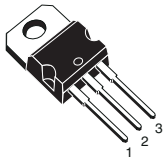
STP180NS04ZC

N-channel clamped 3.5 mΩ - 120 A TO-220 fully protected SAFeFET™ Power MOSFET

Features

Type	V_{DSS}	$R_{DS(on)}$ max	I_D
STP180NS04ZC	Clamped	< 4.2 mΩ	120 A

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



TO-220

Applications

- Switching application

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.

Figure 1. Internal schematic diagram

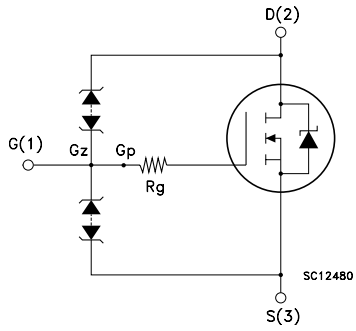


Table 1. Device summary

Order code	Marking	Package	Packaging
STP180NS04ZC	P180NS04ZC	TO-220	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage (V_{GS} = 0)	33 (1)	V
V_{DG}	Drain-gate voltage	33 (1)	V
V_{GS}	Gate-source voltage	± 20 (1)	V
I_D (2)	Drain current (continuous) at T_C = 25 °C	120	A
I_D (2)	Drain current (continuous) at T_C=100 °C	120	A
I_{DG}	Drain gate current (continuous)	±50	mA
I_{GS}	Gate-source current (continuous)	±50	mA
I_{DM} (3)	Drain current (pulsed)	480	A
P_{TOT}	Total dissipation at T_C = 25 °C	300	W
	Derating factor	2	W/°C
$V_{ESD(G-S)}$	Gate-source ESD (HBM-C=100 pF, R=1.5 kΩ)	± 8	kV
$V_{ESD(G-D)}$	Gate-drain ESD (HBM-C=100 pF, R=1.5 kΩ)	± 8	kV
$V_{ESD(D-S)}$	Drain-source ESD (HBM-C=100 pF, R=1.5 kΩ)	± 8	kV
T_J T_{stg}	Operating junction temperature Storage temperature	-55 to 175	°C

1. Voltage is limited by zener diodes
2. Current limited by wire bonding
3. Pulse width limited by safe operating area

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.50	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.5	°C/W
T_l	Maximum lead temperature for soldering purpose	300	°C

Table 4. Avalanche data

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not repetitive (pulse width limited by Tjmax δ < 1%)	80	A
E_{AS}	Single pulse avalanche energy (starting Tj=25 °C, I_D=I_{AS}, V_{DD}=21 V) *(see Figure 17, Figure 14.)*	1000	mJ

2 Electrical characteristics

(T_{CASE}=25°C unless otherwise specified)

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DG}$	Clamped voltage	I_D = 1 mA, V_{GS} = 0 -40 < Tj < 175 °C	33		41	V
$V_{DSR(CL)}$	Drain-source clamping voltage (DC)	$I_{GS(CL)}$ = -2 mA, I_D = 1 A		41		V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 16 V V_{DS} = 16 V, T_j = 150 °C V_{DS} = 16 V, T_j = 175 °C			1 50 100	µA µA µA
I_{GSS} (1)	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ±10 V V_{GS} = ±10 V,T_j = 175 °C V_{GS} = ±16 V,T_j = 175 °C			2 50 150	µA µA µA
V_{GSS}	Gate-source breakdown voltage	I_{GS} = ±100 µA	18		25	V
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 40 A		3.5	4.2	mΩ
R_G	Internal gate resistor			14		Ω

1. Gate Oxide, without zener diodes, tested at wafer sorting (I_{GSS} < ± 100 nA @ ± 20 V Tj=25°). *Figure 17.: Unclamped Inductive load test circuit* for electrical schematics

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward transconductance	V_{DS} =15 V, I_D = 40 A		95		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} =25 V, f=1 MHz, V_{GS}=0		4560 1700 550		pF pF pF
$t_{r(Voff)}$ t_f t_c	Off voltage rise time Fall time Cross-over time	V_{CLAMP}=30 V, I_D=80 A, V_{GS}=10 V, R_G=4.7 Ω *(see Figure 16)*		250 115 290		ns ns ns
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD}=20 V, I_D = 120 A V_{GS} =10 V *(see Figure 15)*		110 29 40		nC nC nC

