



STP60NF06

N-channel 60V - 0.014Ω - 60A TO-220
STripFET II™ Power MOSFET

General features

Type	V _{DSS}	R _{DS(on)}	I _D
STP60NF06	60V	<0.016Ω	60A

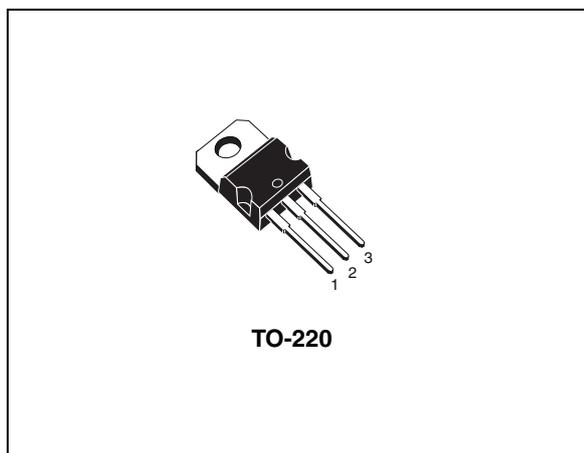
- Exceptional dv/dt capability
- 100% avalanche tested
- Application oriented characterization

Description

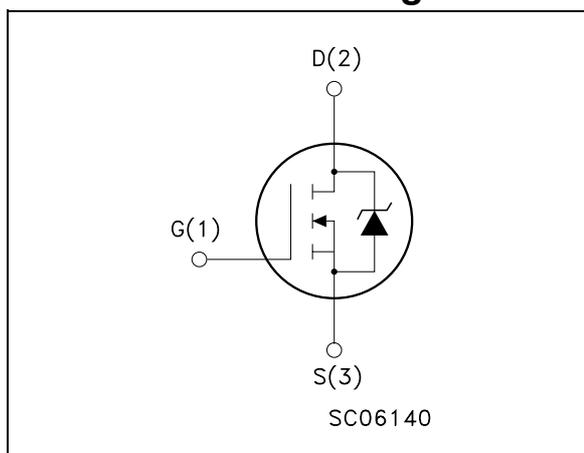
This Power MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters for Telecom and Computer application. It is also intended for any application with low gate charge drive requirements.

Applications

- Switching application



Internal schematic diagram



Order code

Part number	Marking	Package	Packaging
STP60NF06	P60NF06	TO-220	Tube

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	60	V
V_{GS}	Gate- source voltage	± 20	V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	60	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	42	A
$I_{DM}^{(1)}$	Drain current (pulsed)	240	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	110	W
	Derating factor	0.74	W/ $^\circ\text{C}$
$dv/dt^{(2)}$	Peak diode recovery voltage slope	7.5	V/ns
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. $I_{SD} \leq 60\text{A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} \leq 48\text{V}$, $T_j \leq T_{jmax}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.36	$^\circ\text{C}/\text{W}$
R_{thj-a}	Thermal resistance junction-ambient max	62.5	$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max)	30	A
E_{AS}	Single pulse avalanche energy (starting $T_j=25^\circ\text{C}$, $I_d=I_{AR}$, $V_{DD}=30\text{V}$)	370	mJ

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	$I_D = 250 \mu A, V_{GS} = 0$	60			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	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20V$			± 100	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	$V_{GS} = 10V, I_D = 30A$		0.014	0.016	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 30A$		50		S
C_{iss}	Input capacitance			1660		pF
C_{oss}	Output capacitance	$V_{DS} = 25V, f = 1 \text{ MHz},$ $V_{GS} = 0$		400		pF
C_{rss}	Reverse transfer capacitance			140		pF
Q_g	Total gate charge	$V_{DD} = 30V, I_D = 60A,$ $V_{GS} = 10V$		54	73	nC
Q_{gs}	Gate-source charge	$V_{GS} = 10V$		9		nC
Q_{gd}	Gate-drain charge	(see Figure 12)		23		nC

1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 30V, I_D = 30A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 11)		15		ns
t_r	Rise time	(see Figure 11)		65		ns
$t_{d(off)}$	Turn-off-delay time	$V_{DD} = 30V, I_D = 30A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 11)		45		ns
t_f	Fall time	(see Figure 11)		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	$I_{SD} = 60A, V_{GS} = 0$			1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 60A, V_{DD}=30V$ $di/dt = 100A/\mu s, T_j = 150^\circ C$ <i>(see Figure 13)</i>		70		ns
Q_{rr}	Reverse recovery charge			185		nC
I_{RRM}	Reverse recovery current			5		A

