DS280MB810EVM User's Guide

The DS280MB810 is an 8 Channel Linear Repeater with the ability to extend the reach and robustness of high speed serial links for up to 28 Gbps interfaces. Simplified equalization control, low power consumption, and ultra-low additive jitter make the DS280MB810 ideal for front-port interfaces such as 100G-SR4/LR4/CR4 and backplane applications. The small 8 mm x 13 mm package easily fits behind numerous standard front-port connectors, including SFP28, QSFP28, CFP2/CFP4, and CDFP, without the need for a heat sink. The optimized package dimensions, high-speed signal escape, and the pin-compatible retimer portfolio make the DS280MB810 well-suited for high-density backplane and front port applications. The DS280MB810 can be configured via the default SMBus slave mode or with an external EEPROM. With this kit, users can quickly evaluate the linear equalizer's performance.

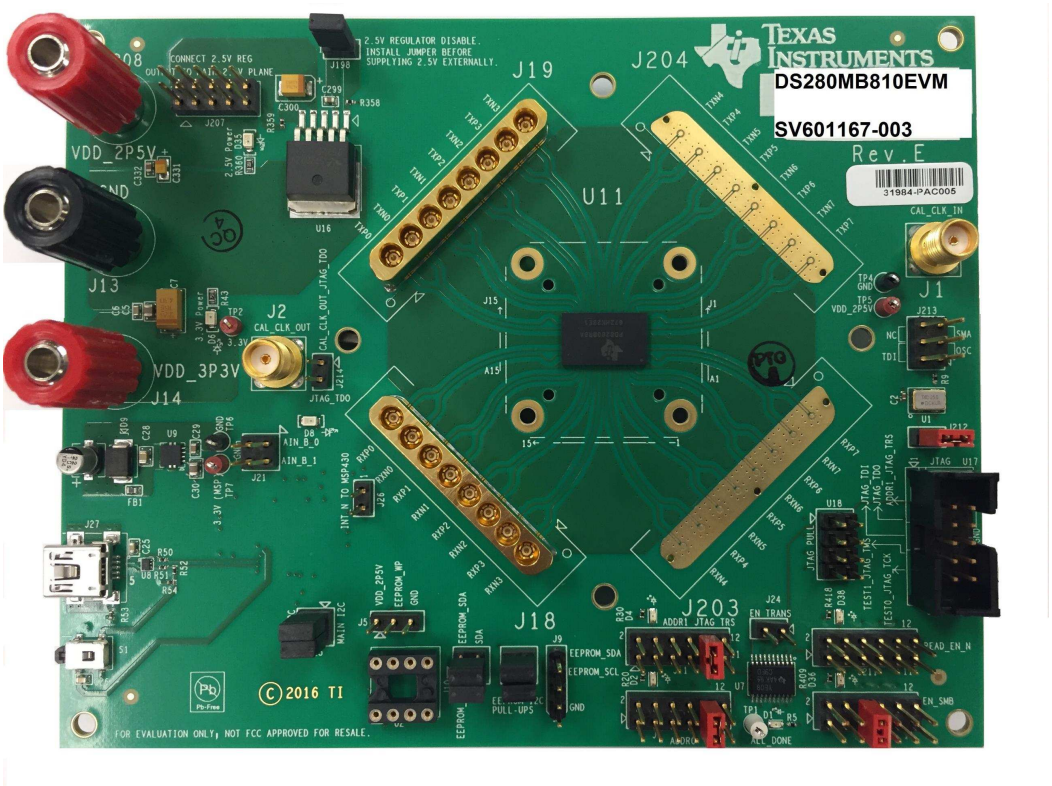


Figure 1. DS280MB810EVM.

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1 Features

- 8-Channel Unidirectional Repeater operating at rates up to 28 Gbps; 4 channels available for EVM testing
- Linear Equalization that allows for support of link training protocols
- Programmed by external EEPROM or SMBus interfaces
- Single supply operation: 2.5V ± 5% or 3.3 V ± 5%

2 Applications

- Front-Port Eye Opener for Optical (28G-VSR and CAUI-4) and Copper Cables (100G-CR4)
- Backplane Reach Extension (100G-KR4)
- SFP28, QSFP28, CFP2/CFP4, CDFP

3 Ordering Information

Table 1. DS280MB810 Ordering Information

EVM ID	DEVICE ID	DEVICE PACKAGE
DS280MB810EVM	DS280MB810	nfBGA (135)

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 please see Section 8.

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4 Setup

This section describes the jumpers and connectors on the EVM as well as how to connect, set up, and use the DS280MB810EVM.

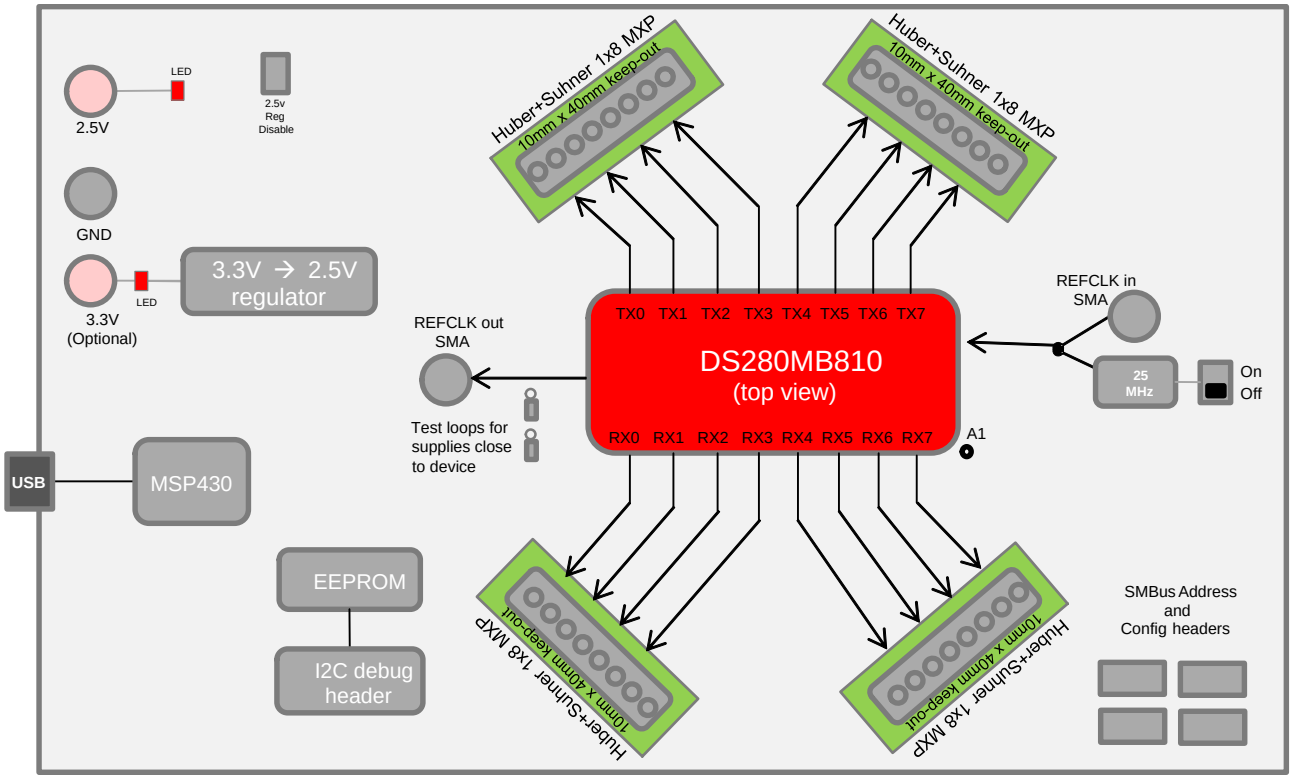


Figure 2. DS280MB810EVM Block Diagram.

