



## STW55NM60N

N-channel 600 V, 0.047  $\Omega$ , 51 A, MDmesh™ II Power MOSFET  
TO-247

### Features

| Type       | V <sub>DSS</sub><br>(@T <sub>jmax</sub> ) | R <sub>DS(on)</sub><br>max | I <sub>D</sub> |
|------------|---|----------------------------|----------------|
| STW55NM60N | 650 V                                     | < 0.060 $\Omega$           | 51 A           |

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

### Application

- Switching applications

### Description

This series of devices is designed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip 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.

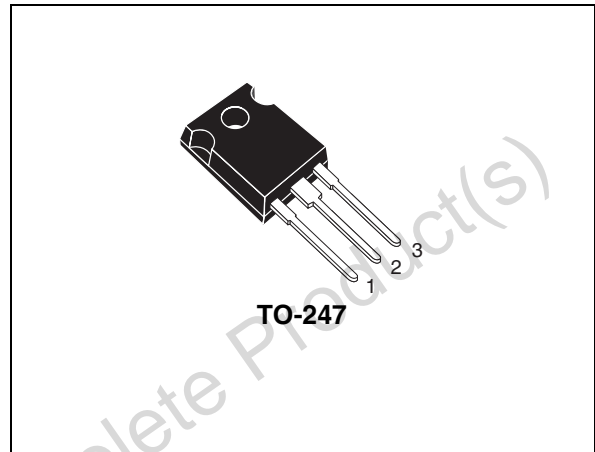


Figure 1. Internal schematic diagram

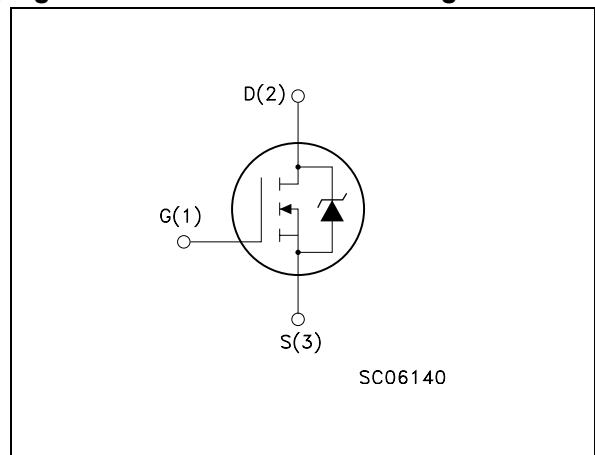


Table 1. Device summary

| Order code | Marking  | Package | Packaging |
|------------|----------|---------|-----------|
| STW55NM60N | W55NM60N | TO-247  | Tube      |

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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 ( $V_{GS} = 0$ )                   | 600        | V                |
| $V_{GS}$       | Gate- source voltage                                    | $\pm 25$   | V                |
| $I_D$          | Drain current (continuous) at $T_C = 25^\circ\text{C}$  | 51         | A                |
| $I_D$          | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 32         | A                |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                  | 204        | A                |
| $P_{TOT}$      | Total dissipation at $T_C = 25^\circ\text{C}$           | 350        | 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.  $I_{SD} \leq 51\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$

**Table 3. Thermal data**

| Symbol         | Parameter                                      | Value | Unit                      |
|----------------|--|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max           | 0.36  | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | 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 $T_j = 25^\circ\text{C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ ) | 1600  | mJ   |

## 2 Electrical characteristics

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

**Table 5. On/off states**

| Symbol        | Parameter  | Test conditions  | Min. | Typ.  | Max.     | Unit                           |
|---------------|--|--|------|-------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$   | 600  |       |          | V                              |
| $dv/dt^{(1)}$ | Drain source voltage slope                       | $V_{DD} = 480\text{ V}$ , $I_D = 51\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$              | 30   |       |          | V/ns                           |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$<br>$V_{DS} = \text{Max rating}$ , @ $125^{\circ}\text{C}$ |      |       | 1<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$   |      |       | 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                | $V_{GS} = 10\text{ V}$ , $I_D = 25.5\text{ A}$   |      | 0.047 | 0.060    | $\Omega$                       |

