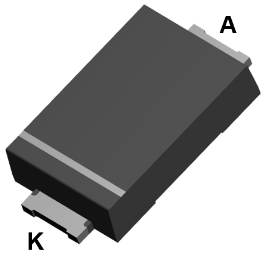
THE DATASHEET OF

SMA6F33AY

SMA6FxxAY

Datasheet

Automotive 600 W TVS in SMA Flat



SMA Flat
(Jedec DO221-AC)

Unidirectional

Product status link	
SMA6FY	SMA6F5.0AY, SMA6F6.0AY, SMA6F6.5AY, SMA6F8.5AY, SMA6F10AY, SMA6F11AY, SMA6F12AY, SMA6F13AY, SMA6F14AY, SMA6F15AY, SMA6F16AY, SMA6F18AY, SMA6F20AY, SMA6F22AY, SMA6F23AY, SMA6F24AY, SMA6F26AY, SMA6F28AY, SMA6F30AY, SMA6F31AY, SMA6F33AY, SMA6F36AY, SMA6F40AY, SMA6F48AY, SMA6F58AY, SMA6F64AY, SMA6F70AY, SMA6F85AY, SMA6F100AY, SMA6F130AY, SMA6F154AY, SMA6F170AY, SMA6F188AY

Features

- AEC-Q101 qualified
- Peak pulse power: 600 W (10/1000 µs) and 4 kW (8/20 µs)
- Flat and thin package: 1 mm
- Stand-off voltage range from 5 V to 188 V
- Unidirectional type
- Low leakage current: 0.2 µA at 25 °C and 1 µA at 85 °C
- Operating T_j max: 175 °C
- High power capability at T_j max.: up to 400 W (10/1000 µs)
- Lead finishing: matte tin plating

Complies with the following standards

- UL94, V0
- J-STD-020 MSL level 1
- J-STD-002, JESD 22-B102 E3 and MIL-STD-750, method 2026
- JESD-201 class 2 whisker test
- IPC7531 footprint and JEDEC registered package outline
- IEC 61000-4-4 level 4:
  - 4 kV
- ISO10605, IEC 61000-4-2, C = 150 pF - R = 330 Ω exceeds level 4:
  - 30 kV (contact discharge)
  - 30 kV (air discharge)
- ISO10605, C = 330 pF, R = 330 Ω exceeds level 4:
  - 30 kV (contact discharge)
  - 30 kV (air discharge)
- ISO7637-2 (Not applicable to parts with V_{RM} lower than battery voltage)
  - Pulse 1: V_S = -150 V
  - Pulse 2a: V_S = +112 V
  - Pulse 3a: V_S = -220 V
  - Pulse 3b: V_S = +150 V

Description

The SMA6FY Transil series are designed to protect sensitive automotive circuits against surges defined in ISO 7637 series and against electrostatic discharges according to ISO 10605.

The Planar technology makes it compatible with high-end circuits where low leakage current and high junction temperature are required to provide long term reliability and stability.

1 Characteristics

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

Symbol	Parameter		Value	Unit
V_{PP}	Peak pulse voltage	ISO10605 (C = 330 pF, R = 330 Ω): Contact discharge Air discharge	 30 30	kV
		ISO10605 / IEC 61000-4-2 (C = 150 pF, R = 330 Ω) Contact discharge Air discharge	 30 30	
P_{PP}	Peak pulse power dissipation	10/1000 µs, T_j initial = T_{amb}	600	W
T_{stg}	Storage temperature range		-65 to +175	°C
T_j	Operating junction temperature range		-55 to +175	°C
T_L	Maximum lead temperature for soldering during 10 s		260	°C

