

# TLE5014 Evaluation Kit

TLE5014

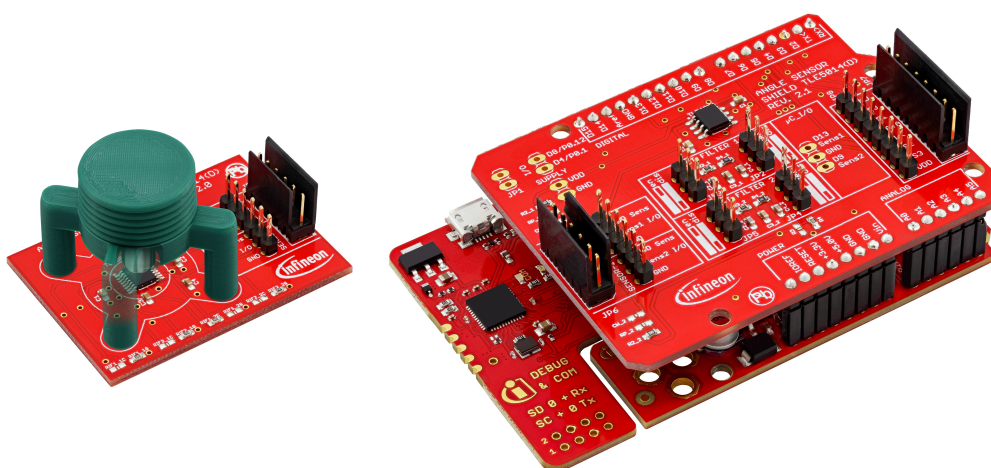
## About this document

### Scope and purpose

This document provides an introduction to the TLE5014 evaluation kits. It describes the different types of evaluation kits available, gives an overview about the hardware used and possible configurations. The software part is also described, it includes the software installation and a detailed explanation about the GUI features.

### Intended audience

This document is intended for anyone who wants to use the TLE5014 evaluation kits.



Name	Ordering Number	Description
TLE5014 CPS Evalkit	SP005410377	Include: Programmer & Satellite board Interface: SENT/SPC/SPW
TLE5014SP Evalkit	SP005410379	Include: Programmer & Satellite board Interface: SPI
TLE5014CPS satellite board	SP005410381	Include: Satellite board only Interface: SENT/SPC/SPW
TLE5014SP satellite board	SP005410383	Include: Satellite board only Interface: SPI

Table of contents

Table of contents

	<b>About this document</b> .....	1
	<b>Table of contents</b> .....	2
<b>1</b>	<b>General description</b> .....	3
1.1	Programmer kit .....	3
1.2	Satellite board .....	3
1.2.1	TLE5014CPS satellite board .....	3
1.2.2	TLE5014SP satellite board .....	4
<b>2</b>	<b>Getting started</b> .....	5
2.1	User interface installation .....	5
2.2	TLE5014CPS satellite board configuration .....	5
2.3	Shield jumper setting .....	6
<b>3</b>	<b>User interface</b> .....	7
3.1	Connection to the evaluation kit .....	7
3.1.1	Configuration selection - TLE5014CPS board only .....	7
3.2	User interface - TLE5014SP .....	8
3.3	User interface - TLE5014CPS .....	8
<b>4</b>	<b>User menu</b> .....	10
4.1	EEPROM Register .....	10
4.2	Program by feature (with TLE5014CPS only) .....	11
4.2.1	PWM frequency calculation .....	12
4.3	Read SSM (with TLE5014CPS only) .....	12
4.4	Burn angle-base .....	13
4.5	Look-up table programming .....	14
	<b>Disclaimer</b> .....	16

**1 General description**

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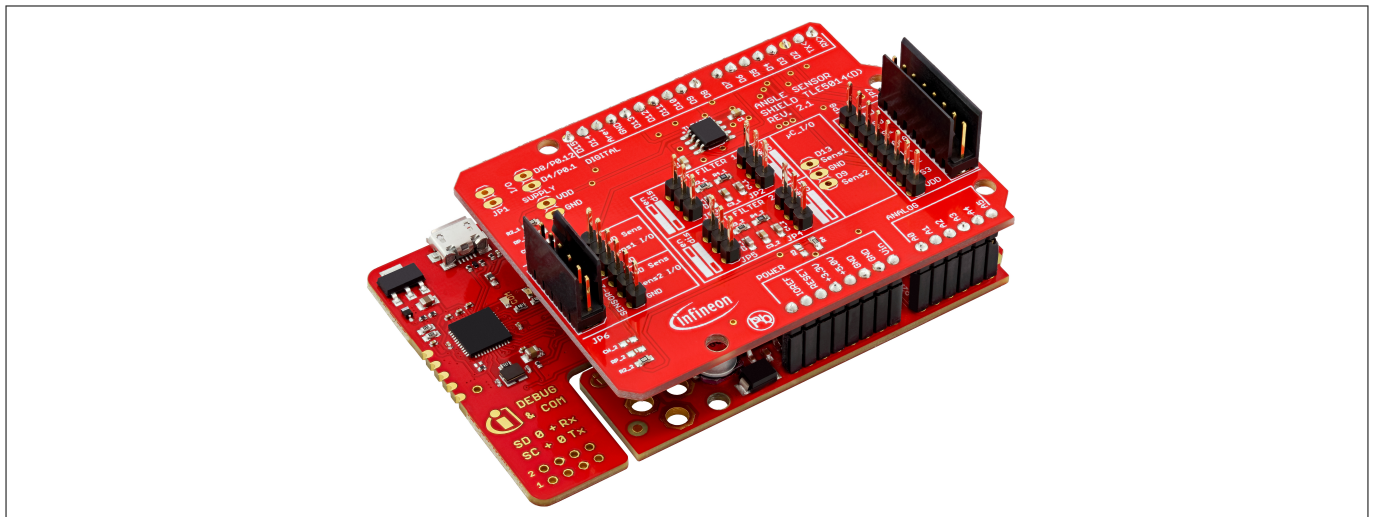
The evaluation kits enable a quickly and thoroughly evaluation of the TLE5014 GMR based angle sensor. An evaluation kit consists of a programmer including a microcontroller with a shield and a satellite board. Additionally to the hardware, a graphical user interface (GUI) is available to interact with the sensor. Please visit Infineon TLE5014 webpage, section “Tools & Software” to download the latest version of the software. The connection between the evaluation kit and a PC requires a Micro-USB cable.

There are two different types of evaluation kits available:

- The TLE5014CPS Evaluation kit: It features the TLE5014C16D/P16D/S16D (SENT/SPC/PWM interface).
- The TLE5014SP Evaluation kit features the TLE5014SP16D (SSC interface).

