HDMI® IPAD™ product presentation

HDMI signal conditioning
Is this presentation suited for you?

Where do you stand with HDMI® interfacing?

**Beginner?**
I am not familiar with this subject. I am in the discovery phase and would like an overview and a basic understanding of the technology.

**Intermediate?**
I have a basic understanding of this subject. I would like to go deeper in details and tackle more aspects of this subject.

**Advanced?**
I am very familiar with this subject. I would like to deepen my knowledge and become an expert.

**Overview**

**Basic**

**In depth**

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High-definition multimedia interface (HDMI) Ecosystem

HDMI connectors address many applications
HDMI connector

ESD protection requirements

Datalines
- High frequency
- Differential signaling

Control lines
- Low frequency
- I²C bus must drive poor-quality cables

Power supply
- 5 V DC
- Requires current limiter
ESD protection is needed for…

- Advanced technology with very **thin lithography** and gate oxide highly vulnerable to ESD
- Integrated electronics systems with **PCBs having a high component density** facilitate ESD **coupling** and **propagation**
- IC manufacturers reluctant to make robust embedded ESD protection diodes that would require a **significant active area of their advanced and expensive technology**.

When the **application uses RF** (Wi-Fi or Bluetooth), a **common-mode filter** is **required**, in addition to ESD protection, to avoid **RF performance decrease** due to the EMI generated by the high-speed link.
HDMI – Dataline ESD protection

Why ultra-low capacitance?

- The parasitic capacitance of ESD protection devices must be low enough to allow HDMI signals to be transmitted without degradation.

- A high parasitic capacitance of the ESD protection devices would increase too much the signal rise/fall time and prevent the communication.

Example of the impact of parasitic capacitance on an HDMI signal simulated with discrete capacitance.
HDMI – Control lines: Why a specific I²C driver?

- The parasitic capacitance of poor quality or long cables increases the rise time of the I²C bus used by the High-bandwidth Digital Content Protection (HDCP) protocol.

- If this rise time exceeds the HDMI specification, a blue screen prevents the user from watching their video content.

- To mitigate this issue, an optimized I²C timing booster is needed.

**Without optimized I²C booster**

- Rise time > 1200 ns

**With ST's optimized I²C booster**

- Rise time < 400 ns

- High risk of interoperability issue

  - I²C timing compliant with HDMI
The 5 V pin of the HDMI connector provides power to devices connected to the HDMI source.

The HDMI specification allows:
- Up to 500 mA of maximum output current from the source
- Up to 55 mA of maximum sunk current
- Up to 100 mV of maximum voltage drop-out
HDMI placement and layout - Tips

High-speed data
- Needs ESD protection close to HDMI connector
- Routing is impedance-controlled

Interface IC
- Single-chip interface is recommended for easier layout

HDMI chipset
- Cannot integrate system-level ESD protection (±8000 V) as per IEC 61000-4-2 Level 4 → it requires an interface IC with system-level ESD protection
- Compliant with the basic HDMI specification, it will not handle optimized I²C booster
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<th>CONTROL LINES</th>
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**HDMI2C1-14HD & HDMI2C2-14HD**
- QFN 36L
  - 500-µm pitch
  - 6.5 x 3.5 mm

**HDMI2C1-14HDS**
- QFN 24L
  - 500-µm pitch
  - 4 x 4 mm

**HDMI2C1-6C1**
- QFN 18L
  - 500-µm pitch
  - 3.5 x 3.5 mm
ST solution for HDMI interfaces w/ RF

HDMI application with RF

Requires ESD integrated common-mode filter on datalines with ST’s ECMF series
ST solution for HDMI interfaces w/o RF

HDMI application without RF
Requires single-chip HDMI interface IC such as HDMI2Cx-14HDx
Let’s go further

Intermediate product presentation soon available: ‘Understanding HDMI IPAD™ series specification’

Datasheets:
- HDMI2C1-14HD: ESD protection & signal conditioning for HDMI 2.0 source interface
- HDMI2C2-14HD: ESD protection & signal booster for HDMI™ 2.0 sink interface
- HDMI2C1-6C1: ESD protection and signal booster for HDMI™ Source control stage interface

Application Notes:
- TVS short-pulse dynamic resistance measurement ... (AN4022)
- IEC 61000-4-2 standard testing (AN3353)

Selection:
- Selection guide [pdf]
- www.st.com/hdmi-ipad
Thank you