

Automotive-grade N-channel 600 V, 0.13 Ω , 21 A FDmesh™ II Power MOSFETs (with fast diode) in D²PAK and TO-247 packages

Datasheet - production data

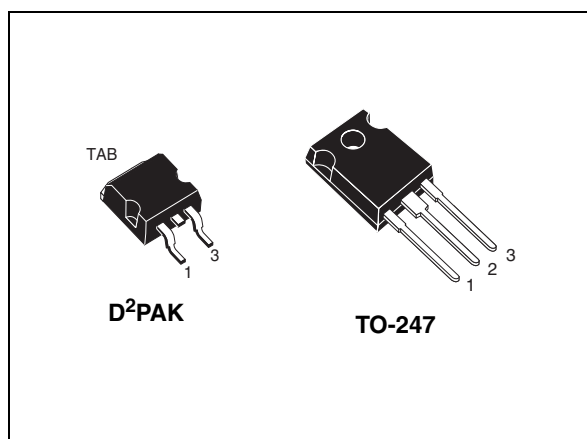
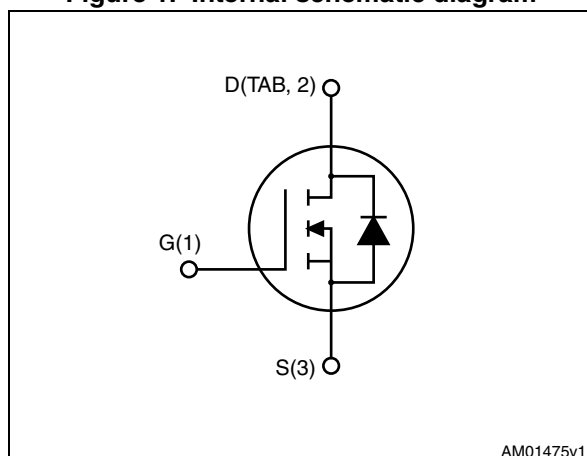


Figure 1. Internal schematic diagram



Features

Order codes	$V_{DS} @ T_{jmax}$	$R_{DS(on)} max$	I_D
STB27NM60ND	650 V	0.16 Ω	21 A
STW27NM60ND			

- Designed for automotive applications and AEC-Q101 qualified
- The worldwide best $R_{DS(on)}$ * area amongst the fast recovery diode devices
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Extremely high dv/dt and avalanche capabilities

Applications

- Switching applications

Description

These FDmesh™ II Power MOSFETs with intrinsic fast-recovery body diode are produced using the second generation of MDmesh™ technology. Utilizing a new strip-layout vertical structure, these revolutionary devices feature extremely low on-resistance and superior switching performance. They are ideal for bridge topologies and ZVS phase-shift converters.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STB27NM60ND	27NM60ND	D ² PAK	Tape and reel
STW27NM60ND	27NM60ND	TO-247	Tube

Contents

1 **Electrical ratings** 3

2 **Electrical characteristics** 4

 2.1 Electrical characteristics (curves) 7

3 **Test circuits** 10

4 **Package mechanical data** 11

5 **Packing mechanical data** 16

6 **Revision history** 18



1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	21	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	13	A
$I_{DM}^{(1)}$	Drain current (pulsed)	84	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	160	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	40	V/ns
T_{stg}	Storage temperature	-55 to 150	$^{\circ}\text{C}$
T_J	Max. operating junction temperature	150	$^{\circ}\text{C}$

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 21\text{ A}$, $di/dt \leq 600\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	D ² PAK	TO-247	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.78		$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max		50	$^{\circ}\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-ambient max	30		$^{\circ}\text{C}/\text{W}$

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

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max)	10	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$)	850	mJ

2 Electrical characteristics

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

Table 5. On/off states

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	600			V
$dv/dt^{(1)}$	Drain source voltage slope	$V_{DD} = 480\text{ V}$, $I_D = 21\text{ A}$, $V_{GS} = 10\text{ V}$	48			V/ns
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 600\text{ V}$			1	μA
		$V_{DS} = 600\text{ V}$ @ $T_C = 125\text{ }^{\circ}\text{C}$			100	μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 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	$V_{GS} = 10\text{ V}$, $I_D = 10.5\text{ A}$		0.13	0.16	Ω

1. Characteristic value at turn off on inductive load.

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{ V}$, $I_D = 10.5\text{ A}$	-	17	-	S
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	2400	-	pF
C_{oss}	Output capacitance		-	150	-	pF
C_{rss}	Reverse transfer capacitance		-	15	-	pF
$C_{oss}^{(2)}$ eq.	Equivalent output capacitance	$V_{GS} = 0$, $V_{DS} = 0\text{ to }480\text{ V}$	-	320	-	pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 10.5\text{ A}$ $R_G = 4.7\text{ }\Omega$ $V_{GS} = 10\text{ V}$ (see Figure 21), (see Figure 16)	-	60	-	ns
t_r	Rise time		-	30	-	ns
$t_{d(off)}$	Turn-off delay time		-	50	-	ns
t_f	Fall time		-	40	-	ns

