



# STB60NF06 STB60NF06-1

N-channel 60V - 0.014Ω - 60A - D<sup>2</sup>PAK/I<sup>2</sup>PAK  
STripFET™ II Power MOSFET

## General features

| Type        | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|------------------|---------------------|----------------|
| STB60NF06-1 | 60V              | <0.016Ω             | 60A            |
| STB60NF06   | 60V              | <0.016Ω             | 60             |

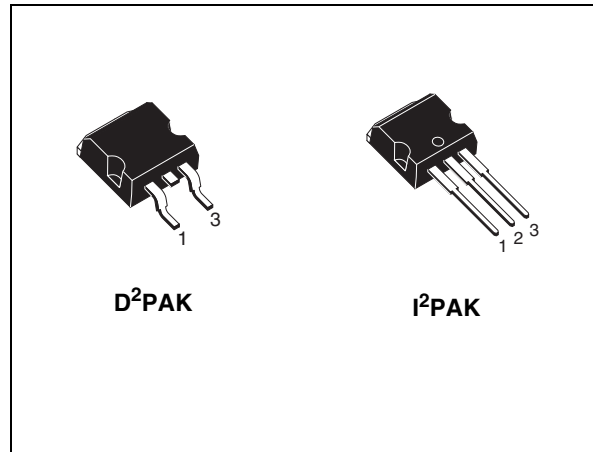
- Exceptional dv/dt capability
- 100% avalanche tested
- Application oriented characterization

## Description

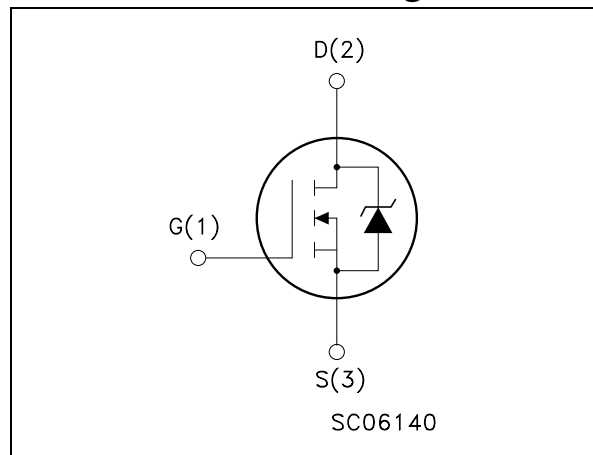
This Power MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters for Telecom and Computer application. It is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

## Applications

- Switching application



## Internal schematic diagram



## Order codes

| Part number | Marking | Package            | Packaging   |
|-------------|---------|--------------------|-------------|
| STB60NF06T4 | B60NF06 | D <sup>2</sup> PAK | Tape & reel |
| STB60NF06-1 | B60NF06 | I <sup>2</sup> PAK | 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                   |
| $V_{DGR}$      | Drain-gate voltage ( $R_{GS} = 20\text{ k}\Omega$ )     | 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                       | 4          | V/ns                |
| $T_{stg}$      | Storage temperature                                     | -65 to 175 | $^\circ\text{C}$    |
| $T_j$          | Max. operating junction temperature                     |            |                     |

1. Pulse width limited by safe operating area.

2.  $I_{SD} \leq 60\text{A}$ ,  $di/dt \leq 400\text{A}/\mu\text{s}$ ,  $V_{DD} \leq 24\text{V}$ ,  $T_j \leq T_{JMAX}$

**Table 2. Thermal data**

|                |                                                |      |                           |
|----------------|------------------------------------------------|------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max           | 1.36 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max        | 62.5 | $^\circ\text{C}/\text{W}$ |
| $T_J$          | Maximum lead temperature for soldering purpose | 300  | $^\circ\text{C}$          |

**Table 3. Avalanche characteristics**

| Symbol   | Parameter                                                                                                    | Max Value | Unit |
|----------|--------------------------------------------------------------------------------------------------------------|-----------|------|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max)                           | 30        | A    |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 30\text{ V}$ ) | 360       | mJ   |

## 2 Electrical characteristics

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

**Table 4. 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>$V_{DS} = \text{Max rating}$ ,<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                           | $V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$                                                    | 2    |       | 4         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{V}$ , $I_D = 30\text{A}$                                                    |      | 0.015 | 0.016     | $\Omega$                       |

