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Protection & Filters application book for:
Lidar

ST PROTECT

Automotive grade

All products presented are automotive grade and PPAP capable

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ESDCANxx-2BWY

Datasheet

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

Features

- AEC-Q101 qualified
- Dual-line ESD and EOS protection
- 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 µs)
- Low clamping factor V_{CL} / V_{BR}
- ECOPACK2 RoHS compliant component

SOT323-3L
(Jedec SC-70)

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 kΩ 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

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Protection & Filters solutions for automotive lidar

Ethernet	
Connector side	*ESD1001-1BM2Y(*)*
PHY-side	HSP051-2W3Y

Long-reach LVDS
ECMFY series
HSP051-2W3Y
ESDAVLC6-2BLY
ESDXLC6-1BT2Y(*)

Analog / digital signal
ESDA051-1JY
USBLC6-xSC6Y
EMIF06-1005MX12Y

MOSFET gate protection
ESDA051-1JY
ESDA14V2LY
SM4T18(C)AY

MOSFET Drain protection
ESDAxxLY SM4Txx(C)AY

VBat
SMA6TY series

CAN & FlexRay
ESDCAN series

Hall sensor inputs
EMIF03-22K10M8Y(*)

PSI5
ESDA25LY

TIA
ESDAVLC6-2BLY
ESDXLC6-1BT2Y(*)

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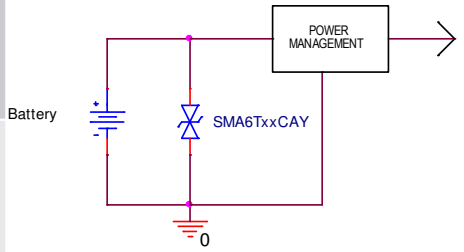
** Under development*

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: ▪ overvoltage test required ▪ 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 ▪ -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 ▪ 24 V ±0.2 V applied for 60 s for 12 V systems	Bidirectional devices needed 12 V systems ▪ V_{BR} ≥ 26.7 V 24 V systems (incl. overvoltage test) ▪ V_{BR} ≥ 37.1 V	**SMA6T28CAY** (for 12 V systems) **SMA6T39CAY** (for 24 V systems
ISO 16750-2: ▪ Centralized load dump suppression ▪ 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 ▪ V_{BR} ≥ 34.2 V 24 V systems (incl. overvoltage test) ▪ V_{BR} ≥ U_{S*} . If U_{S*} = 58 V, V_{BR}≥ 64.6 V	**SMA6T36CAY** (for 12 V systems) **SMA6T68CAY** (for 24 V systems)
Low speed signal	No capacitance constraints	
ISO7637-2 ▪ 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	



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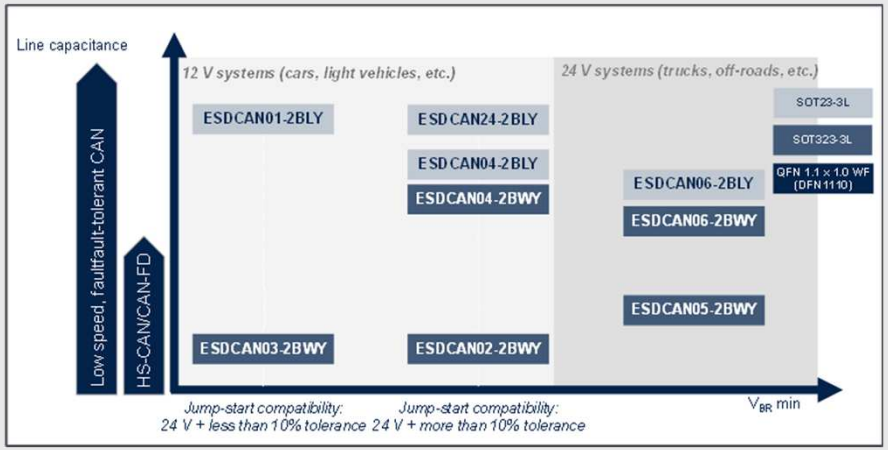
Wide CAN transceiver protection portfolio covering both 12 V and 24 V-battery systems

