

# Application Brief



SEMTECH PROTECTION PRODUCTS



## ESD/CDE Protection

For High Definition Multimedia Interface (HDMI)

### Breakthrough Protection Device for HDMI 1.3 with ultra low capacitance of 0.3pF

**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 1.3 is the current specification, which supersedes its predecessor, HDMI 1.2, by doubling the bandwidth and increasing the maximum data rate from 1.65Gbps per differential pair to 3.4Gbps.

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.

*HDMI has been a dramatic success with more than 60 million HDMI-equipped devices shipped in 2006. In June 2006, the new HDMI 1.3 standard was introduced for improved color depth and audio output. HDMI 1.3 doubles the data rate of HDMI signals to 3.4Gbps per differential pair.*

## RClamp<sup>®</sup>0524P for HDMI 1.3

With a maximum differential capacitance value of 0.4pF, Semtech's RClamp0524P 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, RClamp0524P 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 RClamp0524P.

In addition to streamlining high-speed signal line design and maintaining the impedance requirement, RClamp0524P is designed specifically to provide ESD protection to Level 4, IEC 61000-4-2 ESD standard ( $\pm 8\text{kV}$  contact ESD and  $\pm 15\text{kV}$  air ESD) and, at the

same time, to provide superior clamping voltage performance. The RClamp0524P'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 RClamp0524P, coupled with its innovative package design, make it a superior protection device for HDMI applications. Semtech has produced 2-layer and 4-layer HDMI evaluation boards, which are available for customers to evaluate the RClamp0524P's TDR and eye pattern performance. Figure 2 and Figure 3, respectively, show the TDR results on 4-layer and 2-layer HDMI evaluation boards. Both results show that the TDR has met, and is well within, the HDMI CTS requirement ( $100\text{ Ohm} \pm 15\%$  for differential impedance).

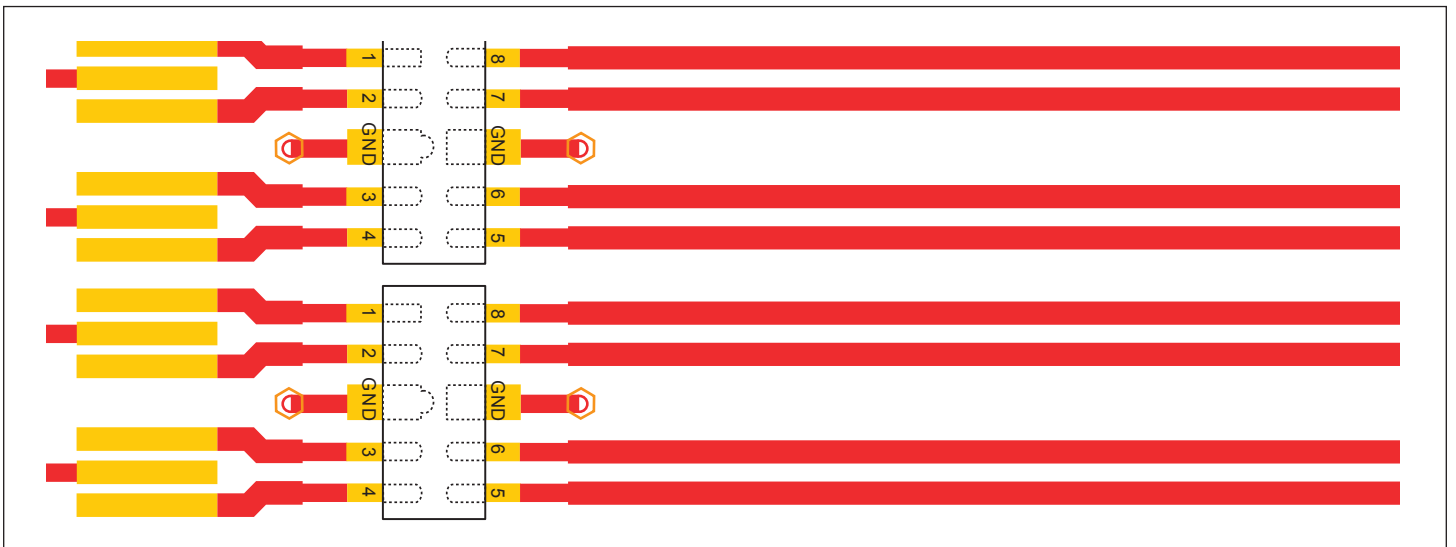
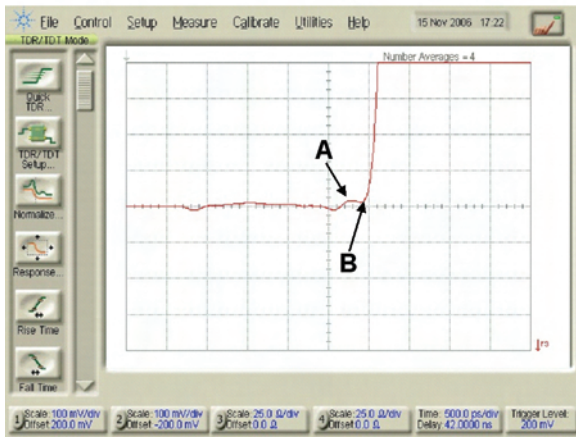


