



# STB30N65M5, STF30N65M5, STI30N65M5 STP30N65M5, STW30N65M5

N-channel 650 V, 0.125  $\Omega$ , 22 A, MDmesh™ V Power MOSFET  
D<sup>2</sup>PAK, TO-220FP, I<sup>2</sup>PAK, TO-220, TO-247

## Features

Order codes	V <sub>DSS</sub> @ T <sub>JMAX</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STB30N65M5	710 V	< 0.139 $\Omega$	22 A
STF30N65M5	710 V	< 0.139 $\Omega$	22 A <sup>(1)</sup>
STI30N65M5	710 V	< 0.139 $\Omega$	22 A
STP30N65M5	710 V	< 0.139 $\Omega$	22 A
STW30N65M5	710 V	< 0.139 $\Omega$	22 A

1. Limited only by maximum temperature allowed

- Worldwide best R<sub>DS(on)</sub>\*area
- Higher V<sub>DSS</sub> rating
- Excellent switching performance
- Easy to drive
- 100% avalanche tested
- High dv/dt capability

## Applications

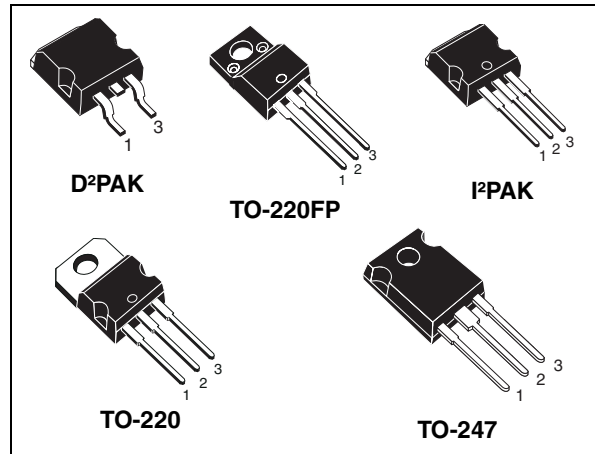
- Switching applications

## Description

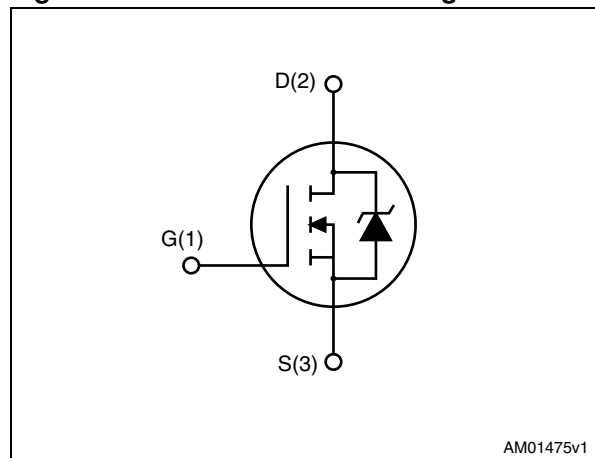
These devices are N-channel MDmesh™ V Power MOSFETs based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

**Table 1. Device summary**

Order codes	Marking	Package	Packaging
STB30N65M5	30N65M5	D <sup>2</sup> PAK	Tape and reel
STF30N65M5	30N65M5	TO-220FP	Tube
STI30N65M5	30N65M5	I <sup>2</sup> PAK	Tube
STP30N65M5	30N65M5	TO-220	Tube
STW30N65M5	30N65M5	TO-247	Tube



**Figure 1. Internal schematic diagram**



AM01475v1

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220, D <sup>2</sup> PAK TO-247, I <sup>2</sup> PAK	TO-220FP	
V <sub>GS</sub>	Gate-source voltage	± 25		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	22	22 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	13	13 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	88	88 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	140	30	W
I <sub>AR</sub>	Max current during repetitive or single pulse avalanche (pulse width limited by T <sub>JMAX</sub> )	7		A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>j</sub> = 25°C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50V)	500		mJ
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	15		V/ns
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T <sub>C</sub> =25 °C)		2500	V
T <sub>stg</sub>	Storage temperature	- 55 to 150		°C
T <sub>j</sub>	Max. operating junction temperature	150		°C

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3. I<sub>SD</sub> ≤ 21 A, di/dt = 400 A/μs, V<sub>Peak</sub> < V<sub>(BR)DSS</sub>

**Table 3. Thermal data**

Symbol	Parameter	Value					Unit
		D <sup>2</sup> PAK	TO-220FP	I <sup>2</sup> PAK	TO-220	TO-247	
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.83	3.6	0.83			°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max		62.5			50	°C/W
R <sub>thj-pcb</sub>	Thermal resistance junction-pcb max	30					°C/W
T <sub>l</sub>	Maximum lead temperature for soldering purpose		300				°C

## 2 Electrical characteristics

( $T_C = 25\text{ °C}$  unless otherwise specified)

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ( $V_{GS} = 0$ )	$I_D = 1\text{ mA}$	650			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 650\text{ V}$ $V_{DS} = 650\text{ V}, T_C = 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			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	$V_{GS} = 10\text{ V}, I_D = 11\text{ A}$		0.125	0.139	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	2880	-	pF
$C_{oss}$	Output capacitance			68		pF
$C_{rss}$	Reverse transfer capacitance			5		pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$	-	190	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related	$V_{GS} = 0, V_{DS} = 0\text{ to }520\text{ V}$	-	65	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz open drain}$	-	1.6	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}, I_D = 11\text{ A},$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 20</a> )	-	64	-	nC
$Q_{gs}$	Gate-source charge			16		nC
$Q_{gd}$	Gate-drain charge			25		nC

- $C_{oss\text{ eq}}$  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%  $V_{DSS}$
- $C_{oss\text{ eq}}$  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%  $V_{DSS}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(off)}$	Turn-off delay time	$V_{DD} = 400\text{ V}$ , $I_D = 14\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 21</a> )		50		ns
$t_r$	Rise time		-	8	-	ns
$t_c$	Cross time				20	ns
$t_f$	Fall time				10	ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		22	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				88	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 22\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 22\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 21</a> )	-	336		ns
$Q_{rr}$	Reverse recovery charge			6		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			32		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 22\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 21</a> )	-	395		ns
$Q_{rr}$	Reverse recovery charge			7		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			34		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 for TO-220, D<sup>2</sup>PAK, I<sup>2</sup>PAK

