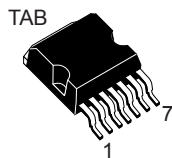
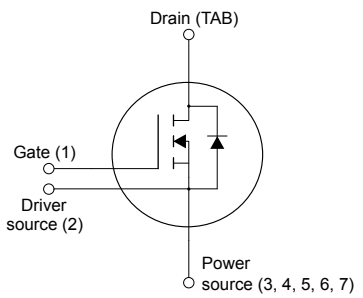


# Automotive-grade silicon carbide Power MOSFET, 650 V, 55 mΩ typ., 45 A in an H<sup>2</sup>PAK-7 package



**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>
SCTH35N65G2V-7AG	650 V	67 mΩ	45 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

[SCTH35N65G2V-7AG](#)

### Product summary

<b>Order code</b>	SCTH35N65G2V-7AG
<b>Marking</b>	35N65AG
<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	650	V
$V_{GS}$	Gate-source voltage	-10 to 22	V
	Gate-source voltage (recommended operating range)	-5 to 18	
$I_D$	Drain current (continuous) at $T_C = 25\text{ °C}$	45	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	35	
$I_{DM}^{(1)}$	Drain current (pulsed)	90	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	208	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	0.72	°C/W
$R_{thJA}$	Thermal resistance, junction-to-ambient	62.5	°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	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	650			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$			5	$\mu\text{A}$
$I_{GSS}$	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	3.2	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 20\text{ V}$ , $I_D = 20\text{ A}$		45	67	m $\Omega$
		$V_{GS} = 18\text{ V}$ , $I_D = 20\text{ A}$		55		
		$V_{GS} = 20\text{ V}$ , $I_D = 20\text{ A}$ , $T_J = 175\text{ °C}$		65		

**Table 4. Dynamic, based on HiP247 package option**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 400\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	1370	-	pF
$C_{oss}$	Output capacitance		-	125	-	pF
$C_{riss}$	Reverse transfer capacitance		-	30	-	pF
$Q_g$	Total gate charge	$V_{DD} = 400\text{ V}$ , $V_{GS} = 0\text{ to }20\text{ V}$ , $I_D = 20\text{ A}$	-	73	-	nC
$Q_{gs}$	Gate-source charge		-	14	-	nC
$Q_{gd}$	Gate-drain charge		-	27	-	nC
$R_g$	Gate input resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	2	-	$\Omega$

**Table 5. Switching energy (inductive load), based on HiP247 package option**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{DD} = 400\text{ V}$ , $I_D = 20\text{ A}$	-	100	-	$\mu\text{J}$
$E_{off}$	Turn-off switching energy	$R_G = 10\text{ }\Omega$ , $V_{GS} = -5\text{ to }20\text{ V}$	-	35	-	$\mu\text{J}$

