STB34NM60N, STP34NM60N, STW34NM60N

N-channel 600 V, 0.092 Ω, 31.5 A MDmesh™ II Power MOSFETs in D²PAK, TO-247 and TO-220 packages

Datasheet - production data

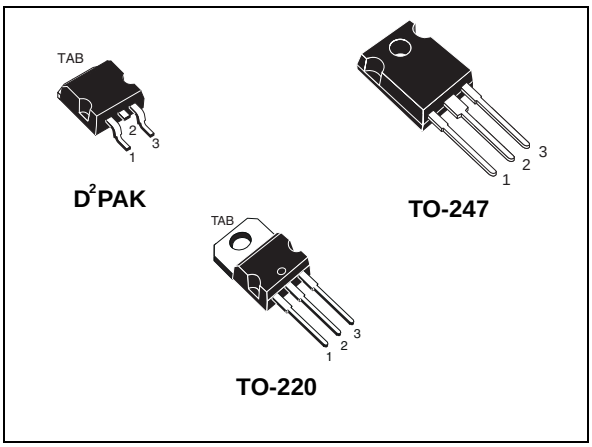
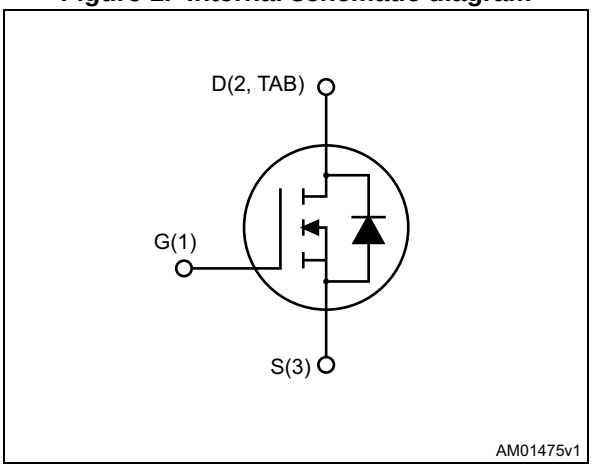


Figure 1. Internal schematic diagram



Features

Order codes	V_{DSS}	$R_{DS(on)}$	I_D	P_{TOT}
STB34NM60N	600 V	0.105 Ω	31.5 A	250 W
STP34NM60N				
STW34NM60N				

- 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	D²PAK	Tape and reel
STP34NM60N		TO-220	Tube
STW34NM60N		TO-247	

Contents

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 °C	31.5	A
I_D	Drain current (continuous) at T_C = 100 °C	20	A
I_{DM} (1)	Drain current (pulsed)	126	A
P_{TOT}	Total dissipation at T_C = 25 °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 °C, I_D=I_{AS}, V_{DD}= 50 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	°C
T_j	Operating junction temperature	150	

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 31.5$ A, di/dt $\leq$ 400 A/µs, V_{DS} peak $\leq V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$
3. $V_{DS} \leq$ 480 V

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		D^2PAK	TO-220	TO-247	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.5			°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-amb max		**62.5**	**50**	
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb max	**30**			

1.

2 Electrical characteristics

(T_{CASE} = 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 (V_{GS}= 0)	I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V V_{DS} = 600 V, Tc=125 °C			1 100	µA 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	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D= 14.5 A		0.092	0.105	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	-	2722	-	pF
C_{oss}	Output capacitance		-	173	-	pF
C_{rss}	Reverse transfer capacitance		-	1.75	-	pF
$C_{oss\ eq.}$ (1)	Equivalent capacitance time related	V_{GS} = 0, V_{DS} = 0 to 480 V	-	458	-	pF
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 15.75 A, R_G=4.7 Ω, V_{GS}=10 V *(see Figure 21 and 16)*	-	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 V, I_D = 31.5 A V_{GS} =10 V *(see Figure 17)*	-	84	-	nC
Q_{gs}	Gate-source charge		-	14	-	nC
Q_{gd}	Gate-drain charge		-	45	-	nC
R_G	Intrinsic gate resistance	f = 1 MHz, gate DC Bias=0 test signal level=20 mV open drain	-	2.9	-	Ω

1. $C_{oss\ eq.}$ 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. 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 A, V_{GS}=0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD}= 31.5 A, V_{DD}= 60 V di/dt = 100 A/µs, *(see Figure 18)*	-	412		ns
Q_{rr}	Reverse recovery charge		-	8		nC
I_{RRM}	Reverse recovery current		-	39		A
t_{rr}	Reverse recovery time	I_{SD}= 12 A,V_{DD}= 60 V di/dt=100 A/µs, T_j=150 °C *(see Figure 18)*	-	490		ns
Q_{rr}	Reverse recovery charge		-	10		nC
I_{RRM}	Reverse recovery current		-	43		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 D²PAK and TO-220

