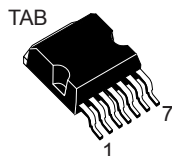
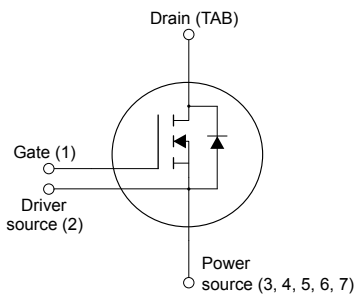


# Automotive-grade silicon carbide Power MOSFET 650 V, 40 mΩ typ., 30 A in an H<sup>2</sup>PAK-7 package



**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>
SCT040H65G3AG	650 V	55 mΩ	30 A

- AEC-Q101 qualified 
- Very low R<sub>DS(on)</sub> over the entire temperature range
- High speed switching performances
- Very fast and robust intrinsic body diode
- 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 3<sup>rd</sup> generation SiC MOSFET technology. The device features a very low R<sub>DS(on)</sub> 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

[SCT040H65G3AG](#)

### Product summary

Order code	SCT040H65G3AG
Marking	40H65G3AG
Package	H <sup>2</sup> PAK-7
Packing	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	650	V
$V_{GS}$	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	
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25 \text{ }^\circ\text{C}$	30	A
	Drain current (continuous) at $T_C = 100 \text{ }^\circ\text{C}$	30	
$I_{DM}^{(2)}$	Drain current (pulsed)	160	A
$P_{TOT}$	Total power dissipation at $T_C = 25 \text{ }^\circ\text{C}$	221	W
$T_{stg}$	Storage temperature range	-55 to 175	$^\circ\text{C}$
$T_J$	Operating junction temperature range		$^\circ\text{C}$

- $I_D$  is limited by package.
- Pulse width is limited by safe operating area.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.68	$^\circ\text{C}/\text{W}$
$R_{thJA}$	Thermal resistance, junction-to-ambient	50	$^\circ\text{C}/\text{W}$

## 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	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$			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	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1.8	3.0	4.2	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 15\text{ V}, I_D = 20\text{ A}$		50		m $\Omega$
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}$		40	55	
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 175\text{ °C}$		50		

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 400\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	920	-	pF
$C_{oss}$	Output capacitance		-	94	-	pF
$C_{riss}$	Reverse transfer capacitance		-	13	-	pF
$Q_g$	Total gate charge	$V_{DD} = 400\text{ V}, V_{GS} = -5\text{ to }18\text{ V}, I_D = 20\text{ A}$	-	39.5	-	nC
$Q_{gs}$	Gate-source charge		-	11.5	-	nC
$Q_{gd}$	Gate-drain charge		-	14.5	-	nC
$R_g$	Gate input resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	1.4	-	$\Omega$

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{DD} = 400\text{ V}, I_D = 20\text{ A},$	-	79	-	$\mu\text{J}$
$E_{off}$	Turn-off switching energy	$R_G = 15\text{ }\Omega, V_{GS} = -5\text{ V to }18\text{ V}$	-	67	-	$\mu\text{J}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}, I_D = 20\text{ A},$ $R_G = 15\text{ }\Omega, V_{GS} = -5\text{ to }18\text{ V}$	-	10	-	ns
$t_r$	Rise time		-	17	-	ns
$t_{d(off)}$	Turn-off delay time		-	26	-	ns
$t_f$	Fall time		-	8	-	ns

**Table 7. Reverse SiC diode characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Continuous diode forward current	$T_C = 25\text{ }^\circ\text{C}$	-		30	A
		$T_C = 100\text{ }^\circ\text{C}$	-		30	
$V_{SD}$	Diode forward voltage	$I_{SD} = 20\text{ A}$ , $V_{GS} = 0\text{ V}$	-	2.8		V
$t_{rr}$	Reverse recovery time	$I_{SD} = 20\text{ A}$ , $di/dt = 1000\text{ A}/\mu\text{s}$ , $V_{DD} = 400\text{ V}$	-	18		ns
$Q_{rr}$	Reverse recovery charge		-	97		nC
$I_{RRM}$	Reverse recovery current		-	9		A

1.  $I_{SD}$  is limited by package.

