EVM User's Guide: DS560MB410
DS560MB410EVM

ABSTRACT

The DS560MB410 is a 4-channel linear redriver with the ability to extend the reach and robustness of high-speed serial links for up to 56 Gbps PAM4 interfaces. The DS560MB410EVM evaluation board (hereafter referred to as DS560MB410EVM) provides users with the ability to evaluate the performance and features of the DS560MB410 device.

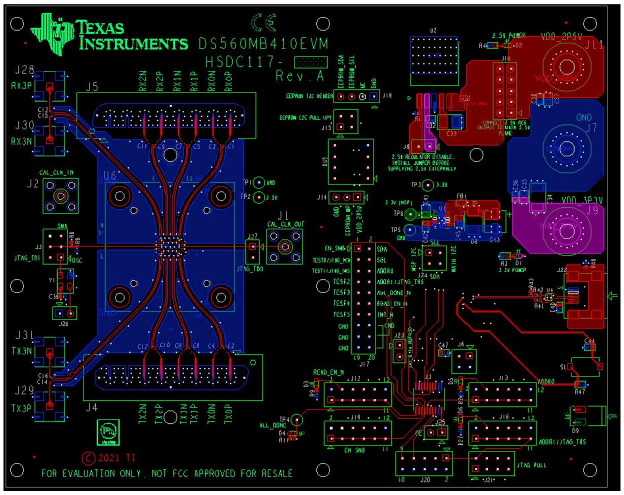

Figure 1-1. DS560MB410EVM

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Trademarks

All trademarks are the property of their respective owners.

1 Features

- 4-channel unidirectional redriver operating at rates up to 32 Gbps NRZ and 56 Gbps PAM4
- 3 channels are available through an H+S 1×8 MXP Cable and 1 channel is available through a 2.92 mm SMA
- Linear equalization supports link training protocols
- Programmed by on-board USB-to-I2C circuit (USB2ANY)
- Single supply operation: 2.5 V ± 5% supplied directly to IC
  - 3.3 V ± 5% supplied to 3.3 V-to-2.5 V on-board LDO

2 Applications

- Backplane or Mid-plane reach extension (200G-KR4)
- SFP28, QSFP28, CFP2/CFP4, and CDFP

3 Ordering Information

Table 3-1. DS560MB410 Ordering Information

EVM ID	DEVICE ID	DEVICE PACKAGE
DS560MB410EVM	DS560MB410	nfBGA (101)

Note

Huber+Suhner MXP cable assembles are not provided with this EVM. Users are expected to provide cabling to connect to other boards and test equipment. For MXP cabling recommendations, refer to Section 8.

4 Setup

This section describes the jumpers and connectors on the EVM as well as how to connect, set up, and use the DS560MB410EVM.

4.1 Modes of Programmable Communication

The DS560MB410EVM can be programmed in one of two modes, which are as follows:

1. **SMBus target mode** – provides full access to the DS560MB410 status and control settings through the on-board USB2ANY. ADDR0 (J6) and ADDR1 (J11) headers are used to set the SMBus target address.
2. **Controller mode** – provides access to the DS560MB410's EEPROM-programmable control settings through an 8-pin EEPROM. A subset of SMBus register bits are writeable through the EEPROM. The EEPROM can program up to 16 DS560MB410 devices.

For convenient use, a USB-to-mini USB cable provides a direct connection through the J27.

4.2 Configuration Overview

The following tables provide a description of the connectors on the DS560MB410EVM.

Table 4-1. Description of SMBus and EEPROM Connections

COMPONENT(S)	NETS INCLUDED	DESCRIPTION
J4	RXN2, RXP2, RXN1, RXP1, RXN0, RXP0	MXP high-speed differential input pairs
J5	TXP0, TXN0, TXP1, TXN1, TXP2, TXN2	MXP high-speed differential output pairs
J28, J30	RX3P, RX3N	Channel 3 high-speed differential inputs SMAs
J29, J31	TX3P, TX3N	Channel 3 high-speed differential outputs SMAs
J18	SDA, SCL, GND	I2C/SMBus data, clock, and GND pins
J13	ADDR0	4-level strap pins used to set the SMBus address
J16	ADDR1	
J19	EN_SMB	4-level input to select between SMBus controller (float) or target mode (high)

Table 4-1. Description of SMBus and EEPROM Connections (continued)

COMPONENT(S)	NETS INCLUDED	DESCRIPTION
J12	READ_EN_N	Assert low to initiate EEPROM read in SMBus controller mode (weak pull-up)
XU1	EEPROM	8-pin DIP Socket for EEPROM
J2	CAL_CLK_IN	External 25 MHz Calibration Clock Input (for pin-compatible Retimer only)
J1	CAL_CLK_OUT	25 MHz Calibration Clock Output (for pin compatible Retimer only)
J9	VDD_3P3V	3.3 V for DC Power
J11	VDD_2P5V	2.5 V for DC Power
J7	GND	Ground for DC Power
J22	USB	Mini USB connection for EVM software control

Table 4-2. Test Point Connections (Output Voltage)

Component	Name	Description
TP1	GND	Common Ground
TP2	VDD	+2.5 V Input
TP5	GND	Ground
TP3	VDD	+3.3 V Input

5 SigCon Architect

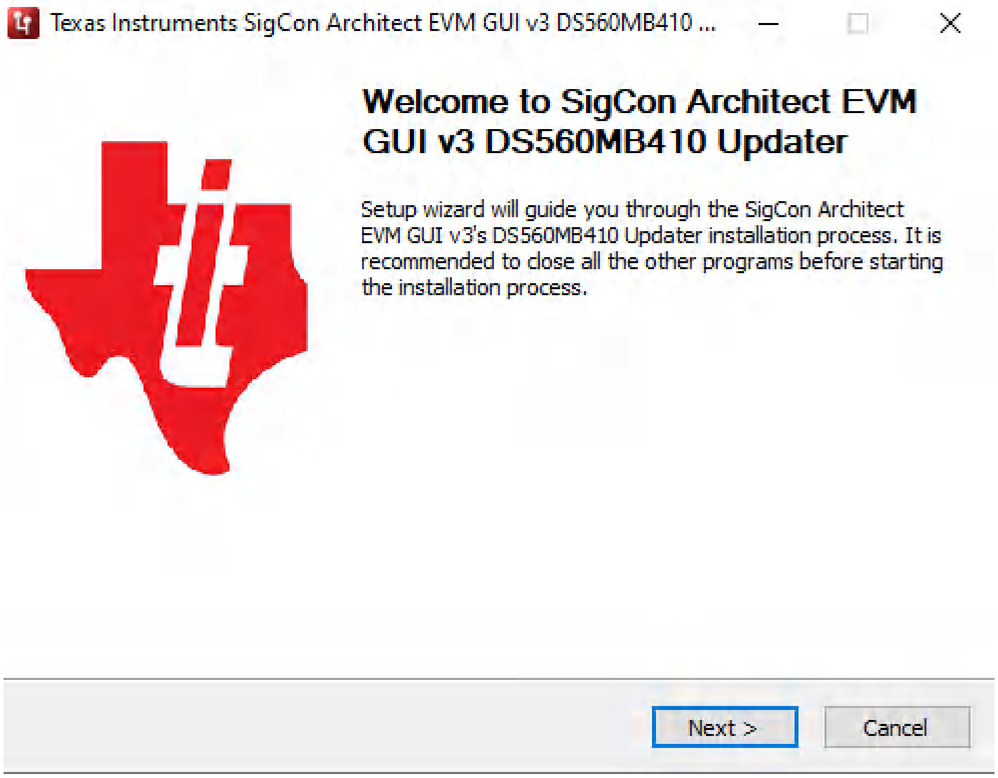
The SigCon Architect software allows for simple configuration of the DS560MB410.

5.1 Installation

Prerequisites:

- SigCon Architect 3.0

1. Use your web browser to download the DS560MB410 SigCon Architect profile installer from the product page on TI.com.
2. Once the installer has downloaded, extract the installer from the .zip file and run the executable file.
3. When the executable runs, a setup wizard will appear as shown in Figure 5-1. It is recommended to close any running programs prior to proceeding.

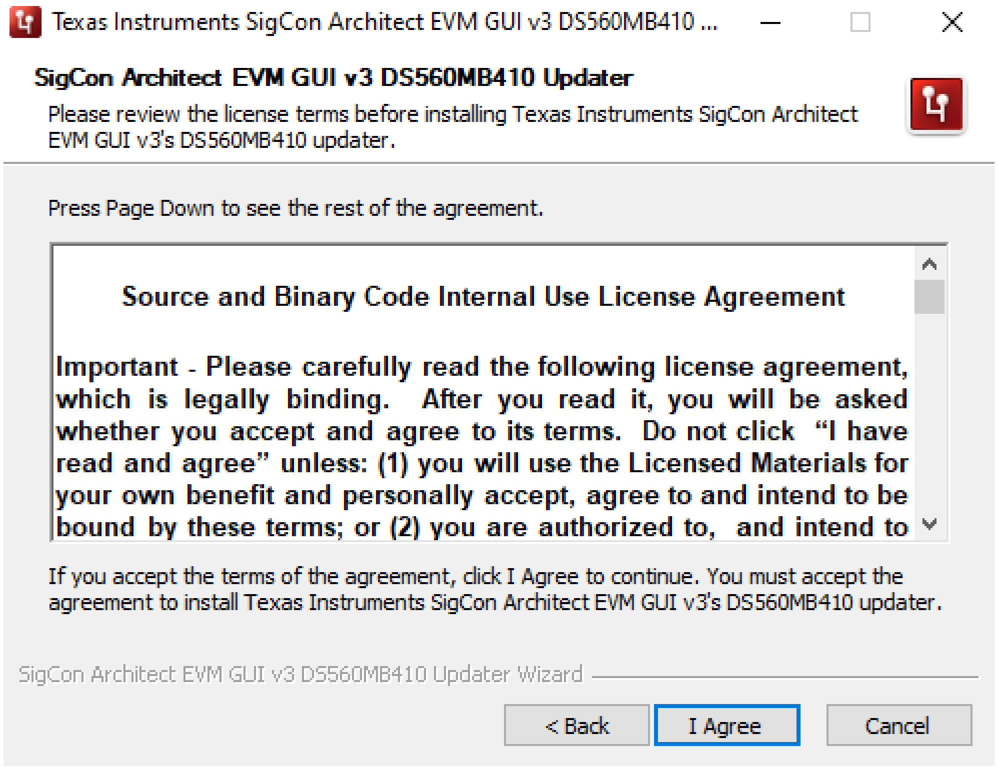


Welcome to SigCon Architect EVM GUI v3 DS560MB410 Updater

Setup wizard will guide you through the SigCon Architect EVM GUI v3's DS560MB410 Updater installation process. It is recommended to close all the other programs before starting the installation process.