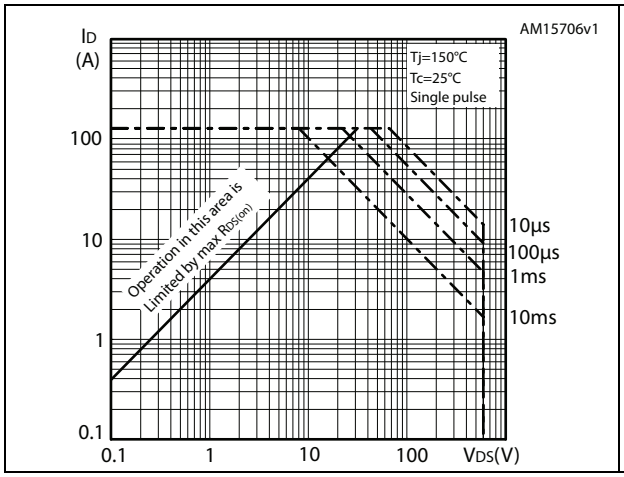


Figure 3. Thermal impedance for D²PAK and TO-220

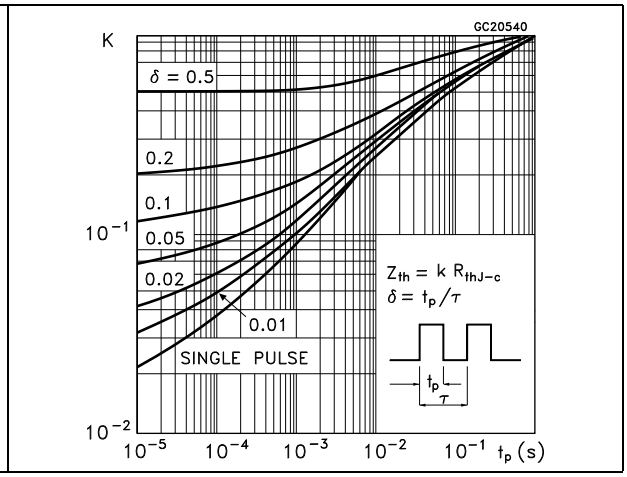


Figure 4. Safe operating area for TO-247

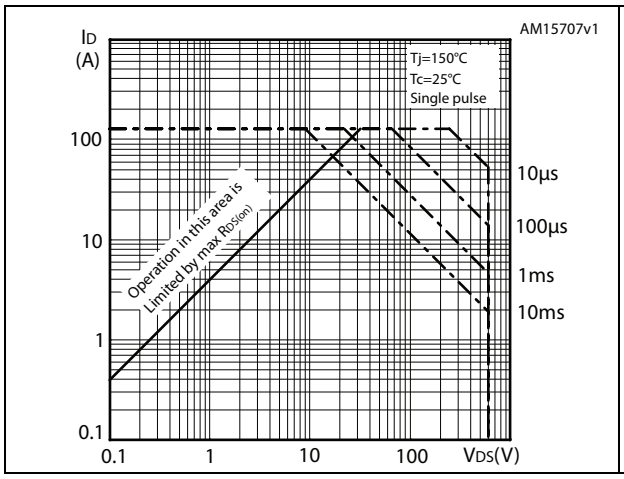


Figure 5. Thermal impedance for TO-247

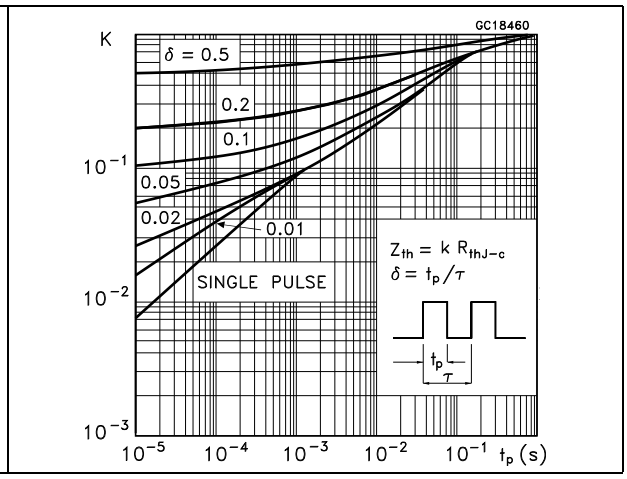


Figure 6. Output characteristics

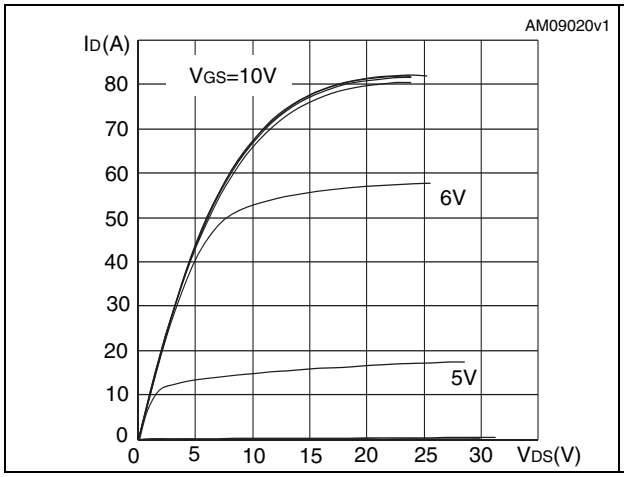