CAN needs	Product key parameters	ST solutions
ISO 16750-2: ▪ overvoltage test required ▪ 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 ▪ -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 ▪ 24 V ±0.2 V applied for 60 s for 12 V systems	Bidirectional devices needed 12 V systems ▪ V_{BR} ≥ 26.7 V 24 V systems (incl. overvoltage test) ▪ V_{BR} ≥ 37.1 V	
Data rate ▪ 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	

FlexRay

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

FlexRay needs	Product key parameters	ST solutions
ISO 16750-2: ▪ overvoltage test required ▪ 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 ▪ -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 ▪ 24 V ±0.2 V applied for 60 s for 12 V systems	Bidirectional devices needed 12 V systems ▪ V_{BR} ≥ 26.7 V 24 V systems (incl. overvoltage test) ▪ V_{BR} ≥ 37.1 V	**ESDCAN02-2BWY (for 12 V systems)** **ESDCAN03-2BWY (for 12 V systems)** **ESDCAN05-2BWY (for 24 V systems)**
Data rate up to 10 Mbps	Cline ≤ 3 pF/Bandwidth: 1.1 GHz	
IEC 61000-4-2 level 4 8 kV contact/15 kV air	Contact discharge: up to 30 kV Air discharge: ≥ 30 kV	

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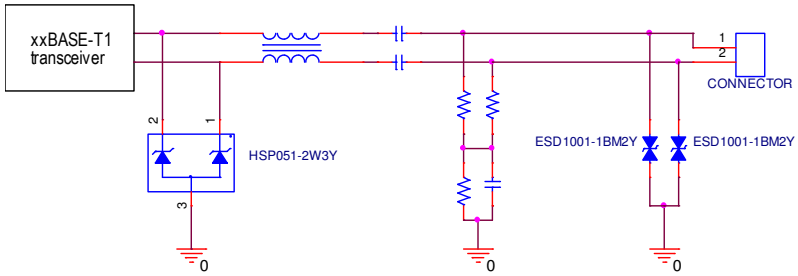
Automotive Ethernet xxBASE-T1

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

Connector side Ethernet needs	Product key parameters	ST solutions
IEEE 1000BASE-T1 requirements: ▪ 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} ≥ 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	



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** Under development*

Complete BOM

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(*)*** **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

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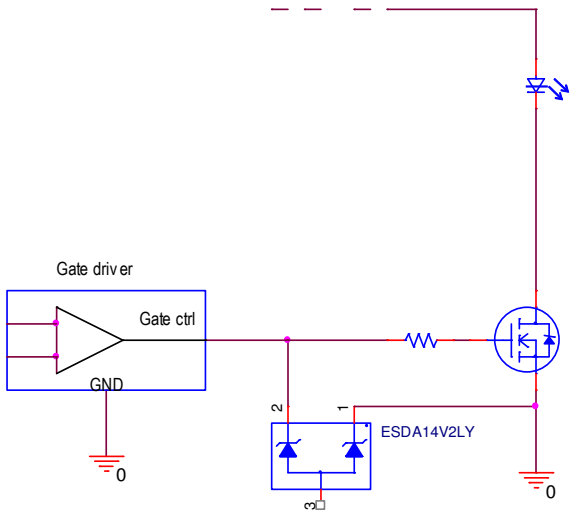
Link	Max datarate per lane (Gbps)	Max symbol rate per lane (Gbaud)
APIX 1	1	1
APIX 2	3	3
APIX 3	6	6
FPD-link III	4	4
FPD-link IV	8	8
GMSL1	3.125	3.125
GMSL2	6	6
GMSL3 PAM4	12	6
A-PHY G1 PAM4	2	1
A-PHY G1 NRZ	2	2
A-PHY G2 PAM4	4	2
A-PHY G2 NRZ	4	4
A-PHY G3 PAM4	8	4
A-PHY G3 NRZ	8	8
A-PHY G4 PAM8	12	4
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 Garde4 PAM4	12	6
ASA-ML Garde5 PAM4	16	8

