N-channel 600 V, 0.115 Ω typ., 21 A MDmesh™ M6 Power MOSFET in a PowerFLAT™ 8x8 HV package
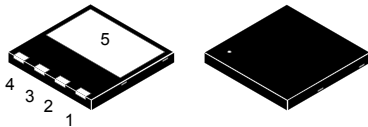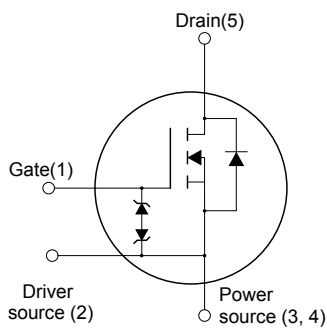

PowerFLAT™ 8x8 HV

NG1DS2PS34D5Z

Product status link
STL33N60M6

Product summary	
Order code	STL33N60M6
Marking	33N60M6
Package	PowerFLAT™ 8x8 HV
Packing	Tape and reel

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STL33N60M6	600 V	137 mΩ	21 A

- 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.

DS12638 - **Rev 3** - August 2018
For further information contact your local STMicroelectronics sales office.

www.st.com

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 °C	21	A
	Drain current (continuous) at T_{case} = 100 °C	13	
I_{DM}[1]	Drain current (pulsed)	78	A
P_{TOT}	Total dissipation at T_{case} = 25 °C	150	W
dv/dt[2]	Peak diode recovery voltage slope	15	V/ns
dv/dt[3]	MOSFET dv/dt ruggedness	50	
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.   *$I_{SD} ≤ 21 A$, di/dt = 400 A/µs, $V_{DS} < V_{(BR)DSS}$, V_{DD} = 400 V*

3.   *$V_{DS} ≤ 480 V$*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.83	°C/W
$R_{thj-pcb}$ [1]	Thermal resistance junction-pcb	45	°C/W

1.   *When mounted on FR-4 board of inch², 2oz Cu.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_{Jmax})	4	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, $I_D = I_{AR}$, V_{DD} = 50 V)	500	mJ

2 Electrical characteristics

(T_{case} = 25 °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 V, I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_{case} = 125 °C[1]			100	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±5	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 10.5 A		0.115	0.137	Ω

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 V, f = 1 MHz, V_{GS} = 0 V	-	1515	-	pF
C_{oss}	Output capacitance		-	128	-	
C_{rss}	Reverse transfer capacitance		-	4.2	-	
$C_{oss\ eq.}$[1]	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	269	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	1.5	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 25 A,	-	33.4	-	nC
Q_{gs}	Gate-source charge	V_{GS} = 0 to 10 V	-	7.2	-	
Q_{gd}	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior)	-	16.3	-	

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 12.5 A,	-	19.5	-	ns
t_r	Rise time	R_G = 4.7 Ω, V_{GS} = 10 V	-	33	-	
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Switching times test circuit for resistive load and Figure 18. Switching time waveform)	-	38.5	-	
t_f	Fall time		-	7.5	-	

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		21	A
I_{SDM} [1]	Source-drain current (pulsed)		-		78	A
V_{SD} [2]	Forward on voltage	I_{SD} = 21 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 25 A, di/dt = 100 A/µs,	-	265		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V	-	3.07		µC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	23.2		A
t_{rr}	Reverse recovery time	I_{SD} = 25 A, di/dt = 100 A/µs, V_{DD} = 60 V,	-	374		ns
Q_{rr}	Reverse recovery charge	T_j = 150 °C	-	5.78		µC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	30.9		A

