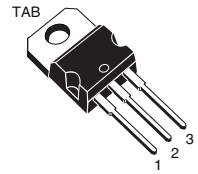
# STP105N3LL

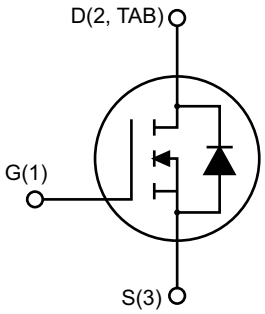
## N-channel 30 V, 2.7 mΩ typ., 150 A, STripFET™ H6 Power MOSFET in a TO-220 package

**Datasheet – production data**




**TO-220**

**Figure 1. Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|---|---|---|---|
| STP105N3LL | 30 V | 3.5 mΩ | 150 A |

- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss

## Applications

- Switching applications

## Description

This device is an N-channel Power MOSFET developed using the STripFET™ H6 technology, with a new trench gate structure. The resulting Power MOSFET exhibits very low $R_{DS(on)}$ in all packages.

**Table 1. Device summary**

| Order code | Marking | Packages | Packaging |
|---|---|---|---|
| STP105N3LL | P105N3LL | TO-220 | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 30 | V |
| $V_{GS}$ | Gate-source voltage | ± 20 | V |
| $I_D$ | Continuous drain current at $T_C$ = 25 °C (silicon limited) | 150 | A |
| $I_D$ | Continuous drain current at $T_C$ = 100 °C (silicon limited) | 105 | A |
| $I_D$ | Continuous drain current at $T_C$ = 25 °C (package limited) | 80 | A |
| $I_{DM}$ (1) | Pulsed drain current | 320 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 140 | W |
| | Derating factor | 0.9 | W/°C |
| $E_{AS}$ (2) | Single pulse avalanche energy | 150 | mJ |
| $T_{stg}$ | Storage temperature | -55 to 175 | °C |
| $T_j$ | Max. operating junction temperature | 175 | °C |

1. Pulse width limited by safe operating area
2. Starting $T_j$ = 25°C, $I_{AV}$ = 40 A

**Table 3. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 1.1 | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient max | 62.5 | °C/W |

# 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 | 30 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = 30 V | | | 1 | µA |
| | | $V_{DS}$ = 30 V, Tc = 125 °C | | | 10 | µA |
| $I_{GSS}$ | Gate body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ± 20 V | | | ±100 | 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, $I_D$ = 40 A | | 2.7 | 3.5 | mΩ |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 40 A | | 3.5 | 4.5 | mΩ |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 25 V, f=1 MHz, $V_{GS}$ = 0 | - | 3500 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 400 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 380 | - | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 15 V, $I_D$ = 80 A $V_{GS}$ = 4.5 V *Figure 14* | - | 42 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 9 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 18 | - | nC |
| $R_g$ | Gate input resistance | f = 1 MHz, gate DC Bias = 0, test signal level = 20 mV, $I_D$ = 0 | - | 1 | - | Ω |

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

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 15 V, $I_D$ = 40 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 5 V *Figure 13* | - | 19 | - | ns |
| $t_r$ | Rise time | | - | 91 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 24.5 | - | ns |
| $t_f$ | Fall time | | - | 23.4 | - | ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 80 | A |
| $I_{SDM}$ (1) | Source-drain current (pulsed) | | - | | 320 | A |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$ = 40 A, $V_{GS}$ = 0 | - | | 1.1 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 80 A, di/dt = 100 A/µs, $V_{DD}$ = 24 V *Figure 15* | - | 28.6 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 22.8 | | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 1.6 | | 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**

