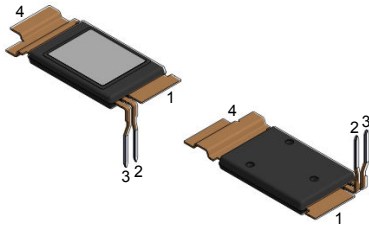
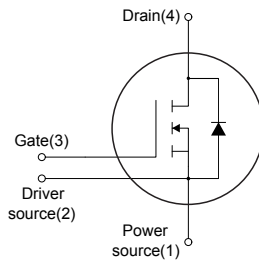


## Automotive-grade silicon carbide Power MOSFET 1200 V, 8.5 mΩ typ., 239 A in a STPAK package



**STPAK**


NG3DS2PS1D4



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ typ.	$I_D$
SCTHS250N120G3AG	1200 V	8.5 mΩ	239 A

- AEC-Q101 qualified 
- Very low  $R_{DS(on)}$  over the entire temperature range
- High speed switching performances
- Very fast and robust intrinsic body diode
- Very high operating junction temperature capability ( $T_J = 200\text{ °C}$ )
- Source sensing pin for increased efficiency

### Application

- Main inverter (electric traction)

### Description

This silicon carbide Power MOSFET device has been developed using ST's advanced and innovative 3<sup>rd</sup> generation SiC MOSFET technology. The device features a very low  $R_{DS(on)}$  over the entire temperature range combined with low capacitances and very high switching operations, which improve application performance in frequency, energy efficiency, system size and weight reduction.

#### Product status link

[SCTHS250N120G3AG](#)

#### Product summary

<b>Order code</b>	SCTHS250N120G3AG
<b>Marking</b>	SC250N12G3AG
<b>Package</b>	STPAK
<b>Packing</b>	Tray

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	-10 to 22	V
	Gate-source voltage (recommended operating values)	-5 to 18	
	Gate-source transient voltage, $t_p < 1 \mu s$ , $t \leq 10$ hours over lifetime	-11 to 25	
$I_D$	Drain current (continuous) at $T_C = 25 \text{ }^\circ\text{C}$	239	A
	Drain current (continuous) at $T_C = 100 \text{ }^\circ\text{C}$	180	
$I_{DM}^{(1)}$	Drain current (pulsed)	720	A
$P_{TOT}$	Total power dissipation at $T_C = 25 \text{ }^\circ\text{C}$	994	W
$V_{ISO}$	Insulation withstand voltage applied between each pin and the heat sink plate (DC voltage, $t = 1 \text{ s}$ )	4.3	kV
$T_{stg}$	Storage temperature range	-55 to 200	$^\circ\text{C}$
$T_J$	Operating junction temperature range		

1. Pulse width is limited by safe operating area.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.176	$^\circ\text{C/W}$

## 2 Electrical characteristics

$T_C = 25\text{ °C}$  unless otherwise specified.

**Table 3. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	1200			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 1200\text{ V}$			20	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = -10\text{ to }22\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 10\text{ mA}$	2.0	3.2	4.4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 18\text{ V}$ , $I_D = 120\text{ A}$		8.5	10.5	m $\Omega$
		$V_{GS} = 18\text{ V}$ , $I_D = 120\text{ A}$ , $T_J = 175\text{ °C}$		14		
		$V_{GS} = 18\text{ V}$ , $I_D = 120\text{ A}$ , $T_J = 200\text{ °C}$		15.3		

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 800\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	7370	-	pF
$C_{oss}$	Output capacitance		-	363	-	pF
$C_{riss}$	Reverse transfer capacitance		-	56	-	pF
$R_g$	Gate input resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	0.65	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 800\text{ V}$ , $V_{GS} = -5\text{ to }18\text{ V}$ , $I_D = 120\text{ A}$	-	304	-	nC
$Q_{gs}$	Gate-source charge		-	81	-	nC
$Q_{gd}$	Gate-drain charge		-	114	-	nC