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

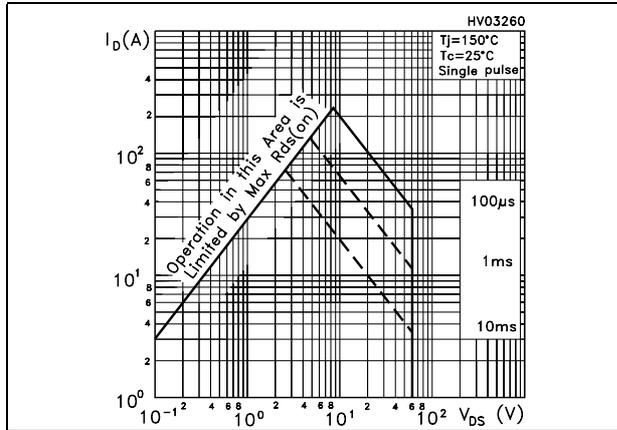


Figure 2. Thermal impedance

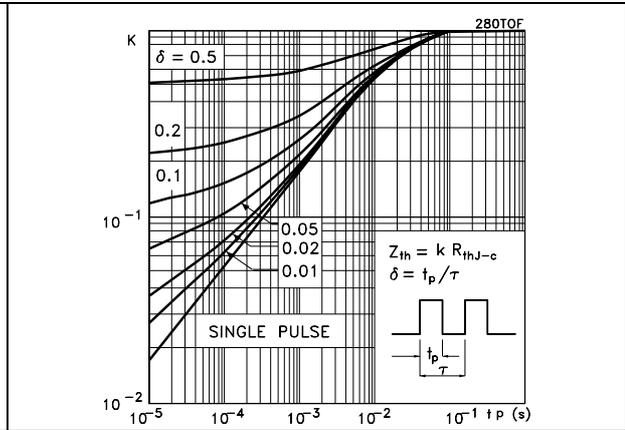


Figure 3. Output characteristics

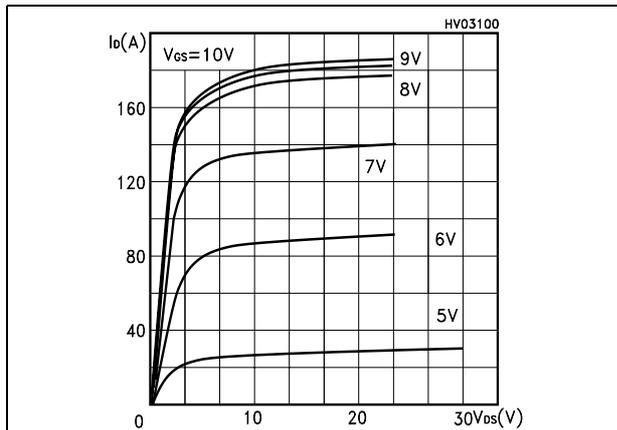


Figure 4. Transfer characteristics

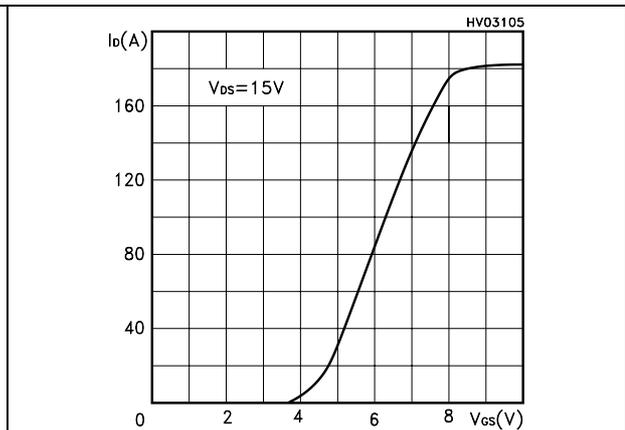