Table 6. Dynamic (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 21\text{ A}$, $V_{GS} = 10\text{ V}$, (see Figure 17)	-	80	-	nC
Q_{gs}	Gate-source charge		-	15	-	nC
Q_{gd}	Gate-drain charge		-	40	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}$, gate DC Bias = 0, test signal level = 20 mV, $I_D = 0$	-	1.6	-	Ω

1. Pulsed: pulse duration=300 μ s, duty cycle 1.5%
2. $C_{oss\text{ eq}}$ 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 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)		-		84	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 21\text{ A}$, $V_{GS} = 0$	-		1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 21\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 18)	-	160		ns
Q_{rr}	Reverse recovery charge		-	1		μC
I_{RRM}	Reverse recovery current		-	15		A
t_{rr}	Reverse recovery time	$I_{SD} = 21\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 18)	-	230		ns
Q_{rr}	Reverse recovery charge		-	2		μC
I_{RRM}	Reverse recovery current		-	19		A

1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

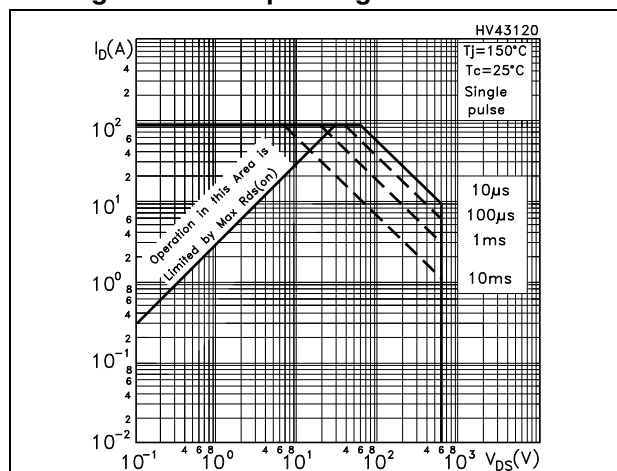
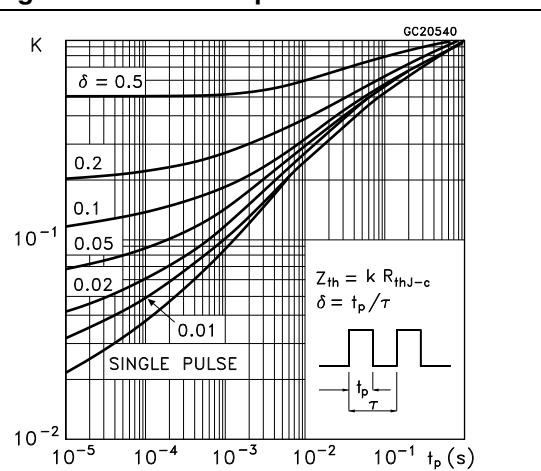
Figure 2. Safe operating area for D²PAKFigure 3. Thermal impedance for D²PAK

