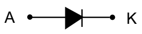
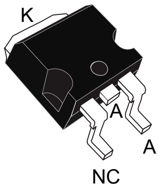
650 V, 30 A high surge silicon carbide power Schottky diode





D²PAK HV

Product label
SUSTAINABLE TECHNOLOGY

Product status link
STPSC30G065G2Y

Product summary	
$I_{F(AV)}$	30 A
V_{RRM}	650 V
T_j(max.)	175 °C
V_F(typ.)	1.30 V

Features

- AEC-Q101 qualified and PPAP capable
- No reverse recovery charge in application current range
- Switching behaviour independent of temperature
- High forward surge capability
- Operating T_j from -55 °C to +175 °C
- ECOPACK2 compliant component

Application

- On board chargers
- DC-DC converters
- PFC stage

Description

The SiC diode STPSC30G065G2Y, available in D2PAK HV, is an ultrahigh performance power Schottky rectifier. It is manufactured using a silicon carbide substrate. The wide band-gap material allows the design of a low VF 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 behaviour is independent of temperature.

Based on technology optimization, this diode has an improved forward surge current capability, making it ideal for use in PFC, where this ST SiC diode boost the performance in hard switching conditions. Using the latest design improvement of the "G" series of ST SiC diodes, as well as implemented tests in production, this diode is becoming the reference point in the combination of efficiency and application robustness to the application design.

1 Characteristics

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

Symbol	Parameter			Value	Unit
V_{RRM}	Repetitive peak reverse voltage (T_j = -55 °C to +175 °C)			650	V
$I_{F(RMS)}$	Forward rms current			63	A
$I_{F(AV)}$	Average forward current	T_c = 135 °C, δ = 1		30	A
I_{FRM}	Repetitive peak forward current	T_c = 135 °C, T_j = 175 °C, δ = 0.1, f_{sw} > 10 kHz		129	A
I_{FSM}	Surge non repetitive forward current	t_p = 10 ms sinusoidal	T_c = 25 °C	200	A
			T_c = 150 °C	160	
		t_p = 10 µs square	T_c = 25 °C	1100	
T_{stg}	Storage temperature range			-65 to +175	°C
T_j	Operating junction temperature range			-55 to +175	°C

Table 2. Thermal resistance parameters

Symbol	Parameter	Value		Unit
		Typ.	Max.	
$R_{th(j-c)}$	Junction to case	0.50	0.71	°C/W

For more information, you can 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 (1)	Reverse leakage current	T_j = 25 °C	$V_R = V_{RRM}$	-	25	300	µA
		T_j = 175 °C		-	150	1200	
V_F (2)	Forward voltage drop	T_j = 25 °C	I_F = 30 A	-	1.30	1.45	V
		T_j = 175 °C		-	1.49	1.70	

1. *Pulse test: t_p = 10 ms, δ < 2%*
2. *Pulse test: t_p = 380 µs, δ < 2%*

To evaluate the conduction losses, use the following equation:

$P = 0.879 \times I_{F(AV)} + 0.027 \times I_F{}^2{}_{(RMS)}$

For more information, you can 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} [1]	Total capacitive charge	V_R = 400 V	-	86	-	nC
C_j	Total capacitance	V_R = 0 V, T_c = 25 °C, F = 1 MHz	-	1890	-	pF
		V_R = 400 V, T_c = 25 °C, F = 1 MHz	-	120	-	

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

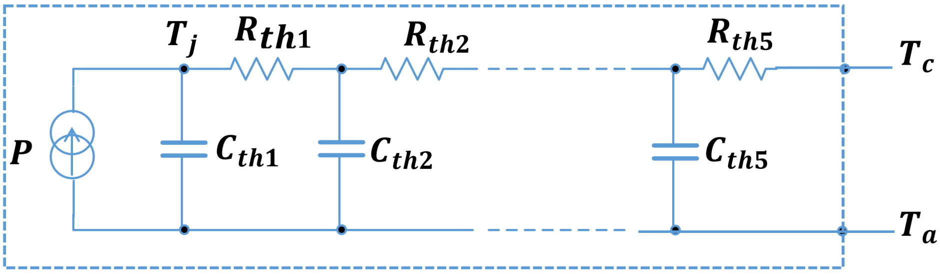


Figure 1. **Thermal transient impedance model circuit of the diode – $Z_{th(j-c)}$**

Table 5. **Components typical values of the diode thermal transient impedance model $Z_{th(j-c)}$**

