TI Designs
12G SDI and 10-GbE Video Over IP Repeater With Reclocker Reference Design

**TEXAS INSTRUMENTS**

TI Designs

This verified reference design is functionally a repeater signal-conditioning solution for 12G SDI and 10-GbE video applications. This design consists of the LMH1219, 12G adaptive equalizer with an integrated reclocker and the LMH1218, 12G cable driver with an integrated reclocker. The design provides a serial interface to connect to a host computer. It also comes with Graphical User Interface (GUI) program for configuring and monitoring the devices on the board.

As the block diagram shows, the LMH1219 adaptive cable equalizer receives the SDI signal and compensates for the cable losses encountered between the signal source and the input. The second input of the LMH1219 receives signal from the optical module and cleans up the jitter due to the optical media impairments. The equalized and reclocked output of the LMH1219 is sent to the LMH1218 cable driver with reclocker and another output to a pair of SMA connectors. The LMH1218, cable driver with reclocker provides SDI and optical interface output signals.

Design Features

- One SDI and One 10-GbE I/O (SFP+)
- Low Power Consumption With Automatic Power Down With Loss of Input Signal
- Ability to Diagnose Signal Eye Diagram and Determine Incoming Signal Horizontal and Vertical Eye Opening
- Ability to Estimate Coaxial Input Cable Length
- User controlled GUI interface for device settings and monitoring
- Single Power Supply—Does Not Require Firmware, Heatsink, or Reference Clock
- Lab-Tested HW Example Including 12G-SDI Test Data

Featured Applications

- SMPTE Compatible Serial Digital Interface
- Digital Video Processing and Editing
- 10-GbE SDI Media Gateway

Design Resources

TIDA-00428	Design Folder
LMH1218	Product Folder
LMH1219	Product Folder
TPD4E004	Product Folder
TPS735	Product Folder

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1 System Description

1.1 *Software and Hardware Description and Setup*

The general procedure for setting up and testing with the TIDA-00428 reference design is as follows:

1. Verify that the following jumpers have been installed:

   (a) J21: Tie pins 1 and 2.

   (b) J9: Tie pins 1 and 2.

   (c) J16: Tie pins 1 and 2.

   (d) J20, J103, J33: Make sure there are no jumpers on these headers.

   Figure 1 shows the TIDA-00428 jumper settings.
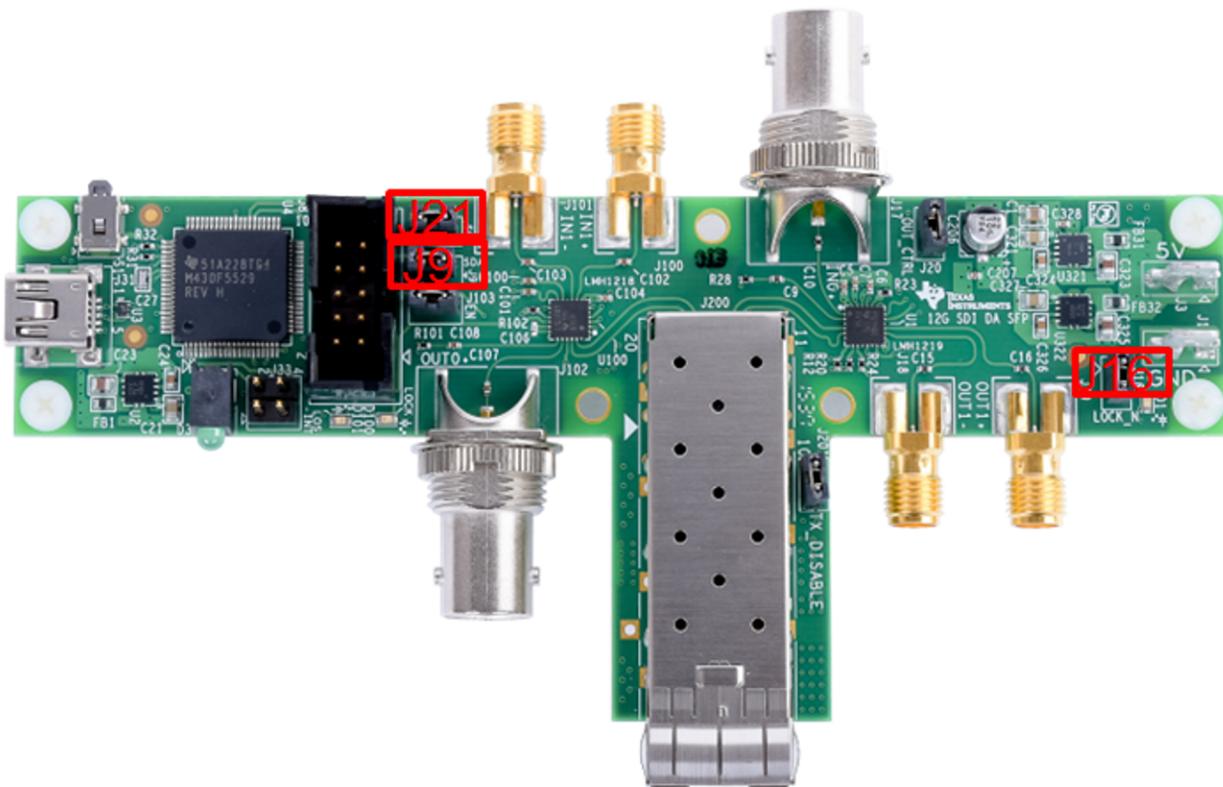
Figure 1. TIDA-00428 Jumper Settings

