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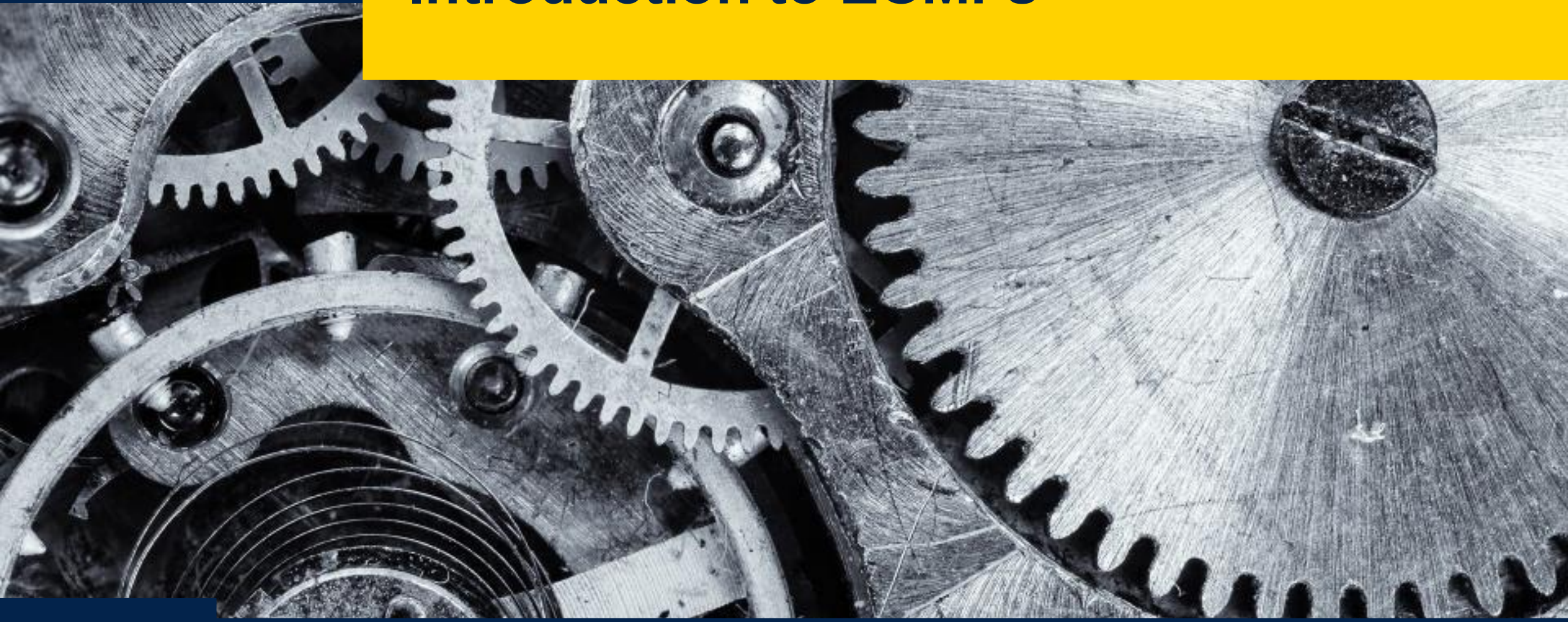
ECMF portfolio

ST PROTECT

Introduction to ECMFs



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Why ECMF

1 EMI challenge

- In the past, the frequency band of useful signals carrying data (up to 80 to 100 MHz) was much lower than the EMI/noise spectrum (above 800 MHz).
- Standard low pass (RC or LC) filters were therefore suitable for removing noise.

2 Limitations of low pass filters

- With increasing datarates (USB2.0 480 Mbps/240 MHz to USB4 20 Gbps/10 GHz), useful signals and EMI/RF noise now share the same frequency band.
- RC or LC filters would attenuate both signals and noise.