Figure 5-1. DS560MB410 Profile Installer

4. Read through the licensing agreement, and accept the terms of the agreement by selecting **I Agree**.



SigCon Architect EVM GUI v3 DS560MB410 Updater

Please review the license terms before installing Texas Instruments SigCon Architect EVM GUI v3's DS560MB410 updater.

Press Page Down to see the rest of the agreement.

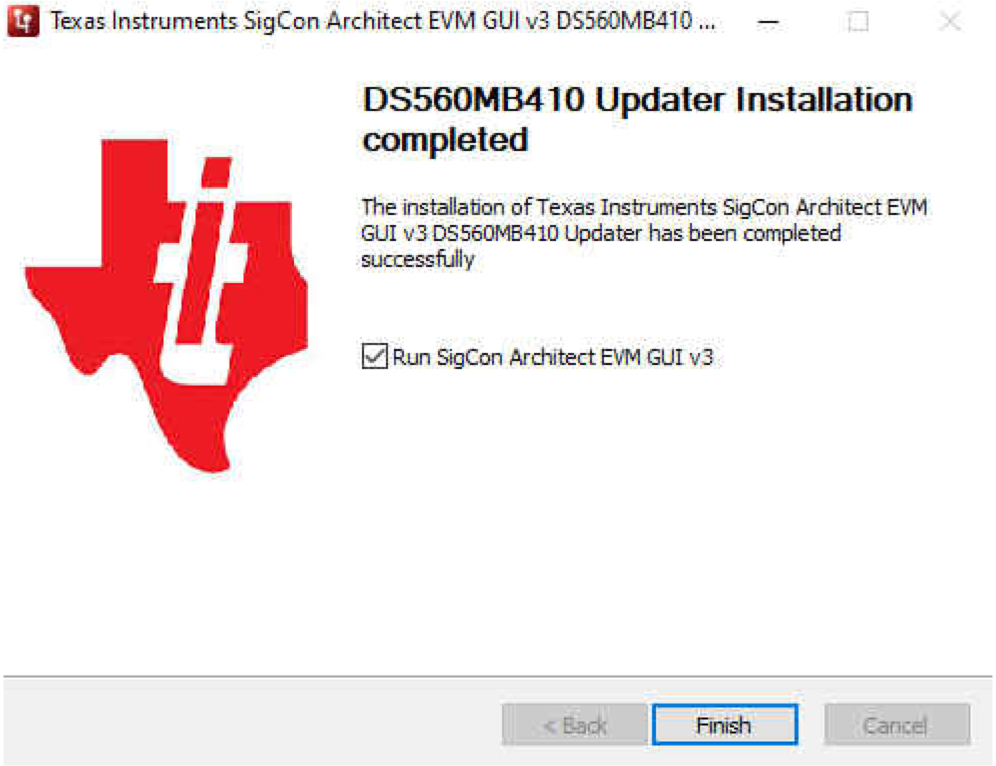
Source and Binary Code Internal Use License Agreement

Important - Please carefully read the following license agreement, which is legally binding. After you read it, you will be asked whether you accept and agree to its terms. Do not click "I have read and agree" unless: (1) you will use the Licensed Materials for your own benefit and personally accept, agree to and intend to be bound by these terms; or (2) you are authorized to, and intend to

If you accept the terms of the agreement, click I Agree to continue. You must accept the agreement to install Texas Instruments SigCon Architect EVM GUI v3's DS560MB410 updater.

Figure 5-2. DS560MB410 Profile License Agreement

5. When complete, the user will be presented with an *Installation completed* window, shown in Figure 5-3. Press **Finish** to continue. If **Run SigCon Architect EVM GUI v3** is selected, then SigCon Architect 3.0 will open.



Texas Instruments SigCon Architect EVM GUI v3 DS560MB410 ...

DS560MB410 Updater Installation completed

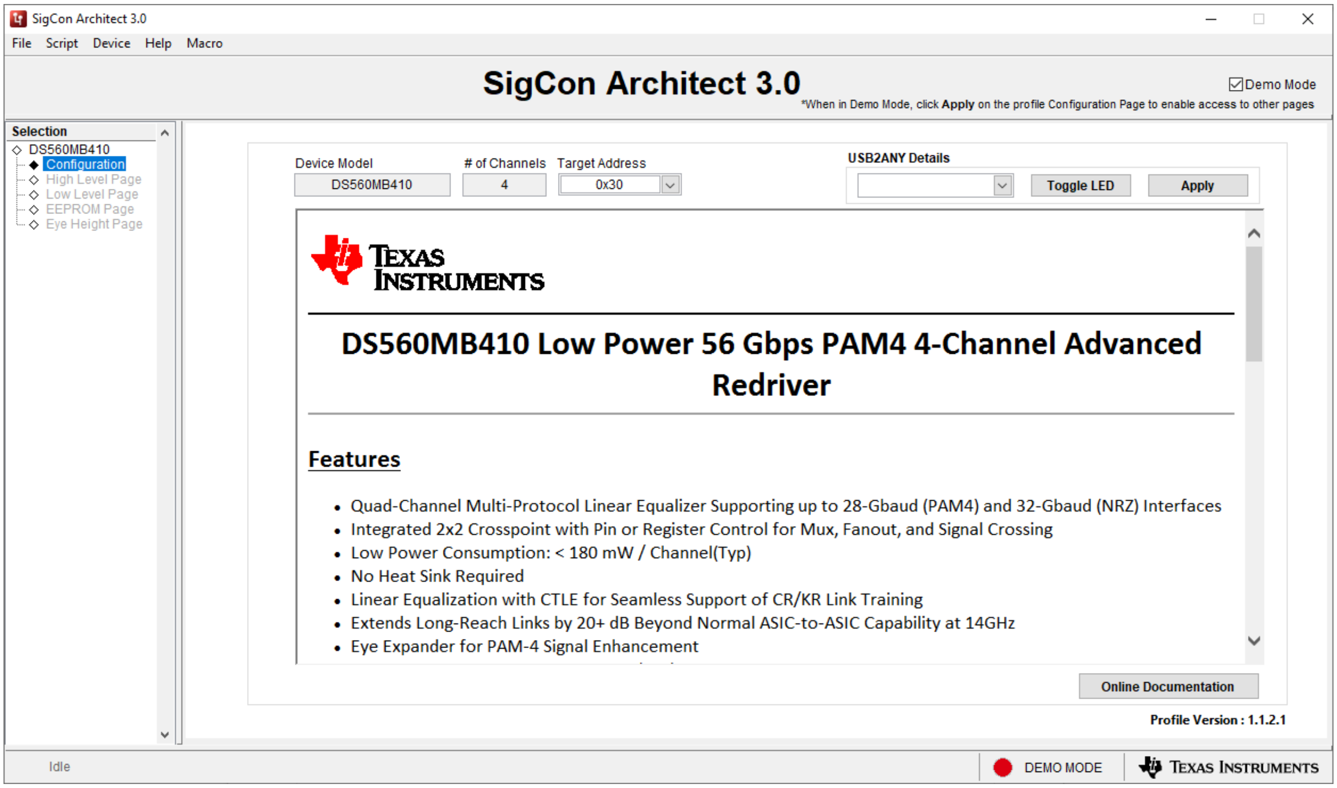
The installation of Texas Instruments SigCon Architect EVM GUI v3 DS560MB410 Updater has been completed successfully

☑ Run SigCon Architect EVM GUI v3

Figure 5-3. DS560MB410 Profile Installation Complete

5.2 Configuration

The *Configuration Page* is used for establishing communication with the DS560MB410. Figure 5-4 shows how prior to establishing a connection with the DS560MB410, the other profile pages will be unselectable, indicated by their gray color.



