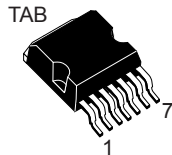
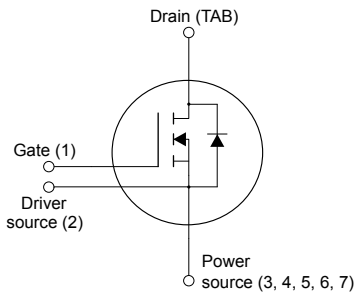


## Automotive-grade silicon carbide Power MOSFET 1200 V, 75 mΩ typ., 33 A in an H<sup>2</sup>PAK-7 package



**H<sup>2</sup>PAK-7**


N-chG1DS2PS34567DTAB



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
SCTH40N120G2V7AG	1200 V	105 mΩ	33 A

- AEC-Q101 qualified 
- Very fast and robust intrinsic body diode
- Extremely low gate charge and input capacitance
- Source sensing pin for increased efficiency

### Applications

- Main inverter (electric traction)
- DC/DC converter for EV/HEV
- On board charger (OBC)

### Description

This silicon carbide Power MOSFET device has been developed using ST's advanced and innovative 2<sup>nd</sup> generation SiC MOSFET technology. The device features remarkably low on-resistance per unit area and very good switching performance. The variation of switching loss is almost independent of junction temperature.

#### Product status link

[SCTH40N120G2V7AG](#)

#### Product summary

<b>Order code</b>	SCTH40N120G2V7AG
<b>Marking</b>	40N120AG
<b>Package</b>	H <sup>2</sup> PAK-7
<b>Packing</b>	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	1200	V
$V_{GS}$	Gate-source voltage	-10 to 22	V
	Gate-source voltage (recommended operating values)	-5 to 18	
	Gate-source voltage (pulsed, $t_p = 25$ ns repetitive overshoot during switching for an accumulated time of 10 h)	-11 to 25	
$I_D$	Drain current (continuous) at $T_C = 25$ °C	33	A
	Drain current (continuous) at $T_C = 100$ °C	23	
$I_{DM}^{(1)}$	Drain current (pulsed)	92	A
$P_{TOT}$	Total power dissipation at $T_C = 25$ °C	250	W
$T_{stg}$	Storage temperature range	-55 to 175	°C
$T_J$	Operating junction temperature range		°C

1. Pulse width is limited by safe operating area.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.6	°C/W
$R_{thJA}$	Thermal resistance, junction-to-ambient	50	°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	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$			10	$\mu\text{A}$
$I_{GSS}$	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	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1.9	3.2	5.0	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 18\text{ V}, I_D = 20\text{ A}$		75	105	m $\Omega$
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 175\text{ °C}$		167		

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iSS}$	Input capacitance	$V_{DS} = 800\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	1230	-	pF
$C_{oSS}$	Output capacitance		-	56	-	pF
$C_{rSS}$	Reverse transfer capacitance		-	15	-	pF
$Q_g$	Total gate charge	$V_{DD} = 800\text{ V}, V_{GS} = -5\text{ to }18\text{ V}, I_D = 20\text{ A}$	-	63	-	nC
$Q_{gs}$	Gate-source charge		-	15	-	nC
$Q_{gd}$	Gate-drain charge		-	20	-	nC
$R_g$	Gate input resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	1	-	$\Omega$

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$	-	235	-	$\mu\text{J}$
$E_{off}$	Turn-off switching energy	$R_G = 4.7\text{ }\Omega, V_{GS} = -5\text{ V to }18\text{ V}$	-	77	-	$\mu\text{J}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = -5\text{ to }18\text{ V}$	-	11	-	ns
$t_r$	Rise time		-	5	-	
$t_{d(off)}$	Turn-off delay time		-	18	-	
$t_f$	Fall time		-	13	-	

**Table 7. Reverse SiC diode characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Diode forward voltage	$I_{SD} = 20\text{ A}$ , $V_{GS} = 0\text{ V}$	-	3.4	-	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 20\text{ A}$ , $di/dt = 2000\text{ A}/\mu\text{s}$ , $V_{DD} = 800\text{ V}$ , $V_{GS} = -5\text{ to }18\text{ V}$	-	19	-	ns
$Q_{rr}$	Reverse recovery charge		-	132	-	nC
$I_{RRM}$	Reverse recovery current		-	20	-	A