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

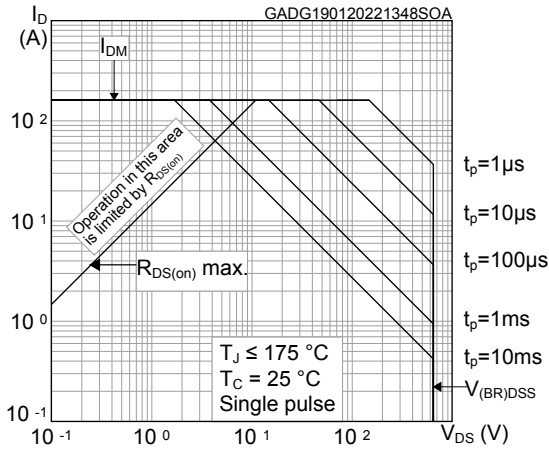


Figure 2. Maximum transient thermal impedance

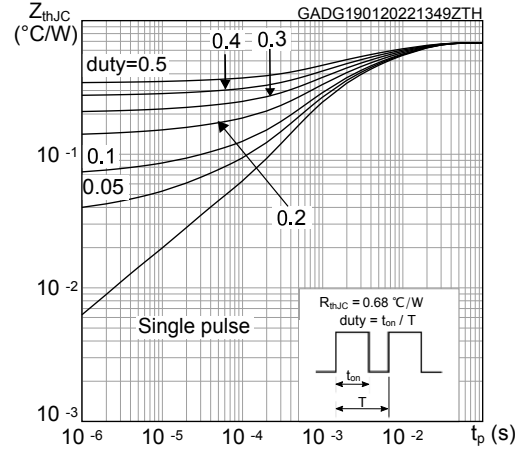


Figure 3. Typical output characteristics ( $T_J = 25\text{ °C}$ )

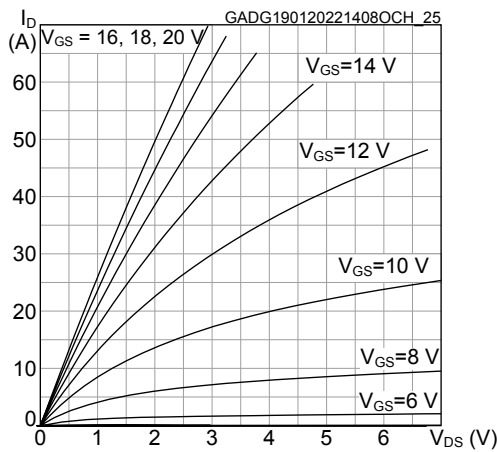


Figure 4. Typical output characteristics ( $T_J = 175\text{ °C}$ )

