EMI4172

Common Mode Filter with ESD Protection

Functional Description

The EMI4172 is an integrated common mode filter providing both ESD protection and EMI filtering for high speed digital serial interfaces such as HDMI or MIPI D-PHY.

The EMI4172 provides protection for two differential data line pairs in a small RoHS-compliant WDFN10 package.

Features

- Highly Integrated Common Mode Filter (CMF) with ESD Protection provides protection and EMI reduction for systems using High Speed Serial Data Lines with cost and space savings over discrete solutions
- Large Differential Mode Bandwidth with Cutoff Frequency > 2 GHz
- High Common Mode Stop Band Attenuation: >15 dB at 700 MHz
- Provides ESD Protection to IEC61000-4-2 Level 4, ±8 kV Contact Discharge
- Low Channel Input Capacitance Provides Superior Impedance Matching Performance
- Low Profile Package with Small Footprint in WDFN10 2 x 2.5 mm Pb−Free Package
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- HDMI/DVI Display in Mobile Phones
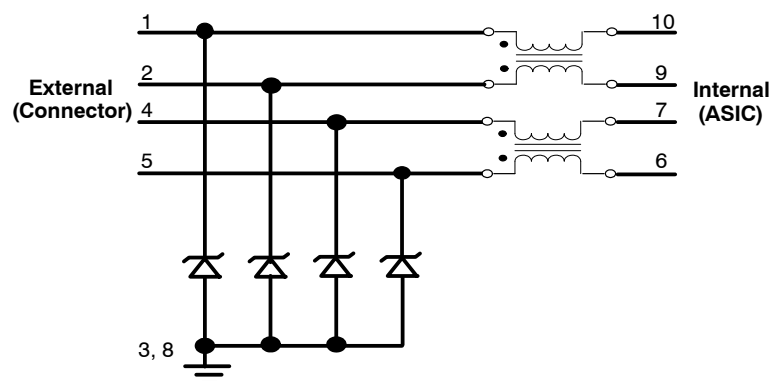- MIPI D-PHY (CSI-2, DSI, etc) in Mobile Phones and Digital Still Cameras

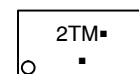**Figure 1. EMI4172 Electrical Schematic**

ON Semiconductor®

http://onsemi.com

**WDFN10
CASE 511BM**

MARKING DIAGRAMS

2TM■

2T = Specific Device Code
M = Date Code
■ = Pb−Free Package
(*Note: Microdot may be in either location)

PIN CONNECTIONS

In_1+	1		10	Out_1+
In_1−	2		9	Out_1−
GND	3		8	GND
In_2+	4		7	Out_2+
In_2−	5		6	Out_2−

(Top View)

ORDERING INFORMATION

Device	Package	Shipping[†]
EMI4172MTTAG	WDFN10 (Pb−Free)	3000/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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PIN FUNCTION DESCRIPTION

Pin Name	Pin No.	Type	Description
In_1+	1	I/O	CMF Channel 1+ to Connector (External)
In_1−	2	I/O	CMF Channel 1− to Connector (External)
Out_1+	10	I/O	CMF Channel 1+ to ASIC (Internal)
Out_1−	9	I/O	CMF Channel 1− to ASIC (Internal)
In_2+	4	I/O	CMF Channel 2+ to Connector (External)
In_2−	5	I/O	CMF Channel 2− to Connector (External)
Out_2+	7	I/O	CMF Channel 2+ to ASIC (Internal)
Out_2−	6	I/O	CMF Channel 2− to ASIC (Internal)
V_N	3, 8	GND	Ground

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Operating Temperature Range	T_{OP}	−40 to +85	°C
Storage Temperature Range	T_{STG}	−65 to +150	°C
Maximum Lead Temperature for Soldering Purposes (1/8" from Case for 10 seconds)	T_L	260	°C
DC Current per Line	I_{LINE}	100	mA

