EVAL-ADA4558EBZ User Guide
UG-1537

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Evaluating the ADA4558 Bridge Sensor Signal Conditioner IC with LIN Interface, Sensor Nonlinearity Correction, and Temperature Compensation

FEATURES

Full featured evaluation board for the ADA4558
PC control via USB or LIN interface
PC software for configuration and data measurement

EVALUATION KIT CONTENTS

EVAL-ADA4558 evaluation board

ADDITIONAL EQUIPMENT AND SOFTWARE NEEDED

EVAL-ADA4558EBZ software downloadable from the ADA4558 product page
MATLAB Runtime (MATLAB Compiler), Version 7.14
USB cable (Type A plug to Mini Type B plug)

GENERAL DESCRIPTION

The EVAL-ADA4558EBZ allows quick and easy evaluation of the ADA4558. The ADA4558 is an automotive grade, signal conditioner IC for Wheatstone bridge sensors. The device provides digital nonlinearity correction and temperature compensation.

The EVAL-ADA4558EBZ can be controlled via the evaluation software by using the USB port or by using the local interconnect network (LIN) port. All power supplies are powered by the USB port and on-board dc-to-dc converters.

For full details on the ADA4558, see the ADA4558 data sheet and the ADA4558 Hardware Reference Manual, which should be consulted in conjunction with this user guide when using the EVAL-ADA4558EBZ.

EVALUATION BOARD PHOTOGRAPH

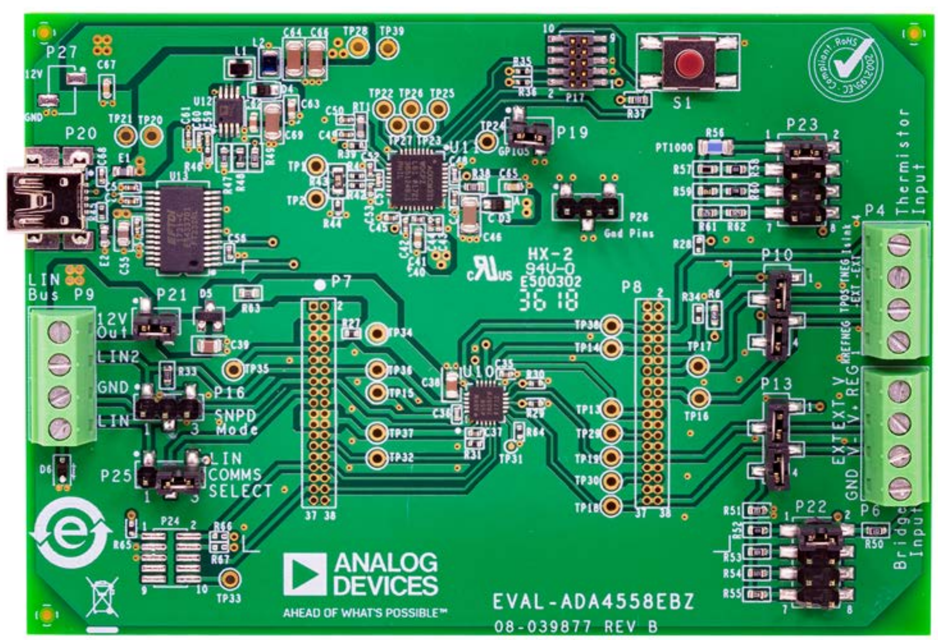

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Figure 1.

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REVISION HISTORY

5/2019—Revision 0: Initial Version

GETTING STARTED

SOFTWARE INSTALLATION PROCEDURES

The EVAL-ADA4558EBZ product page contains the EVAL-ADA4558EBZ software that must be installed on the PC to allow the evaluation of the EVAL-ADA4558EBZ using its USB port.

Installing the EVAL-ADA4558EBZ Software

To install the EVAL-ADA4558EBZ software, download the **EVAL-ADA4558 Installer.exe** file from the EVAL-ADA4558EBZ product page and complete the following steps:

1. Double-click the **EVAL-ADA4558 Installer.exe** file to begin the EVAL-ADA4558EBZ software install. The software installs to the following default location: **C:\Analog Devices\ADA4558**.
2. A dialog box may appear asking for permission to allow the program to make changes to the PC. Click **Yes**.
3. A dialog box then appears asking for permission to install. Click **Next** (see Figure 2).

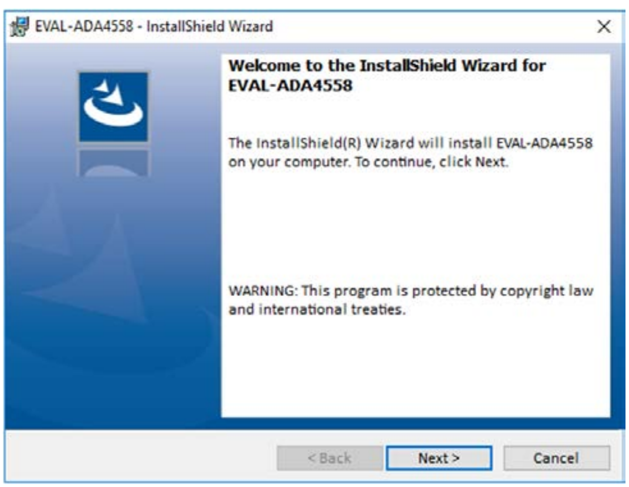

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Figure 2. EVAL-ADA4558EBZ Software Installation: Grant Permission for Install

4. Select the location to install the software and then click **Next** (see Figure 3). It is recommended to use the default folder location.

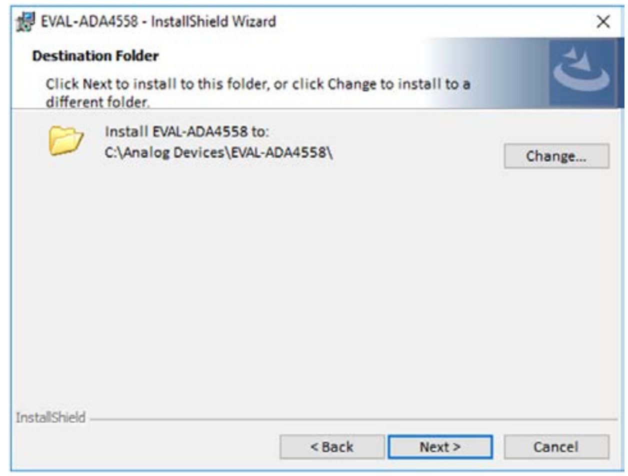

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Figure 3. EVAL-ADA4558EBZ Software Installation: Select Location for Software Installation

5. A wizard summary then displays. Click **Install** (see Figure 4).

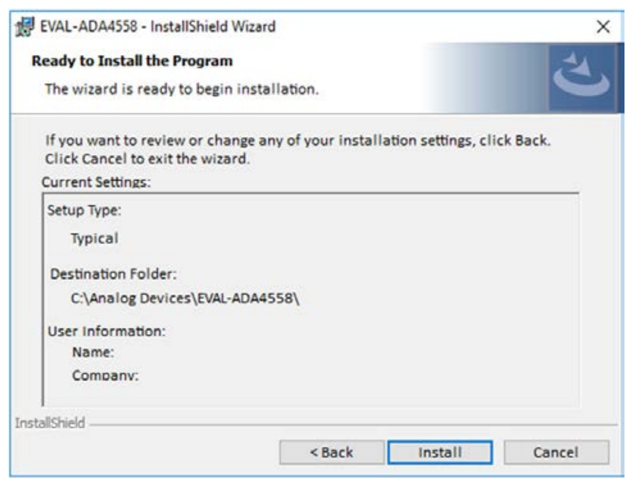

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Figure 4. EVAL-ADA4558EBZ Software Installation: Wizard Summary

