



# STD40NF03L

N-channel 30V - 0.0090Ω - 40A - DPAK  
Low gate charge STripFET™ II Power MOSFET

## General features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STD40NF03L | 30V              | <0.011Ω             | 40A            |

- Logic level device
- Optimal R<sub>DS(on)</sub> x Q<sub>g</sub> trade-off
- Conduction losses reduced
- Switching losses reduced
- Low threshold drive

## Description

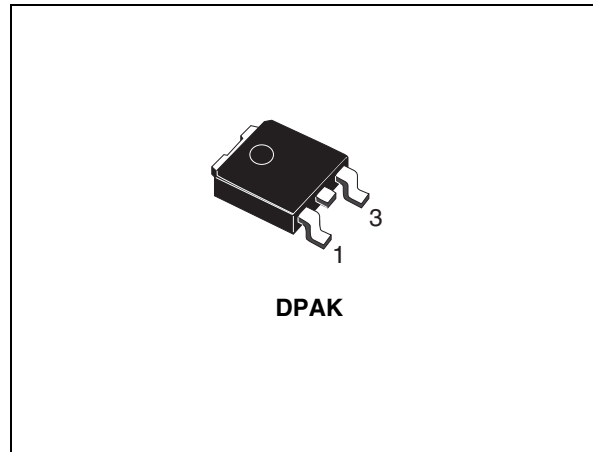
This application specific Power MOSFET is the third generation of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows the best trade-off between on-resistance and gate charge. When used as high and low side in buck regulators, it gives the best performance in terms of both conduction and switching losses. This is extremely important for motherboards where fast switching and high efficiency are of paramount importance.

## Applications

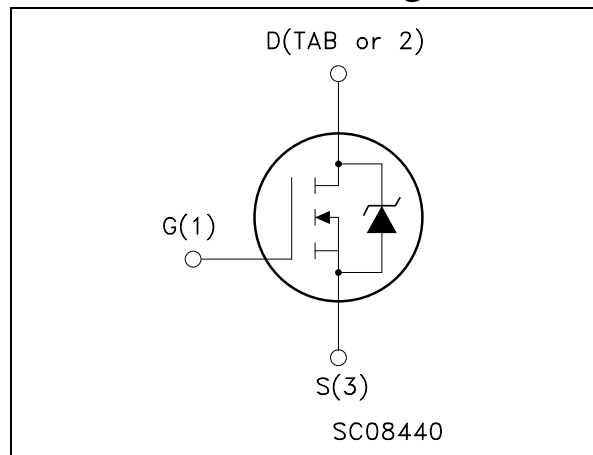
- Switching application

## Order codes

| Part number  | Marking  | Package | Packaging   |
|--------------|----------|---------|-------------|
| STD40NF03LT4 | D40NF03L | DPAK    | Tape & reel |



## Internal schematic diagram



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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter                                               | Value      | Unit |
|----------------|---------------------------------------------------------|------------|------|
| $V_{DS}$       | Drain-source voltage ( $V_{GS} = 0$ )                   | 30         | V    |
| $V_{DGR}$      | Drain-gate voltage ( $R_{GS} = 20\text{ k}\Omega$ )     | 30         | V    |
| $V_{GS}$       | Gate- source voltage                                    | $\pm 20$   | V    |
| $I_D^{(1)}$    | Drain current (continuous) at $T_C = 25^\circ\text{C}$  | 40         | A    |
| $I_D$          | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 28         | A    |
| $I_{DM}^{(2)}$ | Drain current (pulsed)                                  | 160        | A    |
| $P_{tot}$      | Total dissipation at $T_C = 25^\circ\text{C}$           | 80         | W    |
|                | Derating Factor                                         | 0.53       | W/°C |
| $dv/dt^{(3)}$  | Peak diode recovery voltage slope                       | 5.5        | V/ns |
| $E_{AS}^{(4)}$ | Single pulse avalanche energy                           | 850        | mJ   |
| $T_{stg}$      | Storage temperature                                     | -55 to 175 | °C   |
| $T_j$          | Max. operating junction temperature                     |            |      |

