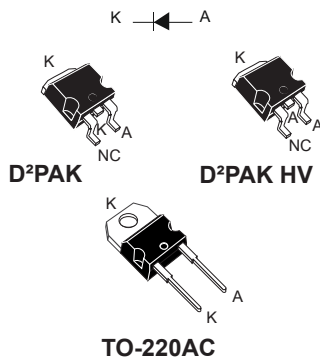


## 650 V, 12 A power Schottky silicon carbide diode



### Features

- No or negligible reverse recovery
- Switching behavior independent of temperature
- Dedicated to PFC applications
- High forward surge capability
- Operating  $T_j$  from  $-40\text{ °C}$  to  $175\text{ °C}$
- D<sup>2</sup>PAK HV creepage distance (anode to cathode) = 5.38 mm min.
- ECOPACK2 compliant
- Power efficient product

### Applications

- DC/DC converter
- High frequency inverter
- Snubber
- Boost PFC function

### 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.

Housed in D<sup>2</sup>PAK HV, this diode is perfectly suited for a usage in PFC applications, in charging station, DC/DC, easing the compliance to IEC-60664-1.

#### Product label



#### Product status link

[STPSC12065](#)

#### Product summary

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

# 1 Characteristics

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

Symbol	Parameter	Value	Unit
$V_{RRM}$	Repetitive peak reverse voltage	650	V
$I_{F(RMS)}$	Forward rms current	22	A
$I_{F(AV)}$	Average forward current	$T_C = 145\text{ °C}$ , DC <sup>(1)</sup>	A
$I_{FRM}$	Repetitive peak forward current	$T_C = 145\text{ °C}$ , $T_J = 175\text{ °C}$ , $\delta = 0.1$	A
$I_{FSM}$	Surge non repetitive forward current	$t_p = 10\text{ ms}$ sinusoidal, $T_C = 25\text{ °C}$	50
		$t_p = 10\text{ ms}$ sinusoidal, $T_C = 125\text{ °C}$	40
		$t_p = 10\text{ }\mu\text{s}$ square, $T_C = 25\text{ °C}$	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

For more information, please refer to the following application note:

- AN5088: Rectifiers thermal management, handling and mounting recommendations

**Table 3. Static electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_R$ <sup>(1)</sup>	Reverse leakage current	$T_J = 25\text{ °C}$	-	15	150	$\mu\text{A}$
		$T_J = 150\text{ °C}$		200	1000	
		$T_J = 25\text{ °C}$	600 V	8	50	
$V_F$ <sup>(2)</sup>	Forward voltage drop	$T_J = 25\text{ °C}$	-	1.30	1.45	V
		$T_J = 150\text{ °C}$	-	1.45	1.65	
		$T_J = 175\text{ °C}$	-	1.50		

1. Pulse test:  $t_p = 5\text{ ms}$ ,  $\delta < 2\%$

2. Pulse test:  $t_p = 500\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses use the following equation:

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

For more information, please refer to the following application notes related to the power losses :

- AN604: Calculation of conduction losses in a power rectifier
- AN4021: Calculation of reverse losses on a power diode

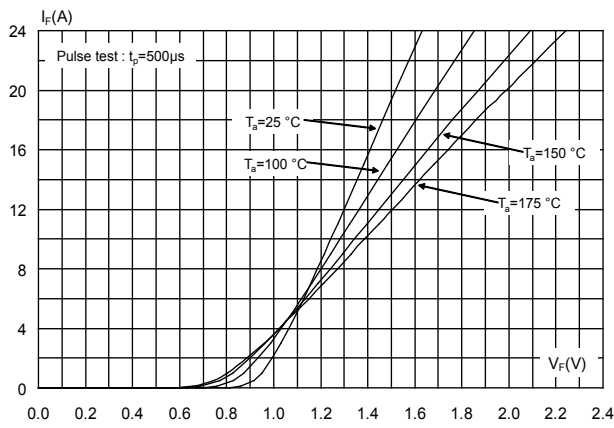
**Table 4. Dynamic electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$Q_{Cj}$	Total capacitive charge	$V_R = 400\text{ V}$	-	36	-	nC
$C_j$	Total capacitance	$V_R = 0\text{ V}, T_c = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$	-	750	-	pF
		$V_R = 400\text{ V}, T_c = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$	-	60	-	

