



# STD40NF10 STP40NF10

N-channel 100V - 0.025Ω - 50A TO-220 / DPAK  
Low gate charge STripFET™ II Power MOSFET

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub> Max	I <sub>D</sub>
STD40NF10	100V	<0.028Ω	50A
STP40NF10	100V	<0.028Ω	50A

- Exceptional dv/dt capability
- Low gate charge
- 100% avalanche tested

## Application

- Switching applications

## Description

This Power MOSFET is the latest development of STMicroelectronics unique "single feature size" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps allowing remarkable manufacturing reproducibility.

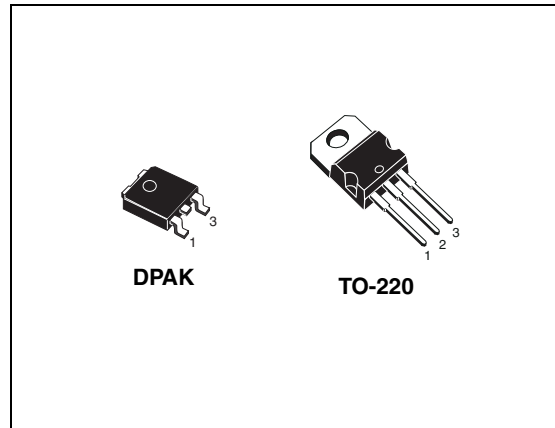


Figure 1. Internal schematic diagram

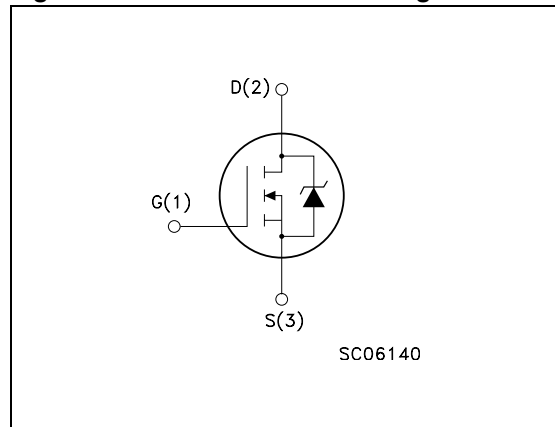


Table 1. Device summary

Order codes	Marking	Package	Packaging
STP40NF10	P40NF10	TO-220	Tube
STD40NF10	D40NF10	DPAK	Tape & reel

## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220	DPAK	
$V_{DS}$	Drain-source voltage ( $v_{gs} = 0$ )	100		V
$V_{GS}$	Gate- source voltage	±20		V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	50		A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	35		A
$I_{DM}^{(2)}$	Drain current (pulsed)	200		A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	150	125	W
	Derating factor	1	0.83	W/°C
$dv/dt^{(3)}$	Peak diode recovery voltage slope	27		V/ns
$E_{AS}^{(4)}$	Single pulse avalanche energy	385		mj
$T_{stg}$	Storage temperature	– 55 to 175		°C
$T_j$	Max. operating junction temperature			

- Limited by wire bonding
- Pulse width limited by safe operating area
- $I_{SD} \leq 50\text{A}$ ,  $di/dt \leq 600\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$ .
- Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 50\text{A}$ ,  $V_{DD} = 25\text{V}$

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		TO-220	DPAK	
$R_{thj-case}$	Thermal resistance junction-case Max	1	1.2	°C/W
$R_{thj-a}$	Thermal resistance junction-ambient Max	62.5		°C/W
$T_l$	Maximum lead temperature for soldering purpose	300		°C

