



STW45NM50FD

N-channel 500V - 0.07 Ω - 45A - TO247
FDmesh™ Power MOSFET (with fast diode)

General features

| Type | V _{DSS} | R _{DS(on)} | I _D |
|-------------|------------------|---------------------|----------------|
| STW45NM50FD | 500V | <0.1 Ω | 45A |

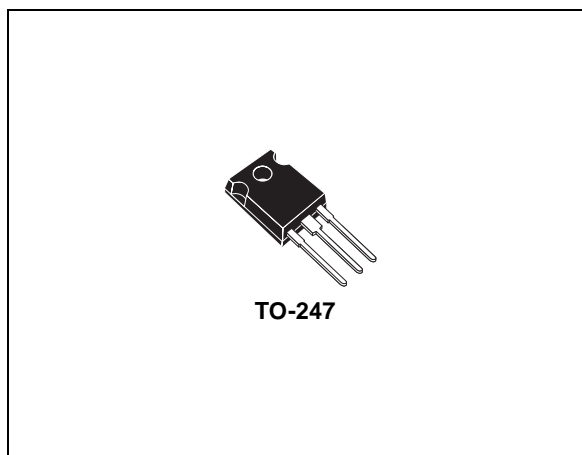
- 100% avalanche tested
- High dv/dt and avalanche capabilities
- Low input capacitance and gate charge
- Low gate input resistance
- Tight process control and high manufacturing yields

Description

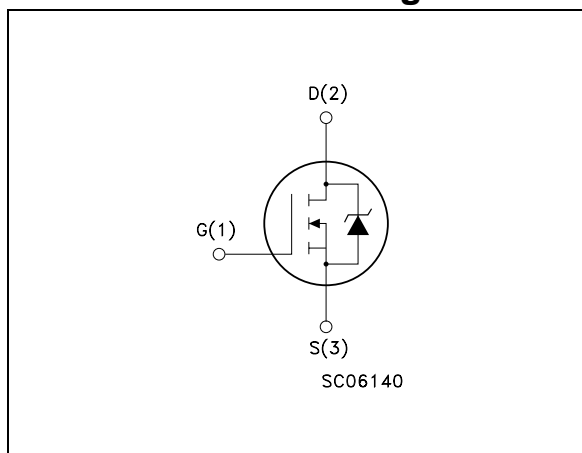
The FDmesh™ associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

Applications

- Switching application



Internal schematic diagram



Order codes

| Part number | Marking | Package | Packaging |
|-------------|-----------|---------|-----------|
| STW45NM50FD | W45NM50FD | TO-247 | Tube |

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1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|--------------------|---|------------|------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 500 | V |
| V_{DGR} | Drain-gate voltage ($R_{GS} = 20K\Omega$) | 500 | V |
| V_{GS} | Gate-source voltage | ± 30 | V |
| I_D | Drain current (continuous) at $T_C = 25^\circ C$ | 45 | A |
| I_D | Drain current (continuous) at $T_C = 100^\circ C$ | 28.4 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 180 | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ C$ | 417 | W |
| | Derating factor | 2.08 | W/°C |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 20 | V/ns |
| T_J T_{stg} | Operating junction temperature Storage temperature | -65 to 150 | °C |

1. Pulse width limited by safe operating area

2. $I_{SD} \leq 45A$, $di/dt \leq 400A/\mu s$, $V_{DD} = 80\%V_{(BR)DSS}$

Table 2. Thermal resistance

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case Max | 0.3 | °C/W |
| R_{thj-a} | Thermal resistance junction-ambient Max | 30 | °C/W |
| T_l | Maximum lead temperature for soldering purpose | 300 | °C |

Table 3. Avalanche data

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_J Max) | 22.5 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_J = 25^\circ C$, $I_d = I_{AR}$, $V_{DD} = 50V$) | 800 | mJ |

