



STP165N10F4

N-channel 100 V, 4.4 mΩ, 120 A TO-220
STripFET™ DeepGATE™ Power MOSFET

Features

| Order code | V _{DSS} | R _{DS(on)} max | I _D |
|-------------|------------------|-------------------------|----------------|
| STP165N10F4 | 100 V | < 5.5 mΩ | 120 A |

- N-channel enhancement mode
- 100% avalanche rated
- Low gate charge
- Very low on-resistance

Application

Switching applications

Description

The STP165N10F4 is an N-channel enhancement mode Power MOSFET built with STripFET™ DeepGATE™ technology with a new gate structure. The product is tailored to minimize on-resistance.

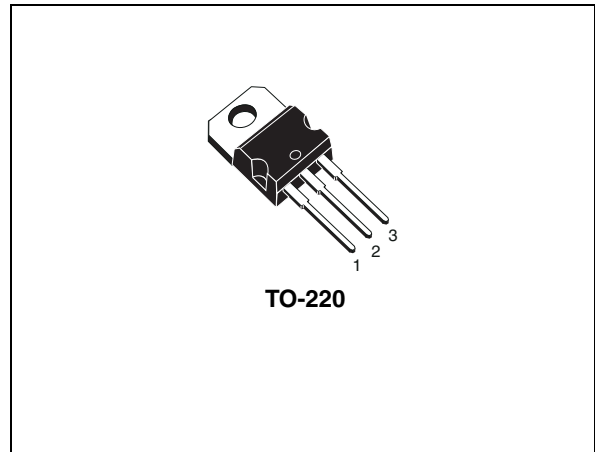


Figure 1. Internal schematic diagram

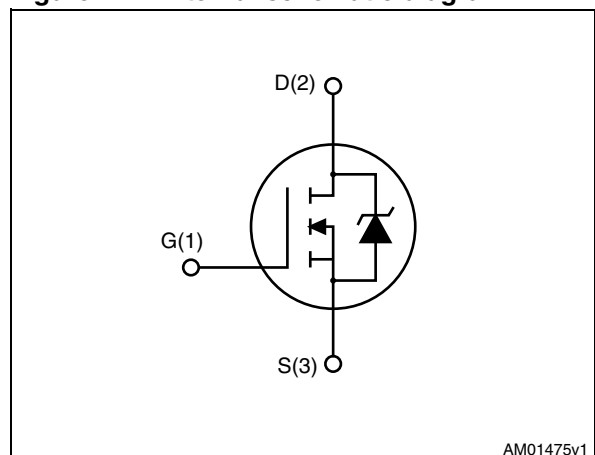


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|-------------|----------|---------|-----------|
| STP165N10F4 | 165N10F4 | TO-220 | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|-------------|---------------------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 100 | V |
| V_{GS} | Gate- source voltage | ± 20 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 120 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 110 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 480 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 315 | W |
| | Derating factor | 2.1 | W/ $^\circ\text{C}$ |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy | 500 | mJ |
| T_{stg} | Storage temperature | - 55 to 150 | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | 150 | |

1. Pulse width limited by safe operating area
2. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = 58\text{ A}$, $V_{DD} = 50\text{ V}$

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 0.48 | $^\circ\text{C}/\text{W}$ |
| R_{thj-a} | Thermal resistance junction-ambient max | 62.5 | $^\circ\text{C}/\text{W}$ |
| T_l | Maximum lead temperature for soldering purpose | 315 | $^\circ\text{C}$ |

2 Electrical characteristics

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

Table 4. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|---|--|------|------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown voltage | $I_D = 250 \mu\text{A}$, $V_{GS} = 0$ | 100 | | | V |
| I_{DSS} | Zero gate voltage Drain current ($V_{GS} = 0$) | $V_{DS} = \text{max rating}$ $V_{DS} = \text{max rating}$, $T_C = 125^{\circ}\text{C}$ | | | 1 100 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20 \text{ V}$ | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250 \mu\text{A}$ | 2 | | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10 \text{ V}$, $I_D = 60 \text{ A}$ | | 4.4 | 5.5 | $\text{m}\Omega$ |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|---------------------------------|--|------|-------|------|------|
| C_{iss} | Input capacitance | | | 10750 | | pF |
| C_{oss} | Output capacitance | $V_{DS} = 25 \text{ V}$, $f = 1 \text{ MHz}$, $V_{GS} = 0$ | - | 939 | - | pF |
| C_{rss} | Reverse transfer capacitance | | | 603 | | pF |
| Q_g | Total gate charge | $V_{DD} = 50 \text{ V}$, $I_D = 120 \text{ A}$, $V_{GS} = 10 \text{ V}$ <i>(see Figure 14)</i> | | 192 | | nC |
| Q_{gs} | Gate-source charge | | - | 48 | - | nC |
| Q_{gd} | Gate-drain charge | | | 62 | | nC |