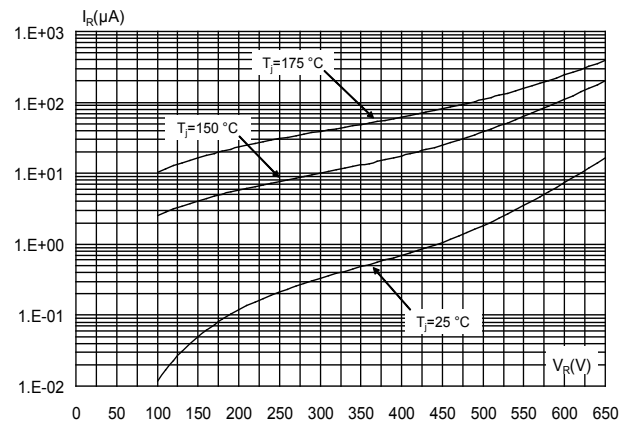
1. Most accurate value for the capacitive charge:  $Q_{Cj}(V_R) = \int_0^{V_R} C_j(V)dV$

## 1.1 Characteristics (curves)

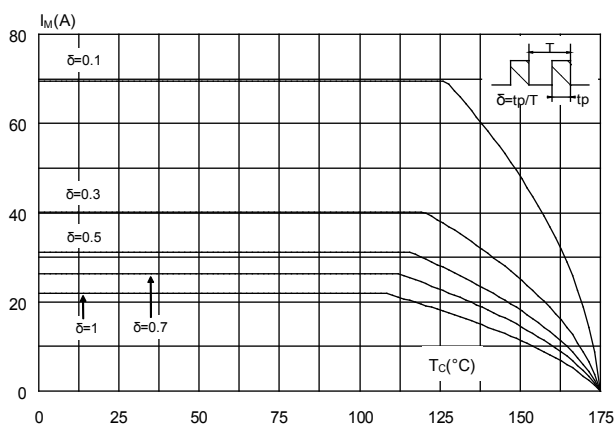
**Figure 1. Forward voltage drop versus forward current (typical values)**



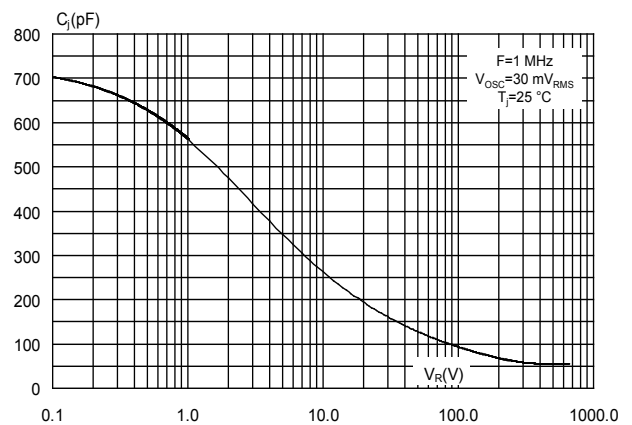
**Figure 2. Reverse leakage current versus reverse voltage applied (typical values)**



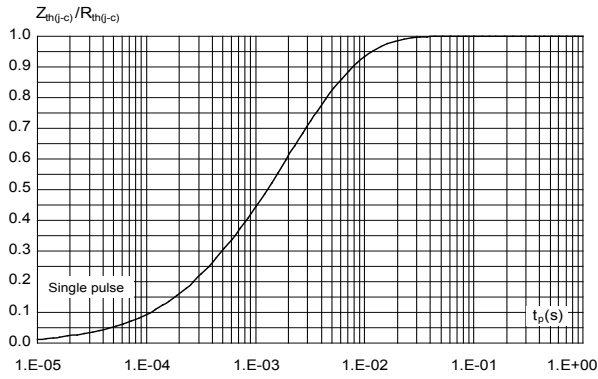
**Figure 3. Peak forward current versus case temperature**



