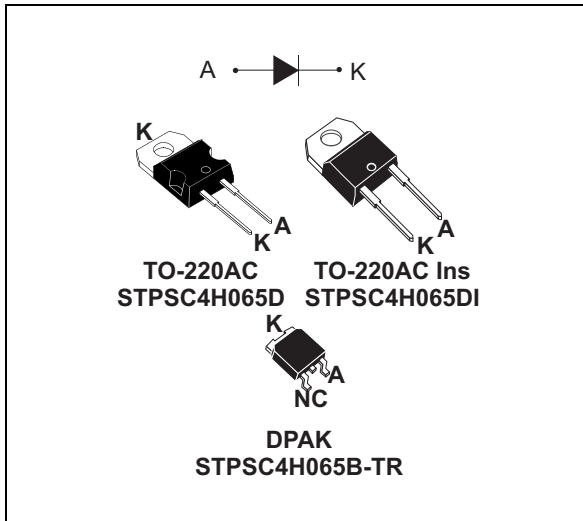


## 650 V power Schottky silicon carbide diode

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
- 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
$I_{F(AV)}$	4 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
$V_{RRM}$	Repetitive peak reverse voltage		650	V
$I_{F(RMS)}$	Forward rms current		22	A
$I_{F(AV)}$	Average forward current	TO-220AC, DPAK, $T_c = 145\text{ °C}^{(1)}$ , DC	4	A
		TO-220AC Ins, $T_c = 125\text{ °C}^{(1)}$ , DC		
$I_{FSM}$	Surge non repetitive forward current	$t_p = 10\text{ ms}$ sinusoidal, $T_c = 25\text{ °C}$	38	A
		$t_p = 10\text{ ms}$ sinusoidal, $T_c = 125\text{ °C}$	35	
		$t_p = 10\text{ }\mu\text{s}$ square, $T_c = 25\text{ °C}$	200	
$I_{FRM}$	Repetitive peak forward current	TO-220AC, DPAK, $T_c = 145\text{ °C}^{(1)}$ , $T_j = 175\text{ °C}$ , $\delta = 0.1$	17	A
		TO-220AC Ins, $T_c = 125\text{ °C}^{(1)}$ , $T_j = 175\text{ °C}$ , $\delta = 0.1$		
$T_{stg}$	Storage temperature range		-55 to +175	°C
$T_j$	Operating junction temperature <sup>(2)</sup>		-40 to +175	°C

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

**Table 3. Thermal resistance**

Symbol	Parameter	Typ. value	Max. value	Unit	
$R_{th(j-c)}$	Junction to case	TO-220AC, DPAK	1.8	2.7	°C/W
		TO-220AC Ins	3	4.5	

**Table 4. Static electrical characteristics**

Symbol	Parameter	Tests conditions		Min.	Typ.	Max.	Unit
$I_R^{(1)}$	Reverse leakage current	$T_j = 25\text{ °C}$	$V_R = V_{RRM}$	-	3	40	$\mu\text{A}$
		$T_j = 150\text{ °C}$		-	35	170	
$V_F^{(2)}$	Forward voltage drop	$T_j = 25\text{ °C}$	$I_F = 4\text{ A}$	-	1.56	1.75	V
		$T_j = 150\text{ °C}$		-	1.98	2.5	

- $t_p = 10\text{ ms}$ ,  $\delta < 2\%$
- $t_p = 500\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses use the following equation:  $P = 1.35 \times I_{F(AV)} + 0.288 \times I_{F(RMS)}^2$

Table 5. Dynamic electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Unit
$Q_{cj}^{(1)}$	Total capacitive charge	$V_R = 400\text{ V}$		12.5	nC
$C_j$	Total capacitance	$V_R = 0\text{ V}, T_C = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$		200	pF
		$V_R = 400\text{ V}, T_C = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$		21	

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

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

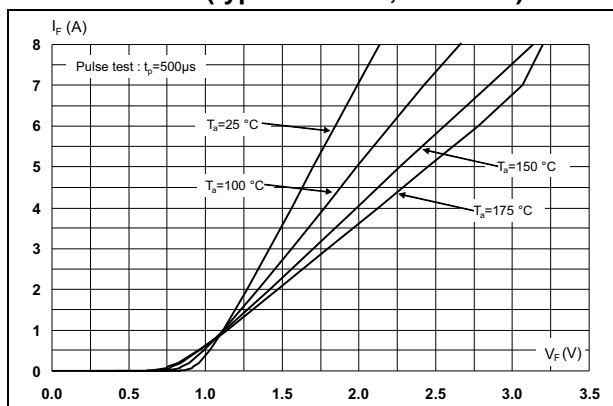


Figure 2. Forward voltage drop versus forward current (typical values, high level)

