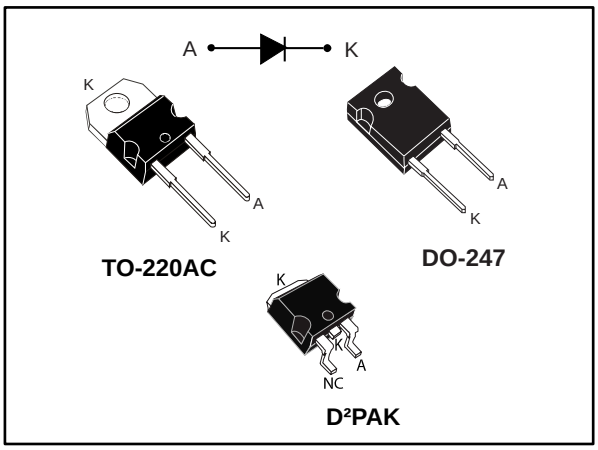
STPSC20065-Y

Automotive 650 V power Schottky silicon carbide diode

Datasheet - production data



Features

- AEC-Q101 qualified
- No reverse recovery charge in application current range
- Switching behavior independent of temperature
- Dedicated to PFC applications
- High forward surge capability
- ECOPACK®2 compliant component
- PPAP capable
- Operating T_j from -40 °C to 175 °C

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

Table 1: Device summary

Symbol	Value
$I_{F(AV)}$	20 A
V_{RRM}	650 V
T_j (max.)	175 °C
V_F (typ.)	1.30 V

This is information on a product in full production.

1 Characteristics

Table 2: 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		40	A
$I_{F(AV)}$	Average forward current	T_c = 140 °C, DC current	20	A
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	70	
		t_p = 10 µs square, T_c = 25 °C	400	
I_{FRM}	Repetitive peak forward current	T_c = 140 °C, T_j = 175 °C, δ = 0.1	87	A
T_{stg}	Storage temperature range		-55 to +175	°C
T_j	Operating junction temperature(1)		-40 to +175	°C

Notes:

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

Table 3: Thermal parameters

Symbol	Parameter	Value		Unit
		Typ.	Max.	
$R_{th(j-c)}$	Junction to case	0.60	0.90	°C/W

Table 4: Static electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_R(1)	Reverse leakage current	T_j = 25 °C	$V_R = V_{RRM}$	-	30	300	µA
		T_j = 150 °C		-	280	2000	
		T_j = 25 °C	V_R = 600 V		15	150	
V_F(2)	Forward voltage drop	T_j = 25 °C	I_F = 20 A	-	1.30	1.45	V
		T_j = 150 °C		-	1.45	1.65	
		T_j = 175 °C		-	1.5		

Notes:

(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:

$P = 1.02 \times I_{F(AV)} + 0.039 \times I_{F^2(RMS)}$

Table 5: Dynamic electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Q_{Cj}(1)	Total capacitive charge	V_R = 400 V	-	62	-	nC
C_j	Total capacitance	V_R = 0 V, T_c = 25 °C, F = 1 MHz	-	1250	-	pF
		V_R = 400 V, T_c = 25 °C, F = 1 MHz	-	100	-	

Notes:

(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)

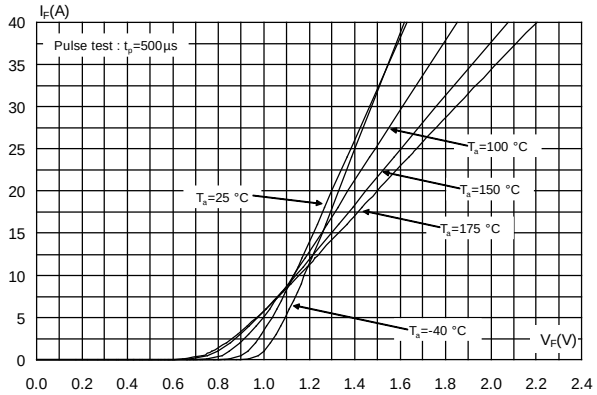


Figure 2: Reverse leakage current versus reverse voltage applied (typical values)

