



# STB24NF10 STP24NF10

N-channel 100V - 0.0055Ω - 26A - TO-220 - D<sup>2</sup>PAK  
Low gate charge STripFET™ II Power MOSFET

## General features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-----------|------------------|---------------------|----------------|
| STB24NF10 | 100V             | <0.060Ω             | 26A            |
| STP24NF10 | 100V             | <0.060Ω             | 26A            |

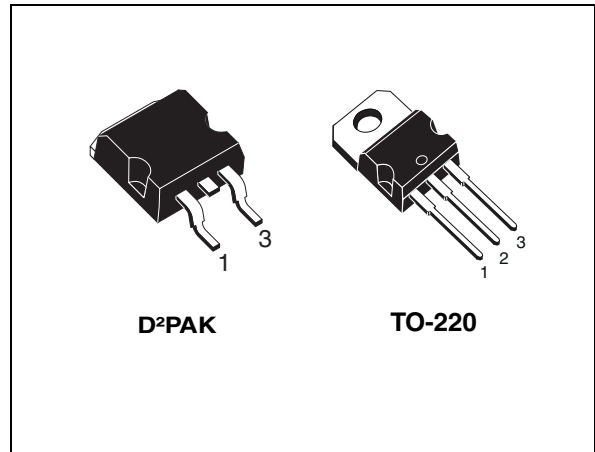
- Exceptional dv/dt capability
- 100% avalanche tested
- Application oriented characterization

## Description

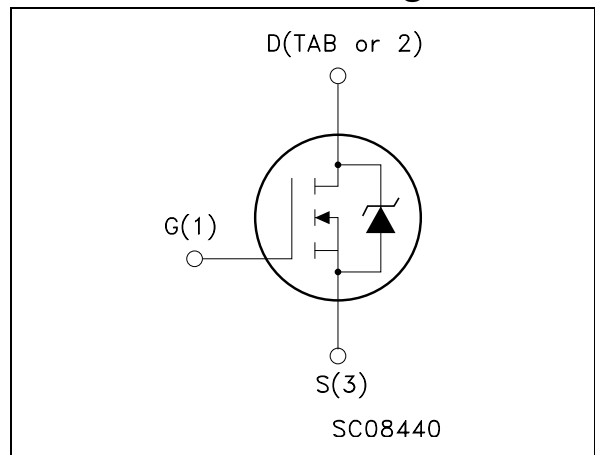
This Power MOSFET series realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize the on-resistance. It is therefore suitable as primary switch in advanced high-efficiency, high-frequency isolated DC-DC converters for Telecom and Computer application. It is also intended for any applications with low gate drive requirements.

## Applications

- Switching application



## Internal schematic diagram



## Order codes

| Part number | Marking | Package            | Packaging   |
|-------------|---------|--------------------|-------------|
| STP24NF10   | P24NF10 | TO-220             | Tube        |
| STB24NF10   | B24NF10 | D <sup>2</sup> PAK | Tape & reel |

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol             | Parameter                                              | Value      | Unit                |
|--------------------|--------------------------------------------------------|------------|---------------------|
| $V_{DS}$           | Drain-source voltage ( $V_{GS} = 0$ )                  | 100        | V                   |
| $V_{DGR}$          | Drain-gate voltage ( $R_{GS}=20k\Omega$ )              | 100        | V                   |
| $V_{GS}$           | Gate-source voltage                                    | $\pm 20$   | V                   |
| $I_D$              | Drain current (continuous) at $T_C = 25^\circ\text{C}$ | 26         | A                   |
| $I_D$              | Drain current (continuous) at $T_C=100^\circ\text{C}$  | 18         | A                   |
| $I_{DM}^{(1)}$     | Drain current (pulsed)                                 | 104        | A                   |
| $P_{TOT}$          | Total dissipation at $T_C = 25^\circ\text{C}$          | 85         | W                   |
|                    | Derating factor                                        | 0.57       | W/ $^\circ\text{C}$ |
| $dv/dt^{(2)}$      | Peak diode recovery voltage slope                      | 9          | V/ns                |
| $E_{AS}^{(3)}$     | Single pulse avalanche energy                          | 220        | mJ                  |
| $T_J$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature  | -55 to 175 | $^\circ\text{C}$    |

