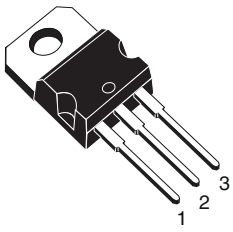
# STP190N55LF3

## N-channel 55 V, 2.9 mΩ, 120 A, TO-220 STripFET™ Power MOSFET

## Features

| Type | $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ | $P_D$ |
|---|---|---|---|---|
| STP190N55LF3 | 55 V | < 3.7 mΩ | 120 A | 312 W |

- Logic level drive
- 100% avalanche tested




TO-220

## Application

- Switching applications
  - Automotive

## Description

This n-channel enhancement mode Power MOSFET is the latest refinement of STMicroelectronics' unique “single feature size” strip-based process, which has decreased the critical alignment steps, offering remarkable manufacturing reproducibility. The outcome is a transistor with extremely high packing density for low on resistance, rugged avalanche characteristics and low gate charge.

**Figure 1. Internal schematic diagram**

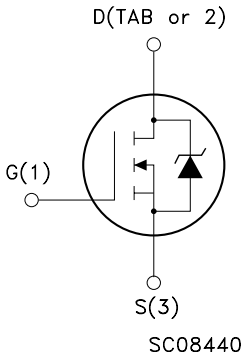



**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STP190N55LF3 | 190N55LF3 | TO-220 | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage ($V_{GS}$=0) | 55 | V |
| $V_{GS}$ | Gate-Source voltage | ± 18 | V |
| $I_D$ (1) | Drain current (continuous) at $T_C$ = 25 °C | 120 | A |
| $I_D$ (1) | Drain current (continuous) at $T_C$ = 100 °C | 120 | A |
| $I_{DM}$ (2) | Drain current (pulsed) | 480 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 312 | W |
| | Derating factor | 2.08 | W/°C |
| $E_{AS}$ (3) | Single pulse avalanche energy | 1000 | mJ |
| $T_{stg}$ | Storage temperature | -55 to 175 | °C |
| $T_j$ | Max. operating junction temperature | 175 | °C |

1. Current limited by package
2. Pulse width limited by safe operating area
3. Starting Tj = 25 °C, $I_D$ = 60 A, $V_{DD}$ = 40 V

**Table 3. Thermal resistance**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| Rthj-case | Thermal resistance junction-case max | 0.48 | °C/W |
| Rthj-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 °C unless otherwise specified)

**Table 4. Static**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown Voltage | $I_D$ = 250 µA, $V_{GS}$= 0 | 55 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = Max rating,<br>$V_{DS}$ = Max rating,Tc = 125 °C | | | 10<br>100 | µA<br>µA |
| $I_{GSS}$ | Gate body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ±18 V | | | ±200 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$= $V_{GS}$, $I_D$ = 250 µA | 1 | | 2.5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS}$= 10 V, $I_D$= 30 A<br>$V_{GS}$= 5 V, $I_D$= 30 A | | 2.9<br>3.3 | 3.7<br>4.5 | mΩ<br>mΩ |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ (1) | Forward transconductance | $V_{DS}$ = 15 V, $I_D$=60 A | | 250 | | S |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS}$ = 25 V, f=1 MHz, $V_{GS}$=0 | | 6200<br>1450<br>80 | | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total gate charge<br>Gate-source charge<br>Gate-drain charge | $V_{DD}$= 44 V, $I_D$ = 120 A<br>$V_{GS}$ = 5 V<br>*(see Figure 16)* | | 60<br>20<br>30 | 80 | nC<br>nC<br>nC |

