# User's Guide AFE881H1 Evaluation Module

# <image>

This user's guide describes the characteristics, operation, and recommended use cases of the AFE881H1EVM. This document provides examples and instructions on how to use the AFE881H1EVM board and included software. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the AFE881H1EVM. This document also includes a schematic, reference printed circuit board (PCB) layouts, and a complete bill of materials (BOM).

# **Table of Contents**

1 Overview	3
1.1 Kit Contents	3
1.2 Related Documentation From Texas Instruments	3
2 USB2ANY Interface Adapter	4
2.1 Signal Definitions for J10	4
2.2 USB2ANY Theory of Operation	<mark>5</mark>
3 EVM Hardware Overview	<mark>6</mark>
3.1 Electrostatic Discharge Caution	6
3.2 EVM Block Diagram	6
3.3 EVM Jumper Summary	7
3.4 Terminal and Pin Definitions	<mark>8</mark>
3.5 Connecting the USB2ANY	9
3.6 Connecting the USB Cable to the USB2ANY Interface Adapter	10
3.7 Optional EVM Operations	10
4 Software Overview	<b>11</b>
4.1 Software Installation	<b>11</b>
4.2 Launching the Software	12
4.3 Software Features	1 <mark>3</mark>



5 Schematics, PCB Layout, and Bill of Materials	. 16
5.1 Board Schematic	. 16
5.2 PCB Components Layout	17
5.3 Bill of Materials	19

# **List of Figures**

Figure 2-1. AFE881H1EVM Hardware Setup	4
Figure 2-2. USB2ANY Interface Adapter Block Diagram	5
Figure 3-1. AFE881H1EVM Block Diagram	<mark>6</mark>
Figure 3-2. Default Header Settings for the AFE881H1EVM	7
Figure 3-3. Terminal and Pin Locations for the AFE881H1EVM	9
Figure 3-4. USB2ANY Connection to the AFE881H1EVM	9
Figure 3-5. Confirmation of USB2ANY Driver Installation	10
Figure 4-1. AFE881H1EVM Software Installation Prompts	.11
Figure 4-2. Launching the AFE881H1EVM GUI	12
Figure 4-3. AFE881H1EVM GUI at Launch	.12
Figure 4-4. USB2ANY Digital Controller Connection Status	.12
Figure 4-5. AFE881H1 Register Page	13
Figure 4-6. AFE881H1 High Level Tab	14
Figure 4-7. Launch Script Window	.14
Figure 4-8. Scripting Tool Recording a Macro	15
Figure 4-9. Deselecting App Execution Aliases	.15
Figure 5-1. AFE881H1EVM Schematic	16
Figure 5-2. AFE881H1EVM PCB Top Layer Layout	17
Figure 5-3. AFE881H1EVM PCB Mid Layer 1 Layout	17
Figure 5-4. AFE881H1EVM PCB Mid Layer 2 Layout	18
Figure 5-5. AFE881H1EVM PCB Bottom Layer Layout	18

# List of Tables

Table 1-1. AFE881H1EVM Kit Contents	3
Table 1-2. Related Documentation	3
Table 2-1. USB2ANY Connector AFE881H1EVM (J10) Pinout	4
Table 3-1. AFE881H1EVM Jumper Summary	7
Table 3-2. AFE881H1EVM Terminal and Pin Definitions	<mark>8</mark>
Table 5-1. Bill of Materials for the AFE881H1EVM	. 19

# Trademarks

LabVIEW<sup>™</sup> is a trademark of National Instruments Corporation. Python<sup>™</sup> is a trademark of Python Software Foundation. HART<sup>®</sup> is a registered trademark of FieldComm Group. All trademarks are the property of their respective owners.



# 1 Overview

The AFE881H1 16-bit digital-to-analog converter (DAC) is a highly-integrated, high-accuracy, and extremely lowpower device with voltage-outputs designed for HART® enabled sensor transmitter applications. The AFE881H1 includes most of the components required to construct a transmitter for 2-wire (loop-powered), 4-mA to 20mA sensor transmitter applications. These components include a 16-bit highly accurate DAC, a HART FSK modem, an internal 10-ppm/°C voltage reference, and an internal diagnostic ADC. To accommodate intrinsic and functional safety concerns, external voltage-to-current conversion and power-regulation are required.