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 24\text{A}$ ,  $di/dt \leq 300\text{A}/\mu\text{s}$ ,  $V_{DD}=80\%V_{(BR)DSS}$
3. Starting  $T_J = 25^\circ\text{C}$ ,  $I_D=12\text{A}$ ,  $V_{DD}=30\text{V}$

**Table 2. Thermal resistance**

| Symbol         | Parameter                                      | Value | Unit                      |
|----------------|------------------------------------------------|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case Max           | 1.76  | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient Max        | 62.5  | $^\circ\text{C}/\text{W}$ |
| $T_J$          | Maximum lead temperature for soldering purpose | 300   | $^\circ\text{C}$          |

## 2 Electrical characteristics

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

**Table 3. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                      | Min. | Typ.  | Max.      | Unit                           |
|---------------|--------------------------------------------------|--------------------------------------------------------------------------------------|------|-------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\mu\text{A}$ , $V_{GS} = 0$                                                | 100  |       |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$ ,<br>$V_{DS} = \text{Max rating} @ 125^{\circ}\text{C}$ |      |       | 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                           | $V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$                                           | 2    | 3     | 4         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{V}$ , $I_D = 12\text{A}$                                           |      | 0.055 | 0.060     | $\Omega$                       |

**Table 4. Dynamic**

| Symbol                              | Parameter                                                               | Test conditions                                                                       | Min. | Typ.             | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------|------------------|------|----------------|
| $g_{fs}^{(1)}$                      | Forward transconductance                                                | $V_{DS} = 15\text{V}$ , $I_D = 12\text{A}$                                            |      | 10               |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 25\text{V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$                             |      | 870<br>125<br>50 |      | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 80\text{V}$ , $I_D = 24\text{A}$<br>$V_{GS} = 10\text{V}$<br>(see Figure 7) |      | 30<br>6<br>10    | 41   | nC<br>nC<br>nC |

1. Pulsed: pulse duration=300 $\mu\text{s}$ , duty cycle 1.5%

**Table 5. Switching times**

| Symbol                                        | Parameter                                                           | Test conditions                                                                                              | Min. | Typ.                 | Max. | Unit                 |
|-----------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------|----------------------|------|----------------------|
| $t_{d(on)}$<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 | $V_{DD} = 50\text{V}$ , $I_D = 12\text{A}$ ,<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{V}$<br>(see Figure 12) |      | 60<br>15<br>50<br>20 |      | ns<br>ns<br>ns<br>ns |

**Table 6. Source drain diode**

| Symbol                            | Parameter                                                                    | Test conditions                                                                                       | Min | Typ.              | Max | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----|-------------------|-----|---------------|
| $I_{SD}$                          | Source-drain current                                                         |                                                                                                       |     |                   | 26  | A             |
| $I_{SDM}^{(1)}$                   | Source-drain current (pulsed)                                                |                                                                                                       |     |                   | 104 | A             |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 24A$ , $V_{GS} = 0$                                                                         |     |                   | 1.5 | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 24A$ ,<br>$di/dt = 100A/\mu s$ ,<br>$V_{DD} = 30V$ , $T_j = 150^\circ C$<br>(see Figure 14) |     | 100<br>375<br>7.5 |     | ns<br>nC<br>A |

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration=300 $\mu s$ , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

