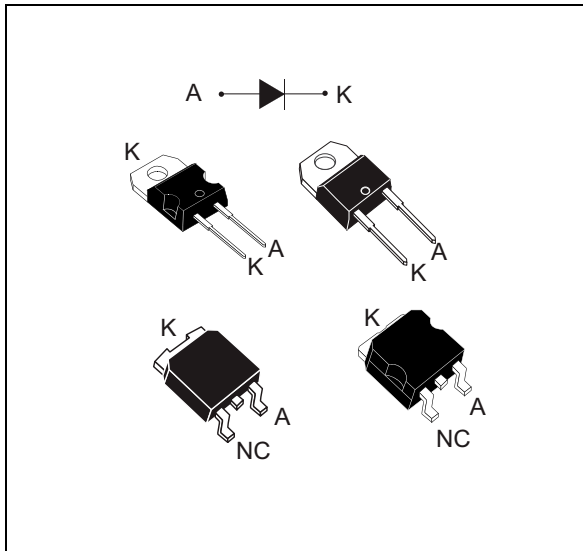


## 650 V power Schottky silicon carbide diode

Datasheet - production data



### Description

The SiC diode is an ultrahigh 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, this ST SiC diode will boost the performance in hard switching conditions. Its high forward surge capability ensures a good robustness during transient phases.

### Features

- No reverse recovery charge in application current range
- Switching behavior independent of temperature
- Dedicated to PFC applications
- High forward surge capability
- Insulated package TO-220AC Ins:
  - Insulated voltage: 2500 V rms
  - Typical package capacitance: 7 pF

Table 1. Device summary

Symbol	Value
$I_{F(AV)}$	6 A
$V_{RRM}$	650 V
$T_j$ (max)	175 °C

# 1 Characteristics

**Table 2. Absolute ratings (limiting values at 25 °C unless otherwise specified)**

Symbol	Parameter		Value	Unit
V <sub>RRM</sub>	Repetitive peak reverse voltage		650	V
I <sub>F(RMS)</sub>	Forward rms current		22	A
I <sub>F(AV)</sub>	Average forward current	TO-220AC, DPAK, D <sup>2</sup> PAK, T <sub>C</sub> = 135 °C <sup>(1)</sup> , DC	6	A
		TO-220AC Ins, T <sub>C</sub> = 110 °C <sup>(1)</sup> , DC		
I <sub>FSM</sub>	Surge non repetitive forward current	t <sub>p</sub> = 10 ms sinusoidal, T <sub>C</sub> = 25 °C	60	A
		t <sub>p</sub> = 10 ms sinusoidal, T <sub>C</sub> = 125 °C	52	
		t <sub>p</sub> = 10 μs square, T <sub>C</sub> = 25 °C	400	
I <sub>FRM</sub>	Repetitive peak forward current	TO-220AC, DPAK, D <sup>2</sup> PAK, T <sub>C</sub> = 135 °C <sup>(1)</sup> , T <sub>J</sub> = 175 °C, δ = 0.1	25	A
		TO-220AC Ins, T <sub>C</sub> = 110 °C <sup>(1)</sup> , T <sub>J</sub> = 175 °C, δ = 0.1		
T <sub>stg</sub>	Storage temperature range		-55 to +175	°C
T <sub>j</sub>	Operating junction temperature <sup>(2)</sup>		-40 to +175	°C

1. Value based on R<sub>th(j-c)</sub> max.
2.  $\frac{dP_{tot}}{dT_j} < \frac{1}{R_{th(j-a)}}$  condition to avoid thermal runaway for a diode on its own heatsink

**Table 3. Thermal resistance**

Symbol	Parameter		Typ. value	Max. value	Unit
R <sub>th(j-c)</sub>	Junction to case	TO-220AC, DPAK, D <sup>2</sup> PAK	1.6	2.4	°C/W
		TO-220AC Ins	2.9	4.2	

**Table 4. Static electrical characteristics**

Symbol	Parameter	Tests conditions		Min.	Typ.	Max.	Unit
I <sub>R</sub> <sup>(1)</sup>	Reverse leakage current	T <sub>j</sub> = 25 °C	V <sub>R</sub> = V <sub>RRM</sub>	-	5	60	μA
		T <sub>j</sub> = 150 °C		-	50	250	
V <sub>F</sub> <sup>(2)</sup>	Forward voltage drop	T <sub>j</sub> = 25 °C	I <sub>F</sub> = 6 A	-	1.56	1.75	V
		T <sub>j</sub> = 150 °C		-	1.98	2.5	

1. t<sub>p</sub> = 10 ms, δ < 2%
2. t<sub>p</sub> = 500 μs, δ < 2%

To evaluate the conduction losses use the following equation:  $P = 1.35 \times I_{F(AV)} + 0.192 \times I_{F(RMS)}^2$

