# STY50N105DK5

## N-channel 1050 V, 0.110 Ω typ., 46 A MDmesh™ DK5 Power MOSFET in a Max247 package

Datasheet - production data

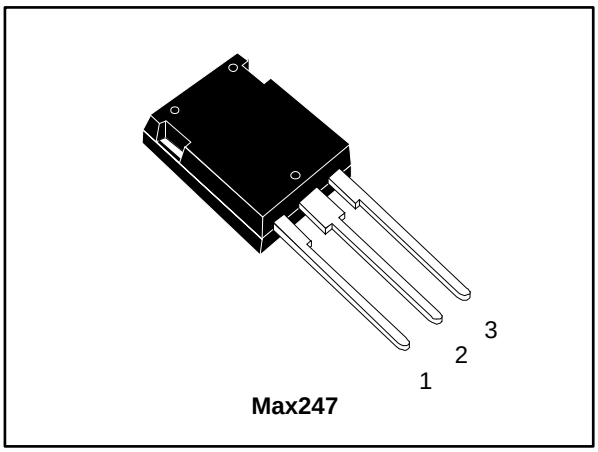
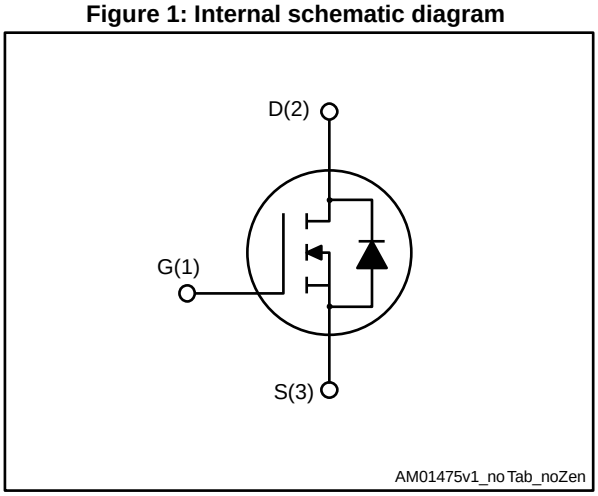



**Figure 1: Internal schematic diagram**




## Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ | $P_{TOT}$ |
|---|---|---|---|---|
| STY50N105DK5 | 1050 V | 0.120 Ω | 46 A | 625 W |

- Fast-recovery body diode
- Best $R_{DS(on)}$ x area
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness

## Applications

- Switching applications

## Description

This very high voltage N-channel Power MOSFET is part of the MDmesh™ DK5 fast recovery diode series. The MDmesh™ DK5 combines very low recovery charge ($Q_{rr}$) and recovery time ($t_{rr}$) with an excellent improvement in $R_{DS(on)}$ * area and one of the most effective switching behaviors, ideal for half bridge and full bridge converters.

**Table 1: Device summary**

| Order code | Marking | Packages | Packaging |
|---|---|---|---|
| STY50N105DK5 | 50N105DK5 | Max247 | Tube |

# Contents

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{GS}$ | Gate-source voltage | ±30 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 46 | A |
| | Drain current (continuous) at $T_C$ = 100 °C | 30 | A |
| $I_{DM}$ (1) | Drain current (pulsed) | 184 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 625 | W |
| dv/dt (2) | Peak diode recovery voltage slope | 50 | V/ns |
| dv/dt (3) | MOSFET dv/dt ruggedness | 50 | V/ns |
| $T_j$ | Operating junction temperature range | -55 to 150 | °C |
| $T_{stg}$ | Storage temperature range | | |

**Notes:**

(1)Pulse width limited by safe operating area

(2)$I_{SD}$ ≤ 23 A, di/dt ≤ 400 A/µs; $V_{DS\ peak}$ ≤ $V_{(BR)DSS}$, $V_{DD}$ = 525 V

(3)$V_{DS}$ ≤ 840 V

**Table 3: Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 0.2 | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-ambient | 30 | |

**Table 4: Avalanche characteristics**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{AS}$ | Single pulse avalanche energy (pulse width limited by $T_{JMAX}$) | 16 | A |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J$ = 25°C, $I_D$ = $I_{AS}$, $V_{DD}$ = 50 V) | 1550 | mJ |

