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## N-channel 600 V, 0.092 $\Omega$ , 31.5 A MDmesh™ II Power MOSFETs in D<sup>2</sup>PAK and TO-220 packages

Datasheet - production data

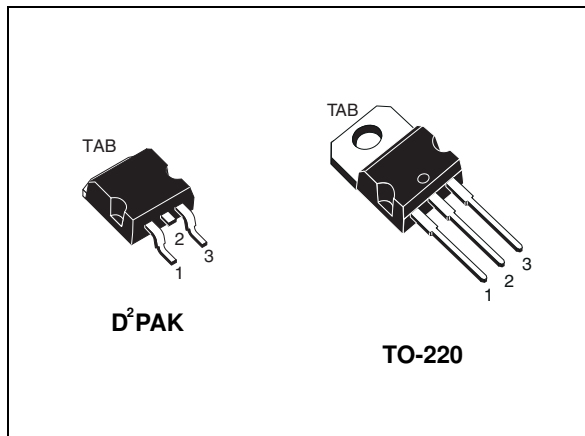
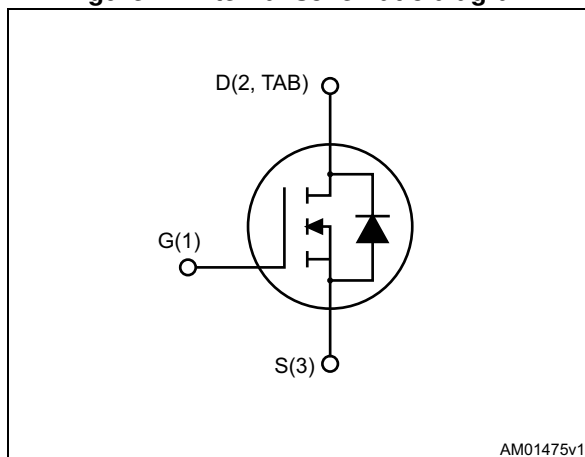


Figure 1. Internal schematic diagram



### Features

Order codes	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>TOT</sub>
STB34NM60N	600 V	0.105 $\Omega$	31.5 A	250 W
STP34NM60N				

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

### Applications

- Switching applications

### Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STB34NM60N	34NM60N	D <sup>2</sup> PAK	Tape and reel
STP34NM60N		TO-220	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	600	V
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	31.5	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	20	A
$I_{DM}^{(1)}$	Drain current (pulsed)	126	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	250	W
$I_{AR}$	Max current during repetitive or single pulse avalanche (pulse width limited by $T_{jmax}$ )	7	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ )	345	mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50	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.  $I_{SD} \leq 31.5\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS\text{ peak}} \leq V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$
3.  $V_{DS} \leq 480\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK	TO-220	
$R_{thj-case}$	Thermal resistance junction-case max	0.5		$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb max		62.5	
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb max	30		

1. When mounted on 1 inch<sup>2</sup> FR-4, 2 Oz copper board.

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ( $V_{GS} = 0$ )	$I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 600\text{ V}$ $V_{DS} = 600\text{ V}, T_c = 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 14.5\text{ A}$		0.092	0.105	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	2722	-	pF
$C_{oss}$	Output capacitance		-	173	-	pF
$C_{rss}$	Reverse transfer capacitance		-	1.75	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0, V_{DS} = 0\text{ to }480\text{ V}$	-	458	-	pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}, I_D = 15.75\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see <a href="#">Figure 19</a> and <a href="#">14</a> )	-	18	-	ns
$t_r$	Rise time		-	36	-	ns
$t_{d(off)}$	Turn-off delay time		-	104	-	ns
$t_f$	Fall time		-	73	-	ns
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 31.5\text{ A}$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 15</a> )	-	84	-	nC
$Q_{gs}$	Gate-source charge		-	14	-	nC
$Q_{gd}$	Gate-drain charge		-	45	-	nC
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz},$ gate DC Bias=0 test signal level=20 mV open drain	-	2.9	-	$\Omega$

1.  $C_{oss\text{ eq.}}$  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 6. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		31.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		126	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}= 31.5 \text{ A}, V_{GS}=0$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD}= 31.5 \text{ A}, V_{DD}= 60 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$ , (see <a href="#">Figure 16</a> )	-	412		ns
$Q_{rr}$	Reverse recovery charge		-	8		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	39		A
$t_{rr}$	Reverse recovery time	$I_{SD}= 31.5 \text{ A}, V_{DD}= 60 \text{ V}$ $di/dt=100 \text{ A}/\mu\text{s}$ , $T_J=150 \text{ }^\circ\text{C}$ (see <a href="#">Figure 16</a> )	-	490		ns
$Q_{rr}$	Reverse recovery charge		-	10		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	43		A

