



# STD20NF20 STF20NF20, STP20NF20

N-channel 200 V, 0.10  $\Omega$ , 18 A DPAK, TO-220, TO-220FP  
low gate charge STripFET™ Power MOSFET

## Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> | P <sub>W</sub> |
|-----------|------------------|---------------------|----------------|----------------|
| STD20NF20 | 200 V            | < 0.125 $\Omega$    | 18 A           | 110 W          |
| STF20NF20 | 200 V            | < 0.125 $\Omega$    | 18 A           | 30 W           |
| STP20NF20 | 200 V            | < 0.125 $\Omega$    | 18 A           | 110 W          |

- Exceptional dv/dt capability
- Low gate charge
- 100% avalanche tested

## Application

- Switching applications

## Description

This Power MOSFET series realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters.

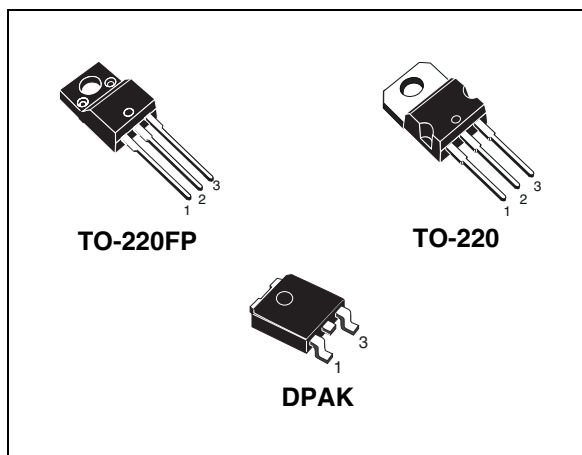


Figure 1. Internal schematic diagram

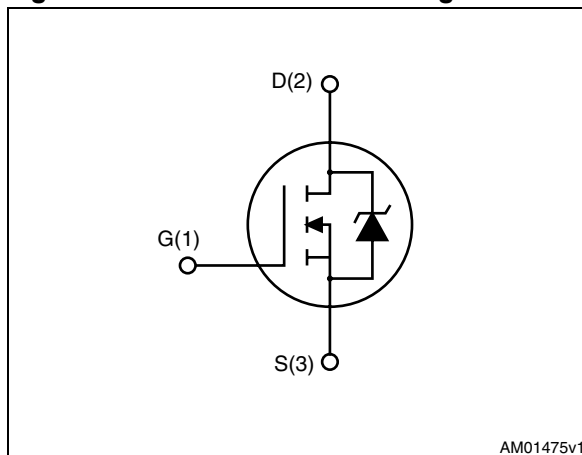


Table 1. Device summary

| Order codes | Marking | Package  | Packaging     |
|-------------|---------|----------|---------------|
| STD20NF20   | 20NF20  | DPAK     | Tape and reel |
| STF20NF20   | 20NF20  | TO-220FP | Tube          |
| STP20NF20   | 20NF20  | TO-220   | Tube          |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                                                                                                               | Value        |          | Unit                  |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------|----------|-----------------------|
|                |                                                                                                                                         | TO-220, DPAK | TO-220FP |                       |
| $V_{DS}$       | Drain-source voltage ( $V_{GS} = 0$ )                                                                                                   | 200          |          | V                     |
| $V_{GS}$       | Gate- source voltage                                                                                                                    | $\pm 20$     |          | V                     |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$                                                                        | 18           |          | A                     |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$                                                                       | 11           |          | A                     |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                                                                                                  | 72           |          | A                     |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$                                                                                 | 110          | 30       | W                     |
|                | Derating factor                                                                                                                         | 0.72         | 0.2      | W/ $^{\circ}\text{C}$ |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                                                                                                       | 15           |          | V/ns                  |
| $V_{ISO}$      | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ }^{\circ}\text{C}$ ) |              | 2500     | V                     |
| $T_{stg}$      | Storage temperature                                                                                                                     | -55 to 175   |          | $^{\circ}\text{C}$    |
| $T_j$          | Max. operating junction temperature                                                                                                     |              |          |                       |

1. Pulse width limited by safe operating area

2.  $I_{SD} \leq 18\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$

**Table 3. Thermal data**

| Symbol         | Parameter                                      | TO-220 | DPAK              | TO-220FP | Unit                        |
|----------------|------------------------------------------------|--------|-------------------|----------|-----------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max           | 1.38   | 1.38              | 5        | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max        | 62.5   | 50 <sup>(1)</sup> | 62.5     | $^{\circ}\text{C}/\text{W}$ |
| $T_I$          | Maximum lead temperature for soldering purpose |        |                   | 300      | $^{\circ}\text{C}$          |

