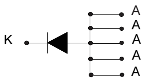
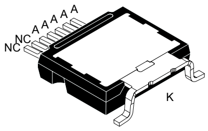
Automotive 1200 V, 20 A power Schottky high surge silicon carbide diode





HU³PAK

STPOWER

Product label
SUSTAINABLE TECHNOLOGY

Product status link
STPSC20G12L2Y

Product summary	
$I_{F(AV)}$	20 A
V_{RRM}	1200 V
T_j (max.)	175 °C
V_F (typ.)	1.35 V

Features

- AEC-Q101 qualified and PPAP capable
- None or negligible reverse recovery
- Switching behavior independent of temperature
- Robust high voltage periphery
- Operating T_j from -55 °C to 175 °C
- SMD with top side cooling package (HU3PAK)
- ECOPACK2 compliant component

Applications

- Vehicle to load converter
- Wound rotor synchronous motor
- HEV/EV OBC (On board battery chargers)
- EV Charging station

Description

The SiC diode, available in HU3PAK (SMD topside cooling package), is a 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 1200 V rating. Thanks to the Schottky construction, no recovery is shown during turn-off and ringing patterns are negligible. The minimal capacitive turn-off behavior is independent of temperature.

Based on the latest technology optimization, this diode has an improved forward surge current capability, making it ideal for use in PFC, where this ST SiC diode will boost the performance in hard switching conditions while bringing robustness to the design. Its high forward surge capability ensures a good robustness during transient phases.

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)			1200	V
$I_{F(RMS)}$	Forward rms current			64	A
$I_{F(AV)}$	Average forward current	T_c = 150 °C, δ = 1		20	A
I_{FRM}	Repetitive peak forward current	T_c = 150 °C, T_j = 175 °C, δ = 0.1, f_{sw} > 10 kHz		76	A
I_{FSM}	Surge non repetitive forward current	t_p = 10 ms sinusoidal	T_c = 25 °C	180	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	0.45	0.60	°C/W

For more information you can refer to:

- TN1378: HU³PAK package mounting and thermal behavior.

Table 3. Static electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_R (1)	Reverse leakage current	T_j = 25 °C	$V_R = V_{RRM}$	-	10	150	µA
		T_j = 150 °C		-	33	500	
		T_j = 175 °C			75		
V_F (2)	Forward voltage drop	T_j = 25 °C	I_F = 20 A	-	1.35	1.50	V
		T_j = 150 °C		-	1.75	2.10	
		T_j = 175 °C			1.90		

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:

$P = 0.924 \times I_{F(AV)} + 0.059 \times I_F{}^2{}_{(RMS)}$

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	Min.	Typ.	Max.	Unit
Q_{Cj} (1)	Total capacitive charge	V_R = 800 V	-	103	-	nC
C_j	Total capacitance	V_R = 0 V, T_c = 25 °C, F = 1 MHz	-	1548	-	pF
		V_R = 800 V, T_c = 25 °C, F = 1 MHz	-	73	-	

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 – $Z_{th(j-c)}$

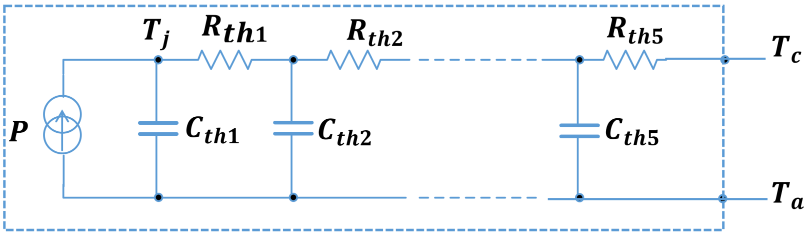


Table 5. Components typical values of the diode thermal transient impedance model $Z_{th(j-c)}$

Ref.	Value (K/W)	Ref.	Value (J/K)
R_{th1}	18.44 m	C_{th1}	1.63 m
R_{th2}	156.64 m	C_{th2}	1.46 m
R_{th3}	169.33 m	C_{th3}	6.03 m
R_{th4}	83.42 m	C_{th4}	19.5 m
R_{th5}	21.89 m	C_{th5}	214.37 m