1. Current limited by package
2. Pulse width limited by safe operating area.
3.  $I_{SD} \leq 40\text{A}$ ,  $di/dt \leq 350\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$
4. Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 20\text{A}$ ,  $V_{DD} = 25\text{V}$

**Table 2. Thermal data**

|                |                                                |      |      |
|----------------|------------------------------------------------|------|------|
| $R_{thj-case}$ | Thermal resistance junction-case max           | 1.88 | °C/W |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max        | 100  | °C/W |
| $T_J$          | Maximum lead temperature for soldering purpose | 300  | °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                   | $I_D = 250\mu\text{A}$ , $V_{GS} = 0$                                                         | 30   |                  |                  | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{max rating}$<br>$V_{DS} = \text{max rating}$ ,<br>$T_C = 125^{\circ}\text{C}$ |      |                  | 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                           | $V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$                                                    | 1    |                  |                  | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{V}$ , $I_D = 20\text{A}$<br>$V_{GS} = 5\text{V}$ , $I_D = 10\text{A}$       |      | 0.0090<br>0.0150 | 0.0110<br>0.0195 | $\Omega$<br>$\Omega$           |

**Table 4. Dynamic**

| Symbol                                        | Parameter                                                               | Test conditions                                                                                                              | Min. | Typ.                  | Max. | Unit                 |
|-----------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------|-----------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance                                                | $V_{DS} = 15\text{V}$ , $I_D = 20\text{A}$                                                                                   |      | 23                    |      | 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>$V_{GS} = 0$                                                                  |      | 1440<br>560<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     | $V_{DD} = 15\text{V}$ , $I_D = 20\text{A}$<br>$R_G = 4.7\Omega$ , $V_{GS} = 5\text{V}$<br>(see <a href="#">Figure 13</a> )   |      | 22<br>165<br>21<br>25 |      | 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            | $V_{DD} = 15\text{V}$ , $I_D = 40\text{A}$ ,<br>$V_{GS} = 5\text{V}$ , $R_G = 4.7\Omega$<br>(see <a href="#">Figure 14</a> ) |      | 22.5<br>9<br>12       | 30   | 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)                     |                                                                                                                     |      |                 | 40<br>160 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 20A$ , $V_{GS} = 0$                                                                                       |      |                 | 1.3       | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 40A$ , $di/dt = 100A/\mu s$ ,<br>$V_{DD} = 20V$ , $T_j = 150^\circ C$<br>(see <a href="#">Figure 15</a> ) |      | 42<br>52<br>2.5 |           | 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

