STL31N65M5

N-channel 650 V, 0.135 Ω typ., 15 A MDmesh™ V Power MOSFET in a PowerFLAT™ 8x8 HV package

Datasheet - production data

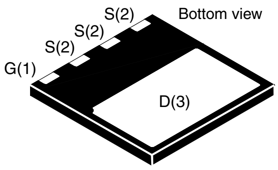
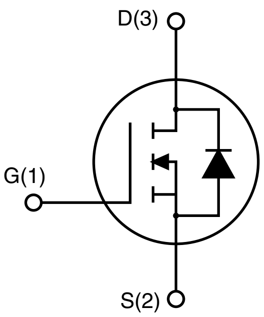


Figure 1. Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max	I_D
STL31N65M5	710 V	0.162 Ω	15 A(1)

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

- Worldwide best $R_{DS(on)}$ * area
- Higher V_{DSS} rating and high dv/dt capability
- Excellent switching performance

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.

Table 1. Device summary

Order code	Marking	Packages	Packaging
STL31N65M5	31N65M5	PowerFLAT™ 8x8 HV	Tape and reel

Contents

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 °C	15	A
I_D (1)	Drain current (continuous) at T_C = 100 °C	12	A
I_{DM} (1),(2)	Drain current (pulsed)	60	A
I_D(3)	Drain current (continuous) at T_{amb} = 25 °C	2.8	A
I_D(3)	Drain current (continuous) at T_{amb} = 100 °C	1.8	A
P_{TOT} (3)	Total dissipation at T_{amb} = 25 °C	2.8	W
P_{TOT} (1)	Total dissipation at T_C = 25 °C	125	W
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	5	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	410	mJ
dv/dt (4)	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	- 55 to 150	°C
T_j	Max. operating junction temperature	150	°C

1. The value is rated according to $R_{thj\text{-}case}$ and limited by package.
2. Pulse width limited by safe operating area.
3. When mounted on FR-4 board of inch², 2oz Cu.
4. $I_{SD} \leq 15$ A, di/dt $\leq$ 400 A/µs, V_{DD} = 400 V, $V_{DS(peak)} < V_{(BR)DSS}$.

Table 3. Thermal data

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

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

2 Electrical characteristics

(T_C = 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	I_D = 1 mA, V_{GS} = 0	650			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 650 V			1	µA
		V_{DS} = 650 V, T_C=125 °C			100	µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 11 A		0.135	0.162	Ω

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	-	1865	-	pF
C_{oss}	Output capacitance		-	45	-	pF
C_{rss}	Reverse transfer capacitance		-	4	-	pF
$C_{o(er)}$ (1)	Equivalent output capacitance energy related	V_{GS} = 0, V_{DS} = 0 to 80% $V_{(BR)DSS}$	-	43	-	pF
$C_{o(tr)}$ (2)	Equivalent output capacitance time related		-	146	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	2.8	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 11 A, V_{GS} = 10 V (see *Figure 16*)	-	45	-	nC
Q_{gs}	Gate-source charge		-	11.5	-	nC
Q_{gd}	Gate-drain charge		-	20	-	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 V, I_D = 14 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 20*)	-	46	-	ns
t_r (v)	Voltage rise time		-	8	-	ns
t_f (i)	Current fall time		-	8.5	-	ns
t_c(off)	Crossing time		-	11	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} (1)	Source-drain current		-		15	A
I_{SDM} (1),(2)	Source-drain current (pulsed)		-		60	A
V_{SD} (3)	Forward on voltage	I_{SD} = 15 A, V_{GS} = 0	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 15 A, di/dt= 100 A/µs V_{DD} = 100 V (see *Figure 17*)	-	290		ns
Q_{rr}	Reverse recovery charge		-	4		µC
I_{RRM}	Reverse recovery current		-	27		A
t_{rr}	Reverse recovery time	I_{SD} = 15 A, di/dt= 100 A/µs V_{DD} = 100 V, T_j = 150 °C (see *Figure 17*)	-	340		ns
Q_{rr}	Reverse recovery charge		-	5		µC
I_{RRM}	Reverse recovery current		-	29		A