1.1 Characteristics (curves)

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

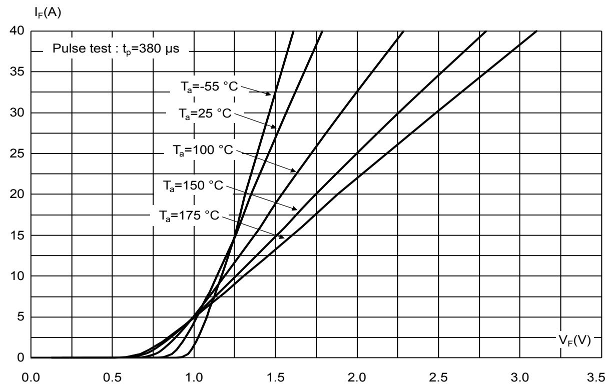


Figure 3. Reverse leakage current versus reverse voltage applied (typical values)

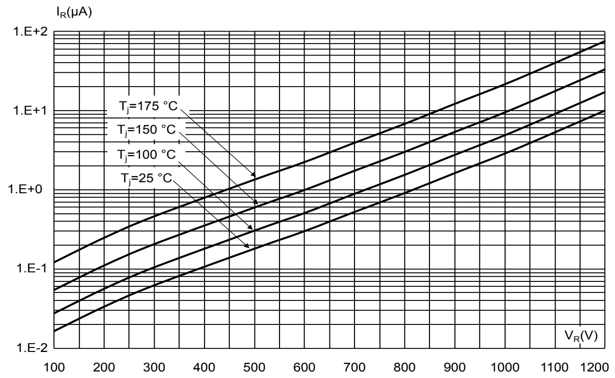


Figure 4. Peak forward current versus case temperature

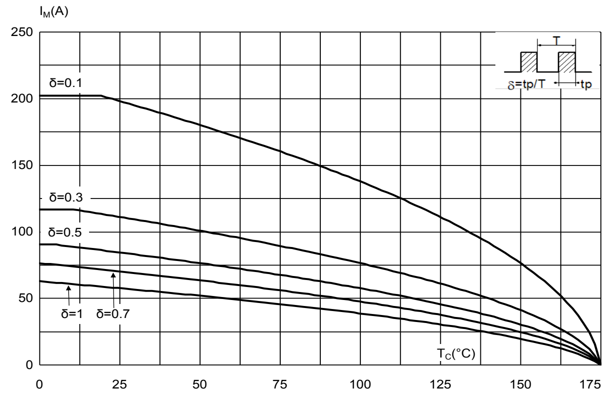


Figure 5. Junction capacitance versus reverse voltage applied (typical values)

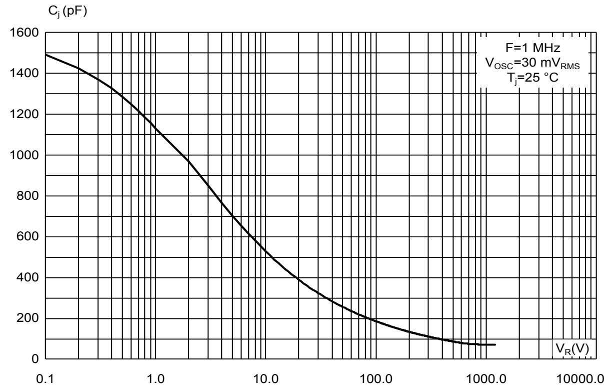


Figure 6. Relative variation of thermal impedance junction to case versus pulse duration

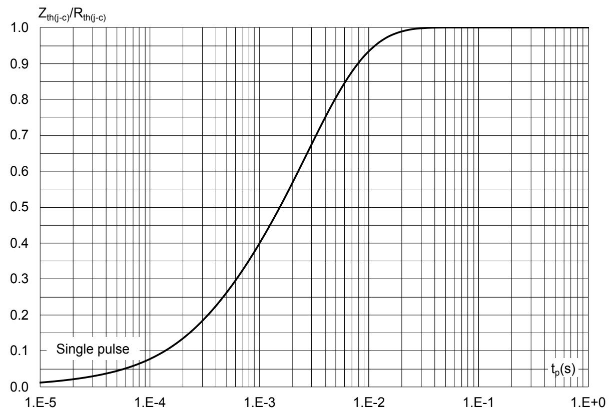


Figure 7. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)