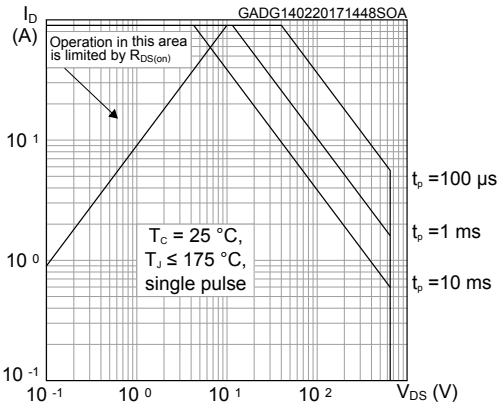
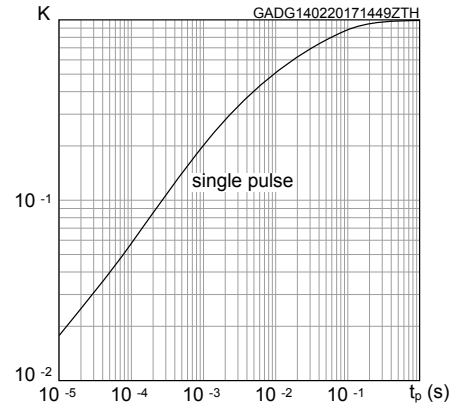
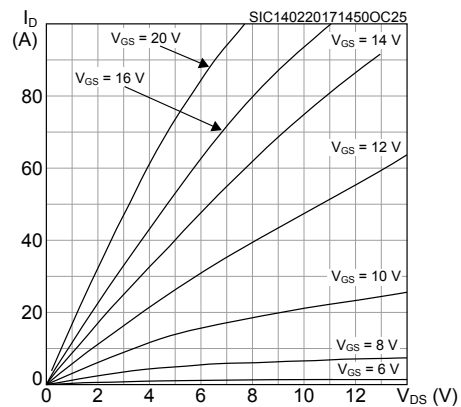
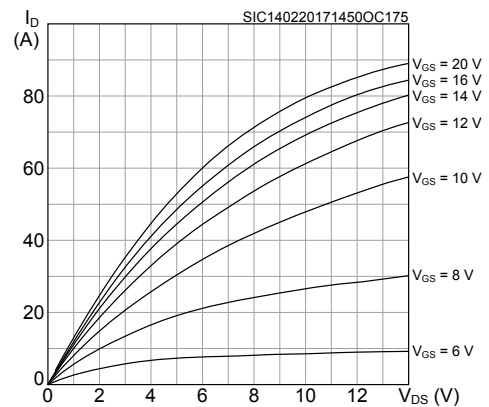
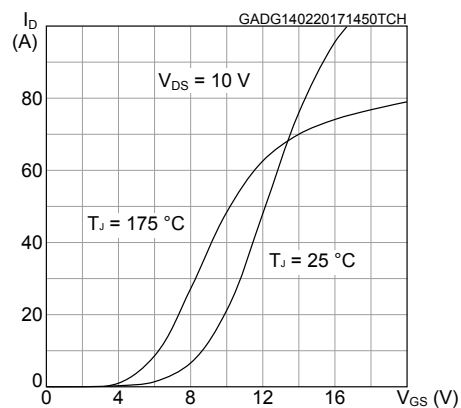
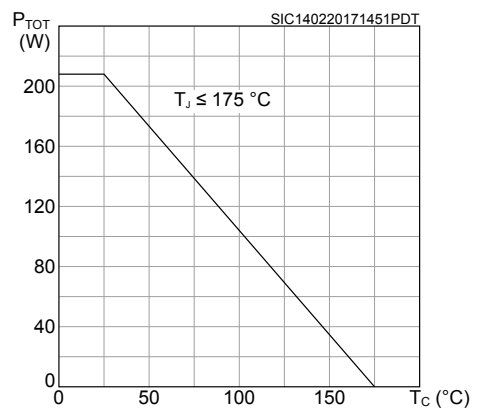
**Table 6. Switching times, based on HiP247 package option**

