



# STB270N4F3 STI270N4F3

N-channel 40 V, 1.6 mΩ, 160 A, D<sup>2</sup>PAK, I<sup>2</sup>PAK  
STripFET™ III Power MOSFET

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on) max</sub>	I <sub>D</sub>	P <sub>TOT</sub>
STB270N4F3	40 V	< 2.0 mΩ	160 A	330 W
STI270N4F3	40 V	< 2.6 mΩ	120 A	330 W

- 100% avalanche tested
- Standard threshold drive

## Applications

- High current, switching application
  - Automotive

## Description

This STripFET™ III Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance providing superior switching performances.

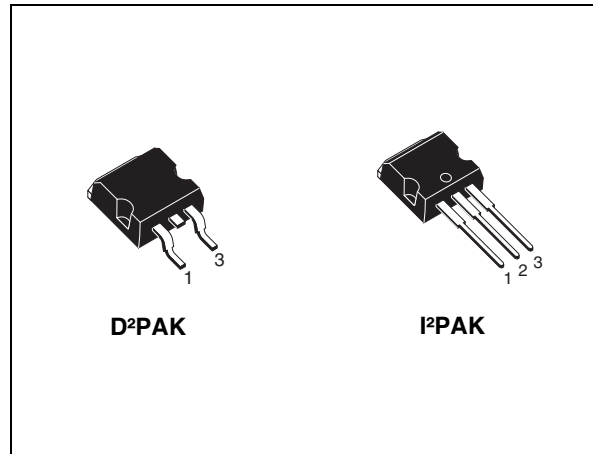


Figure 1. Internal schematic diagram

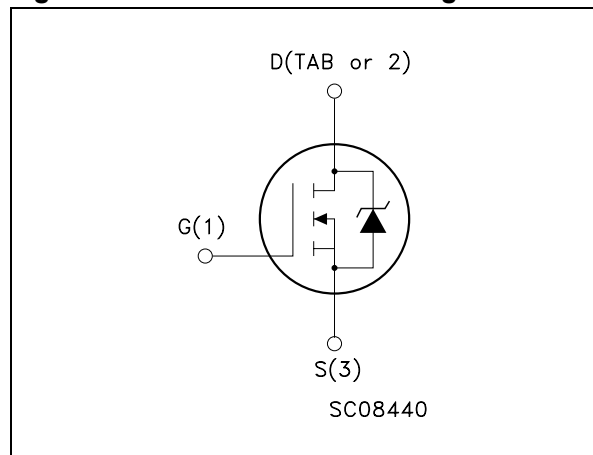


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB270N4F3	270N4F3	D <sup>2</sup> PAK	Tape and reel
STI270N4F3	270N4F3	I <sup>2</sup> PAK	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		I <sup>2</sup> PAK	D <sup>2</sup> PAK	
V <sub>DS</sub>	Drain-source voltage (V <sub>GS</sub> = 0)	40		V
V <sub>GS</sub>	Gate-source voltage	± 20		V
I <sub>D</sub> <sup>(1)</sup>	Drain current (continuous) at T <sub>C</sub> = 25 °C	120	160	A
I <sub>D</sub> <sup>(1)</sup>	Drain current (continuous) at T <sub>C</sub> =100 °C	120	160	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	480	640	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	330		W
	Derating factor	2.2		W/°C
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	3.5		V/n
E <sub>AS</sub> <sup>(4)</sup>	Single pulse avalanche energy	1		J
T <sub>J</sub> T <sub>stg</sub>	Operating junction temperature Storage temperature	-55 to 175		°C

1. Current limited by package
2. Pulse width limited by safe operating area
3. I<sub>SD</sub> ≤ 120 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>
4. Starting T<sub>j</sub>=25 °C, I<sub>D</sub> =80 A, V<sub>DD</sub>= 32 V

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		I <sup>2</sup> PAK	D <sup>2</sup> PAK	
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.45		°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb max		35	°C/W
R <sub>thj-a</sub>	Thermal resistance junction-ambient max	62.5		°C/W
T <sub>l</sub>	Maximum lead temperature for soldering purpose (for 10 sec, 1.6 mm from case)	300		°C

