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N-channel 600 V, 0.052 Ω typ., 50 A MDmesh™ DM2 Power MOSFET in a TO-247 package

Datasheet - production data

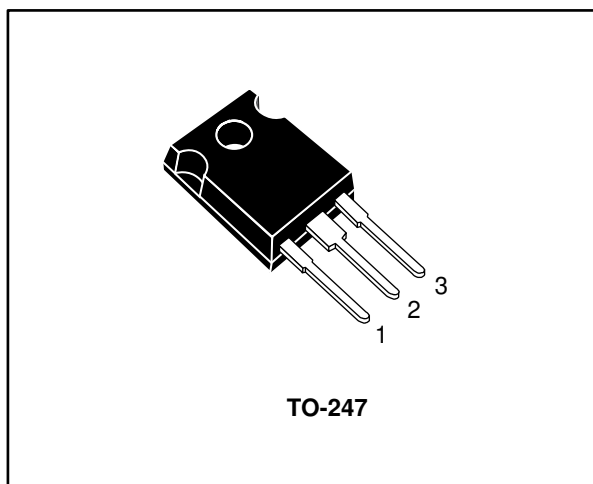
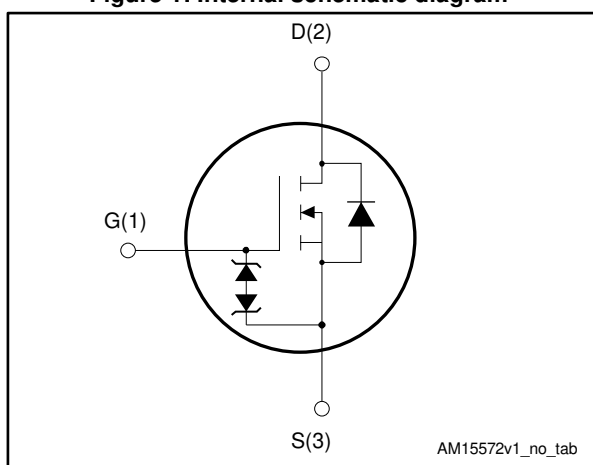


Figure 1: Internal schematic diagram



Features

| Order code | V _{DS} | R _{DS(on)} max. | I _D | P _{TOT} |
|-------------|-----------------|--------------------------|----------------|------------------|
| STW56N60DM2 | 600 V | 0.060 Ω | 50 A | 360 W |

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

This high voltage N-channel Power MOSFET is part of the MDmesh™ DM2 fast recovery diode series. It offers very low recovery charge (Q_{rr}) and time (t_{rr}) combined with low $R_{DS(on)}$, rendering it suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

| Order code | Marking | Package | Packing |
|-------------|----------|---------|---------|
| STW56N60DM2 | 56N60DM2 | TO-247 | 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 $T_{case} = 25\text{ }^\circ\text{C}$ | 50 | A |
| | Drain current (continuous) at $T_{case} = 100\text{ }^\circ\text{C}$ | 31 | |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 200 | A |
| P_{TOT} | Total dissipation at $T_{case} = 25\text{ }^\circ\text{C}$ | 360 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 50 | V/ns |
| $dv/dt^{(3)}$ | MOSFET dv/dt ruggedness | 50 | |
| T_{stg} | Storage temperature | -55 to 150 | $^\circ\text{C}$ |
| T_j | Operating junction temperature | | |

Notes:

⁽¹⁾ Pulse width is limited by safe operating area.

⁽²⁾ $I_{SD} \leq 50\text{ A}$, $di/dt=900\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

⁽³⁾ $V_{DS} \leq 480\text{ V}$.

Table 3: Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|-------------------------------------|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case | 0.35 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 50 | |

Table 4: Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------------|---|-------|------|
| $I_{AS}^{(1)}$ | Avalanche current, repetitive or not repetitive | 12 | A |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy | 800 | mJ |

Notes:

⁽¹⁾ Pulse width limited by T_{jmax} .

⁽²⁾ starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$.

