



STFW4N150 STP4N150, STW4N150

N-channel 1500 V, 5 Ω , 4 A, PowerMESH™ Power MOSFET
in TO-220, TO-247, TO-3PF

Features

| Type | V _{DSS} | R _{DS(on)} max | I _D | P _w |
|-----------|------------------|-------------------------|----------------|----------------|
| STFW4N150 | 1500 V | < 7 Ω | 4 A | 63 W |
| STP4N150 | 1500 V | < 7 Ω | 4 A | 160 W |
| STW4N150 | 1500 V | < 7 Ω | 4 A | 160 W |

- 100% avalanche tested
- Intrinsic capacitances and Q_g minimized
- High speed switching
- Fully isolated TO-3PF plastic packages
- Creepage distance path is 5.4 mm (typ.) for TO-3PF

Application

- Switching applications

Description

Using the well consolidated high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of very high voltage Power MOSFETs with outstanding performances. The strengthened layout coupled with the company's proprietary edge termination structure, gives the lowest R_{DS(on)} per area, unrivalled gate charge and switching characteristics.

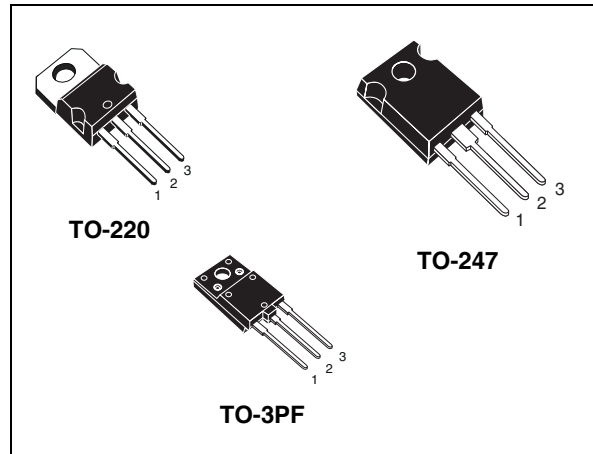


Figure 1. Internal schematic diagram.

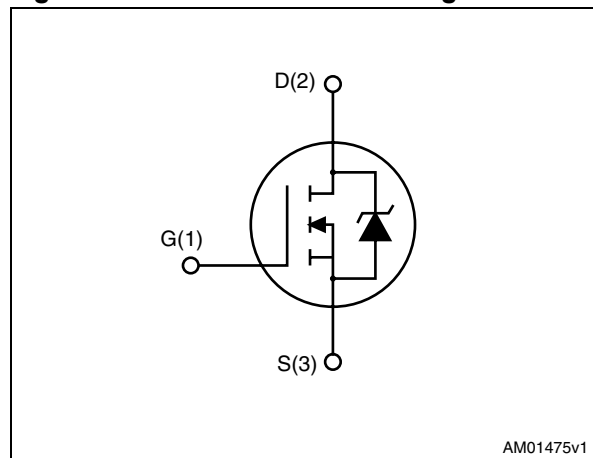


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|---------|-----------|
| STFW4N150 | 4N150 | TO-3PF | Tube |
| STP4N150 | P4N150 | TO-220 | Tube |
| STW4N150 | W4N150 | TO-247 | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | | Unit |
|----------------|--|------------|--------|--------------------|------------------|
| | | TO-220 | TO-247 | TO-3PF | |
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 1500 | | | V |
| V_{GS} | Gate- source voltage | ± 30 | | | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 4 | 4 | 4 ⁽¹⁾ | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 2.5 | 2.5 | 2.5 ⁽¹⁾ | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 12 | 12 | 12 ⁽¹⁾ | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 160 | | 63 | W |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink ($t=1\text{ s}; T_C=25\text{ }^\circ\text{C}$) | | | 3500 | V |
| 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

Table 3. Thermal data

| Symbol | Parameter | Value | | | Unit |
|----------------|---|--------|--------|--------|---------------------------|
| | | TO-220 | TO-247 | TO-3PF | |
| $R_{thj-case}$ | Thermal resistance junction-case max | 0.78 | | 2 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.5 | 50 | | $^\circ\text{C}/\text{W}$ |

Table 4. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|--|-------|------|
| I_{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max) | 4 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | 350 | mJ |

