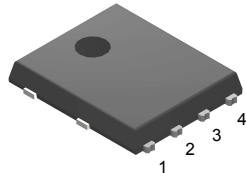
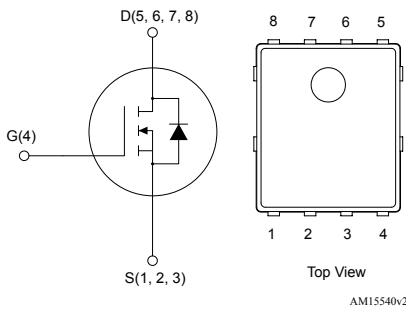



## Automotive N-channel standard level 40 V, 2.6 mΩ max., 154 A STripFET F8 Power MOSFET in a PowerFLAT 5x6 package


**PowerFLAT 5x6**


### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STL165N4F8AG	40 V	2.6 mΩ	154 A

- AEC-Q101 qualified 
- MSL1 grade
- 175 °C maximum operating junction temperature
- 100% avalanche tested
- Low gate charge  $Q_g$
- Wettable flank package

### Applications

- Automotive motor control
- Body and convenience
- Chassis and safety
- Power train for ICE

### Description

The **STL165N4F8AG** is a 40 V N-channel enhancement mode Power MOSFET designed in STripFET F8 technology featuring an enhanced trench gate structure. It ensures a state-of-the-art of figure of merit for very low on-state resistance while reducing internal capacitances and gate charge for faster and more efficient switching.



#### Product status link

[STL165N4F8AG](#)

#### Product summary

<b>Order code</b>	STL165N4F8AG
<b>Marking<sup>(1)</sup></b>	165N4F8
<b>Package</b>	PowerFLAT 5x6
<b>Packing</b>	Tape and reel

1. Engineering samples are clearly identified with a dedicated special symbol in the marking of each unit

# 1 Electrical ratings

**Table 1. Absolute maximum ratings (at  $T_C = 25\text{ °C}$  unless otherwise specified)**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	40	V
$V_{GS}$	Gate-source voltage	$\pm 20$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ °C}$ <sup>(2)</sup>	154	A
	Drain current (continuous) at $T_C = 100\text{ °C}$ <sup>(2)</sup>	109	
	Drain current (continuous) at $T_C = 25\text{ °C}$ <sup>(3)</sup>	120	
$I_{DM}^{(1)(2)(4)}$	Drain current (pulsed), $t_P = 10\text{ }\mu\text{s}$	615	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	111	W
$I_{AS}$	Single pulse avalanche current (pulse width limited by maximum junction temperature)	60	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ °C}$ , $I_D = 60\text{ A}$ , $R_{Gmin} = 25\text{ }\Omega$ )	151	mJ
$T_J$	Operating junction temperature range	-55 to 175	$^{\circ}\text{C}$
$T_{stg}$	Storage temperature range		$^{\circ}\text{C}$

1. Specified by design, not tested in production.
2. This is the theoretical current value only related to the silicon.
3. This current value is limited by package.
4. Pulse width is limited by safe operating area.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJA}^{(1)}$	Thermal resistance, junction-to-ambient (on 2s2p FR-4 board vertical in still area)	16.9	$^{\circ}\text{C/W}$
$R_{thJC}$	Thermal resistance, junction-to-case	1.35	$^{\circ}\text{C/W}$

1. Defined according to JEDEC standards (JESD51-5, -7).

## 2 Electrical characteristics

$T_J = 25\text{ °C}$  unless otherwise specified.

**Table 3. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	40			V
$I_{DSS}$	Zero gate voltage drain current	$V_{DS} = 40\text{ V}$ , $V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
		$V_{DS} = 40\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$ <sup>(1)</sup>			100	
$I_{GSS}$	Gate-body leakage current	$V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2		4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 60\text{ A}$		2.1	2.6	m $\Omega$

1. Specified by design and evaluated by characterization, not tested in production.

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$ <sup>(1)</sup>	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	2400	-	pF
$C_{oss}$ <sup>(1)</sup>	Output capacitance		-	690	-	pF
$C_{rss}$ <sup>(1)</sup>	Reverse transfer capacitance		-	18	-	pF
$Q_g$ <sup>(1)</sup>	Total gate charge	$V_{DD} = 25\text{ V}$ , $I_D = 120\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$	-	28	-	nC
$Q_{gs}$ <sup>(1)</sup>	Gate-source charge		-	13	-	nC
$Q_{gd}$ <sup>(1)</sup>	Gate-drain charge		-	3	-	nC