1. *Pulse width is limited by safe operating area.*

2. *Pulsed: pulse duration = 300 µs, duty cycle 1.5%*

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area
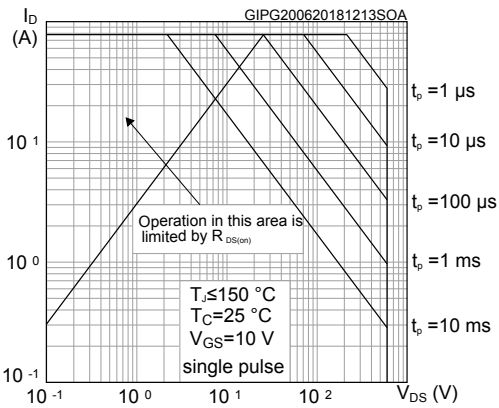
Figure 2. Thermal impedance
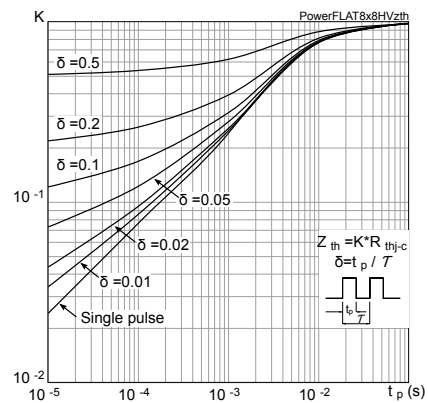
Figure 3. Output characteristics
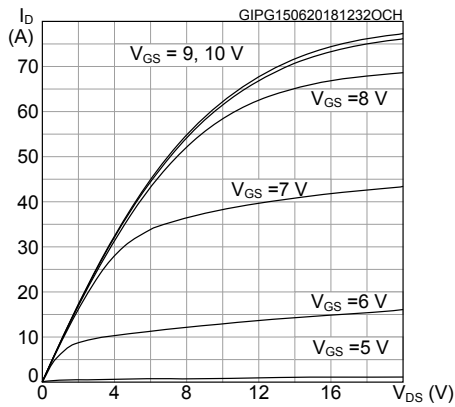
Figure 4. Transfer characteristics
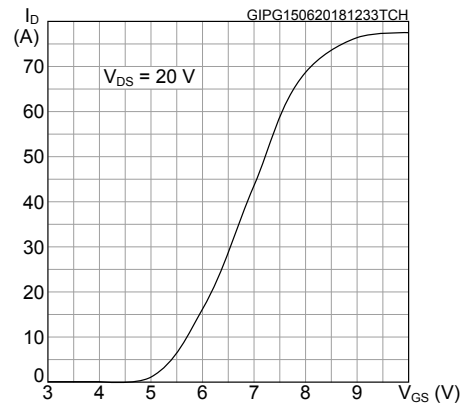
Figure 5. Gate charge vs gate-source voltage
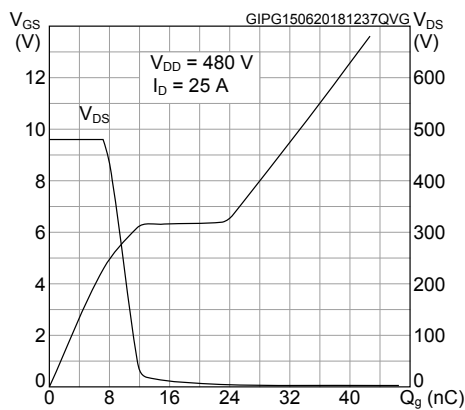
Figure 6. Static drain-source on-resistance
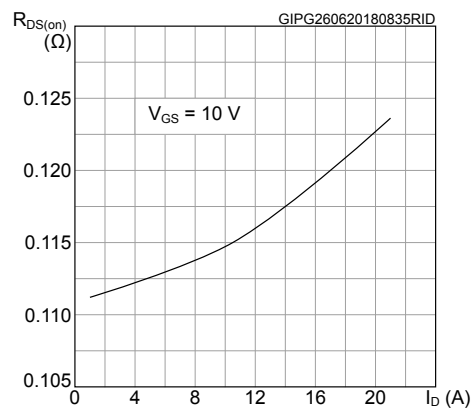
Figure 7. Capacitance variations
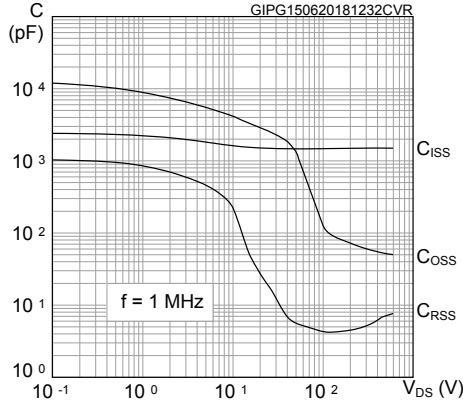
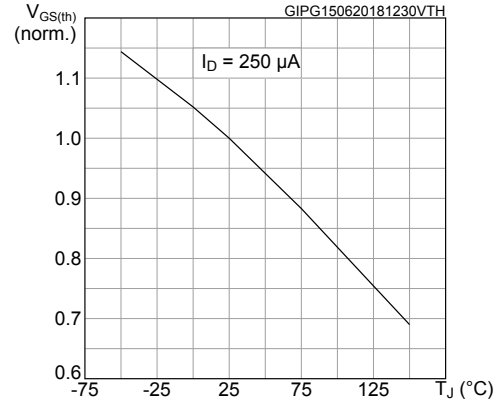### Figure 8. Normalized gate threshold voltage vs temperature
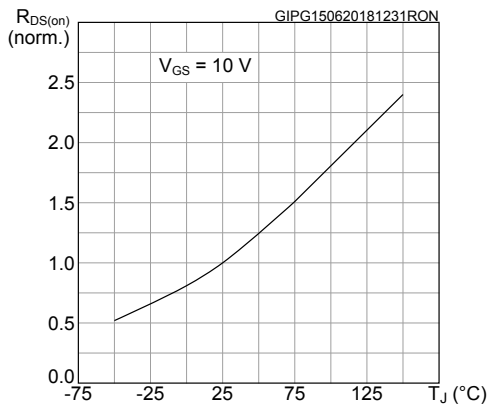