1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

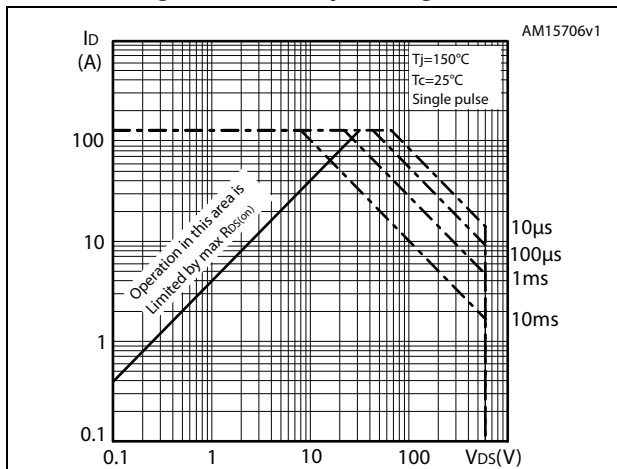


Figure 3. Thermal impedance

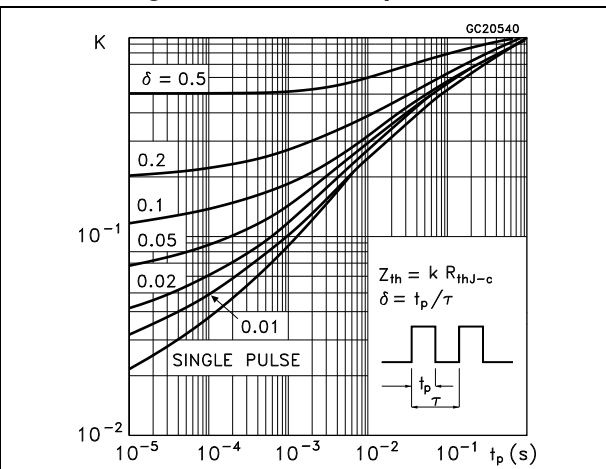


Figure 4. Output characteristics

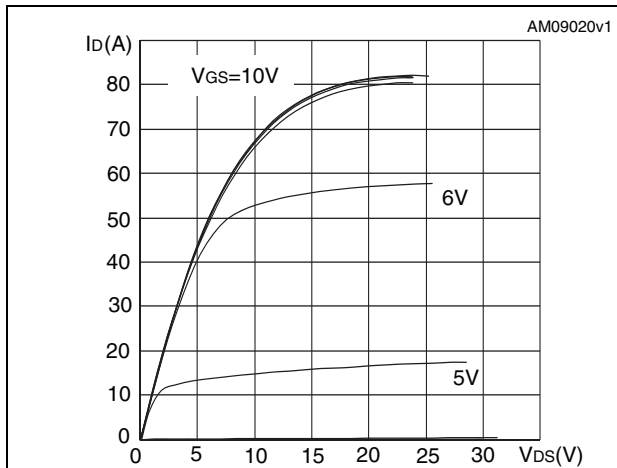


Figure 5. Transfer characteristics

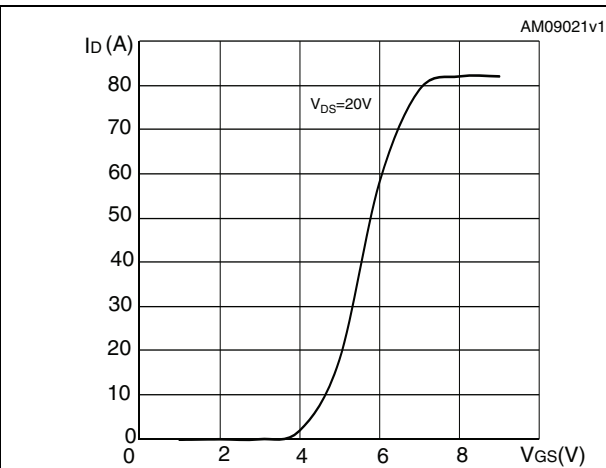


Figure 6. Gate charge vs gate-source voltage

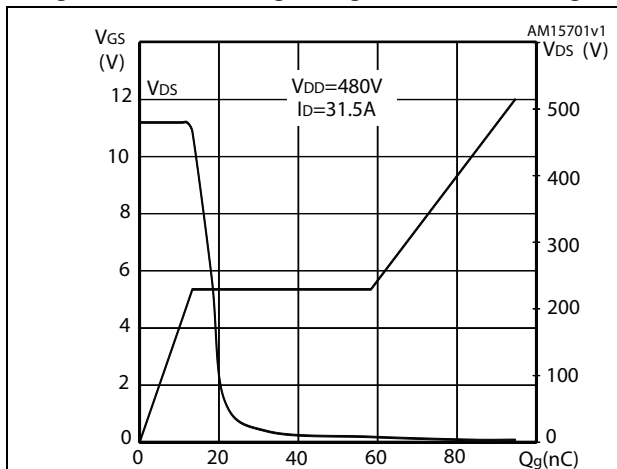


Figure 7. Static drain-source on-resistance

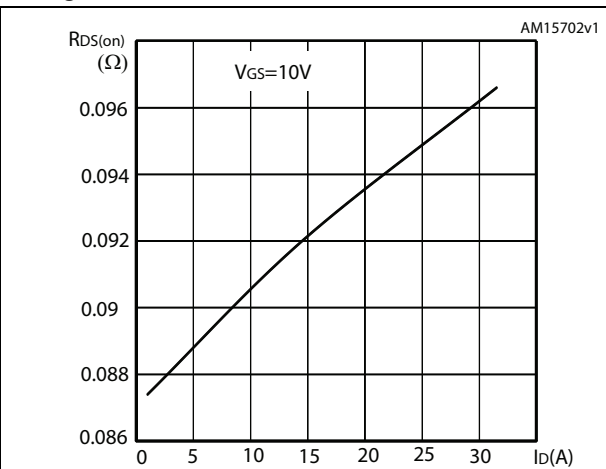


