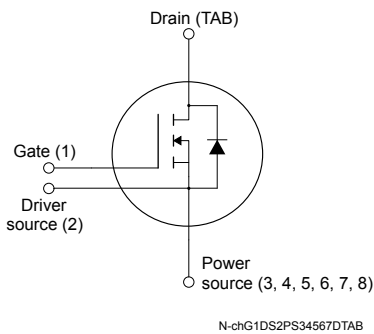
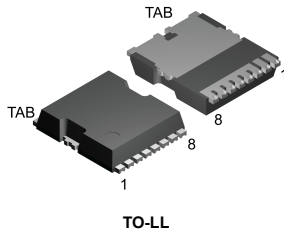


## Silicon carbide Power MOSFET 650 V, 29 mΩ typ., 60 A in a TO-LL package



### Product status link

[SCT027TO65G3](#)

### Product summary

<b>Order code</b>	SCT027TO65G3
<b>Marking</b>	027TO65G3
<b>Package</b>	TO-LL
<b>Packing</b>	Tape and reel

### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> typ.	I <sub>D</sub>
SCT027TO65G3	650 V	29 mΩ	60 A

- Very fast and robust intrinsic body diode
- Very low R<sub>DS(on)</sub> over the entire temperature range
- High speed switching performances
- Source sensing pin for increased efficiency

### Applications

- Switching mode power supply
- DC-DC converters

### 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.

# 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 $T_C = 25 \text{ }^\circ\text{C}$	60	A
	Drain current (continuous) at $T_C = 100 \text{ }^\circ\text{C}$	60	
$I_{DM}^{(2)}$	Drain current (pulsed)	267	A
$P_{TOT}$	Total power dissipation at $T_C = 25 \text{ }^\circ\text{C}$	395	W
$T_{stg}$	Storage temperature range	-55 to 175	$^\circ\text{C}$
$T_J$	Operating junction temperature range		$^\circ\text{C}$

1. Limited by bonding wires.
2. Pulse width is limited by safe operating area.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.38	$^\circ\text{C}/\text{W}$
$R_{thJA}$	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	$V_{DS} = V_{GS}$ , $I_D = 5\text{ mA}$	1.8	3.0	4.2	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 15\text{ V}$ , $I_D = 30\text{ A}$		32.8		m $\Omega$
		$V_{GS} = 18\text{ V}$ , $I_D = 30\text{ A}$		29	39.3	
		$V_{GS} = 18\text{ V}$ , $I_D = 30\text{ A}$ , $T_J = 175\text{ °C}$		39		

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 400\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	1173	-	pF
$C_{oss}$	Output capacitance		-	128	-	pF
$C_{riss}$	Reverse transfer capacitance		-	16	-	pF
$Q_g$	Total gate charge	$V_{DD} = 400\text{ V}$ , $V_{GS} = -5\text{ to }18\text{ V}$ , $I_D = 30\text{ A}$	-	52.9	-	nC
$Q_{gs}$	Gate-source charge		-	15.4	-	nC
$Q_{gd}$	Gate-drain charge		-	18.5	-	nC
$R_g$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	1.5	-	$\Omega$

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{DD} = 400\text{ V}$ , $I_D = 30\text{ A}$ ,	-	83.3	-	$\mu\text{J}$
$E_{off}$	Turn-off switching energy	$R_G = 5.6\ \Omega$ , $V_{GS} = -5\text{ V to }18\text{ V}$	-	99.6	-	$\mu\text{J}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 30\text{ A}$ , $R_G = 5.6\ \Omega$ , $V_{GS} = -5\text{ to }18\text{ V}$	-	15.9	-	ns
$t_r$	Rise time		-	6.9	-	ns
$t_{d(off)}$	Turn-off delay time		-	28.8	-	ns
$t_f$	Fall time		-	8.2	-	ns