**Table 5. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{DD} = 800\text{ V}$ , $I_D = 120\text{ A}$ ,	-	2156	-	$\mu\text{J}$
$E_{off}$	Turn-off switching energy	$R_G = 4.7\text{ }\Omega$ , $V_{GS} = -5\text{ V to }18\text{ V}$	-	2611	-	$\mu\text{J}$

**Table 6. Reverse SiC diode characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Diode forward voltage	$I_{SD} = 120\text{ A}$ , $V_{GS} = 0\text{ V}$	-	3.1	-	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 120\text{ A}$ , $di/dt = 1\text{ kA}/\mu\text{s}$ , $V_{GS} = -5\text{ to }18\text{ V}$ , $V_{DD} = 800\text{ V}$	-	38.6	-	ns
$Q_{rr}$	Reverse recovery charge		-	530	-	nC
$I_{RRM}$	Reverse recovery current		-	24.5	-	A

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

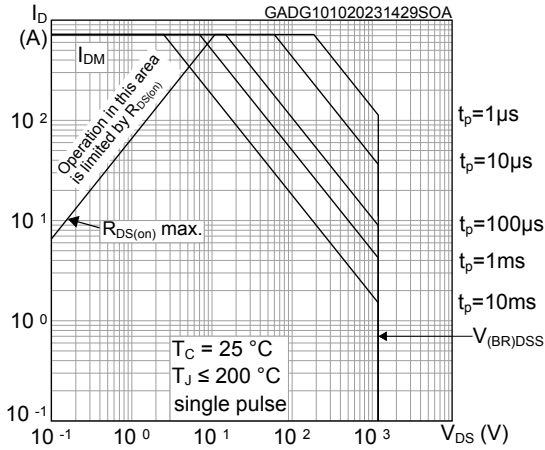


Figure 2. Maximum transient thermal impedance

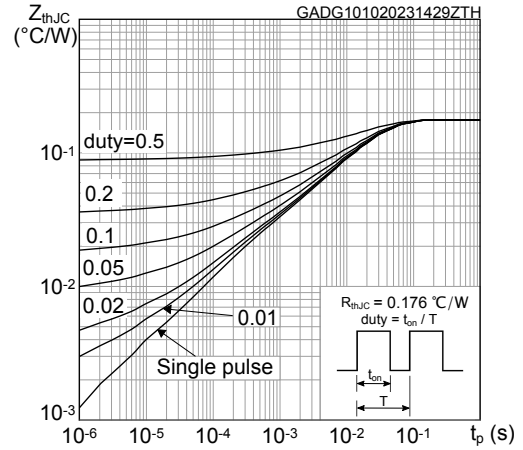


Figure 3. Typical output characteristics ( $T_J = 25\text{ °C}$ )

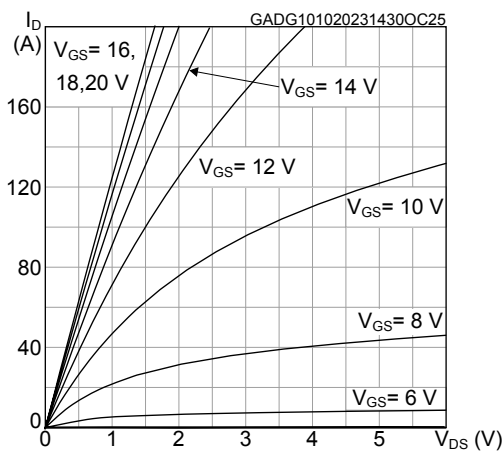


Figure 4. Typical output characteristics ( $T_J = 200\text{ °C}$ )