# 1.1 Kit Contents

Table 1-1 details the contents of the EVM kit. Contact the TI Product Information Center at (972) 644-5580 if any component is missing. Download the latest versions of the related software on the TI website, www.ti.com.

Table 1-1. AFE881H1EVM	Kit Contents
Item	Quantity
AFE881H1EVM	1

Table 1-1.	AFE881H1EVM	Kit Contents
------------	-------------	--------------

#### Note

The EVM requires the USB2ANY digital controller. This controller is not included, and must be purchased separately.

## **1.2 Related Documentation From Texas Instruments**

The documents in Table 1-2 provides information regarding Texas Instruments integrated circuits used in the assembly of the AFE881H1EVM. This user's guide is available from the TI web site under literature number SLAU858. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions may be available from the TI web site at , or call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Table 1-2. Related Documentation		
Document	Literature Number	
AFE881H1 product data sheet	SLASEU7	
USB2ANY interface adapter user's guide	SNAU228	
REF3312 product data sheet	SBOS392	
SN74LVC8T245 product data sheet	SCES584	
SN74LVC2T45 product data sheet	SCES516	

#### Table 1-2 Related Documentation

Download the latest version of the EVM graphical user interface (GUI) installer from the Order and start development subsection of the AFE881H1EVM web folder on TI.com. Run the GUI installer to install the EVM GUI software on your personal computer (PC).

# 2 USB2ANY Interface Adapter

The AFE881H1EVM is controlled by a USB2ANY Interface Adapter. A PC runs the software that communicates with the USB2ANY, which provides the power and digital signals used to communicate with the EVM board. Connectors on the EVM board are used to connect the required external power supply. Figure 2-1 shows a diagram of the connections from the PC to the AFE881H1EVM.



Figure 2-1. AFE881H1EVM Hardware Setup

## 2.1 Signal Definitions for J10

Table 2-1 shows the pinout for the 30-pin connector socket used to communicate between the EVM and the USB2ANY. Be aware that the I<sup>2</sup>C communications lines (I2C\_SCL and I2C\_SDA1) are not used. Both the connectors and cables from the USB2ANY to the AFE881H1EVM are keyed to make sure the cable is correctly connected.

Pin on J10	Signal	Definition
4, 6, 8, 16, 27, 28	GND	Ground
11	ALARM	Alarm notification; open drain.
		When an alarm occurs, this pin is held low. Otherwise, this pin goes to Hi-Z.
12	CS	SPI communication for AFE881H1 chip select
13	MISO	SPI communication for AFE881H1 digital output
14	MOSI	SPI communication for AFE881H1 digital input
15	3p3V	3.3-V supply voltage
17	CD	Carrier detect. A logic high on this pin indicates a valid carrier is present.
18	SCLK	SPI communication for AFE881H1 digital clock
19	GPIO1	GPIO1 (unused)
20	GPIO2	GPIO2 (unused)
25	RTS	Request to send.
		A logic high on this pin enables the demodulator and disables the modulator.
		A logic low on this pin enables the modulator and disables the demodulator.
		Do not leave any digital input pins floating.
26	UARTOUT	UART data output.
29	RESET	Reset.
		A logic low on this pin places the device into power-down mode and resets the device.
		Logic high returns the device to normal operation.
		Do not leave any digital input pins floating.
30	UARTIN	UART data input. Do not leave any digital input pins floating.
1, 2, 3, 5, 7, 9, 10, 21, 22, 23, 24	NC	Not connected

Table 2-1. USB2ANY	Connector AFE881H1EVM	(J10	) Pinout
--------------------	-----------------------	------	----------

# 2.2 USB2ANY Theory of Operation

Figure 2-2 shows the block diagram for the USB2ANY platform. This platform is a general-purpose dataacquisition system that is used on several different Texas Instruments evaluation modules. The details of operation are included in the USB2ANY Interface Adapter User's Guide.



Figure 2-2. USB2ANY Interface Adapter Block Diagram

# 3 EVM Hardware Overview

To use the EVM hardware, set the jumpers, connect the USB2ANY to the EVM together with the 30-pin ribbon cable, apply external power (optional), and connect the USB cable from the USB2ANY to the PC. This section presents the details of these procedures.

