

**Restrictions:**

IDT's ZSSC3170 SSC Modular Evaluation Kit (SSC Evaluation Kit) hardware and software are designed for evaluation of the ZSSC3170, laboratory setup, and module development only. The ZSSC3170 SSC Modular Evaluation Kit hardware and software must not be used for module production and production test setups.

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## Contents

1	Kit Contents .....	4
2	ZSSC3170 Evaluation Board .....	5
2.1.	Overview .....	5
2.2.	Schematic .....	6
2.3.	Connections to the ZSSC3170 .....	8
2.4.	Reset Switch .....	8
3	Pinout and Package .....	9
4	ZSSC3170 Software .....	10
4.1.	Overview .....	10
4.2.	USB Driver Installation .....	10
4.3.	User Files .....	11
4.4.	General Setup of the Software .....	11
4.4.1.	Interface Selection .....	12
4.4.2.	ZSSC3170 Configuration .....	13
4.4.3.	Analog Front End (AFE) Adjustment .....	14
4.4.4.	Temperature Sensor Selection .....	14
4.4.5.	ADC Settings .....	14
4.4.6.	Application Settings .....	15
4.5.	Operation Section .....	15
4.5.1.	Normal Operation Mode (NOM) .....	16
4.5.2.	Command Mode (CM) .....	16
4.5.3.	Power IC OFF .....	16
4.5.4.	Data Read-Out .....	16
4.5.5.	Enable Error Check .....	17

4.5.6.	Average Count and Statistics.....	17
4.6.	Output Configuration .....	17
4.6.1.	I <sup>2</sup> C™ Interface.....	17
4.6.2.	PWM Interface .....	17
4.6.3.	LIN Interface.....	18
4.7.	Calibration Window.....	19
4.8.	RAM-Register Dialog Window.....	20
4.9.	Calibration-Register (RAM) Dialog .....	21
4.10.	Get Raw Values Dialog .....	21
4.11.	Send Command.....	22
5	Calibration Example .....	23
5.1.	Hardware Setup.....	23
5.2.	Software Startup.....	24
5.3.	Calibration Data Acquisition .....	25
5.4.	Calculation of the Coefficients and Limits .....	25
6	Ordering Information .....	26
7	Related Documents.....	27
8	Glossary .....	27
9	Document Revision History.....	28

## List of Figures

Figure 1.1	ZSSC3170 SSC Evaluation Kit.....	4
Figure 2.1	ZSSC3170 SSC Evaluation Board – Overview .....	5
Figure 2.2	SSC Evaluation Board Schematic .....	7
Figure 3.1	Pin Configurations for Different Packaging Options .....	9
Figure 4.1	Main Window of the Evaluation Software .....	12
Figure 4.2	Interface Selection Section .....	12
Figure 4.3	Additional I <sup>2</sup> C™ and LIN Interface Settings in the “Send Command” Menu.....	13
Figure 4.4	DUT Configuration Section .....	13
Figure 4.5	Bridge Sensor Adaptation and Mode.....	14
Figure 4.6	Temperature Sensor.....	14
Figure 4.7	ADC Adjust .....	14
Figure 4.8	Application and Settings .....	15
Figure 4.9	Normal Operation Section .....	15
Figure 4.10	Measure Output Window .....	16
Figure 4.11	PWM Config.....	17
Figure 4.12	LIN Config.....	18
Figure 4.13	“Sensor – Calibration” Dialog.....	19
Figure 4.14	Displaying RAM-EEP Register Contents .....	20
Figure 4.15	“Calibration-Register (RAM)” Dialog.....	21
Figure 4.16	“Get Raw Values” Dialog .....	21

Figure 4.17 “Send-Command” Dialog .....22  
Figure 5.1 Hardware Setup for Calibration Example .....23  
Figure 5.2 Select Interface .....24  
Figure 5.3 Select Span and Sensor Mode .....24  
Figure 5.4 Displaying the Result of the Coefficient Calculation .....26

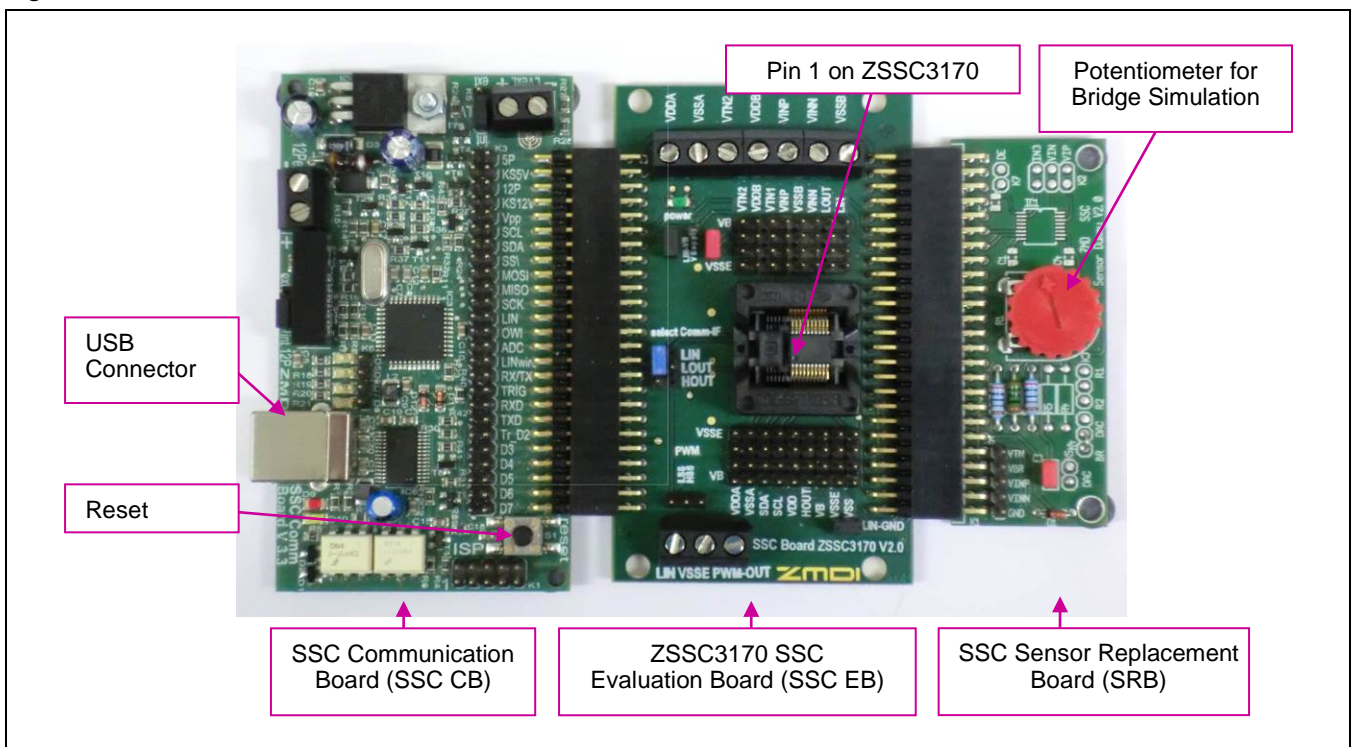
# 1 Kit Contents

The ZSSC3170 Evaluation Kit consists of the following parts:

- SSC Communication Board (SSC CB) V3.3 (including USB cable) \*
- ZSSC3170 SSC Evaluation Board (SSC EB) V2.0
- SSC Sensor Replacement Board (SRB) V2.0
- 5 samples of the ZSSC3170DAT2 (SSOP20 5.3mm)
- SSC Evaluation Kit start up information

Note: The ZSSC3170 Evaluation Software is downloaded from [www.IDT.com/ZSSC3170KIT](http://www.IDT.com/ZSSC3170KIT) as described in section 4.1.

Figure 1.1 ZSSC3170 SSC Evaluation Kit



The SSC Evaluation Kit provides the hardware needed for communication and calibration of the ZSSC3170 sensor signal conditioning (SSC) IC. A PC can communicate with the ZSSC3170 SSC Evaluation Board via the SSC Communication Board (CB) through a USB connection. The software should function on any Windows® 2000/XP/ Vista /Windows® 7/Windows® 8 system after the installation of a USB driver.

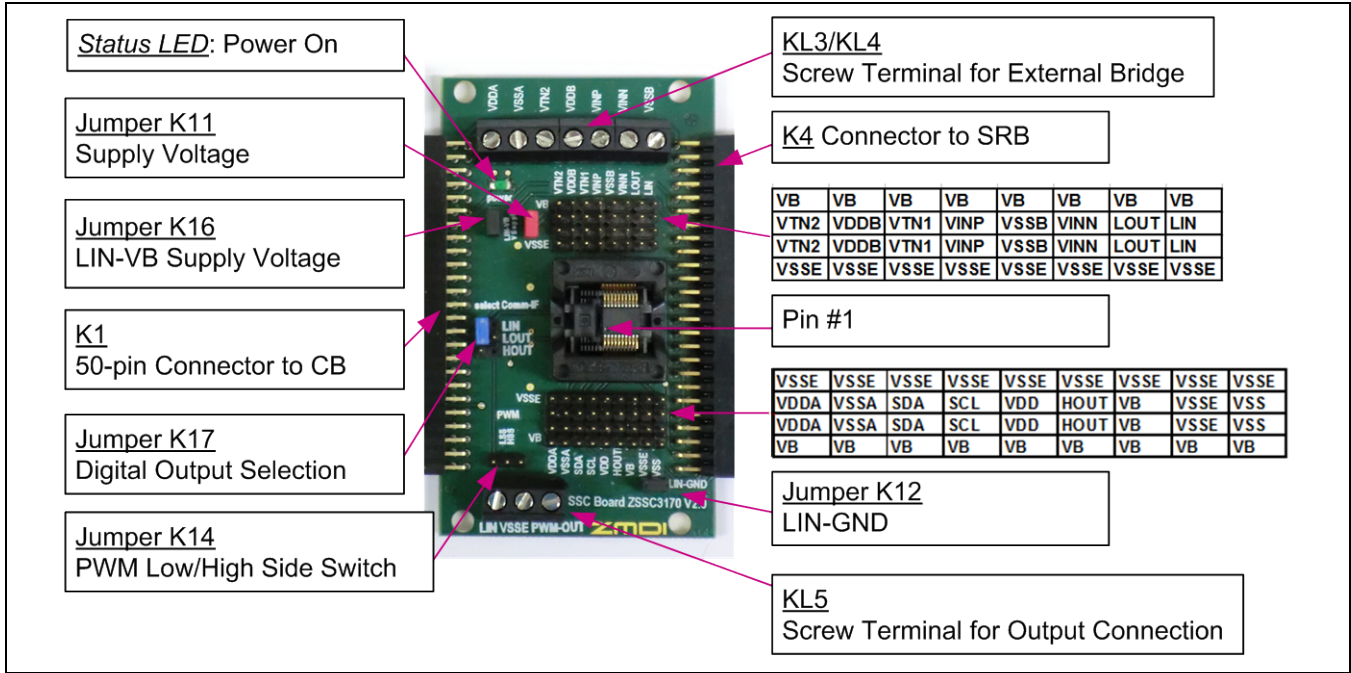
The Sensor Replacement Board (SRB) provides a replacement for an actual sensor and can be used for the first step of calibration or a dry-run calibration as described in section 4. On the SRB, the sensor replacement signal is controlled by a potentiometer (see Figure 1.1).