2. Power supply connection instructions:

As Figure 2 shows, connect a 5-V DC power supply (1000 mA maximum) between J3 (5 V) and J1 (GND).
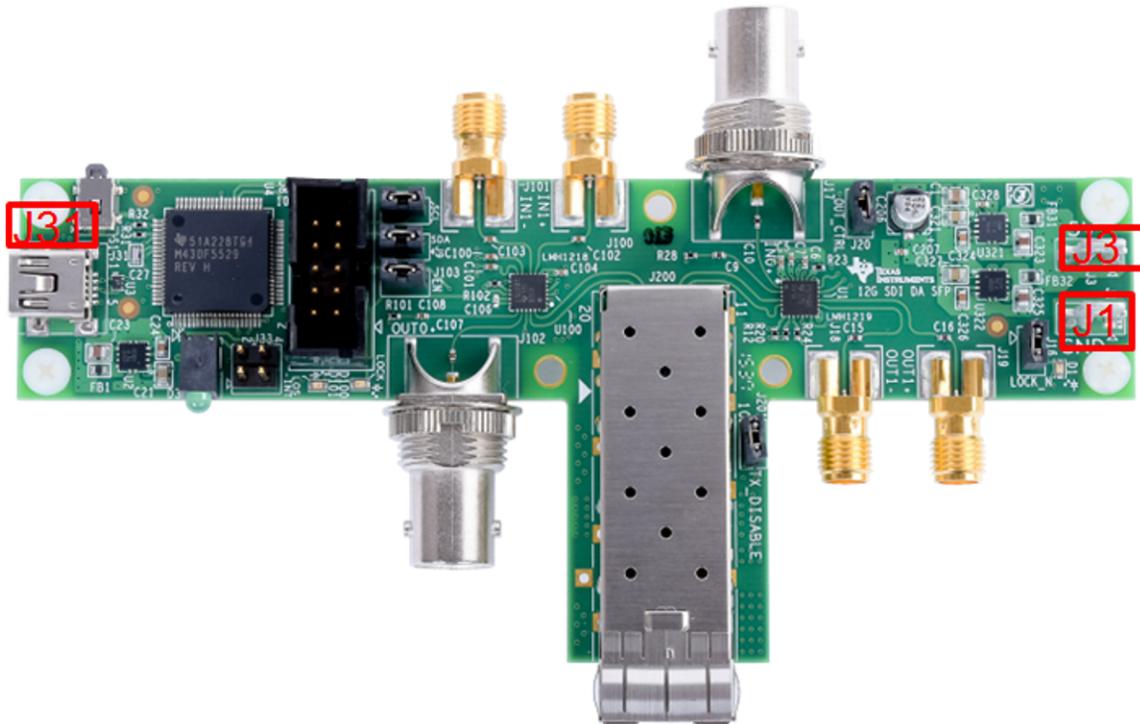
Figure 2. 5-V Power Supply Connections

3. Connect the TIDA-00428 device to a PC using a universal serial bus (USB) cable on J31.

4. (One-time step): Install the USB2ANY Explorer software. Contact TI Application Support to obtain this software.

(a) Connect to a PC with a USB-to-Mini USB cable through the mini USB port located on J31. Open the USB2ANY Explorer software. When the prompt appears to *Update Firmware*, click the *Yes* button and proceed to update the EVM firmware.

5. (One-time step): Download a copy of the SigCon Architect tool, which supports the LMH1219 and LMH1218 devices from the following link (SigCon Architect). To install this software, choose from the following two options:

(a) SigCon Architect Installer (run-time engine *not* embedded): This option is for users that already have the LabVIEW RTE installed or for users that do not have LabVIEW RTE but are installing SigCon Architect software on a PC with an active Internet connection.

(b) SigCon Architect Installer wRTE (run-time engine embedded): This option is for users that do not have LabVIEW RTE and are installing SigCon Architect software on a PC without an active Internet connection.

Install the SigCon Architect software using the step-by-step instructions. Refer to the user's guide for the SigCon Architect software, *SigCon Architect: Installation and Starter's Guide* (SNLU178).

6. Contact TI Application Support to obtain profiles for the LMH1219 and LMH1218 devices. Install the downloaded profile by launching (double-click) the file and following the pop-up instructions. When the installation completes, click the *Finish* button and the Sigcon Architect tool automatically launches.

7. Select the *Configuration* tab of the LMH1218 as shown in Figure 3. Set the *Slave Address* field to 0x1A and click the *Apply* button.

(a) After the software communicates with the reference design board, the *Low Level Page*, *High Level Page*, and *Eye Monitor Page* options become selectable (see Figure 4).
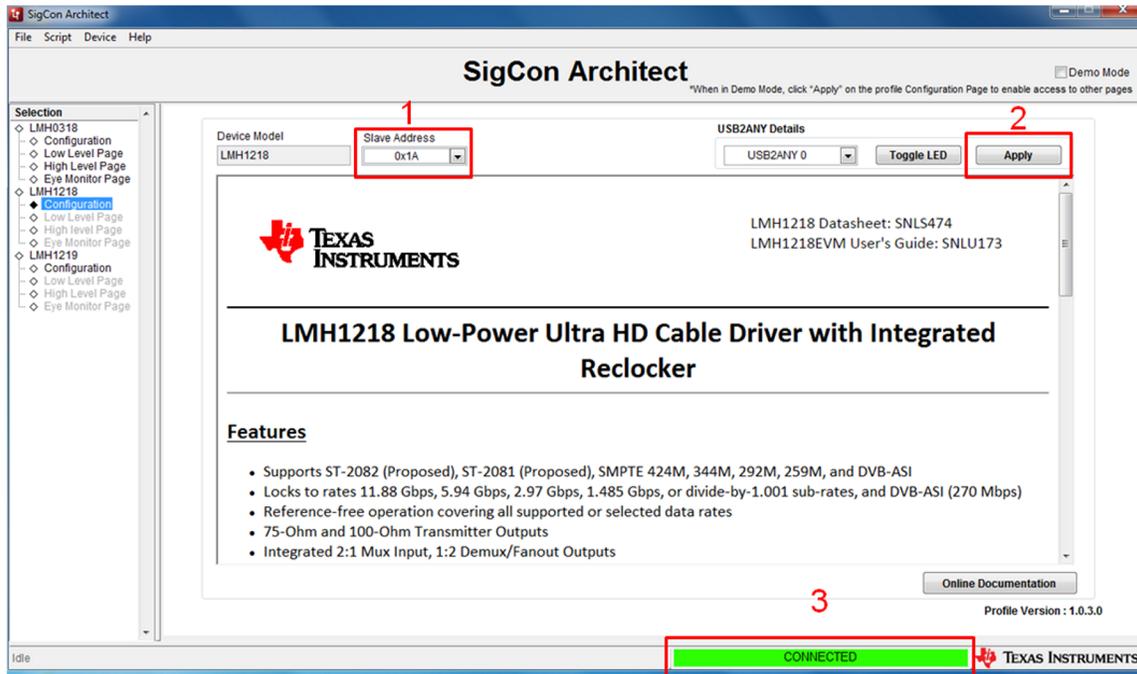