# 3.1 Electrostatic Discharge Caution

**CAUTION** Many of the components on the AFE881H1EVM are susceptible to damage by electrostatic discharge (ESD). Observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

## 3.2 EVM Block Diagram

A block diagram of the EVM hardware setup is shown in Figure 3-1. This board provides connections and test points for the SPI and UART communication, power, reference, ground connections, ADC inputs, HART modem, and the analog output of the DAC.



Figure 3-1. AFE881H1EVM Block Diagram



# 3.3 EVM Jumper Summary

Table 3-1 summarizes all of the EVM jumper functionality.

Header	Name	Function
J2	PVDD to IOVDD	Short 1-2 – PVDD connected to IOVDD
		<b>Open 1-2</b> – PVDD, IOVDD disconnected (default)
J3	USB 3.3V	Short 1-2 – PVDD connected to USB2ANY 3p3V (default)
		Open 1-2 – PVDD disconnected from USB2ANY 3p3V
		Short 3-4 – IOVDD connected to USB2ANY 3p3V (default)
		Open 3-4 – IOVDD disconnected from USB2ANY 3p3V
J5	Ext REF	Short 1-2 – VREFIO connected to external reference
		<b>Open 1-2</b> – VREFIO disconnected from external reference (default)
J6	IOVDD Shunt	Short 1-2 – IOVDD connected to device (default)
		Open 1-2 – IOVDD disconnected from device
J7	REF EN	Short 1-2 – REFEN connected to IOVDD (default)
		Short 2-3 – REFEN connected to GND
J8	UARTIN	Short 1-2 – UART_IN connected to bus transceiver (default)
		<b>Open 1-2</b> – UART_IN disconnected from bus transceiver
J13	POL SEL	<b>Short 1-2</b> – POL_SEL connected to PVDD through 100-k $\Omega$ resistor
		<b>Short 2-3</b> – POL_SEL connected to GND through 100-k $\Omega$ resistor (default)
J14	Resistor Load	Short 1-2 – VOUT connected to 10-kΩ load
		<b>Open 1-2</b> – VOUT no resistive load (default)
J17	Cap Load	Short 1-2 – VOUT connected to 100-pF load
		<b>Open 1-2</b> – VOUT no capacitive load (default)
J19, J20	FILT SEL	Short 1-2 – HART IN pin external filter selected
		Short 2-3 – HART IN pin internal filter selected
J23	Level Translator	Short 1-2 – Bus transceiver OE connected to GND (default)
		Short 2-3 – Bus transceiver OE connected to IOVDD

Figure 3-2 shows the default jumper settings with the device using USB power. The EVM can be fully operated using only the USB2ANY connector for both power and communication.



Figure 3-2. Default Header Settings for the AFE881H1EVM

# 3.4 Terminal and Pin Definitions

Table 3-2 shows the EVM terminal and pin definitions, allowing the user to operate and connect the device to optional power settings and other input and output signals.

Terminal or Pin	Name	Function
J1	VDD	Shunt 1-2: Connect VDD to PVDD for use when VDD = PVDD = 1.8 V
		<b>Open 1-2:</b> Disconnects VDD when PVDD > 1.8 V
J2	PVDD	Banana Jack: Optional for external PVDD
J3	3p3V	Shunt 1-2: Connect PVDD to USB2ANY 3.3-V supply
		Shunt 3-4: Connect IOVDD to USB2ANY 3.3-V supply
J4	GND	Banana Jack: Optional for external GND
J5	VREFIO	Shunt 1-2: Connect REF3312 to VREFIO for external reference
		Open 1-2: Open for device internal reference
J6	IOVDD	Shunt 1-2: Connect IOVDD to power
J7	REF EN	Shunt 1-2: Enable device internal reference
		Shunt 2-3: Disable device internal reference
J8	UARTIN	Shunt 1-2: Connect UARTIN to device from USB2ANY through voltage level shifter
J9	SPI Conn	Pin 1: RESET
		Pin 5: SDI
		Pin 7: CS Pin 9: SDO
		Pin 2, 4, 6, 8, 10: GND
J10	USB2ANY	30-pin ribbon cable connection, see Table 2-1
J11	ADC	Terminal 1: AIN0
		Terminal 2: GND
J12	UART Conn	Pin 1: UART_IN Pin 3: UART_OUT
		Pin 5: RTS Pin 7: CD
J13	POL SEL	Shunt 1.2: Pull up to PVDD
	_	Shunt 2-3: Pull down to GND
		Open: Connection to AIN1 terminal of J11
J14	RES_LOAD	Shunt 1-2: Connect 10-kΩ load to VOUT
J15	VOUT	Terminal 1: GND
		Terminal 2: VOUT
J16	CLK_OUT	Pin 1: CLK_OUT
		Pin 2: GND
J17	CAP_LOAD	Shunt 1-2: Connect 150-pF load to VOUT
J18	IOVDD	Banana Jack: Optional for external IOVDD
J19, J20	FILT_SEL	Shunt 1-2: HART IN terminal internal filter selected
		Shunt 2-3: HART IN terminal external filter selected
J21	HART_IN	Terminal 1: GND
		Terminal 2: HART input
J22	HART_OUT	Terminal 1: GND
		Terminal 2: HART output

