



STD12NF06 STD12NF06T4

N-channel 60 V, 0.08Ω, 12 A, DPAK, IPAK
STripFET™ II Power MOSFET

Features

| Type | V _{DSS} | R _{DS(on)} | I _D |
|-------------|------------------|---------------------|----------------|
| STD12NF06 | 60V | <0.1Ω | 12A |
| STD12NF06T4 | 60V | <0.1Ω | 12A |

- Exceptional dv/dt capability
- Low gate charge

Applications

- Switching application

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.

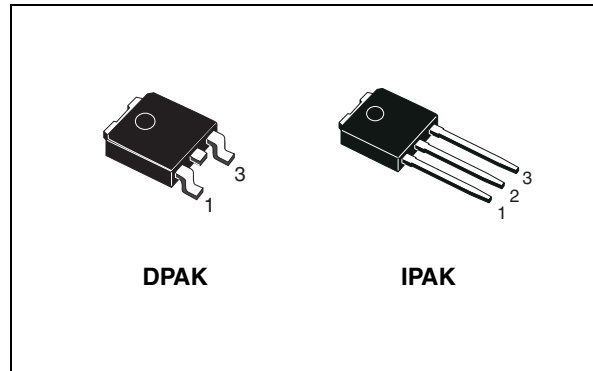


Figure 1. Internal schematic diagram

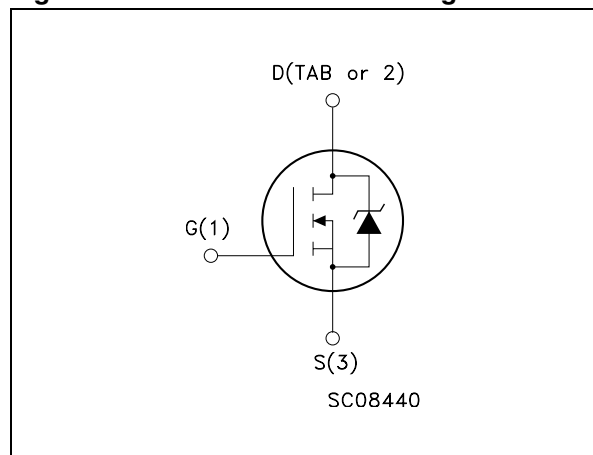


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|---------------|---------|---------|---------------|
| STD12NF06T4T4 | D12NF06 | DPAK | Tape and reel |
| STD12NF06T4-1 | D12NF06 | IPAK | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|---------------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 60 | V |
| V_{DGR} | Drain-gate voltage ($R_{GS} = 20K\Omega$) | 60 | V |
| V_{GS} | Gate-source voltage | ± 20 | V |
| I_D | Drain current (continuous) at $T_C = 25^\circ C$ | 12 | A |
| I_D | Drain current (continuous) at $T_C = 100^\circ C$ | 8.5 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 48 | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ C$ | 30 | W |
| | Derating factor | 0.2 | W/ $^\circ C$ |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 15 | V/ns |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy | 140 | mJ |
| T_{stg} | Storage temperature | -55 to 175 | $^\circ C$ |
| T_J | Max. operating junction temperature | | |

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 12$ A, $di/dt \leq 200$ A/ μs , $V_{DS} \leq V_{(BR)DSS}$, $T_J \leq T_{JMAX}$
3. Starting $T_J = 25^\circ C$, $I_D = 6$ A, $V_{DD} = 30$ V

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|------------|--|-------|--------------|
| R_{thJC} | Thermal resistance junction-case Max | 5 | $^\circ C/W$ |
| R_{thJA} | Thermal resistance junction-ambient Max | 100 | $^\circ C/W$ |
| T_I | Maximum lead temperature for soldering purpose | 275 | $^\circ C$ |

