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### Evaluating the ADPD1080/ADPD1081 Photometric Front Ends

#### **FEATURES**

Supports the detection of UART UDP transfer capability ADPD1080/ADPD1081 full configuration

Register level High level Graph view Time graph Frequency graph

#### **EVALUATION KIT CONTENTS**

EVAL-ADPD1081Z-PPG evaluation board Ribbon cable

### ADDITIONAL EQUIPMENT NEEDED

PC running Windows 7 or Windows 10 operating system EVAL-ADPDUCZ microcontroller board

#### **ONLINE RESOURCES**

ADPD1080/ADPD1081 data sheet Applications Wavetool software package

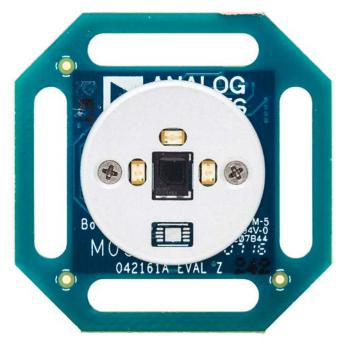
### **GENERAL DESCRIPTION**

The EVAL-ADPD1081Z-PPG evaluation board provides users with a simple means of evaluating the ADPD1080/ADPD1081 photometric front end with an optimized discrete optical design for vital signs monitoring applications. The evaluation system includes the Applications Wavetool graphical user interface (GUI) that provides users with low level and high level configurability, real-time frequency and time domain analysis, and user datagram protocol (UDP) transfer capability so the evaluation board can easily interface to the user development system.

The EVAL-ADPD1081Z-PPG is powered through the ribbon cable from the EVAL-ADPDUCZ microcontroller board (obtained separately). The evaluation board provides three green light emitting diodes (LEDs) and a 7 mm<sup>2</sup> photodiode (PD). The design of the evaluation board is optimized for wrist-based photoplethysmography (PPG) measurements.

For additional information on the functionality of the ADPD1080/ ADPD1081, refer to the ADPD1080/ADPD1081 data sheet.

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### EVAL-ADPD1081Z-PPG EVALUATION BOARD PHOTOGRAPH

Figure 1.

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### **REVISION HISTORY**

2/2018—Revision 0: Initial Version

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### **GETTING STARTED** INSTALLING THE APPLICATIONS WAVETOOL

Download the Applications Wavetool software package from the EVAL-ADPD1081Z-PPG product page at www.analog.com/eval-ADPD1081. Unzip the folder and run the Applications Wavetool executable file. Follow the prompts, beginning with the setup window shown in Figure 2 for software installation.

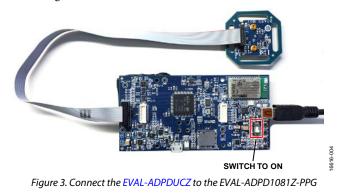


Figure 2. ApplicationsWavetool Setup Window

### CONNECTING THE EVAL-ADPDUCZ MICROCONTROLLER BOARD AND THE EVAL-ADPD1081Z-PPG EVALUATION BOARD

Connect the USB cable to the EVAL-ADPDUCZ evaluation board, connect the ribbon cable to the EVAL-ADPD1081Z-PPG board, and switch the power switch to the **ON** position (see Figure 3).

When the USB cable is connected, the second LED below the power switch illuminates, indicating that the on-board battery is being charged. When the power switch is turned to the **ON** position, the LED immediately below the power switch illuminates, indicating that the EVAL-ADPDUCZ microcontroller board is on.



# CHECKING THE USB SERIAL CONNECTION IN WINDOWS®

Ensure that the COM port driver is installed correctly. To verify proper installation, go to **Control Panel > All Control Panel Items > System > Device Manager**, as shown in Figure 4. In this case, the proper COM port selection is **USB Serial Port (COM16)**.

