



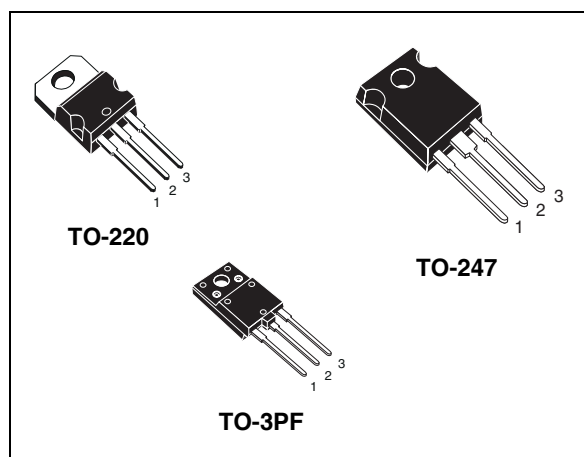
# STFW4N150 STP4N150, STW4N150

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.

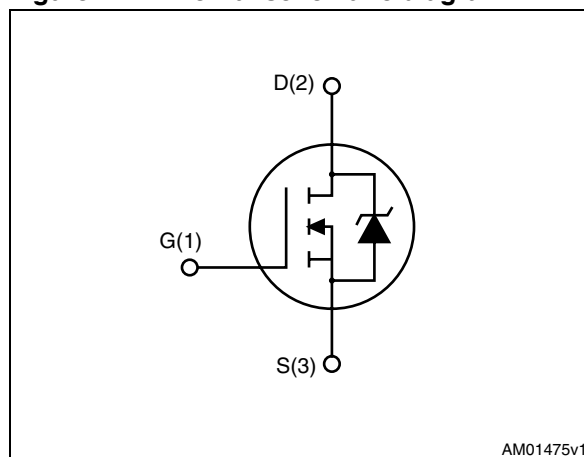


Table 1. Device summary

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

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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                    |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$           | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$                                                                     | -    | 1300<br>120<br>12    |      | pF<br>pF<br>pF       |
| $t_{d(on)}$<br>$T_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on delay time<br>Rise time<br>Turn-off delay time<br>Fall time     | $V_{DD} = 750\text{ V}$ , $I_D = 2\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br><a href="#">Figure 19</a> | -    | 35<br>30<br>45<br>45 |      | ns<br>ns<br>ns<br>ns |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$                 | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 600\text{ V}$ , $I_D = 4\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br><a href="#">Figure 20</a>                             | -    | 30<br>10<br>9        | 50   | nC<br>nC<br>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><a href="#">Figure 21</a>                             | -    | 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><a href="#">Figure 21</a> | -    | 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

