

SETTING UP THE EVALUATION BOARD AS AN ENERGY METER

Figure 8 shows a typical setup for the ADE7913 evaluation board. In this example, an energy meter for a 3-phase, 4-wire wye distribution system is shown. Shunts are used to sense the phase currents and are connected as shown in Figure 8. The line voltages are connected directly to the board as shown. The board is supplied from one power supply provided by the PC through the USB cable.

Figure 9 shows a setup for the ADE7913 evaluation board as an energy meter for a 3-phase, 3-wire, delta distribution system. The Phase B voltage is considered as reference and the V1PIN test pins of Phase A and Phase C ADE7913 ADCs are connected to it.

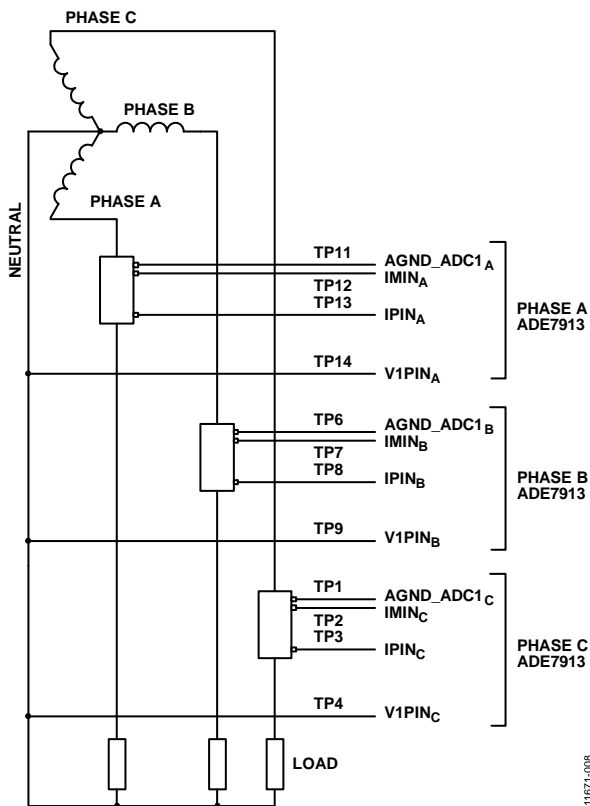


Figure 8. Typical Setup for the ADE7913 Evaluation Board for 3-Phase, 4-Wire, Wye Distribution System

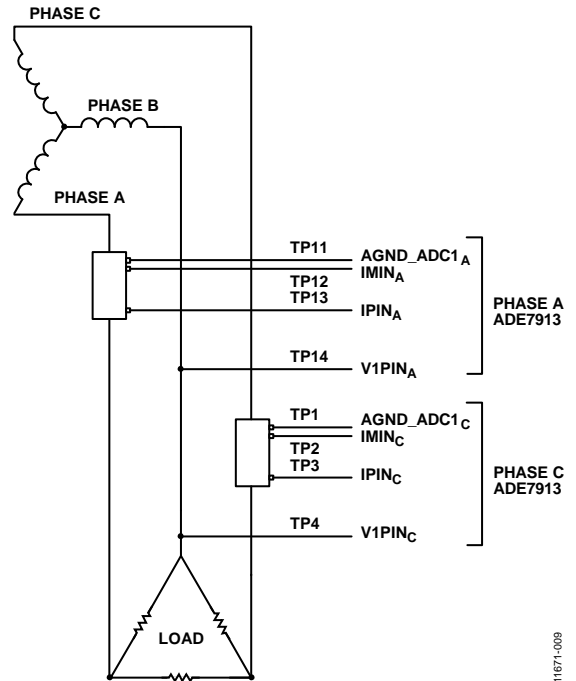


Figure 9. Typical Setup for the ADE7913 Evaluation Board for 3-Phase, 3-Wire Delta Distribution Systems

Using the Evaluation Board with Another Microcontroller

It is possible to manage the ADE7913 evaluation board with a different microcontroller mounted on another board. The evaluation board can be connected to this second board through the P5 connector. The SDP interface and the SDP Blackfin boards are, in this case, unused.

EVALUATION BOARD SOFTWARE

The [ADE7913](#) evaluation board is supported by Windows® based software that allows the user to access all the functionality of the [ADE7913](#).