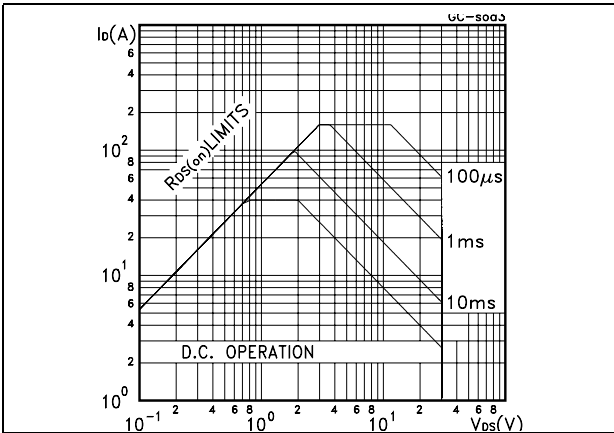


Figure 2. Thermal impedance

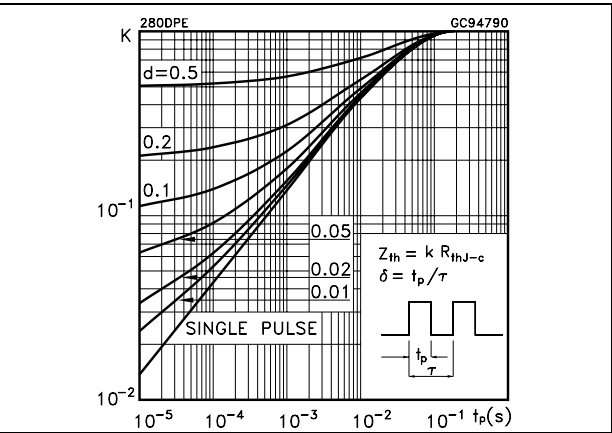


Figure 3. Output characteristics

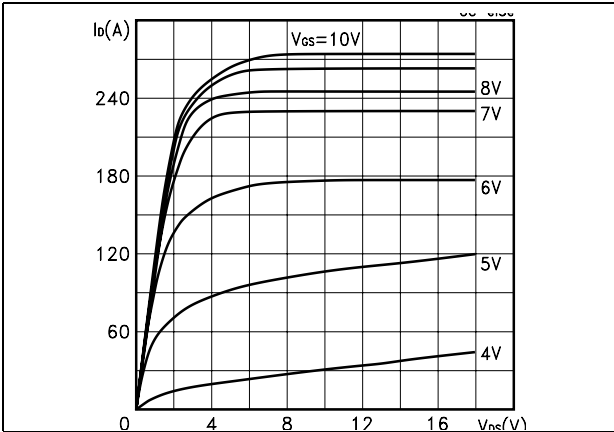


Figure 4. Transfer characteristics

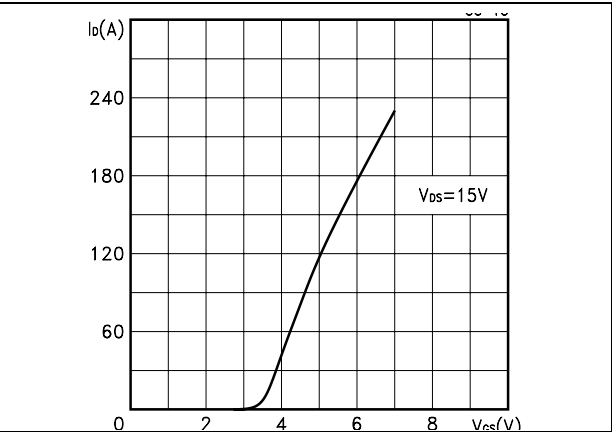


Figure 5. Transconductance

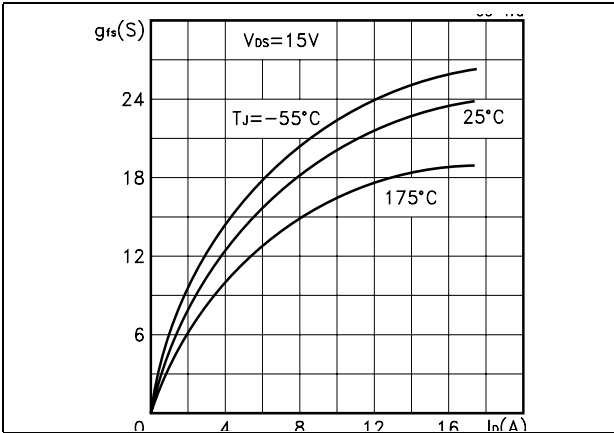