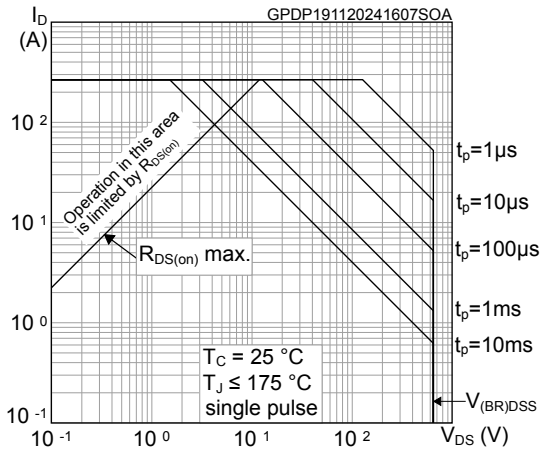
**Table 7. Reverse SiC diode characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Continuous diode forward current	$T_C = 25\text{ }^\circ\text{C}$	-		60	A
		$T_C = 100\text{ }^\circ\text{C}$	-		60	
$V_{SD}$	Diode forward voltage	$I_{SD} = 30\text{ A}, V_{GS} = 0\text{ V}$	-	2.73		V
$t_{rr}$	Reverse recovery time	$I_{SD} = 30\text{ A}, 1\text{ kA}/\mu\text{s}, V_{DD} = 400\text{ V}$	-	15.4		ns
$Q_{rr}$	Reverse recovery charge		-	85.2		nC
$I_{RRM}$	Reverse recovery current		-	9.2		A

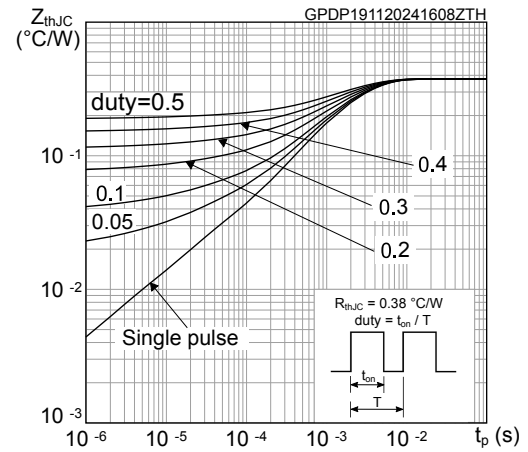
1. Limited by bonding wires.

## 2.1 Electrical characteristics (curves)

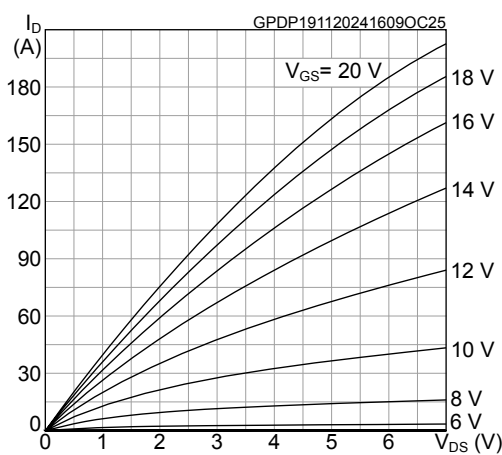
**Figure 1. Safe operating area**



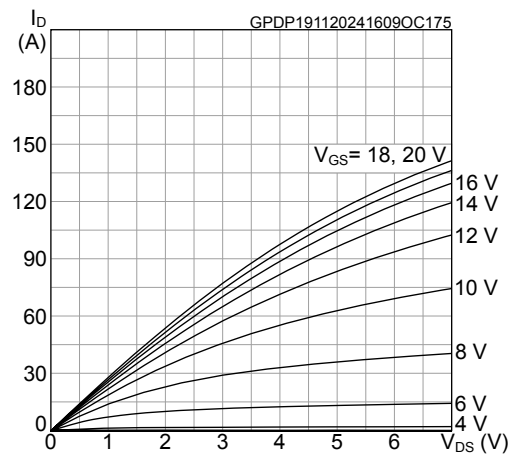
**Figure 2. Maximum transient thermal impedance**



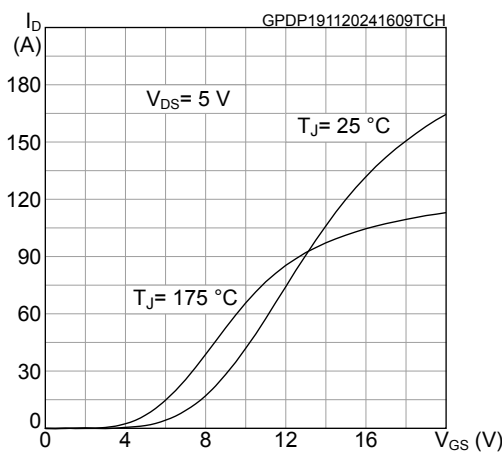
**Figure 3. Typical output characteristics (T<sub>J</sub> = 25 °C)**