1. When mounted on 1inch<sup>2</sup> FR-4, 2 Oz copper board.

**Table 4. Avalanche characteristics**

| Symbol   | Parameter                                                                                                              | Max value | Unit |
|----------|------------------------------------------------------------------------------------------------------------------------|-----------|------|
| $I_{AR}$ | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)                                     | 18        | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 110       | mJ   |

## 2 Electrical characteristics

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

**Table 5. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                            | Min. | Typ. | Max.      | Unit                           |
|---------------|--------------------------------------------------|--------------------------------------------------------------------------------------------|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$                                                         | 200  |      |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$<br>$V_{DS} = \text{Max rating}$ , $T_C = 125^{\circ}\text{C}$ |      |      | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                                                 |      |      | $\pm 100$ | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                         | 2    | 3    | 4         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 10\text{ A}$                                               |      | 0.10 | 0.125     | $\Omega$                       |

**Table 6. Dynamic**

| Symbol                                        | Parameter                                                               | Test conditions                                                                                                          | Min. | Typ.                 | Max. | Unit                 |
|-----------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------|----------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance                                                | $V_{DS} = 25\text{ V}$ , $I_D = 10\text{ A}$                                                                             | -    | 13                   |      | 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>$V_{GS} = 0$                                                            | -    | 940<br>197<br>30     |      | 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     | $V_{DD} = 100\text{ V}$ , $I_D = 10\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see Figure 15) | -    | 15<br>30<br>40<br>10 |      | 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            | $V_{DD} = 160\text{ V}$ , $I_D = 20\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br>(see Figure 16)                             | -    | 28<br>5.6<br>14.5    | 39   | 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          |
|-----------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------|----------|---------------|
| $I_{SD}$<br>$I_{SDM}^{(1)}$       | Source-drain current<br>Source-drain current<br>(pulsed)                     |                                                                                                                                              | -    |                     | 18<br>72 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 20\text{ A}$ , $V_{GS} = 0$                                                                                                        | -    |                     | 1.6      | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 50\text{ V}$<br>(see Figure 20)                                     | -    | 155<br>775<br>10    |          | ns<br>nC<br>A |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 20\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 50\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see Figure 20) | -    | 183<br>1061<br>11.6 |          | ns<br>nC<br>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, DPAK

