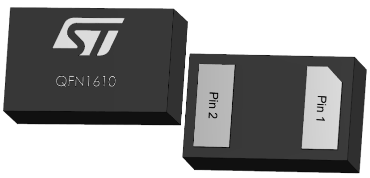
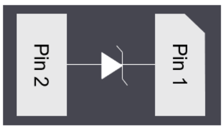
ESDAxxPxxx-1U1M

Datasheet

Unidirectional high power transient voltage suppressor in QFN-2L



QFN-2L 1.6 X 1.0 X 0.55 mm



Pin configuration

Product label

Product status link
ESDA7P60-1U1M, ESDA7P120-1U1M, ESDA8P80-1U1M, ESDA13P70-1U1M, ESDA15P60-1U1M, ESDA17P50-1U1M, ESDA20P50-1U1M, ESDA25P35-1U1M.

Product summary	
Order code	See Table 13.
Package	QFN-2L 1.6 x 1.0
Packing	Tape and reel

Features

- Single line unidirectional EOS and ESD protection diode
- Protects one I/O line or power line
- Stand-off voltage range from 5.5 V to 22 V
- Low leakage current at V_{RM}
- High peak pulse power (8/20 µs) up to 1400 W
- Low power derating across the temperature range
- Fast turn-on and low clamping voltage
- Operating Tj max: 150 °C
- 1.6 mm x 1.0 mm QFN package saves board space
  – 75 % smaller in footprint compared to SOD-123FL
- ECOPACK2 ROHS compliant component
- Complies with J-STD-020 MSL level 1
- Complies with IEC 61000-4-5 (Lightning)
  – 8/20 µs: up to 120 A
- Complies with IEC 61000-4-2 level 4
  – ±30 kV (air discharge)
  – ±30 kV (contact discharge)

Applications

Where transient overvoltage protection in ESD sensitive equipment is required, such as:

- USB type-C Vbus
- USB-PD up to 20 V
- Battery protection (Vbatt) / charger port
- Power supply line protection
- Hard disks and SSD
- Portable multimedia devices and accessories
- Industrial application
- Medical and healthcare equipment

Description

ESDAxxPxxx-1U1M transient voltage suppressor (TVS) series are designed for use in harsh environments to protect sensitive electronics from damage or latch-up due to electrical overstress (EOS), lightning surge and ESD without aging effect and performance drifts.

The series features desirable characteristics for board level protection including fast response time, excellent clamping voltage capability compared to standard TVS devices, and high surge current capability with low derating across the temperature range. In addition, this series is available in a small 1.6 mm × 1.0 mm footprint, ideal for space constrained applications.

The ESDAxxPxxx-1U1M series can be evaluated thanks to the STEVAL-OET005 evaluation board.

1 Characteristics

Table 1. **Absolute maximum ratings (T_{amb} = 25 °C)**

Symbol	Parameter		Value	Unit
V_{PP}	Peak pulse voltage	IEC 61000-4-2 – C = 150 pF, R = 330 Ω: Contact discharge Air discharge	 ±30 ±30	kV
P_{PP}	Peak pulse power	IEC 61000-4-5 (2Ω) – tp = 8/20 µs	700 – 1400	W
I_{PP}	Peak pulse current	IEC 61000-4-5 (2Ω) – tp = 8/20 µs	See Table 2.	A
T_{stg}	Storage junction temperature range		-55 to + 150	°C
T_j	Maximum operating junction temperature		-55 to + 150	°C
T_L	Maximum lead temperature for soldering during 10 s		260	°C

Figure 1. **Electrical characteristics (definitions)**

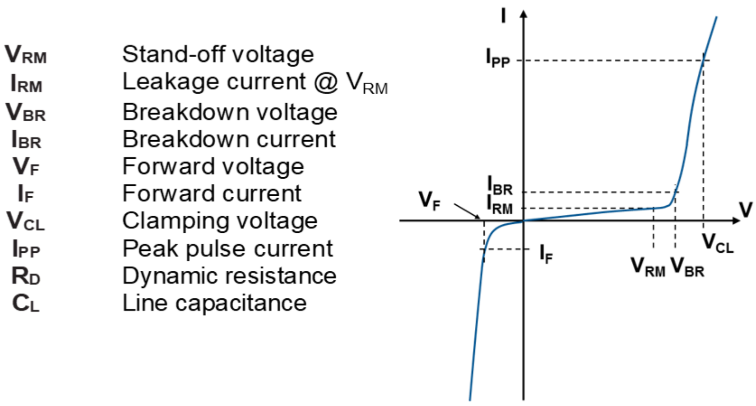


Table 2. **Electrical characteristics - parameter values (T_{amb} = 25 °C, unless otherwise specified)**

