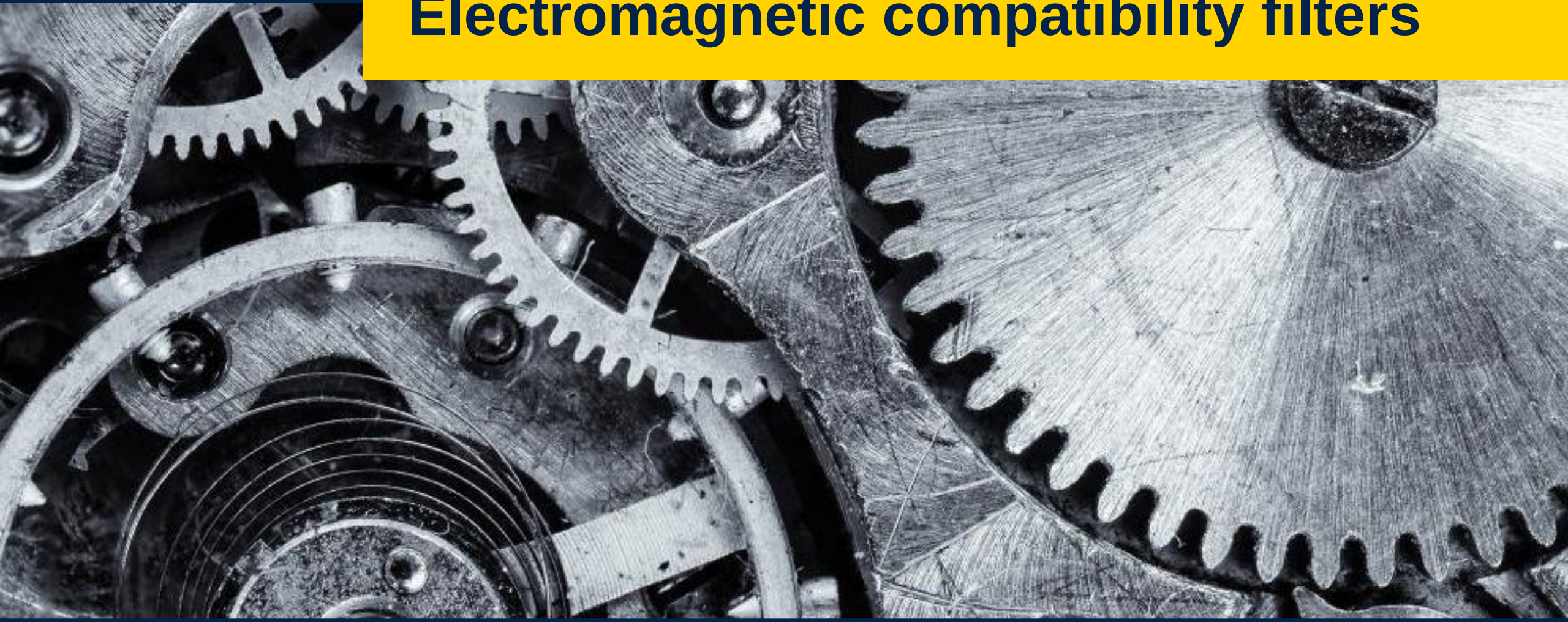
ST ECMF portfolio – technical selection guide

ST ECMF
Electromagnetic compatibility filters



Sources of electromagnetic interference (EMI)

Natural sources

Solar flares, cosmic radiation, lightning, and other atmospheric phenomena such as high winds and storms. Most natural EMI sources produce radiated interference. Lightning can be a source for both radiated and conducted EMI.

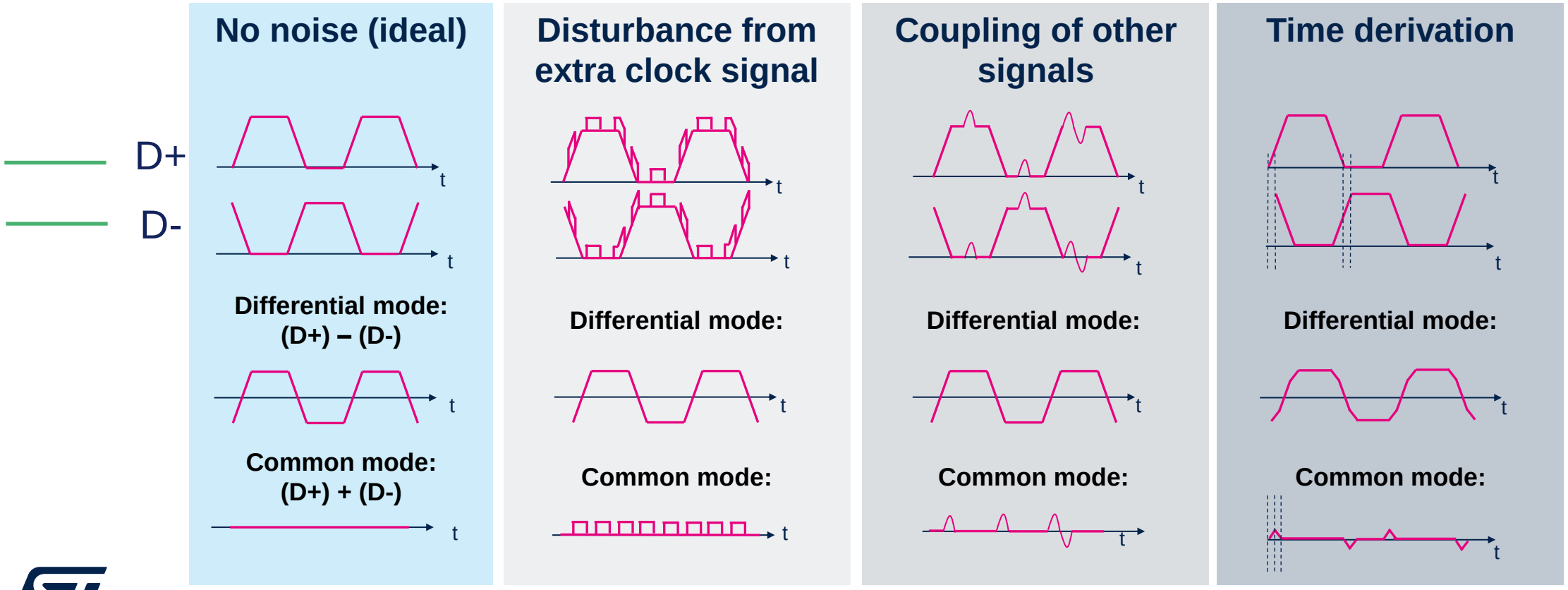
Artificial sources

these include intentional and unintentional sources. Intentional sources of EMI include all types of wireless transmissions such as satellites, Wi-Fi, Bluetooth, RFID readers, radio and television transmissions, and so on.