**1.1 Programmer kit**

The programmer includes a microcontroller and a shield. The microcontroller board is an XMC™ 1100 Boot kit. It embeds an XMC™ 1100 and an On-Board COM and Segger J-Link debugger. A Micro-USB port enables the communication between the microcontroller and a PC. The shield consists of an Infineon LDO (TLE4254), two SENT filters compliant with the SAE J2716 standard (the user can bypass the filters by adjusting the corresponding jumpers) and two connectors dedicated to the different satellite boards. Additional 2.54mm headers are available to easily probe signals with an oscilloscope or use a custom wiring.



**Figure 1** Microcontroller & shield

**1.2 Satellite board**

In order to complement the different evaluation kit approaches, Infineon is offering the two different types of satellite boards as standalone version and order number. Customers can thereby decide to either order the full-package of the TLE5014 evaluation kits or concentrate on the standalone TLE5014 satellite boards, which are incorporating the digital GMR sensor. The two satellite boards are TLE5014CPS satellite board and the TLE5014SP satellite board.

**1.2.1 TLE5014CPS satellite board**

The TLE5014CPS satellite board embeds a TLE5014F16D. The TLE5014F16D is a dual-die sensor with a top/ bottom configuration. With this derivate the user can modify any internal settings (for more detail, please refer to the TLE5014 Datasheet and TLE5014 User manual). Required discrete components such as decoupling capacitors are also present on the board. A 3D printed rotation knob incorporates a magnet, the whole can be placed on the board to enable fast prototyping and evaluation.

1 General description

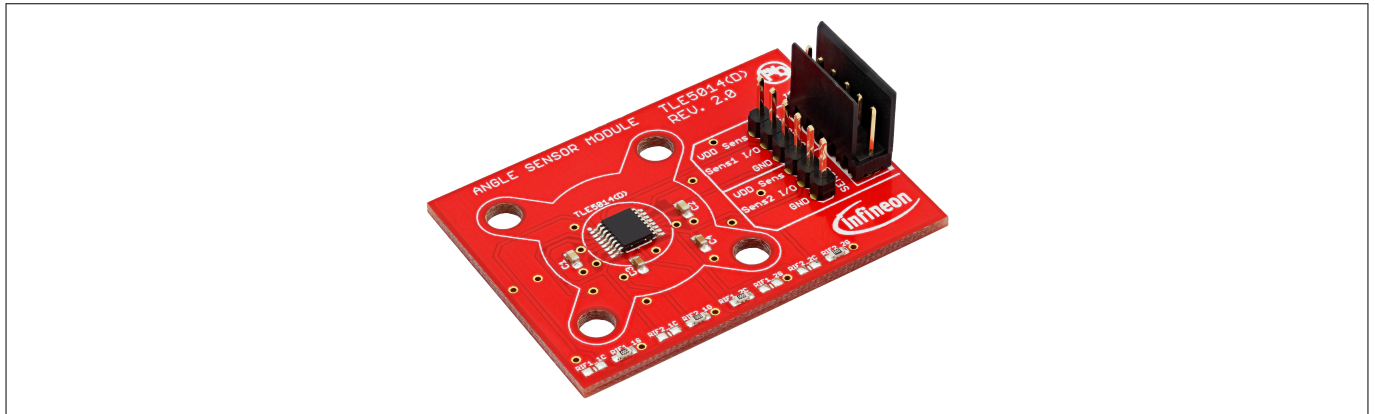


Figure 2 TLE5014CPS satellite board

1.2.2 TLE5014SP satellite board

Similar to the TLE5014 satellite board, this satellite board embeds a TLE5014SP16D. It provides a dual-die top/bottom configuration. The TLE5014SP16D is using the SSC interface to communicate with the microcontroller (for more detail, please refer to the TLE5014SP Datasheet and TLE5014SP User manual). A 3D printed rotation knob incorporates a magnet, the whole can be placed on the board to enable fast prototyping and evaluation.

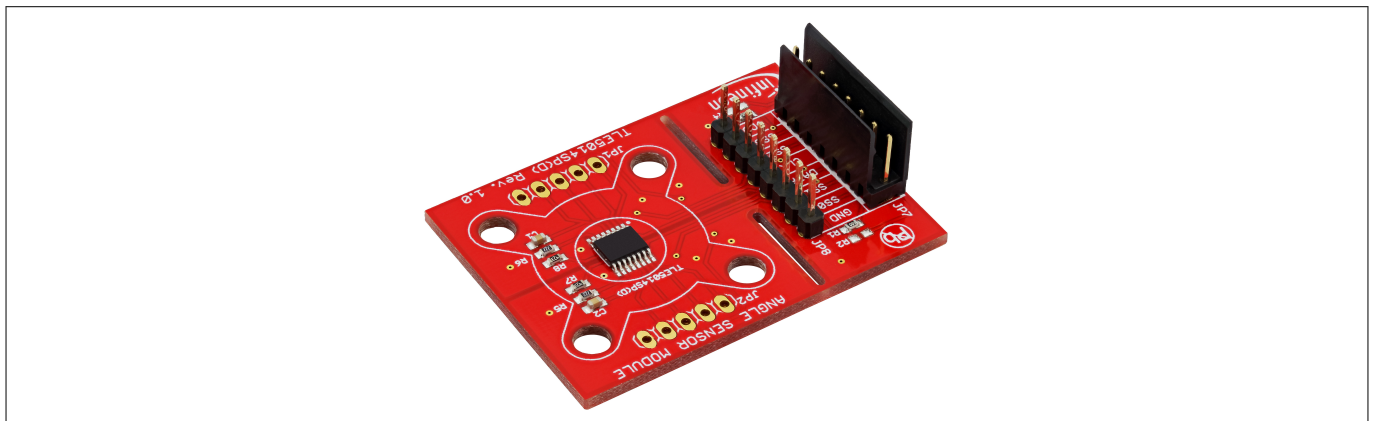


Figure 3 TLE5014SP satellite board



2 Getting started

## 2 Getting started

### 2.1 User interface installation

- Download and install the latest Segger driver from the following web page: <https://www.segger.com/downloads/jlink>
- Connect the programmer with an USB cable to an USB 2.0 port.
- Open the .ZIP archive downloaded on the Infineon website and install the programmer software by double-clicking on the file "TLE5014- Bootkit-Vx.x.x.msi"
- Start the installed software
- if the microcontroller is used for the first time or a newer software revision is available, click on the FLASH MCU button.