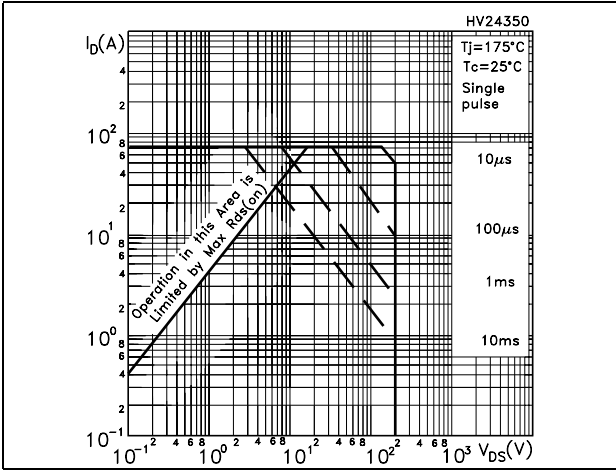


Figure 3. Thermal impedance area for TO-220, DPAK

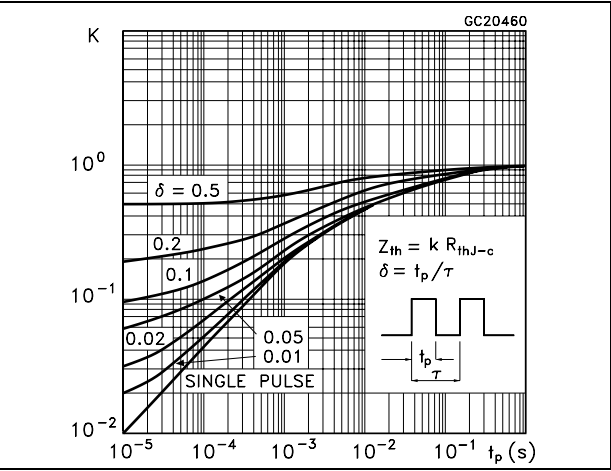


Figure 4. Safe operating area for TO-220FP

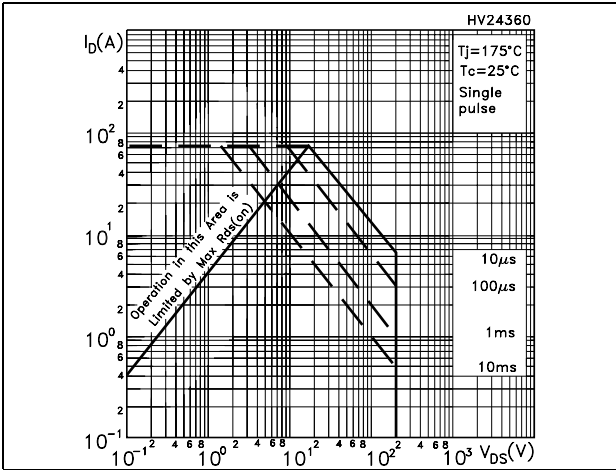


Figure 5. Thermal impedance for TO-220FP

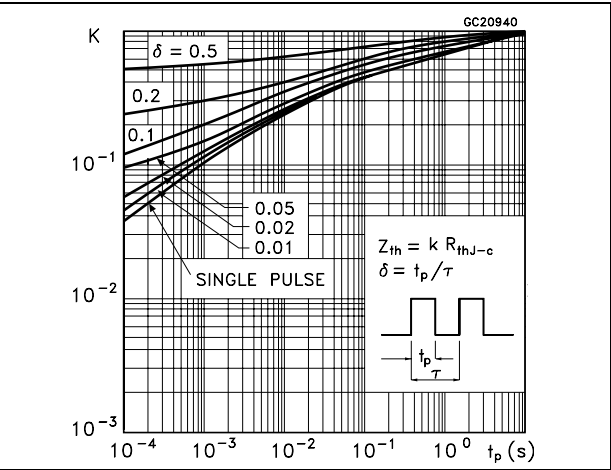


Figure 6. Output characteristics

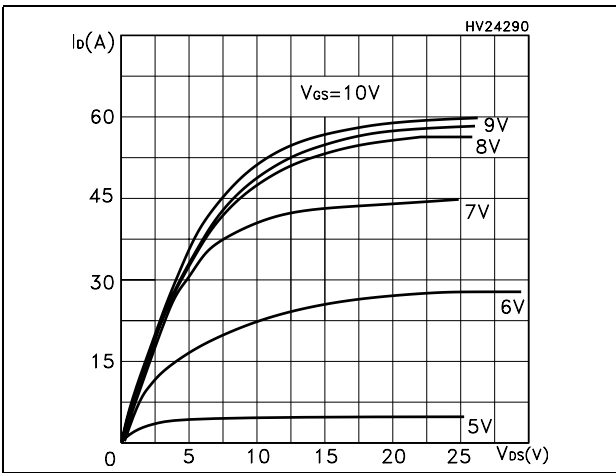


Figure 7. Transfer characteristics