1. Specified by design and evaluated by characterization, not tested in production.

**Table 5. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ <sup>(1)</sup>	Turn-on delay time	$V_{DD} = 20\text{ V}$ , $I_D = 60\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	12	-	ns
$t_r$ <sup>(1)</sup>	Rise time		-	2.6	-	ns
$t_{d(off)}$ <sup>(1)</sup>	Turn-off delay time		-	16	-	ns
$t_f$ <sup>(1)</sup>	Fall time		-	3.5	-	ns

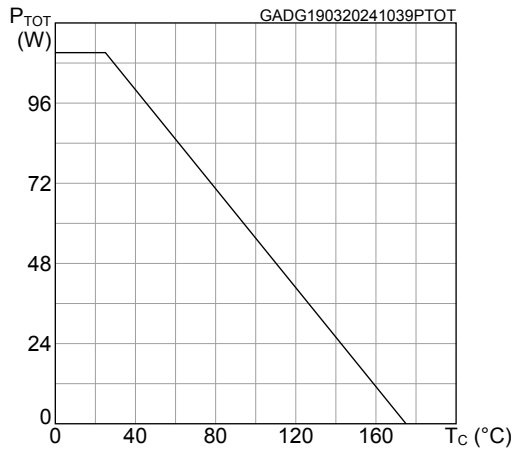
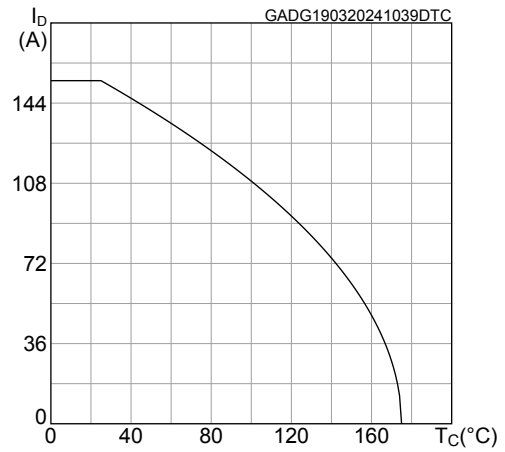
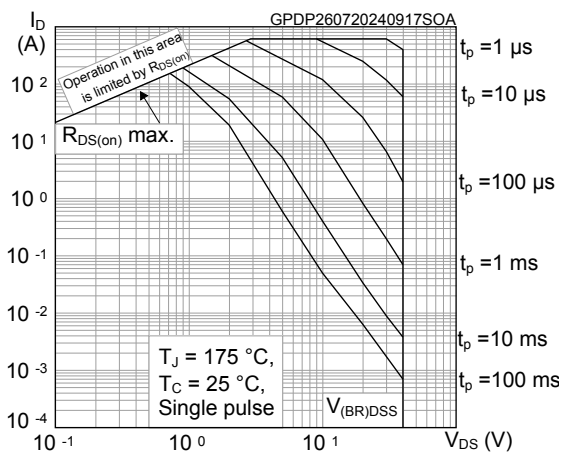
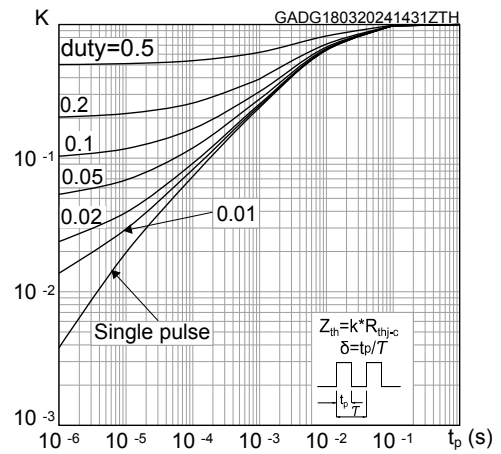
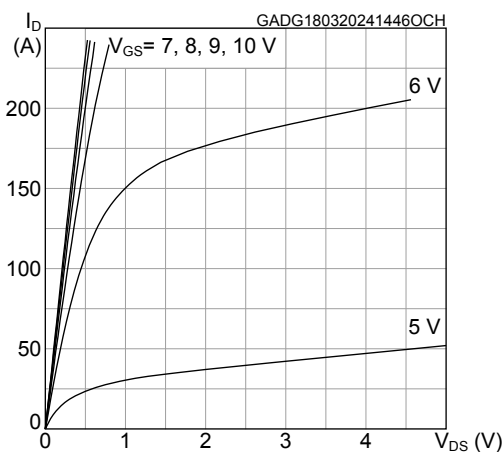
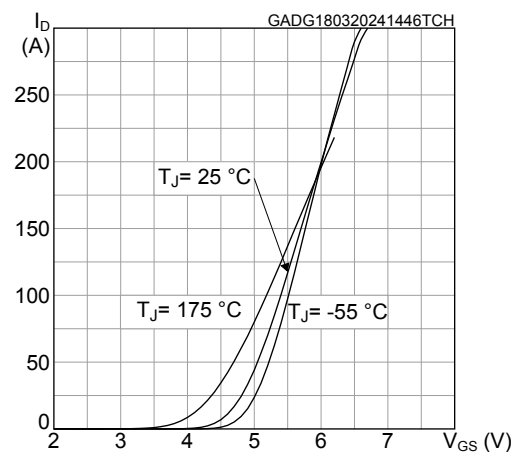
1. Specified by design and evaluated by characterization, not tested in production.