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

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$	40			V	
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ , $V_{DS} = \text{Max rating}$ @125 °C			10	$\mu\text{A}$	
					100	$\mu\text{A}$	
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 200$	nA	
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2		4	V	
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 80\text{ A}$	I <sup>2</sup> PAK		2.1	2.6	m $\Omega$
			D <sup>2</sup> PAK		1.6	2.0	m $\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{ V}$ , $I_D = 80\text{ A}$	-	200		S
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	7400		pF
$C_{oss}$	Output capacitance			1800		pF
$C_{rss}$	Reverse transfer capacitance			47		pF
$Q_g$	Total gate charge	$V_{DD} = 20\text{ V}$ , $I_D = 160\text{ A}$	-	110	150	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10\text{ V}$		27		nC
$Q_{gd}$	gate-drain charge	(see Figure 14)		25		nC

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

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on delay time	$V_{DD} = 20\text{ V}$ , $I_D = 80\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 16)	-	22	-	ns
	Rise time			180	-	ns
$t_{d(off)}$ $t_f$	Turn-off delay time	$V_{DD} = 20\text{ V}$ , $I_D = 80\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 16)	-	110	-	ns
	Fall time			45	-	ns

Table 7. Source drain diode

Symbol	Parameter		Test conditions	Min	Typ.	Max	Unit
$I_{SD}$	Source-drain current	D <sup>2</sup> PAK		-		160	A
		I <sup>2</sup> PAK		-		120	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)	D <sup>2</sup> PAK		-		640	A
		I <sup>2</sup> PAK		-		480	A
$V_{SD}^{(2)}$	Forward on voltage		$I_{SD}=80\text{ A}, V_{GS}=0$	-		1.5	V
$t_{rr}$	Reverse recovery time		$I_{SD}=160\text{ A},$ $di/dt = 100\text{ A}/\mu\text{s},$ $V_{DD}=32\text{ V}, T_j=150\text{ }^\circ\text{C}$ <i>(see Figure 15)</i>	-	70		ns
$Q_{rr}$	Reverse recovery charge	nC					
$I_{RRM}$	Reverse recovery current	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

