DS250DF810EVM User's Guide

The DS250DF810 is an eight-channel multi-rate retimer with integrated signal conditioning. It is used to extend the reach and robustness of long, lossy, crosstalk-impaired high-speed serial links while achieving a bit error rate (BER) of 10-15 or less. Each channel of the DS250DF810 independently locks to serial data rates in a continuous range from 20.6 Gbps to 25.8 Gbps or to any supported sub-rate (÷2 and ÷4), including key data rates such as 10.3125 Gbps and 12.5 Gbps. Integrated physical AC coupling capacitors (TX and RX) eliminate the need for external capacitors on the PCB. The DS250DF810 has a single power supply and minimal need for external components. These features reduce PCB routing complexity and BOM cost. The advanced equalization features of the DS250DF810 include a low-jitter 3-tap transmit finite impulse response (FIR) filter, an adaptive continuous-time linear equalizer (CTLE), and an adaptive decision feedback equalizer (DFE). This enables reach extension for lossy interconnect and backplanes with multiple connectors and crosstalk. The integrated CDR function is ideal for front-port optical module applications to reset the jitter budget and retime the high-speed serial data. The DS250DF810 implements 2x2 cross-point on each channel pair, providing the host with both lane crossing and fanout options.

The DS250DF810 can be configured via the default SMBus slave mode or with an external EEPROM. Up to 16 devices can share a single EEPROM. A non-disruptive on-chip eye monitor and PRBS generator and checker functions allow for in-system diagnostics. With this kit, users can quickly evaluate the DS250DF810 retimer performance.

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1 Hardware Description and Setup

The general procedure for setting up and testing with the DS250DF810 Evaluation Module (DS250DF810EVM) hardware is as follows:

1. Check the EVM jumper settings to ensure they match Figure 1 below.
2. Connect the EVM to a PC using the provided USB cable.
3. Connect 3.3V power (2A max) as shown below. The EVM has an on-board 3.3V-to-2.5V regulator to supply the Retimer with the required 2.5V.

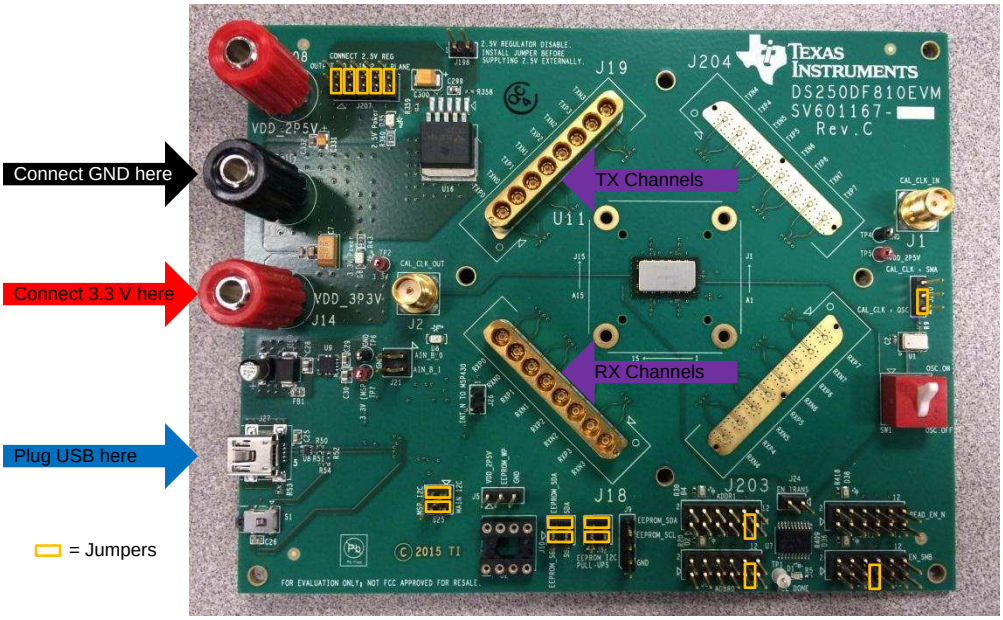


Figure 1. DS250DF810EVM, Showing Necessary Connections for Power, Signal, and USB Communications

4. Connect the EVM to the system under test.

The default EVM configuration has four differential RX inputs and four differential TX outputs accessible to the user. Connect the RX and TX signals to the test channel using Huber+Suhner 1x8 MXP cable assemblies (See Section 6 for ordering information).

NOTE: All TX and RX channels are AC coupled with physical 220 nF capacitors on the package of the device, so external AC coupling capacitors are not needed when using this EVM.

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2 Software Description

2.1 Setup

The **one-time** procedure for installing the GUI software is as follows:

1. Download and install the TI SigCon Architect GUI. The steps for installing the software are as follows:
    1. Go to www.ti.com/tool/sigconarchitect and download the latest version of SigCon Architect. At the time this document was written, the latest version of SigCon Architect is 2.0.0.4.

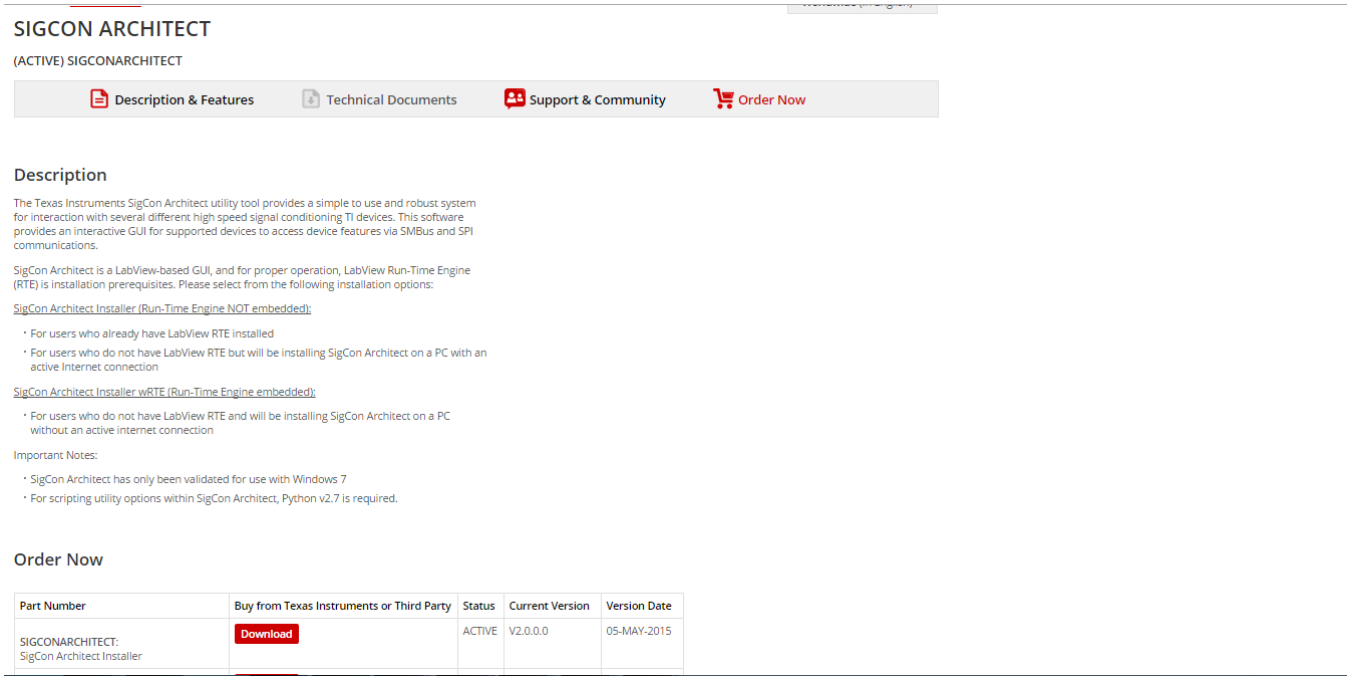


Figure 2. Download SigCon Architect from www.ti.com

2. Extract the executable file (.EXE) from the downloaded file and run the executable.
3. Follow the installation wizard's instructions to install SigCon Architect.
4. Download the DS250DF810 profile file from the TI SigCon Architect page.
5. Extract the executable file (.EXE) from the downloaded file and run the executable.

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2. Run the SigCon Architect software.
    1. Start the software by double-clicking its icon on the desktop.
    2. On the “Selection” panel, the DS250DF810 should appear.
    3. If DS250DF810 is not listed:
        1. Go to “Device” tab and choose “Manage Devices”.
        2. Click on “+” icon and then select the “DS250DF810” device model.
        3. Fill in the “New Device Name, DS250DF810 is recommended.
        4. Select the slave address as configured on EVM (typical setting is 0x30).
        5. Click “OK”.
    4. Navigate to the “Configuration” page of DS250DF810 via the “Selection” panel. Choose “Slave Address” “0x30” from the drop down menu. Verify the “USB2ANY Details” specify “USB2ANY 0”, and click “Apply”. Successful connection is indicated by the green “CONNECTED” indicator on the bottom of the application.

