

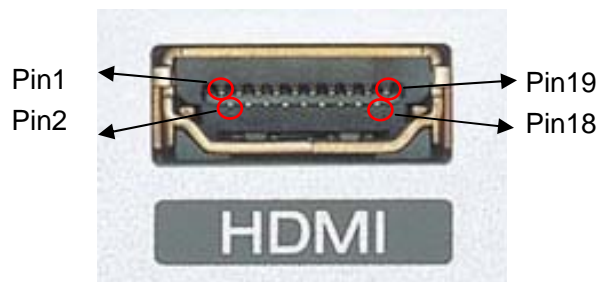
EMC and ESD protection countermeasure for HDMI

With the development of HD & full HD video technology, HDMI port has been widely used in all kinds of A/V equipments. HDMI supports hot plug and play technology, provides ultra high transfer rate. According to the latest HDMI1.4 specification, HDMI provide a max transfer rate of 4.8Gbps, which could well address the need of full HD video transmission.

However, ultra high transfer rate may cause some EMC problem. At the same time, ESD protection solution is also very important for HDMI. Here we will discuss about EMC and ESD protection countermeasure of HDMI.

EMC countermeasure

There are four pairs of differential signal lines (TMDS) assigned in HDMI. Each TMDS provides a max transfer rate of 3.4Gbps. Detailed Pin assignments and description are shown as following figures.



H1:	T.M.D.S	DATA2+
H2:	T.M.D.S	DATA2 shield
H3:	T.M.D.S	DATA2-
H4:	T.M.D.S	DATA1+
H5:	T.M.D.S	DATA1 shield
H6:	T.M.D.S	DATA1-
H7:	T.M.D.S	DATA0+
H8:	T.M.D.S	DATA0 shield
H9:	T.M.D.S	DATA0-
H10:	T.M.D.S	DATA CLOCK+
H11:	T.M.D.S	DATA CLOCK shield
H12:	T.M.D.S	DATA CLOCK-
H13:	CEC (Consumer Electronics Control)	
H14:	Reserved (in cable but N.C. on device)	
H15-D6:	SCL(DDC Clock)	
H16-D7:	SDA(DDC Data)	
H17:	DDC/CEC Ground	
H18:	+5V Power supply	
H19:	Hot plug detective	

Fig.1 HDMI1.4 type A pin assignment

In order to realize a good EMC effect, related EMC solution is recommended as following Fig.

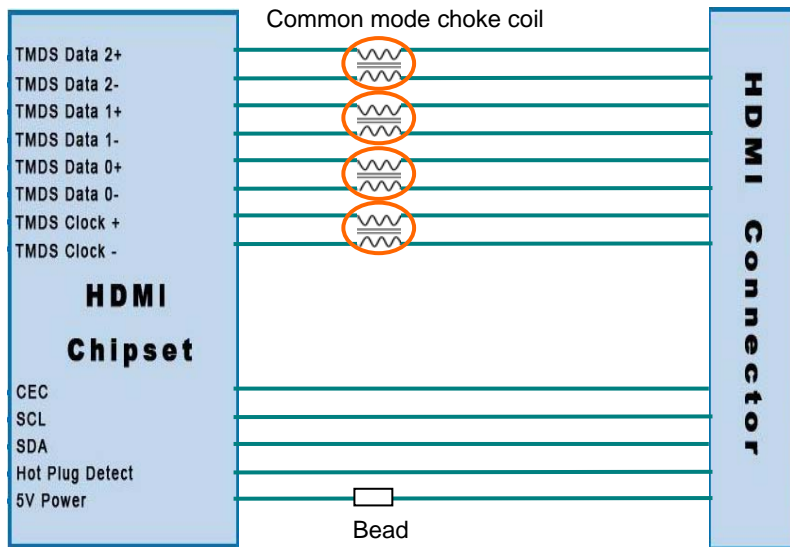


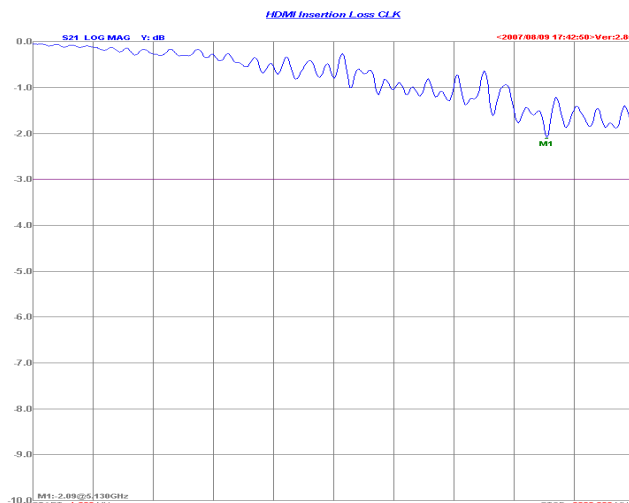
Fig. 2. EMC solution for HDMI

According to above solution, a piece of bead is placed on power line, which is used to suppress EMI and prevent EMI emitting follow the lines. According to HDMI specification, it may provide a max. current of 500mA to HDMI device, thus we recommend Sunlord's bead: **PZ1608D121-1R0TF**.

