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Protections and Filters application book for: Automotive cameras



Automotive grade

All products presented are automotive grade and PPAP capable

ESDCANxx-2BWY
Datasheet

Automotive dual-line TVS in SOT323-3L for CAN bus

Features

- AEC-Q101 qualified
- Breakdown voltage, V_{BR} :
 - ESDCAN02-2BWY: 28.5 V
 - ESDCAN03-2BWY: 26.5 V
 - ESDCAN04-2BWY: 27.5 V
 - ESDCAN05-2BWY: 39 V
 - ESDCAN06-2BWY: 38 V
- Max pulse power up to 170 W (8/20 μ s)
- Low clamping factor V_{CL} / V_{BR}

Complies with the following standards

- UL94, V0
- J-STD-020 MSL level 1
- IPC7531 footprint and JEDEC registered package
- ISO 16750-2 (Jump start and reversed battery tests)
- IEC 61000-4-4 (EFT)
 - 4 kV
- ISO 10605 C = 150 pF, R = 330 Ω , exceeds level 4:
 - ± 30 kV (contact and air discharge)
- ISO 10605 C = 330 pF, R = 2 k Ω exceeds level 4:
 - ± 30 kV (contact and air discharge)
- ISO 10605 C = 330 pF, R = 330 Ω exceeds level 4:
 - ± 30 kV (contact and air discharge)
- ISO 7637-3:
 - Pulse 3a: -150 V
 - Pulse 3b: +150 V
 - Pulse 2a: +/- 85 V

Product status link

ESDCAN02-2BWY, ESDCAN03-2BWY, ESDCAN04-2BWY, ESDCAN05-2BWY, ESDCAN06-2BWY

Part numbers for automotive grade protection & filter devices end with a “Y”

They have datasheets with relevant information for automotive applications

Protection & filter solutions for automotive cameras

Ethernet	
Connector side	<i>ESD1001-1BM2Y(*)</i>
PHY-side	<u>HSP051-2W3Y</u>

Long-reach LVDS
<u>ECMFY series</u>
<u>HSP051-2W3Y</u>
<u>ESDAVLC6-2BLY</u>
<i>ESDXLC6-1BT2Y(*)</i>

Short-reach LVDS
<u>ECMFY series</u>
<u>HSP051-2W3Y</u>
<u>USBLC6-2SC6Y</u>
<i>ESDXLC6-1BT2Y(*)</i>

Antenna
<i>ESDXLC6-1BT2Y(*)</i>
<i>ESDZX161-1BM2Y(*)</i>

MOSFET protection
<u>ESDA051-1JY</u>
<u>ESDA14V2LY</u>
<u>SM4T18(C)AY</u>



Parallel video lines
<u>EMIF06-1005MX12Y</u>
<u>USBLC6-xSC6Y</u>

Power over coax (PoC)
<u>SM6F18AY</u>

CAN & FlexRay
<u>ESDCAN series</u>

PSE
<u>ESDA051-1JY</u>
<u>SM6F18AY</u>

VBat
<u>SMA6TY series</u>

I²C
<u>USBLC6-2SC6Y</u>



Long-reach LVDS (SERDES) FPD-link, GMSL, APIX, MIPI A-PHY

Standalone ESD protection or integrated solution with both ESD protection and common mode noise filter in the same package

