



STP60NS04ZB

N-channel clamped - 10mΩ - 60A - TO-220
Fully protected Mesh Overlay™ Power MOSFET

General features

Type	V _{DSS}	R _{DS(on)}	I _D
STP60NS04ZB	Clamped	< 0.015Ω	60A

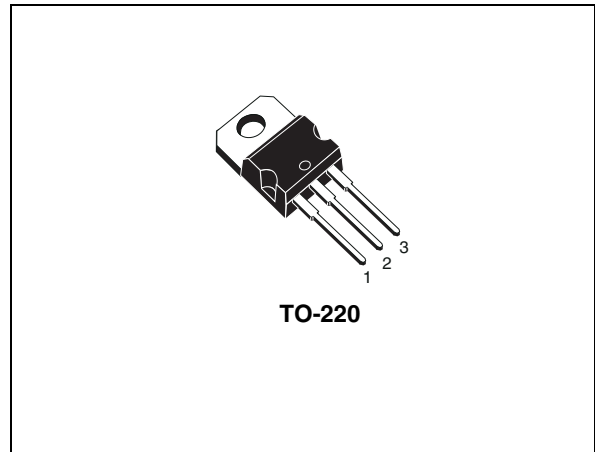
- 100% avalanche tested
- Low capacitance and gate charge
- 175 °C maximum junction temperature

Description

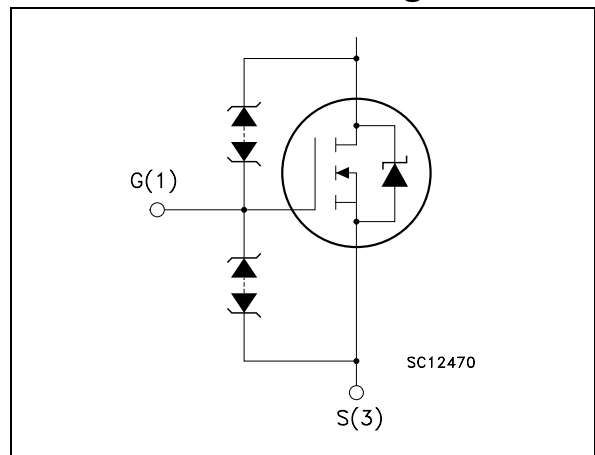
This fully clamped Power MOSFET is produced by using the latest advanced Company's Mesh Overlay process which is based on a novel strip layout. The inherent benefits of the new technology coupled with the extra clamping capabilities make this product particularly suitable for the harshest operation conditions such as those encountered in the automotive environment. Any other application requiring extra ruggedness is also recommended.

Applications

- Switching application



Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STP60NS04ZB	P60NS04ZB	TO-220	Tube

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	Clamped	V
V_{GS}	Gate- source voltage	Clamped	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_{DG}	Drain gate current (continuous)	± 50	mA
I_{GS}	Gate source current (continuous)	± 50	mA
$I_{DM}^{(1)}$	Drain current (pulsed)	240	A
P_{tot}	Total dissipation at $T_C = 25^\circ\text{C}$	150	W
	Derating factor	1	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate-source ESD (HBM - C = 100pF, R=1.5 k Ω)	6	KV
$V_{ESD(G-D)}$	Gate-drain ESD (HBM - C = 100pF, R=1.5 k Ω)	4	KV
$V_{ESD(D-S)}$	Drain-source ESD (HBM - C = 100pF, R=1.5 k Ω)	4	KV
T_{stg}	Storage temperature	-65 to 175	$^\circ\text{C}$
T_j	Max. operating junction temperature		

1. Pulse width limited by safe operating area.

Table 2. Thermal data

Rthj-case	Thermal resistance junction-case max	1	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal resistance junction-ambient max	62.5	$^\circ\text{C}/\text{W}$
T_J	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	60	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 30\text{ V}$)	400	mJ

