



STL45N65M5

N-channel 650 V, 0.075 Ω typ., 22.5 A MDmesh™ V
Power MOSFET in PowerFLAT™ 8x8 HV package

Datasheet — preliminary data

Features

Order code	V _{DSS} @ T _{Jmax}	R _{DS(on)} max	I _D
STL45N65M5	710 V	< 0.086 Ω	22.5 A ⁽¹⁾

1. The value is rated according to R_{thj-case} and limited by package.

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

This device is an N-channel MDmesh™ V Power MOSFET based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

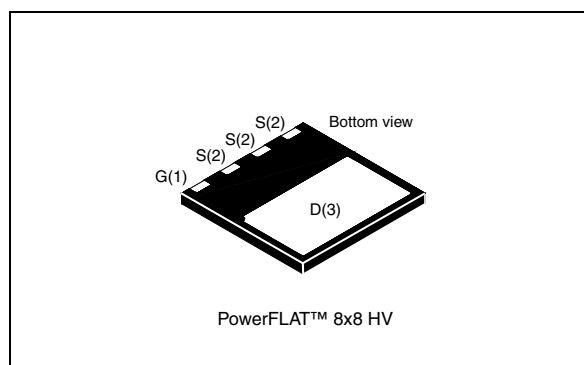


Figure 1. Internal schematic diagram

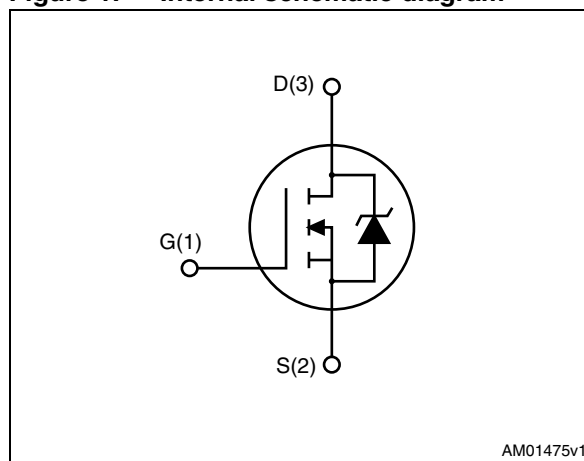


Table 1. Device summary

Order code	Marking	Package	Packaging
STL45N65M5	45N65M5	PowerFLAT™ 8x8 HV	Tape and reel

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	650	V
V_{GS}	Gate-source voltage	± 25	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	22.5	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	18	A
$I_{DM}^{(1),(2)}$	Drain current (pulsed)	90	A
$I_D^{(3)}$	Drain current (continuous) at $T_{amb} = 25\text{ }^{\circ}\text{C}$	3.8	A
$I_D^{(3)}$	Drain current (continuous) at $T_{amb} = 100\text{ }^{\circ}\text{C}$	2.4	A
$P_{TOT}^{(3)}$	Total dissipation at $T_{amb} = 25\text{ }^{\circ}\text{C}$	2.8	W
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	160	W
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	9	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	810	mJ
$dv/dt^{(4)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^{\circ}\text{C}$
T_j	Max. operating junction temperature	150	$^{\circ}\text{C}$

1. The value is rated according to $R_{thj-case}$ and limited by package.
2. Pulse width limited by safe operating area.
3. When mounted on FR-4 board of inch², 2oz Cu.
4. $I_{SD} \leq 22.5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} = 400\text{ V}$, $V_{DS(peak)} < V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.78	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}^{(1)}$	Thermal resistance junction-ambient max	45	$^{\circ}\text{C}/\text{W}$

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

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	$I_D = 1\text{ mA}$, $V_{GS} = 0$	650			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 650\text{ V}$ $V_{DS} = 650\text{ V}$, $T_C = 125\text{ °C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 14.5\text{ A}$		0.075	0.086	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	3470 82 7	-	pF pF pF
$C_{o(er)}^{(1)}$	Equivalent output capacitance energy related	$V_{GS} = 0$, $V_{DS} = 0\text{ to }80\% V_{(BR)DSS}$	-	79	-	pF
$C_{o(tr)}^{(2)}$	Equivalent output capacitance time related		-	280	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	2	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 520\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 16)	-	82 18.5 35	-	nC nC nC