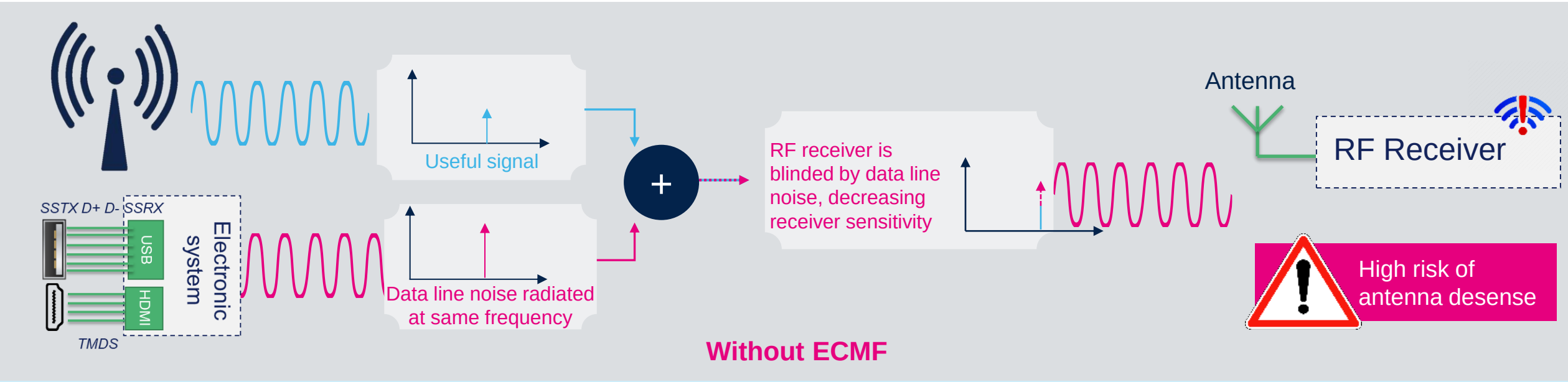
IEC 61000-4-2	Electrostatic discharge immunity test
IEC 61000-4-4	Electrical fast transient immunity test
IEC 61000-4-5	Surge immunity test

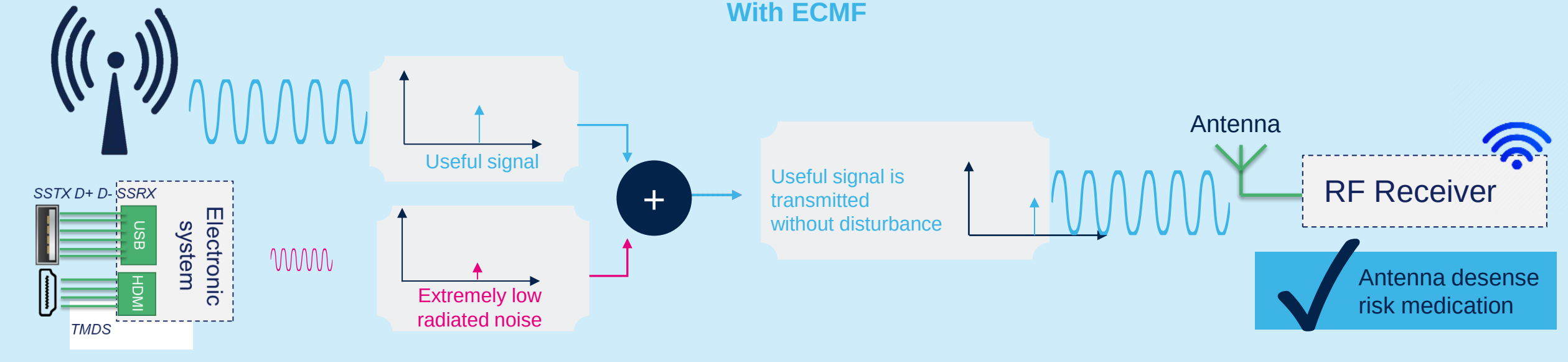
Causes of common mode noise

Noise disturbance is radiation near D+/D- in application or through cable or flex. Common mode noise is the main source of noise radiation