2 Electrical characteristics

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

Table 5: Static

| 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 | $V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$ | | | 10 | μA |
| | | $V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_{\text{case}} = 125\text{ °C}$ | | | 100 | |
| I_{GSS} | Gate-body leakage current | $V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$ | | | ± 5 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10\text{ V}$, $I_D = 25\text{ A}$ | | 0.052 | 0.060 | Ω |

Table 6: Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------------|-------------------------------|---|------|------|------|---------------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$ | - | 4100 | - | μF |
| C_{oss} | Output capacitance | | - | 190 | - | |
| C_{rss} | Reverse transfer capacitance | | - | 3.2 | - | |
| $C_{oss\text{ eq}}$ | Equivalent output capacitance | $V_{DS} = 0\text{ to }480\text{ V}$, $V_{GS} = 0\text{ V}$ | - | 325 | - | μF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$, $I_D = 0\text{ A}$ | - | 4.2 | - | Ω |
| Q_g | Total gate charge | $V_{DD} = 480\text{ V}$, $I_D = 50\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 15 : "Gate charge test circuit") | - | 90 | - | nC |
| Q_{gs} | Gate-source charge | | - | 18 | - | |
| Q_{gd} | Gate-drain charge | | - | 44 | - | |

Table 7: Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 300\text{ V}$, $I_D = 25\text{ A}$ $R_G = 4.7\text{ }\Omega$ (see Figure 14 : "Switching times test circuit for resistive load" and Figure 19 : "Switching time waveform") | - | 24 | - | ns |
| t_r | Rise time | | - | 60 | - | |
| $t_{d(off)}$ | Turn-off delay time | | - | 130 | - | |
| t_f | Fall time | | - | 12 | - | |

