



# HDMI® IPAD™ product presentation

HDMI signal conditioning

# High-definition multimedia interface (HDMI) Ecosystem

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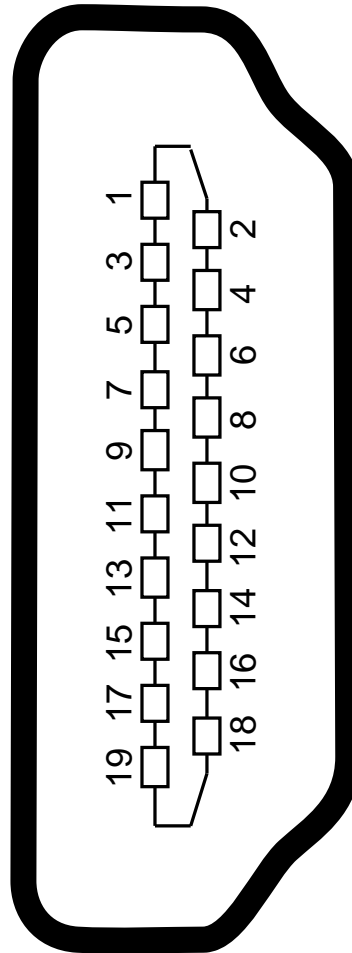
HDMI connectors address many applications

# HDMI connector

## ESD protection requirements

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### HDMI connector



#### Datalines

- High frequency
- Differential signaling

#### Control lines

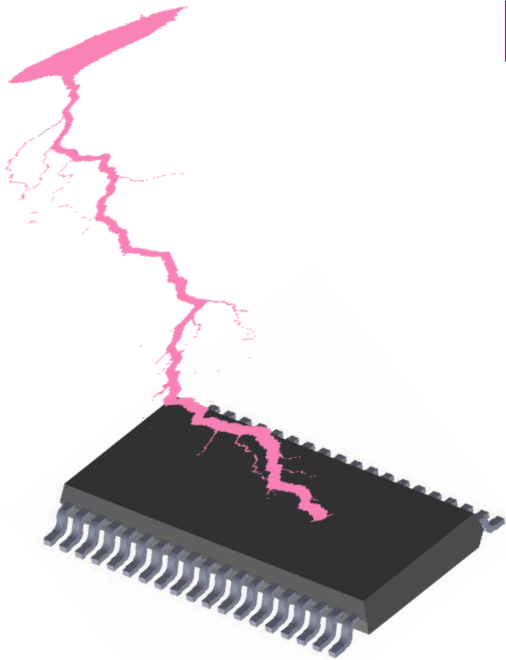
- Low frequency
- I<sup>2</sup>C bus must drive poor-quality cables

#### Power supply

- 5 V DC
- Requires current limiter

# HDMI connector

## ESD protection is needed for...



Core ICs such as microcontrollers, micro-processors, transceivers, etc.

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.