Figure 4. Safe operating area for TO-247

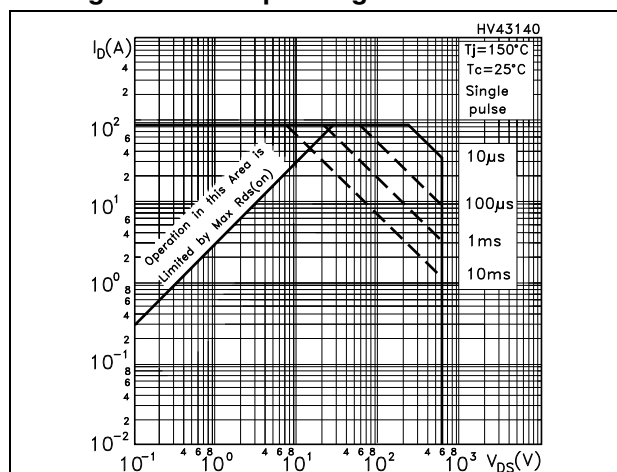


Figure 5. Thermal impedance for TO-247

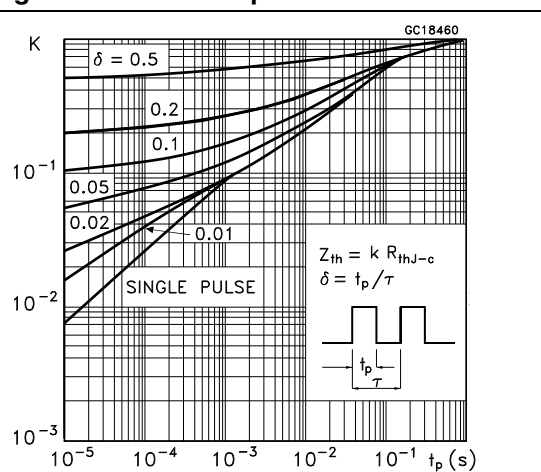


Figure 6. Output characteristics

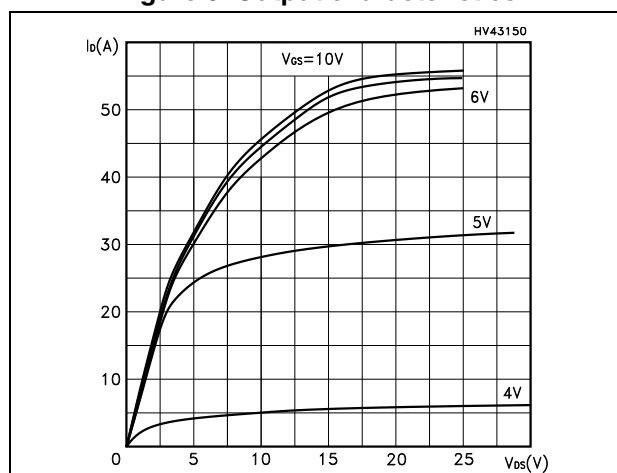


Figure 7. Transfer characteristics

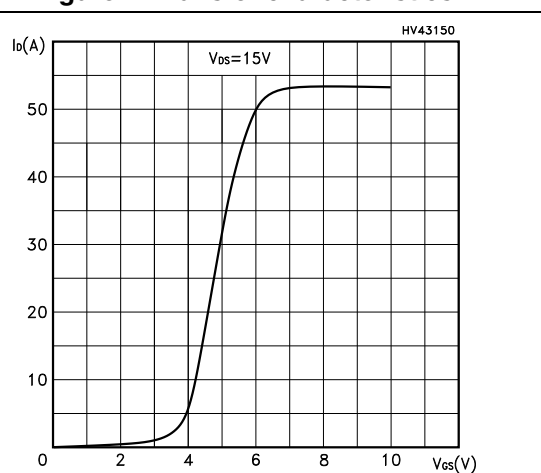


Figure 8. Transconductance

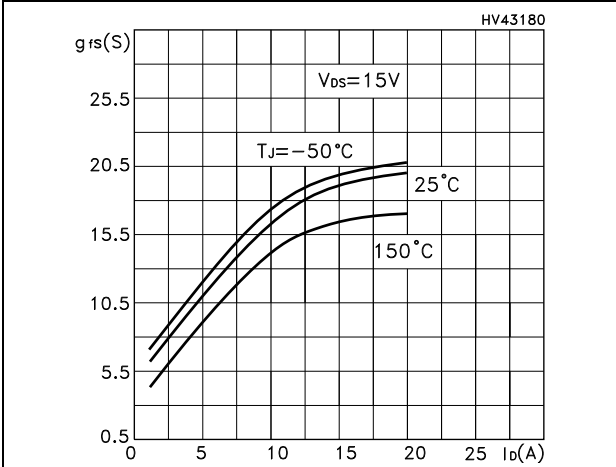


