

Extend DisplayPort Cable Reach with an Active Equalizer – DS32EV400

National Semiconductor
Lab Report
Winston Wong
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Abstract

This application report examines the performance of National's quad active equalizer, the DS32EV400 to extend the cable reach in a DisplayPort Application.

Summary

- National's equalizer, DS32EV400 supports the DisplayPort protocol with 12m total cable length.
- The built-in DisplayPort signal conditioning from the Source (graphic card) and the Sink (Dell Monitor) is able to support cables up to 6m to 8m in length.
- Adding National's DS32EV400 Equalizer can double the reach to about 12 meters in total length.

Test Setup

- DisplayPort Source: Graphic Card – Nvidia GeForce 9600GT
- DisplayPort Sink: 0" LCD Display - Dell 3008WFP
- 2m, 6m, 10m, 14m DisplayPort cables (Molex 28 AWG)
- Tektronix DSA71604 Real Time Scope
- DS32EV400 Quad Equalizer, EQ setting = 4

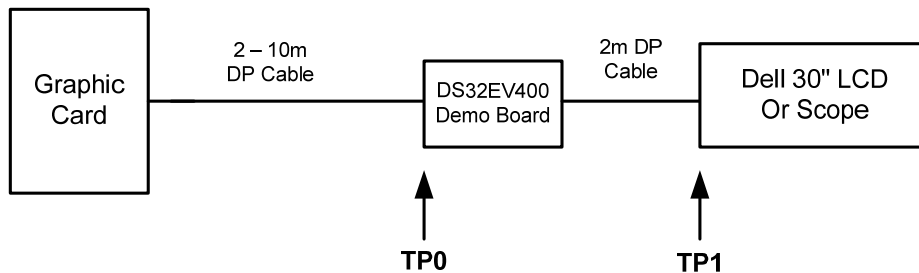


Figure 1. Test Set Up with Test Points noted



Figure 2. DisplayPort Equalizer (DS32EV400) Test Board Photo

Waveforms

The system runs a packet based protocol at a fixed line rate of 2.7 Gbps. When 2560 x 1600 resolution is selected, there are four active channels of video data. With the 1920 x 1080 resolution selected, two channels of data are active. Figure 3 shows the waveform at TP0 after 2 meters of DisplayPort cable. The built-in De-Emphasis signal conditioning feature is observable with an approximate setting of -3db. The eye is open and error free transmission is expected.



Figure 3. Eye Pattern at 2.7 Gbps / 2 meters / TP0

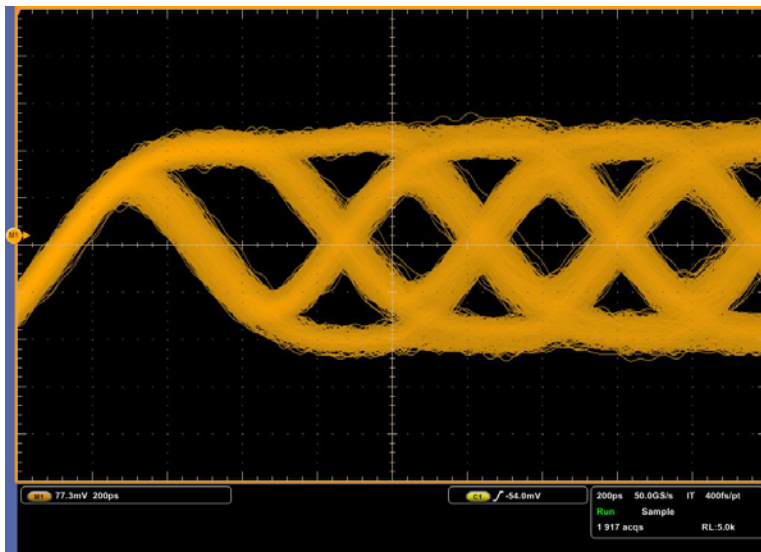


Figure 4. Eye Pattern at 2.7 Gbps / 6 meters / TP0

After 6 meters of cable, signal swing amplitude is decreased, and the eye is more closed down. Based on the input equalization is the sink (DES) device, error free data recovery is more difficult due to eye opening and height.

