

N-channel 600 V, 0.340 Ω typ., 11 A MDmesh™ M2 EP Power MOSFET in a TO-220 package

Datasheet - production data

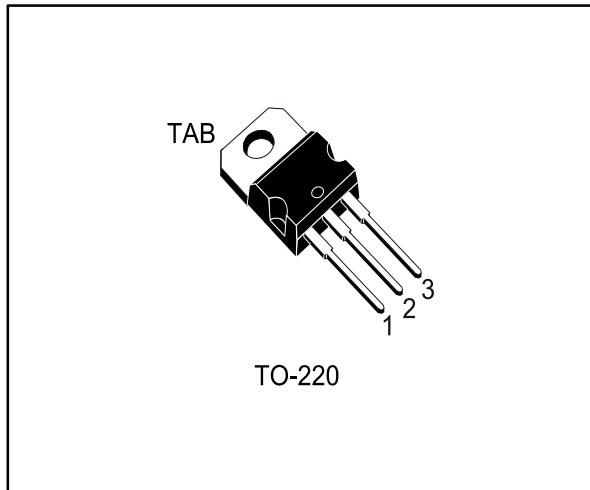
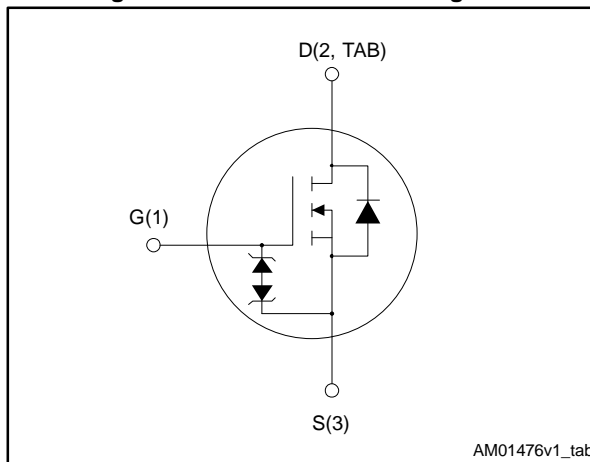


Figure 1: Internal schematic diagram



Features

| Order code | V_{DS} @ T_{Jmax} | $R_{DS(on)}$ max. | I_D |
|---------------|-----------------------|-------------------|-------|
| STP15N60M2-EP | 650 V | 0.378 Ω | 11 A |

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- Very low turn-off switching losses
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications
- Tailored for very high frequency converters ($f > 150$ kHz)

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 EP enhanced performance technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance, optimized switching characteristics with very low turn-off switching losses, rendering it suitable for the most demanding very high frequency converters.

Table 1: Device summary

| Order code | Marking | Package | Packaging |
|---------------|-----------|---------|-----------|
| STP15N60M2-EP | 15N60M2EP | TO-220 | Tube |

Contents

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1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|-------------|------|
| V_{GS} | Gate-source voltage | ± 25 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ °C}$ | 11 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ °C}$ | 7 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 44 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ °C}$ | 110 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 15 | V/ns |
| $dv/dt^{(3)}$ | MOSFET dv/dt ruggedness | 50 | V/ns |
| T_{stg} | Storage temperature | - 55 to 150 | °C |
| T_j | Max. operating junction temperature | | |

Notes:

(1) Pulse width limited by safe operating area.

(2) $I_{SD} \leq 11\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

(3) $V_{DS} \leq 480\text{ V}$

Table 3: Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|---|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.14 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.5 | °C/W |

Table 4: Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AR} | Avalanche current, repetetive or not repetetive (pulse width limited by T_{jmax}) | 2.8 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$; $V_{DD} = 50\text{ V}$) | 125 | mJ |

2 Electrical characteristics

$T_C = 25\text{ °C}$ unless otherwise specified

Table 5: On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|--|------|-------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$ | 600 | | | V |
| I_{DSS} | Zero gate voltage Drain current | $V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$ | | | 1 | μA |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_C = 125\text{ °C}$ | | | 100 | μA |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$, $I_D = 5.5\text{ A}$ | | 0.340 | 0.378 | Ω |

