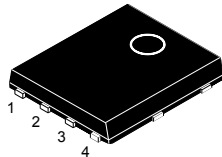
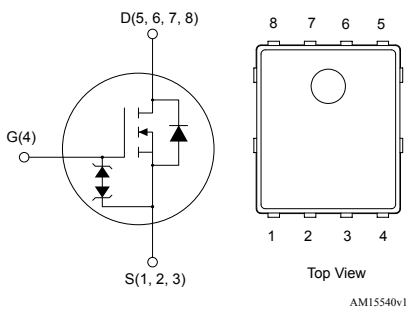


N-channel 600 V, 390 mΩ typ., 6.4 A MDmesh™ M6 Power MOSFET in a PowerFLAT™ 5x6 HV package


PowerFLAT™ 5x6 HV

Product status

STL12N60M6

Product summary

Order code	STL12N60M6
Marking	12N60M6
Package	PowerFLAT™ 5x6 HV
Packing	Tape and Reel

Features

Order code	$V_{DS} @ T_{Jmax}$	$R_{DS(on)}$ max.	I_D	P_{TOT}
STL12N60M6	650 V	490 mΩ	6.4 A	48 W

- Reduced switching losses
- Lower $R_{DS(on)}$ per area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications
- LLC converters
- Boost PFC converters

Description

The new MDmesh™ M6 technology incorporates the most recent advancements to the well-known and consolidated MDmesh family of SJ MOSFETs. STMicroelectronics builds on the previous generation of MDmesh devices through its new M6 technology, which combines excellent $R_{DS(on)}$ per area improvement with one of the most effective switching behaviors available, as well as a user-friendly experience for maximum end-application efficiency.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_{case} = 25\text{ }^\circ\text{C}$	6.4	A
	Drain current (continuous) at $T_{case} = 100\text{ }^\circ\text{C}$	4	
$I_{DM}^{(1)}$	Drain current (pulsed)	24	A
P_{TOT}	Total power dissipation at $T_{case} = 25\text{ }^\circ\text{C}$	48	W
$I_{AR}^{(2)}$	Avalanche current, repetitive or not repetitive	1.8	A
$E_{AS}^{(3)}$	Single pulse avalanche energy	130	mJ
$dv/dt^{(4)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(5)}$	MOSFET dv/dt ruggedness	100	
T_{stg}	Storage temperature range	-55 to 150	$^\circ\text{C}$
T_j	Operating junction temperature range		

1. Pulse width is limited by safe operating area.
2. Pulse width limited by T_{jmax} .
3. starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$.
4. $I_{SD} \leq 6.4\text{ A}$, $di/dt = 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.
5. $V_{DS} \leq 480\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	2.6	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50	

1. When mounted on a 1-inch² FR-4, 2 Oz copper board.

2 Electrical characteristics

($T_{\text{case}} = 25\text{ °C}$ unless otherwise specified)

Table 3. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$, $I_{\text{D}} = 1\text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 600\text{ V}$			1	μA
		$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 600\text{ V}$, $T_{\text{case}} = 125\text{ °C}$ ⁽¹⁾			100	
I_{GSS}	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$, $V_{\text{GS}} = \pm 25\text{ V}$			± 10	μA
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$, $I_{\text{D}} = 250\text{ }\mu\text{A}$	3.25	4	4.75	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$, $I_{\text{D}} = 3.2\text{ A}$		390	490	m Ω

1. Defined by design, not subject to production test.

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ISS}	Input capacitance	$V_{\text{DS}} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{\text{GS}} = 0\text{ V}$	-	452	-	μF
C_{OSS}	Output capacitance		-	39.4	-	
C_{RSS}	Reverse transfer capacitance		-	4.5	-	
$C_{\text{OSS eq.}}$ ⁽¹⁾	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }480\text{ V}$, $V_{\text{GS}} = 0\text{ V}$	-	85	-	μF
R_{G}	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_{\text{D}} = 0\text{ A}$	-	6	-	Ω
Q_{g}	Total gate charge	$V_{\text{DD}} = 480\text{ V}$, $I_{\text{D}} = 9\text{ A}$, $V_{\text{GS}} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	12.3	-	nC
Q_{gs}	Gate-source charge		-	3	-	
Q_{gd}	Gate-drain charge		-	6.5	-	

1. $C_{\text{OSS eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{OSS} when V_{DS} increases from 0 to 80% V_{DSS} .

