Keywords: pulse template, termination, network, termination network, pulse

APPLICATION NOTE 2877

Modifying the pulse shape of DS315x using Test Registers

Dec 04, 2003

Abstract: This application note describes how to modify the pulse shapes of the DS3151, DS3152, DS3153 and DS3154. While the pulse of the DS315x will always be within specification, sometimes the pulse shape is not exactly what the customer would prefer. This application note will describe how to modify the pulse width and the amplitude in T3, E3 and STS-1 mode and the waveshape of the pulse in T3 and STS-1 mode. All of this can be accomplished by changing the values of the internal test registers. The DS3154DK design kit was used to obtain the scope plots used in this application note.

Introduction

This application note describes how to modify the pulse shapes of the DS3151, DS3152, DS3153, and DS3154 (DS315x). While the pulse of the DS315x will always be within specification, sometimes the pulse shape is not exactly what the customer would prefer. This application note describes how to modify the pulse width and the amplitude in T3, E3, and STS-1 mode and how to modify the waveshape of the pulse in T3 and STS-1 mode. All of this can be accomplished by changing the values of the internal test registers. The DS3154DK design kit was used to obtain the scope plots used in this application note.
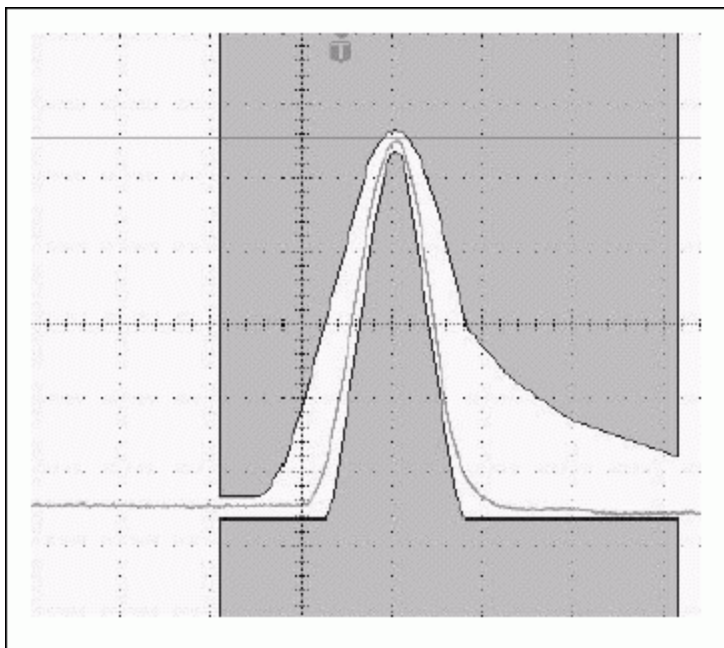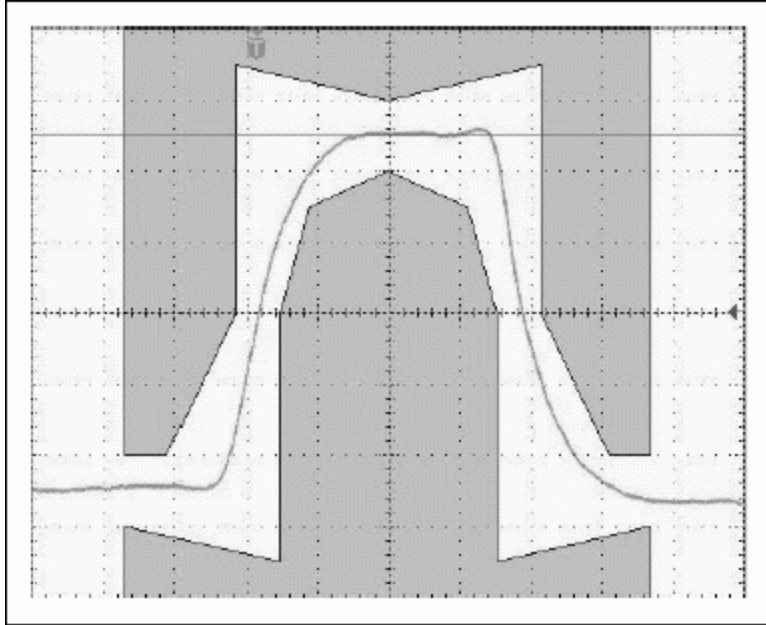
Figure 1. The typical E3 and T3 transmission pulse.

Figure 1 shows the transmitted pulse shape in E3 and T3 mode without the use of test registers. The pulse width and the amplitude of the pulse can be modified in E3, T3, or STS-1 mode by changing the register values of the test registers at address 0Ah for line interface unit (LIU) port 1, 1Ah for LIU port 2, 2Ah for LIU port 3, and 3Ah for LIU port 4.

Modifying the Pulse Width of the Transmission Pulse in E3, T3, or STS-1 Mode

The LIU can use either an 11-stage delay-locked loop (DLL) circuit or a 12-stage DLL circuit. The more

stages present in the DLL, the narrower the pulse width will be, or vice versa. By setting the register addresses 0Ah, 1Ah, 2Ah, and 3Ah (LIU ports 1, 2, 3, and 4, respectively) to a value of 01h, the LIU will use an 11-stage DLL circuit. By setting test register addresses 0Ah, 1Ah, 2Ah, and 3Ah to a value of 02h, the LIU will use a 12-stage DLL circuit.

By default, the E3 mode LIU uses an 11-stage DLL and the TLBO is ignored. In T3 and STS-1 mode, the LIU uses an 11-stage DLL when TLBO = 1 and a 12-stage DLL when TLBO = 0.

In E3 mode, if we want to decrease the pulse width, then we can force the LIU to use a 12-stage DLL by setting the register addresses 0Ah, 1Ah, 2Ah, and 3Ah to 02h for LIU ports 1, 2, 3, and 4, respectively. **Figure 2** shows the transformation for the E3 pulse width from a typical pulse shape to a narrower pulse shape.