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

## ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_{LEAK}	Channel Leakage Current	T_A = 25°C, V_{IN} = 5 V, GND = 0 V			1.0	μA
V_F	Channel Negative Voltage	T_A = 25°C, I_F = 10 mA	0.1		1.5	V
C_{IN}	Channel Input Capacitance to Ground (Pins 1, 2, 4, 5 to Pins 3, 8)	T_A = 25°C, At 1 MHz, GND = 0 V, V_{IN} = 1.65 V		0.8	1.3	pF
R_{CH}	Channel Resistance (Pins 1−10, 2−9, 4−7 and 5−6)			8.0		Ω
f_{3dB}	Differential Mode Cut−off Frequency	50 Ω Source and Load Termination		2.0		GHz
F_{atten}	Common Mode Stop Band Attenuation	@ 700 MHz		15		dB
V_{ESD}	In−system ESD Withstand Voltage a) Contact discharge per IEC 61000−4−2 standard, Level 4 **(External Pins)** b) Contact discharge per IEC 61000−4−2 standard, Level 1 **(Internal Pins)**	(Notes 1 and 2)	±8 ±2			kV
V_{CL}	TLP Clamping Voltage (See Figure 12)	Forward I_{PP} = 8 A Forward I_{PP} = 16 A Forward I_{PP} = −8 A Forward I_{PP} = −16 A		12 18 −6 −12		V V V V
R_{DYN}	Dynamic Resistance Positive Transients Negative Transients	T_A = 25°C, I_{PP} = 1 A, t_P = 8/20 μs Any I/O pin to Ground; Notes 1 and 3		1.36 0.6		
V_{RWM}	Reverse Working Voltage	(Note 3)			5.0	V
V_{BR}	Breakdown Voltage	I_T = 1 mA; (Note 4)	5.6		9.0	V

1. Standard IEC61000−4−2 with $C_{Discharge}$ = 150 pF, $R_{Discharge}$ = 330, GND grounded.
2. These measurements performed with no external capacitor.
3. TVS devices are normally selected according to the working peak reverse voltage (V_{RWM}), which should be equal to or greater than the DC or continuous peak operating voltage level.
4. V_{BR} is measured at pulse test current I_T.
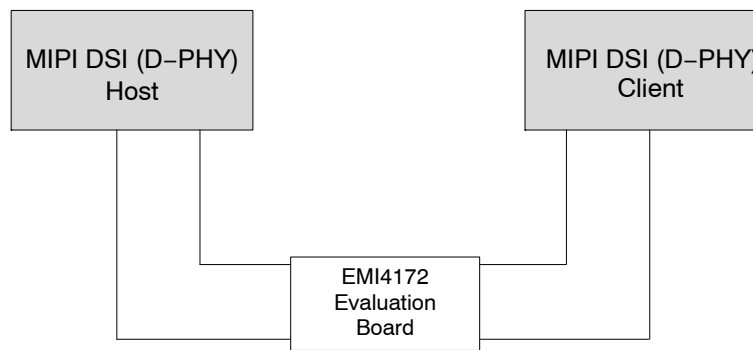
EMI4172

TYPICAL CHARACTERISTICS
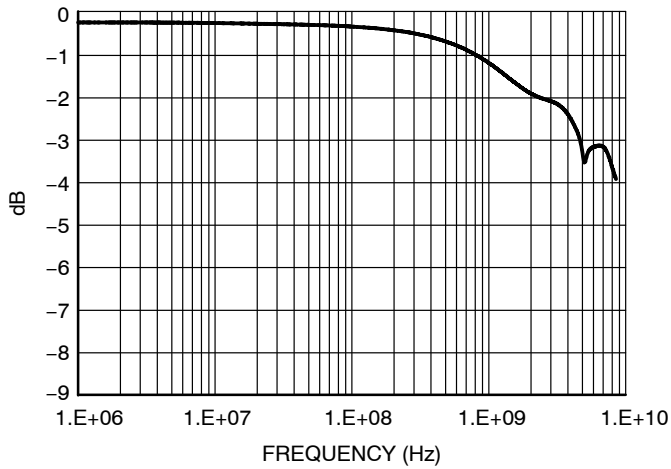
Figure 2. Differential Mode Attenuation vs. Frequency
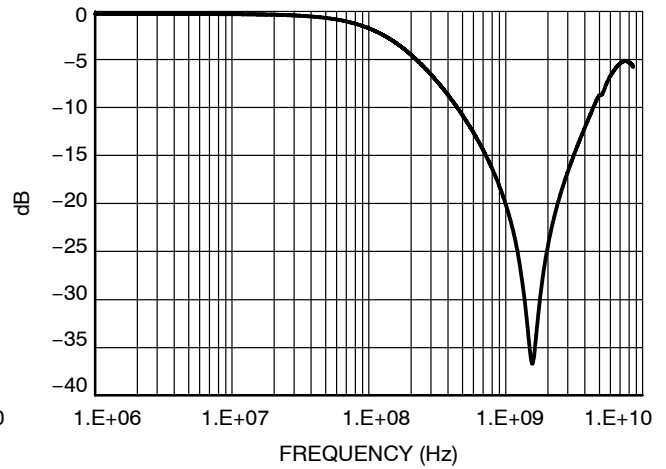
Figure 3. Common Mode Attenuation vs. Frequency