Figure 1. **Electrical characteristics - parameter definitions**

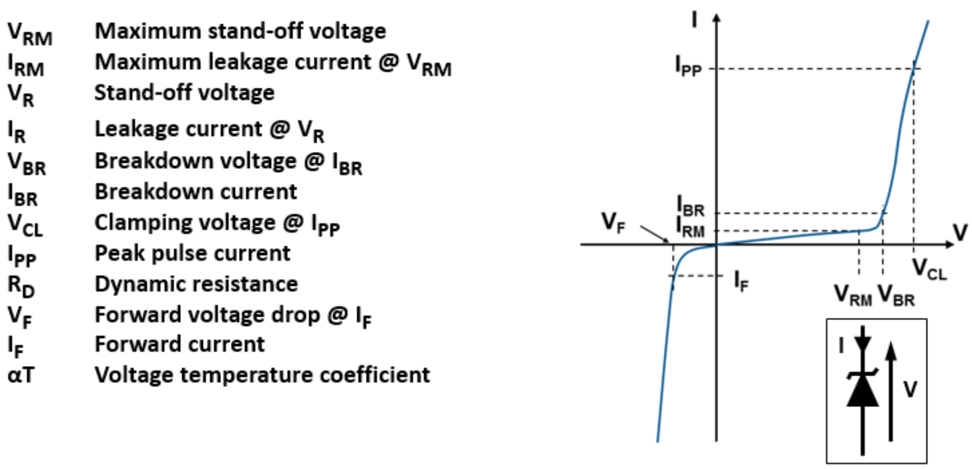


Figure 2. **Pulse definition for electrical characteristics**

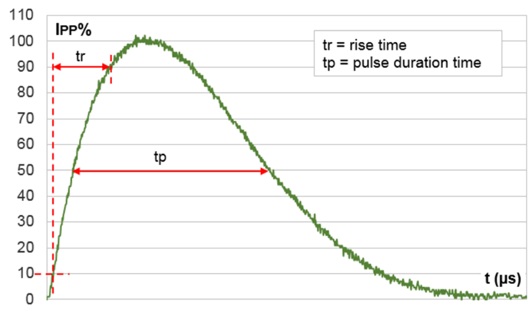


Table 2. Electrical characteristics - parameter values (T_{amb} = 25 °C, unless otherwise specified)

Type	I_{RM} max at V_{RM}			V_{BR} at I_R (1)				10 / 1000 µs			8 / 20 µs			αT
								V_{CL} (2)(3)	I_{PP} (4)	R_D	V_{CL} (2)(3)	I_{PP} (4)	R_D	
	25 °C	85 °C		Min.	Typ.	Max.		Max.		Max.	Max.		Max.	Max.
	µA		V	V			mA	V	A	Ω	V	A	Ω	10^{-4}/°C
SMA6F5.0AY	20	50	5.0	6.4	6.74	7.1	10	9.2	68	0.031	13.4	298	0.021	5.7
SMA6F6.0AY	20	50	6.0	6.7	7.05	7.4	10	10.3	61	0.048	13.7	290	0.022	5.9
SMA6F6.5AY	20	50	6.5	7.2	7.58	8	10	11.2	56	0.057	14.5	276	0.024	6.1
SMA6F8.5AY	20	50	8.5	9.4	9.9	10.4	1	14.4	41.7	0.096	19.5	205	0.044	7.3
SMA6F10AY	0.2	1	10	11.1	11.7	12.3	1	17	37	0.127	21.7	184	0.051	7.8
SMA6F11AY	0.2	1	11	12.3	13	13.7	1	18	33.8	0.127	24.2	165	0.064	8.1
SMA6F12AY	0.2	1	12	13.3	14	14.7	1	19.9	31	0.168	25.3	157	0.068	8.3
SMA6F13AY	0.2	1	13	14.4	15.2	16	1	21.5	29	0.190	27.2	147	0.076	8.4
SMA6F14AY	0.2	1	14	15.7	16.5	17.3	1	23.1	26	0.223	29	136	0.086	8.6
SMA6F15AY	0.2	1	15	16.7	17.6	18.5	1	24.4	25.1	0.235	32.5	123	0.114	8.8
SMA6F16AY	0.2	1	16	17.9	18.8	19.8	1	26	23.1	0.268	34.7	115	0.130	9.0
SMA6F18AY	0.2	1	18	20	21.1	22.2	1	29.2	21.5	0.326	39.3	102	0.168	9.2
SMA6F20AY	0.2	1	20	22.2	23.4	24.6	1	32.4	19.4	0.402	42.8	93	0.196	9.4
SMA6F22AY	0.2	1	22	24.4	25.7	27	1	35.5	17.7	0.480	48.3	83	0.257	9.6
SMA6F23AY	0.2	1	23	25.7	27	28.4	1	37.8	16.4	0.573	49.2	81	0.257	9.6
SMA6F24AY	0.2	1	24	26.7	28.1	29.5	1	38.9	16	0.588	50	80	0.256	9.6
SMA6F26AY	0.2	1	26	28.9	30.4	31.9	1	42.1	14.9	0.685	53.5	75	0.288	9.7
SMA6F28AY	0.2	1	28	31.1	32.7	34.3	1	45.4	13.8	0.804	59	68	0.363	9.8
SMA6F30AY	0.2	1	30	33.2	35	36.8	1	48.4	13	0.885	64.3	62	0.442	9.9
SMA6F31AY	0.2	1	31	34.2	36	37.8	1	50.2	12.3	1.01	65	61	0.45	9.9
SMA6F33AY	0.2	1	33	36.7	38.6	40.5	1	53.3	11.8	1.08	69.7	57	0.512	10
SMA6F36AY	0.2	1	36	40	42.1	44.2	1	58.1	10.3	1.35	76	52	0.612	10
SMA6F40AY	0.2	1	40	44.4	46.7	49	1	64.5	9.7	1.60	84	48	0.729	10.1
SMA6F48AY	0.2	1	48	53.2	56	58.8	1	77.4	8.1	2.28	100	40	1.03	10.3
SMA6F58AY	0.2	1	58	64.6	68	71.4	1	93.6	6.7	3.34	121	33	1.51	10.4
SMA6F64AY	0.2	1	64	71.1	74.8	78.6	1	103	5.8	4.17	134	30	1.84	10.5
SMA6F70AY	0.2	1	70	77.9	82	86.1	1	113	5.5	4.91	146	27	2.22	10.5
SMA6F85AY	0.2	1	85	95	100	105	1	137	4.6	7.17	178	22.5	3.29	10.6
SMA6F100AY	0.2	1	100	111	117	123	1	162	3.8	10.3	212	19	4.68	10.7
SMA6F130AY	0.2	1	130	144	152	160	1	209	3	16.3	265	15	7	10.8
SMA6F154AY	0.2	1	154	171	180	189	1	246	2.4	23.8	317	12.6	10.2	10.8
SMA6F170AY	0.2	1	170	190	200	210	1	275	2.2	30	353	11.3	12.7	10.8
SMA6F188AY	0.2	1	188	209	220	231	1	328	2	48.5	388	10.3	15.2	10.8