Order code	V_{RM}	I_{RM}	V_{BR} at I_R		8 / 20µs[1][2]			C_L	V_F at I_F	
					V_{CL}[3]	I_{PP}	R_D			
	Max.	Min.	Typ.		Max.		Max.	Typ.	Typ.	
	V	µA	V	mA	V	A	Ω	pF	V	mA
ESDA7P60-1U1M	5.0	0.2	6.7	1	11.6	60	0.06	450	0.75	10
ESDA7P120-1U1M	5.5	1.5	6.8	1	11.5	120	0.035	800	0.75	10
ESDA8P80-1U1M	6.3	1.0	7.3	1	13.2	80	0.06	480	0.75	10
ESDA13P70-1U1M	12.0	0.2	13.0	1	20.0	70	0.09	390	0.75	10
ESDA15P60-1U1M	13.2	0.05	14.3	1	22.7	57	0.10	335	0.75	10
ESDA17P50-1U1M	15.0	0.05	16.4	1	26.5	46	0.15	290	0.75	10
ESDA20P50-1U1M	18.0	0.05	19.5	1	31.0	40	0.20	240	0.75	10
ESDA25P35-1U1M	22.0	0.2	24.6	1	41.0	35	0.45	195	0.75	10

1. *Specified by design – not tested in production.*
2. *Measured from pin 1 to 2, in accordance with IEC 61000-4-5 (8/20 µs current waveform).*
3. *To calculate typical clamping voltage at other surge level, use the following formula: $V_{CL\ typ} = V_{BR\ typ.} + R_D \times I_{PPappli}$ where $I_{PPappli}$ is the surge current in the application.*

Table 3. ESDA7P60-1U1M Electrical characteristics (T_{amb} = 25 °C, unless otherwise specified)

Symbol	Parameter definition	Test condition	Min.	Typ.	Max.	Unit
V_{RM}	Reverse Stand-Off voltage	Pin 1 to pin 2			5.0	V
I_{RM}	Reverse leakage current at V_{RM}	Pin 1 to pin 2, V_{RM} = 5.0 V			200	nA
V_{BR}	Reverse breakdown voltage	Pin 1 to pin 2, I_{BR} = 1 mA	6.4	6.8	7.2	V
V_F	Forward voltage	Pin 2 to pin 1, I_F = 10mA		0.75		V
V_{CL} (1)	ESD clamping voltage	IEC 61000-4-2, C = 150 pF, R = 330 Ω, +8 kV contact discharge, measured at 30 ns		8.9		V
	EOS clamping voltage	IEC 61000-4-5 surge (8/20µs), I_{PP} = 60 A		10.2	11.6	V
R_d (1)	Dynamic resistance	8/20 µs waveform		0.06		Ω
$C_{I/O-GND}$ (1)	Line capacitance	Pin 1 to pin 2, $V_{I/O}$ = 0 V, 1 MHz, V_{OSC} = 30 mV		450		pF

1. *Specified by design – Not tested in production.*

Table 4. ESDA7P120-1U1M Electrical characteristics (T_{amb} = 25 °C, unless otherwise specified)

Symbol	Parameter definition	Test condition	Min.	Typ.	Max.	Unit
V_{RM}	Reverse Stand-Off voltage	Pin 1 to pin 2			5.5	V
I_R (1)	Reverse leakage current at V_R	Pin 1 to pin 2, V_{RM} = 5.0 V			350	nA
I_{RM}	Reverse leakage current at V_{RM}	Pin 1 to pin 2, V_{RM} = 5.5 V			1.5	µA
V_{BR}	Reverse breakdown voltage	Pin 1 to pin 2, I_{BR} = 1 mA	6.4	6.8	7.2	V
V_F	Forward voltage	Pin 2 to pin 1, I_F = 10 mA		0.75		V
V_{CL} (1)	ESD clamping voltage	IEC 61000-4-2, C = 150 pF, R = 330 Ω, +8 kV contact discharge, measured at 30 ns		7.7		V
	EOS clamping voltage	IEC 61000-4-5 surge (8/20µs), I_{PP} = 80 A		9.5	10.0	V
		IEC 61000-4-5 surge (8/20µs), I_{PP} = 100 A		10.2	10.7	
		IEC 61000-4-5 surge (8/20µs), I_{PP} = 120 A		11.0	11.5	
R_d (1)	Dynamic resistance	8/20 µs waveform		0.035		Ω
$C_{I/O-GND}$ (1)	Line capacitance	Pin 1 to pin 2, $V_{I/O}$ = 0 V, 1 MHz, V_{OSC} = 30 mV		800		pF

1. *Specified by design – Not tested in production.*

Table 5. **ESDA8P80-1U1M Electrical characteristics (T_{amb} = 25 °C, unless otherwise specified)**

