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#### APPLICATION NOTE 4113

## Guidelines for MAX9257/MAX9258 EV Kit Operation in I<sup>2</sup>C Mode

*Abstract: Evaluating serializer/deserializer (SerDes) components prior to their selection for a desired application is crucial for a successful hardware design. The guidelines provided in this application note allow speedy setup of the MAX9257/MAX9258 EV kit in I<sup>2</sup>C mode and show step-by-step screen captures of each change to the graphic user interface (GUI). Following these instructions, you should have a setup running in I<sup>2</sup>C mode very quickly.*

The following information provides insight into the test setup that utilizes the full functionality and features of the [MAX9257/MAX9258](#) EV kit. As a specific example, the I<sup>2</sup>C mode was chosen. Before implementing this mode, follow the general guidelines to power up the EV kit and start the software. **This application note assumes that the user is already in possession and familiar with the use of the MAX9257/MAX9258 EV kit. Note that the MAX9257/MAX9258 EV kit is a "by-request-only" EV kit.**

1. Verify that all the jumpers are set in their default positions, which can be seen in **Table 1**.

**Table 1. MAX9257/MAX9258 EV Kit Jumper Settings**

JU1	Shunted	Active-low PD pin is pulled up to $V_{CC}$ by a 1k $\Omega$ resistor
JU2	Open	LVDS line-probing connector
JU3	Open	LVDS line-probing connector
JU4	Shunted	Active-low ERROR pin is pulled up to $V_{CCOUT}$ by a 1k $\Omega$ resistor
JU5	Shunted	LOCK pin is pulled up to $V_{CCOUT}$ by a 1k $\Omega$ resistor
JU6	Shunted	MAX9258 $V_{CC}$ is connected to an on-board LDO +3.3V output
JU7	Shunted	MAX9258 $V_{CCOUT}$ is connected to an on-board LDO +3.3V output
JU8	Shunted	MAX9258 $V_{CCPLL}$ is connected to an on-board LDO +3.3V output
JU9	Shunted	MAX9258 $V_{CCSPLL}$ is connected to an on-board LDO +3.3V output
JU10	Shunted	MAX9258 $V_{CCLVDS}$ is connected to an on-board LDO +3.3V output
JU11	Shunt across pins 2-3	MAX9258 is powered by an on-board LDO (U4), whose input is +5V
JU14	Shunt across pins 2-3	LVDS cable line 1 is connected to ground
JU15	Shunted	MAX9258 RX pin is connected to the on-board emulating ECU Rx line
JU16	Shunted	MAX9258 TX pin is connected to the on-board emulating ECU Tx line
JU17	Shunt across pins 2-3	MAX9257 SCL/TX pin is pulled up to $V_{CCIO}$
JU18	Shunt across pins 2-3	MAX9257 SDA/RX pin is pulled up to $V_{CCIO}$
JU19	Shunted	MAX9257 $V_{CC}$ is connected to an on-board LDO +3.3V output
JU20	Shunted	MAX9257 $V_{CCIO}$ is connected to an on-board LDO +3.3V output
JU21	Shunted	MAX9257 $V_{CCFPLL}$ is connected to an on-board LDO +3.3V output
JU22	Shunted	MAX9257 $V_{CCSPLL}$ is connected to an on-board LDO +3.3V output
JU23	Shunted	MAX9257 $V_{CCLVDS}$ is connected to an on-board LDO +3.3V output
JU24	Shunt across pins 2-3	J6 connector has one side connected to ground
JU25	Shunt across pins 2-3	MAX9257 REM pin is connected to ground
JU26	Shunt across pins 1-2	MAX9257 SCL/TX pin is connected to the on-board emulating camera Rx line
JU27	Shunt across pins 1-2	MAX9257 SDA/RX pin is connected to the on-board emulating camera Tx line
JU29	Shunt across pins 2-3	LVDS cable line 1 is connected to ground
JU30	Open	LVDS line-probing connector
JU31	Open	LVDS line-probing connector

2. Connect a 5V-power supply to the 5V and GND pads on both sides of the EV board (**Figure 1**). Keep the power turned off until all connections are made and all jumper positions have been verified.