The software communicates with the microcontroller placed on the interface board using the USB port. The software communicates with the SDP Blackfin board using the USB. The microcontroller communicates with the [ADE7913](#) ADCs placed on the evaluation board to process the requests that are sent from the PC.

IMPORTANT DISCLAIMER

The evaluation board contains three [ADE7913](#) ADCs, labeled Phase A [ADE7913](#), Phase B [ADE7913](#), and Phase C [ADE7913](#). The software can work with boards containing up to four [ADE7913](#) ADCs. For this reason, it contains settings referring to Phase N [ADE7913](#), the eventual fourth [ADE7913](#) (such as shown in Figure 16, for example). It is safe to disregard any warnings that may be generated stating that the Phase N [ADE7913](#) is not populated on board.

INSTALLING THE DRIVERS

When using the [ADE7913](#) evaluation tools for the first time, a driver must be installed to allow successful communication. The driver `SDPDriversNET.exe` can be found in the evaluation software package in the `SDP drivers` folder.

To install the driver, follow this procedure:

1. When the Setup Wizard appears, click **Next**, and follow the installation instructions.

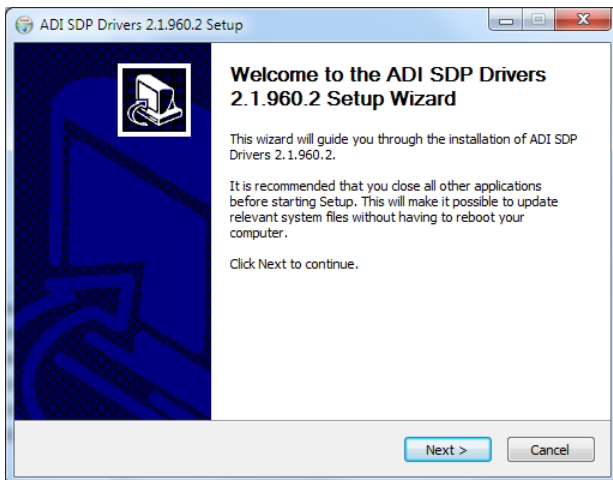


Figure 10. SDP Drivers Setup

2. When installation is complete, click **Finish** to close the window.

Connect the USB cable from the PC to the Blackfin SDP board. Windows detects the device and locates the correct driver automatically.

INSTALLING AND UNINSTALLING THE [ADE7913](#) SOFTWARE

The [ADE7913](#) software is supplied with the evaluation software package. It contains the LabVIEW™-based program that runs on the PC. This program must be installed.

Before using LabView 2010 on the PC for the first time, run an installer prior to executing the LabVIEW-based program. This installer is available in the `installation_files` folder. If a copy of LabView 2010 is available on the PC, the executable is provided in the `executable` folder. The LabView source files are provided in the `LabView_project\source` folder.

1. To install the [ADE7913](#) software, double-click `installation_files\setup.exe`. This launches the setup program that automatically installs all the software components, including the uninstall program, and creates the required directories.
2. To launch the software, go to the **Start/Programs/ADE7913 Eval Software** menu and click **ADE7913 Eval Software**.

Both the [ADE7913](#) evaluation software program and the NI run-time engine are easily uninstalled by using the **Add/Remove Programs** option in the control panel.

1. Before installing a new version of the [ADE7913](#) evaluation software, first uninstall the previous version.
2. Select the **Add/Remove Programs** option in the Windows control panel.
3. Select the program to uninstall and click the **Add/Remove** button.

FRONT PANEL

When the software is launched, the **Front Panel** is opened. This panel contains two areas: the main menu on the left, and a box that displays the name of the communication port used by the PC to connect to the interface port on the right (see Figure 11).

The software automatically detects the SDP Blackfin board. If the port detection is successful, the SDP label appears in the **IO Board** field, as shown in Figure 11.

