

# **User Guide for ADE9178EVKIT SW**

Energy Metering IC Firmware

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The ADE9178EVKIT SW is supported by Windows® based software that allows the user access all the functionality of the ADE9178. The ADE9178EVKIT SW runs on the PC and communicates with MAX32625PICO via USB, which in turn, communicates with the ADE9178 on the [ADE9178EVKIT](#) to process requests.

# 1 Getting Started

## 1.1 Installing the ADE9178EVKIT Software over

To set up the ADE9178EVKIT SW, install the following:

- [LabVIEW Runtime 2019 SP1 f3 \(64-bit\)](#)<sup>1</sup>
- [NI-VISA Runtime 23.5](#)<sup>2</sup>

### 1.1.1 ADE9178EVKIT SW

1. Download the ADE9178EVKIT SW installer from [product page](#).<sup>3</sup>
2. Run the ADE9178EVKIT SW installer executable (.exe) file.
3. Follow on-screen instructions to complete the installation.

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<sup>1</sup> <https://www.ni.com/en/support/downloads/software-products/download.labview-runtime.html#348045>

<sup>2</sup> <https://www.ni.com/en/support/downloads/drivers/download.ni-visa.html#521671>

<sup>3</sup> <https://www.analog.com/en/products/ade9178.html#part-details>

## 2 Using the ADE9178EVKIT SW Software

Start by opening the software from Start > Analog Devices > ADE9178EVKIT SW or C:\Program Files\Analog Devices\ADE9178EVKIT SW and launch it. The dashboard shown in figure 1 pops up.

### 2.1 Dashboard

The dashboard shown in figure 1 allows users to connect the software to the hardware and to launch various tools as follows:

1. Identify the COM port associated with [ADE9178EVKIT](#) and then select the COM Port available in the dropdown list. If there is no COM port in the list, click refresh button.
2. Click "Connect" button to establish the connection with [ADE9178EVKIT](#).
3. Once connected, the LED indicator on the dashboard will turn green. This indicates a successful connection.
4. Double-click any of the items on the panel to launch it
5. Click this button to disconnect the [ADE9178EVKIT](#).

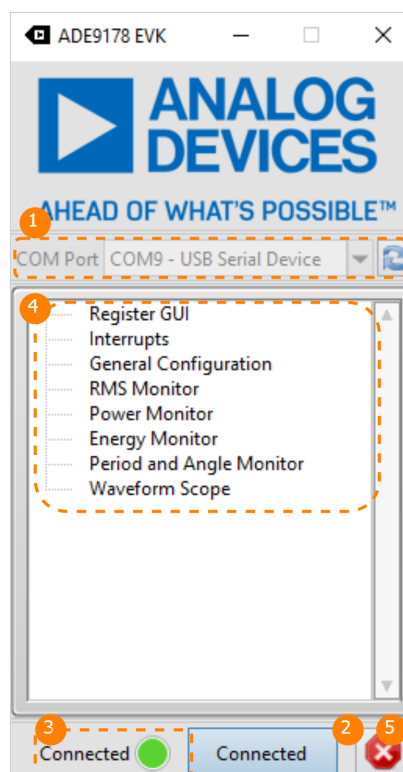


Figure 1 Dashboard

## 2.2 Register Graphical User Interface (GUI)

The Register GUI tool allows user to read from and write to any of the user-accessible registers in the ADE9178 and ADE9113s.

The panel has three distinct section; Find, Interact, Scripting/Documentation



### Note

The top nibble of the address serves as a phase offset, and only the bottom byte represents the actual address of the ADE9113 register, meaning that addresses starting with 0x1xx belong to Phase A, addresses starting with 0x2xx belong to Phase B, and so on.

