TLx49012 evaluation kit user guide

XENSIV™ angle sensors

About this document

Scope and purpose

This document describes the hardware and software functionality of the XENSIV™ TLx49012 evaluation kit (TLX49012 EVAL KIT).

Intended audience

This document is intended for hardware and software engineers involved in the evaluation of the XENSIV™ TLx49012 angle sensors.

About this product group

Infineon's portfolio of XENSIV™ angle sensors comprises single and dual-channel solutions suitable for all types of automotive, industrial, and consumer rotation applications. These high-precision sensors are available with Hall, anisotropic magnetoresistance (AMR), giant magnetoresistance (GMR), and tunneling magnetoresistance (TMR) sensor technology.

Target applications

- Automotive body electronics
- Industrial motor drives and controls
- Drones

Evaluation Board

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

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

Safety precautions

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

Table 1 Safety precautions

	**Caution:** *The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.*
	**Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*
	**Caution:** *The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.*

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1 The board at a glance

The TLx49012 evaluation kit enables the evaluation of the TLx49012 magnetic position sensor. The compatible software provided is designed to visualize data acquired from the TLx49012 position sensor with all supported interface settings and configurations.

The TLx49012 sensors are used to determine the position in applications where a rotational movement must be monitored. The versatility of the sensor can be seen in the multitude of supported output interfaces.

The TLx49012 evaluation kit offers a full set of features for sensor interfacing, data acquisition, interpretation and logging, volatile memory configuration, and sensor Customer Multi-Time Programmable memory (CMTP) configuration read/programming in limited cases.

The TLx49012 evaluation kit (V1.1) is shown in Figure 1.

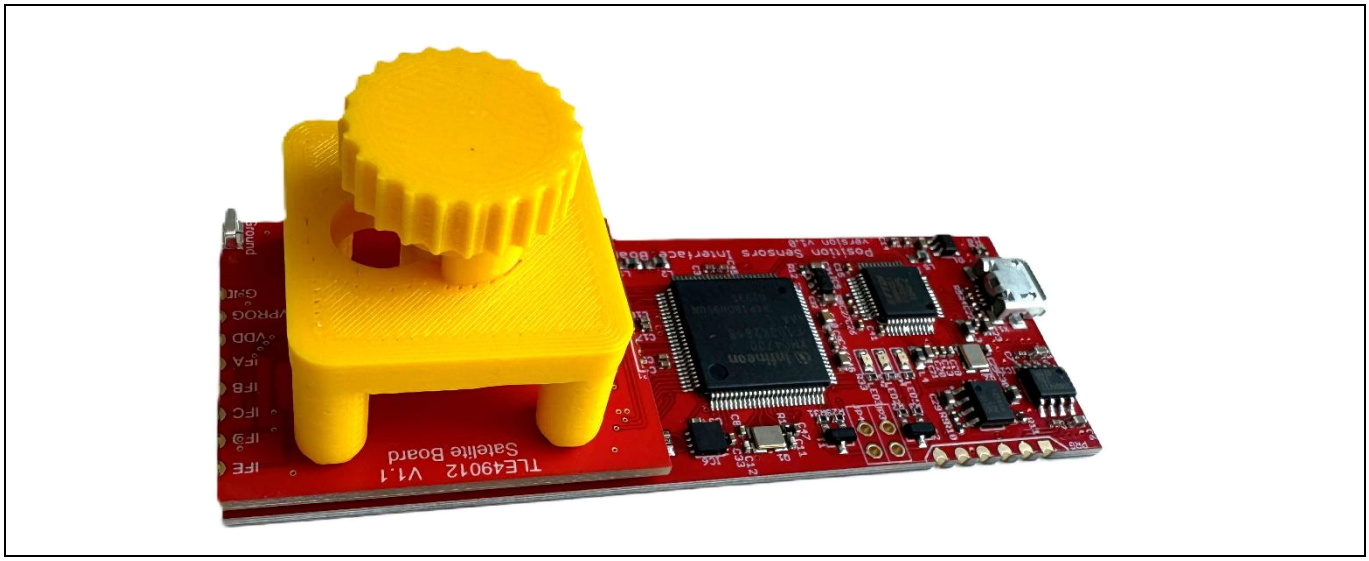


Figure 1 TLx49012 evaluation kit

Note: Figure 1 is generic; the latest variant may include modifications.

The evaluation kit consists of the following components:

- TLx49012 Satellite Board
- Position sensors interface board (PSIB)
- Magnetic rotational knob with support for end/out of shaft positioning

Table 2 TLx49012 evaluation kit list with ordering part numbers

Name	Description	Infineon Sample Request (ISaR) SP number
TLx49012 EVAL KIT	TLE49012-S0001 evaluation kit, based on POSIF board	SP006064343
TLI49012 EVAL KIT	TLI49012 evaluation kit	SP006227376

2 System and functional description

This section provides a detailed description of the latest hardware design version of TLx49012 evaluation kit. See Appendix 1 – Hardware revision history for details on previous hardware variants.

2.1 Getting started

The evaluation kit is composed of two separate PCBs connected via clip-on surface mount technology (SMT) connectors:

- **Position Sensors Interface Board:** The primary purpose of this PCB is to control the system and to interface it with the PC via USB
- **TLx49012 Satellite Board:** The primary purpose of this board is to interface the sensors and to provide the necessary peripherals for analysis and measurements to the PSIB board

2.2 Description of functional units

2.2.1 TLx49012 Satellite Board

This section offers a detailed description of the latest hardware design version of the **TLI49012 Satellite Board**, version **V1.3**.

The hardware is composed of the following main blocks:

- **Onboard SMT connectors (J1-J4):** Used for connecting the satellite board to the PSIB MCU board
- **TLx49012 (U1):** Sensor under evaluation. The sensor is supplied with ON/OFF controlled 3.3 V from the PSIB board
- **DC-DC boost converter (IC1):** DC-DC boost converter used to generate the programming voltage necessary for CMTP programming
- **External EEPROM (IC3, P1):** I^2C External EEPROM used for storing board information
- **Auxiliary connector:** PCB-side connector for TLx49012 pinout. It can be used for debugging or connecting an external mounted TLx49012 sensor (Note that onboard sensor must not be populated on the satellite board for this use case) or using the satellite board on its own
- **LED (S1):** Used to indicate the presence of the programming voltage (DS1)

Attention: ***The hardware version presented in this document is for the TLI49012 Satellite Board. The TLE49012 Satellite Board presents no hardware changes from this except for the modified silkscreen.***

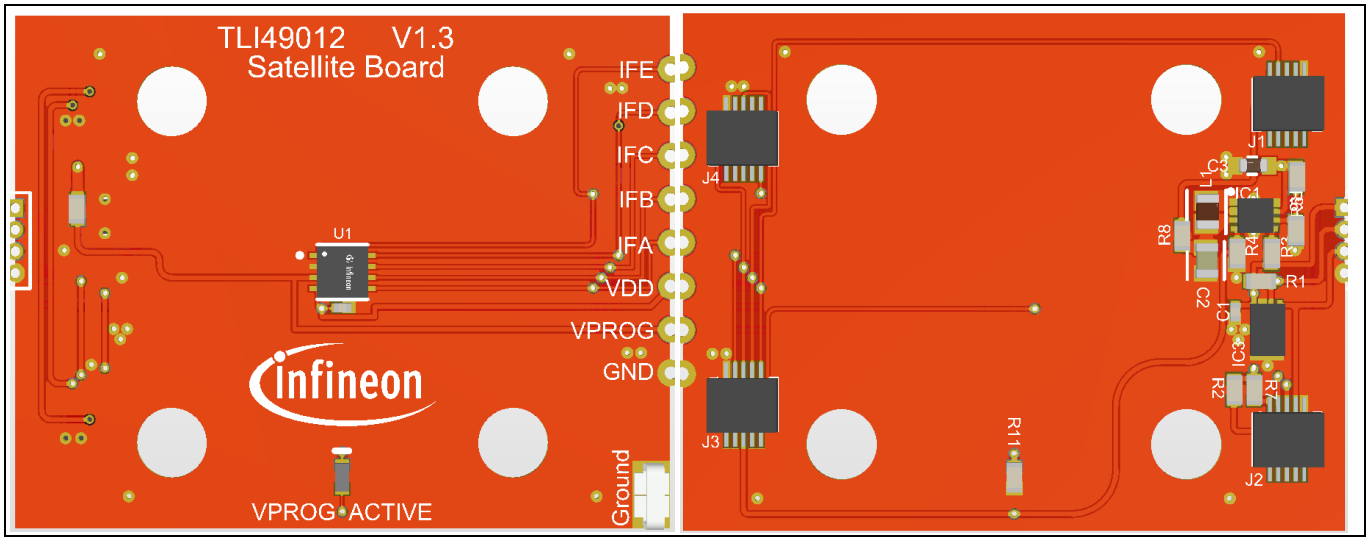


Figure 2 TLx49012 Satellite Board 3D view with pinout – Top (left), bottom (right)

2.2.2 Position sensors interface board (PSIB)

The main purpose of the PSIB board is to control the system and to interface it with the PC via USB.

The hardware of the position sensor interface board consists of the following main blocks:

- **On board SMT connectors (S1-S4):** Used for connecting the satellite board to the PSIB microcontroller unit (MCU) board
- **Power supply**: The input voltage is provided by the 5 V USB supply. This input is then regulated to 3.3 V by TLS208D1EJV33 (IC1). Both the 5 V and the 3.3 V supplies are controlled using voltage trackers TLE4254GA (IC4) and TLE4250-2G (IC5)
- **Target Microcontroller (U1):** The main microcontroller is an XMC4700 in a PG-LQFP-100-25 package with 2048 KB of flash. This device does all the required data processing and handles the communication with the sensors and data forwarding to USB via the FTDI controller
- **FTDI controller (IC3):** This device is responsible for the USB communication, converting the UART interface to USB, and vice versa
- **USB connector (J1):** The board is equipped with a Micro-USB connector, which serves dual purposes:
  - Supplying the board with ~5 V from USB port
  - Ensuring data communication between the PC and microcontroller