### 2.2 TLE5014CPS satellite board configuration

The TLE5014F16D is by default configured with the following settings:

- SENT single secure sensor (incl. rolling counter and inverted nibble)
- Unit time (UT) of 3us
- Pause pulse enable
- No short serial message

The TLE5014F16D is fully configurable, every interface settings and interfaces are available. When using the TLE5014F16D with the SPC protocol, the address ID are encoded via hard-wiring. On the TLE5014CPS satellite board the default configuration is:

- Channel 1 has the address ID=0
- Channel 2 has the address ID=1

It is possible to change the address by changing the "zero-ohm" resistors. Please refer to the table and figure below.

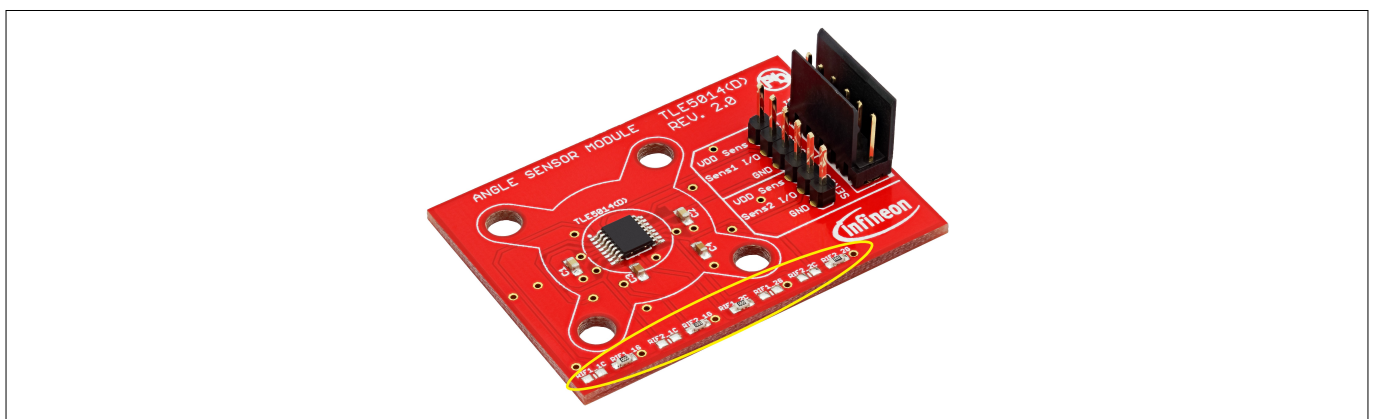


Figure 4 TLE5014CPS - Address configuration

	RIF1_1C	RIF1_1G	RIF2_1C	RIF2_1G
ID=0		X		X
ID=1	X			X
ID=2		X	X	
ID=3	X		X	

---

## 2 Getting started

### 2.3 Shield jumper setting

When using the TLE5014CPS satellite board, the four jumpers located on the shield can be used to enable or disable the SENT filter. Please follow the table below to configure the filter. The SENT filter is described in the TLE5014 Datasheet.

**Table 1** Jumper setting

Jumper	Position	Description
J2/J3	en	SENT filter for sensor 1 enabled
J2/J3	dis	SENT filter for sensor 1 disabled
J4/J5	en	SENT filter for sensor 2 enabled
J4/J5	dis	SENT filter for sensor 2 disabled

**Attention:** For reading/writing the EEPROM the SENT filter has to be disabled

3 User interface

3 User interface

3.1 Connection to the evaluation kit

To connect the evaluation kit, select the COM port in the list (Step 1) and click on the Connect button (Step 2). Finally select which Satellite board should be used for the evaluation.

**Attention:** Only one satellite board can be plug-in at a time.

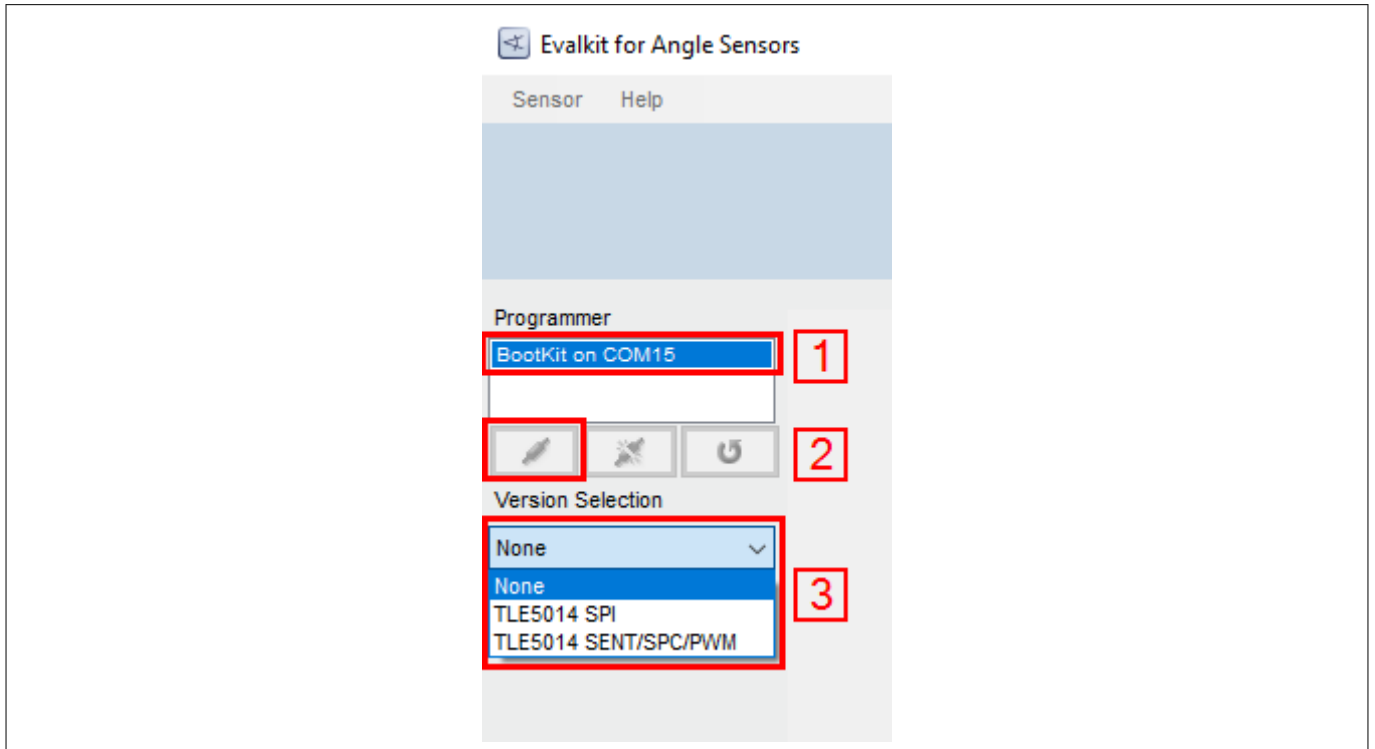


Figure 5 Connection to the evaluation kit

3.1.1 Configuration selection - TLE5014CPS board only

When using the TLE5014CPS satellite board two additional steps are required. It is necessary to select the correct configuration via the drop-down list (Step 4).

