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# STFW4N150 STP4N150, STW4N150

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

## Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> | P <sub>w</sub> |
|-----------|------------------|-------------------------|----------------|----------------|
| STFW4N150 | 1500 V           | < 7 $\Omega$            | 4 A            | 63 W           |
| STP4N150  | 1500 V           | < 7 $\Omega$            | 4 A            | 160 W          |
| STW4N150  | 1500 V           | < 7 $\Omega$            | 4 A            | 160 W          |

- 100% avalanche tested
- Intrinsic capacitances and Q<sub>g</sub> 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<sub>DS(on)</sub> per area, unrivalled gate charge and switching characteristics.

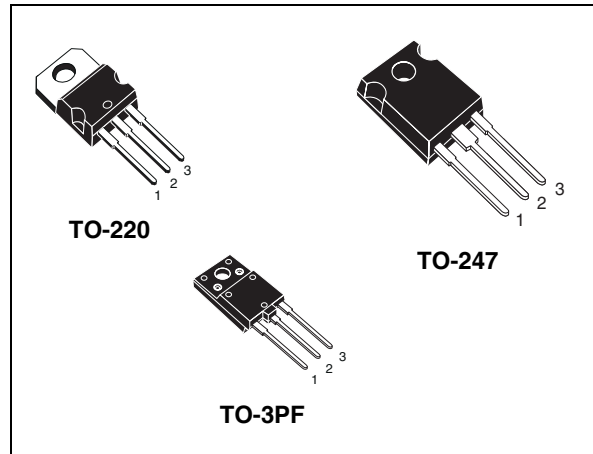


Figure 1. Internal schematic diagram.

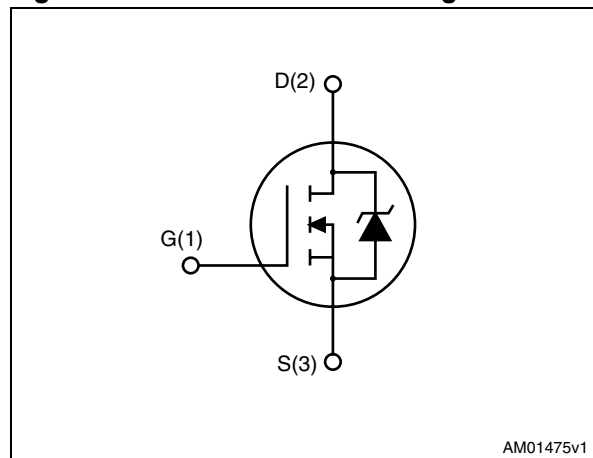


Table 1. Device summary

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

## Contents

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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   | $\pm 30$   |        |                    | V                |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$   | 4          | 4      | 4 <sup>(1)</sup>   | A                |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$  | 2.5        | 2.5    | 2.5 <sup>(1)</sup> | A                |
| $I_{DM}^{(1)}$ | Drain current (pulsed)   | 12         | 12     | 12 <sup>(1)</sup>  | 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 ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$<br>$V_{DS} = \text{Max rating}$ , $T_C = 125\text{ °C}$ |      |      | 10<br>500 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 30\text{ V}$   |      |      | $\pm 100$ | 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         | $\Omega$                       |

**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            | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$  | -    | 1300 |      | pF   |
| $C_{oss}$      | Output capacitance           |  |      | 120  |      | pF   |
| $C_{rss}$      | Reverse transfer capacitance |  |      | 12   |      | pF   |
| $t_{d(on)}$    | Turn-on delay time           | $V_{DD} = 750\text{ V}$ , $I_D = 2\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br><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            | $V_{DD} = 600\text{ V}$ , $I_D = 4\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br><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  $\mu\text{s}$ , 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         | $I_{SD} = 4 \text{ A},$<br>$di/dt = 100 \text{ A}/\mu\text{s}$<br>$V_{DD} = 45 \text{ V}$<br><i>Figure 21</i>                          | -    | 510  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |  |      | 3    |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  |      | 12   |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 4 \text{ A},$<br>$di/dt = 100 \text{ A}/\mu\text{s}$<br>$V_{DD} = 45 \text{ V}, T_j = 150^\circ\text{C}$<br><i>Figure 21</i> | -    | 615  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |  |      | 4    |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |  |      | 12.6 |      | 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 for TO-220