\* For detailed information about the SSC Communication Board, please refer to the *SSC Communication Board Datasheet*.

## 2 ZSSC3170 Evaluation Board

### 2.1. Overview

Figure 2.1 ZSSC3170 SSC Evaluation Board – Overview



The main purpose of the SSC Evaluation Kit is to perform communication between the user's PC and the ZSSC3170 (referred to as the DUT). The PC sends commands and data via the USB port on the CB (virtual COM port). The microcontroller on the CB interprets these commands and relays them to the DUT in the I<sup>2</sup>C<sup>TM</sup>† or LIN communication mode (via connector K1; see Figure 2.1). The microcontroller also forwards any data bytes from the DUT back to the PC via the USB connection. These bytes can be bridge and temperature readings to be displayed by the ZSSC3170 SSC Evaluation Kit software or raw ADC readings used during calibration or EEPROM content bytes.

The SSC CB microcontroller controls the power signals required for entering the Command Mode, and it is able to read the PWM output signal of ZSSC3170 and send this value back to PC. Because the ZSSC3170 provides a high and low side switch PWM signal, an inverted LIN communication protocol is also required. This is generated automatically by the SSC EB and controlled via the SSC CB.

† I<sup>2</sup>C<sup>TM</sup> is a trademark of NXP.

## 2.2. Schematic

Figure 2.2 shows the schematic of the ZSSC3170 SSC Evaluation Board (SSC EB). The SSC EB is powered by a 12V supply controlled by the microcontroller on the SSC CB. The green LED displays the status of this supply (maximum current that can be provided is 40mA).

There is a reverse polarity protection diode connected to a series resistor and then directly to the power supply of the ZSSC3170 (VB as shown in Figure 2.1). If the PWM interface is used, a 5V supply is required. Both power supplies are controlled by the microcontroller of the SSC CB. Jumper K11 can be used to remove the power supply for the ZSSC3170 manually or for a simple measurement of the supply current.

The PWM output of ZSSC3170 is connected to screw terminal KL5 and the SSC CB.

Transistor T1 serves as level shifter between ZSSC3170 and microcontroller's power domain, so a direct processing of this analog signal by the  $\mu\text{C}$  is also possible.

Jumper K17 ("select Comm-IF") selects the communication path for LIN communication. Select LIN, LOUT, or HOUT. If the LIN interface is used, jumpers K12 ("LIN-GND") and K16 ("LIN-VB" ) must be shorted because only a  $10\Omega$  series resistor is required for VB with LIN communication and the VSS pin of the ZSSC3170 must be connected directly to GND<sup>‡</sup>. For the PWM interface, the K12 and K16 jumpers are not needed and the K14 jumper selects the PWM mode, either HSS or LSS.

If PWM and the high-side switch are enabled, LIN communication requires inverted LIN signal levels. This transformation is done by IC2 if the K17 jumper ("select Comm-IF") is set to HOUT. The control signal for the communication direction of IC2 is provided by the SSC CB's  $\mu\text{C}$  via signal D4 on the K1 connector. If D4 is set to high, the communication from the master ( $\mu\text{C}$ ) to the ZSSC3170 is enabled. If D4 is set to low, the ZSSC3170 can send its response to the SSC CB.

The SSC EB is connected to the SSC CB via the 50-pin K1 female connector. On-board there are several strips for simple access to all IC signals. The SSC EB board type is hard-coded by three resistors on K1 connector pins D7 (low), D6 (high), and D5 (high).

The SRB can be connected to the SSC EB's 50-pin male K4 connector. Alternatively, an external bridge sensor element and an external temperature sensor can be connected using the on-board screw terminal KL3/KL4.

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<sup>‡</sup> For details about ZSSC3170 application examples, refer to the *ZSSC3170 Data Sheet*.

Figure 2.2 SSC Evaluation Board Schematic

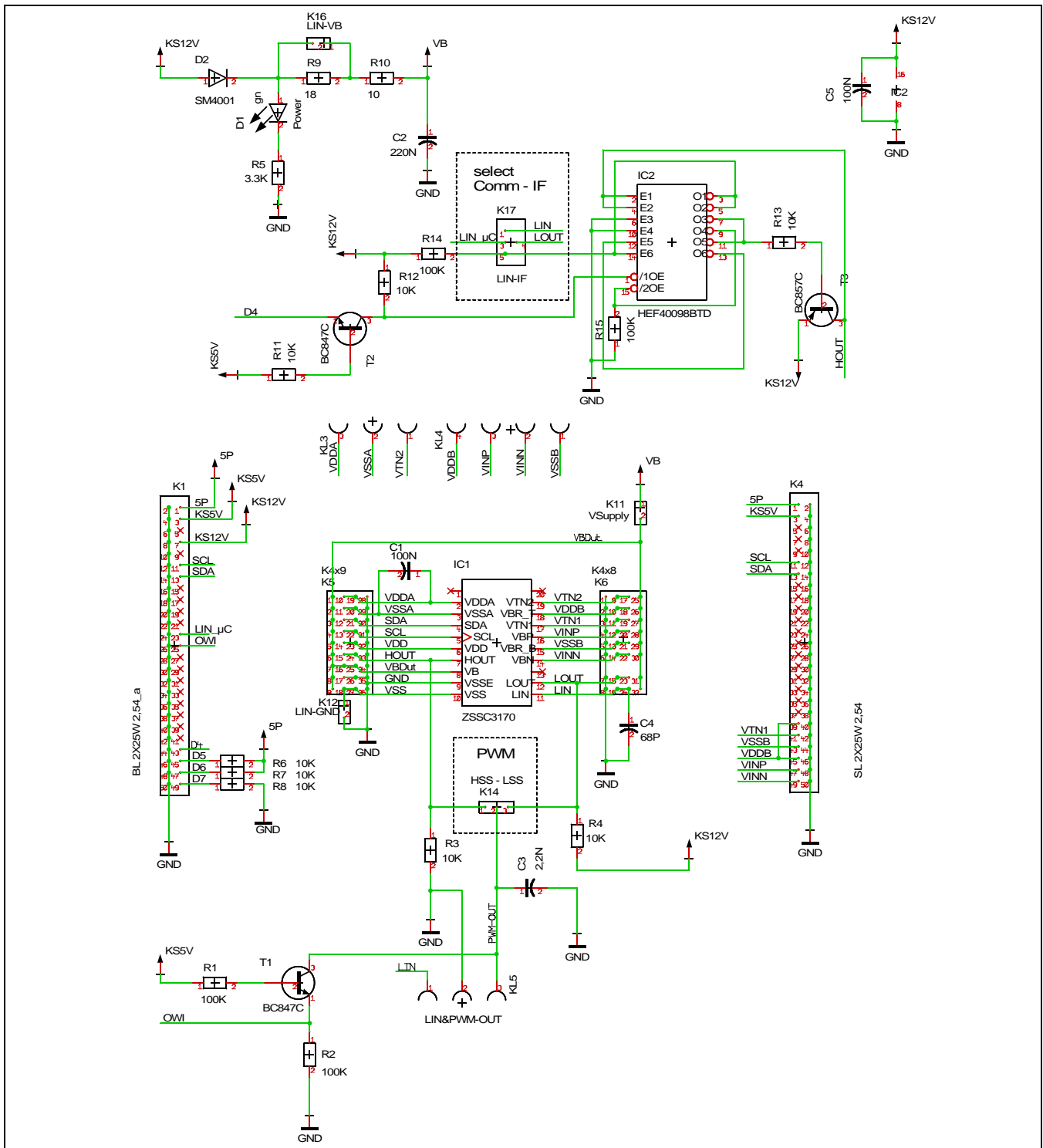


Table 2.1 gives an overview of the settings for jumpers on the board needed to enable the PWM-HSS, PWM-LSS, or LIN output modes. The jumper settings have no effect in I<sup>2</sup>C™ mode.

**Table 2.1 Jumper Setup for ZSSC3170 Functionality Options**

Mode of the ZSSC3170	Jumper Setting			
	K12 LIN-GND	K14 HSS-LSS	K16 LIN-VB	K17 Select Comm-IF
PWM – HSS	Open	HSS	Open	HOUT
PWM – LSS	Open	LSS	Open	LOUT
LIN	Shorted	Open	Shorted	LIN

**Important:** When acquiring measurement or calibration data, disconnect all measurement devices from the sensor input test pins in order to minimize noise during the measurements.

### 2.3. Connections to the ZSSC3170

The SSC EB has an SSOP-20 socket for inserting the SSOP-20 ZSSC3170 under test.

NOTE: Only one ZSSC3170 connection option can be used at a time (e.g., either through the SSC CB or via individual connections).

### 2.4. Reset Switch

Use the push button on the SSC CB to reset communications if needed.



