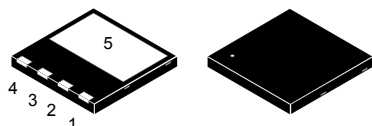
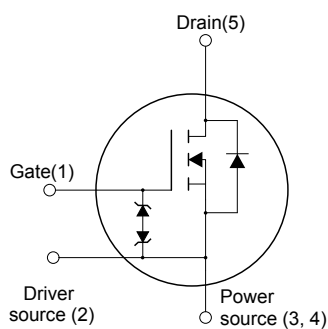


N-channel 600 V, 0.115 Ω typ., 21 A MDmesh™ M6 Power MOSFET in a PowerFLAT™ 8x8 HV package



PowerFLAT™ 8x8 HV



NG1DS2PS34D5Z

Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STL33N60M6	600 V	137 m Ω	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.

Product status link

[STL33N60M6](#)

Product summary

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

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 $T_{case} = 25\text{ }^{\circ}\text{C}$	21	A
	Drain current (continuous) at $T_{case} = 100\text{ }^{\circ}\text{C}$	13	
$I_{DM}^{(1)}$	Drain current (pulsed)	78	A
P_{TOT}	Total dissipation at $T_{case} = 25\text{ }^{\circ}\text{C}$	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	$^{\circ}\text{C}$
T_j	Operating junction temperature range		

1. Pulse width is limited by safe operating area.
2. $I_{SD} \leq 21\text{ A}$, $di/dt = 400\text{ A}/\mu\text{s}$, $V_{DS} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$
3. $V_{DS} \leq 480\text{ V}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.83	$^{\circ}\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	45	$^{\circ}\text{C}/\text{W}$

1. When mounted on FR-4 board of $inch^2$, 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 $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	500	mJ

2 Electrical characteristics

($T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified).

Table 4. On/off states

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
		$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 600\text{ V}$, $T_{\text{case}} = 125\text{ }^{\circ}\text{C}^{(1)}$			100	
I_{GSS}	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$, $V_{\text{GS}} = \pm 25\text{ V}$			± 5	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	$V_{\text{GS}} = 10\text{ V}$, $I_{\text{D}} = 10.5\text{ A}$		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	$V_{\text{DS}} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{\text{GS}} = 0\text{ V}$	-	1515	-	pF
C_{oss}	Output capacitance		-	128	-	
C_{rss}	Reverse transfer capacitance		-	4.2	-	
$C_{\text{oss eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }480\text{ V}$, $V_{\text{GS}} = 0\text{ V}$	-	269	-	pF
R_{G}	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_{\text{D}} = 0\text{ A}$	-	1.5	-	Ω
Q_{g}	Total gate charge	$V_{\text{DD}} = 480\text{ V}$, $I_{\text{D}} = 25\text{ A}$,	-	33.4	-	nC
Q_{gs}	Gate-source charge	$V_{\text{GS}} = 0\text{ to }10\text{ V}$	-	7.2	-	
Q_{gd}	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior)	-	16.3	-	

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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 300\text{ V}$, $I_{\text{D}} = 12.5\text{ A}$,	-	19.5	-	ns
t_{r}	Rise time	$R_{\text{G}} = 4.7\text{ }\Omega$, $V_{\text{GS}} = 10\text{ V}$	-	33	-	
$t_{\text{d(off)}}$	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	$I_{SD} = 21\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 25\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	265		ns
Q_{rr}	Reverse recovery charge		-	3.07		μC
I_{RRM}	Reverse recovery current		-	23.2		A
t_{rr}	Reverse recovery time	$I_{SD} = 25\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^{\circ}\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	374		ns
Q_{rr}	Reverse recovery charge		-	5.78		μC
I_{RRM}	Reverse recovery current		-	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