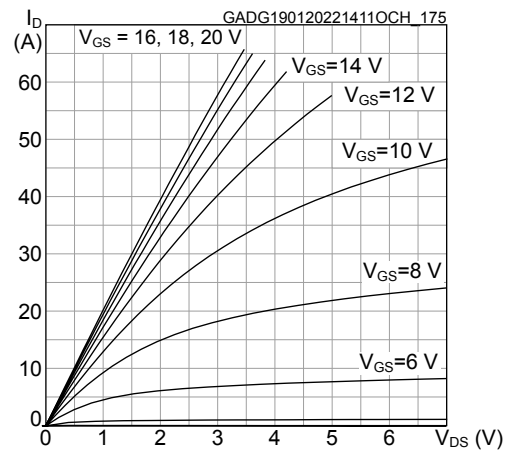


Figure 5. Typical transfer characteristics

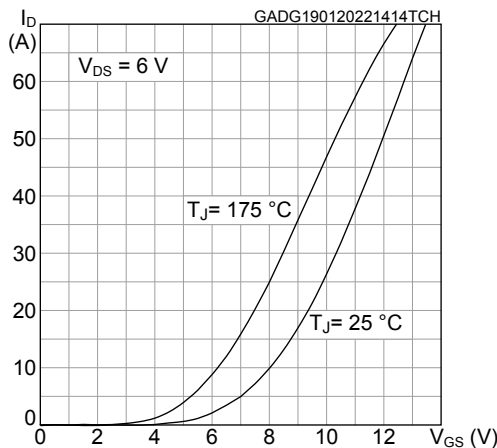
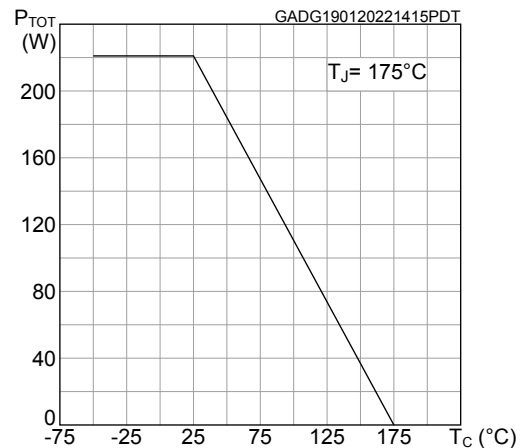
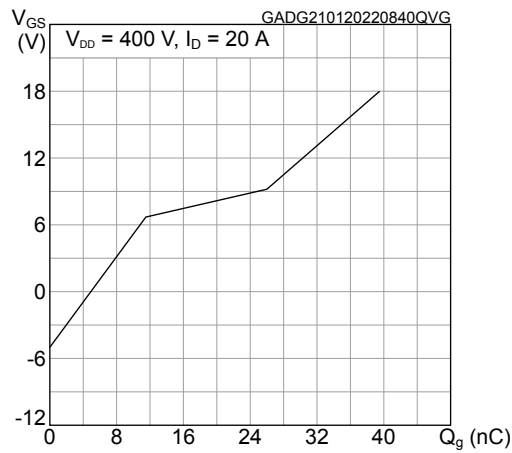


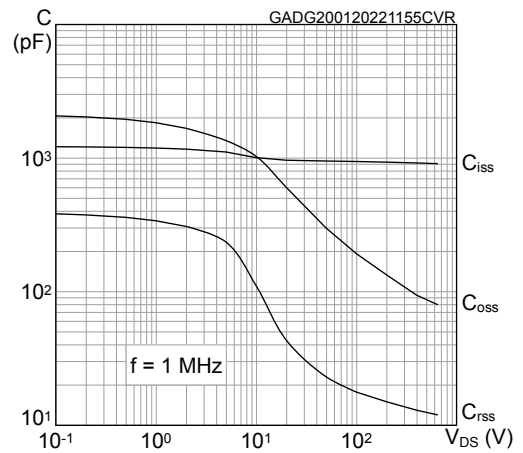
Figure 6. Total power dissipation



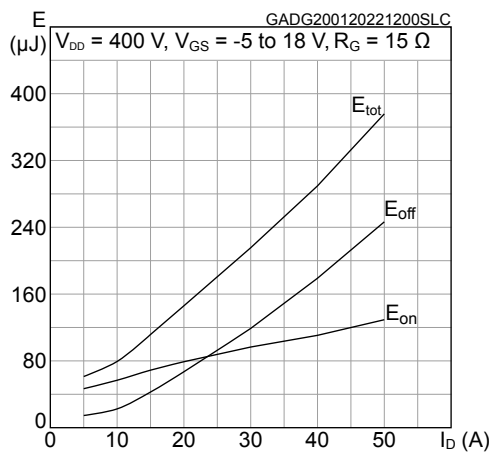
**Figure 7. Typical gate charge characteristics**



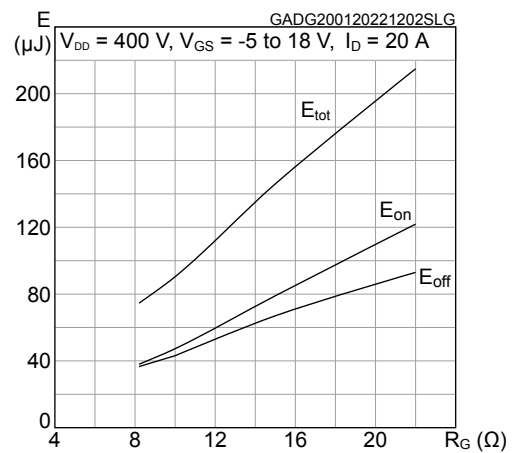
**Figure 8. Typical capacitance characteristics**



