

Evaluating the **ADPD105** Photometric Front End

FEATURES

Supports the detection of UART

UDP transfer capability

ADPD105 full configuration

Register level

High level

Graph view

Time graph

Frequency graph

EVALUATION KIT CONTENTS

EVAL-ADPD105Z-GEN evaluation board

Mini USB cable

ADDITIONAL EQUIPMENT NEEDED

PC running Windows 7 operating system

ONLINE RESOURCES

ADPD105 data sheet

ADPD103_ADPD105 OpenMarket WaveTool software

GENERAL DESCRIPTION

The **EVAL-ADPD105Z-GEN** evaluation board provides users with a simple means of connecting optics to the **ADPD105** photometric front end to evaluate the **ADPD105** in a number of different applications, from vital signs monitoring to industrial sensing. The evaluation board includes the **ADPD103_ADPD105 OpenMarket 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 USB port powers the **EVAL-ADPD105Z-GEN**. On-board voltage regulators provide voltage supplies for the **ADPD105**, **ADuCM360**, and FTDI Chip FT232. There are on-board regulators that provide 3.3 V and 4.3 V LED supplies, as well as a selectable option to add an external LED supply. The evaluation board provides an LED and photodiode (PD) for a finger photoplethysmography (PPG) measurement that is useful for a quick functionality check of the evaluation system.

The schematic and board layout as well as the board itself, see Figure 1, indicate signal names for easy identification. For additional information on the functionality of the **ADPD105**, refer to the **ADPD105** data sheet.

EVAL-ADPD105Z-GEN EVALUATION BOARD PHOTOGRAPH

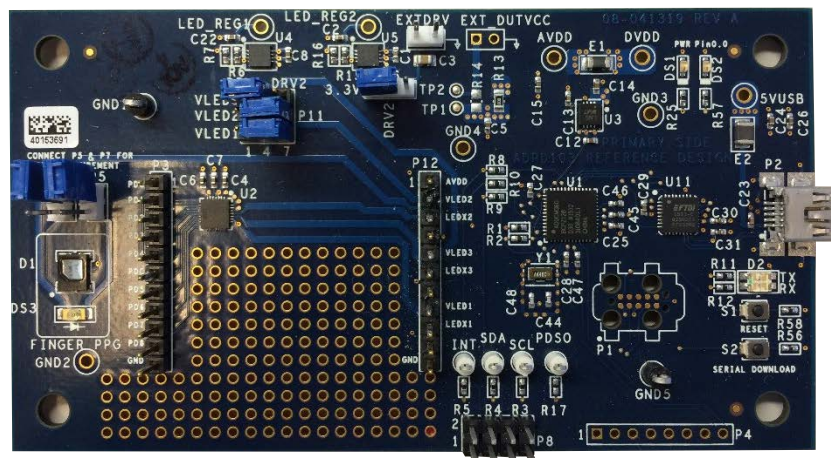


Figure 1.

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REVISION HISTORY

7/2016—Revision 0: Initial Version

GETTING STARTED

INSTALLING THE ADPD103_ADPD105 OPENMARKET WAVETOOL

Download the [ADPD103_ADPD105 OpenMarket WaveTool](#) software package from the [EVAL-ADPD105Z-GEN](#) product page. Unzip the folder and run the **ADPD103_ADPD105_OpenMarket_WaveTool_Setup.exe** file found in the **WaveTool_x_x_x** folder. Follow the prompts, beginning with Figure 2, for software installation.

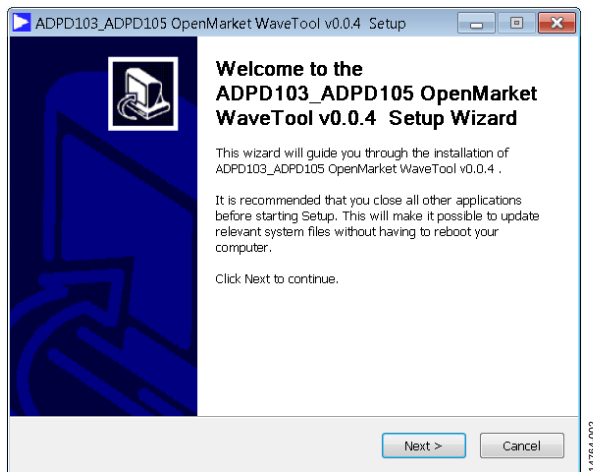


Figure 2. *ADPD103_ADPD105 OpenMarket WaveTool Setup Window*

CHECKING THE USB SERIAL CONNECTION IN WINDOWS 7

Connect the USB cable to the [EVAL-ADPD105Z-GEN](#) evaluation board. Ensure 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 3. In this case, the proper COM port selection is **USB Serial Port (COM16)**.

The [EVAL-ADPD105Z-GEN](#) evaluation board uses an FT232 USB UART IC. If the USB driver installation does not install properly, refer to the corresponding *FTDI Driver Installation* guide to the operating system in use, found on the FTDI website.

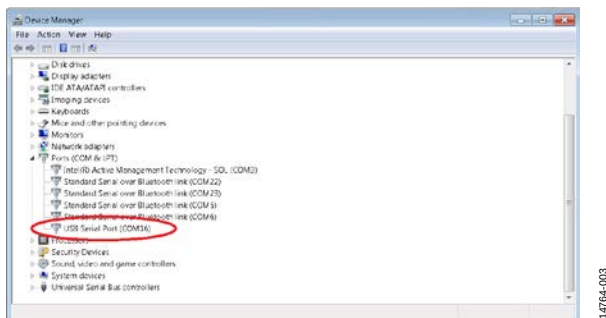


Figure 3. *USB Serial Port in Windows® 7*

RUNNING THE ADPD103_ADPD105 OPENMARKET WAVETOOL

To start the [ADPD103_ADPD105 OpenMarket WaveTool](#) application, navigate to the **ADPD103_ADPD105 OpenMarket WaveTool** from the **Start** menu and click **ADPD103_ADPD105_Tool** (see Figure 4).

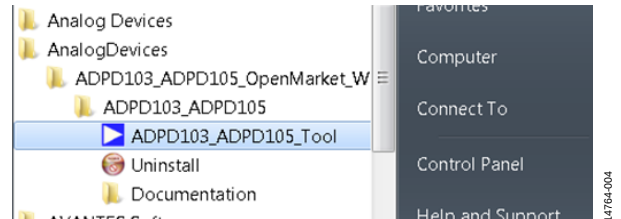


Figure 4. *Navigate to ADPD103_ADPD105_Tool from the Start Menu*

At startup, the application automatically checks whether the installed [ADPD103_ADPD105 OpenMarket WaveTool](#) version is up to date. If there is a newer version available, the user is prompted to download the newest version, shown in Figure 5.

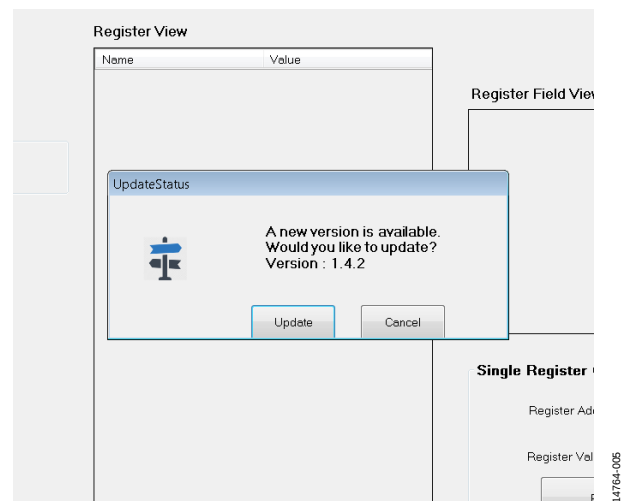


Figure 5. *Automatic Version Update Prompt*

USB UNIVERSAL ASYNCHRONOUS RECEIVER/TRANSMITTER (UART) CONNECTION

After the application opens, select **File > Connect** (see Figure 6). From the drop-down menu, select either **Auto Connect** or **Select Port**, depending on if the specific COM port selection is necessary.

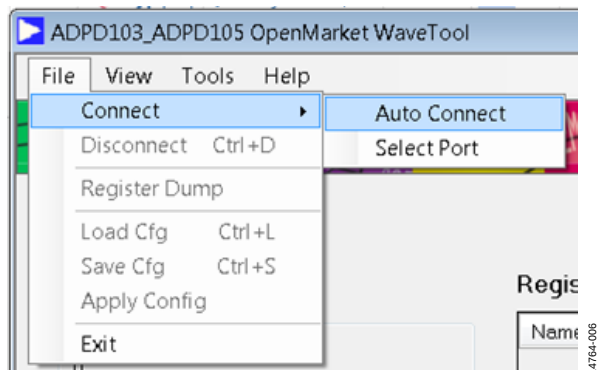


Figure 6. UART Connect

If a specific COM port selection is not needed, select **Auto Connect** to automatically connect the [ADPD103_ADPD105 OpenMarket WaveTool](#) to the device.

Choose **Select Port** to connect the [ADPD103_ADPD105 OpenMarket WaveTool](#) to the device via a particular COM port, shown in Figure 7.

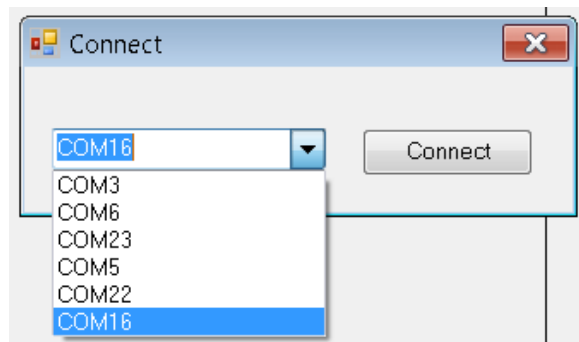


Figure 7. Port Selection

ADPD103_ADPD105 OPENMARKET WAVETOOL MAIN WINDOW

The main window has two different modes: register level (**RegisterLevel**) and high level (**HighLevel**), shown in Figure 8 and Figure 16, respectively.

The **RegisterLevel** configuration window accesses each register or can load a complete list of registers that are stored in a configuration file on the PC.

The high level configuration performs a high level configuration of the **ADPD105** without individual register writes. The high level configuration screen sets up parameters, for example, such as LED current, number of LED pulses, and AFE integration time.

USING THE REGISTERLEVEL CONFIGURATION

Figure 8 shows the **ADPD105** configuration window in the **RegisterLevel** window. The following controls and descriptions are listed in the configuration window:

- **Firmware Version** shows the firmware version.
- **Config File in Use** shows information about the configuration file that is in use.

