



STW55NM60ND

N-channel 600 V, 0.047 Ω typ., 51 A FDmesh™ II Power MOSFET
(with fast diode) in a TO-247 package

Datasheet — production data

Features

| Type | V _{DSS} (@T _J max) | R _{DS(on)} max | I _D |
|-------------|---|----------------------------|----------------|
| STW55NM60ND | 650 V | < 0.060 Ω | 51 A |

- The worldwide best R_{DS(on)} amongst the fast recovery diode devices in TO-247
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- High dv/dt and avalanche capabilities

Application

- Switching applications

Description

This FDmesh™ II Power MOSFET with intrinsic fast-recovery body diode is produced using the second generation of MDmesh™ technology. Utilizing a new strip-layout vertical structure, this revolutionary device features extremely low on-resistance and superior switching performance. It is ideal for bridge topologies and ZVS phase-shift converters.

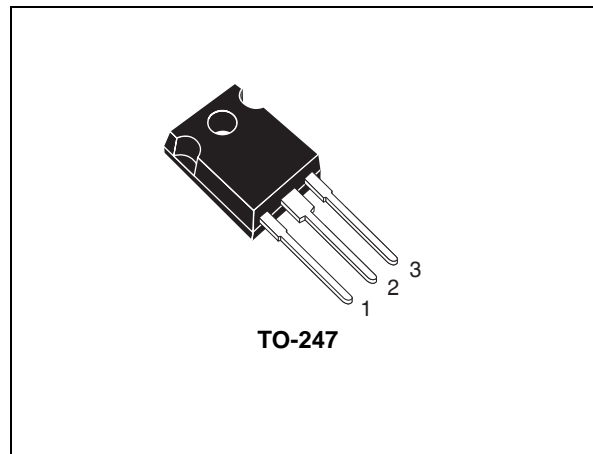


Figure 1. Internal schematic diagram

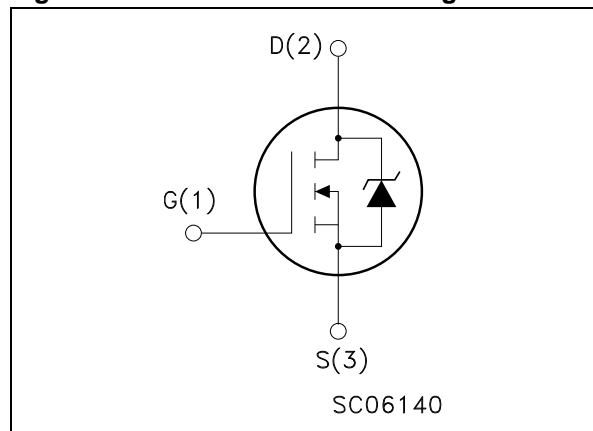


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|-------------|----------|---------|-----------|
| STW55NM60ND | 55NM60ND | TO-247 | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------------------|
| V_{DS} | Drain-source voltage | 600 | V |
| V_{GS} | Gate- source voltage | ± 25 | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 51 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 32 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 204 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 350 | W |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 40 | 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. $I_{SD} \leq 51\text{ A}$, $di/dt \leq 600\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$

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 | Max 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 $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$) | 1600 | mJ |

2 Electrical characteristics

($T_{CASE}=25^{\circ}C$ 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 | $V_{DD}=480 \text{ V}, I_D= 51 \text{ A}, V_{GS} = 10 \text{ V}$ | | 30 | | V/ns |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = 600 \text{ V}$ $V_{DS} = 600 \text{ V}, T_C = 125^{\circ}C$ | | | 10 100 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20 \text{ V}$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on-resistance | $V_{GS} = 10 \text{ V}, I_D = 25.5 \text{ A}$ | | 0.047 | 0.060 | 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 | $V_{DS} = 15 \text{ V}, I_D = 25.5 \text{ A}$ | | 45 | | S |
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 50 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$ | | 5800 300 30 | | pF pF pF |
| $C_{oss \text{ eq.}}^{(2)}$ | Equivalent output capacitance | $V_{GS} = 0, V_{DS} = 0 \text{ to } 480 \text{ V}$ | | 900 | | pF |
| $t_{d(on)}$ t_r $t_{d(off)}$ t_f | Turn-on delay time Rise time Turn-off delay time Fall time | $V_{DD} = 300 \text{ V}, I_D = 25.5 \text{ A}$ $R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$ (see Figure 19), (see Figure 14) | | 33 68 188 96 | | ns ns ns ns |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 480 \text{ V}, I_D = 51 \text{ A}, V_{GS} = 10 \text{ V},$ (see Figure 15) | | 190 30 90 | | nC nC nC |
| R_g | Gate input resistance | f=1 MHz Gate DC Bias = 0 Test signal level = 20 mV Open drain | | 2.5 | | Ω |