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  | $V_{DS} = 15\text{ V}$ , $I_D = 25.5\text{ A}$   |      | 45                |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$                                  |      | 5800<br>300<br>30 |      | pF<br>pF<br>pF |
| $C_{oss\text{ eq.}}^{(2)}$          | Equivalent output capacitance   | $V_{GS} = 0$ , $V_{DS} = 0\text{ to }480\text{ V}$   |      | 900               |      | pF             |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 480\text{ V}$ , $I_D = 51\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ ,<br>(see Figure 15) |      | 190<br>30<br>90   |      | nC<br>nC<br>nC |
| $R_g$                               | Gate input resistance   | $f = 1\text{ MHz}$ gate DC bias = 0<br>Test signal level = 20 mV<br>open drain                 |      | 2.5               |      | $\Omega$       |

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

2.  $C_{oss\text{ eq.}}$  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  | $V_{DD} = 300\text{ V}$ , $I_D = 25.5\text{ A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see Figure 14) |      | 40   |      | ns   |
| $t_r$        | Rise time           |  |      | 30   |      | ns   |
| $t_{d(off)}$ | Turn-off delay time |  |      | 225  |      | ns   |
| $t_f$        | Fall time           |  |      | 70   |      | ns   |

Table 8. Source drain diode

| Symbol          | Parameter                     | Test conditions   | Min | Typ. | Max | Unit          |
|-----------------|-------------------------------|---|-----|------|-----|---------------|
| $I_{SD}$        | Source-drain current          |   |     |      | 51  | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |   |     |      | 204 | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 25.5\text{ A}$ , $V_{GS} = 0$   |     |      | 1.3 | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 51\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$<br>(see Figure 16)                                     |     | 600  |     | ns            |
| $Q_{rr}$        | Reverse recovery charge       |   |     | 15   |     | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |   |     | 51   |     | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 51\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see Figure 16) |     | 750  |     | ns            |
| $Q_{rr}$        | Reverse recovery charge       |   |     | 18   |     | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |   |     | 51   |     | 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

