

PROTECTION PRODUCTS

DisplayPort Protection

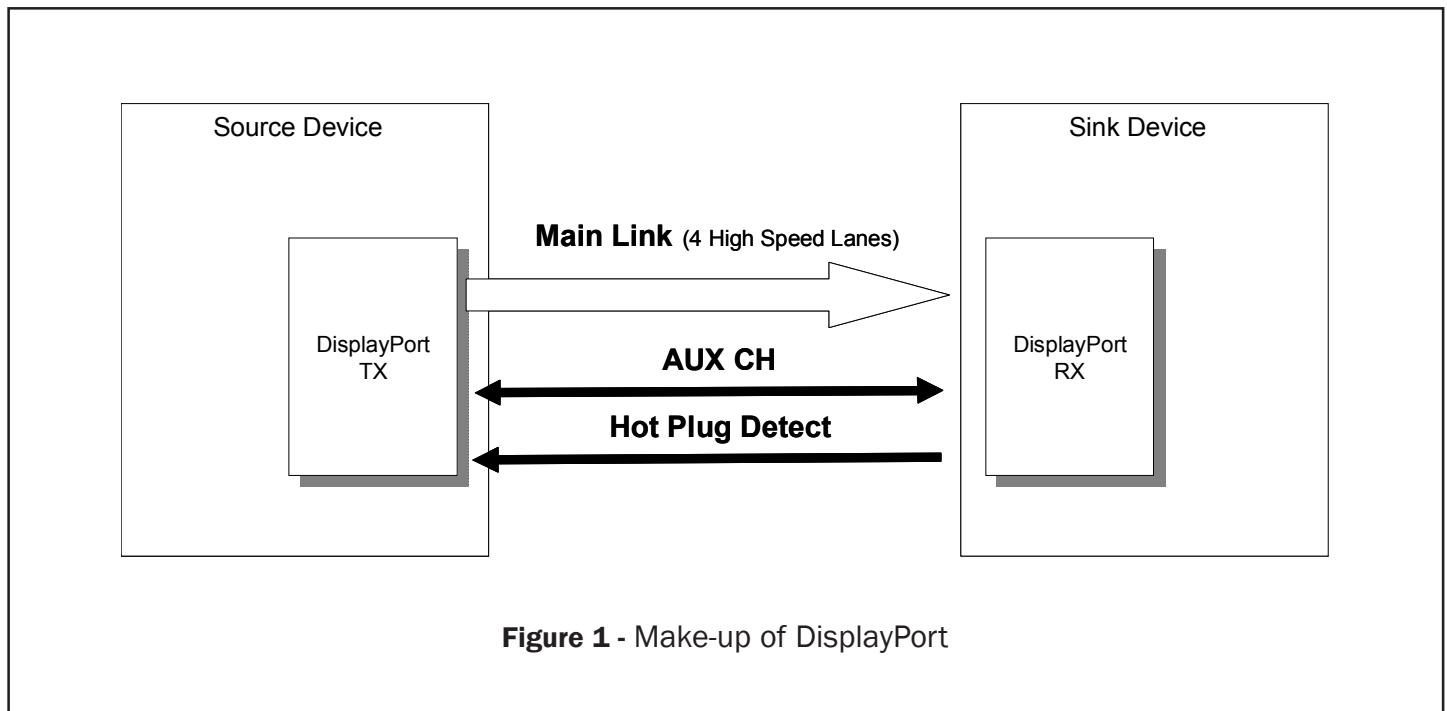
VEESA (Video Electronic Standard Association) has set forth DisplayPort as the new license-free digital interface standard used primarily between a computer and its display(s) or a computer and a home theater system. The DisplayPort consists of a main link, auxiliary channel and a hot plug detect as shown in Figure 1. The DisplayPort connector supports 1 to 4 data pairs as the main link. These data pairs are referred to as lanes in the DisplayPort Specification. Unlike HDMI, the clock signal is embedded in these data pairs. Both audio and video can be transmitted on these data pairs. DisplayPort supports video speeds of 1.62Gbps and 2.7Gbps. The auxiliary channel serves as the main link management and device control. It runs at a constant 1Mbps rate.

