



STW43NM50N

N-channel 500 V, 0.070 Ω , 37 A MDmesh™ II Power MOSFET
TO-247

Features

| Type | V _{DSS} @ T _{jmax} | R _{DS(on)} max | I _D |
|------------|--------------------------------------|-------------------------|----------------|
| STW43NM50N | 550 V | < 0.085 Ω | 37 A |

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Application

- Switching applications

Description

This series of devices implements second generation MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's silicon layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

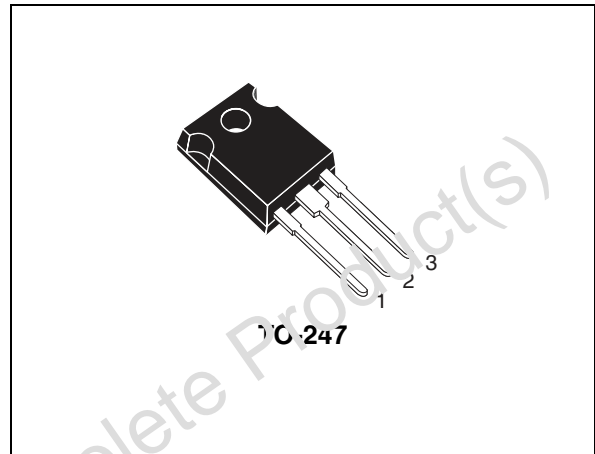


Figure 1. Internal schematic diagram

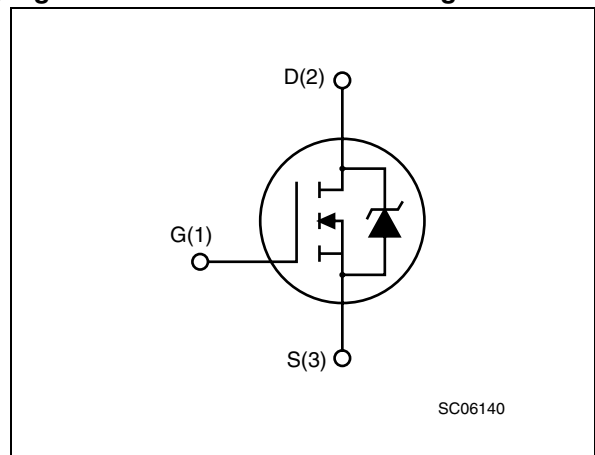


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|------------|---------|---------|-----------|
| STW43NM50N | 43NM50N | TO-247 | Tube |

Contents

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Obsolete Product(s) - Obsolete Product(s)

1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------------------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 500 | V |
| V_{GS} | Gate-source voltage | ± 25 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 37 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 23 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 148 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 255 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 15 | V/ns |
| T_{stg} | Storage temperature | -55 to 150 | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | 150 | $^\circ\text{C}$ |

1. Pulse width limited by safe operating area

2. $I_{SD} \leq 37\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 0.49 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 50 | $^\circ\text{C}/\text{W}$ |
| T_l | Maximum lead temperature for soldering purpose | 300 | $^\circ\text{C}$ |

Table 4. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AS} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max) | 15 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j=25\text{ }^\circ\text{C}$, $I_D=I_{AS}$, $V_{DD}=50\text{ V}$) | 1000 | 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 | 500 | | | V |
| dv/dt ⁽¹⁾ | Drain source voltage slope | V _{DD} = 400 V, I _D = 37 A, V _{GS} =10 V | | 30 | | V/ns |
| I _{DSS} | Zero gate voltage drain current (V _{GS} = 0) | V _{DS} = Max rating V _{DS} = Max rating, @125 °C | | | 100 | μA |
| I _{GSS} | Gate-body leakage current (V _{DS} = 0) | V _{GS} = ± 20 V | | | 100 | nA |
| V _{GS(th)} | Gate threshold voltage | V _{DS} = V _{GS} , I _D = 250 μA | 2 | 3 | 4 | V |
| R _{DS(on)} | Static drain-source on resistance | V _{GS} = 10 V, I _D = 10 A | | 0.070 | 0.085 | Ω |