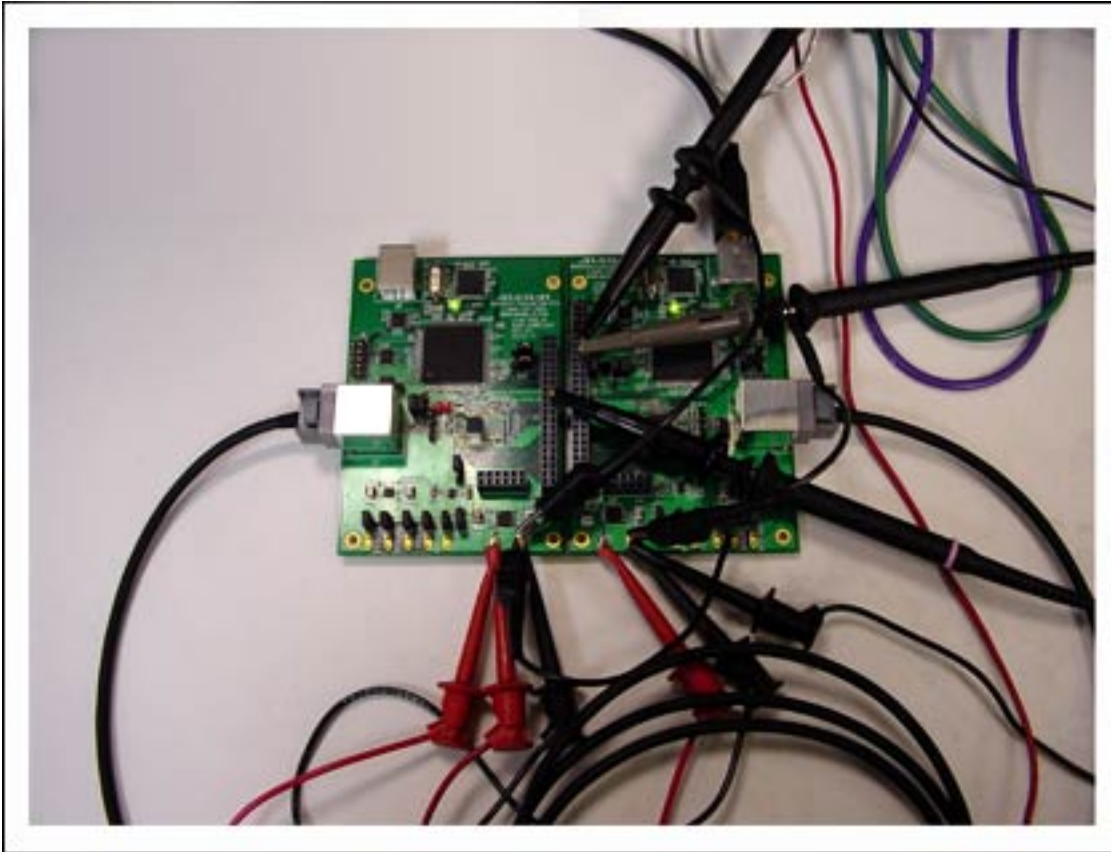
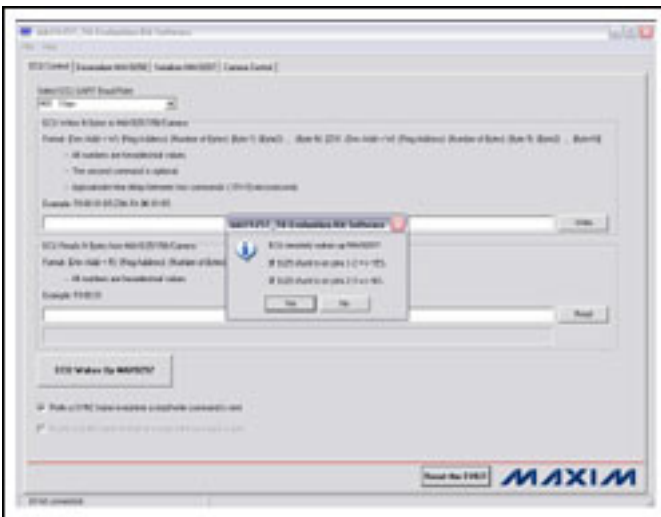


Figure 1. Setup configuration for lab tests.

