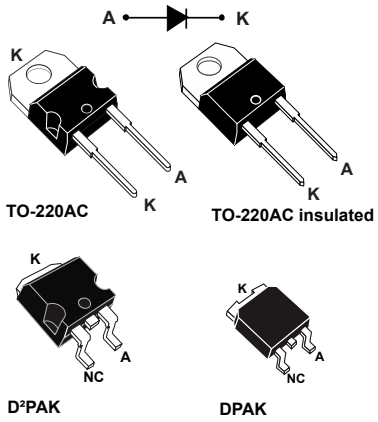
650 V, 10 A high surge silicon carbide power Schottky diode



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
- Power efficient product
- ECOPACK®2 compliant component

Applications

- Switch mode power supply
- PFC
- DCDC converters
- LLC topologies
- Boost diode

Description

This 10 A, 650 V 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.

This STPSC10H065 is 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.

Product status
STPSC10H065

Product summary	
Symbol	Value
$I_{F(AV)}$	10 A
V_{RRM}	650 V
$T_{j(max.)}$	175 °C

Product label
SUSTAINABLE TECHNOLOGY

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	TO-220AC, DPAK, D²PAK, T_C = 135 °C, DC (1)	10	A
		TO-220AC Ins, T_C = 85 °C, DC(1)		
I_{FRM}	Repetitive peak forward current	TO-220AC, DPAK, D²PAK, T_c = 135 °C, T_j = 175 °C, δ = 0.1(1)	41	A
		TO-220AC Ins, T_c = 85 °C, T_j = 175 °C, δ = 0.1(1)		
I_{FSM}	Surge non repetitive forward current	t_p = 10 ms sinusoidal, T_c = 25 °C	90	A
		t_p = 10 ms sinusoidal, T_c = 125 °C	80	
		t_p = 10 µs square, T_c = 25 °C	470	
T_{stg}	Storage temperature range		-55 to +175	°C
T_j	Operating junction temperature range(2)		-40 to +175	°C

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

Table 2. Thermal resistance parameters

Symbol	Parameter		Typ. value	Max. value	Unit
$R_{th(j-c)}$	Junction to case	TO-220AC, DPAK, D²PAK	1.25	1.5	°C/W
		TO-220AC Ins.	2.1	3.5	

Table 3. Static electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_R (1)	Reverse leakage current	T_j = 25 °C	$V_R = V_{RRM}$	-	9	100	µA
		T_j = 150 °C		-	85	425	
V_F (2)	Forward voltage drop	T_j = 25 °C	I_F = 10 A	-	1.56	1.75	V
		T_j = 150 °C		-	1.98	2.5	

1. *Pulse test: t_p = 10 ms, δ < 2%*
2. *Pulse test: t_p = 500 µs, δ < 2%*

To evaluate the conduction losses, use the following equation:

$P = 1.35 \times I_{F(AV)} + 0.115 \times I_F{}^2{}_{(RMS)}$

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	Typ.	Unit
Q_{Cj} (1)	Total capacitive charge	V_R = 400 V	28.5	nC
C_j	Total capacitance	V_R = 0 V, T_c = 25 °C, F = 1 MHz	480	pF
		V_R = 400 V, T_c = 25 °C, F = 1 MHz	48	

1. *Most accurate value for the capacitive charge:*

$$Q_{cj} = \int_0^{V_{OUT}} C_J(V_R) \bullet dV_R \quad (1)$$

1.1 Characteristics (curves)

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

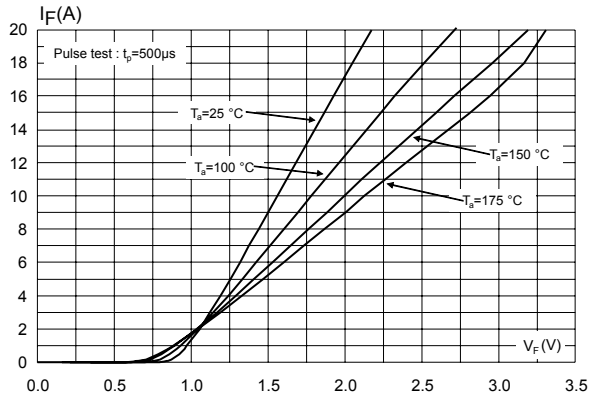


Figure 2. Forward voltage drop versus forward current (typical values, high level)