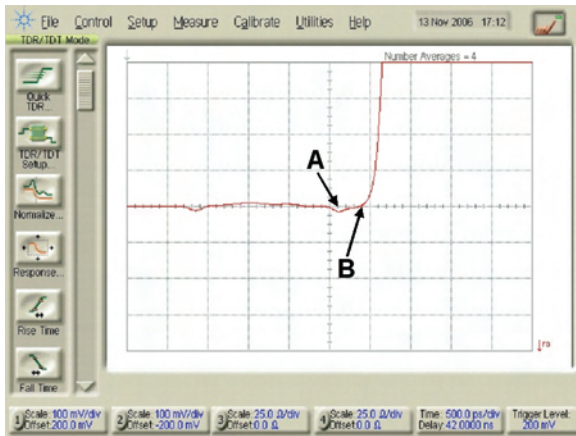
Figure 1: Flow-through layout of Semtech's RClamp0524P for HDMI Applications

# RClamp<sup>®</sup>0524P for HDMI 1.3



	A	B	
<b>X-axis</b>	2.097	2.214	<b>(nsec)</b>
<b>Y-axis</b>	104.0	103.0	<b>(Ohm)</b>

Figure 2: RClamp0524P 4-Layer HDMI TDR Result



	A	B	
<b>X-axis</b>	1.923	2.216	<b>(nsec)</b>
<b>Y-axis</b>	96.0	101.0	<b>(Ohm)</b>

Figure 3: RClamp0524P 2-Layer HDMI TDR Result

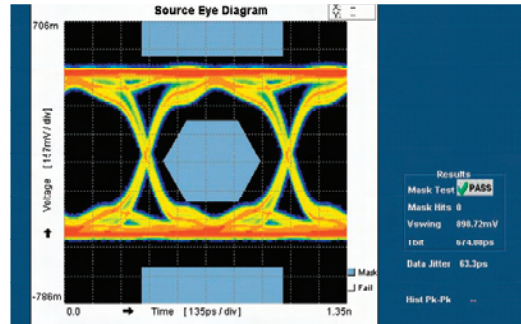


Figure 4: RClamp0524P HDMI Eye Pattern Result (1.48Gbps)

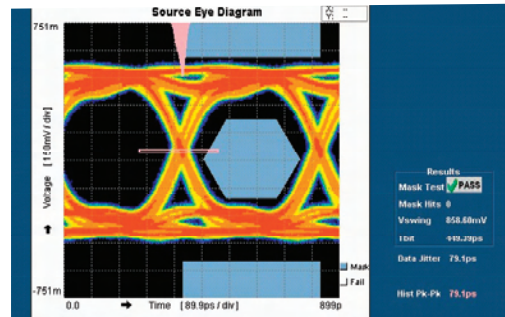


Figure 5: RClamp0524P HDMI Eye Pattern Result (2.25Gbps)

