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Protection & filters

STMicroelectronics Industrial Offering

2020

Protection around MCU



Protection and filters socket around mcus



SMA4F



ESDA7P120-1U1M



DSILC6-4P6 (TAG)



EMIF03-SIM02M8



SMA6F



ESDA5V3L



RS-232

RS-485

ESDA14V2BP6



ESDA6V1BC6

SWD & JTAG
ESDALC6V1W5



EMIF06-MSD02N16
SD 2.0



USBLC6-2SC6



TCPPO1-M12
Type-C Port Protection



HSP051-4M10
ETH 1G, secondary



ECMF04-4HSWM10
High Speed Differential
MIPI, USB 3.1, Display port, HDMI



IO-Link

SPT01-335DEE

CAN



ESDCAN03-2BWY

ESDA6V1L

KNX

SMAJ40CA



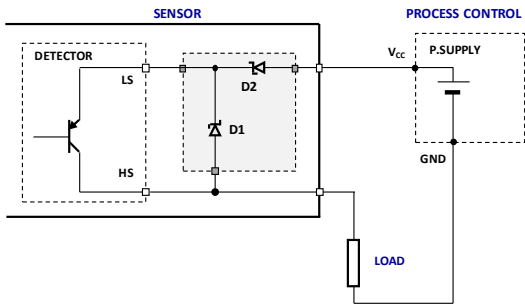
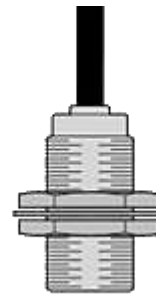
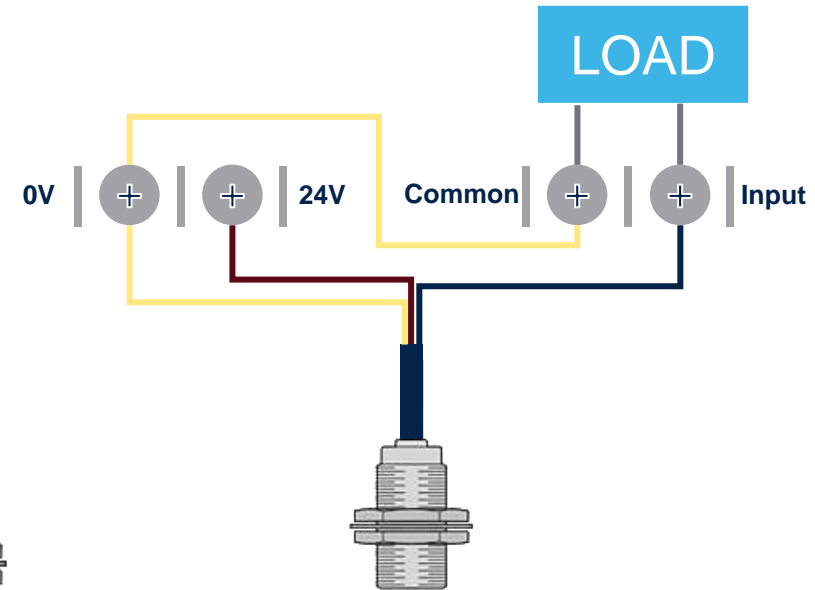
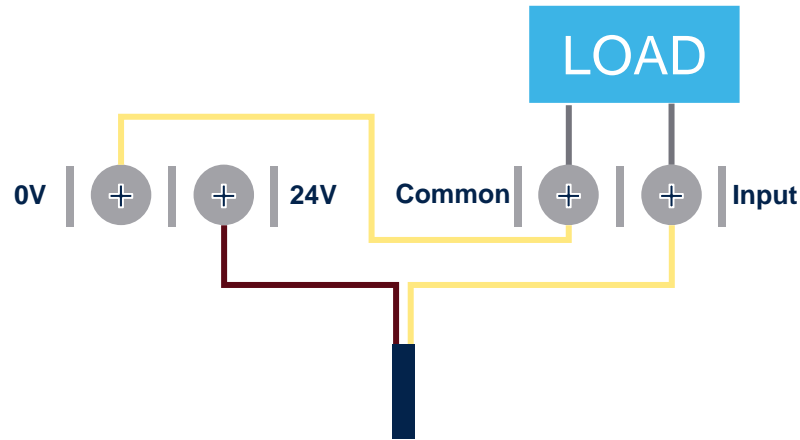
PLC inputs

CLT03-2Q3

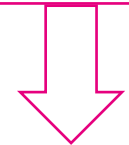


Protection for sensors

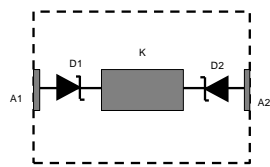
Proximity sensors sensors type



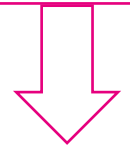
2-wire sensor



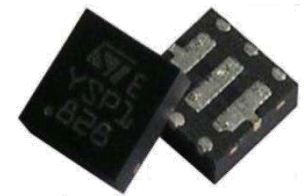
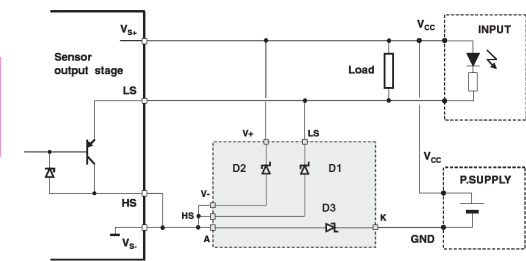
SPT02-236DDB



3-wire sensor



SPT01-335DEE



SPT01-335DEE

3-wire sensors

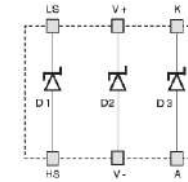
Features:

- Compliant for interface with logic input type 1, 2 and 3 IEC 61131-2 standard
- Recommended to protect any 3-wire sensor compliant with EN 60947-5-2 standard
- Highly compact with integrated power solution in SMD version

Order codes :

SPT01-335DEE : Status : in production

Datasheet : available on www.st.com



Key parameters :

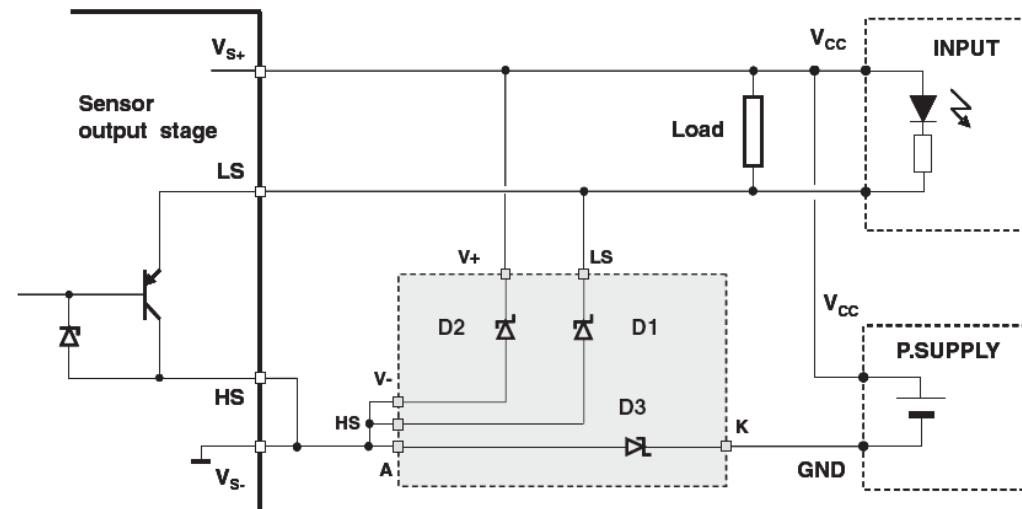
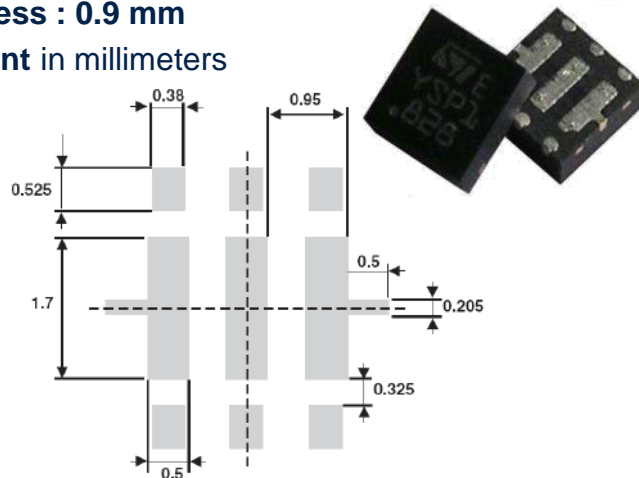
V_{RM}	36 V
Leakage current	200 nA @ 33 V
Surge capability	2 A (8/20 μ s)

Package : QFN 3x3

Dimensions : 3.0 mm x 3.0 mm

Thickness : 0.9 mm

Footprint in millimeters



SPT02-236DDB

2-wire sensors

Features:

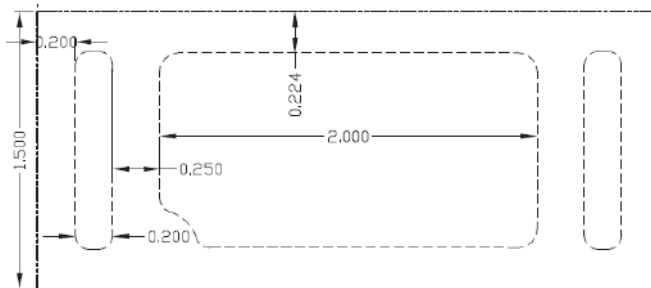
- Compliant for interface with logic input type 1, 2 and 3 IEC 61131-2 standard
- Recommended to protect any 2-wires sensor compliant with EN 60947-5-2 standard
- Highly compact with integrated power solution in SMD version