2 Electrical characteristics

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

Table 4. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 250\mu A, V_{GS} = 0$ | 500 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating},$ $V_{DS} = \text{Max rating @ } 125^{\circ}C$ | | | 10 100 | μA μA |
| I_{GSS} | Gate body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 30V$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\mu A$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10V, I_D = 22.5A$ | | 0.07 | 0.10 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|--|------|--------------------|------|----------------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 22.5A$ | | 20 | | S |
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 25V, f = 1 \text{ MHz},$ $V_{GS} = 0$ | | 3600 1260 80 | | pF pF pF |
| $C_{oss \text{ eq.}}^{(2)}$ | Equivalent output capacitance | $V_{GS} = 0, V_{DS} = 0V \text{ to } 400V$ | | 350 | | pF |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 400V, I_D = 45A$ $V_{GS} = 10V$ (see Figure 13) | | 92 22 40 | 120 | nC nC nC |
| R_G | Gate input resistance | $f = 1 \text{ MHz}$ Gate DC Bias = 0 test signal level = 20mV open drain | | 2 | | 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 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------------------------|---|--|------|----------------|------|----------------|
| $t_{d(on)}$ t_r | Turn-on delay time Rise time | $V_{DD}=250\text{ V}$, $I_D=22.5\text{ A}$, $R_G=4.7\Omega$, $V_{GS}=10\text{ V}$ (see Figure 14) | | 28 28 | | ns ns |
| $t_{r(Voff)}$ t_f t_c | Off-voltage rise time Fall time Cross-over time | $V_{DD}=400\text{ V}$, $I_D=45\text{ A}$, $R_G=4.7\Omega$, $V_{GS}=10\text{ V}$ (see Figure 14) | | 11 25 44 | | ns ns ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|-----------------------------------|--|---|-----|---------------------|-----|---------------|
| I_{SD} | Source-drain current | | | | 45 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 180 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD}=45\text{ A}$, $V_{GS}=0$ | | | 1.5 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD}=45\text{ A}$, $T_j=25^\circ\text{C}$ $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=100\text{ V}$, (see Figure 17) | | 200 1600 16 | | ns nC A |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD}=45\text{ A}$, $T_j=150^\circ\text{C}$ $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=100\text{ V}$, (see Figure 17) | | 324 4017 24.8 | | ns nC 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 1. Safe operating area