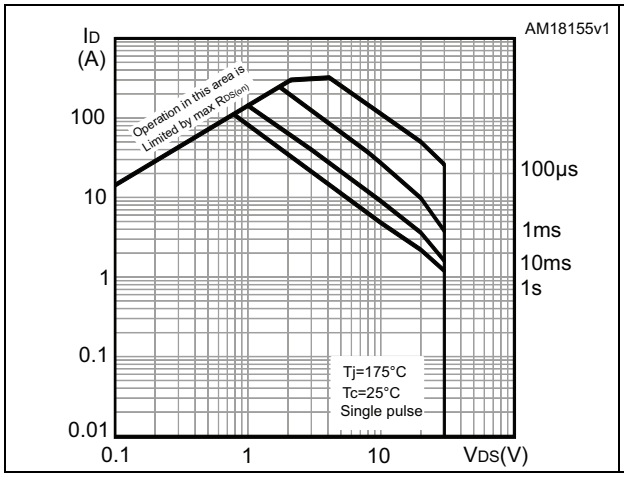



**Figure 3. Thermal impedance**

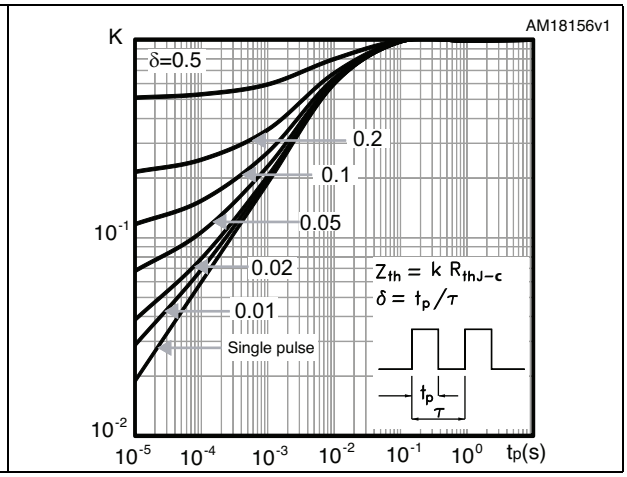



**Figure 4. Output characteristics**

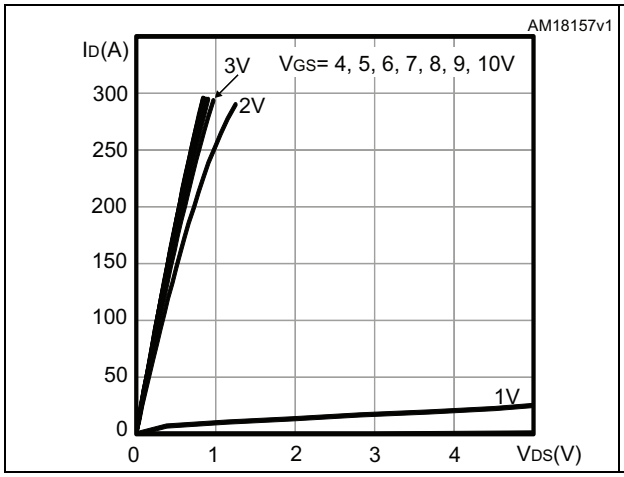



**Figure 5. Transfer characteristics**

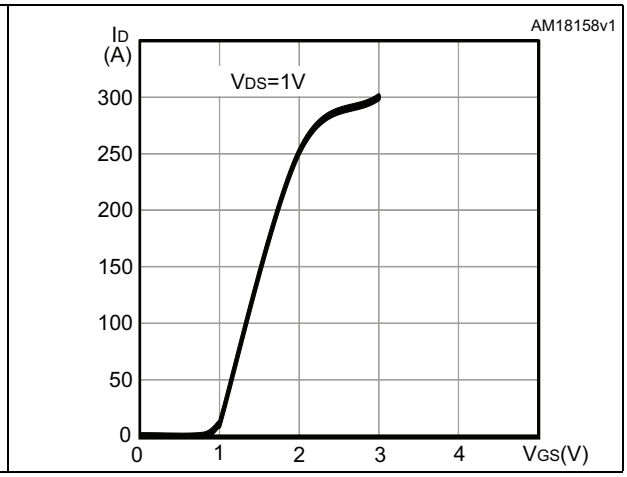