Symbol	Parameter definition	Test condition	Min.	Typ.	Max.	Unit
V_{RM}	Reverse Stand-Off voltage	Pin 1 to pin 2			6.3	V
I_R (1)	Reverse leakage current at V_R	Pin 1 to pin 2, V_{RM} = 5.5 V			200	nA
I_{RM}	Reverse leakage current at V_{RM}	Pin 1 to pin 2, V_{RM} = 6.3 V			1.0	µA
V_{BR}	Reverse breakdown voltage	Pin 1 to pin 2, I_{BR} = 1 mA	6.9	7.3	8.0	V
V_F	Forward voltage	Pin 2 to pin 1, I_F = 10mA		0.75		V
V_{CL} (1)	ESD clamping voltage	IEC 61000-4-2, C = 150 pF, R = 330 Ω, +8 kV contact discharge, measured at 30 ns		7.3		V
	EOS clamping voltage	IEC 61000-4-5 surge (8/20µs), I_{PP} = 60 A		10.8	12.0	V
		IEC 61000-4-5 surge (8/20µs), I_{PP} = 80 A		11.8	13.2	
R_d (1)	Dynamic resistance	8/20 µs waveform		0.06		Ω
$C_{I/O-GND}$ (1)	Line capacitance	Pin 1 to pin 2, $V_{I/O}$ = 0 V, 1 MHz, V_{OSC} = 30 mV		480		pF

1. *Specified by design – Not tested in production.*

Table 6. **ESDA13P70-1U1M Electrical characteristics (T_{amb} = 25 °C, unless otherwise specified)**

Symbol	Parameter definition	Test condition	Min.	Typ.	Max.	Unit
V_{RM}	Reverse Stand-Off voltage	Pin 1 to pin 2			12.0	V
I_R (1)	Reverse leakage current at V_R	Pin 1 to pin 2, V_{RM} = 9.0 V			100	nA
I_{RM}	Reverse leakage current at V_{RM}	Pin 1 to pin 2, V_{RM} = 12.0 V			200	nA
V_{BR}	Reverse breakdown voltage	Pin 1 to pin 2, I_{BR} = 1 mA	12.5	13.0	13.5	V
V_F	Forward voltage	Pin 2 to pin 1, I_F = 10mA		0.75		V
V_{CL} (1)	ESD clamping voltage	IEC 61000-4-2, C = 150 pF, R = 330 Ω, +8 kV contact discharge, measured at 30 ns		13.7		V
	EOS clamping voltage	IEC 61000-4-5 surge (8/20µs), I_{PP} = 10 A		14.2	16.0	V
		IEC 61000-4-5 surge (8/20µs), I_{PP} = 60 A		18.4	20.0	
R_d (1)	Dynamic resistance	8/20 µs waveform		0.09		Ω
$C_{I/O-GND}$ (1)	Line capacitance	Pin 1 to pin 2, $V_{I/O}$ = 0 V, 1 MHz, V_{OSC} = 30 mV		390		pF

1. *Specified by design – Not tested in production.*

Table 7. **ESDA15P60-1U1M Electrical characteristics (T_{amb} = 25 °C, unless otherwise specified)**

Symbol	Parameter definition	Test condition	Min.	Typ.	Max.	Unit
V_{RM}	Reverse Stand-Off voltage	Pin 1 to pin 2			13.2	V
I_{RM}	Reverse leakage current at V_{RM}	Pin 1 to pin 2, V_{RM} = 13.2 V		1.0	50	nA
V_{BR}	Reverse breakdown voltage	Pin 1 to pin 2, I_{BR} = 1 mA	13.6	14.3	15.3	V
V_F	Forward voltage	Pin 2 to pin 1, I_F = 10 mA		0.75		V
V_{CL} (1)	ESD clamping voltage	IEC 61000-4-2, C = 150 pF, R = 330 Ω, +8 kV contact discharge, measured at 30 ns		15.2		V
	EOS clamping voltage	IEC 61000-4-5 surge (8/20µs), I_{PP} = 57 A		20.8	22.7	V
R_d (1)	Dynamic resistance	8/20 µs waveform		0.1		Ω
$C_{I/O-GND}$ (1)	Line capacitance	Pin 1 to pin 2, $V_{I/O}$ = 0 V, 1 MHz, V_{OSC} = 30 mV		335		pF

1. *Specified by design – Not tested in production.*

Table 8. **ESDA17P50-1U1M Electrical characteristics (T_{amb} = 25 °C, unless otherwise specified)**

Symbol	Parameter definition	Test condition	Min.	Typ.	Max.	Unit
V_{RM}	Reverse Stand-Off voltage	Pin 1 to pin 2			15.0	V
I_{RM}	Reverse leakage current at V_{RM}	Pin 1 to pin 2, V_{RM} = 15.0 V		1.0	50	nA
V_{BR}	Reverse breakdown voltage	Pin 1 to pin 2, I_{BR} = 1 mA	15.6	16.4	17.4	V
V_F	Forward voltage	Pin 2 to pin 1, I_F = 10 mA		0.75		V
V_{CL} (1)	ESD clamping voltage	IEC 61000-4-2, C = 150 pF, R = 330 Ω, +8 kV contact discharge, measured at 30 ns		17.9		V
	EOS clamping voltage	IEC 61000-4-5 surge (8/20µs), I_{PP} = 46 A		24.4	26.5	V
R_d (1)	Dynamic resistance	8/20 µs waveform		0.15		Ω
$C_{I/O-GND}$ (1)	Line capacitance	Pin 1 to pin 2, $V_{I/O}$ = 0 V, 1 MHz, V_{OSC} = 30 mV		290		pF