4.1 Modes of Programmable Communication

The DS280MB810EVM can be programmed in one of two modes:

1. **SMBus Mode** – Provides full access to the DS280MB810 status and control settings via the on-board USB2ANY. ADDR0 and ADDR1 pins are used to set the SMBus slave address.
2. **External EEPROM** – Provides access to the DS280MB810's EEPROM programmable control settings via an 8 pin EEPROM. Only a subset of SMBus slave register bits is written to EEPROM. The EEPROM can program up to 16 slave devices.

For convenient use, a USB-to-Mini cable provides a direct connection via J27.

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4.2 Configuration Overview

The following tables provide a description of the connectors on the DS280MB810EVM.

Table 2. Description of SMBus and EEPROM Connections

Component	Name	Description
J18.1, J18.2, J18.3, J18.4, J18.5, J18.6, J18.7, J18.8	RXN3, RXP3, RXN2, RXP2, RXN1, RXP1, RXN0, RXP0	High-speed differential input pairs
J19.1, J19.2, J19.3, J19.4, J19.5, J19.6, J19.7, J19.8	TXP0, TXN0, TXP1, TXN1, TXP2, TXN2, TXP3, TXN3	High-speed differential output pairs
J14.1, J14.3	SDA, SCL	SMBus Access (OPTIONAL)
J6	ADDR0	4-level strap pins used to set
J11	ADDR1	the SMBus address
J209	EN_SMB	4-level input to select between SMBus master (float) or slave mode (high)
J211	READ_EN_N	Weak pull up for SMBus Master or Slave Mode
U2	EEPROM	8-pin DIP Socket for EEPROM
J1	CAL_CLK_IN	External 25MHz Calibration Clock Input
J2	CAL_CLK_OUT	External 25MHz Calibration Clock Output
J208	PWR	2.5 V for DC Power
J14	PWR	3.3 V for DC Power
J19	GND	Ground
J27	USB2ANY	USB connection for EVM software control

Table 3. Test Point Connections (Output Voltage)

Component	Name	Description
TP4	GND	Common Ground
TP5	VDD	+2.5 V Input
TP6	GND	Common Ground
TP7	VDD	+3.3 V Input

4.3 Software Setup with SigCon Architect

The general procedure for setting up and testing with the DS280MB810EVM is as follows. For hardware setup and connections in the steps below, reference the illustrations in Figure 2 and Figure 4 to implement the appropriate setup.

1. **(One-time step)** Choose one of the TI SigCon Architect installers to download from the SigCon Architect Tools Folder on TI.com. Follow the prompts to install software.
   - **SNLC055:** With LabVIEW RTE embedded. Download this folder to install SigCon Architect on a computer without Internet access.
   - **SNLC054:** Without LabVIEW RTE embedded. Download this folder to install SigCon Architect on a computer with Internet access.
2. **(One-time step)**Download the relevant zip folder for the desired profile. For this evaluation module, select the zip folder for all available repeater profiles.
   - **SNLC056:** Repeater profile updaters.

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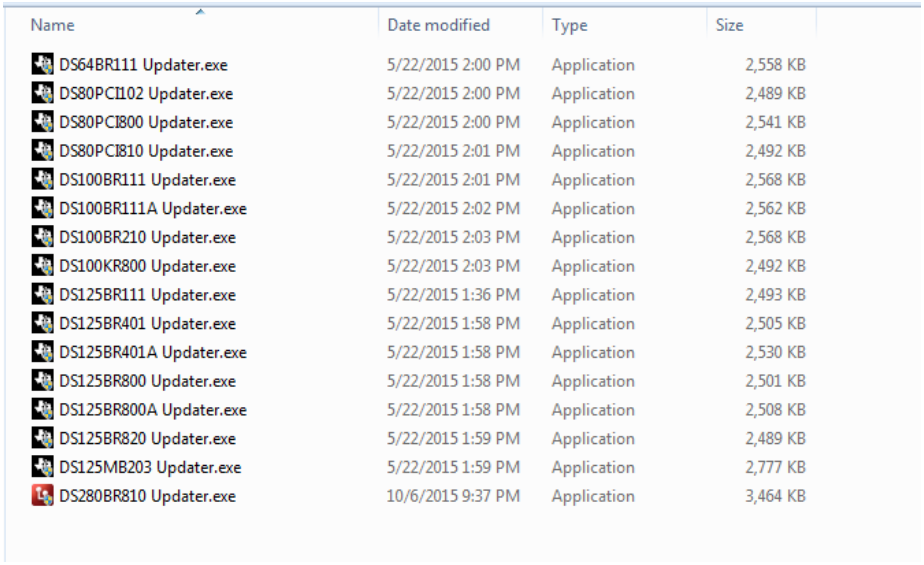


Figure 3. Repeater Profile Updater Installers.

Choose the Updater.exe profile for the relevant device. In this case, install “DS280MB810 Updater.exe.” Follow the prompts to install.

Once SigCon Architect and the correct updater profiles are installed, close any existing instance of SigCon Architect again.

3. Connect 2.5 V power via banana plugs to VIN on J208 and GND to GND on J13, or connect 3.3 V power via banana plugs to VIN on J14 and GND to GND on J13.
   - For VDD = 2.5 V: Tie J198 jumper pins 1-2.
   - For VDD = 3.3 V: Remove jumper shunt between pins 1 and 2 on J198. Tie J207 jumper pins 10-9, 8-7, 6-5, 4-3, and 2-1.
4. Install the appropriate jumper shunt to operate with an internal or external calibration clock.

NOTE: The Reference Clock is not required for DS280MB810 operation.

5. Install the appropriate jumper shunts to operate in default configuration with VDD = 2.5 V in SMBus Slave Mode or EEPROM Master Mode. The default configuration for the DS280MB810EVM operates in SMBus Slave Mode, as shown below in Figure 4.
   - J6 and J11: Tie jumper pins 10-9 in order to set the device slave address = 0x30. For all other SMBus slave addresses, reference the DS280MB810 data sheet.
   - J25: Tie jumper pins 3-1 and 4-2 in order to connect the SMBUS signals.
   - J10: Tie jumper pins 3-1 and 4-2.
   - J8: Tie jumper pins 2-1 and 4-3.
   - **(SMBus Only)** J209: Tie jumper pins 6-5 to set ENSMB = 1 (1 kΩ to VDD).
   - **(EEPROM Only)** J209: Float the jumper shunt to set ENSMB=F.