*When in Demo Mode, click **Apply** on the profile Configuration Page to enable access to other pages

Device Model: DS560MB410
# of Channels: 4
Target Address: 0x30

DS560MB410 Low Power 56 Gbps PAM4 4-Channel Advanced Redriver

Features

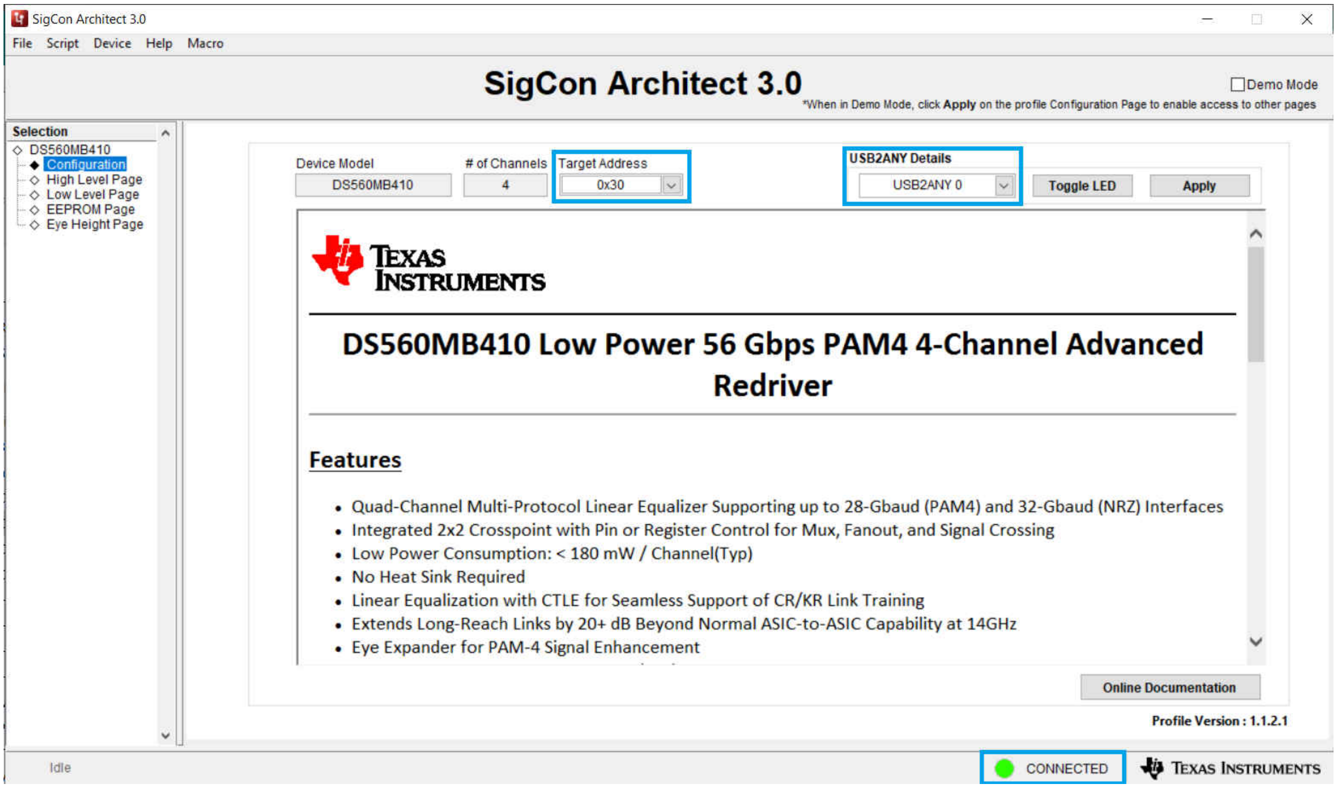
- Quad-Channel Multi-Protocol Linear Equalizer Supporting up to 28-Gbaud (PAM4) and 32-Gbaud (NRZ) Interfaces
- Integrated 2x2 Crosspoint with Pin or Register Control for Mux, Fanout, and Signal Crossing
- Low Power Consumption: < 180 mW / Channel(Typ)
- No Heat Sink Required
- Linear Equalization with CTLE for Seamless Support of CR/KR Link Training
- Extends Long-Reach Links by 20+ dB Beyond Normal ASIC-to-ASIC Capability at 14GHz
- Eye Expander for PAM-4 Signal Enhancement

Profile Version : 1.1.2.1

Figure 5-4. DS560MB410 Profile Prior to Establishing Communication

5.2.1 Establishing a Connection

1. Connect the computer to the DS560MB410 through a USB2ANY device and USB cable. If using a DS560MB410EVM, then this is accomplished by connecting the included USB cable to the EVM and computer. If using a stand alone USB2ANY device, then a connection can be made between the I2C pins on the USB2ANY and the SMBus pins on the DS560MB410. A common ground connection is also required.
2. Ensure the DS560MB410 is in SMBus Target mode.
3. Select appropriate SMBus address by using the *Target Address* menu.
4. Select appropriate USB2ANY by using the *USB2ANY Details* menu.
5. Click *Apply* to connect to the device. The status indicator at the bottom of SigCon Architect will turn green to indicate a successful connection.



*When in Demo Mode, click **Apply** on the profile Configuration Page to enable access to other pages

Device Model: DS560MB410
# of Channels: 4
Target Address: 0x30
USB2ANY Details: USB2ANY 0

DS560MB410 Low Power 56 Gbps PAM4 4-Channel Advanced Redriver

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- Eye Expander for PAM-4 Signal Enhancement

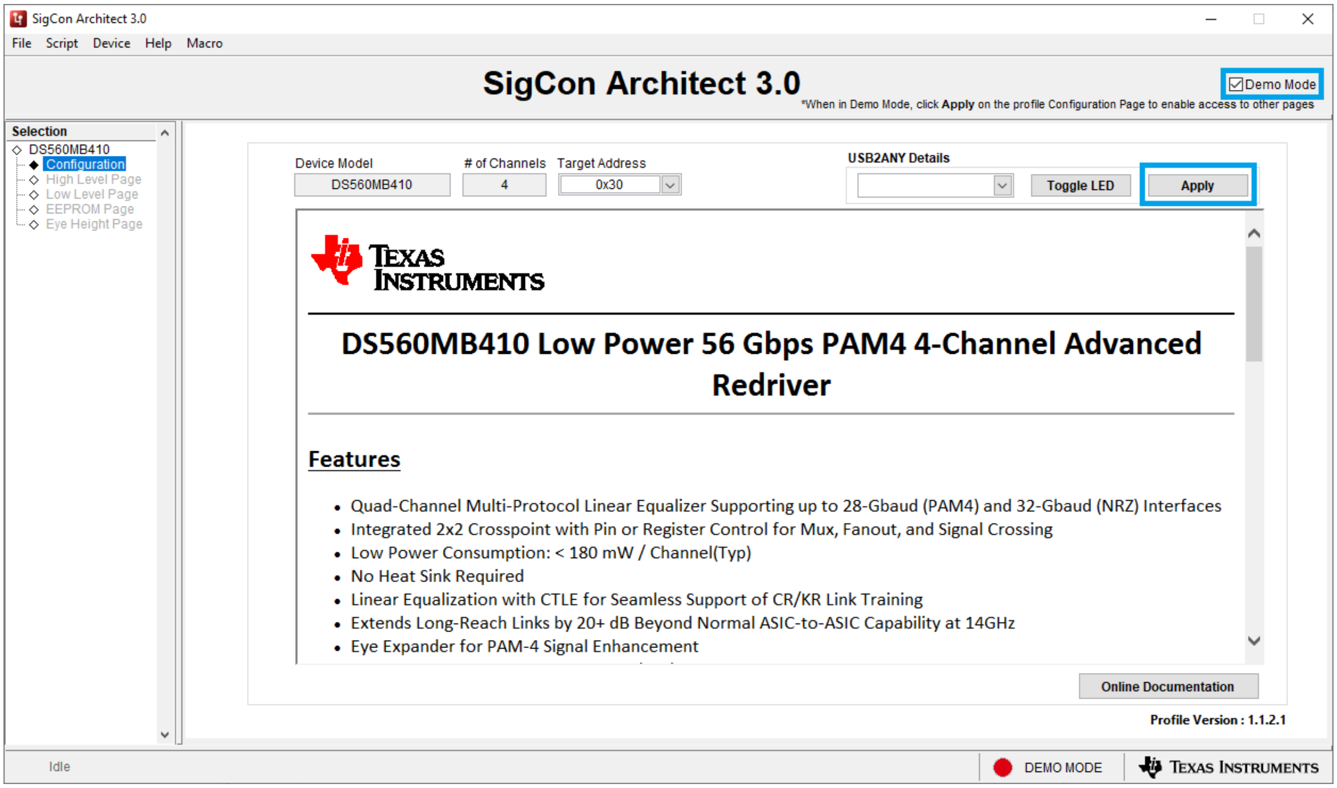
Profile Version : 1.1.2.1

Figure 5-5. Establishing a Connection with the DS560MB410

5.2.2 Enabling Demo Mode

Demo mode can be used to test out device behavior of the DS560MB410 profile without connecting a DS560MB410.

1. Select the checkbox by *Demo Mode* in the top right corner of SigCon Architect.
2. Click the *Apply* button to enter Demo Mode.



*When in Demo Mode, click **Apply** on the profile Configuration Page to enable access to other pages

Device Model: DS560MB410
# of Channels: 4
Target Address: 0x30

DS560MB410 Low Power 56 Gbps PAM4 4-Channel Advanced Redriver

Features

- Quad-Channel Multi-Protocol Linear Equalizer Supporting up to 28-Gbaud (PAM4) and 32-Gbaud (NRZ) Interfaces
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- No Heat Sink Required
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- Extends Long-Reach Links by 20+ dB Beyond Normal ASIC-to-ASIC Capability at 14GHz
- Eye Expander for PAM-4 Signal Enhancement

Profile Version : 1.1.2.1

Figure 5-6. Enabling Demo Mode

5.3 High Level Page

The *High Level Page* is used to view channel status and configure commonly used channel settings. The majority of device settings used in a typical use case can be configured through the *High Level Page*. Additional device settings can be accessed through the *Low Level Page*.

5.3.1 Device Status

The *Device Status* tab shows a high level overview of the status of each channel in the DS560MB410. Although a summary of channel settings can be viewed from this this tab, they cannot be changed from this tab. Channel settings that are displayed in this tab can be changed from the *Block Diagram* tab.

