



# STD65NF06 STP65NF06

N-channel 60V - 11.5mΩ - 60A - DPAK/TO-220  
STripFET™ II Power MOSFET

## General features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-----------|------------------|---------------------|----------------|
| STD65NF06 | 60V              | <14mΩ               | 60A            |
| STP65NF06 | 60V              | <14mΩ               | 60A            |

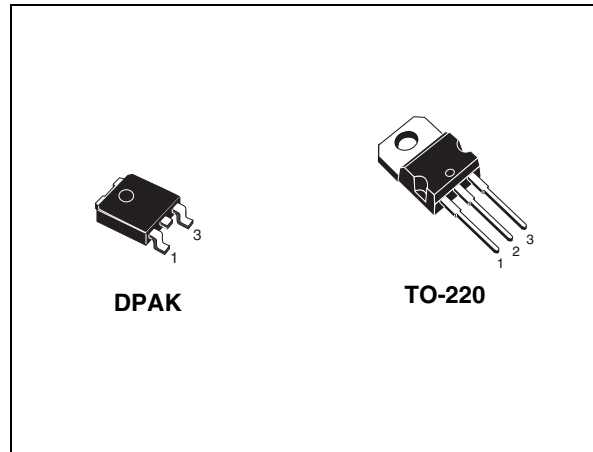
- Standard level gate drive
- 100% avalanche tested

## Description

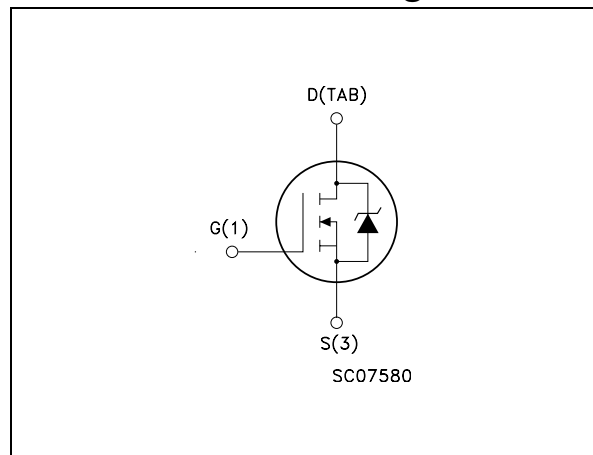
This Power MOSFET is the latest development of STMicroelectronics unique “single feature size”™ strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

## Applications

- Switching application



## Internal schematic diagram



## Order codes

| Part number | Marking | Package | Packaging   |
|-------------|---------|---------|-------------|
| STD65NF06   | D65NF06 | DPAK    | Tape & reel |
| STP65NF06   | P65NF06 | TO-220  | Tube        |

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter                                               | Value      | Unit                |
|----------------|---------------------------------------------------------|------------|---------------------|
| $V_{DS}$       | Drain-source voltage ( $V_{GS} = 0$ )                   | 60         | V                   |
| $V_{GS}$       | Gate- source voltage                                    | $\pm 20$   | V                   |
| $I_D$          | Drain current (continuous) at $T_C = 25^\circ\text{C}$  | 60         | A                   |
| $I_D$          | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 42         | A                   |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                  | 240        | A                   |
| $P_{tot}$      | Total dissipation at $T_C = 25^\circ\text{C}$           | 110        | W                   |
|                | Derating Factor                                         | 0.73       | W/ $^\circ\text{C}$ |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope                       | 10         | V/ns                |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy                           | 390        | mJ                  |
| $T_{stg}$      | Storage temperature                                     | -55 to 175 | $^\circ\text{C}$    |
| $T_j$          | Max. operating junction temperature                     |            |                     |

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 60\text{A}$ ,  $di/dt \leq 300\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$
3. Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 30\text{A}$ ,  $V_{DD} = 40\text{V}$

**Table 2. Thermal data**

| Symbol              | Parameter                                                                   | TO-220 | DPAK | Unit                      |
|---------------------|-----------------------------------------------------------------------------|--------|------|---------------------------|
| $R_{thj-case}$      | Thermal resistance junction-case max                                        | 1.36   |      | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$       | Thermal resistance junction-ambient max                                     | 62.5   | --   | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max                                         | --     | 50   | $^\circ\text{C}/\text{W}$ |
| $T_l$               | Maximum lead temperature for soldering purpose (for 10sec. 1.6mm from case) | 300    | --   | $^\circ\text{C}/\text{W}$ |