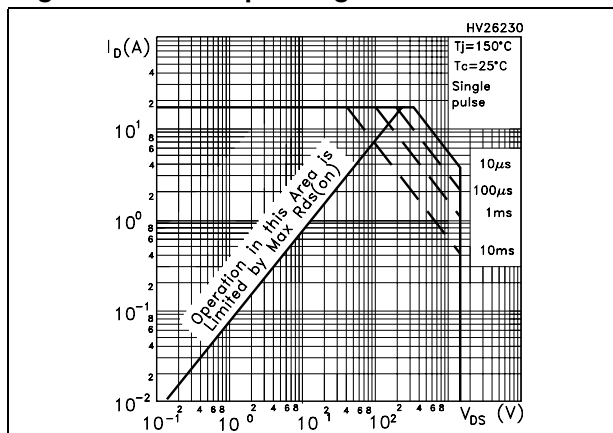


Figure 3. Thermal impedance for TO-220

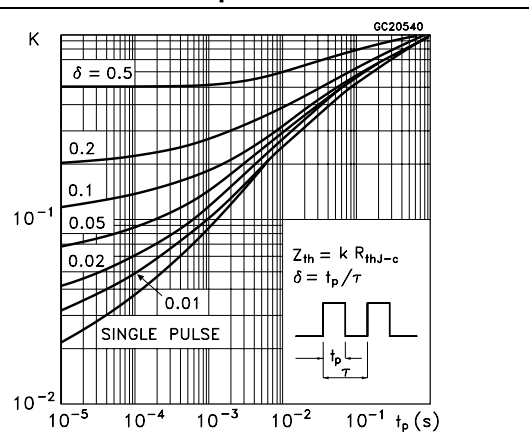


Figure 4. Safe operating area for TO-3PF

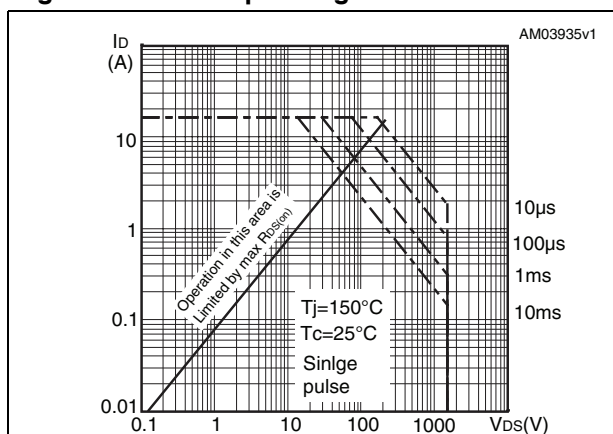


Figure 5. Thermal impedance for TO-3PF

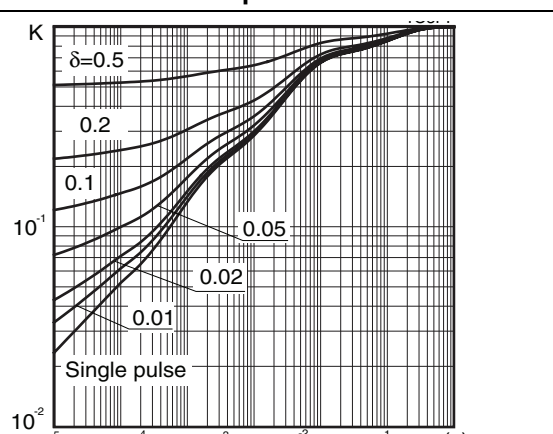


Figure 6. Safe operating area for TO-247

