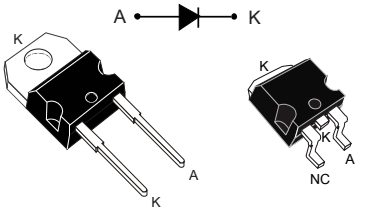
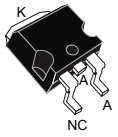
STPSC12065-Y

Datasheet

Automotive 650 V, 12 A, silicon carbide power Schottky diode





D²PAK HV

Product label
SUSTAINABLE TECHNOLOGY

Product status link
STPSC12065-Y

Product summary	
$I_{F(AV)}$	12 A
V_{RRM}	650 V
T_j (max.)	175 °C
V_F (typ.)	1.30 V

Features

- AEC-Q101 qualified
- No or negligible reverse recovery
- Switching behavior independent of temperature
- Dedicated to PFC applications
- High forward surge capability
- PPAP capable
- Operating T_j from -40 °C to 175 °C
- V_{RRM} guaranteed from -40 to +175 °C
- D²PAK HV creepage distance (anode to cathode) = 5.38 mm min. (with top coating)
- ECOPACK®2 compliant

Applications

- On board charger

Description

The SiC diode is an ultra high performance power Schottky diode. It is manufactured using a silicon carbide substrate. The wide band gap material allows the design of a Schottky diode structure with a 650 V rating. Due to the Schottky construction, no recovery is shown at turn-off and ringing patterns are negligible. The minimal capacitive turn-off behavior is independent of temperature.

Especially suited for use in PFC applications, the STPSC12065-Y will boost performance in hard switching conditions. Its high forward surge capability ensures good robustness during transient phases.

1 Characteristics

Table 1. Absolute ratings (limiting values at 25 °C, unless otherwise specified)

Symbol	Parameter		Value	Unit
V_{RRM}	Repetitive peak reverse voltage (T_j = -40 °C to +175 °C)		650	V
$I_{F(RMS)}$	Forward rms current		22	A
$I_{F(AV)}$	Average forward current	T_c = 145 °C(1), DC	12	A
I_{FRM}	Repetitive peak forward current	T_c =145 °C(1), T_j = 175 °C, δ = 0.1	53	A
I_{FSM}	Surge non repetitive forward current	t_p = 10 ms sinusoidal, T_c = 25 °C	50	A
		t_p = 10 ms sinusoidal, T_c = 125 °C	40	
		t_p = 10 µs square, T_c = 25 °C	220	
T_{stg}	Storage temperature range		-55 to +175	°C
T_j	Operating junction temperature		-40 to +175	°C

1. *Value based on $R_{th(j-c)}$ max.*

Table 2. Thermal resistance parameters

Symbol	Parameter	Value		Unit
		Typ.	Max.	
$R_{th(j-c)}$	Junction to case	0.85	1.25	°C/W

Table 3. Static electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_R (1)	Reverse leakage current	T_j = 25 °C	$V_R = V_{RRM}$	-	15	150	µA
		T_j = 150 °C		-	200	1000	
		T_j = 25 °C	V_R = 600 V		8	50	
V_F (2)	Forward voltage drop	T_j = 25 °C	I_F = 12 A	-	1.30	1.45	V
		T_j = 150 °C		-	1.45	1.65	
		T_j = 175 °C		-	1.50		

1. *Pulse test: t_p = 5 ms, δ < 2%*
2. *Pulse test: t_p = 500 µs, δ < 2%*

To evaluate the conduction losses, use the following equation:

$P = 1.02 \times I_{F(AV)} + 0.065 \times I_F{}^2{}_{(RMS)}$

Table 4. Dynamic electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Q_{Cj} (1)	Total capacitive charge	V_R = 400 V	-	36	-	nC

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_j	Total capacitance	V_R = 0 V, T_c = 25 °C, F = 1 MHz	-	750	-	pF
		V_R = 400 V, T_c = 25 °C, F = 1 MHz	-	60	-	

1. *Most accurate value for the capacitive charge:* $Q_{cj}(V_R) = \int_0^{V_R} C_j(V)dV$

1.1 Characteristics (curves)

Figure 1. Forward voltage drop versus forward current (typical values)