6. When the installation completes, click **Finish** (see Figure 5).

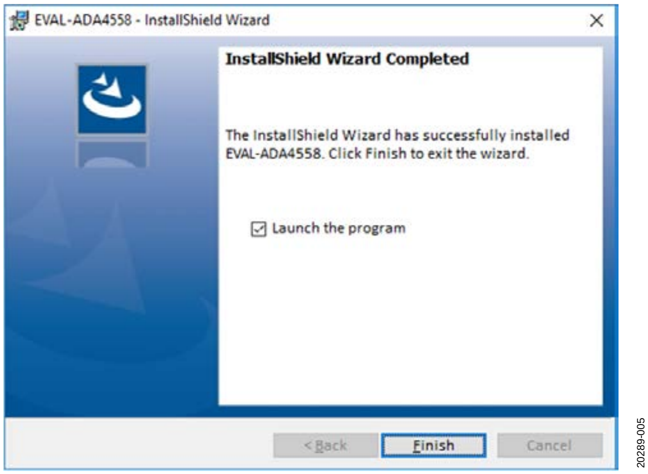

Figure 5. EVAL-ADA4558EBZ Software Installation: Installation Complete

Installing MATLAB Runtime (MATLAB Compiler)

The EVAL-ADA4558EBZ requires installing MATLAB Runtime (MATLAB Compiler), Version 7.14. Install and follow the on screen instructions on the MathWorks MATLAB Runtime page. Downloading the MATLAB software may require obtaining a user license from MATLAB.

EVALUATION BOARD SETUP PROCEDURES

USB Driver Installation

The EVAL-ADA4558EBZ USB serial port drivers are included in the Windows® operating system. Connect the EVAL-ADA4558EBZ USB port to the PC. When first connected to the PC, Windows installs the USB driver and assigns a COM port to the EVAL-ADA4558EBZ.

Warning

The USB drivers must be installed and a COM port must be assigned to connect the EVAL-ADA4558EBZ to the EVAL-ADA4558EBZ software.

Verify EVAL-ADA4558EBZ Connection

Take the following steps to verify that the EVAL-ADA4558EBZ is connected:

1. Allow the **Found New Hardware Wizard** to run after the EVAL-ADA4558EBZ board is plugged into the PC.
2. Check that the EVAL-ADA4558EBZ is connected to the PC correctly using the **Device Manager** of the PC.
   - Access the **Device Manager** as follows:
     - Press the Windows key and **X** together to open a list of operating system links.
     - Press **M** to open the **Device Manager**.
   - Under **Ports (COM & LPT)**, the **USB Serial Port** appears and the assigned COM port displays in parentheses.

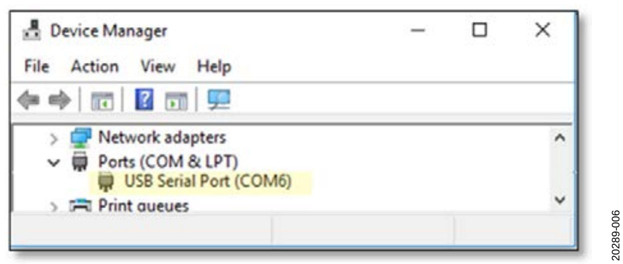

*Figure 6. **Device Manager**: Verifying EVAL-ADA4558EBZ Connection to PC*

EVALUATION BOARD HARDWARE

POWER SUPPLIES

The USB connector (P20) powers the EVAL-ADA4558EBZ. The 5 V USB powers the ADP1612 dc-to-dc converter (U12). U12 then outputs 12 V which supplies the ADA4558 and its components. Test Point TP20 can measure the 5 V USB input, and Test Point TP28 can measure the 12 V rail.

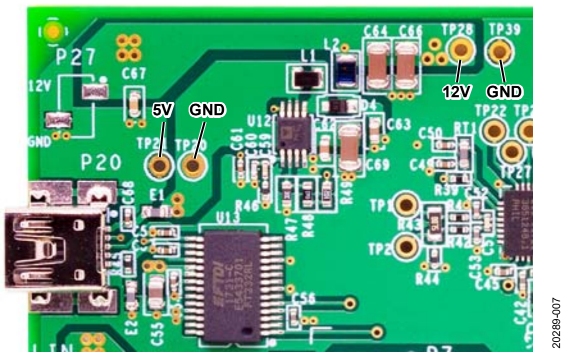

Figure 7. Power Supply

LIN COMMUNICATION SELECTION

Communication with the EVAL-ADA4558EBZ is via a LIN serial network protocol. The EVAL-ADA4558EBZ LIN pin is available at the screw terminal block (P9) for connecting to the LIN master. Figure 8 shows the LIN pin and GND pin used to connect the EVAL-ADA4558EBZ to its LIN master. The LIN2 pin is not used, and the 12V Out pin is an optional 12 V supply for external LIN tools.

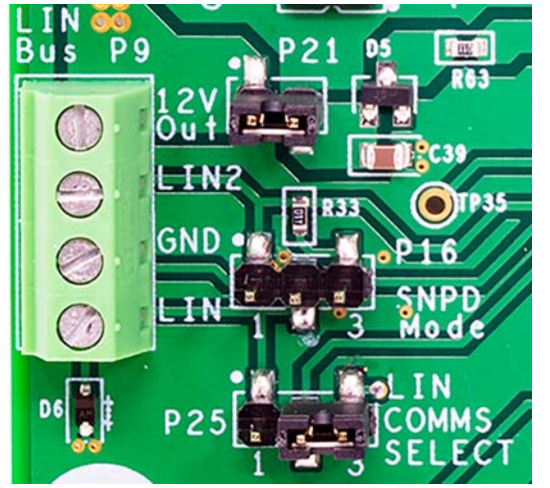

Figure 8. LIN Connector

For evaluation purposes, the EVAL-ADA4558EBZ includes the option of an on-board LIN master IC (U11, ADuCM331), which allows a quick setup for evaluating the ADA4558. The EVAL-ADA4558EBZ software interfaces to the on-board LIN master by the USB port and allows reading and writing access to the ADA4558. P25 allows the selection between an on-board LIN master or an external LIN master. Place a link between Pin 1 and Pin 2 of P25 to select the external LIN master or place a link between Pin 2 and Pin 3 of P25 to select the on-board LIN master. If there is no link at P25, the ADA4558 disconnects from both the external LIN master and the on-board LIN master. Note that P17 and S1 are a JTAG and reset button for the on-board LIN master (U11).

INPUT SIGNALS

The screw terminal blocks (P4 and P6) connect the sensor inputs as shown in Figure 9.