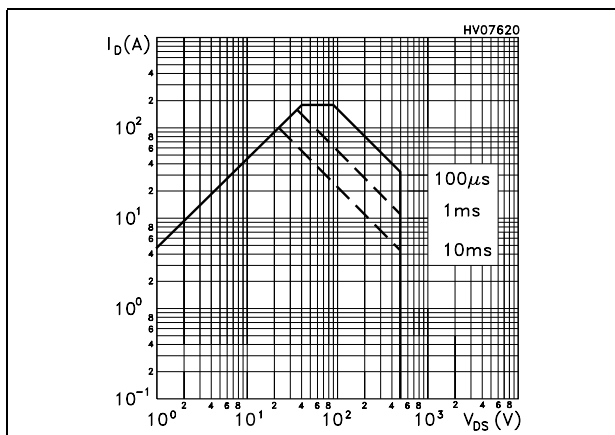


Figure 2. Thermal impedance

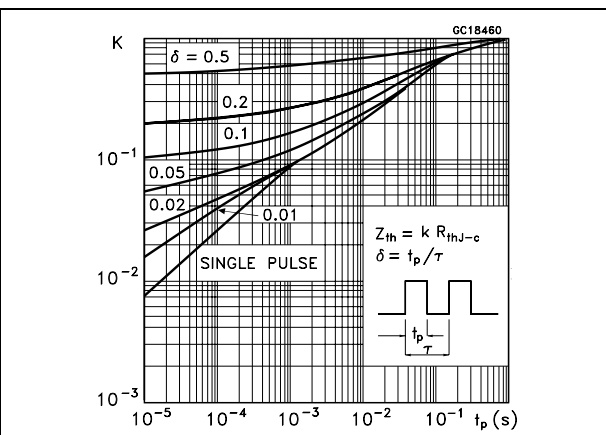


Figure 3. Output characteristics

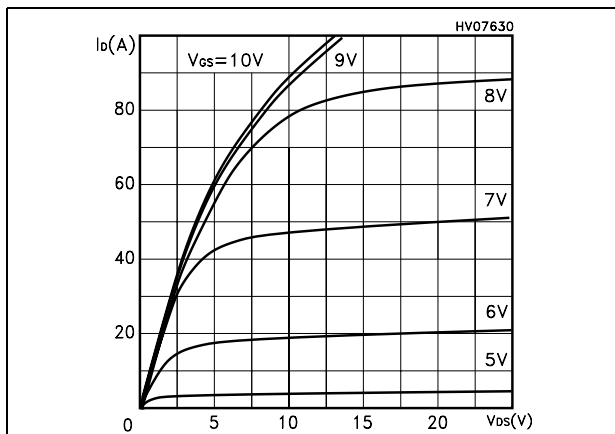


Figure 4. Transfer characteristics

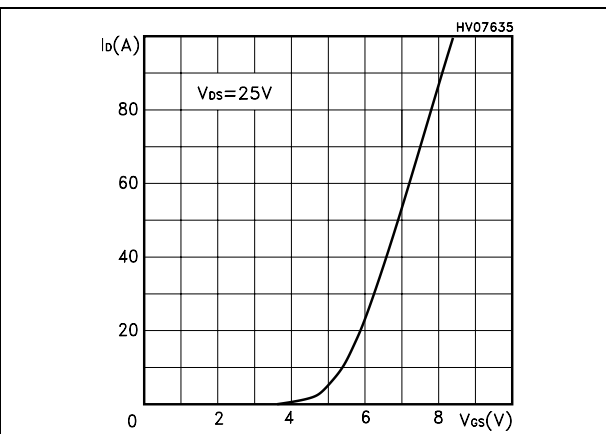


Figure 5. Transconductance

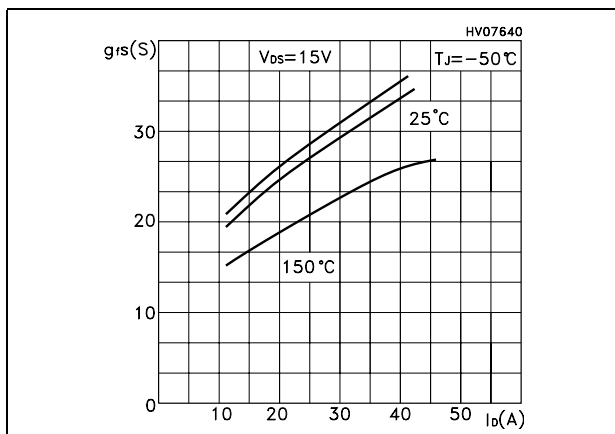