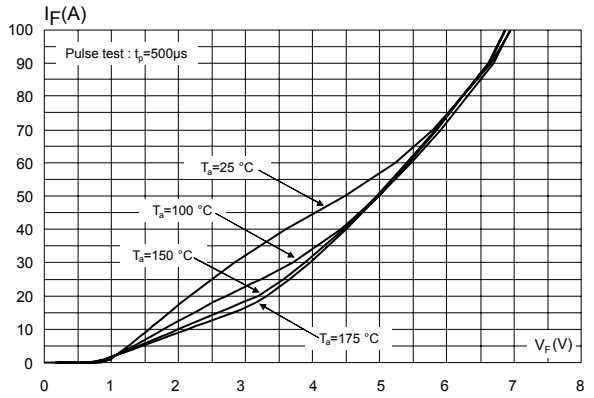


Figure 3. Reverse leakage current versus reverse voltage applied (typical values)

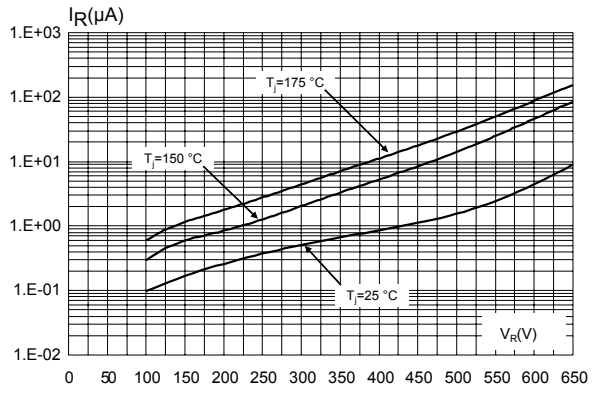


Figure 4. Peak forward current versus case temperature (TO-220AC, DPAK, D²PAK)

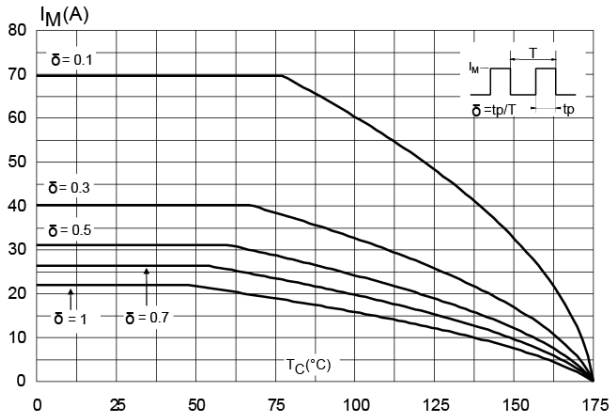


Figure 5. Peak forward current versus case temperature (TO-220AC Ins)

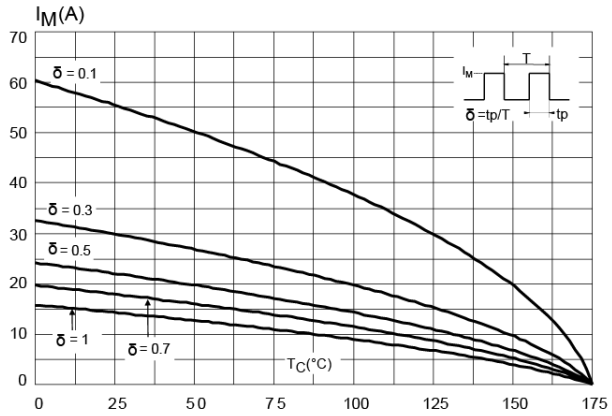


Figure 6. Junction capacitance versus reverse voltage applied (typical values)

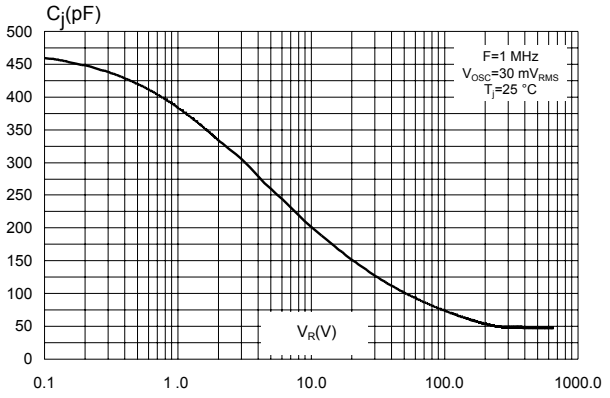


Figure 7. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC, DPAK and D²PAK)

