



# STD16NF06L STD16NF06L-1

N-channel 60V - 0.060Ω - 24A - DPAK/IPAK  
STripFET™ II Power MOSFET

## General features

| Type         | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|--------------|------------------|---------------------|----------------|
| STD16NF06L-1 | 60V              | <0.070Ω             | 24A            |
| STD16NF06L   | 60V              | <0.070Ω             | 24A            |

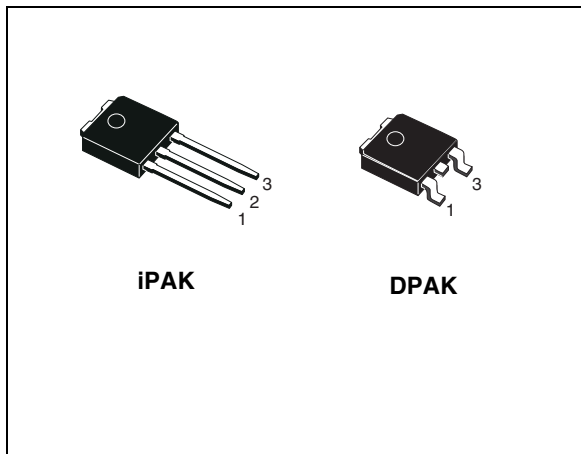
- Logic level device
- Low threshold drive

## Description

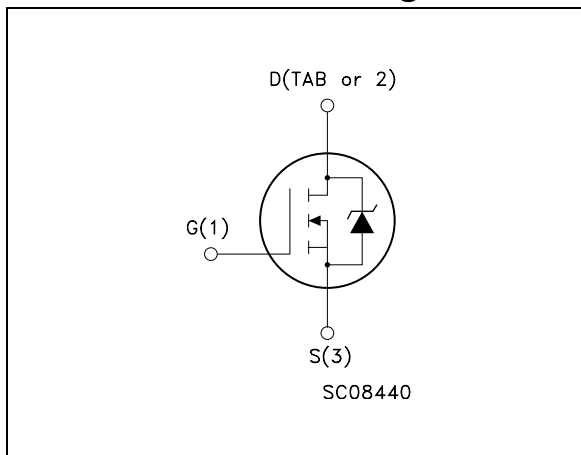
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing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

## Applications

- Switching application



## Internal schematic diagram



## Order codes

| Part number  | Marking  | Package | Packaging   |
|--------------|----------|---------|-------------|
| STD16NF06L-1 | D16NF06L | IPAK    | Tube        |
| STD16NF06LT4 | D16NF06L | DPAK    | Tape & reel |

# Contents

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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                                    | $\pm 18$   | V                   |
| $I_D$          | Drain current (continuous) at $T_C = 25^\circ\text{C}$  | 24         | A                   |
| $I_D$          | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 17         | A                   |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                  | 96         | A                   |
| $P_{tot}$      | Total dissipation at $T_C = 25^\circ\text{C}$           | 40         | W                   |
|                | Derating Factor   | 0.27       | W/ $^\circ\text{C}$ |
| $dv/dt^{(2)}$  | Peak diode recovery avalanche energy                    | 11.5       | V/ns                |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy                           | 200        | 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.  $I_{SD} \leq 6\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} = V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$
3. Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 20\text{A}$ ,  $V_{DD} = 48\text{V}$

**Table 2. Thermal data**

|                |   |      |                           |
|----------------|---|------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max                          | 3.75 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}$  | Thermal resistance junction-to PCB max                        | 62   | $^\circ\text{C}/\text{W}$ |
| $T_J$          | Maximum lead temperature for soldering purpose <sup>(1)</sup> | 300  | $^\circ\text{C}$          |

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

## 2 Electrical characteristics

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

**Table 3. On/off states**

| Symbol        | Parameter  | Test conditions   | Min. | Typ.           | Max.           | Unit                 |
|---------------|--|---|------|----------------|----------------|----------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\mu A, V_{GS} = 0$  | 60   |                |                | V                    |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$<br>$V_{DS} = \text{Max rating},$<br>$T_C = 125^{\circ}C$ |      |                | 1<br>10        | $\mu A$<br>$\mu A$   |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 18V$  |      |                | $\pm 100$      | nA                   |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}, I_D = 250\mu A$   | 1    |                |                | V                    |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10V, I_D = 8A$<br>$V_{GS} = 5V, I_D = 8A$                                   |      | 0.060<br>0.070 | 0.070<br>0.085 | $\Omega$<br>$\Omega$ |

