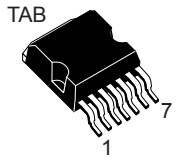
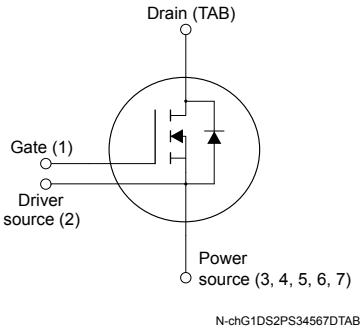
SCTH40N120G2V7AG

Datasheet

Automotive-grade silicon carbide Power MOSFET 1200 V, 75 mΩ typ., 33 A in an H²PAK-7 package



H²PAK-7



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
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 2nd 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	
Order code	SCTH40N120G2V7AG
Marking	40N120AG
Package	H²PAK-7
Packing	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 °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 V, I_D = 1 mA	1200			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 1200 V			10	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = -10 to 22 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	1.9	3.2	5.0	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 18 V, I_D = 20 A		75	105	mΩ
		V_{GS} = 18 V, I_D = 20 A, T_J = 175 °C		167		

Table 4. Dynamic

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

Table 5. Switching energy (inductive load)

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

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 800 V, I_D = 20 A, R_G = 4.7 Ω, V_{GS} = -5 to 18 V	-	11	-	ns
t_f	Rise time		-	5	-	
$t_{d(off)}$	Turn-off delay time		-	18	-	
t_r	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 A, V_{GS} = 0 V	-	3.4	-	V
t_{rr}	Reverse recovery time	I_{SD} = 20 A, di/dt = 2000 A/µs, V_{DD} = 800 V, V_{GS} = -5 to 18 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

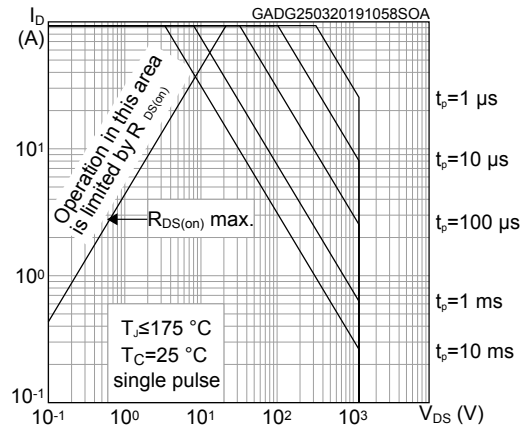


Figure 2. Maximum transient thermal impedance

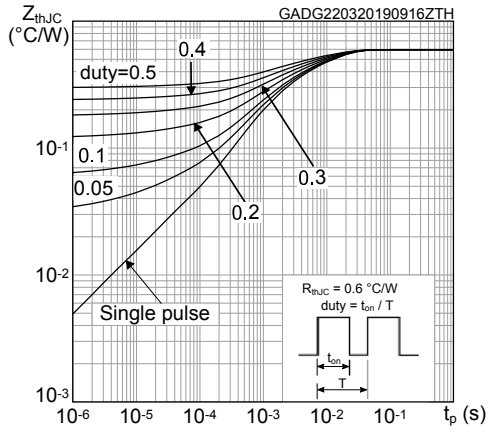


Figure 3. Output characteristics (T_J = -50 °C)

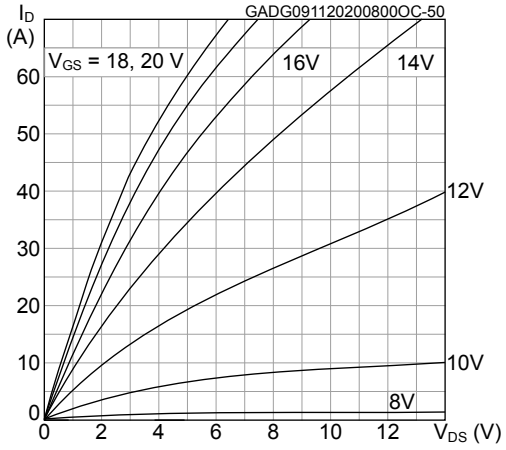


Figure 4. Output characteristics (T_J = 25 °C)

