



# STB270N04 STB270N04-1 - STP270N04

N-CHANNEL 40V - 2.1mΩ - 160A - TO-220 - D<sup>2</sup>PAK - I<sup>2</sup>PAK  
STripFET™ Power MOSFET

## General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>TOT</sub>
STB270N04-1	40V	<2.9mΩ	120A	330W
STB270N04	40V	<2.5mΩ	160A	330W
STP270N04	40V	<2.9mΩ	120A	330W

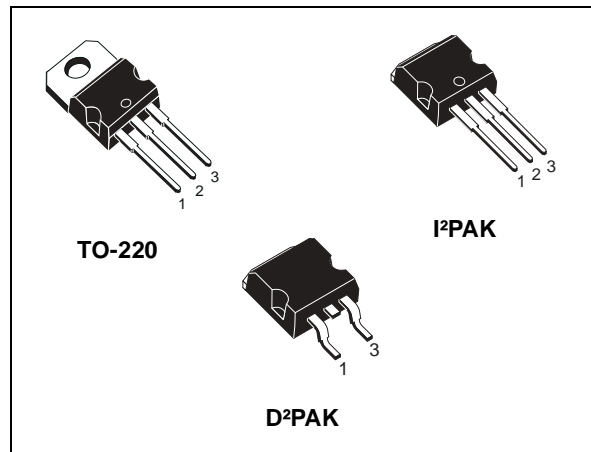
- 100% avalanche tested
- Standard threshold drive

## Description

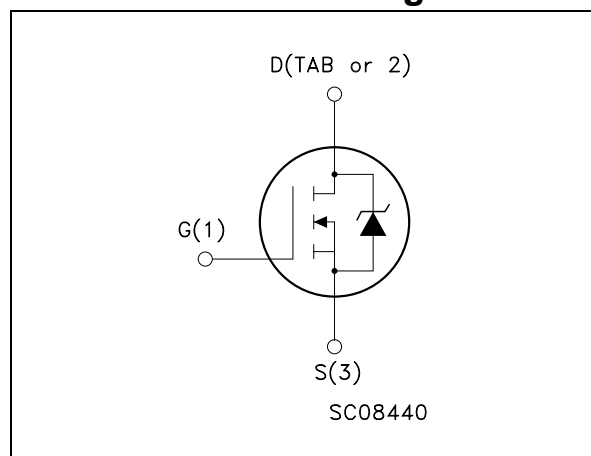
This N-Channel enhancement mode MOSFET is the latest refinement of STMicroelectronic unique "Single Feature Size™" strip-based process with less critical alignment steps and therefore a remarkable manufacturing reproducibility. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and low gate charge.

## Applications

- High current, switching application
- Automotive



## Internal schematic diagram



## Order codes

Sales Type	Marking	Package	Packaging
STB270N04-1	B270N04	I <sup>2</sup> PAK	TUBE
STB270N04	B270N04	D <sup>2</sup> PAK	TAPE & REEL
STP270N04	P270N04	TO-220	TUBE

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220/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/ns
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> ≤ 120A, di/dt ≤ 200A/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> =80A, V<sub>dd</sub>=32V

**Table 2. Thermal data**

Symbol	Parameter	Value		Unit
		TO-220/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>I</sub>	Maximum lead temperature for soldering purpose (for 10 sec, 1.6mm from case)	300	--	°C

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

## 2 Electrical characteristics

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

**Table 3. On/off states**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$I_D = 250\mu A, V_{GS} = 0$	40			V
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max Rating},$ $V_{DS} = \text{MaxRating}$ @125°C			10 100	$\mu A$ $\mu A$
$I_{GSS}$	Gate Body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20V$			$\pm 200$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	2		4	V
$R_{DS(on)}$	Static Drain-Source On Resistance	$V_{GS} = 10V, I_D = 80A$		2.5	2.9	m $\Omega$
			<b>TO-220</b> <b>I<sup>2</sup>PAK</b>		2.1	2.5

**Table 4. Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward Transconductance	$V_{DS} = 15V, I_D = 80A$		200		S
$C_{iss}$	Input Capacitance	$V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$		7400		pF
$C_{oss}$	Output Capacitance			1800		pF
$C_{rss}$	Reverse Transfer Capacitance			47		pF
$Q_g$	Total Gate Charge	$V_{DD} = 20V, I_D = 160A$		110	150	nC
$Q_{gs}$	Gate-Source Charge	$V_{GS} = 10V$		27		nC
$Q_{gd}$	Gate-Drain Charge	(see Figure 2)		25		nC