3 Invention of CMFs

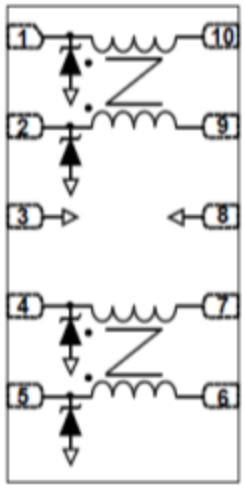
- A new method was developed to filter noise in high-speed differential links. Useful signals are transmitted in phase opposition (differential mode signal), while noise is generated by signals in phase (common-mode signal).
- Common-mode filters succeed in attenuating common-mode EMI/RF noise and preserving the differential signal (data).

ST innovates with ECMF

ESD protection

CMF
(Common-mode filter)

ECMF



- **Very small size**
- **High and deep rejection**
- **Low clamping voltage**

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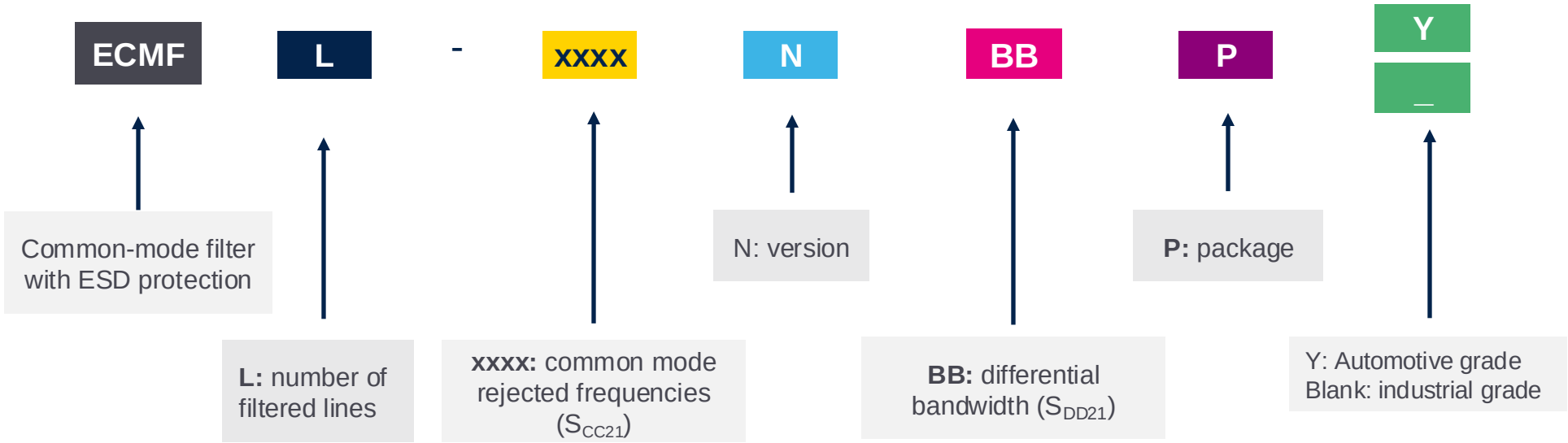
ECMF part-numbering scheme



ECMF4-2450A60N10

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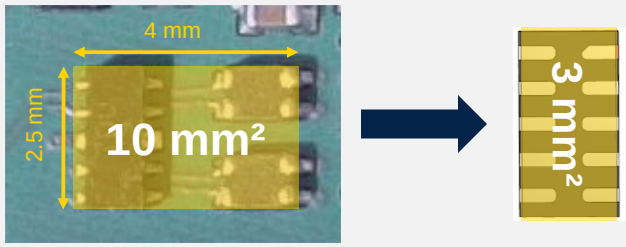
ECMF benefits

Meet or exceed the international standard for ESD protection (IEC 61000-4-2 level 4).

Compact and integrated design

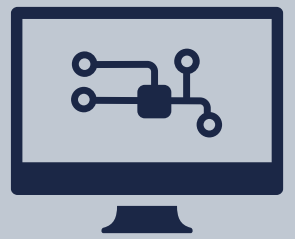


3 times smaller: reduce footprint (-70%) and manufacturing costs.