**Figure 4. Typical output characteristics (T<sub>J</sub> = 175 °C)**



**Figure 5. Typical transfer characteristics**



**Figure 6. Total power dissipation**

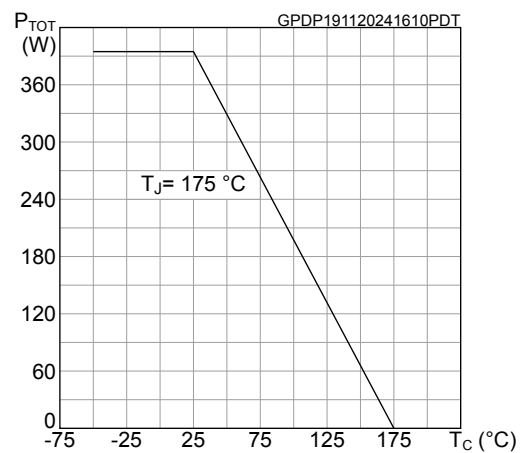


Figure 7. Maximum continuous drain current vs case temperature

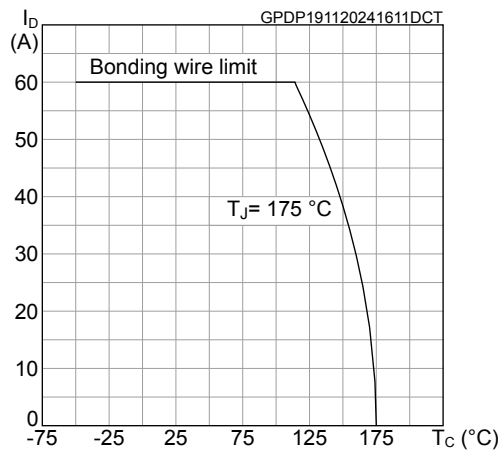


Figure 8. Normalized breakdown voltage vs temperature

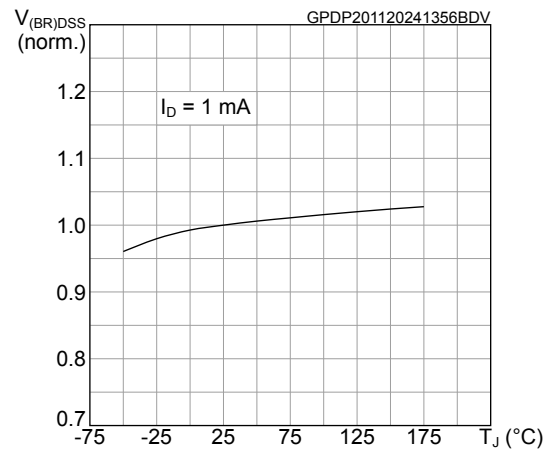


Figure 9. Normalized gate threshold vs temperature

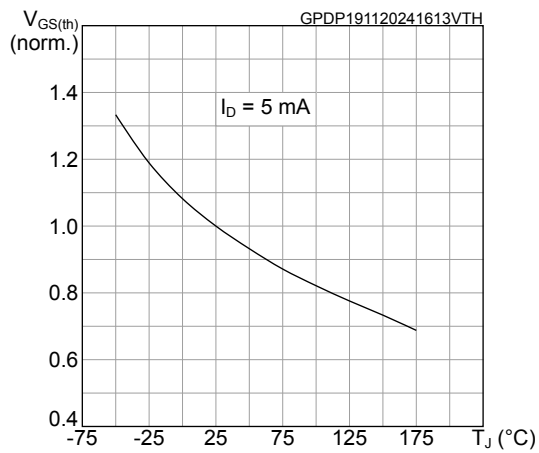


