

TLV493D-A1B6 MS2GO

3D Magnetic Sensor 2 Go evaluation kit

User Manual





About this document

Scope and purpose

This document provides an introduction to the 3D Magnetic Sensor 2 Go kit and should enable the reader to efficiently carry out own evaluations with the 3D magnetic sensor TLV493D-A1B6.

Intended audience

This document is aimed at everyone who wants to work with the 3D Magnetic Sensor 2 Go evaluation kit.



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Introduction



1 Introduction

Infineon's **3D Magnetic Sensor 2 Go** is a compact evaluation kit to familiarize the user with the 3D Hall sensor TLV493D-A1B6. In a short time the board is set up and own 3D magnetic measurements can be executed. All required hardware is included and the software can be downloaded for free from the Infineon web page.

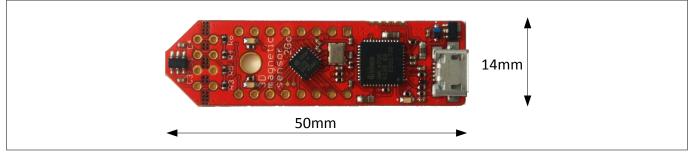
This user manual describes the different parts of the board, the software installation process and clarifies how the Graphical User Interface (GUI) can be used to do first evaluations. Further it is shown where to find example code and an Arduino library as a easy starting point for own developments.

1.1 Hardware overview

The 3D Magnetic Sensor 2 Go kit contains:

- The 3D evaluation board (EvalBoard) as shown in *Figure 1*, a ready-to-use printed circuit board (PCB) with the 3D Hall sensor. The EvalBoard is based on the XMC2Go-Kit. More technical documents and detailed description can be found at *http://www.infineon.com/xmc2go*
- A standalone 7x7x5 mm ferrite block magnet

To use the 3D Magnetic Sensor 2 Go kit the user has to acquire a USB cable with a micro USB connection-end for the EvalBoard side and a conventional USB connection for the PC side.





1.2 Software

The required software to run the kit can be found at the Infineon web site. For further information refer to the chapter *Software installation*.

The software package contains:

- A Graphical User Interface (GUI) for sensor evaluation.
- Firmware to be flashed into the XMC microcontroller for the low level communication with the sensor.
- USB driver J-Link from Segger which is necessary to establish the USB connection.

This software was designed to be used with Windows 7 and Windows 10. It is compatible with both 32-bit and 64-bit system types. Backward compatibility with older Windows versions is ensured only by the .NET platform as specific tests were not conducted on older operating systems.

The USB protocols capabilities are defined by the Segger driver. Versions USB 2.0 and USB 3.0 are compatible. The GUI is used to enable a communication between the sensor and the PC. The user can configure the sensor to operate in different modes. In those modes the update rate of the magnetic field measured (X, Y and Z components) and current consumption vary.



Introduction

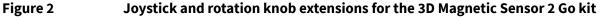
1.3 Hardware extensions

Additionally to the provided standalone magnet there are several dedicated extensions available that can be mounted to the 3D Magnetic Sensor 2 Go kit.

Table 13D Magnetic Sensor 2 Go extensions

Туре	Orderable part number (OPN)
Joystick	JOYSTICKFOR3D2GOKITTOBO1
Rotation knob	ROTATEKNOB3D2GOKITTOBO1
Linear slider	LINEARSLIDER2GOTOBO1
Out of shaft	OUTOFSHAFTFOR3D2GOTOBO1





Joystick

The magnet used in the joystick extension is an axial magnetized magnet as shown in *Figure 3*. The magnet material is ferrite, of class Y35, which is equivalent to a remanence of between 400 mT and 410 mT. The magnet disk has a size of 5 mm diameter and 5 mm thickness. For more information about the magnet, please follow this link:

https://www.supermagnete.de/eng/disc-magnets-ferrite/disc-magnet-5mm_FE-S-05-05



Introduction

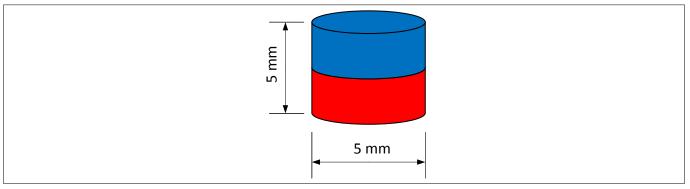


Figure 3

Magnet used in the Joystick extension

Rotation knob

The magnet used in the rotate knob extension is a diametrically magnetized magnet as shown in *Figure 4*. The magnet material is Neodymium Iron Boron (NdFeB) of class N45. The magnet is protected against corrosion with Nickel coating (Ni-Cu-Ni). The magnet size is 4 mm diameter and 10 mm thickness. For more information about the magnet, please follow this link:

https://www.supermagnete.de/eng/rod-magnets-neodymium/rod-magnet-diameter-4mm-height-10mmneodymium-n45-nickel-plated_S-04-10-DN

