



STD2NC45-1

N-channel 450 V, 4.1 Ω , 1.5 A, IPAK
SuperMESH™ Power MOSFET

Features

- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized
- New high voltage benchmark

Application

- Switching applications

Description

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage Power MOSFETs including revolutionary MDmesh™ products.

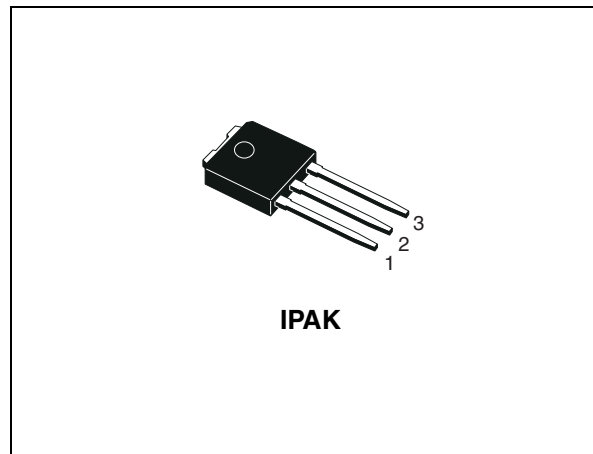


Figure 1. Internal schematic diagram

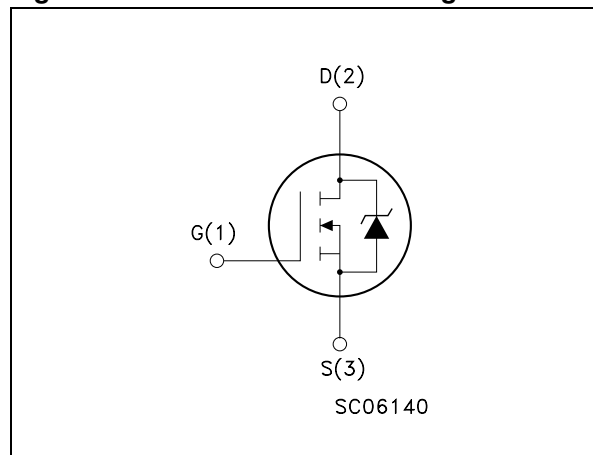


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|------------|---------|---------|-----------|
| STD2NC45-1 | D2NC45 | IPAK | Tube |

Contents

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|---------------------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 450 | V |
| V_{GS} | Gate- source voltage | ± 30 | V |
| I_D | Drain current (continuous) at $T_C = 25^\circ\text{C}$ | 1.5 | A |
| I_D | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 0.95 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 6 | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 30 | W |
| | Derating factor | 0.24 | W/ $^\circ\text{C}$ |
| $dv/dt^{(2)}$ | Peak diode recovery voltage slope | 3 | V/ns |
| T_{stg} | Storage temperature | -65 to 150 | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | | $^\circ\text{C}$ |

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 0.5\text{A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 4.1 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 100 | $^\circ\text{C}/\text{W}$ |
| T_l | Maximum lead temperature for soldering purpose | 275 | $^\circ\text{C}$ |

Table 4. Avalanche characteristics

| Symbol | Parameter | Value | Unit |
|----------|---|-------|------|
| I_{AS} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max) | 1.5 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{V}$) | 25 | mJ |

2 Electrical characteristics

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

Table 5. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|---|--|------|------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 250\mu A, V_{GS} = 0$ | 450 | | | 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 50 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 30V$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\mu A$ | 2.3 | 3 | 3.7 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10V, I_D = 0.5A$ | | 4.1 | 4.5 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|--|--|------|--------------------|------|----------------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} > I_{D(on)} \times R_{DS(on)max},$ $I_D = 0.5A$ | - | 1.1 | | S |
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$ | - | 160 27.5 4.7 | | pF pF pF |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 360V, I_D = 1.5A,$ $V_{GS} = 10V, R_G = 4.7\Omega$ (see Figure 17) | - | 7 1.3 3.2 | 10 | nC nC nC |