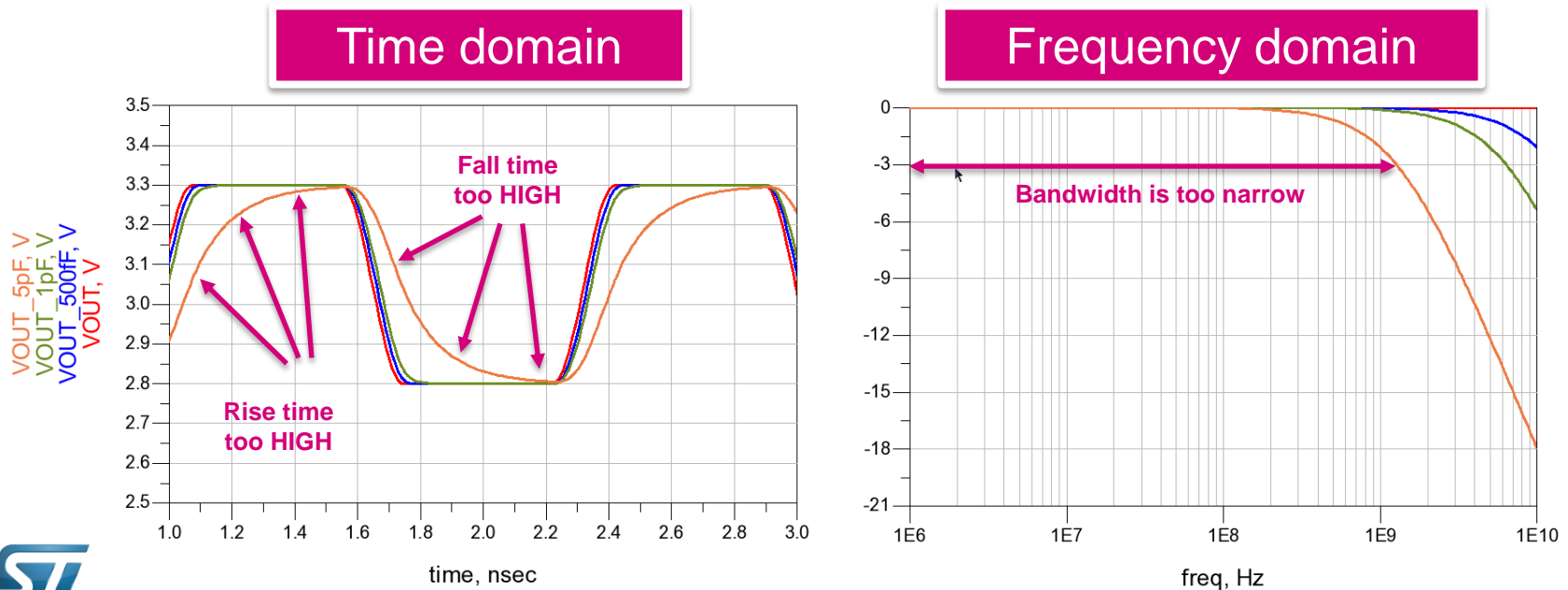
# HDMI – Dataline ESD protection

## Why ultra-low capacitance ?

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- 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*



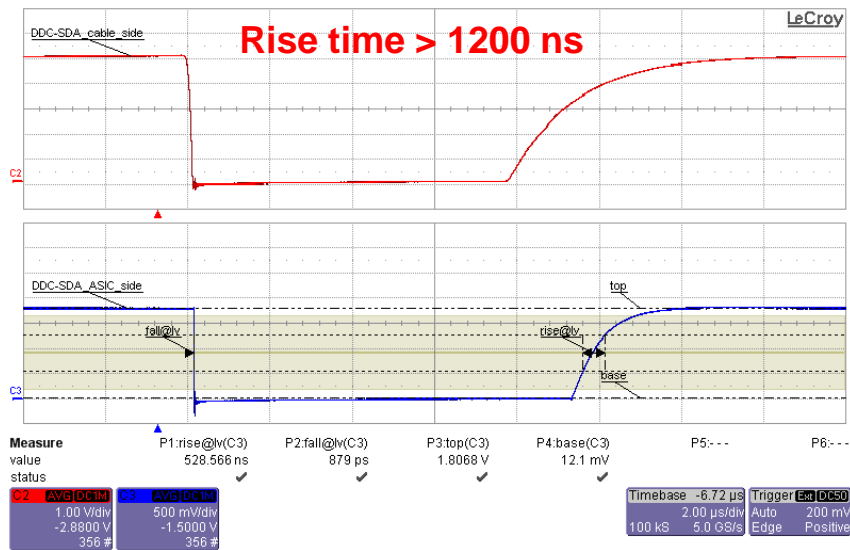
# HDMI – Control lines:

## Why a specific I<sup>2</sup>C driver?

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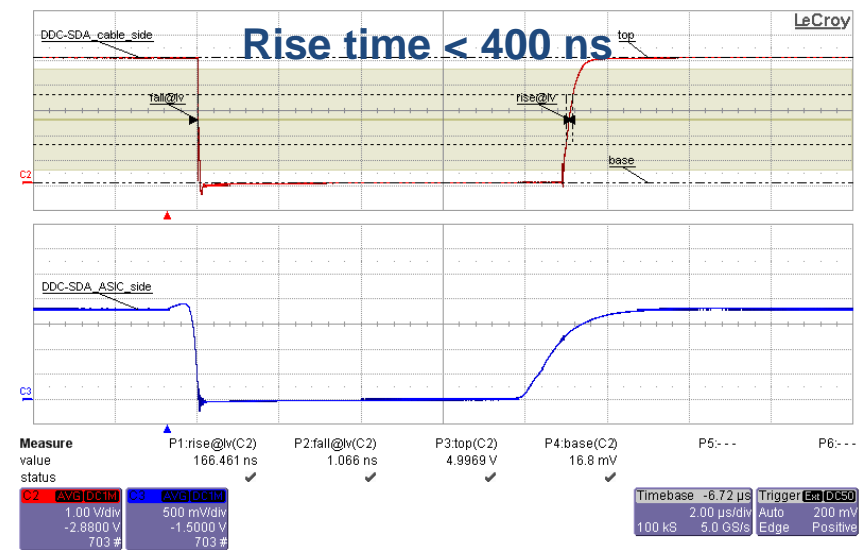
- The parasitic capacitance of **poor quality or long cables** increases the rise time of the I<sup>2</sup>C bus used by the High-bandwidth Digital Content Protection (HDCP) protocol.
- If this rise time exceeds the HDMI specification, **a blue screen prevents the user from watching their video content.**
- To mitigate this issue, an **optimized I<sup>2</sup>C timing booster** is needed.