1. When mounted on FR-4 of 1 inch<sup>2</sup>, 2 oz Cu

## 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                   | $I_D = 250\mu\text{A}$ , $V_{GS} = 0$                                                | 60   |      |           | 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    |      | 4         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{V}$ , $I_D = 30\text{A}$                                           |      | 11.5 | 14        | m $\Omega$                     |

**Table 4. Dynamic**

| Symbol                                        | Parameter                                                               | Test conditions                                                                                                               | Min. | Typ.                 | Max. | Unit                 |
|-----------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------|----------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance                                                | $V_{DS} = 25\text{V}$ , $I_D = 30\text{A}$                                                                                    |      | 50                   |      | 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>$V_{GS} = 0$                                                                   |      | 1700<br>400<br>135   |      | 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     | $V_{DD} = 30\text{V}$ , $I_D = 30\text{A}$<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{V}$<br>(see <a href="#">Figure 12</a> )   |      | 15<br>60<br>40<br>16 |      | 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            | $V_{DD} = 30\text{V}$ , $I_D = 60\text{A}$ ,<br>$V_{GS} = 10\text{V}$ , $R_G = 4.7\Omega$<br>(see <a href="#">Figure 13</a> ) |      | 54<br>10<br>20       | 75   | nC<br>nC<br>nC       |

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

**Table 5. 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)                     |                                                                                                                     |      |                  | 60<br>240 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 60A$ , $V_{GS} = 0$                                                                                       |      |                  | 1.5       | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 60A$ , $di/dt = 100A/\mu s$ ,<br>$V_{DD} = 25V$ , $T_j = 150^\circ C$<br>(see <a href="#">Figure 14</a> ) |      | 70<br>150<br>4.4 |           | 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