Package : μ QFN-2L with exposed pad

Dimensions : 3.0 x 1.5mm

Thickness : 0.8 mm

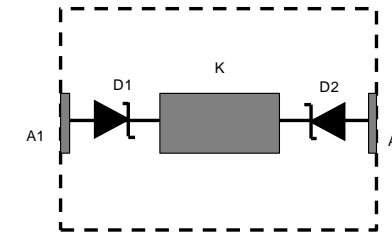
Footprint in millimeters



Order codes :

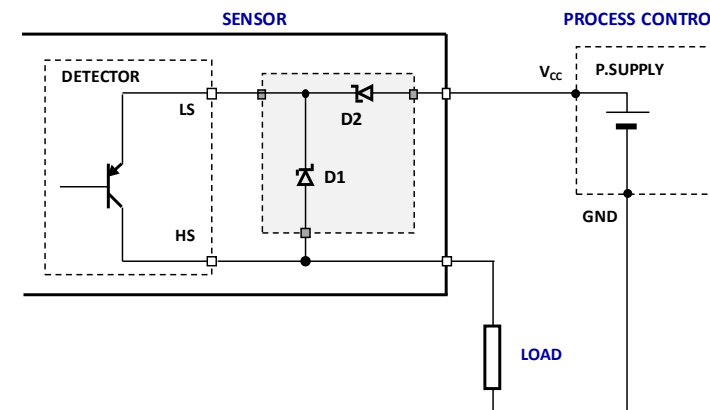
SPT02-236DDB: Status : in production

Datasheet : [available on www.st.com](http://www.st.com)



Key parameters :

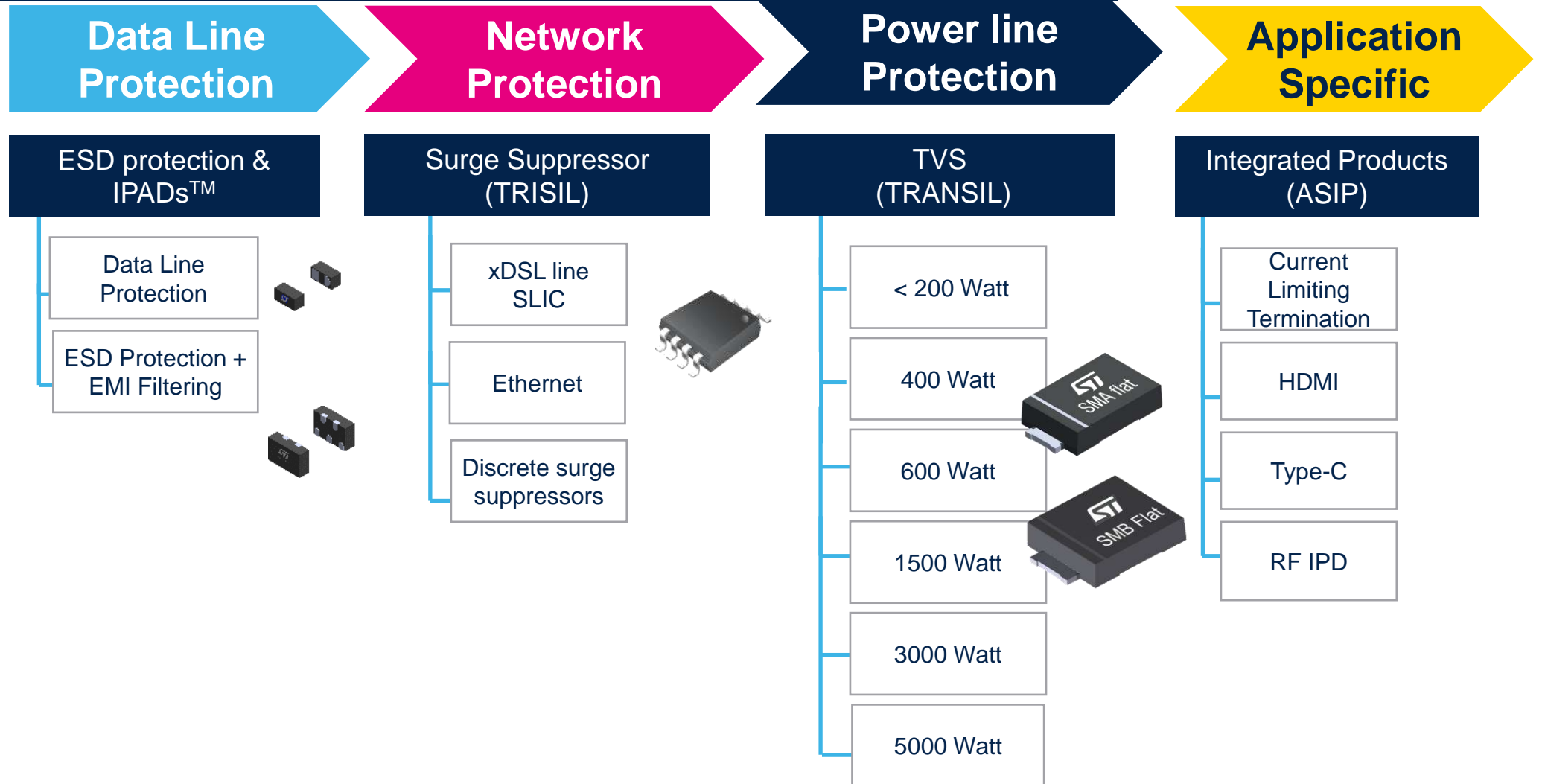
V_{RM}	36V
Leakage current	1 μ A @ 36 V
V_{CL}	46V
Surge capability	2 A (8/20 μ s)





Protection & filter portfolio overview

Higher Immunity, Miniaturization & Better Performances



Power line protection





Protection & filter portfolio overview

Higher Immunity, Miniaturization & Better Performances with large selection of packages

Power line Protection

TVS
(TRANSIL)



< 200 Watt

400 Watt

600 Watt

1500 Watt

3000 Watt

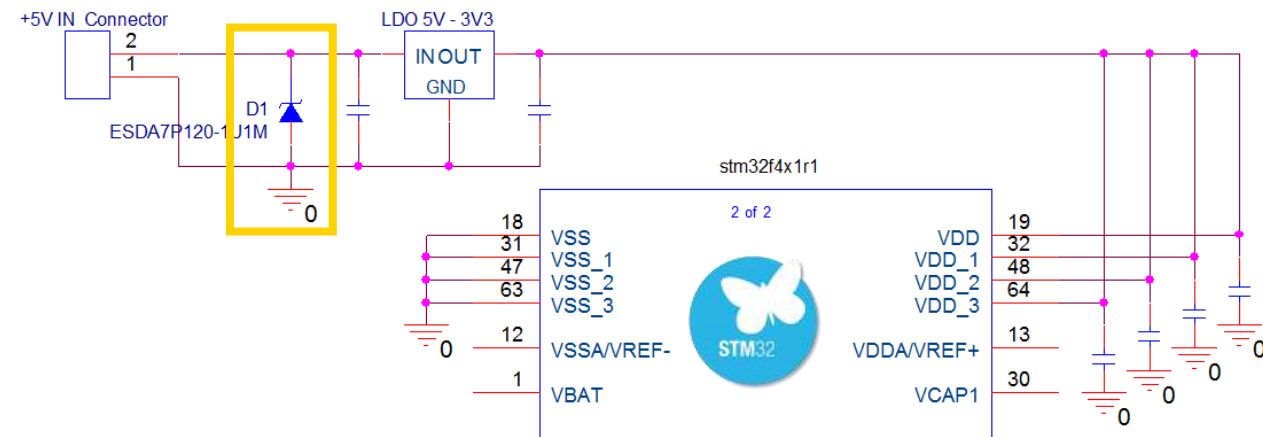
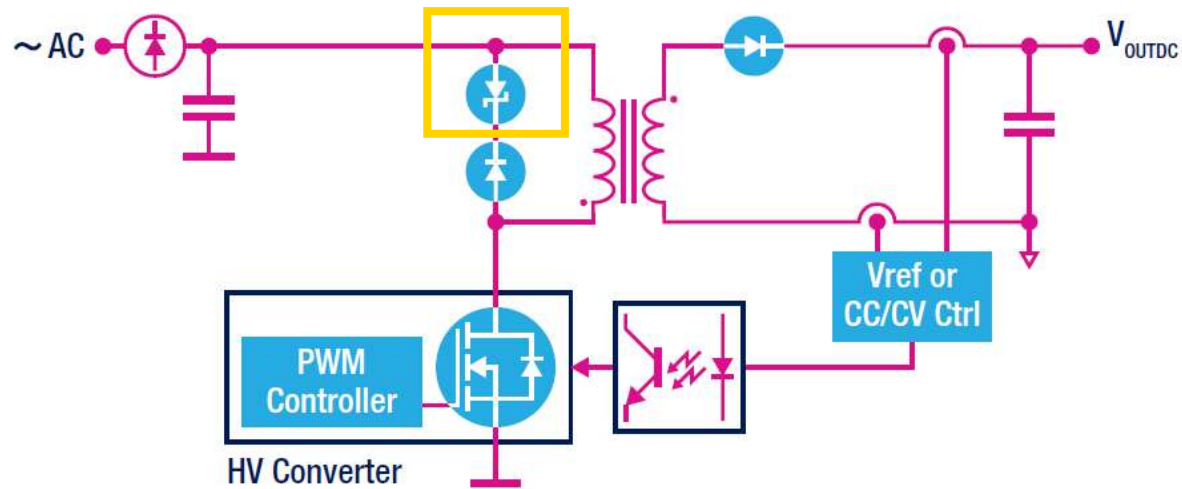
5000 Watt