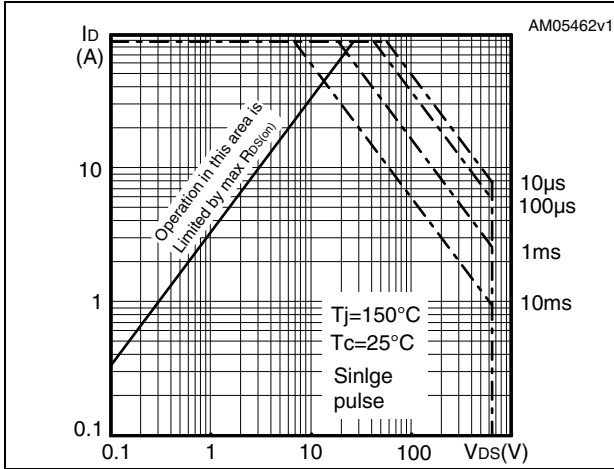


Figure 3. Thermal impedance for TO-220, D<sup>2</sup>PAK, I<sup>2</sup>PAK

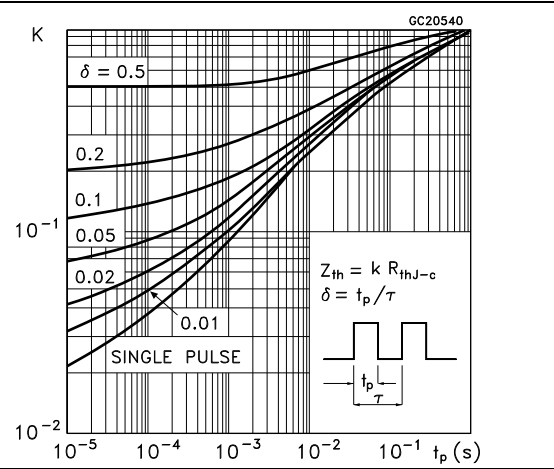


Figure 4. Safe operating area for TO-220FP

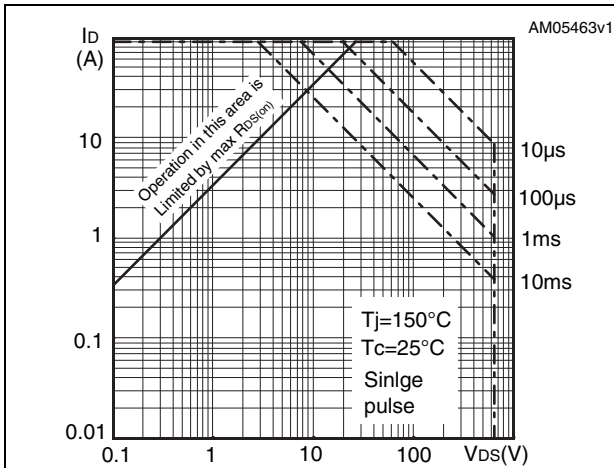


Figure 5. Thermal impedance for TO-220FP

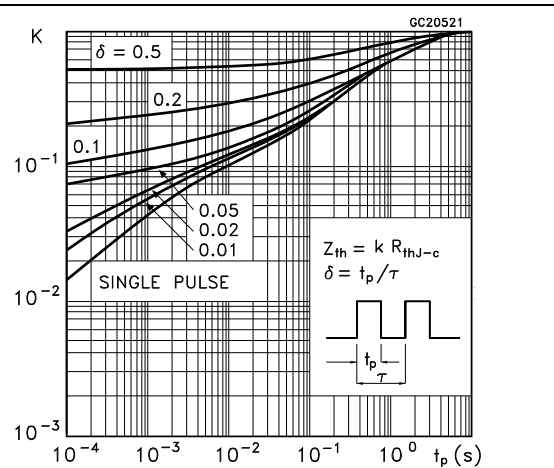


Figure 6. Safe operating area for TO-247

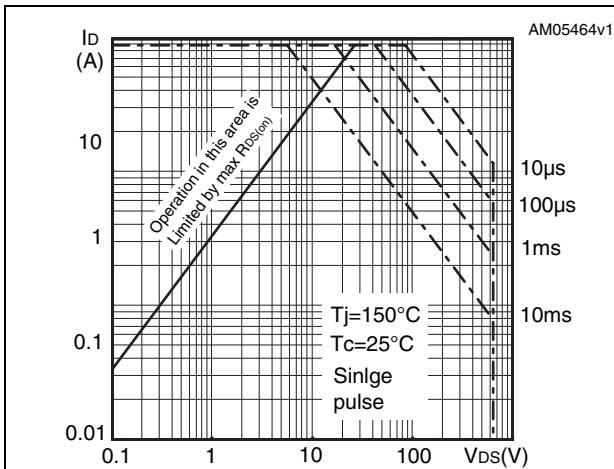


Figure 7. Thermal impedance for TO-247

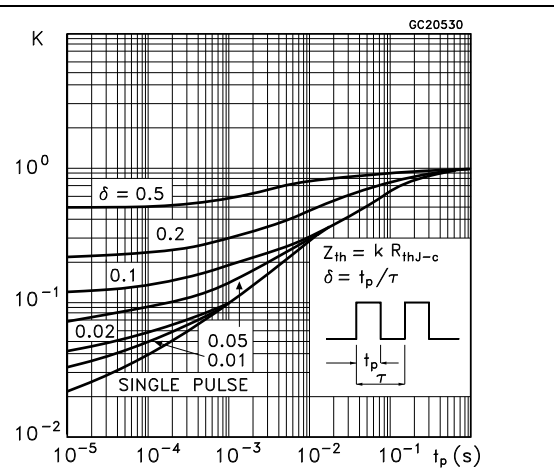


Figure 8. Output characteristics

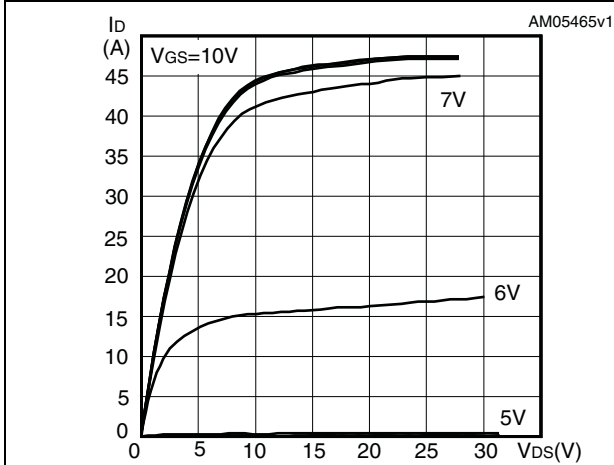


Figure 9. Transfer characteristics

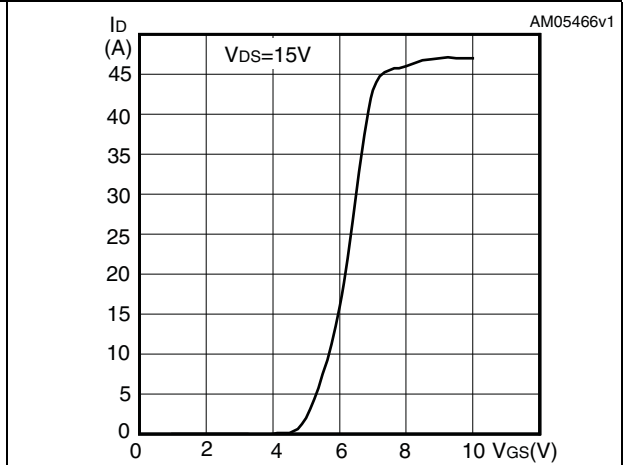