- **Register View** shows the current register values of the device. Change register values by entering a hexadecimal value into the value column of the register view list and press the **Enter** key.
- **Register Field View** shows how the register is subdivided into fields that determine how each bit field is used. For example, Figure 8 shows the PAD_IO_CTRL, Register 0x02, is composed of the bit fields INT_POL, INT_DRV, and INT_ENA to configure the operation of the INT pin.
- **Single Register Control** allows reading and writing of individual registers.
- Load a configuration file (.dcfg) by selecting **File > LoadCfg** and selecting a .dcfg file included with the software installation or a custom .dcfg file developed by the user for a desired configuration.
- Save a configuration file (.dcfg) by selecting **File > SaveCfg**.
- The **Go to HighLevel** button switches to the **3 LED's High Level Control** view.

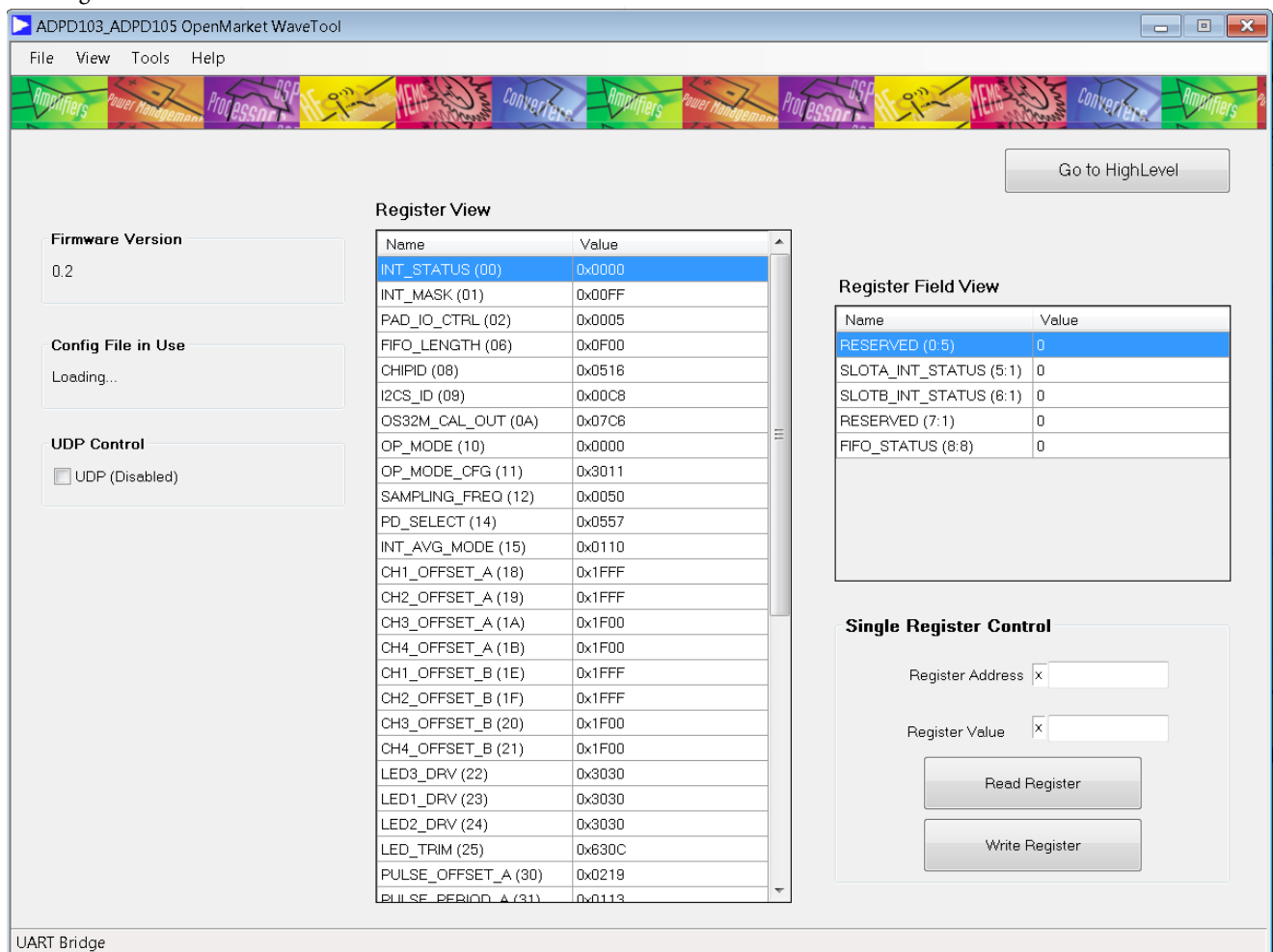


Figure 8. RegisterLevel Window

Register View

The **Name** column in the **Register View** list displays the register name as defined by the register map, followed by (in parentheses) the address in abbreviated hexadecimal format (see Figure 9). The **Value** column displays the register value of the corresponding register in the **Name** column in full hexadecimal format.

Register View

Name	Value
INT_STATUS (00)	0x0000
INT_MASK (01)	0x00FF
PAD_IO_CTRL (02)	0x0005
FIFO_LENGTH (06)	0x0000
CHIPID (08)	0x0416
I2CS_ID (09)	0x00C8
OS32M_CAL_OUT (0A)	0x07E8
OP_MODE (10)	0x0000
OP_MODE_CFG (11)	0x3011
SAMPLING_FREQ (12)	0x0014
PD_SELECT (14)	0x055E
INT_AVG_MODE (15)	0x0220
CH1_OFFSET_A (18)	0x1E00
CH2_OFFSET_A (19)	0x1E00
CH3_OFFSET_A (1A)	0x1E00
CH4_OFFSET_A (1B)	0x1E00
CH1_OFFSET_B (1E)	0x1E00

Figure 9. Register View List

Clicking any register in the **Register View** list reveals the register categories in the **Register Field View** list, as shown in Figure 10. The **Register Field View** is read only.

Name	Value
RESERVED (0:5)	0
SLOTA_INT_STATUS (5:1)	0
SLOTB_INT_STATUS (6:1)	0
RESERVED (7:1)	0
FIFO_STATUS (8:8:r)	0

Figure 10. Register Field View List

Enter data in cells in the **Value** column of the **Register View** list in either hexadecimal or decimal format. A hexadecimal number is entered with a 0x prefix to the number, whereas a decimal number does not include these prefix characters. For example, entering 0xFF (hexadecimal) or 255 (decimal), results in the same value written to the register.

Hovering over a cell in the **Value** column in the **Register View** list shows the delineation of the register fields for that cell (see Figure 11), whereas hovering over a cell in the **Name** column shows a description of the corresponding register.

INT_MASK (01)	0x00FF	SLOTA_INT_MASK (5:1)	1
PAD_IO_CTRL (02)	0x0005	INT_MASK @ 0x1	
I2CS_CTL_MATCH (06)	0x0F01	0x00FF	
CHIPID (08)	0x0416	Field (r)	Value
I2CS_ID (09)	0x00C8	RESERVED	1F
OS32M_CAL_OUT (0A)	0x07D7	SLOTA_INT_MASK	1
SW_RESET (0F)	0x0000	SLOTB_INT_MASK	1
OP_MODE (10)	0x0000	RESERVED	1
		FIFO_INT_MASK	0
		RESERVED	0

Figure 11. Register Value List Selection Hover Description

The **Register View** list has a context-sensitive menu available by right-clicking anywhere in the **Register View** list (see Figure 12).

Refresh Selected
Refresh All F5
☒ Show Hex

Figure 12. Register View Context-Sensitive Menu

By using the context-sensitive menu, it is possible to refresh the selected register, refresh all registers, or set the selected register to display in hexadecimal or decimal format. The selected format remains set, even when the [ADPD103_ADPD105 OpenMarket WaveTool](#) is opened and closed, until the format is reset.

For example, in Figure 13, the Time Slot B offset registers (**CHx_OFFSET_B**) display in decimal format but others, such as LED drive settings (**LEDx_DRV**), display in hexadecimal format.

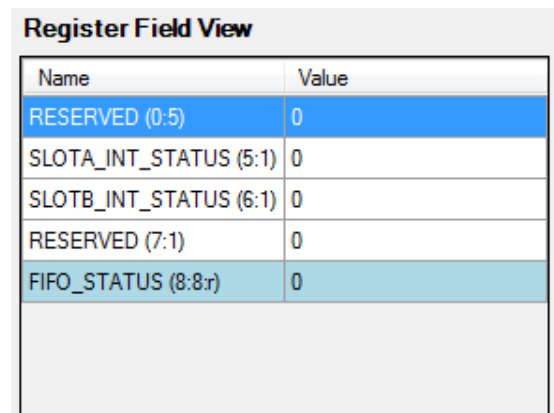
CH1_OFFSET_B (1E)	7680
CH2_OFFSET_B (1F)	7680
CH3_OFFSET_B (20)	7680
CH4_OFFSET_B (21)	7680
LED1_DRV (23)	0x3037
LED3_DRV (22)	0x103F
LED2_DRV (24)	0x1032
LED_TRIM (25)	0x02CC

Figure 13. Register View List Values in Decimal and Hexadecimal Format

Register Field View

The **Register Field View** list is a read-only view to see specific register field value(s). It automatically tracks the selected register in the **Register View** list.

The **Register Field View** list is composed of two columns, shown in Figure 14.



The image shows a screenshot of the 'Register Field View' window. It contains a table with two columns: 'Name' and 'Value'. The table lists several register fields, each with a name indicating its bit range and a corresponding hexadecimal value. The first row, 'RESERVED (0:5)', is highlighted in blue. The other rows are 'SLOTA_INT_STATUS (5:1)', 'SLOTB_INT_STATUS (6:1)', 'RESERVED (7:1)', and 'FIFO_STATUS (8:8:r)', all with a value of '0'. The 'FIFO_STATUS' row is also highlighted in blue. Below the table is a large empty rectangular area. A vertical label '14764-014' is on the right side of the window.

Name	Value
RESERVED (0:5)	0
SLOTA_INT_STATUS (5:1)	0
SLOTB_INT_STATUS (6:1)	0
RESERVED (7:1)	0
FIFO_STATUS (8:8:r)	0

Figure 14. **Register Field View List**

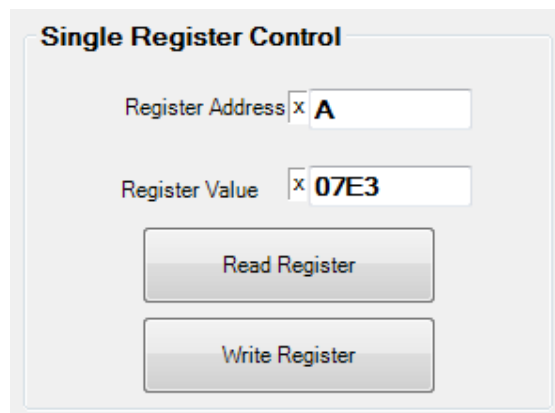
The **Register Field View** list shows each register field, where the **Name** column shows the register name (start bit:length in bits) and the **Value** column shows the hexadecimal value (without the prefix characters 0x) of the corresponding register.

Single Register Control

The **Single Register Control** pane includes controls to read or write an individual register.