Figure 4. MIPI D−PHY LP Mode Test Setup
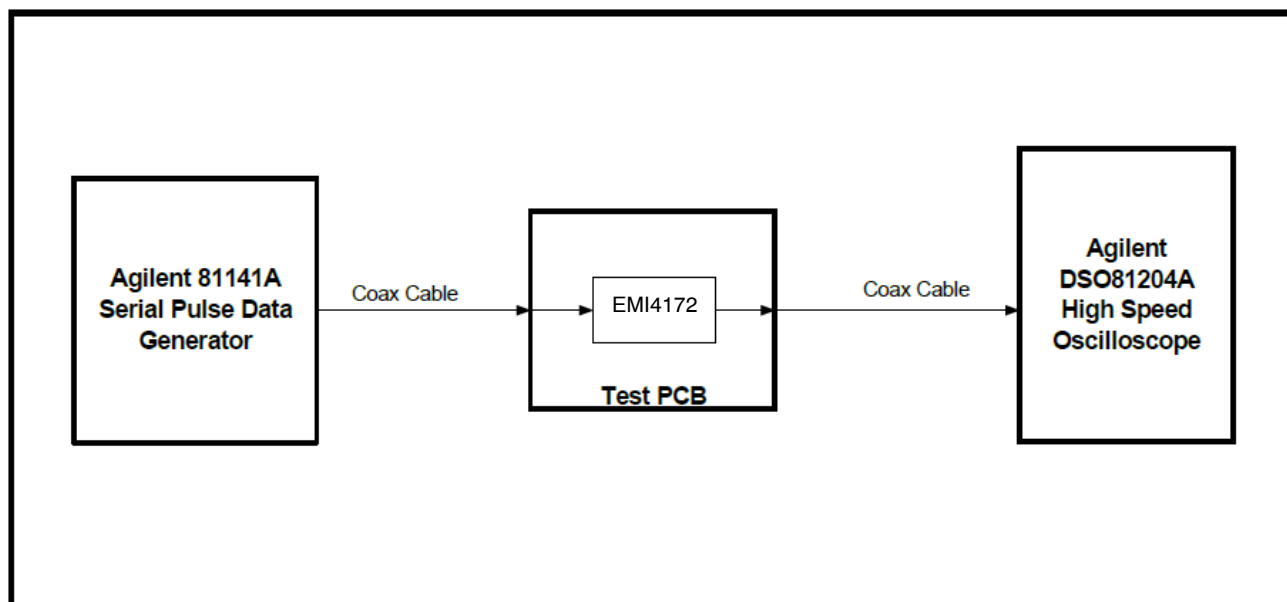
Figure 5. EMI4172 MIPI D−PHY LP Mode Measured Results

Figure 6. EMI4172 Eye Diagram Test Setup

Figure 7. EMI4172 Measured Eye Diagram @ 3.4Gbps (EVB through on left, EVB with EMI4172 on right)

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Transmission Line Pulse (TLP) Measurements

