

## N-channel 200 V, 0.01 $\Omega$ typ., 130 A STripFET™ II with fast recovery diode Power MOSFET in a Max247 package

Datasheet - production data

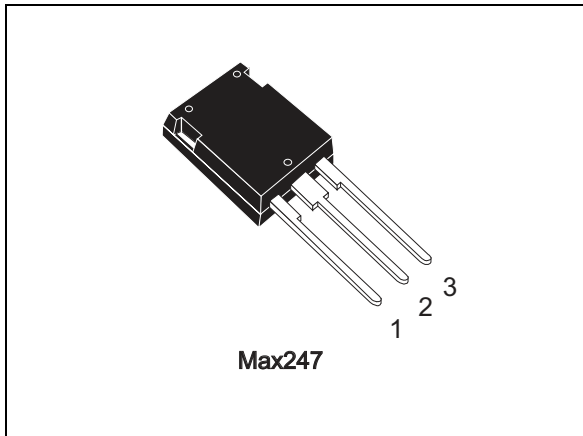
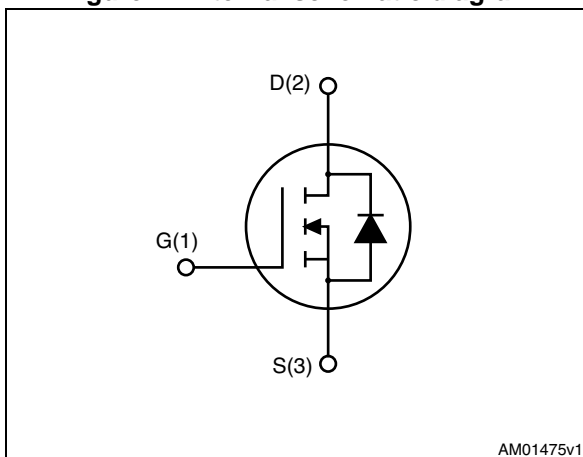


Figure 1. Internal schematic diagram



### Features

| Order code  | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ | $P_{TOT}$ |
|-------------|----------|-------------------|-------|-----------|
| STY130NF20D | 200 V    | 0.012 $\Omega$    | 130 A | 450 W     |

- Exceptional dv/dt capability
- 100% avalanche tested
- Low gate charge

### Applications

- Switching applications

### Description

This Power MOSFET is produced using STMicroelectronics' unique STripFET™ process, which is specifically designed to minimize input capacitance and gate charge. The device offers extremely fast switching performance thanks to the intrinsic fast body diode, making the device ideal for hard switching topologies.

Table 1. Device summary

| Order code  | Marking  | Packages | Packaging |
|-------------|----------|----------|-----------|
| STY130NF20D | 130NF20D | Max247   | Tube      |

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter                                                      | Value       | Unit             |
|--------------------|----------------------------------------------------------------|-------------|------------------|
| $V_{GS}$           | Gate-source voltage                                            | $\pm 20$    | V                |
| $I_D$              | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 130         | A                |
| $I_D$              | Drain current (continuous) at $T_C=100\text{ }^\circ\text{C}$  | 82          | A                |
| $I_{DM}^{(1)}$     | Drain current (pulsed)                                         | 520         | A                |
| $P_{TOT}$          | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$          | 450         | W                |
| $I_{AR}^{(1)}$     | Avalanche current, repetitive or not repetitive                | 130         | A                |
| $E_{AS}$           | Single pulse avalanche energy <sup>(2)</sup>                   | 800         | mJ               |
| $dv/dt^{(3)}$      | Peak diode recovery voltage slope                              | 25          | V/ns             |
| $T_J$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature          | - 55 to 150 | $^\circ\text{C}$ |

1. Pulse width limited by  $T_{jmax}$
2. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$
3.  $I_{SD} \leq 130\text{ A}$ ,  $di/dt \leq 1000\text{ A}/\mu\text{s}$ , peak  $V_{DS} \leq V_{(BR)DSS}$

**Table 3. Thermal resistance**

| Symbol         | Parameter                           | Value | Unit                      |
|----------------|-------------------------------------|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 0.28  | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 30    | $^\circ\text{C}/\text{W}$ |