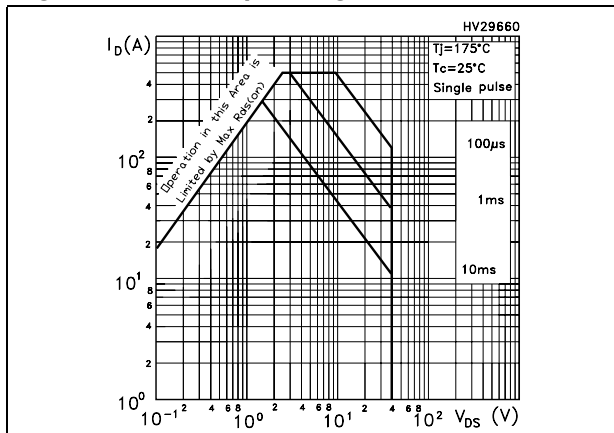


Figure 3. Thermal impedance

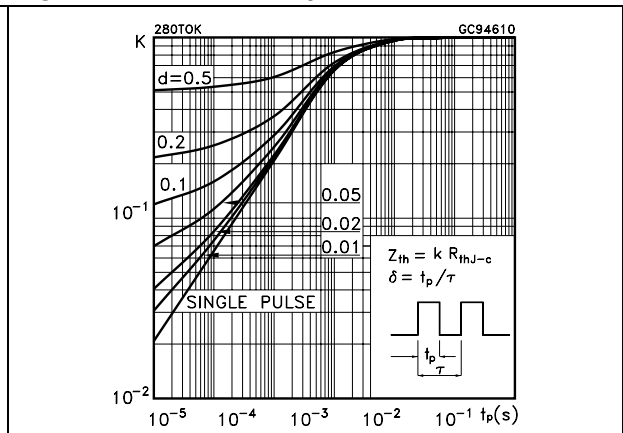


Figure 4. Output characteristics

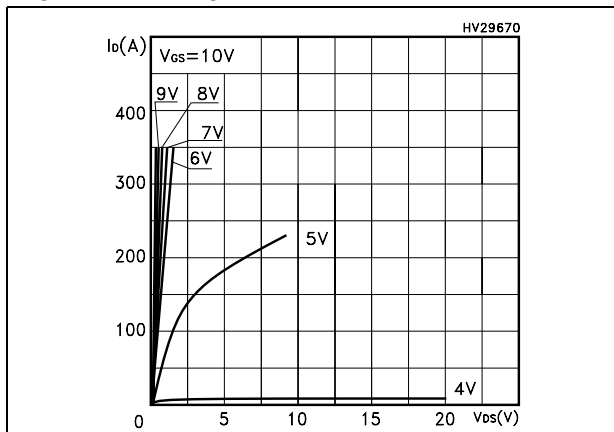


Figure 5. Transfer characteristics

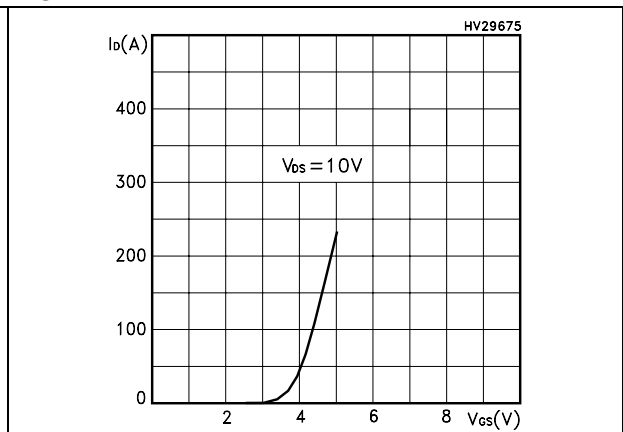


Figure 6. Static drain-source on resistance

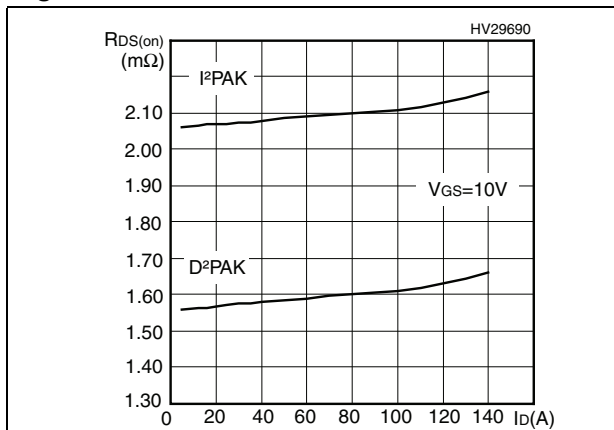