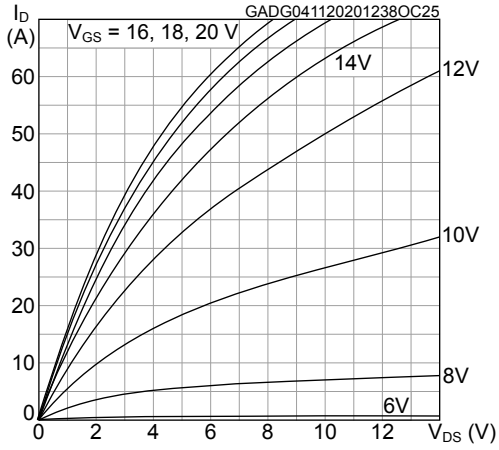


Figure 5. Output characteristics (T_J = 175 °C)

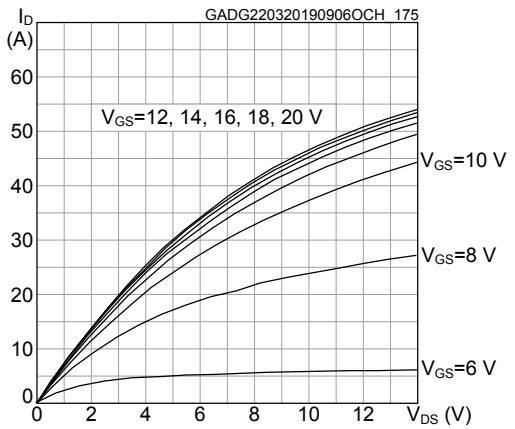


Figure 6. Transfer characteristics

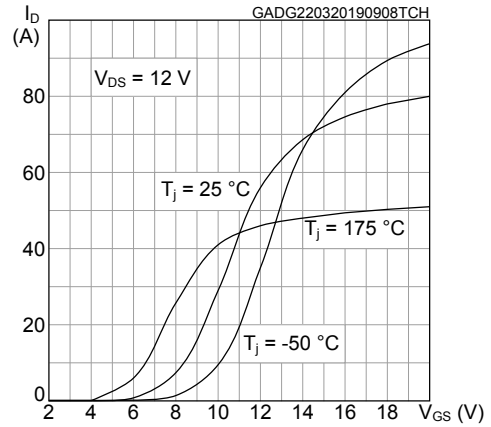


Figure 7. Total power dissipation

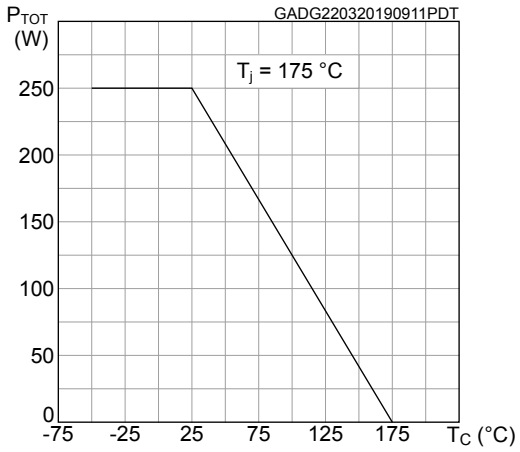


Figure 8. Gate charge vs gate-source voltage

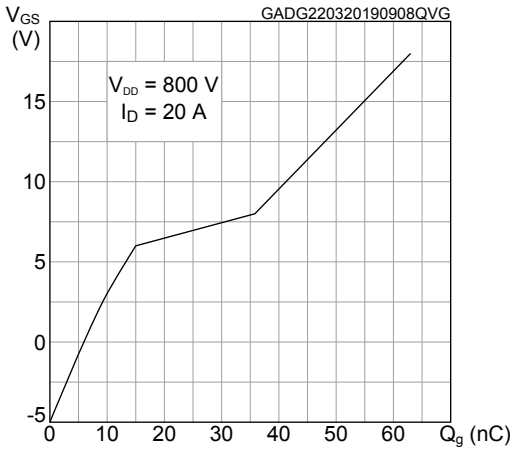


Figure 9. Capacitance variations

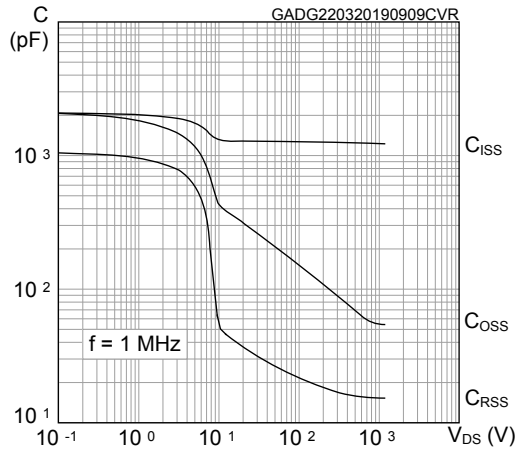