Ref.	Value (K/W)	Ref.	Value (J/K)
R_{th1}	18.71m	C_{th1}	1.22m
R_{th2}	139.81m	C_{th2}	1.43m
R_{th3}	195.71m	C_{th3}	5.91m
R_{th4}	118.51m	C_{th4}	28.94m
R_{th5}	27.25m	C_{th5}	427.97m

1.1 Characteristics (curves)

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

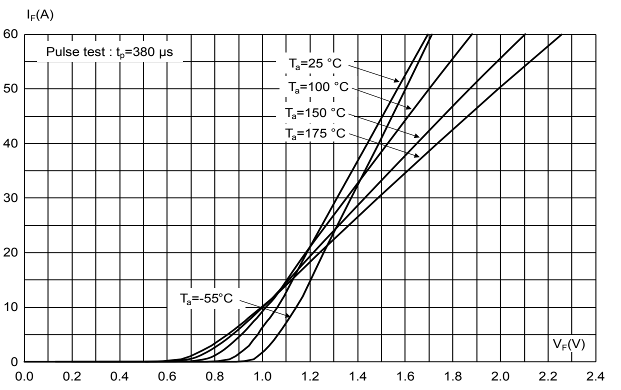


Figure 3. Reverse leakage current versus reverse voltage applied (typical values)

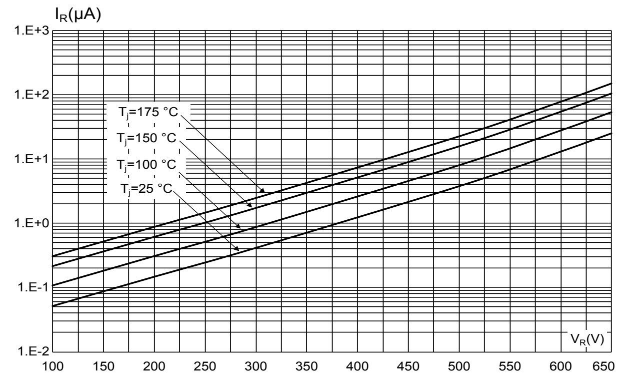


Figure 4. Peak forward current versus case temperature (f_{sw} > 10 kHz)

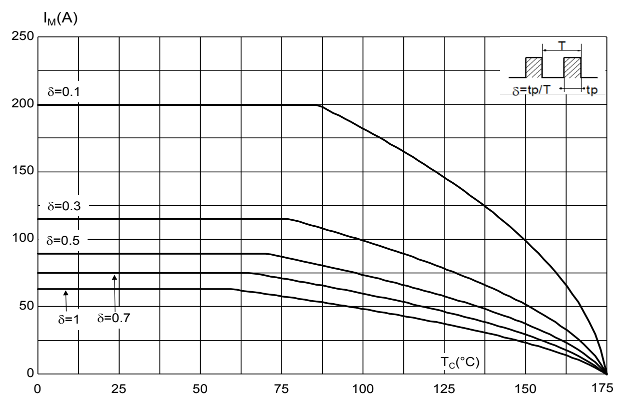


Figure 5. Junction capacitance versus reverse voltage applied (typical values)

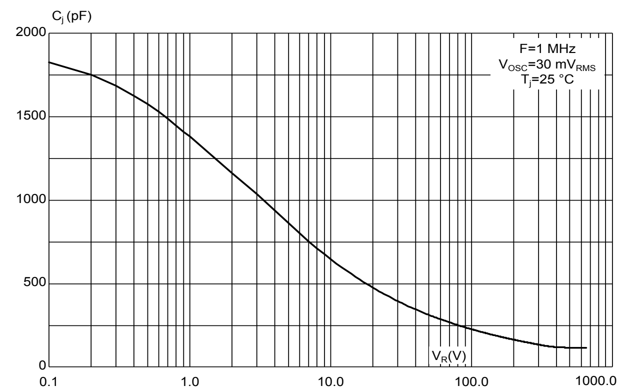


Figure 6. Relative variation of thermal impedance junction to case versus pulse duration

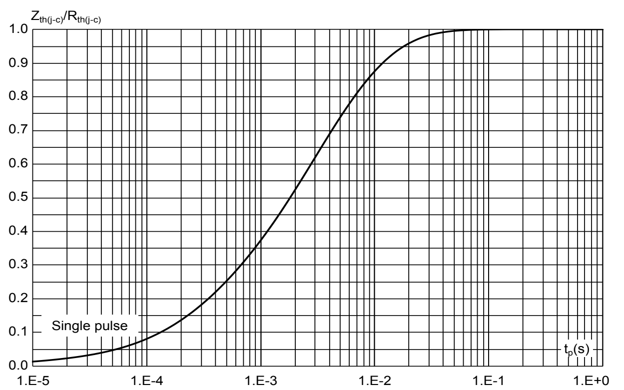


Figure 7. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)