**Table 6. Source-drain diode**

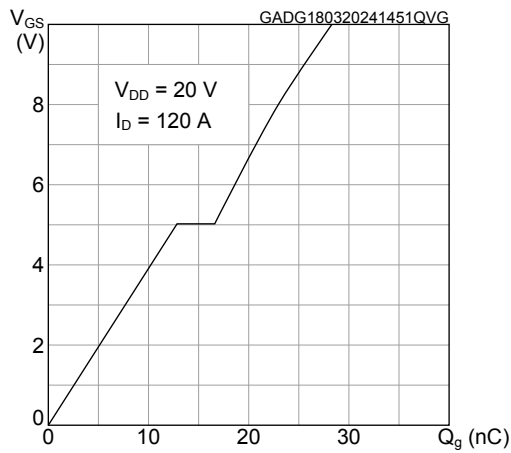
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1) (2)}$	Forward on current (continuous)	$T_C = 25\text{ °C}$	-		80	A
$V_{SD}$	Forward on voltage	$I_{SD} = 60\text{ A}, V_{GS} = 0\text{ V}$	-		1.1	V
$t_{rr}^{(1)}$	Reverse recovery time	$I_D = 60\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_{DD} = 32\text{ V}$	-	41		ns
$Q_{rr}^{(1)}$	Reverse recovery charge		-	1.7		nC
$I_{RRM}^{(1)}$	Reverse recovery current		-	35		A

1. Specified by design and evaluated by characterization, not tested in production.
2. This is the theoretical current value only related to the silicon.

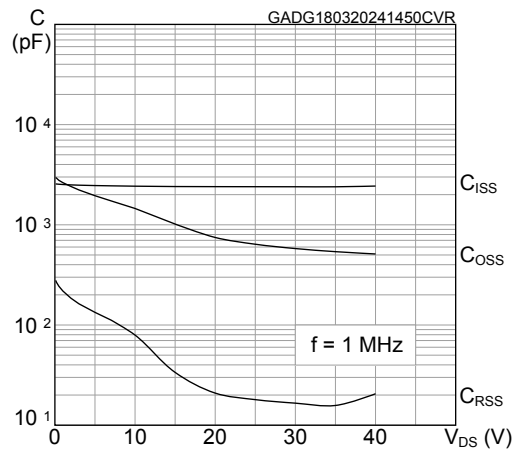
## 2.1 Electrical characteristics (curves)

**Figure 1. Total power dissipation**

**Figure 2. Drain current vs case temperature**

**Figure 3. Safe operating area**

**Figure 4. Normalized transient thermal impedance**

**Figure 5. Typical output characteristics**

**Figure 6. Typical transfer characteristics**


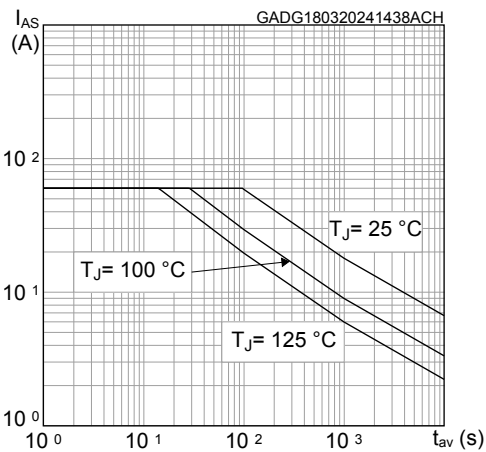
**Figure 7. Typical gate charge characteristics**



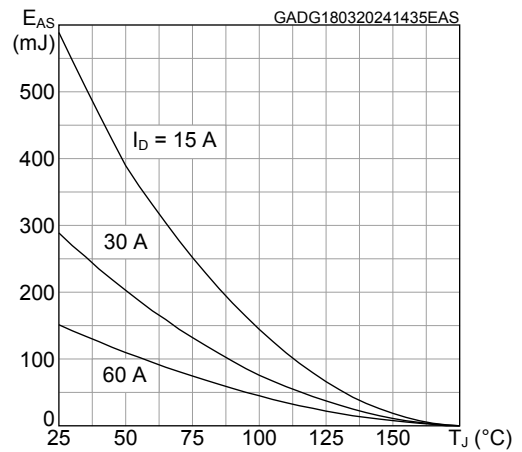
**Figure 8. Typical capacitance characteristics**



