

Signal Integrity Solutions for HDMI



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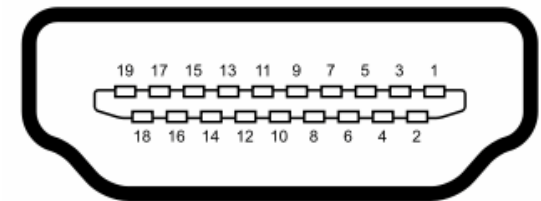
Presented by: **Minhong Mi, Ansoft Corporation**

- Introduction to HDMI
- Overview of the ALIVH technology, Surge/Static Discharge Protection and EMI Noise Filtering Components
- Overview of the ALIVH Design Kit
 - Components for High Speed Digital Applications (HDMI)
- Applying **DK concept** to optimize the design of an **HDMI Evaluation Board**
- Conclusions

Introduction to HDMI

- **HDMI: High-Definition Multimedia Interface**
- **History:**
 - Developed by Sony, Hitachi, Thomson (RCA), Philips, Matsushita (Panasonic), Toshiba and Silicon Image,
 - V1.3 released on 22nd June, 2006
- **Applications:**
 - Connecting DVDs , Plasma, LCD, DLP, LCOS PVRs, MHP, OCAP, and many more
- **Key Specs:**
 - Uses TMDS (Transition Minimized Differential Signaling) for Video Data Transfer
 - Up to 340Mps (10.2Gbps) in v1.3

HDMI™
HIGH-DEFINITION MULTIMEDIA INTERFACE



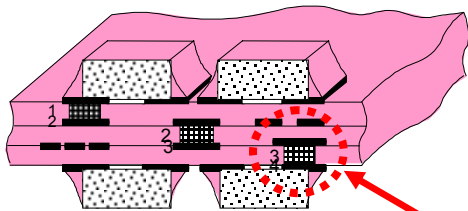
Type A Connector Pin Assignment

Panasonic's ALIVH Process

- ALIVH = Any Layer Inner Via Hole

ALIVH

All layer IVH structure



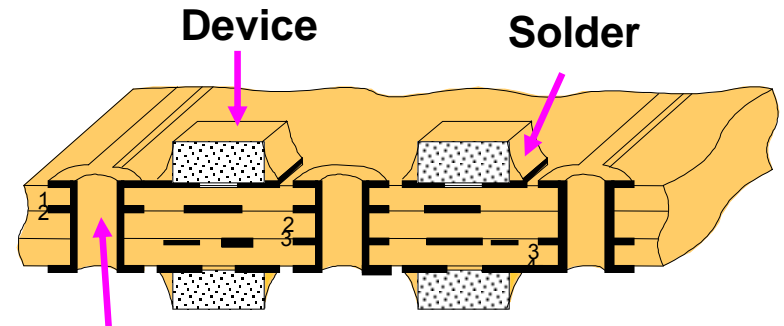
Via

- Via on via
- Pad on via
- All layer uniform specification

The surface can be used by almost 100% because it is not poriferous.

Multilayer printed wiring board

Through hole structure



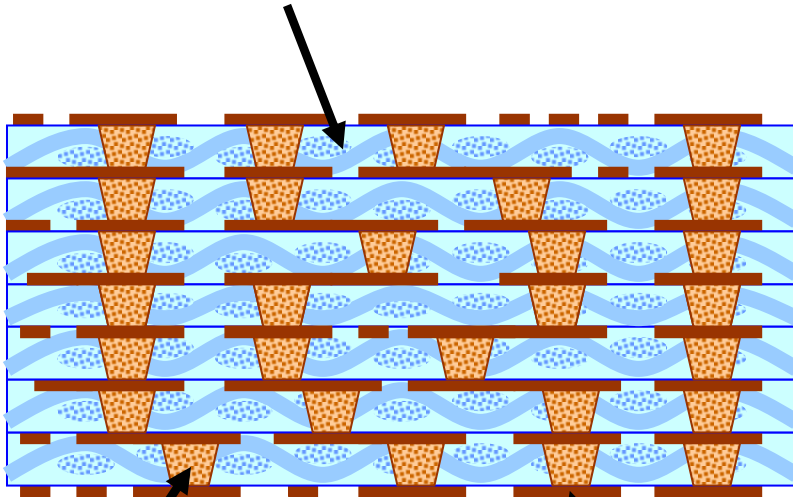
Through hole
Parts cannot be mounted on top the hole.

- Miniaturization with high density mounting
- Easy design
- Correspondence to high speed specification circuit by short wiring

Comparison ALIVH-G with Buildup

All layer IVH <ALIVH G type>

The glass woven cloth epoxy resin



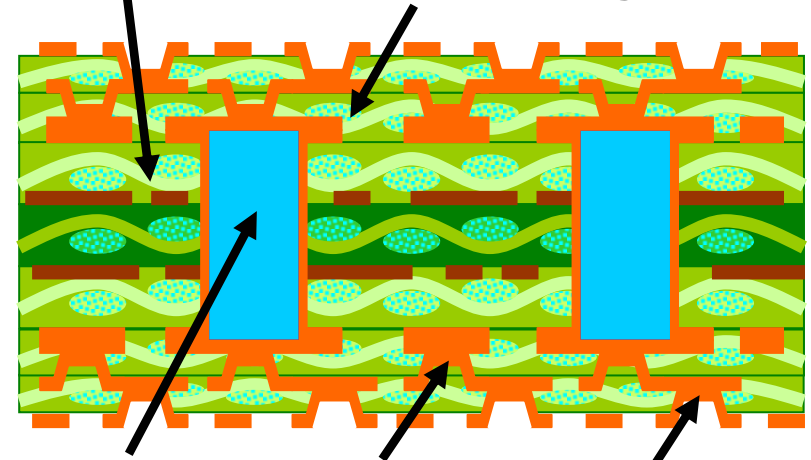
Electro-conductive paste

Laser hole

- High density wiring on all uniform layer .
- The short wiring connection is possible with a Via on Via and the pad on Via structure.
- High smoothness and accurate board thickness are possible with the heat press process.

Multilayer base substrate+Buildup substrate

The glass woven cloth epoxy resin
Insulating resin
<RCF or Prepreg>



Drill hole

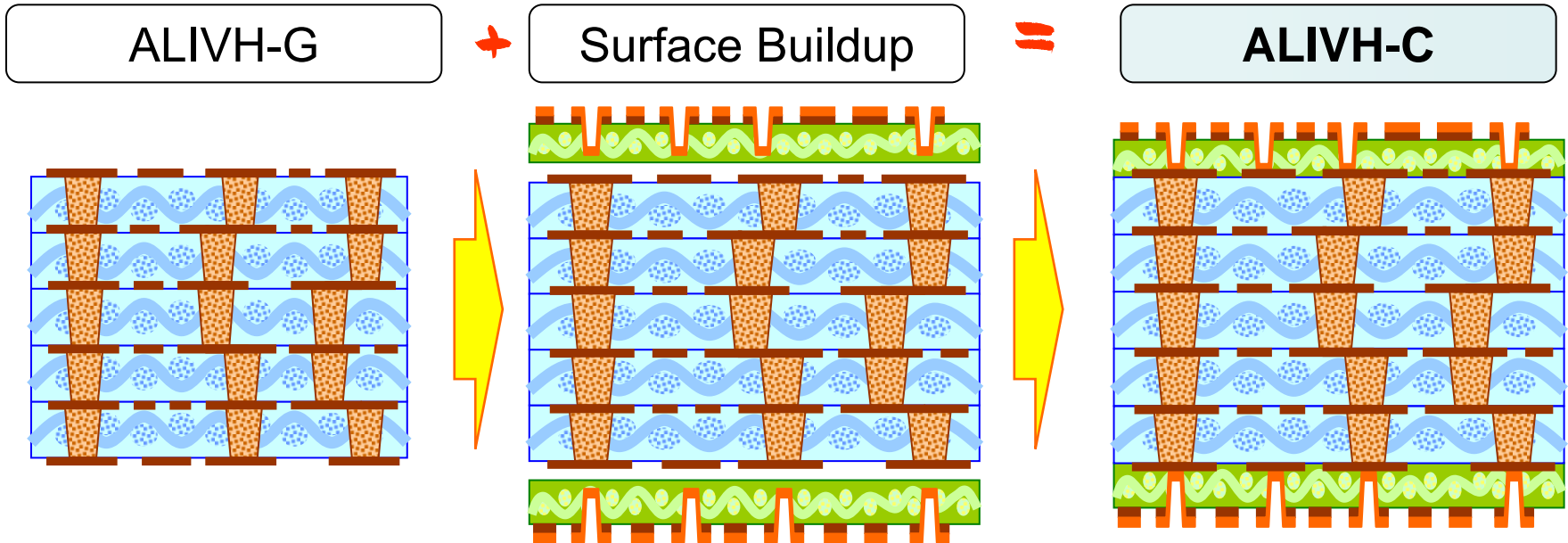
Copper plating

Laser or Photo hole

- It is only possible to use small diameter Vias for high wiring density Build-up layers.
- Long wiring for core layer because of detour around the through-hole structures
- The copper plating is necessary.

Comparison ALIVH-G with ALIVH-C

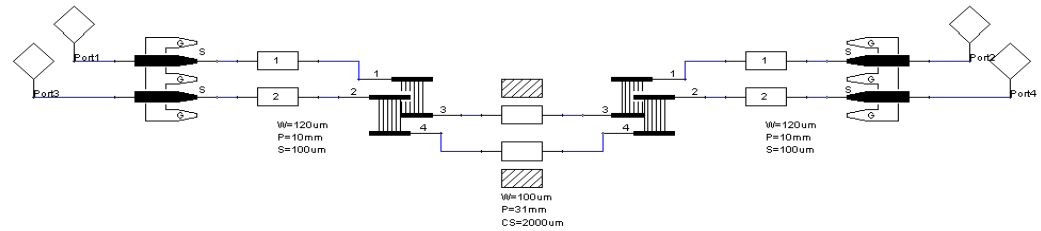
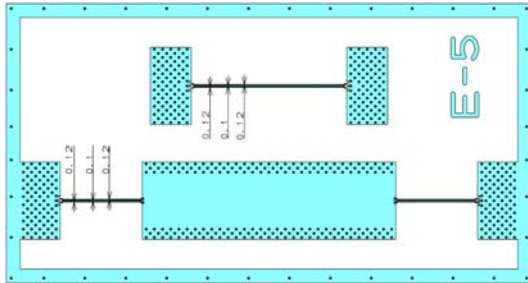
Combination of ALIVH-G type and Buildup



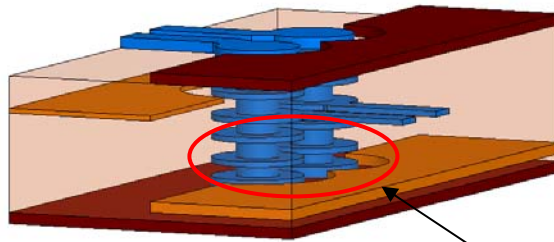
All layer IVH structure

- ◆ Taking advantage of inner lines ALIVH G, fine pitch and high density surface mount is possible.
- ◆ Compatible with Build-up board design.