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

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM}(1)	Source-drain current Source-drain current (pulsed)				120 480	A A
V_{SD}(2)	Forward on voltage	I_{SD}=120 A, V_{GS}=0			1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}=120 A, di/dt = 100 A/µs, V_{DD}= 32 V, Tj=150 °C *(see Figure 16)*		56 70 12		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 2. Safe operating area

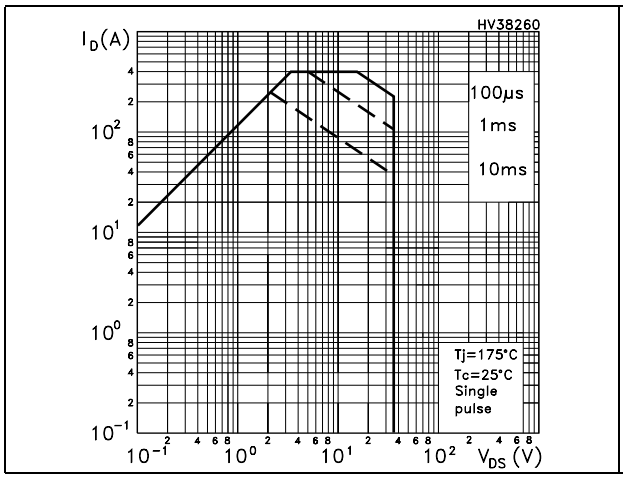


Figure 3. Thermal impedance

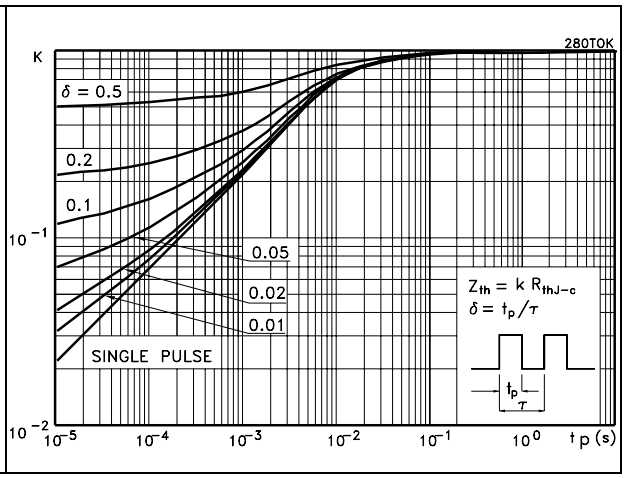


Figure 4. Output characteristics

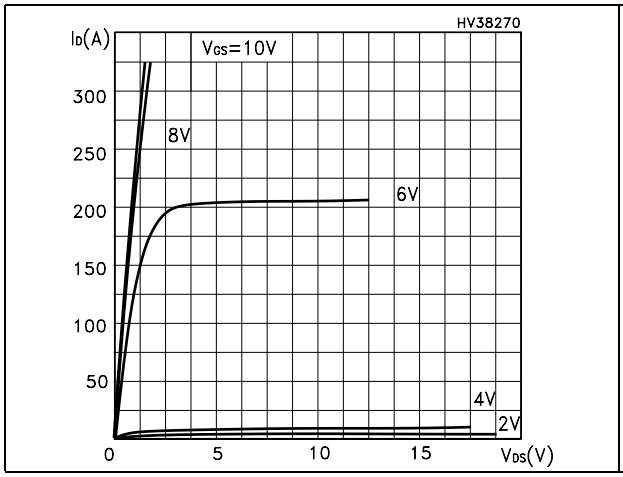


Figure 5. Transfer characteristics

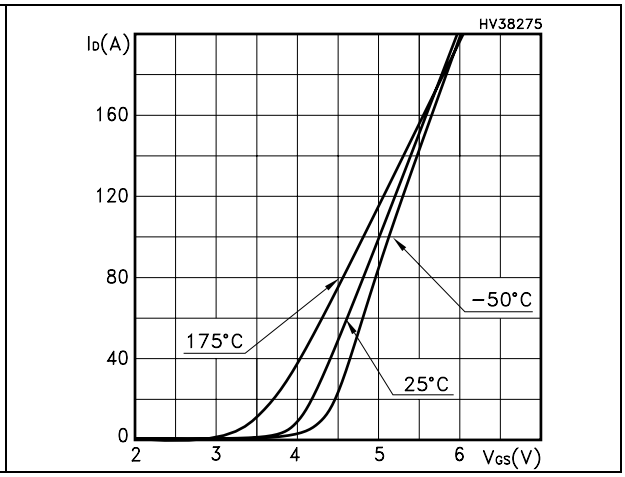


Figure 6. Transconductance

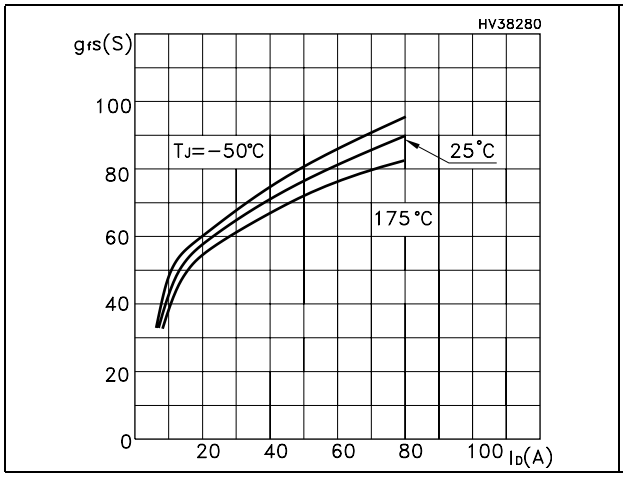


Figure 7. Static drain-source on resistance

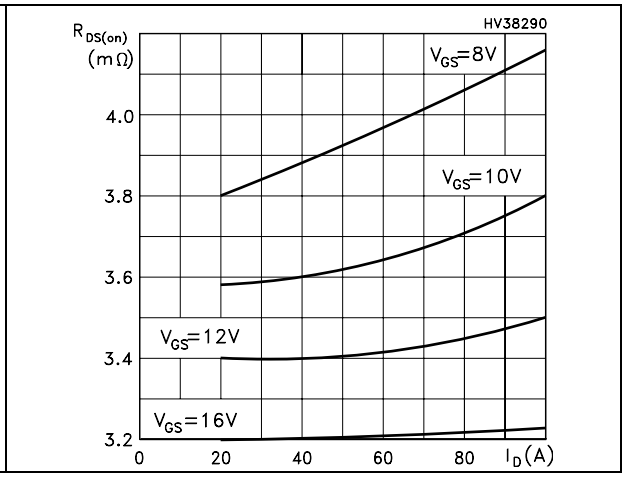


Figure 8. Gate charge vs gate-source voltage

