ASIPs around the MCU

Application Specific Integrated Products

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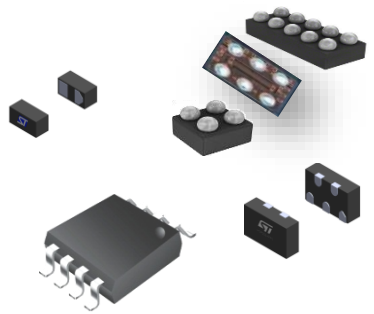
Product lineup

Product lineup

- **ESD protections**
  - Clamping arrays
  - High speed port protections
  - Rail to rail protections
  - Single line protections
- **TVS**
  EOS 8/20 µs
  EOS 10/1000 µs
  - 400 W 10/1000 µs
  - 600 W 10/1000 µs
  - 1500 W 10/1000 µs
  - 3000 W 10/1000 µs
  - Dataline <24 A 8/20 µs
  - Power line >24 A 8/20 µs
- **Lightning protections**
  - xDSL
  - SLIC
  - Ethernet
  - Telecom lines
  - Discrete surge suppressors
- **Current limiters**
  - Current limiting termination
- **Automotive protections**
  - Auto dataline ESD
  - Auto load dump
  - Auto power rail TVS
- **ASIP**
  - EMI filters
  - Common mode filters
  - Smart ASIP for interface function
  - Custom integration



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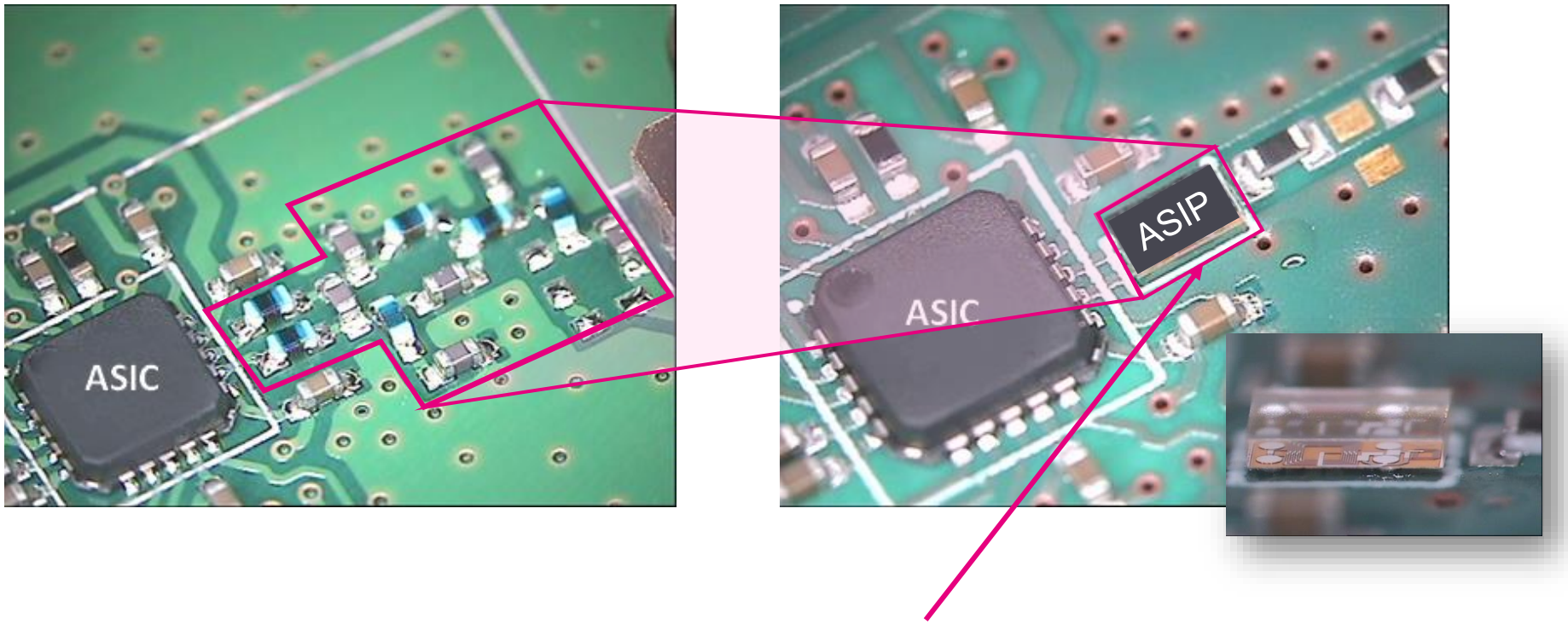
What is an ASIP?

What is an ASIP?