ECMF medication to avoid antenna desense



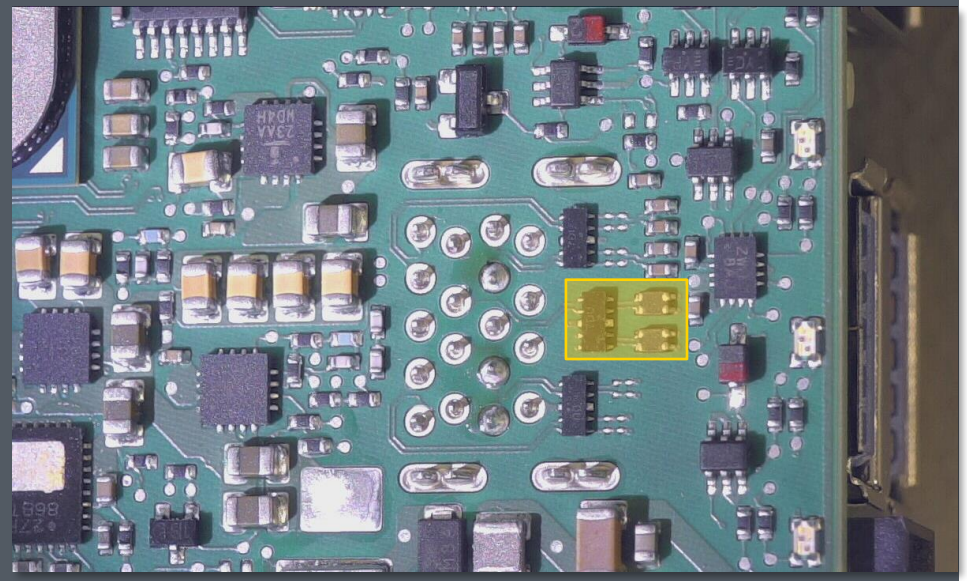


Features and benefits

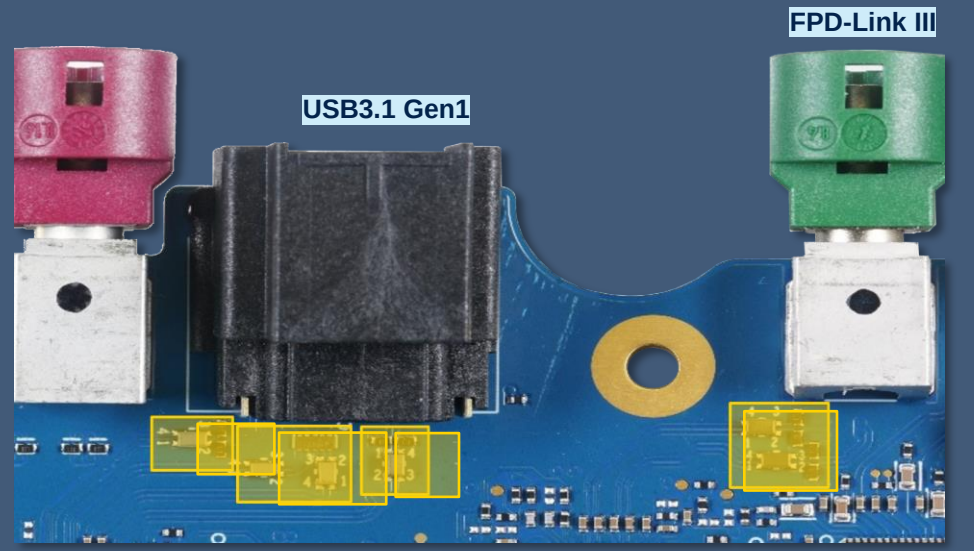
Applications that need ECMF

Many applications use separate ESD + common-mode filters, but ECMF does both in a single package

Industrial PC



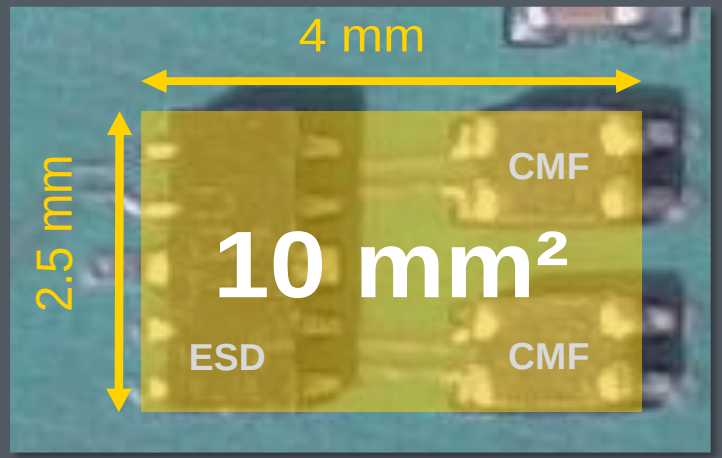
Automotive cockpit controller



Source: Automotive Teardown Tracks, Infotainment module - Yole SystemPlus, July 2024

Higher integration and reliability with ECMF series

Current solutions



ST ECMF = ESD + CMF

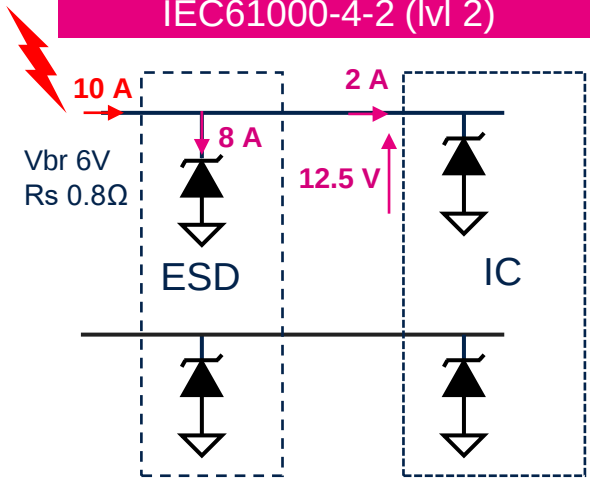
- **1.35 mm X 2.2 mm = 3 mm²**
- **Cuts size by 3 (70% PCB space saving)**
- **Simplify** the layout and design
- Compatible with **USB, HDMI, FPD-link, GMSL, etc.**
- From **3 components to 1**:
  - fewer components → **lower FIT*** and **higher UPH****
  - fewer solder joints → better **reliability**

*FIT = failure in time **UPH = unit per hour

Improve ESD robustness with ECMF series

Typical discrete
ESD protection topology

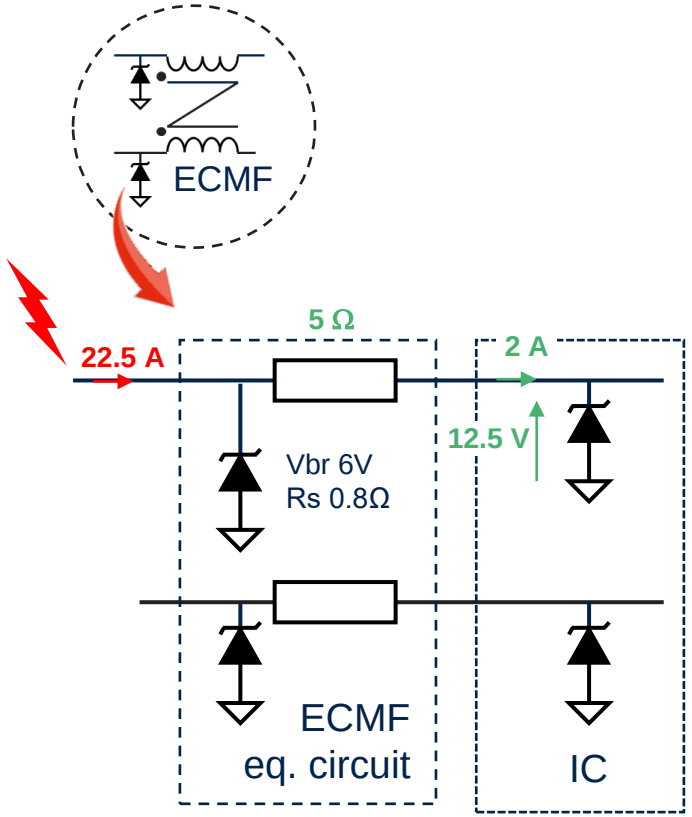
Destruction @ 5 kV
IEC61000-4-2 (lvl 2)