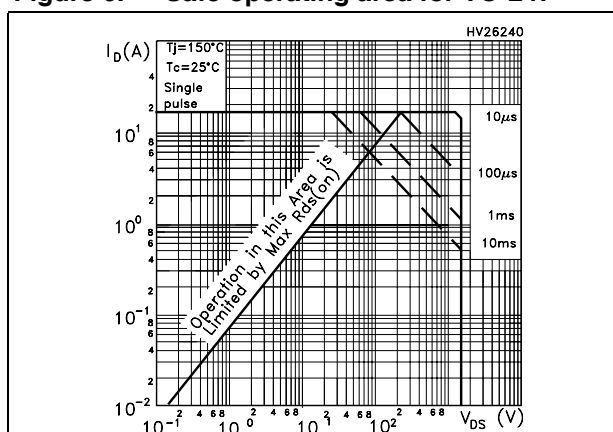


Figure 7. Thermal impedance for TO-247

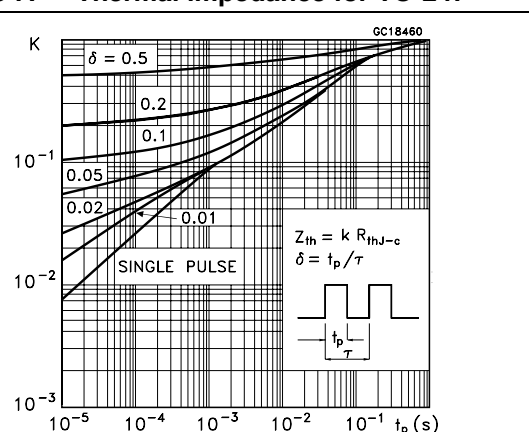


Figure 8. Output characteristics

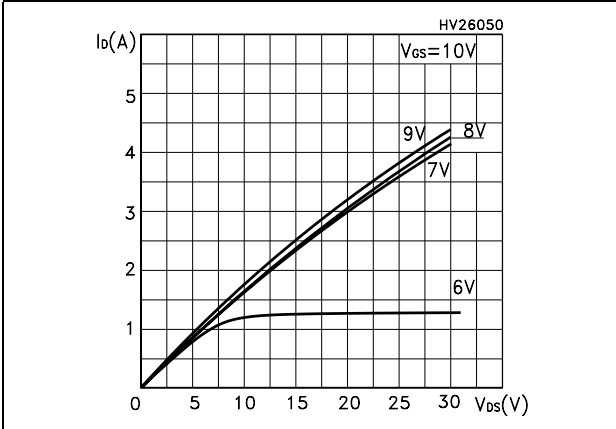


Figure 9. Transfer characteristics

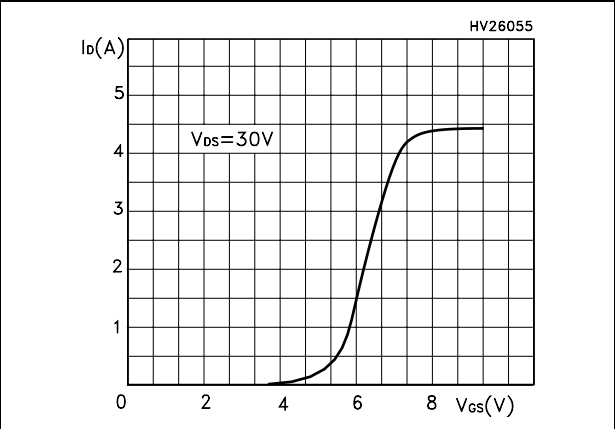


Figure 10. Transconductance

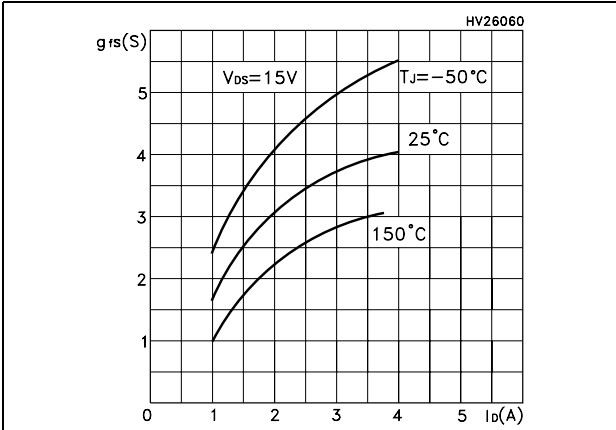