The **Read Register** button reads and displays the value of the register entered in the **Register Address** field.

The **Write Register** button writes the register with the value entered in the **Register Value** field.



The image shows a screenshot of the 'Single Register Control' pane. It has a light gray background. At the top, the title 'Single Register Control' is in bold. Below the title are two input fields. The first is labeled 'Register Address' and contains the value 'A'. The second is labeled 'Register Value' and contains the value '07E3'. Below these fields are two buttons: 'Read Register' and 'Write Register'. A vertical label '14764-015' is on the right side of the pane.

Figure 15. **Single Register Control Pane**

HIGH LEVEL

Figure 16 shows the [ADPD103_ADPD105 OpenMarket WaveTool HighLevel](#) configuration window. This window offers an entire set of high level parameter controls. The configurable parameters are as follows:

- **Sampling Frequency**—adjusts the sampling rate.
- **Internal Average** (identical for both timeslots in the [ADPD105](#))—controls the output data rate, which is equal to the sampling frequency divided by the internal average. For example, a sampling frequency of 400 Hz and an internal average setting of 4, as shown in Figure 16, results in an output data rate of 100 Hz.
- **ADPD Slot Mode**—specifies all the [ADPD105](#) slot modes.
- **Slot A Control and Slot B Control**
 - **LED Control**
 - **LED**—selects an LED from the drop-down menu.
 - **LED Status**—specifies whether the selected LED is in the on or off state.
 - **Number Of Pulses**—sets the number of LED pulses.
 - **TIA Gain**—sets the gain of the transimpedance amplifier (TIA) via a drop-down menu.
- **Timing Control**—see the [ADPD105](#) data sheet for detailed descriptions of the timing controls.
 - **AFE Width (us)**—sets the AFE integration time in microseconds.
 - **Pulse Width (us)**—sets the LED pulse width in microseconds.
 - **Pulse Offset (us)**—sets the LED pulse offset in microseconds.
 - **AFE Offset (us)**—sets the coarse AFE integration offset in microseconds.
 - **AFE Fine Offset (ns)**—sets the fine AFE integration offset in nanoseconds.
- **LED 1, LED 2, and LED 3 current controls**
 - **I_LED Coarse**—coarse setting for the LED current via the **I_LED Coarse** drop-down menu.
 - **Scale Factor**—100% or 40% scale factor applied to the coarse LED current setting.
 - **Final I_LED**—sets **Final I_LED** current in the **Final I_LED** field by using the slider. The field displays in milliamps.

To switch to the RegisterLevel configuration, click the **Go to RegisterLevel** button.

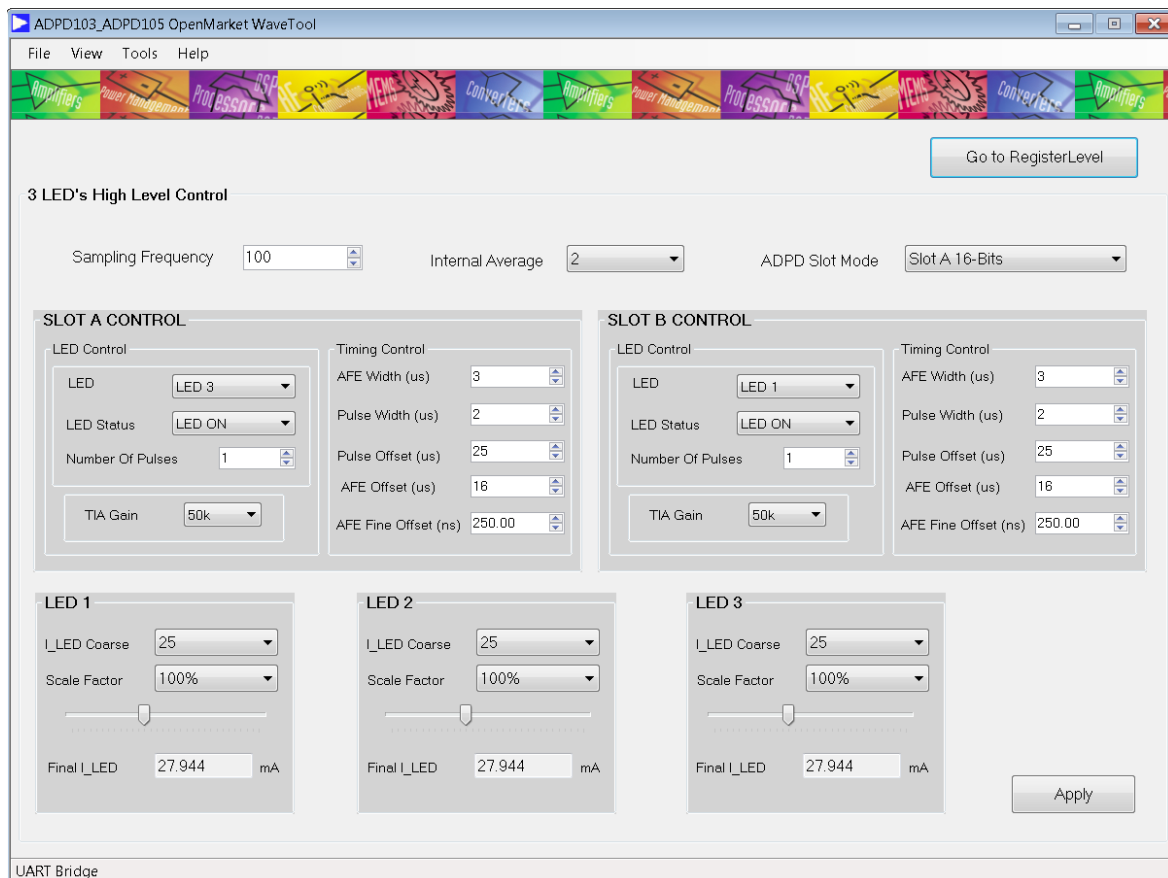


Figure 16. HighLevel Window

ADPD SLOT MODE

The **ADPD Slot Mode** contains Slot A, Slot B, and the sum and digital integration modes.

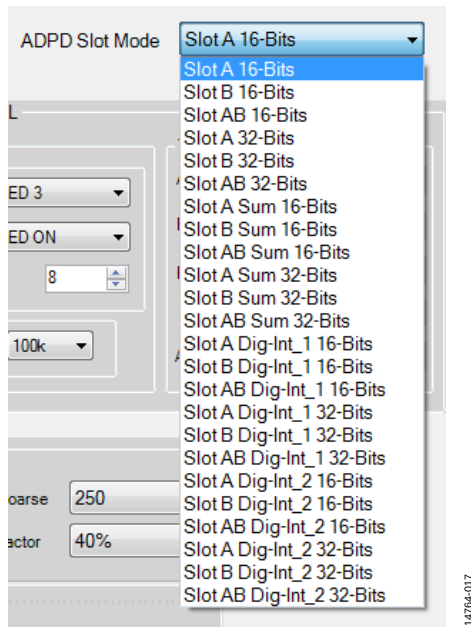


Figure 17. **ADPD Slot Mode** Drop-Down Menu

Slot A (16 Bits)

The 4-channel, 16-bit data displays in the **Time View** tab for Time Slot A only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot B (16 Bits)

The 4-channel, 16-bit data displays in the **Time View** tab for Time Slot B only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot AB (16 Bits)

The 4-channel, 16-bit data displays in the **Time View** tab for both Time Slot A and Time Slot B. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot A (32 Bits)

The 4-channel, 32-bit data displays in the **Time View** tab for Time Slot A only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot B (32 Bits)

The 4-channel, 32-bit data displays in the **Time View** tab for Time Slot B only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot AB (32 Bits)

The 4-channel, 32-bit data displays in the **Time View** tab for both Time Slot A and Time Slot B. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot A Sum (16 Bits)

The sum of 4-channel, 16-bit data displays in the **Time View** tab for Time Slot A only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot B Sum (16 Bits)

The sum of 4-channel, 16-bit data displays in the **Time View** tab for Time Slot B only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot AB Sum (16 Bits)

The sum of 4-channel, 16-bit data displays in the **Time View** tab for both Time Slot A and Time Slot B. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot A Sum (32 Bits)

The sum of 4-channel, 32-bit data displays in the **Time View** tab for Time Slot A only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot B Sum (32 Bits)

The sum of 4-channel, 32-bit data displays in the **Time View** tab for Time Slot B only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot AB Sum (32 Bits)

The sum of 4-channel, 32-bit data displays in the **Time View** tab for both Time Slot A and Time Slot B. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot A Dig Int-1 (16-Bits)

16-bit digital integrated sample data displays in the **Time View** tab for Time Slot A only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot B Dig Int-1 (16 Bits)

16-bit digital integrated sample data displays in the **Time View** tab for Time Slot B only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot AB Dig Int-1 (16 Bits)

16-bit digital integrated sample data displays in the **Time View** tab for Time Slot A and Time Slot B. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot A Dig Int-2 (16 Bits)

16-bit digital integrated sample and background data displays in the **Time View** tab for Time Slot A only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot B Dig Int-2 (16-Bits)

16-bit digital integrated sample and background data displays in the **Time View** tab for Time Slot B only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot AB Dig Int-2 (16 Bits)

16-bit digital integrated sample and background data displays in the **Time View** tab for Time Slot A and Time Slot B. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot A Dig Int-1 (32 Bits)

32-bit digital integrated sample data displays in the **Time View** tab for Time Slot A only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot B Dig Int-1 32 Bits:

32-bit digital integrated sample data displays in the **Time View** tab for Time Slot B only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot AB Dig Int-1 (32 Bits)

32-bit digital integrated sample data displays in the **Time View** tab for Time Slot A and Time Slot B. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot A Dig Int-2 (32 Bits)

32-bit digital integrated sample and background data display in the **Time View** tab for Time Slot A only. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot B Dig Int-2 (32 Bits)

32-bit digital integrated sample and background data display in the **Time View** tab for Time Slot B only. When in **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

Slot AB Dig Int-2 (32 Bits)

32-bit digital integrated sample and background data display in the **Time View** tab for Time Slot A and Time Slot B. When in the **Frequency View** tab, see Figure 39, use the **Channel Select** drop-down menu to display the FFT for the selected channel.

LOAD AND SAVING CONFIGURATIONS

To load and save device configuration files, use **File > Load Cfg** and **File > Save Cfg**, respectively, as shown in Figure 18 and Figure 19. The load configuration option (**Load Cfg**) loads the set of registers contained in the user selected **.dcfg** file to the **ADPD105**. The save configuration option (**Save Cfg**) saves all writable registers of the **ADPD105** to a **.dcfg** file via the **Open** file dialog box.

Find sample configuration files installed with the **ADPD103_ADPD105 OpenMarket WaveTool** application in the **SampleCfgs** folder.