2 Electrical characteristics

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

Table 4. On /off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 25mA, V_{GS} = 0$ | 60 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^{\circ}C$ | | | 1 10 | μA μA |
| I_{GSS} | Gate body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20V$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\mu A$ | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10V, I_D = 6A$ | | 0.08 | 0.1 | W |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|--|------|------------------|------|----------------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} = 15V, I_D = 6A$ | - | 5 | | S |
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 25V, f = 1 \text{ MHz},$ $V_{GS} = 0$ | - | 315 70 30 | | pF pF pF |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 48V, I_D = 12A$ $V_{GS} = 10V$ | - | 10 3.0 3.5 | 12 | nC nC nC |

1. Pulsed: pulse duration=300 μs , duty cycle 1.5%

Table 6. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit | |
|--------------|---------------------|--|------|------|------|------|----|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 30V, I_D = 6A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ <i>Figure 14 on page 8</i> | | 7 | | ns | |
| t_r | Rise time | | - | 18 | - | ns | |
| $t_{d(off)}$ | Turn-off delay time | | | | 17 | | ns |
| t_f | Fall time | | | | 6 | | ns |
| | | | | | | | |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|----------------|-------------------------------|---|-----|------|-----|------|
| I_{SD} | Source-drain current | | - | | 12 | A |
| I_{SDM} | Source-drain current (pulsed) | | - | | 48 | A |
| $V_{SD}^{(1)}$ | Forward on voltage | $I_{SD} = 12A, V_{GS} = 0$ | - | | 1.3 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 12A,$ $di/dt = 100A/\mu s,$ $V_{DD} = 30V, T_J = 150^\circ C$ <i>Figure 16 on page 8</i> | - | 50 | | ns |
| Q_{rr} | Reverse recovery charge | | | 65 | | nC |
| I_{RRM} | Reverse recovery current | | | 3.5 | | A |