Table 5. Other parameters

Symbol	Parameter	Test conditions	Typ.	Unit
$Q_{cj}^{(1)}$	Total capacitive charge	$V_R = 400\text{ V}$	18	nC
$C_j$	Total capacitance	$V_R = 0\text{ V}, T_C = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$	300	pF
		$V_R = 400\text{ V}, T_C = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$	30	

1. Most accurate value for the capacitive charge:  $Q_{cj} = \int_0^{V_{OUT}} C_j(V_R).dv_R$

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

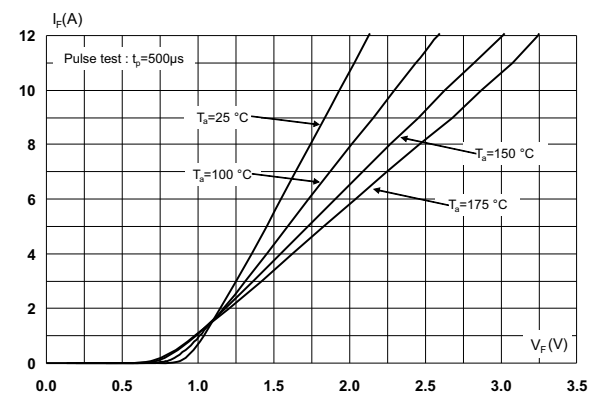


Figure 2. Forward voltage drop versus forward current (typical values, high level)

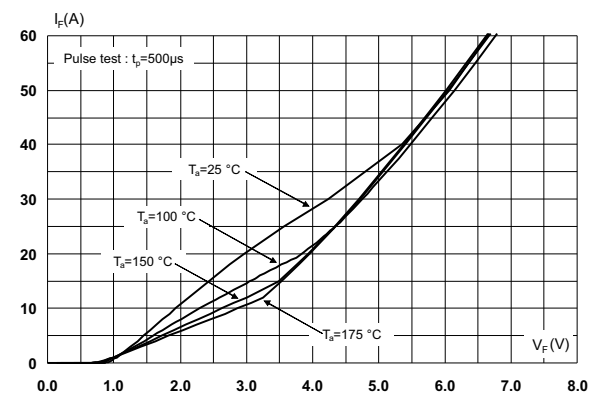


Figure 3. Reverse leakage current versus reverse voltage applied (typical values)

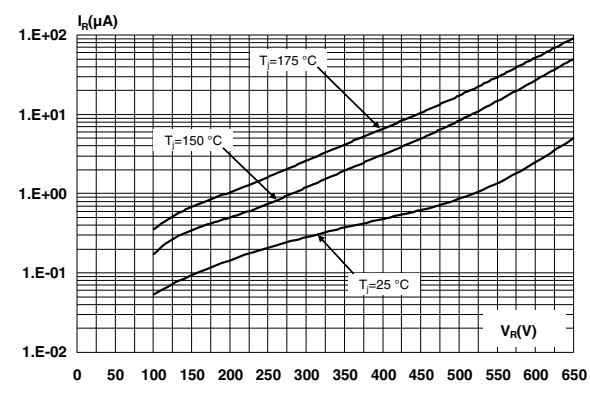
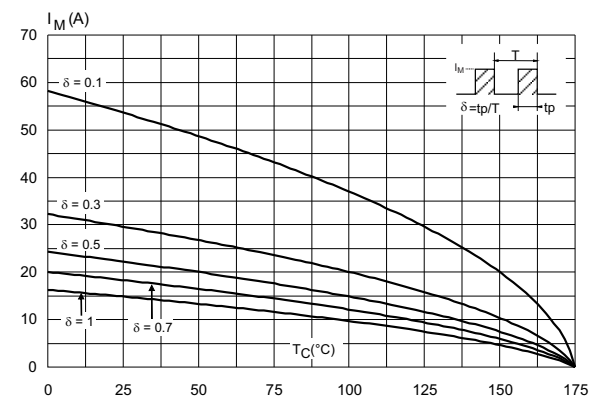
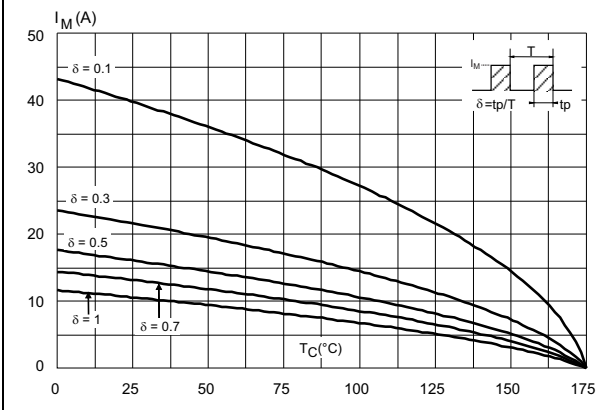