Figure 9. Static drain-source on-resistance

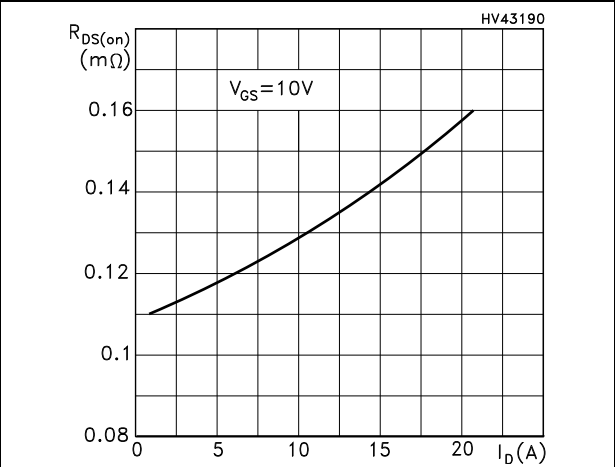


Figure 10. Gate charge vs gate-source voltage

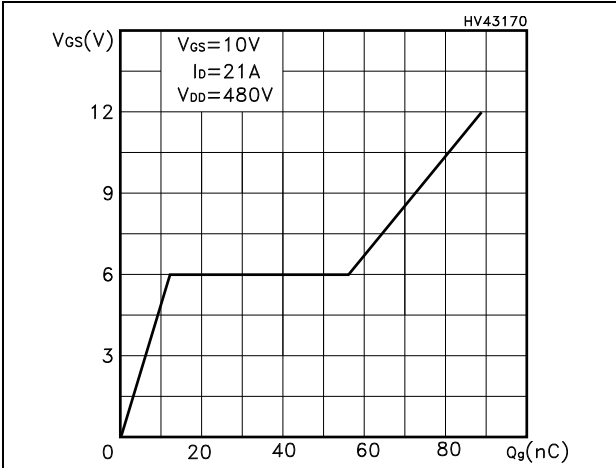


Figure 11. Capacitance variations

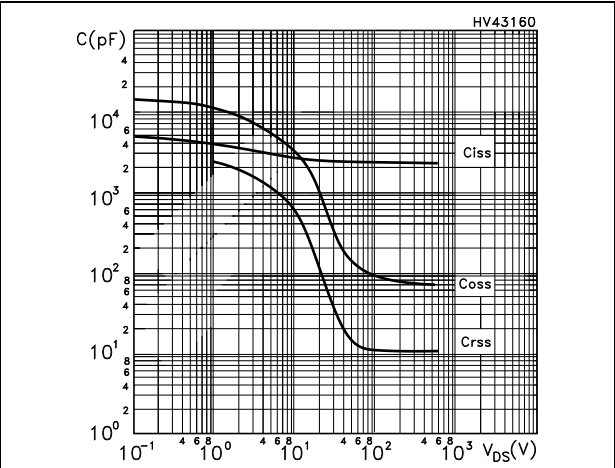


Figure 12. Normalized gate threshold voltage vs temperature

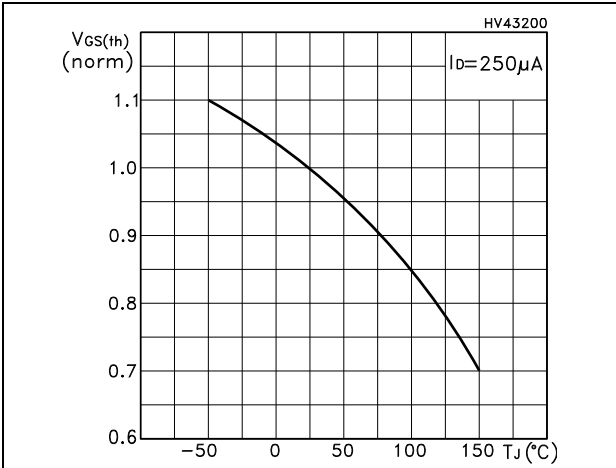


Figure 13. Normalized on-resistance vs temperature