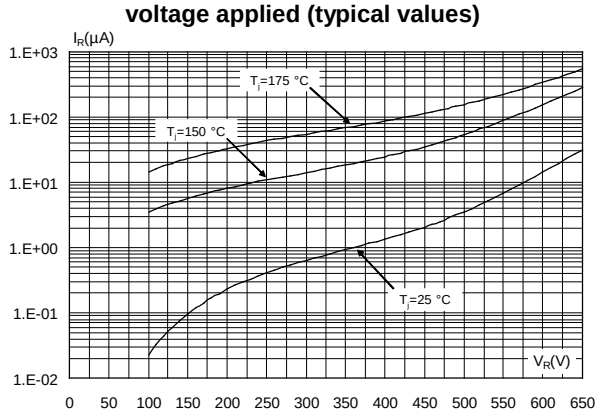


Figure 3: Peak forward current versus case temperature

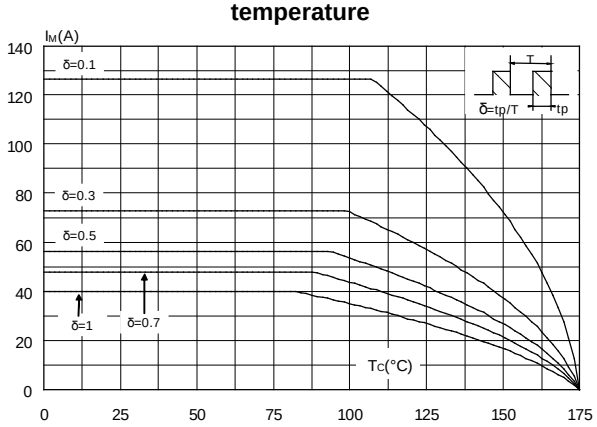


Figure 4: Junction capacitance versus reverse voltage applied (typical values)

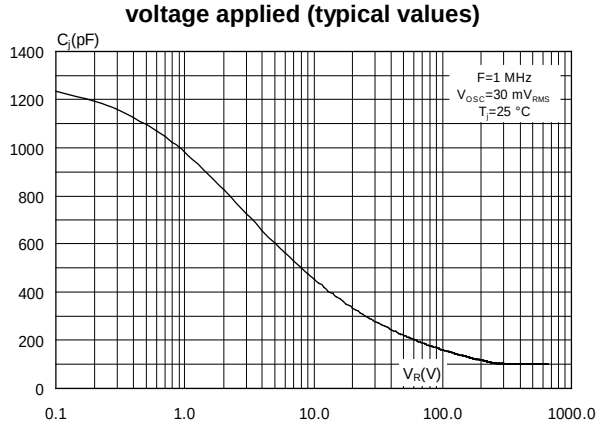


Figure 5: Relative variation of thermal impedance junction to case versus pulse duration

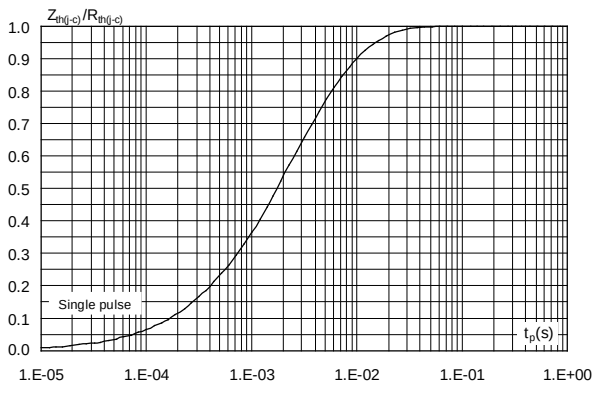


Figure 6: Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)