Figure 11. Static drain-source on resistance

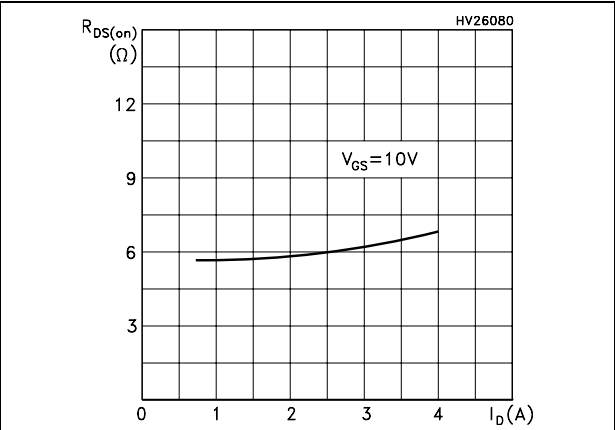


Figure 12. Gate charge vs gate-source voltage

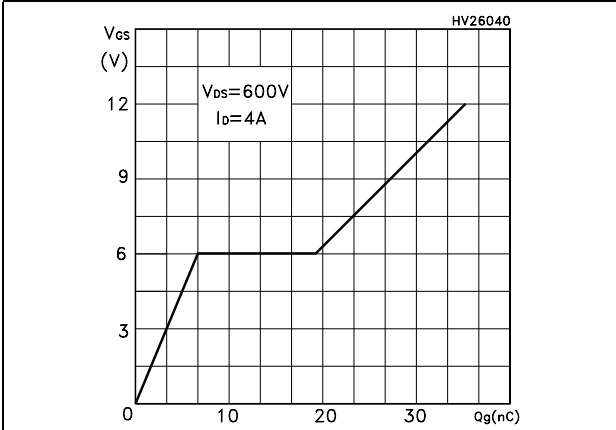


Figure 13. Capacitance variations

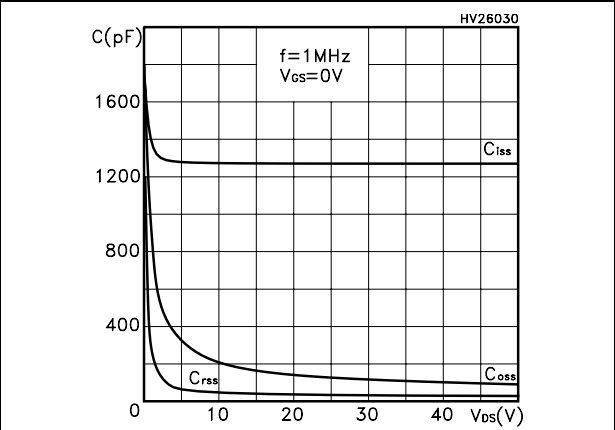


Figure 14. Normalized gate threshold voltage vs temperature

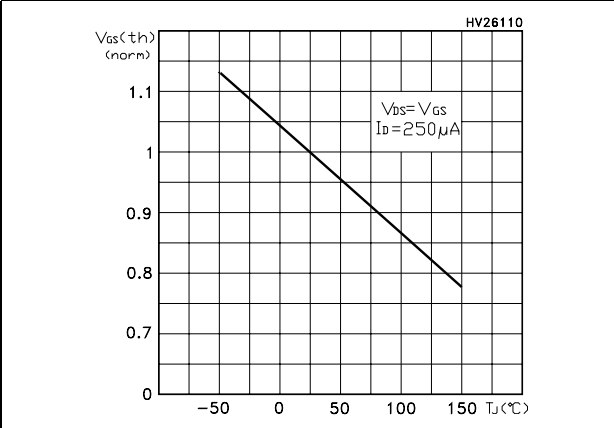