TVS protection examples

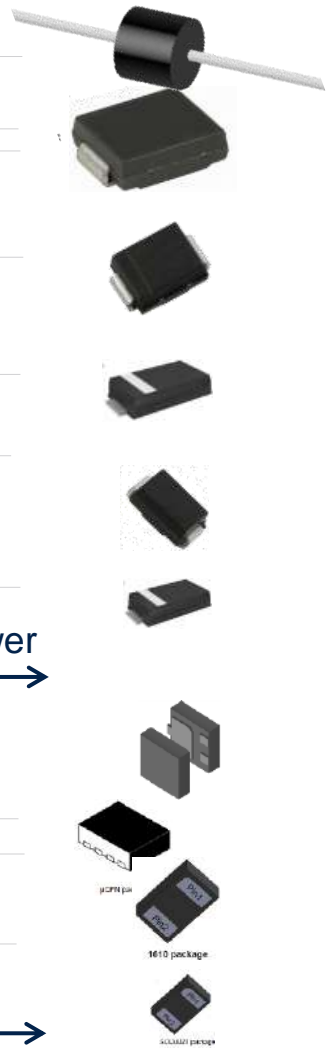
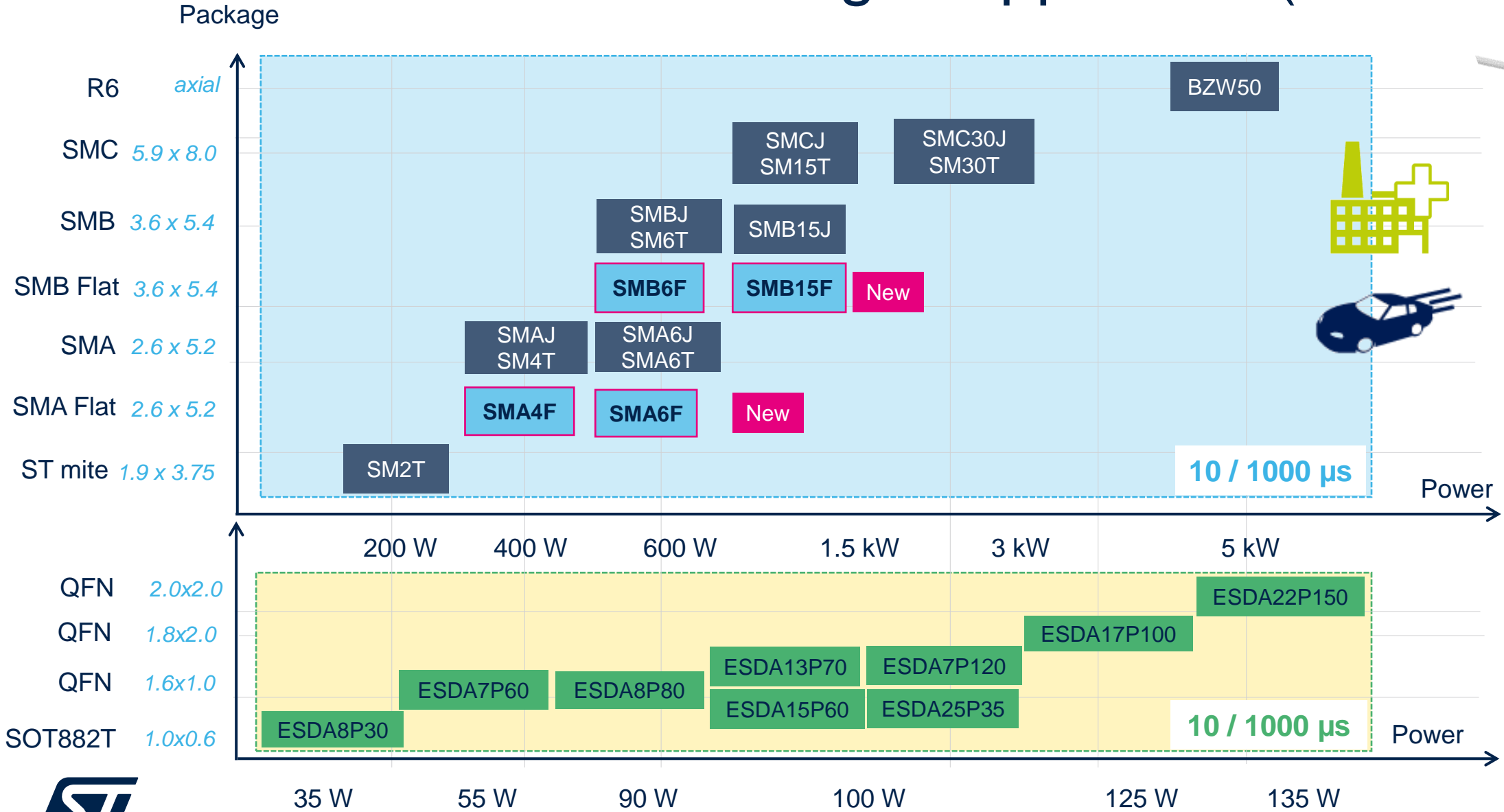
MOSFET PROTECTION

DC POWER RAIL PROTECTION

Typical configuration for isolated auxiliary power supply



Transient voltage suppressor (TRANSIL™)



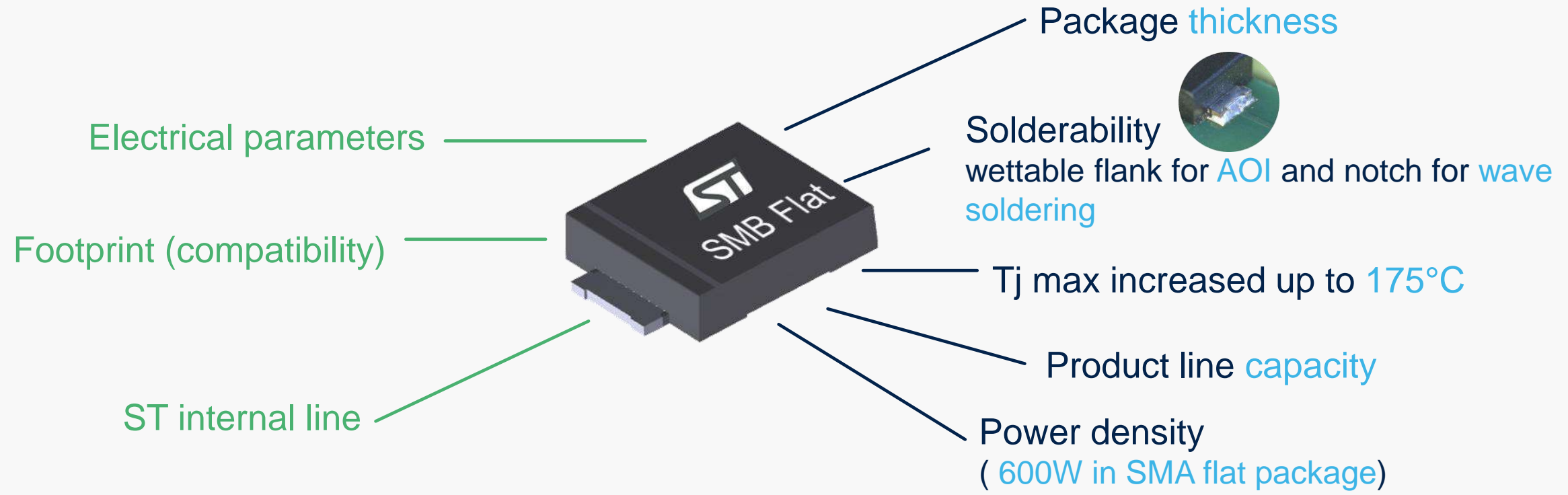
TVS flat in SMA and in SMB smart industry