**Table 4. Dynamic**

| Symbol         | Parameter                    | Test conditions   | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|---|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance     | $V_{DS} = 15V, I_D = 12A$   |      | 12   |      | S    |
| $C_{iss}$      | Input capacitance            | $V_{DS} = 25V, f = 1MHz,$<br>$V_{GS} = 0$   |      | 370  |      | pF   |
| $C_{oss}$      | Output capacitance           |   |      | 69   |      | pF   |
| $C_{rss}$      | Reverse transfer capacitance |   |      | 30   |      | pF   |
| $t_{d(on)}$    | Turn-on delay time           | $V_{DD} = 30V, I_D = 8A$<br>$R_G = 4.7\Omega, V_{GS} = 5V$<br>(see <a href="#">Figure 13</a> )  |      | 12   |      | ns   |
| $t_r$          | Rise time                    |   |      | 30   |      | ns   |
| $t_{d(off)}$   | Turn-off delay time          |   |      | 20   |      | ns   |
| $t_f$          | Fall time                    |   |      | 6    |      | ns   |
| $Q_g$          | Total gate charge            | $V_{DD} = 30V, I_D = 8A,$<br>$V_{GS} = 5V, R_G = 4.7\Omega$<br>(see <a href="#">Figure 14</a> ) |      | 7.5  |      | nC   |
| $Q_{gs}$       | Gate-source charge           |   |      | 2.5  |      | nC   |
| $Q_{gd}$       | Gate-drain charge            |   |      | 4.2  |      | nC   |

1. Pulsed: Pulse duration = 300  $\mu s$ , 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)                     |  |      |                 | 16<br>64 | A<br>A             |
| $V_{SD}^{(2)}$                    | Forward on voltage   | $I_{SD} = 16A, V_{GS} = 0$   |      |                 | 1.5      | V                  |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 16A, di/dt = 100A/\mu s,$<br>$V_{DD} = 25V, T_j = 150^\circ C$<br>(see <a href="#">Figure 15</a> ) |      | 53<br>85<br>3.2 |          | ns<br>$\mu C$<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