Figure 10. Gate charge vs gate-source voltage

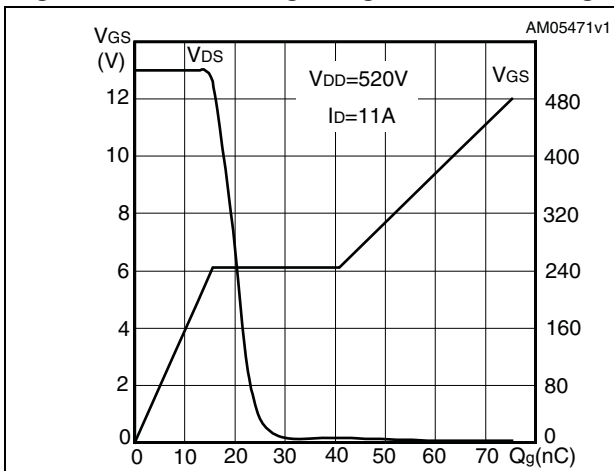


Figure 11. Static drain-source on resistance

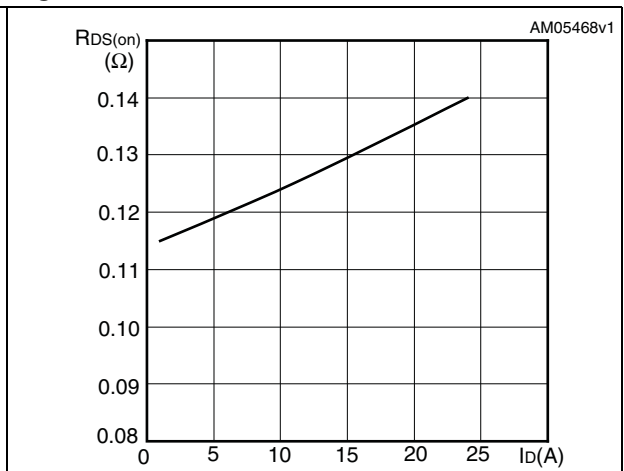


Figure 12. Capacitance variations

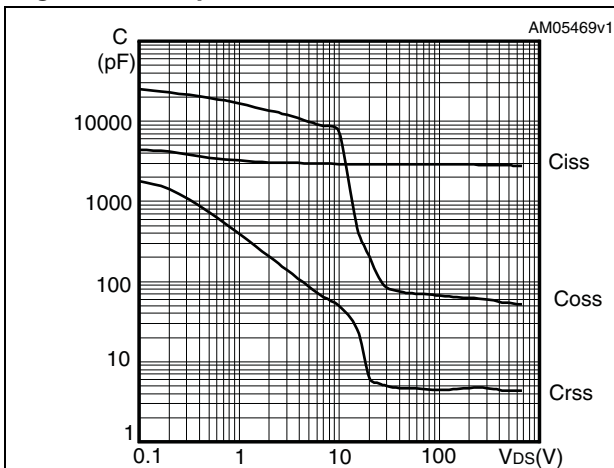


Figure 13. Output capacitance stored energy

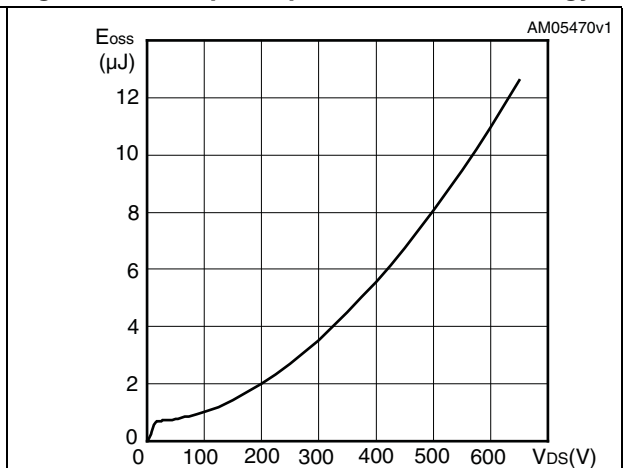


Figure 14. Normalized gate threshold voltage vs temperature

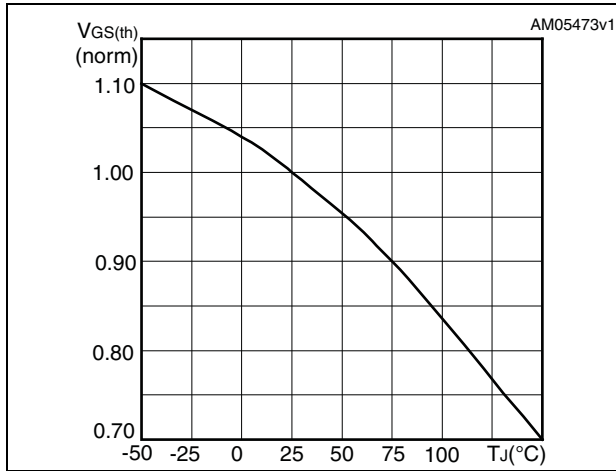


Figure 15. Normalized on resistance vs temperature

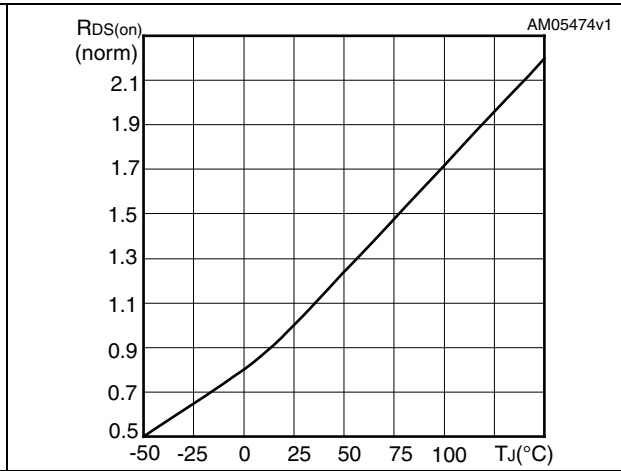


Figure 16. Source-drain diode forward characteristics

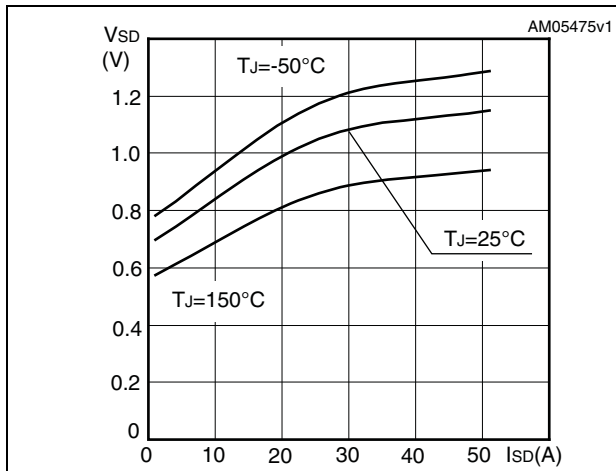