- Single Sensor: Only one sensor connected to the bus (Suitable for SENT/PWM/SPC with a single sensor)
- Bus Operation: Several sensors connected to the bus (Only relevant when evaluating the SPC protocol in a bus mode application.)

In the sensor drop-down list select the desired channel (Step 5). The Evaluation Kit supports up to two channels.

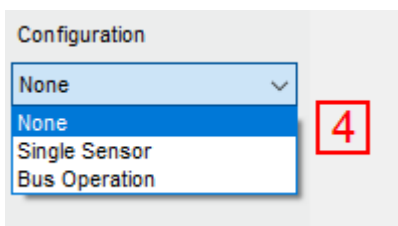


Figure 6 Configuration drop-down list

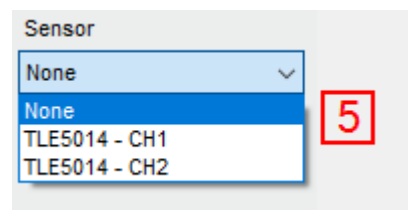


Figure 7 Channel drop-down list

3 User interface

3.2 User interface - TLE5014SP

Click the Start button (Step 1) to start the angle read-out. The display shows the real time angle read-out of the sensor via a circular gauge and a 2D graph. The angle information is displayed between 0° and +/- 180°. At any time the current angle can be read in the Textbox (Step 2). The list (Step 3) logs the angle value with several other parameters such as the SSC safety word or the CRC value. The list can be Save (Step 4) in a .csv format to run some post analysis. The EEPROM of the sensor can be accessed via the Sensor button (Step 5), for more information about interacting with the EEPROM, please refer to the corresponding chapter.

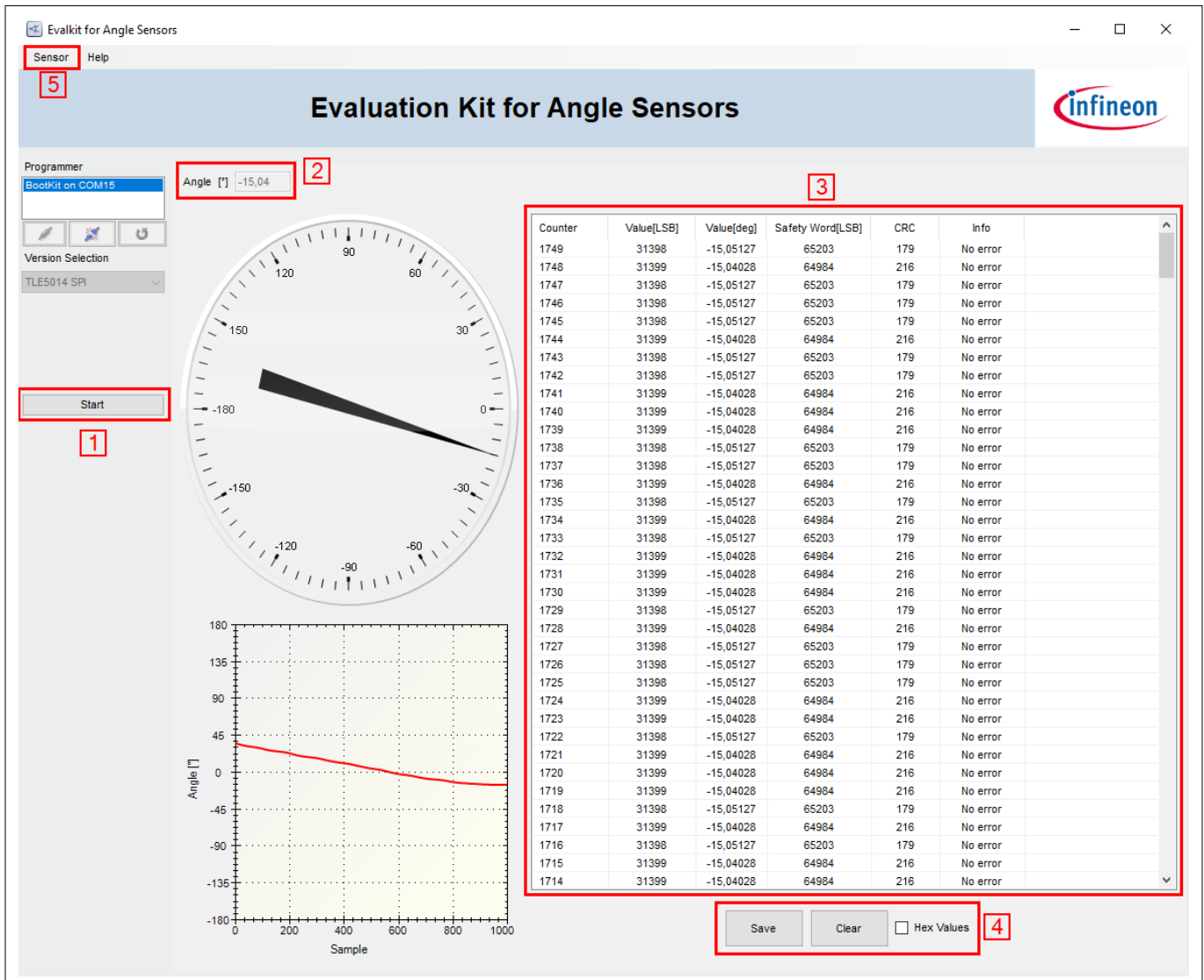


Figure 8 User interface TLE5014SP

3.3 User interface - TLE5014CPS

Similar to the TLE5014SP interface, click the Start button (Step 1) to start the angle read-out. The display shows the real time angle read-out of the sensor via a circular gauge and a 2D graph. . At any time the current angle and additional information can be read in the Textbox (Step 2). The list (Step 3) logs the angle value with a complete description of the SENT/SPC frame. The list can be Save (Step 4) in a .csv format to run some post analysis. The Sensor button (Step 5) provides a direct access to the memory, please refer to the corresponding chapter. It is also possible to change the sensor’s configuration with some pre-programmed settings. Finally the short serial message of the SENT/SPC protocol can be decoded via a dedicated window.

