



STP40NF10

N-channel 100 V, 0.025 Ω , 50 A TO-220
low gate charge STripFET™ II Power MOSFET

Features

| Order code | V _{DSS} | R _{DS(on)} max. | I _D |
|------------|------------------|--------------------------|----------------|
| STP40NF10 | 100 V | < 0.028 Ω | 50 A |

- Exceptional dv/dt capability
- Low gate charge
- 100% avalanche tested

Application

Switching applications

Description

This N-channel 100 V 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 allowing remarkable manufacturing reproducibility.

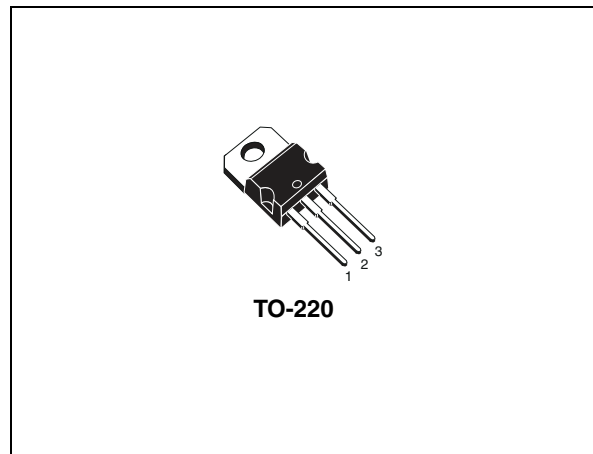


Figure 1. Internal schematic diagram

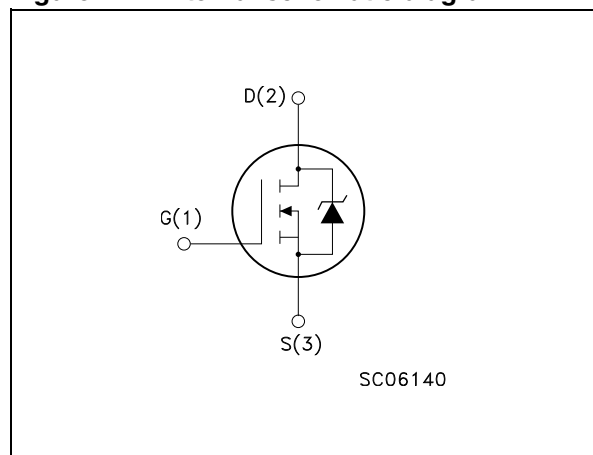


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|------------|----------|---------|-----------|
| STP40NF10 | P40NF10@ | TO-220 | Tube |

Contents

| | | |
|----------|---|-----------|
| 1 | Electrical ratings | 3 |
| 2 | Electrical characteristics | 4 |
| | 2.1 Electrical characteristics (curves) | 6 |
| 3 | Test circuit | 8 |
| 4 | Package mechanical data | 9 |
| 5 | Revision history | 11 |

1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|-------------|---------------------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 100 | V |
| V_{GS} | Gate- source voltage | ± 20 | V |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 50 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 35 | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 200 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 150 | W |
| | Derating factor | 1 | W/ $^\circ\text{C}$ |
| $dv/dt^{(3)}$ | Peak diode recovery voltage slope | 27 | V/ns |
| $E_{AS}^{(4)}$ | Single pulse avalanche energy | 385 | mJ |
| T_{stg} | Storage temperature | - 55 to 175 | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | | |

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 50\text{ A}$, $di/dt \leq 600\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.
4. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = 50\text{ A}$, $V_{DD} = 25\text{ V}$

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 1 | $^\circ\text{C}/\text{W}$ |
| R_{thj-a} | Thermal resistance junction-ambient max | 62.5 | $^\circ\text{C}/\text{W}$ |
| T_l | Maximum lead temperature for soldering purpose | 300 | $^\circ\text{C}$ |