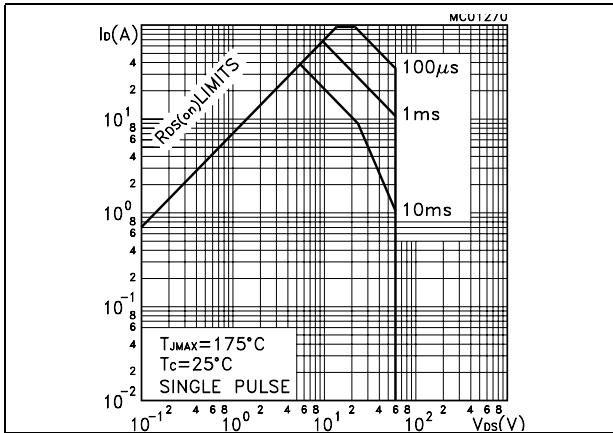


Figure 2. Thermal impedance

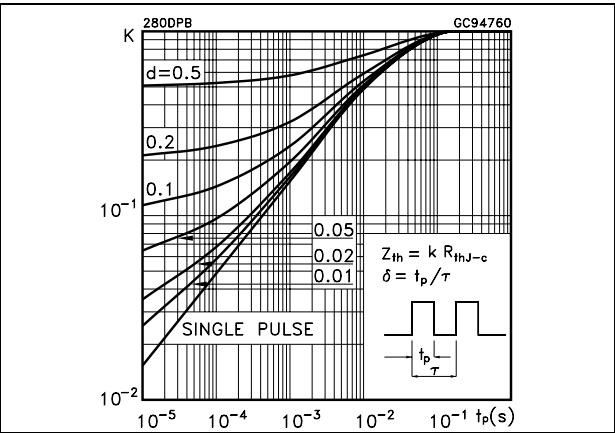


Figure 3. Output characteristics

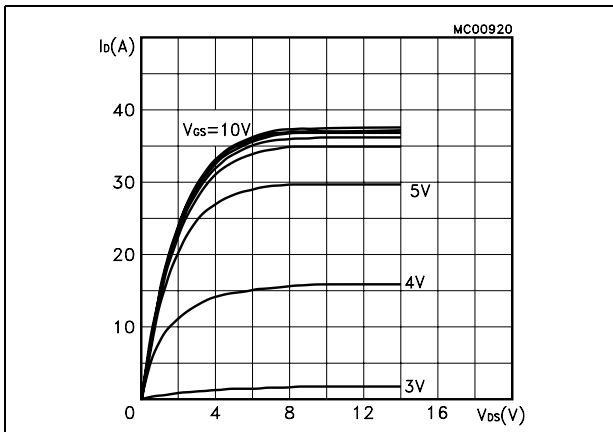


Figure 4. Transfer characteristics

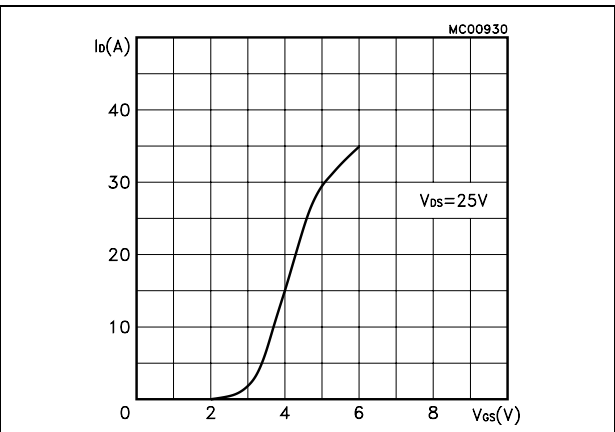


Figure 5. Transconductance

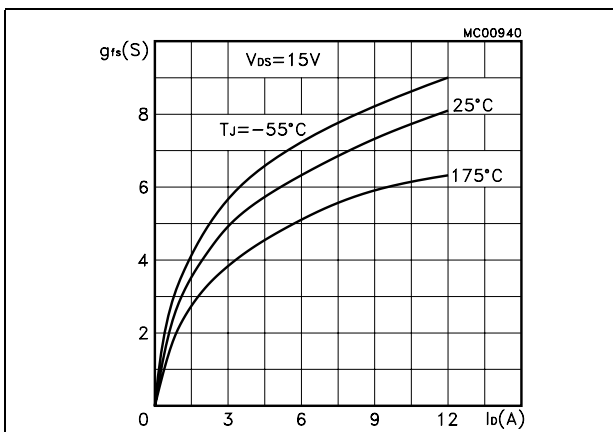


Figure 6. Static drain-source on resistance