1. *To calculate V_{BR} versus T_j: V_{BR} at $T_J = V_{BR}$ at 25 °C x (1 + αT x (T_j - 25))*
2. *To calculate V_{CLmax} versus $I_{PPappli}$: $V_{CLmax} = V_{BR\,max} + R_D$ x $I_{PPappli}$*
3. *To calculate V_{CL} versus T_j: V_{CL} at $T_J = V_{CL}$ at 25 °C x (1 + αT x (T_j - 25))*

4. Surge capability given for both directions

1.1 Characteristics (curves)

Figure 3. Maximum peak power dissipation versus initial junction temperature

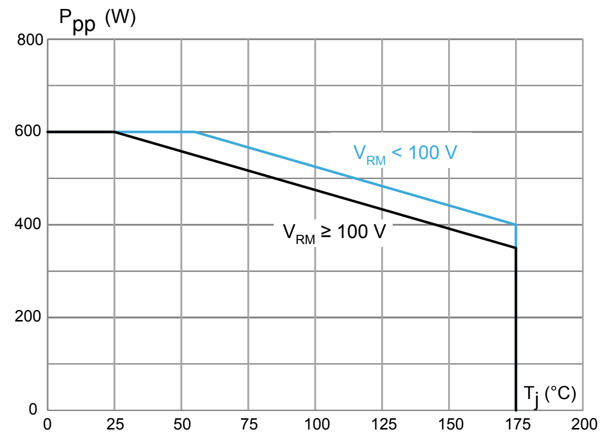


Figure 4. Maximum peak pulse power versus exponential pulse duration

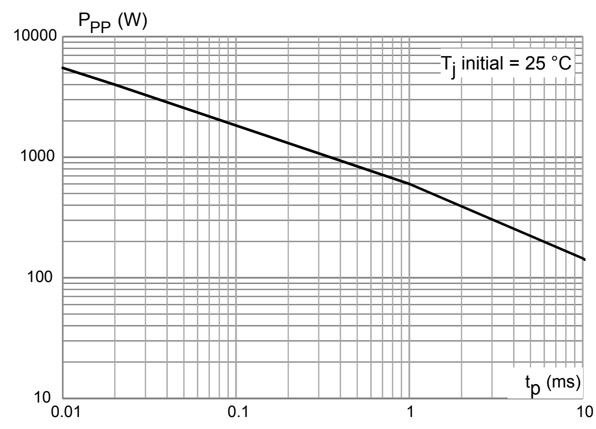


Figure 5. Maximum clamping voltage versus peak pulse current

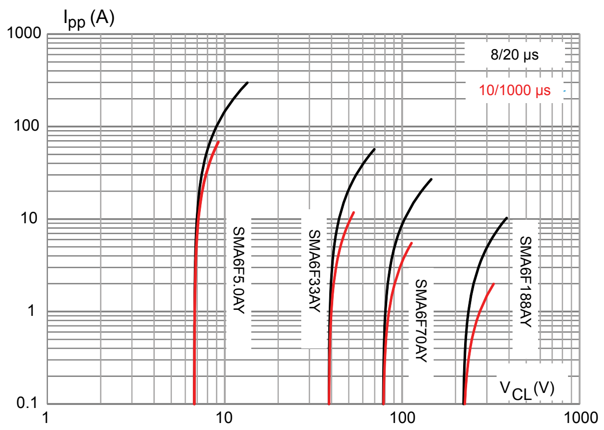


Figure 6. Dynamic resistance versus pulse duration

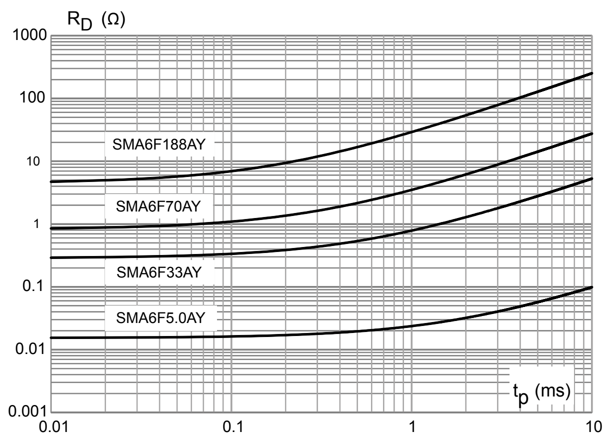


Figure 7. Junction capacitance versus reverse applied voltage (unidirectional types)

