# STP36N60M6, STW36N60M6

## N-channel 600 V, 85 mΩ typ., 30 A MDmesh™ M6 Power MOSFETs in TO-220 and TO-247 packages

Datasheet - production data

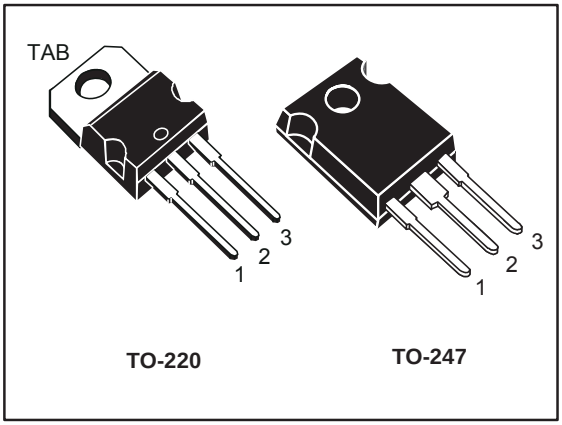
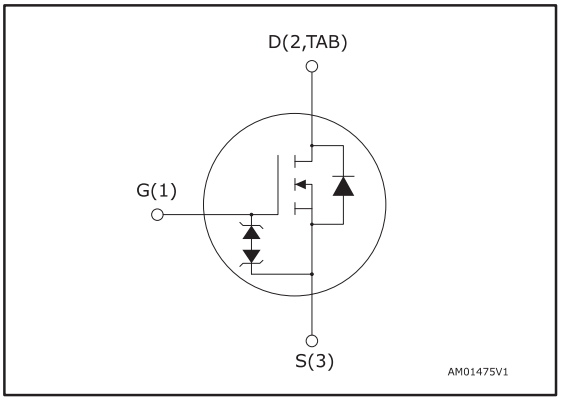



**Figure 1: Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|---|---|---|---|
| STP36N60M6 | 600 V | 99 mΩ | 30 A |
| STW36N60M6 | | | |

- Reduced switching losses
- Lower $R_{DS(on)}$ x area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications

## Description

The new MDmesh™ M6 technology incorporates the most recent advancements to the well-known and consolidated MDmesh family of SJ MOSFETs. STMicroelectronics builds on the previous generation of MDmesh devices through its new M6 technology, which combines excellent $R_{DS(on)}$ * area improvement with one of the most effective switching behaviors available, as well as a user-friendly experience for maximum end-application efficiency.

**Table 1: Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STP36N60M6 | 36N60M6 | TO-220 | Tube |
| STW36N60M6 | | TO-247 | |



This is information on a product in full production.

# Contents

1 Electrical ratings ..... 3
2 Electrical characteristics ..... 4
2.1 Electrical characteristics (curves) ..... 6
3 Test circuits ..... 9
4 Package information ..... 10
4.1 TO-220 type A package information ..... 11
4.2 TO-247 package information ..... 13
5 Revision history ..... 15

# 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 °C | 30 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 19 | A |
| $I_D$(1) | Drain current (pulsed) | 102 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 208 | 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 range | -55 to 150 | °C |
| $T_j$ | Operating junction temperature range | | |

**Notes:**

(1)Pulse width limited by safe operating area.

(2)$I_{SD}$ ≤ 30 A, di/dt ≤ 400 A/µs, $V_{DS(peak)}$ < $V_{(BR)DSS}$, $V_{DD}$ = 400 V.

(3)$V_{DS}$ ≤ 480 V

**Table 3: Thermal data**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | TO-220 | TO-247 | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 0.6 | | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient | 62.5 | 50 | °C/W |

**Table 4: Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$) | 5 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V) | 750 | mJ |

# 2 Electrical characteristics

$T_C$ = 25 °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 V, $I_D$ = 1 mA | 600 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{GS}$ = 0 V, $V_{DS}$ = 600 V | | | 1 | µA |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = 600 V, $T_C$ = 125 °C(1) | | | 100 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V, $V_{GS}$ = ±25 V | | | ±5 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 3.25 | 4 | 4.75 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 15 A | | 85 | 99 | mΩ |

**Notes:**

(1)Defined by design, not subject to production test.