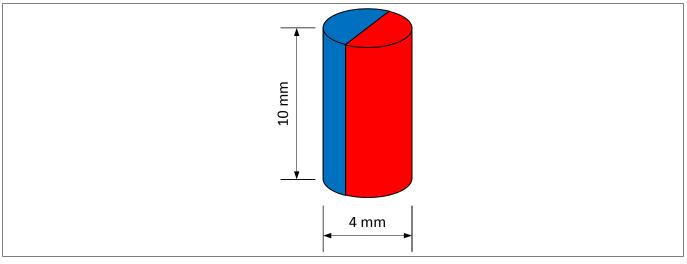


Figure 4 Magnet used in the rotation knob extension

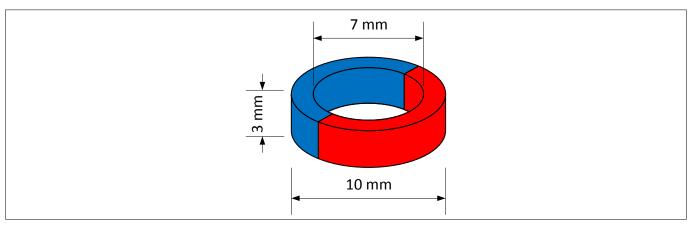
Out of shaft

The magnet used in the out of shaft extension is a diametrically magnetized ring magnet as shown in *Figure 5*. The magnet material is Neodymium Iron Boron (NdFeB) of class N45. The magnet is protected against corrosion with Nickel coating (Ni-Cu-Ni). The magnet size is 10 mm outer diameter, 7 mm inner diameter and 3 mm thickness. For more information about the magnet, please follow this link:

https://www.supermagnete.de/eng/ring-magnets-neodymium/ring-magnet-10mm-7mm-3mm_R-10-07-03-DN



Introduction





Linear slider

The linear slider extension comes with two axial magnetized magnets of the same size as shown in *Figure 6*. The first magnet material is Neodymium Iron Boron (NdFeB) of class N45. The magnet is protected against corrosion with Nickel coating (Ni-Cu-Ni). The second magnet material is ferrite, of class Y35, which is equivalent to a remanence of between 400 mT and 410 mT. Both magnet disk has a size of 5 mm diameter and 5 mm thickness. For more information about the magnets, please follow this links:

https://www.supermagnete.de/eng/disc-magnets-neodymium/disc-magnet-5mm-5mm_S-05-05-N https://www.supermagnete.de/eng/disc-magnets-ferrite/disc-magnet-5mm-5mm_FE-S-05-05

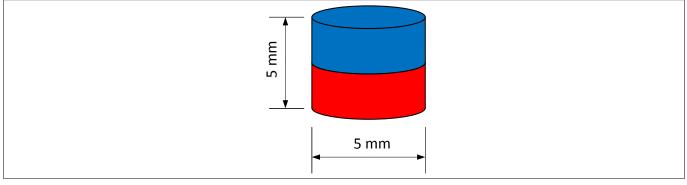


Figure 6

Magnet used in the linear slider extension



EvalBoard description

2 EvalBoard description

The evaluation board (EvalBoard) is a ready-to-use printed circuit board (PCB) which contains:

- The 3D magnetic sensor TLV493D-A1B6. For the availability of 3D Magnetic Sensor 2 Go kits with different sensor variants check the Infineon web page: https://www.infineon.com/cms/en/product/sensor/ magnetic-sensors/magnetic-position-sensors/3d-magnetics/
- XMC1100 microcontroller based on ARM Cortex[™]-M0 at 48 MHz frequency connected to the 3D sensor.
- XMC4200 microcontroller based on ARM Cortex[™]-M4 at 144 MHz frequency used for debugging and USB communication.
- Micro USB connector for power supply and communication with the Graphical User Interface (GUI).
- LED for indication of power supply and debugging.
- Two LEDs for user configuration.
- Voltage regulator, reverse current protection diode and ESD protection diode.
- Pin headers to access data lines (e.g. via oscilloscope, external microcontroller).

The different components and its location are shown in *Figure 7*. The 3D magnetic sensor can be separated from the rest of the EvalBoard by cutting the break line.