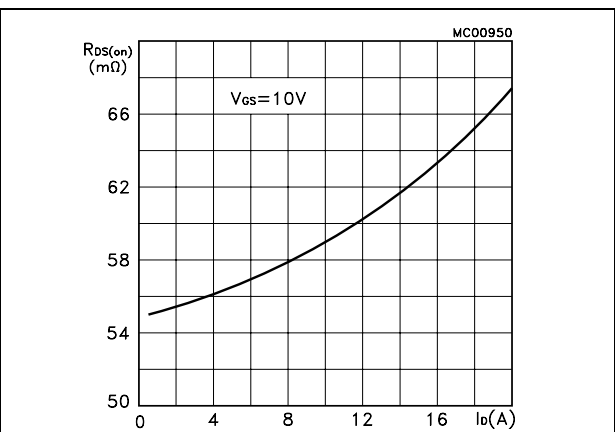


Figure 7. Gate charge vs. gate-source voltage Figure 8. Capacitance variations

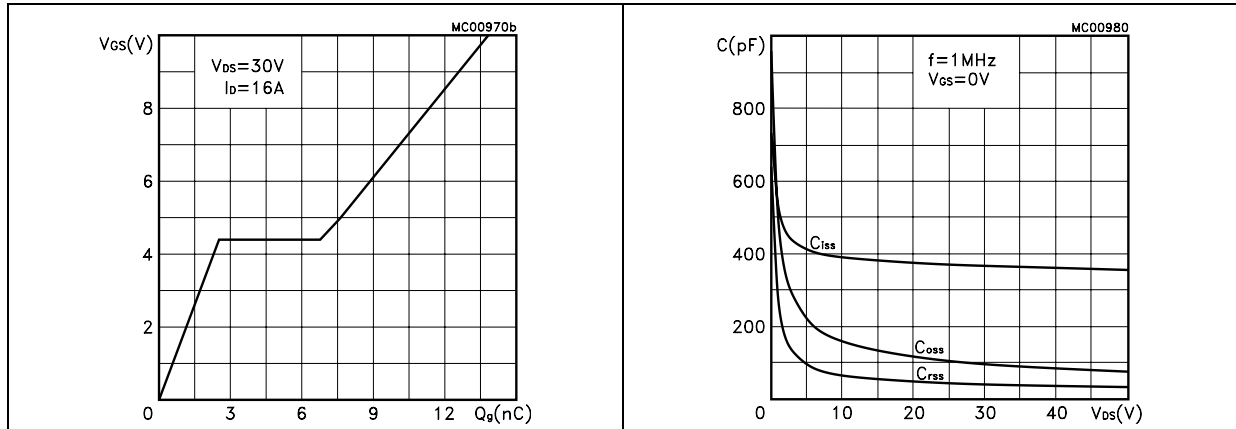


Figure 9. Normalized gate threshold voltage vs. temperature Figure 10. Normalized on resistance vs. temperature

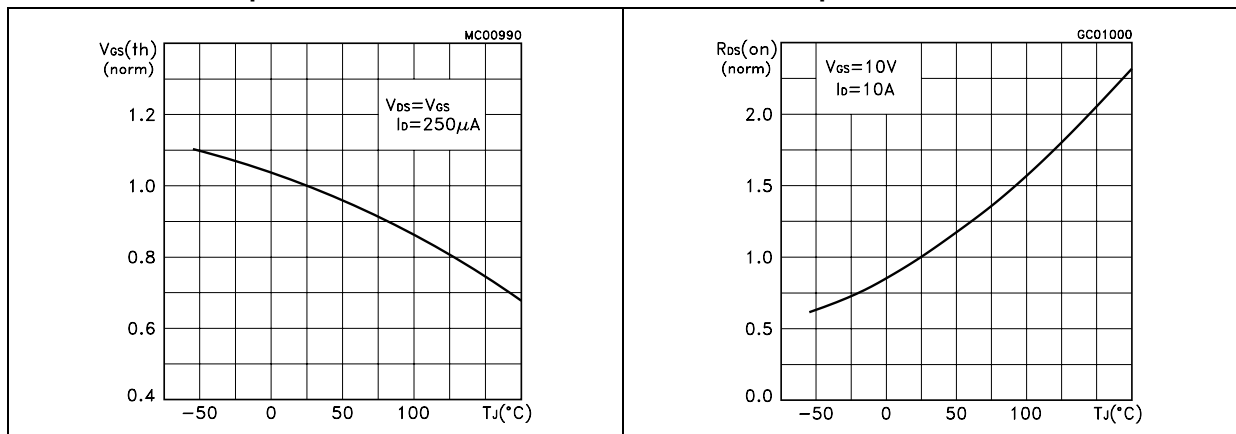
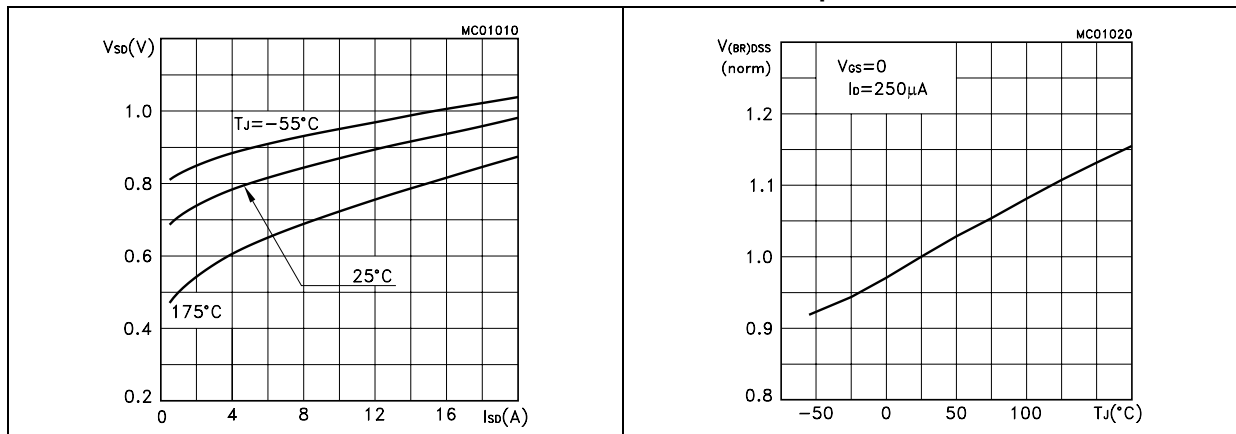


