

**AD-ACEVSE22KWZ-KIT****FEATURES**

- ▶ Metrology subsystem plus selected other features of a level 2, 7kW to 22kW electric vehicle supply equipment (EVSE)
- ▶ Full-featured board for ADE9112, ADE9113, and ADE9178
- ▶ Rated up to three phase, 240V RMS line to neutral voltage
- ▶ Rated up to 32A current measurement with on-board shunts
- ▶ Supports up to 22kW combined power transfer to load
- ▶ Features MAX32672 low power, secure microcontroller
- ▶ Supports LCD display for energy and state updates
- ▶ Supports MODBUS™ protocol over RS-485 communication interface
- ▶ Supports Protobuf™ messages to communicate with Everest open source software (OSS)
- ▶ IEC61851-compatible state machine implementation

**EVALUATION BOARD CONTENTS**

- ▶ AD-ACEVSE22KWZ-SL
- ▶ LCD companion board BR-079862

**EQUIPMENT NEEDED**

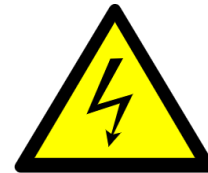
- ▶ USB-TTL serial adapter (ADAFRUIT™ Industries 954 USB to TTL recommended)
- ▶ USB to RS-485 (Waveshare™ USB to RS-485 recommended)
- ▶ EV emulator (optional) (Megger® EVCA210 recommended)
- ▶ 12V, 2A supply
- ▶ Single or three-phase supply capable of providing 100 VAC to 240 VAC 0.6A per phase
- ▶ Single- or three-phase load

**ONLINE RESOURCES**

- ▶ [Python 3.11.X](#)
- ▶ [ADE9178 data sheet](#)
- ▶ [Secure Boot Tools v3.0.0](#)
- ▶ [Everest OSS](#)

**HAZARDOUS HIGH VOLTAGE**

This equipment is connected to hazardous line voltages. Exercise proper caution when connecting the sensors and voltage leads. Ensure that the system is enclosed in a protective casing.

**GENERAL DESCRIPTION**

The AD-ACEVSE22KWZ-KIT is a reference design for the metrology subsystem plus selected other features of a level 2, 7 kW to 22 kW AC electric vehicle supply equipment (EVSE). It includes the ADE9113 isolated  $\Sigma$ - $\Delta$  analog-to-digital converter (ADC) coupled with the ADE9178 metrology DSP to accurately measure energy delivered to an electric vehicle (EV). It includes the MAX32672 ultralow-power ARM® Cortex®-M4 processor, a cost-effective, highly integrated, and highly reliable 32-bit microcontroller to accumulate energy measurements and securely send it to a host for display. A charge control state machine is run on the microcontroller to transition through different charge states when a charging plug is inserted into an electric vehicle. The kit includes a flexible printed circuit (FPC) connector and LCD to read the energy measurements and state transitions during a charging cycle. The power input/output, control pilot (CP), and proximity pilot (PP) signals are exposed on connectors at the edge of the board. The energy delivered to the EV is measured as a voltage drop across shunts and a resistor ladder network, which makes it easy to set up the boards in the field.

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**REVISION HISTORY**

**6/2025—Rev. 0 to Rev. A**

Changes to EV Emulator Testing Section.....	6
Changes to LCD User Interface Section.....	13
Added Figure 8; Renumbered Sequentially.....	13
Changes to Figure 9 to Figure 11.....	13
Added Figure 12 and Table 3; Renumbered Sequentially.....	13
Changes to Running the Script Section.....	14
Changes to Table 4.....	15
Changes to Using Modbus Host Tools Section.....	17
Change to Simulating a Charge Session Section.....	17
Changes to Table 6.....	23
Changes to Table 10.....	29

**10/2024—Revision 0: Initial Version**

EVALUATION BOARD PHOTOGRAPH

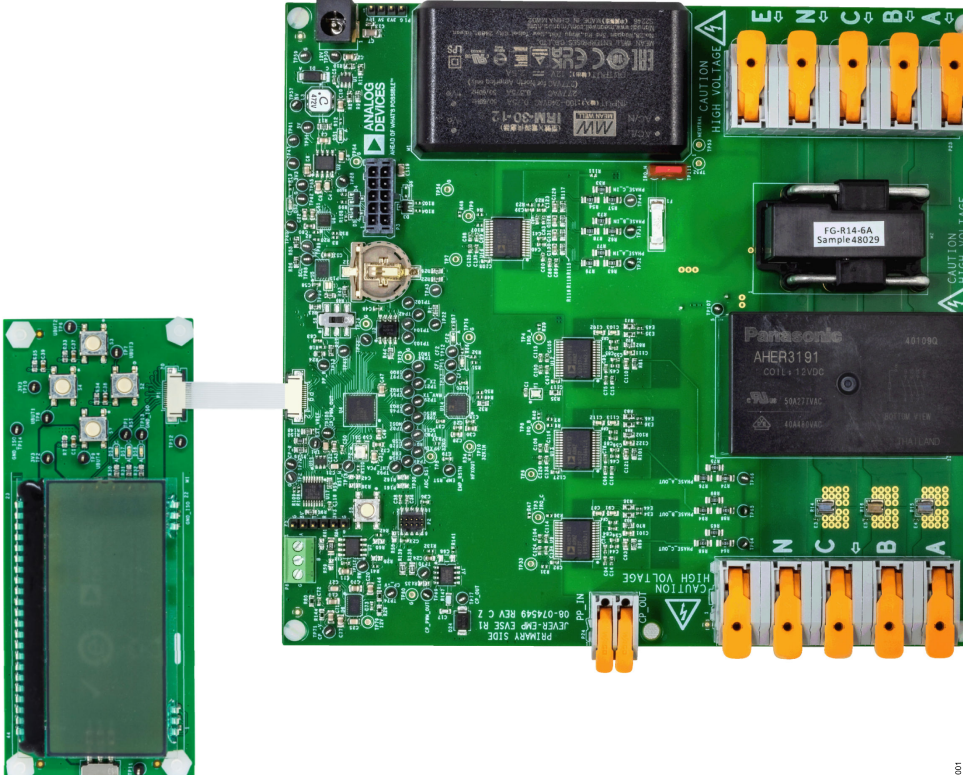


Figure 1. AD-ACEVSE22KWZ-KIT Evaluation Board Photograph

**BLOCK DIAGRAM**

Figure 2 shows the block diagram of the board design. Dashed lines indicate the isolation barrier of the design. The section on top of the dashed line is the high voltage section in the design. Anything below the dashed line is low voltage. The protective earth is shown on the low voltage side below the dashed line. Current and voltage measurement on phases A, B, and C are performed after the input AC power supply and after the relay to remove losses from the on-board circuitry from the energy measurement. It is performed after the relay, just before the connector to the EV. This means metrology should always be read as zero when the relay is open. Voltage is also measured before the relay on each phase. The difference between the two voltage measurements can be used to detect stuck relay events. PEN fault detection is also

performed using these voltage dividers on the input side of the relay. The relay is controlled by the charge control state machine running on the microcontroller. The control pilot and proximity pilot functionalities are implemented according to the IEC61851-1 standard to establish low level communication with an EV communication controller. The onboard FRAM stores calibration and configuration parameters for the ADC. A MAXQ1065 cryptographic coprocessor is included on the board to store private and public keys for elliptic curve Diffie-Hellman key exchange (ECDHE). A MAX31343 real-time clock (RTC) is included to generate accurate timestamps to send to the host controller. A MAX33046 RS-485 transceiver chip is included to provide an interface to access and modify ADE9178 registers to configure it for a charge session.

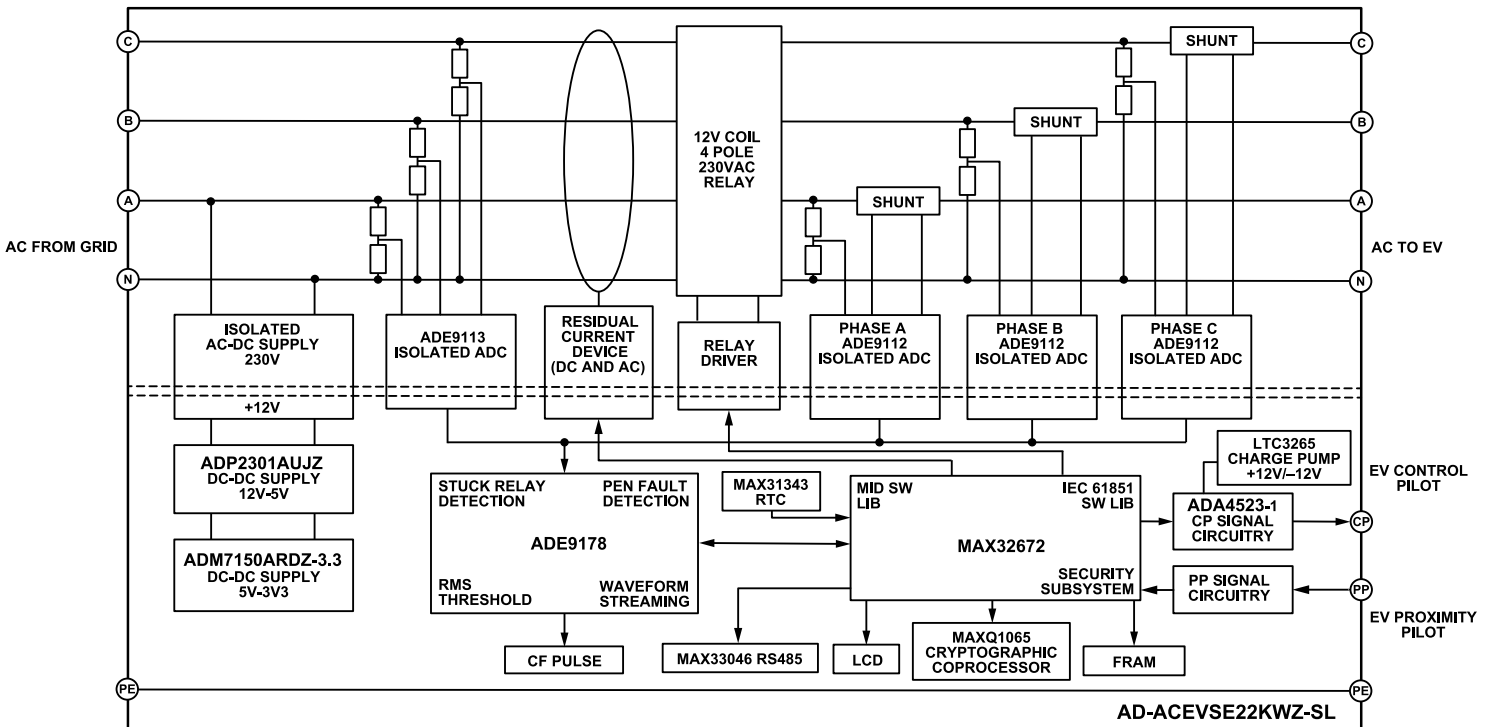


Figure 2. System Block Diagram

## GETTING STARTED

Use the following instructions to evaluate the AD-ACEVSE22KWZ-KIT. While testing, the single-phase input must be connected to phase A and must not exceed 240V RMS line to neutral voltage or 32A. Place the board inside a protective casing before connecting to high power.

For setup take the following steps:

1. Connect the LCD companion board to the AD-ACEVSE22KWZ-SL using the flexible printed circuit (FPC) connector (P9). See the [Figure 5](#) for more information.
2. Connect the 12V power supply to P15.
3. Upon powering the device, the LCD screen displays a brief welcome message before switching to the status screen ([Figure 9](#)).
4. If the LCD does not show the status screen, the firmware on the board must be rewritten. See [Flashing the Board](#) for detailed instructions on writing to the board.

For single-phase power test setup, take the following steps:

1. Unplug the 12V supply from P15.
2. Connect a single-phase input to the power, neutral, and ground ports of P23 (A, N, and E, respectively), as shown in [Figure 3](#). A single-phase wall outlet is suitable.
3. Make sure the jumper between TP110 and TP111 is installed.
4. Connect a single-phase load to the A\_OUT, N\_OUT, and E\_OUT ports of P13. Use an incandescent lamp (not exceeding 32A) as a load.

Continue to the next section to test the system using RS-485 commands to simulate a vehicle charge session. To test the system using an EV emulator in place of the RS-485 peripheral, proceed to the [EV Emulator Testing](#) section thereafter.

## RS-485 TESTING

This test procedure outlines the steps necessary to evaluate RS-485 communications, charge control state machine (CCSM) operation, and metrology in addition to familiarizing users with the firmware companion scripts available for the AD-ACEVSE22KWZ-KIT. Single-phase power is not required, but running the tests without power connected results in zero charge accumulation.

1. Install Python 3.11 on the host PC.
2. Connect the RS-485 port, as described in [MODBUS Communication](#).
3. The protective casing must be closed before proceeding to step 4.
4. Connect the single-phase input and wait for the LCD to display the status screen.
5. Run the `adi_run_session.py` script, as described in [Simulating a Charge Session](#). This simulates a 10-second charge session. The user will hear the relay switch and power begins flowing to the load. The LCD displays charge accumulation information throughout the simulated session.