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

**Table 6. Switching on/off (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$<br>$t_r$ | Turn-on delay time<br>Rise time | $V_{DD}$= 27.5 V, $I_D$= 60 A,<br>$R_G$=4.7 Ω, $V_{GS}$=10 V<br>*(see Figure 15),*<br>*(see Figure 18)* | | 20<br>40 | | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off delay time<br>Fall time | $V_{DD}$= 27.5 V, $I_D$= 60 A,<br>$R_G$=4.7 Ω, $V_{GS}$=10 V<br>*(see Figure 15),*<br>*(see Figure 18)* | | 160<br>40 | | ns<br>ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$<br>$I_{SDM}$ | Source-drain current<br>Source-drain current (pulsed)(1) | | | | 120<br>480 | A<br>A |
| $V_{SD}$ | Forward on voltage | $I_{SD}$= 120 A, $V_{GS}$=0 | | | 1.5 | V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}$= 120 A,<br>di/dt = 100A/µs,<br>$V_{DD}$= 35 V, Tj= 150 °C<br>*(see Figure 17)* | | 50<br>90<br>3.6 | | ns<br>nC<br>A |

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

## 2.1 Electrical characteristics (curves)

**Figure 2. Safe operating area**

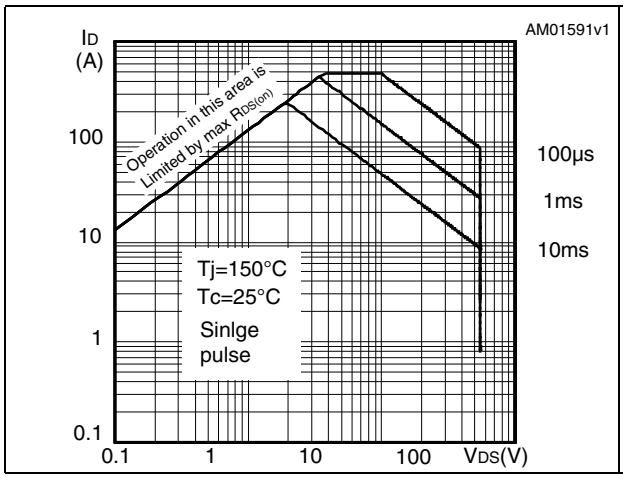



**Figure 3. Thermal impedance**

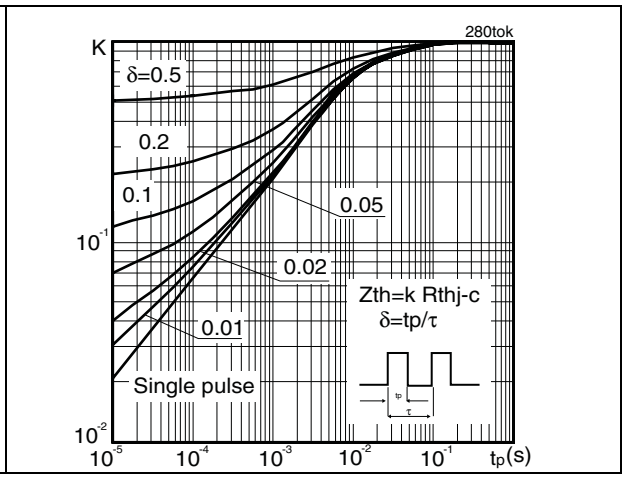



**Figure 4. Output characteristics**

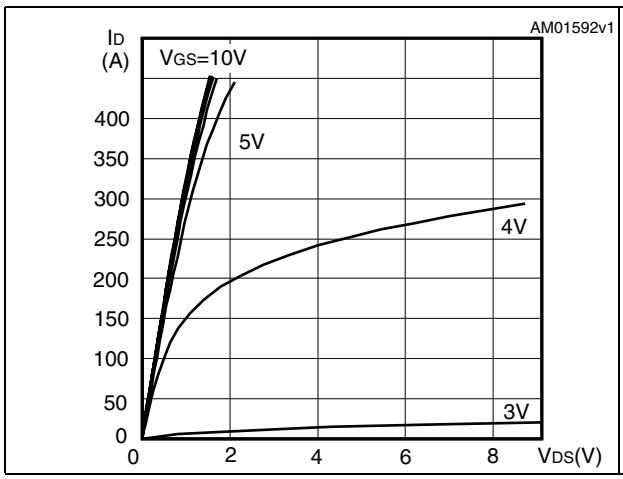



**Figure 5. Transfer characteristics**

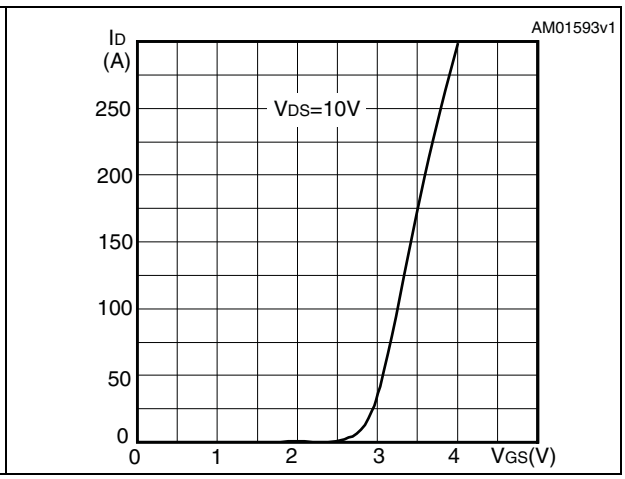