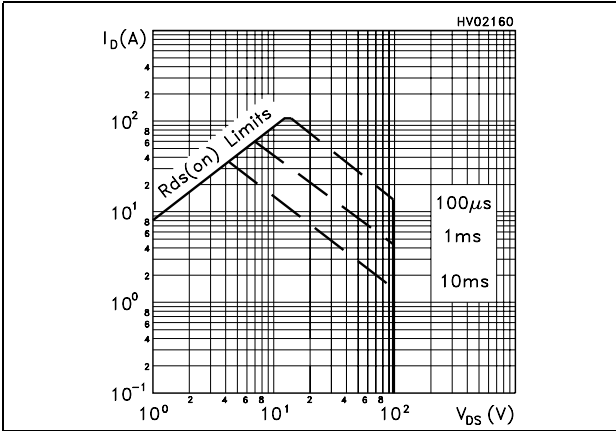


Figure 2. Thermal impedance

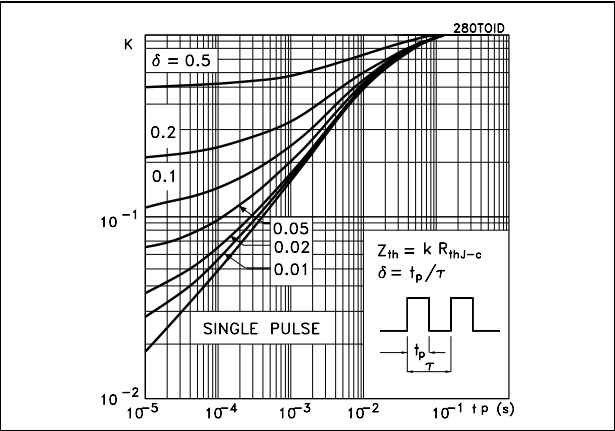


Figure 3. Output characteristics

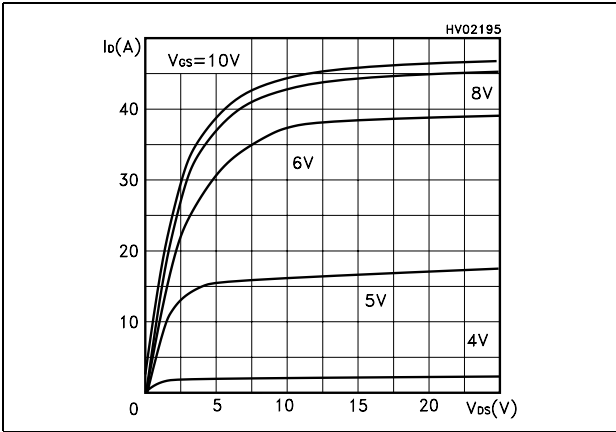


Figure 4. Transfer characteristics

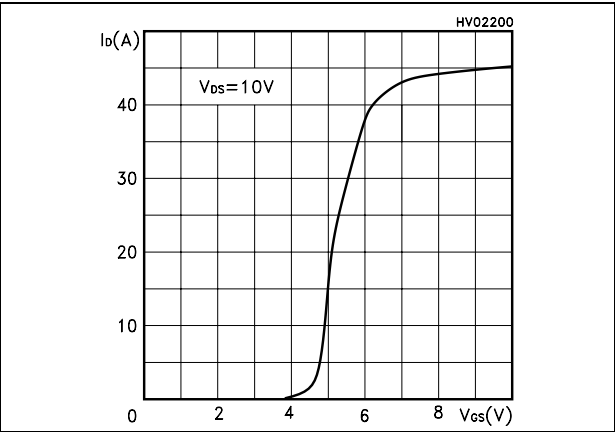


Figure 5. Transconductance

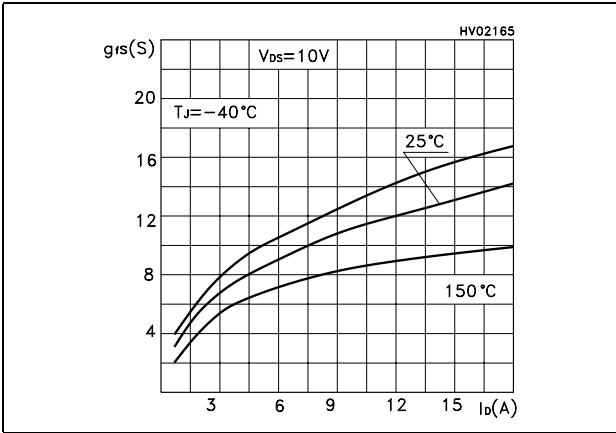


