Keywords: PRBS, pseudo-random bit sequence, serializer, deserializer, eye diagram, ECU, bit error rate tester, BERT, continuous PRBS, PRBS pattern length, JAE connector

APPLICATION NOTE 4254

PRBS Mode Setup for the MAX9257/MAX9258 Evaluation Kit

Jun 26, 2008

Abstract: The following application note details how to utilize the internal bit error-rate testing (BERT) feature of the MAX9257/MAX9258 serializer/deserializer (SerDes) in its pseudorandom bit sequence (PRBS) mode. This integrated feature of the SerDes chipset allows quick verification of full functionality of the link, and allows a first look at the quality of the signal transmission across the link without requiring the system engineer to design a BER/PRBS system.

Applications that use a serializer/deserializer (SerDes) often require the designer to check the quality of the link by comparing the transmitted data with the received data. One way to analyze the quality of the link is by generating an eye diagram for the worst-case pattern pseudorandom bit sequence (PRBS). The eye diagram provides an abundance of information about potential problems in a SerDes system, such as excessive reflections, impedance mismatch, and nonideal termination of the differential link. However, it should always be checked for bit errors as well.

The MAX9257/MAX9258 SerDes chipset features an internal PRBS function that allows a user to check the quality of the link and determine if and especially how many bit errors have been logged for a given time, bit pattern, and data-transmission rate. This application note details how to set up the MAX9257/MAX9258 evaluation (EV) kit for this internal PRBS test with bit-error analysis, and compares test results for 0.5m and 2m shielded cables.

This application note assumes that the reader is familiar with and in possession of a MAX9257/MAX9258 EV kit (**Figure 1**). Data sheets for the chipset and the EV kit can be obtained through Maxim's website.

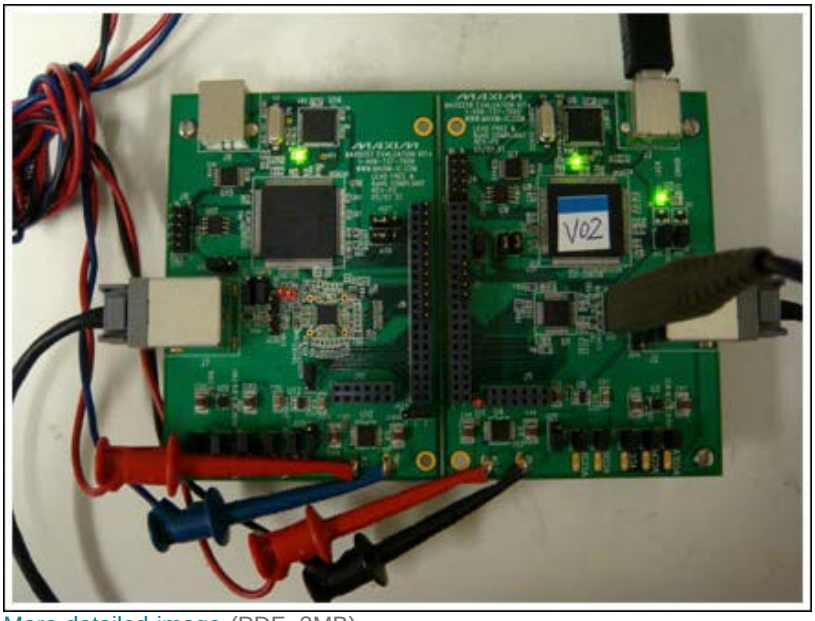

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Figure 1a. MAX9257/MAX9258 EV kit with JAE cable link locked.