2 Electrical characteristics

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

Table 5. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown voltage | $I_D = 1\text{ mA}$, $V_{GS} = 0$ | 1500 | | | V |
| I_{DSS} | Zero gate voltage Drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$ | | | 10 500 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 30\text{ V}$ | | | ± 100 | nA |
| $V_{GS(th)}$ | 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 | $V_{GS} = 10\text{ V}$, $I_D = 2\text{ A}$ | | 5 | 7 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|--|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} = 30\text{ V}$, $I_D = 2\text{ A}$ | - | 3.5 | | S |
| C_{iss} | Input capacitance | $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | - | 1300 | | pF |
| C_{oss} | Output capacitance | | | 120 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 12 | | pF |
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 750\text{ V}$, $I_D = 2\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ <i>Figure 19</i> | - | 35 | | ns |
| T_r | Rise time | | | 30 | | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 45 | | ns |
| t_f | Fall time | | | 45 | | ns |
| Q_g | Total gate charge | $V_{DD} = 600\text{ V}$, $I_D = 4\text{ A}$, $V_{GS} = 10\text{ V}$ <i>Figure 20</i> | - | 30 | 50 | nC |
| Q_{gs} | Gate-source charge | | | 10 | | nC |
| Q_{gd} | Gate-drain charge | | | 9 | | nC |

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

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|---------------|
| I_{SD} | Source-drain current | | - | | 4 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 12 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 4 \text{ A}, V_{GS} = 0$ | - | | 2 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 4 \text{ A},$ $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 45 \text{ V}$ <i>Figure 21</i> | - | 510 | | ns |
| Q_{rr} | Reverse recovery charge | | | 3 | | μC |
| I_{RRM} | Reverse recovery current | | | 12 | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 4 \text{ A},$ $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 45 \text{ V}, T_j = 150^\circ\text{C}$ <i>Figure 21</i> | - | 615 | | ns |
| Q_{rr} | Reverse recovery charge | | | 4 | | μC |
| I_{RRM} | Reverse recovery current | | | 12.6 | | 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 for TO-220