Figure 6. Static drain-source on resistance

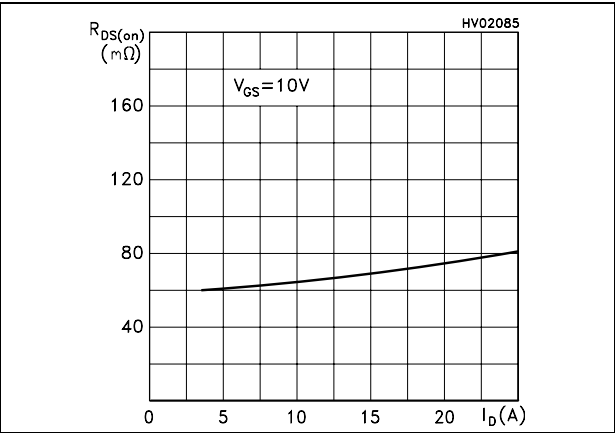


Figure 7. Gate charge vs gate-source voltage    Figure 8. Capacitance variations

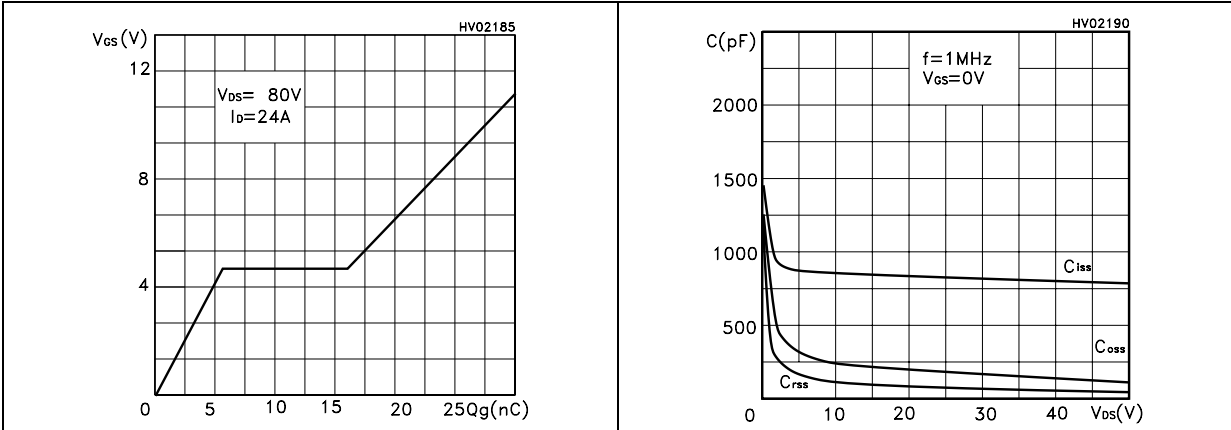


Figure 9. Normalized gate threshold voltage vs temperature    Figure 10. Normalized on resistance vs temperature