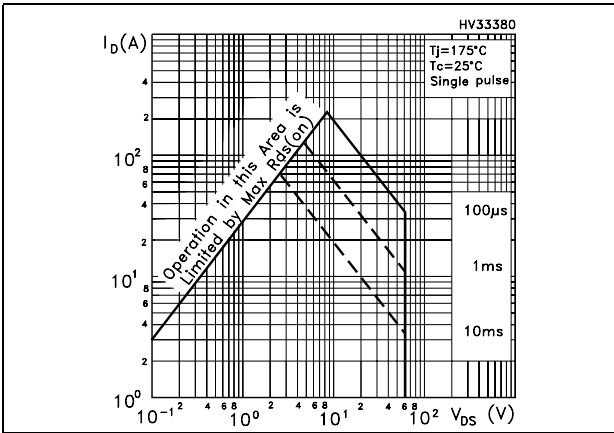


Figure 2. Thermal impedance

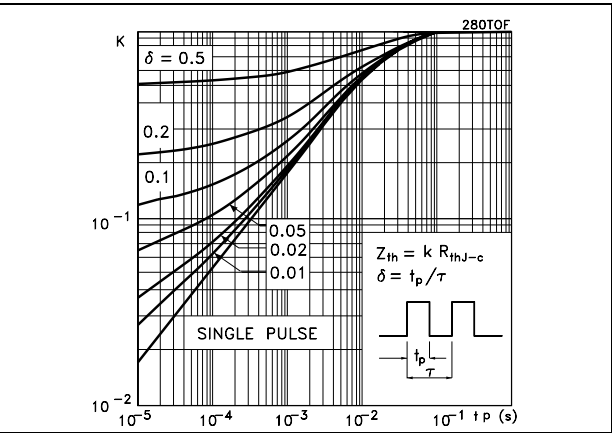


Figure 3. Output characteristics

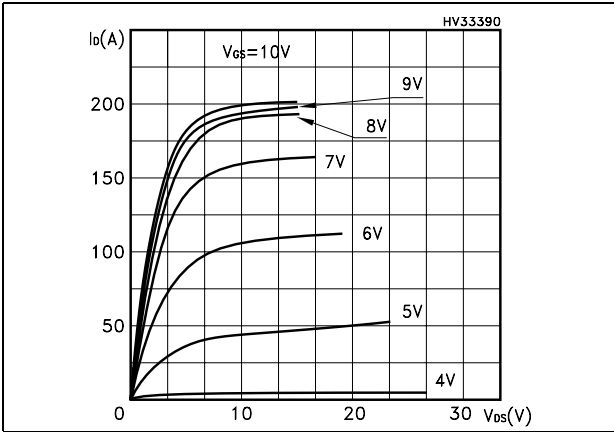


Figure 4. Transfer characteristics

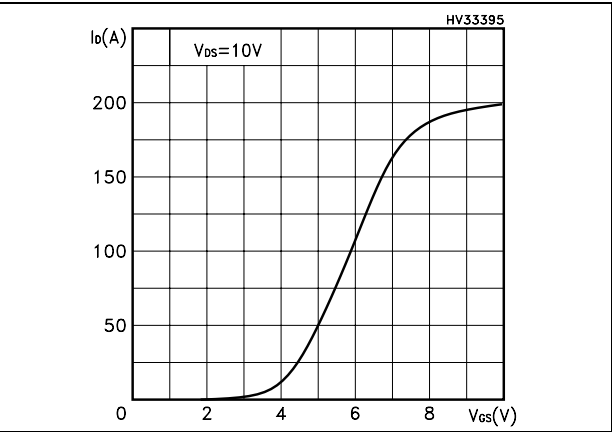


Figure 5. Normalized breakdown voltage temperature

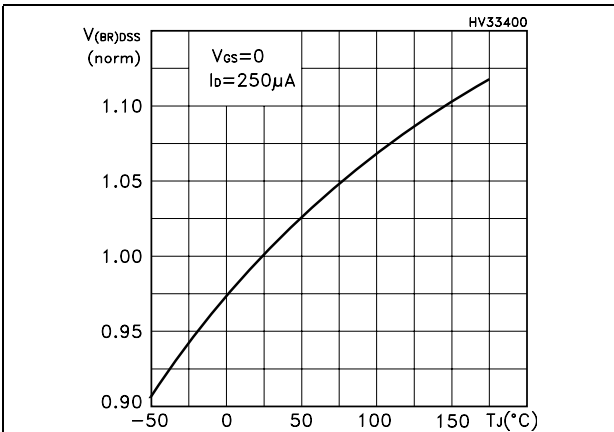


Figure 6. Static drain-source on resistance

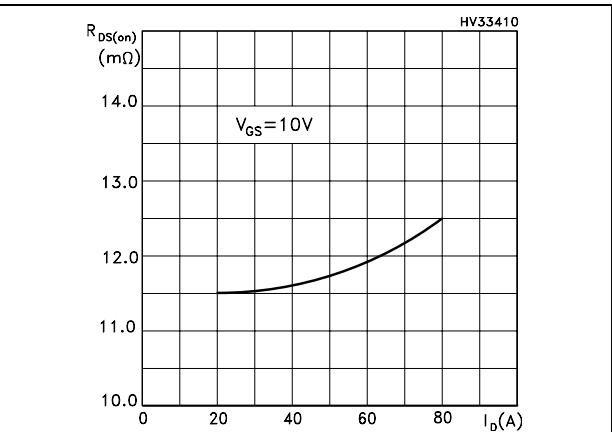


Figure 7. Gate charge vs gate-source voltage      Figure 8. Capacitance variations