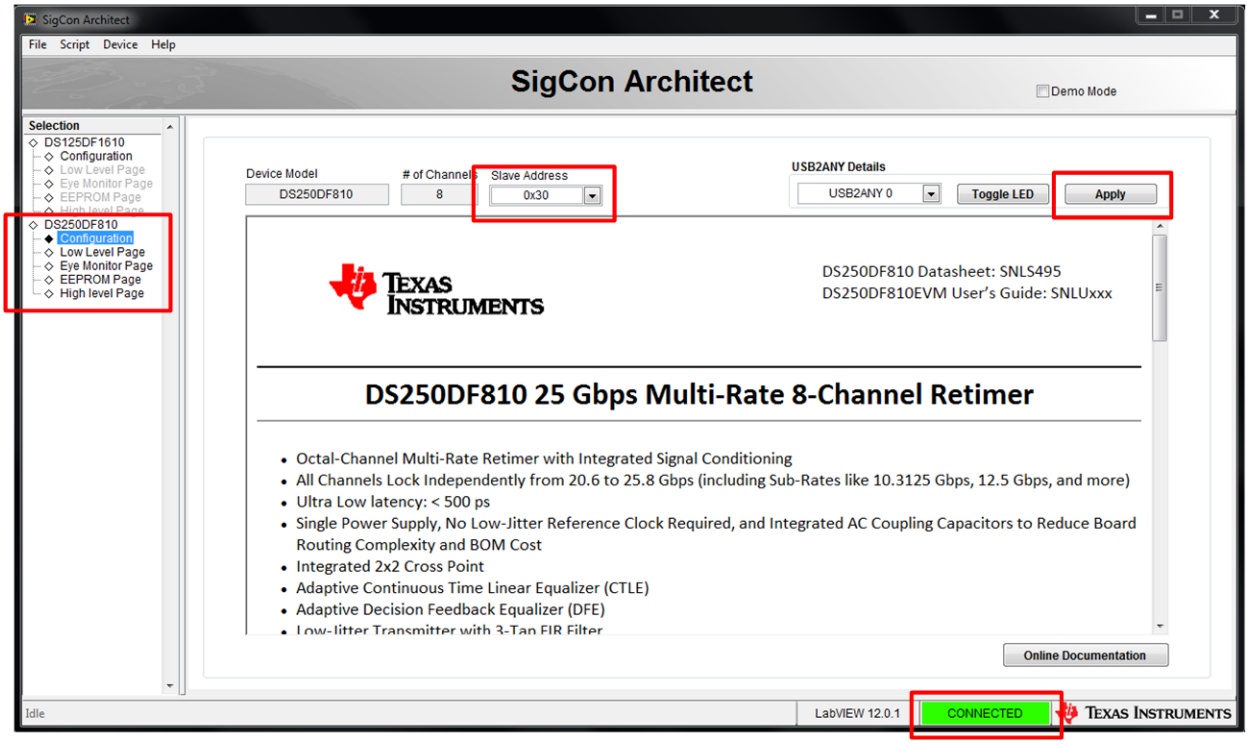


Figure 3. Sigcon Architect Start-Up Screen

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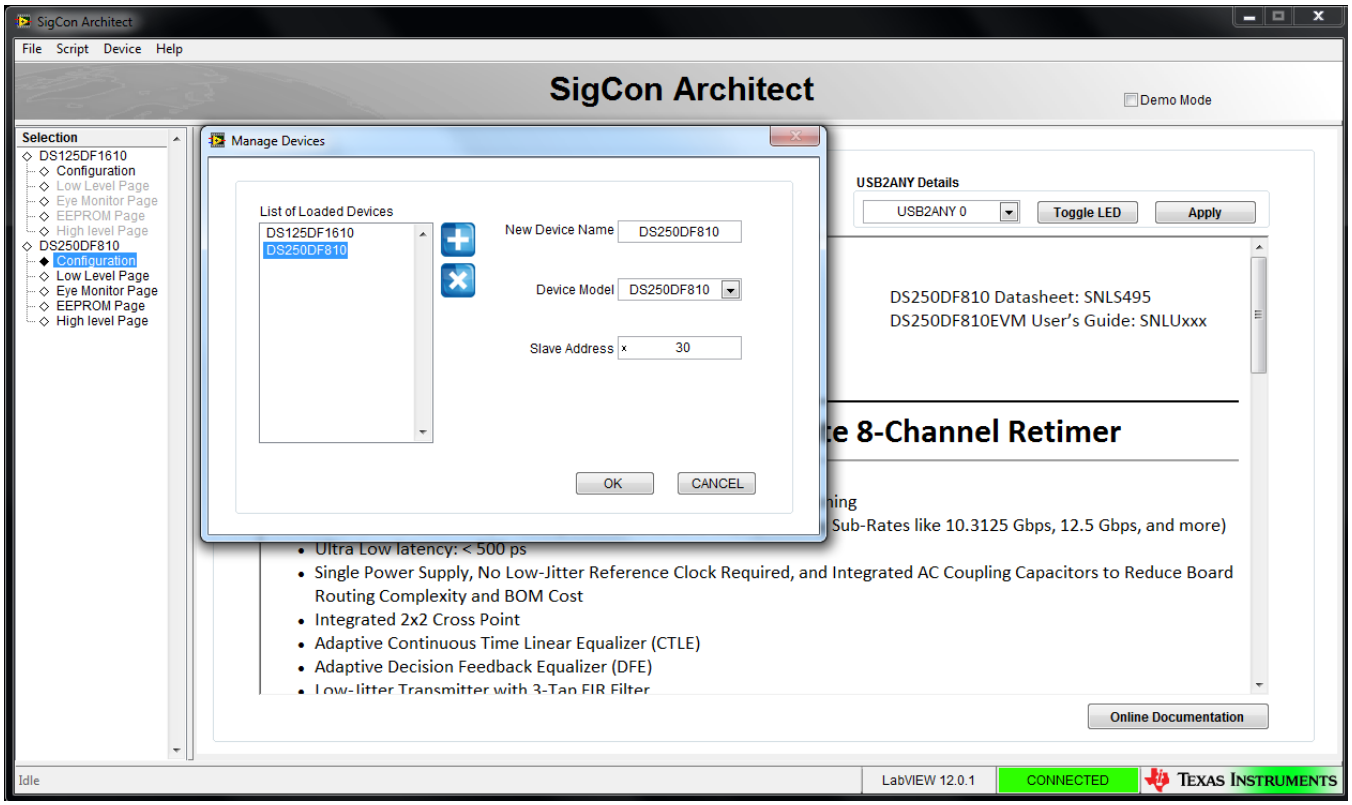


Figure 4. Capture Illustrating the "Manage Devices" Pop-Up Window for Adding New Part Numbers to the "Selection" Panel

3. Once connection is successfully established, users can read and write various settings to the device in real-time, using the functional pages.

2.2 Functional Pages

2.2.1 Low-Level Page

The low-level page allows the user to read and write to all registers on the DS250DF810. To access it, navigate to the "Low Level Page", as shown below.

- The user may click "Read All" to load the data in each register from the device to the "Register Map."
- The user may access the Shared, Global or Channel registers via "Block Select."
- To Read a register:
  - Type the readable address in the "Current Address" text box or select a register from the Register Map.
  - Click "Read Register". The data in this register will appear in the "Data" text box.
- To Write a register:
  - Type the writeable address in the "Current Address" text box or select a register from the Register Map.
  - The user may either type the data value (in HEX) to write to this address in the "Data" text box, or check/uncheck boxes as desired for individual bits within the register. Then click "Write Register."
  - If Broadcast is selected for channel register writes, the specified write will be performed to all channels in the device.

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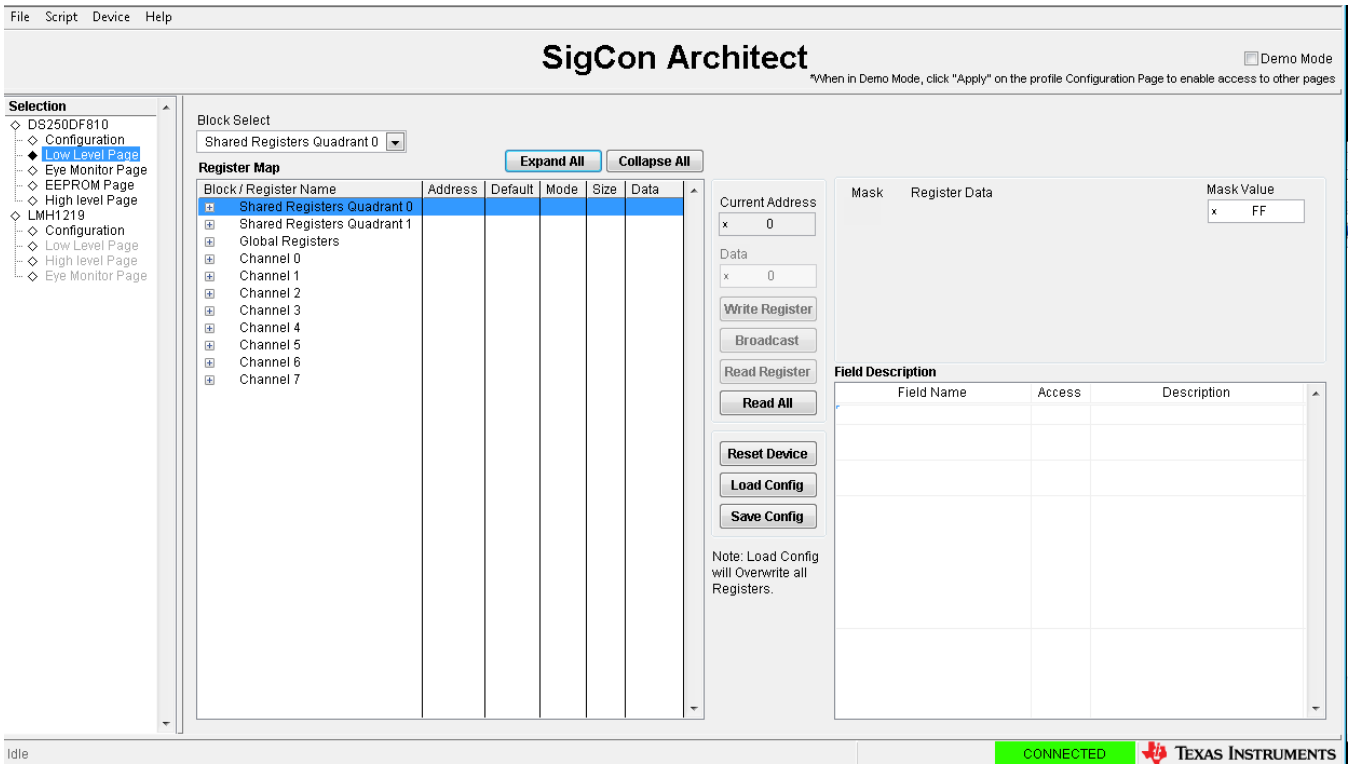


Figure 5. Low-Level Page Capture Illustrating the Different Block Select Options

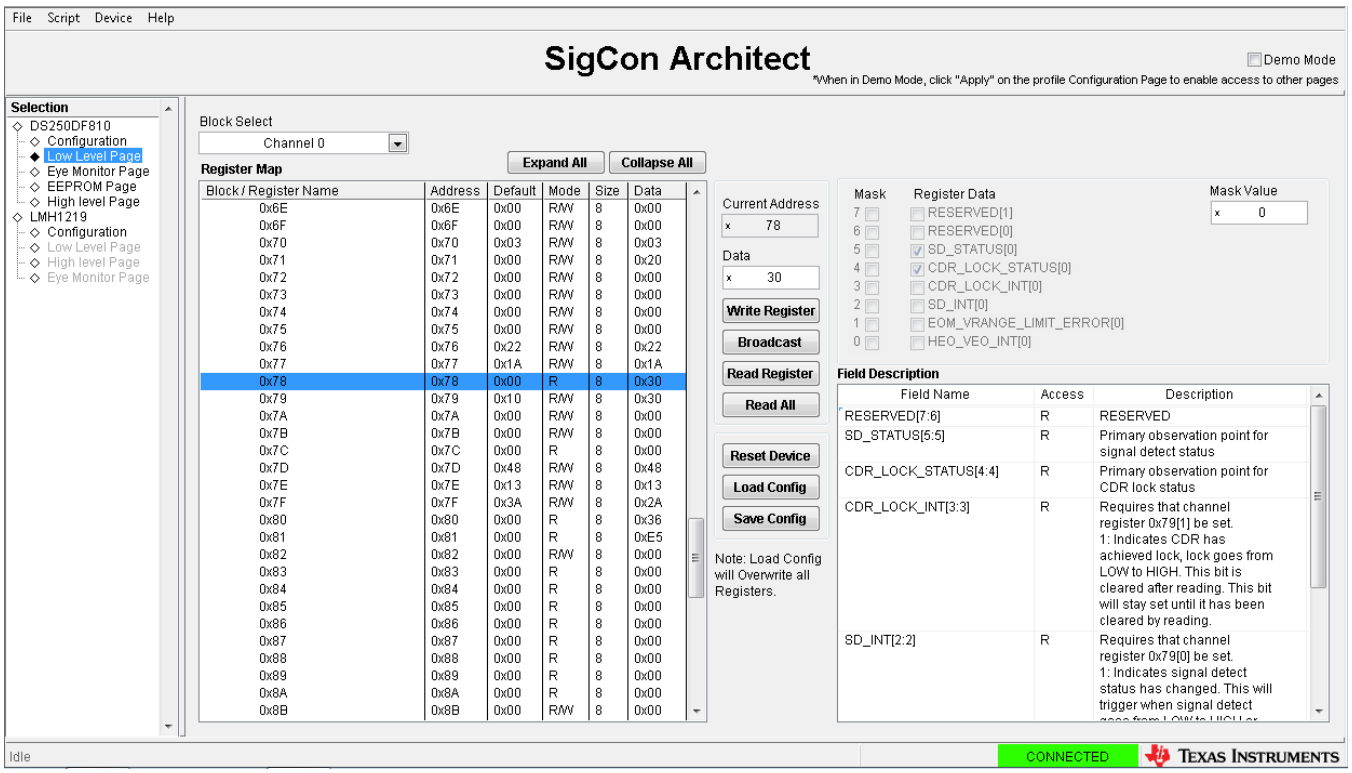


Figure 6. Low-Level Page Capture After Selecting Access to an Individual Register

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2.2.2 Eye Opening Monitor (EOM) Page

The Eye monitor page allows the user to visualize DS250DF810 eye plots, a means of assessing received signal quality after equalization.