1. Energy related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}
2. Time related 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 (v)	Voltage delay time	$V_{DD} = 400\text{ V}$, $I_D = 22.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 20)	-	79.5	-	ns
t_r (v)	Voltage rise time			11		ns
t_f (i)	Current fall time			9.3		ns
t_c (off)	Crossing time			16		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Source-drain current		-		22.5	A
$I_{SDM}^{(1).(2)}$	Source-drain current (pulsed)				90	A
$V_{SD}^{(3)}$	Forward on voltage	$I_{SD} = 22.5\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 22.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 17)	-	346		ns
Q_{rr}	Reverse recovery charge			6		μC
I_{RRM}	Reverse recovery current			35		A
t_{rr}	Reverse recovery time	$I_{SD} = 22.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 17)	-	432		ns
Q_{rr}	Reverse recovery charge			8.4		μC
I_{RRM}	Reverse recovery current			39		A

1. The value is rated according to $R_{thj-case}$ and limited by package.

2. Pulse width limited by safe operating area

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

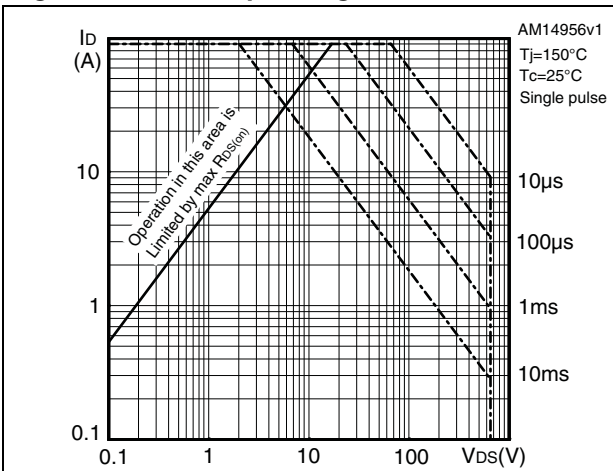


Figure 3. Thermal impedance

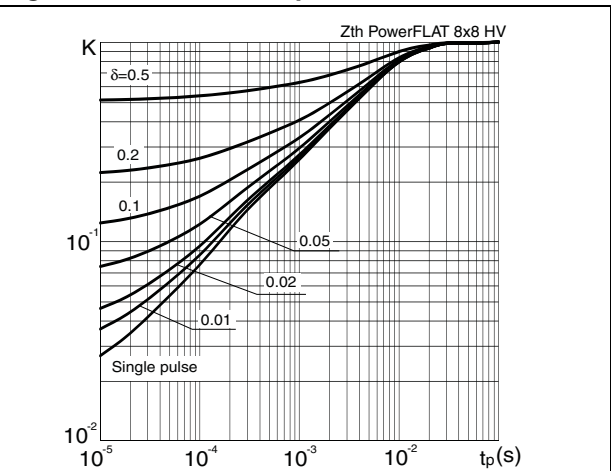


Figure 4. Output characteristics

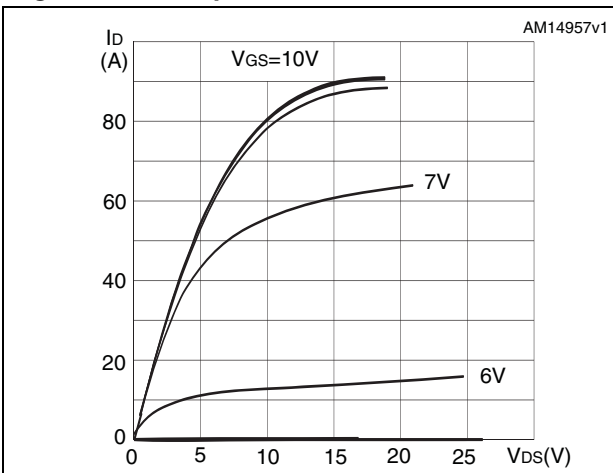


Figure 5. Transfer characteristics

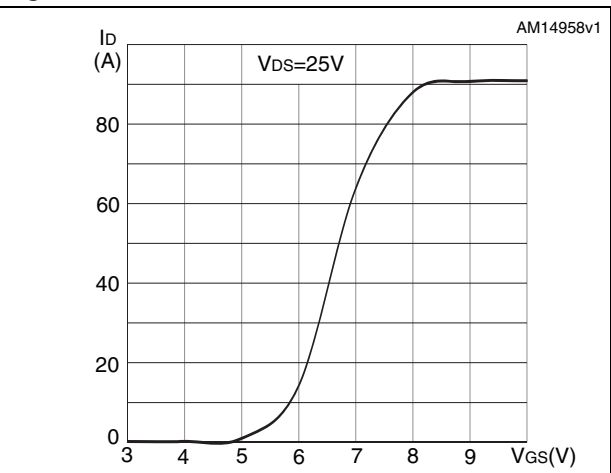


Figure 6. Gate charge vs gate-source voltage