- Design simplification
- Integration



Application **S**pecific **I**ntegrated **P**roducts

- **Integration** of capacitors, inductors and resistors and protections
- Size **reduction**
- BOM **reduction**
- Design **simplification**
- **Performance** optimization
- **Reliability** improvement

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Note: tolerances and matching are absolute tolerances. Smaller dispersion achievable based on schematic & layout study

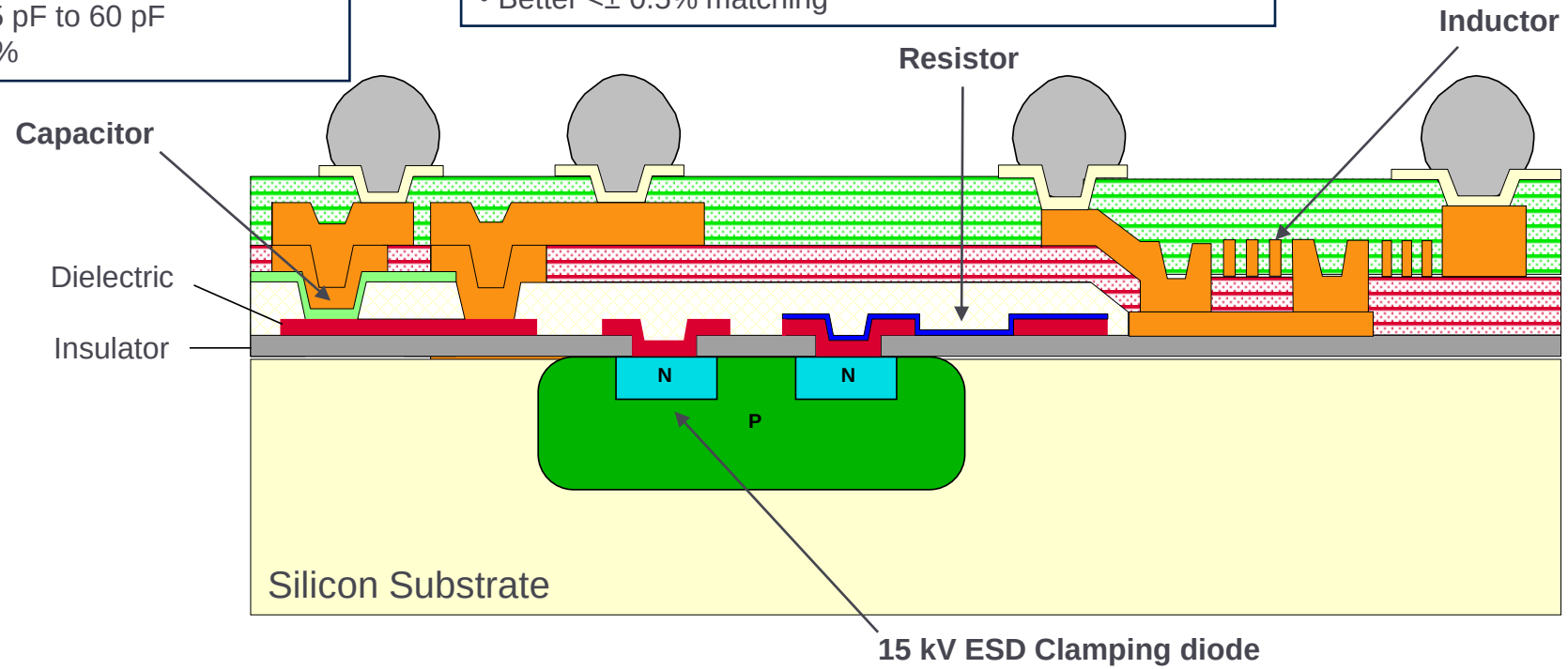
What is an ASIP?

MIM capacitors
- **From <1 pF to 100+ nF capacitors**
- 0.6 nF/mm² ± 20% tolerance
- 2-5 nF/mm² ± 10% tolerance
- 150 nF/mm² ± 20% tolerance (3D caps*)
- Tunable Caps 0.5 pF to 60 pF
- Matching < ± 0.5%

Resistors
- **From 1 Ω to few hundreds of kΩ**
- From ± 5% to ± 20% tolerance
- From 35 Ω/sq ± 10% to few kΩ/sq ±20%
- Better <± 0.5% matching

Inductors
- **Up to 140 nH**
- Up to 10 µm thickness double layer inductor

➔ high Q-factor



ESD protections
- IEC 61000-4-2 level 4 system-standard compliance
- 6 V & 14 V breakdown voltages
- Uni & bidirectional structures
- From 100 pF to 0.25 pF capacitance for High Bandwidth

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** The 3D cap technology only allows for integration of high-density capacitors. No other passive or active components can be integrated on the same die (see slide 9).*

What is an ASIP?

SHORT TIME TO SAMPLES
~8 weeks (depending on complexity)