Long-reach LVDS needs	Product key parameters	ST solutions
IEC 61000-4-2 level 4 ISO 10605 (C = 150 pF, R = 330 Ω) 8 kV contact / 15 kV air	Contact discharge: ≥ 8 kV Air discharge: ≥ 15 kV	
Design flexibility	Multiline or single line // unidirectional or bidirectional	
Higher data rate: 8 GBaud / lane: MIPI A-PHY G3 P1 NRZ, FPD-link IV & ASA-ML	Bandwidth up to 12 GHz: ESDXLC6-1BT2Y & ECMF2-40A100M6Y	
Voltage ≤ 2.5 V	V _{RM} = 3 V: HSP061-4M10Y ESDXLC6-1BT2Y V _{RM} = 5 V: HSP051-2W3Y (uni) ESDAVLC6-2BLY (bidir)	ESD protection for 8GBaud / lane ESDXLC6-1BT2Y (under development) High-speed ESD protection for other standards ESDXLC6-1BT2Y / HSP061-4M10Y HSP051-2W3Y / ESDAVLC6-2BLY
Avoid disturbing Wi-Fi, BT	V _{RM} = 5 V ECMF2-40A100M6Y compliant with MIPI A-PHY eye diagram, 12.5 GHz bandwidth Rejection @ 2.4 GHz → min -15 dB, 5 GHz → min -20 dB & rejection @ 6 GHz: min -15 dB	ESD protection + CMF ECMF2-40A100M6Y 2 lines μQFN-6L ECMF4-2459A6M10Y 4 lines μQFN-10L
Avoid disturbing GPS, Wi-Fi and BT	V _{RM} = 3 V Rejection @ 1.5 GHz: -24 dB, 2.4 GHz: -30 dB Rejection @ 5 GHz & 6 GHz: -16 dB	ESD protection + CMF ECMF04-4HSWM10Y 4 lines μQFN-10L

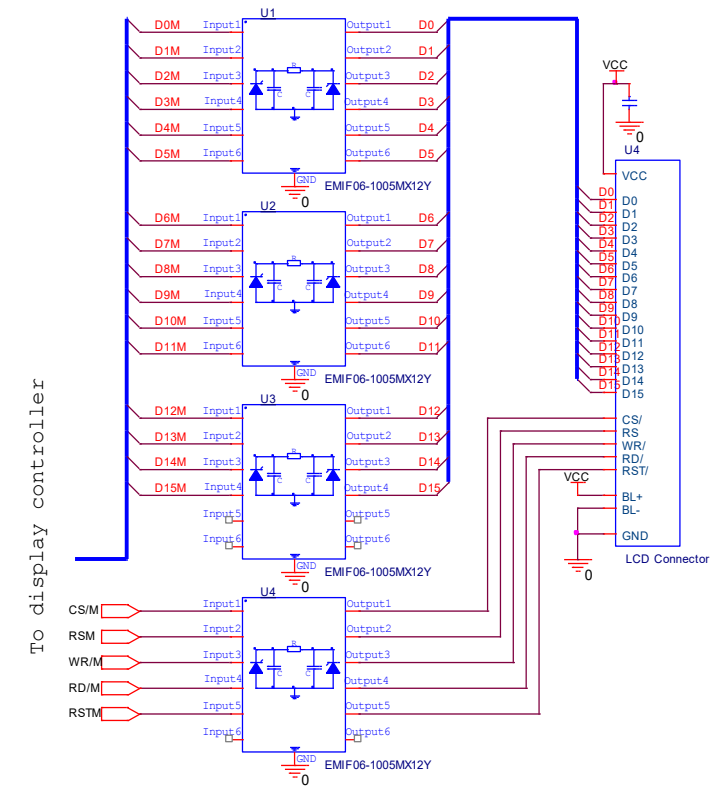
Link	Max datarate per lane (Gbps)	Max symbol rate per lane (Gbaud)
APIX 1	1	1
APIX 2	3	3
APIX 3	6	6
FPD-link III	4	4
FPD-link IV	8	8
GMSL1	3.125	3.125
GMSL2	6	6
GMSL3 PAM4	12	6
A-PHY G1 PAM4	2	1
A-PHY G1 NRZ	2	2
A-PHY G2 PAM4	4	2
A-PHY G2 NRZ	4	4
A-PHY G3 PAM4	8	4
A-PHY G3 NRZ	8	8
A-PHY G4 PAM8	12	4
A-PHY G4 PAM4	12	8
A-PHY G5 PAM16	16	4
A-PHY G5 PAM4	16	8
A-PHY G6 PAM8	24	8
A-PHY G7 PAM8	32	8
ASA-ML Grade1 PAM2	2	2
ASA-ML Grade2 PAM2	4	4
ASA-ML Grade3 PAM2	8	8
ASA-ML Grade4 PAM4	12	6
ASA-ML Grade5 PAM4	16	8



Parallel video lines

Standalone ESD protection or integrated solution with ESD protection and EMI filter in the same package