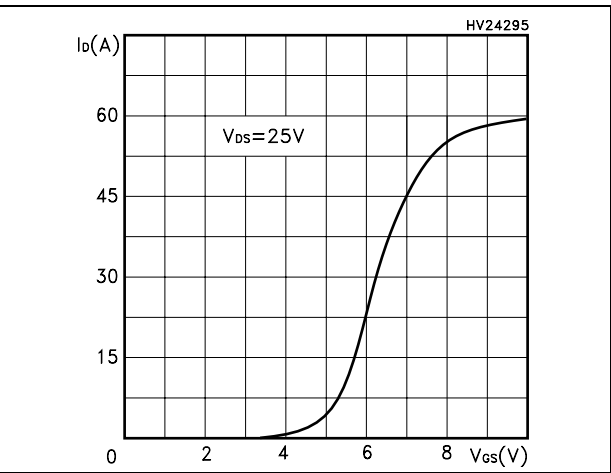


Figure 8. Transconductance

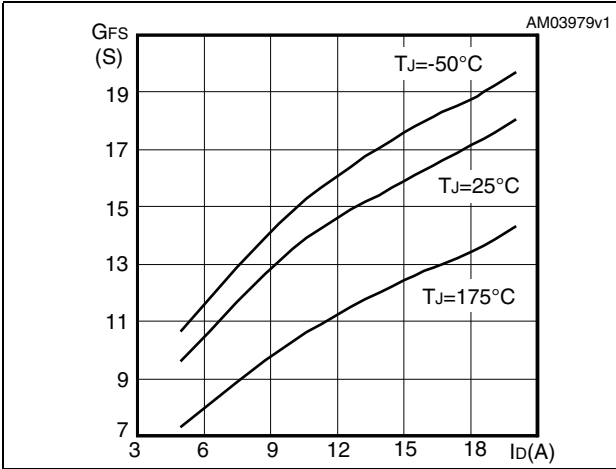


Figure 9. Static drain-source on resistance

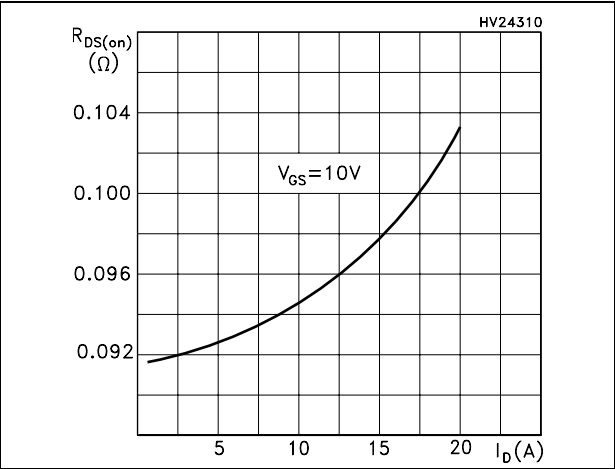


Figure 10. Gate charge vs gate-source voltage

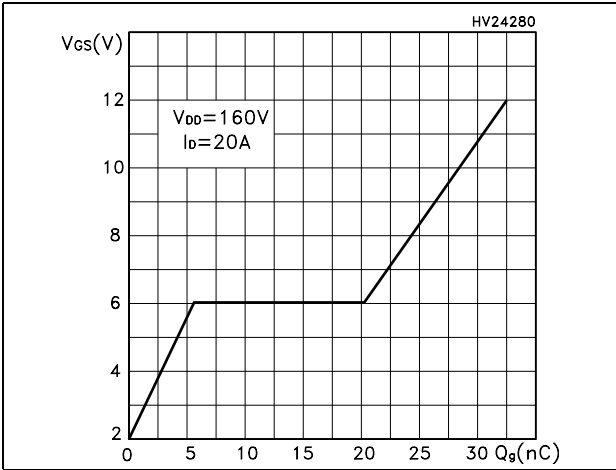


Figure 11. Capacitance variations

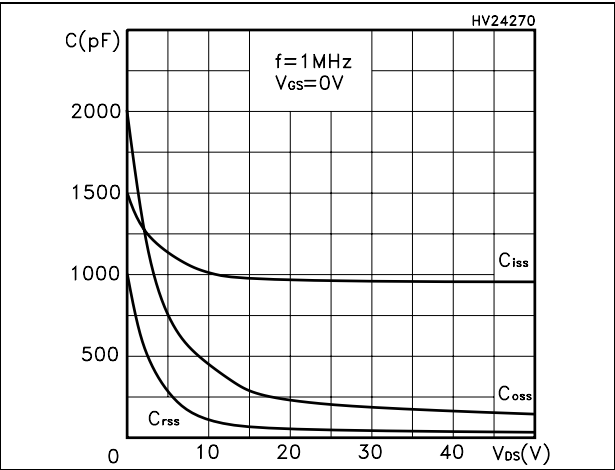


Figure 12. Normalized gate threshold voltage vs temperature