BETTER PERFORMANCE THAN DISCRETES
Less parasitics / better matching

CUSTOMIZABLE & FLEXIBLE SOLUTION
Multi Product Wafer for best optimization

SMALLER THAN DISCRETES
Up to 70%

LOWER COST THAN DISCRETES
Reduces BOM, PCB size, improves quality

BALISTIC QUALIFICATION

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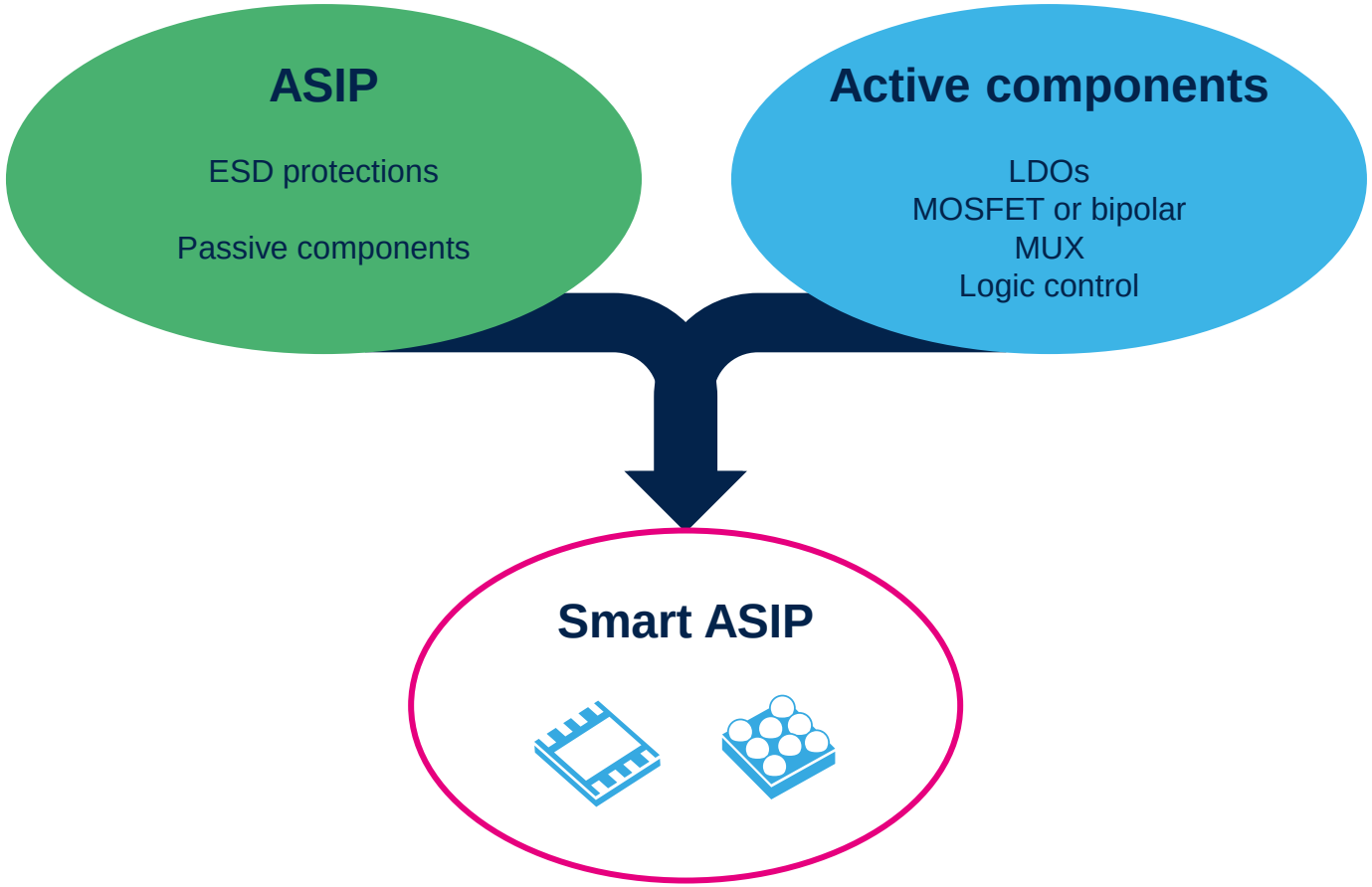
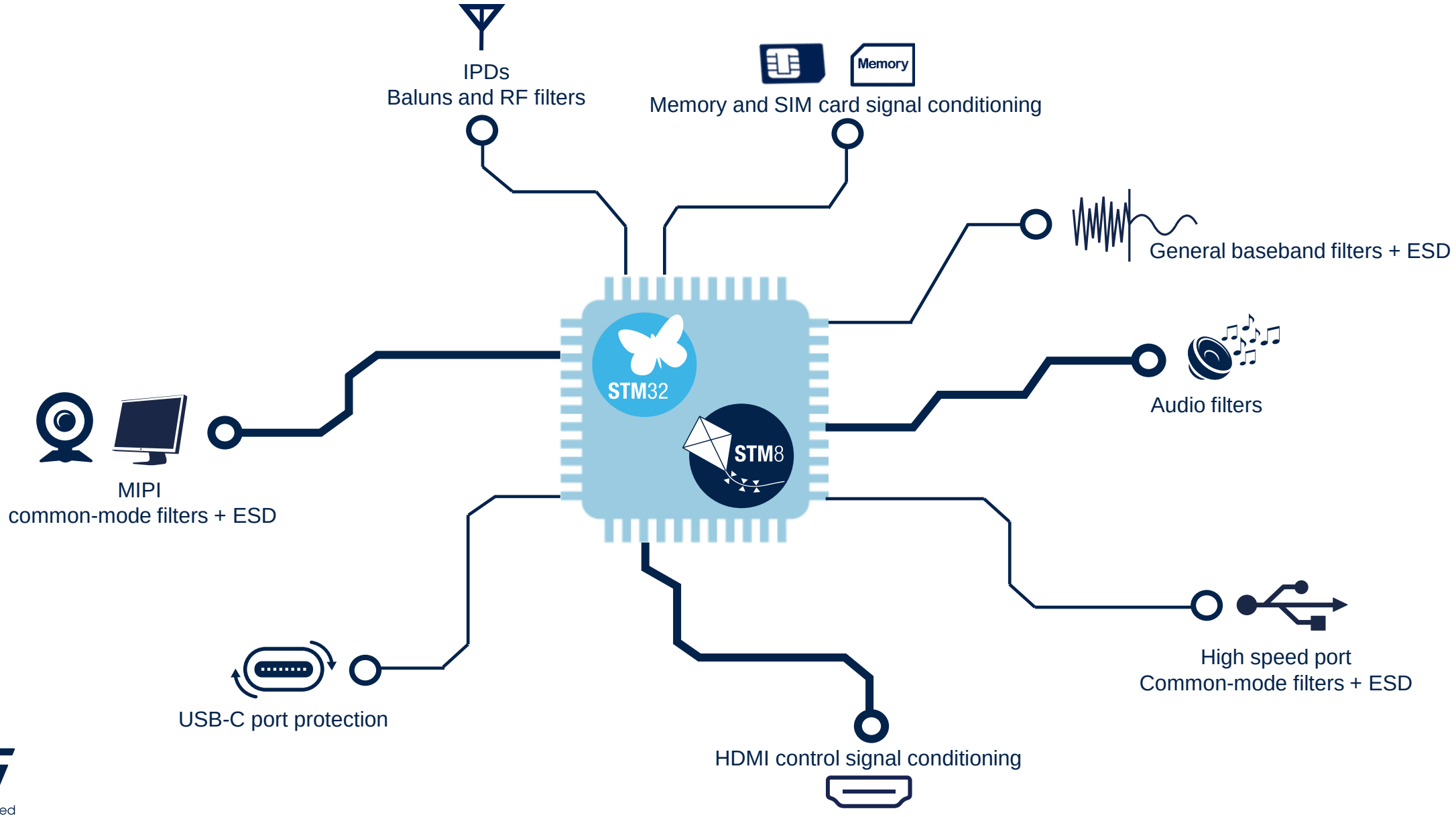
What is a smart ASIP?