### 3 Pinout and Package

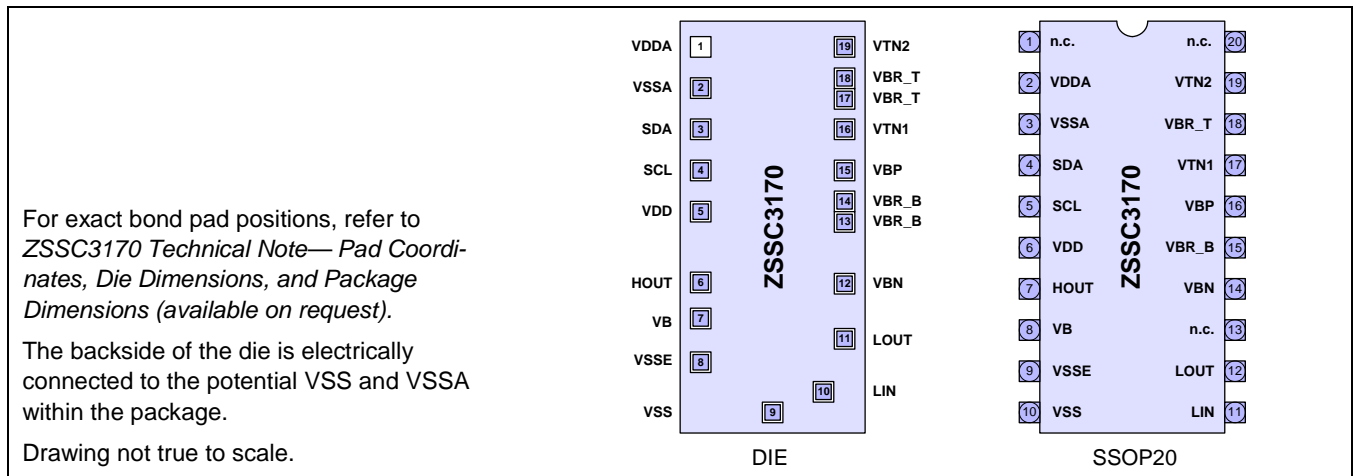
**Note:** The ZSSC3170 is only available for purchase as die. The SSOP20 package is only available for evaluation purposes as samples in the Evaluation Kit. An SSOP20 Green Package (5.3mm body, 0.65mm lead pitch) is the standard delivery form for samples.

**Table 3.1 Pin Definition of ZSSC3170**

Die Pin	SSOP20 Pin	Name	Description	Remarks
1	2	VDDA	Positive Analog Supply Voltage	Power supply
2	3	VSSA	Negative Analog Supply Voltage	Ground
3	4	SDA	I <sup>2</sup> C™ Clock	Analog I/O, internal pull-up
4	5	SCL	I <sup>2</sup> C™ Data I/O	Analog input, internal pull-up
5	6	VDD	Positive Digital Supply Voltage	Power supply
6	7	HOUT	PWM High-Side Switch	High voltage I/O
7	8	VB	Positive External Supply Voltage	High voltage I/O
8	9	VSSE	External Ground (PWM Modes)	High voltage I/O
9	10	VSS	Ground (LIN Mode)	Ground
10	11	LIN	LIN	LIN high voltage I/O
11	12	LOUT	PWM Low-Side Switch	High voltage I/O
12	14	VBN	Negative Input Sensor Bridge	Analog input
13 / 14	15	VBR_B	Negative (Bottom) Bridge Supply Voltage	Analog I/O
15	16	VBP	Positive Input Sensor Bridge	Analog input
16	17	VTN1	Temperature Sensor 1	Analog I/O
17 / 18	18	VBR_T	Positive (Top) Bridge Supply Voltage	Analog I/O
19	19	VTN2	Temperature Sensor 2	Analog I/O

The two-fold implementation of the bridge supply bond pads enables direct bonding from the ZSSC3170 pads to supply pads on the sensor die.

**Figure 3.1 Pin Configurations for Different Packaging Options**



## 4 ZSSC3170 Software

### 4.1. Overview

The ZSSC3170 SSC Modular Evaluation Kit does not include the software, which must be downloaded from [www.IDT.com/ZSSC3170KIT](http://www.IDT.com/ZSSC3170KIT) to ensure receiving the latest release. To download the software, navigate to the software link on the ZSSC3170 product page as follows:

- Click on the link titled “ZSSC3170 Evaluation Software Rev. X” (where X is the current revision) and follow the dialog instructions as needed to download the zip file for the software.
- Open the zip file and extract the *ZSSC3170\_SW\_Rev.X.exe* file.
- To install the ZSSC3170 SSC Evaluation Kit software on the user’s PC hard drive, double-click on the downloaded *ZSSC3170\_SW\_Rev.X.exe* file. Respond to the dialog box to select the installation directory, and the software will complete the installation, which results in a program shortcut on the desktop of the PC.

The default software installation folder is `..\program files\ZMDI\ZSSC3170`. IDT can provide the user with algorithms and assistance in developing their full production calibration software.

The software logs various data and commands into log files as described in section 4.3.

The software contains six menus that are intended for the following functions:

- Main Window: IC setup, configuration, and communication via check boxes, entry fields, and pull-down menus
- RAM/EEPROM Dialog: Direct access to RAM/EEPROM registers (consecutively numbered)
- Calibration Register Dialog: Direct access to RAM/EEPROM registers (sorted by category)
- Calibration Dialog: Acquisition of raw values from sensor and calculation of coefficients
- Get Raw Values Dialog: Special Dx commands for the ZSSC3170<sup>§</sup>
- Send Command Dialog: Low-level write/read communication with the SSC CB<sup>\*\*</sup>

### 4.2. USB Driver Installation

The USB driver installation is only required if the CB revision is earlier than Rev.3.3. For more information refer to the *SSC CB Application Note - USB Driver Installation*, which is provided at [www.IDT.com/ZSSC3170KIT](http://www.IDT.com/ZSSC3170KIT).

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<sup>§</sup> For details of the Dx commands, refer to the *ZSSC3170 Functional Description*.

<sup>\*\*</sup> For details about SSC CB command structure, refer to the *SSC Communication Board Data Sheet* and *SSC Command Syntax*.

### 4.3. User Files

User files are saved in *[My Documents]\ZMDI\ZSSC3170* and consist of log files and EEPROM files.

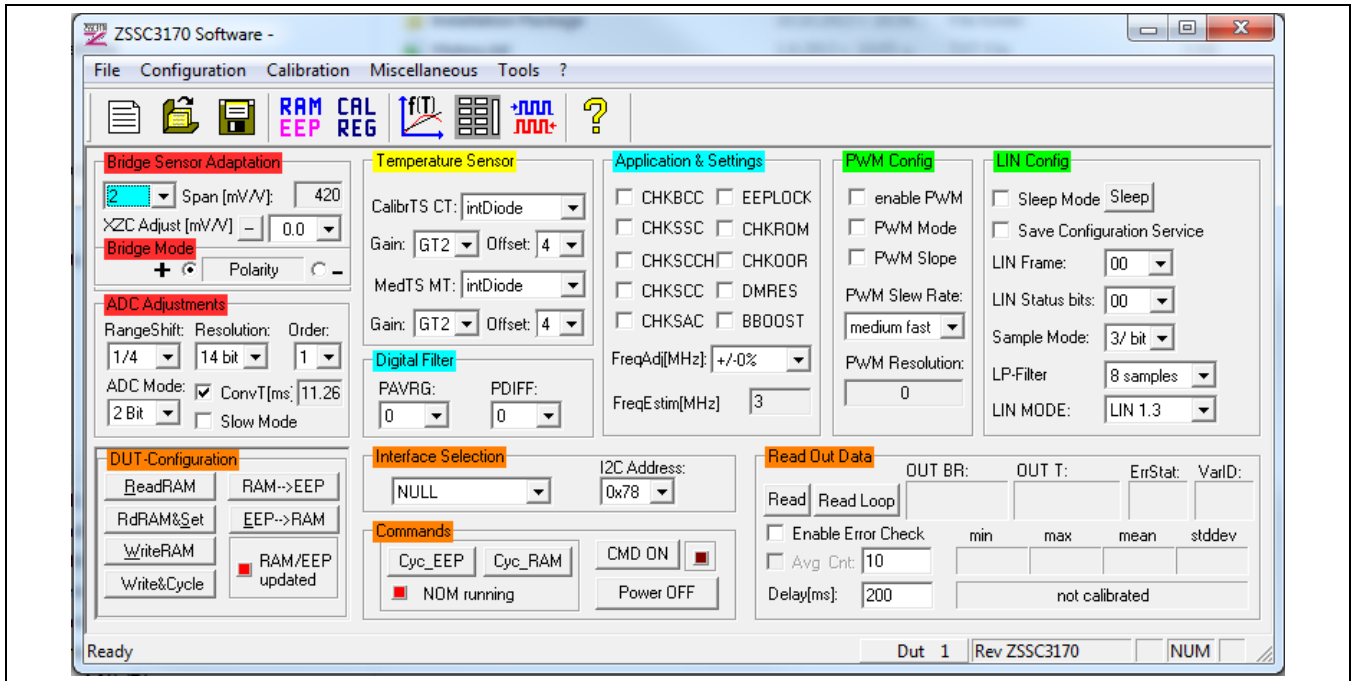
- *ZSSC3170\_COMx.log*  
A communication log file created when connection with the SSC CB and the ZSSC3170 is established (via LIN or I<sup>2</sup>C™ interface). This file is a log of the communication to the ZSSC3170 during the software session and can be saved after closing the software by renaming the file. Otherwise, it is overwritten the next time the software is opened.
- *save\_[date]\_[time].3170*  
A log file containing IC settings and acquired RAW data. This file can be used to load/save EEPROM contents.
- *save\_[date]\_[time].3170.txt*  
A log file in text format containing IC settings and acquired RAW data. This file can be used to view the EEPROM contents.

### 4.4. General Setup of the Software

Because of the large number of different functionalities of the ZSSC3170, the user interface is divided into different segments. Within these segments, a number of associated functionalities are implemented. Several submenus allow access to sub-functionalities. After the ZSSC3170 Software is started, the main window is displayed (see Figure 4.1).

The main window includes all the settings for configuration of the ZSSC3170 in a clear structure that hides the corresponding HEX commands behind buttons and pull-down menus. For a detailed description of the commands, refer to the *ZSSC3170 Functional Description*. An information box that explains functionality appears when the cursor is placed over most buttons, drop-down menus, and check boxes.