**Table 5. Dynamic**

| Symbol                                        | Parameter                                                               | Test conditions                                                                                                               | Min. | Typ.                  | Max. | Unit                 |
|-----------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------|-----------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance                                                | $V_{DS} = 15\text{V}$ , $I_D = 30\text{A}$                                                                                    |      | 20                    |      | 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>$V_{GS} = 0$                                                                   |      | 1810<br>360<br>125    |      | 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> )   |      | 16<br>108<br>43<br>20 |      | 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            | $V_{DD} = 48\text{V}$ , $I_D = 60\text{A}$ ,<br>$V_{GS} = 10\text{V}$ , $R_G = 4.7\Omega$<br>(see <a href="#">Figure 13</a> ) |      | 49<br>18<br>14        | 66   | nC<br>nC<br>nC       |

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

**Table 6. 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                                                           | $I_{SD} = 60A$ , $V_{GS} = 0$                                                                                       |      |                | 1.3       | 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> ) |      | 73<br>182<br>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

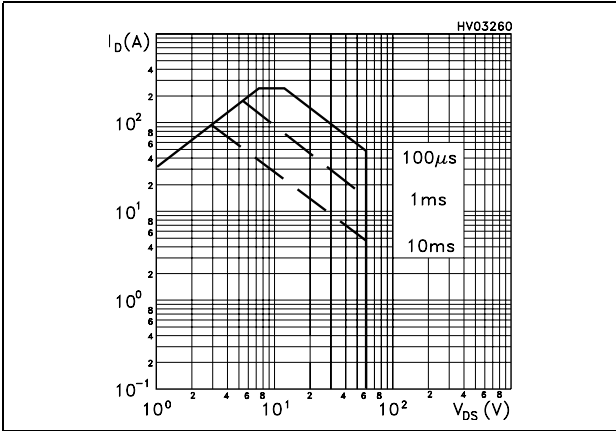


Figure 2. Thermal impedance

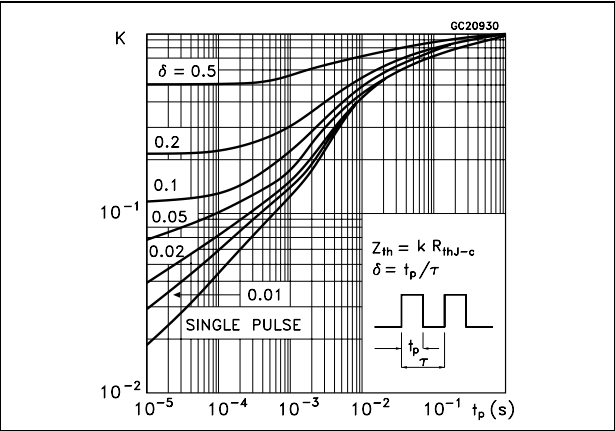


Figure 3. Output characteristics

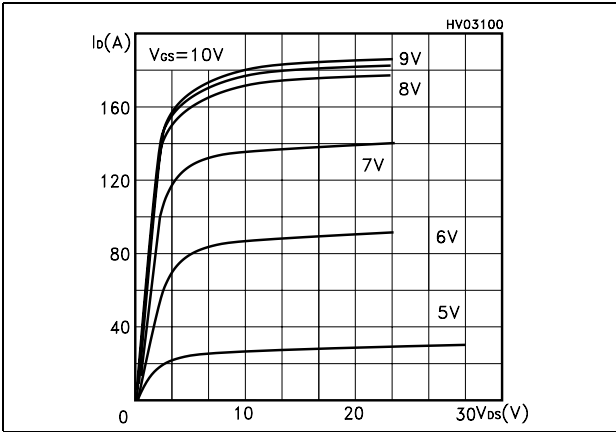


Figure 4. Transfer characteristics

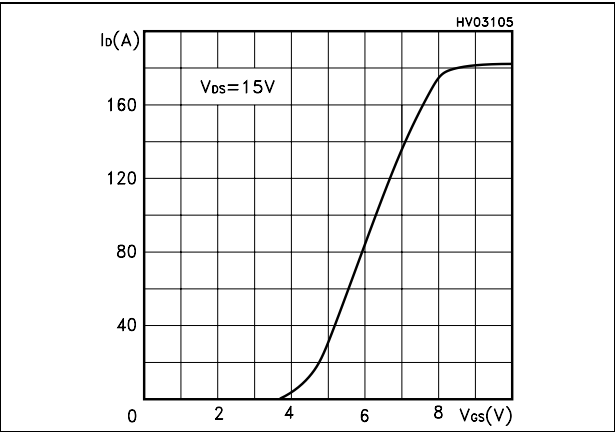


Figure 5. Transconductance

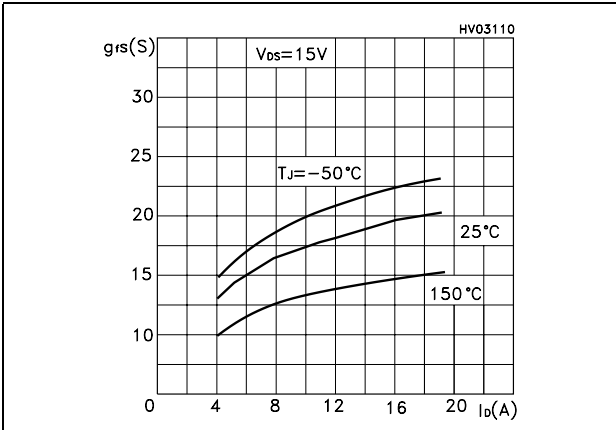


Figure 6. Static drain-source on resistance

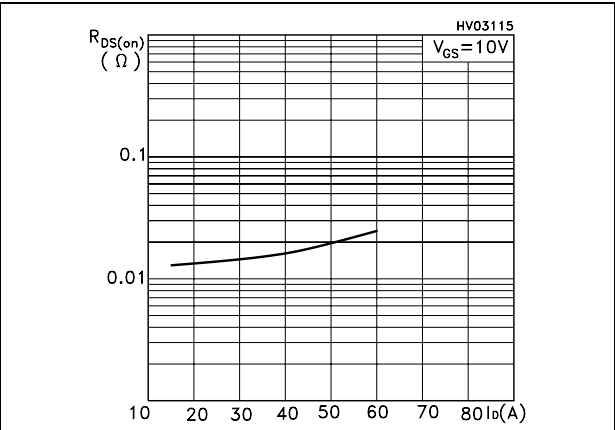


Figure 7. Gate charge vs gate-source voltage      Figure 8. Capacitance variations

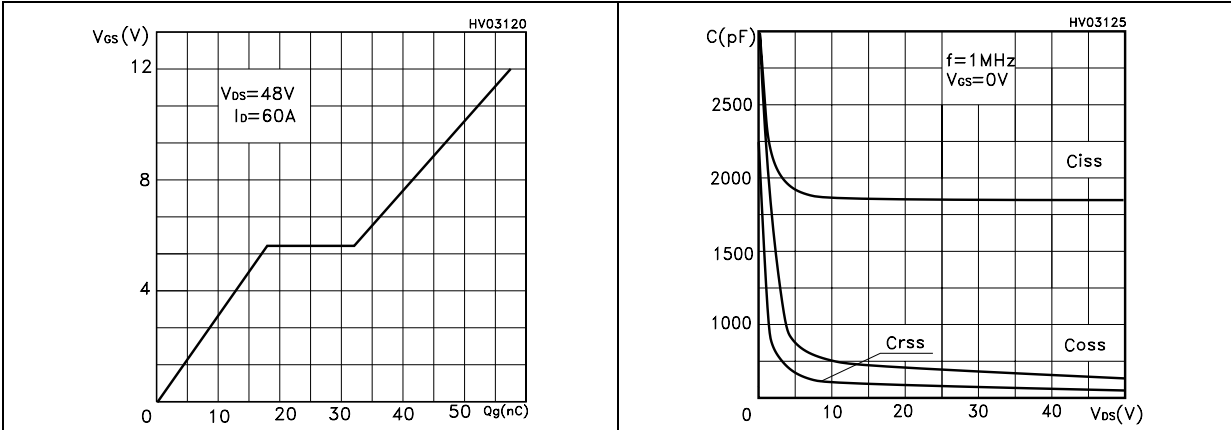


Figure 9. Normalized gate threshold voltage vs temperature      Figure 10. Normalized on resistance vs temperature