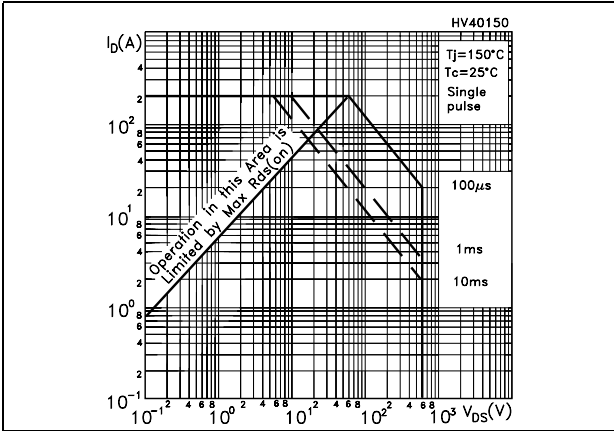


Figure 3. Thermal impedance

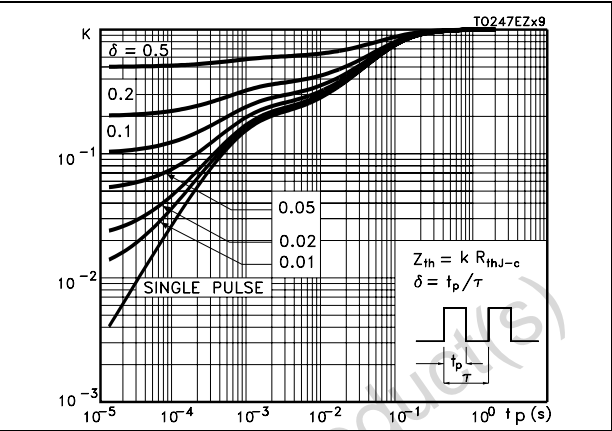


Figure 4. Output characteristics

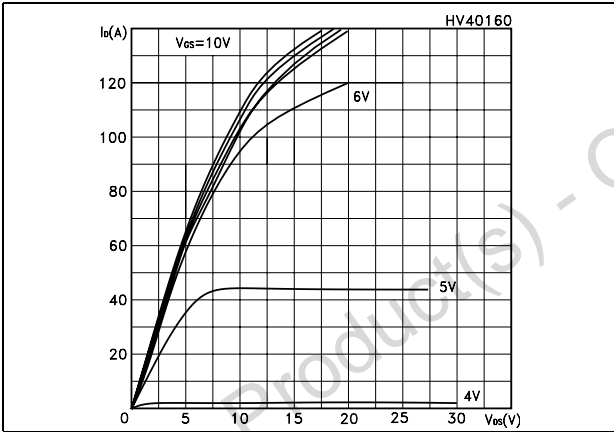


Figure 5. Transfer characteristics

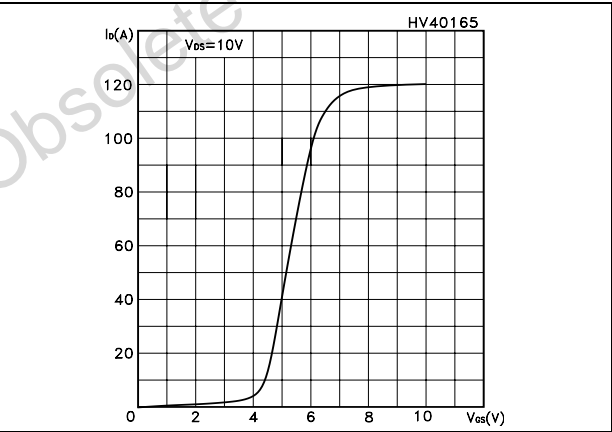


Figure 6. Transconductance

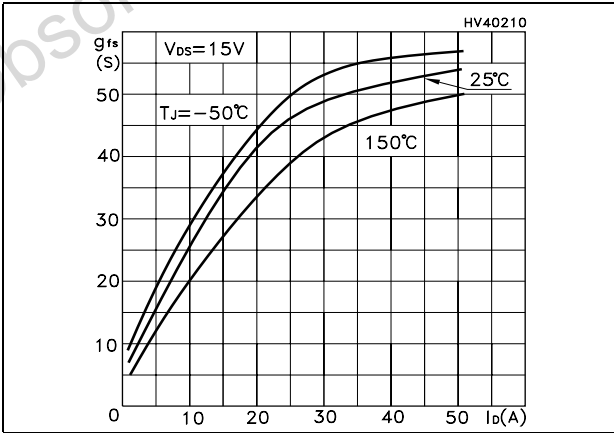


Figure 7. Static drain-source on resistance

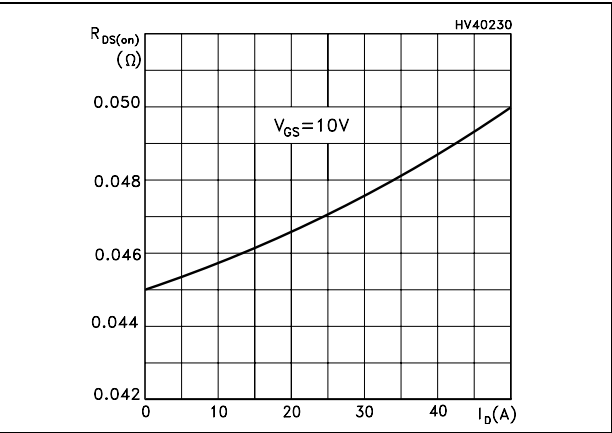


Figure 8. Gate charge vs gate-source voltage    Figure 9. Capacitance variations

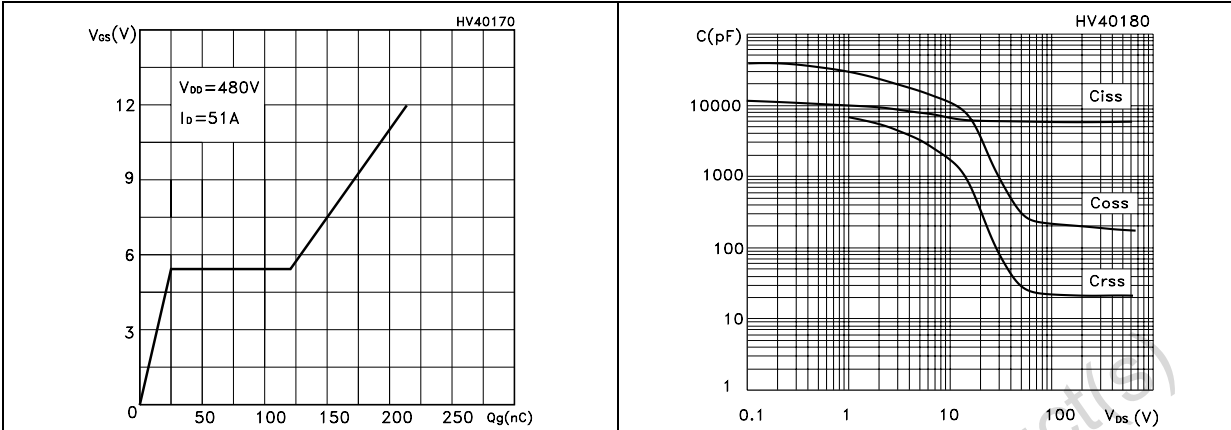


Figure 10. Normalized gate threshold voltage vs temperature    Figure 11. Normalized on resistance vs temperature