Figure 4.1 Main Window of the Evaluation Software



#### 4.4.1. Interface Selection

The ZSSC3170 supports two interfaces for communication: LIN and I<sup>2</sup>C™ (see Figure 4.2). After starting the software, select the interface for the application in the “Interface Selection” section.

Adjacent to the drop down menu for the interface is a menu for selecting the I<sup>2</sup>C™ addresses to be used.

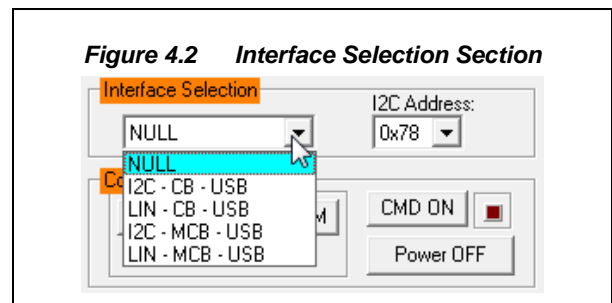


Figure 4.2 Interface Selection Section


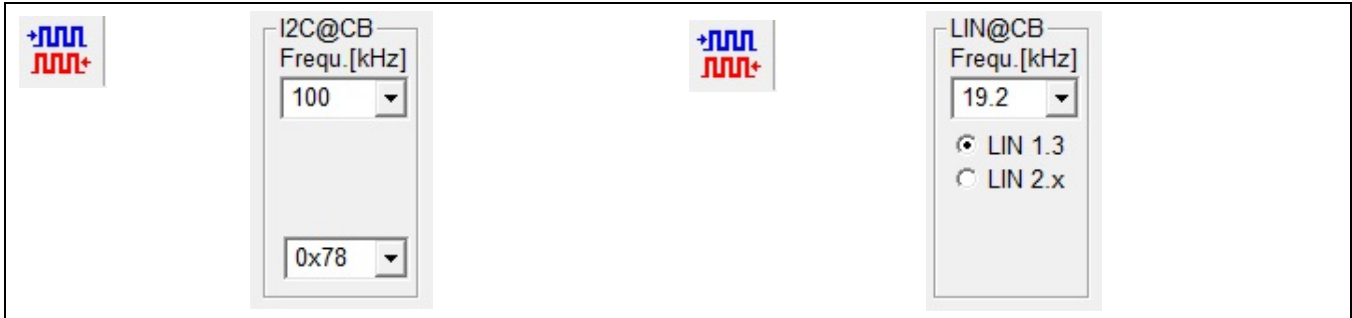
If the I<sup>2</sup>C™ interface is selected, additional settings for the I<sup>2</sup>C™ interface are enabled in the “Send Command” menu. The “Send Command” menu can be accessed with the  button (see section 4.11 for details).

Figure 4.3 Additional PC™ and LIN Interface Settings in the “Send Command” Menu

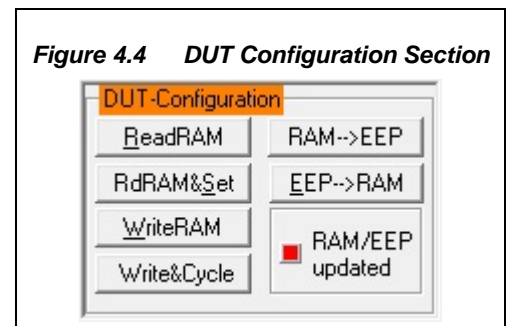


#### 4.4.2. ZSSC3170 Configuration

The “DUT Configuration” section includes the following buttons:

- **ReadRAM** : Reads the complete RAM contents and updates only the “RAM\_Register” menu.
- **RdRAM&Set** : Reads the complete RAM contents and updates all of the ZSSC3170 software.
- **Write RAM** : Copies the current software settings into the RAM of the ZSSC3170.
- **RAM-->EEP** : Copies the RAM contents into EEPROM. The free-user-memory registers (1C<sub>HEX</sub>, 1D<sub>HEX</sub>, and 1E<sub>HEX</sub>) will also be copied using the contents of the IDT software registers<sup>††</sup>.
- **EEP-->RAM** : Copies the EEPROM contents into RAM using the C0<sub>HEX</sub> command.
- **Write&Cycle** : Copies the current software settings into the RAM of the ZSSC3170 and starts the measurement cycle using the current RAM settings (command: 02<sub>HEX</sub><sup>††</sup>).

Figure 4.4 DUT Configuration Section



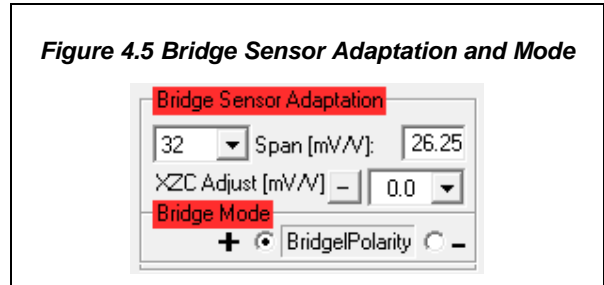
The “RAM/EEP updated” virtual LED (see Figure 4.4) displays the software configuration status compared with the attached ZSSC3170’s register content. If the content is identical, the LED is green (on).

<sup>††</sup> The contents of the “RAM-Register” dialog will be used for free-user-memory registers.  
<sup>††</sup> For details about ZSSC3170 commands, refer to the *ZSSC3170 Functional Description*.

#### 4.4.3. Analog Front End (AFE) Adjustment

The ZSSC3170 has different options for adapting the analog front end (AFE) to the specific sensing element. The “Bridge Sensor Adaptation” and “Bridge Mode” sections (shown in Figure 4.5) influence the programmable gain amplifier (PGA) and extended zero compensation.

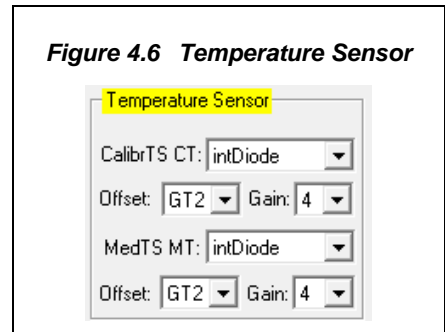
Refer to the *ZSSC3170 Data Sheet* for details about PGA and XZC settings.



The polarity of the sensor signal can be selected by the radio button and can be changed if the PCB layout requires swapped input pins.

#### 4.4.4. Temperature Sensor Selection

The next stage in the AFE is the multiplexer that selects the input signal for measuring temperature (Figure 4.6). The ZSSC3170 can use two different temperature channels: one for the temperature that is used for the ZSSC3170’s internal calibration calculation and one that is used as an optional additional output signal during Normal Operating Mode (NOM). If only one temperature sensor is used and a temperature readout during NOM is required, then “CalibrTS CT” and “MediumTS MT” must be set to the same settings (note: “medium” means ambient).

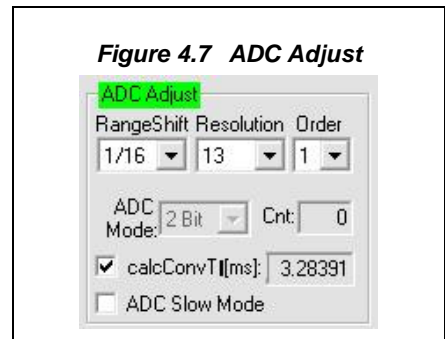


#### 4.4.5. ADC Settings

The last stage of the AFE is the analog to digital converter (ADC). The signal path within the AFE is fully differential, so it is necessary to provide an input signal within the common mode range. Otherwise the ADC will provide a signal that is equal to 0000<sub>HEX</sub> (underflow) or  $2^{ADC\_Resolution}$  (overflow) in the “Sensor – Calibration” menu during calibration.

Refer to the *ZSSC3170 Data Sheet* for details about ADC settings.

If the analog input voltage does not fit the ADC range and an underflow or overflow occurs, the “Range Shift” option can be used for fine-tuning. A lower “Span” setting in the “Sensor Adaptation” section can also be useful for fitting the ADC range.

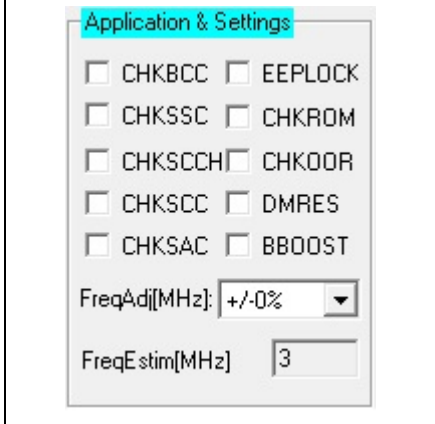


#### 4.4.6. Application Settings

The internal microcontroller of the ZSSC3170 can detect various errors and perform different types of measurement cycles. It controls multiple protection options that can be configured by the ZSSC3170 Software.

Figure 4.8 illustrates all the application options for the ZSSC3170, which can be enabled/disabled via the checkboxes. The example in Figure 4.8 shows the ZSSC3170 settings with no options enabled. For more details about the related options, refer to the *ZSSC3170 Functional Description*.

Figure 4.8 Application and Settings

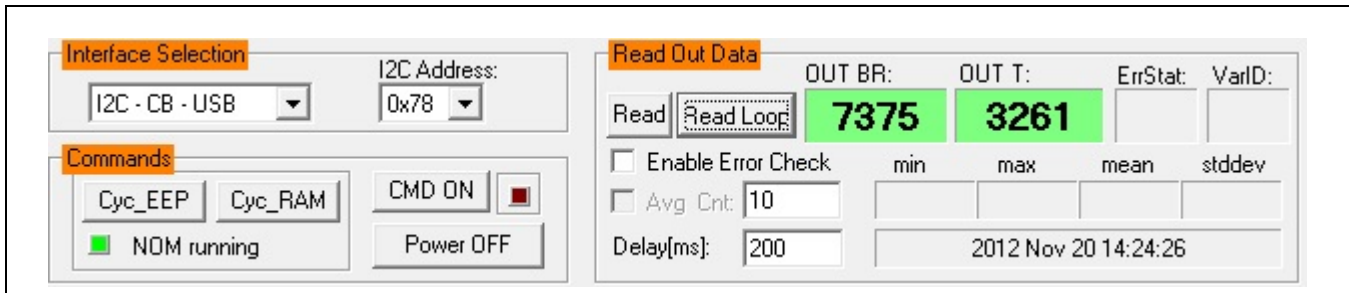


- **CHKBCC** : Enables the Broken Chip Check.
- **CHKSSC** : Enables the Sensor Short Check.
- **CHKSCCH** : Enables the Sensor Connection Check (the ZSSC3170's CHKSCCHIC setting) high-capacity mode.
- **CHKSCC** : Enables Sensor Connection Check.
- **CHKSAC** : Enables Sensor Aging Check.
  