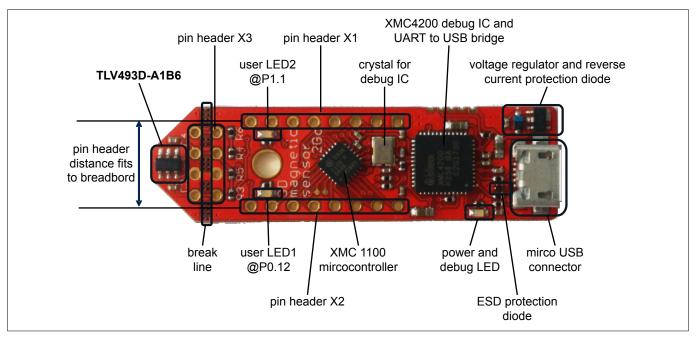


Figure 7 Main components of the EvalBoard

2.1 Hardware revision history

Evalboard version	Description of changes
3.2	 Implemented sensor V_{DD} control: Sensor V_{DD} pin connected to XMC pin P1.0 (previously 3.3V) LED1 connected to XMC pin P0.12 (previously P1.0)
3.0	Sensor application circuit updated for EMC performance
2.0	Layout updated
1.0	Initial version



EvalBoard description

2.2 Optional external power supply

The 3D Magnetic Sensor 2 Go EvalBoard is supplied via the USB cable. It is also possible to provide an external power supply. If this is the case, a few considerations must be taken into account as described below.

The 3D Magnetic Sensor 2 Go EvalBoard must be supplied by external 5 Volt DC power supply connected to the micro USB plug. The voltage regulator shifts the voltage level to 3.3 V for the microcontrollers and the 3D magnetic sensor. The Power & Debug LED indicates that the presence of the generated 3.3 V supply voltage.

Out of the box with the pre-programmed application and the on-board debugger in operation the EvalBoard typically draws about 75 mA. This current can be delivered via the USB plug of a PC, which is specified to deliver up to 500 mA. An on-board reverse current protection diode will ensure safe operation and protects the USB port of the Laptop/PC in case power is provided through the pin header X1.

It is not recommended to apply an additional power supply to the V_{DD} pin of X1 (3.3 V) when the board is powered via USB, because the 3.3 V supply could drive against the on-board power supply. The V_{DD} pin can be used to power an external circuit. But care must be taken not to draw more current than 150 mA, which is the maximum current the on-board voltage regulator can deliver. After power-up the Debug LED starts blinking. In case there is connection to a PC with correctly installed drivers, the Debug LED will turn from blinking to constant illumination.

2.3 Pin header connector

The pin headers X1 and X2 can be used to extend the evaluation board or to perform measurements on the XMC1100. The order of pins available at X1 and X2 corresponds to the pinning schema of the XMC1100 microcontroller in the TSSOP-16 pin package. The pinning table is also printed onto the bottom side of the PCB (depending on the version). The pin header X3 can be used to access directly the 3D magnetic sensor pins.

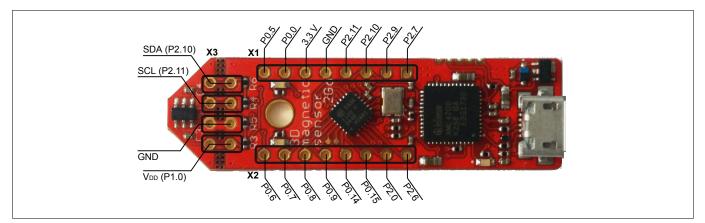


Figure 8 EvalBoard pin header connectors

The 3D Hall sensor pins can be accessed via the pin headers as shown in *Table 2*.

Table 2	Pin header description for the 3D magnetic sensor (X3)
---------	--

TLV493D-A1B6 pin number	Pin name on board	XMC1100 port pin	Sensor pin description
1	SCL	P2.11	Interface clock and \INT pin, open drain
3	GND	GND	Ground pin
4	+3V3	P1.0	Supply pin
6	SDA	P2.10	Interface data pin, open drain

The XMC1100 port pins P0.12 and P1.1 are connected the two user LEDs and are not available on the pin headers.