1. *Specified by design – Not tested in production.*

Table 9. **ESDA20P50-1U1M Electrical characteristics (T_{amb} = 25 °C, unless otherwise specified)**

Symbol	Parameter definition	Test condition	Min.	Typ.	Max.	Unit
V_{RM}	Reverse Stand-Off voltage	Pin 1 to pin 2			18.0	V
I_{RM}	Reverse leakage current at V_{RM}	Pin 1 to pin 2, V_{RM} = 18.0 V		1.0	50	nA
V_{BR}	Reverse breakdown voltage	Pin 1 to pin 2, I_{BR} = 1 mA	18.5	19.5	20.5	V
V_F	Forward voltage	Pin 2 to pin 1, I_F = 10 mA		0.75		V
V_{CL} (1)	ESD clamping voltage	IEC 61000-4-2, C = 150 pF, R = 330 Ω, +8 kV contact discharge, measured at 30 ns		20.2		V
	EOS clamping voltage	IEC 61000-4-5 surge (8/20µs), I_{PP} = 40 A		27.5	31.0	V
R_d (1)	Dynamic resistance	8/20 µs waveform		0.2		Ω
$C_{I/O-GND}$ (1)	Line capacitance	Pin 1 to pin 2, $V_{I/O}$ = 0 V, 1 MHz, V_{OSC} = 30 mV		240		pF

1. *Specified by design – Not tested in production.*

Table 10. **ESDA25P35-1U1M Electrical characteristics (T_{amb} = 25 °C, unless otherwise specified)**

Symbol	Parameter definition	Test condition	Min.	Typ.	Max.	Unit
V_{RM}	Reverse Stand-Off voltage	Pin 1 to pin 2			22.0	V
I_{RM}	Reverse leakage current at V_{RM}	Pin 1 to pin 2, V_{RM} = 22.0 V			200	nA
V_{BR}	Reverse breakdown voltage	Pin 1 to pin 2, I_{BR} = 1 mA	23.3	24.6	25.8	V
V_F	Forward voltage	Pin 2 to pin 1, I_F = 10 mA		0.75		V
V_{CL} (1)	ESD clamping voltage	IEC 61000-4-2, C = 150 pF, R = 330 Ω, +8 kV contact discharge, measured at 30 ns		29.0	31.0	V
	EOS clamping voltage	IEC 61000-4-5 surge (8/20µs), I_{PP} = 35 A		39.0	41.0	V
R_d (1)	Dynamic resistance	8/20 µs waveform		0.45		Ω
$C_{I/O-GND}$ (1)	Line capacitance	Pin 1 to pin 2, $V_{I/O}$ = 0 V, 1 MHz, V_{OSC} = 30 mV		195		pF