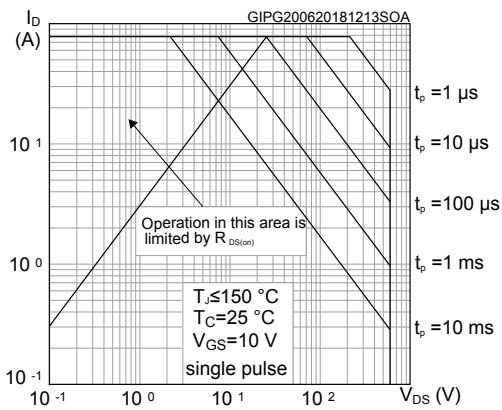


Figure 2. Thermal impedance

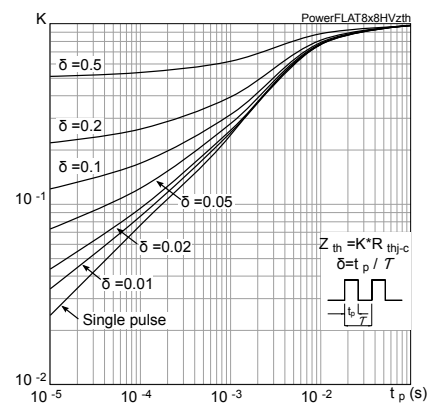


Figure 3. Output characteristics

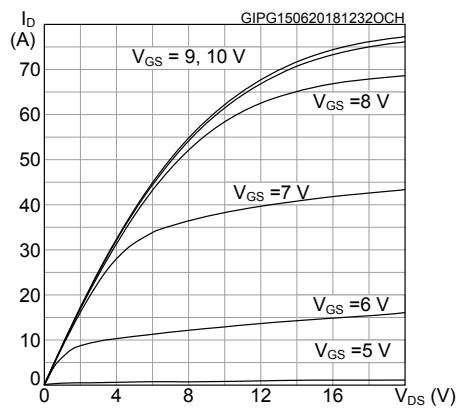


Figure 4. Transfer characteristics

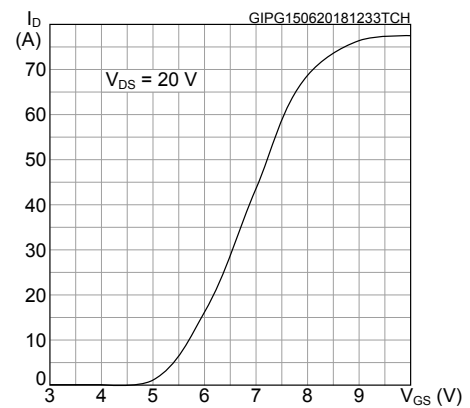


Figure 5. Gate charge vs gate-source voltage

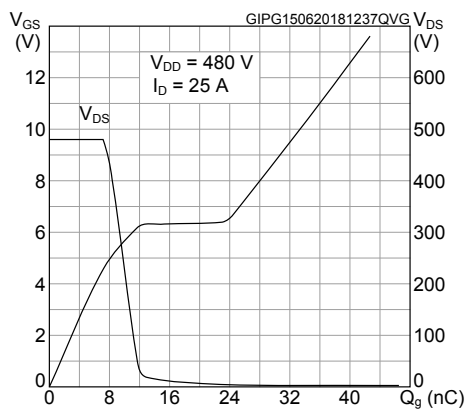


Figure 6. Static drain-source on-resistance