Table 6: Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|--|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$ | - | 590 | - | pF |
| C_{oss} | Output capacitance | | - | 30 | - | pF |
| C_{rss} | Reverse transfer capacitance | | - | 1.1 | - | pF |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}$, $V_{GS} = 0\text{ V}$ | - | 148 | - | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$, $I_D = 0\text{ A}$ | - | 7 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}$, $I_D = 11\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 15: "Gate charge test circuit") | - | 17 | - | nC |
| Q_{gs} | Gate-source charge | | - | 3.1 | - | nC |
| Q_{gd} | Gate-drain charge | | - | 7.3 | - | nC |

Notes:

⁽¹⁾ $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 7: Switching energy

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------|---|--|------|------|------|---------------|
| $E_{(off)}$ | Turn-off energy (from 90% V_{GS} to 0% I_D) | $V_{DD} = 400\text{ V}$, $I_D = 1.5\text{ A}$ $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ | - | 4.7 | - | μJ |
| | | $V_{DD} = 400\text{ V}$, $I_D = 3.5\text{ A}$ $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ | - | 5.2 | - | μJ |

Table 8: Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 300\text{ V}$, $I_D = 5.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14: "Switching times test circuit for resistive load" and Figure 19: "Switching time waveform") | - | 11 | - | ns |
| t_r | Rise time | | - | 10 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 40 | - | ns |
| t_f | Fall time | | - | 15 | - | ns |

Table 9: Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 11 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 44 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $V_{GS} = 0\text{ V}$, $I_{SD} = 11\text{ A}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times") | - | 280 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 2.7 | | μC |
| I_{RRM} | Reverse recovery current | | - | 19.5 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching and diode recovery times") | - | 400 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 3.8 | | μC |
| I_{RRM} | Reverse recovery current | | - | 19 | | A |

Notes:

(1)Pulse width is limited by safe operating area

(2)Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.2 Electrical characteristics (curves)

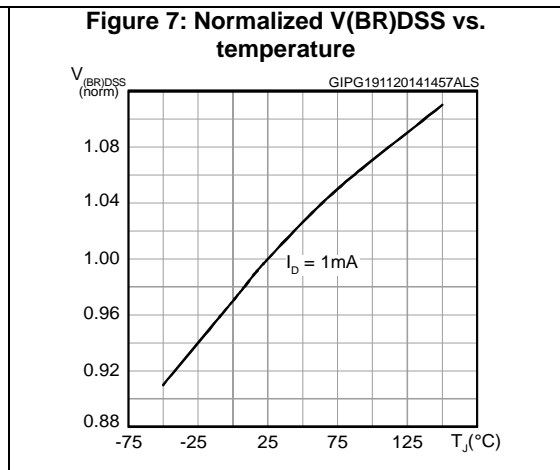
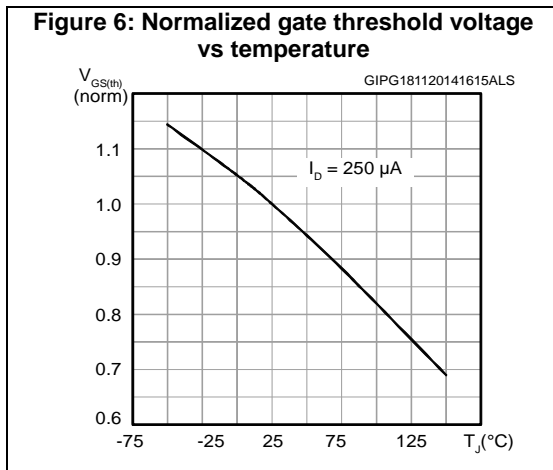
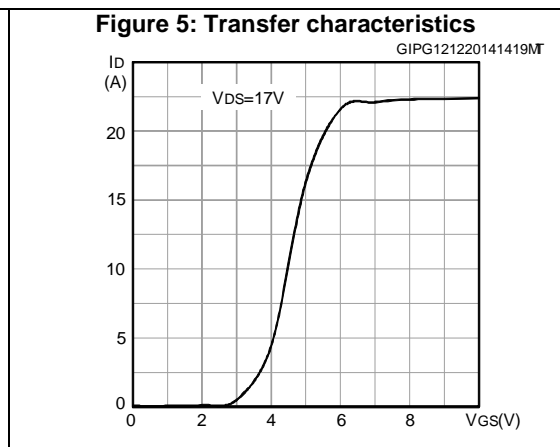
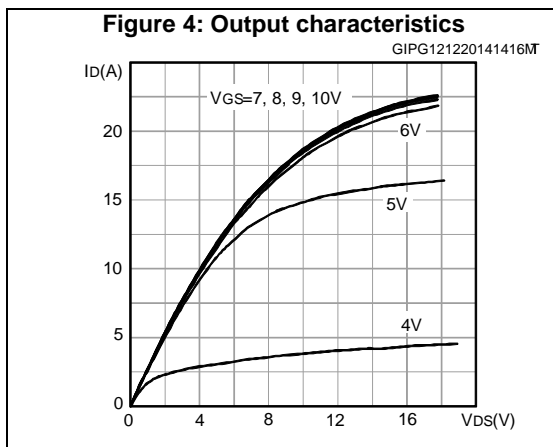
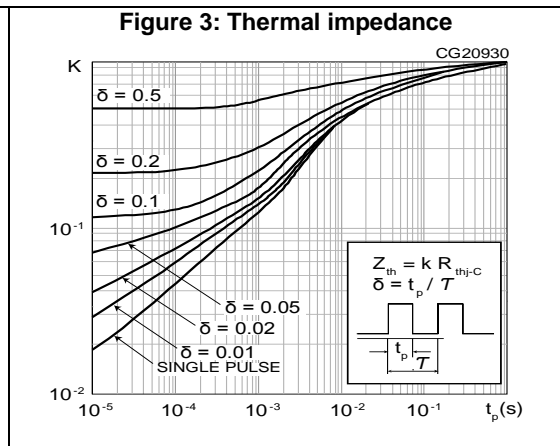
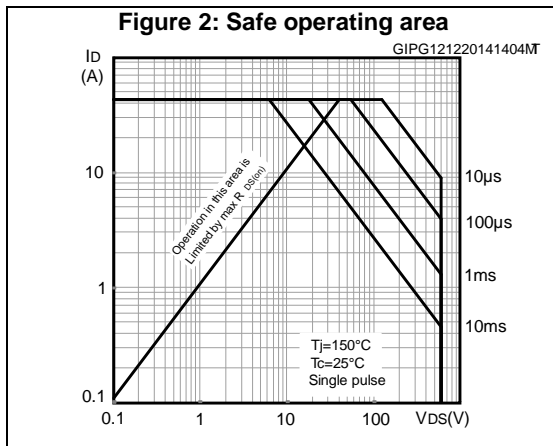