1. Pulsed: pulse duration= 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

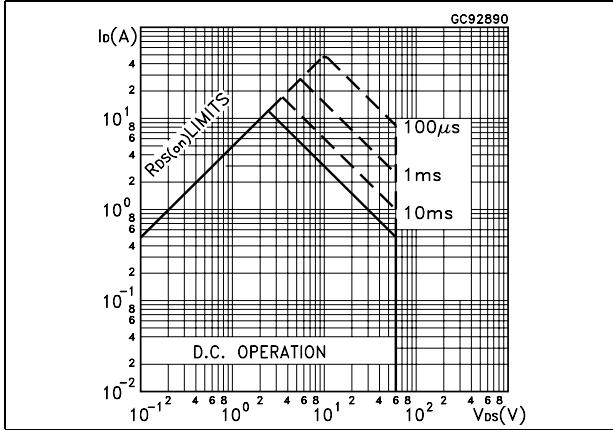


Figure 3. Thermal impedance

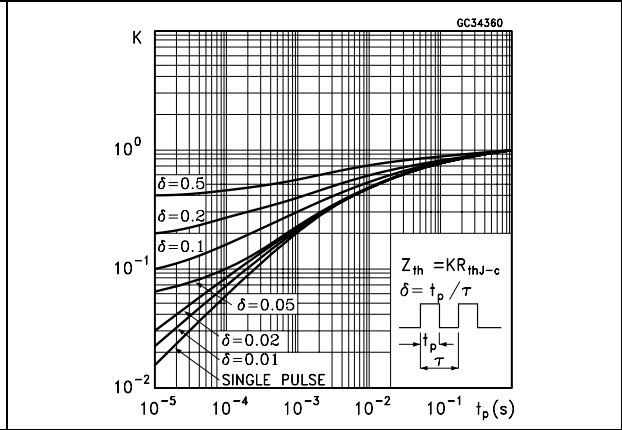


Figure 4. Output characteristics

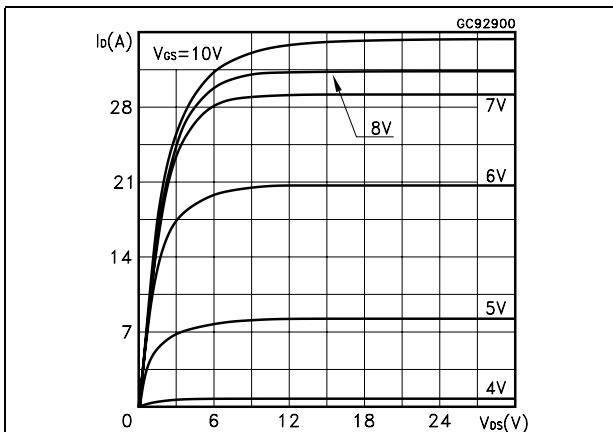


Figure 5. Transfer characteristics

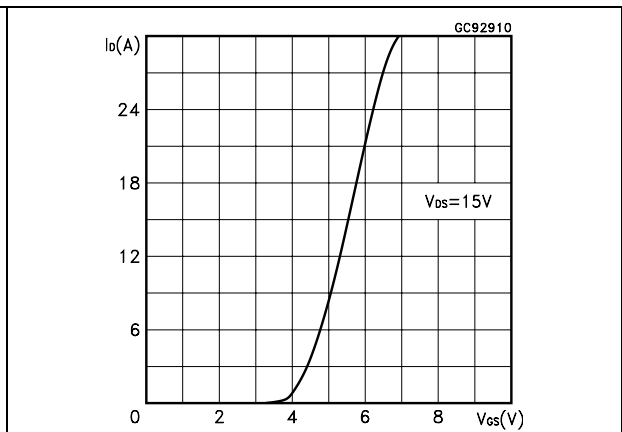