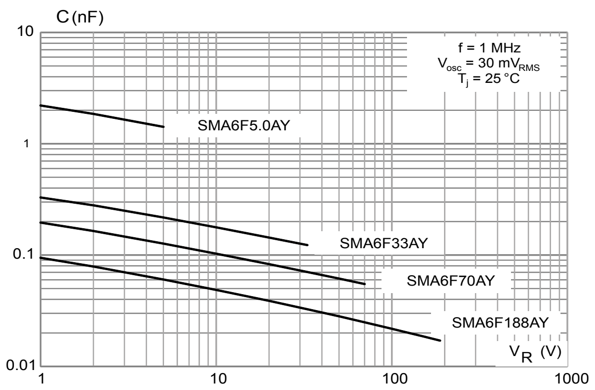


Figure 8. Leakage current versus junction temperature

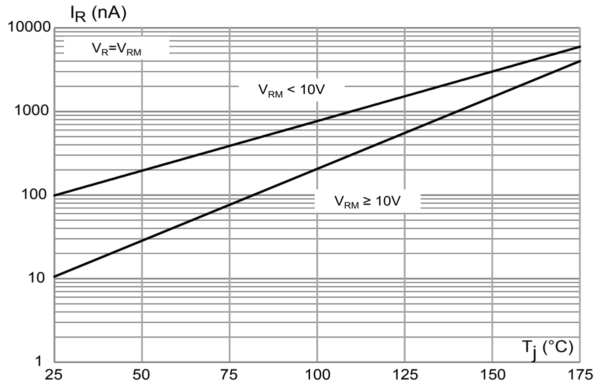


Figure 9. Peak forward voltage drop versus peak forward current

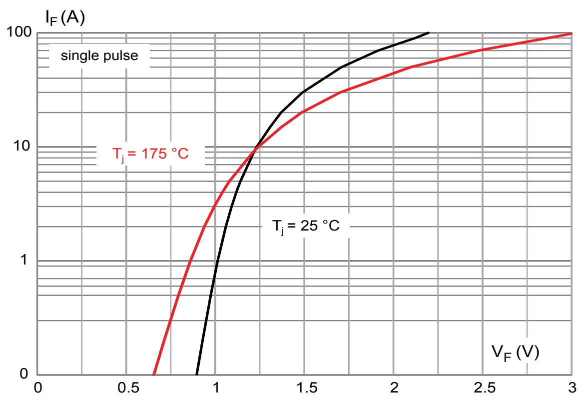


Figure 10. Thermal impedance junction to ambient versus pulse duration

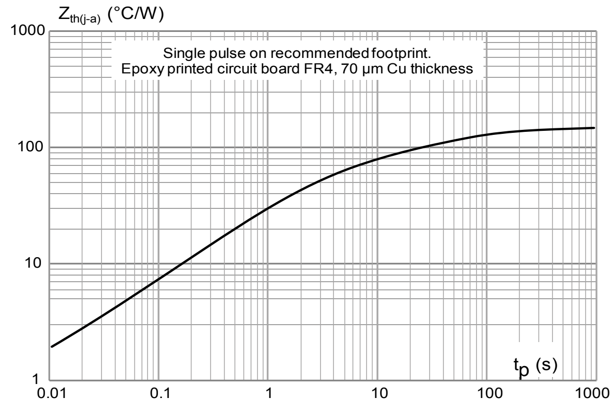


Figure 11. Thermal resistance junction to ambient versus copper area under each lead