Transmission Line Pulse (TLP) provides current versus voltage (I-V) curves in which each data point is obtained from a 100 ns long rectangular pulse from a charged transmission line. A simplified schematic of a typical TLP system is shown in Figure 8. TLP I-V curves of ESD protection devices accurately demonstrate the product's ESD capability because the 10 s of amps current levels and under 100 ns time scale match those of an ESD event. This is illustrated in Figure 9 where an 8 kV IEC61000-4-2 current waveform is compared with TLP current pulses at 8 and 16 A. A TLP curve shows the voltage at which the device turns on as well as how well the device clamps voltage over a range of current levels. Typical TLP I-V curves for the EMI4172 are shown in Figure 10.
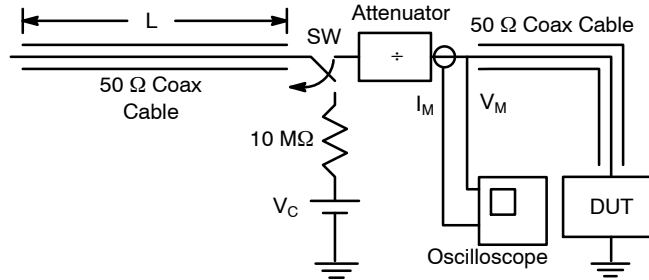
Figure 8. Simplified Schematic of a Typical TLP System
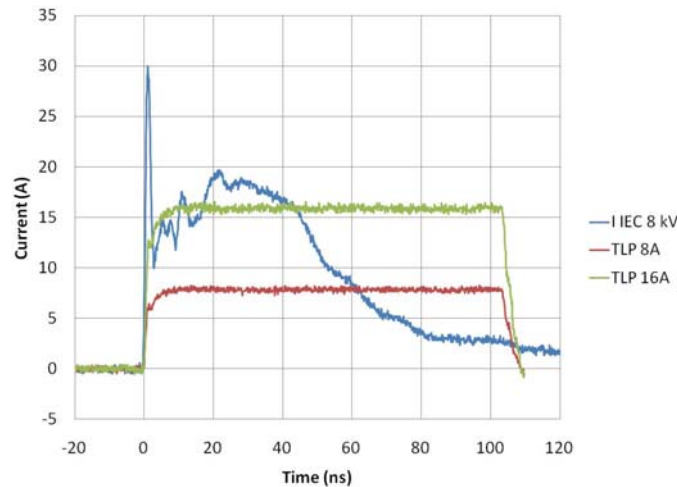
Figure 9. Comparison Between 8 kV IEC61000−4−2 and 8 A and 16 A TLP Waveforms
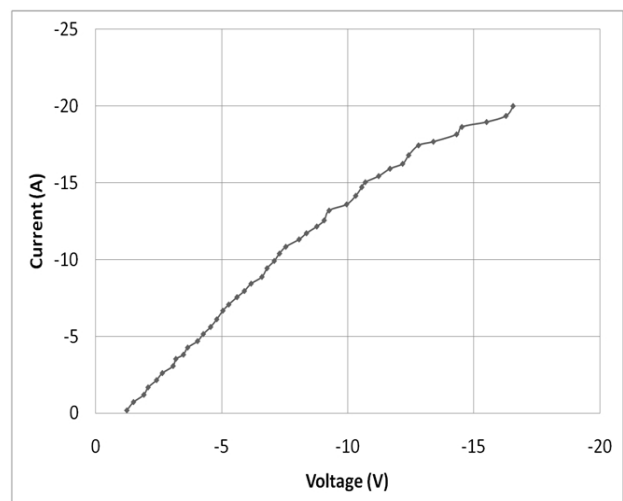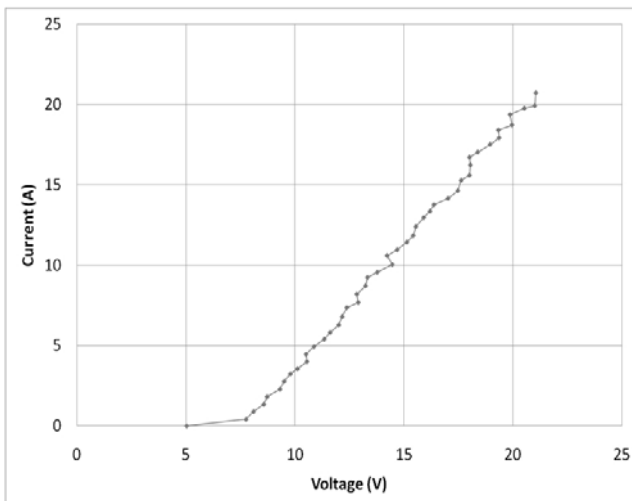
Figure 10. Positive and Negative TLP Waveforms