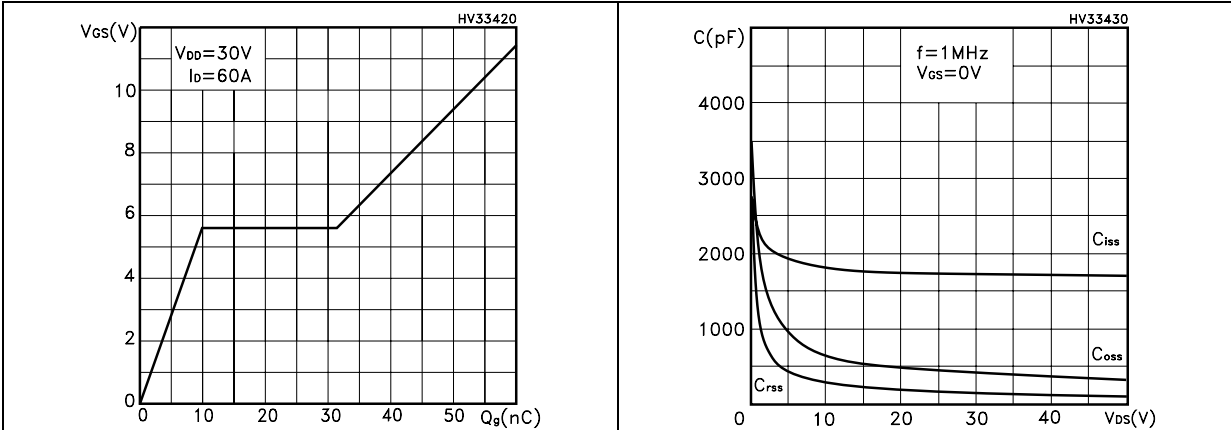


Figure 9. Normalized gate threshold voltage vs temperature      Figure 10. Normalized on resistance vs temperature

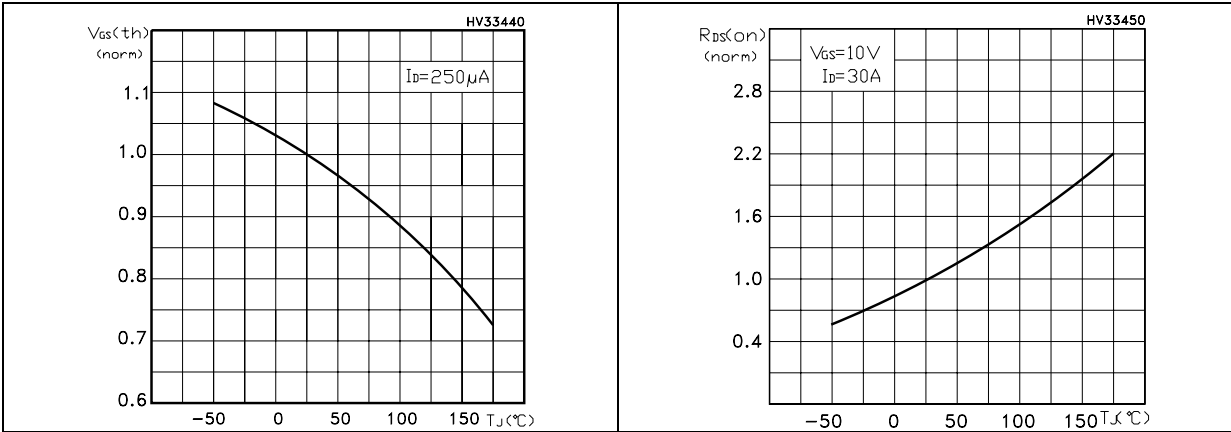
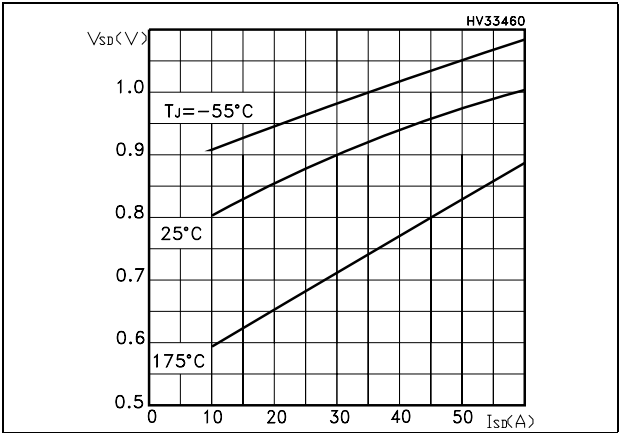
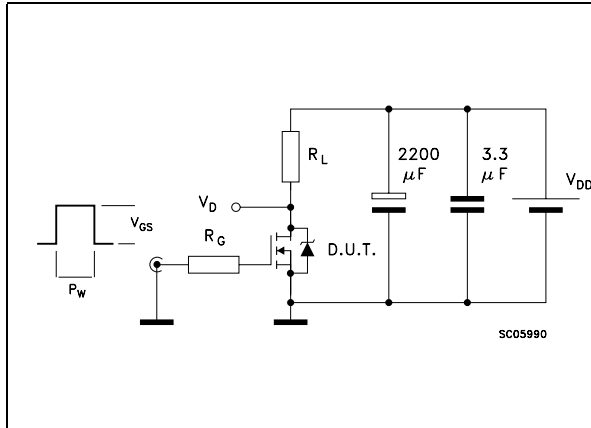