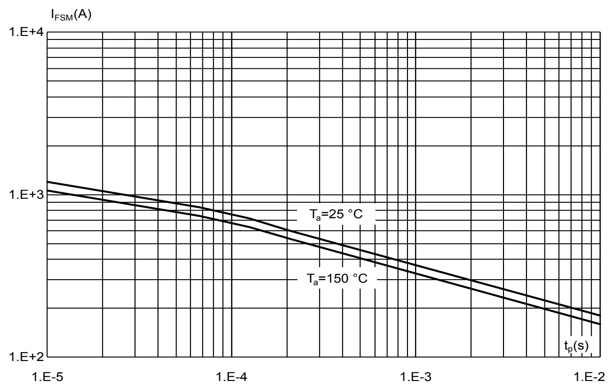
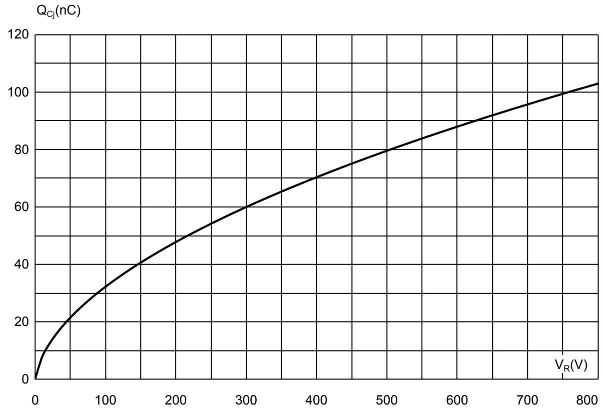


Figure 8. Total capacitive charges versus reverse voltage applied (typical values)