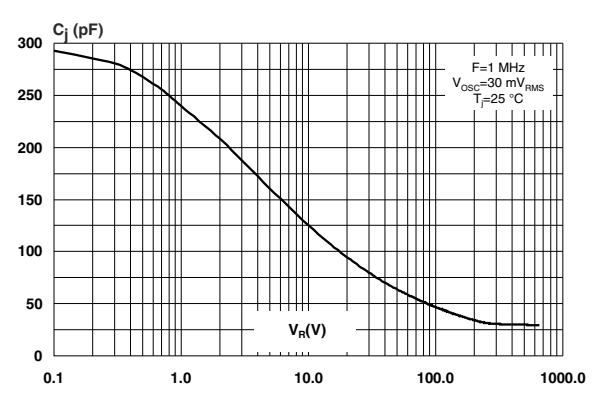
Figure 4. Peak forward current versus case temperature (TO-220AC, DPAK, D<sup>2</sup>PAK)



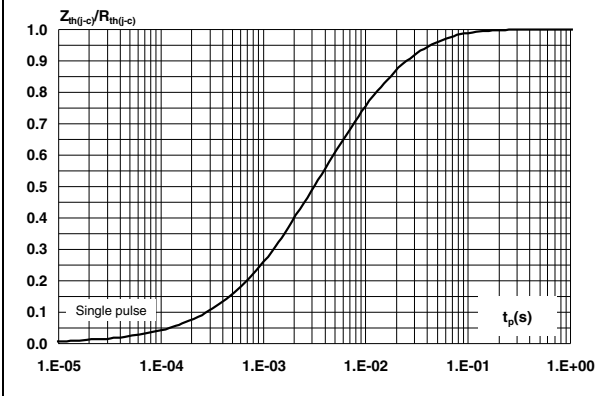
**Figure 5. Peak forward current versus case temperature (TO-220AC Ins)**



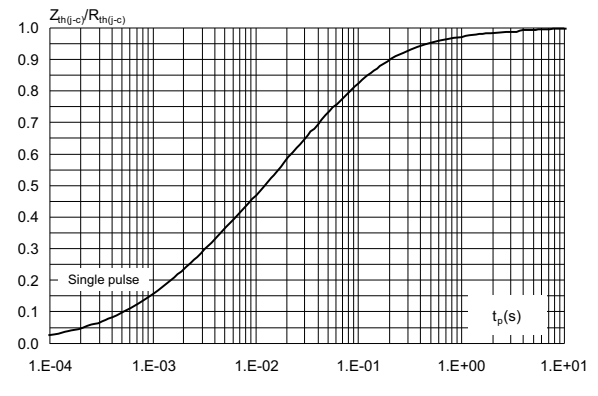
**Figure 6. Junction capacitance versus reverse voltage applied (typical values)**



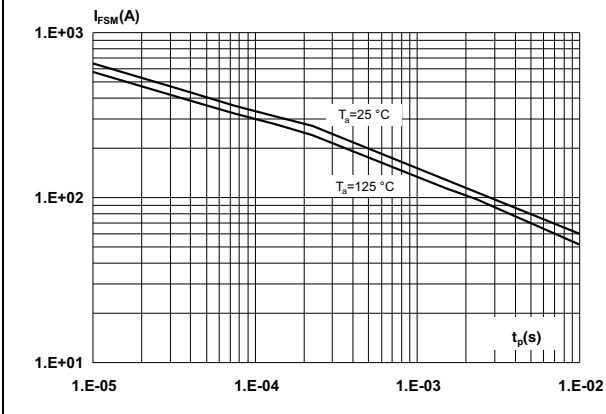
**Figure 7. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC, DPAK and D<sup>2</sup>PAK)**



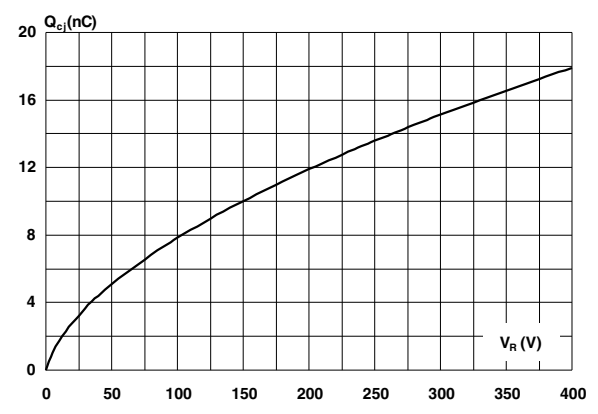
**Figure 8. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC Ins)**