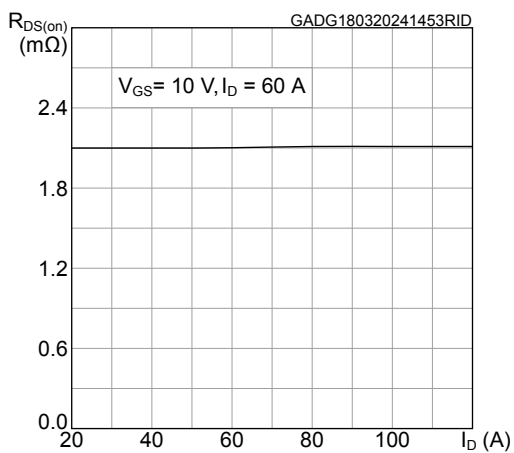
**Figure 9. Avalanche characteristics**



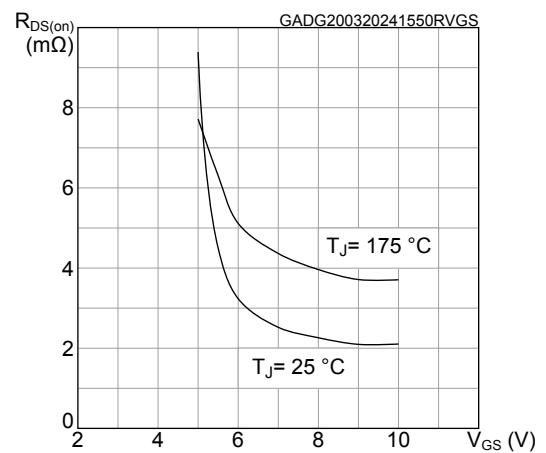
**Figure 10. Avalanche energy**



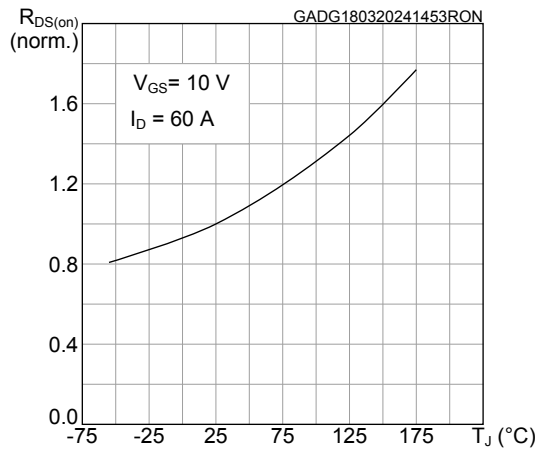
**Figure 11. Typical drain-source on-resistance**



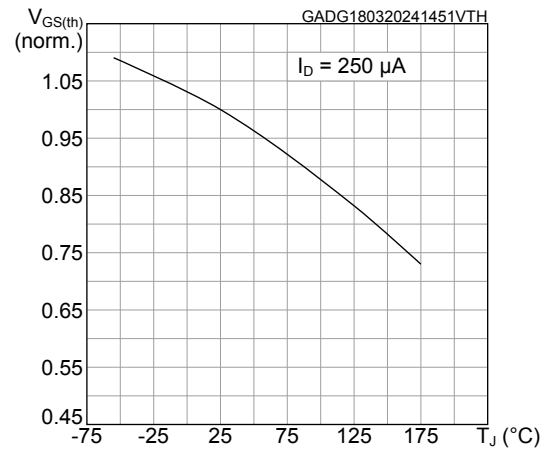
**Figure 12. Typical on-resistance vs gate-source voltage**



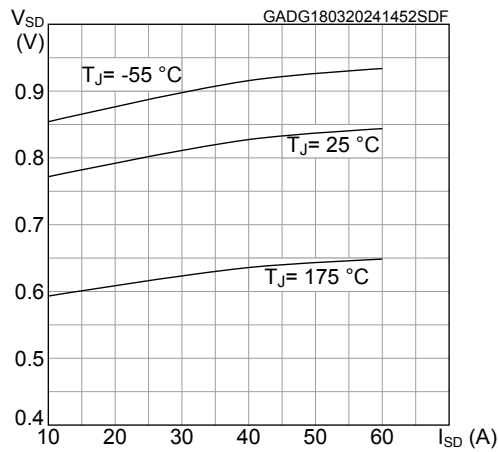
**Figure 13. Normalized on-resistance vs temperature**