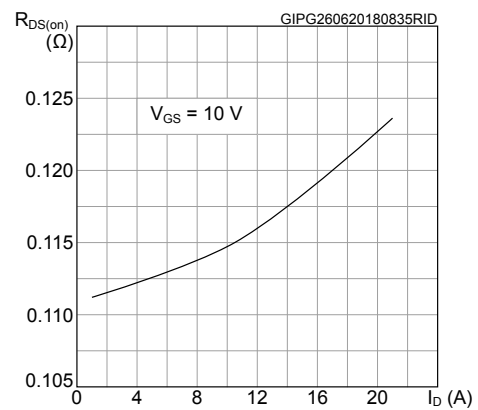
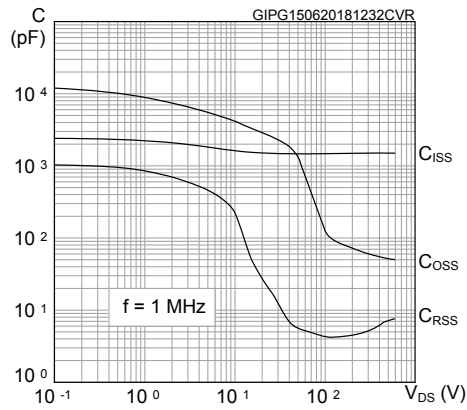
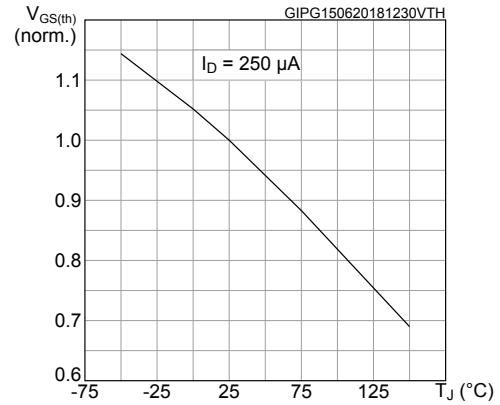
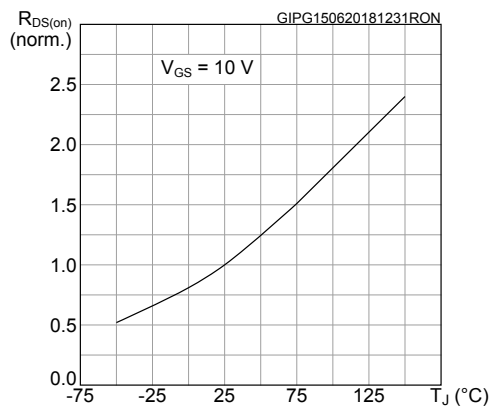
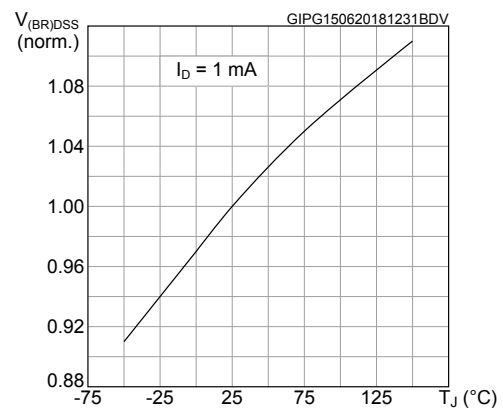
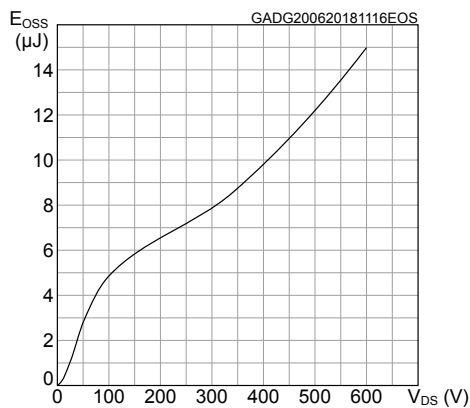
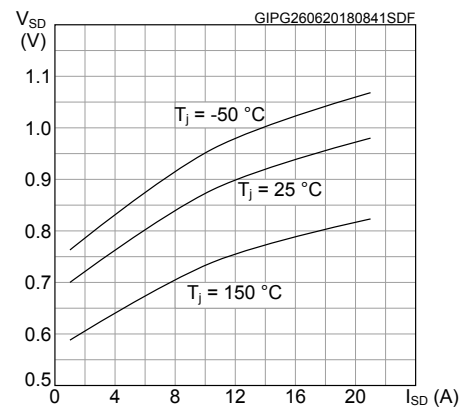
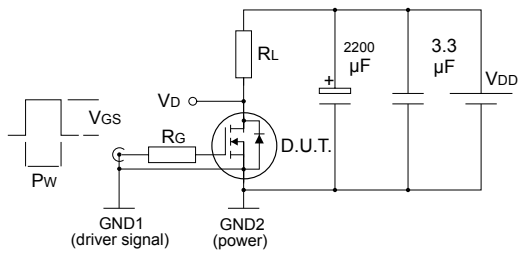
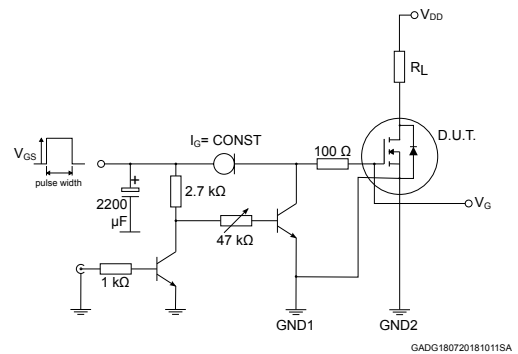