1. Pulsed: pulse duration= 300 μs , 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_{DSS}

Table 7. 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 | $I_{SD} = 51\text{ A}, V_{GS} = 0$ | | | 1.3 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 51\text{ A}, V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 16)</i> | | 200 | | ns |
| Q_{rr} | Reverse recovery charge | | | 1.8 | | μC |
| I_{RRM} | Reverse recovery current | | | 18 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 51\text{ A}, V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s},$ $T_j = 150\text{ }^\circ\text{C}$ <i>(see Figure 16)</i> | | 280 | | ns |
| Q_{rr} | Reverse recovery charge | | | 3.4 | | μC |
| I_{RRM} | Reverse recovery current | | | 24 | | 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

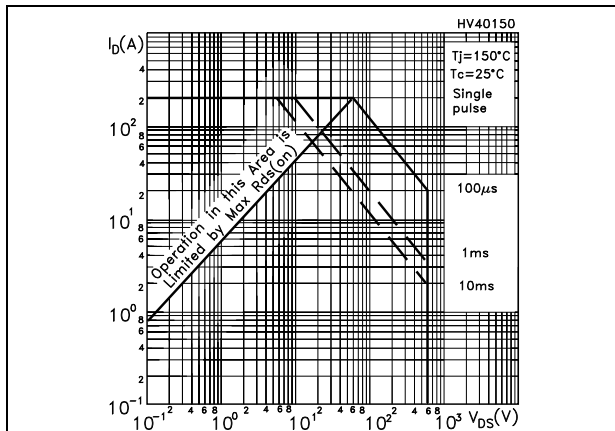


Figure 3. Thermal impedance

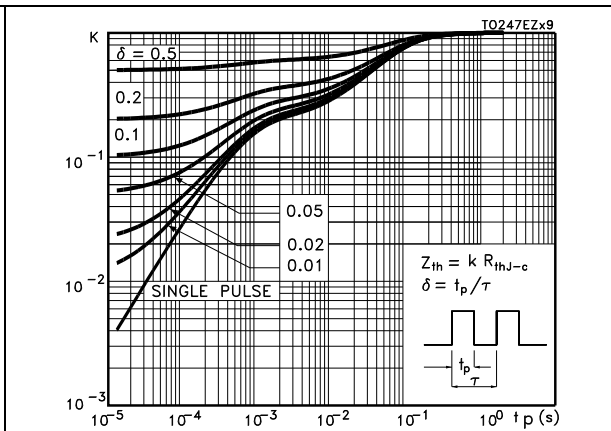


Figure 4. Output characteristics

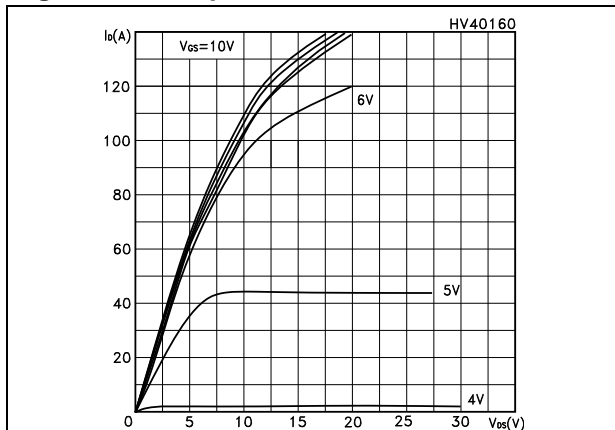


Figure 5. Transfer characteristics