3. Connect the JAE cable between J2 and J7.
4. Connect CH1 of the oscilloscope to J1-37.
5. Connect CH2 of the oscilloscope to J1-35.
6. Connect CH3 of the oscilloscope to J5-12.
7. Connect the USB cable between the PC and J3 (**note**: not J8).
8. Start the **MAX9257\_58 Evaluation Kit Software** program by opening its icon in the **Start** menu.
9. Click the **Yes** button when asked if ECU remotely wakes up the MAX9257. The software main window appears as shown in **Figure 2**.



[More detailed image](#) (PDF)

Figure 2. The software main window appears when the **Yes** button is clicked to indicate that the ECU remotely wakes up the MAX9257. Once ECU wakes up MAX9257, TxIN, RxOUT, and CCEN all are high.

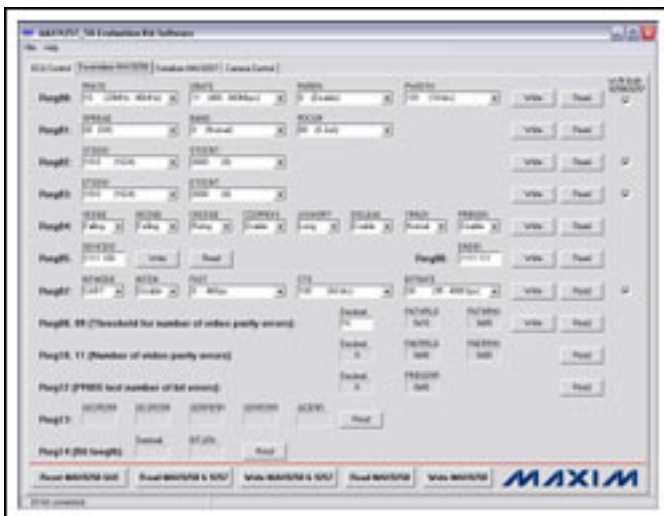
10. Verify that the "EV kit connected." message is displayed on the status bar of the software main window. This indicates the proper connection of the EV kit.
11. Click the **ECU Wakes Up MAX9257** button on the **ECU Control** page (Figure 3).



[More detailed image](#) (PDF)

Figure 3. Click the ECU Wakes Up MAX9257 button.

12. Click the **Deserializer MAX9258** tab to navigate to the **Deserializer MAX9258** page (Figure 4).



[More detailed image](#) (PDF)

Figure 4. Navigate to the Deserializer MAX9258 page.

13. Click **Read MAX9258 & 9257** button to read all of the MAX9258 and MAX9257 registers.
14. Set both MAX9258 register 03 **ETOCNT** and MAX9257 register 03 **ETOCNT** to **0100** by selecting the **ETOCNT** dropdown menu and click **Write** button on the right of **Reg03**.
15. Set both MAX9258 register 07 **CTO** and MAX9257 register 08 **CTO** to **111** by selecting the **CTO** dropdown menu and click **Write** button on the right of **Reg07**.
16. Click the **Serializer MAX9257** tab to navigate to the **Serializer MAX9257** page.
17. Enable the MAX9257 SEREN bit by selecting the **SEREN** dropdown menu and click **Write** button on the right of **Reg04**. Note that the SEREN window should always be activated whenever there is communication on the link.
18. Click the **Camera Control** tab to navigate to the **Camera Control** page.
19. Click the **Slow Blink D4** button; verify that LED D4 flashes for about five seconds.
20. Click the **Enable PCLK\_IN/HSYNC\_IN/VSYNC\_IN** button; verify that LOCK indicator LED D1 turns on. If it turns on, this means that the system is locked.
21. Use your 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.

Now that the general functionality of the board has been verified, the EV kit can be put into I<sup>2</sup>C mode by following the steps below. I<sup>2</sup>C is a desired mode, as it allows the user to maintain control over all control registers and their contents.

If the camera has an I<sup>2</sup>C interface, both the MAX9258 and MAX9257 should be configured to work on an I<sup>2</sup>C interface. Because the onboard emulating camera works on default UART interface, the camera first needs to be switched from its UART interface to its I<sup>2</sup>C interface. Follow the steps below to access the evaluation board's I<sup>2</sup>C interface.