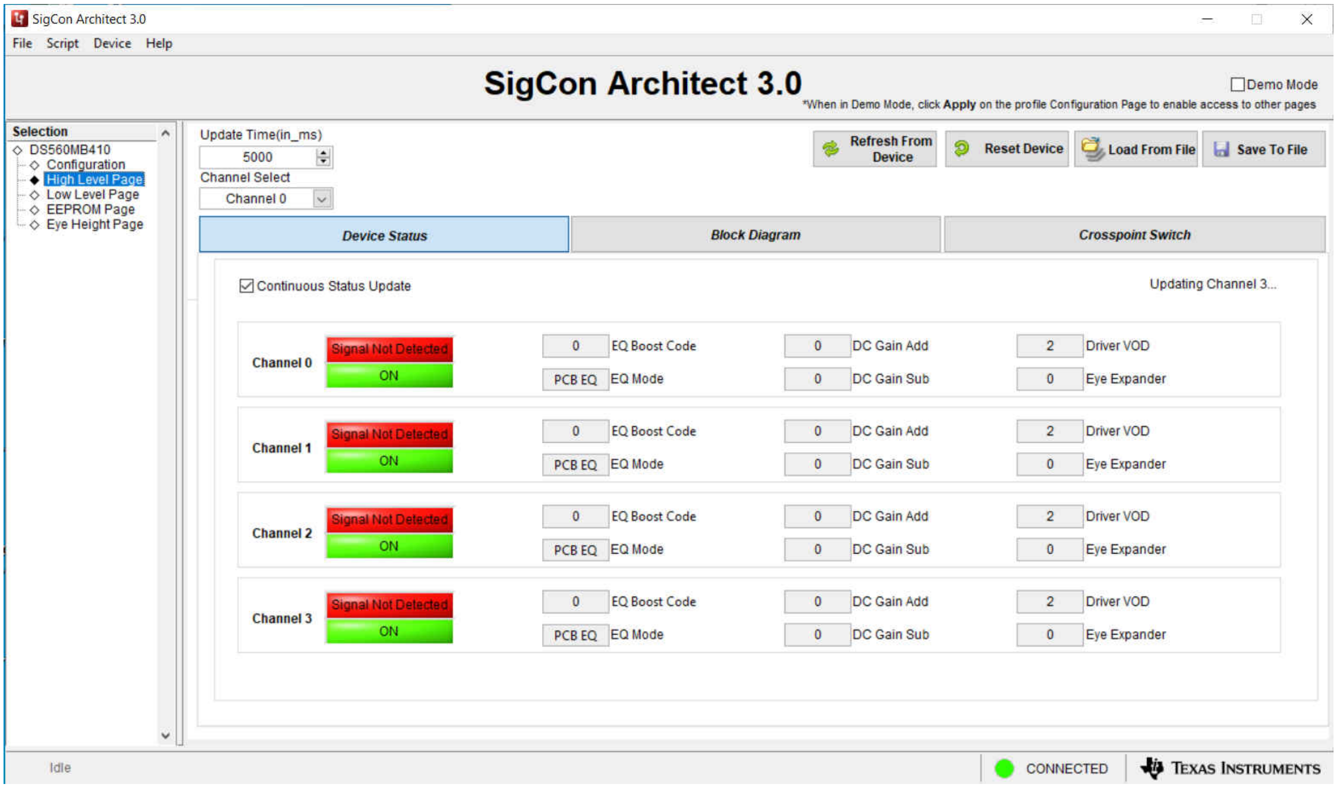


Figure 5-7. Device Status Tab

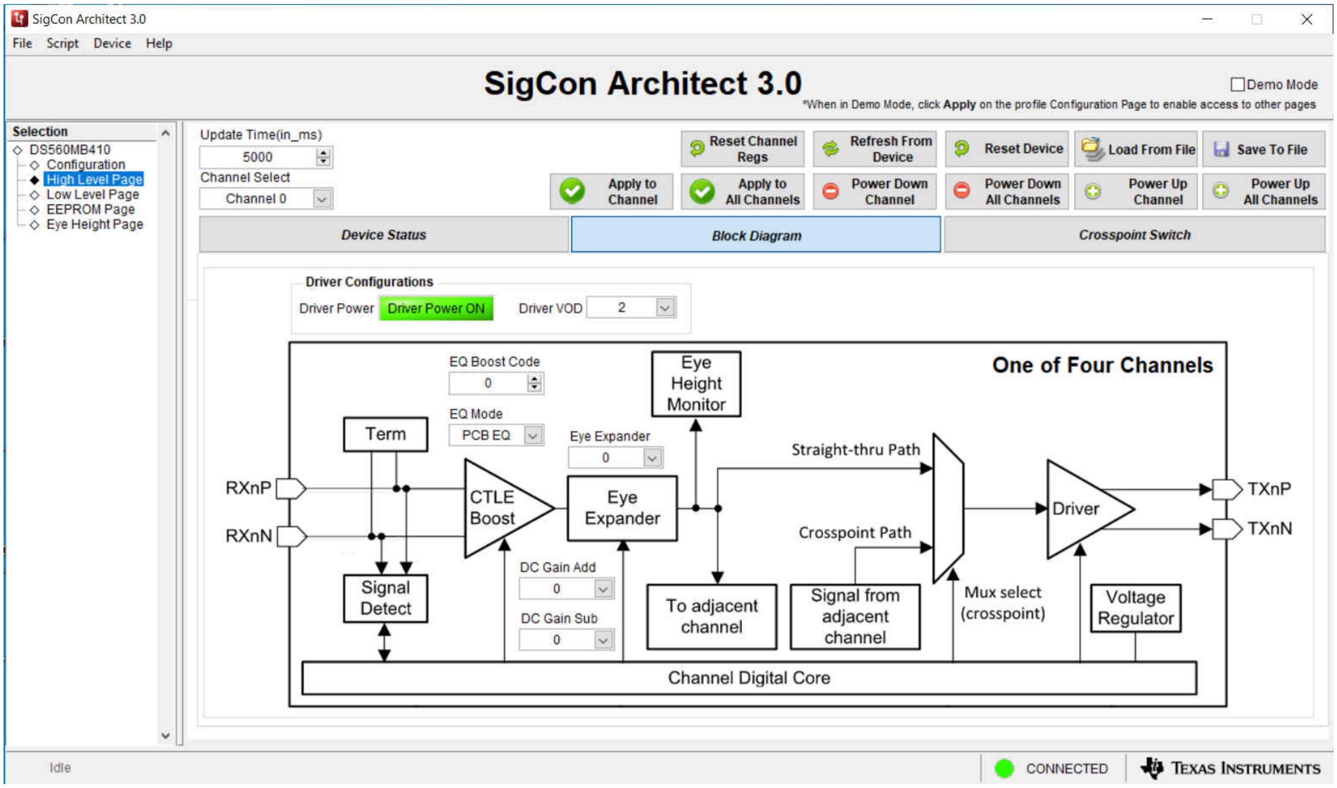
Table 5-1. Device Status Settings and Buttons

Seting or Button Name	Behavior
Update Time	Sets the time interval at which the device status is updated. This is only in use while *Continuous Status Update* is checked.
Channel Select	This setting is persistent when switching between the *Device Status*, *Block Diagram*, and *Crosspoint Switch* tabs. This selection is only used in the *Block Diagram* tab.
Refresh From Device	Reads register data from the device. This data will then be updated in the DS560MB410 Profile pages.
Reset Device	Resets all device registers to their default values.
Load From File	Opens a window allowing the user to select a file with register data. Once the appropriate file is selected, register data from the file will be written to device registers.
Save To File	Opens a window enabling the user to save device register data to their computer. This file contains data for all of the device registers.
Continuous Status Update	When checked, the registers from the device will be polled at the rate set by the *Update Time* setting.

5.3.2 Block Diagram

The *Block Diagram* tab allows for configuration of channel registers that are pertinent to most use cases. Each parameter can easily be adjusted by selecting the appropriate value from the drop down menus

It is important to select the appropriate channel through the *Channel Select* drop down menu in the top left prior to adjusting the channel settings. Unapplied changes will not be saved when the channel is changed. To apply changes, click *Apply to Channel*. To apply changes to all channels, click *Apply to All Channels*.



*When in Demo Mode, click **Apply** on the profile Configuration Page to enable access to other pages

Update Time(in_ms) 5000

Channel Select Channel 0

Driver Power Driver Power ON

Driver VOD 2

EQ Boost Code 0

EQ Mode PCB EQ

Eye Expander 0

DC Gain Add 0

DC Gain Sub 0

Idle

CONNECTED

Figure 5-8. Block Diagram Tab

Table 5-2. Block Diagram Settings and Buttons

Seting or Button Name	Behavior
Update Time	Sets the time interval at which the device status is updated.
Channel Select	This setting is persistent when switching between the *Device Status*, *Block Diagram*, and *Crosspoint Switch* tabs. This setting is used to select which channel will be written to when *Apply to Channel* is clicked.
Refresh From Device	Reads register data from the device. This data will then be updated in the DS560MB410 Profile pages.
Reset Device	Resets all device registers to their default values.
Load From File	Opens a window allowing the user to select a file with register data. Once the appropriate file is selected, register data from the file will be written to device registers.
Save To File	Opens a window enabling the user to save device register data to their computer. This file contains data for all of the device registers.
Apply to Channel	Applies channel settings to the channel selected by the *Channel Select* setting.
Apply to All Channels	Applies channel settings to all device channels.
Power Down Channel	Powers down channel that is currently selected by the *Channel Select*" setting. Corresponds to channel register 0x04[6] and 0x04[3].
Power Down All Channels	Powers down all channels. Corresponds to channel register 0x04[6] and 0x04[3].
Power Up Channel	Powers up channel that is currently selected by the *Channel Select*" setting. Corresponds to channel register 0x04[6] and 0x04[3].
Power Up All Channels	Powers up all channels. Corresponds to channel register 0x04[6] and 0x04[3].
Driver VOD	Sets the differential output voltage (VOD) for the selected channel. Select from 0-3. Corresponds to channel register 0x06[7:6].
EQ Boost Code	Enables compensation for insertion loss. Select from 0-30. Corresponds to channel register 0x10[5:0].
EQ Mode	Enables selection of different equalization profiles depending on device use case. Select either *PCB EQ* or *Cable EQ*. Corresponds to channel register 0x04[0].