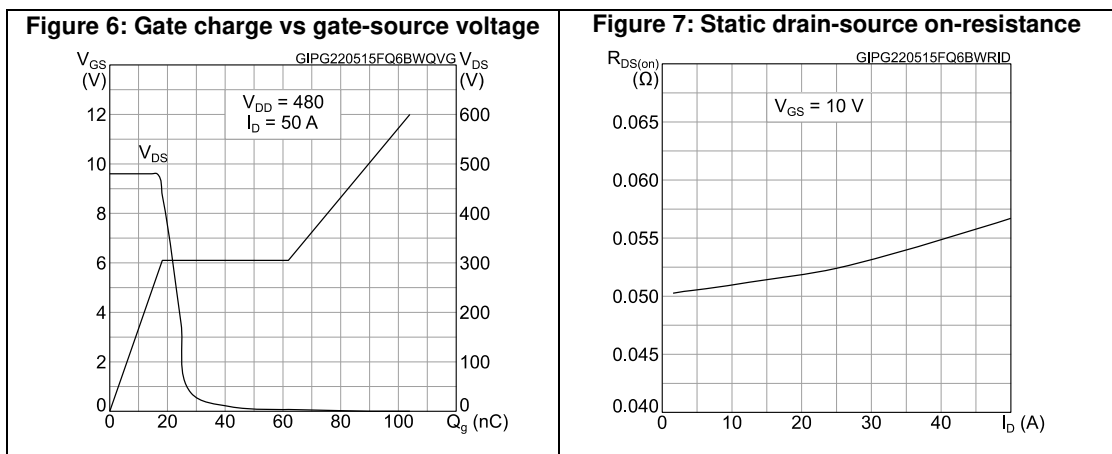
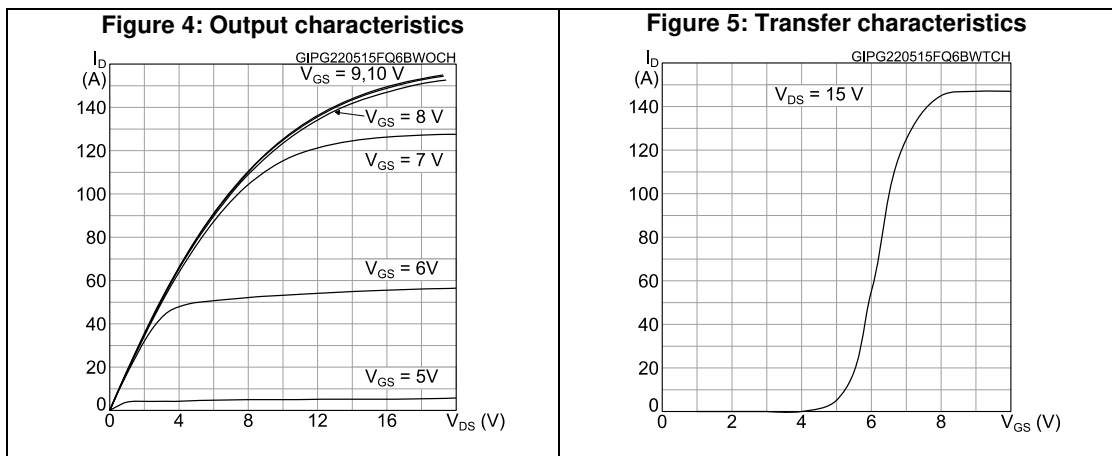
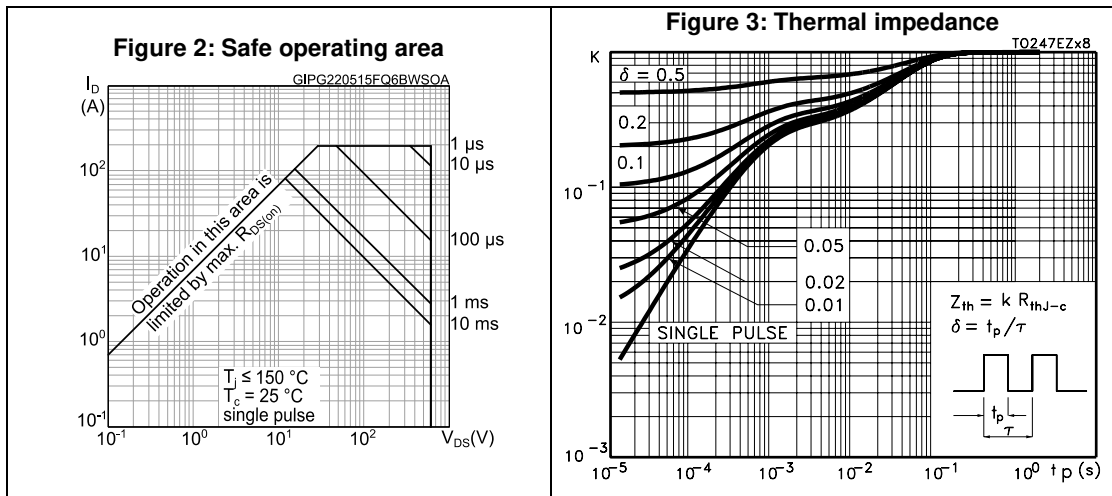
Table 8: Source-drain diode