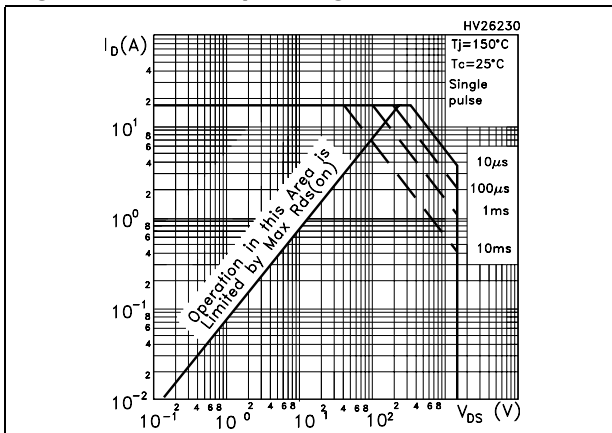


Figure 3. Thermal impedance for TO-220

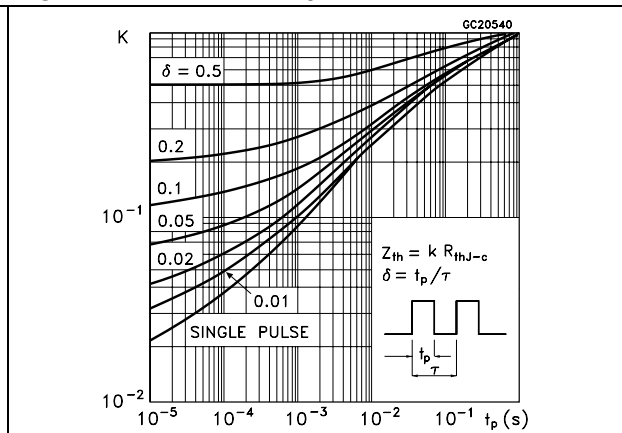


Figure 4. Safe operating area for TO-3PF

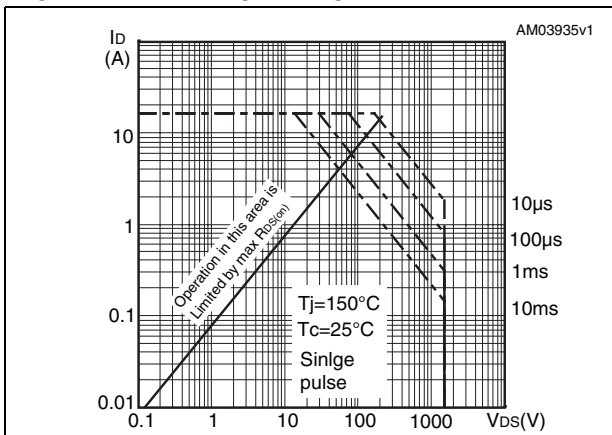


Figure 5. Thermal impedance for TO-3PF

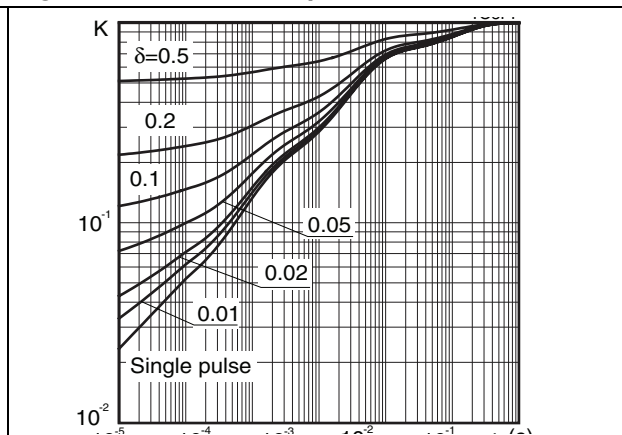


Figure 6. Safe operating area for TO-247