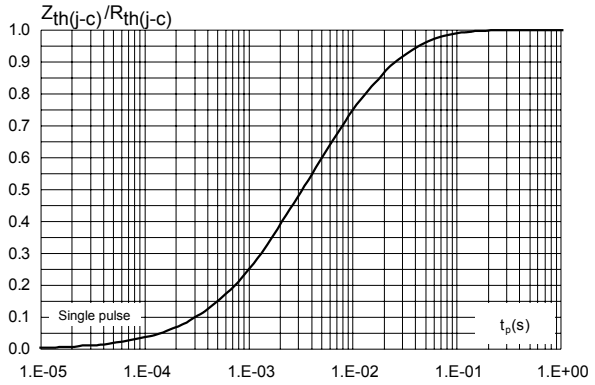


Figure 8. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC Ins)

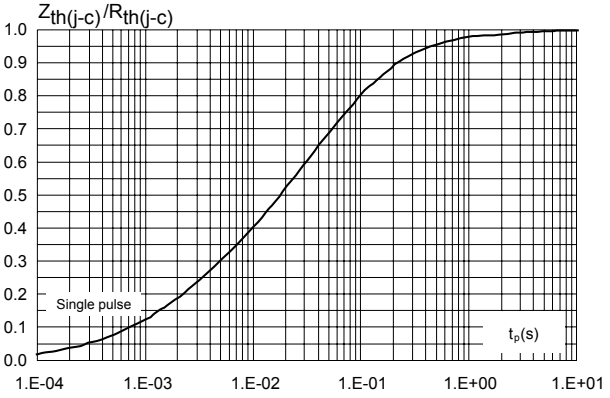


Figure 9. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)

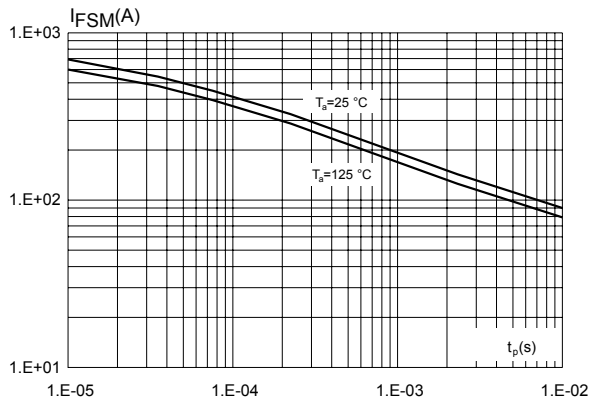


Figure 10. Total capacitive charges versus reverse voltage applied (typical values)

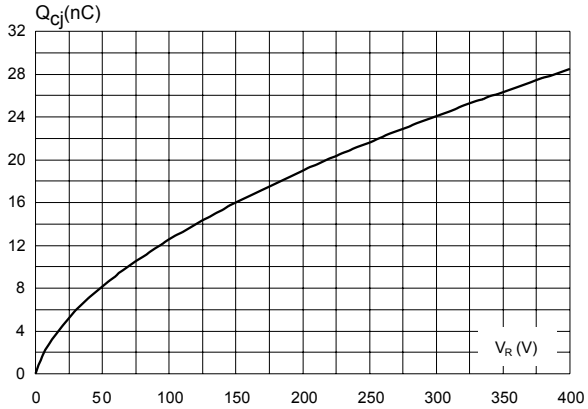
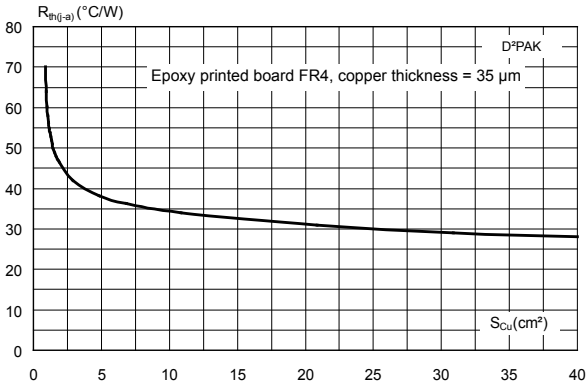


Figure 11. Thermal resistance junction to ambient versus copper surface under tab for D²PAK package (typical values)



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. ECOPACK is an ST trademark.