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                          | Test conditions                                          | Min. | Typ. | Max.      | Unit          |
|---------------|------------------------------------|----------------------------------------------------------|------|------|-----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage     | $V_{GS} = 0, I_D = 1\text{ mA}$                          | 200  |      |           | V             |
| $I_{DSS}$     | Zero gate voltage drain current    | $V_{GS} = 0, V_{DS} = 200\text{ V}$                      |      |      | 10        | $\mu\text{A}$ |
|               |                                    | $V_{GS} = 0, V_{DS} = 200\text{ V}, T_C = 125\text{ °C}$ |      |      | 100       | $\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current          | $V_{DS} = 0, V_{GS} = \pm 20\text{ V}$                   |      |      | $\pm 100$ | nA            |
| $V_{GS(th)}$  | 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 | $V_{GS} = 10\text{ V}, I_D = 65\text{ A}$                |      | 0.01 | 0.012     | $\Omega$      |

**Table 5. Dynamic**

| Symbol            | Parameter                             | Test conditions                                       | Min. | Typ.  | Max. | Unit     |
|-------------------|---------------------------------------|-------------------------------------------------------|------|-------|------|----------|
| $C_{iss}$         | Input capacitance                     | $V_{GS} = 0, V_{DS} = 25\text{ V}, f = 1\text{ MHz},$ | -    | 11100 | -    | pF       |
| $C_{oss}$         | Output capacitance                    |                                                       | -    | 2190  | -    | pF       |
| $C_{rss}$         | Reverse transfer capacitance          |                                                       | -    | 334   | -    | pF       |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related   | $V_{GS} = 0, V_{DS} = 0\text{ to }160$                | -    | 1525  | -    | pF       |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related |                                                       | -    | 1139  | -    | pF       |
| $R_G$             | Intrinsic gate resistance             | $f = 1\text{ MHz}, I_D = 0$                           | -    | 1.4   | -    | $\Omega$ |
| $Q_g$             | Total gate charge                     | $V_{DD} = 160\text{ V}, I_D = 130\text{ A}$           | -    | 338   | -    | nC       |
| $Q_{gs}$          | Gate-source charge                    | $V_{GS} = 10\text{ V}$                                | -    | 47    | -    | nC       |
| $Q_{gd}$          | Gate-drain charge                     | (see <a href="#">Figure 16</a> )                      | -    | 183   | -    | nC       |

- $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$
- $C_{o(tr)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                                     | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 100\text{ V}$ , $I_D = 65\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 15</a> ) | -    | 232  | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                     | -    | 218  | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                                     | -    | 283  | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                     | -    | 250  | -    | ns   |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                  | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                  | -    |      | 130  | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                  | -    |      | 520  | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 130\text{ A}$ , $V_{GS} = 0$                                                                                           | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 130\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 100\text{ V}$                                     | -    | 190  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                  | -    | 1.4  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                  | -    | 14   |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 130\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 100\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ | -    | 257  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                  | -    | 2.4  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                  | -    | 18   |      | A             |

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration=300 $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