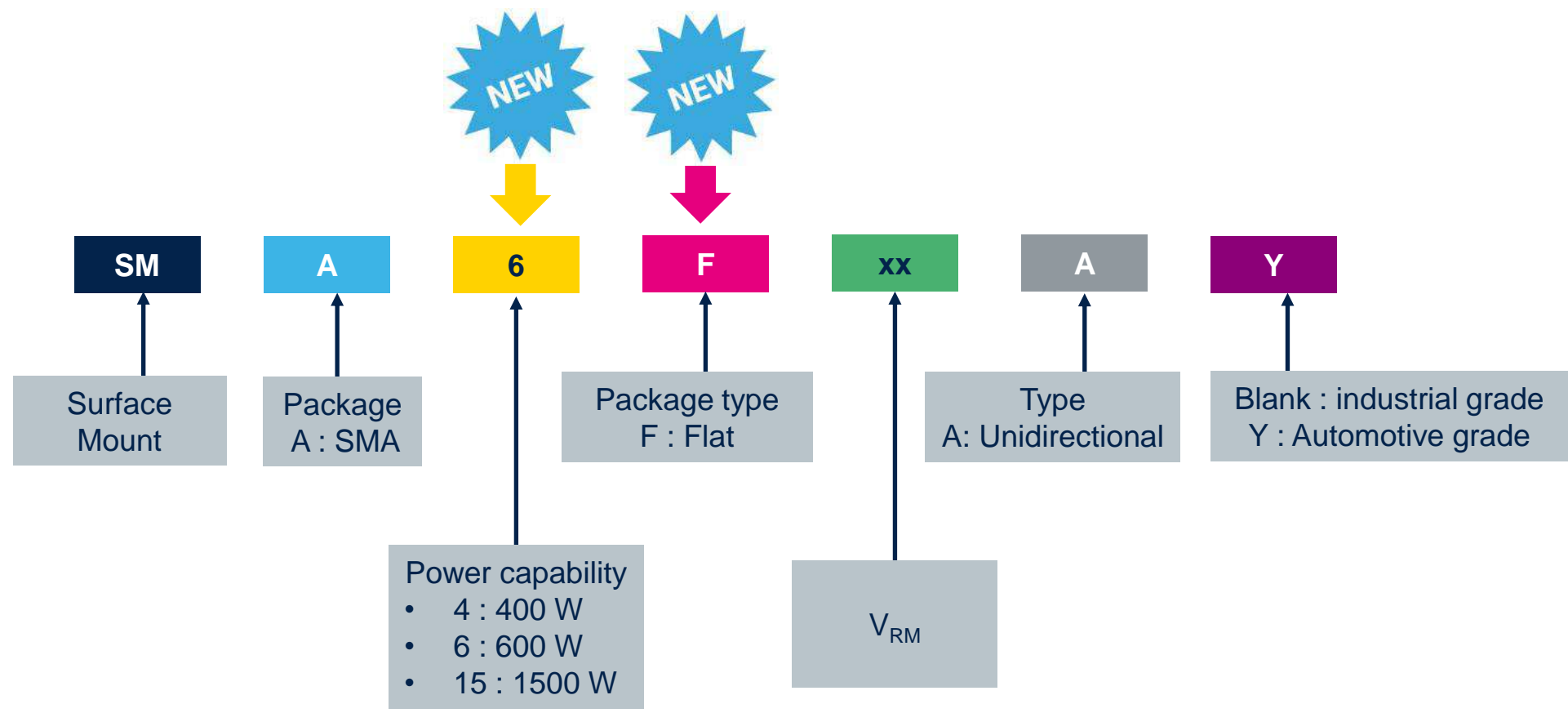


A well known technology in a brand new package

Unchanged

Improved



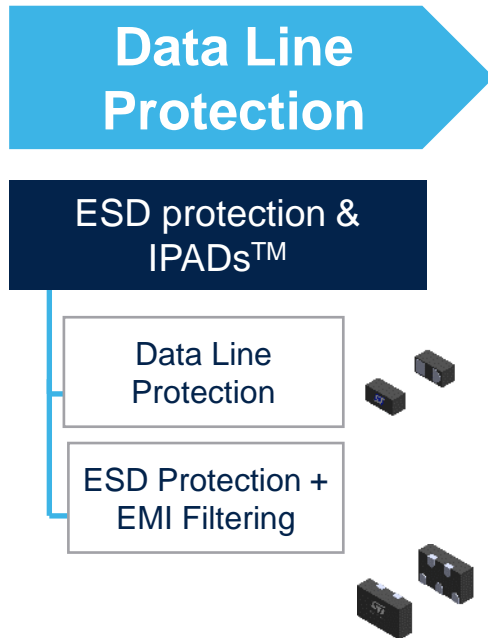


Data line protection



Protection & filter portfolio overview

Higher Immunity, Miniaturization & Better Performances with large selection of packages



Number of protected lines

Up to 8 lines

Single line

Uni-Directional
3V to 36V_{RM}

Bi-Directional
3V_{RM}

Multi-line ESD Protection

Uni-Directional
3V to 15V_{RM}

Bi-Directional
3V to 36 V_{RM}

Uni-Directional
1V to 5V_{RM}

Bi-Directional
5V_{RM}

Single-line ESD Protection

Uni-Directional
5V to 10V_{RM}

Bi-Directional
5V_{RM}

Uni-Directional
3V to 12V_{RM}

Bi-Directional
3 to 24V_{RM}

Uni-Directional
3V_{RM}

Standard
> 30pF

Low and Ultra Low
<30pF

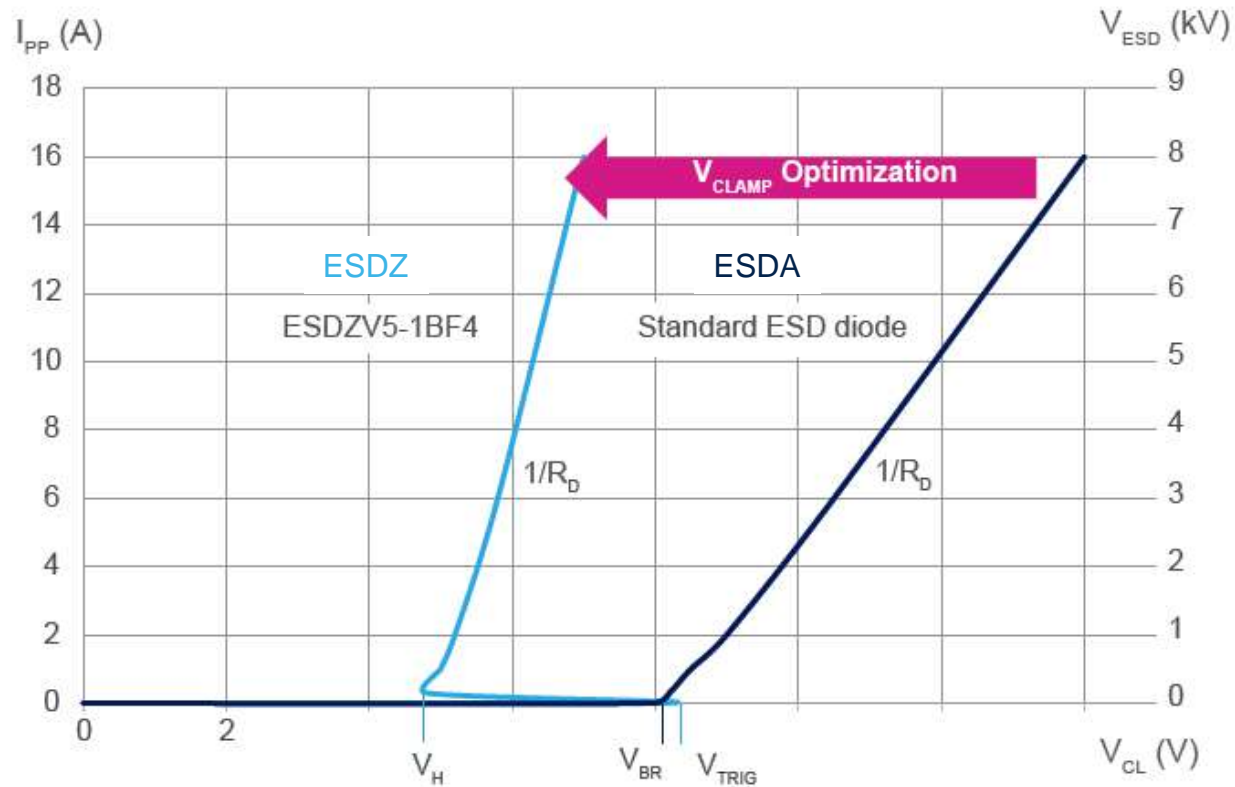
Extra low
<3pF

Typ line Capacitance (pF)



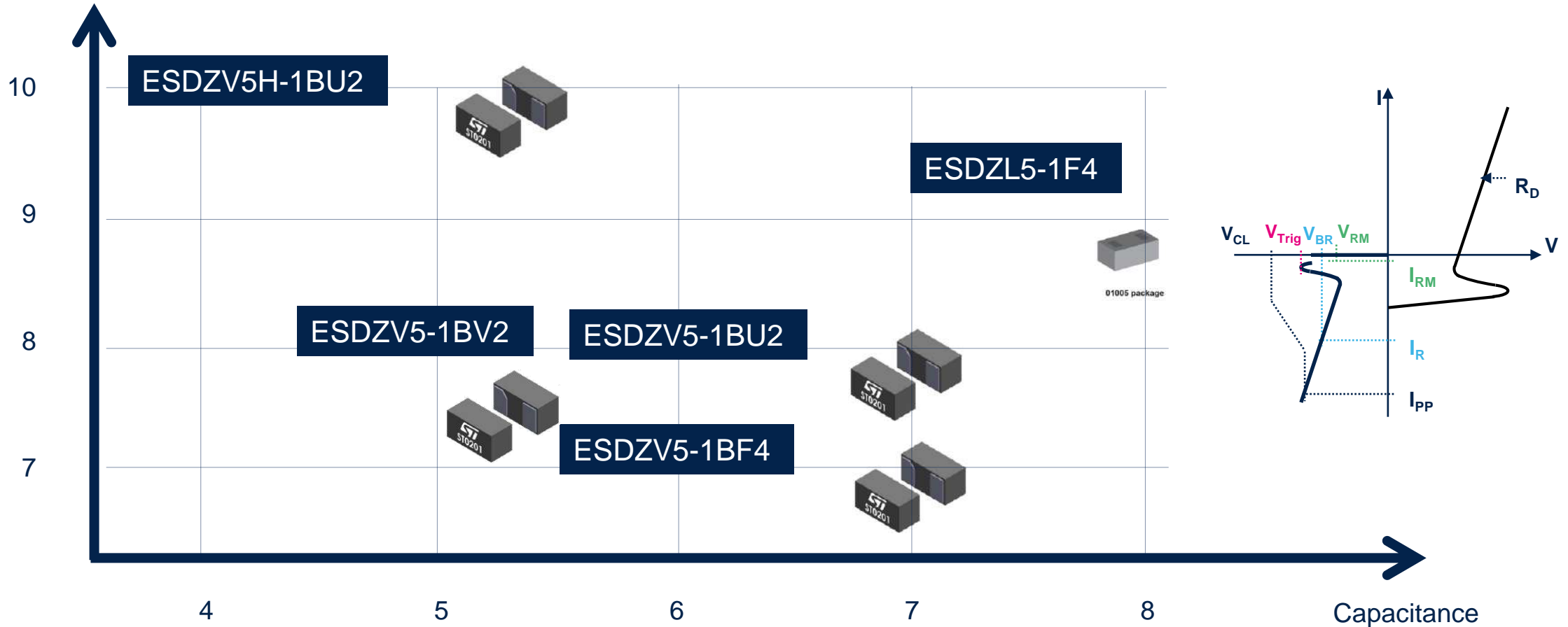
Industry's best Protection efficiency (clamping voltage)