### Without optimized I<sup>2</sup>C booster



High risk of interoperability issue

### With ST's optimized I<sup>2</sup>C booster

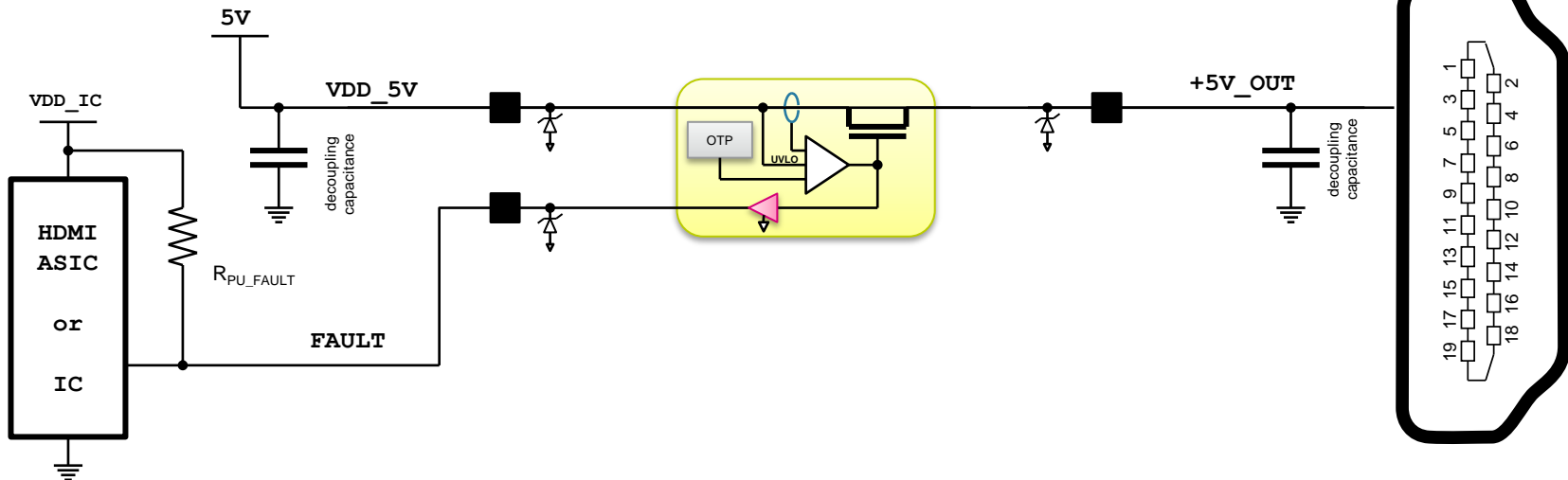


I<sup>2</sup>C timing compliant with HDMI

# HDMI – Power supply

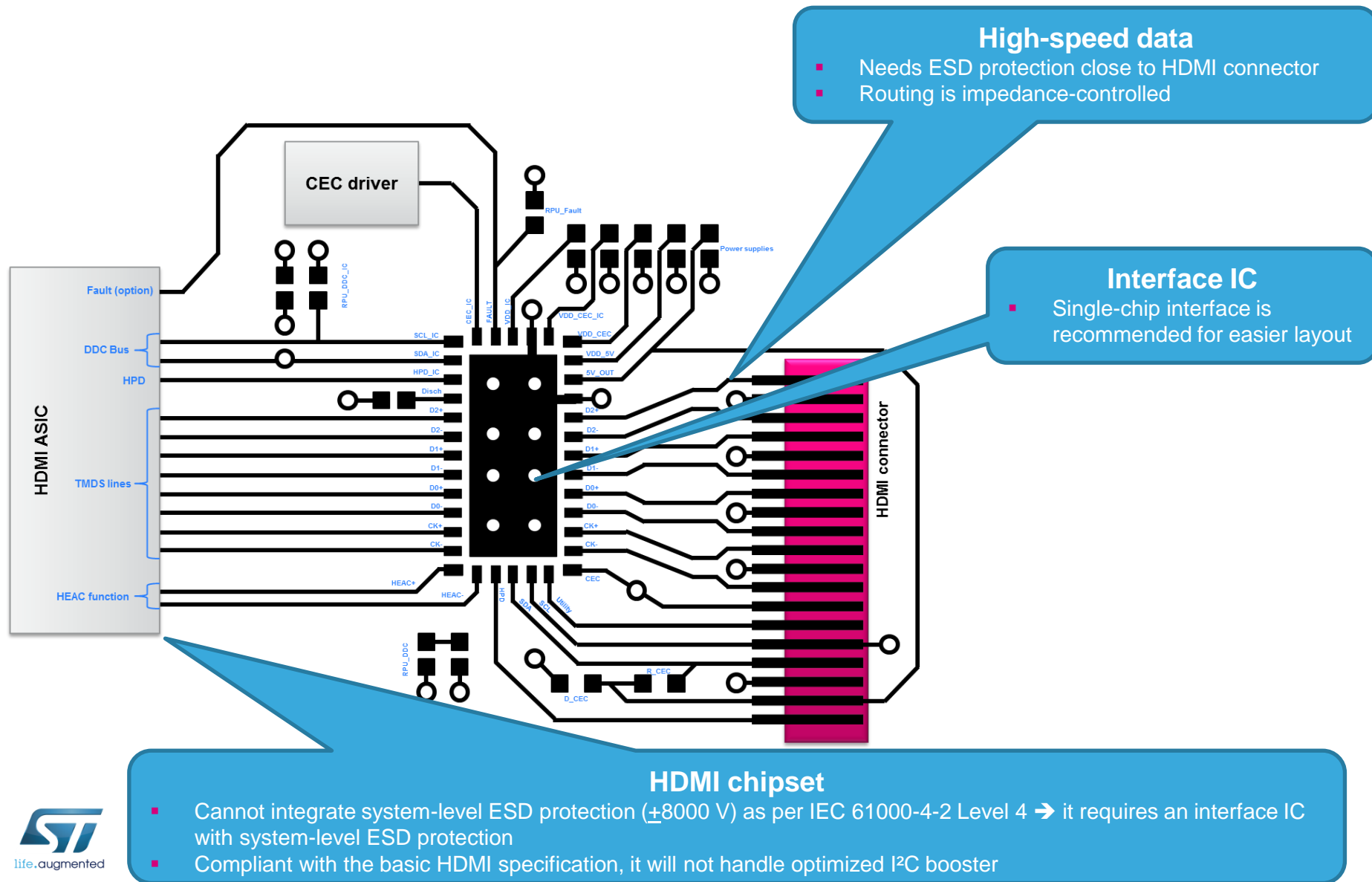
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- The 5 V pin of the HDMI connector provides power to devices connected to the HDMI source.
- The HDMI specification allows:
  - Up to 500 mA of maximum output current from the source
  - Up to 55 mA of maximum sunk current
  - Up to 100 mV of maximum voltage drop-out



# HDMI placement and layout - Tips

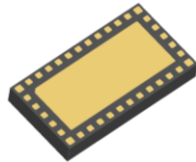
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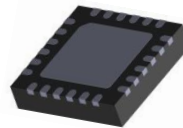
	Data lines	CONTROL LINES							
	TMDS ESD protection	ESD protection	I <sup>2</sup> C booster	HPD signal conditioning	CEC handling level shifter	HEAC signal	+5 V current limiter	5 V & I <sup>2</sup> C backdrive protection	ENABLE signal
S o u r c e	HDMI2C1-14HD								
	HDMI2C1-14HDS								
		HDMI2C1-6C1							
S i n k	HDMI2C2-14HD								