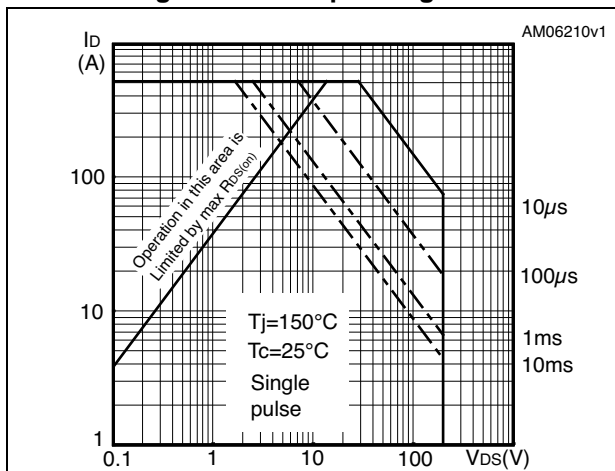


Figure 3. Thermal impedance

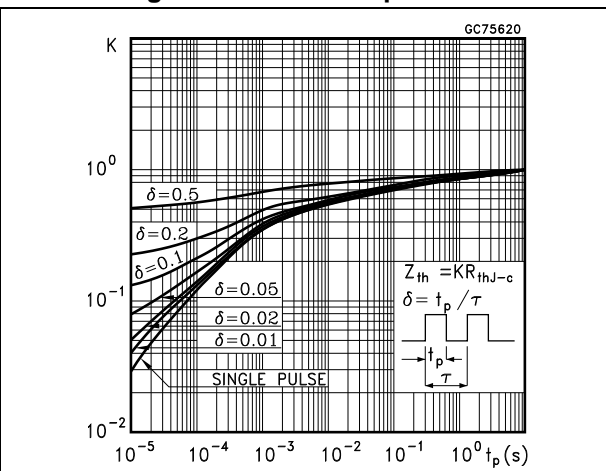


Figure 4. Output characteristics

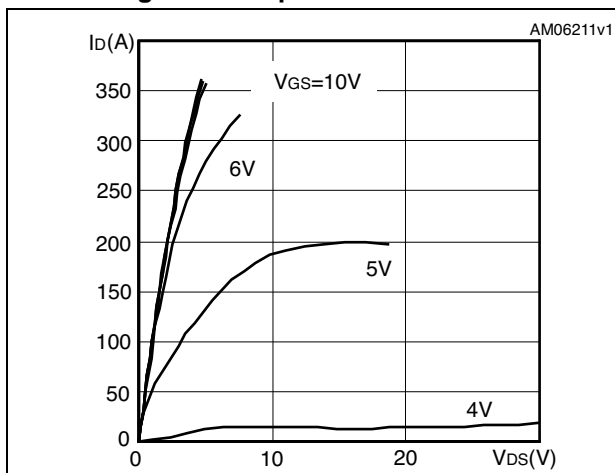


Figure 5. Transfer characteristics

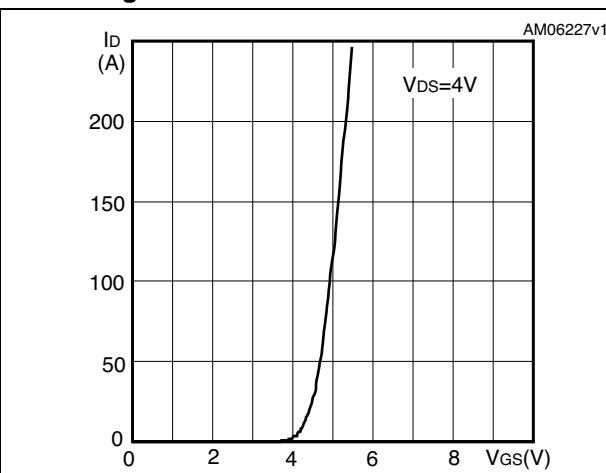


Figure 6. Gate charge vs gate-source voltage

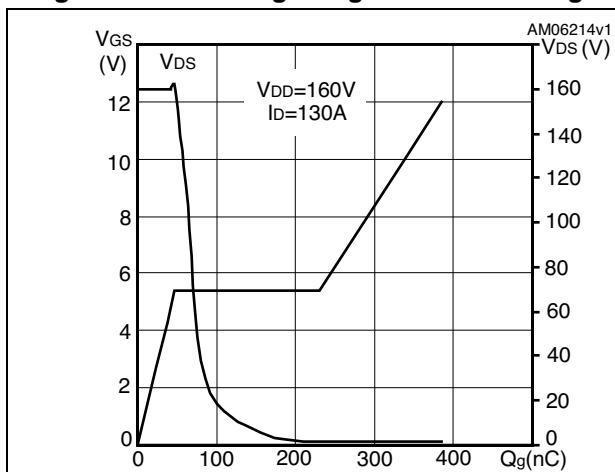