Figure 3. SigCon Architect LMH1218 Configuration
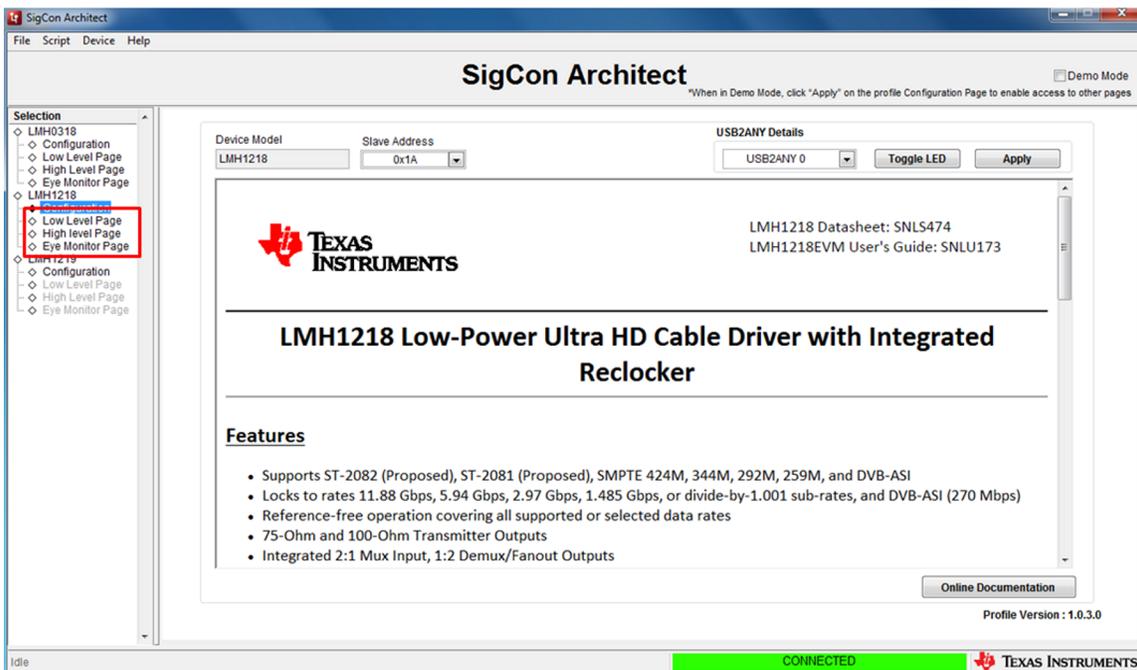
Figure 4. LMH1218 Configuration Complete

8. Repeat Step 7 for the LMH1219 device to enable communication (see Figure 5 and Figure 6).
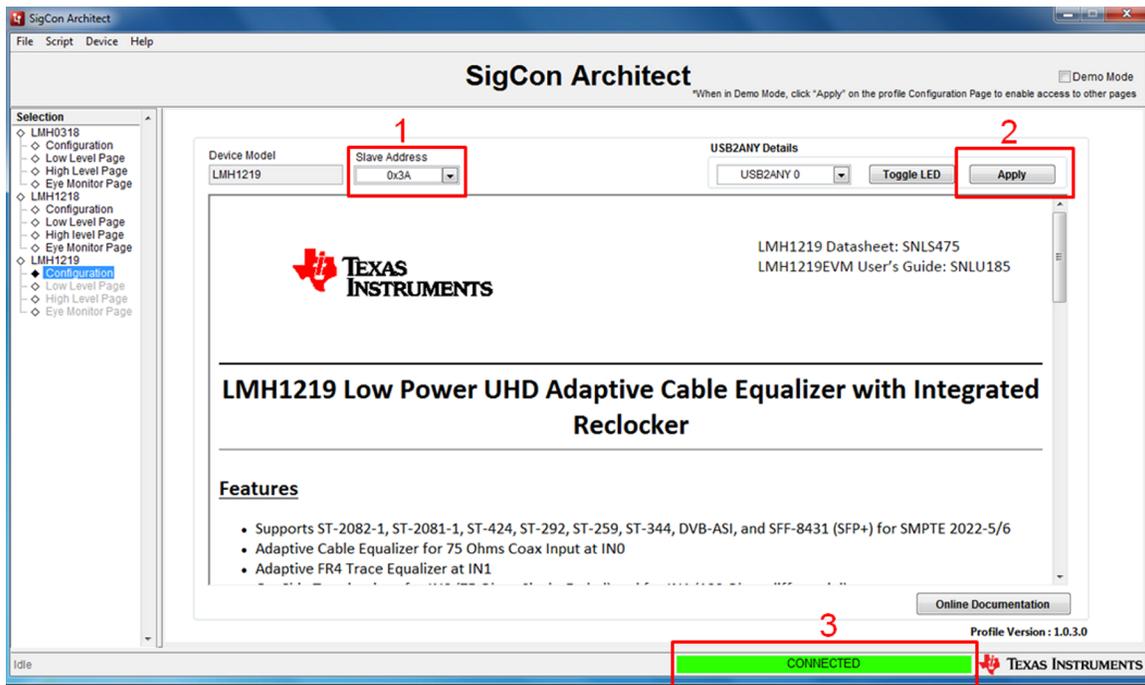
Figure 5. LMH1219 Configuration
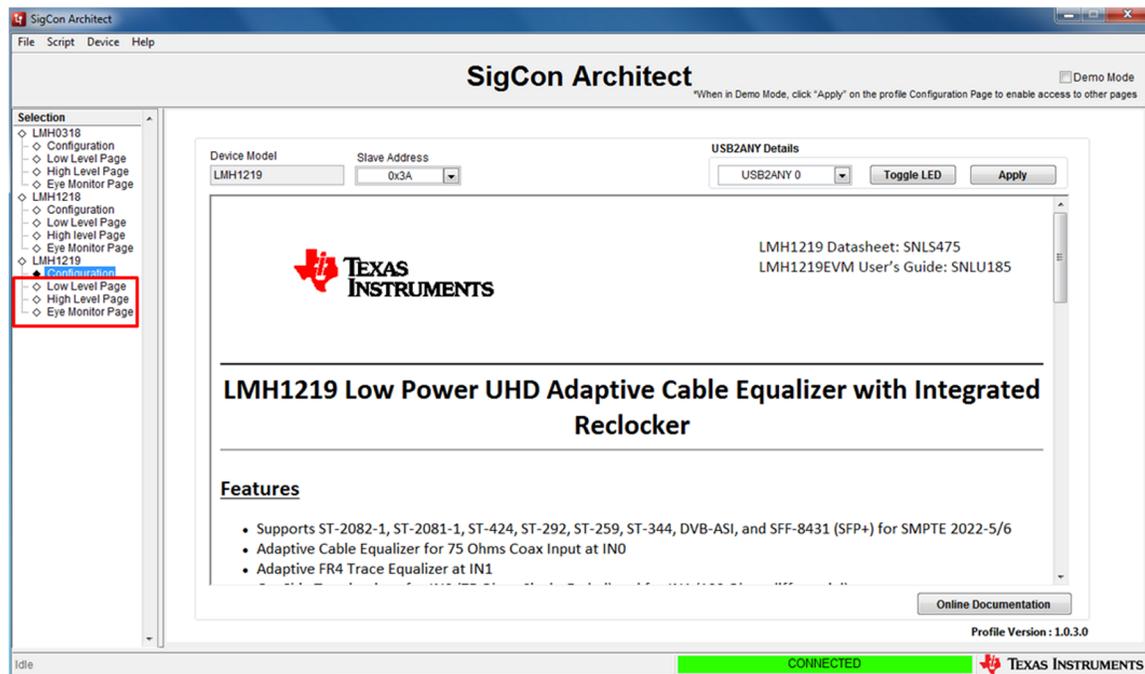
Figure 6. LMH1219 Configuration Complete