2 Electrical characteristics

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

Table 4. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|---|--|------|-------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown voltage | $I_D = 250\ \mu\text{A}$, $V_{GS} = 0$ | 100 | | | V |
| I_{DSS} | Zero gate voltage Drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$ | | | 1 10 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20\ \text{V}$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$ | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\ \text{V}$, $I_D = 25\ \text{A}$ | | 0.025 | 0.028 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|---------------------------------|---|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} = 15\ \text{V}$, $I_D = 28\ \text{A}$ | - | 22 | | S |
| C_{iss} | Input capacitance | $V_{DS} = 25\ \text{V}$, $f = 1\ \text{MHz}$, $V_{GS} = 0$ | - | 2180 | | pF |
| C_{oss} | Output capacitance | | | 298 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 83.7 | | pF |
| Q_g | Total gate charge | $V_{DD} = 50\ \text{V}$, $I_D = 40\ \text{A}$, $V_{GS} = 10\ \text{V}$ <i>(see Figure 15)</i> | - | 46.5 | 62 | nC |
| Q_{gs} | Gate-source charge | | | 13.3 | | nC |
| Q_{gd} | Gate-drain charge | | | 17.5 | 22.5 | 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 | $V_{DD} = 50\ \text{V}$, $I_D = 25\ \text{A}$ $R_G = 4.7\ \Omega$, $V_{GS} = 10\ \text{V}$ <i>(see Figure 14)</i> | - | 21 | - | ns |
| t_r | Rise time | | | 46 | - | ns |
| $t_{d(off)}$ | Turn-off-delay time | | | 54 | - | ns |
| t_f | Fall time | | | 13 | - | ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|-----------------|-------------------------------|--|------|------|-----|------|
| I_{SD} | Source-drain current | | - | | 80 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | - | | 320 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 50A, V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 50A, V_{DD} = 25V$ $di/dt = 100A/\mu s,$ $T_j = 150^\circ C$ <i>(see Figure 16)</i> | - | 80 | | ns |
| Q_{rr} | Reverse recovery charge | | | 250 | | nC |
| I_{RRM} | Reverse recovery current | | | 6.4 | | 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 TO-220

