Application Note

How to Configure the DS320PR410 Using SigCon Architect

David Waier

ABSTRACT

This document explains how to configure your DS320PR410 four-channel PCI-Express Gen 5.0 redriver using the user-friendly Texas Instruments SigCon Architect GUI. The intended audience includes hardware or system engineers working with the DS320PR410-RSC-EVM or with the DS320PR410 in SMBus modes.

TI recommends that the reader be familiar with the *DS320PR410 Four-Channel Linear Redriver for PCIe 5.0, CXL 2.0* data sheet. This document and all other collateral data related to the DS320PR410 redriver (application notes, models, and so forth) are available for download from the TI website on the DS320PR410 product page. Alternatively, contact your local Texas Instruments field sales representative for assistance.

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Trademarks

1 Getting Started and GUI Overview

The following section describes the steps needed to install the Texas Instruments SigCon Architect GUI and the DS320PR410 SigCon Architect GUI profile.

1. Download and install the Texas Instruments SigCon Architect GUI EVM v3 program. Follow the steps in the *SigCon Architect: Installation and Starter's Guide* for detailed instructions.
2. Download and install the DS320PR410 SigCon Architect GUI Profile Updater from the TI website or secure resource folder.
3. Connect a USB2ANY Interface Adapter or Aardvark I^2C Host Adapter to the desired DS320PR410 and PC.
4. Launch the SigCon Architect EVM GUI v3 program and make sure that the DS320PR410 profile has been installed. When successfully installed, the program is shown as an instance of the DS320PR410 device below the ***Selection*** column of the SigCon Architect GUI.

Descriptions of each DS320PR410 SigCon Architect GUI page are listed in the following:

1. *Configuration Page:* Used to configure device SMBus/I^2C Addresses, device EVM model, number of devices (in DS320PR410EVM-CUSTOM mode only), and interface adapter.

Note

The *Configuration Page* page must be configured before accessing any of the additional GUI pages.

2. *Low Level Page*: Individual register access to each device. This page can be used to change specific register settings or to verify that changes from the *High Level Page* have taken effect.
3. *EEPROM Page*: Used to create, read, and write EEPROM Hex files (following Intel™ Hex format). When the DS320PR410 is configured in SMBus/I^2C primary mode (MODE = L1), the redriver loads the settings stored in an external EEPROM upon power-up. The user can configure these settings using this page.
4. *High Level Page*: Main page used to change EQ settings (EQ Index/CTLE, DC Gain) of the device and to monitor the active status of each channel.
5. *Eye Height Page*: Used to perform an *EyeScan* of selected channels and display the *EyeScan* result plot in graphical form. This can assist in tuning the DS320PR410 and choosing an EQ Index for your system. Please refer to the *Eye Scan with TI PCI-Express Gen5.0 Redrivers* application note for further details.

2 Configuration Page

The following section describes features of the *Configuration Page* in the DS320PR410 GUI and configuration of the GUI to program the DS320PR410.. This page is used to set up the GUI for correct device communication over SMBus/I^{2}C.

1. Launch the SigCon Architect EVM GUI v3 application.
2. Click the *Configuration* tab below the DS320PR410 profile on the left side of the GUI, as shown in Figure 2-1.

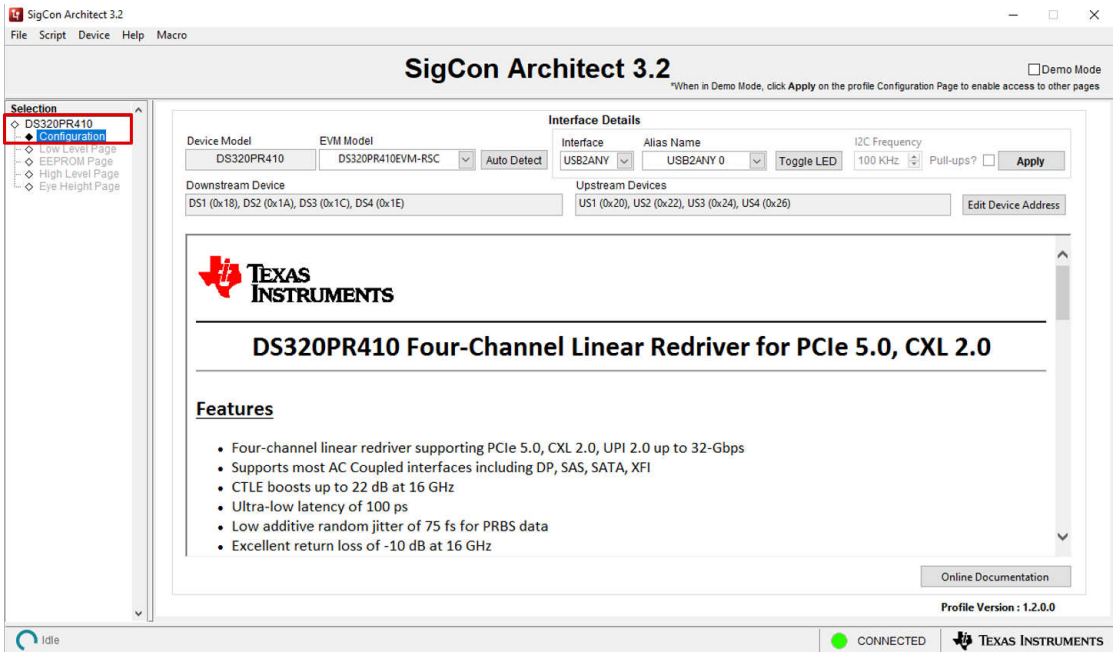

Figure 2-1. DS320PR410 Configuration Page

3. Click the *Auto Detect* button to detect the connected device's SMBus/I^{2}C addresses as shown in Figure 2-2. As needed, select the *Edit Device Address* button to manually edit the assigned Downstream and Upstream device addresses.

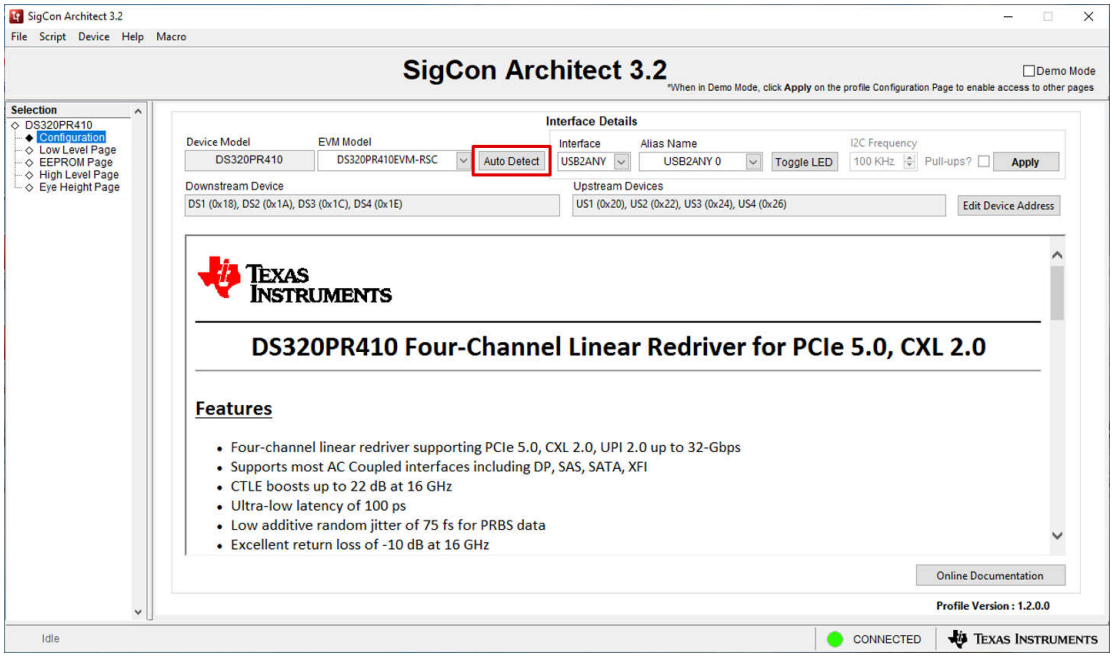

Figure 2-2. SMBus Address Auto Detect

4. Select the correct interface adapter below the *Interface* drop-down menu (USB2ANY or Aardvark). After selecting the correct interface adapter, click *Apply* to connect to the selected DS320PR410 devices. As shown in Figure 2-3, if the correct interface adapter is selected and the SMBus addresses are configured correctly, the status indicator in the bottom-left corner of the GUI shows a green LED and the text *Connected*. After successful connection, the other tabs under the DS320PR410 profile become available for selection. Click the desired tab on the left side of the GUI to begin programming the device / devices.