In T3 and STS-1 mode, when TLBO = 0, the LIU uses a 12-stage DLL. To increase the pulse width, we can force the LIU to use an 11-stage DLL by setting the register addresses 0Ah, 1Ah, 2Ah, and 3Ah to 01h for LIU ports 1, 2, 3, and 4, respectively. **Figure 3** shows the transformation of the T3 pulse width from a typical pulse to a wider pulse.
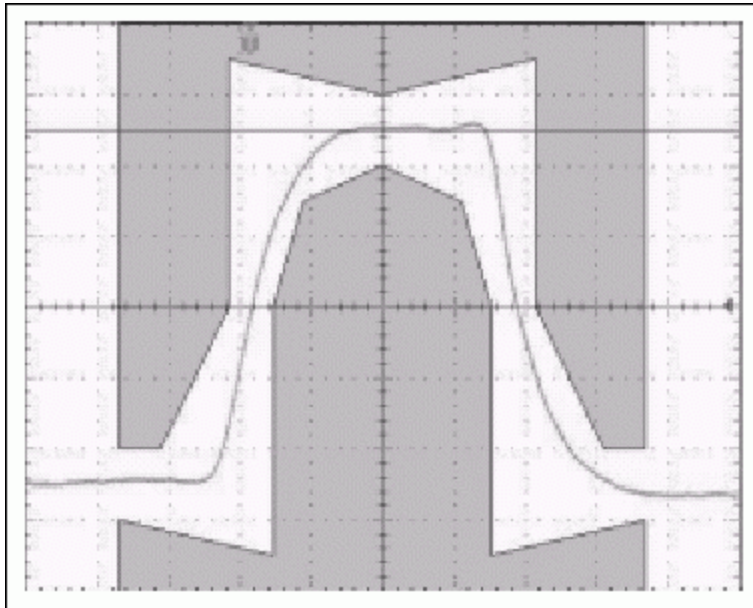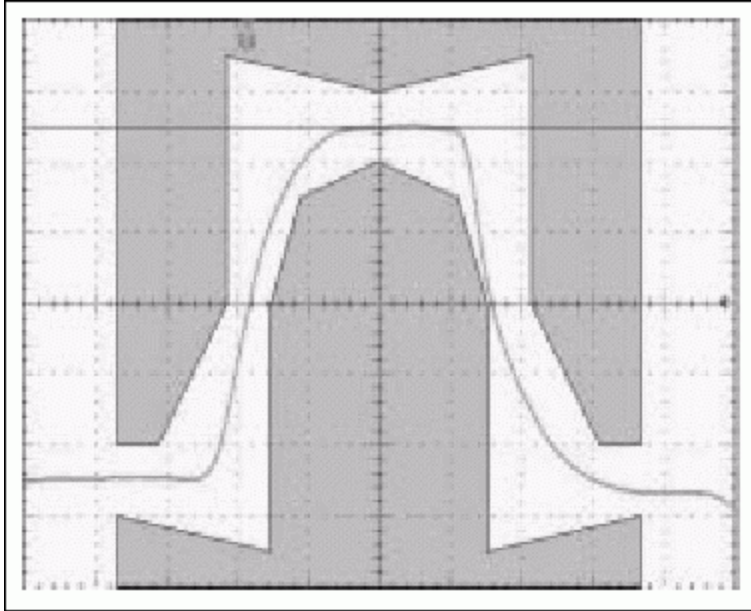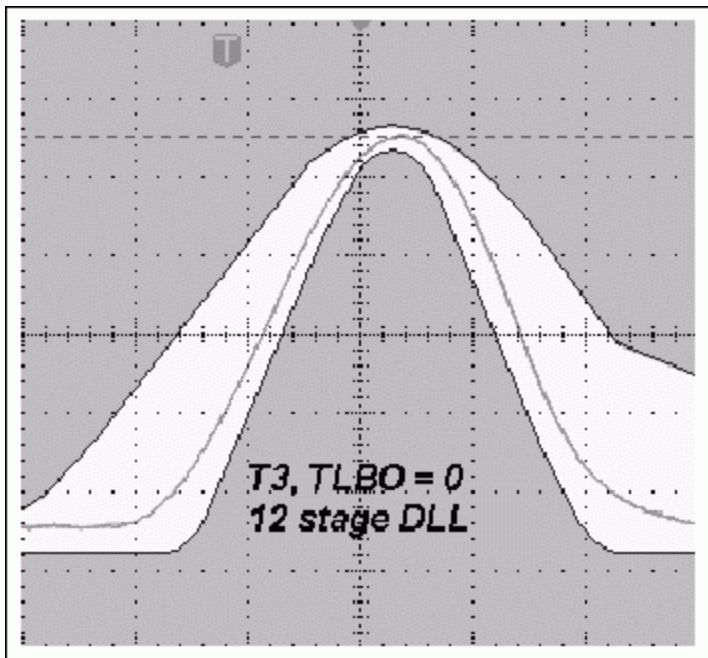
Figure 2. The typical E3 pulse and the narrower E3 pulse using a 12-stage DLL.
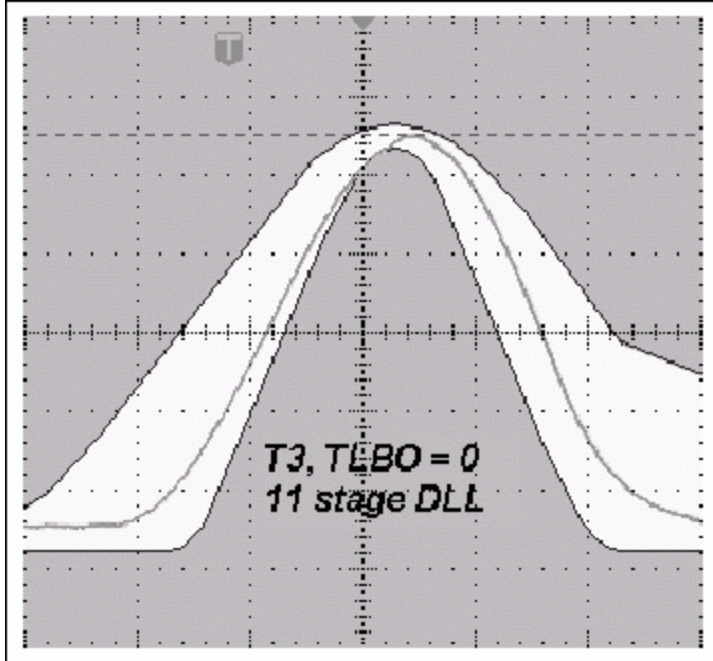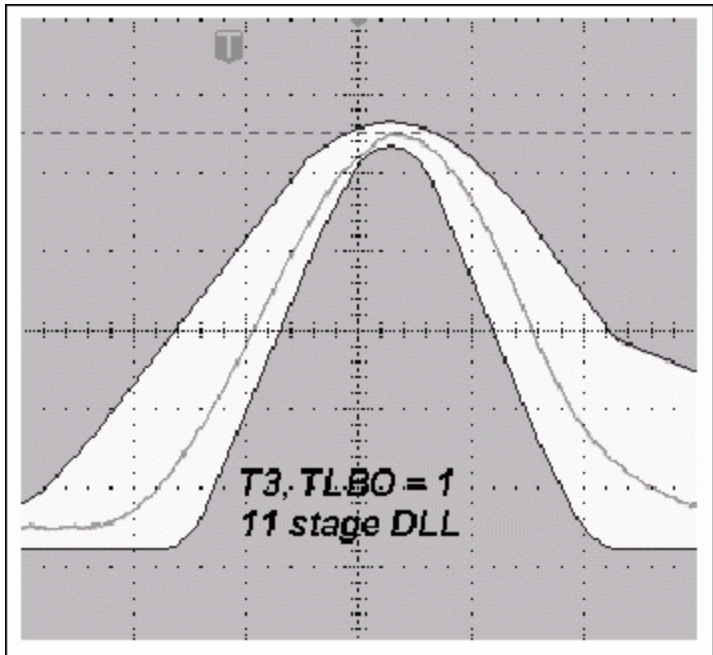
Figure 3. The typical T3 pulse with 12-stage DLL and the wider T3 pulse using an 11-stage DLL when TLBO = 0.

