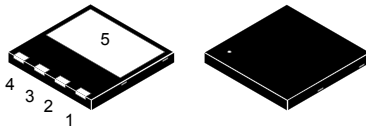
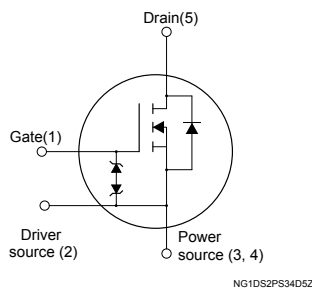


## N-channel 600 V, 70 mΩ typ., 31 A MDmesh™ M6 Power MOSFET in a PowerFLAT™ 8x8 HV package


**PowerFLAT™ 8x8 HV**

**Product status link**
[STL47N60M6](#)
**Product summary**

<b>Order code</b>	STL47N60M6
<b>Marking</b>	47N60M6
<b>Package</b>	PowerFLAT™ 8x8 HV
<b>Packing</b>	Tape and reel

### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STL47N60M6	600 V	82 mΩ	31 A

- Reduced switching losses
- Lower R<sub>DS(on)</sub> x area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected
- Excellent switching performance thanks to the extra driving source pin

### Applications

- Switching applications

### 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<sub>DS(on)</sub> 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 $T_C = 25\text{ °C}$	31	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ °C}$	20	A
$I_{DM}^{(1)}$	Drain current (pulsed)	124	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	190	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	100	V/ns
$T_{stg}$	Storage temperature range	-55 to 150	°C
$T_j$	Operating junction temperature range		

1. Pulse width is limited by safe operating area.
2.  $I_{SD} \leq 31\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS(peak)} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$
3.  $V_{DS} \leq 480\text{ V}$

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.66	°C/W
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50	°C/W

1. When mounted on 1 inch<sup>2</sup> FR-4, 2 Oz copper board

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$ )	5.3	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	800	mJ

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			100	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 5$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 15.5\text{ A}$		70	82	$\text{m}\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	2340	-	$\text{pF}$
$C_{oss}$	Output capacitance		-	149	-	$\text{pF}$
$C_{riss}$	Reverse transfer capacitance		-	3.7	-	$\text{pF}$
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }480\text{ V}$ , $V_{GS} = 0\text{ V}$	-	390	-	$\text{pF}$
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	1.4	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}$ , $I_D = 36\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	52.2	-	$\text{nC}$
$Q_{gs}$	Gate-source charge		-	16.5	-	$\text{nC}$
$Q_{gd}$	Gate-drain charge		-	23	-	$\text{nC}$

1.  $C_{oss\text{ eq.}}$  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 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$ , $I_D = 18\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 13. Switching times test circuit for resistive load and Figure 18. Switching time waveform)	-	21.5	-	ns
$t_r$	Rise time		-	18.7	-	ns
$t_{d(off)}$	Turn-off delay time		-	54.6	-	ns
$t_f$	Fall time		-	8.1	-	ns

**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Source-drain current		-		31	A
$I_{SDM}^{(2)(1)}$	Source-drain current (pulsed)		-		124	A
$V_{SD}^{(3)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 31\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 36\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	281		ns
$Q_{rr}$	Reverse recovery charge		-	3.67		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	26.1		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 36\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	424		ns
$Q_{rr}$	Reverse recovery charge		-	7.2		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	34		A

1. This value is limited by package.
2. Pulse width is limited by safe operating area.
3. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