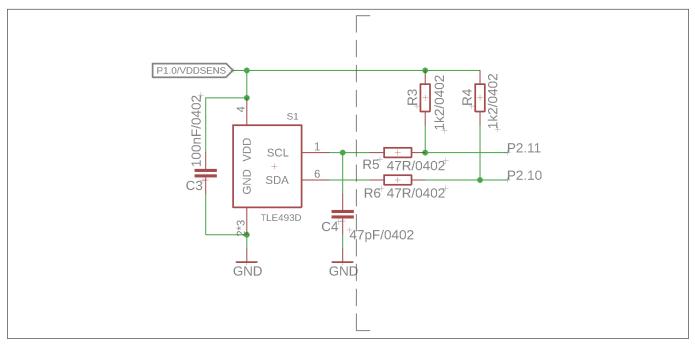


EvalBoard description

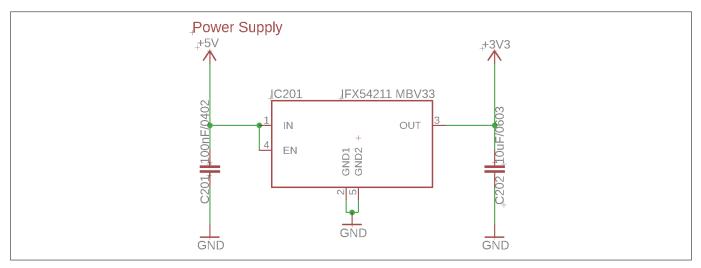
Table 3	Pins used for the user LEDs
LED	XMC1100 port pin
LED1	P0.12
LED2	P1.1

2.4 EvalBoard schematics

The schematics of the different blocks from the EvalBoard of the3D Magnetic Sensor 2 Go kit are provided in this chapter. They can be used to design customized PCBs. The user (integrator) is responsible for the correct functioning on system level as well as for the validation and testing.





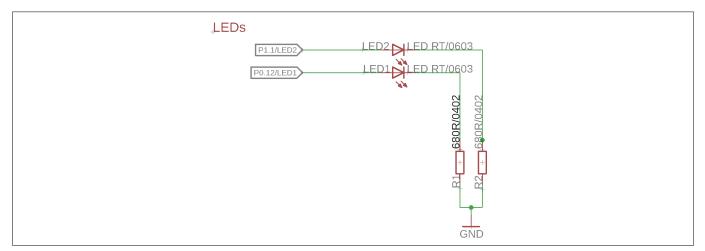




EvalBoard schematic: the voltage regulator (for the power supply)

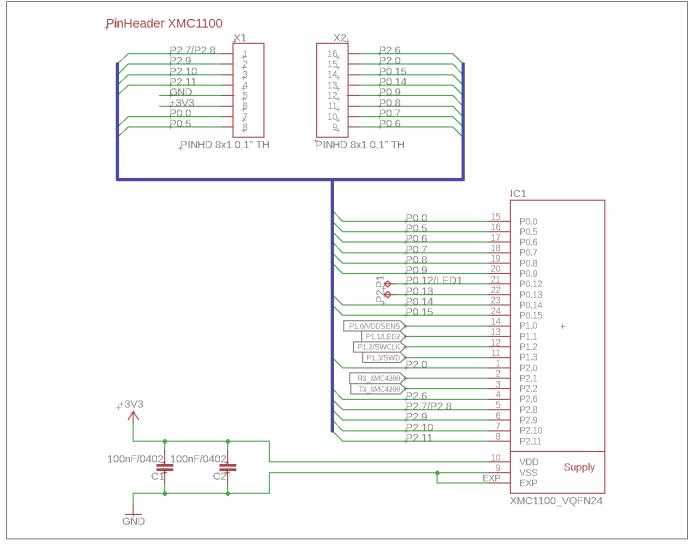


EvalBoard description





EvalBoard schematic: the LEDs for user configuration (connected to XMC1100 pins)