Figure 5. Source-drain diode forward characteristics

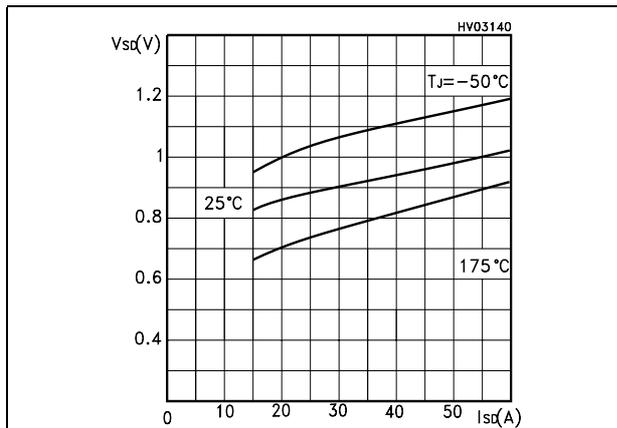


Figure 6. Static drain-source on resistance

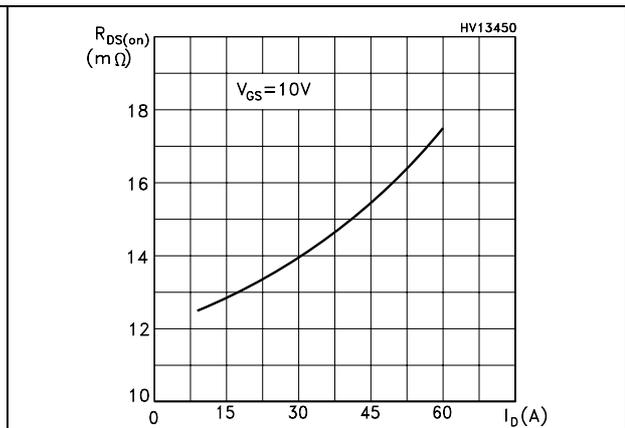


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

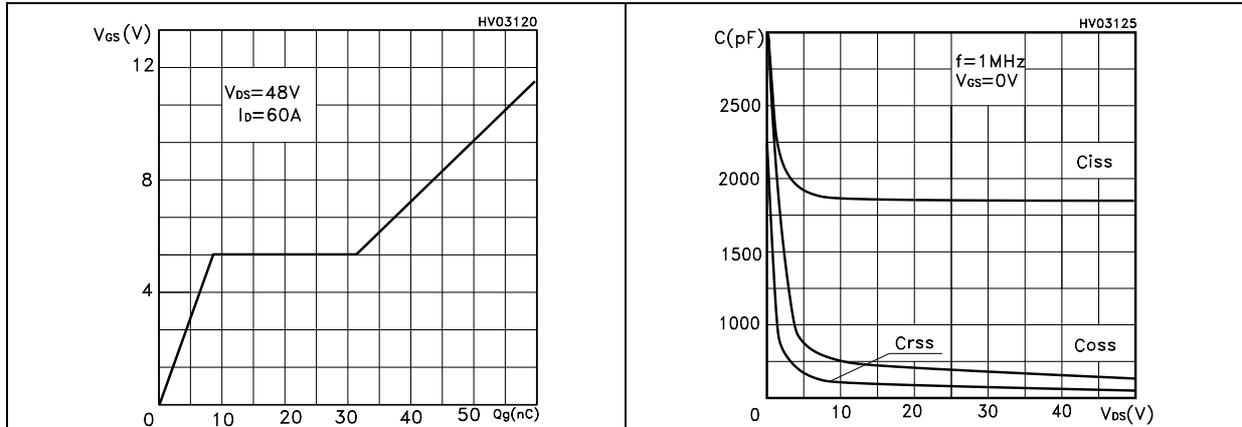
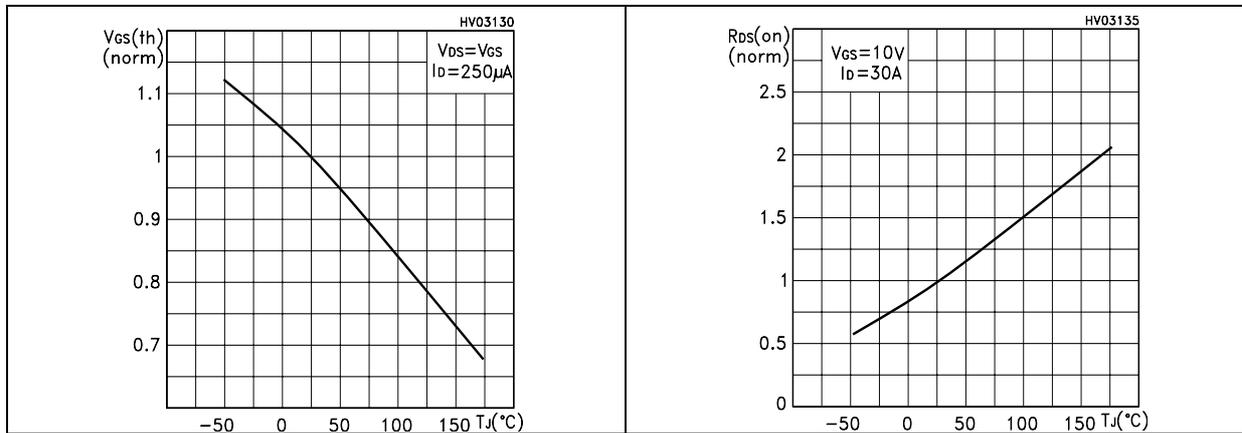