1. Characteristic value at turn off on inductive load

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|---|--|------|-------------------|------|----------------|
| g _{fs} ⁽¹⁾ | Forward transconductance | V _{DS} =15 V, I _D = 18.5 A | - | 18 | - | S |
| C _{iss} C _{oss} C _{rss} | Input capacitance Output capacitance Reverse transfer capacitance | V _{DS} = 50 V, f = 1 MHz, V _{GS} = 0 | - | 4200 290 20 | - | pF pF pF |
| C _{oss eq.} ⁽²⁾ | Equivalent output capacitance | V _{GS} = 0, V _{DS} = 0 to 400 V | - | 590 | - | pF |
| Q _g Q _{gs} Q _{gd} | Total gate charge Gate-source charge Gate-drain charge | V _{DD} = 400 V, I _D = 37 A, V _{GS} = 10 V, <i>(see Figure 15)</i> | - | 140 72 23 | - | nC nC nC |
| R _g | Gate input resistance | f=1 MHz Gate DC Bias=0 Test signal level = 20 mV open drain | - | 1.4 | - | Ω |

1. Pulsed: Pulse duration = 300 μs, duty cycle 1.5%

2. 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_{DS}

Table 7. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 250\text{ V}$, $I_D = 18.5\text{ A}$ $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 14) | - | 30 | - | ns |
| t_r | Rise time | | - | 20 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 140 | - | ns |
| t_f | Fall time | | - | 42 | - | ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|-----------------|-------------------------------|--|-----|------|-----|---------------|
| I_{SD} | Source-drain current | | - | | 37 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 148 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 37\text{ A}$, $V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 37\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 16) | - | 530 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 11 | | μC |
| I_{RRM} | Reverse recovery current | | - | 42 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 37\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16) | - | 630 | | ns |
| Q_{rr} | Reverse recovery charge | | - | 14 | | μC |
| I_{RRM} | Reverse recovery current | | - | 45 | | A |