Figure 17. Normalized B<sub>VDSS</sub> vs temperature

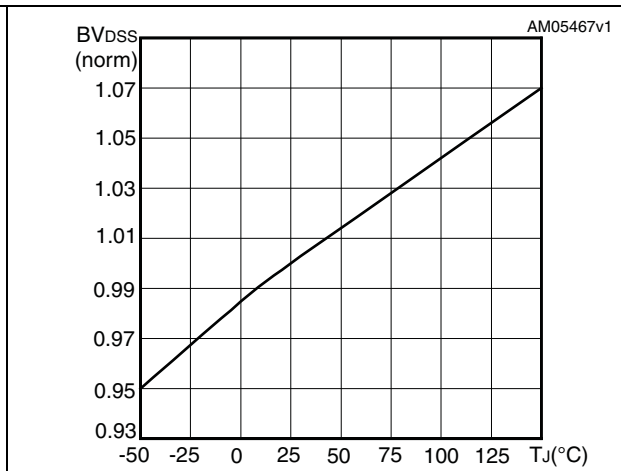
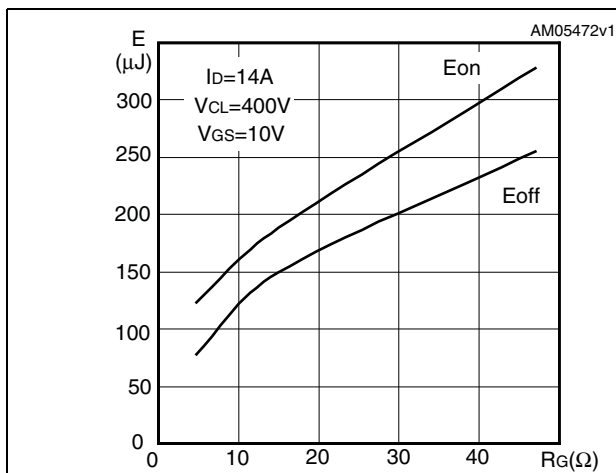


Figure 18. Switching losses vs gate resistance (1)

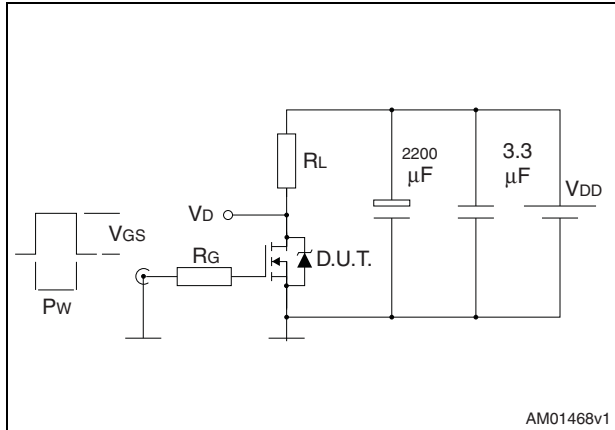


1. Eon including reverse recovery of a SiC diode

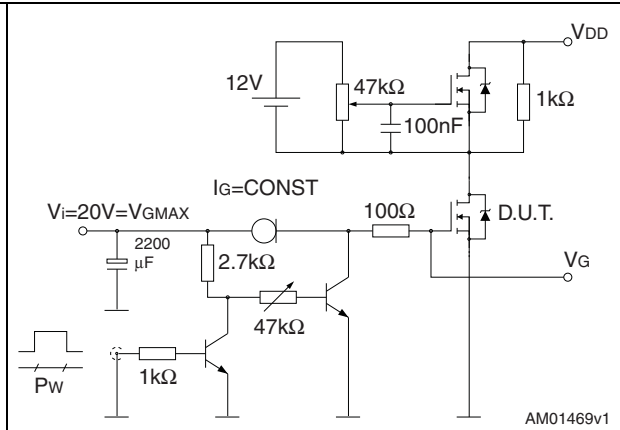


### 3 Test circuits

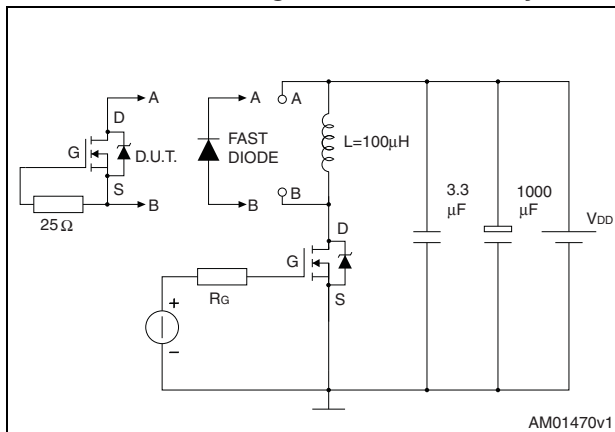
**Figure 19. Switching times test circuit for resistive load**



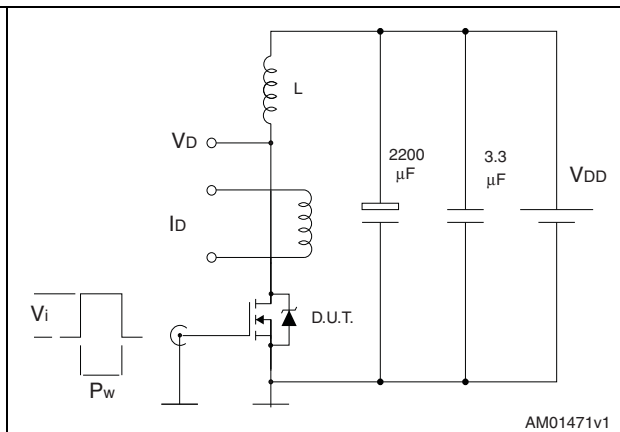
**Figure 20. Gate charge test circuit**



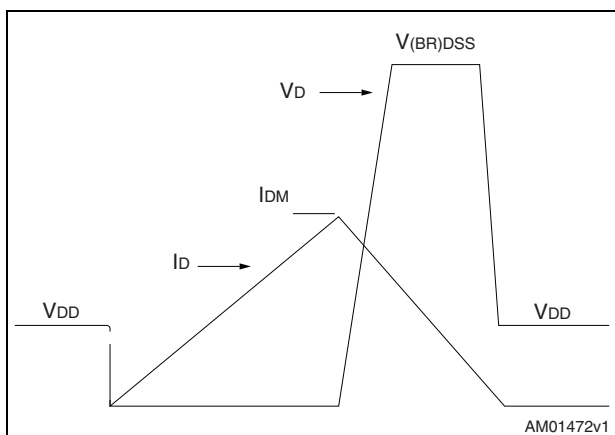
**Figure 21. Test circuit for inductive load switching and diode recovery times**