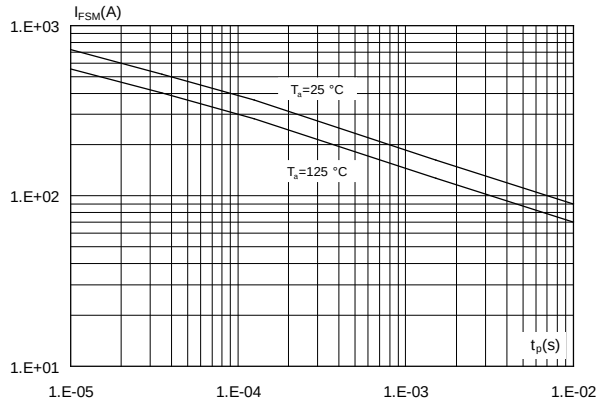


Figure 7: Total capacitive charges versus reverse voltage applied (typical values)

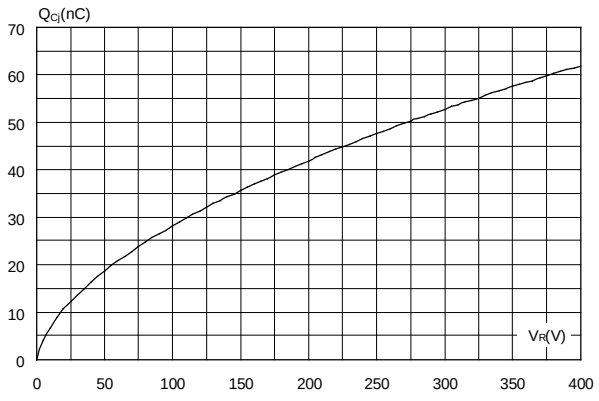
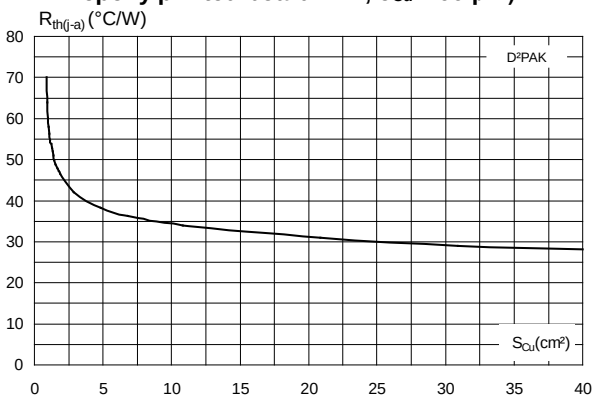


Figure 8: Thermal resistance junction to ambient versus copper surface under tab (typical values, epoxy printed board FR4, e_{Cu} = 35 µm)



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.

- Cooling method: by conduction (C)
- Epoxy meets UL 94,V0
- Recommended torque value: 0.55 N·m for TO-220AC
- Maximum torque value: 0.7 N·m for TO-220AC
- Recommended torque value: 0.8 N·m for DO-247
- Maximum torque value: 1 N·m for DO-247