3 System design

3.1 Schematics

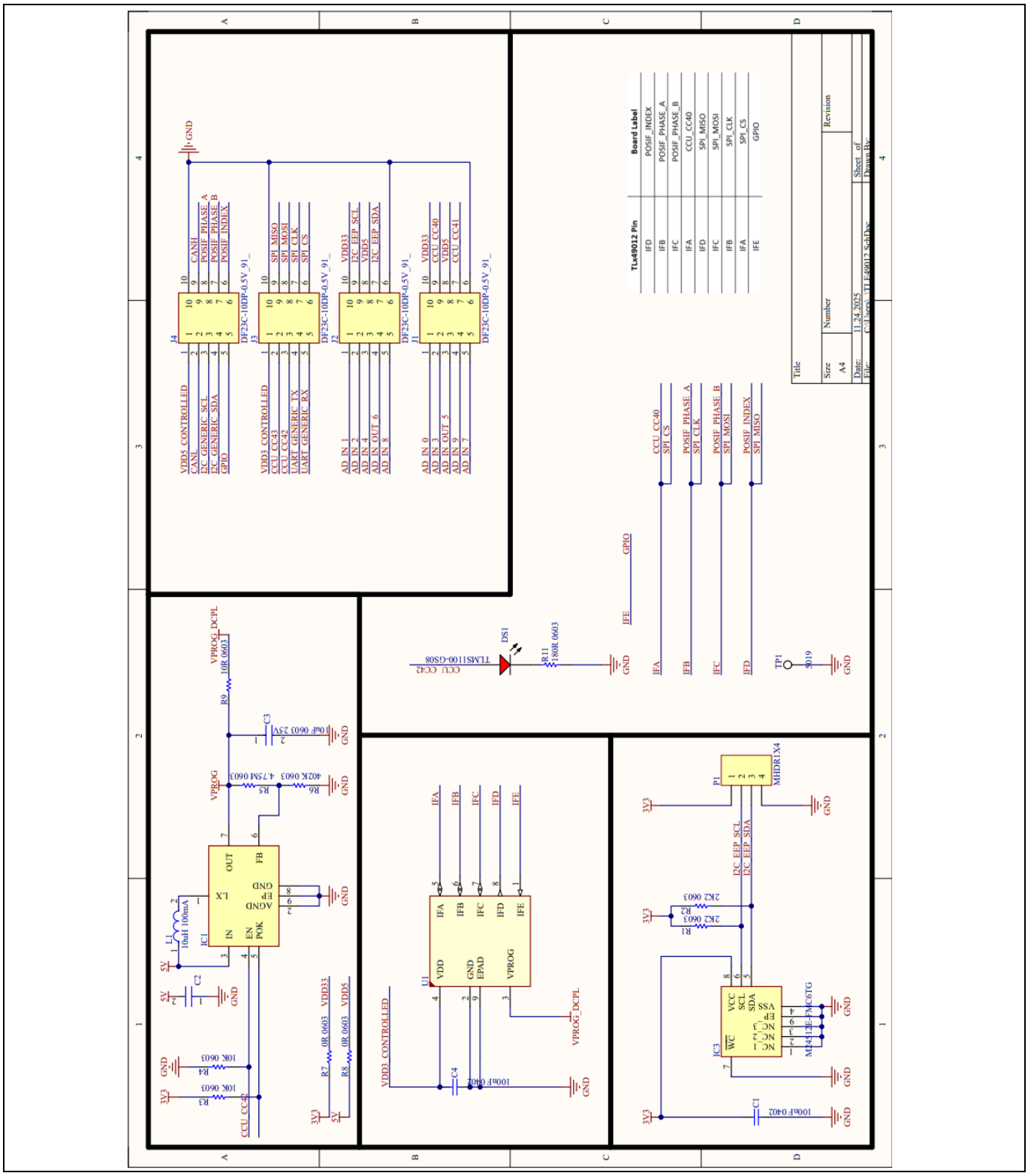


Figure 3 TLx49012 Satellite Board schematic

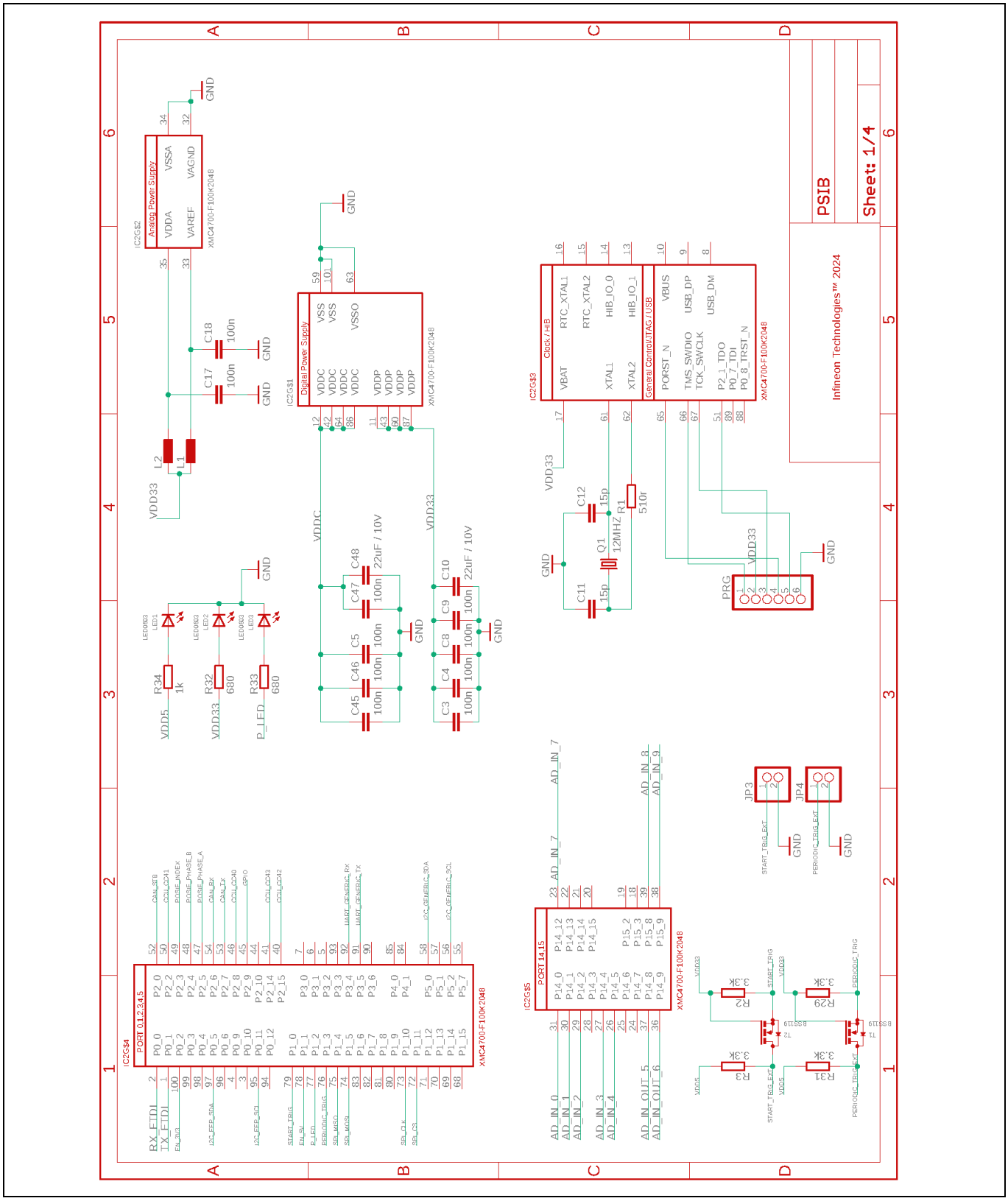


Figure 4 Position sensors interface board (PSIB) schematic – page 1 of page 4

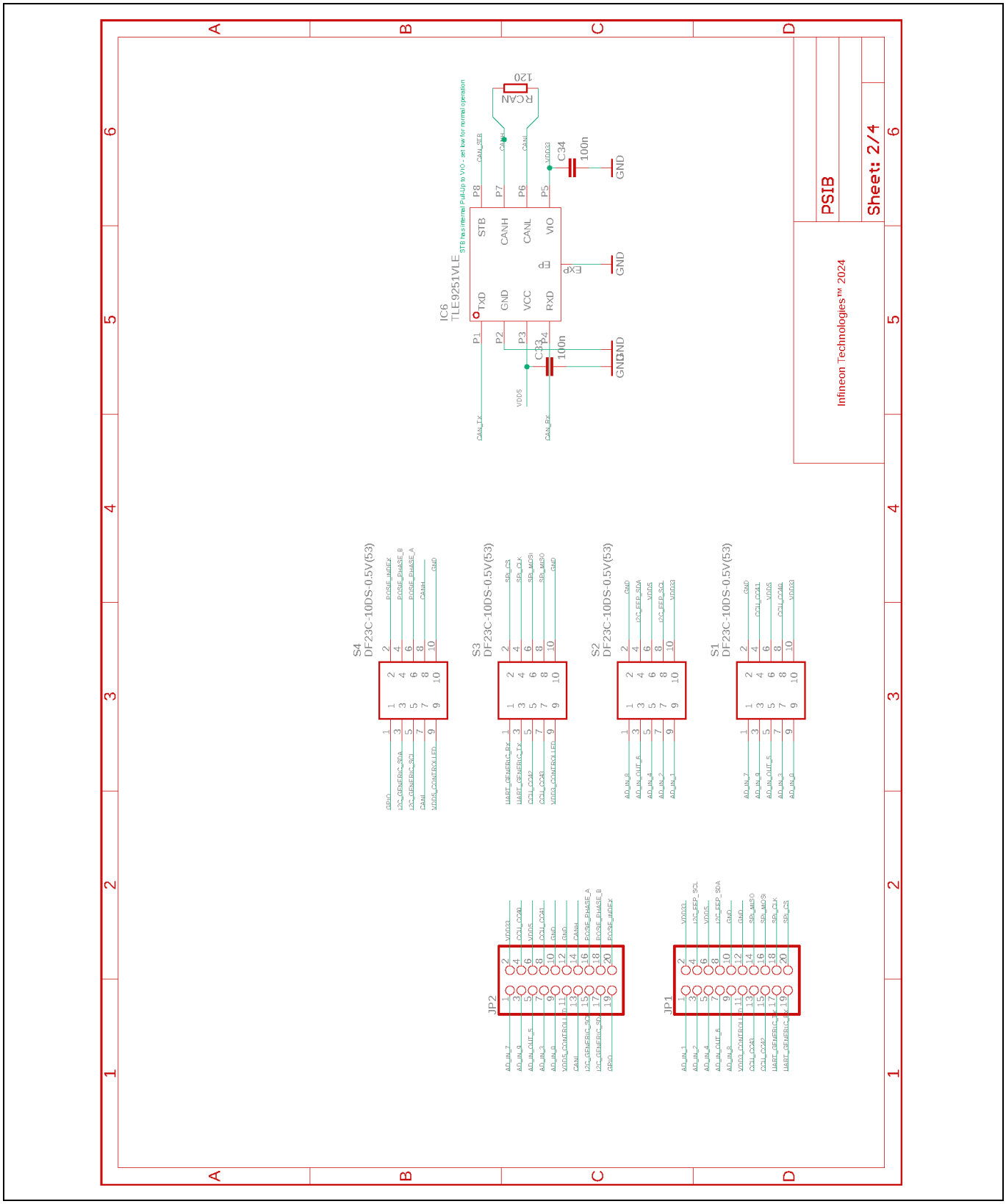


Figure 5 Position sensors interface board (PSIB) schematic – page 2 of page 4

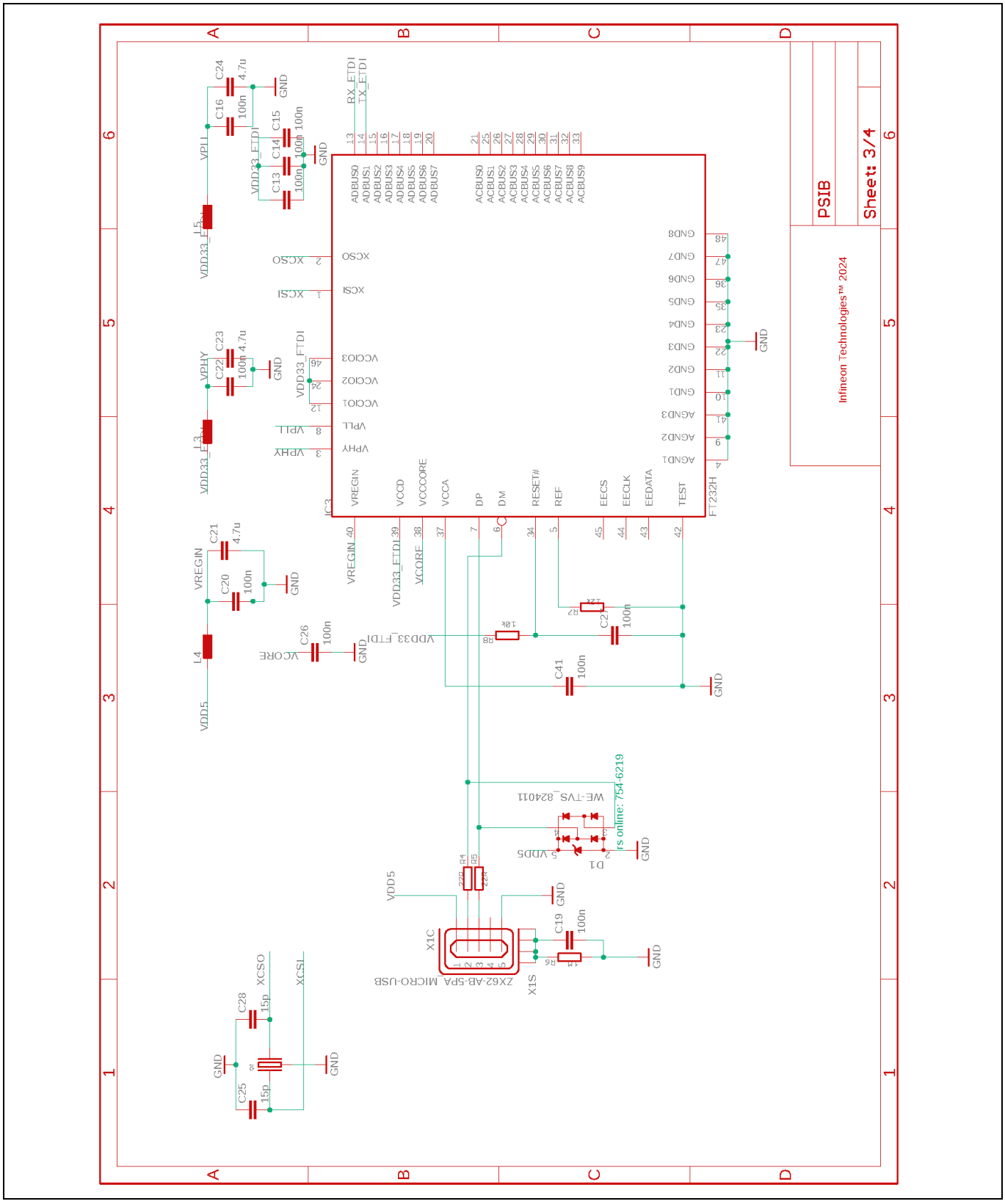


Figure 6 Position sensors interface board (PSIB) schematic – page 3 of page 4

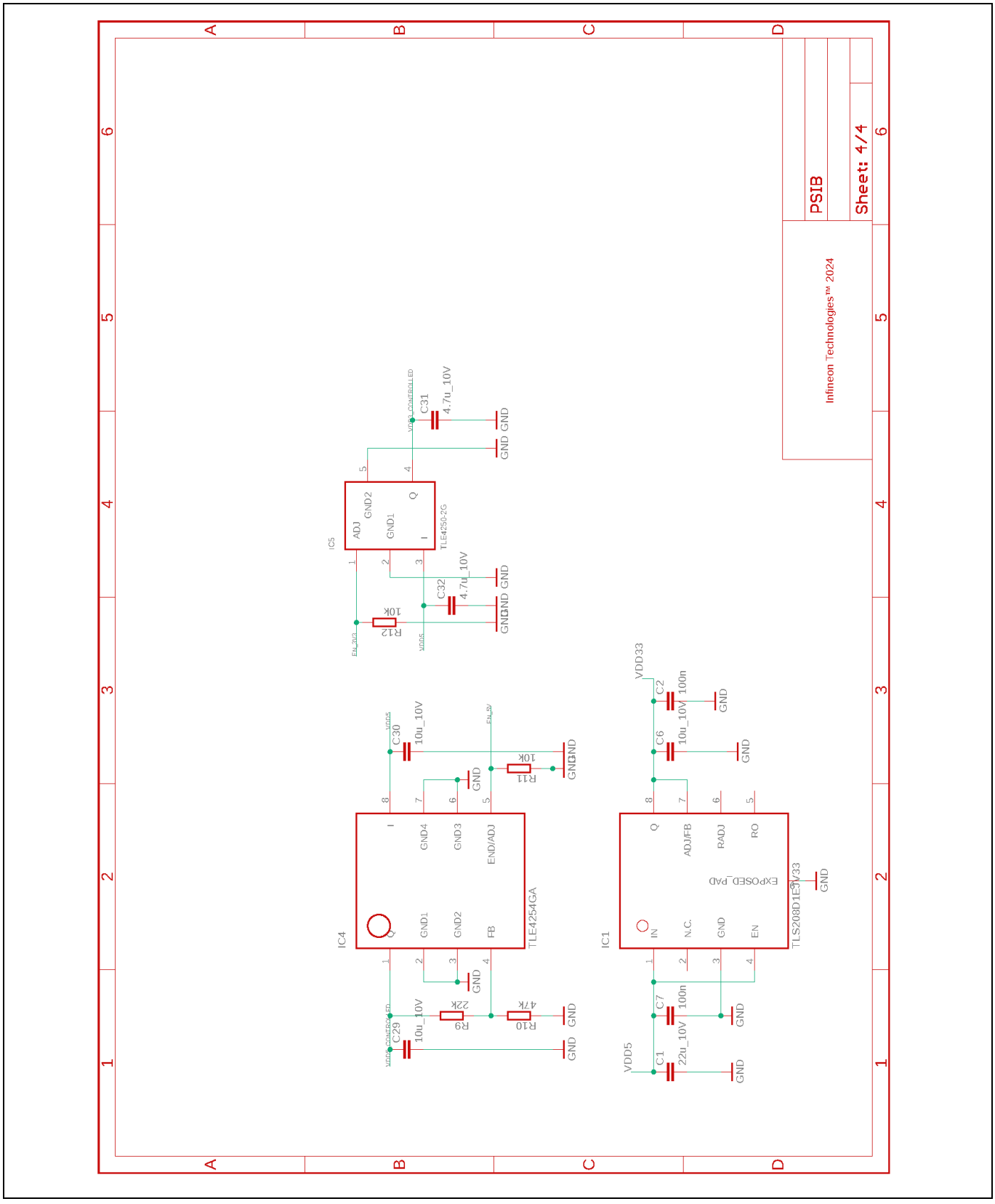


Figure 7 Position sensors interface board (PSIB) schematic – page 4 of page 4

3.2 Layout

The design described in Section 2.2.1 is physically implemented in PCB technology using a standard process with the following characteristics:

- **PCB material:** FR4
- **PCB thickness:** 1.65 mm ±10%
- **Copper:** 2 layers top/bottom (35 µm, 35 µm thickness)

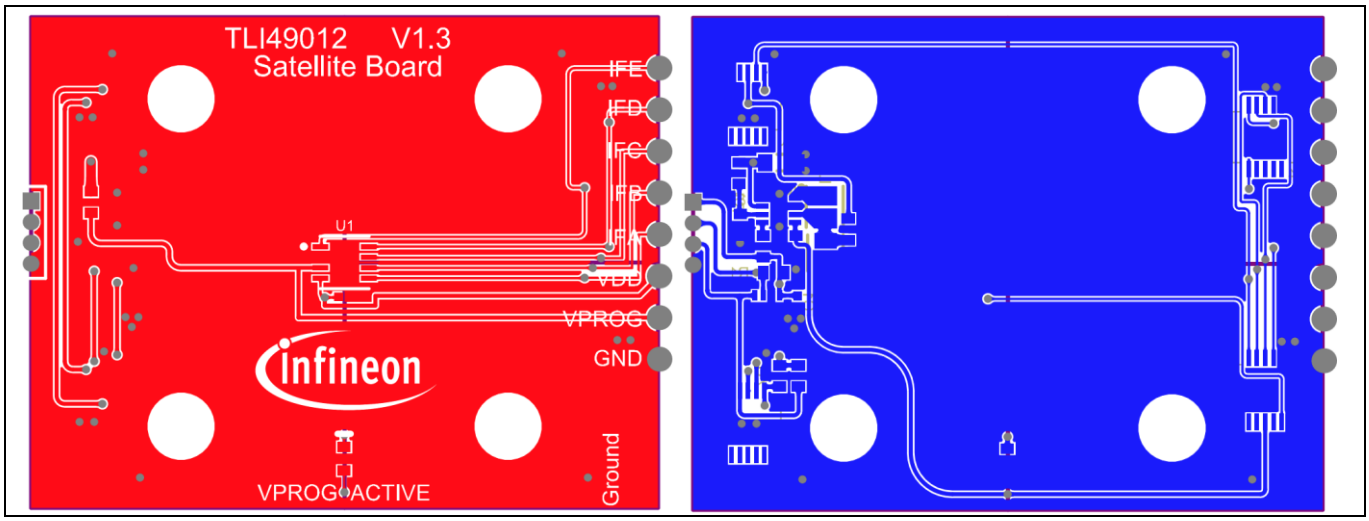


Figure 8 TLx49012 satellite board PCB layout – Top (left), bottom (right)

3.3 Bill of materials

Table 3 TLx49012 Satellite Board bill of materials

Designator	Description	Quantity	Assembled on PCB	Infineon part
C1, C4	100 nF 0402 16 V	2	Yes	No
C2	C0805C106K8PACTU	1	Yes	No
C3	10 µF 0603 25 V	1	Yes	No
DS1	150060VS75000	1	Yes	No
IC1	MAX17291ATA+	1	Yes	No
IC3	M24512E-FMC6TG	1	Yes	No
J1, J2, J3, J4	DF23C-10DP-0.5V_91_	4	Yes	No
L1	LQM21DH100M70L	1	Yes	No
P1	MHDR1X4	1	No	No
R1, R2	2K2 0603	2	Yes	No
R3, R4	10K 0603	2	Yes	No
R5	4.75M 0603	1	Yes	No
R6	402K 0603	1	Yes	No
R7, R8	0R 0603	2	Yes	No
R9	10R 0603	1	Yes	No
R11	180R 0603	1	Yes	No

Designator	Description	Quantity	Assembled on PCB	Infineon part
TP1	5019	1	Yes	No
U1	TLx49012 (XENSIV™ evaluated sensor)	1	Yes	Yes

4 Evaluation software

Download the evaluation software via the Infineon Development Center online platform or Infineon Development Center Launcher application. It is recommended to install the Infineon Developer Center Launcher application before installing the evaluation software.

The software package contains:

- A graphical user interface (GUI) software for sensor evaluation
- FTDI CMD Drivers

4.1 Requirements

The TLx49012 evaluation kit hardware and software bundle is developed and tested on the following PC configurations:

- **Operating system:** Windows 10/Windows 11
- **RAM:** 8 GB (maximum RAM usage estimated at 250 MB, when data logging is ON)
- **Storage:** 512 GB (minimum required for installation: 250 MB, including dependencies)
- **CPU:** 3 GHz, 4 cores (lower performance CPUs might impact the performance of the GUI)

4.2 Software download

To access the evaluation software, go to the **Assets** section of your preferred platform and search for “TLx49012” and it displays as XENSIV™ TLx49012 Angle Sensor Evaluation Kit.

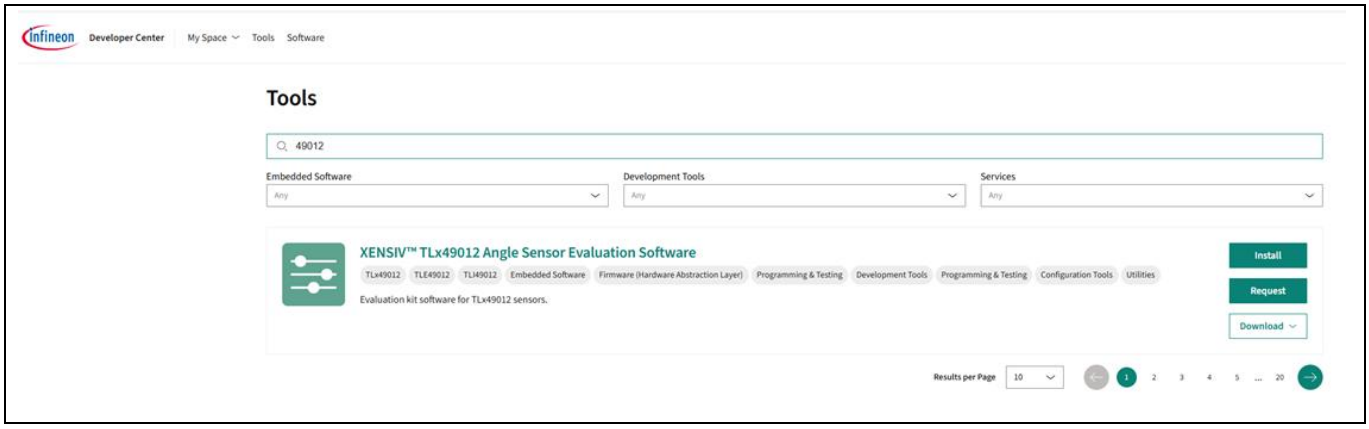


Figure 9 Infineon Development Center – online tools

Note: ***XENSIV™ TLx49012 Angle Sensor Evaluation Software*** *is only available for users registered with a myInfineon account and who have obtained a valid license through the request process outlined in Section 4.2.1.*

4.2.1 Requesting access to a restricted evaluation kit tool

This section describes the request procedure for accessing an Infineon restricted evaluation kit tool.

Note: Only users who have a valid account with myInfineon can place a request.

Note: Users must use the Infineon Developer Center website. Tool request procedure is not available from the Infineon Developer Center (IDC) Launcher.

Follow these steps for requesting a software package:

1. Browse for software
2. Add to cart
3. Answer question form
4. Submit order

4.2.1.1 Browse for the required tool

- Navigate to the IDC website and “Tools” section. Enter a keyword for the target tool in the search bar (Figure 10)
- Click the **Request** button to add the tool to the Cart

*Note: If the target tool is already in the cart, the **Request** button will be disabled.*
This procedure is exemplified for a generic tool. Apply the procedure for the target tool

Figure 10 Browse for the tool

4.2.1.2 Add the tool to cart

Click the **Request** button, you can view the cart content and continue with the request process (Figure 11).

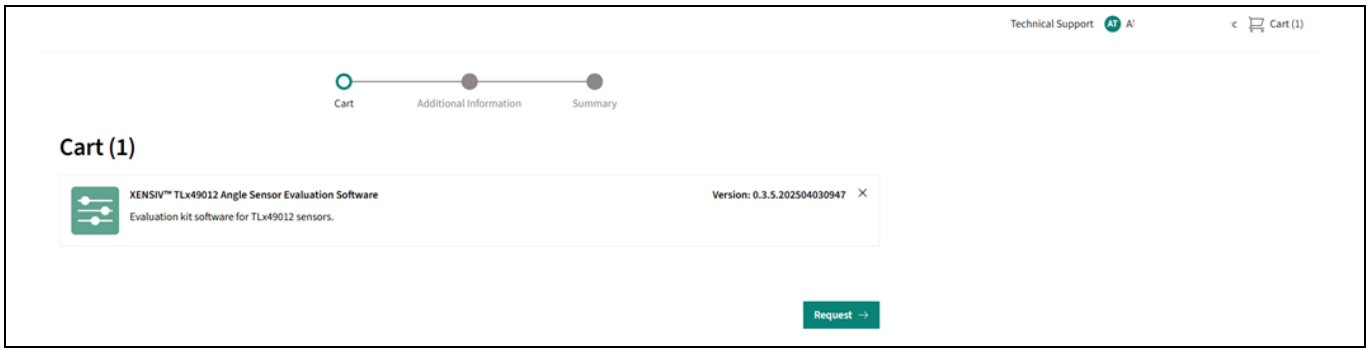


Figure 11 View Cart

4.2.1.3 Questionnaire

After requesting the tool from the cart, you must fill out the required details for a set of questions to proceed with the order (Figure 12).

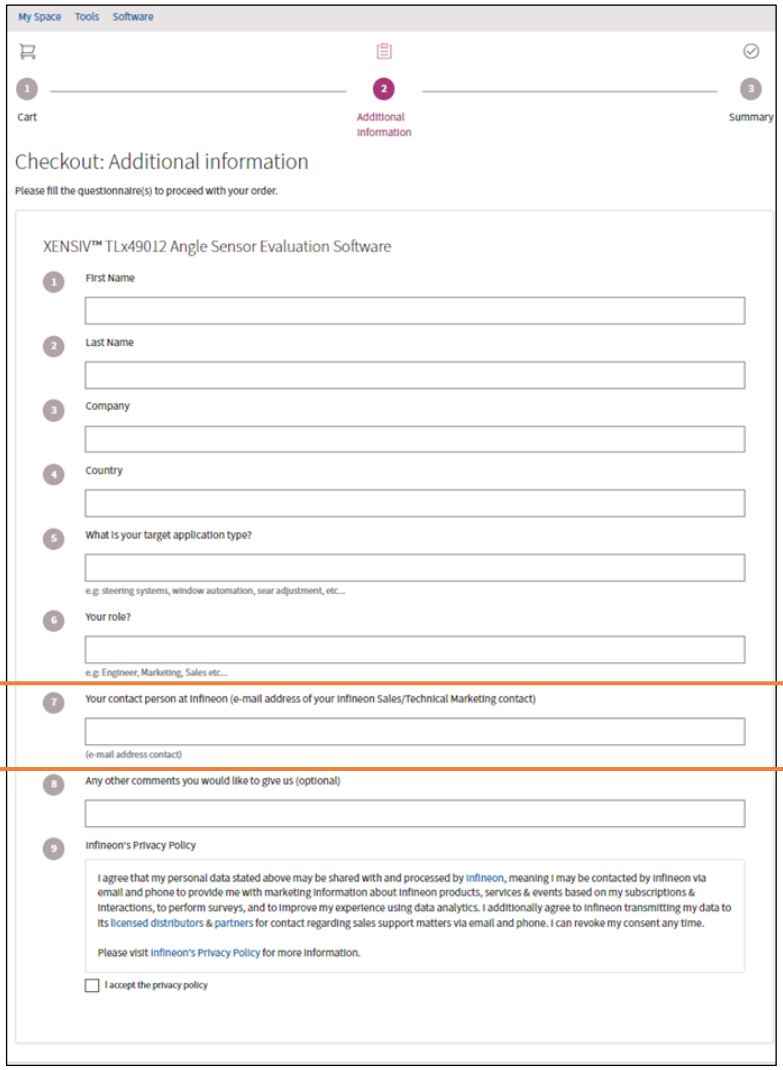


Figure 12 Questionnaire

Question number 7 highlighted in Figure 12 is used to verify the user's right of access to the restricted tool. Tool owner can check with the Infineon contact if the request is valid.

Note: If a valid contact person is not provided, the request will be denied.

4.2.1.4 Submit order

As soon as the checkout is completed, you can see all your requests including status of the approval under My Space > My Orders (Figure 13).

Figure 13 Submit request

4.3 Software installation

1. Download the XENSIV™ TLx49012 Angle Sensor Evaluation Kit installer as mentioned in the earlier section and click the **Install** button

Note: Ensure that administrator rights are enabled before installation.