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

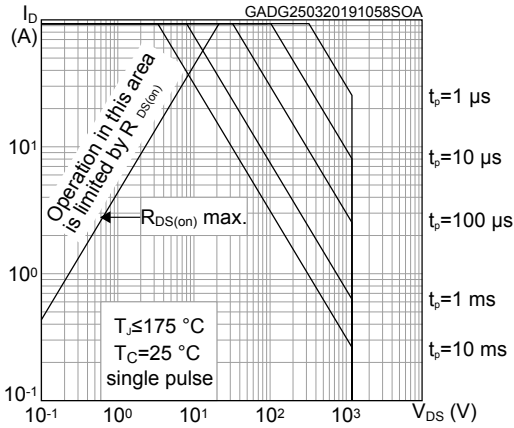


Figure 2. Maximum transient thermal impedance

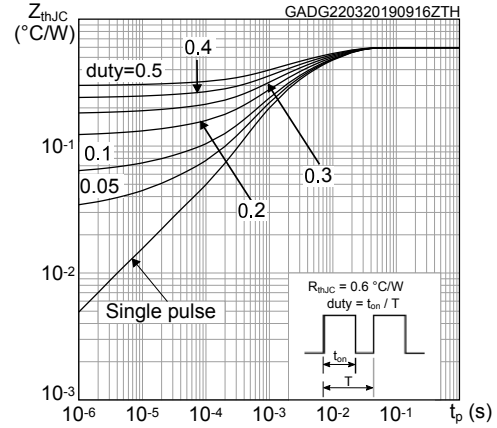


Figure 3. Output characteristics ( $T_J = -50 \text{ }^\circ\text{C}$ )

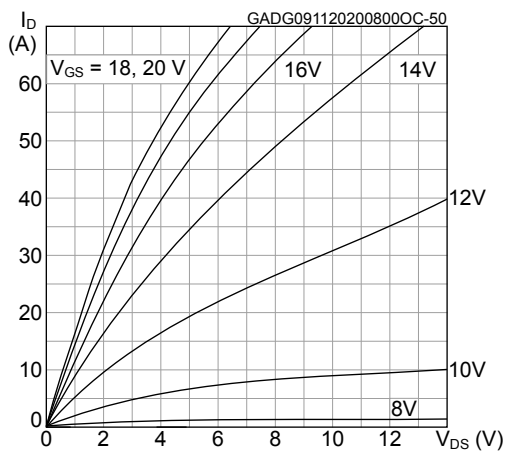


Figure 4. Output characteristics ( $T_J = 25 \text{ }^\circ\text{C}$ )

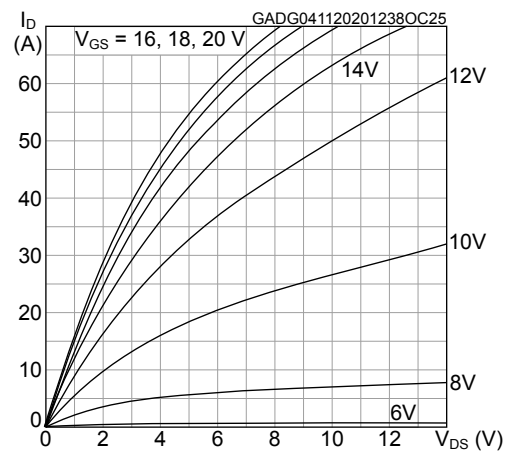


Figure 5. Output characteristics ( $T_J = 175 \text{ }^\circ\text{C}$ )