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

**Table 5. Switching times**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD}=20\text{ V}$ , $I_D=80\text{ A}$ , $R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$ (see Figure 14)		22 180		ns ns
$t_{d(off)}$ $t_f$	Turn-off Delay Time Fall Time	$V_{DD}=20\text{ V}$ , $I_D=80\text{ A}$ , $R_G=4.7\Omega$ , $V_{GS}=10\text{ V}$ (see Figure 14)		110 45		ns ns

**Table 6. Source drain diode**

Symbol	Parameter		Test Conditions	Min	Typ.	Max	Unit
$I_{SD}$	Source-drain Current	D <sup>2</sup> PAK				160	A
		TO-220 I <sup>2</sup> PAK				120	A
$I_{SDM}^{(1)}$	Source-drain Current (pulsed)	D <sup>2</sup> PAK				640	A
		TO-220 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		$I_{SD}=160\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}=32\text{ V}$ , $T_j=150^\circ\text{C}$		70		ns
$Q_{rr}$	Reverse Recovery Charge				225		nC
$I_{RRM}$	Reverse Recovery Current				3.2		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 1. Safe operating area

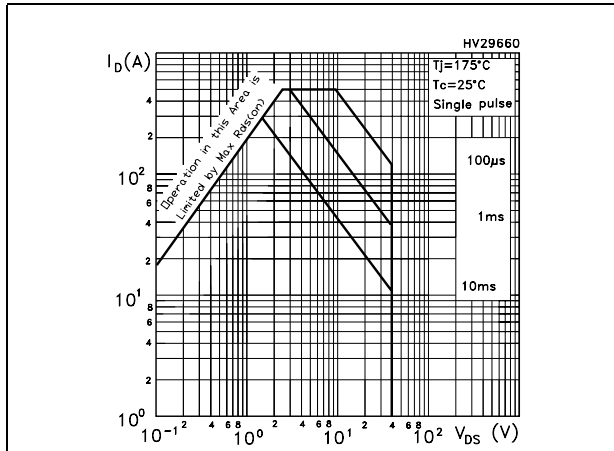


Figure 2. Thermal impedance

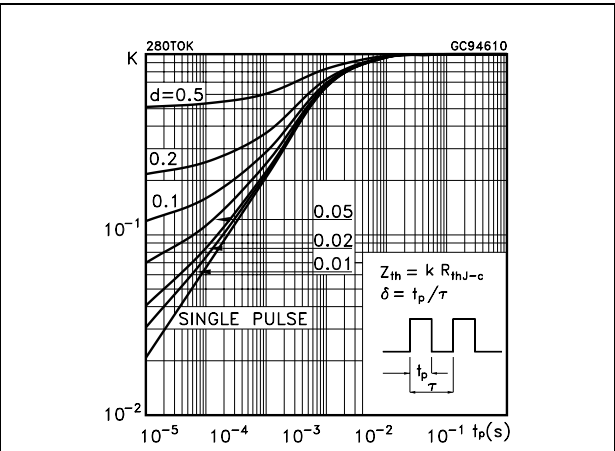