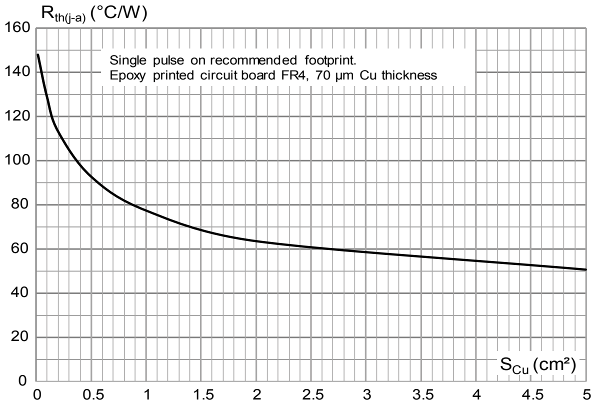


Figure 12. ISO7637-2 pulse 1: Vs = -150 V with 12 V battery

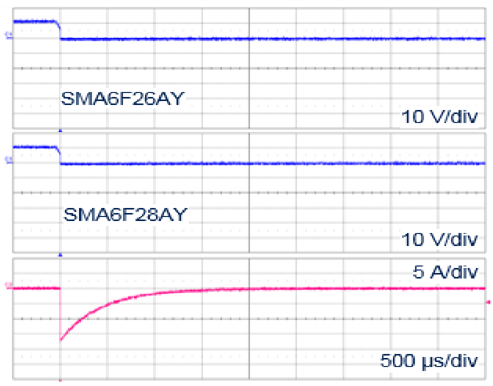


Figure 13. ISO7637-2 pulse 2a: Vs = +112 V with 12 V battery

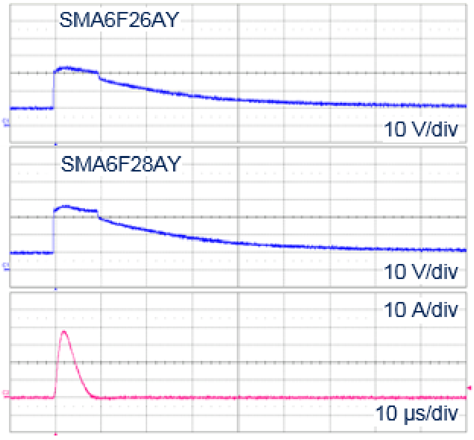


Figure 14. ISO7637-2 pulse 3a: Vs = -220 V with 12 V battery

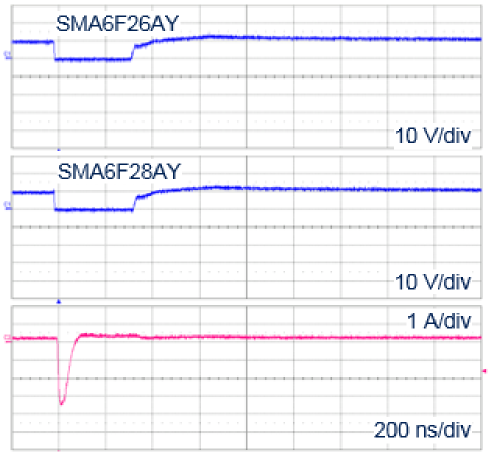
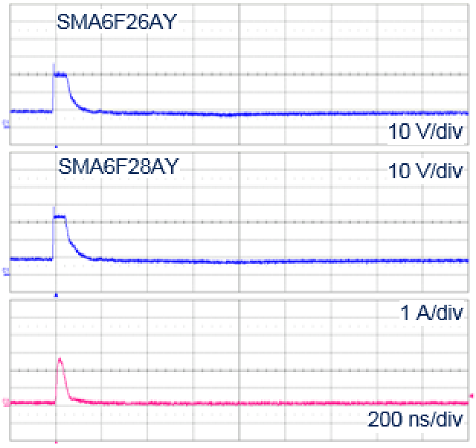


Figure 15. ISO7637-2 pulse 3b: Vs = +150 V with 12 V battery



2 Package information

In order 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 SMA Flat package information

Figure 16. SMA Flat package outline

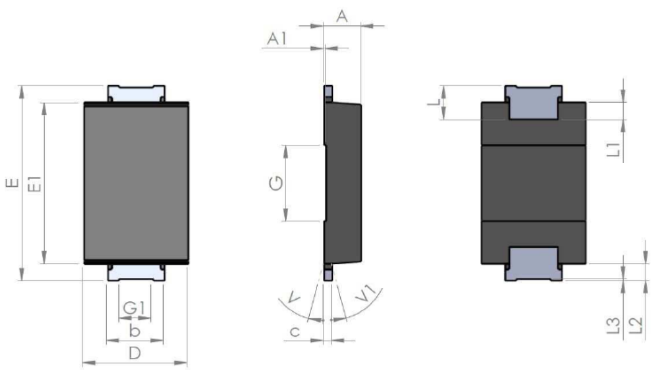


Table 3. SMA Flat mechanical data

Symbol	Millimeters			Inches(1)		
	Min	Typ	Max	Min	Typ	Max
A	0.90		1.10	0.035		0.044
A1		0.05			0.002	