Figure 6. Static drain-source on resistance

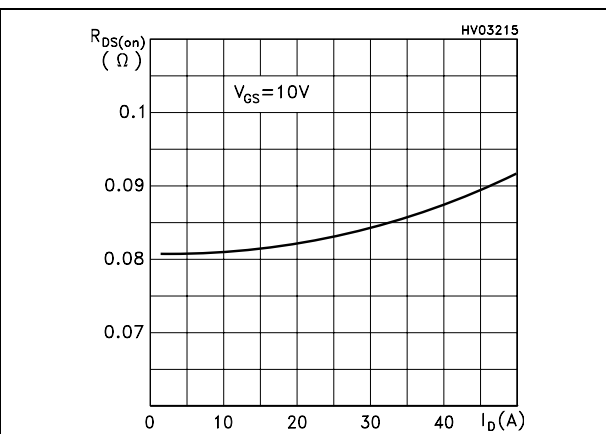


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

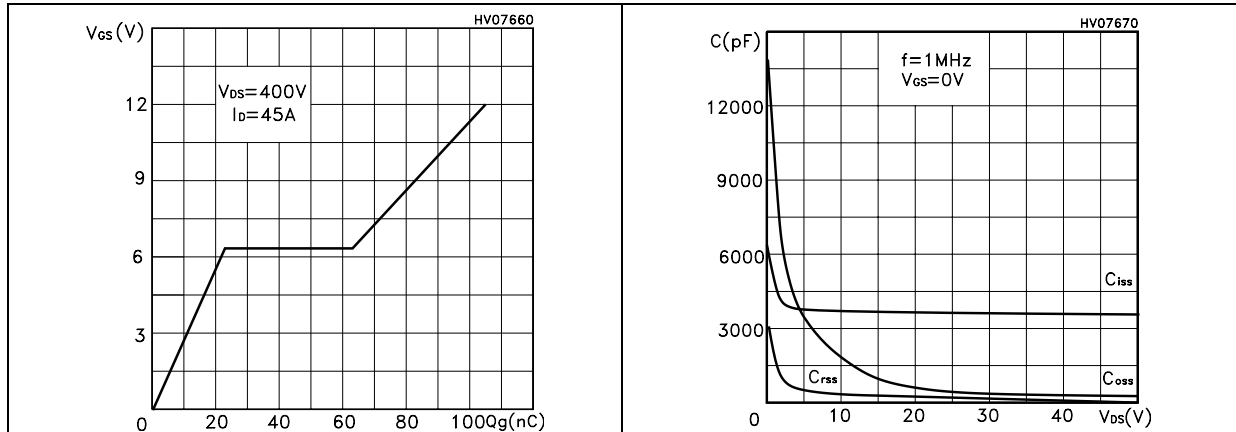


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

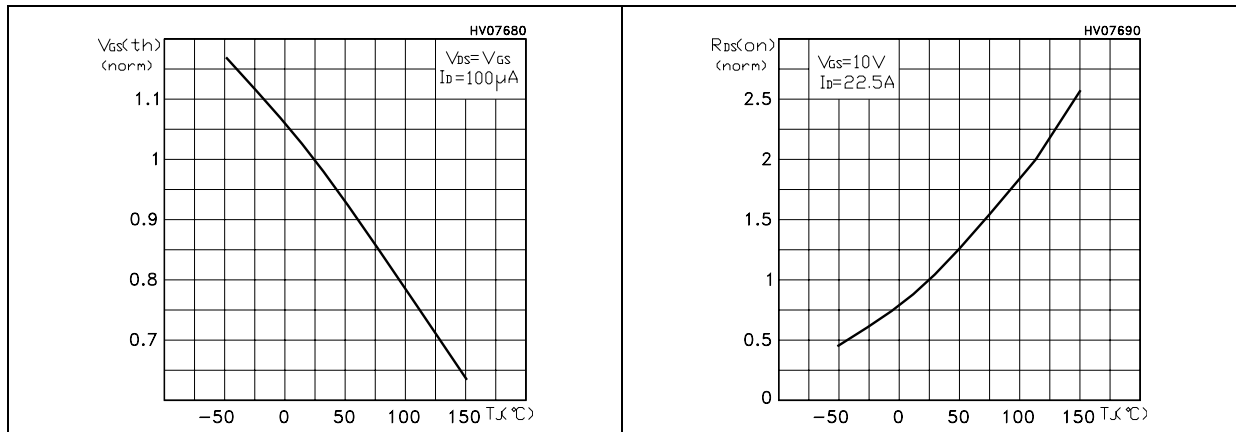
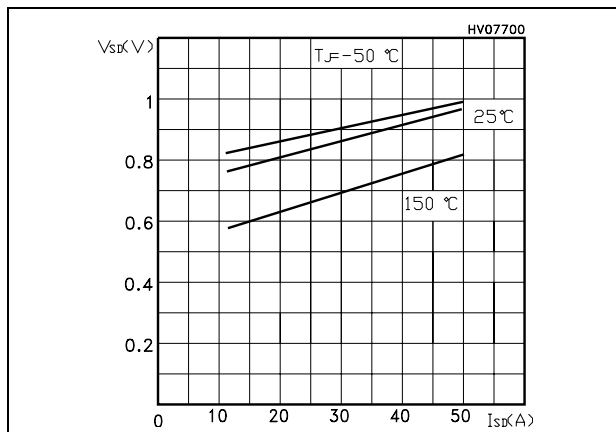


