

Application Brief



SEMTECH PROTECTION PRODUCTS

ESD/CDE Protection

For High Definition Multimedia Interface (HDMI)



Breakthrough protection device for HDMI 1.4 with ultra low cap. of 0.25pF

High Definition Multimedia Interface (HDMI) is an uncompressed, all-digital audio/video interface that provides a high-speed link between audio/video source devices, such as DVD players, and sink devices, such as HDTV. In order to receive HDMI certification, both sink and source devices need to comply with respective test requirements set forth by the HDMI Compliance Test Specification (CTS). HDMI 1.4 is the current specification, which runs at a maximum rate of 3.4 Gbps per channel and is capable of transmitting uncompressed signals up to 10.2 Gbps under typical HDMI connection (3 TMDS channels).

With the increase in data speed, signal integrity maintenance is crucial in order to meet HDMI eye pattern and TDR requirements. This is not a trivial task since the differential impedance can be easily affected by the introduction of even a small amount of capacitance or inductance. In addition, the externally accessible HDMI ports are becoming increasingly more susceptible to transient threats. The threats can come from any charged entity; for example, from either a user's direct touch or from hot plugging a charged cable. The internal on-chip ESD structures do not provide sufficient protection needed to keep the sensitive HDMI chip from becoming damaged.

To protect against the over-voltage stress induced by users and ESD testing, external protection is required. With this added concern, HDMI designers need to meet the ESD immunity requirement of IEC 61000-4-2 while maintaining signal integrity and impedance requirements per the HDMI CTS.

Requirements

- Pass Compliance Test Specification (CTS) on sink and source sides: 100 +/- 15% trace impedance
- Pass eye pattern test using HDMI eye mask

Applications and Features

- Ultra-low capacitance: 0.25pF typical (line-to-line)
- Industry's lowest clamping voltage
- Small package solution, including flow through leadless package (SLP) to maintain signal integrity
- Solid-state silicon-avalanche technology does not degrade after repeated strikes
- RoHS/WEEE Compliant
- Meets industry immunity standard:
IEC 61000-4-2 (ESD) +/-18kV (air), +/-12kV (contact)

RClamp® 0584J for HDMI 1.4

With a maximum differential capacitance value of 0.4pF, Semtech's RClamp0584J can be used directly on 2 pairs of 100 Ohm differential impedance signal lines regardless of the board type, number of layers, thickness, or board material. To further facilitate the high-speed design, RClamp0584J is housed in a small leadless package with 0.5mm pitch, flow-through layout. The package design helps to reduce discontinuities and increase common noise rejection through tight-pitch coupling. Figure 1 (see below) shows an example of high-speed differential trace routing with Semtech's RClamp0584J.

In addition to streamlining high-speed signal line design and maintaining the impedance requirement, RClamp0584J is designed specifically to provide ESD protection to Level 4, IEC 61000-4-2 ESD standard ($\pm 12\text{kV}$ contact ESD and $\pm 18\text{kV}$ air ESD) and, at the same time, to

provide superior clamping voltage performance. The RClamp0584J's low clamping voltage reduces the over-voltage stress on the HDMI chip, which increases the overall HDMI system's reliability.

Test Results and Recommendations

The low capacitance, clamping voltage, and operating voltage of the Semtech's RClamp0584J, coupled with its innovative package design, make it a superior protection device for HDMI applications. Semtech has produced 4-layer HDMI evaluation board, for customers to evaluate the RClamp0584J's TDR and eye pattern performance. Figure 2 shows the TDR result on HDMI evaluation board. The result shows that the TDR has met, and is well within, the HDMI CTS requirement (100 Ohm $\pm 15\%$ for differential impedance).