Figure 7. Capacitance variations

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


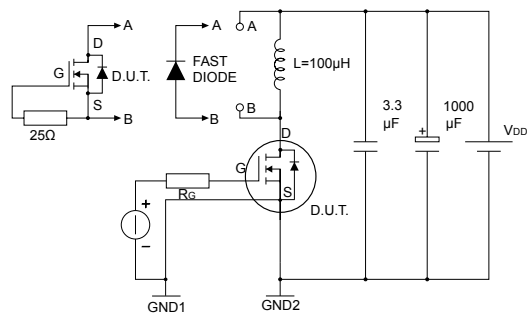
3 Test circuits

Figure 13. Switching times test circuit for resistive load


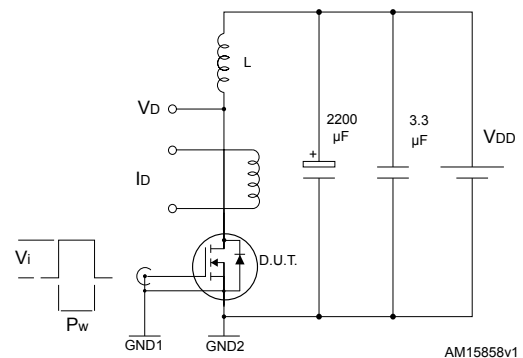
AM15855v1

Figure 14. Test circuit for gate charge behavior


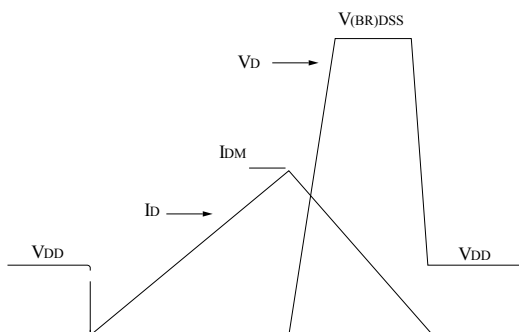
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Figure 15. Test circuit for inductive load switching and diode recovery times


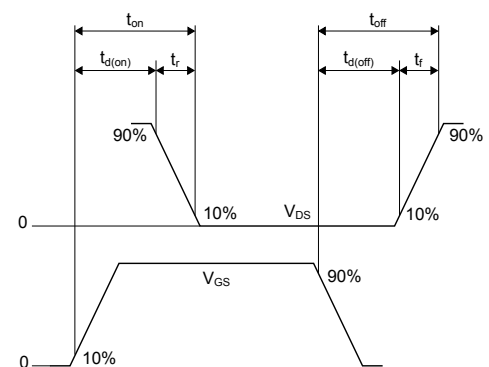
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Figure 16. Unclamped inductive load test circuit


AM15858v1

Figure 17. Unclamped inductive waveform


AM01472v1

Figure 18. Switching time waveform


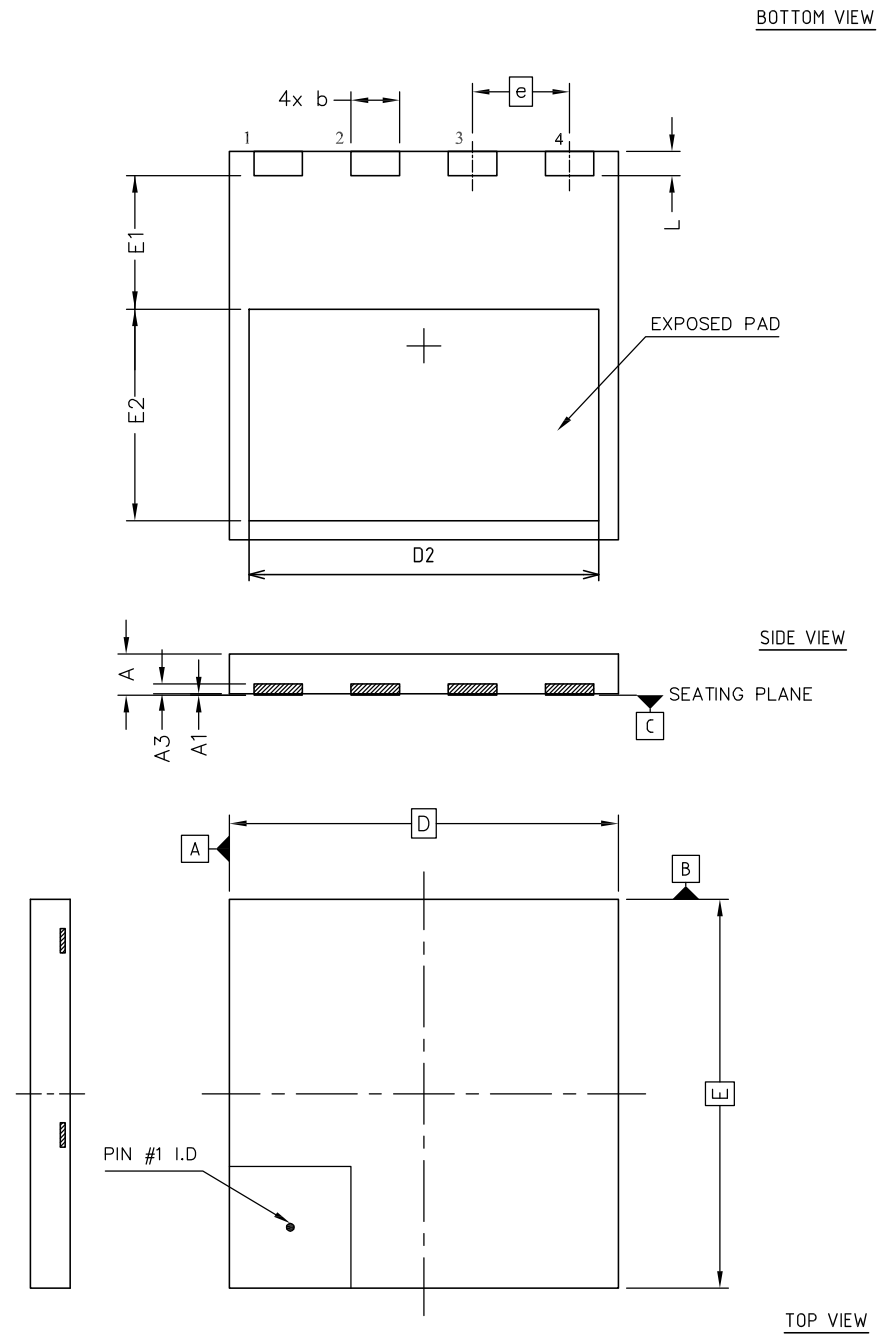
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4 Package information