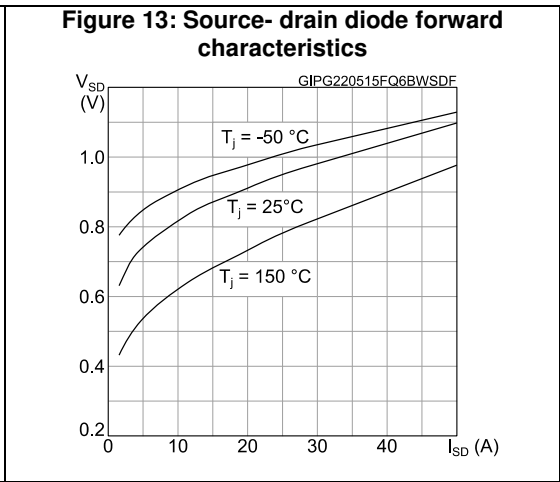
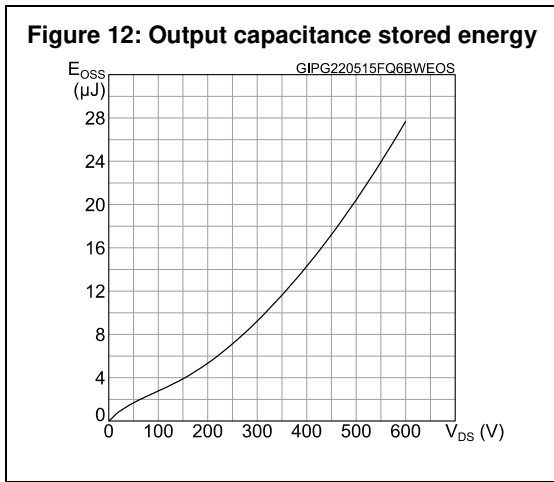
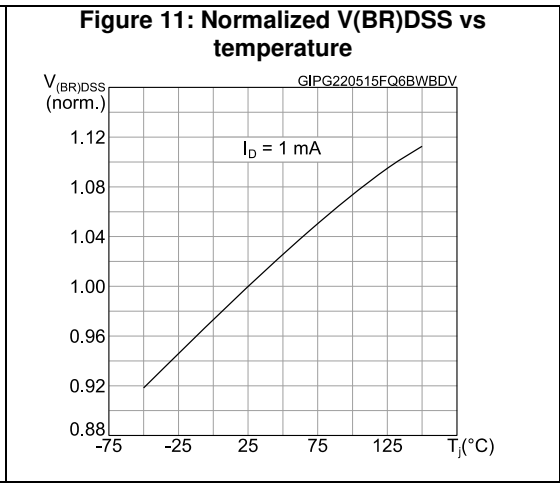
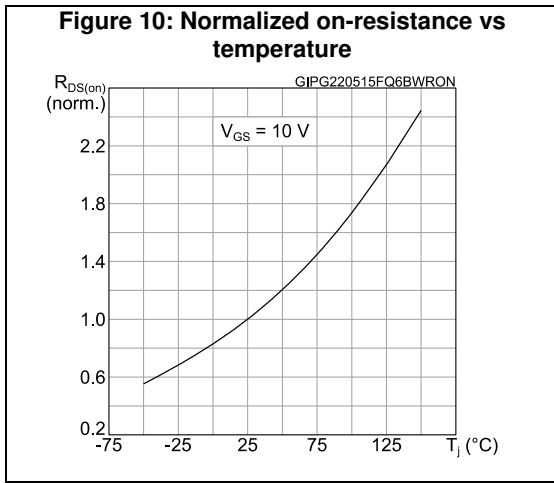
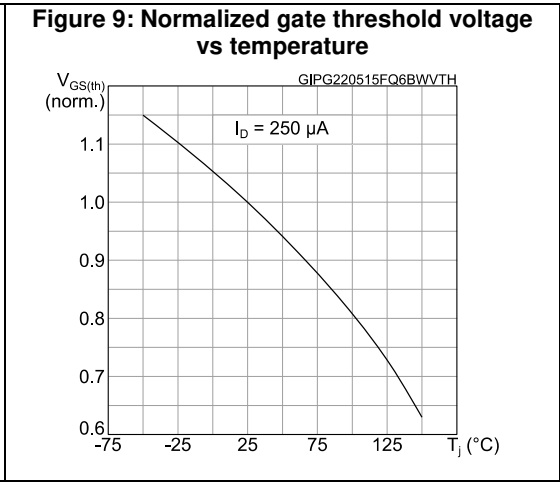
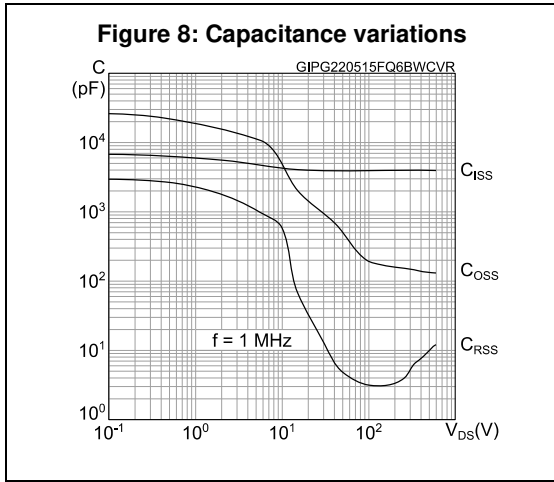
| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 50 | A |
| I_{SDM} | Source-drain current (pulsed) | | - | | 200 | A |
| $V_{SD}^{(1)}$ | Forward on voltage | $V_{GS} = 0\text{ V}$, $I_{SD} = 50\text{ A}$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 50\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 16 : "Test circuit for inductive load switching and diode recovery times") | - | 140 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 0.7 | | μC |
| I_{RRM} | Reverse recovery current | | - | 10.6 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 50\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16 : "Test circuit for inductive load switching and diode recovery times") | - | 245 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 2.6 | | μC |
| I_{RRM} | Reverse recovery current | | - | 21 | | A |