**Figure 6. Gate charge vs gate-source voltage**

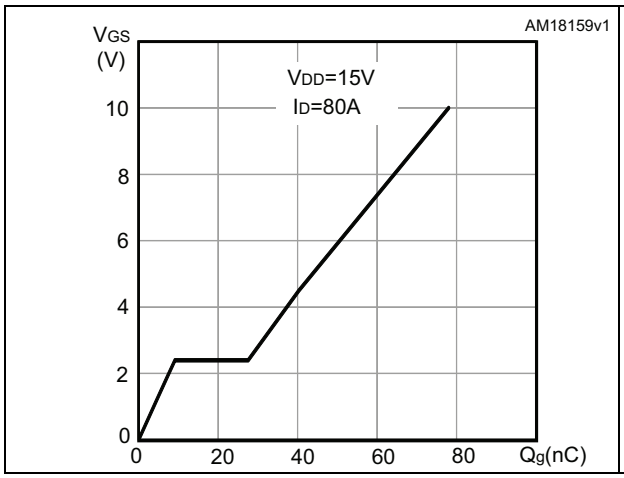



**Figure 7. Static drain-source on-resistance**

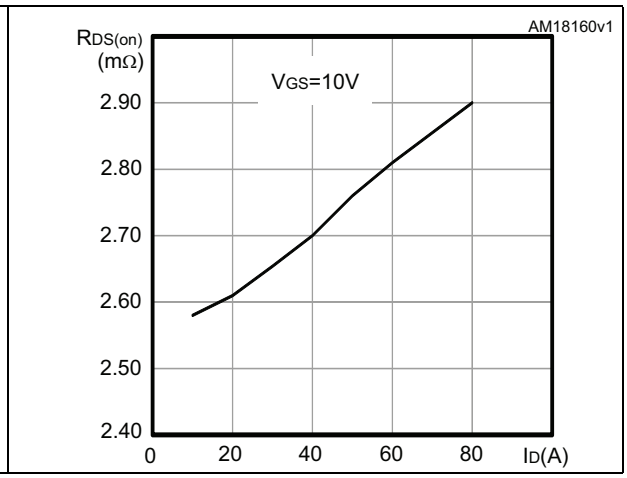


**Figure 8. Capacitance variations**

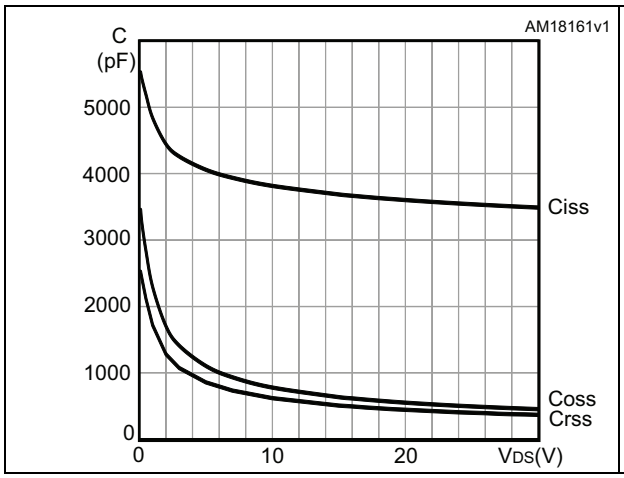



**Figure 9. Normalized gate threshold voltage vs