1. The value is rated according to $R_{thj\text{-}case}$ 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

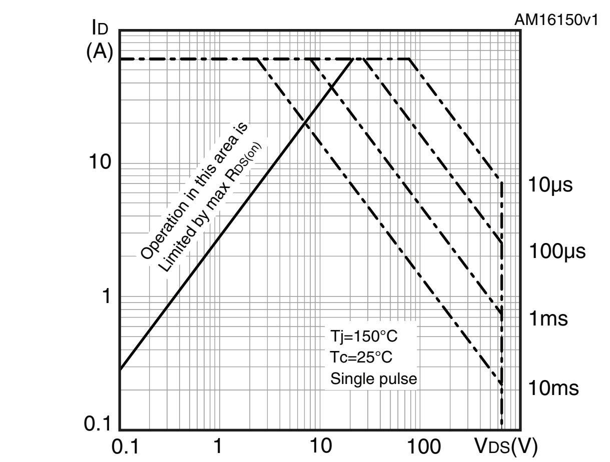


Figure 3. Thermal impedance

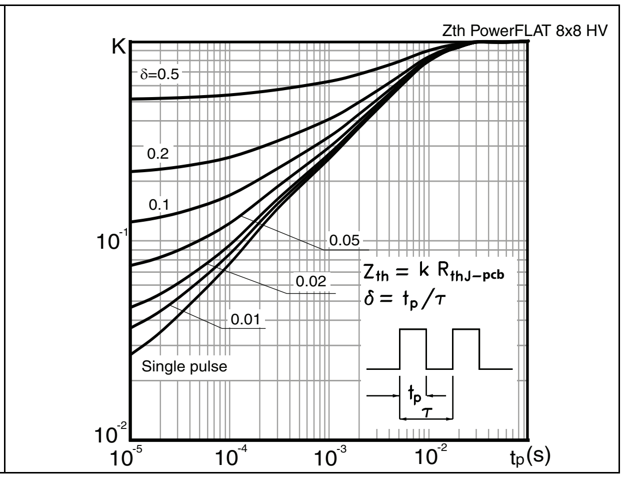


Figure 4. Output characteristics

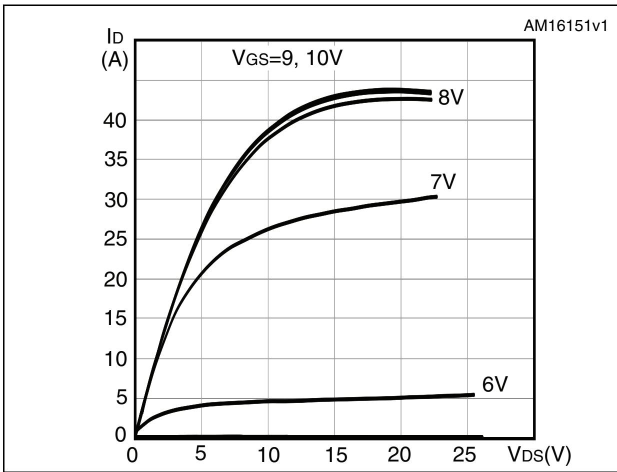


Figure 5. Transfer characteristics

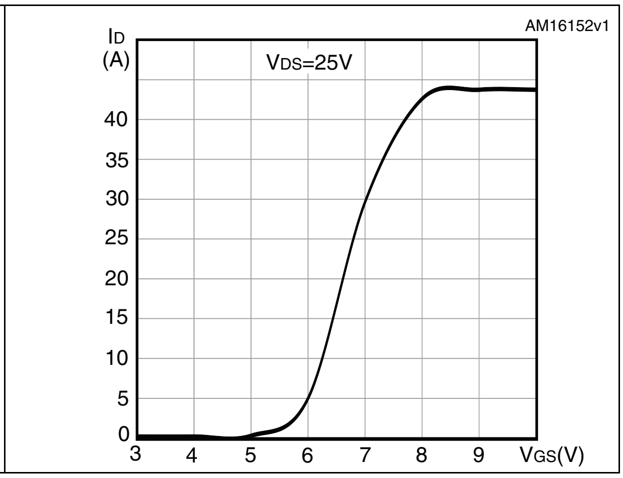