Table 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------------------|---|------|------------|------|----------|
| $t_{d(on)}$ t_r | Turn-on delay time Rise time | $V_{DD} = 50\text{ V}$, $I_D = 60\text{ A}$ $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 13) | - | 29.6 62 | - | ns ns |
| $t_{d(off)}$ t_f | Turn-off-delay time Fall time | $V_{DD} = 50\text{ V}$, $I_D = 60\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 13) | - | 154 106 | - | ns ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|--------------------|------|---------------|
| I_{SD} | Source-drain current | | - | | 120 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 480 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 120\text{ A}$, $V_{GS} = 0$ | - | | 1.4 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD} = 120\text{ A}$, $V_{DD} = 80\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 15) | - | 86.8 313 7.2 | | 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

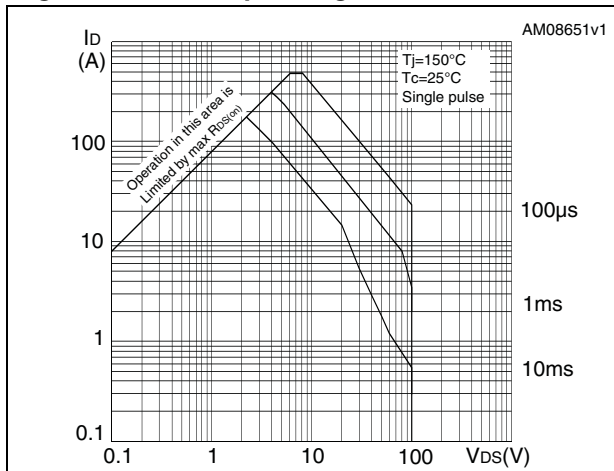


Figure 3. Thermal impedance

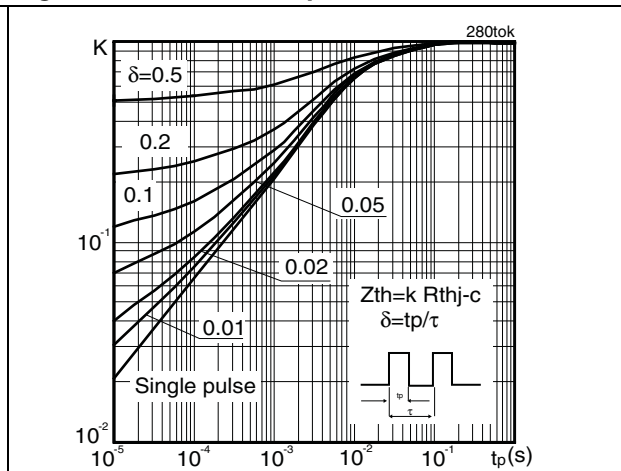


Figure 4. Output characteristics

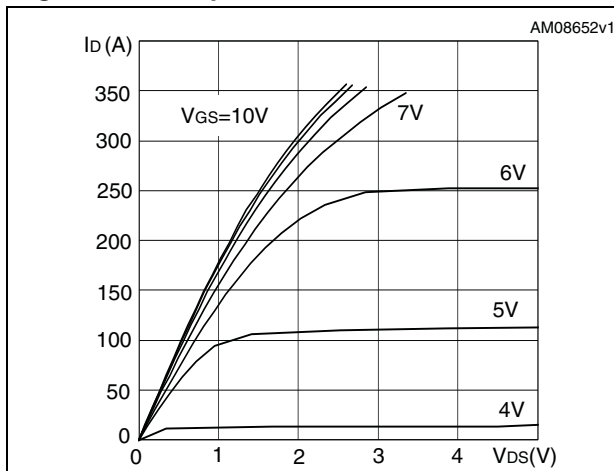