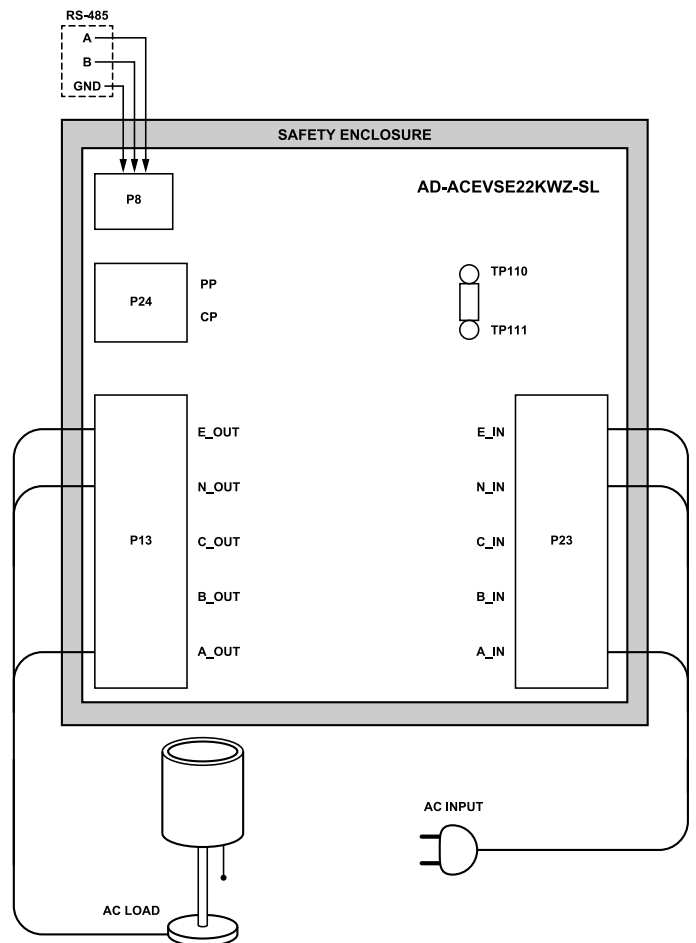


Figure 3. RS-485 Test Setup

## GETTING STARTED

## EV EMULATOR TESTING

This test procedure uses an EV emulator to control the charge control state machine with the control pilot (CP) and proximity pilot (PP). As with the RS-485 test, the objective is to cycle through a complete charge session and measure the power drawn by a load.

1. Connect a vehicle emulator to the control pilot (CP) and proximity pilot (PP) terminals of P24, as shown in [Figure 4](#).
2. Set the EV emulator to state A (vehicle not connected).
3. If the EV emulator has a configurable current limit, it must be set at or below 32A.
4. The protective casing must be closed before proceeding to step 5.
5. Connect the single phase input and wait for the LCD to display the status screen.
6. Set the EV emulator to state B (vehicle connected, not ready to charge).
7. Set the EV emulator to state C (vehicle ready to charge, ventilation not required). The relay clicks and power begins to flow to the load.
8. To finish the charge session, set the EV emulator back to state B and then to state A. This opens the relay and halt the flow of power to the load.

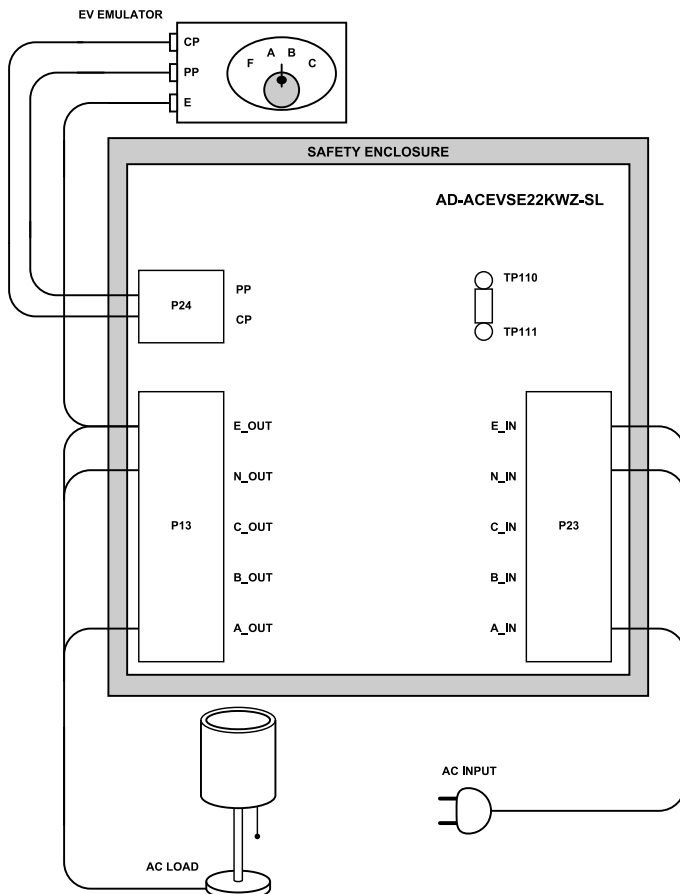


Figure 4. EV Emulator Test Setup

## EVALUATION BOARD HARDWARE

The AD-ACEVSE22KWZ-SL supports a variety of onboard systems, including a real-time clock (RTC), ferroelectric read-only memory (FRAM), cryptographic coprocessor, RS-485 interface, LCD, user buttons, AC to DC power supply, relay, and residual-current detector (RCD). These components enable the core technologies demonstrated by the MAX32672 MCU and ADE9178/ADE9112/ADE9113 metrology chipset.

The MAX32672 MCU manages metrology, safety, security, and communications on the board. It uses the Protobuf data format over UART to send data to the host application processor. The metrology chipset contains one ADE9178, three ADE9112s (one per power phase), and one ADE9113 for monitoring supply voltage before the relay.

The RTC features a battery backup and can provide accurate timestamps for the power meter messages. The FRAM provides encrypted, nonvolatile memory for calibration and configuration settings. It also allows the system to securely store charge session data and recover from power interruptions during a charge session. The MAXQ1065 cryptographic coprocessor can enable secure transmissions to the host application processor and tamper proofing. The LCD expander board features indicator LEDs, user buttons, and an LCD with screens displaying metrology data, system self test results, and charge session information.

The high power section of the board contains a nominally open quadruple pole single throw relay for controlling grid to EV power flow. A residual current device (RCD) also provides backup fault current detection.

### POWERING THE BOARD

The AD-ACEVSE22KWZ-SL features 12V, 5V, and 3.3V nets to support various onboard and offboard components. The device

has a barrel connector (P15) compatible with 12V, 2A DC external power supplies. Additionally, connecting TP110 and TP111 with the included jumper (installed by default) allows the board to be powered by the phase A AC input. 5V and 3V3 supply nets are generated on the board using the 12V net.

The AD-ACEVSE22KWZ-SL has one set of three-phase input connectors (P23) and one set of three-phase output connectors (P13). See [Table 2](#) or the silkscreen for wiring directions.

### CONNECTING THE BOARD FOR EVALUATION

Testing the AD-ACEVSE22KWZ-KIT requires connecting a source and load to the input and output terminals, and collecting accumulation data by stepping through a charge session using the CCSM. There are two ways to control the CCSM on the AD-ACEVSE22KWZ-SL. The first is by simulating a vehicle connected to the control pilot (CP) and proximity pilot (PP) signals. The second is by directly changing the state using Modbus commands. This section outlines the hardware connections required for each test method.

The CP and PP connections (P24) are labeled on the silkscreen. When an EV or EV emulator is connected, low level communication, as defined by IEC61851, is used to actuate the CCSM. This functionality has been evaluated using a Megger® EVCA210 EV adaptor.

To connect to the RS-485 interface, see [MODBUS Communication](#).

The three-phase output power must be connected to P13. The phases are labeled on the silkscreen and also documented in the [Figure 5](#). The three-phase input must be connected to P23. The jumper connecting TP110 and TP111 allows the AD-ACEVSE22KWZ-SL to power itself from input phase A.

### CONNECTOR PINOUTS

[Table 1](#) and [Table 2](#) define the test points and connectors available on the AD-ACEVSE22KWZ-SL.

**Table 1. Test Points**

NET	Signal	Notes
TP1	EXT_VREF	3V3 REFERENCE VOLTAGE
TP2	GND_ISO	ISOLATED GROUND
TP3	ADC_IRQ_C	ADE9112 PHASE C IRQ
TP4	ADC_IRQ_A	ADE9112 PHASE A IRQ
TP5	EMP_PD1	ADE9178 PULLDOWN1
TP6	PHASEB_XTALOUT	ADE9112 PHASE B XTAL
TP7	NEUTRAL_XTALOUT	ADE9113 XTAL
TP8	ADC_IRQ_B	ADE9112 PHASE B IRQ
TP9	ADC_IRQ_N	ADE9113 NEUTRAL IRQ
TP10	EMP_PD2	ADE9178 PULLDOWN2
TP11	EMP_CF1	
TP12	EMP_CF2	
TP13	PP_READ	
TP17	NC	NOT CONNECTED

## EVALUATION BOARD HARDWARE

Table 1. Test Points (Continued)

NET	Signal	Notes
TP18	RESET_MCU	MAX32672 RESET PIN
TP20	EMP_CSB	ADE9178 SPI CHIP SELECT
TP21	ADC_ZX_A	
TP22	EMP_ADC_RSTN_GPIO	ADE9178 AND ADE9112 RESET
TP23	FRAM_CS	FRAM SPI CHIP SELECT
TP27	RELAY_CTRL1	
TP28	HOST_UART_RX	HOST APP PROCESSOR UART RX
TP29	WAVEFORM_TX	
TP30	TAMPER_IN	
TP31	V1P_IN_N	
TP32	V2P_IN_N	
TP33	PHASEC_XTALOUT	
TP41	HOST_UART_TX	HOST APP PROCESSOR UART TX
TP42	HOST_SPARE	UNUSED
TP43	RCD_AOUT	
TP44	I1P_IN_N	
TP47	TPU_RESET_OUT	
TP48	EMP_IRQ3	ADE9178 INTERRUPT 3 NET
TP49	EMP_COM_RDY	ADE9178 READY PIN
TP50	VDD_12V	12V REFERENCE VOLTAGE
TP51	VDD_5V	5V REFERENCE VOLTAGE
TP52	AC/L	
TP53	AC/N	
TP54	GND_ISO	ISOLATED GROUND
TP55	VDD_3V3	3V3 REFERENCE VOLTAGE
TP56	GND_ISO	ISOLATED GROUND
TP57	VDD_5V	5V REFERENCE VOLTAGE
TP58	EMP_COM_ERR	ADE9178 ERROR PIN
TP59	GND_ISO	ISOLATED GROUND
TP60	TPU_RDY	
TP61	TPU_WDI	
TP62	GND_ISO	ISOLATED GROUND
TP64	V1P_IN_C	
TP65	V1P_IN_B	
TP66	V1P_IN_A	
TP69	CP_PWM_OUT	CP PWM GEN OUTPUT
TP70	IN-	
TP71	CP_-V	CP NEGATIVE VOLTAGE TEST
TP73	CP_READ	CP INPUT VOLTAGE TO ADC
TP74	CP_+V	CP POSITIVE VOLTAGE TEST
TP75	GND_ISO	ISOLATED GROUND
TP76	GND_ISO	ISOLATED GROUND
TP77	CP_OUT	CP OUTPUT TO EV
TP78	GND_ISO	ISOLATED GROUND
TP79	VDD_12V	12V REFERENCE VOLTAGE
TP80	GND_ISO	ISOLATED GROUND
TP81	EMP_MISO	ADE9178 AND FRAM SPI MISO
TP82	EMP_MOSI	ADE9178 AND FRAM SPI MOSI
TP83	EMP_SCLK	ADE9178 AND FRAM SPI SCLK

## EVALUATION BOARD HARDWARE

Table 1. Test Points (Continued)

NET	Signal	Notes
TP88	SCL	
TP89	SDA	
TP91	EMP_IRQ2	ADE9178 INTERRUPT 2 NET
TP92	INT_PCA	
TP97	EMP_IRQ0	ADE9178 INTERRUPT 0 NET
TP98	EMP_IRQ1	ADE9178 INTERRUPT 1 NET
TP99	RTC_INT	RTC INTERRUPT NET
TP102	RCD_TEST	
TP103	RCD_X30_INT	
TP104	RCD_X6_INT	
TP105	CP_PWM_OUT	
TP106	VDD_12V	12V REFERENCE VOLTAGE
TP107	RELAY_SUP	
TP110	PHASE_A_IN	PHASE A INPUT TO AC-DC BLOCK
TP111	AC_DC_IN	12V NAC-DC INPUT POWER
TP112	RS485_RW_LINE	