Figure 6. Gate charge vs gate-source voltage

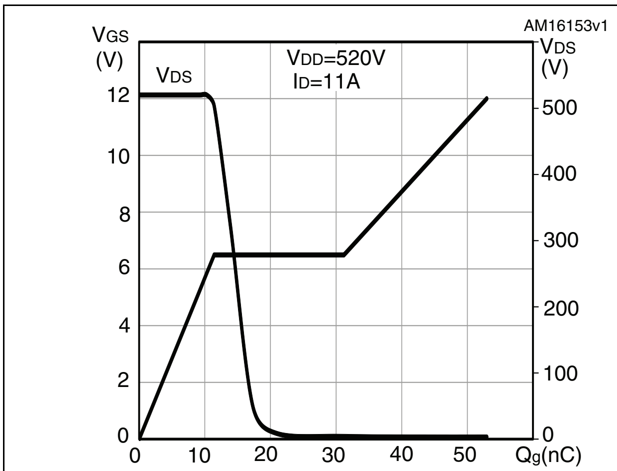


Figure 7. Static drain-source on-resistance

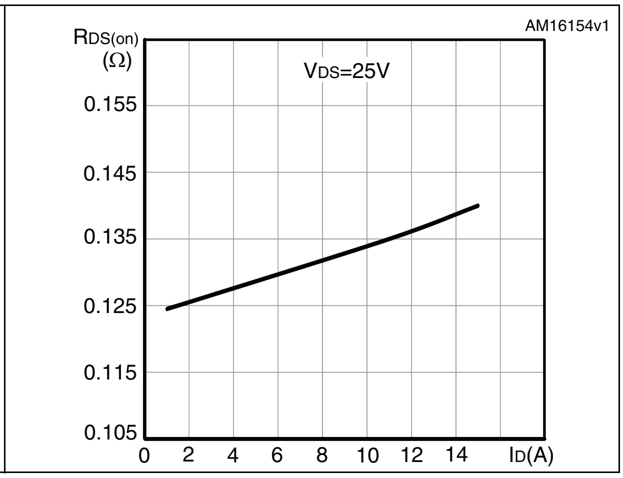


Figure 8. Capacitance variations

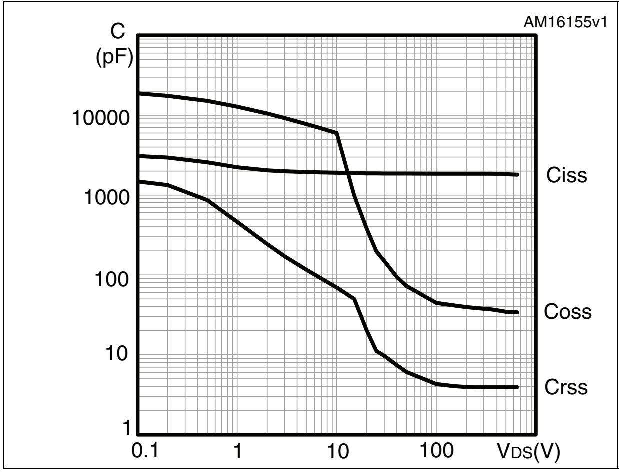


Figure 9. Output capacitance stored energy

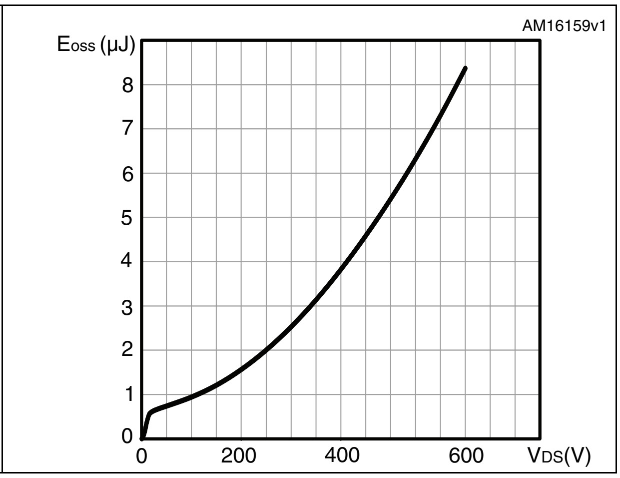


Figure 10. Normalized gate threshold voltage vs. temperature