High performance MCU input

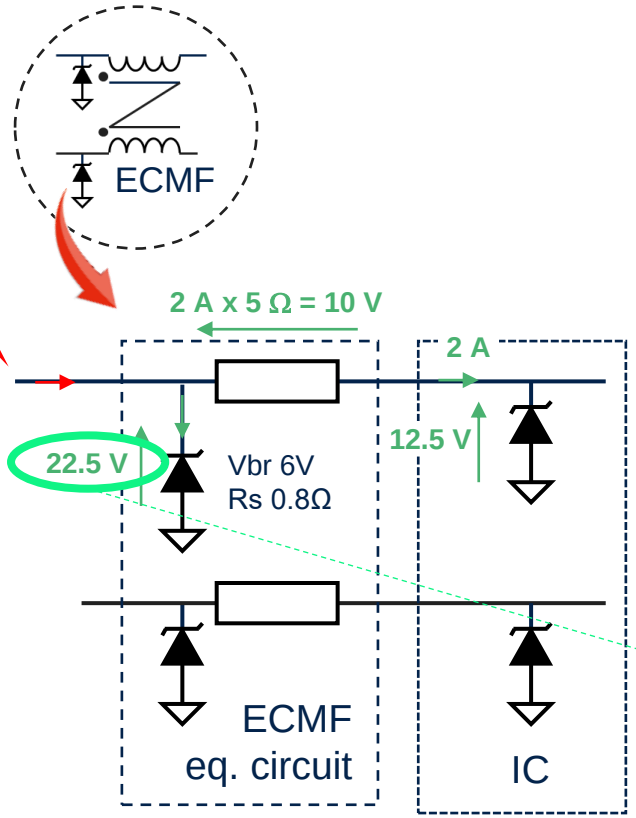
- 3.6 V max operating
- 2 kV HBM ESD
- 250 V CMD ESD
- 5.5 V AMR
- 12.5 V typical voltage before MCU's destruction
- The MCU fails at 2A TLP, which corresponds to 12.5 V VCL

Insert ECMF



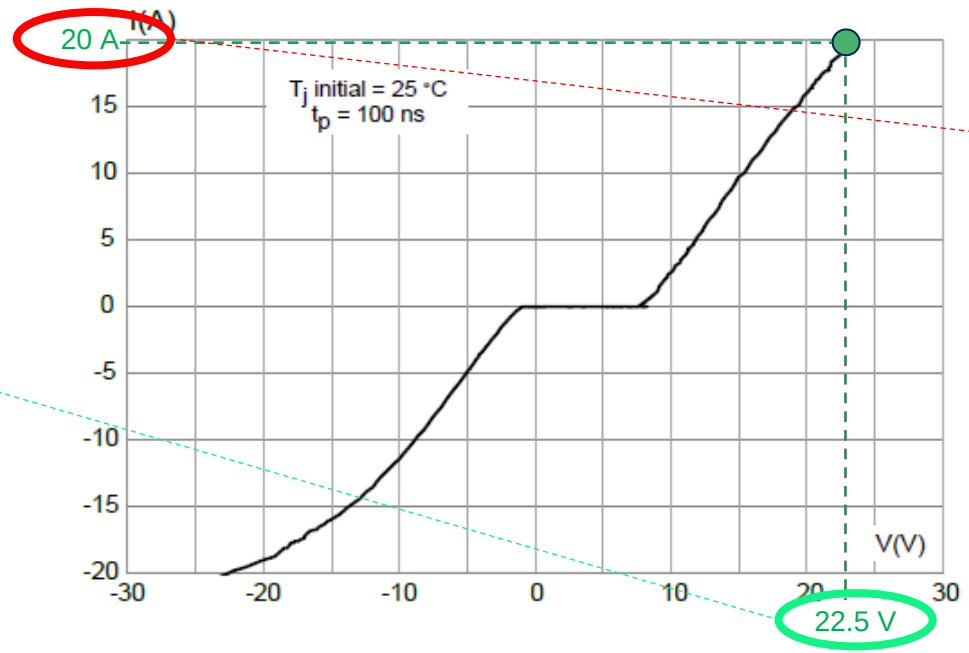
ECMF integrates serial resistance with typical value between 3 and 5 Ω

ECMF improves ESD immunity of ICs

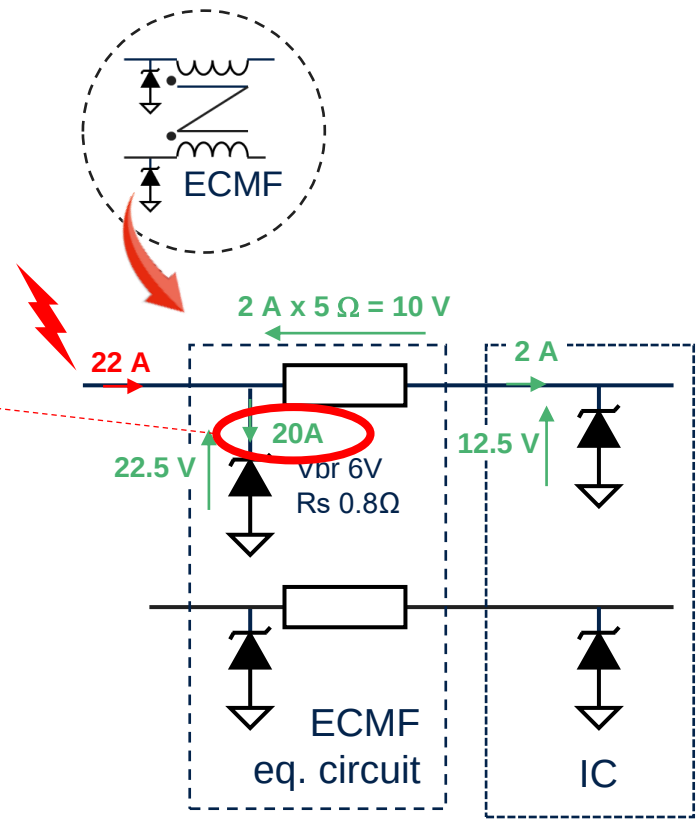


ECMF integrates serial resistance with typical value between 3 and 5 Ω

Destruction @ 11 kV IEC61000-4-2 (lvl 4)



Serial resistor of the ECMF4 = 5 Ω



ECMF integrates serial resistance with typical value between 3 and 5 Ω

Compatible with automatic optical inspection

Automatic optical inspection (AOI) to monitor solder joint quality after PCB assembly

Tiny **wettable flanks** DFN packages are compatible with automotive industry **quality** requirements like **AOI**