**Figure 9. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)**



**Figure 10. Total capacitive charges versus reverse voltage applied (typical values)**



## 2 Package information

- Epoxy meets UL94, V0
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.7 N·m
- Cooling method: conduction (C)

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 2.1 TO-220AC package information

Figure 11. TO-220AC package outline

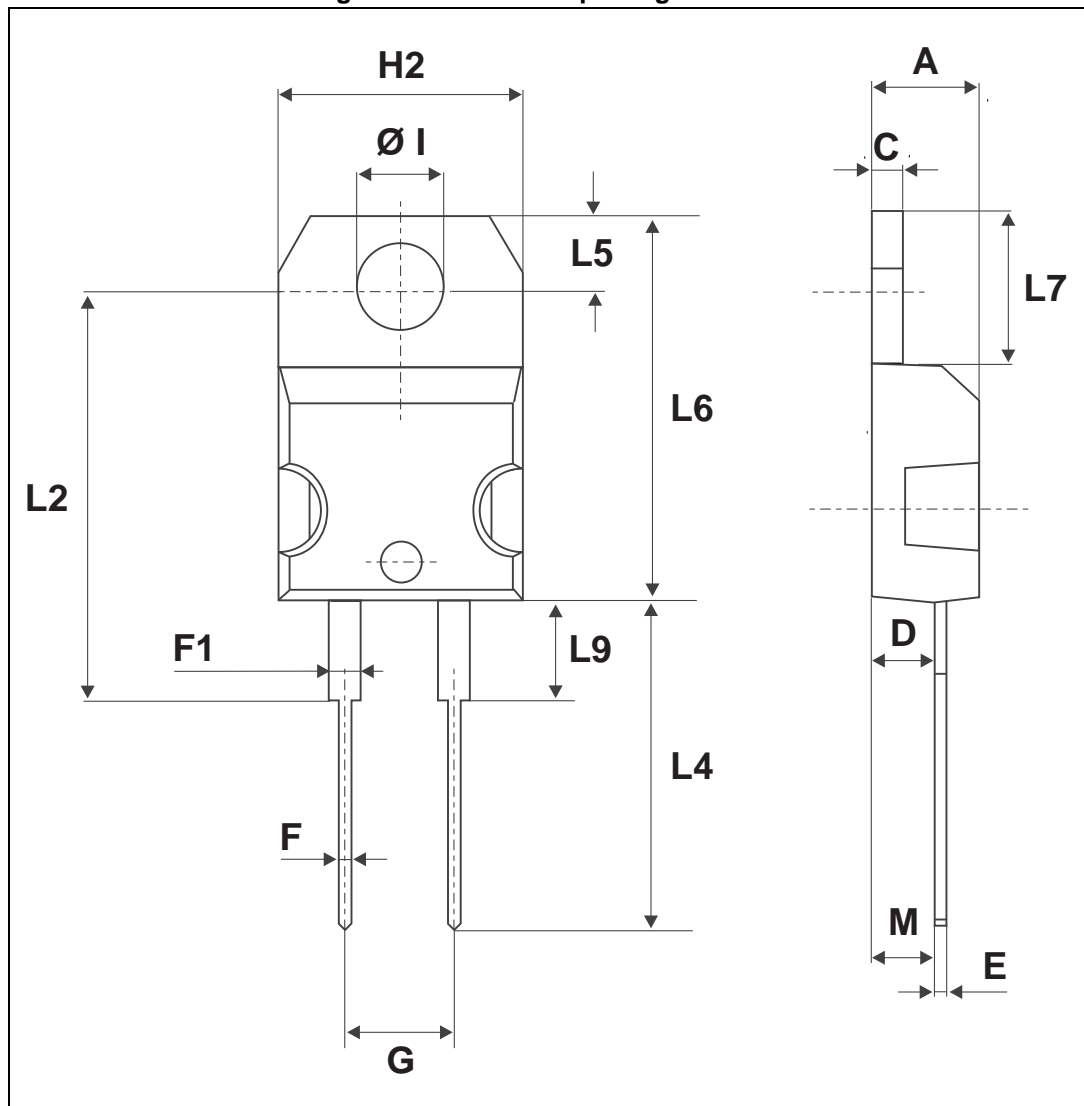


Table 6. TO-220AC package mechanical data

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.	
Diam. I	3.75	3.85	0.147	0.151