Figure 7. Static drain-source on-resistance

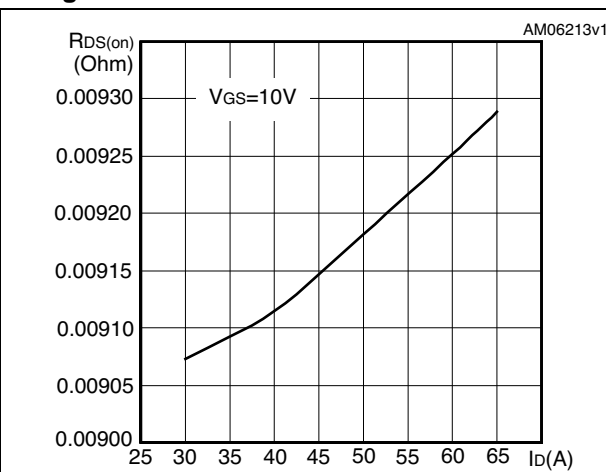


Figure 8. Capacitance variations

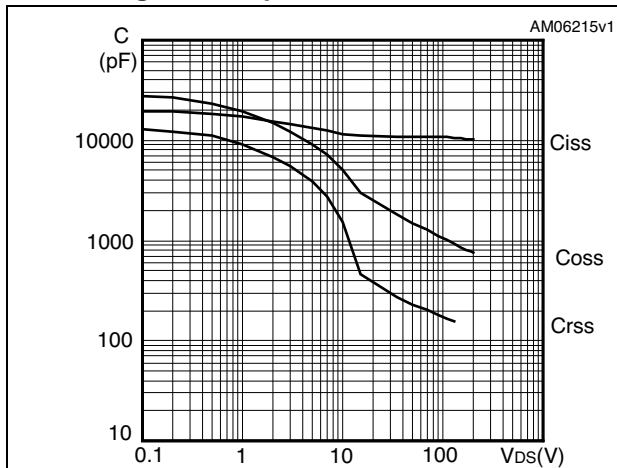


Figure 9. Output capacitance stored energy

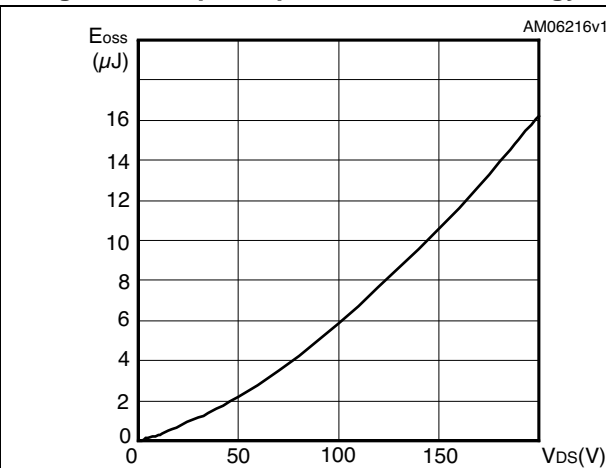


Figure 10. Normalized gate threshold voltage vs temperature

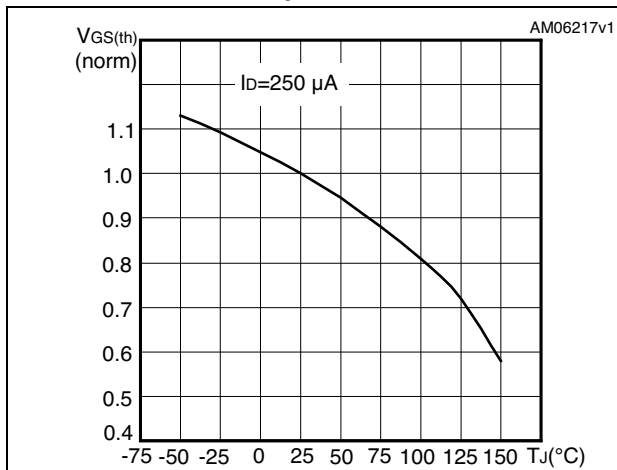