ALIVH-C vs. Build-Up

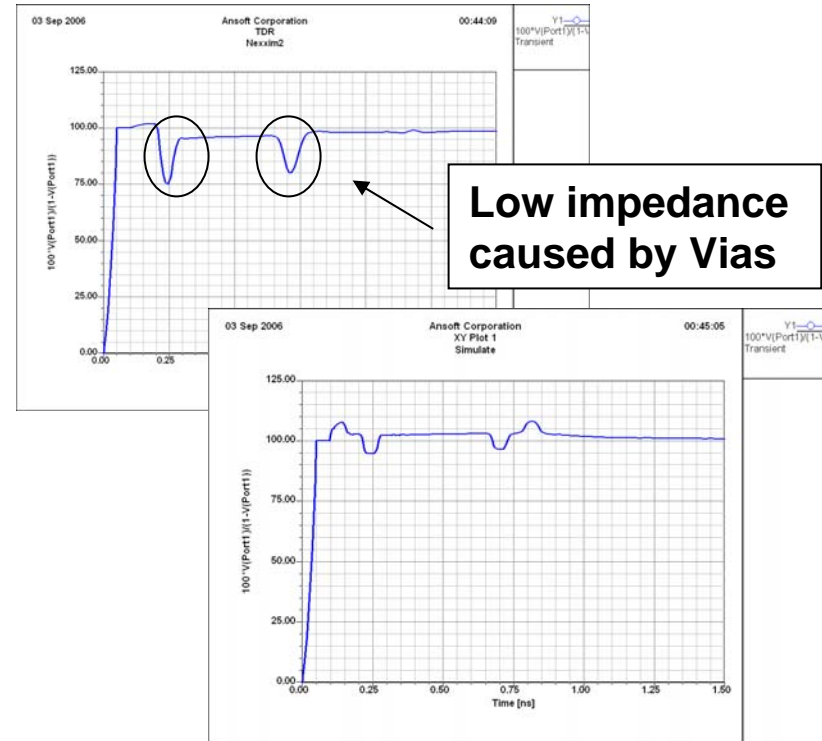
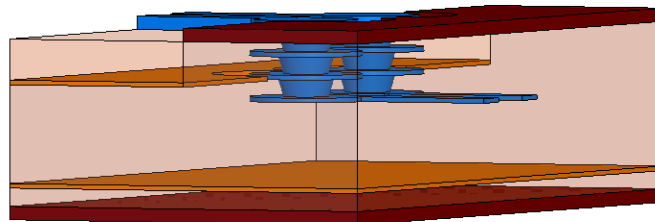


Build-Up



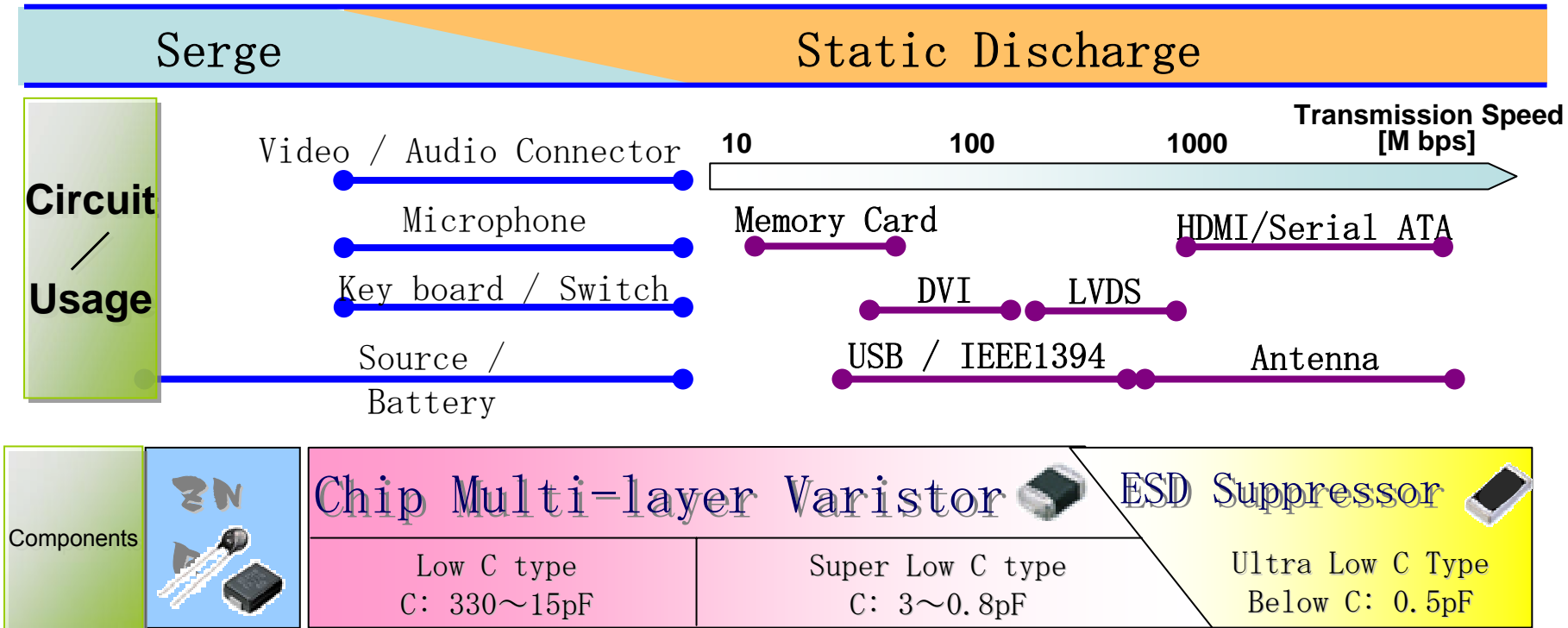
“Open-stub”

ALIVH-C



Static Discharge Measures : External

⇒ Selection of the Static Discharge and Surge Components



Lightning Surge, Switching pulse, static discharge...

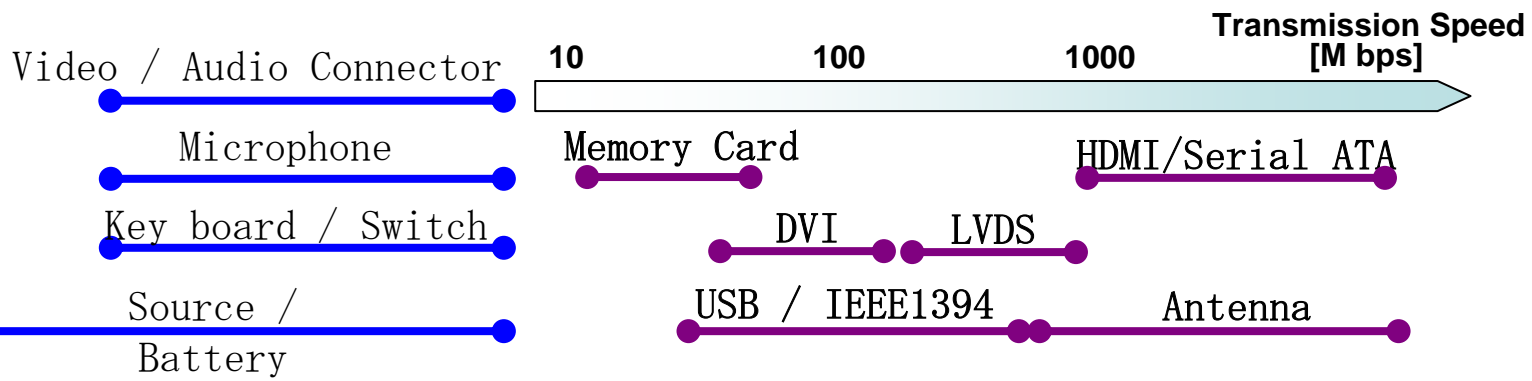
PED has been supplying all the components for low voltage application to AC sources for all over the world!

Static Discharge Measures : External

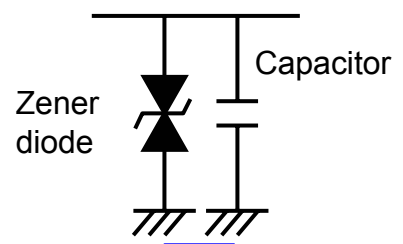
⇒ Effect of the Stray Capacitance due to high speed transmission



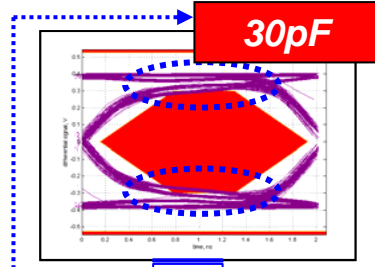
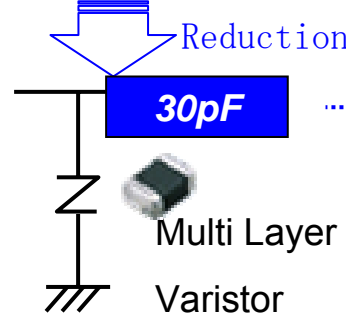
Circuit / Usage



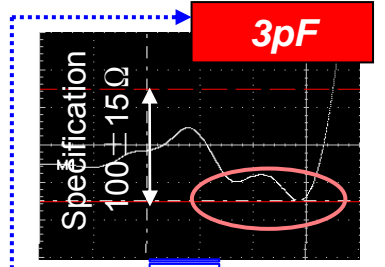
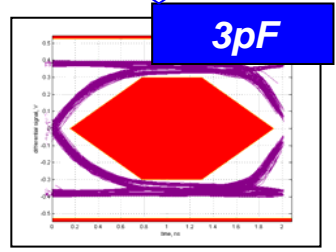
Before



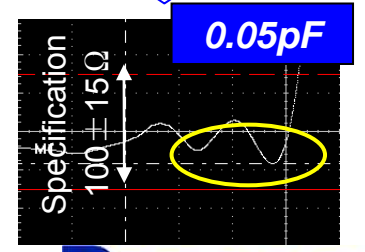
After



Lower C

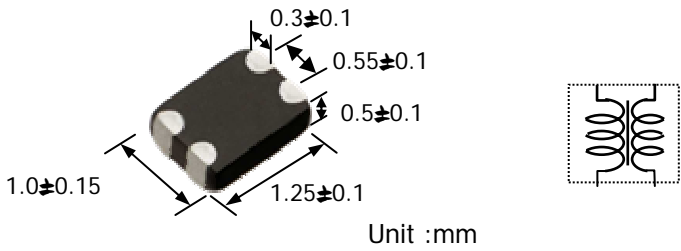


Lower C



HDMI Common Mode Noise Filter

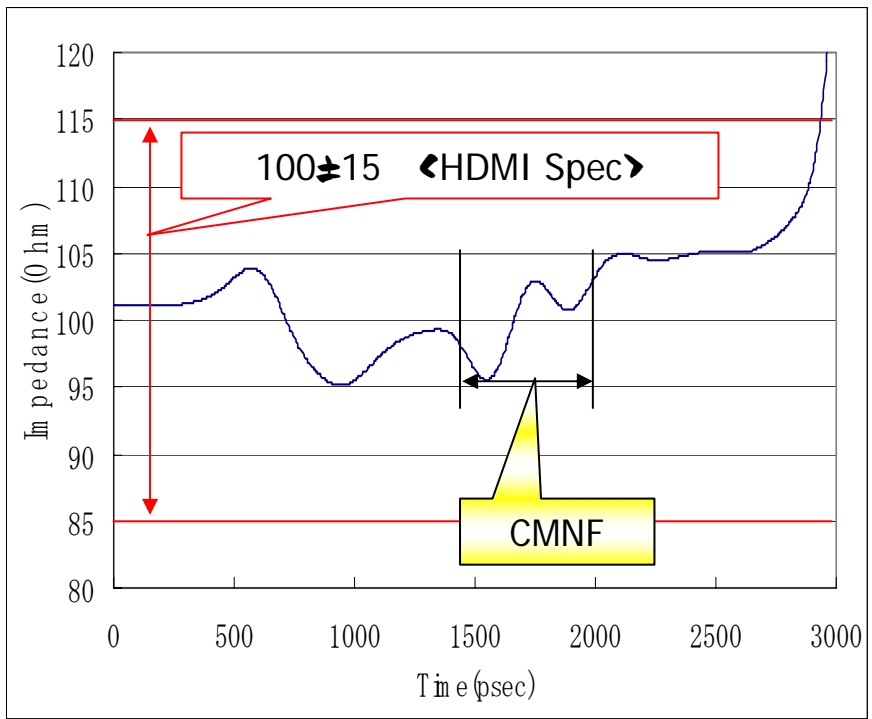
■ Dimensions



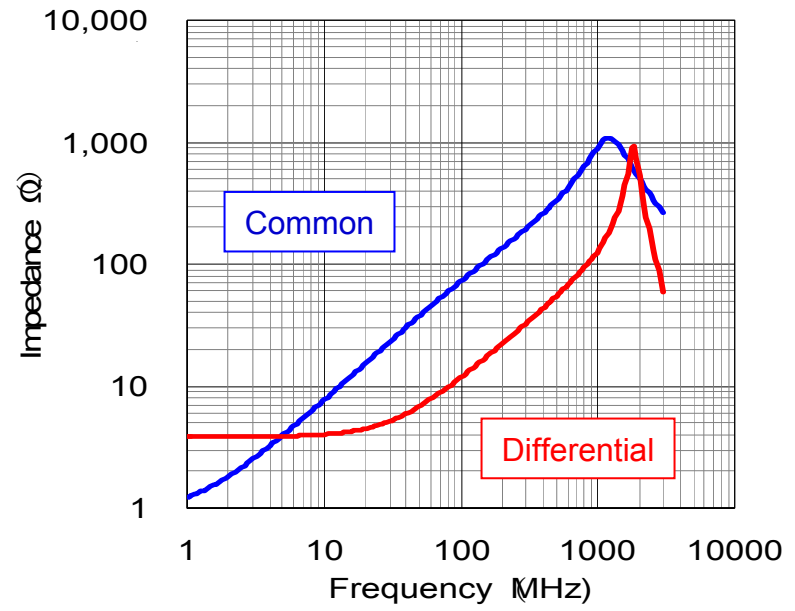
■ Spec as reference

Unit Name	Impedance (Ω) at 100MHz		Rated Voltage (V DC)	Rated Current (mA)	DC Resistor (Ω) max.
	Common	Differential			
EXC24CG900U	90 typ.	20 max.	5	130	2.7