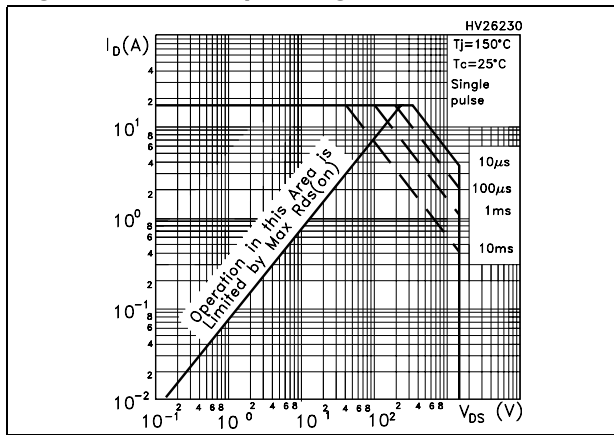


Figure 3. Thermal impedance for TO-220

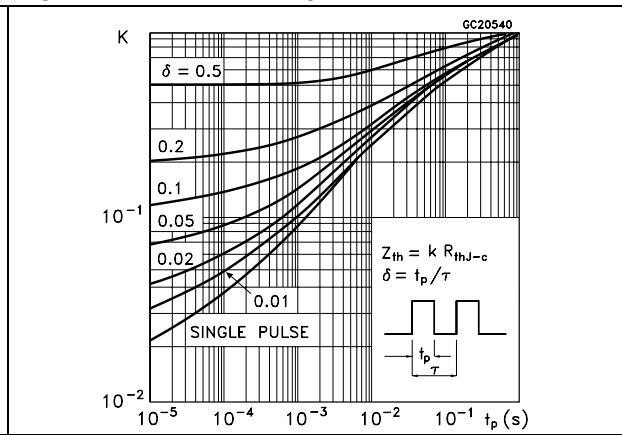


Figure 4. Safe operating area for TO-3PF

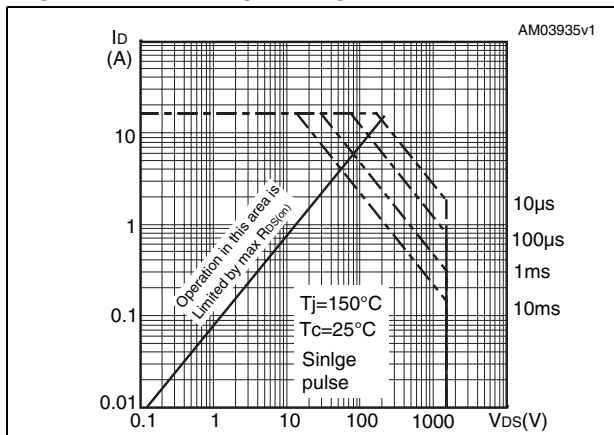


Figure 5. Thermal impedance for TO-3PF

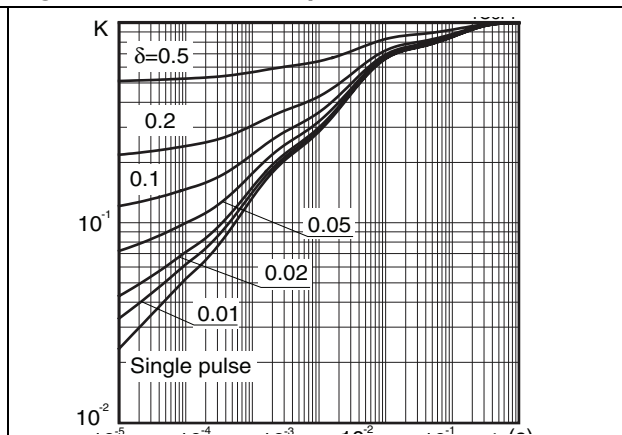


Figure 6. Safe operating area for TO-247

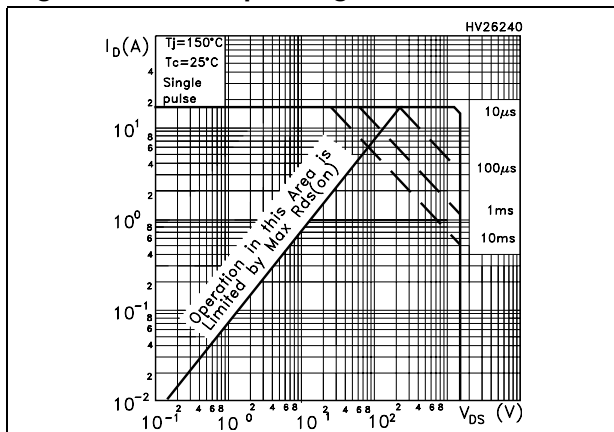


Figure 7. Thermal impedance for TO-247

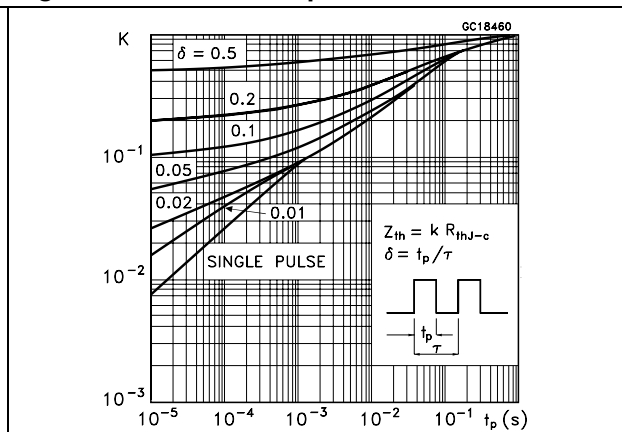