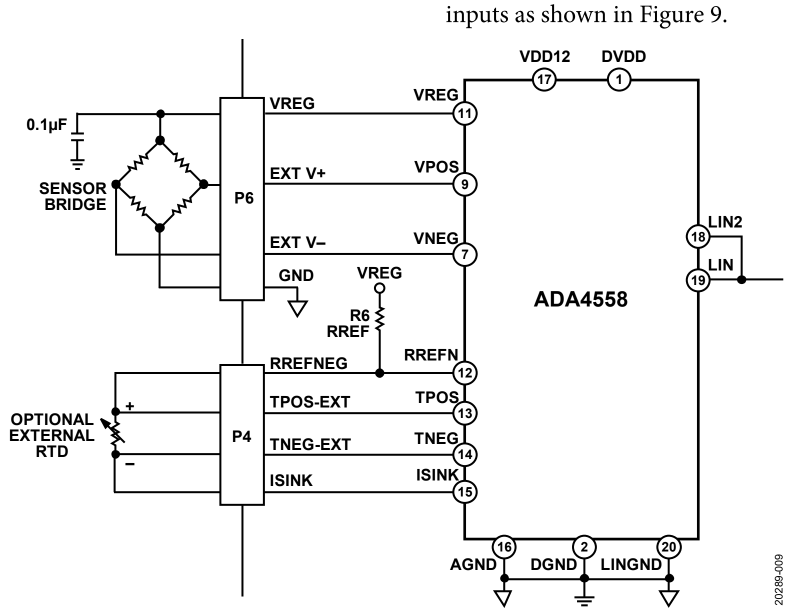

Figure 9. Input Signal Connection Diagram

Bridge Sensor Input

Use P6 to connect a bridge sensor to the EVAL-ADA4558EBZ. Figure 10 shows the following:

- The VReg pin is the 4 V excitation output from the EVAL-ADA4558EBZ, which is the supply to the bridge sensor.
- The EXT V+ pin is the positive differential input to the EVAL-ADA4558EBZ.
- The EXT V− pin is the negative differential input to the EVAL-ADA4558EBZ.
- The GND pin is the supply ground for the bridge sensor.

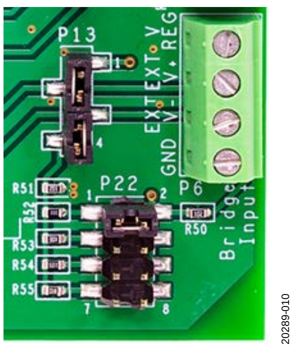

Figure 10. Bridge Sensor Input

For evaluation purposes, a resistor network is available to apply a known voltage to the EVAL-ADA4558EBZ bridge input signal. Place two links on P13 (Pin 1 to Pin 2 and Pin 3 to Pin 4) to enable the resistor network. Remove the two links to disable the resistor network. For resistor network selection, use P22 (see Figure 11).

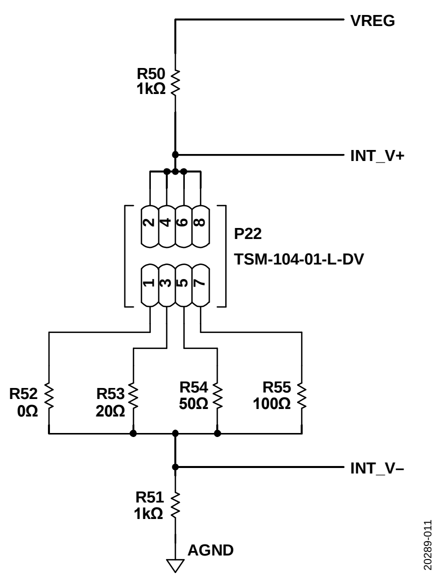

Figure 11. On-Board Test Resistors for the Bridge Sensor Input

Remote Temperature Sensor Input

Use P4 to connect a resistance temperature detector (RTD) to the EVAL-ADA4558EBZ. Figure 12 shows the following inputs for the EVAL-ADA4558EBZ:

- The RREFNEG pin is the sensing pin for the negative side of the reference resistor.
- The TPOS-EXT pin is the positive sensing pin for the RTD.
- The TNEG-EXT pin is the negative sensing pin for the RTD.
- ISink is constant current sink from the EVAL-ADA4558EBZ.

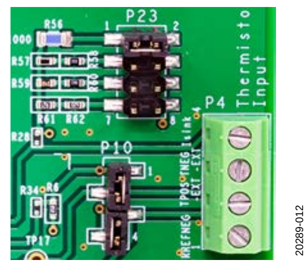

Figure 12. Remote Temperature Sensor Input

For evaluation purposes, a resistor network is available to apply a known voltage to the EVAL-ADA4558EBZ external temperature sensor input. Place two links on P10 (Pin 1 to Pin 2 and Pin 3 to Pin 4) to add the resister voltages to the TPOS-EXT and TNEG-EXT traces. Remove the two links to disconnect the resistor voltages from the external temperature sensor inputs. For resistor network selection, use P23 (see Figure 13).

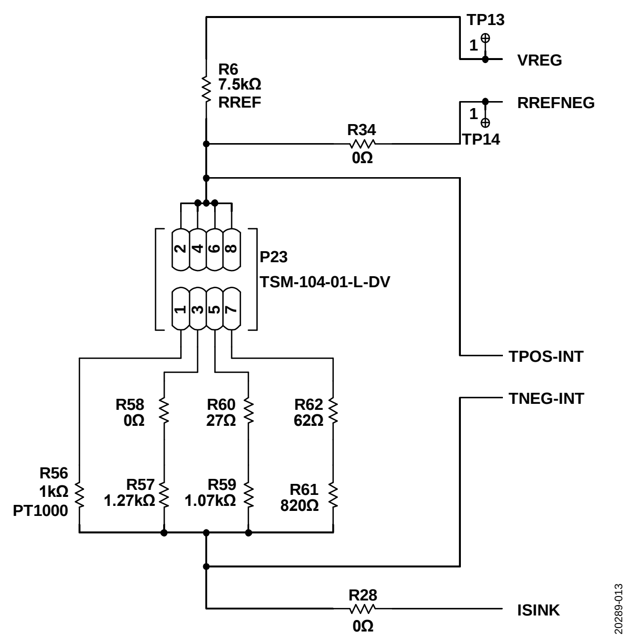

Figure 13. On-Board Test Resistors for the External Temperature Sensor Input

In Figure 13, TPOS-INT and TNEG-INT are the internal options that need to be switched by the links.

LINK CONFIGURATION OPTIONS

Multiple links options must be set to select the appropriate operating setup before using the EVAL-ADA4558EBZ. The functions of these link options are outlined in Table 1.

SETUP CONDITIONS

Before applying power and signals to the EVAL-ADA4558EBZ, ensure that all link positions are as required by the operating mode. The EVAL-ADA4558EBZ has two operating modes available: external LIN master or internal LIN master. Note that optional voltages can be applied to the sensor signal path.

Table 1 lists the default positions in which the links are set when the EVAL-ADA4558EBZ is packaged. When the EVAL-ADA4558EBZ ships, it has the on-board LIN master mode operating with a voltage signal applied to the signal input path.