- More active functionalities added
- When discrete circuits become:
  - Too complex
  - Too big
  - Too expensive
  - Not performant enough



Typical ASIPs around the MCU

Typical ASIPs around the MCU



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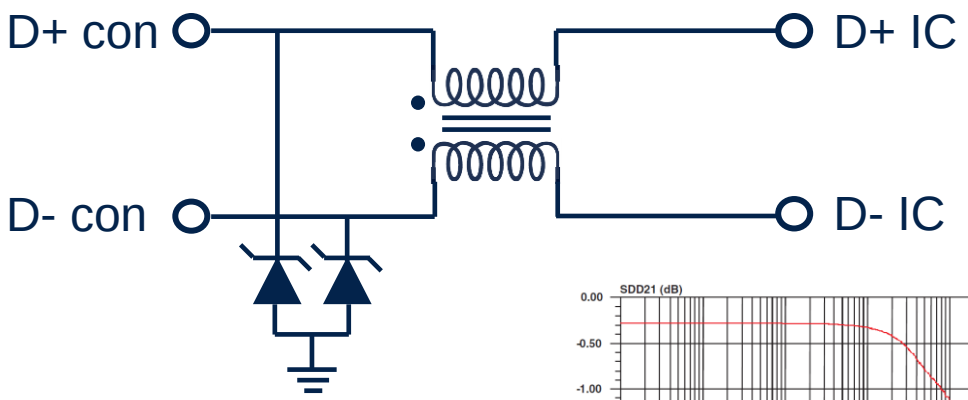
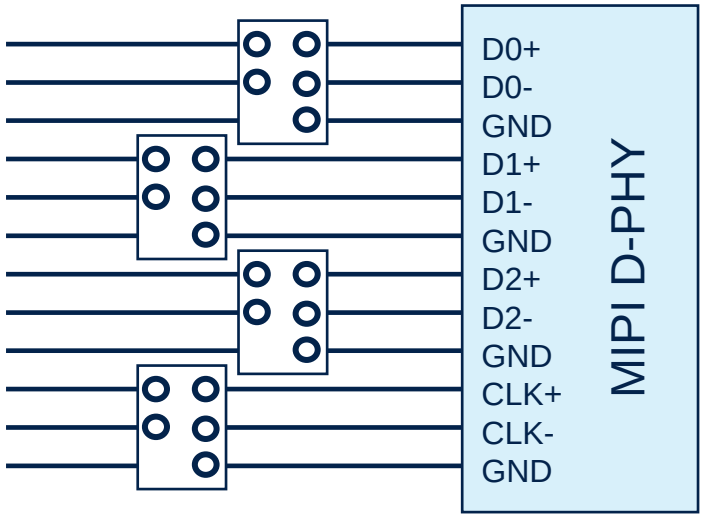
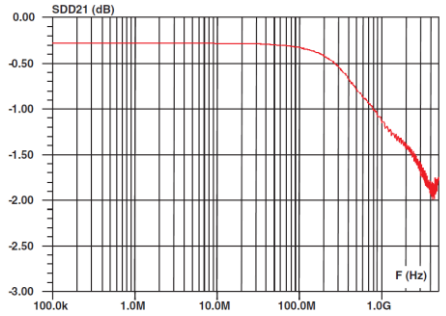
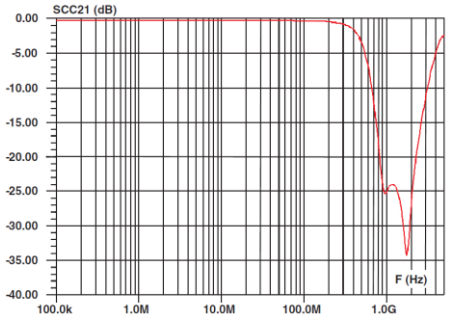
Common mode filters + ESD