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

Table 7. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------------------------|---|--|------|-----------------|------|----------------|
| $t_{d(on)}$ t_r | Turn-on delay time Rise time | $V_{DD} = 225V, I_D = 0.5A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 16) | - | 6.7 4 | - | ns ns |
| $t_{r(Voff)}$ t_f t_c | Off-voltage rise time Fall time Cross-over time | $V_{DD} = 360V, I_D = 1.5A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 16) | - | 8.5 12 18 | - | ns ns ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|---------|
| I_{SD} | Source-drain current | | - | | 1.5 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 6.0 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 1.5A, V_{GS} = 0$ | - | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 1.5A, di/dt = 100A/\mu s$ $V_{DD} = 100V, T_j = 150^\circ C$ <i>(see Figure 21)</i> | - | 225 | | ns |
| Q_{rr} | Reverse recovery charge | | | 530 | | μC |
| I_{RRM} | Reverse recovery current | | | 4.7 | | A |

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5 %

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for IPAK

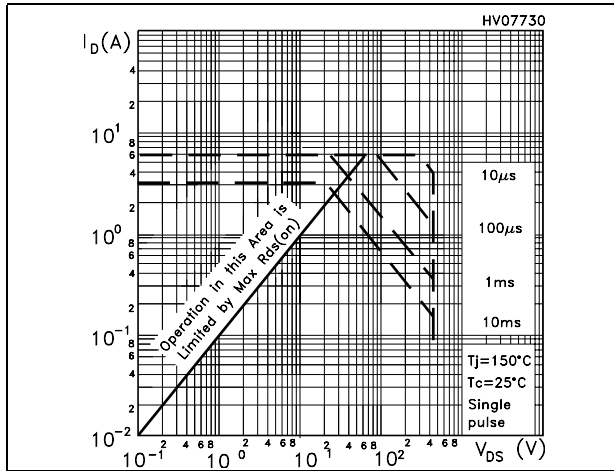


Figure 3. Thermal impedance for IPAK