Figure 5. Transfer characteristics

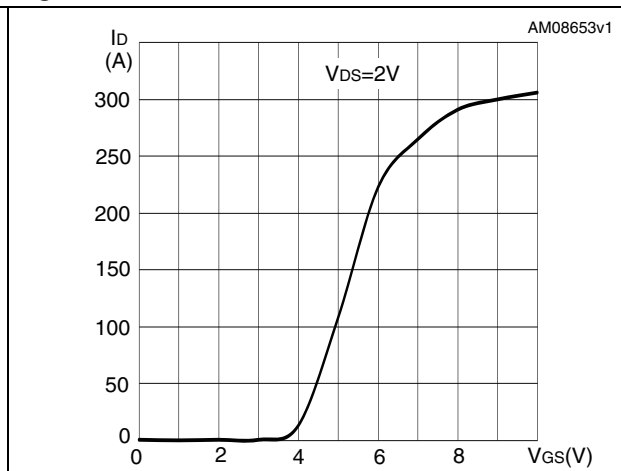


Figure 6. Normalized $B_{V_{DS}}$ vs temperature

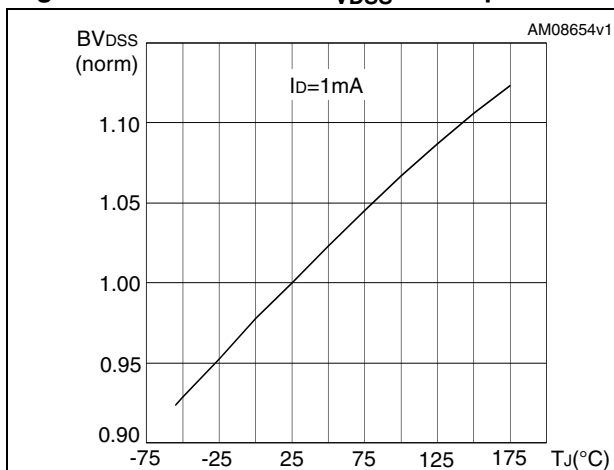


Figure 7. Static drain-source on resistance

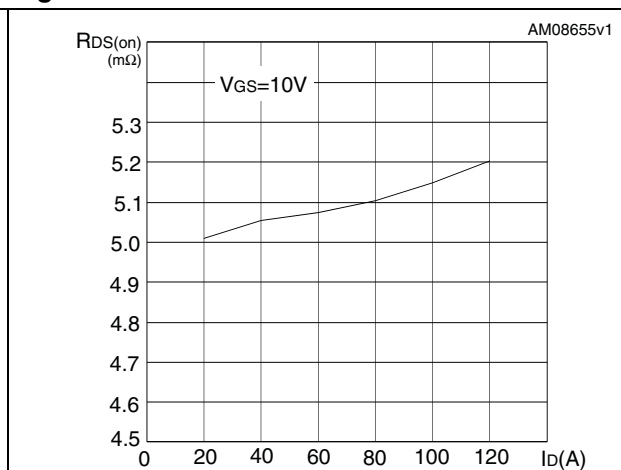


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

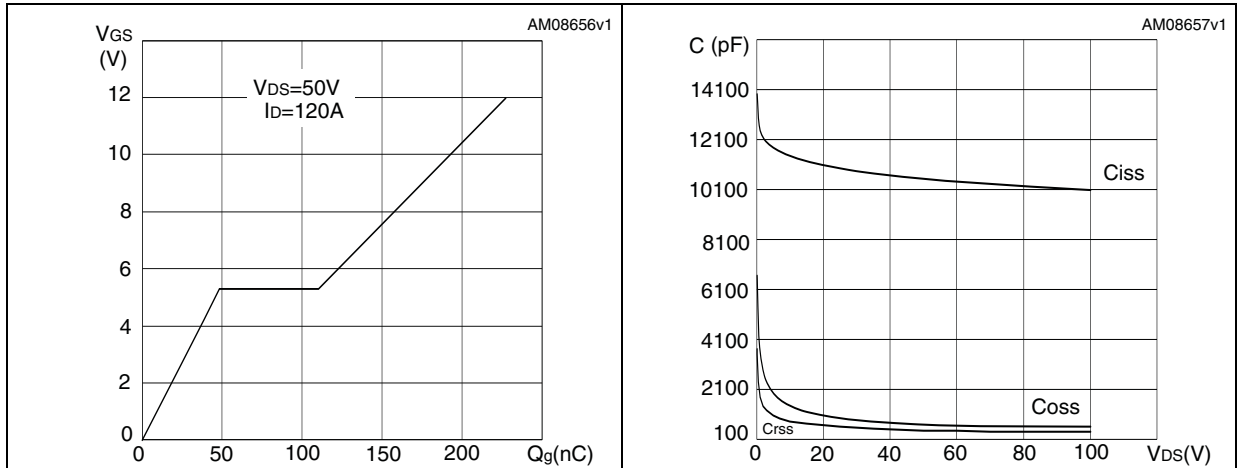


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

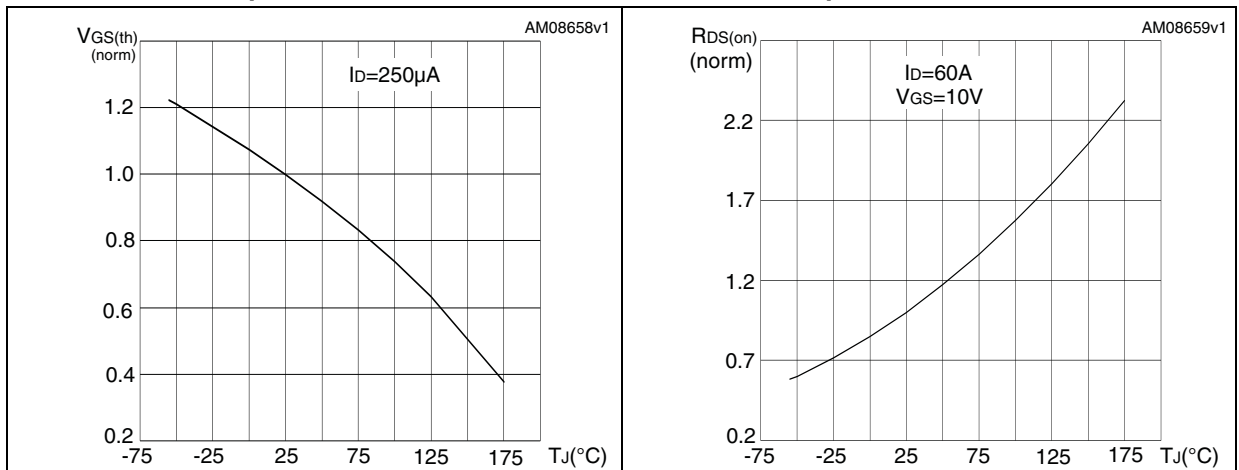
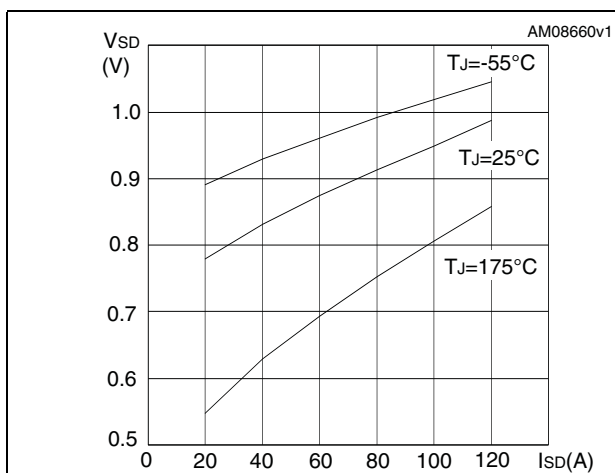


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Switching times test circuit for resistive load