TDR Characteristics

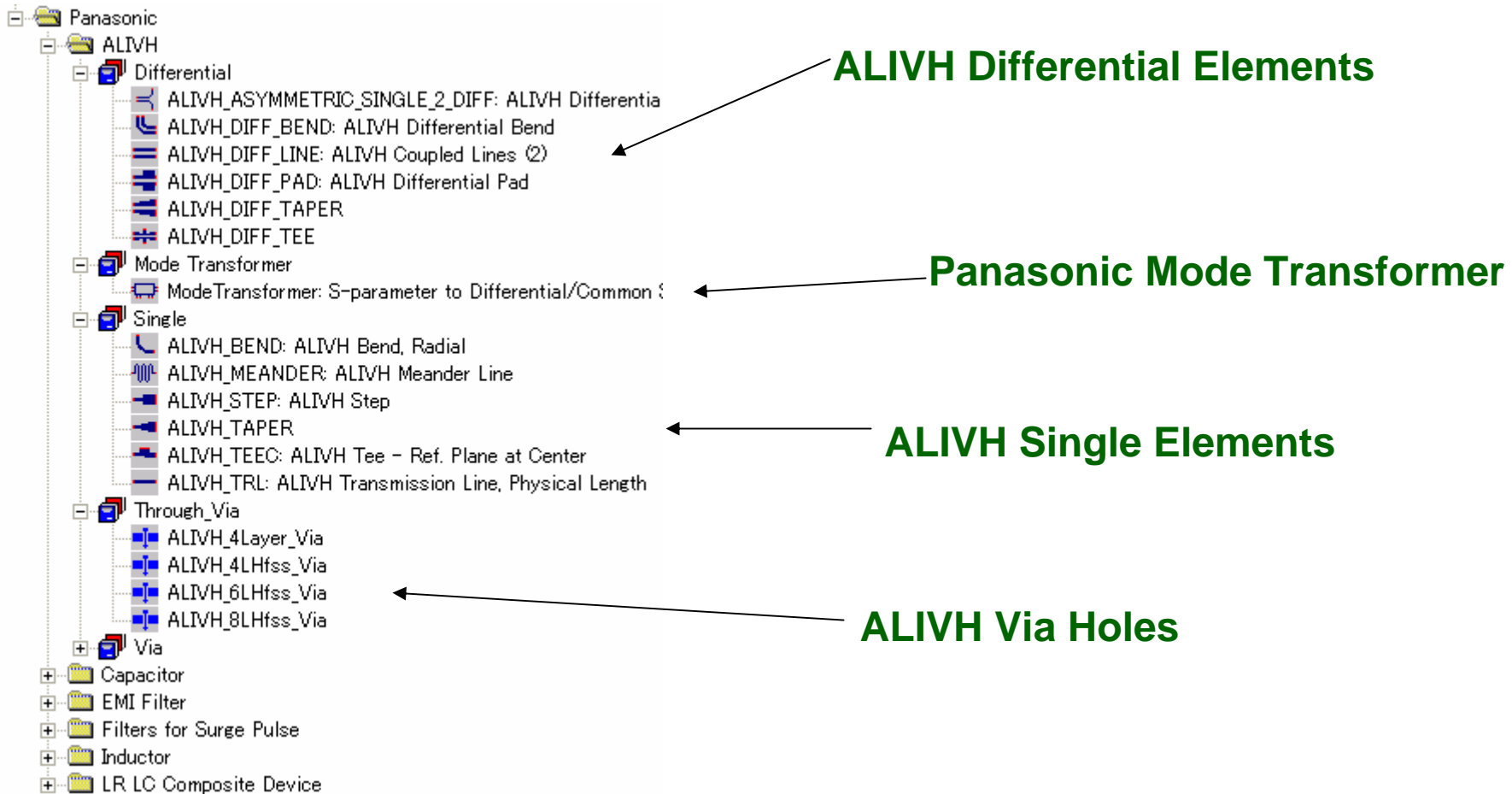


■ Impedance Characteristics

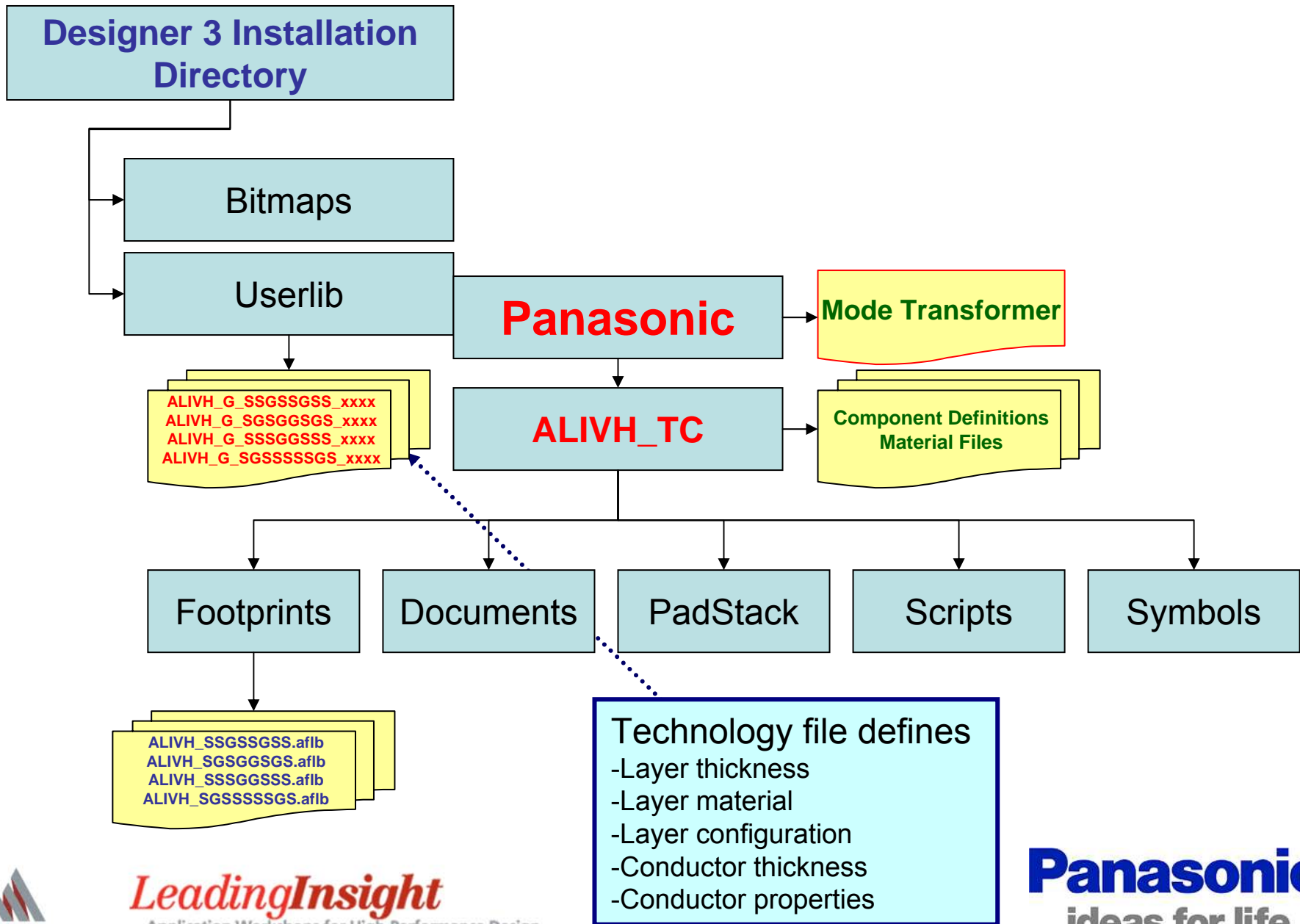


PED Developed “ALIVH” Evaluation Kit

HDMI Design Kit in Designer/Nexxim

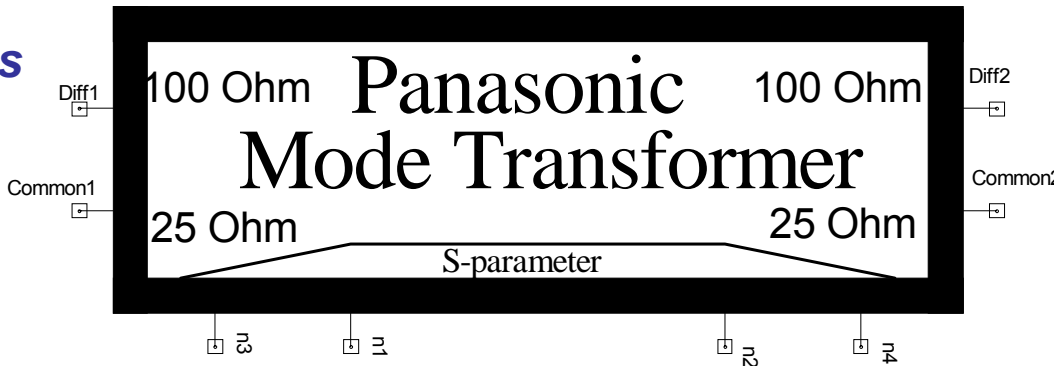
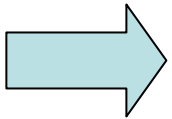


Design Kit Structures

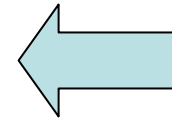


Mode Transformer

Differential-Common S-parameters



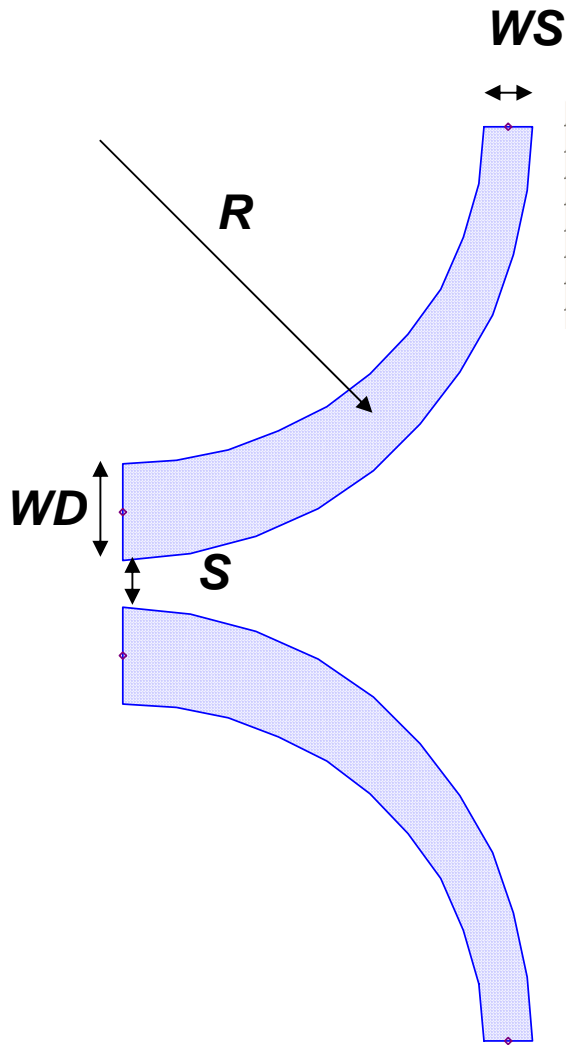
Differential-Common S-parameters



Regular S-Parameters

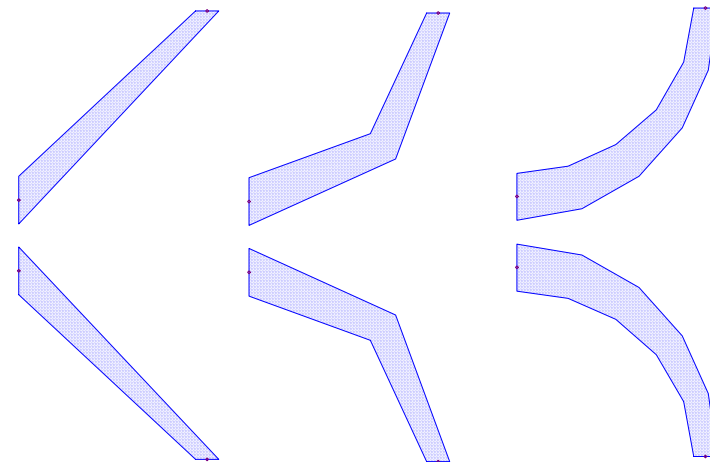
Schematic Only element

Signal Divider as an example



Name	Value	Unit	Evaluated Value	Description	Callback	Override
WD	200	um	200um	Width of differential line	...	<input type="checkbox"/>
WS	100	um	100um	Width of single line	...	<input type="checkbox"/>
N	10		10	Number of segments	...	<input type="checkbox"/>
S	100	um	100um	Separation	...	<input type="checkbox"/>
R	800	um	800um	Radius	...	<input type="checkbox"/>
ANG	90	deg	90deg		...	<input type="checkbox"/>
SignalLayer	S1			Signal Line Layer	Set_Alivh_Layer	<input type="checkbox"/>