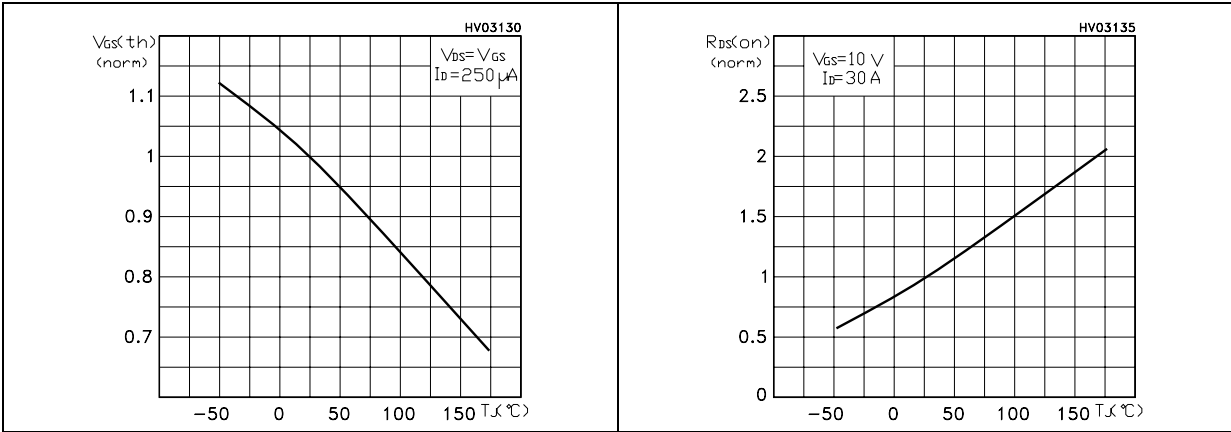
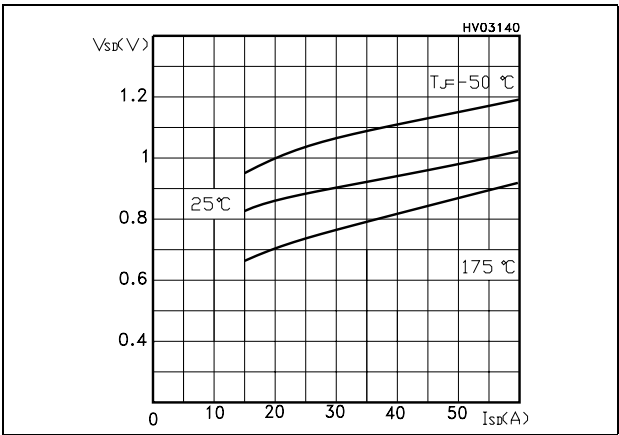
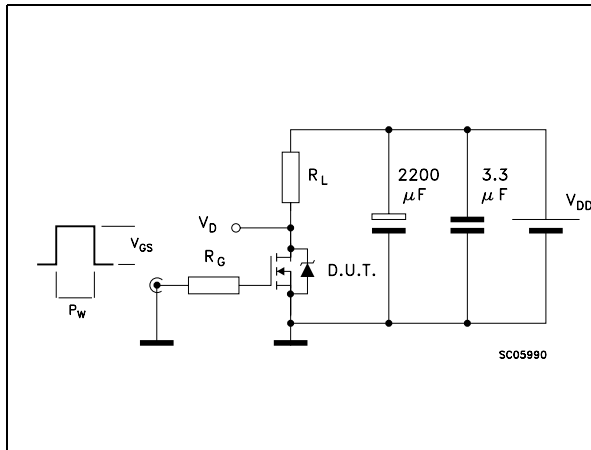