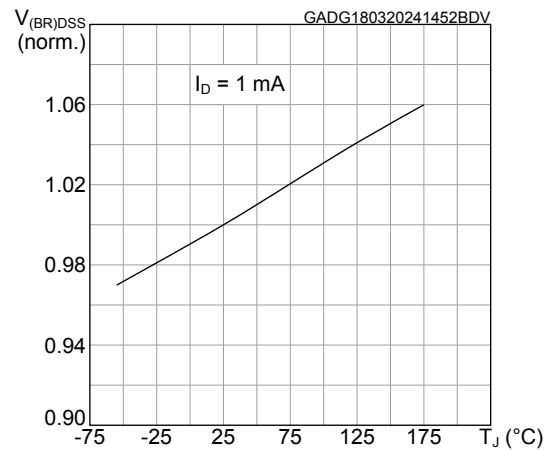
**Figure 14. Normalized gate threshold voltage vs temperature**



**Figure 15. Typical reverse diode forward characteristics**



**Figure 16. Normalized  $V_{(BR)DSS}$  vs temperature**

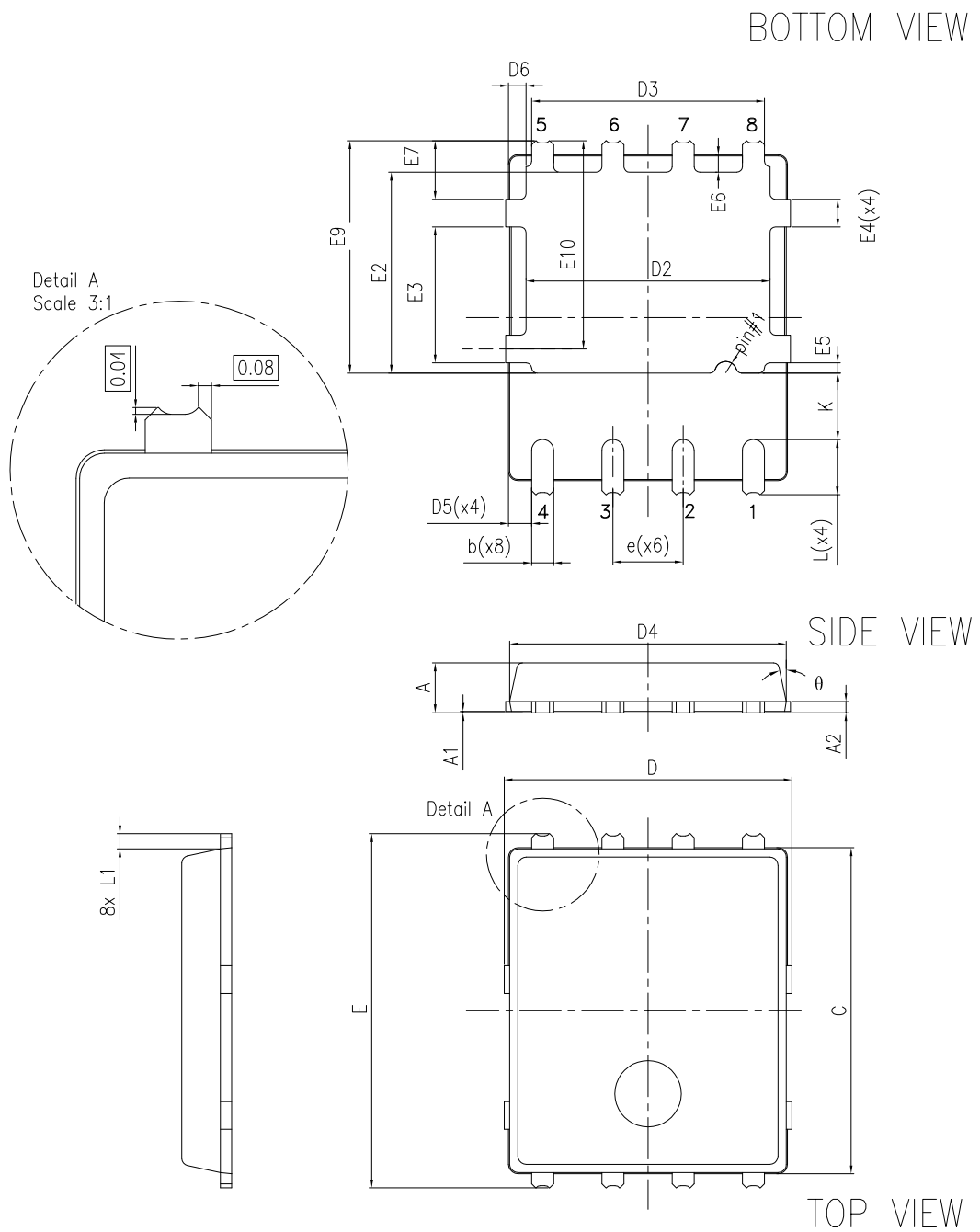


### 3 Package information

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 PowerFLAT 5x6 WF type C package information