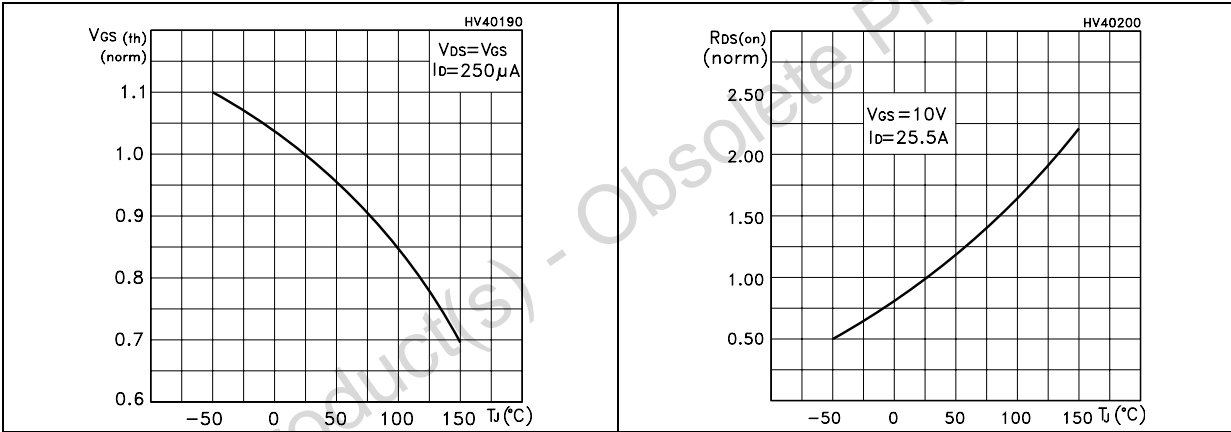
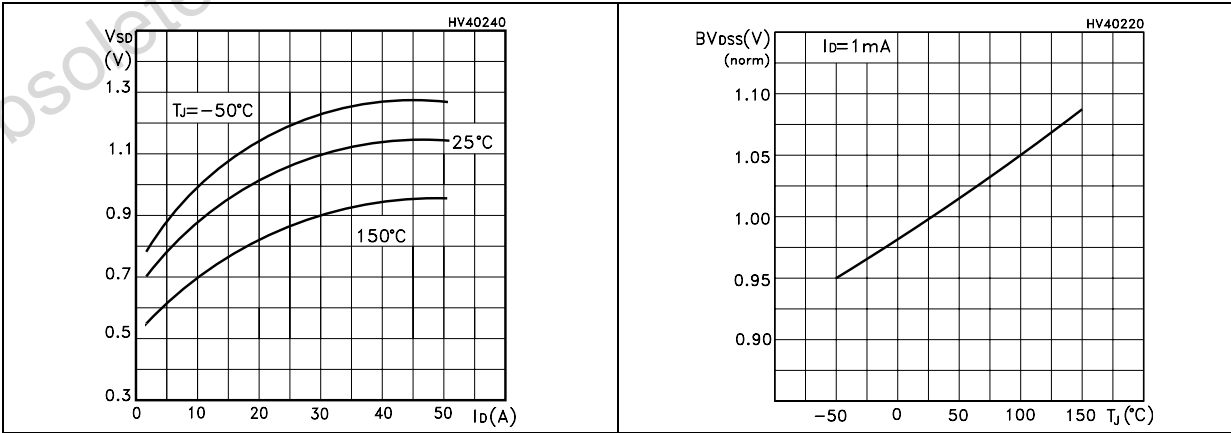
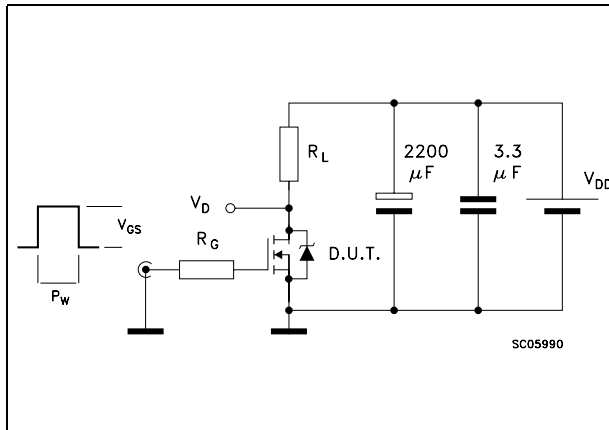