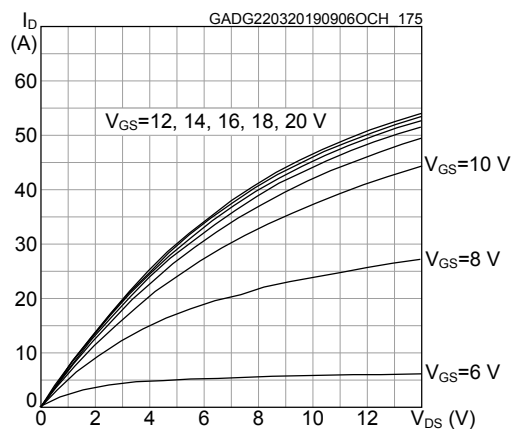
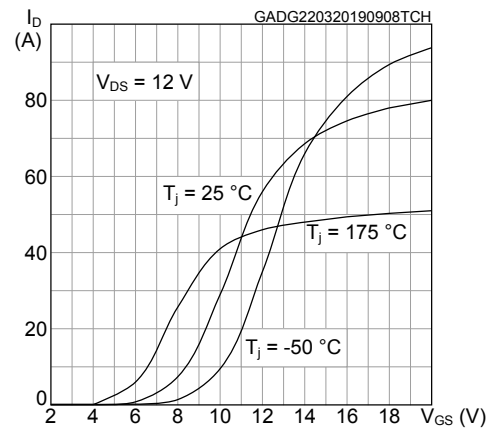
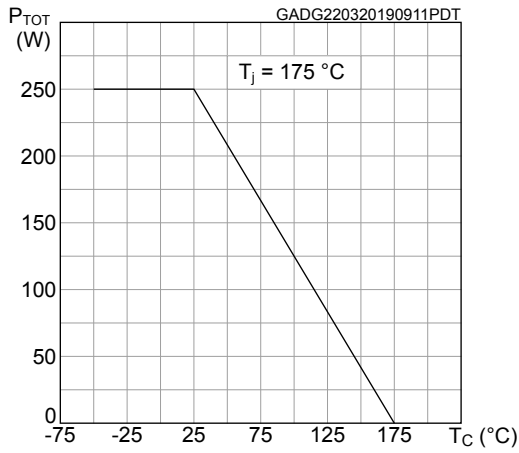


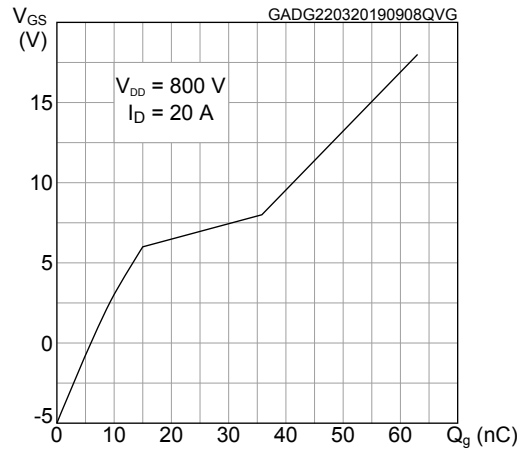
Figure 6. Transfer characteristics



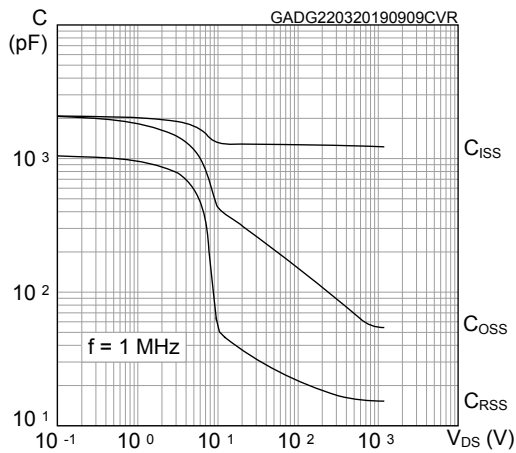
**Figure 7. Total power dissipation**



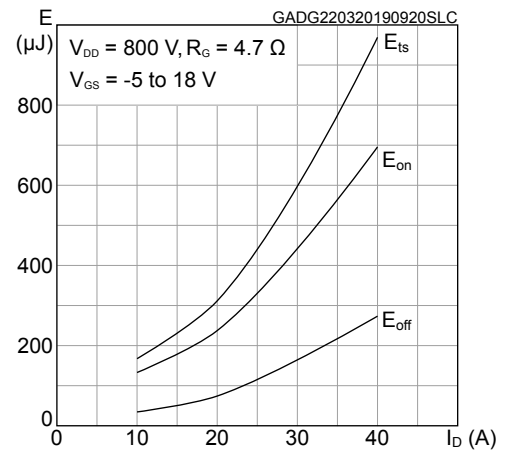
**Figure 8. Gate charge vs gate-source voltage**