Figure 17. PowerFLAT 5x6 WF type C package outline



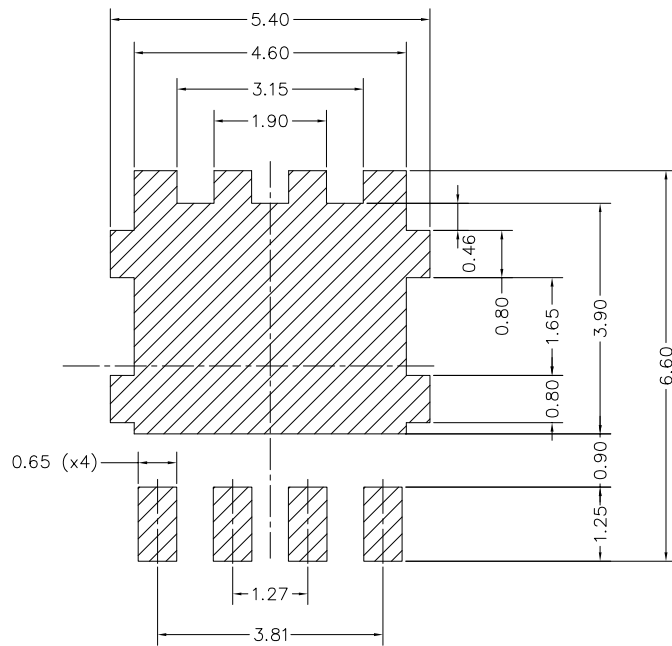
8231817\_WF\_typeC\_r23



**Table 7. PowerFLAT 5x6 WF type C mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.00
A1	0.00		0.05
A2		0.25	
b	0.30		0.50
C	5.80	6.00	6.10
D	5.00	5.20	5.40
D2	4.15		4.45
D3	4.05	4.20	4.35
D4	4.80	5.00	5.10
D5	0.25	0.40	0.55
D6	0.15	0.30	0.45
e		1.27	
E	6.20	6.40	6.60
E2	3.50		3.70
E3	2.35		2.55
E4	0.40		0.60
E5	0.08		0.28
E6	0.20	0.325	0.45
E7	0.85	1.00	1.15
E9	4.00	4.20	4.40
E10	3.55	3.70	3.85
K	1.05		1.35
L	0.90	1.00	1.10
L1	0.175	0.275	0.375
θ	0°		12°

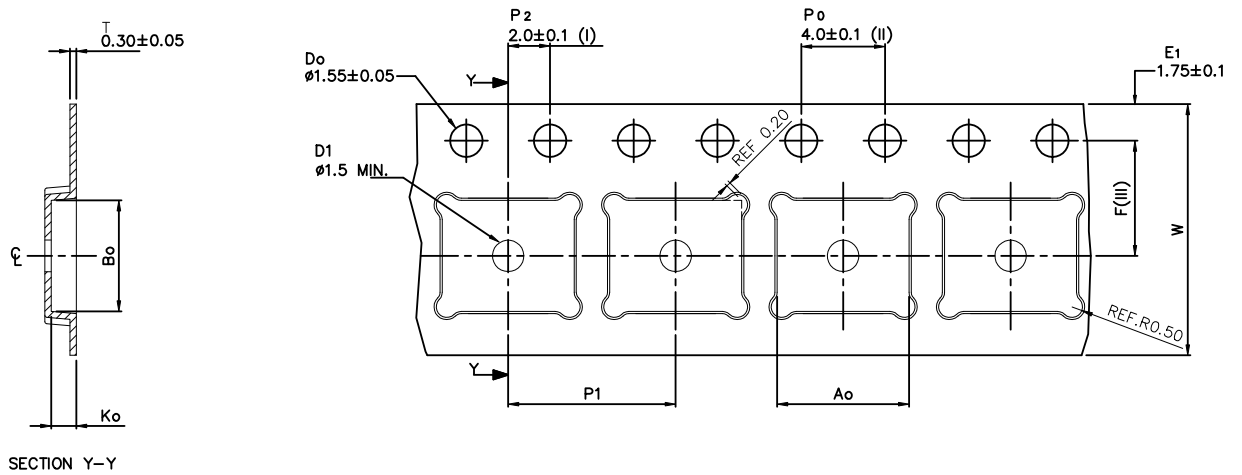
Figure 18. PowerFLAT 5x6 recommended footprint (dimensions are in mm)