Figure 6. Static drain-source on resistance

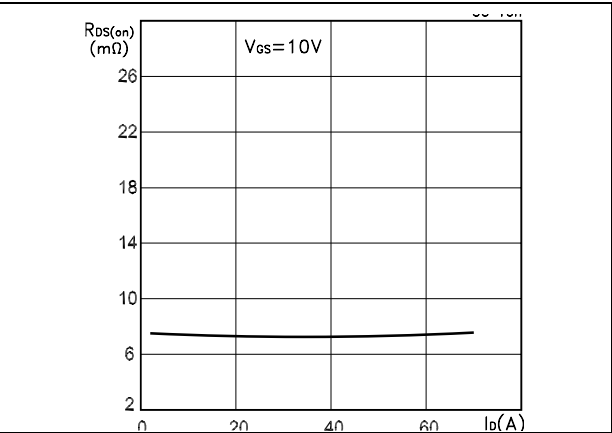


Figure 7. Gate charge vs. gate-source voltage Figure 8. Capacitance variations

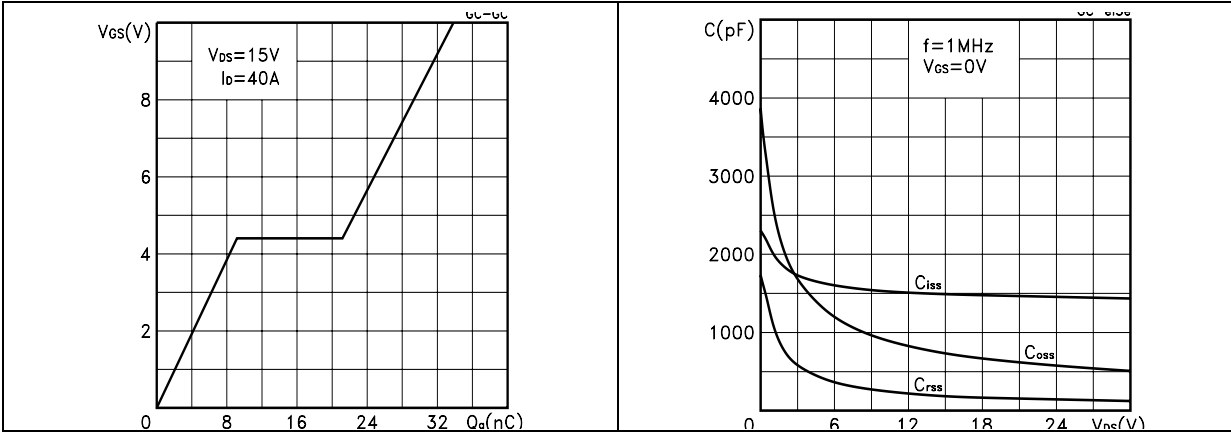


Figure 9. Normalized gate threshold voltage vs. temperature Figure 10. Normalized on resistance vs. temperature