Similarly, in T3 and STS-1 mode, when TLBO = 1, the LIU uses an 11-stage DLL. To decrease the pulse width, we can force the LIU to use a 12-stage DLL by setting the register addresses 0Ah, 1Ah, 2Ah, and 3Ah to 02h for LIU ports 1, 2, 3, and 4, respectively. **Figure 4** shows the transformation of the T3 pulse from a typical pulse shape to a narrower pulse.
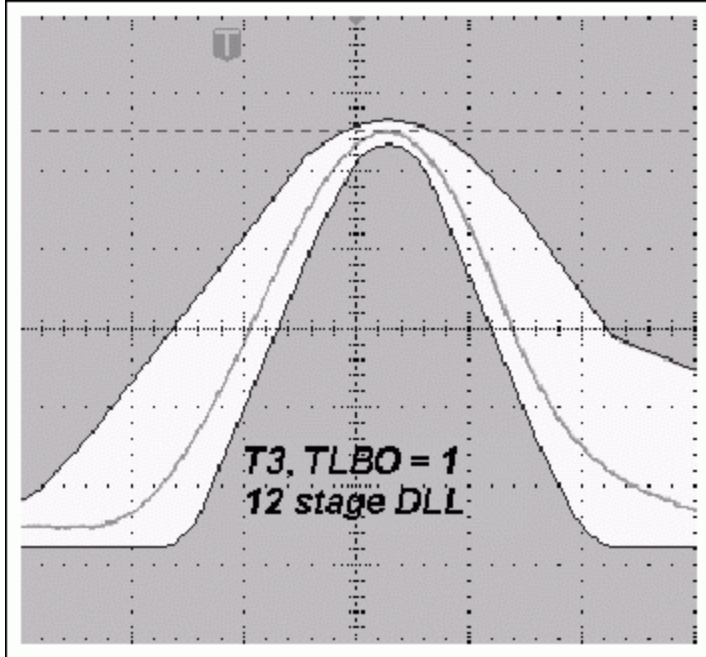
Figure 4. The typical T3 pulse with 11-stage DLL and the narrower T3 pulse using a 12-stage DLL when TLBO = 1.

Modifying the Amplitude of the Transmission Pulse in E3, T3, or STS-1 Mode

By setting the DS315x test register addresses 0Ah, 1Ah, 2Ah, and 3Ah to different values, the amplitude of the transmission pulse can be increased or decreased in E3, T3, and STS-1 mode. When the register addresses 0Ah, 1Ah, 2Ah, and 3Ah are set to a value of 08h, the amplitude is increased by 2% for LIU ports 1, 2, 3, and 4, respectively. **Figure 5** shows 2% increase in amplitude for the E3 pulse.
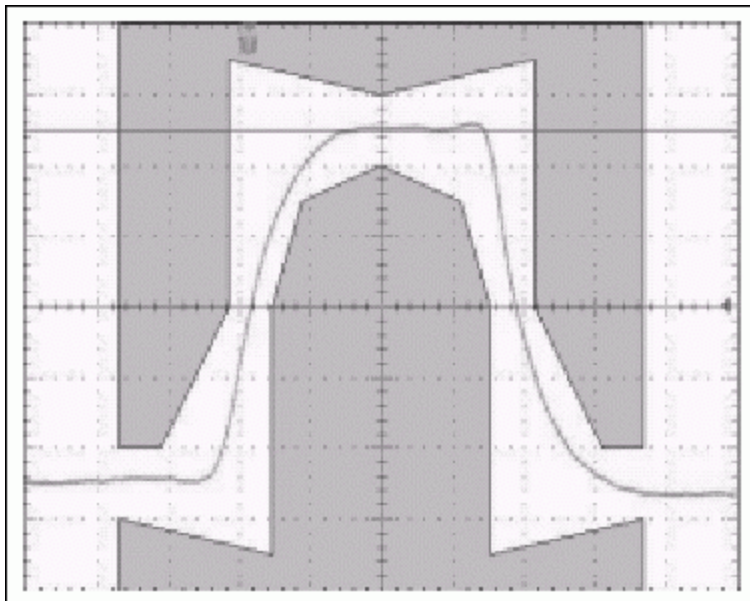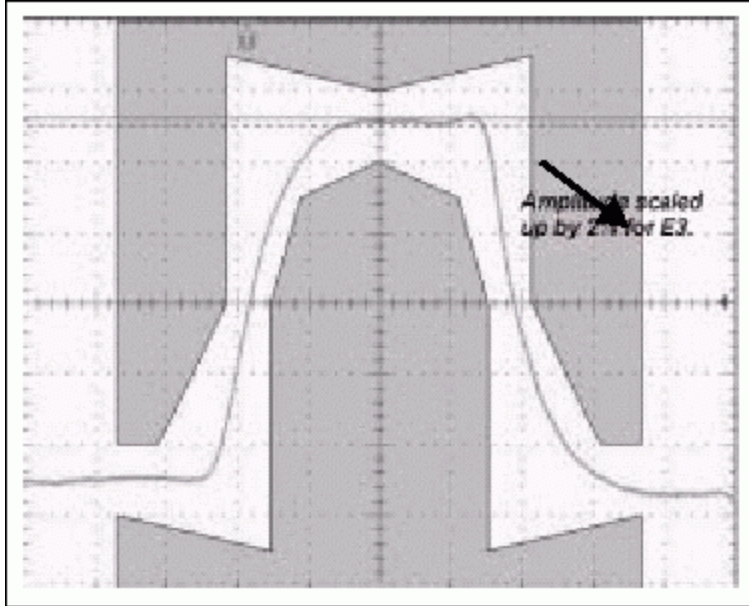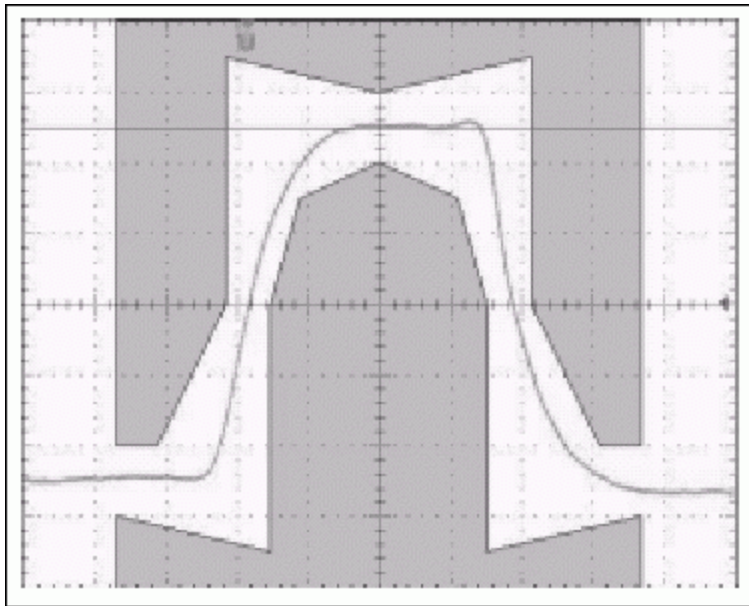
Figure 5. The typical E3 pulse and the same pulse increased by 2% in amplitude by setting the test register value to 08h.