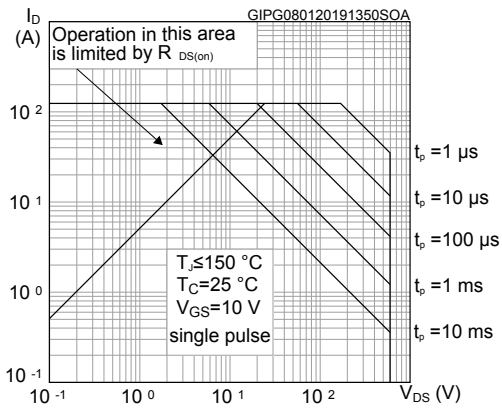


Figure 2. Thermal impedance

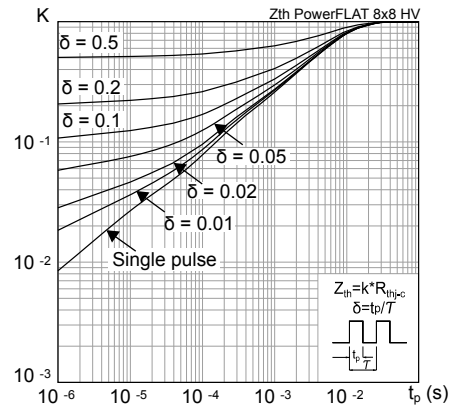


Figure 3. Output characteristics

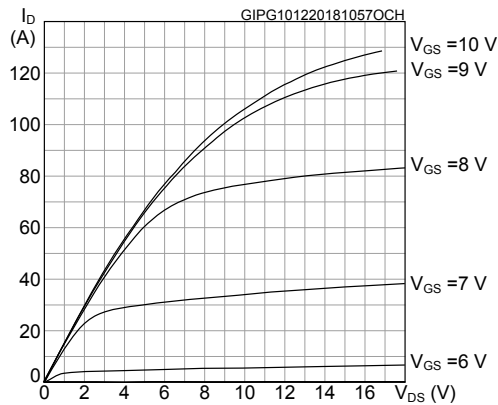


Figure 4. Transfer characteristics

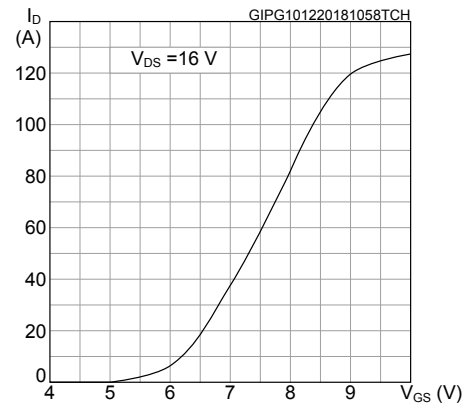


Figure 5. Gate charge vs gate-source voltage

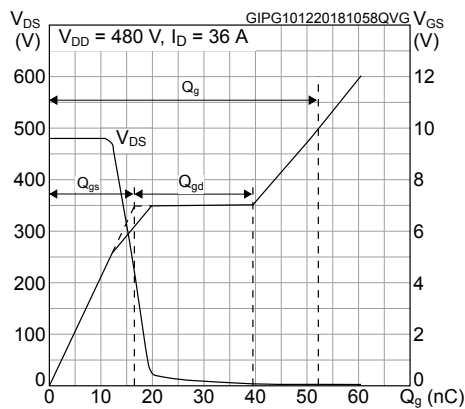


Figure 6. Static drain-source on-resistance

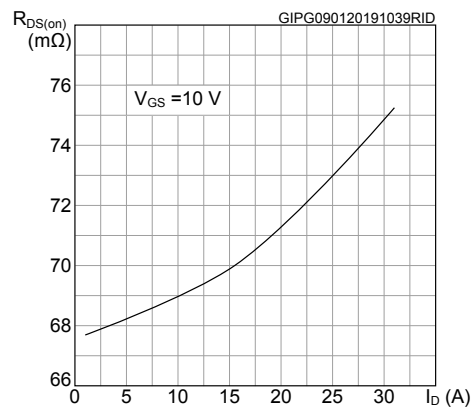


Figure 7. Capacitance variations