Meanwhile, four pieces of common mode choke coils are placed in differential liens to suppress the common mode noise, recommending components: **SDCW2012H-2-900TF**.

After placing common mode choke coil, HDMI should meet with HDMI transmission compliance test. Insertion loss test, Characteristic impedance test and Eye diagram test are shown as following Figures.

1. Insertion loss test



Attenuation(Insertion Loss) summary result

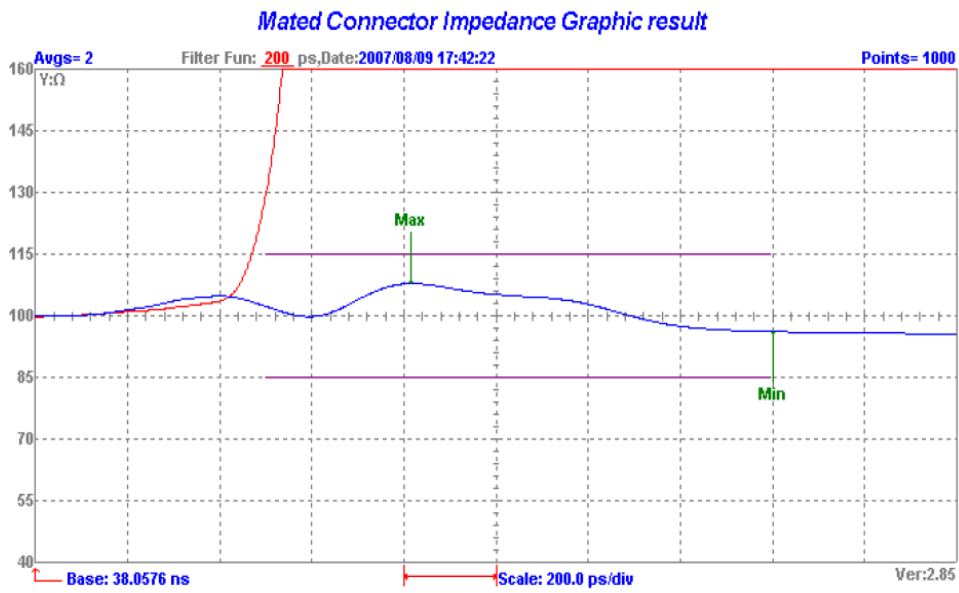
Start	Stop	Lim From	Lim To	CLK
1	6000	-3	-3	-2.09
MHz	MHz	dB	dB	Pass

Fig.3 Insertion loss test

Test result shows that the max. insertion loss is -2.09dB within 6GHz frequency range.

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2. Characteristic impedance test



Mated Connector Impedance summary result

Pair Num	Result	Spc Max	Spc Min	Max value	Min Value	Δ Value	Avg	Unit
CLK	Pass	115	85	107.94	96.26	11.68	102.1	Ohms