Table 1. Link Option Functions

Link No.	Function	Default Position
P10	Enables or disables the on-board resistor network for the external temperature sensing input. Position A: two links are inserted connecting Pin 1 to Pin 2 and Pin 3 to Pin 4 and the on-board resistor network is connected to the external temperature traces, TPOS-EXT and TNEG-EXT. Position B: two links are removed and the on-board resistor network is disconnected from the external temperature traces, TPOS-EXT and TNEG-EXT.	A
P13	Enables or disables the on-board resistor network for the bridge sensing input. Position A: two links are inserted connecting Pin 1 to Pin 2 and Pin 3 to Pin 4 and connecting the on-board resistor network to the bridge sensing traces, EXT V+ and EXT V−. Position B: two links are removed and the on-board resistor network is disconnected from the bridge sensing traces, EXT V+ and EXT V−.	A
P16	SNPD mode. Unused option for the ADA4558. Position A: link inserted between Pin 1 and Pin 2 and configured for no SNPD input. Position B: link inserted between Pin 2 and Pin 3 and configured for SNPD input.	A
P19	GPIO5 of the on-board LIN master IC (U11). Controls startup sequence of U11. Position A: link inserted and connects GPIO5 to ground. Position B: link removed and disconnects GPIO5 from ground.	A
P21	Links in series with the supply to the ADA4558. Powers down the ADA4558 or measures the supply current to the ADA4558. Position A: link inserted and power applied to the ADA4558. Position B: link removed and power disconnected to the ADA4558.	A
P22	On-board test resistors network selection for the bridge sensor input. Position A: link inserted between Pin 1 and Pin 2 and connects a voltage across R52 to the bridge sensor input. For a value of 0 Ω, Position A simulates a balanced bridge signal indicating 0% signal and a differential voltage input of 0 V. Position B: link inserted between Pin 3 and Pin 4 and connects a voltage across R53 to the bridge sensing inputs. For the 20 Ω value, Position B simulates a 40 mV input to the bridge sensor input. Position C: link inserted between Pin 5 and Pin 6 and connects a voltage across R54 to the bridge sensing inputs. For the 50 Ω value, Position C simulates a 98 mV input to the bridge sensor input. Position D: Link inserted between Pin 7 and Pin 8 and connects a voltage across R55 to the bridge sensing inputs. For the 100 Ω value, Position B simulates a 190 mV input to the bridge sensor input.	A
P23	On-board test resistor network selection for the external temperature sensing input. Position A: link inserted between Pin 1 and Pin 2 and connects R56 (on-board PT1000) to the temperature sensing inputs. Position B: link inserted between Pin 3 and Pin 4 and simulates PT1000 resistance of 1.27 kΩ using R57 and R58. Position C: link inserted between Pin 5 and Pin 6 and simulates PT1000 resistance of 1.097 kΩ using R59 and R60. Position D: link inserted between Pin 7 and Pin 8 and simulates PT1000 resistance of 882 Ω using R61 and R62.	A

Link No.	Function	Default Position
P25	LIN communication selection. P25 defines which LIN master is connected to the ADA4558. Position A: link inserted between Pin 1 and Pin 2 and connects the external LIN master to the ADA4558 using P9. Position B: link inserted between Pin 2 and Pin 3 and connects the on-board LIN master to the ADA4558. Position C: link removed and disconnects the ADA4558 from both the external and on-board LIN master.	B
P26	P26 is the three ground pins for probing the evaluation board voltages. No links are inserted.	

MODES OF OPERATION

EVALUATING USING THE ON-BOARD LIN MASTER AND EVAL-ADA4558EBZ SOFTWARE

The ADA4558 uses a LIN serial network protocol interface to measure the bridge sensor signal and temperature sensor. The bridge sensor signal is linearized with temperature compensation. For more information about the operation of the LIN interface, refer to the ADA4558 data sheet and ADA4558 Hardware Reference Manual.

The EVAL-ADA4558EBZ uses the ADuCM331 LIN interface to transfer data to the EVAL-ADA4558EBZ USB port.

The EVAL-ADA4558EBZ software communicates with the EVAL-ADA4558EBZ USB port to allow read and write access to the ADA4558.

EVALUATING USING THE EXTERNAL LIN MASTER

The EVAL-ADA4558EBZ can also be connected to a target LIN master without the EVAL-ADA4558EBZ software. In this case, the EVAL-ADA4558EBZ is connected to the LIN 12 V serial interface using the P9 screw terminal block. For more information about the operation of the LIN interface, refer to the ADA4558 data sheet and ADA4558 Hardware Reference Manual.

HOW TO USE THE SOFTWARE

STARTING THE SOFTWARE

After completing the steps in the Evaluation Board Setup Procedures section, launch the EVAL-ADA4558EBZ software as follows:

1. Connect the EVAL-ADA4558EBZ to the PC and note the assigned COM port.
2. From the **Start** menu, select **Programs** > **Analog Devices** > **ADA4558**. The main window of the software then displays.
3. Set the **COM Port** setting to match the EVAL-ADA4558EBZ COM port and click **OPEN**. The main window then appears (see Label 1 in Figure 14).

OVERVIEW OF THE MAIN WINDOW

The main window of the software (see Figure 14) shows a block diagram and the wiring of the two input sensors. The ADA4558 block shows an overview of the calibration path where each sensor input channel has calibration settings for its analog front end (AFE) and its digital correction algorithm. The blue buttons within in the ADA4558 block provide a demonstration of the calibration procedure.

The LIN interface provides access to configure the ADA4558 and to read calibrated sensor measurements.

Hardware Connection Details

The **COM Port** section displays the connection status to the hardware (Label 1 in Figure 14).

LIN Signal Frames

The **LIN Signal Frames** buttons allow users to read measurements for the bridge sensor and the temperature sensor (Label 2 in Figure 14).

Memory Map View

The **Memory Map View** allows users to read and write to the EEPROM and system registers (Label 3 in Figure 14).

Master Request

The **Master Request** section displays the LIN header frame or diagnostic request frame for any communication sent from the LIN master to the ADA4558 (Label 4 in Figure 14).

Slave Response

The **Slave Response** section displays the signal frame response or the diagnostic response frame for any communication between the LIN master and the ADA4558 (Label 5 in Figure 14).

Bridge Sensor AFE Settings

The **Bridge Sensor AFE Settings** section demonstrates the AFE calibration procedure for the bridge sensor input (Label 6 in Figure 14).

Temperature Sensor AFE Settings

The **Temperature Sensor AFE Settings** section demonstrates the AFE calibration procedure for the external temperature sensor input (Label 7 in Figure 14).