- Start the program or click the **Reset the EVKIT** button on the **ECU Control** page.
- If the MAX9257 REM is set to high (JU25 shunt is set across pins 1-2), click the **ECU Wakes Up MAX9257** button on the **ECU Control** page. If the MAX9257 REM is set to low (JU25 shunt is set across pins 2-3), skip this step.
- Navigate to the **Deserializer MAX9258** page. Click the **Read MAX9258 & 9257** button to refresh the current register values on the GUI. This showcases what were the last-known (or, in case of startup, default) values of the registers.
- Keep the four checkboxes under the **W/R Both 9258&9257** label checked. This allows the SerDes registers to be set up at the same time, allowing the user to eliminate any unwanted discrepancies between SerDes parameter setups.
- Set **t<sub>CTO</sub>** on both MAX9258 and MAX9257 to 64 bits (CTO = 100).
- Navigate to the **Camera Control** page; click the **Exit UART Mode -> Enter I<sup>2</sup>C Mode** button.
- Follow the reminder message—move the shunts from JU26/JU27 pins 1-2 to pins 2-3. Click the **OK** button.
- Now the camera and the SerDes work on the I<sup>2</sup>C interface. You can verify proper functionality and emulation of the camera by testing the on/off and fast/slow blinking features of the D4 diode. Control buttons for this are located on the left side of the software. Navigate to any page and exercise the features (e.g., rewriting to the various accessible registers) of the SerDes.
- The emulating camera's I<sup>2</sup>C interface can operate on speeds up to 4.25MHz, which is the same for the MAX9258 and the MAX9257. Before changing the ECU I<sup>2</sup>C master clock, configure the MAX9258 and the MAX9257 **BITRATE** register bits properly.
- Ensure that **SEREN** is set to **Enabled** if data is to be transmitted through the link.

## Instruments and Components for a Valid Setup to Verify the MAX9257/MAX9258 EV Kit Performance

- Hewlett-Packard E3620A: Dual 0 to 25V, 0 to 1A Power Supply Source
- Tektronix TDS 3014: 4-Channel DSO with 100MHz BW, 1.25Gsps Sampling Speed, and Standard 10x Probes
- Windows® XP-Based PC or Notebook Computer that Supports USB Interfacing
- 2m JAE-Based Cable (for a Valid Link Between the MAX9257 Serializer and MAX9258 Deserializer)

## I<sup>2</sup>C-Mode Communication with the MAX9257/MAX9258 EV Kit Board

This test program describes the steps to communicate with the EV kit board in I<sup>2</sup>C mode. For this mode to work or to be set up properly, the system must first be started in UART interface mode. Setting up the MAX9257/MAX9258 requires that the software be set to INTMODE = I<sup>2</sup>C (make sure to check the box on the right side of the screen to update/write to both of the devices MAX9257 and MAX9258). Writing to the device and conducting a single trigger off the TxIN pin allows capturing the sequence of commands to be written to the device (e.g., setting it up for I<sup>2</sup>C mode). **Figure 5** shows a snapshot of the transmitted (TxIN, CH2) and received (RxIN, CH3) sequence of setting the board up in finite CTO mode, which is the mode that is required to configure the board for I<sup>2</sup>C mode. Note that all these steps are still conducted in UART mode (JU26 and JU27 shunted across pins 1-2).