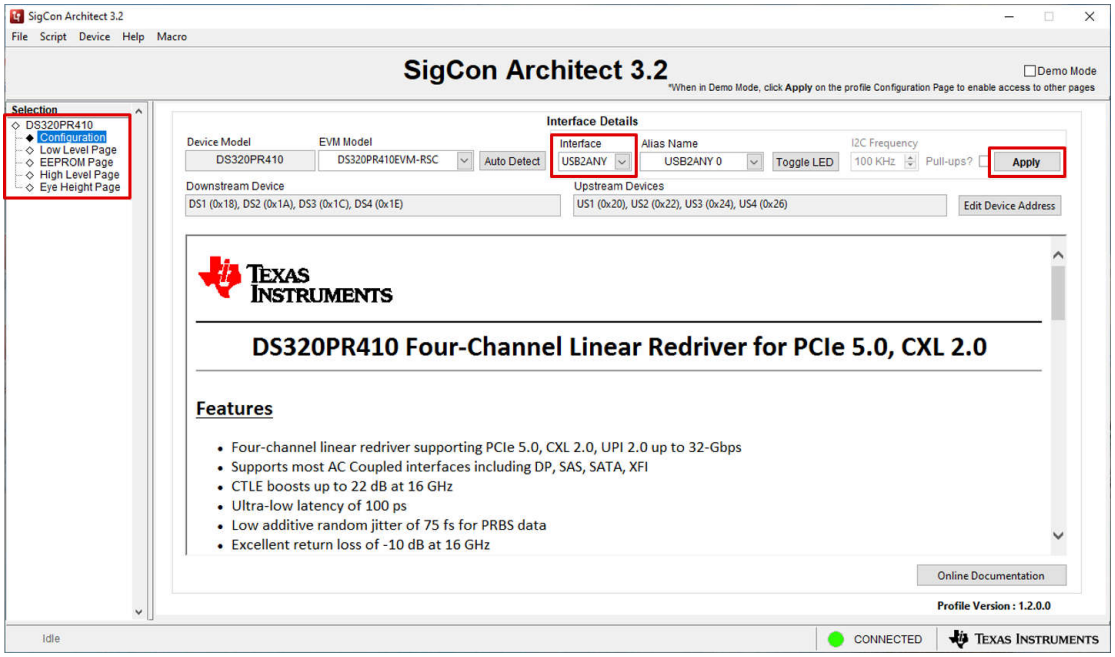

Figure 2-3. Interface Adapter Select and Apply Settings

5. By default, the GUI is configured to communicate with the DS320PR410-RSC-EVM evaluation module, which contains 8 DS320PR410 devices (4 facing Downstream, 4 facing Upstream). However, the DS320PR410 GUI also allows for support of between 1 and 16 DS320PR410 devices using the *EVM Model* drop-down menu to select the *DS320PR410EVM-CUSTOM* model, shown in Figure 2-4.

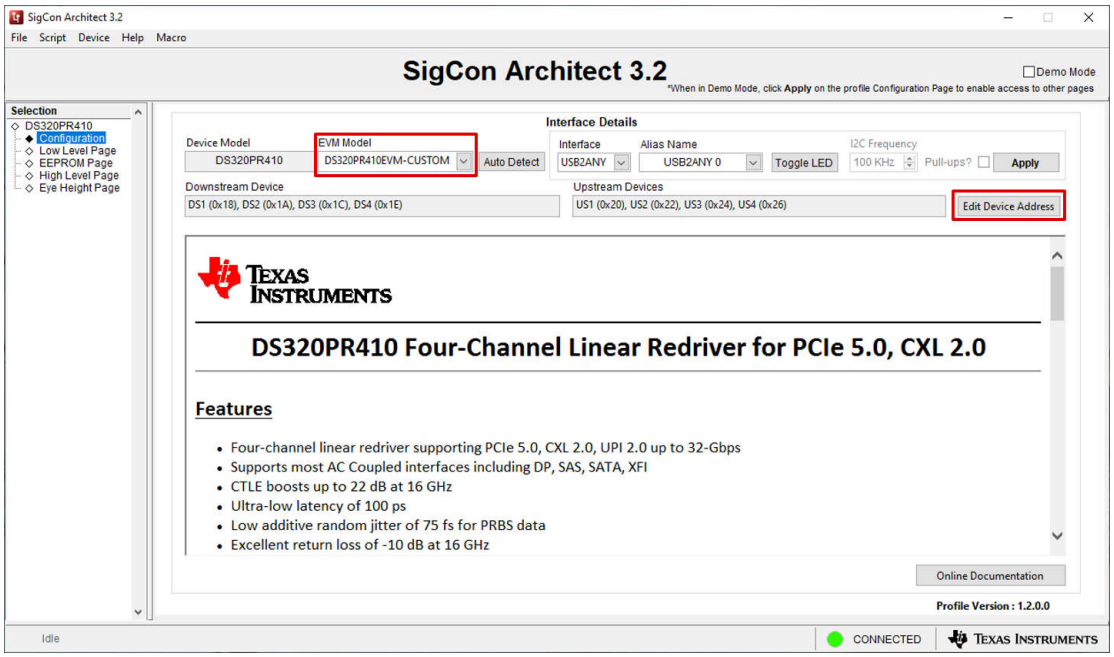

Figure 2-4. DS320PR410EVM-CUSTOM Configuration

Using the *Edit Device Address* button, the desired number of Downstream and Upstream DS320PR410 devices for GUI configuration can be selected, as shown in Figure 2-5. After selecting the desired device counts and the SMBus addresses, press the *OK* button. Then, click *Apply* to apply the edited configuration to the GUI.

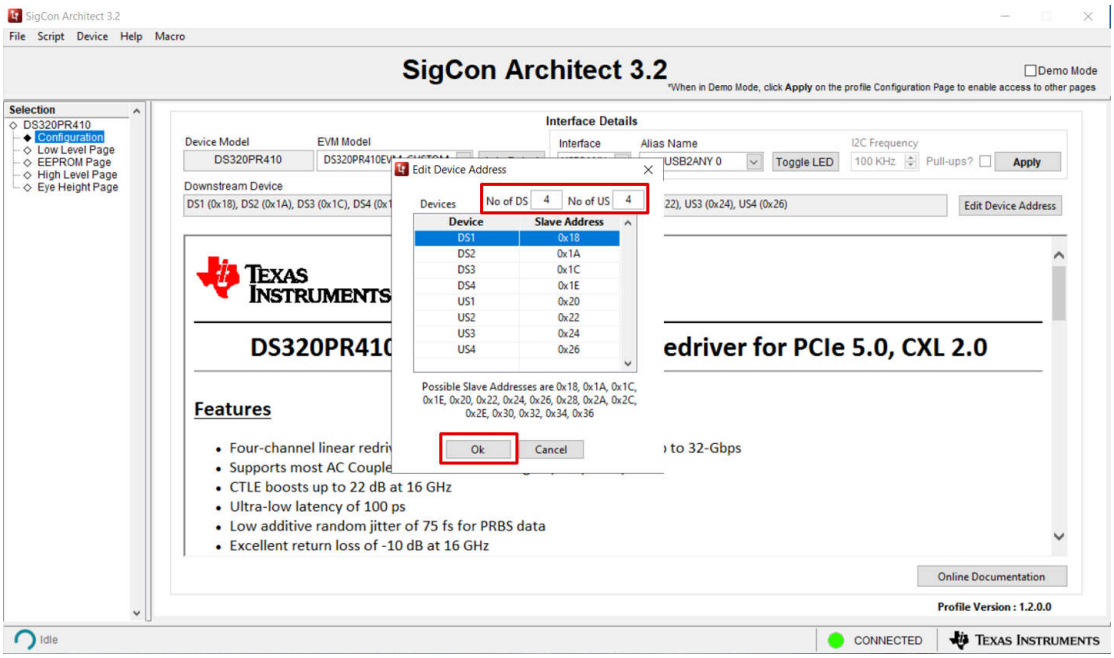

Figure 2-5. DS320PR410EVM-CUSTOM Edit Device Address

Note

Downstream and Upstream device addresses are assigned in ***increasing sequenial numeric order*** and can be manually edited to reflect orientation of the redrivers in the system.

Optionally, general GUI functionality can be explored in *Demo Mode*, which can be selected using the check-box in the upper-right corner of the GUI. When in *Demo Mode*, the GUI does not attempt to communicate to any device over an interface adapter. Figure 2-6 shows an example of the DS320PR410 GUI in *Demo Mode*. where the status indicator in the bottom right corner indicates a red LED and the text *Demo Mode*. To access all pages of the GUI in *Demo Mode*, click the *Apply* button.

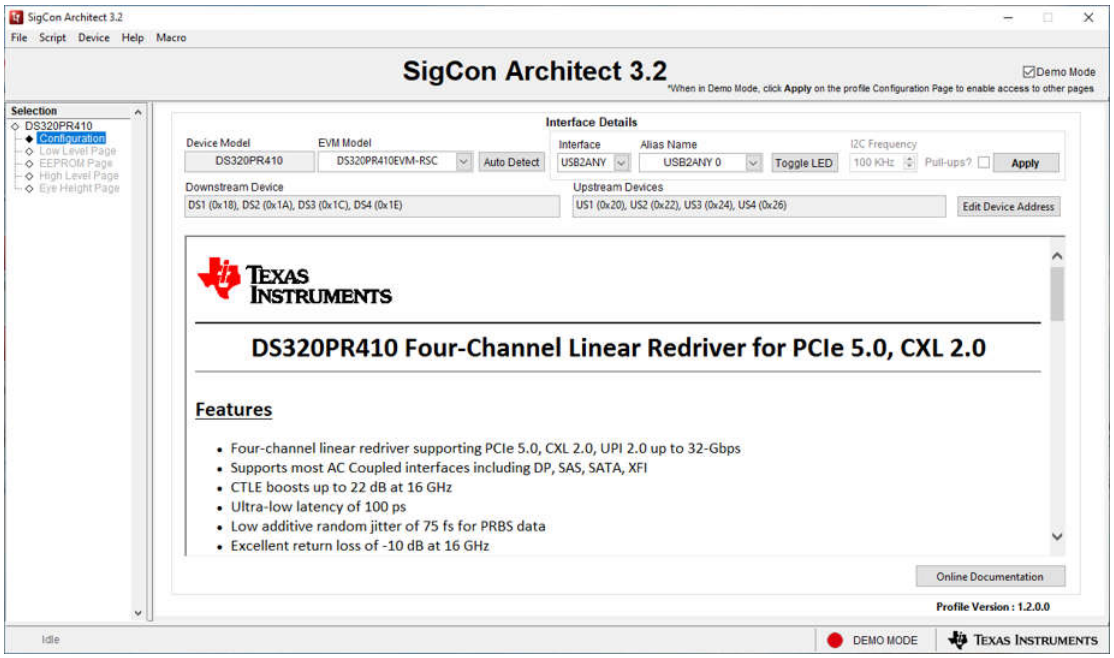

Figure 2-6. DS320PR410 GUI Demo Mode

3 Low Level Page

The following section describes features of the *Low Level Page* in DS320PR410 GUI. This page can be used to access individual registers of each DS320PR410 device, change specific device settings, verify current device status, and to verify changes from the GUI *High Level Page*. For further information on DS320PR410 registers, please refer to the *DS320PR410 Programming Guide*.