Figure 10. Switching energy vs drain current

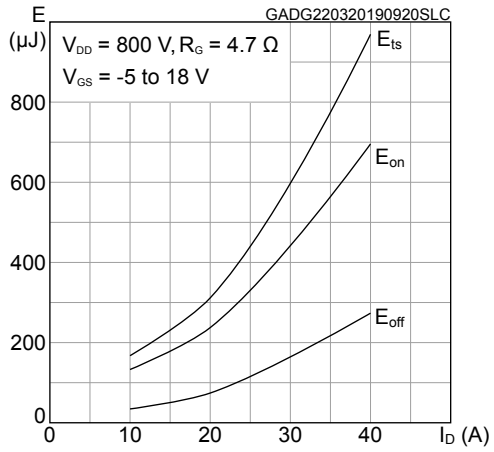


Figure 11. Switching energy vs junction temperature

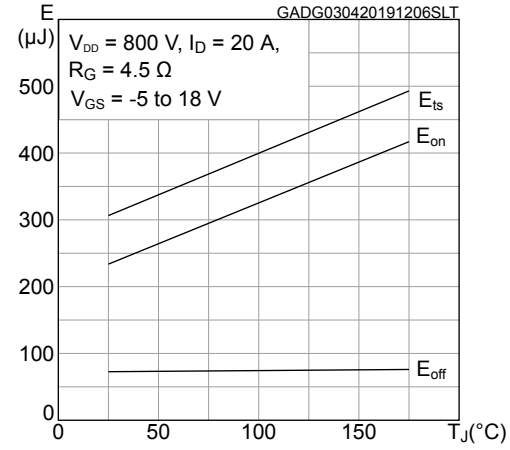


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

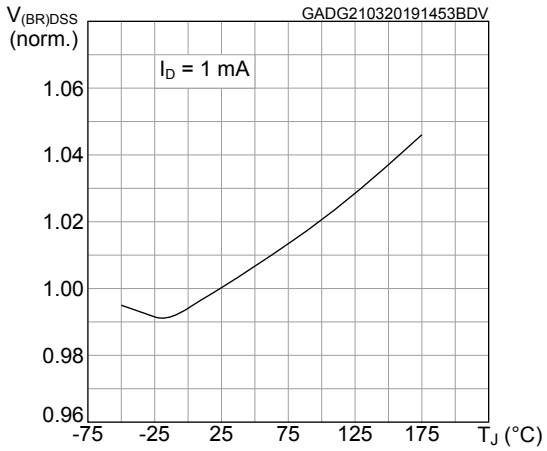


Figure 13. Normalized gate threshold voltage vs temperature

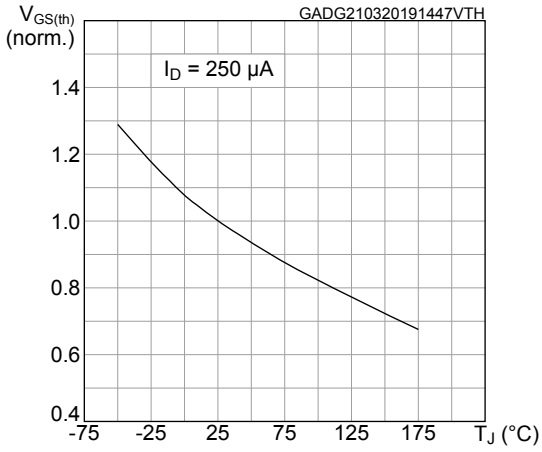


Figure 14. Normalized on-resistance vs temperature