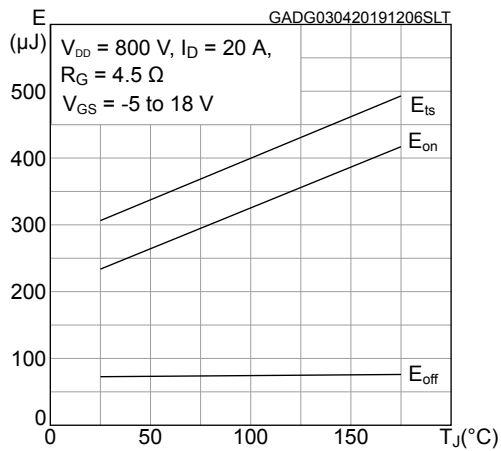
**Figure 9. Capacitance variations**



**Figure 10. Switching energy vs drain current**



**Figure 11. Switching energy vs junction temperature**



**Figure 12. Normalized  $V_{(BR)DSS}$  vs temperature**

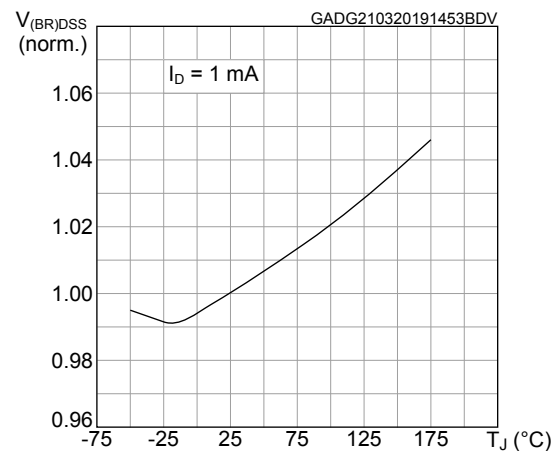


Figure 13. Normalized gate threshold voltage vs temperature

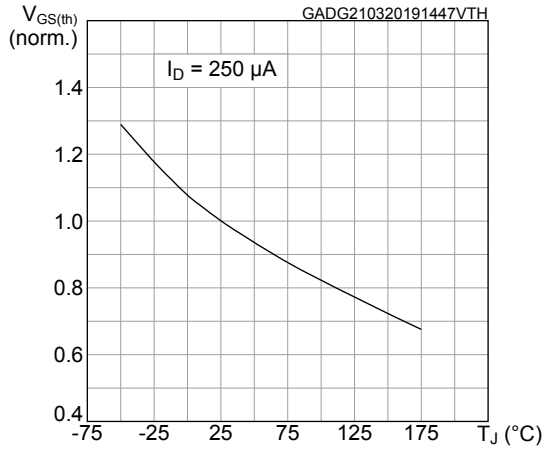


Figure 14. Normalized on-resistance vs temperature

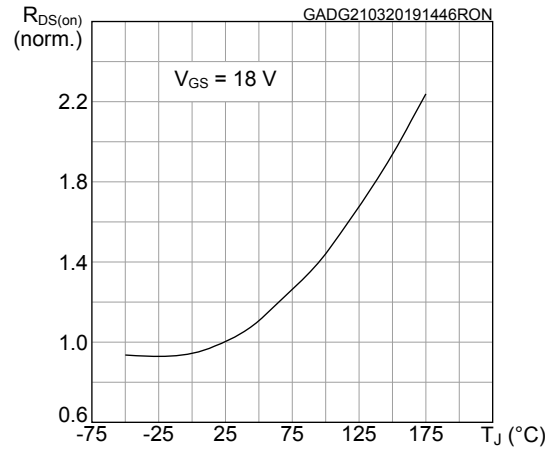


Figure 15. Reverse conduction characteristics (T<sub>J</sub> = -50 °C)

