



# STB70N10F4, STD70N10F4 STP70N10F4, STW70N10F4

N-channel 100 V, 0.015  $\Omega$ , 60 A, STripFET™ DeepGATE™  
Power MOSFET in TO-220, DPAK, TO-247, D<sup>2</sup>PAK

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STB70N10F4	100 V	< 0.0195 $\Omega$	65 A
STD70N10F4	100 V	< 0.0195 $\Omega$	60 A
STP70N10F4	100 V	< 0.0195 $\Omega$	65 A
STW70N10F4	100 V	< 0.0195 $\Omega$	65 A

- Exceptional dv/dt capability
- Extremely low on-resistance R<sub>DS(on)</sub>
- 100% avalanche tested

## Application

- Switching applications

## Description

This STripFET™ DeepGATE™ Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance, with a new gate structure, providing superior switching performance.

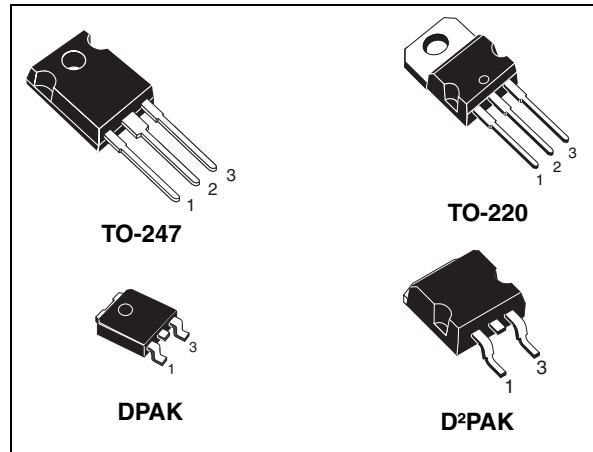


Figure 1. Internal schematic diagram

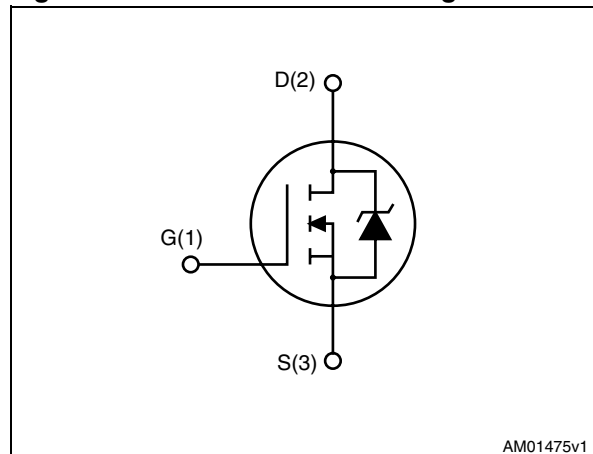


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB70N10F4	70N10F4	D <sup>2</sup> PAK	Tape and reel
STD70N10F4	70N10F4	DPAK	Tape and reel
STP70N10F4	70N10F4	TO-220	Tube
STW70N10F4	70N10F4	TO-247	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220, TO-247, D <sup>2</sup> PAK	DPAK	
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	100		V
$V_{GS}$	Gate-source voltage	$\pm 20$		V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	65	60	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	46	43	A
$I_{DM}^{(1)}$	Drain current (pulsed)	260	240	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	150	125	W
	Derating factor	1	0.83	W/ $^\circ\text{C}$
$E_{AS}^{(2)}$	Single pulse avalanche energy	120		mJ
$T_{stg}$	Storage temperature	– 55 to 175		$^\circ\text{C}$
$T_j$	Max. operating junction temperature			

1. Pulse width limited by safe operating area

2. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 32.5\text{ A}$ ,  $V_{DD} = 45\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		TO-220, TO-247, D <sup>2</sup> PAK	DPAK	
$R_{thj-case}$	Thermal resistance junction-case max	1	1.2	$^\circ\text{C}/\text{W}$
$R_{thj-a}$	Thermal resistance junction-ambient max	62.5	50 <sup>(1)</sup>	$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose	300		$^\circ\text{C}$

1. When mounted on FR-4 board of 1 inch<sup>2</sup>, 2 oz Cu

## 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	$I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$	100			V
$I_{DSS}$	Zero gate voltage Drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{max rating}$ $V_{DS} = \text{max rating}$ , $T_C = 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	2		4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 30\text{ A}$		0.015	0.0195	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	5800		pF
$C_{oss}$	Output capacitance			300	-	pF
$C_{rss}$	Reverse transfer capacitance			190		pF
$Q_g$	Total gate charge	$V_{DD} = 80\text{ V}$ , $I_D = 65\text{ A}$ , $V_{GS} = 10\text{ V}$ (see Figure 16)	-	85		nC
$Q_{gs}$	Gate-source charge			20	-	nC
$Q_{gd}$	Gate-drain charge			25		nC