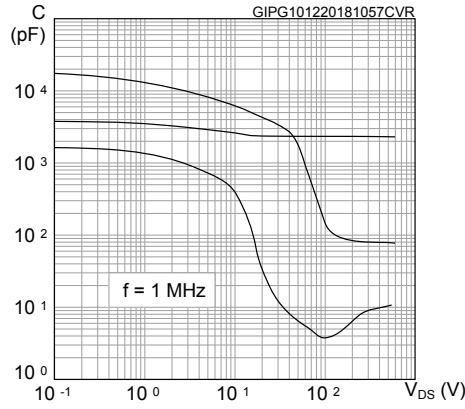


Figure 8. Normalized gate threshold voltage vs temperature

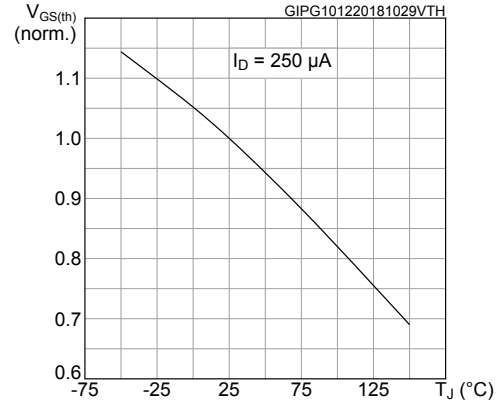


Figure 9. Normalized on-resistance vs temperature

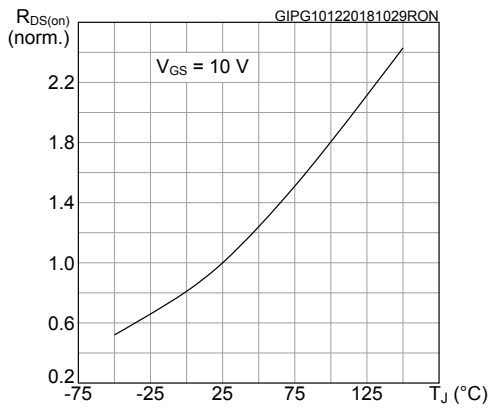


Figure 10. Normalized  $V_{(BR)DSS}$  vs temperature

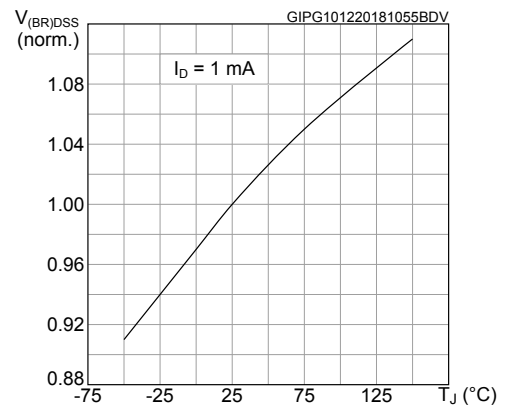


Figure 11. Output capacitance stored energy

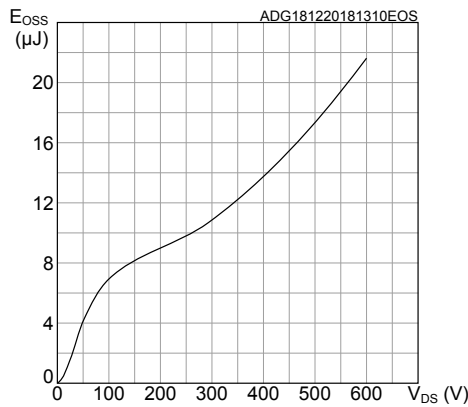
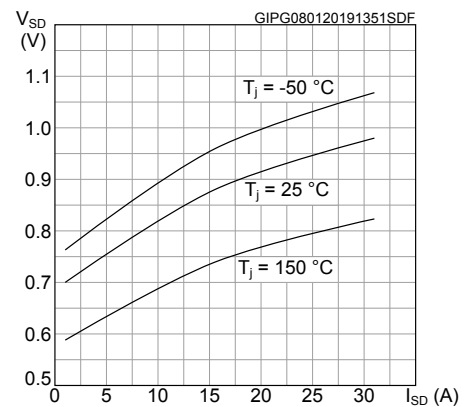
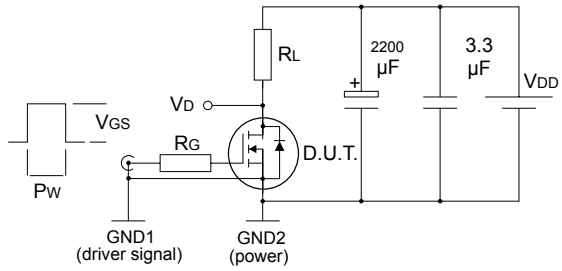