- Select the channel for eye plotting. Note that plots can only be generated for a given channel if “CDR Locked” is indicated.
- The EOM_SEL_VRANGE pull-down allows the user to adjust the vertical scale for eye plots.
- The user may perform a “Single Capture” of eye monitor plot, or select “Continuous Capture” to accumulate multiple plots over a period of time.
- The Horizontal Eye Opening (HEO) and Vertical Eye Opening (VEO) may be read on the Eye Monitor page.
- If the user desires to do their own analysis or post-processing of the EOM data, the “Export Raw Data” and “Export Density” buttons respectively generate an Excel spreadsheet containing the 63x63 eye monitor values matrix.

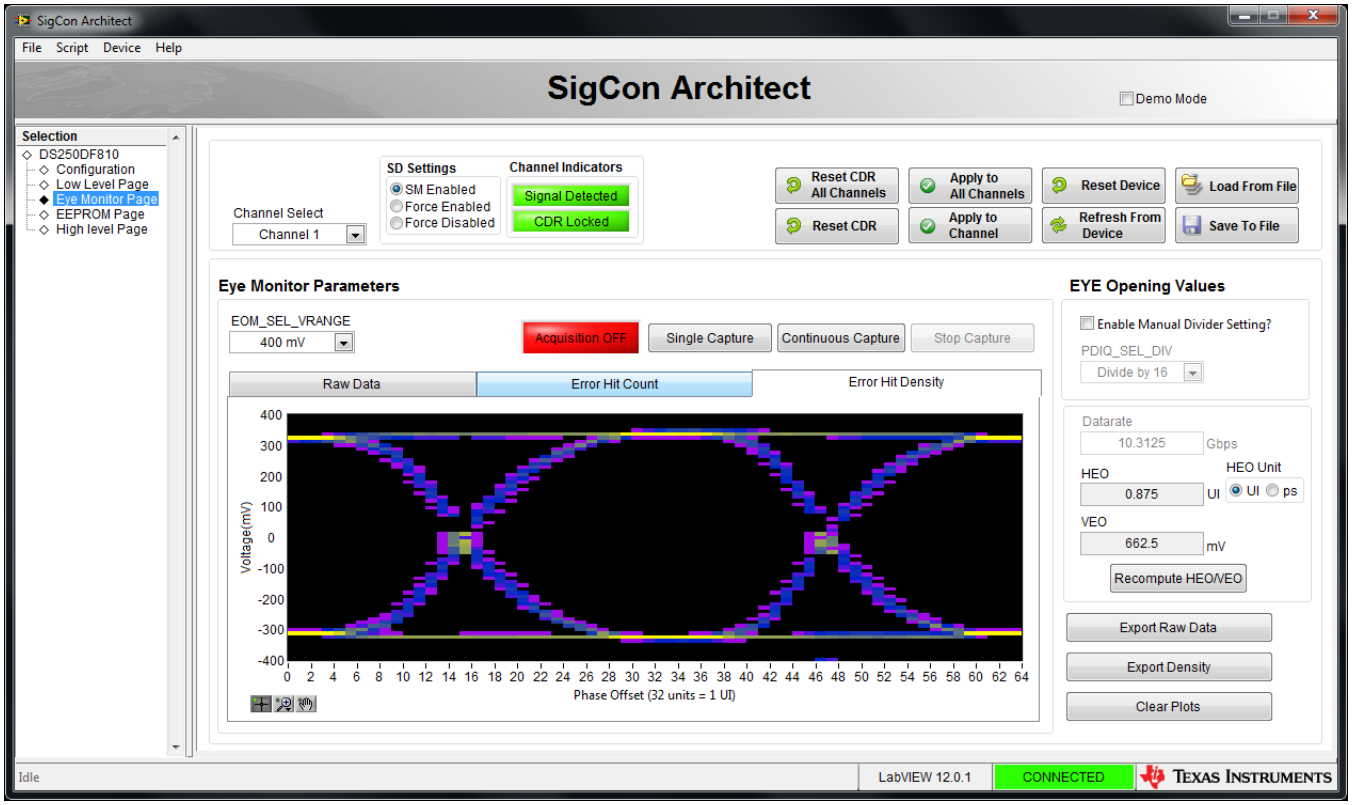


Figure 7. Eye Monitor Page for DS250DF810 Profile

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2.2.3 EEPROM Page

The SigCon Architect EEPROM page allows the user to either: create a DS250DF810 Hex file that is programmable to an EEPROM, or configure a DS250DF810 device based on values from an existing DS250DF810 Hex file.

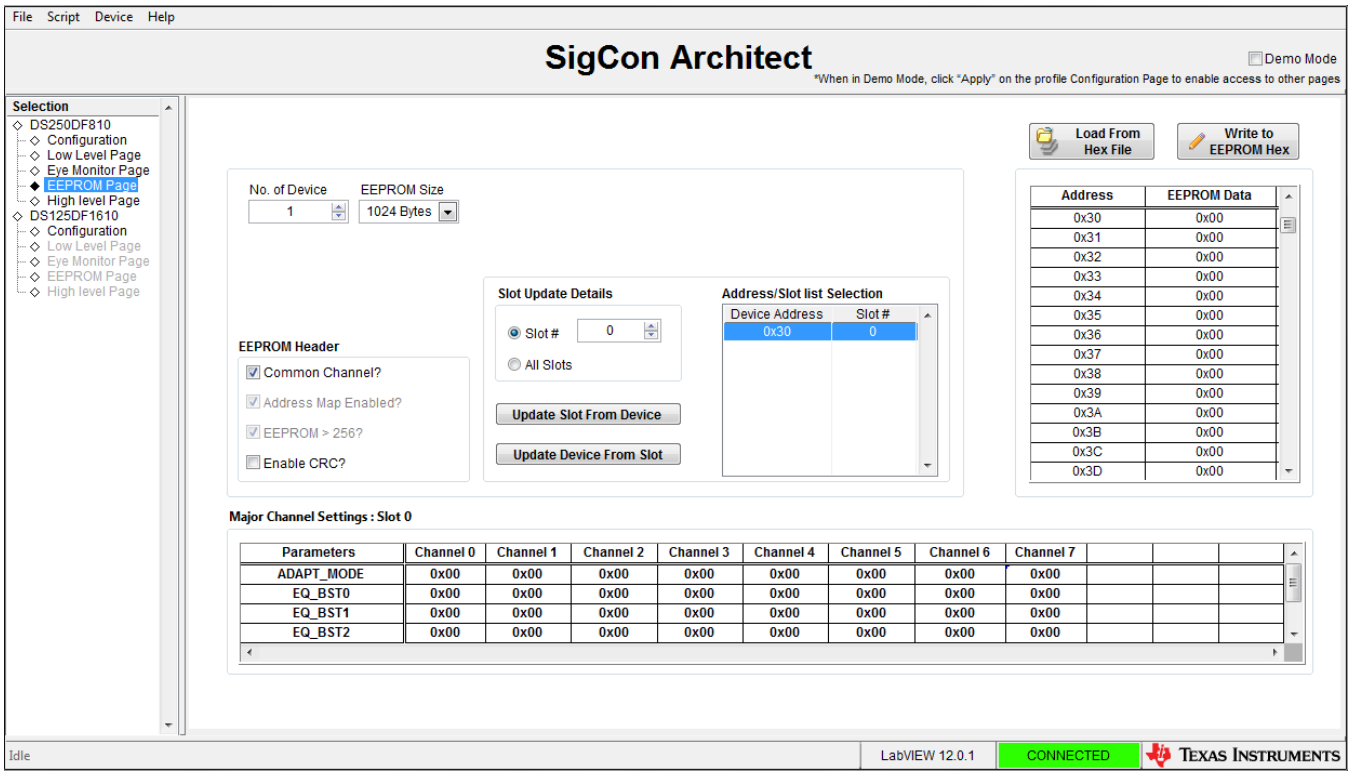


Figure 8. EEPROM Page for DS250DF810 Profile

The user may choose to update the EEPROM page settings based on values read from the DS250DF810 device by clicking “Update Slot from Device”. To create the programmable hex file, click “Write to EEPROM Hex”. Note that the evaluation module does not include an EEPROM, but an external EEPROM can be used. SigCon Architect cannot directly program the EEPROM. The EEPROM Hex File can be burned on the EEPROM via I^2C communication (i.e. AARDVARK or equivalent interface adapter). The EEPROM control settings are described in greater detail below.

- Common Channel: If this box is checked, all channels receive the same configuration. Different devices can receive different configurations, but within one device, all channels will receive the same configuration. If this box is unchecked, then the EEPROM will store the configuration as unique channel configurations. Each of the four channels can receive a unique configuration.
- EEPROM>256:
  - This setting must be enabled if there are more than 4 EEPROM slots.
  - When this box is checked, the “EEPROM Size” drop down menu is automatically populated by 512 Bytes if previously populated by 256 Bytes.
  - When this box is unchecked, the “EEPROM Size” drop down menu is automatically populated by 256 Bytes. Up to 4 EEPROM slots can be programmed.
- Enable CRC: If enabled, each device will have a CRC value specific to the base header, address map header, and data. If disabled, the CRC is not computed.
- Slot Update Details: The number of slots refers to the total number of unique SMBus register settings to load from the EEPROM. The user can choose to update all slots, or which slot # to update the SigCon Architect EEPROM page from.