ESD Voltage Clamping

For sensitive circuit elements it is important to limit the voltage that an IC will be exposed to during an ESD event to as low a voltage as possible. The ESD clamping voltage is the voltage drop across the ESD protection diode during an ESD event per the IEC61000−4−2 waveform. Since the IEC61000−4−2 was written as a pass/fail spec for larger systems such as cell phones or laptop computers it is not clearly defined in the spec how to specify a clamping voltage at the device level. ON Semiconductor has developed a way to examine the entire voltage waveform across the ESD protection diode over the time domain of an ESD pulse in the form of an oscilloscope screenshot, which can be found on the datasheets for all ESD protection diodes. For more information on how ON Semiconductor creates these screenshots and how to interpret them please refer to On Semiconductor Application Notes AND8307/D and AND8308/D.

IEC61000−4−2 Spec.

Level	Test Voltage (kV)	First Peak Current (A)	Current at 30 ns (A)	Current at 60 ns (A)
1	2	7.5	4	2
2	4	15	8	4
3	6	22.5	12	6
4	8	30	16	8

IEC61000−4−2 Waveform
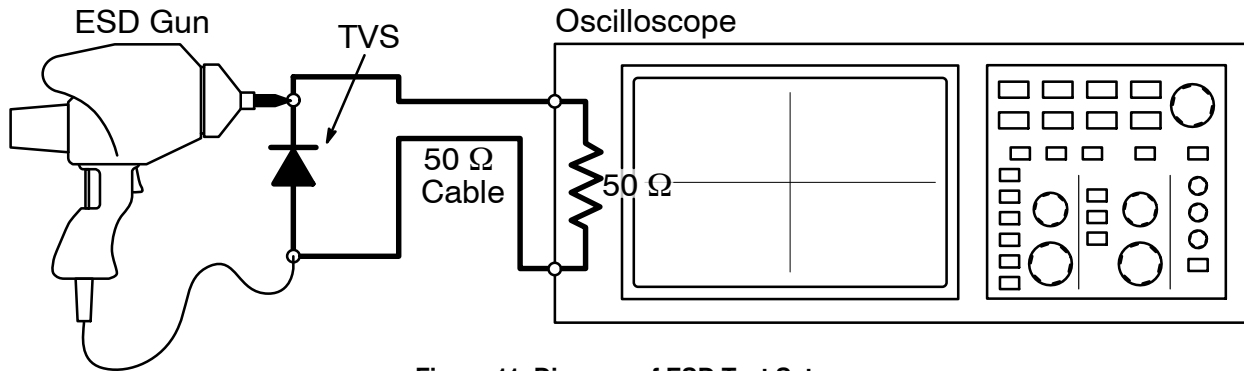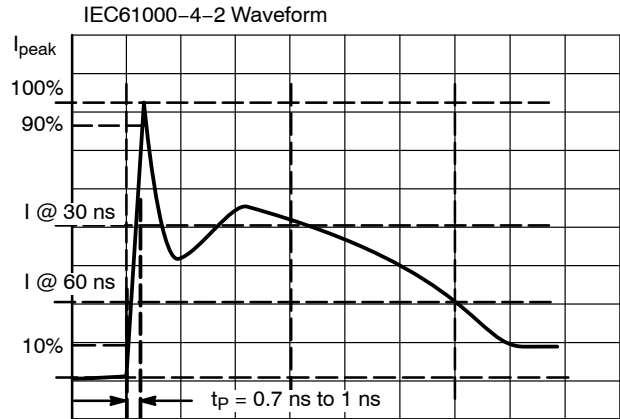
Figure 11. Diagram of ESD Test Setup
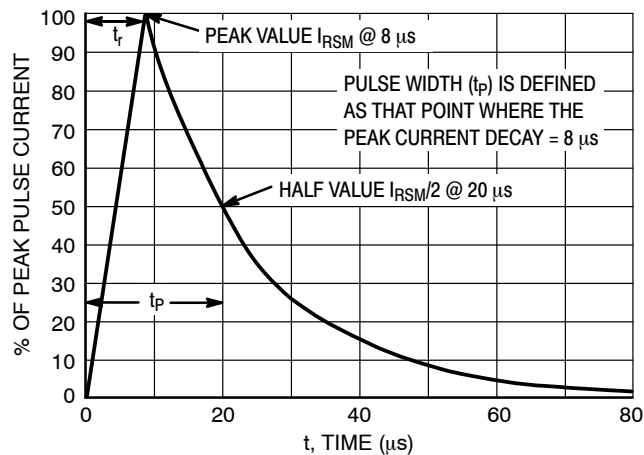
Figure 12. 8 x 20 μs Pulse Waveform
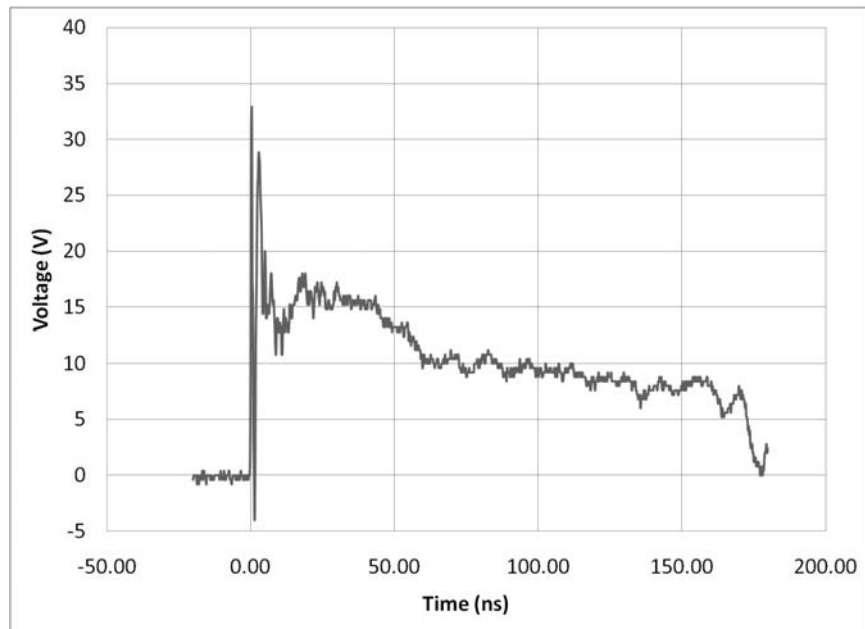
Figure 13. ESD Clamping Voltage +8 kV per IEC6100−4−2 (external to internal pin)
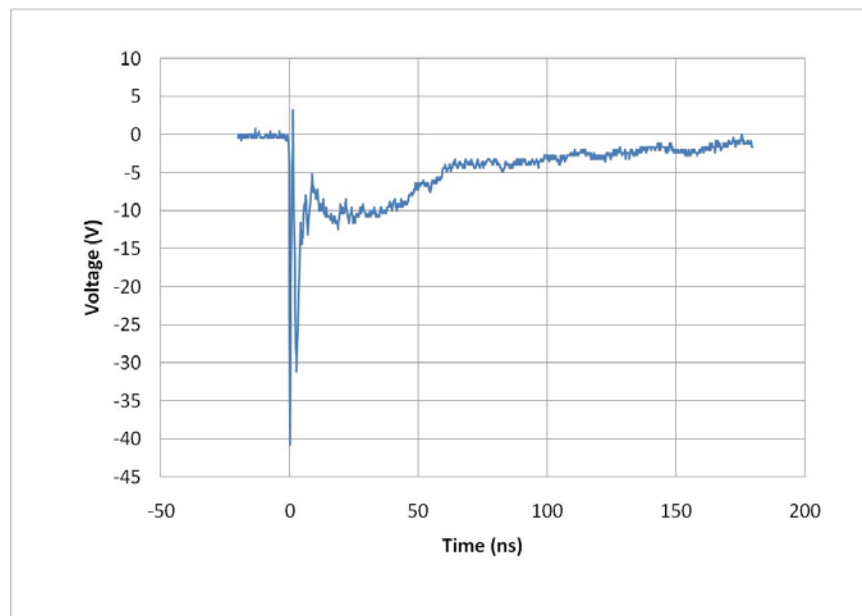
Figure 14. ESD Clamping Voltage −8 kV per IEC6100−4−2 (external to internal pin)