Figure 8. Capacitance variations

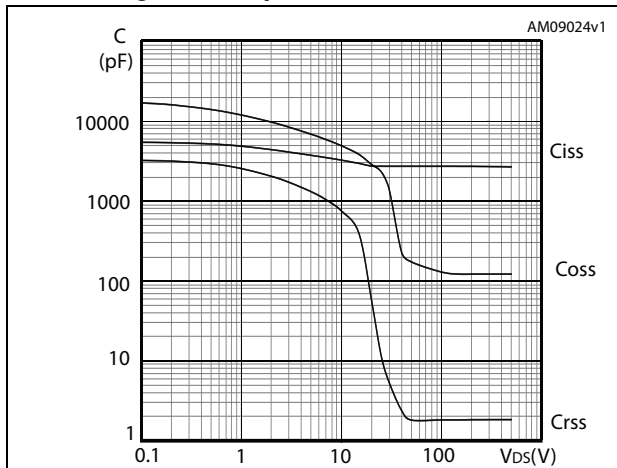


Figure 9. Output capacitance stored energy

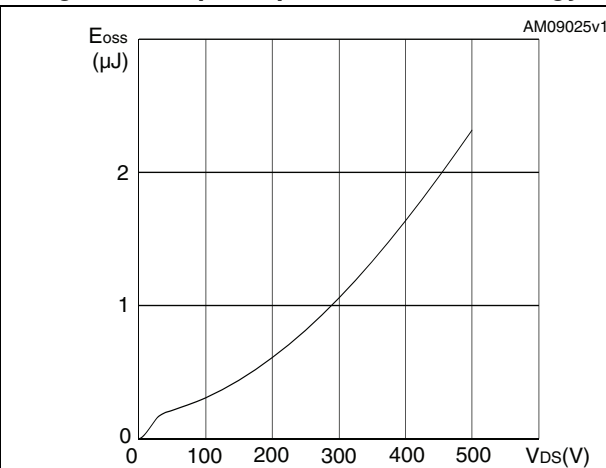


Figure 10. Normalized gate threshold voltage vs temperature

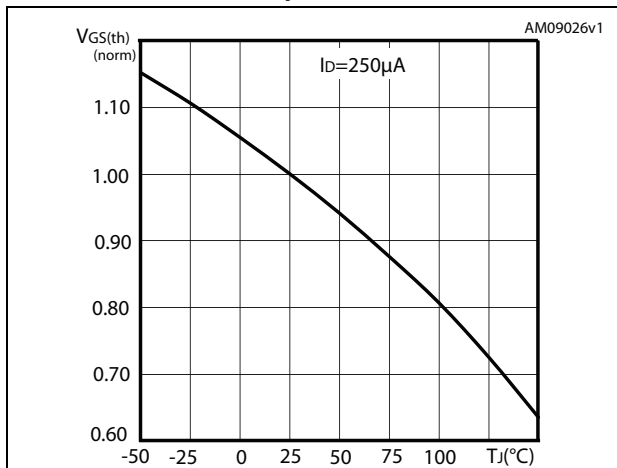


Figure 11. Normalized on-resistance vs temperature

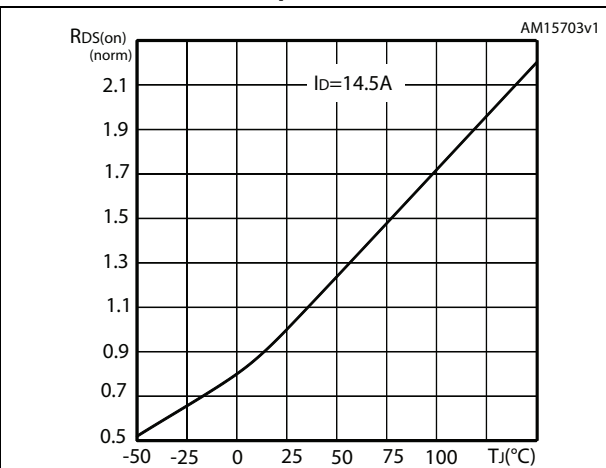


Figure 12. Normalized BVDS vs temperature

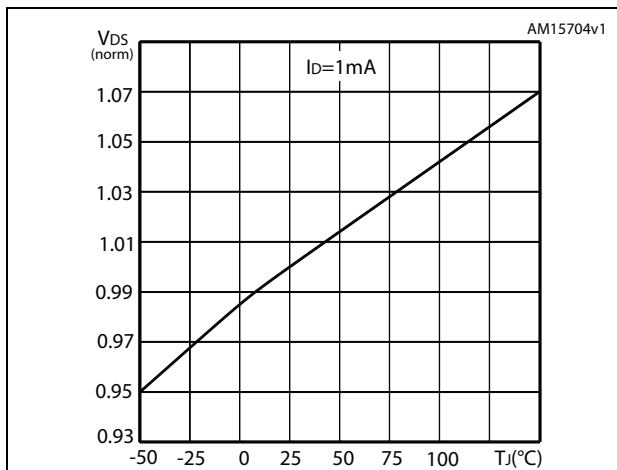
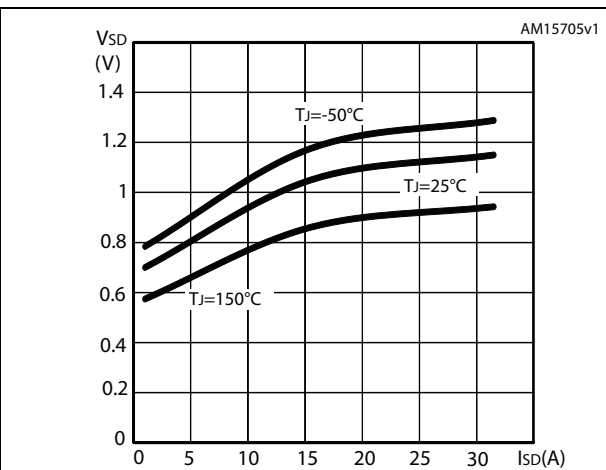