Number of segments controls the shape



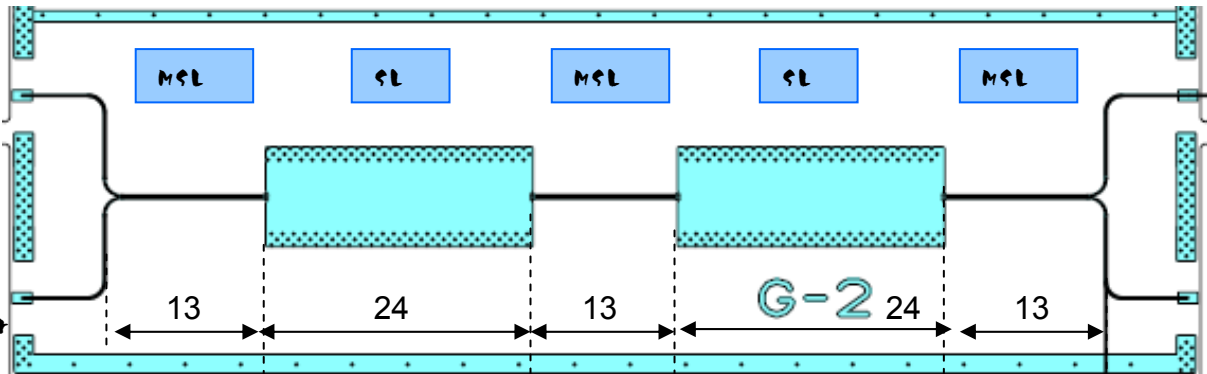
$N=1$

$N=2$

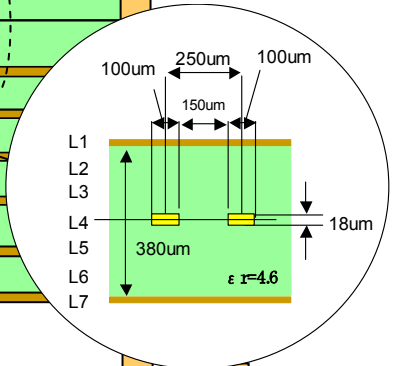
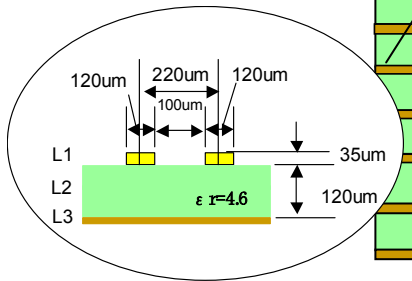
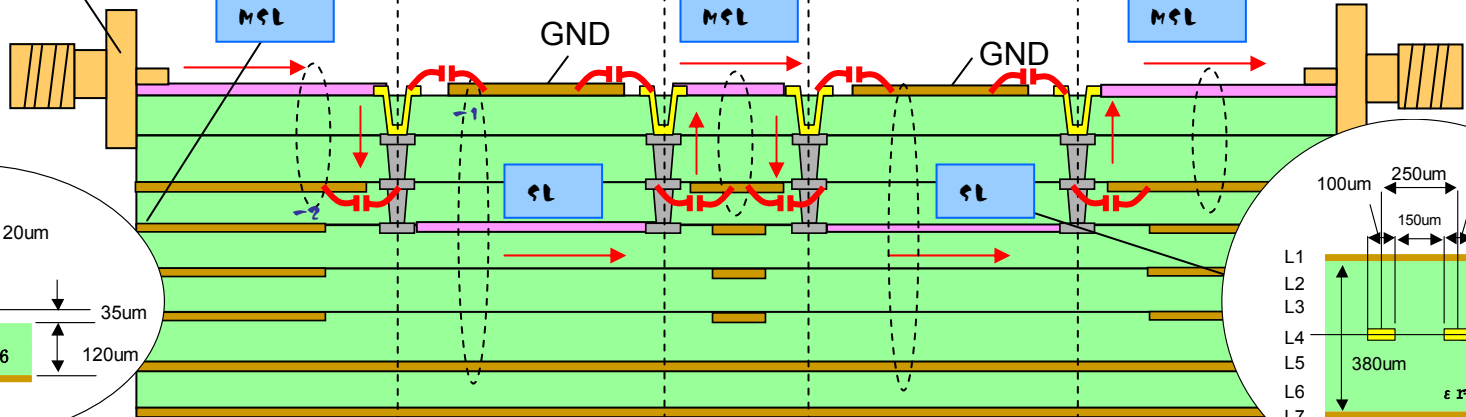
$N=5$

Structural specification of a test coupon

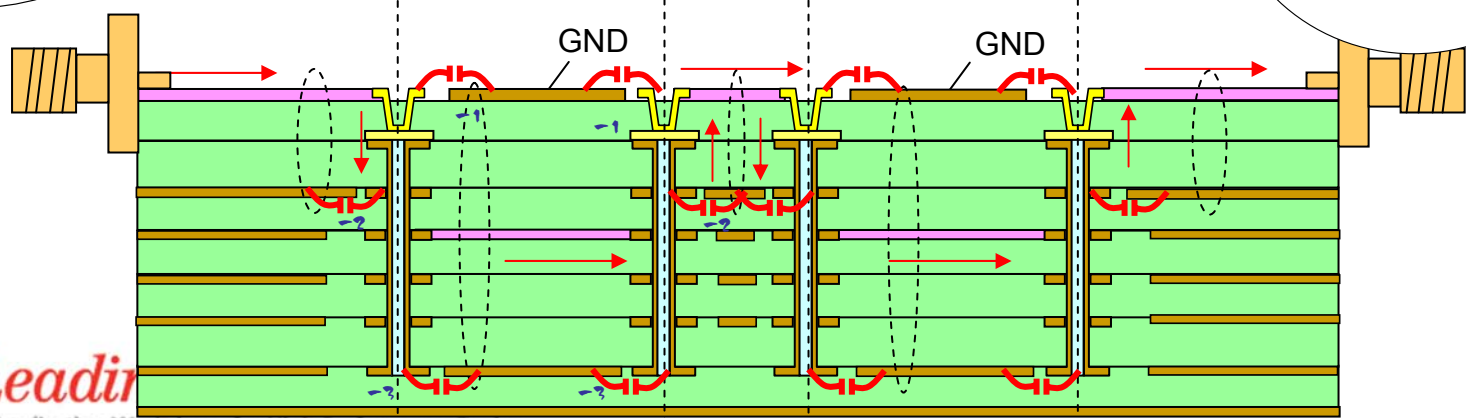
G-2-2



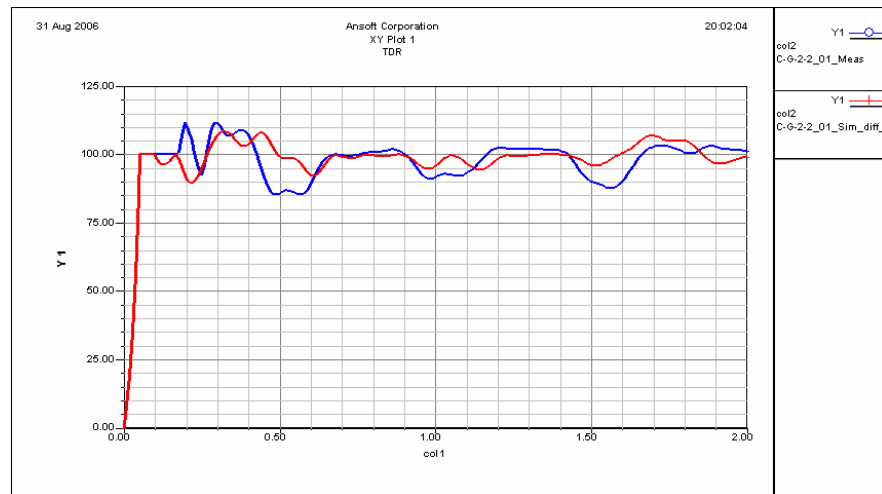
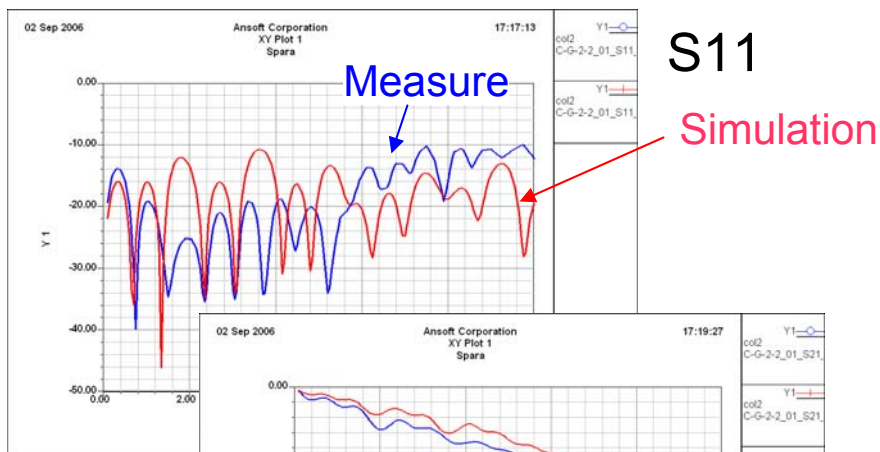
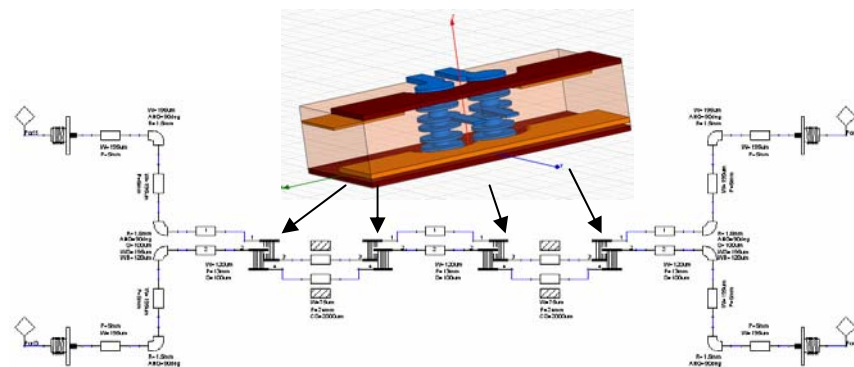
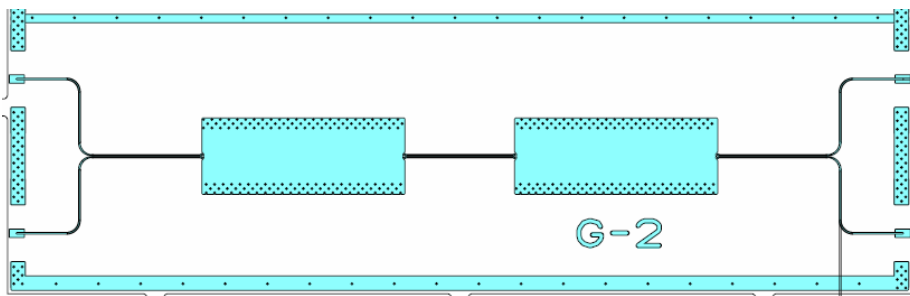
ALIVH-C