The DisplayPort connector is an external port that is exposed to the user. All these exposed signal pairs are vulnerable to electrostatic discharge (ESD) either directly from a user or from plugging a charged cable into the port. In order to ensure the functionality of this port, the DisplayPort needs to be ESD hardened to the IEC61000-4-2 ESD standard as indicated in the DisplayPort Specification. A level 4 discharge would require withstanding a $\pm 15\text{kV}$ air and $\pm 8\text{kV}$ contact discharge. In order to meet this stringent standard, external protection devices are required at the port entrance.

Due to the high-speed nature of the DisplayPort main link, choosing the appropriate protection device is crucial to maintain signal integrity on both the transmitter (source) and receiver (sink) side of the system. The DisplayPort Compliance Test Specification will test for signal integrity and good interoperability. Designing with a protection device that offers superior protection to the IEC61000-4-2 specification with minimal effects on the high speed differential pairs is not easily accomplished. The electrical and mechanical properties of the protection device can impact the high speed signal. Both effects will be seen as a discontinuity on the balanced differential pairs that will result in an impedance change or mismatch. Changes or mismatches will result in signal degradation, reflection and loss.

Semtech RClamp[®]0524P provides ESD protection in excess of IEC61000-4-2 level 4 without adversely affecting signal integrity of the DisplayPort high speed differential signal. The RClamp0524P has a typical capacitance of only 0.30pF between I/O pins. This reduces its electrical affect on the high speed signal and allows it to be used on circuits operating in excess of 3GHz without signal attenuation. Its circuit diagram is shown in Figure 2.

The RClamp0524P is housed in a SLP2510P8 package designed specifically to reduce its affect on the high



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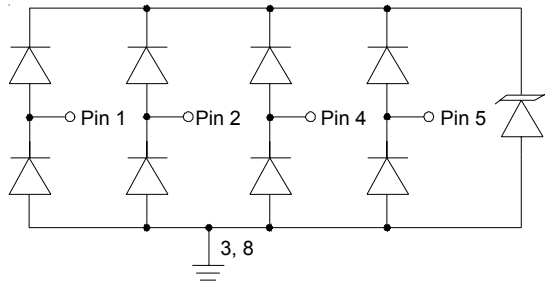


Figure 2 - RClamp0524P Circuit Diagram

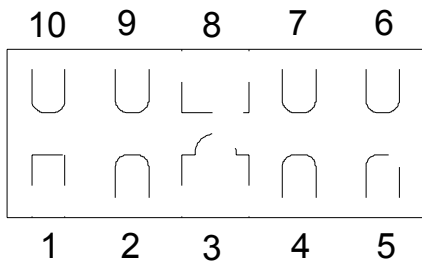


Figure 3 - Pinout of RClamp0524P

speed differential signals. The SLP2510P8 measures 2.5 x 1.0 x 0.58mm as shown in Figure 3 and is designed for easy PCB layout by allowing the traces to run straight through the device. Trace layout is crucial in high speed signal layout design because bends and turns result in signal attenuation as a loss and reflection. The RClamp0524P is also designed so traces within a lane of the DisplayPort connector can be

routed as a tightly coupled differential pair at 0.5mm pitch for good common mode rejection. It also allows different lanes to be routed as a loosely coupled differential pair at 1.0mm pitch between the pairs for reduced crosstalk. Figure 4 shows an example of the flow through trace routing of the high speed differential signal through the RClamp0524P straight out from the connector pads.

The combination of small size, low capacitance, and high level of ESD protection makes the RClamp0524P a superior solution to protect the sensitive DisplayPort interface. Figure 5 shows the application schematic recommendation for protecting the main link, auxiliary channel, hot plug and power of the DisplayPort interface. To verify signal integrity of a DisplayPort source, an eye mask specification is required by the DisplayPort Specification. This eye mask definition is shown in Figure 6. Table 1 shows the vertices for a reduced bit rate of 1.62Gbps, and Table 2 shows the vertices for the high bit rate of 2.7Gbps. Eye pattern testing of a DisplayPort protected by the RClamp0524P at 1.62Gbps and 2.7Gbps was conducted and the results are shown in Figures 7 and 8. In both cases the eye mask was not violated.

Conclusion

Based on data presented on the previous pages of this application note, it can be concluded that the RClamp0524P is a solution that offers superior protection to the IEC61000-4-2 level 4 while maintaining the signal integrity of DisplayPort.