Figure 13. Source-drain diode forward characteristics



### 3 Test circuits

Figure 14. Switching times test circuit for resistive load

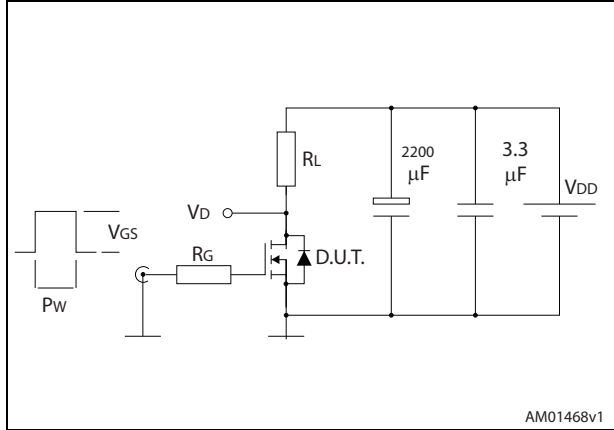


Figure 15. Gate charge test circuit

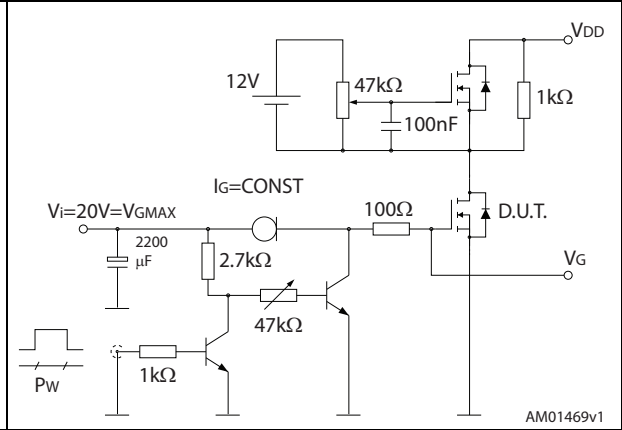


Figure 16. Test circuit for inductive load switching and diode recovery times

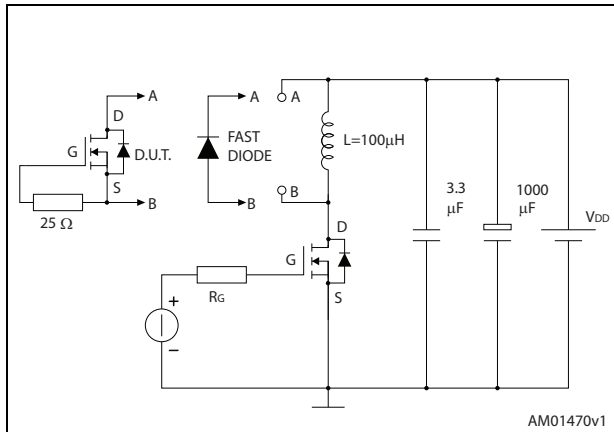


Figure 17. Unclamped inductive load test circuit