Figure 8: Static drain-source on-resistance

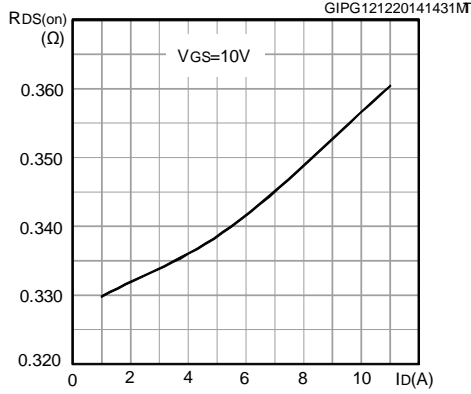


Figure 9: Normalized on-resistance vs temperature

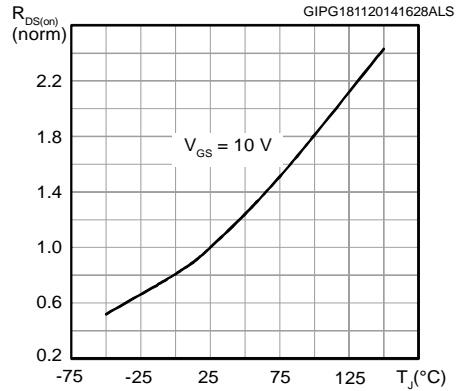


Figure 10: Gate charge vs. gate-source voltage

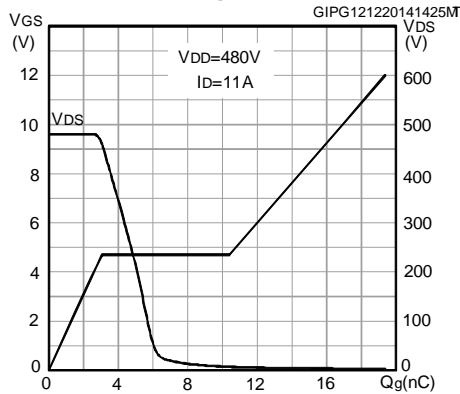


Figure 11: Capacitance variations

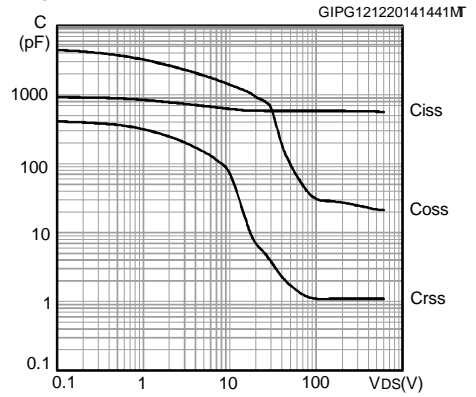


Figure 12: Turn-off switching loss vs drain current

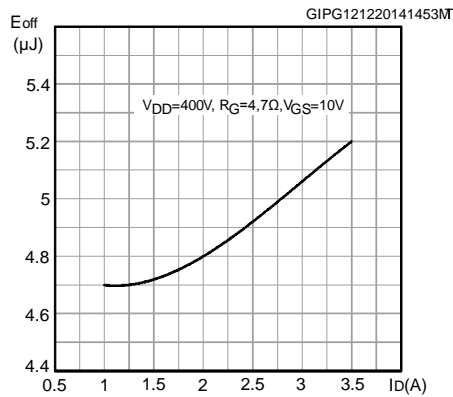