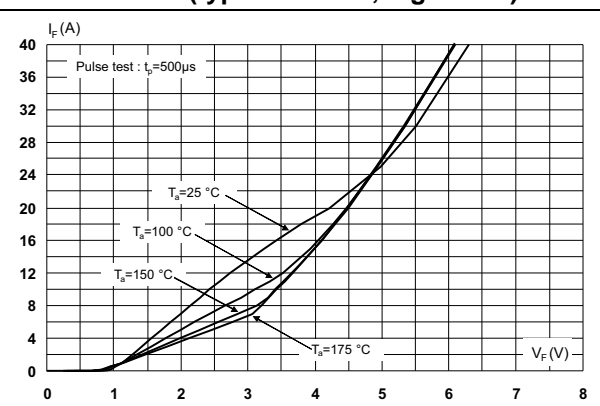


Figure 3. Reverse leakage current versus reverse voltage applied (typical values)

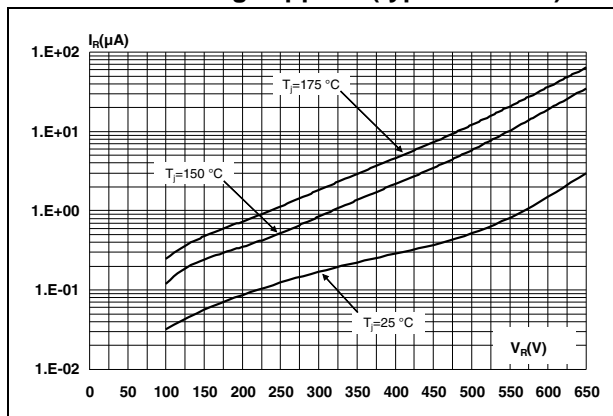


Figure 4. Peak forward current versus case temperature (TO-220AC and DPAK)

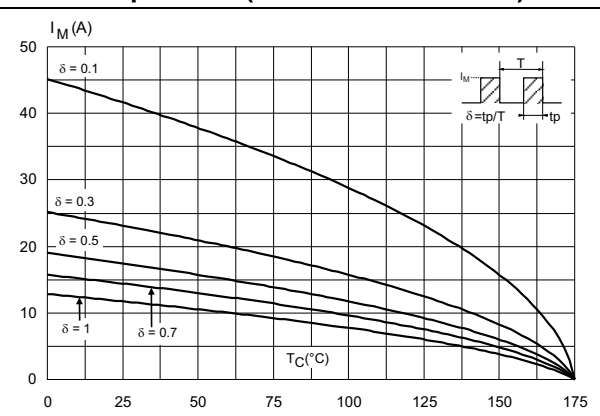


Figure 5. Peak forward current versus case temperature (TO-220AC Ins)

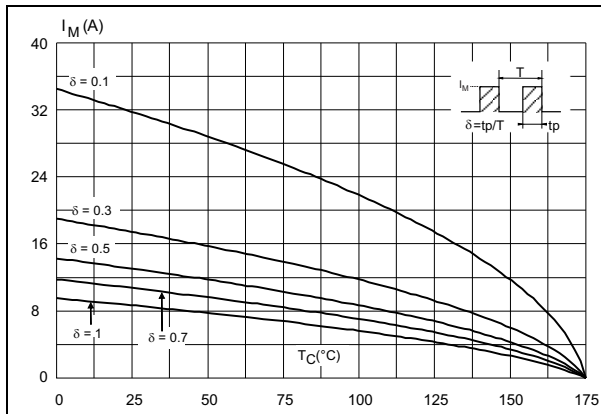


Figure 6. Junction capacitance versus reverse voltage applied (typical values)