Compatibility with high-speed interfaces

USB2, 3 and 4+, HDMI up to 2.1, DisplayPort, Thunderbolt, SerDes automotive (MIPI A-PHY, FPD Link, and GSML)

Easy implementation



Design and simulation tools are available for engineers.

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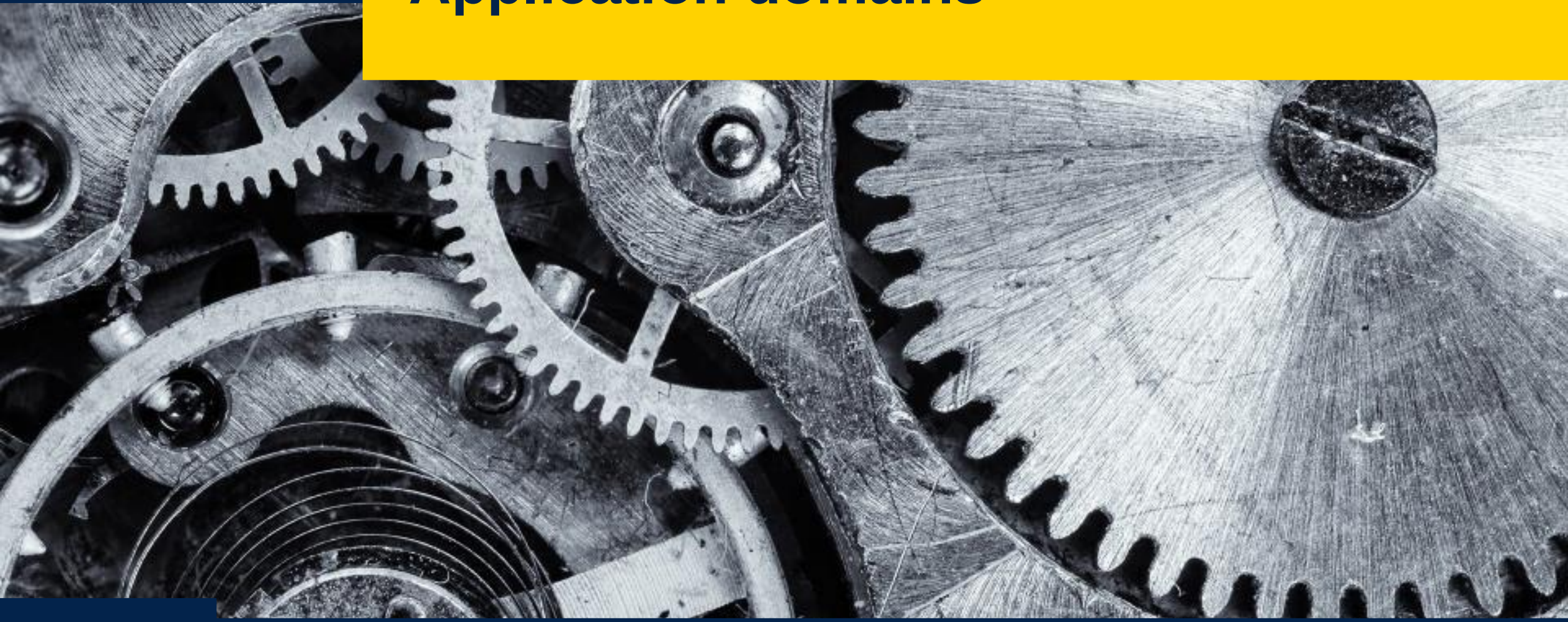
Application domains