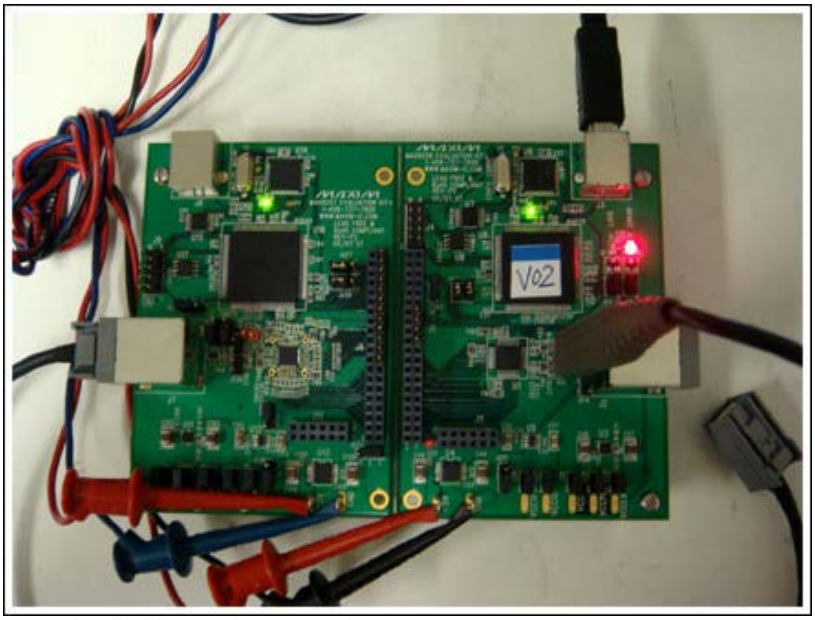

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Figure 1b. MAX9257/MAX9258 EV kit with JAE cable link unlocked/in error (the link is severed).

To begin the testing procedure, follow these guidelines to power up the EV kit and start the software.

1. Verify that all the jumpers are set in their default positions. For default shunt positions, see Table 1 in the manual that came with the MAX9257/MAX9258 EV kit.
2. Connect a 5V power supply to the 5V and GND pads on both sides of the EV kit board. **Keep the power turned off until all connections are made and all jumper positions have been verified.**
3. Connect the JAE cable between J2 and J7.
4. Connect the USB cable between the PC and J3 (attention: not J8).
5. Download the most recent version of the MAX9257/MAX9258 EV kit software.
6. Install the MAX9257/MAX9258 EV kit software on your computer by running the INSTALL.EXE program. The

program files are copied and icons are created in the Windows® **Start** menu.

7. Start the **MAX9257_8 Evaluation Kit** program by opening its icon in the **Start** menu.
8. Click the **Yes** button when asked if the ECU remotely wakes up the MAX9257. The software main window appears as shown in **Figure 2**.