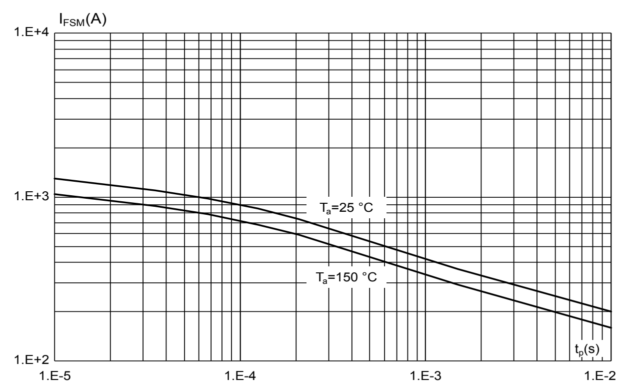


Figure 8. **Total capacitive charges versus reverse voltage applied (typical values)**

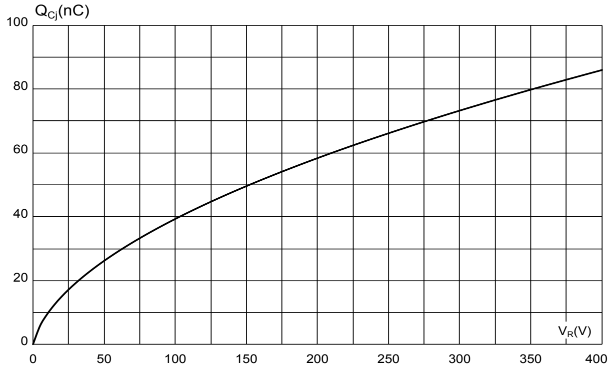
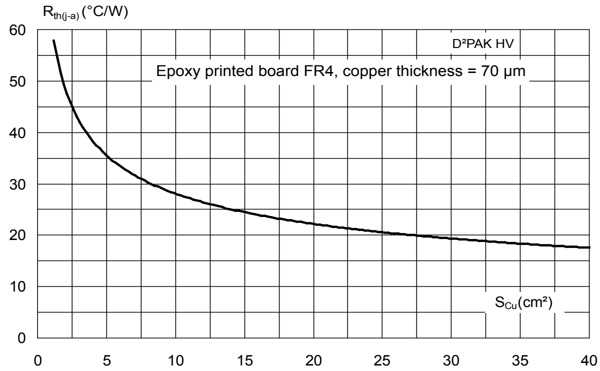


Figure 9. **Thermal resistance junction to ambient versus copper surface under tab (typical values)**



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. ECOPACK is an ST trademark.