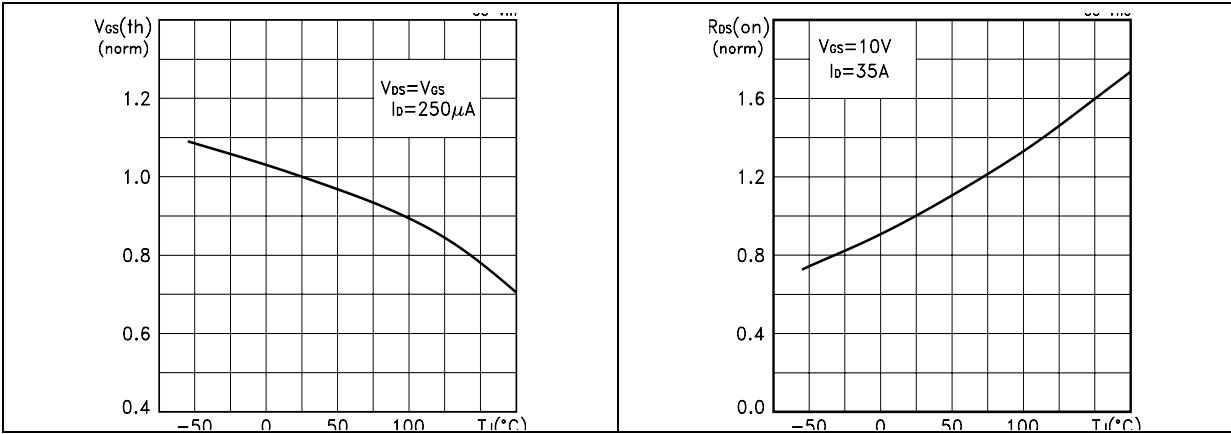
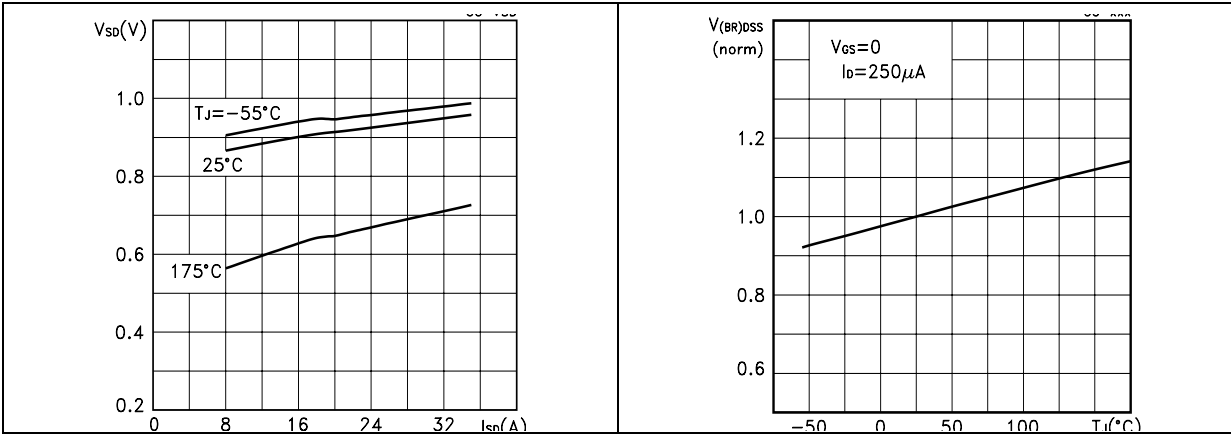


Figure 11. Source-drain diode forward characteristics Figure 12. Normalized breakdown voltage vs. temperature