**Table 6: Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$= 100 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 1960 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 93 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 6 | - | pF |
| $C_{oss\ eq.}$(1) | Equivalent output capacitance | $V_{DS}$ = 0 to 480 V, $V_{GS}$ = 0 V | - | 332 | - | pF |
| $R_G$ | Intrinsic gate resistance | f = 1 MHz, $I_D$ = 0 A | - | 1.6 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 480 V, $I_D$ = 30 A, $V_{GS}$ = 0 to 10 V (see *Figure 17: "Test circuit for gate charge behavior"*) | - | 44.3 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 10.1 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 25 | - | nC |

**Notes:**

(1)$C_{oss\ eq.}$ 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 times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 300 V, $I_D$ = 15 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 18: "Test circuit for inductive load switching and diode recovery times"* and *Figure 21: "Switching time waveform"*) | - | 15.2 | - | ns |
| $t_r$ | Rise time | | - | 5.3 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | - | 50.2 | - | ns |
| $t_f$ | Fall time | | - | 7.3 | - | ns |

**Table 8: Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 30 | A |
| $I_{SDM}$,(1) | Source-drain current (pulsed) | | - | | 102 | A |
| $V_{SD}$ (2) | Forward on voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 30 A | - | | 1.6 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 30 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V (see *Figure 18: "Test circuit for inductive load switching and diode recovery times"*) | - | 340 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 5.3 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 31 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 30 A, di/dt = 100 A/µs, $V_{DD}$ = 60 V, $T_j$ = 150 °C (see *Figure 18: "Test circuit for inductive load switching and diode recovery times"*) | - | 430 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 7.7 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 36 | | A |

**Notes:**

(1)Pulse width is 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 for TO-220**