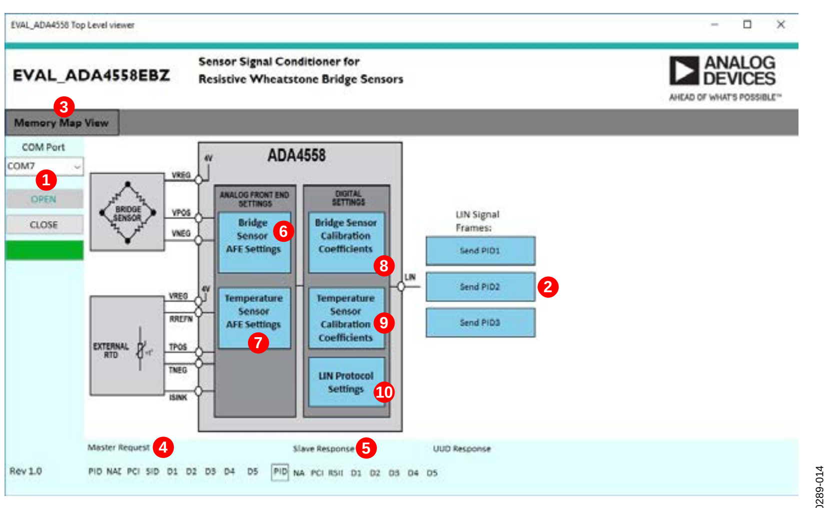

Figure 14. Evaluation Software Main Window

Bridge Sensor Calibration Coefficients Section

The **Bridge Sensor Calibration Coefficients** section demonstrates the calibration procedure for the nonlinearity of the digital correction of the bridge sensor with temperature compensation (Label 8 in Figure 14).

Temperature Sensor Calibration Coefficients

The **Temperature Sensor Calibration Coefficients** section demonstrates the digital calibration procedure for the temperature sensor (Label 9 in Figure 14).

LIN Protocol Settings

The **LIN Protocol Settings** section displays the node address and signal frame IDs used by the application for the LIN frame requests (Label 10 in Figure 14).

Exit the Software

Click **X** to close the software.

EVALUATION AND TESTING

SENSOR MEASUREMENTS USING THE LIN SIGNAL FRAMES

The **LIN Signal Frames** buttons (Label 2 in Figure 14) allow users to send LIN requests for measurement. The resulting measurements display as shown in Figure 15 where the value represents a hex number for the measurement ADC code.

By default, the EVAL-ADA4558EBZ is configured to measure the on-board test resistors for the bridge sensor input and external temperature sensor input, where the bridge sensor full-scale input is calibrated to 190 mV, and the external temperature is a PT1000 and calibrated for a full-scale range of −40°C to +150°C.

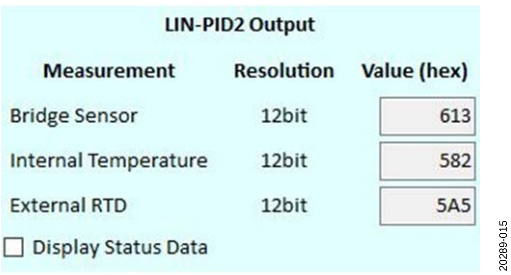

Figure 15. EVAL-ADA4558EBZ Software Signal Frame Measurements

The supported signal frames are listed as per the LIN signal frames button options. See the ADA4558 Hardware Reference Manual for further details on the supported signal frames. Selecting one of the **Send PIDx** buttons sends a signal frame using the settings in the **LIN Protocol Settings** box. If the signal frame PIDx matches the ADA4558 current EEPROM setting for the PIDx, the ADA4558 sends its signal frame response.

Check off the **Display Status Data** box to see the status flags. Figure 16 shows the available status flags and example data. See the signal frame descriptions table in the ADA4558 Hardware Reference Manual for further details.

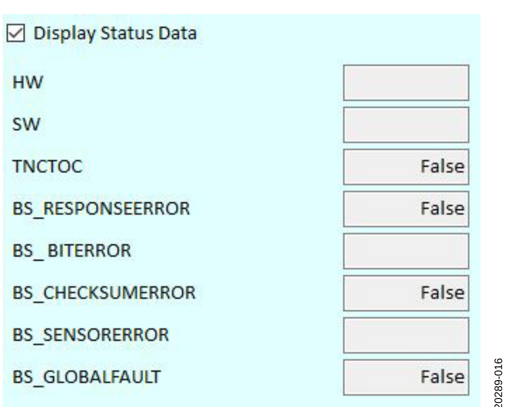

Figure 16. EVAL-ADA4558EBZ Software Signal Frame Status Flags

AFE CALIBRATION FOR THE BRIDGE SENSOR

The ADA4558 AFE must be calibrated with its bridge sensor connected before taking measurements. This section demonstrates the AFE calibration procedure to generate offset correction trims. The four calculated trims must be saved to the ADA4558 EEPROM. See Label 6 in Figure 14 for the **Bridge Sensor AFE Settings** button.

Configuration Mode

To enable configuration mode, send the configuration password frame followed by the configuration mode frame (see Figure 17).

To enable configuration mode, take the following steps:

1. Click **Send configuration mode password**.
2. Click **Enable Configuration Mode**.

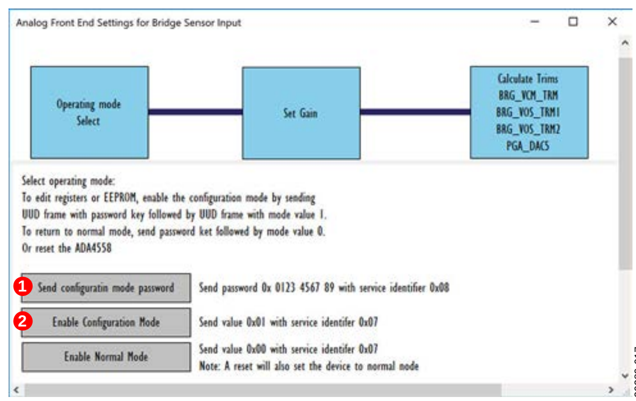

Figure 17. How to Set Configuration Mode in the ADA4558EBZ Evaluation Software

Set Gain

The ADA4558 provides 24 gain options for the bridge signal input. The **Set Gain** section shown in Figure 18 details the steps for selecting and programming the gain.

To select the gain value, take the following steps:

1. Click **Set Gain** (Label 1 in Figure 18).
2. Enter the voltage span of the bridge sensor in volts. The **Enter Sensor max voltage span** shows 0.06 V (Label 2 in Figure 18).
3. Under the **Select Gain** dropdown menu, select the highest gain value that remains green (see Figure 18).
4. Click **Write gain settings to EEPROM address 0x0B** (Label 3 of Figure 18) and verify that the **Write EEPROM Response** returns **Positive**.
5. Click **Write gain settings to System Register address 0xB1** (Label 4 of Figure 18) and verify that the **Write Sys Reg Response** returns **Positive**.

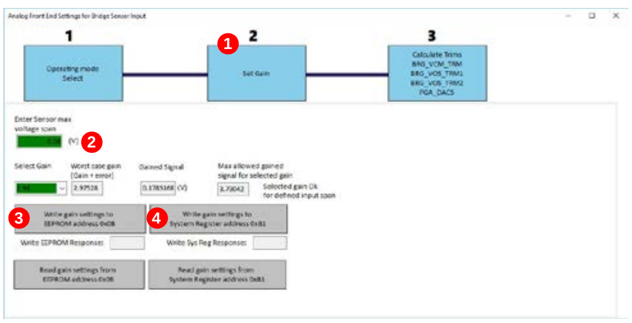

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Figure 18. How to Set Gain in the EVAL-ADA4558EBZ Software

AFE Trim Values

The ADA4558 provides trims to minimize the offset errors of the bridge sensor. To calculate the AFE trim values, take the following steps:

1. Connect the bridge sensor to the EVAL-ADA4558EBZ and apply a 0% signal for the bridge sensor.
2. To open the trim calculation page, click the **Calculate Trims** button (Label 1 in Figure 19).
3. Enter the target ADC code (Label 2 in Figure 19), which is the target ADC code for the input bridge signal of 0%. The recommended value is 1000 hex to allow for variations.
4. Click **Run Offset Correction sequence** (Label 3 in Figure 19) to run the trim calibration sequence and display this sequence in the text window. Note that the trim results display as a hex ADC code in the four text fields (VCM_TRIM, BRG_VOS1, BRG_VOS2 and DAC5). For further details on the calibration procedure, see the ADA4558 Hardware Reference Manual.
5. Click **Write trims to EEPROM address 9** (Label 4 of Figure 19) and verify that the **Write to EEPROM response** returns **Positive** (Label 5 in Figure 19).