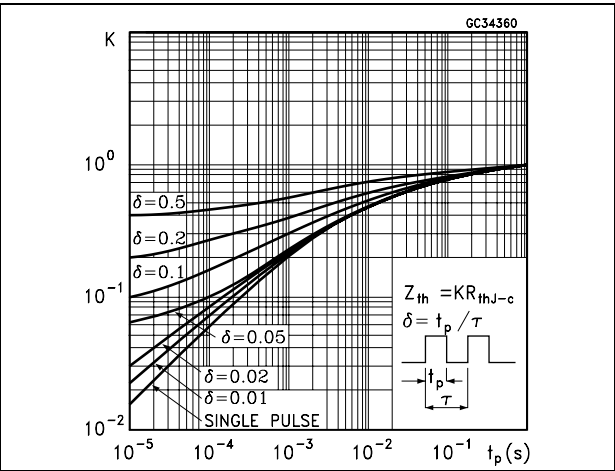


Figure 4. Output characteristics

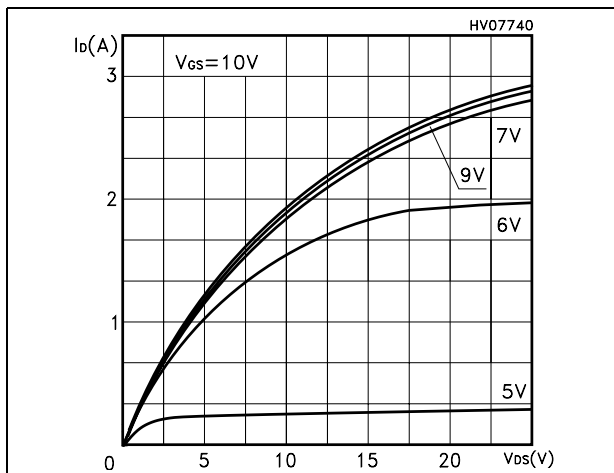


Figure 5. Transfer characteristics

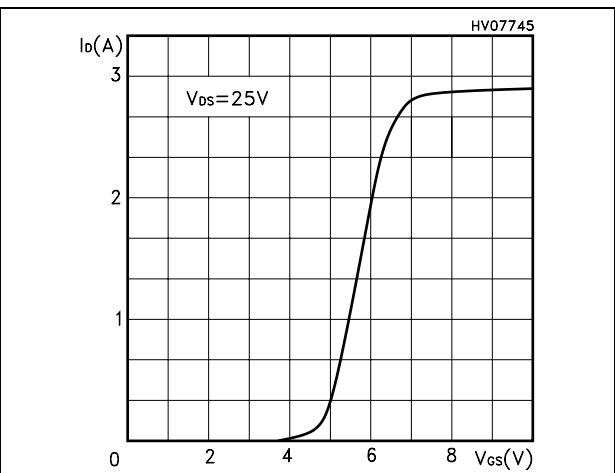


Figure 6. Transconductance

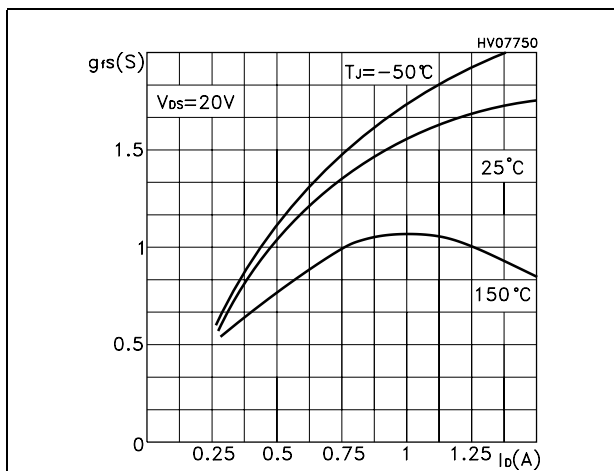


Figure 7. Static drain-source on resistance

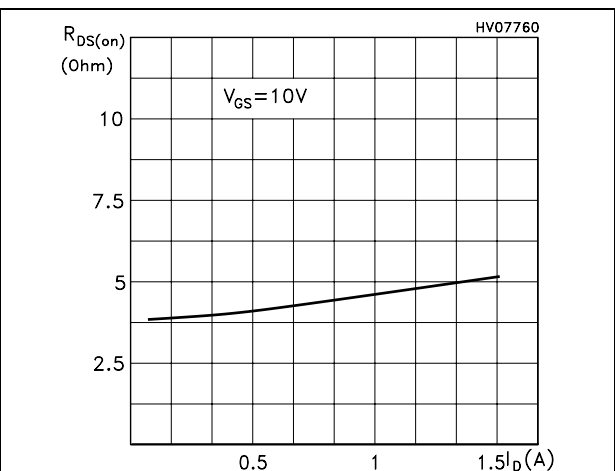


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

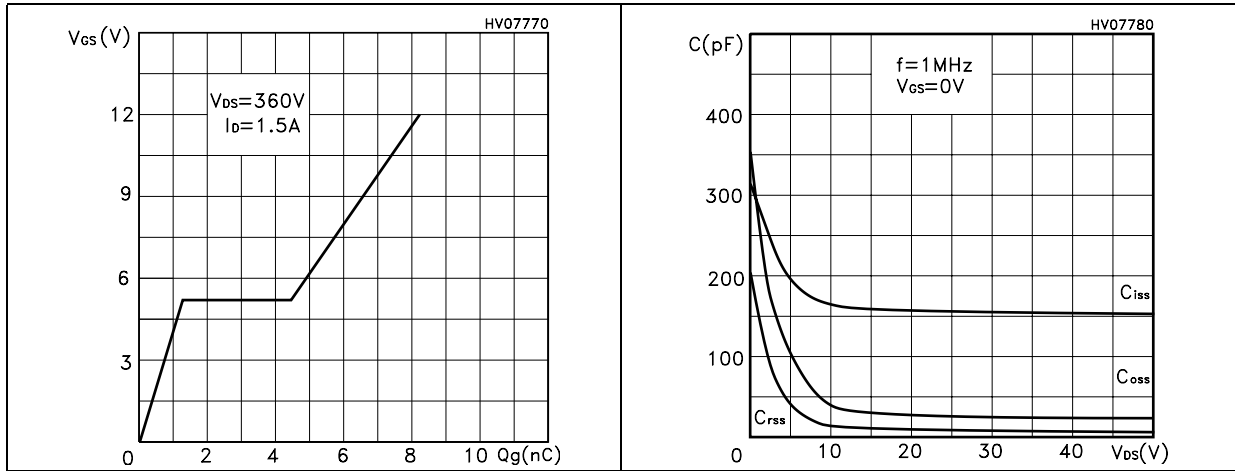


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

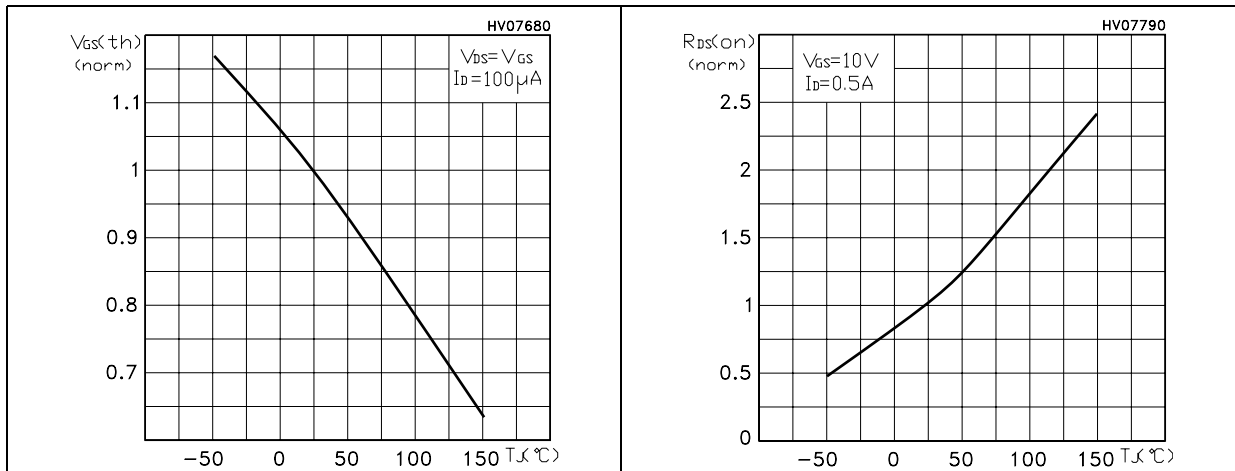


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized $B_{V_{DS}}$ vs temperature