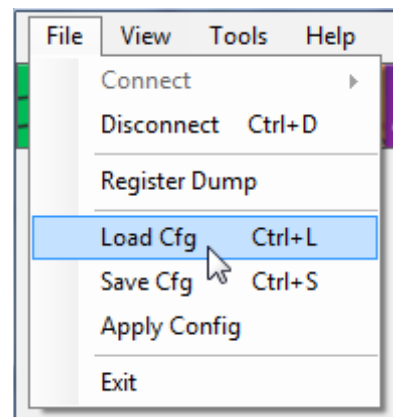


Figure 18. Load Configuration

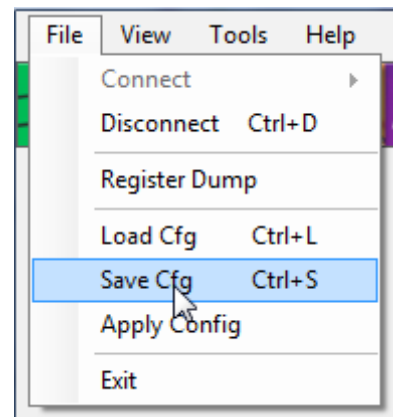


Figure 19. Save Configuration

Selecting **Load Cfg** opens a file dialog box. Device configuration files have the extension **.dcfg**. Once loaded, the configuration file used by the evaluation board displays in the **RegisterLevel** window in the **Config File in Use** pane, shown in Figure 8 and Figure 20. The full path of the **.dcfg** file is shown when the mouse hovers over the file name. If no file is loaded, the **Config File in Use** pane displays **None**.

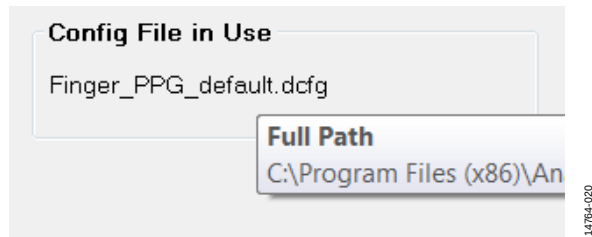


Figure 20. Config File in Use Pane

A configuration file uses the following format:

Address Data #(comment optional)

The address is an 8-bit address and the data must be in 16-bit format, as follows:

```
14 0555 #setup input PD configuration
15 0220 #number of averages = 4
18 1F80 #slot A channel 1 ADC offset
19 1F80 #slot A channel 2 ADC offset
```

APPLY CONFIGURATION

A previously loaded configuration remains in the memory of the [ADPD103_ADPD105 OpenMarket WaveTool](#) software until overwritten by a new configuration file using **File > Load Cfg**, shown in Figure 18. Therefore, to return to a previously loaded configuration quickly, it is not necessary to reload the configuration. Instead, select **File > Apply Config**.

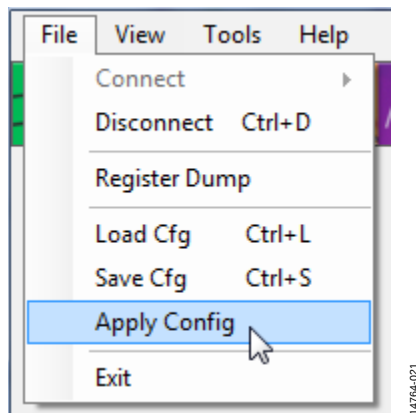


Figure 21. Apply Configuration

DUMP REGISTERS

With the [ADPD103_ADPD105 OpenMarket WaveTool](#) software, the user can dump all the registers to a single file by selecting **File > Register Dump**, shown in Figure 22. A file dialog box opens, prompting the user to save the file to a specific location with a specific name. Register contents are then dumped to the specified file.

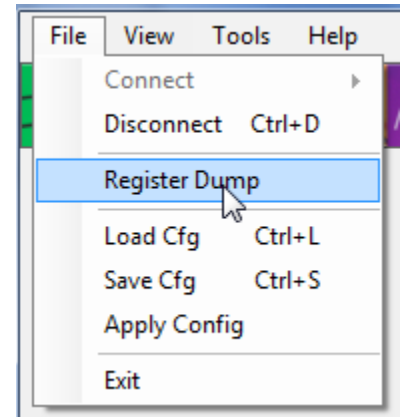


Figure 22. Dumping Registers

The following is an example of a register dump:

```
PD_SELECT (14) 0555
INT_AVG_MODE (15) 0220
CH1_OFFSET_A (18) 1F80
CH2_OFFSET_A (19) 1F80
```

The register is listed by name and the address is listed in the corresponding hexadecimal value.

GRAPH VIEW

Use **Graph View** for real-time frequency and time domain analysis of the **ADPD105** raw data. Access **Graph View** from the main window via the **View** menu, shown in Figure 23.

When the **Graph View** opens, it defaults to the time domain view (**Time View** tab) as shown in Figure 24. There is also a **Frequency View** tab for frequency domain analysis.

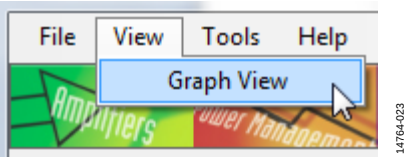


Figure 23. **View** Menu

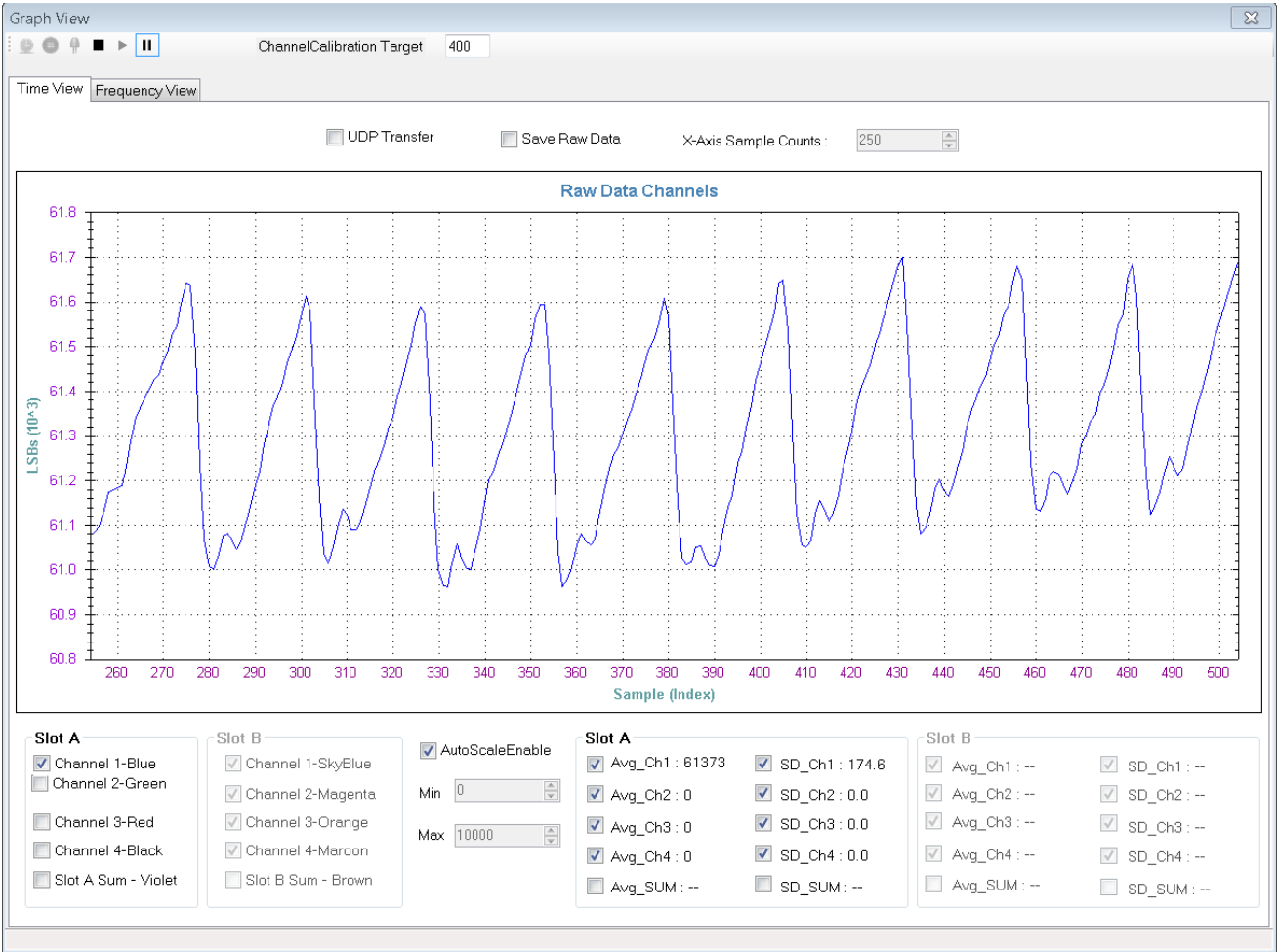


Figure 24. **Time View** Tab

Time View

The **Time View** tab displays the raw data from the [ADPD105](#) in time domain format. Plot or send the raw data through the UDP to the host system that is controlled by the **UDP Transfer** checkbox in the **Time View**, which has three controls:

- The UDP on/plot off mode, where the **UDP Transfer** checkbox is checked (see Figure 25). In this mode, the data is sent through the UDP and does not display in the graph.

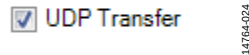


Figure 25. UDP On/Plot Off Mode

- The UDP off/plot on mode, where the UDP Transfer checkbox is not selected (see Figure 26). In this mode, the data displays in the graph but is not sent through the UDP.

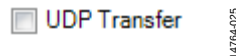


Figure 26. UDP Off/Plot On Mode

- The UDP on/plot on mode, where the **UDP Transfer** checkbox fill is solid by selecting three consecutive times (see Figure 27). In this mode, the data is sent through the UDP and also displays in the graph.

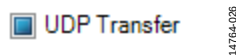


Figure 27. UDP On/Plot On Mode

The **UDP Transfer Tool** is set up within the [ADPD103_ADPD105 OpenMarket WaveTool](#) package; see the UDP Transfer Tool section. The **UDP Transfer Tool** receives the data from [ADPD103_ADPD105 OpenMarket WaveTool](#) and transfers the data to the assigned UDP port.

To save the raw data into a file, check the **Save Raw Data** checkbox, as shown in Figure 28. When the box is checked, the user is prompted to save the file.

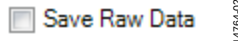


Figure 28. Checkbox to Save Sensor Raw Data to a File

Configure the x-axis sample count for graph plotting through the **X-Axis Sample Counts** spin box (see Figure 29).

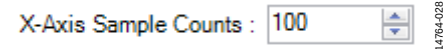


Figure 29. X-Axis Sample Counts Spin Box

Note the minimum value for sample count is limited to 100. If the sample count is assigned with values smaller than 100, it automatically corrects to 100.

The **Time View** tab shows the raw data graph that plots **Sample (Index)** vs. **LSBs (10^3)** data.