Figure 3. Output characteristics

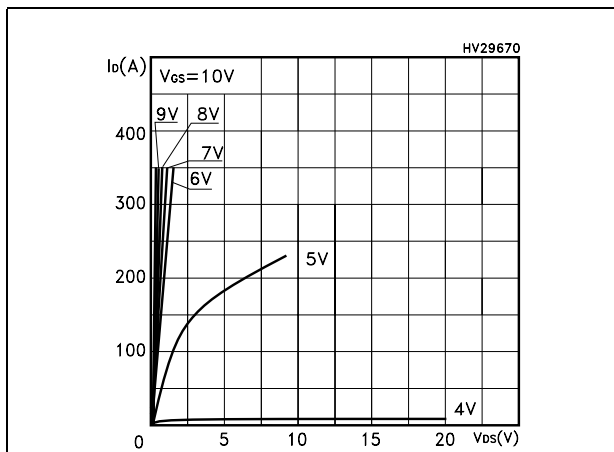


Figure 4. Transfer characteristics

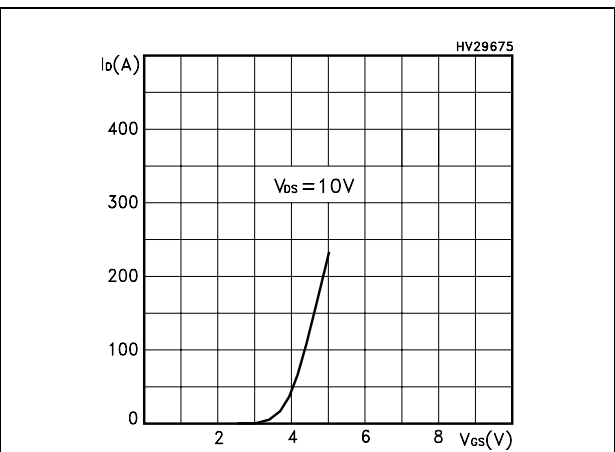


Figure 5. Static drain-source on resistance

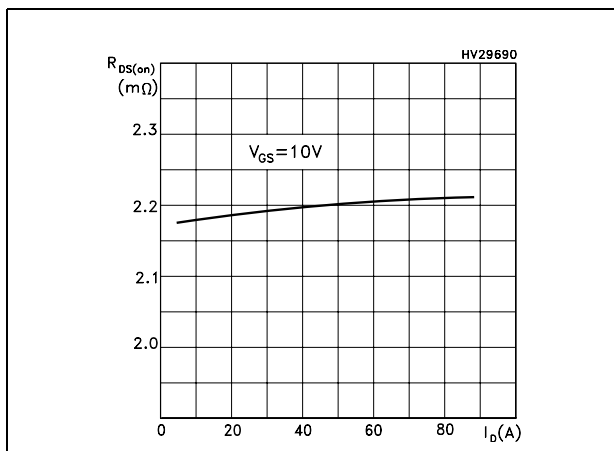


Figure 6. Normalized  $B_{V_{DS}}$  vs temperature

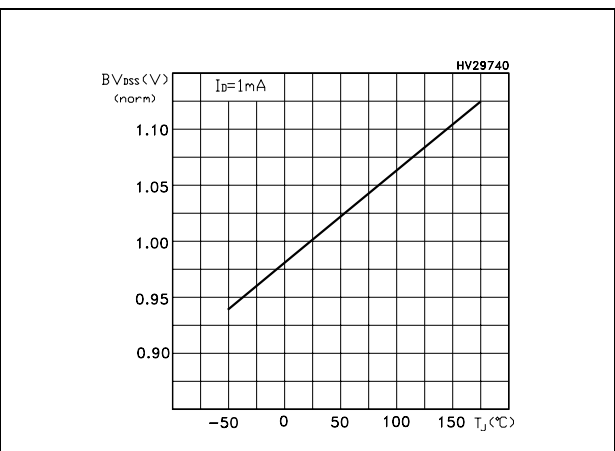


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

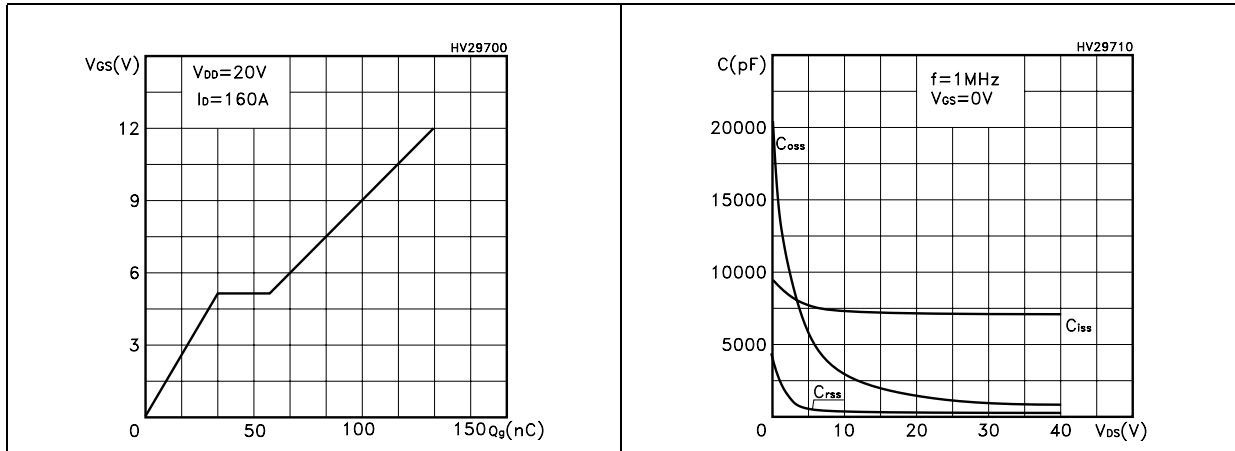


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

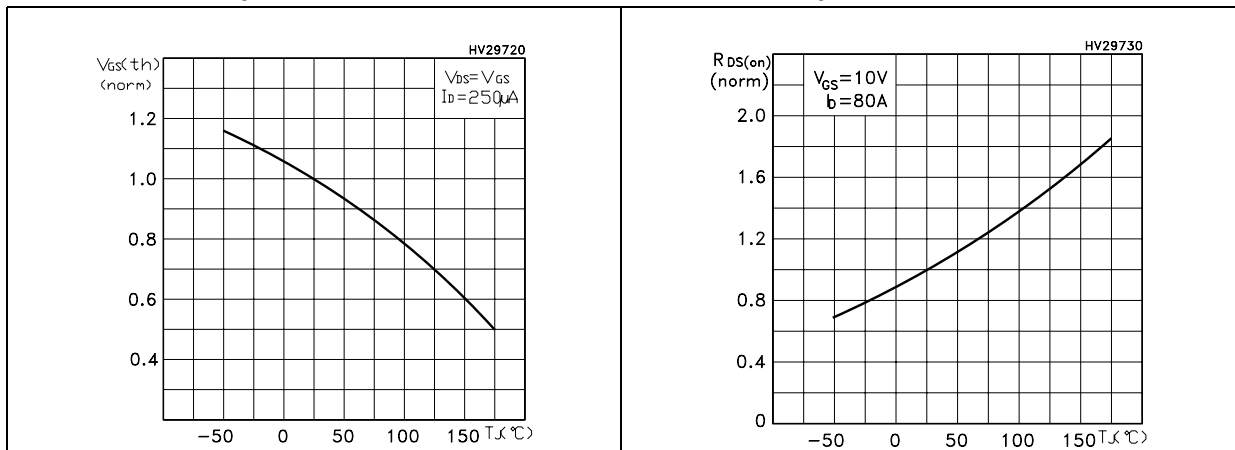
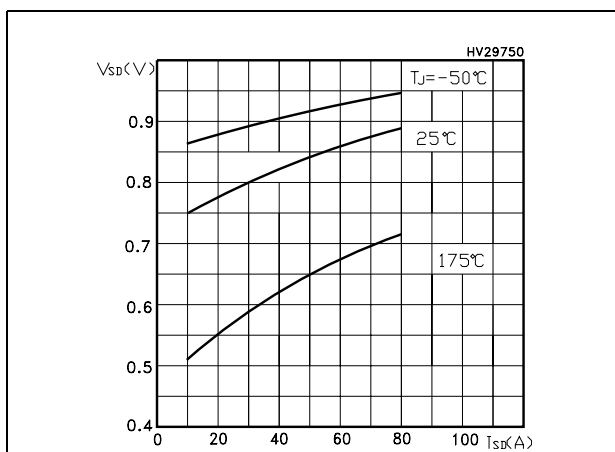