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	$I_D = 1mA, V_{GS} = 0$ $-40 < T_j < 175^{\circ}C$	33			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 16V; T_j = 150^{\circ}C$ $V_{DS} = 16V; T_j = 175^{\circ}C$			50 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 10V; T_j = 175^{\circ}C$ $V_{GS} = \pm 16V; T_j = 175^{\circ}C$			50 150	μA μA
V_{GSS}	Gate-source breakdown voltage	$I_{GS} = 100\mu A$	18			V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1mA$ $-40 < T_j < 150^{\circ}C$	1.7	3	4.2	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 30A$ $V_{GS} = 16V, I_D = 30A$		11 10	15 14	$m\Omega$ $m\Omega$

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 30A$	20	40		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25V, f = 1MHz,$ $V_{GS} = 0$		1700 800 190	2100 1000 240	pF pF pF
$t_{r(Voff)}$ t_f t_c	Turn-on delay time Fall time Cross-over time	$V_{clamp} = 30V, I_D = 60A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 14)		60 45 100	75 60 130	ns ns ns
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 18V, I_D = 60A,$ $V_{GS} = 10V, R_G = 4.7\Omega$ (see Figure 15)		48 13 16	42	nC nC nC

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

Table 5. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)				60 240	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 60A, V_{GS} = 0$			1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 60A, di/dt = 100A/\mu s,$ $V_{DD} = 15V, T_j = 150^\circ C$ (see Figure 16)		50 62 2.6		ns nC 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