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

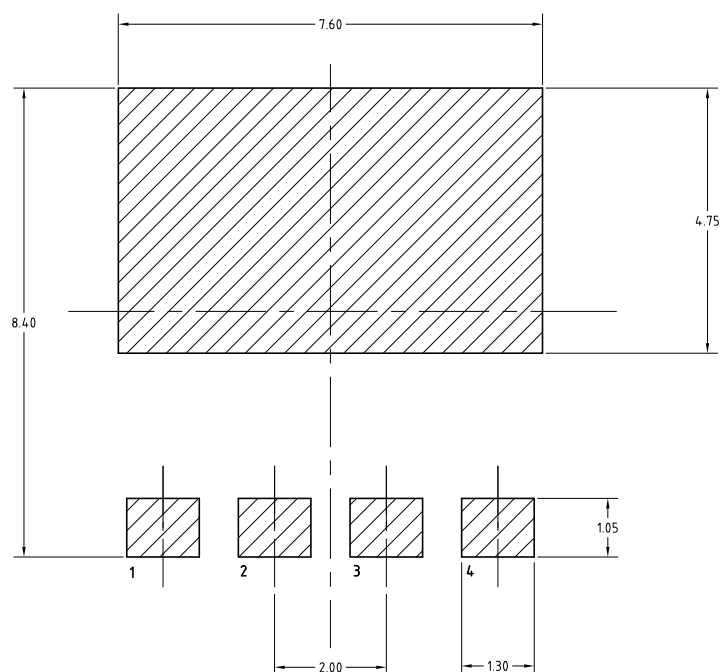


8222871_Rev_4

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

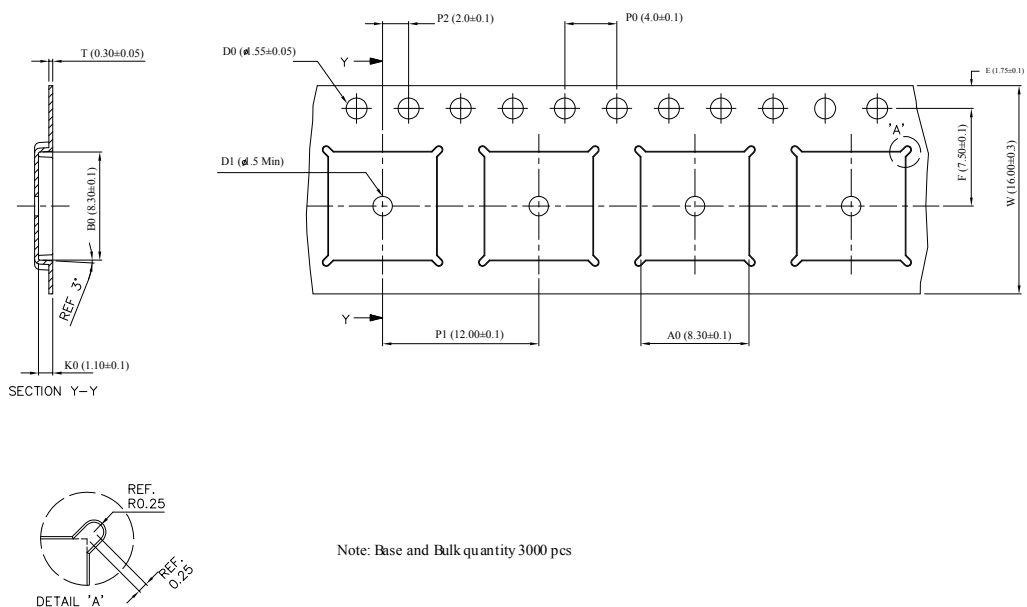


8222871_REV_4_footprint