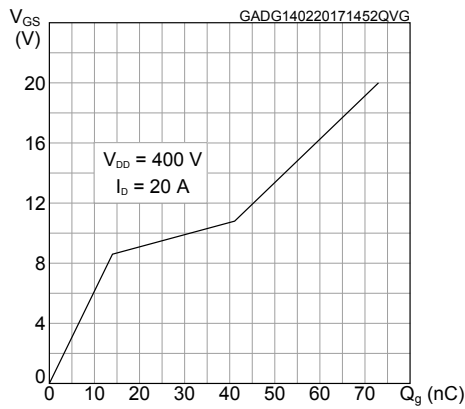
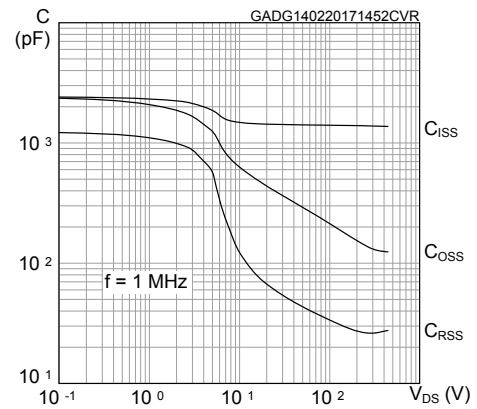
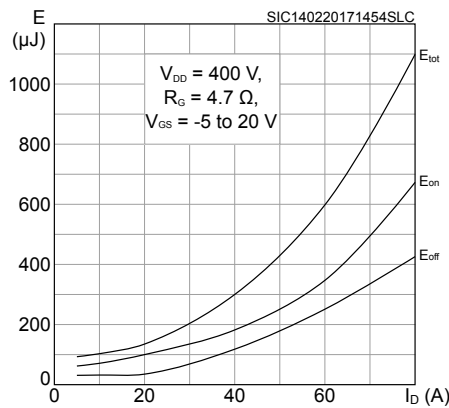
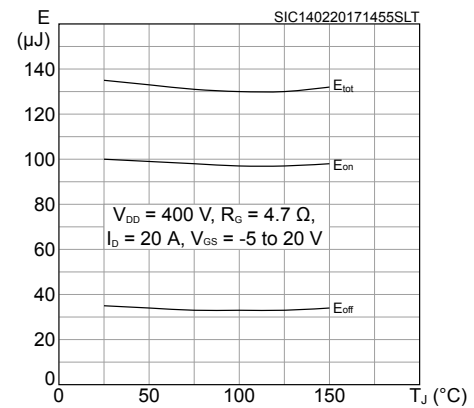
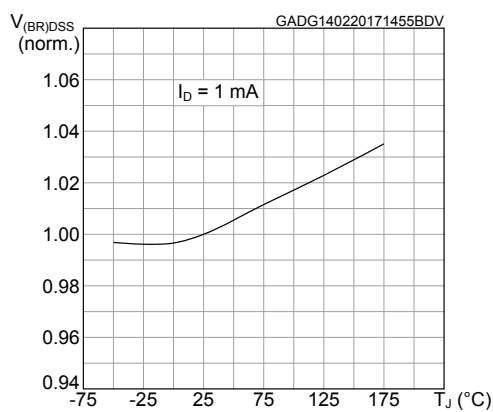
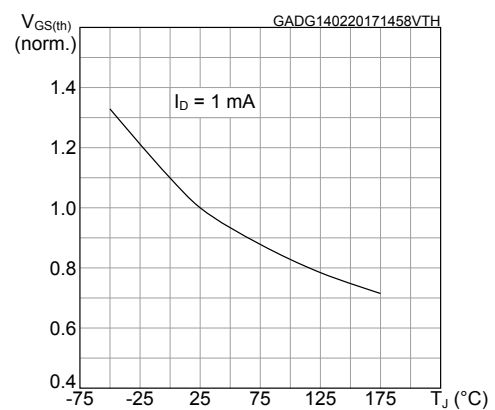
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 20\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = -5\text{ to }20\text{ V}$	-	16	-	ns
$t_f$	Fall time		-	14	-	
$t_{d(off)}$	Turn-off delay time		-	35	-	
$t_r$	Rise time		-	9	-	

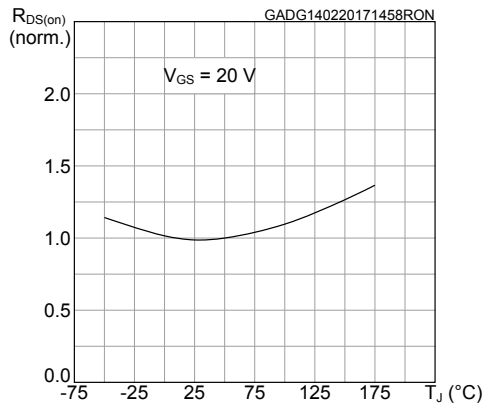
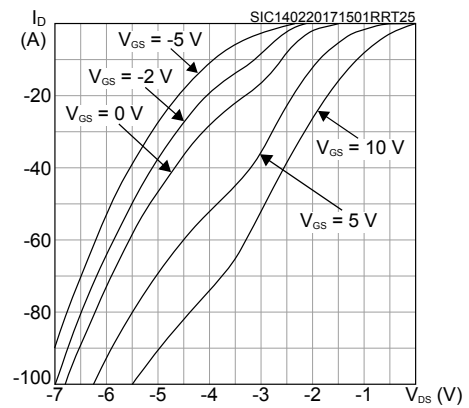
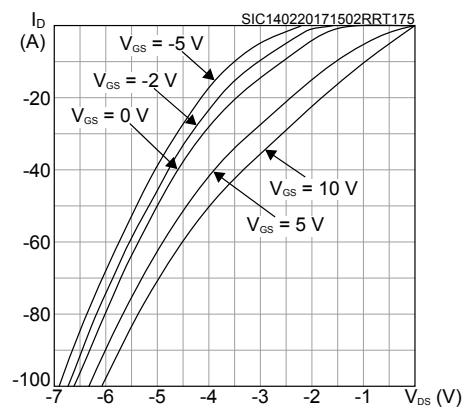
**Table 7. Reverse SiC diode characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Diode forward voltage	$I_F = 20\text{ A}$ , $V_{GS} = 0\text{ V}$	-	3.3	-	V
$t_{rr}$	Reverse recovery time	$V_{DD} = 400\text{ V}$ , $I_F = 20\text{ A}$ , $di/dt = 1000\text{ A}/\mu\text{s}$	-	18	-	ns
$Q_{rr}$	Reverse recovery charge		-	85	-	nC
$I_{RRM}$	Reverse recovery current		-	7	-	A