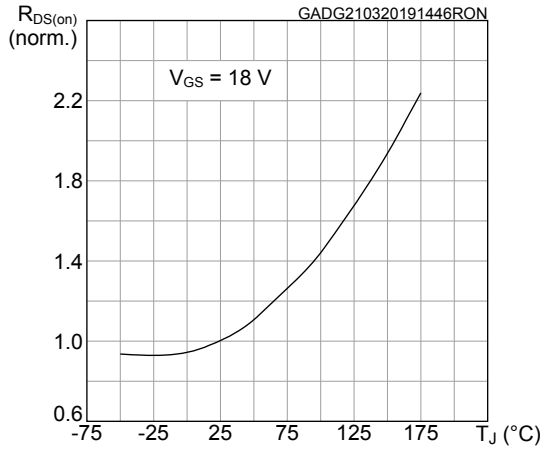


Figure 15. Reverse conduction characteristics (T_J= -50 °C)

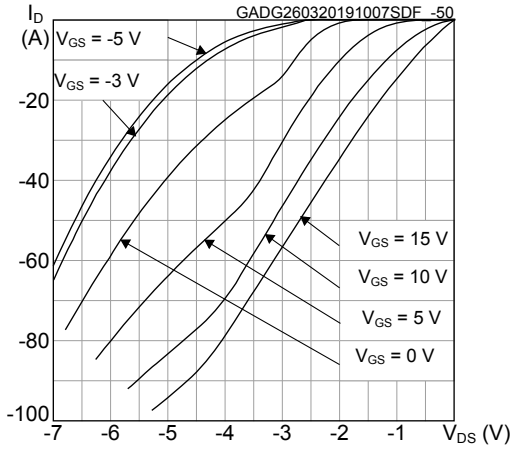


Figure 16. Reverse conduction characteristics (T_J = 25 °C)

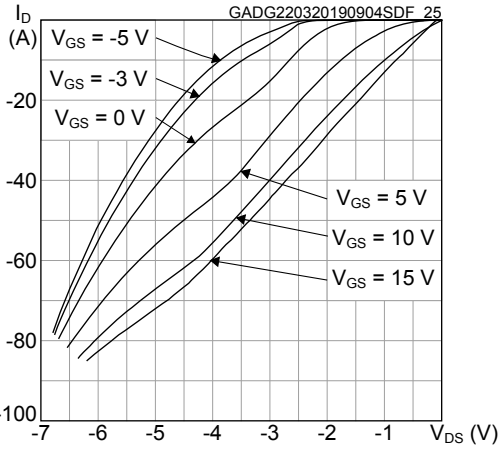
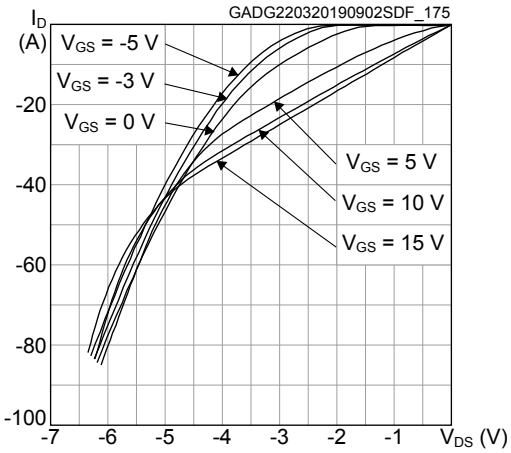


Figure 17. Reverse conduction characteristics (T_J = 175 °C)



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. ECOPACK is an ST trademark.