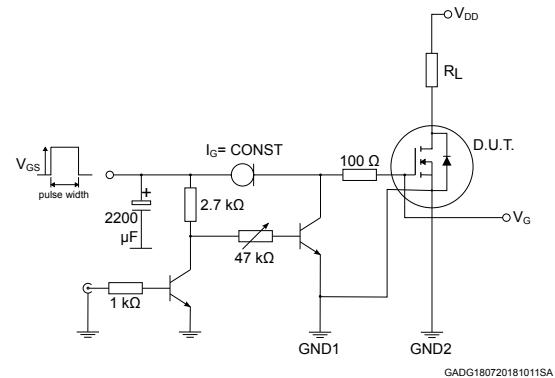
Figure 12. Source-drain diode forward characteristics



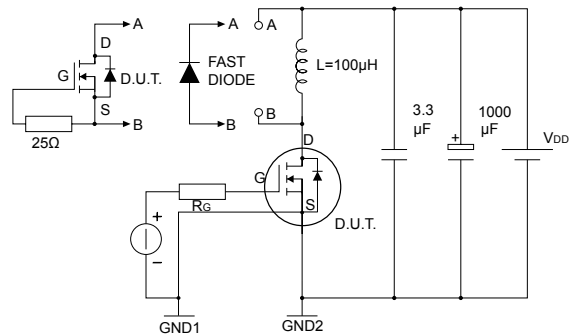
### 3 Test circuits

**Figure 13. Switching times test circuit for resistive load**


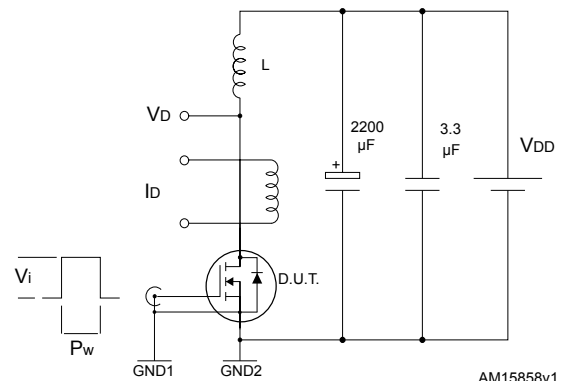
AM15855v1

**Figure 14. Test circuit for gate charge behavior**


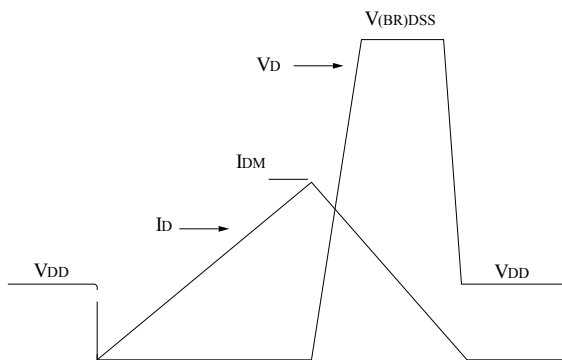
GADG180720181011SA

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