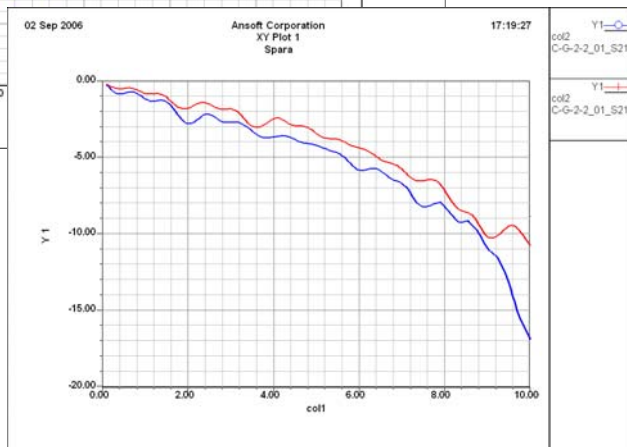
Buildup



Comparison of Measured and Simulation



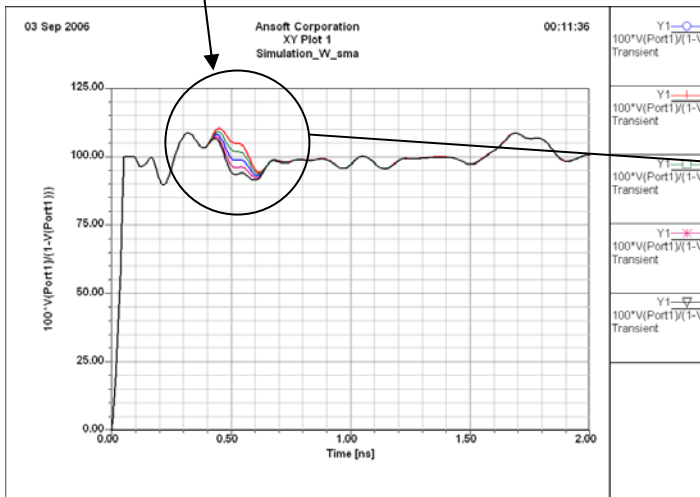
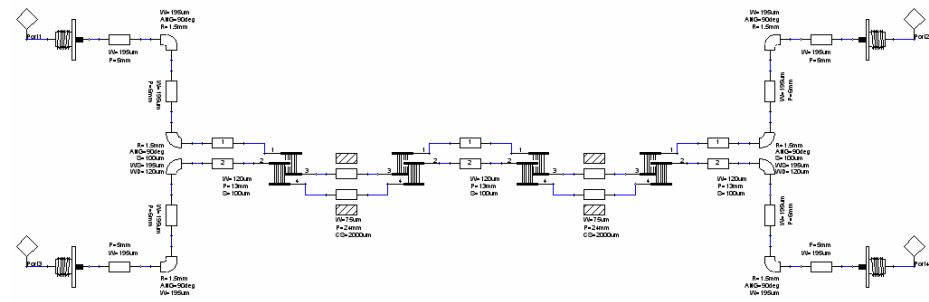
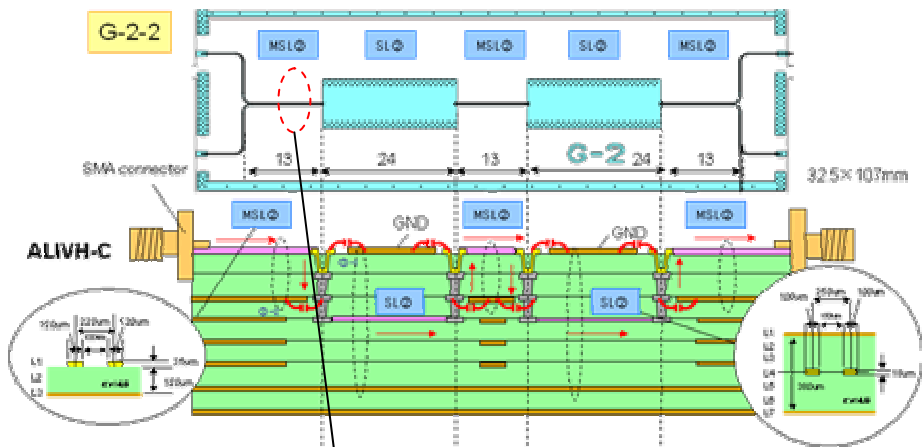
S21



TDR

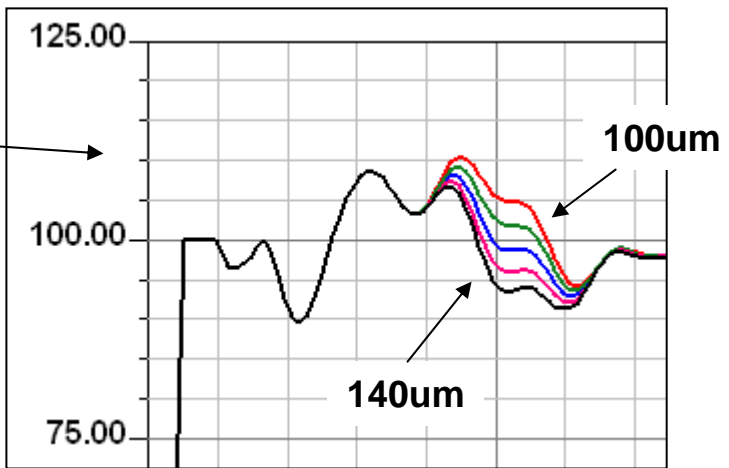


Effects of Line Width Variations

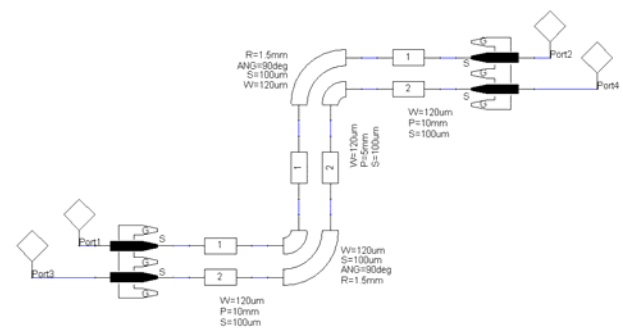
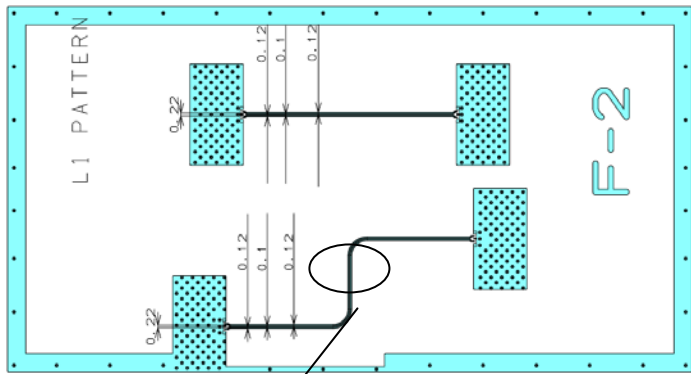