The installer file contains the following:

- Binaries/compiled objects needed for running the GUI
- FTDI driver for establishing a serial port communication with the onboard FTDI device
- .NET 4.8 online installer (needed only for older versions of Windows, if you do not have this already installed). Requires a stable Internet connection

2. Accept the License Agreement and click **Next**

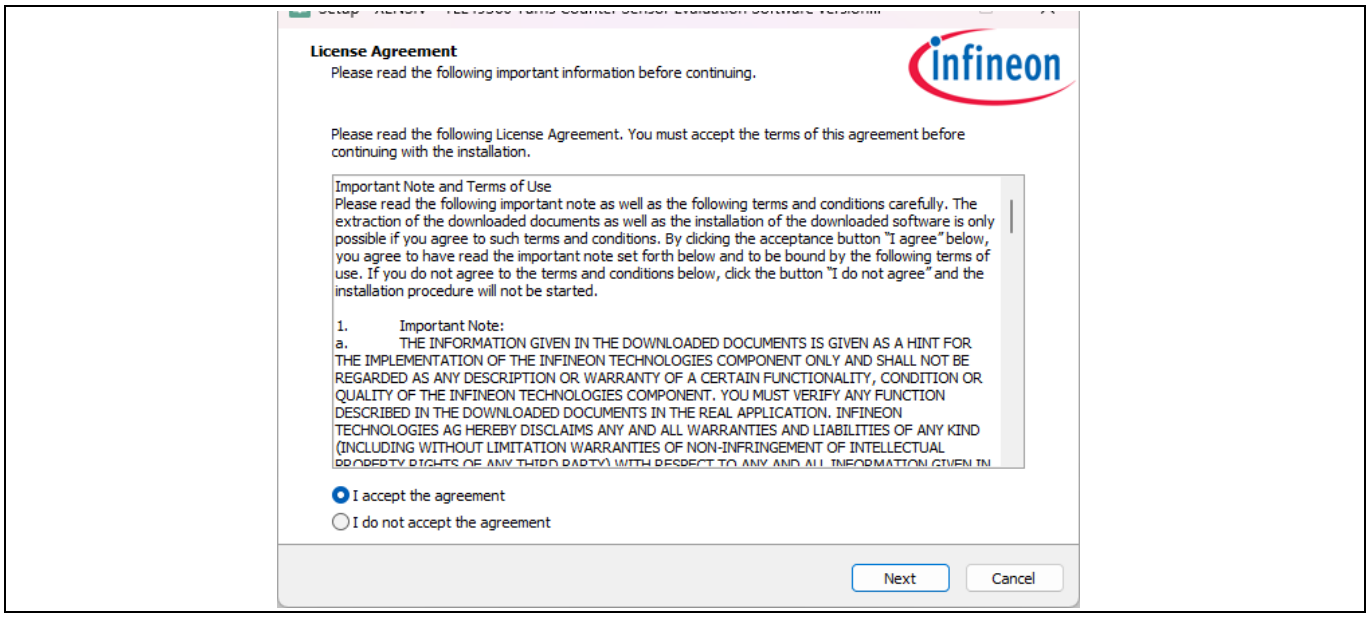


Figure 14 Software installation – license agreement

3. Select **Quick Installation** (recommended) and click **Install** to begin the installation process

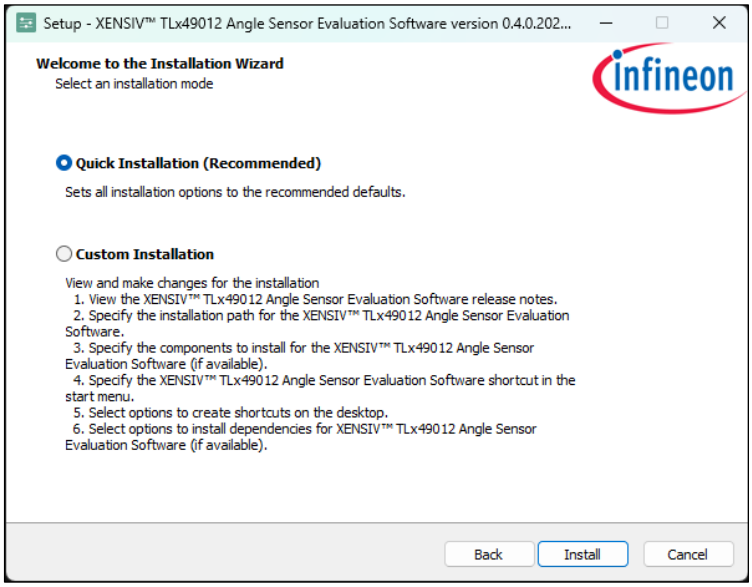


Figure 15 Software installation step – quick installation

4. After the binaries have been copied to the installation folder, install the **FTDI CMD Drivers**. If this driver is already installed on your PC, skip this operation. If this driver is not installed, the USB connection between the PC and the TLx49012 evaluation kit will not function

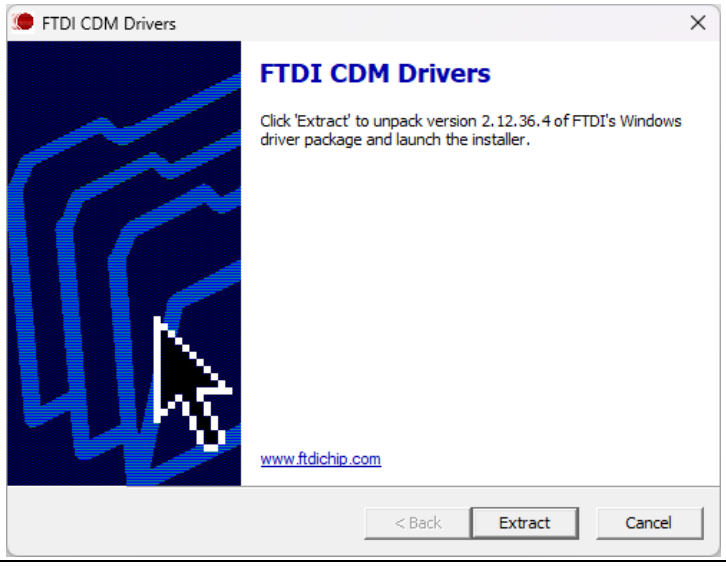


Figure 16 Software installation step – FTDI CDM drivers installation

5. Install **.NET Framework 4.8**. For operating systems starting from **Windows 10 build 1903** and later, this comes pre-installed. If the framework is not already installed, an active Internet connection is required to complete the installation process

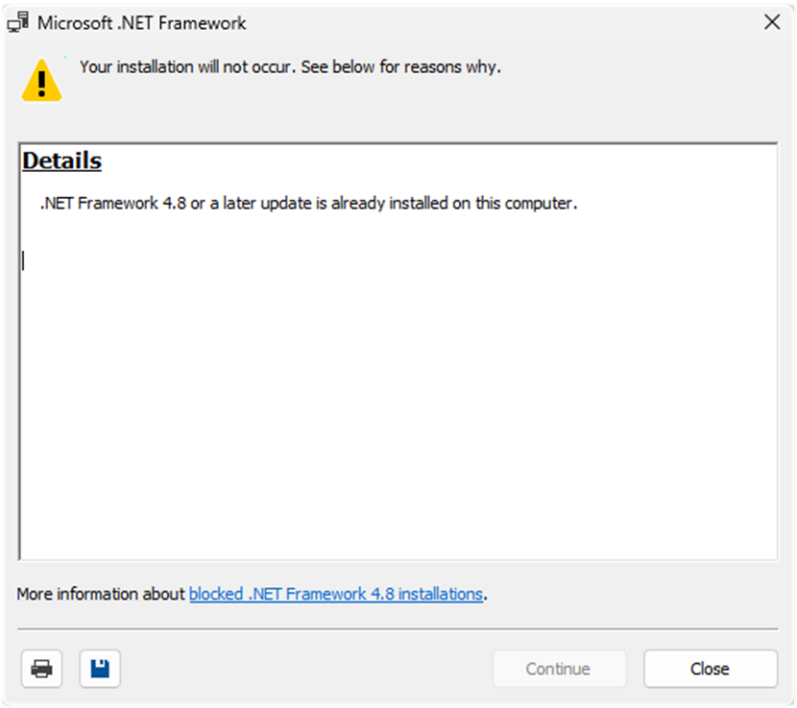


Figure 17 Software installation – .NET 4.8 installation

6. You are notified when all installer processes are complete and a shortcut is created on the desktop by default. You can choose to run the installed **XENSIV™ TLx49012 Angle Sensor Evaluation Software** and click **Finish** to exit the setup

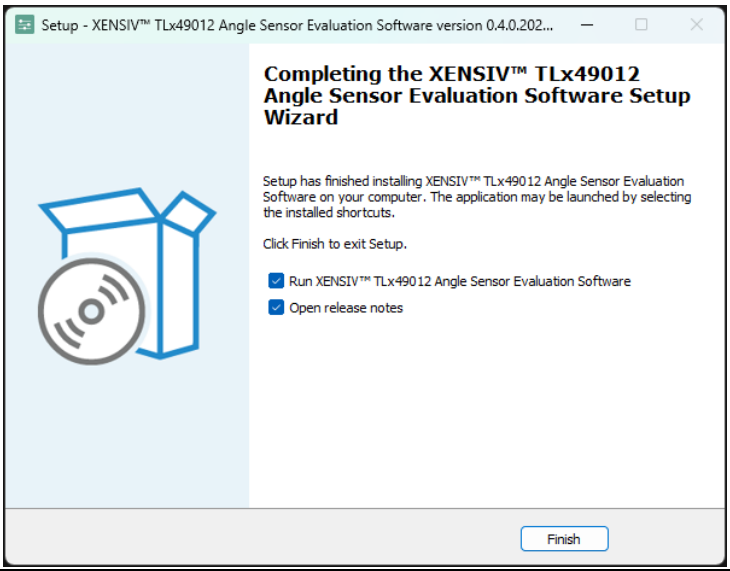


Figure 18 Software installation – completion

4.4 Uninstalling the software

To uninstall the software package, go to **Start** > **Add or remove programs** and search for the **XENSIV™ TLx49012 Angle Sensor Evaluation Software**. Select **Uninstall** to delete the software from your PC.

Figure 19 Software uninstall

All installation files are deleted from the system except:

- FTDI driver, which can be uninstalled separately if required
- .NET 4.8 dependencies, which in most cases are part of the operating system

5 Using the evaluation software

This section describes all features and their usage of the XENSIV™ TLx49012 Angle Sensor Evaluation Software in correlation with the evaluation hardware. Ensure that the **TLx49012 evaluation kit** is connected to your PC via Micro-USB cable before exploring the next steps.

5.1 Startup screen

Figure 20 shows the default screen of the XENSIV™ TLx49012 Angle Sensor Evaluation Software after startup. The graphical user interface (GUI) software monitors all USB ports and checks if any of them matches the signature of the **TLx49012 evaluation kit**. If a match is found, a new device will be displayed as shown in Figure 20: “Port xx”. By selecting the device, the software will connect and flash the correct firmware for the target microcontroller. Software will also check for correct sensor detection.

Note: If the target does not have the latest firmware, it will be updated automatically.

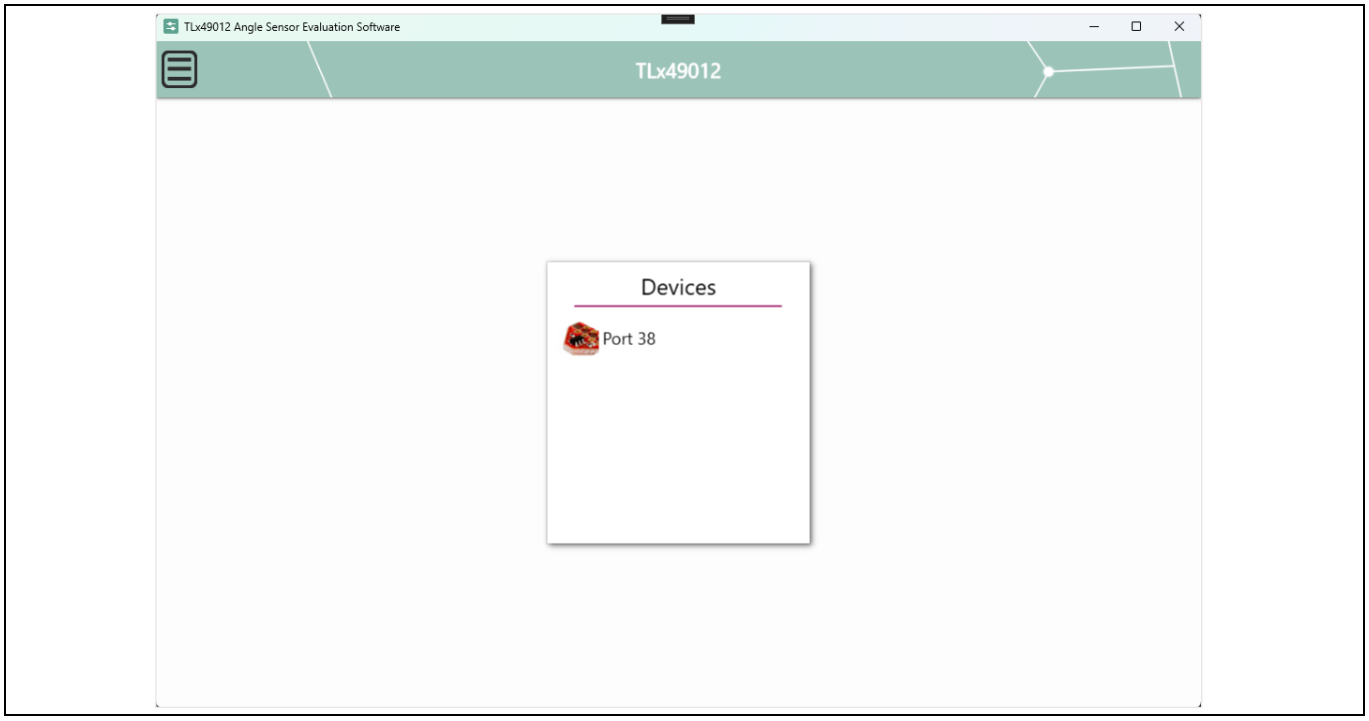


Figure 20 Software usage – Startup screen

5.2 Application settings

In the top-left corner of the application, you can find the **Application Settings** button. Once it is selected, the settings menu will be displayed with multiple options (Figure 21):

- **Settings:** Displays the flashing application settings (described in detail after this section)
- **Fullscreen:** Toggles the application into full screen mode.
- **Report an issue!:** Send the user to a webpage where issues can be reported
- **User Guide:** Displays the user guide for this specific software
- **About:** Displays the current software and the firmware version
- **Quit:** Closes the application

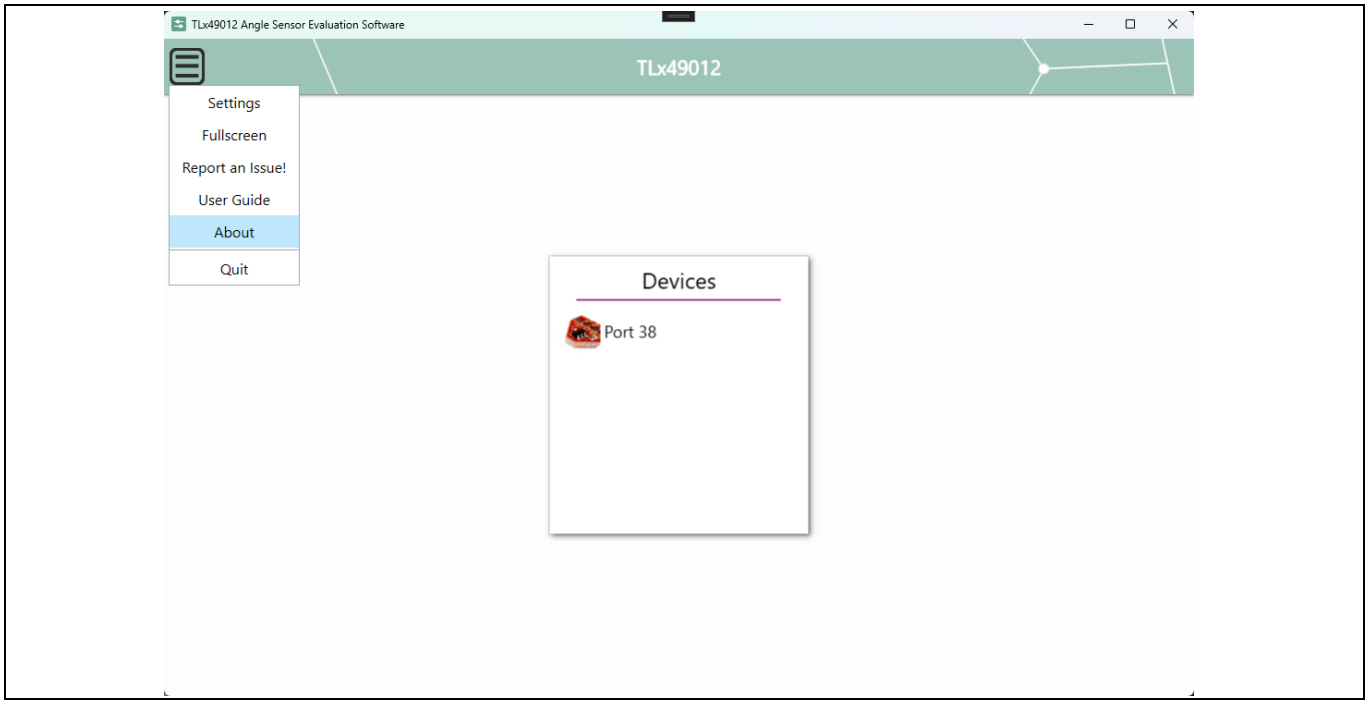


Figure 21 Software usage – Application Settings menu

Firmware flashing can be forced by selecting this option from **Settings** in the upper left menu (Figure 22). Select this option before connecting to the board (selecting the “Port xx”). This feature can be used for troubleshooting when automatic firmware updates encounter difficulties.

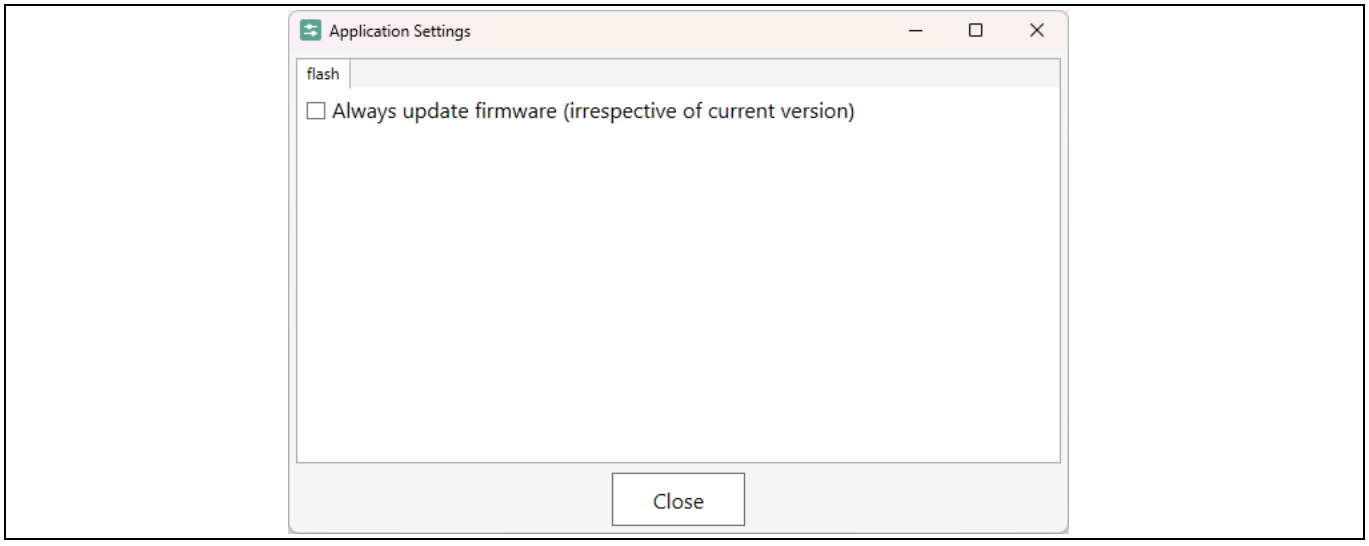


Figure 22 Software usage – Firmware flashing override

5.3 Main menu

After successfully connecting to the evaluation kit, the software will display the main menu shown in Figure 23. You can select between the main functionalities offered by the evaluation kit software by selecting the corresponding button:

- **IF Readout:** Implements various interface readouts and features of the TLx49012 sensor
- **SPI Readout:** Implements an SPI readout of different register values, while the sensor is in Test mode
- **Memory Map**: Implements various internal sensor memory operations, strictly for the **TLx49012** sensor
- **Sensor Configuration**: Implements a configuration window that can be used to configure the **TLx49012** sensor

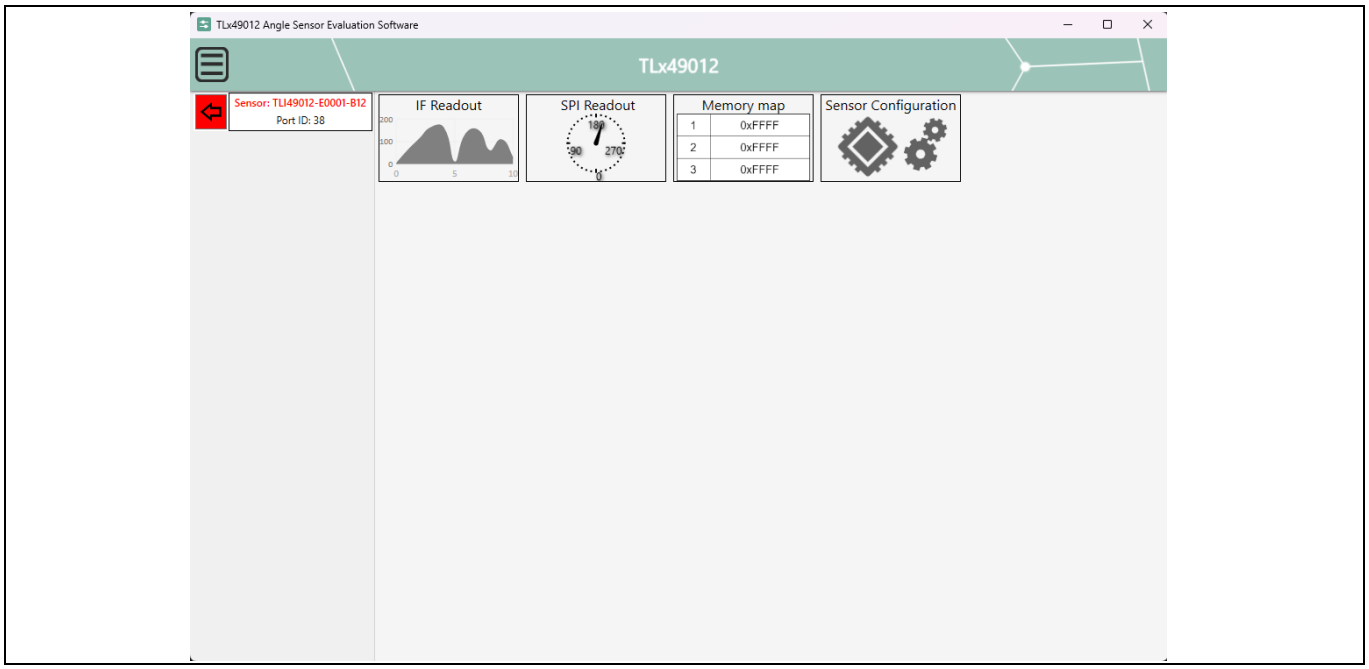


Figure 23 Software usage – Main menu

5.4 IF Readout view

The **Interface Readout** view is accessible by selecting the corresponding button in the software main menu. The open view is shown in Figure 24.