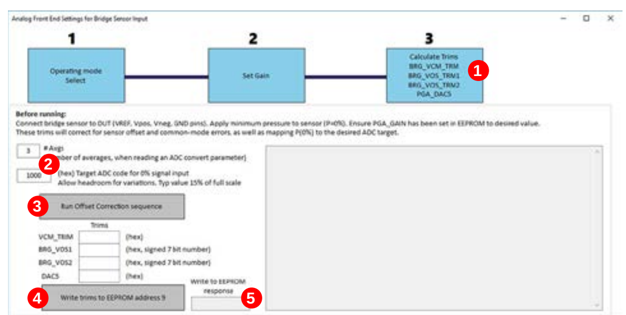

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Figure 19. How to Set AFE Trims in the EVAL-ADA4558EBZ Software

AFE Settings for the External Temperature Sensor

An external temperature sensor must be calibrated to maximize its ADC range. This section demonstrates the AFE settings to define the gain and current settings for a remote RTD. The selected settings must be written to the ADA4558 EEPROM. See Label 7 in Figure 14 for the **Temperature Sensor AFE Settings** button.

Take the following steps to define the AFE settings for the external temperature sensor:

1. Set the ADA4558 to configuration mode if not already enabled. Follow the same steps as those detailed in the Configuration Mode section.
2. To open the settings for the external temperature sensor, click **External Temperature Sensor Settings** (Label 1 in Figure 20).
3. Click **EXTTS_ISNK** (Label 2 in Figure 20) and set the sink current for the RTD. As a guideline, choose 1 mA for a PT100 or 0.2 mA for a PT1000.
4. Click and select the gains for the RTD by using the **EXTTS_TEMP_GAIN1** and **EXTTS_TEMP_GAIN2** dropdown menus (Label 3 in Figure 20).
5. Click and select the gains for the reference temperature sensing resistor by using the **EXTS_REF_GAIN1** and **EXTS_REF_GAIN2** dropdown menus (Label 4 in Figure 20). For examples of selecting gains, see the ADA4558 Hardware Reference Manual.
6. Click **Write external temperature setting to EEPROM address 12** and verify that the **write EEPROM response** returns **Positive** (Label 5 in Figure 20).
7. The EVAL-ADA4558EBZ operates from the system registers. Click **Write external temperature settings to system registers** to update the registers (Label 6 in Figure 20).

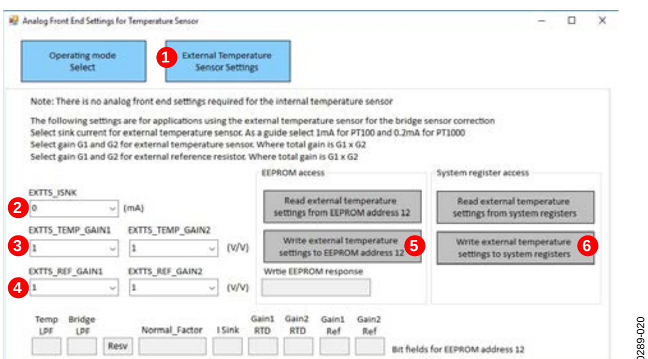


Figure 20. How to Set RTD Gain and Current in the ADA4558EBZ Evaluation Software

Note that the internal temperature sensor does not require AFE calibration.

BRIDGE SENSOR CALIBRATION FOR NONLINEARITY CORRECTION AND TEMPERATURE COMPENSATION

The ADA4558 digital block must be calibrated with its bridge sensor across the temperature and signal range of the sensor. This section demonstrates the coefficient calculation for the nonlinear correction algorithm. The calculated coefficients must be saved to the ADA4558 EEPROM. See Label 8 in Figure 14 for the **Bridge Sensor Calibration Coefficients** button.

Calibration data must be collected to adequately characterize the bridge sensor. The following example demonstrates how to collect measurements for six calibration points and to write these points to the calculator input file, **trim.dat**.

To collect calibration measurements for the bridge sensor nonlinear correction coefficient calculator, take the following steps:

1. Click **Collect data for correction coefficient calculator** (Label 1 in Figure 21).
2. Click **Select calibration line** (Label 2 in Figure 21) and select a line to log the measurements.
3. Enter the temperature to measure in degrees Celsius (°C) in the **Define calibration RTD point (C)** box (Label 3 in Figure 21).
4. Enter the bridge sensor signal level as a nominal scale from 0 to 10 in the **Define calibration Bridge signal, Nominal 0 to 10** box (Label 4 in Figure 21).
5. Apply the defined temperature and signal levels to the sensors and click **Read measurements** (Label 5 in Figure 21).
6. Repeat Step 2 through Step 5 to fill in the six lines of the calibration measurements.
7. Click **Write calibration data to trim.dat file** (Label 6 in Figure 21) to create the **trim.dat** file and overwrite any existing **trim.dat** files in the **\BridgeCalibration** subfolder.

Note that users can optionally click **Open trim.dat file** (Label 7 in Figure 21) to view the calibration file.

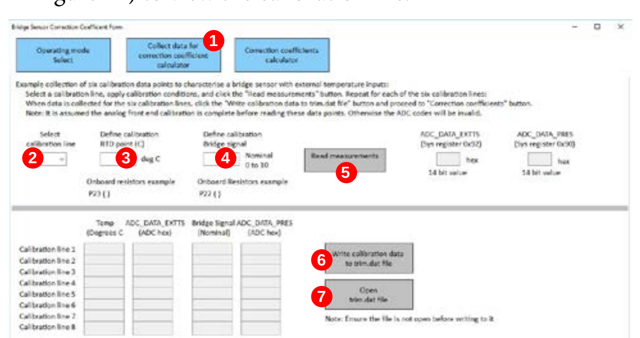
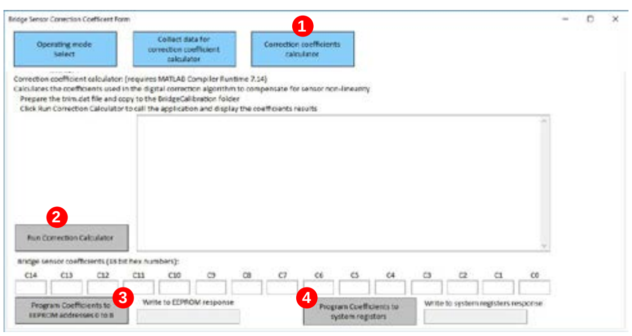


*Figure 21. Generate the **trim.dat** file for the Bridge Sensor Calibration*

Note that the calibration data must be collected for the bridge sensor connected and be available in the **trim.dat** file for the coefficient calculator. An example **trim.dat** file is provided for reference. The **trim.dat** file must be in the same subfolder as the calculator file, **ada4558_p_cal.exe**. This installation uses the **\BridgeCalibration** subfolder.