3 User interface

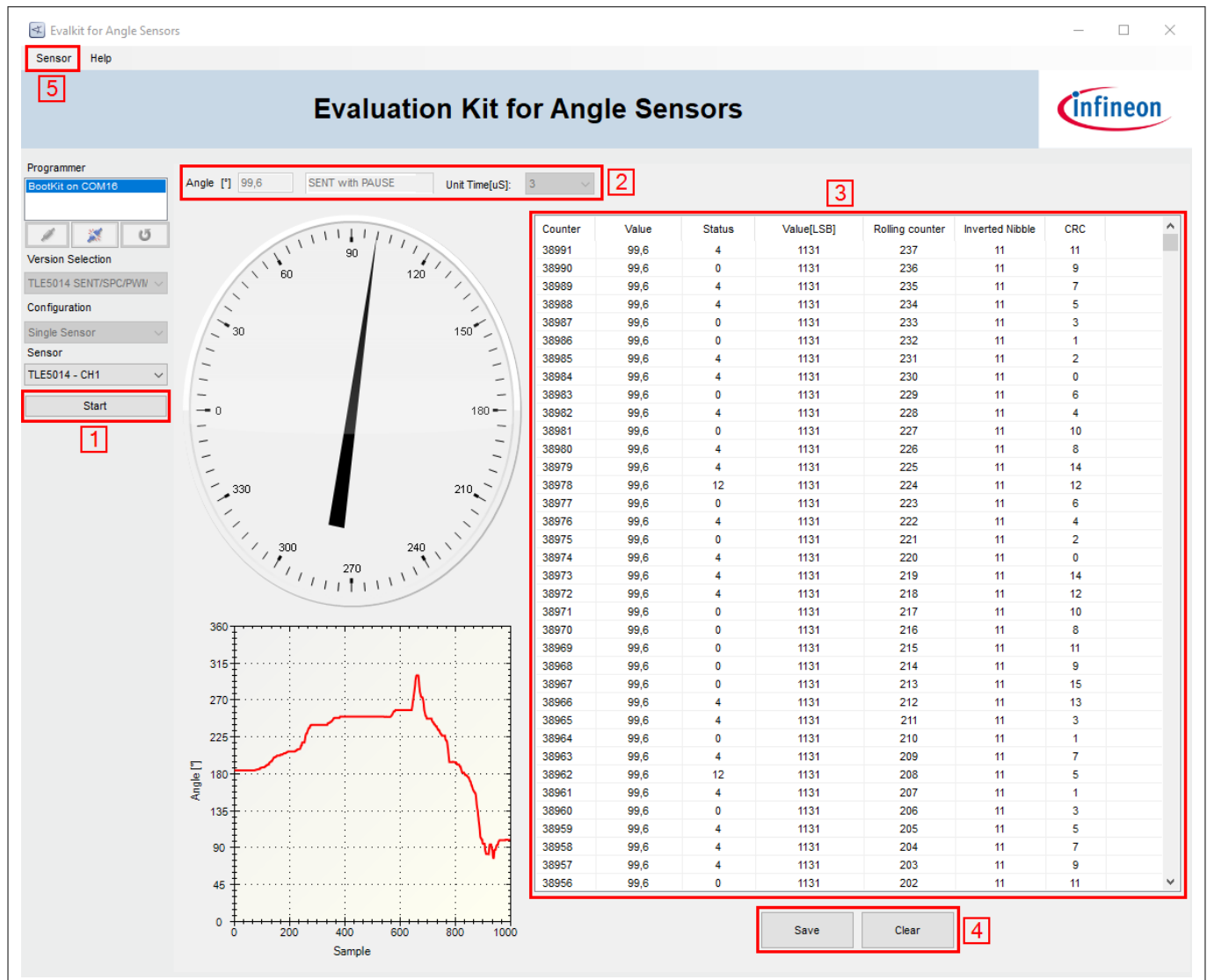


Figure 9 User interface TLE5014CPS

4 User menu

### 4 User menu

Click on the Sensor menu and select one of the following options:

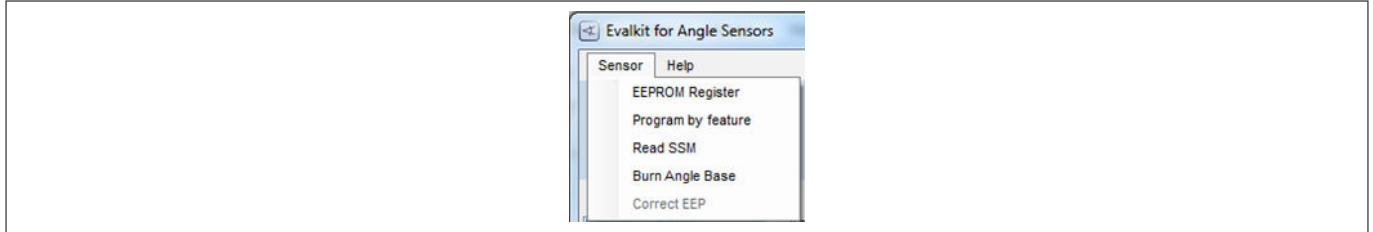


Figure 10 User menu

#### 4.1 EEPROM Register

Click on the register in the left column (Step 1) to highlight the register and display the content on the right (Step 3). The value is displayed in both format: hexadecimal and decimal. An overview of the EEPROM is always available in the middle (Step 2). Interaction with EEPROM is done via the buttons located at the bottom of the window (Step 4).