Parallel video line needs	Product key parameters	ST solutions
IEC 61000-4-2 level 4 ISO 10605 (C = 150 pF, R = 330 Ω) 8 kV contact / 15 kV air	Contact discharge: ≥ 15 kV Air discharge: ≥ 15 kV	
Positive signal	Unidirectional	
Design flexibility	Dual lines, four lines and six lines // unidirectional	
Voltage 1.8 V or 3.3 V	$V_{RM} \geq 3 \text{ V}$ (EMIF06-1005MX12Y) $V_{RM} \geq 5.25 \text{ V}$ (USBLC6-xSC6Y)	<u>USBLC6-4SC6Y</u> <u>USBLC6-2SC6Y</u> <u>EMIF06-1005MX12Y</u> <u>ECMF04-4HSWM10Y</u> <u>ECMF2-40A100M6Y</u>
Pixel clock frequency up to 200 MHz	Bandwidth: <ul style="list-style-type: none"> 120 MHz: EMIF06-1005MX12Y Up to 3 GHz: USBLC6-xSC6Y & ECMF04-4HSWM10Y Up to 12 GHz: ECMF2-40A100M6Y 	
Noise filtering Avoid to disturb antennas	Attenuation ≥ -15 dB (250 MHz to 6 GHz) $S_{cc21} \geq -15 \text{ dB}$ (900 MHz to 6 GHz) $S_{cc21} \geq -15 \text{ dB}$ (2.4 GHz to 6 GHz)	<u>EMIF06-1005MX12Y</u> <u>ECMF04-4HSWM10Y</u> <u>ECMF2-40A100M6Y</u>

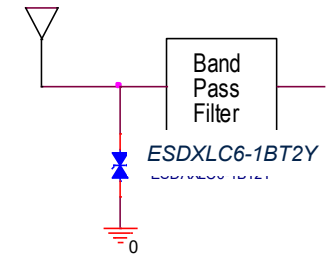




Antennas

Antennas are ESD protected according to ISO 10605 (C=150 pF, R=330 Ω) Very low harmonics ensure no disturbance in application

Wi-Fi antenna needs	Key product parameters	ST solutions
RF power = 23 dBm ($V_{PEAK} = 4.5$ V with 50 Ω load)	$V_{BR} \geq 6$ V	<p>ESDXLC6-1BT2Y Single line 0402 package</p> <p>ESDZX161-1BM2Y *</p>
Alternative signal	Bidirectional device	
f = 2.4 GHz f = 5.0 GHz	Extralow capacitance (≤ 0.5 pF) Bandwidth = 12 GHz Typical IL @ 2.4 GHz = 0.2 dB	
Very low harmonic generation ≤ -41 dBm @ 23 dBm	H3 = -41 dBm at 23 dBm power; f = 2.4 GHz	
IEC 61000-4-2 level 4 ISO 10605 (C = 150 pF, R = 330 Ω) 8 kV contact / 15 kV air	Contact discharge: 16 kV Air discharge: 30 kV	



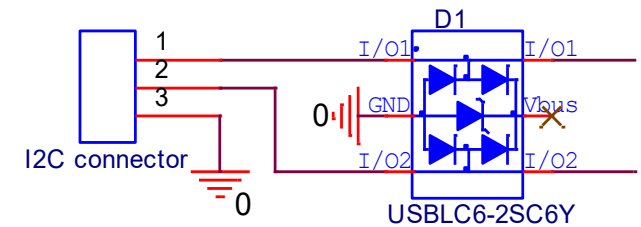
* With a risk of connection to the battery consideration:
ISO 16750-2 compliant min $V_{RM} = 13.5$ V

* *Under development*



I²C socket is ESD protected according to ISO 10605 (C=150 pF, R=330 Ω) with one single device.