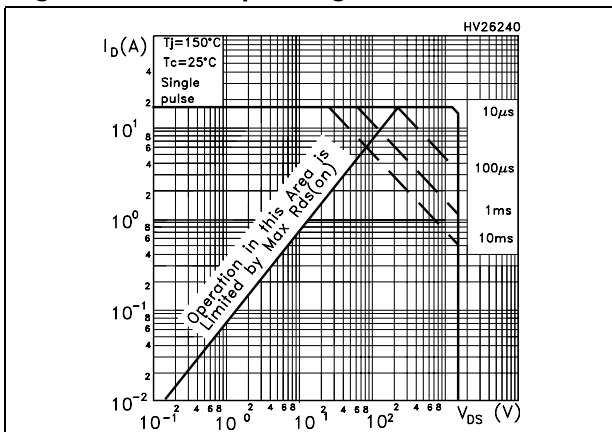


Figure 7. Thermal impedance for TO-247

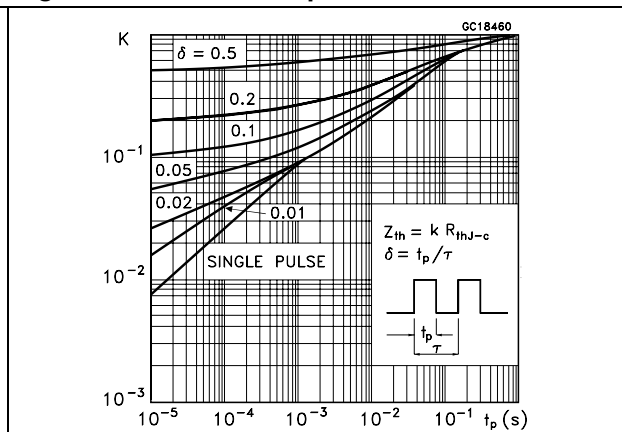


Figure 8. Output characteristics

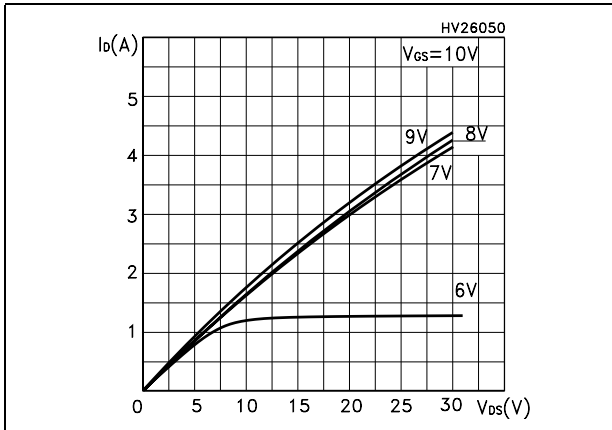


Figure 9. Transfer characteristics

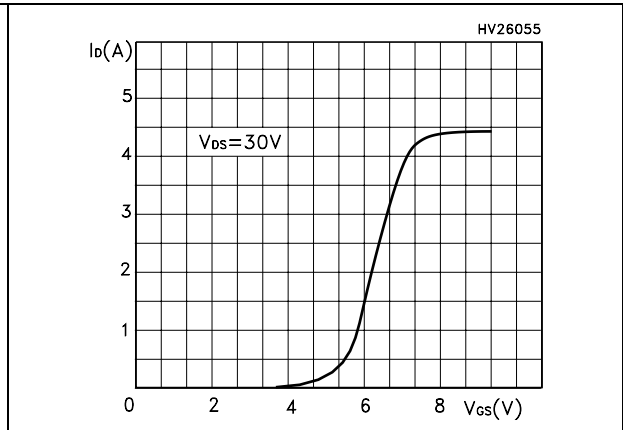