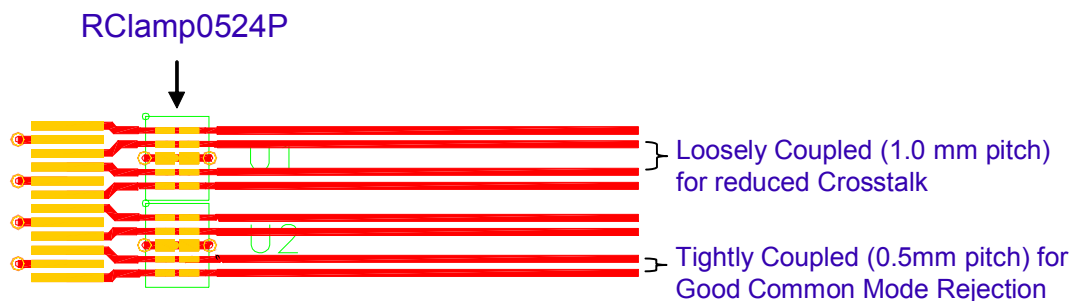


Figure 4 - Example of Straight flow-through layout of RClamp0524P

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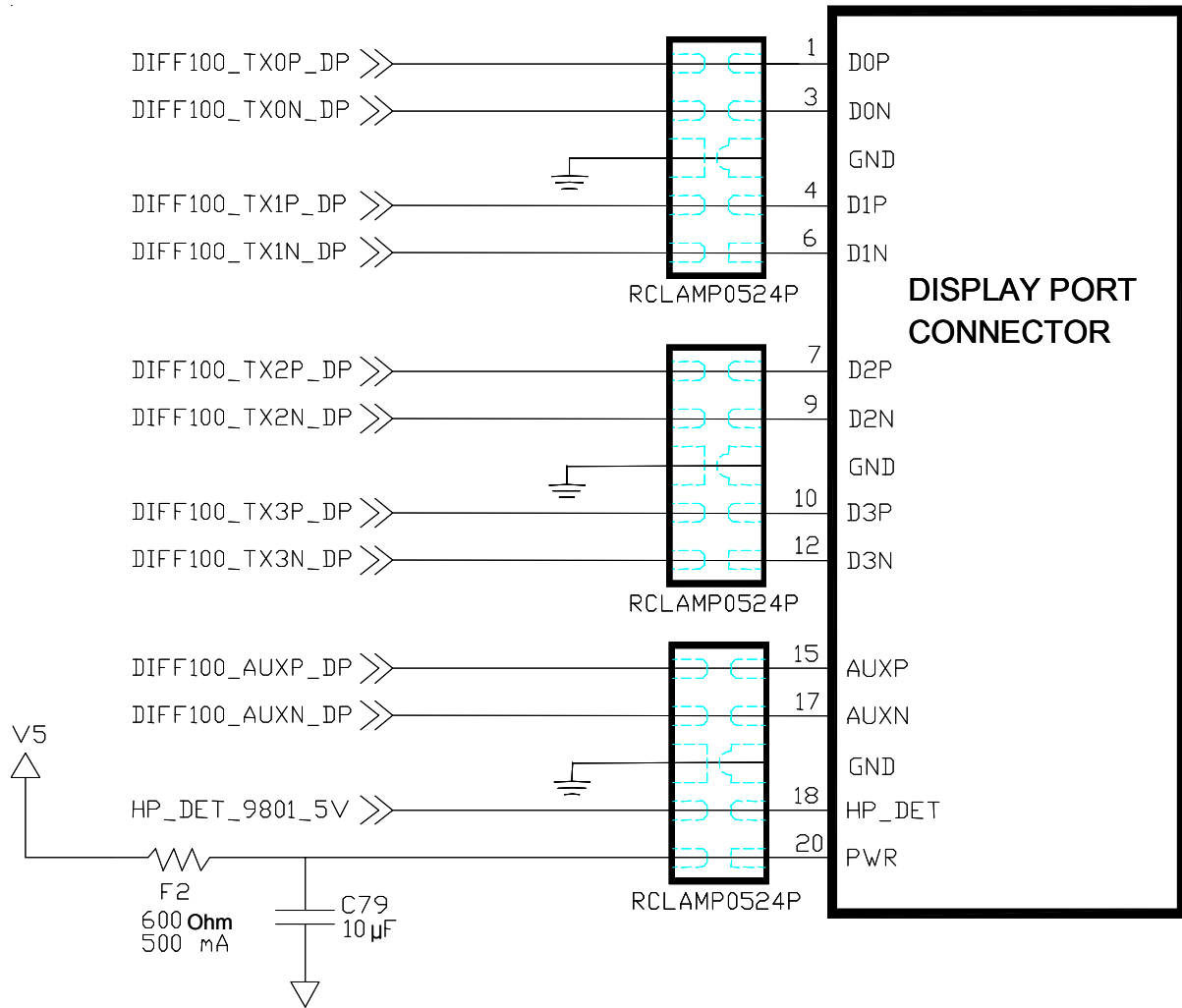