The plot of each individual channel is controlled using the checkboxes, shown in Figure 30. By clicking any checkbox in the **Slot A** or **Slot B** panes, the corresponding channel data is plotted with the specified color in the **Raw Data Channels** graph.



Figure 30. Channel Display Controls

The auto scaling of the **Time View** graph can be enabled or disabled by the **AutoScaleEnable** checkbox (see Figure 31). The minimum and maximum scale range can also be adjusted while the auto scale option is disabled.

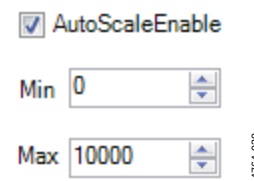


Figure 31. **AutoScaleEnable** Control and Scale Range Setting

The average and standard deviation for every channel and sum of all channels are displayed in the **Slot A** and **Slot B** panes (see Figure 32). These statistics are enabled or disabled by the checkbox preceded by each label.

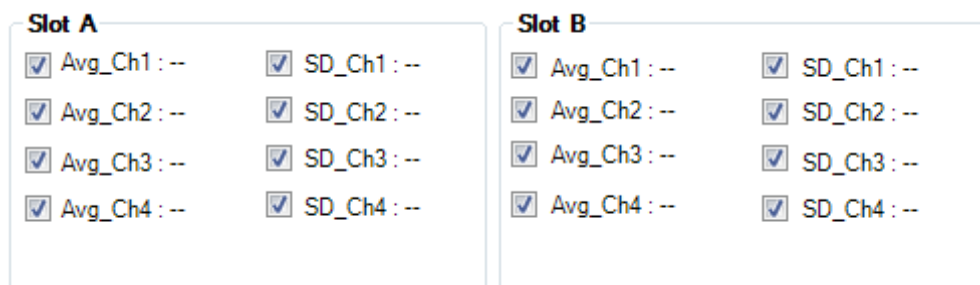


Figure 32. Average and Standard Deviation Controls

General Controls

Using standard controls, the user can start (see Figure 33), stop the current mode and return to idle mode (see Figure 34), and pause the device in the current operating state (see Figure 35), no longer updating the graphs but still receiving data from the device.



Figure 33. **Start** Button



Figure 34. **Stop and Return to Idle** Button



Figure 35. **Pause and Resume** Button

FREQUENCY VIEW

The **Frequency View** tab shows the fast fourier transform (FFT) of the raw data in the form of a graph that plots **Amplitude** vs. **Frequency (Hz)**. The user can select the x-axis scale type as linear or logarithmic in the **XAxis Scale Type** drop-down list, shown in Figure 36.

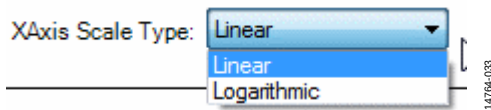


Figure 36. **X-Axis Scale Type** Drop-Down Menu

The **FFT Samples** spin box provides the number of samples that calculate the FFT.



Figure 37. **FFT Samples** Spin Box

The minimum value for sample count is limited to 50 samples. If the **FFT Samples** spin box is assigned with values smaller than 50, it automatically corrects to 50.

The **Frequency View** tab displays any one of the enabled channels from the **Channel Select** drop-down list. For example, if Slot A is enabled, the user can select any channel within Slot A, shown in Figure 38.

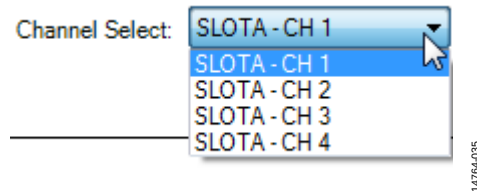


Figure 38. Slot A Channels

The linear scale of the FFT **Spectrum** graph is shown in Figure 39 and the logarithmic scale of the FFT **Spectrum** graph is shown in Figure 40.

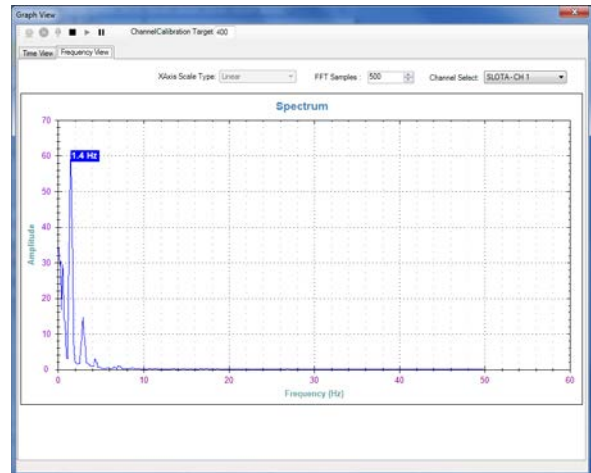


Figure 39. Linear FFT **Spectrum** Graph

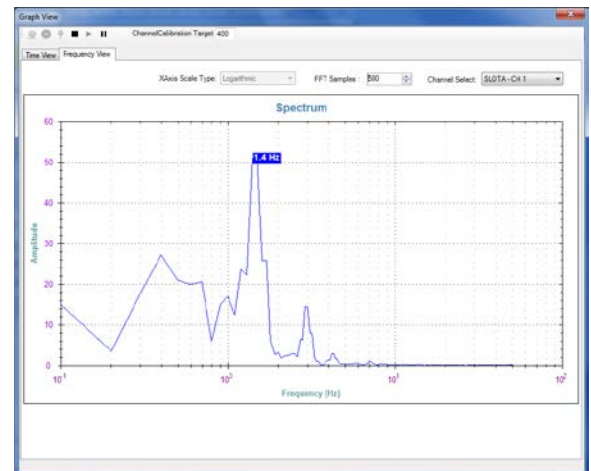


Figure 40. Logarithmic FFT **Spectrum** Graph

TOOLS DROP-DOWN MENU OPTIONS

The **Options** selection from the **Tools** drop-down menu shows the general board settings as well as the UDP configuration.

General

The **General** tab contains information about the device, the platform, and the firmware version.

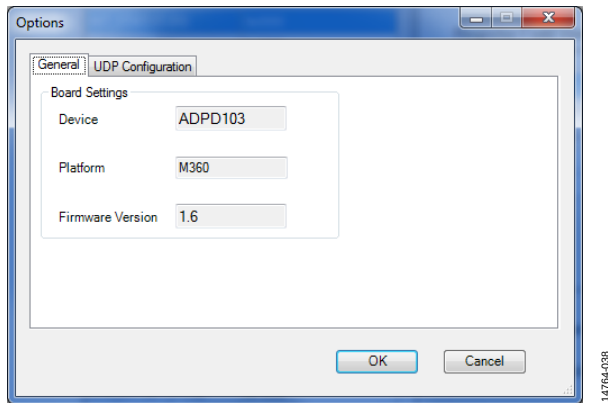


Figure 41. **General** Tab in **Options** Dialog Box

UDP Configuration

The **UDP Configuration** tab allows the user to configure the port numbers for UDP communication. The UDP transfer tool sends the raw data to the client via the specified port numbers. The IP address field must display the IP address the UDP transfer tool is running.

Use the **Raw Data Transfer Port** field to assign the port number for sending raw data from [ADPD103_ADPD105 OpenMarket WaveTool](#) to the UDP transfer tool (see Figure 42).

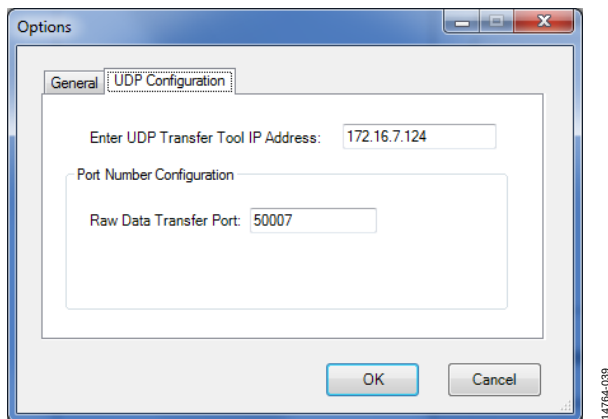


Figure 42. **UDP Configuration** Tab in **Options** Dialog Box

AUTOMATIC UPDATE

The **Tools > Auto Update** function enables/disables the automatic software update functionality at the time of tool start (see Figure 43). When **Auto Update** is enabled, it checks for the availability of a new [ADPD103_ADPD105 OpenMarket WaveTool](#) update and prompts the user to update the tool with the latest version.

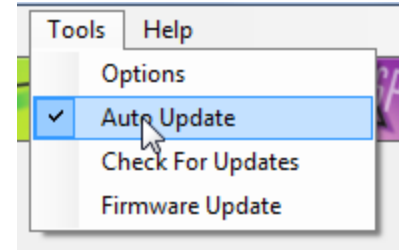


Figure 43. **Auto Update** Option

CHECK FOR UPDATES

Use the **Tools > Check For Updates** function to manually check for the availability of a new software update (see Figure 44).

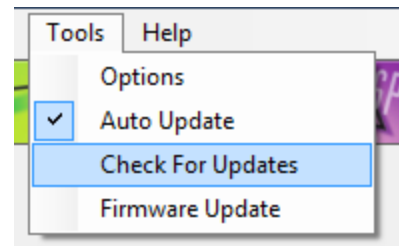


Figure 44. **Check For Updates** Option

FIRMWARE UPDATE

Use the **Tools > Firmware Update** function to start the firmware update process (see Figure 45).

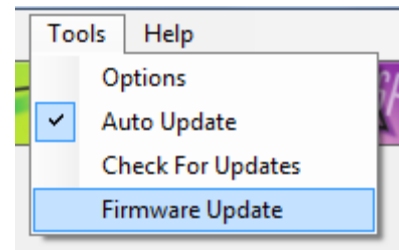


Figure 45. **Firmware Update** Option

Note the [ADPD103_ADPD105 OpenMarket WaveTool](#) must be connected with the evaluation board to perform the firmware update; otherwise, the [ADPD103_ADPD105 OpenMarket WaveTool](#) shows a disconnect message (see Figure 46).

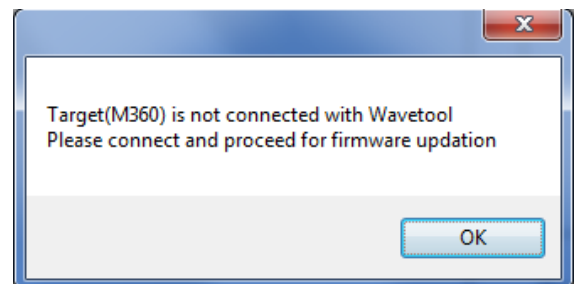


Figure 46. **Connection Status for Firmware Update**

When **Firmware Update** is selected, the CM3WSD firmware flashing tool opens. To flash the firmware, the user must ensure that the correct path and file name are selected in the **CM3WSD** dialog box, shown in Figure 47.