Figure 11. Source-drain diode forward characteristics



### 3 Test circuit

Figure 12. Switching times test circuit for resistive load

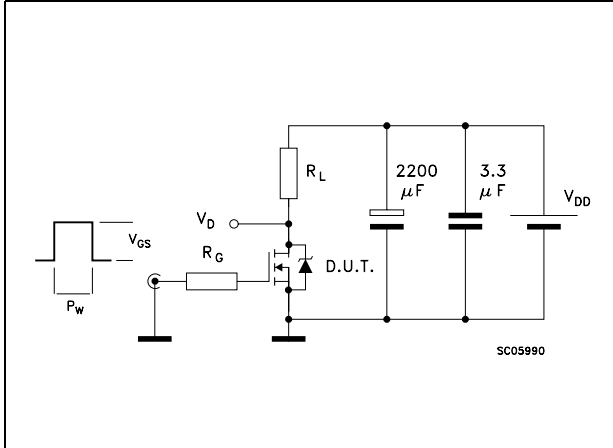


Figure 13. Gate charge test circuit

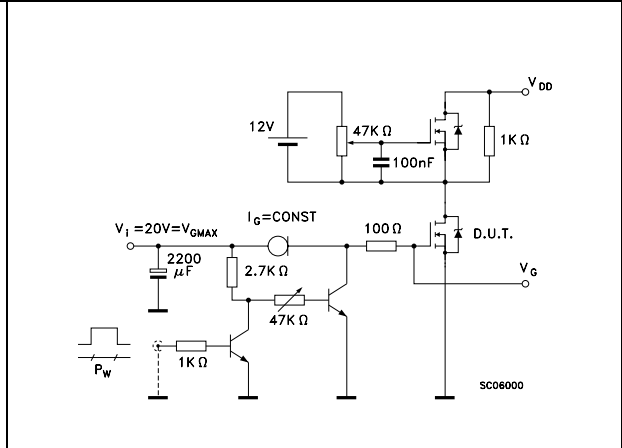


Figure 14. Test circuit for inductive load switching and diode recovery times

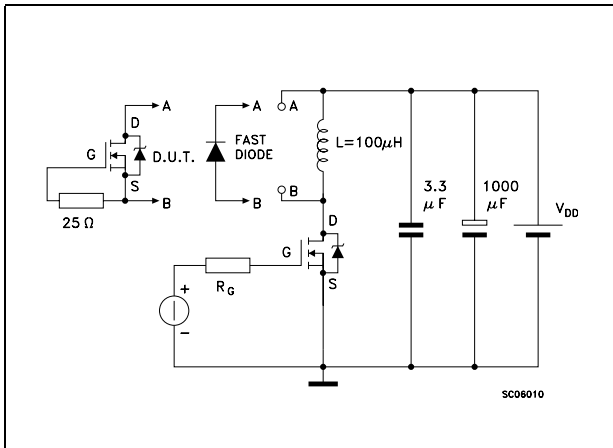


Figure 15. Unclamped Inductive load test circuit

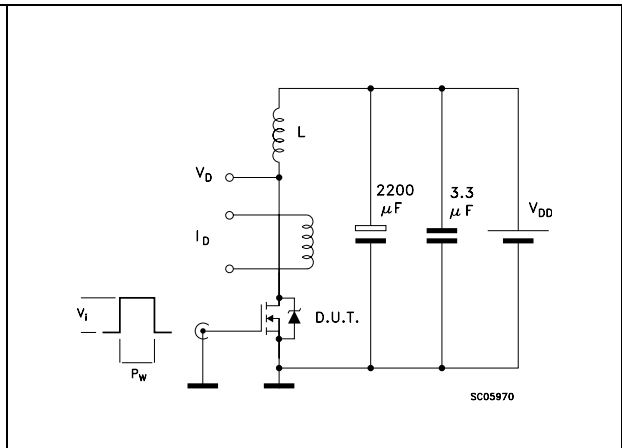


Figure 16. Unclamped inductive waveform

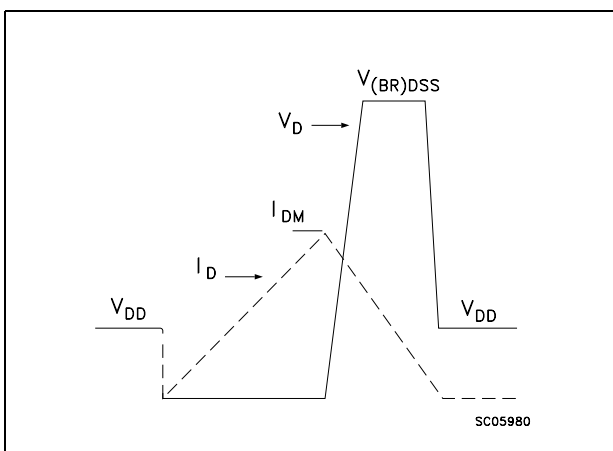
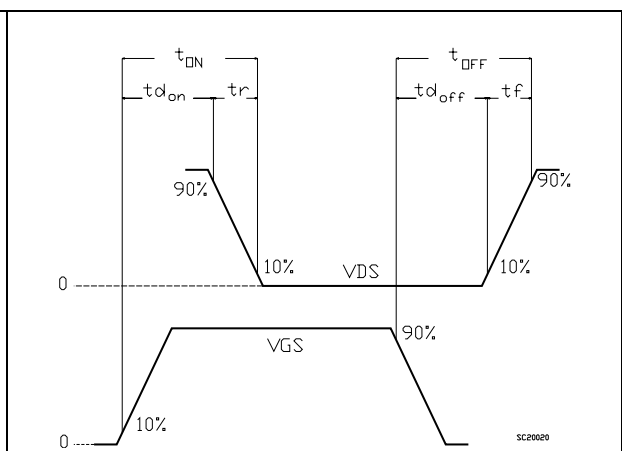