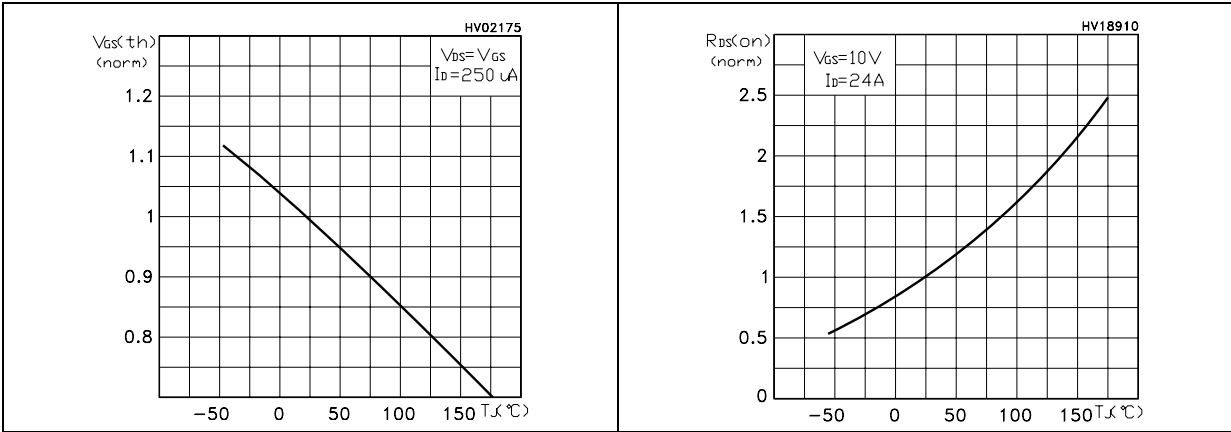
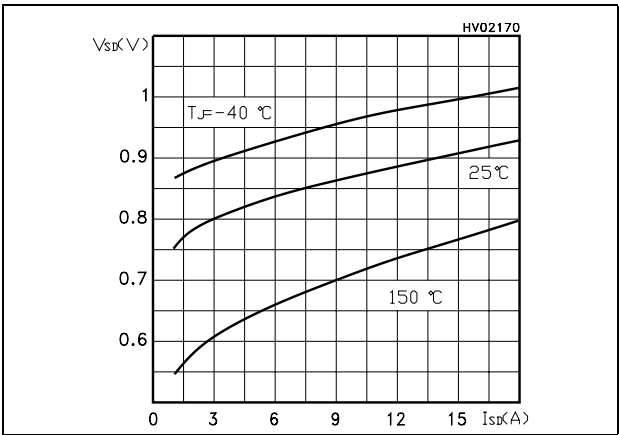


Figure 11. Source-drain diode forward characteristics

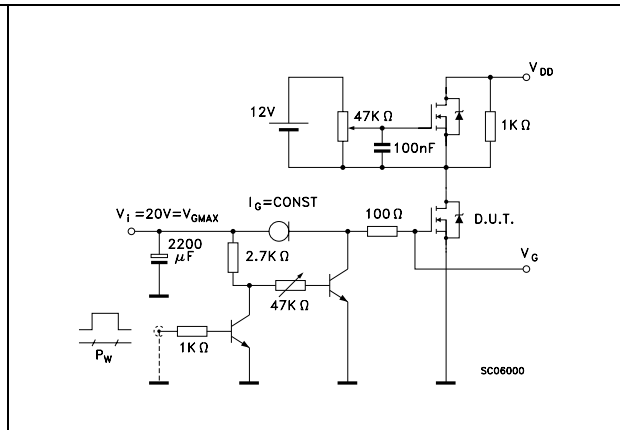


### 3 Test circuit

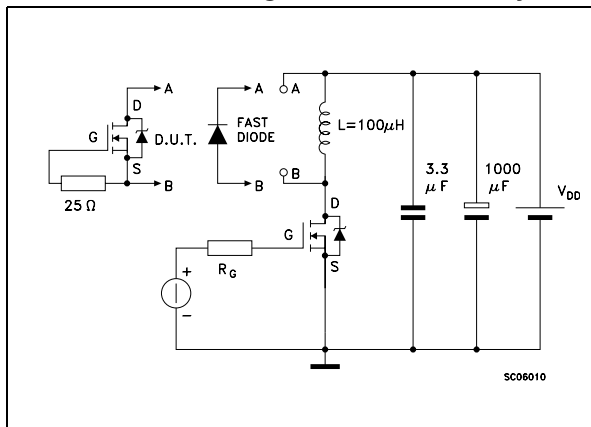
**Figure 12. Switching times test circuit for resistive load**