Notes:

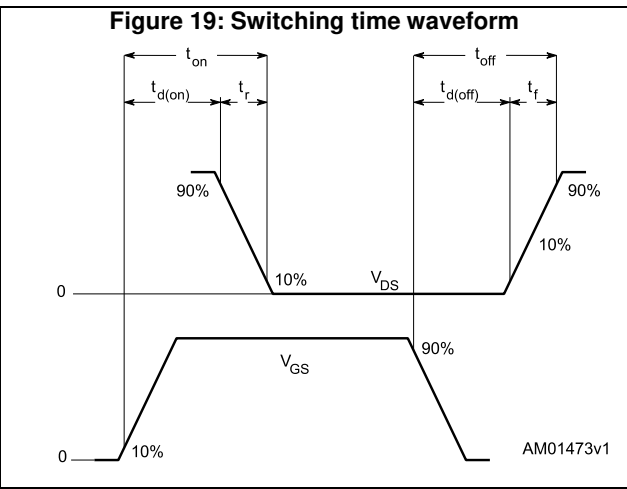
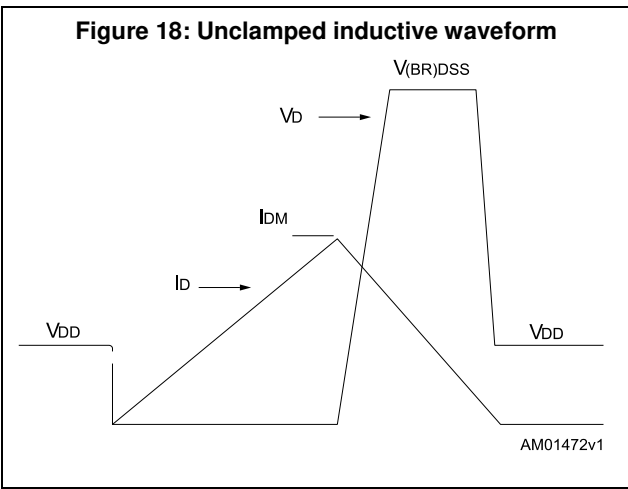
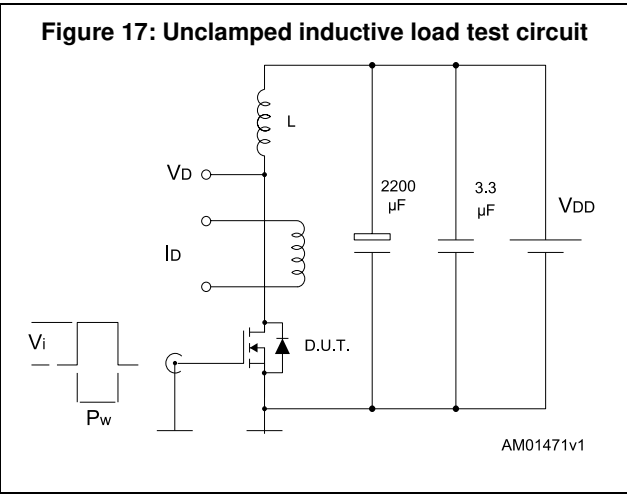
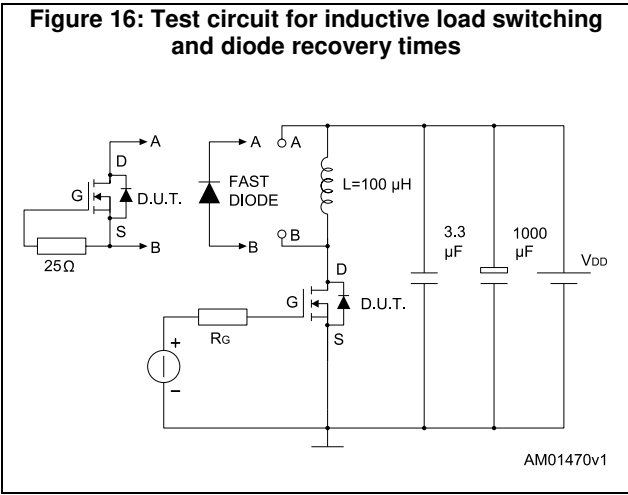