Figure 10. Transconductance

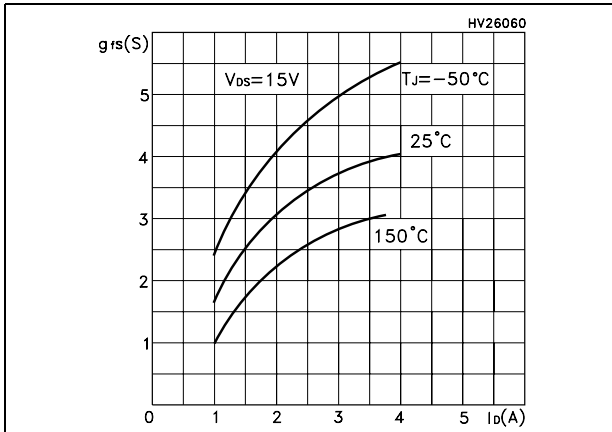


Figure 11. Static drain-source on resistance

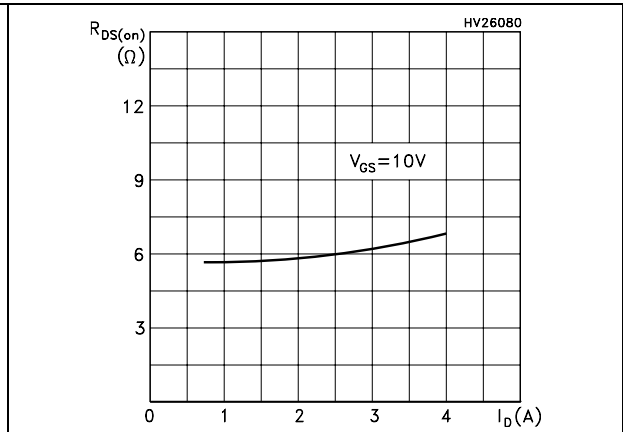


Figure 12. Gate charge vs gate-source voltage Figure 13. Capacitance variations

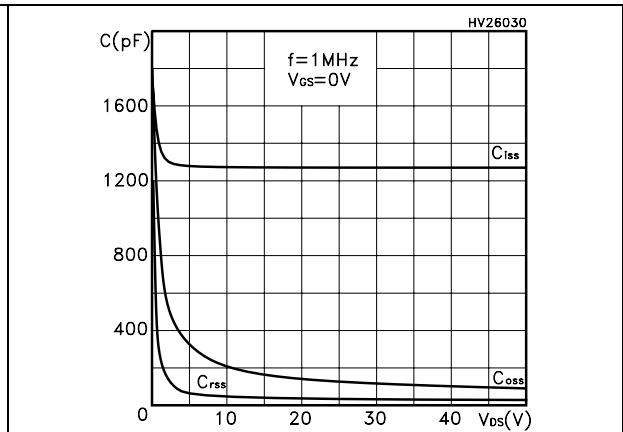
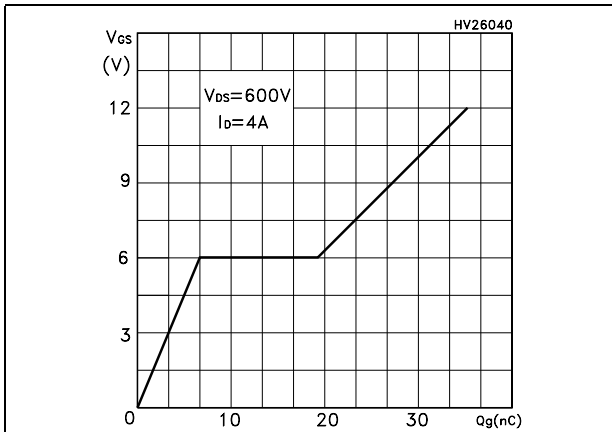