EvalBoard schematic: the XMC1100 microcontroller and pin headers



EvalBoard description

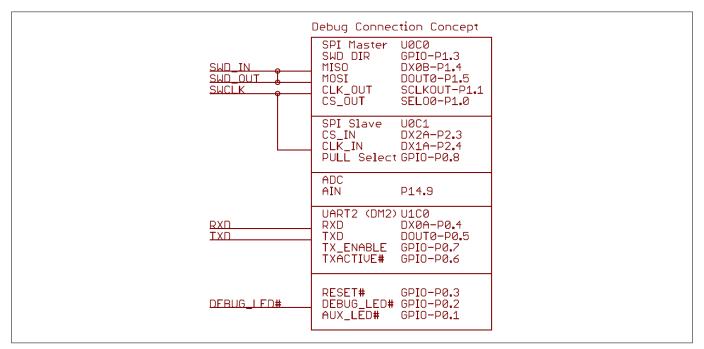


Figure 13

Sketch of the debug connection



EvalBoard description

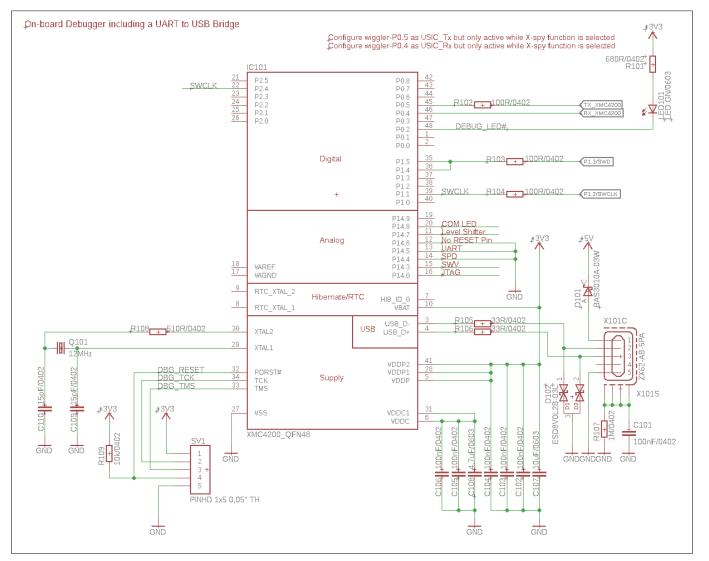


Figure 14

EvalBoard schematic: the XMC4200 microcontroller and micro USB connector



Software installation

3 Software installation

The following description guides through the installation procedure of the free evaluation software for the 3D Magnetic Sensor 2 Go kit.

Steps

1. Download the software.

Follow the link below to reach the **Sensor 2 Go** information page on the Infineon website. As shown in *Figure 15*, you can find the download link for the latest version of the 3D Magnetic Sensor 2 Go GUI on the right hand side.

https://www.infineon.com/cms/en/product/promopages/sensors-2go/

3D Magnetic Sensor 2GO - User Manual 01_01 Feb 04, 2016 PDF 1.93 mb 3D Magnetic Sensor for Consumer, Industrial and Automotive 03_00 Feb 28, 2018 PDF 1.24 mb ormation ex ree dimensional sensing with extremly low power nsumption

Figure 15 Download the "3D Magnetic Sensor 2 Go" software from the Infineon web page

2. Start the installation process.

Browse to your download folder and extract the downloaded .zip file. Afterwards, double click on the **.msi** file to start the installer. The window in *Figure 16* pops up. Click **"Next"**.



Software installation

EvalKit for Sensor	or TLx493D Magnetic
>Welcome	The installer will guide you through the steps required to install 3D Magnetic 2Go 3.0.0 on your computer.
>License	
>Directory	
>Confirm	
>Install	WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extend possible under the law.
>Finish	Exit < Back Next >

Figure 16

Start the software installation

3. Read the license agreement carefully and tick the box to accept the terms. Click **Next**.

EvalKit fo Sensor	r TLx493D Magnetic
>Welcome	Important Note and Terms of Use
>License	as well as the installation of the downloaded software is only possible if you agree to such terms and conditions. By clicking the acceptance button "lagree" below, you agree to have read the important note set
>Directory	forth below and to be bound by the following terms of use. If you do not agree to the terms and conditions below, click the button "I do not agree" and the installation procedure will not be started.
>Confirm	Important Note: a. THE INFORMATION GIVEN IN THE DOWNLOADED DOCUMENTS IS GIVEN AS A HINT FOR THE IMPLEMENTATION OF THE INFINEON TECHNOLOGIES COMPONENT ONLY AND SHALL
>Install	NOT BE REGARDED AS ANY DESCRIPTION OR WARRANTY OF A CERTAIN FUNCTIONALITY, CONDITION OR QUALITY OF THE
>Finish	
	Exit <back next=""></back>

Figure 17 Accept the license agreement

4. Choose your installation path. The software requires the SEGGER J-Link driver and .NET framework version 4.5 or later to be installed on your PC. If not yet available, check the respective items. Click **Next**



Software installation

EvalKit fo Sensor	r TLx493D Magnetic
>Welcome	The installer will install 3D Magnetic 2Go 3.0.0 to the following folder. To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
>License	C:\Program Files (x86)\Infineon Technologies\3D Magnetic 2Go
>Directory	☑ Add Desktop Shortcut
>Confirm	Install JLink .NET Framework Version 4.5 or later already installed
>Install	
>Finish	Exit <back next=""></back>

Figure 18 Select you installation folder

5. Confirm the installation settings by clicking on **Install**.

EvalKit for Sensor	or TLx493D Magnetic
>Welcome	Click "Install" to begin the installation. Click "Back" to review or change any of your installation settings. Click "Cancel" to exit the wizard.
>License	
>Directory	
>Confirm	
>Install	
>Finish	Exit < Back Install

Figure 19 Confirm the installation

6. Once the installation is complete, click on **Finish** to close the installer.



Software installation

EvalKit fo Sensor	r TLx493D Magnetic	infineon	
>Welcome	Setup Wizard has successfully finished Click "Finish" to exit.		
>License			
>Directory			
>Confirm			
>Install			
>Finish	Exi	t <back finish<="" th=""><th></th></back>	

Figure 20

Installation finished

You can now start the evaluation software. Open the start menu, browse to Infineon Technologies > 3D
 Sensor 2go Kit and open the application by clicking on 3D 2Go.