## 2.2 TO-220AC ins package information

Figure 12. TO-220AC Ins package outline

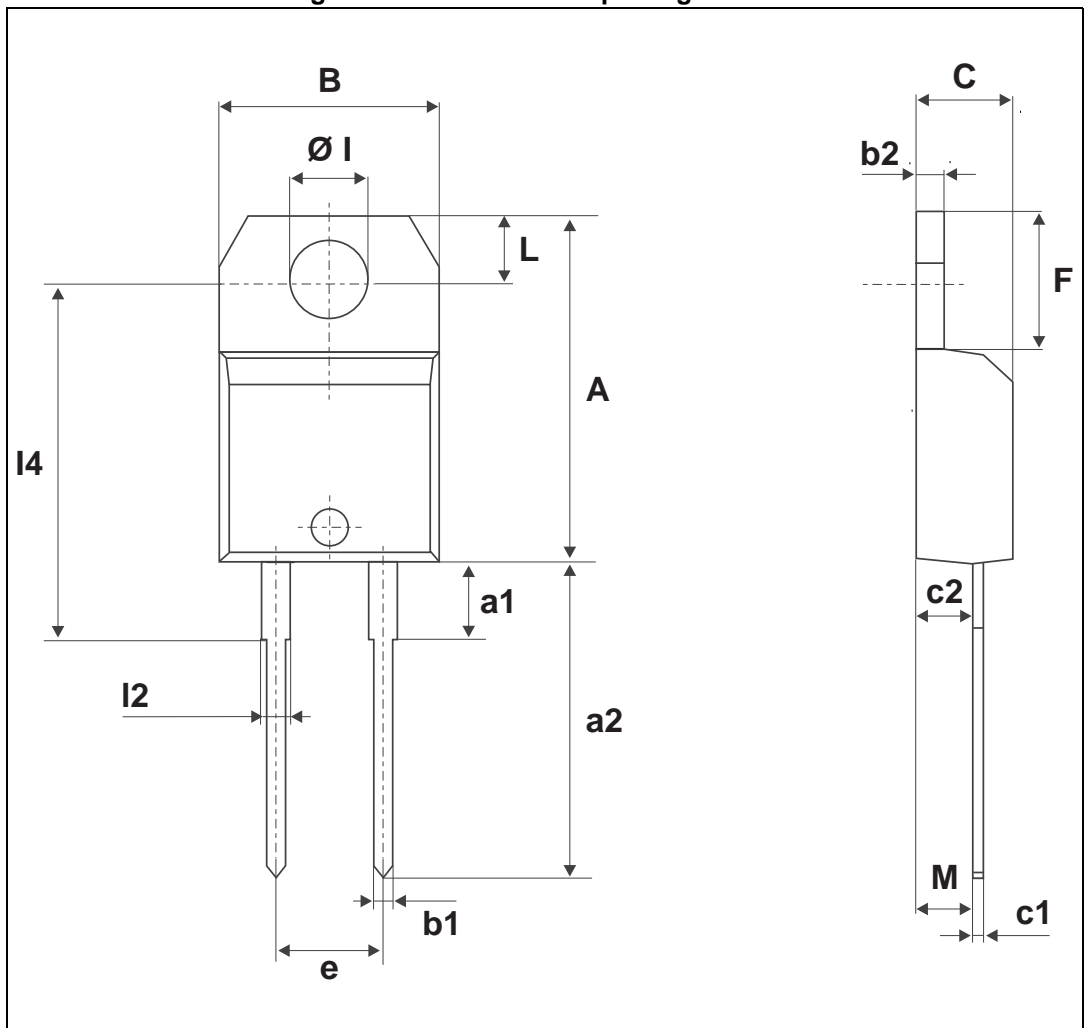


Table 7. TO-220AC Ins package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	15.20		15.90	0.598		0.625
a1		3.75			0.147	
a2	13.00		14.00	0.511		0.551
B	10.00		10.40	0.393		0.409
b1	0.61		0.88	0.024		0.034
b2	1.23		1.32	0.048		0.051
C	4.40		4.60	0.173		0.181
c1	0.49		0.70	0.019		0.027
c2	2.40		2.72	0.094		0.107
e	4.80		5.40	0.189		0.212
F	6.20		6.60	0.244		0.259
ØI	3.75		3.85	0.147		0.151
I4	15.80	16.40	16.80	0.622	0.646	0.661
L	2.65		2.95	0.104		0.116
I2	1.14		1.70	0.044		0.066
M		2.60			0.102	