2.1 DPACK package information

- Epoxy meets UL94, V0

Figure 12. DPAK package outline

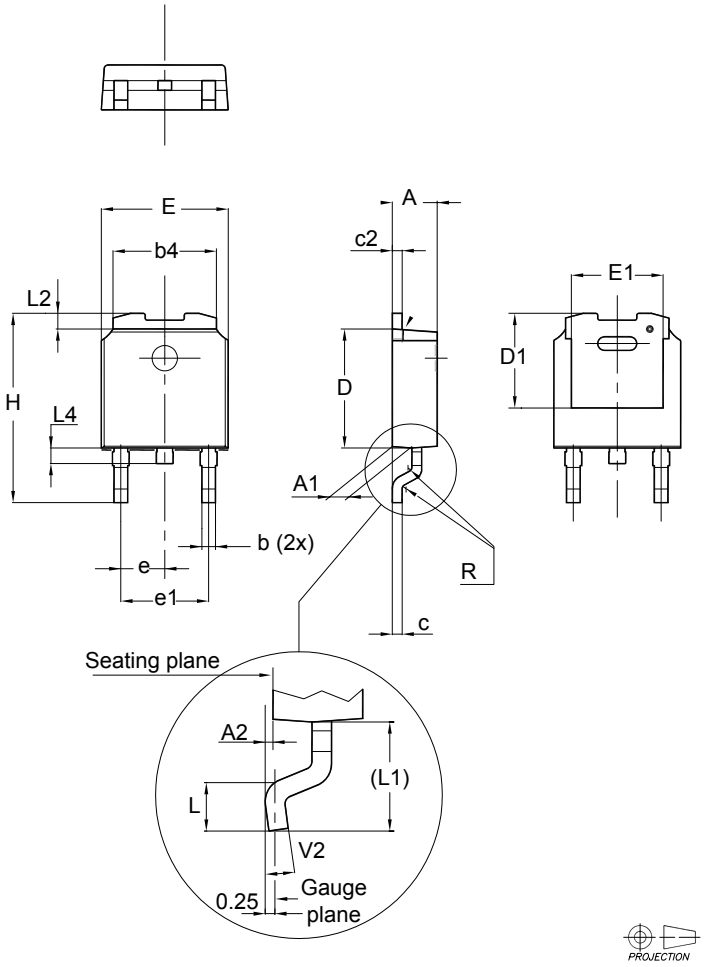
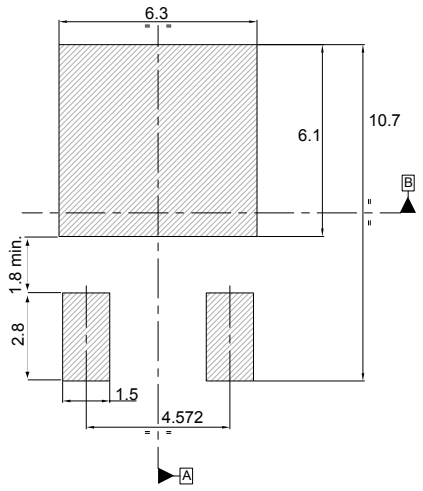


Table 5. DPAK mechanical data

Dim.	Dimensions					
	Millimeters			Inches[1]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.20		2.40	0.087		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	0.205		0.213
c	0.45		0.60	0.018		0.024
c2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
D1	4.95	5.10	5.25	0.195	0.201	0.207
E	6.40		6.60	0.252		0.260
E1	4.60	4.70	4.80	0.181	0.185	0.189
e	2.159	2.286	2.413	0.085	0.090	0.095
e1	4.445	4.572	4.699	0.175	0.180	0.185
H	9.35		10.10	0.368		0.398
L	1.00		1.50	0.039		0.059
(L1)	2.60	2.80	3.00	0.102	0.110	0.118
L2	0.65	0.80	0.95	0.026	0.031	0.037
L4	0.60		1.00	0.024		0.039
R		0.20			0.008	
V2	0°		8°	0°		8°

1. *Inches dimensions given for reference only*

Figure 13. DPAK recommended footprint (dimensions are in mm)