# 2 Electrical characteristics

($T_{CASE}$ = 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 | $I_D$ = 1 mA, $V_{GS}$ = 0 V | 1050 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{DS}$ = 1050 V, $V_{GS}$ = 0 V | | | 1 | µA |
| | | $V_{DS}$ = 1050 V, $V_{GS}$ = 0 V, $T_C$ = 125 °C(1) | | | 50 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | | | ±10 | µA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 100 µA | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS}$ = 10 V, $I_D$ = 23 A | | 0.110 | 0.120 | Ω |

**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 | - | 6675 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 370 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 10 | - | pF |
| $C_{o(tr)}$(1) | Equivalent capacitance time related | $V_{GS}$ = 0 V, $V_{DS}$ = 0 to 840 V | - | 630 | - | pF |
| $C_{o(er)}$(2) | Equivalent capacitance energy related | | - | 219 | - | |
| $R_G$ | Intrinsic gate resistance | f = 1 MHz open drain | - | 3 | - | Ω |
| $Q_g$ | Total gate charge | $V_{DD}$ = 840 V, $I_D$ = 46 A, $V_{GS}$ = 10 V (see *Figure 15: "Test circuit for gate charge behavior"*) | - | 204 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 36 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 133 | - | nC |

**Notes:**

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

(2)Energy related is defined as a constant equivalent capacitance giving the same stored energy 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 | $V_{DD}$ = 525 V, $I_D$ = 23 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (see *Figure 14: "Test circuit for resistive load switching times"* and *Figure 19: "Switching time waveform"*) | - | 40.6 | - | ns |
| $t_r$ | Rise time | | - | 64.5 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 262 | - | ns |
| $t_f$ | Fall time | | - | 49.5 | - | ns |

**Table 8: Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 46 | A |
| $I_{SDM}$ | Source-drain current (pulsed) | | - | | 184 | A |
| $V_{SD}$(1) | Forward on voltage | $I_{SD}$ = 46 A, $V_{GS}$ = 0 V | - | | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 46 A, $V_{DD}$ = 60 V, di/dt = 100 A/µs (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*) | - | 273 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 3 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 23 | | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 46 A, $V_{DD}$ = 60 V, di/dt = 100 A/µs, $T_j$ = 150 °C (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*) | - | 477 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 10 | | µC |
| $I_{RRM}$ | Reverse recovery current | | - | 42 | | A |