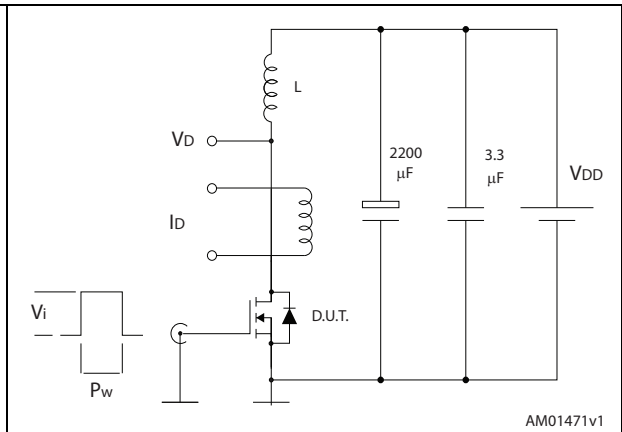


Figure 18. Unclamped inductive waveform

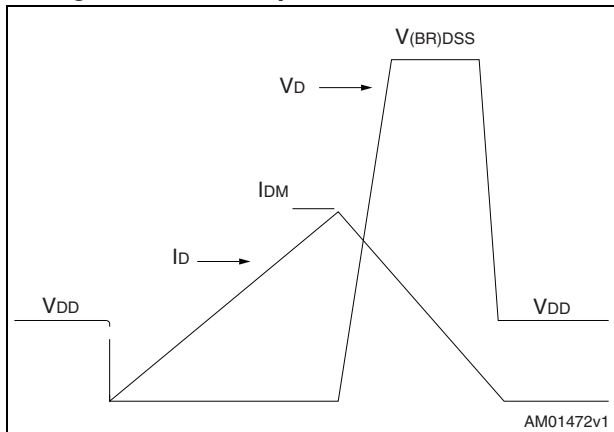
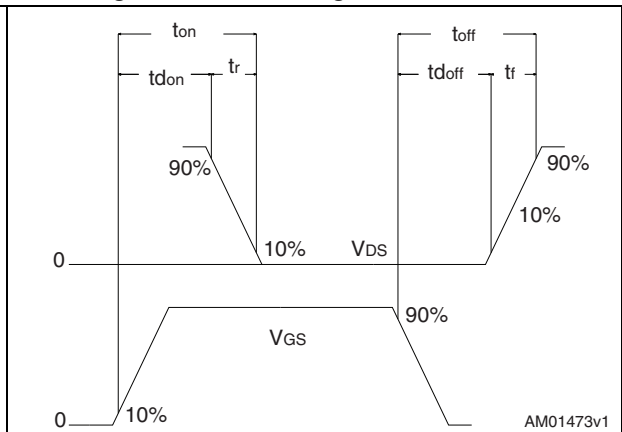


Figure 19. Switching time waveform



## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 4.1 D<sup>2</sup>PAK package information

Figure 20. D<sup>2</sup>PAK (TO-263) outline

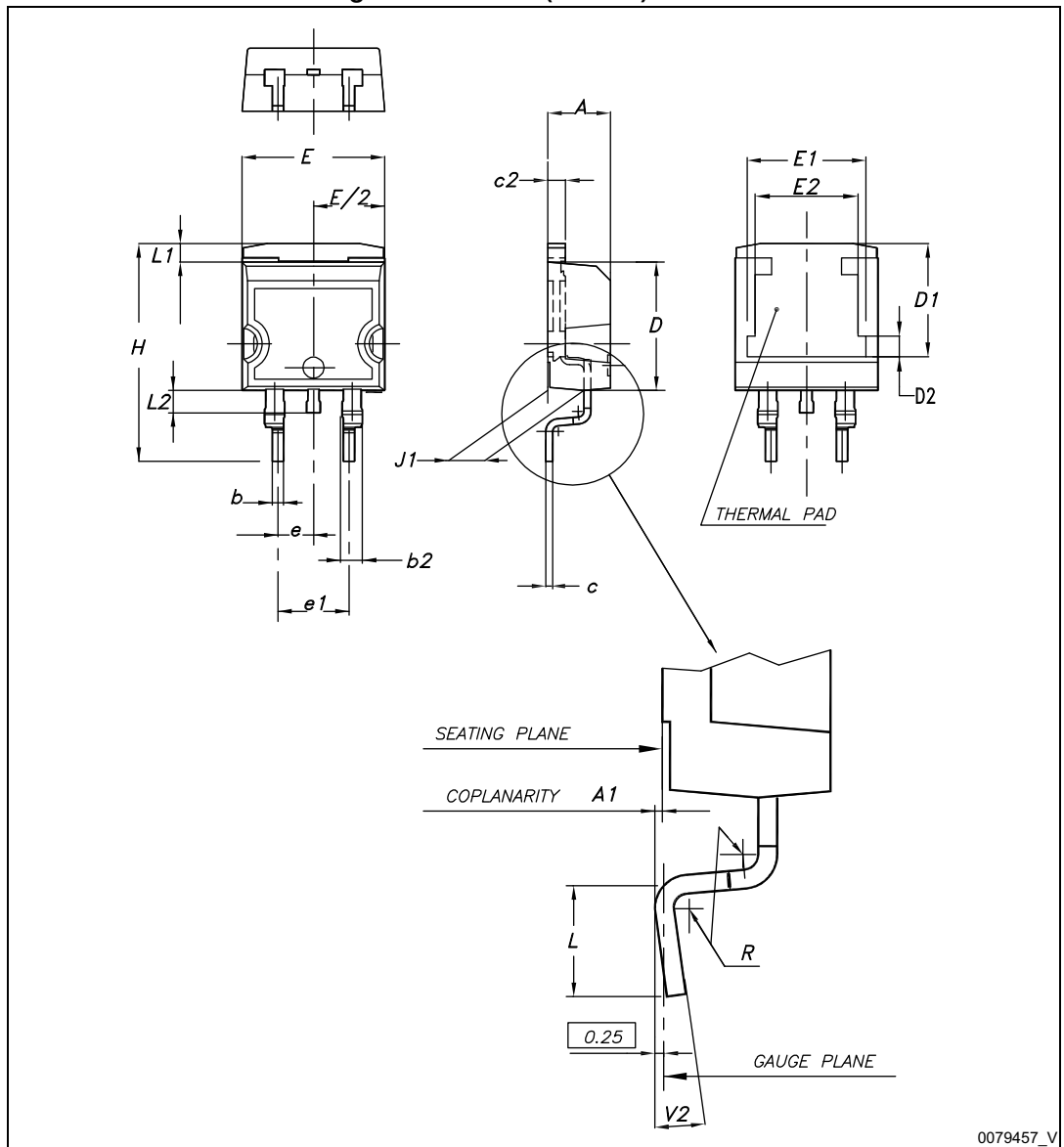
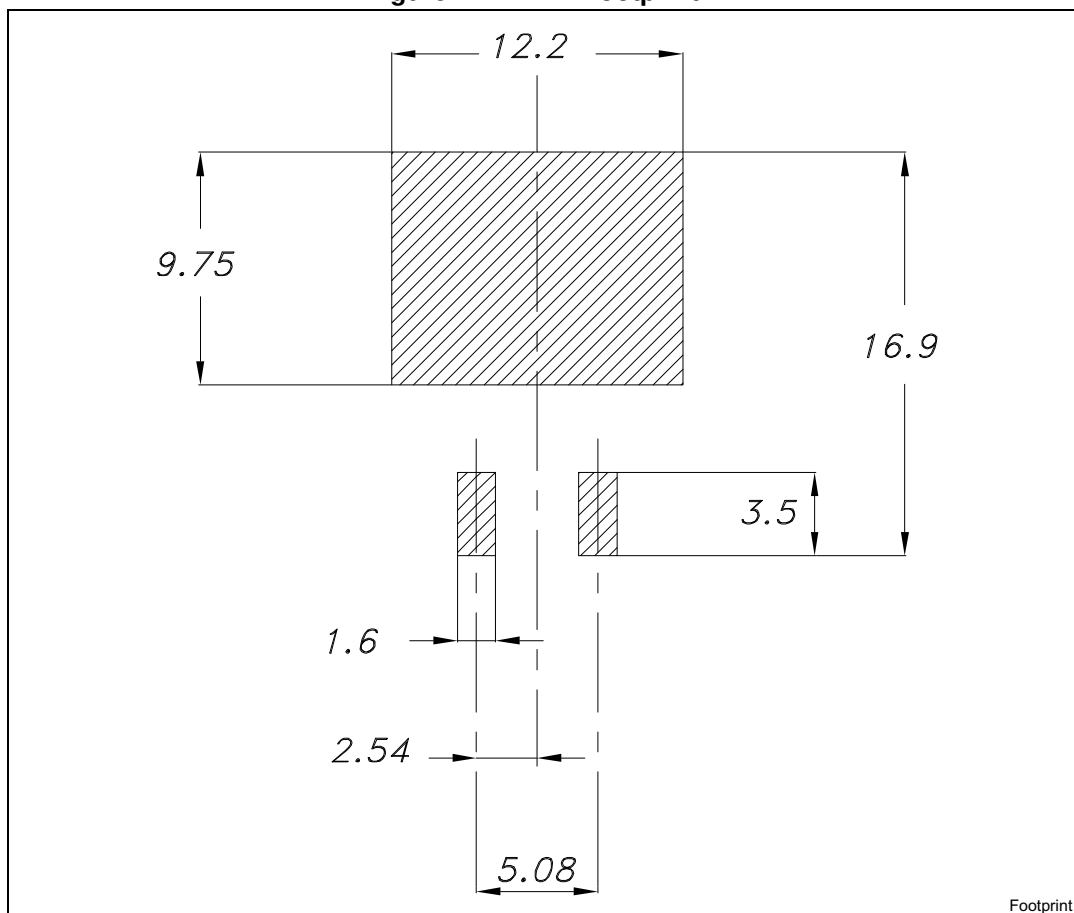