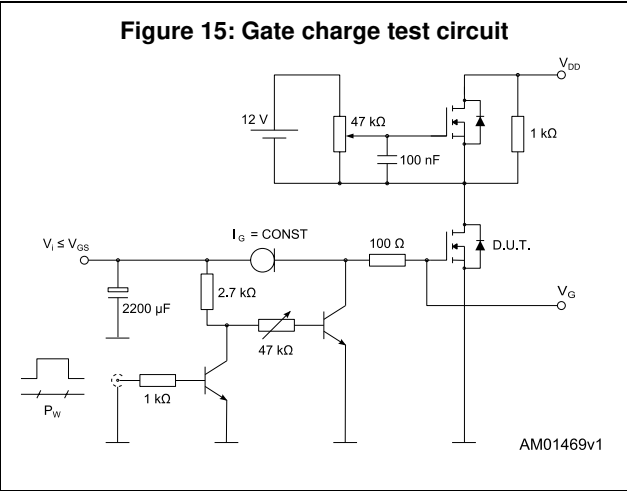
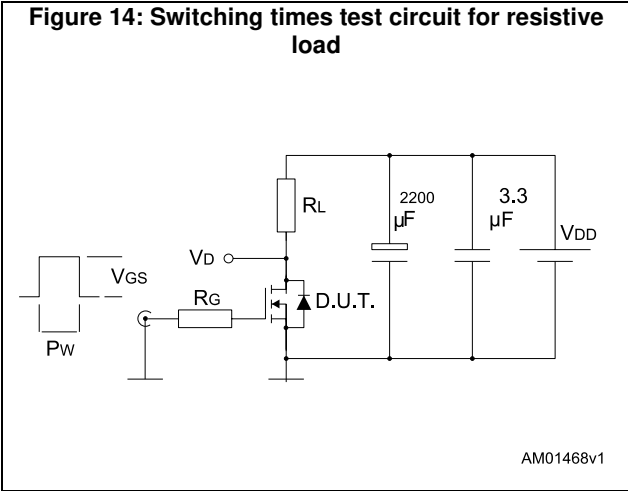
⁽¹⁾ Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)