Figure 15. Normalized on resistance vs temperature

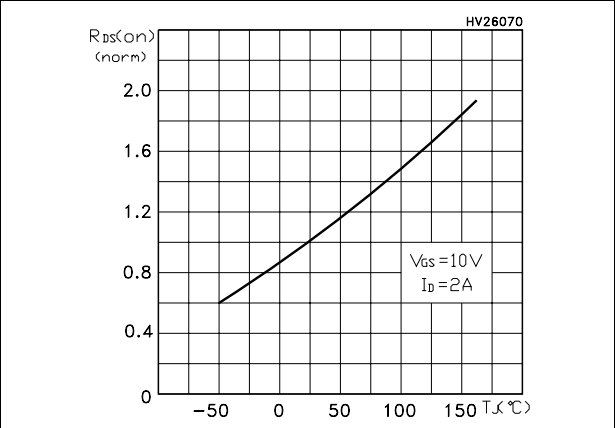


Figure 16. Source-drain diode forward characteristics

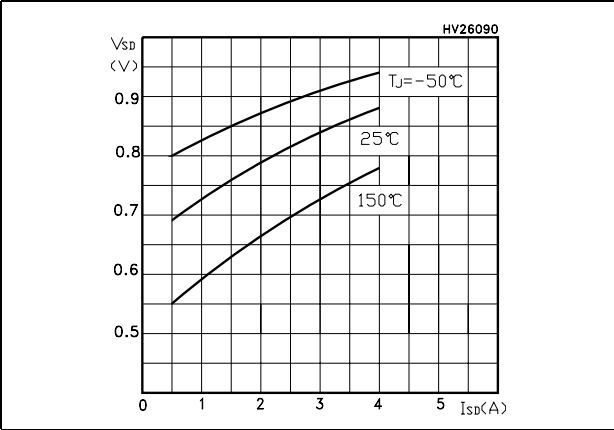


Figure 17. Normalized  $B_{VDS}$  vs temperature

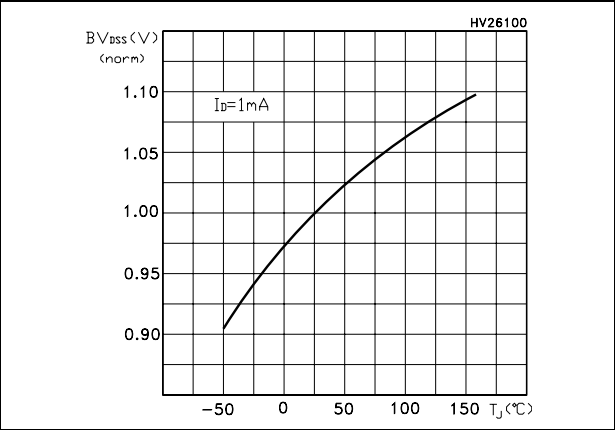
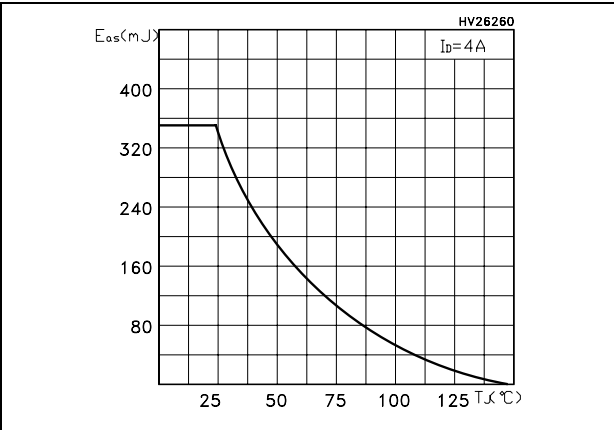
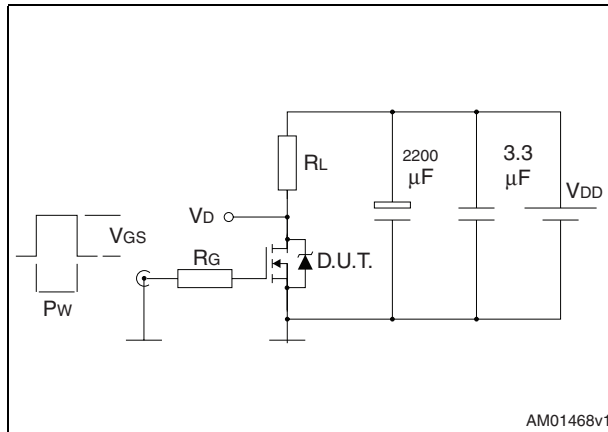