TDR

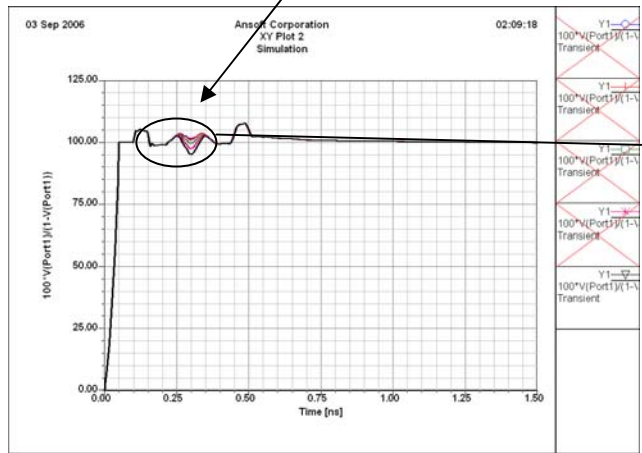
Line Width



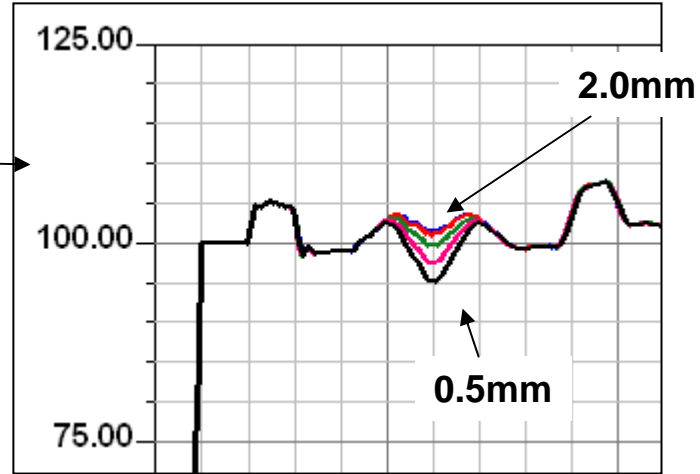
Effect of Line Spacing Variation



Line Spacing



TDR

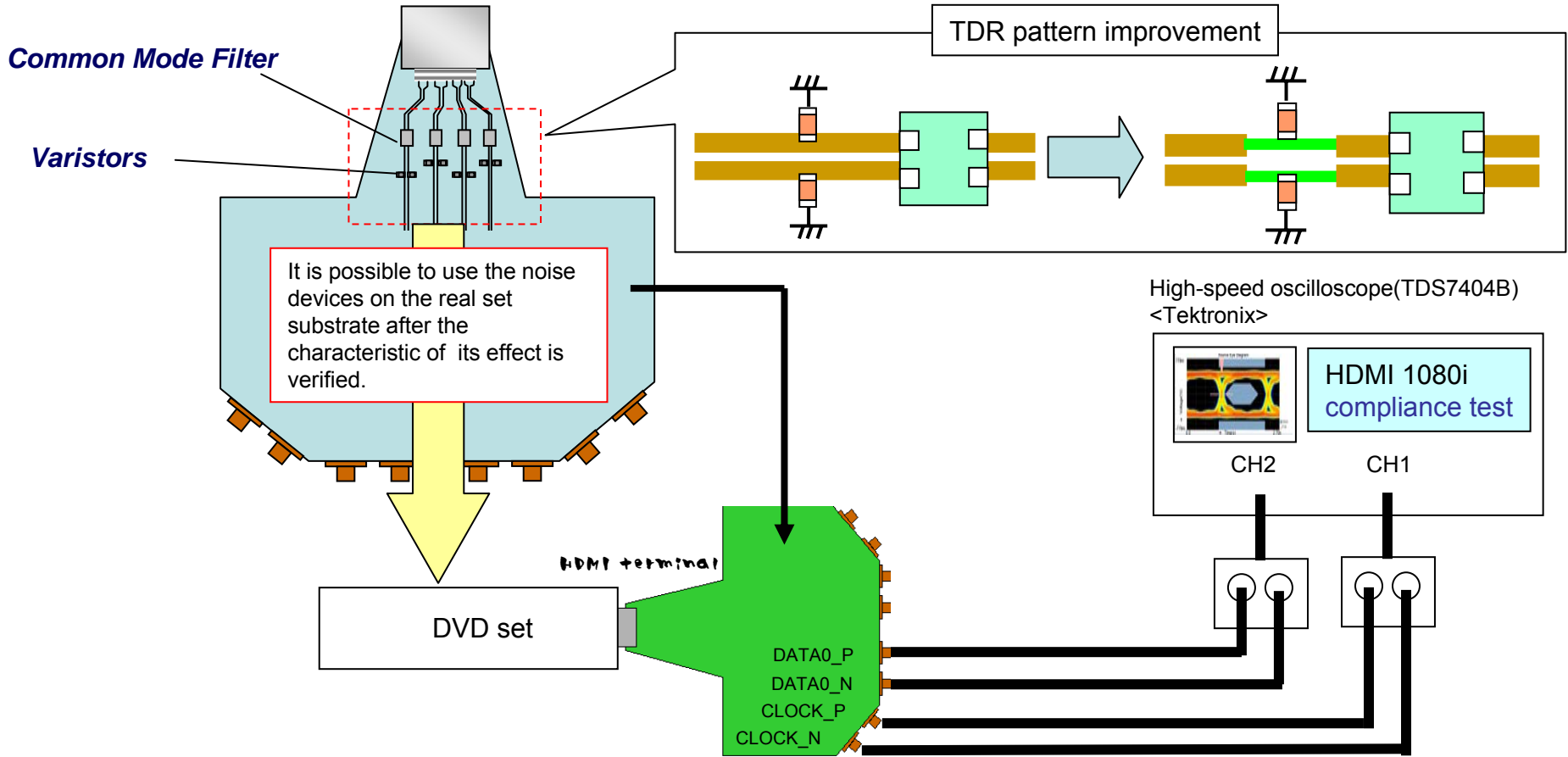


Applying DK Concept to design Evaluation Board

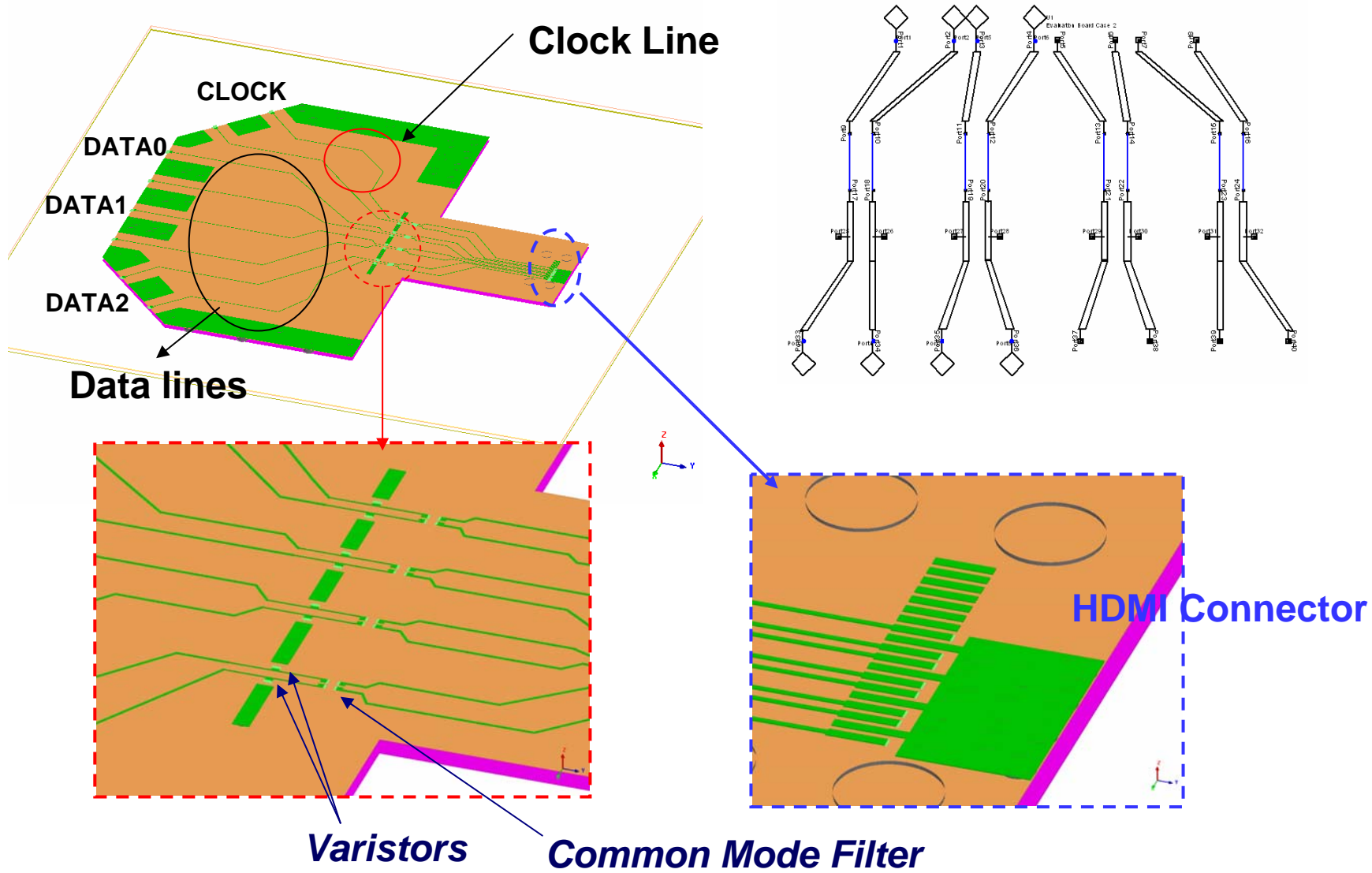


Test Board of noise suppression devices for HDMI signal line

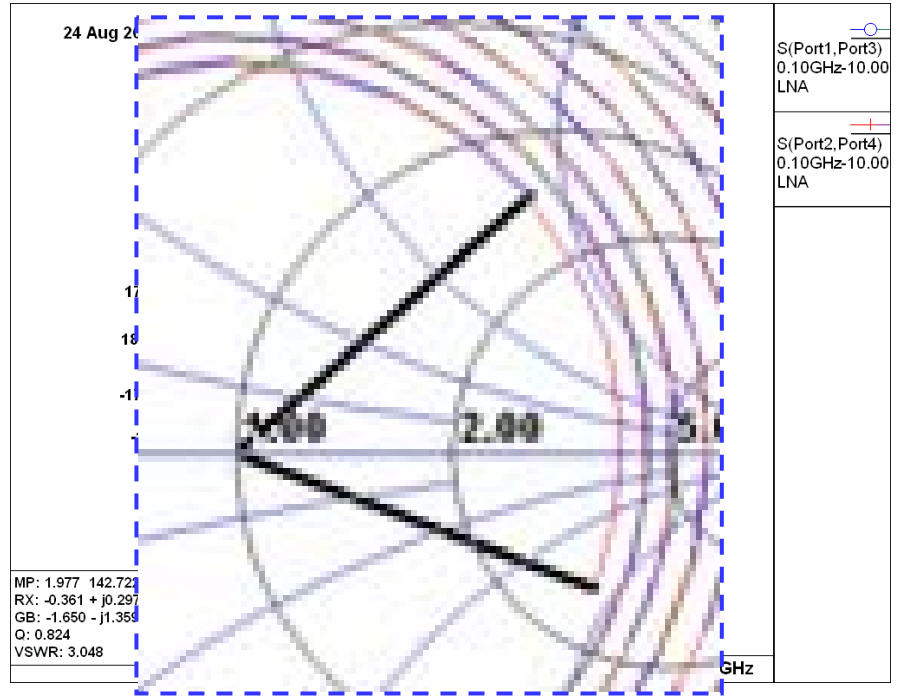
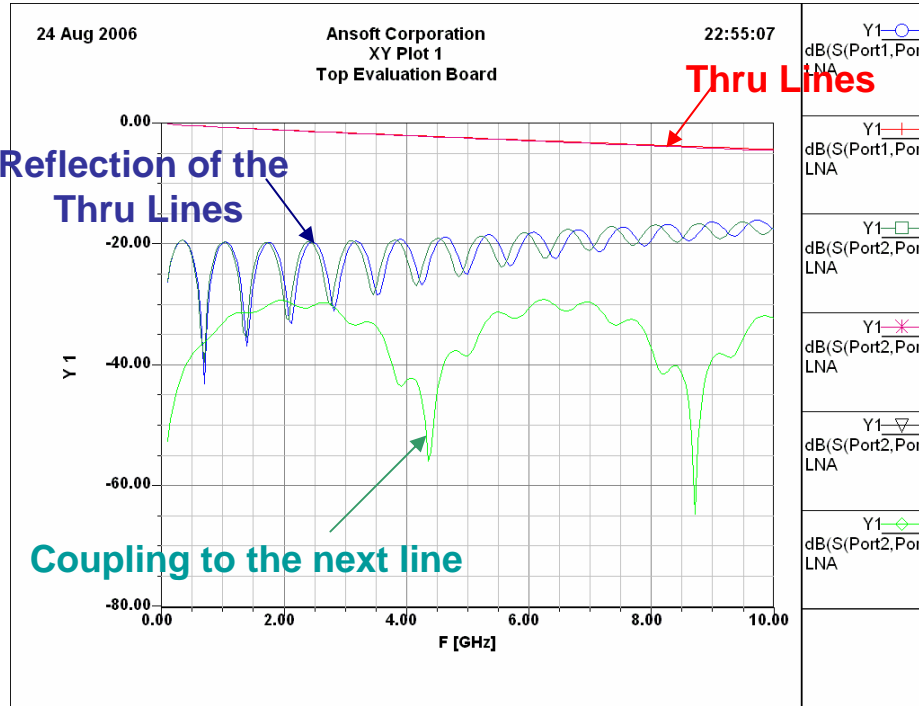
The verification loads of the noise measures parts by the real set substrate of the set manufacturer are canceled, the device characteristic is understood, and it ties to the adoption.