Table 2. Connectors

	Component	Pin	Signal	Description
P1	POWER HEADER	1	VDD_12V	12V NET CONNECTION
		2	VDD_5V	5V NET CONNECTION
		3	VDD_3V3	3V3 NET CONNECTION
		4	GND_ISO	ISOLATED GROUND
P2	SWDIO PROG	1	VDD_3V3	3V3 SUPPLY FROM PROGRAMMER
		2	SWDIO	SWDIO DATA FOR DEBUG AND FLASH
		3	GND_ISO	ISOLATED GROUND
		4	SWDCLK	SWDIO CLOCK FOR DEBUG AND FLASH
		5	GND_ISO	ISOLATED GROUND
		6	DBG_UART0_TX	DEBUG AND FLASH UART TX
		7	NC	NOT CONNECTED
		8	DBG_UART0_RX	DEBUG AND FLASH UART RX
		9	GND_ISO	ISOLATED GROUND
		10	RESET_MCU	ADE9178 RESET SIGNAL
P3	BOARD CONNECTION TO HOST APPLICATION PROCESSOR	1	HOST_SPARE	UNUSED SIGNAL FOR FUTURE ASSIGNMENT
		2	HOST_UART_TX	UART TX FOR PROTOBUF COMMUNICATION
		3	GND_ISO	ISOLATED GROUND
		4	HOST_UART_RX	UART RX FOR PROTOBUF COMMUNICATION
		5	RESET_MCU	MAX32672 RESET PIN FOR HOST APP USE
		6	ADC_ZX_A	PHASE A ZX ADE9112 OUTPUT
		7	GND_ISO	ISOLATED GROUND
		8	CP_OUT	CP OUTPUT FOR HOST APP PROCESSOR
		9	GND_ISO	ISOLATED GROUND
		10	VDD_12V	12V NET CONNECTION
P4	TX JUMPER	1	RS485_DI	RS-485 DI PIN
		2	DBG_UART0_TX	DEBUG AND FLASH UART TX
P5	UART DEBUG	1	GND_ISO	ISOLATED GROUND
		2	VDD_5V	5V NET CONNECTION
		3	DBG_UART0_TX	DEBUG AND FLASH UART TX

## EVALUATION BOARD HARDWARE

Table 2. Connectors (Continued)

	Component	Pin	Signal	Description
		4	DBG_UART0_RX	DEBUG AND FLASH UART RX
		5	VDD_3V3	3V3 NET CONNECTION
		6	GND_ISO	ISOLATED GROUND
P6	RX JUMPER	1	RS485_RO	RS-485 RO PIN
		2	DBG_UART0_RX	DEBUG AND FLASH UART RX
P8	RS-485	1	A	RS-485 POSITIVE TRANSMISSION SIGNAL
		2	B	RS-485 NEGATIVE TRANSMISSION SIGNAL
		3	GND_ISO	ISOLATED GROUND
P9	FPC CONNECTOR	1	LED1	LED 1 DRIVER PIN
		2	LED2	LED 2 DRIVER PIN
		3	LED3	LED 3 DRIVER PIN
		4	UBUT1	USER BUTTON 1-PIN
		5	UBUT2	USER BUTTON 2-PIN
		6	UBUT3	USER BUTTON 3-PIN
		7	UBUT4	USER BUTTON 4-PIN
		8	SCL_LCD	LCD DRIVER I <sup>2</sup> C CLOCK PIN
		9	SDA_LCD	LCD DRIVER I <sup>2</sup> C DATA PIN
		10	RESET_LCD_MCU	LCD DRIVER RESET PIN
		11	VDD_3V3	3V3 SUPPLY TO LCD BOARD
		12	GND_ISO	ISOLATED GROUND
P13	CONNECTORS TO EVSE CABLE	1A/B	EARTH	ISOLATED GROUND
		2A/B	ADE9113_OUT	NEUTRAL OUTPUT TO EV
		3A/B	PHASE_C_OUT	PHASE C OUTPUT TO EV
		4A/B	PHASE_B_OUT	PHASE B OUTPUT TO EV
		5A/B	PHASE_A_OUT	PHASE A OUTPUT TO EV
P15	BARREL CONNECTOR	1	VDD_12V	12V INPUT
		2	GND_ISO	ISOLATED GROUND
		3	GND_ISO	ISOLATED GROUND
P19	RTC INT-CLK	1	CLKO	RTC OUTPUT CLOCK
		2	RTC_INT	RTC INTERRUPT NET
P23	CONNECTORS TO WALL SUPPLY	1A/B	PHASE_A_IN	PHASE A INPUT (ALSO POWERS BOARD)
		2A/B	PHASE_B_IN	PHASE B INPUT FROM GRID
		3A/B	PHASE_C_IN	PHASE C INPUT FROM GRID
		4A/B	ADE9113_IN	NEUTRAL INPUT FROM GRID
		5A/B	EARTH	ISOLATED GROUND
P24	PP AND CP TERMINAL	1A/B	PP_IN	PROXIMITY PILOT SIGNAL
		2A/B	CP_OUT	CONTROL PILOT SIGNAL

EVALUATION BOARD HARDWARE

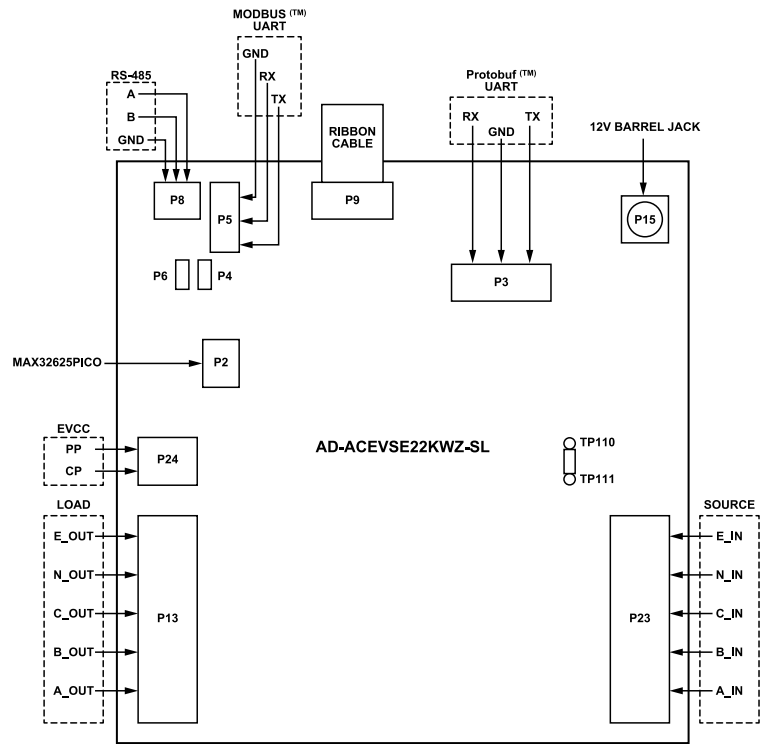


Figure 5. Simplified Connector Diagram

## EVALUATION BOARD SOFTWARE

This section documents the installation process, hardware setup, and software setup required to run basic python scripts to bring up the system.

### FLASHING THE BOARD

This section details the process of flashing new firmware code to the AD-ACEVSE22KWZ-KIT using the Analog Devices [Secure Boot Tools](#) program. Before continuing, download this tool and unzip the directory. Note: the board need not be flashed upon receipt as the boards are programmed before shipping.

### Hardware Setup

To setup the hardware, take the following steps:

1. A UART to USB device is required (see [Equipment Needed](#) for recommendations).
  - ▶ If using the recommended USB-TTL adapter, install the device driver.
2. Connect the USB side of the device to the host computer.
3. Connect the UART side of the device to P5 (see [Table 2](#)) on the AD-ACEVSE22KWZ-SL.
  - ▶ Connect UART device TX line to pin 4 of P5.
  - ▶ Connect UART device RX line to pin 3 of P5.
  - ▶ Connect UART device GND to pin 1 of P5.
4. Disconnect the RS-485 interface by removing jumpers P6 and P4 (see [Table 2](#)).
5. Set switch S8 to the position shown in [Figure 6](#) to enable the secure boot loader (SBL) of the MAX32672.
6. Power the board by connecting a 12V adapter to the onboard barrel jack terminal (P15).

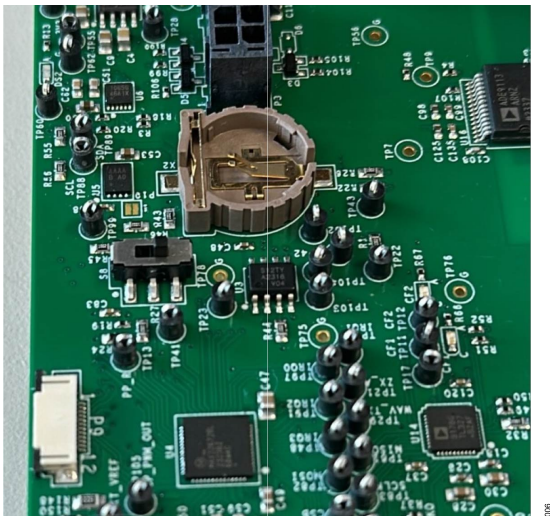


Figure 6. SBL Switch Reference

### Secure Boot Tool Operation

1. Launch the ADI [Secure Boot Tools-v3.0.0](#) application and wait for the window to load.
2. Select **Secure ROM Bootloader** and click **OK**.
3. Select the **SCP Sender** tab if it is not already selected.
4. Configure the tool for the MAX32672 and set the COM port to the USB-TTL port. Use the device manager to identify the correct COM port of the adapter.
5. For the **SCP Package**, select the AD-ACEVSE22KWZ-SL.zip file found within the AD-ACEVSE22KWZ-SL-BSP folder. Once properly configured, it should look as follows:

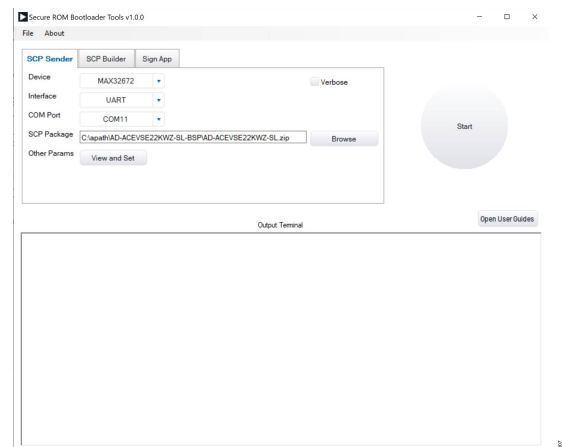


Figure 7. Bootloader Tools

6. Reset the AD-ACEVSE22KWZ-KIT by pressing the software reset button (S5).
7. Click **Start**.
8. Once the session completes, an **SCP session OK** message is printed to the terminal.
9. Return S8 to its original position to prevent the SBL from running on subsequent board resets.

EVALUATION BOARD SOFTWARE

LCD USER INTERFACE

The 08-079862 LCD companion board features four buttons: S2, S3, S4, and S7 on the silkscreen. The upper button (S4) returns to the status screen. The right button (S3) cycles through phases A, B, and C on the RMS values screen. The lower button (S2) brings up the board information screen.

Upon evaluation software start up, the LCD initially displays the start up screen as shown in [Figure 8](#). During this time, various board peripherals are being initialized, with their functionality being tested. This includes an RCD self test to verify faults can be detected.

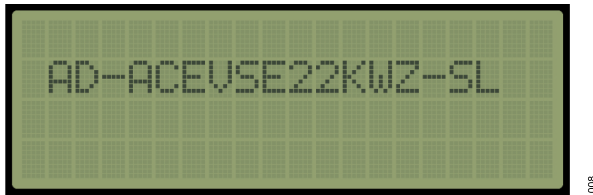


Figure 8. Start Up Screen

After a successful start up, the LCD displays the status screen. This shows the charge session state, CP, and PP voltages. Once a charge session begins, this screen also shows the session duration and energy accumulation.



Figure 9. Status Screen

The RMS screen shows the voltage, current, and frequency values for one phase. Note that the voltage, current, and frequency are measured on the vehicle side of the relay. As a result, the voltage and current are both zero unless the relay is closed. Similarly, the

frequency value is displayed as 50 Hz unless the relay is closed where it shows the measured value.

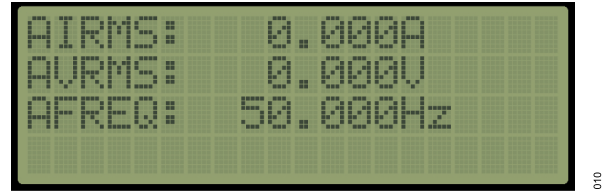


Figure 10. RMS Values Screen

The board information screen displays the firmware version and engineering change request of the board.

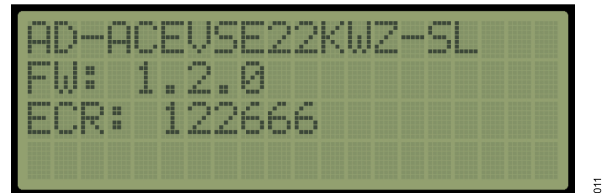


Figure 11. Board Information Screen

In the event of a failed start up, the evaluation software is not started and the LCD displays the initialization error screen. Each set bit corresponds to an error which occurred during start up. Note that LCD initialization errors do not fail a start up, allowing AD-ACEVSE22KWZ-SL operation with the LCD companion board disconnected. This is because LCD companion board is solely used to display information to the user inside the evaluation software.

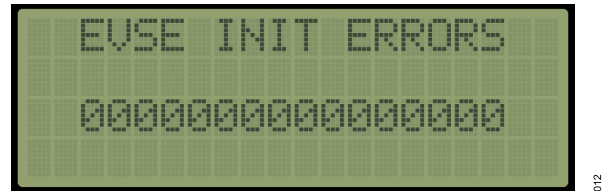


Figure 12. Initialization Error Screen

Table 3. Initialization Error Screen Bits

Bit Number	Name	Description
1	GPIO_ERROR	Set if an error occurs when initializing MCU GPIO pins.
2	SPI_ERROR	Set if an error occurs when initializing MCU SPI buses.
3	I2C_ERROR	Set if an error occurs when initializing MCU I2C buses.
4	INT_ERROR	Set if an error occurs when enabling interrupts.
5	LCD_ERROR	Set if an error occurs when initializing LCD. Note that LCD initialization errors do not cause a start up to fail.
6	RTC_ERROR	Set if an error occurs when initializing the <a href="#">MAX31343</a> RTC.
7	FRAM_ERROR	Set if an error occurs when initializing the on-board FRAM.
8	METR_ERROR	Set if an error occurs when initializing the <a href="#">ADE9178</a> .
9	MUTX_ERROR	Set if an error occurs when initializing software semaphores.
10	TASK_ERROR	Set if an error occurs when initializing software services.
11	RTOS_ERROR	Set if an error occurs when initializing RTOS tasks.