- ECMF = combination of ESD protection and Common-Mode choke
  - 2 to 6 line devices
  - Applications: high-speed communication ports
    - USB 3.x
    - HDMI 2.x
    - MIPI
  - Goals:
    - Protect against IEC61000-4-2 level 4 ESD
    - Suppress common-mode noise
    - Keep signal integrity
    - Save space on PCB









Example: ECMF02-2BF3 on MIPI

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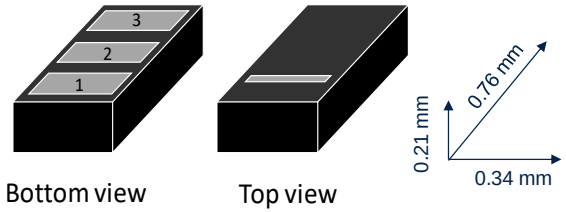
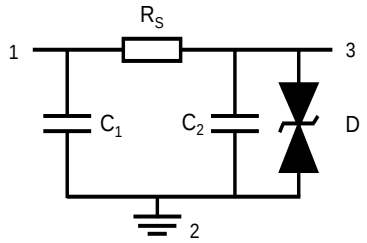
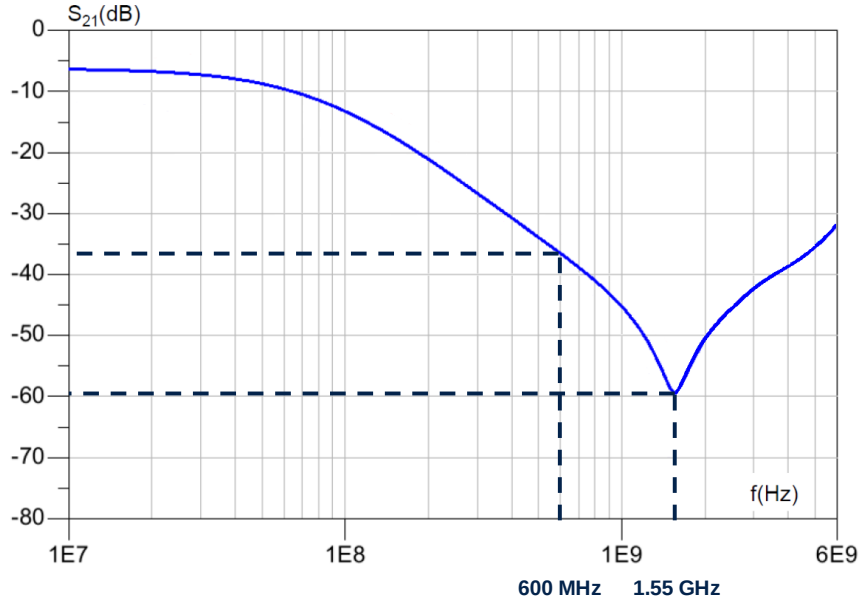
General baseband filters + ESD

- Example: EMIF01-1008AF4
  - Low pass filter with integrated ESD protection

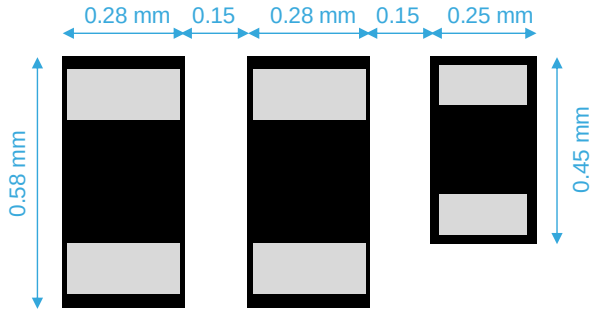






- MiM(1) capacitors
- Resistor:
  - R_S (typ) = 100 Ω
- Total line capacitance:
  - C_{line}(typ) = C_1 + C_2 + C_D = 80 pF
- ESD protection:
  - 8 kV contact discharge IEC 610000-4-2 on pin 3
  - Exceeding HBM 2kV min on pin 1