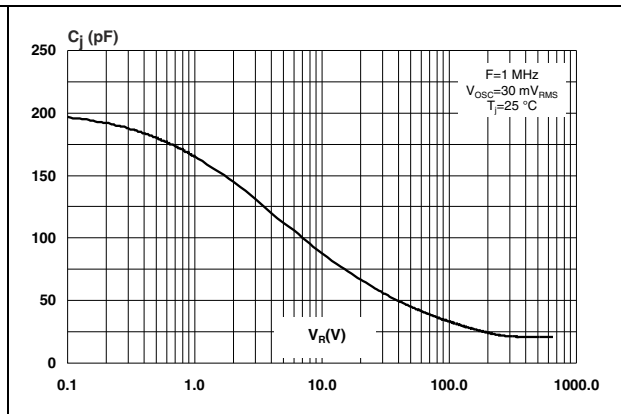


Figure 7. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC and DPAK)

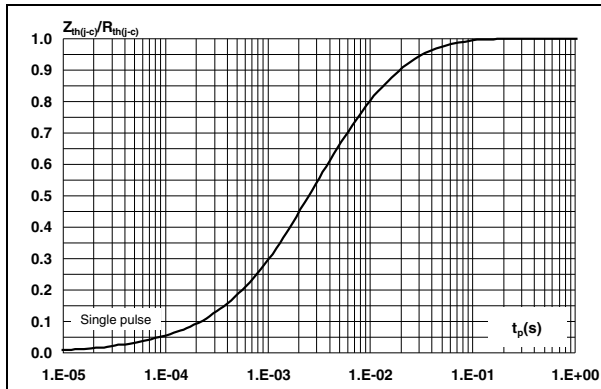


Figure 8. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC Ins)

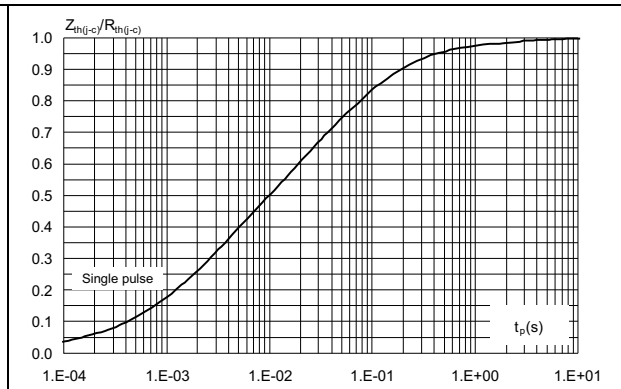


Figure 9. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)

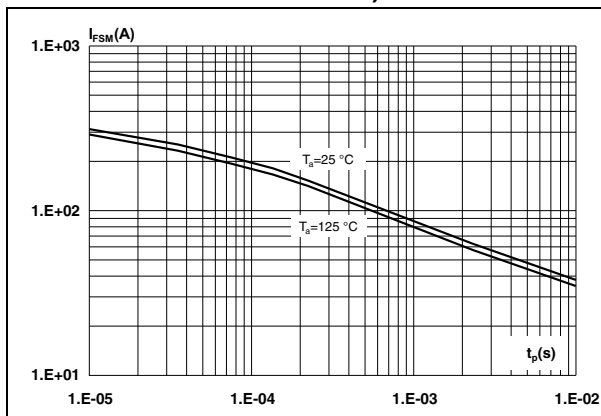
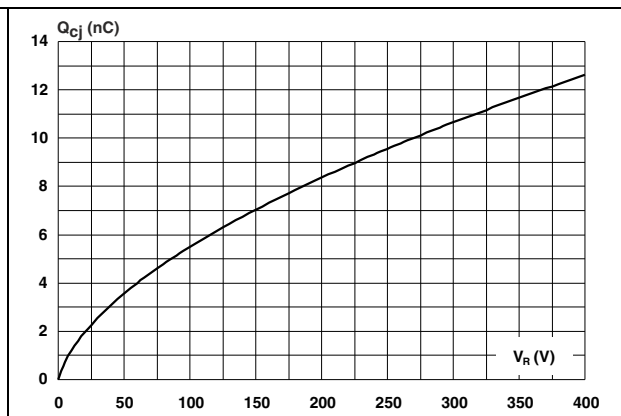


Figure 10. Total capacitive charges versus reverse voltage applied (typical values)



## 2 Package information

- Epoxy meets UL94, V0
- Recommended torque value (TO-220AC and TO-220AC Ins): 0.4 to 0.6 N·m
- Cooling method: conduction (C)

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.