b	1.25		1.65	0.049		0.065
c	0.15		0.40	0.005		0.016
D	2.25		2.90	0.088		0.115
E	5.00		5.35	0.196		0.211
E1	3.95		4.60	0.155		0.182
G		2.00			0.079	
G1		0.85			0.033	
L	0.75		1.20	0.029		0.048
L1		0.45			0.018	
L2		0.45			0.018	
L3		0.05			0.002	
V			8°			8°
V1			8°			8°

1. *Values in inches are converted from mm and rounded to 3 decimal digits.*

Figure 17. SMA Flat recommended footprint in mm (inches)

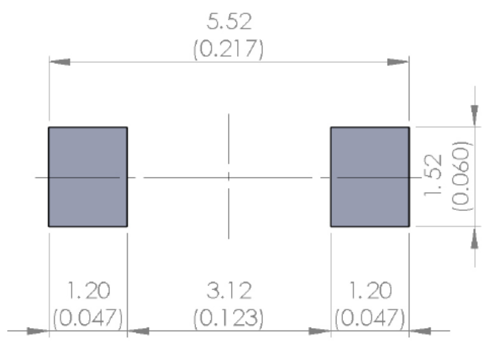


Figure 18. SMA Flat marking

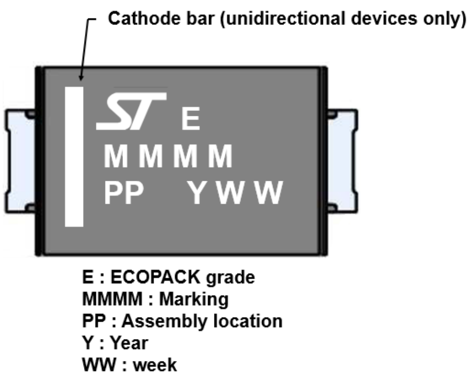
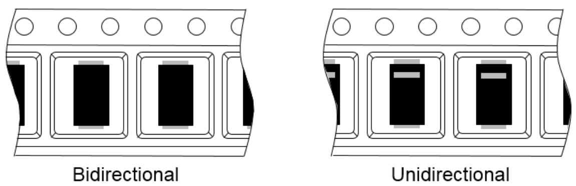


Figure 19. Package orientation in reel



Taped according to EIA-481
Pocket dimensions are not on scale.
Pocket shape may vary depending on package
On bidirectional devices, marking and logo may not be always in the same direction.