When the test register addresses 0Ah, 1Ah, 2Ah, and 3Ah are set to a value of 10h, the amplitude is increased by 4% for LIU ports 1, 2, 3 and 4 respectively. **Figure 6** shows 4% increase in amplitude for the E3 pulse.
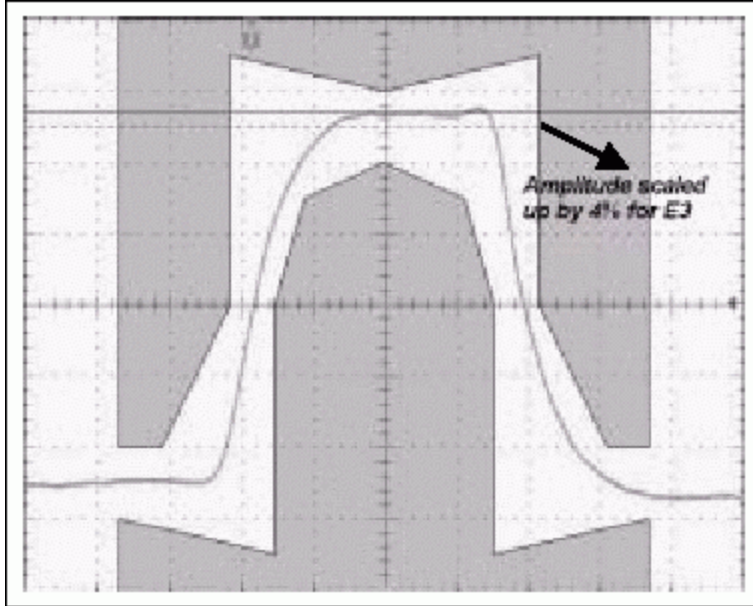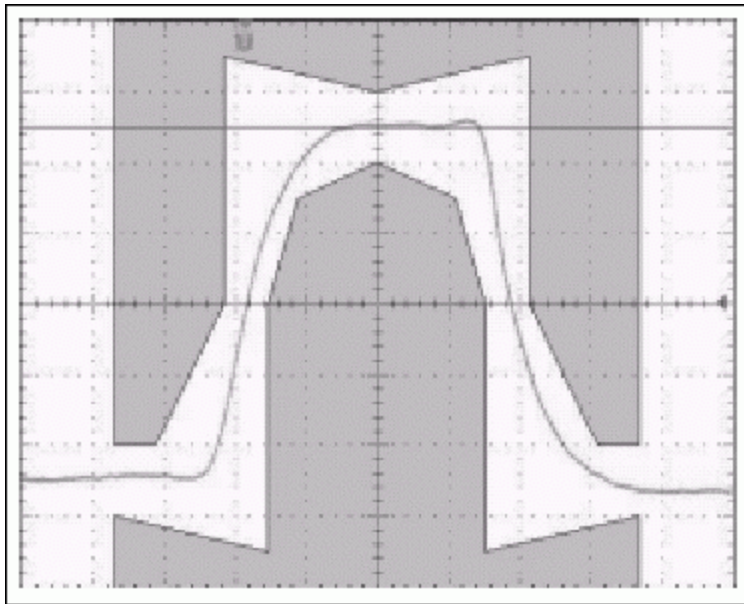
Figure 6. The typical E3 pulse and the same pulse increased by 4% in amplitude by setting the test register value to 10h.

When the register addresses 0Ah, 1Ah, 2Ah, and 3Ah are set to value of 20h, the amplitude is increased by 8% for LIU ports 1, 2, 3, and 4, respectively. **Figure 7** shows 8% increase in amplitude for the E3 pulse.
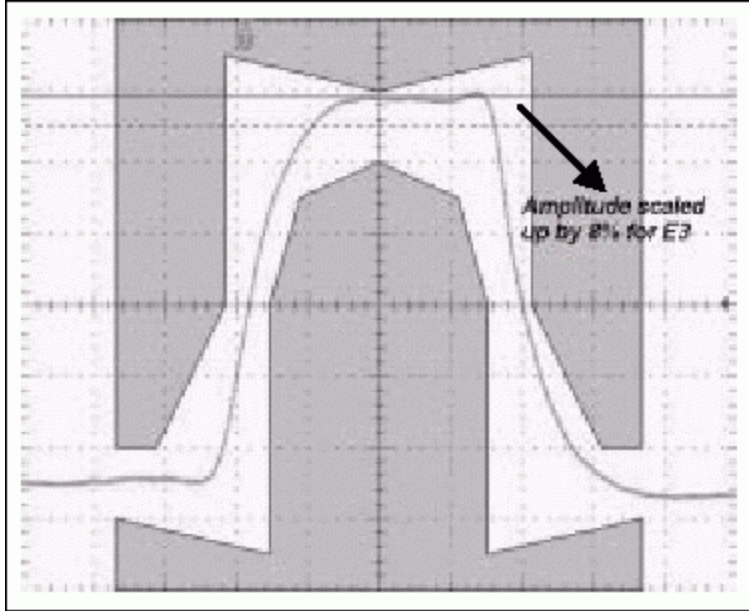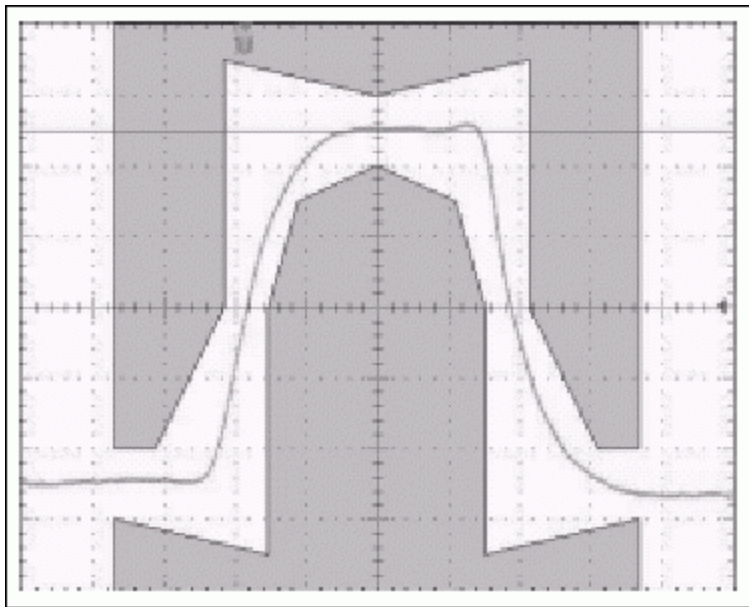
Figure 7. The typical E3 pulse and the same pulse increased by 8% in amplitude by setting the test register value to 20h.