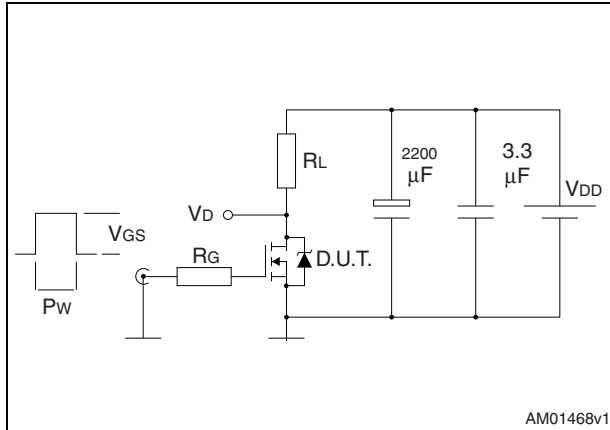


Figure 14. Gate charge test circuit

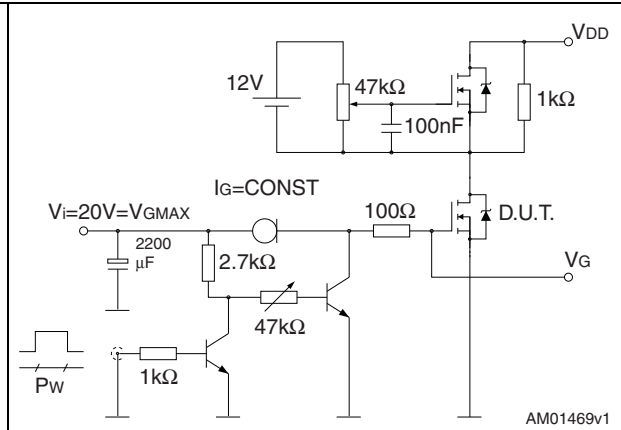


Figure 15. Test circuit for inductive load switching and diode recovery times

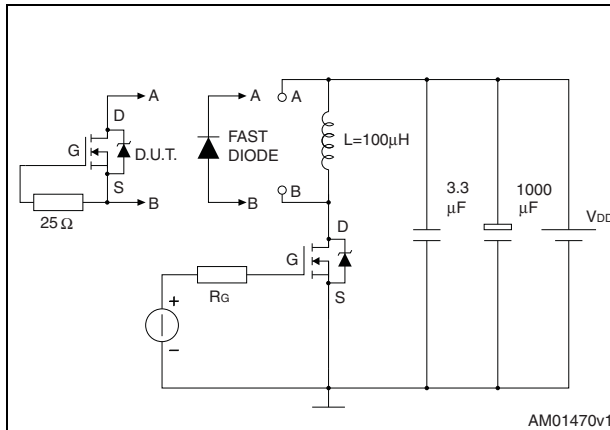


Figure 16. Unclamped inductive load test circuit

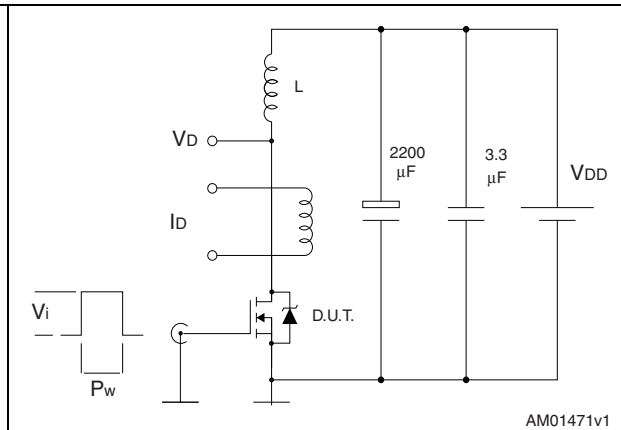


Figure 17. Unclamped inductive waveform

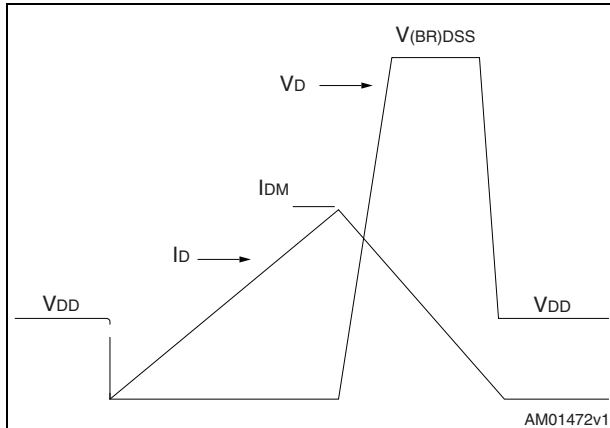
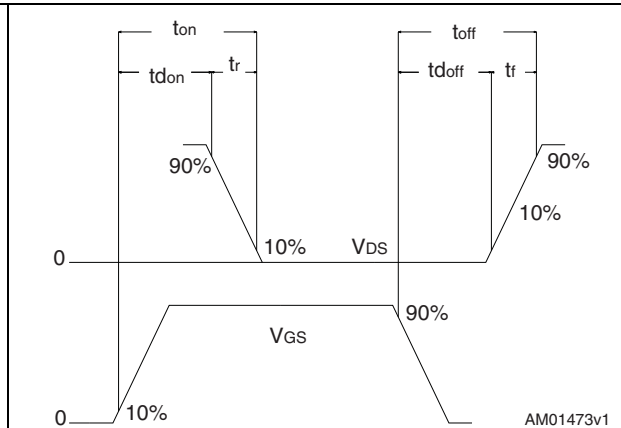