Figure 7. Normalized  $B_{V_{DS}}$  vs temperature

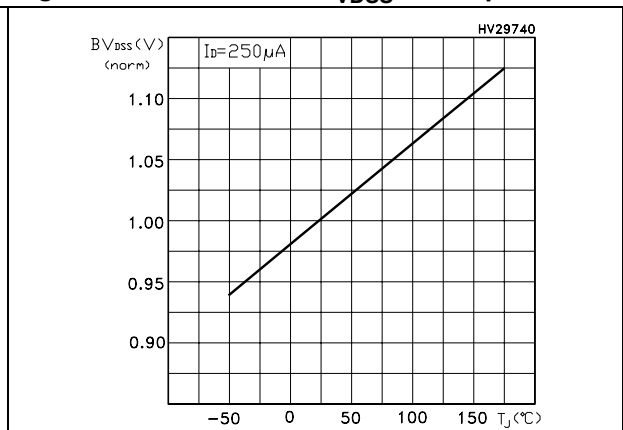


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

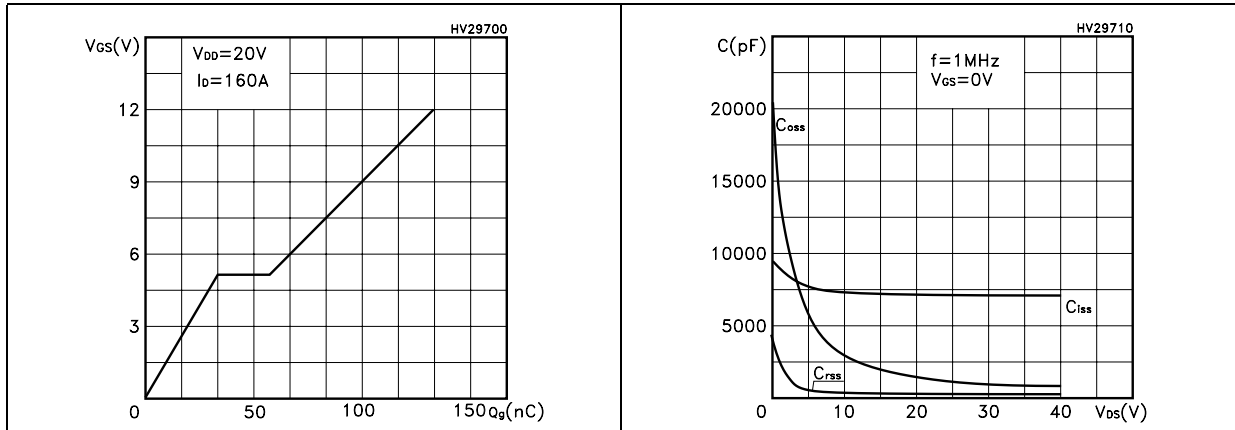


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

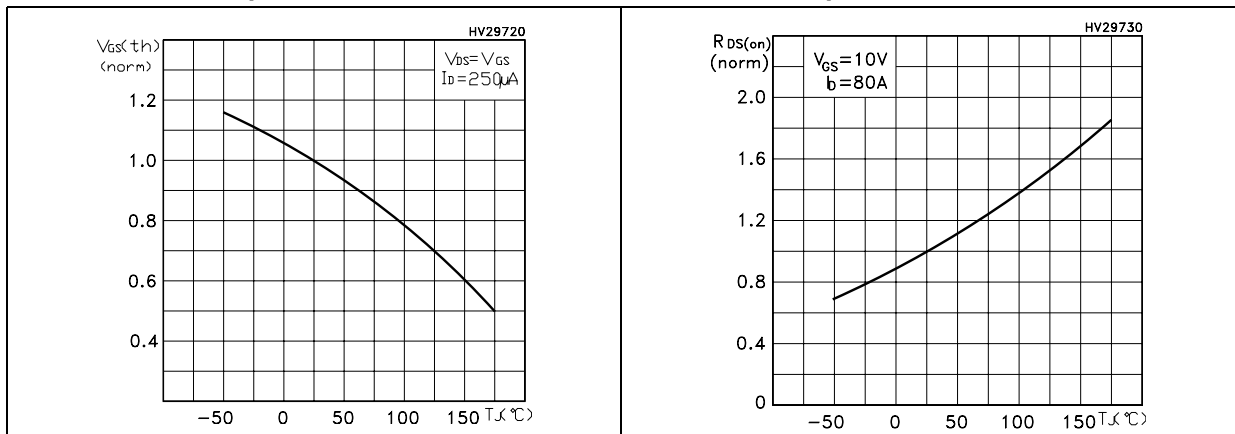
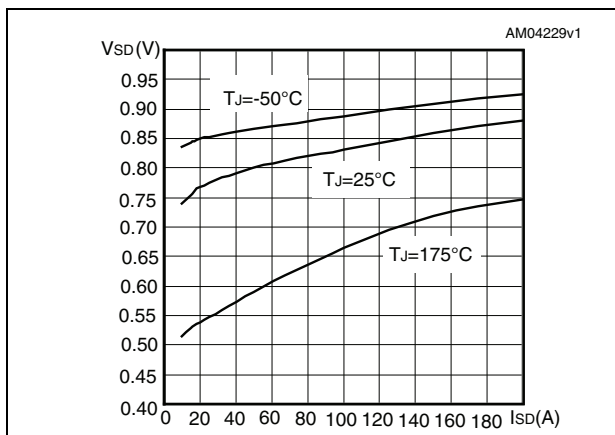
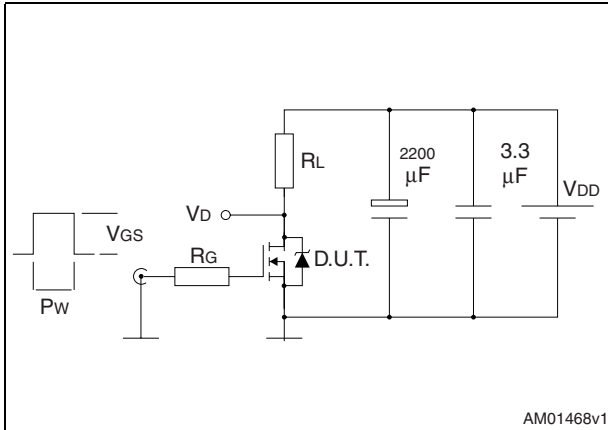