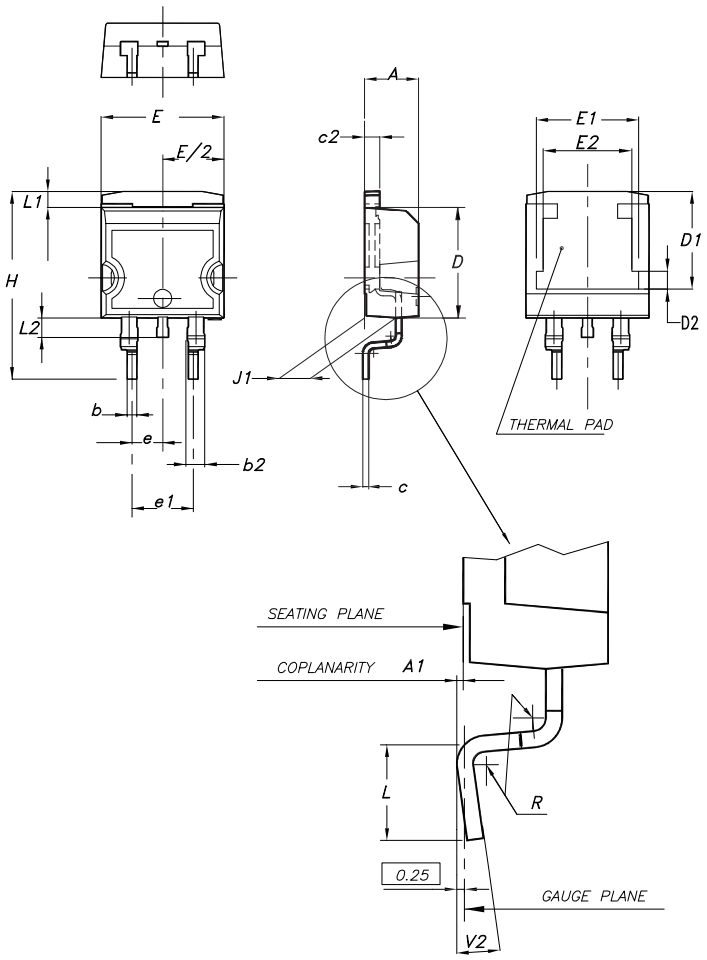


The device must be positioned within ⌖ 0.05 A B

2.2 D²PAK package information

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

Figure 14. D²PAK package outline

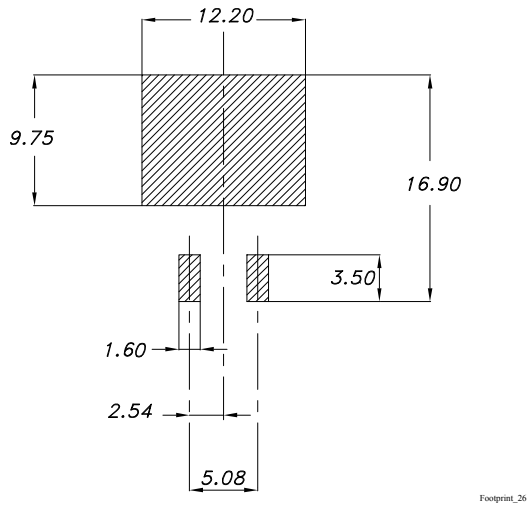


Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.

Table 6. **D²PAK package mechanical data**

Ref.	Dimensions					
	Millimeters			Inches (for reference only)		
	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	10.00		10.40	0.394		0.409
E1	8.30	8.50	8.70	0.335	0.343	0.346
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	15.00		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		0.40			0.015	
V2	0°		8°	0°		8°