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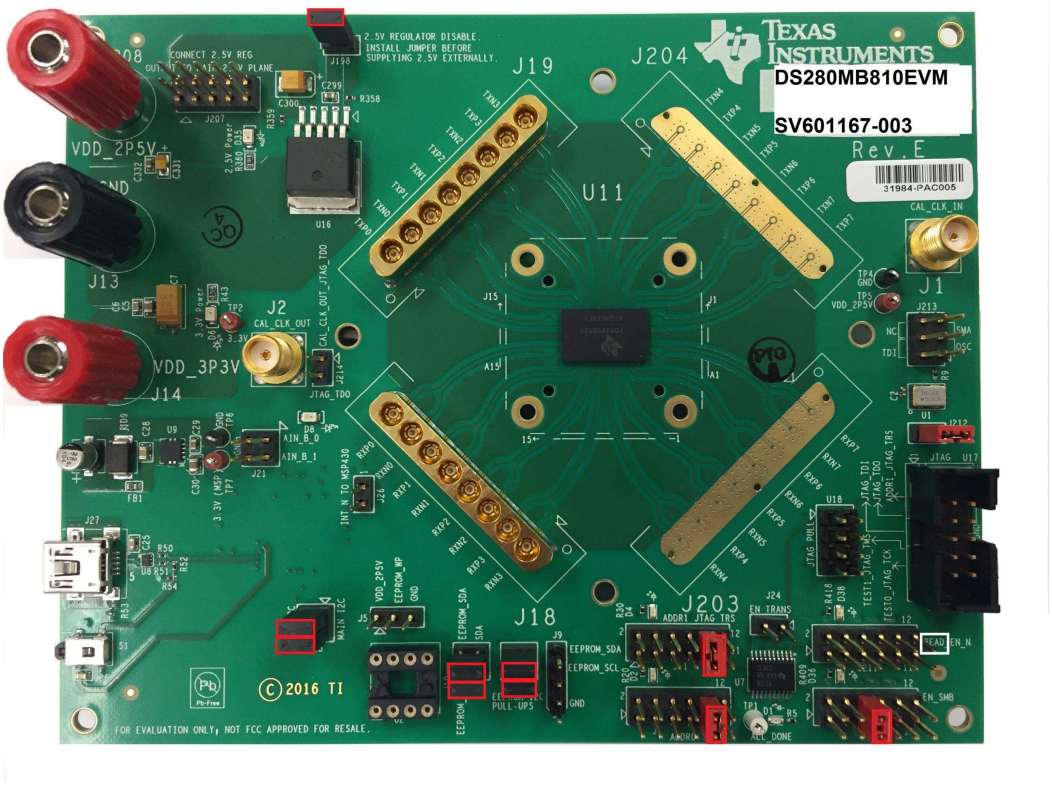


Figure 4. DS280MB810EVM Default Configuration.

NOTE: The jumper on J211 (if present) is connected only to pin 12, which is the pin in the white box in Figure 4 (the top right pin).

6. Connect a PC to DS280MB810EVM with a USB-to-Mini cable via J27.
7. Open SigCon Architect, and navigate to the “Configuration” page of DS280MB810 via the “Selection” column. 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, as seen below in Figure 5. Once connection is successfully established, users can read and write various settings to the device in real-time, as described in the following steps.

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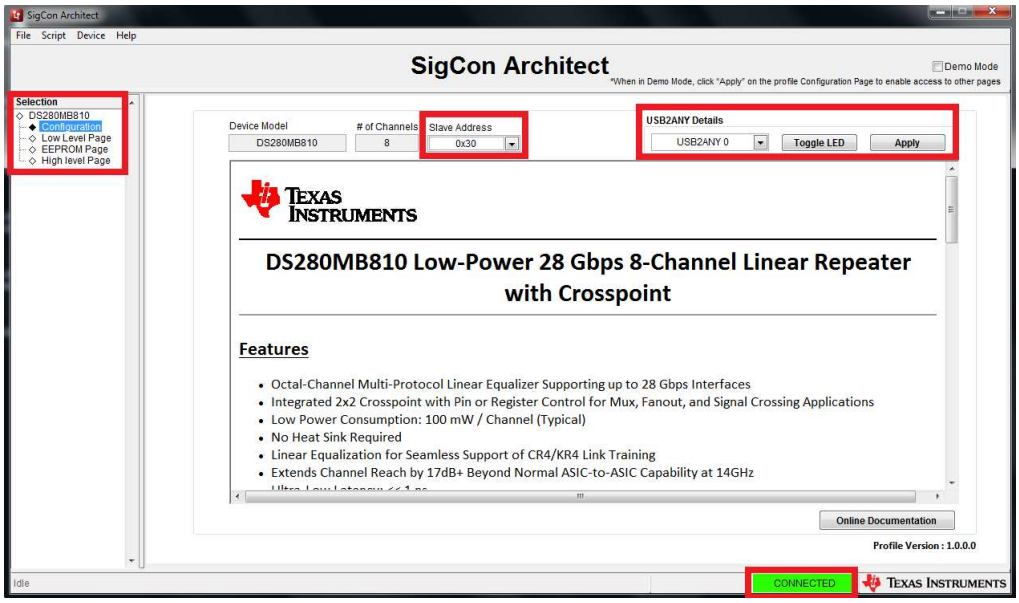


Figure 5. SigCon Architect Configuration Page.

8. In order to read and write to all registers on the DS280MB810, navigate to the “Low Level Page," as shown below in Figure 6. Only in SMBus Slave Mode can the user read and write to all programmable registers. Click “Read All” in order to load the data in each register from the device to the “Register Map."
   - **Read Register:** Type the readable address in the “Current Address” text box. Click “Read Register." The data in this register will appear in the “Data” text box.
   - **Write Register:** Type the writable address in the “Current Address” text box, and type the data to write to this address in the “Data” text box. Click “Write Register.”

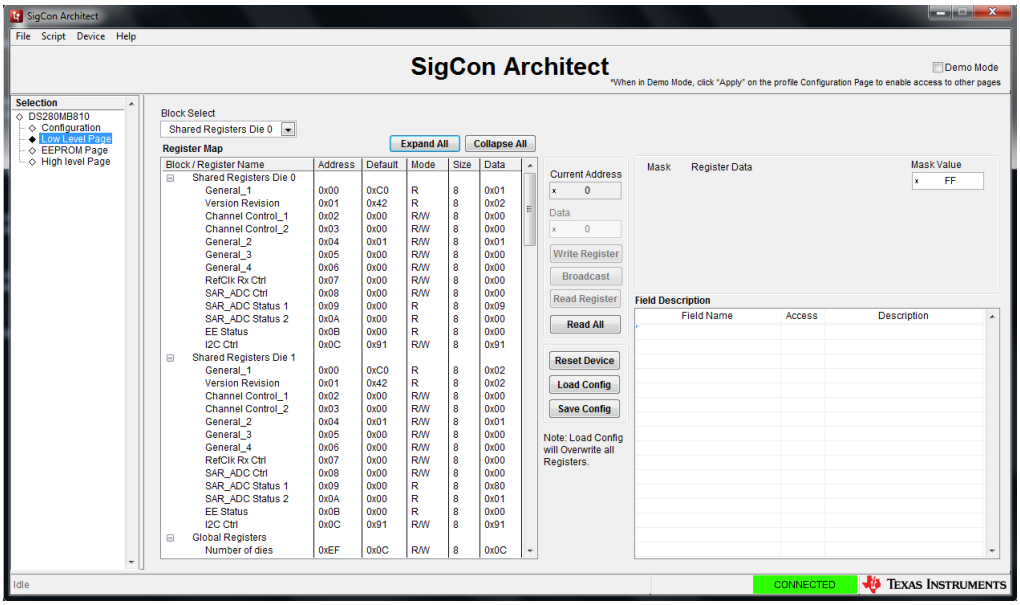


Figure 6. SigCon Architect Low Level Page.