Figure 14. Normalized gate threshold voltage vs temperature

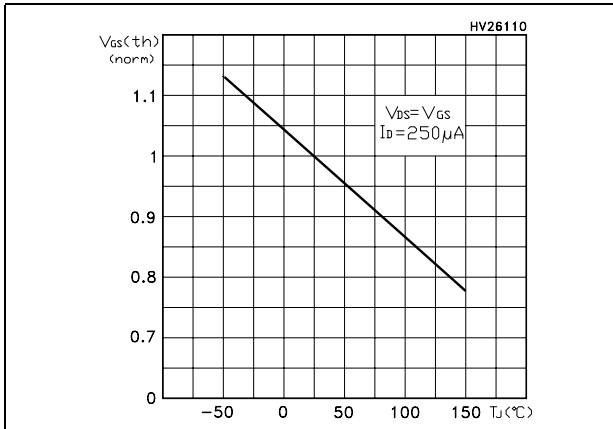


Figure 15. Normalized on resistance vs temperature

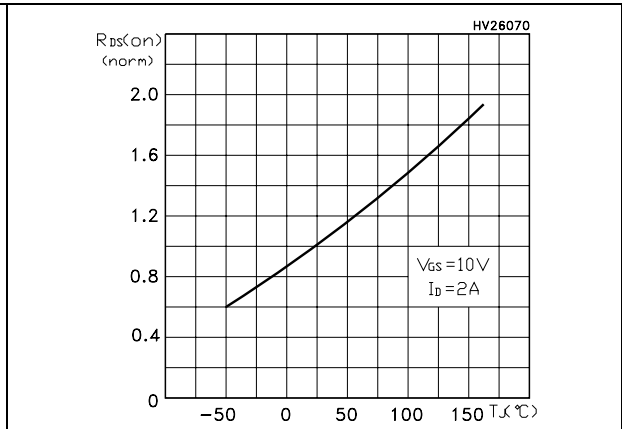


Figure 16. Source-drain diode forward characteristics

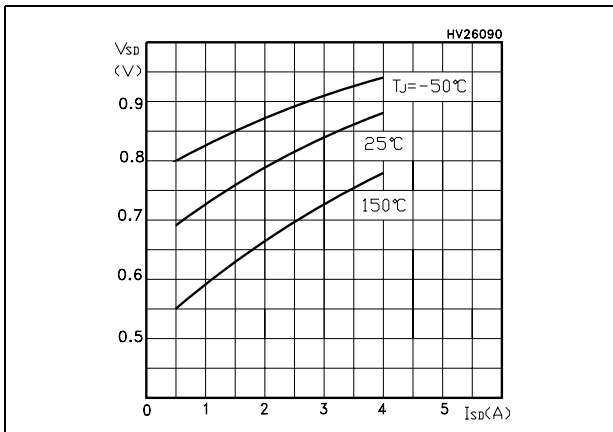


Figure 17. Normalized B<sub>VDSS</sub> vs temperature

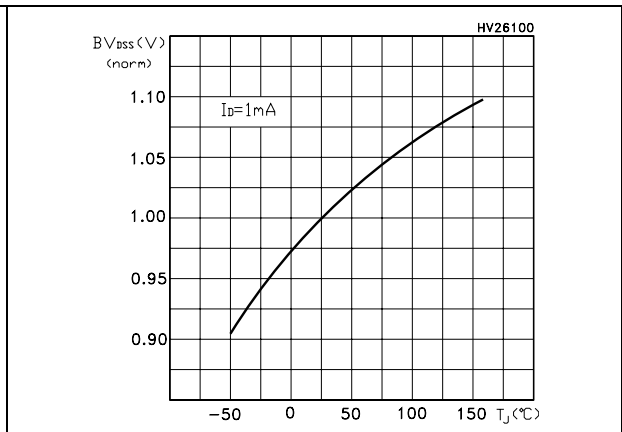
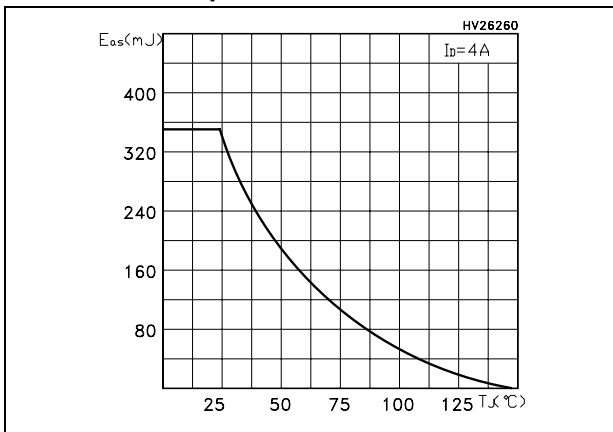
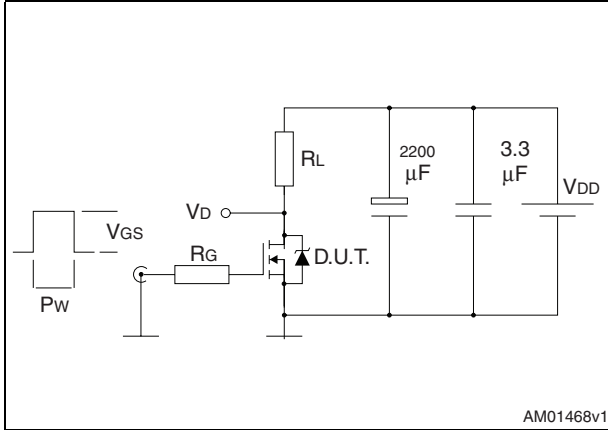