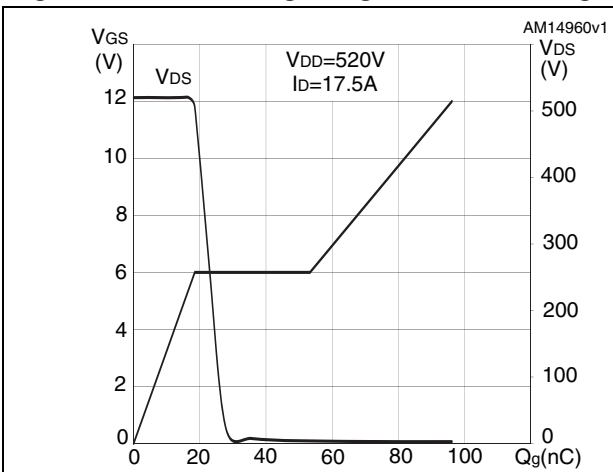


Figure 7. Static drain-source on-resistance

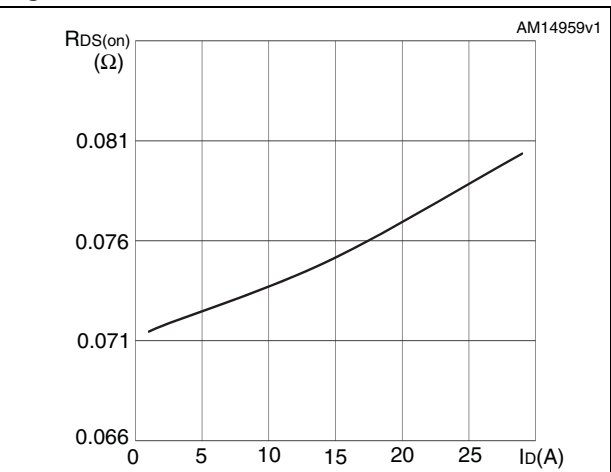


Figure 8. Capacitance variations

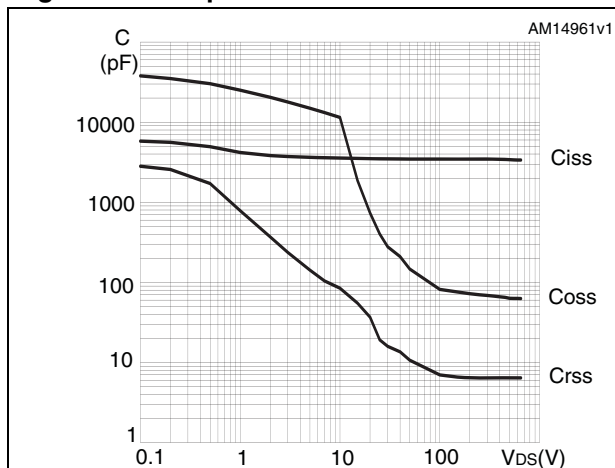


Figure 9. Output capacitance stored energy

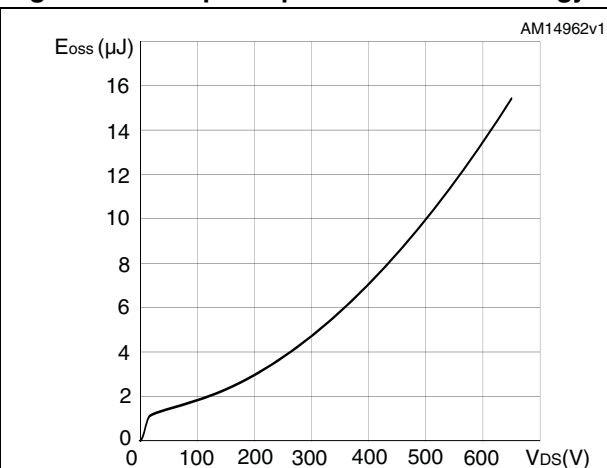


Figure 10. Normalized gate threshold voltage vs. temperature

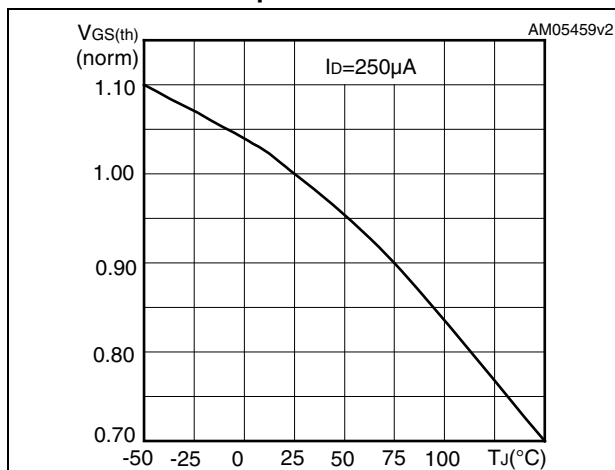


Figure 11. Normalized on-resistance vs. temperature

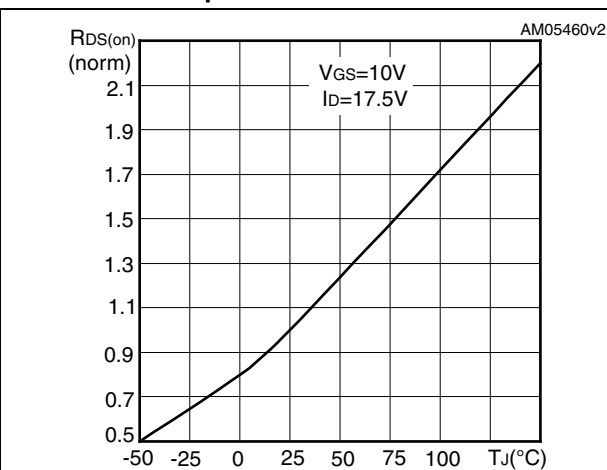


Figure 12. Drain-source diode forward characteristics

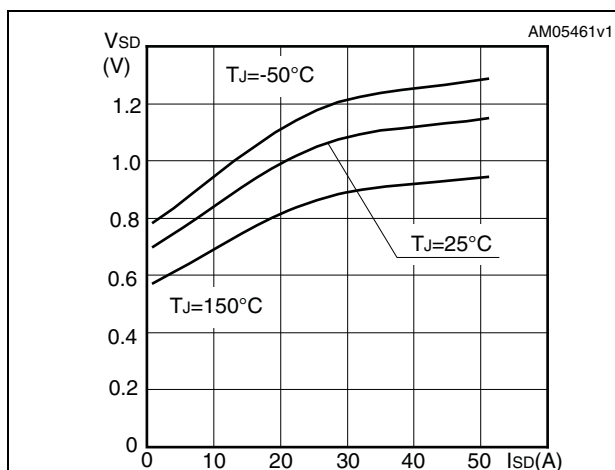
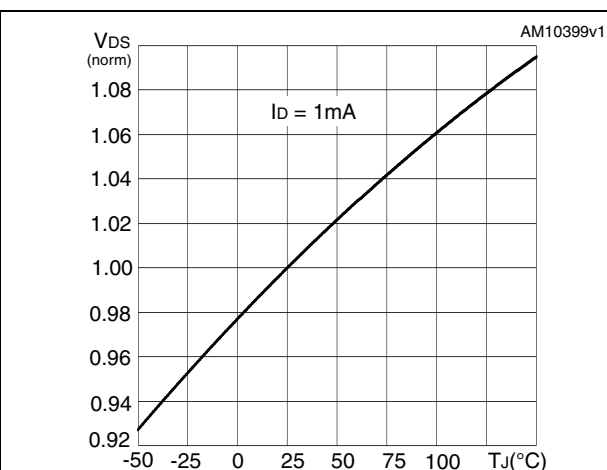
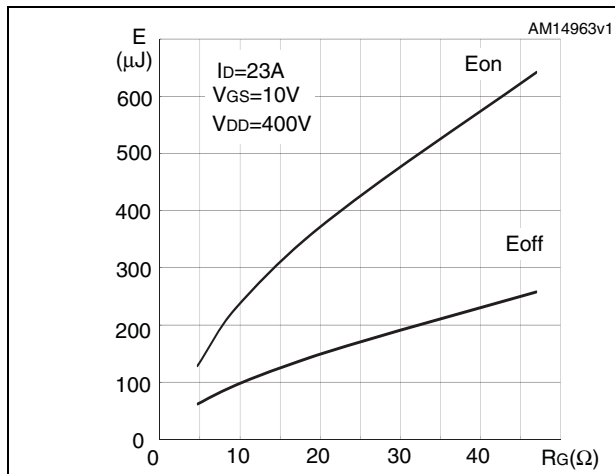
Figure 13. Normalized V_{DS} vs. temperature