1. Pulse width 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

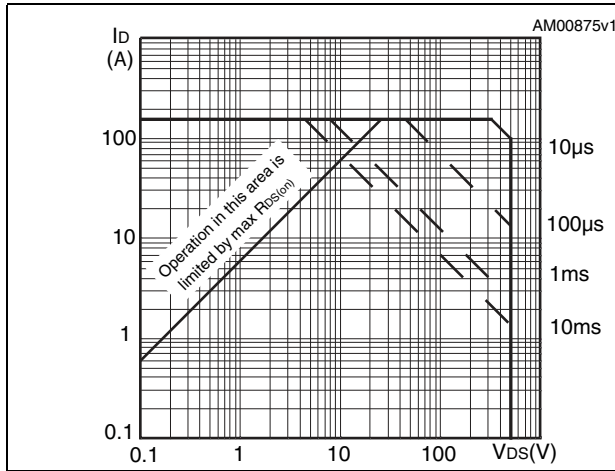


Figure 3. Thermal impedance

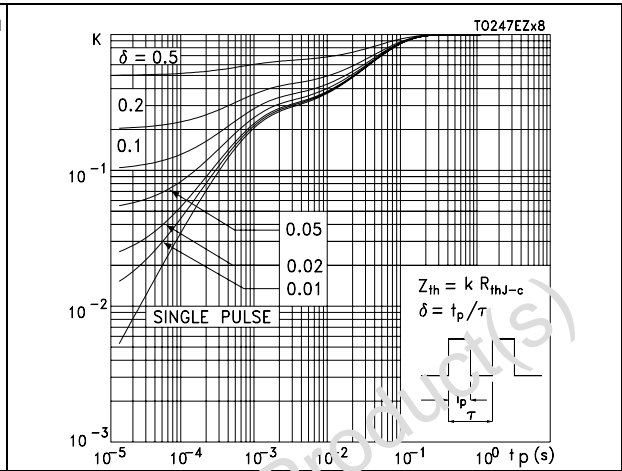


Figure 4. Output characteristics

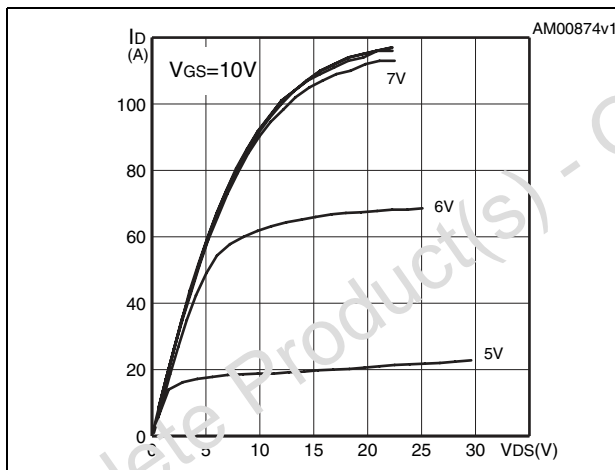


Figure 5. Transfer characteristics

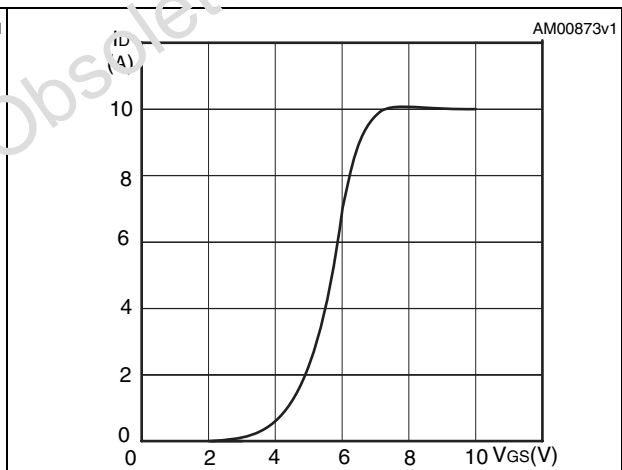


Figure 6. Transconductance

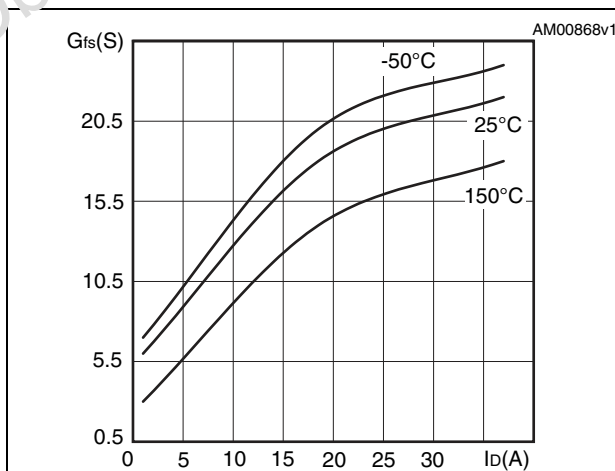