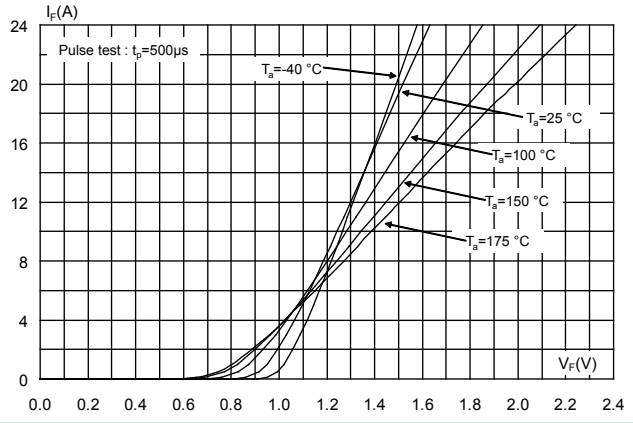


Figure 2. Reverse leakage current versus reverse voltage applied (typical values)

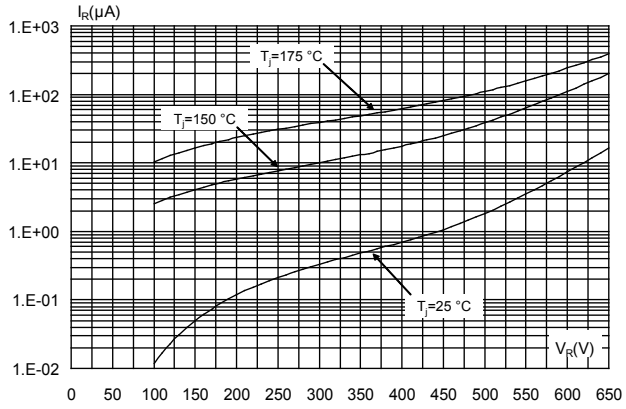


Figure 3. Peak forward current versus case temperature

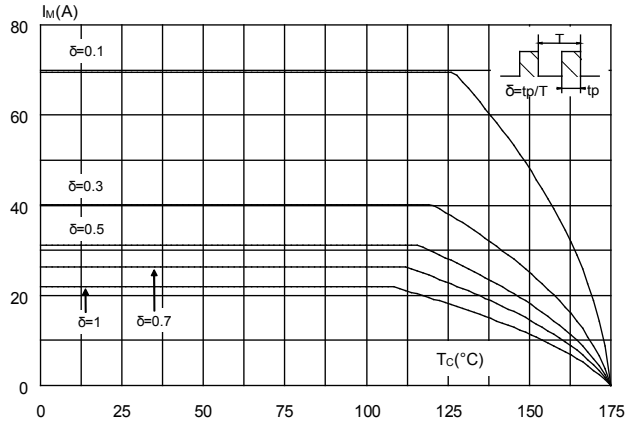


Figure 4. Junction capacitance versus reverse voltage applied (typical values)

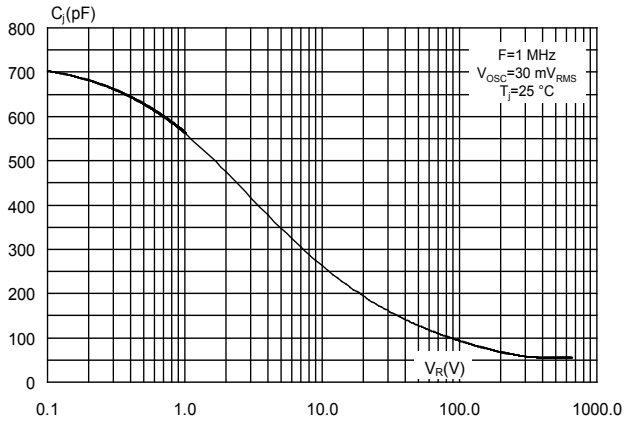


Figure 5. Relative variation of thermal impedance junction to case versus pulse duration