9. After successfully establishing communication between the SigCon Architect software and the device, select the *High Level Page* tab for the LMH1218 (see Figure 7). By default, the channel CTLE gain has been set to compensate for a long PCB trace. When using a serial digital interface (SDI) with the TIDA-00428 device, TI recommends setting the CTLE gain to 0x00 (see Figure 8). See the *LMH1218 Programming Guide* for the applicable settings (SNLU174).

> **NOTE:** The LMH1218 CTLE gain setting is set to 0x80 to equalize long traces. In some cases, this setting must be forced to 0x00 (see Figure 7).
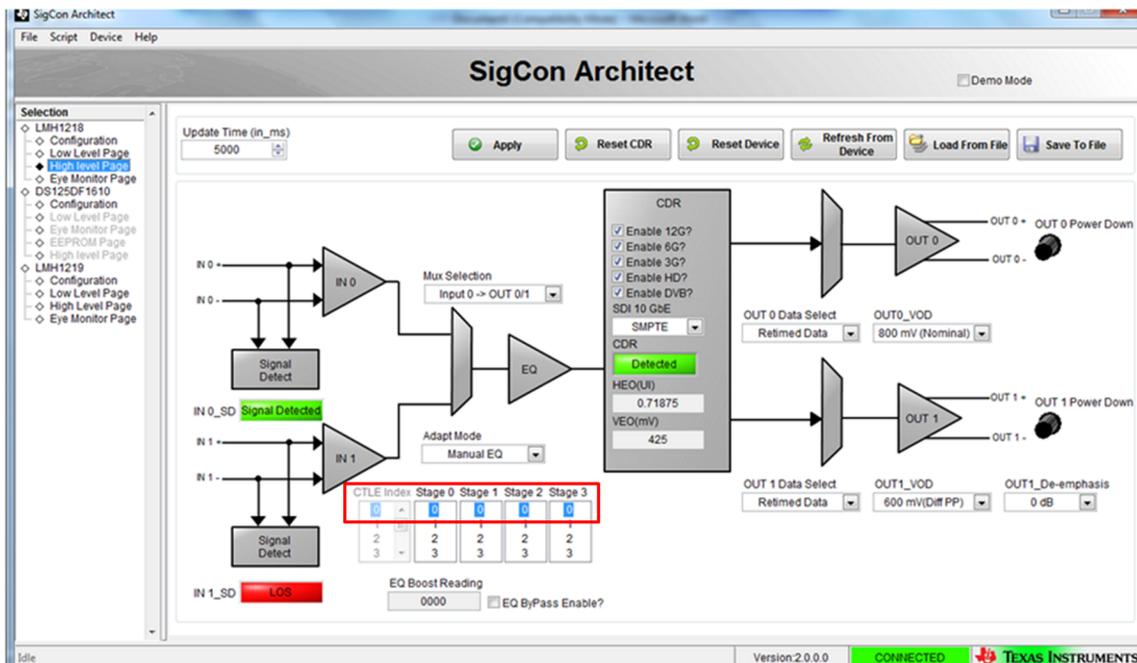
Figure 7. LMH1218 High Level GUI
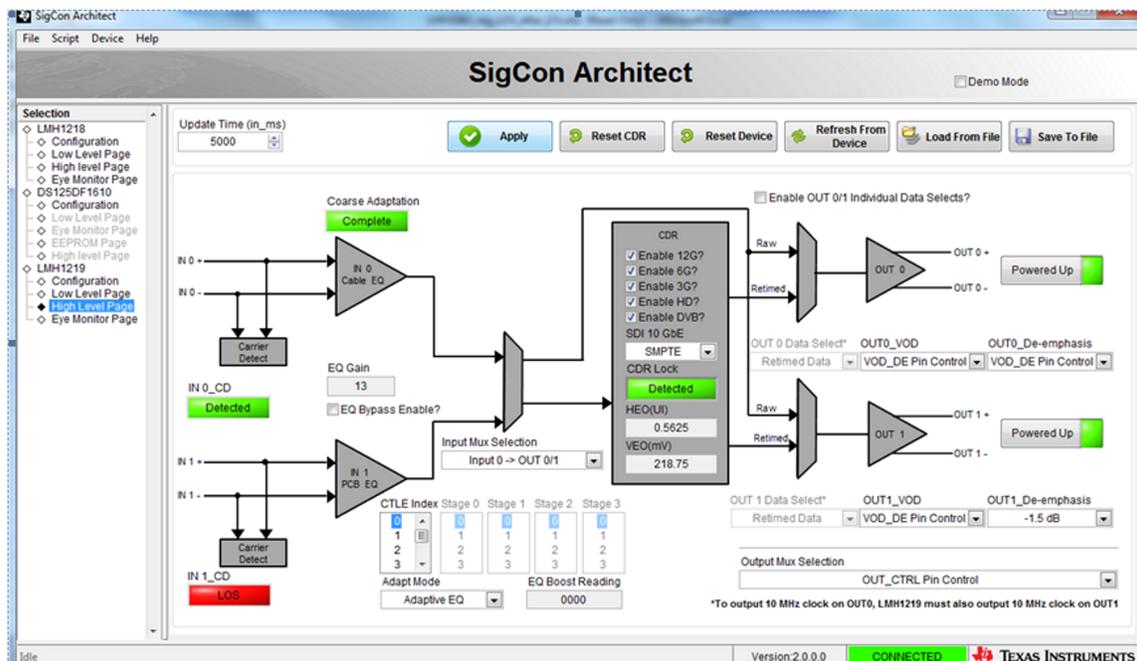
Figure 8. LMH1219 High Level GUI