8231817\_FOOTPRINT\_rev23

### 3.2 PowerFLAT 5x6 packing information

Figure 19. PowerFLAT 5x6 tape (dimensions are in mm)



Ao	6.30	+/- 0.1
Bo	5.30	+/- 0.1
Ko	1.20	+/- 0.1
F	5.50	+/- 0.1
P1	8.00	+/- 0.1
W	12.00	+/- 0.3

(I) Measured from centreline of sprocket hole to centreline of pocket.

(II) Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$ .

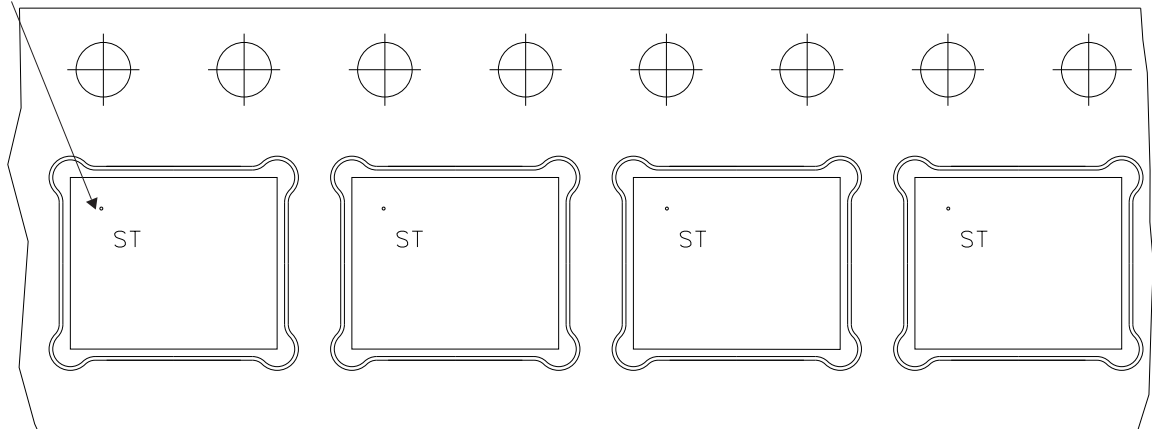
(III) Measured from centreline of sprocket hole to centreline of pocket