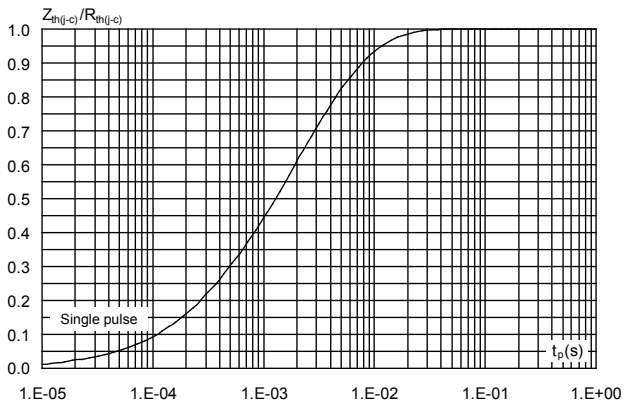


Figure 6. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)

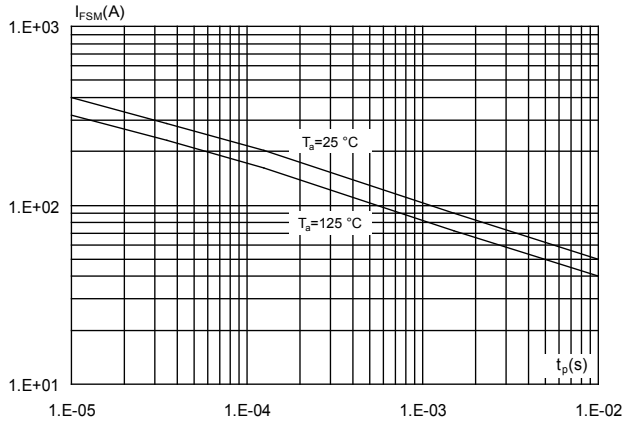


Figure 7. Total capacitive charges versus reverse voltage applied (typical values)

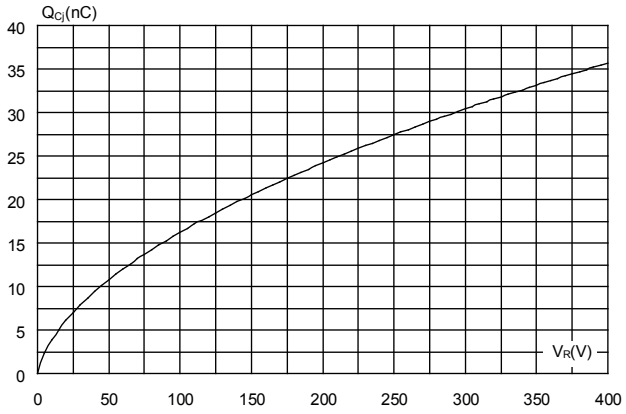
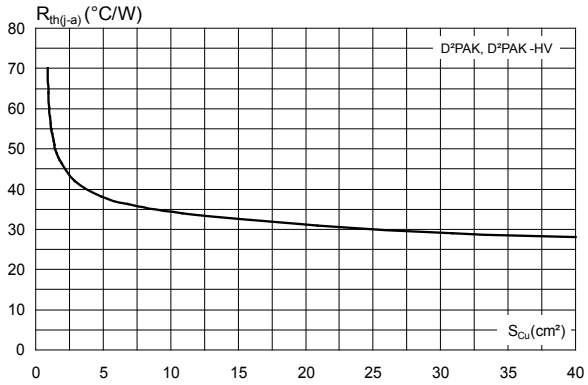


Figure 8. Thermal resistance junction to ambient versus copper surface under tab (typical values, epoxy printed board FR4, e_{Cu} = 35 µm)



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 TO-220AC package information

- Epoxy meets UL 94,V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.70 N·m