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9. In order to view a high level summary of the device status and control settings, navigate to the “High Level Page," and remain on the “Device Status tab” as shown below in Figure 7. 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 not a 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.
   - **Driver Power:** The Driver Power can be turned on or off and the current status is displayed on the Device Status page. The Driver Power is detected at the TX side of each channel.
   - **Control Settings:** The remaining control settings are programmable through SigCon Architect. The displayed values are the current settings programmed on the device. Step 10 describes how to edit these settings.

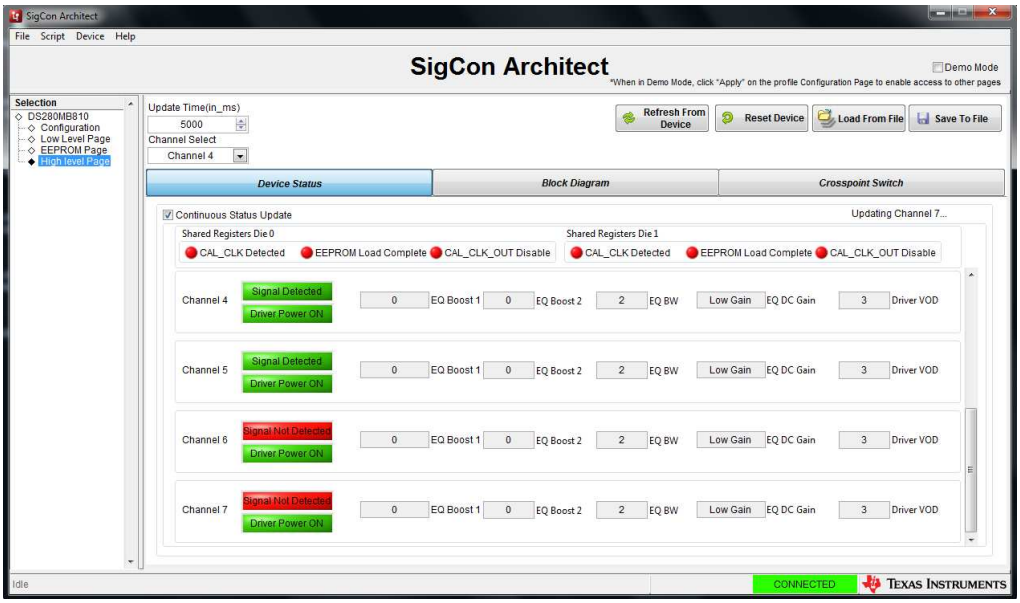


Figure 7. SigCon Architect High Level Page: Device Status.

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10. In order to program high level settings, navigate to the “Block Diagram” tab on the “High Level Page” as shown below in Figure 8. The EQ Settings and Output Configurations are programmable from this page. In order to navigate to specific channels use the “Channel Select” drop down menu. Click “Refresh from Device” to apply the device’s current settings to the control setting boxes. Click “Apply to Channel” to program the device from the “Block Diagram” page. After programming the device, the changed settings can be verified on the “Device Status” page, Figure 7. The CAL_CLK Detected indicator provides a visual representation of whether a calibration clock is active.
    - **EQ Settings:**
        - The Equalizer works as a high pass filter compensating for input channel loss.
        - The EQ Boost 1, EQ Boost 2, and EQ Boost BW values respectively apply boost to their respective segments as shown below on the block diagram.
        - The EQ DC Gain setting can be either Low or High Gain.
    - **Driver Output:**
        - A linear equalizer does not utilize a limiting amplifier. Linear equalizers are necessary for an application with link training or end to end equalization.
        - Driver VOD and EQ DC Gain settings can be changed on this page. The Approximate DC gain in dB ranges from -4.5 to +5.0 dB.

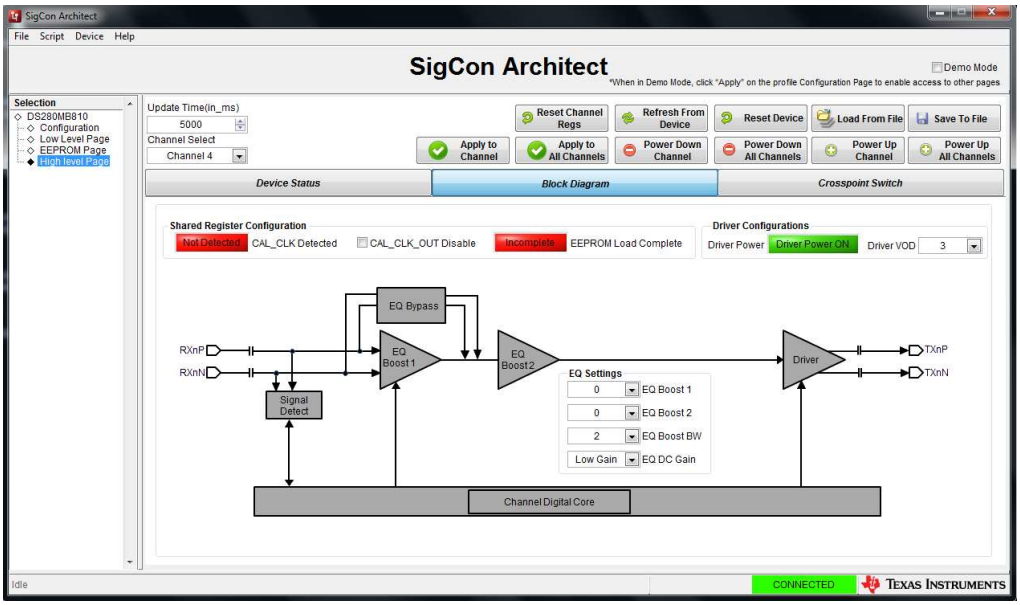


Figure 8. SigCon Architect High Level Page: Block Diagram.