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 50\text{ V}$ , $I_D = 30\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 15)	-	30		ns
$t_r$	Rise time			20	-	ns
$t_{d(off)}$	Turn-off-delay time	$V_{DD} = 50\text{ V}$ , $I_D = 30\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 15)	-	65		ns
$t_f$	Fall time			20	-	ns

Table 7. Source drain diode

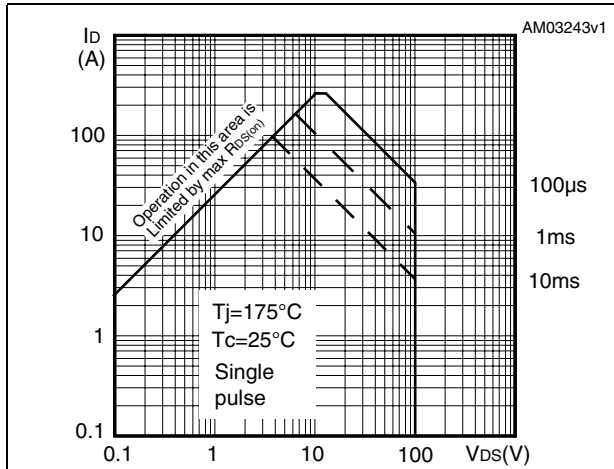
Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$I_{SD}$	Source-drain current		-		60	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		240	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 60 \text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 60 \text{ A}$ , $V_{DD} = 25 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$ , $T_j = 150 \text{ }^\circ\text{C}$ <i>(see Figure 17)</i>	-	80		ns
$Q_{rr}$	Reverse recovery charge			280		nC
$I_{RRM}$	Reverse recovery current			6.7		A

1. Pulse width limited by safe operating area.

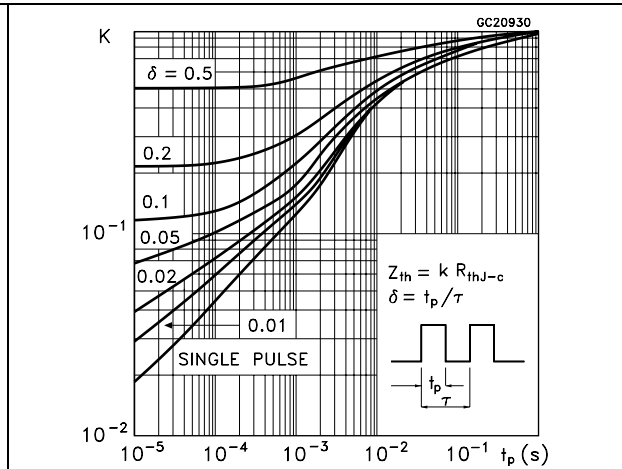
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

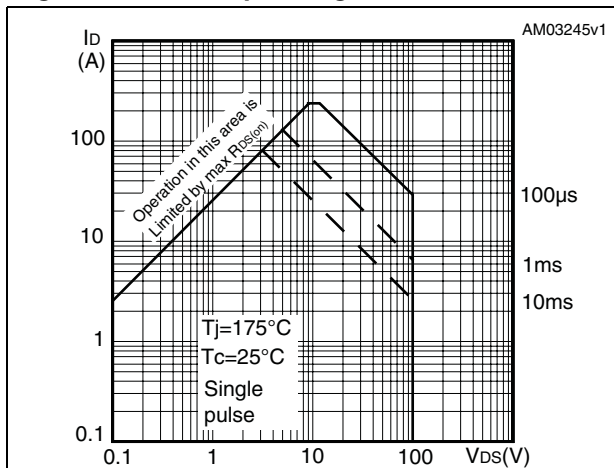
**Figure 2. Safe operating area for TO-220, TO-247, D<sup>2</sup>PAK**



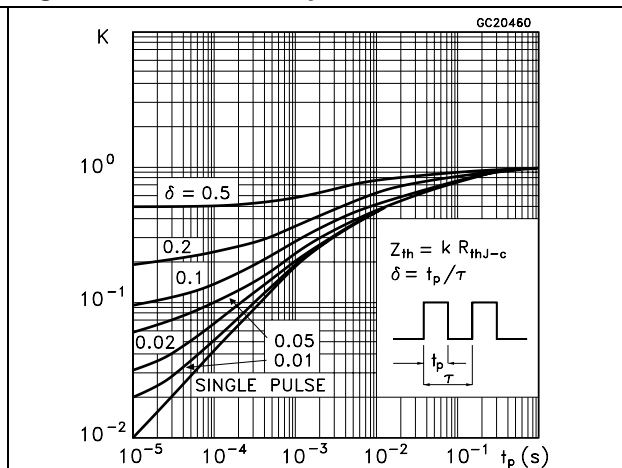
**Figure 3. Thermal impedance for TO-220, TO-247, D<sup>2</sup>PAK**