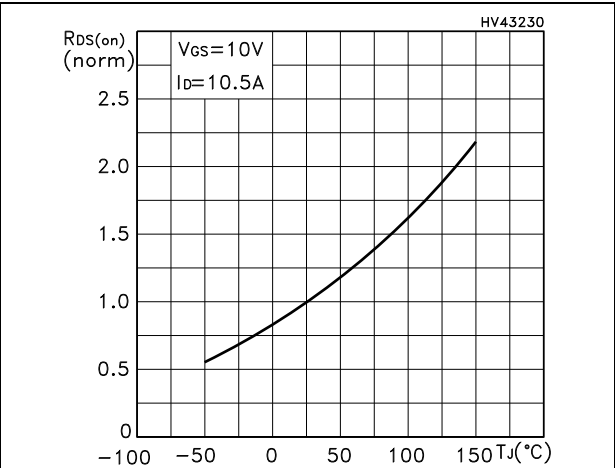


Figure 14. Source-drain diode forward characteristics

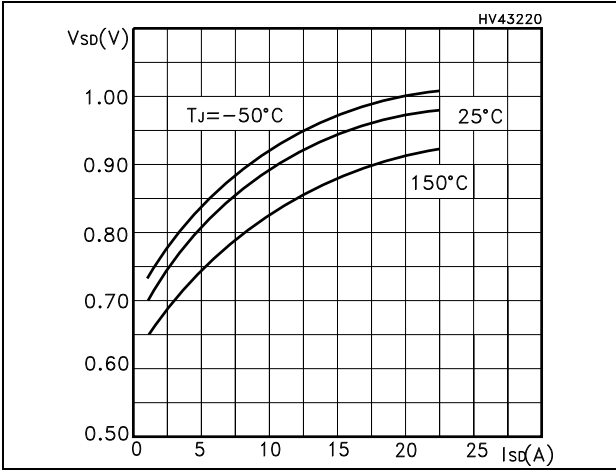
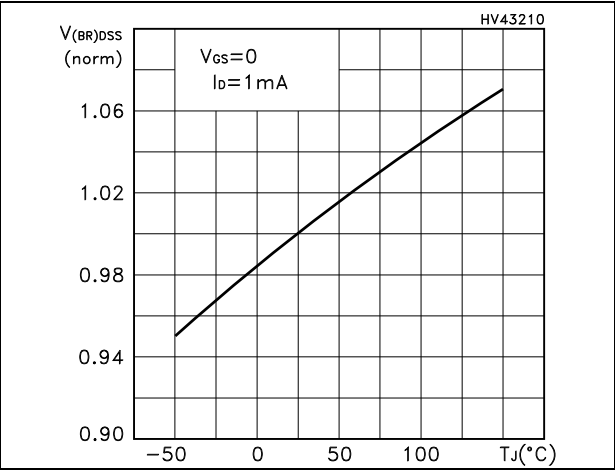
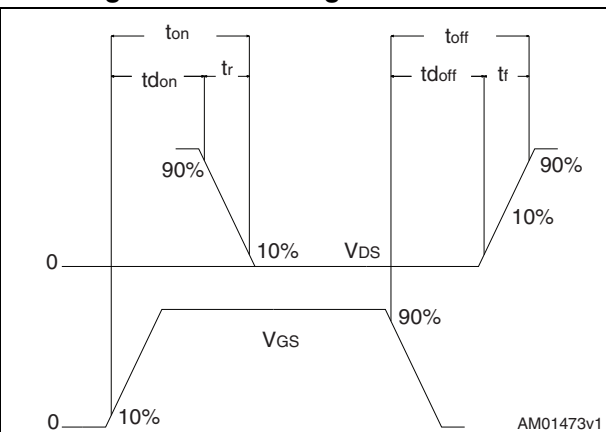
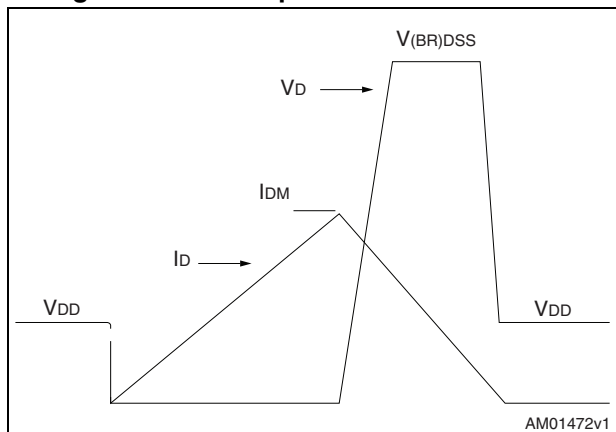
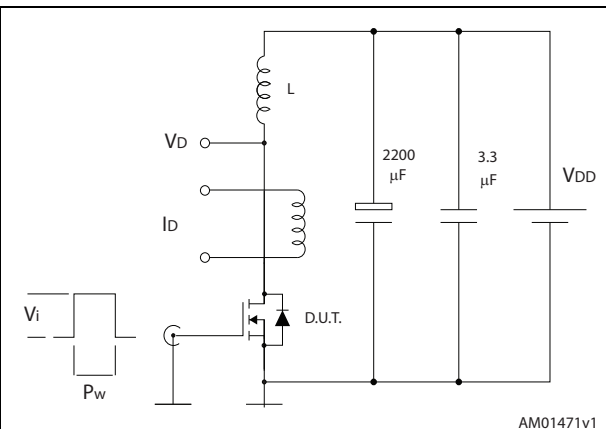
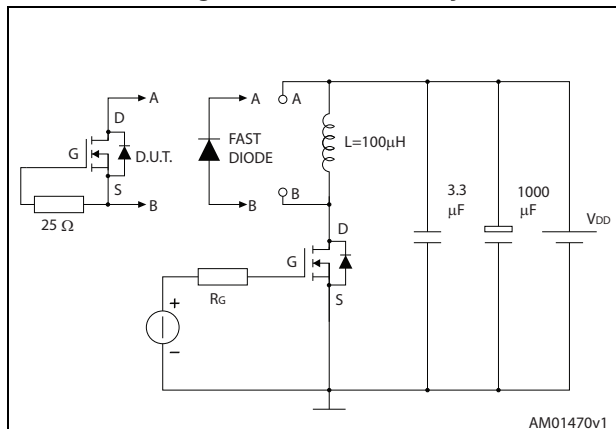
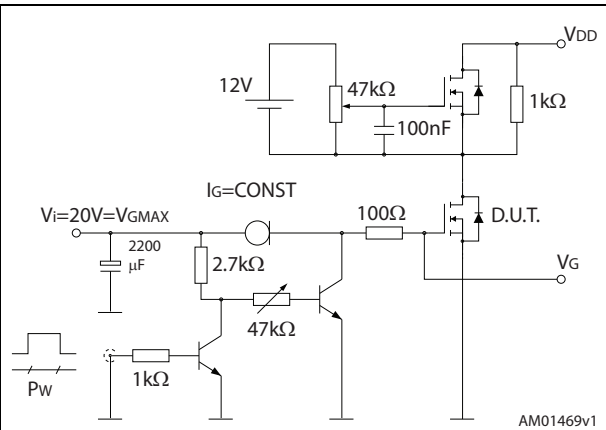
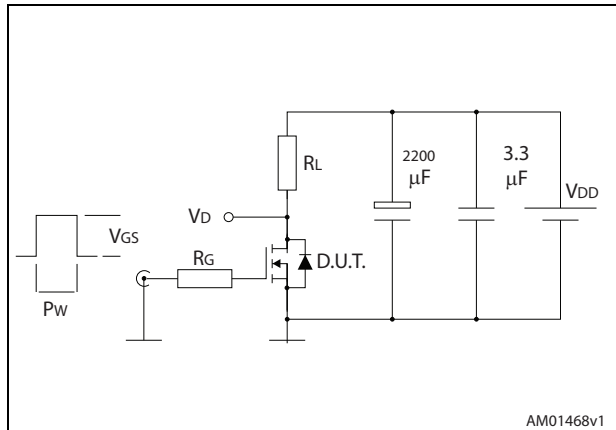