Figure 11. Normalized on-resistance vs temperature

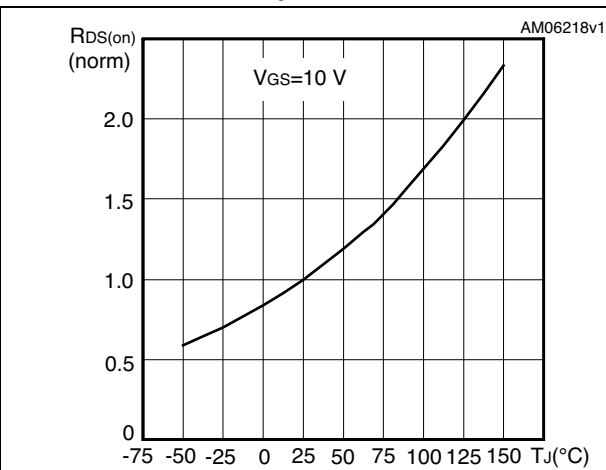


Figure 12. Source-drain diode forward characteristics

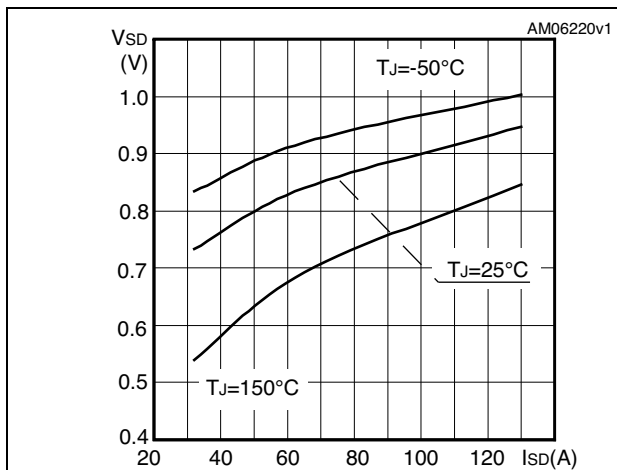


Figure 13. Normalized V<sub>(BR)DSS</sub> vs temperature

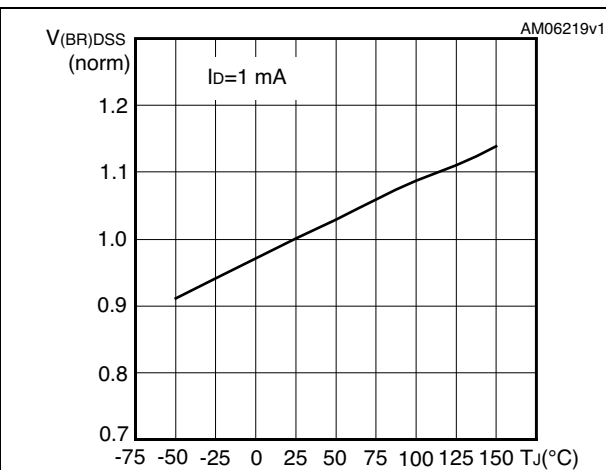
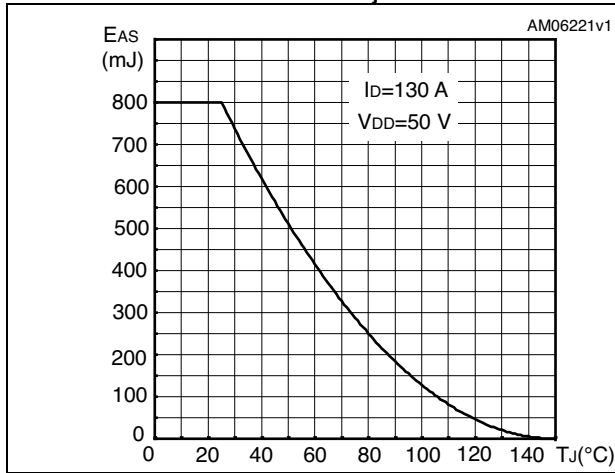