2   Block Diagram
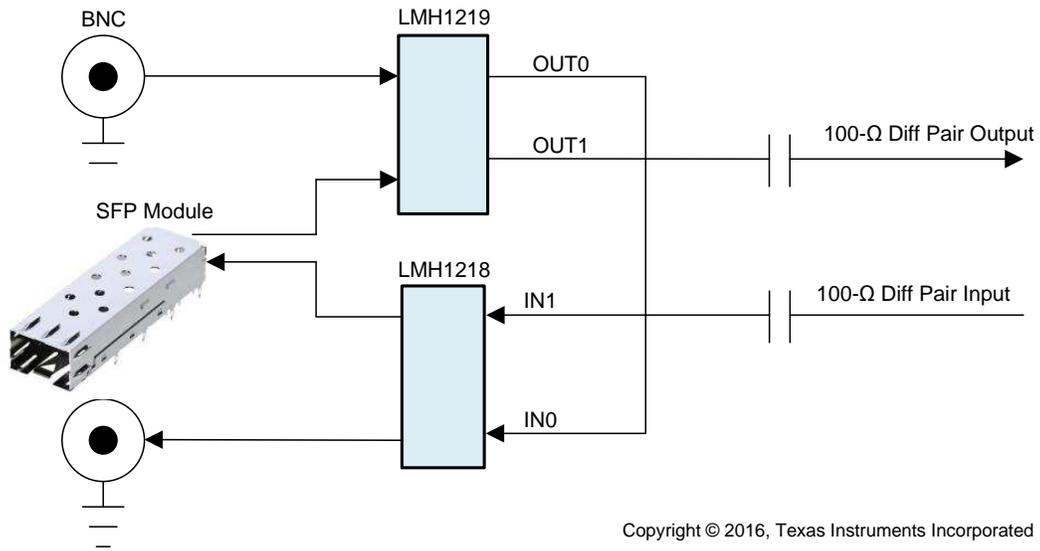
Figure 9. TIDA-00428 Block Diagram

12G SDI and 10-GbE Video Over IP Repeater With Reclocker Reference Design

3 System Design Theory

3.1 Connectors and Recommended Settings

Table 1 lists the available connectors, their functions, recommended default settings, and comments.

Table 1. Connector and Jumper Settings

CONNECTOR	PIN CONNECTIONS		FUNCTION	RECOMMENDED DEFAULT SETTINGS	COMMENTS
	FROM	TO			
J1	—	—	Power ground	Connect to the ground of the external power supply	—
J3	—	—	5-V power supply	Connect to the external 5-V power supply	—
J8	—	—	USB2ANY connector	Do not connect	Reserved for debug purpose
J9	1	2	SDA pullup resistor	Install this jumper	—
J16	1	2	Lock indicator LED	Install this jumper	—
J17	—	—	LMH1219 IN0+ BNC	Connect to 75-Ω SDI coax input	SDI input signal
J18	—	—	LMH1219 OUT1−	LMH1219 OUT1- SMA	Connect to scope or other monitoring instrument
J19	—	—	LMH1219 OUT+	LMH1219 OUT1+ SMA	Connect to scope or other monitoring instrument
J20	1	2	LMH1219 OUT_CTRL	Do not install	LMH1219 equalizer and reclocker enabled
J21	1	2	SCL Pullup resistor	Install this jumper	—
J31	—	—	Mini USB connector	Connect to PC USB port	—
J33	—	—	MSP430™ settings	Do not install this jumper	Reserved for debug purpose
J100	—	—	LMH1218 IN1+	LMH1218 IN1+ SMA	Connect to pattern generator
J101	—	—	LMH1218 IN1−	LMH1218 IN1− SMA	Connect to pattern generator
J102	—	—	LMH1218 OUT0+ BNC	Connect to 75-Ω SDI coax	SDI output signal
J103	1	2	Enable signal for the LMH1218	Do not connect	This jumper powers down the LMH1218 device
J201	1	2	TX_DISABLE disables SFP transmitter	Install this jumper	Install this jumper to enable SFP transmitter

4   Test Data

4.1   SDI SMPTE 75-Ω Coax Media Test Result

Two TIDA-00428 boards were connected as shown in Figure 10. The 12G SDI cable reach is limited to 70 m to 80 m of the B1694A 75-Ω coax cable. SMPTE compatible SDI repeaters with reclocking capability are used to extend this cable reach. The jitter and eye diagrams were measured at different points within this test setup. See Table 2 for the test results.
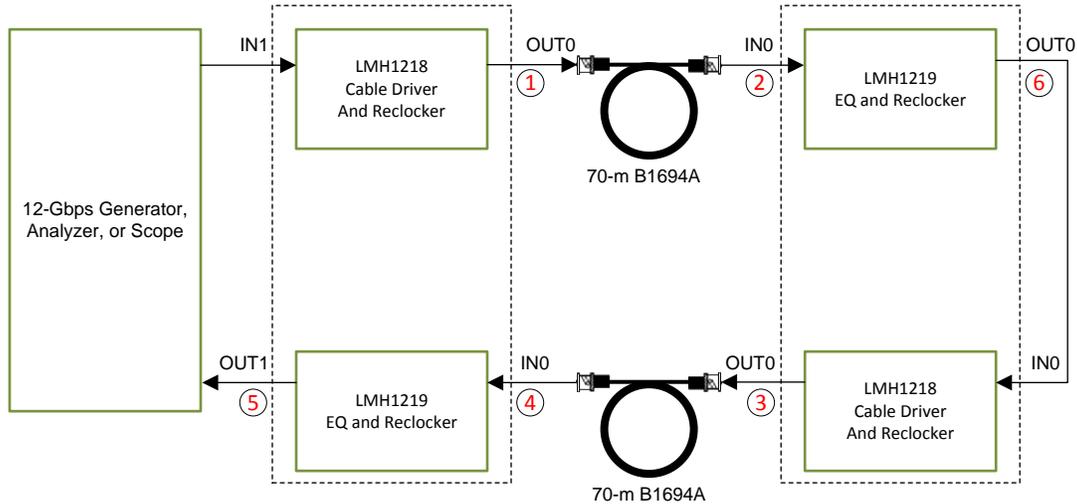
Figure 10. SDI SMPTE 75-Ω Coax Media Setup