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 300\text{ V}$, $I_{\text{D}} = 4.5\text{ A}$, $R_{\text{G}} = 4.7\text{ }\Omega$, $V_{\text{GS}} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	16.6	-	ns
t_{r}	Rise time		-	6.4	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	23.9	-	
t_{f}	Fall time		-	9.9	-	

Table 6. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		6.4	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		24	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 6.4\text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 9\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,	-	174		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	1.27		μC
I_{RRM}	Reverse recovery current		-	14.6		A
t_{rr}	Reverse recovery time	$I_{SD} = 9\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,	-	241		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	1.9		μC
I_{RRM}	Reverse recovery current		-	15.6		A

1. Pulse width is limited by safe operating area.
2. Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics curves

Figure 1. Safe operating area

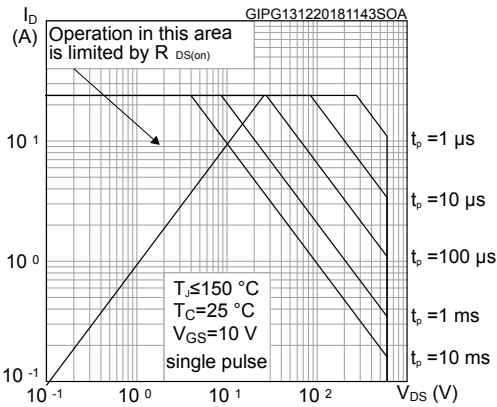


Figure 2. Thermal impedance

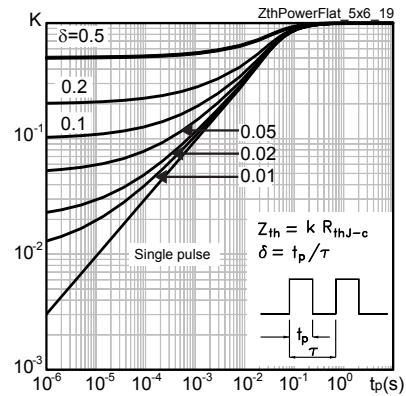


Figure 3. Output characteristics

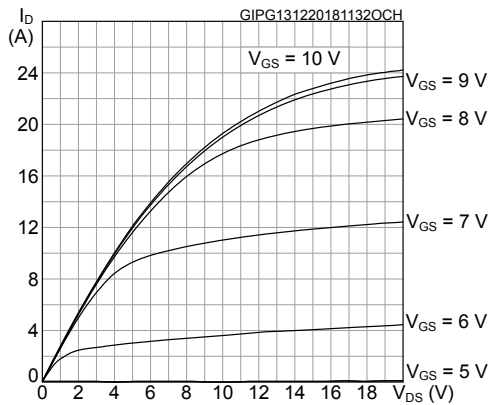


Figure 4. Transfer characteristics

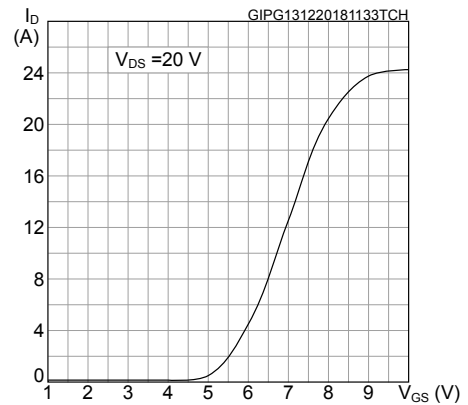


Figure 5. Gate charge vs gate-source voltage

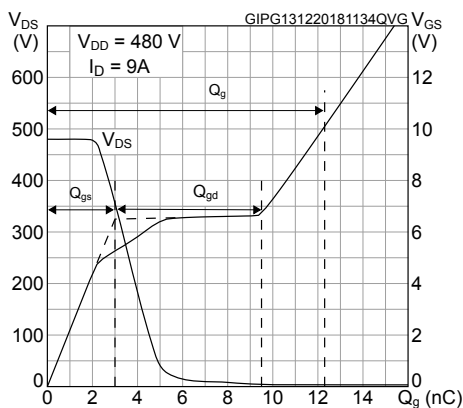