Figure 7. Transfer characteristics

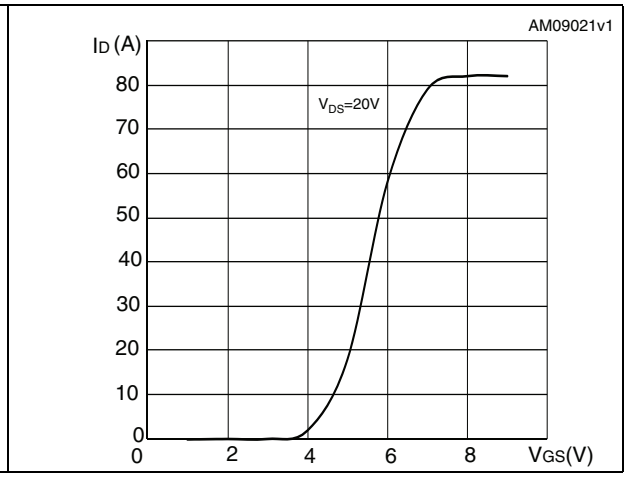


Figure 8. Gate charge vs gate-source voltage

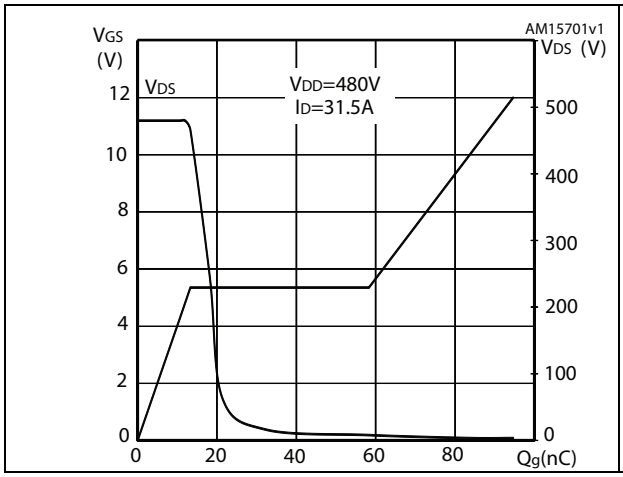


Figure 9. Static drain-source on-resistance

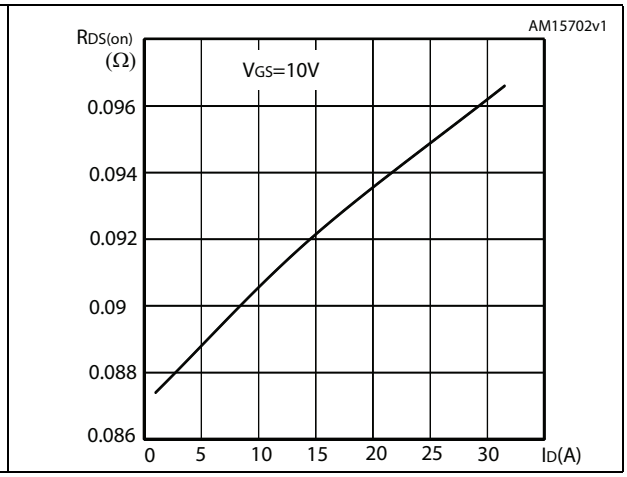


Figure 10. Capacitance variations

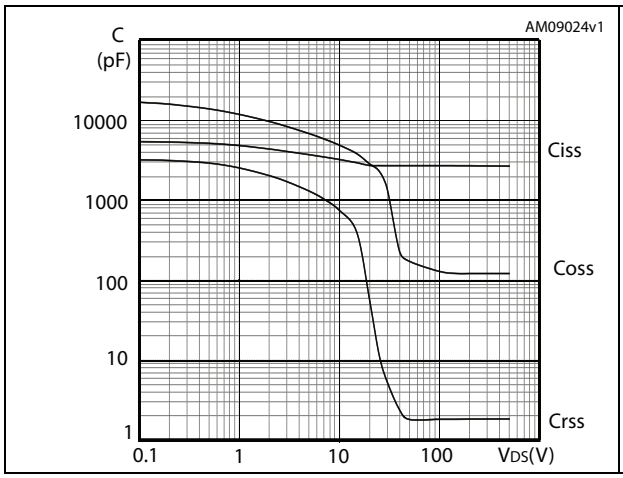


Figure 11. Output capacitance stored energy