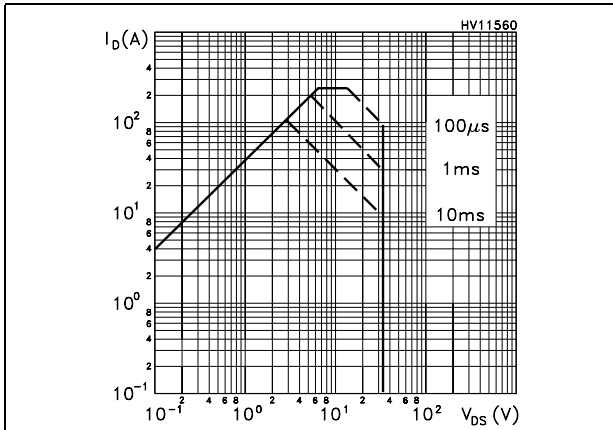


Figure 2. Thermal impedance

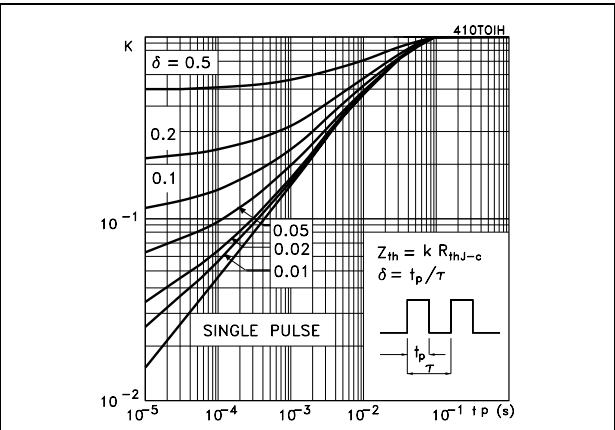


Figure 3. Output characteristics

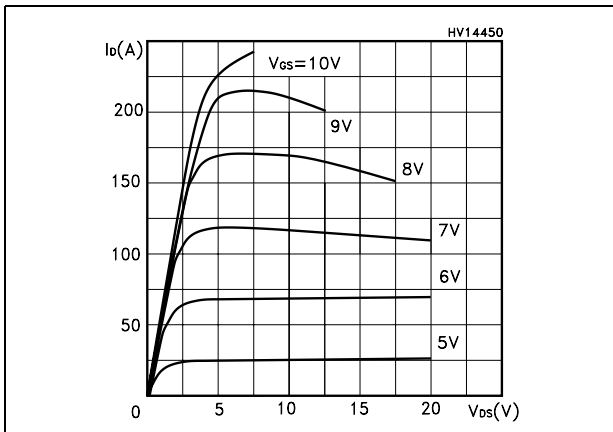


Figure 4. Transfer characteristics

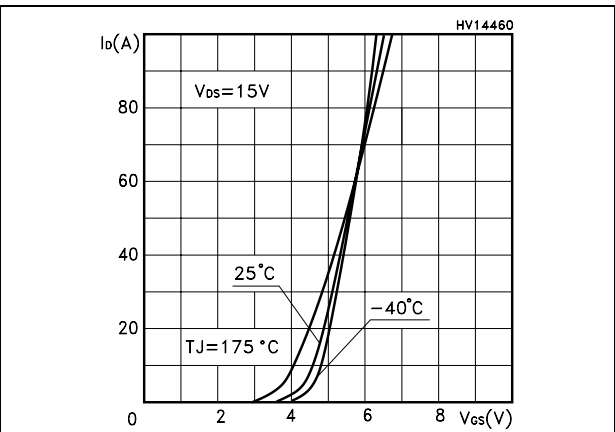