Figure 12. Source-drain diode forward characteristics    Figure 13. Normalized  $B_{V_{DS}}$  vs temperature

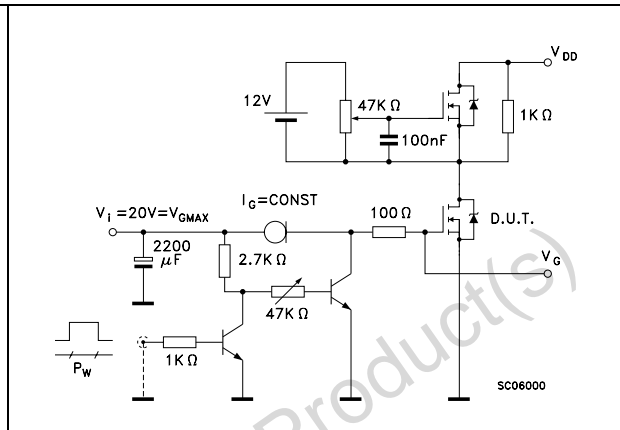


### 3 Test circuit

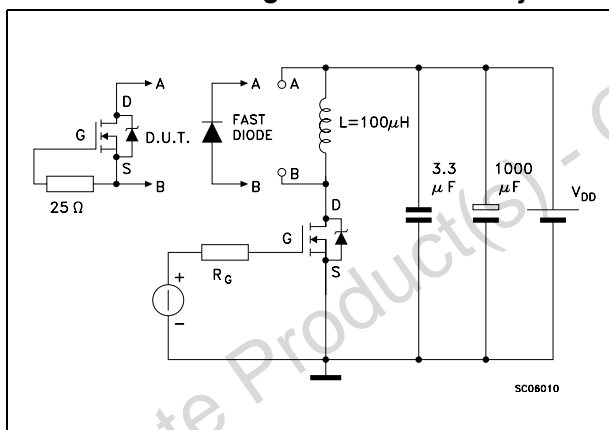
**Figure 14. Switching times test circuit for resistive load**



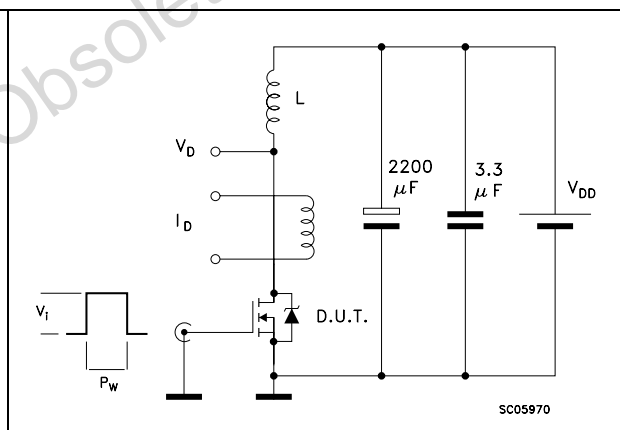
**Figure 15. Gate charge test circuit**



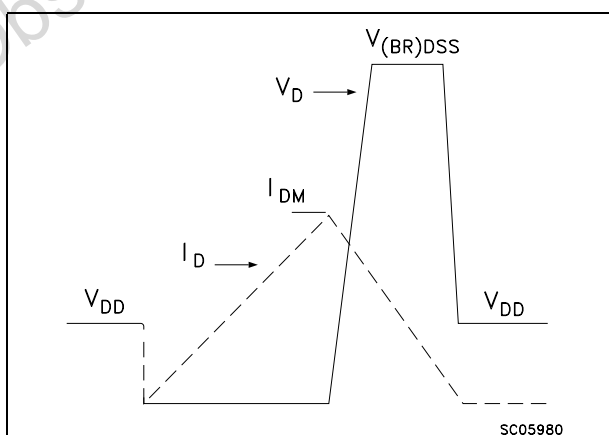
**Figure 16. Test circuit for inductive load switching and diode recovery times**