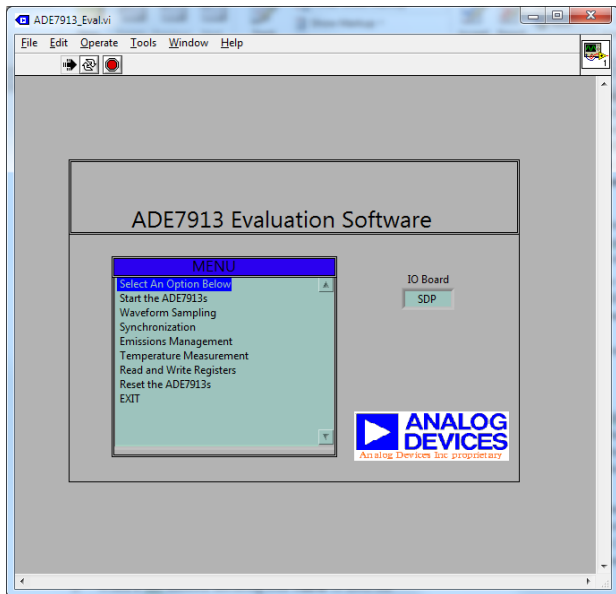


Figure 11. Front Panel of the [ADE7913](#) Software

Troubleshooting the COM Port Detection

If the software does not detect the SDP Blackfin board, the message shown in Figure 12 is displayed.

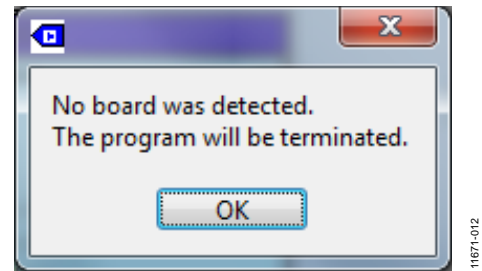


Figure 12. SDP Blackfin Board Not Detected Message

If this message appears, the following steps should be taken:

1. Click **OK** to terminate the program (see Figure 11).
2. Verify that the SDP Blackfin board is connected to the PC using the USB cable.
3. Ensure that the required drivers are installed as described in the Installing the Drivers section.
4. Using the **Device Manager** tool, ensure that the SDP Blackfin board was recognized by the PC and appears under the **ADI Development Tools** entry as **Analog Devices System Demonstration Platform SDP-B**.
5. Launch the [ADE7913](#) evaluation software once more.

EVALUATION SOFTWARE FUNCTIONS

The **ADE7913** evaluation software allows access to all registers and features of the **ADE7913**. The menu options available are

- Start the **ADE7913s**
- Waveform Sampling
- Synchronization
- Emissions Management
- Temperature Measurement
- Read and Write Registers
- Reset the **ADE7913s**
- EXIT (stops LabView)

The options provide access to all internal registers and allow the evaluation of the ADC performance. To access these functions, click the desired option in the **MENU** (see Figure 11).

Clicking an option in the **MENU** displays a window where the specific function can be accessed. Each window includes an **EXIT** button used to return to the main window.

Note that only one option from the **MENU** can be open at a time; click **EXIT** to return to the main window before choosing another option from the **MENU**.

START THE ADE7913

The **Start the ADE7913s** window is shown in Figure 13. The Phase A **ADE7913** is clocked from a 4.096 MHz crystal. It then generates clock output to the other Phase B and Phase C **ADE7913** ADCs at its CLKOUT pin. The software automatically sets the Phase A **ADE7913** to generate clock output and start all three **ADE7913** ADCs with the following default settings:

- ADC output frequency set at 8 kHz. Note that in order to ensure complete coherency of the waveform samples coming out from all three ADCs, this output frequency should be the same on all ADCs.
- The bandwidth of the digital low-pass filter of the ADC is set at 3.3 kHz.
- The third ADC measures the auxiliary voltage instead of the temperature sensor.
- The Phase C **ADE7913** generates a $\overline{\text{DREADY}}$ signal at its CLKOUT/DREADY pin. This signal is used by the microcontroller as an external interrupt to start the acquisition of coherent waveform samples from all **ADE7913** ADCs populating the evaluation board.

If different settings are desired, select them from the boxes in the upper half of the window. Then, click **START PHASE A ADE7913 FIRST** to update the Phase A **ADE7913**.

Note that the Phase A **ADE7913** clocks the other **ADE7913** ADCs populating the evaluation board by enabling CLKOUT functionality at the CLKOUT/DREADY pin (Bit 0, CLKOUT_EN, in the CONFIG register set to 1). Always enable CLKOUT if functional Phase B and Phase C **ADE7913** ADCs are required for evaluation.