Clamping voltage is divided by 2



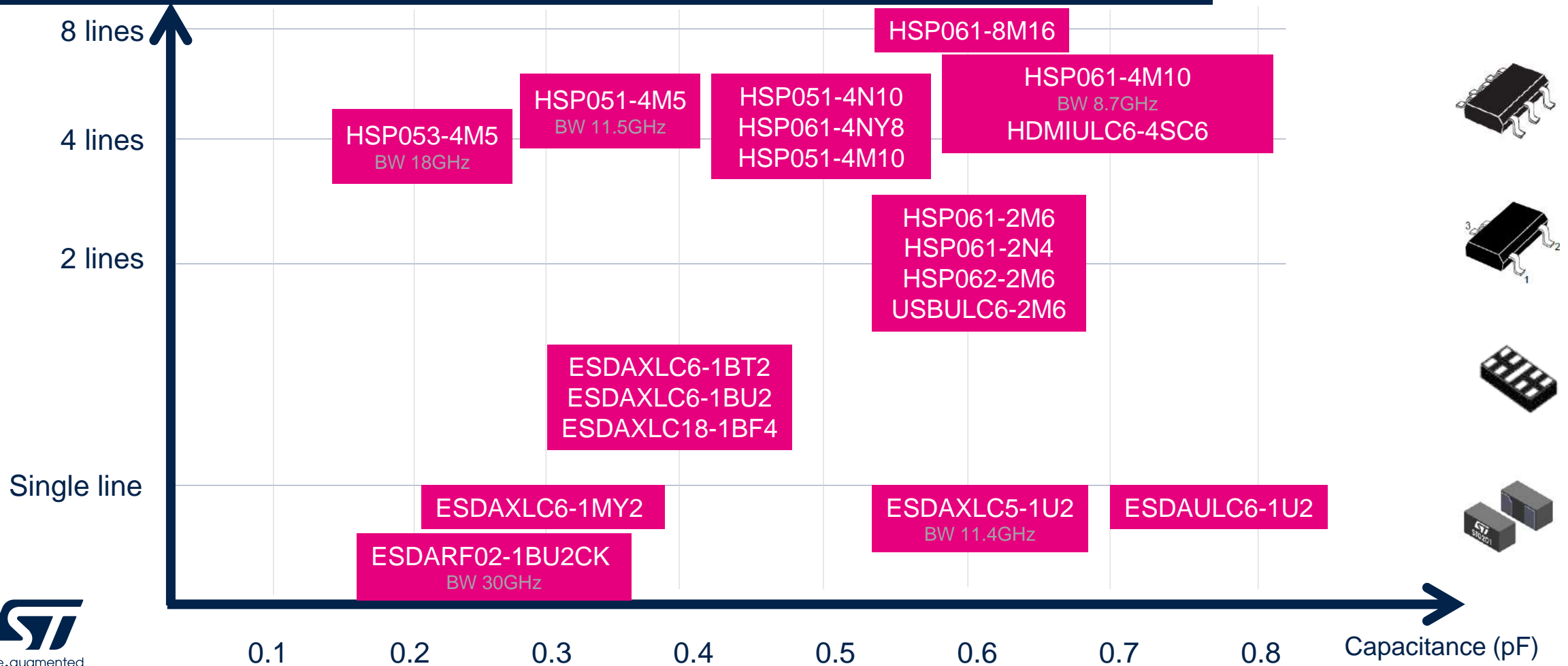
Single Line ESD Z

V_{CL} 8 kV contact discharge
after 30 ns, IEC 61000-4-2



High speed port ESD protection

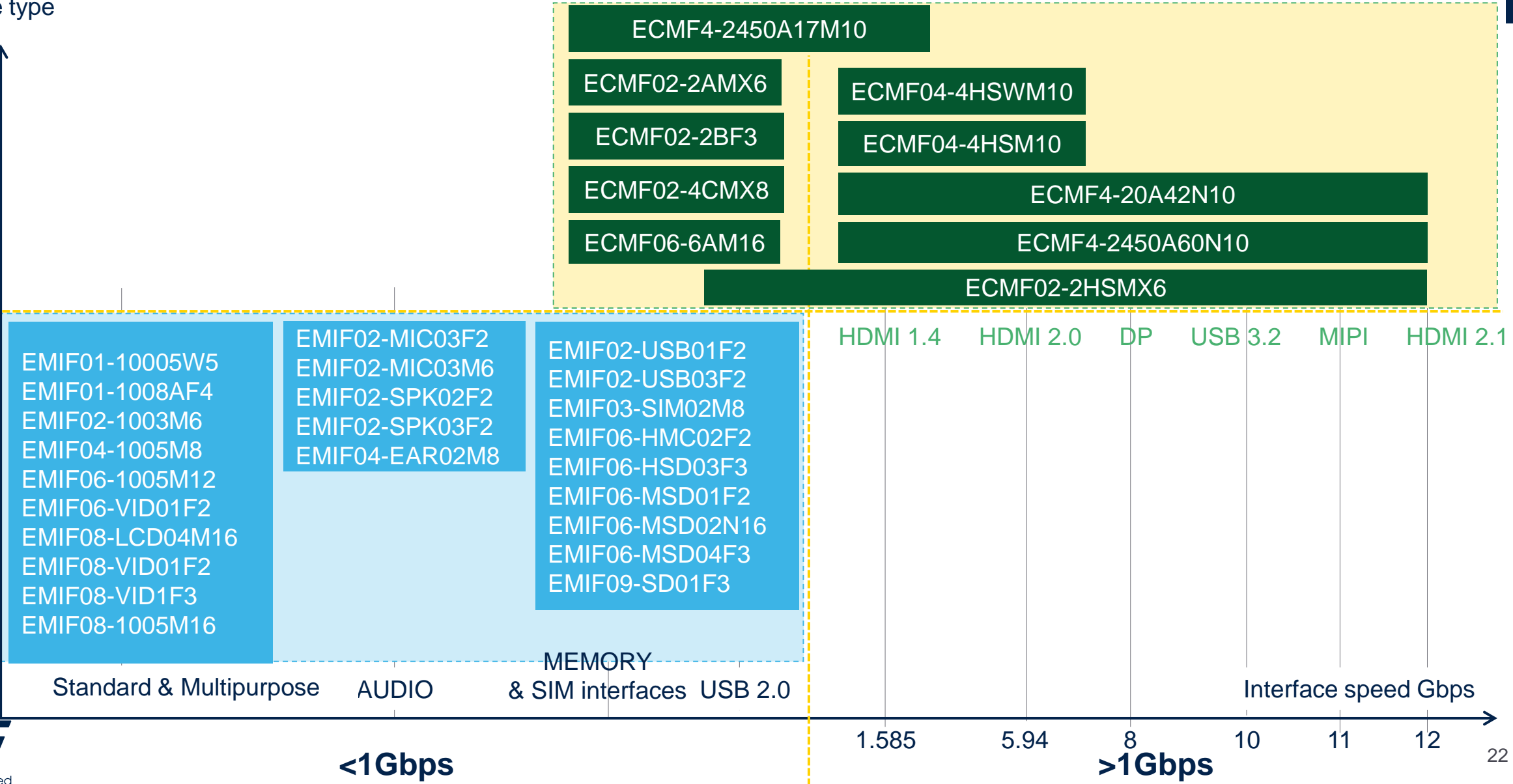
High Speed Port protection <1pF



Interface type

Differential

Single Ended





- Datasheets
- OrCAD Symbol and Footprint files
- Pspice models
- ICP, MDF
- Excel x-ref (on request)

More material...

600W TVS in flat SMA package
So thin you can't see it
▶ discover our wide range of stand-off voltages

TVS Flat for automotive: ISO 7637/10605 rated and 175 °C capability



AEC-Q101 qualified, ST's TVS Flat series ensures improved robustness and reliability in harsh environments

ST's transient voltage suppressors (TVS) are made to meet the stress levels specified in standards such as ISO 10605 and ISO 7637, to meet all automotive requirements. Able to withstand 10/1000 us transient voltage surges and with power capability at 175 °C, they fit tough environments thanks to low power dissipation at high temperature. Manufactured on ST's upgraded production lines using robust and well-known die products leads to improved reliability for your applications.

KEY FEATURES

- AEC-Q101 qualified
- Increased power density
- Lower cost per unit ratio
- RoHS compliant with SMA, SMD cables
- T_j (max) = 175 °C
- 1 mm thickness

KEY BENEFITS

- Better applications
- 100% redesign thanks to backward footprint compatibility
- Promotes space saving and more power in similar packages
- Automatic visual inspection compatible

KEY APPLICATIONS

- Electronic loads for e-tikes, cars and trucks
- Power rail
- Motor gate
- Battery management system
- Electronic control units

DIFFERENTIATION AND IMPROVEMENTS

Made for auto applications, SMA flat package is tested 1 mm thick while SMA is about 2.3 mm.

High temperature capability
With a maximum T_j rating of 175 °C, our series are able to comply with harsh environments.

Low power dissipation at high temperature

- 3MA47Y: up to 200W at 175°C
- 3MA47Y: up to 400W at 175°C

Increased power/rate ratio

- By increasing power capability with 3MA47Y series: 600W in SMA Flat instead of 500W

Low inductance

- Leakage current rated 5-times lower than most of our competitors
- It's superior at 85 °C

Rated according to automotive standards

- ISO 10605 (I_{sc} = 150 pF, 8 – 300 Ω)
- ISO 10605 (I_{sc} = 300 pF, 8 – 300 Ω)
- ISO 7637-2 Pulse 1, 2B, 3A, 3B, 3C



TVS FLAT RANGE

Automotive grade	Stand-off voltage range (V _o)	Breakdown voltage range (V _{br})	10/100 us temp. capability (P _{avg})	6/25 us temp. capability (P _{avg})	Availability	Package
3MA47Y47	6 to 21 V	6.8 to 21 V	400W	2.1 kW	Production	SMA Flat
3MA47Y47	6 to 21 V	6.8 to 21 V	600W	4 kW	Production	SMA Flat

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Wandoujia

GET IT ON Google Play

Available on the App Store

STMicroelectronics - February 2016 - Product Life Cycle - All rights reserved. The information and drawings in this document are for reference only and are not intended for use in any other application. All other names are the property of their respective owners.