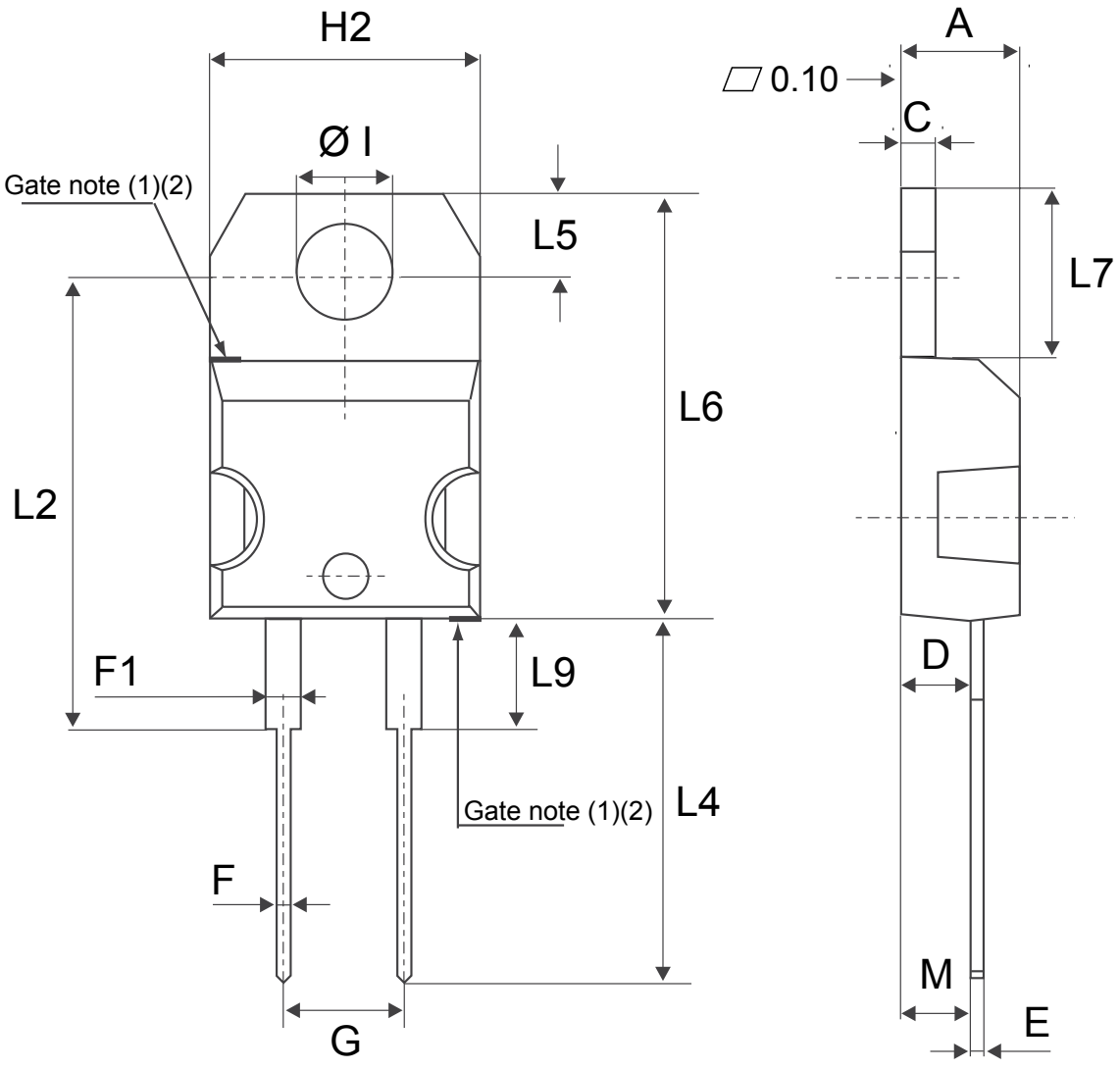
Figure 15. **D²PAK recommended footprint (dimensions are in mm)**



2.3 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 16. TO-220AC package outline



(1) :Max resin gate protusion 0.5 mm

(2) :Resin gate position is accepted in each of the two positions shown on the drawings or their symmetrical

Table 7. **TO-220AC package mechanical data**

Ref.	Dimensions			
	Millimeters		Inches (for reference only)	
	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	2.60 typ.		0.102 typ.	
Diam	3.75	3.85	0.147	0.151