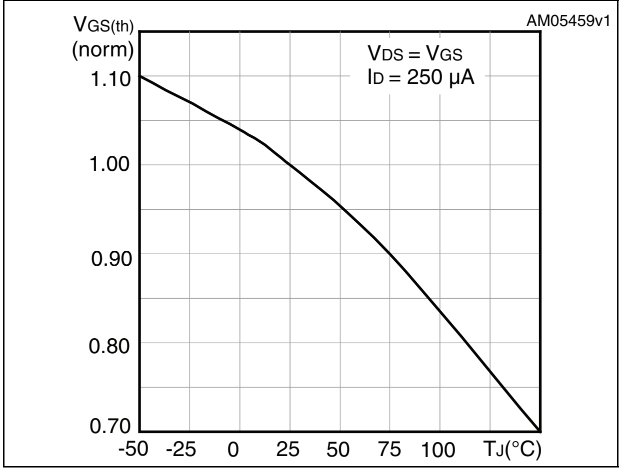


Figure 11. Normalized on-resistance vs. temperature

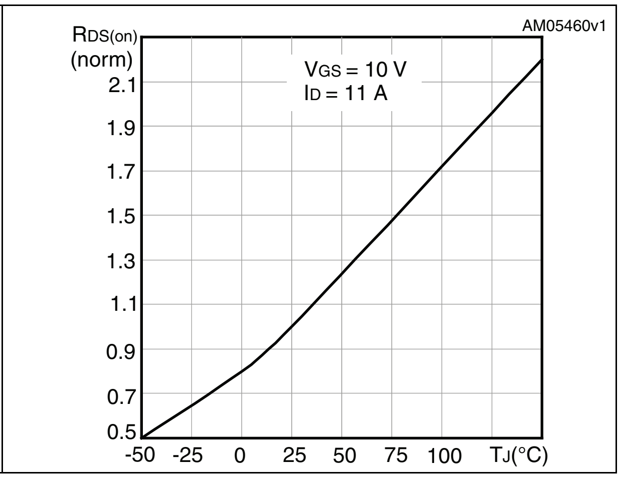


Figure 12. Drain-source diode forward characteristics

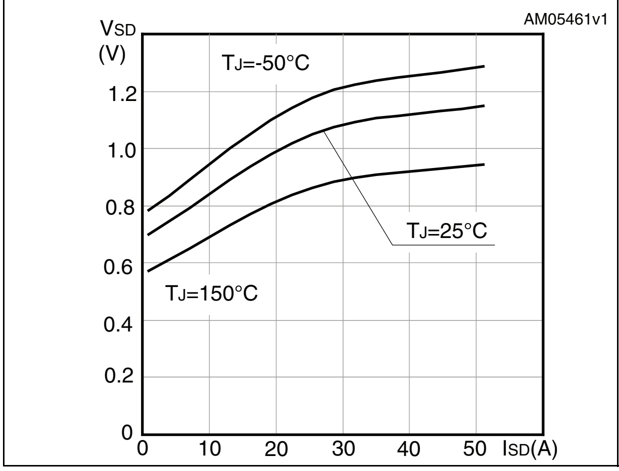


Figure 13. Normalized V_{DS} vs. temperature

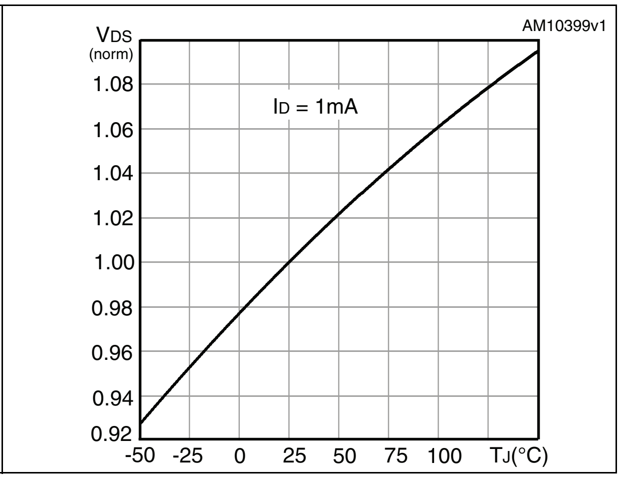
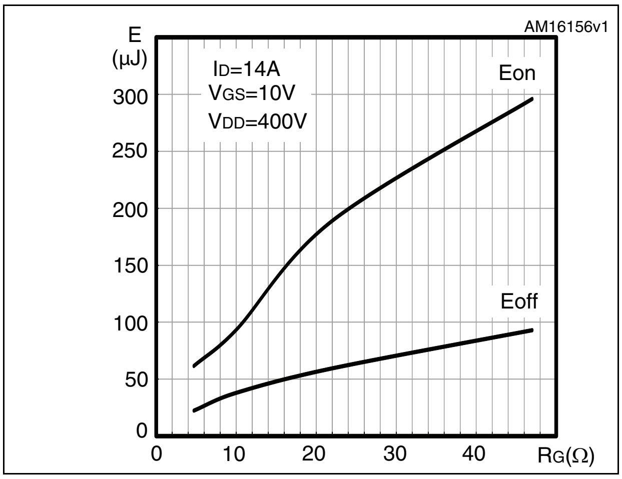


Figure 14. Switching losses vs. gate resistance [(1)]