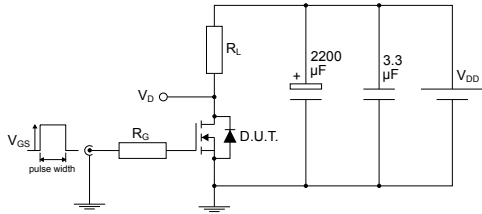
## 2.1 Electrical characteristics (curves), based on HiP247 package option

**Figure 1. Safe operating area**

**Figure 2. Thermal impedance**

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

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

**Figure 5. Transfer characteristics**

**Figure 6. Total power dissipation**


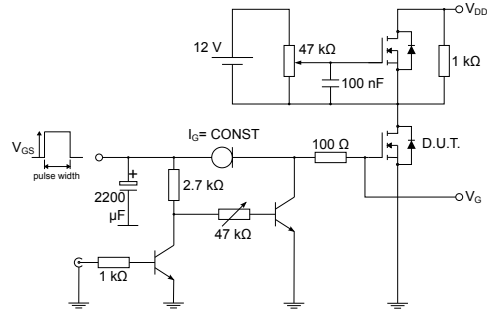
**Figure 7. Gate charge vs gate-source voltage**

**Figure 8. Capacitance variations**

**Figure 9. Switching energy vs. drain current**

**Figure 10. Switching energy vs. junction temperature**

**Figure 11. Normalized  $V_{(BR)DSS}$  vs. temperature**

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


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

**Figure 14. Reverse conduction characteristics ( $T_J = 25\text{ °C}$ )**

**Figure 15. Reverse conduction characteristics ( $T_J = 175\text{ °C}$ )**


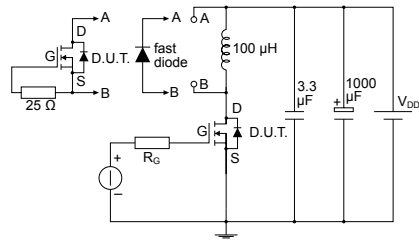
### 3 Test circuits

**Figure 16. Test circuit for resistive load switching times**


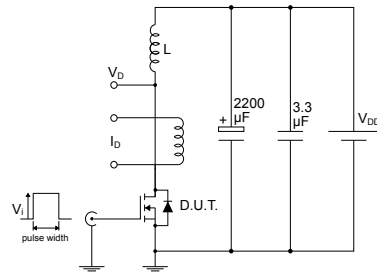
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**Figure 17. Test circuit for gate charge behavior**


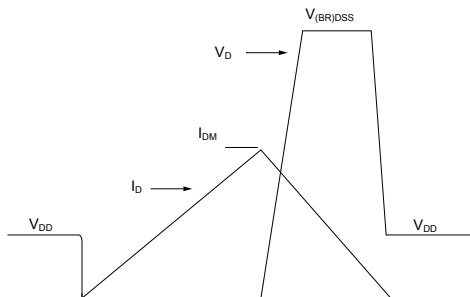
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**Figure 18. Test circuit for inductive load switching and diode recovery times**


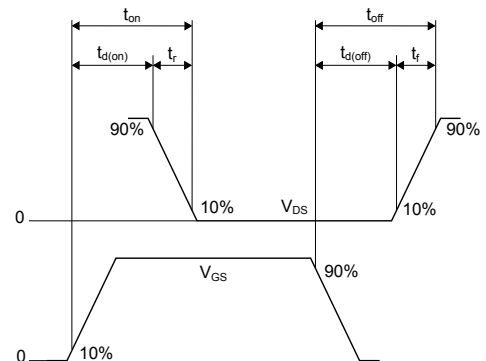
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**Figure 19. Unclamped inductive load test circuit**