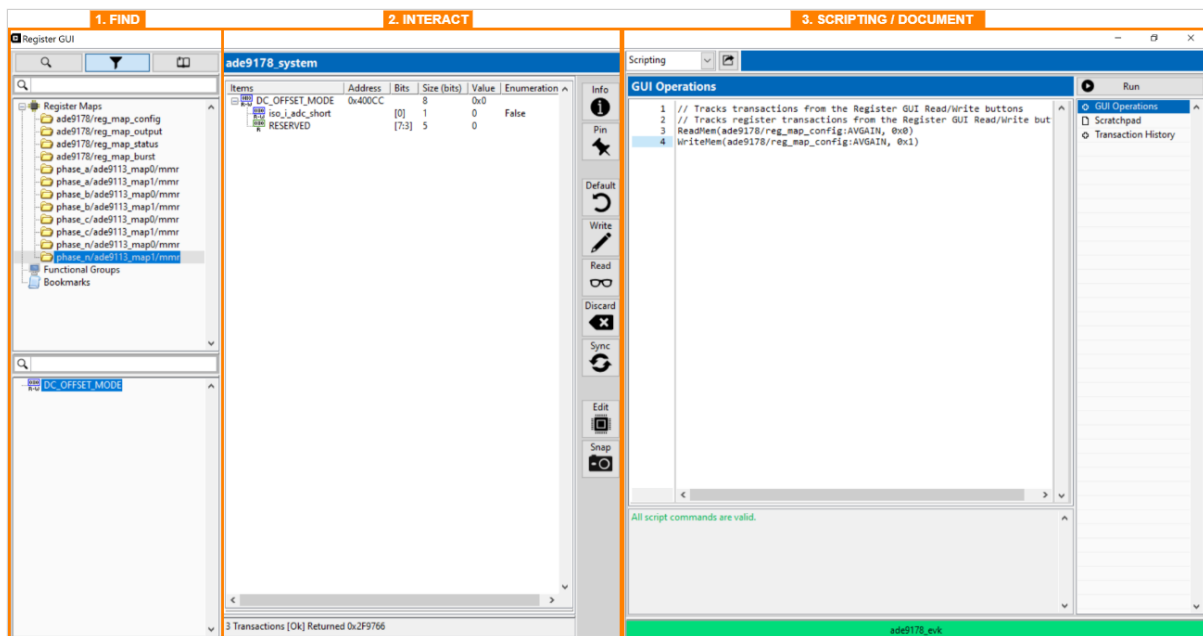


Figure 2 Register GUI

### 2.2.1 Find Section

This section shows the register maps and bookmarks on the top, and the registers in the selected map at the bottom.

#### 2.2.1.1 Searching

For searching, go to the Find section for a few ways to filter through the register map:

- Use the two search bars in the Find section for quick navigation. The Tab and Shift + Tab shortcuts can be used to switch between the search bars.
- To search the entire register map for all four phases, launch the Search dialog from the top left corner of the Find section. This feature supports regular expressions too.

### 2.2.1.2 Select multiple registers

To select multiple registers together use the standard Ctrl+Left Click and Shift + Left Click shortcuts while clicking on the registers to select and display them in the Interact section together.

### 2.2.1.3 Bookmarks

Bookmarks allow you to group registers together for simple access and interaction as follows:

1. To bookmark registers, select them in the Find section, then right-click, and select Add selected bookmarks.
2. To see all the bookmarked registers together click Bookmarks in the Find section.
3. The current visible registers can be filtered to show just the bookmarked ones by clicking on the Filter Bookmarks button in the top-right corner of the Find section.

## 2.2.2 Interact Section

This section displays information about the selected registers and provides controls to interact with these selected registers.

### 2.2.2.1 Reading and writing registers

1. Select the register you want to interact with in the Find section. The icons next to the register names convey the access permission: red is write only, blue is read and write, and green is read only.
2. To read, click the "Read" button or press F5.
3. To write, double-click on the Value field, enter the desired value, and click the "Write" button or Press F2. To see other Write options, right-click the button.
4. Click the "Edit" button to access a more visual way of doing a read or a write. Note that if a value or name is in bold and/or has an asterisk next to it, it means that it has been modified in the panel but not written to the device. All panels are updated whenever a read is executed, but values in registers may have changed between reads.



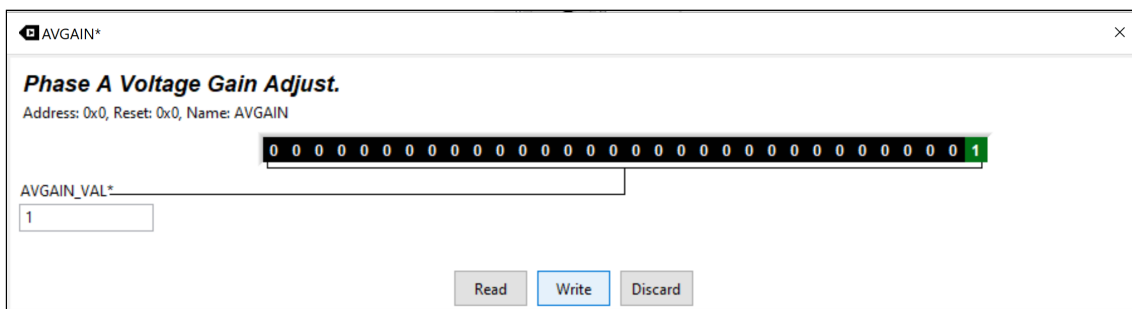


Figure 3 Edit Page after clicking 'edit' button in Register GUI

#### 2.2.2.2 Pinning

Pining allows multiple registers to permanently stay in the Interact section of the window.

1. To pin multiple registers within the same register map, select the registers as previously explained in Step 2, and then click the Pin icon.
2. To pin registers from multiple register maps, take the following steps:
  - a. Pin registers from one register map, as described in Step 4, a.
  - b. Select registers from another register map. The previously pinned registers as well as the newly selected registers are now shown in the Interact section of the window.
  - c. Click the Pin icon to unpin all registers.
  - d. Click the Pin icon again, which now pins all registers currently in the Interact section of the window.
  - e. Repeat Step b through Step d with as many other register maps as needed.

### 2.2.2.3 Snap

Snapshots use the Snapshot UI Manager to save register values in a file and apply the registers at a later time (see Figure 4).

1. Save to a file as follows:
  - a. Select the registers you would like to save.
  - b. Click Snap to launch the Snapshot UI Manager, and then click Take Snap.
  - c. If needed, add comments and rename the file by changing the Snapshot Name and then clicking Rename Memory.
  - d. Click Save to File to save the snapshot as a .snpsht file in C:\Users\\Documents\LabVIEW Data\cfg\Snapshot Files.