1. Eon including reverse recovery of a SiC diode

3 Test circuits

Figure 15. Switching times test circuit for resistive load

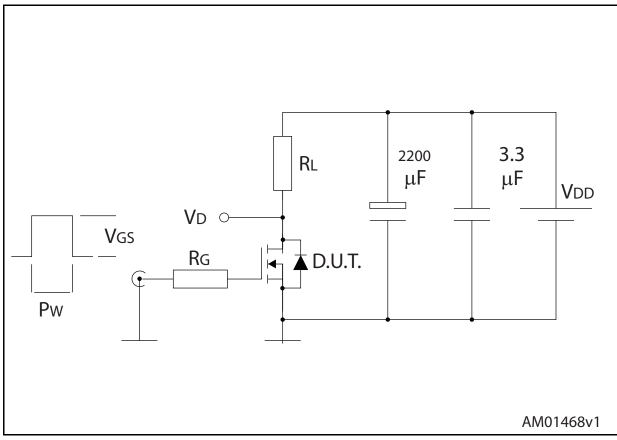


Figure 16. Gate charge test circuit

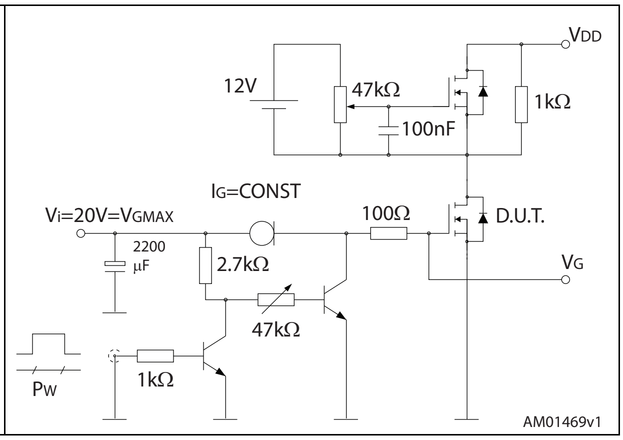


Figure 17. Test circuit for inductive load switching and diode recovery times

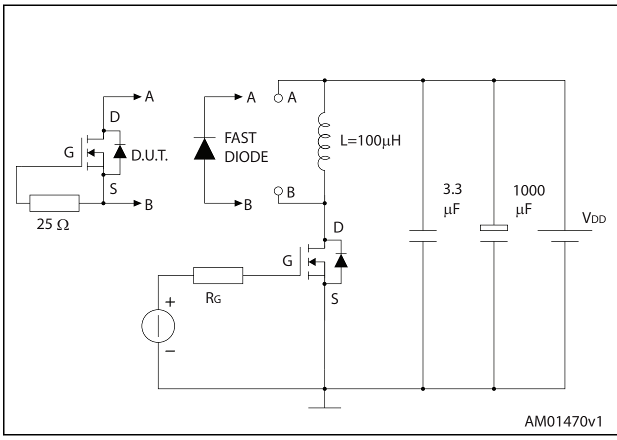


Figure 18. Unclamped inductive load test circuit

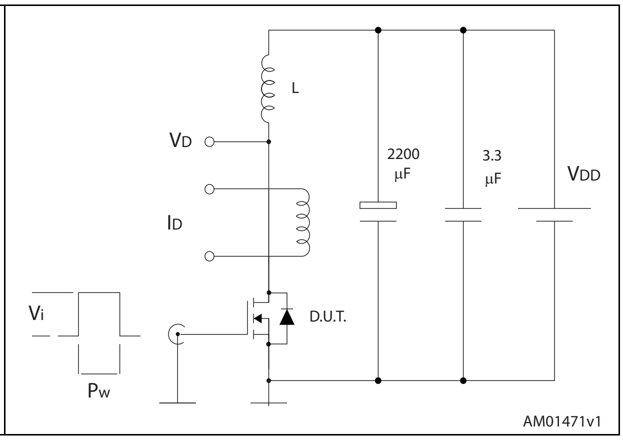


Figure 19. Unclamped inductive waveform

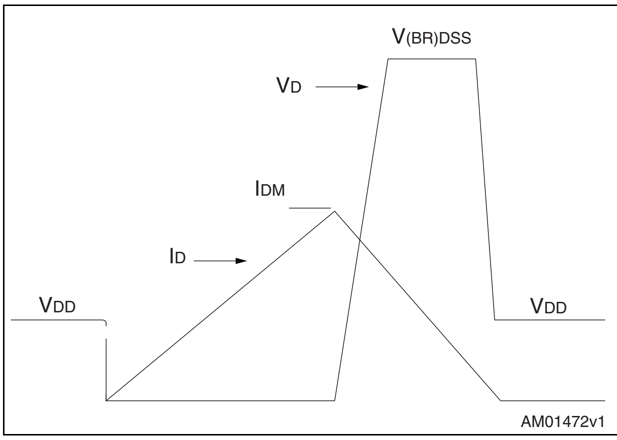
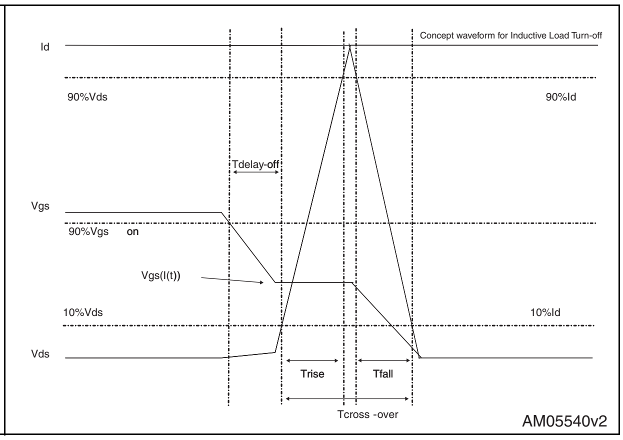