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown voltage	$I_D = 250 \mu A, V_{GS} = 0$	100			V
$I_{DSS}$	Zero gate voltage Drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^{\circ}C$			1 10	$\mu A$ $\mu A$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20V$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu A$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 25A$		0.025	0.028	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 28A$		22		S
$C_{iss}$	Input capacitance			2180		pF
$C_{oss}$	Output capacitance	$V_{DS} = 25V, f = 1 \text{ MHz},$ $V_{GS} = 0$		298		pF
$C_{rss}$	Reverse transfer capacitance			83.7		pF
$Q_g$	Total gate charge	$V_{DD} = 50V, I_D = 40A,$ $V_{GS} = 10V$		46.5	62	nC
$Q_{gs}$	Gate-source charge			13.3		nC
$Q_{gd}$	Gate-drain charge	(see Figure 17)		17.5	22.5	nC

1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5.

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 50V, I_D = 25A$ $R_G = 4.7 \Omega, V_{GS} = 10V$ (see Figure 16)		21		ns
$t_r$	Rise time			46		ns
$t_{d(off)}$	Turn-off-delay time	$V_{DD} = 27V, I_D = 40A,$ $R_G = 4.7 \Omega, V_{GS} = 10V$ (see Figure 16)		54		ns
$t_f$	Fall time			13		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$I_{SD}$	Source-drain current				80	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				320	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 50A, V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 50A, V_{DD} = 25V$ $di/dt = 100A/\mu s,$ $T_j = 150^\circ C$ <i>(see Figure 18)</i>		80		ns
$Q_{rr}$	Reverse recovery charge			250		nC
$I_{RRM}$	Reverse recovery current			6.4		A