Figure 14. Maximum avalanche energy vs starting  $T_j$





### 3 Test circuit

Figure 15. Switching times test circuit for resistive load

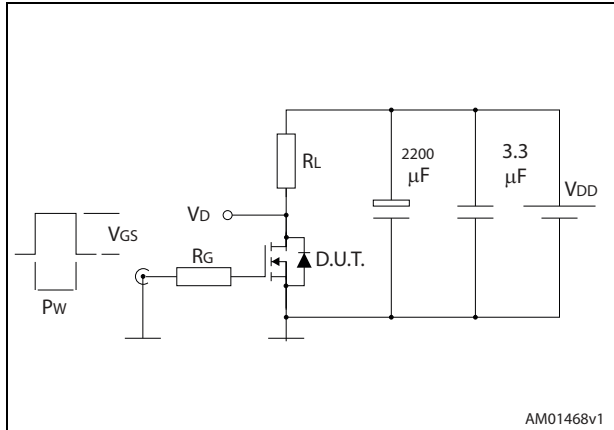


Figure 16. Gate charge test circuit

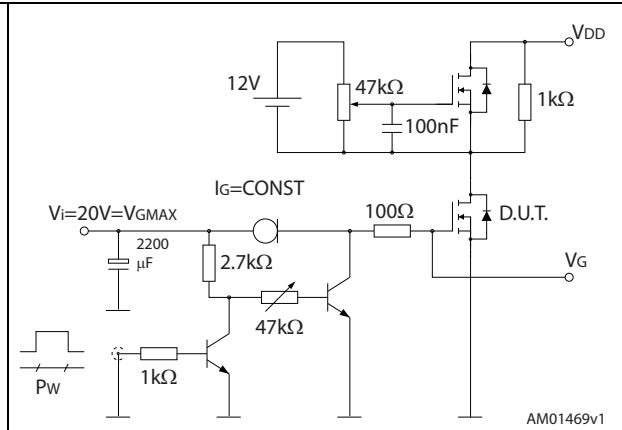


Figure 17. Test circuit for inductive load switching and diode recovery times

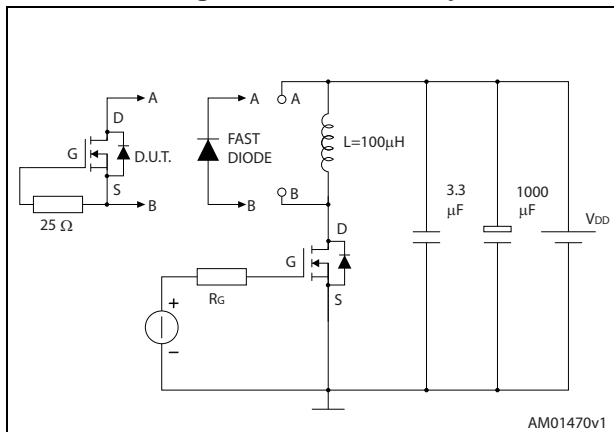


Figure 18. Unclamped inductive load test circuit

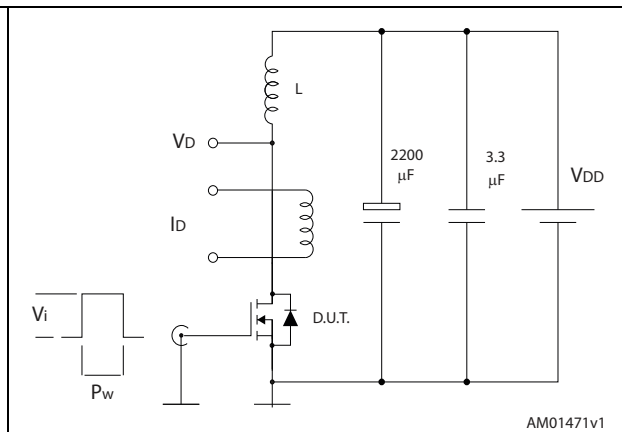


Figure 19. Unclamped inductive waveform

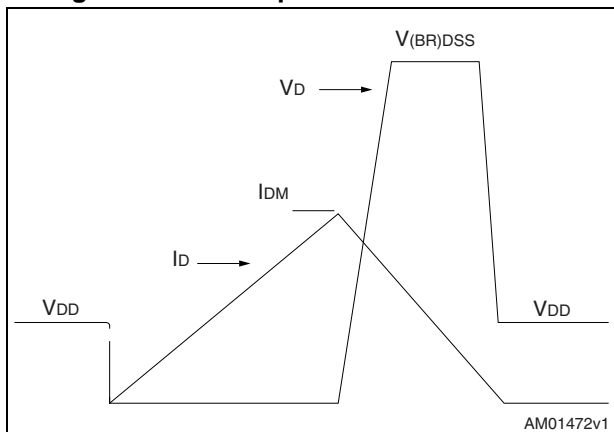
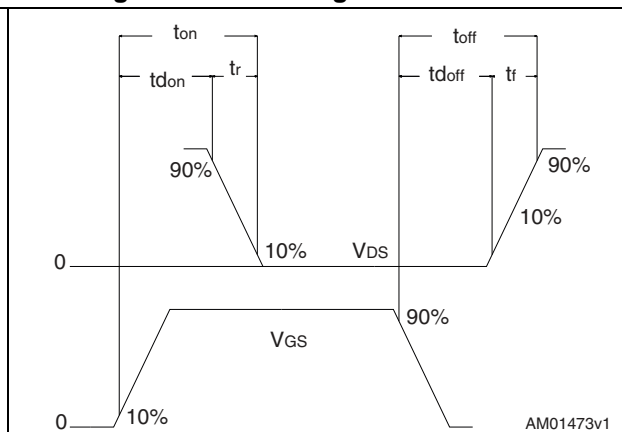