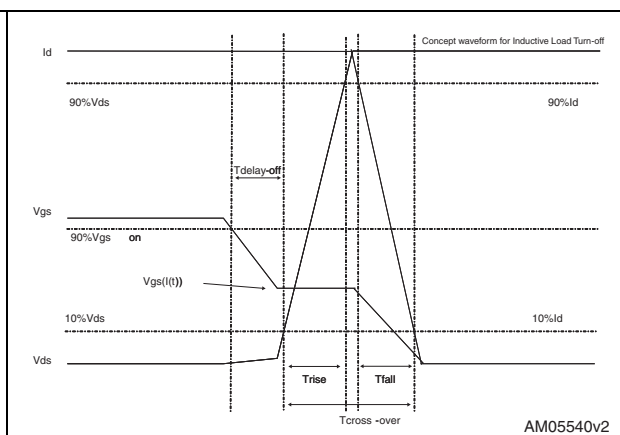
**Figure 22. Unclamped inductive load test circuit**



**Figure 23. Unclamped inductive waveform**



**Figure 24. Switching time waveform**



## 4 Package mechanical data

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). ECOPACKm is an ST trademark.

Table 8. 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		
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 25. D<sup>2</sup>PAK (TO-263) drawing

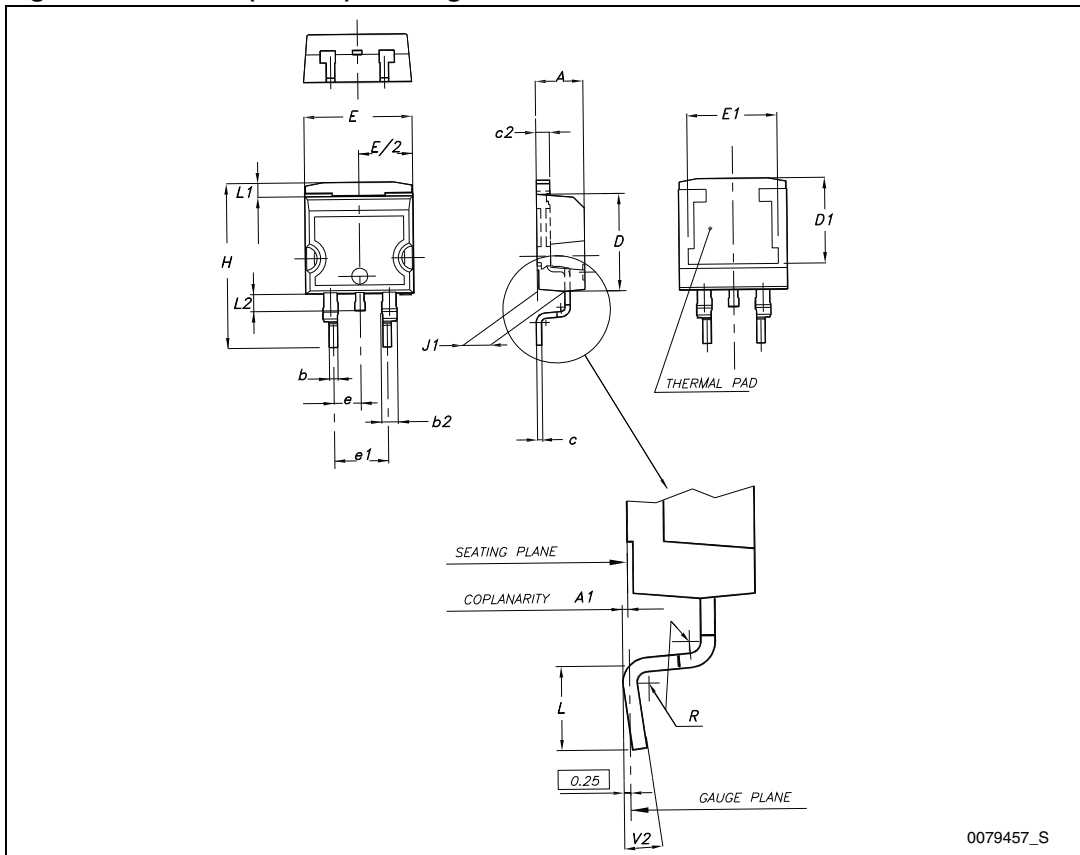
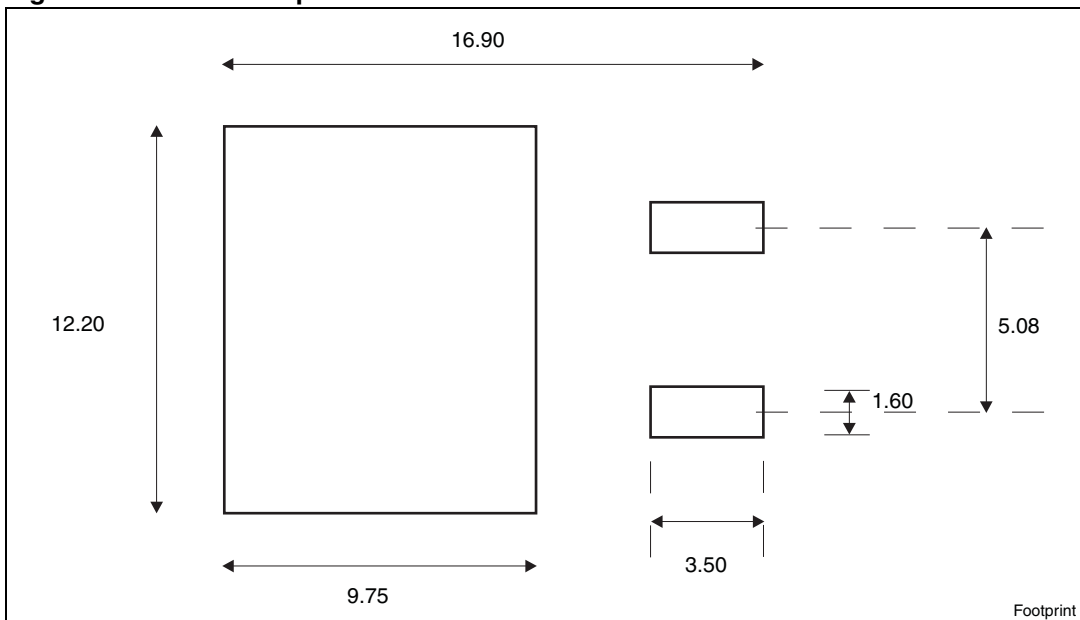


Figure 26. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimensions are in millimeters

Table 9. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 27. TO-220FP drawing