This view displays, plots, and logs decoded data from the evaluated sensor through the configured interface. It also contains additional features and functionalities detailed in the next sections.

The **Interface Readout** view functionalities and features can be divided into the following groups, highlighted in Figure 24:

1. Readout control
2. Volatile sensor memory configuration
3. TLx49012 interface configuration detection
4. Interface selection for multiple interface modes
5. TLx49012 data display
6. Sensor data logging

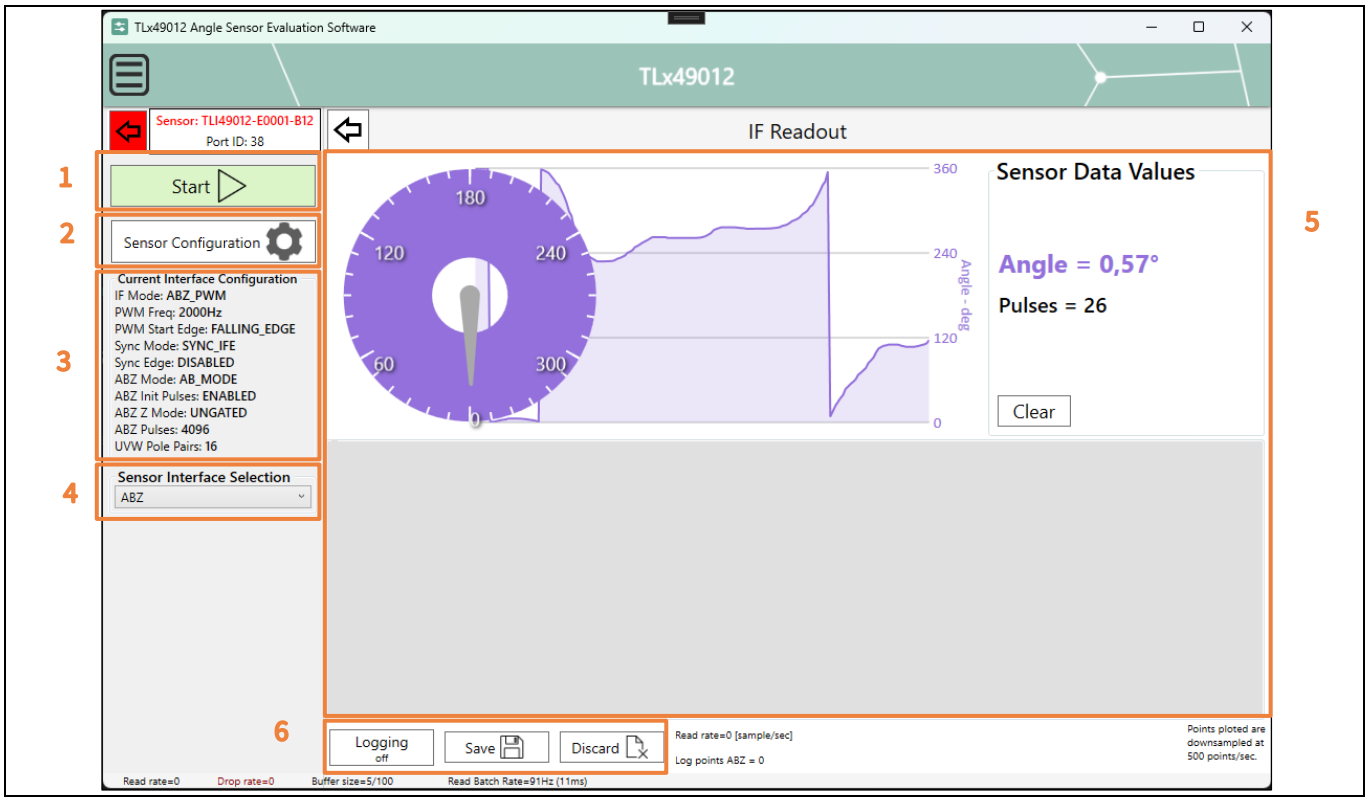


Figure 24 Software usage – IF Readout view

5.4.1 Readout control

The Readout control initiates continuous readout based on the active sensor configuration, retrieved from the TLx49012 sensor's volatile memory on the connected board. Depending on the communication protocol, four distinct views can be viewed (Figure 25). The possible modes are listed as follows accompanied with their corresponding read frequency:

- SPI Mode: 5000 Hz
- ABZ Mode: 1000 Hz
- UVW Mode: 5000 Hz
- PWM Mode: Variable 250 Hz to 4000 Hz

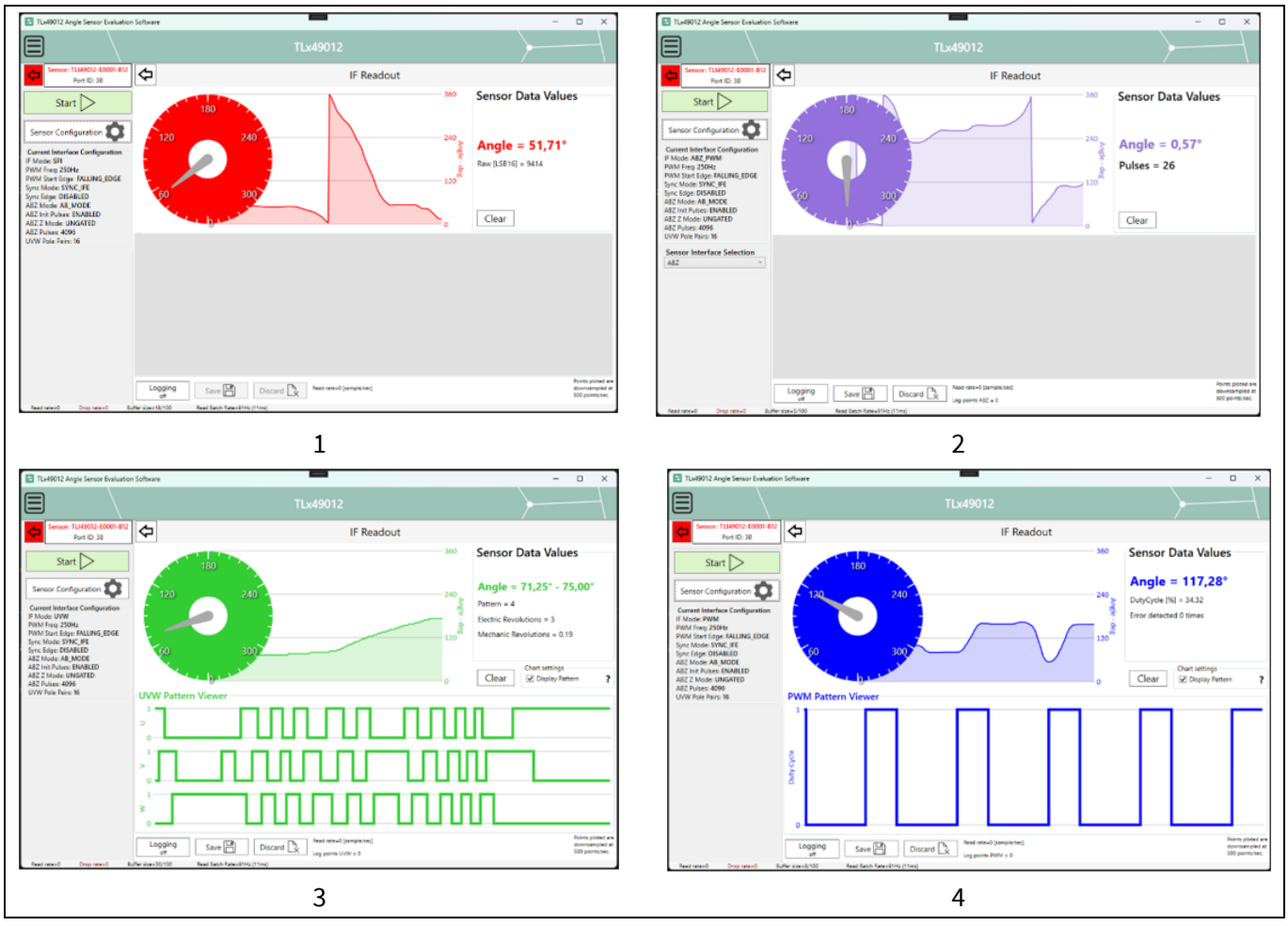


Figure 25 IF readout view – Possible readout views

5.4.2 TLx49012 extended configuration (Sensor Configuration)

The TLx49012 is a highly configurable sensor. These configurations can be implemented through changing specific bitfields in the Memory Map. This can be implemented fully in the Memory Map view (shown in Section 5.6) by writing specific bits or alternatively, a straightforward combo-box/textbox approach is provided through the **Sensor Configuration** button. Clicking this button will prompt you to choose if you want to keep the current data or to perform a full sensor reset as shown in Figure 26. This is implemented because the sensor has to be in Test Mode for the internal Memory Map to be accessed and changed, and as such, entering Test Mode will require a reset.

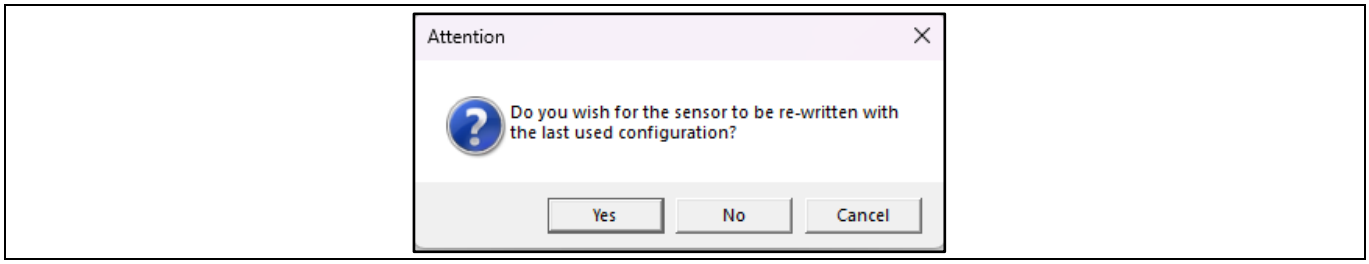


Figure 26 Sensor configuration – Data persistence

After you make a choice, the **Extended Sensor Configuration** window will be displayed. This window provides a simple but complete way to change the **USER_CONFIG** registers as well as the **LUT_CONFIG** registers.

The **Extended Sensor Configuration** view functionalities and features can be divided into the following groups, highlighted in Figure 27:

1. Configuration selection tabs
2. View for current selection
3. Help button for explanations
4. The different buttons have the following functionalities:
   - **Reload:** The values from the registers are **all** re-populated into the UI, bringing the UI to the initial status
   - **Write:** Selected view with its associated configuration (as seen in the window) is written in the sensor. CRC is automatically calculated for both the USER and Look-up table (LUT) memory. After the write operation takes place, the sensor is soft-reset, and the registers from the bitmap configuration are re-read, and the values will be reloaded in the UI elements
   - **Reset:** The sensor is hard-reset through a power cycle (power off, power on), and the memory is re-read and UI re-populated
   - **Export as csv:** The values from the current view that are in the UI are logged and extracted into *.CSV* format. You will be prompted to enter a comment for the saved file, and upon confirming, the file will be saved in the selected location
   - **Import from csv:** This enables on-demand loading of the USER or LUT values. Clicking this button will prompt you to select a *.CSV* file. If the file contains invalid data values, the software will reject the input, and no changes will be made

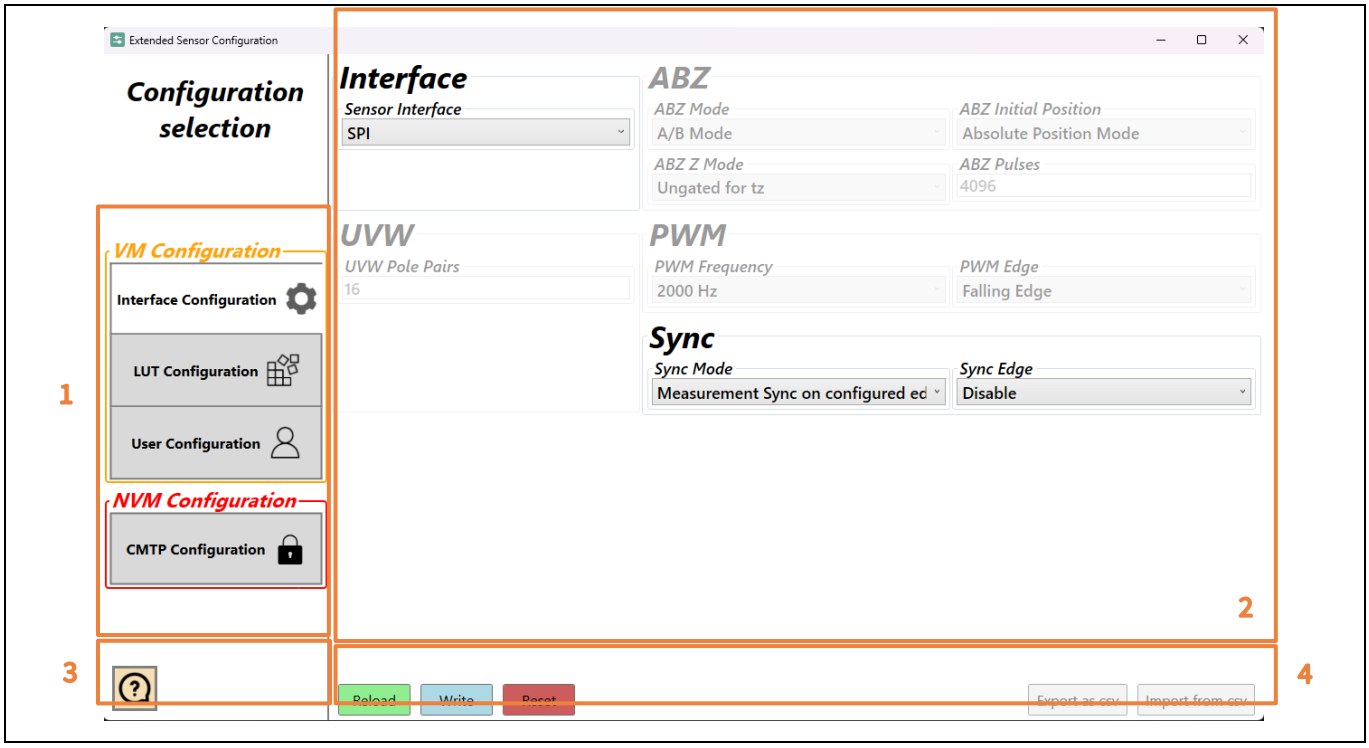


Figure 27 Extended sensor configuration – Configuration selection

Attention: ***The Extended Sensor Configuration window cannot be used with the A11 design step.***

Attention: ***The Extended Sensor Configuration window can only be used with B11 design step sensor if the sensor's CMTP is fully fused. If not, the changes will not take effect. Additionally, certain bitfields are not configurable in the B11 design step sensors.***

5.4.2.1 Interface configuration

The sensor's active communication interface is determined by the ***if_mode*** bitfield stored in volatile memory, which is loaded at startup from the CMTP. Alternatively, this interface can be changed temporarily through the **Interface configuration** tab in which the sensor is "soft-reset" by setting the appropriate bit in the ***stat_en_0_reg***.

The **Interface Configuration** tab provides a simple way of interpretation and configuration of the ***usr_config_1_reg*** and ***usr_config_2_reg*** registers. The tab contains data about the possible changes that you can make through the UI elements as shown in Figure 28 (8 drop downs and 2 text boxes):

- **Sensor Interface:** SPI/PWM/ABZ/UVW/ABZ + PWM/UVW + PWM
- ABZ Mode
- ABZ Z Mode
- ABZ Initial Position Pulses
- ABZ Pulses
- PWM Frequency
- PWM Starting Edge
- UVW Pole Pairs
- Sync Mode

- Sync Edge

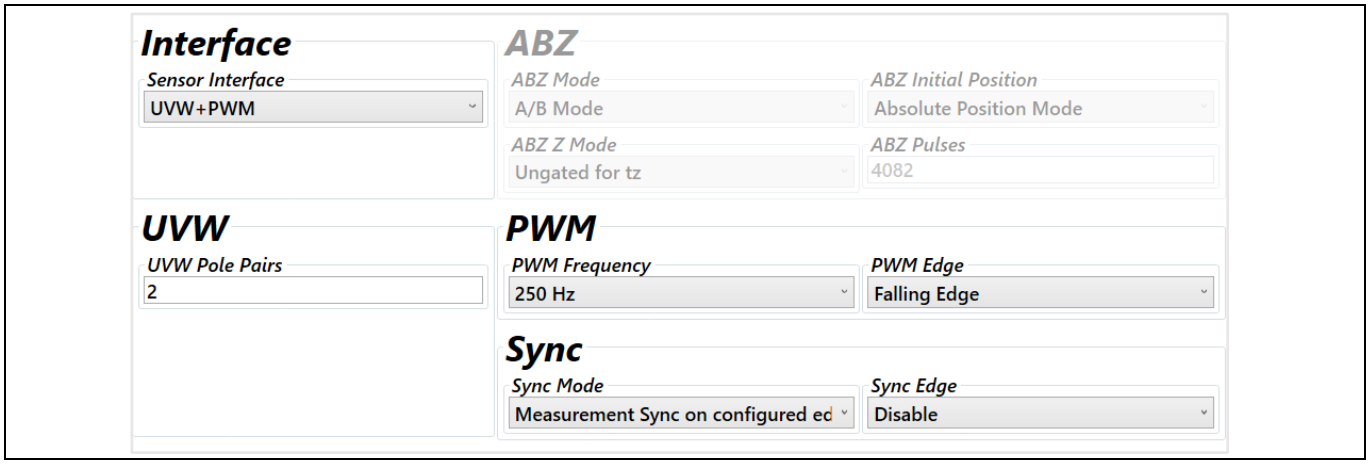


Figure 28 Extended Sensor Configuration – Interface Configuration tab

5.4.2.2 LUT configuration

The volatile multipoint calibration (MPC) LUT area of the bitmap can be visualized and modified through the UI of the application in the LUT Configuration tab. This view offers automatic CRC recalculation, data change indication, and hover-enabled graph data points. This can be observed in Figure 29.

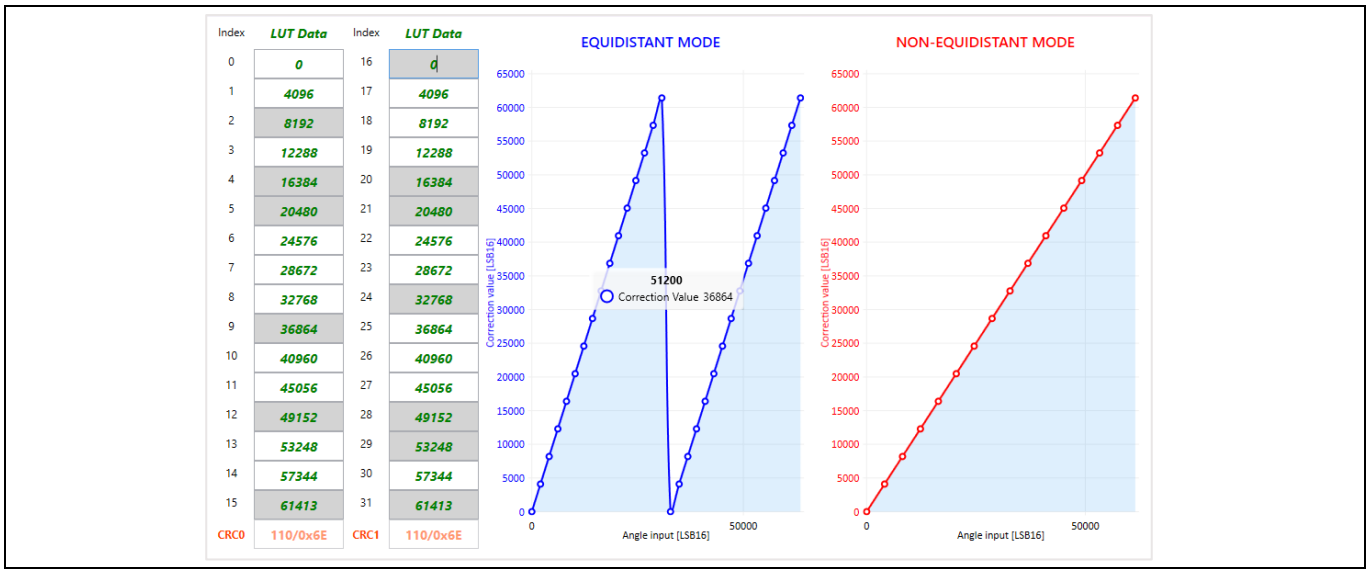


Figure 29 Extended Sensor Configuration – LUT Configuration tab

5.4.2.3 User configuration

The **User Configuration** tab provides an extended way to see and configure the ***usr_config_1_reg*** to ***usr_config_15_reg*** registers. The UI elements are organized into **six** main categories, each having multiple drop downs, and text boxes used for input as shown in Figure 30:

- Basic Interface Configuration
- Status Flags Configuration
- Input Spike Filtering Configuration
- Angle Configuration
- Dynamic Compensation Configuration
- System Configuration