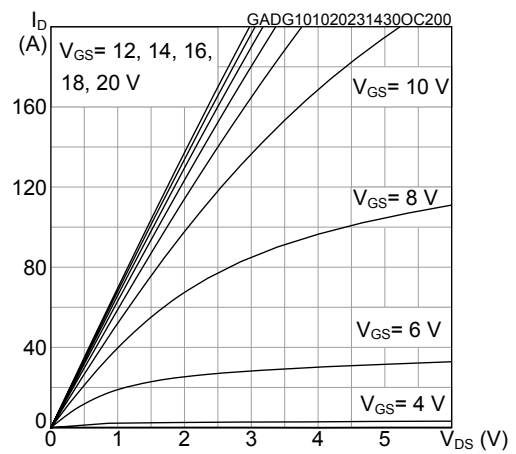


Figure 5. Typical transfer characteristics

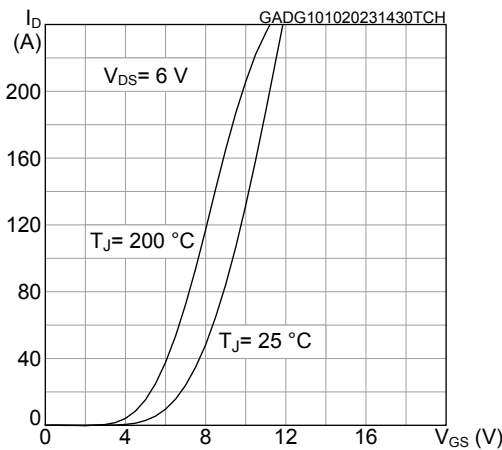


Figure 6. Total power dissipation

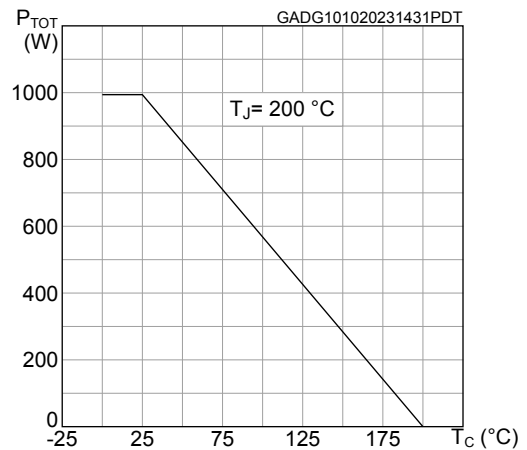


Figure 7. Typical gate charge characteristics

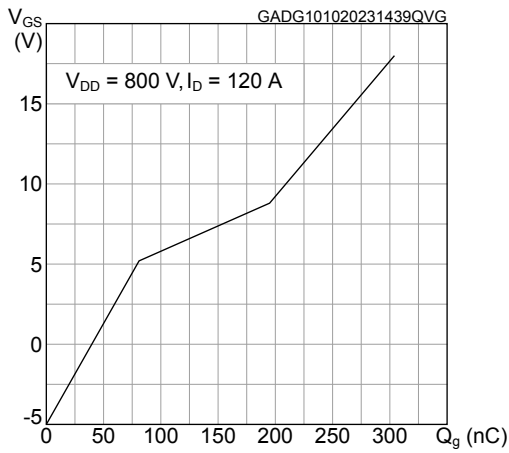


Figure 8. Typical capacitance characteristics

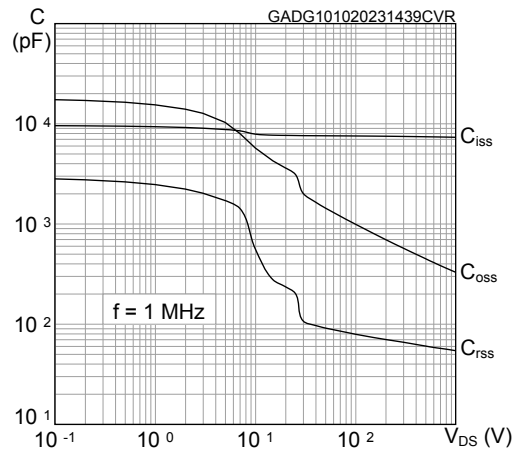