Figure 18. Switching time waveform

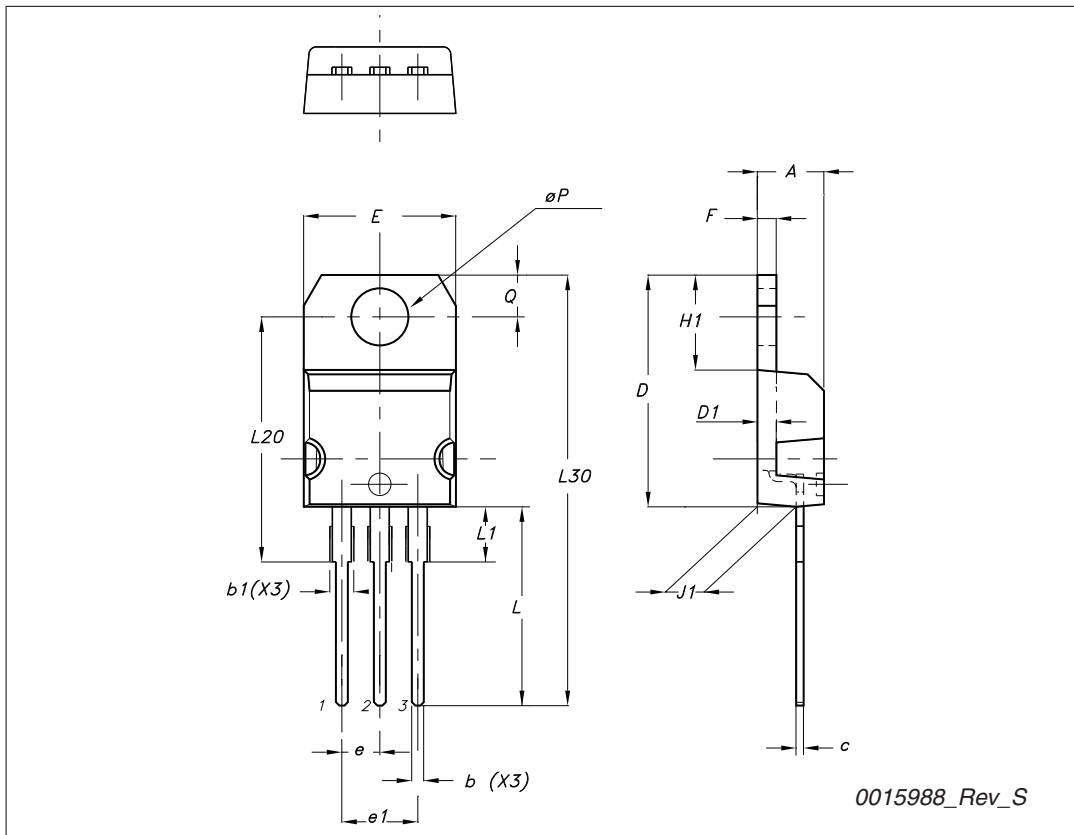


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

TO-220 type A mechanical data

| Dim | mm | | |
|-----|-------|-------|-------|
| | Min | Typ | Max |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 10.40 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| F | 1.23 | | 1.32 |
| H1 | 6.20 | | 6.60 |
| J1 | 2.40 | | 2.72 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| ∅P | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |



5 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 19-May-2009 | 1 | First release |
| 12-Nov-2010 | 2 | – Removed package H ² PAK. – Document status promoted from preliminary data to datasheet. |

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