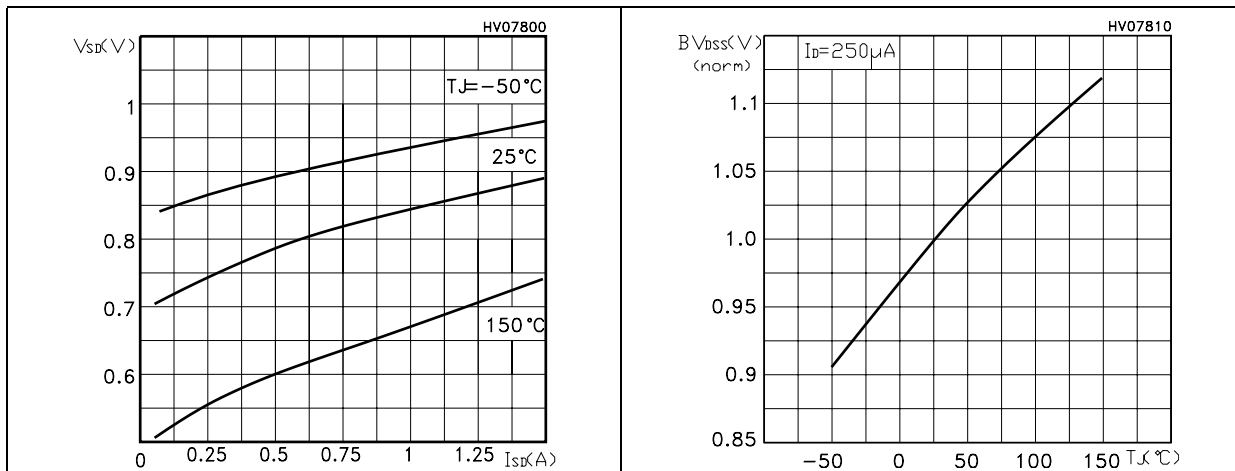


Figure 14. Max Id current vs Temperature

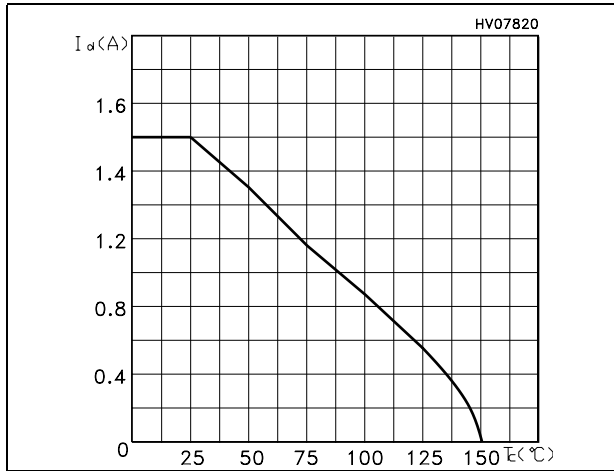
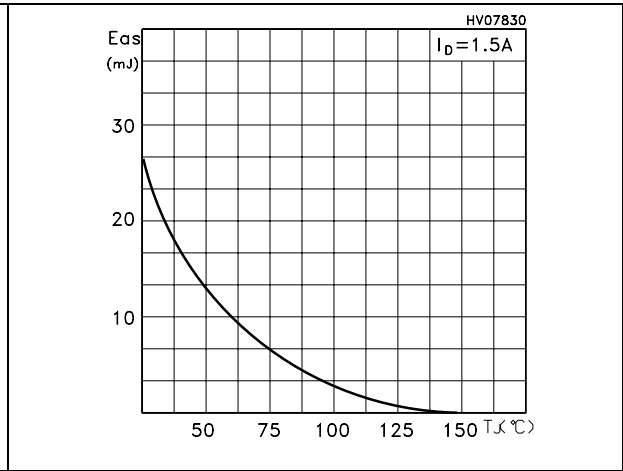