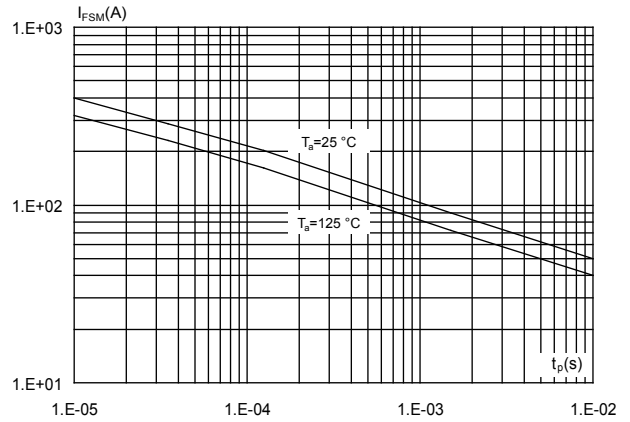
**Figure 4. Junction capacitance versus reverse voltage applied (typical values)**



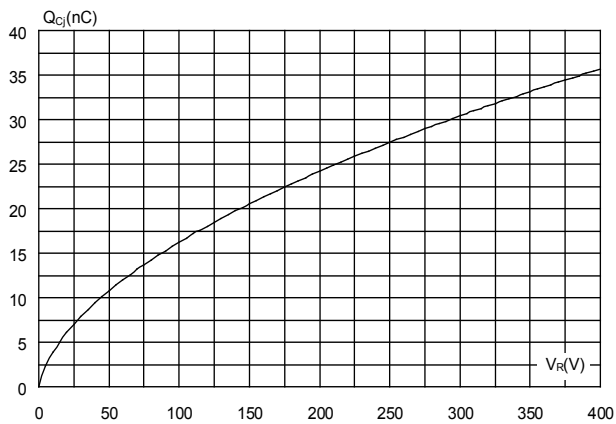
**Figure 5. Relative variation of thermal impedance junction to case versus pulse duration**



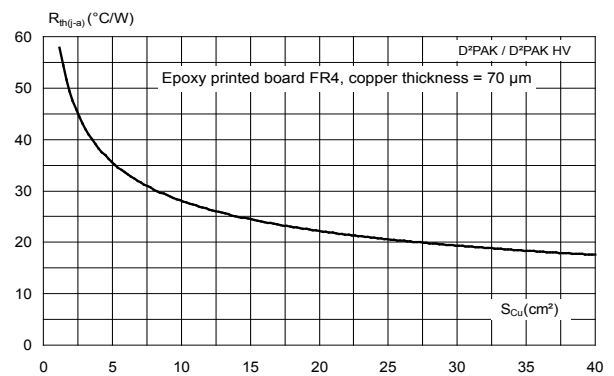
**Figure 6. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)**