Infineon Security Platform Solution Infineon Technologies		Default Programs	
3D Sensor 2Go Kit		Help and Support	
🔛 SD 200	Ŧ	Run	
4 Back			
Search programs and files		Shut down 🕨	

Figure 21

Shortcut to the 3D Magnetic 2Go evaluation software (GUI)

3.1 Driver installation

To enable the communication between the 3D Magnetic Sensor 2 Go kit it is necessary to install the J-Link driver on your PC.

The driver is included in the GUI installer and will start automatically within the installation progress. In case of issues, you can directly download the latest version from the SEGGER homepage:

https://www.segger.com/downloads/jlink

Steps

1. Start the installation. Invoke your downloaded driver executable or wait for the 3D Magnetic Sensor 2 Go installer to open the window shown in *Figure 22*. Click on **Next**.



Software installation

🔝 SEGGER - J-Link V6.00e Setup		
j-Liorde ^{ter} 14 ¹ *1	Welcome to SEGGER - J-Link 06.00e Setup Setup will guide you through the installation of SEGGER - J-Link V6.00e. It is recommended that you close all other applications before starting Setup. This will make it possible to update relevant system files without having to reboot your computer. Click Next to continue. Next > Cancel	

Figure 22 J-Link driver setup

2. Read and accept the license agreement. Click on I Agree.

🔜 SEGGER - J-Link V6.00e Setup
License Agreement Please review the license terms before installing SEGGER - J-Link V6.00e.
Press Page Down to see the rest of the agreement.
Important - Read carefully: DEFINITIONS: For the purpose of this agreement, the terms shall have the following meaning when the entire word is marked bold: The "software" means all J-Link related software components included in the J-Link software & documentation pack provided by SEGGER which can be downloaded at: http://www.seqger.com/link-software.html "Licensor" shall mean SEGGER except under the following circumstances:
If you accept the terms of the agreement, click I Agree to continue. You must accept the agreement to install SEGGER - J-Link V6.00e.

Figure 23

J-Link license agreement

3. Check that the "Install USB Driver for J-Link" option is active. Click on Next.



Software installation

SEGGER - J-Link V6.00e Setup	- • •
Choose optional components Choose optional components to be installed.	J Link
Choose optional components that should be installed:	
Install USB Driver for J-Link	
Choose options for creating shortcuts:	
Create entry in start menu Add shortcuts to desktop	
< Back	Next > Cancel

Figure 24 J-Link installation options

4. Choose the installation folder. It is recommend to keep the default settings. Click on **Install**. Now the installation should be executed.

Choose Install Location		
Choose the folder in which to insta	ll SEGGER - J-Link V6.00e.	J Link
Setup will install SEGGER - J-Link V6 click Browse and select another fol	5.00e in the following folder. To insta der. Click Install to start the installat	all in a different folder, ion.
Destination Folder		
C:\Program Files (x86)\SEGGE	R\JLink_V600e	Browse
Space required: 63.6MB Space available: 115.8GB		
	< Back Ins	tall Cancel

Figure 25

J-Link choose install location

5. Once the installation is completed, close the installer by clicking on **Finish**.



Software installation

🔜 SEGGER - J-Link V6.00e Setup		
jelinde internet	Completing SEGGER - J-Link V6.00e Setup The latest version of the J-Link Software & Documentation pack can be found at the location linked below.	
SEGGER	J-Link Software & Documentation pack	
	< <u>B</u> ack <u>Finish</u> Cancel	

Figure 26

J-Link installation complete



4 3D magnetic sensor evaluation

This chapter describes how the GUI can be used to make first evaluations with Infineon's 3D magnetic sensor.

4.1 Getting started

Once the software is installed, the following steps are necessary to do the first magnetic measurements.

Steps

- 1. Connect the EvalBoard to the PC via the USB cable. Use the micro USB port for the EvalBoard and USB port for the PC. The power LED on the EvalBoard will switch on, indicating the EvalBoard is supplied with enough power.
- 2. Open the 3D 2Go GUI by clicking the shortcut in the start menu. On the top left side you should find the XMC2Go board in the list. If not, check that the EvalBoard is correctly connected to the PC and the J-Link driver is installed. Click on the **Connect to selected programmer button** which is marked in *Figure 27* to establish the connection with the 3D Magnetic Sensor 2 Go kit. The first time you connect the board, a firmware will be downloaded to the XMC1100 which takes short time. This is indicated by the blinking power LED on the EvalBoard.