#### Table 3-2. AFE881H1EVM Terminal and Pin Definitions

Figure 3-3 shows the terminal and pin locations on the EVM.



Figure 3-3. Terminal and Pin Locations for the AFE881H1EVM

# 3.5 Connecting the USB2ANY

To connect the EVM board and the USB2ANY Interface Adapter together, firmly slide the cable ends of the 30-pin ribbon cable into the USB2ANY Interface Adapter and the AFE881H1EVM, as shown in Figure 3-4. Make sure that the connectors are completely pushed together. Loose connections between the USB2ANY and the EVM may cause intermittent operation.



Figure 3-4. USB2ANY Connection to the AFE881H1EVM



## 3.6 Connecting the USB Cable to the USB2ANY Interface Adapter

Figure 3-5 shows the typical response to connecting the USB2ANY Interface Adapter board to a USB port for the first time. Typically, the PC responds with a *Found New Hardware, USB Device* pop-up dialog window. The pop-up window then changes to *Found New Hardware, USB Human Interface Device*. This pop-up indicates that the device is ready to be used. The USB2ANY Interface Adapter uses the human interface device drivers that are included in the Windows<sup>®</sup> operating system (OS).

In some cases, the *Add Hardware Wizard* appears. If this prompt occurs, allow the system device manager to install the human interface drivers by clicking Yes when requested to install drivers.



Figure 3-5. Confirmation of USB2ANY Driver Installation

#### CAUTION

The EVM default configuration does not require external power supplies, and power is sourced from the USB2ANY. If external supplies are used, disconnect the supply connection from the 3p3V line coming from the USB2ANY before attaching external supplies.

## 3.7 Optional EVM Operations

This section describes the various operational options that can be used by the EVM.

#### 3.7.1 Power Configuration

The default configuration of the AFE881H1EVM allows the board to be powered from the 3p3V line coming from the USB2ANY. Jumper J3 connects power from the 3p3V line to the PVDD and IOVDD pins of the device. To use external power supplies, remove the jumpers in J3 to connect supplies to J1 and J4 for connections to PVDD and IOVDD. When the external supply is 1.8 V, install R1 on the board; this resistor is not installed by default. Provide the external 1.8-V supply to PVDD, VDD, and IOVDD through J1 and J4.

#### 3.7.2 External SPI and UART Controllers

To use an external SPI or UART controller with EVM board, disconnect the USB2ANY controller, and disable the U2 level shifter by uninstalling R13 and installing R2.



# **4 Software Overview**

This section discusses how to use the AFE881H1EVM software.

#### 4.1 Software Installation

Before starting software installation, verify that the USB2ANY controller is not connected or else the driver may not properly install.

Download and run the latest version of the EVM GUI installer from the *Tools and Software* section of the AFE881H1EVM web folder to install the EVM GUI software on your PC. The software installation automatically copies the required LabVIEW<sup>™</sup> software files and drivers to the local machine. The AFE881H1EVM installer installs all the driver files necessary to operate the USB2ANY controller.

Choose the destination directory for the GUI software, accept the license agreements, and follow the on-screen instructions shown in Figure 4-1 to complete the installation.