Figure 6. Transconductance

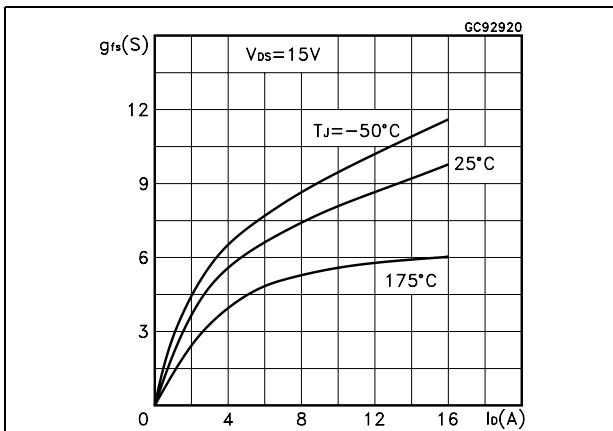


Figure 7. Static drain-source on resistance

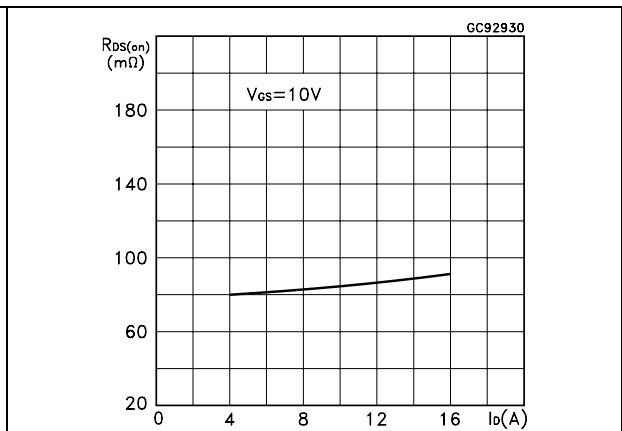


Figure 8. Gate charge vs. gate-source voltage

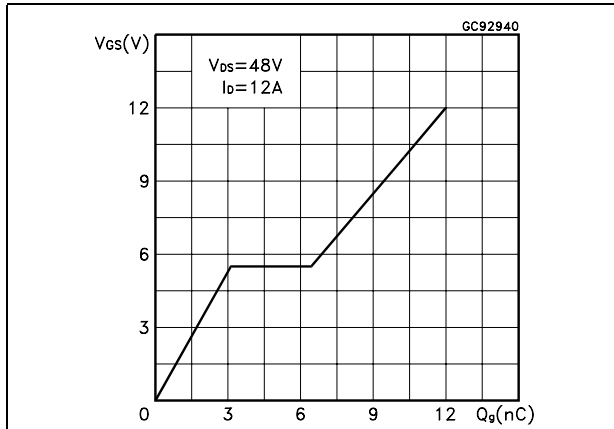


Figure 9. Capacitance variations

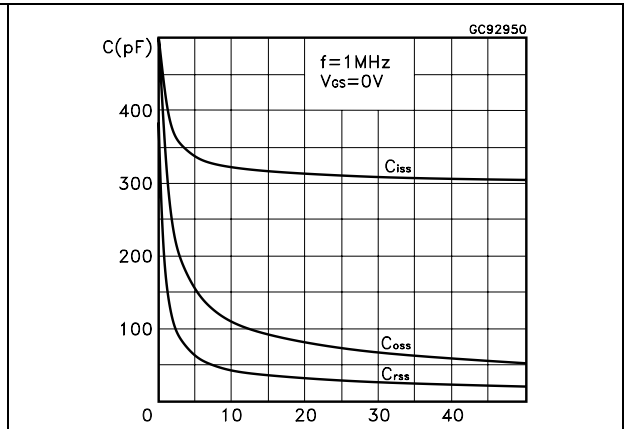