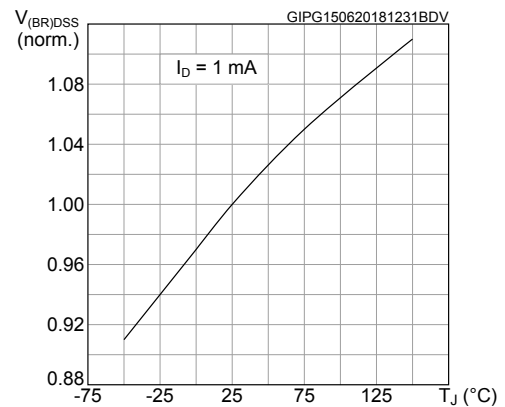### Figure 9. Normalized on-resistance vs temperature

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


Figure 11. Output capacitance stored energy
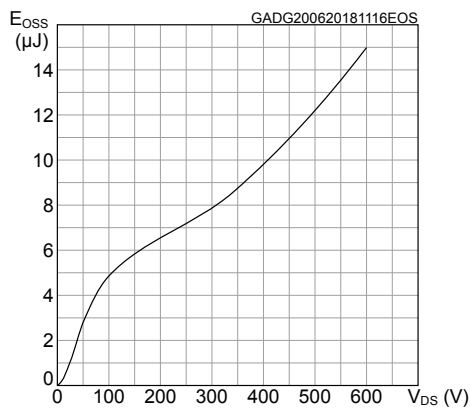
### Figure 12. Source-drain diode forward characteristics
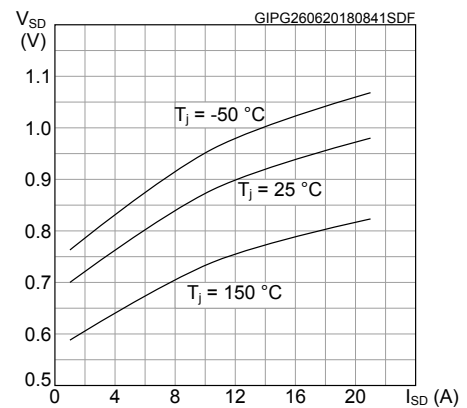
3   Test circuits