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

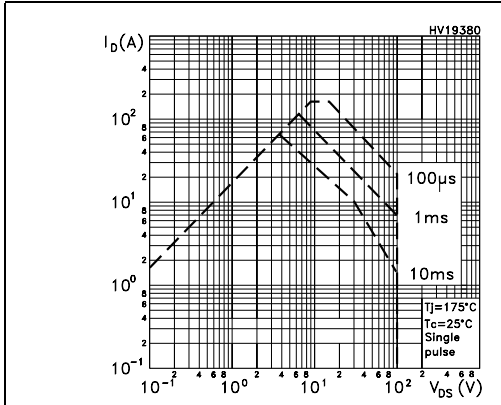


Figure 3. Thermal impedance for TO-220

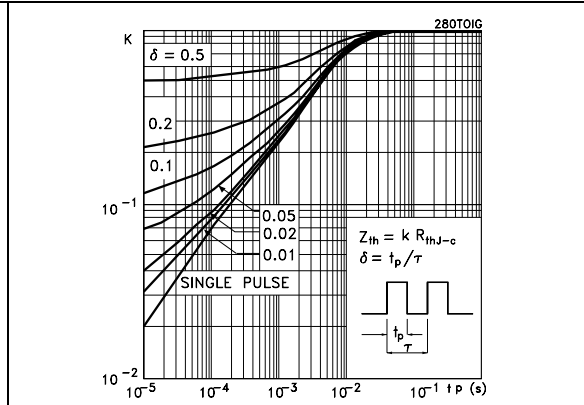


Figure 4. Safe operating area for DPAK

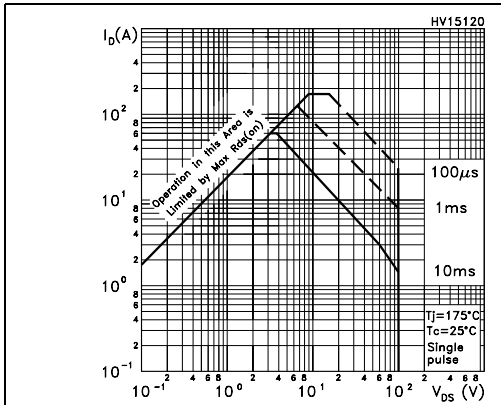


Figure 5. Thermal impedance for DPAK

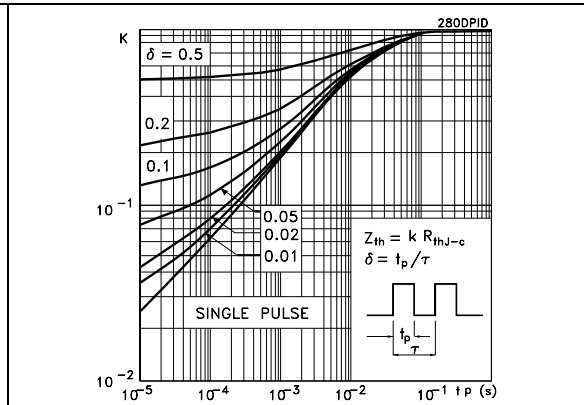


Figure 6. Output characteristics

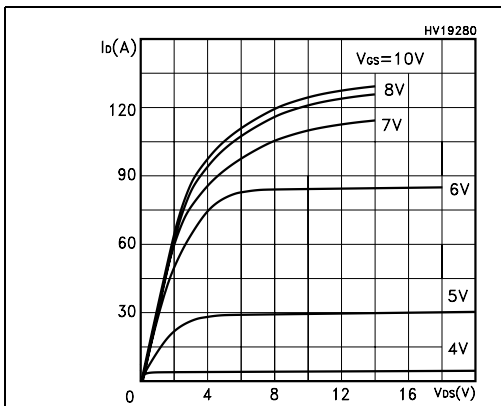