1. Use the *Device Select* drop-down menu shown in Figure 3-1 to select which device is desired to read or write to. The DS320PR410-RSC-EVM includes four downstream and four upstream devices.

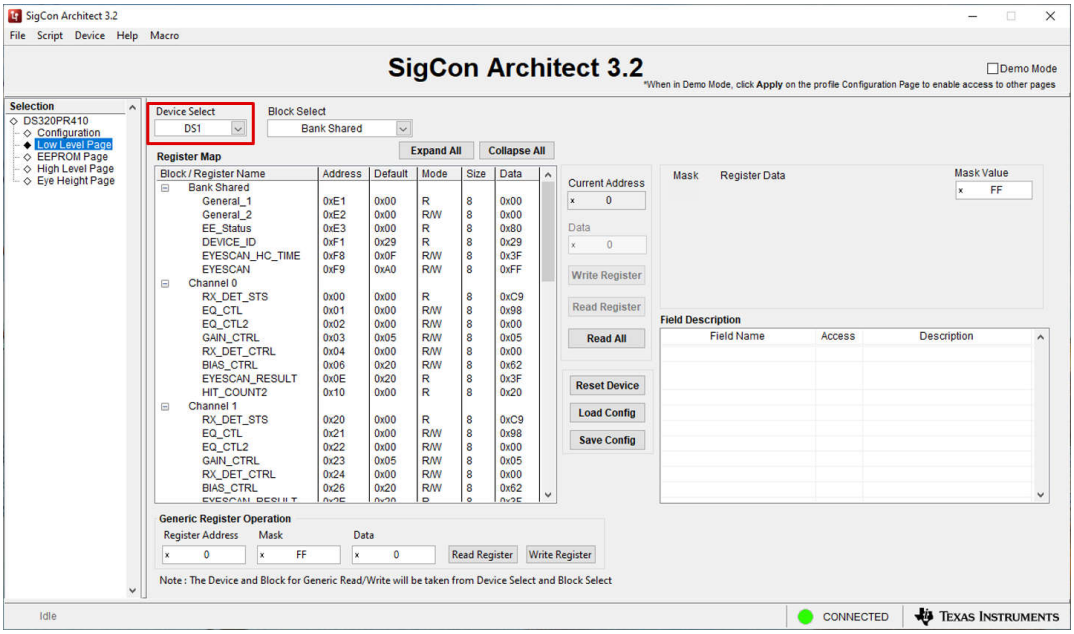

Figure 3-1. Low Level Page: Device Select Drop-Down

2. Once the desired device is selected using the *Device Select* drop-down, the complete register map appears in the GUI *Register Map* table. Use the *Block Select* drop-down menu shown in Figure 3-2 to jump to the desired section of the table to view device *Bank Shared* registers, device *Channel* registers, and device *Bank* registers. The register *Bank* includes all device channels 0-3.

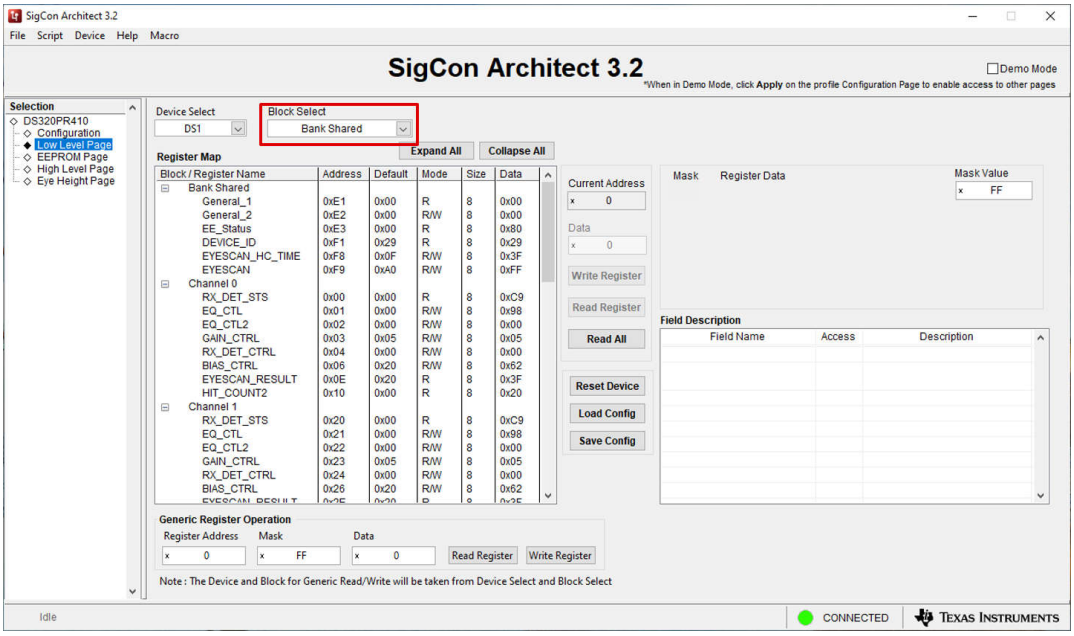

Figure 3-2. Low Level Page: Block Select Drop-Down Menu

3. Click the *Real All* button to read the configuration registers of the entire device into the GUI. Alternately, click a specific register, and click the *Read Register* device to update the selected target register in the GUI. The *Current Address* field automatically updates with the selected (highlighted) register. This field and associated buttons are shown in Figure 3-3.

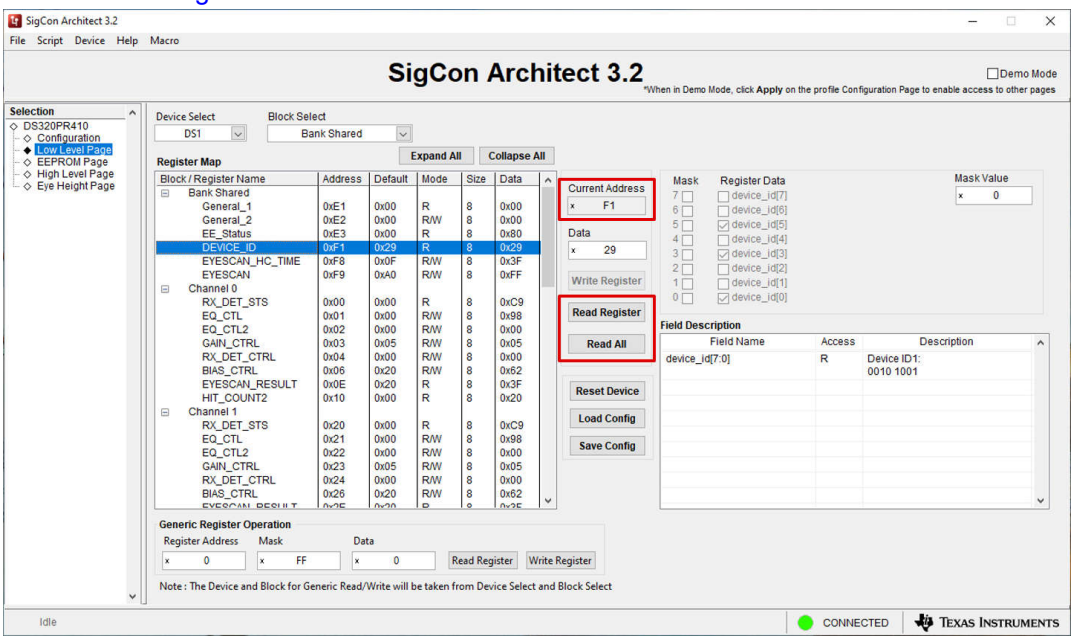

Figure 3-3. Low Level Page: Read Register Buttons

4. To write to the selected register, select or deselect the boxes in the *Register Data* fields or manually enter a hex value into the *Data* field. Then, click the *Write Register* button to write the specified data into the highlighted device register. To verify the change was made, click the *Read Register* button. Note the *Field Description* table describes the function of each bit in the highlighted register. This field and associated buttons or check buttons are highlighted in Figure 3-4.