Figure 13. Switching times test circuit for resistive load
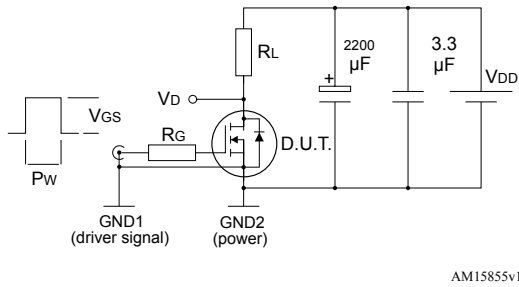
AM15855v1

Figure 14. Test circuit for gate charge behavior

GADG180720181011SA

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

AM15857v1
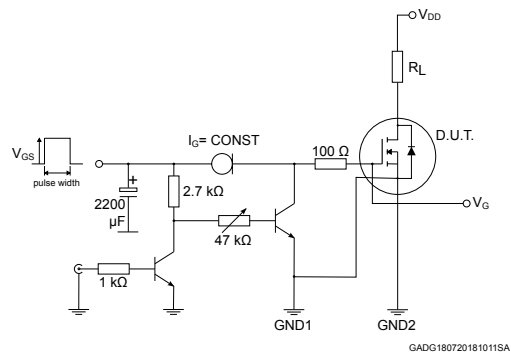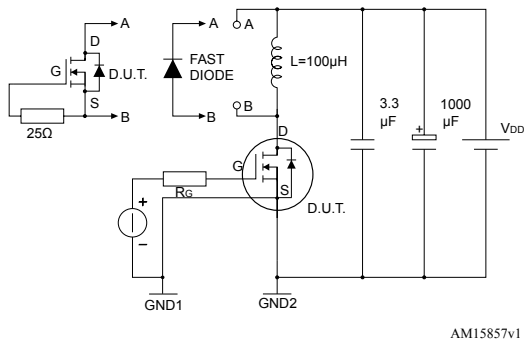
Figure 16.   Unclamped inductive load test circuit

AM15858v1
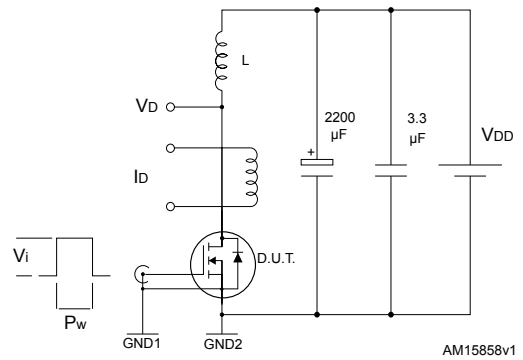
Figure 17. Unclamped inductive waveform

AM01472v1

Figure 18. Switching time waveform

AM01473v1
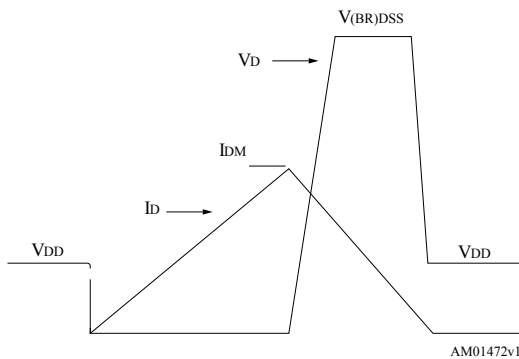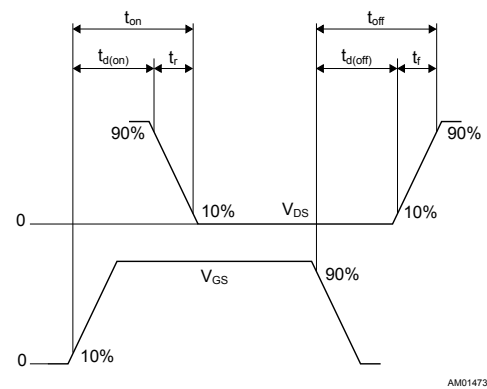
4 Package information