## Conclusion

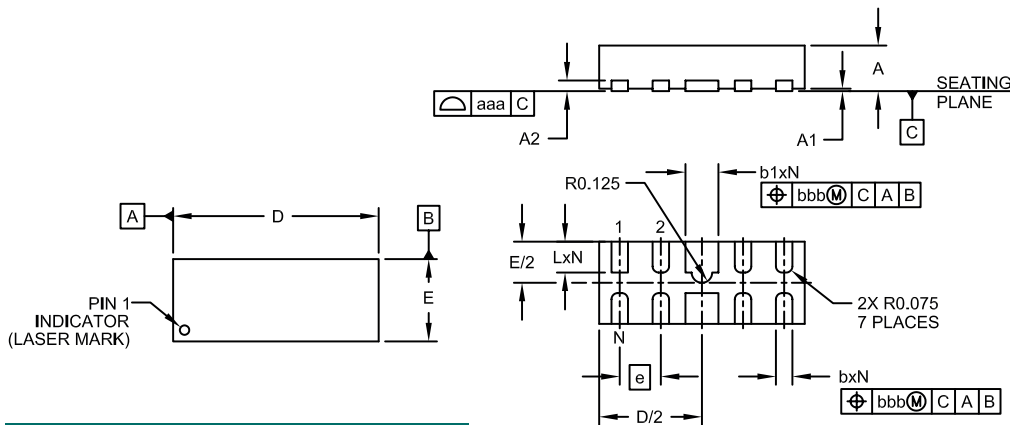
Designers of HDMI systems are faced with the difficult challenge of providing reliable ESD protection while meeting the signal integrity requirement per HDMI CTS. Proper selection of added external protection devices is imperative. The chosen protection device must exhibit very low capacitance while 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 RClamp0524P will ensure the compliance of an HDMI application to both HDMI 1.3 CTS and ESD requirements without the need for any further board or device compensation.

# Application Brief

## 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	$V_{BR}$	$I_t = 1mA$ Any I/O pin to ground	6			V
Reverse Leakage Current	$I_R$	$V_{RWM} = 5V, T = 25^\circ C$ Any I/O pin to ground			1	$\mu A$
Clamping Voltage	$V_c$	$I_{pp} = 1A, t_p = 8/20\mu s$ Any I/O pin to ground			15	V
Junction Capacitance	$C_j$	$V_R = 0V, f = 1MHz$ Between I/O pins		0.30	0.4	pF
Junction Capacitance	$C_j$	$V_R = 0V, f = 1MHz$ Any I/O pin to ground			0.8	pF

## Outline Drawing – SLP2510P8

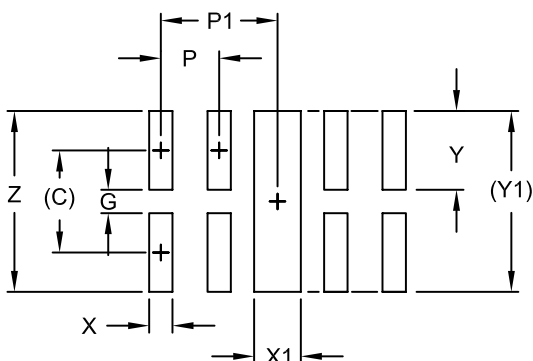


DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.020	.023	.026	.050	0.58	0.65
A1	0.00	.001	.002	0.00	0.03	0.05
A2		(.005)		(0.13)		
b	.006	.008	.010	0.15	0.20	0.25
b1	.014	.016	.018	0.35	0.40	0.45
D	.094	.098	.102	2.40	2.50	2.60
E	.035	.039	.043	0.90	1.00	1.10
e		.020 BSC		0.50 BSC		
L	.012	.015	.017	0.30	0.38	0.425
N		8		8		
aaa		.003		0.08		
bbb		.004		0.10		

Notes:

- Controlling dimensions are in millimeters (Angles in degrees).

## Land Pattern – SLP2510P8



DIM	DIMENSIONS	
	INCHES	MILLIMETERS
C	(.034)	(0.875)
G	.008	0.20
P	0.20	0.50
P1	.039	1.00
X	.008	0.20
X1	.016	0.40
Y	.027	0.675
Y1	(.061)	(1.55)
Z	.061	1.55

Notes:

- Controlling dimensions are in millimeters (Angles in degrees).
- This land pattern is for reference purposes only.
- Consult your manufacturing group to ensure your company's manufacturing guidelines are met.

Visit our website to locate the most current product specifications, datasheets and contact information for your local Semtech Field Applications Engineer.

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