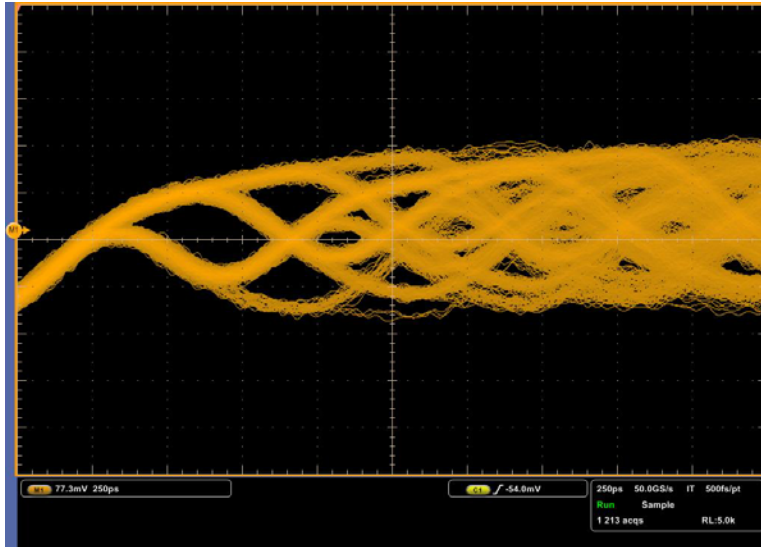


Figure 5. Eye Pattern at 2.7 Gbps / 10 meters / TP0

After 10 meters of cable, the signal is very degraded, the eye is closed and errors are seen on the display when it is connected directly at TP0.

DS32EV400 Active Equalizer

The DS32EV400 is a four channel active equalizer that is compatible with 8b/10b (DisplayPort) applications. It provides gain to counteract the loss of the cable and open the eye for error free data recovery.

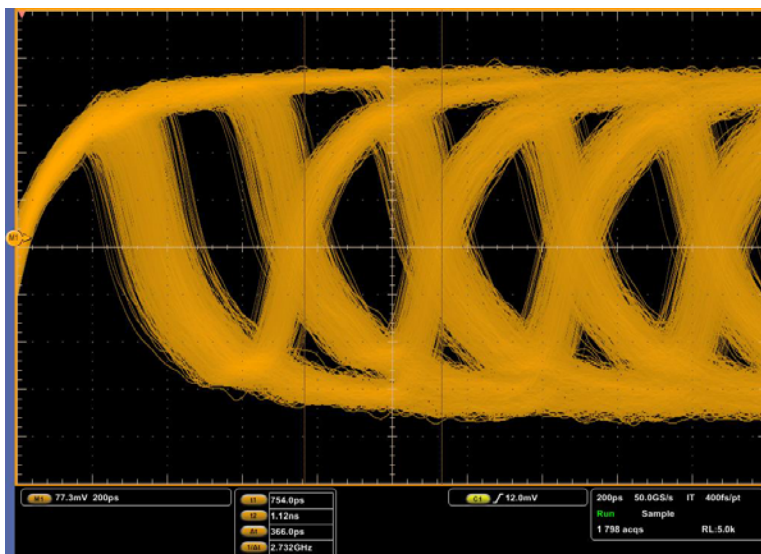


Figure 6. Eye Pattern at 2.7 Gbps / 10+2 meters / TP1

The DS32EV400 is inserted after the 10 meter cable and recovers the eye (Figure 5) and then drives it another 2 meters (12 meters total length) to the scope. The jitter is reduced and the amplitude is restored. When the Display is connected the image is again error free.