2.4 TO-220AC Ins. 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 17. **TO-220AC Ins. package outline**

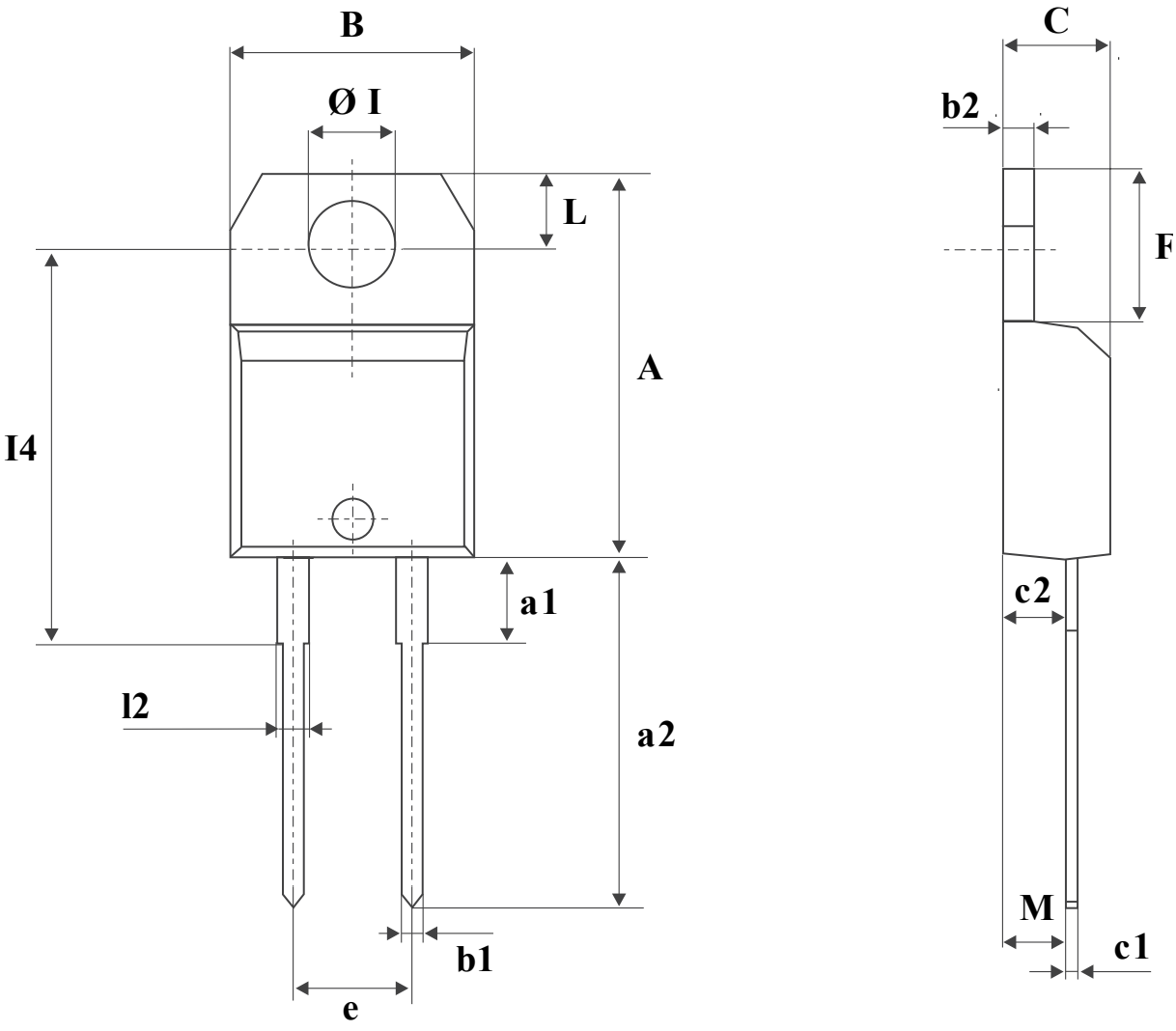


Table 8. **TO-220AC Ins. package mechanical data**

Ref.	Dimensions					
	Millimeters			Inches (for reference only)		
	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
L	2.65		2.95	0.104		0.116
l2	1.14		1.70	0.044		0.066
l4	15.80	16.40	16.80	0.622	0.645	0.661
M		2.60			0.102	
Øl	3.75		3.85	0.147		0.151

3 Ordering information

Table 9. Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
STPSC10H065G-TR	STPSC10H065G	D²PAK	1.48 g	1000	Tape and reel
STPSC10H065D	STPSC10H065D	TO-220AC	1.86 g	50	Tube
STPSC10H065DI	STPSC 10H065DI	TO-220AC Ins.	2.12 g	50	Tube
STPSC10H065B-TR	PSC10 H065	DPAK	0.32 g	2500	Tape and reel

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
31-Aug-2012	1	First issue.
10-Oct-2012	2	Added Max. value to Table 3.
07-Nov-2013	3	Updated Figure 1, Figure 2, Figure 13, Figure 14 and Table 8.
07-Jan-2014	4	Added TO-220AC Ins package.
22-Jul-2015	5	Updated Table 10 and reformatted to current standard.
10-Dec-2015	6	Inserted package name on cover page.
26-Jan-2017	7	Updated D²PAK package information.
09-Jan-2020	8	Updated Features.

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