U AFE8B1H1EVM			×	4 AFE881H1EVM - 🗆 🗙
Welcome				Destination Directory Select the installation directories.
Welcome to the AFE831H1 Installer	E			All software will be installed in the following locations. To install software into a different location, click the Browne button and select another directory.
	$\odot$		)	Directory for AFE881H1EVM C:\Program Files (x85)\Texas instruments\AFE881H1EVM\ Browse
Please wat while the	ne installer initializes.			Directory for National Instruments products C:\Program Files (c65) National Instruments\ Browse
		Car	ncel	<< Back Next >> Cancel
I AFE881H1EVM			×	4 AFE881H1EVM X
License Agreement You must accept the licenses displayed below t	o proceed.			Start Installation Review the following summary before continuing.
Source and Object Code Intern	al Use License Agreement		^	Adding or Changing
Important - Please carefully read the follow binding. After you read it, you will be ask terms. Do not click "I have read and agre- Materials for your own benefit and person bound by these terms or (2) you are auth these terms on behalf of your company . Important - Read carefully: In this Agreeme exercise the rights granted for your own benefit	ting license agreement, whi did whether you accept and e" unless; (1) you will use ally accept, agree to and vrized to, and intend to b and 'you' means you person it, but it means your compar (I) accept the License Agreeme	ch is leg agree to he Licen intend to e bound Illy if you iy (or you x.	ally o its sed be by, will	Cirk the Neel bythen to beein initialiation. Cirk the Back bythen to change the initialiation satteres
	O I do not accept the License Ag	reement.		
	<< Back Next>>	Car		Save File << Back Next>> Cancel
	4 AFE881H1EVM			×
	Installation Complete	•		
	The installer has finished up	dating your	system.	
				<c back="" next="">&gt; Finish</c>

#### Figure 4-1. AFE881H1EVM Software Installation Prompts

To use the scripting tool, the Python<sup>™</sup> programming environment must also be installed. Download the latest x86 version of Python 2.7 at https://www.python.org/downloads/.

# 4.2 Launching the Software

After installation, a shortcut to launch the GUI can be found in the *Start* menu. If installed in the default directory, the AFE881H1EVM software can also be launched by navigating to the *Texas Instruments* folder in the *Program Files* (*x86*) directory, as Figure 4-2 shows.

Contraction of the second	plication Tools			~ (
- → × ↑ 📜 « Windows (C:) > P	rogram Files (x86) > Texas Instruments > A	FE881H1EVM ~ じ	,O Search AFE88	31H1EVM
ADS131A04 EVM	Name	Date modified	Туре	Size
ADS131B04-Q1 EVM	Shared Library	6/23/2021 1:11 PM	File folder	4.00
ADS131M04 EVM	AFE881H1EVM.anases	6/23/2021 1:05 PM 6/23/2021 1:05 PM	ADDATES FILE	6,519 KB
ADS131M08 EVM	AFE881H1EVM.ini	6/23/2021 1:05 PM 3/17/2019 9:34 AM	Configuration setti Application extens	1 KB 104 KB
AFE881H1EVM	<ul> <li>Page List.ini</li> <li>Register Map.xml</li> </ul>	6/23/2021 12:54 PM 6/23/2021 12:49 PM	Configuration setti XML Document	1 KB 77 KB
Scripts	SB2ANY.dll	2/10/2020 2:57 PM	Application extens	3,413 KB
AFE10004EVM				
Analog Engineers Calculator 🗸				

Figure 4-2. Launching the AFE881H1EVM GUI

Figure 4-3 shows the GUI after launch. If the USB2ANY controller is not connected to the PC when the software is launched, the GUI defaults to *demo* mode. Figure 4-4 illustrates the bottom-left corner of the GUI showing the hardware connection status: DEMO MODE or CONNECTED. After the USB2ANY controller is properly connected to the PC, close and reopen the AFE881H1EVM software to detect the device.