Figure 5 - DisplayPort Protection Application Schematic

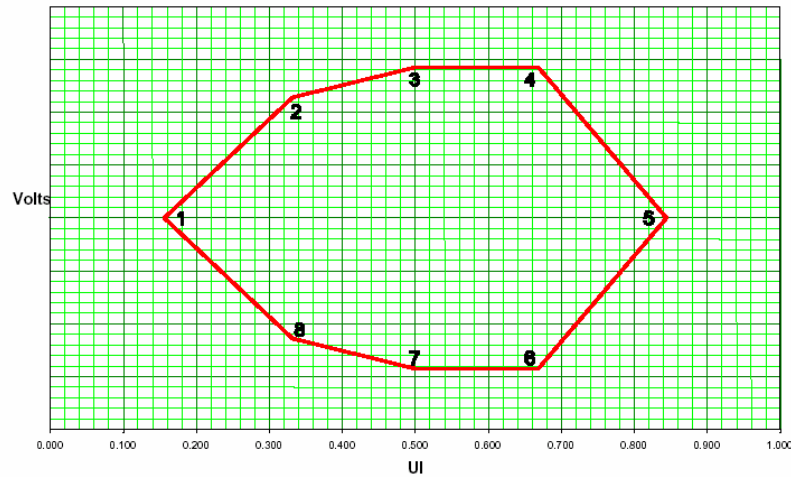


Figure 6 - Eye Mask at the Source Connector Pins

Point	A0	Voltage(V)
1	0.210	0.000
2	0.355	0.140
3	0.500	0.175
4	0.645	0.175
5	0.790	0.000
6	0.645	-0.175
7	0.500	-0.175
8	0.210	-0.140

Table 1 - Mask Vertices for Reduced Bit Rate (1.62Gbps)

Point	A0	Voltage(V)
1	0.127	0.000
2	0.291	0.160
3	0.500	0.200
4	0.709	0.200
5	0.873	0.000
6	0.709	-0.200
7	0.500	-0.200
8	0.291	-0.160

Table 2 - Mask Vertices for High Bit Rate (2.7Gbps)