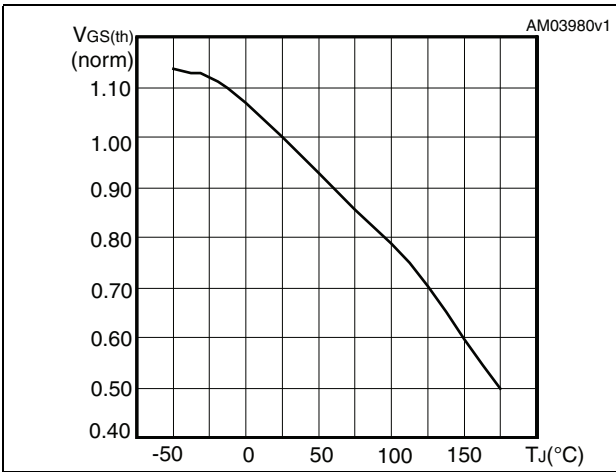


Figure 13. Normalized on resistance vs temperature

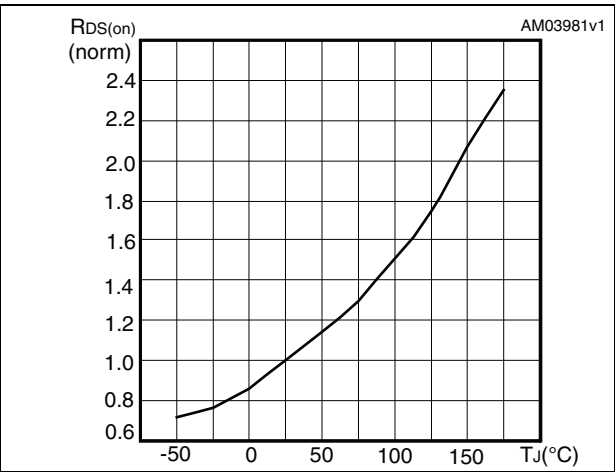
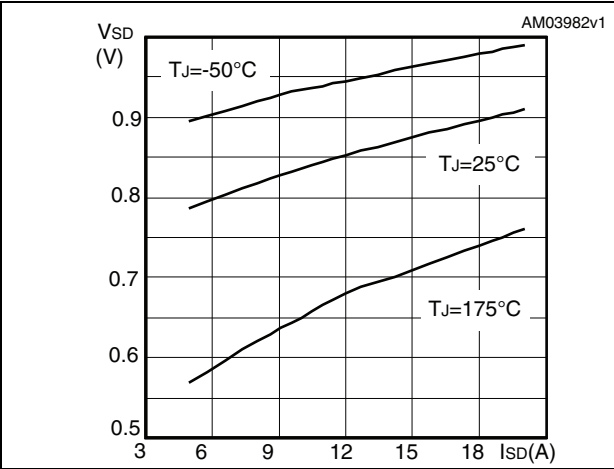
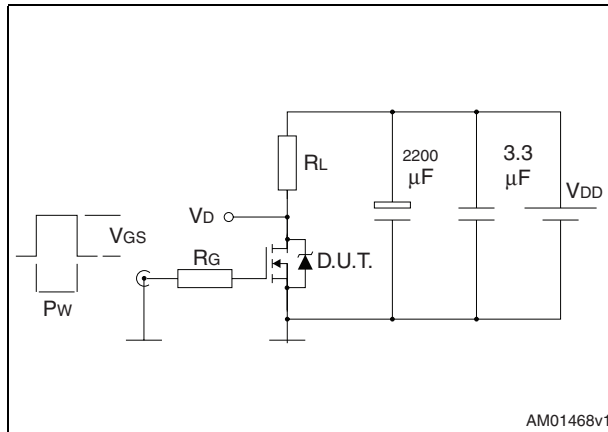


Figure 14. Source-drain diode forward characteristics

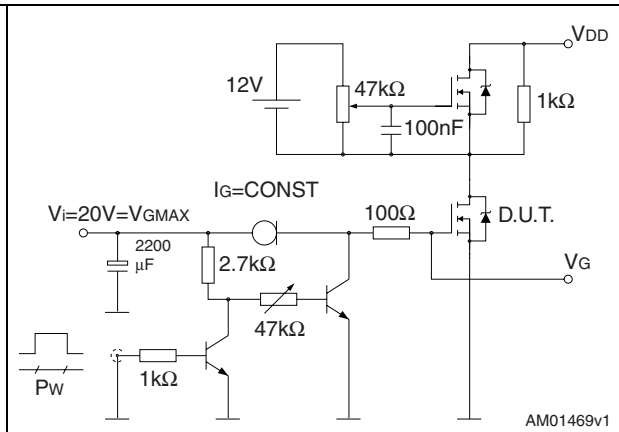


### 3 Test circuits

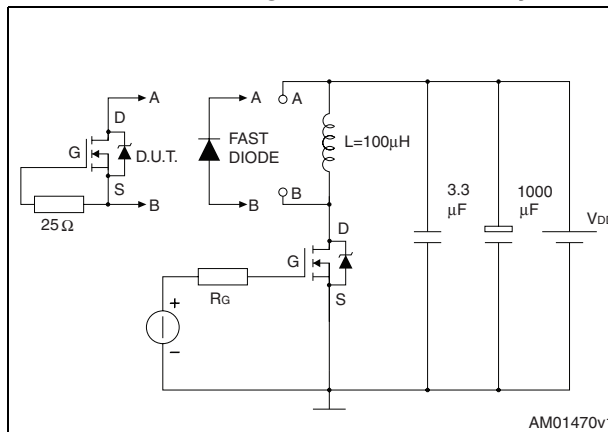
**Figure 15. Switching times test circuit for resistive load**