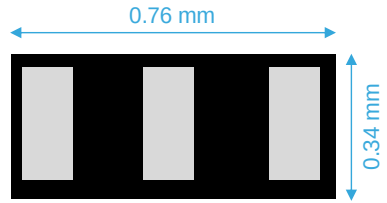
Discrete solution



0.59 mm²

-56%

ASIP



0.26 mm²

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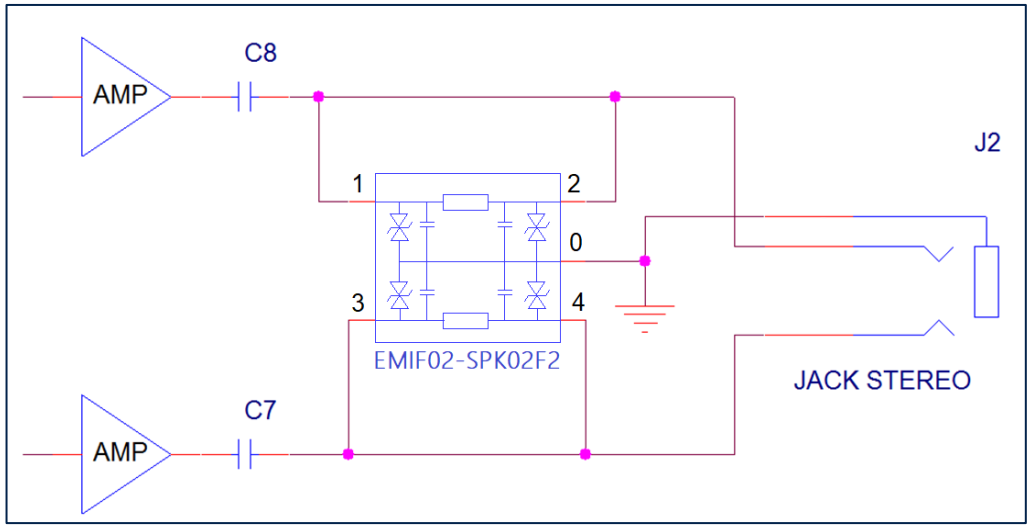
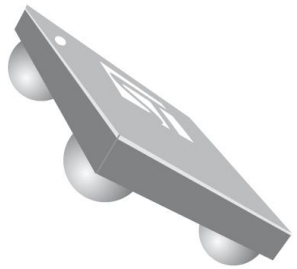
Audio filters

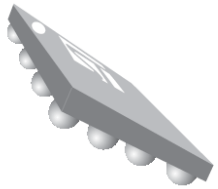


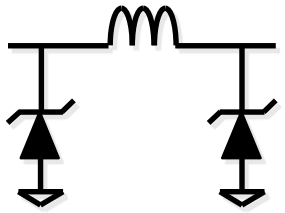


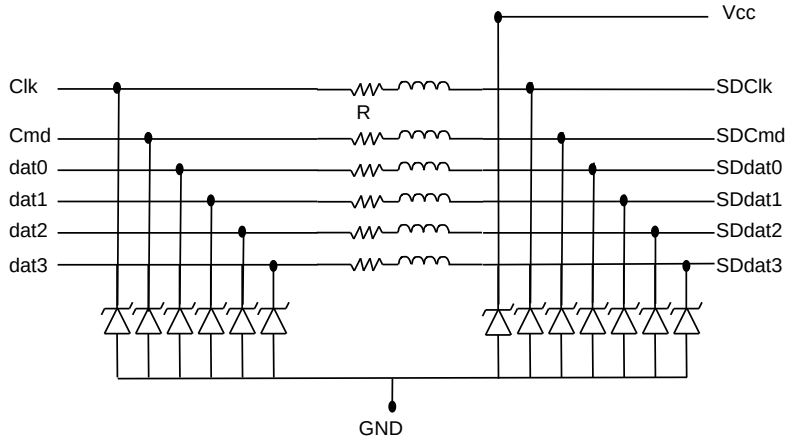
Flip-chip 4 bumps

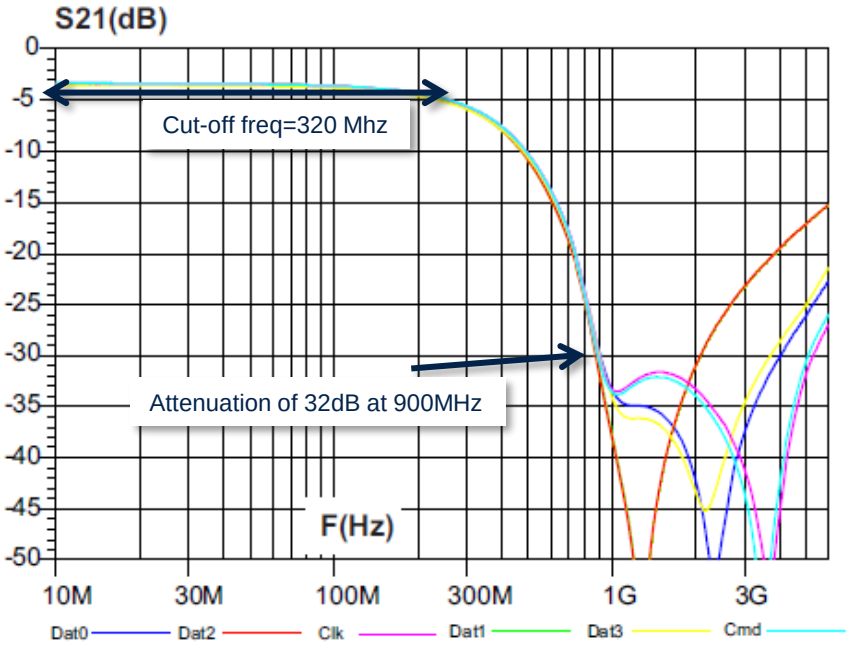
Needs for data lines	Product key parameters	ST solutions
Analog signal	Bidirectional serial res of 0.07 Ω*	EMIF02-SPK02F2 EMIF02-SPK03F2*
Rejection of Bluetooth and WiFi frequencies	Rejection >40 dB at 900 MHz Rejection >20 dB at 2.4 GHz	
IEC 61000-4-2 level 4	Contact discharge: 8 kV Air discharge: 15 kV	