Figure 11. Source-drain diode forward characteristics



3 Test circuit

Figure 12. Switching times test circuit for resistive load

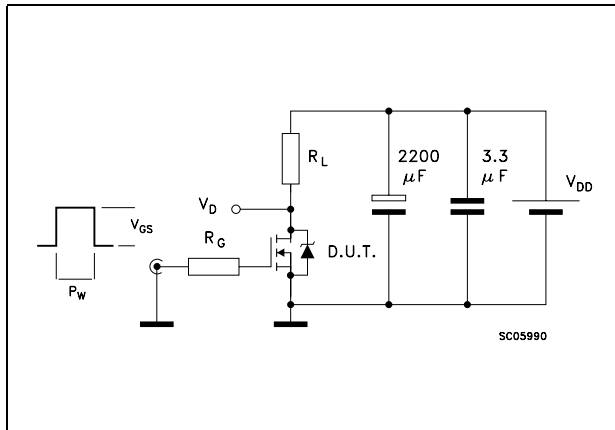


Figure 13. Gate charge test circuit

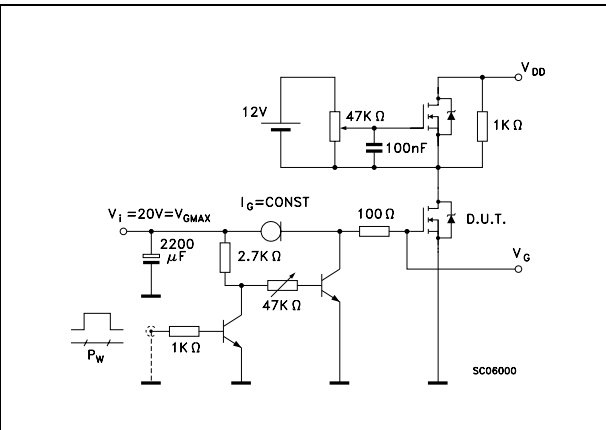


Figure 14. Test circuit for inductive load switching and diode recovery times

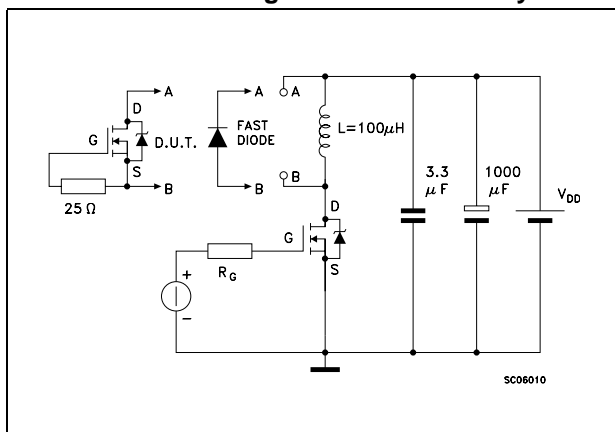


Figure 15. Unclamped inductive load test circuit

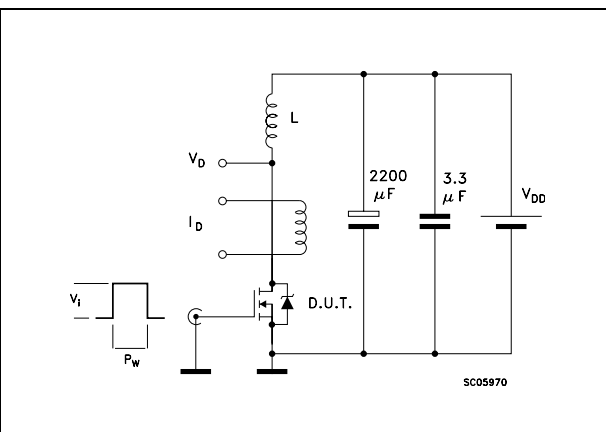


Figure 16. Unclamped inductive waveform

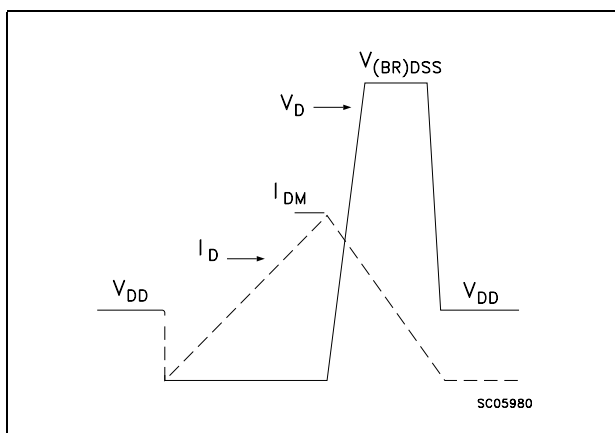
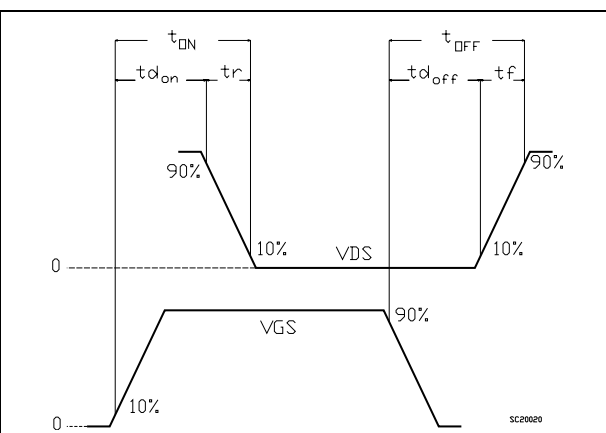