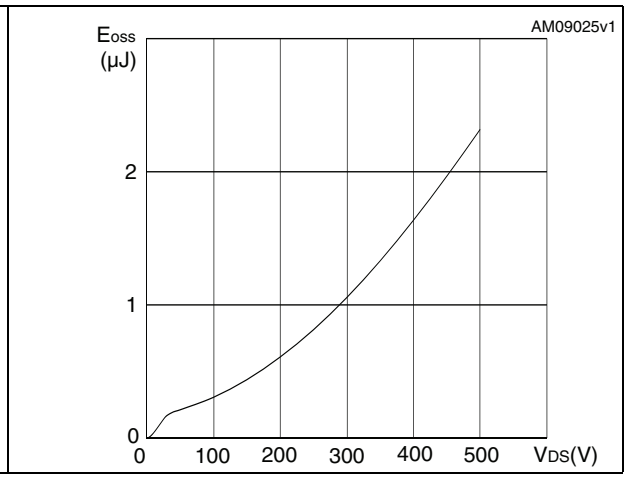


Figure 12. Normalized gate threshold voltage vs temperature

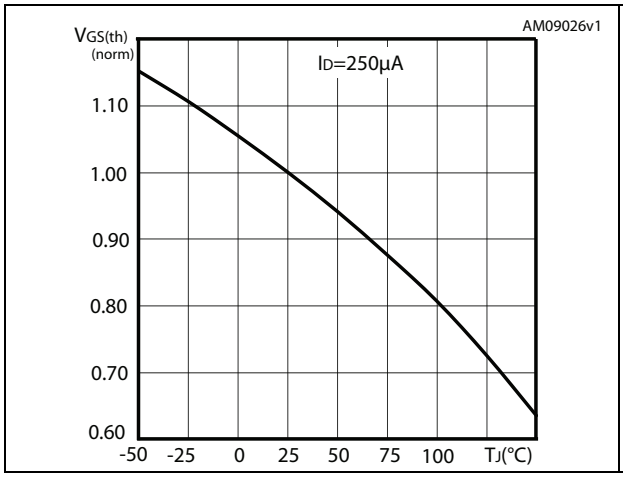


Figure 13. Normalized on-resistance vs temperature

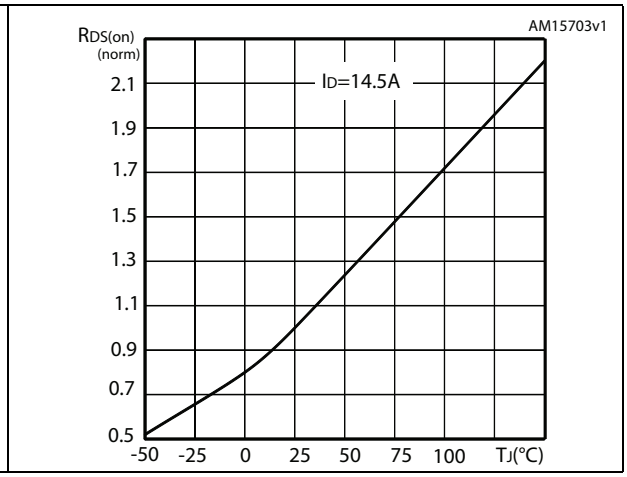


Figure 14. Normalized B_{VDSS} vs temperature

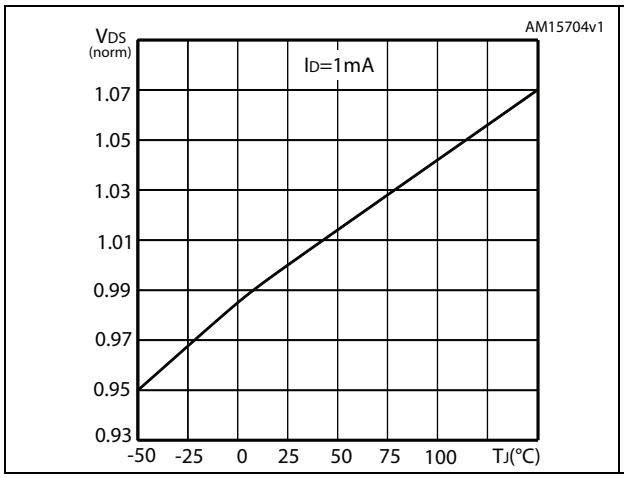
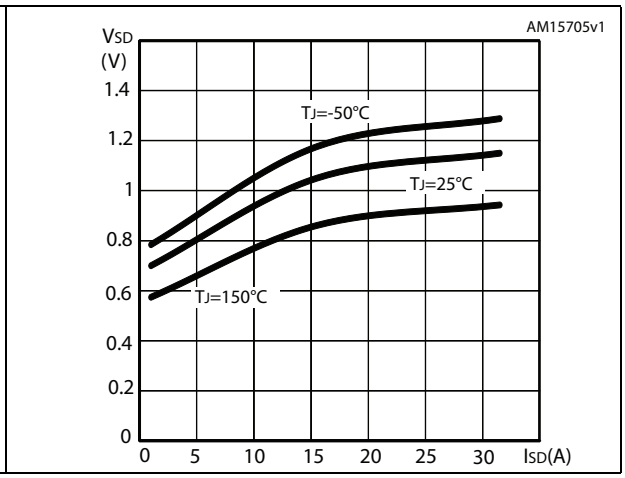