Figure 14. Switching losses vs. gate resistance ⁽¹⁾



1. E_{on} including reverse recovery of a SiC diode

3 Test circuits

Figure 15. Switching times test circuit for resistive load

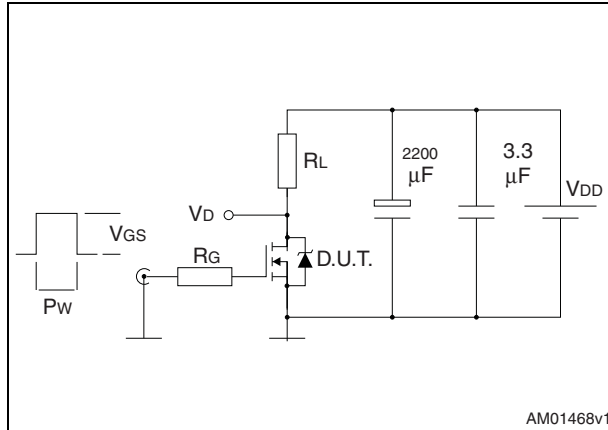


Figure 16. Gate charge test circuit

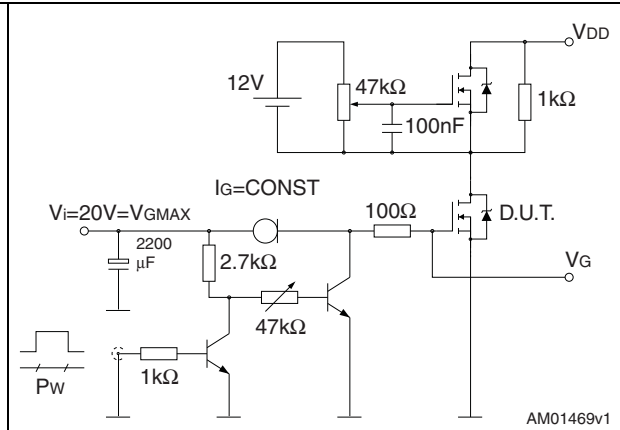


Figure 17. Test circuit for inductive load switching and diode recovery times

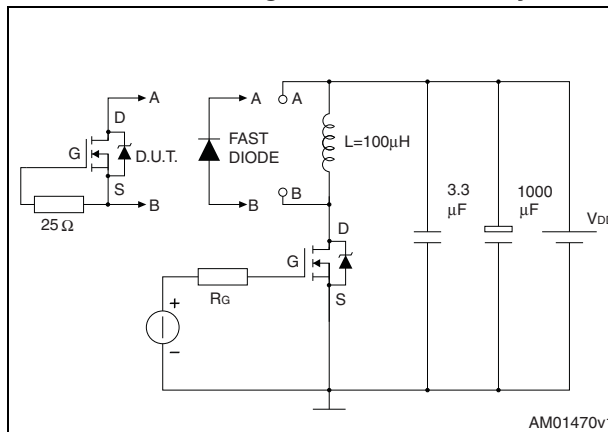


Figure 18. Unclamped inductive load test circuit

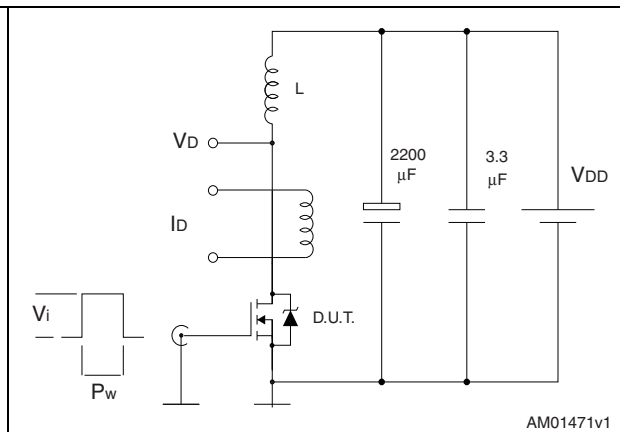


Figure 19. Unclamped inductive waveform

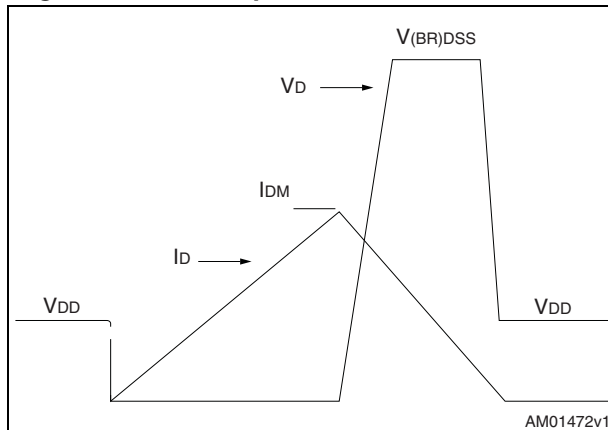