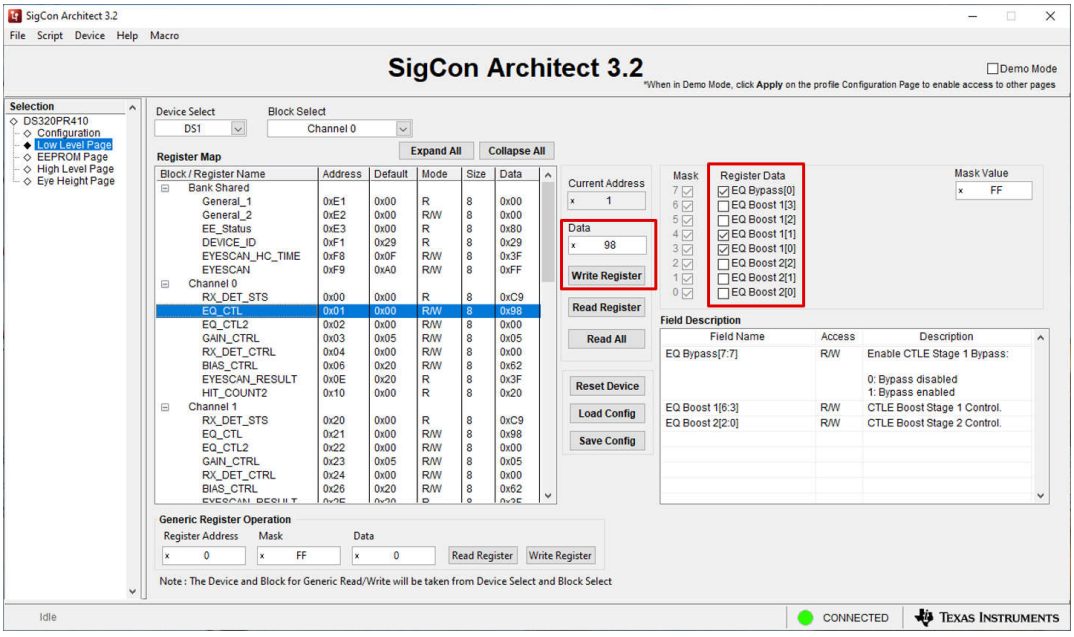

Figure 3-4. Low Level Page: Data Field and Write Register Button

5. Use the *Save Config* button to save the current register configuration in a .cfg file and the *Load Config* button to load a device .cfg file. Click the *Reset Device* button to reset every device register to the *Default* register value specified in the *Register Map*. Each of these buttons are outlined in Figure 3-5.

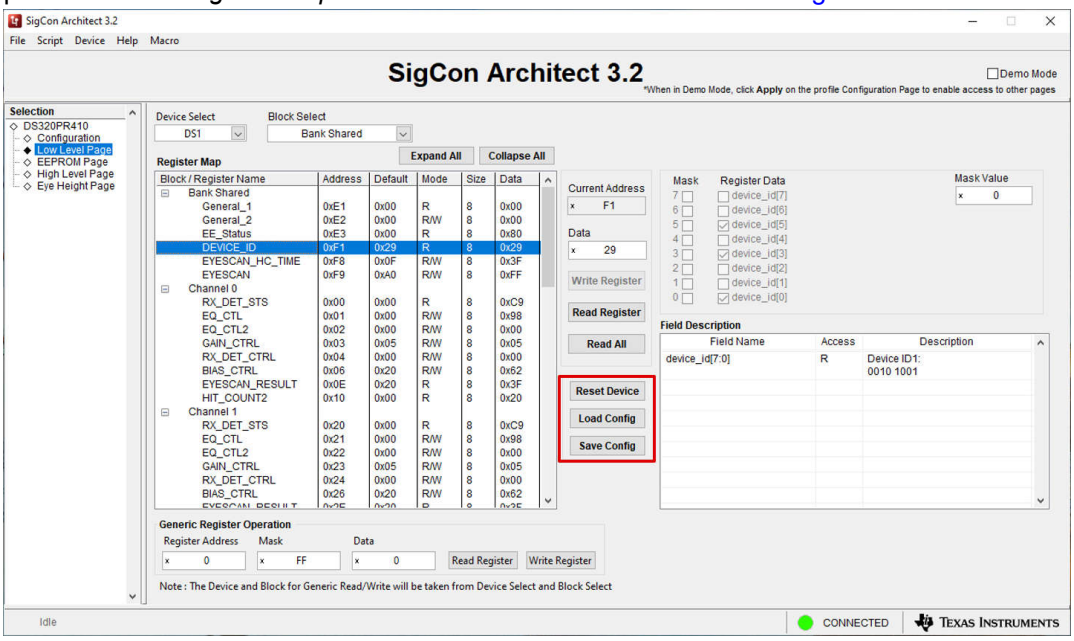

Figure 3-5. Low Level Page: Reset, Load, and Save Device Configuration Buttons

6. If desired, the *Generic Register Operation* portion of the page can be used to read and write generic device registers with a custom mask. This can be found at the bottom of the *Low Level Page*, as indicated by Figure 3-6.

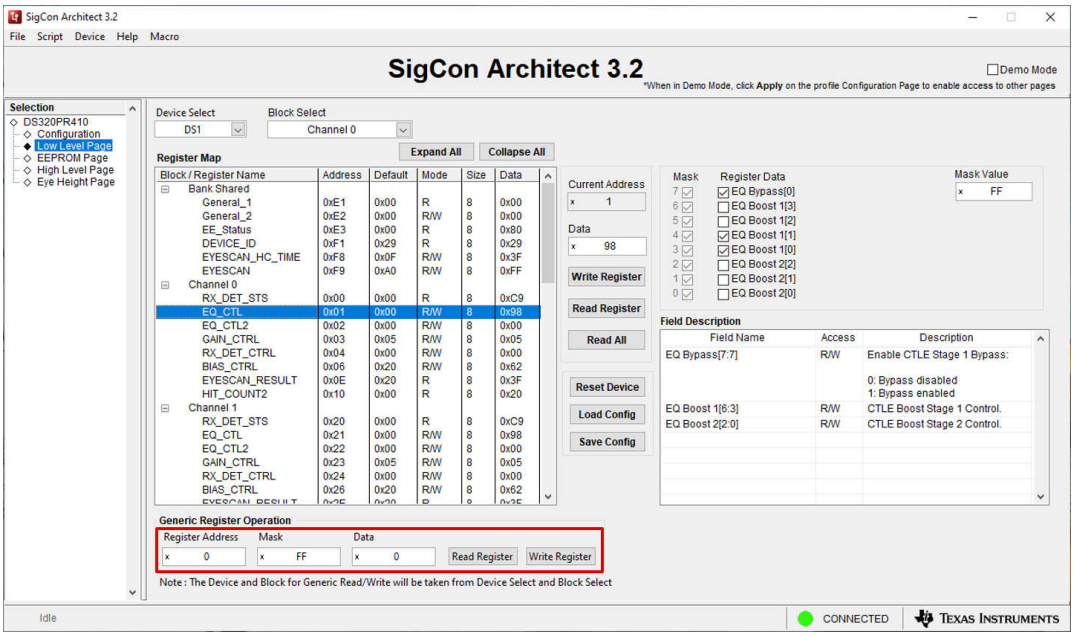

Figure 3-6. Low Level Page: Generic Register Operation

4 EEPROM Page

The SigCon Architect GUI's DS320PR410 profile can be used to generate an EEPROM file in Intel™ Hex format for a single redriver or multiple DS320PR410 redrivers. When the DS320PR410 is configured in SMBus/I^{2}C primary mode (MODE = L1), the redriver loads the settings stored in an external EEPROM upon power-up. The user can configure those settings using the *EEPROM Page*. The following section provides an example of how to navigate the DS320PR410 GUI *EEPROM Page* and create an EEPROM hex file.

In this example, eight DS320PR410 redrivers are present. EQ Index 2 is selected for devices at addresses 0x18, 0x1A, 0x1C, 0x1E and EQ Index 5 is selected for devices at addresses 0x20, 0x22, 0x24, 0x26) For each device, the same value is used for every channel. For programming fewer or additional devices, decrease or increase the number of devices (*No. of Devices*) and configurations (*No. of Configs*) as needed.

1. Multiple devices can be programmed at once. Select the number of devices and the number of configurations using the menus shown in Figure 4-1. Up to 32 different configurations can be created and assigned to each device and channel, if desired.

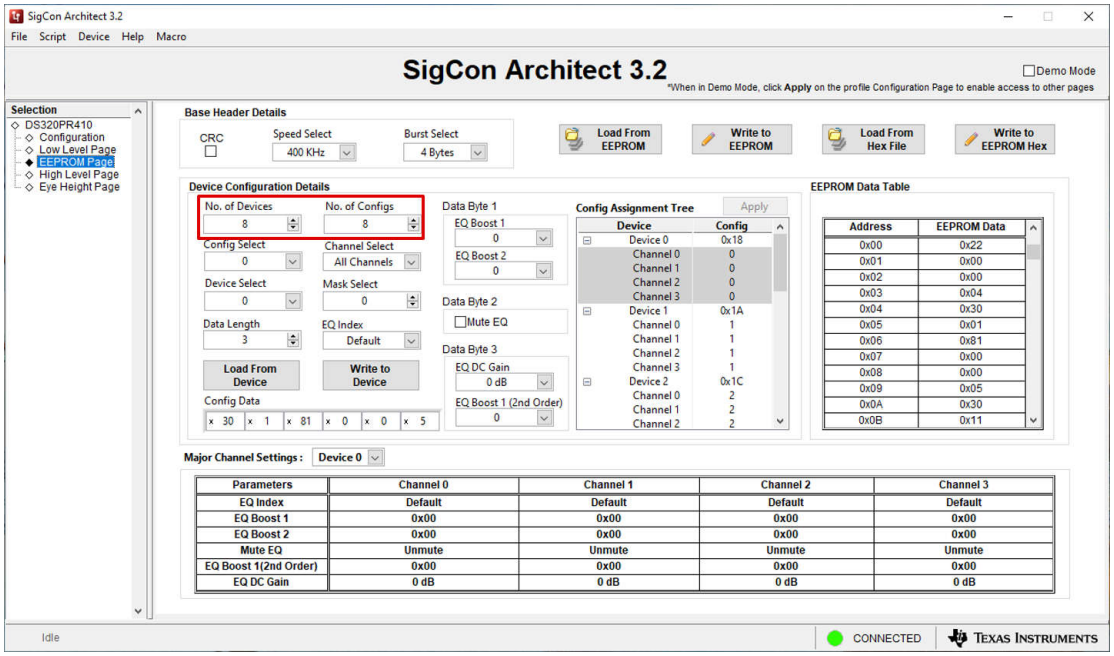

Figure 4-1. EEPROM Page: Number of Configs and Number of Devices

2. To program the first device, select Configuration 0 and Device 0 from the respective drop-down menus, *Config Select* and *Device Select*. Note the *Config Assignment Tree* shows the hex address of each device (0x18 for Device 0). Verify that the *Data Length* is set to 3, as 3 bytes of data are needed to program the DS320PR410. Each of these menus are shown in Figure 4-2.