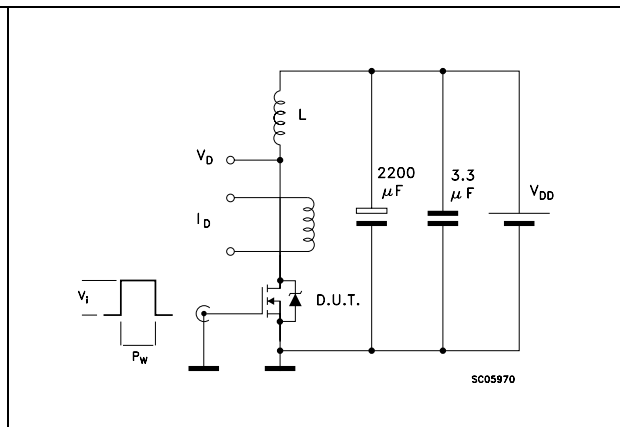
**Figure 13. Gate charge test circuit**



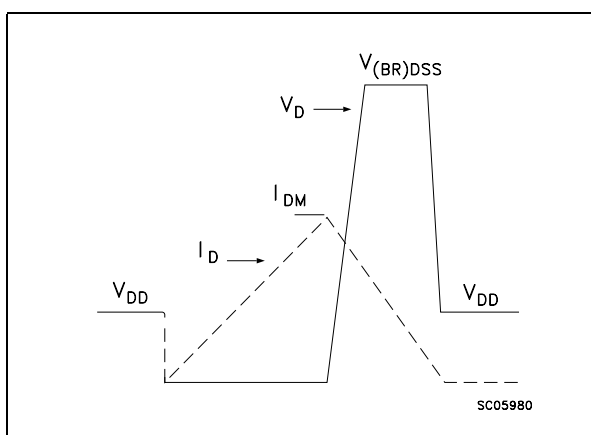
**Figure 14. Test circuit for inductive load switching and diode recovery times**



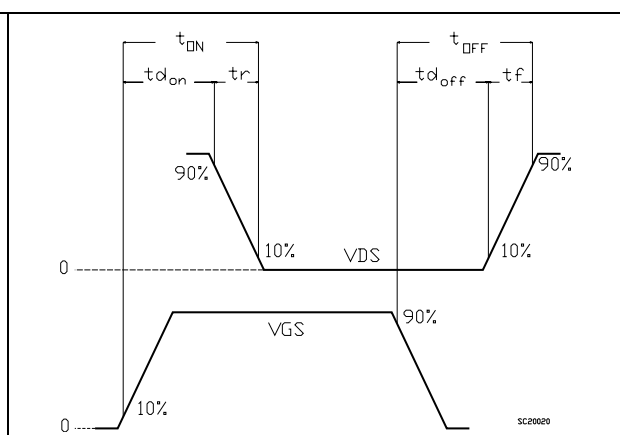
**Figure 15. Unclamped inductive load test circuit**