- **EELOCK** : Enables EEPROM lock for LIN communication. If enabled, the EEPROM cannot be changed via the LIN interface and must be reset via the I<sup>2</sup>C™ interface.
- **CHKROM** : Enables ROM check after power-on. If enabled, the start-up time will be increased by approximately 10ms.
- **CHKOOR** : Enables the ROM check after power on. If enabled, the start-up time will be increased by approximately 10ms. If a ROM error occurs, the ZSSC3170 will change to the Diagnostic Mode.
- **DMRES** : If enabled, the ZSSC3170 is reset if the ZSSC3170 enters the Steady Diagnostic Mode.
- **BBOOST** : Enables the bias boost option for the AFE.

#### 4.5. Operation Section

The “Commands” and “Read Out Data” sections control the collection of data and configuration of the ZSSC3170.

Figure 4.9 Normal Operation Section



#### 4.5.1. Normal Operation Mode (NOM)

In the “Commands” section, use the **Cyc\_EEP** or **Cyc\_RAM** button to exit Command Mode (CM) and start NOM using either EEPROM or RAM registers settings respectively. The ZSSC3170 can now continually perform a measurement cycle. The status of the virtual LED “NOM running” (see Figure 4.9) is updated accordingly.

#### 4.5.2. Command Mode (CM)

In the “Commands” section, use the **CMD ON** button to start the Command Mode of the ZSSC3170 by sending the Start\_CM command (0x7274) to the ZSSC3170. The status of the virtual LED “CMD ON” (see Figure 4.9) indicates when the ZSSC3170 is in the Command Mode by turning green.

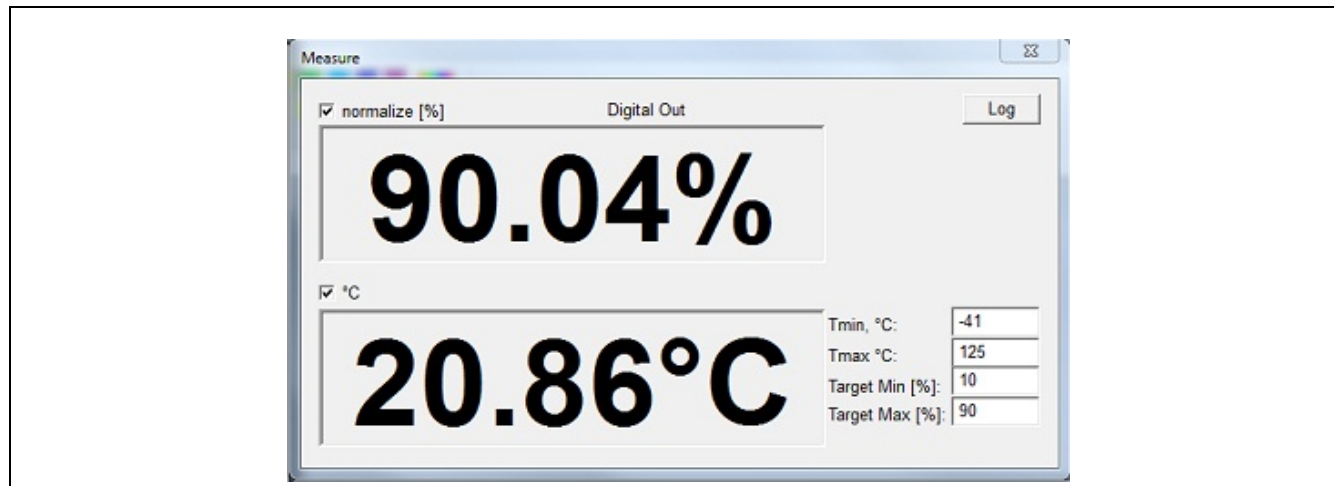
#### 4.5.3. Power IC OFF

The **Power OFF** button in the “Commands” section (see Figure 4.9) can be used to power off the ZSSC3170. All communication interfaces are disabled, so no further communication is possible until the **CMD ON** button is sent or an interface is selected.

#### 4.5.4. Data Read-Out

The **Read** and **ReadLoop** buttons in the “Read Out Data” section (see Figure 4.9) start a read-out of sensor data. When a loop measurement is started, the button text will change to “Stop.” Clicking again on the button stops the loop. A separate measurement output window as shown in Figure 4.10 can be opened by clicking over the measurement results under “OUT BR” or when selected from the menu via “Tools -> Measure Output.” The temperature results in degrees Celsius are valid only if the temperature limits and targets are the same as during calibration.

Figure 4.10 Measure Output Window





#### 4.5.5. Enable Error Check

The “Enable Error Check” checkbox in the “Read Out Data” section (see Figure 4.9) turns on the error checks selected in the “Application & Settings” section (see section 4.4.6). An error message will be displayed if any of the errors selected occur.

#### 4.5.6. Average Count and Statistics

The “Avg Cnt” checkbox in the “Read Out Data” section (see Figure 4.9) starts the averaging and statistics calculations. It is only enabled if the measurement is in a loop mode (see section 4.5.4). The resulting data is displayed in the adjacent fields after the specified cycles in the field are passed.

### 4.6. Output Configuration

The ZSSC3170 provides three different output interfaces:

- LIN interface
- PWM interface
- I<sup>2</sup>C™ interface

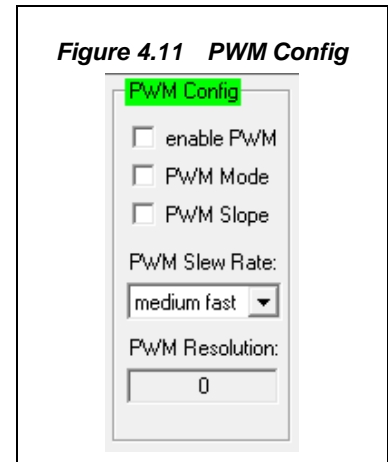
#### 4.6.1. I<sup>2</sup>C™ Interface

If the I<sup>2</sup>C interface is used (see section 4.4.1), the output signal format is fixed and cannot be changed<sup>§§</sup>.

#### 4.6.2. PWM Interface

The PWM interface can be used to generate an analog output signal using a low-pass filter. The settings for the PWM interface are illustrated in Figure 4.11.

- **enable PWM** : Enables the PWM interface. Either the LIN or PWM interface can be selected. Using both interfaces simultaneously during NOM is not available.
- **PWM Mode** : Selects between the two modes for the PWM interface that the ZSSC3170 supports. If checked, the high-side switch mode (HSS) is enabled, including an internal pull-down resistor. If not checked, the low-side switch mode (LSS) is enabled, including an internal pull-up resistor.
- **PWM Slope** : The slope of the PWM signal is controlled by monitoring either the voltage or the current at the PWM output. If checked, voltage control is activated. If not checked, current control is activated.



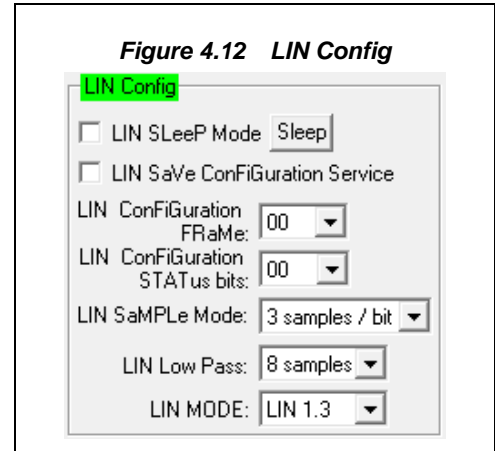
- **PWM Slew Rate** : Selects the rise or fall rate of PWM slope. Use a slower value to achieve a more robust system for EMC. Typically, the slew rate is +/-2V per μs for the voltage range of 0.5V to 4V.

<sup>§§</sup> For details about ZSSC3170's I<sup>2</sup>C™ interface, refer to the *ZSSC3170 Functional Description*.

### 4.6.3. LIN Interface

The LIN interface has various options for the digital output configuration as shown in Figure 4.12. For a more detailed description of the LIN configuration, refer to the *ZSSC3170 Functional Description*.

- LIN Sleep Mode**: If checked, the ZSSC3170 is able to go to Sleep Mode after receiving a “Go-To-Sleep” command. The ZSSC3170 will not respond to any other LIN command until the device receives a wake up signal<sup>\*\*\*</sup>. The “Sleep” button sends a go-to-sleep command to the ZSSC3170.  
 Note: LIN Sleep Mode must be disabled for proper PWM operation.
- LIN Save ConFIguration Service**: The *Save-Configuration* service is used to initiate the slave node to save its configuration into EEPROM. This service is only available if this checkbox is checked. Otherwise, this request will cause a *Save-Configuration Negative* response as described in the *ZSSC3170 Functional Description*.
- LIN ConFIguration FRaMe**: This option selects the data format during read out in Normal Operation Mode.



	Data Byte 0			Data Byte 3
<b>00</b>	12-Bit Bridge Sensor	12-Bit Temperature	4-Bit Status	4-Bit Variant ID
<b>01</b>	12-Bit Bridge Sensor	10-Bit Temperature	2-Bit Status	8-Bit Variant ID
<b>10</b>	12-Bit Bridge Sensor	8-Bit Temperature	4-Bit Status	8-Bit Variant ID
<b>11</b>	11-Bit Bridge Sensor	9-Bit Temperature	4-Bit Status	8-Bit Variant ID

- LIN ConFIguration STATus bits**: In addition to sensor signal and temperature data included in the digital read out, the ZSSC3170 also provides various information with the remaining 4 status bits during NOM. There are different settings available, which can be selected by this pull-down menu as shown in the table below:

	LSB	LSB + 1	LSB + 2	LSB + 3
<b>00</b>	Bridge Sensor Error	Temperature Error	Values Refreshed	Response Error
<b>01</b>	Bridge Sensor Signal Out of Limits	Temperature Out of Limits	Bridge Sensor or Temperature Invalid	Response Error
<b>10</b>	Bridge Sensor Error	Response Error	Checksum Error	Bit Error
<b>11</b>	Bridge Sensor Error	Temperature Error	Checksum Error	Bit Error

<sup>\*\*\*</sup> For details about ZSSC3170’s LIN interface functionality, refer to the *ZSSC3170 Functional Description*.