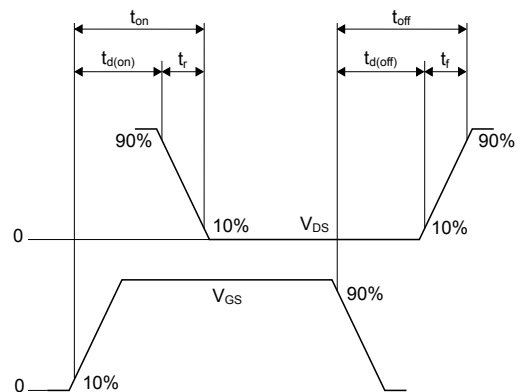
AM15857v1

**Figure 16. Unclamped inductive load test circuit**


AM15858v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


AM01473v1

## 4 Package information

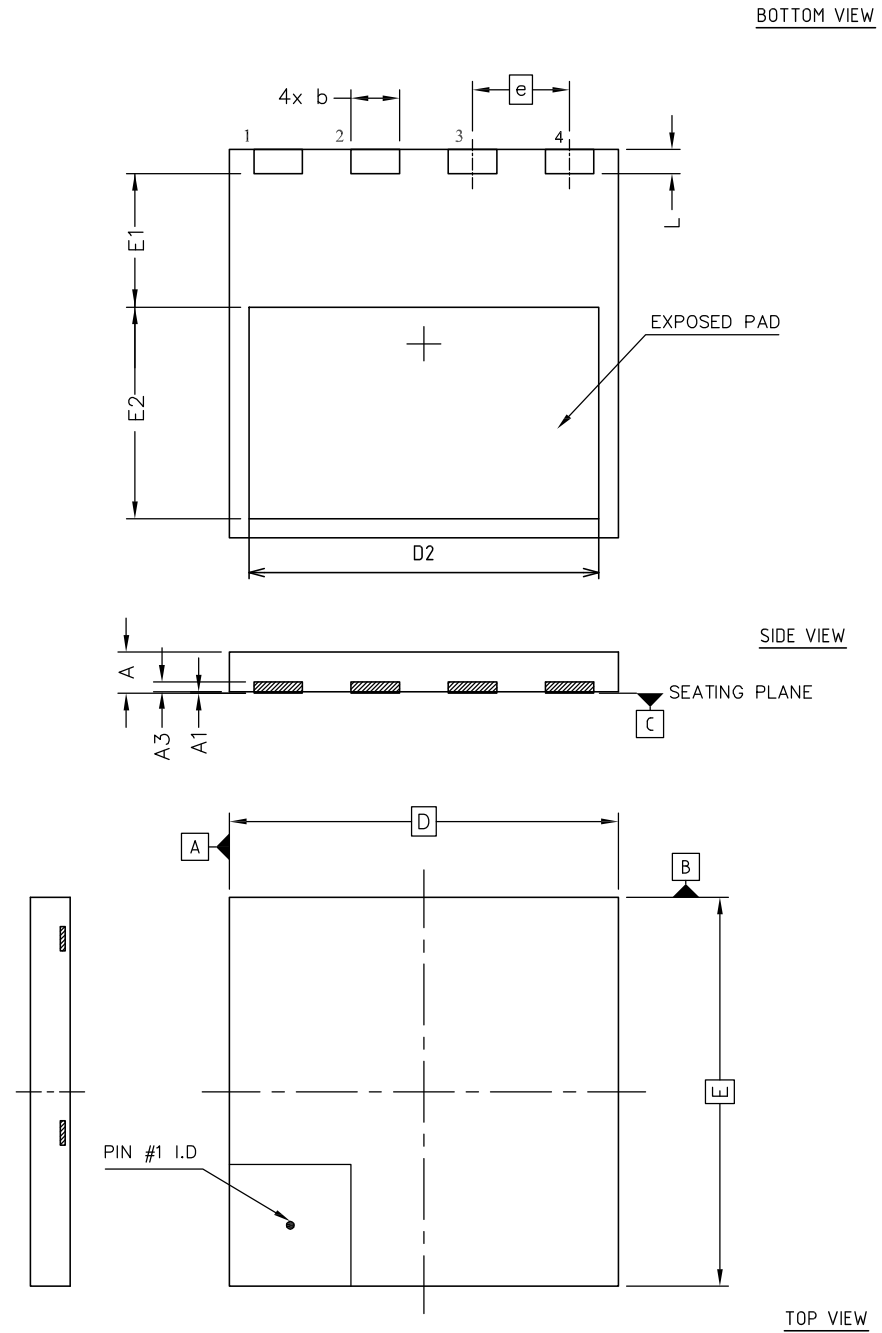
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In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK®** packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.