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™ 8x8 HV package information
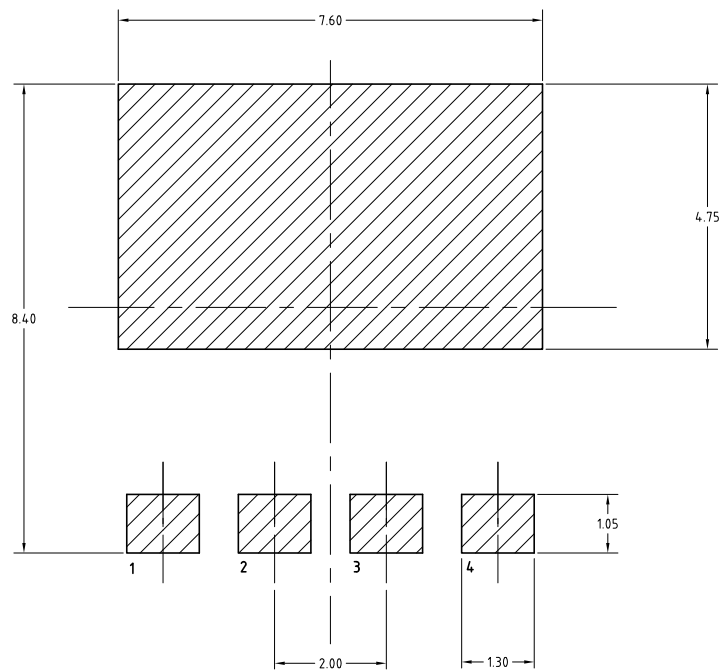
Figure 19. PowerFLAT™ 8x8 HV package outline
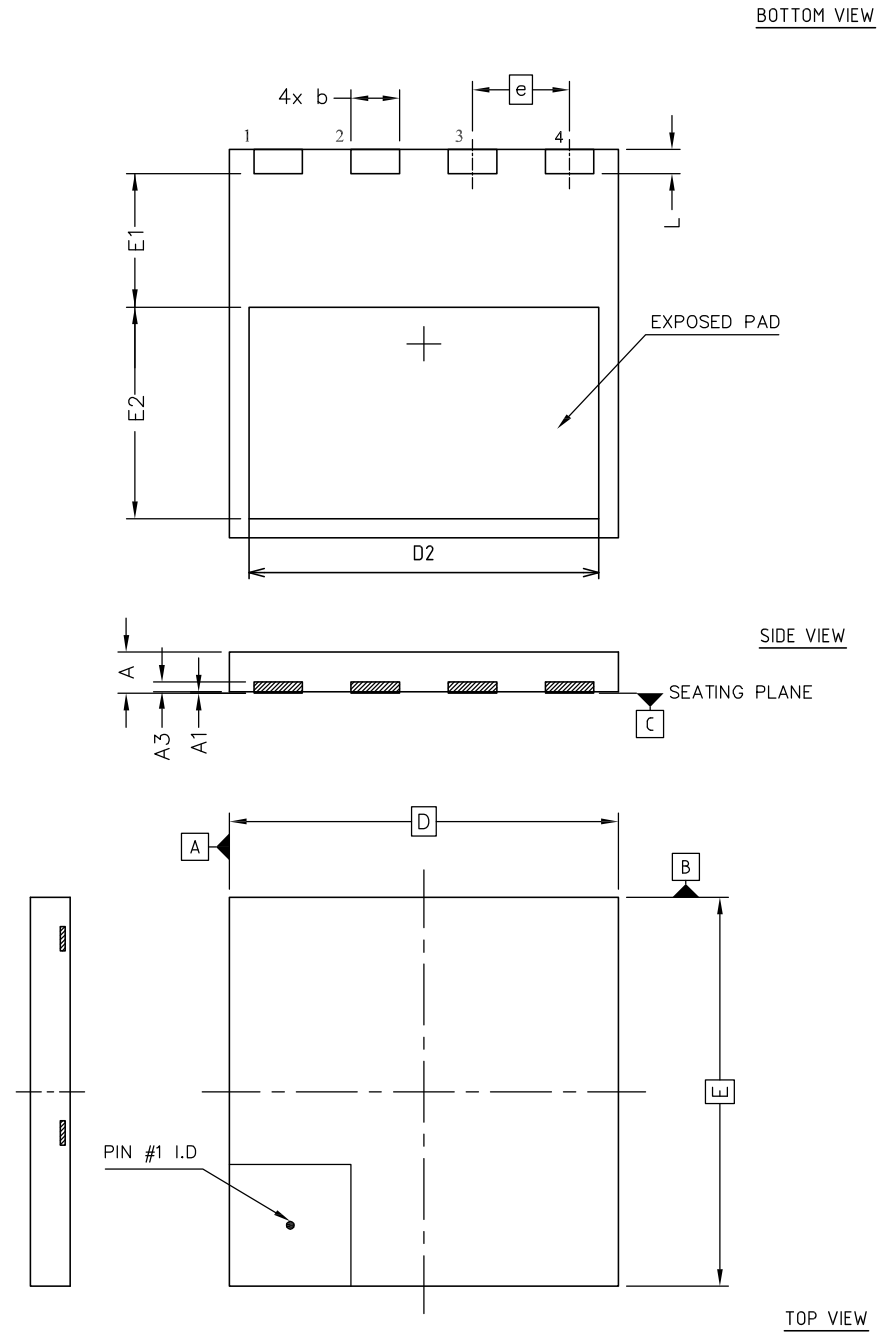
8222871_Rev_4