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Table 3. Initialization Error Screen Bits (Continued)

Bit Number	Name	Description
12	EXTD_ERROR	Set if an error occurs when initializing LCD board IO expander.
13	CONF_ERROR	Unused bit.
14	DMA_ERROR	Unused bit.
15	UART_ERROR	Set if an error occurs when initializing UART buses.
16	RCD_ERROR	Set if an error occurs when initializing RCD or the RCD self test fails.

## PROTOBUF LOGGING SCRIPT

The AD-ACEVSE22KWZ-KIT reports data to the EVerest open-source stack using Protobuf. This script helps to read Protobuf messages sent out from the AD-ACEVSE22KWZ-KIT. All received messages are logged as a standard serial output into a CSV file.

## Physical Connection

A UART to USB device must be properly connected to the AD-ACEVSE22KWZ-SL to interface with it using Protobuf. See the following instructions:

1. A UART to USB device is required (see [Equipment Needed](#) for recommendations).
2. Connect the USB side of the device to the host computer.
3. Connect the UART side of the device to P3 (see [Table 2](#)) on the AD-ACEVSE22KWZ-KIT.
  - ▶ Connect UART device TX line to pin 4 of P3.
  - ▶ Connect UART device RX line to pin 2 of P3.
  - ▶ Connect UART device GND to pin 3 of P3.

## Running the Script

Once the host PC is physically connected to the AD-ACEVSE22KWZ-KIT, run the Protobuf logger script. First, open the root directory of the AD-ACEVSE22KWZ-KIT BSP in PowerShell and run the following code:

```
> cd dist
> python -m venv venv
> venv/scripts/activate
> pip install -r requirements.txt
> python adi_protobuf_logger.py
```

The script initially asks which COM port the communication device is connected to on the host machine. To retrieve the COM port, navigate to the ports tab within the device manager. Once found, enter *comx*, as in COM4.

```
> python adi_protobuf_logger.py
Input the serial port connected to AD-
ACEVSE22KWZ-SL
Example response: 'comX'

> com4
Connection successful
```

## EVALUATION BOARD SOFTWARE

## Output Log

The output logs are stored in an auto-created directory called *pb\_output* within the BSP directory. An incomplete packet or a

failed translation to Protobuf format is marked as a `read fail` in the CSV file. It includes the size of the corresponding bitstream (in bytes) and its value (in hexadecimal).

**Table 4. Protobuf Message Fields**

Message Type	Description	Field ID	Field Name
keep_alive	Notify host of proof-of-life with additional status fields. Sent at regular intervals after successful start up.	1	time_stamp
		2	hw_type
		3	hw_revision
		4	protocol_version_major
		5	protocol_version_minor
		6	sw_version_string
		7	hwcap_max_current
		8	hwcap_min_current
		9	hwcap_max_phase_count
		10	hwcap_min_phase_count
		11	supports_changing_phases_during_charging
power_meter	Notify host of metrology-related fields. Sent at regular intervals during a charge session.	1	time_stamp
		2	vrmsL1
		3	vrmsL2
		4	vrmsL3
		5	irmsL1
		6	irmsL2
		7	irmsL3
		8	irmsN
		9	wattHrL1
		10	wattHrL2
		11	wattHrL3
		12	totalWattHr
		13	tempL1
		14	tempL2
		15	tempL3
		16	tempN
		17	wattL1
		18	wattL2
		19	wattL3
		20	freqL1
		21	freqL2
		22	freqL3
		23	phaseSeqError
reset	Notify host of reset.	1	reset_reason
cp_state	Notify host of CP state change.	1	cp_state
pp_state	Notify host of PP state change.	1	pp_state
relais_state	Notify host of relay state change.	1	relais_state
error_flags	Notify host of current state of error flags.	1	diode_fault
		2	rcd_selftest_failed
		3	rcd_triggered
		4	ventilation_not_available
		5	connector_lock_failed
		6	cp_signal_fault

## EVALUATION BOARD SOFTWARE

Table 4. Protobuf Message Fields (Continued)

Message Type	Description	Field ID	Field Name
		7	over_current

## MODBUS COMMUNICATION

The AD-ACEVSE22KWZ-KIT uses Modbus RTU protocol when debugging the system and ADE9178 registers. Specifically, the Enron Modbus variant is used to handle 32-bit registers in a single address. A host computer running Microsoft Windows is required as the primary device during communication.

## Physical Connection

A communication device must be properly connected to the AD-ACEVSE22KWZ-KIT to interface with it using Modbus. Either RS-485 or UART can be used for Modbus RTU protocol. See the following sections for instructions.

## Option 1: UART

Take the following steps for UART:

1. A UART to USB device is required (see [Equipment Needed](#) for recommendations).
2. Connect the USB side of the device to the host computer.
3. Connect the UART side of the device to P5 (see [Table 2](#)) on the AD-ACEVSE22KWZ-KIT.
  - ▶ Connect UART device TX line to pin 4 of P5.
  - ▶ Connect UART device RX line to pin 3 of P5.
  - ▶ Connect UART device GND to pin 1 of P5.
4. Disconnect the RS-485 interface by removing jumpers P6 and P4 (see [Table 2](#)).

## Option 2: RS-485

Take the following steps for RS-485:

1. An RS-485 to USB device is required (see [Equipment Needed](#) for recommendations).
2. Connect the USB side of the device to the host computer.
3. Connect the RS-485 side of the device to P8 (see [Table 2](#)) on the AD-ACEVSE22KWZ-KIT.
  - ▶ Connect signal line A to pin 1 of P8.
  - ▶ Connect signal line B to pin 2 of P8.
  - ▶ Connect GND to pin 3 of P8.
4. Connect the RS-485 interface by installing jumpers P6 and P4 (see [Table 2](#)).

## EVALUATION BOARD SOFTWARE

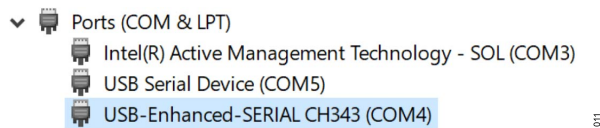
## Using Modbus Host Tools

Once the host PC is physically connected to the AD-ACEVSE22KWZ-KIT, either use an existing Modbus primary tool ([Simply Modbus](#) is recommended), or the basic command line script included in the AD-ACEVSE22KWZ-KIT BSP. To use the included command line script, run the following code inside a PowerShell terminal (starting at the root directory of the BSP).

```
> cd dist
> python -m venv venv
> venv/scripts/activate
> pip install -r requirements.txt
> python adi_modbus_ui.py
```

The script initially asks which COM port the communication device is connected to on the host machine. To retrieve the COM port, navigate to device manager and see under the ports tab. Once found, enter *comx*.

Example:



```
python adi_modbus_ui.py
Input the serial port connected to AD-
ACEVSE22KWZ-SL
Example response: 'COM5'
```

```
> com4
Connection successful
```

```
Type your command (type 'help' for help, type
'exit' to exit):
```

Once connected, type “help” in the console for a list of available commands.

```
> help
Possible commands, parameters will be prompted
after calling a specific command:
- read_coil
- read_discrete
- read_holding_reg
- read_input_reg
- write_single_coil
- write_single_reg
- write_multiple_reg
- exit
```

Choose one of the following commands. For example, to write '0xDECAFBAD' to ADE9178 register AVGAIN:

First, write the 'SET\_MODE' coil to debug mode.

```
> write_single_coil
input the address e.g('8')
> 19
input the desired value to written e.g('True'
for 1 and 'False' for 0)
> True
1
Type your command (type 'help' for help, type
'exit' to exit):
```

Now, write to the desired register.

```
> write_single_reg
input the address e.g('40008')
> 40001
input the value to write in hex e.g(a1b2c3d4)
> decafbad
decafbad
Type your command (type 'help' for help, type
'exit' to exit):
```

See the console respond with the same data to indicate a successful write.

**Note:** If the AD-ACEVSE22KWZ-KIT and/or ADE9178 resets, user-written register values are NOT saved.

## Simulating a Charge Session

To simulate a charge session over Modbus, connect to the P5 UART port or the P8 RS-485 port, as described above. If a Python environment is not yet created in the dist directory, create one using the “venv” command, activate it, and install the requirements, as shown in the following. If the environment is already created, simply activate it. As with the `adi_modbus_ui.py` script, there is a prompt to enter a com port number. [Using Modbus Host Tools](#) shows the instructions to find the port number. Once the port is entered, the script simulates the control pilot (CP) and proximity pilot (PP) voltages to step through a charge session.

```
> cd dist
> python -m venv venv
> venv/scripts/activate
> pip install -r requirements.txt
> python adi_run_session.py
```

## EVALUATION BOARD SOFTWARE

## Holding Registers

**Note:** Details for ADE9178 registers can be found in the [ADE9178 data sheet](#).

**Table 5. ADE9178 Holding Registers**

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
40001	0x000	AVGAIN	Phase A Voltage Gain Adjust	0x00000000	R/W
40002	0x001	AVOS	Phase A Voltage Channel Offset	0x00000000	R/W
40003	0x002	AVPHCAL	Phase A Voltage Phase Correction Factor	0x00000000	R/W
40004	0x003	AVRMSOS	Phase A Voltage RMS Offset	0x00000000	R/W
40005	0x004	AVRMSHALFOS	Phase A Voltage Half Cycle RMS Offset	0x00000000	R/W
40006	0x005	AVRMSONEOS	Phase A Voltage One Cycle RMS Offset	0x00000000	R/W
40007	0x006	AVDIPHALF_LVL	Phase A Voltage RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40008	0x007	AVDIPONE_LVL	Phase A Voltage RMSONE Dip Detection Threshold Level	0x00000000	R/W
40009	0x008	AVSWELLHALF_LVL	Phase A Voltage RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40010	0x009	AVSWELLONE_LVL	Phase A Voltage RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40011	0x00A	AVDIPHALF_CYC	Phase A Voltage RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40012	0x00B	AVDIPONE_CYC	Phase A Voltage RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40013	0x00C	AVSWELLHALF_CYC	Phase A Voltage RMSHALF Swell Half Line Cycle Configuration	0xFFFFFFFF	R/W
40014	0x00D	AVSWELLONE_CYC	Phase A Voltage RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40015	0x00E	AIGAIN	Phase A Current Gain Adjust	0x00000000	R/W
40016	0x00F	AIOS	Phase A Current Channel Offset	0x00000000	R/W
40017	0x010	AIPHCAL	Phase A Current Phase Correction Factor	0x00000000	R/W
40018	0x011	AIRMSOS	Phase A Current RMS Offset	0x00000000	R/W
40019	0x012	AIRMSHALFOS	Phase A Current Half Cycle RMS Offset	0x00000000	R/W
40020	0x013	AIRMSONEOS	Phase A Current One Cycle RMS Offset	0x00000000	R/W
40021	0x014	AIDIPHALF_LVL	Phase A Current RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40022	0x015	AIDIPONE_LVL	Phase A Current RMSONE Dip Detection Threshold Level	0x00000000	R/W
40023	0x016	AISWELLHALF_LVL	Phase A Current RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40024	0x017	AISWELLONE_LVL	Phase A Current RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40025	0x018	AIDIPHALF_CYC	Phase A Current RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40026	0x019	AIDIPONE_CYC	Phase A Current RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40027	0x01A	AISWELLHALF_CYC	Phase A Current RMSHALF Swell Half Line Cycle Configuration	0xFFFFFFFF	R/W
40028	0x01B	AISWELLONE_CYC	Phase A Current RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40029	0x01C	BVGAIN	Phase B Voltage Gain Adjust	0x00000000	R/W
40030	0x01D	BVOS	Phase B Voltage Channel Offset	0x00000000	R/W
40031	0x01E	BVPHCAL	Phase B Voltage Phase Correction Factor	0x00000000	R/W
40032	0x01F	BVRMSOS	Phase B Voltage RMS Offset	0x00000000	R/W
40033	0x020	BVRMSHALFOS	Phase B Voltage Half Cycle RMS Offset	0x00000000	R/W
40034	0x021	BVRMSONEOS	Phase B Voltage One Cycle RMS Offset	0x00000000	R/W
40035	0x022	BVDIPHALF_LVL	Phase B Voltage RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40036	0x023	BVDIPONE_LVL	Phase B Voltage RMSONE Dip Detection Threshold Level	0x00000000	R/W
40037	0x024	BVSWELLHALF_LVL	Phase B Voltage RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40038	0x025	BVSWELLONE_LVL	Phase B Voltage RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40039	0x026	BVDIPHALF_CYC	Phase B Voltage RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40040	0x027	BVDIPONE_CYC	Phase B Voltage RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40041	0x028	BVSWELLHALF_CYC	Phase B Voltage RMSHALF Swell Half Line Cycle Configuration	0xFFFFFFFF	R/W
40042	0x029	BVSWELLONE_CYC	Phase B Voltage RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40043	0x02A	BIGAIN	Phase B Current Gain Adjust	0x00000000	R/W