2.1 TO-220AC package information

Figure 9: TO-220AC package outline

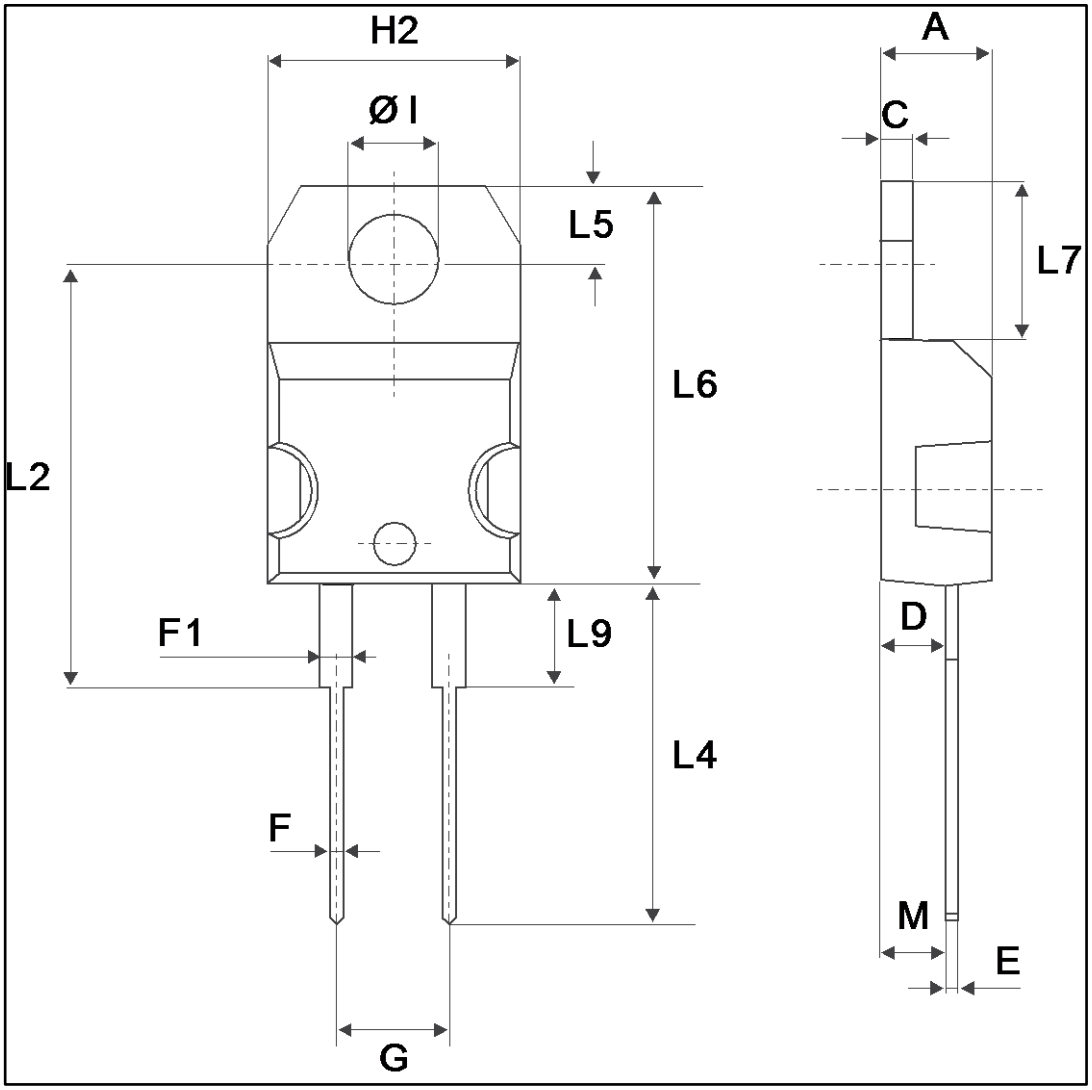


Table 6: TO-220AC package mechanical data

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.	
ØI	3.75	3.85	0.147	0.151

2.2 DO-247 package information

Figure 10: DO-247 package outline

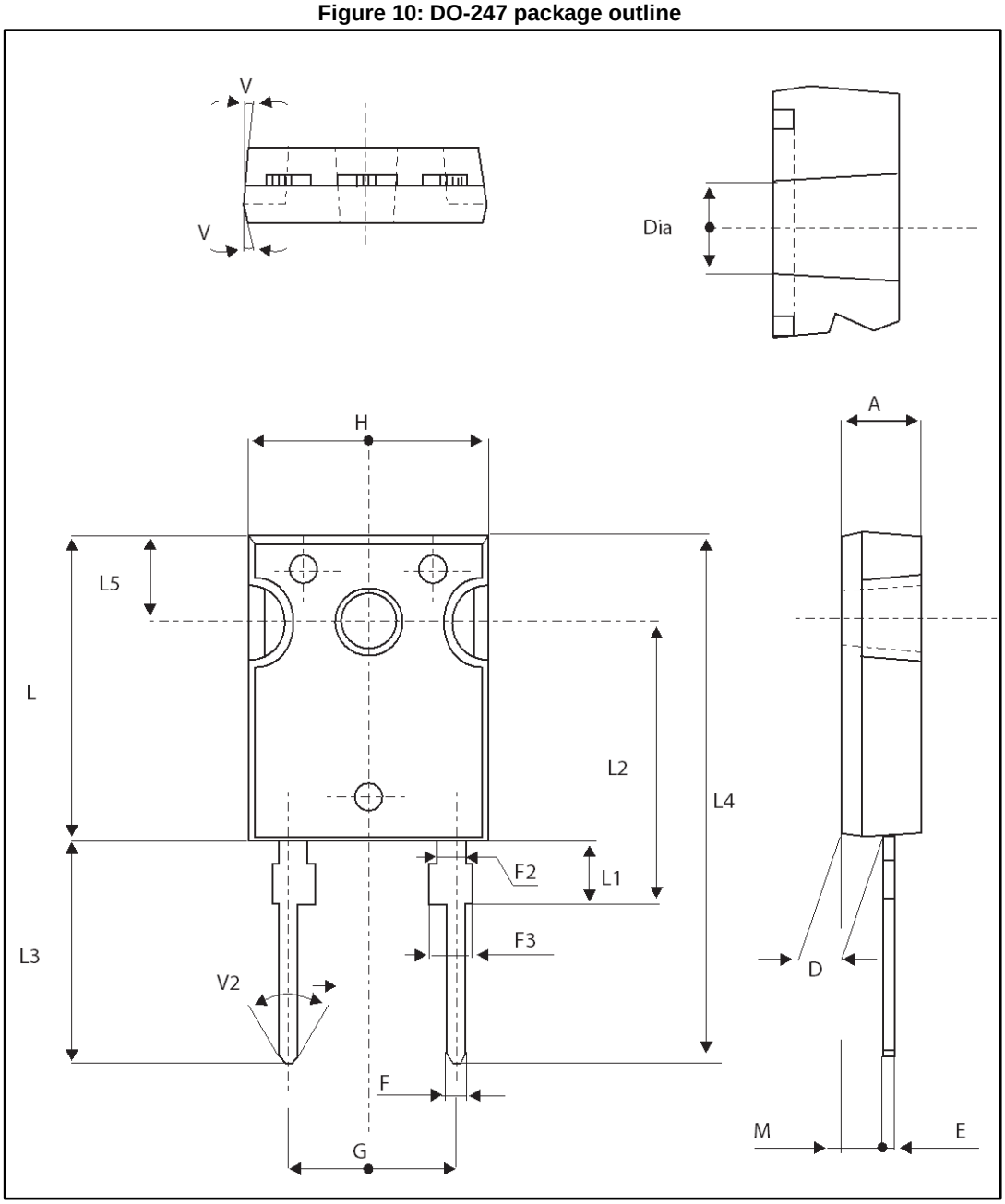


Table 7: DO-247 package mechanical data

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.85	5.15	0.191	0.203
D	2.20	2.60	0.086	0.102
E	0.40	0.80	0.015	0.031
F	1.00	1.40	0.039	0.055
F2	2.00 typ.		0.078 typ.	
F3	2.00	2.40	0.078	0.094
G	10.90 typ.		0.429 typ.	
H	15.45	15.75	0.608	0.620
L	19.85	20.15	0.781	0.793
L1	3.70	4.30	0.145	0.169
L2	18.50 typ.		0.728 typ.	
L3	14.20	14.80	0.559	0.582
L4	34.60 typ.		1.362 typ.	
L5	5.50 typ.		0.216 typ.	
M	2.00	3.00	0.078	0.118
V	5°		5°	
V2	60°		60°	
Dia.	3.55	3.65	0.139	0.143