Figure 17. Switching time waveform

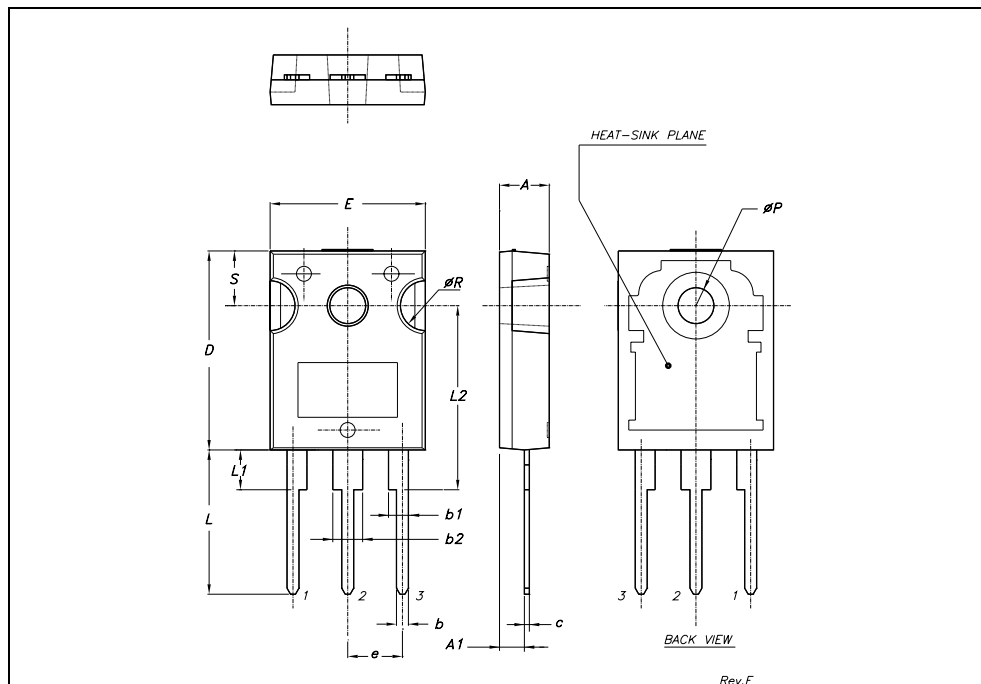


4 Package mechanical data

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

TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.85 | | 5.15 | 0.19 | | 0.20 |
| A1 | 2.20 | | 2.60 | 0.086 | | 0.102 |
| b | 1.0 | | 1.40 | 0.039 | | 0.055 |
| b1 | 2.0 | | 2.40 | 0.079 | | 0.094 |
| b2 | 3.0 | | 3.40 | 0.118 | | 0.134 |
| c | 0.40 | | 0.80 | 0.015 | | 0.03 |
| D | 19.85 | | 20.15 | 0.781 | | 0.793 |
| E | 15.45 | | 15.75 | 0.608 | | 0.620 |
| e | | 5.45 | | | 0.214 | |
| L | 14.20 | | 14.80 | 0.560 | | 0.582 |
| L1 | 3.70 | | 4.30 | 0.14 | | 0.17 |
| L2 | | 18.50 | | | 0.728 | |
| øP | 3.55 | | 3.65 | 0.140 | | 0.143 |
| øR | 4.50 | | 5.50 | 0.177 | | 0.216 |
| S | | 5.50 | | | 0.216 | |



5 Revision history

Table 8. Revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 05-Apr-2005 | 8 | Modified value on Table 7.: Source drain diode |
| 26-Apr-2006 | 9 | New template |

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