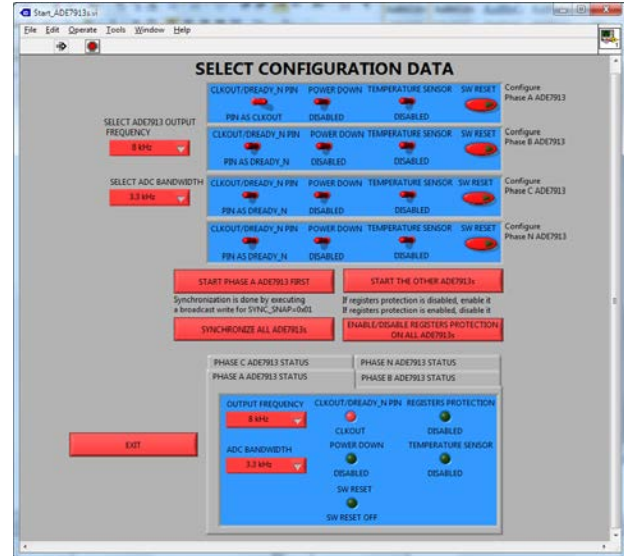


Figure 13. Start the **ADE7913s**

After the Phase A **ADE7913** is started correctly, click **START THE OTHER ADE7913s** to configure the other **ADE7913** ADCs on the evaluation board.

SYNCHRONIZE ALL ADE7913s executes a broadcast write to the SYNC_SNAP register equal to 0x01 to synchronize all **ADE7913** ADCs of the evaluation board.

ENABLE/DISABLE REGISTERS PROTECTION ON ALL ADE7913s manages the registers protection of the **ADE7913** ADCs. If at least one **ADE7913** has the registers protected, then pressing this option disables the protection by executing a broadcast write to the Lock register equal to 0x9C. If all **ADE7913** ADCs have the registers unprotected, then pressing this option enables the protection by executing a broadcast write to Lock register equal to 0xCA. Note that when the registers are protected, no register can be further written until the protection is disabled. It is therefore recommended to evaluate the **ADE7913** ADCs while maintaining the registers protection disabled.

The bottom half of the window is composed by stacked windows, each showing the configuration settings of each **ADE7913**.

WAVEFORM SAMPLING

The Waveform Sampling window is shown in Figure 14. It provides full access to the ADC outputs (waveforms) of the ADE7913 ADCs that populate the board.

1. Enter an acquisition time (**ACCUMULATION TIME**) expressed in milliseconds.
2. Select the ADE7913 ADCs to be analyzed by checking the **A**, **B**, and **C** boxes. Leave the **N** box unchecked because the ADE7913 evaluation board contains only three ADE7913 ADCs.
3. Select **START ANALYSIS**.

The SDP Blackfin board acquires the waveform samples using the Phase C ADE7913 DREADY signal as an interrupt. The green bar under the plot shows the acquisition progress. A box under the **START ANALYSIS** button selects which waveform is visualized in the plot. By default, all the waveforms acquired from all ADE7913 ADCs selected for analysis are displayed.

- For single waveform visualization, select the desired waveform under **SELECT WAVEFORMS**.
- For multiple waveform visualization, select the desired waveforms under **SELECT WAVEFORMS** while pressing the CTRL key.

To write the waveforms into files,

1. Select the folder for file storage (**SELECT FOLDER**).
2. Select **WRITE WAVEFORMS TO FILES**.

The program stores every waveform into a file called Waveform_sample_X.dat, where X is a number between 0 or 8. The order of the waveforms listed in the **SELECT WAVEFORMS** box is reflected in the file name identification number. As the default selects all waveforms to be acquired, Waveform_sample_0.dat contains Phase A current waveform, Waveform_sample_1.dat contains Phase A voltage 1 waveform, Waveform_sample_2.dat contains Phase A voltage 2 waveform, and so on.

The plot always visualizes 100 ms worth of waveform samples. If the acquisition time is greater, a scroll bar below the plot allows the visualization of an additional 100 ms periods.

A Fourier analysis of the acquired waveforms may be enabled by changing the position of the **SELECT ANALYSIS** switch. In this case, the window shown in Figure 15 is enabled. Only one waveform at a time is visualized in the plot.