Figure 18. Maximum avalanche energy vs temperature

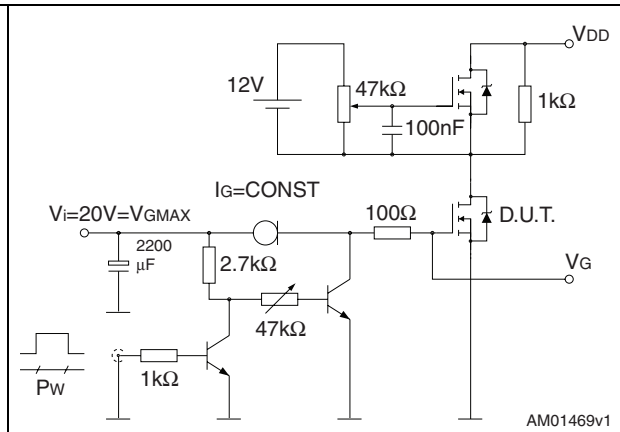


### 3 Test circuits

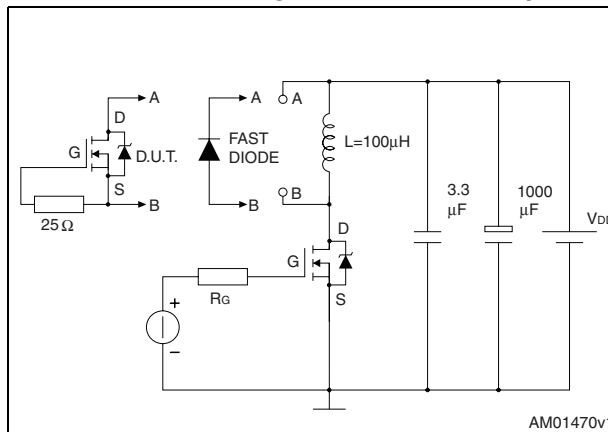
**Figure 19. Switching times test circuit for resistive load**



**Figure 20. Gate charge test circuit**



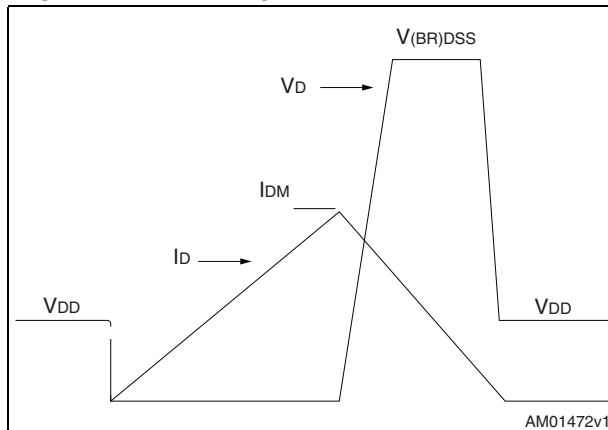
**Figure 21. Test circuit for inductive load switching and diode recovery times**



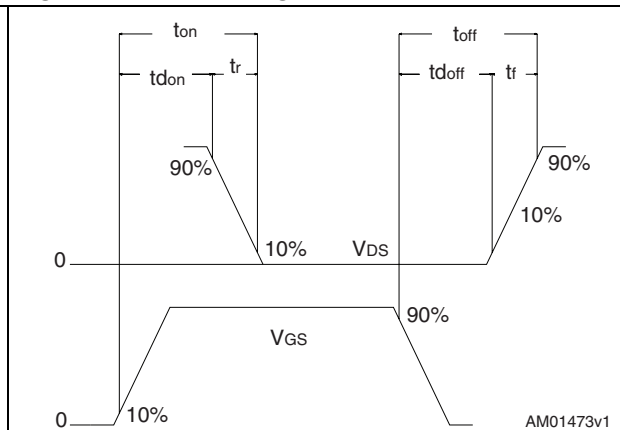
**Figure 22. Unclamped inductive load test circuit**