Figure 10. Normalized on-resistance vs temperature

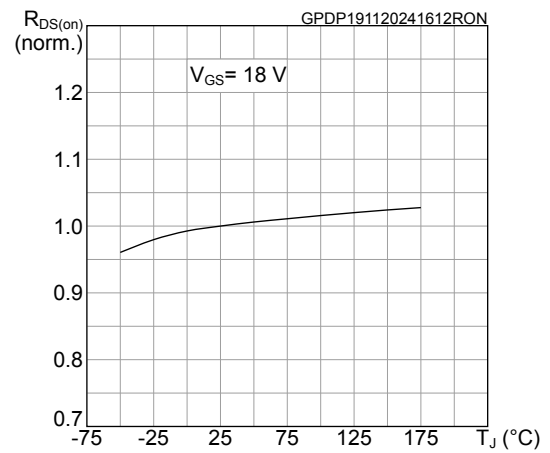


Figure 11. Typical capacitance characteristics

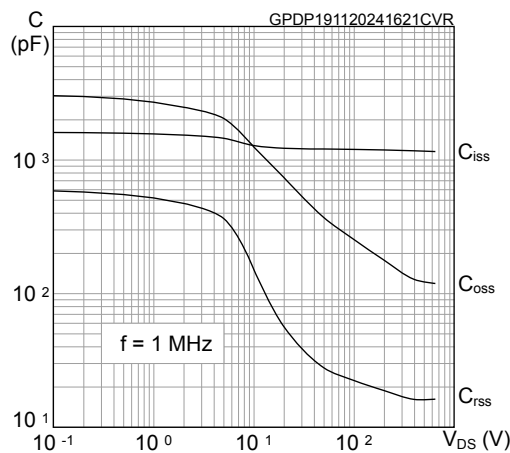


Figure 12. Typical gate charge characteristics

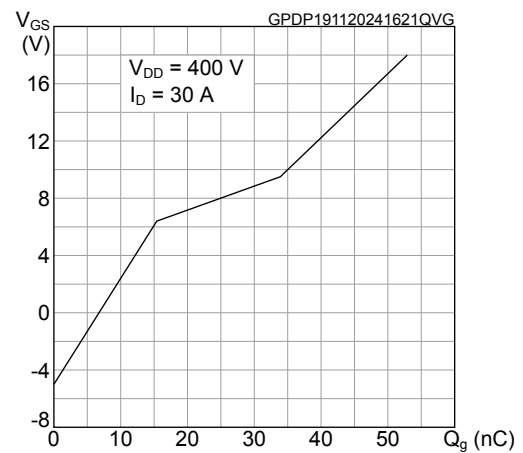


Figure 13. Typical reverse conduction characteristics  
( $T_J = 25\text{ }^\circ\text{C}$ )

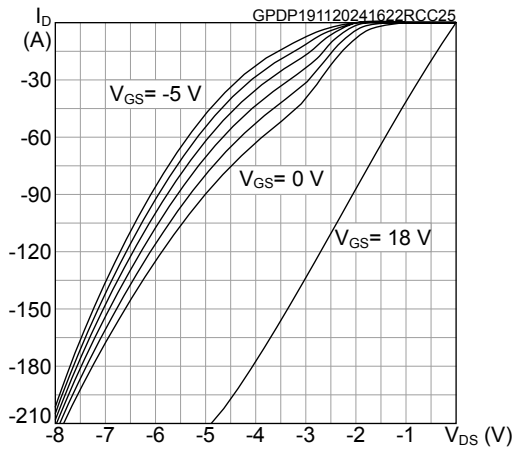


Figure 14. Typical reverse conduction characteristics  
( $T_J = 175\text{ }^\circ\text{C}$ )