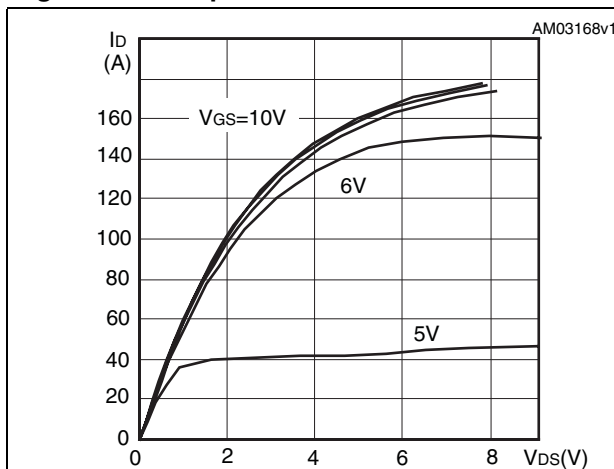
**Figure 4. Safe operating area for DPAK**



**Figure 5. Thermal impedance for DPAK**



**Figure 6. Output characteristics**



**Figure 7. Transfer characteristics**

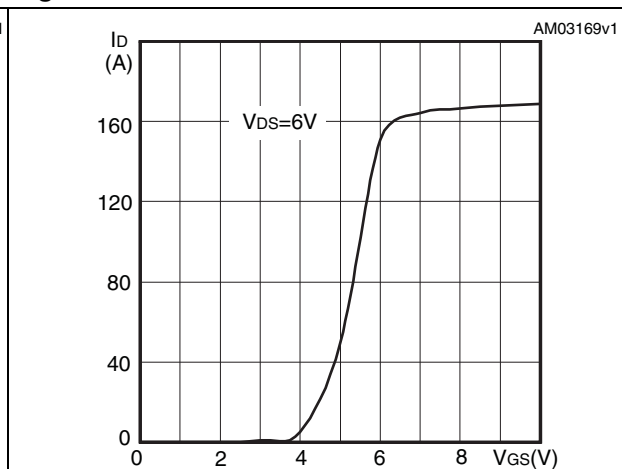


Figure 8. Normalized  $B_{VDSS}$  vs temperature

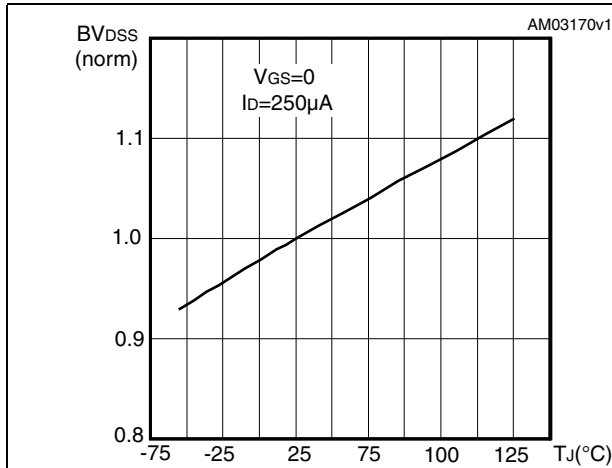


Figure 9. Static drain-source on resistance

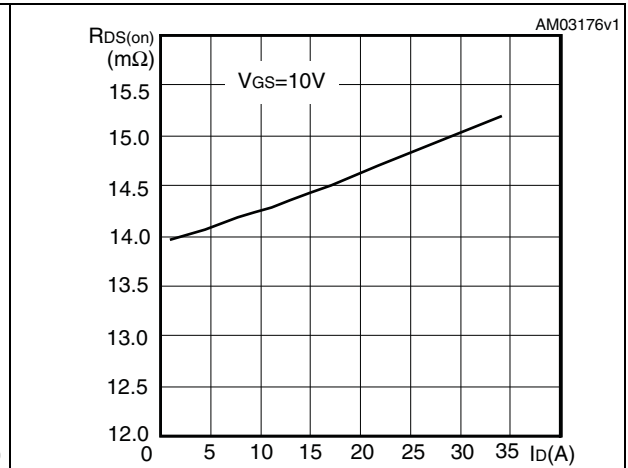