## 4.1 PowerFLAT™ 8x8 HV package information

Figure 19. PowerFLAT™ 8x8 HV package outline

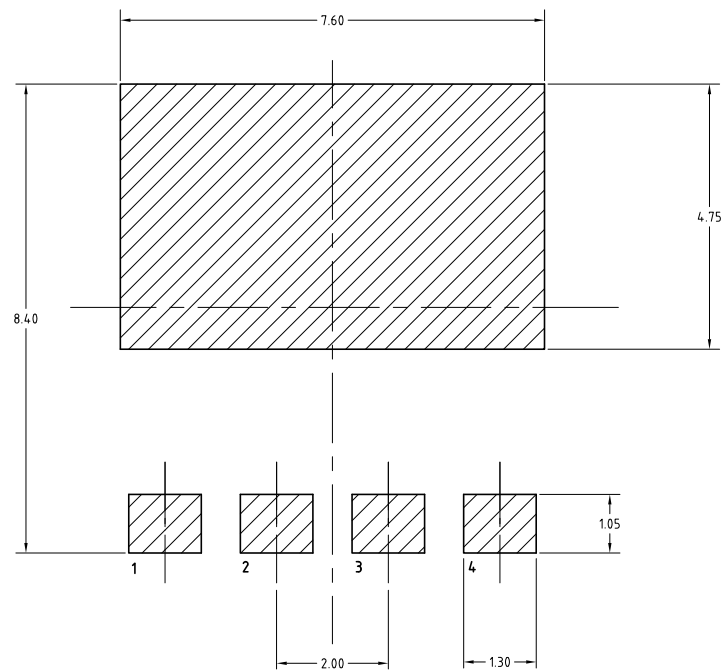


8222871\_Rev\_4

**Table 8. PowerFLAT™ 8x8 HV mechanical data**

Ref.	Dimensions (in mm)		
	Min.	Typ.	Max.
A	0.75	0.85	0.95
A1	0.00		0.05
A3	0.10	0.20	0.30
b	0.90	1.00	1.10
D	7.90	8.00	8.10
E	7.90	8.00	8.10
D2	7.10	7.20	7.30
E1	2.65	2.75	2.85
E2	4.25	4.35	4.45
e	2.00 BSC		
L	0.40	0.50	0.60

**Figure 20. PowerFLAT™ 8x8 HV footprint**

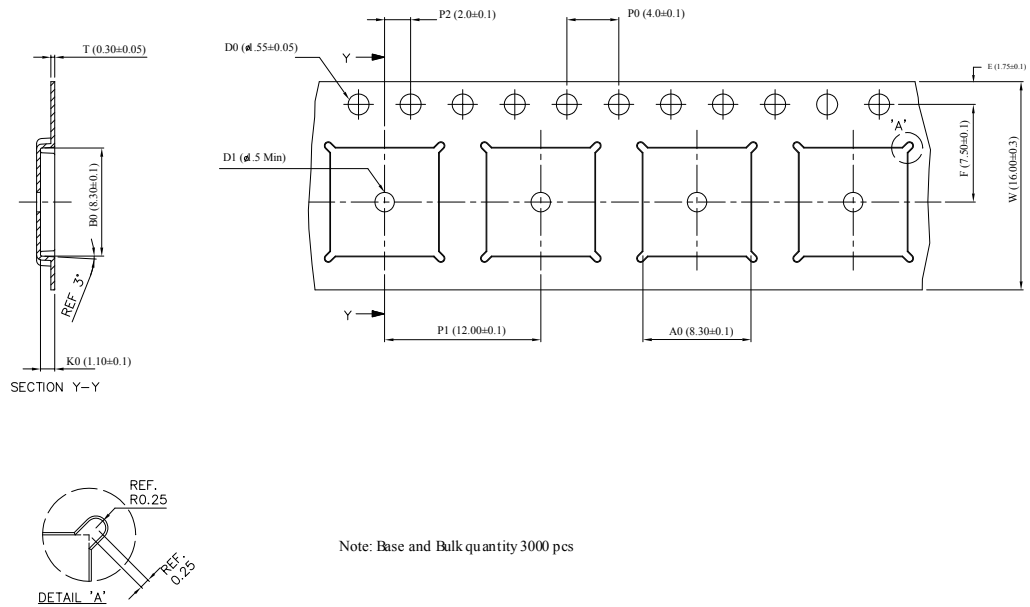


8222871\_REV\_4\_footprint

*Note: All dimensions are in millimeters.*

## 4.2 PowerFLAT™ 8x8 HV packing information

Figure 21. PowerFLAT™ 8x8 HV tape



8229819\_Tape\_revA

Note: All dimensions are in millimeters.