Figure 9. TO-220AC package outline

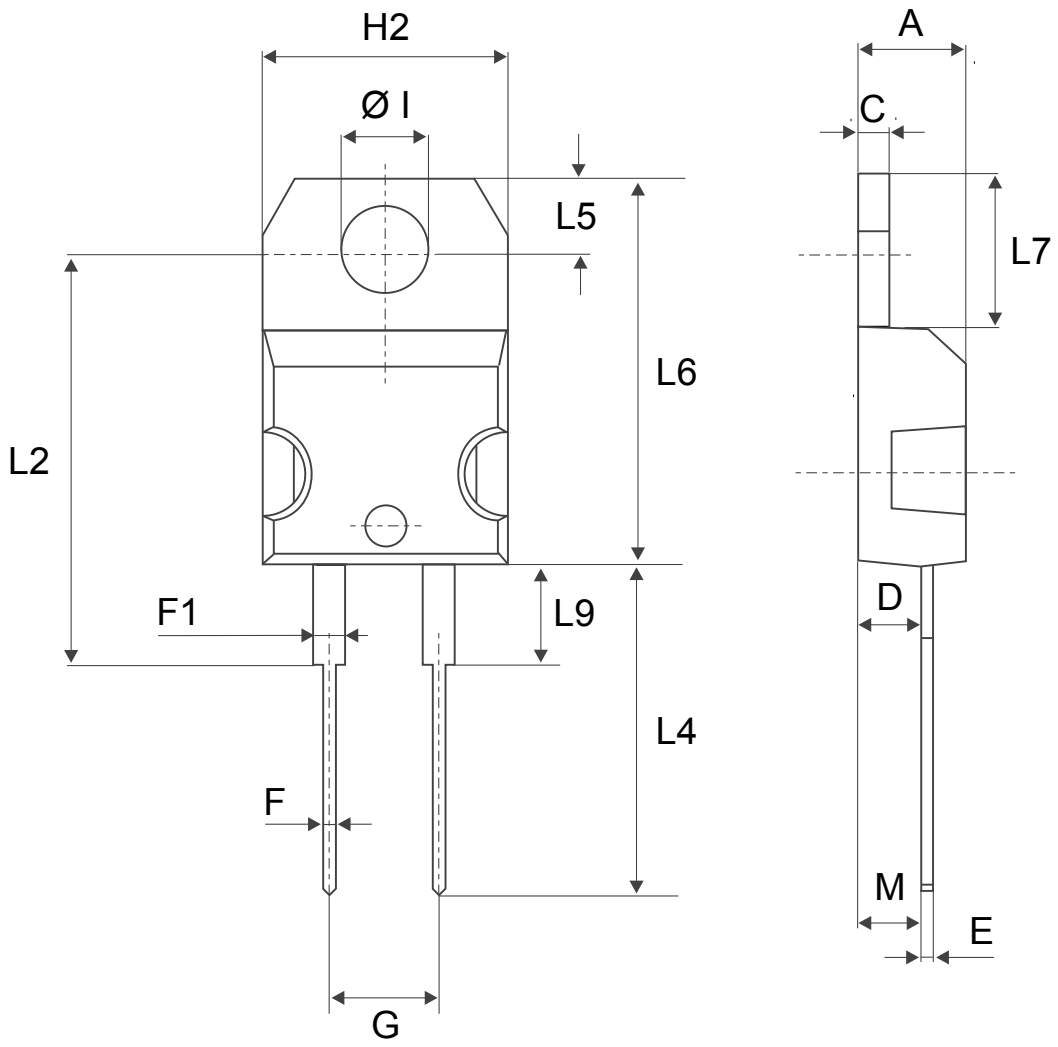


Table 5. TO-220AC package mechanical data

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
C	1.23	1.32	0.048	0.051
D	2.40	2.72	0.094	0.107
E	0.49	0.70	0.019	0.027
F	0.61	0.88	0.024	0.034
F1	1.14	1.70	0.044	0.066
G	4.95	5.15	0.194	0.202
H2	10.00	10.40	0.393	0.409
L2	16.40 typ.		0.645 typ.	
L4	13.00	14.00	0.511	0.551
L5	2.65	2.95	0.104	0.116
L6	15.25	15.75	0.600	0.620
L7	6.20	6.60	0.244	0.259
L9	3.50	3.93	0.137	0.154
M	2.6 typ.		0.102 typ.	
ØI	3.75	3.85	0.147	0.151

2.2 D²PAK package information

- Epoxy meets UL94, V0.
- Cooling method: by conduction (C)