Figure 7. Transfer characteristics

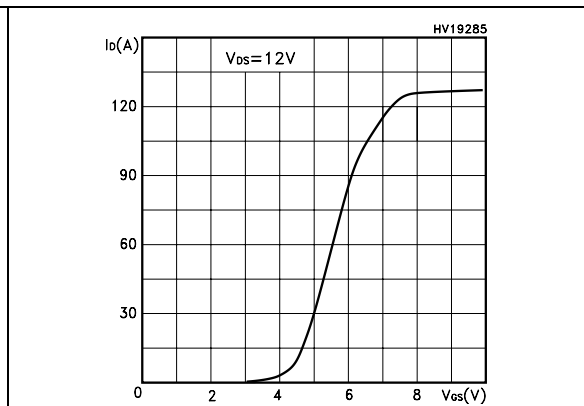


Figure 8. Transconductance

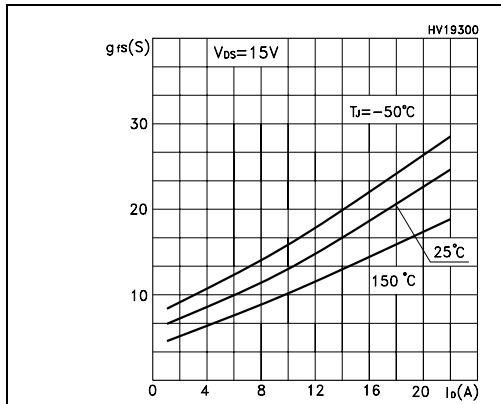


Figure 9. Static drain-source on resistance

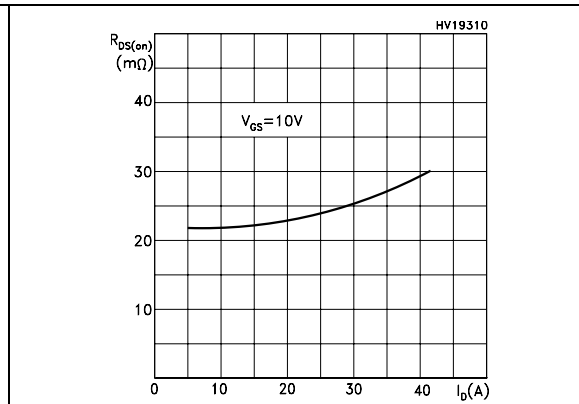


Figure 10. Gate charge vs. gate-source voltage Figure 11. Capacitance variations

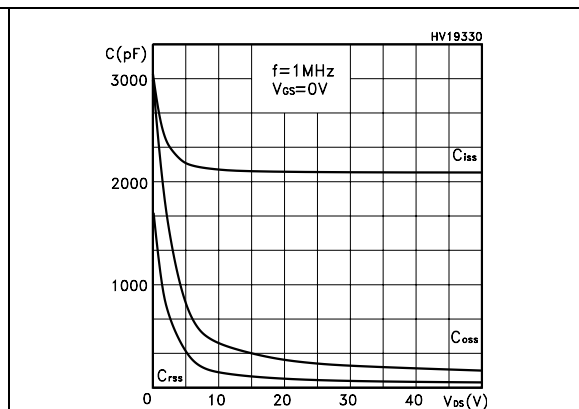
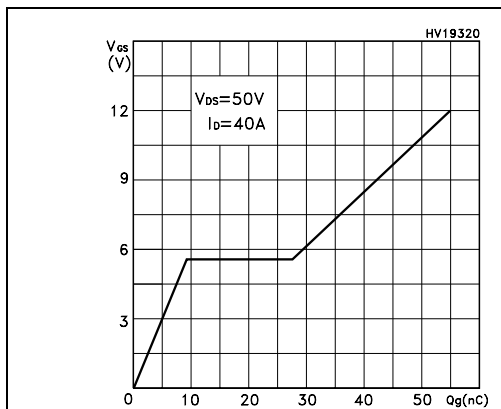