Figure 8. Output characteristics

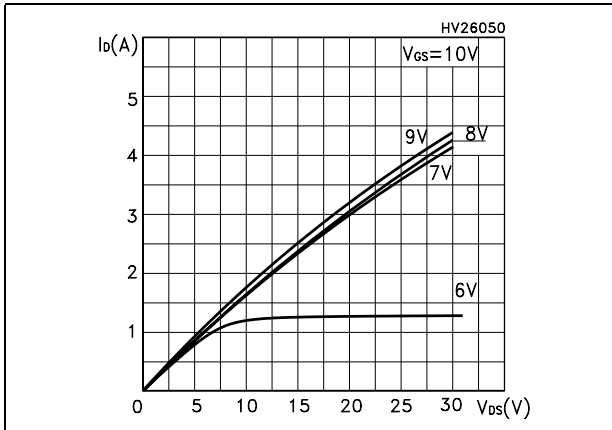


Figure 9. Transfer characteristics

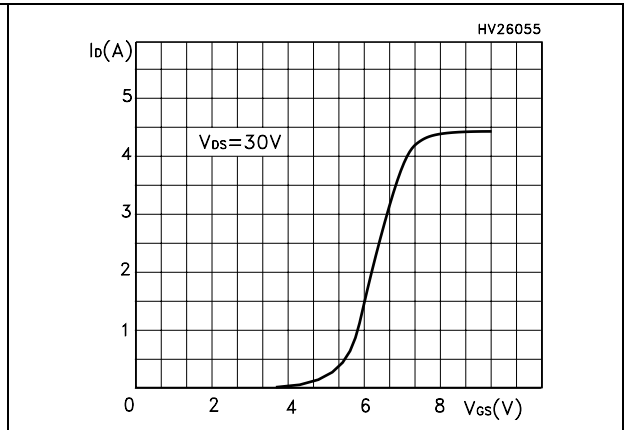


Figure 10. Transconductance

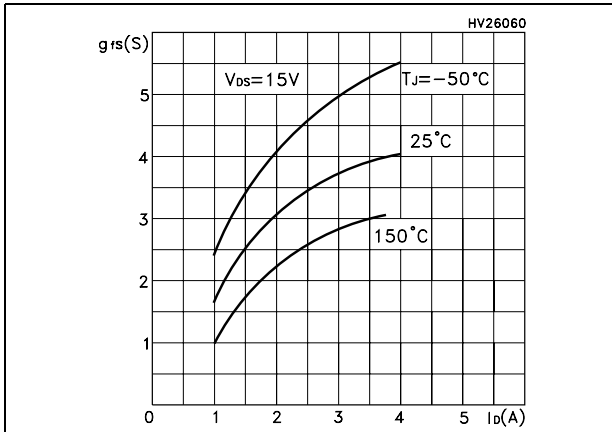


Figure 11. Static drain-source on resistance

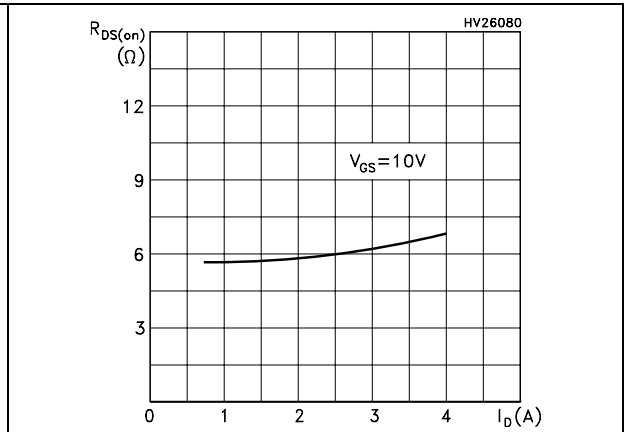


Figure 12. Gate charge vs gate-source voltage Figure 13. Capacitance variations

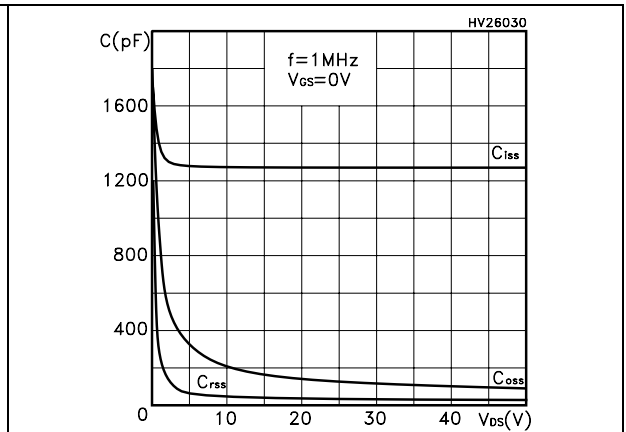
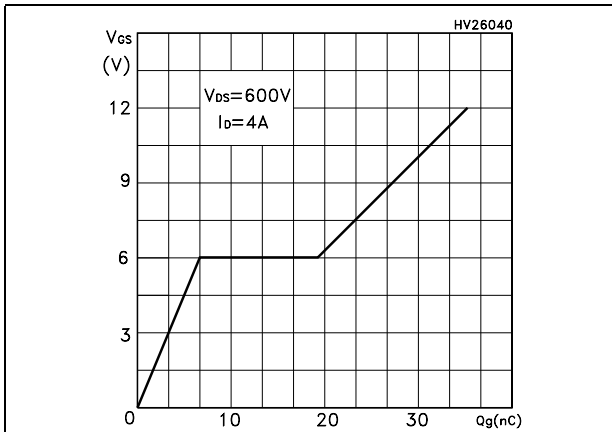