Figure 20. Tape and reel orientation

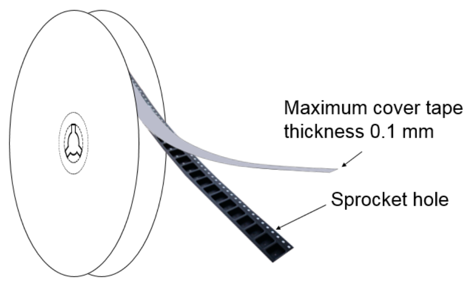


Figure 21. 13" reel dimension values

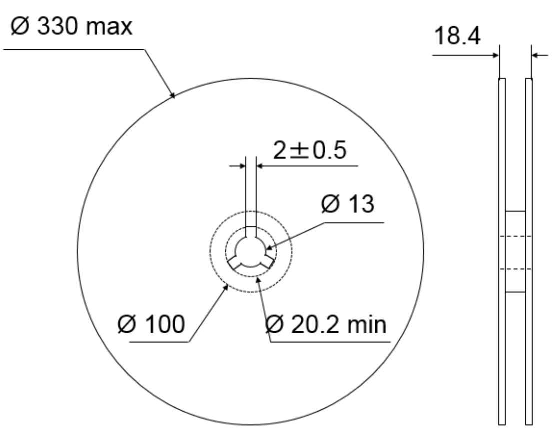


Figure 22. Inner box dimension values

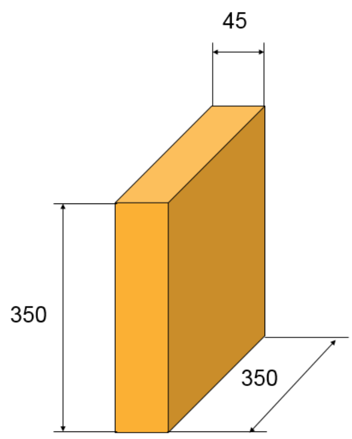


Figure 23. Tape outline

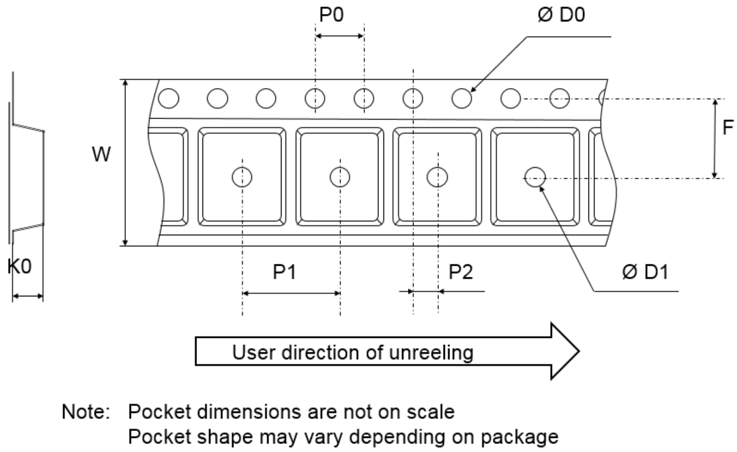
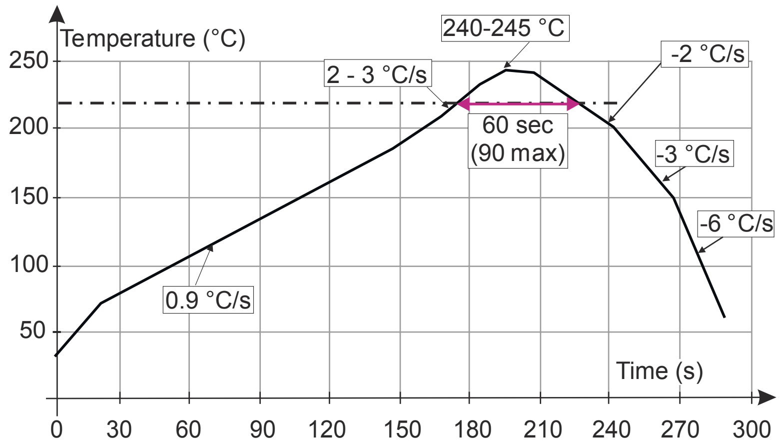