**Notes:**

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

## 2.1 Electrical characteristics (curves)

**Figure 2: Forward bias safe operating area**

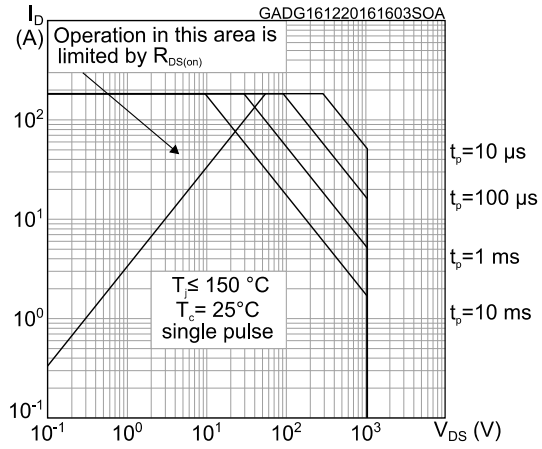



**Figure 3: Thermal impedance**

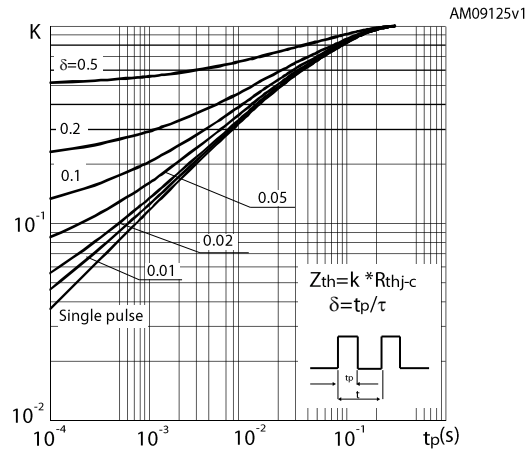



**Figure 4: Output characteristics**

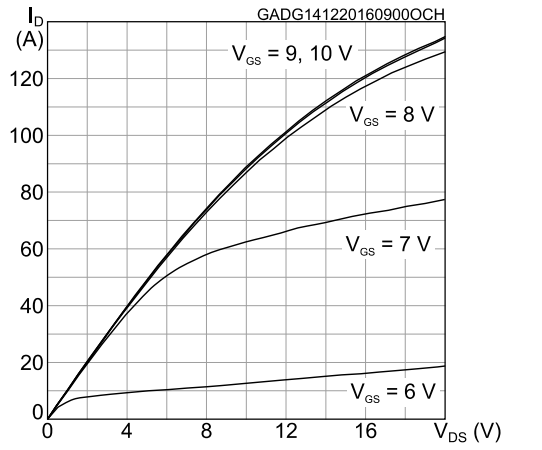



**Figure 5: Transfer characteristics**

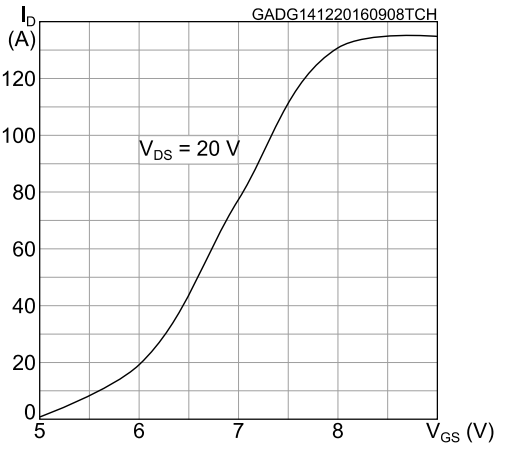



**Figure 6: Gate charge vs gate-source voltage**

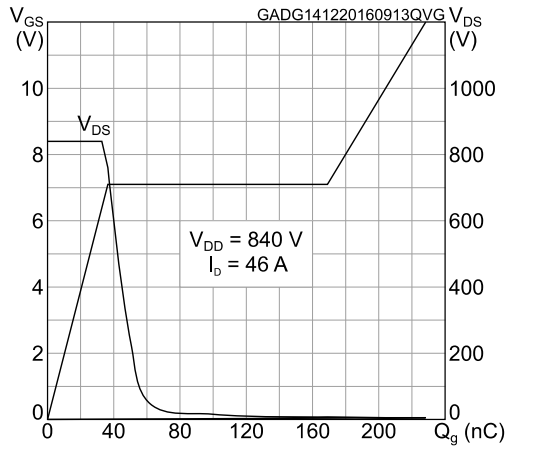