**Figure 16. Unclamped inductive waveform**



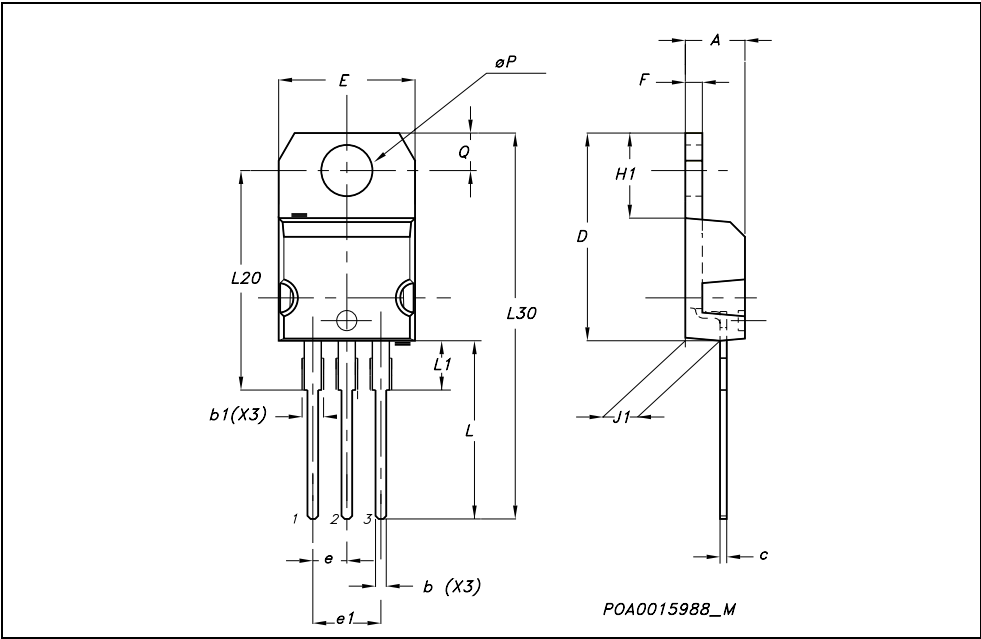
**Figure 17. Switching time waveform**



## 4 Package mechanical data

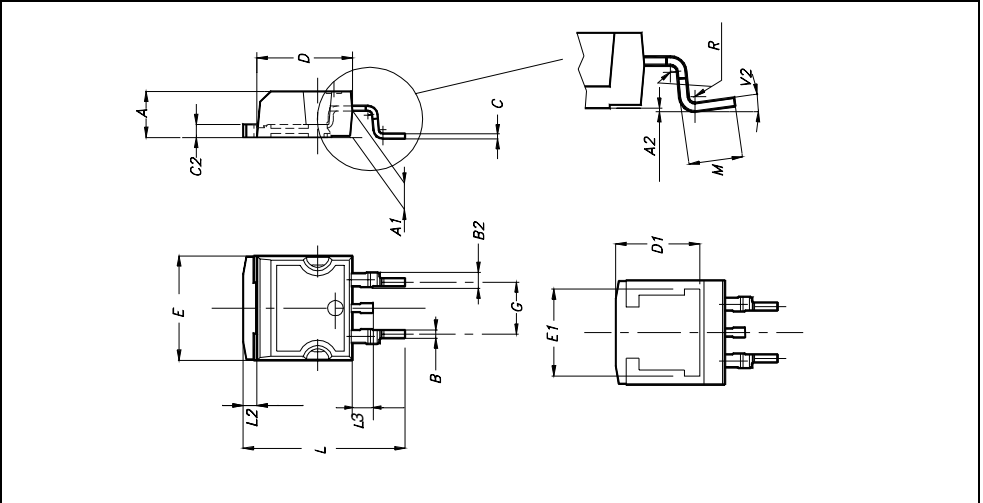
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings 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](http://www.st.com)

| 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                     | 1.15  |       | 1.70  | 0.045 |       | 0.066 |
| c                      | 0.49  |       | 0.70  | 0.019 |       | 0.027 |
| D                      | 15.25 |       | 15.75 | 0.60  |       | 0.620 |
| 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 |       | 0.052 |
| 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 |



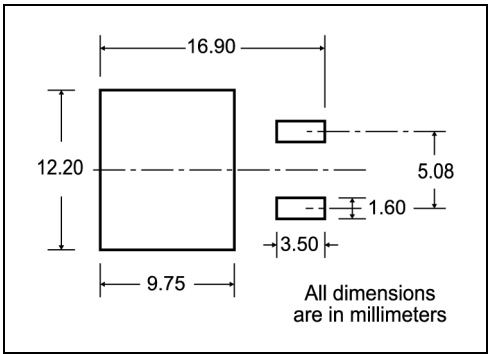
D<sup>2</sup>PAK MECHANICAL DATA

| DIM. | mm.  |     |       | inch  |       |       |
|------|------|-----|-------|-------|-------|-------|
|      | MIN. | TYP | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6   | 0.173 |       | 0.181 |
| A1   | 2.49 |     | 2.69  | 0.098 |       | 0.106 |
| A2   | 0.03 |     | 0.23  | 0.001 |       | 0.009 |
| B    | 0.7  |     | 0.93  | 0.027 |       | 0.036 |
| B2   | 1.14 |     | 1.7   | 0.044 |       | 0.067 |
| C    | 0.45 |     | 0.6   | 0.017 |       | 0.023 |
| C2   | 1.23 |     | 1.36  | 0.048 |       | 0.053 |
| D    | 8.95 |     | 9.35  | 0.352 |       | 0.368 |
| D1   |      | 8   |       |       | 0.315 |       |
| E    | 10   |     | 10.4  | 0.393 |       |       |
| E1   |      | 8.5 |       |       | 0.334 |       |
| G    | 4.88 |     | 5.28  | 0.192 |       | 0.208 |
| L    | 15   |     | 15.85 | 0.590 |       | 0.625 |
| L2   | 1.27 |     | 1.4   | 0.050 |       | 0.055 |
| L3   | 1.4  |     | 1.75  | 0.055 |       | 0.068 |
| M    | 2.4  |     | 3.2   | 0.094 |       | 0.126 |
| R    |      | 0.4 |       |       | 0.015 |       |
| V2   | 0°   |     | 4°    |       |       |       |