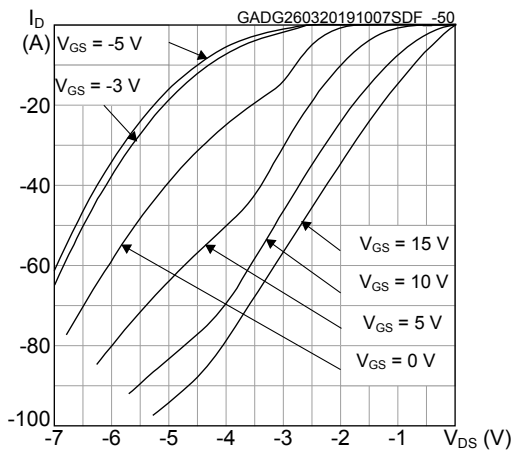


Figure 16. Reverse conduction characteristics (T<sub>J</sub> = 25 °C)

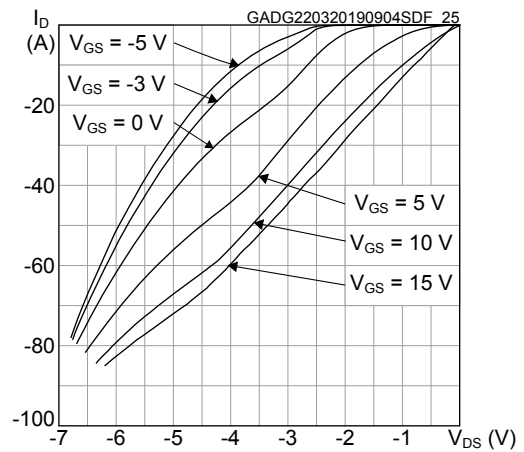
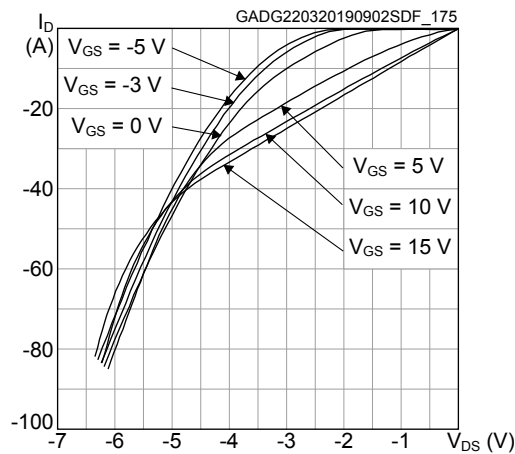


Figure 17. Reverse conduction characteristics (T<sub>J</sub> = 175 °C)