**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)**



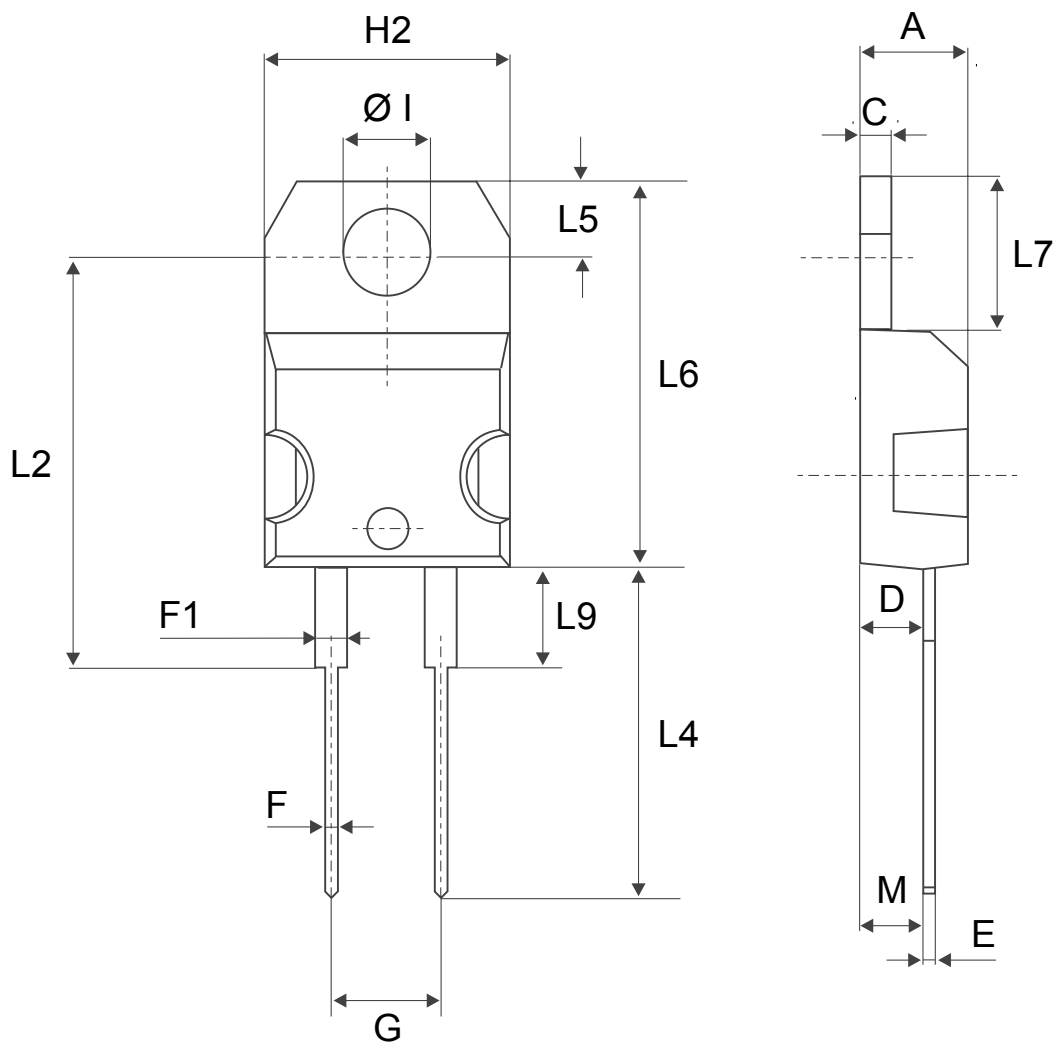
## 2 Package information

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](http://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 D<sup>2</sup>PAK package information

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

Figure 10. D<sup>2</sup>PAK package outline

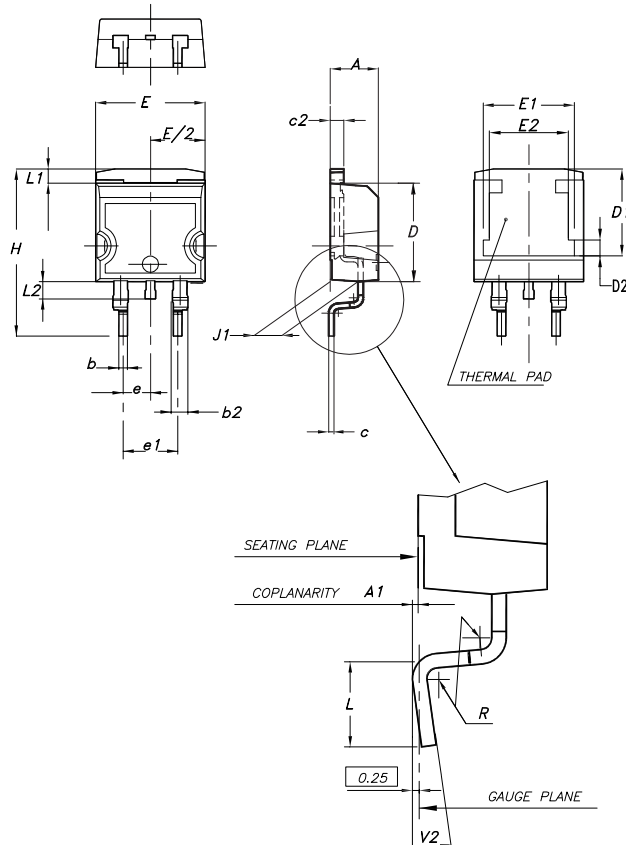
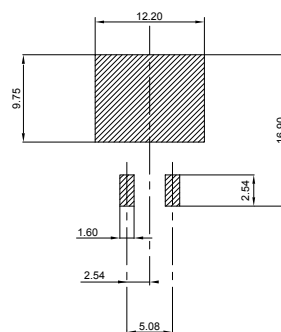