The EVAL-ADPDUCZ microcontroller board uses an FT232 USB universal asynchronous receiver transmitter (UART) IC. If the USB driver installation does not install properly, refer to the corresponding FTDI driver installation guide for the operating system in use.

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Signal Strategy And Strategy	
> cm IDE ATA/ATAFI controllers	
> 📲 Imaging devices	
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If while and other pointing devices	
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> 📥 System devices	
Universal Seriel Bus controllers	

Figure 4. USB Serial Port in Windows 7

### **RUNNING THE APPLICATIONS WAVETOOL**

To start the Applications Wavetool application, navigate to the **Start** menu > **Analog Devices** > **ApplicationsWavetool** and click **ApplicationsWavetool**.

### **INSTRUCTIONS TO LOAD THE FIRMWARE**

The EVAL-ADPDUCZ microcontroller board may have an older version of the firmware installed during manufacture. In this situation, the user receives the message shown in Figure 5 when trying to connect to the Applications Wavetool.

ANALOG			
DEVICES OF WHAT'S POSSIBLE**			
Warning			
		Ok	
		Qk	
		 Qk	
Tool only support firmware v	HW ID :	 Qk	

Figure 5. Warning Message for Outdated Firmware

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## EVAL-ADPD1081Z-PPG User Guide

If the firmware must be updated, take the following steps:

- 1. Download and install the latest DfuSe USB device firmware upgrade software.
- 2. Plug in a micro USB cable between the EVAL-ADPDUCZ and the PC with the power to the EVAL-ADPDUCZ turned off (see Figure 6).
- 3. Press and hold the **BOOT0** button, and switch the power switch to the **ON** position



Figure 6. Micro USB Connection and BOOT0 Button Used When Upgrading Firmware

- Go to Device Manager > Universal Serial Bus controllers and wait until the PC detects STM Device in DFU Mode (see Figure 7).
- 🖌 🌒 Universal Serial Bus controllers
  - 🏺 Generic USB Hub
  - 🏺 Generic USB Hub
  - Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller 1C26
  - Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller 1C2D
  - STM Device in DFU Mode
  - 🏺 USB Root Hub
  - 🏺 USB Root Hub

#### Figure 7. STM Device in DFU Mode Displayed

- 5. Release the **BOOT0** button.
- Open the DfuSe Demo by going to Start > All Programs > STMicroelectronics > DfuSe > DfuSe Demo. Figure 8 shows the DfuSe demo settings at startup.
- In the Upgrade or Verify Action section, click the Choose button, and select the Adpd\_M4\_uC.dfu from the Firmware folder of the downloaded software package.

8. Click the **Upgrade** button and follow the prompts to upgrade the firmware of the EVAL-ADPDUCZ microcontroller board.

After the firmware is updated, connection to the Applications Wavetool can be completed.

STM Device in DI	vices FU Mode	•	Application Mode:	DFU Mode:		
Supports Uplo Supports Dow Can Detach		Manifestation tolerant Accelerated Upload (ST)	Vendor ID: Procuct ID: Version:	Vendor ID: 0483 Procuct ID: DF11 Version: 2200		
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Actions						
Select Target(s):	Target Id	Name	Available Secto	rs (Double Click for more)		
	00	Internal Flash	12 sectors			
	01	Option Bytes	1 sectors			
	02	OTP Memory	2 sectors			
	03	Device Feature	1 sectors			
Upload Action File:		Upgrade or V File: Vendor ID:	erify Action Targets in	file:		
Choose.	U	pload Procuct ID:				
Transferred data	size	Version				
	0 KB(0 Bytes)	Verify after	er download			
0 KB(0 Bytes) of		Ontimize	Ingrade duration (Rem	ove some FEs)		
0 KB(0 Bytes) of Operation duratio	n	Choose	Upgrade duration (Rem			

Figure 8. DfuSe Demo Settings

### **USB UART CONNECTION**

To establish the connection, follow the menu path **Connection** > **Connect** > **UART Bridge**.