Figure 11. Source-drain diode forward characteristics

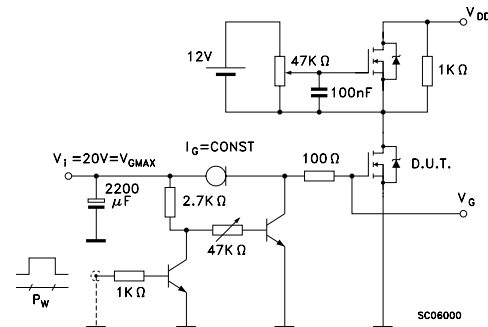


### 3 Test circuit

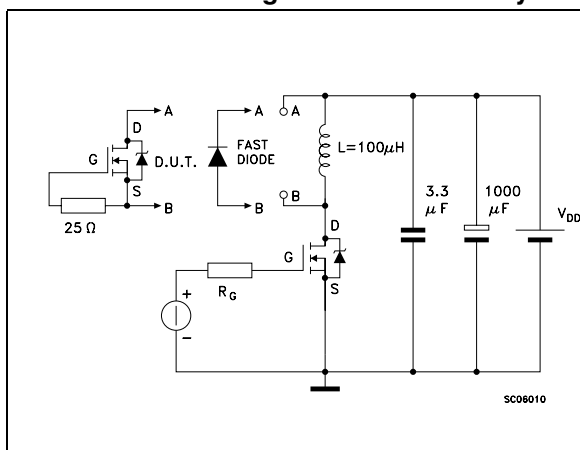
**Figure 12. Switching times test circuit for resistive load**



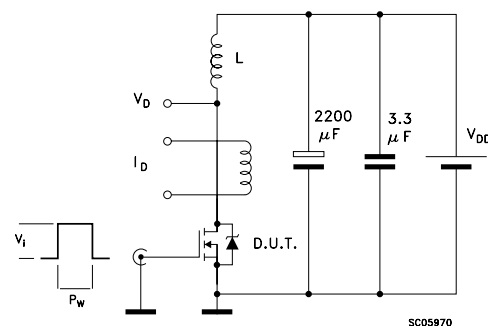
**Figure 13. Gate charge test circuit**



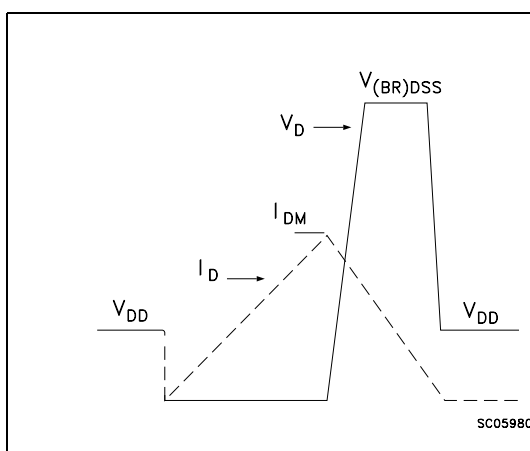
**Figure 14. Test circuit for inductive load switching and diode recovery times**



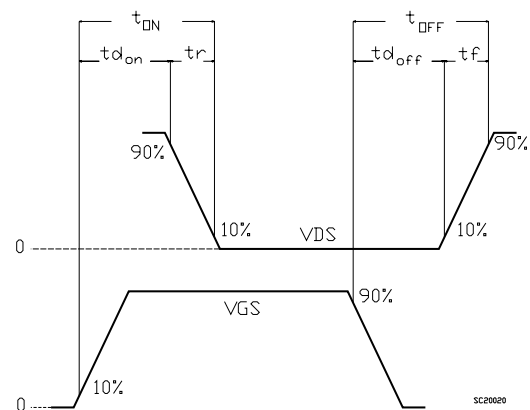
**Figure 15. Unclamped Inductive load test circuit**