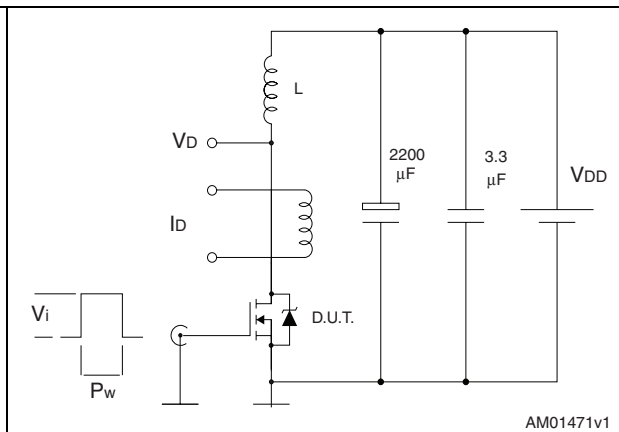
**Figure 16. Gate charge test circuit**



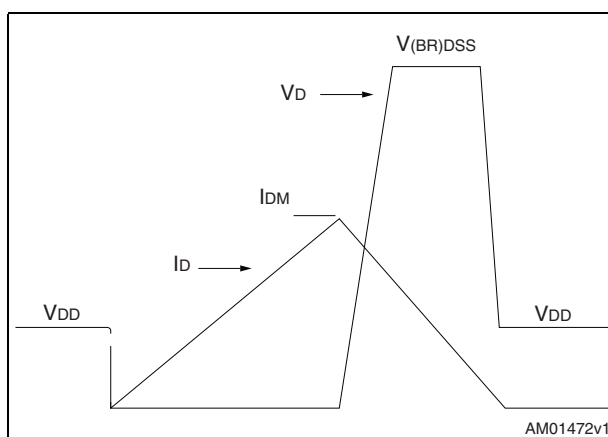
**Figure 17. Test circuit for inductive load switching and diode recovery times**



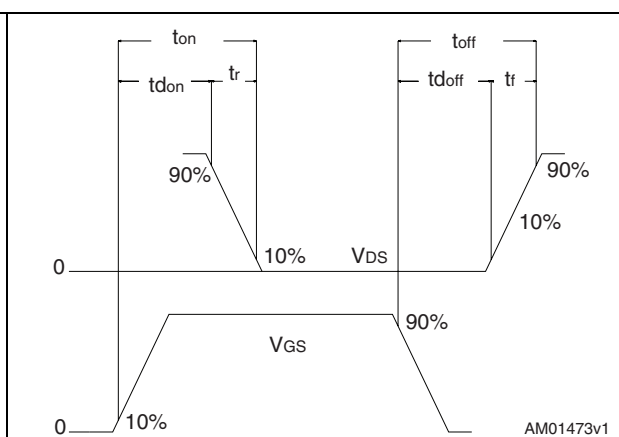
**Figure 18. Unclamped inductive load test circuit**



**Figure 19. Unclamped inductive waveform**



**Figure 20. Switching time waveform**

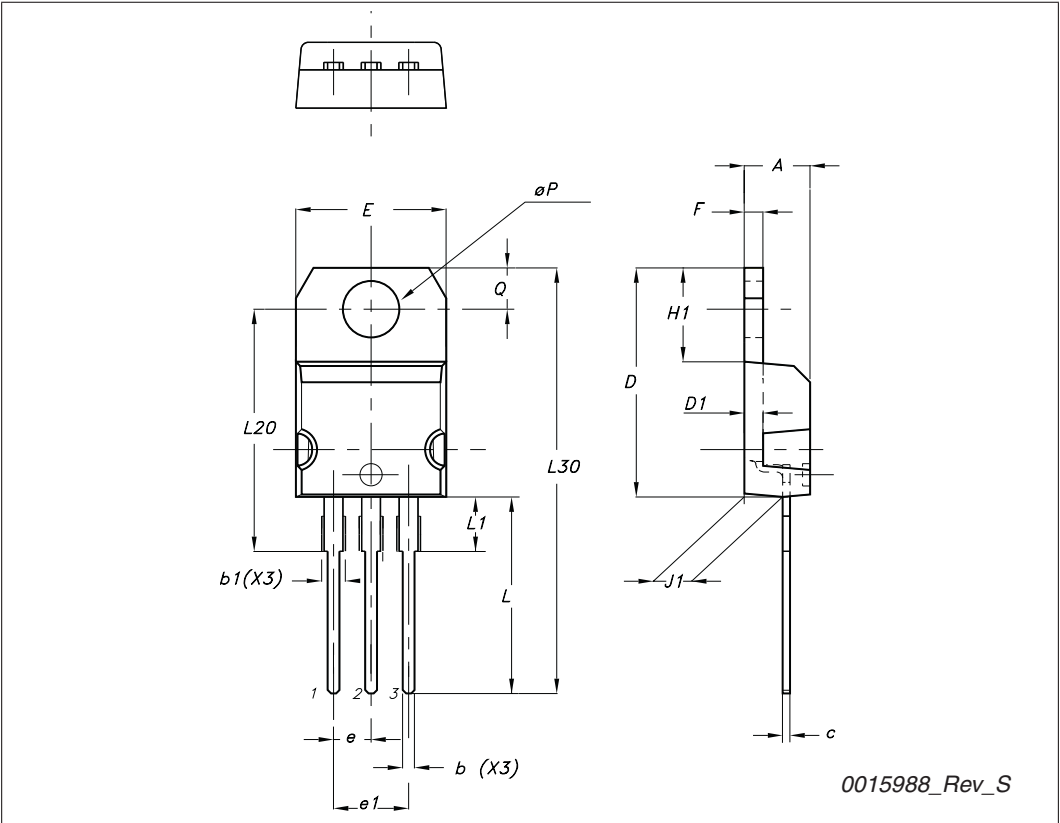


## 4 Package mechanical data

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](http://www.st.com). ECOPACK is an ST trademark.