Figure 20. Switching time waveform



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

Figure 21. PowerFLAT™ 8x8 HV drawing mechanical data

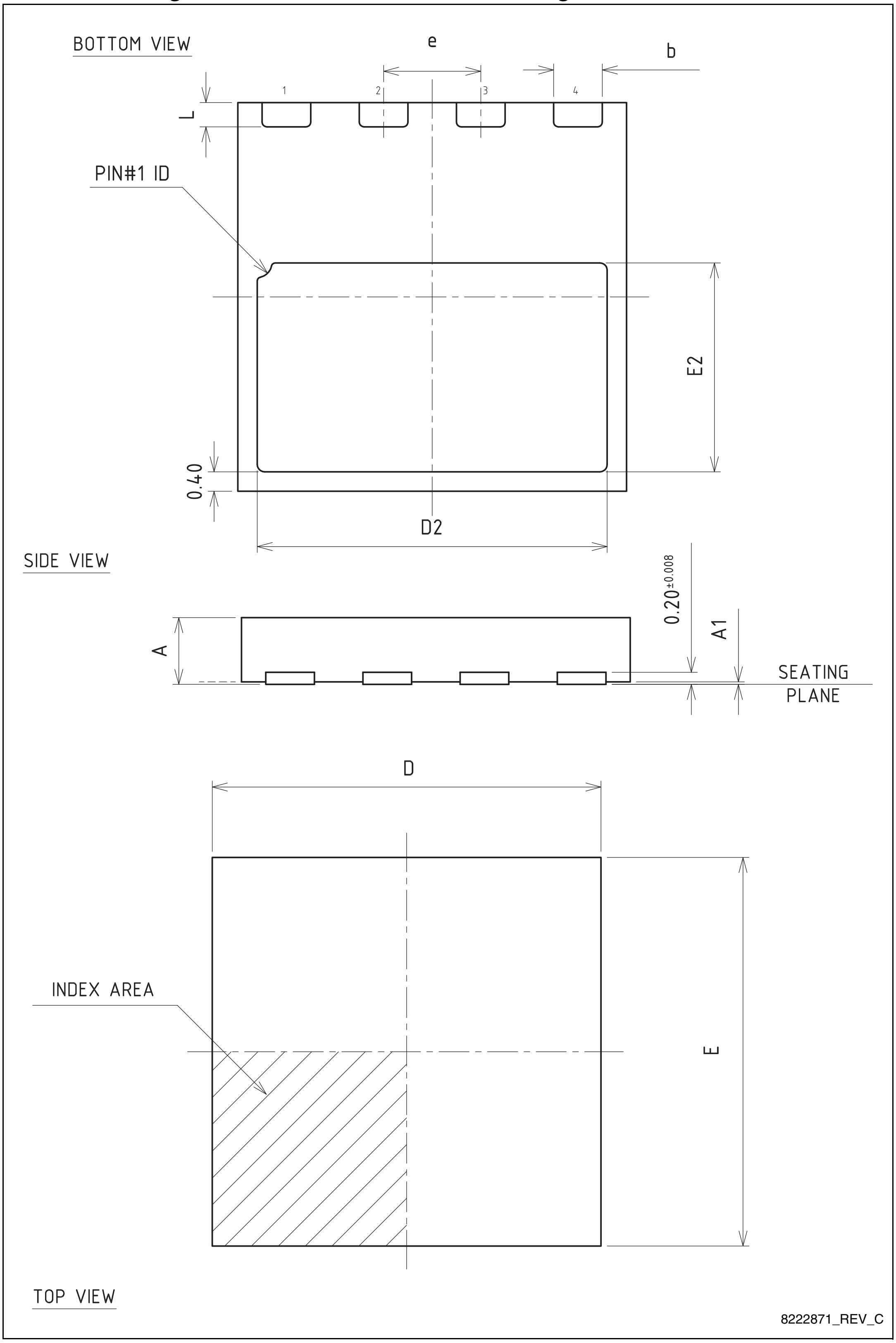
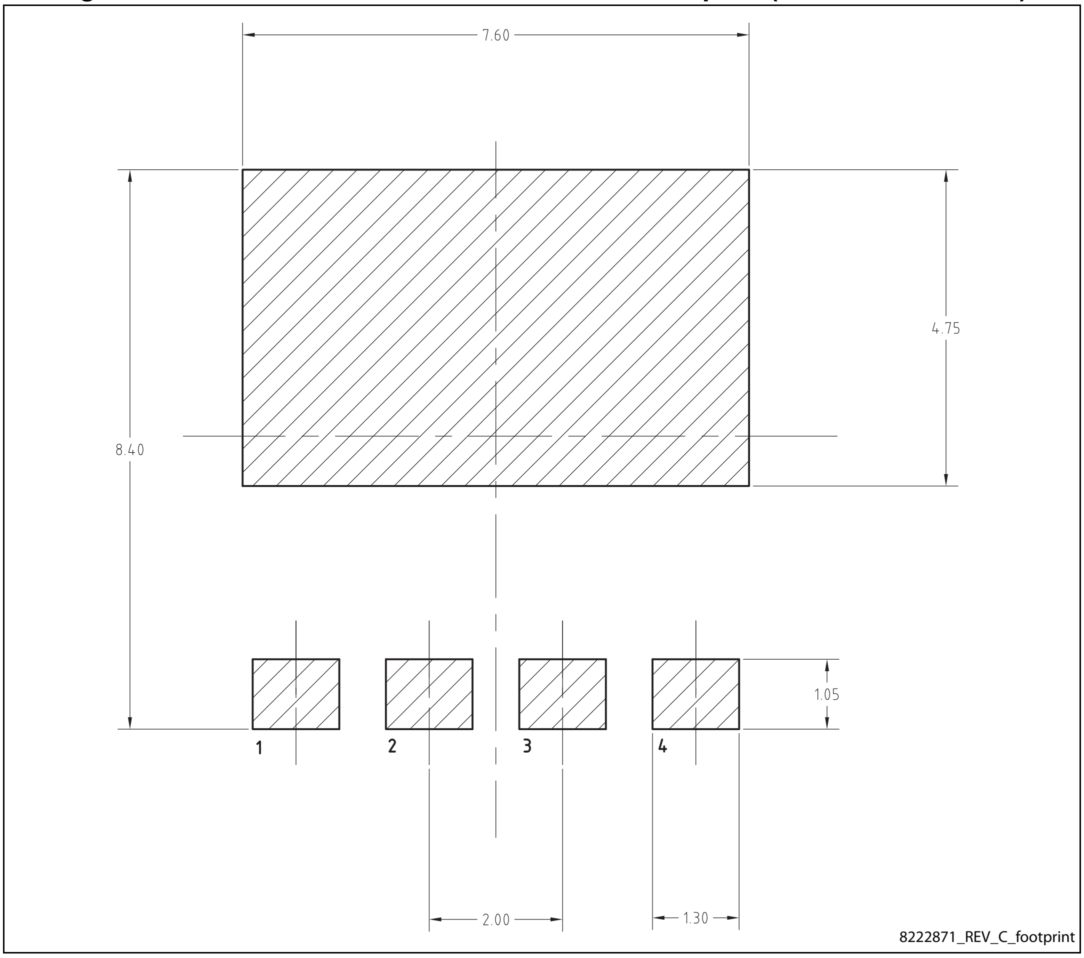