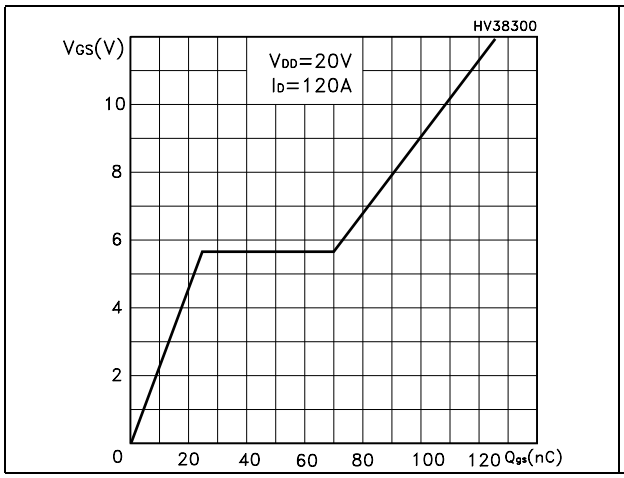


Figure 9. Capacitance variations

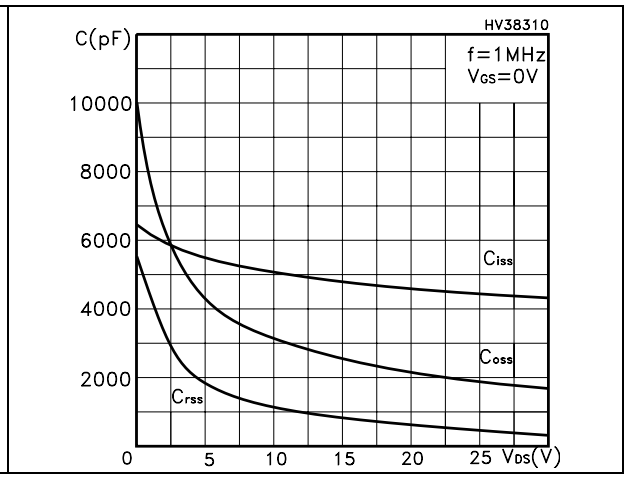


Figure 10. Normalized gate threshold voltage vs temperature

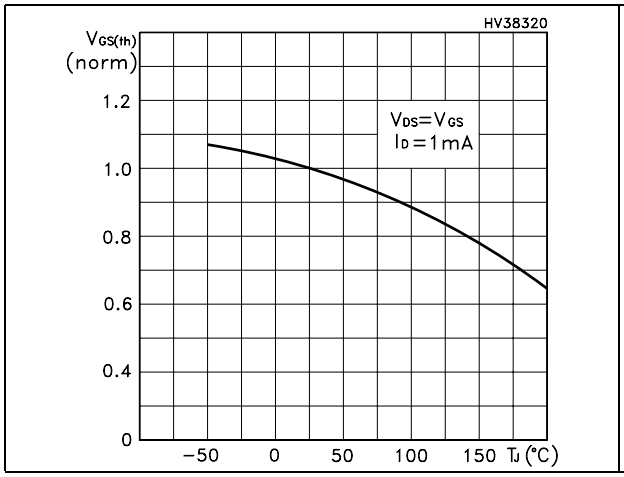


Figure 11. Normalized on resistance vs temperature

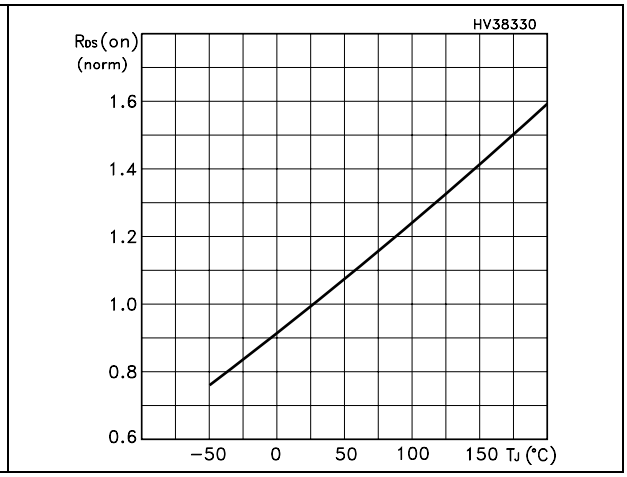


Figure 12. Source-drain diode forward characteristics

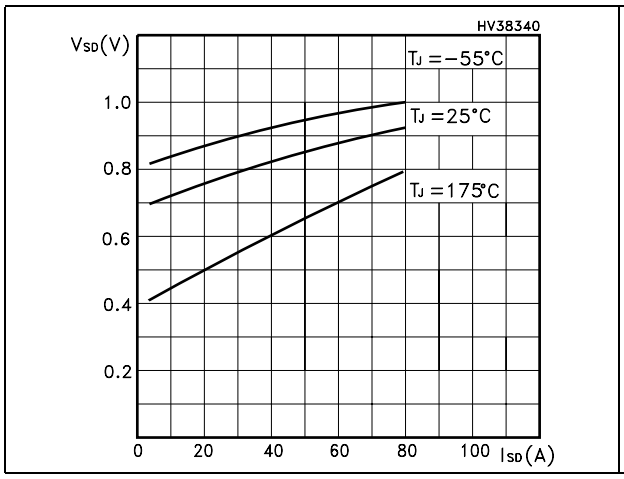
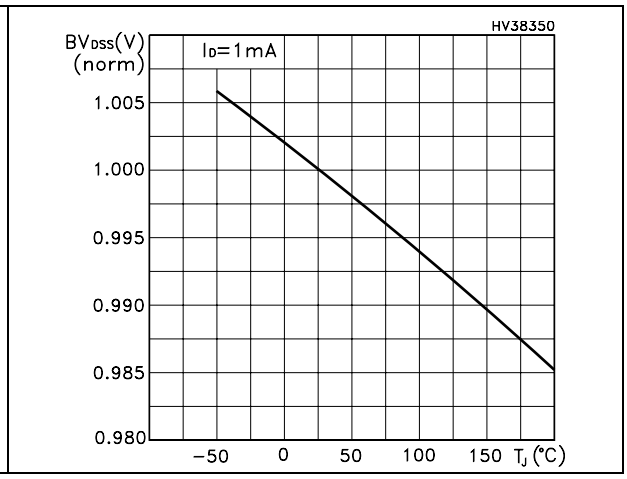