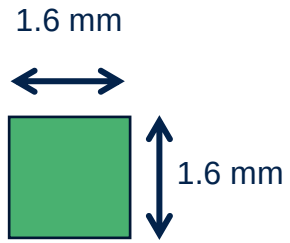
SD and SIM cards

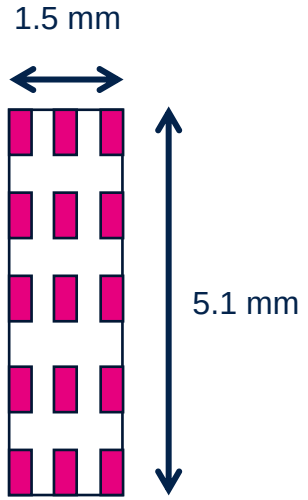












ASIP: 2.56 mm²

Discrete: 7.7 mm²
18 x 0201

3 times smaller

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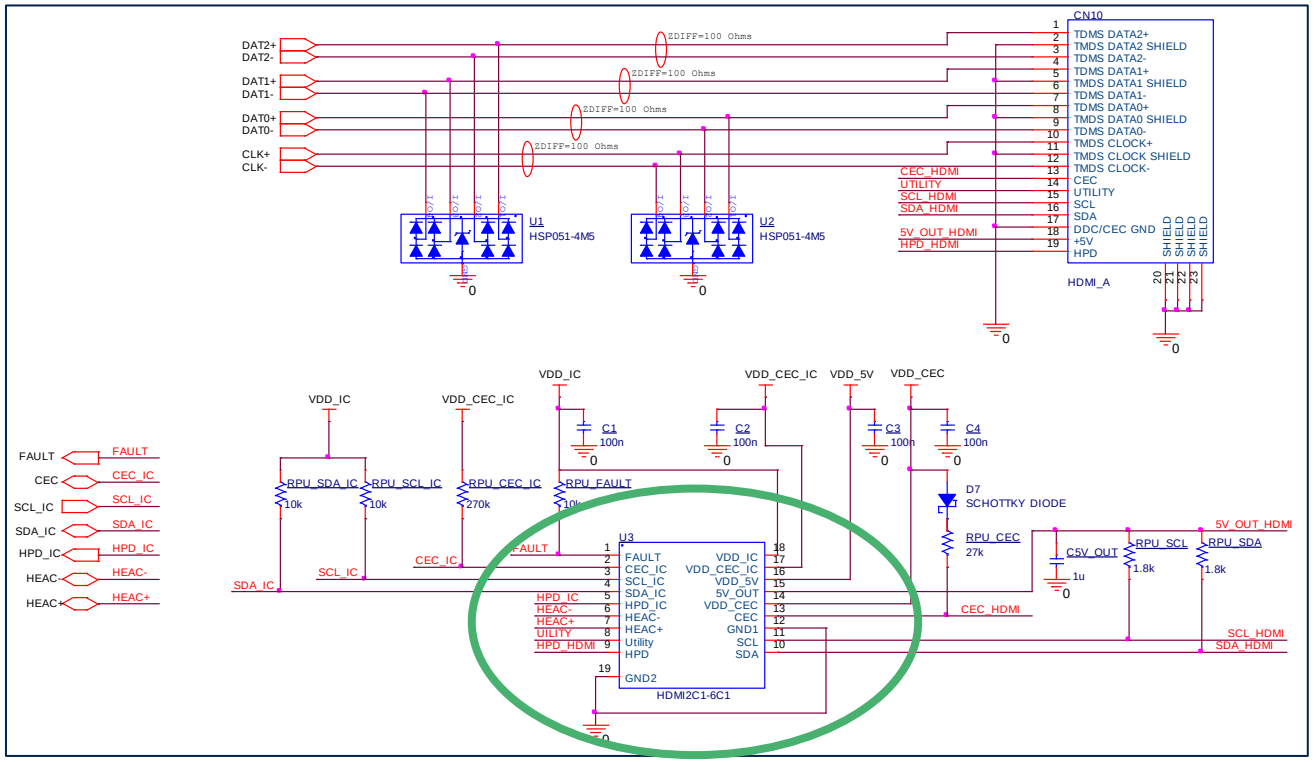
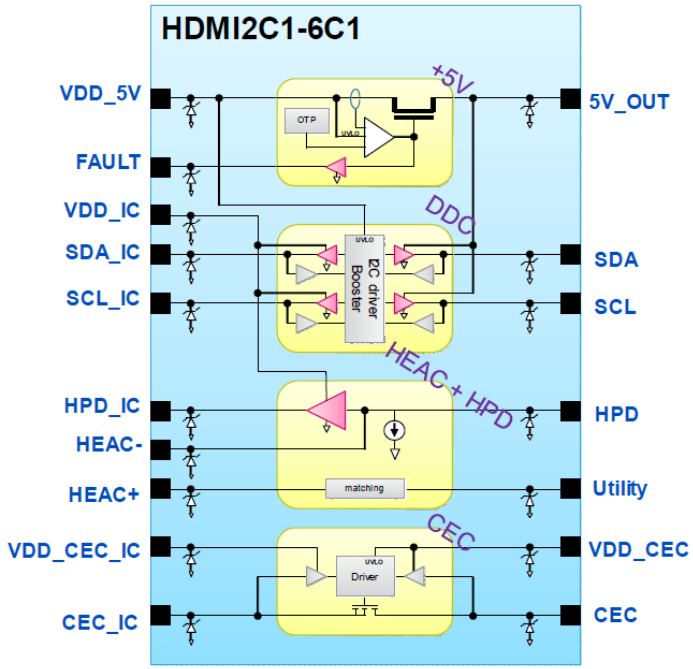
HDMI control signal conditioning