Table 7. D<sup>2</sup>PAK (TO-263) mechanical data

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	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
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°

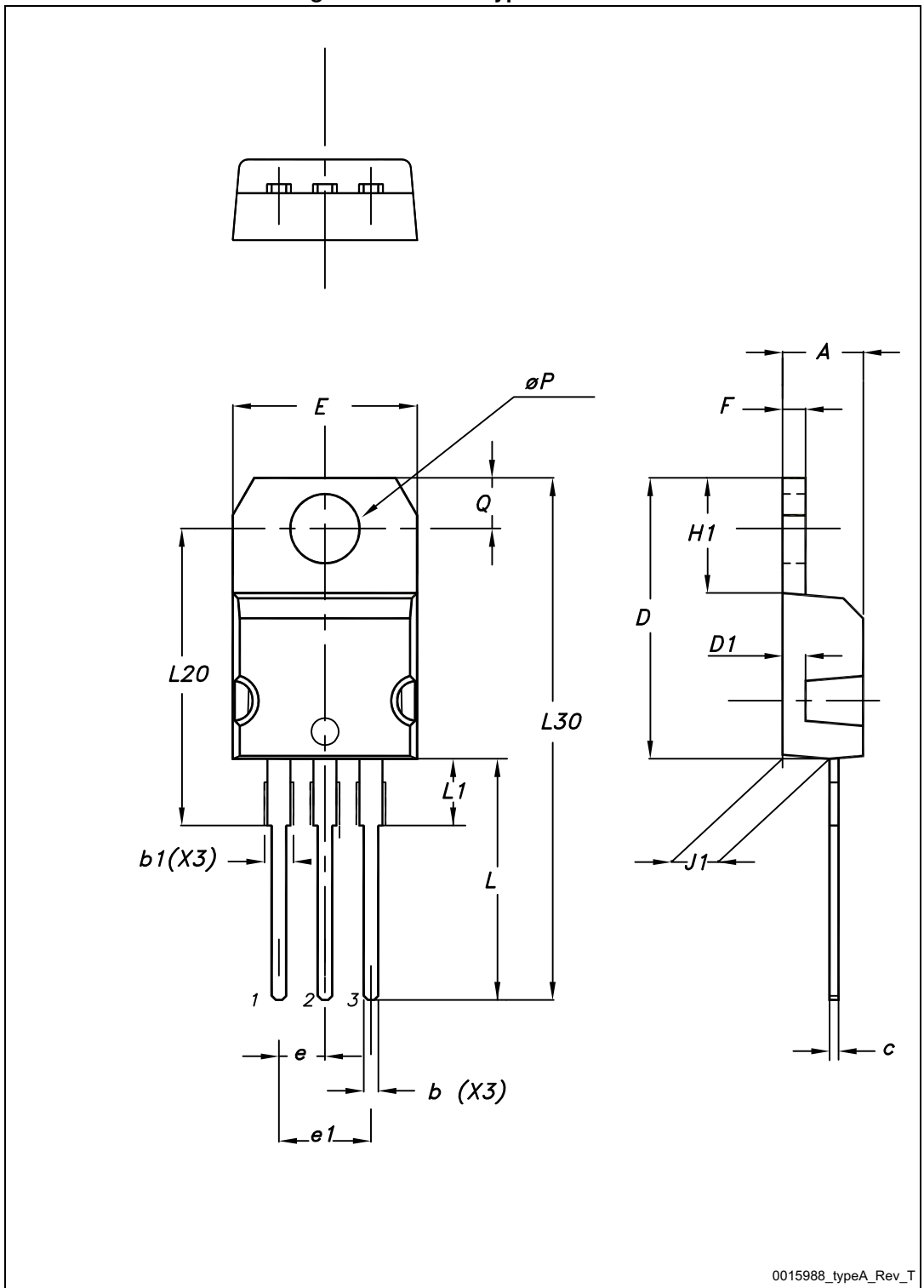
Figure 21. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