To take a snapshot of all registers belonging to all phases, use Shift + Left Click to select all register maps, and then Shift + Left Click to select all registers. This process brings all the registers to the Interact section. Now, follow Step 6a2 through Step 6a4 to take a snapshot

- 2. To write from a file, take the following steps:
  - a. Click Snap to launch the Snapshot UI Manager.
  - b. Select the desired snapshot file, and then click Apply

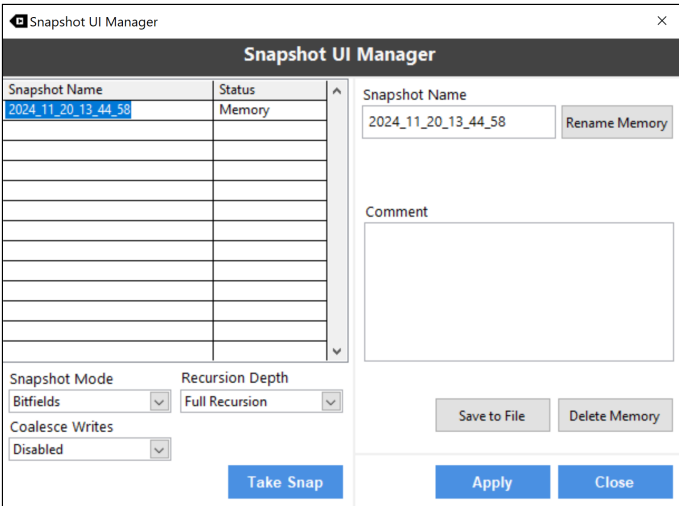


Figure 4 Snapshot UI

2.2.3 Scripting/Documentation Section

This section allows users to interact with the registers using scripts or display information about the registers.

2.2.3.1 Scripting

Script-based interaction is found in the Scripting section and allows text-based interaction with the registers via the four tabs on the right. GUI operations shows the operations performed by using the Interact buttons. Scratchpad 1 and Scratchpad 2 allow you to modify registers using a script as follows:

- 1. Enter newline delimited commands in the same format as the GUI operations window (see Table 1).
- 2. Click Run to execute the script.

Other script files can be easily created by selecting the desired lines and then right click and select Save Selected Script. This saves the script in C:\Users\<Your Username>\Documents\LabVIEW Data\scripts. Lastly, the Transaction History shows a timestamped version of all the reads and writes to the registers.

Table 1. Example Scripting Operations

Command	Description
WriteMem(ade9178/reg_map_config:AVGAIN, 0x12)	Write 0x12 to the ade9178 AVGAIN register
ReadMem(ade9178/reg_map_config:AVGAIN)	Read AVGAIN register on ade9178
Wait (2000m)	Wait for 2000 ms
Import (Saved_Script)	Insert a saved script named Saved_Script
Dialog ("message")	Pop up dialog box with message

### 2.2.3.2 Documentation

For documentation, detailed information about the selected registers can be viewed in two ways: click the Info button in the Interact section or use the dropdown menu in the Scripting/Documentation section.

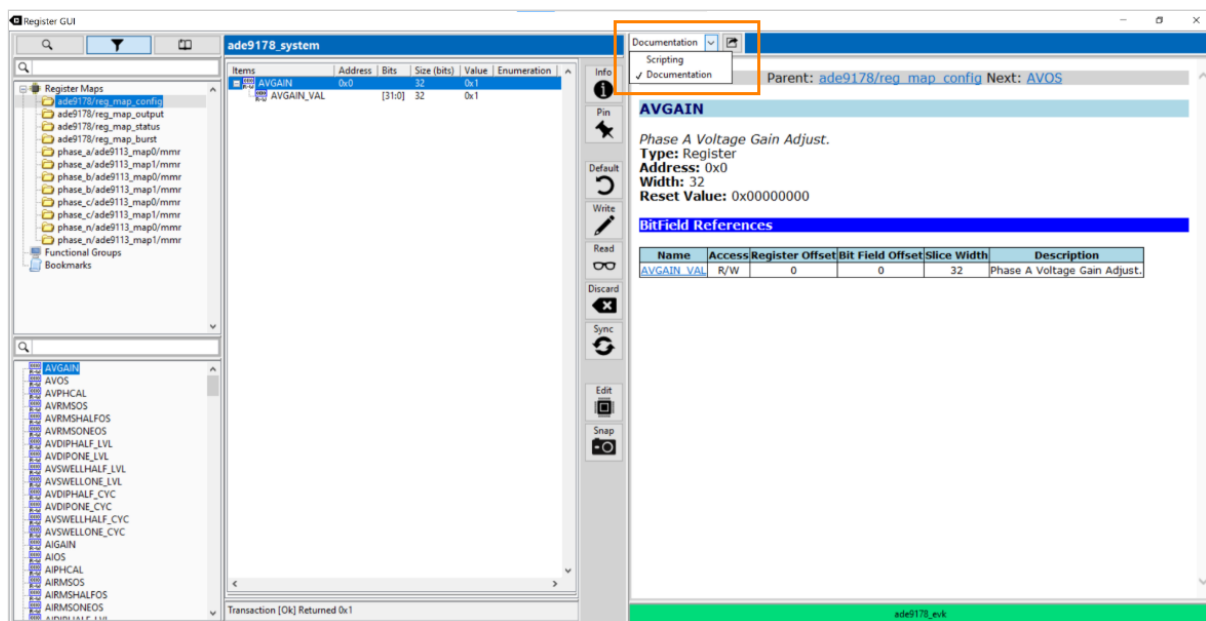


Figure 5 Documentation Panel

## 2.3 Interrupts

The Interrupts Panel allows user to interact with the STATUSx, MASKx and ERROR\_STATUS registers of on ADE9178. The panel is divided into five sections, each handling a pair of STATUSx and MASKx registers as shown in Figure 6.