1. *Specified by design – Not tested in production.*

1.1 Characteristics (curves)

Figure 2. Maximum peak power dissipation versus initial junction temperature

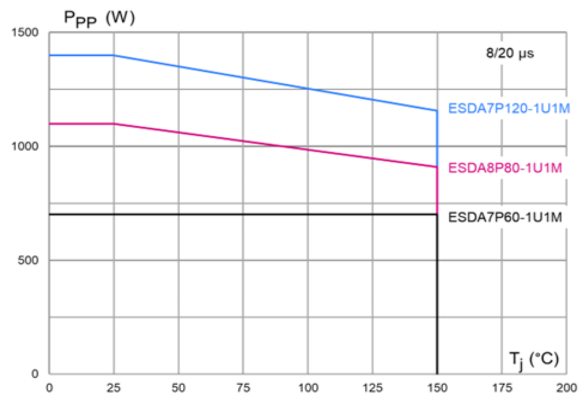


Figure 3. Maximum peak power dissipation versus initial junction temperature

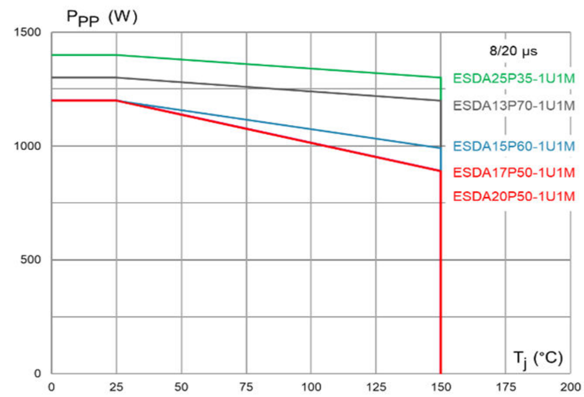


Figure 4. Maximum peak pulse power versus exponential pulse duration

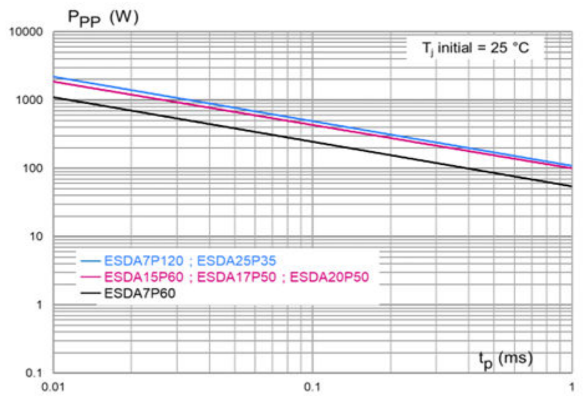


Figure 5. Maximum peak pulse current versus clamping voltage

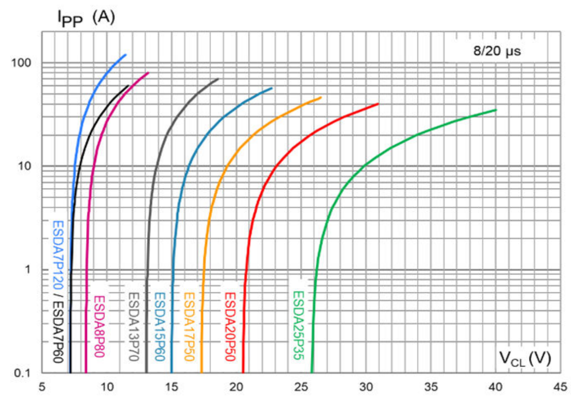


Figure 6. Maximum clamping voltage at I_{PP} max versus junction temperature

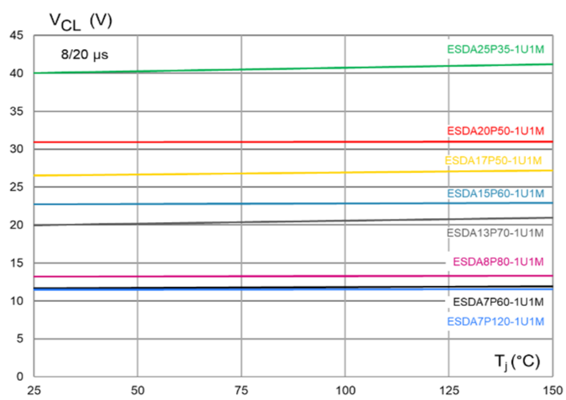


Figure 7. Leakage current versus junction temperature

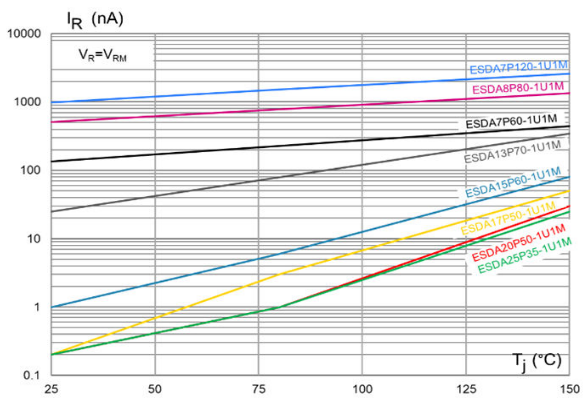


Figure 8. ESDA7P120-1U1M ESD response to IEC 61000-4-2 (+8kV contact discharge)

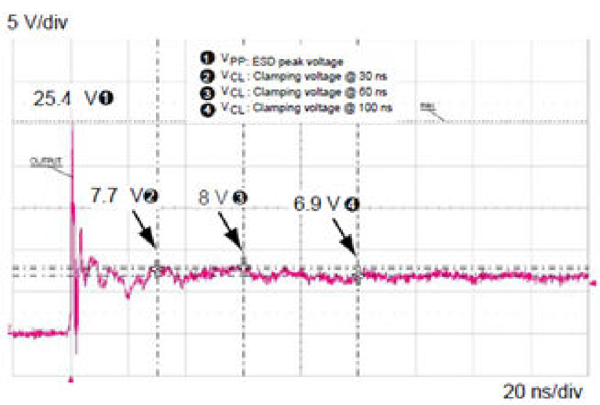


Figure 9. ESDA7P120-1U1M ESD response to IEC 61000-4-2 (-8kV contact discharge)