I2C needs	Product key parameters	ST solutions
IEC 61000-4-2 level 4 ISO 10605 (C = 150 pF, R = 330 Ω) 8 kV contact / 15 kV air	min 12 kV contact / min 15 kV air	HSP051-2W3Y (two lines – SOT323-3L)
Voltage ≤ 5.0 V	V _{RM} = 5 V	USBLC6-2SC6Y (two lines – SOT23-6L)
Positive signal	Unidirectional	
Data rate: 3.4 Mbps	Bandwidth > 400 MHz	

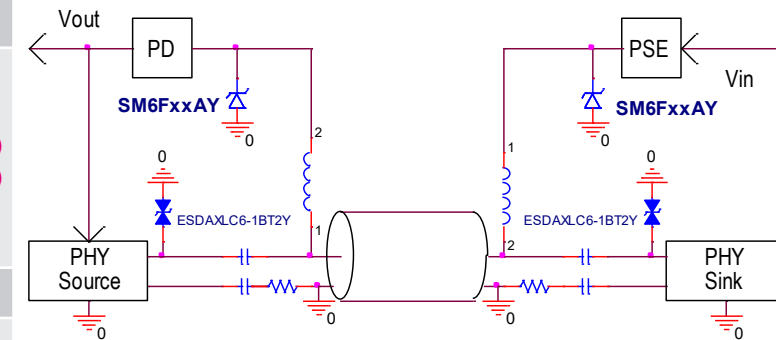




Power Over Coax (PoC)

Small and flat 600 W TVS compliant with all ISO standards

Power over coax (PoC) needs	Product key parameters	ST solutions
Voltage ≤ 13 V	$V_{RM} \geq 13$ V	<u>SM6F13AY</u>
Positive signal	Unidirectional	
ISO 16750-2 overvoltage test required/Short-to-Vbat <ul style="list-style-type: none"> 18 V ± 0.2 V applied for 60 min for 12 V systems 36 V ± 0.2 V applied for 60 min for 24 V systems 	<ul style="list-style-type: none"> $V_{BR} \geq 20$ V for 12 V systems $V_{BR} \geq 36.7$ V for 24 V systems 	<u>SM6F18AY</u> (for 12 V systems) <u>SM6F33AY</u> (for 24 V systems)
ISO 16750-2: reversed voltage test required <ul style="list-style-type: none"> -14 V ± 0.2 V applied for 60 s for 12 V systems -28 V ± 0.2 V applied for 60 s for 24 V systems jump-start test required <ul style="list-style-type: none"> 24 V ± 0.2 V applied for 60 s for 12 V systems 	Bidirectional devices needed 12 V systems <ul style="list-style-type: none"> $V_{BR} \geq 26.7$ V 24 V systems (incl. overvoltage test) <ul style="list-style-type: none"> $V_{BR} \geq 37.1$ V 	<u>SMA6T28CAY</u> (for 12 V systems) <u>SMA6T39CAY</u> (for 24 V systems)
Low speed signal	No capacitance constraints	
ISO7637-2 <ul style="list-style-type: none"> Pulse1: VS = -150 V Pulse 2a: VS = +112 V Pulse 3a: VS = -220 V Pulse 3b: VS = +150 V 	PASS	
ISO 10605 (C=330 pF, R = 330 Ω) ≥ 15 kV	Contact discharge: ≥ 30 kV Air discharge: ≥ 30 kV	