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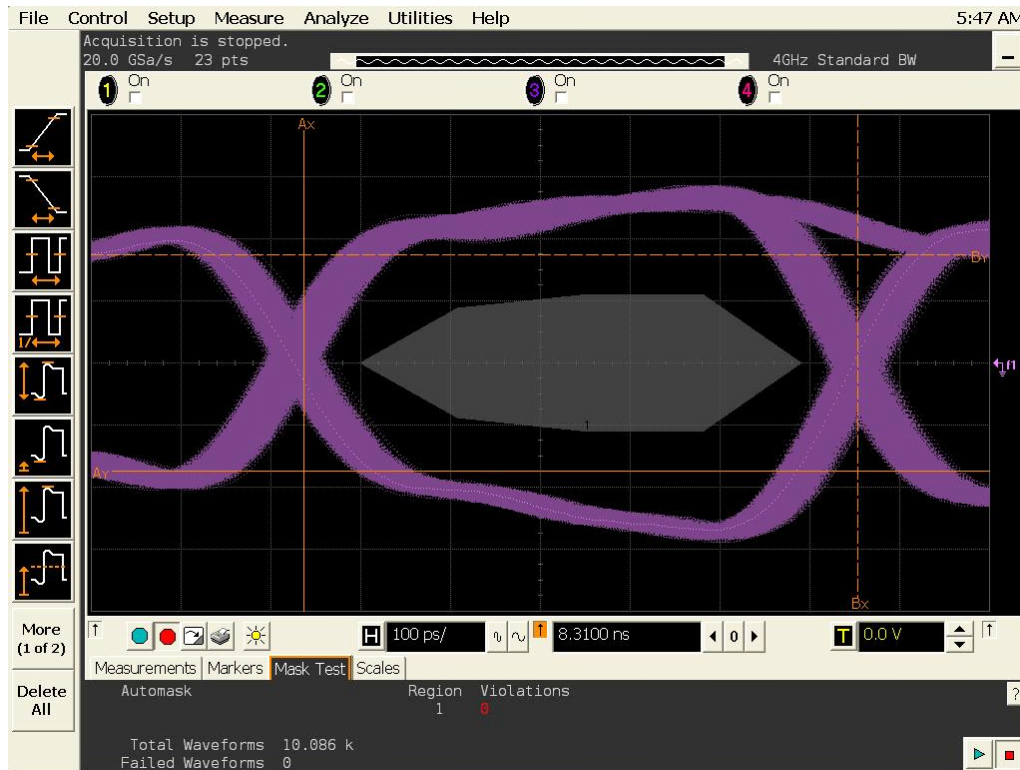


Figure 7 - DisplayPort at 1.62 Gbps with RClamp0524P Protection

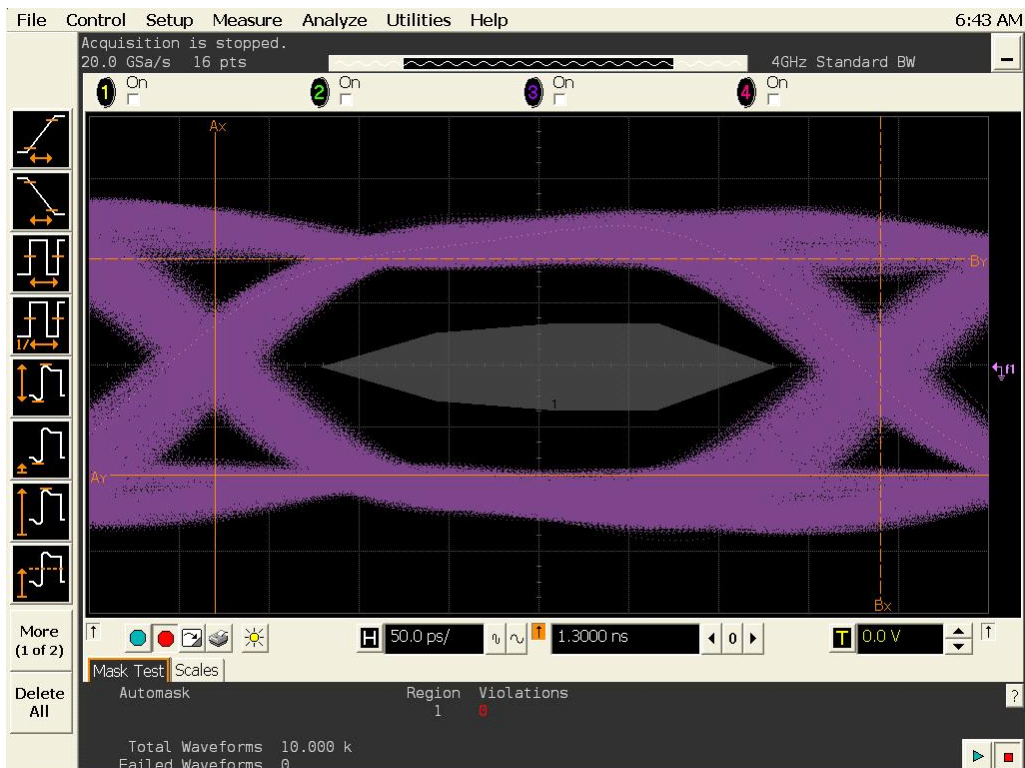


Figure 8 - DisplayPort at 2.7Gbps with RClamp0524P Protection