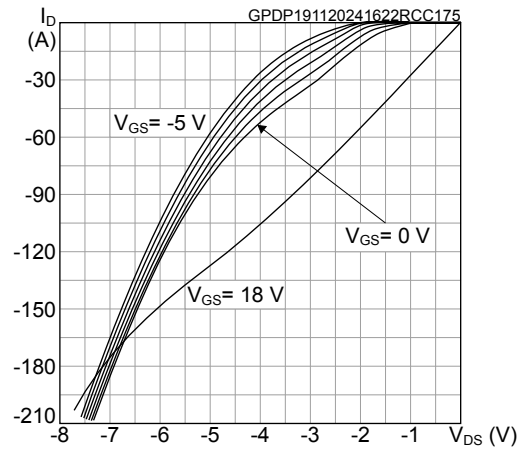


Figure 15. Typical switching energy vs drain current

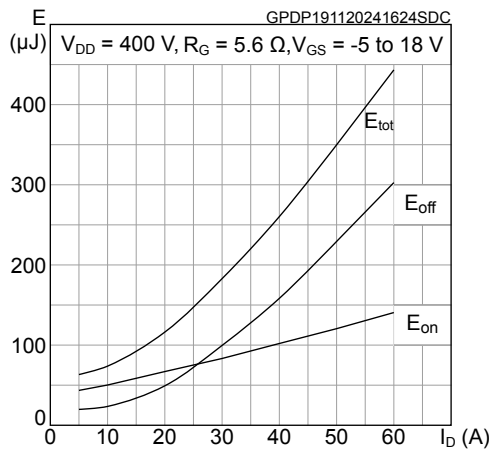


Figure 16. Typical switching energy vs supply voltage

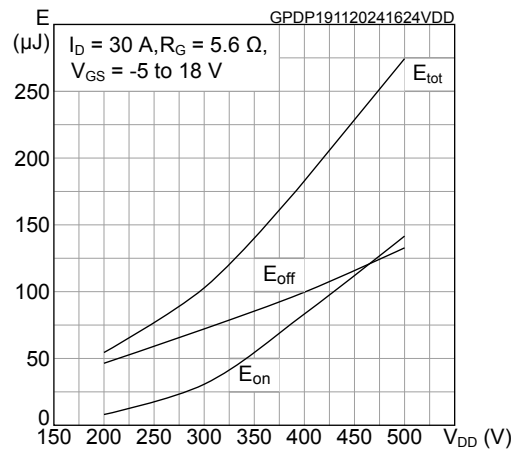
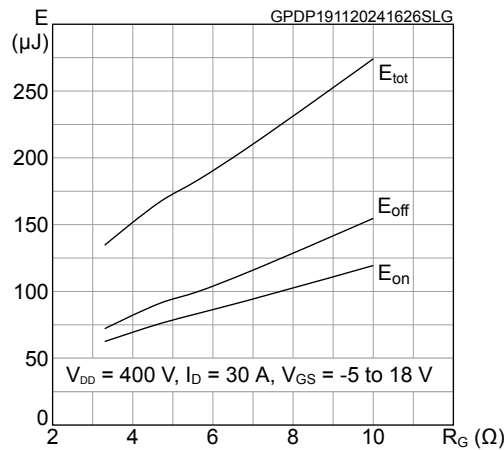