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
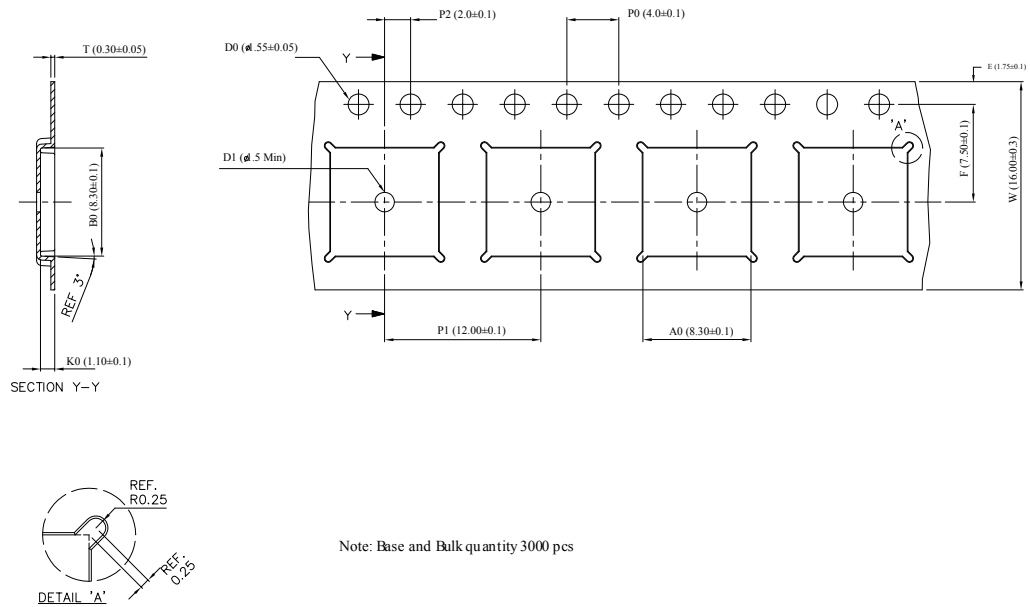
8229819_Tape_revA

Note: All dimensions are in millimeters.