temperature**

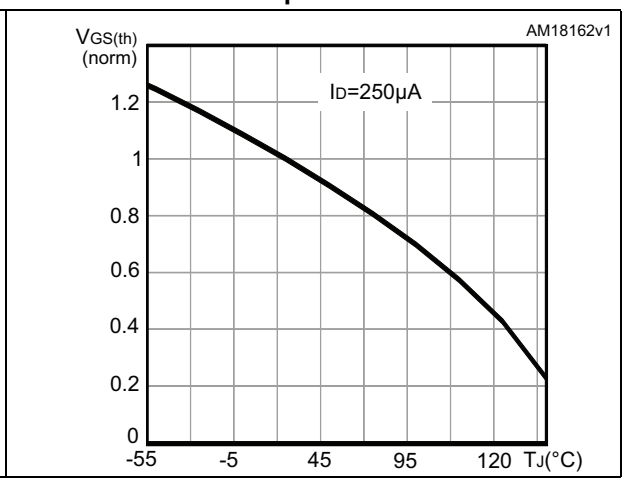



**Figure 10. Normalized on-resistance vs temperature**

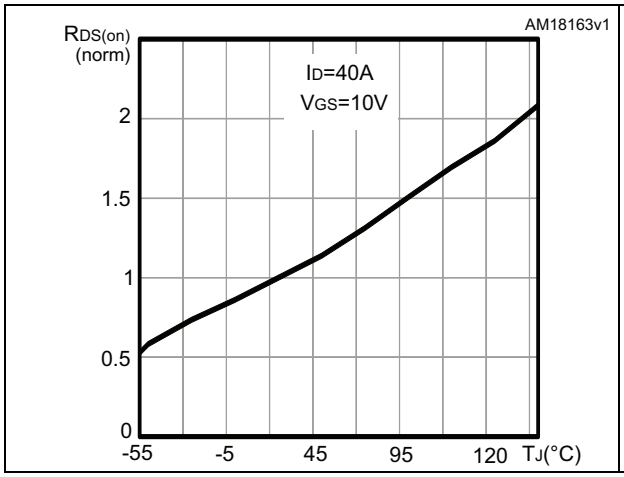



**Figure 11. Normalized $V_{(BR)DSS}$ vs temperature**

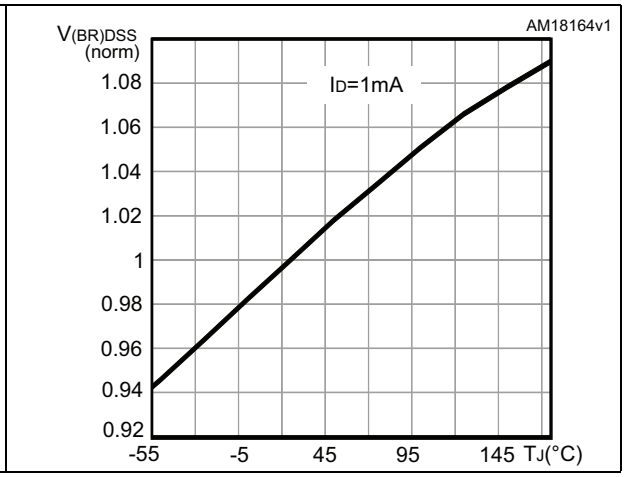
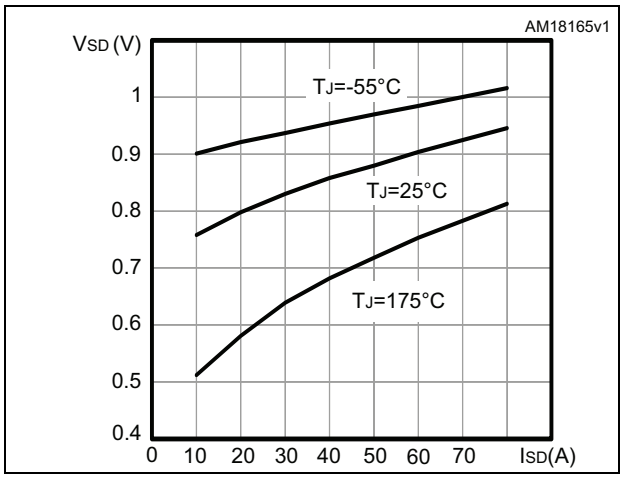