Figure 11 is the scope shot at point 3 in the preceding Figure 10.
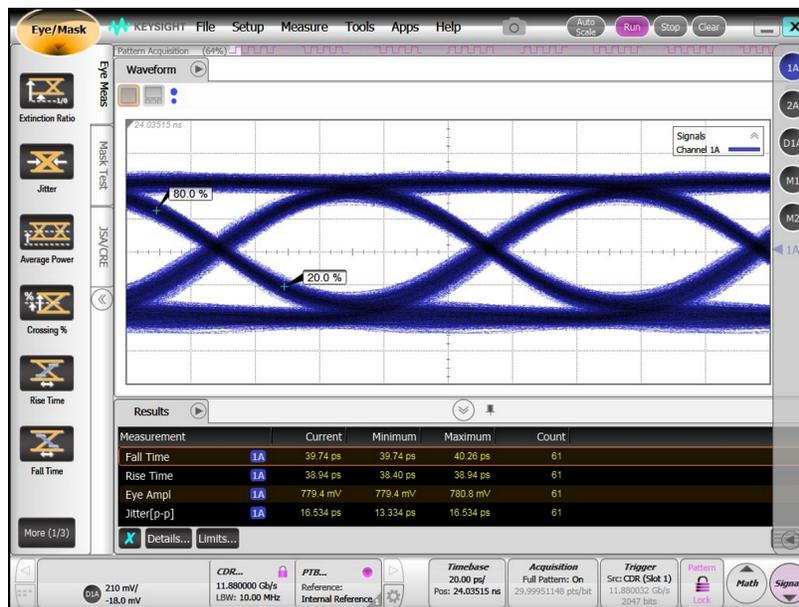
Figure 11. LMH1218 Eye Diagram at OUT0 Point 3

The following figures in this subsection show different shots at different points, as indicated in Figure 10.
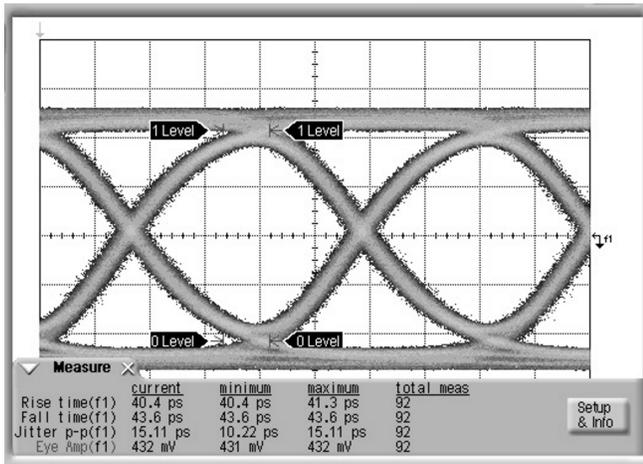
Figure 12. Output Eye Diagram PRBS10 11.88 Gbps at Point 6
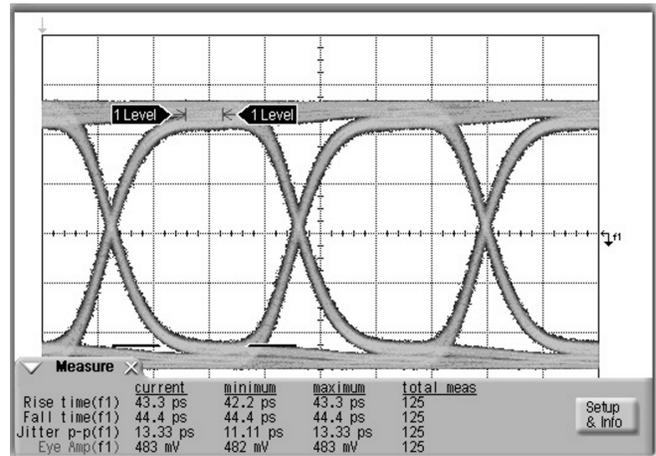
Figure 13. Output Eye Diagram PRBS10 5.94 Gbps at Point 6
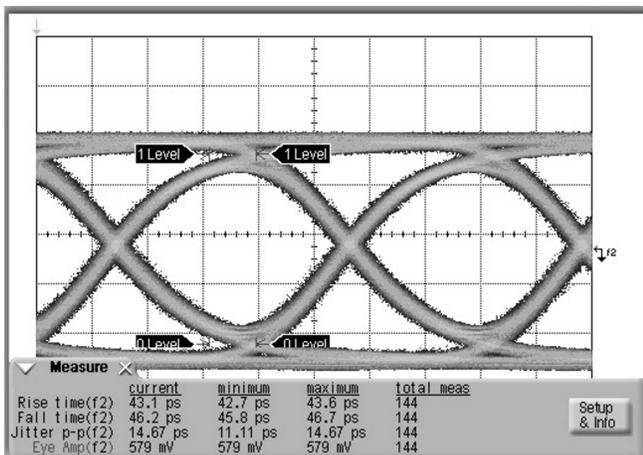
Figure 14. Output Eye Diagram PRBS10 11.88 Gbps at Point 5
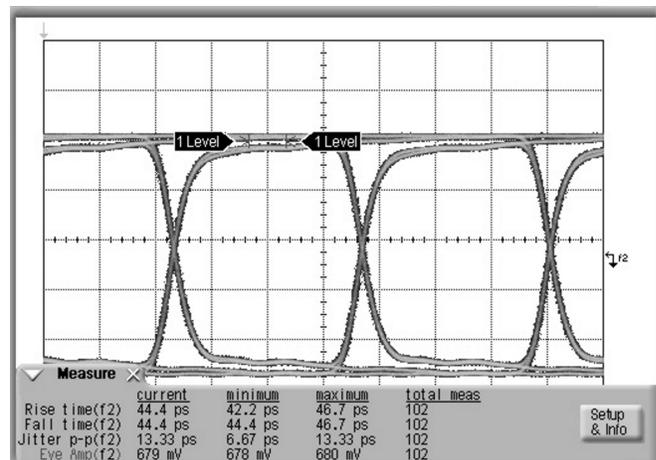
Figure 15. Output Eye Diagram PRBS10 2.97 Gbps at Point 5
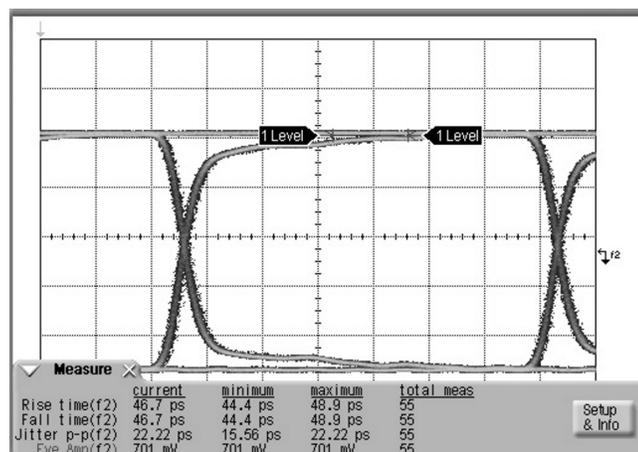
Figure 16. Output Eye Diagram PRBS10 1.485 Gbps at Point 5