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- EEPROM Size: The EEPROM size must be set to 256, 512, or 1024 bytes. A single external EEPROM can be used by up to 16 DS250DF810 devices.
  - The first 3 bytes of EEPROM data is the base header. The base header contains the CRC enabled, address map header enabled, EEPROM<256 bytes, device count, and maximum EEPROM burst size settings.
  - If multiple devices are programmed, an address map header is needed for each device. The address map header specifies the CRC value and the Device EEPROM Start Address.
  - EEPROM Size ≤ 256 Bytes:
    - EEPROM Size = 3 Bytes (Base Header) + # of devices * 8 Bytes/device (Address Header) + # of slots * 66 Bytes/slot (Data)
  - EEPROM Size > 256 Bytes:
    - EEPROM Size = 3 Bytes (Base Header) + # of devices * 12 Bytes/device (Address Header) + # of slots * 66 Bytes/slot (Data)

2.2.4 High-Level Page

2.2.4.1 Overview

The High-Level Page on the Selection Panel enables the user to easily configure and/or check the status of the DS250DF810 high-speed data path functional blocks: Clock and data recovery (CDR), Receiver equalization, Transmitter output driver, PRBS generator and checker, and cross-point. The figure below shows the landing page after uses selects “High-Level Page on the Selection Panel. The first button option is the “Block Diagram”, an illustrative page highlighting the DS250DF810’s functional stages. The configuration features for the additional tabs within the High-Level Page are described further in the next sub-sections.

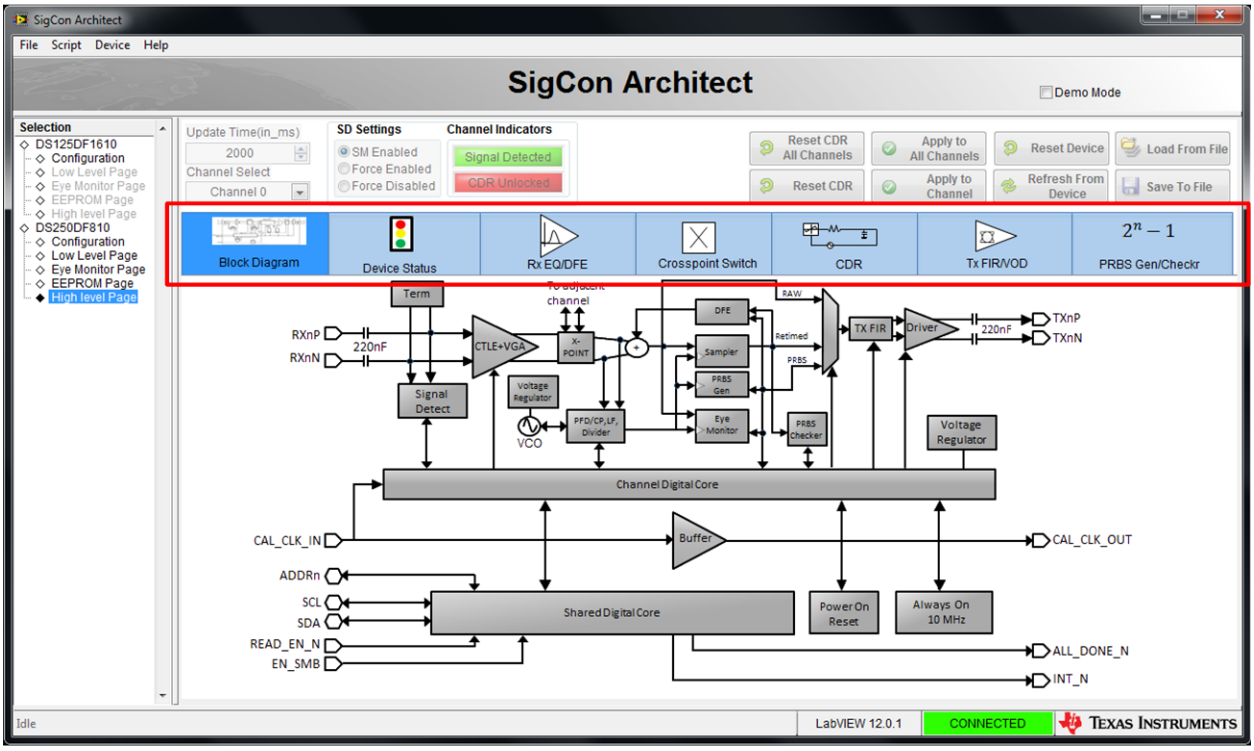


Figure 9. High-Level Page, with Block Diagram Tab Selected

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2.2.4.2 Device Status

In order to view a real-time high-level summary of the current device status and control settings, navigate to the “High Level Page”, and choose the “Device Status” tab. Click “Refresh From Device” to ensure the settings shown are from the device. The settings on this page are not editable.

- Signal Detect Status: For each channel the device status is displayed as “Signal Not Detected” if there is no detectable signal present at the RX side of this channel or “Signal Detected” if there is a signal present at the RX side of this channel.
- CDR Locked: For each channel the CDR lock status is displayed. Note that each channel’s CDR status and configuration is independent from the others.
- EQ Boost: This field displays the Rx Continuous-Time Linear Equalizer (CTLE) boost value as a four digit figure. Each digit corresponds to one of the four CTLE stages, and each can have a value from 0 to 3.
- DFE Taps: The boost values in mV for each of the five Decision Feedback Equalizer (DFE) taps are displayed here.
- HEO and VEO: The HEO and VEO values in mV are displayed for each of the retimer channels.
- Tx FIR filter taps: The Device Status tab displays the current decimal value and polarity for the FIR pre-cursor, main-cursor and post-cursor taps for each of the channels. The coefficient sum (i.e. absolute sum of the FIR tap values) is also displayed. Finally, the page displays approximate values for the effective post-cursor and pre-cursor de-emphasis based on the channel’s current FIR tap settings.

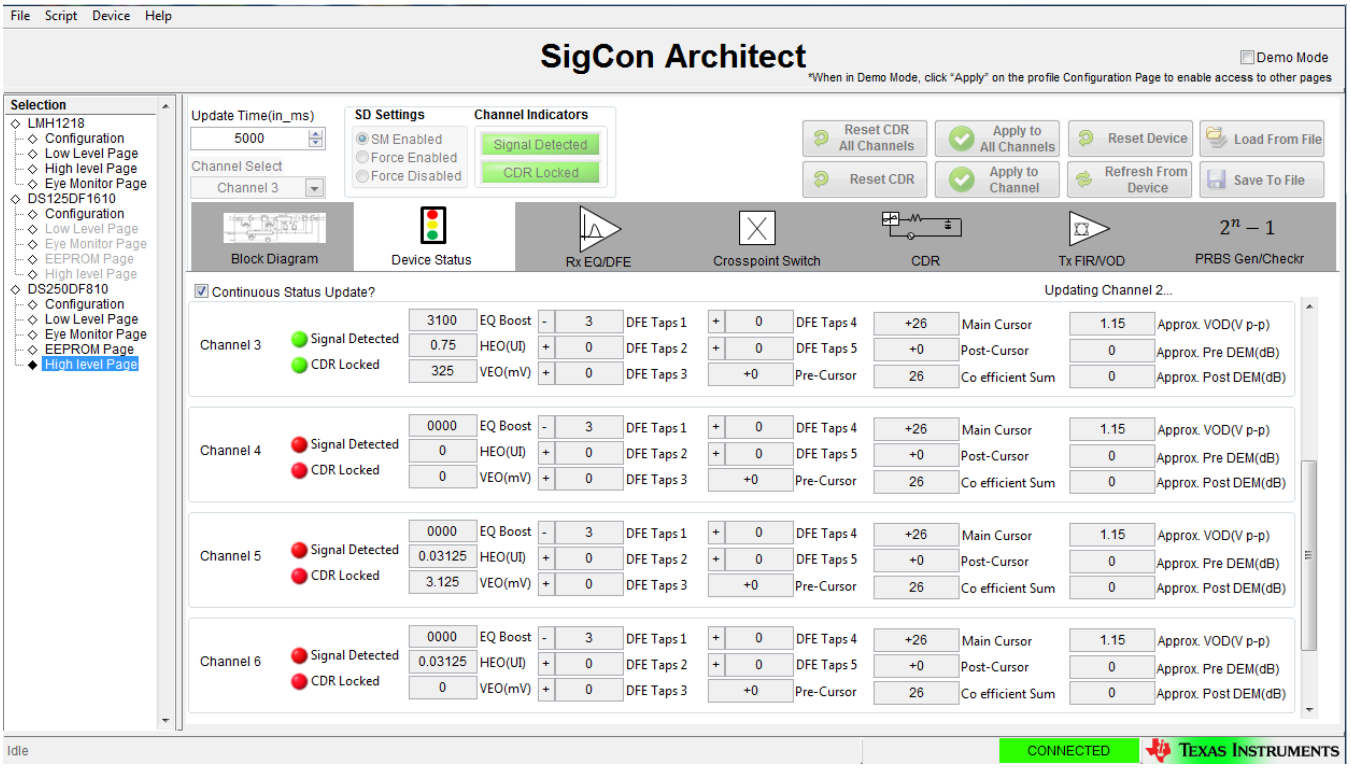


Figure 10. High-Level Page, with Device Status Tab Selected

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2.2.4.3 Rx EQ/DFE

The Rx EQ/DFE tab provides the user with full status and control capability of the DS250DF810 Rx equalization functions. The figure below illustrates the Rx EQ page functions, which are described below in more detail.