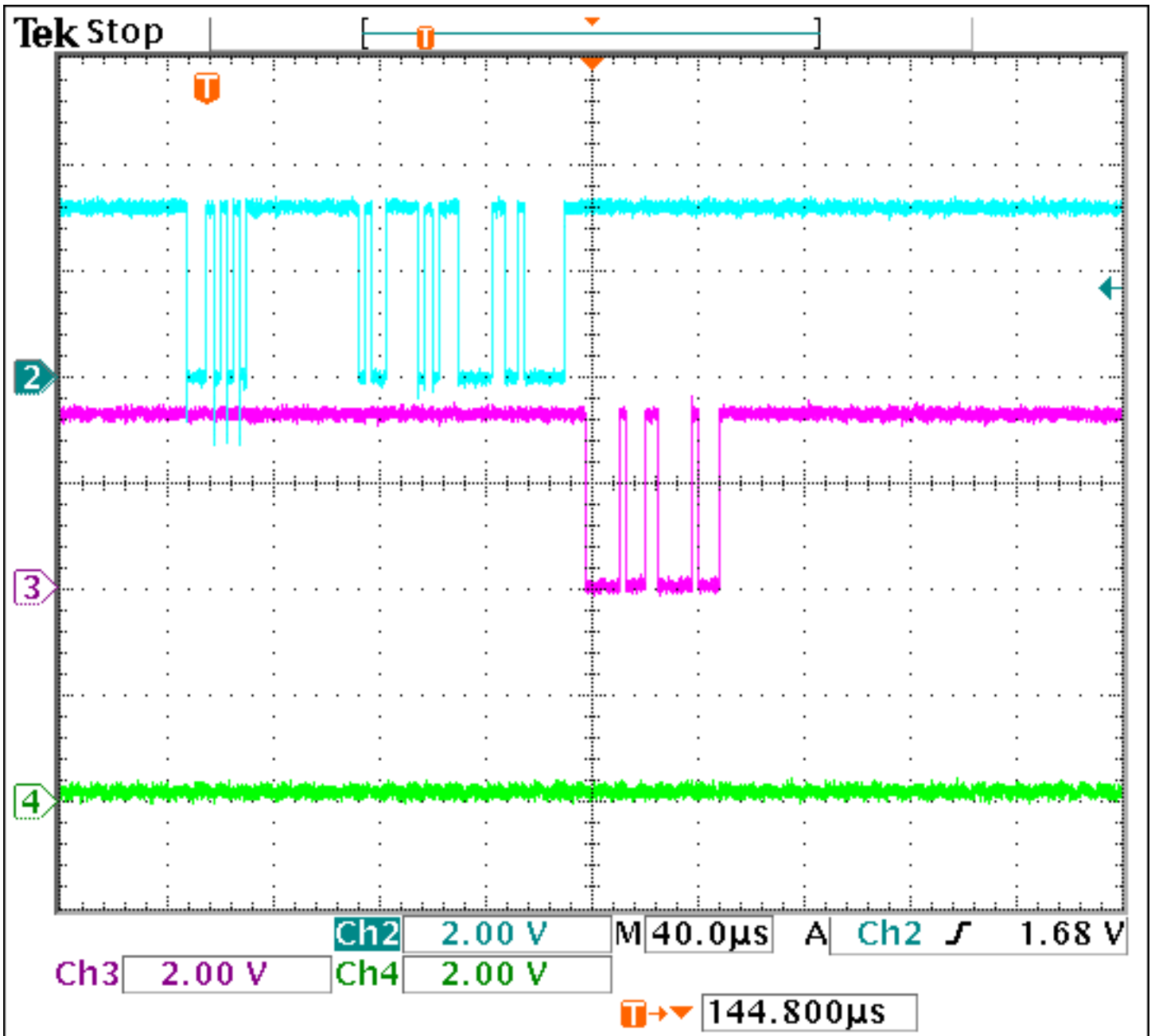
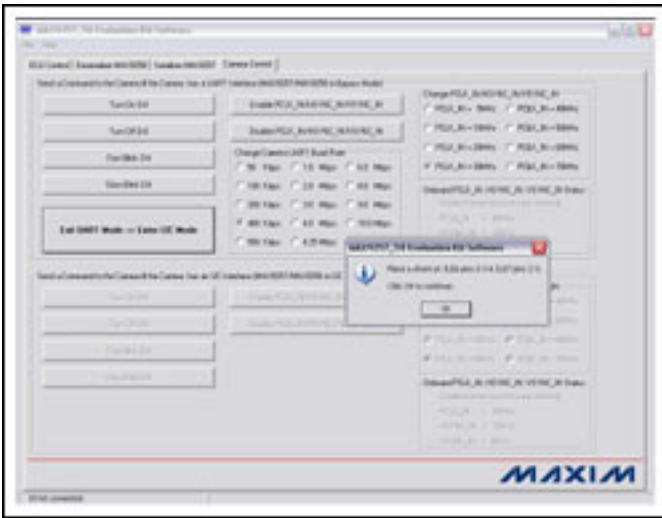


Figure 5. Monitoring RxIN and TxIN with a digital oscilloscope (DSO) shows that the data transmitted over the link is received by the MAX9258.