Figure 10. Gate charge vs gate-source voltage

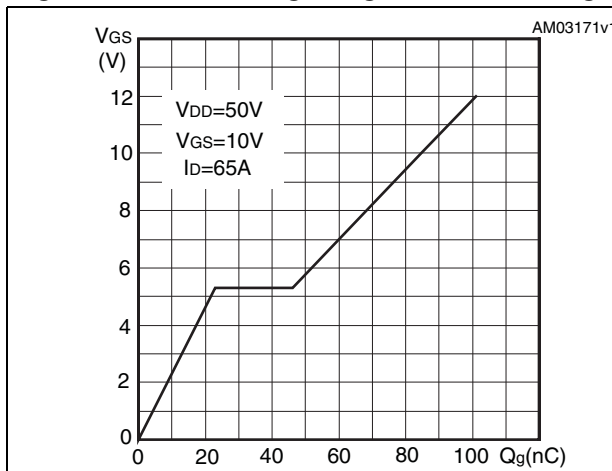


Figure 11. Capacitance variations

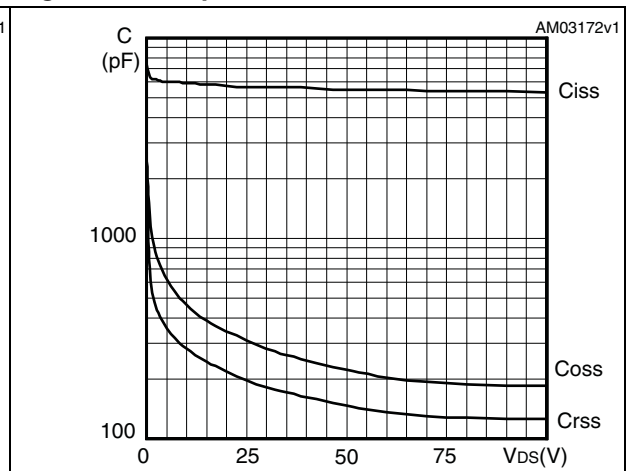


Figure 12. Normalized gate threshold voltage vs temperature

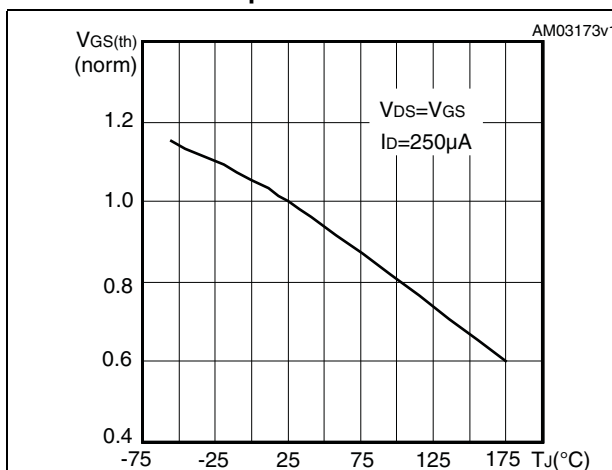


Figure 13. Normalized on resistance vs temperature

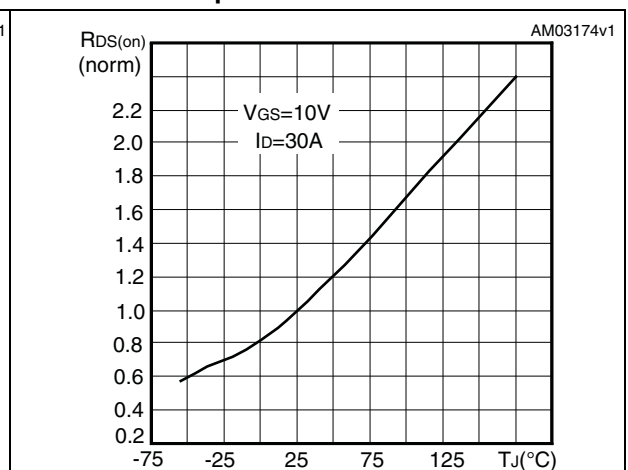
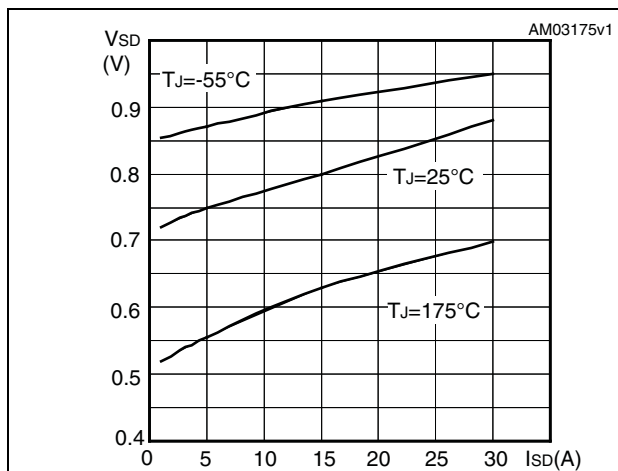