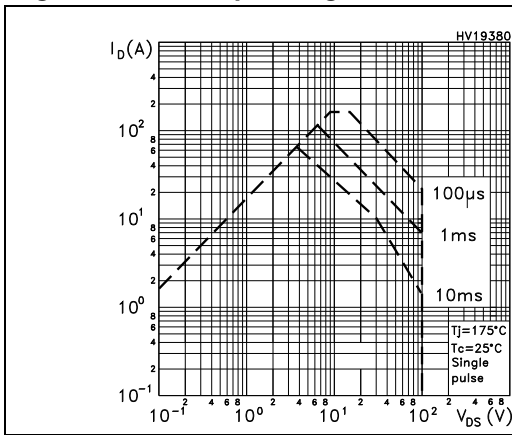


Figure 3. Thermal impedance for TO-220

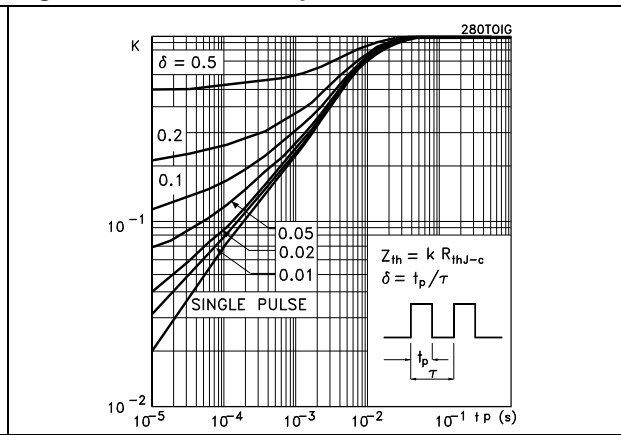


Figure 4. Output characteristics

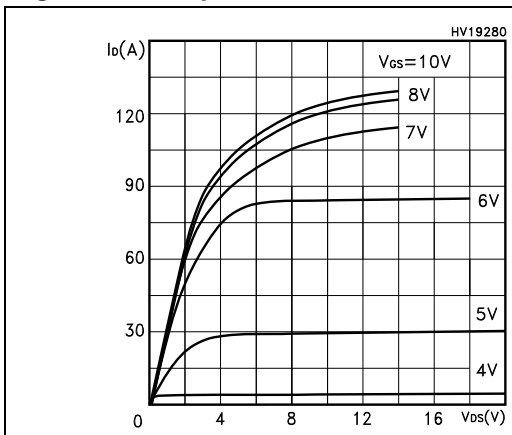


Figure 5. Transfer characteristics

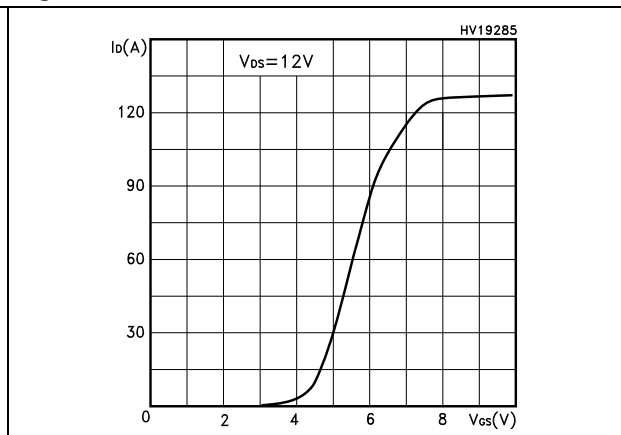


Figure 6. Transconductance

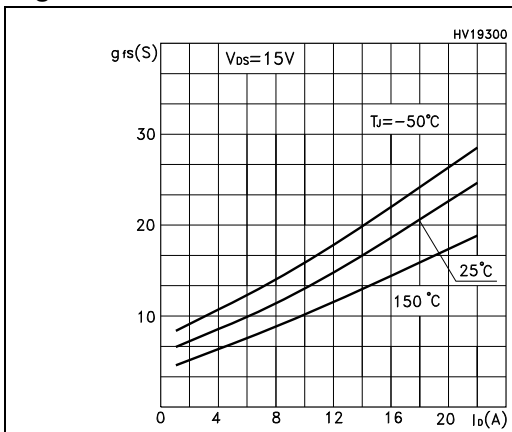


Figure 7. Static drain-source on resistance

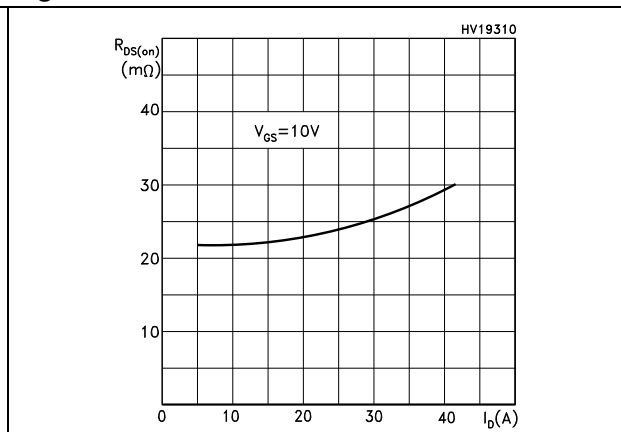