Once the jumpers have been set, the camera control tab must turn off the UART mode and enter the I<sup>2</sup>C mode: click on **Exit UART Mode -> Enter I<sup>2</sup>C Mode**. For the I<sup>2</sup>C mode to work properly, the JU26 and JU27 must be shunted across pins 2-3—simply follow the instructions that appear in the software popup window (**Figure 6**).



[More detailed image](#) (PDF)

Figure 6. Screen directions for proper I<sup>2</sup>C operation. Make sure that jumpers JU26 and JU27 are shunted to pins 2-3 for I<sup>2</sup>C mode.

Now the system has enabled the lower portion of the **Camera Control** page. As seen in **Figure 7**, the upper portion of the page is grayed out, reflecting that the UART mode is not enabled, though the I<sup>2</sup>C mode is.



[More detailed image](#) (PDF)

Figure 7. The upper portion of the **Camera Control** page is grayed out, indicating that I<sup>2</sup>C mode is enabled.

If you click the buttons on the left side for turning on/off and fast/slow blinking D4, thus emulating camera control, you will see that you have full control in I<sup>2</sup>C mode on the camera side. D4 is located right above the FPGA and close to the microcontroller on the deserializer board.

In order for the link to work properly, you must set up your SerDes and pixel clock links. For test purposes, let us assume we are running the SerDes at a pixel clock rate of 10MHz and a bit resolution of 12 bits (**Figures 8 and 9**).



[More detailed image \(PDF\)](#)

Figure 8. **Serializer MAX9257** page after setting up all parameters.



[More detailed image \(PDF\)](#)

Figure 9. **Camera Control** screen after proper setup.

Note that the SerDes screens are similar and, for the purpose of this application note, only the serializer setup screen has been displayed for the camera mode. Follow the same settings for SerDes screens to operate the system properly in camera mode.

This will result in the settings shown in **Table 2**.

**Table 2. Results of Setting Up the SerDes**

Page Designator	Signal	Setting
Camera Control	PCLK_IN	10MHz
	PRATE	00 (5MHz to 10MHz)
SerDes Control	SRATE	01 (100Mbps to 200Mbps)
	PWIDTH	001 (12 bits)

Make sure to write all these parameters before enabling the PCLK on the **Camera Control** page.

Clicking the **Enable PCLK\_IN/HSYNC\_IN/VSYNC\_IN** button on the **Camera Control** page displays the screen in **Figure 10**. This screen shows a typical transmitting sequence for enabling or disabling the PCLK on the **Camera Control** page. It exists solely for verification purposes and to show how the signals should appear when data is transmitted in I<sup>2</sup>C mode.