When the register addresses 0Ah, 1Ah, 2Ah, and 3Ah are set to value of 40h, the amplitude is decreased by 8% for LIU ports 1, 2, 3, and 4, respectively. **Figure 8** shows 8% decrease in amplitude for the E3 pulse.
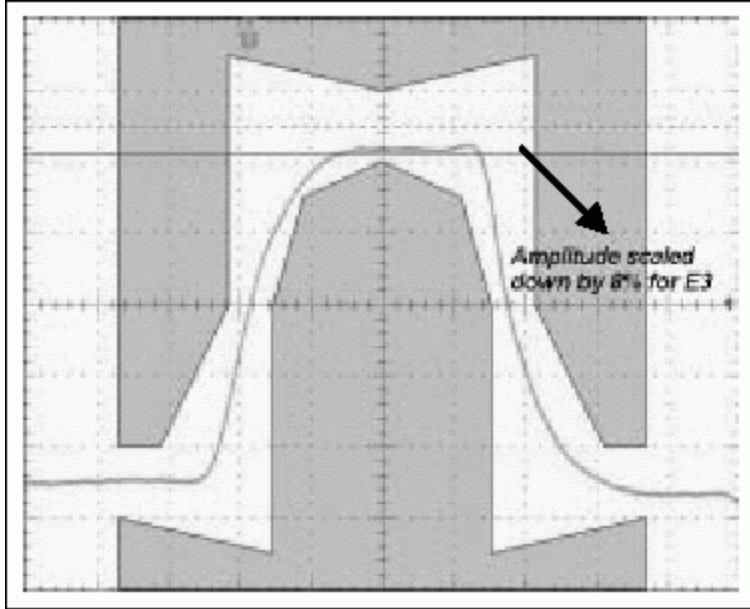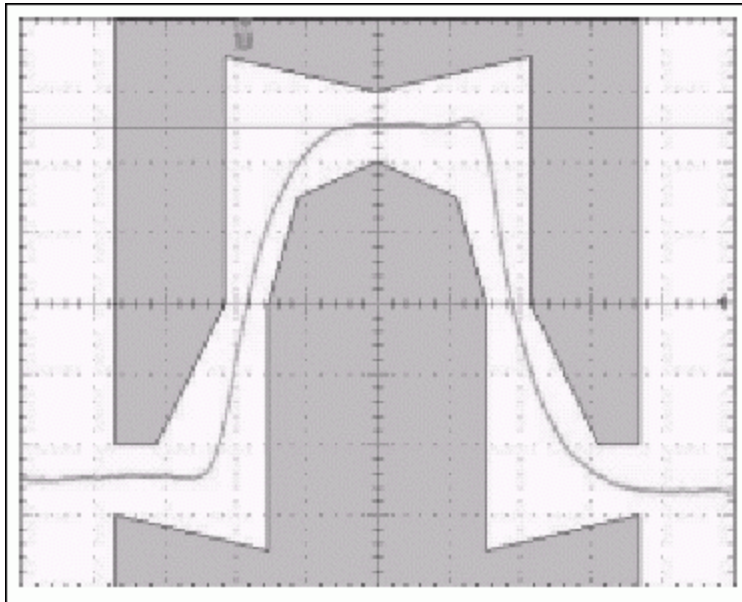
Figure 8. The typical E3 and the same pulse decreased by 8% in amplitude by setting the test register value to 40h.

A value of 10h causes the LIU to increase the amplitude by 4% and a value of 20h causes the LIU to increase the amplitude by 8%. Adding these two values to 30h (10h+20h) causes the LIU to increase the pulse amplitude by 12%. Selecting a value of 50h (10h+40h) causes the amplitude to decrease by 4%. **Figure 9** shows 4% decrease in amplitude for the E3 pulse. The value of 60h is not recommended because it will increase the amplitude until the current limiter trips.
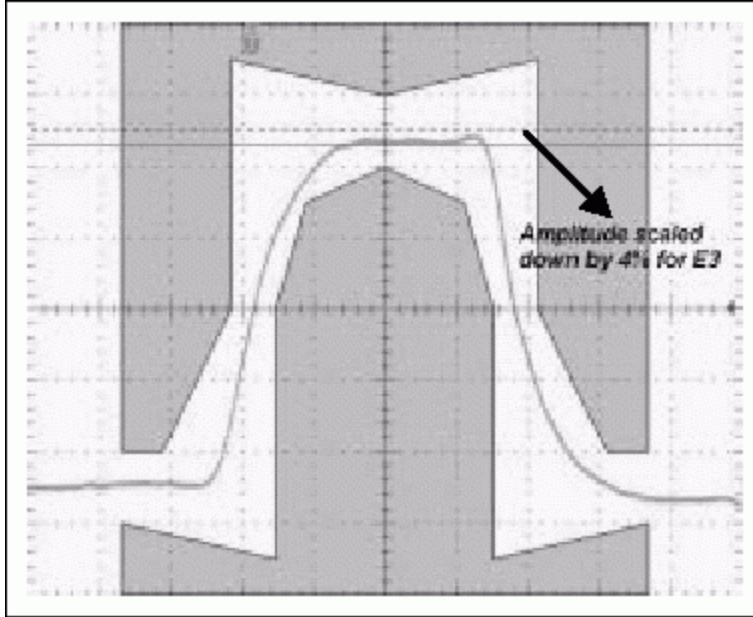
Figure 9. The typical E3 pulse and the same pulse decreased by 4% in amplitude by setting the test register value to 50h.

Adjusting the Timing of the Transmission Waveshape in T3 or STS-1 Mode

The timing of the transmission waveshape in T3 or STS-1 mode can be adjusted by changing the register values of the test registers with the register address of 0Bh for LIU port 1, 1Bh for LIU port 2, 2Bh for LIU port 3, and 3Bh for LIU port 4. **Figure 10** shows a typical T3 pulse. To explain the effects of changing the test register values at address 0Bh for LIU port 1, 1Bh for LIU port 2, 2Bh for LIU port 3, and 3Bh for LIU port 4 on a T3 or STS-1 pulse, the T3 pulse is divided into 12 sections.
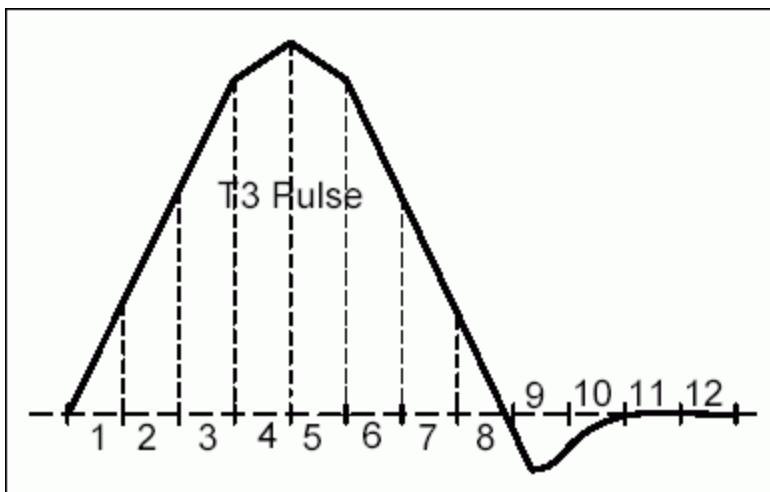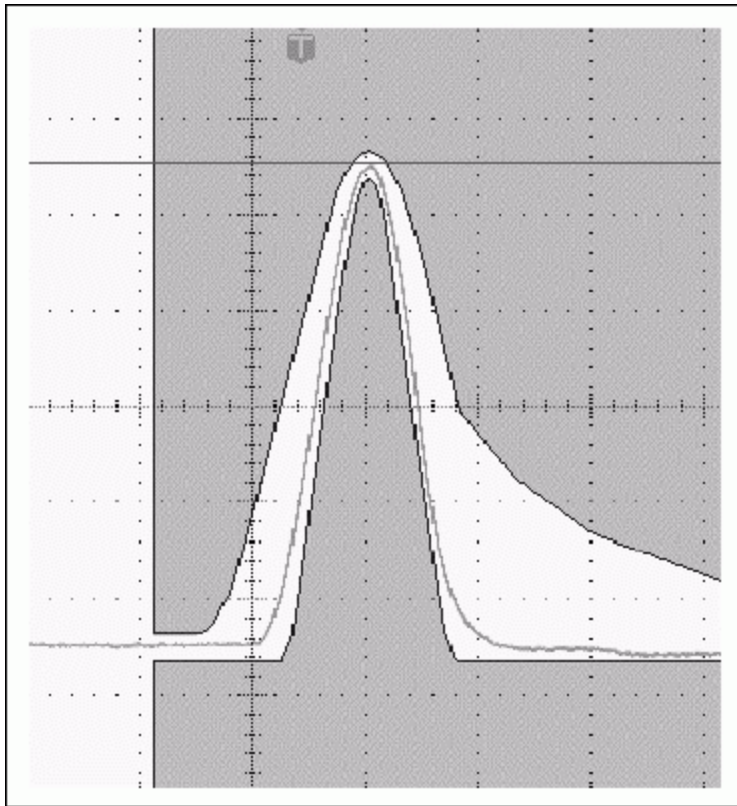