Figure 12. Normalized gate threshold voltage vs. temperature

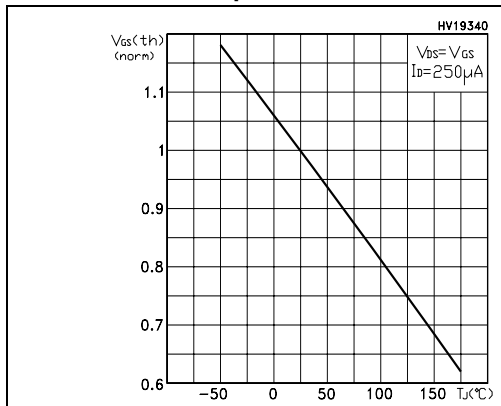


Figure 13. Normalized on resistance vs. temperature

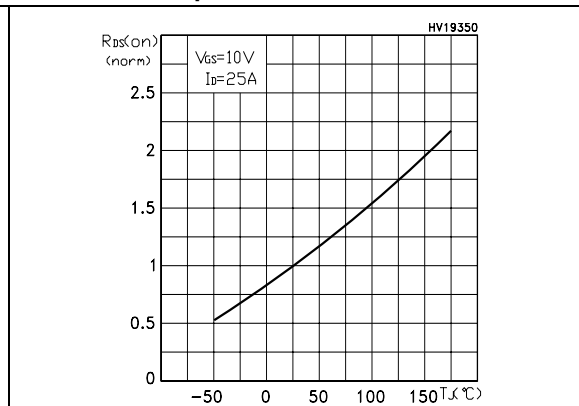


Figure 14. Source-drain diode forward characteristics

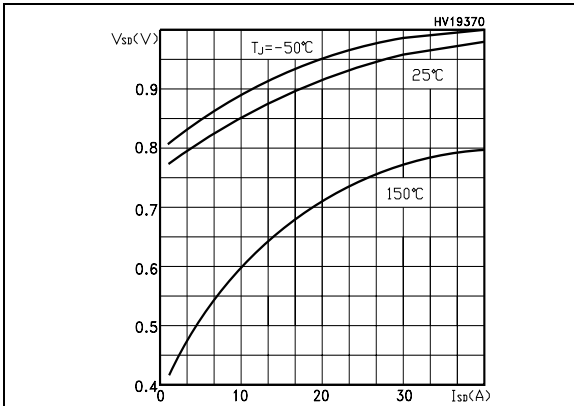
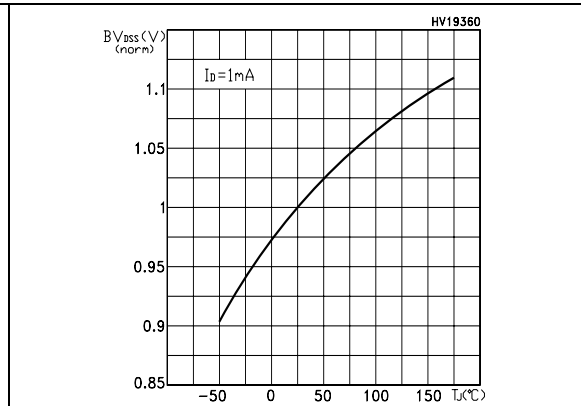