Figure 12. Source-drain diode forward characteristics



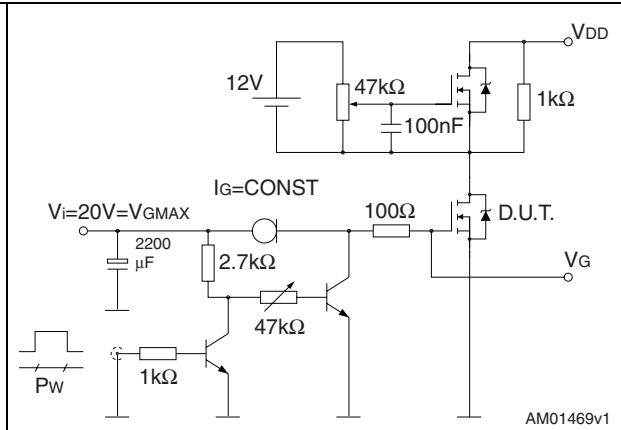
### 3 Test circuit

**Figure 13. Switching times test circuit for resistive load**



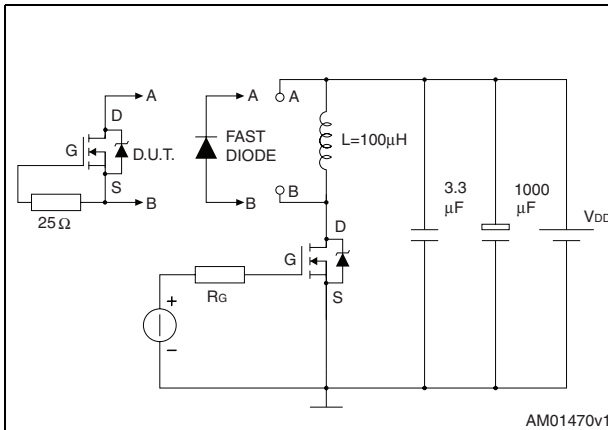
AM01468v1

**Figure 14. Gate charge test circuit**



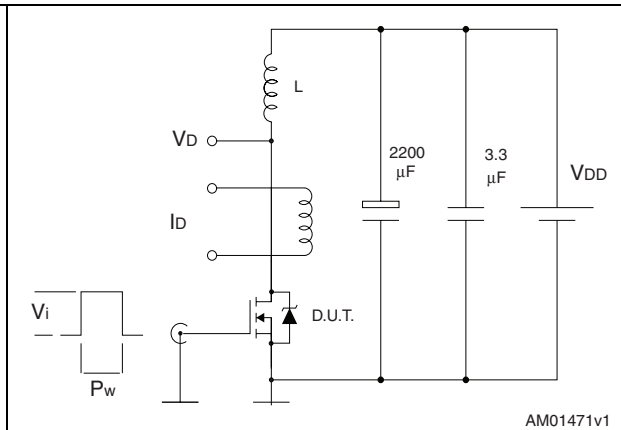
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**Figure 15. Test circuit for inductive load switching and diode recovery times**