- **LIN SaMPLe Mode** : Selects the sample count per bit for signal detection (3 or 5 samples per bit).
- **LIN Low Pass** : LIN transceivers normally have filters to remove short spikes on the bus. The number of samples can be selected from the drop-down menu.
- **LIN MODE** : The ZSSC3170 supports three different LIN modes: LIN 1.3, LIN 2.0 and LIN 2.1. Select the mode that the LIN master in the final application uses.

#### 4.7. Calibration Window


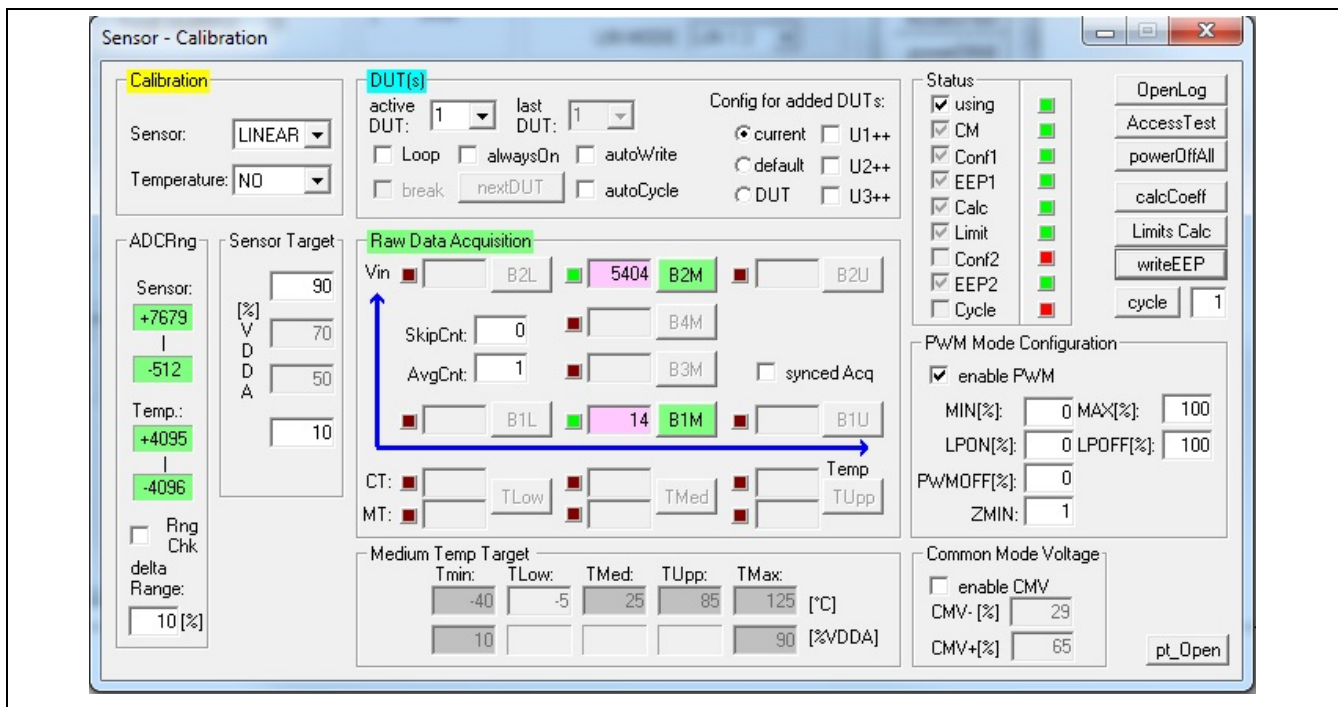

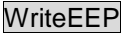
The “Sensor – Calibration” dialog is accessed by clicking on the  icon or select “Calibration” on the top menu and then “Calibration” from the drop-down menu. It is used to perform a calibration of the ZSSC3170 with either the SRB or the user’s sensor module. Section 5 gives an example calibration using the commands on this screen.

Figure 4.13 “Sensor – Calibration” Dialog



### 4.8. RAM-Register Dialog Window

The “RAM-Register” dialog window is accessed by clicking the  button. This dialog window is used to read and write register contents in the ZSSC3170 memories and has the same functionality as the “DUT Configuration” section in the main window.

There is also a  button to store all register contents into the EEPROM of the ZSSC3170. Register indexing corresponds to the ZSSC3170 memory addresses.

The configuration of the ZSSC3170 is stored in 32 EEPROM 16-bit words.

- Calibration coefficients for conditioning the bridge sensor signal via conditioning calculations and output limits are stored in 8 registers: 0<sub>HEX</sub> to 7<sub>HEX</sub>.
- Calibration coefficients for conditioning the temperature signal are stored in 3 registers: 8<sub>HEX</sub> to A<sub>HEX</sub>.
- LIN settings include registers B<sub>HEX</sub> to D<sub>HEX</sub> data for limits and registers 14<sub>HEX</sub> to 1A<sub>HEX</sub> for frame configuration.
- Sensor Aging Check limits are stored in register E<sub>HEX</sub>.
- There are five words for setting the configuration of the ZSSC3170 for the application: registers F<sub>HEX</sub> to 13<sub>HEX</sub> (indicated by a yellow background).
- Register 1B<sub>HEX</sub> is used for storing the EEPROM signature, which is used in NOM to check the validity of the EEPROM contents after power-on.
- Four additional 16-bit registers are available for optional user data: registers 1C<sub>HEX</sub> to 1F<sub>HEX</sub>.

For more information regarding the registers, refer to the *ZSSC3170 Functional Description*.


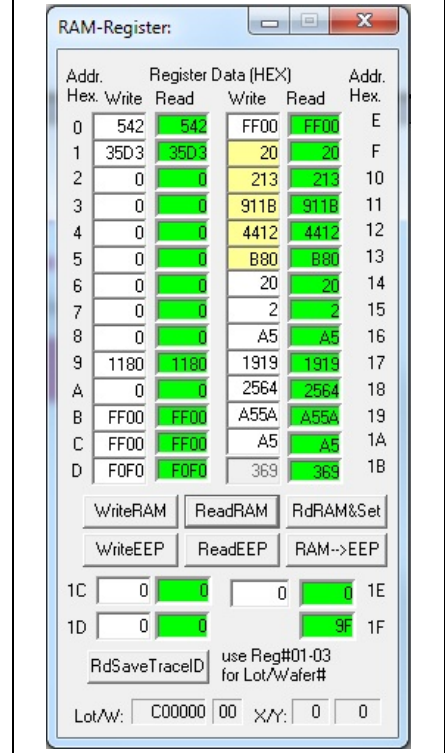
Note: If current settings differ from the memory contents, registers that do not correspond to memory will have a  background after the “Read” operation.

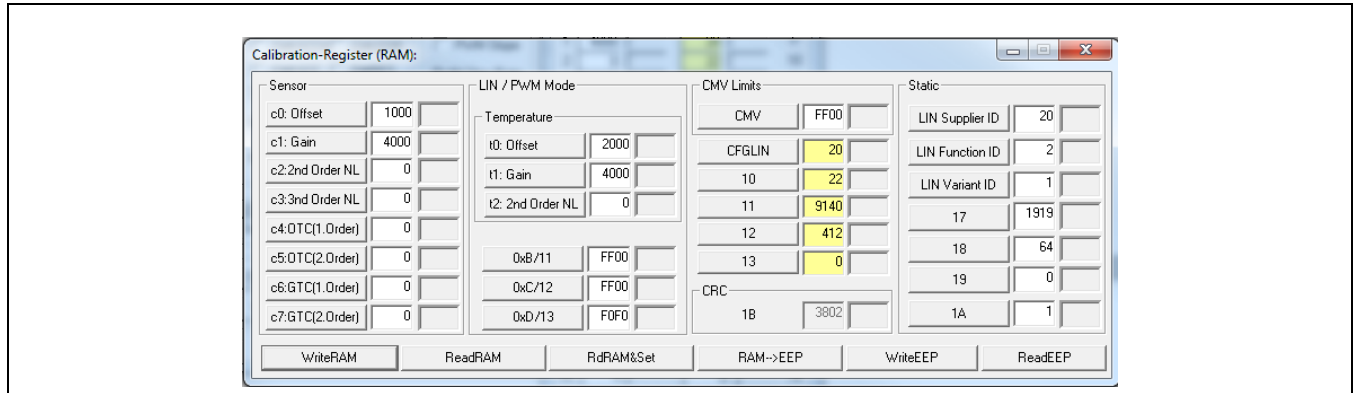
Figure 4.14 Displaying RAM-EEP Register Contents



### 4.9. Calibration-Register (RAM) Dialog

The “Calibration-Register (RAM)” dialog is accessed by clicking the **CAL REG** button at the top of the menu. This dialog provides the same functionality as the “RAM-Register” dialog window, except that the registers are separated by functionality groups.