Each row in a section displays the bit name and the corresponding values in the STATUSx register (represented by a circle) and the MASKx register (represented by a square). These circles and squares function as both controls and indicators, allowing users to visualize the current register values and update them as needed.

To read the registers,

1. Click the "Read All" button to read the current values of all registers at once.
2. After clicking, the circles (STATUSx) and squares (MASKx) in each section will be updated with the latest values from the registers.

To write the registers

1. Select the values you want to write by clicking on the circles and squares.
2. Click the corresponding "Write" button to execute the operation. The program automatically reads and displays the values in all registers right after each write.

The screenshot shows a software interface titled "Interrupts". It contains five main columns, each representing a different register set: STATUS0/MASK0, STATUS1/MASK1, STATUS2/MASK2, STATUS3/MASK3, and ERROR\_STATUS/MASK. Each column lists 32 bits, with bit names and their corresponding values in the STATUSx register (represented by a circle) and the MASKx register (represented by a square). The bits are: EGYRDY [00], REVAPA [01], REVAPB [02], REVAPC [03], REVPSUM1 [04], REVPSUM2 [05], CF1 [06], CF2 [07], RMSONERDY [08], PF\_RDY [09], ISUMMISMTCH [10], WATTNLOAD [11], VANLOAD [12], CRC\_CHG [13], RSTDONE [14], SEQERR [15], ZKTOAV [16], ZKTOBV [17], ZKTOCV [18], ZKAV [19], ZKBV [20], ZKCV [21], ZKCOMB [22], ZKAI [23], ZKBI [24], ZKCI [25], ZKAUX0 [26], ZKAUX1 [27], ZKAUX2 [28], ZKAUX3 [29], ZKAUX4 [30], and ZKAUX5 [31]. The ERROR\_STATUS/MASK column includes: ADC\_INIT\_ERROR [00], ERROR0 [01], ERROR1 [02], ERROR2 [03], ERROR3 [04], ERROR4 [05], ADC\_CRC\_ERROR [06], DREADY\_FREQ\_ERROR [08], ADC0\_STATUS0 [09], ADC0\_STATUS1 [10], ADC0\_STATUS2 [11], ADC1\_STATUS0 [12], ADC1\_STATUS1 [13], ADC1\_STATUS2 [14], ADC2\_STATUS0 [15], ADC2\_STATUS1 [16], ADC2\_STATUS2 [17], ADC3\_STATUS0 [18], ADC3\_STATUS1 [19], ADC3\_STATUS2 [20], ERROR6 [21], ERROR7 [22], and several RESERVED bits [23] through [31]. At the bottom of the panel, there are buttons for "Write STATUS0" through "Write STATUS3", "Write ERROR\_STATUS", "Write MASK0" through "Write MASK3", "Write ERROR\_MASK", "Write All", and "Read All".

Figure 6 Interrupt Panel

## 2.4 General Configuration

This panel simplifies user interaction with ADE9178 by consolidating configuration registers into one panel. The panel is organized into group as shown in figure 7.

To adjust the register values,

1. Click on the register field to reveal a dropdown menu or an input box where user can select or enter the desired value
2. After adjusting the configuration, click "Write" to apply changes

Figure 7 General Configuration Panel

## 2.5 RMS Monitor

The RMS Monitor panel displays series of RMS values as shown in figure 8.

- **RMS Value Display:** The main area of the panel shows the current RMS values being monitored.
- **Cycle Adjustment:** Options to view RMS values for one cycle, half cycle or the sum.
- **Update Interval:** A setting to change how often (in millisecond) the RMS values are updated

- **Pause:** Click "Pause" button to temporarily stop RMS values from updating. Click "Pause" again to resume updates.
- **Stop:** Click "Stop" to halt the updates indefinitely.