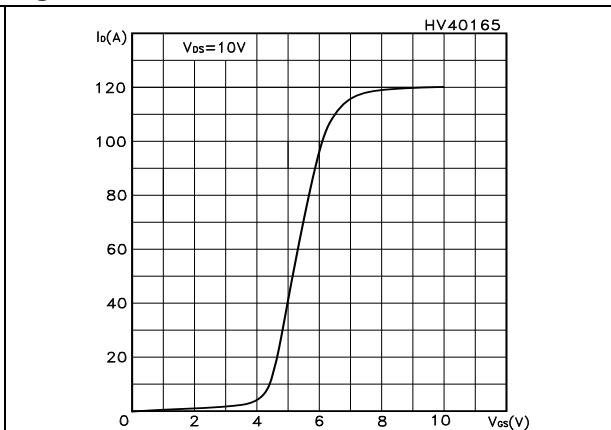


Figure 6. Transconductance

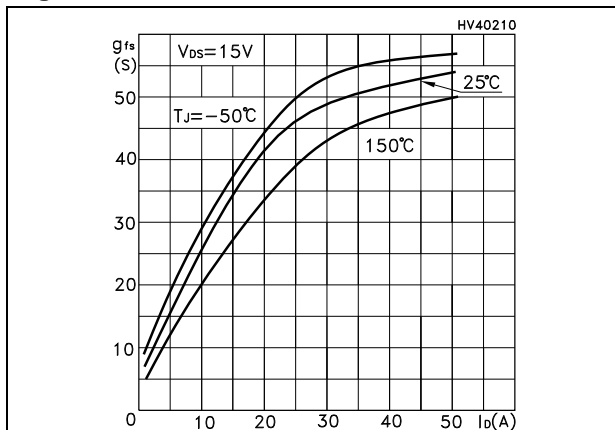


Figure 7. Static drain-source on-resistance

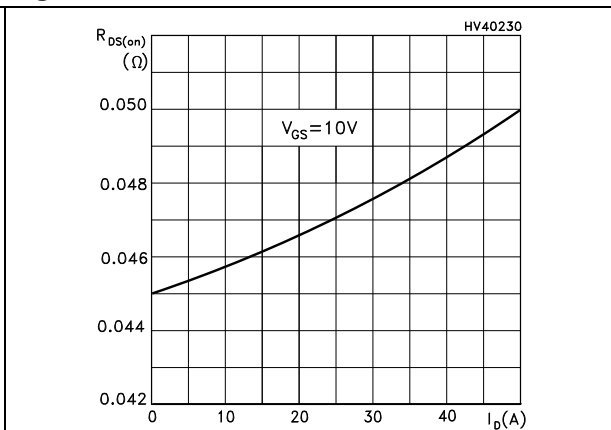


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

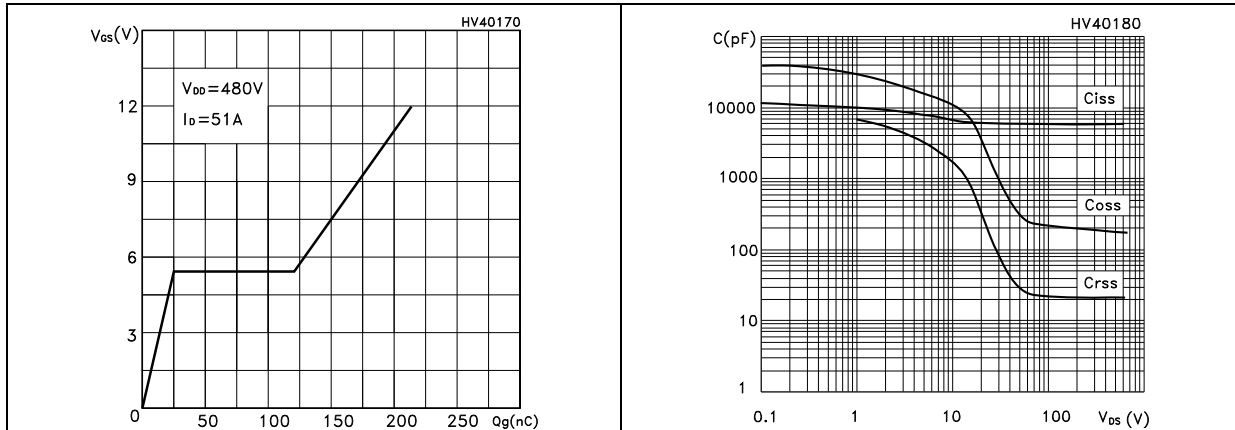


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

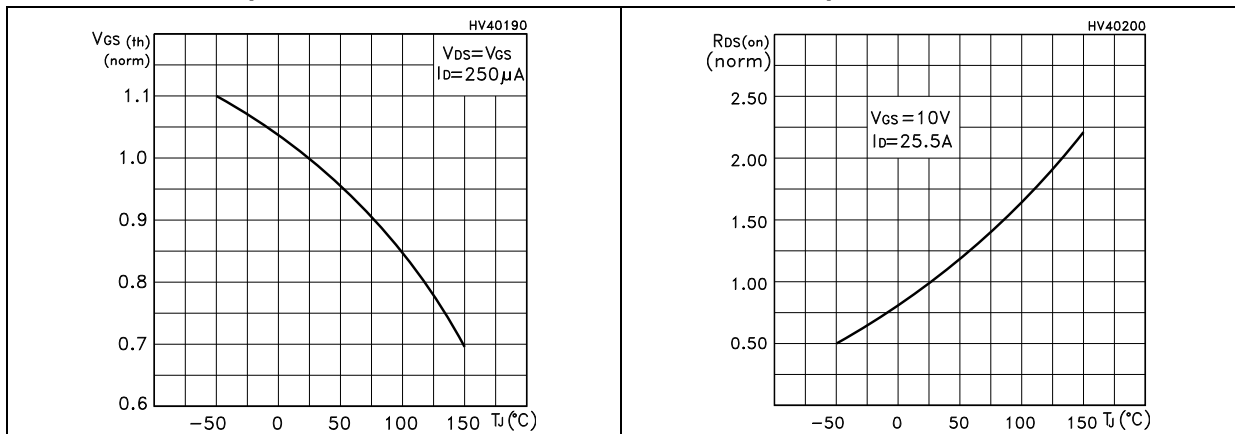
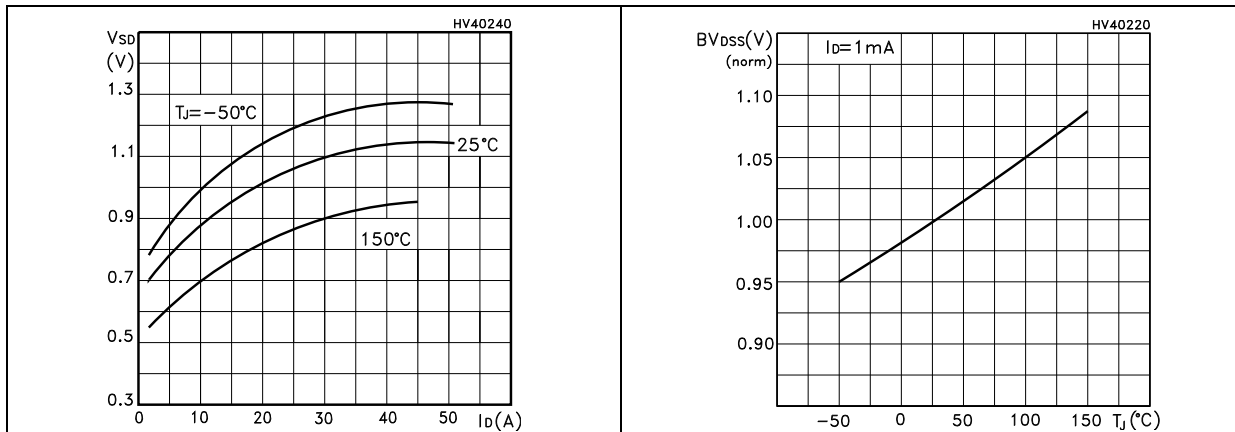


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized B_{VDSS} vs temperature