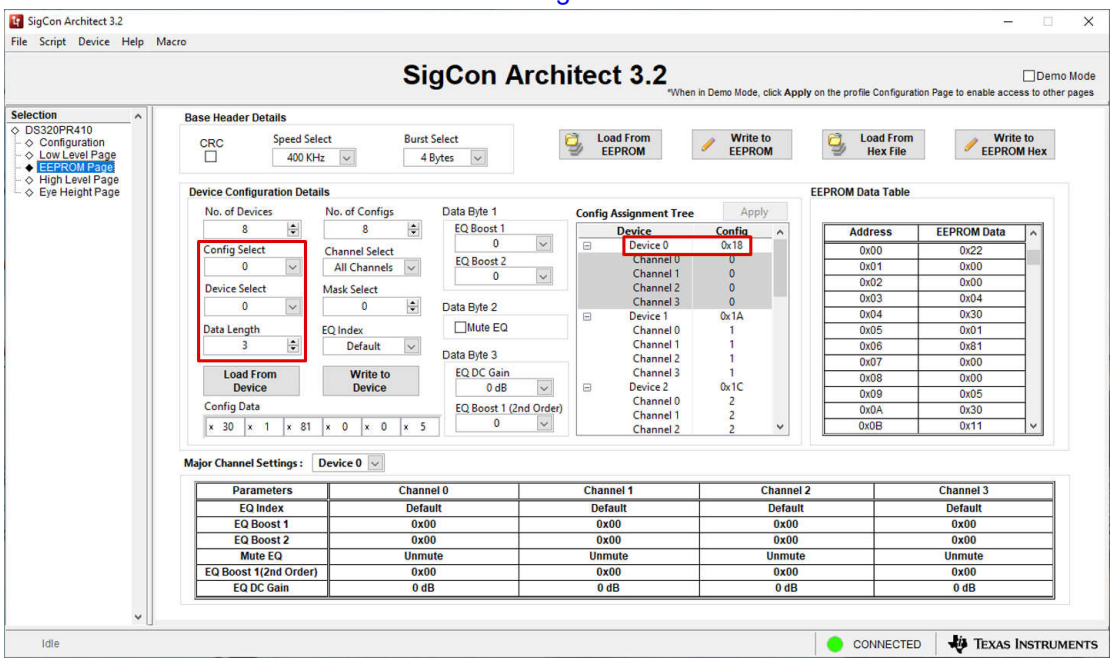

Figure 4-2. EEPROM Page: Config Select, Device Select, and Configuration Assignment Tree

3. To select the desired channel or channels, choose an *EQ Index* from the drop-down menu. The *EQ Index* drop-down automatically adjusts the *EQ Boost 1*, *EQ Boost 2*, and *EQ Boost 1 (2nd Order)* fields. Select the desired *EQ DC Gain*. Note in the *Config Assignment Tree* that the channels of Device 0 selected using the *Channel Select*drop-down menu are configured using Configuration 0. Continue this process for each *Device* and *Configuration*, selecting the appropriate *EQ Index* and *EQ DC Gain* for each. Each of these drop-down menus are shown in Figure 4-3.

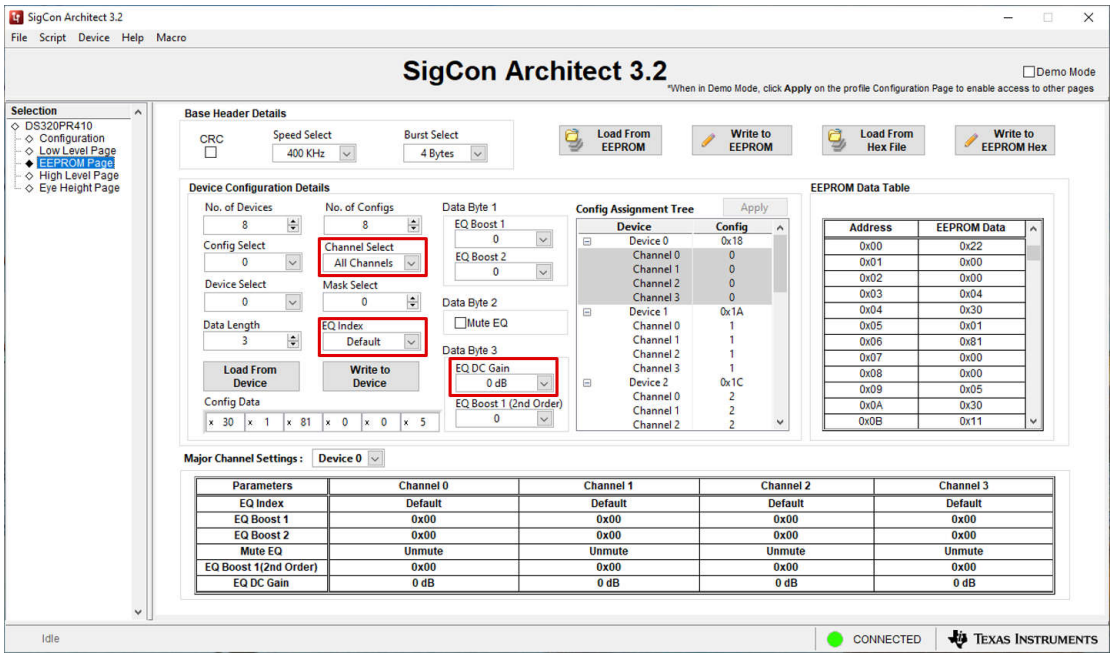

Figure 4-3. EEPROM Page: Channel Select, EQ Index, and EQ DC Gain

Optionally, the *Major Channel Settings* table can be used to check each device's EQ settings. The device drop-down menu can be used to select the desired device for viewing as shown in Figure 4-4.

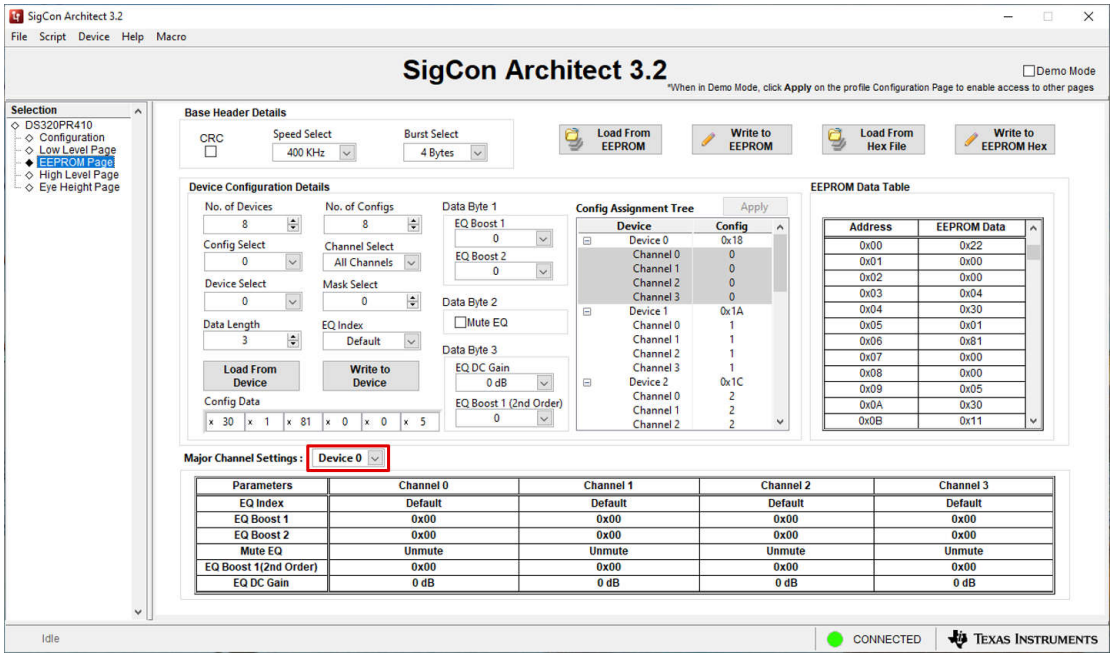

Figure 4-4. EEPROM Page: Major Channel Settings

4. After all devices have been configured, click the *Write to EEPROM* button to write the external EEPROM with the new settings. The button indicator turns green when the write is completed, as shown in Figure 4-5.