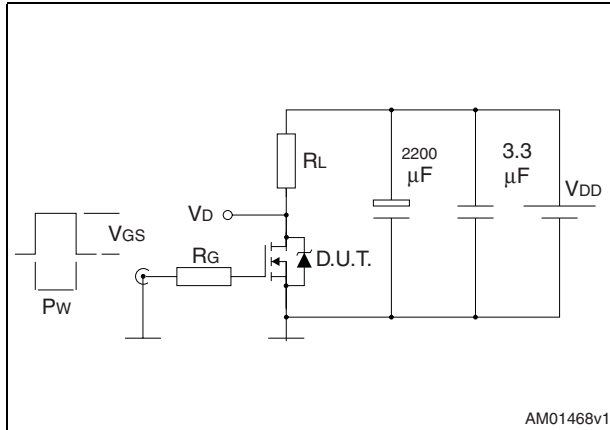
Figure 14. Source-drain diode forward characteristics



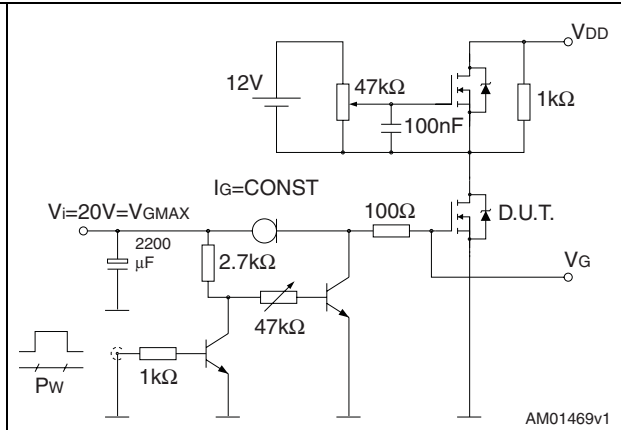


### 3 Test circuits

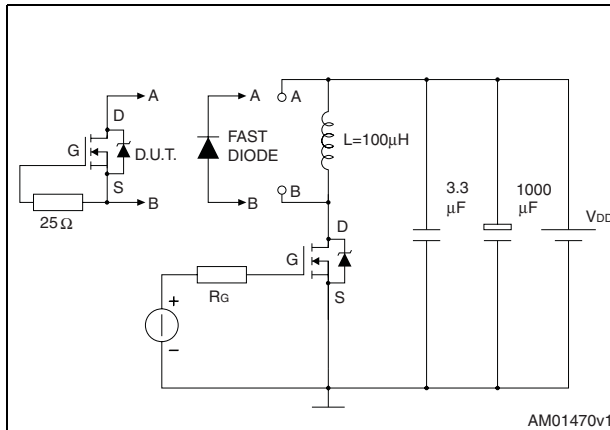
**Figure 15. Switching times test circuit for resistive load**



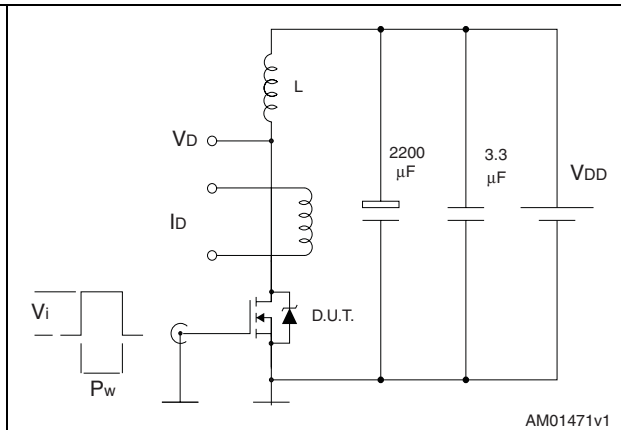
**Figure 16. Gate charge test circuit**



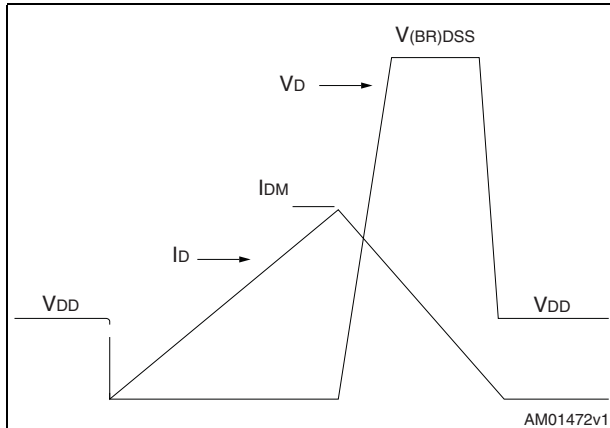
**Figure 17. Test circuit for inductive load switching and diode recovery times**