Figure 22. PowerFLAT™ 8x8 HV recommended footprint (dimensions in mm.)



5 Packaging mechanical data

Figure 23. PowerFLAT™ 8x8 HV tape

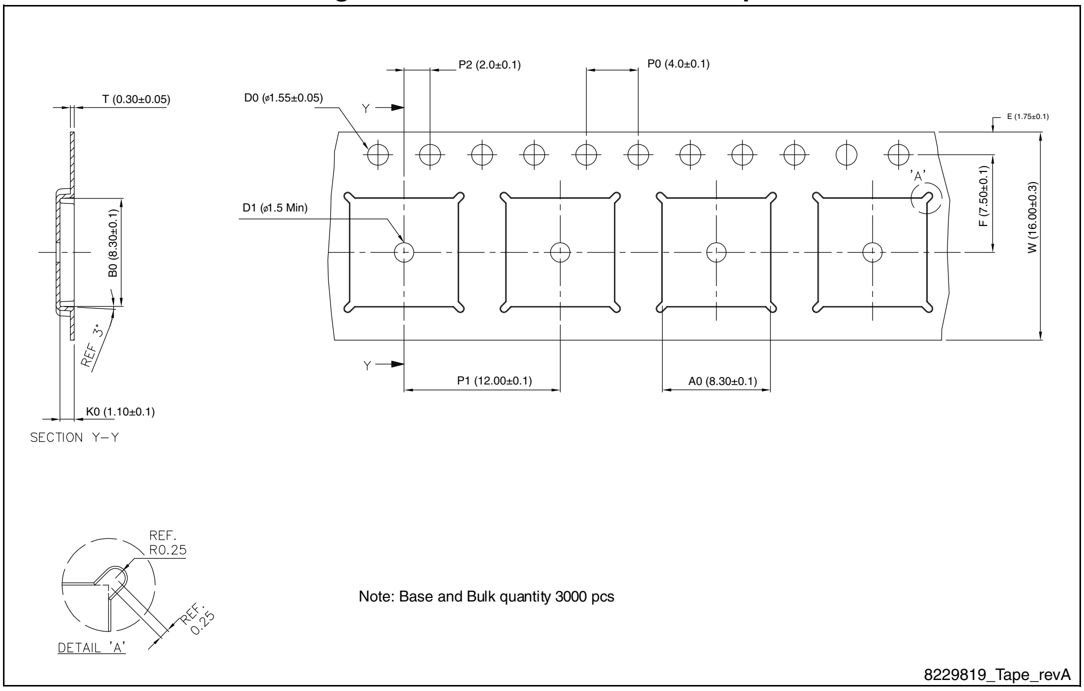


Figure 24. PowerFLAT™ 8x8 HV package orientation in carrier tape.