Figure 15. Normalized breakdown voltage vs.  $t_j$





### 3 Test circuit

Figure 16. Switching times test circuit for resistive load

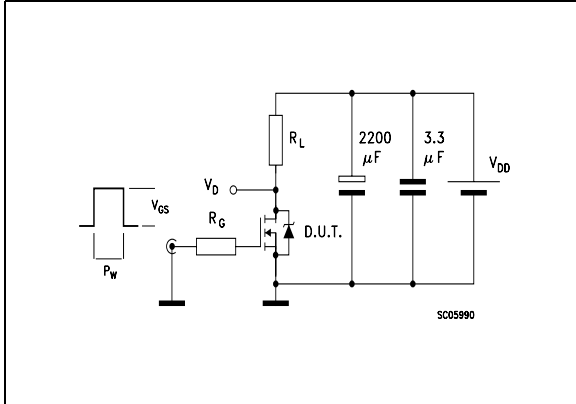


Figure 17. Gate charge test circuit

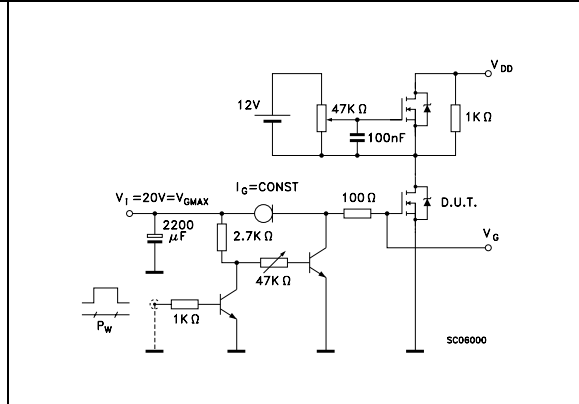


Figure 18. Test circuit for inductive load switching and diode recovery times

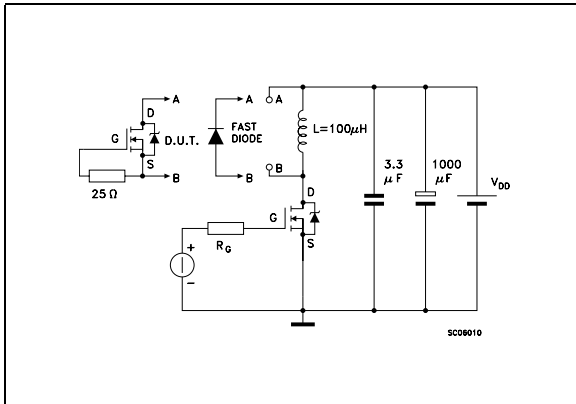


Figure 19. Unclamped Inductive load test circuit

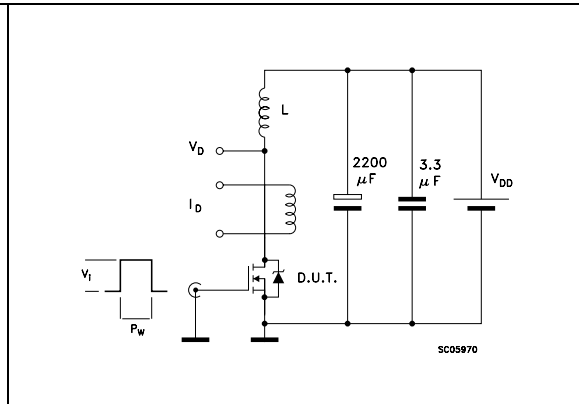


Figure 20. Unclamped inductive waveform

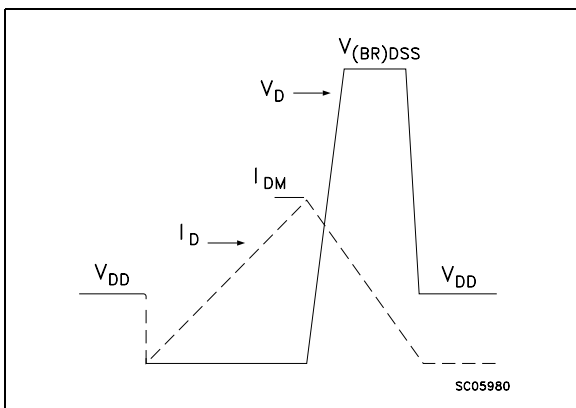
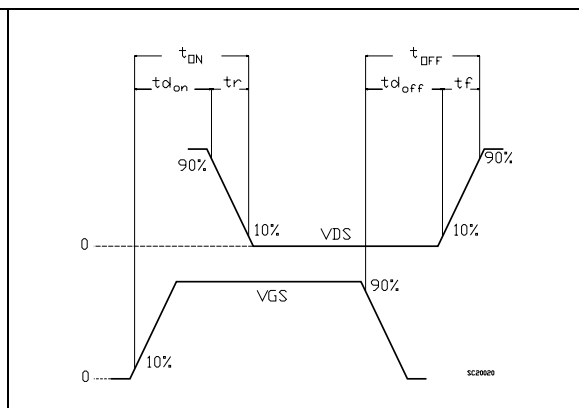


Figure 21. Switching time waveform

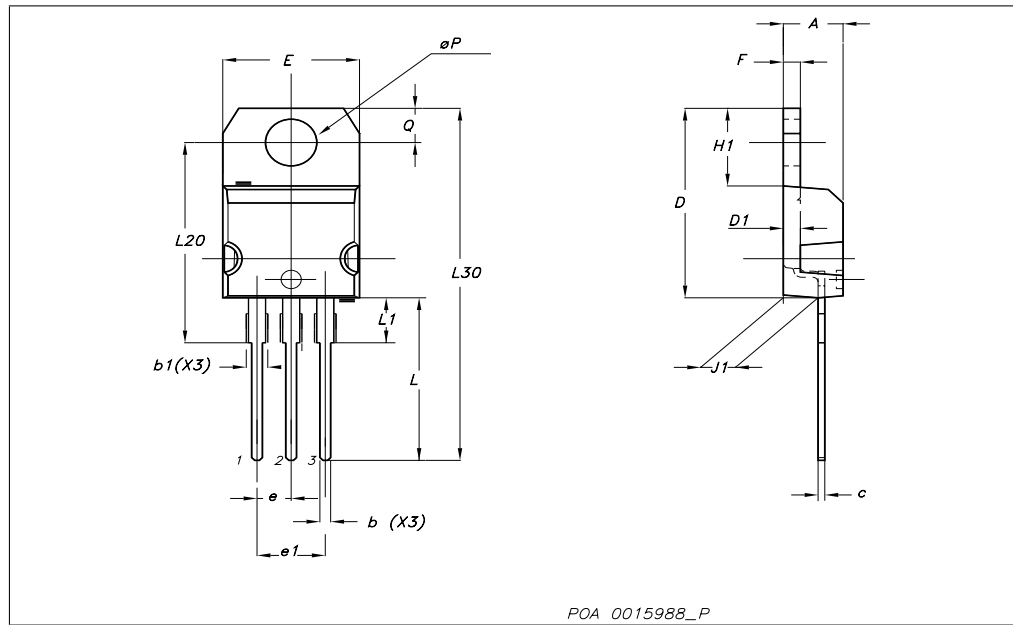


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at : [www.st.com](http://www.st.com)