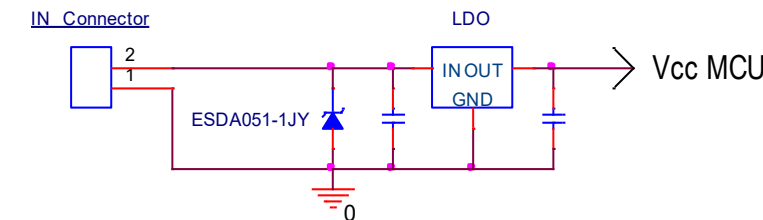




PSE/Power control input

Small and flat 600 W TVS compliant with all ISO standards

PSE/Power control input needs	Product key parameters	ST solutions
Voltage 5 V or 13 V	$V_{RM} = 5\text{ V}$ (ESDA051-1JY) $V_{RM} = 13\text{ V}$ (SM6F13AY)	ESDA051-1JY SM6F13AY
Positive signal	Unidirectional	
ISO 16750-2 overvoltage test required/Short-to-Vbat <ul style="list-style-type: none"> 18 V \pm0.2 V applied for 60 min for 12 V systems 36 V \pm0.2 V applied for 60 min for 24 V systems 	<ul style="list-style-type: none"> $V_{BR} \geq 20\text{ V}$ for 12 V systems $V_{BR} \geq 36.7\text{ V}$ for 24 V systems 	SM6F18AY (for 12 V systems) SM6F33AY (for 24 V systems)
ISO 16750-2: reversed voltage test required <ul style="list-style-type: none"> -14 V \pm0.2 V applied for 60 s for 12 V systems -28 V \pm0.2 V applied for 60 s for 24 V systems jump-start test required <ul style="list-style-type: none"> 24 V \pm0.2 V applied for 60 s for 12 V systems 	Bidirectional devices needed 12 V systems <ul style="list-style-type: none"> $V_{BR} \geq 26.7\text{ V}$ 24 V systems (incl. overvoltage test) <ul style="list-style-type: none"> $V_{BR} \geq 37.1\text{ V}$ 	SMA6T28CAY (for 12 V systems) SMA6T39CAY (for 24 V systems)
Low speed signal	No capacitance constraints	
ISO7637-2 <ul style="list-style-type: none"> Pulse 1: VS = -150 V Pulse 2a: VS = +112 V Pulse 3a: VS = -220 V Pulse 3b: VS = +150 V 	PASS	
ISO 10605 (C = 330 pF, R = 330 Ω) $\geq 15\text{ kV}$	Contact discharge: $\geq 30\text{ kV}$ Air discharge: $\geq 30\text{ kV}$	

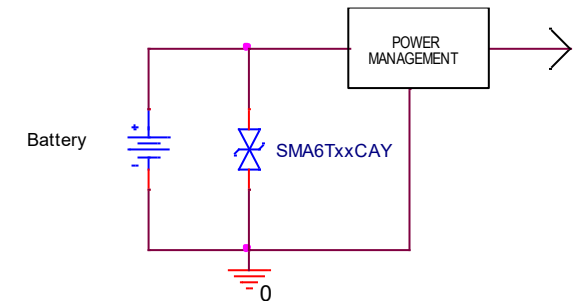




V_{BAT} input

600W TVS in small SMA compliant with all ISO standards

V _{BAT} output needs	Product key parameters	ST solutions
ISO 16750-2: <ul style="list-style-type: none"> overvoltage test required <ul style="list-style-type: none"> 18 V ±0.2 V applied for 60 min for 12 V systems 36 V ±0.2 V applied for 60 min for 24 V systems reversed voltage test required <ul style="list-style-type: none"> -14 V ±0.2 V applied for 60 s for 12 V systems -28 V ±0.2 V applied for 60 s for 24 V systems jump-start test required <ul style="list-style-type: none"> 24 V ±0.2 V applied for 60 s for 12 V systems 	Bidirectional devices needed 12 V systems <ul style="list-style-type: none"> V_{BR} ≥ 26.7 V 24 V systems (incl. overvoltage test) <ul style="list-style-type: none"> V_{BR} ≥ 37.1 V 	<u>SMA6T28CAY</u> (for 12 V systems) <u>SMA6T39CAY</u> (for 24 V systems)
ISO 16750-2: <ul style="list-style-type: none"> Centralized load dump suppression <ul style="list-style-type: none"> U_{S*} = 35 V ±0.2 V for 12 V systems U_{S*} specified by OEM (typical value 58 V ±0.2 V) 	12 V systems <ul style="list-style-type: none"> V_{BR} ≥ 34.2 V 24 V systems (incl. overvoltage test) <ul style="list-style-type: none"> V_{BR} ≥ U_{S*}. If U_{S*} = 58 V, V_{BR} ≥ 64.6 V 	<u>SMA6T36CAY</u> (for 12 V systems) <u>SMA6T68CAY</u> (for 24 V systems)
Low speed signal	No capacitance constraints	
ISO7637-2 <ul style="list-style-type: none"> Pulse 1: VS = -150 V Pulse 2a: VS = +112 V Pulse 3a: VS = -220 V Pulse 3b: VS = +150 V 	PASS	
ISO 10605 (C=330 pF, R = 330 Ω) ≥15 kV	Contact discharge: ≥ 30 kV Air discharge: ≥30 kV	