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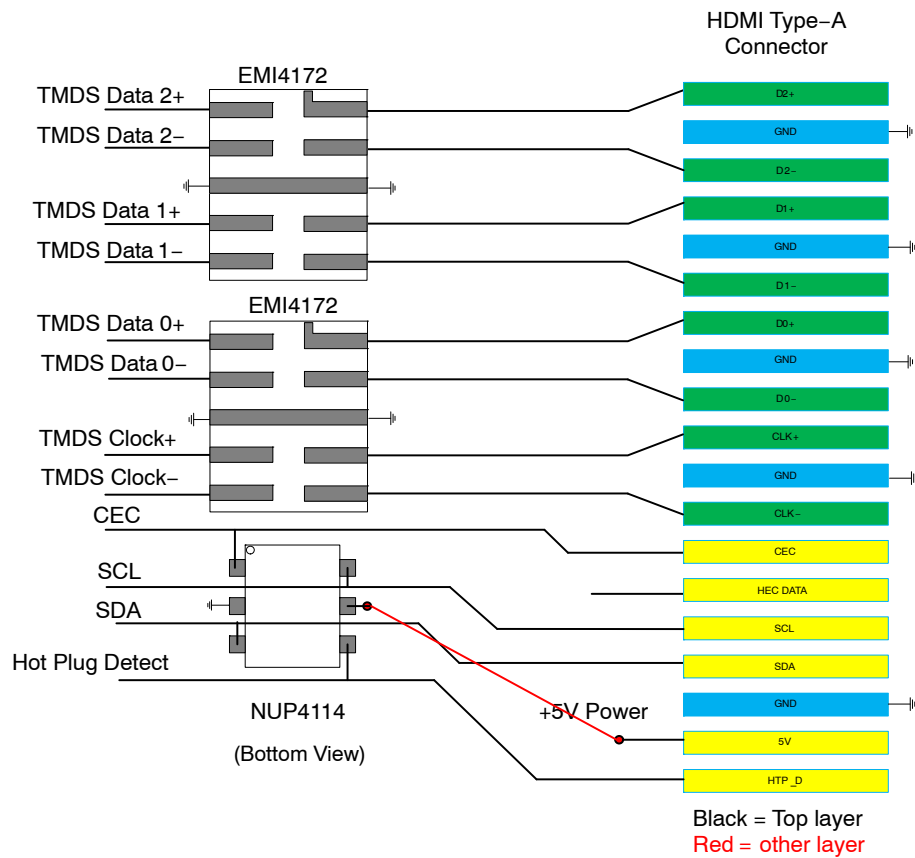
Figure 15. EMI4172 HDMI Type – A Connector Application Diagram
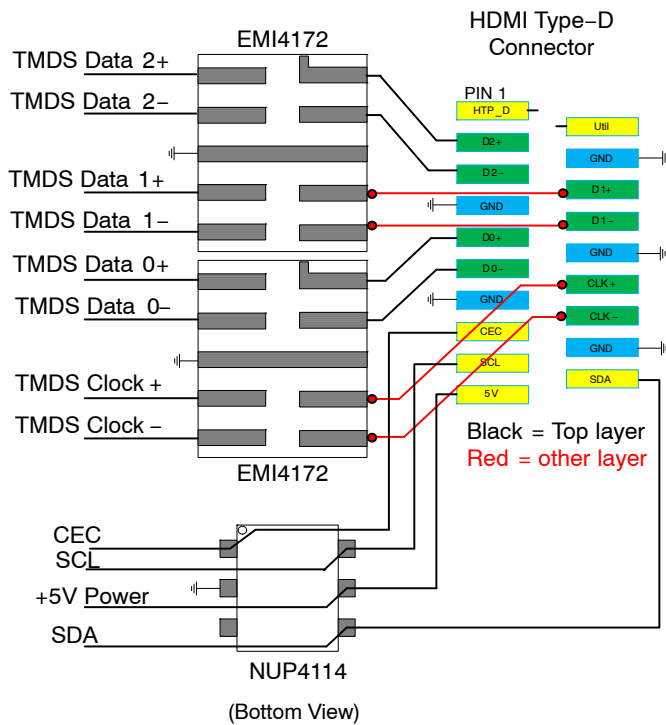
Figure 16. EMI4172 HDMI Type – D Connector Application Diagram
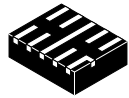
WDFN10 2.5x2, 0.5P
CASE 511BM
ISSUE O