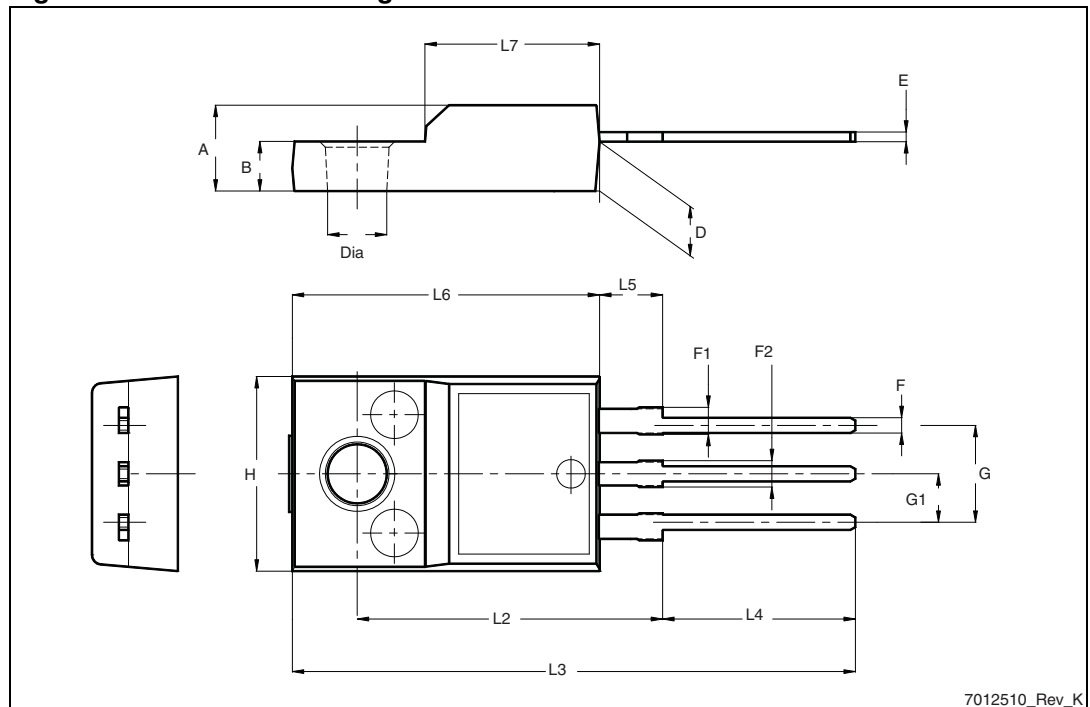


Table 10. I<sup>2</sup>PAK (TO-262) mechanical data

DIM.	mm.		
	min.	typ	max.
A	4.40		4.60
A1	2.40		2.72
b	0.61		0.88
b1	1.14		1.70
c	0.49		0.70
c2	1.23		1.32
D	8.95		9.35
e	2.40		2.70
e1	4.95		5.15
E	10		10.40
L	13		14
L1	3.50		3.93
L2	1.27		1.40