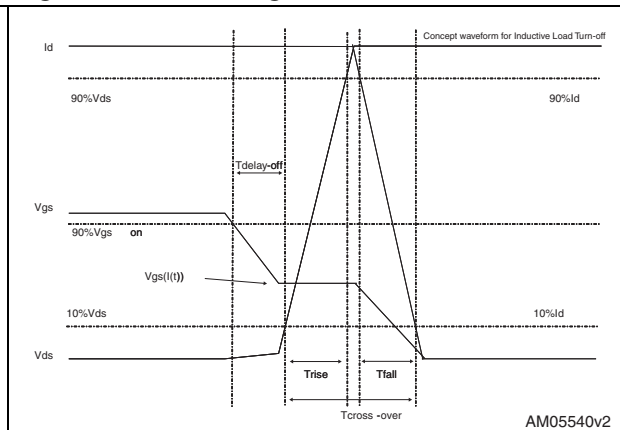


Figure 20. Switching time waveform



4 Package mechanical data

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.

Table 8. PowerFLAT™ 8x8 HV mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80	0.90	1.00
A1	0.00	0.02	0.05
b	0.95	1.00	1.05
D		8.00	
E		8.00	
D2	7.05	7.20	7.30
E2	4.15	4.30	4.40
e		2.00	
L	0.40	0.50	0.60
aaa		0.10	
bbb		0.10	
ccc		0.10	

BOTTOM VIEW

Dimensions: L , b , $E2$, $D2$, 0.40 .

Feature Callouts: PIN#1 ID, 1, 2, 3, 4.

Datum Reference Frame: $\oplus$ bbb $\odot$ C A B.

SIDE VIEW

Dimensions: A , $0.20_{-0.008}$, $A1$, D , E .

Feature Callouts: SEATING PLANE.