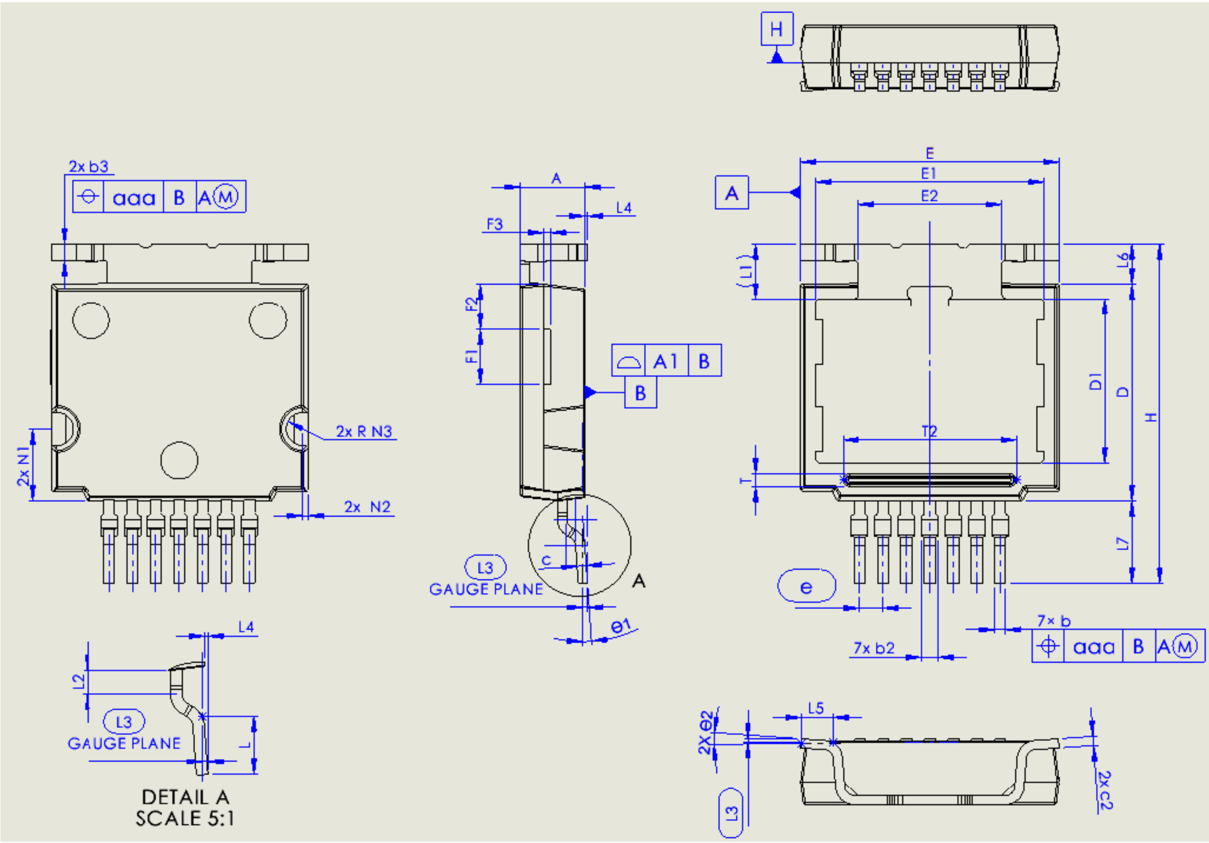
2 Package information

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 HU^{3}PAK package information

- Epoxy meets UL94, V0

Figure 9. HU^{3}PAK package outline



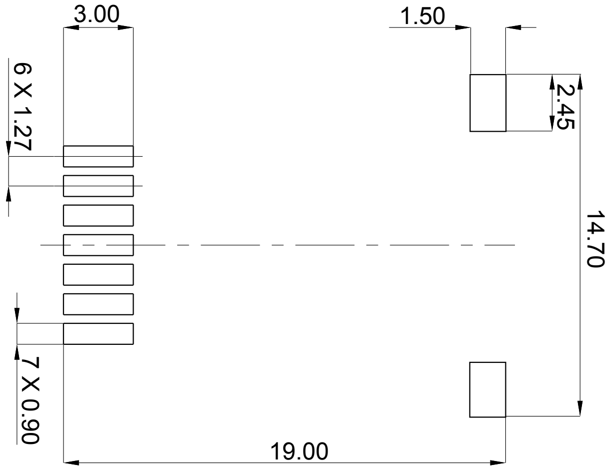
Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.

Table 6. HU³PAK package mechanical data

Ref.	Dimensions		
	mm		
	Min.	Typ.	Max.
A	3.40	3.50	3.60
A1		0.05	
b	0.50	0.60	0.70
b2	0.50	0.70	1.00
b3	0.80	0.90	1.00
c	0.40	0.50	0.60
c2	0.40	0.50	0.60
D	11.70	11.80	11.90
D1	8.80	8.955	9.10
E	13.90	14.00	14.10
E1	12.30	12.40	12.50
E2	7.75	7.80	7.85
e	BSC 1.27		
H	18.00	18.58	19.00
L	2.40	2.52	2.60
L1		3.05	
L2	0.90	1.00	1.10
L3	BSC 0.26		
L4	0.075	0.125	0.175
L5	1.83	1.93	2.03
L6	2.14	2.24	2.34
L7	4.44	4.54	4.64
aaa		0.10	
F1	2.90	3.00	3.10
F2	2.40	2.50	2.60
F3	0.25	0.35	0.45
N1	3.80	3.90	4.00
N2	0.25	0.30	0.45
N3	0.80	0.90	1.00
T	0.50	0.67	0.70
T2	9.18	9.38	9.43
θ1		0°	8°
θ2		0°	8°

1. Package outline exclusive of any mold flashes dimensions.
2. Package outline exclusive of burr dimensions.
3. Max resin gate protrusion: 0.25 mm.
4. The planarity of the package backside 50 micron max.
5. BSC: basic spacing between centers

Figure 10. **HU^{3}PAK recommended footprint (dimensions are in mm)**



Note: For packing details you can see technical note TN1173: Packing information for IPAD, protection, rectifiers, thyristors and AC Switches.

3 Ordering information

Table 7. Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
STPSC20G12L2Y	PSC20G12L2Y	HU3PAK	2.32 g	600	Tape and reel

Revision history

Table 8. **Document revision history**

Date	Revision	Changes
03-Oct-2024	1	Initial release.
16-Oct-2024	2	Updated TN1378: HU3PAK package mounting and thermal behavior.