Evalkit for 3D Sensors		
	Evaluation Kit for 3D Sensors	Infineon
Programmer XMC2Go on COM9		
/ 🗶 U		

- Figure 27 Establish the connection to the EvalBoard
- 3. The GUI automatically detects the sensor type on the 3D Magnetic Sensor 2 Go kit. Different configuration modes can be selected which are briefly described in *Table 4*. For details refer to the TLV493D-A1B6 data sheet and user manual. After you have selected the mode, click on **Start** to begin with the measurements.

Table 4 Sensor modes		
Sensor mode	Description	
Ultra low power mode	Cyclic sensor measurements with a update rate of 10 Hz. Between the measurements, the sensor stays in power down mode which reduces the power consumption.	
Low power mode	Cyclic sensor measurements with a update rate of 100 Hz. Between the measurements, the sensor stays in power down mode which reduces the power consumption.	

. .



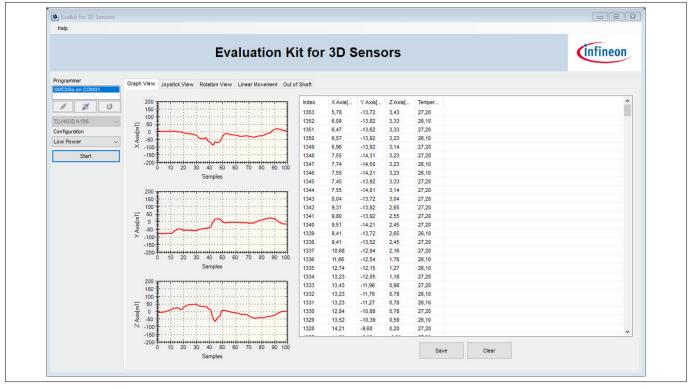
Table 4Sensor modes (continued)		
Sensor mode	Description	
Fast mode	Sensor measurements are running continuously. Fastest update rate.	
Master controlled mode	Sensor measurements are triggered by the microcontroller, which enables high flexibility.	

4.2 Graph View

The graph view displays the magnetic field measurements in X, Y and Z direction.

Figure 28 shows the graph view window. On the left hand side there are three histograms which plot the magnetic field for each measured sample. On the right a table displays all measured data, including the temperature. With the **save** button it is possible to export the measurement data into a .csv file. This is especially helpful for processing the data afterwards.

If a new mode should to be evaluated click the **Stop** button on the left control panel. **Save** the data and **Clear** it. Select a new configuration and click again on **Start** to begin the new evaluation.





Graph view

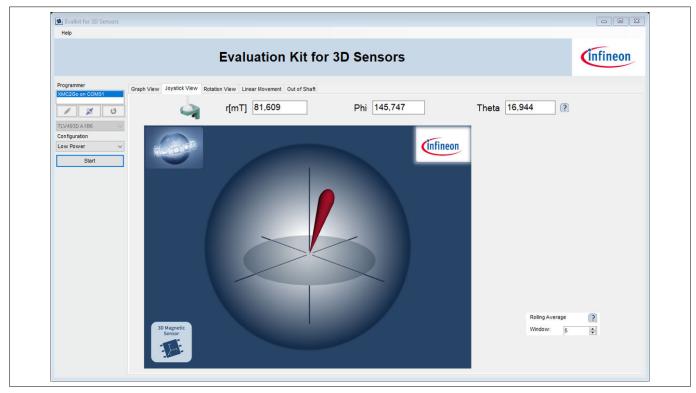


4.3 Joystick view

The joystick view is a virtual representation of a real joystick with an attached magnet, mounted above the 3D magnetic sensor.

It is intended to be used with the Joystick adapter available for the 3D Magnetic Sensor 2 Go kit. For order details and information about the used magnet refer to section *Hardware extensions*.

The software measures the magnetic field in all three dimensions and calculates the angles necessary to determine the joystick position. Further information is given in the application note "Infineon 3D Magnetic Sensor - How to Make a Magnetic Design for Joystick" which can be found on the Infineon home page.





4.4 Rotation view

In this view the calculated spherical coordinates of the magnetic field are displayed. Additionally it includes a graphical presentation of the 3D Magnetic Sensor 2 Go rotary knob attachment .

The polar coordinates consist of the radius r as well as the angles Phi and Theta. They are calculated out of the measured three dimensional magnetic field with following equations:

$$r = \sqrt{Bx^2 + By^2 + Bz^2}$$

Phi = arccos $\frac{Bz}{r}$

Theta = $\arctan \frac{By}{Bx}$

Below the polar coordinates a virtual rotation knob can be found. It can be used with the rotary knob attachment described in *Hardware extensions*. When the user turns the hardware knob, also the indicator in the GUI turns. This is achieved by measuring the magnetic field and calculating the angle between Bx and By as described above. Also a push functionality is implemented depending on the radius r of the magnetic field.