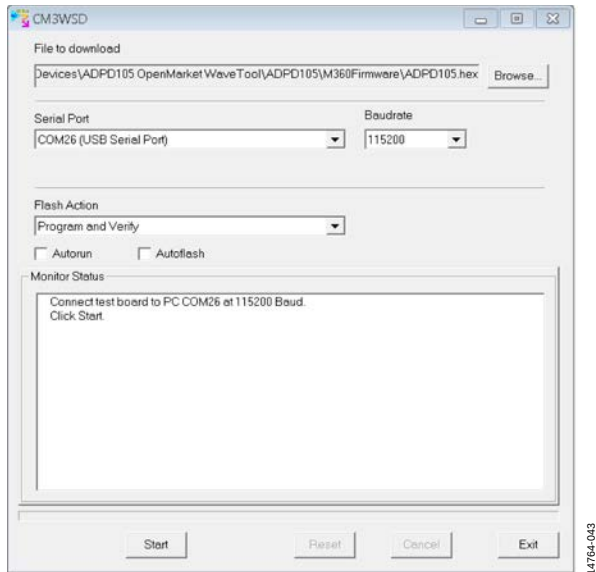


Figure 47. Firmware Flashing Tool

With the correct path name and file name entered in the **File to download** field and the correct USB serial port selected from the **Serial Port** drop-down menu, click **Start**. The user is prompted to pulse the reset button while holding down the download button on the evaluation board (circled in Figure 48). The firmware download starts when this step is completed.

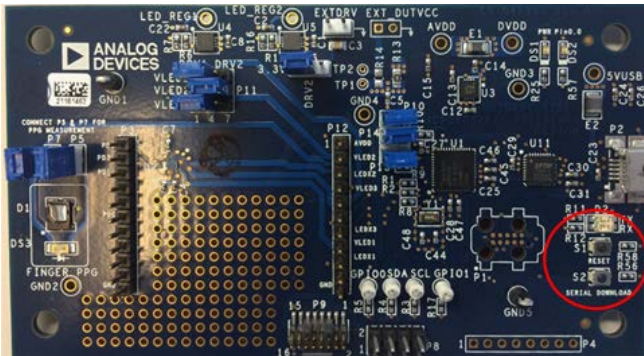


Figure 48. Serial Download and Reset Buttons to Flash Firmware

When the firmware download completes, click the **Reset** button in the **CM3WSD** dialog box and click the **Exit** button. The user can now return to the [ADPD103_ADPD105 OpenMarket WaveTool](#) and reconnect the device via **File > Connect** to commence testing with the updated firmware.

SEND REPORT

If the software update failed for ten times continuously, the [OpenMarket WaveTool](#) opens the dialog box shown in Figure 49.

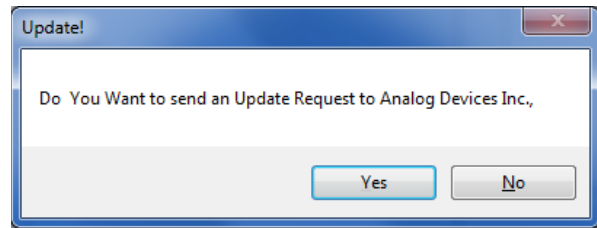


Figure 49. Update! Dialog Box

When the user clicks **Yes**, the **Email Request** dialog box appears (see Figure 50).

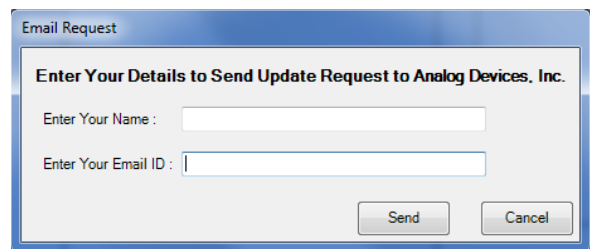


Figure 50. Email Request Dialog Box

Enter the user name in the **Enter Your Name** field and email ID (this is the email address used when registering to receive the software package) in the **Enter Your Email ID** field. After entering a user name and email ID, click **Send** to initiate the report to Analog Devices, Inc.

EXITING THE ADPD103_ADPD105 OPENMARKET WAVETOOL APPLICATION

Follow the subsequent two step process to exit the application:

1. Disconnect the device via **File > Disconnect Ctrl+D**, shown in Figure 51.
2. Exit the application via **File > Exit**, shown in Figure 52.

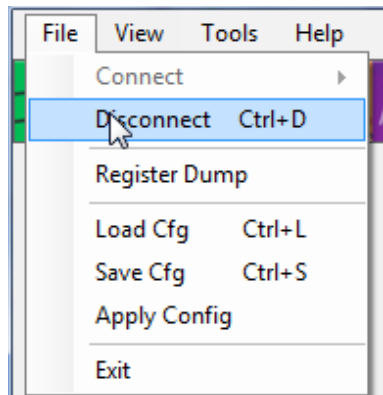


Figure 51. Disconnecting the EVAL-ADPD105Z-GEN

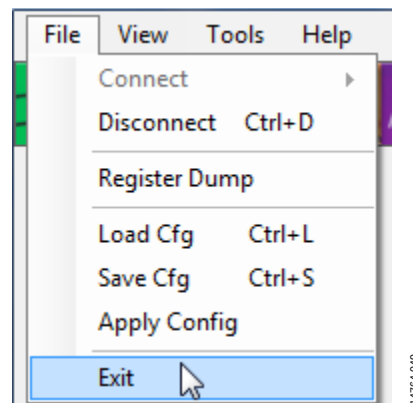


Figure 52. Exiting the Application

UDP TRANSFER TOOL

This section explains the raw data reception and data format for various modes from the UDP transfer tool over UDP.

UDP TRANSFER TOOL SETUP

To setup the the UDP transfer tool, follow these steps:

1. Open the [ADPD103_ADPD105 OpenMarket WaveTool](#) and go to **Tools > Options > UDP Configuration**. Enter the IP address of the remote PC where the UDP transfer tool is running.

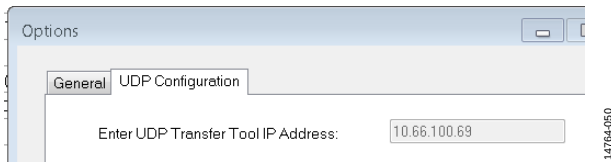


Figure 53. UDP Configuration Tab

2. Connect the hardware (**File > Connect > Auto Connect** or **File > Connect > Select Port**) using the UART bridge on the host PC.

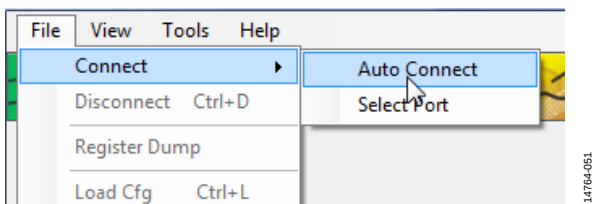


Figure 54. Selecting Auto Connect

3. Open **Graph View** and check the **UDP Transfer** box in the **Time View** tab.

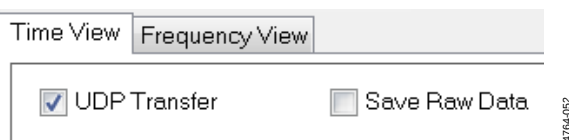


Figure 55. Enable UDP Transfer

4. Click the **Start** button (see Figure 33) to send the raw data through the UDP.

To save the raw data being transferred via the UDP to a data file, open the receiver tool (**UDPTransferTool.exe**) and enter the IP address of the system (see Figure 56).

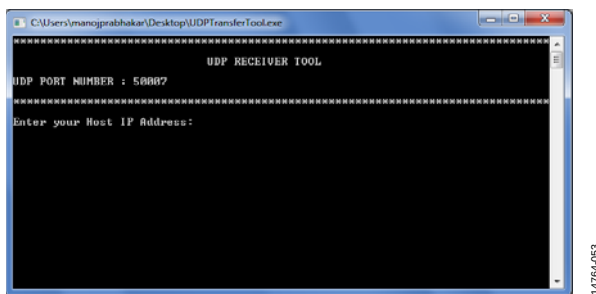


Figure 56. UDP Receiver Tool

5. Enter a file name to save the raw data from the [ADPD103_ADPD105 OpenMarket WaveTool](#) and press enter (see Figure 57).

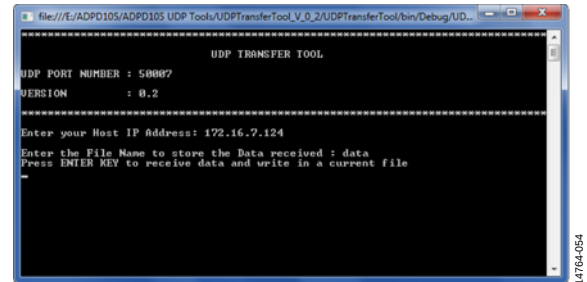


Figure 57. Entering a File Name to Store Data

6. The received packet count is continuously displayed in the [ADPD103_ADPD105 OpenMarket WaveTool](#) tool and the raw data is stored in the file (see Figure 58).

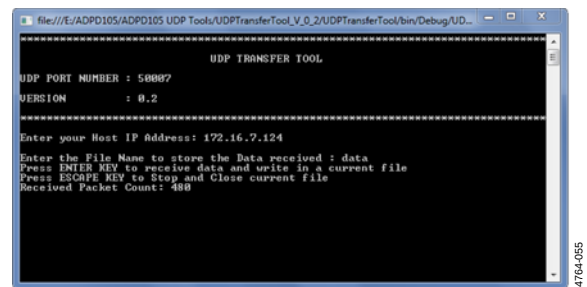


Figure 58. Receiving Raw Data

7. Press the **ESC** key to stop receiving the data and close the current file (see Figure 59).

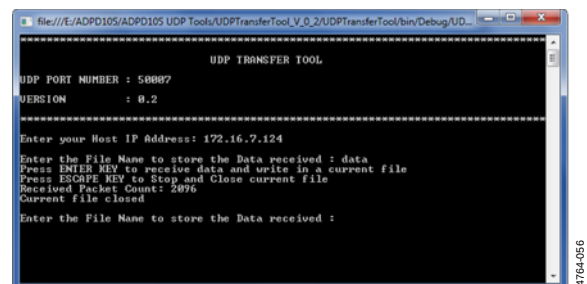


Figure 59. Closing the File

RAW DATA FORMAT

Before using the UDP transfer tool, ensure the [ADPD103_ADPD105 OpenMarket WaveTool](#) is opened and running with the UDP transfer enabled. See Figure 60 for an example of stored sample raw data.