DATE 29 JUN 2010

SCALE 4:1
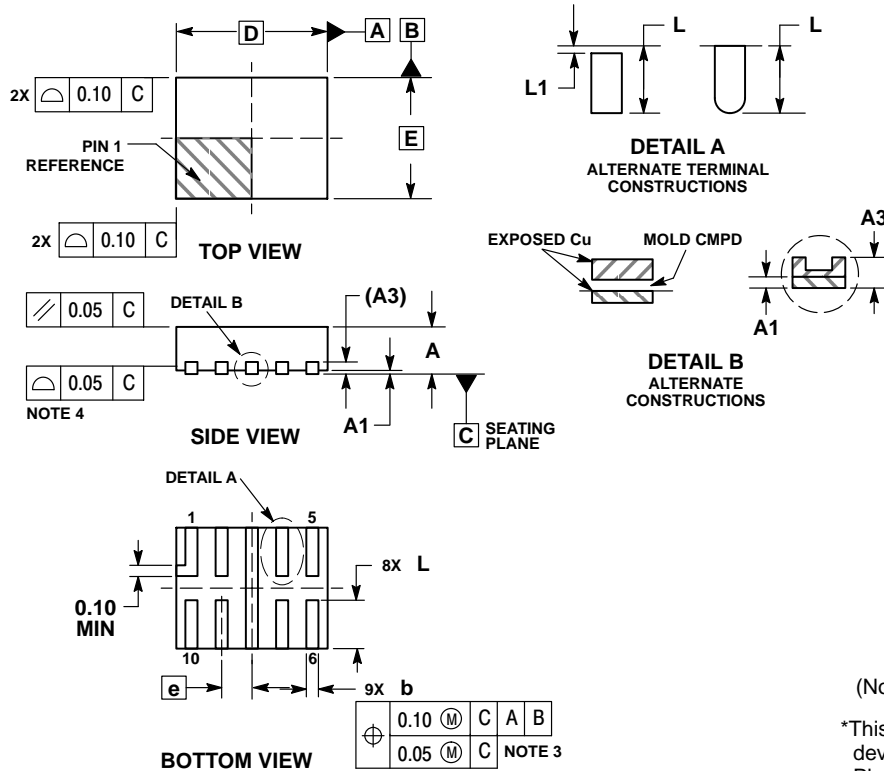
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

TOP VIEW

2X | 0.10 | C
2X | 0.10 | C

PIN 1 REFERENCE

SIDE VIEW

0.05 | C
0.05 | C
NOTE 4

BOTTOM VIEW

DETAIL A

0.10 MIN

8X L

9X b

| ⊕ | 0.10 Ⓜ | C A B |
| ⊕ | 0.05 Ⓜ | C | NOTE 3 |

DETAIL A
ALTERNATE TERMINAL CONSTRUCTIONS

DETAIL B
ALTERNATE CONSTRUCTIONS

EXPOSED Cu   MOLD CMPD

| DIM | MILLIMETERS | |
	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A3	0.20 REF	
b	0.15	0.25
D	2.50 BSC	
E	2.00 BSC	
e	0.50 BSC	
L	0.70	0.90
L1	0.05	0.15

GENERIC MARKING DIAGRAM*

XXM▪
○   ▪
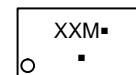
XX = Specific Device Code
M = Date Code
▪ = Pb–Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb–Free indicator, "G" or microdot " ▪", may or may not be present.

RECOMMENDED MOUNTING FOOTPRINT

8X 1.07
8X 0.30
PACKAGE OUTLINE
2.30
1
0.45
0.50 PITCH

DIMENSIONS: MILLIMETERS

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical–documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at
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