FLTVSFLAT0618

FLTVSFA0219



Protection & filter portfolio overview

Higher Immunity, Miniaturization & Better Performances with large selection of packages

Application Specific

Integrated Products (ASIP)

Current Limiting Termination

HDMI

Type-C

RF IPD



Smart Industry

Digital input interfaces

Safety & Flexibility

- 60V rated inputs
- Self powered
- HS/LS compatible
- Test pulse embedded

Diag

- Thermal Alarm
- Over / under Voltage

Output

- SPI interface
- CMOS interface
- Opto-coupler interface

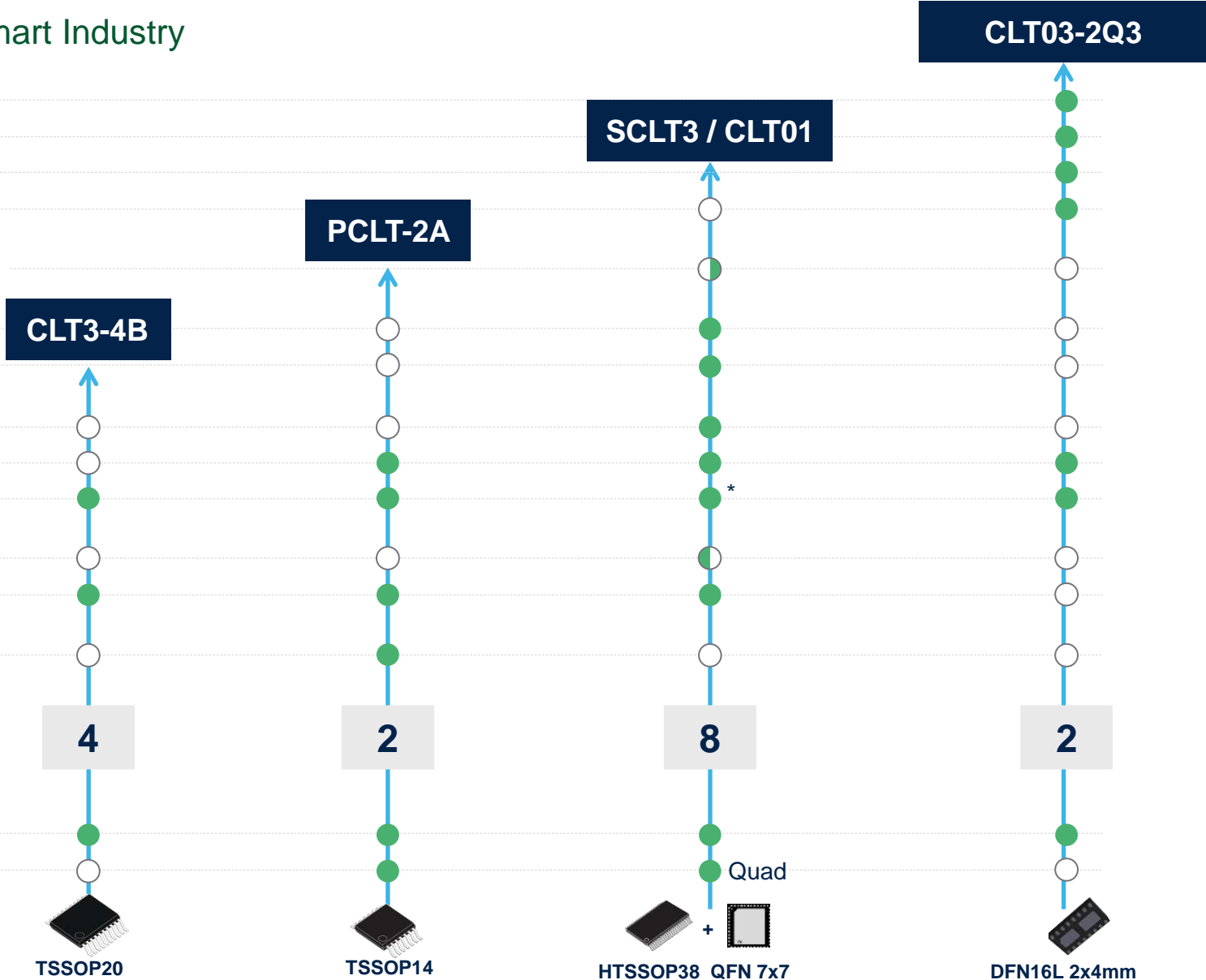
Immunity

- Digital filter
- Surge protection
- Programmable current

- Number of channels

- Characteristic, IEC61131-2
 - Type 1 & 3
 - Type 2

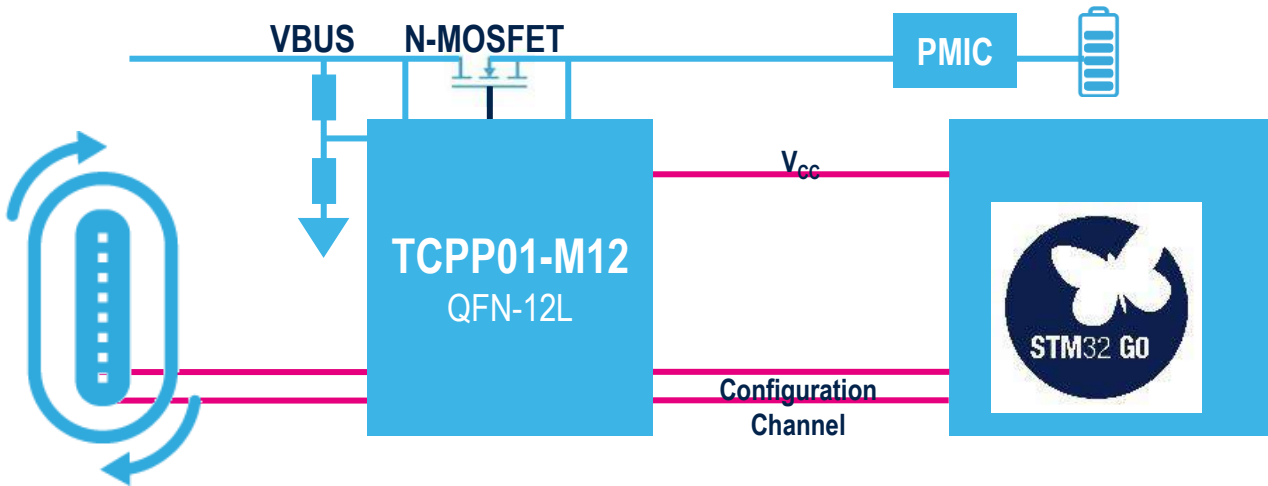
* Through LEDx outputs





Type-C Port Protection

Protect your USB-C application against overvoltage



- Overvoltage protection for CC pins

- Externally programmable overvoltage protection on V_{BUS} line

- Supports Programmable Power Supply

TOP 3 ISSUES when migrating to USB-C connector

ESD, poor quality chargers or short-circuit in receptacle can damage the application



1 - **ESD** or EOS event can destroy internal circuitry



2 - **Defective adapter** can provide a voltage higher than expected



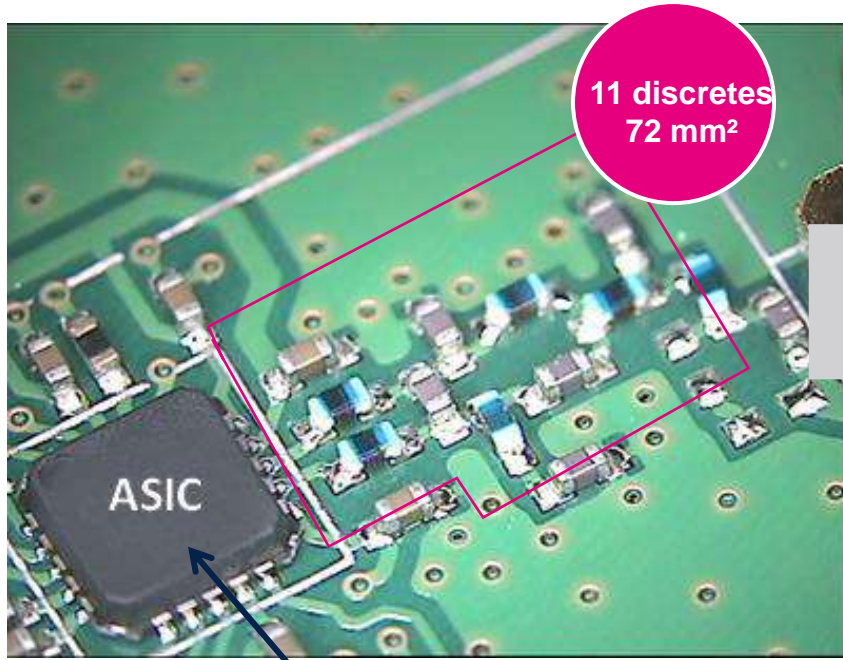
3 - **CC pin short to VBUS**

VBUS pin is adjacent to CC pin and due to small pin pitch inside type-C receptacle a **short between VBUS and CC** can damage USB-C controller

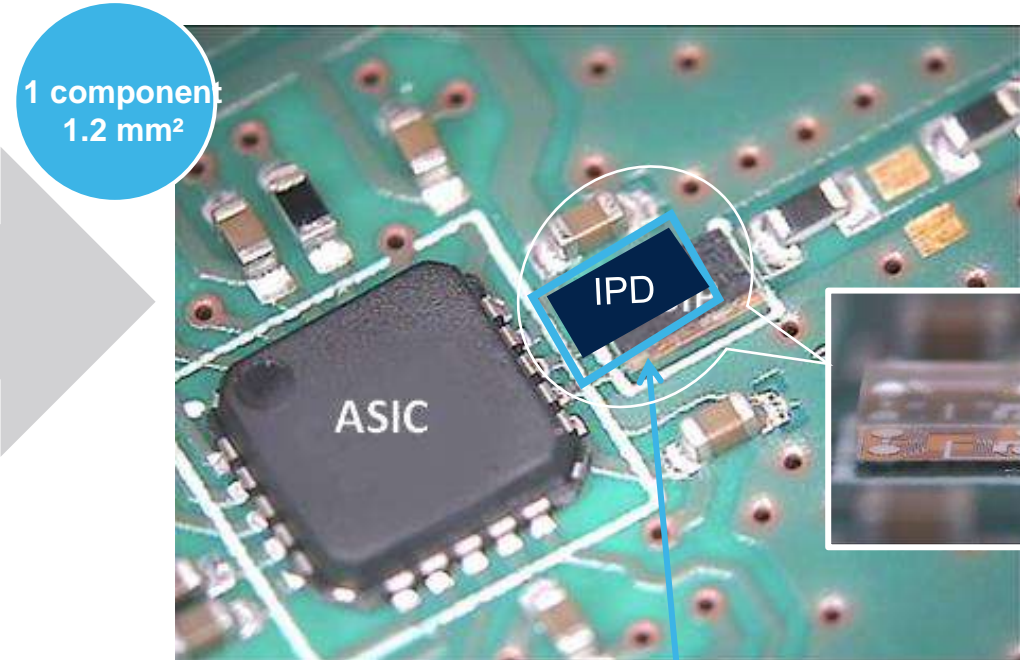
What is RF IPD ?