Figure 15. Normalized $V_{(BR)DSS}$ vs temperature



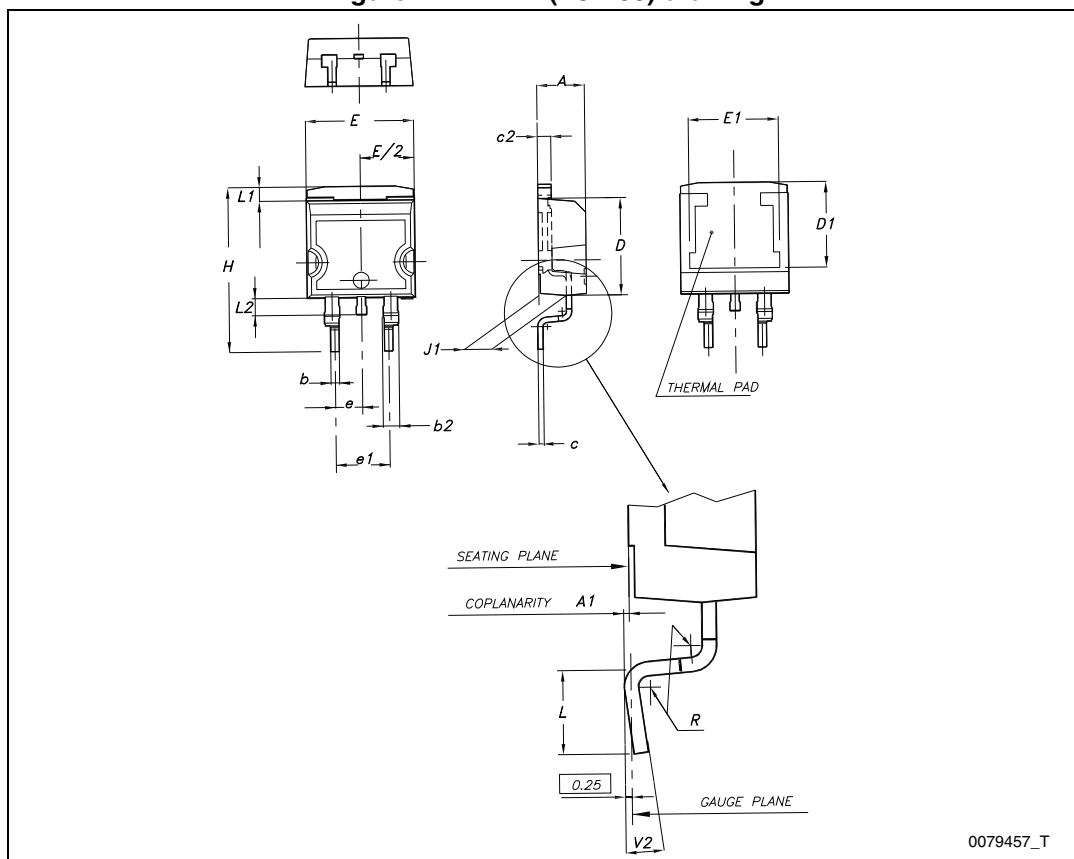
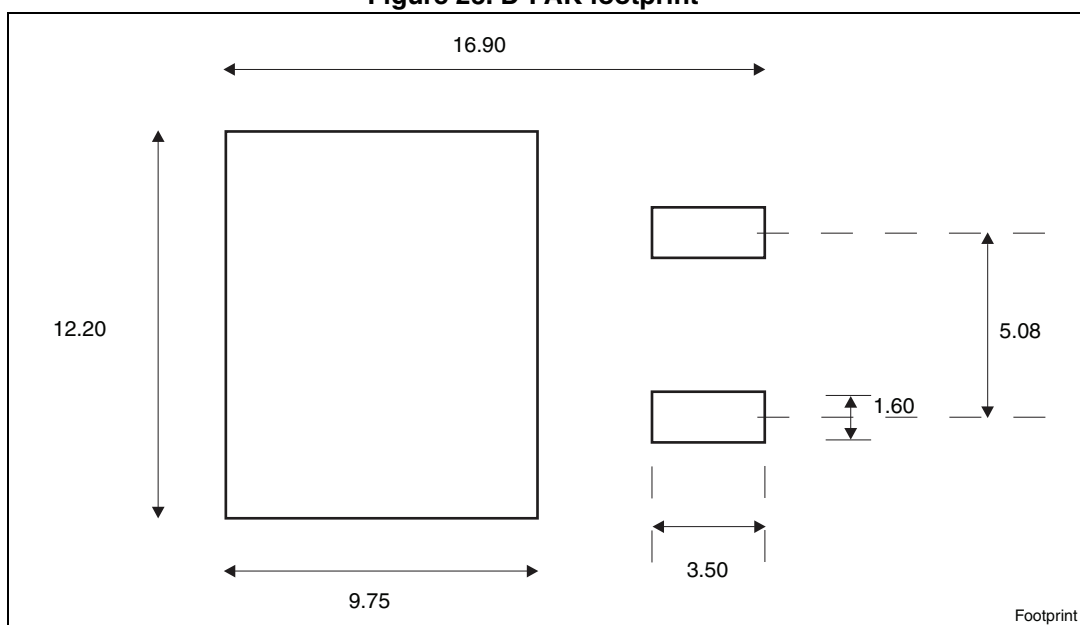


4 Package mechanical data

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. D²PAK (TO-263) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