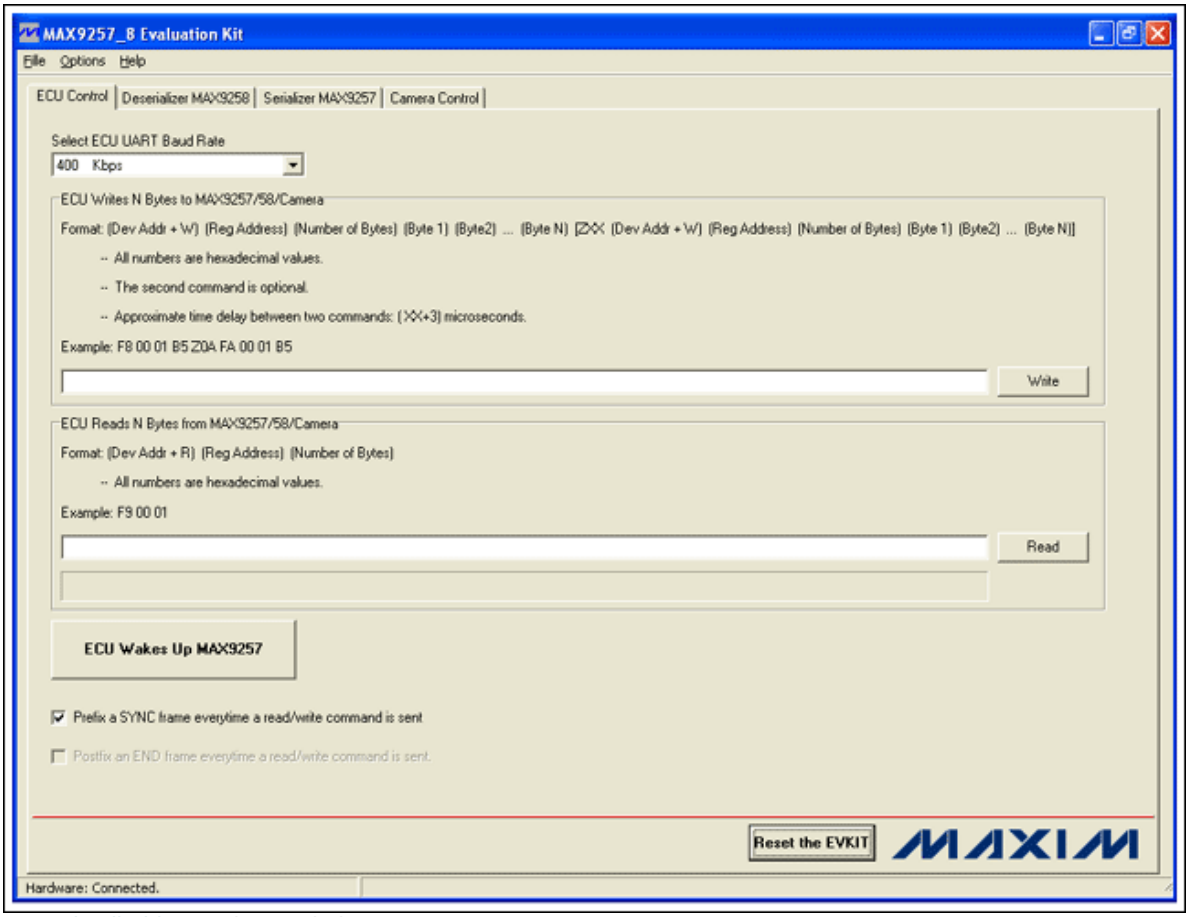

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*Figure 2. On the start-up screen, click on **ECU Wakes Up MAX9257** button to wake up the serializer. Ensure that your EV kit is connected by checking the comment in the lower left corner of the start-up screen.*

9. Verify that the **Hardware Connected** message is displayed on the status bar (lower left corner) of the software's main window. This indicates the EV kit's proper connection.
10. Click the **ECU Wakes Up MAX9257** button on the **ECU Control** tab sheet.
11. Next, click on the **Camera Control** tab to verify your EV kit's start-up clock frequency in default mode (PCLK = PRATE = 30MHz). (See **Figure 3**.)