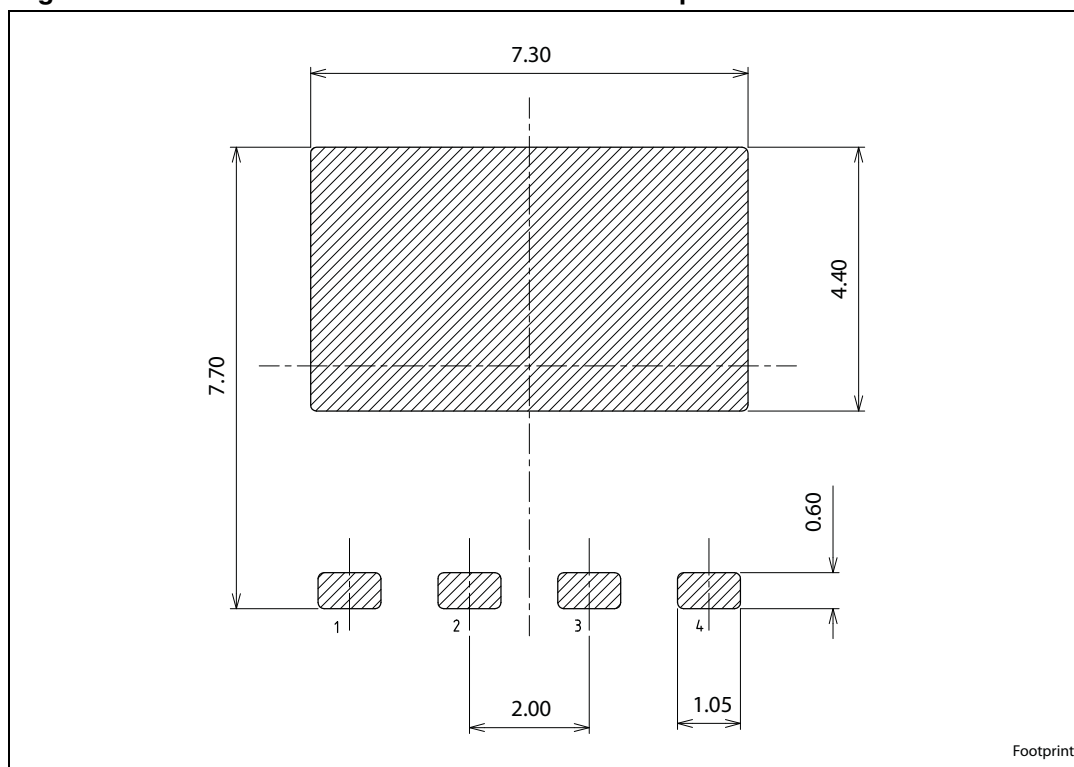
Datum Reference Frame: $\parallel$ ccc C, $\frac{1}{2}$ 0.08 C, C, B.

TOP VIEW

Feature Callouts: INDEX AREA.

Datum Reference Frame: $\frac{1}{2}$ aaa C, $\frac{1}{2}$ aaa C.