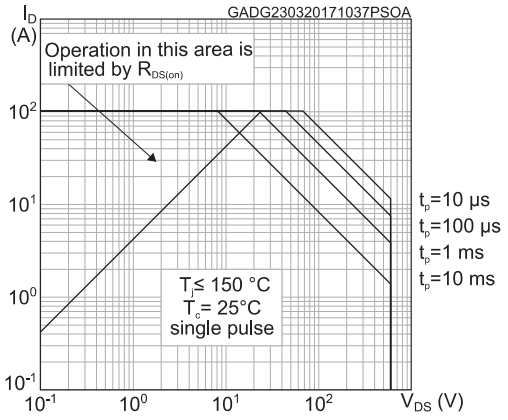



**Figure 3: Thermal impedance for TO-220**

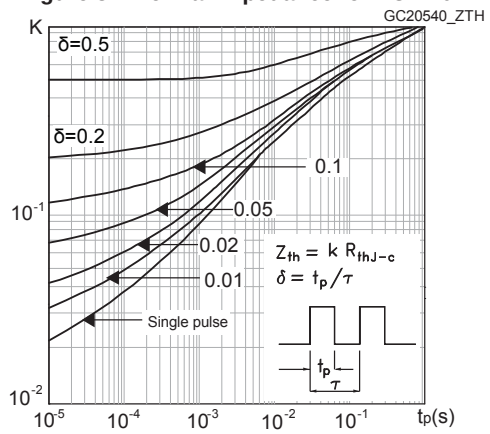



**Figure 4: Safe operating area for TO-247**

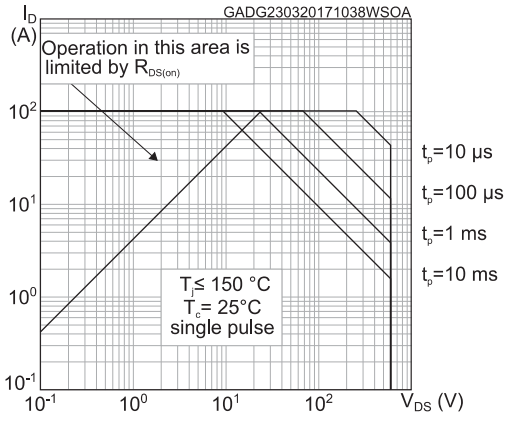



**Figure 5: Thermal impedance for TO-247**

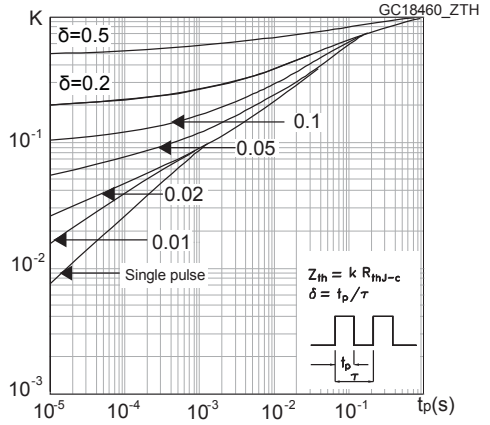



**Figure 6: Output characteristics**

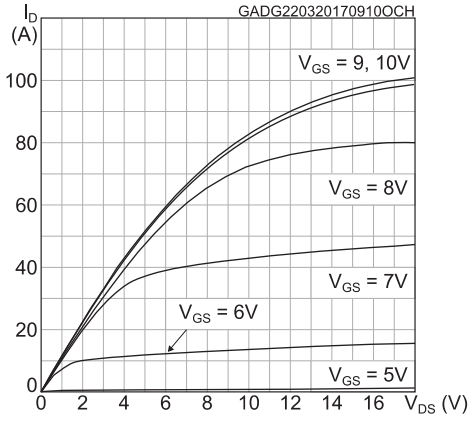



**Figure 7: Transfer characteristics**

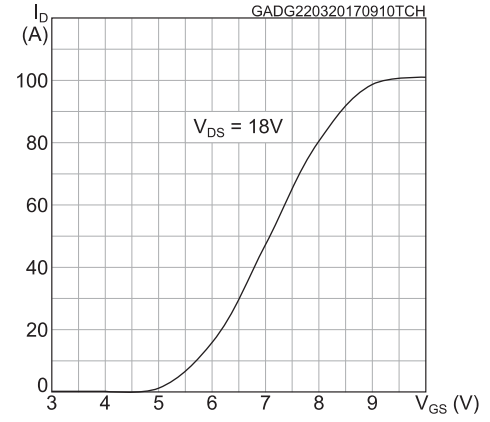


**Figure 8: Gate charge vs gate-source voltage**

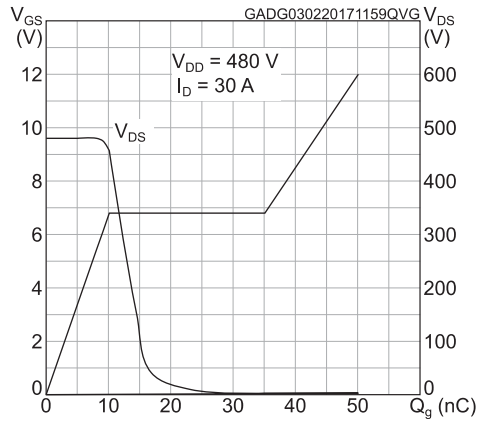