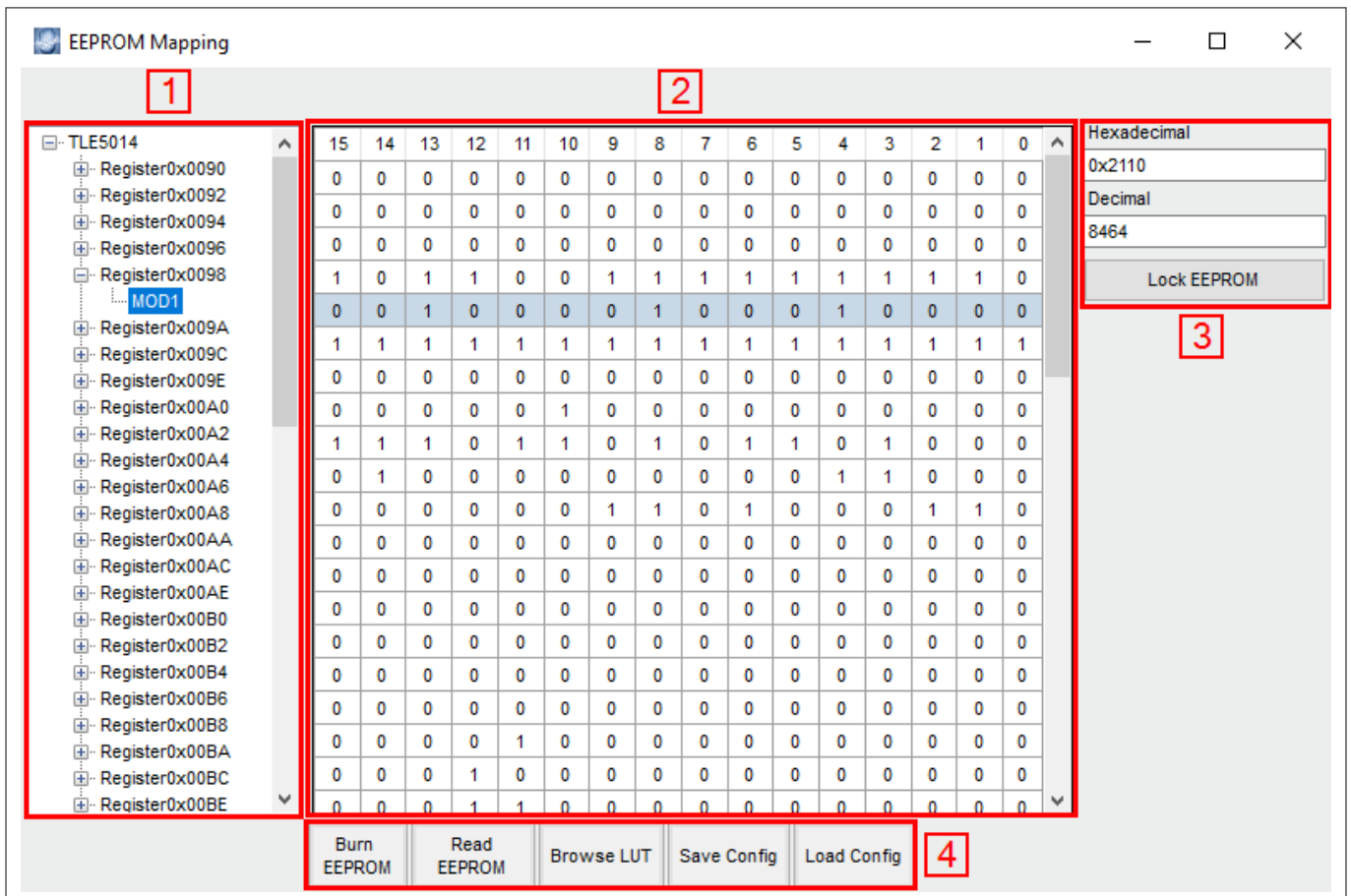


Figure 11 EEPROM register

Button	Description
Read EEPROM	Read the current EEPROM values and update the displayed EEPROM content. A register content can be modified by editing the value on the right either in a hexadecimal or a decimal value and pressing RETURN.



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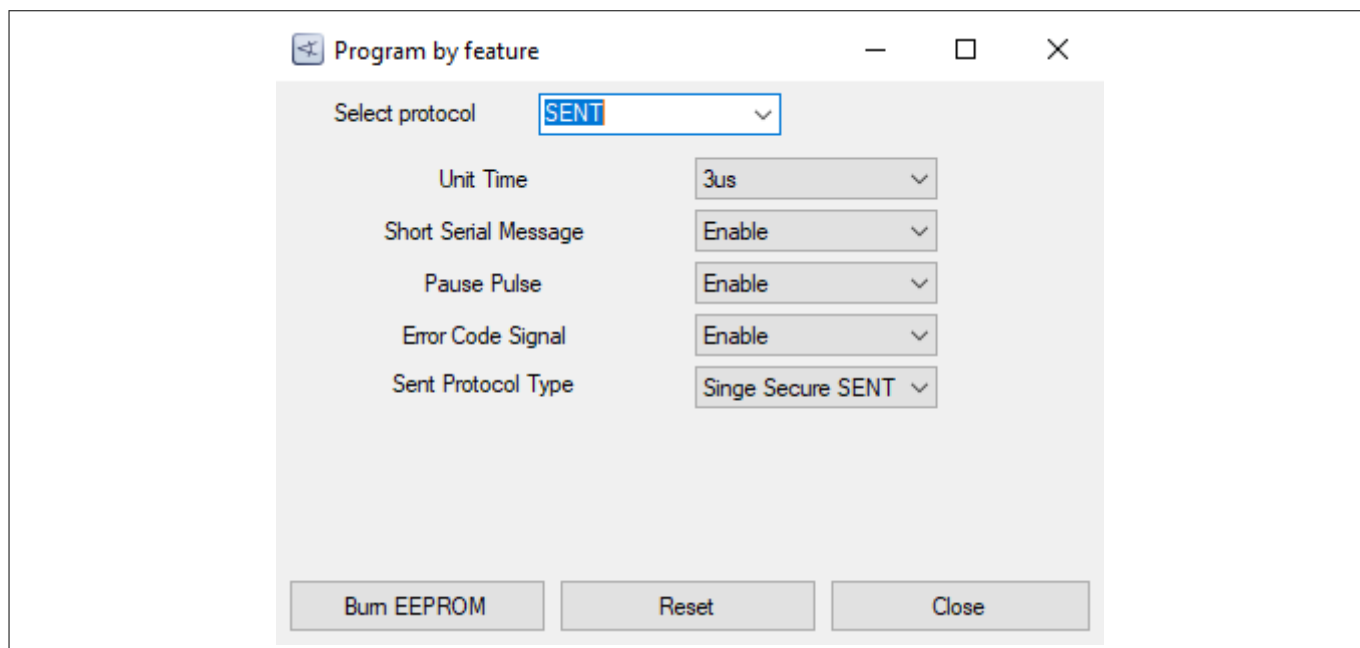
**4 User menu**

Button	Description
Burn EEPROM	<p>Burn the displayed content to the TLE5014 EEPROM. A successfully EEPROM burning is indicated with a “Burn successful!” message.</p> <p><b>Attention:</b> <i>Care has to be taken not to modify EEPROM registers which change the sensor configuration. This could result in a wrong function of the device.</i></p>
Browse LUT	<p>Browse for a .txt file which contains the values intended to be used in the look-up table.</p> <p><b>Attention:</b> <i>After re-loading LUT values (Browse LUT) or EEPROM content (Load Config) the EEPROM has to be burned by pressing Burn EEPROM.</i></p>
Save Config	<p>Save the actual EEPROM settings in a .txt file.</p>
Load Config	<p>Load the EEPROM content from a .txt file.</p> <p><b>Attention:</b> <i>After re-loading LUT values (Browse LUT) or EEPROM content (Load Config) the EEPROM has to be burned by pressing Burn EEPROM.</i></p>
Lock EEPROM	<p>Locks the EEPROM. A further re-programming is not possible.</p> <p><b>Attention:</b> <i>There is no “Unlock” function implemented.</i></p>

## 4.2 Program by feature (with TLE5014CPS only)

In this window the sensor can be programmed with predefined settings. Modification can be done and then burned to the EEPROM.