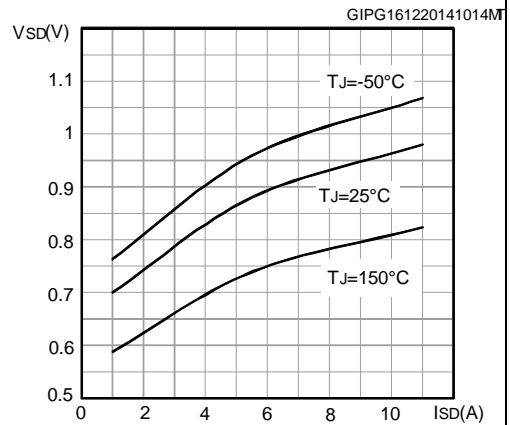
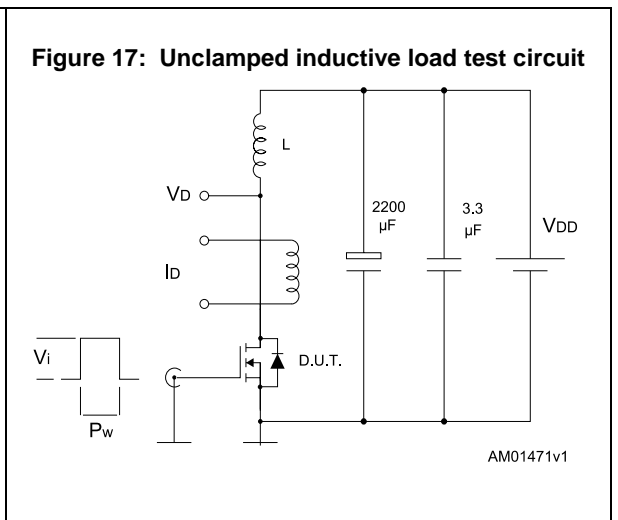
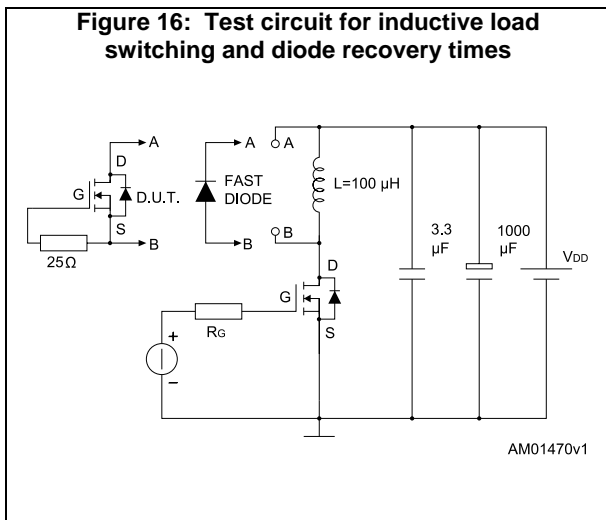
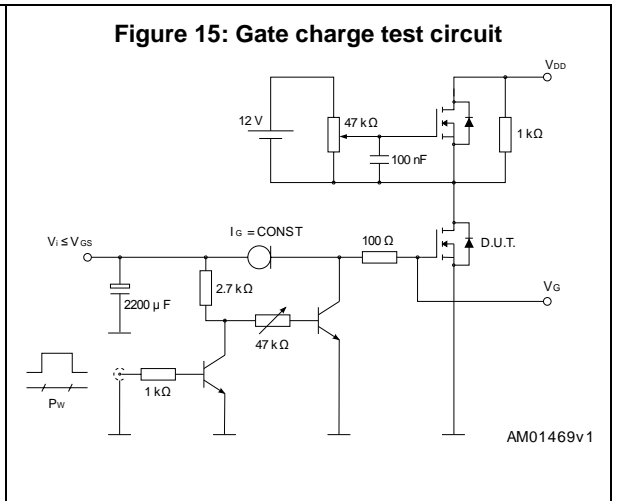
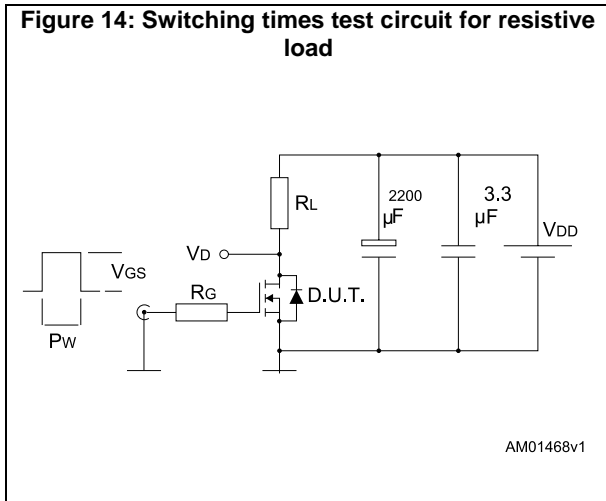
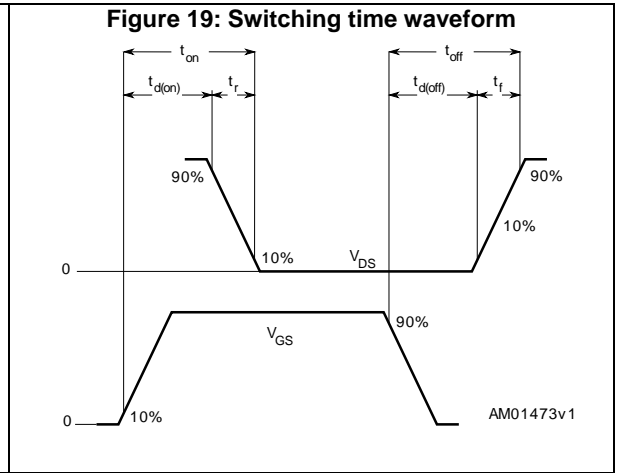
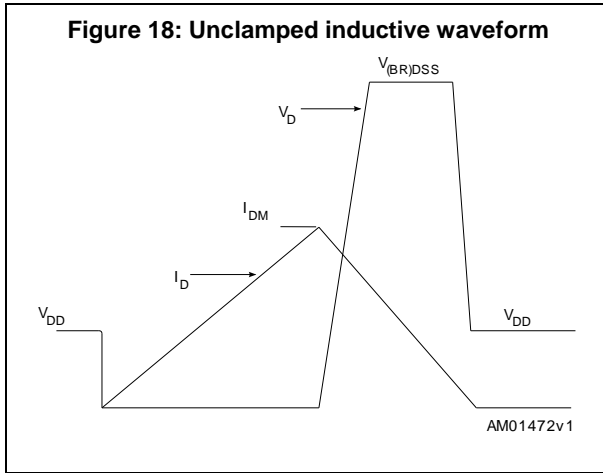


Figure 13: Source-drain diode forward characteristic



3 Test circuits





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.