Application domains

ECMF in automotive applications

Detection for ADAS

Blind spot camera

Bird's eye and rear view

Driver monitoring system (DMS)

Radar

Lidar

Sensitive display

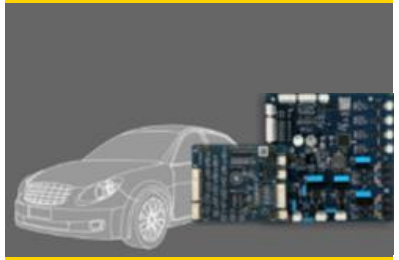
Vehicle controller unit (VCU)

Occupant monitoring system (OMS)

High resolution lighting

Infotainment display

BMS



ECMF in personal electronics applications

Home gateway

Streaming box

HDMI stick

Telepresence

Tablet & notebook + docking

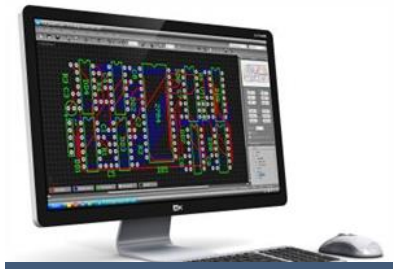
Game console

Point of sales

Smart watch & smart band

ECMF in industrial applications

Industrial PC



Panel PC

Embedded PC

Medical equipment

Measurement equipment

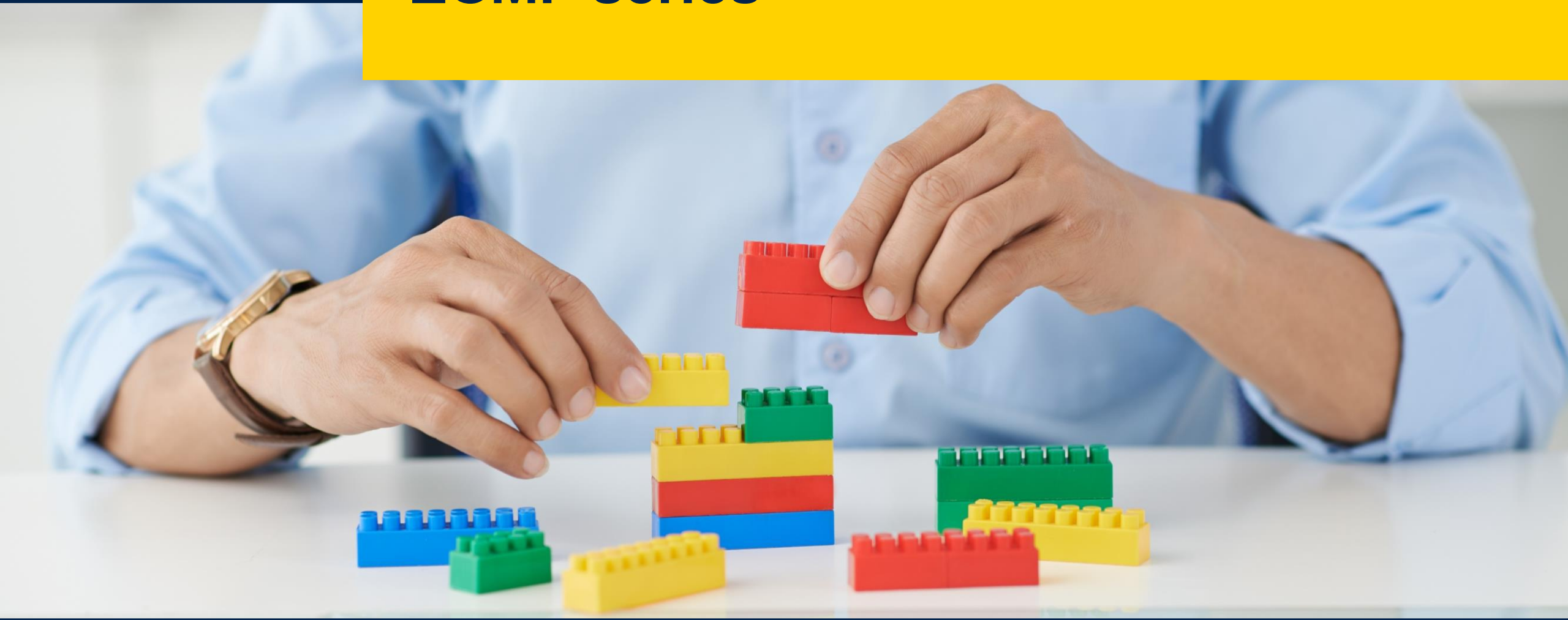
Home automation Security

Camera network Security

Fitness equipment

Lawn mower robot

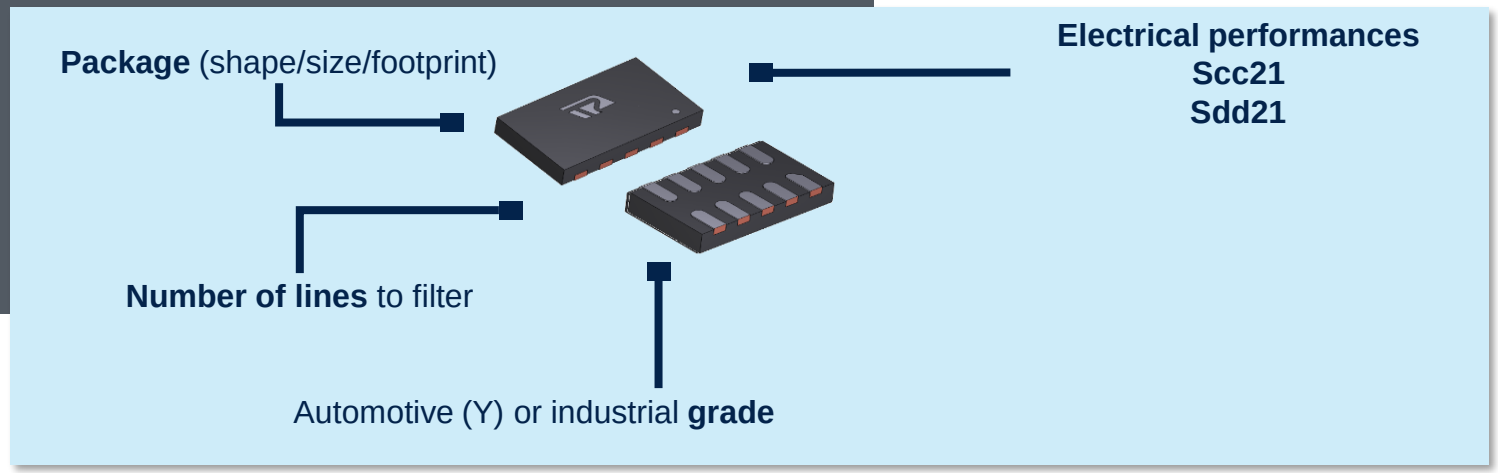
ECMF series



Selecting the right ST ECMF product

It is crucial to consider certain essential criteria to ensure the compatibility and efficiency of your application