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature



3 Test circuit

Figure 11. Switching times test circuit for resistive load

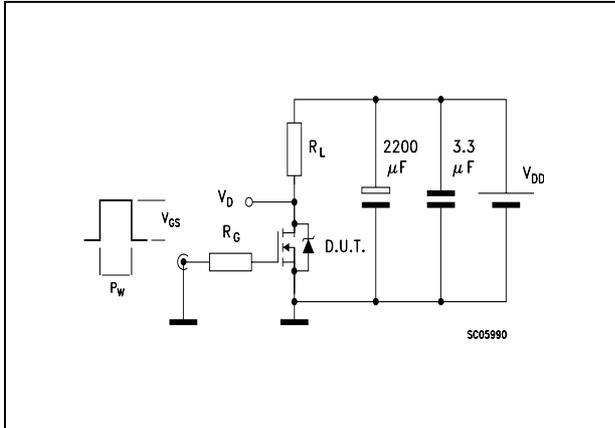


Figure 12. Gate charge test circuit

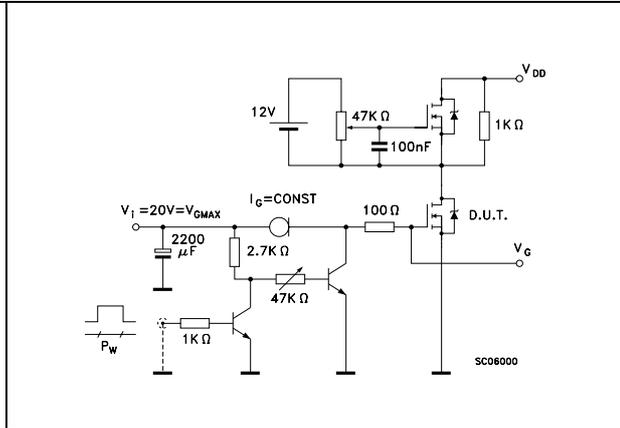


Figure 13. Test circuit for inductive load switching and diode recovery times

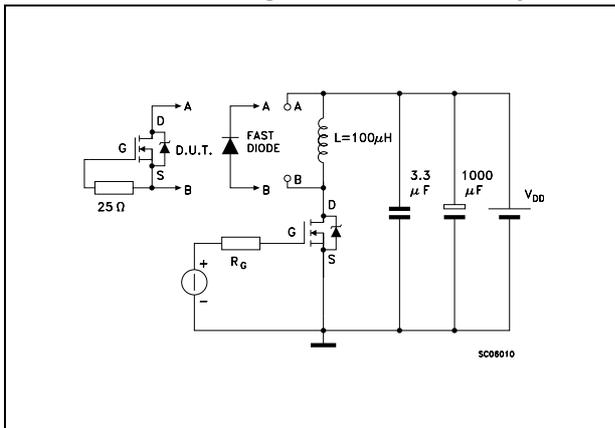


Figure 14. Unclamped Inductive load test circuit

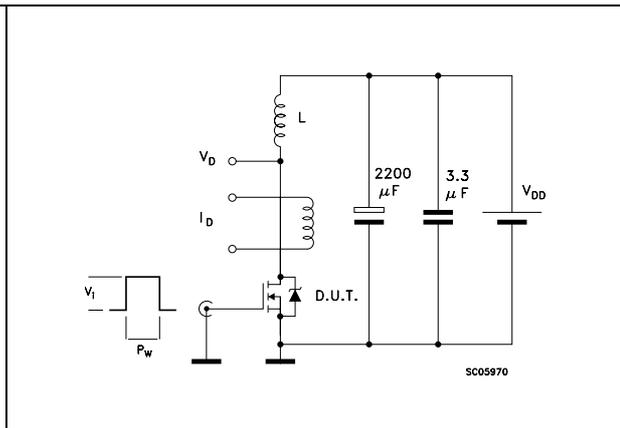


Figure 15. Unclamped inductive waveform

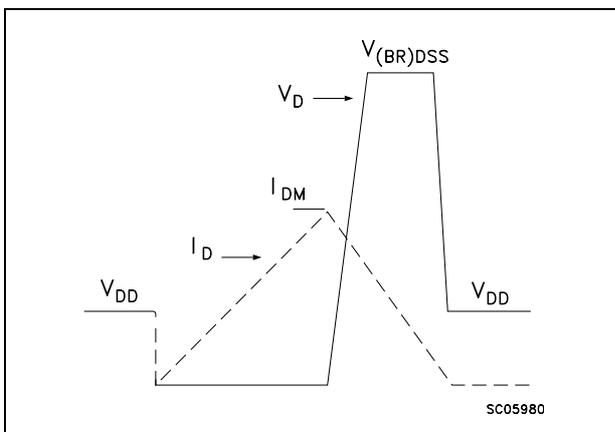
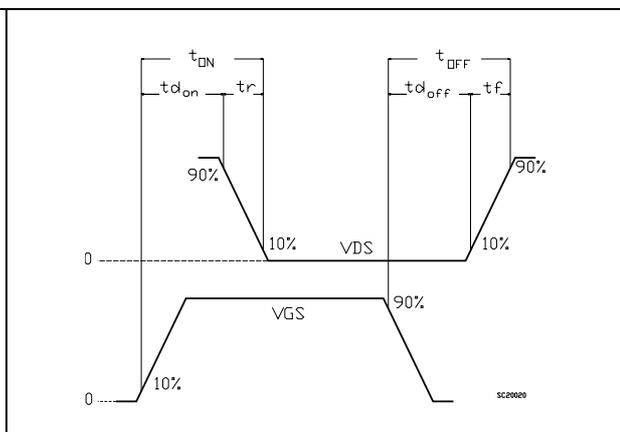