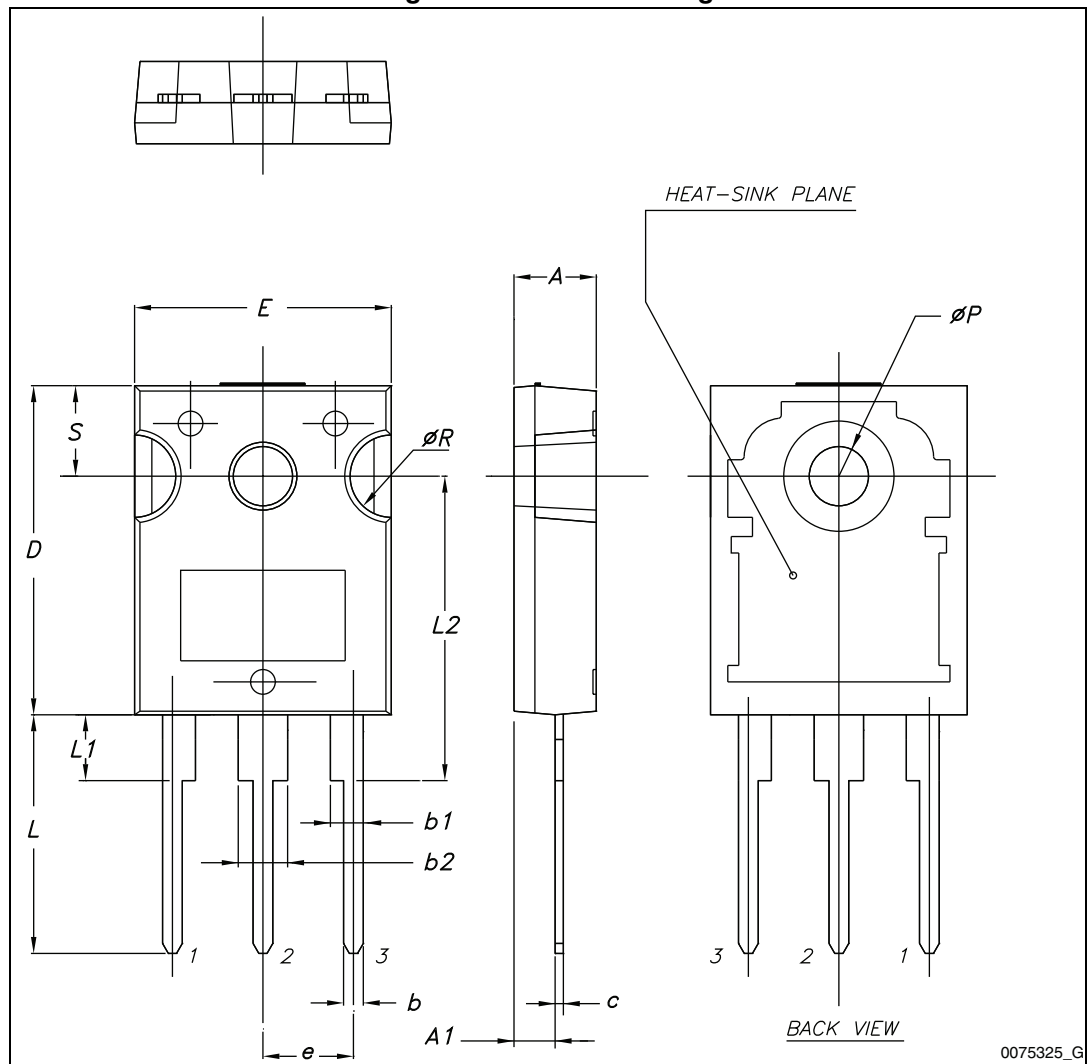
Figure 22. D²PAK (TO-263) drawingFigure 23. D²PAK footprint^(a)

a. All dimension are in millimeters

Table 9. TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 24. TO-247 drawing



5 Packing mechanical data

Table 10. D²PAK (TO-263) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base qty		1000
P2	1.9	2.1	Bulk qty		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Figure 25. Tape