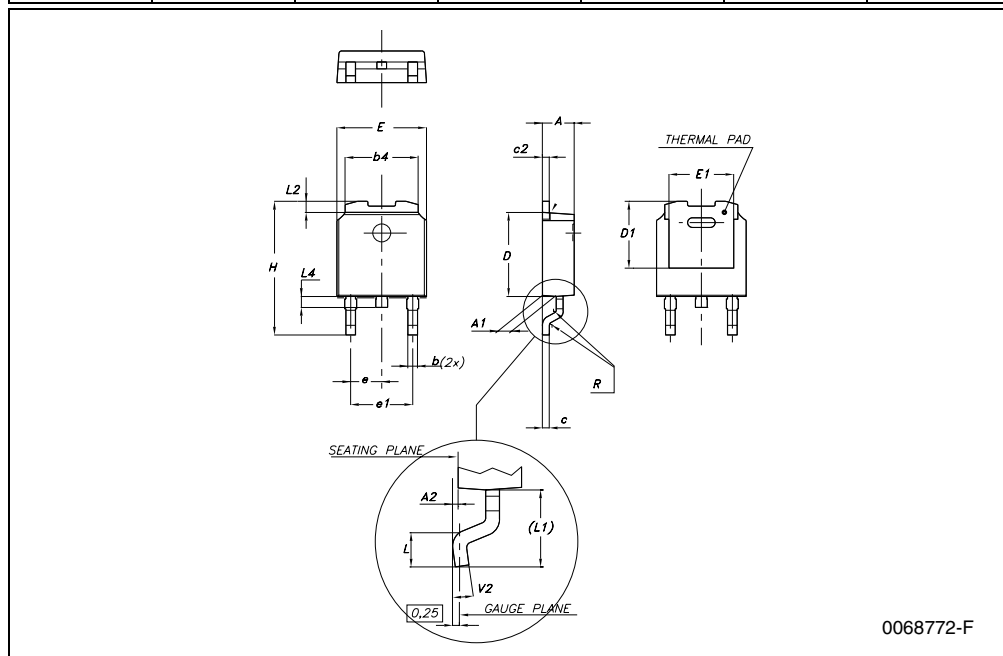
TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
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
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



**DPAK MECHANICAL DATA**

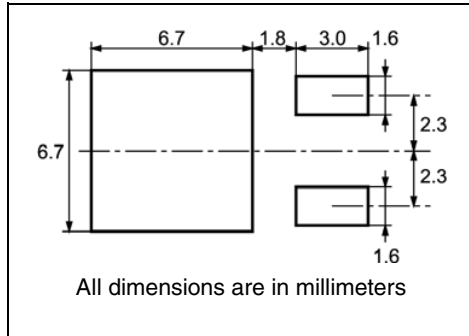
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
b4	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
e		2.28			0.090	
e1	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L	1			0.039		
(L1)		2.8			0.110	
L2		0.8			0.031	
L4	0.6		1	0.023		0.039
R		0.2			0.008	
V2	0°		8°	0°		8°



0068772-F

## 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

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

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

Bending radius

R min.

FEED DIRECTION

User Direction of Feed

TRL

## 6 Revision history

Table 8. Document revision history

Date	Revision	Changes
16-Dec-2004	1	First version.
17-Aug-2006	2	The document has been reformatted.
31-Jan-2007	3	Typo mistake on <a href="#">Table 2</a> .
19-Sep-2007	4	Added DPAK

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