Figure 17. Typical switching energy vs gate resistance

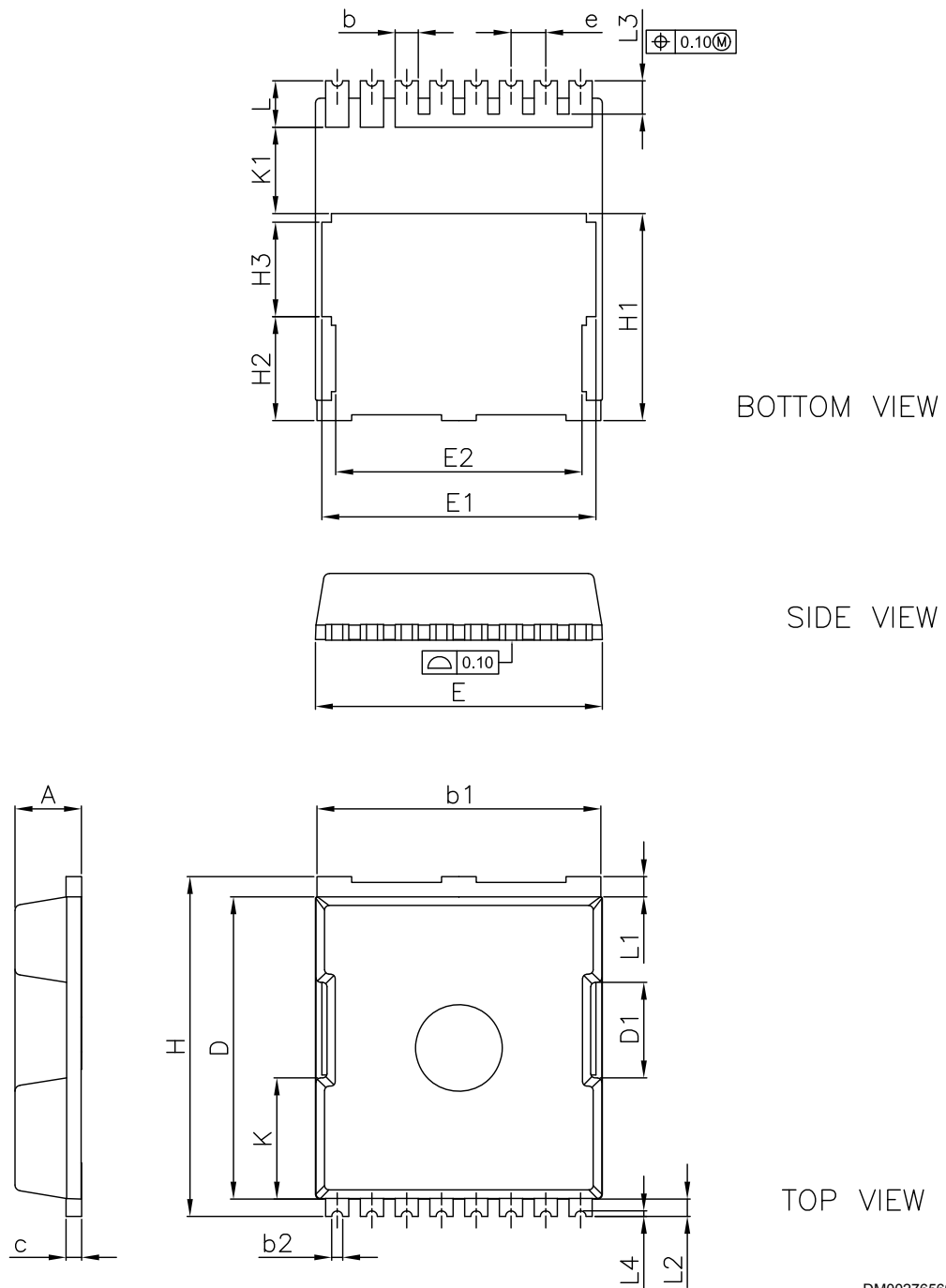


### 3 Package information

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 TO-LL package information

Figure 18. TO-LL package outline



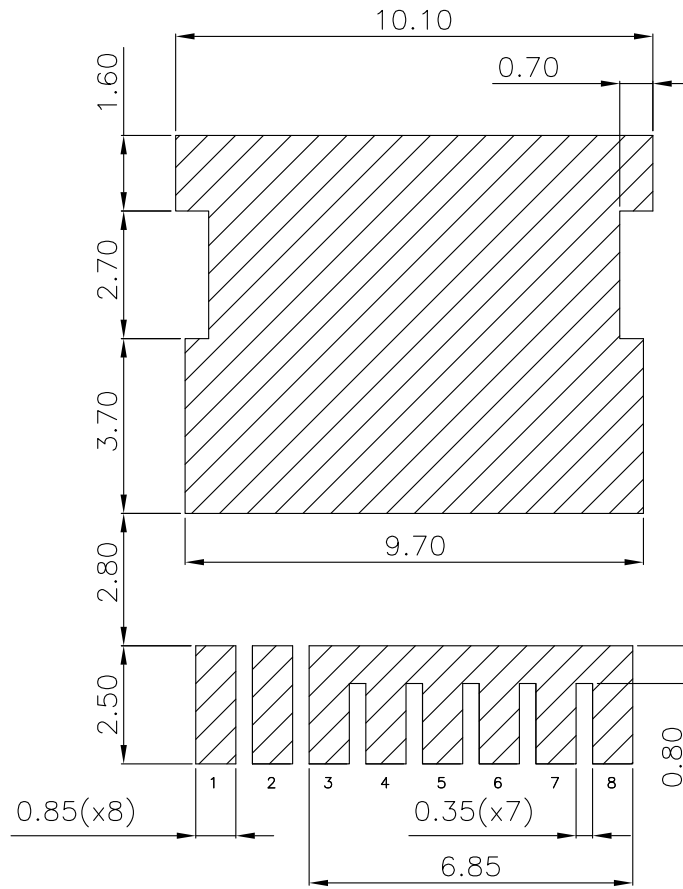
DM00276569\_SiC\_Rev\_7



**Table 8. TO-LL package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.40
b	0.60	0.80	0.90
b1	9.70	9.80	9.90
b2	0.20		0.50
c	0.40	0.50	0.60
D	10.28	10.43	10.58
D1	3.15	3.30	3.45
E	9.70	9.90	10.10
E1	9.31	9.46	9.61
E2	8.35	8.50	8.65
e	1.10	1.20	1.30
H	11.48	11.73	11.88
H1	7.00	7.15	7.30
H2	3.34	3.59	3.84
H3	3.11	3.26	3.41
K	4.03	4.18	4.33
K1	2.70		
L	1.45	1.60	1.75
L1	0.55	0.70	0.85
L2	0.45	0.60	0.75
L3	1.00	1.15	1.30
L4	0.05		0.40