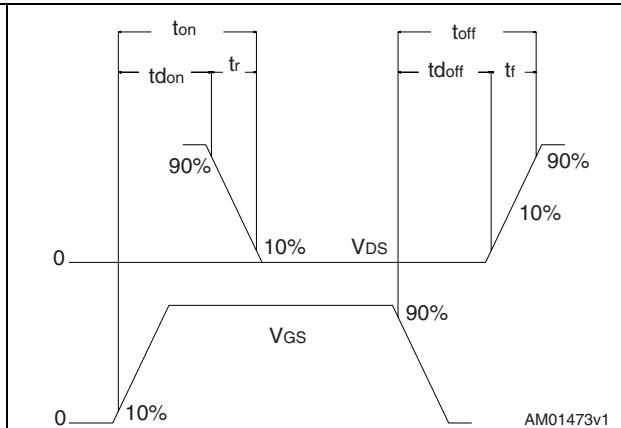
**Figure 18. Unclamped inductive load test circuit**



**Figure 19. Unclamped inductive waveform**



**Figure 20. Switching time waveform**

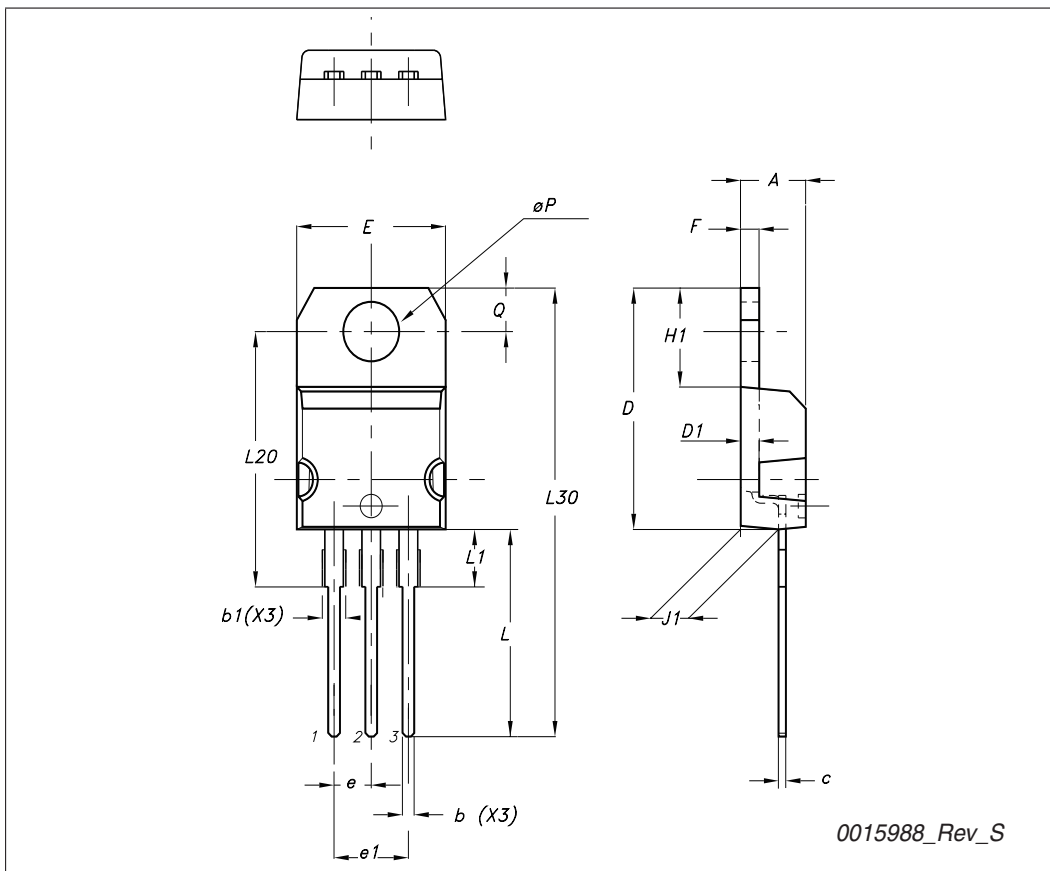


## 4 Package mechanical data

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](http://www.st.com). ECOPACK is an ST trademark.