## EVALUATION BOARD SOFTWARE

Table 5. ADE9178 Holding Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
40044	0x02B	BIOS	Phase B Current Channel Offset	0x00000000	R/W
40045	0x02C	BIPHCAL	Phase B Current Phase Correction Factor	0x00000000	R/W
40046	0x02D	BIRMSOS	Phase B Current RMS Offset	0x00000000	R/W
40047	0x02E	BIRMSHALFOS	Phase B Current Half Cycle RMS Offset	0x00000000	R/W
40048	0x02F	BIRMSONEOS	Phase B Current One Cycle RMS Offset	0x00000000	R/W
40049	0x030	BIDIPHALF_LVL	Phase B Current RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40050	0x031	BIDIPONE_LVL	Phase B Current RMSONE Dip Detection Threshold Level	0x00000000	R/W
40051	0x032	BISWELLHALF_LVL	Phase B Current RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40052	0x033	BISWELLONE_LVL	Phase B Current RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40053	0x034	BIDIPHALF_CYC	Phase B Current RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40054	0x035	BIDIPONE_CYC	Phase B Current RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40055	0x036	BISWELLHALF_CYC	Phase B Current RMSHALF Swell Half Line Cycle Configuration	0xFFFFFFFF	R/W
40056	0x037	BISWELLONE_CYC	Phase B Current RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40057	0x038	CVGAIN	Phase C Voltage Gain Adjust	0x00000000	R/W
40058	0x039	CVOS	Phase C Voltage Channel Offset	0x00000000	R/W
40059	0x03A	CVPHCAL	Phase C Voltage Phase Correction Factor	0x00000000	R/W
40060	0x03B	CVRMSOS	Phase C Voltage RMS Offset	0x00000000	R/W
40061	0x03C	CVRMSHALFOS	Phase C Voltage Half Cycle RMS Offset	0x00000000	R/W
40062	0x03D	CVRMSONEOS	Phase C Voltage One Cycle RMS Offset	0x00000000	R/W
40063	0x03E	CVDIPHALF_LVL	Phase C Voltage RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40064	0x03F	CVDIPONE_LVL	Phase C Voltage RMSONE Dip Cycle Given in Line Cycles	0x00000000	R/W
40065	0x040	CVSWELLHALF_LVL	Phase C Voltage RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40066	0x041	CVSWELLONE_LVL	Phase C Voltage RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40067	0x042	CVDIPHALF_CYC	Phase C Voltage RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40068	0x043	CVDIPONE_CYC	Phase C Voltage RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40069	0x044	CVSWELLHALF_CYC	Phase C Voltage RMSHALF Swell Half Line Cycle Configuration	0xFFFFFFFF	R/W
40070	0x045	CVSWELLONE_CYC	Phase C Voltage RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40071	0x046	CIGAIN	Phase C Current Gain Adjust	0x00000000	R/W
40072	0x047	CIOS	Phase C Current Channel Offset	0x00000000	R/W
40073	0x048	CIPHCAL	Phase C Current Phase Correction Factor	0x00000000	R/W
40074	0x049	CIRMSOS	Phase C Current RMS Offset	0x00000000	R/W
40075	0x04A	CIRMSHALFOS	Phase C Current Half Cycle RMS Offset	0x00000000	R/W
40076	0x04B	CIRMSONEOS	Phase C Current One Cycle RMS Offset	0x00000000	R/W
40077	0x04C	CIDIPHALF_LVL	Phase C Current RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40078	0x04D	CIDIPONE_LVL	Phase C Current RMSONE Dip Detection Threshold Level	0x00000000	R/W
40079	0x04E	CISWELLHALF_LVL	Phase C Current RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40080	0x04F	CISWELLONE_LVL	Phase C Current RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40081	0x050	CIDIPHALF_CYC	Phase C Current RMSHALF Dip Specified in Half Line Cycles	0xFFFFFFFF	R/W
40082	0x051	CIDIPONE_CYC	Phase C Current RMSONE Dip Specified in Line Cycles	0xFFFFFFFF	R/W
40083	0x052	CISWELLHALF_CYC	Phase C Current RMSHALF Swell Specified in Half Line Cycles	0xFFFFFFFF	R/W
40084	0x053	CISWELLONE_CYC	Phase C Current RMSONE Swell Specified in Line Cycles	0xFFFFFFFF	R/W
40085	0x054	AUX0GAIN	Auxiliary 0 Channel Gain Adjust	0x00000000	R/W
40086	0x055	AUX0OS	Auxiliary 0 Channel Offset	0x00000000	R/W
40087	0x056	AUX0PHCAL	Auxiliary 0 Channel Phase Correction Factor	0x00000000	R/W
40088	0x057	AUX0RMSOS	Auxiliary 0 Channel RMS Offset	0x00000000	R/W
40089	0x058	AUX0RMSHALFOS	Auxiliary 0 Half Cycle RMS Offset	0x00000000	R/W
40090	0x059	AUX0RMSONEOS	Auxiliary 0 One Cycle RMS Offset	0x00000000	R/W
40091	0x05A	AUX0DIPHALF_LVL	Auxiliary 0 Channel RMSHALF Dip Detection Threshold Level	0x00000000	R/W

## EVALUATION BOARD SOFTWARE

Table 5. ADE9178 Holding Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
40092	0x05B	AUX0DIPONE_LVL	Auxiliary 0 Channel RMSONE Dip Detection Threshold Level	0x00000000	R/W
40093	0x05C	AUX0SWELLHALF_LVL	Auxiliary 0 Channel RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40094	0x05D	AUX0SWELLONE_LVL	Auxiliary 0 Channel RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40095	0x05E	AUX0DIPHALF_CYC	Auxiliary 0 RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40096	0x05F	AUX0DIPONE_CYC	Auxiliary 0 RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40097	0x060	AUX0SWELLHALF_CYC	Auxiliary 0 RMSHALF Swell Half Line Cycles Configuration	0xFFFFFFFF	R/W
40098	0x061	AUX0SWELLONE_CYC	Auxiliary 0 RMSHALF Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40099	0x062	AUX1GAIN	Auxiliary 1 Channel Gain Adjust	0x00000000	R/W
40100	0x063	AUX1OS	Auxiliary 1 Channel Offset	0x00000000	R/W
40101	0x064	AUX1PHCAL	Auxiliary 1 Channel Phase Correction Factor	0x00000000	R/W
40102	0x065	AUX1RMSOS	Auxiliary 1 Channel Filtered RMS Offset	0x00000000	R/W
40103	0x066	AUX1RMSHALFOS	Auxiliary 1 Channel Half Cycle RMS Offset	0x00000000	R/W
40104	0x067	AUX1RMSONEOS	Auxiliary 1 Channel One Cycle RMS Offset	0x00000000	R/W
40105	0x068	AUX1DIPHALF_LVL	Auxiliary 1 Channel RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40106	0x069	AUX1DIPONE_LVL	Auxiliary 1 Channel RMSONE Dip Detection Threshold Level	0x00000000	R/W
40107	0x06A	AUX1SWELLHALF_LVL	Auxiliary 1 Channel RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40108	0x06B	AUX1SWELLONE_LVL	Auxiliary 1 Channel RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40109	0x06C	AUX1DIPHALF_CYC	Auxiliary 1 RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40110	0x06D	AUX1DIPONE_CYC	Auxiliary 1 RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40111	0x06E	AUX1SWELLHALF_CYC	Auxiliary 1 RMSHALF Swell Half Line Cycles Configuration	0xFFFFFFFF	R/W
40112	0x06F	AUX1SWELLONE_CYC	Auxiliary 1 RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40113	0x070	AUX2GAIN	Auxiliary 2 Channel Gain Adjust	0x00000000	R/W
40114	0x071	AUX2OS	Auxiliary 2 Channel Offset	0x00000000	R/W
40115	0x072	AUX2PHCAL	Auxiliary 2 Channel Phase Correction Factor	0x00000000	R/W
40116	0x073	AUX2RMSOS	Auxiliary 2 Channel Filtered RMS Offset	0x00000000	R/W
40117	0x074	AUX2RMSHALFOS	Auxiliary 2 Channel Half Cycle RMS Offset	0x00000000	R/W
40118	0x075	AUX2RMSONEOS	Auxiliary 2 Channel One Cycle RMS Offset	0x00000000	R/W
40119	0x076	AUX2DIPHALF_LVL	Auxiliary 2 Channel RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40120	0x077	AUX2DIPONE_LVL	Auxiliary 2 Channel RMSONE Dip Detection Threshold Level	0x00000000	R/W
40121	0x078	AUX2SWELLHALF_LVL	Auxiliary 2 Channel RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40122	0x079	AUX2SWELLONE_LVL	Auxiliary 2 Channel RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40123	0x07A	AUX2DIPHALF_CYC	Auxiliary 2 RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40124	0x07B	AUX2DIPONE_CYC	Auxiliary 2 RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40125	0x07C	AUX2SWELLHALF_CYC	Auxiliary 2 RMSHALF Swell Half Line Cycles Configuration	0xFFFFFFFF	R/W
40126	0x07D	AUX2SWELLONE_CYC	Auxiliary 2 RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40127	0x07E	AUX3GAIN	Auxiliary 3 Channel Gain Adjust	0x00000000	R/W
40128	0x07F	AUX3OS	Auxiliary 3 Channel Offset	0x00000000	R/W
40129	0x080	AUX3PHCAL	Auxiliary 3 Channel Phase Correction Factor	0x00000000	R/W
40130	0x081	AUX3RMSOS	Auxiliary 3 Channel Filtered RMS Offset	0x00000000	R/W
40131	0x082	AUX3RMSHALFOS	Auxiliary 3 Channel Half Cycle RMS Offset	0x00000000	R/W
40132	0x083	AUX3RMSONEOS	Auxiliary 3 Channel One Cycle RMS Offset	0x00000000	R/W
40133	0x084	AUX3DIPHALF_LVL	Auxiliary 3 Channel RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40134	0x085	AUX3DIPONE_LVL	Auxiliary 3 Channel RMSONE Dip Detection Threshold Level	0x00000000	R/W
40135	0x086	AUX3SWELLHALF_LVL	Auxiliary 3 Channel RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40136	0x087	AUX3SWELLONE_LVL	Auxiliary 3 Channel RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40137	0x088	AUX3DIPHALF_CYC	Auxiliary 3 RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40138	0x089	AUX3DIPONE_CYC	Auxiliary 3 RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40139	0x08A	AUX3SWELLHALF_CYC	Auxiliary 3 RMSHALF Swell Half Line Cycles Configuration	0xFFFFFFFF	R/W

## EVALUATION BOARD SOFTWARE

Table 5. ADE9178 Holding Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
40140	0x08B	AUX3SWELLONE_CYC	Auxiliary 3 RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40141	0x08C	AUX4GAIN	Auxiliary 4 Channel Gain Adjust	0x00000000	R/W
40142	0x08D	AUX4OS	Auxiliary 4 Channel Offset	0x00000000	R/W
40143	0x08E	AUX4PHCAL	Auxiliary 4 Channel Phase Correction Factor	0x00000000	R/W
40144	0x08F	AUX4RMSOS	Auxiliary 4 Channel Filtered RMS Offset	0x00000000	R/W
40145	0x090	AUX4RMSHALFOS	Auxiliary 4 Channel Half Cycle RMS Offset	0x00000000	R/W
40146	0x091	AUX4RMSONEOS	Auxiliary 4 Channel One Cycle RMS Offset	0x00000000	R/W
40147	0x092	AUX4DIPHALF_LVL	Auxiliary 4 Channel RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40148	0x093	AUX4DIPONE_LVL	Auxiliary 4 Channel RMSONE Dip Detection Threshold Level	0x00000000	R/W
40149	0x094	AUX4SWELLHALF_LVL	Auxiliary 4 Channel RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40150	0x095	AUX4SWELLONE_LVL	Auxiliary 4 Channel RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40151	0x096	AUX4DIPHALF_CYC	Auxiliary 4 RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40152	0x097	AUX4DIPONE_CYC	Auxiliary 4 RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40153	0x098	AUX4SWELLHALF_CYC	Auxiliary 4 RMSHALF Swell Half Line Cycles Configuration	0xFFFFFFFF	R/W
40154	0x099	AUX4SWELLONE_CYC	Auxiliary 4 RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40155	0x09A	AUX5GAIN	Auxiliary 5 Channel Gain Adjust	0x00000000	R/W
40156	0x09B	AUX5OS	Auxiliary 5 Channel Offset	0x00000000	R/W
40157	0x09C	AUX5PHCAL	Auxiliary 5 Channel Phase Correction Factor	0x00000000	R/W
40158	0x09D	AUX5RMSOS	Auxiliary 5 Channel Filtered RMS Offset	0x00000000	R/W
40159	0x09E	AUX5RMSHALFOS	Auxiliary 5 Channel Half Cycle RMS Offset	0x00000000	R/W
40160	0x09F	AUX5RMSONEOS	Auxiliary 5 Channel One Cycle RMS Offset	0x00000000	R/W
40161	0x0A0	AUX5DIPHALF_LVL	Auxiliary 5 Channel RMSHALF Dip Detection Threshold Level	0x00000000	R/W
40162	0x0A1	AUX5DIPONE_LVL	Auxiliary 5 RMSONE Dip Specified in Line Cycles	0x00000000	R/W
40163	0x0A2	AUX5SWELLHALF_LVL	Auxiliary 5 Channel RMSHALF Swell Detection Threshold Level	0xFFFFFFFF	R/W
40164	0x0A3	AUX5SWELLONE_LVL	Auxiliary 5 Channel RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40165	0x0A4	AUX5DIPHALF_CYC	Auxiliary 5 RMSHALF Dip Half Line Cycles Configuration	0xFFFFFFFF	R/W
40166	0x0A5	AUX5DIPONE_CYC	Auxiliary 5 RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40167	0x0A6	AUX5SWELLHALF_CYC	Auxiliary 5 RMSHALF Swell Half Line Cycles Configuration	0xFFFFFFFF	R/W
40168	0x0A7	AUX5SWELLONE_CYC	Auxiliary 5 RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40169	0x0A8	APGAIN	Phase A Power Gain Adjust	0x00000000	R/W
40170	0x0A9	AWATTOS	Phase A Total Active Power Offset Correction	0x00000000	R/W
40171	0x0AA	BPGAIN	Phase B Power Gain Adjust	0x00000000	R/W
40172	0x0AB	BWATTOS	Phase B Total Active Power Offset Correction	0x00000000	R/W
40173	0x0AC	CPGAIN	Phase C Power Gain Adjust	0x00000000	R/W
40174	0x0AD	CWATTOS	Phase C Total Active Power Offset Correction	0x00000000	R/W
40175	0x0AE	CONFIG0	Configuration Register 0	0x00000D80	R/W
40176	0x0AF	PEAK_CONFIG	Peak Detection Configuration Register	0x00000000	R/W
40177	0x0B0	PEN_CONFIG	PEN Fault Channel Selection Configuration Register	0x00003420	R/W
40178	0x0B1	CF1_CONFIG	CF1 Configuration Register	0x00000001	R/W
40179	0x0B2	CF2_CONFIG	CF2 Configuration Register	0x00000001	R/W
40180	0x0B3	ISUMRMSOS	Offset Correction for ISUMRMS Calculation	0x00000000	R/W
40181	0x0B4	ISUMLVL	Threshold to Compare ISUMRMS Against	0x00000000	R/W
40182	0x0B5	VNOM	Nominal Phase Voltage RMS	0x00000000	R/W
40183	0x0B6	USER_PERIOD	User Configured Line Period Value	0x00500000	R/W
40184	0x0B7	RMSHALF_CONFIG	RMSHALF Mode Selection Configuration	0x00000000	R/W
40185	0x0B8	USER_PERIOD_HALF	User Configured Half Line Cycle Period Value	0x00280000	R/W
40186	0x0B9	CF1_THR	Energy Threshold for CF1 Pulse Generation	0x0000FFFF	R/W
40187	0x0BA	CF2_THR	Energy Threshold for CF2 Pulse Generation	0x0000FFFF	R/W