2.1 D²PAK high voltage package information

- Epoxy meets UL94, V0

Figure 10. D²PAK high voltage package outline

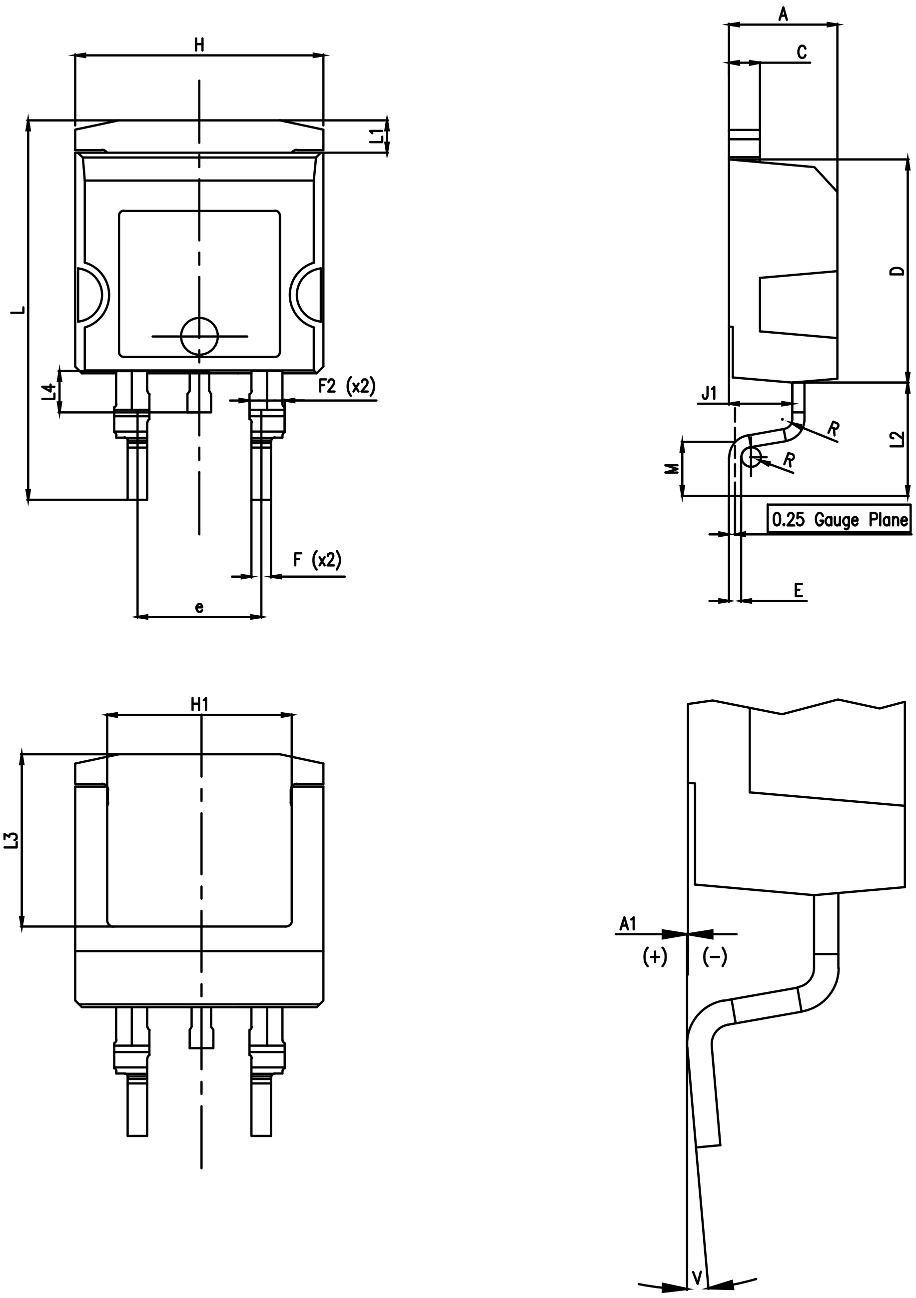
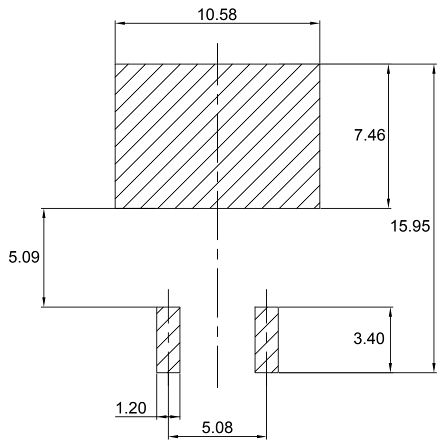


Table 6. D²PAK high voltage package mechanical data

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	-	0.85
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	1.50	-	1.7
M	2.60	-	2.9
R	0.20	-	0.60
V	0°	-	8°

Figure 11. D²PAK high voltage footprint in mm



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

2.2 Creepage distance between anode and cathode

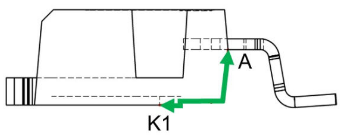
Table 7. Creepage distance between anode and cathode

Symbol	Parameter		Value	Unit
Cd_{A-K1}	Minimum creepage distance between A and K1 (with top coating)	D²PAK HV	5.38	mm
Cd_{A-K2}	Minimum creepage distance between A and K2 (without top coating)		3.48	

Note: D²PAK HV creepage distance (anode to cathode) = 5.38 mm min. (refer to IEC 60664-1)

Figure 12. Creepage with top coating

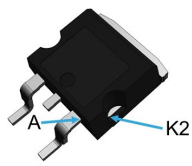
Creepage



Minimum distance between A & K1 = 5.38 mm (with top coating)

Figure 13. Creepage without top coating

Creepage



Minimum distance between A & K2 = 3.48 mm (without top coating)

3 Ordering information

Table 8. **Ordering information**

Order code	Marking	Package	Weight	Base qty.	Delivery mode
STPSC30G065G2Y	PSC30G065Y	D²PAK HV	1.48 g	1000	Tape and reel 13”

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
25-Apr-2024	1	Initial release.