Figure 10. Normalized gate threshold voltage vs. temperature

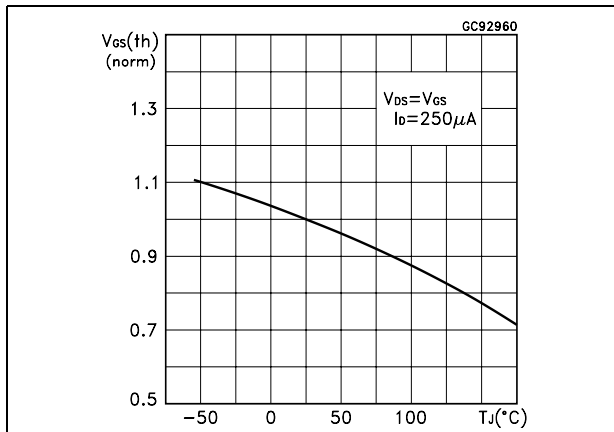


Figure 11. Normalized on resistance vs. temperature

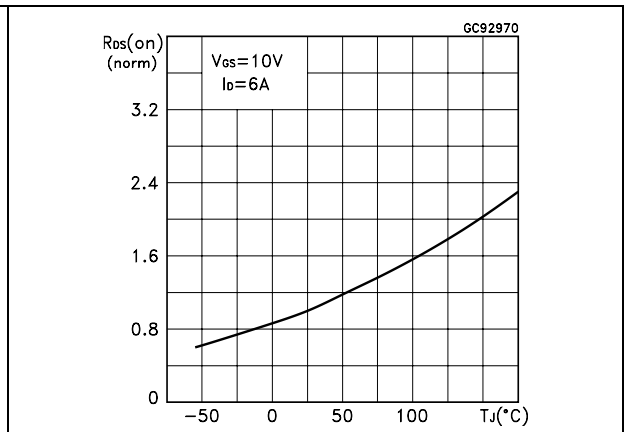


Figure 12. Source-drain diode forward characteristics

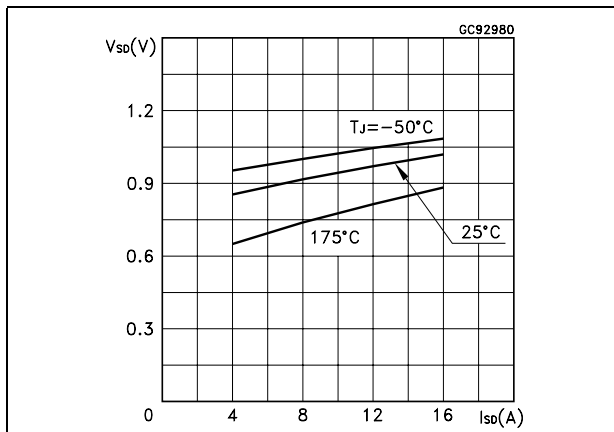
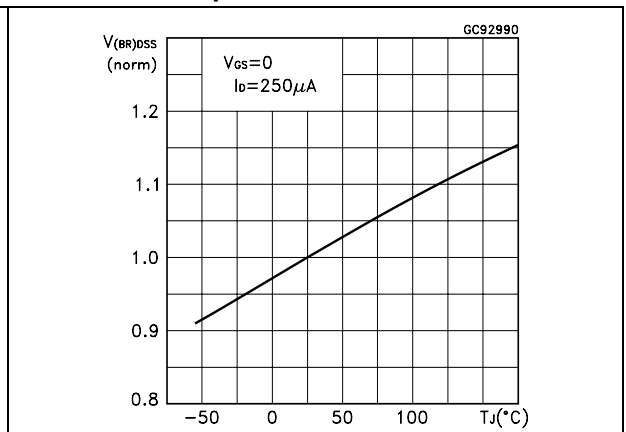