### 2.3 DPAK package information

Figure 13. DPAK package outline

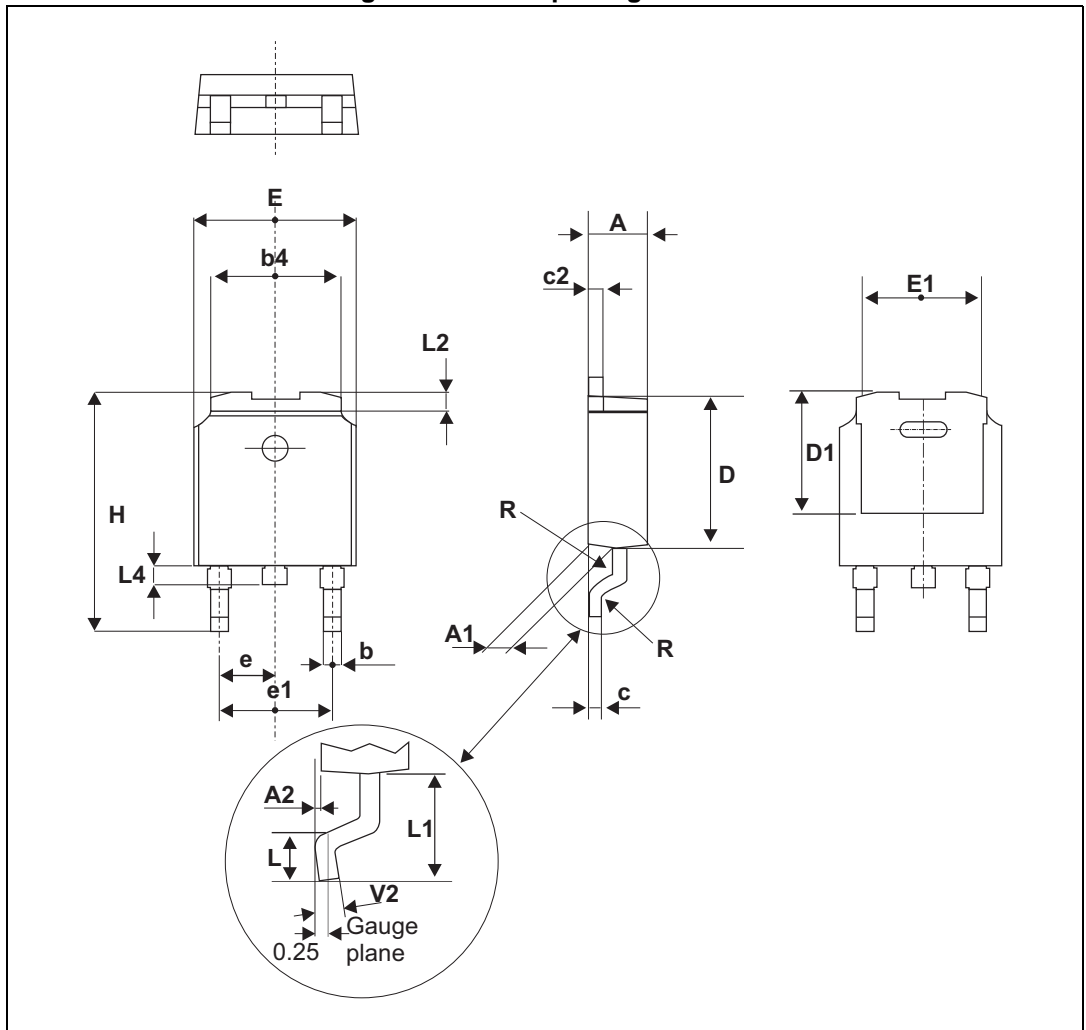
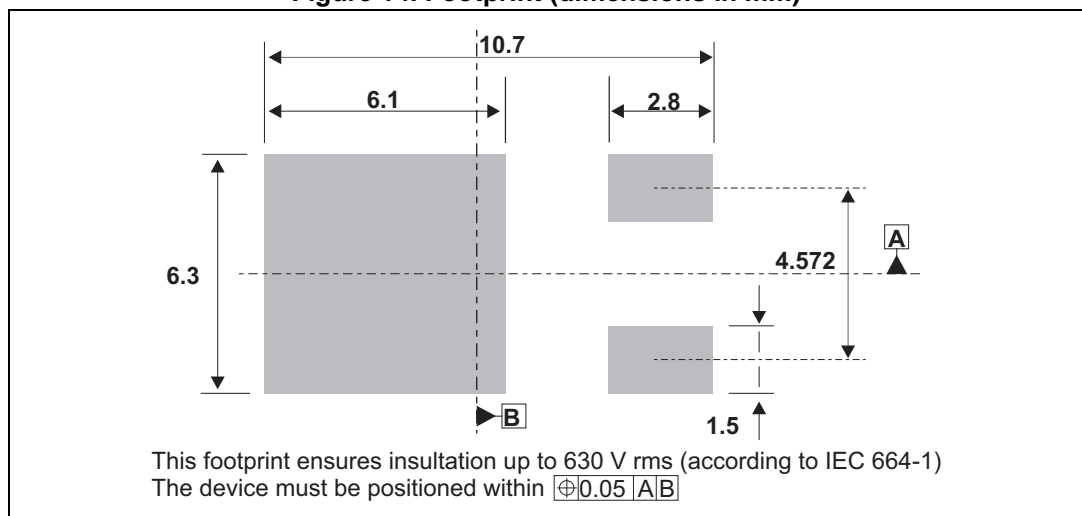