Figure 22. PowerFLAT™ 8x8 HV recommended footprint



5 Packaging mechanical data

Figure 23. PowerFLAT™ 8x8 HV tape

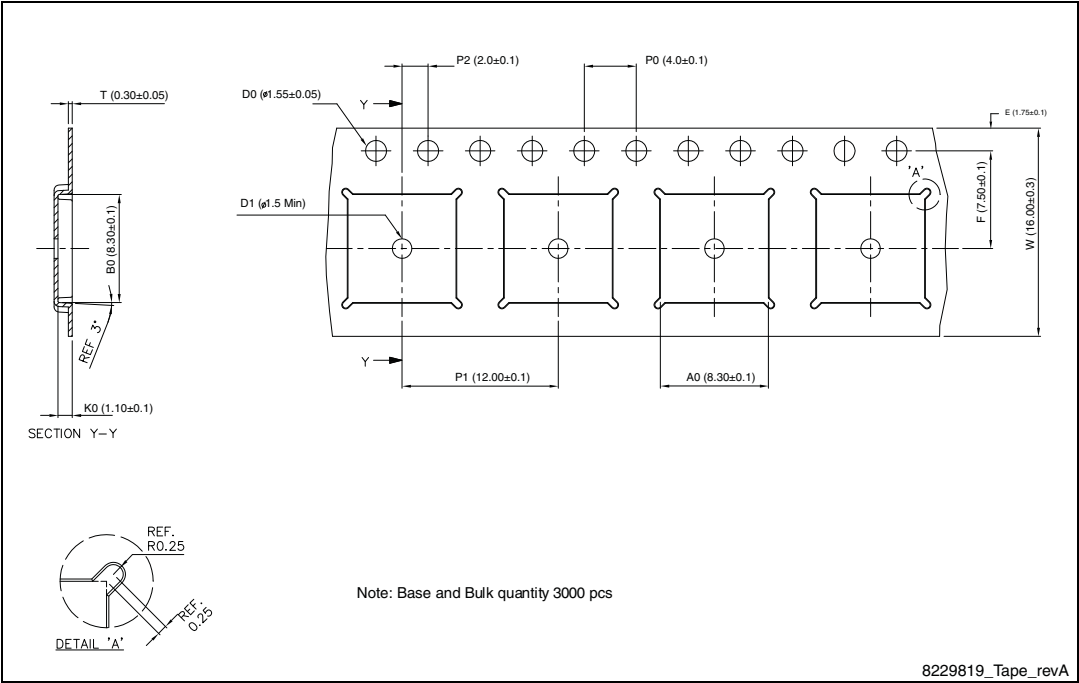
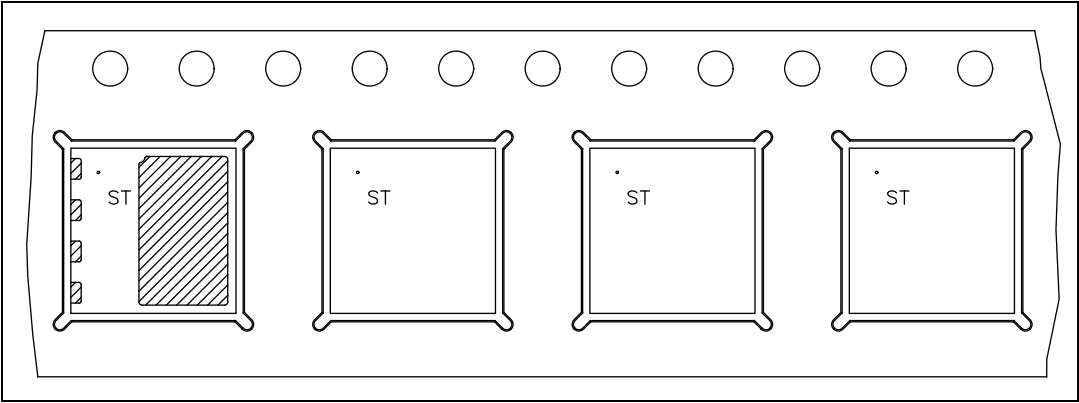


Figure 24. PowerFLAT™ 8x8 HV package orientation in carrier tape.



Front View:

- Overall diameter: $\phi 330.0^{+0.2}_{-0.0}$
- Inner hub diameter: $\phi 76.2$
- Hub bore diameter: $\phi 17.8$
- Spindle hole diameter: $\phi 1.7$
- Flange thickness: 2.0
- Slot width: 4.0W * 10.0D CUT SLOT (3 PLCS)
- Slot depth: 10.0
- Slot radius: R4.0
- Angle between slots: 60°
- Outer edge chamfer: $R1.5 \pm 0.3$

Side View:

- Total height: $16.4^{+0.0}_{-0.0}$
- Tape thickness: $2.4^{+0.0}_{-0.0}$
- Bottom flange thickness: 0.6
- Inner hub diameter: $\phi 100.0^{+0.2}_{-0.0}$
- Flange thickness: 2.0

Rear View:

- Outer rim radius: R57.7
- Internal spoke radius: R113
- Spoke thickness: R50
- Spoke width: 6.5 ± 0.2
- Spoke angle: 120°
- Center hole diameter: $\phi 6.5 \pm 0.2$
- Reference point: SEE DETAIL C

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
20-Sep-2012	1	First release.

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