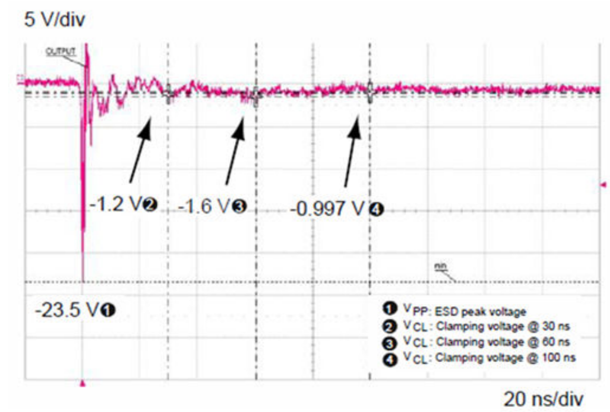
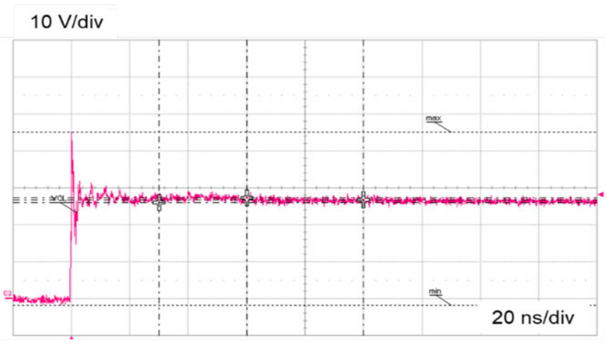
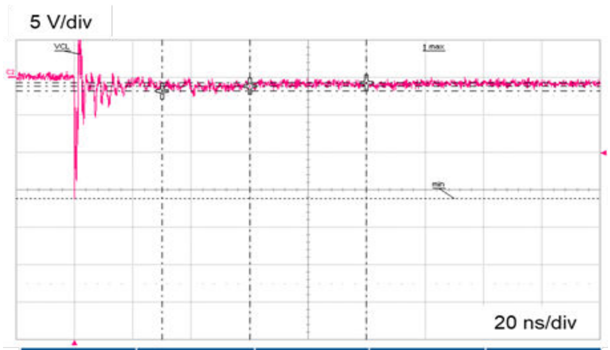


Figure 10. ESDA25P35-1U1M ESD response to IEC 61000-4-2 (+8kV contact discharge)



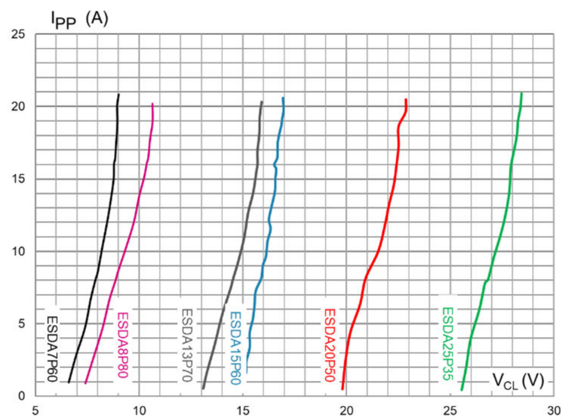
ESD level	V_{PP}	V_{CL}@30ns	V_{CL}@60ns	V_{CL}@100ns
+8kV	45V	26V	27V	27V

Figure 11. ESDA25P35-1U1M ESD response to IEC 61000-4-2 (-8kV contact discharge)



ESD level	V_{PP}	V_{CL}@30ns	V_{CL}@60ns	V_{CL}@100ns
-8kV	-16.2V	-1.8V	-1.2V	-0.8V

Figure 12. TLP



2 Package information

To meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions, and product status are available at: www.st.com. ECOPACK is an ST trademark.

2.1 QFN-2L 1.6 x 1.0 package information

Figure 13. QFN-2L 1.6 x 1.0 package outline

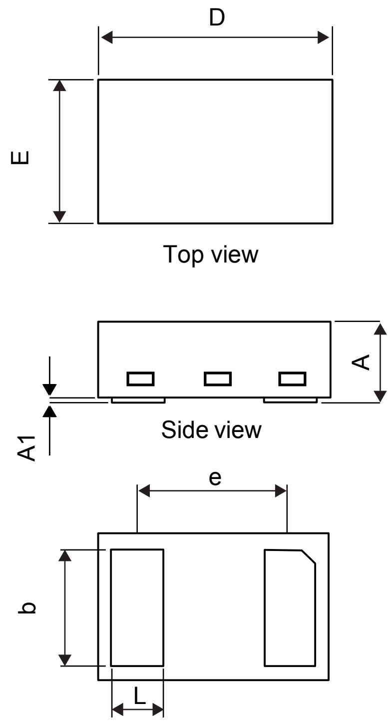


Table 11. QFN-2L 1.6 x 1.0 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches(1)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.51	0.55	0.60	0.0200	0.0217	0.0236
A1	0.00	0.02	0.05	0.0000	0.0008	0.0020
b	0.75	0.80	0.85	0.0295	0.0315	0.0335
D	1.55	1.60	1.65	0.0610	0.0630	0.0650
E	0.95	1.00	1.05	0.0370	0.0390	0.0420
e		1.05			0.0413	
L	0.30	0.35	0.40	0.0118	0.01378	0.0158