3D magnetic sensor evaluation

Evalkit for 3D Sensors Help			
	Evaluation Kit for 3D Se	ensors	infineon
Programmer XMC2Go on COM31 TLV493D A1B6 Configuration Low Power Start Start	Rotation View Linear Movement Out of Shaft Image: mail of mail	i 145,747 Theta 16,944	2

Figure 30 Polar coordinates

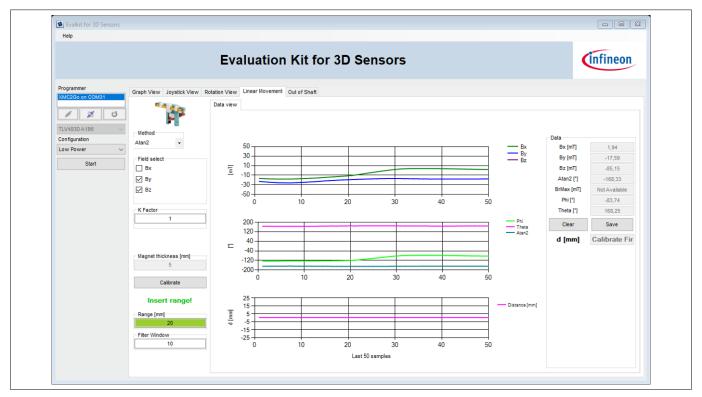
4.5 Linear movement

This view is meant to be used with the linear slider extension. It allows to measure the position of the magnet in a slide by configuration.

For details have a look on the video "3D magnetic sensor linear slider adapter for sensor 2GO Kits" on the following page:

https://www.infineon.com/cms/en/product/promopages/sensors-2go/#Add-ons-3D-Magnetic-2GO







4.6 Out of shaft

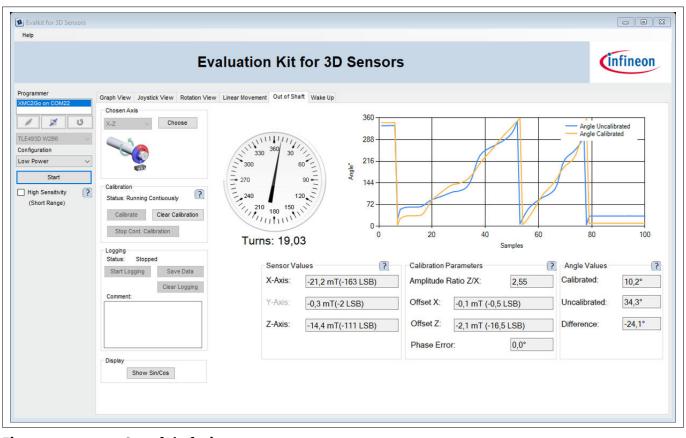
This view is meant to be used with the out of shaft extension. It allows to measure the angle of the magnet while the sensor is placed at the side of it.

For details have a look on the video "3D magnetic sensor out of shaft adapter angle measurement" on the following page:

https://www.infineon.com/cms/en/product/promopages/sensors-2go/#Add-ons-3D-Magnetic-2GO



3D magnetic sensor evaluation





Out of shaft view



Example code for developers

5 Example code for developers

Additionally to the graphical user interface a low level library is provided as a quick entry point for own developments with the 3D magnetic sensor. It can be downloaded from the link below.

https://www.infineon.com/cms/de/product/sensor/magnetic-sensors/magnetic-position-sensors/3d-magnetics/#!tools

The library comes with a generic C code example as well as a specific implementation for the XMC based 3D Magnetic Sensor 2 Go kit. An comprehensive documentation can be found under the respective "doc" folder. For the html version open the "index.html" file with your browser.



XMC for Arduino

6 XMC for Arduino

Finally, the 3D Magnetic Sensor 2 Go kit can be used in combination with the Arduino IDE. A library is provided to enable a fast evaluation in the individual application. More details and the download can be found at the link below:

https://github.com/Infineon/TLV493D-A1B6-3DMagnetic-Sensor



Revision history

Revision history

Document version	Date of release	Description of changes
1.0	2015-05	Initial version
1.1	2016-01	New version based on GUI version 2.0.1
1.2	2019-08	Added Hardware revision historyUpdated Table 2 and Table 3Updated section Hardware extensionsAdded new view descriptions to the section 3D magnetic sensor evaluationAdded XMC for ArduinoAdded Example code for developersVarious editorial changesLayout update

Trademarks

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

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