3 Test circuits



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-247 package information

Figure 20: TO-247 package outline

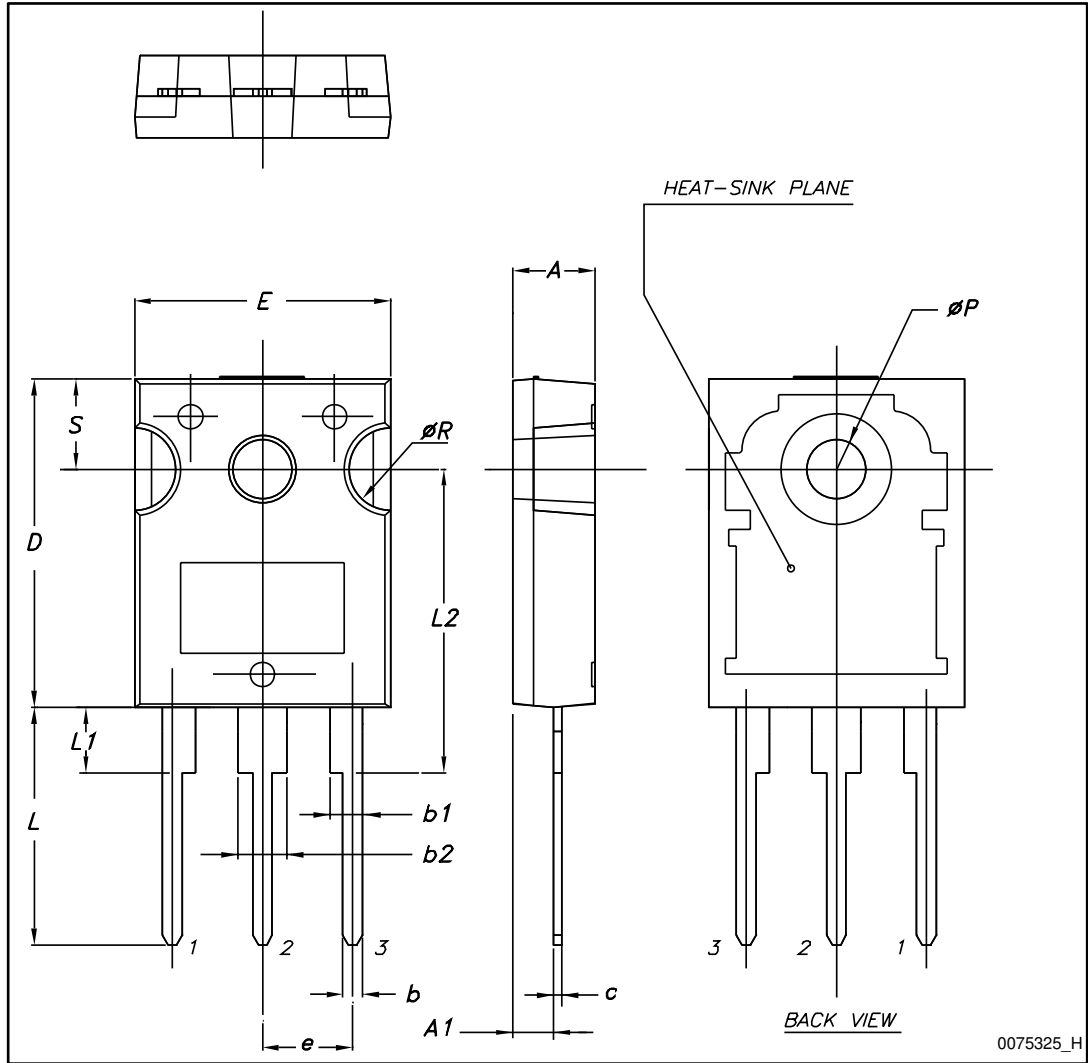


Table 9: TO-247 package mechanical data

| 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 10: Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 08-Oct-2014 | 1 | First release. |
| 09-Jun-2015 | 2 | Text and formatting changes throughout document. On cover page: - updated title description and features In Section 1 Electrical ratings: - updated Table 2. Absolute maximum ratings - updated Table 4. Avalanche characteristics In Section 2 Electrical characteristics: - updated and renamed Table 5. Static (was On /off states) - updated Table 6. Dynamic - updated Table 7. Switching times - updated Table 8. Source drain diode Added Section 2.1 Electrical characteristics (curves) |
| 15-Jun-2015 | 3 | Datasheet promoted from preliminary data to production data |

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