3 Test circuits

Figure 14. Switching times test circuit for resistive load

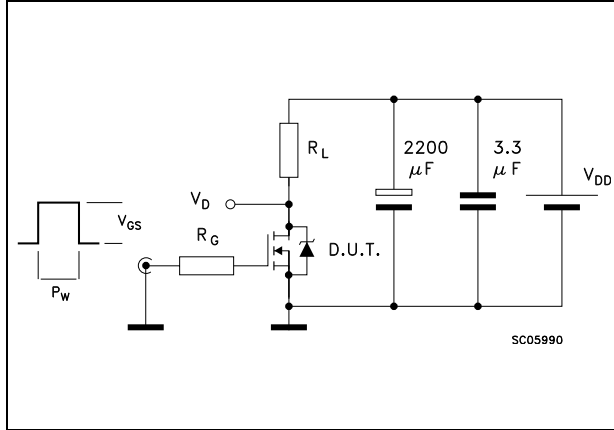


Figure 15. Gate charge test circuit

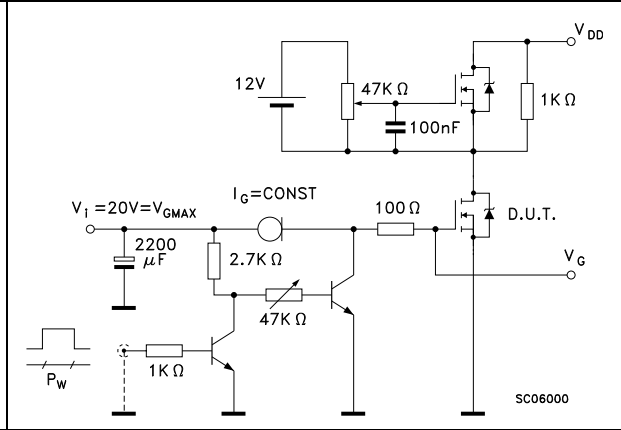


Figure 16. Test circuit for inductive load switching and diode recovery times

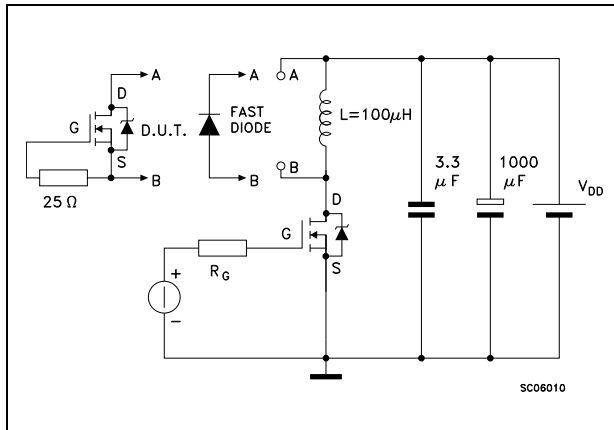


Figure 17. Unclamped Inductive load test circuit

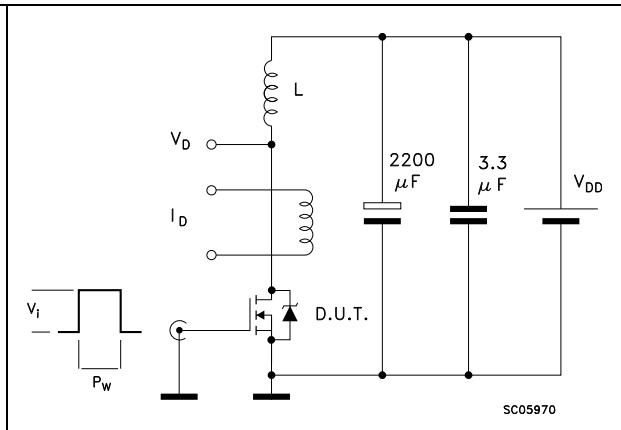


Figure 18. Unclamped inductive waveform

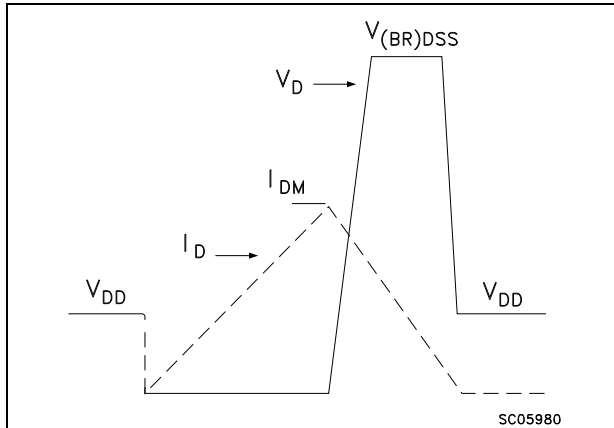
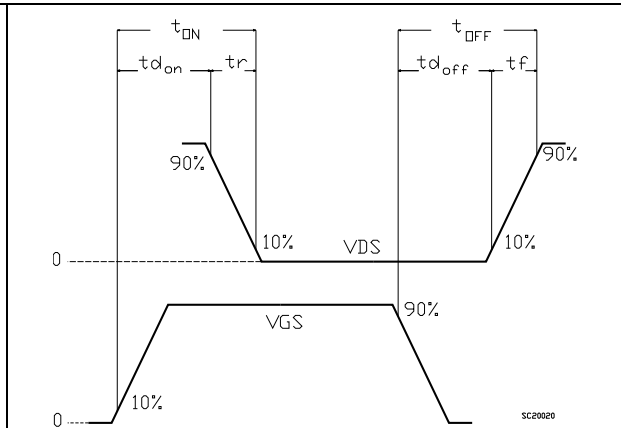