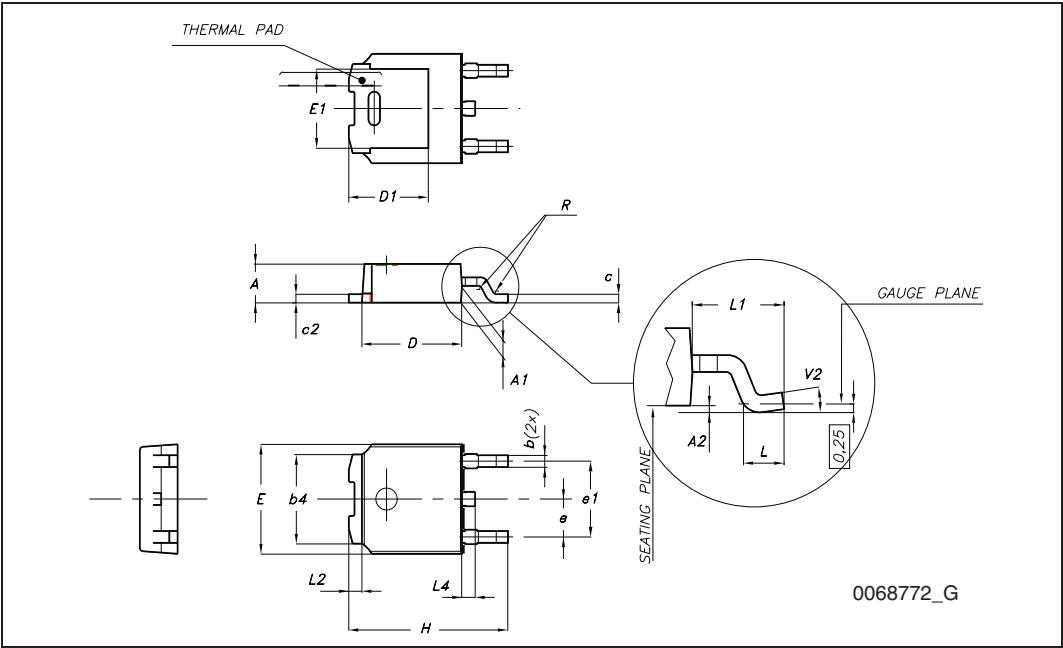
TO-220 type A mechanical data

| Dim | mm    |       |       |
|-----|-------|-------|-------|
|     | Min   | Typ   | Max   |
| A   | 4.40  |       | 4.60  |
| b   | 0.61  |       | 0.88  |
| b1  | 1.14  |       | 1.70  |
| c   | 0.48  |       | 0.70  |
| D   | 15.25 |       | 15.75 |
| D1  |       | 1.27  |       |
| E   | 10    |       | 10.40 |
| e   | 2.40  |       | 2.70  |
| e1  | 4.95  |       | 5.15  |
| F   | 1.23  |       | 1.32  |
| H1  | 6.20  |       | 6.60  |
| J1  | 2.40  |       | 2.72  |
| L   | 13    |       | 14    |
| L1  | 3.50  |       | 3.93  |
| L20 |       | 16.40 |       |
| L30 |       | 28.90 |       |
| ØP  | 3.75  |       | 3.85  |
| Q   | 2.65  |       | 2.95  |



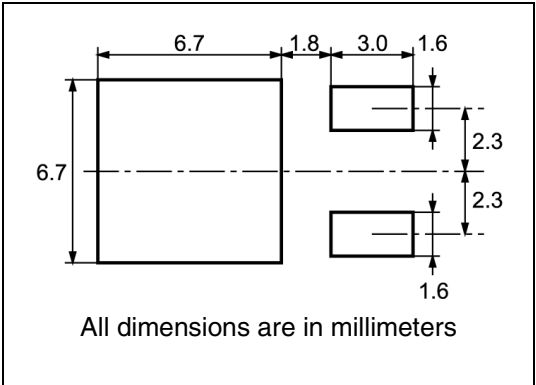
TO-252 (DPAK) mechanical data

| DIM. | mm.  |      |       |
|------|------|------|-------|
|      | min. | typ  | max.  |
| A    | 2.20 |      | 2.40  |
| A1   | 0.90 |      | 1.10  |
| A2   | 0.03 |      | 0.23  |
| b    | 0.64 |      | 0.90  |
| b4   | 5.20 |      | 5.40  |
| c    | 0.45 |      | 0.60  |
| c2   | 0.48 |      | 0.60  |
| D    | 6.00 |      | 6.20  |
| D1   |      | 5.10 |       |
| E    | 6.40 |      | 6.60  |
| E1   |      | 4.70 |       |
| e    |      | 2.28 |       |
| e1   | 4.40 |      | 4.60  |
| H    | 9.35 |      | 10.10 |
| L    | 1    |      |       |
| L1   |      | 2.80 |       |
| L2   |      | 0.80 |       |
| L4   | 0.60 |      | 1     |
| R    |      | 0.20 |       |
| V2   | 0 °  |      | 8 °   |