Figure 7. Static drain-source on resistance

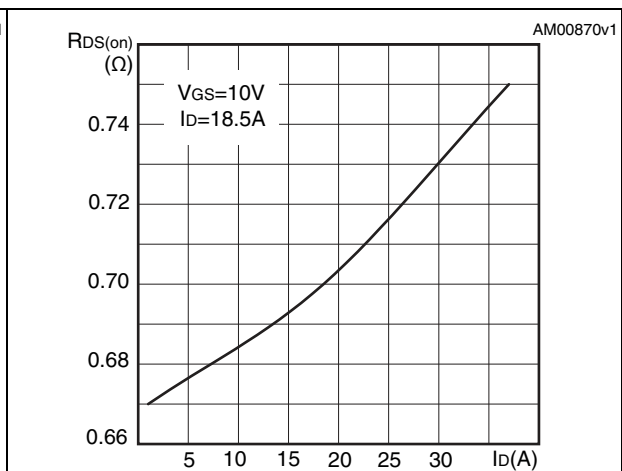


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

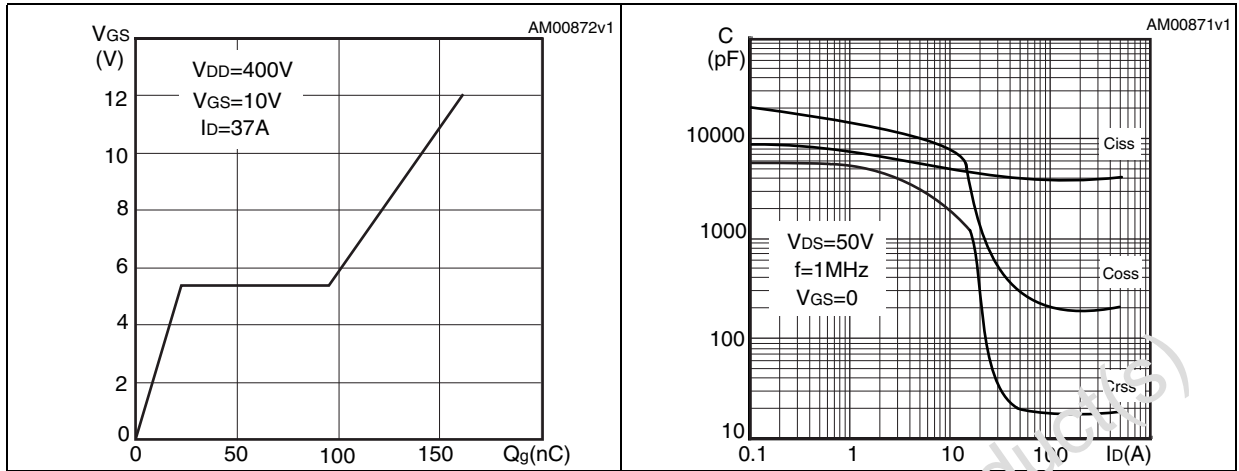


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

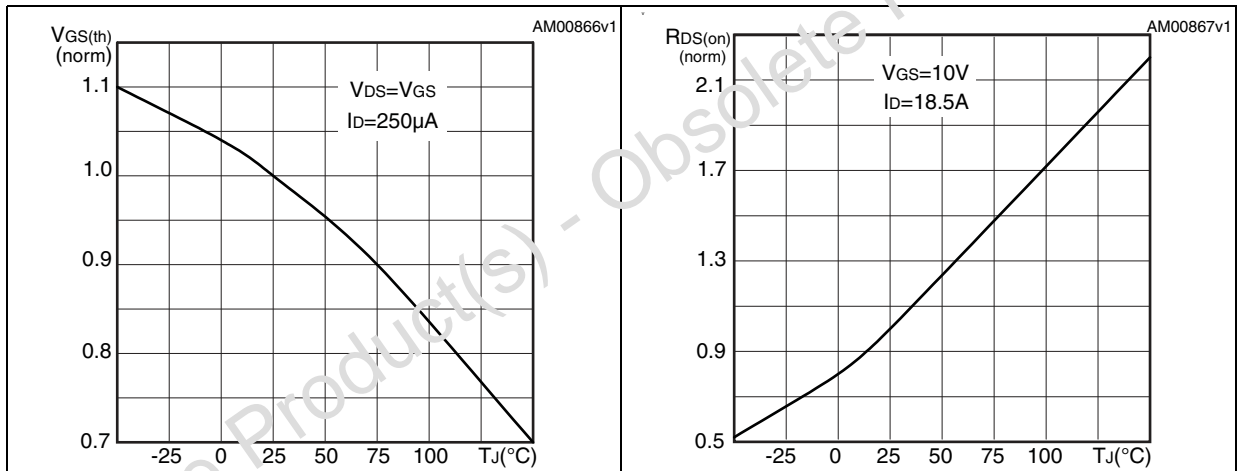
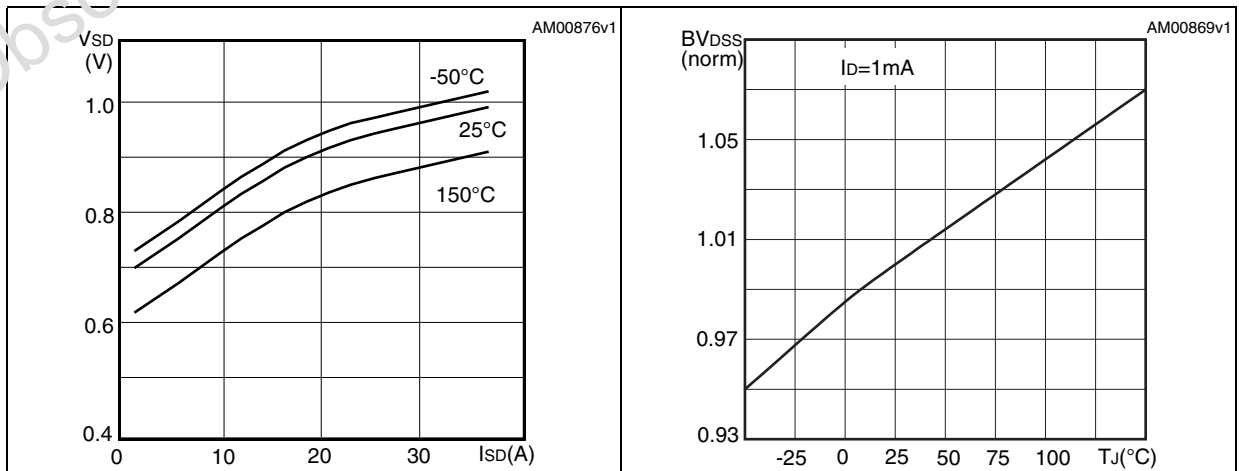


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized B_{VDSS} vs temperature