### 3 Test circuit

**Figure 13. Switching times test circuit for resistive load**

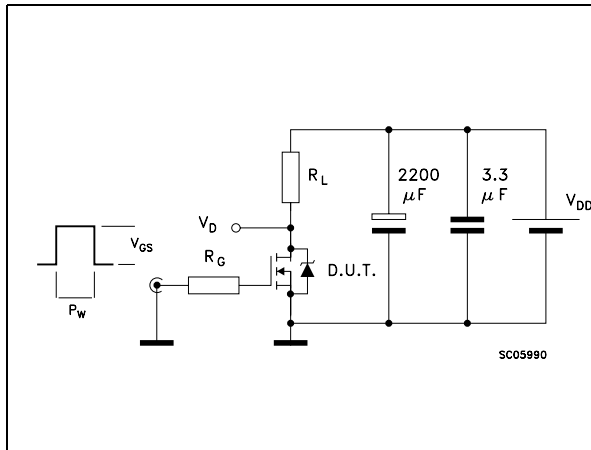


**Figure 14. Gate charge test circuit**

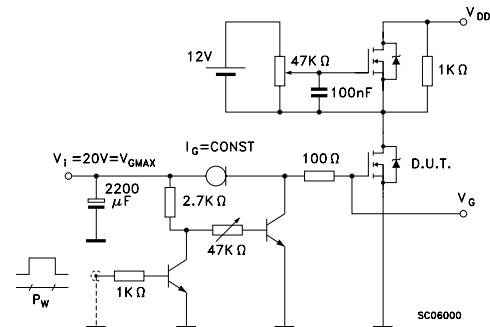


**Figure 15. Test circuit for inductive load switching and diode recovery times**

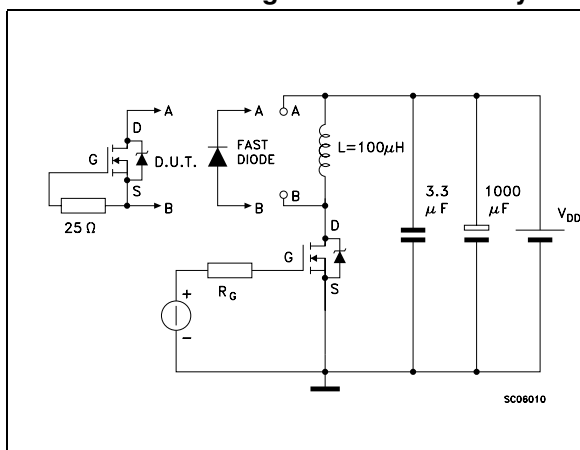


**Figure 16. Unclamped Inductive load test circuit**

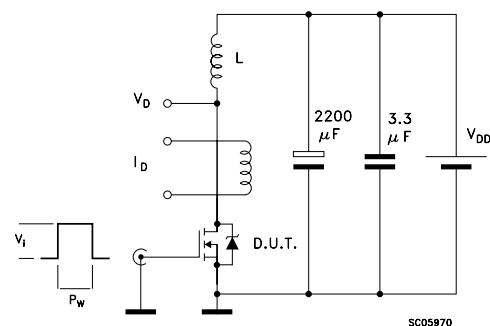


**Figure 17. Unclamped inductive waveform**

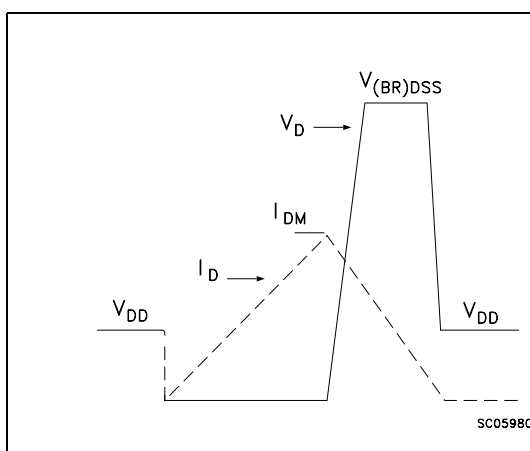
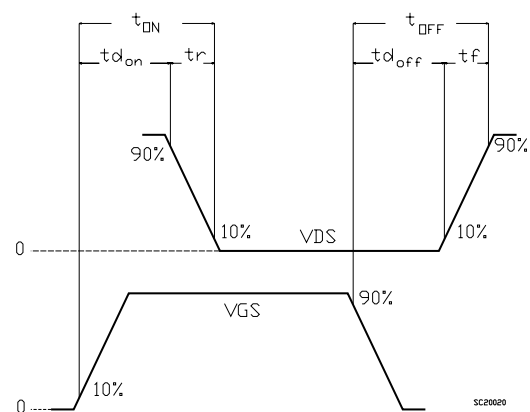


**Figure 18. Switching time waveform**

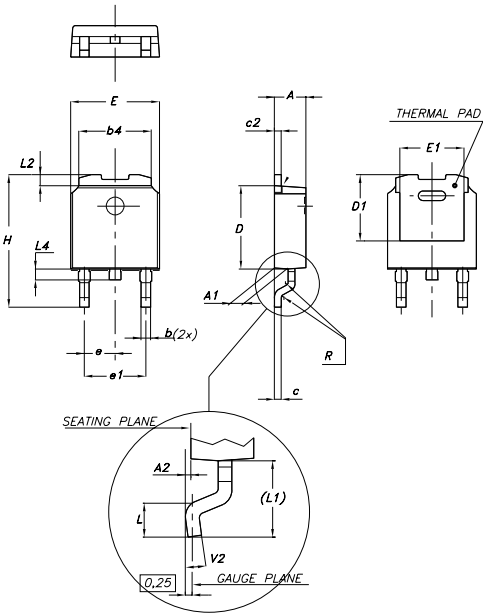


## 4 Package mechanical data

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)