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Table 5. ADE9178 Holding Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
40188	0x0BB	ZXTOUT	Zero Crossing Timeout Configuration Register	0x0000FFFF	R/W
40189	0x0BC	ZXTHRSRSH	Zero Crossing Threshold Register	0x000019EA	R/W
40190	0x0BD	ZX_LP_SEL	Zero Crossing and Line Period Configuration	0x0000000F	R/W
40191	0x0BE	SEQ_CYC	Line Cycles for Phase Sequence Error Detection	0x00000001	R/W
40192	0x0BF	ACT_NL_LVL	No Load Threshold in the Active Power Datapath	0x0000FFFF	R/W
40193	0x0C0	APP_NL_LVL	No Load Threshold in the Apparent Power Datapath	0x0000FFFF	R/W
40194	0x0C1	EP_CFG	Energy and Power Accumulation Configuration	0x00000000	R/W
40195	0x0C2	EGY_TIME	Energy Accumulation Update Time Configuration	0x000000FF	R/W
40196	0x0C3	VSUMRMSONEOS	Offset Correction for VSUMRMS Calculation	0x00000000	R/W
40197	0x0C4	VSUMSWELLONE_LVL	VSUM RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40198	0x0C5	VSUMSWELLONE_CYC	VSUM RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40199	0x0C6	VABRMSONEOS	Offset Correction for VP2P (AV - BV) RMSONE Calculation	0x00000000	R/W
40200	0x0C7	VABDIPONE_LVL	VP2P (AV - BV) RMSONE Dip Detection Threshold Level	0x00000000	R/W
40201	0x0C8	VABDIPONE_CYC	VP2P (AV - BV) RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40202	0x0C9	VABSWELLONE_LVL	VP2P (AV - BV) RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40203	0x0CA	VABSWELLONE_CYC	VP2P (AV - BV) RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40204	0x0CB	VBCRMSONEOS	Offset Correction for VP2P (BV - CV) RMSONE Calculation	0x00000000	R/W
40205	0x0CC	VBCDIPONE_LVL	VP2P (BV - CV) RMSONE Dip Detection Threshold Level	0x00000000	R/W
40206	0x0CD	VBCDIPONE_CYC	VP2P (BV - CV) RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40207	0x0CE	VBCSWELLONE_LVL	VP2P (BV - CV) RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40208	0x0CF	VBCSWELLONE_CYC	VP2P (BV - CV) RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40209	0x0D0	VACRMSONEOS	Offset Correction for VP2P (AV - CV) RMSONE Calculation	0x00000000	R/W
40210	0x0D1	VACDIPONE_LVL	VP2P (AV - CV) RMSONE Dip Detection Threshold Level	0x00000000	R/W
40211	0x0D2	VACDIPONE_CYC	VP2P (AV - CV) RMSONE Dip Line Cycles Configuration	0xFFFFFFFF	R/W
40212	0x0D3	VACSWELLONE_LVL	VP2P (AV - CV) RMSONE Swell Detection Threshold Level	0xFFFFFFFF	R/W
40213	0x0D4	VACSWELLONE_CYC	VP2P (AV - CV) RMSONE Swell Line Cycles Configuration	0xFFFFFFFF	R/W
40214	0x0D5	CF_LTMR	CF Calibration Pulse Width Configuration Register	0x00000000	R/W
40215	0x0D6	WFS_CONFIG	Waveform Streaming Configuration Register	0x0000000C	R/W
40216	0x0D7	ADC_CONTROL	ADC Control Register	0x00000000	R/W
40217	0x0D8	ADC_CONFIG	ADC Configuration Register	0x00000004	R/W
40218	0x0D9	ADC_REDIRECT0	ADC Datapath Redirection Register 0	0x06431D2A	R/W
40219	0x0DA	ADC_REDIRECT1	ADC Datapath Redirection Register 1	0x0410150B	R/W
40220	0x0DB	CRC_OPTEN	Configuration Registers CRC Selection	0x00000000	R/W
40221	0x0DC	CRC_FORCE	Force Configuration Registers CRC Update	0x00000000	R/W
40222	0x0DD	CONFIG_LOCK	Configuration Lock Register	0x00000000	R/W
40223	0x400	STATUS0	Status Register 0	0x00004000	R/W
40224	0x401	STATUS1	Status Register 1	0x00000000	R/W
40225	0x402	STATUS2	Status Register 2	0x00000000	R/W
40226	0x403	STATUS3	Status Register 3	0x00000000	R/W
40227	0x404	ERROR_STATUS	Firmware Status Register	0x00000000	R/W
40228	0x405	MASK0	Interrupt Enable Register 0	0x00004000	R/W
40229	0x406	MASK1	Interrupt Enable Register 1	0x00000000	R/W
40230	0x407	MASK2	Interrupt Enable Register 2	0x00000000	R/W
40231	0x408	MASK3	Interrupt Enable Register 3	0x00000000	R/W
40232	0x409	ERROR_MASK	Firmware Status Interrupt Enable Register	0x007FFFFFFF	R/W

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Table 6. System Holding Registers

Modbus Address	System Address	Name	Description	Reset	Access
40233	0x01	MAX_CHARGE_CURRENT	Default maximum charging current is 32A. Other current values are 6A, 12A, 18A, 24A, 32A, 40A, 48A, 65A, 75A, 80A. Note: single write only (MODBUS function code 6).	0x20	R/W
40234	0x02	CP_VOLTAGE	Override CP_VOLTAGE, value in Volts. Reset value is approximate to user hardware setup.	0x0C	R/W
40235	0x03	CP_PWM_LOW_VOLTAGE	Override CP_PWM_LOW_VOLTAGE, value in Volts. Used to simulate diode short condition. Reset value is approximate to user hardware setup.	0x0C	R/W
40236	0x04	PP_VOLTAGE	Override PP_VOLTAGE, value in Volts. Reset value is approximate to user hardware setup.	0x00	R/W

## Input Registers

Note: Details for ADE9178 registers can be found in the [ADE9178 data sheet](#).

Table 7. ADE9178 Input Registers

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
30001	0x200	AVRMS	Phase A Filter Based Voltage RMS.	0x00000000	R
30002	0x201	AVRMSHALF	Phase A Voltage Channel Half Cycle RMS	0x00000000	R
30003	0x202	AVRMSONE	Phase A Voltage Channel One Cycle RMS	0x00000000	R
30004	0x203	AVDIPHALF	Phase A Voltage Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30005	0x204	AVDIPONE	Phase A Voltage Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30006	0x205	AVSWELLHALF	Phase A Voltage Maximum RMSHALF for Last Detected Swell	0x00000000	R
30007	0x206	AVSWELLONE	Phase A Voltage Maximum RMSONE for Last Detected Swell	0x00000000	R
30008	0x207	AIRMS	Phase A Filter Based Current RMS	0x00000000	R
30009	0x208	AIRMSHALF	Phase A Current Channel Half Cycle RMS	0x00000000	R
30010	0x209	AIRMSONE	Phase A Current Channel One Cycle RMS	0x00000000	R
30011	0x20A	AIDIPHALF	Phase A Current Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30012	0x20B	AIDIPONE	Phase A Current Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30013	0x20C	AISWELLHALF	Phase A Current Maximum RMSHALF for Last Detected Swell	0x00000000	R
30014	0x20D	AISWELLONE	Phase A Current Maximum RMSONE for Last Detected Swell	0x00000000	R
30015	0x20E	BVRMS	Phase B Filter Based Voltage RMS	0x00000000	R
30016	0x20F	BVRMSHALF	Phase B Voltage Channel Half Cycle RMS	0x00000000	R
30017	0x210	BVRMSONE	Phase B Voltage Channel One Cycle RMS	0x00000000	R
30018	0x211	BVDIPHALF	Phase B Voltage Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30019	0x212	BVDIPONE	Phase B Voltage Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30020	0x213	BVSWELLHALF	Phase B Voltage Maximum RMSHALF for Last Detected Swell	0x00000000	R
30021	0x214	BVSWELLONE	Phase B Voltage Maximum RMSONE for Last Detected Swell	0x00000000	R
30022	0x215	BIRMS	Phase B Filter Based Current RMS	0x00000000	R
30023	0x216	BIRMSHALF	Phase B Current Channel Half Cycle RMS	0x00000000	R
30024	0x217	BIRMSONE	Phase B Current Channel One Cycle RMS	0x00000000	R
30025	0x218	BIDIPHALF	Phase B Current Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30026	0x219	BIDIPONE	Phase B Current Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30027	0x21A	BISWELLHALF	Phase B Current Maximum RMSHALF for Last Detected Swell	0x00000000	R
30028	0x21B	BISWELLONE	Phase B Current Maximum RMSONE for Last Detected Swell	0x00000000	R
30029	0x21C	CVRMS	Phase C Filter Based Voltage RMS	0x00000000	R
30030	0x21D	CVRMSHALF	Phase C Voltage Channel Half Cycle RMS	0x00000000	R
30031	0x21E	CVRMSONE	Phase C Voltage Channel One Cycle RMS	0x00000000	R