4.2 10-GbE Ethernet Fiber Media Test Result

The LMH1218 and LMH1219 devices support dual media: 75-Ω coax cable and optical fiber for 10-GbE Ethernet applications. Figure 17 shows the test setup:
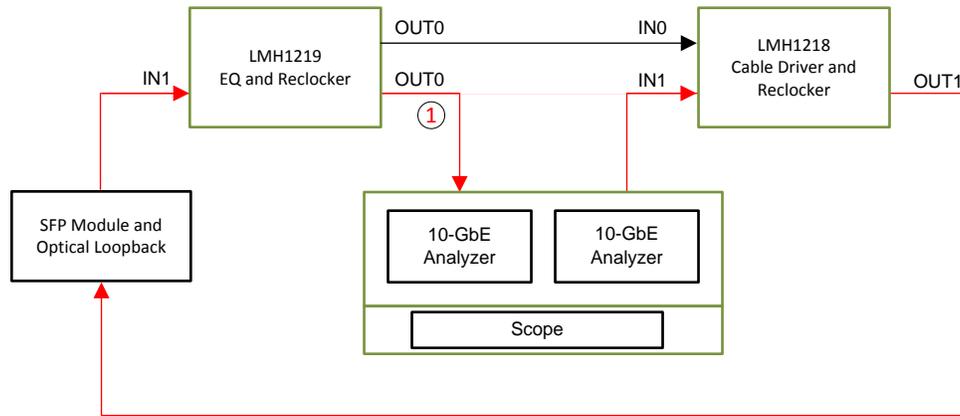
Figure 17. 10-GbE Optical Fiber Media Setup

Figure 18 and Figure 19 show the TIDA-00428 setup for a 10-GbE application.
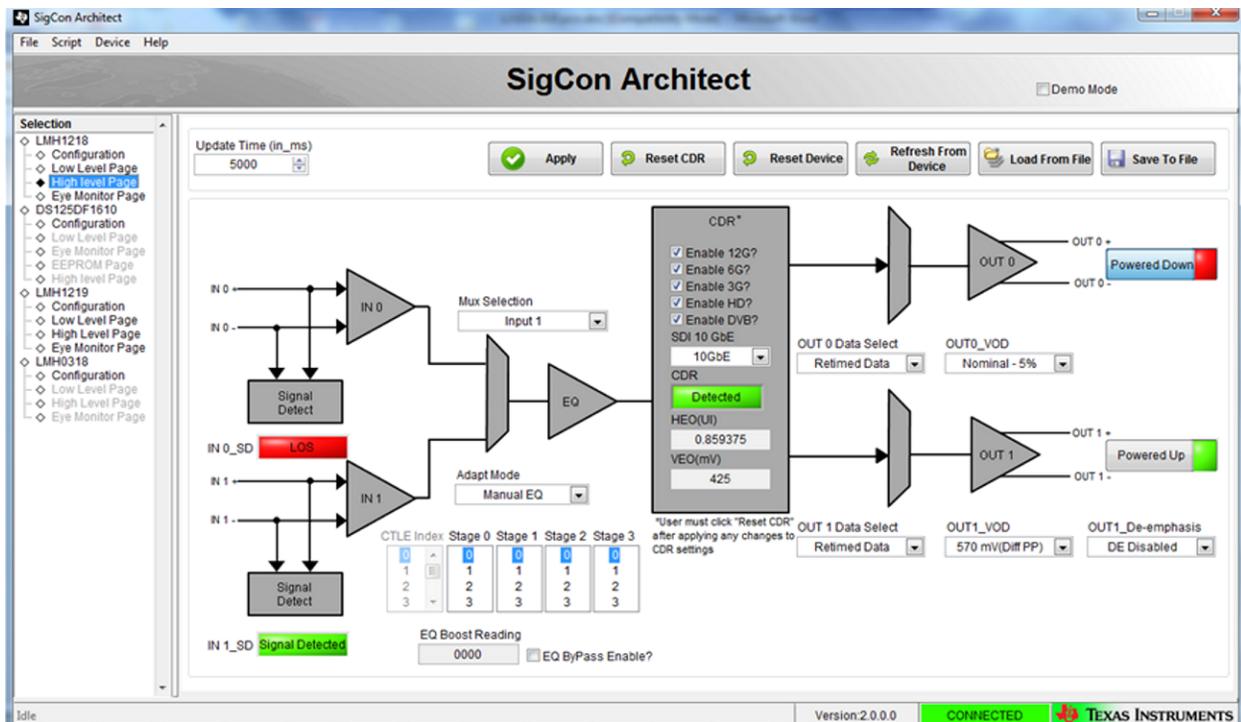
Figure 18. LMH1218 10-GbE GUI Setup