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11. In order to program each of the internal 2x2 crosspoints, navigate to the “Crosspoint Switch” tab on the “High Level Page” as shown below in Figure 9. The Crosspoint Switch Status of the entire device is displayed on the right-hand side. The colors help to show the configuration of each channel in the DS280MB810.
    - **Crosspoint Configuration:**
        - Default: Results in a 1:1 function.
        - Fanout: Results in a 1:2 function
        - Lane Crossing: Swaps the outputs within the 2x2 crosspoint

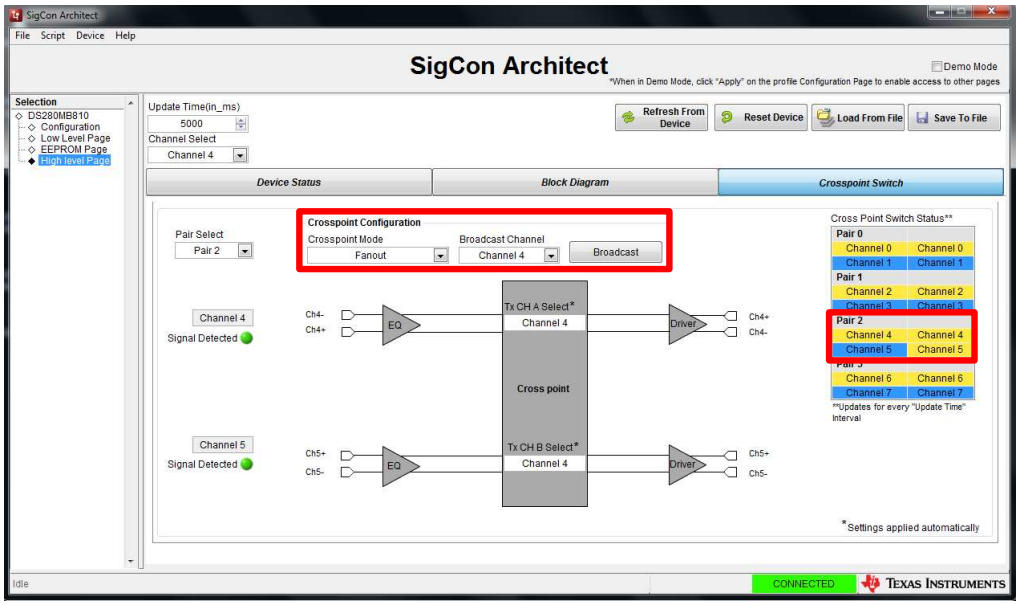


Figure 9. SigCon Architect High Level Page: Crossspoint Switch.

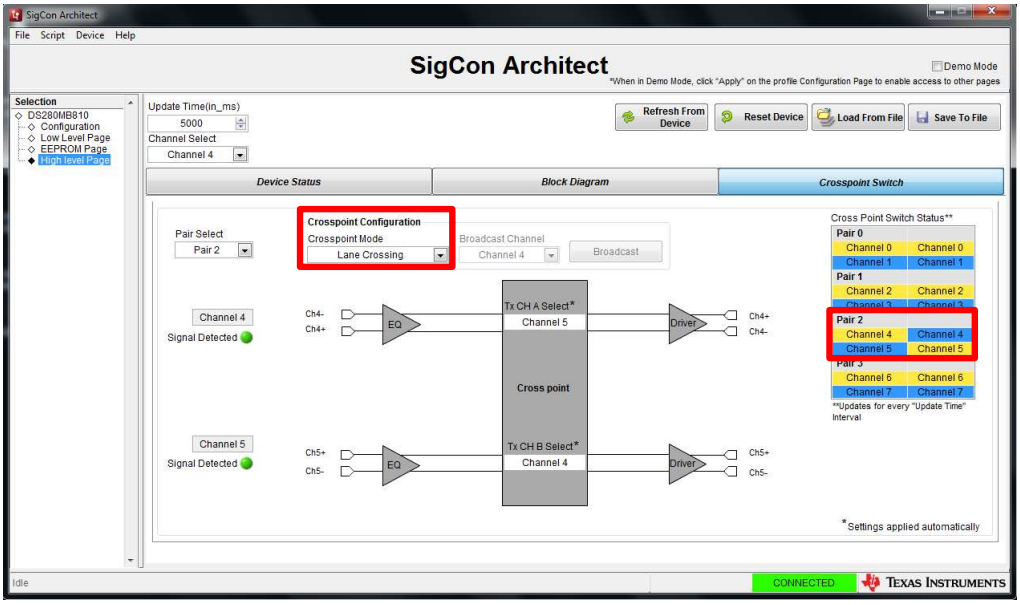


Figure 10. SigCon Architect High Level Page: Crosspoint Switch.

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12. In order to create a Hex file programmable to an EEPROM, navigate to the “EEPROM Page," as shown in Figure 11. In order to update the settings from the device click “Update Slot from Device." In order to create the programmable hex file, click “Write to EEPROM Hex." 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 I2C communication (i.e. AARDVARK or equivalent interface adapter). The EEPROM control settings are described in greater detail below.
    - **Output Configurations:** 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 configurations 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 number to update the SigCon Architect EEPROM page from.
    - **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 x DS280MB810 devices.
        - The first 3 bytes of EEPROM data is the base header. The base header contains the CRC Enable Bit, Aaddress Map Header Enable Bit, EEPROM > 256 Bytes Enable Bit, 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.
        - If EEPROM Size > 256 Bytes Enable Bit is NOT set:
            - EEPROM Size = 3 Bytes (Base Header) + Number of devices x 8 Bytes/device (Address Header) + Number of slots x 66 Bytes/slot (Data)
        - If EEPROM Size > 256 Bytes Enable Bit is set:
            - EEPROM Size = 3 Bytes (Base Header) + Number of devices x 12 Bytes/device (Address Header) + Number of slots x 66 Bytes/slot (Data)

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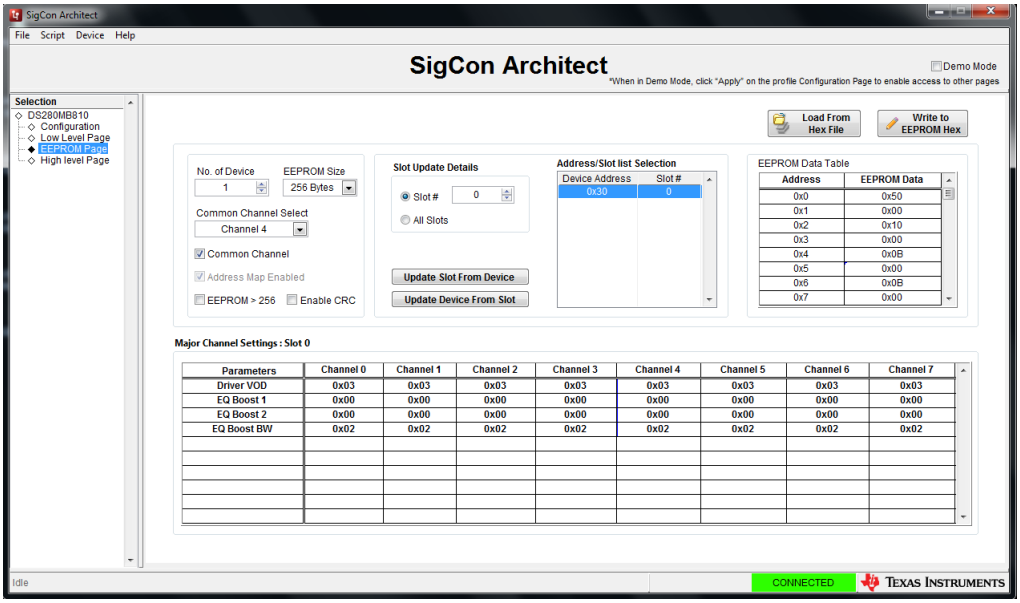


Figure 11. SigCon Architect EEPROM Page.