**Figure 6. Normalized $B_{VDSS}$ vs temperature**

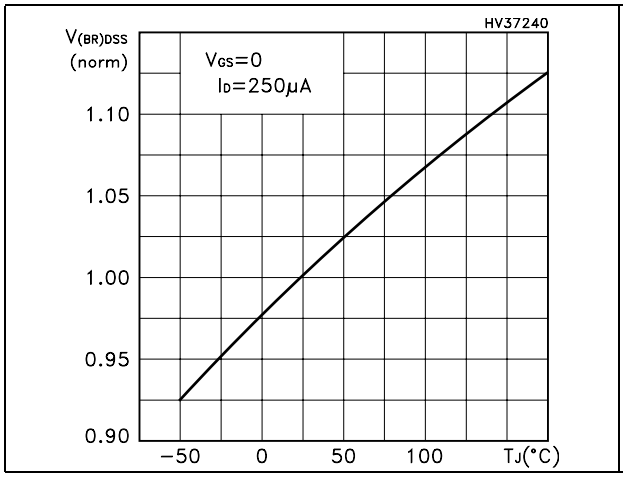



**Figure 7. Static drain-source on resistance**

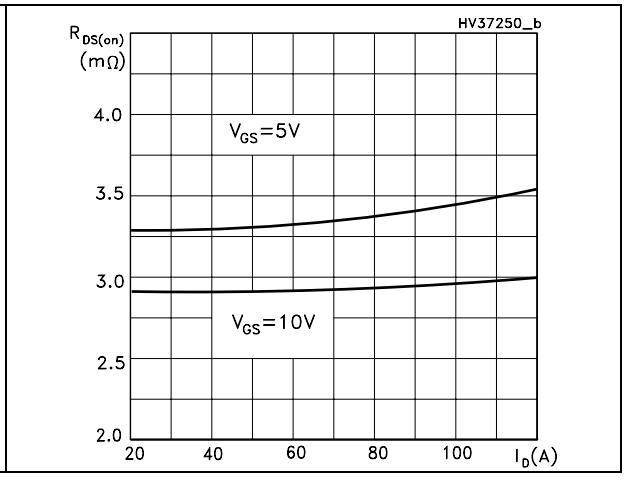


**Figure 8. Gate charge vs gate-source voltage**

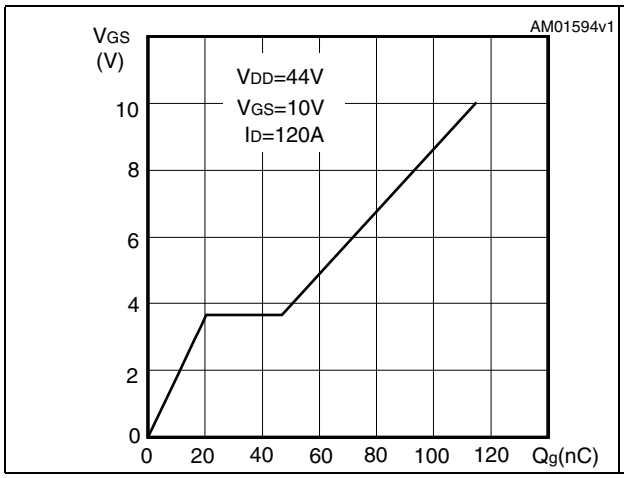



**Figure 9. Capacitance variations**

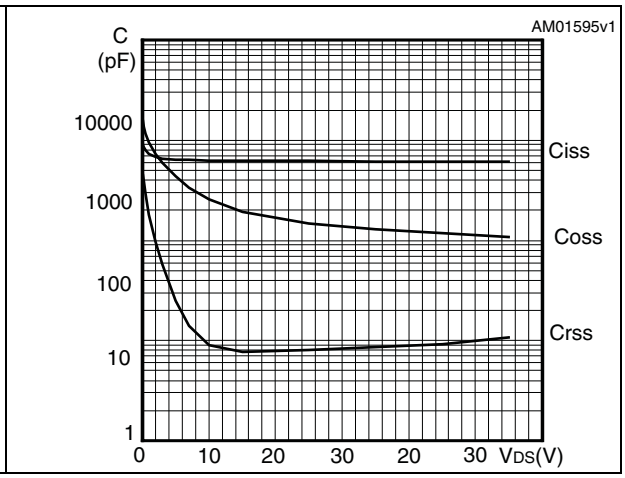



**Figure 10. Normalized gate threshold voltage vs temperature**

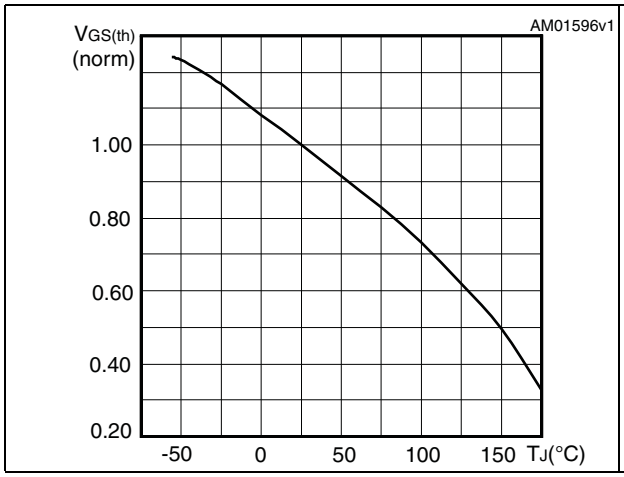



**Figure 11. Normalized on resistance vs temperature**

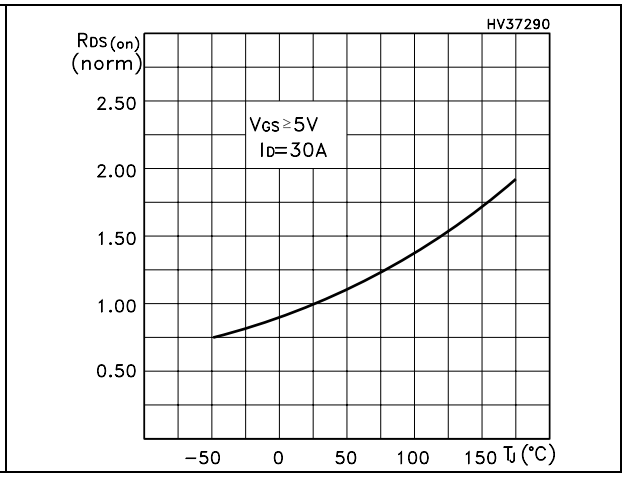
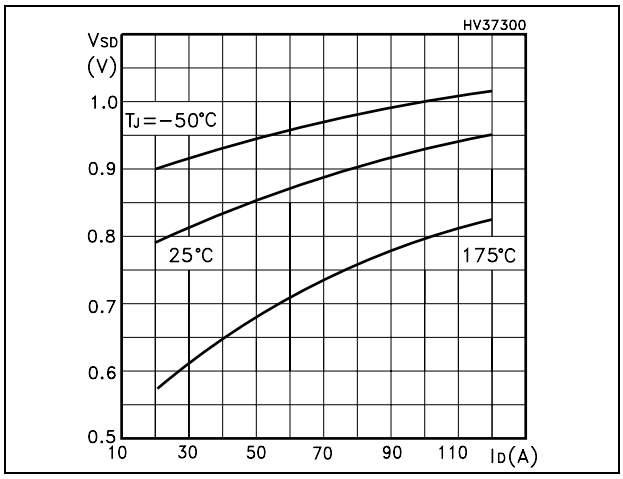