The type of windowing may be selected: **Hanning**, **Blackman-Harris**, or **none**.

Various **FFT Settings** may be selected: 0 dB level reference may be at the signal peak, the theoretical maximum, or at a manual entry. When selecting **Signal Peak**, the plot uses the amplitude of the maximum peak of the waveform as the 0 dB level and writes it in the **Manual** entry box.

Other selection include the **Bandwidth** under analysis (default is between 10 Hz and 4000 Hz), the **Fundamental Frequency**

(the default is 50 Hz), the width of the FFT bins, **Fund/Harm Sideband Bins**, (the default is 10 Hz), and the **Number of Harmonics** used in the ADC specifications visualized under the plot (default is 6).

When the FFT plot is visualized, the program calculates and visualizes the following ADC specifications:

- **SNR** (signal-to-noise ratio)
- **THD** (total harmonic distortion)
- **SNDR** (signal-to-noise and distortion ratio)
- **SFDR** (spurious-free dynamic range)
- **Signal** (rms of the fundamental component)
- **Noise** (rms of the noise)
- **Harmonics** (rms value of all harmonics)

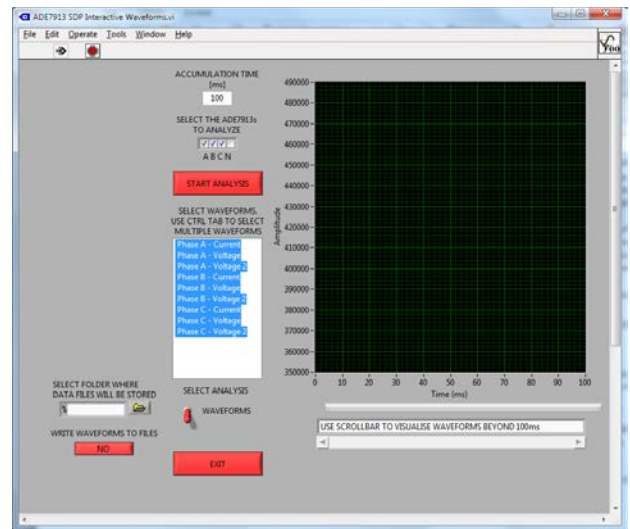


Figure 14. Waveform Sampling

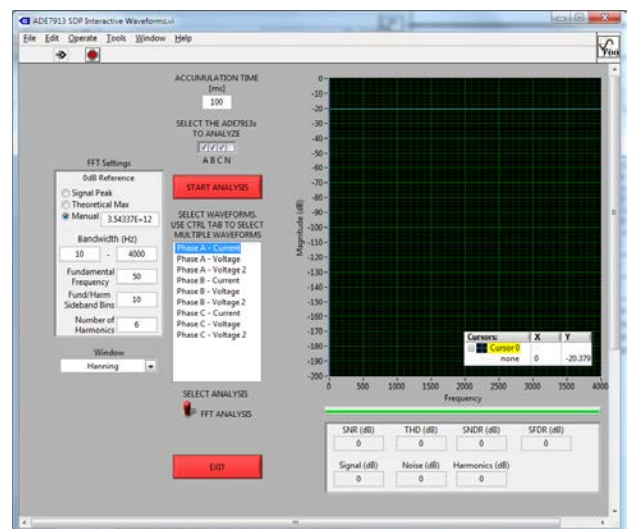


Figure 15. Fourier Analysis

SYNCHRONIZATION WINDOW

The Synchronization window is shown in Figure 16. It manages the synchronization process of all ADE7913 ADCs populating the board.

SYNCHRONIZE ALL ADE7913s executes a broadcast write to the SYNC_SNAP register equal to 0x01 to synchronize all ADE7913 ADCs of the evaluation board.

Another second synchronization method uses the internal counters of every ADE7913 to synchronize them. When pressed, **LATCH AND READ ADE7913s INTERNAL COUNTERS** broadcasts a write to the SYNC_SNAP register equal to 0x02, latching the counters and then visualizing them into the CNT_SNAPSHOT boxes. The software then uses the counter of the ADE7913 used to generate DREADY interrupts as a reference to calculate corrections values for each counter.

SYNCHRONIZE ALL ADE7913s BY WRITING ADE7913s INTERNAL COUNTERS then writes new values into the internal counters of each ADE7913, synchronizing all ADE7913 ADCs.