AFE881H1EVM				- 🗆 ×
File Script Debug Help				
				Demo Mode
Pages ▲ ⊖ ◇ High Level Configuration ◆ AFE881H1 High Level		AFE881H1EVM	Go to Low Level Configural	tion
L ◇ AFE831H1 Registers	DAC Barge (PVDD-2.7%, spin = 2x) 4.54 to 1.24 v v 1000000 1.05 to 1.24 v 100000 0.45 to 1.24 v 1000000 0.45 to 1.24 v 1000000000 0.45 to 1.24 v 100000000000000000000000000000000000	DAC CIR SE EN DAC CIR Code 0 DAC CIR Code 10 DAC CIR Range 6139/10 1239/10 Siew Rate Step Siew Rate Mode Linear Stew 0	Configuration Divable SDO Divable SDO Divable VDM Constructed Divable VDT Enable VDT	USB 3.3V +3.3V ON Note: Device POR may change CRC-EN state HW RESET SW RESET Append CRC
		ADC Range Conversion Rate 1ºVREF V 3440 Hz V DIRECT, MODE Auto Mode V ADC Buffer Power Down BUF, PO V	Read ADC0         -0         100           Read ADC1         -0         100           27.1 *C         -           cead SD Mux         -0         -	addr ×0 ×0
	HART Modem HART TX Data	HART RX Data	ALARM STATUS MASK ALRM ACTION	RD Register
	HART Enable		MODEM Alarm O WDT Fault O — Ø SD Mux O — Ø — DAC Alarm V	WR Register
	500 mVpp × 0	× 0 Disable HART TX	CRC Fault I No Action VREF Fault I DAC Alarm V	Poll ALARN and CD?
	Tx Frequency 0: 38.4 kHz @ 1200 BAUD WR FIFO	RD FIFO RTS CD Enable polling to read.	AINO Fault	RD ALARM & CD PIN RD ALARM STATUS
v Idla		1	THERM Warning	e Inetri impar

Figure 4-3. AFE881H1EVM GUI at Launch

^	^
~	~
DEMO MODE V TEXAS INSTRUMENTS	CONNECTED V TEXAS INSTRUMENTS

Figure 4-4. USB2ANY Digital Controller Connection Status



## 4.3 Software Features

The AFE881H1EVM GUI allows for SPI communication with the AFE881H1 and control of the device. While the entire register map is available to the user, some features have been integrated into user controls for easy operation.

#### 4.3.1 AFE881H1 Register Page

Figure 4-5 shows the *AFE881H1 Register* page of the AFE881H1EVM GUI. This page allows direct access to all registers on the AFE881H1. The GUI handles page address management, allowing seamless access to registers.

The *Register Map* section in the center of the page lists all the registers, grouped by the pages in the device. Directly above the *Register Map* section are four buttons that allow read and write access to all registers.

The *Field View* section on the right side of the page shows the various fields in the currently selected register. Select a register name to highlight the register. The *Field View* section displays the register contents as described in the data sheet.

AFE881H1EVM																	-		×
File Script Debug Help																			
																	Dem	no Mode	?
Pages	Write Selected Write Modified	Read S	Selected	Read	All		U	Jpda	te Mo	de	mme	diate		•					
	Register Map													Field View					
	Register Name	Address	Default	Mode	Size	Value	15	14	13 1	2 1	1 10	9	8	Field Name	Field V	alue			
	NOP DAC_DATA CONFIG DAC_CFG DAC_CFG DAC_CFG DAC_CFG DAC_CFG CAC_OFFSET DAC_OFFSET ADC_INDEX_CFG TRIGGER SPECIAL_CFG FIFO_CFG ALARU_ACT WDT AIN0_THRESHOLD FIFO_U2H_WR UBM ALARU_STATUS_MASK MODEM_STATUS_MASK MODEM_STATUS_MASK ALARU_STATUS ADC_HAGS ADC_AIN1 ADC_TEMP ADC_TATUS ADC_AIN1 ADC_TEMP	0x001 0x021 0x02 0x03 0x04 0x05 0x04 0x06 0x07 0x08 0x08 0x08 0x08 0x08 0x08 0x08	0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0xFF00 0xFF00 0xFF00 0xFF00 0xFF00 0xFF00 0xFF00 0xFF00 0x0000 0x0000 0x10F 0x0000 0x1000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	RWW RWW RWW RWW RWW W RWW W RWW RWW RWW RWW RWW RWW RWW RWW RWW R RWW R RWW R RWW R R R R	$\begin{array}{c} 16\\ 16\\ 16\\ 16\\ 16\\ 16\\ 16\\ 16\\ 16\\ 16\\$	0x0000 0x0045 0x0034 0x0034 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x7500 0x7500 0x7500 0x7500 0x7500 0x7500 0x7500 0x0000 0x1000 0x0000 0x1000 0x000 0x0000 0x000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x00000 0x0000 0x0000 0x0000 0x00000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0         0           0         0	0         0         0           0         0         0         0           0         1         0         0         0           0         0         0         0         0         0           0         0         0         0         0         0         0           0	0         0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0						
v															0750	lia m			~
Idle														CONNE	CTED	TEX TEX	AS INS	STRUME	NTS

Figure 4-5. AFE881H1 Register Page



## 4.3.2 High Level Configuration Page

The *High Level Configuration* page is used to set the configuration of the AFE881H1EVM GUI. Figure 4-6 shows the *AFE881H1 High Level* tab of the *High Level Configuration* Page. This tab is used to set the DAC range and outputs, ADCs controls and settings, and HART modem functions for the device. Alarms and status information are also displayed on this tab.