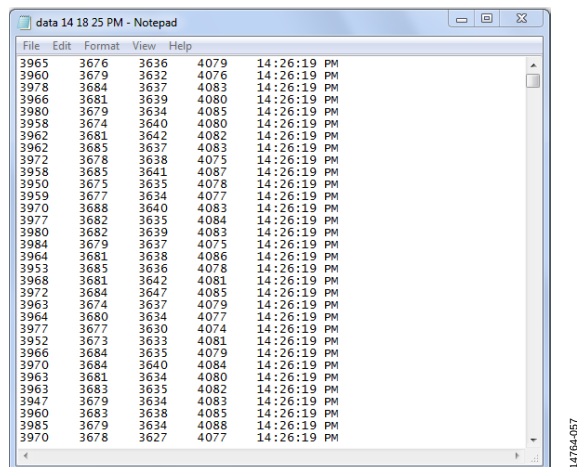


Figure 60. Sample Data

The sample data transmits in the form of ASCII bytes in hexadecimal characters. The sample data format is F0136CFC0000000FE90000105000000EA000000FCC.

The hexadecimal data is formatted with the following characteristics:

- The first two characters (F0) represent sync.
- Next two characters (13) represent size.
- Next two characters (6C) represent the sequence number.
- Next four characters (FC00) represent the time stamp.
- The remaining characters represent the hexadecimal channel raw data and its count (based on the slot modes of the [ADPD103_ADPD105 OpenMarket WaveTool](#)).

Table 1. UDP Data Count for Various Modes

Slot Mode	Data Format	Data Count
Slot A Sum, 16 bits Slot B Sum, 16 bits Slot A Sum, 32 bits Slot B Sum, 32 bits Slot A Dig Int, 16 bits Slot B Dig Int, 16 bits	00000FE9	1
Slot AB Sum, 32 bits Slot A Dig Int, 32 bits Slot B Dig Int, 32 bits	00000FE9 00001050	2
Slot A, 16 bits Slot B, 16 bits Slot A, 32 bits Slot B, 32 bits	00000FE9 00001050 00000EA0 00000FCC	4
Slot AB, 16 bits	00000F7E 0000105C 00000EA8 00000FCC 00000FE9 00001064 00000EAD 00000FCE	8

UDP CONTROLLER TOOL

Open the **UDPControllertool** (see Figure 61) and complete the **Enter your Host IP Address** field. This is the IP address of the host PC where the **ADPD103_ADPD105 OpenMarket WaveTool** is running.

After entering the corresponding IP address, the user can send and receive commands between the controller and the **ADPD103_ADPD105 OpenMarket WaveTool**.

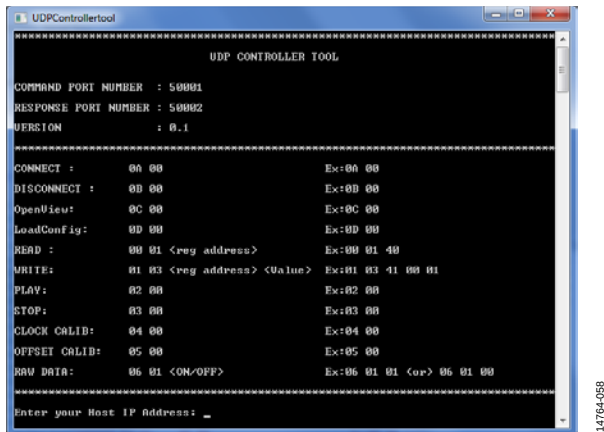


Figure 61. UDPControllertool Window

UDP CONTROLLER APPLICATION TESTING PROCEDURE

Port Connection

To use the read register or write register functions, the port must be connected in the **ADPD103_ADPD105 OpenMarket WaveTool**. Connect the port using the following steps:

1. Open the **ADPD105 OpenMarket WaveTool** application.
2. Connect the port by selecting **File > Connect**. Select either **Auto Connect** to automatically select the port or **Select Port** to manually select the port.
3. Ensure the UDP control IP address is assigned correctly.

Read Register

After connecting the port, send the register read command as **00 01 <reg address>**, for example, send as **00 01 01** to read from register **0x01** (see Figure 62). The following are the defined read command components:

- 00 = register read command
- 01 = number of parameters
- 01 = register address

The response is received with the register value.

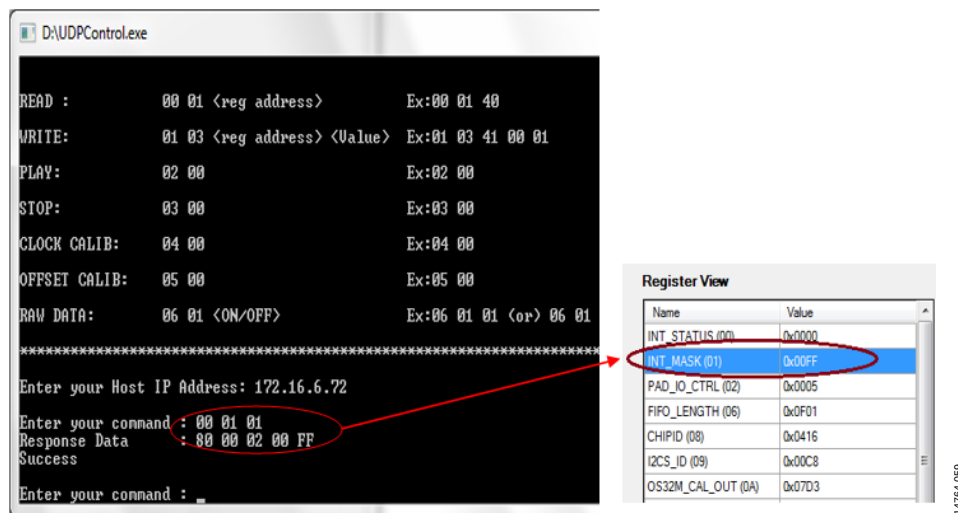


Figure 62. Read Register Operation

Write Register

After connecting the port following the instructions in the Port Connection section, send the register write command as **00 03 <reg address> <Value>**, for example, send as 00 03 01 00 01 (see Figure 63).

The following are the defined write command components:

- 00 = register write command
- 03 = number of parameters
- 01 = register address
- 00 01 = register value

The response is received with the register value.

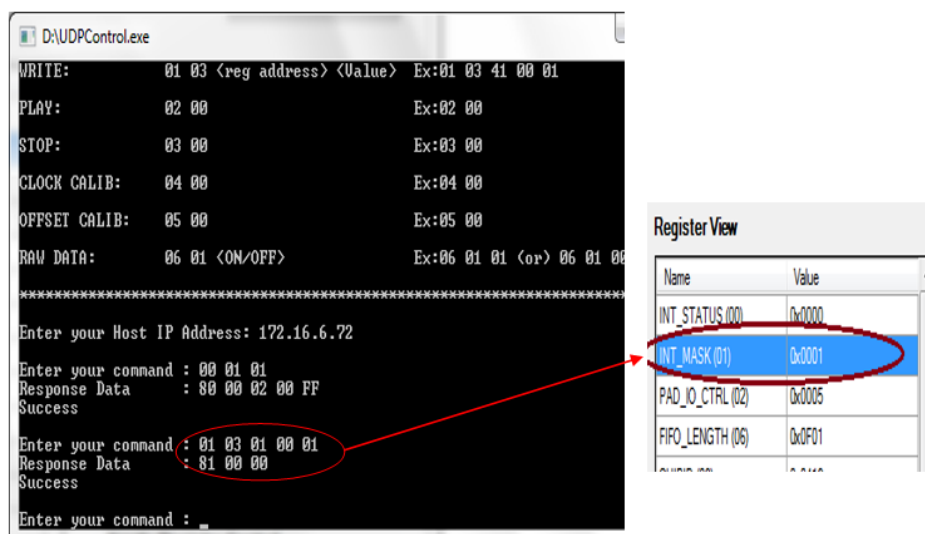


Figure 63. Write Register Operation

Run

Open the [ADPD103_ADPD105 OpenMarket WaveTool](#) application and connect the port (see the Port Connection section). If the bridge is connected, then open the graph view by selecting **View > Graph**.

Next, send the play command as **02 00**, where

02 = play command

00 = number of parameters

Stop

Open the [ADPD103_ADPD105 OpenMarket WaveTool](#) application and connect the port (see the Port Connection section). If the bridge is connected, then open the graph view: **View > Graph**.

Next, send the stop command as **03 00**, where

03 = stop command

00 = number of parameters

Load Configuration

Open the [ADPD103_ADPD105 OpenMarket WaveTool](#) application and connect the port (see the Port Connection section). If bridge is connected, then a command can be sent to the [ADPD103_ADPD105 OpenMarket WaveTool](#) through the UDP.

Next, send the load configuration file command as **0D 00**, which gives a list of available configuration file names, shown in Figure 64. Select the particular configuration file from the list shown.

Likewise, commands can be given for connect, disconnect, open view, and raw data by referring to the command list in Table 2.

COMMANDS SUMMARY

Table 2 summarizes the list of commands, command code and example formats for various functions that are currently available in the [ADPD103_ADPD105 OpenMarket WaveTool](#).

Table 2. Commands Summary

Command	Command Code ¹	Example
Connect	0A 00	0A 00
Disconnect	0B 00	0B 00
Open view	0C 00	0C 00
Load configuration (Load Cfg)	0D 00	0D 00
Read	00 01 <reg address>	00 01 40
Write	01 03 <reg address> <Value>	01 03 41 00 01
Run	02 00	02 00
Stop	03 00	03 00
Raw data	06 01 <ON/OFF>	06 01 01 (or) 06 01 00

¹ See Figure 64.

```

file:///F:/Backup/Mar_21/UDPControlTool_V_0_1/UDPControl/bin/Debug/UDPControl.EXE
READ :      00 01 <reg address>      Ex:00 01 40
WRITE:      01 03 <reg address> <Value> Ex:01 03 41 00 01
PLAY:       02 00                      Ex:02 00
STOP:       03 00                      Ex:03 00
CLOCK CALIB: 04 00                      Ex:04 00
OFFSET CALIB: 05 00                      Ex:05 00
RAW DATA:   06 01 <ON/OFF>             Ex:06 01 01 (or) 06 01 00

*****
Enter your Host IP Address: 172.16.7.37
Enter your Command : 0D 00

List of Configuration Files :

1 >dydg.dcfg
2 >Finger_PPG_020916.dcfg
3 >Finger_PPG_default.dcfg
4 >gfg.dcfg
5 >hfhghghg.dcfg
6 >hjhgj.dcfg
7 >M03_103_GGRI_Default.dcfg

Enter load config command with any of above choice as shown below..
Eg.,0D 01 <01/02/03...>choice
Enter your command : _
  
```

Figure 64. List of .dcfg Files Available in the [ADPD103_ADPD105 OpenMarket WaveTool](#) Configuration Directory