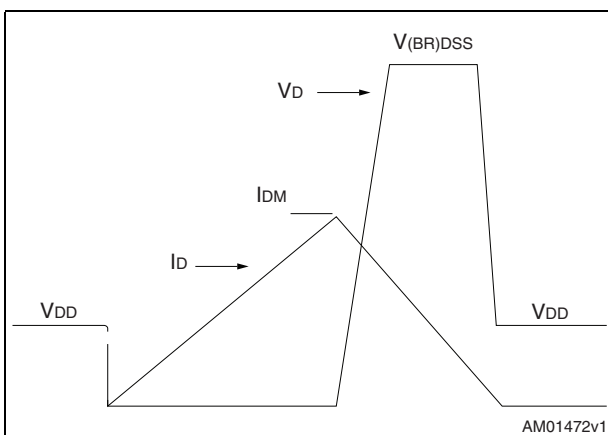
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**Figure 16. Unclamped inductive load test circuit**



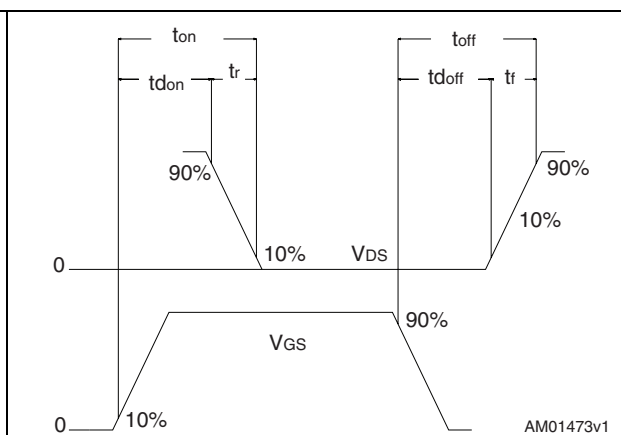
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**Figure 17. Unclamped inductive waveform**



AM01472v1

**Figure 18. Switching time waveform**



AM01473v1

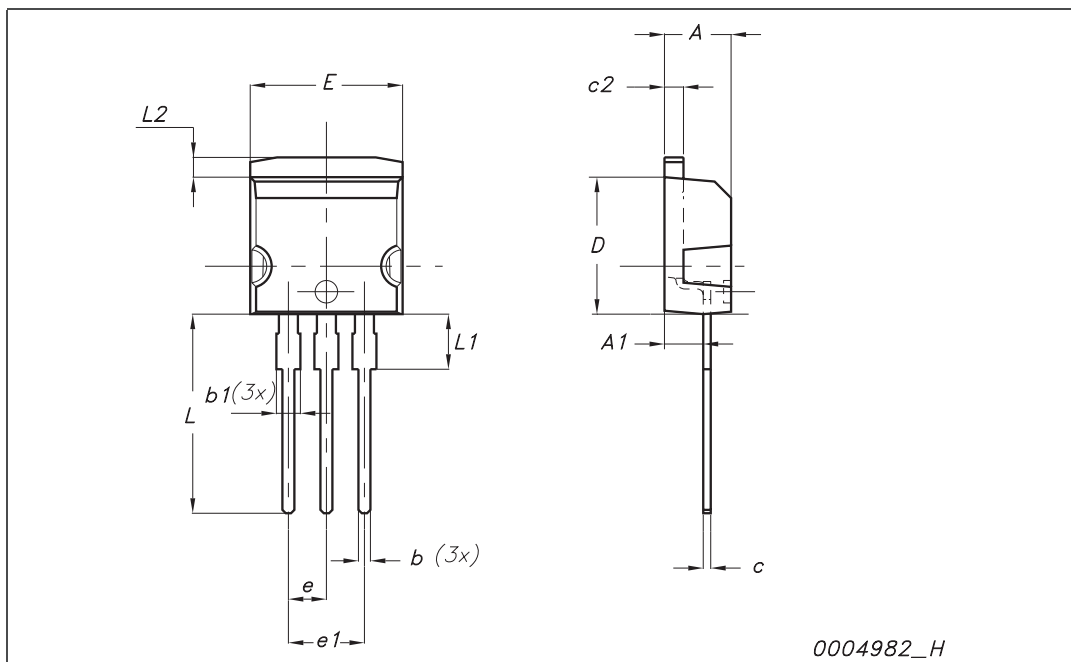


## 4 Package mechanical data

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). ECOPACK is an ST trademark.