Figure 6. Static drain-source on-resistance

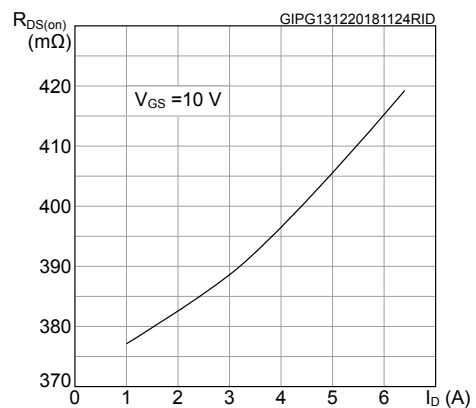


Figure 7. Capacitance variations

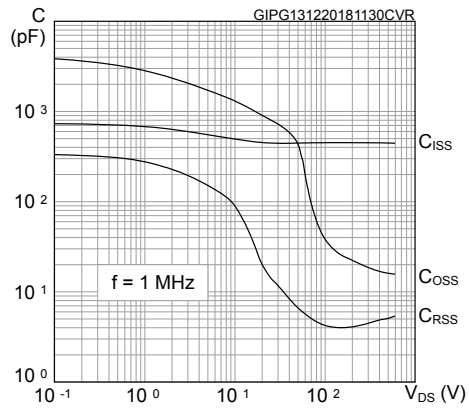


Figure 8. Output capacitance stored energy

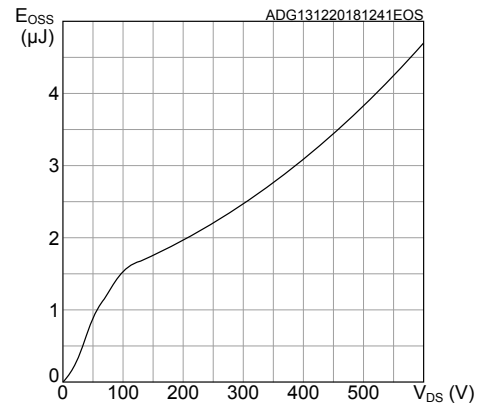


Figure 9. Normalized gate threshold voltage vs temperature

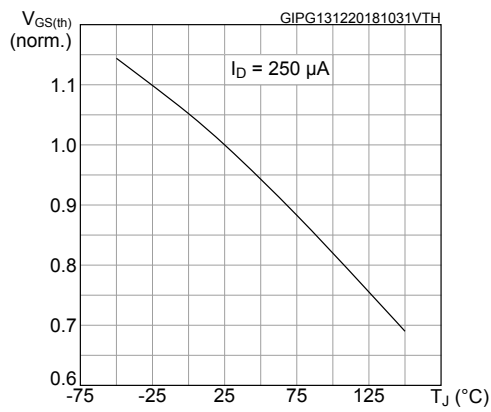


Figure 10. Normalized on-resistance vs temperature

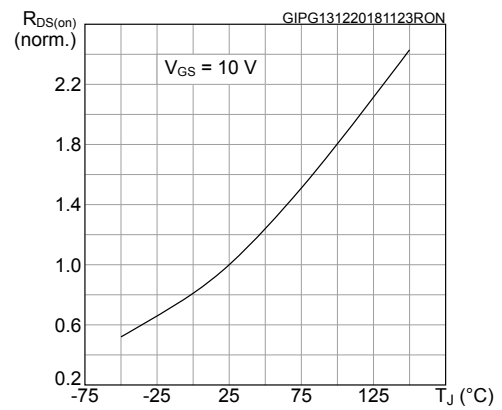


Figure 11. Normalized V(BR)DSS vs temperature

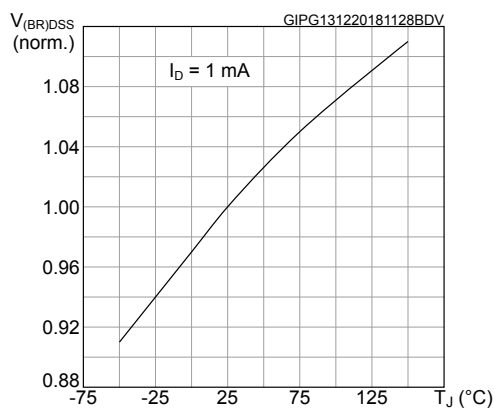
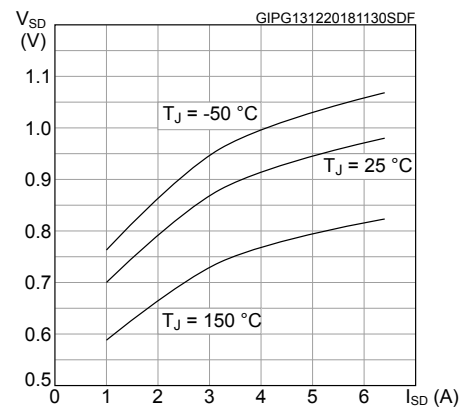
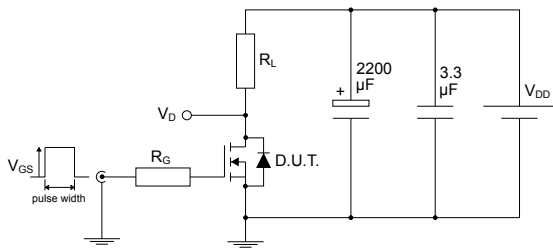


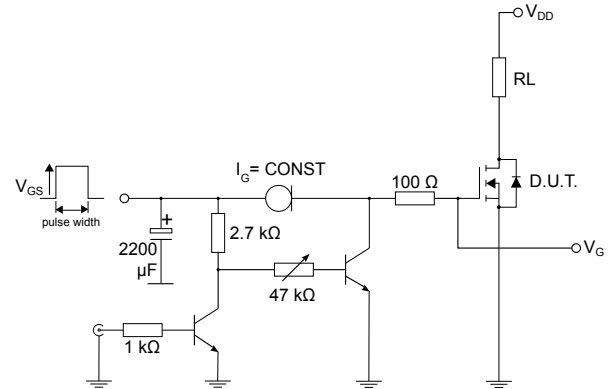
Figure 12. Source-drain diode forward characteristics