Figure 11. TO-220AC dimension definitions

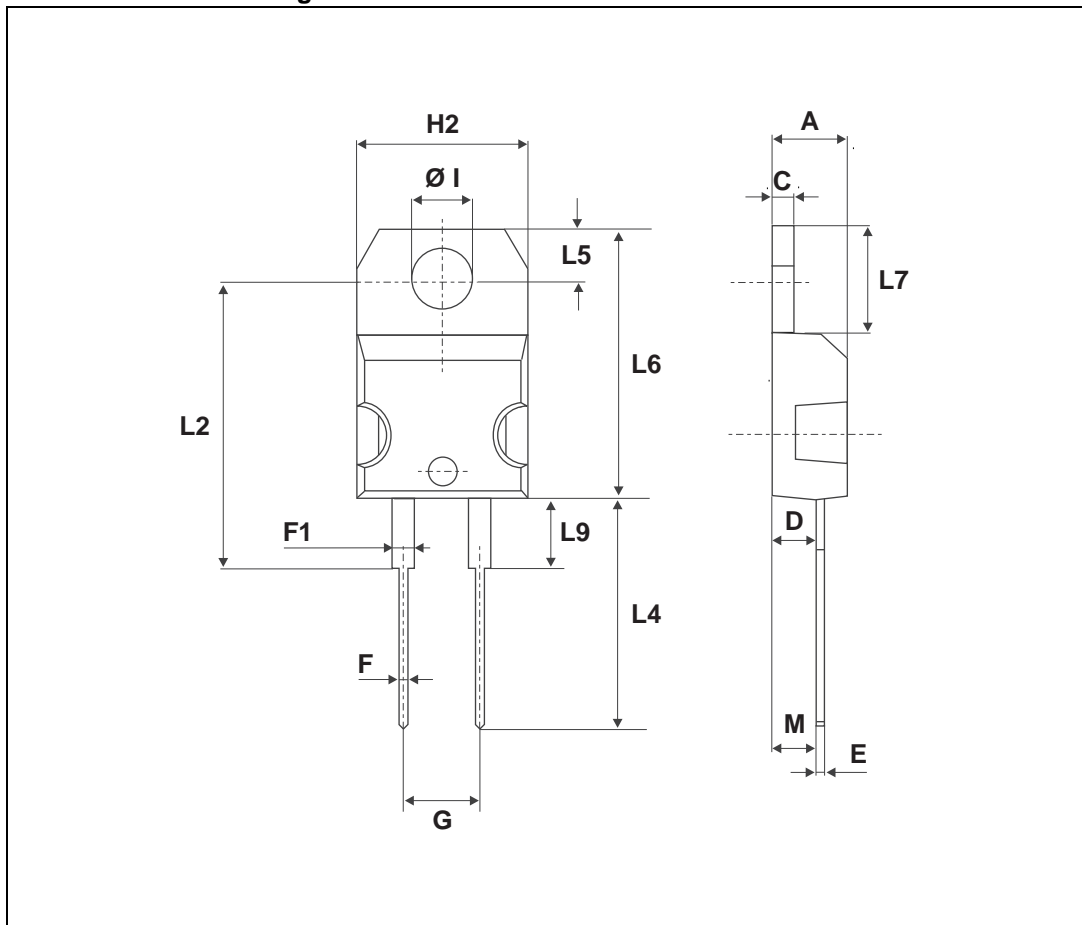


Table 6. TO-220AC dimension values

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

Figure 12. TO-220AC Ins dimension definitions

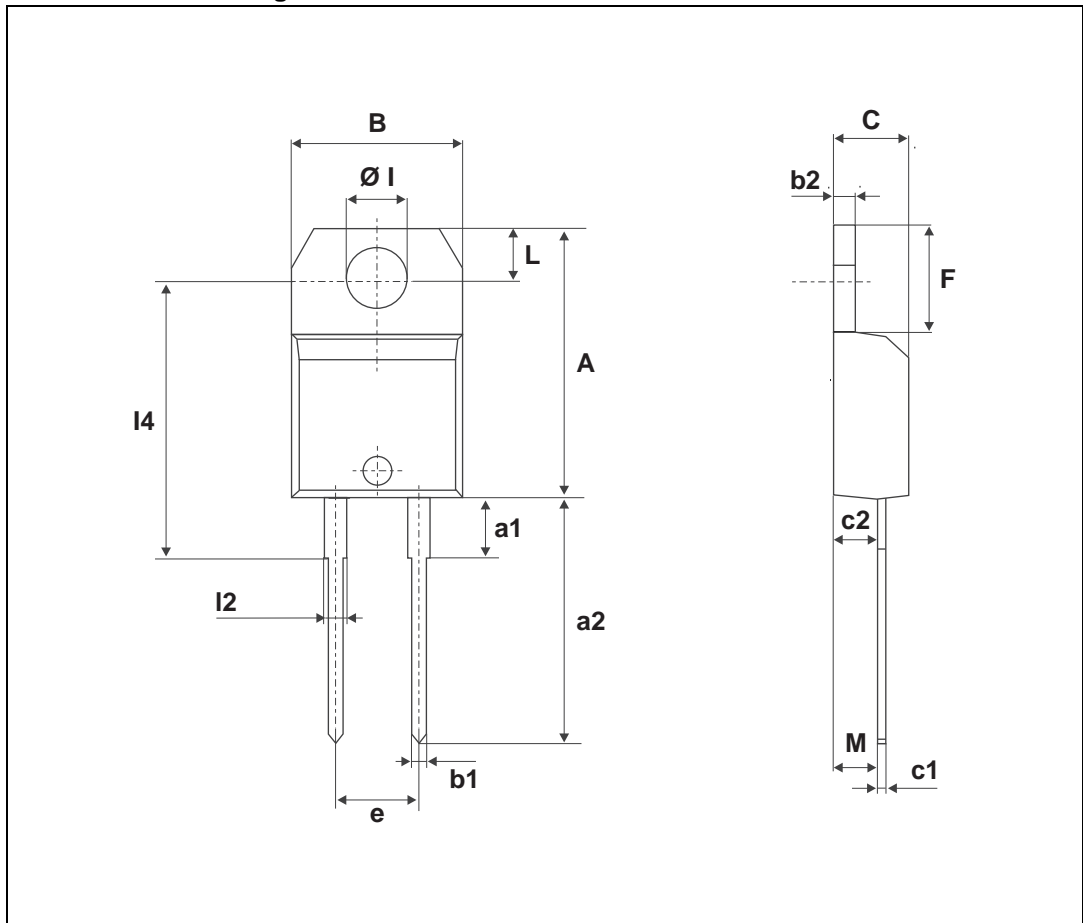


Table 7. TO-220AC Ins dimension values

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	



Figure 13. DPAK dimension definitions