Table 8. DPAK package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.20		2.40	0.086		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
b	0.64		0.90	0.025		0.035
b4	5.20		5.40	0.204		0.212
c	0.45		0.60	0.017		0.023
c2	0.48		0.60	0.018		0.023
D	6.00		6.20	0.236		0.244
D1		5.10			0.201	
E	6.40		6.60	0.251		0.259
E1		4.70			0.185	
e		2.28			0.090	
e1	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.397
L	1.00		1.50	0.039		0.059
L1		2.80			0.11	
L2		0.80			0.032	
L4	0.60		1.00	0.023		0.039
R		0.2			0.008	
V2	0°		8°	0°		8°

Figure 14. Footprint (dimensions in mm)



## 2.4 D<sup>2</sup>PAK package information

Figure 15. D<sup>2</sup>PAK package outline

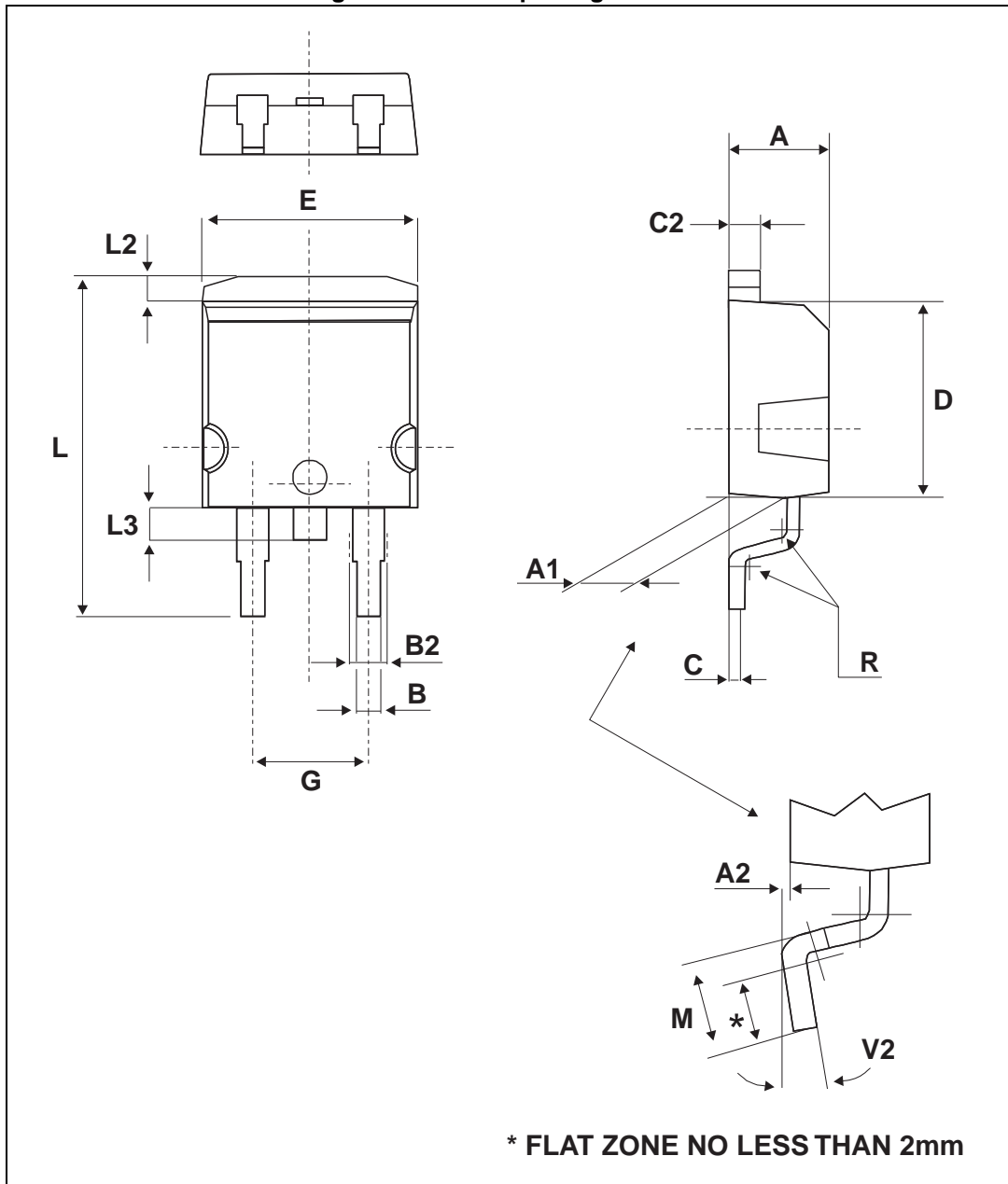
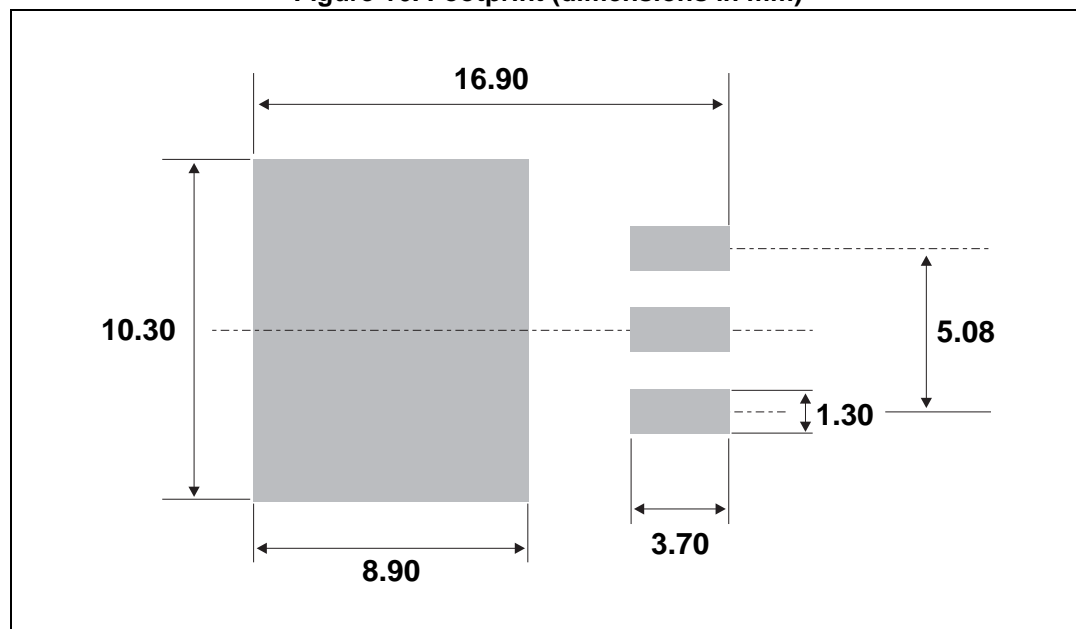