HDMI2C1-14HD  
& HDMI2C2-14HD



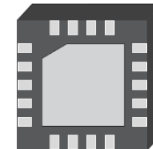
QFN 36L  
500-µm pitch  
6.5 x 3.5 mm

HDMI2C1-14HDS



QFN 24L  
500-µm pitch  
4 x 4 mm

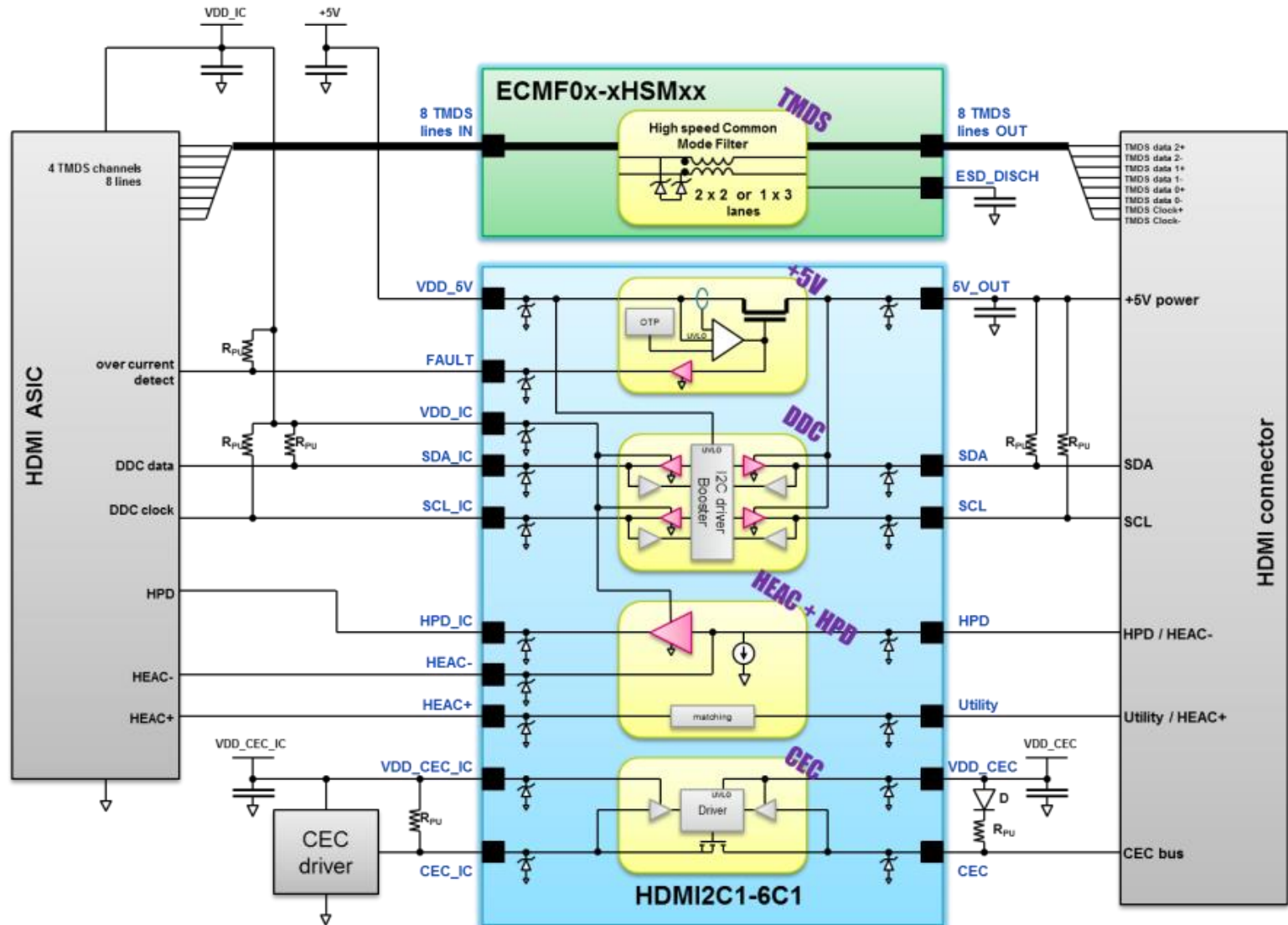
HDMI2C1-6C1



QFN 18L  
500-µm pitch  
3.5 x 3.5 mm

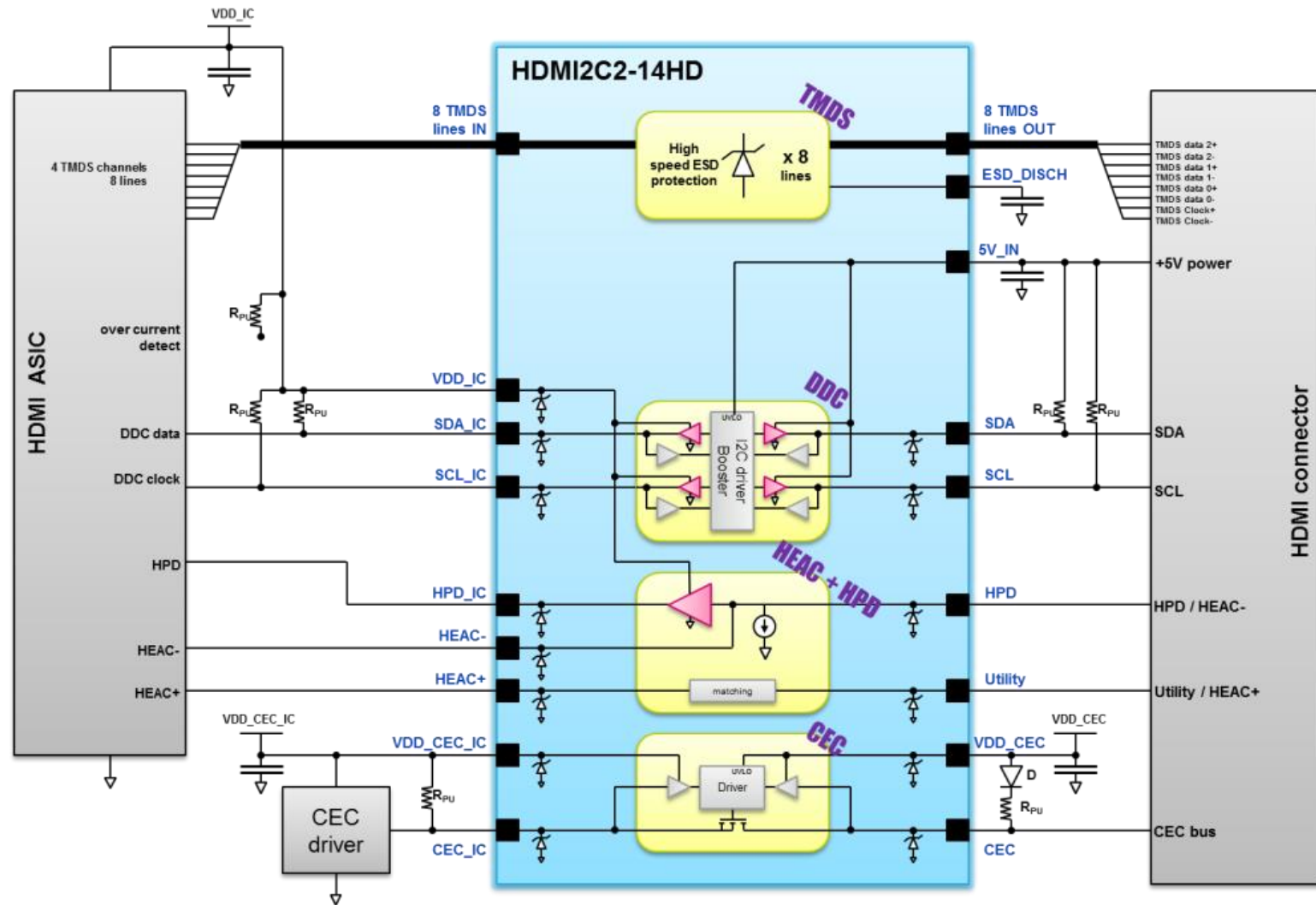
# ST solution for HDMI interfaces w/ RF

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# ST solution for HDMI interfaces w/o RF

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**HDMI application without RF**  
Requires single-chip HDMI interface IC such as **HDMI2Cx-14HDx**

## Basic presentation

*Intermediate product presentation soon available:  
'Understanding HDMI IPAD™ series specification'*

## In-depth information

### 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
- [www.st.com/hdmi-ipad](http://www.st.com/hdmi-ipad)



Thank you