1. *Values in inches are converted from mm and rounded to 5 decimal digits.*

Figure 14. **Recommended footprint in mm**

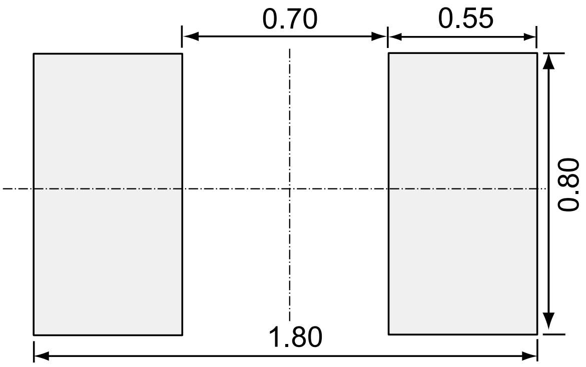
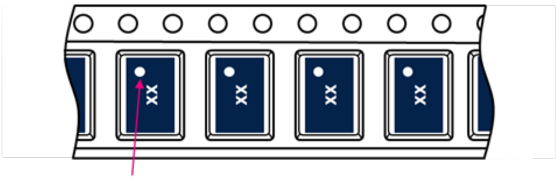


Figure 15. **Marking**

refer to Table 13. Ordering information for marking value

Figure 16. **Package orientation in reel**



Pin 1 located according to EIA-481

Note: Pocket dimensions are not on scale. Only pin 1 mark must be used to orient the component for its placement on a PCB.

Figure 17. **Tape and reel orientation**

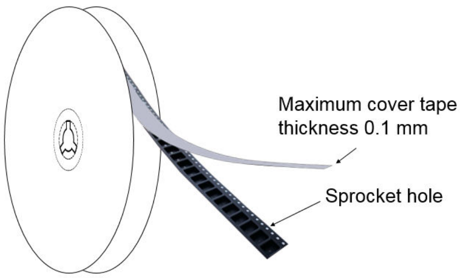


Figure 18. **7" reel dimension values (mm)**

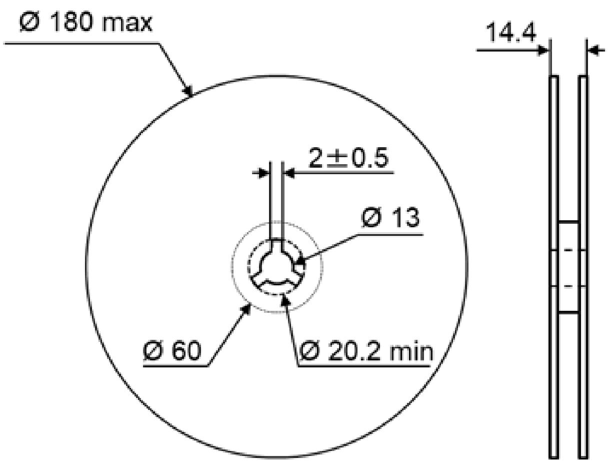


Figure 19. **Inner box dimension values (mm)**

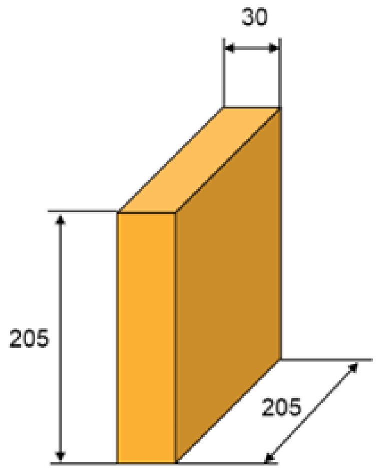
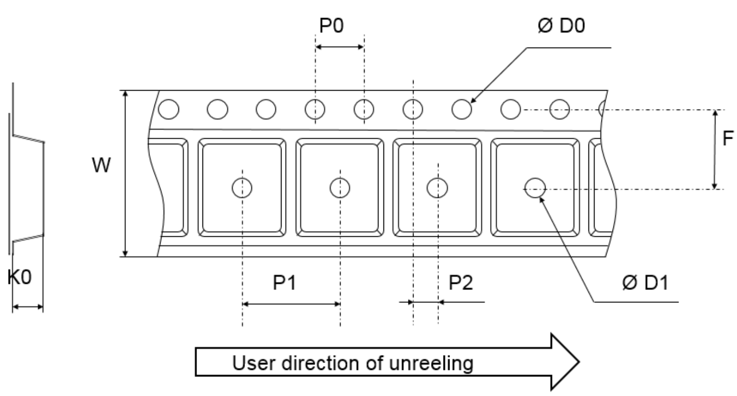


Figure 20. Tape outline

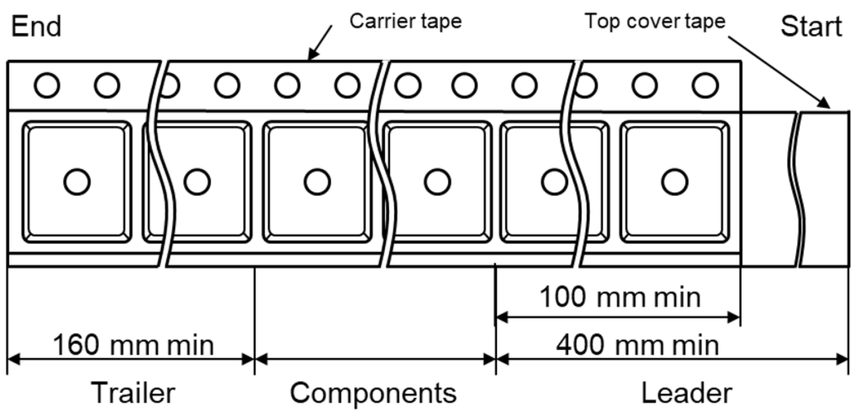


Note: Pocket dimensions are not on scale
Pocket shape may vary depending on package