**Figure 12. Source-drain diode forward characteristics**



# 3 Test circuit

**Figure 13. Unclamped inductive load test circuit**

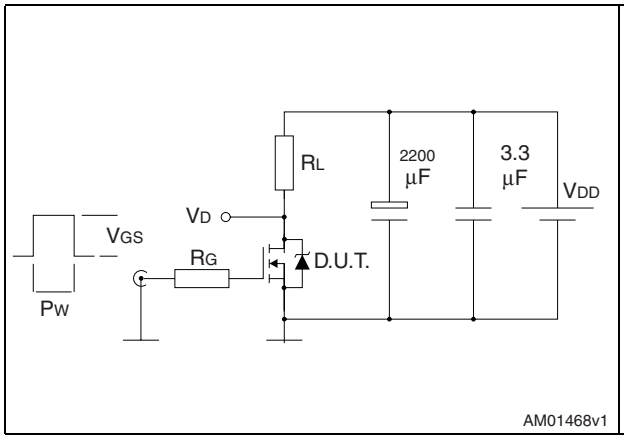



**Figure 14. Unclamped inductive waveform**

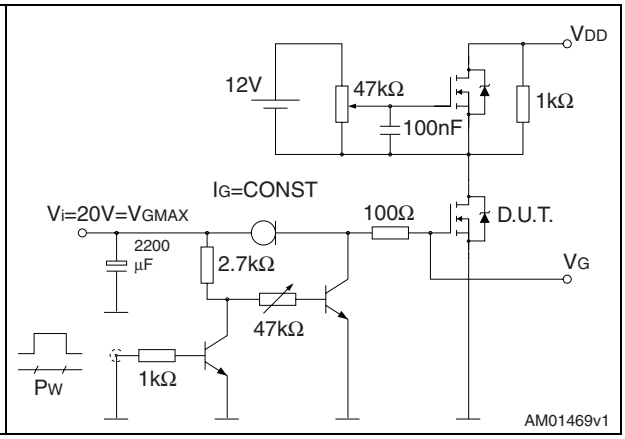



**Figure 15. Switching times test circuit for resistive load**

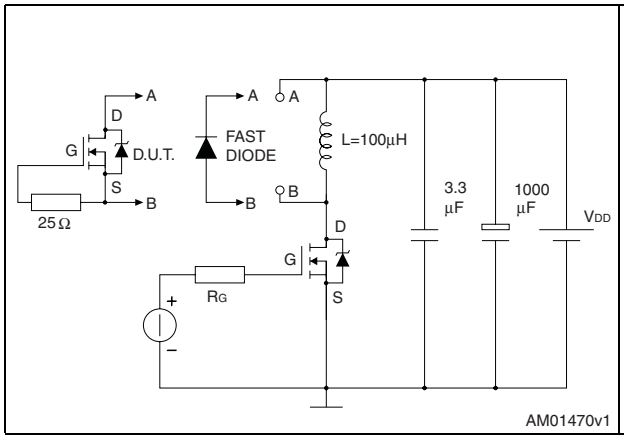



**Figure 16. Gate charge test circuit**

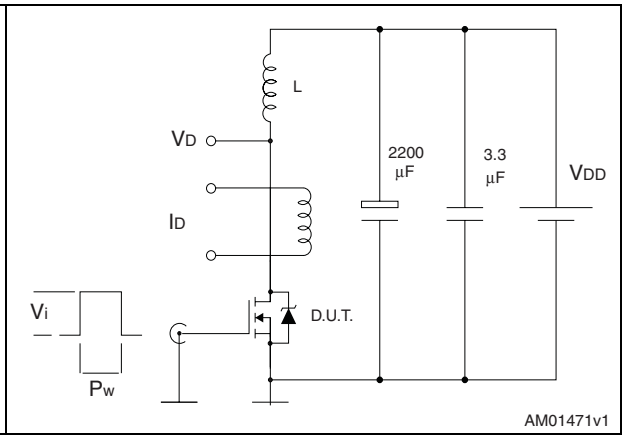