Figure 5. Transconductance

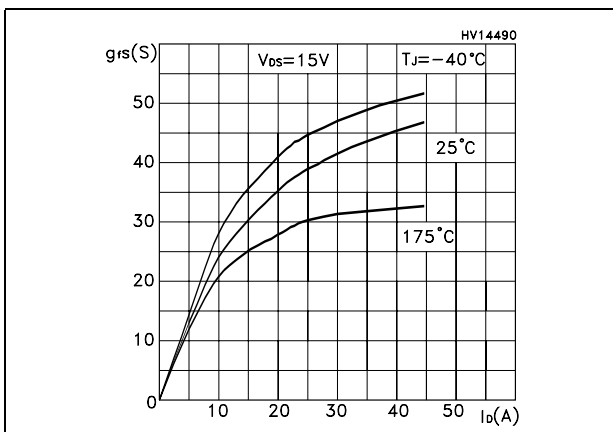


Figure 6. Static drain-source on resistance

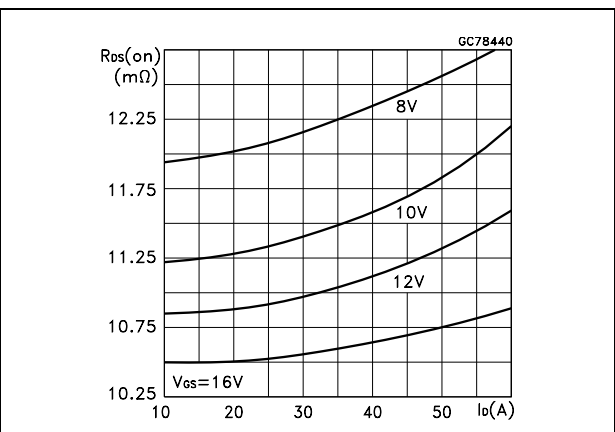


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

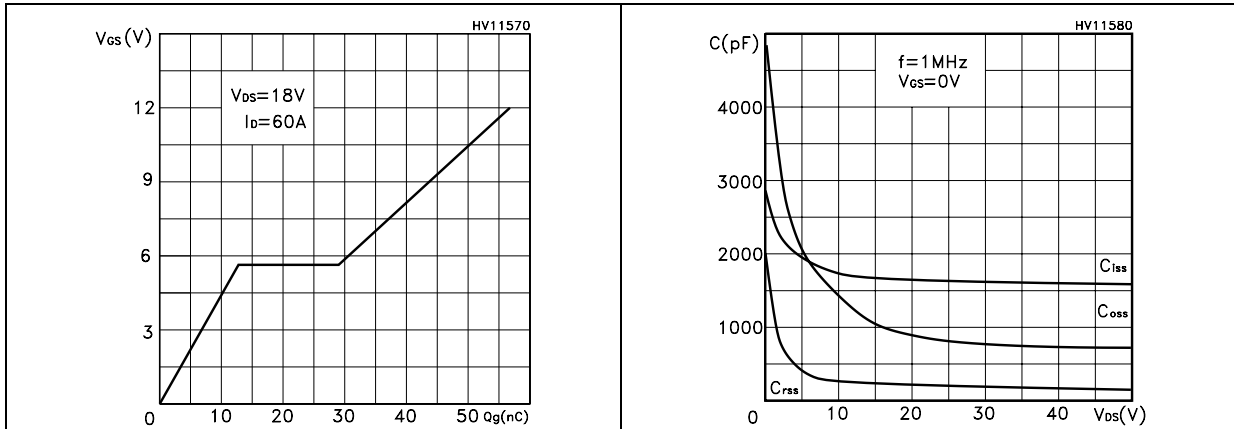