Figure 10. D²PAK package outline

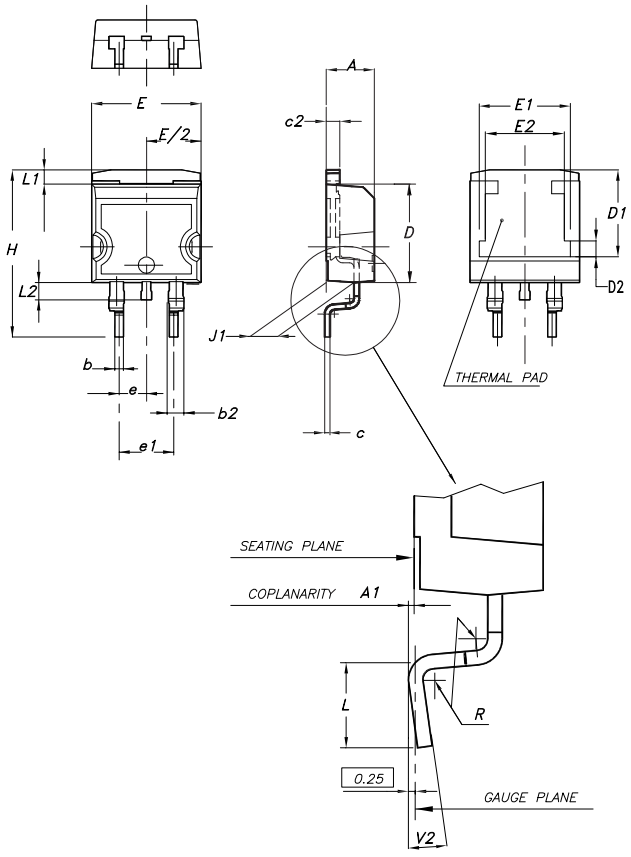
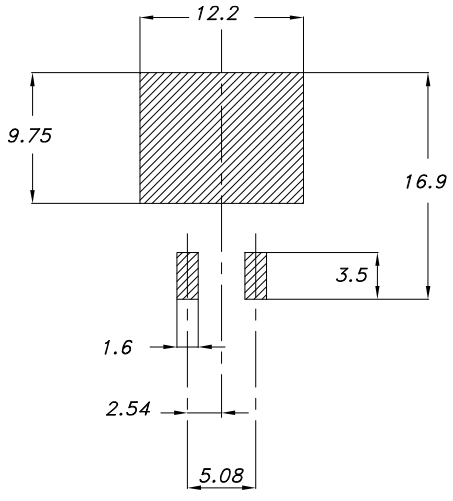


Table 6. D²PAK package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.028		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.018		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50	7.75	8.00	0.295	0.305	0.315
D2	1.10	1.30	1.50	0.043	0.051	0.060
E	10		10.40	0.394		0.409

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
E1	8.30	8.50	8.70	0.326	0.335	0.343
E2	6.85	7.05	7.25	0.266	0.278	0.282
e		2.54			0.100	
e1	4.88		5.28	0.190		0.205
H	15		15.85	0.591		0.624
J1	2.49		2.69	0.097		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.049		0.055
L2	1.30		1.75	0.050		0.069
R		0.4			0.015	
V2	0°		8°	0°		8°

Figure 11. D²PAK recommended footprint (dimensions are in mm)