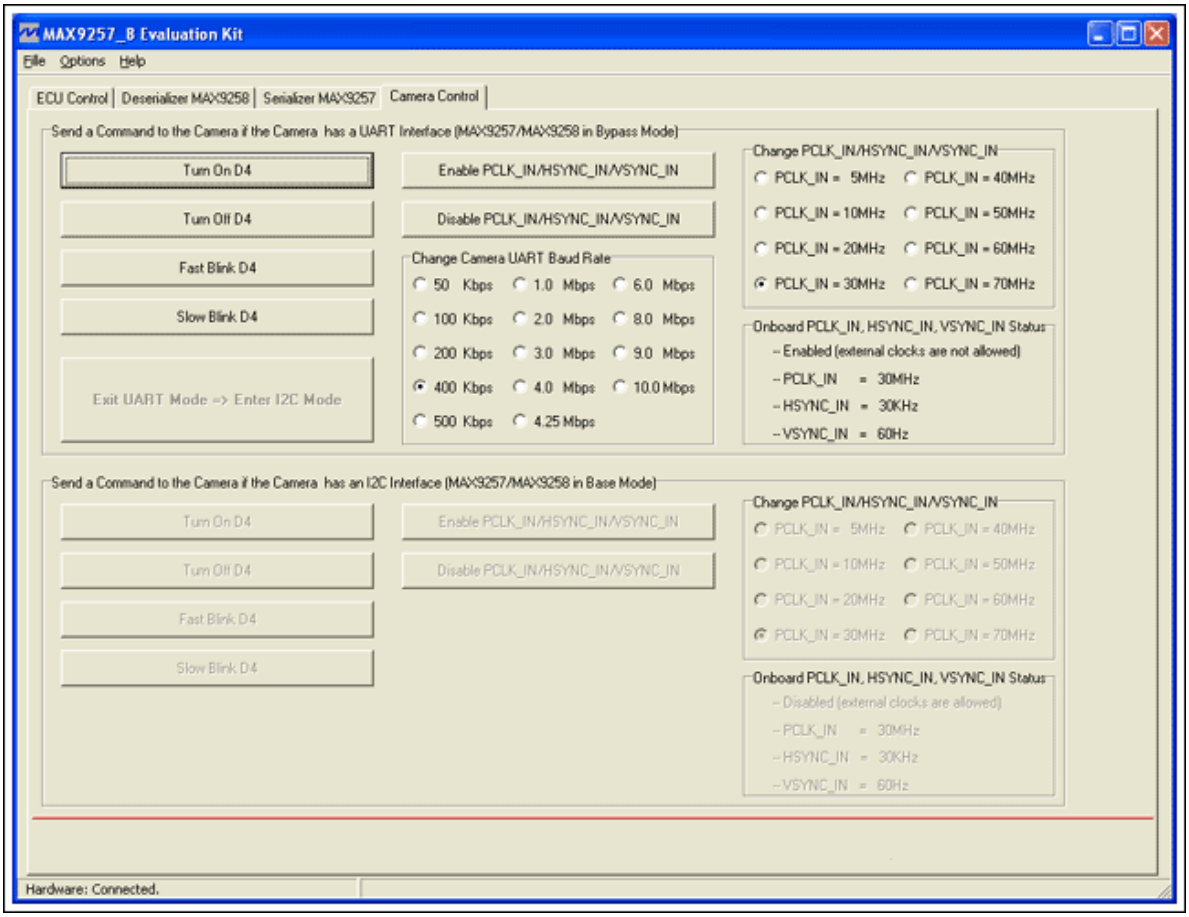

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*Figure 3. **Camera Control** tab sheet depicts the default clock frequency of 30MHz (the basis for this application note).*

12. Click the **Enable PCLK_IN/HSYNC_IN/VSYNC_IN** button, and verify that LOCK indicator LED (D1) turns on. If it lights up (green), this means that the system is locked (as in Figure 1b).
13. Once the clock frequency has been verified, click the **Deserializer MAX9258** tab to move to the **Deserializer MAX9258** tab sheet (**Figure 4**).

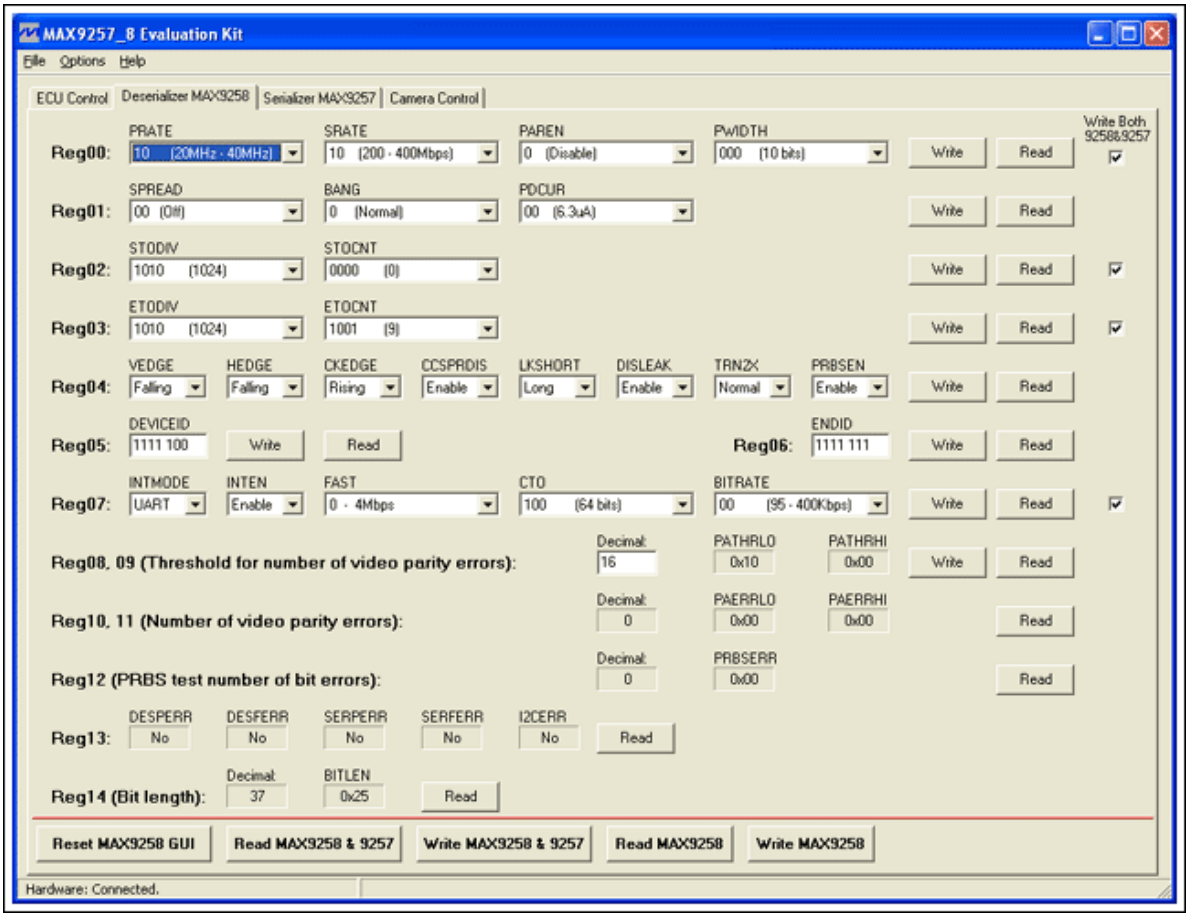

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*Figure 4. **Deserializer MAX9258** tab sheet shows the MAX9258 register setup for continuous PRBS mode.*