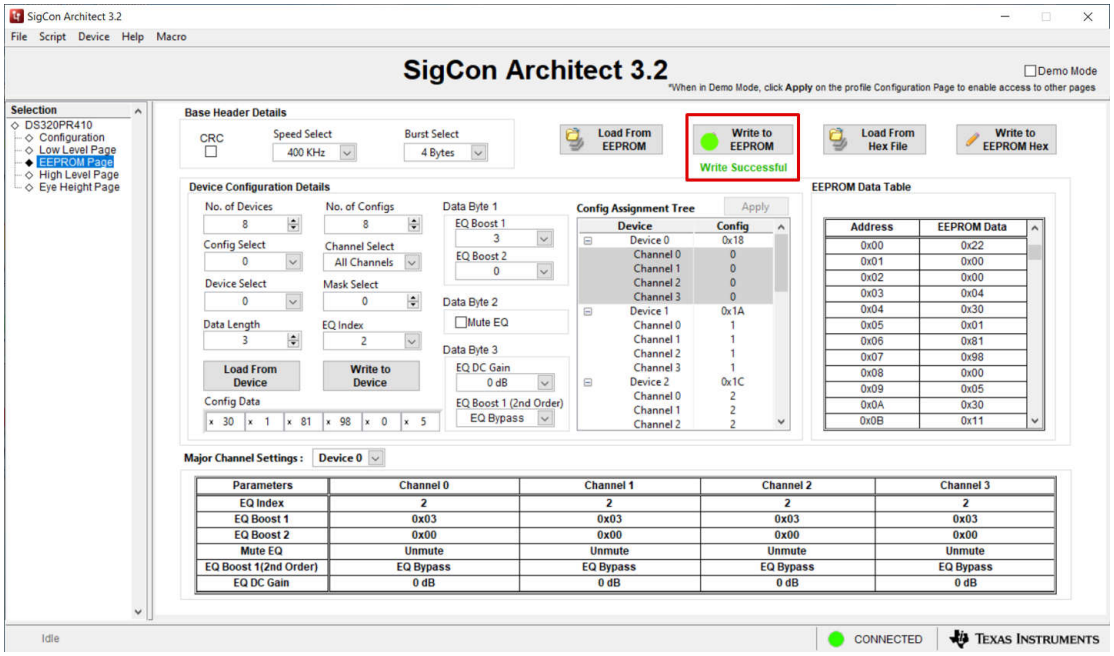

Figure 4-5. EEPROM Page: Write to EEPROM

5. To save the current EEPROM settings configured using the GUI into a hex file, click the *Write to EEPROM Hex* button shown in Figure 4-6 to write a hex file with these settings. Save the hex file to any desired location using the File Explorer.
6. To load EEPROM settings back into the GUI from a hex file, click the *Load from Hex File* button. Select the desired hex file to load from the File Explorer. If the user desires to write these settings to an external

EEPROM connected to the accessed SMBus lines, click the *Write to EEPROM* button and wait for the green *Write Successful* indicator to appear to indicate a successful EEPROM write.

7. To load EEPROM settings into the GUI from an external EEPROM connected to the accessed SMBus lines, click the *Load from EEPROM* button.

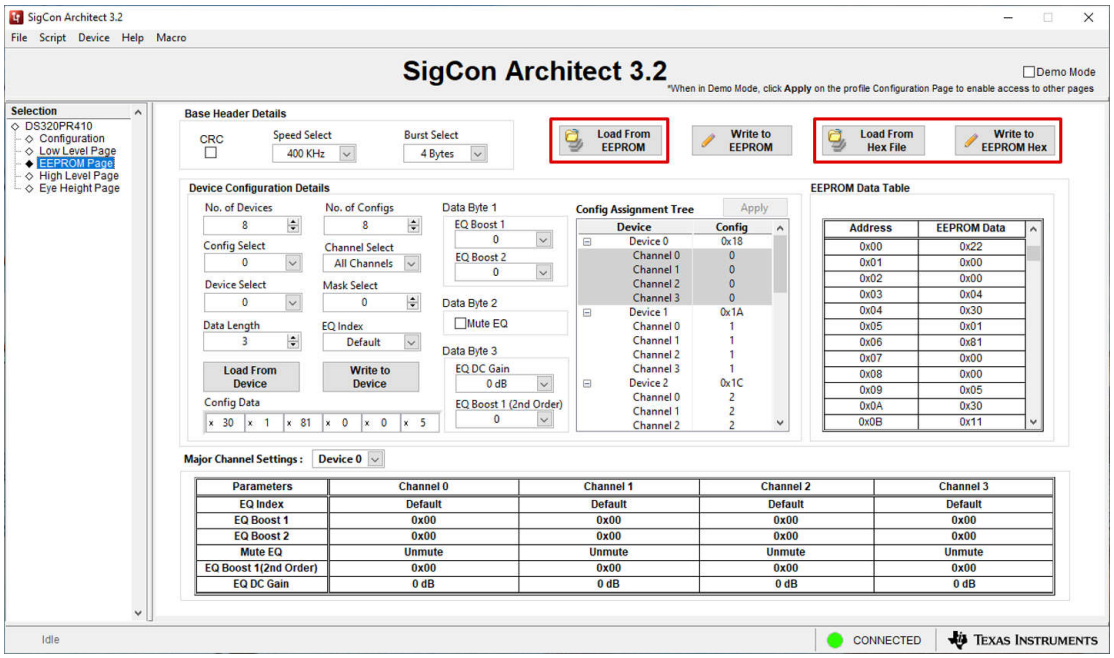

Figure 4-6. EEPROM Page: Load from EEPROM, Load from Hex File, Write to EEPROM Hex

5 High Level Page

The DS320PR410 redriver features a continuous-time linear equalizer (CTLE) that applies high-frequency boost and low-frequency attenuation to help equalize the frequency-dependent insertion loss effects of a passive channel. CTLE settings are referred to as EQ settings in this section for clarity and brevity.

The *High Level Page* is used to quickly and easily adjust the EQ settings as needed for your specific application. A further description of the EQ settings can be found in the *DS320PR410 Four-Channel Linear Redriver for PCIe™ 5.0, CXL 2.0*, data sheet. The page contains a *Device Status* tab to monitor each connected device's channel status and a *Block Diagram* tab to adjust the EQ settings of each connected device. The following steps walk through the features of the detailed features of the *High Level Page*.

1. After clicking on the *High Level Page* tab on the left side of the GUI, the *Device Status* tab is shown, such as in Figure 5-1. Each channel status is updated sequentially, showing each connected device's channel RX Detect and EEPROM Bank Load status, along with the channel's current EQ settings. The RX Detect status bar appears green if proper receiver impedance detection is found and red if proper receiver impedance detection is not found. EEPROM Load status bars appear green if the device's register bank has properly loaded EEPROM data and red if EEPROM data has failed to load. Note that the EEPROM Load status always indicates a failed (red) load status when the device is operating in SMBus/I^{2}C secondary mode (MODE = L2). The current EQ settings are shown to the right of each channel's status indicators.

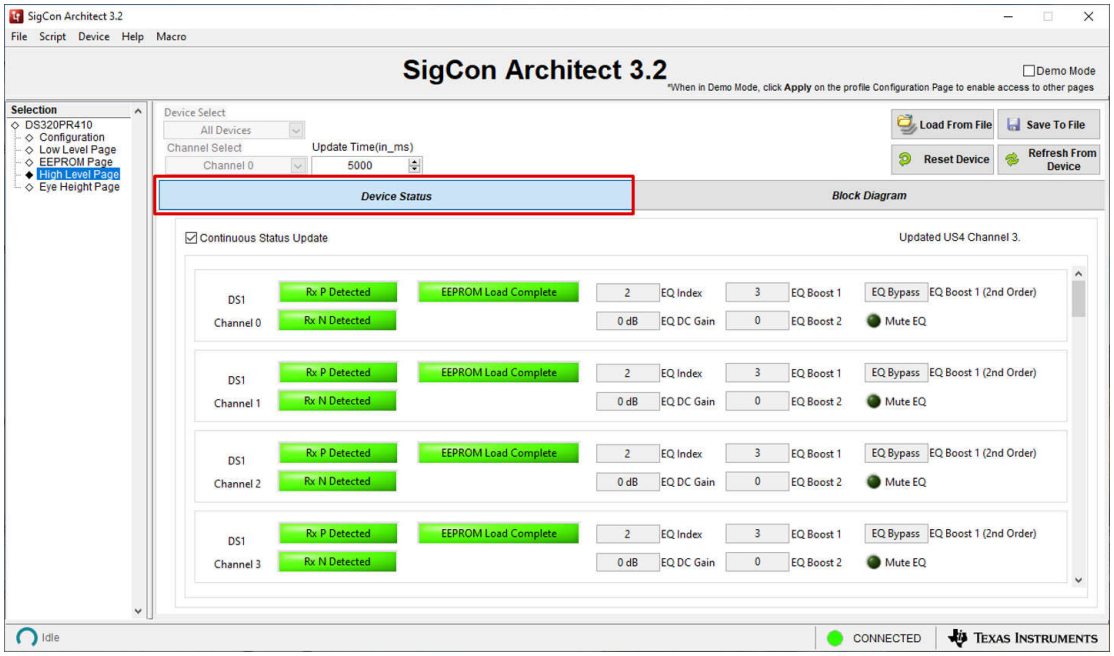

Figure 5-1. High Level Page: Device Status Tab

2. Click the *Block Diagram* tab to show the screen highlighted in Figure 5-2. Here, the EQ settings (EQ Index, EQ Boosts, EQ DC Gain) for each channel can be adjusted. To program the settings for a specific device or channel, select a device and channel from the respective *Device Select* and *Channel Select* drop-down menus.