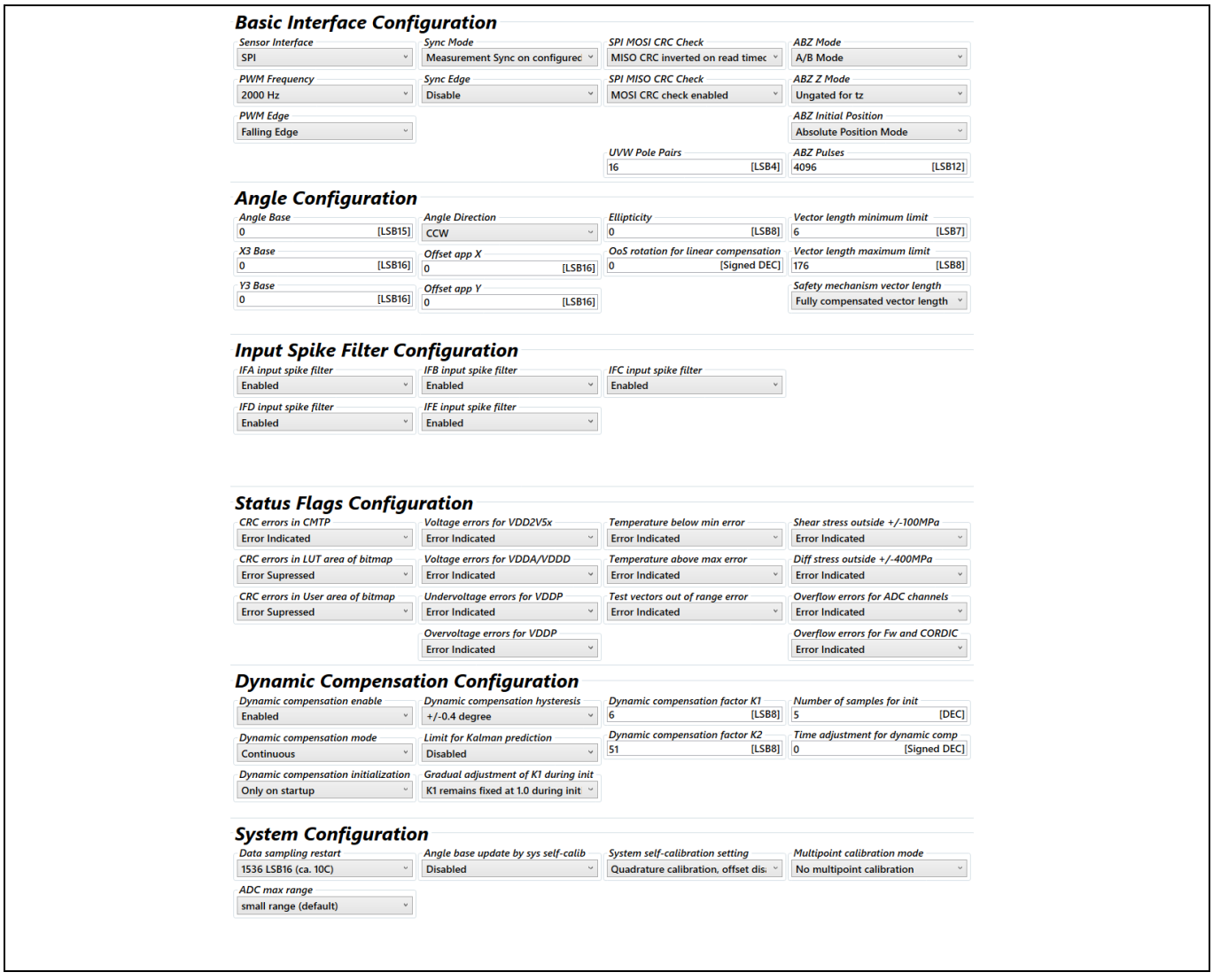


Figure 30 Extended Sensor Configuration – User Configuration tab

5.4.2.4 CMTP configuration

The **CMTP Configuration** tab provides a way to convert the values saved in **Volatile Memory** tabs into Non-Volatile Memory data that can either be saved into a **.CSV** file for later use or writing to the sensor's internal memory. This view contains two checkboxes that you can select to write either the LUT or USER part of CMTP or both, see Figure 32.

Clicking the **Write** button will prompt you to confirm the selection as shown in Figure 31.

Attention: ***The sensor has a limited number of writes. In the current version of the sensor, the CMTP can only be written once per address. This does mean that you can write the LUT and the USER section of the CMTP only once. After this is implemented, the software will automatically check and stop the user from trying to write the section further. See Memory map section for more information about write cycles.***

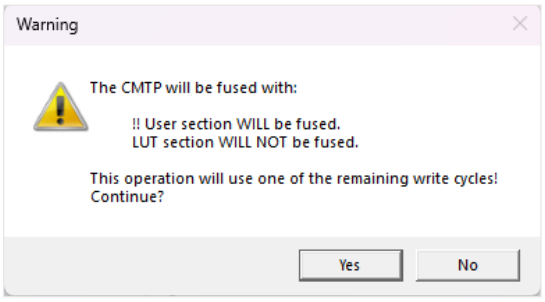


Figure 31 Extended Sensor Configuration – CMTP writing warning

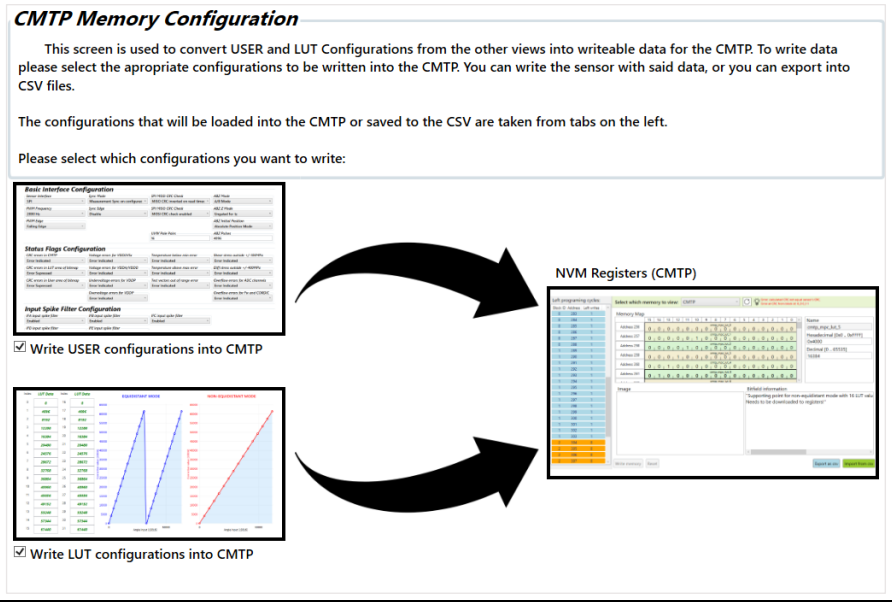


Figure 32 Extended Sensor Configuration – CMTP Configuration tab

5.4.3 TLx49012 interface configuration detection

The control panel is found in the **Interface Readout** view that displays the TLx49012 volatile memory configuration (Figure 33). The following parameters are displayed:

- Interface mode
- PWM Frequency (Hz)
- PWM Starting Edge
- Sync Mode
- Sync Edge
- ABZ Mode
- ABZ Initial position pulses
- ABZ Z Mode
- ABZ Pulses
- UVW Pole Pairs

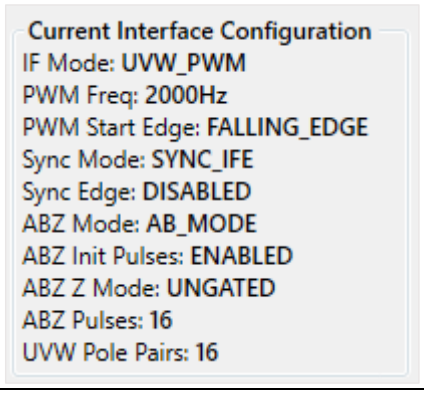


Figure 33 IF Readout view – TLx49012 configuration

5.4.4 Interface selection for multiple interface mode

In dedicated modes, the sensor provides data through multiple interfaces. Those modes are ABZ + PWM or UVW + PWM. Whenever the software detects such a mode, an extra drop down is displayed to select between one of the two. The drop down is populated with the appropriate data based on the detected mode as shown in Figure 34.

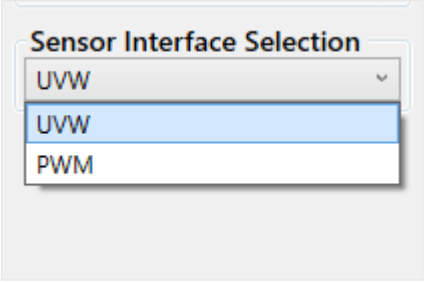


Figure 34 IF Readout view – Sensor Interface Selection

5.4.5 TLx49012 data display

During continuous readouts in the **Interface Readout** view, TLx49012 data is decoded and displayed in multiple UI elements.

These graphical elements are automatically reconfigured based on the configuration found in the sensor's internal volatile registers that you have updated, or that the sensor has loaded from the CMTP. Data decoding and display is based on the value found in the ***if_mode*** field of the ***usr_config_1_reg*** and the sensor's chip variant.

5.4.5.1 TLx49012 data display – SPI mode

Interface readout data display in **SPI Mode** has the following UI elements (Figure 35):

1. Cartesian chart with values from 0 to 360 on the Y axis. Holds 180 samples on the X axis. The chart is updated at 200 Hz
2. Angular gauge for displaying the 0˚ to 360˚ angle position of the magnetic field
3. Labels for displaying decimal values for the current angle (degrees) and the raw register values [LSB16].
4. Plotted data can be cleared by clicking the **Clear** button

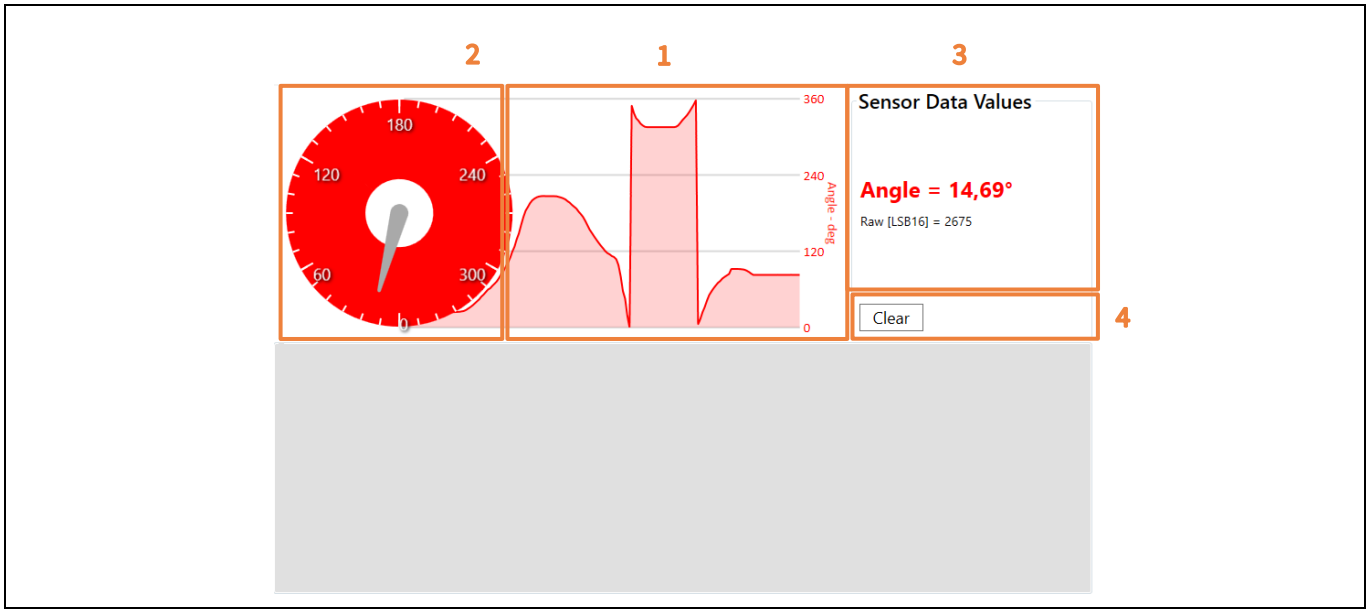


Figure 35 IF Readout View – TLx49012 display – SPI Mode

5.4.5.2 TLx49012 data display – ABZ mode

Interface readout data display in **ABZ Mode** has the following UI elements (Figure 36):

1. Cartesian chart with values from 0 to 360 on the Y axis. Holds 180 samples on the X axis. The chart is updated at 200 Hz
2. Angular gauge for displaying the 0˚ to 360˚ angle position of the magnetic field
3. Labels for displaying decimal values for the current angle (degrees) and the counted pulses from the sensor
4. Plotted data can be cleared by clicking the **Clear** button

Note: *If the sensor is configured in absolute position mode, the initial pulses will only be sent after a sensor Power-down reset. Stopping and starting the readout after the initial pulses will offer only relative position mode. This means that the angle displayed in the software will depend on the initial position of the magnetic field when the readout is started.*

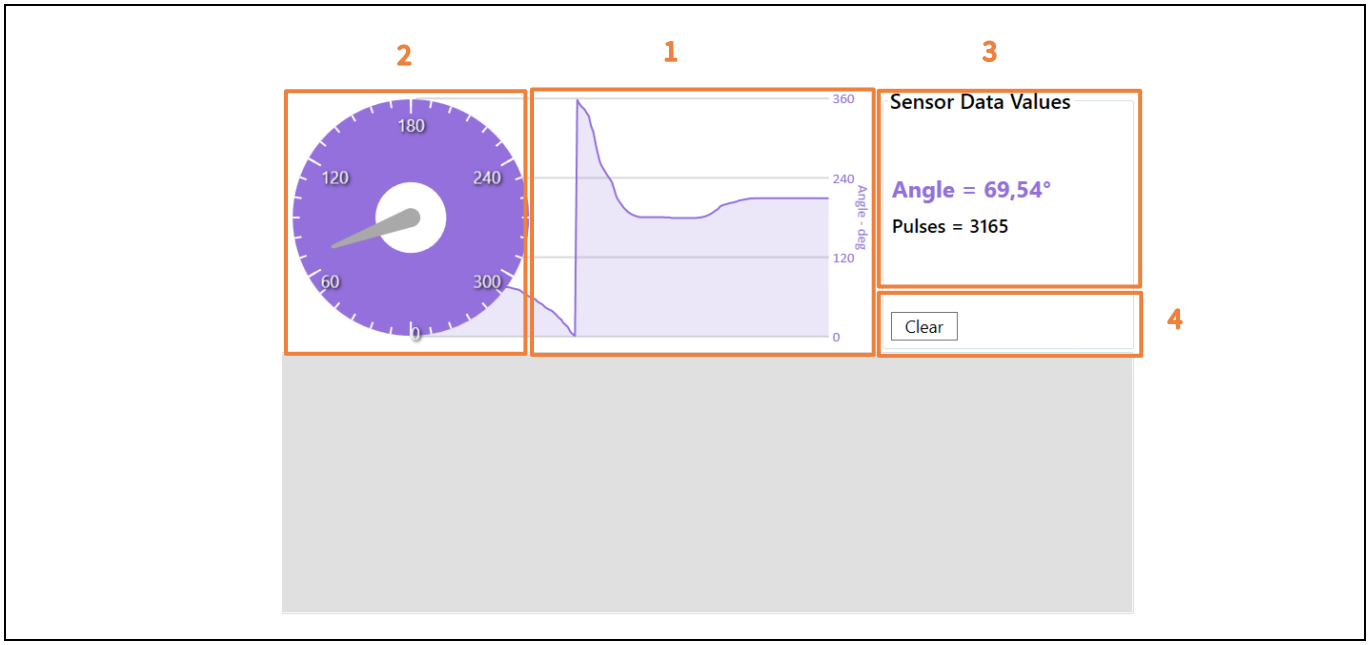


Figure 36 IF Readout view – TLx49012 display – ABZ Mode

5.4.5.3 TLx49012 data display – PWM mode

Interface readout data display in the **PWM Mode** has the following UI elements (Figure 37):

1. Cartesian chart with values from 0 to 360 on the Y axis. Holds 180 samples on the X axis. The chart is updated at 200 Hz
2. Angular gauge for displaying the 0˚ to 360˚ angle position of the magnetic field
3. Labels for displaying decimal values for the current angle (degrees), duty cycle (%), and how many times an error has been detected
4. Plotted data can be cleared by clicking the **Clear** button. An additional button is present to hide/show the extra charts from **(5)**. Hiding the additional UI elements can significantly improve the viewing experience of the other charts
5. An extra **Step Line Chart** can be visualized in this mode. This chart displays an additional view of the PWM signal from the sensor

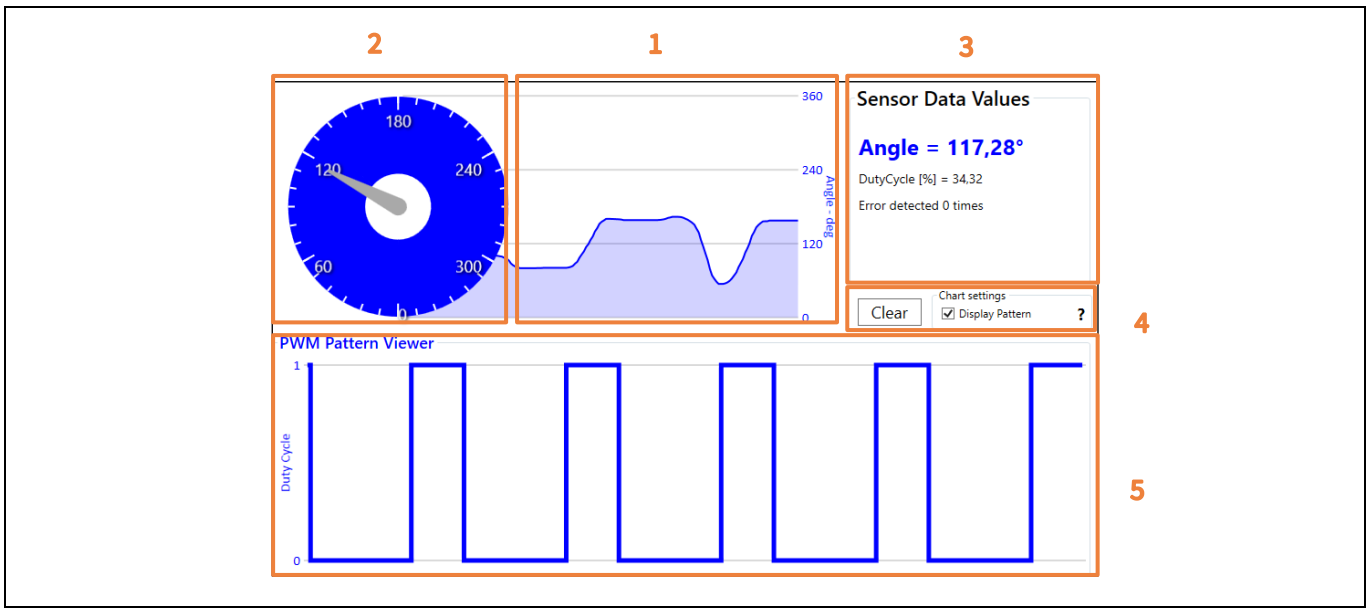


Figure 37 Readout View – TLx49012 display – PWM Mode

5.4.5.4 TLx49012 data display – UVW mode

Interface readout data display in **UVW Mode** has the following UI elements (Figure 38):

1. Cartesian chart with values from 0 to 360 on the Y axis. Holds 180 samples on the X axis. The chart is updated at 200 Hz
2. Angular gauge for displaying the 0˚ to 360˚ angle position of the magnetic field
3. Labels for displaying decimal values for the current angle range (degrees), current UVW pattern, electrical revolutions, and mechanical revolutions
4. Plotted data can be cleared by clicking the **Clear** button. An additional button is present to hide/show the extra charts from **(5)**. Hiding the additional UI elements can significantly improve the viewing experience of the other charts
5. Three extra **Step Line Charts** can be visualized in this mode. These charts display the received states of the UVW data lines from the sensor for an easy visualization of the pattern change

*Note: Due to the way the UVW interface works, the angle cannot be exact. In this mode, the angle is reported as an angular range referenced to the magnet's initial position. The resulting angle reflects the initial condition of the magnet when the **Start** button is selected, because UVW delivers relative position data rather than an absolute angle.*

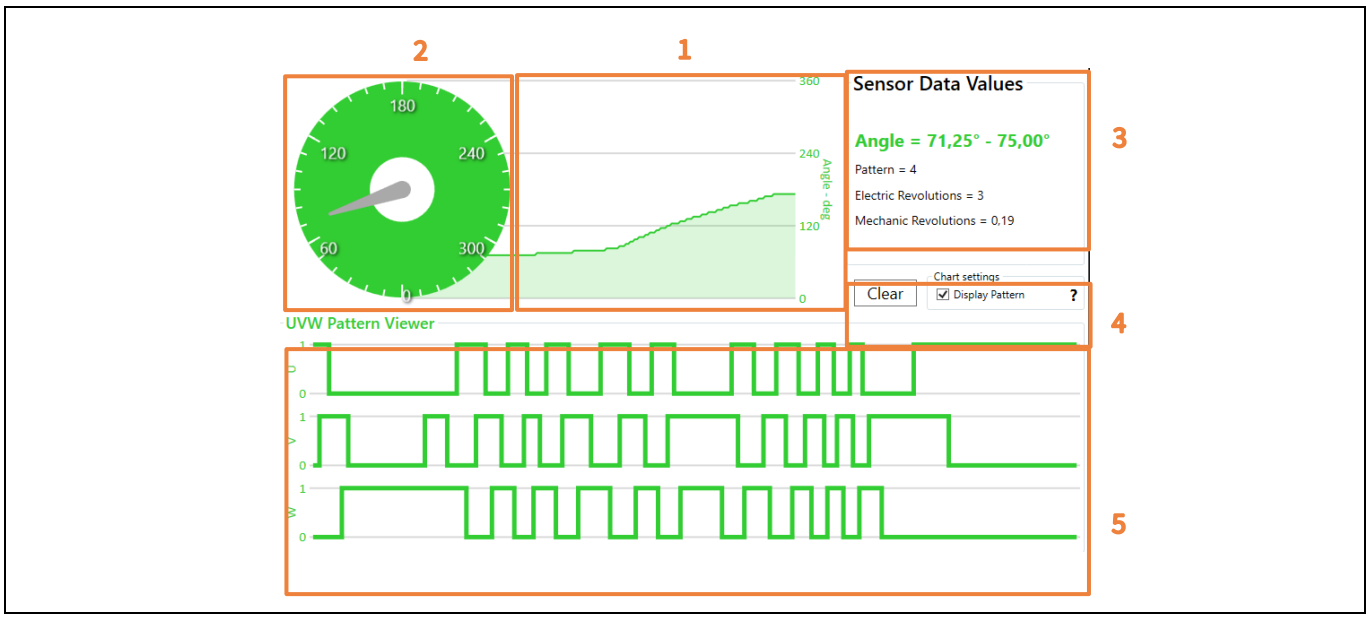


Figure 38 IF Readout View – TLx49012 display – UVW Mode

5.4.6 Sensor data logging

You have the option to select if the acquired data needs to be logged and extracted in *.CSV* format. By default, logging is disabled to minimize RAM usage. You can click on the **Logging** button (Figure 39), and if the state is changed to “ON”, the software will save all acquired values in RAM. Note that for protecting RAM usage, a maximum of 1,000,000 points can be stored, if this limit is reached, a pop-up window will notify you and data logging will be stopped.