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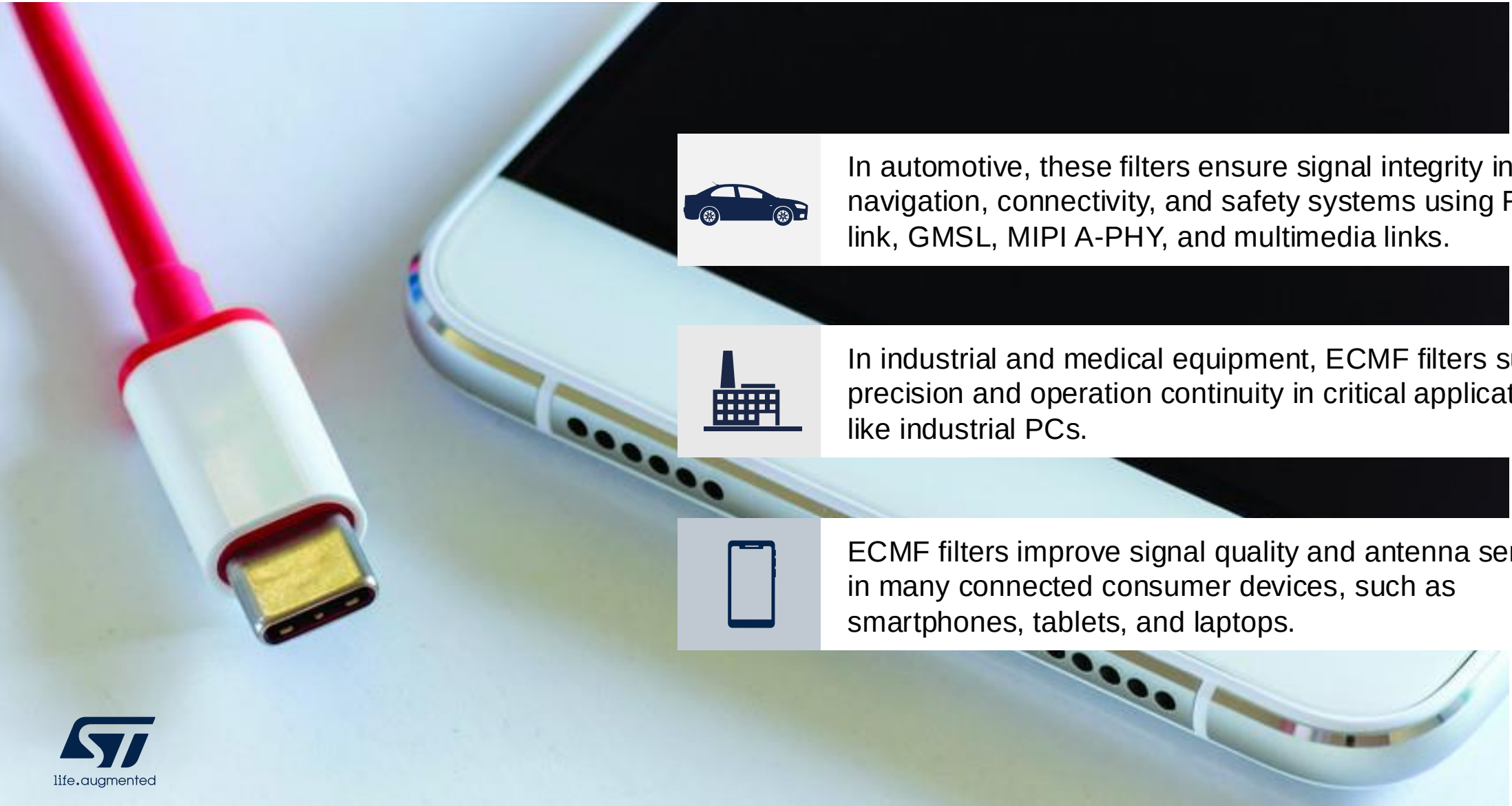
Where can you find ECMF?



In automotive, these filters ensure signal integrity in navigation, connectivity, and safety systems using FPD-link, GMSL, MIPI A-PHY, and multimedia links.

In industrial and medical equipment, ECMF filters support precision and operation continuity in critical applications like industrial PCs.

ECMF filters improve signal quality and antenna sensitivity in many connected consumer devices, such as smartphones, tablets, and laptops.