Figure 4.15 “Calibration-Register (RAM)” Dialog

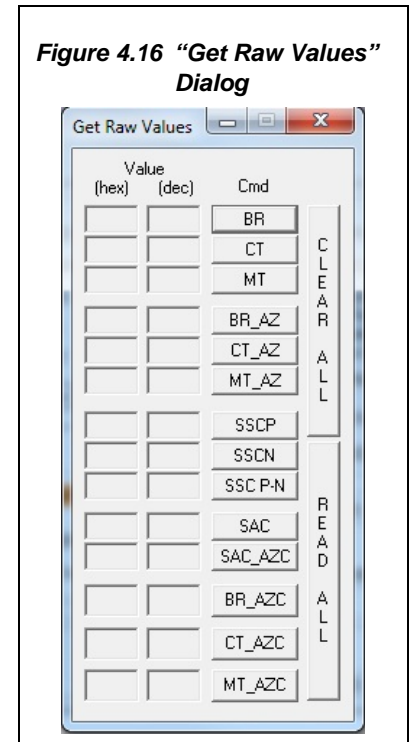


### 4.10. Get Raw Values Dialog

The “Get Raw Values” dialog is used to acquire the raw values of the measurements for the following values:


- BR** Bridge Signal Raw Data (main channel)
- CT** Calibration Temperature Raw Data
- MT** Medium (i.e., ambient) Temperature Raw Data
- BR\_AZ** Sensor Signal Auto-Zero Raw Data
- CT\_AZ** Calibration Temperature Auto-Zero Raw Data
- MT\_AZ** Medium (i.e., ambient) Temperature Auto-Zero Raw Data
- SSCP** Positive-Biased Sensor Short Check Raw Data
- SSCN** Negative-Biased Sensor Short Check Raw Data
- SSCP-N** Positive-Negative Biased Sensor Short Check Raw Data
- SAC** Common Mode Voltage Raw Data

Figure 4.16 “Get Raw Values” Dialog



- SAC\_AZC Common Mode Voltage Raw Data Auto-Zero Compensated
- BR\_AZC Sensor Signal Main Channel Raw Data including Auto-Zero Compensation
- CT\_AZC Calibration Temperature Raw Data including Auto-Zero Compensation
- MT\_AZC Medium (i.e., ambient) Temperature Raw Data including Auto-Zero Compensation

#### 4.11. Send Command

The “Send Command” dialog is accessed via the  button at the top. This dialog is used for transferring commands from the PC to the microcontroller on the SSC CB and reading the result of the commands.

A full summary and detailed command description of the applicable controller commands are given in the *ZSSC3170 Functional Description*.

For more functionality, the *IDT SSC Terminal* software can be used. This can be downloaded from IDT’s website at [www.IDT.com](http://www.IDT.com) as described in the *SSC Communication Board Data Sheet* (see section 7). This is the lowest level of communication for transferring commands from the PC to the microcontroller on the SSC CB. A full summary and detailed command description of the applicable controller commands are given in *SSC Command Syntax* (see section 7).

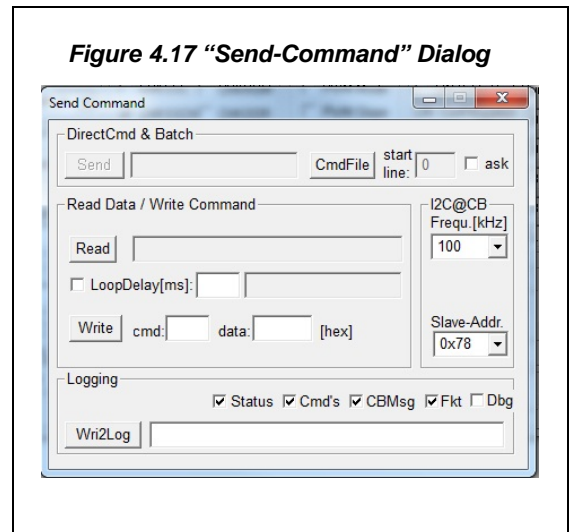


Figure 4.17 “Send-Command” Dialog

For the ZSSC3170 communication mode, use the settings explained for I<sup>2</sup>C™ and LIN (see section 4.4.1).

For the communication between the SSC CB and the ZSSC3170, the ZSSC3170’s slave address and the communication frequency can be selected from the drop-down menus on the right.

The “Send Command” dialog includes the following buttons:

- Send Sends a command to the SSC CB. Alternatively, a \*.370x\_cmd command file can be loaded by clicking the “CmdFile” button and browsing to locate the command file. The starting line of the command file can be specified. If the “ask” check box is selected, a dialog asking for confirmation appears before each command is executed.
- Read Reads the output data buffer of the ZSSC3170. A loop delay can also be added between the readings.



**Write**

Performs the same function as the “Send” command except that the command field and the data field are separated. The ZSSC3170 software generates the actual instruction to be sent to the SSC CB.

**Wri2Log**

Writes text entered in adjacent field to the log file. The checkboxes can be used to write various data into the log file, such as status, commands, messages, etc.

## 5 Calibration Example

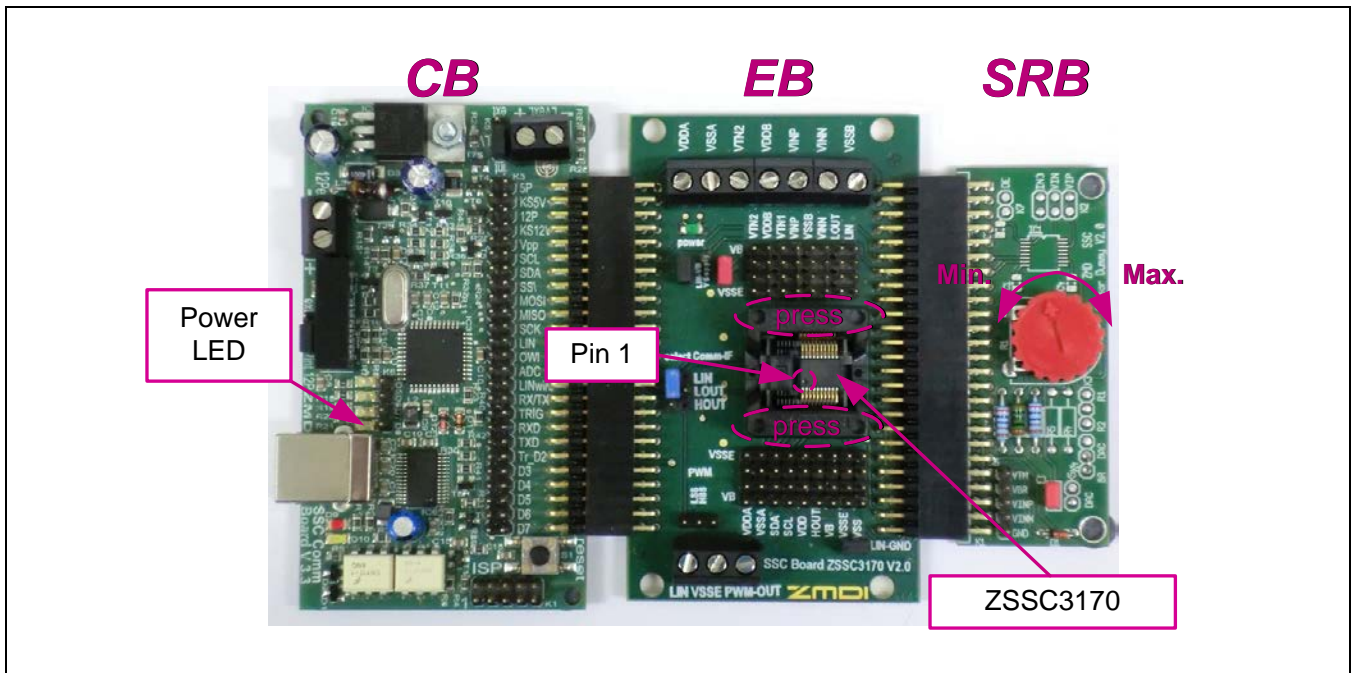


The following directions perform an example of a simple calibration using the sensor replacement board (SRB). The calibrated output will be displayed as a calibration result.

### 5.1. Hardware Setup

- Connect the SSC CB, SSC EB, and SRB as shown in Figure 5.1.
- Press down on top of the socket on the SSC EB to open it and insert a ZSSC3170 (see Figure 5.1; note pin 1 orientation).
- Connect a USB cable from the USB connector on the SSC CB to an available USB port on the PC. Verify that the green PWR LED is lit on the SSC CB.

**Figure 5.1** Hardware Setup for Calibration Example



## 5.2. Software Startup


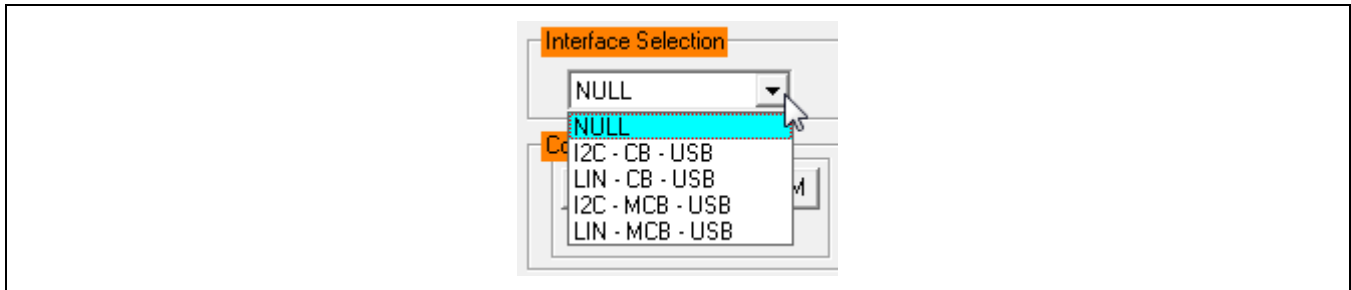
- a) Start the ZSSC3170 Software by clicking on the desktop icon  or activate the software from the Windows Start Menu folder: #Start\_Menu#\ZMD\ZSSC3170\ZSSC3170.
- b) Select “I2C – CB – USB” or “LIN – CB – USB” interface from the drop down menu in the “Interface Selection” section of the main window as shown in Figure 5.2.