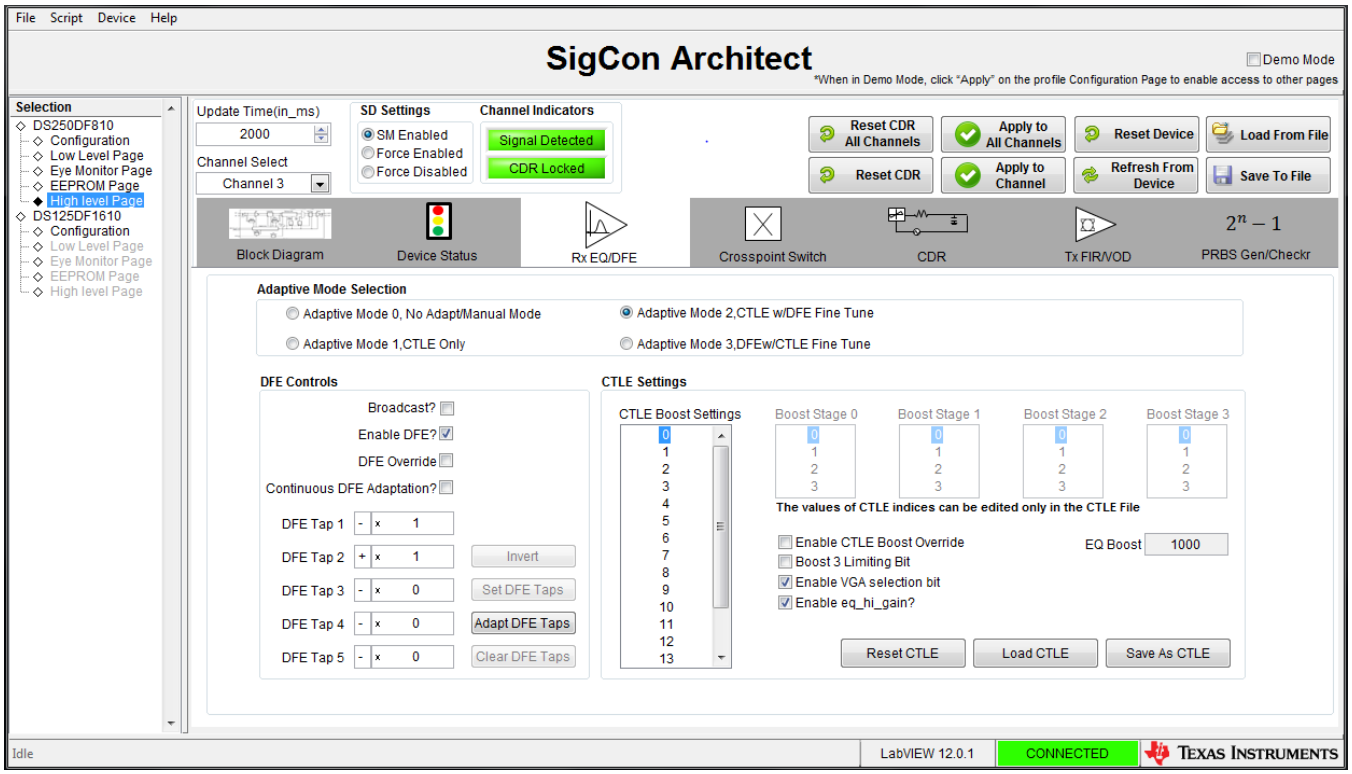


Figure 11. Rx EQ/DFE Tab

- Adapt Mode
  - Upon landing on the Rx EQ page, the GUI will display the current status for the retimer adapt mode for the channel selected in the Channel Select pull-down.
  - The Rx EQ page allows the user to set the DS250DF810 device to any of the four available adapt modes. To do so, the user should click on the desired adapt mode then click “Apply to Channel” to configure a specific retimer channel. Alternatively the user may broadcast the new adapt mode setting by clicking on “Apply to all channels.”
- CTLE Settings
  - Select the desired channel on Channel Select pull-down.
  - The GUI will display the current CTLE boost value on the EQ Boost field of the CTLE Settings section.
  - If the user wishes to manually set the EQ value:
    - Adapt Mode 0 may be selected (i.e. no adaption mode).
    - Check the “Enable CTLE Boost Override” option.
    - Click on “Reset CDR” button on the top right of page.
  - Boost 3 Limiting bit
    - When checked, this option configures the last CTLE boost stage to have a limiting output.
  - VGA (Variable Gain Amplifier) gain bit
    - When checked, it enables the Rx VGA block.
  - EQ Hi gain mode bit
    - When checked, the EQ is set to the high-gain mode of operation. This bit is enabled by default.

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- EQ boost table - If the user wishes to customize the sixteen value CTLE boost table:
  - The user can enter the desired values individually on the “CTLE Boost Settings”.
  - After entering all of the CTLE table values, the user should click on “Save as CTLE” button to save the file.
  - This CTLE table file can be loaded for use with new devices by clicking “Load CTLE” and selecting the file from its location.
- DFE Controls
  - Upon landing on the “Rx EQ” tab, the” DFE Controls” section will display the current weight values and polarities for the five DFE taps for the selected channel.
  - The user may check the “DFE Override” box to manually configure the DFE tap values.
  - The user may enable continuous DFE adaption by checking the corresponding box on the “DFE Controls” section.

2.2.4.4 Cross-Point Switch

The cross-point tab allows the user to easily configure the 2x2 cross-point implemented for each of the adjacent channel pairs of the DS250DF810 retimer.

- With the “Pair Select” pull-down, the user can choose which cross-point pair to configure (0-1, 2-3, 4-5, or 6-7.)
- The cross-point mode is selected using the “Crosspoint Configuration” pull-down.
- The cross-point channels mappings are illustrated on the “Crosspoint Settings” table on the page, and the displayed color matches the current cross-point mode.

There are three cross-point configuration modes selectable via the “Crosspoint Configuration” pull-down:

- Default
  - The transmitter for a given channel obtains data from its own receiver.
- Fanout
  - Upon selecting the “Fanout” option on the pull-down, the user will be asked to select a channel on the “Broadcast Channel” pull-down.
  - After the user selects the broadcast channel and clicks on “Broadcast”, the received data for the selected channel will be output both on its Tx output and also on the Tx output of its cross-point pair channel.
- Lane Crossing
  - Upon selecting the “Lane Crossing” option, the GUI will automatically configure the cross-point pair in question such that the Tx output of a given channel obtains its data from the Rx of its adjacent cross-point pair channel

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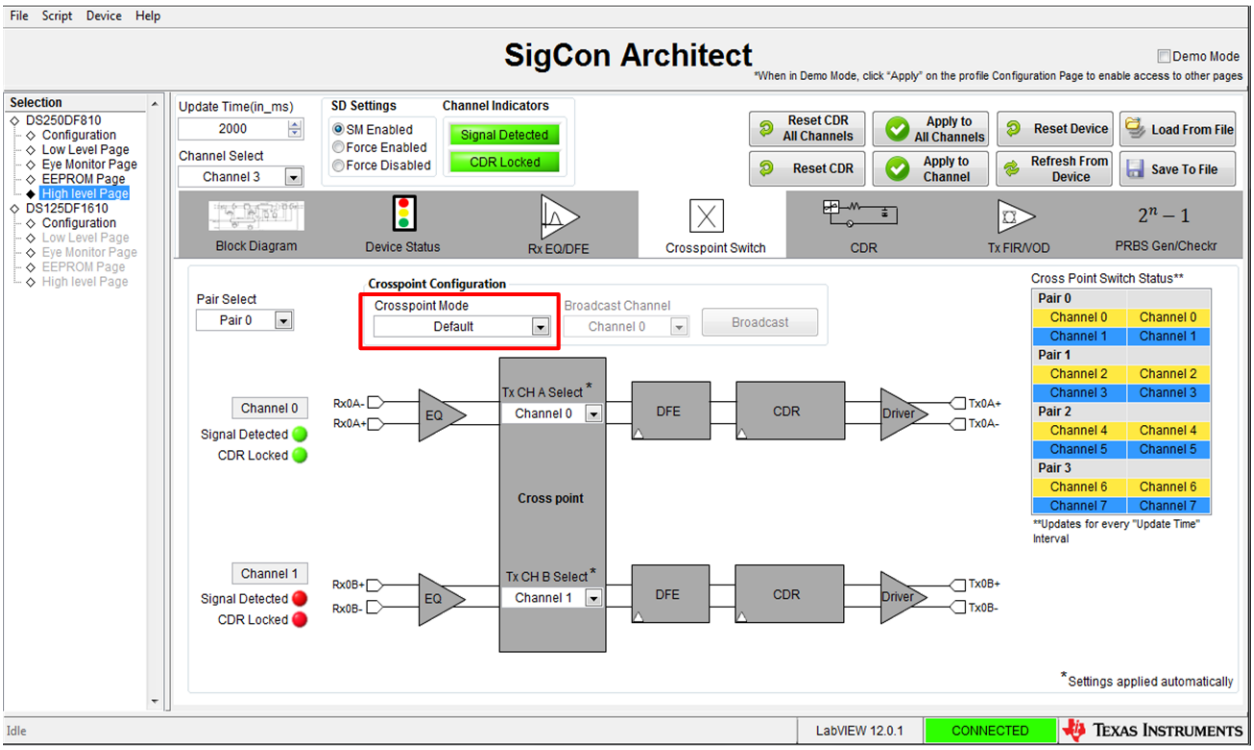