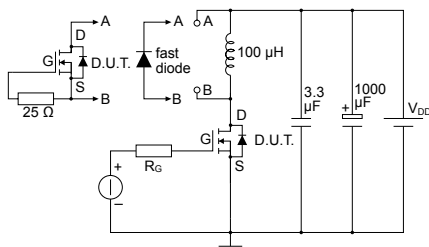
3 Test circuits

Figure 13. Test circuit for resistive load switching times


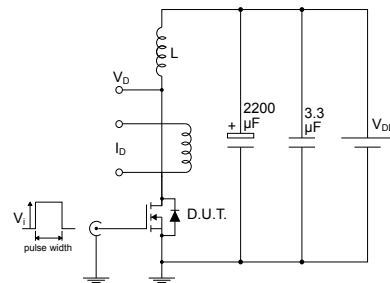
AM01468v1

Figure 14. Test circuit for gate charge behavior


AM01469v10

Figure 15. Test circuit for inductive load switching and diode recovery times


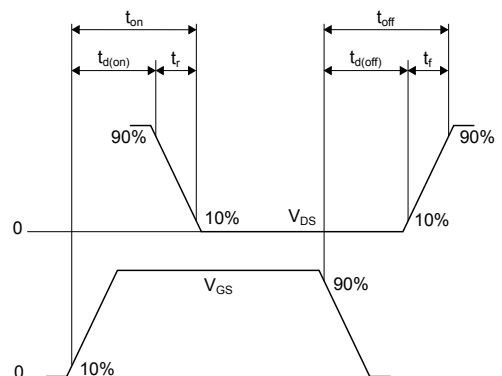
AM01470v1

Figure 16. Unclamped inductive load test circuit


AM01471v1

Figure 17. Unclamped inductive waveform


AM01472v1

Figure 18. Switching time waveform


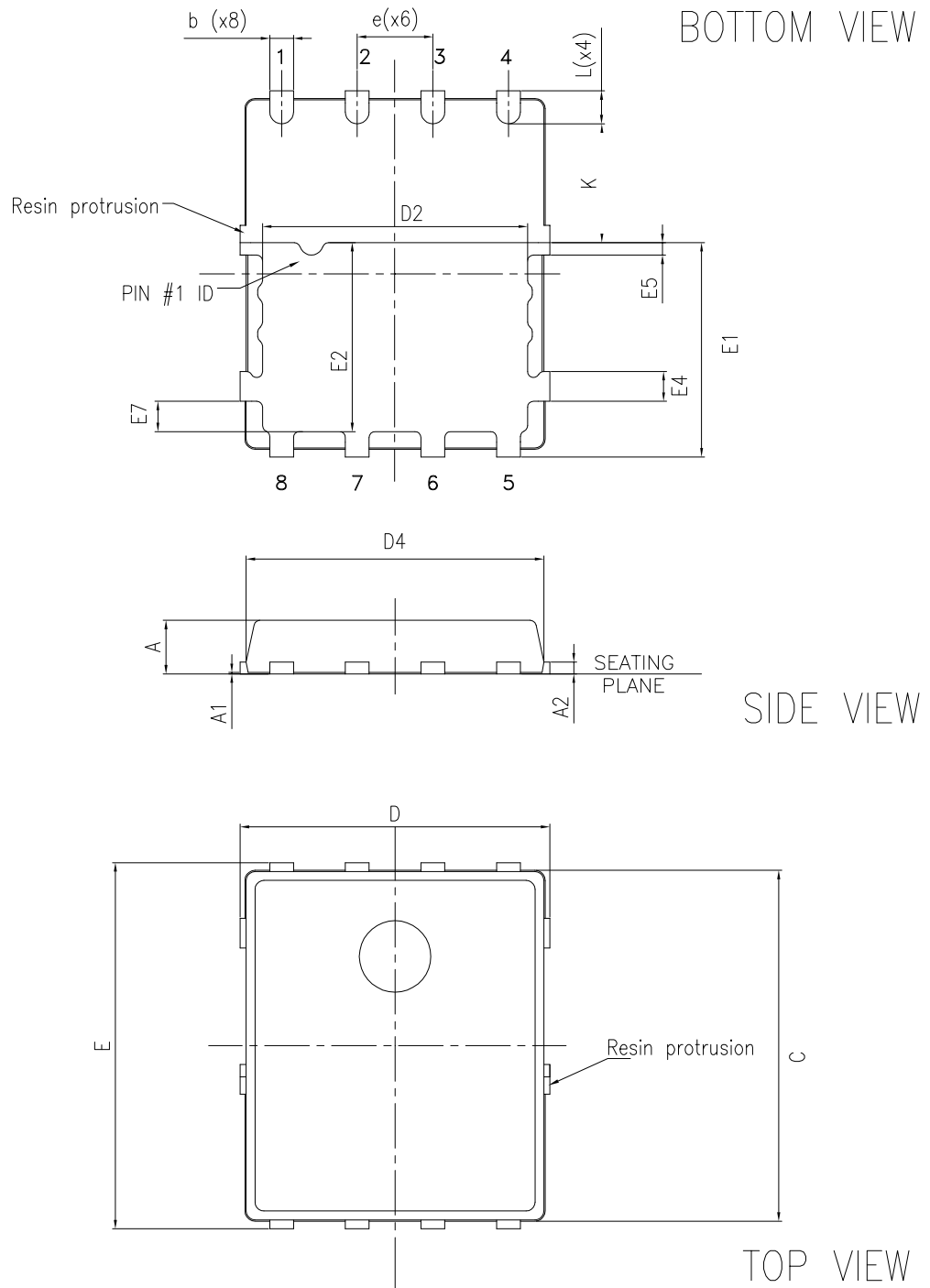
AM01473v1

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. ECOPACK® is an ST trademark.