**Figure 19. TO-LL recommended footprint (dimensions are in mm)**



DM00276569\_7\_SIC\_FP

### 3.2 TO-LL packing information

Figure 20. Carrier tape outline and dimensions

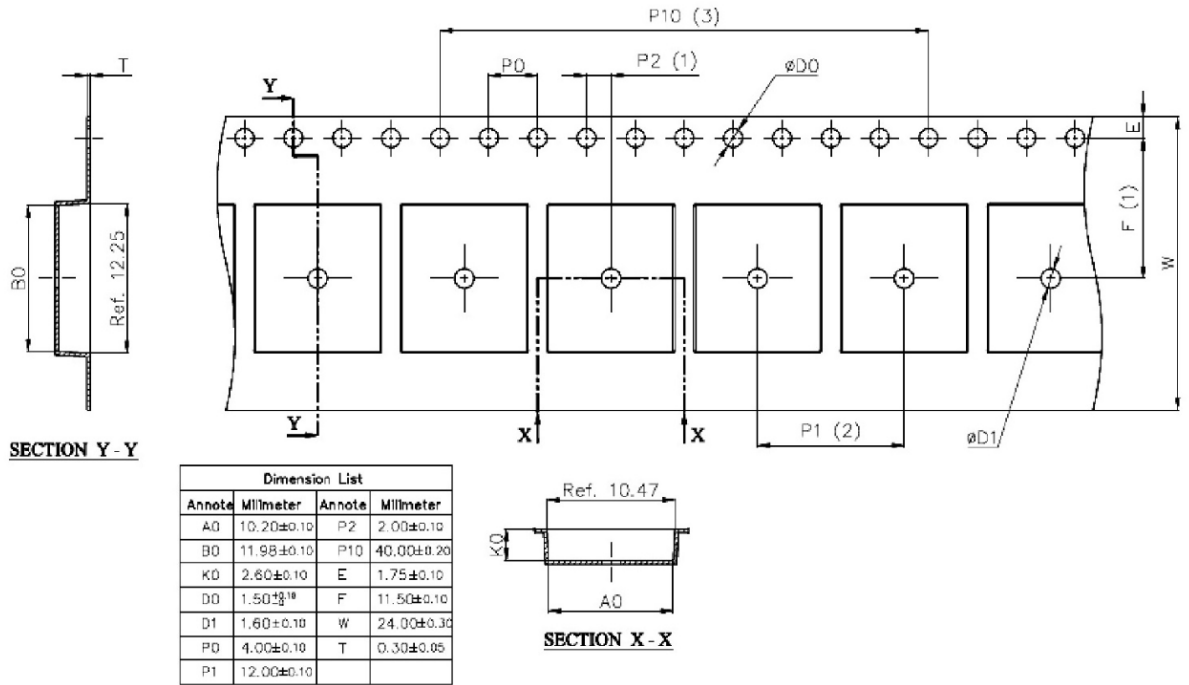
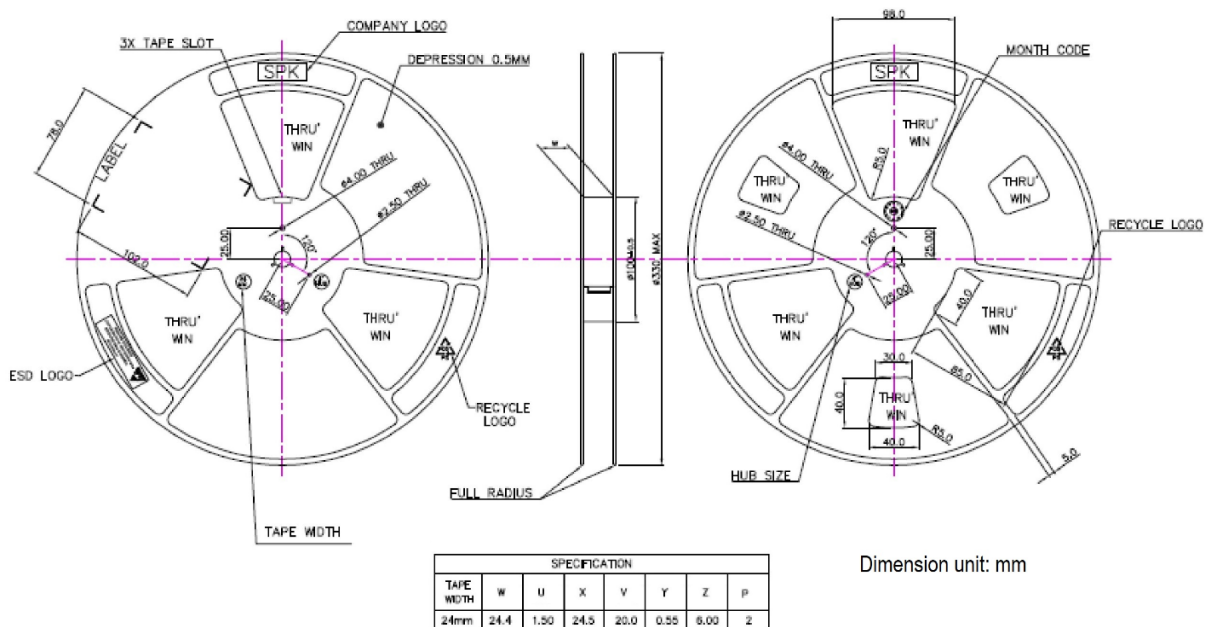
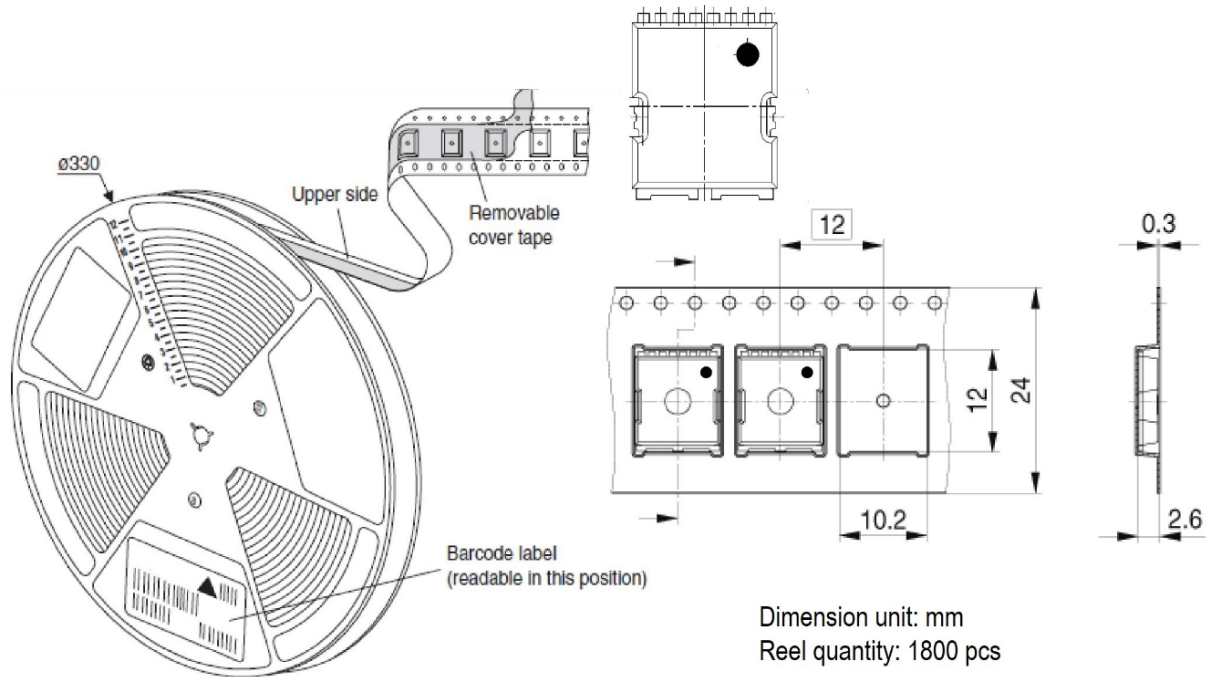


Figure 21. Reel outline and dimensions



**Figure 22. TO-LL orientation in tape pocket**



## Revision history

**Table 9. Document revision history**

Date	Revision	Changes
22-Nov-2024	1	First release.

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## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>2</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>3</b>
<b>2.1</b>	Electrical characteristics (curves) .....	<b>5</b>
<b>3</b>	<b>Package information</b> .....	<b>8</b>
<b>3.1</b>	TO-LL package information .....	<b>8</b>
<b>3.2</b>	TO-LL packing information .....	<b>11</b>
	<b>Revision history</b> .....	<b>13</b>

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