Figure 9. Typical switching energy vs drain current

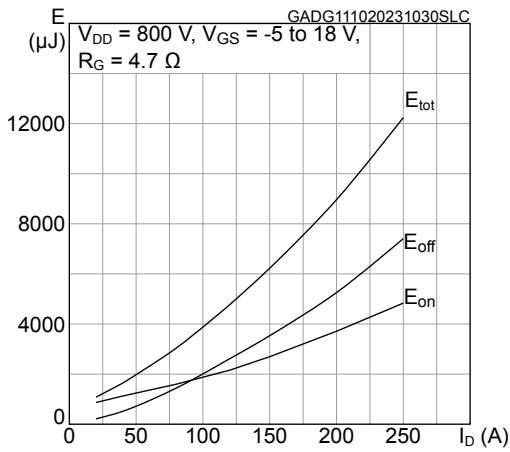


Figure 10. Typical switching energy vs gate resistance

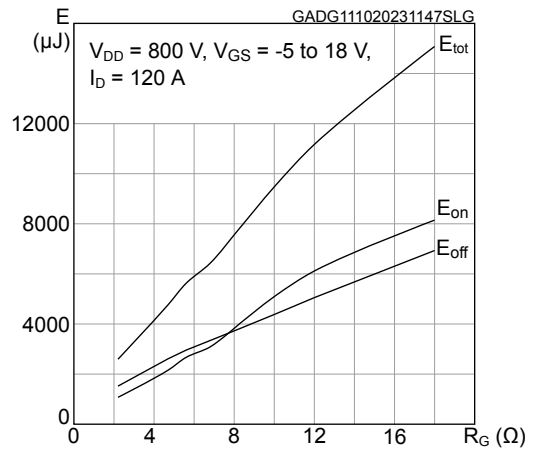


Figure 11. Switching energy vs. junction temperature

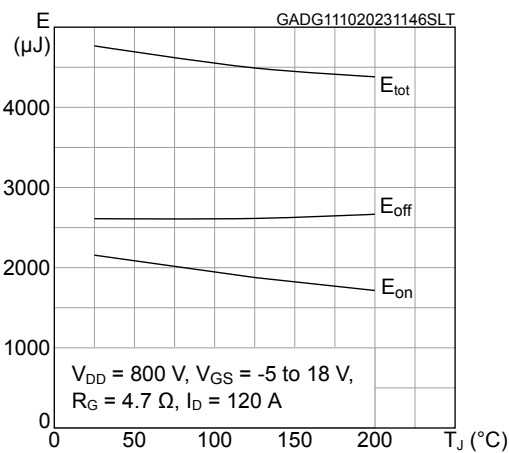
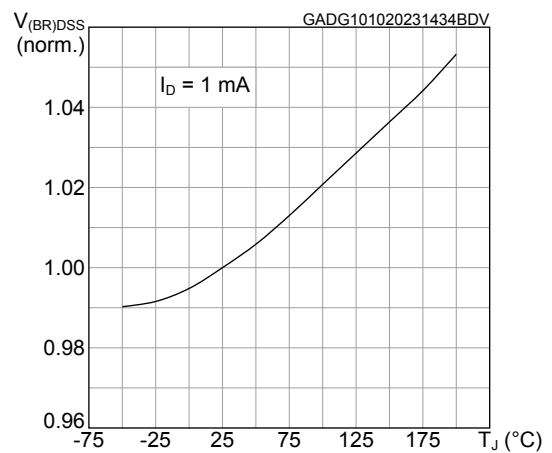
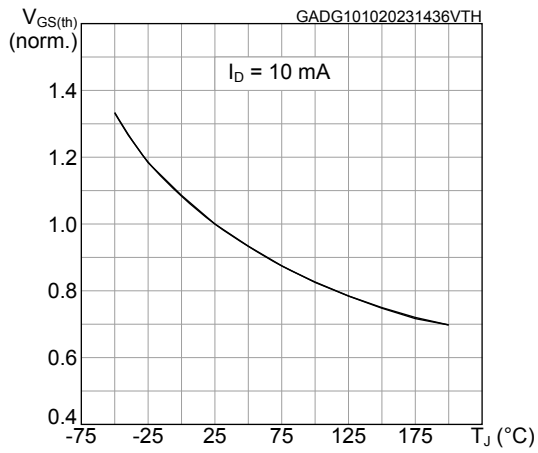