Figure 28. I<sup>2</sup>PAK (TO-262) drawing

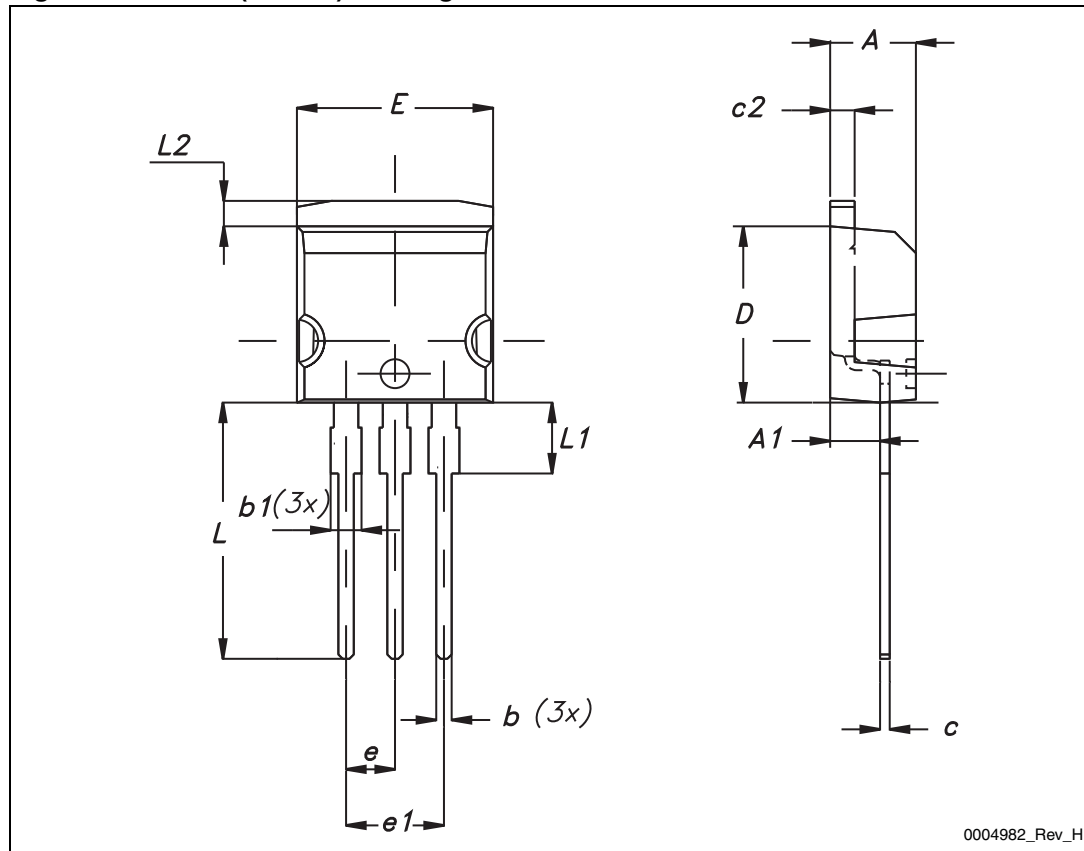


Table 11. TO-220 type A mechanical data

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

Figure 29. TO-220 type A drawing

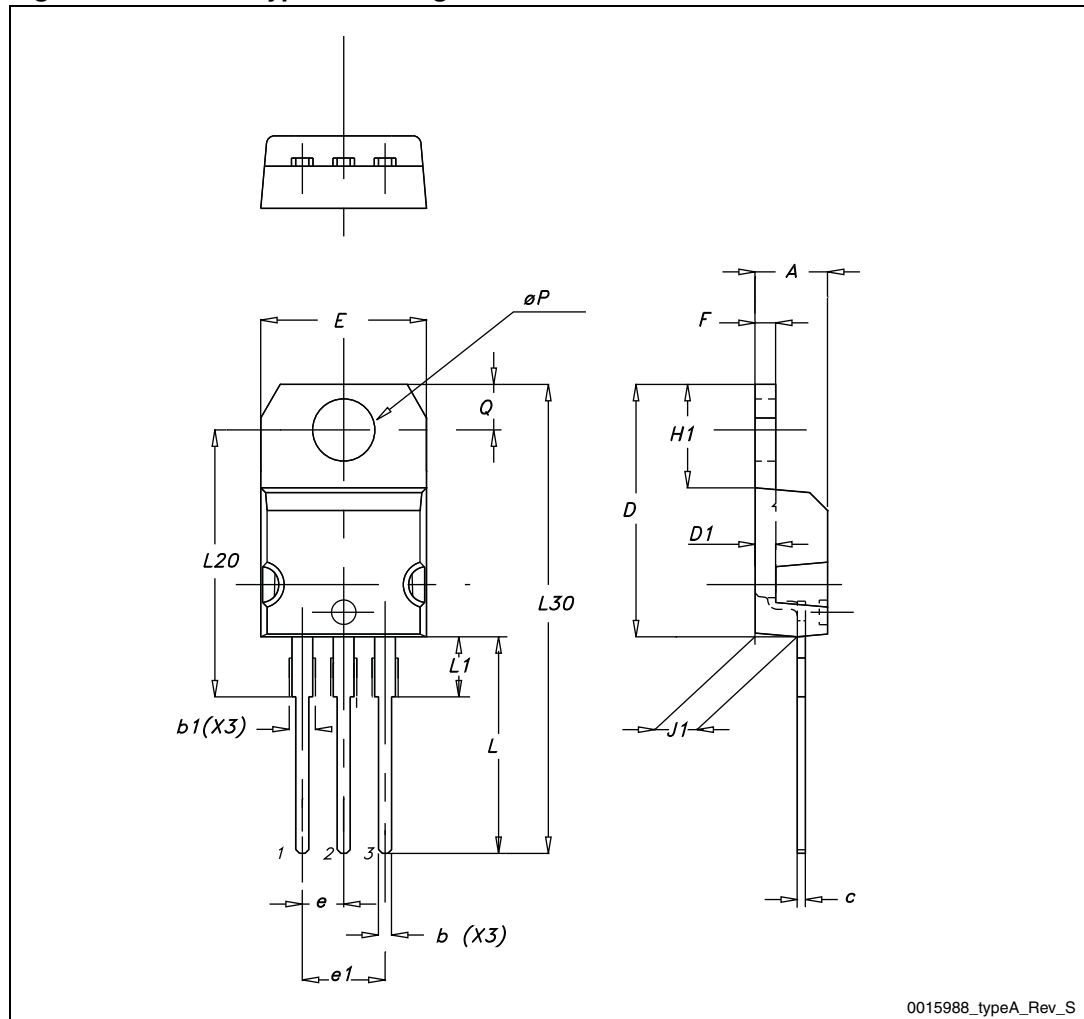
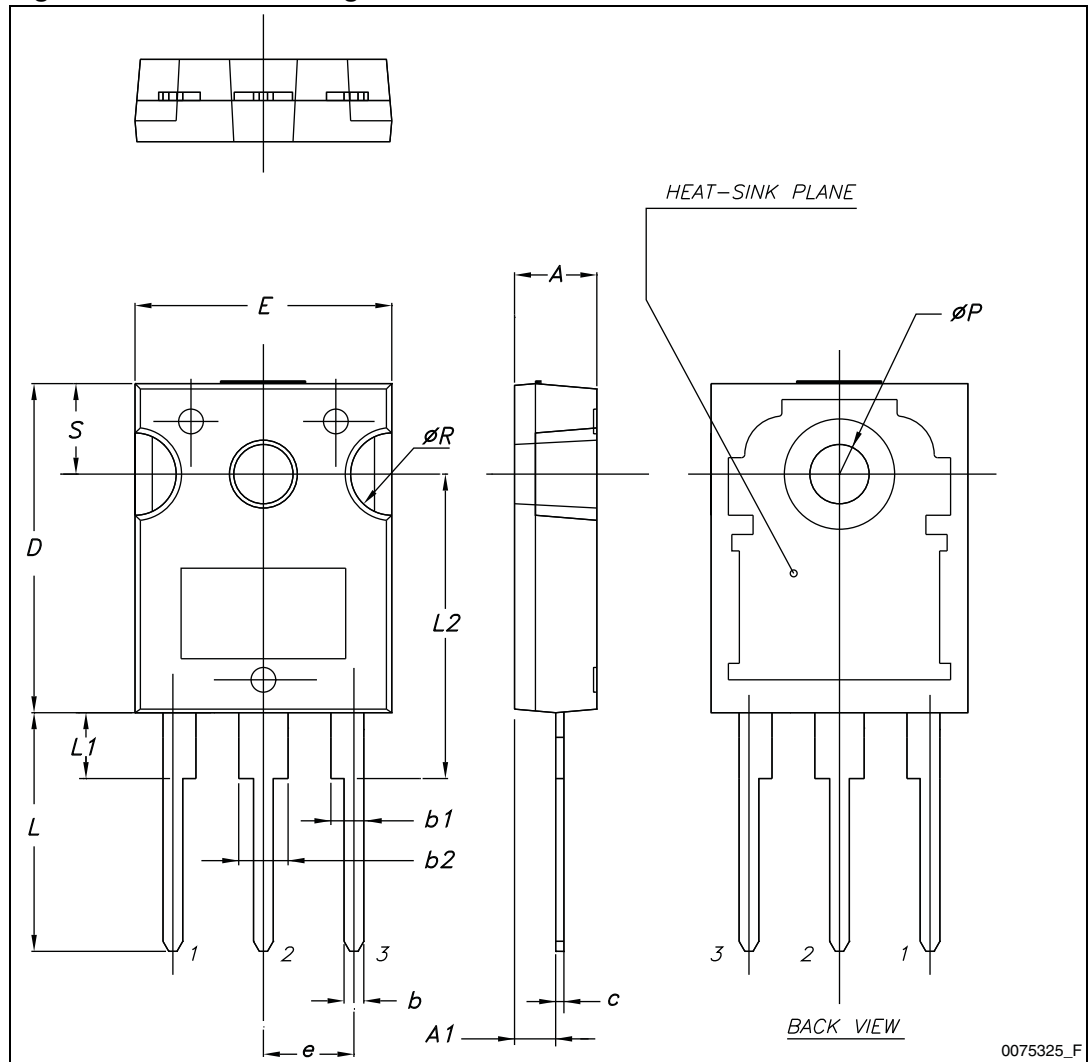




Table 12. TO-247 mechanical data

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		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S		5.50	