Figure 22. PowerFLAT™ 8x8 HV package orientation in carrier tape

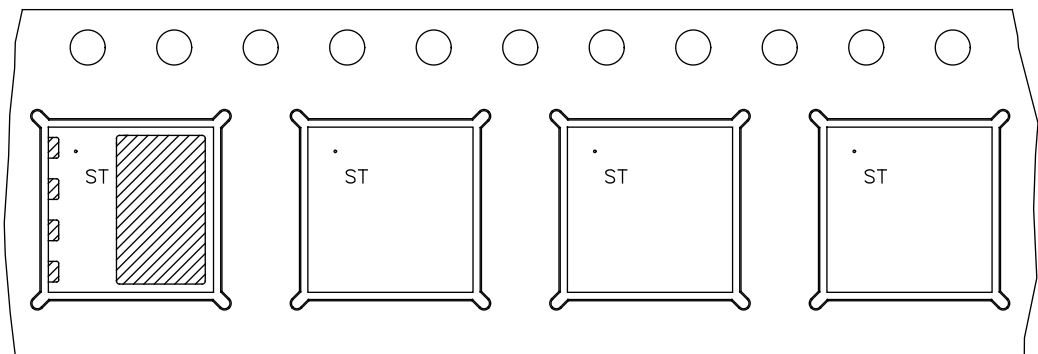
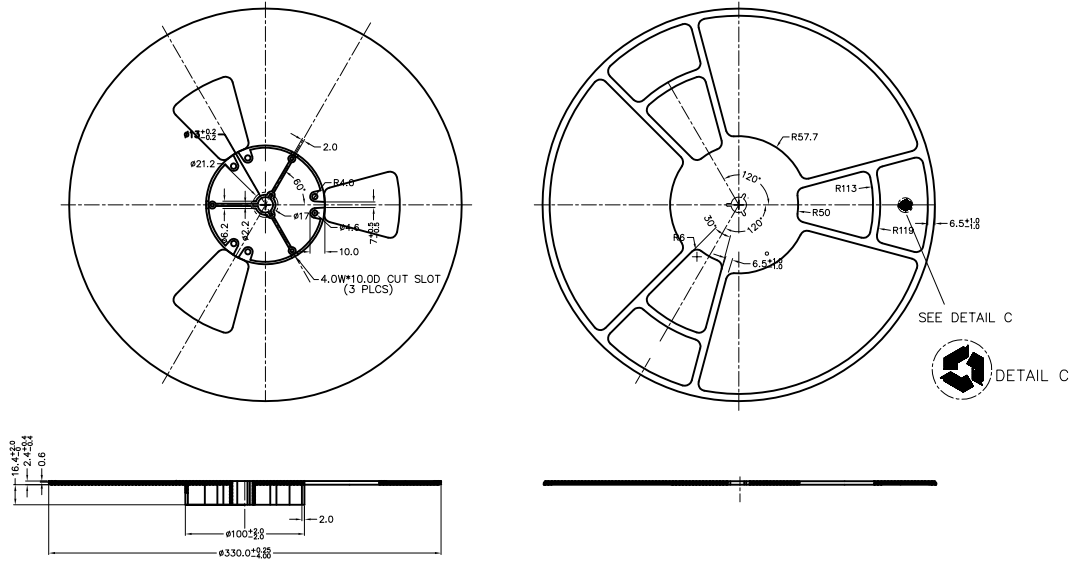


Figure 23. PowerFLAT™ 8x8 HV reel



8229819\_Reel\_revA

Note: All dimensions are in millimeters.

## Revision history

**Table 9. Document revision history**

Date	Revision	Changes
15-Nov-2017	1	First release
22-Jan-2019	2	Modified <a href="#">Table 1. Absolute maximum ratings</a> , <a href="#">Table 2. Thermal data</a> , <a href="#">Table 3. Avalanche characteristics</a> , <a href="#">Table 4. On/off states</a> , <a href="#">Table 5. Dynamic</a> , <a href="#">Table 6. Switching times</a> and <a href="#">Table 7. Source-drain diode</a> . Added <a href="#">Section 2.1 Electrical characteristics (curves)</a> . Modified <a href="#">Section 3 Test circuits</a> . Minor text changes.

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