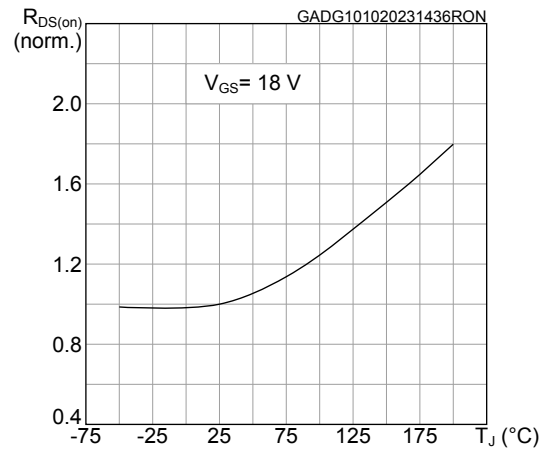
Figure 12. Normalized breakdown voltage vs temperature



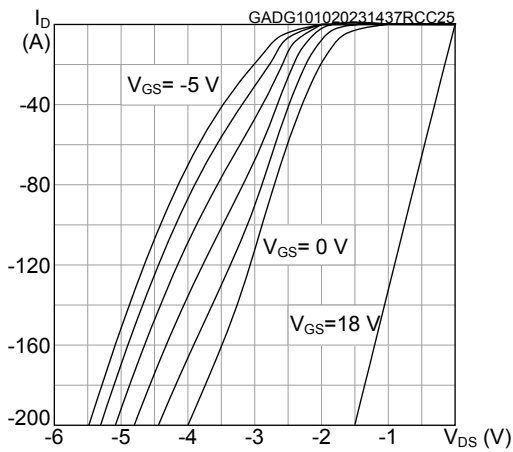
**Figure 13. Normalized gate threshold vs temperature**



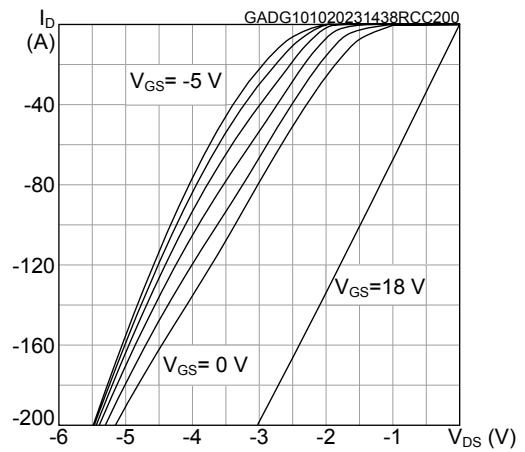
**Figure 14. Normalized on-resistance vs temperature**