To calculate the bridge sensor correction coefficients, take the following steps:

1. Click **Correction coefficients calculator** (Label 1 in Figure 22).
2. Click **Run Correction Calculator** (Label 2 in Figure 22). The calculator is called and the progress displays in the main text box window. Once completed, the coefficient values (hex ADC codes) display in the 15 text boxes, **C0** through **C14** shown in Figure 22.
3. After the calculator completes successfully and displays the coefficients, click **Program Coefficients to EEPROM address 0 to 8** (Label 3 in Figure 22) and verify the **Write to EEPROM response** returns **Positive**.
4. The EVAL-ADA4558EBZ operates from the system registers. Click **Program Coefficients to system registers** to update the registers (Label 4 in Figure 22).



20289-022

Figure 22. Generate the Bridge Sensor Linearization Coefficients

Note that the user must validate any correction coefficients generated provided the required performance.

TEMPERATURE SENSOR CALIBRATION FOR THE ADA4558 DIGITAL BLOCK

The ADA4558 uses a temperature sensor to compensate for the bridge sensor signal dependences on temperature. An embedded temperature sensor or external RTD are supported. Define the temperature sensor for the correction algorithm and write any calibration coefficients to the ADA4558 EEPROM.

Bit 5 of EEPROM Address 13 defines the temperature sensor for the correction algorithm. Clear the bit to select the internal temperature sensor. Set the bit to select the external temperature sensor.

To define the selected temperature sensor, take the following steps:

1. Click **Temperature Sensor Calibration Coefficients** button (Label 9 in Figure 14).
2. Click **Temperature sensor channel select** to open the select temperature window (Label 1 in Figure 23).
3. Click **Select temperature sensor** (Label 2 in Figure 23) and choose either the internal or external temperature sensor.
4. Click **Write to EEPROM 0xD** (Label 3 in Figure 23) and verify that the **Write to EEPROM response** (Label 4 in Figure 23) returns **Positive**.

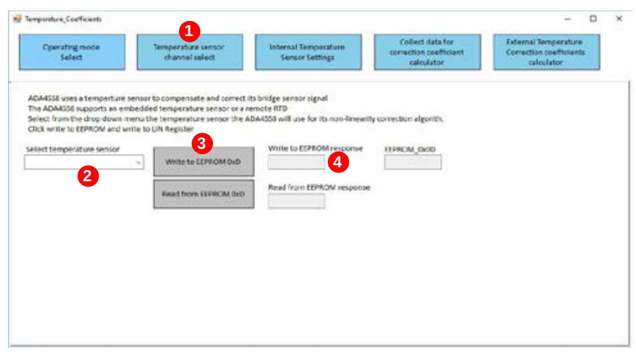


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Figure 23. Selecting the Temperature Sensor Channel

The external temperature sensor must be calibrated for use with the digital correction algorithm. The internal temperature sensor does not require calibration for the digital correction algorithm but can be calibrated for signal frame information.

Internal Temperature Sensor Calibration

The internal temperature sensor measurement can be calibrated to a 12-bit ADC code ranging from ADC Code 0 to ADC Code 4095, where ADC Code 0 is mapped to −40°C (or whatever is desired), and ADC Code 4095 is mapped to 150°C (or whatever is desired). The calibrated internal temperature ADC code is reported over the LIN signal frames.

To calibrate internal temperature measurements for LIN signal frames, take the following steps:

1. Click **Internal Temperature Settings** to open the calibration window for the internal temperature (Label 1 in Figure 24).
2. Enter the first calibration measuring point in degrees Celsius (°C) in the **Calibration Temp1 (C)** box (Label 2 in Figure 24).
3. Click **Read ADC_DATA_TEMP 1** (Label 3 in Figure 24).
4. Enter the second calibration measuring point in degrees Celsius (°C) to the **Calibration Temp2 (C)** box (Label 4 in Figure 24).
5. Click **Read ADC_DATA_TEMP 2** (Label 5 in Figure 24).
6. Enter the minimum temperature in degrees Celsius (°C) that ADC Code 0 can represent in the **Map Temp Min (C)** box (Label 6 in Figure 24).
7. Enter the maximum temperature in degrees Celsius (°C) that ADC Code 4095 can represent in the **Map Temp Max (C)** box (Label 7 in Figure 24).
8. Click **Calculate Coefficients** (Label 8 in Figure 24). The coefficient calculator is called and the result is displayed as hex numbers in the **INT_TCoeff0 [11:0]** and **INT_TCoeff1 [11:0]** boxes.
9. Click **Write to EEPROM** (Label 9 in Figure 24).

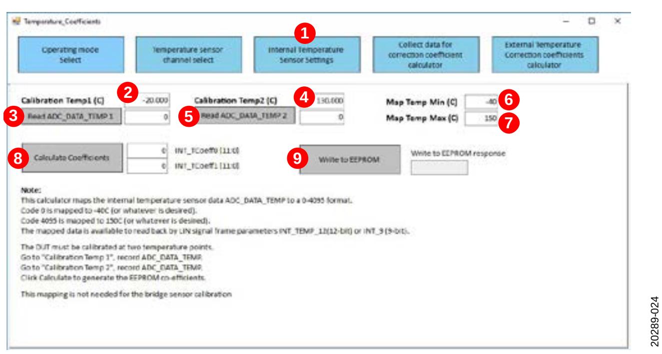

Figure 24. Calibration Window for Internal Temperature

External Temperature Sensor Calibration

To calibrate the external temperature sensor, take the following steps:

1. Click **Collect data for correction coefficient calculator** (Label 1 in Figure 25).
2. Click **select calibration line** (Label 2 in Figure 25) to define a calibration point.
3. Enter the current temperature applied to the RTD in the **Define calibration temperature point** box (Label 3 in Figure 25).
4. Enter the maximum and minimum temperature ranges in the **Define maximum temperature range** box and the **Define minimum temperature range** box (Label 4 in Figure 25).
5. Click **Read measurements** (Label 5 in Figure 25) for the measurements read to display on screen for the selected calibration line.
6. Collect three calibration points spread across the temperature range. Fill in the calibration lines (Label 6 in Figure 25) and then click **Write calibration data to trim.dat file** (Label 7 in Figure 25).

Users can optionally click **Open trim.dat file** (Label 8 in Figure 25) to view the calibration file for the calculator.