Figure 17. Switching time waveform



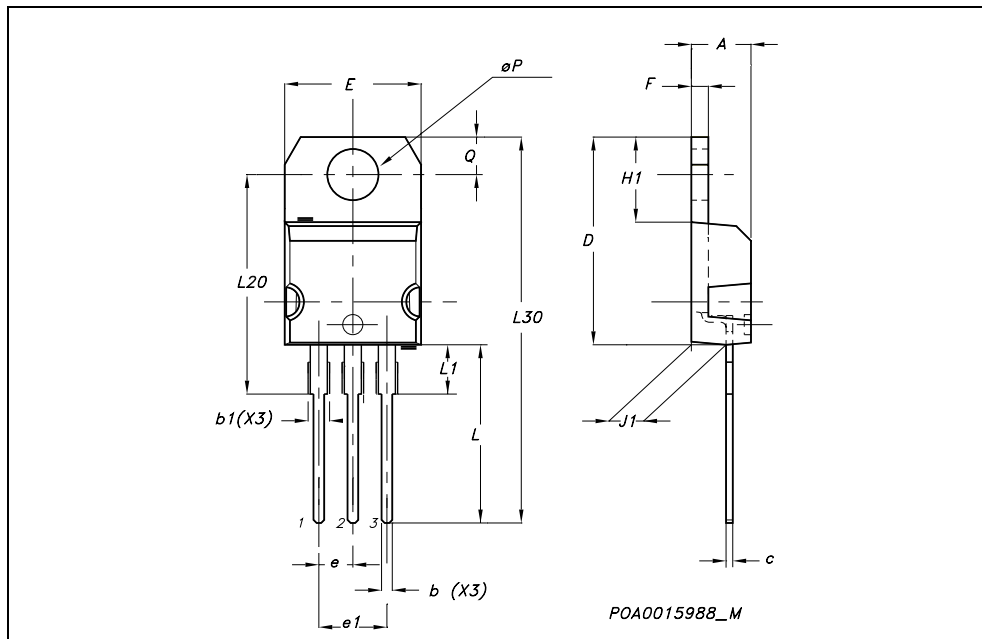
## 4 Package mechanical data

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)