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**Figure 20. Unclamped inductive waveform**


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**Figure 21. Switching time waveform**


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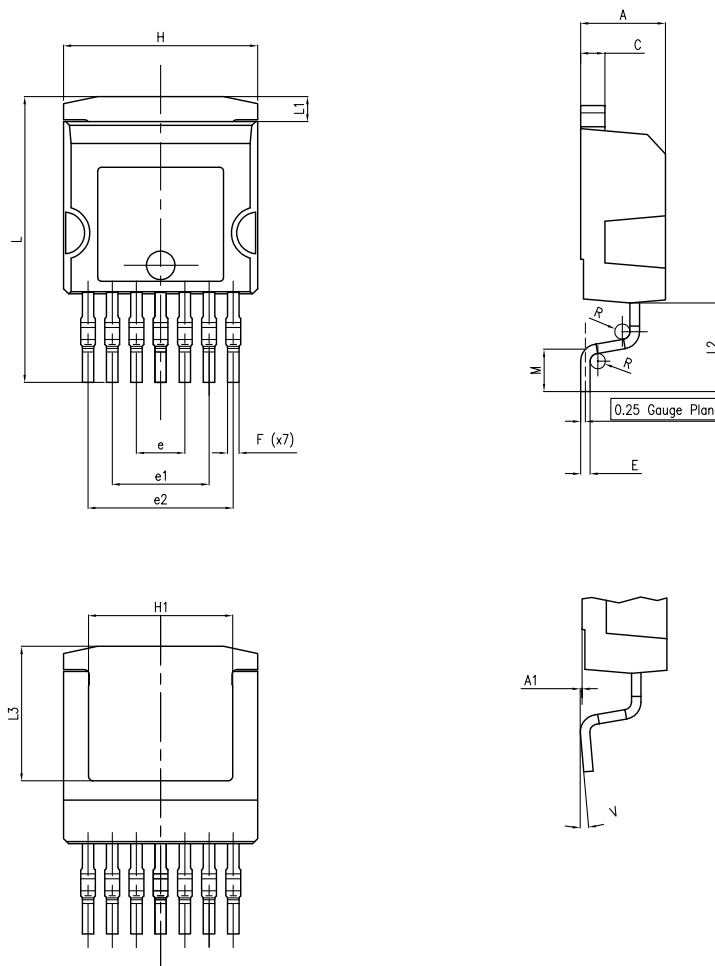


## 4 Package information

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.

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

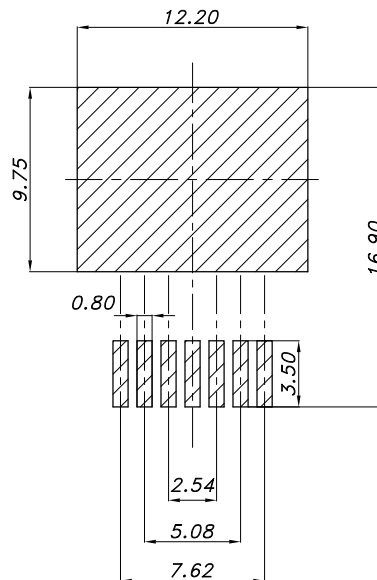
Figure 22. H<sup>2</sup>PAK-7 package outline