Figure 18. Maximum avalanche energy vs temperature



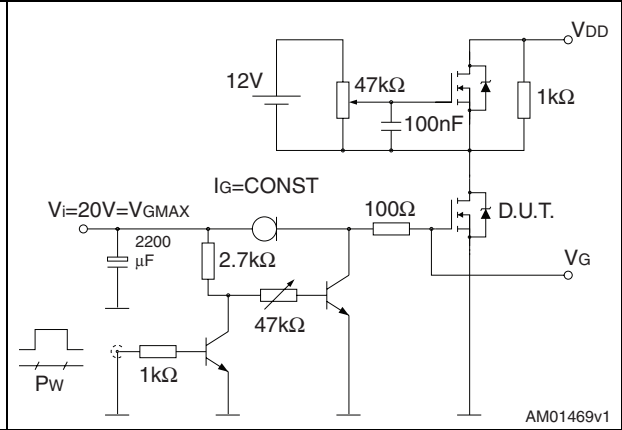
### 3 Test circuits

**Figure 19. Switching times test circuit for resistive load**



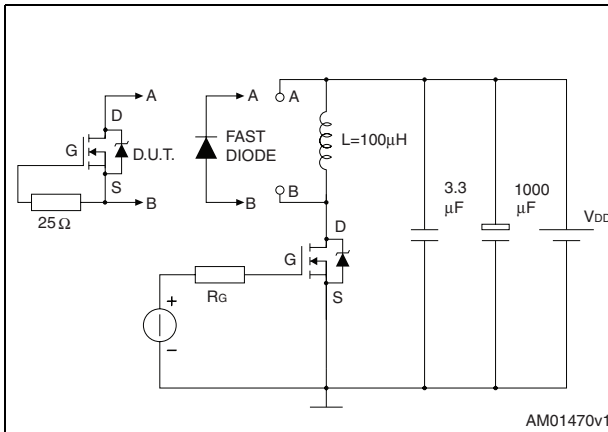
AM01468v1

**Figure 20. Gate charge test circuit**



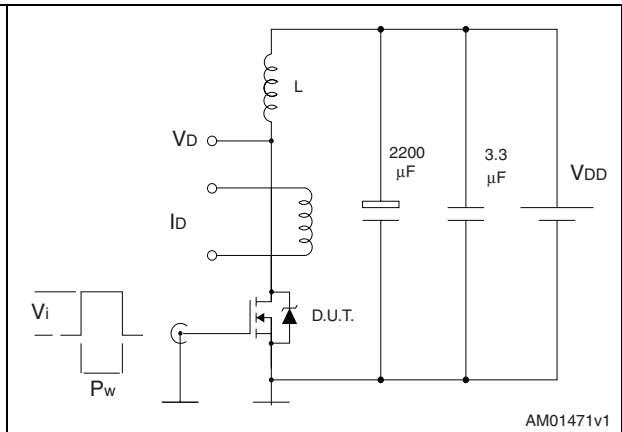
AM01469v1

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



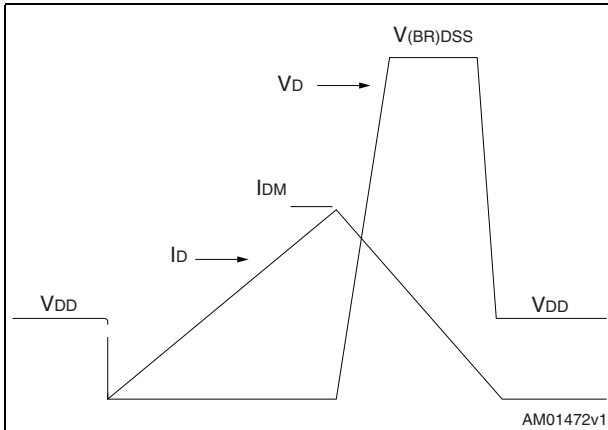
AM01470v1

**Figure 22. Unclamped inductive load test circuit**



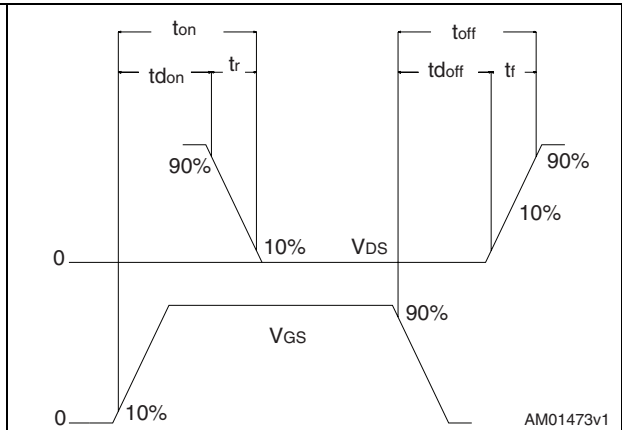