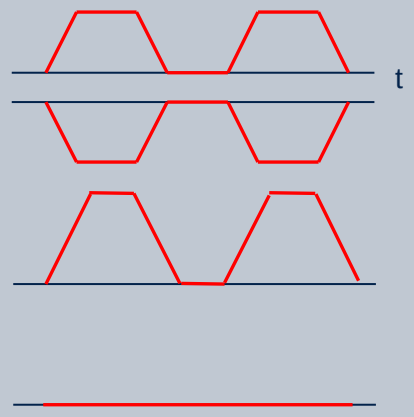
- Common mode noise **attenuation** (Scc21)
- Differential **bandwidth** (Sdd21)
- Automotive or industrial **grade** (A Y at the end of the part number indicates automotive)
- **Number of lines** to filter



Main standards using differential lines

Standard	USB 2.0	MIPI D-PHY	HDMI 1.4	USB 3.2 Gen 1	Display Port	HDMI 2.0	USB 3.2 Gen 2	MIPI A-PHY	HDMI 2.1	USB4
Data rate per lane	480 Mbps	Up to 2.5 Gbps	Up to 3.4 Gbps	5 Gbps	5.4 Gbps	6 Gbps	10 Gbps	Up to 8 Gbps	Up to 12 Gbps	20 Gbps
Number of pairs (or lanes)	1	1 or more	4	Gen 1x1: 2 Gen 1x2: 4	4	4	Gen 2x1: 2 Gen 2x2: 4	1 or more	4	Gen 3x1: 2 Gen 3x2: 4

1 pair consists of 2 signals in phase opposition (D+ and D-)



D+

D-

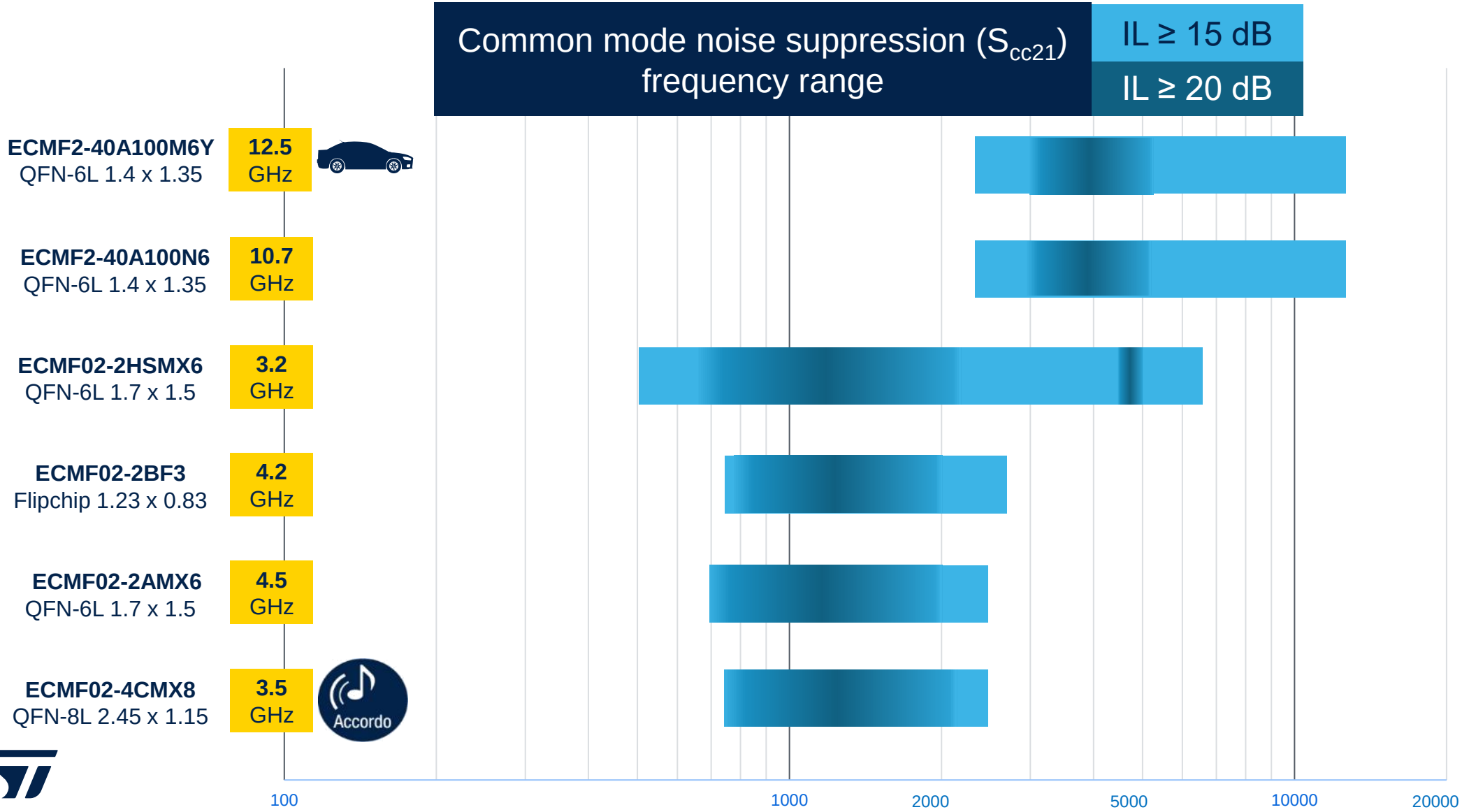
(D+)-(D-) diff mode

(D+)+(D-) common mode

In the ideal case, common mode is nil.