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

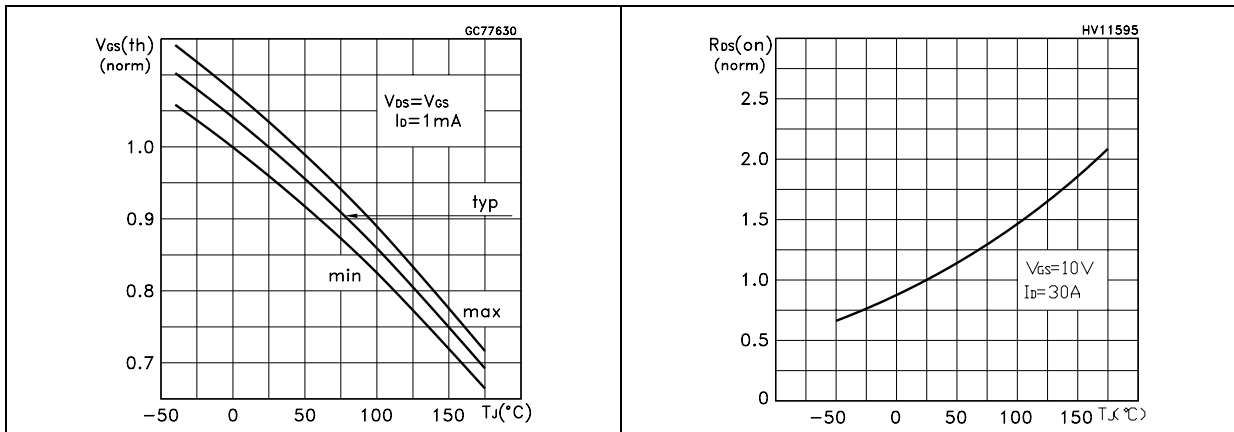


Figure 11. Source-drain diode forward characteristics Figure 12. Zero gate voltage drain current vs temperature

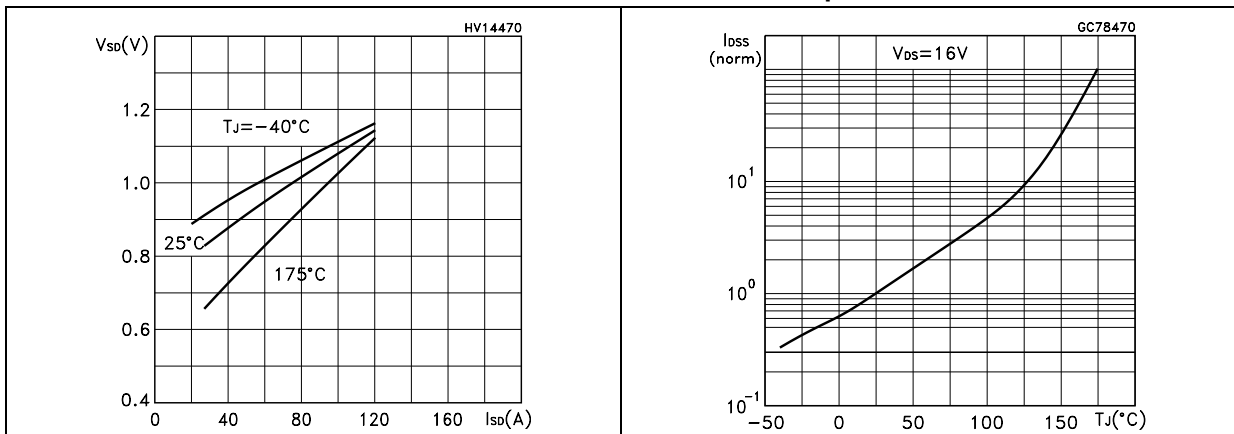
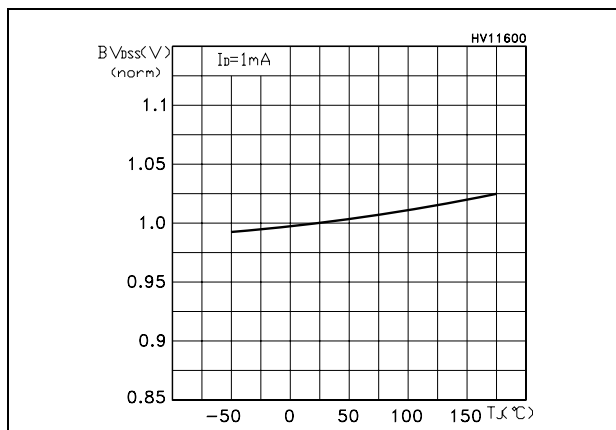