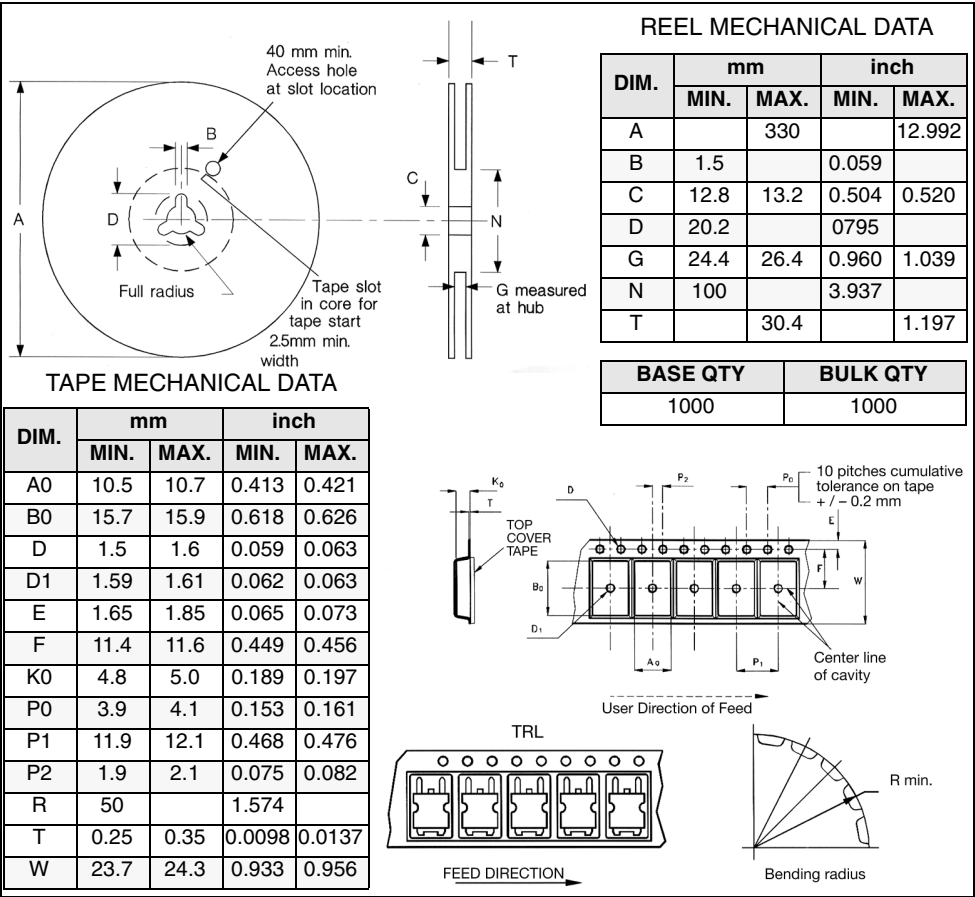


# 5 Packaging mechanical data

## D<sup>2</sup>PAK FOOTPRINT



## TAPE AND REEL SHIPMENT



\* on sales type

## 6 Revision history

**Table 7. Revision history**

| Date        | Revision | Changes                         |
|-------------|----------|---------------------------------|
| 09-Sep-2004 | 6        | Complete version                |
| 09-Aug-2006 | 7        | New template, no content change |

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