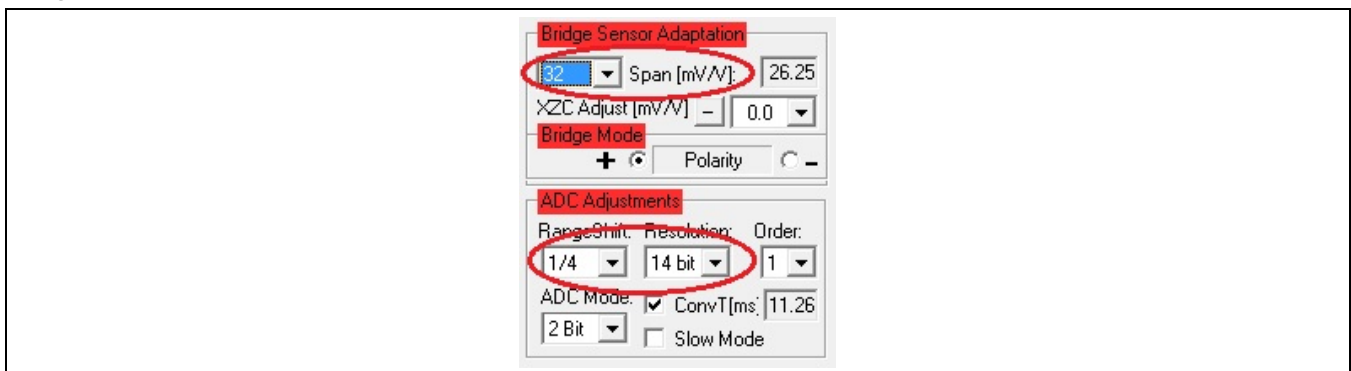
Figure 5.2 Select Interface



- c) Select the following settings as shown in Figure 5.3:
  - In the “Sensor Adaptation” section, set the “Span [mV/V]” (sensor sensitivity) menu to **32mV/V**, which is the typical span when using the SRB. With the 5V supply, this equals a total span of 160mV.
  - In the “ADC Adjustments” section, set the “Resolution” menu to **14 bits** (equivalent to 16384 steps of the ADC).
  - In the “ADC Adjustments” section, set the “Range Shift” menu to  $\frac{1}{4}$ , which fits the input signal range to the ADC output value (“analog zero”). For example for a range shift of  $\frac{1}{4}$  and 14 bits resolution, the read-out values would be between -4096 and +12287.


Note: Write the configuration into the RAM by pressing on the **WriteRAM** button in the “DUT Configuration” section.

Figure 5.3 Select Span and Sensor Mode





### 5.3. Calibration Data Acquisition

- a) Click on the  icon or select “Calibration” on the top menu and then “Calibration” from the drop-down menu. The “Sensor – Calibration” window appears as shown in Figure 5.4. Select the calibration mode from the drop down menu.

For this example, the recommended mode is

- ✓ **LINEAR** (two points only) for the sensor
  - ✓ **NO** calibration for the temperature (temperature calibration requires a chamber with a controlled environment)
- b) Type the desired sensor target corresponding in percent to the VDD supply. It is recommended that the output targets for the sensor points be between 10% and 90%.
  - c) Next, start data collection. Normally this would be done with a real sensor attached on a remote board in a controlled chamber. Instead, this calibration example run uses the SRB as the input as follows:
    - ✓ **Minimum** [10%] Sensor Signal: turn the SRB counter-clockwise (CCW) to the end and press the **B1M** button (see Figure 5.4).
    - ✓ **Maximum** [90%] Sensor Signal: turn the SRB clockwise (CW) to the end and press the **B2M** button.

Acquired data will be displayed in the text boxes next to the buttons.

Note: only active buttons corresponding to the calibration mode are green.

### 5.4. Calculation of the Coefficients and Limits

- a) The **calcCoeff** button at the right of the “Sensor – Calibration” screen calculates the calibration coefficients. The result of the calculation (if successful) is displayed on the screen (see Figure 5.4). The ZSSC3170’s calibration microcontroller removes the offset and temperature dependency so that the measuring output result is within the target values (%VDDA or in this case, between 10% and 90%).

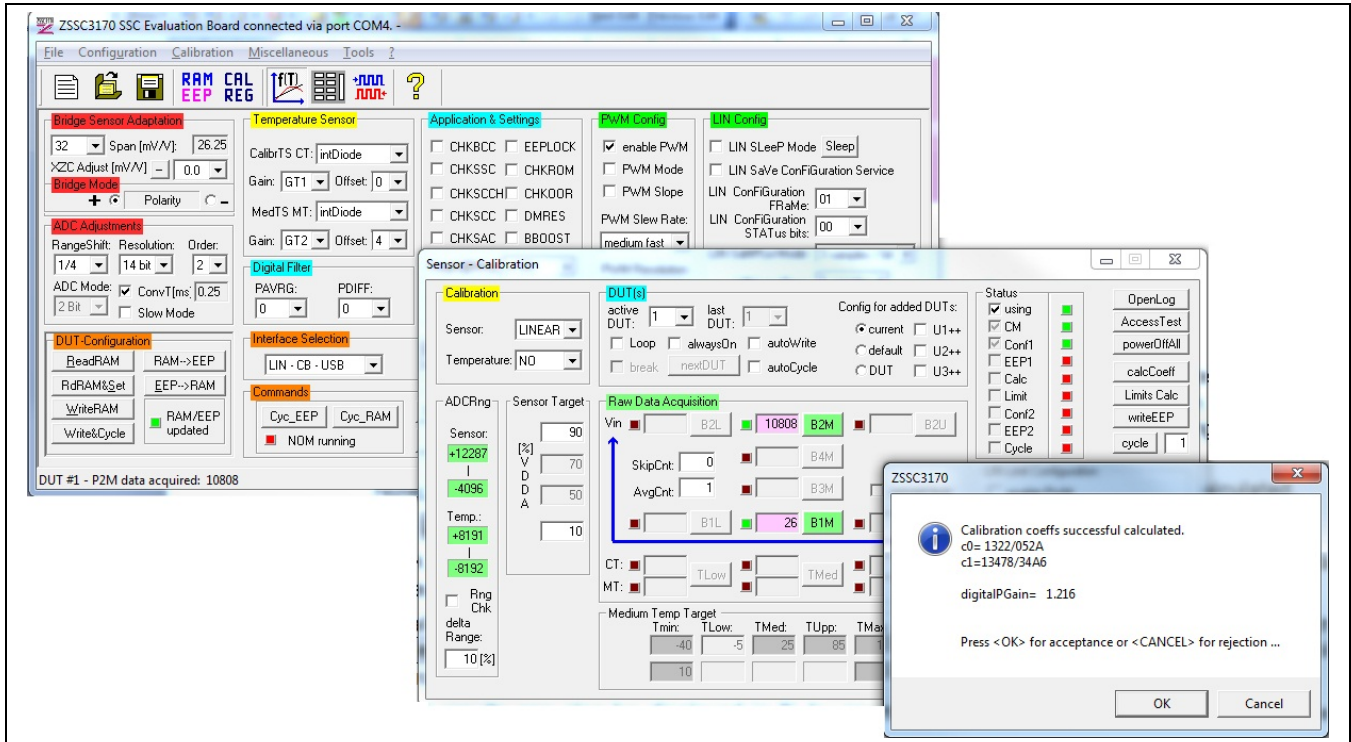
Note: The number of calibration points is equal to the number of coefficients to be calculated.

- b) The **Limits Calc** button calculates sensor aging (CMV) and output limits.
- c) Click on **writeEEP** to make these calculations effective and written in the EEPROM. Option: starting a measuring cycle can be triggered by pressing the **cycle** button.

Close the calibration window and trigger a measurement in the main window (see Figure 4.1) by clicking on either the **Read** or **Read Loop** button in the “Read Out Data” section. The ZSSC3170 is already running in Normal Operation Mode (NOM) because the **cycle** button was pressed in the calibration window.

Measurement results can also be displayed in % by opening the “Tools -> Measure Output” window (see Figure 4.10) and selecting the output format in the checkbox.

Figure 5.4 Displaying the Result of the Coefficient Calculation



Note: all active buttons corresponding to the calibration method selected are green.

## 6 Ordering Information

Item	Product Sales Code	Description
1	ZSSC3170-KIT	ZSSC3170 Evaluation Kit V1.0 (incl. Pos. 2, 3, 4, 5, 6)
2 *	SSC Comm. Board V3.3	SSC Communication Board V3.3 (incl. USB cable)
3 *	SSC Board ZSSC3170 V2.0	ZSSC3170 SSC Evaluation Board (SSC EB) V2.0 (includes 5 ZSSC3170 samples)
4 *	SSC Sensor Replacement Board V2.0	SSC Sensor Replacement Board V2.0
5 *	SSC Test Board V1.0	SSC Test Board V1.0 (unpopulated PCB for circuit prototyping)
6 *	ZSSC3170DAT2	Samples of the ZSSC3170DAT2 (SSOP20 5.3mm; note this package option is only available for samples—only die are available for purchase)

\* Note: Items 2 through 6 can be ordered separately only after ordering item 1.

## 7 Related Documents

Document
<i>ZSSC3170 Data Sheet</i>
<i>ZSSC3170 Functional Description</i>
<i>SSC CB Application Note - USB Driver Installation</i>
<i>SSC Communication Board Data Sheet</i>
<i>SSC Sensor Replacement Board Data Sheet</i>
<i>SSC Command Syntax</i>
<i>ZSSC3170 Technical Note— Pad Coordinates, Die Dimensions, &amp; Package Dimensions</i>

Visit [www.IDT.com/ZSSC3170](http://www.IDT.com/ZSSC3170) and [www.IDT.com/ZSSC3170KIT](http://www.IDT.com/ZSSC3170KIT) or contact your nearest sales office for the latest version of these and other related documents.

## 8 Glossary

Term	Description
ADC	Analog-to-Digital Converter
AFE	Analog Front End
CB	Communication Board
CMC	Calibration Microcontroller
CMV	Common Mode Voltage
OWI	One-Wire Interface
PCB	Printed Circuit Board
PGA	Programmable Gain Amplifier
SCC	Sensor Connection Check
SRB	Sensor Replacement Board
SSC	Sensor Signal Conditioner or Sensor Short Check
μC	Microcontroller

## 9 Document Revision History

Revision	Date	Description
1.00	January 23, 2012	First release.
2.00	November 28, 2012	Edits related to update for software. Updates for contact information.
2.10	October 11, 2013	PWM operation and LIN Sleep mode incompatibility note added. DVD references removed from the document. Edits in section 4.4.6 related to software update to change CHKSSCH to CHKSCCH. Updates to section 4.2 related to USB driver installation, which is now not used unless the SSC Communication Board revision is earlier than 3.3. Updates for contact information and cover imagery. Minor updates for clarity and related documents.
2.11	November 26, 2014	Update for Figure 4.15 for new software version. Update for imagery for cover and contact information.
	March 30, 2016	Changed to IDT branding.

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