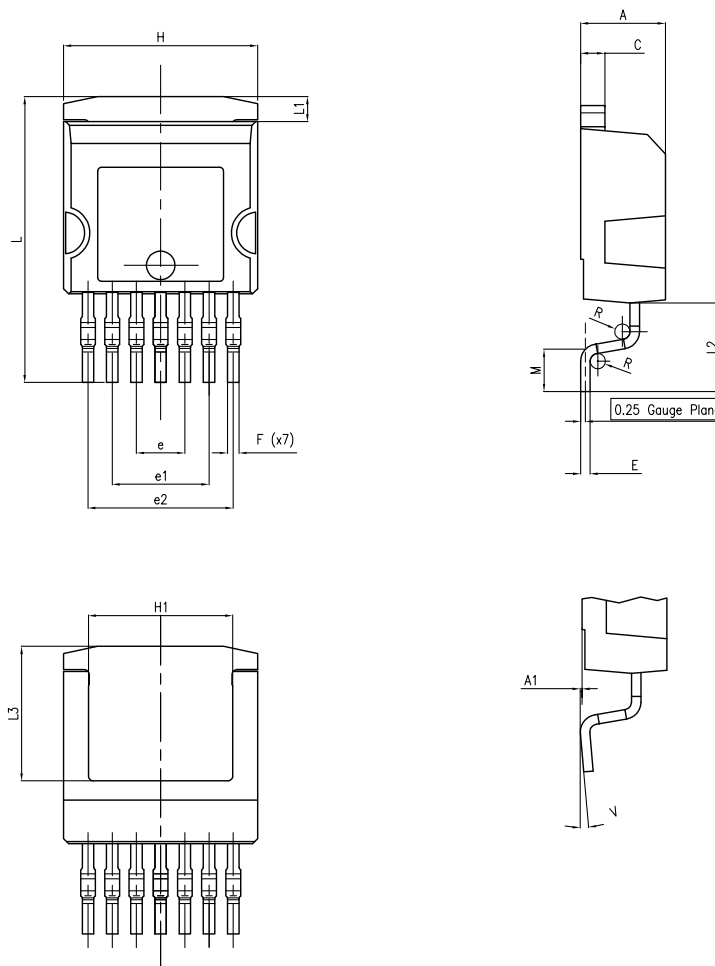


### 3 Package information

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 H<sup>2</sup>PAK-7 package information

Figure 18. H<sup>2</sup>PAK-7 package outline

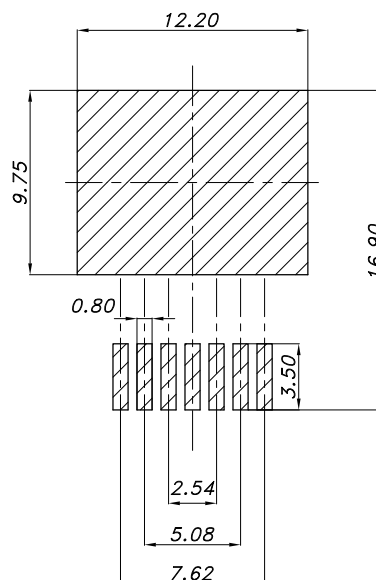




**Table 8. H<sup>2</sup>PAK-7 package mechanical data**

Dim.	mm	
	Min.	Max.
A	4.30	4.80
A1	0.03	0.20
C	1.17	1.37
e	2.34	2.74
e1	4.88	5.28
e2	7.42	7.82
E	0.45	0.60
F	0.50	0.70
H	10.00	10.40
H1	7.40	7.60
L	14.75	15.25
L1	1.27	1.40
L2	4.35	4.95
L3	6.85	7.25
M	1.90	2.50
R	0.20	0.60
V	0°	8°