**Figure 9: Static drain-source on-resistance**

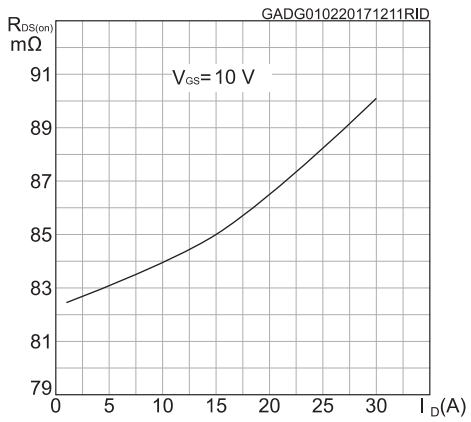



**Figure 10: Capacitance variations**

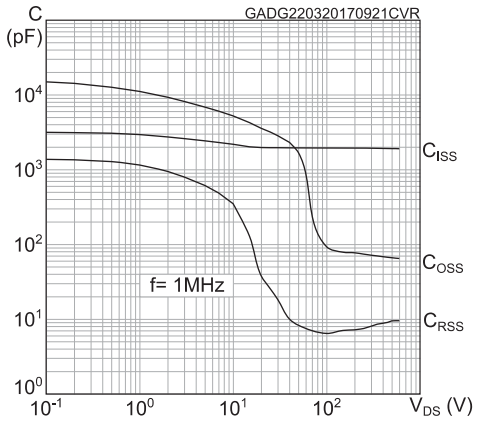



**Figure 11: Normalized gate threshold voltage vs temperature**

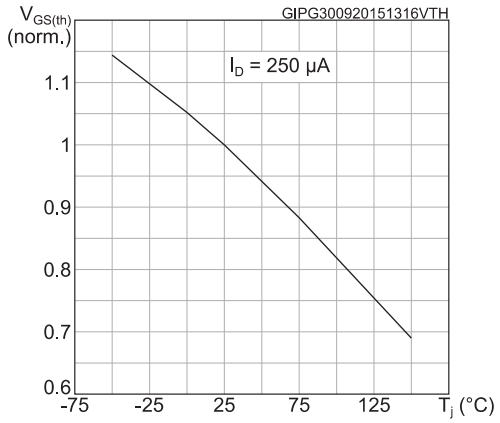



**Figure 12: Normalized on-resistance vs temperature**

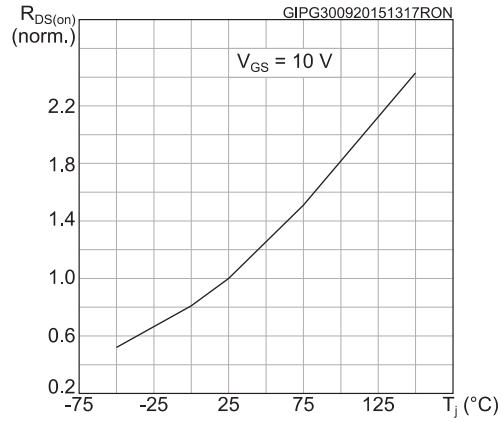



**Figure 13: Normalized $V_{(BR)DSS}$ vs temperature**

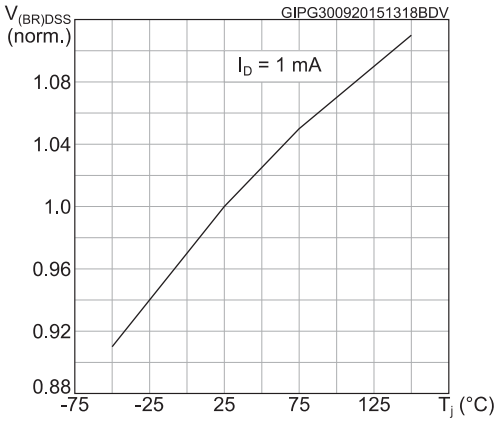


**Figure 14: Output capacitance stored energy**

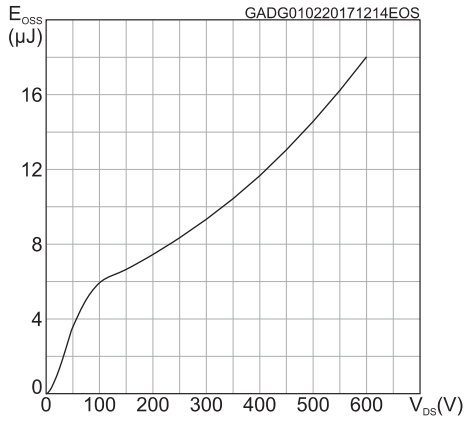
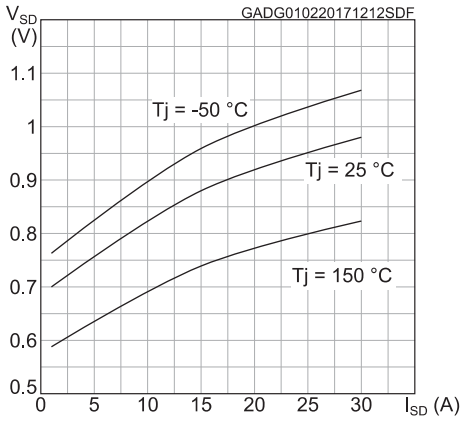