→ No radiation

ECMF series: 2-line portfolio
Sorted by application datarate capability

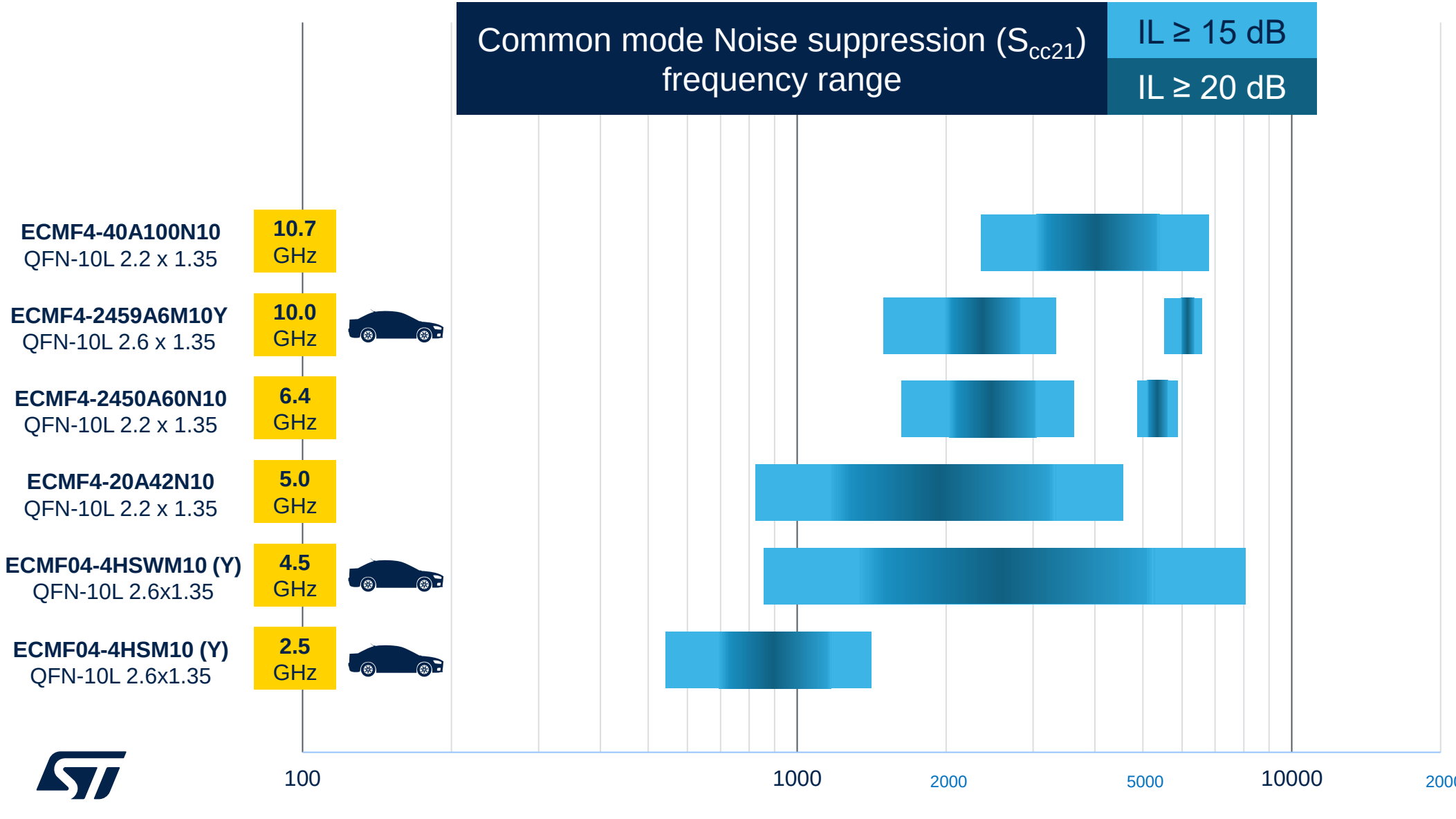


ECMF series: 2-line portfolio
Sorted by decreasing differential bandwidth

Continuous growth of bandwidth to cover high-speed standards
HDMI2.1, MIPI A-PHY, USB4 & USB 3.2

Part-number	# of lines	Directionality	Package	V_{BR}(min)	Scc21 (CM attenuation)	Diff bandwidth	Applications	Status
ECMF2-40A100M6Y	2	Unidir	QFN-6L 1.4 x 1.35	5.3 V	-15 dB @ 2.4 GHz -15 dB @ 5.9 GHz	12.5 GHz	USB4 HDMI 2.1 USB 3.2 USB 2.0 MIPI A-PHY FPD Link III	Mass-production
ECMF2-40A100N6	2	Unidir	QFN-6L 1.4 x 1.35	5.3 V	-5 dB @ 700 MHz -15 dB @ 2.4 GHz -20 dB @ 5.0 GHz	10.7 GHz	USB4 HDMI 2.1 USB 3.2 USB 2.0 MIPI A-PHY DisplayPort	Mass-production
ECMF02-2HSMX6	2	Unidir	QFN-6L 1.7 x 1.5	6 V	-10 dB @ 300 MHz -20 dB @ 2.4 & 5 GHz -15 dB from 0.5 to 6 GHz	3.2 GHz	USB 3.1 USB 2.0 MIPI D-PHY	Mass-production
ECMF02-2AMX6	2	Unidir	QFN-6L 1.7 x 1.5	6 V	-34 dB @ 900 MHz -20 dB from 0.8 to 2.2 GHz	4.5 GHz	USB 2.0 MIPI D-PHY	Mass-production
ECMF02-2BF3	2	Bidir	Flipchip 1.23 x 0.83	6 V	-23 dB @ 900 MHz -20 dB from 0.8 to 2.2 GHz	4.2 GHz	USB 2.0 MIPI D-PHY	Mass-production
ECMF02-4CMX8	2 + 2	Bidir	QFN-8L 2.45 x 1.15	6 V (data) 15 V (V_{BUS})	-25 dB @ 900 MHz -33 dB @ 1.8 GHz	3.5 GHz	USB 2.0	Mass-production

ECMF series: 4-line portfolio
Sorted by application datarate capability



ECMF series: industrial 4-line portfolio Sorted by decreasing differential bandwidth

Continuous growth of bandwidth to cover high-speed standards HDMI2.1, USB4 & USB3.2 Gen 2