Figure 11. Source-drain diode forward characteristics Figure 12. Normalized breakdown voltage vs. temperature



### 3 Test circuit

Figure 13. Switching times test circuit for resistive load



Figure 14. Gate charge test circuit

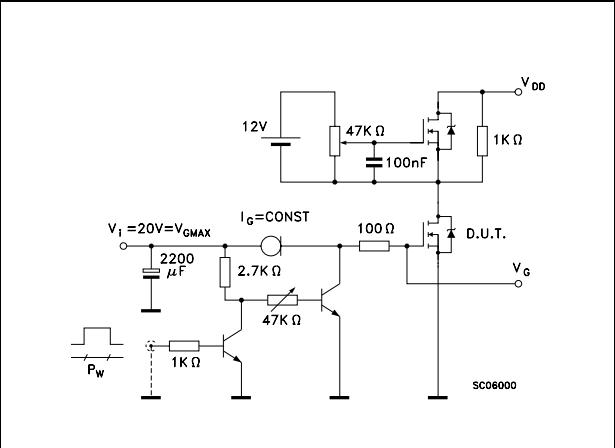


Figure 15. Test circuit for inductive load switching and diode recovery times



Figure 16. Unclamped Inductive load test circuit

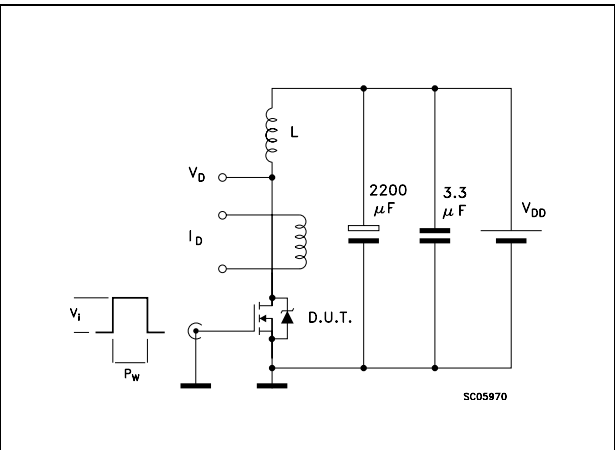
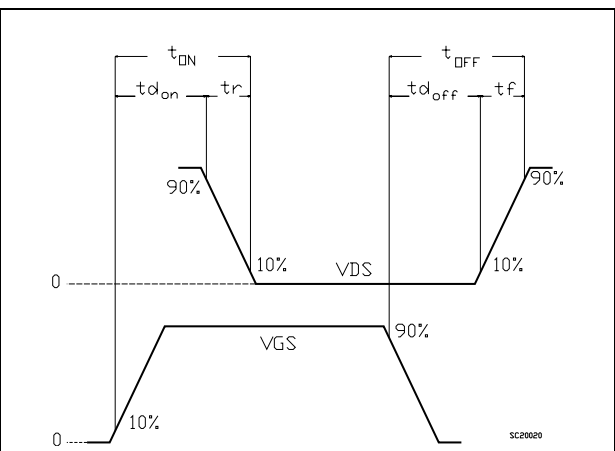