MOSFET gate protection

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

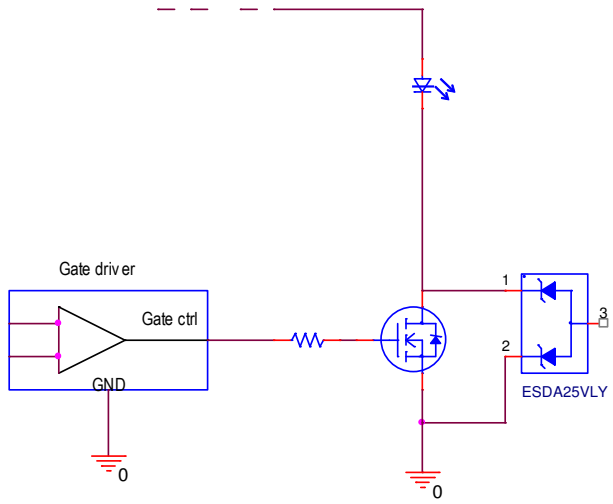
MOSFET gate needs	Product key parameters	ST solutions
- 5 V ≤ Voltage ≤ 15 V	V_{RM} = 5 V (ESDA051-1JY) V_{RM} = 12 V (ESDA14V2LY) V_{RM} = 15 V (SM4T18(C)AY)	**ESDA051-1JY** **ESDA14V2LY** **SM4T18(C)AY**
Signal direction	Unidirectional (ESDA051-1JY, ESDA14V2LY, SM4T18AY) Bidirectional (ESDA14V2LY, SM4T18CAY)	
Switching frequency: • Low: Si MOSFET	Low: No capacitance constraints	
Switching frequency: • High: GaN MOSFET	High: Ultralow capacitance	**HSP051-2W3Y** **ESDAXLC6-1BT2Y**
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	



MOSFET Drain protection

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

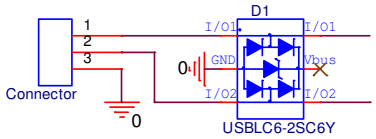
MOSFET drain needs	Product key parameters	ST solutions
Switching frequency: • Low: Si MOSFET	Low: No capacitance constraints	**SM4Txx(C)AY**
Switching frequency: • High: GaN MOSFET	High: Low capacitance	**ESDAxxLY**
IEC 61000-4-2 (R=330 Ω, C=150 pF) level 4 8 kV contact / 15 kV air	ISO 10605 (R=330 Ω, C=330 pF) Contact discharge: ≥ 30 kV Air discharge: ≥ 30 kV	



Analog / Digital signal protection

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

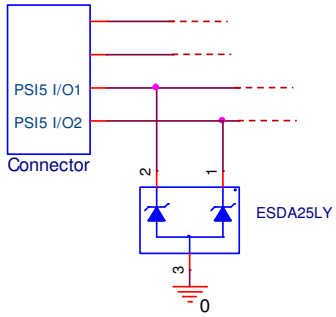
Analog / digital signal needs	Product key parameters	ST solutions
Voltage ≤ 5 V	V_{RM} = 5 V	ESDA051-1JY USBLC6-2SC6Y USBLC6-4SC6Y
Digital (positive signal)	Unidirectional	
Data rate up to 100 Mbps	Bandwidth ≥ 3 GHz (USBLC6-xSC6Y)	
Design flexibility	Smaller packages	HSP051-2W3Y
Avoid radiations	fc@-3dB = 100 MHz Attenuation > 20 dB on [400 MHz to 6 GHz]	EMIF06-1005MX12Y
Analog (positive & negative signal)	Bidirectional	ESDAVLC6-2BLY ESDA6V1-5SC6Y (I/O4 connected to PCB GND, GND pin NC)
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	