Figure 13. Normalized BV_{DSS} vs temperature



3 Test circuit

Figure 14. Unclamped inductive waveform

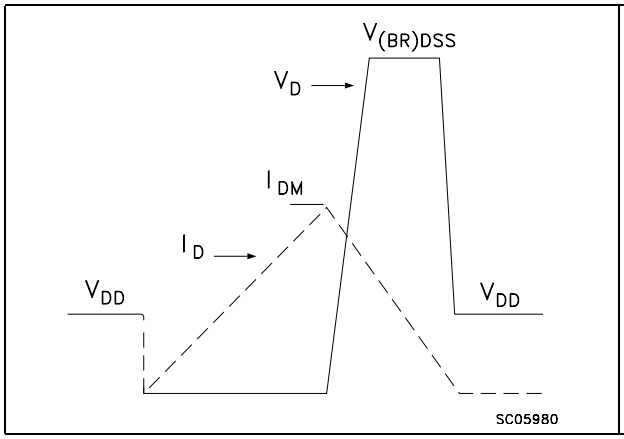


Figure 15. Gate charge test circuit

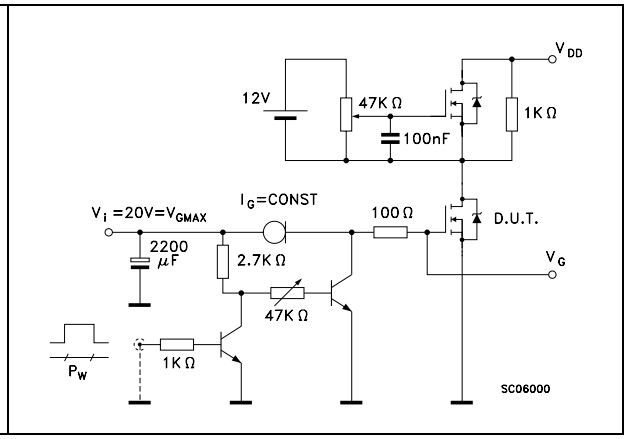


Figure 16. Test circuit for inductive load switching and diode recovery times

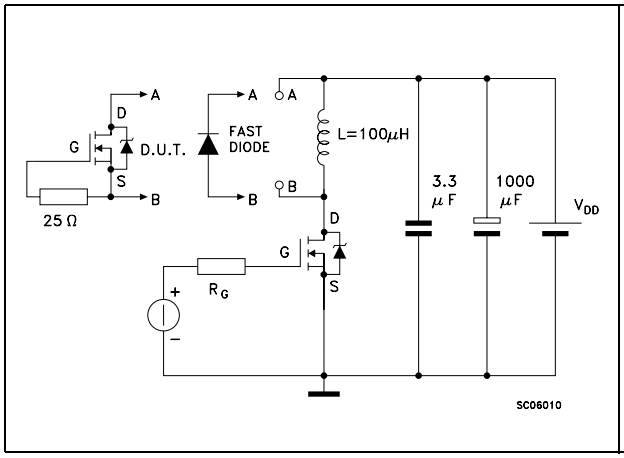
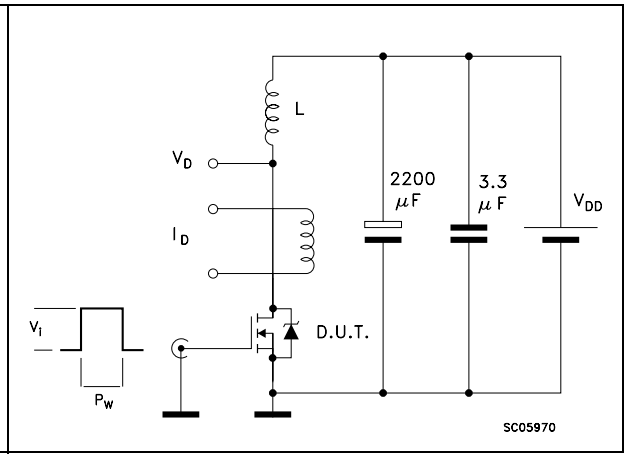