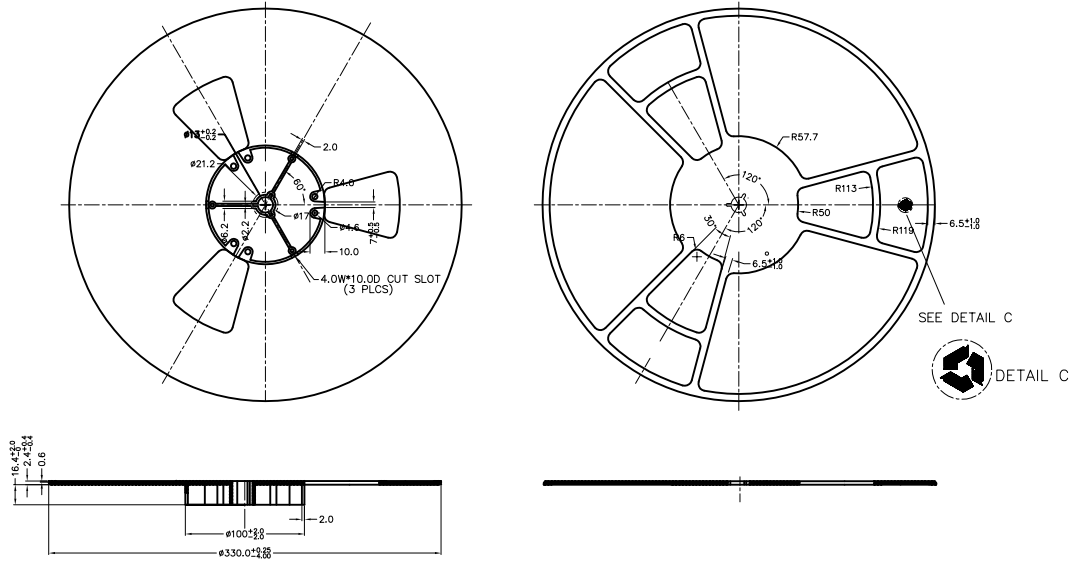**Figure 22. PowerFLAT™ 8x8 HV package orientation in carrier tape**
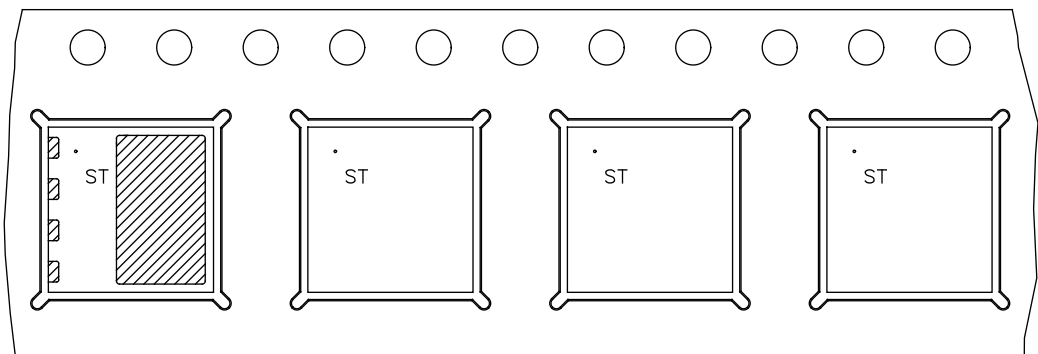
Figure 23. PowerFLAT™ 8x8 HV reel

8229819_Reel_revA

Note: All dimensions are in millimeters.

Revision history

Table 9. Document revision history

Date	Version	Changes
02-Jul-2018	1	Initial release.
18-Jul-2018	2	Modified Section 3 Test circuits. Minor text changes.
02-Aug-2018	3	Updated features in cover page.

Contents

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