Application needs	Product key parameters	ST solutions
Control lines: compliance with certification standard	8 kV IEC61000-4-2 ESD protections	HDMI2C1-6C1
	DDC bi-directional signal conditioning and dynamic pull-up	
	CEC bi-directional level-shifter, backdrive protection	
	HEAC link protection and line matching	
	HPD pull-down, signal conditioning with level –shifting and backdrive protection	
	Short-circuit protection on 5V output	

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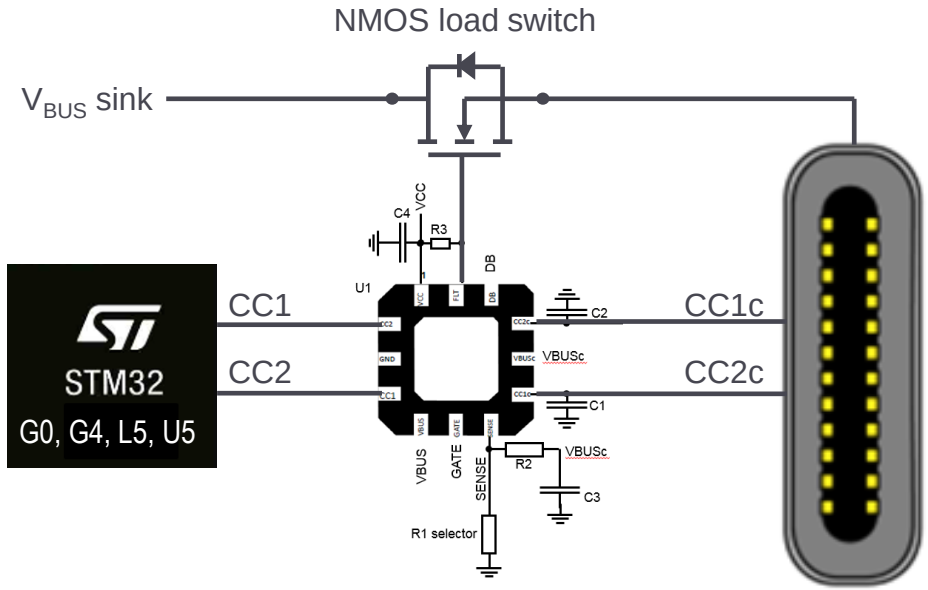
USB type C port protection

- TCPP series (USB **T**ype **C** **P**ort **P**rotection)
  - V_{BUS} power path, OVP and ESD protection
  - Comes with a Nucleo shield
  - Main features
    - ESD protection for CC1, CC2 and V_{BUS}
    - IEC61000-4-2 Level 4 compliant
    - 24 V OVP on CC lines against short-to-V_{BUS} overvoltage
    - 22 V OVP on V_{BUS}
    - Integrated gate driver for external V_{BUS} load-switch
    - OTP at 135 °C
    - QFN 12-pin package 3 x 3 mm (pitch 0.5 mm)



TCPP01-M12 (sink)

STM32 Nucleo

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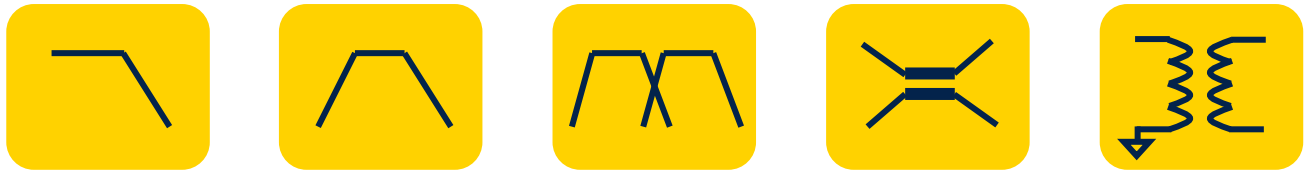
Integrated Passive Devices

- Products (non-exhaustive list)
  - RF filters
  - RF diplexers or triplexers
  - RF couplers
  - Baluns
  - RF matching networks



- Applications (non-exhaustive list)
  - Any application requiring RF filtering functions

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Conclusion

Conclusion

- ST offers a large variety ASIPs and IPDs for advanced applications in the IoT market.
- Those are ideal companion chips for MCUs.
- ASIPs allow design simplification as well as space-saving through higher integration.
- IPDs allow high integration of passive components to design performant price-competitive RF filters.

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Thank you

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