Figure 17. Unclamped Inductive load test circuit

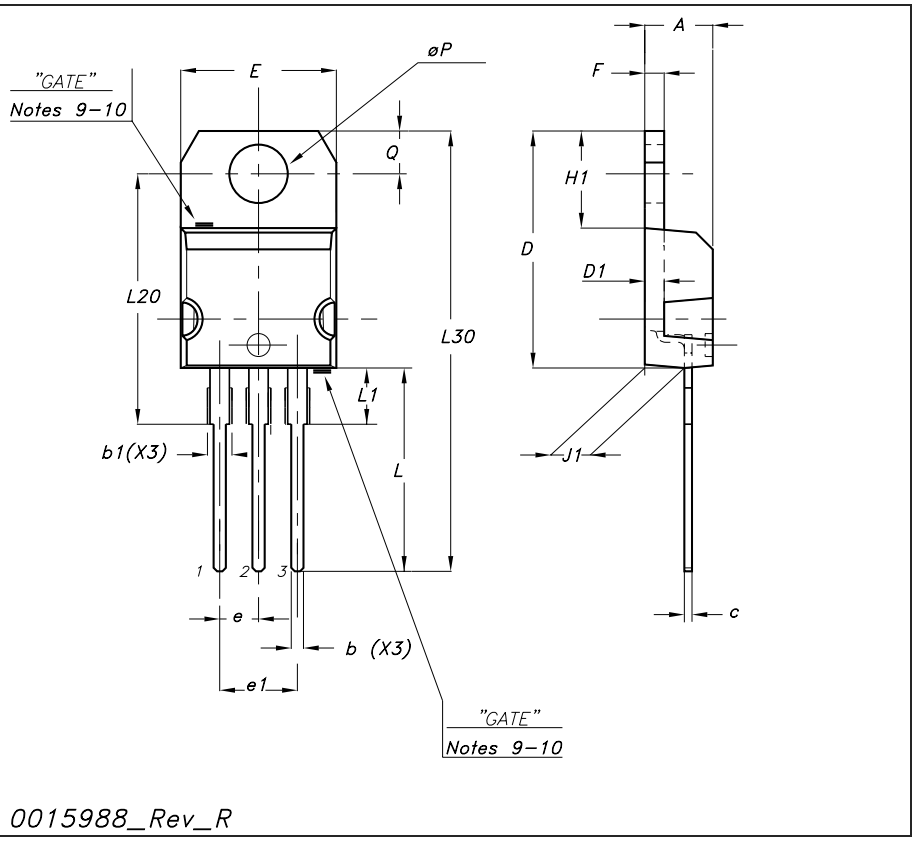


4 Package mechanical data

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	0.48		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



5 Revision history

Table 8. Document revision history

Date	Revision	Changes
03-Apr-2008	1	First release

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