Table 5-2. Block Diagram Settings and Buttons (continued)

Seting or Button Name	Behavior
Eye Expander	Adjusts linearity of equalization to better tune for PAM4. Select from 0-3. Corresponds to channel register 0x30[6:5].
DC Gain Add	Adds drive current for tuning PAM4 linearity. Select from 0-1. Corresponds to channel register 0x0B[6].
DC Gain Sub	Subtracts drive current for tuning PAM4 linearity. Select from 0-1. Corresponds to channel register 0x0B[5].

5.3.3 Crosspoint Switch

The *Crosspoint Switch* tab enables configuration of the device crosspoint. The crosspoint allows for channel pairs to be switched between *Through*, *Lane Crossing*, and *Fanout* modes. To make changes in the crosspoint page, *Override MUXSEL[1:0] Pin Control* must be selected. Once overridden, changes made to the crosspoint configuration are automatically applied to the device, without the use of the *Apply to Channel* button.

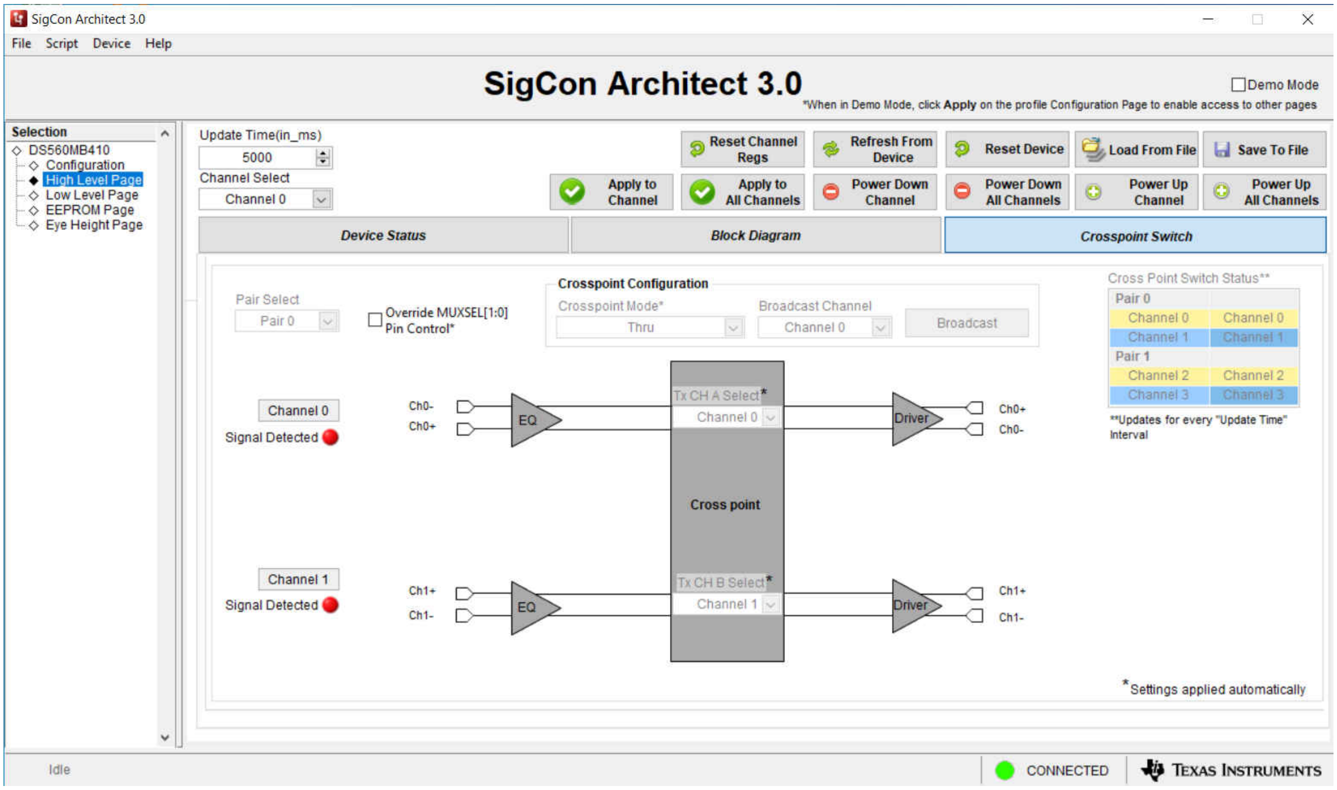


Figure 5-9. Crosspoint Switch Tab

Table 5-3. Crosspoint Switch Settings and Buttons

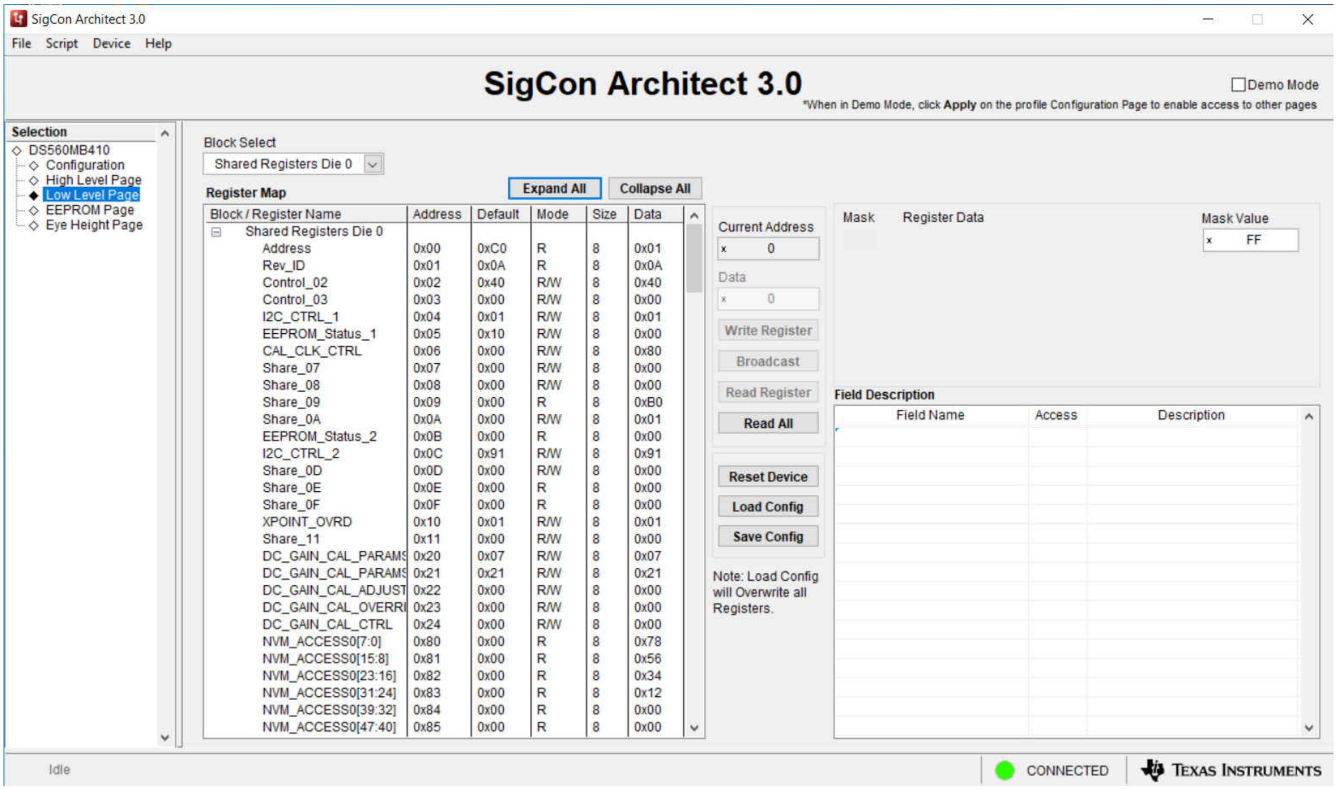
Seting or Button Name	Behavior
Update Time	Sets the time interval at which the device status is updated.
Channel Select	This setting is persistent when switching between the *Device Status*, *Block Diagram*, and *Crosspoint Switch* tabs. This setting is used to select which channel will be written to when *Apply to Channel* is clicked.
Refresh From Device	Reads register data from the device. This data will then be updated in the DS560MB410 Profile pages.
Reset Device	Resets all device registers to their default values.
Load From File	Opens a window allowing the user to select a file with register data. Once the appropriate file is selected, register data from the file will be written to device registers.
Save To File	Opens a window enabling the user to save device register data to their computer. This file contains data for all of the device registers.