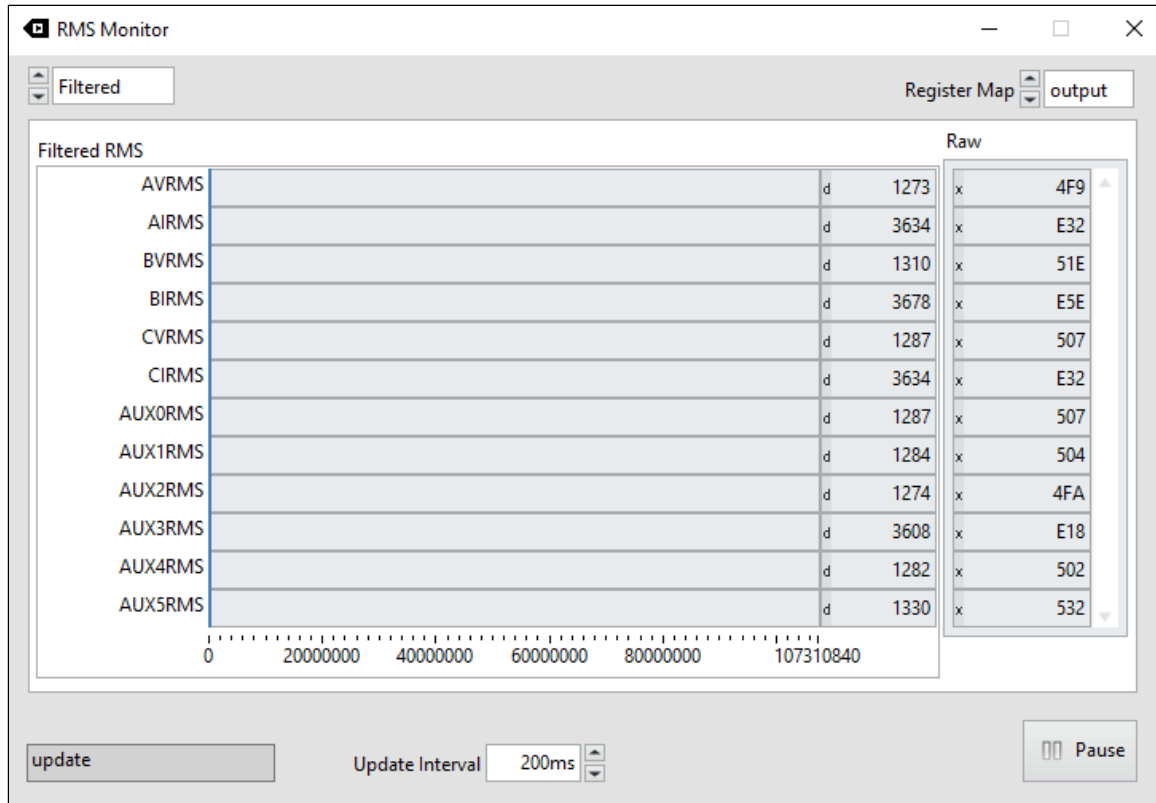


Figure 8 RMS Monitor Panel

## 2.6 Power Monitor

The Power Monitor panel displays power values across phase A, B, C as shown in figure 9.

- **Total Active Power:** AWATT, BWATT, CWATT.
- **Total Apparent Power:** AVA, BVA, CVA.
- **Update Interval:** A setting to change how often (in millisecond) the RMS values are updated
- **Pause:** Click "Pause" button to temporarily stop power values from updating. Click "Pause" again to resume updates.
- **Stop:** Click "Stop" to halt the updates indefinitely.

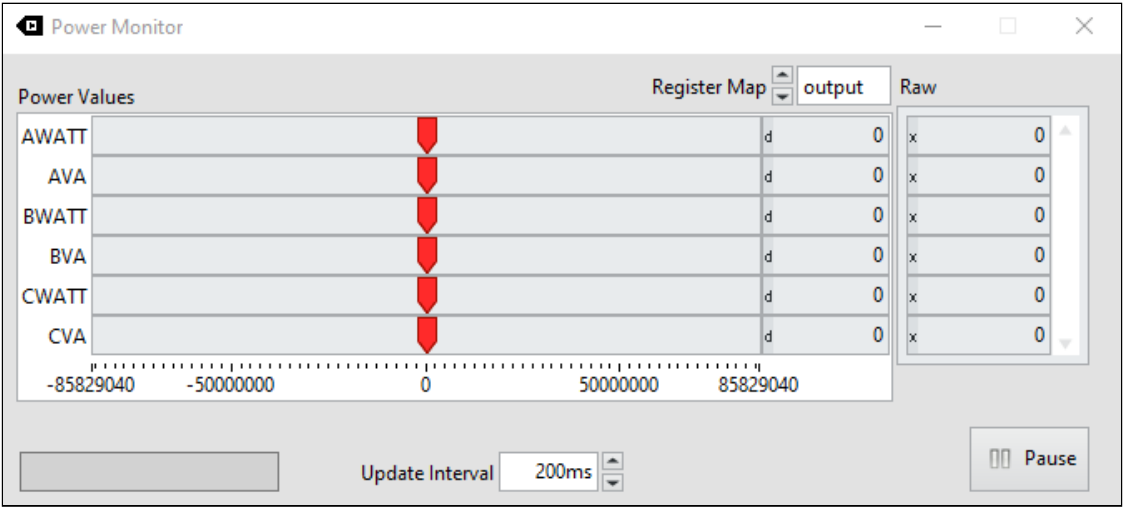


Figure 9 Power Monitor Panel

## 2.7 Energy Monitor

The Energy Monitor visualizes energy accumulation over time for each phase. Users can configure energy-related registers and choose which energy metrics to display on a graph. This panel provides insight into the total active and total apparent energy consumed by each phase.