LATCH AND READ ADE7913s INTERNAL COUNTERS can then be used to read again the internal counters to verify the achieved synchronization degree.

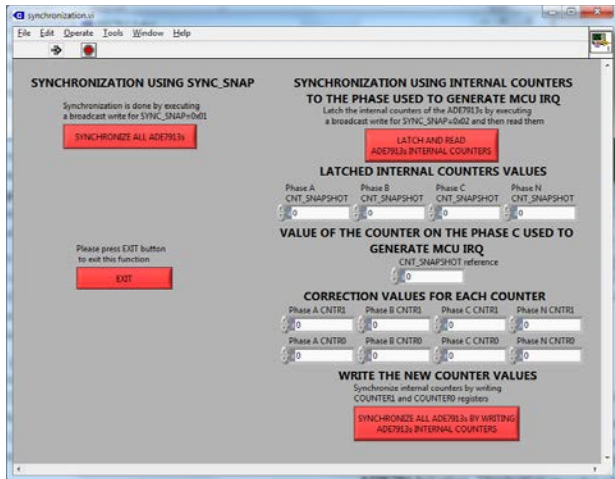


Figure 16. ADE7913s Synchronization

EMISSIONS MANAGEMENT

The Emissions Management window is shown in Figure 17. It manages the EMI_CTRL register that controls the isolated dc-to-dc converter integrated in the ADE7913 ADCs.

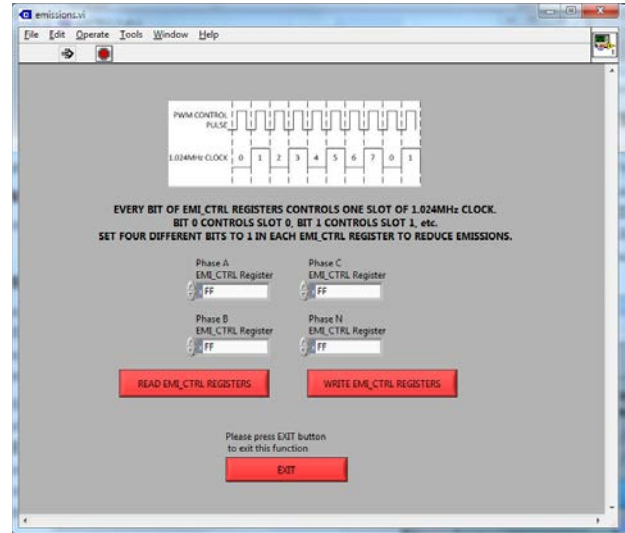


Figure 17. Emissions Management

The window displays a picture showing the relation between the bits of the EMI_CTRL register, the 1.024 MHz clock, and the PWM control pulses. In the middle section of the window, the program can read and write the EMI_CTRL registers of all ADE7913 ADCs populating the evaluation board.

Initialize the Phase A ADE7913 EMI_CTRL register as follows for best emissions performance:

- EMI_CTRL_A to 0x55
- EMI_CTRL_B to 0xAA
- EMI_CTRL_C to 0x55
- EMI_CTRL_N to 0xAA

TEMPERATURE MEASUREMENT

The Temperature Measurement window is shown in Figure 18. The left half of the window selects the temperature sensor measurement on each ADE7913. The **Temperature Offset** boxes display the content of the TEMPOS register of each ADE7913.

After selecting the temperature sensor, press **WRITE CONFIG REGISTERS** to write the new selection into the CONFIG registers. **READ CONFIG REGISTERS** reads the CONFIG registers and visualizes the state of Bit 3 (TEMP_EN) into the temperature sensor selection switch and the CONFIG register value into the boxes at the bottom of the window.

READ V2WV REGISTER reads the V2WV registers of each ADE7913 and displays its content into the V2/Temperature reading boxes. The software computes the temperature in °C and displays it in the **Temperature [deg C]** boxes on the right side of the window.

The **Temperature Gain Correction (FP)** and the **Temperature Offset Correction** factors are introduced in floating point format into the boxes placed on the lower left side of the window. They are used by the software to compute the temperature of each ADE7913.