Table 5-3. Crosspoint Switch Settings and Buttons (continued)

Seting or Button Name	Behavior
Override MUXSEL[1:0] Pin Control	Enables register control of the device crosspoint. This must be selected to make changes to the crosspoint configuration.
Pair Select	Selects the pair of channels that the *Crosspoint Mode* is applied to. *Pair 0* corresponds to channels 0-1. *Pair 1* corresponds to channels 2-3.
Crosspoint Mode	Selects the crosspoint configuration for the selected channels. User can select between *Through*, *Lane Crossing*, and *Fanout* modes. When the *Fanout* mode is selected, it is necessary to select which channel is being broadcasted.
Broadcast Channel	Selects which channel is broadcasted while a crosspoint is in *Fanout* mode. After a selection is made, it is necessary to click the *Broadcast* button for changes to apply.

5.4 Low Level Page

The *Low Level Page* allows for direct access to the device registers. Different groups of registers can easily be jumped to by selecting a group from the *Block Select* menu.



*When in Demo Mode, click **Apply** on the profile Configuration Page to enable access to other pages

Block Select: Shared Registers Die 0

Current Address: x 0

Data: x 0

Mask Value: x FF

Note: Load Config will Overwrite all Registers.

Block / Register Name	Address	Default	Mode	Size	Data
⊟ Shared Registers Die 0					
Address	0x00	0xC0	R	8	0x01
Rev_ID	0x01	0x0A	R	8	0x0A
Control_02	0x02	0x40	R/W	8	0x40
Control_03	0x03	0x00	R/W	8	0x00
I2C_CTRL_1	0x04	0x01	R/W	8	0x01
EEPROM_Status_1	0x05	0x10	R/W	8	0x00
CAL_CLK_CTRL	0x06	0x00	R/W	8	0x80
Share_07	0x07	0x00	R/W	8	0x00
Share_08	0x08	0x00	R/W	8	0x00
Share_09	0x09	0x00	R	8	0xB0
Share_0A	0x0A	0x00	R/W	8	0x01
EEPROM_Status_2	0x0B	0x00	R	8	0x00
I2C_CTRL_2	0x0C	0x91	R/W	8	0x91
Share_0D	0x0D	0x00	R/W	8	0x00
Share_0E	0x0E	0x00	R	8	0x00
Share_0F	0x0F	0x00	R	8	0x00
XPOINT_OVRD	0x10	0x01	R/W	8	0x01
Share_11	0x11	0x00	R/W	8	0x00
DC_GAIN_CAL_PARAMS	0x20	0x07	R/W	8	0x07
DC_GAIN_CAL_PARAMS	0x21	0x21	R/W	8	0x21
DC_GAIN_CAL_ADJUST	0x22	0x00	R/W	8	0x00
DC_GAIN_CAL_OVERRI	0x23	0x00	R/W	8	0x00
DC_GAIN_CAL_CTRL	0x24	0x00	R/W	8	0x00
NVM_ACCESS0[7:0]	0x80	0x00	R	8	0x78
NVM_ACCESS0[15:8]	0x81	0x00	R	8	0x56
NVM_ACCESS0[23:16]	0x82	0x00	R	8	0x34
NVM_ACCESS0[31:24]	0x83	0x00	R	8	0x12
NVM_ACCESS0[39:32]	0x84	0x00	R	8	0x00
NVM_ACCESS0[47:40]	0x85	0x00	R	8	0x00

Figure 5-10. Low Level Page

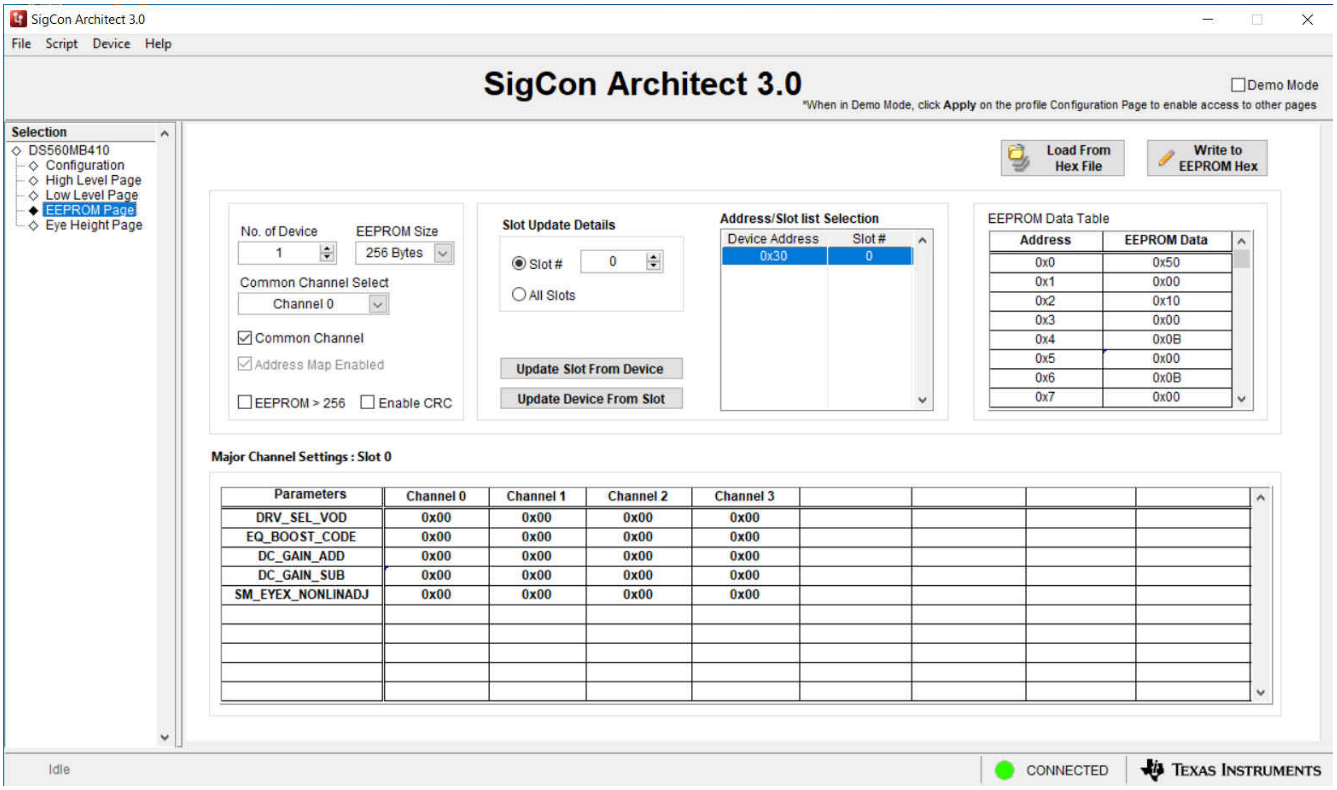
Selecting a register will allow the user to read and write data to the register. This can be done by entering hexadecimal register data into the *Data* input box. Register data can also be changed by selecting different configurations under *Register Data*. After changing register data, it is important to write the data back to the register. This needs to be done prior to selecting another register, otherwise the change will not be persistent. For alterations to the channel registers, it is possible to broadcast a change to all channels by first making changes to the register data and then using the Broadcast button. This will write the register data to the corresponding register of each channel.

5.5 EEPROM Page

The *EEPROM Page* allows for generation and modification of an EEPROM hex file. This file can be loaded onto an EEPROM device and used with the DS560MB410 while the redriver is in Controller mode.

To generate an EEPROM configuration, first configure the DS560MB410 redriver using the *High Level Page* and *Low Level Page*. Then press *Update Slot from Device*. This will update the selected EEPROM slot with the device configuration. Multiple redrivers can have independent configurations in a single EEPROM hex file. Each independent configuration is represented by the *Slot #*. After updating the slot from the device, the EEPROM hex file can be saved by pressing the *Write to EEPROM Hex* button.

A hex file can be loaded and modified using the *EEPROM Page* as well. This can be done by loading the hex file using the *Load from Hex File* button. Then, press *Update Device from Slot* to update the redriver settings from the selected EEPROM hex file. After doing this, modifications can be made using the *High Level Page* and *Low Level Page*. After making modifications, press *Update Slot from Device* to update the selected EEPROM slot with the modified device configuration. The EEPROM hex file can then be saved using the *Write to EEPROM Hex* button.



*When in Demo Mode, click **Apply** on the profile Configuration Page to enable access to other pages

No. of Device: 1
EEPROM Size: 256 Bytes
Common Channel Select: Channel 0
☑ Common Channel
☑ Address Map Enabled
☐ EEPROM > 256
☐ Enable CRC

Slot Update Details
● Slot # 0
○ All Slots

Address/Slot list Selection

Device Address	Slot #
0x30	0

EEPROM Data Table

Address	EEPROM Data
0x0	0x50
0x1	0x00
0x2	0x10
0x3	0x00
0x4	0x0B
0x5	0x00
0x6	0x0B
0x7	0x00

Major Channel Settings : Slot 0

Parameters	Channel 0	Channel 1	Channel 2	Channel 3
DRV_SEL_VOD	0x00	0x00	0x00	0x00
EQ_BOOST_CODE	0x00	0x00	0x00	0x00
DC_GAIN_ADD	0x00	0x00	0x00	0x00
DC_GAIN_SUB	0x00	0x00	0x00	0x00
SM_EYEX_NONLINADJ	0x00	0x00	0x00	0x00

Figure 5-11. EEPROM Page

5.6 Eye Height Page

The DS560MB410 eye height monitor is an on-chip tool to help determine the ideal CTLE boost index range for NRZ and PAM4 signals. This eye height monitor provides information about the eye height across a range of EQ Boost Codes. For each EQ Boost Code, an internal DAC is swept through 64 steps. At each step, the number of times the signal crosses the DAC voltage in a given time interval is recorded. This is recorded in channel registers 0x22-0x25. The eye openings, shown in white, the on *Eye Height Page* correspond to DAC voltages where the number of crossings did not change much between consecutive DAC values. From this data, an optimum EQ Boost Code is recommended.