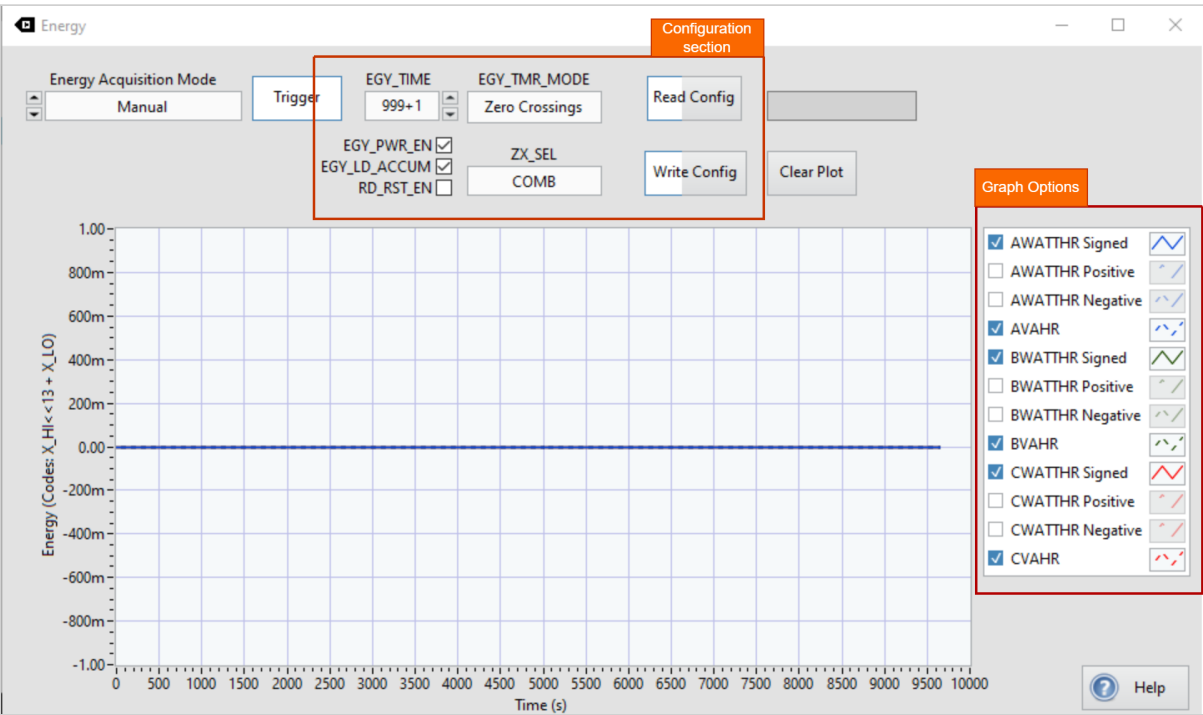


Figure 10 Energy Monitor Panel

## 2.7.1 Energy Acquisition

The Energy Monitor panel provides 3 energy acquisition modes to control how and when energy data is captured. These modes can be selected using the Energy Acquisition Mode dropdown in the top left corner of the panel.

1. **Manual mode:** energy data is acquired only when the user manually triggers it. Select Manual Mode from the dropdown menu and then click the "Trigger" button beside the mode selector. Each click will acquire one set of energy data.
2. **Software timed mode:** energy data is automatically acquired at a regular interval set by the user. After selecting Software Timed Mode, an additional input field labeled Read Interval (ms) will appear, allowing you to specify the time interval between data acquisitions in milliseconds.
3. **EGYRDY Hardware Timed mode:** select this mode to let the hardware trigger data collection whenever energy data is ready

## 2.7.2 Configuration

The following configuration can be adjusted from the Energy Monitor Panel.

- EGY\_TIME
- EGY\_TMR\_MODE
- EGY\_PWR\_EN
- EGY\_LD\_ACCUM
- RD\_RST\_EN
- ZX\_SEL

For more details of each configuration, simply click "Help" button at the bottom right corner, and hovering the cursor over the configuration name on the panel.

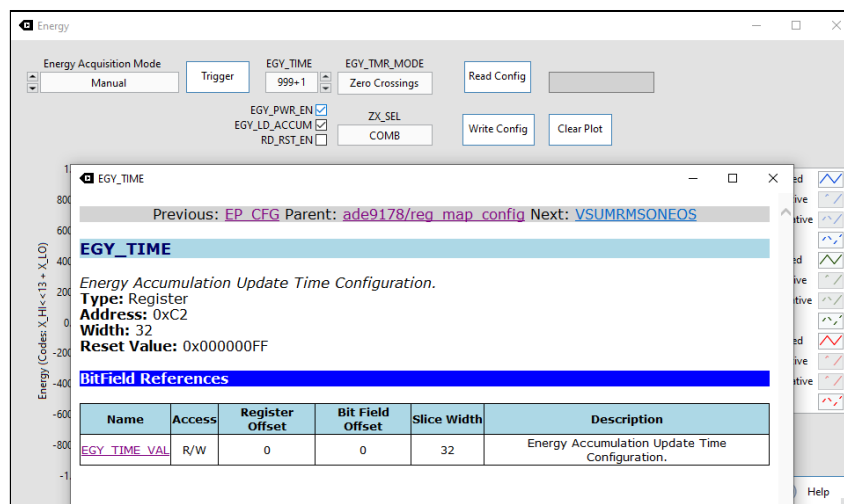


Figure 11 Example of Help Panel

To read configuration, click "Read Config" button. This will fetch the current values from energy-related registers.



To write configuration after making the necessary changes, click the "Write Config" button to apply the new settings to the registers.

### 2.7.3 Energy Accumulation Graph

In the graph section, user can choose whether to display Total Active Energy or Total Apparent Energy for each phase by selecting the checkboxes beside the graph.