14. Click **Read MAX9258 & 9257** button to read all of the MAX9258 and MAX9257 registers.
15. For this example, set register 00 for both the MAX9258 and the MAX9257. For the permanent PRBS and BER test, a 10-bit pattern width was selected. Set **PWIDTH** to **000** (10 bits) and click the **Write** button on the right side of **Reg00**.
16. With a 30MHz parallel data rate (**PRATE; serializer**), the serial data rate (**SRATE; deserializer**) needs to be changed to 200Mbps to 400Mbps in register 00. To make this change, set **SRATE** to **10** and click the **Write** button on the right side of **Reg00**.
17. Next, set **ETOCNT** in both MAX9258's register 03 and MAX9257's register 03 to **1001** by selecting the **ETOCNT** dropdown menu; then click the **Write** button on the right side of **Reg03**.
18. Set CTO in both MAX9258's register 07 and MAX9257's register 08 to **100** by selecting the **CTO** dropdown menu and click the **Write** button on the right side of **Reg07**.
19. Next, enable the PRBS mode by selecting **Enable** from the dropdown menu of **PRBSEN** in **Reg04**; then click the **Write** button on the right side of **Reg04**.
20. Click the **Serializer MAX9257** tab to move to the **Serializer MAX9257** tab sheet (shown in **Figure 5**).