Figure 10. A typical T3 pulse divided into 12 sections.

When the register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to value of 01h, it increases the width of section 3 by 350ps. So it increases the total width from section 1 to 4 by 350ps. It also increases the amplitude of the pulse. The undershoot of the pulse on section 9 and 10 decreases. **Figure 11** shows a

typical T3 pulse and the changes in the pulse for writing the value 01h to the test register addresses 0Bh, 1Bh, 2Bh, and 3Bh.
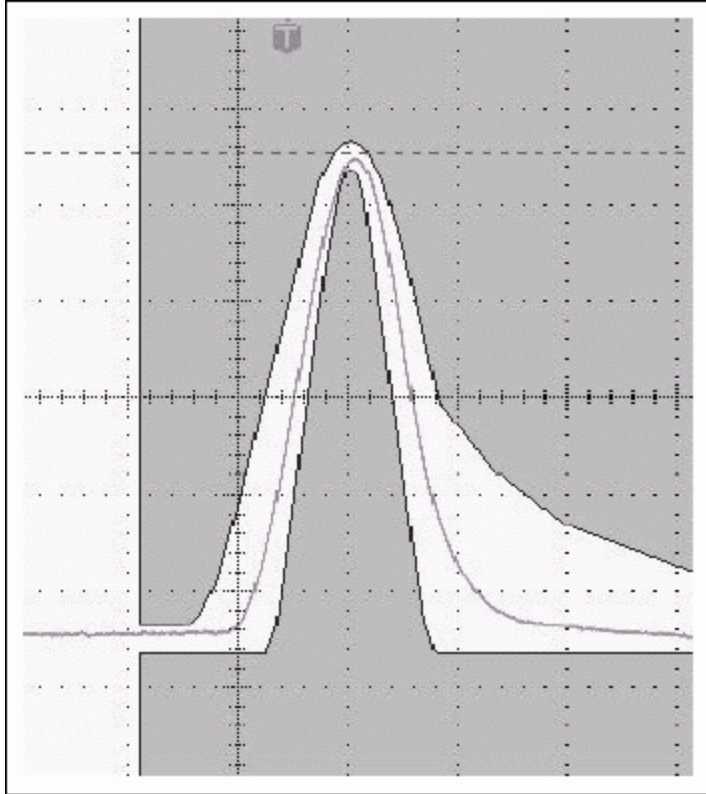
Figure 11. Typical T3 pulse and the changes in the same pulse for setting the test register to a value of 01h.

When the register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to a value of 81h, section 2 and 3 each increase in width by 350ps. So it increases the total width from section 1 to 4 by 700ps. It also increases the amplitude of the pulse. The undershoot of the pulse in section 9 and 10 decreases more than when does we set the registers to value 01h. **Figure 12** shows a typical T3 pulse and the changes in the pulse for writing the value 81h to the test register addresses 0Bh, 1Bh, 2Bh, and 3Bh.
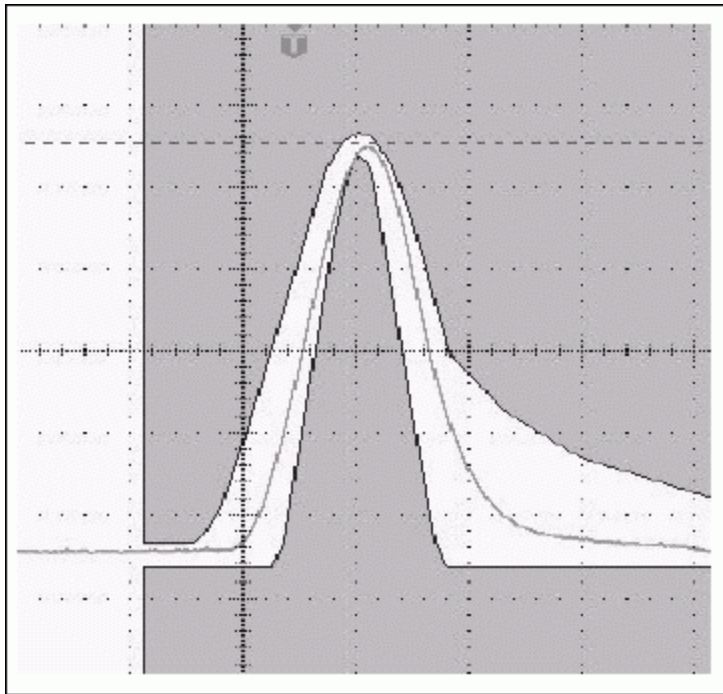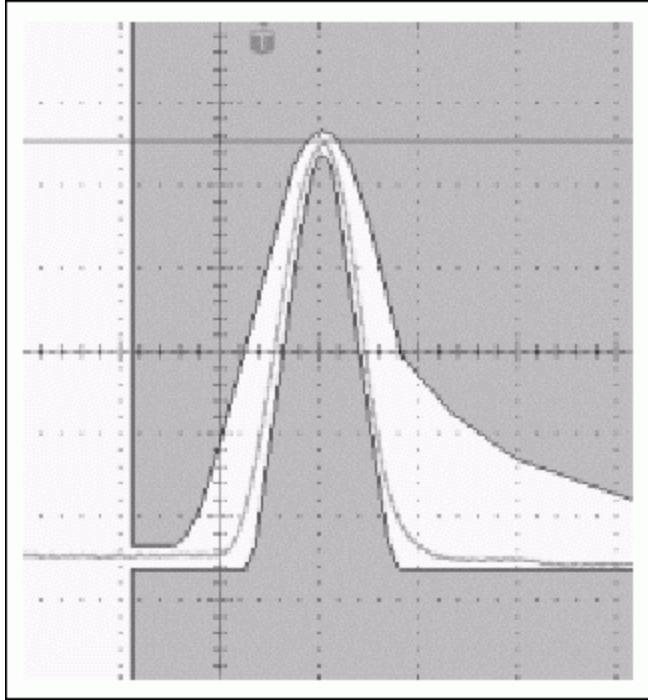
Figure 12. Typical T3 pulse and the changes in the same pulse for setting the test register to a value of 81h.