Figure 4-6. AFE881H1 High Level Tab

## 4.3.3 Using the Python Scripting Tool

The AFE881H1EVM software provides a scripting tool to automate register reads and writes for reuse. To use the scripting tool, the Python<sup>TM</sup> programming environment must be installed. Download the latest x86 version of Python 2.7 at <u>https://www.python.org/downloads/</u>. To launch the scripting tool, click *Script > Launch Window*, as shown in Figure 4-7.

File       Script       Debug       Help         Launch Window       Start Recording         Start Recording       Aressing         Page       Stop Recording         AFE881H1 High Level       Aressing         AFE881H1 Registers       DAC         DAC Range       (PVD)         0.15V to 1.25V       ×(0		AFE881H	1EVM			
Launch Window         Start Recording         Page         Stop Recording         ◆ AFE881H1 High Level         ◆ AFE881H1 Registers         DAC Range (PVD         0.15V to 1.25V         ×[0	File	Script	Debug	Help		
DAC Data ×[8000 DAC Gain		Script Laur Start Stop Tign to AFE AFE881	Debug nch Wind t Recordir 0 Recordir evercom 881H1 Hi H1 Regis	Help ow ng ng nguratio gh Leve ters	n	DAC DAC Range (PVDE 0.15V to 1.25V XO DAC Data X8000 DAC Gain

Figure 4-7. Launch Script Window



The scripting tool launches a Python IDLE window. This window lists any register interaction when recording a macro. To record a macro, find the *Launch Window* function in the *Scripting* tab. Figure 4-8 shows the scripting tool recording a macro. After the actions are recorded, use the **Stop** button to end the script. This script can be saved and reused as desired.



Figure 4-8. Scripting Tool Recording a Macro

If the python IDLE window does not appear, check the settings for application execution aliases. To do so, open the Windows *Settings*, and then select *Apps*. In the resulting *Apps* window, select *Apps & features*, and then click on the *Manage app execution aliases* link. The next page loads a list of apps. Deselect both application installers for python.exe and python3.exe. Figure 4-9 shows the windows settings for managing application execution aliases.



Figure 4-9. Deselecting App Execution Aliases

# 5 Schematics, PCB Layout, and Bill of Materials

# 5.1 Board Schematic

The AFE881H1EVM schematic is shown in Figure 5-1.



Figure 5-1. AFE881H1EVM Schematic



# 5.2 PCB Components Layout

Figure 5-2 through Figure 5-5 show the board layout for the AFE881H1EVM.



Figure 5-2. AFE881H1EVM PCB Top Layer Layout



Figure 5-3. AFE881H1EVM PCB Mid Layer 1 Layout



Figure 5-4. AFE881H1EVM PCB Mid Layer 2 Layout



Figure 5-5. AFE881H1EVM PCB Bottom Layer Layout



## 5.3 Bill of Materials

Table 5-1 lists the AFE881H1EVM BOM.