- **xWATTHR signed:** Phase x Signed Accumulated Total Active Energy
- **xWATTHR Positive:** Phase x Accumulated Positive Total Active Energy
- **xWATTHR Negative:** Phase x Accumulated Negative Total Active Energy
- **xVAHR:** Phase x Accumulated Total Apparent Energy

To clear the currently displayed data from the graph, click the "Clear Plot" button. This will remove all data from the graph

## 2.8 Period and Angle Monitor

The Period and Angle Monitor panels gives user a comprehensive view of line periods and angles between phase A, B, C.

- **Line Period on each phase voltage:** APERIOD, BPERIOD, CPERIOD
- **Line Period on combined phase A, B, C Voltages:** COM\_PERIOD
- **Angles between phases:**
  - Between Voltages: ANGL\_AV\_BV, ANGL\_BV\_CV, ANGL\_AV\_CV
  - Between Voltages/Currents: ANGL\_AV\_AI, ANGL\_BV\_BI, ANGL\_CV\_CI
  - Between Currents: ANGL\_AI\_CI, ANGL\_AI\_BI, ANGL\_BI\_CI
- **Pause:** Click "Pause" button to temporarily stop period and angle values from updating. Click "Pause" again to resume updates.
- **Stop:** Click "Stop" to halt the updates indefinitely.

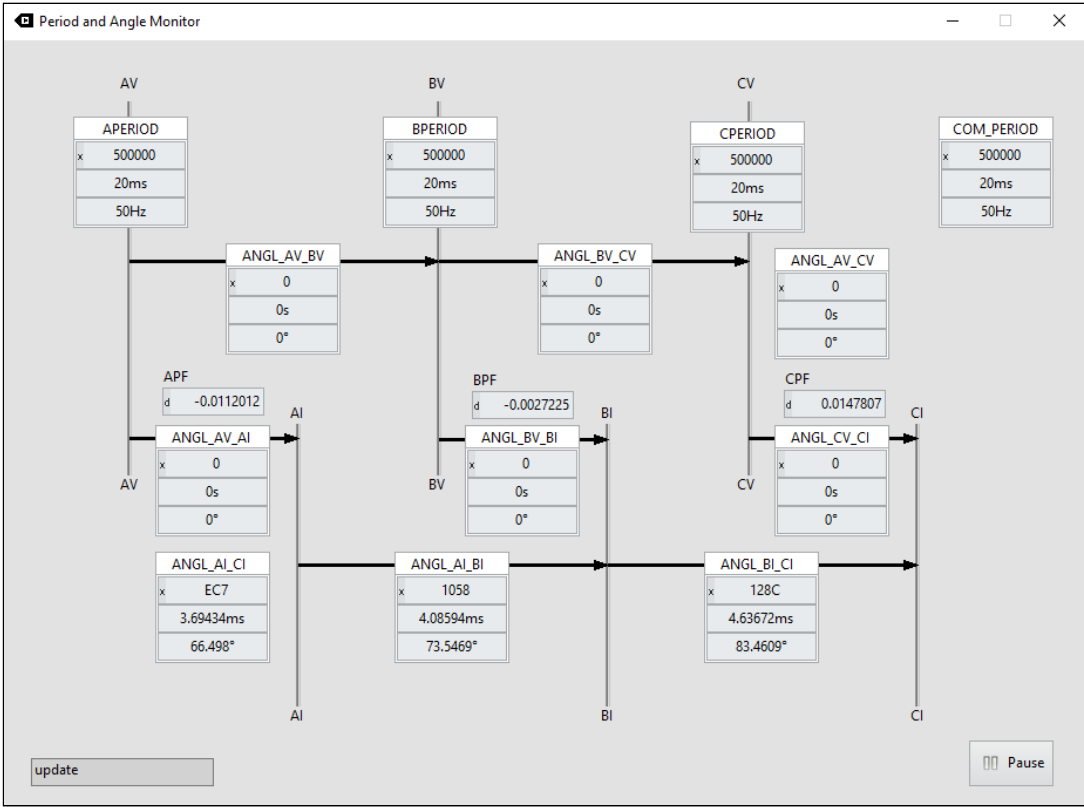


Figure 12 Period and Angle Monitor Panel

## 2.9 Waveform Scope

The waveform scope provides a visualization of the ADC outputs against time, as well as a frequency domain analysis of the captured samples. Users can capture data from the ADE9178EVKIT and view the corresponding waveforms for each phase, including key metrics listing in [table 2](#).