Figure 16. Switching time waveform

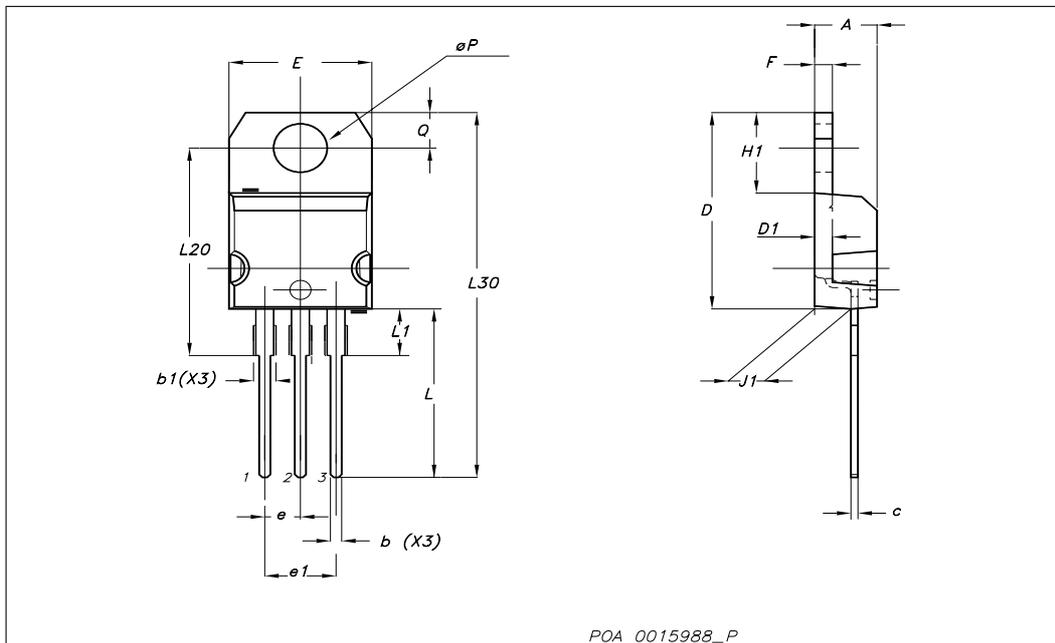


4 Package mechanical data

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

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	
θP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



5 Revision history

Table 8. Revision history

Date	Revision	Changes
09-Sep-2004	3	Complete version
17-Aug-2006	4	The document has been reformatted
04-Oct-2006	5	Changes in <i>Dynamic</i>
02-Mar-2007	6	<i>Safe operating area</i> has been updated

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