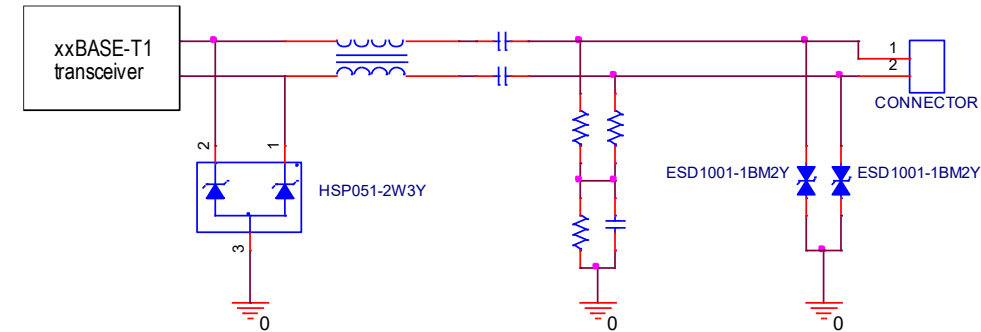


Automotive Ethernet xxBASE-T1

Low capacitance ESD protection in line with IEEE 1000BASE-T1

Connector side Ethernet needs	Product key parameters	ST solutions
IEEE 1000BASE-T1 requirements: <ul style="list-style-type: none"> ▪ Bidirectional ▪ Operation voltage ≥ 24 V ▪ Trigger voltage ≥ 100 V ▪ ESD: ISO 10605 (C=150 pF, R = 330 Ω) min = 15 kV contact ▪ S parameters requirements 	PASS	ESD1001-1BM2Y

PHY side Ethernet needs	Product key parameters	ST solutions
Voltage ≤ 3 V	$V_{RM} \geq 5$ V (HSP051-2W3Y)	HSP051-2W3Y
Positive signal	Unidirectional	
Data rate: up to 1 Gbps (125 MBaud, PAM 3)	Bandwidth up to 3 GHz	
IEC 61000-4-2 level 4 ISO 10605 (C=150 pF, R = 330 Ω) 8 kV contact/15 kV air	Contact discharge: ≥ 12 kV Air discharge: ≥ 15 kV	





Wide CAN transceiver protection portfolio covering both 12 V and 24 V-battery systems

CAN needs		Product key parameters	ST solutions
ISO 16750-2: <ul style="list-style-type: none"> overvoltage test required <ul style="list-style-type: none"> 18 V ±0.2 V applied for 60 min for 12 V systems 36 V ±0.2 V applied for 60 min for 24 V systems reversed voltage test required <ul style="list-style-type: none"> -14 V ±0.2 V applied for 60 s for 12 V systems -28 V ±0.2 V applied for 60 s for 24 V systems jump-start- test required <ul style="list-style-type: none"> 24 V ±0.2 V applied for 60 s for 12 V systems 		Bidirectional devices needed 12 V systems <ul style="list-style-type: none"> $V_{BR} \geq 26.7$ V 24 V systems (incl. overvoltage test) <ul style="list-style-type: none"> $V_{BR} \geq 37.1$ V 	
Data rate <ul style="list-style-type: none"> Fault tolerant CAN: 125 kbps High speed CAN: 1 Mbps CAN-FD: 5 Mbps CAN-FD SIC: 8 Mbps CAN XL: 10 Mbps 	Cline ≤ 3 pF for High-speed CAN, CAN-FD, CAN-FD-SIC		
Design flexibility		Dual-line in SOT23-3L	
IEC 61000-4-2 level 4 8 kV contact/15 kV air		Contact discharge: up to 30 kV Air discharge: ≥ 30 kV	



Wide FlexRay transceiver protection portfolio covering 12 V and 24 V battery systems