4.1 PowerFLAT™ 5x6 HV package information

Figure 19. PowerFLAT™ 5x6 HV package outline

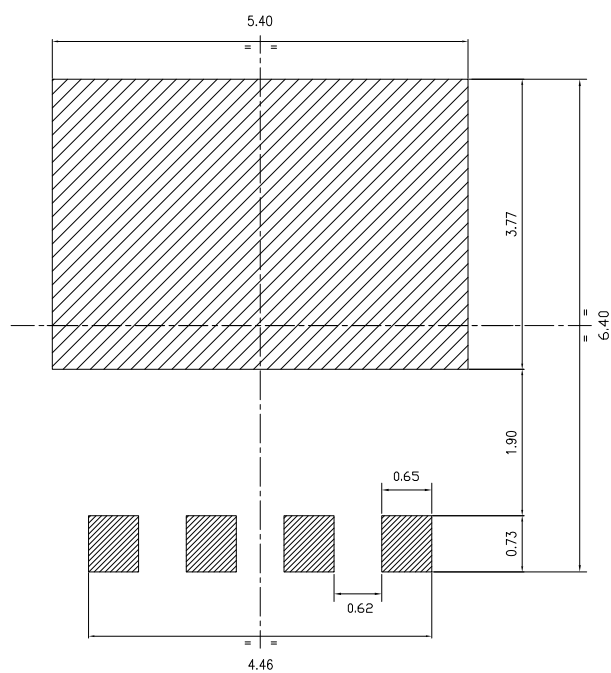


8368143_Rev_4

Table 7. PowerFLAT™ 5x6 HV mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.00
A1	0.02		0.05
A2		0.25	
b	0.30		0.50
C	5.60	5.80	6.00
D	5.10	5.20	5.30
D2	4.30	4.40	4.50
D4	4.60	4.80	5.00
E	6.05	6.15	6.25
E1	3.50	3.60	3.70
E2	3.10	3.20	3.30
E4	0.40	0.50	0.60
E5	0.10	0.20	0.30
E7	0.40	0.50	0.60
e		1.27	
L	0.50	0.55	0.60
K	1.90	2.00	2.10

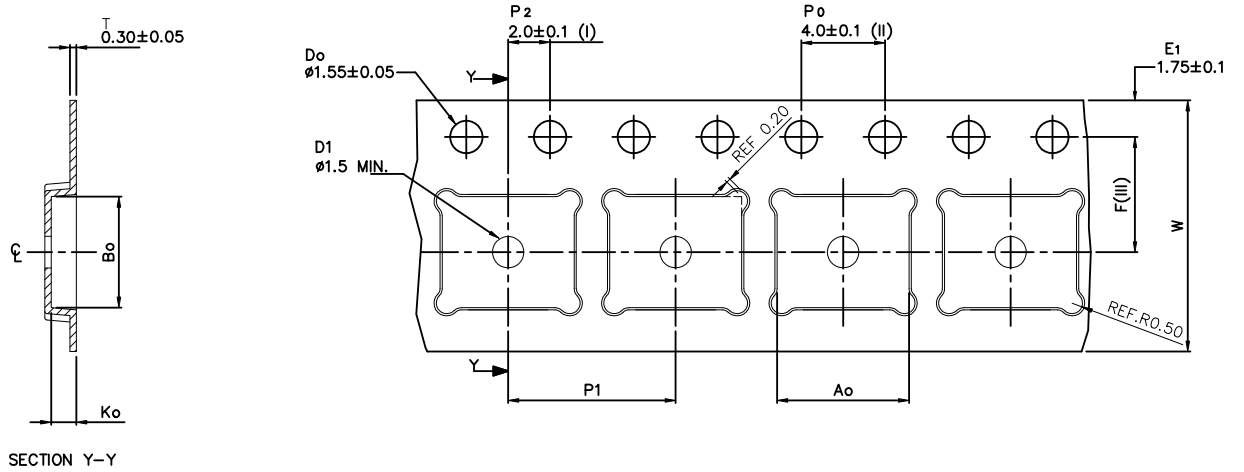
Figure 20. PowerFLAT™ 5x6 HV recommended footprint (dimensions are in mm)



8368143_Rev_4_footprint

4.2 PowerFLAT™ 5x6 packing information

Figure 21. PowerFLAT™ 5x6 tape (dimensions are in mm)



A_0	6.30 ± 0.1
B_0	5.30 ± 0.1
K_0	1.20 ± 0.1
F	5.50 ± 0.1
P_1	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 ± 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 22. PowerFLAT™ 5x6 package orientation in carrier tape