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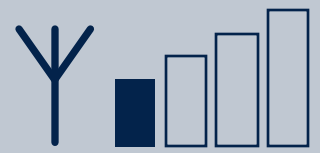
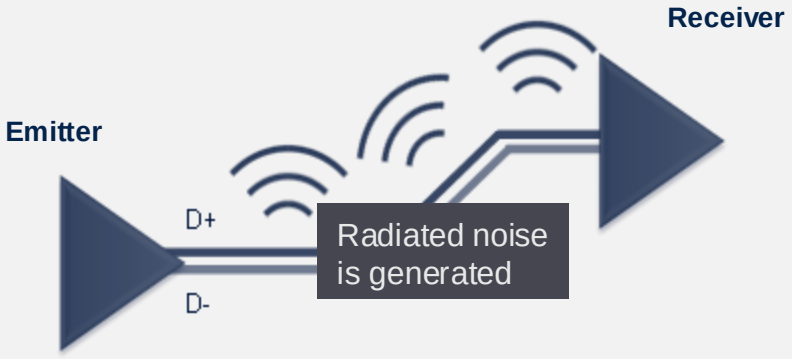
ECMF preserves signal quality

- Wi-Fi
- Bluetooth
- GPS
- V2X
- Cellular



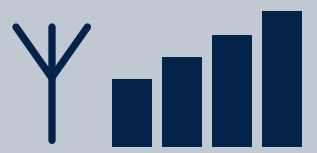


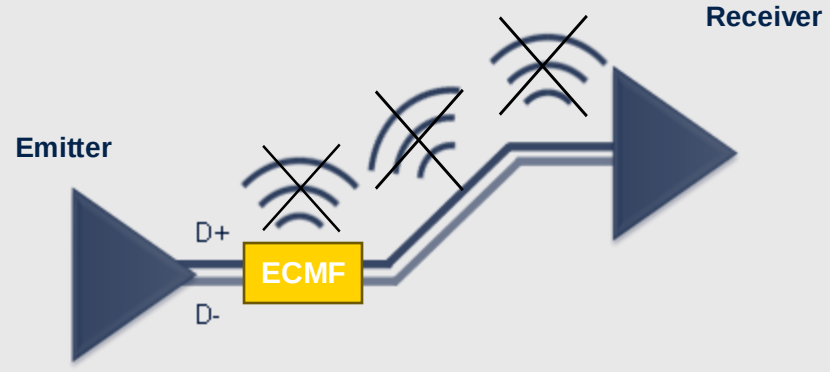
- MIPI A, D-PHY
- SATA
- HDMI
- DisplayPort
- FPD-link/GMSL
- USB 2.0
- USB 3.2
- USB 4

ECMF

Avoid desense

- Wi-Fi
- Bluetooth
- GPS
- V2X
- Cellular





- MIPI A, D-PHY
- SATA
- HDMI
- DisplayPort
- FPD-link / GMSL
- USB 2.0
- USB 3.2
- USB 4

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ECMF selection guide

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Select the right ECMF

Package (shape/size/footprint)

Number of lines to filter

Automotive* or industrial **grade**

Electrical performances

Transparency
- Reverse stand-off voltage: V_{RM}
- Polarity: unidirectional or bidirectional
- Differential bandwidth: S_{DD21}
- Serial resistance (insertion loss)

Efficiency
- Common-mode attenuation: S_{CC21}
- ESD & EOS robustness level: V_{ESD} & I_{pp}
- Clamping voltage: V_{CL}

*: Part number ending with a “Y”