**Figure 23. Unclamped inductive waveform**



**Figure 24. Switching time waveform**

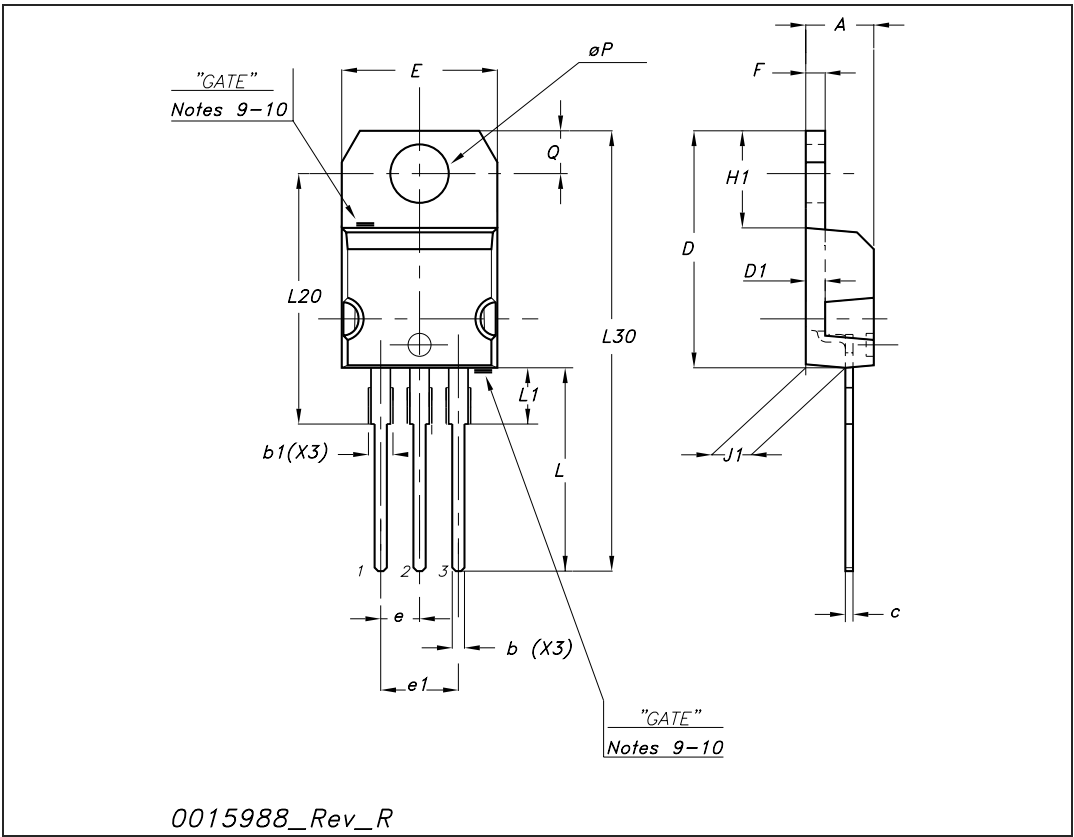


## 4 Package mechanical data

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.