3.1 H²PAK-7 package information

Figure 18. **H²PAK-7 package outline**

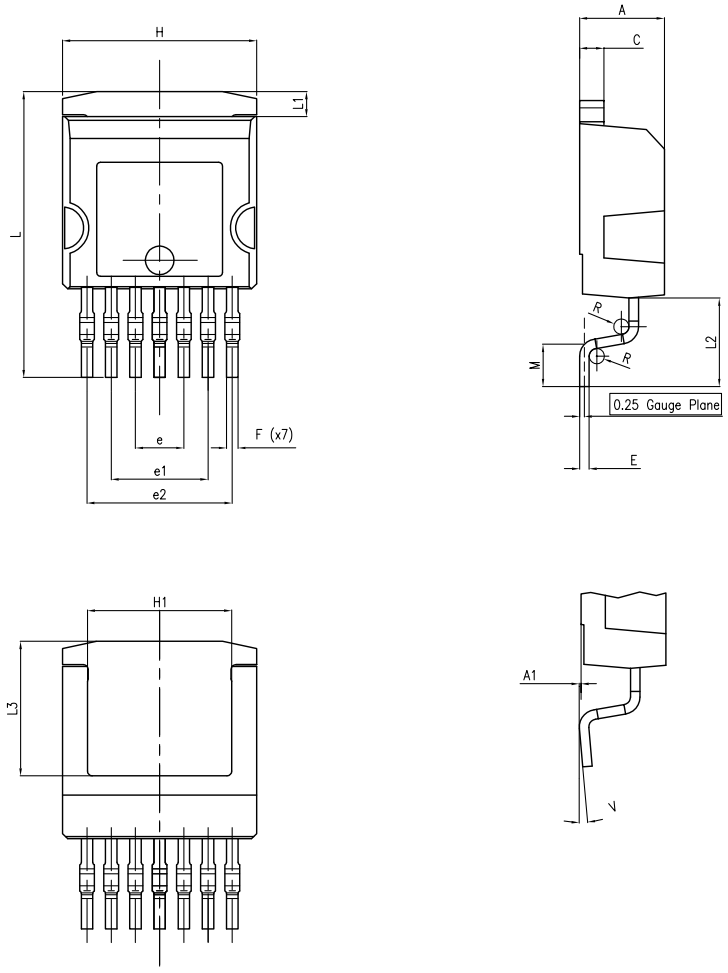


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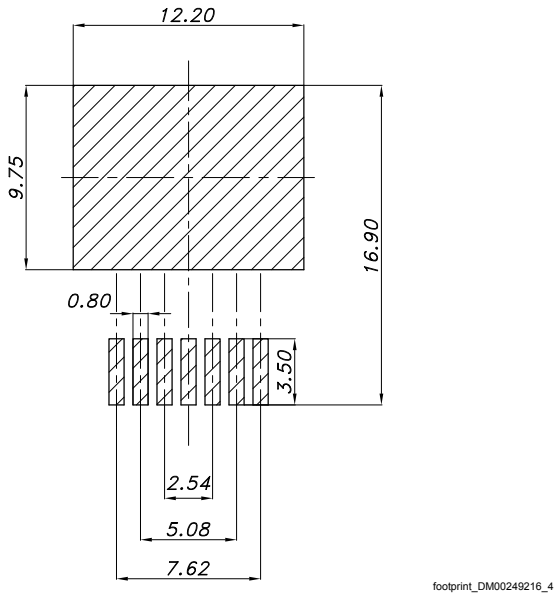
Table 8. **H²PAK-7 package mechanical data**

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. **H²PAK-7 recommended footprint**



Note: Dimensions are in mm.