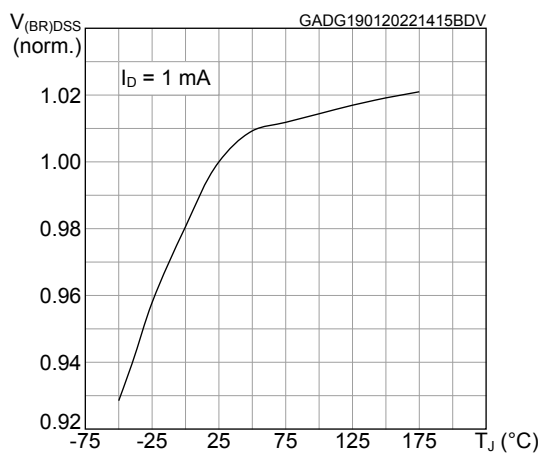
**Figure 9. Typical switching energy vs drain current**



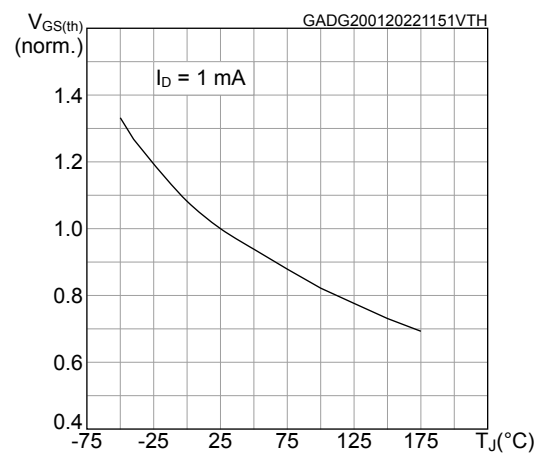
**Figure 10. Typical switching energy vs gate resistance**



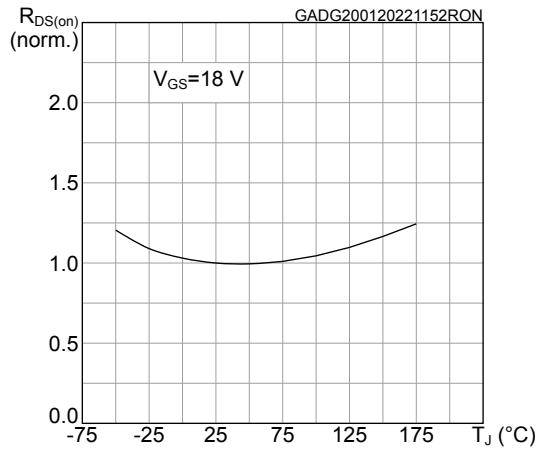
**Figure 11. Normalized breakdown voltage vs temperature**



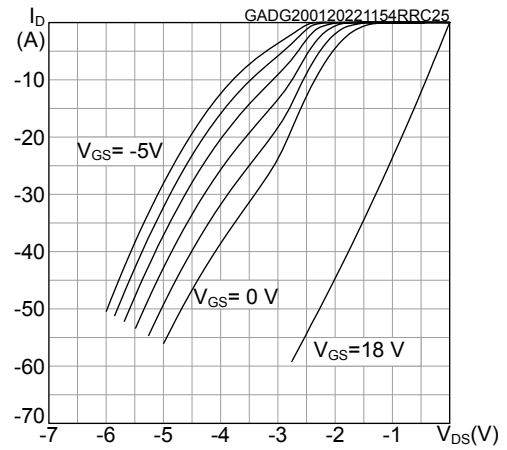
**Figure 12. Normalized gate threshold vs temperature**



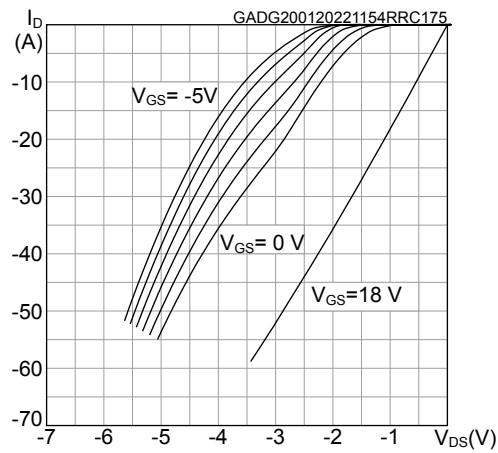
**Figure 13. Normalized on-resistance vs temperature**