4.1 TO-220 type A package information

Figure 20: TO-220 type A package outline

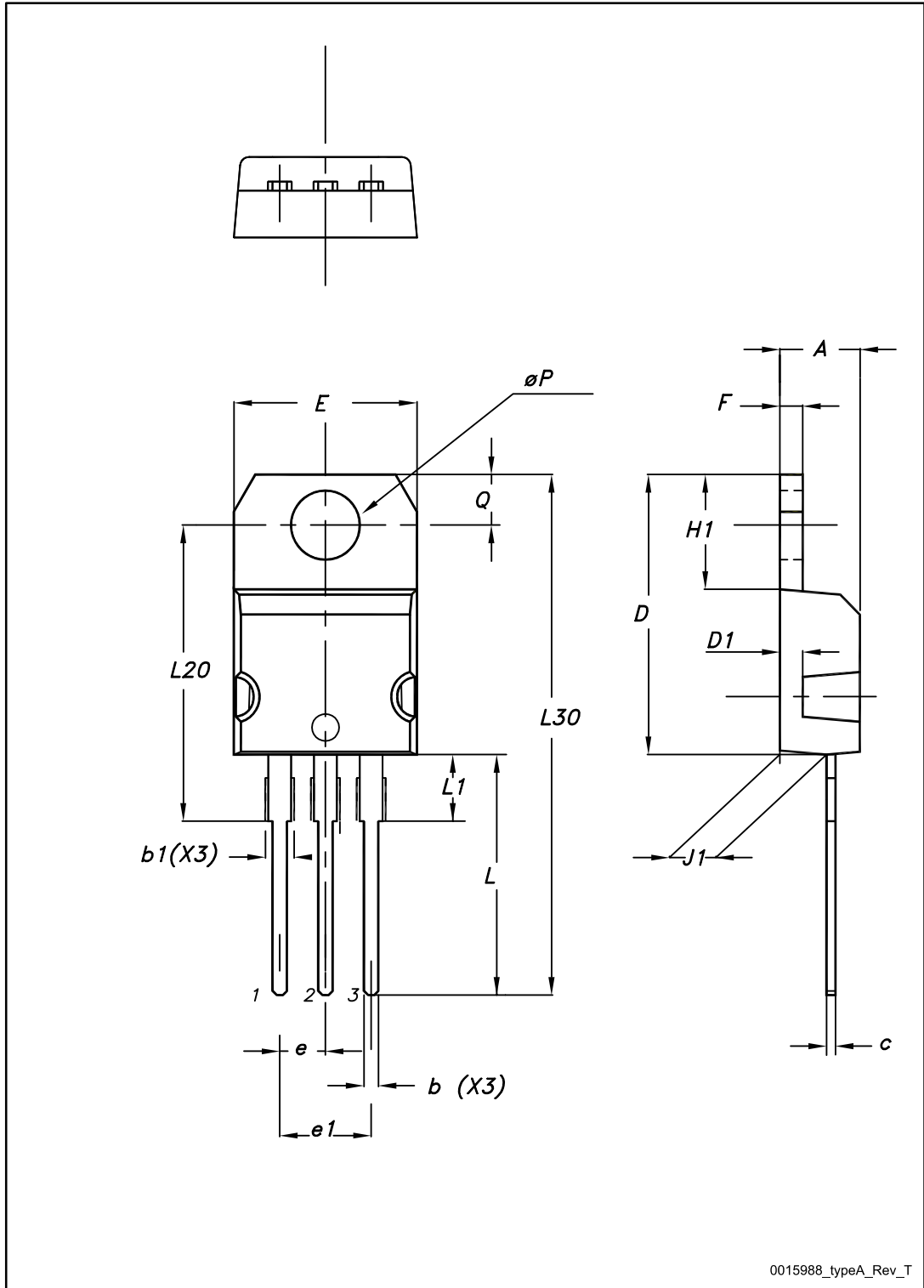


Table 10: TO-220 type A mechanical data

| 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 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

5 Revision history

Table 11: Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 15-Dec-2014 | 1 | First release. |
| 18-Dec-2014 | 2 | Document status promoted from preliminary data to production data. Updated Table 6: "Dynamic" . Minor text changes. |

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