Figure 15. Source-drain diode forward characteristics



3 Test circuits

Figure 16. Switching times test circuit for resistive load

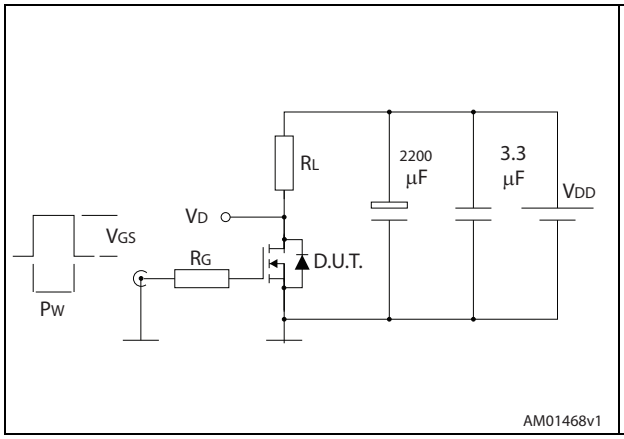


Figure 17. Gate charge test circuit

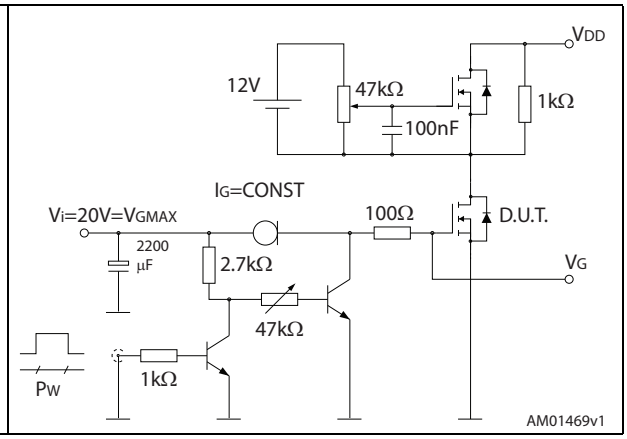


Figure 18. Test circuit for inductive load switching and diode recovery times

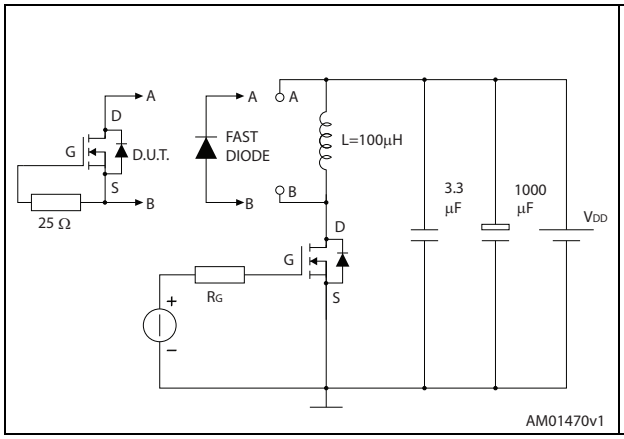


Figure 19. Unclamped inductive load test circuit