Figure 17. Unclamped inductive waveform



Figure 18. Switching time waveform



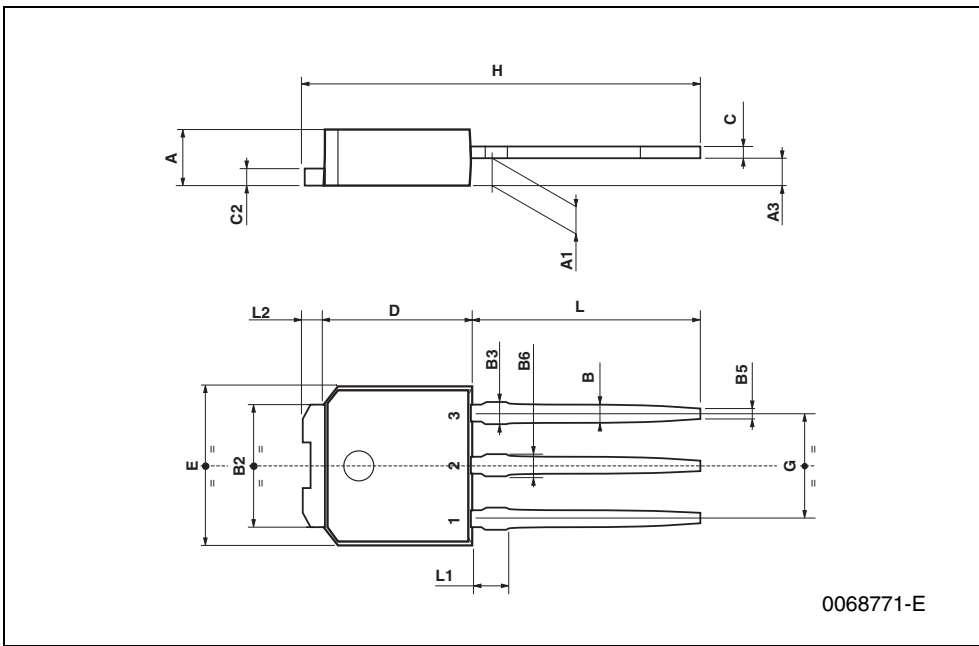


## 4 Package mechanical data

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)