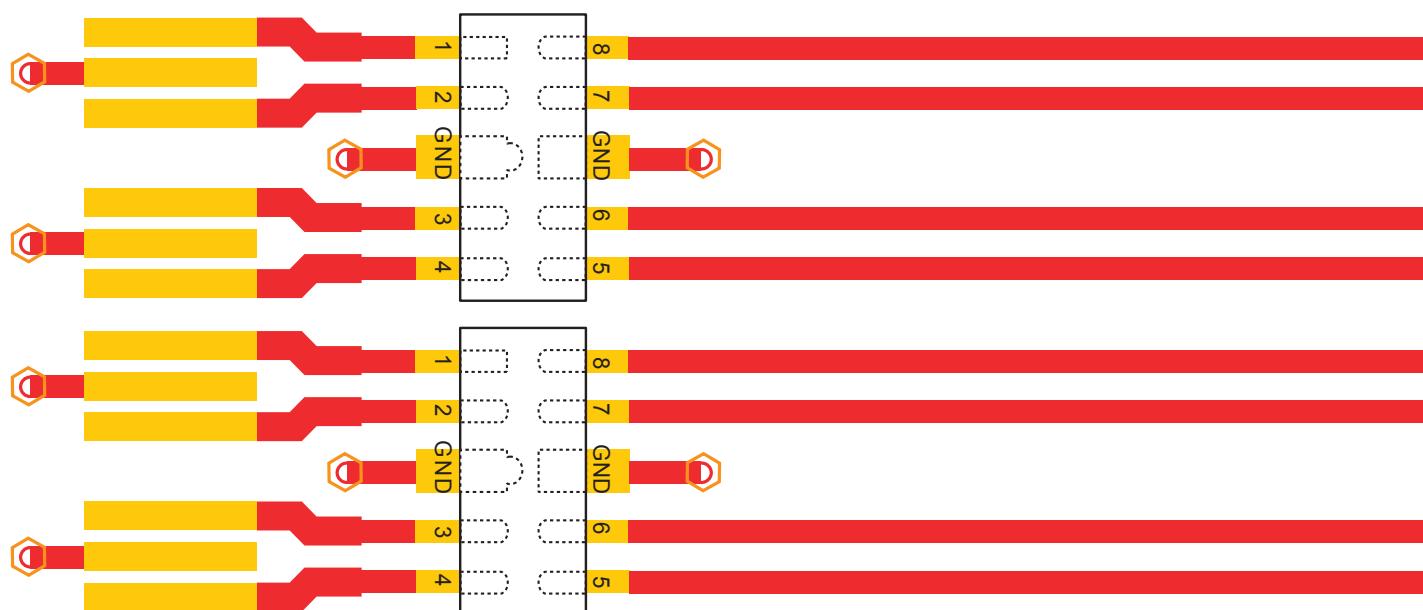
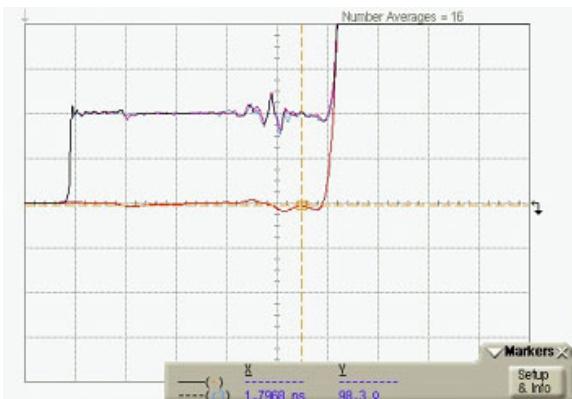