☑ Demo Mode

*When in Demo Mode, click **Apply** on the profile Configuration Page to enable access to other pages

Channel Select: Channel 0

Signal Type: PAM4

EQ Boost Code: Start Value 0, End Value 33

DAC Step Size(mV): 1.56 mV

Suggested Optimal Value: 4

☐ Set EQ Boost Code to suggested Optimal Value(within selected range of values)

VEO 1: 18.72 mV

VEO 2: 17.16 mV

VEO 3: 12.48 mV

EQ Boost Code: 0

Eye Expander: 0

DC Gain Add: 0

DC Gain Sub: 0

Idle

Figure 5-12. Eye Height Page

Table 5-4. Eye Height Page Settings and Buttons

Setting or Button Name	Behavior
Channel Select	Selects channel that eye height sweep is performed on.
Signal Type	Selects either PAM4 and NRZ, adjusts the algorithm used to recommend an optimum EQ Boost Code based on selection.
EQ Boost Code	Selects the range of EQ Boost Codes that are swept. Reducing the range will decrease the eye height sweep time.
Apply to All Channels	If "*Set EQ Boost Code …*" option is selected, after a sweep is complete, clicking this button will set EQ Boost Code of all channels to the optimum value based on sweep data.
Apply to Channel	No action in *Eye Height Page.*
Refresh From Device	Reads register data from the device. This data will then be updated in the DS560MB410 Profile pages.
Reset Device	Resets all device registers to their default values.
Load From File	Opens a window allowing the user to select a file with register data. Once the appropriate file is selected, register data from the file will be written to device registers.
Save To File	Opens a window enabling the user to save device register data to their computer. This file contains data for all of the device registers.
DAC Step Size (mV)	Selects the step size of the internal DAC. Effectively sets the vertical eye measurement limit.
Sweep Parameter	Starts sweep of DAC values and EQ Boost Codes to collect eye height data.
Stop Sweep	Stops sweep.
Set EQ Boost Code to suggested Optimal Value	If selected, then after a sweep completes, the optimal EQ Boost Code will be written to the currently selected channel.
Recompute VEO	Recomputes VEO based on data and *Signal Type*.
Export Processed Data	Exports processed data to excel.
Export Raw Hit Data	Exports raw hit data to excel.
Clear Plot	Clears plot.

6 Common Problems and Suggested Solutions

PROBLEM	ADDITIONAL INFORMATION	POSSIBLE SOLUTIONS
Cannot power on the EVM	2.5 Volt Power mode D2 LED is off	• J8: jumper pins 1-2 tied. • J10: jumper pins should be set to float. • Verify configuration with GUI.
	3.3 Volt Power mode D1 LED is off	• J8: remove jumper shunt; this shunt needs to be removed to enable 2.5 V regulator. • J10: jumper pins 9-10, 7-8, 5-6, 3-4, and 1-2 tied to connect the regulator output to the DS560MB410 VDD supply.
Cannot connect to the device in SMBus Target Mode	SigCon Architect is operating in Demo Mode	• Verify the jumper settings are correct.
		• Verify the target address is set to 0x30 for SMBus target mode.
		• Verify the device is powered on.
		• Update Firmware on EVM using *USB2ANY Explorer*.
	Never used SigCon Architect, and cannot establish connection with device	• Reinstall SigCon Architect. It is essential SigCon Architect is closed during any portion of the installation process.
Oscilloscope's Eye Diagram is not as expected	Pattern does not lock on oscilloscope	• Transmit a signal from the pattern generator (for example, BERT) with a different PRBS pattern. Once initial pattern lock is established, re-attempt desired pattern.
		• Transmit a signal from the pattern generator (for example, BERT) with a lower frequency. Once initial pattern lock is established, re-attempt desired frequency.
	Eye diagram does not pass mask	• Vary EQ Boost Settings.
Cannot burn EEPROM Hex File to EEPROM with SigCon Architect		• SigCon Architect can only be used to generate the Hex File. Another interface adapter must be used to burn the Hex File to the EEPROM. (for example, AARDVARK or equivalent).

7 Bill of Materials

The following table represents the bill of materials (BOM) for the DS560MB410EVM.

#	QUANTITY	REFERENCE	VALUE	PART NUMBER	DESCRIPTION
1	16	C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16	0.22 µF	GRM033R60J224ME90	CAP, CERM, 0.22 µF, 6.3 V, ± 20%, X5R, 0201
2	1	C17	0.1 µF	GCM155R71C104KA55D	CAP, CERM, 0.1 µF, 16 V, ± 10%, X7R, 0402
3	1	C24	1 µF	CL03A105MP3NSNC	CAP CER 1 µF 10 V 20% X5R 0201
4	6	C25, C26, C27, C29, C30, C31	0.1 µF	GRM033R6YA104KE14D	CAP CER 0.1 µF 35 V 10% X5R 0201
5	1	C28	10 µF	CL05A106MP5NUNC	CAP, CERM, 10 µF, 10 V, ± 20%, X5R, 0402
6	1	C32	1 µF	C1608X7R1E105K080AB	CAP, CERM, 1 µF, 25 V, ± 10%, X7R, 0603
7	1	C33	47 µF	GRM32ER71A476KE15L	CAP, CERM, 47 µF, 10 V, ± 10%, X7R, 1210
8	1	C34	22 µF	T495C226K010ATE300	CAP, TA, 22 µF, 10 V, ± 10%, 0.3 Ω, SMD
9	1	C35	10 µF	GRM21BR61E106KA73L	CAP, CERM, 10 µF, 25 V, ± 10%, X5R, 0805_140
10	2	C36, C38	1 µF	GRM188R61E105KA12D	CAP, CERM, 1 µF, 25 V, ± 10%, X5R, 0603
11	1	C37	10 µF	GRM21BR71A106KE51L	CAP, CERM, 10 µF, 10 V, ± 10%, X7R, 0805
12	1	C39	0.1 µF	C1005X7R1H104K050BB	CAP, CERM, 0.1 µF, 50 V, ± 10%, X7R, 0402
13	4	C40, C47, C52, C53	0.1 µF	0603YC104JAT2A	CAP, CERM, 0.1 µF, 16 V, ±5%, X7R, 0603
14	1	C41	2.2 µF	0805YD225KAT2A	CAP, CERM, 2.2 µF, 16 V, ±10%, X5R, 0805
15	1	C42	0.01 µF	C1608X7R1H103K080AA	CAP, CERM, 0.01 µF, 50 V, ±10%, X7R, 0603

#	QUANTITY	REFERENCE	VALUE	PART NUMBER	DESCRIPTION
16	1	C43	22 µF	EEE-1AA220WR	CAP ALUM 22 µF 10 V 20% SMD
17	2	C44, C46	220 pF	06035A221FAT2A	CAP, CERM, 220 pF, 50 V, ±1%, C0G/NP0, 0603
18	1	C45	1 µF	C2012X7R1C105K125AA	CAP CER 1 µF 16 V 10% X7R 0805
19	2	C48, C49	30 pF	GRM1885C2A300JA01D	CAP, CERM, 30 pF, 100 V, ±5%, C0G/NP0, 0603
20	1	C50	0.47 µF	GRM188R71A474KA61D	CAP, CERM, 0.47 µF, 10 V, ±10%, X7R, 0603
21	1	C51	2200 pF	C0603X222K5RACTU	CAP, CERM, 2200 pF, 50 V, ±10%, X7R, 0603
22	2	D1, D2	Red	LS L29K-G1J2-1-Z	LED, Red, SMD
23	4	D3, D4, D5, D6	Green	APHD1608LCGCK	LED, Green, SMD
24	1	D8	7.5 V	1SMB5922BT3G	Diode, Zener, 7.5 V, 550 mW, SMB
25	1	D9	Green	SSF-LXH305GD-TR	LED, Green, SMD
26	1	FB1	60 Ω	BK1608HS600-T	Ferrite Bead, 60 Ω at 100 MHz, 0.8 A, 0603
27	2	J1, J2	142-0701-201	142-0701-201	Connector, TH, SMA
28	4	J28, J29, J30, J31	0732520091	0732520091	CONN 2.92MM JACK STR 50 Ω SMD
29	1	J3	TSW-103-07-G-D	61300621121	Header, 100mil, 3x2, Gold, TH
30	2	J4, J5	1X8A_81_MXP-S50-0-2/111_NE	1X8A_81_MXP-S50-0-2/111_NE	Straight PCB plug Pin-in-hole/SMT
31	1	J6	TSW-102-07-G-D	61300421121	Header, 100mil, 2x2, Gold, TH
32	1	J7	7007	7007	Binding Post, BLACK, TH
33	1	J8	5-146278-2	5-146278-2	Header, 100mil, 2x1, Tin, TH
34	2	J9, J11	7006	7006	Binding Post, RED, TH
35	1	J10	61301021121	61301021121	Header, 2.54 mm, 5x2, Gold, TH