After ending the measurements, you will have the following options (Figure 39):

- Discarding acquired data, by clicking the **Discard** button
- Saving acquired data to disk in *.CSV* format by clicking the **Save** button

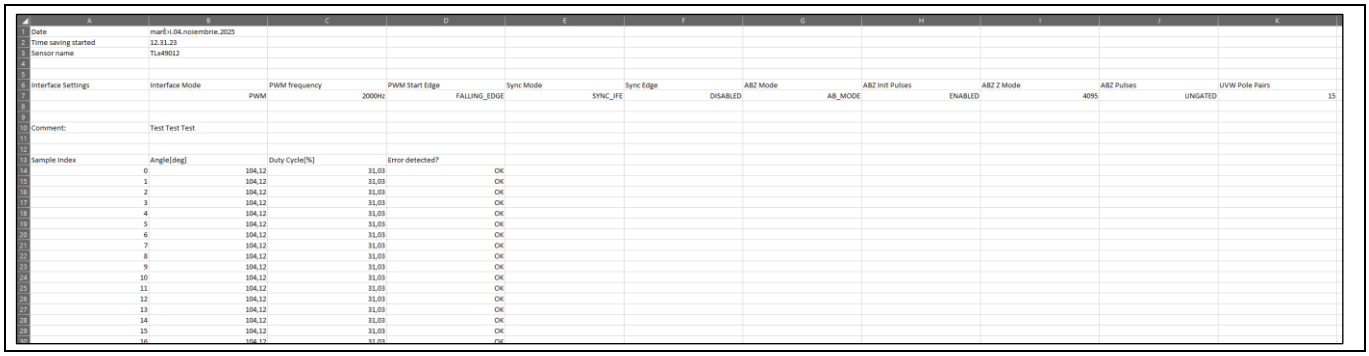
Figure 39 IF Readout view – Data logging control

The comma-separated values (*.CSV*) format implemented in this tool is used as a delimiter with the semicolon sign “;”. If the default separator of the operating system differs, you can use the “column split by delimiter” function of post-processing software (for example, Microsoft Excel).

The exported *.CSV* file has the following structure:

- **Header:** In this section, the software will log generic data (date, timestamp, sensor name, and user comment)
- **Interface Configuration:** In this section, the software will log specific interface data (Interface Mode, PWM Frequency, PWM Start Edge, Sync Mode, Sync Edge, ABZ Mode, ABZ Init Pulses, ABZ Z Mode, ABZ Pulses, UVW Pole Pairs)
- **Data:** Each logged line consists of a data bundle, different for each interface mode, containing:
  - Index
  - Angle (degrees)
  - Interface-specific data:
    - **SPI Mode:** Raw register data (LSB16)
    - **ABZ Mode:** Pulses count
    - **PWM Mode:** Duty Cycle (%) and Error detection
    - **UVW Mode:** Pattern, Electric Revolutions, Mechanical Revolutions

An example of exported data for the PWM Mode is shown in Figure 40.



	A	B	C	D	E	F	G	H	I	J	K
1	Date	marți,04.noiembrie.2025									
2	Time saving started	12.31.23									
3	Sensor name	TLx49012									
4											
5											
6	Interface Settings	Interface Mode	PWM frequency	PWM Start Edge	Sync Mode	Sync Edge	ABZ Mode	ABZ Init Pulses	ABZ Z Mode	ABZ Pulses	UVW Pole Pairs
7		PWM	2000Hz	FALLING_EDGE	SYNC_IFE	DISABLED	AB_MODE	ENABLED	4095	UNGATED	15
8											
9											
10	Comment:	Test Test Test									
11											
12											
13	Sample Index	Angle[deg]	Duty Cycle[%]	Error detected?							
14		0	104,12	31,03	OK						
15		1	104,12	31,03	OK						
16		2	104,12	31,03	OK						
17		3	104,12	31,03	OK						
18		4	104,12	31,03	OK						
19		5	104,12	31,03	OK						
20		6	104,12	31,03	OK						
21		7	104,12	31,03	OK						
22		8	104,12	31,03	OK						
23		9	104,12	31,03	OK						
24		10	104,12	31,03	OK						
25		11	104,12	31,03	OK						
26		12	104,12	31,03	OK						
27		13	104,12	31,03	OK						
28		14	104,12	31,03	OK						
29		15	104,12	31,03	OK						
30		16	104,12	31,03	OK						

Figure 40 Data logging example – Exporting PWM Mode data in .CSV format

5.5 SPI readout view

The **SPI Readout** view is accessible by clicking the corresponding button in the software main menu. The open view is shown in Figure 41**.**

This view displays plots and logs decoded data from the evaluated sensor through the SPI protocol. It also contains additional features and functionalities detailed in the next sections.

Upon accessing this view, the software will check if the sensor is in Test Mode. If the sensor is not, the procedure to enter this mode will automatically be executed.

Attention: ***Entering Test Mode requires the sensor to be powered down, resetting any configuration made in the IF Readout view. This does not apply when switching directly from the Memory map section, as the sensor is put in Test Mode when that view is initialized.***

The **SPI Readout** view functionalities can be divided into the following groups, as highlighted in Figure 41:

1. Readout control
2. Register configuration
3. TLx49012 basic configuration
4. TLx49012 extended configuration
5. Synchronization Trigger
6. LUT registers
7. Readout control
8. TLx49012 SPI data display
9. Sensor data logging

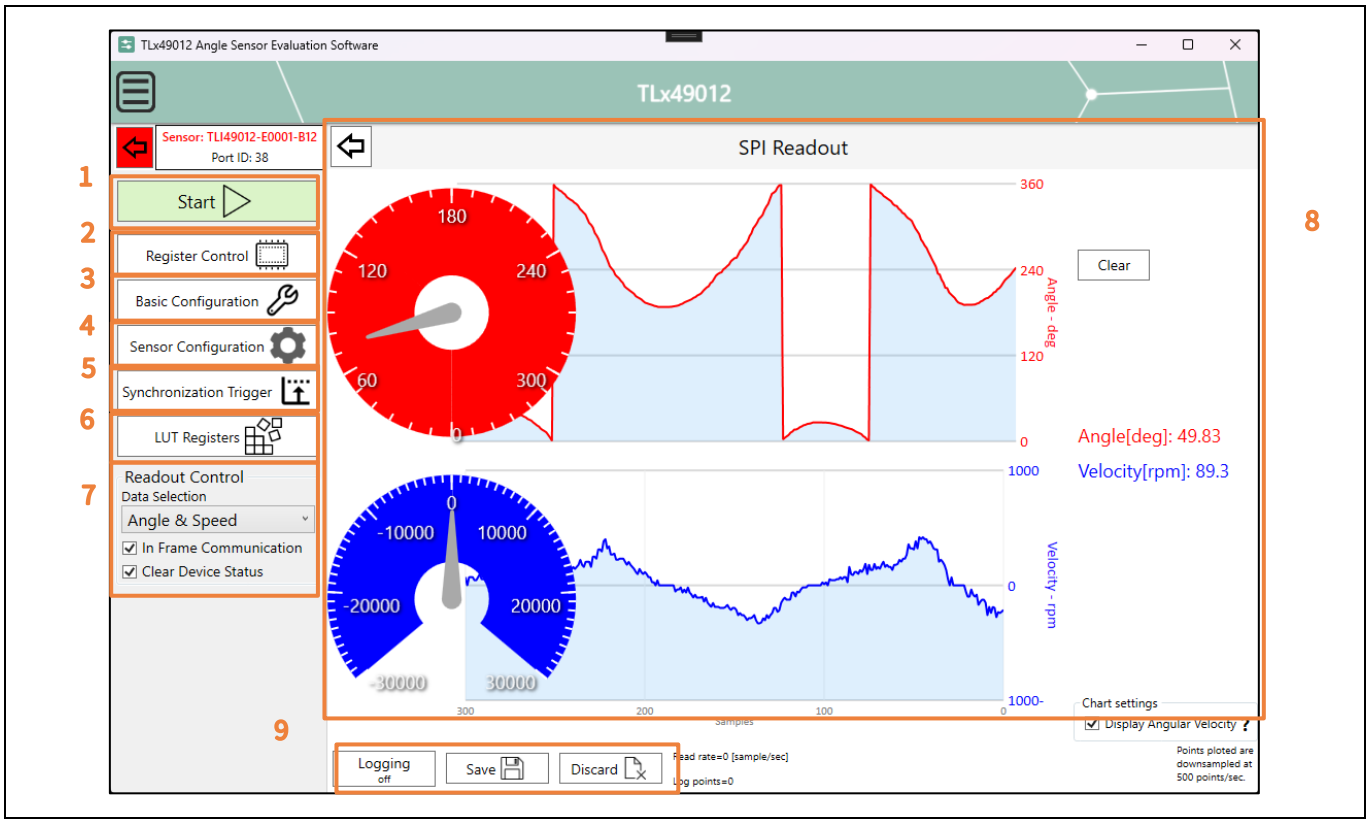


Figure 41 Software usage – SPI Readout view

5.5.1 Readout control

The readout control provides a way to start the continuous readout. By clicking the **Start** button, you can start an SPI continuous readout at a fixed frequency of 5000 Hz. The user interface will continuously update with the received data.

The continuous readout supports **In Frame** or **Next Frame** SPI communication schemes with or without **Device Status** clear. This can be changed in the **Readout Control** section of the software.

5.5.2 Register configuration

This window provides advanced control over the raw values of the registers through write and read operations on almost the full address range.

It supports single and continuous readouts with **In Frame** or **Next Frame** SPI communications schemes with or without **Device Status** clear. Fixed 1000 Hz read frequency.

The **Register Control** window has the following UI elements as seen in Figure 42:

1. Cartesian chart with raw register data for continuous readouts
2. Numeric (HEX and DEC) display for the decoded raw SPI frame
3. Device Status explicit bit decoding
4. **Register Address** (HEX) input data is used for all read and write operations
5. **Reg. Write Data** (HEX) input data is used for all write operations to the selected **Register Address**
6. Device Power-On Reset
7. CSV logging with full SPI frame data and explicit bit decoding of the Device Stat

After each write operation, a sensor soft reset from bitmap, read, and GUI update is executed. Bitmap CRC check is disabled.

Attention: ***NO CMTP programming – only bitmap registers.***

Attention: ***It is up to you to select the correct type of SPI scheme for the desired register address. For In-Frame communication, "Register Address" is only limited to the maximum 7-bit value of 127 (0x7F).***

Attention: ***A few registers can be written/read locked depending on unlock password (access rights) and control register configurations (for example, ifx_config, cmtp_word).***

Figure 42 SPI Readout view – Register Control

5.5.3 TLx49012 Basic Configuration

The **Basic Configuration** window offers ease of access to interpretation and configuration of the ***angle_pred_reg***, ***usr_config_7_reg***, ***usr_config_11_reg***, and ***ifx_config_9_reg*** registers. When the window is initialized, the volatile memory of the TLx49012 is read and interpreted, being transcribed into the UI elements as shown in Figure 43 (4 drop downs and 2 text boxes):

- Angle Base **(1)s**
- Current Angle (truncated on 15bits) **(1)**
- Direction **(1)**
- Dynamic Comp Mode **(2)**
- Dynamic Comp Enable **(2)**
- ADC Blank Cycles **(3)**

In the **Basic Configuration** window, the following operations can be applied using the available buttons **(4)**:

- **Reload:** The values from the internal memory are re-read and the UI elements are updated. A new angle is displayed
- **Write:** Selected configuration (as seen in the window) is written in the sensor. CRC is automatically calculated for the configuration to be written. After the write operation takes place, the sensor is soft-reset, and the registers from the bitmap configuration are re-read, and the values will be reloaded in the UI elements
- **Reset:** The sensor is hard-reset through a power cycle (power off, power on), and the memory is re-read and UI re-populated
- **Close:** The window is closed and the Interface readout view is updated with the new values from the volatile memory

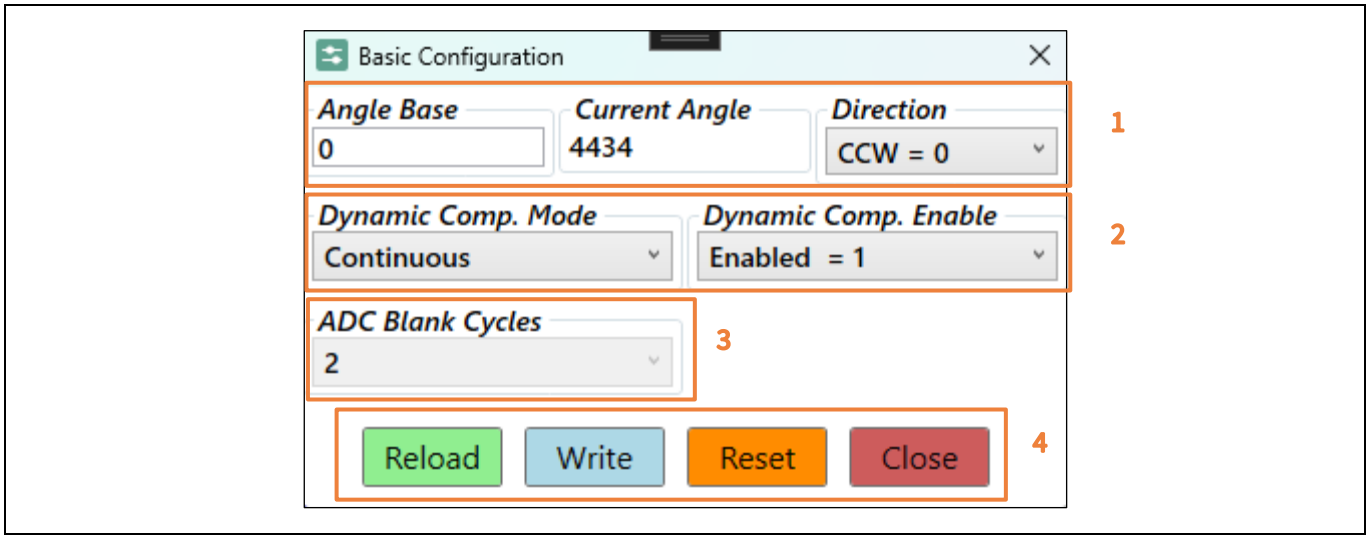


Figure 43 SPI Readout view – Basic Configuration

5.5.4 TLx49012 Extended Configuration

The **Extended Configuration** window offers ease of access to interpretation and configuration of the USER, LUT, and CMTP sections of the sensor's memory. For more information, see Section 5.4.2.

5.5.5 Synchronization trigger

The sensor allows different control functions on the IFE pin for ease of use. The function assigned to the IFE pin depends on the user interface and configured setting:

- **SPI:** Latches the measured angle and angular velocity to dedicated synchronization registers
- **ABZ:** Triggers initial position pulses or a reset of the sensor logic
- **UVW:** Triggers a reset of the sensor logic
- **PWM:** Synchronizes the measured angle and continuously provides it via the PWM interface or triggers a reset of the sensor logic

This window has only the capability to send synchronization signals only when the configured interface is SPI. The sensitive edge on the IFE pin can be programmed to:

- Falling edge
- Rising edge (default)
- Falling and Rising edge
- No edge (function deactivated)

The **Synchronization Trigger** window has the following features and UI elements (Figure 44):

- Synchronized Angle. Available in Raw 14-bit [LSB] and in degrees [°] **(1)**
- Angle Synchronized Status **(1)**
- Angle Read Status **(1)**
- Synchronized Velocity. Available in Raw 14-bit [LSB] **(2)**
- Velocity Synchronized Status **(2)**
- Velocity Read Status **(2)**
- Synchronization Mode. Only mode 0 is active in this window **(3)**

- Synchronization Edge (3)

In the **Synchronization Trigger** window, the following operations can be applied using the available buttons (4):

- **Trigger:** The trigger signal is sent on the IFE line
- **Read:** The angle and velocity registers are read, and the UI is updated
- **Trigger + Read:** The trigger signal is sent on the IFE line, and the angle and velocity registers are read, and the UI is updated
- **Write:** Selected configuration (as seen in the window) is written in the sensor. CRC is automatically calculated for the configuration to be written. After the write operation takes place, the volatile memory will be re-read, and the values will be reloaded in the UI elements
- **Reset:** The sensor is hard-reset through a power cycle (power off, power on), and the memory is re-read and UI re-populated. **This action resets the Synchronization Edge configuration**

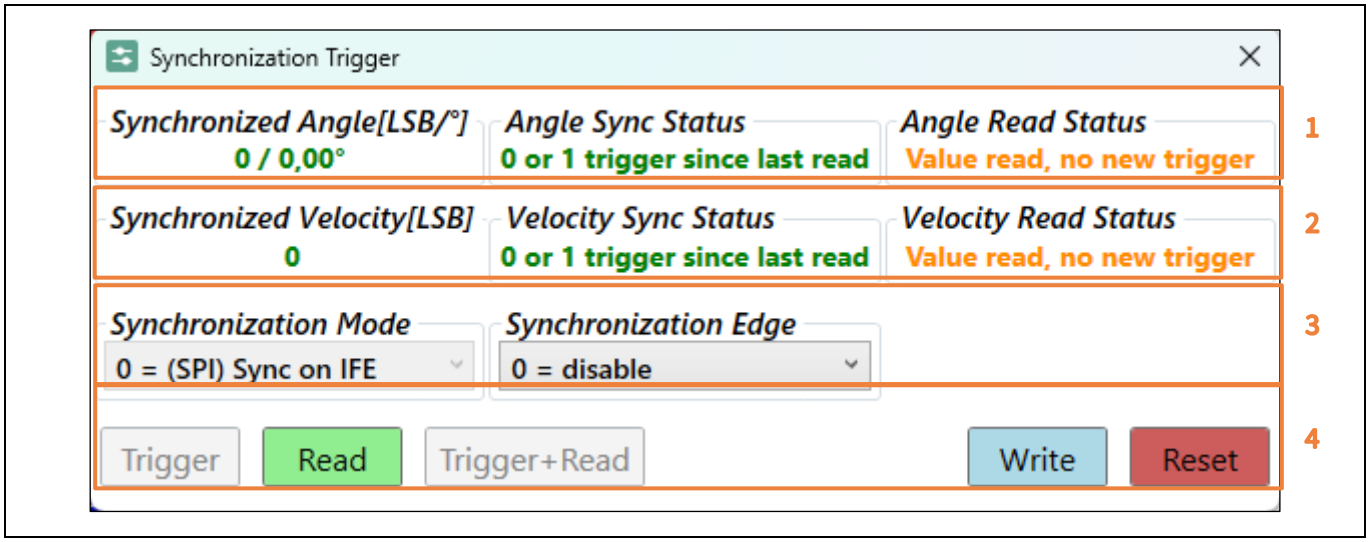


Figure 44 SPI Readout view – Synchronization Trigger, disabled

To use this window, select a **Synchronization edge** from the drop down and write it into the volatile memory using the **Write** button. After this process has been implemented and no issues have been displayed, the **Trigger** and **Trigger + Read** buttons become available.

To read a value, first use the **Trigger** button. This updates the internal register with the captured angle and velocity value. You can then use the **Read** button to request the values that were saved when the trigger signal was sent. A successful operation is shown in Figure 45.

Additionally, you can use the **Trigger+Read** button to send the trigger signal to the sensor and read the value immediately after. This has the same outcome as clicking the **Trigger** and the **Read** button in quick succession.

Clicking the **Trigger** button multiple times before initiating a read operation causes the device to store only the value captured by the last trigger signal; earlier captured values are overwritten. This operation is also reflected in the Status group boxes as shown in Figure 45.