## EVALUATION BOARD SOFTWARE

Table 7. ADE9178 Input Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
30032	0x21F	CVDIPHALF	Phase C Voltage Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30033	0x220	CVDIPONE	Phase C Voltage Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30034	0x221	CVSWELLHALF	Phase C Voltage Maximum RMSHALF for Last Detected Swell	0x00000000	R
30035	0x222	CVSWELLONE	Phase C Voltage Maximum RMSONE for Last Detected Swell	0x00000000	R
30036	0x223	CIRMS	Phase C Filter Based Current RMS	0x00000000	R
30037	0x224	CIRMSHALF	Phase C Current Channel Half Cycle RMS	0x00000000	R
30038	0x225	CIRMSONE	Phase C Current Channel One Cycle RMS	0x00000000	R
30039	0x226	CIDIPHALF	Phase C Current Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30040	0x227	CIDIPONE	Phase C Current Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30041	0x228	CISWELLHALF	Phase C Current Maximum RMSHALF for Last Detected Swell	0x00000000	R
30042	0x229	CISWELLONE	Phase C Current Maximum RMSONE for Last Detected Swell	0x00000000	R
30043	0x22A	AUX0RMS	Auxiliary 0 Filter Based RMS	0x00000000	R
30044	0x22B	AUX0RMSHALF	Auxiliary 0 Channel Half Cycle RMS.	0x00000000	R
30045	0x22C	AUX0RMSONE	Auxiliary 0 Channel One Cycle RMS	0x00000000	R
30046	0x22D	AUX0DIPHALF	Auxiliary 0 Channel Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30047	0x22E	AUX0DIPONE	Auxiliary 0 Channel Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30048	0x22F	AUX0SWELLHALF	Auxiliary 0 Channel Maximum RMSHALF for Last Detected Swell	0x00000000	R
30049	0x230	AUX0SWELLONE	Auxiliary 0 Channel Maximum RMSONE for Last Detected Swell	0x00000000	R
30050	0x231	AUX1RMS	Auxiliary 1 Channel Filter Based RMS	0x00000000	R
30051	0x232	AUX1RMSHALF	Auxiliary 1 Channel Half Cycle RMS	0x00000000	R
30052	0x233	AUX1RMSONE	Auxiliary 1 Channel One Cycle RMS	0x00000000	R
30053	0x234	AUX1DIPHALF	Auxiliary 1 Channel Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30054	0x235	AUX1DIPONE	Auxiliary 1 Channel Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30055	0x236	AUX1SWELLHALF	Auxiliary 1 Channel Maximum RMSHALF for Last Detected Swell	0x00000000	R
30056	0x237	AUX1SWELLONE	Auxiliary 1 Channel Maximum RMSONE for Last Detected Swell	0x00000000	R
30057	0x238	AUX2RMS	Auxiliary 2 Channel Filter Based RMS	0x00000000	R
30058	0x239	AUX2RMSHALF	Auxiliary 2 Channel Half Cycle RMS	0x00000000	R
30059	0x23A	AUX2RMSONE	Auxiliary 2 Channel One Cycle RMS	0x00000000	R
30060	0x23B	AUX2DIPHALF	Auxiliary 2 Channel Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30061	0x23C	AUX2DIPONE	Auxiliary 2 Channel Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30062	0x23D	AUX2SWELLHALF	Auxiliary 2 Channel Maximum RMSHALF for Last Detected Swell	0x00000000	R
30063	0x23E	AUX2SWELLONE	Auxiliary 2 Channel Maximum RMSONE for Last Detected Swell	0x00000000	R
30064	0x23F	AUX3RMS	Auxiliary 3 Channel Filter Based RMS	0x00000000	R
30065	0x240	AUX3RMSHALF	Auxiliary 3 Channel Half Cycle RMS	0x00000000	R
30066	0x241	AUX3RMSONE	Auxiliary 3 Channel One Cycle RMS	0x00000000	R
30067	0x242	AUX3DIPHALF	Auxiliary 3 Channel Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30068	0x243	AUX3DIPONE	Auxiliary 3 Channel Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30069	0x244	AUX3SWELLHALF	Auxiliary 3 Channel Maximum RMSHALF for Last Detected Swell	0x00000000	R
30070	0x245	AUX3SWELLONE	Auxiliary 3 Channel Maximum RMSONE for Last Detected Swell	0x00000000	R
30071	0x246	AUX4RMS	Auxiliary 4 Channel Filter Based RMS	0x00000000	R
30072	0x247	AUX4RMSHALF	Auxiliary 4 Channel Half Cycle RMS	0x00000000	R
30073	0x248	AUX4RMSONE	Auxiliary 4 Channel One Cycle RMS	0x00000000	R
30074	0x249	AUX4DIPHALF	Auxiliary 4 Channel Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30075	0x24A	AUX4DIPONE	Auxiliary 4 Channel Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30076	0x24B	AUX4SWELLHALF	Auxiliary 4 Channel Maximum RMSHALF for Last Detected Swell	0x00000000	R
30077	0x24C	AUX4SWELLONE	Auxiliary 4 Channel Maximum RMSONE for Last Detected Swell	0x00000000	R
30078	0x24D	AUX5RMS	Auxiliary 5 Channel Filter Based RMS	0x00000000	R
30079	0x24E	AUX5RMSHALF	Auxiliary 5 Channel Half Cycle RMS	0x00000000	R

## EVALUATION BOARD SOFTWARE

Table 7. ADE9178 Input Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
30080	0x24F	AUX5RMSONE	Auxiliary 5 Channel One Cycle RMS	0x00000000	R
30081	0x250	AUX5DIPHALF	Auxiliary 5 Channel Minimum RMSHALF for Last Detected Dip	0x007FFFFFFF	R
30082	0x251	AUX5DIPONE	Auxiliary 5 Channel Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30083	0x252	AUX5SWELLHALF	Auxiliary 5 Channel Maximum RMSHALF for Last Detected Swell	0x00000000	R
30084	0x253	AUX5SWELLONE	Auxiliary 5 Channel Maximum RMSONE for Last Detected Swell	0x00000000	R
30085	0x254	AWATT	Phase A Low-Pass Filtered Total Active Power	0x00000000	R
30086	0x255	AVA	Phase A Total Apparent Power	0x00000000	R
30087	0x256	APF	Phase A Power Factor	0x00000000	R
30088	0x257	AWATTHR_POS_LO	Phase A Accumulated Positive Total Active Energy, LSB	0x00000000	R
30089	0x258	AWATTHR_POS_HI	Phase A Accumulated Positive Total Active Energy, MSB	0x00000000	R
30090	0x259	AWATTHR_NEG_LO	Phase A Accumulated Negative Total Active Energy, LSB	0x00000000	R
30091	0x25A	AWATTHR_NEG_HI	Phase A Accumulated Negative Total Active Energy, MSB	0x00000000	R
30092	0x25B	AWATTHR_SIGNED_LO	Phase A Accumulated Signed Total Active Energy, LSB	0x00000000	R
30093	0x25C	AWATTHR_SIGNED_HI	Phase A Accumulated Signed Total Active Energy, MSB	0x00000000	R
30094	0x25D	AVAHR_LO	Phase A Accumulated Total Apparent Energy, LSB	0x00000000	R
30095	0x25E	AVAHR_HI	Phase A Accumulated Total Apparent Energy, MSB	0x00000000	R
30096	0x25F	BWATT	Phase B Low-Pass Filtered Total Active Power	0x00000000	R
30097	0x260	BVA	Phase B Total Apparent Power	0x00000000	R
30098	0x261	BPF	Phase B Power Factor	0x00000000	R
30099	0x262	BWATTHR_POS_LO	Phase B Accumulated Positive Total Active Energy, LSB	0x00000000	R
30100	0x263	BWATTHR_POS_HI	Phase B Accumulated Positive Total Active Energy, MSB	0x00000000	R
30101	0x264	BWATTHR_NEG_LO	Phase B Accumulated Negative Total Active Energy, LSB	0x00000000	R
30102	0x265	BWATTHR_NEG_HI	Phase B Accumulated Negative Total Active Energy, MSB	0x00000000	R
30103	0x266	BWATTHR_SIGNED_LO	Phase B Accumulated Signed Total Active Energy, LSB	0x00000000	R
30104	0x267	BWATTHR_SIGNED_HI	Phase B Accumulated Signed Total Active Energy, MSB	0x00000000	R
30105	0x268	BVAHR_LO	Phase B Accumulated Total Apparent Energy, LSB	0x00000000	R
30106	0x269	BVAHR_HI	Phase B Accumulated Total Apparent Energy, MSB	0x00000000	R
30107	0x26A	CWATT	Phase C Low-Pass Filtered Total Active Power	0x00000000	R
30108	0x26B	CVA	Phase C Total Apparent Power	0x00000000	R
30109	0x26C	CPF	Phase C Power Factor	0x00000000	R
30110	0x26D	CWATTHR_POS_LO	Phase C Accumulated Positive Total Active Energy, LSB	0x00000000	R
30111	0x26E	CWATTHR_POS_HI	Phase C Accumulated Positive Total Active Energy, MSB	0x00000000	R
30112	0x26F	CWATTHR_NEG_LO	Phase C Accumulated Negative Total Active Energy, LSB	0x00000000	R
30113	0x270	CWATTHR_NEG_HI	Phase C Accumulated Negative Total Active Energy, MSB	0x00000000	R
30114	0x271	CWATTHR_SIGNED_LO	Phase C Accumulated Signed Total Active Energy, LSB	0x00000000	R
30115	0x272	CWATTHR_SIGNED_HI	Phase C Accumulated Signed Total Active Energy, MSB	0x00000000	R
30116	0x273	CVAHR_LO	Phase C Accumulated Total Apparent Energy, LSB	0x00000000	R
30117	0x274	CVAHR_HI	Phase C Accumulated Total Apparent Energy, MSB	0x00000000	R
30118	0x275	ANGL_AV_BV	Phase A Voltage to Phase B Voltage Angle Register	0x00000000	R
30119	0x276	ANGL_BV_CV	Phase B Voltage to Phase C Voltage Angle Register	0x00000000	R
30120	0x277	ANGL_AV_CV	Phase A Voltage to Phase C Voltage Angle Register	0x00000000	R
30121	0x278	ANGL_AV_AI	Phase A Voltage to Current Angle Register	0x00000000	R
30122	0x279	ANGL_BV_BI	Phase B Voltage to Current Angle Register	0x00000000	R
30123	0x27A	ANGL_CV_CI	Phase C Voltage to Current Angle Register	0x00000000	R
30124	0x27B	ANGL_AI_BI	Phase A Current to Phase B Current Angle Register	0x00000000	R
30125	0x27C	ANGL_BI_CI	Phase B Current to Phase C Current Angle Register	0x00000000	R
30126	0x27D	ANGL_AI_CI	Phase A Current to Phase C Current Angle Register	0x00000000	R
30127	0x27E	ISUMRMS	Filter Based RMS Based on the Sum of Current Channels	0x00000000	R

## EVALUATION BOARD SOFTWARE

Table 7. ADE9178 Input Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
30128	0x280	PEN_PERIOD	Period Value Used for PEN Channels RMSONE Calculation	0x00500000	R
30129	0x281	APERIOD	Line Period on Phase A Voltage	0x00500000	R
30130	0x282	BPERIOD	Line Period on Phase B Voltage	0x00500000	R
30131	0x283	CPERIOD	Line Period on Phase C Voltage	0x00500000	R
30132	0x284	COM_PERIOD	Line Period on Combined Phase A, B, and C Voltages	0x00500000	R
30133	0x285	IPEAK	Current Peak Register	0x00000000	R
30134	0x286	VPEAK	Voltage Peak Register	0x00000000	R
30135	0x287	AUXPEAK	Auxiliary Channels Peak Register	0x00000000	R
30136	0x288	PHSIGN	Power Sign Register	0x00000000	R
30137	0x289	PHNOLOAD	Phase No Load Register	0x00000000	R
30138	0x28A	VSUMRMSONE	One Cycle RMS for PEN Fault	0x00000000	R
30139	0x28B	VSUMSWELLONE	Maximum VSUMRMSONE for Last Detected Swell	0x007FFFFFFF	R
30140	0x28C	VABRMSONE	VP2P (AV - BV) One Cycle RMS	0x00000000	R
30141	0x28D	VABDIPONE	VP2P (AV - BV) Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30142	0x28E	VABSWELLONE	VP2P (AV - BV) Maximum RMSONE for Last Detected Swell	0x007FFFFFFF	R
30143	0x28F	VBCRMSONE	VP2P (BV - CV) One Cycle RMS	0x00000000	R
30144	0x290	VBCDIPONE	VP2P (BV - CV) Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30145	0x291	VBCSWELLONE	VP2P (BV - CV) Maximum RMSONE for Last Detected Swell	0x007FFFFFFF	R
30146	0x292	VACRMSONE	VP2P (AV - CV) One Cycle RMS	0x00000000	R
30147	0x293	VACDIPONE	VP2P (AV - CV) Minimum RMSONE for Last Detected Dip	0x007FFFFFFF	R
30148	0x294	VACSWELLONE	VP2P (AV - CV) Maximum RMSONE for Last Detected Swell	0x007FFFFFFF	R
30149	0x295	CRC_RSLT	Configuration Registers CRC Value	0x00000000	R
30150	0x40A	VERSION	Version of ADE9178 IC	0x00040000	R
30151	0x40B	VERSION2	Metrology Algorithm Version	0x0A96A1CE	R
30152	0x600	AVRMS_1	SPI Burst Read Access by Function. See AVRMS	0x00000000	R
30153	0x601	BVRMS_1	SPI Burst Read Access by Function. See BVRMS	0x00000000	R
30154	0x602	CVRMS_1	SPI Burst Read Access by Function. See CVRMS	0x00000000	R
30155	0x603	AIRMS_1	SPI Burst Read Access by Function. See AIRMS	0x00000000	R
30156	0x604	BIRMS_1	SPI Burst Read Access by Function. See BIRMS	0x00000000	R
30157	0x605	CIRMS_1	SPI Burst Read Access by Function. See CIRMS	0x00000000	R
30158	0x606	AUX0RMS_1	SPI Burst Read Access by Function. See AUX0RMS	0x00000000	R
30159	0x607	AUX1RMS_1	SPI Burst Read Access by Function. See AUX1RMS	0x00000000	R
30160	0x608	AUX2RMS_1	SPI Burst Read Access by Function. See AUX2RMS	0x00000000	R
30161	0x609	AUX3RMS_1	SPI Burst Read Access by Function. See AUX3RMS	0x00000000	R
30162	0x60A	AUX4RMS_1	SPI Burst Read Access by Function. See AUX4RMS	0x00000000	R
30163	0x60B	AUX5RMS_1	SPI Burst Read Access by Function. See AUX5RMS	0x00000000	R
30164	0x60C	AWATT_1	SPI Burst Read Access by Function. See AWATT	0x00000000	R
30165	0x60D	BWATT_1	SPI Burst Read Access by Function. See BWATT	0x00000000	R
30166	0x60E	CWATT_1	SPI Burst Read Access by Function. See CWATT	0x00000000	R
30167	0x60F	AVA_1	SPI Burst Read Access by Function. See AVA	0x00000000	R
30168	0x610	BVA_1	SPI Burst Read Access by Function. See BVA	0x00000000	R
30169	0x611	CVA_1	SPI Burst Read Access by Function. See CVA	0x00000000	R
30170	0x612	APF_1	SPI Burst Read Access by Function. See APF	0x00000000	R
30171	0x613	BPF_1	SPI Burst Read Access by Function. See BPF	0x00000000	R
30172	0x614	CPF_1	SPI Burst Read Access by Function. See CPF	0x00000000	R
30173	0x615	AVRMSONE_1	SPI Burst Read Access by Function. See AVRMSONE	0x00000000	R
30174	0x616	BVRMSONE_1	SPI Burst Read Access by Function. See BVRMSONE	0x00000000	R
30175	0x617	CVRMSONE_1	SPI Burst Read Access by Function. See CVRMSONE	0x00000000	R