**Figure 16. Unclamped inductive waveform**



**Figure 17. Switching time waveform**



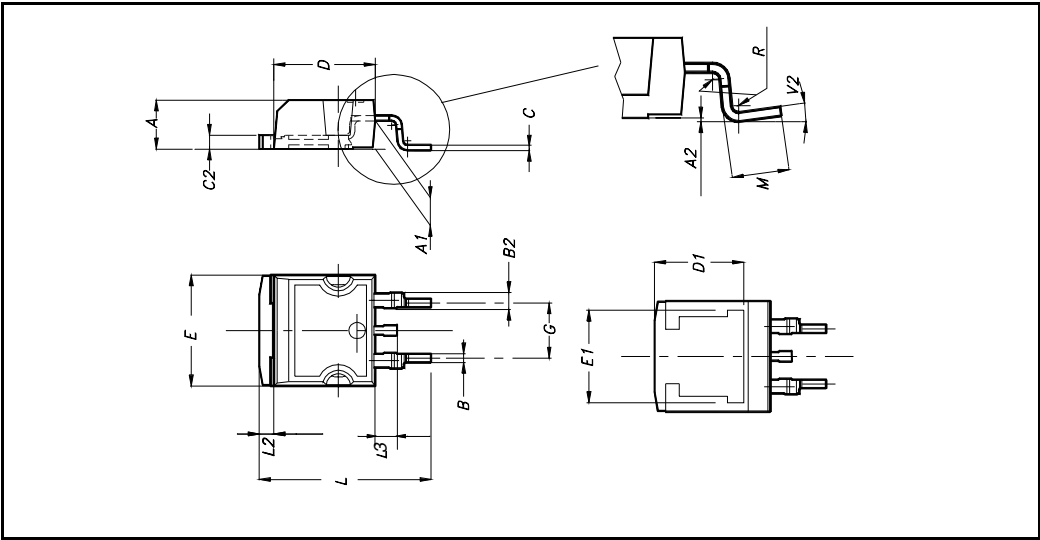


## 4 Package mechanical data

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)

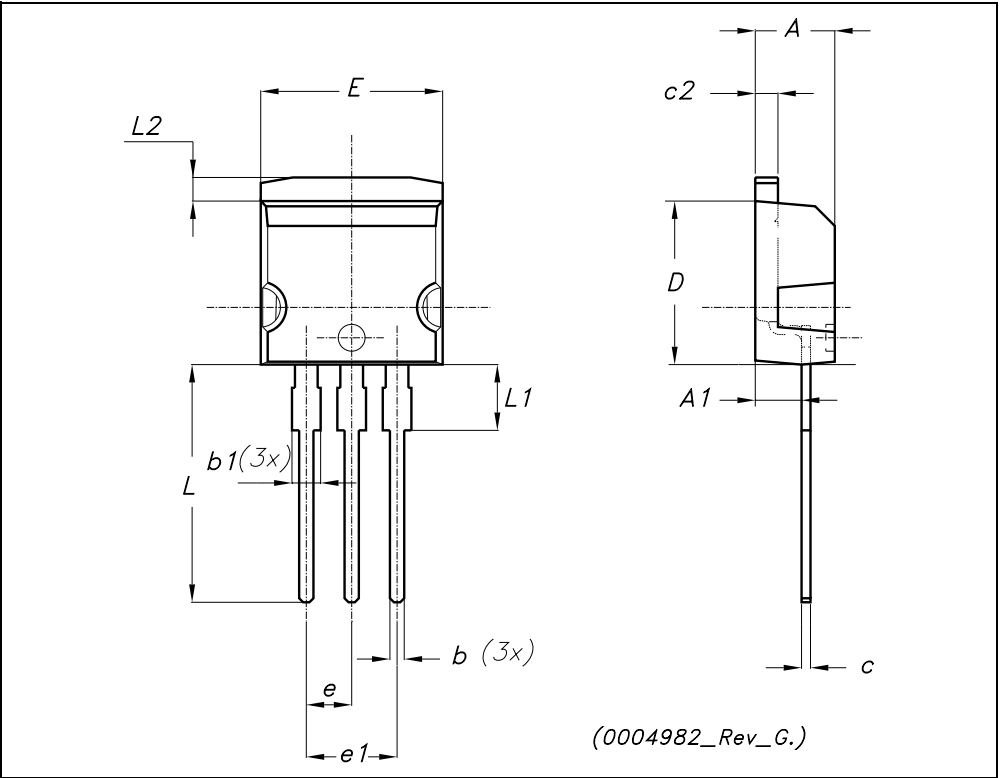
D<sup>2</sup>PAK MECHANICAL DATA

| 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°    |       |       |       |