**Figure 12. Source-drain diode forward characteristics**



# 3 Test circuits

**Figure 13. Switching times test circuit for resistive load**

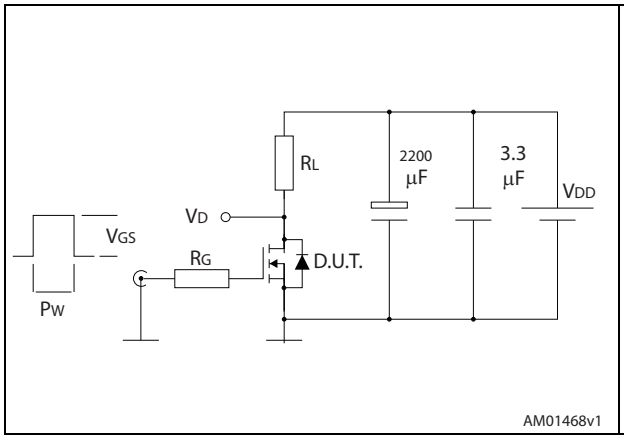



**Figure 14. Gate charge test circuit**

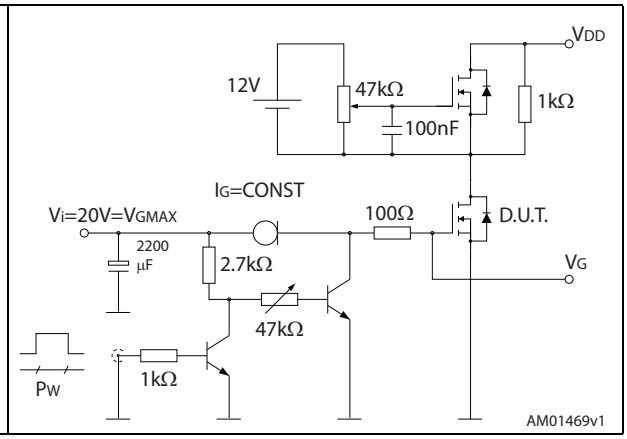



**Figure 15. Test circuit for inductive load switching and diode recovery times**

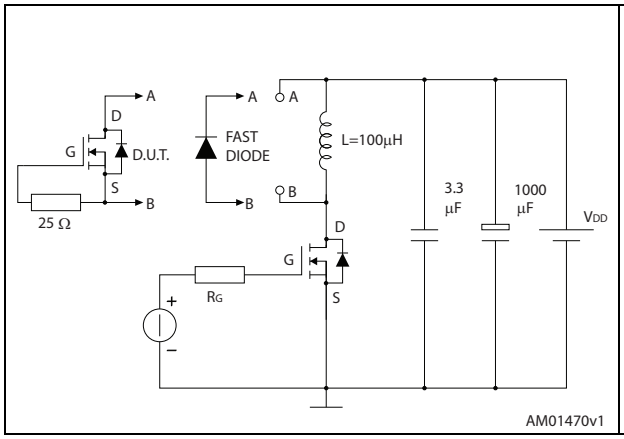



**Figure 16. Unclamped inductive load test circuit**

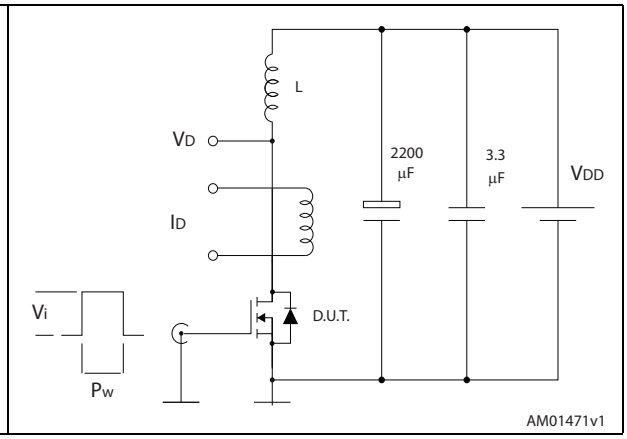



**Figure 17. Unclamped inductive waveform**

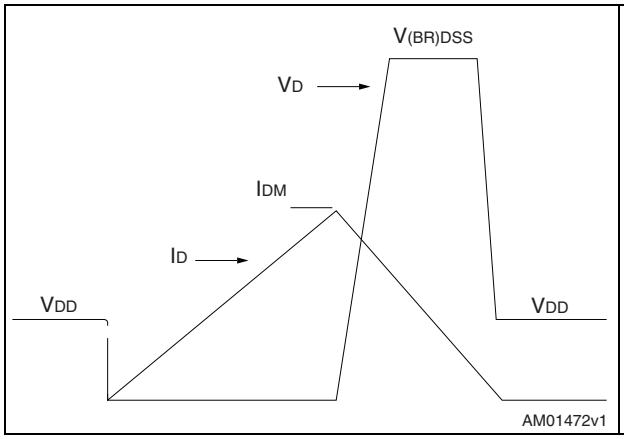
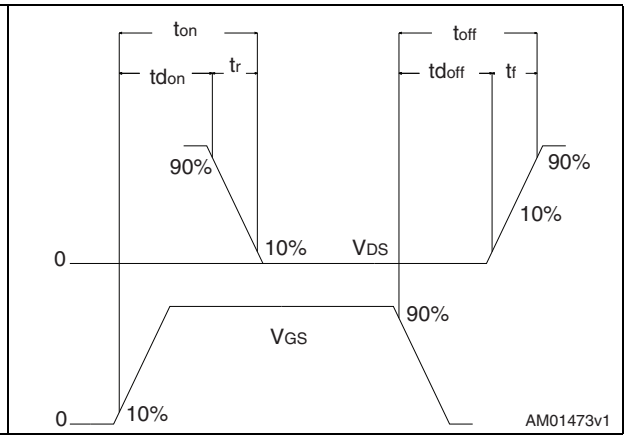



**Figure 18. Switching time waveform**



# 4 Package information

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.