Figure 19. Switching time waveform



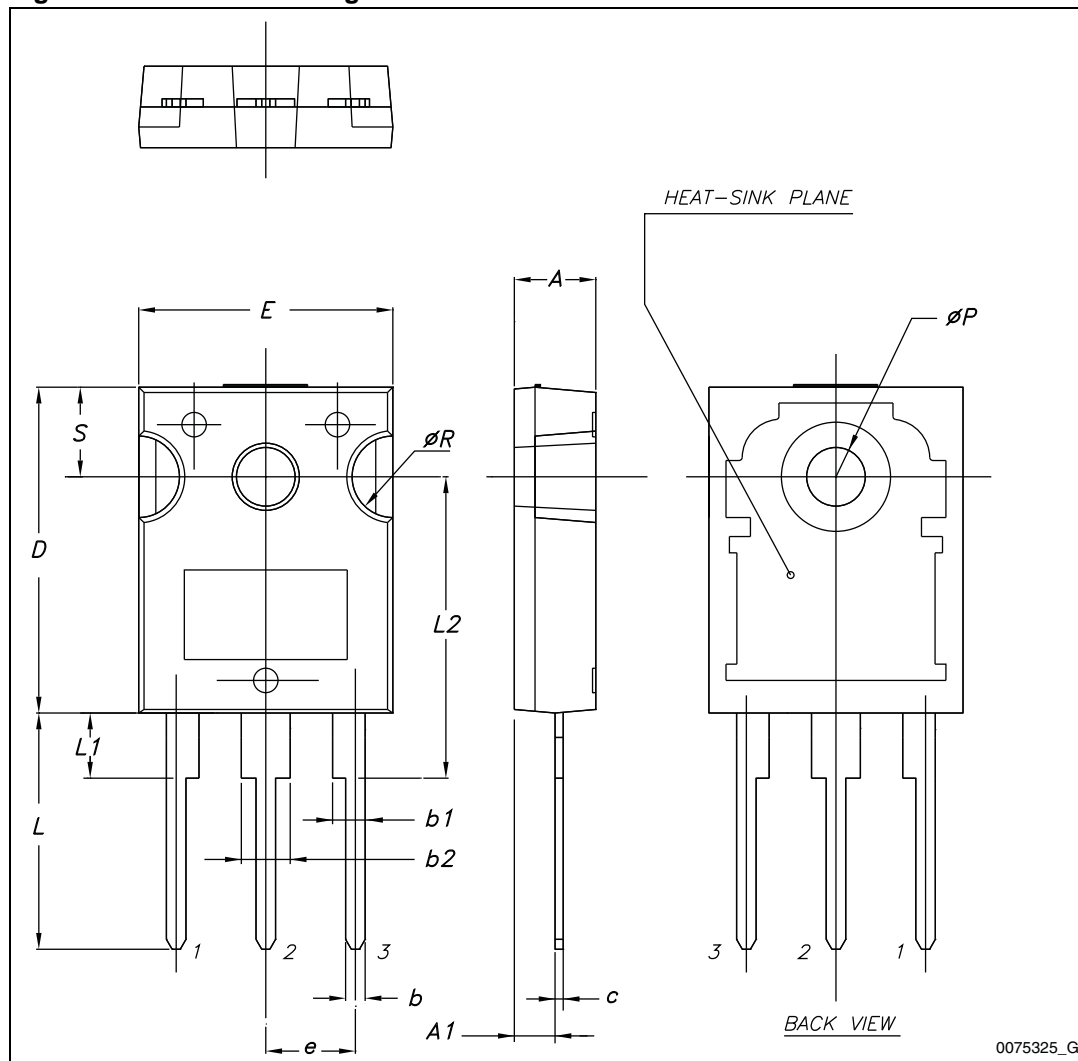
4 Package mechanical data

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.

Table 8. 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 | 5.30 | 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 |

Figure 20. TO-247 drawing



0075325_G

5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 16-Nov-2007 | 1 | First release. |
| 22-Apr-2008 | 2 | Document status promoted from preliminary data to datasheet. |
| 19-Dec-2012 | 3 | Title changed on the cover page. Minor text changes. Updated Section 4: Package mechanical data . |

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