Simulation model of Evaluation Board

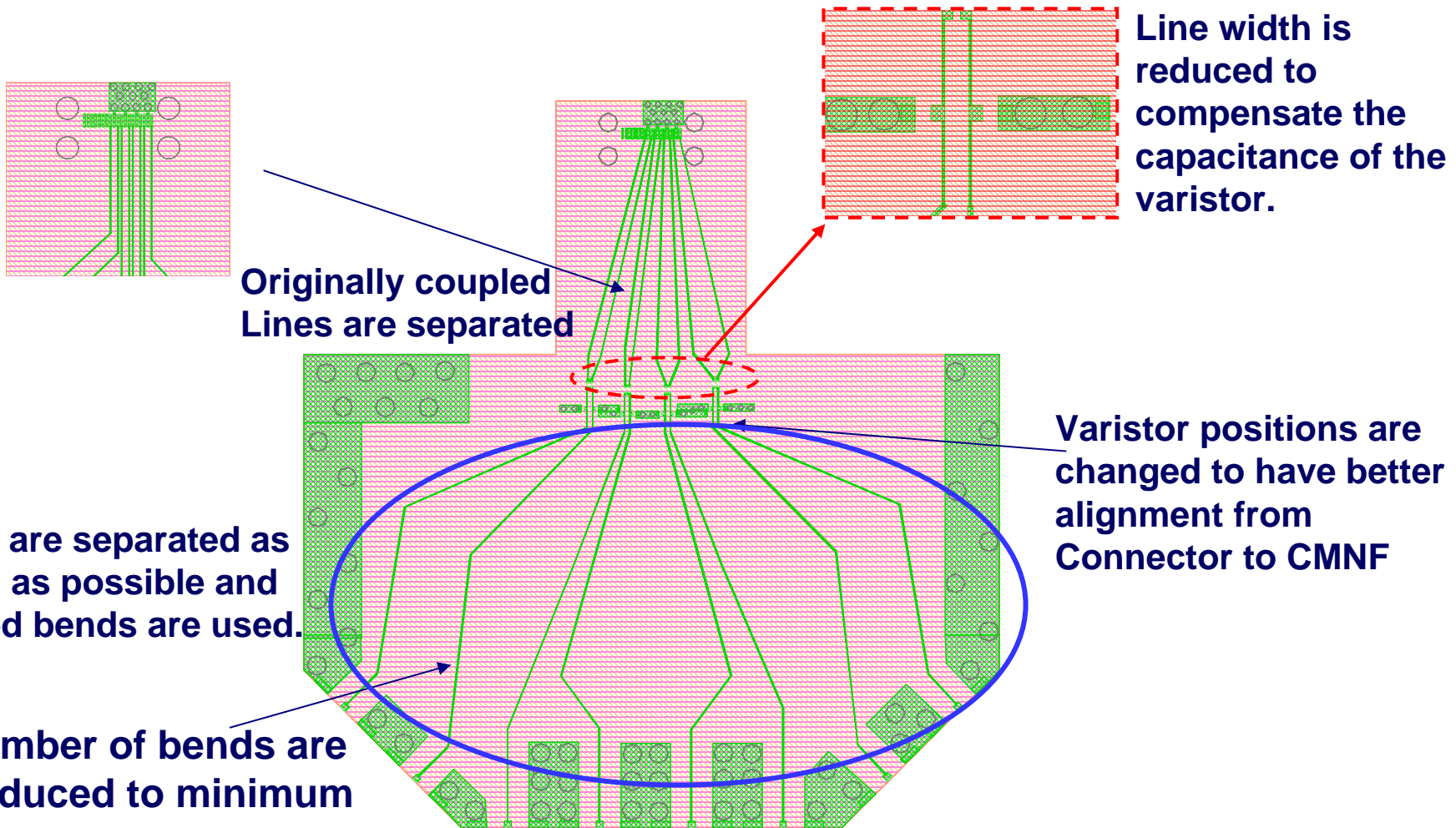


Simulation Results



Skew between 1-3 and 2-4

Can be better if we re-design



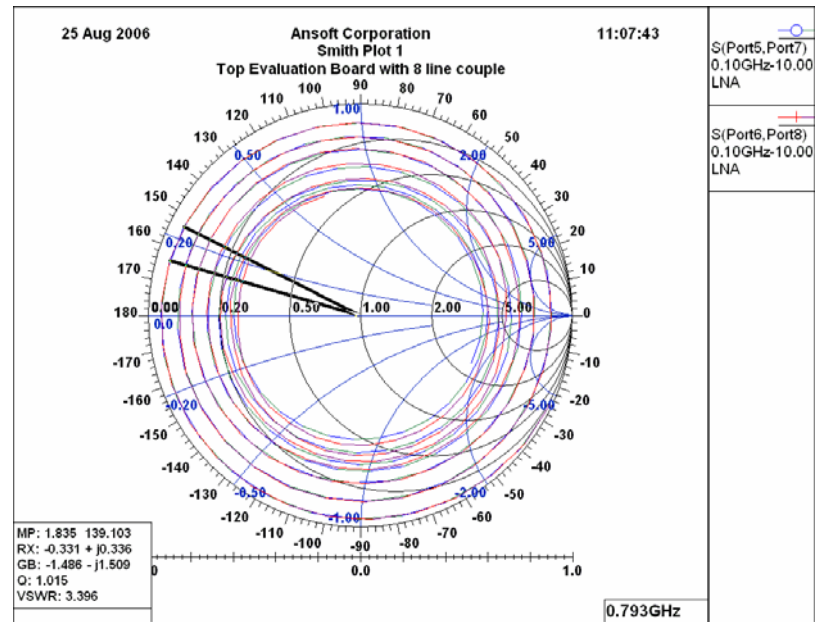
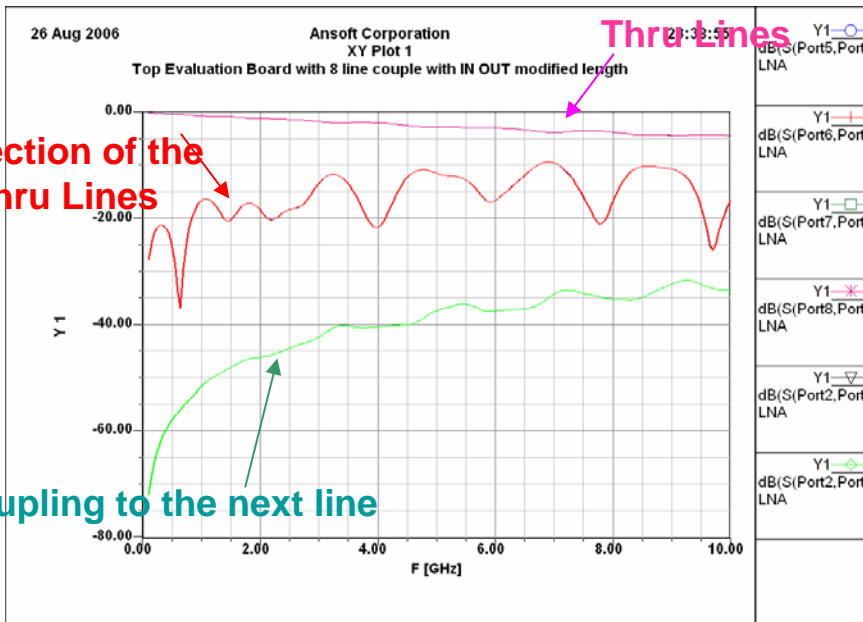
***Clock and Data Lines are adjusted to the same length
Lines are adjusted to the shortest possible length.***

Results of the new design at 10GHz

Reflection of the Thru Lines

Coupling to the next line

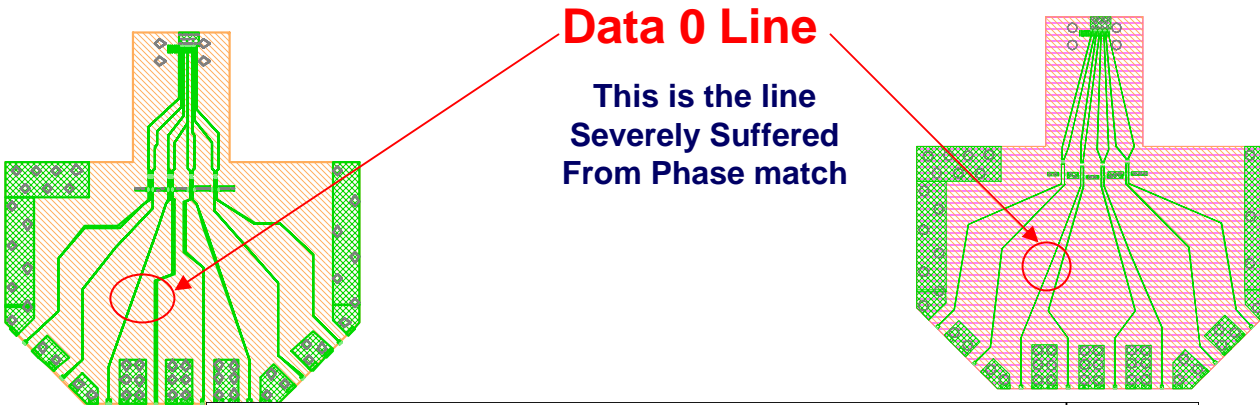
Thru Lines



Skew between 1-3 and 2-4



Eye Diagram

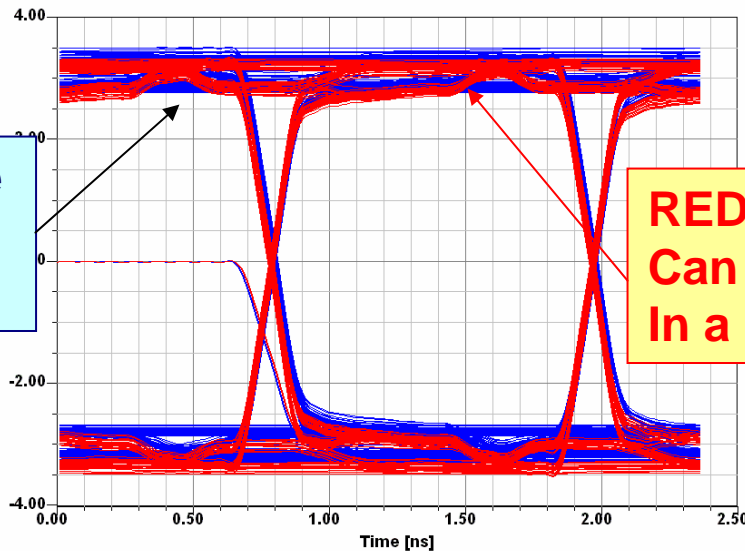


27 Aug 2006

Ansoft Corporation
Eye Pattern output
CMNF MLCV_Eye_pattern

00:56:50

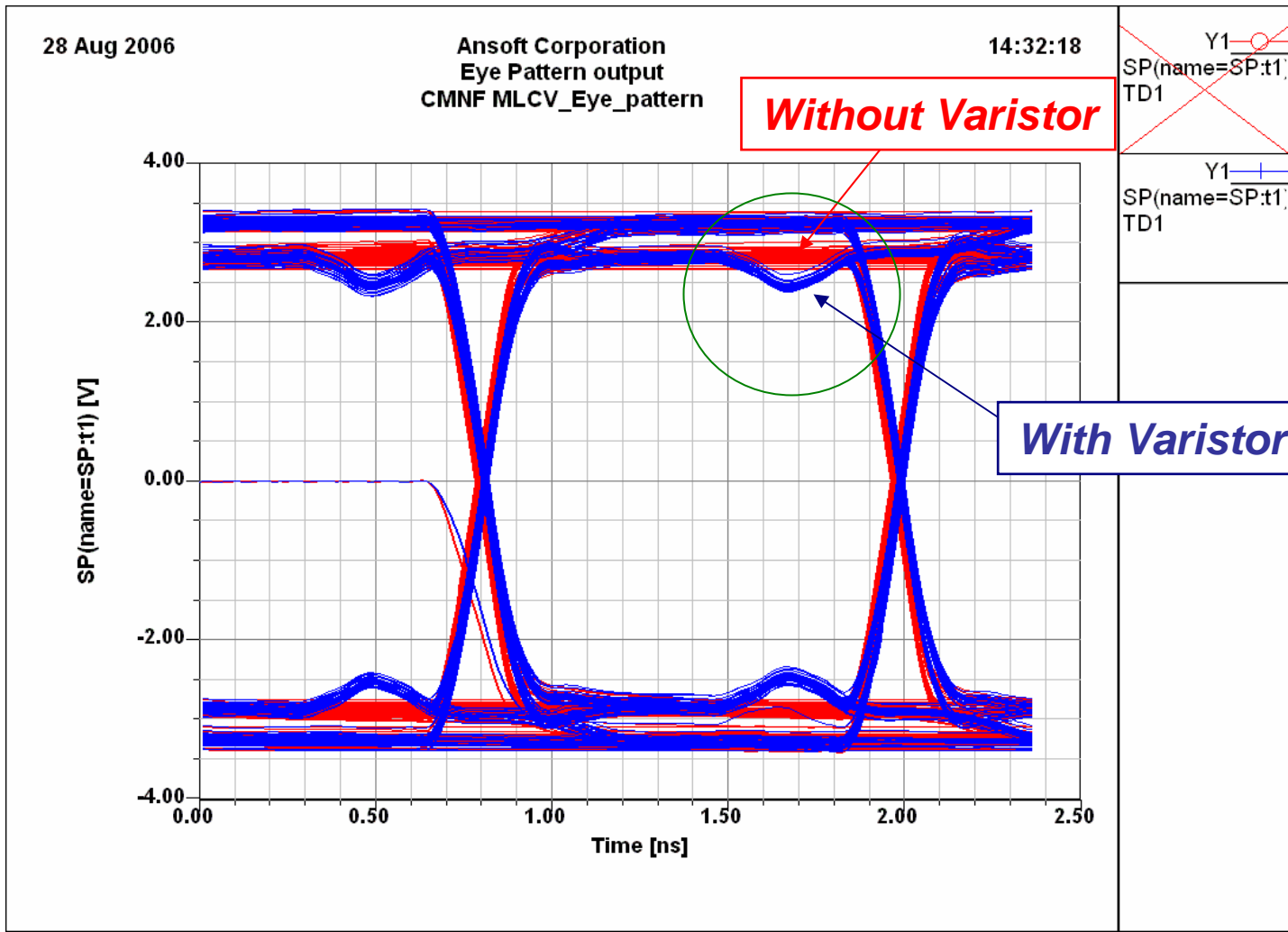
Y1 SP(name=SP:t1) TD1
Y1 SP(name=SP:t1) TD1



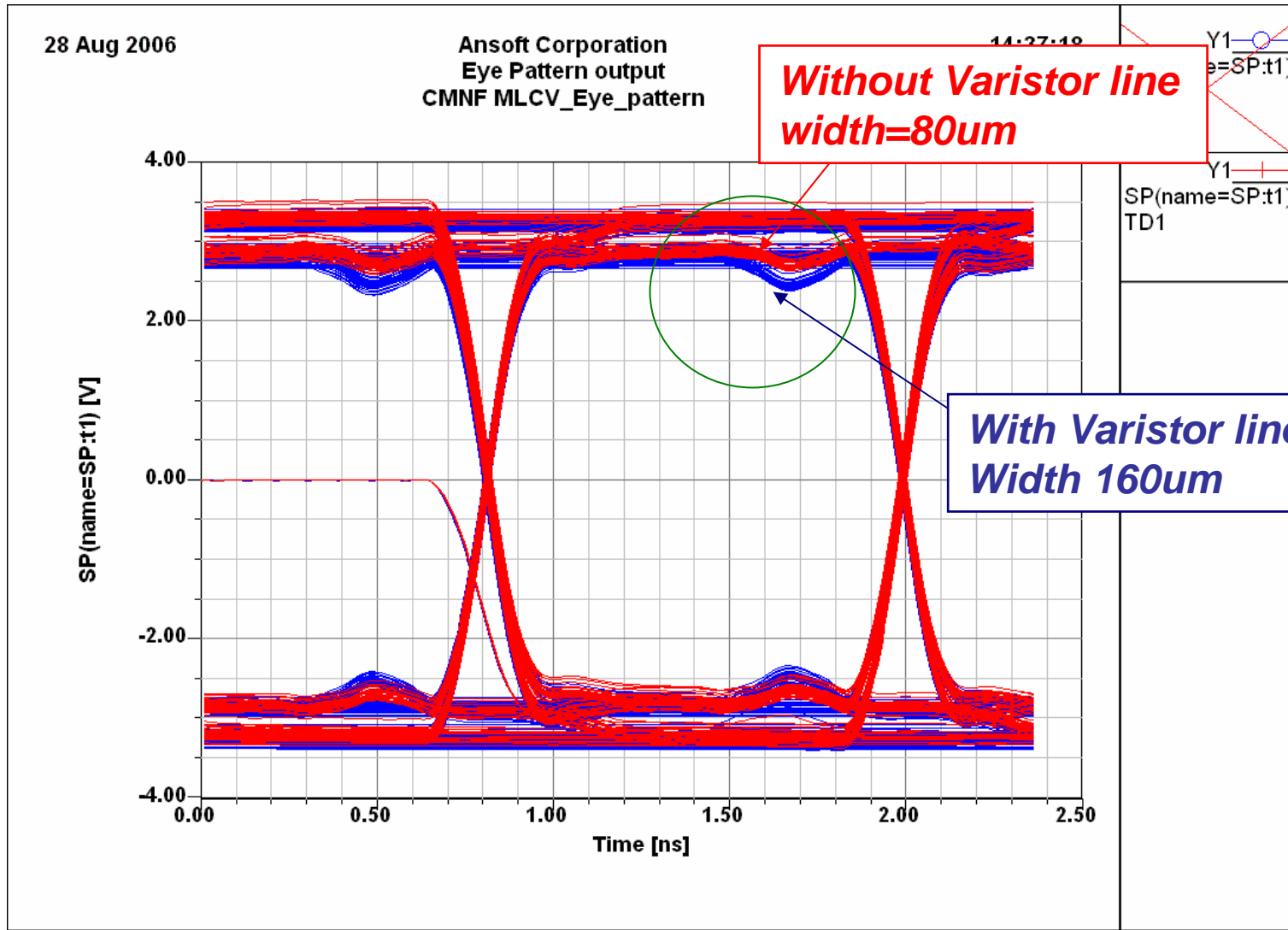
Blue: Can not see the Effect of Varistor Cutout portion