Figure 19. TO-220 type A package outline

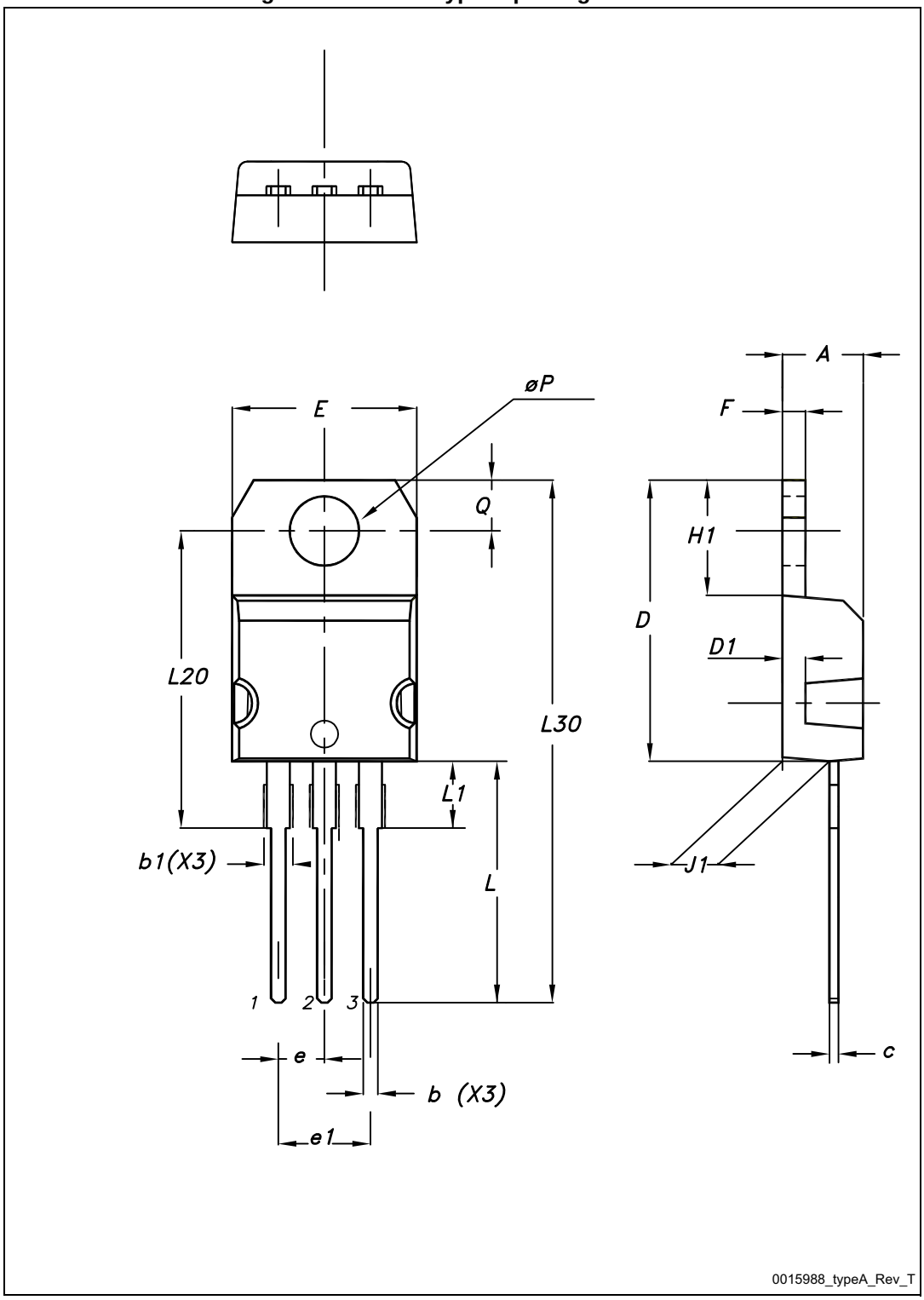


Table 8. TO-220 type A package mechanical data

| 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 9. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 13-Dec-2012 | 1 | First release. |
| 03-Apr-2014 | 2 | – Added: *Section 2.1: Electrical characteristics (curves)*<br>– Minor text changes |
| 06-Jul-2015 | 3 | – Updated *Table 1: Device summary*.<br>– Updated title, features and description in cover page.<br>– Minor text changes. |