EVALUATION BOARD SCHEMATICS AND ARTWORK

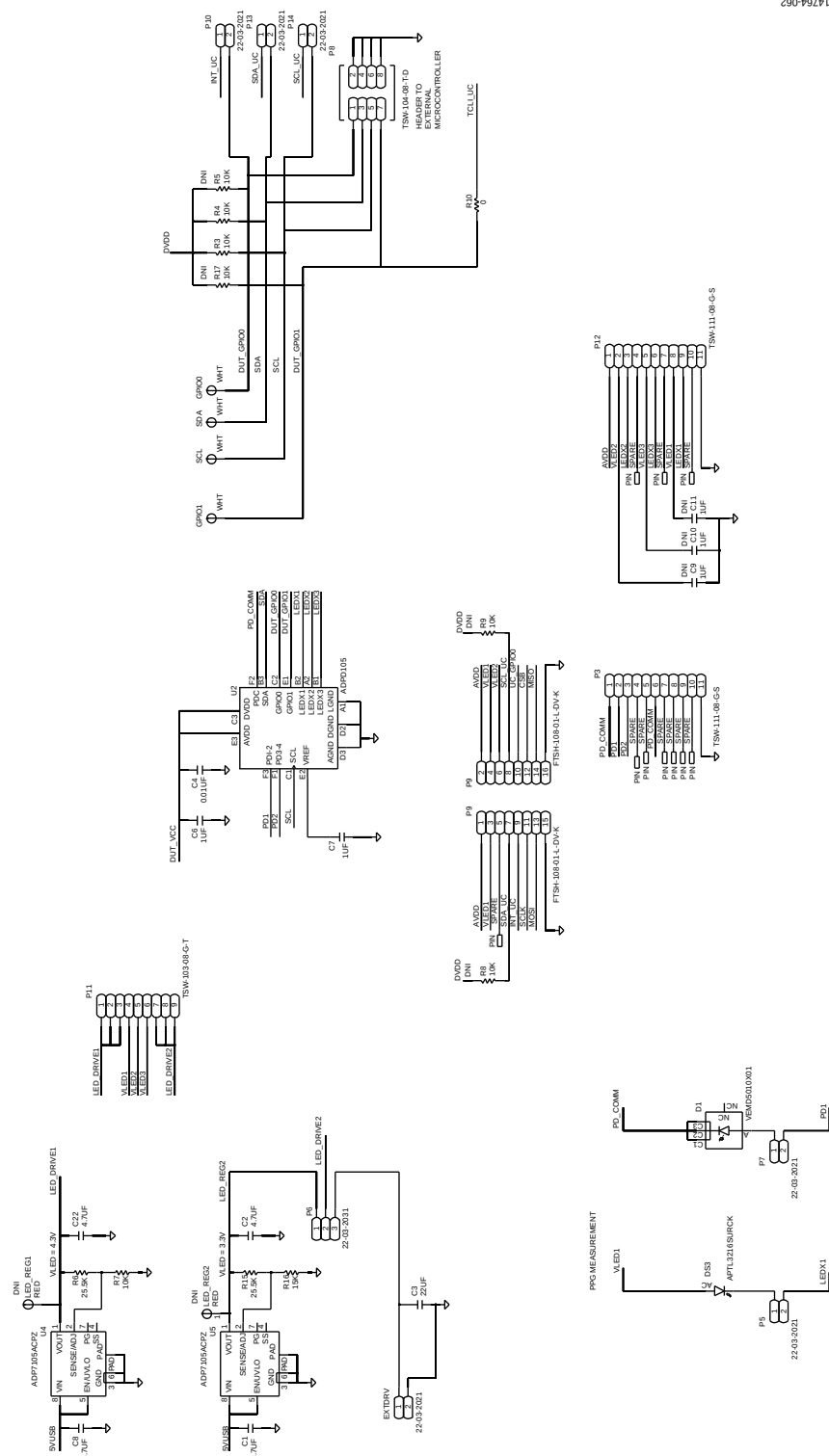


Figure 65. EVAL-ADPD105Z-GEN Schematic, ADPD105 Interface

14764-063

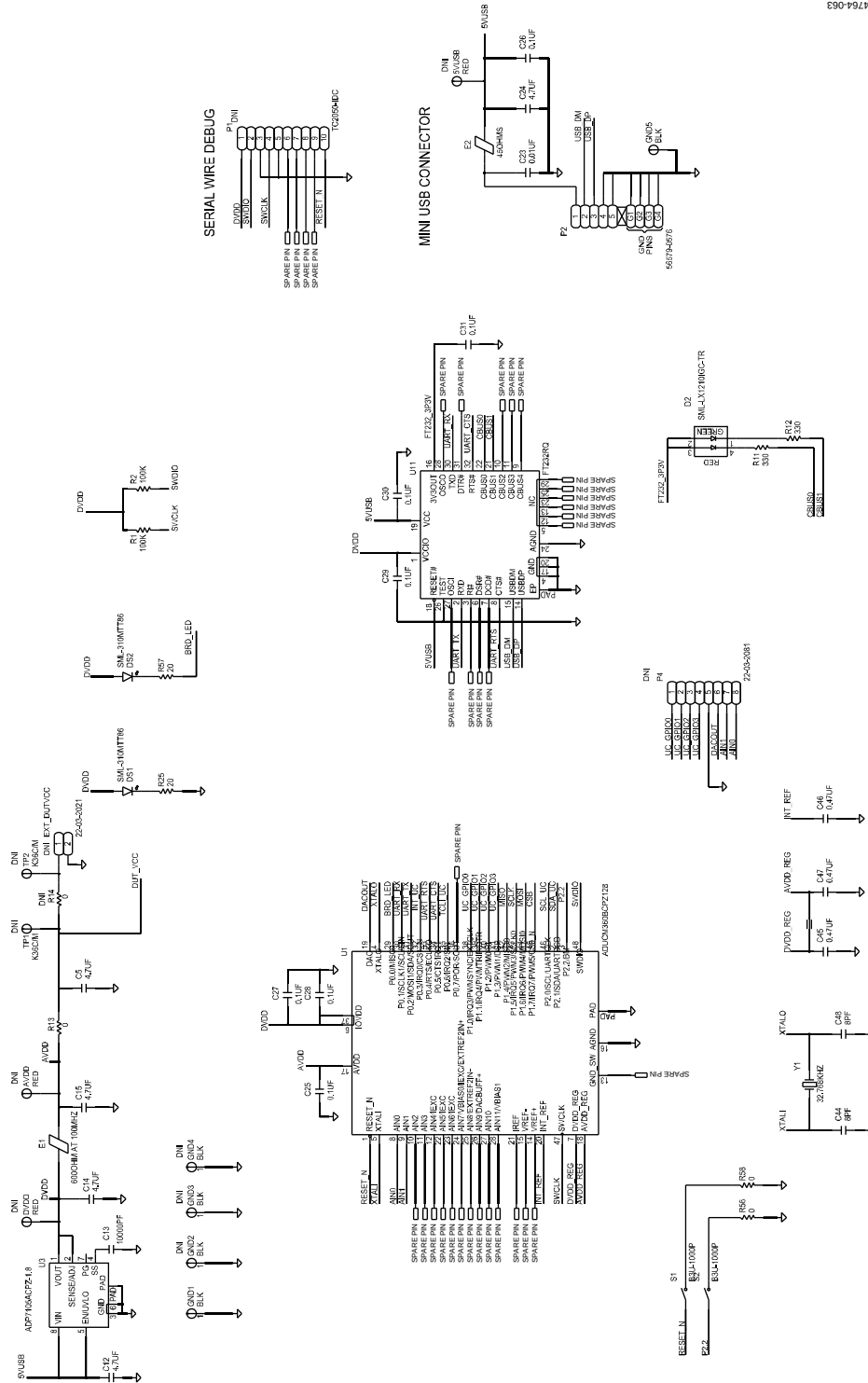


Figure 66. EVAL-ADPD105Z-GEN Schematic, UART/M360 Interface

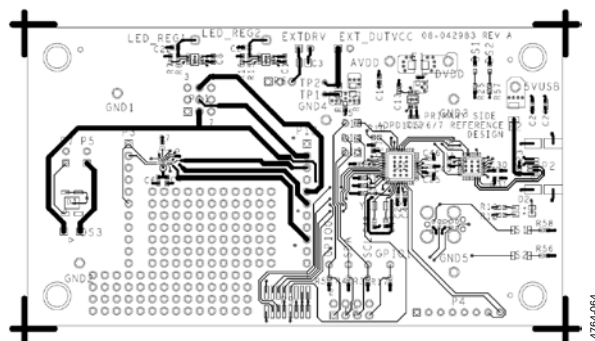


Figure 67. EVAL-ADPD105Z-GEN Primary Layer

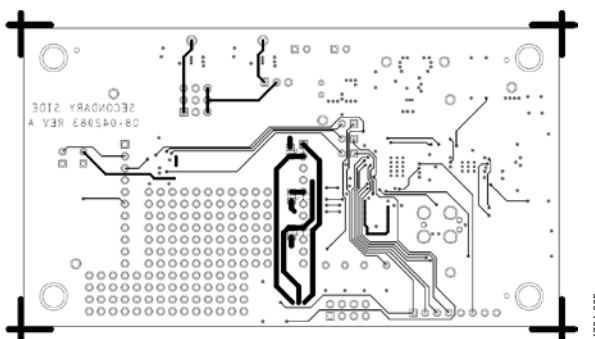


Figure 68. EVAL-ADPD105Z-GEN Secondary Layer

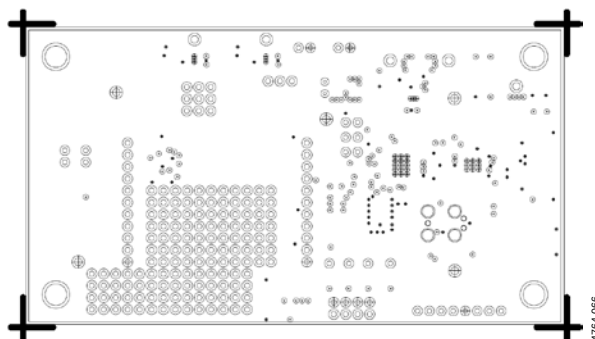


Figure 69. EVAL-ADPD105Z-GEN Ground Layer

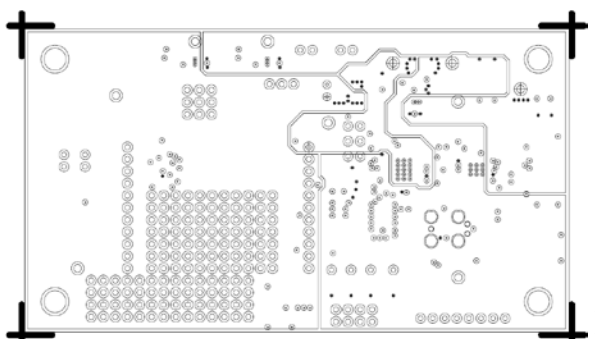


Figure 70. EVAL-ADPD105Z-GEN Power Layer

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.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. **CONFIDENTIALITY.** This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. **ADDITIONAL RESTRICTIONS.** Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. **TERMINATION.** ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. **LIMITATION OF LIABILITY.** THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). **EXPORT.** Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. **GOVERNING LAW.** This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.