**Figure 15: Source-drain diode forward characteristics**



# 3 Test circuits

**Figure 16: Test circuit for resistive load switching times**

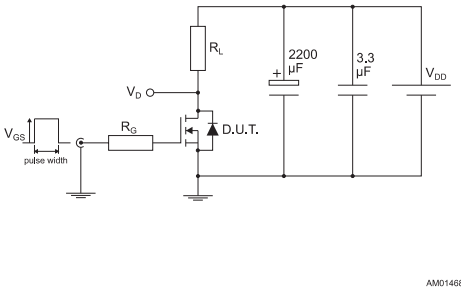



**Figure 17: Test circuit for gate charge behavior**

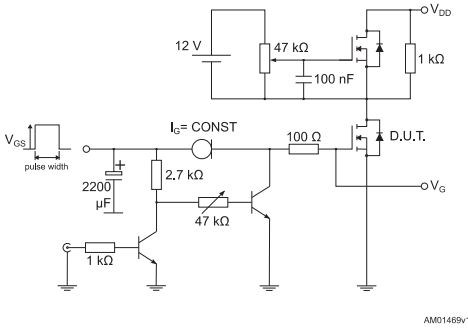



**Figure 18: Test circuit for inductive load switching and diode recovery times**

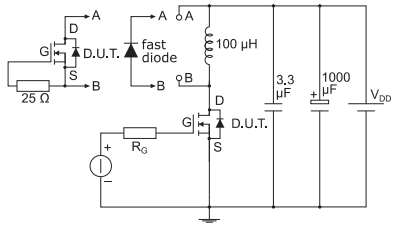



**Figure 19: Unclamped inductive load test circuit**

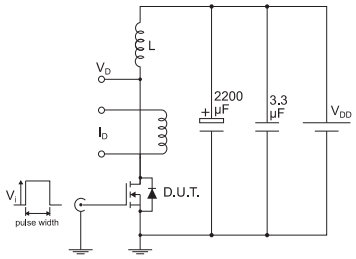



**Figure 20: Unclamped inductive waveform**

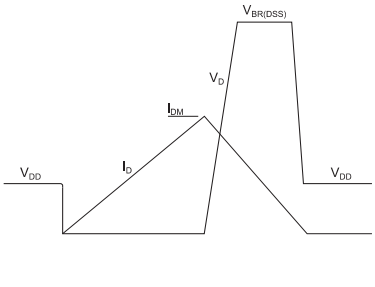
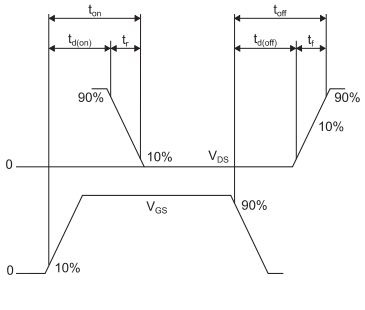