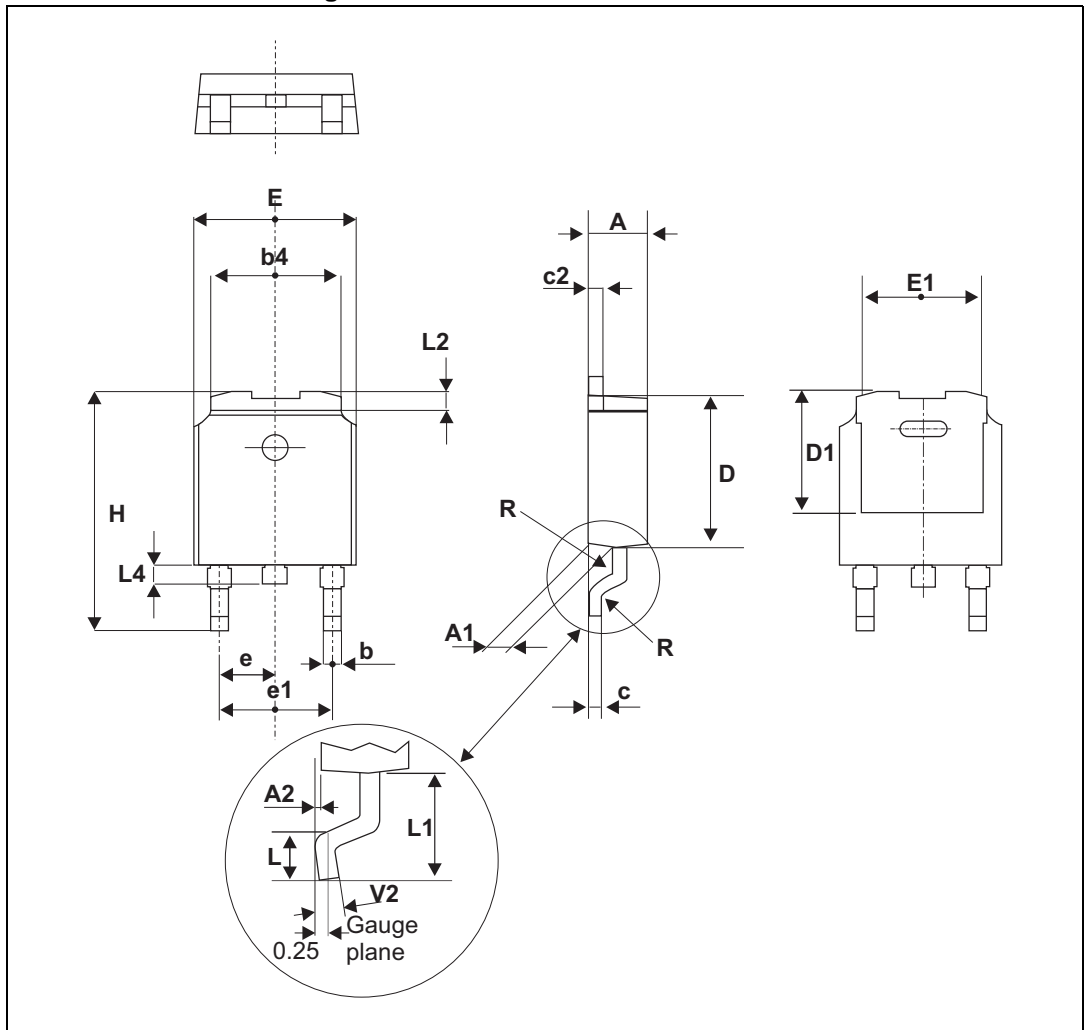
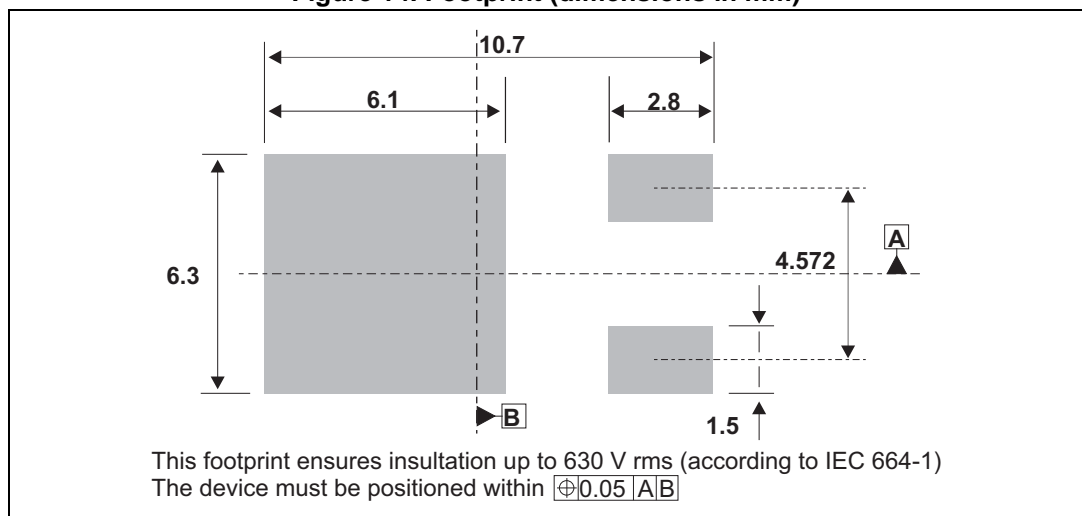


Table 8. DPAK dimension values

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)



### 3 Ordering information

**Table 9. Ordering information**

Order code	Marking	Package	Weight	Base qty	Delivery mode
STPSC4H065D	STPSC4H065D	TO-220AC	1.86 g	50	Tube
STPSC4H065DI	STPSC4H065DI	TO-220AC Ins	2.12 g	50	Tube
STPSC4H065B-TR	STPSC 4H065	DPAK	0.32 g	2500	Tape and reel

### 4 Revision history

**Table 10. Document revision history**

Date	Revision	Changes
31-Aug-2012	1	First issue.
10-Oct-2012	2	Added Max. value in <a href="#">Table 3</a> .
07-Nov-2013	3	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	4	Added TO-220AC Ins package.

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2014 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)