Figure 14. Normalized gate threshold voltage vs temperature

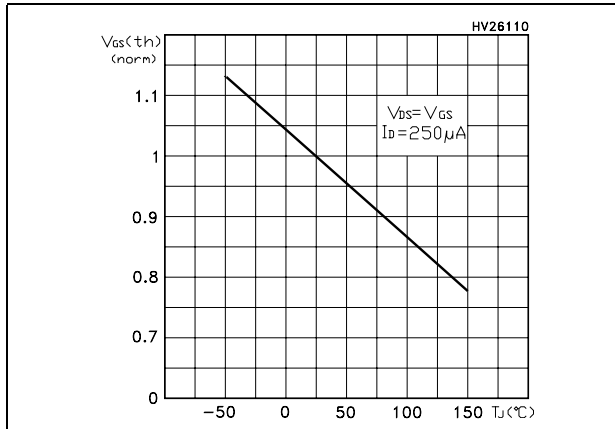


Figure 15. Normalized on resistance vs temperature

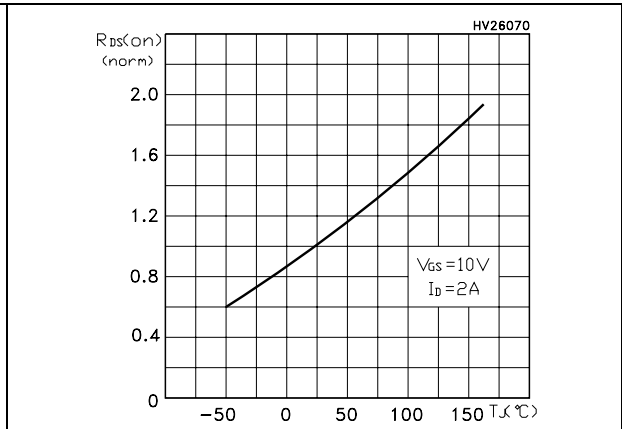


Figure 16. Source-drain diode forward characteristics

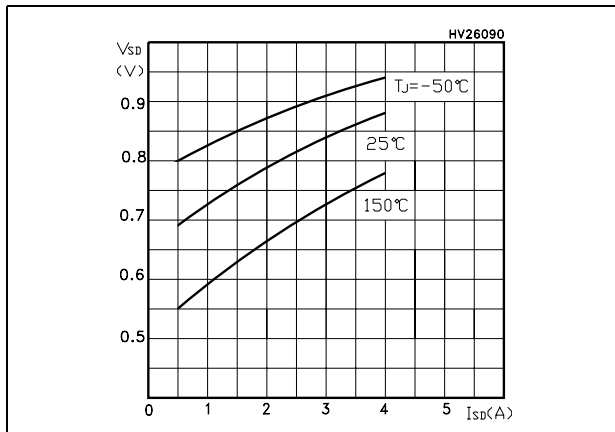


Figure 17. Normalized B_{VDSS} vs temperature

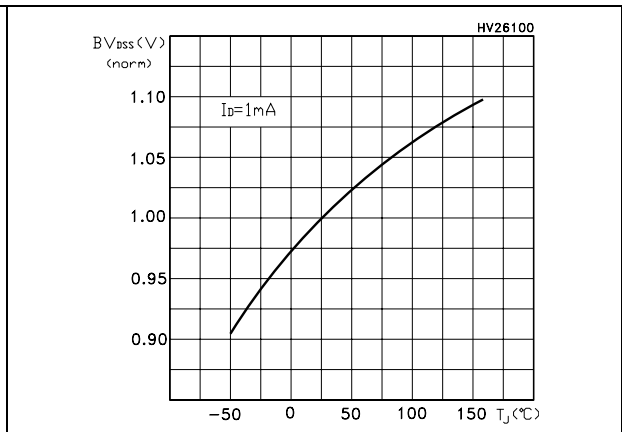
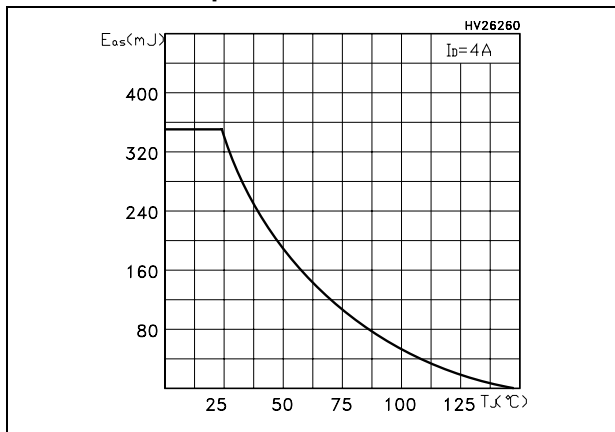
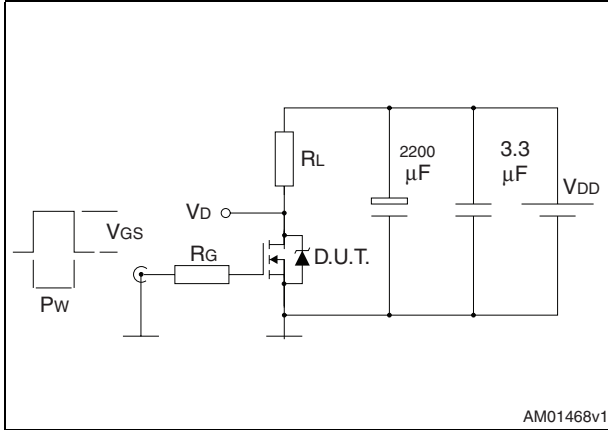