3 Test circuits

Figure 14. Switching times test circuit for resistive load

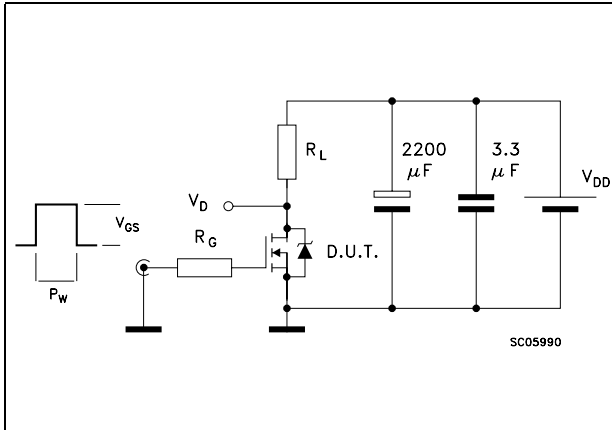


Figure 15. Gate charge test circuit

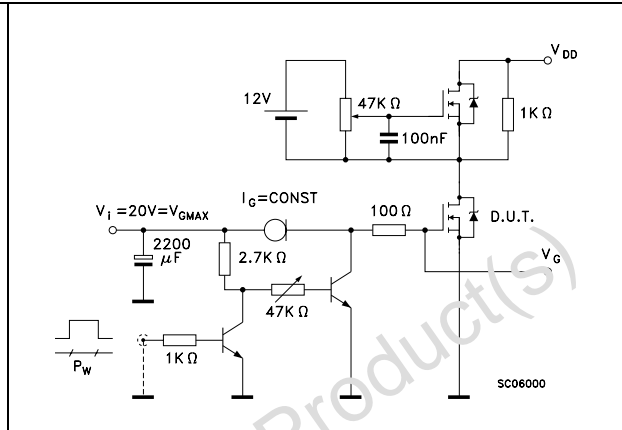


Figure 16. Test circuit for inductive load switching and diode recovery times

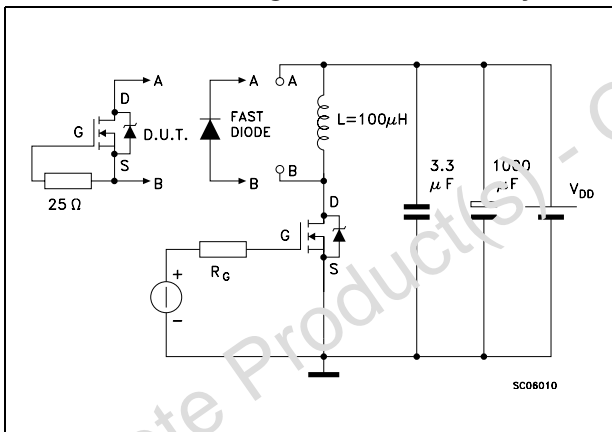


Figure 17. Unclamped inductive load test circuit

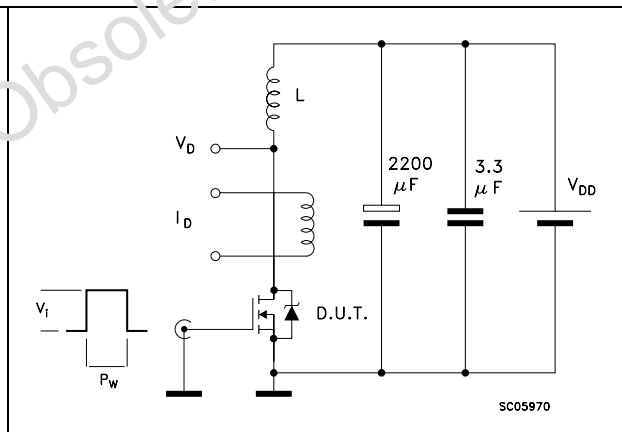


Figure 18. Unclamped inductive waveform

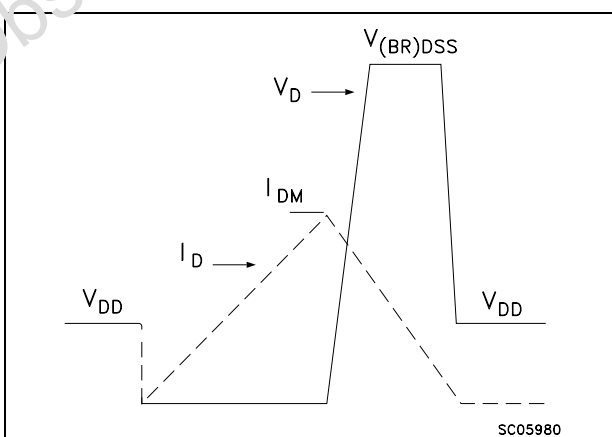
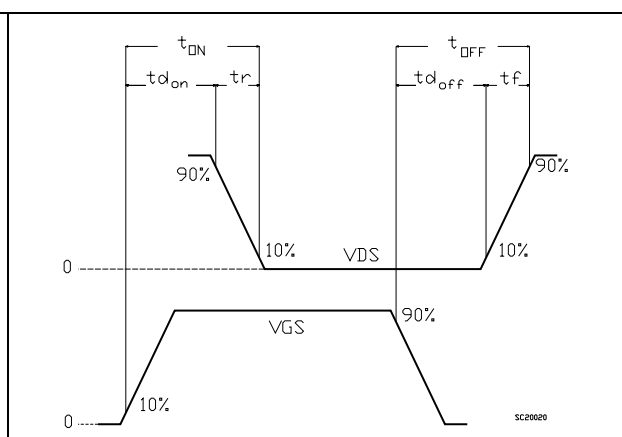


Figure 19. Switching time waveform



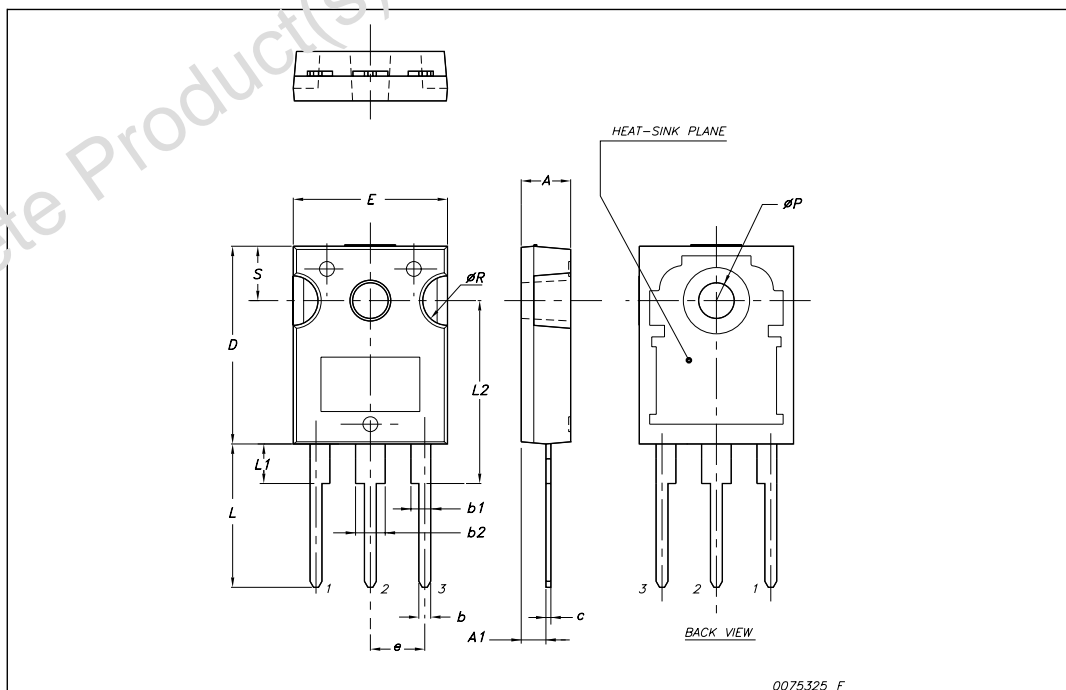
4 Package mechanical data

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.

Obsolete Product(s) - Obsolete Product(s)

TO-247 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 | | 5.45 | |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 8.50 | |
| øP | 3.55 | | 3.65 |
| øR | 4.50 | | 5.50 |
| S | | 5.50 | |



5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 15-Nov-2007 | 1 | First release |
| 04-Aug-2008 | 2 | Document status promoted from preliminary data to datasheet |
| 15-Oct-2008 | 3 | 2.1: Electrical characteristics (curves) has been corrected |
| 27-Jan-2009 | 4 | V _{GS} value has been corrected in Table 2 |
| 08-Jan-2010 | 5 | Updated V _{GS} on Table 2: Absolute maximum ratings . |

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