NOTE: Profile versions 1.0.1.0 and earlier do not support CRC with EEPROM size set to larger 256 bytes. This feature will be available in future releases.

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5 Example Hardware Test Setup

In order to test the functionality of the DS280MB810EVM, connect TXP0 and TXN0 with MXP cable assemblies to DC blocking capacitors and a Keysight DCA-x Oscilloscope or equivalent (50 Ω terminated). Connect the data source, high speed BERT or other device with MXP cable assemblies to RXP0 and RXN0. Add input and output channels as desired to emulate a system topology. Use the Jitter/Noise and Eye/Mask functions on the Oscilloscope to view the output. The test set up can be seen below in Figure 12.

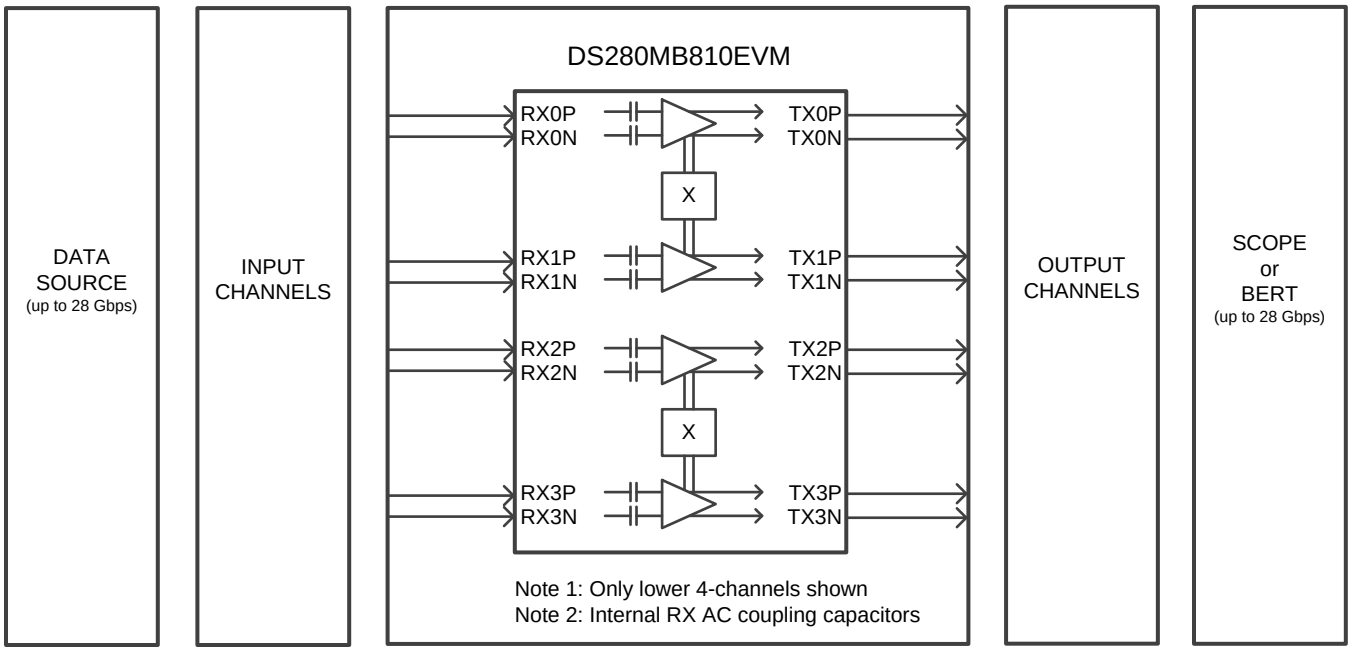


Figure 12. Example Test Set Up

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5.1 Equalizing Moderate Pre-Channel Loss

The following is an example test setup configuration which demonstrates the DS280MB810 equalizing for moderate pre-channel insertion loss introduced by an FR4 channel at 25.78125 Gbps and 10.3125 Gbps.

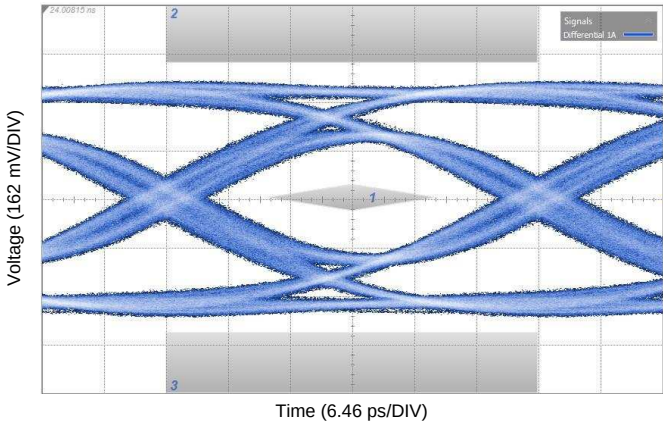


Figure 13. 25.78125 Gbps CAUI-4 Eye Mask with 5in input channel and minimal output channel

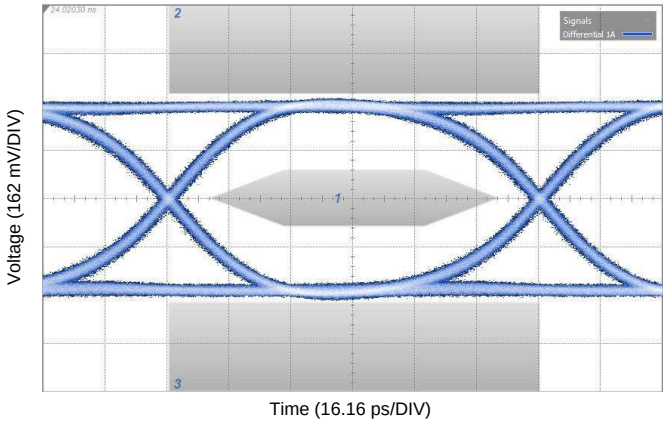


Figure 14. 10.3125 Gbps nPPI Eye Mask with 5in Input Channel and Minimal Output Channel

Table 4. Settings and Measurements for CAUI-4 and nPPI with 5in Input Channel and Minimal Output Channel

	25.78125 Gbps (CAUI-4)	10.3125 Gbps (nPPI)
Transmission Line 1	5 in 5 mil FR4 + 8in SMA cable	5 in 5 mil FR4 + 8 in SMA cable
DS280MB810 Rx Channel Loss	14 dB @ 12.9 GHz (includes 4 dB from the EVM and Huber+Suhner cable assembly)	6 dB @ 5.2 GHz (includes 2 dB from the EVM and Huber+Suhner cable assembly)
DS280MB810 Tx Channel Loss	4.5 dB @ 12.9 GHz (includes 4 dB from the EVM and Huber+Suhner cable assembly)	2 dB @ 5.2 GHz (attributed to the EVM and Huber+Suhner cable assembly)
EQ BST1	3	3
EQ BST2	0	0
EQ BW	3	3
VOD	3	2
EQ DC Gain Mode	Low	Low
Total Jitter @ 1E-15	11.9 ps_{P-P}	13.0 ps_{P-P}
Differential Eye Height @ 1E-15	338 mV_{P-P}	544 mV_{P-P}
Mask violations	0	0