Figure 18. Maximum avalanche energy vs temperature



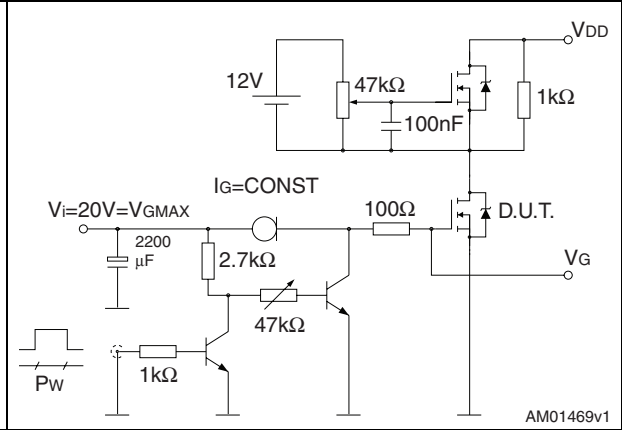
3 Test circuits

Figure 19. Switching times test circuit for resistive load



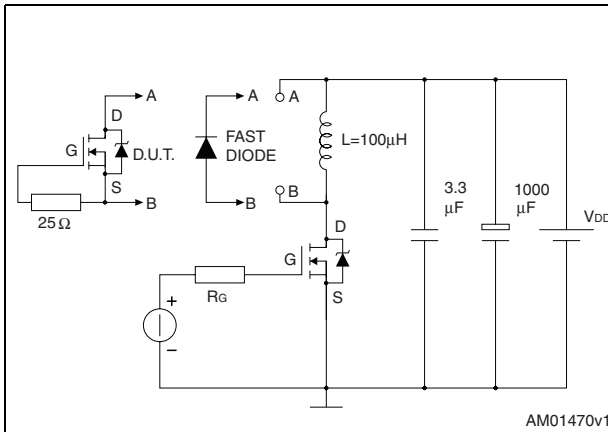
AM01468v1

Figure 20. Gate charge test circuit



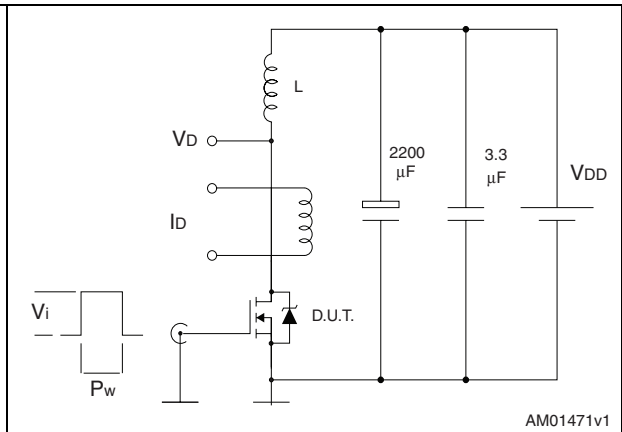
AM01469v1

Figure 21. Test circuit for inductive load switching and diode recovery times



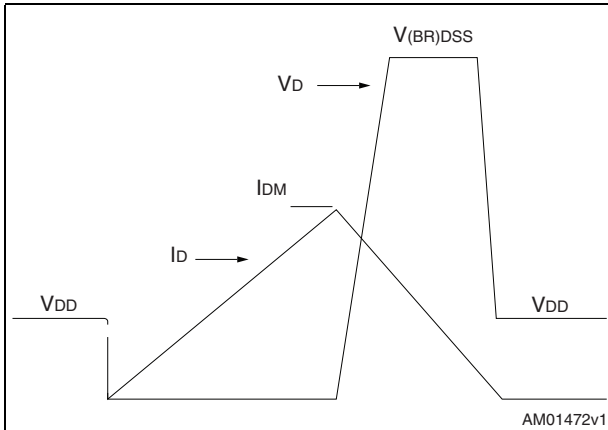
AM01470v1

Figure 22. Unclamped inductive load test circuit



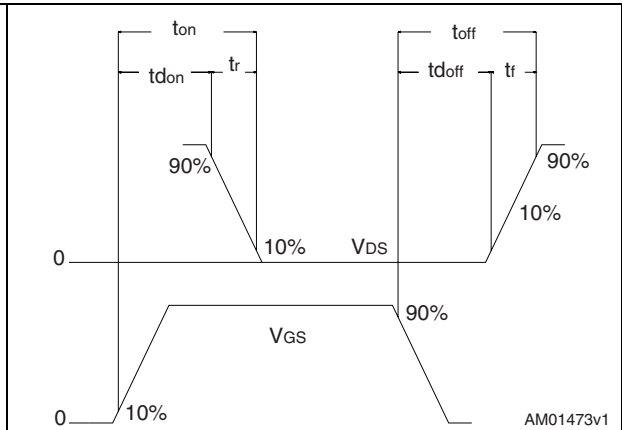
AM01471v1

Figure 23. Unclamped inductive waveform



AM01472v1

Figure 24. Switching time waveform



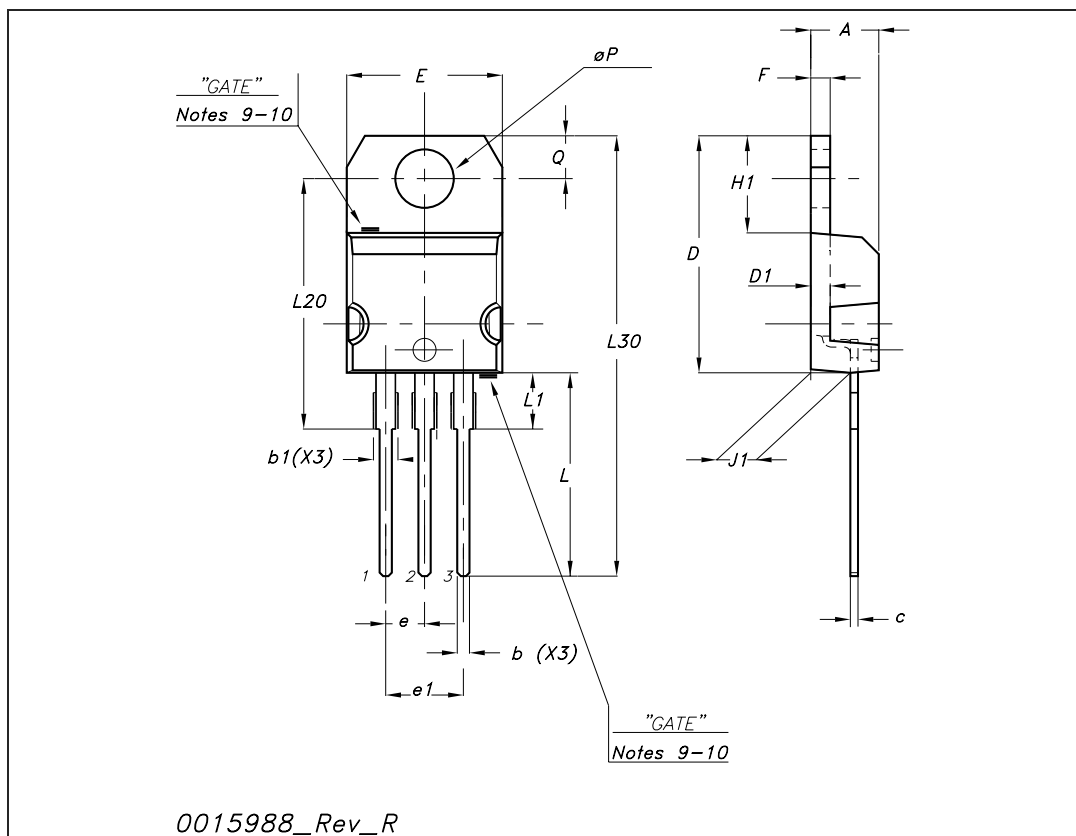
AM01473v1