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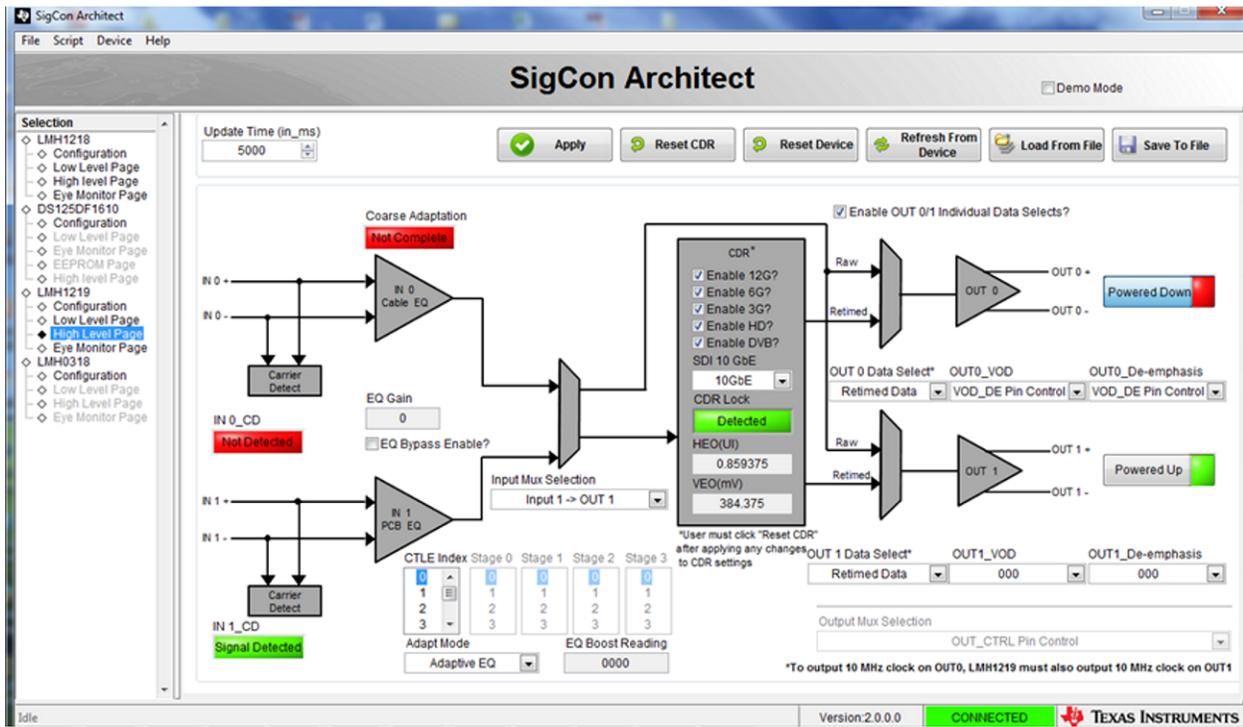
Figure 19. LMH1219 10-GbE GUI Setup

[Figure 20](#) shows a 10.3125-GbE eye diagram at point 1, as indicated in [Figure 17](#).
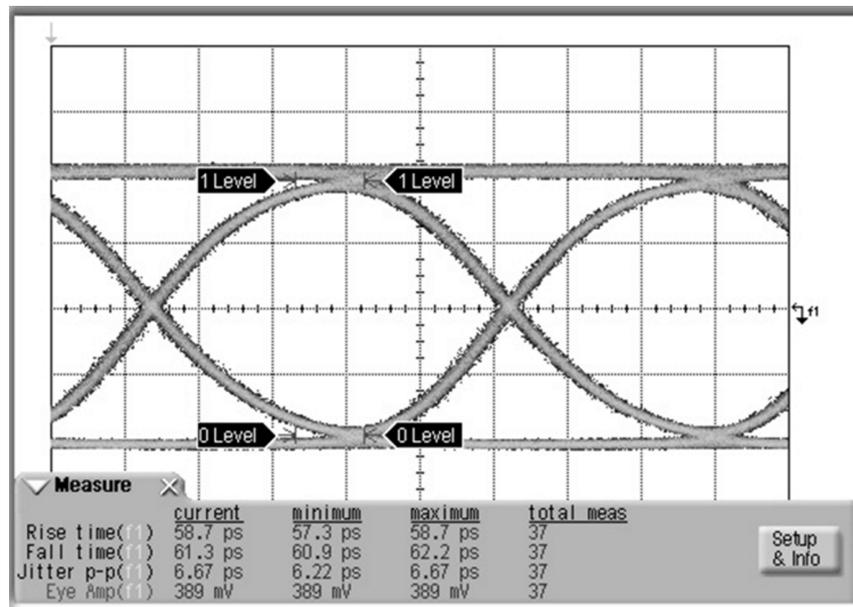
Figure 20. Output Eye Diagram PRBS10 10.3125 Gbps at Point 1

Table 2 shows the output jitter measurements for dual media coax and optical fiber.

Table 2. Output Jitter Measurements for Dual Media

MEDIA	POINT MEASURED	DATA RATE (Gbps)	RISE TIME (ps)	FALL TIME (ps)	EYE AMPLITUDE	JITTER p-p (ps)	JITTER (UI)
75-Ω coax	3	11.88	39	40	800	17	0.2
75-Ω coax	6	11.88	40	44	432	15	0.17
75-Ω coax	6	5.94	43	44	483	13	0.07
75-Ω coax	5	11.88	43	46	579	15	0.17
75-Ω coax	5	2.97	44	44	680	13	0.03
75-Ω coax	5	1.485	47	47	701	22	0.03
FIBER	1	10.3125	59	62	389	7	0.04

The 12G SDI cable reach is normally within 70 m to 80 m. As the results show, the TIDA-00428 device can be used as a repeater or reclocker between two pieces of 12G SDI equipment to enable a cable reach beyond 140 m. The device can also be used in 10-GbE optical fiber applications. This test demonstrates the ability of the TIDA-00428 to enable a much longer cable reach.

> **NOTE:** The board draws approximately 30 mA of current without the connection of any SFP optical modules or SDI signals.

5 Design Files

5.1 Schematics

To download the schematics, see the design files at TIDA-00428.

5.2 Bill of Materials

To download the bill of materials (BOM), see the design files at TIDA-00428.

5.3 Layout Prints

To download the layer plots, see the design files at TIDA-00428.

5.4 Altium Project

To download the Altium project files, see the design files at TIDA-00428.

5.5 Gerber Files

To download the Gerber files, see the design files at TIDA-00428.

5.6 Assembly Drawings

To download the assembly drawings, see the design files at TIDA-00428.

6 Software Files

To download the software files, see the design files at TIDA-00428.

7 References

1. Texas Instruments, *Two-Port 40- and 100-GbE QSFP28 Signal Conditioner Reference Design*, TIDA-00427 Design Guide (TIDUBG6)

Revision History

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

Changes from Original (July 2016) to A Revision   **Page**

- Deleted the TPS75725 device from the *Design Resources* table 1

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