**Figure 15. Typical reverse conduction characteristics ( $T_J = 25^\circ\text{C}$ )**



**Figure 16. Typical reverse conduction characteristics ( $T_J = 200^\circ\text{C}$ )**

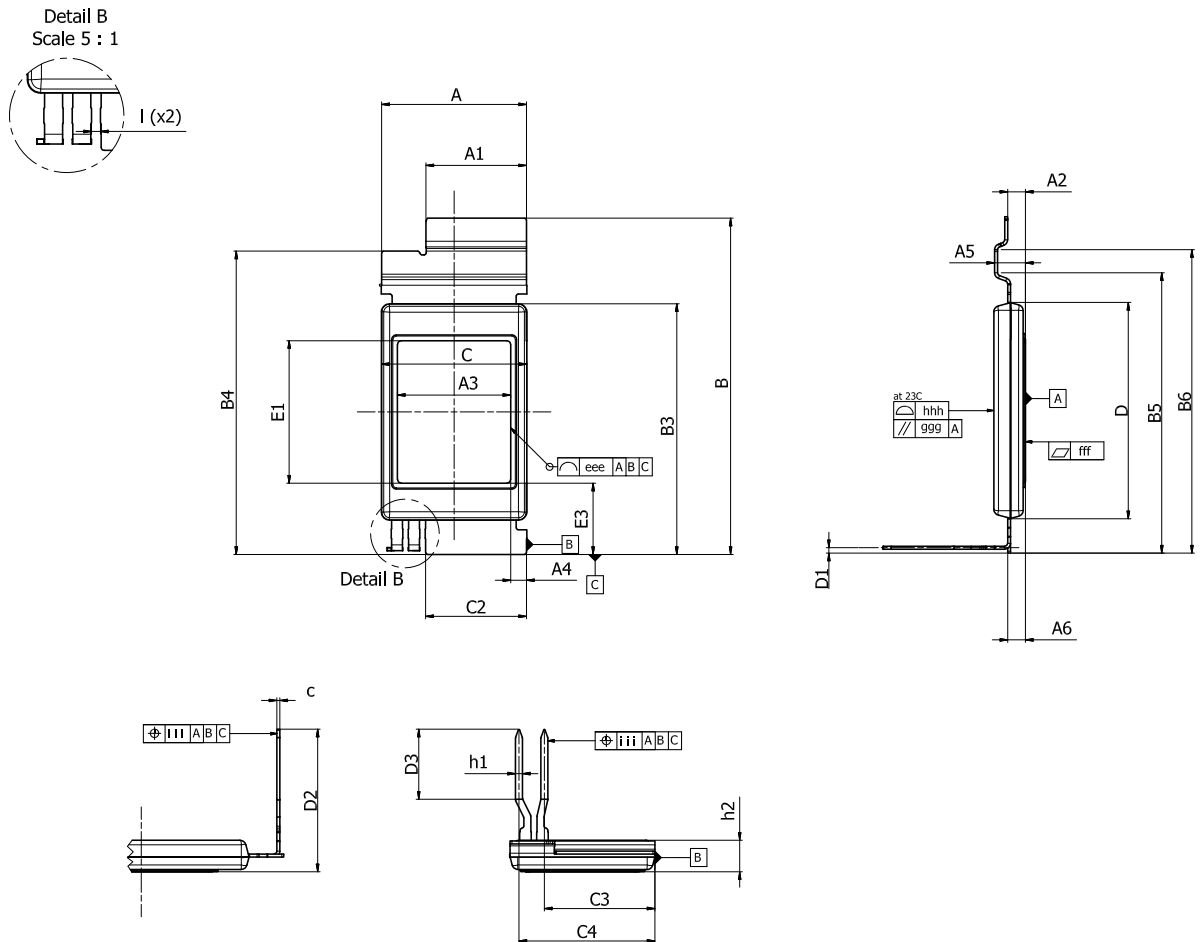


### 3 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

#### 3.1 STPAK package information

Figure 17. STPAK package outline



DM00305987\_10

**Table 7. STPAK package mechanical data**

Ref.	Dimensions			Notes
	mm			
	Min.	Typ.	Max.	
A	18.60	18.80	19.00	
A1	12.85	13.05	13.25	
A2	2.00	2.30	2.60	
A3	13.40	13.90	14.40	Exposed Pad
A4	1.95	2.45	2.95	
A5	3.80	4.00	4.20	
A6	2.10	2.30	2.50	
B	43.40	43.70	44.00	
B3	32.20	32.50	32.80	
B4	39.10	39.40	39.70	
B5	36.07	36.37	36.67	
B6	39.07	39.37	39.67	
c	0.34	0.39	0.44	
C		18.55	19.10	Encompass both large and small cav.
C2	12.90	13.10	13.30	
C3		14.35		
C4		17.65		
D	27.90	28.10	28.30	
D1		0.69		
D2	18.50	19.00	19.50	
D3	9.10	9.60	10.10	
E1	17.20	17.70	18.20	Exposed pad
E3	9.15	9.65	10.15	
h1	0.85	0.90	0.95	x2 - Pins width
h2	4.00	4.10	4.20	
l	0.60	0.70	0.80	
eee		0.50		
fff		0.10 at 23 °C – 0.05 at 220 °C		Convex with center higher than edges
ggg		0.05		
hhh		0.10		
iii		0.60		



## Revision history

**Table 8. Document revision history**

Date	Revision	Changes
24-Oct-2023	1	First release.
24-Jun-2024	2	Updated <a href="#">Features</a> on cover page. Updated <a href="#">Table 7. STPAK package mechanical data.</a>

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