Figure 1: Flow-through layout of Semtech's RClamp0584J for HDMI Applications

RClamp® 0584J for HDMI 1.4



X-axis	1.79	nsec
Y-axis	98.3	ohm

Figure 2: RClamp0584J 4-Layer HDMI TDR Result

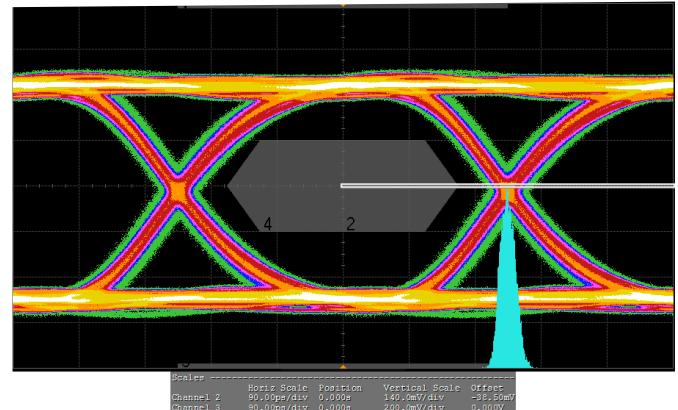


Figure 3: RClamp0584J HDMI Eye Pattern Result

Conclusion

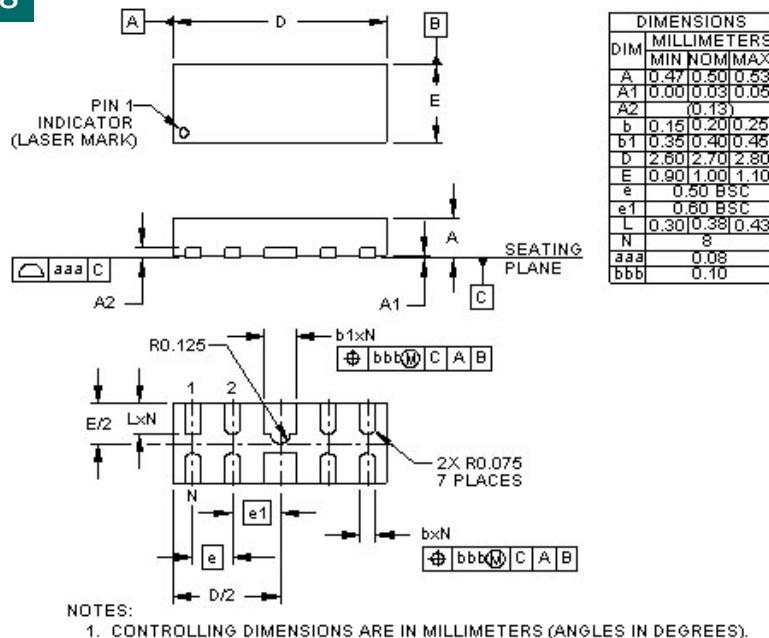
Designers of HDMI systems are faced with the difficult challenge of providing reliable ESD protection while meeting the signal integrity requirement per HDMI CTS. Proper selection of added external protection devices is imperative. The chosen protection device must exhibit very low capacitance while keeping the ESD clamping voltage at a minimum to maintain the quality and reliability of the protected IC. This will ensure that the HDMI chip

will not experience catastrophic or latent failure during a transient threat. With an ultra-low capacitance value and superior ESD protection capability, Semtech's RClamp0584J will ensure the compliance of an HDMI application to both HDMI 1.4 CTS and ESD requirements without the need for any further board or device compensation.

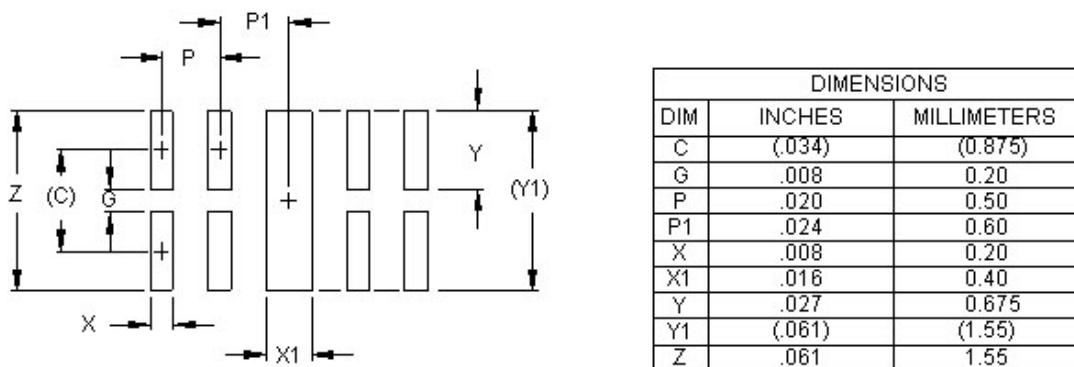
Electrical Characteristics (T=25°)

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V_{RWM}	Any I/O pin to ground			5	V
Reverse Breakdown Voltage	V_{BR}	$I_t = 1\text{mA}$ Any I/O pin to ground	6.5			V
Reverse Leakage Current	I_R	$V_{RWM} = 5\text{V}$, $T=25^\circ\text{C}$ Any I/O pin to ground			0.1	μA
Clamping Voltage	V_c	$I_{pp} = 1\text{A}$, $t_p = 8/20\mu\text{s}$ Any I/O pin to ground			12	V
Junction Capacitance	C_j	$V_R = 0\text{V}$, $f = 1\text{MHz}$ Between I/O pins		0.25	0.4	pF
Junction Capacitance	C_j	$V_R = 0\text{V}$, $f = 1\text{MHz}$ Any I/O pin to ground			0.6	pF

Outline Drawing – SLP2710P8



Land Pattern – SLP2710P8



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