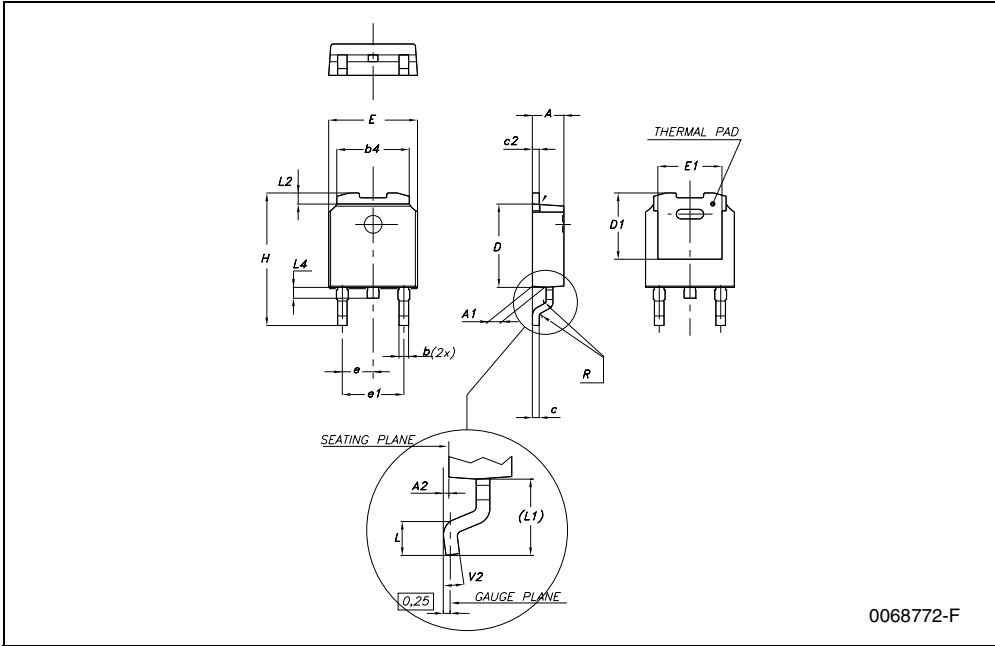
**TO-251 (IPAK) MECHANICAL DATA**

| 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 |
| A3   | 0.7  |      | 1.3  | 0.027 |       | 0.051 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.031 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| B3   |      |      | 0.85 |       |       | 0.033 |
| B5   |      | 0.3  |      |       | 0.012 |       |
| B6   |      |      | 0.95 |       |       | 0.037 |
| 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 |
| E    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| G    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 15.9 |      | 16.3 | 0.626 |       | 0.641 |
| L    | 9    |      | 9.4  | 0.354 |       | 0.370 |
| L1   | 0.8  |      | 1.2  | 0.031 |       | 0.047 |
| L2   |      | 0.8  | 1    |       | 0.031 | 0.039 |



**DPAK MECHANICAL DATA**

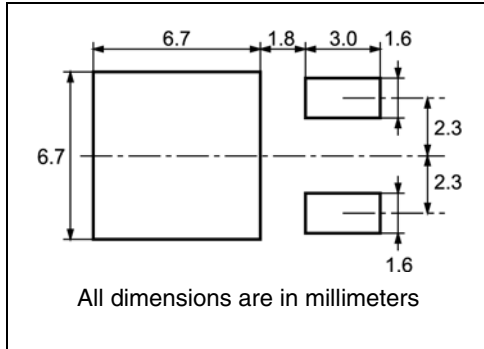
| DIM. | mm.  |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23 | 0.001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



0068772-F

# 5 Packing mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT

**TAPE MECHANICAL DATA**

| DIM. | mm   |      | inch  |       |
|------|------|------|-------|-------|
|      | MIN. | MAX. | MIN.  | MAX.  |
| A0   | 6.8  | 7    | 0.267 | 0.275 |
| B0   | 10.4 | 10.6 | 0.409 | 0.417 |
| B1   |      | 12.1 |       | 0.476 |
| D    | 1.5  | 1.6  | 0.059 | 0.063 |
| D1   | 1.5  |      | 0.059 |       |
| E    | 1.65 | 1.85 | 0.065 | 0.073 |
| F    | 7.4  | 7.6  | 0.291 | 0.299 |
| K0   | 2.55 | 2.75 | 0.100 | 0.108 |
| P0   | 3.9  | 4.1  | 0.153 | 0.161 |
| P1   | 7.9  | 8.1  | 0.311 | 0.319 |
| P2   | 1.9  | 2.1  | 0.075 | 0.082 |
| R    | 40   |      | 1.574 |       |
| W    | 15.7 | 16.3 | 0.618 | 0.641 |

**REEL MECHANICAL DATA**

| DIM. | mm   |      | inch  |        |
|------|------|------|-------|--------|
|      | MIN. | MAX. | MIN.  | MAX.   |
| A    |      | 330  |       | 12.992 |
| B    | 1.5  |      | 0.059 |        |
| C    | 12.8 | 13.2 | 0.504 | 0.520  |
| D    | 20.2 |      | 0.795 |        |
| G    | 16.4 | 18.4 | 0.645 | 0.724  |
| N    | 50   |      | 1.968 |        |
| T    |      | 22.4 |       | 0.881  |

| BASE QTY | BULK QTY |
|----------|----------|
| 2500     | 2500     |

## 6 Revision history

**Table 6. Revision history**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>                  |
|-------------|-----------------|---------------------------------|
| 28-Feb-2005 | 1               | Initial release                 |
| 03-Mar-2005 | 2               | Preliminary version             |
| 29-Nov-2005 | 3               | Added package IPAK              |
| 03-Jul-2006 | 4               | New template, no content change |
| 19-Feb-2007 | 5               | Typo mistake on page 1          |

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