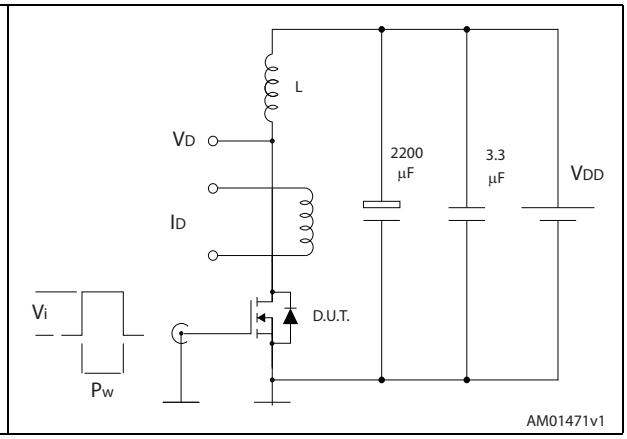


Figure 20. Unclamped inductive waveform

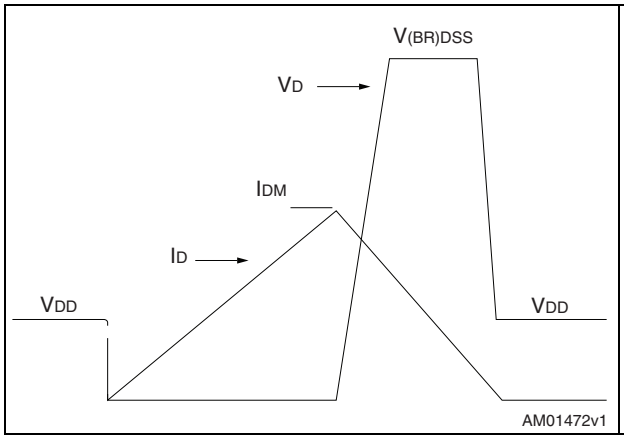
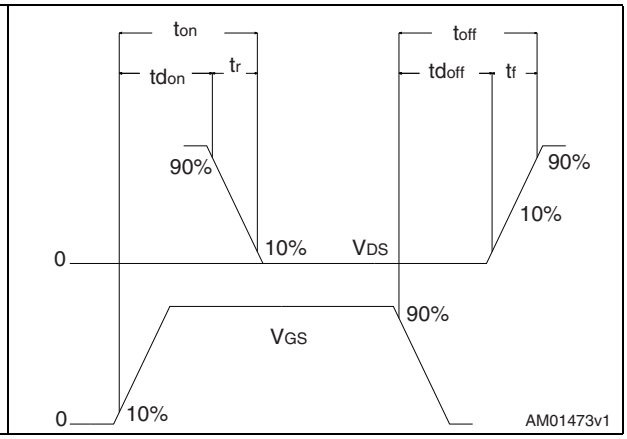


Figure 21. Switching time waveform



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 7. 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) drawing

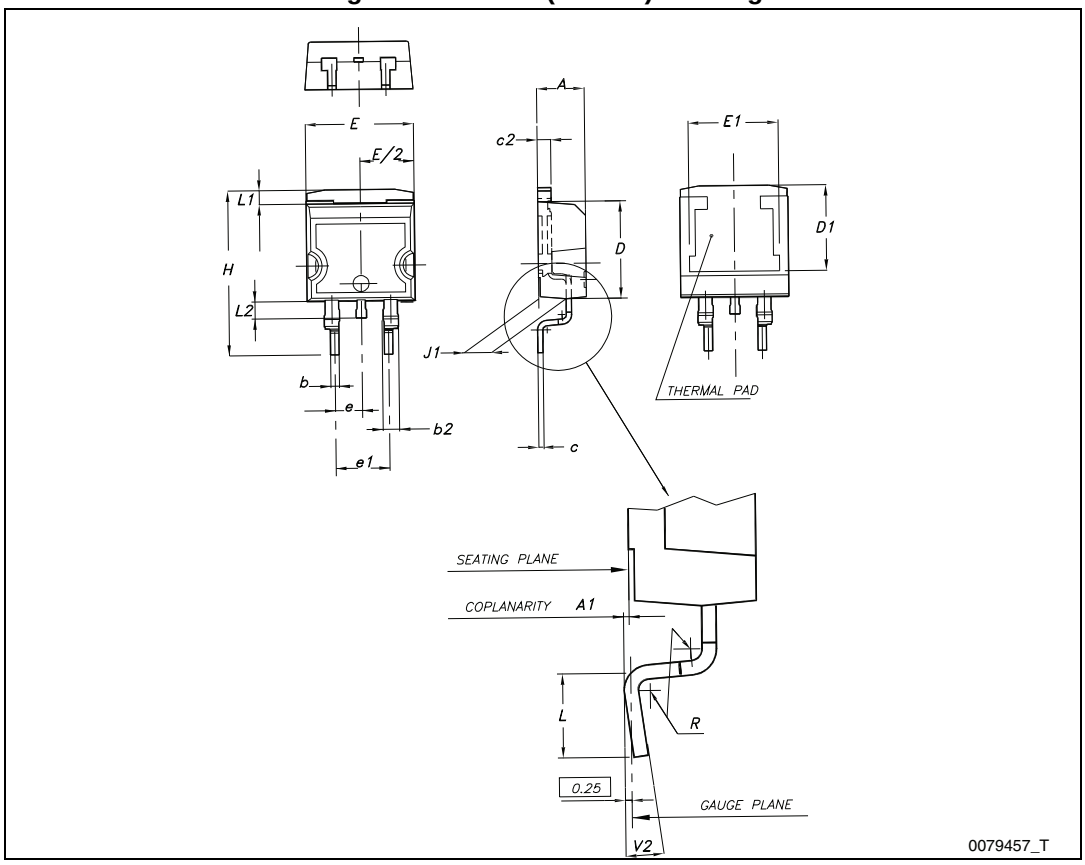
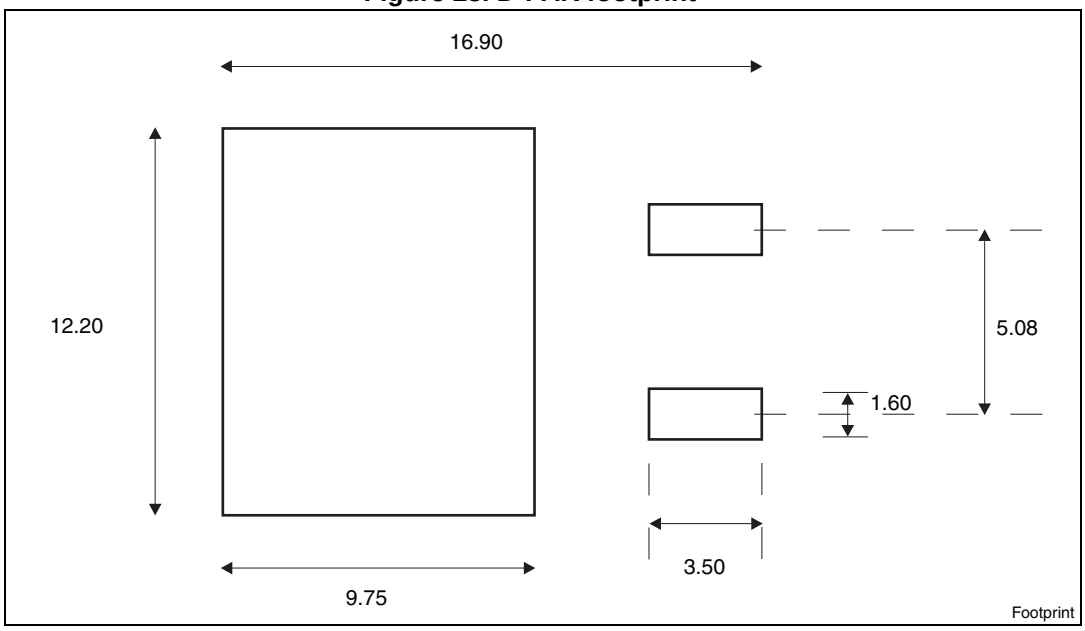