2.3 D²PAK high voltage package information

Figure 12. D²PAK high voltage package outline

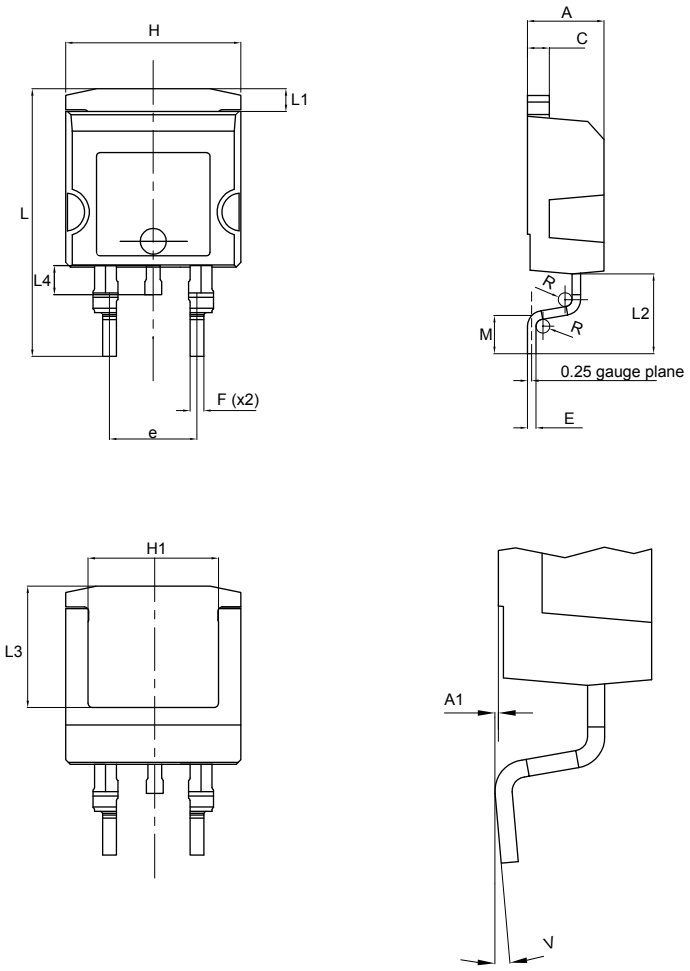
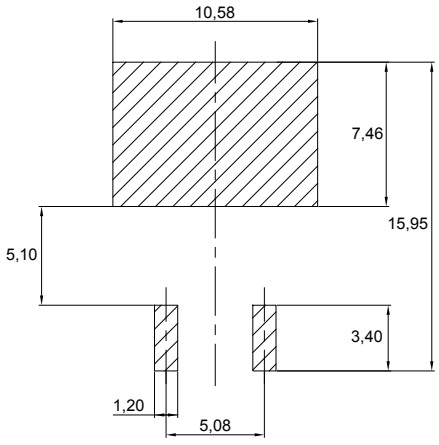


Table 7. D²PAK high voltage package mechanical data

Ref.	Dimensions		
	Min.	Typ.	Max.
A	4.30		4.70
A1	0.03		0.20
C	1.17		1.37
e	4.98		5.18
E	0.50		0.90
F	0.78		0.85
H	10.00		10.40
H1	7.40		7.80
L	15.30		15.80
L1	1.27		1.40
L2	4.93		5.23
L3	6.85		7.25
L4	1.5		1.7
M	2.6		2.9
R	0.20		0.60
V	0°		8°

Figure 13. D²PAK High Voltage footprint in mm



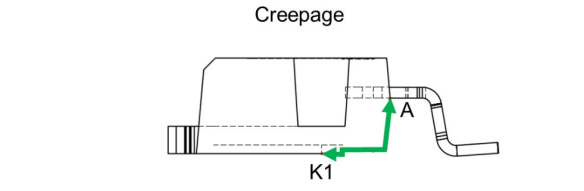
2.3.1 Creepage distance between Anode and Cathode

Table 8. Creepage distance between anode and cathode

Symbol	Parameter		Value	Unit
Cd_{A-K1}	Minimum creepage distance between A and K1 (with top coating)	D²PAK HV	5.38	mm
Cd_{A-K2}	Minimum creepage distance between A and K2 (without top coating)		3.48	

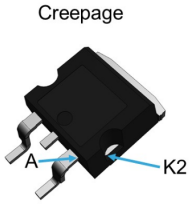
Note: D²PAK HV creepage distance (anode to cathode) = 5.38 mm min. (refer to IEC 60664-1)

Figure 14. Creepage with top coating



Minimum distance between A & K1 = 5.38 mm (with top coating)

Figure 15. Creepage without top coating



Minimum distance between A & K2 = 3.48 mm (without top coating)

3 Ordering information

Table 9. Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
STPSC12065DY	PSC12065DY	TO-220AC	1.86 g	50	Tube
STPSC12065GY-TR	PSC12065GY	D²PAK	1.48 g	1000	Tape and reel
STPSC12065G2Y-TR	PSC12065G2Y	D²PAK HV	1.48 g	1000	Tape and reel

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
10-May-2016	1	First issue.
06-Nov-2017	2	Added D²PAK package.
10-Sep-2018	3	Added D²PAK HV package.
04-Dec-2018	4	Updated Section 2.3.1 Creepage distance between anode and cathode. Minor text changes to improve readability. Updated title of document.