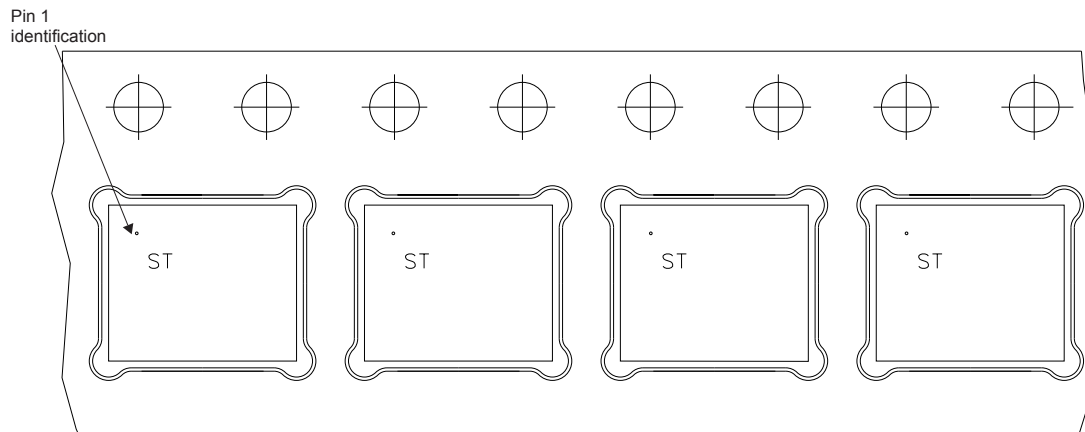
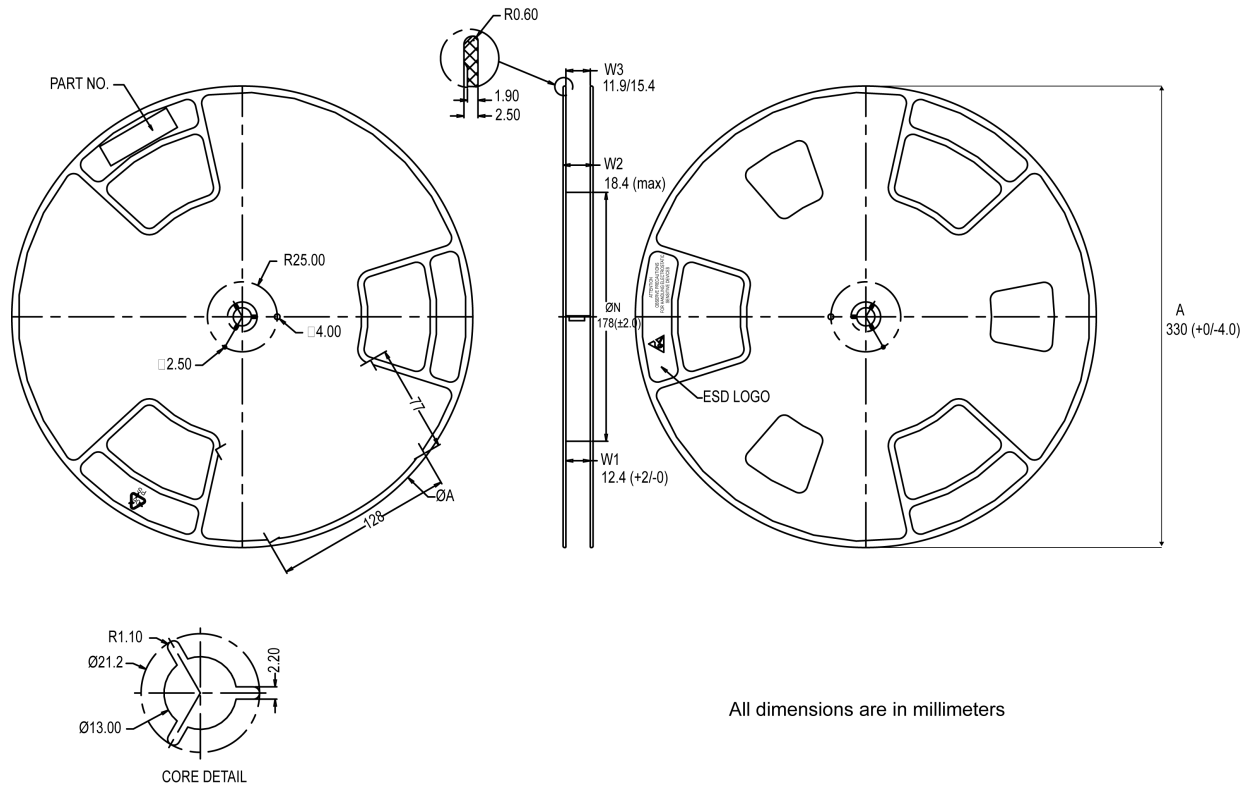


Figure 23. PowerFLAT™ 5x6 reel



All dimensions are in millimeters

8234350_Reel_rev_C

Revision history

Table 8. Document revision history

Date	Revision	Changes
13-Jan-2019	1	First release.

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4	Package information	8
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