Figure 12. Cross-Point Tab, Default Mode Selected

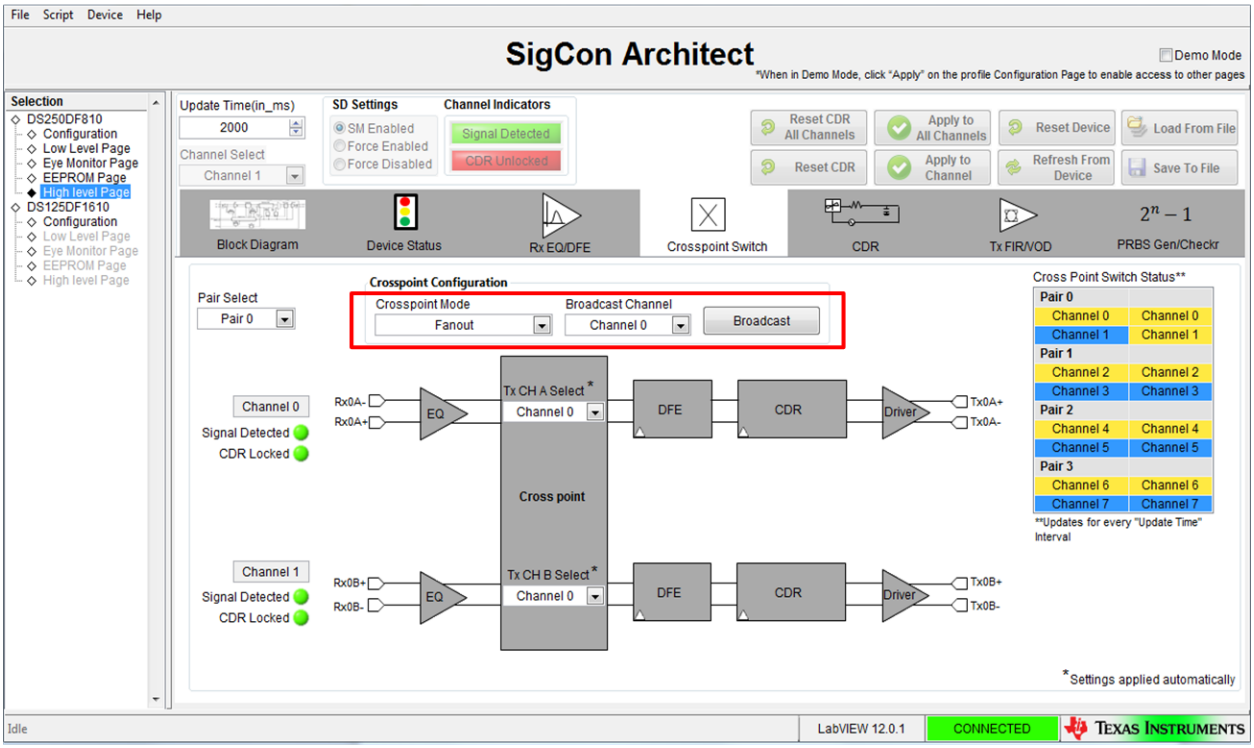


Figure 13. Cross-Point Tab, Fanout Mode Selected

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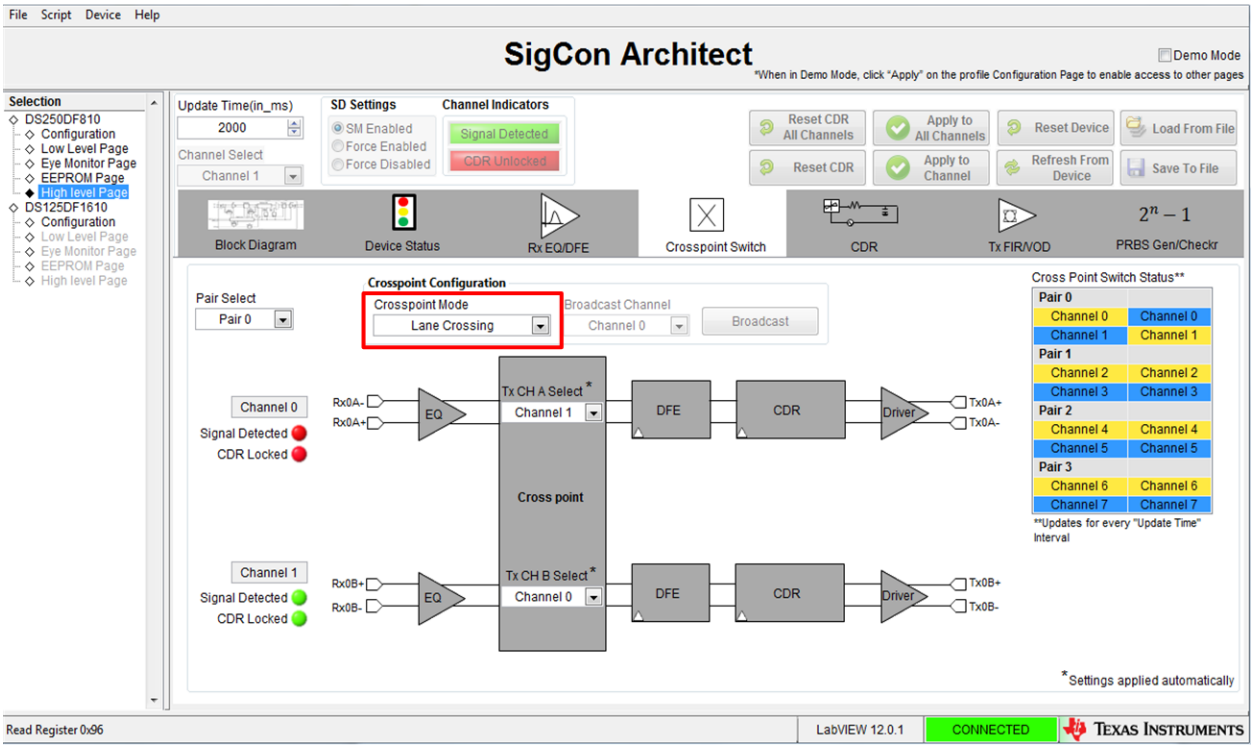


Figure 14. Cross-Point Tab, Lane Crossing Mode Selected

2.2.4.5 CDR (Clock and Data Recovery)

The CDR tab provides a quick way to configure the DS250DF810 retimer to operate at the desired data rates and sub-rates. The DS250DF810 channels must each be pre-programmed for the expected data rate(s) to ensure CDR lock. On the CDR tab the user can select between the Standard and Manual modes of CDR lock configuration.

- Upon landing on the CDR tab, the page will automatically display the mode that the retimer is currently set to, along with the data rate setting and also the divider setting (in the case of Manual Mode.)
- Standard Mode allows the user to program the retimer rate/sub-rate to one of within a set of pre-defined standard values.
  - Select the desired channel on Channel Select pull-down.
  - The user first clicks on the “Standard Mode” option on the page.
  - The user then selects the desired rate within the “Standard Data Rate Selection” Options.

NOTE: The default settings for the DS250DF810 are “Standard Mode”, and “100Gb Ethernet” (i.e 25.78125 Gb/s data rate per channel).

- Manual Mode allows the user to manually program a retimer channel to CDR lock to a specific data rate. This function is intended for applications requiring a data rate that exists within the VCO range, but that are not listed within the “Standard Data Rate Selection” options.

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- To configure a channel via “Manual Mode”:
  - Select the desired channel on Channel Select pull-down.
  - Select “Manual Mode” option on the page; the user will then see the manual mode input fields become adjustable.
  - Select the desired divider setting from the “Divider Configuration” pull-down.
    - Select “divide-by-1” when data rate > 13 Gbps.
    - Select “divide-by-2” when 13 Gbps ≥ data rate > 6.5 Gbps.
    - Select “divide-by-4” for data rate ≤ 6.5 Gbps.
  - Enter desired Data Rate for group 0 then click “Write Rate Regs”. The GUI defaults to max PPM tolerance.
  - Enter desired Data Rate for for group 1 then click “Write Rate Regs”. The GUI defaults to max PPM tolerance.
  - Click “Reset CDR”.

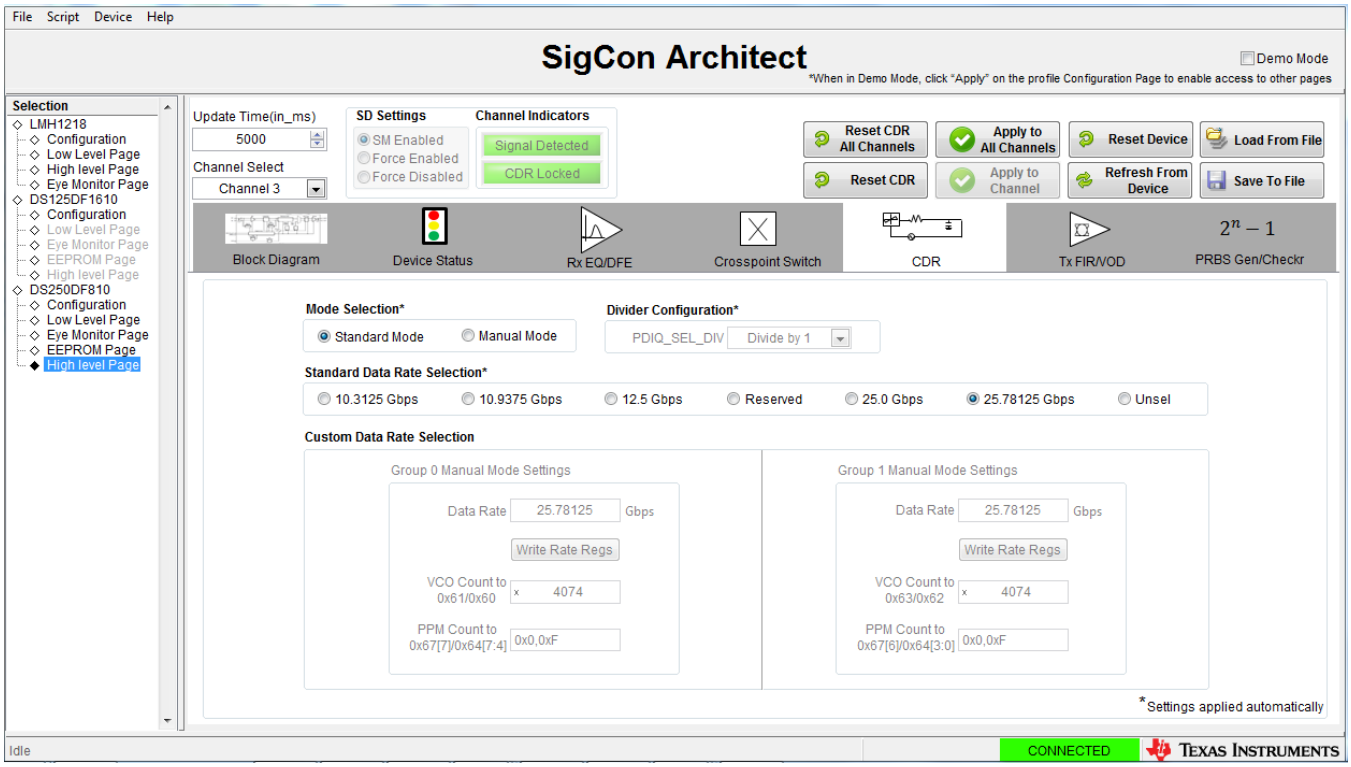


Figure 15. CDR Tab, Standard Mode Selected

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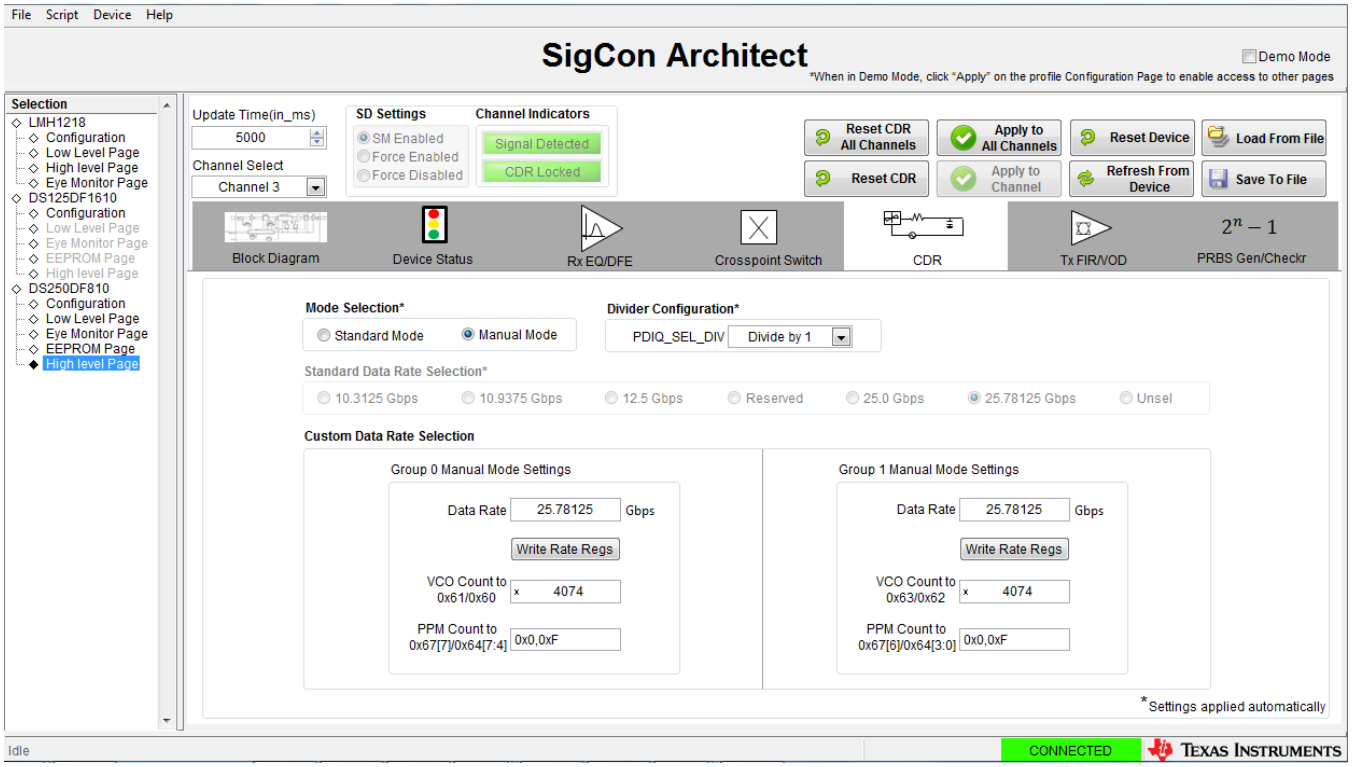


Figure 16. CDR Tab, Manual Mode Selected

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2.2.4.6 TX FIR/VOD

The TX FIR tab allows the user to configure the FIR tap settings for each of the retimer channels, to set the output to specific voltage amplitude and/or realize specific transmit pre-cursor and post-cursor equalization ratios.