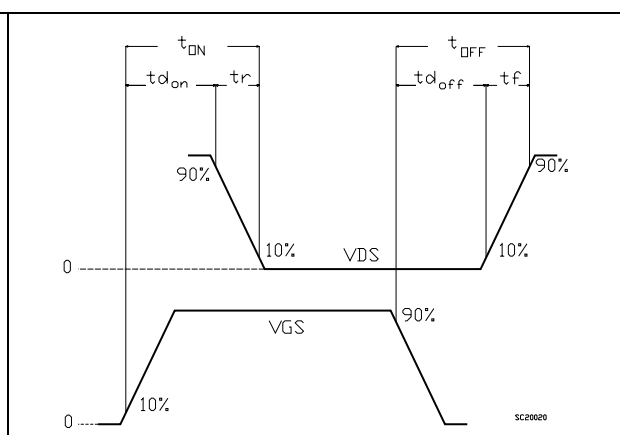
**Figure 17. Unclamped inductive load test circuit**



**Figure 18. Unclamped inductive waveform**



**Figure 19. Switching time waveform**





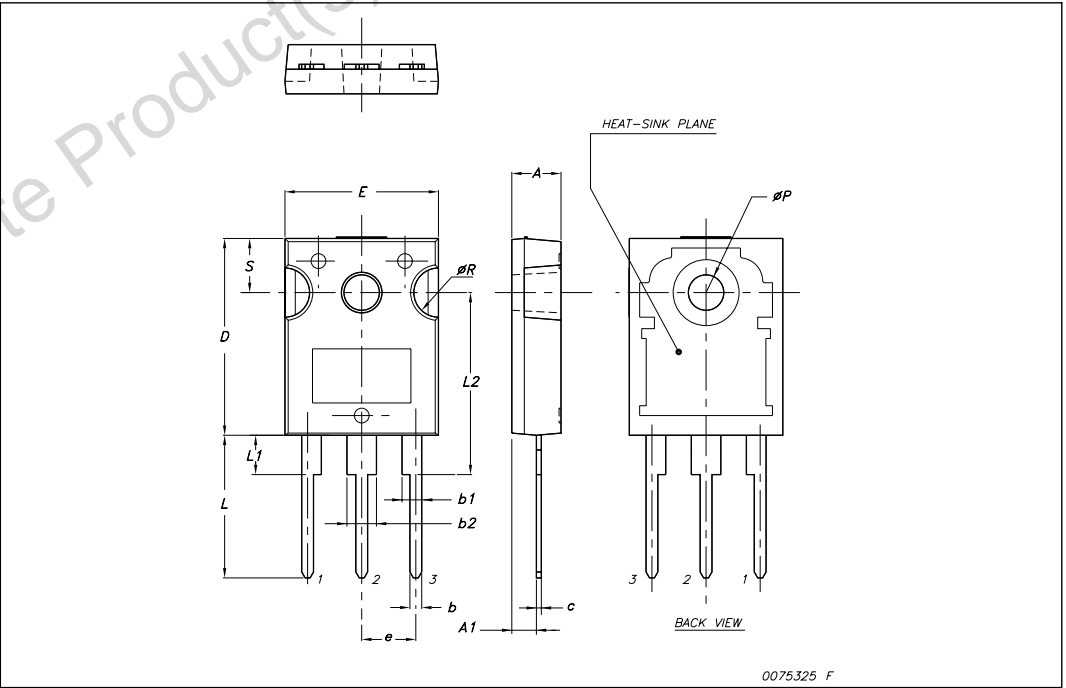
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

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   |       | 18.50 |       |
| øP   | 3.55  |       | 3.65  |
| øR   | 4.50  |       | 5.50  |
| S    |       | 5.50  |       |



## 5 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 06-Nov-2007 | 1        | Initial release   |
| 19-Dec-2007 | 2        | <a href="#">Figure 9: Capacitance variations</a> has been updated |
| 16-Jan-2008 | 3        | Document status promoted from preliminary data to datasheet.      |
| 31-Jul-2008 | 4        | E <sub>AS</sub> value has been updated in <a href="#">Table 4</a> |

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