PSI5 protection

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

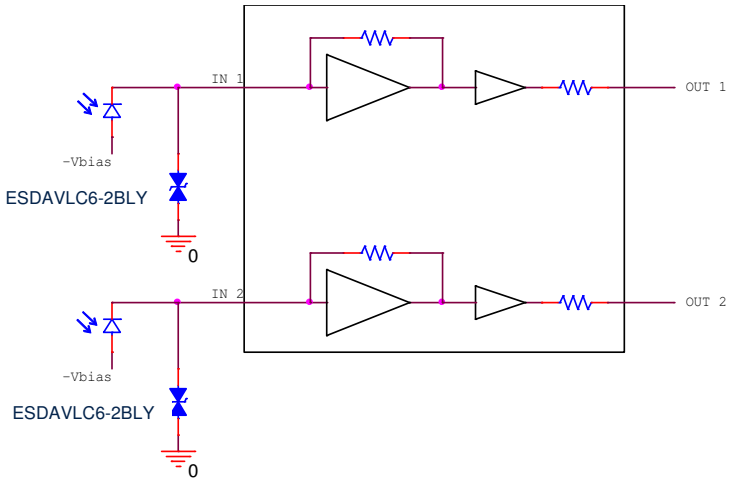
PSI5 signal needs	Product key parameters	ST solutions
Voltage ≤ 16.5 V	V_{RM} ≥ 16.5 V V_{BR} ≥ 24 V (if jump-start is applicable)	**ESDA25LY**
Digital (positive signal)	Unidirectional	
Data rate up to 189 kbps	Bandwidth ≥ 250 kHz	
IEC 61000-4-2 level 4 ISO 10605 (C=150 pF, R = 330 Ω) 8 kV contact / 15 kV air	Contact discharge: ≥ 8 kV Air discharge: ≥15 kV	



Transimpedance amplifier (TIA) input protection

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

TIA needs	Product key parameters	ST solutions
Voltage ≤ 3 V	V_{RM} =5 V	**ESDAVLC6-2BLY** ***ESDXLC6-1BT2Y(*)***
Positive or negative signal	Bidirectional	
Frequency up to 1 GHz	Bandwidth ≥ 3 GHz	
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	

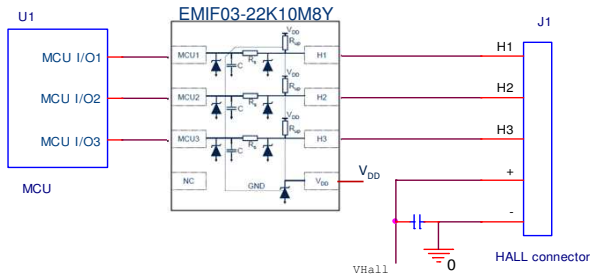


** Under development*

Hall sensors protection signal conditioning

Application specific product embedding ESD protection, EMI filters and pull-up resistors in single package

Hall sensors signal needs	Product key parameters	ST solutions
Voltage ≤ 5 V	V_{RM} = 5 V	
Short-circuit to VBAT test required ▪ 16 V ±0.2 V applied for 60 s for 12 V systems (maximal VBAT as per ISO 16750-2 direct current supply voltage) ISO 16750-2: ▪ overvoltage test required ▪ 18 V ±0.2 V applied for 60 min for 12 V systems	V_{BR} ≥ 18 V	
Digital (positive signal)	Unidirectional	***EMIF03-22K10M8Y(*)***
Generally, current in each MCU input pins < 5 mA in case of short circuit between hall sensors pins and VBAT	Serial resistance Rs = 22 kΩ (0.8 mA for 18 V on hall sensors pins)	
Motor speed up to 100k rpm	Bandwidth ≥ 200 kHz	
Current through hall sensors ≥ 1 mA to prevent connector oxidation	Pull up resistors Rup = 1 kΩ (5 mA with V_{DD} = 5 V)	
Design flexibility	Multiline ESD protection only	**ESDA25SC6Y**
IEC 61000-4-2 level 4 ISO 10605 (C=150 pF, R = 330 Ω) 8 kV contact / 15 kV air	Contact discharge: ≥ 25 kV Air discharge: ≥ 30 kV	



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** Under development*

Glossary

- **ADAS:** Advanced driver assistance systems
- **ASIC:** Application specific integrated circuits
- **ASIP:** Application specific integrated passives
- **ECU:** Electronics control unit
- **FPGA:** Field programmable gate array
- **IVN:** In-vehicle network
- **Lidar:** Light detection and ranging
- **LVDS:** Low voltage differential signaling
- **MPSoC:** Multiprocessor system on chip
- **PPAP:** Production part approval process
- **PMIC:** Power management integrated circuits
- **SERDES:** Serializer-deserializer
- **TIA:** Transimpedance amplifier

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