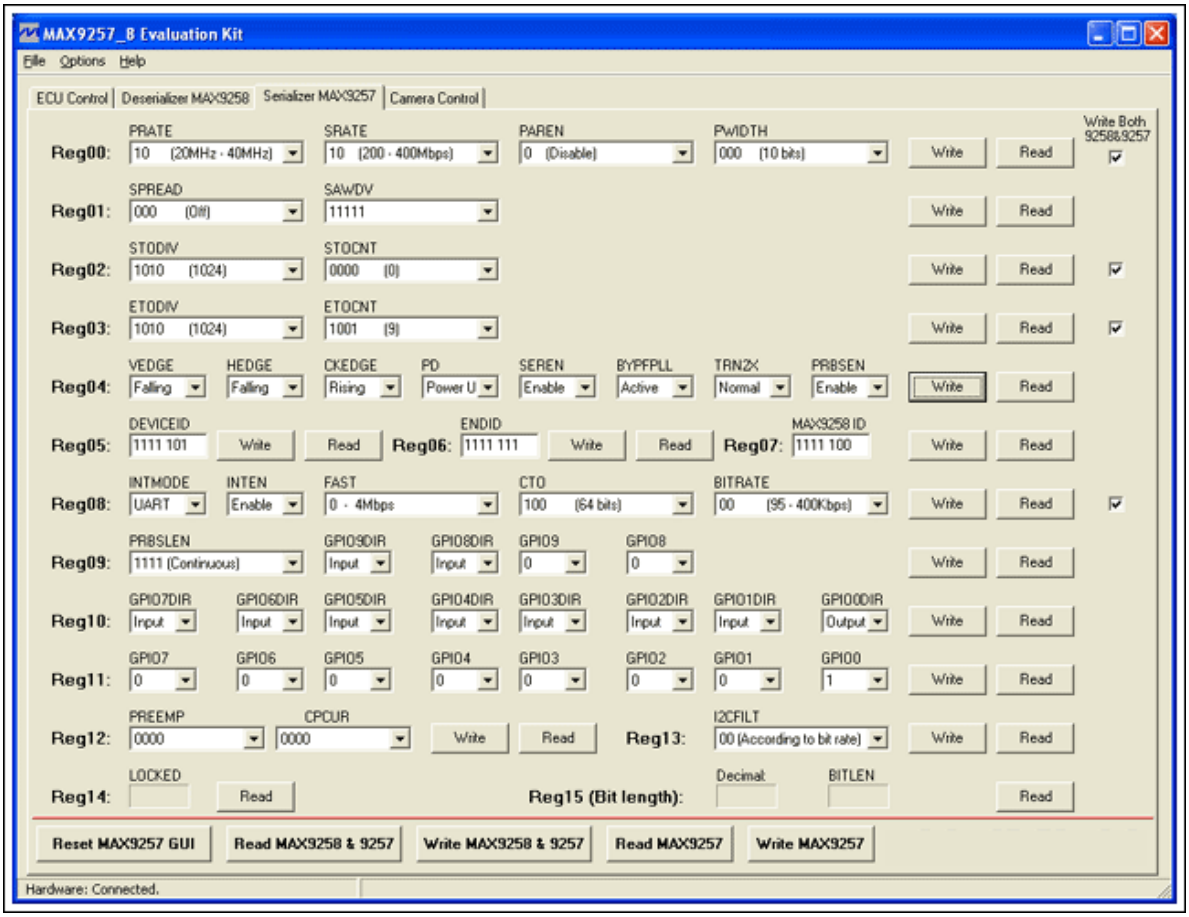

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*Figure 5. The **Serializer MAX9257** tab sheet provides the MAX9257 register setup for continuous PRBS mode.*

21. Enable the PRBS mode by selecting **Enable** from the dropdown menu of **PRBSEN** in **Reg04**, then click the **Write** button on the right side of **Reg04**.
22. Select the desired **PRBS** length from **Reg09**. For this application note, continuous PRBS mode was selected. Set **PRBSLEN** to **1111** for permanent PRBS mode and click the **Write** button on the right side of **Reg09**. Note that this mode can only be exited by powering down the EV kit and resetting its software.
23. Enable the MAX9257 SEREN bit by selecting the **SEREN** dropdown menu and clicking the **Write** button to the right of **Reg04**.

Use a multichannel oscilloscope to check the waveforms during the evaluation of this board. By setting the trigger accordingly, single transmit/receive sequences and data sent across the link can be observed.

For this application note, the BER test was conducted for cable lengths of 0.5m and 2m, as well as for two resolution rates (10 bit and 12 bit). In addition to these BER tests (with the MAX9257/MAX9258's integrated BER test configuration), the signal quality of the deserializer link was monitored and logged through eye diagram measurements (see **Figures 6** and **7** for continuous PRBS mode only).