Figure 11. Source-drain diode forward characteristics

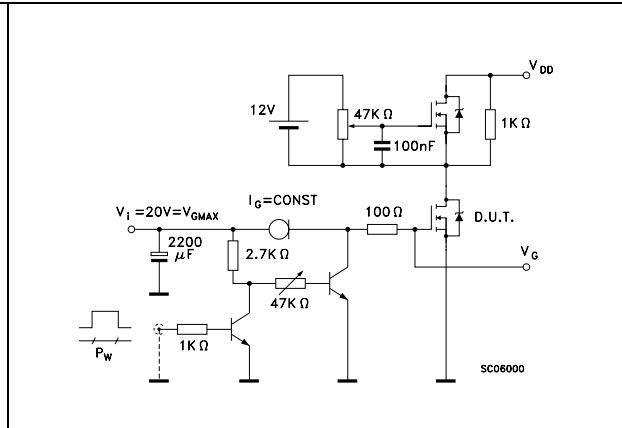


### 3 Test circuit

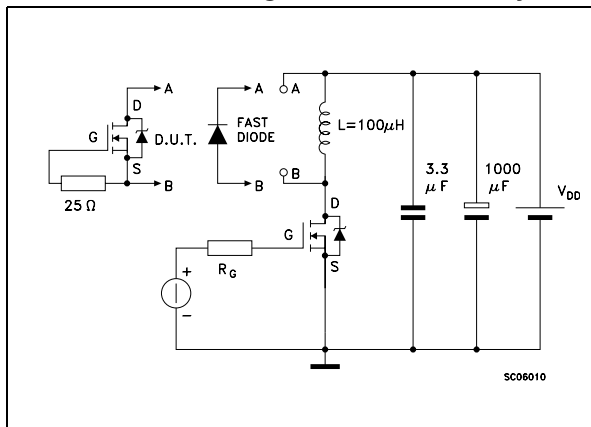
**Figure 12. Switching times test circuit for resistive load**



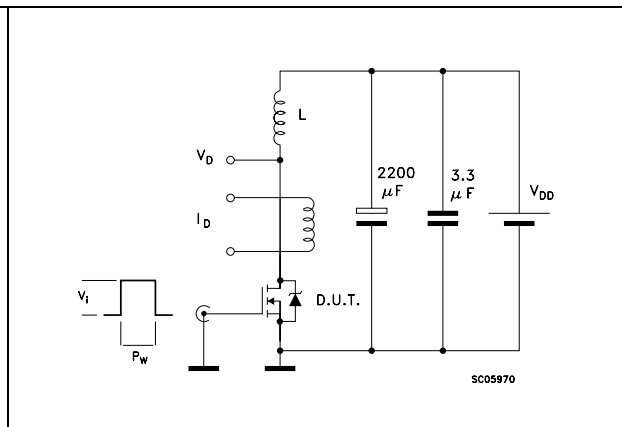
**Figure 13. Gate charge test circuit**



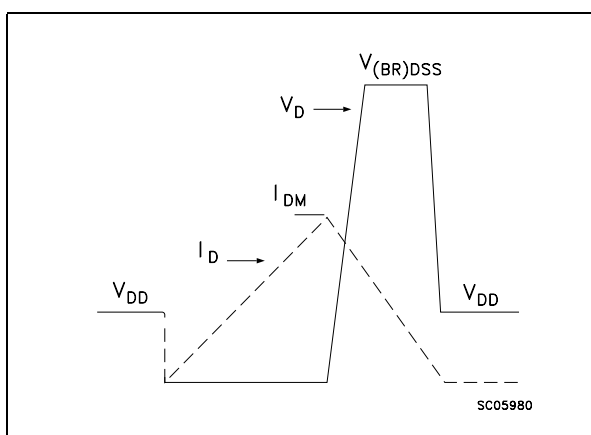
**Figure 14. Test circuit for inductive load switching and diode recovery times**



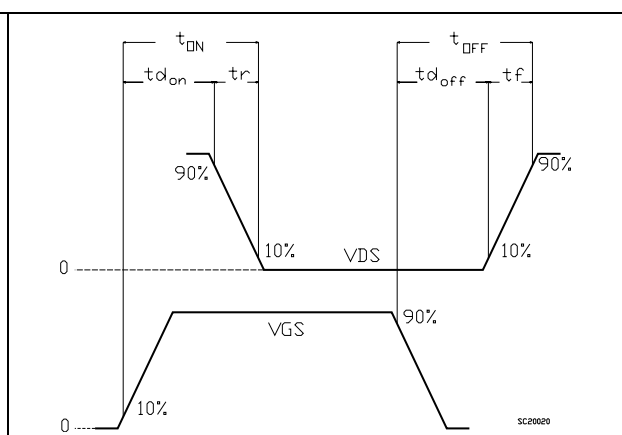
**Figure 15. Unclamped Inductive load test circuit**