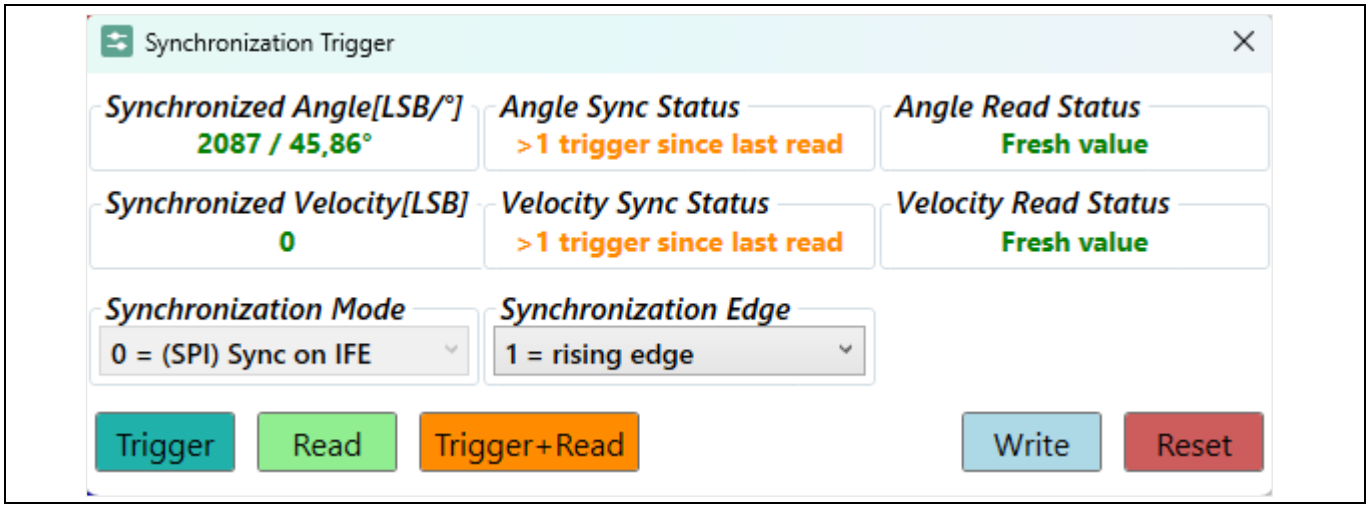


Figure 45 SPI Readout view – Synchronization Trigger, Multiple Trigger signals

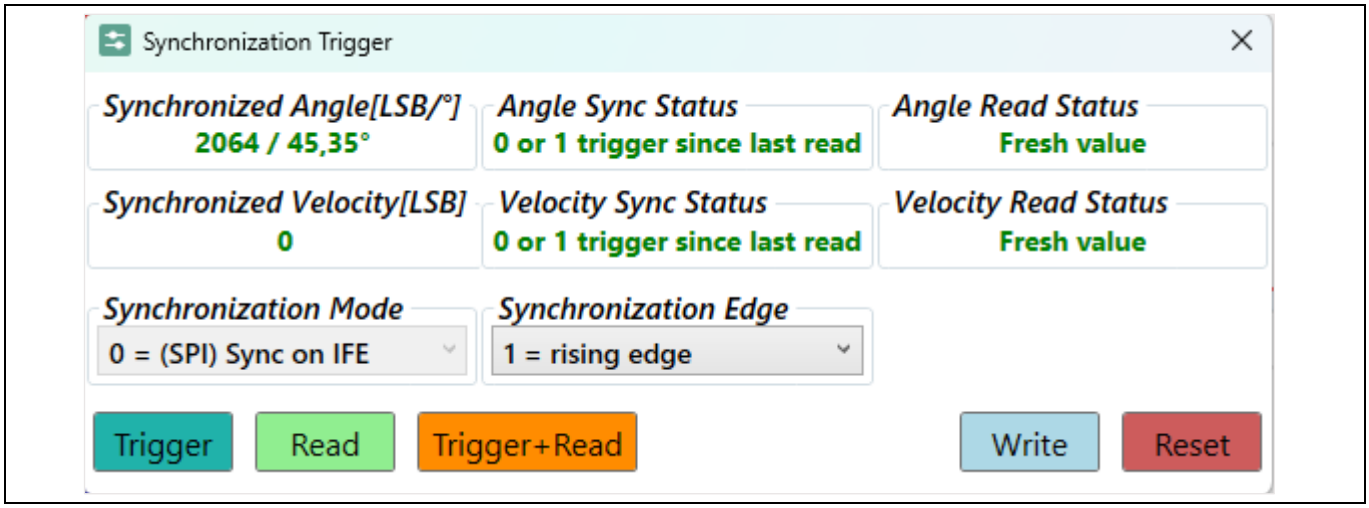


Figure 46 SPI Readout view – Synchronization Trigger, normal operation

5.5.6 LUT registers

The volatile MPC LUT area of the bitmap can be visualized and modified through the UI of the application in the **Volatile LUT Registers Configuration** window. This method offers automatic CRC recalculation, data change indication, hover-enabled graph data points, and LUT Export and Import into *.CSV* format.

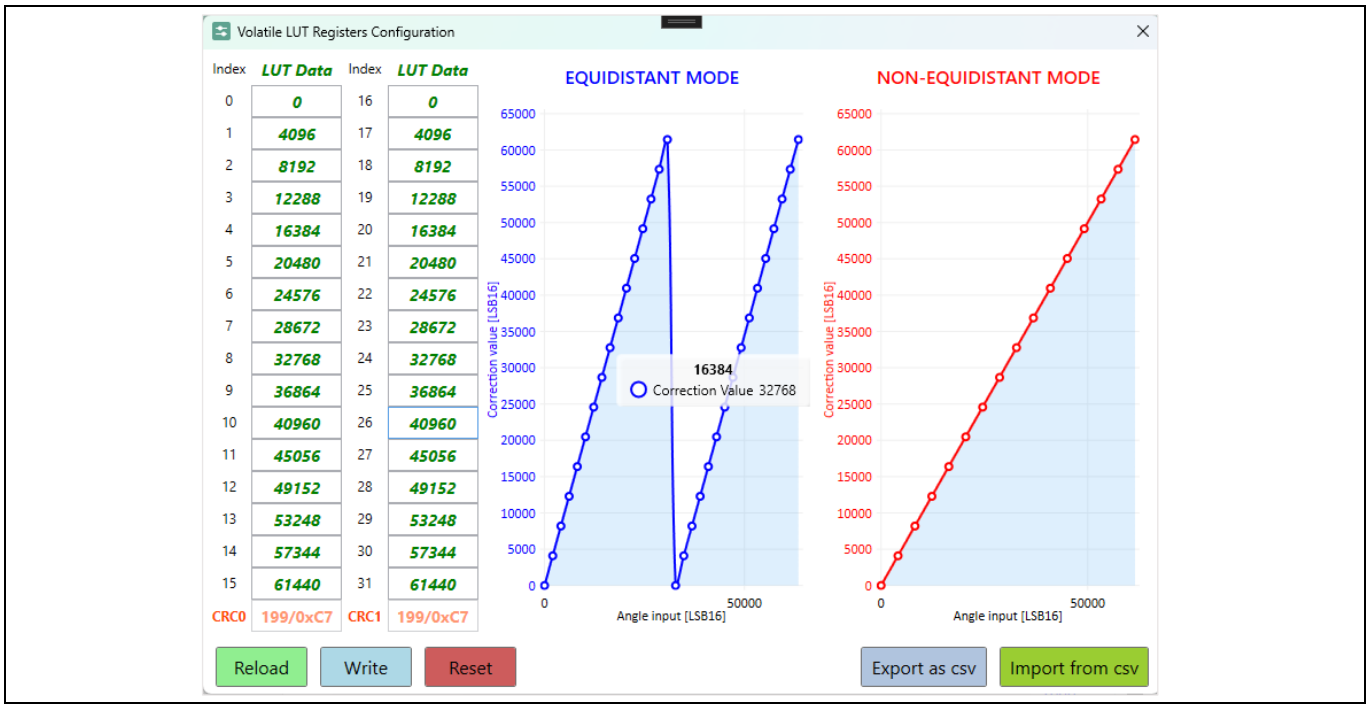


Figure 47 SPI Readout view – Volatile LUT Registers Configuration

In the **Volatile LUT Registers Configuration** window, the following operations can be applied using the available buttons:

- **Reload:** The values from the registers are re-read and the UI is re-populated
- **Write:** Selected configuration (as seen in the window) is written in the sensor. CRC is automatically calculated for the LUT to be written. After the write operation takes place, the registers will be re-read, and the values will be reloaded in the UI elements
- **Reset:** The sensor is hard-reset through a power cycle (power off, power on), and the memory is re-read and UI re-populated
- **Export as csv:** The values that are currently in the UI are logged and extracted into *.CSV* format. You will be prompted to enter a comment for the saved file, and upon confirming, the file will be saved in the selected location
- **Import from csv:** This button enables on-demand loading of the LUT values. Clicking this button will prompt you to select a *.CSV* file. If the file contains invalid data values, the software will reject the input, and no changes will be made. An example of a correctly exported/imported *.CSV* file is shown in Figure 48

	A	B	C
1	Date	06.11.2025	
2			
3	Comment:		
4			
5			
6	Index	Name	Value[LSB16]
7	0	mpc_lut_data_0	0
8	1	mpc_lut_data_1	4096
9	2	mpc_lut_data_2	8192
10	3	mpc_lut_data_3	12288
11	4	mpc_lut_data_4	16384
12	5	mpc_lut_data_5	20480
13	6	mpc_lut_data_6	24576
14	7	mpc_lut_data_7	28672
15	8	mpc_lut_data_8	32768
16	9	mpc_lut_data_9	36864
17	10	mpc_lut_data_10	40960
18	11	mpc_lut_data_11	45056
19	12	mpc_lut_data_12	49152
20	13	mpc_lut_data_13	53248
21	14	mpc_lut_data_14	57344
22	15	mpc_lut_data_15	61440
23	16	mpc_lut_data_16	0
24	17	mpc_lut_data_17	4096
25	18	mpc_lut_data_18	8192
26	19	mpc_lut_data_19	12288
27	20	mpc_lut_data_20	16384
28	21	mpc_lut_data_21	20480
29	22	mpc_lut_data_22	24576
30	23	mpc_lut_data_23	28672
31	24	mpc_lut_data_24	32768
32	25	mpc_lut_data_25	36864
33	26	mpc_lut_data_26	40960
34	27	mpc_lut_data_27	45056
35	28	mpc_lut_data_28	49152
36	29	mpc_lut_data_29	53248
37	30	mpc_lut_data_30	57344
38	31	mpc_lut_data_31	61440
39	32	lut_word_crc	51143

Figure 48 SPI Readout view – LUT export file example

5.5.7 Readout control

The readout control provides the option of selecting three types of data for the readout based on the selection made in the **Data Selection** drop down (Figure 49):

1. **Angle & Speed readout:** By selecting the appropriate item and clicking the **Start** button, you can start a SPI continuous readout at fixed frequency of 5000 Hz. The user interface will continuously update with the received data from the sensor's **angle_pred_reg** and **angle_vel_reg** registers
2. **Vector length readout:** By selecting the appropriate item and then clicking the **Start** button, you can start a SPI continuous readout at fixed frequency of 5000 Hz. The user interface will continuously update with the received data from the sensor's **vec_len_reg** and **vec_len3_reg** registers
3. **X/Y/SysCal readout:** By selecting the appropriate item and then clicking the **Start** button, you can start a SPI continuous readout at fixed frequency of 1000 Hz. The user interface will continuously update with the received data from the sensor's **x3_spi**, **y3_spi**, **xn_spi** and **yn_spi** registers. In this view, you can observe, after multiple magnet turns, the effects of the system self-calibration results applied to the compensated parameters. This effect is most noticeable when the sensor and magnet are placed in the **Out-Of-Shaft** configuration

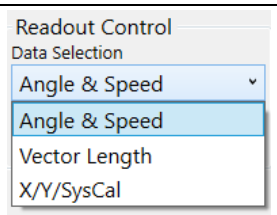


Figure 49 SPI Readout view – Readout Data Selection

There are also two additional options that you can select for the communication to be implemented **In Frame** and to clear device status at every readout. Those options are selected/unselected by the 2 checkboxes as shown in Figure 50.

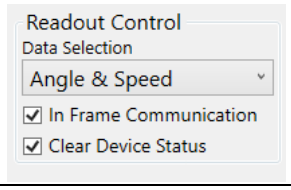


Figure 50 SPI Readout view – Readout Control

5.5.8 TLx49012 SPI data display

During continuous readouts in the **SPI Readout** view, TLx49012 data is decoded and displayed in multiple UI elements.

These graphical elements are automatically reconfigured based on the type of received data from the sensor and the selection made by you.

5.5.8.1 TLx49012 SPI data display – Angle & Speed

1. Angle & Speed data display in this mode includes the following UI elements (Figure 51)
2. Cartesian chart with fixed Y axis for the calculated angle value in degrees. Holds 300 samples on the X axis. The chart is updated at 500 Hz
3. Angular gauge for displaying calculated angle in degrees
4. Cartesian chart with autoscaling on the Y axis for calculated velocity in RPM. Holds 300 samples on the X axis. The chart is updated at 500 Hz
5. Speed Gauge for displaying the current calculated velocity in RPM.
6. Labels for displaying decimal values for angle in degrees and velocity in RPM.
7. Plotted data can be cleared by clicking the **Clear** button.
8. An additional button is present to hide/show the velocity gauge/charts. Hiding these UI elements can significantly improve the viewing experience of the other charts

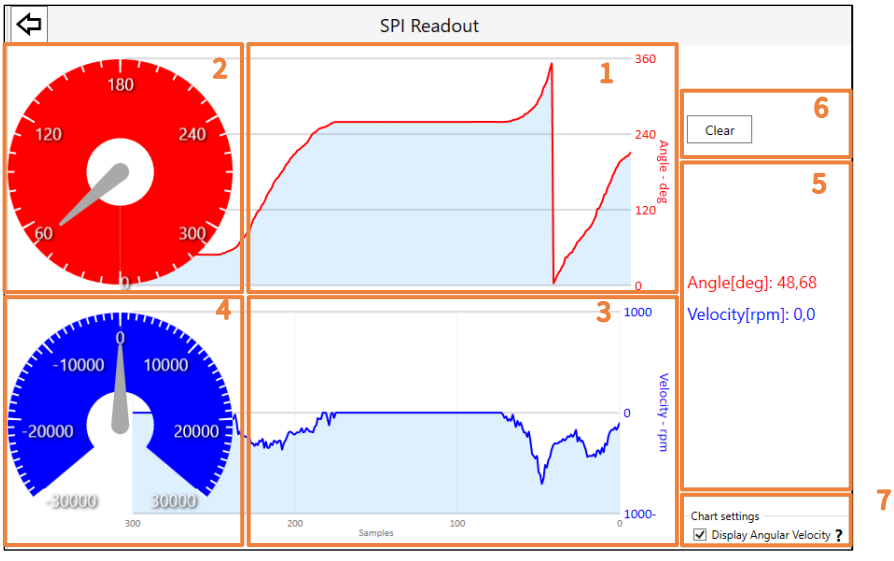


Figure 51 SPI Readout view – Angle & Speed view

5.5.8.2 TLx49012 SPI data display – Vector Length

Vector Length data display in this mode includes the following UI elements (Figure 52):

1. Cartesian Chart for Vector Length (value based on Xn/Yn). Value is displayed raw in [LSB]. Holds 300 samples on the X axis. The chart is updated at 500 Hz
2. Cartesian Chart for Vector Length 3 (value based on X3/Y3). Value is displayed raw in [LSB]. Holds 300 samples on the X axis. The chart is updated at 500 Hz
3. Labels for displaying values for Vector Length and Vector Length 3
4. Plotted data can be cleared by clicking the **Clear** button

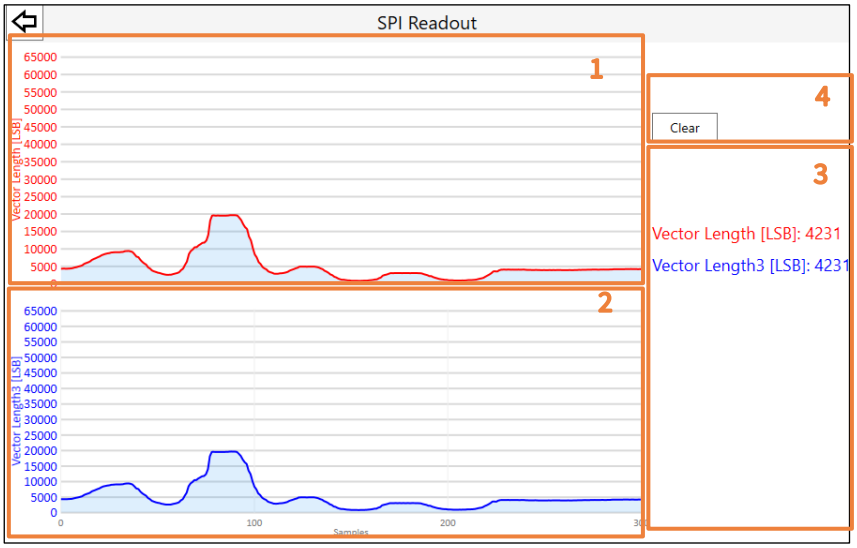


Figure 52 SPI Readout view – Vector Length

5.5.8.3 TLx49012 SPI data display – X/Y/SysCal

X/Y/SysCal data display in this mode includes the following UI elements (Figure 53):

1. Lissajous scatter plot for X3 & Y3 values. Values are displayed in (DEC). Holds 350 samples. The chart is updated at 200 Hz
2. Lissajous scatter plot for Xn & Yn compensated values. Values are displayed in (DEC). Holds 350 samples. The chart is updated at 200 Hz
3. Labels for displaying values for X/Y/Xn/Yn/SysCal, vector length limits, and calculated vector length 3
4. Labels for displaying the current SysCal Parameters and the active status
5. Plotted data can be cleared by clicking the **Clear** button. Additional buttons are present that can be used to Zoom into the charts

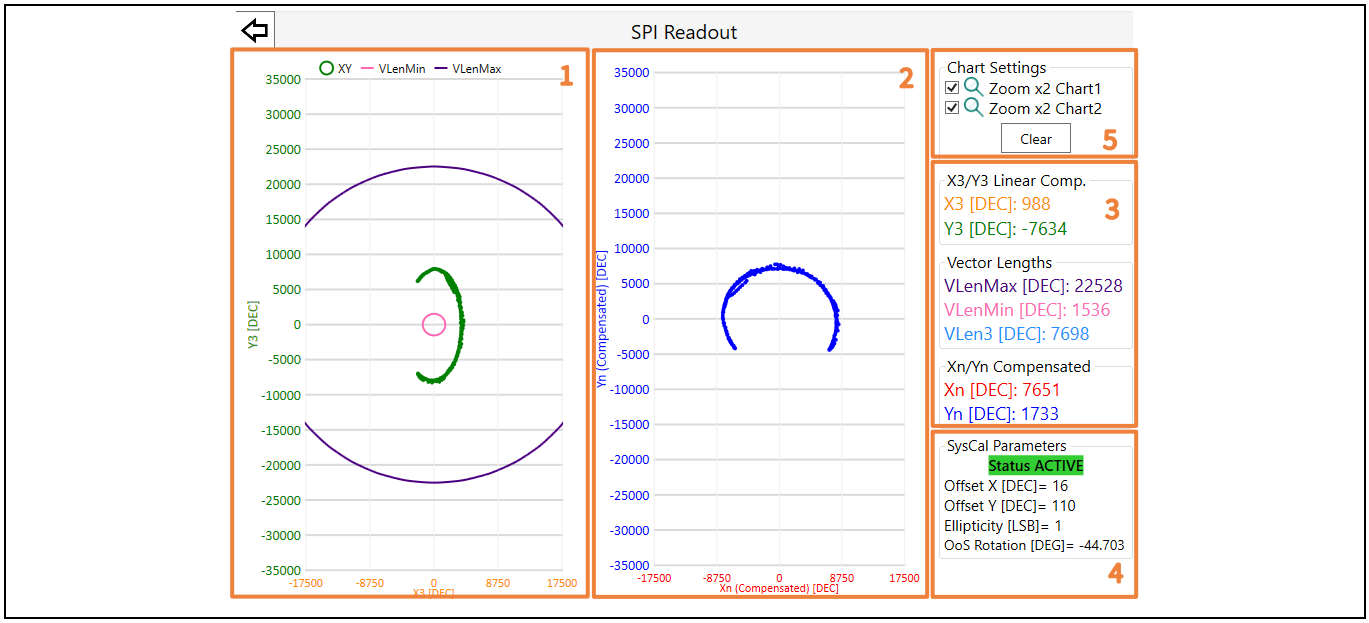


Figure 53 SPI Readout view – Vector Length

5.5.9 Sensor data logging

You have the option to select if the acquired data needs to be logged and extracted in *.CSV* format. By default, logging is disabled to minimize RAM usage. You can click on the **Logging** button (Figure 54), and if the state is changed to “ON”, the software will save all acquired data in RAM. Note that for protecting RAM usage, it is allowed to store maximum 1.000.000 points, if this limit is reached, a pop-up window will notify you, and data logging will be stopped.

After ending the measurements, you have the following options (Figure 54):

- Discarding acquired data, by clicking the **Discard** button
- Saving acquired data to disk in *.CSV* format by clicking the **Save** button

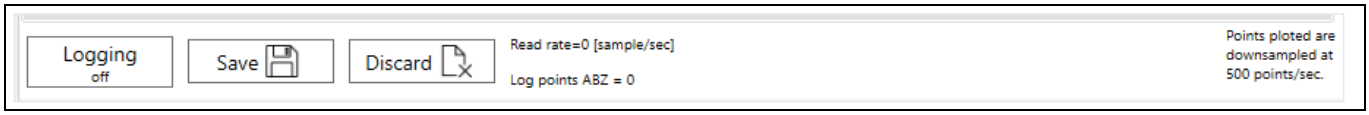


Figure 54 Software usage – Data logging control

The *.CSV* format implemented in this tool use as delimiter as the semicolon sign “;”. If the default separator of the operating system differs, you can use the “column split by delimiter” function of post-processing software (for example, Microsoft Excel).

The exported *.CSV* file has the following structure:

- **Header:** In this section, the software will log generic data (date, timestamp, sensor name, and user comment)
- **Data:** Each logged line consists of a data bundle containing:
  - Index
  - View Specific Data:
    - **Angle & Speed:** angle reg, device status (DEC), device status (HEX), Data (DEC), Data (HEX), Angle (deg), CRC (DEC), CRC (HEX), angle velocity reg, device status (DEC), device status (HEX),

Data (DEC), Data (HEX), Velocity (rpm), CRC (DEC), CRC (HEX), OFC, LFOK, DIAG, MAG, SUP, RST, OT, CAL

- **Vector Length:** vec_len_reg, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), vec_len3_reg, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), OFC, LFOK, DIAG, MAG, SUP, RST, OT, CAL
- **X/Y/X3/Y3:** X3 register, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), Y3 register, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), Vector Length 3 (Calculated), Xn (compensated) register, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), Yn (compensated) register, device status (DEC) device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), SYS CAL ON, SysCal Offset X register, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), SysCal Offset Y register, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), SysCal Ellipticity register, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), SysCal OoS Rotation register, device status (DEC), device status (HEX), Data (DEC), Data (HEX), CRC (DEC), CRC (HEX), OFC, LFOK, DIAG, MAG, SUP, RST, OT, CAL

An example of exported data for the X/Y/X3/Y3 view is shown in Figure 55.