**Figure 17. Test circuit for inductive load switching and diode recovery times**

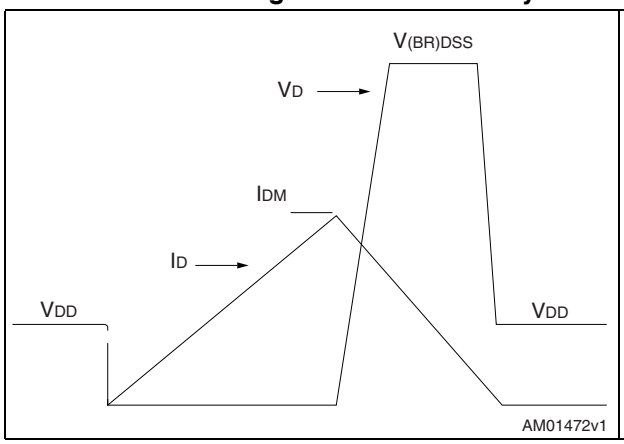
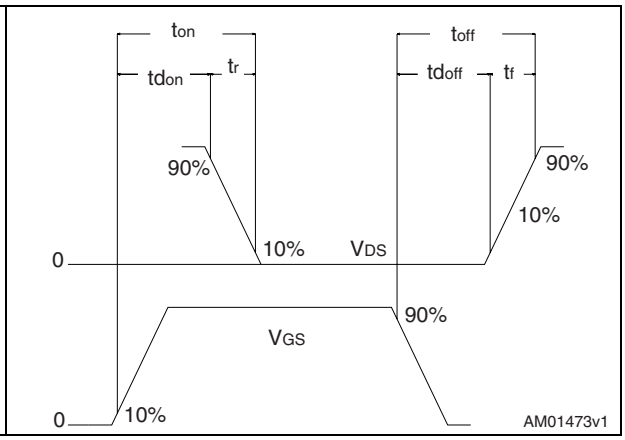



**Figure 18. Switching time waveform**

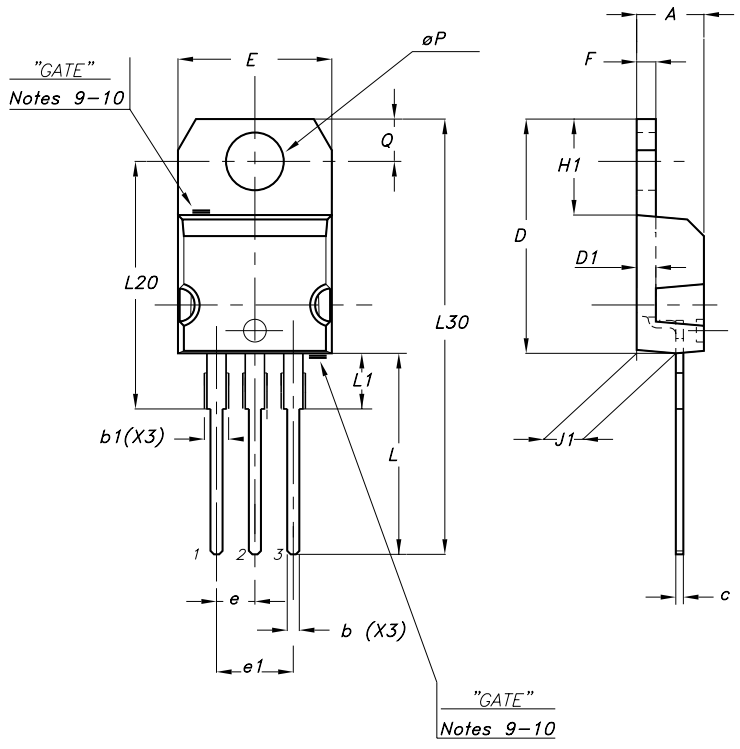


# 4 Package mechanical data

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 | 0.48 | | 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 |
|---|---|---|
| 05-Nov-2008 | 1 | First release |

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