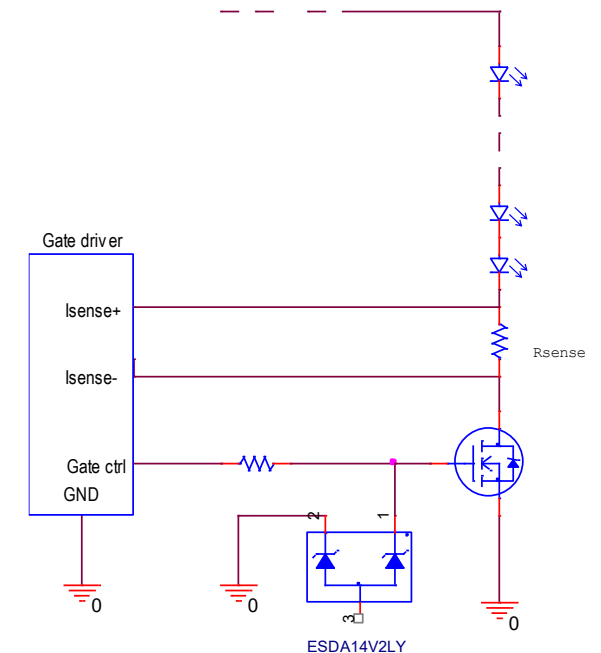
FlexRay needs	Product key parameters	ST solutions
<p>ISO 16750-2:</p> <ul style="list-style-type: none">▪ overvoltage test required<ul style="list-style-type: none">▪ 18 V \pm0.2 V applied for 60 min for 12 V systems▪ 36 V \pm0.2 V applied for 60 min for 24 V systems▪ reversed voltage test required<ul style="list-style-type: none">▪ -14 V \pm0.2 V applied for 60 s for 12 V systems▪ -28 V \pm0.2 V applied for 60 s for 24 V systems▪ jump-start test required<ul style="list-style-type: none">▪ 24 V \pm0.2 V applied for 60 s for 12 V systems	<p>Bidirectional devices needed</p> <p>12 V systems</p> <ul style="list-style-type: none">▪ $V_{BR} \geq 26.7$ V <p>24 V systems (incl. overvoltage test)</p> <ul style="list-style-type: none">▪ $V_{BR} \geq 37.1$ V	<p><u>ESDCAN02-2BWY</u> (for 12 V systems) <u>ESDCAN03-2BWY</u> (for 12 V systems) <u>ESDCAN05-2BWY</u> (for 24 V systems)</p>
<p>Data rate up to 10 Mbps</p>	<p>Cline ≤ 3 pF/Bandwidth: 1.1 GHz</p>	
<p>IEC 61000-4-2 level 4 8 kV contact/15 kV air</p>	<p>Contact discharge: up to 30 kV Air discharge: ≥ 30 kV</p>	



MOSFET protection

Robust protection devices rated at 30 kV versus ISO 10605 (R=330 Ω , C=330 pF)

MOSFET gate needs	Product key parameters	ST solutions
- 5 V \leq voltage \leq 16 V	$V_{RM} = 5$ V (ESDA051-1JY) $V_{RM} = 12$ V (ESDA14V2LY) $V_{RM} = 15$ V (SM4T18(C)AY)	<u>ESDA051-1JY</u> <u>ESDA14V2LY</u> <u>SM4T18(C)AY</u>
Signal direction	Unidirectional (ESDA051-1JY, ESDA14V2LY, SM4T18AY) Bidirectional (ESDA14V2LY, SM4T18CAY)	
Low speed signal	No capacitance constraints	
IEC 61000-4-2 (R=330 Ω , C=150 pF) level 4 8 kV contact/15 kV air	ISO 10605 (R=330 Ω , C=330 pF) Contact discharge: ≥ 30 kV Air discharge: ≥ 30 kV	



- **ADAS** Advanced driver assistance systems
- **Bird's eye, bird view** See SVM
- **CPD** Child presence detection
- **CVBS** Composite video broadcast signal
- **DOMS** Driver and occupant monitoring system
- **DMS** Driver monitoring system
- **ECU** Electronics control unit
- **IMS** Interior monitoring system
- **ISP** Image sensor processor/processing
- **IVN** In-vehicle network
- **LVDS** Low voltage differential signaling
- **NIR LED** Near infrared light emitting diode
- **OMS** Occupant monitoring system
- **POC** Power over coax
- **PSE** Power sourcing equipment (LDO, buck, DC-DC)
- **SERDES** Serializer-deserializer
- **SSD** Solid-state drive
- **SVM** Surround view monitor

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