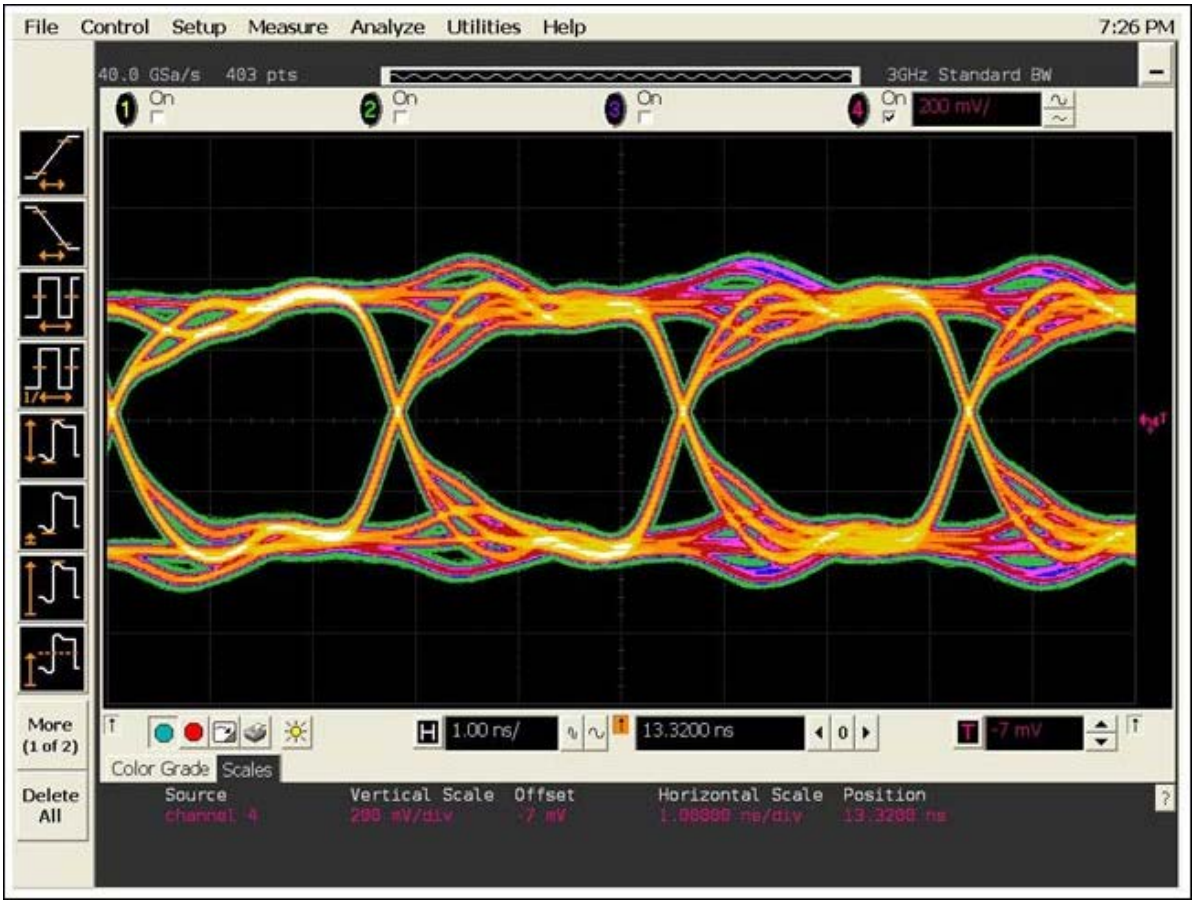

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Figure 6. Permanent PRBS mode—eye diagram, JAE connector 0.5m.