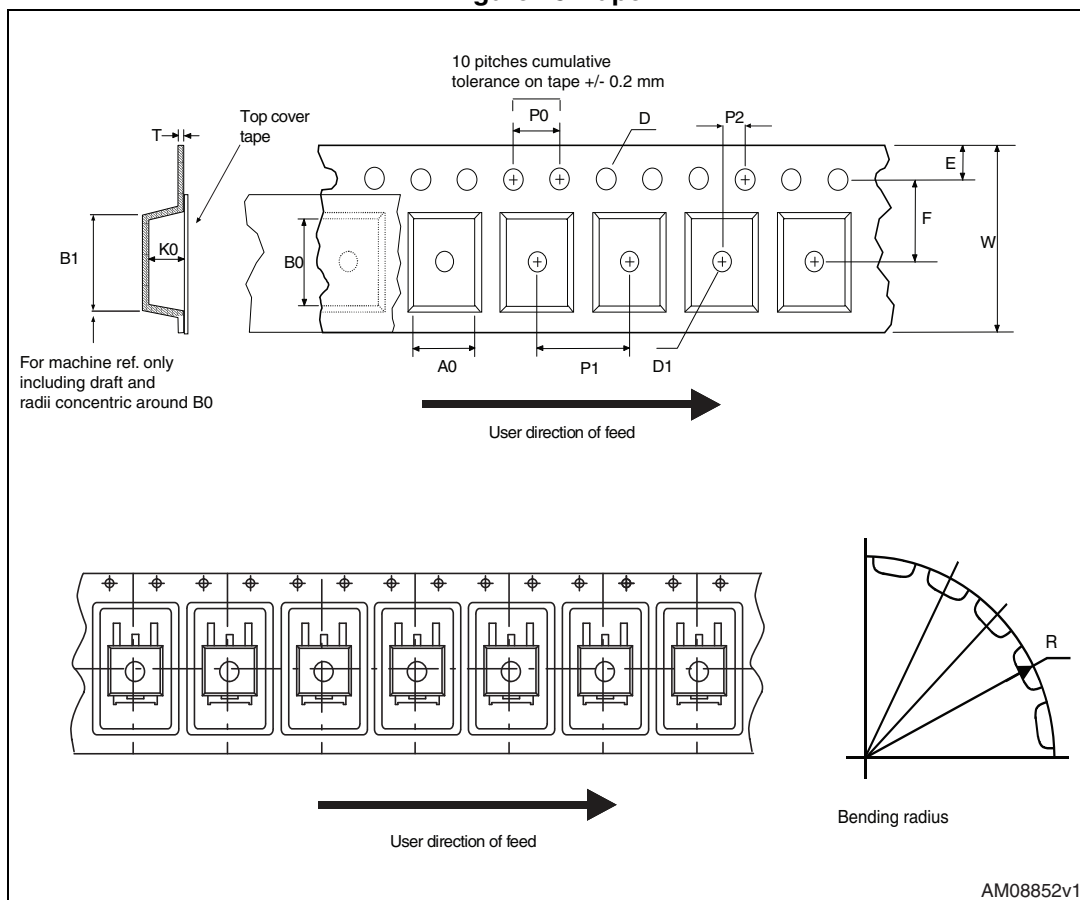
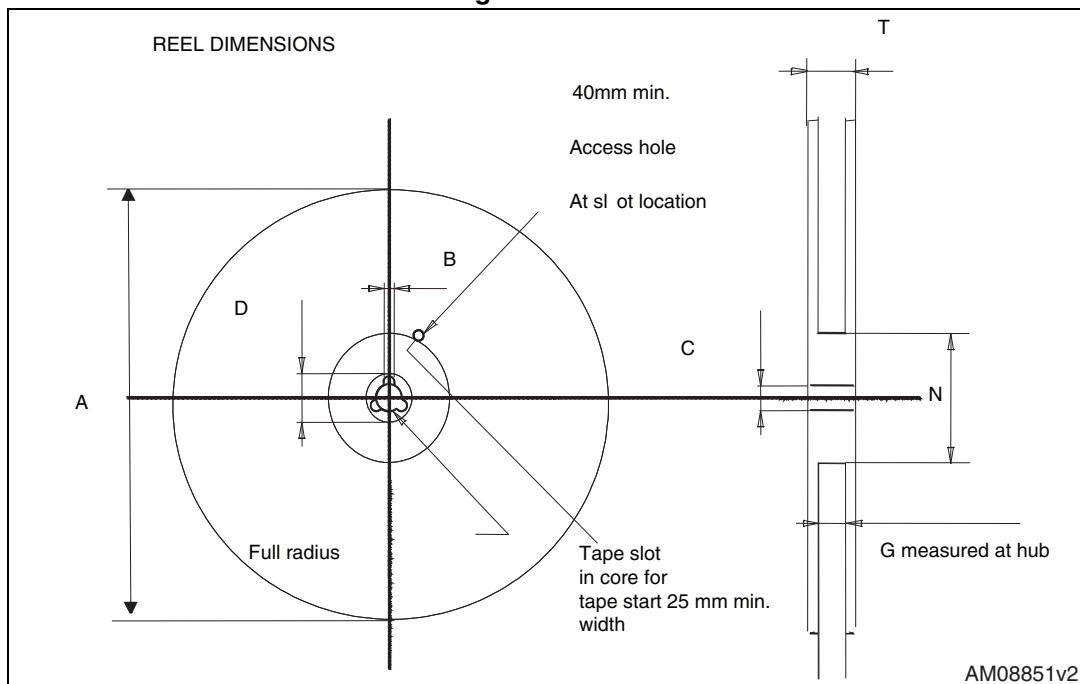


Figure 26. Reel



6 Revision history

Table 11. Document revision history

Date	Revision	Changes
02-Mar-2009	1	First release.
08-Mar-2011	2	Document status promoted from preliminary data to datasheet.
28-Nov-2011	3	Inserted new device in D ² PAK. Updated Table 1: Device summary , Table 3: Thermal data , Section 3: Test circuits and Section 4: Package mechanical data Inserted Section 5: Packing mechanical data . – Minor text changes.
31-Oct-2013	4	– Updated: title and features in cover page – Updated: Section 4: Package mechanical data and Section 5: Packing mechanical data – Minor text changes

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