Table 9. D<sup>2</sup>PAK package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40	4.60	0.173	0.181	A	4.40
A1	2.49	2.69	0.098	0.106	A1	2.49
A2	0.03	0.23	0.001	0.009	A2	0.03
B	0.70	0.93	0.027	0.037	B	0.70
B2	1.14	1.70	0.045	0.067	B2	1.14
C	0.45	0.60	0.017	0.024	C	0.45
C2	1.23	1.36	0.048	0.054	C2	1.23
D	8.95	9.35	0.352	0.368	D	8.95
E	10.00	10.40	0.393	0.409	E	10.00
G	4.88	5.28	0.192	0.208	G	4.88
L	15.00	15.85	0.590	0.624	L	15.00
L2	1.27	1.40	0.050	0.055	L2	1.27
L3	1.40	1.75	0.055	0.069	L3	1.40
M	2.40	3.20	0.094	0.126	M	2.40
R		0.40			0.016	
V2	0°		8°	0°		8°

Figure 16. Footprint (dimensions in mm)



### 3 Ordering information

**Table 10. Ordering information**

Order code	Marking	Package	Weight	Base qty	Delivery mode
STPSC6H065D	STPSC6H065D	TO-220AC	1.86 g	50	Tube
STPSC6H065DI	STPSC 6H065DI	TO-220AC Ins	2.12 g	50	Tube
STPSC6H065G-TR	STPSC6H065G	D <sup>2</sup> PAK	1.48 g	1000	Tape and reel
STPSC6H065B-TR	STPSC 6H065	DPAK	0.32 g	2500	Tape and reel

### 4 Revision history

**Table 11. Document revision history**

Date	Revision	Changes
18-Jun-2012	1	First issue.
31-Aug-2012	2	Added diode configuration graphic on front page. Updated value of $Q_{cj}$ and footnote equation in <a href="#">Table 5</a> .
10-Oct-2012	3	Added Max. value in <a href="#">Table 3</a> .
07-Nov-2013	4	Updated <a href="#">Figure 1</a> , <a href="#">Figure 2</a> , <a href="#">Figure 13</a> , <a href="#">Figure 14</a> , and <a href="#">Table 8</a> .
07-Jan-2014	5	Added TO-220AC Ins package.
22-Jul-2015	6	Updated <a href="#">Table 10</a> and reformatted to current standard.

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