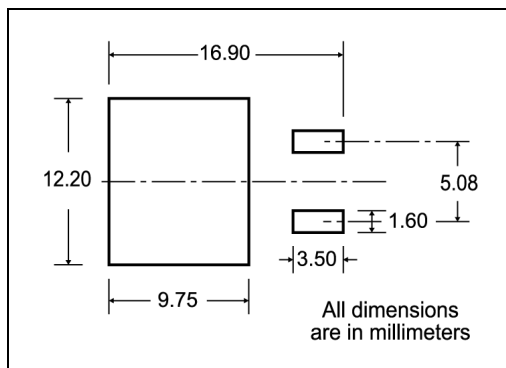


TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA

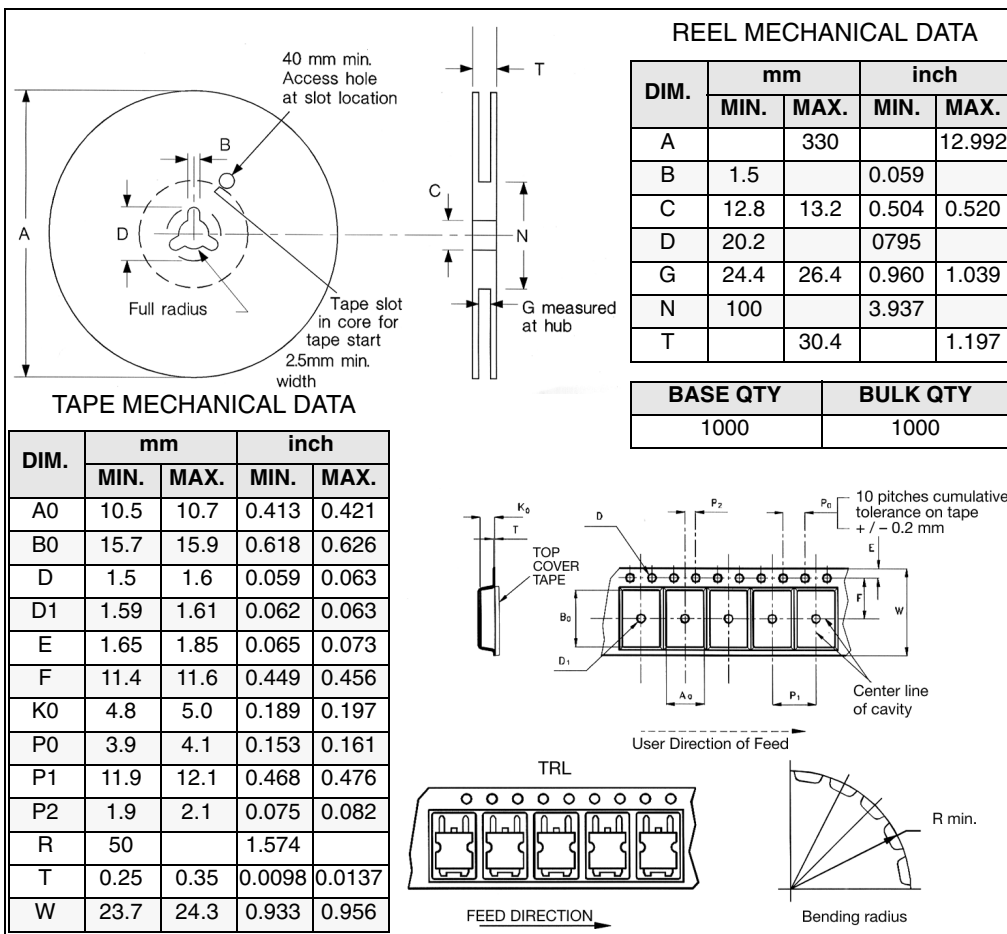
| DIM. | mm.  |     |       | inch  |      |       |
|------|------|-----|-------|-------|------|-------|
|      | MIN. | TYP | MAX.  | MIN.  | TYP. | MAX.  |
| A    | 4.40 |     | 4.60  | 0.173 |      | 0.181 |
| A1   | 2.40 |     | 2.72  | 0.094 |      | 0.107 |
| b    | 0.61 |     | 0.88  | 0.024 |      | 0.034 |
| b1   | 1.14 |     | 1.70  | 0.044 |      | 0.066 |
| c    | 0.49 |     | 0.70  | 0.019 |      | 0.027 |
| c2   | 1.23 |     | 1.32  | 0.048 |      | 0.052 |
| D    | 8.95 |     | 9.35  | 0.352 |      | 0.368 |
| e    | 2.40 |     | 2.70  | 0.094 |      | 0.106 |
| e1   | 4.95 |     | 5.15  | 0.194 |      | 0.202 |
| E    | 10   |     | 10.40 | 0.393 |      | 0.410 |
| L    | 13   |     | 14    | 0.511 |      | 0.551 |
| L1   | 3.50 |     | 3.93  | 0.137 |      | 0.154 |
| L2   | 1.27 |     | 1.40  | 0.050 |      | 0.055 |



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



## REEL MECHANICAL DATA



\* on sales type

## 6 Revision history

**Table 7. Revision history**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>                   |
|-------------|-----------------|----------------------------------|
| 21-Jun-2004 | 2               | Preliminary version              |
| 16-Jun-2006 | 3               | New template, no content change. |

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