Figure 20. Switching time waveform



## 4 Package mechanical data

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

Figure 21. Max247 drawing

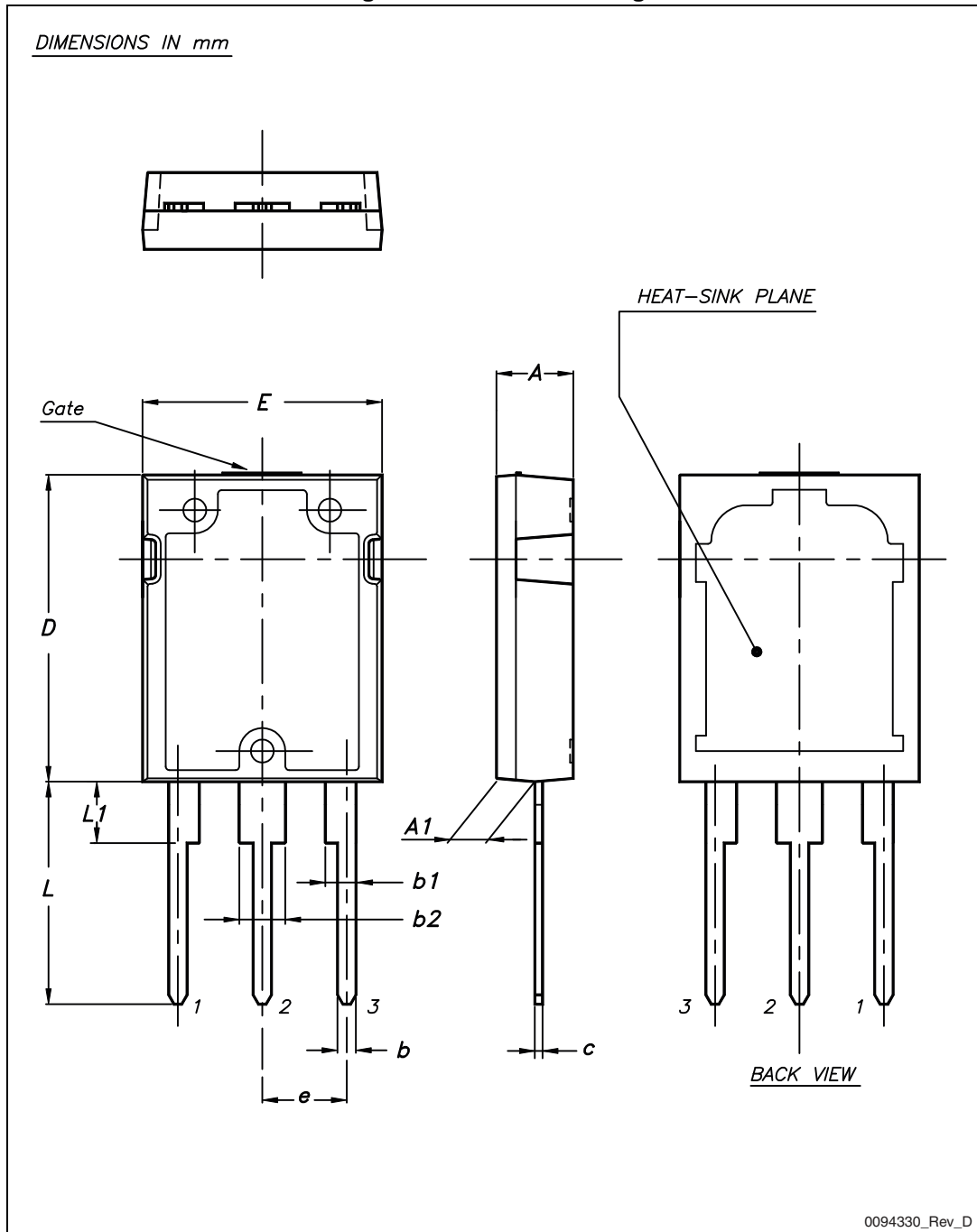


Table 8. Max247 mechanical data

| 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 9. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                          |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27-Jan-2009 | 1        | First release                                                                                                                                                                                                                                    |
| 29-Oct-2009 | 2        | Some values have been updated in <a href="#">Table 4</a> , <a href="#">Table 5</a> , <a href="#">Table 6</a> and <a href="#">Table 7</a>                                                                                                         |
| 11-Jan-2010 | 3        | Document status promoted from preliminary data to datasheet.                                                                                                                                                                                     |
| 16-May-2014 | 4        | <ul style="list-style-type: none"><li>– Modified: title</li><li>– Modified: <a href="#">Figure 5</a>, <a href="#">6</a>, <a href="#">10</a>, <a href="#">11</a> and <a href="#">13</a></li><li>– Minor text changes in the cover page.</li></ul> |

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