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.

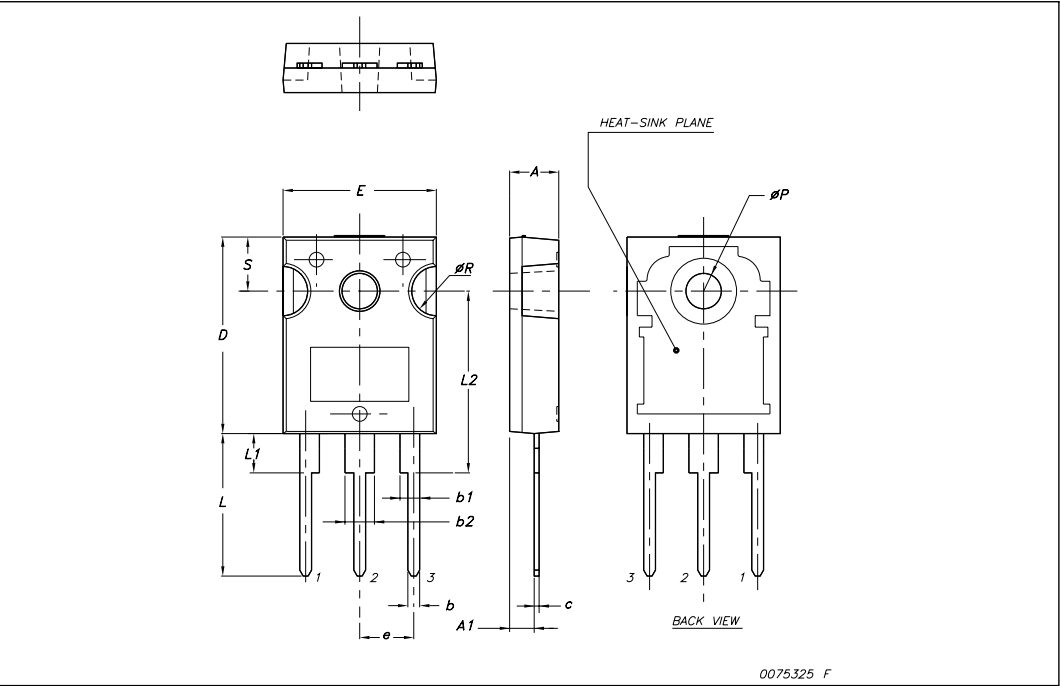
TO-220 mechanical data

| Dim | mm | | | inch | | |
|-----|-------|-------|-------|-------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.48 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.6 | | 0.62 |
| D1 | | 1.27 | | | 0.050 | |
| E | 10 | | 10.40 | 0.393 | | 0.409 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| F | 1.23 | | 1.32 | 0.048 | | 0.051 |
| H1 | 6.20 | | 6.60 | 0.244 | | 0.256 |
| J1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L20 | | 16.40 | | | 0.645 | |
| L30 | | 28.90 | | | 1.137 | |
| ∅P | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