Figure 15. Maximum avalanche energy vs temperature



3 Test circuits

Figure 16. Switching times test circuit for resistive load

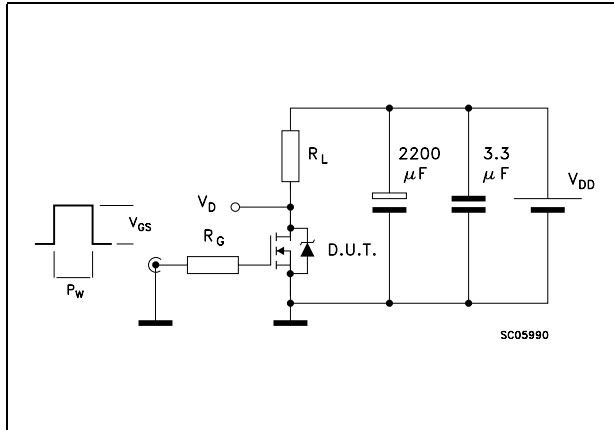


Figure 17. Gate charge test circuit

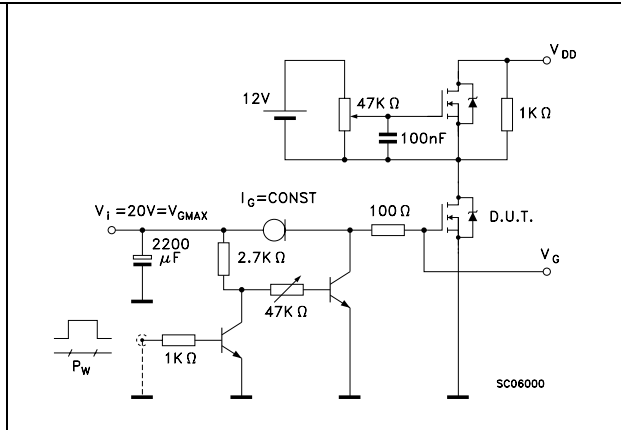


Figure 18. Test circuit for inductive load switching and diode recovery times

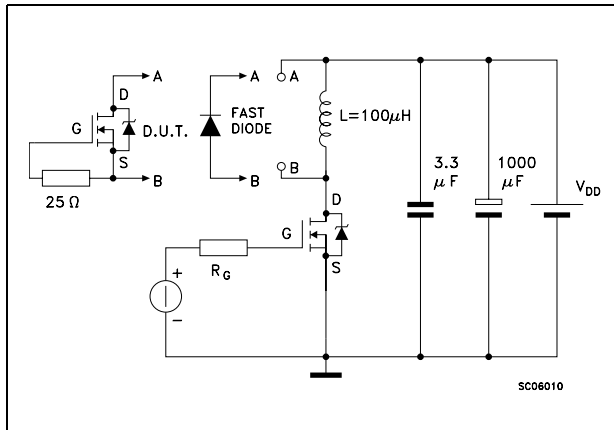


Figure 19. Unclamped inductive load test circuit

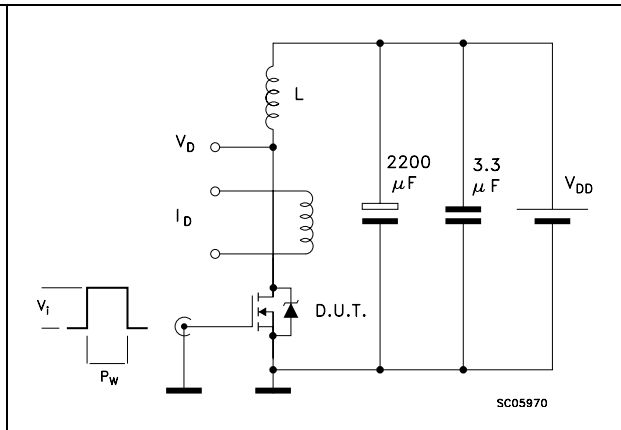


Figure 20. Unclamped inductive waveform

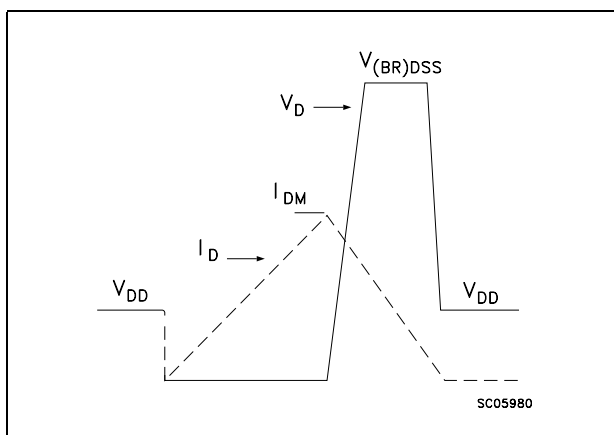