### 4.2 TO-220 package information

Figure 22. TO-220 type A outline



0015988\_typeA\_Rev\_T

Table 8. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

## 5 Packing information

Table 9. D<sup>2</sup>PAK (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 23. Tape

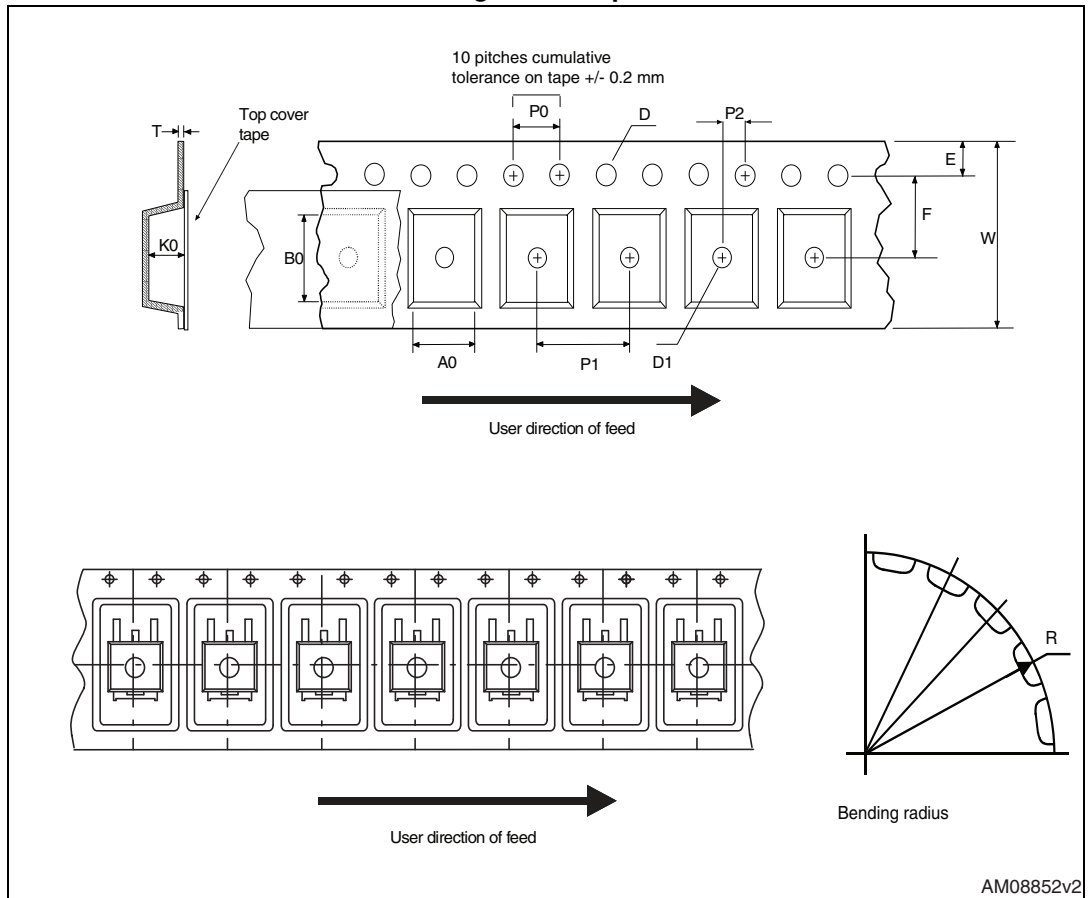
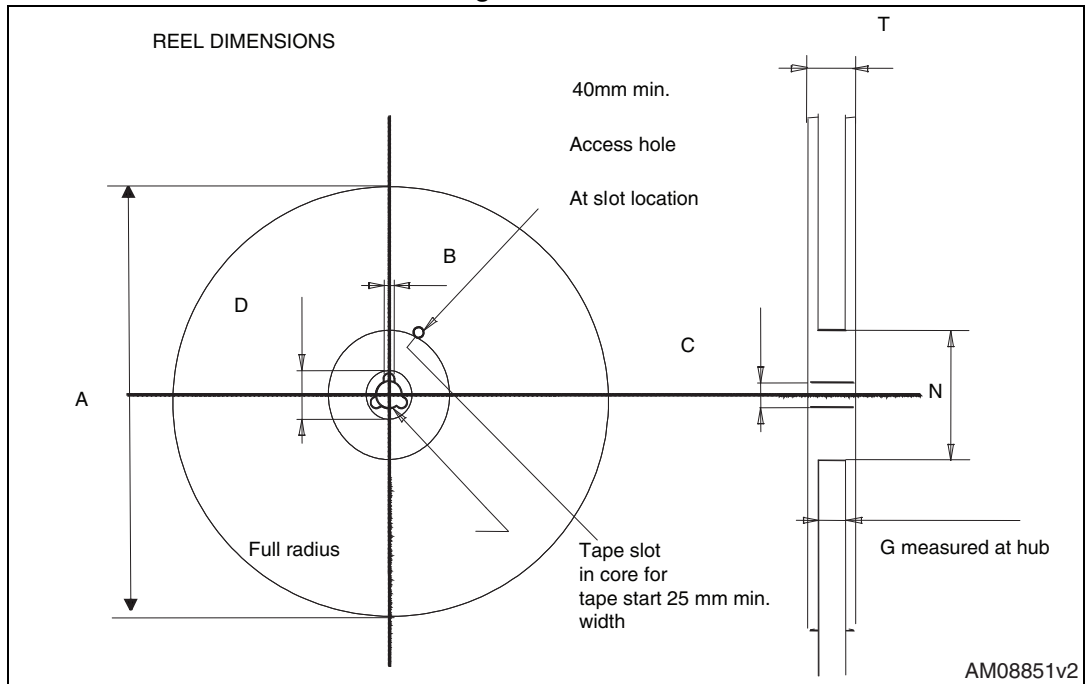