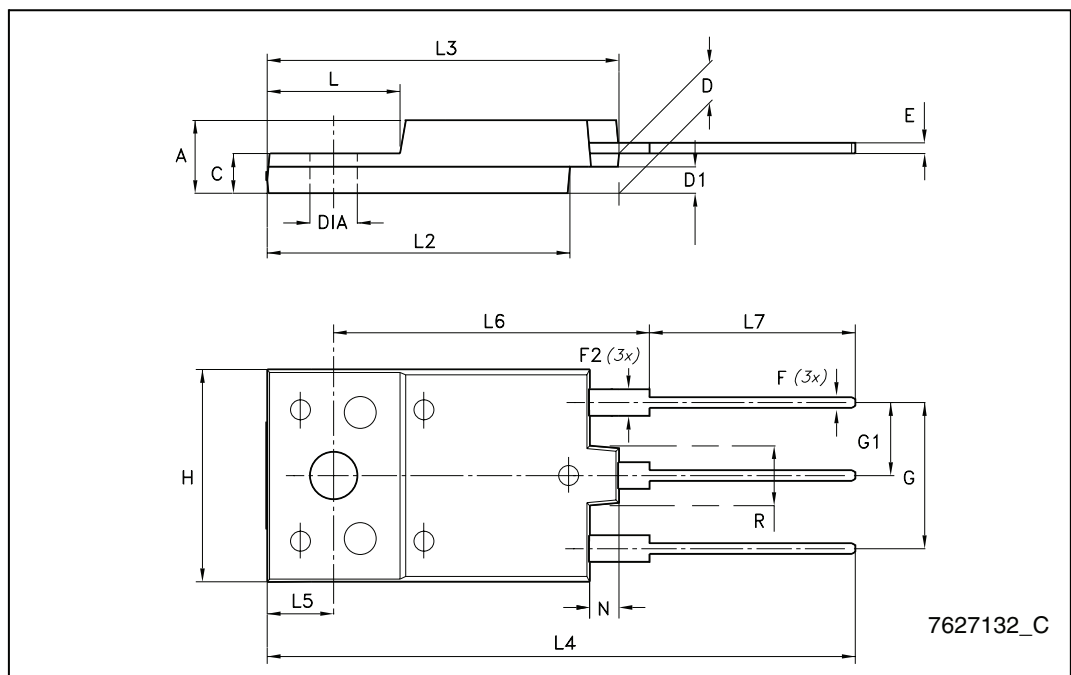
TO-247 Mechanical data

| 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 | |
| ∅P | 3.55 | | 3.65 |
| ∅R | 4.50 | | 5.50 |
| S | | 5.50 | |



TO-3PF mechanical data

| DIM. | mm. | | |
|------|-------|------|-------|
| | min. | typ | max. |
| A | 5.30 | | 5.70 |
| C | 2.80 | | 3.20 |
| D | 3.10 | | 3.50 |
| D1 | 1.80 | | 2.20 |
| E | 0.80 | | 1.10 |
| F | 0.65 | | 0.95 |
| F2 | 1.80 | | 2.20 |
| G | 10.30 | | 11.50 |
| G1 | | 5.45 | |
| H | 15.30 | | 15.70 |
| L | 9.80 | 10 | 10.20 |
| L2 | 22.80 | | 23.20 |
| L3 | 26.30 | | 26.70 |
| L4 | 43.20 | | 44.40 |
| L5 | 4.30 | | 4.70 |
| L6 | 24.30 | | 24.70 |
| L7 | 14.60 | | 15 |
| N | 1.80 | | 2.20 |
| R | 3.80 | | 4.20 |
| Dia | 3.40 | | 3.80 |



5 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 29-Mar-2005 | 1 | Initial release |
| 07-Jul-2005 | 2 | Removed TO-220FP |
| 07-Oct-2005 | 3 | Document status promoted from preliminary data to datasheet |
| 10-Aug-2006 | 4 | Document reformatted, no content change |
| 06-Nov-2007 | 5 | Updated unit on Table 5: On/off states |
| 09-Apr-2008 | 6 | Added new packages: TO-220FH, TO-3PF |
| 21-Jan-2009 | 7 | Remove package TO-220FH |
| 23-Feb-2009 | 8 | Added P_{TOT} value for TO-3PF P_{TOT} (Table 2: Absolute maximum ratings) |
| 23-Jul-2009 | 9 | Added new figures: Figure 4: Safe operating area for TO-3PF and Figure 5: Thermal impedance for TO-3PF |

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