**Figure 7: Static drain-source on-resistance**

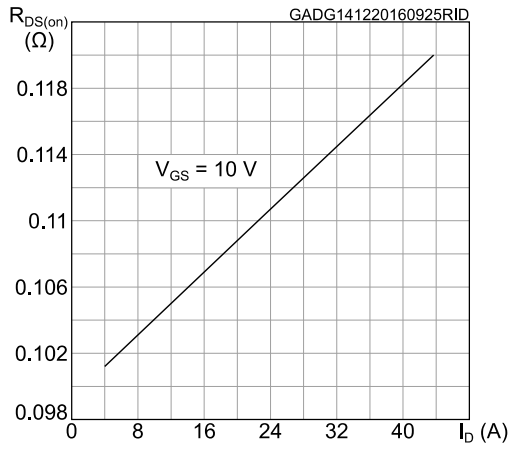


**Figure 8: Capacitance variations**

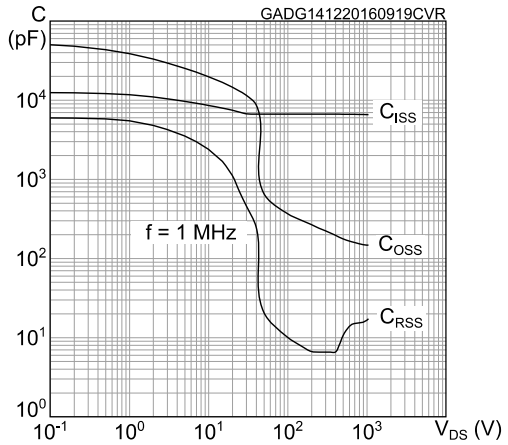



**Figure 9: Normalized gate threshold voltage vs temperature**

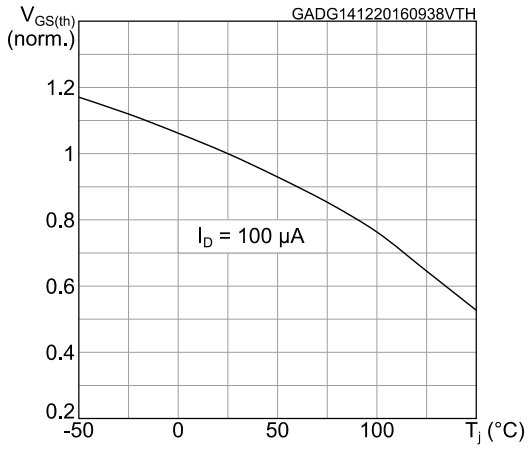



**Figure 10: Normalized on-resistance vs temperature**

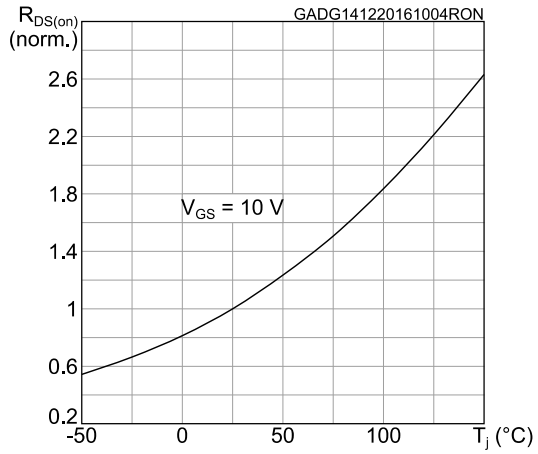



**Figure 11: Normalized $V_{(BR)DSS}$ vs temperature**

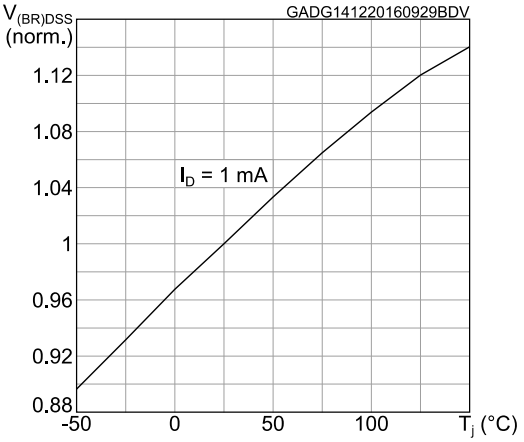



**Figure 12: Source-drain diode forward characteristics**

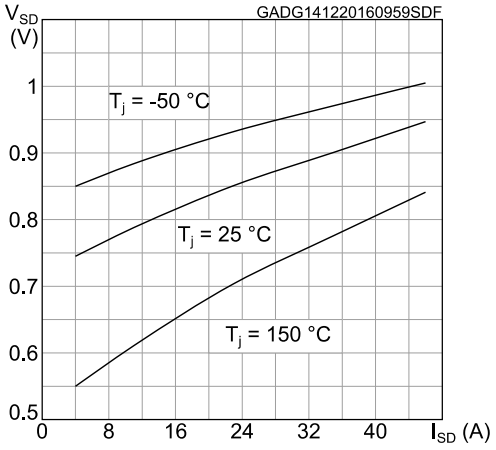
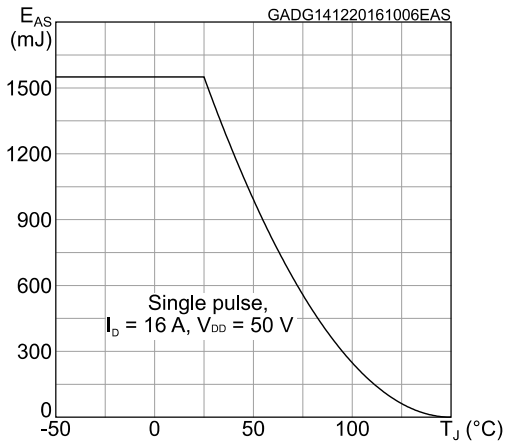