Table 6. D<sup>2</sup>PAK package mechanical data

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
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. D<sup>2</sup>PAK recommended footprint (dimensions are in mm)



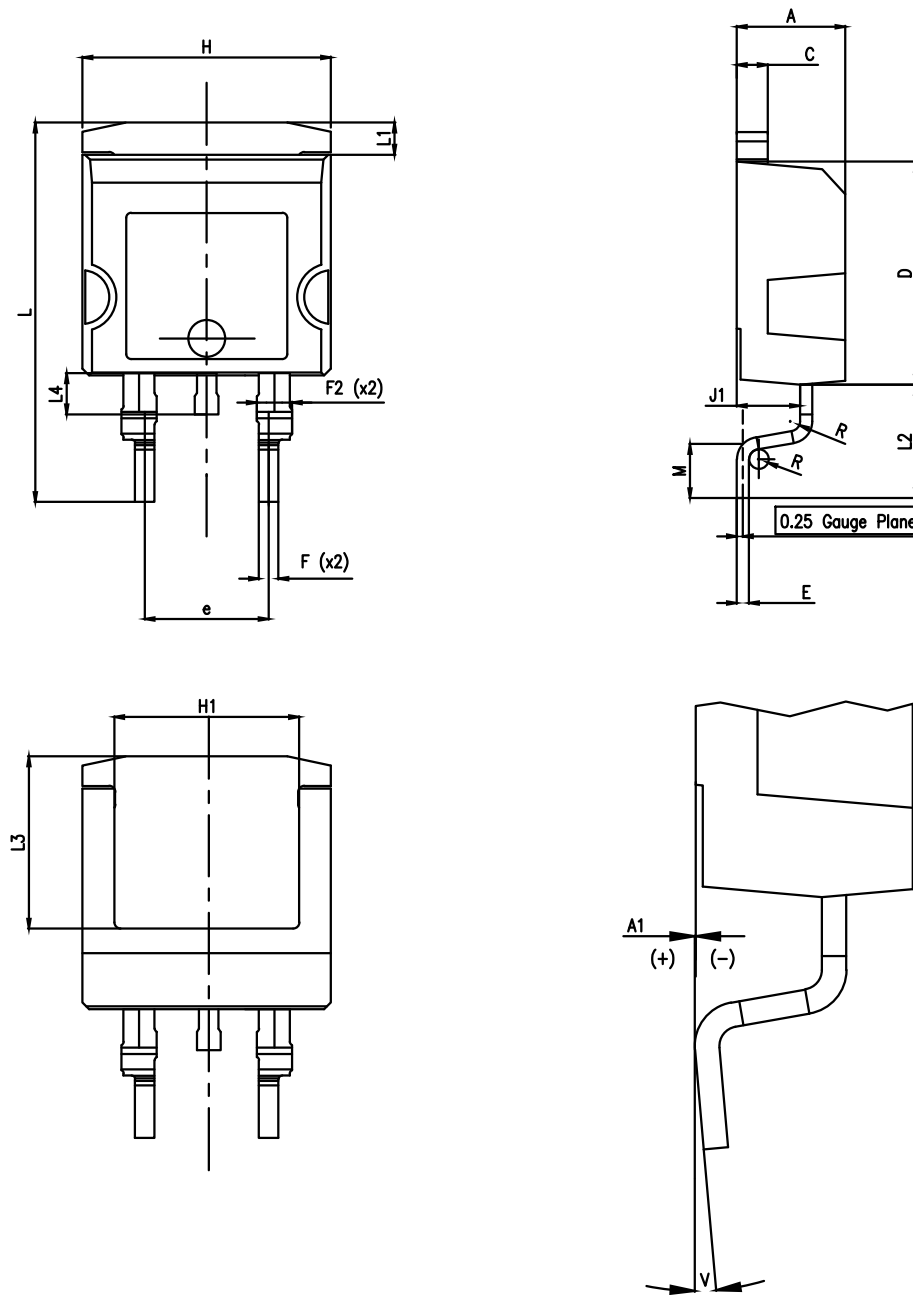
Footprint\_26



### 2.3 D<sup>2</sup>PAK high voltage package information

- Epoxy meets UL94, V0

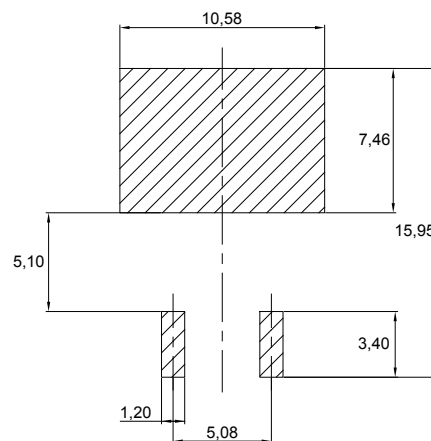
Figure 12. D<sup>2</sup>PAK high voltage package outline



**Table 7. D<sup>2</sup>PAK 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																																															
D	8.95	-	9.35																																															
e	4.98	-	5.18																																															
E	0.50	-	0.90																																															
F	0.78	- </tr <tr> <td>F2</td> <td>1.14</td> <td>-</td> <td>1.70</td> </tr> <tr> <td>H</td> <td>10.00</td> <td>-</td> <td>10.40</td> </tr> <tr> <td>H1</td> <td>7.40</td> <td>-</td> <td>7.80</td> </tr> <tr> <td>J1</td> <td>2.49</td> <td>-</td> <td>2.69</td> </tr> <tr> <td>L</td> <td>15.30</td> <td>-</td> <td>15.80</td> </tr> <tr> <td>L1</td> <td>1.27</td> <td>-</td> <td>1.40</td> </tr> <tr> <td>L2</td> <td>4.93</td> <td>-</td> <td>5.23</td> </tr> <tr> <td>L3</td> <td>6.85</td> <td>-</td> <td>7.25</td> </tr> <tr> <td>L4</td> <td>1.5</td> <td>-</td> <td>1.7</td> </tr> <tr> <td>M</td> <td>2.6</td> <td>-</td> <td>2.9</td> </tr> <tr> <td>R</td> <td>0.20</td> <td>-</td> <td>0.60</td> </tr> <tr> <td>V</td> <td>0°</td> <td>-</td> <td>8°</td> </tr>	F2	1.14	-	1.70	H	10.00	-	10.40	H1	7.40	-	7.80	J1	2.49	-	2.69	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°