RED: Improved Layout Can detect small differences In a layout

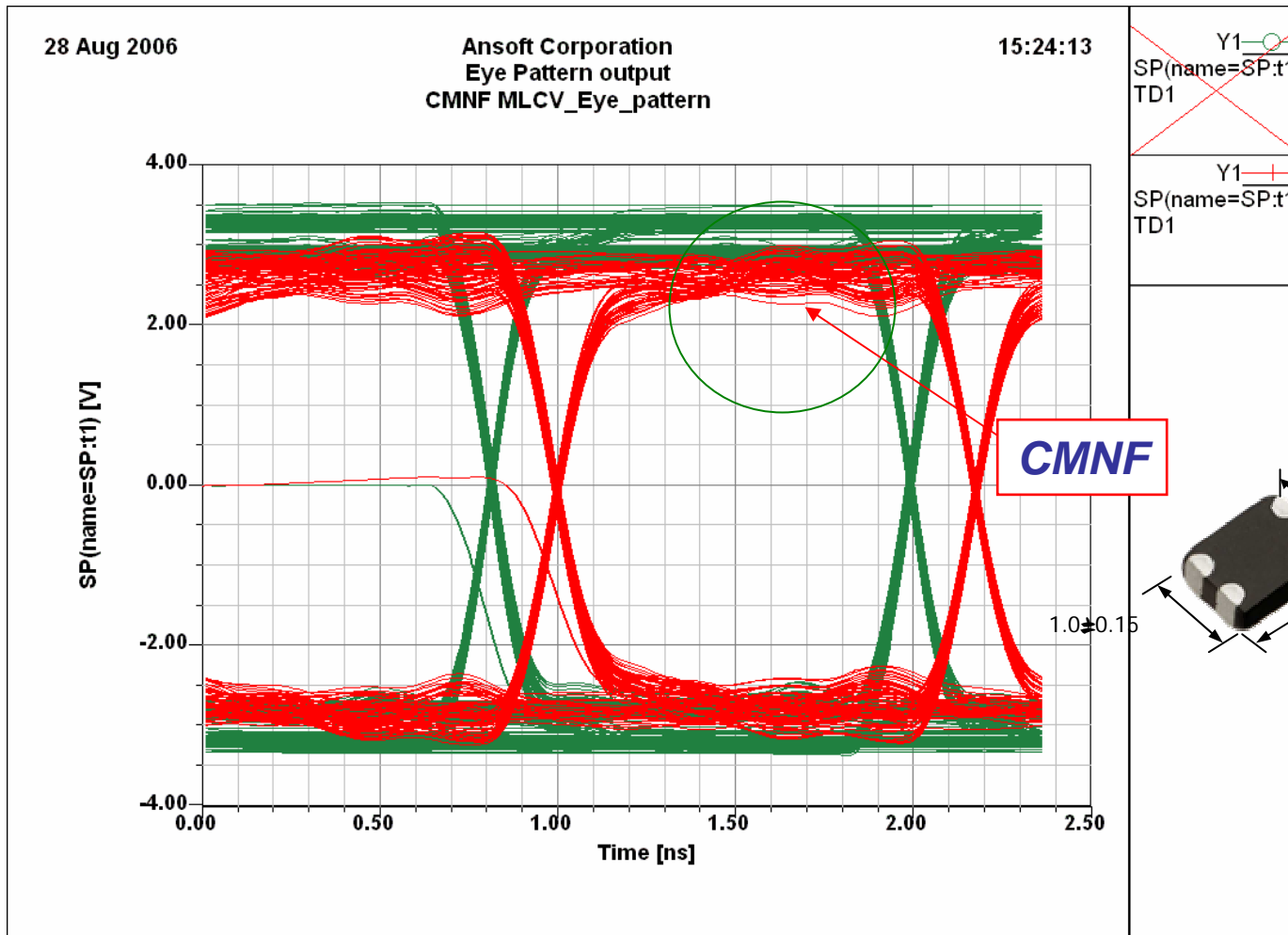
If Varistor Line is 160um



If Varistor Line is changed to 80um

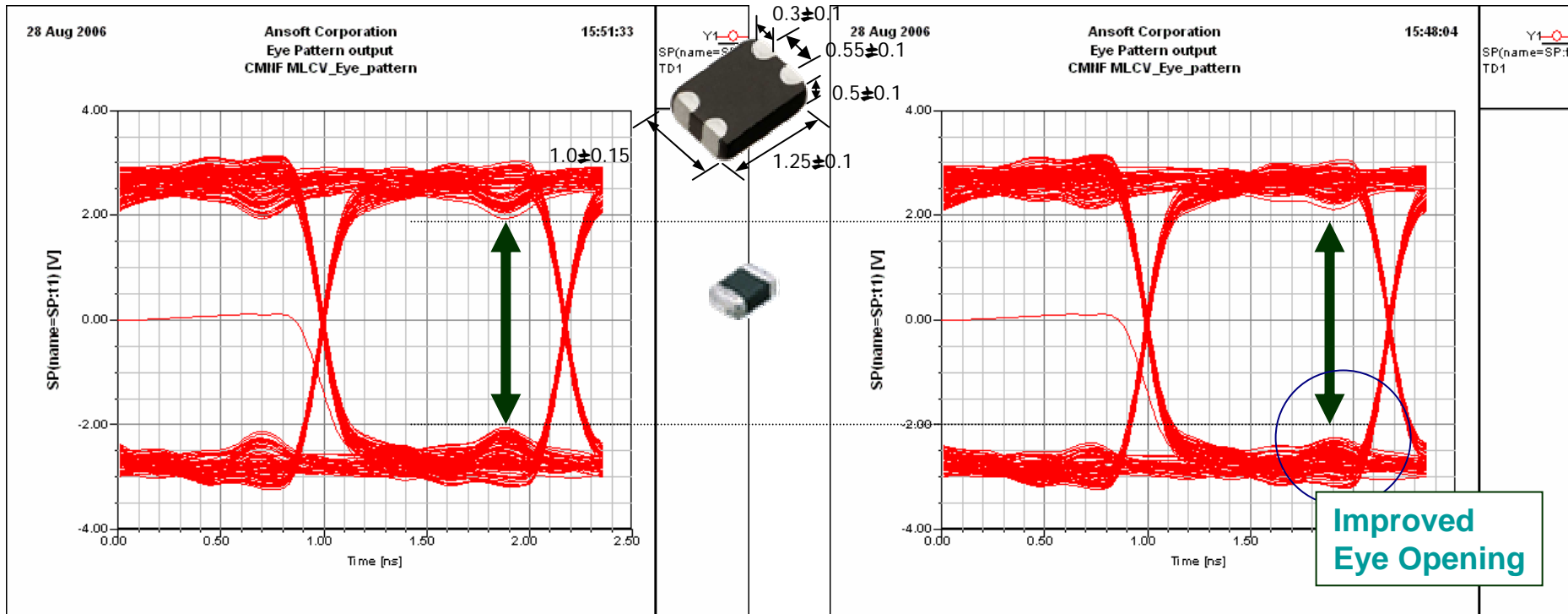


If Varistor Line=80um with CMNF



CMNF and Varistor

(with Varistor Line width changed)

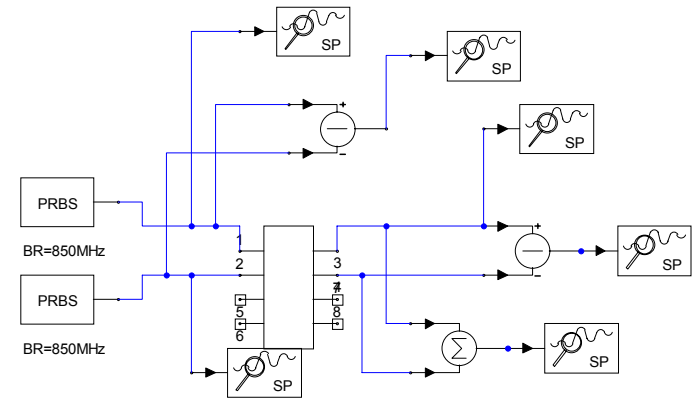
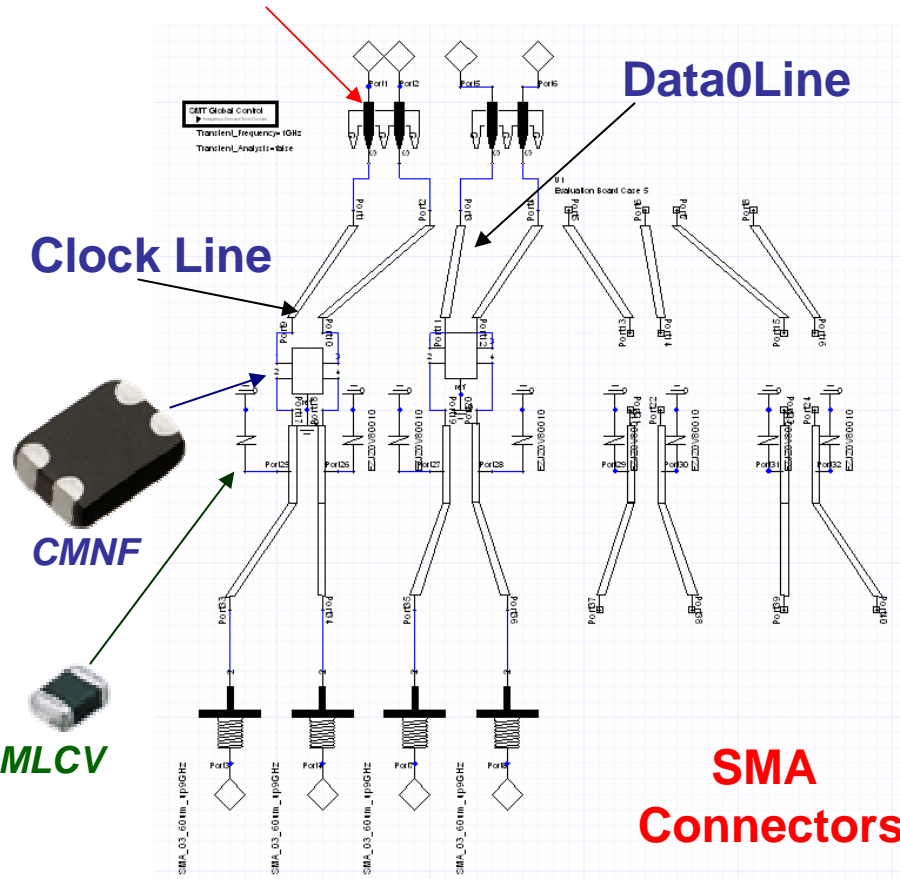


Varistor Line with 160um width

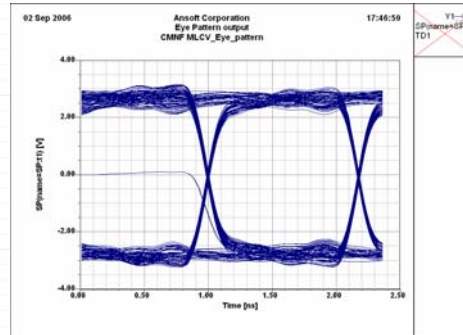
Varistor Line with 80um width

System Including SMA and GSGSG connectors

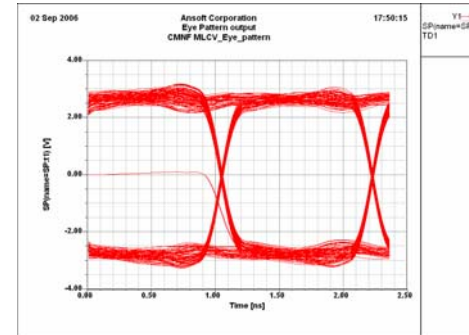
GSGSG Connectors



Without Connectors



With Connectors



Did not show visible changes but with connectors, the waveforms May have less sharpness. (Due to the low pass filter characteristics.)

Conclusions

- PED offers good solutions for HDMI Applications with its ALIVH processes and quality noise suppression components
- Short time to market requires quick and first-time-right design methodologies.
- High performance software from Ansoft and a Design Kit created by PED help achieve the goal.