3.2 Packing information

Figure 20. **Tape outline**

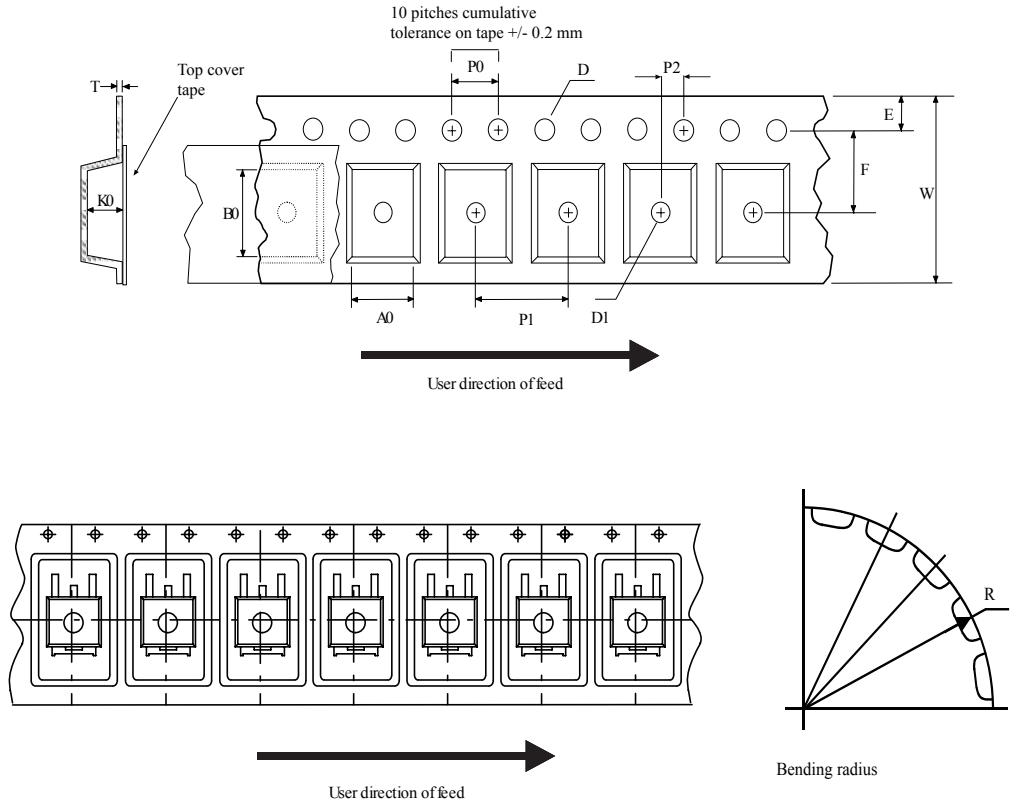


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Figure 21. **Reel outline**

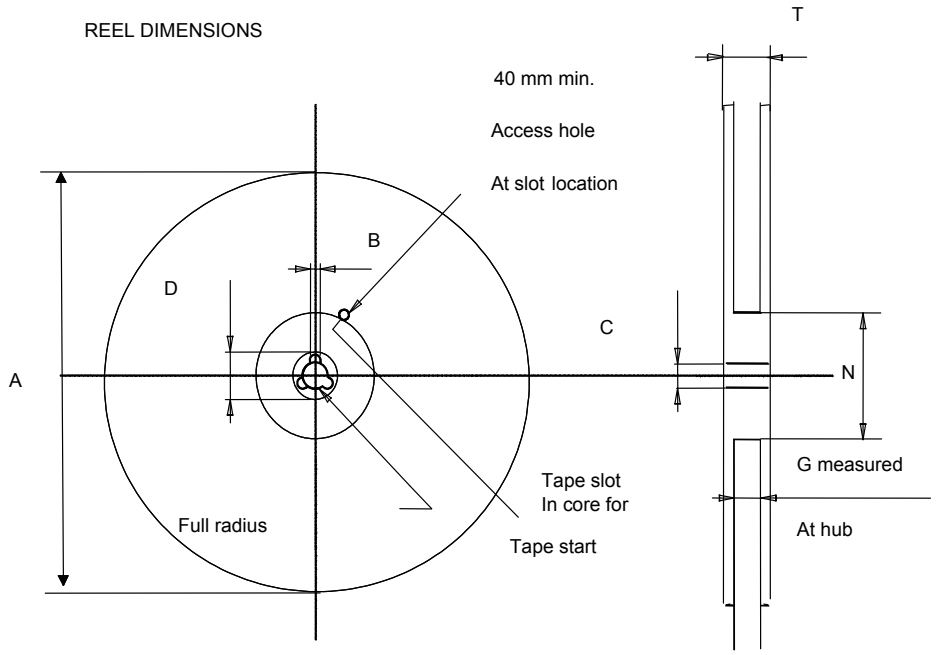

Table 9. **Tape and reel mechanical data**

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 *Product status / summary*. Updated *Table 3. On/off states* and *Table 7. Reverse SiC diode characteristics*.
24-Nov-2021	3	Modified Features and Applications on cover page. Modified Table 1. Absolute maximum ratings, Table 2. Thermal data, Table 3. On/off states, Table 5. Switching energy (inductive load), Table 6. Switching times and Table 7. Reverse SiC diode characteristics. Modified Figure 1. Safe operating area, Figure 2. Maximum transient thermal impedance, Figure 3. Output characteristics (T_J = -50 °C), Figure 4. Output characteristics (T_J = 25 °C), Figure 5. Output characteristics (T_J = 175 °C) and Figure 11. Switching energy vs junction temperature. Minor text changes.

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