Figure 8. Gate charge vs. gate-source voltage Figure 9. Capacitance variations

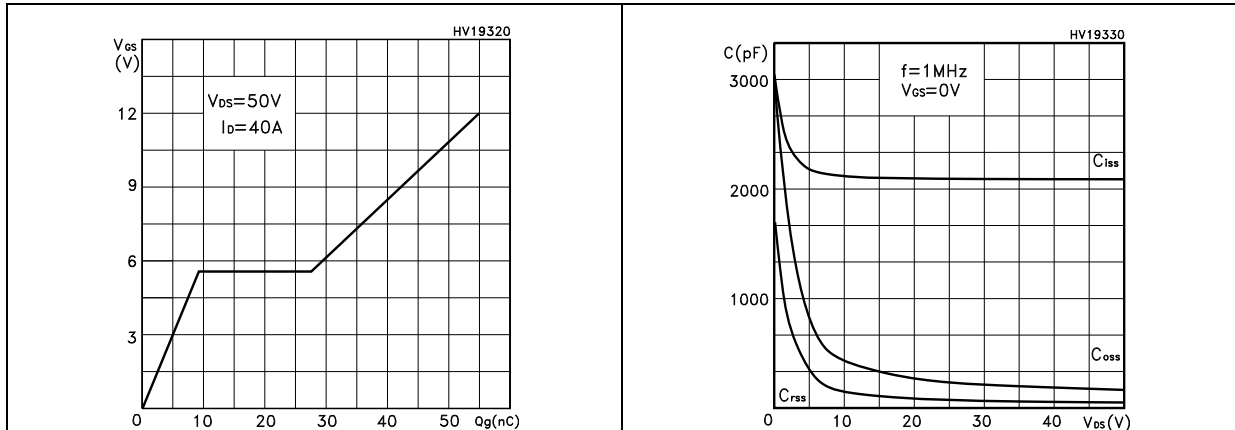


Figure 10. Normalized gate threshold voltage vs. temperature

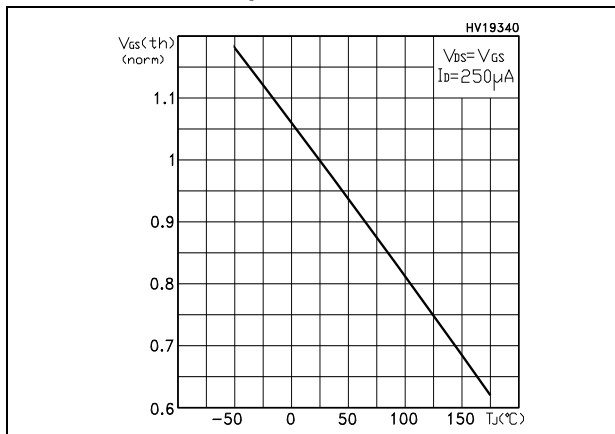


Figure 11. Normalized on resistance vs. temperature

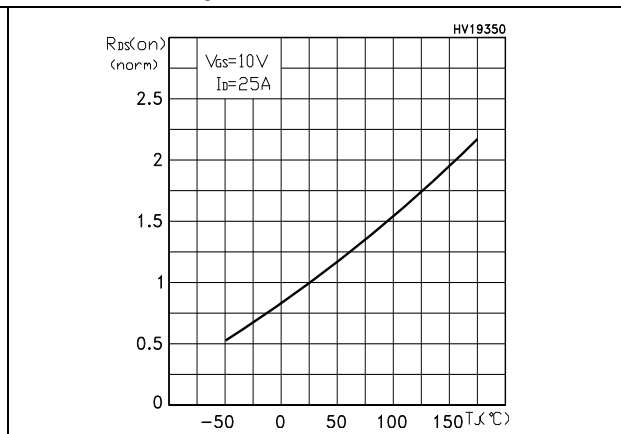


Figure 12. Source-drain diode forward characteristics

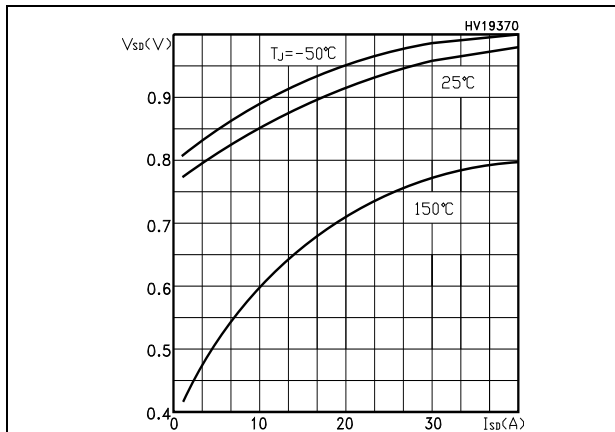
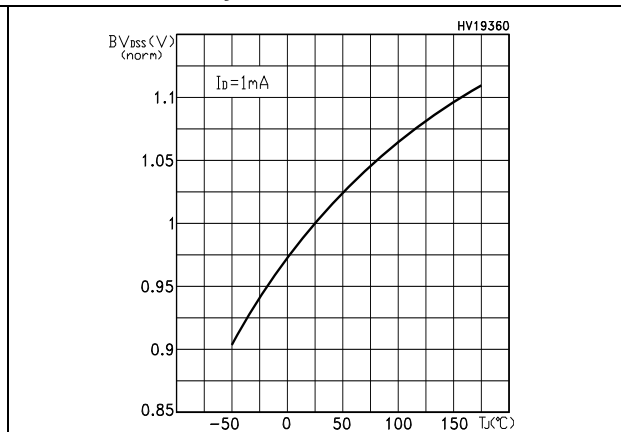
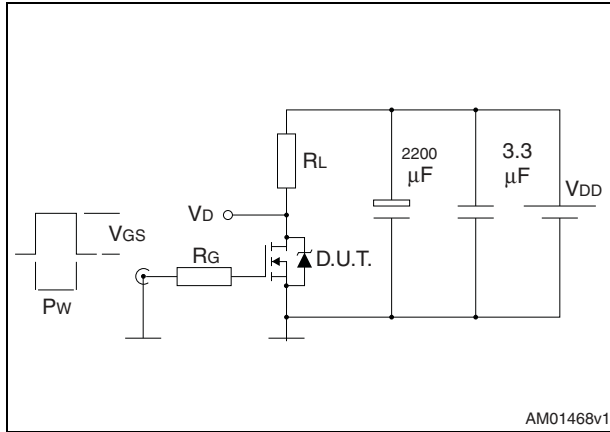