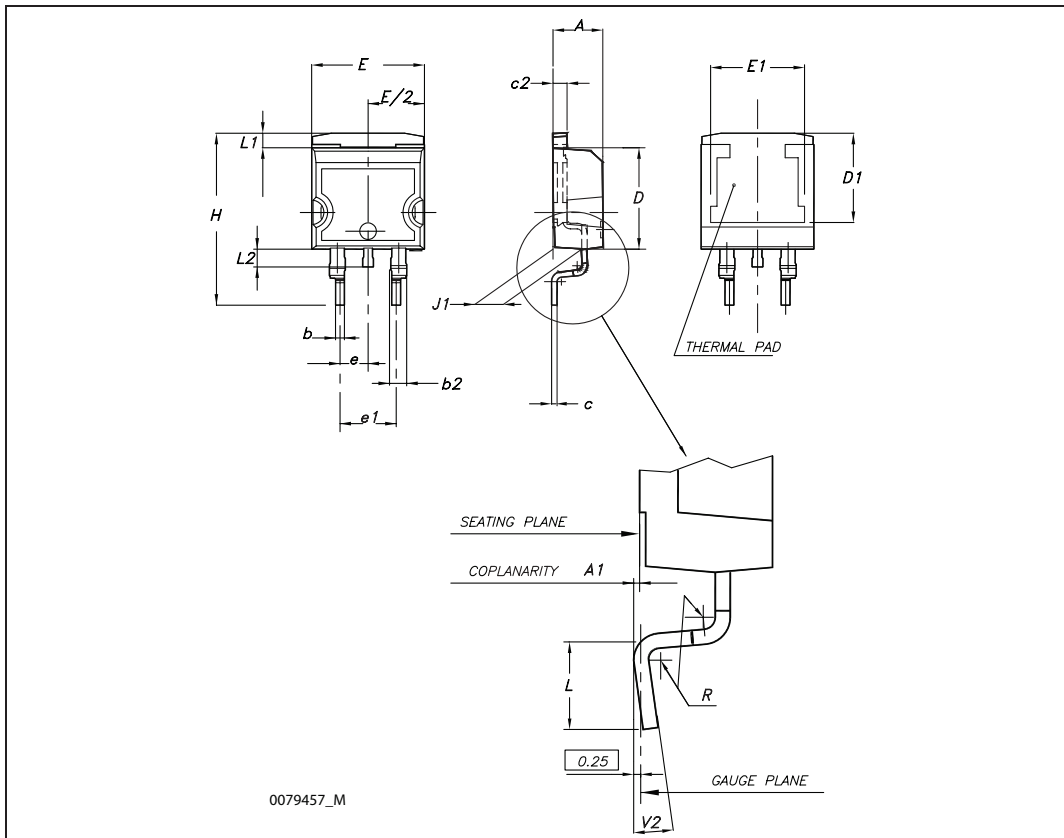
I<sup>2</sup>PAK (TO-262) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



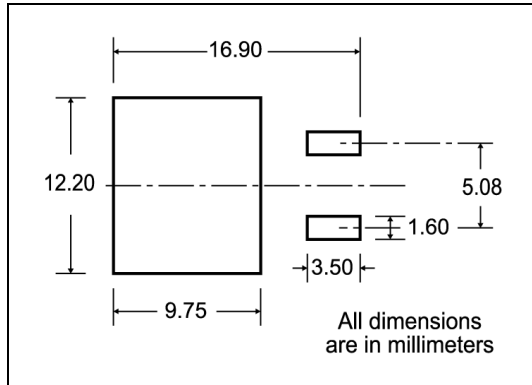
D<sup>2</sup>PAK (TO-263) mechanical data

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

## D<sup>2</sup>PAK 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	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

### 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

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

TRL

Bending radius R min.

\* on sales type

## 6 Revision history

Table 8. Revision history

Date	Revision	Changes
07-Feb-2007	1	Initial release.
02-Apr-2008	2	Some value changes on <a href="#">Table 2</a>
06-May-2009	3	Changed: <a href="#">Description</a> and <a href="#">Figure 12: Source-drain diode forward characteristics</a>
14-Jul-2009	4	Removed package and mechanical data: TO-220

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