**Figure 13: Maximum avalanche energy vs starting $T_J$**



# 3 Test circuits

**Figure 14: Test circuit for resistive load switching times**

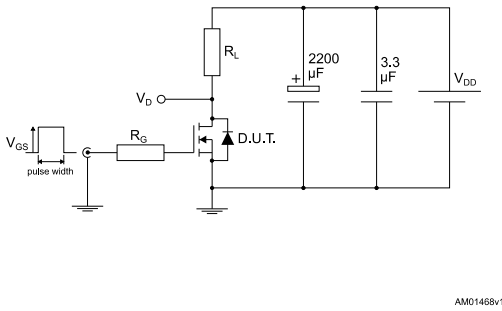



**Figure 15: Test circuit for gate charge behavior**

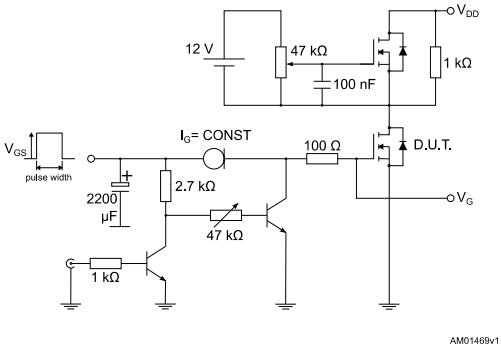



**Figure 16: Test circuit for inductive load switching and diode recovery times**

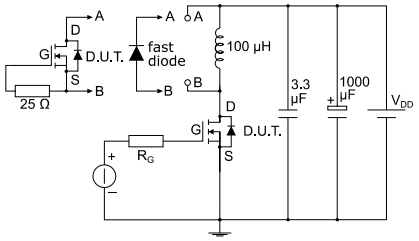



**Figure 17: Unclamped inductive load test circuit**

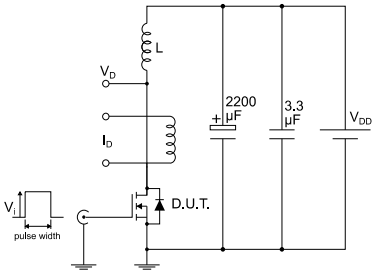



**Figure 18: Unclamped inductive waveform**

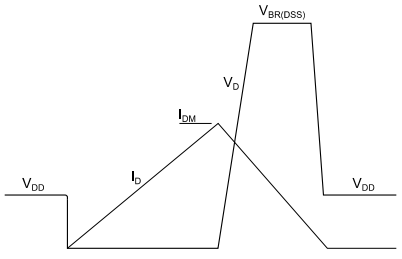
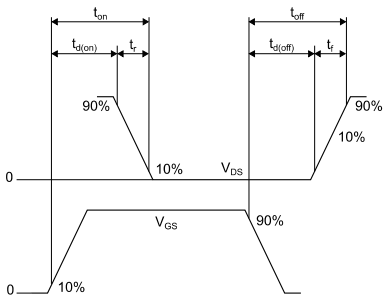