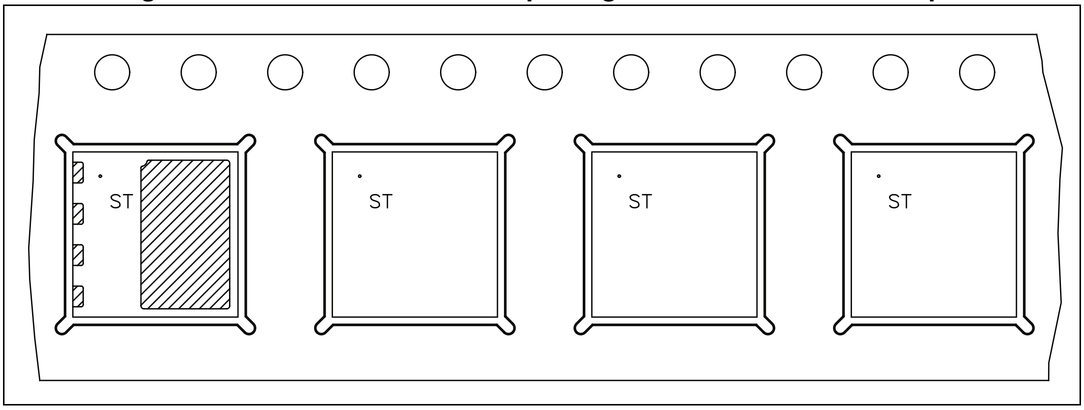
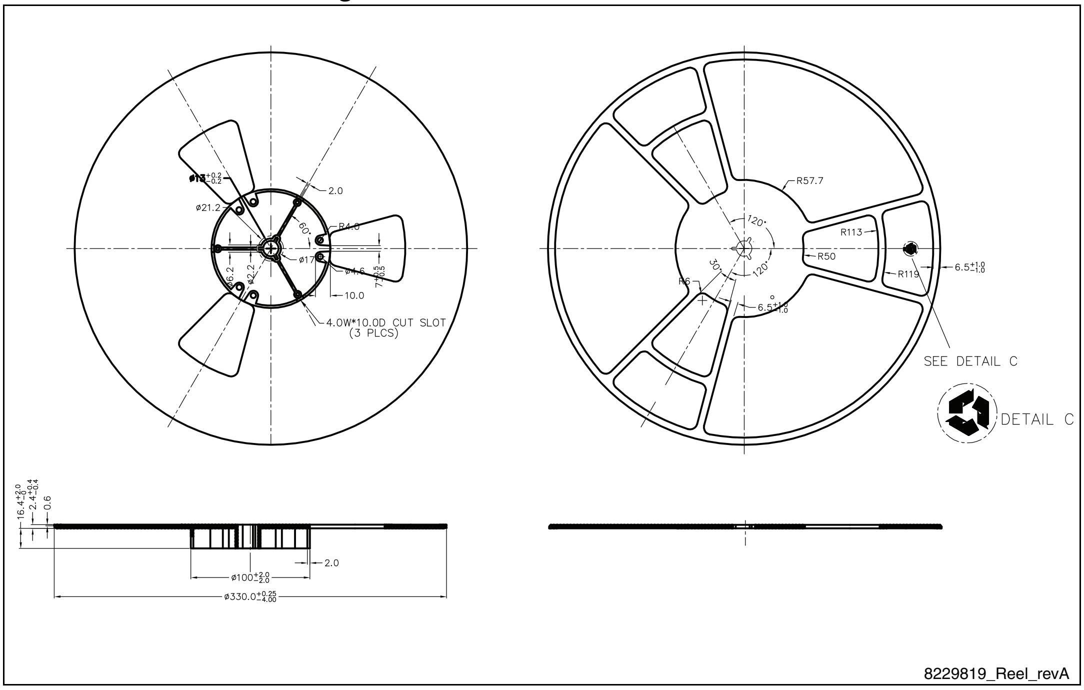


Figure 25. PowerFLAT™ 8x8 HV reel



6 Revision history

Table 9. Document revision history

Date	Revision	Changes
31-Oct-2013	1	First release.