#### Table 5-1. Bill of Materials for the AFE881H1EVM

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
РСВ	1		Printed Circuit Board		DC163	Any
C1, C2, C3	3	10uF	CAP, CERM, 10 uF, 25 V, +/- 20%, X5R, 0603	0603	GRT188R61E106ME13D	MuRata
C5, C6, C8, C9, C10, C11, C12, C20, C24, C25	10	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603	0603	06033C104JAT2A	AVX
C13	1	100pF	CAP, CERM, 100 pF, 100 V, +/- 5%, X7R, 0805	0805	C0805C101J1RACTU	Kemet
C14, C15	2	680pF	CAP, CERM, 680 pF, 25 V, +/- 10%, X7R, 0805	0805	885012207085	Würth Elektronik
C16	1	2200pF	CAP, CERM, 2200 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H222JA01D	MuRata
C17, C18	2	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 1%, C0G/NP0, 0805	0805	08055A102FAT2A	AVX
C19, C21	2	680pF	CAP, CERM, 680 pF, 100 V, +/- 5%, C0G/NP0, 0805	0805	08051A681JAT2A	AVX
C22	1	4700pF	CAP, CERM, 4700 pF, 25 V, +/- 5%, C0G/NP0, 0805	0805	08053A472JAT2A	AVX
C23	1	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 5%, C0G/NP0, AEC- Q200 Grade 1, 0402	0402	CGA2B2C0G1H102J050BA	ТDК
D3, D4	2	V	Diode, TVS, Bi, 5.5 V, 14 Vc, 1x0.6mm	1x0.6mm	ESD105B102ELE6327XTMA1	Infineon Technologies
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J6, J8, J14, J16, J17	6		Header, 100mil, 2x1, Tin, TH	Header, 2x1, 100mil, TH	5-146278-2	TE Connectivity
J2, J4, J18	3		Standard Banana Jack, Uninsulated, 5.5mm	Keystone_575-4	575-4	Keystone
J3	1		Header, 100mil, 2x2, Gold, TH	2x2 Header	TSW-102-07-G-D	Samtec
J7, J13, J19, J20	4		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
J9, J12	2		Header, 100mil, 5x2, Gold, TH	5x2 Header	TSW-105-07-G-D	Samtec
J10	1		Header(shrouded), 2.54mm, 15x2, Gold, TH	Header(shrouded), 2.54mm, 15x2, TH	302-S301	On-Shore Technology
J11	1		Terminal Block, 3.5mm Pitch, 3x1, TH	10.5x8.2x6.5mm	ED555/3DS	On-Shore Technology
J15, J21, J22	3		Terminal Block, 3.5mm Pitch, 2x1, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
R1, R12	2	2.0k	RES, 2.0 k, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEYJ202V	Panasonic

# Table 5-1. Bill of Materials for the AFE881H1EVM (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R3, R5	2	15.8	RES, 15.8, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060315R8FKEA	Vishay-Dale
R4, R6, R11, R14	4	100k	RES, 100 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW0805100KFKEA	Vishay-Dale
R7	1	10.0k	RES, 10.0 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW080510K0FKEA	Vishay-Dale
R8	1	150k	RES, 150 k, 0.1%, 0.125 W, 0805	0805	RG2012P-154-B-T5	Susumu Co Ltd
R9	1	30.0k	RES, 30.0 k, 0.1%, 0.125 W, 0805	0805	RG2012P-303-B-T5	Susumu Co Ltd
R10	1	300k	RES, 300 k, 0.1%, 0.125 W, 0805	0805	RG2012P-304-B-T5	Susumu Co Ltd
TP1, TP5, TP8, TP9, TP11, TP12, TP13, TP14, TP15, TP16	10		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone
TP2, TP3, TP4, TP6	4		Test Point, Multipurpose, Black, TH	Black, TH Black Multipurpose Testpoint		Keystone
TP7	1		Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone
TP10	1		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
U2	1		8-Bit Dual-Supply Bus Transceiver with Configurable Voltage-Level Shifting and Three-State Outputs, DB0024A (SSOP-24)	DB0024A	SN74LVC8T245DBR	Texas Instruments
U4	1		16-Bit, Low-Power DACs With Internal HART Modem, Voltage Reference, and Diagnostic ADC for 4-20mA Loop-Powered Applications, UQFN24	UQFN24	AFE881H1RRUT	Texas Instruments
U3, U5	2		2-Bit Dual Supply Transceiver with Configurable Voltage-Level Shifting and 3-State Outputs, DCU0008A (VSSOP-8)	DCU0008A	SN74LVC2T45DCURG4	Texas Instruments
C4	0	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603	0603	06033C104JAT2A	AVX
C7	0	1uF	CAP, CERM, 1 uF, 50 V, +/- 10%, X7R, 0603	0603	UMK107AB7105KA-T	Taiyo Yuden
J5	0		Header, 100mil, 2x1, Tin, TH	Header, 2x1, 100mil, TH	5-146278-2	TE Connectivity
R2	0	2.0k	RES, 2.0 k, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEYJ202V	Panasonic
U1	0		30 ppm / degC Drift, 3.9 uA, Voltage Reference, -40 to 125 degC, 3-pin SOT-23 (DBZ), Green (RoHS & no Sb/Br)	DBZ0003A	REF3312AIDBZR	Texas Instruments

# IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265 Copyright © 2022, Texas Instruments Incorporated