Discrete balun & matching network

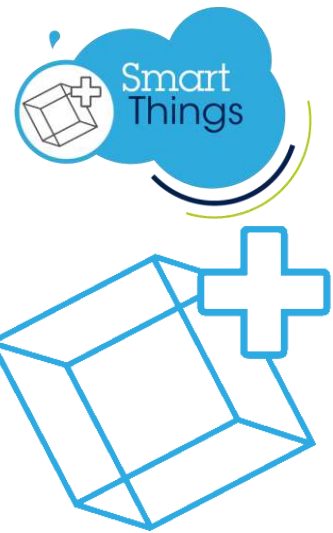
RF IPD balun & matching network



Application **S**pecific **I**ntegrated **C**ircuits



RF **I**ntegrated **P**assives **D**eVICES



RF IC supplier	RF IC name	Matched Balun	Frequency (MHz)	Integrated filter	Size	Package
STMicroelectronics	SPIRIT 1	BALF-SPI-01D3	868/915	Yes	1.4 mm x 2.0 mm	CSP
		BALF-SPI-02D3	433	Yes	1.4 mm x 2.0 mm	CSP
	S2-LP	BALF-SPI2-01D3	868/915	Yes	2.1mm x 1.55 mm	CSP
		BALF-SPI2-02D3	433	Yes	2.1mm x 1.55 mm	CSP
	BlueNRG-MS (QFP32 and CSP34)	BALF-NRG-01D3	2400	Yes	1.4 mm x 0.85 mm	CSP
BlueNRG-1 (QFP32 and CSP34) BlueNRG-2 (QFP32 and CSP34)	BALF-NRG-02D3 BALF-NRG-02J5 (Height <350µm)	2400	Yes	1.4 mm x 0.85 mm	CSP and Thin CSP	

RF IC supplier	RF IC name	Matched Low Pass Filter	Frequency (MHz)	Integrated filter	Size	Package
STMicroelectronics	STM32WB55Cx BLE 5.0	MLPF-WB55-01E3 	2400-2500	Yes	1.5 mm x 1.0 mm	Bumpless CSP (LTCC assy-like)

RF IC Supplier	Ultra Wide Band	Balun 50/100 Ω	Frequency (GHz)	Integrated filter	Size	Package
Ultra Wide Band	Recommended for DW1000 from DecaWave	BAL-UWB-01E3 	3-8	No	1.8 mm x 1.25 mm	Bumpless CSP (LTCC assy-like)



ST protection finder



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SnapPea



ESD quick reference guide

ESD Protection ICs



Quick Reference Guide

life.augmented



www.st.com

Order code: ESD000710

For more information on ST products and solutions, visit www.st.com

WHAT ARE THE MAIN BENEFITS OF ST'S SOLUTIONS?

ST's solutions offer quality and reliability. ESD0004-2 (used 4 capacitors up to 48 kV contact discharge) ESD protection decreases the risk of ESD transient surge down to a residual transient voltage that is harmless for the application. Reduced peak rate in field return and cost efficient maintenance means products are widely designed for customers.

Easily select components by using ST PROTECTION INDEX mobile app available for Android™ and iOS™ to enter the protection key criteria values V_{ESD} and C_{ESD} and choose the most appropriate package.



ST'S ESD PRODUCT RANGE: WIDE PORTFOLIO DESIGNED FOR INDUSTRIAL AND AUTOMOTIVE APPLICATIONS (AEC-Q101 STANDARD)



Line capacitance

- Power Rail ESD Protection ESD Multi purpose
- ESD for Low Speed interface
- ESD for High Speed interface

Stand-off voltage (V_{ESD})


1V 100V

Ensuring device safety

ELECTRO-STATIC DISCHARGE (ESD)

Electro-Static Discharge (ESD) is defined by the ESD Association as the rapid, uncontrolled transfer of electrostatic charge induced by a high-voltage static ESD surge waveform as specified in ESD0004-2. An ESD can be caused by various electrostatic production line mechanisms that are mostly generated by human contact. These surge waveform mechanisms have been identified:

- Static Wicking**
- Hole in the skin**
- Melting Flow**



With their increased complexity, the implementation of miniature components has raised the risk of ESD. It is essential to protect industrial, automotive and IoT applications having connection exposed to human contact. Furthermore, the industry Journal Boardwide Survey shows that 50% of IC-fabricators are due to ESD. It therefore seems necessary to protect ICs with internal ESD protection.

HOW TO CHOOSE THE RIGHT ESD PROTECTION IC FOR AN APPLICATION?

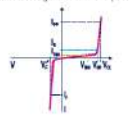
We have put together a list of criteria to help you select the appropriate ESD protection IC for your device.

- Transparency**
During normal operation (no surge event), the ESD protection IC must have the least possible impact on the system performance (such as power consumption or frequency bandwidth).
- Stand-off voltage**
 V_{ESD} defines the normal operating voltage for the protection V_{ESD} must be higher than the application's maximum operating voltage, otherwise the protection will clamp the application voltage.
- Directionality**
If the signal to be protected is negative and positive, attention must be directional to avoid the rectifier phenomenon. If the signal to be protected is only positive, there is no directional protection needed for protection to avoid a negative ESD clamping voltage. However, a bidirectional protection is also to be implemented.
- Line capacitance to ground**
The ESD protection device behaves like a capacitor when high frequencies are reached. This capacitance defines a cut-off frequency that can impact the application's signal integrity. The ESD protection line's capacitance to the ground parameter for high-speed interfaces (Digital or RF lines).
- Efficiency**
 - V_{ESD} clamping voltage: This is the maximum voltage across the ESD Protection IC when an ESD surge occurs, the ESD protection must lower this surge voltage as close as possible to the V_{ESD} in order to protect the IC placed behind the ESD protection.

GLOSSARY

AEC-Q101 - Automotive Electronic Council qualification related to the qualification of discrete components for Automotive market.

Stand-off voltage (V_{ESD}) - The voltage value above which the current for the ESD Protection device increases very fast for a slight increase in voltage. This value is usually defined at 1 mA DC.



ESD - Electrical Over-Stream

IDM - Human Body Model defines ESD surge in controlled environments like manufacturing lines. Most ICs integrate an IDM protection in their I/O circuitry. IEC61000-4-2 applies to an application where an IDM applies to an IC. The level of surge is much higher for system level ESD protection (ESD0004-2). I_{ESD} - Peak pulse current, corresponds to the environment that can flow through a protection IC for a given surge waveform.


I_{ESD} - Maximum leakage current defined at V_{ESD}

Line Capacitance - Equivalent line to ground capacitance for the ESD device. A lower line capacitance allows a larger bandwidth and a better signal integrity.

TLP method - Transmission Line Pulse - This is a method for measuring the clamping voltage V_{ESD} - clamping voltage value for a current pulse with a peak value of I_{ESD} . Usually V_{ESD} presented in datasheets is measured with IEC61000-4-2 15 kV ESD discharge. The clamping voltage obtained at 1 line corresponds to a 10 A TLP waveform.


V_{ESD} - max. max working voltage with a limited max. on-chip current I_{ESD}

Available on Google Play and the App Store.



Available on www.st.com

RECOMMENDED ESD IC PROTECTION FOR MCU INTERFACES:



POWER RAIL ESD AND EOS PROTECTION

Stand-off voltage (V_{ESD})	Protection IC
30V	ESDA3375-103M
15V	ESDA17710-103M
5V	ESDA1770-103M
5V	ESDA1770-103M
5V	ESDA1710-103M

LOW-SPEED INTERFACE

Application	Protection IC
RS-232C/RS-485	ESDA4700PS
Touch Input	ESDA4700
Acoustic MEMS	ESDA4700
Automation control	ESDA4700
Industrial CAN bus	ESDA4700
SMD & QFN	ESDA4700PS

HIGH-SPEED INTERFACE


Application	Protection IC
NIC tag	ESDA1475
USB	ESDA1475-212A
Ethernet IC (passive)	ESDA1475
High-speed differential (MPL, MDC2.1, Display Port and LVDS)	ESDA1475-212A

Power Rail ESD and EOS Protection

Low Speed interface

High Speed interface

Try packages



Application notes

Protection

- [AN5241](#), Fundamentals of ESD protection at system level
- [AN4871](#), USB Type-C protection and filtering
- [AN5121](#), HDMI ESD protection and signal conditioning products for STBs
- [AN3353](#), IEC 61000-4-2 standard testing
- [AN4160](#), TVS devices for power line communication applications è protection ligne CPL
- [AN1826](#), TRANSIENT PROTECTION SOLUTIONS: Transil™ diode versus Varistor
- [AN2689](#), Protection of automotive electronics from electrical hazards, guidelines for design and component selection
- [AN316](#), Transil™ clamping protection mode (Transil vs MOV comparison)
- [AN575](#), CALCULATION OF TRANSIL APPARENT DYNAMIC RESISTANCE
- [AN319](#), RELAY DRIVE PROTECTION
- [AN4994](#), 10 gigabit Ethernet survives ITU-T K20 and Telcordia GR-1089-Core intra-building
- [AN4275](#), IEC 61000-4-5 standard overview
- [AN574](#), TRANSIL™/TRISIL™ COMPARISON
- [AN4647](#), Circuit breaker with transient voltage suppression based on the CBTVS2Axx-1F3: input capacitor sizing of portable equipment
- [AN555](#), AUTOMOTIVE PROTECTION WITH THE RBOxx SERIES