**DPAK MECHANICAL DATA**

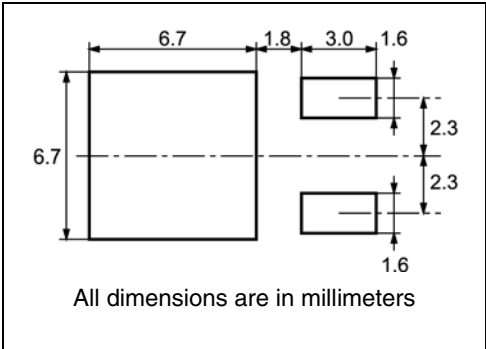
| DIM. | mm.  |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23 | 0.001 |       | 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°    |



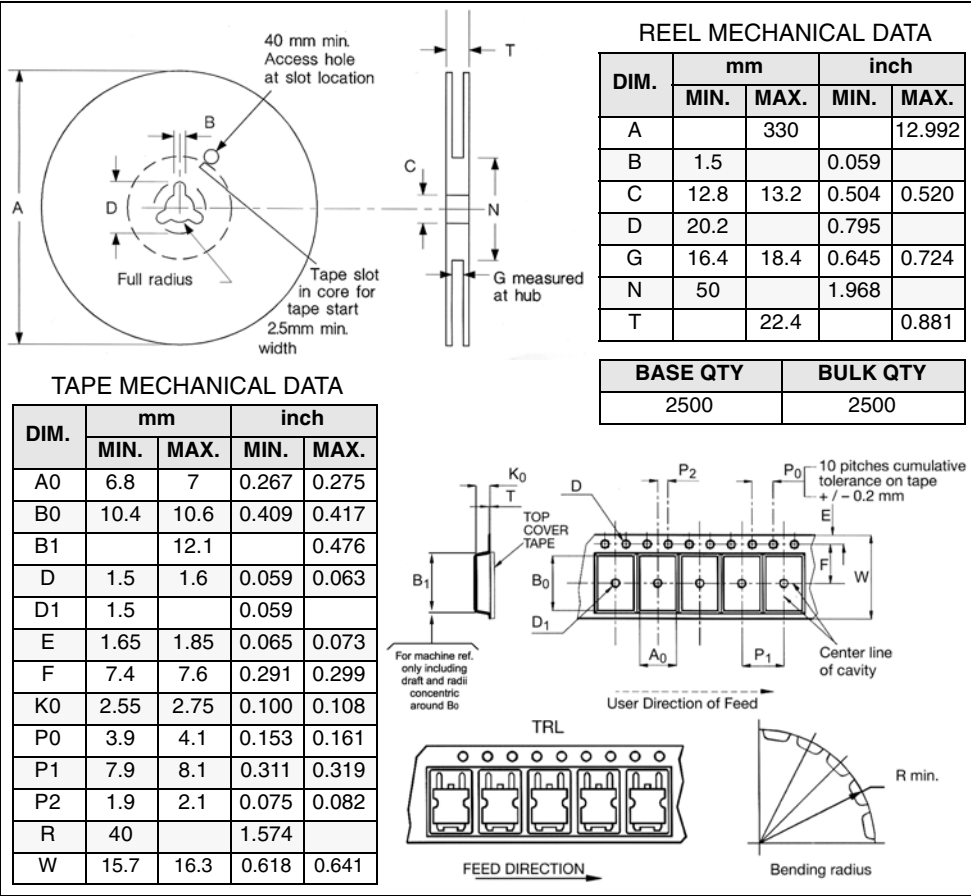
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# 5 Packing mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT



## 6 Revision history

**Table 6. Revision history**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>                  |
|-------------|-----------------|---------------------------------|
| 21-Jun-2004 | 9               | Preliminary data                |
| 11-Jul-2006 | 10              | New template, no content change |
| 20-Feb-2007 | 11              | Typo mistake on page 1          |

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