2-line ECMF selection guide

RF protocol/common-mode **noise to reduce**	Protocols			
	USB2.0	**HDMI 1.4** **MIPI CSI-2** **APIX 2**	**USB 3.2 Gen1** **HDMI 2.0/DP** **FPD-link III/GMSL 2** **APIX 3**	**HDMI2.1** **USB4** **MIPI A-PHY** **FPD-link IV / GMSL 3**
2G low band (900 MHz) **3G low band** (900 MHz) **GNSS** (1.5 GHz) **LTE** (600 MHz, 700 MHz) **5G low band** (600 MHz to 1 GHz)	ECMF02-4CMX8 ECMF02-2AMX6 ECMF02-2BF3 ECMF02-2HSMX6	ECMF02-2HSMX6 ECMF02-2BF3	ECMF02-2HSMX6	
5G mid band (2.5 to 3.7 GHz)	ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF2-40A100M6Y ECMF2-40A100N6
2G high band (1.8 GHz) **3G high band** (2.1 GHz) **Bluetooth** (2.4 GHz) **Wi-Fi** (2.4 GHz) **LTE** (1.7/2.1/2.3/2.5 GHz)	ECMF02-4CMX8 ECMF02-2AMX6 ECMF02-2BF3 ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF2-40A100M6Y ECMF2-40A100N6
V2X (5.9 GHz) **Wi-Fi** (5 GHz)	ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF02-2HSMX6 ECMF2-40A100M6Y ECMF2-40A100N6	ECMF2-40A100M6Y ECMF2-40A100N6

4-line ECMF selection guide

Protocols					
RF protocol/common-mode noise to reduce		**USB2.0**	**HDMI 1.4 MIPI CSI-2 APIX 2**	**USB 3.2 Gen1 HDMI 2.0/DP FPD-link III/GMSL 2 APIX 3**	**HDMI2.1 USB4 MIPI A-PHY FPD-link IV / GMSL 3**
	2G low band (900 MHz) **3G low band** (900 MHz) **GNSS** (1.5 GHz) **LTE** (600 MHz, 700 MHz) **5G low band** (600 MHz to 1 GHz)	ECMF04-4HSM10 ECMF04-4HSWM10 ECMF4-2450A17M10	ECMF4-20A42N10 ECMF04-4HSWM10(Y) ECMF-4HSM10(Y) ECMF4-2450A17M10 ECMF4-2450A60N10 ECMF4-2459A6M10Y	ECMF4-20A42N10 ECMF04-4HSWM10(Y) ECMF-4HSM10(Y) ECMF4-2450A17M10 ECMF4-2450A60N10	ECMF04-4HSWM10(Y) ECMF4-2450A60N10
	5G mid band (2.5 to 3.7 GHz)	ECMF04-4HSWM10 ECMF4-2450A17M10	ECMF4-2450A17M10 ECMF04-4HSWM10 (Y) ECMF4-20A42N10 ECMF4-20A42N10 ECMF4-2459A6M10Y ECMF4-40A100N10	ECMF4-2450A17M10 ECMF04-4HSWM10(Y) ECMF4-20A42N10 ECMF4-20A42N10 ECMF4-40A100N10	ECMF04-4HSWM10(Y) ECMF4-40A100N10
	2G high band (1.8 GHz) **3G high band** (2.1 GHz) **Bluetooth** (2.4 GHz) **Wi-Fi** (2.4 GHz) **LTE** (1.7/2.1/2.3/2.5 GHz)	ECMF04-4HSWM10 ECMF4-2450A17M10	ECMF4-2450A17M10 ECMF04-4HSWM10(Y) ECMF4-20A42N10 ECMF4-2459A6M10Y ECMF4-2450A60N10 ECMF4-40A100N10	ECMF4-2450A17M10 ECMF04-4HSWM10(Y) ECMF4-20A42N10 ECMF4-2450A60N10 ECMF4-40A100N10	ECMF04-4HSWM10(Y) ECMF4-2450A60N10 ECMF4-40A100N10
	V2X (5.9 GHz) **Wi-Fi** (5 GHz)	ECMF04-4HSWM10	ECMF04-4HSWM10(Y) ECMF4-20A42N10 ECMF4-2450A60N10 ECMF4-2459A6M10Y ECMF4-40A100N10	ECMF04-4HSWM10(Y) ECMF4-20A42N10 ECMF4-2450A60N10 ECMF4-40A100N10	ECMF04-4HSWM10 (Y) ECMF4-2450A60N10 ECMF4-40A100N10

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Resources

Blog article about ECMF

Antenna desense medication

Webinar: ECMF

White papers

AN5891: MIPI A-PHY EOS protection in automotive applications

AN4511: Common-mode filters

AN4356: How to solve antenna desense issue with ECMF

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