**Figure 21: Switching time waveform**



# 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.

## 4.1 TO-220 type A package information

**Figure 22: TO-220 type A package outline**

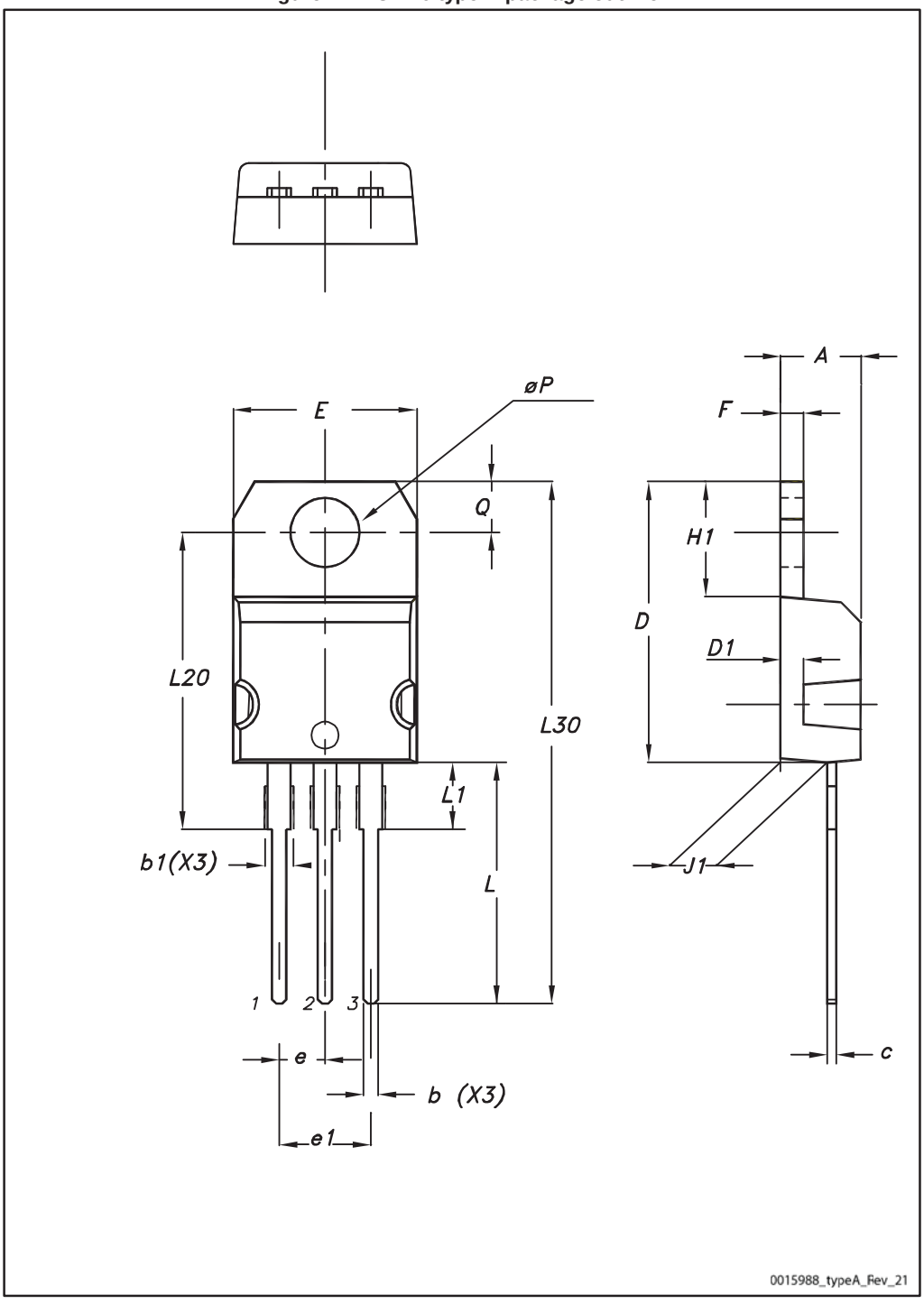


Table 9: TO-220 type A mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.55 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10.00 | | 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 | 13.00 | | 14.00 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