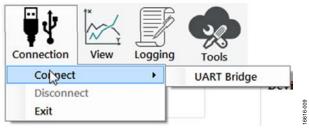


Figure 9. UART Connect

Select the proper COM port to connect the Applications Wavetool to the device. If connection via Bluetooth<sup>®</sup> is required, or if there are any other connection issues, refer to the Applications Wavetool user guide that is provided in the software package download.

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### ACQUIRING DATA Selecting the proper view

The EVAL-ADPD1081Z-PPG is intended for wrist-based PPG measurements. Select the **ADPD Device** data view (see Figure 10). This view opens a window that allows the user to run the ADPD1080/ADPD1081 device and collect data (see Figure 12).

EAD OF WHAT'S POSSI	BLE™			
Connection	View	Logging	Tools	
	AD	PD Device		
Connectio	An	gle Device		
COM Port	Ge	sture Devic	e	
Version Ir	Lor	ng Range P	roximity	
Software V		oke Device		

### LOAD CONFIGURATION

In the upper right corner of the data view window, click the **ADPD Config** button to open the **ADPD Config** (see Figure 11). Click Load DCFG to select a configuration file. For PPG measurements, select the **ADPD108\_M07.dcfg** configuration file.

ADPD Co	nfig									
ligh Level		0							Name PAD 30 CTRL (02)	Value 0x0805
							Reg.Toggle(A)	Register	FIFO_LENGTH (06)	0x1F00
Internal A	verage 2	•							CHIPID (08)	0x0916
Calculated	ODR 50.							Save DCFG	OP_MODE_CFG (11)	0x30A0
						Power Calculation	Register Dump Info	6	SAMPLING_FREQ (12)	0x0050 0x0555
Measured		Hz				rener unennen	tradients availability	Load DCFG	PD_SELECT (14) INT_AVG_MODE (15)	0x0110
Dropped San	iples 0						No Ei	le Selected	CH1_OFFSET_A (18)	0,1500
LOT A CO	NTROL Normal				SLOT B C	ONTROL Normal			CH2 OFFSET A (19)	0×1F00
LED Contre		Timing	Control		LED Cont		Timing Control		CH3_OFFSET_A (1A)	0x3F00
				3			AFE Width(us)	3	CH4_OFFSET_A (18)	0x3F00
LED	LED 1	- AFE Wit			LED	LED 1 👻			CH1_OFFSET_B (1E)	0×1F00
		Pulse W	hdth(us)	2 🗘			Pulse Width(us)	2	CH2_OFFSET_B (1F)	0x1/00
LED Status	LED ON	<ul> <li>Pulse O</li> </ul>	ffset(us)	32 🗇	LED Status	LED ON -	Pulse Offset(us)	32	CH3_OFFSET_B (21) CH4_OFFSET_B (21)	0x3F00 0x3F00
		AFE Off	antes of	23		Lee out	AFE Offsettus)	23	LED3_DRV (22)	0-1030
Number Of	Pulses 2			23	Number Of	Pulses 2			LED1_DRV (23)	0x3836
		AFE Fine	e Offset(ns)	750.00		- 04	AFE Fine Offset(ns)	750.00	LED2_DRV (24)	0×1030
	100k	-			TIA Gain	200k •			LED_TRIM (25)	0.630C
TIA Gain	100%	•			TIA Gain	avva			PULSE_OFFSET_A (30)	0x0220
									PULSE_PEROD_A (31)	0x020F
ED 1		LED 2		LED 3		Single Register	Control		LED_DCSABLE (34) PULSE_OFFSET_B (35)	0.0000
LED Coarse	170 •	LLED Coarse	50	LLED Coarse	50	T Single Register			PULSE_PERIOD_B (36)	0x020F
Tren coaise		Creb Coarse	100	- Liceo coarse				1	AFE CTRL A (35)	0×1AF8
cale Factor	100% -	Scale Factor	10%	✓ Scale Factor	10%	Register Address(h	iex):	Default DCFG	AFE_CTRL_B (3B)	0xLAF8
	40078	and the cost	10.76		10/8	Register Value(		1	AFE_CTRL2 (3C)	0×7006
						Register value(	nex):	Refresh	AFE_FGL_A (3E) AFE_FGL_B (3F)	0x0320
										0.0320