Figure 13. Normalized breakdown voltage vs. temperature



3 Test circuits

Figure 14. Switching times test circuit for resistive load

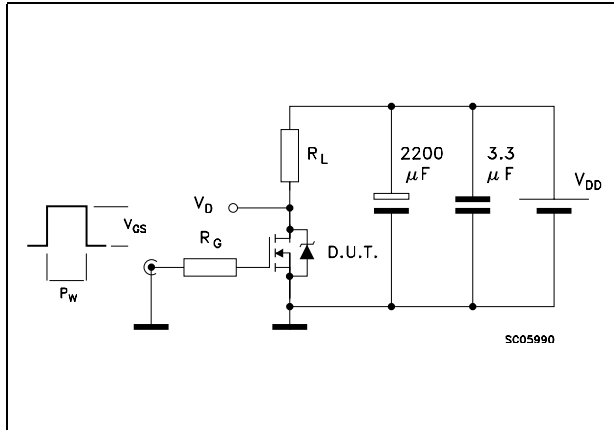


Figure 15. Gate charge test circuit

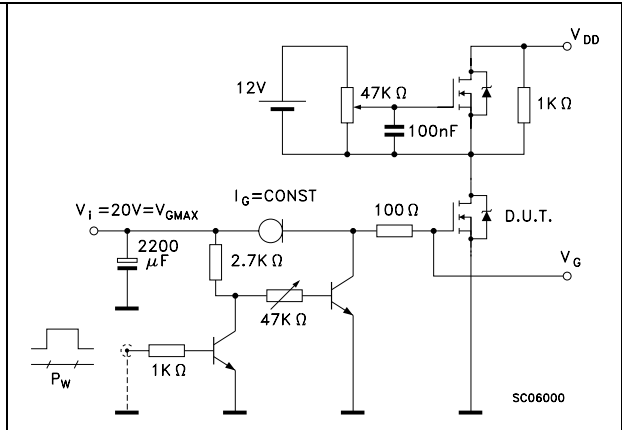


Figure 16. Test circuit for inductive load switching and diode recovery times

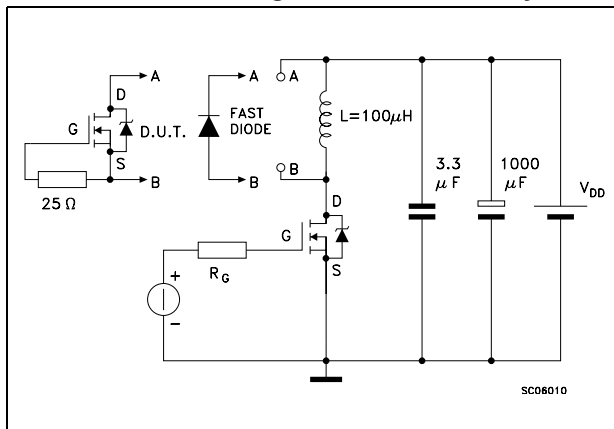


Figure 17. Unclamped inductive load test circuit

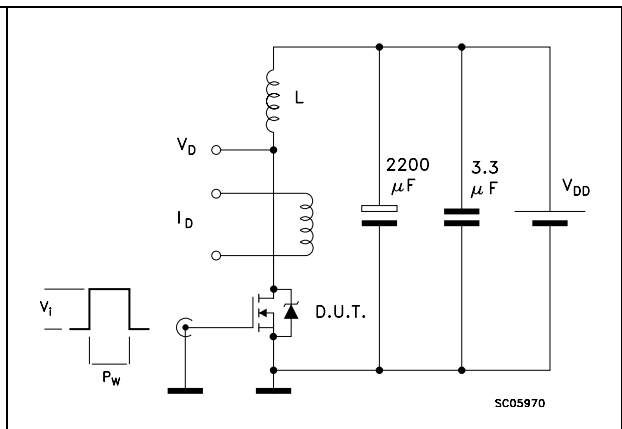
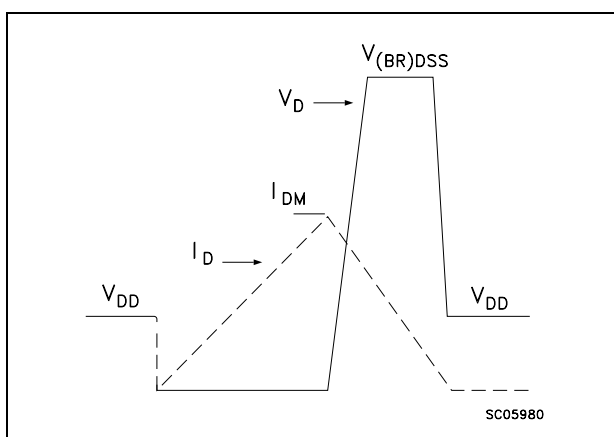