4 User menu

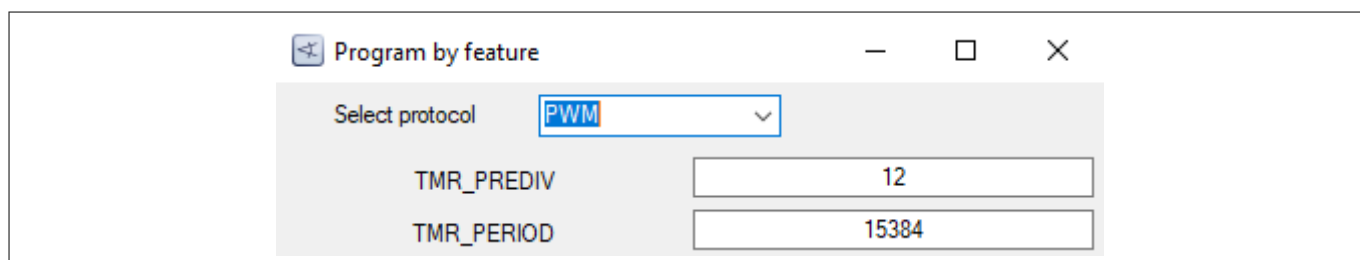


**Figure 12** Program by feature (with TLE5014CPS only)

Button	Description
Burn EEPROM	Burn the EEPROM
Reset	Restore the default configuration but only as long as the EEPROM has NOT been burned.

**4.2.1 PWM frequency calculation**

When setting the Select protocol to PWM, two parameters have to be specified which give the PWM frequency.



**Figure 13** PWM frequency calculation

The PWM frequency is calculated according to the following formula:

$$f[\text{Hz}] = \frac{40000000}{(1 + \text{TMR\_PREDIV})(\text{TMR\_PERIOD})}$$

**Figure 14**

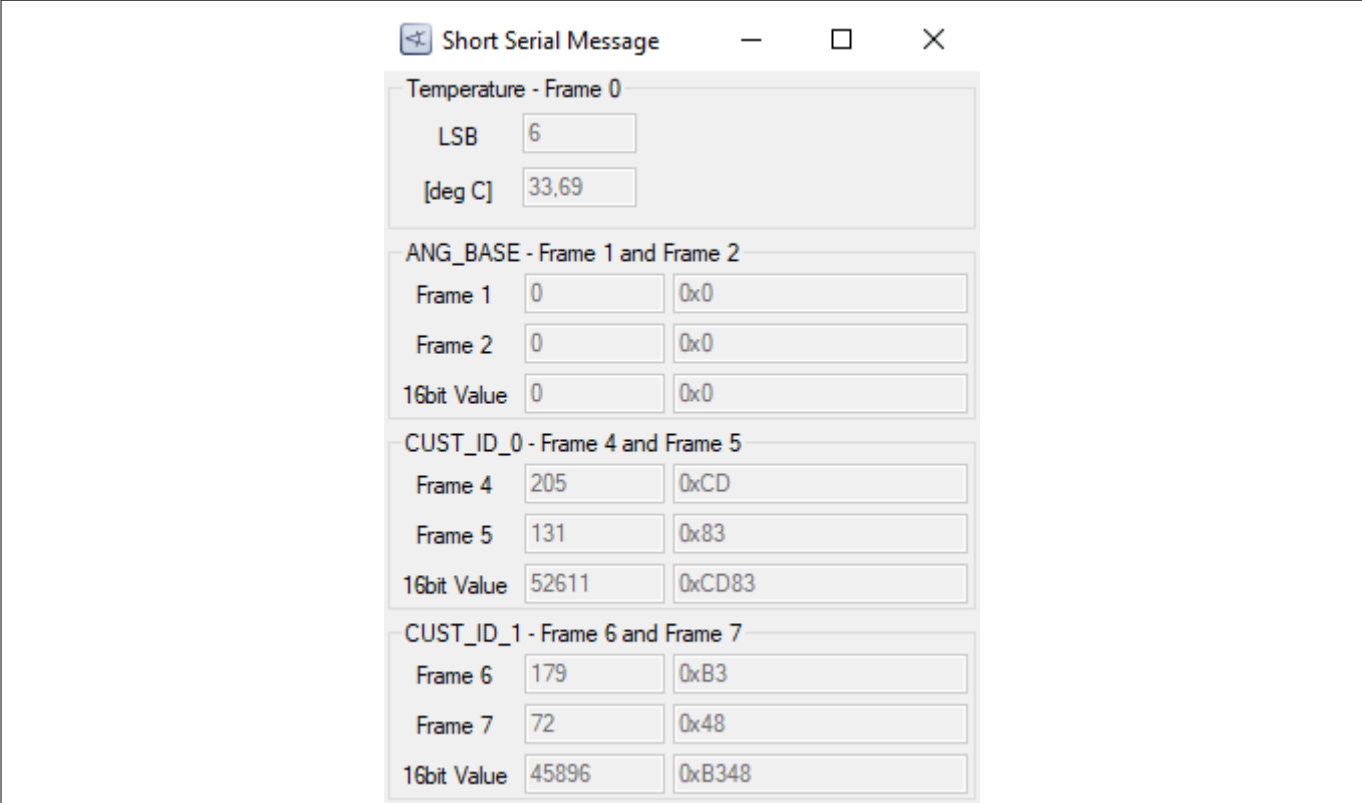
**4.3 Read SSM (with TLE5014CPS only)**

Select Sensor > Read SSM in the menu bar on the top to display the actual content of the short serial message SSM:

- Temperature

## 4 User menu

- Angle base & rotation direction
- 32-bit customer ID



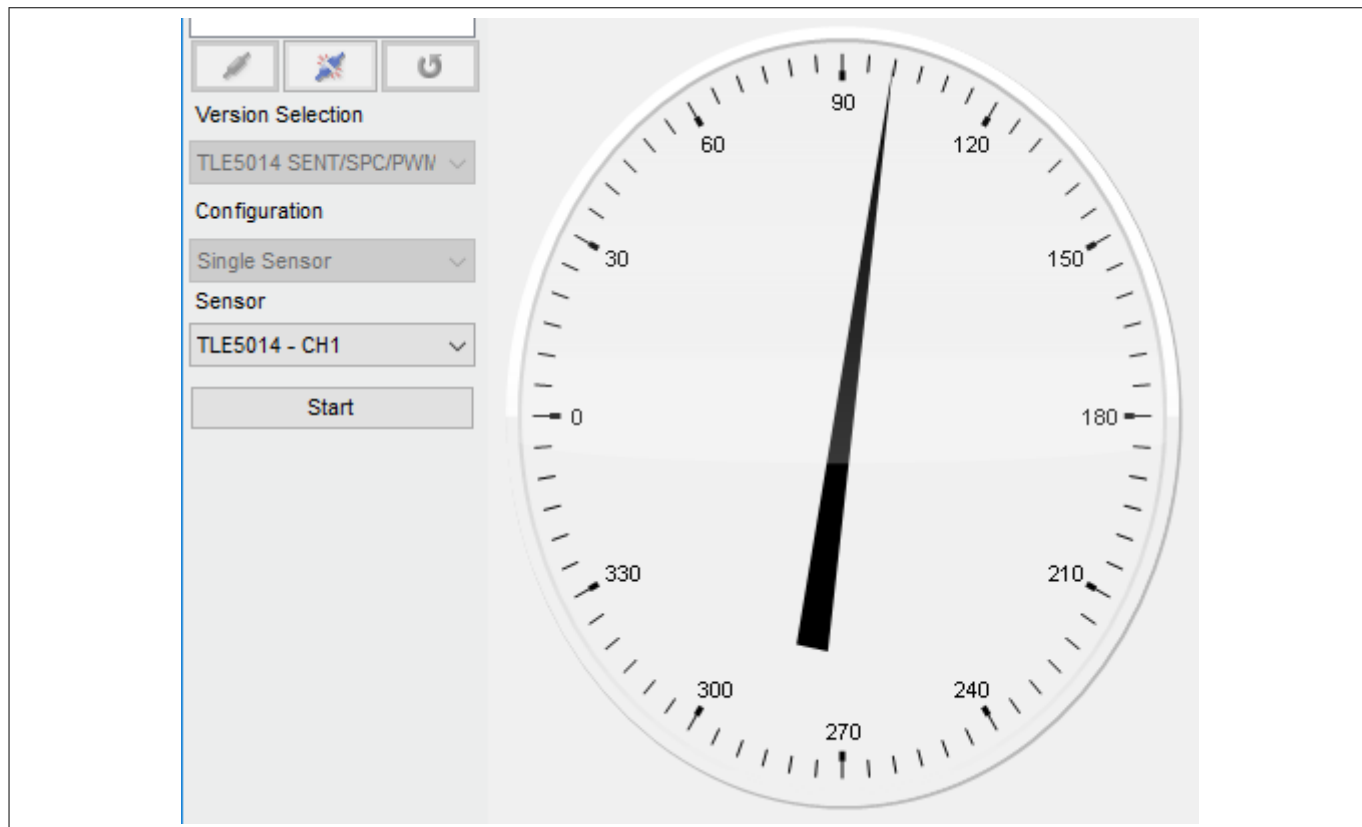
Section	Frame	Value	16bit Value
Temperature - Frame 0	LSB	6	
	[deg C]	33,69	
ANG_BASE - Frame 1 and Frame 2	Frame 1	0	0x0
	Frame 2	0	0x0
	16bit Value	0	0x0
CUST_ID_0 - Frame 4 and Frame 5	Frame 4	205	0xCD
	Frame 5	131	0x83
	16bit Value	52611	0xCD83
CUST_ID_1 - Frame 6 and Frame 7	Frame 6	179	0xB3
	Frame 7	72	0x48
	16bit Value	45896	0xB348

**Figure 15** Short serial message

### 4.4 Burn angle-base

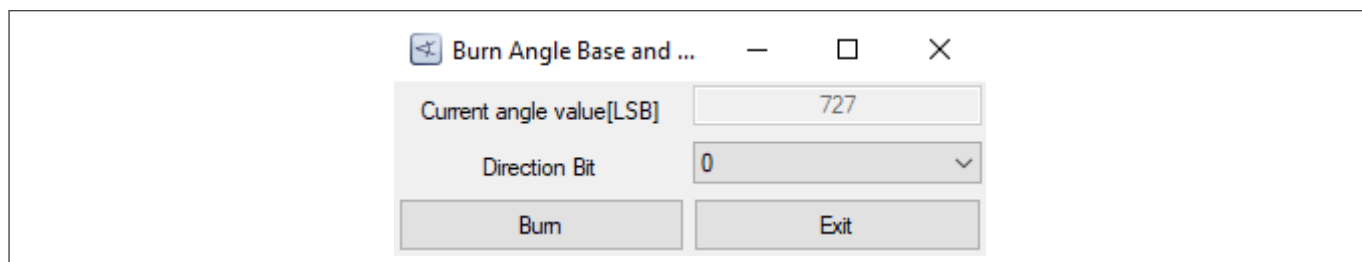
To define a new angle base, first Start the read-out of angle values.

4 User menu



**Figure 16 Burn angle base**

The application has to be turned to the desired new zero-value and read-out has to be stopped by clicking Stop. Select Sensor > Burn Angle Base in the menu bar on the top to display the Burn Angle Base window.



**Figure 17 Burn angle base**

Click Burn to burn the value to the EEPROM as new angle base.

**4.5 Look-up table programming**

The Browse LUT button opens a window to select a .txt file with the data which should be programmed into the look-up table (LUT).

Opening the .txt file loads the content in the displayed EEPROM mapping.

After loading the file press Burn EEPROM to burn the LUT values to the EEPROM.

The .txt file for the LUT values consists of a header and 32 pair of data, separated by a comma. One pair consists of the real angle value and the read out of the sensor at this position as a 12-bit value. The 32 real angle values can not be modified and have to be 0°, 11.25°, 22.5°, ... 348.75°.

---

4 User menu

```
//you can write whatever you want above this field
position,sensorVal
0, 4039
11,25, 71
22.5, 256
33,75, 327
45, 455
57, 500
```

Sensor readout (12-bit value)  
Real position (in degree)

Figure 18 LUT - Example txt file

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