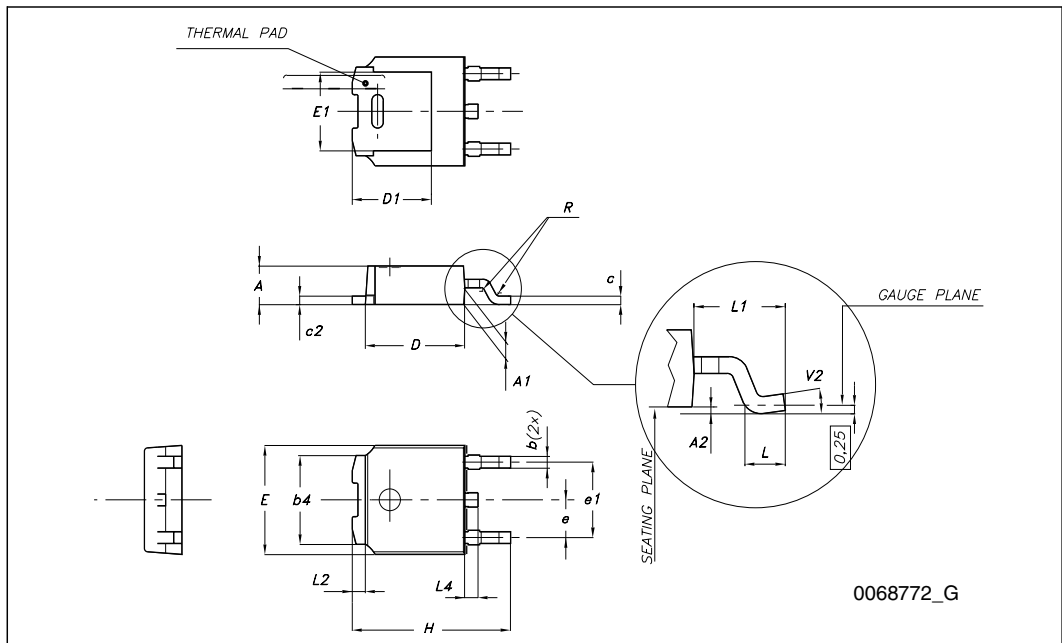
TO-220 type A mechanical data

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



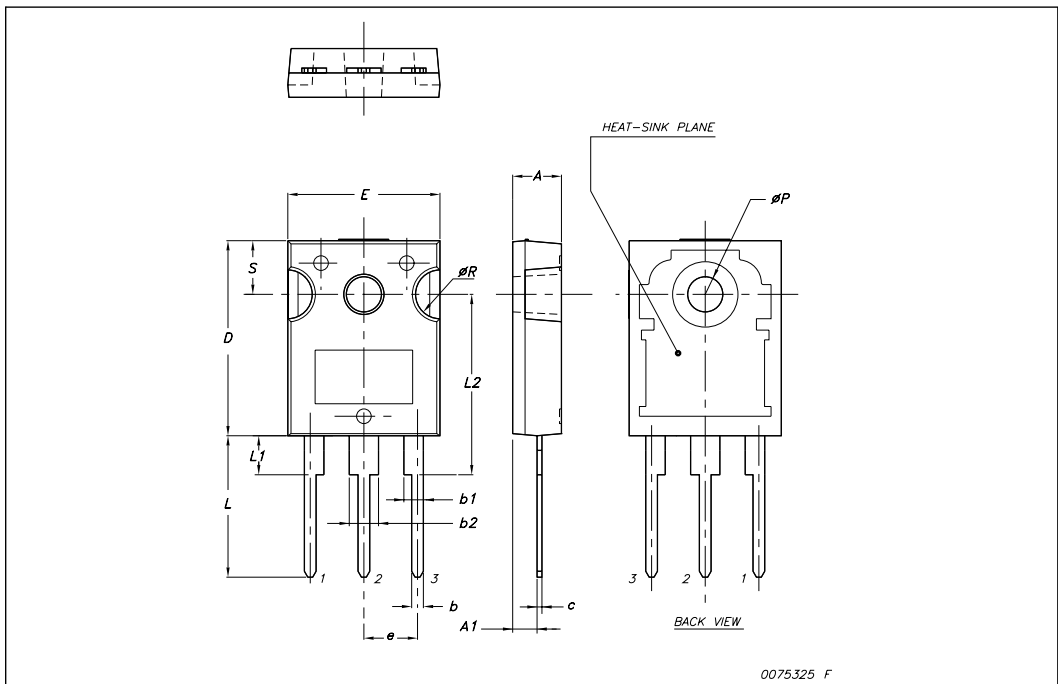
**TO-252 (DPAK) mechanical data**

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°



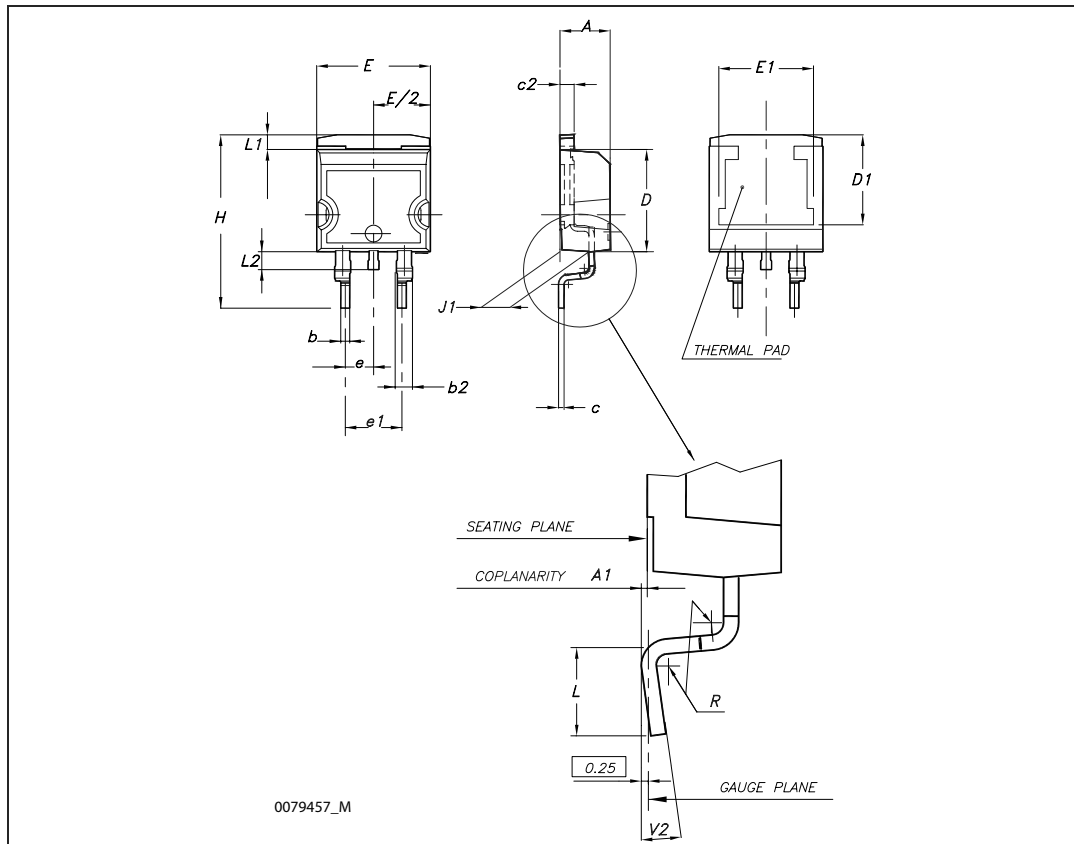
**TO-247 Mechanical data**

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	



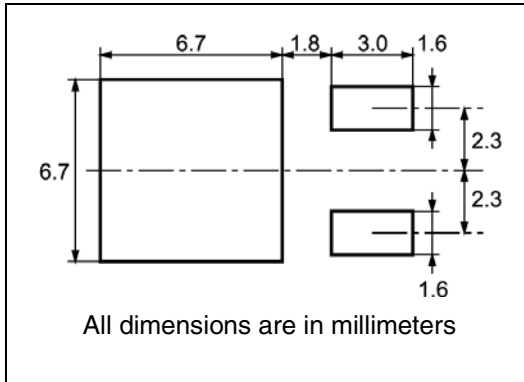
**D<sup>2</sup>PAK (TO-263) mechanical data**

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°



# 5 Packaging mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

### REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

### TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

10 pitches cumulative tolerance on tape +/- 0.2 mm

TOP COVER TAPE

User Direction of Feed

Center line of cavity

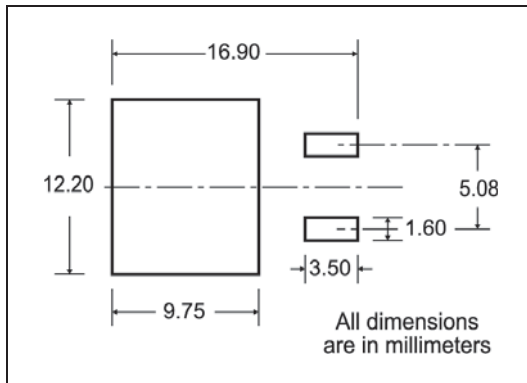
For machine ref. only including draft and radii concentric around B0

TRL

FEED DIRECTION

Bending radius R min.

D<sup>2</sup>PAK FOOTPRINT



TAPE AND REEL SHIPMENT

**TAPE MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

**REEL MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000



## 6 Revision history

**Table 8. Document revision history**

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
12-Nov-2008	1	First release
14-Jan-2009	2	Added new package, mechanical data DPAK
09-Oct-2009	3	Added new package, mechanical data D <sup>2</sup> PAK

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