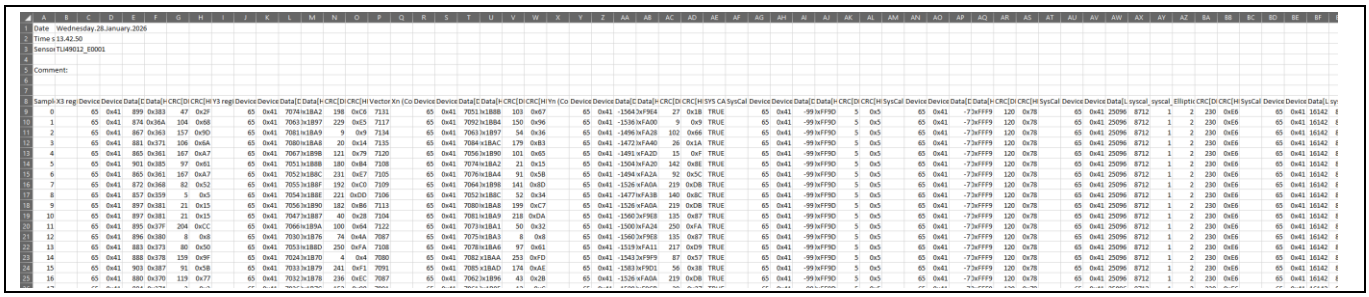


Figure 55 Data Logging example – Exporting X/Y/X3/Y3 view data in .CSV format

5.6 Memory map

The **Memory Map** view is accessible by clicking the corresponding button in the software main menu. The open view is shown in Figure 56.

This view implements various sensor internal memory operations, strictly for the TLx49012 sensor. It also contains additional features and functionalities detailed in the next sections.

The **Memory Map** view reads and displays the CMTP memory and the internal registers as bitmaps. The internal registers lose their content at power down and are loaded from the CMTP at power up.

Upon accessing this view, the software will check if the sensor is in Test Mode. If the sensor is not, the procedure to enter this mode will automatically be executed.

Attention: ***Entering Test Mode requires the sensor to be powered down, resetting any configuration made before, unless the sensor is already in Test Mode.***

The memory of the sensor is displayed as a collection of memory lines, each memory line being comprised of multiple memory bitfields. The user can select any memory line or bitfield and view detailed information by clicking on it.

The **Memory Map** view functionalities and features can be divided into the following groups, highlighted in Figure 56:

1. Memory bitmap display
2. Drop down for selecting the memory zone to be read/written
3. Button for reloading selected memory
4. CRC check for CMTP memory. The software calculates the CRC of the CMTP memory and compares it with the one written. In case of a mismatch an error is shown

Attention: ***For virgin blocks, it is normal to have a CRC error as all fuses are "intact".***

5. Hexadecimal and decimal decoding for selected memory bitfield or line
6. Selected bitfield information
7. Display for CMTP left programming cycles
8. Buttons for writing the information into the registers and performing a power-on reset
9. Buttons for exporting/importing the selected memory zone into/from a *.CSV* file. In the case of importing a *.CSV* file, the file will be checked and in the case of corruption or missing values or invalid data, it will be rejected, and no change will be reflected in the actual Memory Map

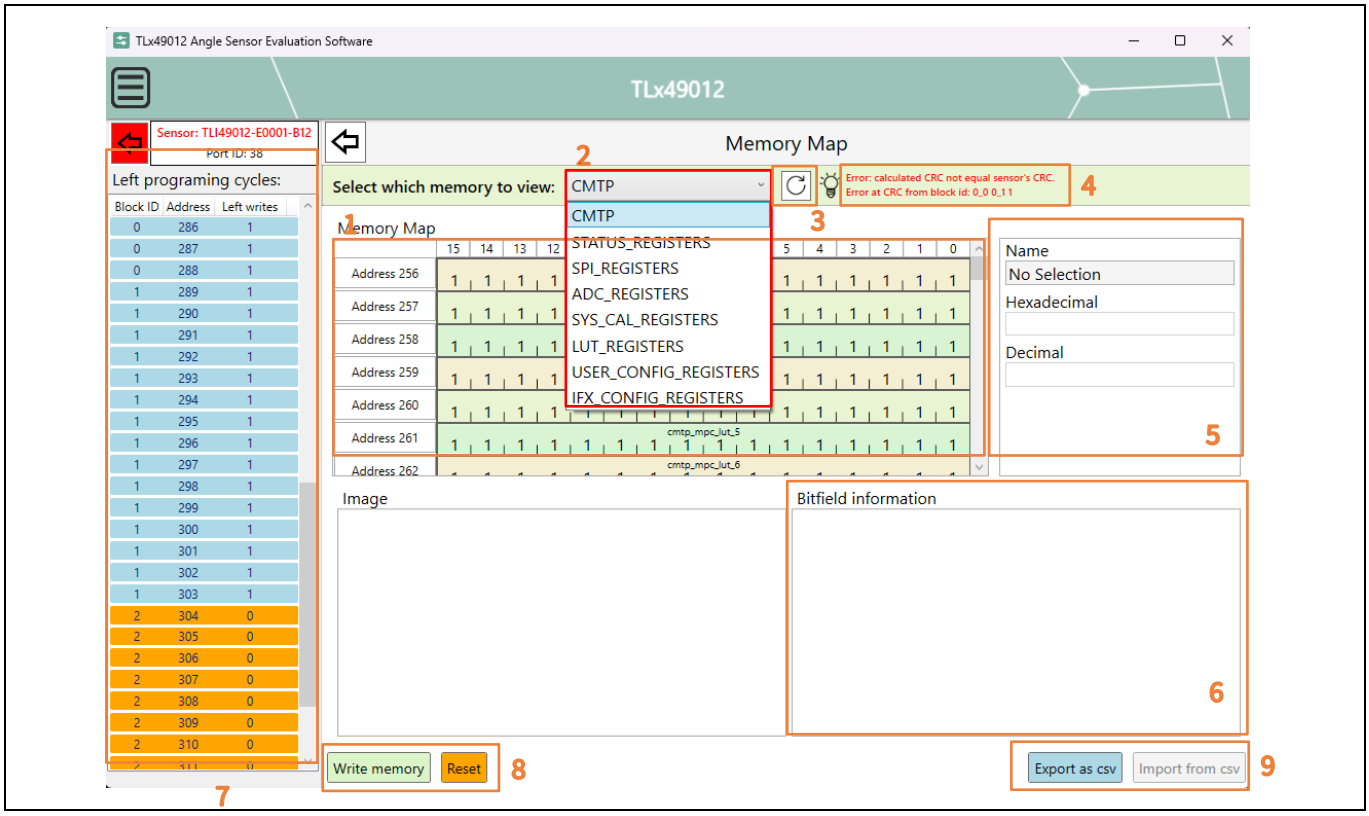


Figure 56 Software usage – Memory Map view

Note: All configurable parameters have tooltips, which hold relevant information for proper understanding of their use case.

5.6.1 Memory map zones

The **Memory Map** view offers viewing capabilities of most of the SPI registers. Those registers range from basic configuration registers such as USER configuration registers and LUT registers, to specific Infineon registers and CMTP registers.

5.6.1.1 Configurable zone

With default access the user can read all registers, however writing access is blocked to most registers. The available registers for writing are the *USER_CONFIG_REGISTERS* and *LUT_REGISTERS* zones. Access to these registers provides the user with default configuration options.

To write in any field, you can either select to write to the whole address line or individual fields. This change only happens with the software and does not reflect on the sensor's internal memory or CMTP memory. When you are OK with the changes, you can use the **Write memory** button to write the current selected zone into the memory of the sensor with the values that are currently displayed in the software. Clicking the button will prompt you to confirm the changes. The CRC that protects the changed fields will automatically be re-calculated by the software and written in the correct field. After the write operation takes place, the sensor is soft-reset, and the registers from the bitmap configuration are re-read, and the values will be reloaded in the UI elements.

The software will additionally check if the values have been updated and will return to you whether the operation is completed successfully or it has failed.

5.6.1.2 LUT zone

The **Memory Map** view offers a way to change the contents of the volatile memory of the sensor and view the effects it has on the operation of the sensor. The LUT of the sensor can be viewed by clicking the LUT_REGISTERS selection in the drop down (2) as shown in Figure 56. The values stored in the LUT within the internal memory are not accessible all at once. Instead, an indexing approach is used to access these values.

To select the starting LUT entry, write the desired index to the “mpc_lut_idx” bitfield at Address 56 (see Figure 58), then click the **Write** button to open the selection window (see Figure 57). In this window, click **Index** to apply the update. The LUT value at the selected index displays in the “mpc_lut_data_0” bitfield at Address 58, and the next entries follow in index order, with the value at index+1 shown in “mpc_lut_data_1”, the value at index+2 in “mpc_lut_data_2”, and so on.

If you need to program LUT contents directly rather than refresh the readout mapping, select **Data** in the same window. This option writes values from the **Memory Map** window into the mapped LUT registers of the sensor. After using the **Data** button to modify LUT entries, you can click the **Index** button to refresh the mapping and verify the updated sequence in the “mpc_lut_data_x” fields beginning at the chosen index.

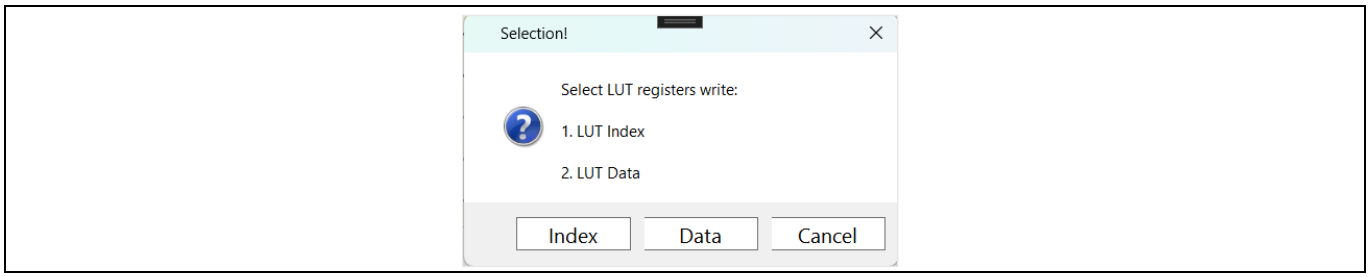


Figure 57 Software usage – Write selection for LUT

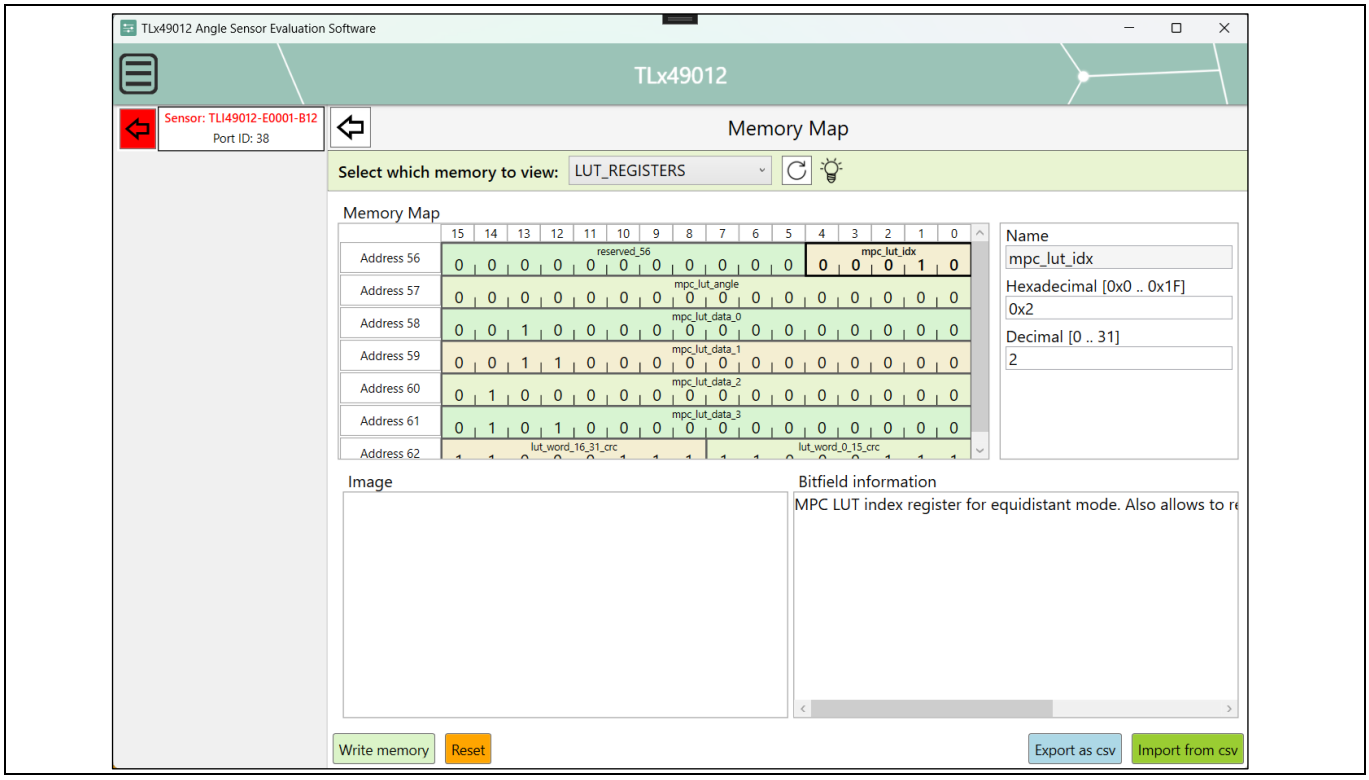


Figure 58 Software usage – LUT Registers

Note: When an index or a sequential offset exceeds the final LUT entry, the mapping wraps around to the first entry. This ensures continuous readout across the LUT boundaries and prevents writing data to locations that you did not intend to change.

5.6.1.3 CMTP zone

The sensor features a non-volatile memory (NVM) also known as the customer multi-time programmable (CMTP) memory, which stores application-specific configuration settings and look-up table (LUT) correction values. This memory allows users to customize the sensor behavior to suit their specific needs. The CMTP memory can be programmed with user-specific data that is kept even when the sensor is powered down. However, this memory can only be programmed for a finite number of times indicated in the software in the left panel of the **Memory Map** view whenever the CMTP zone is selected. Once those programming cycles have run out, that part of the memory remains unchangeable and cannot be reprogrammed further.

It is recommended, before programming the sensor's non-volatile CMTP memory, first modify the registers through volatile means and confirm it is the needed configuration. Once the target configuration is identified, the sensor can be fused with the corresponding bitmap values. This process can be done through the **Extended Sensor Configuration**, or through the steps shown in Section 5.4.2.

5.6.2 Non-volatile memory programming

The NVM programming features are available in the **Memory Map** view that can be accessed through the main menu of the sensor. Programming the CMTP is possible, in this version of the software, through two memory views, namely:

- CMTP view
- USER_CONFIG_REGISTERS view

The CMTP/NVM memory of the sensor can be grouped into blocks, based on the information they contain, each protected by CRC. The block identification can be found under the "Block ID" column in the left programing cycles as seen in **(7)** of Figure 56 and are assigned as such:

- LUT: Block 0
- USER configuration: Block 1
- IFX configuration: Block 2

You can only write Block 0 and 1 for a limited number of times, Block 2 being fused from the factory. A virgin CMTP line is read as 0xFFFF. Configurations in the CMTP must be manually done by selecting the bitfield or line and writing the desired values in the control textbox **(5)** as shown in Figure 56. Reserved or unused bitfields must be set to zero. Alternatively, the CMTP can be imported via the **Import from csv** button. This automatically checks and loads a *.CSV* file from you. This *.CSV* file is first checked and rejected if any problems arise. You can get *.CSV* files by exporting them from this menu, or from the **CMTP Configuration** tab from the **Extended Sensor Configuration** window.

Write the CMTP memory with the data by clicking the **Write Memory** button **(8)** as shown in Figure 56. This will recalculate the CRC for each block. You will be prompted to select which part of the CMTP to be written as seen in Figure 59. Software checks available write cycles for each line and for each CRC of each block, in case of any inconsistencies the operation is aborted.

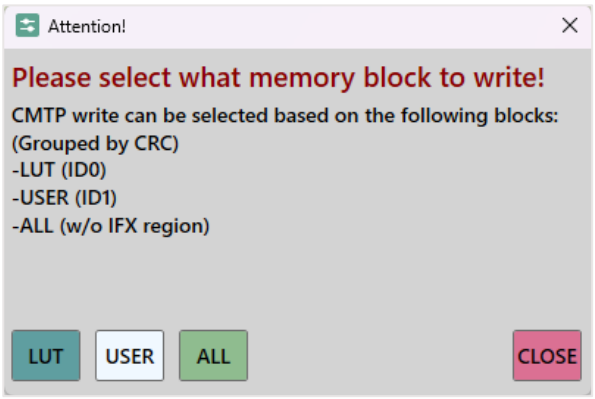


Figure 59 Software usage – CMTP writing selection

5.6.2.1 NVM programming using converted USER data

Alternatively, you can choose to convert the USER_CONFIG_REGISTERS memory map into usable data for the CMTP.
To achieve this, all configurations must be manually done by selecting the bitfield or line and writing the desired values into the control textbox or automatically loading those values via a *.CSV* file. The yellow **Write CMTP** button (1) at the bottom of the view as shown in Figure 60 starts the conversion and writing process. This, however, does not fuse the entire CMTP memory, only the blocks that contain the user configurations (That have Block ID 1). The CRC is also automatically recalculated at every step of the process.

Note: This is the recommended and less error prone method to configure the USER block of the CMTP (starting from the default values).

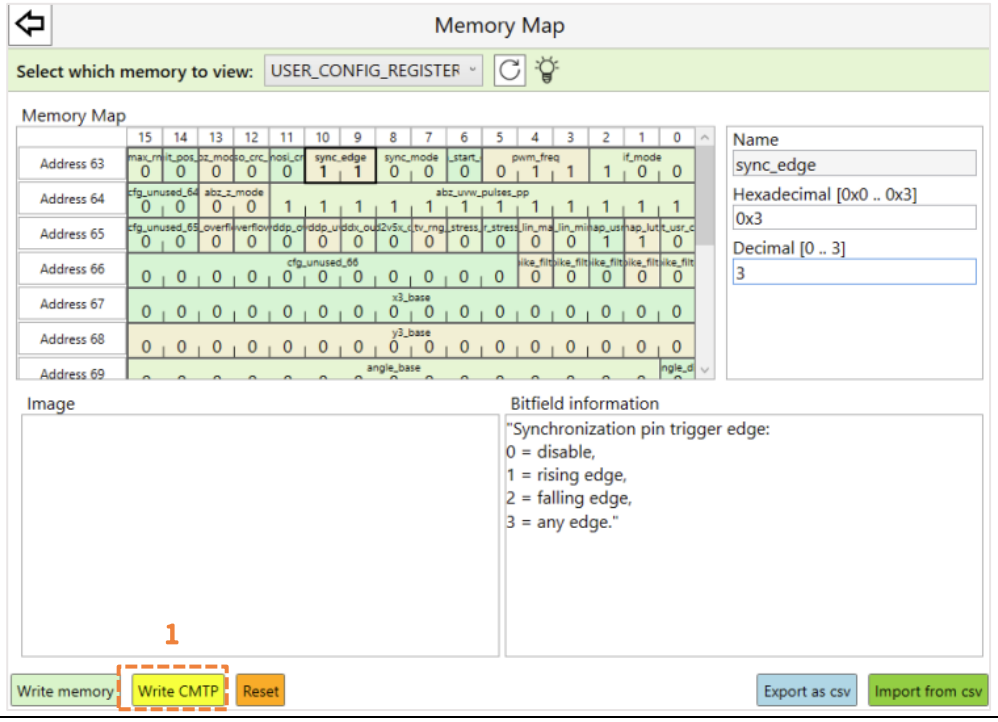


Figure 60 Software usage – USER_CONFIG_REGISTERS conversion into CMTP

6 Related resources

- Webpage: XENSIV™ angle sensors
- Infineon Developer Community: XENSIV™ angle sensors forum
- XENSIV™ TLx49012 Angle Sensor Evaluation Kit

Appendices

A Appendix 1 – Hardware revision history

Table 4 Hardware revision history

Hardware version	Description of changes
V1.1	Initial version of hardware
V1.2	Minor silkscreen modifications
V1.3	Added PCB silkscreen markings for the TLI49012 variant

References

[1] Infineon Technologies AG: *XENSIV™ TLE49012-S0001 angle sensor datasheet*; Available online

Glossary

AMR
anisotropic magnetoresistance (AMR)

CMTP
customer multi-time programmable memory (CMTP)

CPU
central processing unit (CPU)

CRC
cyclic redundancy check (CRC)

PSIB
position sensors interface board (PSIB)

CSV
comma-separated values (CSV)

DC
direct current (DC)

EEPROM
electrically erasable programmable read-only memory (EEPROM)

ESD
electrostatic discharge (ESD)

GMR
giant magnetoresistance (GMR)

GUI
graphical user interface (GUI)

I^2C
inter-integrated circuit (I^2C)

IDC
Infineon Developer Center (IDC)

ISaR
Infineon Sample Request (ISaR)

LED
light-emitting diode (LED)

LUT
look-up table (LUT)

MCU
microcontroller unit (MCU)

MPC
multipoint calibration (MPC)

Glossary

NVM
non-volatile memory (NVM)

PC
personal computer (PC)

PCB
printed circuit board (PCB)

RAM
random access memory (RAM)

SMT
surface mount technology (SMT)

TMR
tunneling magnetoresistance (TMR)

UI
user interface (UI)

USB
universal serial bus (USB)

Revision history

Document revision	Date	Description of changes
1.00	2026-07-21	Initial release

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