Figure 23. D²PAK footprint[a]



a. All dimension are in millimeters

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	
∅P	3.75		3.85
Q	2.65		2.95

Figure 24. TO-220 type A drawing

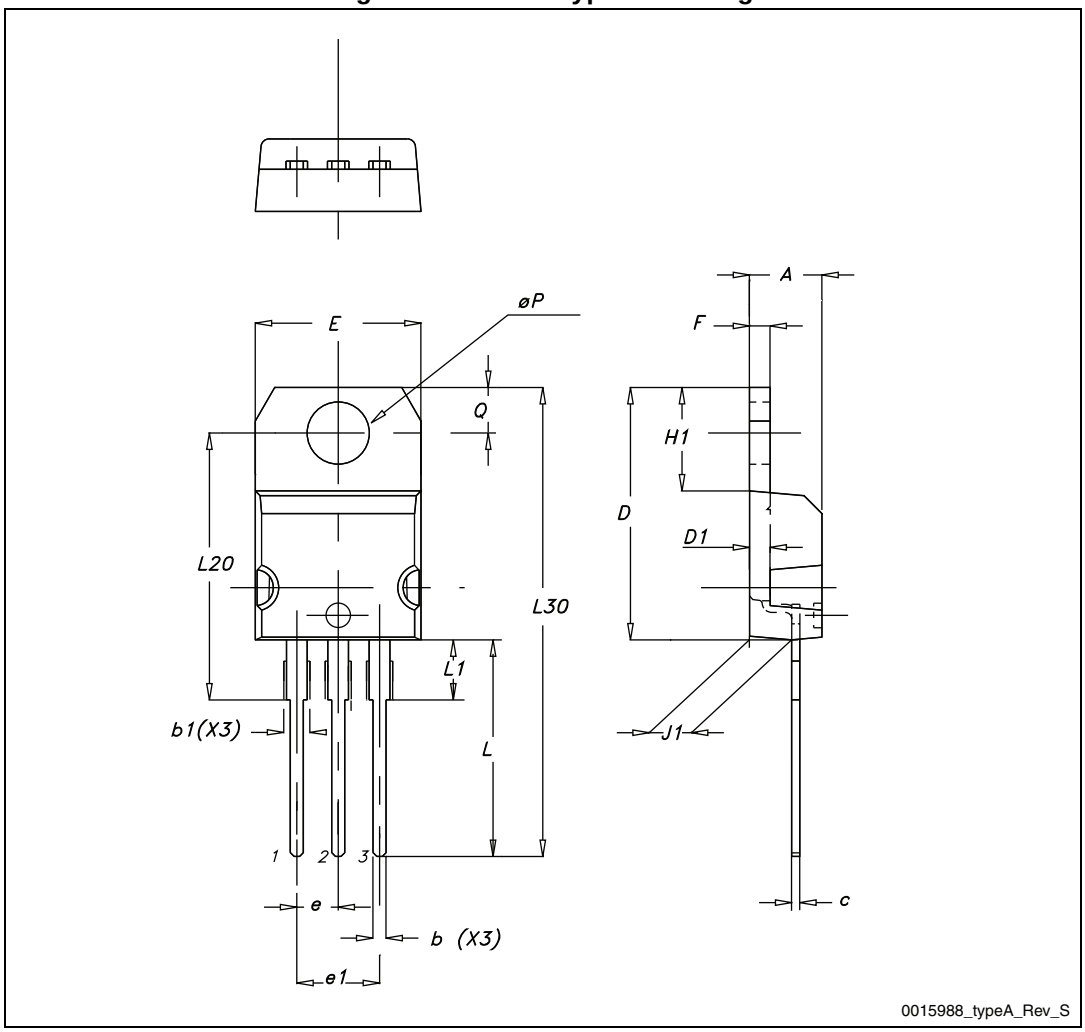
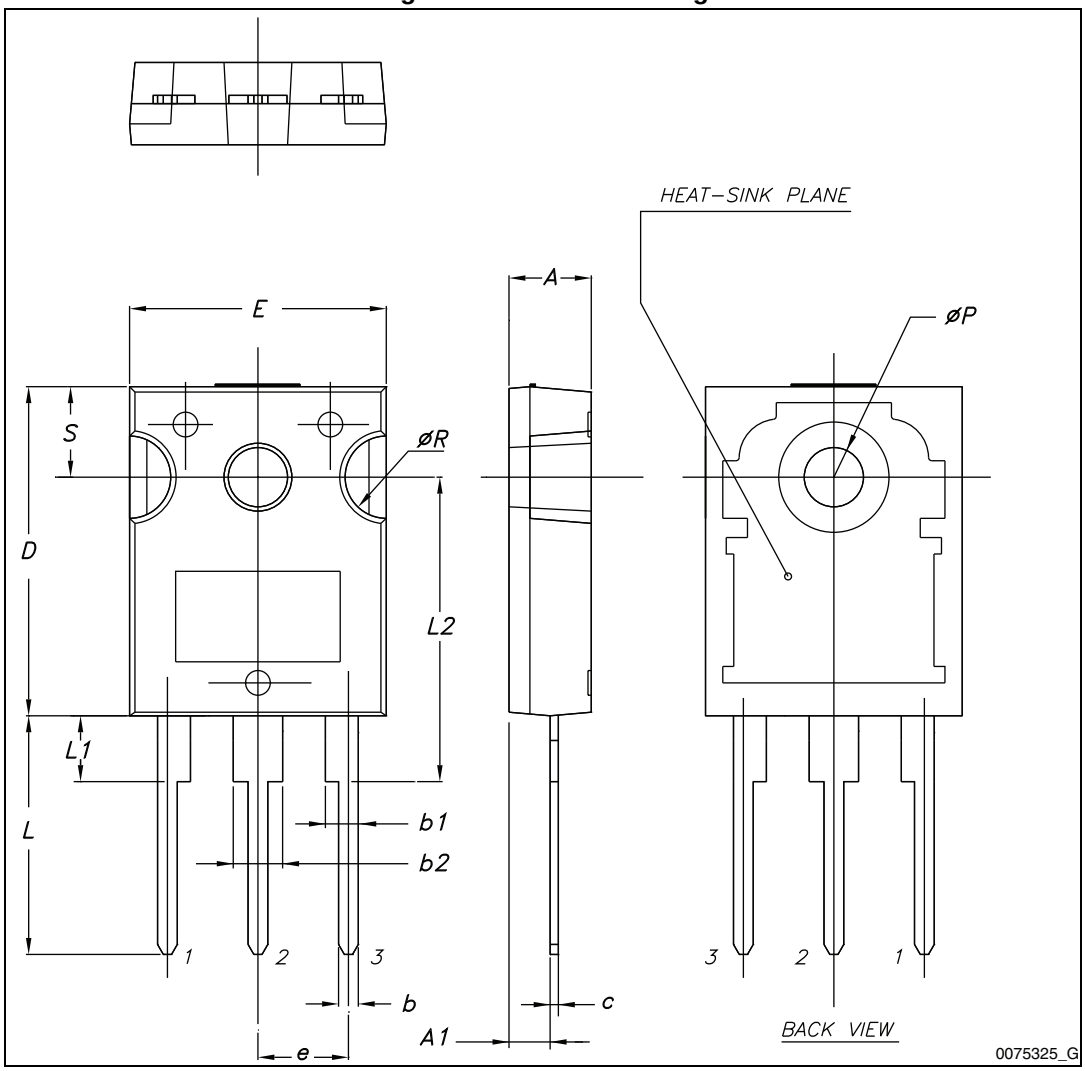


Table 9. TO-247 mechanical data

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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