Figure 17. TX FIR Tab

- Upon landing on the TX FIR tab, the page will display the current decimal values and polarity for the main-cursor, post-cursor and pre-cursor FIR taps.
- In addition, the page also displays approximate values for the voltage output differential (VOD) and the de-emphasis for both pre-cursor and post-cursor.
- The user may adjust the FIR tap values, by clicking on the up/down arrows for each field. After entering the desired value(s), the user can click on “Set Taps” to make the entries effective.
- At any point the user can click on “Read Taps”.

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2.2.4.7 PRBS Tab

The PRBS tab within the High-Level page allows the user to configure the PRBS generator or Checker functions on any of the channels of the DS250DF810 retimer.

- To enable PRBS Generator on a channel:
  - Select the desired channel using the “Channel Select” pull-down.
  - Select the desired pattern using the “Pattern Type” pull-down.
  - Set desired Polarity via pull-down, Non-Invert or Invert.
  - Click “Enable” button.

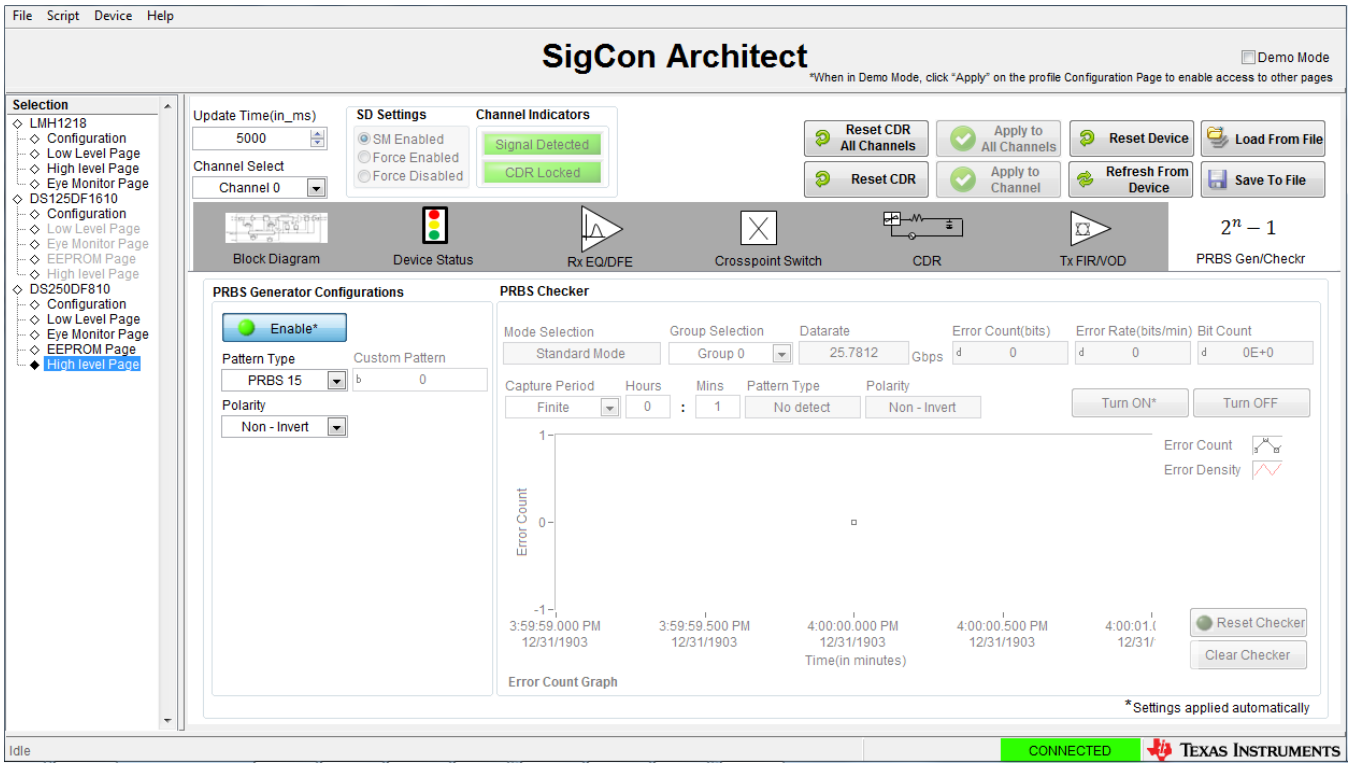


Figure 18. PRBS Tab, PRBS Generator Configuration

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- To enable PRBS Checker on a channel:
  - Select the desired channel using the “Channel Select” pull-down.
  - Set the “Capture Period”.
    - Set pull-down to “Infinite” if it desired to run extended duration test without time limit.
    - If “Finite” period is desired, set the pull-down to “Finite” and enter the desired test duration via the “Hours” and/or the “Mins(Minutes)” input fields.
    - Click “Turn ON”.
    - The user may clear the counter fields by clicking “Clear Checker,” or reset the PRBS checker settings by clicking “Reset Checker”.
    - To turn off the checker and return to default settings, click on “Turn OFF”.

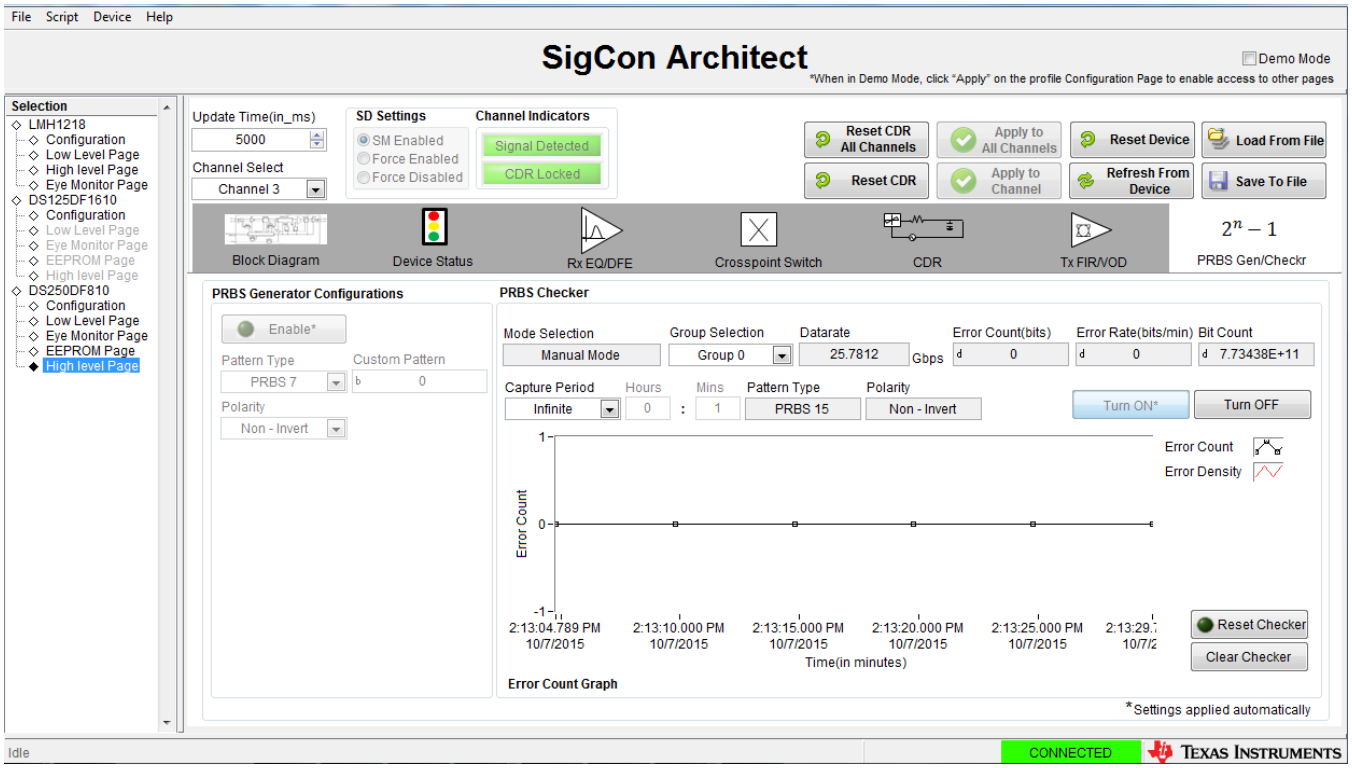


Figure 19. PRBS Tab, PRBS Checker Configuration

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3 Best Practices and Usage Tips

The following is a general procedure that should be followed when using the DS250DF810EVM in a system.

1. Set up your data source (either BERT TX or ASIC TX) to generate a PRBS pattern of the desired data rate.
    1. Not all BERT TX sources have FIR capabilities. The DS250DF810 receiver usually does not need much de-emphasis applied by the link partner transmitter (i.e. the BERT TX or ASIC TX). Typically 3dB of de-emphasis or 0-15% post-cursor will be adequate. If the BERT/ASIC TX has pre-cursor capabilities, then 0-15% pre-cursor should be adequate. Most links should be operable without any TX de-emphasis.
2. Connect the EVM in to the system. Typically this will consist of the following topology:
   BERT TX or ASIC TX → SMA cables → channel_1 → Huber+Suhner cables → DS250DF810 EVM RXn → DS250DF810 EVM TXn → Huber+Suhner cables → channel_2 → SMA cables → BERT RX or ASIC RX
    1. After making your data rate selection, push the “Initialize Channel” button on the Receiver tab. You only need to press this once, provided you do not change data rate or adapt mode. If you want to re-lock the CDR, simply press the “Reset channel CDR” button.
    2. Check the Signal Detect, CDR lock, and Adapt Complete status indicators to see if the link is established.
    3. If the CDR is in lock, the corresponding lock LED on the EVM will light up.
3. Check the Horizontal Eye Opening (HEO) and Vertical Eye Opening (VEO) by clicking on the Acquire HEO/VEO “On” button.
4. Check the Retimer Receiver’s bit error rate by launching the PRBS pattern checker from the Receiver tab. If necessary, tune the link partner transmitter’s FIR settings to achieve the target BER.
5. Tune the Retimer TX FIR settings. It is best to demonstrate that the return path (Retimer TX to BERT/ASIC RX) is working first before trying to optimize the Retimer RX parameters. One way to do this would be to test over a simple channel_1 first to prove that the Retimer can drive data error-free into the BERT/ASIC (optimizing the Retimer TX FIR as needed) then switch to the more difficult channel_1 while keeping channel_2 unchanged.

Things to watch for:

1. At 25-28Gbps data rates, small imperfections in the channel can be problematic. Ensure that cables are properly torqued (not over-torqued), paddle cards are properly mated with backplane connectors, and the BERT RX is properly aligned to the incoming data stream.
2. When adding up the total channel loss, do not forget to include the loss of the test fixture and cables. For example, the DS250DF810 EVM board plus Huber+Suhner cables have ~4dB of insertion loss from the device output to the Huber+Suhner cable end; and another ~4dB from the Huber+Suhner cable end to the device input.

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4 Test Case Examples

The following is an example test case with results collected using this EVM.