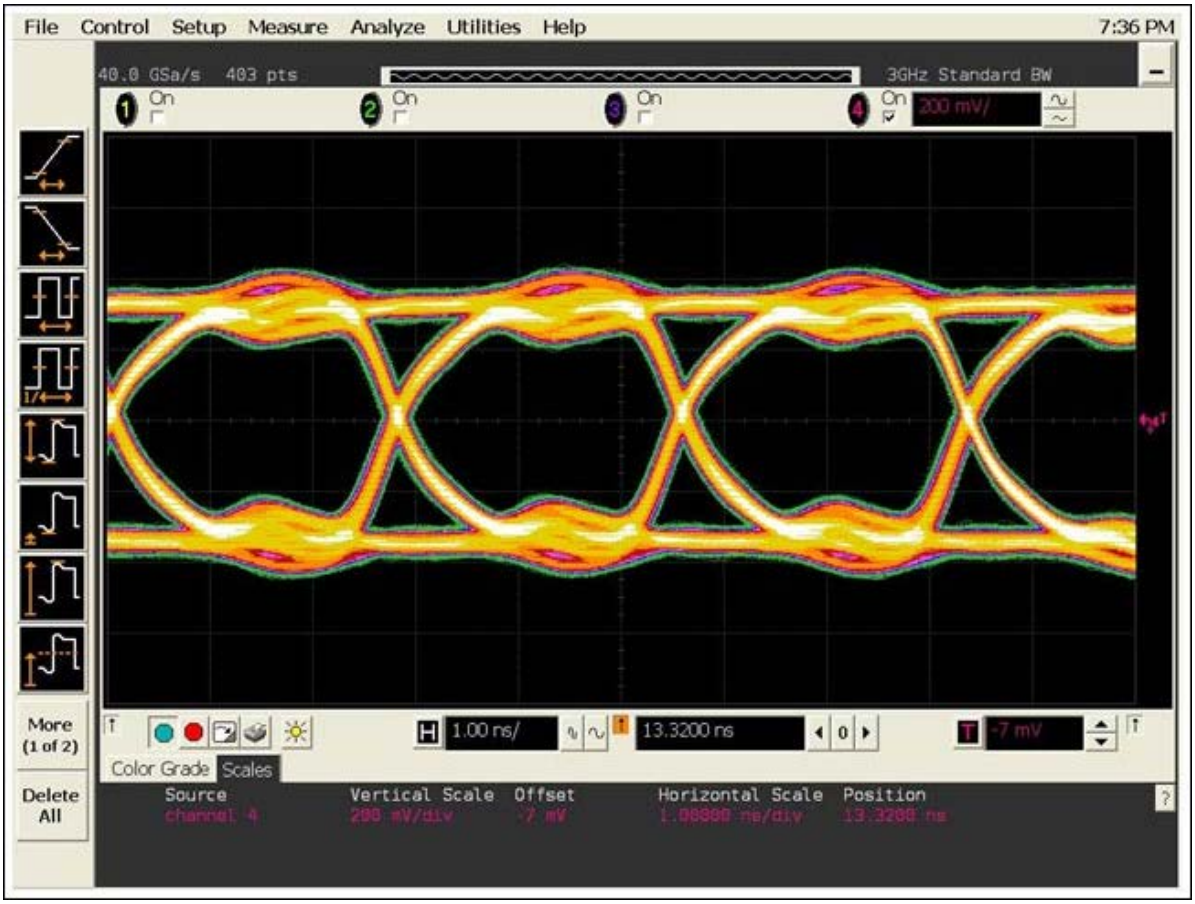

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Figure 7. Permanent PRBS mode—eye diagram, JAE connector 2m.

For the BER tests under the aforementioned cable and resolution conditions, the EV kit's internal BER tester was utilized with different PRBS pattern lengths. The contents of **Reg12** on the **Deserializer MAX9258** tab sheet can be polled (click on the **Read** button to the right of the **PRBSERR** cell) to check on the number of bit errors that have been logged during each run of the individually programmed PRBS pattern lengths.

Tables 1 and **2** depict the BER test results for the 10-bit and 12-bit pattern lengths at a 30MHz transmit clock with shielded 0.5m and 2m JAE cables.

Table 1. 10- and 12-Bit Resolutions for 0.5m Cable

10-Bit Resolution				12-Bit Resolution			
PRBS Pattern	Length (m)	Shielded	Errors	PRBS Pattern	Length (m)	Shielded	Errors
2^{21}	0.5	Yes	0	2^{21}	0.5	Yes	0
2^{22}	0.5	Yes	0	2^{22}	0.5	Yes	0
2^{23}	0.5	Yes	0	2^{23}	0.5	Yes	0
2^{24}	0.5	Yes	0	2^{24}	0.5	Yes	0
2^{25}	0.5	Yes	0	2^{25}	0.5	Yes	0
2^{26}	0.5	Yes	0	2^{26}	0.5	Yes	0
2^{27}	0.5	Yes	0	2^{27}	0.5	Yes	0
2^{28}	0.5	Yes	0	2^{28}	0.5	Yes	0

2^{29}	0.5	Yes	0	2^{29}	0.5	Yes	0
2^{30}	0.5	Yes	0	2^{30}	0.5	Yes	0
2^{31}	0.5	Yes	0	2^{31}	0.5	Yes	0
2^{32}	0.5	Yes	0	2^{32}	0.5	Yes	0
2^{33}	0.5	Yes	0	2^{33}	0.5	Yes	0
2^{34}	0.5	Yes	0	2^{34}	0.5	Yes	0
2^{35}	0.5	Yes	0	2^{35}	0.5	Yes	0

Table 2. 10- and 12-Bit Resolutions for 2m Cable

10-Bit Resolution				12-Bit Resolution			
PRBS Pattern	Length (m)	Shielded	Errors	PRBS Pattern	Length (m)	Shielded	Errors
2^{21}	2	Yes	0	2^{21}	2	Yes	0
2^{22}	2	Yes	0	2^{22}	2	Yes	0
2^{23}	2	Yes	0	2^{23}	2	Yes	0
2^{24}	2	Yes	0	2^{24}	2	Yes	0
2^{25}	2	Yes	0	2^{25}	2	Yes	0
2^{26}	2	Yes	0	2^{26}	2	Yes	0
2^{27}	2	Yes	0	2^{27}	2	Yes	0
2^{28}	2	Yes	0	2^{28}	2	Yes	0
2^{29}	2	Yes	0	2^{29}	2	Yes	0
2^{30}	2	Yes	0	2^{30}	2	Yes	0
2^{31}	2	Yes	0	2^{31}	2	Yes	0
2^{32}	2	Yes	0	2^{32}	2	Yes	0
2^{33}	2	Yes	0	2^{33}	2	Yes	0
2^{34}	2	Yes	0	2^{34}	2	Yes	0
2^{35}	2	Yes	0	2^{35}	2	Yes	0

Related Parts		
MAX9257	Programmable Serializer/Deserializer with UART/I²C Control Channel	Free Samples
MAX9258	Programmable Serializer/Deserializer with UART/I²C Control Channel	Free Samples

More Information
For Technical Support: http://www.maximintegrated.com/support
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