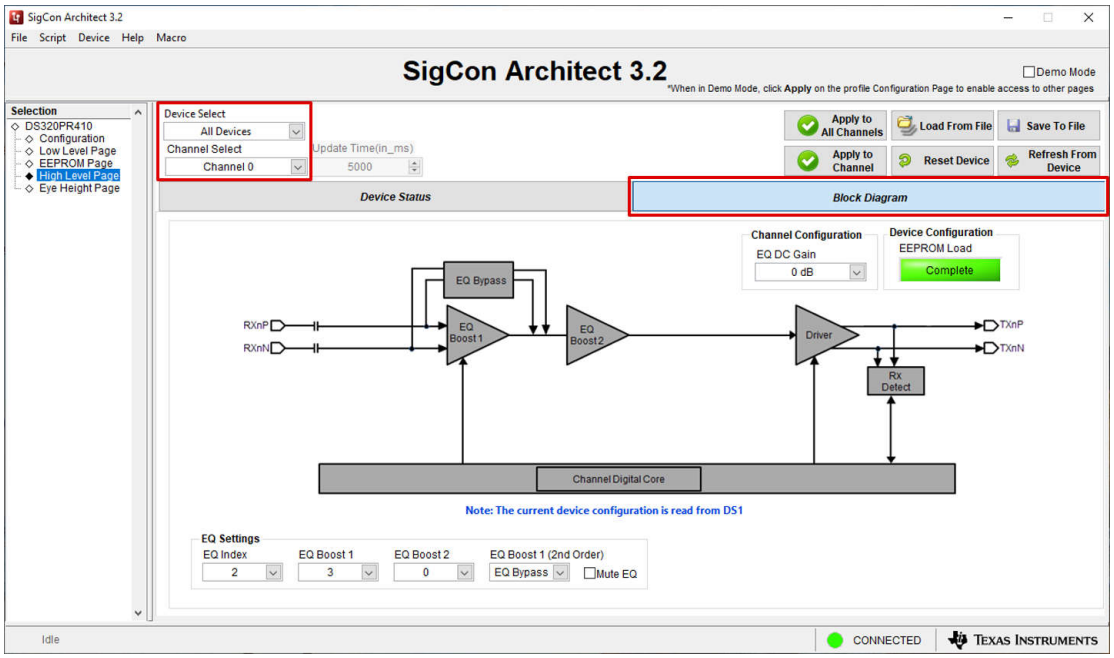

Figure 5-2. High Level Page: Block Diagram Tab, Device and Channel Select

3. Select the desired *EQ Index / EQ Boost* settings and *EQ DC Gain*. The *EQ Index* drop-down menu is the easiest way to quickly adjust the amount of redriver equalization boost applied. After selecting an *EQ Index* value, the *EQ Boost 1*, *EQ Boost 2*, and *EQ Boost 1 (2nd order)* fields are automatically populated. The user can adjust each boost value for finer tuning as needed. Refer to the device data sheet for more information regarding *EQ Index* boost values. These options are highlighted in Figure 5-3.

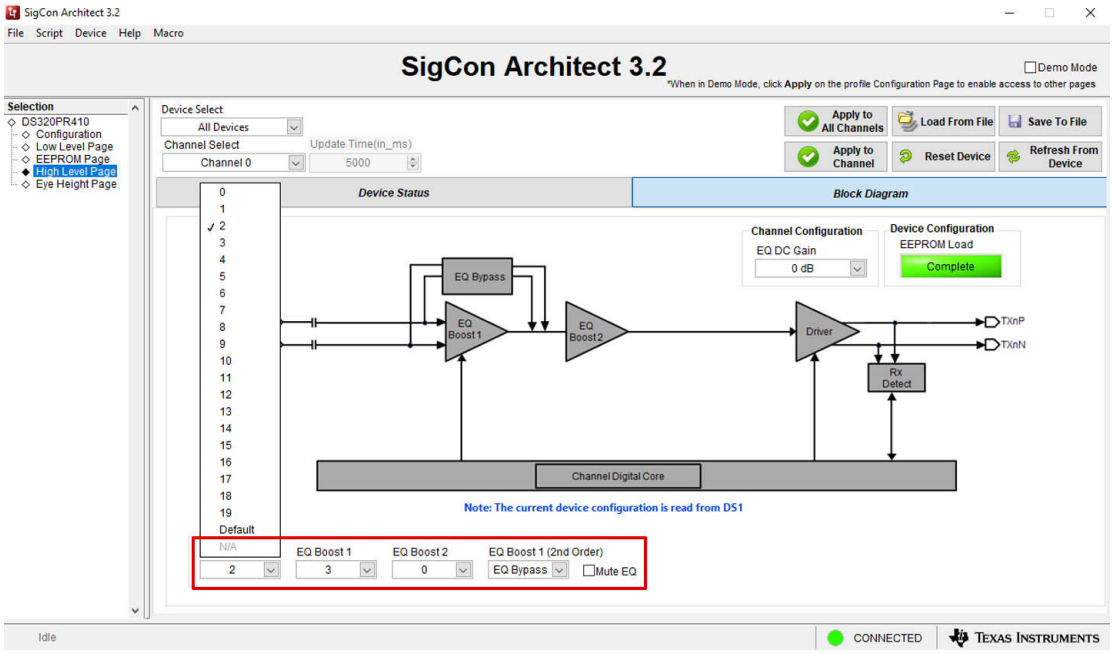

Figure 5-3. High Level Page: EQ Index and EQ Boost Select

The *EQ DC Gain* drop-down menu highlighted in Figure 5-4 can be used to adjust channel DC Gain (Flat Gain). Further information regarding DC Gain can be found in the device data sheet. The *EQ DC Gain* value of 0dB is recommended for most applications.

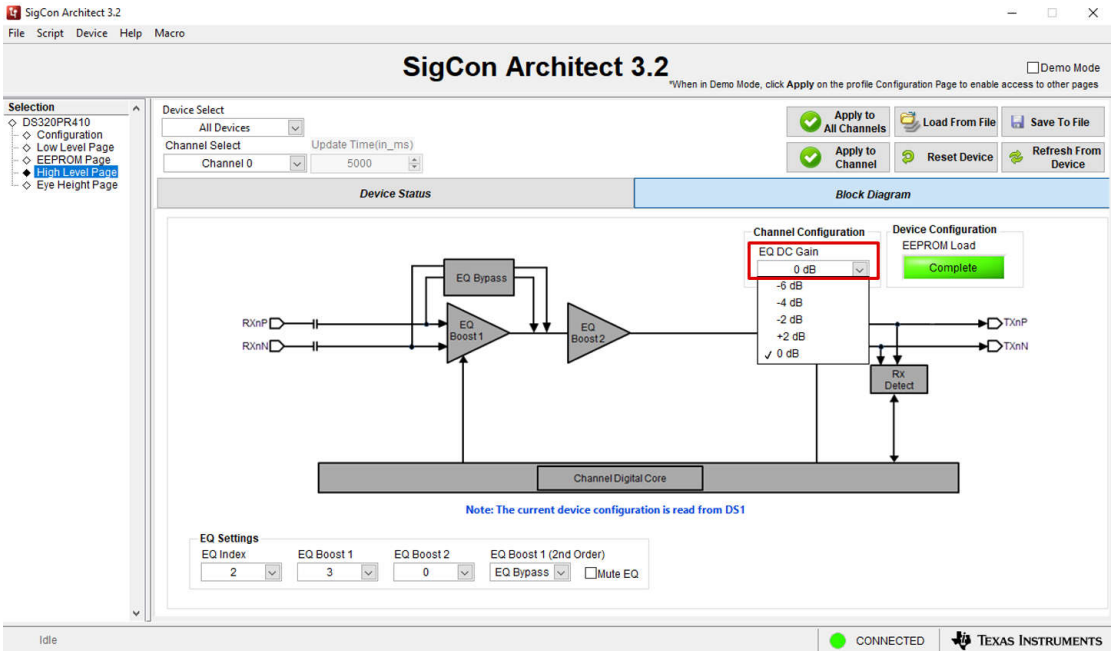

Figure 5-4. High Level Page: EQ DC Gain Select

Click the *Apply to Channel* button to apply the selected EQ settings to the selected Device and selected Channel (indicated by the *Device Select* and *Channel Select* drop-down menus, respectively). Click the *Apply to All Channel* button to apply selected EQ settings to all channels of the device or devices selected using the *Device Select* drop-down menu. These options are highlighted in Figure 5-5.