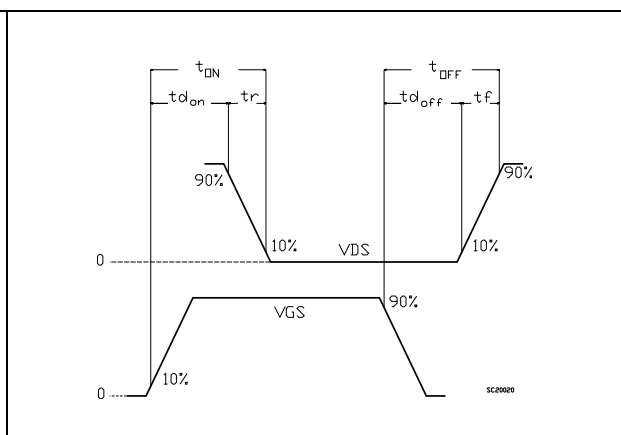


Figure 21. Switching time waveform

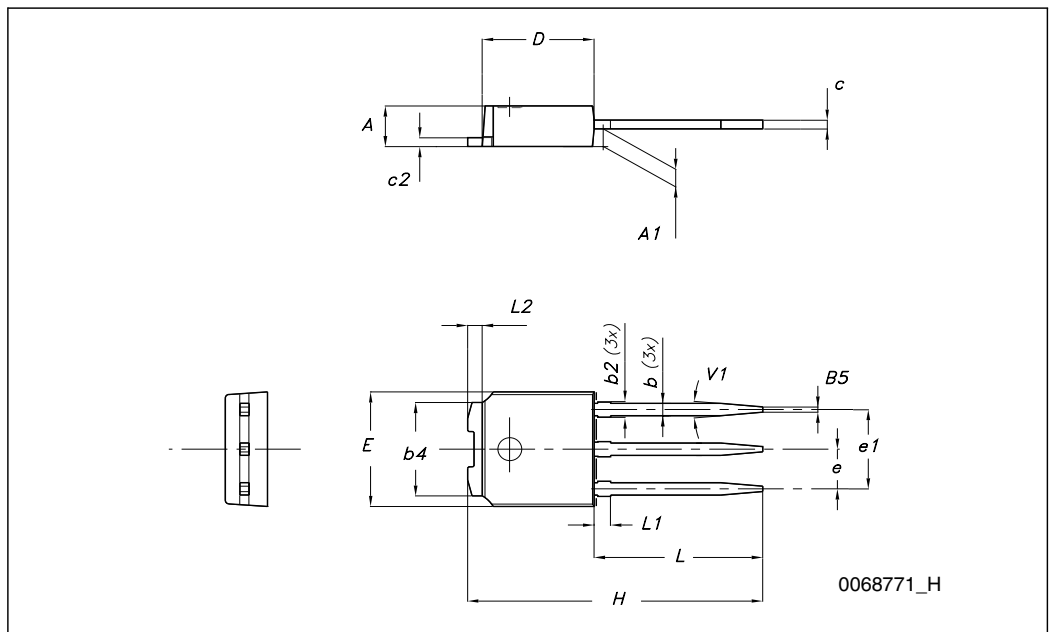


4 Package mechanical data

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° | |



5 Revision history

Table 9. Revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 21-Jun-2004 | 2 | Complete version |
| 12-Jul-2006 | 3 | New template |
| 17-Apr-2009 | 4 | Updated mechanical data New ECOPACK [®] statement in Section 4: Package mechanical data |

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