2.3 D²PAK package information

Figure 11: D²PAK package outline

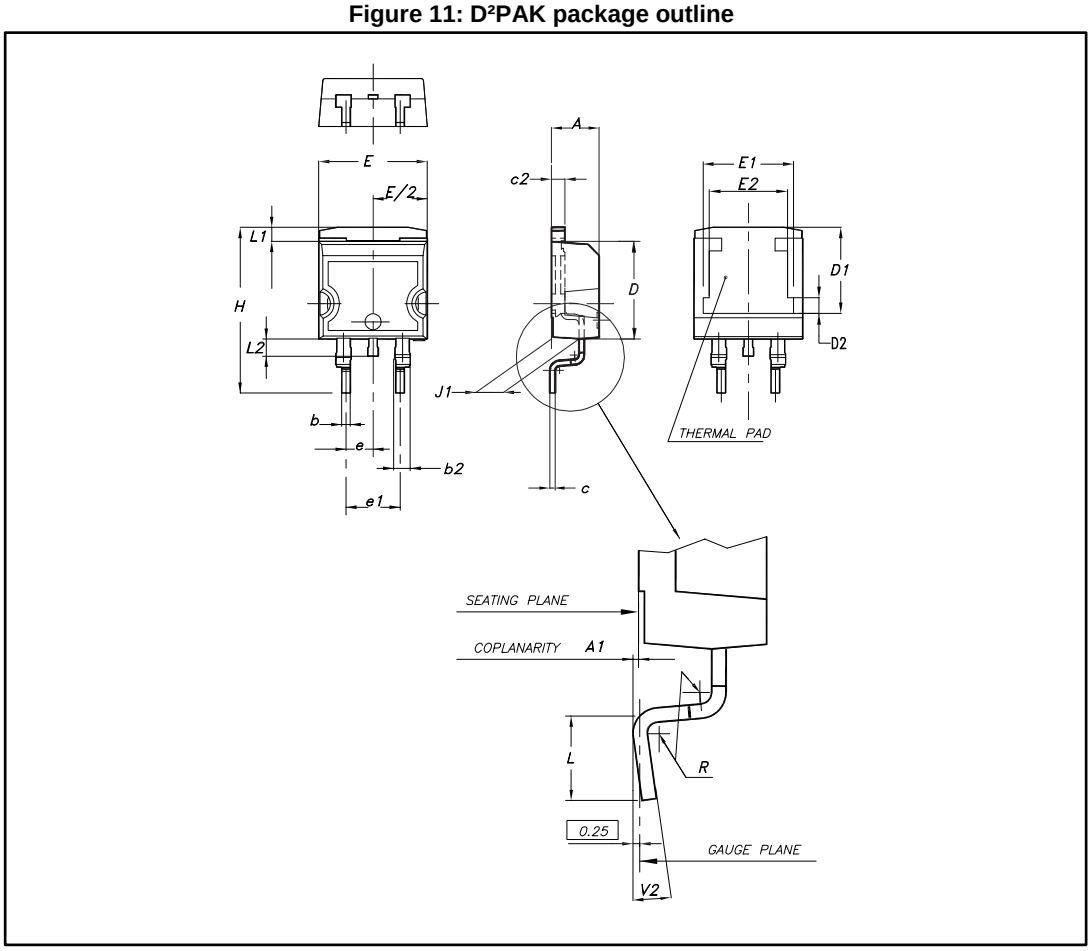
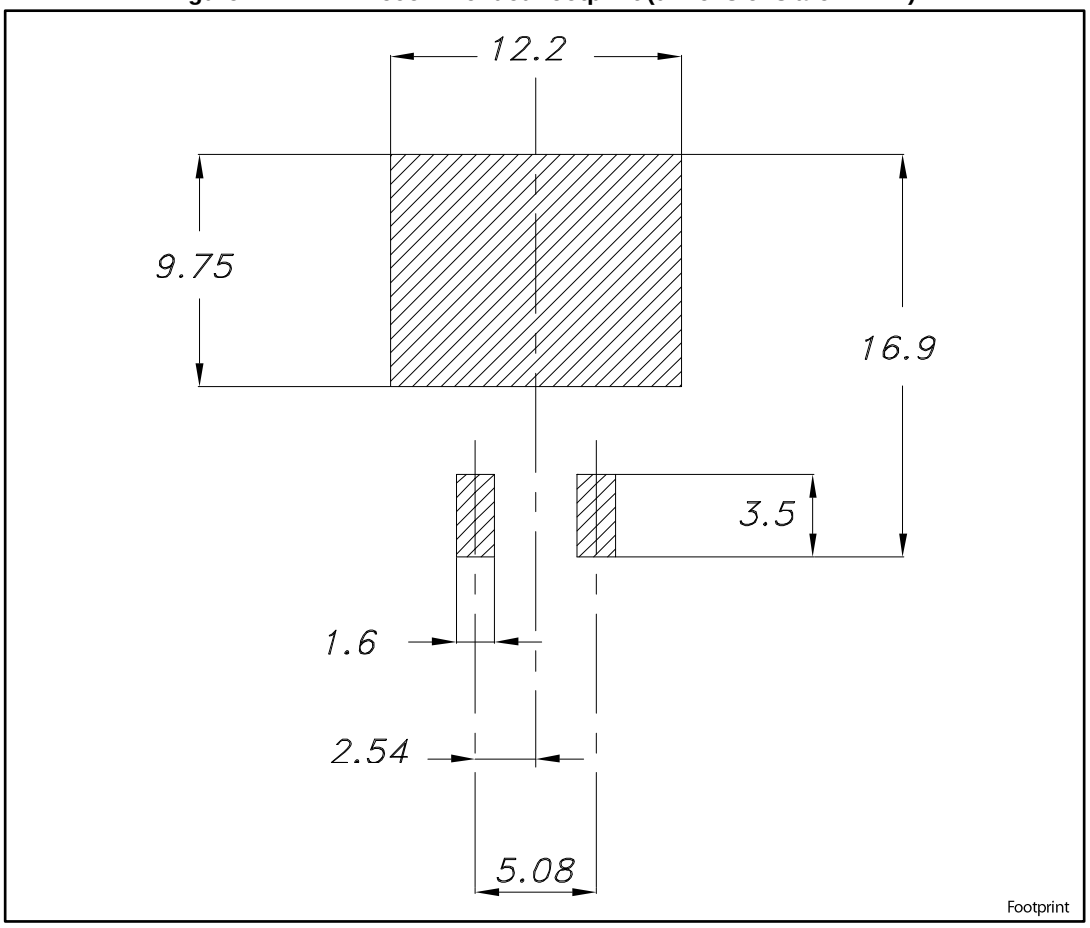


Table 8: D²PAK package mechanical data

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
E1	8.50	8.70	8.90	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		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 12: D²PAK recommended footprint (dimensions are in mm)



3 Ordering information

Table 9: Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
STPSC20065DY	PSC20065DY	TO-220AC	1.86 g	50	Tube
STPSC20065WY	PSC20065WY	DO-247	4.4 g	30	Tube
STPSC20065GY-TR	PSC20065GY	D²PAK	1.48 g	1000	Tape and reel

4 Revision history

Table 10: Document revision history

Date	Revision	Changes
10-May-2016	1	First issue
09-Nov-2017	2	Added D²PAK package.

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