Figure 13. Normalized BV_{DSS} vs temperature



3 Test circuit

Figure 14. Switching times test circuit for resistive load

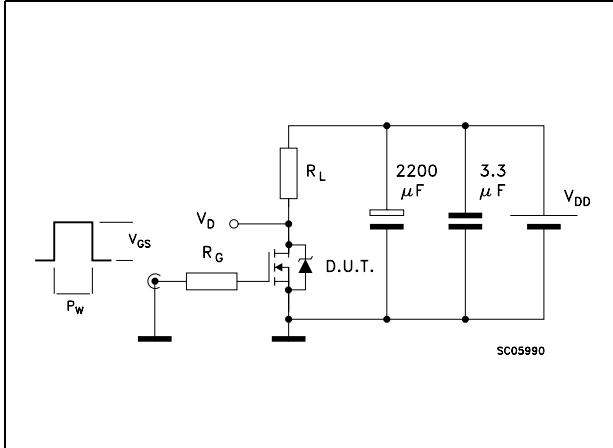


Figure 15. Gate charge test circuit

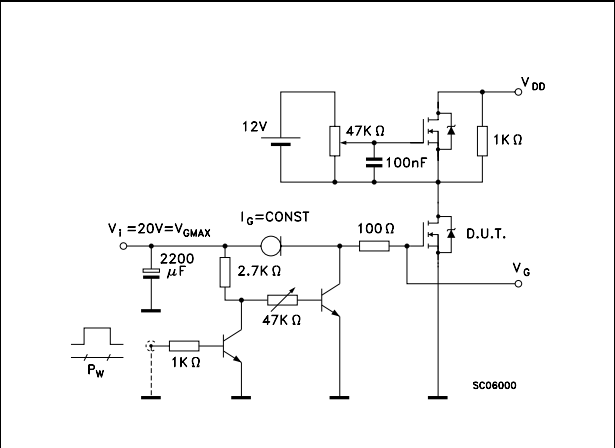


Figure 16. Test circuit for inductive load switching and diode recovery times



Figure 17. Unclamped Inductive load test circuit

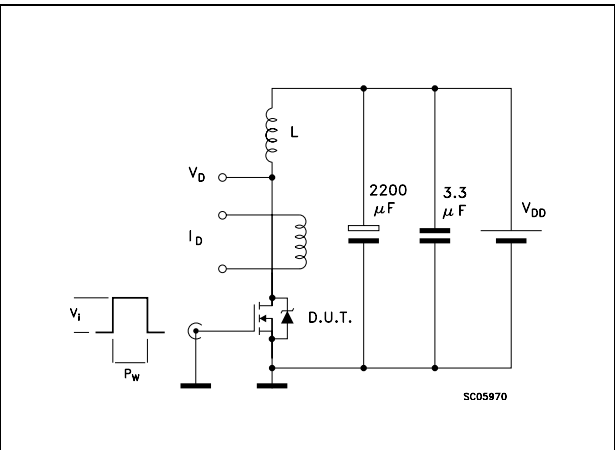


Figure 18. Unclamped inductive waveform

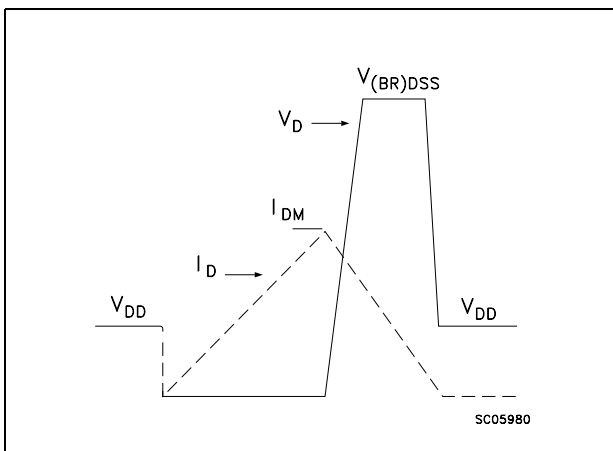
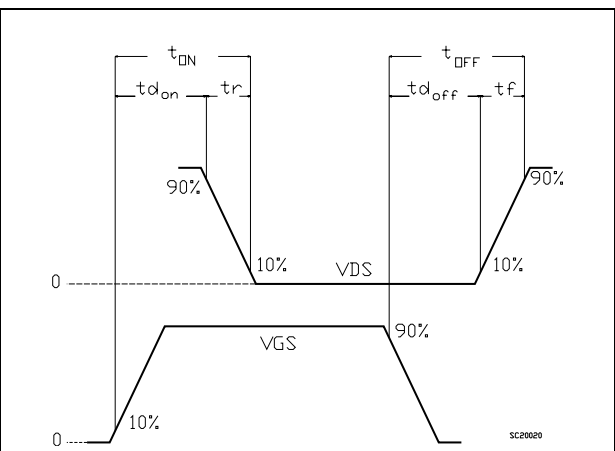


Figure 19. Switching time waveform

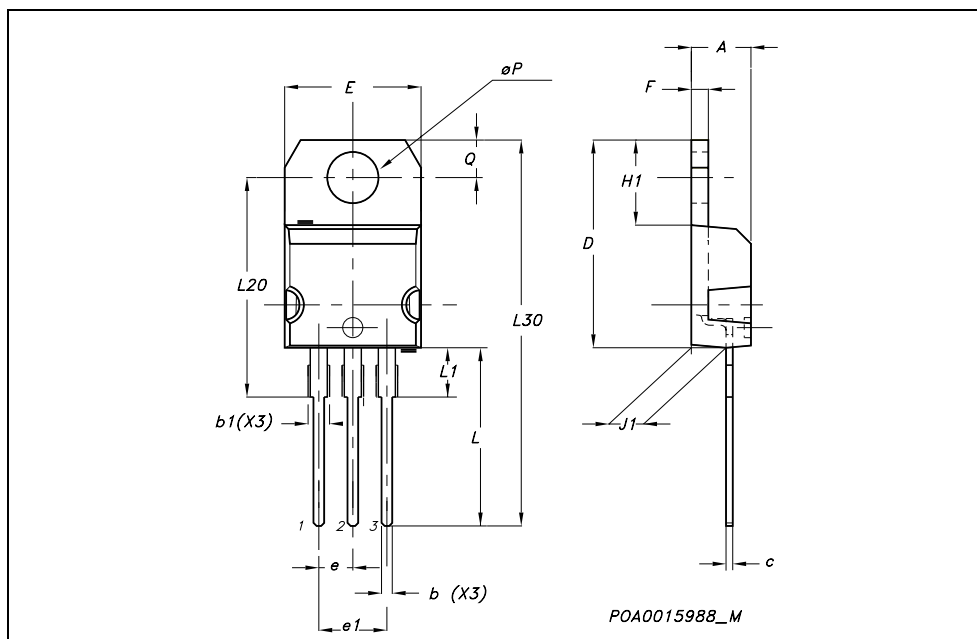


4 Package mechanical data

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	1.15		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



5 Revision history

Table 6. Revision history

Date	Revision	Changes
21-Jun-2004	1	Complete document
04-Oct-2006	2	New template, no content change

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