**Figure 19. H<sup>2</sup>PAK-7 recommended footprint**

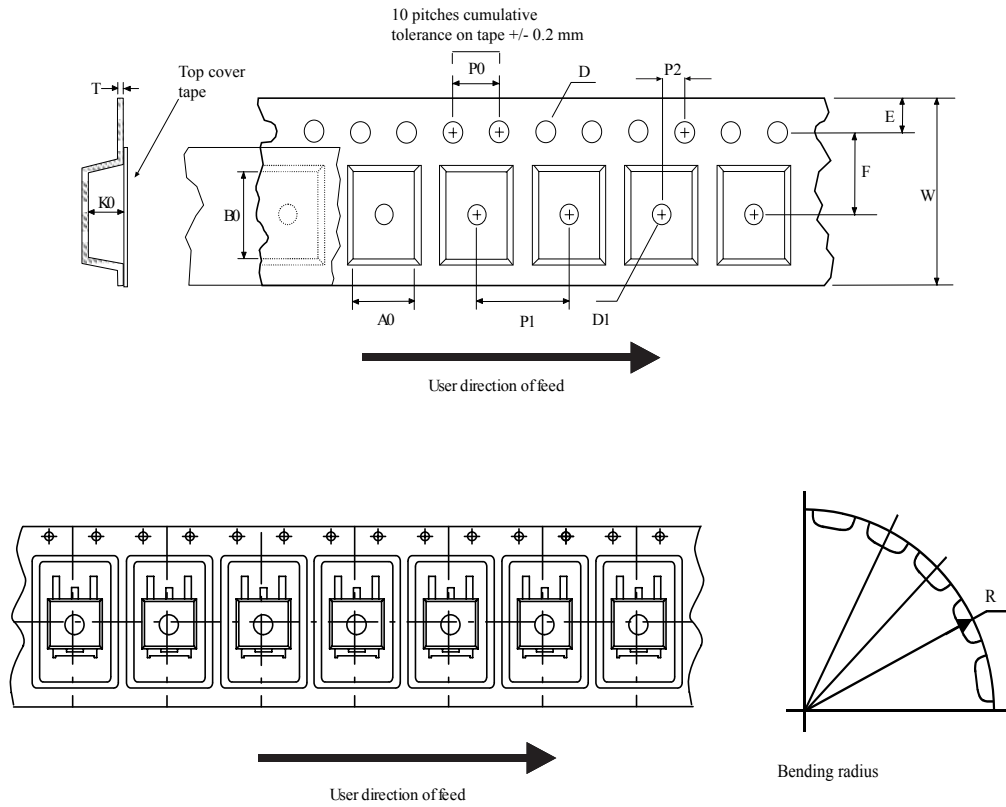


footprint\_DM00249216\_4

*Note: Dimensions are in mm.*

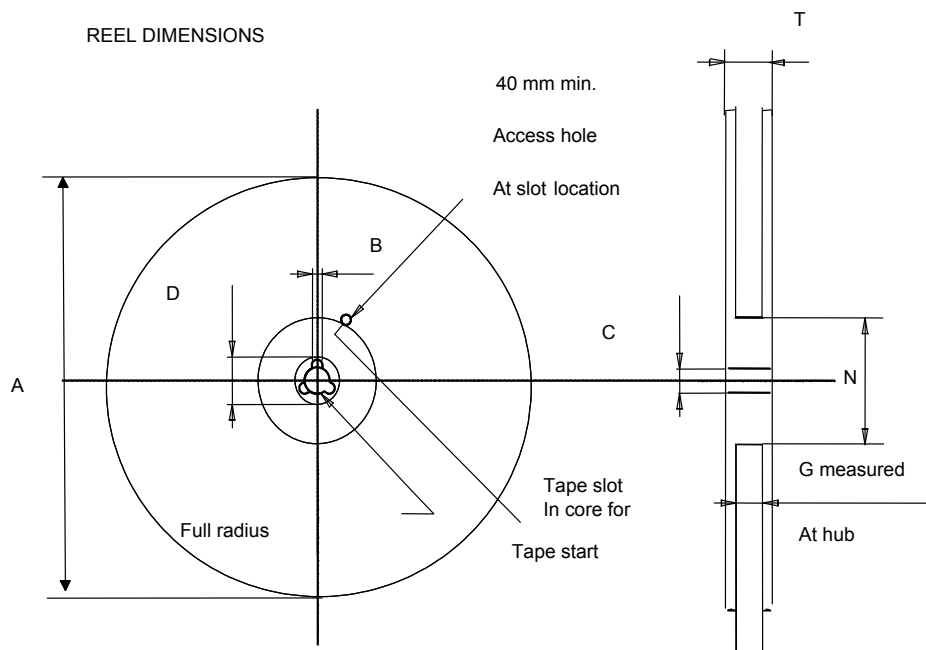
### 3.2 Packing information

Figure 20. Tape outline



AM08852v2

Figure 21. Reel outline



**Table 9. Tape and reel mechanical data**

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

## Revision history

**Table 10. Document revision history**

Date	Version	Changes
01-Apr-2019	1	First release.
24-Jul-2020	2	Updated marking value in <i>Product status / summary</i> . Updated <i>Table 3. On/off states</i> and <i>Table 7. Reverse SiC diode characteristics</i> .
24-Nov-2021	3	Modified <i>Features and Applications</i> on cover page. Modified <i>Table 1. Absolute maximum ratings</i> , <i>Table 2. Thermal data</i> , <i>Table 3. On/off states</i> , <i>Table 5. Switching energy (inductive load)</i> , <i>Table 6. Switching times</i> and <i>Table 7. Reverse SiC diode characteristics</i> . Modified <i>Figure 1. Safe operating area</i> , <i>Figure 2. Maximum transient thermal impedance</i> , <i>Figure 3. Output characteristics (T<sub>J</sub> = -50 °C)</i> , <i>Figure 4. Output characteristics (T<sub>J</sub> = 25 °C)</i> , <i>Figure 5. Output characteristics (T<sub>J</sub> = 175 °C)</i> and <i>Figure 11. Switching energy vs junction temperature</i> . Minor text changes.

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