**Figure 14. Typical reverse conduction characteristics ( $T_J=25^\circ\text{C}$ )**



**Figure 15. Typical reverse conduction characteristics ( $T_J=175^\circ\text{C}$ )**

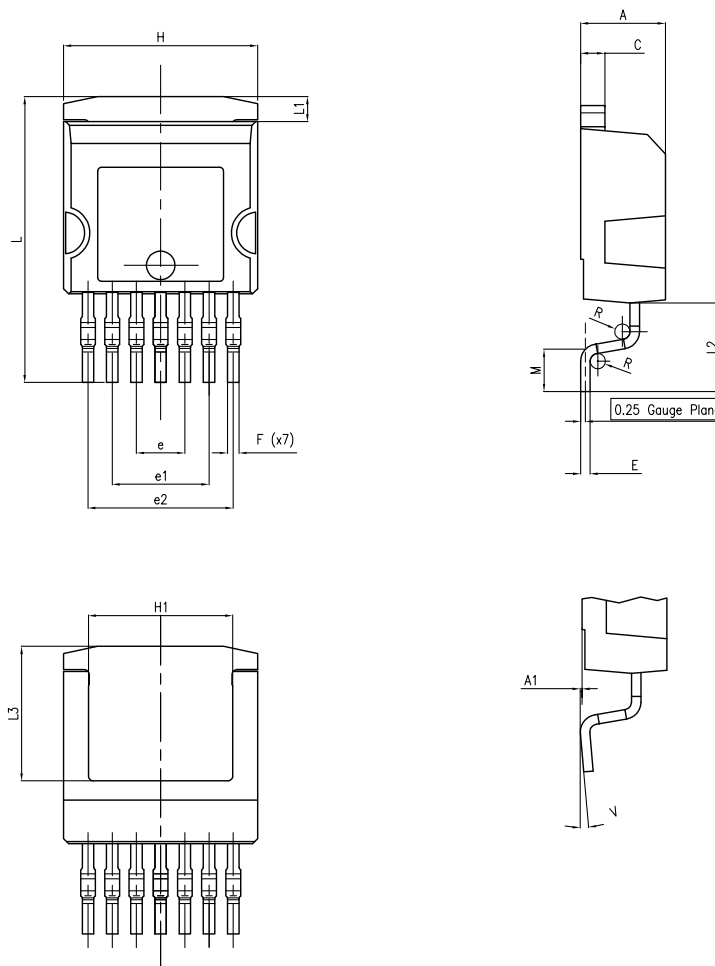


### 3 Package information

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

Figure 16. H<sup>2</sup>PAK-7 package outline

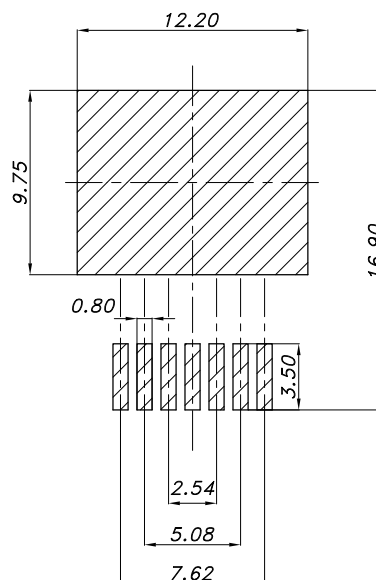




**Table 8. H<sup>2</sup>PAK-7 package mechanical data**

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

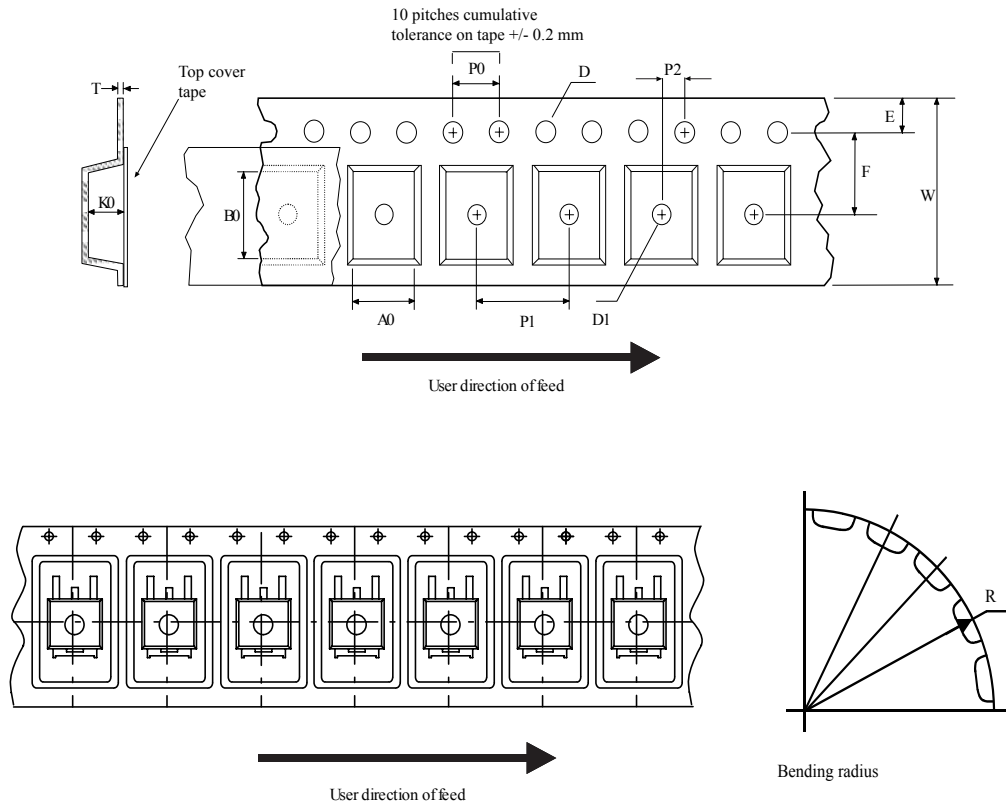


footprint\_DM00249216\_4