## 4.2 TO-247 package information

**Figure 23: TO-247 package outline**

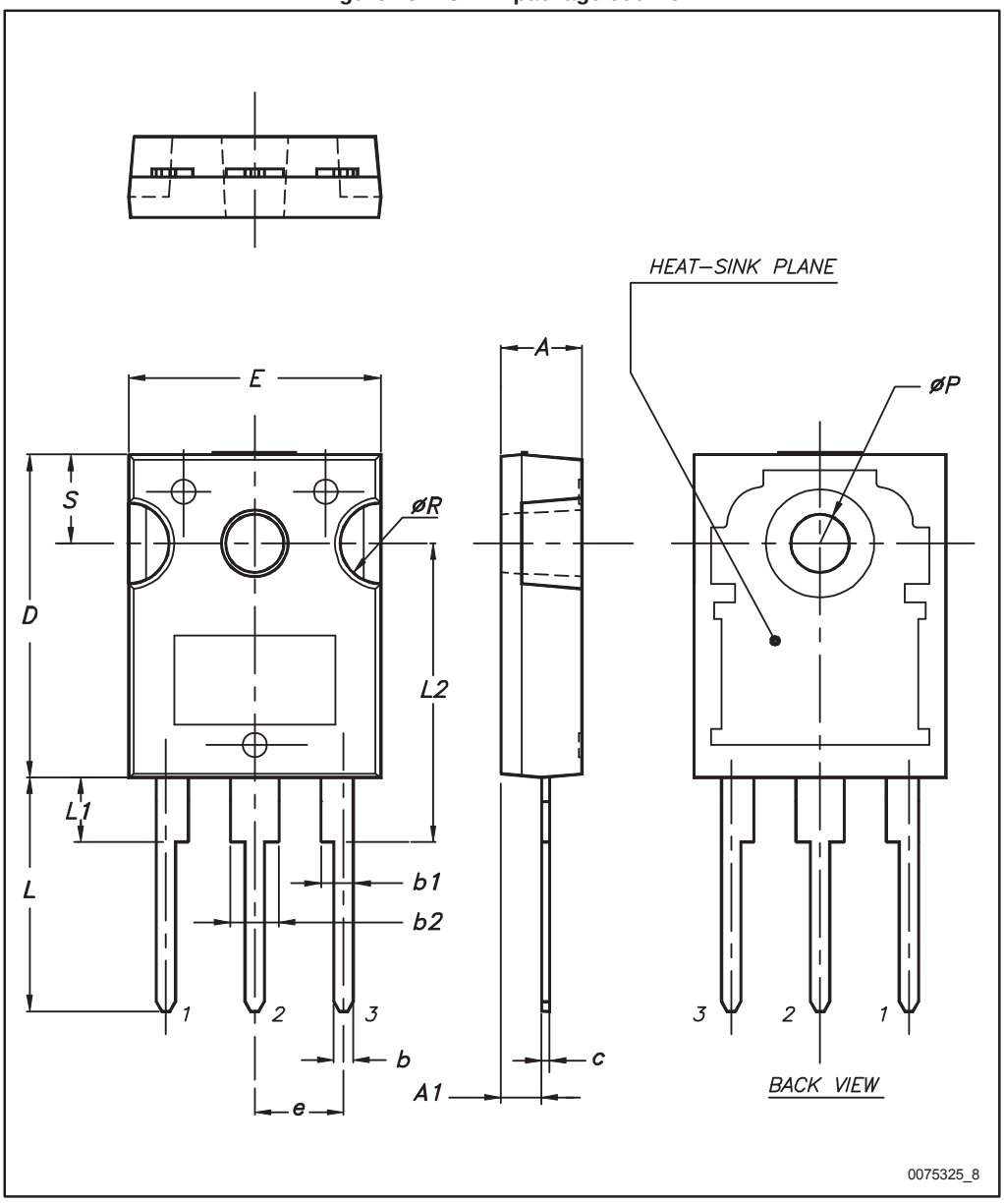


Table 10: TO-247 package mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | 5.30 | 5.45 | 5.60 |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ØP | 3.55 | | 3.65 |
| ØR | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |

# 5 Revision history

Table 11: Document revision history

| Date | Revision | Changes |
|---|---|---|
| 06-Oct-2015 | 1 | First release |
| 14-Oct-2015 | 2 | Updated: $V_{DD}$ value in *Table 8: "Source drain diode"*<br>Minor text changes |
| 27-Mar-2017 | 3 | Updated *Table 2: "Absolute maximum ratings"*.<br>Updated *Section 2: "Electrical characteristics"*.<br>Updated *Section 4: "Package information"*.<br>Minor text changes |

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2017 STMicroelectronics – All rights reserved