Figure 24. Reel



## 6 Revision history

**Table 10. Document revision history**

Date	Revision	Changes
05-Aug-2010	1	Initial release.
02-Sep-2010	2	Updated title on cover page and <a href="#">Table 4: On/off states</a> .
07-Apr-2011	3	Document status promoted from preliminary data to datasheet.
10-Oct-2011	4	Inserted new device in D <sup>2</sup> PAK: Updated: <a href="#">Table 2: Absolute maximum ratings</a> , <a href="#">Table 3: Thermal data</a> and <a href="#">Section 4: Package information</a> with the new device. Inserted <a href="#">Section 5: Packing information</a> . Minor text changes.
12-Dec-2011	5	<ul style="list-style-type: none"> <li>– <a href="#">Figure 9: Output capacitance stored energy</a> has been updated.</li> <li>– <a href="#">Figure 10: Normalized gate threshold voltage vs temperature</a> has been updated.</li> <li>– <a href="#">Figure 11: Normalized on-resistance vs temperature</a> has been updated.</li> <li>– <a href="#">Figure 12: Normalized <math>B_{VDSS}</math> vs temperature</a> has been updated.</li> </ul>
21-Dec-2011	6	Updated: <a href="#">Table 2: Absolute maximum ratings</a> ( $V_{ISO}$ value for TO-220FP)
10-May-2012	7	<a href="#">Figure 6: Gate charge vs gate-source voltage</a> has been updated.
01-Jul-2013	8	<ul style="list-style-type: none"> <li>– The part number STB34NM60N has been moved to a separate datasheet.</li> <li>– Added: MOSFET ruggedness parameter and <a href="#">3</a> on <a href="#">Table 2</a></li> <li>– Modified: <math>I_D</math> value on <a href="#">Table 5</a> and typical values for <math>t_{d(on)}</math>, <math>t_r</math>, <math>t_{d(off)}</math> and <math>t_f</math>, max values for <math>I_{SD}</math> and <math>I_{SDM}</math>, <math>I_{SD}</math> for <math>V_{SD}</math>, typical value and <math>I_{SD}</math> for <math>t_{rr}</math></li> <li>– Modified: <a href="#">Figure 6, 7, 12</a> and <a href="#">13</a></li> <li>– Minor text changes</li> </ul>
20-Mar-2015	9	<ul style="list-style-type: none"> <li>– The part number STW34NM60N has been moved to a separate datasheet.</li> <li>– Updated <a href="#">Section 4: Package information</a>.</li> <li>– Minor text changes.</li> </ul>

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