F2	1.14	-	1.70																																															
H	10.00	-	10.40																																															
H1	7.40	-	7.80																																															
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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. D<sup>2</sup>PAK high voltage footprint in mm**



*Note: For package and tape orientation, reel and inner box dimensions and tape outline please check TN1173.*

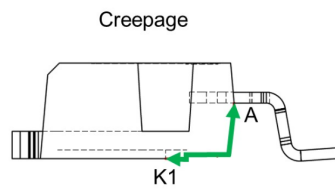
### 2.3.1 Creepage distance between anode and cathode

**Table 8. Creepage distance between anode and cathode**

Symbol	Parameter		Value	Unit
Cd <sub>A-K1</sub>	Minimum creepage distance between A and K1 (with top coating)	D <sup>2</sup> PAK HV	5.38	mm
Cd <sub>A-K2</sub>	Minimum creepage distance between A and K2 (without top coating)		3.48	

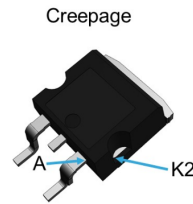
*Note:* D<sup>2</sup>PAK HV creepage distance (anode to cathode) = 5.38 mm min. (refer to IEC 60664-1)

**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
STPSC12065D	PSC12065D	TO-220AC	1.86 g	50	Tube
STPSC12065G-TR	PSC12065G	D <sup>2</sup> PAK	1.48 g	1000	Tape and reel
STPSC12065G2-TR	PSC12065G2	D <sup>2</sup> PAK HV	1.48 g	1000	Tape and reel

## Revision history

**Table 10. Document revision history**

Date	Revision	Changes
29-Apr-2016	1	First issue.
12-Jul-2018	2	Added D <sup>2</sup> PAK package and Applications section.
25-Mar-2021	3	Updated Description title and Description. Inserted STPOWER logo and product label "ST Sustainable". Added D <sup>2</sup> PAK HV package information. Minor text changes.

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