**Figure 16. Unclamped inductive waveform**



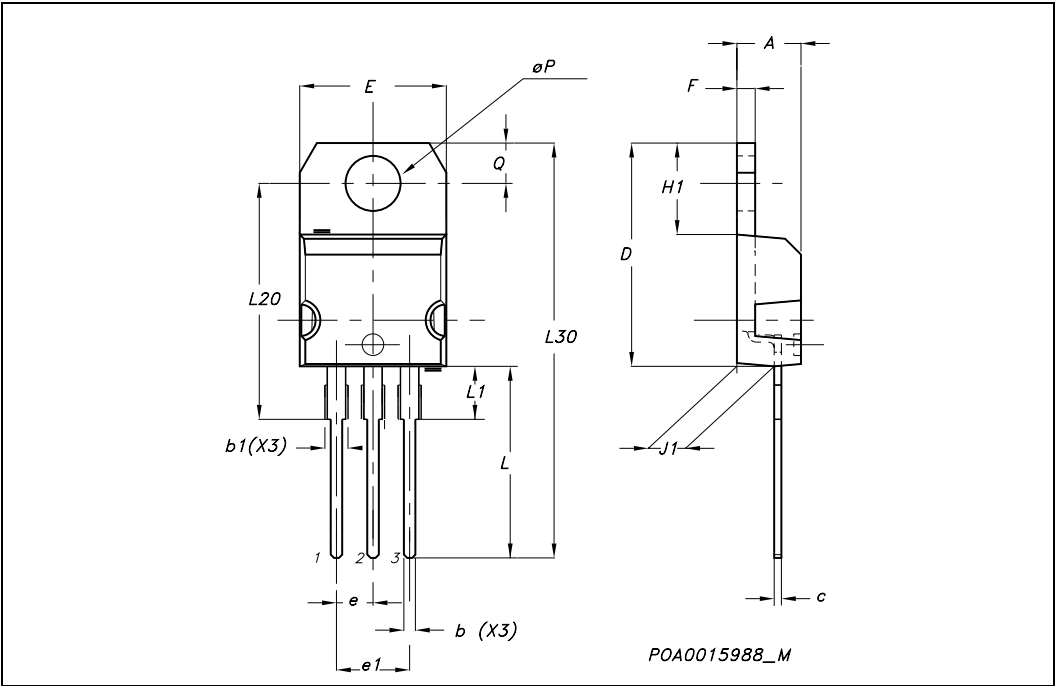
**Figure 17. Switching time waveform**



## 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 |



| DPAK MECHANICAL DATA |      |      |      |       |       |       |
|----------------------|------|------|------|-------|-------|-------|
| DIM.                 | mm.  |      |      | inch  |       |       |
|                      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A                    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1                   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A2                   | 0.03 |      | 0.23 | 0.001 |       | 0.009 |
| B                    | 0.64 |      | 0.9  | 0.025 |       | 0.035 |
| b4                   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| C                    | 0.45 |      | 0.6  | 0.017 |       | 0.023 |
| C2                   | 0.48 |      | 0.6  | 0.019 |       | 0.023 |
| D                    | 6    |      | 6.2  | 0.236 |       | 0.244 |
| D1                   |      | 5.1  |      |       | 0.200 |       |
| E                    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| E1                   |      | 4.7  |      |       | 0.185 |       |
| e                    |      | 2.28 |      |       | 0.090 |       |
| e1                   | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H                    | 9.35 |      | 10.1 | 0.368 |       | 0.397 |
| L                    | 1    |      |      | 0.039 |       |       |
| (L1)                 |      | 2.8  |      |       | 0.110 |       |
| L2                   |      | 0.8  |      |       | 0.031 |       |
| L4                   | 0.6  |      | 1    | 0.023 |       | 0.039 |
| R                    |      | 0.2  |      |       | 0.008 |       |
| V2                   | 0°   |      | 8°   | 0°    |       | 8°    |