When the register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to a value of 02h, it increases the width of section 4 by 350ps. So it increases the width from section 1 to 4 by total of 350ps. It does not increase the amplitude of the pulse. The undershoot of the pulse in section 9 and 10 decreases but the amount is less than, when the register values are 01h. **Figure 13** shows a typical T3 pulse and the changes in the pulse for writing the value 02h to the test register addresses 0Bh, 1Bh, 2Bh, and 3Bh.
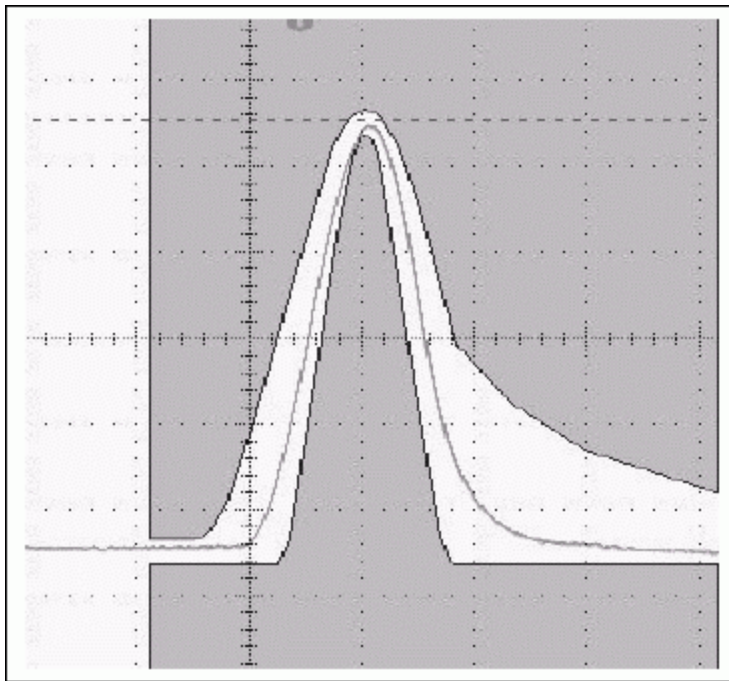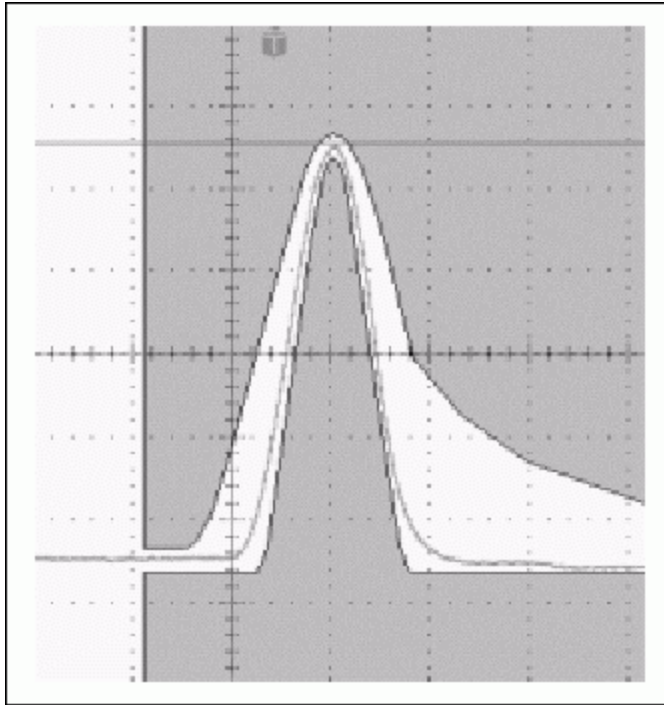
Figure 13. Typical T3 pulse and the changes in the same pulse for setting the test register to a value of 02h.

When the register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to a value of 04h, width of section 5 is increased by 350ps. So the total width from section 5 to 8 is increased by 350ps. It does not decrease the amplitude of the pulse. The undershoot of the pulse on section 9 and 10 increases. **Figure 14** shows a typical T3 pulse and the changes in the test register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to a value of 04h.
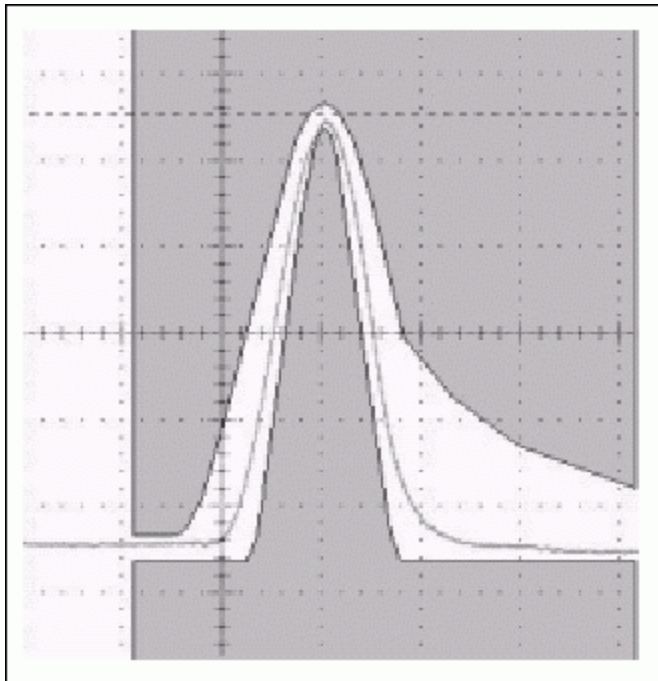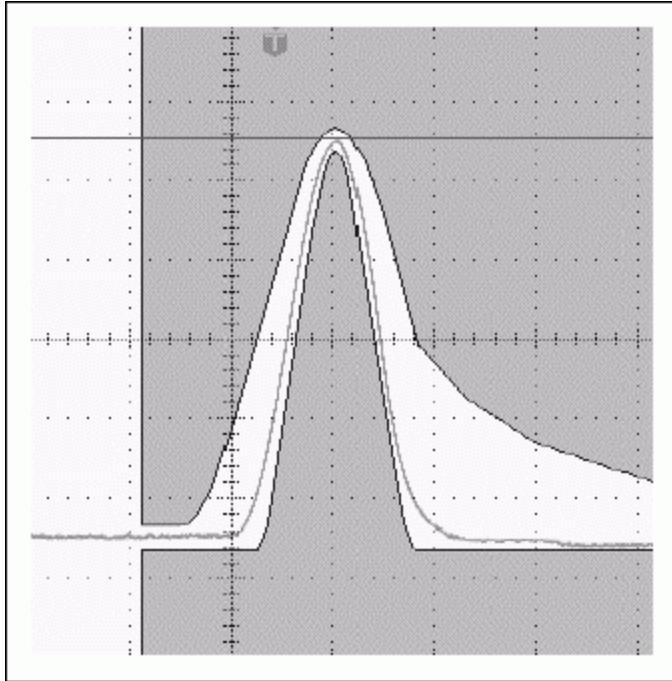
Figure 14. Typical T3 pulse and the changes in the same pulse for setting the test register to a value of 04h.