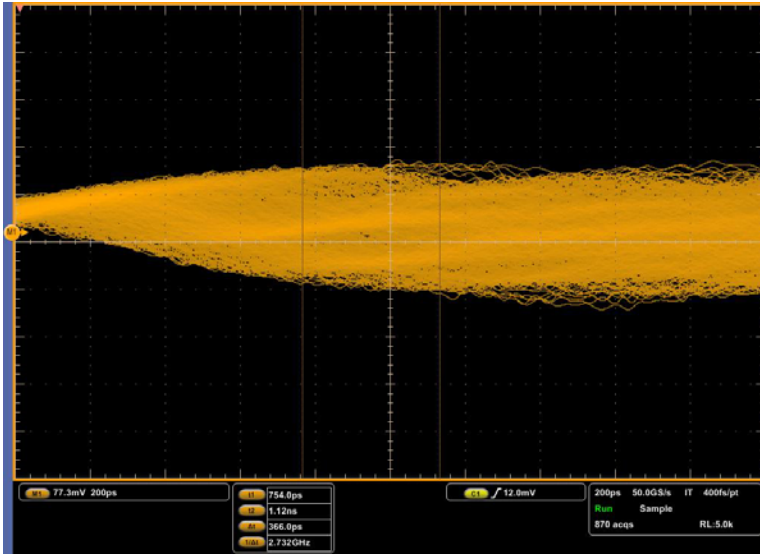


Figure 7. Eye Pattern at 2.7 Gbps / 14 meters / TP0

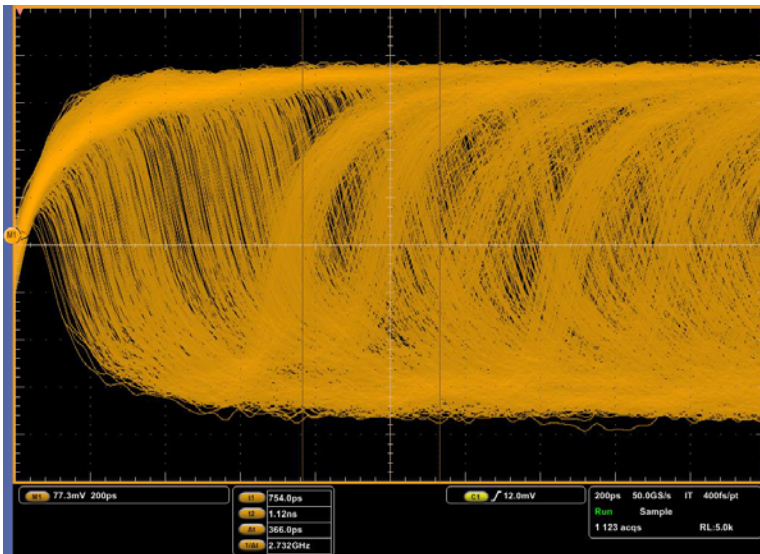


Figure 8. Eye Pattern at 2.7 Gbps / 16 meters / TP1

If the cable from the Source is extended to 14 meters, the eye is totally closed and severely attenuated. The DS32EV400 is unable to recover the eye as the loss is too great. Figure 7 shows the eye from the source after 14 meters of cable. Figure 8 shows the output of the equalizer. Note the amplitude is restored, but the eye is still closed and jitter is excessive.

Cable Loss

Figure 9 shows the Insertion loss (SDD21) for two lengths of AWG 28 DisplayPort cable. At 2.7Gbps, we measure the loss at 1.35GHz. The red trace is for a 10 meter length and reads -21dB. The blue trace is 14 meters in length and measures -28 dB.

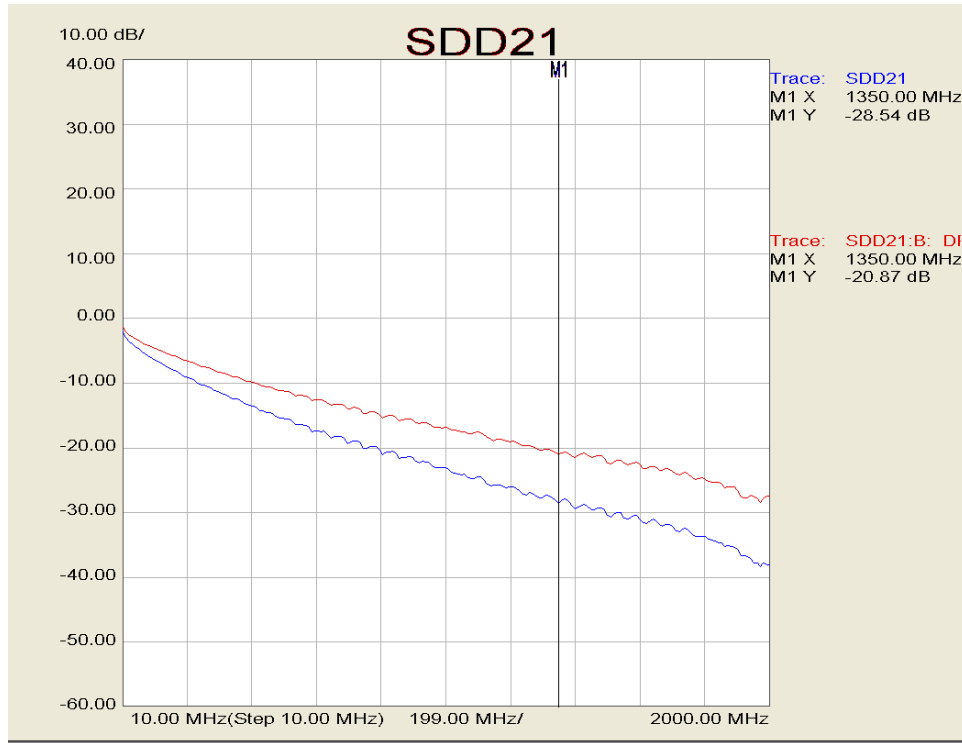


Figure 9. Insertion Loss (SDD21) for 10 and 14 meter 28 AWG Display Port Cable

Conclusion

The DS32EV400 is compatible with the high speed video channels of DisplayPort and can double the cable reach from 6m nominal to a total reach of 12 meters. The DS32EV400 provides 20dB of equalization at 3Gbps and is well suited for the 2.7 Gbps DisplayPort application. Lengths up to 10 meters of AWG 28 can be supported. The DisplayPort AUX channel is a low speed line and can be extended without the need of a equalizer. DisplayPort also provides 1.5W of power in the cable which can be used to power the DS32EV400. A single channel is also available (DS32EV100).

References

- DisplayPort Standards version 1.1
- DS32EV400 Quad Equalizer Datasheet
- DS32EV100 Single Equalizer Datasheet