Figure 25. TO-247 drawing



5 Packaging 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 26. Tape

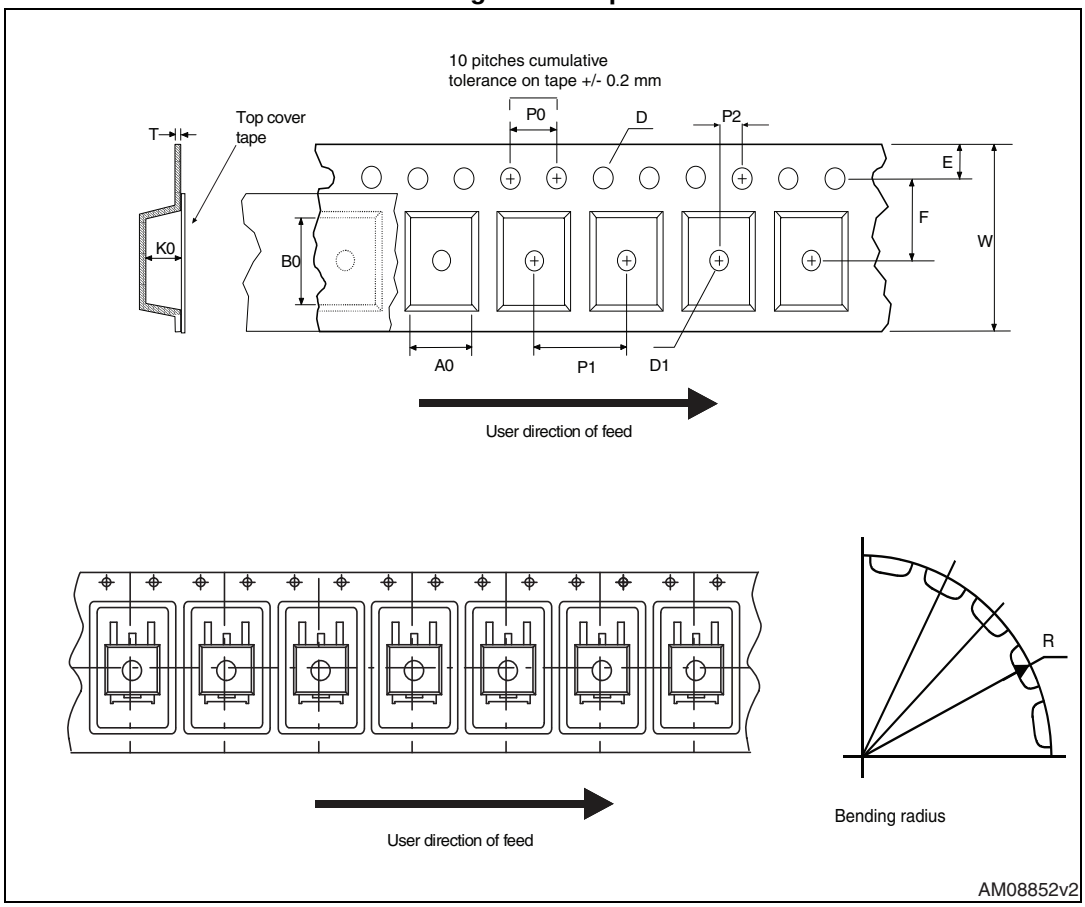
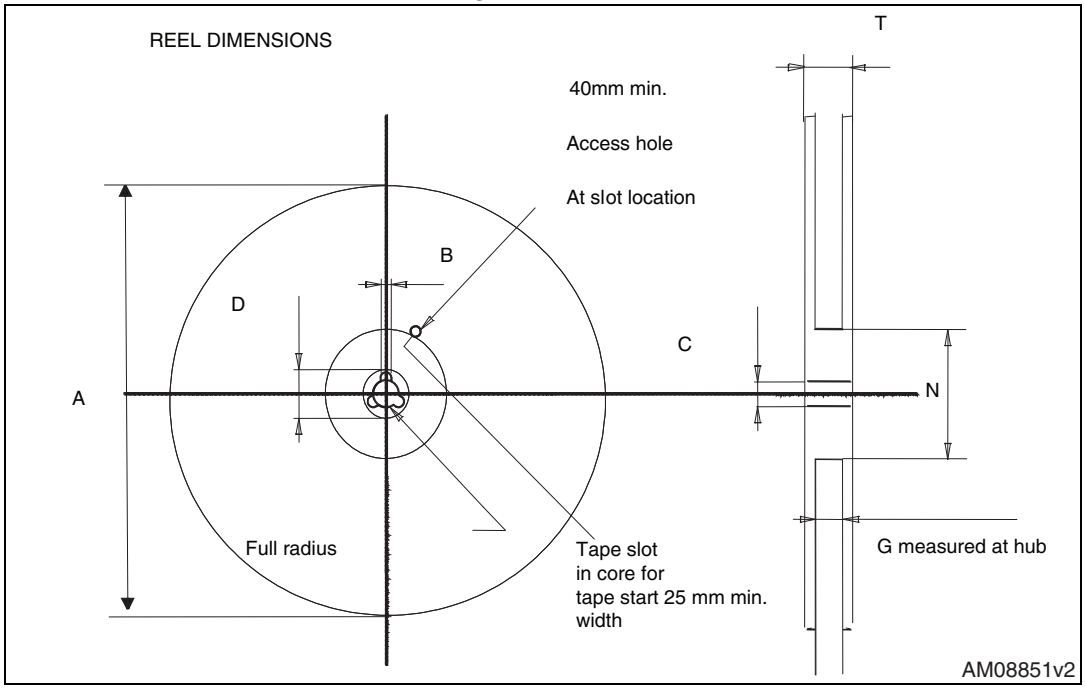


Figure 27. Reel



6 Revision history

Table 11. Document revision history

Date	Revision	Changes
05-Aug-2010	1	Initial release.
02-Sep-2010	2	Updated title on cover page and *Table 4: On/off states*.
07-Apr-2011	3	Document status promoted from preliminary data to datasheet.
10-Oct-2011	4	Inserted new device in D^2PAK: Updated: *Table 2: Absolute maximum ratings*, *Table 3: Thermal data* and *Section 4: Package mechanical data* with the new device. Inserted *Section 5: Packaging mechanical data*. Minor text changes.
12-Dec-2011	5	– *Figure 11: Output capacitance stored energy* has been updated. – *Figure 14: Normalized gate threshold voltage vs temperature* has been updated. – *Figure 15: Normalized on-resistance vs temperature* has been updated. – *Figure 16: Normalized V_{DS} vs temperature* has been updated.
21-Dec-2011	6	Updated: *Table 2: Absolute maximum ratings* (V_{ISO} value for TO-220FP)
10-May-2012	7	*Figure 10: Gate charge vs gate-source voltage* has been updated.
01-Jul-2013	8	– The part number STF34NM60N has been moved to a separate datasheet. – Added: MOSFET ruggedness parameter and *3* on *Table 2* – Modified: I_D value on *Table 5* and typical values for $t_{d(on)}$, t_r, $t_{d(off)}$ and t_f, max values for I_{SD} and I_{SDM}, I_{SD} for V_{SD}, typical value and I_{SD} for t_{rr} – Modified: *Figure 8*, *9*, *14* and *15* – Minor text changes