- [AN4876](#), SLIC protection without a serial resistor or PTC to meet ITU-T K.20/K.21 and GR-1089-CORE using the LCP154DJF
- [AN2064](#), Compliance of series/parallel protections for Telecom CO
- [AN2266](#), SLIC based system protection for European and Asian markets
- [AN2053](#), SLIC protection for both classical and new networks
- [AN320](#), Operation of a Trisil™ crowbar type protection diode

EMIF

- [AN5121](#), HDMI ESD protection and signal conditioning products for STBs
- [AN3353](#), IEC 61000-4-2 standard testing
- [AN4541](#), EMI filters for SD3.0 card high-speed SD card protection and filtering devices
- [AN3141](#), LC filters for mobile phone LCD and camera links

ECMF

- [AN4871](#), USB Type-C protection and filtering
- [AN4356](#), Antenna desense on handheld equipment
- [AN3353](#), IEC 61000-4-2 standard testing
- [AN4511](#), Common mode filters

CLT

- [AN4625](#), STEVAL-IFP023V1 evaluation board for CLT01-38S4 input termination
- [AN2846](#), SCLT3-8 - guidelines for use in industrial automation applications
- [AN2482](#), PCLT (Programmable current limited termination)
- [AN1608](#), CLT3-4BT6 DEMOBOARD: CHECK THE ROBUSTNESS OF CLT3-4BT6



Videos/e-presentations

Antenna desense medication by STMicroelectronics



ESD Protection: why and how to protect microcontrollers efficiently



ST at IoT World 2019: Power Discrete Solutions



Product overview - Protecting circuits against surges, an introduction (eresentation)



Product overview - Automotive-grade ESD protection for CAN bus lines (ePresentation)



Product overview - Power over Ethernet protection (ePresentation)

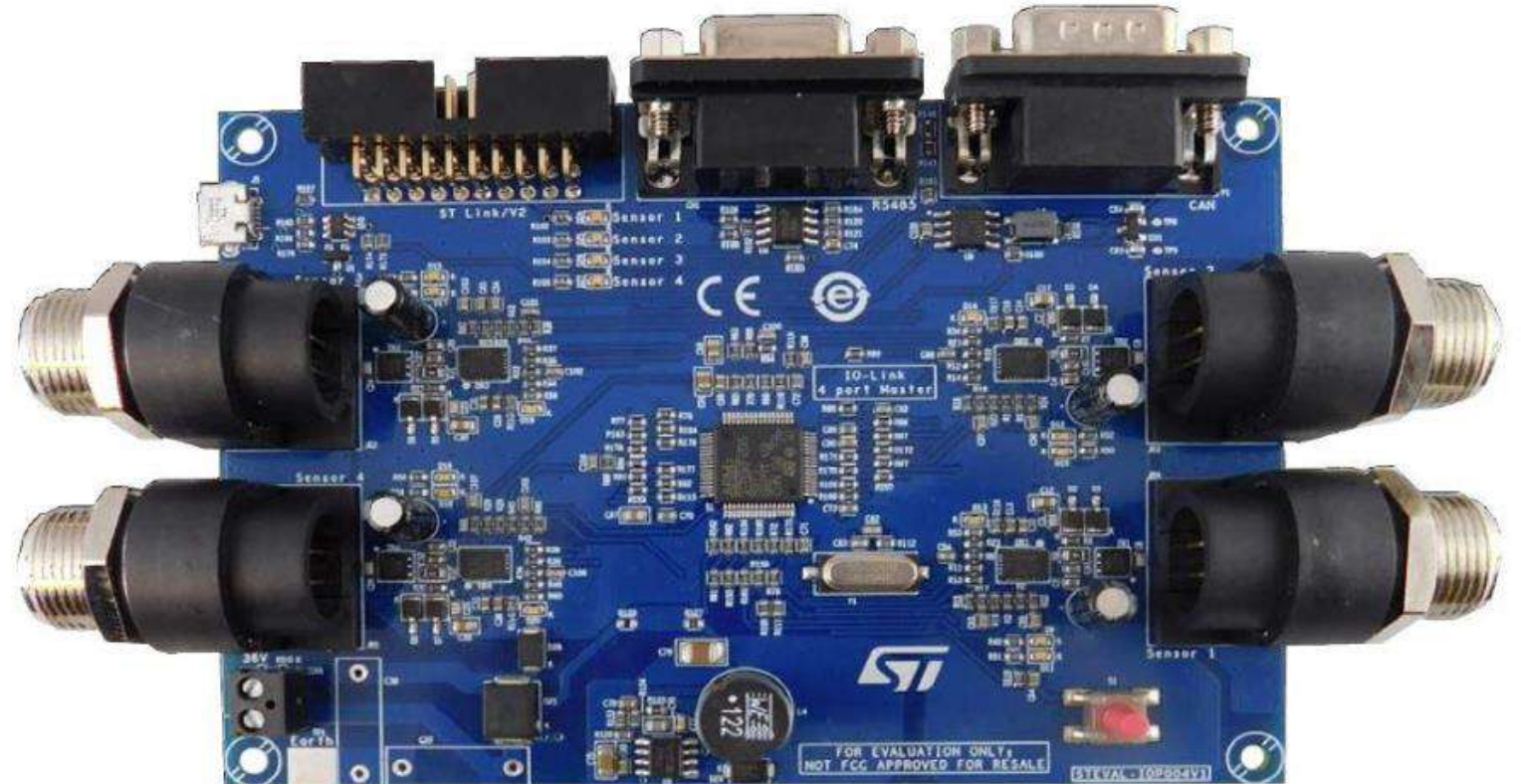


Protection & IPADs in Predictive maintenance

The layout is designed to meet the requirements for **IEC61000-4-2/4/5** for industrial segment

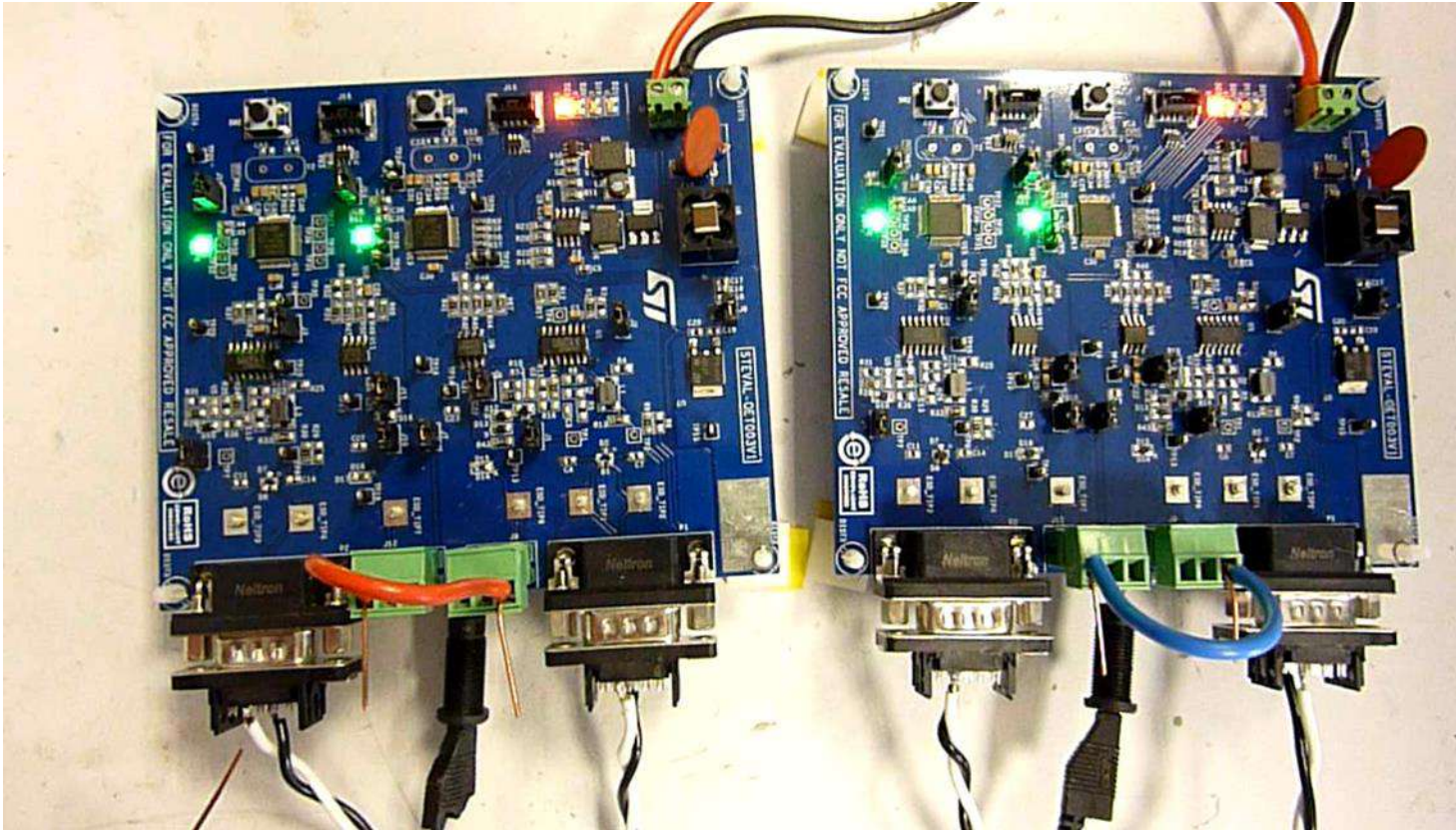
STEVAL-IDP004V1

4x SPT01-335DEE
1x SM15T33CA
1x ESDCAN24-2BLY
1x USBLC6-2SC6Y



Promotion tools industrial CAN bus protection demo

- Demo PCB to show efficiency of ESDCAN and ESDLIN Protection



Evaluation boards

**X-NUCLEO for USB Type-C
Power Delivery**



**STVAL-OET004V1
Evaluation board for USB Type-C**



Thank you

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