*Note: Dimensions are in mm.*

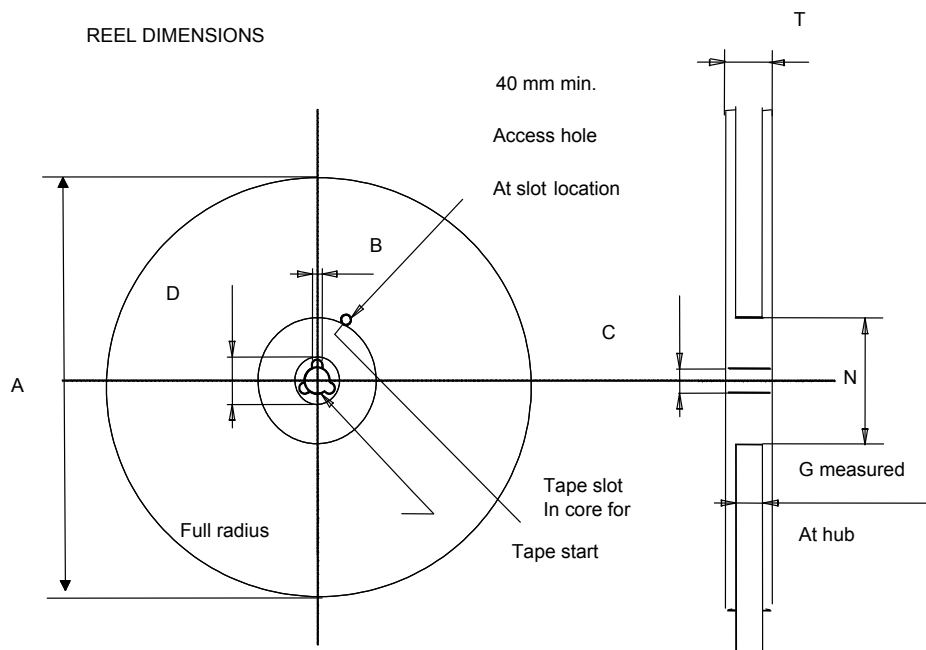
### 3.2 Packing information

Figure 18. Tape outline



AM08852v2

Figure 19. 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	Revision	Changes
03-Dec-2021	1	First release.
21-Jan-2022	2	Modified Section 1 Electrical ratings, Table 4. Dynamic, Table 5. Switching energy (inductive load), Table 6. Switching times and Table 7. Reverse SiC diode characteristics. Added Section 2.1 Electrical characteristics (curves). Minor text changes.

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