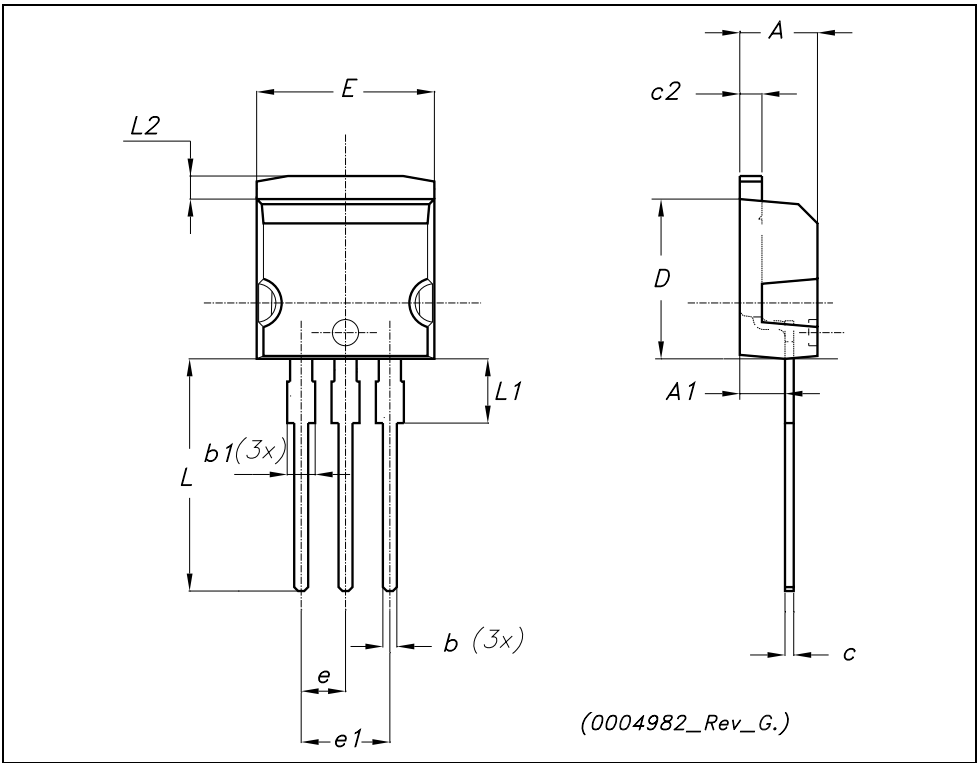
**TO-220 MECHANICAL DATA**

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	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
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		0.052
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	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



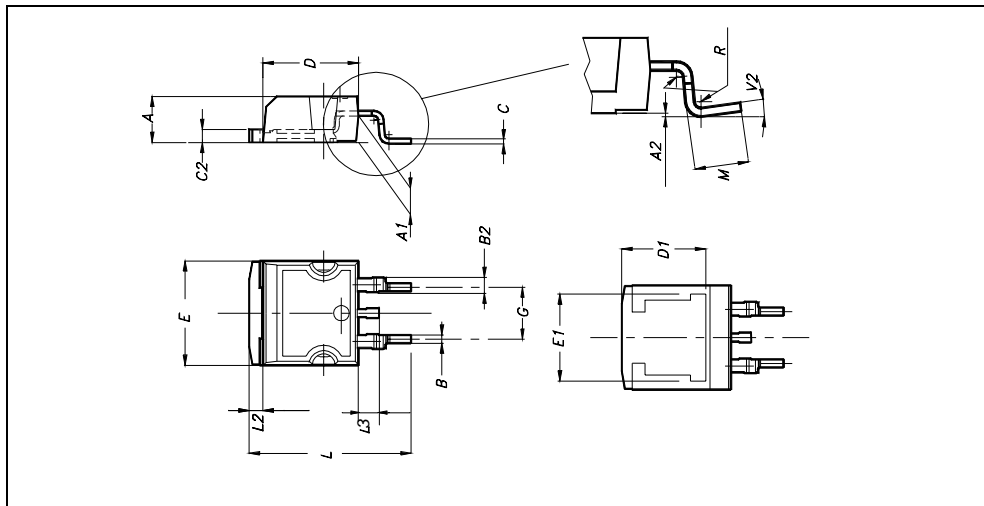
**TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

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



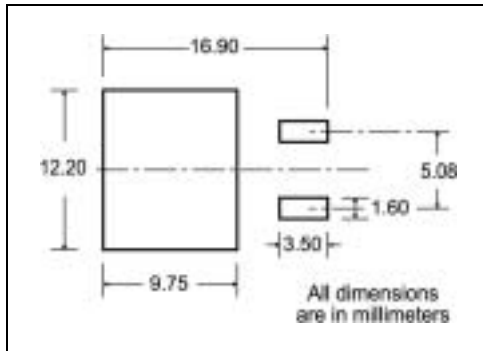
**D<sup>2</sup>PAK MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			



# 5 Packaging mechanical data

## D<sup>2</sup>PAK FOOTPRINT



## TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Tape slot in core for tape start 25mm min. width

Full radius

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

TOP COVER TAPE

User Direction of Feed

Center line of cavity

TRL

FEED DIRECTION

Bending radius

R min.

10 pitches cumulative tolerance on tape +/- 0.2 mm

\* on sales type

## 6 Revision history

**Table 7. Document revision history**

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
07-Oct-2005	1	Initial release.
10-Nov-2005	2	Preliminary version
09-Feb-2006	3	Complete datasheet

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