Base and bulk quantity 3000 pcs  
All dimensions are in millimeters

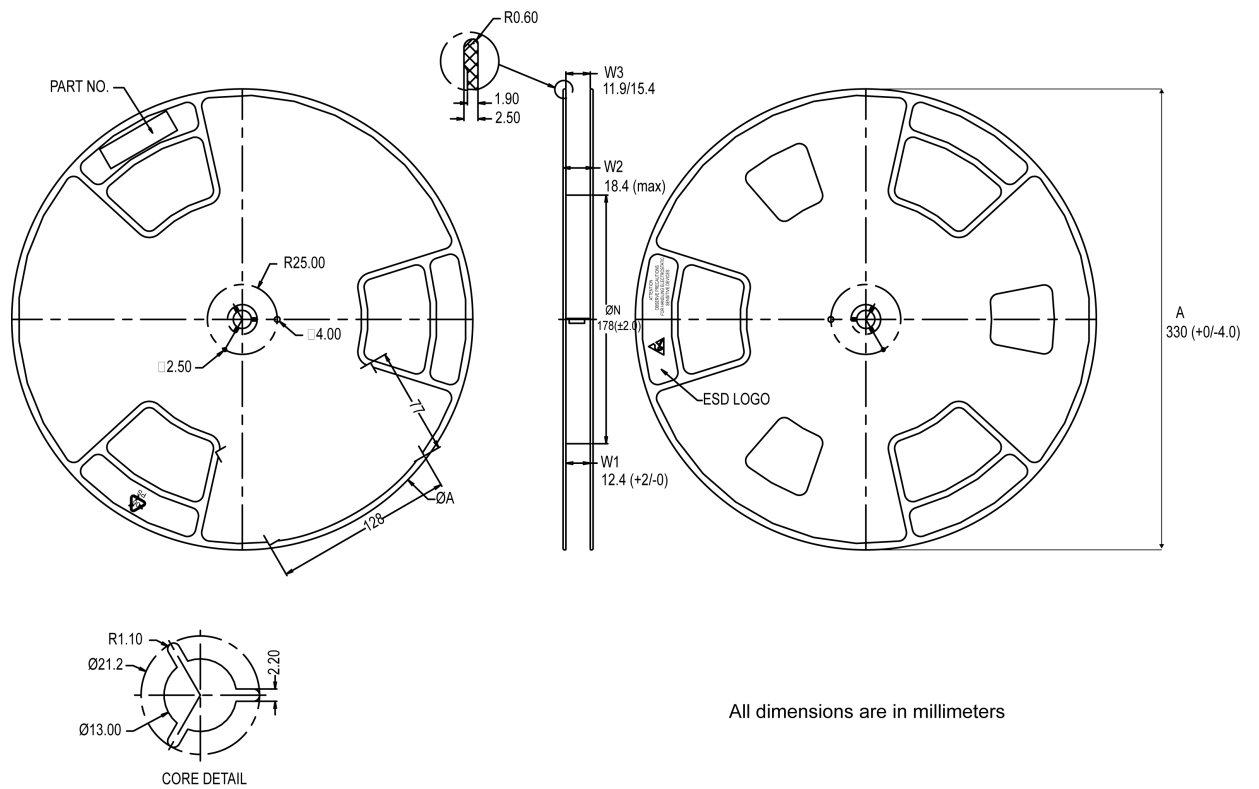
8234350\_Tape\_rev\_C

**Figure 20. PowerFLAT 5x6 package orientation in carrier tape**

Pin 1 identification



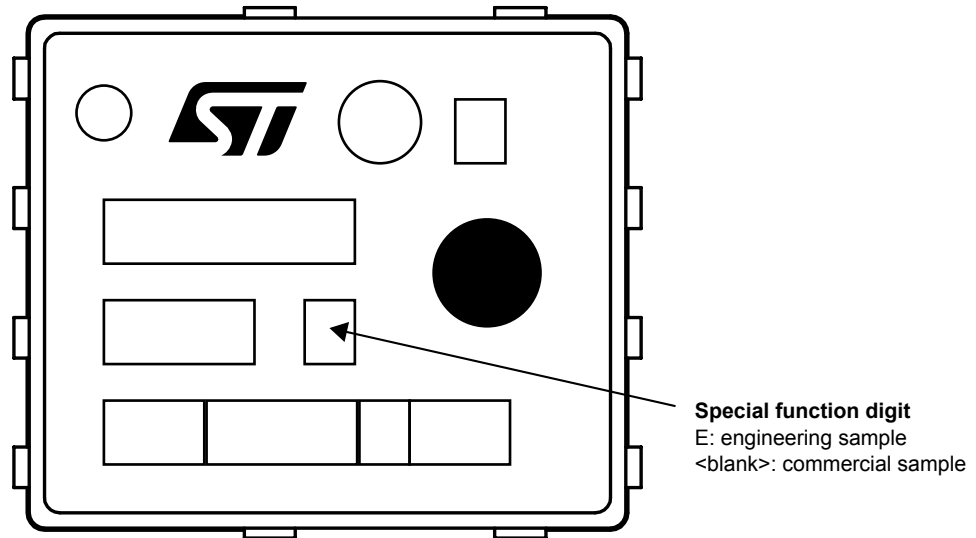
**Figure 21. PowerFLAT 5x6 reel**



8234350\_Reel\_rev\_C

### 3.3 PowerFLAT 5x6 marking information

Figure 22. PowerFLAT 5x6 marking information



**Note:** *Engineering Samples: these samples can be clearly identified by a dedicated special symbol in the marking of each unit. These samples are intended to be used for electrical compatibility evaluation only; usage for any other purpose may be agreed only upon written authorization by ST. ST is not liable for any customer usage in production and/or in reliability qualification trials.*

*Commercial Samples: fully qualified parts from ST standard production with no usage restrictions.*

## Revision history

**Table 8. Document revision history**

Date	Revision	Changes
17-Feb-2023	1	Initial release.
22-Mar-2024	2	<p>Updated <i>Applications and Description</i>.</p> <p>Modified <i>Table 1. Absolute maximum ratings (at <math>T_C = 25\text{ °C}</math> unless otherwise specified)</i>, <i>Table 2. Thermal data</i>, <i>Table 4. Dynamic</i>, <i>Table 5. Switching times</i> and <i>Table 6. Source-drain diode</i>.</p> <p>Added <i>Section 2.1: Electrical characteristics (curves)</i>.</p> <p>Updated <i>Section 3: Package information</i>.</p> <p>Minor text changes.</p>
26-Jul-2024	3	Update <i>Figure 3. Safe operating area</i> .

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