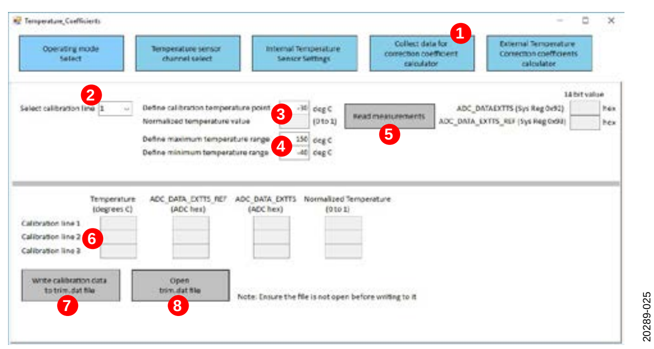

Figure 25. Collect Data for ***External Temperature Correction Coefficient Calculator***

To calculate the external temperature coefficients, take the following steps:

1. Click **External Temperature Correction coefficients calculator** to open the calibration window for the external temperature sensor (Label 1 in Figure 26).
2. Ensure a valid **trim.dat** file is placed in the same folder as the coefficient calculator, as per the **collect data for correction coefficient calculator** step (see Step 1 through Step 6 from the previous list). See the ADA4558 Hardware Reference Manual for further details on how to create the **trim.dat** file.
3. Click **Run** (Label 2 in Figure 26) and the coefficients display in the text boxes. A successful calculation displays the coefficients on screen.
4. Click **Write Ext. TS Coefficients to EEPROM** (Label 3 in Figure 26).
5. Enter the value for **TEMP_COEFF_K** and click **Write TEMP_COEFF_K to EEPROM** (Label 4 in Figure 26) and **Write TEMP_COEFF_K to system registers** (Label 5 in Figure 26) to program the memory. TEMP_COEFF_K adds an optional temperature offset. See the ADA4558 Hardware Reference Manual for further details.

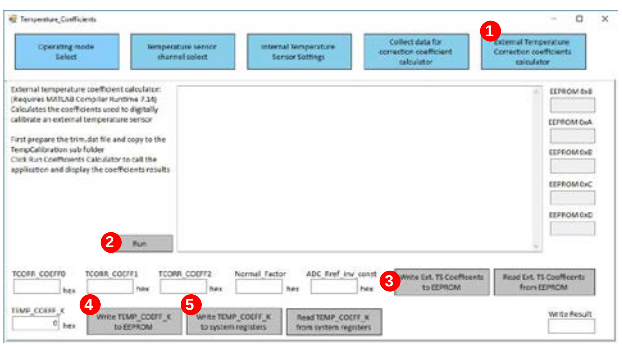

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Figure 26. Calibration Window for External Temperature

Note that the user must validate any correction coefficients generated provided the required performance.

LIN PROTOCOL SETTINGS

The LIN frames sent from the LIN master must match its corresponding settings in the ADA4558 EEPROM for it to respond. The **LIN Protocol Settings** section allows the user to define the **NAD** address and the signal frame ID numbers (see Figure 27). These values are used by the on-board LIN master when sending LIN requests to the ADA4558.

The default values for the EVAL-ADA4558EBZ follow:

- **NAD** = 1 (Label 1 in Figure 27)
- **ID for signal frame 1** = 1 (Label 2 in Figure 27)
- **ID for signal frame 2** = 2 (Label 2 in Figure 27)
- **ID for signal frame 3** = 3 (Label 2 in Figure 27)

The LIN frame header adds parity bits to the signal frame ID, and this protected ID also displays as PID1 to PID3.

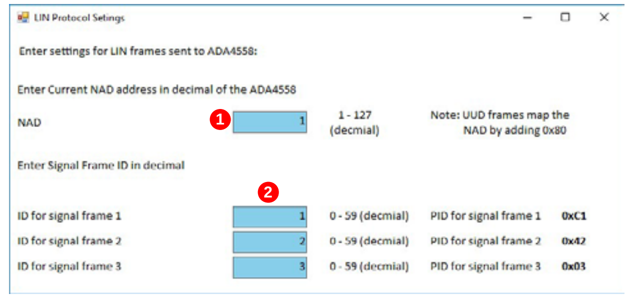

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Figure 27. LIN Protocol Settings

MEMORY MAP VIEW SECTION

The **Memory Map View** section allows users read and write access to system registers and EEPROM settings. The ADA4558 powers up in normal operating mode when configuration settings are loaded from the EEPROM to the system registers. The ADA4558 then proceeds to operate from the system registers.

System Registers

To access the system registers, take the following steps:

1. Select **System Registers Map** (Label 1 in Figure 28) to read or write to the system registers.
2. Click **Enable configuration mode** (Label 2 in Figure 28) to enable writing to the system registers.
3. Click **R** to read individual system registers and click **W** to write to individual system registers (see Figure 28). Click **Read all System Registers** (Label 3 in Figure 28) to read all values.

Refer to the ADA4558 Hardware Reference Manual for a description of each EEPROM or system register.

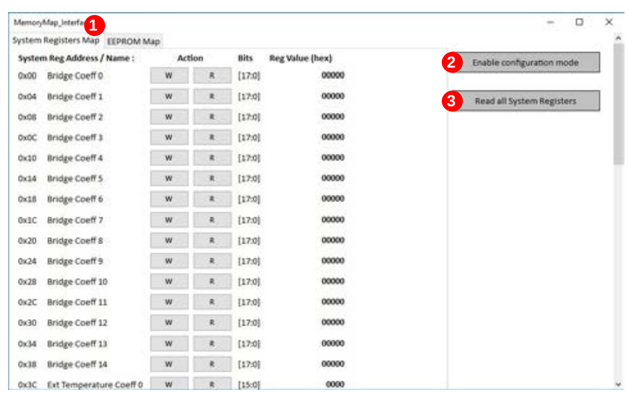

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Figure 28. System Registers Memory Map View

EEPROM Map

To access the EEPROM configurations, take the following steps:

1. Select **EEPROM Map** (Label 1 in Figure 29) to read or write to the EEPROM.
2. Click **Enable configuration mode** (Label 2 in Figure 29) to enable writing to the EEPROM.
3. Click **R** to read individual EEPROM addresses, and click **W** to write individual EEPROM addresses. Click **Read all EEPROM addresses from DUT** and **Write all EEPROM address to DUT** (Label 3 in Figure 29) to read or write to all EEPROM addresses. Click **Load EEPROM values from FILE** and **Write EEPROM values to FILE** (Label 4 in Figure 29) to read or write EEPROM values to file. This application uses the **EEPROM_Data.dat** file from the applications root folder. A sample file is supplied in the application folder with the default values.

Refer to the ADA4558 Hardware Reference Manual for a description of each EEPROM or system register.

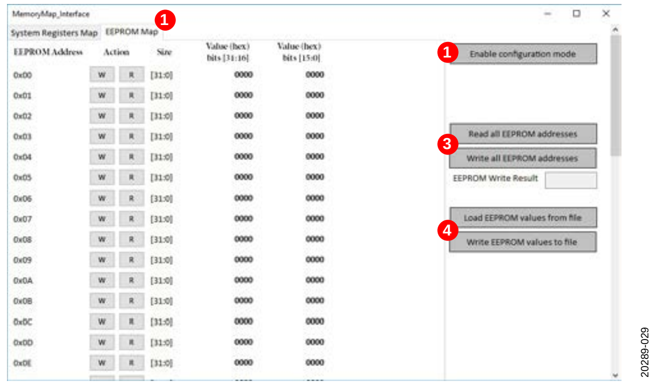

Figure 29. EEPROM Memory Map View

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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