Table 12. Tape dimension values

Ref.	Dimensions		
	Millimeters		
	Min.	Typ.	Max.
D0	1.50	1.55	1.60
D1	0.50		
F	3.45	3.50	3.55
K0	0.62	0.67	0.72
P0	3.90	4.00	4.10
P1	1.90	2.00	2.10
P2	1.90	2.00	2.10
W	7.90	8.00	8.10

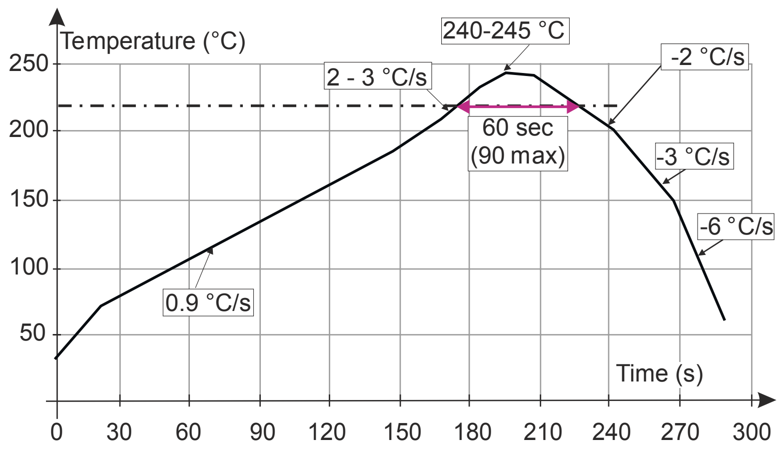
Figure 21. Tape information



3 Recommendation on PCB assembly

3.1 Reflow profile

Figure 22. ST ECOPACK recommended soldering reflow profile for PCB mounting



Note: Minimize air convection currents in the reflow oven to avoid component movement. O_2 rate inside the oven must be below 500 ppm. Maximum soldering profile corresponds to the latest IPC/JEDEC J-STD-020.

4 Ordering information

Figure 23. Ordering information scheme

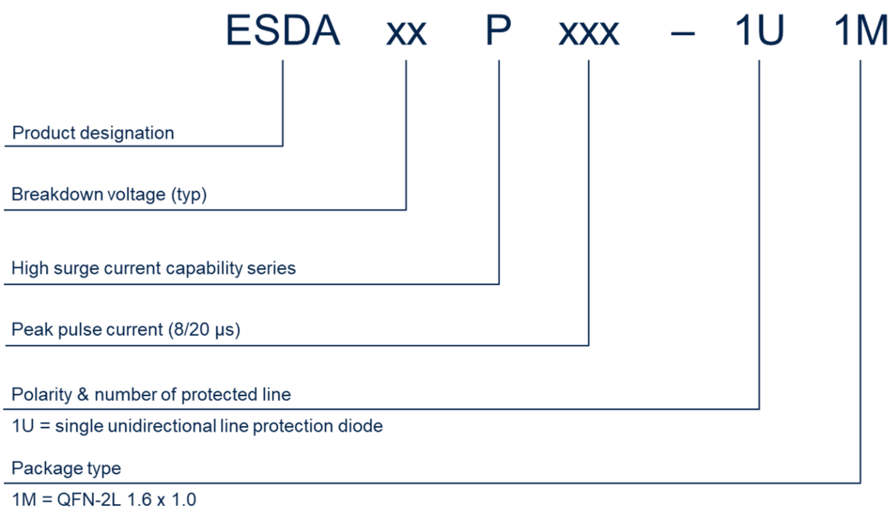


Table 13. Ordering information

Order code	Marking[1]	Package	Weight	Base qty.	Delivery mode
ESDA7P60-1U1M	F	QFN-2L 1.6 x 1.0	2.4 mg	8000	Tape and reel
ESDA7P120-1U1M	E				
ESDA8P80-1U1M	J				
ESDA13P70-1U1M	G				
ESDA15P60-1U1M	J				
ESDA17P50-1U1M	L				
ESDA20P50-1U1M	R				
ESDA25P35-1U1M	P				

1. *The marking can be rotated by multiples of 90° to differentiate assembly locations.*

Revision history

Table 14. Document revision history

Date	Revision	Changes
12-Sep-2023	1	Initial release.
12-Mar-2024	2	Updated *Table 11*.
17-Jan-2025	3	Updated *Table 2*.
11-Mar-2025	4	Updated Table 11.