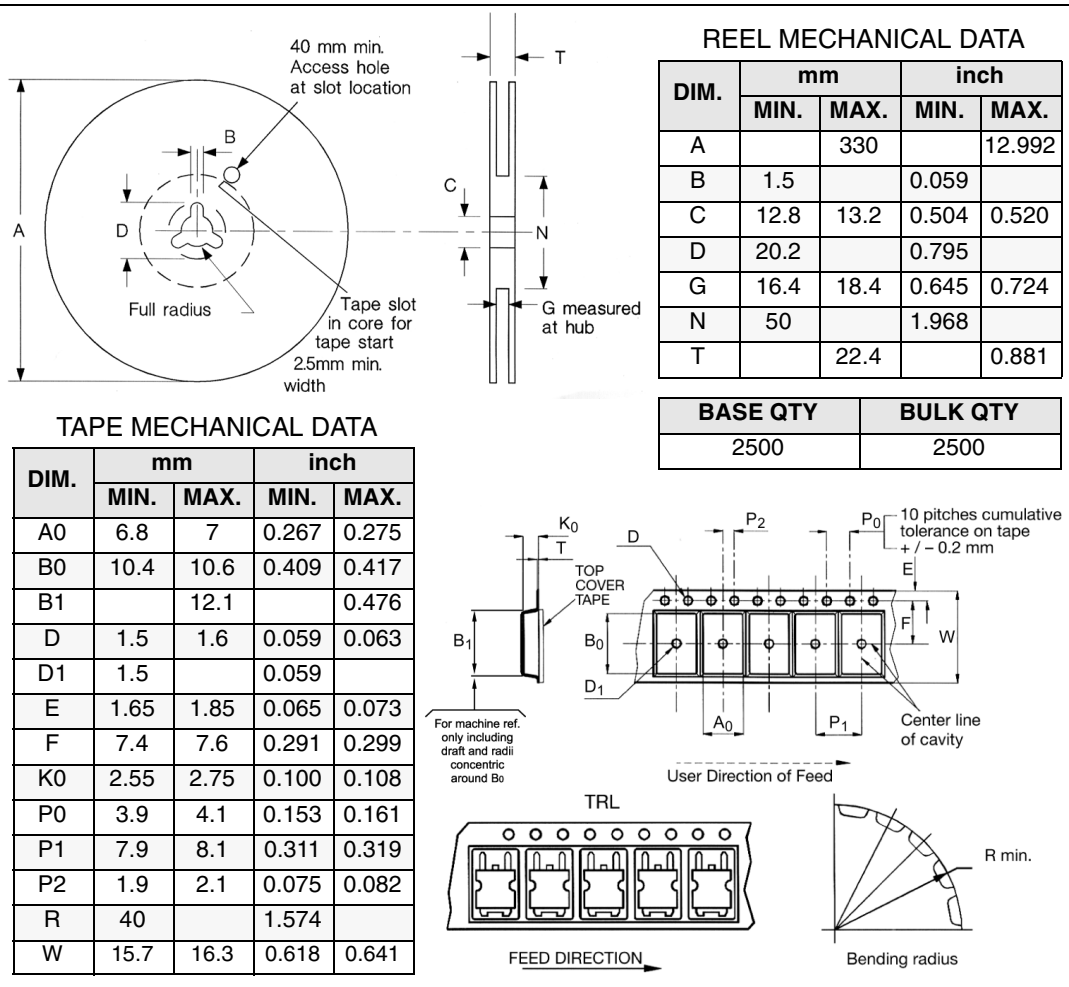


# 5 Packaging mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT



## 6 Revision history

**Table 8. Revision history**

| Date        | Revision | Changes                                     |
|-------------|----------|---------------------------------------------|
| 25-Jan-2007 | 1        | First release                               |
| 20-Mar-2007 | 2        | Typo mistake in first page (order codes)    |
| 27-Apr-2007 | 3        | Updates on <a href="#">Table 6: Dynamic</a> |
| 10-Dec-2009 | 4        | Modified device summary on first page       |

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