Fig.4. Characteristic impedance test

3. Eye diagram test

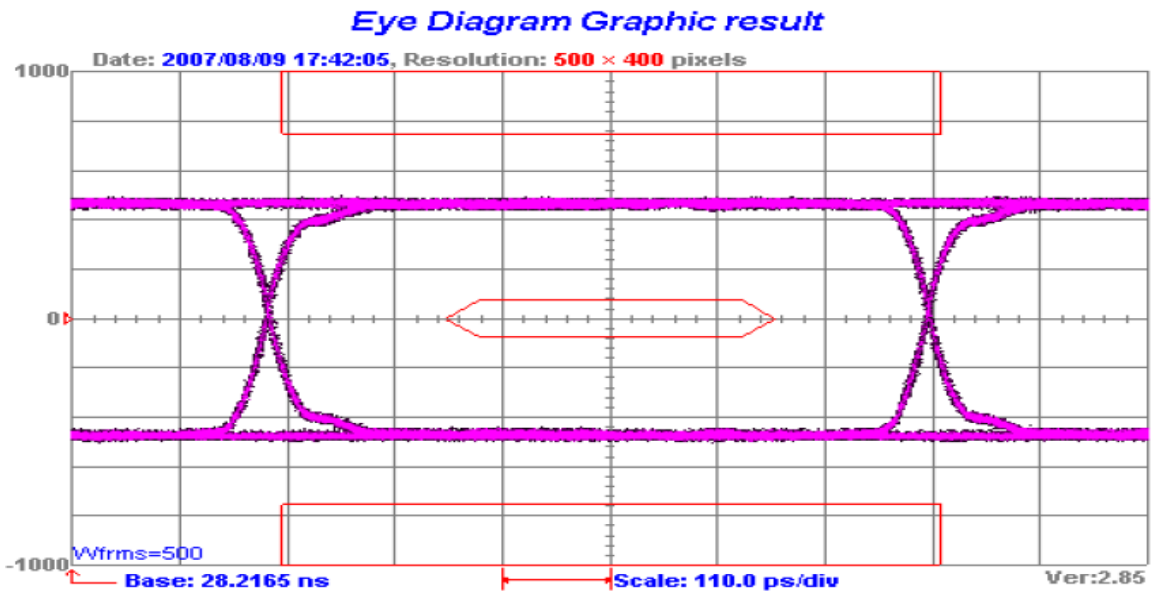


Fig. 5. Eye diagram test

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ESD protection solution

HDMI supports hot plug and play operation and therefore it often suffers from ESD damage. Because of ultra high transfer rate on differential lines, we should choose an appropriate varistor without causing delay to the data transmission. Following Fig. is a totally ESD protection solution for HDMI.

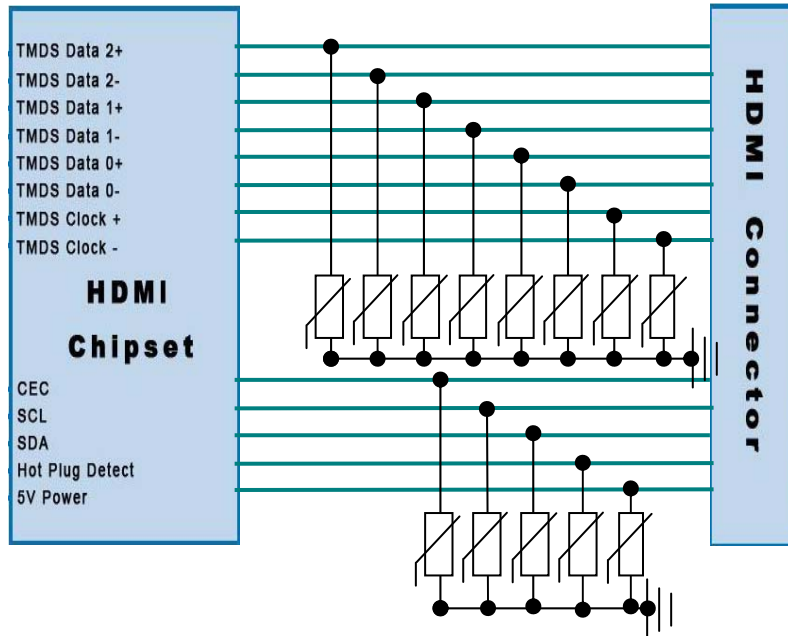
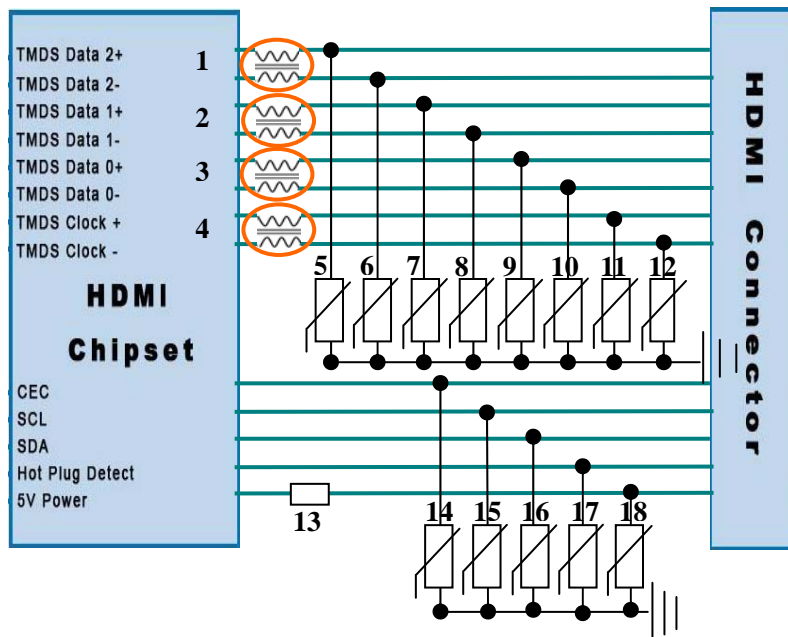


Fig. 6. ESD protection solution

We recommend ultra low capacitance varistor: SDV1005H260C0R5YPTF, whose capacitance is 0.5pF and cut-frequency reaches 2GHz@-3dB, applying on differential signal lines. On other lines (CEC/SCL/Hot Plug Detect/5V Power), we recommend varistor: SDV1005E090C300NPTF.

In summary, EMC and ESD protection solution are recommended as following figure:



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1~4 Common mode choke coil	5~12 Varistor	13 Bead
SDCW2012H-2-900TF	SDV1005H260C0R5 YPTF	PZ1608D121-1R0TF
14~18 Varistor		
SDV1005E090C300NPTF		

Fig. 7. EMC and ESD protection solution

When we layout PCB, Varistor should be assigned closely to the connector to achieve a good ESD suppression effect. We assign common mode choke coils and bead after Varistors on the lines.