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

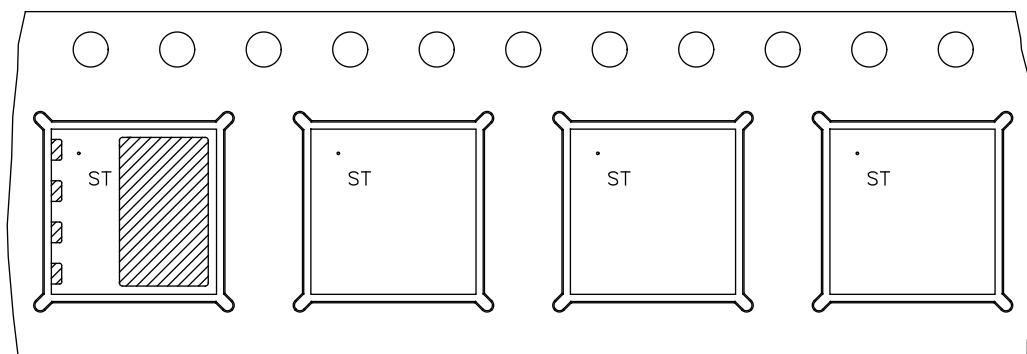
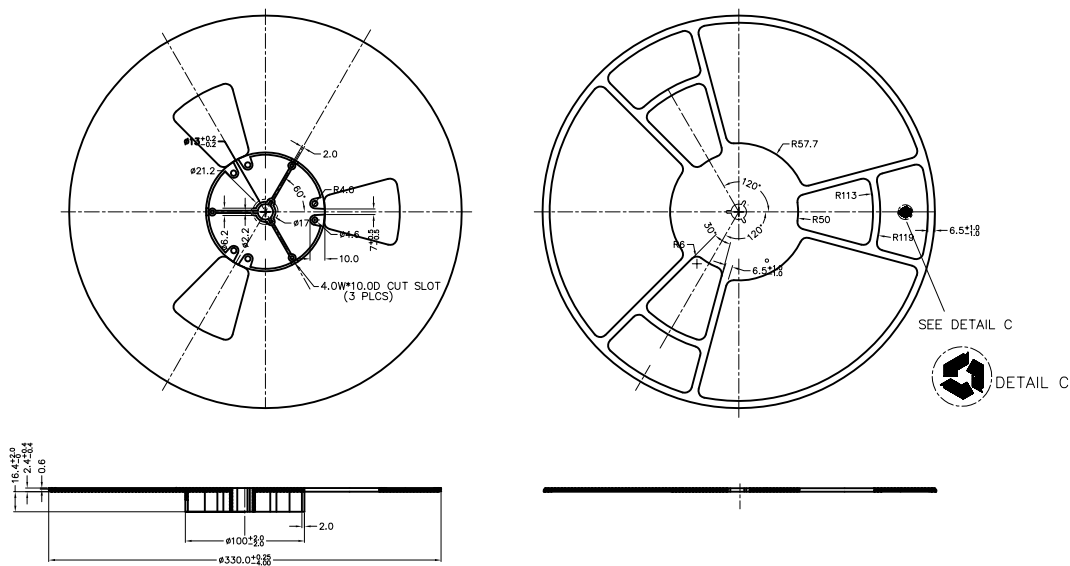


Figure 23. PowerFLAT™ 8x8 HV reel



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.

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