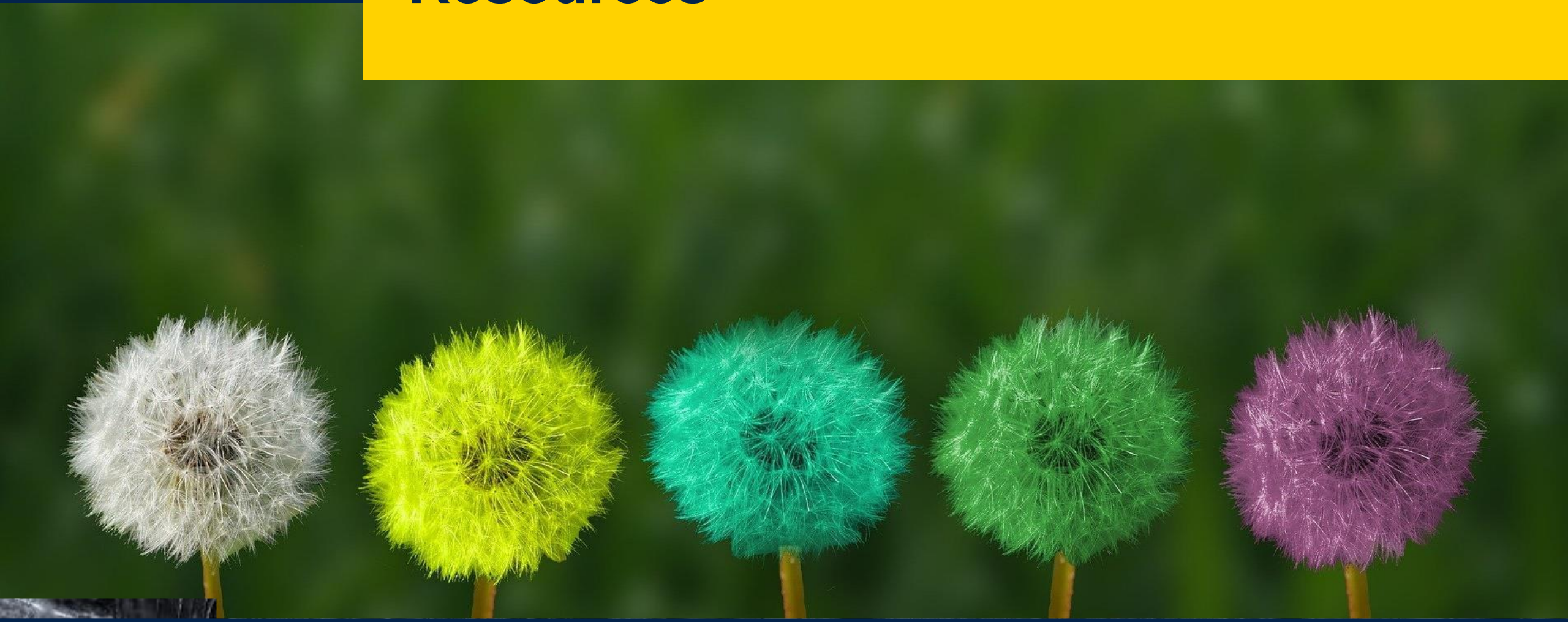
Part-number	# of lines	Directionality	Package	V_{BR}(min)	Scc21 (CM attenuation)	Diff bandwidth	Applications	Status
ECMF4-40A100N10	4	Unidir	QFN-10L 1.35 x 1.4 x 0.5 QFN-10L 1.35 x 2.2 x 0.5	5.3 V	-15 dB @ 2.4 GHz -21 dB @ 5.0 GHz -17 dB @ 6.0 GHz	10.7 GHz	USB4 HDMI 2.1 USB 3.2 MIPI A-PHY DisplayPort	Mass-production
ECMF4-2450A60N10	4	Unidir	QFN-10L 1.35 x 2.2 x 0.5	5.3 V	- 30 dB to - 33 dB @ 2.4 – 2.47 GHz - 20 dB to - 15 dB @ 5.18 – 5.82 GHz	6.45 GHz	USB 3.2 HDMI 2.0 MIPI D-PHY DisplayPort	Mass-production
ECMF4-20A42N10	4	Unidir	QFN-10L 1.35 x 2.2 x 0.5	4.5 V	-13 dB @ 0.7 GHz -23 dB @ 1.5 GHz -25 dB @ 2.4 GHz -23 dB @ 2.7 GHz -13 dB @ 5.0 GHz	5 GHz	USB 3.1 HDMI 2.0 MIPI D-PHY DisplayPort	Mass-production
ECMF04-4HSWM10	4	Unidir	QFN-10L 2.6 x 1.35 x 0.5	4.5 V	-28 dB @ 2.4 GHz -16 dB @ 5.0 GHz	4.2 GHz	USB 3.0 HDMI 2.0 HDMI 1.4 MIPI D-PHY	Mass-production
ECMF04-4HSM10	4	Unidir	QFN-10L 2.6 x 1.35 x 0.5	6 V	- 25 dB between 800 MHz - 900 MHz	2.5 GHz	USB 3.0 HDMI 1.4 MIPI D-PHY	Mass-production

ECMFY series: automotive 4-line portfolio Sorted by decreasing differential bandwidth

Continuous growth of bandwidth to cover high speed standards HDMI2.1, FPD Link, MIPI D-PHY, and GMSL

Part-number	# of lines	Directionality	Package	V_{BR}(min)	Scc21 (CM attenuation)	Diff bandwidth	Applications	Status
ECMF4-2459A6M10Y	4	Unidir	QFN-10L 2.6 x 1.35	5.3 V	-35 dB @ 2.4 GHz -25 dB @ 5.9 GHz	9.0 GHz	USB 3.2 HDMI 2.1 DisplayPort FPD link III GMSL	Mass-production
ECMF04-4HSWM10Y	4	Unidir	QFN-10L 2.6 x 1.35	4.5 V	-30 dB @ 2.4 GHz -16 dB @ 5 GHz & 5.9 GHz	4.5 GHz	USB 3.1 HDMI 2.0 HDMI 1.4 MIPI D-PHY	Mass-production
ECMF04-4HSM10Y	4	Unidir	QFN-10L 2.6 x 1.35	6 V	-20 dB @ 700 MHz -25 dB from 0.8 to 0.9 GHz	2.5 GHz	USB 3.0 HDMI 1.4 MIPI D-PHY	Mass-production

Resources



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 - Industrial

AN4356: How to solve antenna desense issue with ECMF - Industrial

AN5121: HDMI ESD protection, filtering, and signal conditioning products

PDF Product overview

Datasheets

- ECMF02-2HSMX6
- ECMF02-2AMX6
- ECMF02-2BF3
- ECMF02-4CMX8
- ECMF2-40A100N6

- ECMF4-40A100N10
- ECMF4-2450A60N10
- ECMF4-20A42N10
- ECMF2-40A100M6Y
- ECMF04-4HSM10Y
- ECMF04-4HSWM10Y
- ECMF4-2459A6M10Y

Our technology starts with You

Find out more at www.st.com