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5.2 Equalizing High Pre-Channel Loss

The following is an example test setup configuration which demonstrates the DS280MB810 equalizing for high pre-channel insertion loss introduced by an FR4 channel at 25.78125 Gbps and 10.3125 Gbps

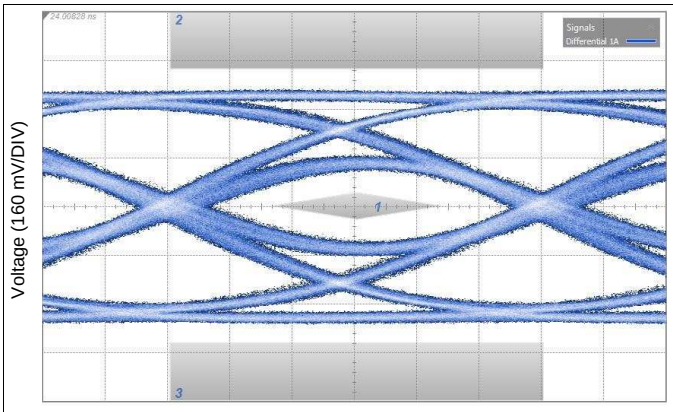


Figure 15. 25.78125 Gbps CAUI-4 Eye Mask with 10in Input Channel and Minimal Output Channel

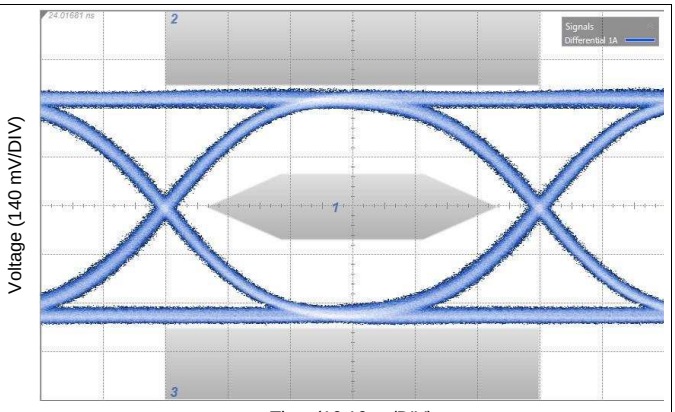


Figure 16. 10.3125 Gbps nPPI Eye Mask with 10in Input Channel and Minimal Output Channel

Table 5. Settings and Measurements for CAUI-4 and nPPI with 10in Input Channel and Minimal Output Channel

	25.78125 Gbps (CAUI-4)	10.3125 Gbps (nPPI)
Transmission Line 1	10 in 5 mil FR4 + 8in SMA cable	10 in 5 mil FR4 + 8 in SMA cable
DS280MB810 Rx Channel Loss	22 dB @ 12.9 GHz (includes 4 dB from the EVM and Huber+Suhner cable assembly)	10 dB @ 5.2 GHz (includes 2 dB from the EVM and Huber+Suhner cable assembly)
DS280MB810 Tx Channel Loss	4.5 dB @ 12.9 GHz (includes 4 dB from the EVM and Huber+Suhner cable assembly)	2 dB @ 5.2 GHz (attributed to the EVM and Huber+Suhner cable assembly)
EQ BST1	6	6
EQ BST2	1	1
EQ BW	3	3
VOD	3	2
EQ DC Gain Mode	Low	Low
Total Jitter @ 1E-15	11.3 ps_{P-P}	13.5 ps_{P-P}
Differential Eye Height @ 1E-15	210 mV_{P-P}	532 mV_{P-P}
Mask violations	0	0

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6 Common Problems and Possible Solutions

PROBLEM	ADDITIONAL INFORMATION	POSSIBLE SOLUTIONS
Cannot power on the EVM.	2.5 Volt Power. D35 LED is off.	• J198: jumper pins 1-2 tied. • J207: jumper pins should be set to float. • Verify configuration with Figure 4 .
	3.3 Volt Power. D35 LED is off.	• J198: remove jumper shunt, pins 1-2 cannot be tied in order to enable 2.5 V regulator. • J207: jumper pins 10-9, 8-7, 6-5, 4-3, and 2-1 tied.
Cannot program with an interface adapter in SMBus Slave Mode.	SigCon Architect is operating in Demo Mode.	• Verify the jumper settings are correct (Figure 4).
		• Verify the slave address is set to 0x30 for SMBus Slave 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 Output Eye Diagram is not as expected.	Pattern does not lock on oscilloscope.	• Transmit a signal from the BERTScope with a different PRBS pattern. Once initial pattern lock is established, re-attempt desired pattern.
		• Transmit a signal from the BERTScope with a lower frequency. Once initial pattern lock is established, re-attempt desired frequency.
	Eye diagram does not pass mask.	• Vary EQ Boost Settings as seen in Figure 8.
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 EPPROM. (i.e. AARDVARK or equivalent).

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7 Bill of Materials

#	QUANTITY	REFERENCE	VALUE	PART NUMBER	DESCRIPTION
1	1	C327	1 uF	C0603X5R0J105M030BC	CAP CER 1UF 6.3V 20% X5R 0201
2	1	C2	0.1uF	C1005X7R1H104K050BB	CAP CER 0.1UF 50V 10% X7R 0402
3	12	C68,C69,C70,C71,C329,C330,C333,C334,C335,C336,C337,C338	0.1uF	C0603X5R1E104K030BB	CAP CER 0.1UF 25V 10% X5R 0201
4	1	C5	10 uF	GRM21BR61E106KA73L	CAP CER 10UF 25V 10% X5R 0805
5	1	C6	1 uF	GRM188R61E105KA12D	CAP CER 1UF 25V 10% X5R 0603
5	1	C7	22 uF	T491C226M016ZT	CAP TANT 22UF 16V 20% 2413
6	1	C18	2.2 nF	C0603C222M3RACTU	CAP CER 2200PF 25V 20% X7R 0603
7	3	C19,C22,C24	0.1 uF	GRM155R71C104KA88D	CAP CER 0.1UF 16V 10% X7R 0402
8	2	C20,C21	30 pF	GRM1885C1H300JA01D	CAP CER 30PF 50V 5% NP0 0603
9	1	C23	0.47 uF	EMK107B7474KA-T	CAP CER 0.47UF 16V 10% X7R 0603
10	1	C25	0.1 uF	C0603C104K4RACTU	CAP CER 0.1UF 16V 10% X7R 0603
11	2	C26,C31	220 pF	C0603C221K5RACTU	CAP CER 220PF 50V 10% X7R 0603
12	1	C27	22 uF	EEE-1AA220WR	CAP ALUM 22UF 10V 20% SMD
13	1	C28	1 uF	C2012X7R1C105K125AA	CAP CER 1UF 16V 10% X7R 0805
14	1	C29	0.01 uF	CGJ3E2X7R1C103K080AA	CAP CER 10000PF 16V 10% X7R 0603
15	1	C30	2.2 uF	LMK212B7225KG-T	CAP CER 2.2UF 10V 10% X7R 0805
16	2	C299,C332	1 uF	CC0603ZRY5V6BB105	CAP CER 1UF 10V Y5V 0603
17	1	C300	47 uF	TAJB476K010RNJ	CAP TANT 47UF 10V 10% 1210
18	1	C328	10 uF	AMK105CBJ106MV-F	CAP CER 10UF 4V 20% X5R 0402
19	1	C331	10 uF	TAJP106M010RNJ	CAP TANT 10UF 10V 20% 0805
20	5	D1,D2,D4,D36,D38	LED	LTST-C191KGKT	LED GREEN CLEAR THIN 0603 SMD.
21	3	D6,D8,D35	RED-LED	LS M67K-J2L1-1-Z	LED MINI TOPLED RED 630NM SMD
22	1	D9	1SMB5922BTS	1SMB5922BT3G	DIODE ZENER 7.5V 3W SMB
23	1	FB1	BK1608HS600-T	BK1608HS600-T	FERRITE BEAD 60 OHM 0603
24	2	J1,J2	SMA	142-0701-201	CONN SMA JACK STR 50 OHM PCB
25	2	J5,J210	HEADER_3	87224-3	CONN HEADER VERT .100 3POS 15AU
26	4	J6,J11,J209,J211	HEADER 6X2	87227-6	CONN HEADER VERT .100 12POS 15AU
27	4	J8,J10,J21,J25	HEADER 2X2	87227-2	CONN HEADER VERT .100 4POS 15AU
28	1	J9	4 HEADER	901200764	CONN HEADER 4POS .100" STR GOLD
29	1	J13	Binding Post, Keystone 7007, Black	7007	POST BINDING ECON NYLON-INS BLK
30	2	J14,J208	Binding Post, Keystone 7006, Red	7006	POST BINDING ECON NYLON-INS RED