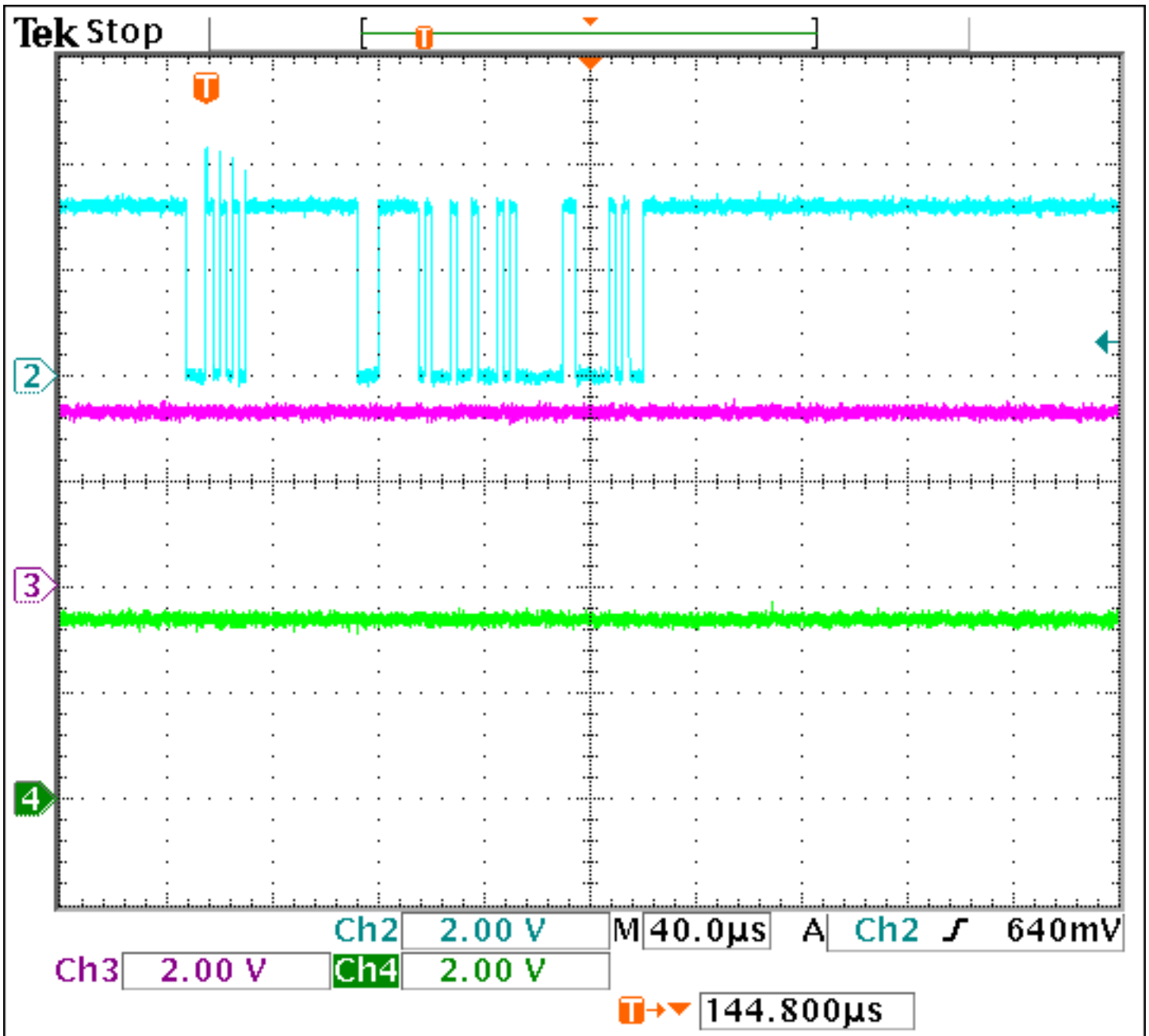


Figure 10. This transmitting sequence illustrates what I<sup>2</sup>C-mode data looks like when PCLK is enabled.

Setting up the deserializer properly should result in the **Figure 11** screen, which shows details on PRATE, SRATE, and PWIDTH. If triggered on the TxIN pin, writing this information to the deserializer produces the **Figure 12** scope screen, which only shows the transmitted information, not the received information.



[More detailed image \(PDF\)](#)

Figure 11. The MAX9258 deserializer is set up properly.