Figure 18. Unclamped inductive waveform

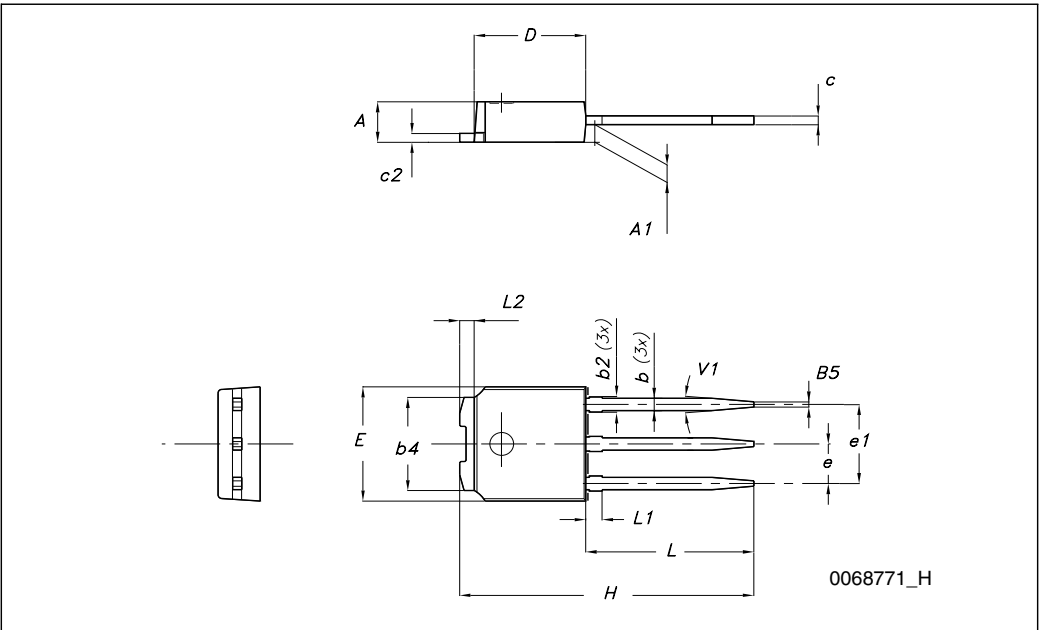


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

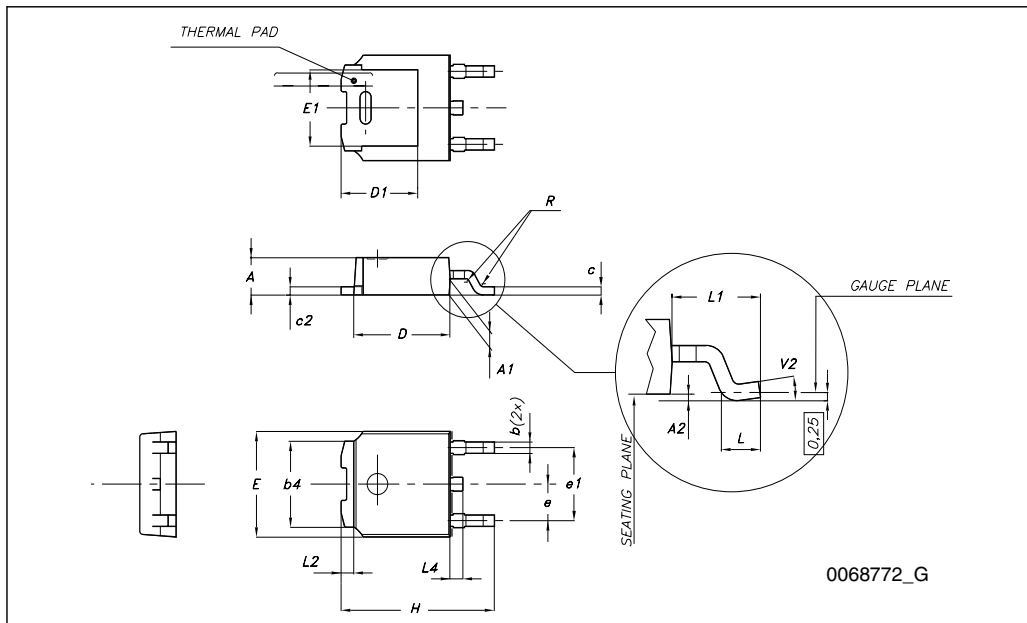
TO-251 (IPAK) mechanical data

| DIM. | mm. | | |
|------|------|-------|------|
| | min. | typ | max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| b | 0.64 | | 0.90 |
| b2 | | | 0.95 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| E | 6.40 | | 6.60 |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | | 16.10 | |
| L | 9.00 | | 9.40 |
| (L1) | 0.80 | | 1.20 |
| L2 | | 0.80 | |
| V1 | | 10° | |



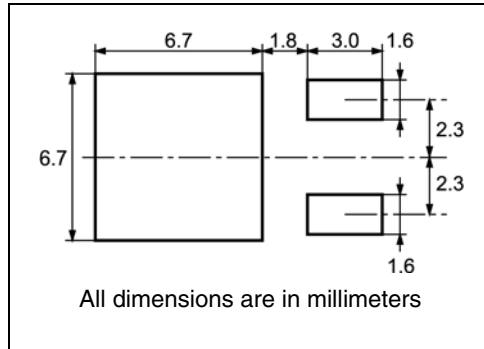
TO-252 (DPAK) mechanical data

| DIM. | mm. | | |
|------|------|------|-------|
| | min. | typ | max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 4.70 | |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1 | | |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1 |
| R | | 0.20 | |
| V2 | 0° | | 8° |



5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

| 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 |

| 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 |

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

6 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 09-Sep-2004 | 3 | Complete document |
| 07-Aug-2006 | 4 | The document has been reformatted |
| 19-Feb-2007 | 5 | Typo mistake on page 1 |
| 15-Apr-2009 | 6 | Table 1: Device summary has been updated Mechanical data updated |
| 26-Nov-2009 | 7 | Updated Q_{rr} in Table 7: Source drain diode . |

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