#	QUANTITY	REFERENCE	VALUE	PART NUMBER	DESCRIPTION
36	4	J12, J13, J16, J19	87227-6	87227-6	Header, 100mil, 6x2, Gold, TH
37	1	J14	61300311121	61300311121	Header, 2.54 mm, 3x1, Gold, TH
38	2	J15, J24	PEC02DAAN	PEC02DAAN	Header, 100mil, 2x2, Tin, TH
39	1	J17	TSW-110-07-G-D	61302021121	Header, 100mil, 10x2, Gold, TH
40	1	J18	61300411121	61300411121	Header, 2.54 mm, 4x1, Gold, TH
41	1	J20	5103308-1	5103308-1	Header (shrouded), 100mil, 5x2, Gold, TH
42	1	J21	TSW-104-07-G-D	61300821121	Header, 100mil, 4x2, Gold, TH
43	1	J22	1734035-2	1734035-2	CONN MINI USB RCPT RA TYPE B SMD
44	3	J23, J25, J26	61300211121	61300211121	Header, 2.54 mm, 2x1, Gold, TH
45	1	J27	TSW-102-07-G-S	61300211121	Header, 100mil, 2x1, Gold, TH
46	1	Q1	50 V	BSS138	MOSFET, N-CH, 50 V, 0.22 A, SOT-23
47	2	R1, R2	10.0k	CRCW040210K0FKED	RES, 10.0 k, 1%, 0.063 W, 0402
48	1	R3	750	RNCP0603FTD750R	RES, 750, 1%, 0.1 W, 0603
49	1	R4	360	RC0603JR-07360RL	RES, 360, 5%, 0.1 W, 0603
50	10	R5, R25, R29, R33, R36, R38, R39, R40, R50, R64	4.7k	CRCW04024K70JNED	RES, 4.7 k, 5%, 0.063 W, 0402
51	2	R6, R8	100	CRCW0402100RFKED	RES, 100, 1%, 0.063 W, 0402
52	14	R7, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63	0	RC0402JR-070RL	RES, 0, 5%, 0.063 W, 0402
53	5	R9, R11, R21, R27, R44	249	CRCW0402249RFKED	RES, 249, 1%, 0.063 W, 0402
54	8	R10, R16, R20, R22, R28, R31, R32, R35	1.0k	CRCW04021K00JNED	RES, 1.0 k, 5%, 0.063 W, 0402

#	QUANTITY	REFERENCE	VALUE	PART NUMBER	DESCRIPTION
55	3	R12, R13, R14	2.7k	CRCW04022K70JNED	RES, 2.7 k, 5%, 0.063 W, 0402
56	1	R15	10k	CRCW040210K0JNED	RES, 10 k, 5%, 0.063 W, 0402
57	5	R17, R18, R19, R24, R26	2.7k	CRCW04022K70JNED	RES, 2.7 k, 5%, 0.063 W, 0402
58	3	R23, R30, R34	20k	CRCW040220K0JNED	RES, 20 k, 5%, 0.063 W, 0402
59	1	R37	10.0k	CRCW060310K0FKEA	RES, 10.0 k, 1%, 0.1 W, 0603
60	2	R41, R42	33	CRCW040233R0JNED	RES, 33 Ω, 5%, 0.063W, 0402
61	1	R43	1.5k	CRCW04021K50JNED	RES, 1.5 kΩ, 5%, 0.063W, 0402
62	1	R45	10k	CRCW060310K0JNEA	RES, 10 k, 5%, 0.1 W, 0603
63	2	R46, R49	33k	CRCW040233K0JNED	RES, 33 kΩ, 5%, 0.063W, 0402
64	1	R47	1.2Meg	CRCW06031M20JNEA	RES, 1.2Meg Ω, 5%, 0.1W, 0603
65	1	R48	200	CRCW0603200RFKEA	RES, 200 Ω, 1%, 0.1W, 0603
66	1	S1	KSR221GLFS	KSR221GLFS	Switch, SMD
67	2	TP1, TP5	Black	5001	TEST POINT PC MINI .040"D BLACK
68	3	TP2, TP3, TP6	Red	5000	TEST POINT PC MINI .040"D RED
69	1	TP4	White	5002	TEST POINT PC MINI .040"D WHITE
70	1	U1	TPS73533DRBR	TPS73533DRBR	C REG LDO 3.3 V 0.5 A 8SON
71	1	U2	TPS75725KTTRG3	TPS75725KTTRG3	IC REG LDO 2.5 V 3 A DDPAK
72	1	U3	TXS0108EPW	TXS0108EPW	IC 8-BIT VOLTAGE-LEVEL TRANSLATOR

#	QUANTITY	REFERENCE	VALUE	PART NUMBER	DESCRIPTION
73	1	U4	TPD4E004DRY	TPD4E004DRY	4-CHANNEL ESD-PROTECTION ARRAY
74	1	U5	MSP430F5529IPN	MSP430F5529IPN	IC MCU 16BIT 128KB FLASH 80LQFP
75	1	U6	DS560MB410ZAS	DS560MB410ZAS	DS560MB410ZAS
76	1	XU1	110-13-308-41-001000	110-13-308-41-001000	Socket, DIP-8, Sleeve Pin, 2.54 mm Pitch
77	1	Y1	7C-25.000MCB-T	7C-25.000MCB-T	XO, 25.000 MHz, 2.5V, SMD
78	1	Y2	ECS-240-20-5PX-TR	ECS-240-20-5PX-TR	Crystal, 24.000 MHz, 20 pF, SMD
79	9	Shunts	STC02SYAN	STC02SYAN	Shunt Placement: J15 (1:2 & 3:4) J24 (1:2 & 3:4) J12 (5:6) J13 (9:10) J16 (9:10) J19 (5:6) J10 (1:2)
80	4	Standoffs	1902C	1902C	HEX STANDOFF #4-40 NYLON 1/2"
81	4	Screws	NY PMS 440 0025 PH	NY PMS 440 0025 PH	MACHINE SCREW PAN PHILLIPS 4-40
82	1	DS560MB410EVM_RevB_PCB			

8 EVM Cable Assemblies

The DS560MB410EVM uses Huber+Suhner 1x8 MXP cable assemblies.

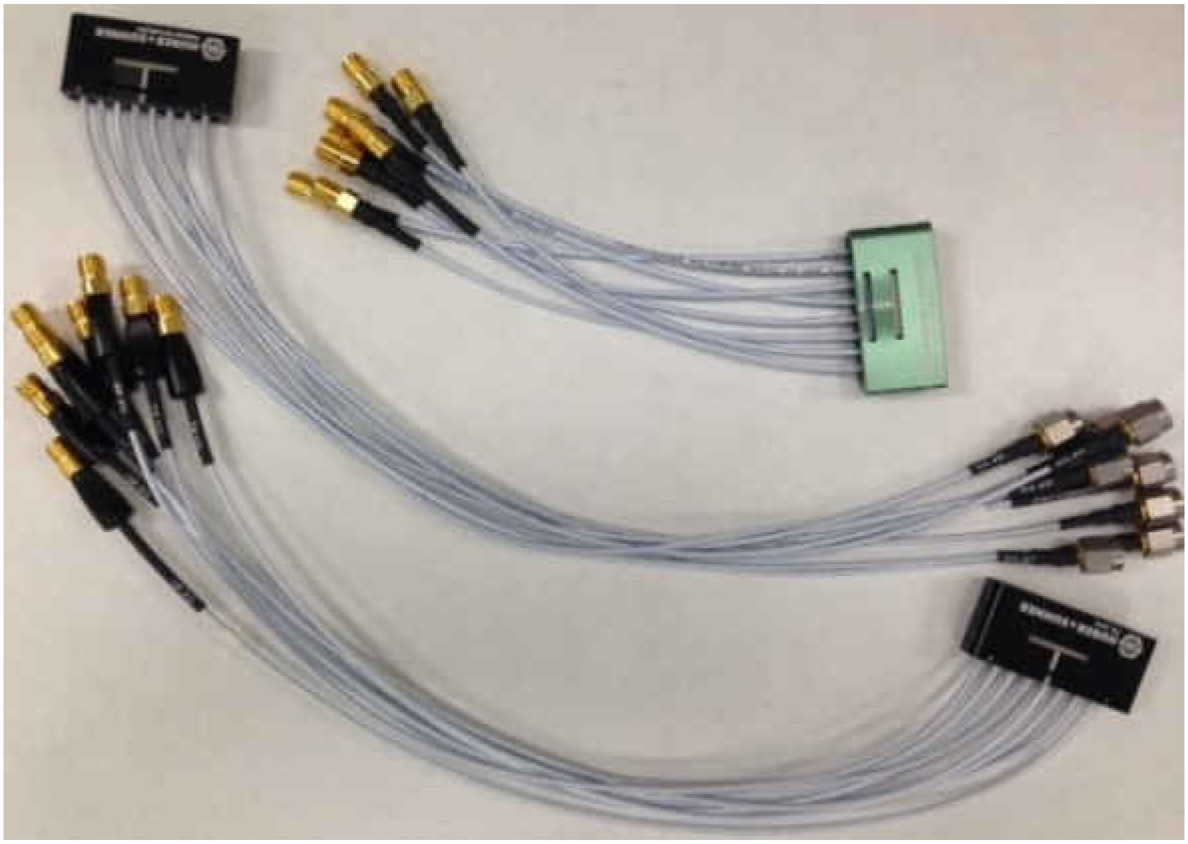


Figure 8-1. Huber+Suhner 1x8 MXP Cable Assemblies

For Huber+Suhner quotes or additional information requests, please contact:

Info.us@hubersuhner.com
HUBER+SUHNER Inc.
8530 Steele Creek Place Drive, Suite H
Charlotte-NC- 28273
+1 704-790-7300

The following are suggested part numbers that can be used with this EVM. Other part numbers and cable lengths have not been tested, but can be considered for use.

1. 85014420, MF53/1x8A_21MXP/21SMA/152: *MXP-18 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 25 Gbps 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.
4. 84099634, MF53/1x8A_21MXP/21/MXP/305: *MXP-50 cable assembly*. This cable assembly is designed specifically for 50+ GHz. It features a MXP connections on both ends of the cable for board bridging and longer cable length options.

9 Revision History

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

Changes from Revision * (December 2022) to Revision A (December 2022)	Page
• First public release of EVM user's guide	3

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス· インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page 電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

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.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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