Figure 30. TO-247 drawing



0075325\_F

## 5 Packaging mechanical data

Table 13. 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 31. Tape

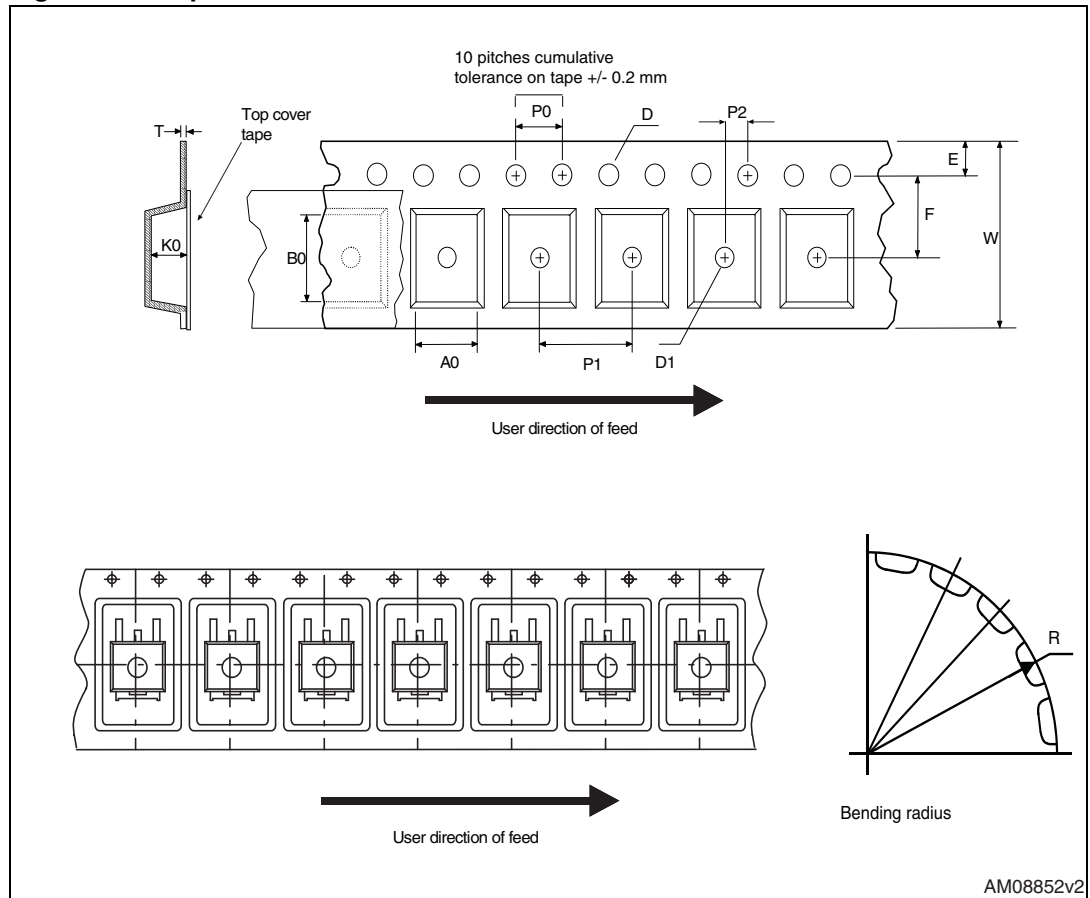
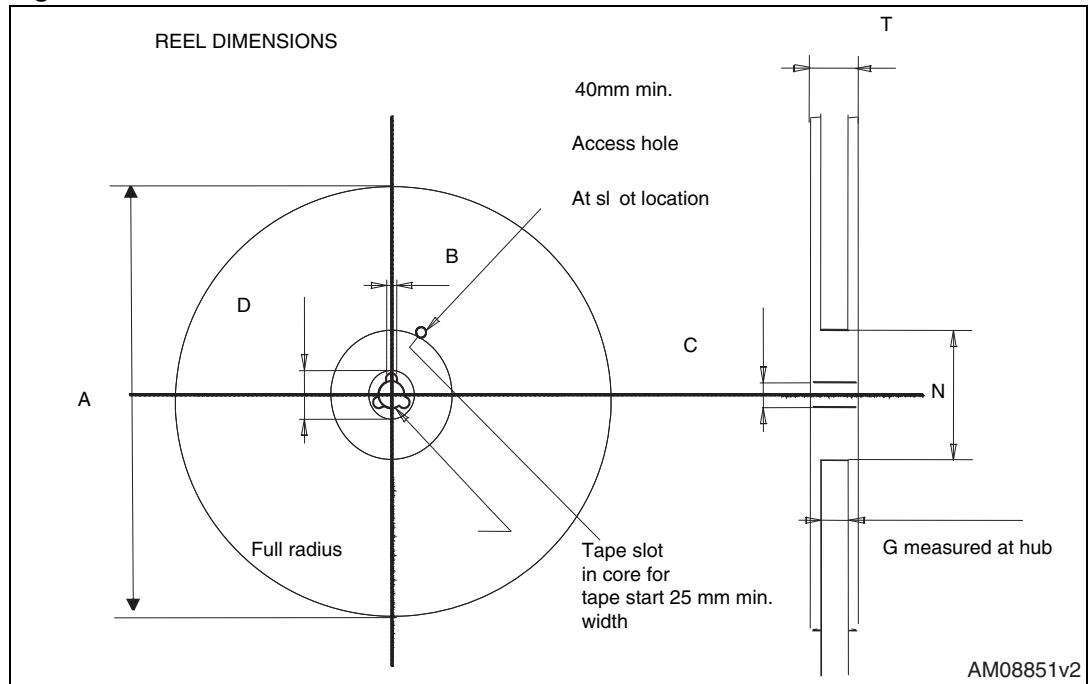


Figure 32. Reel



## 6 Revision history

**Table 14. Document revision history**

Date	Revision	Changes
16-Jan-2009	1	First release
21-Sep-2009	2	Document status promoted from preliminary data to datasheet.
22-Sep-2011	3	<p><math>C_{o(er)}</math> and <math>C_{o(tr)}</math> values changed in <a href="#">Table 5: Dynamic</a>  <a href="#">Table 6: Switching times</a> parameters updates  <a href="#">Figure 24: Switching time waveform</a> has been corrected            Minor text changes  <a href="#">Section 4: Package mechanical data</a> has been modified. Added:</p> <ul style="list-style-type: none"> <li>– <a href="#">Table 8: D<sup>2</sup>PAK (TO-263) mechanical data</a>, <a href="#">Figure 25: D<sup>2</sup>PAK (TO-263) drawing</a> and <a href="#">Figure 26: D<sup>2</sup>PAK footprint</a>;</li> <li>– <a href="#">Table 9: TO-220FP mechanical data</a>, and <a href="#">Figure 27: TO-220FP drawing</a>;</li> <li>– <a href="#">Table 10: I<sup>2</sup>PAK (TO-262) mechanical data</a>, and <a href="#">Figure 28: I<sup>2</sup>PAK (TO-262) drawing</a>;</li> <li>– <a href="#">Table 11: TO-220 type A mechanical data</a>, and <a href="#">Figure 29: TO-220 type A drawing</a>;</li> <li>– <a href="#">Table 12: TO-247 mechanical data</a>, and <a href="#">Figure 30: TO-247 drawing</a>;</li> </ul> <p><a href="#">Section 5: Packaging mechanical data</a> has been modified. Added:</p> <ul style="list-style-type: none"> <li>– <a href="#">Table 13: D<sup>2</sup>PAK (TO-263) tape and reel mechanical data</a>, <a href="#">Figure 31: Tape</a> and <a href="#">Figure 32: Reel</a>;</li> </ul>

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