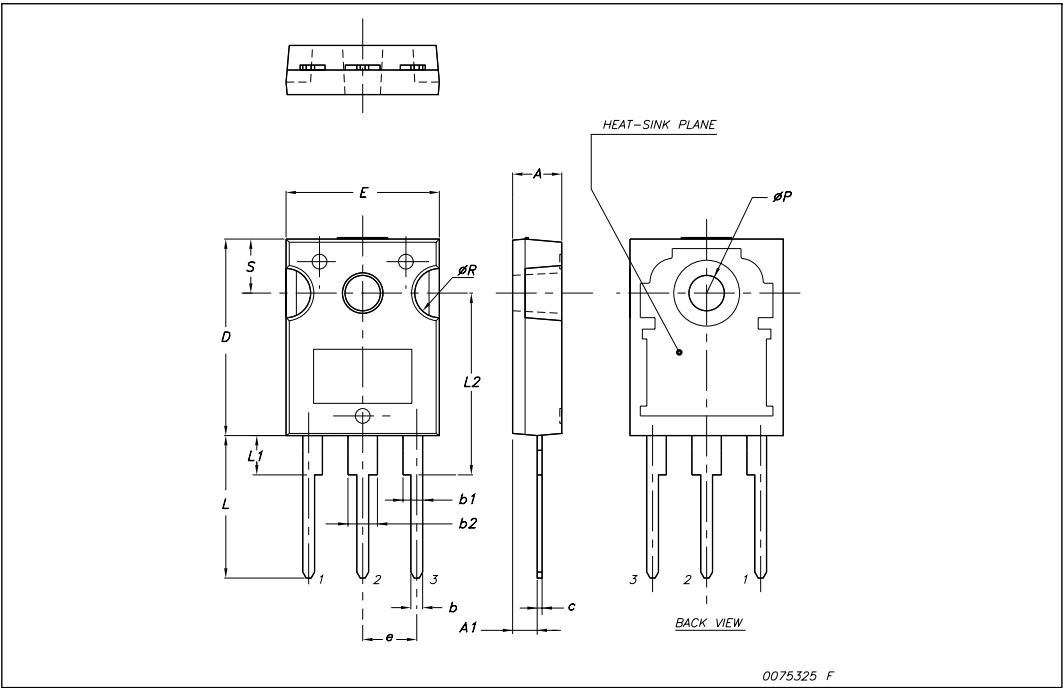
TO-220 mechanical data

| 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 |       |
| ØP  | 3.75  |       | 3.85  | 0.147 |       | 0.151 |
| Q   | 2.65  |       | 2.95  | 0.104 |       | 0.116 |



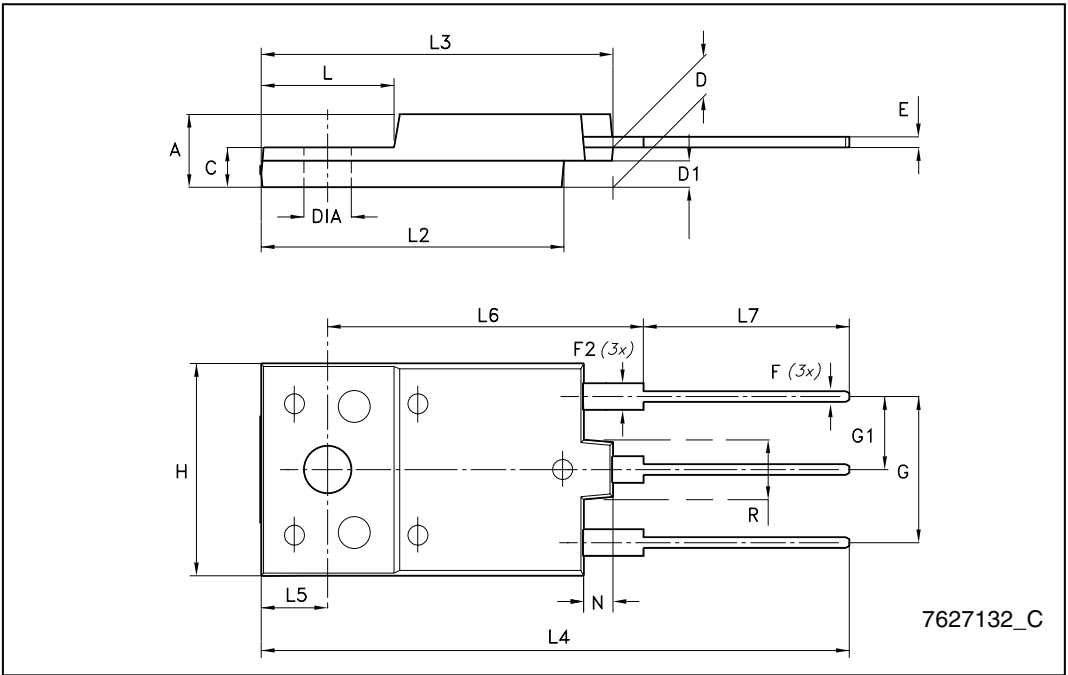
TO-247 Mechanical data

| 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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