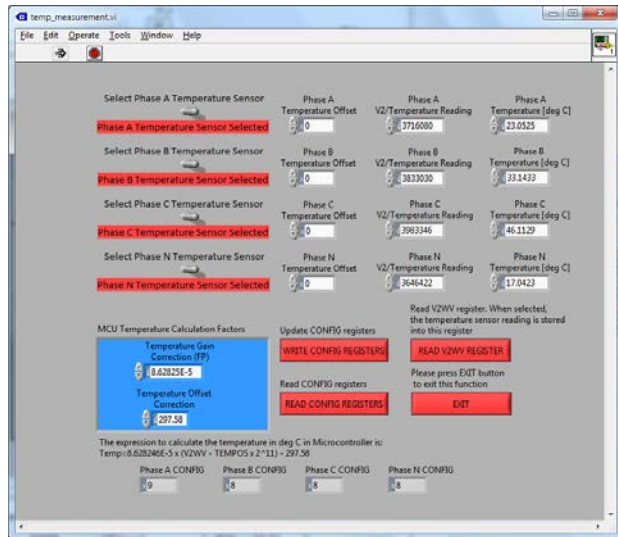


Figure 18. Temperature Measurement

READ AND WRITE REGISTERS

The **Read and Write Registers** window is shown in Figure 19. Every register of each ADE7913 populating the board can be accessed using the boxes beneath **Identify which ADE7913 to access** and then clicking **WRITE** or **READ**.

The registers can be accessed by name or address using the **Register Identification Criteria** switch.

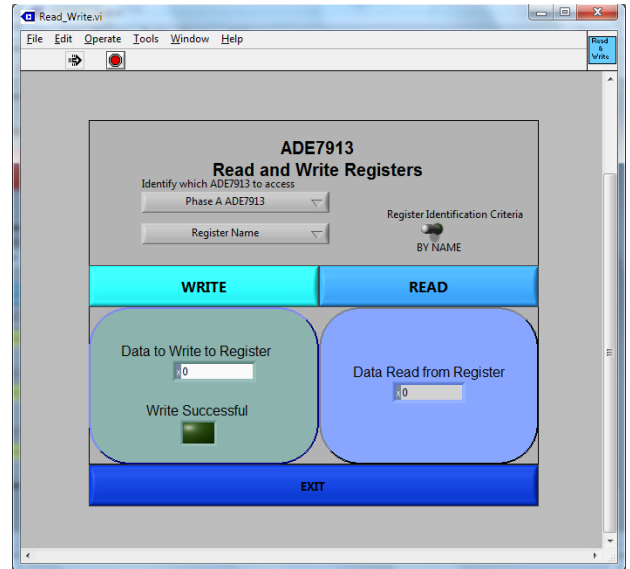


Figure 19. Read and Write Registers

RESET THE ADE7913

The **Reset the ADE7913s** window is shown in Figure 20.

Use **SELECT ADE7913 TO RESET** to select which **ADE7913** to reset. An individual **ADE7913** or all **ADE7913** ADCs may be selected. **RESET** then resets the selected **ADE7913** by writing 10 bytes with a value of 0x00 at Address 0x00.

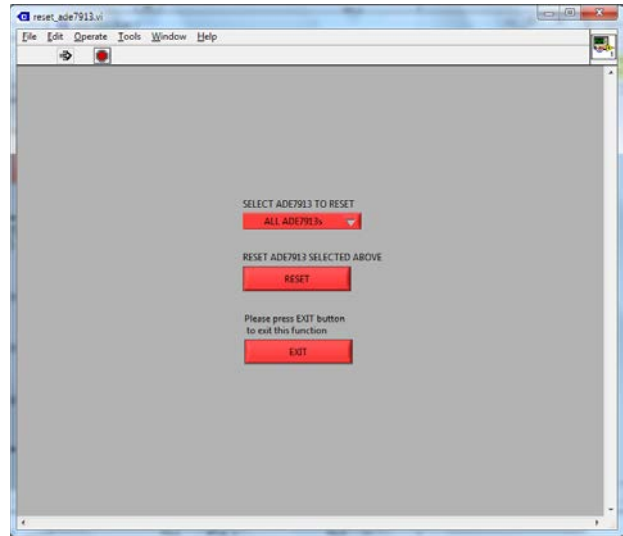


Figure 20. Reset the **ADE7913s**

NOTES

NOTES

**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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