Table 4. Tape dimension values

Ref.	Dimensions		
	Millimeters		
	Min.	Typ.	Max.
D0	1.5	1.55	1.6
D1	1.5		
F	5.4	5.5	5.6
K0	1.1	1.2	1.3
P0	3.9	4.0	4.1
P1	3.9	4.0	4.1
P2	1.9	2.0	2.1
W	11.7	12	12.3

2.2 Reflow profile

Figure 24. ST ECOPACK recommended soldering reflow profile for PCB mounting



Note: Minimize air convection currents in the reflow oven to avoid component movement. Maximum soldering profile corresponds to the latest IPC/JEDEC J-STD-020.

3 Application and design guidelines

More information is available in the application note AN2689 “Protection of automotive electronics from electrical hazards, guidelines for design and component selection”.

4 Ordering information

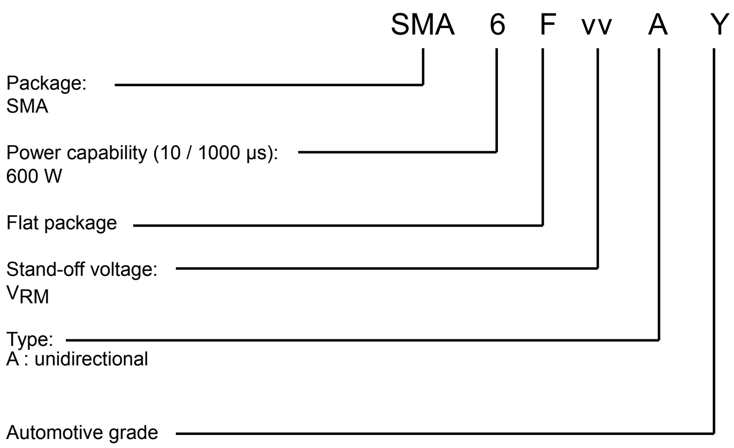


Figure 25. Ordering information scheme

Table 5. Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
SMA6FxxxAY	See Table 6. Marking.	SMA Flat	39 mg	10000	Tape and reel

4.1 Marking

Table 6. Marking

Order code	Marking
SMA6F5.0AY	6AIY
SMA6F6.0AY	6AKY
SMA6F6.5AY	6ALY
SMA6F8.5AY	6APY
SMA6F10AY	6ASY
SMA6F11AY	6AUY
SMA6F12AY	6AWY
SMA6F13AY	6AYY
SMA6F14AY	6BAY
SMA6F15AY	6BCY
SMA6F16AY	6BEY
SMA6F18AY	6BIY
SMA6F20AY	6BMY
SMA6F22AY	6BOY
SMA6F23AY	6BPY
SMA6F24AY	6BQY
SMA6F26AY	6BSY
SMA6F28AY	6BUY
SMA6F30AY	6BWY
SMA6F31AY	6BXY
SMA6F33AY	6BZY
SMA6F36AY	6CCY
SMA6F40AY	6CGY
SMA6F48AY	6COY
SMA6F58AY	6CYY
SMA6F64AY	6DEY
SMA6F70AY	6DKY
SMA6F85AY	6DZY
SMA6F100AY	6EOY
SMA6F130AY	6FSY
SMA6F154AY	6GQY
SMA6F170AY	6HGY
SMA6F188AY	6HYY

Revision history

Table 7. **Document revision history**

Date	Version	Changes
24-Sep-2018	1	Initial release.
26-Aug-2019	2	Updated Table 1. Absolute maximum ratings (T_{amb} = 25 °C), Figure 10. Thermal impedance junction to ambient versus pulse duration, Figure 11. Thermal resistance junction to ambient versus copper area under each lead.
07-Jan-2020	3	Updated links syntax.