**Figure 19: Switching time waveform**



# 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 Max247 package information

**Figure 20: Max247 package outline**

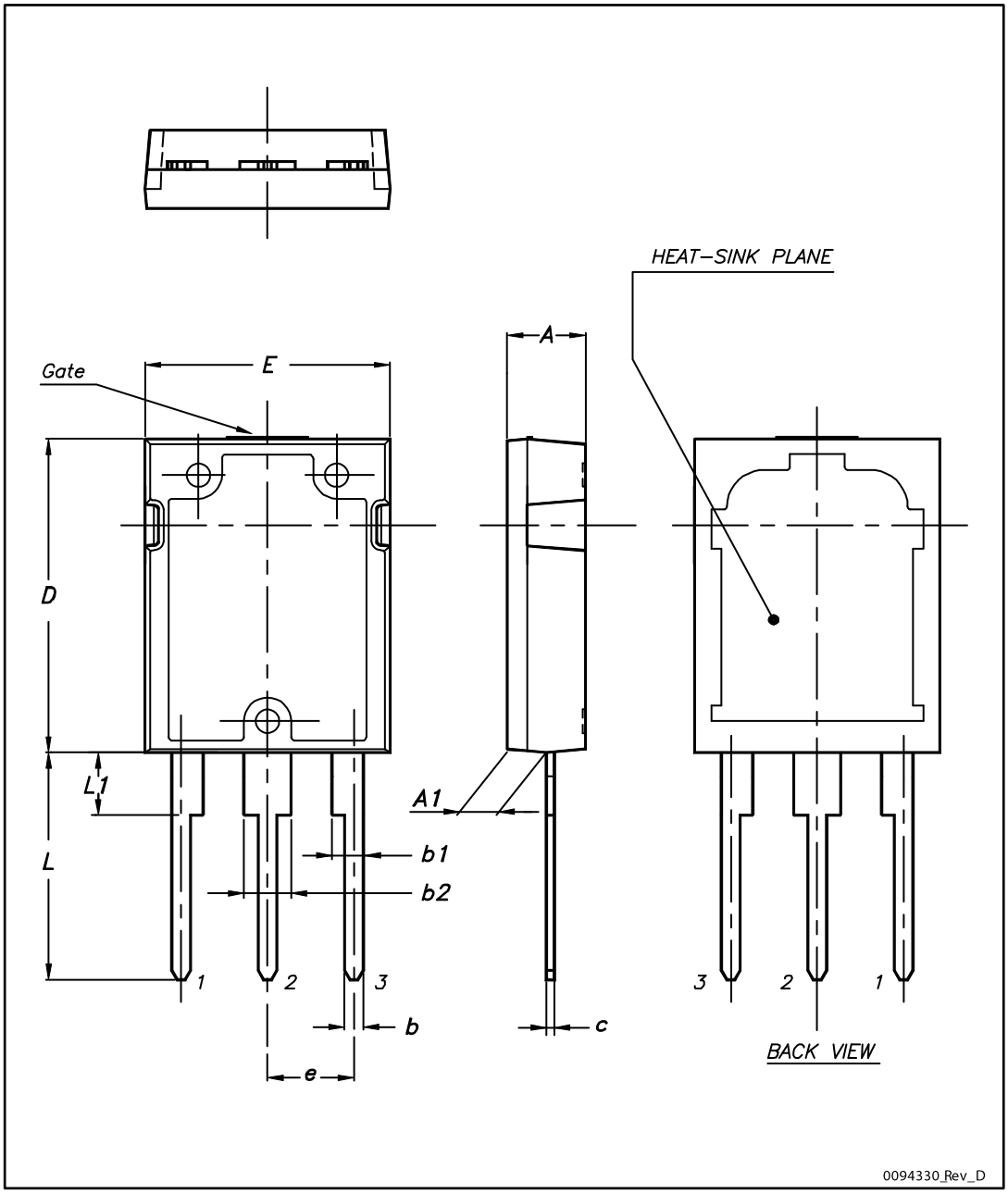


Table 9: Max247 package mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.70 | - | 5.30 |
| A1 | 2.20 | - | 2.60 |
| b | 1.00 | - | 1.40 |
| b1 | 2.00 | - | 2.40 |
| b2 | 3.00 | - | 3.40 |
| c | 0.40 | - | 0.80 |
| D | 19.70 | - | 20.30 |
| e | 5.35 | - | 5.55 |
| E | 15.30 | - | 15.90 |
| L | 14.20 | - | 15.20 |
| L1 | 3.70 | - | 4.30 |

# 5 Revision history

Table 10: Document revision history

| Date | Revision | Changes |
|---|---|---|
| 24-Jan-2013 | 1 | First release |
| 19-Dec-2016 | 2 | Datasheet status promoted from preliminary to production data.<br>Updated features, description and internal schematic diagram on cover page.<br>Updated *Section 1: "Electrical ratings"* and *Section 2: "Electrical characteristics"*.<br>Minor text changes |

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