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Figure 11. ADPD Config View

### OPTIMIZING AND RUNNING THE ADPD1080/ ADPD1081

After the configuration file is loaded, the settings can be further optimized using the **ADPD Config** window shown in Figure 11. Typically, the device is set up under some set of conditions, for example, measuring the response from a fixed reflector or measuring a PPG signal from the wrist (see Figure 12). Settings can be optimized for any set of conditions by manipulating LED drive currents, TIA gain, and AFE timing or by using different operating modes that may be more optimal for a specific set of conditions, for example, using float mode for very low current transfer ratio (CTR). For information on optimization of the ADPD1080/ADPD1081, refer to the ADPD1080/ADPD1081 data sheet. For functional descriptions of the Applications Wavetool, refer to the Applications Wavetool user guide that is provided in the software package download.



Figure 12. Example of a PPG Signal Measured from the Wrist

## **EVALUATION BOARD SCHEMATICS AND ARTWORK**

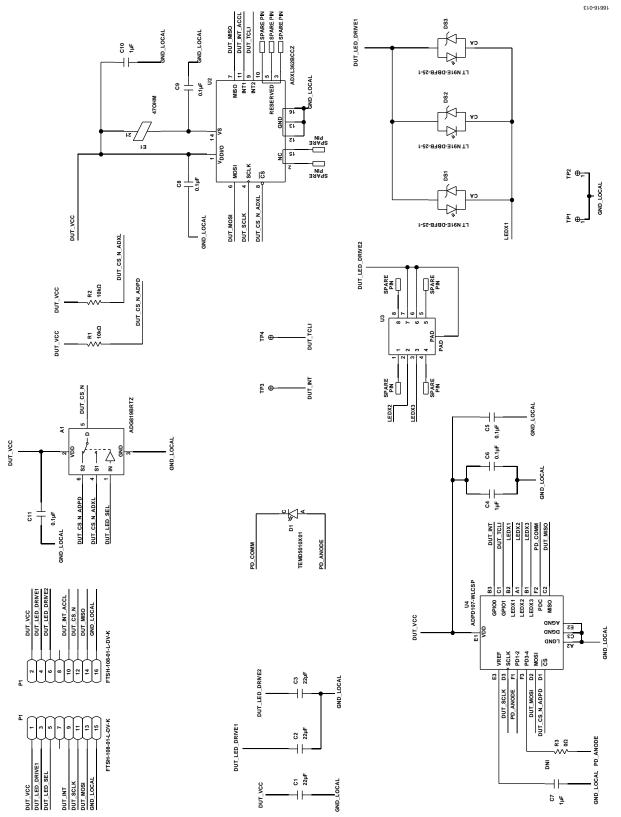


Figure 13. EVAL-ADPD1081Z-PPG Schematic

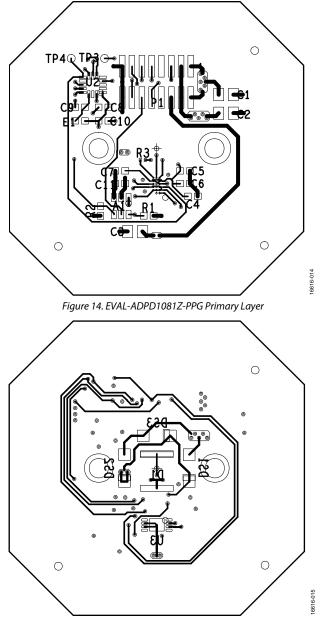


Figure 15. EVAL-ADPD1081Z-PPG Secondary Layer

### NOTES

#### ESD Caution

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

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