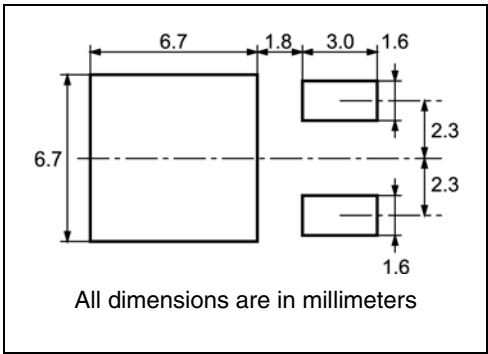
  

The mechanical drawing illustrates the DPAK package geometry. The top view shows dimensions E (total width), b4 (lead width), and e1 (lead pitch). The side view shows dimensions A (package height), A1 (lead height), D (package thickness), and H (total height). A detail view of the lead shows dimensions L2 (lead thickness), L4 (lead width), and L (lead length). Another detail view shows the thermal pad with dimensions E1 (pad width) and D1 (pad thickness). The bottom view shows the seating plane and gauge plane with dimensions A2 (lead thickness), L1 (lead length), and V2 (lead angle). A note indicates a 0.25mm dimension for the gauge plane.

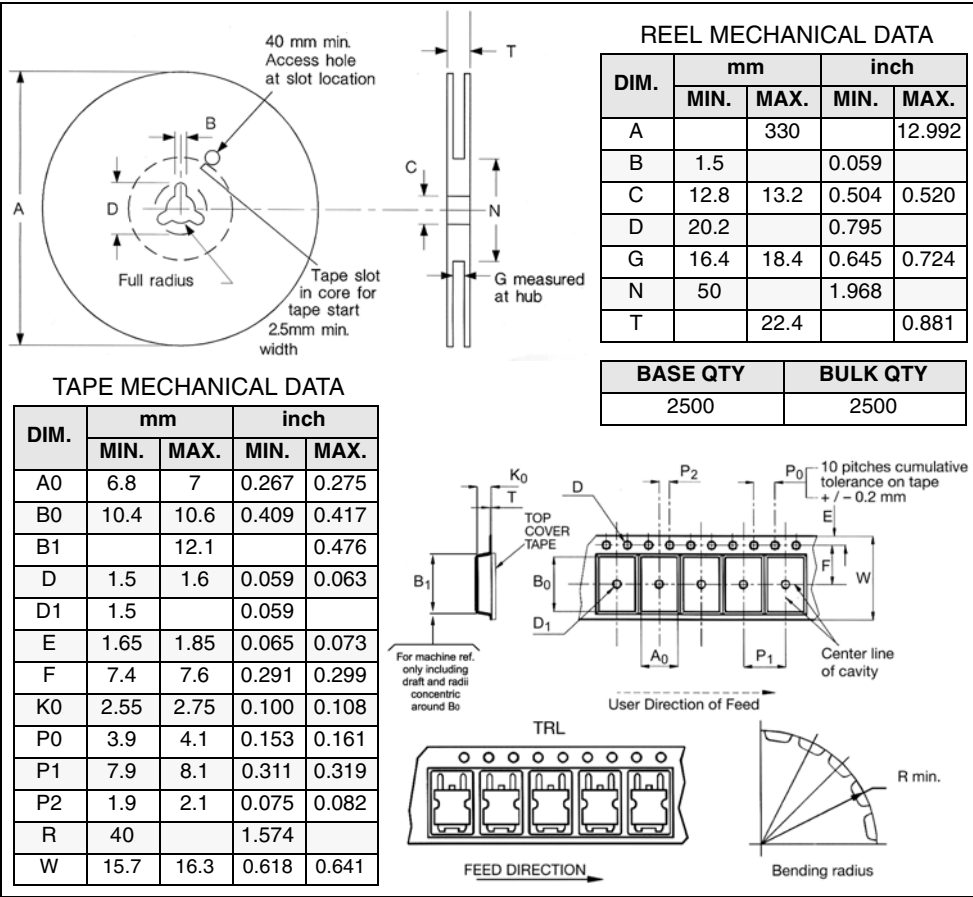
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# 5 Packing mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT



## 6 Revision history

**Table 6. Revision history**

| Date        | Revision | Changes       |
|-------------|----------|---------------|
| 24-Jul-2006 | 1        | First release |

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