- **Data Rate**: 25.78125Gbps
- **Data pattern**: PRBS31
- **Backplane insertion loss**: -35dB @ 12.9GHz
- **Crosstalk at victim RX**: 4.1 mV RMS (24.1 mVppd)
- **Victim TX amplitude**: 1200mVppd
- **Victim TX FIR**: C(-1)=-4, C(0)=24, C(+1)=-3
- **Adapt mode**: 2
- **Adapted RX CTLE**: [3,0,0,0]
- **Adapted DFE**: [-0x14, +0x2, +0x1, -0x2, 0x0]

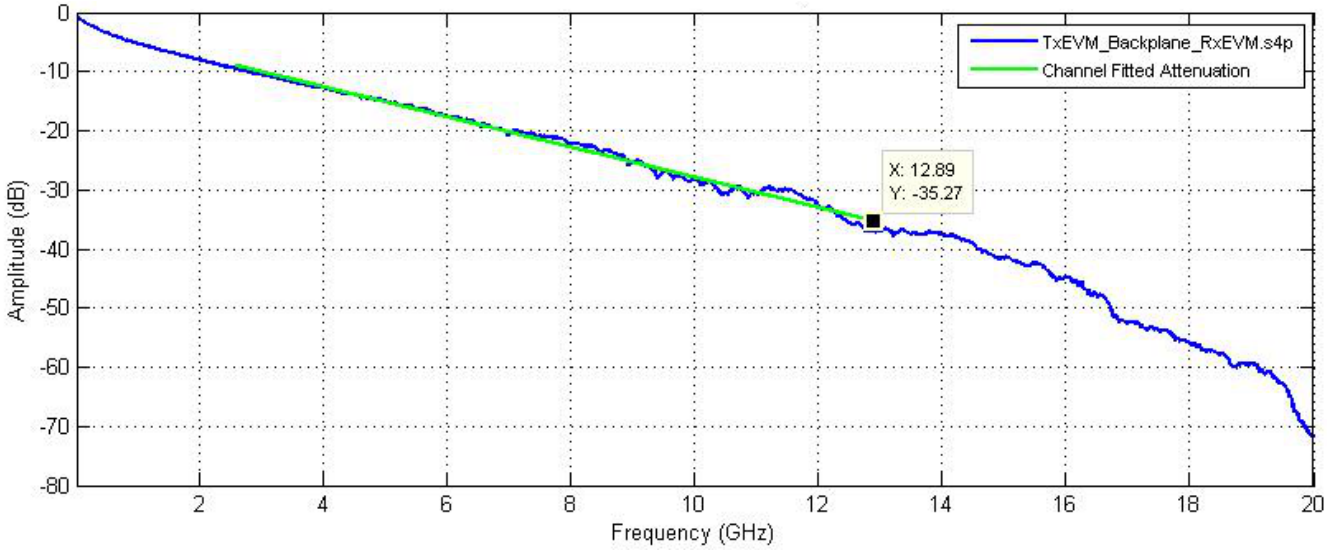
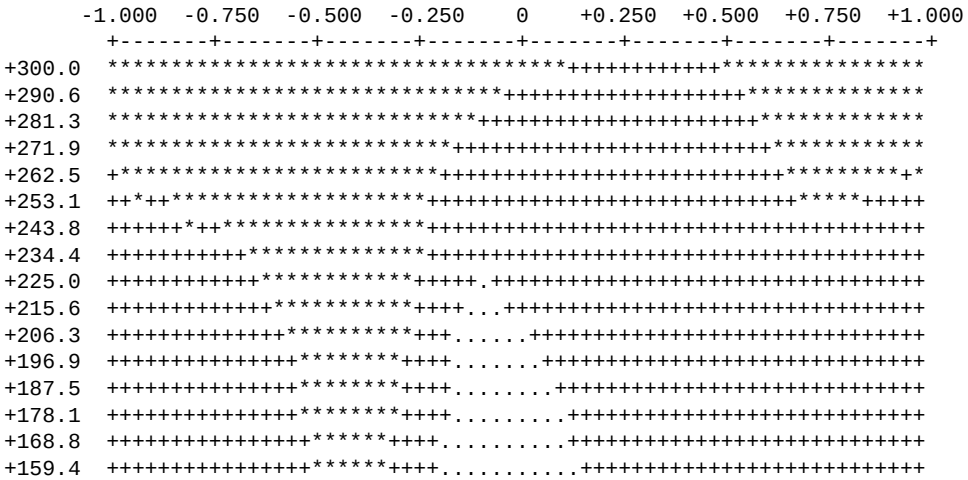


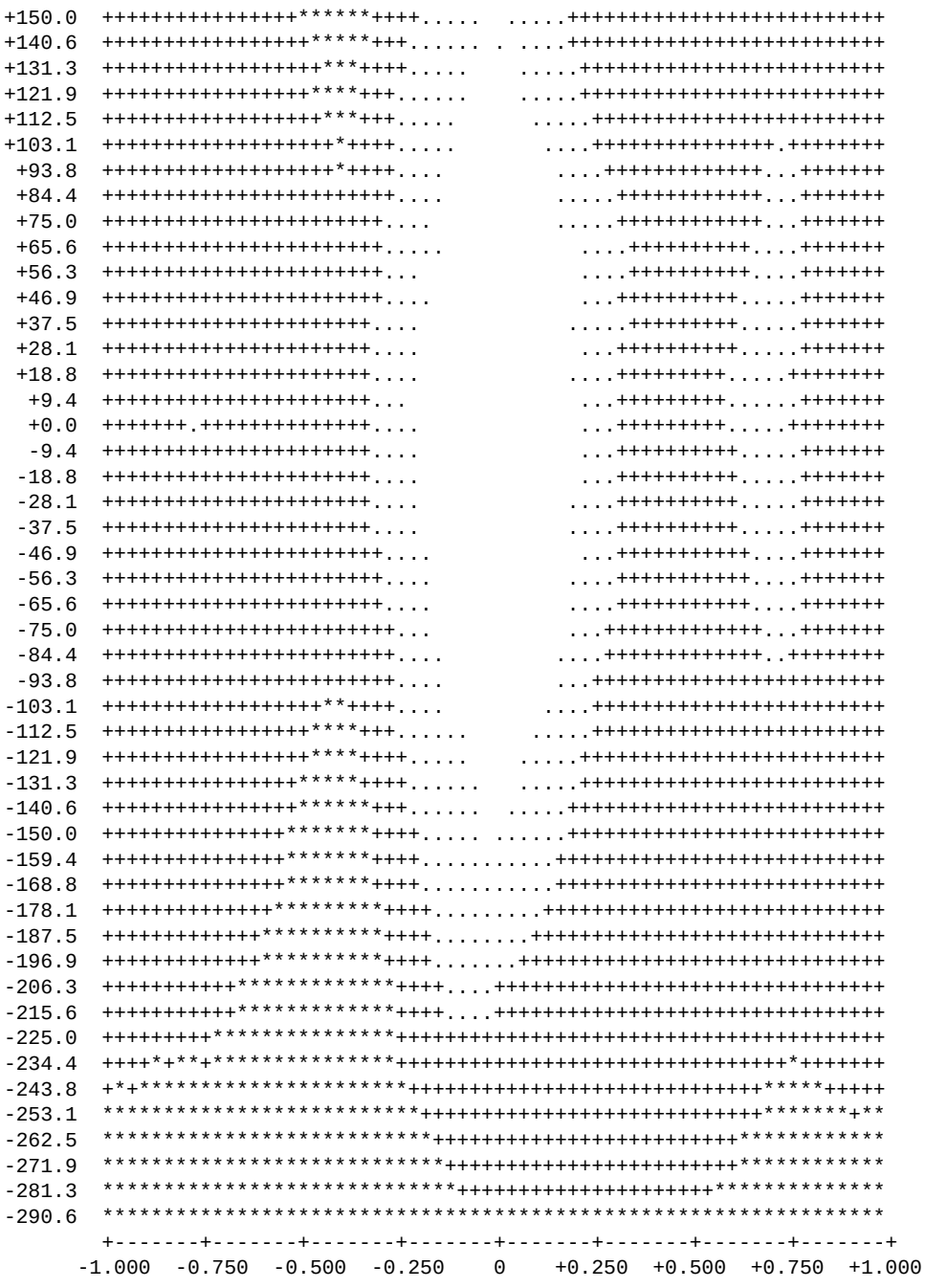
Figure 20. SDD21 Loss Characteristic of Example Test Case

Results:

- Error count = 0, BER < 1E-13
- Horizontal eye opening (HEO): 0.44UI @ 1.5E-5
- Vertical eye opening (VEO): 190mV @ 1.5E-5
- Eye plot:



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5 Supplemental Documents

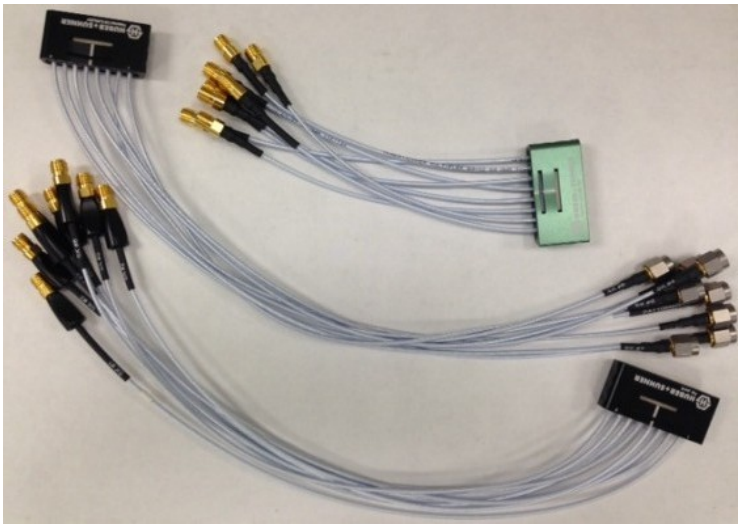
All the EVM design, layout, and other files which are relevant to this EVM are listed below:

FILE DESCRIPTION	FILE NAME
Schematic PDF	DS280DF810_MW_Rev3-01-23-2015.pdf
Board layout file	DS280XX810_EVM_BRD_REVC_15-0024_PCB_030615-1.brd
Board Gerbers	DS280XX810_EVM_BRD_REVC_15-0024_GBR_031915-1.zip
Board s-parameters folder	EVM/s_parameters/

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6 EVM Cable Assemblies

The DS250DF810EVM uses Huber+Suhner 1x8 MXP cable assemblies.



To inquire about purchasing cable assemblies from Huber+Suhner, contact:

Info.us@hubersuhner.com

HUBER+SUHNER Inc.

8530 Steele Creek Place Drive, Suite H

Charlotte-NC- 28273

+1 704-790-7300

There are three part numbers that TI suggests using with this EVM:

1. 85014420, MF53/1x8A_21MXP/21SMA/152: “MXP-15 cable assembly”. This is a lower cost cable assembly compared to the MXP-40, but the SI performance is very good and more than adequate for 25Gbps operation.
2. 84099607, MF53/1x8A_21MXP/11SK/305: “MXP-40 cable assembly”. This cable assembly is designed specifically for 40+ GHz. It features a male cable end and longer cable length options.
3. 84098900, MF53/1x8A_21MXP/21SK_ergo/305: “MXP-40 cable assembly”. This cable assembly is designed specifically for 40+ GHz. It features a female cable end and longer cable length options.

Huber+Suhner brochure available here.

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Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (October 2015) to C Revision	Page
• Initial Public Release	3

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NOTE:

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3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

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4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

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