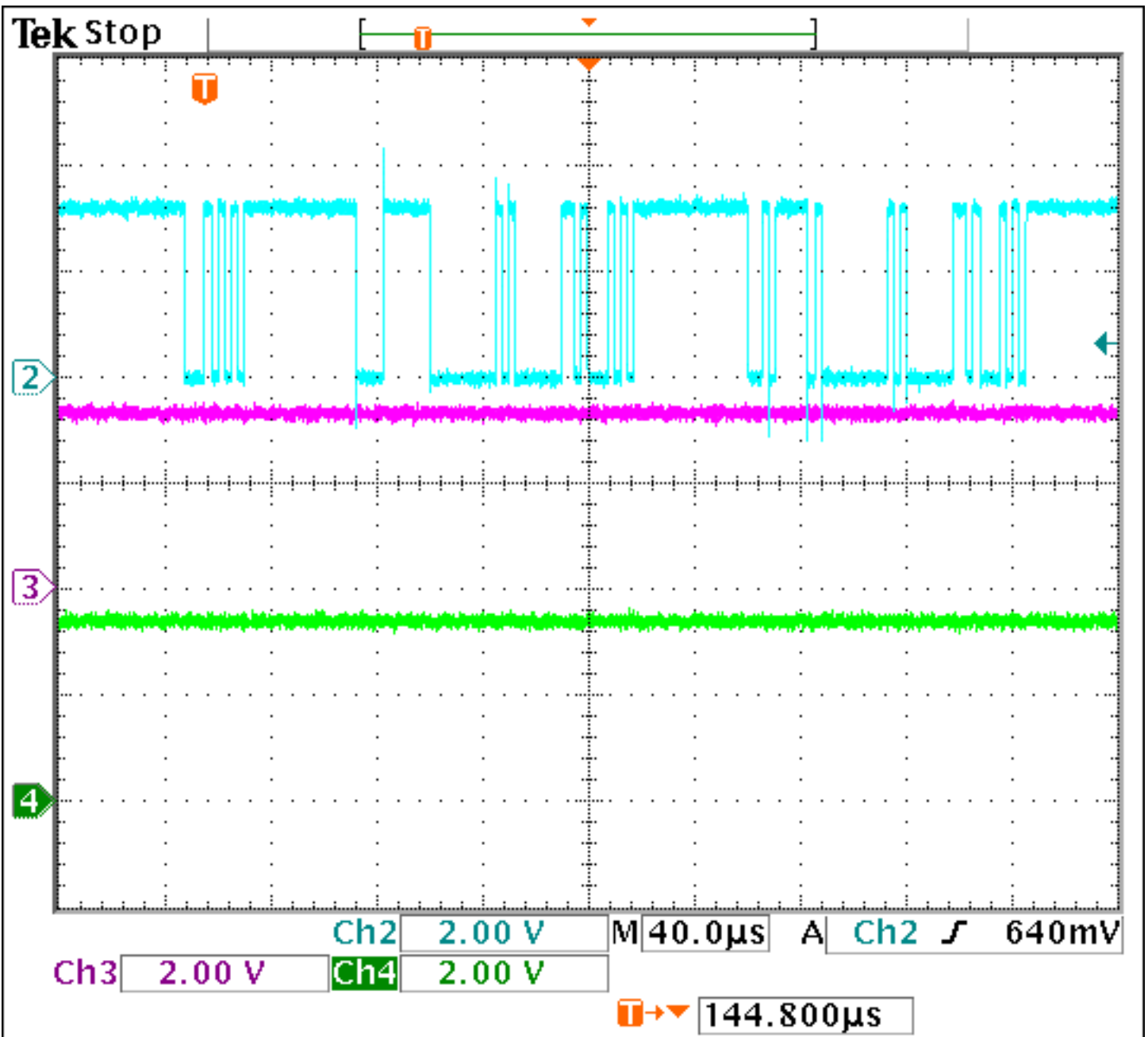


Figure 12. This scope screen shows the transmitted result of writing the appropriate settings to the MAX9258

deserializer.

Likewise, setting up the serializer properly should result in the **Figure 13** screen that shows details on PRATE, SRATE, and PWIDTH. Note that, for proper/any communications, the SEREN bit needs to be enabled on the serializer. Because the I<sup>2</sup>C mode provides highly flexible communication with the interface, the SEREN bit can be enabled even later in the setup.



[More detailed image](#) (PDF)

Figure 13. If the display appears as shown here, the MAX9257 serializer is properly set up. The **Deserializer MAX9258** screen will need to look similar to this screen in order for the system to operate at its full capacity in camera or I<sup>2</sup>C mode.

## Conclusion

From this point, the user can essentially manipulate the screens/bits/registers as needed. If the MAX9257/MAX9258 become nonresponsive, the system may need a reset. Remember to return to the **ECU Control** page, click the **Reset the EVKIT** button, turn off the power supplies, turn them back on, and remotely wake up the MAX9257 again. Start the above procedure again, if you wish to operate in I<sup>2</sup>C mode. Also remember that you will need to reset the two shunts on jumpers JU26 and JU27, because the board resets in UART mode. The UART mode is required to set up the MAX9257/MAX9258 in I<sup>2</sup>C mode after proceeding with finite CTO mode (e.g., set the CTO timing to 64 bits in the CTO register for both the serializer and the deserializer).

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Application Note 4113: [www.maxim-ic.com/an4113](http://www.maxim-ic.com/an4113)

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