## EVALUATION BOARD SOFTWARE

Table 7. ADE9178 Input Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
30176	0x618	AIRMSONE_1	SPI Burst Read Access by Function. See AIRMSONE	0x00000000	R
30177	0x619	BIRMSONE_1	SPI Burst Read Access by Function. See BIRMSONE	0x00000000	R
30178	0x61A	CIRMSONE_1	SPI Burst Read Access by Function. See CIRMSONE	0x00000000	R
30179	0x61B	AUX0RMSONE_1	SPI Burst Read Access by Function. See AUX0RMSONE	0x00000000	R
30180	0x61C	AUX1RMSONE_1	SPI Burst Read Access by Function. See AUX1RMSONE	0x00000000	R
30181	0x61D	AUX2RMSONE_1	SPI Burst Read Access by Function. See AUX2RMSONE	0x00000000	R
30182	0x61E	AUX3RMSONE_1	SPI Burst Read Access by Function. See AUX3RMSONE	0x00000000	R
30183	0x61F	AUX4RMSONE_1	SPI Burst Read Access by Function. See AUX4RMSONE	0x00000000	R
30184	0x620	AUX5RMSONE_1	SPI Burst Read Access by Function. See AUX5RMSONE	0x00000000	R
30185	0x621	VSUMRMSONE_1	SPI Burst Read Access by Function. See VSUMRMSONE	0x00000000	R
30186	0x622	VABRMSONE_1	SPI Burst Read Access by Function. See VABRMSONE	0x00000000	R
30187	0x623	VBCRMSONE_1	SPI Burst Read Access by Function. See VBCRMSONE	0x00000000	R
30188	0x624	VACRMSONE_1	SPI Burst Read Access by Function. See VACRMSONE	0x00000000	R
30189	0x625	AVRMSHALF_1	SPI Burst Read Access by Function. See AVRMSHALF	0x00000000	R
30190	0x626	BVRMSHALF_1	SPI Burst Read Access by Function. See BVRMSHALF	0x00000000	R
30191	0x627	CVRMSHALF_1	SPI Burst Read Access by Function. See CVRMSHALF	0x00000000	R
30192	0x628	AIRMSHALF_1	SPI Burst Read Access by Function. See AIRMSHALF	0x00000000	R
30193	0x629	BIRMSHALF_1	SPI Burst Read Access by Function. See BIRMSHALF	0x00000000	R
30194	0x62A	CIRMSHALF_1	SPI Burst Read Access by Function. See CIRMSHALF	0x00000000	R
30195	0x62B	AUX0RMSHALF_1	SPI Burst Read Access by Function. See AUX0RMSHALF	0x00000000	R
30196	0x62C	AUX1RMSHALF_1	SPI Burst Read Access by Function. See AUX1RMSHALF	0x00000000	R
30197	0x62D	AUX2RMSHALF_1	SPI Burst Read Access by Function. See AUX2RMSHALF	0x00000000	R
30198	0x62E	AUX3RMSHALF_1	SPI Burst Read Access by Function. See AUX3RMSHALF	0x00000000	R
30199	0x62F	AUX4RMSHALF_1	SPI Burst Read Access by Function. See AUX4RMSHALF	0x00000000	R
30200	0x630	AUX5RMSHALF_1	SPI Burst Read Access by Function. See AUX5RMSHALF	0x00000000	R
30201	0x631	AVRMS_2	SPI Burst Read Access by Phase. See AVRMS	0x00000000	R
30202	0x632	AIRMS_2	SPI Burst Read Access by Phase. See AIRMS	0x00000000	R
30203	0x633	AWATT_2	SPI Burst Read Access by Phase. See AWATT	0x00000000	R
30204	0x634	AVA_2	SPI Burst Read Access by Phase. See AVA	0x00000000	R
30205	0x635	APF_2	SPI Burst Read Access by Phase. See APF	0x00000000	R
30206	0x636	AVRMSONE_2	SPI Burst Read Access by Phase. See AVRMSONE	0x00000000	R
30207	0x637	AIRMSONE_2	SPI Burst Read Access by Phase. See AIRMSONE	0x00000000	R
30208	0x638	AVRMSHALF_2	SPI Burst Read Access by Phase. See AVRMSHALF	0x00000000	R
30209	0x639	AIRMSHALF_2	SPI Burst Read Access by Phase. See AIRMSHALF	0x00000000	R
30210	0x63A	BVRMS_2	SPI Burst Read Access by Phase. See BVRMS	0x00000000	R
30211	0x63B	BIRMS_2	SPI Burst Read Access by Phase. See BIRMS	0x00000000	R
30212	0x63C	BWATT_2	SPI Burst Read Access by Phase. See BWATT	0x00000000	R
30213	0x63D	BVA_2	SPI Burst Read Access by Phase. See BVA	0x00000000	R
30214	0x63E	BPF_2	SPI Burst Read Access by Phase. See BPF	0x00000000	R
30215	0x63F	BVRMSONE_2	SPI Burst Read Access by Phase. See BVRMSONE	0x00000000	R
30216	0x640	BIRMSONE_2	SPI Burst Read Access by Phase. See BIRMSONE	0x00000000	R
30217	0x641	BVRMSHALF_2	SPI Burst Read Access by Phase. See BVRMSHALF	0x00000000	R
30218	0x642	BIRMSHALF_2	SPI Burst Read Access by Phase. See BIRMSHALF	0x00000000	R
30219	0x643	CVRMS_2	SPI Burst Read Access by Phase. See CVRMS	0x00000000	R
30220	0x644	CIRMS_2	SPI Burst Read Access by Phase. See CIRMS	0x00000000	R
30221	0x645	CWATT_2	SPI Burst Read Access by Phase. See CWATT	0x00000000	R
30222	0x646	CVA_2	SPI Burst Read Access by Phase. See CVA	0x00000000	R
30223	0x647	CPF_2	SPI Burst Read Access by Phase. See CPF	0x00000000	R

## EVALUATION BOARD SOFTWARE

Table 7. ADE9178 Input Registers (Continued)

Modbus Address	ADE9178 Address	Name	Description	Reset	Access
30224	0x648	CVRMSONE_2	SPI Burst Read Access by Phase. See CVRMSONE	0x00000000	R
30225	0x649	CIRMSONE_2	SPI Burst Read Access by Phase. See CIRMSONE	0x00000000	R
30226	0x64A	CVRMSHALF_2	SPI Burst Read Access by Phase. See CVRMSHALF	0x00000000	R
30227	0x64B	CIRMSHALF_2	SPI Burst Read Access by Phase. See CIRMSHALF	0x00000000	R
30228	0x64C	AUX0RMS_2	SPI Burst Read Access by Phase. See AUX0RMS	0x00000000	R
30229	0x64D	AUX0RMSONE_2	SPI Burst Read Access by Phase. See AUX0RMSONE	0x00000000	R
30230	0x64E	AUX0RMSHALF_2	SPI Burst Read Access by Phase. See AUX0RMSHALF	0x00000000	R
30231	0x64F	AUX1RMS_2	SPI Burst Read Access by Phase. See AUX1RMS	0x00000000	R
30232	0x650	AUX1RMSONE_2	SPI Burst Read Access by Phase. See AUX1RMSONE	0x00000000	R
30233	0x651	AUX1RMSHALF_2	SPI Burst Read Access by Phase. See AUX1RMSHALF	0x00000000	R
30234	0x652	AUX2RMS_2	SPI Burst Read Access by Phase. See AUX2RMS	0x00000000	R
30235	0x653	AUX2RMSONE_2	SPI Burst Read Access by Phase. See AUX2RMSONE	0x00000000	R
30236	0x654	AUX2RMSHALF_2	SPI Burst Read Access by Phase. See AUX2RMSHALF	0x00000000	R
30237	0x655	AUX3RMS_2	SPI Burst Read Access by Phase. See AUX3RMS	0x00000000	R
30238	0x656	AUX3RMSONE_2	SPI Burst Read Access by Phase. See AUX3RMSONE	0x00000000	R
30239	0x657	AUX3RMSHALF_2	SPI Burst Read Access by Phase. See AUX3RMSHALF	0x00000000	R
30240	0x658	AUX4RMS_2	SPI Burst Read Access by Phase. See AUX4RMS	0x00000000	R
30241	0x659	AUX4RMSONE_2	SPI Burst Read Access by Phase. See AUX4RMSONE	0x00000000	R
30242	0x65A	AUX4RMSHALF_2	SPI Burst Read Access by Phase. See AUX4RMSHALF	0x00000000	R
30243	0x65B	AUX5RMS_2	SPI Burst Read Access by Phase. See AUX5RMS	0x00000000	R
30244	0x65C	AUX5RMSONE_2	SPI Burst Read Access by Phase. See AUX5RMSONE	0x00000000	R
30245	0x65D	AUX5RMSHALF_2	SPI Burst Read Access by Phase. See AUX5RMSHALF	0x00000000	R
30246	0x65E	VSUMRMSONE_2	SPI Burst Read Access by Function. See VSUMRMSONE	0x00000000	R
30247	0x65F	VABRMSONE_2	SPI Burst Read Access by Function. See VABRMSONE	0x00000000	R
30248	0x660	VBCRMSONE_2	SPI Burst Read Access by Function. See VBCRMSONE	0x00000000	R
30249	0x661	VACRMSONE_2	SPI Burst Read Access by Function. See VACRMSONE	0x00000000	R

Table 8. System Input Registers

Modbus Address	System Address	Name	Description	Reset	Access
30250	0x01	BOARD_NUM	Holds the board number.	0x00	R
30251	0x02	BOARD_REV	Holds the board revision.	0x0	R
30252	0x03	ECR	Holds the board ECR.	0x0	R
30253	0x04	SOFTWARE_VER	Holds the software version in the following 24-bit structure [major release (bits 23:16), minor release (bits 15:8), patch release (bits 7:0)].	0x0	R
30254	0x05	COMMIT_ID	Holds the commit id.	0x00	R
30255	0x06	CURRENT_STATE	Holds the current state of charge control state machine.	0x0	R

## Discrete Registers

Table 9. System Discrete Inputs

Modbus Address	Name	Description	Access	Reset
10001	CALIBRATION_STATUS	Calibration status: The bit gets set after a calibration and saves its status to the nonvolatile memory. The bit gets reset whenever a new write to user space is performed.	R	0
10002	GPIO_INIT_STATUS	GPIO_Init_Status: Bit gets set after successful initialization.	R	0
10003	SPIO_INIT_STATUS	SPIO_Init_Status: Bit gets set after successful initialization.	R	0
10004	FRAM_INIT_STATUS	FRAM_Init_Status: Bit gets set after successful initialization.	R	0
10005	RESERVED	Reserved register	R	0

## EVALUATION BOARD SOFTWARE

Table 9. System Discrete Inputs (Continued)

Modbus Address	Name	Description	Access	Reset
10006	ADE_INIT_STATUS	ADE_Init_Status: Bit gets set after successful initialization.	R	0
10007	I2C2_INIT_STATUS	I2C2_Init_Status: Bit gets set after successful initialization.	R	0
10008	LCD_INIT_STATUS	LCD_Init_Status: Bit gets set after successful initialization.	R	0
10009	ENERGY_ACCU_STATUS	Energy_accu_status: Bit is set when accumulation is running and gets cleared when not running. This bit can only be cleared by the stop_energy_accu coil, not the reset_energy_accu.	R	0
10010	MODE_STATUS	Mode_status: Bit is '0' in run mode and '1' in debug mode.	R	0
10011	HOST_STATUS	Host_status: Check if host is connected.	R	0

## Coil Registers

Table 10. System Coil Registers

Address	Name	Description	Access	Reset
1	SET_LED1	Sets LED1 (green)	R/W	0
2	SET_LED2	Sets LED2 (yellow)	R/W	0
3	SET_LED3	Sets LED3 (red)	R/W	0
4-6	RESERVED	Reserved registers	R/W	0
7	START_ENERGY_ACCU	Start Energy accumulation	R/W	0
8	STOP_ENERGY_ACCU	Stop energy accumulation	R/W	0
9-18	RESERVED	Reserved registers	R/W	0
19	SET_MODE	Set the firmware in normal mode (value of 0) or debug mode (value of 1) of operation.	R/W	0
20	RESET_MCU	Resets system MCU and ADE9178.	R/W	0
21	SET_RELAY	Turn on/off the 12V relay to cut off AC power.	R/W	0
22	SET_EVSE_PWR	Set EVSE power supply state (one supply exists).	R/W	0
23	SET_CURRENT_ERR	Set current draw error (one current error exists).	R/W	0
24	SET_HOST_FAULT_ERR	Override CP to state F as defined by IEC61851.	R/W	0
25	SET_RCD_FAULT_ERR	Override RCD state to emulate a fault condition.	R/W	0

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