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#	QUANTITY	REFERENCE	VALUE	PART NUMBER	DESCRIPTION
31	4	J18,J19,J203,J204	1x8A_81_MXP-S50-0-2	1x8A_81_MXP-S50-0-2/111_NE	
32	2	J24,J26	HEADER 2	87224-2	CONN HEADER VERT .100 2POS 15AU
33	1	J27	USB_Conn_1734035-2	1734035-2	CONN MINI USB RCPT RA TYPE B SMD
34	1	J198	HEADER, 2-PIN	87224-2	CONN HEADER VERT .100 2POS 15AU
35	1	J207	HEADER 5x2/SM_1	87227-5	CONN HEADER VERT .100 10POS 15AU
36	1	Q1	BSS138	BSS138	MOSFET N-CH 50V 220MA SOT-23
37	3	R1,R3,R48	4.7K	ERJ-2GEJ472X	RES 4.7K OHM 1/10W 5% 0402 SMD
38	2	R2,R4	100	CRCW0402100RFKEDHP	RES 100 OHM .125W 1% 0402 SMD
39	6	R5,R20,R30,R47,R409,R418	249	RC1005F2490CS	RES 249 OHM 1/16W 1% 0402
40	3	R6,R7,R8	2.7K	ERJ-2GEJ272X	RES 2.7K OHM 1/10W 5% 0402 SMD
41	2	R9,R10	0	ERJ-2GE0R00X	RES 0.0 OHM 1/10W JUMP 0402 SMD
42	5	R13,R14,R15,R17,R18	2.7K	ERJ-2GEJ272X	RES 2.7K OHM 1/10W 5% 0402 SMD
43	2	R16,R19	4.7K	ERJ-2GEJ472X	RES 4.7K OHM 1/10W 5% 0402 SMD
44	8	R21,R27,R33,R37,R406,R408,R415,R417	1K	ERJ-2GEJ102X	RES 1.0K OHM 1/10W 5% 0402 SMD
45	4	R26,R36,R407,R416	10K	ERJ-2GEJ103X	RES SMD 10K OHM 5% 1/10W 0402
46	1	R43	750	ERJ-3GEYJ751V	RES 750 OHM 1/10W 5% 0603 SMD
47	1	R45	33k	RC0402JR-0733KL	RES 33K OHM 1/16W 5% 0402 SMD
48	1	R46	200	ERJ-3GEYJ201V	RES 200 OHM 1/10W 5% 0603 SMD
49	1	R49	10.0K	ERJ3EKF1002V	RES 10K OHM 1/10W 1% 0603 SMD
50	2	R50,R51	33	CRCW040233R2FKEDHP	RES 33.2 OHM .125W 1% 0402 SMD
51	1	R52	1.5K	CRCW04021K50FKEDHP	RES 1.50K OHM .125W 1% 0402 SMD
52	1	R53	33K	ERJ-2GEJ333X	RES 33K OHM 1/10W 5% 0402 SMD
53	1	R54	1.2M	ERJ-2GEJ125X	RES 1.2M OHM 1/10W 5% 0402 SMD
54	2	R358,R359	10K	CRCW040210K0FKEDHP	RES 10.0K OHM .125W 1% 0402 SMD
55	1	R360	360	ERJ-3GEYJ361V	RES 360 OHM 1/10W 5% 0603 SMD
56	1	SW1	SW_DIP_SWITCH	76STD01T	SWITCH DIP TOGGLE 1POS
57	1	S1	EVQPSD02K	EVQ-PSD02K	SWITCH TACTILE SPST-NO 0.05A 12V
58	1	TP1	TEST POINT	5002	TEST POINT PC MINI .040"D WHITE
59	3	TP2,TP5,TP7	TEST POINT	5000	TEST POINT PC MINI .040"D RED
60	2	TP4,TP6	TEST POINT	5001	TEST POINT PC MINI .040"D BLACK
61	1	U1	Oscillator, 25 MHz, 2.5V	7C-25.000MCB-T	OSC XO 25.000MHZ CMOS SMD
62	1	U2	PDIP	111-43-308-41-001000	IC SOCKET 8PIN .300 SOLDER TAIL
63	1	U6	MSP430	MSP430F5529IPN or MSP430F5529IPNR	IC MCU 16BIT 128KB FLASH 80LQFP
64	1	U7	TXB0108	TXB0108PWR	IC 8-BIT TRNSTR 15KV ESD 20TSSOP

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#	QUANTITY	REFERENCE	VALUE	PART NUMBER	DESCRIPTION
65	1	U8	TPD4E004DRY	TPD4E004DRYR	TVS DIODE 6SON
66	1	U9	TPS73533DRB	TPS73533DRBT	IC REG LDO 3.3V 0.5A 8SON
67	1	U11	DS280MB810		
68	1	U16	TPS75725	TPS75725KTTRG3	IC REG LDO 2.5V 3A DDPAK
69	1	Y1	24.0 MHz	ECS-240-20-5PX-TR	CRYSTAL 24.000MHZ 20PF SMD
70	1	SV601167 REVE BOARD PCB			

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8 EVM Cable Assemblies

The DS280MB810EVM uses 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

Below 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 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.
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.

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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 2016) to A Revision	Page
• Initial public release	3

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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。

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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.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

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