AM01471v1

**Figure 23. Unclamped inductive waveform**



AM01472v1

**Figure 24. Switching time waveform**



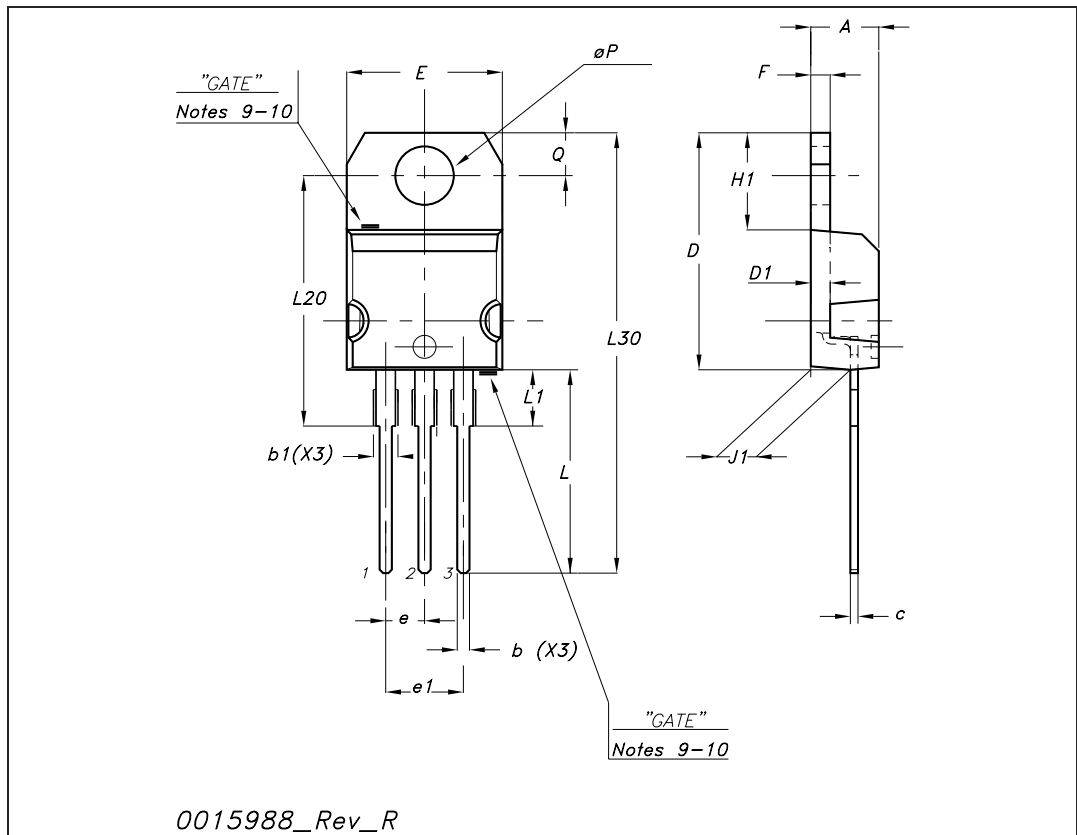
AM01473v1

## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

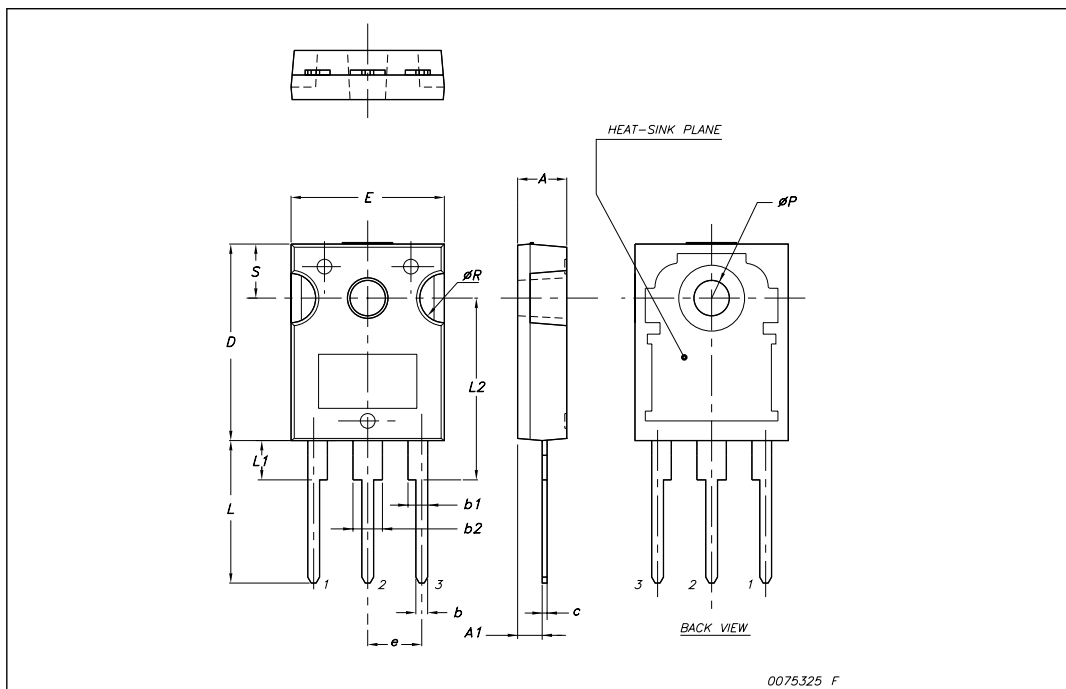
TO-220 mechanical data

| 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 |



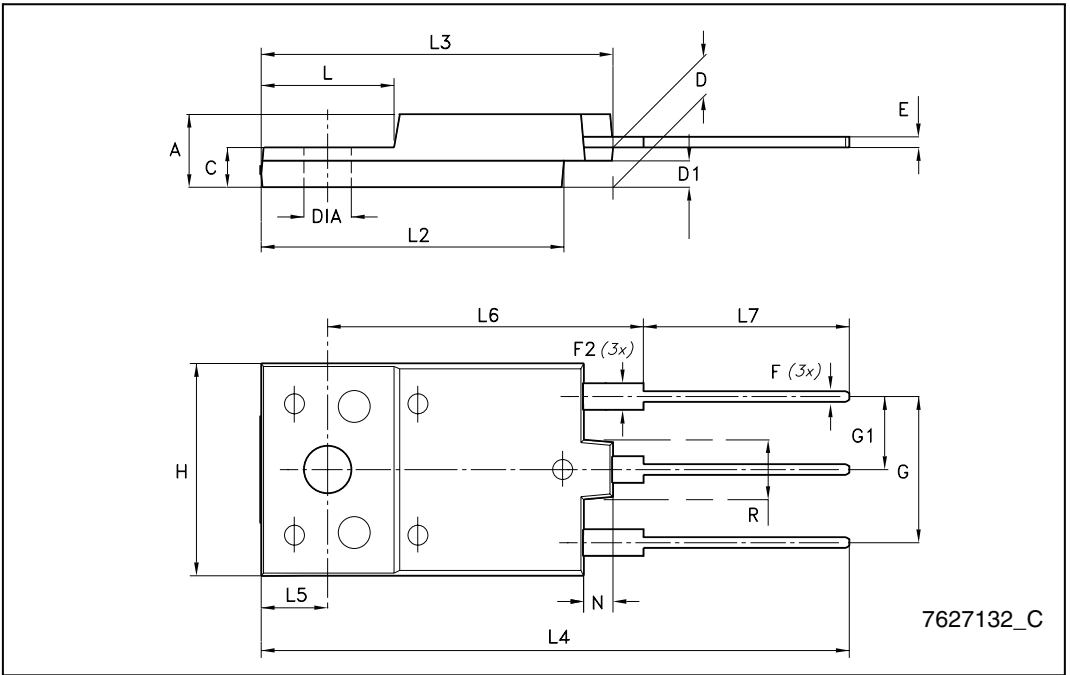
**TO-247 Mechanical data**

| 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 |       |
| øP   | 3.55  |       | 3.65  |
| øR   | 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 <a href="#">Table 5: On/off states</a>   |
| 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 $P_{TOT}$ ( <a href="#">Table 2: Absolute maximum ratings</a> )                                       |
| 23-Jul-2009 | 9        | Added new figures: <a href="#">Figure 4: Safe operating area for TO-3PF</a> and <a href="#">Figure 5: Thermal impedance for TO-3PF</a> |

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