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

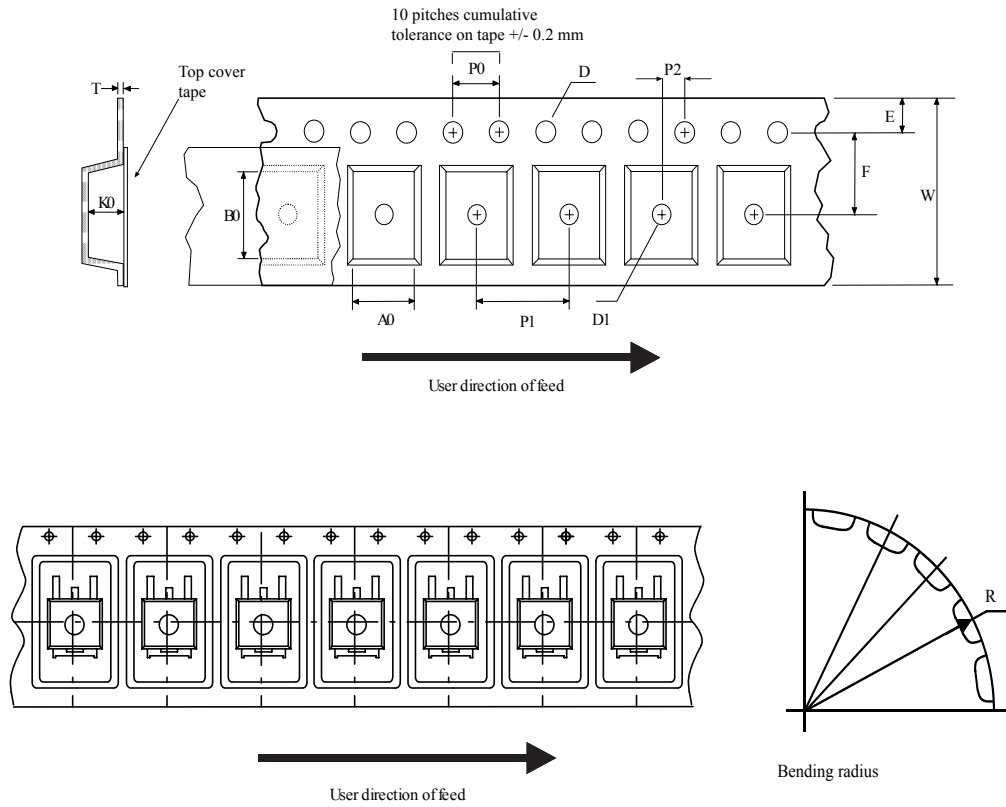


footprint\_DM00249216\_4

*Note: Dimensions are in mm.*

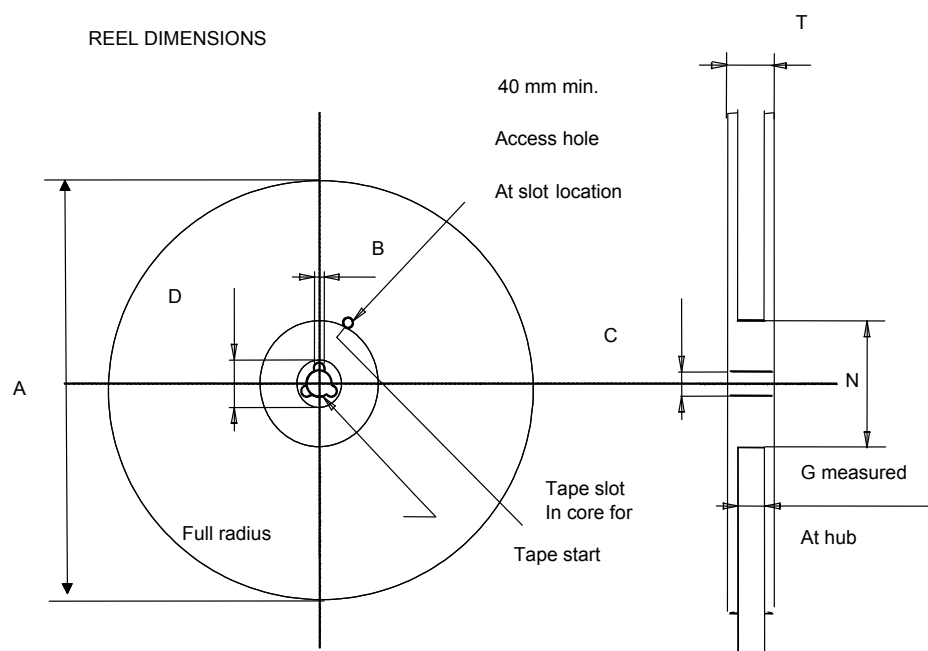
## 4.2 Packing information

Figure 24. Tape outline



AM08852v2

Figure 25. 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
17-Feb-2017	1	First release.
13-Dec-2017	2	Updated document title. Updated <i>Table 4: "On/off states"</i> . Minor text changes.
13-Dec-2018	3	Datasheet promoted from preliminary data to production data. Modified title and features on cover page. Minor text changes.
24-Jan-2020	4	Updated <a href="#">Table 1. Absolute maximum ratings</a> . Minor text changes.
11-Jan-2021	5	Updated <a href="#">Table 7. Reverse SiC diode characteristics</a> . Minor text changes.

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