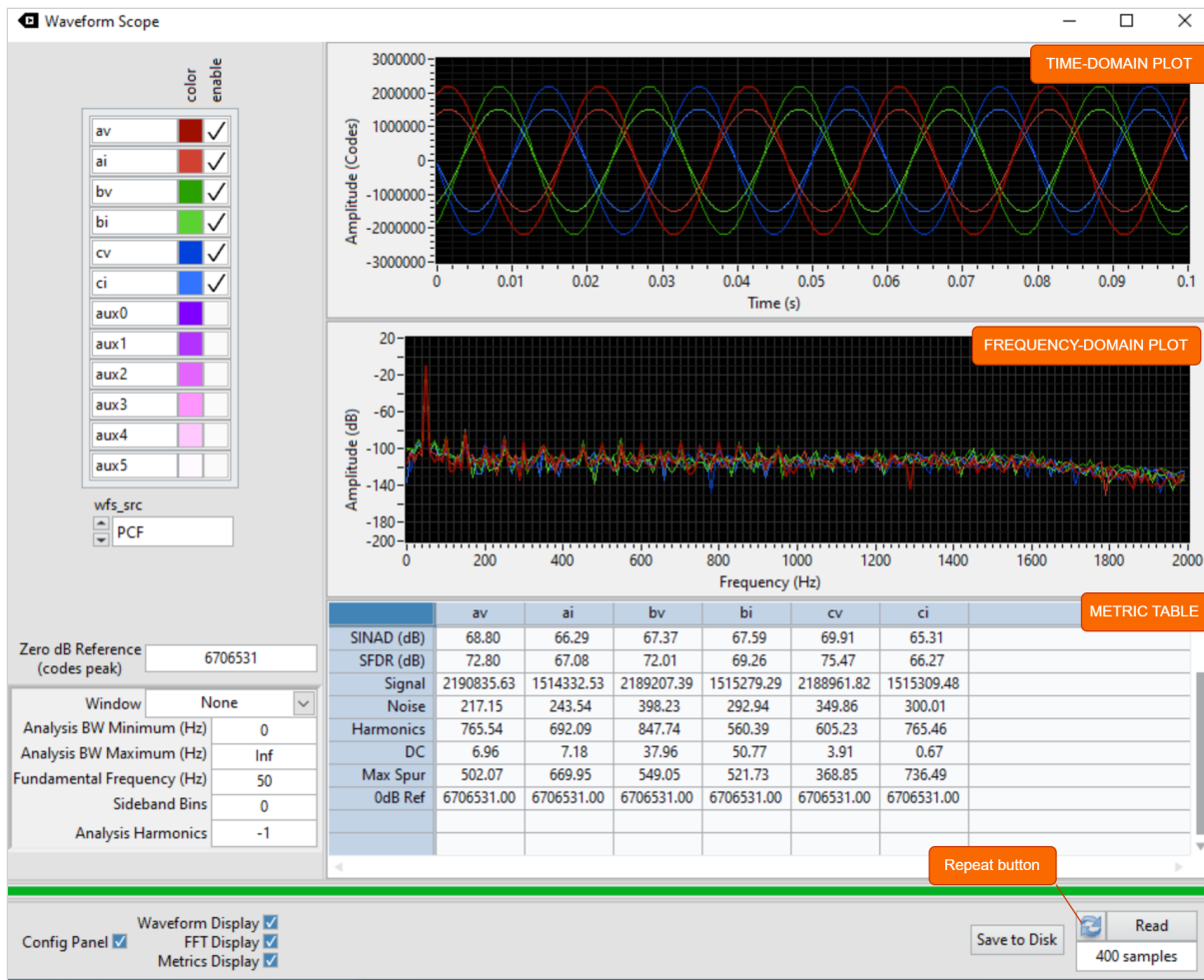


Figure 13 Waveform Scope Panel

## 2.9.1 Capturing Data

1. Choose waveform source, either ADC or PCF
2. Set number of samples. In the bottom-right corner of the window, specify the number of samples to collect, with maximum samples of 400.
3. Click "Read" Button to capture a single batch of samples
4. Enable continuous data collection, by clicking "repeat" button, then clicking "Read" again. When repeat mode is enabled, the system will capture and display successive batches of samples. To stop continuous data collection, simply disable the "repeat" button.

## 2.9.2 Spectral Analysis

Once the data has been captured and displayed on the **Time-Domain Plot**, the software automatically performs spectral analysis to generate a **Frequency-Domain Plot** and populate the **Metrics Table**.

1. Select FFT window type, using the dropdown menu to select one of ten available FFT window types
2. Set the following analysis parameters based on user specific needs:
  - Analysis BW Minimum (Hz)
  - Analysis BW Maximum (Hz)
  - Fundamental Frequency (Hz)
  - Sideband Bins
  - Analysis Harmonics

Metrics table displays the parameters that are calculated based on analysis parameters.

The captured data can be saved to .csv files for further analyzing outside of the software. To save the file,

1. At the bottom-right corner of the window and click the "Save to Disk" button
2. A pop-up window will appear, prompting user to select the destination directory where the files will be saved. Please note that only select phases that were enabled during Read process will be included in the saved files.

Table 2. Parameters Calculated from Spectral Analysis

Parameter	Description
SINAD (dB)	Signal-to-Noise and Distortion Ratio
SFDR (dB)	Spurious-free dynamic range
Signal	Maximum codes obtained from the fundamental frequency
Noise	Maximum codes obtained from noise frequencies
Harmonics	Maximum codes obtained from harmonic frequencies
DC	Maximum codes obtained from DC (0 Hz)
Max Spur	Maximum codes obtained from the spur frequency
0dB Ref	Reference value at 0dB

Table 3. Output File Descriptions

File Name	Contents
metadata.csv	Values from FFT settings
waveforms.csv	Captured codes on each channel and auxiliary register values vs. time in seconds
ffts.csv	Calculated FFT values in dB vs. frequency in Hz
metrics.csv	Values in FFT metrics table