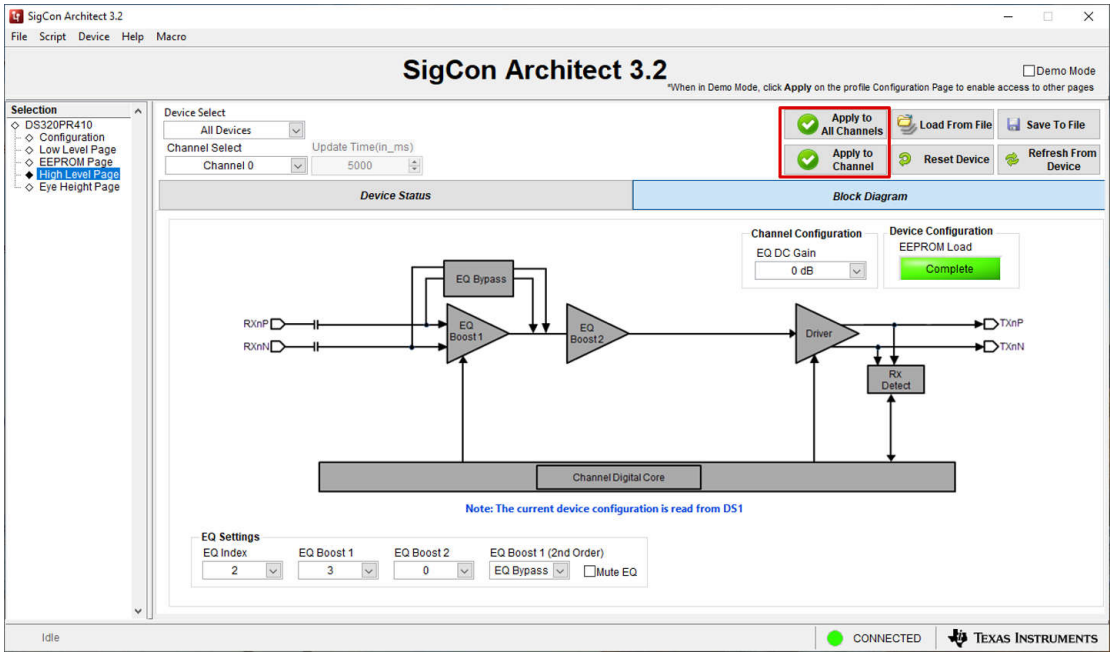

Figure 5-5. High Level Page: Apply to Channel and Apply to All Channels

6 Eye Height Page

The *Eye Height Page* can assist the user in observing the effects of the redriver EQ settings in their system. The page can be used to display the *EyeScan* plot of the signal passing through the redriver for each active channel of the connected devices. Further information regarding *EyeScan* can be found in the *Eye Scan with TI PCI-Express Gen5.0 Redrivers*, application note. TI recommends the use other lane margining tools to monitor signal quality at each end of the PCIe link to determine best system performance. This tool can be used as a reference and cannot provide best system performance based on *EyeScan* results alone.

1. Select the desired *Scale Per Step* as shown in Figure 6-1 for the *EyeScan* capture. This parameter determines the captured voltage range of the *EyeScan* operation, providing four options for added granularity if desired. By default, this parameter is set to ±400mV (12.5mV Step).

Figure 6-1. Eye Height Page: Scale Per Step

2. Select the channels for the desired *EyeScan* capture using the *DSx/USx CHx* check boxes or the *Select All* check boxes for each *Downstream* and *Upstream* device. These options are highlighted in Figure 6-2.

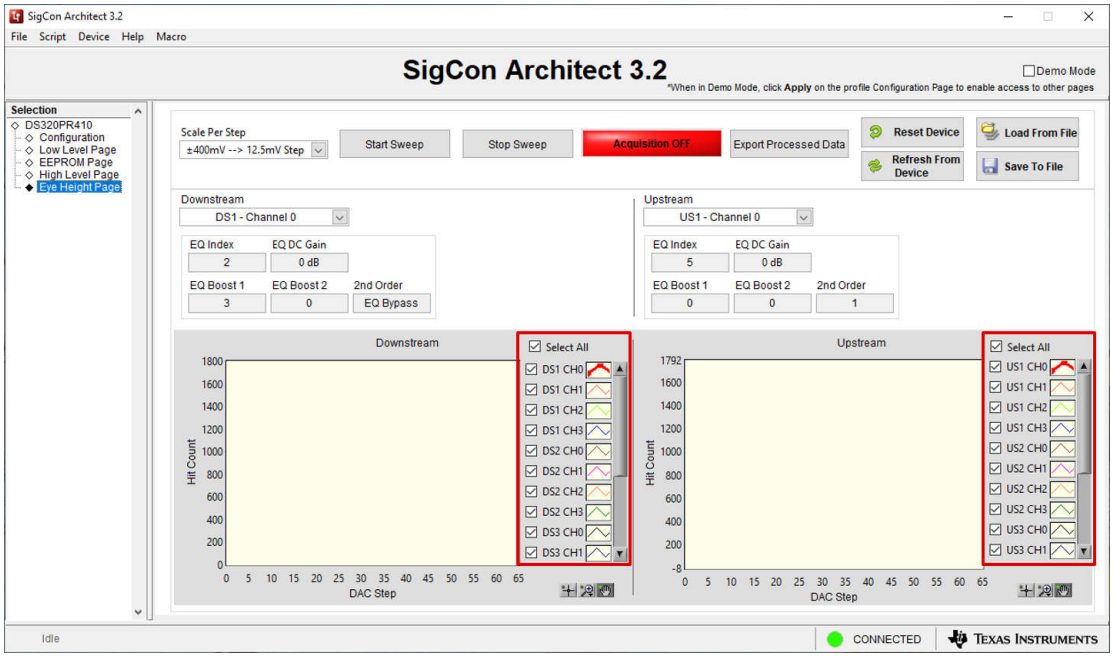

Figure 6-2. Eye Height Page: Select EyeScan Channels

3. Click the *Start Sweep* button to begin the *EyeScan* plot capture. The redriver automatically captures the *EyeScan* for each selected channel using the programmed redriver EQ settings and displays the result in the *Downstream* and *Upstream* plots. The scanning status can be found in the red and green status indicator box on the page, shown in Figure 6-4. Click the *Stop Sweep* button to cancel the current *EyeScan* sweep. Please note that clicking the *Stop Sweep* button ends the capture and plots all channel *EyeScan* results captured up to the point of cancellation. These buttons are highlighted in Figure 6-3.

Figure 6-3. Eye Height Page: Start Sweep and Stop Sweep

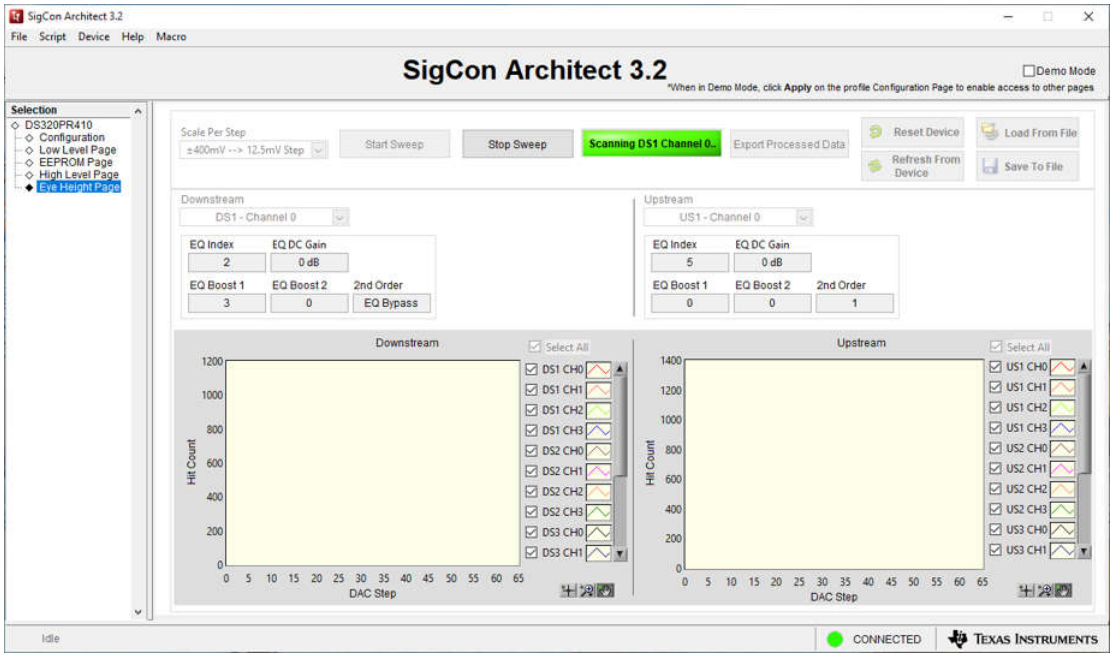

Figure 6-4. Eye Height Page: EyeScan Sweep in Progress

4. After completion of the sweep, the plots display the *EyeScan* sweep results. An example result plot is shown in Figure 6-5. The *Downstream* and *Upstream* plot channel selectors highlighted in Figure 6-6 can be used to emphasize a desired channel on each plot and view the channel's EQ settings. Note that this plot displays the hit counts at varying voltage levels for the selected channels captured directly at the transmitter output pins of the redriver. TI recommends the use other lane margining tools to monitor signal quality at each end of the PCIe link. This tool can be used as a reference and cannot provide best system performance based on this plot alone.

Figure 6-5. Eye Height Page: EyeScan Results

Figure 6-6. Eye Height Page: Plot Channel Selectors

5. To export the selected channel's raw *EyeScan* data, click the *Export Processed Data* button highlighted in Figure 6-7. Save the raw data file using the prompted File Explorer.

Figure 6-7. Eye Height Page: Export Processed Data

6. Additionally, the plots can be customized by clicking the plot icon next to each channel. An example customization menu is shown in Figure 6-8.

Figure 6-8. Eye Height Page: Customize Plot

7 Summary

The DS320PR410 SigCon Architect GUI profile allows for simple device access and configuration to help with EVM bring-up and device diagnostics. Please contact your Texas Instruments field sales representative if you have further questions or need assistance.

8 References

- Texas Instruments, *DS320PR410 Four-Channel Linear Redriver for PCIe™ 5.0, CXL 2.0* data sheet.
- Texas Instruments, *DS320PR410 Programming Guide* programming guide.
- Texas Instruments, *Eye Scan with TI PCI-Express Gen5.0 Redrivers* application note.
- Texas Instruments, *SigCon Architect: Installation and Starter's Guide* user's guide.
- Texas Instruments, *USB2ANY Interface Adapter* tool page.

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265