When the register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to a value of 08h, width of section 7 is increased by 350ps. So the total width from section 5 to 8 is increased by 350ps. It decreases the amplitude of the pulse a little. The undershoot of the pulse on section 9 and 10 increases more than the when the register values are 04h. **Figure 15** shows a typical T3 pulse and the changes in the pulse when the test register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to a value of 08h.
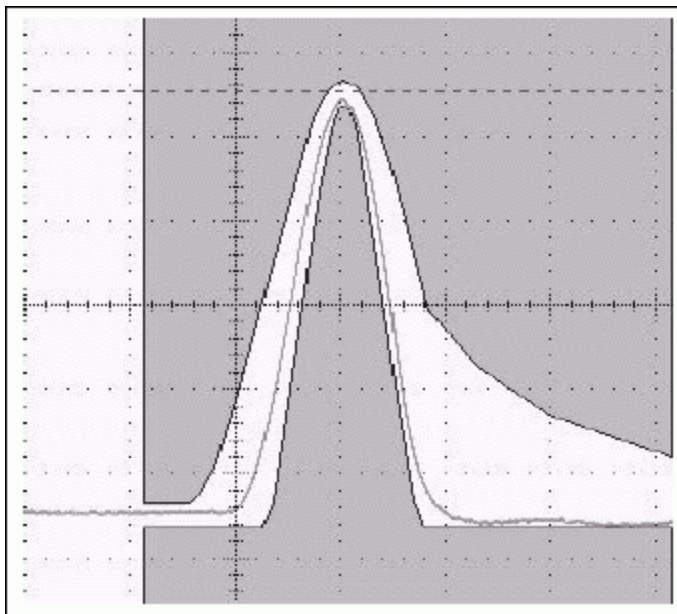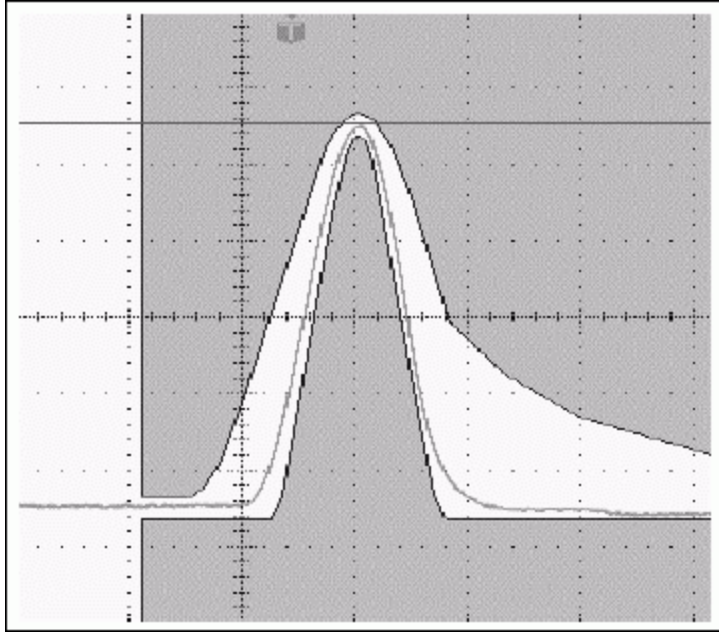
Figure 15. Typical T3 pulse and the changes in the same pulse for setting the test register to a value of 08h.

When the register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to value of 88h, width of sections 6 and 7 are each increased by 350ps. So the total width of sections 5 to 8 is increased by 700ps. It also decreases the amplitude of the pulse. The undershoot of the pulse on section 9 and 10 increases more than, when we set the registers to value 08h. **Figure 16** shows a typical T3 pulse and the changes in the pulse when the test register addresses 0Bh, 1Bh, 2Bh, and 3Bh are set to a value of 88h.
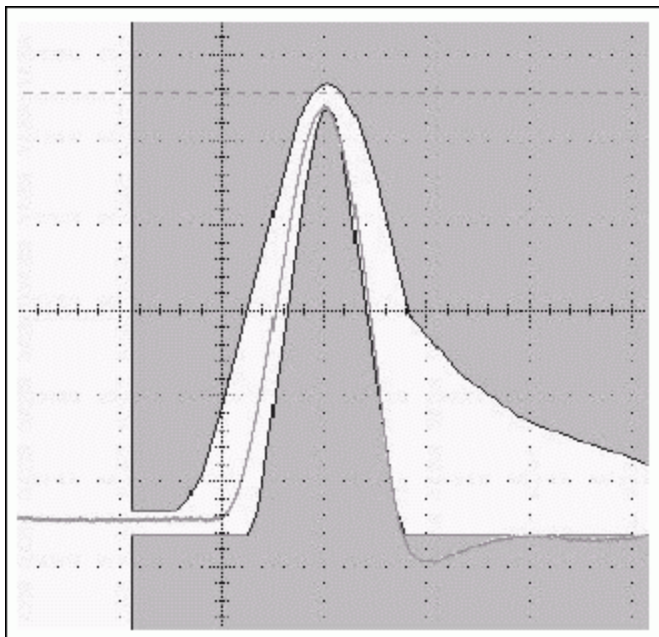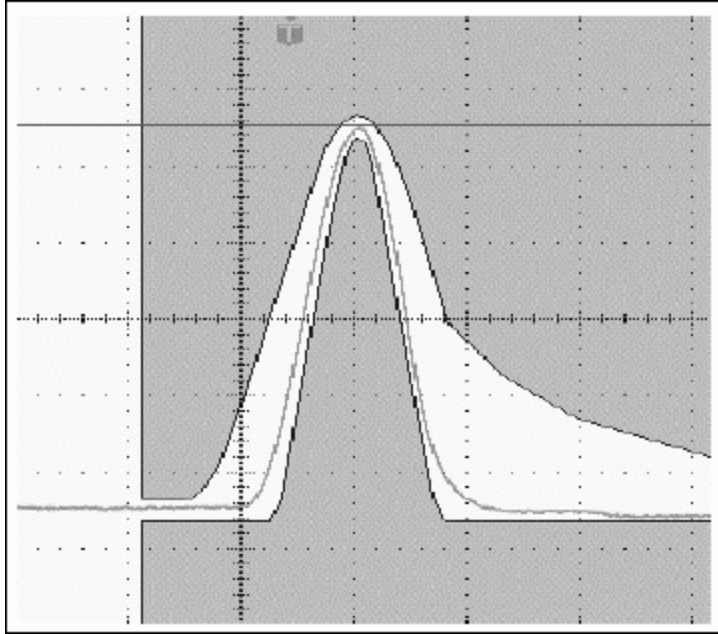
Figure 16. Typical T3 pulse and the changes in the same pulse for setting the test register to a value of 88h.

Conclusion

The decision to modify the waveshape, the pulse width or the amplitude of the pulse should be made based on the pulse shape that the customer obtains with their board.

For further questions about pulse shape of DS315x, or the operation of DS315x, please contact the Maxim Telecommunications applications support team.

Related Parts		
DS3151	Single/Dual/Triple/Quad DS3/E3/STS-1 LIUs	
DS3152	Single/Dual/Triple/Quad DS3/E3/STS-1 LIUs	
DS3153	Single/Dual/Triple/Quad DS3/E3/STS-1 LIUs	
DS3153DK	Triple DS3/E3/STS-1 LIU Demo Kit	
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