Figure 13. Normalized breakdown voltage vs. T_j



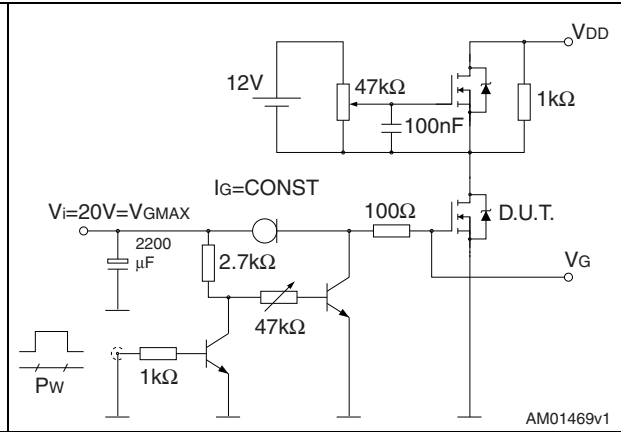
3 Test circuit

Figure 14. Switching times test circuit for resistive load



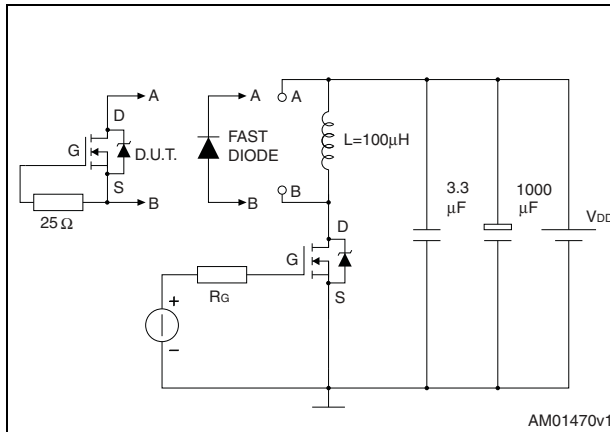
AM01468v1

Figure 15. Gate charge test circuit



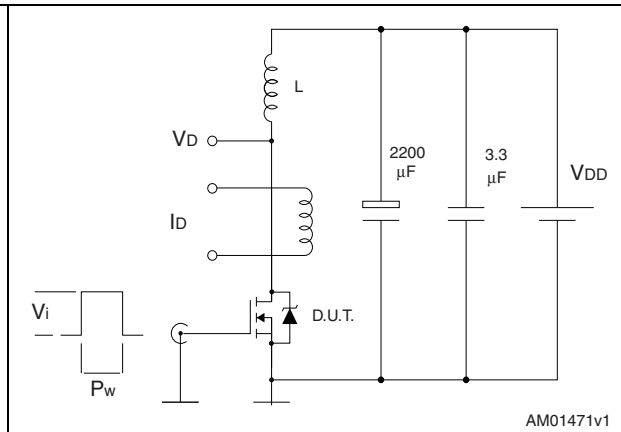
AM01469v1

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



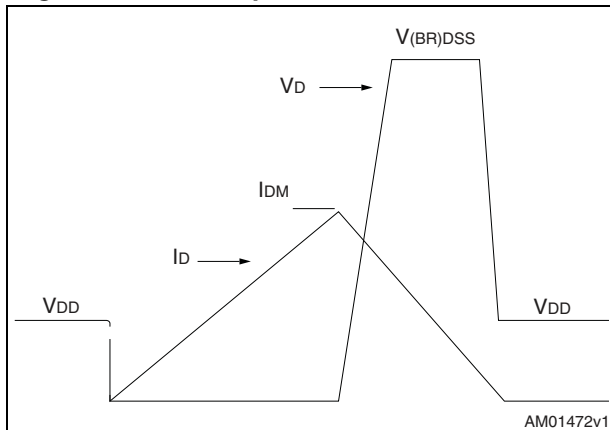
AM01470v1

Figure 17. Unclamped Inductive load test circuit



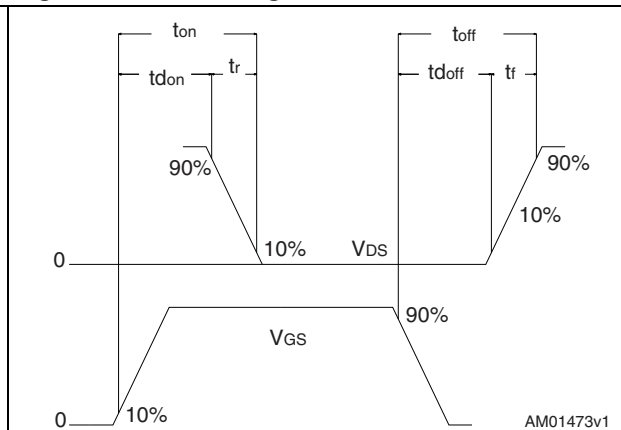
AM01471v1

Figure 18. Unclamped inductive waveform



AM01472v1

Figure 19. Switching time waveform



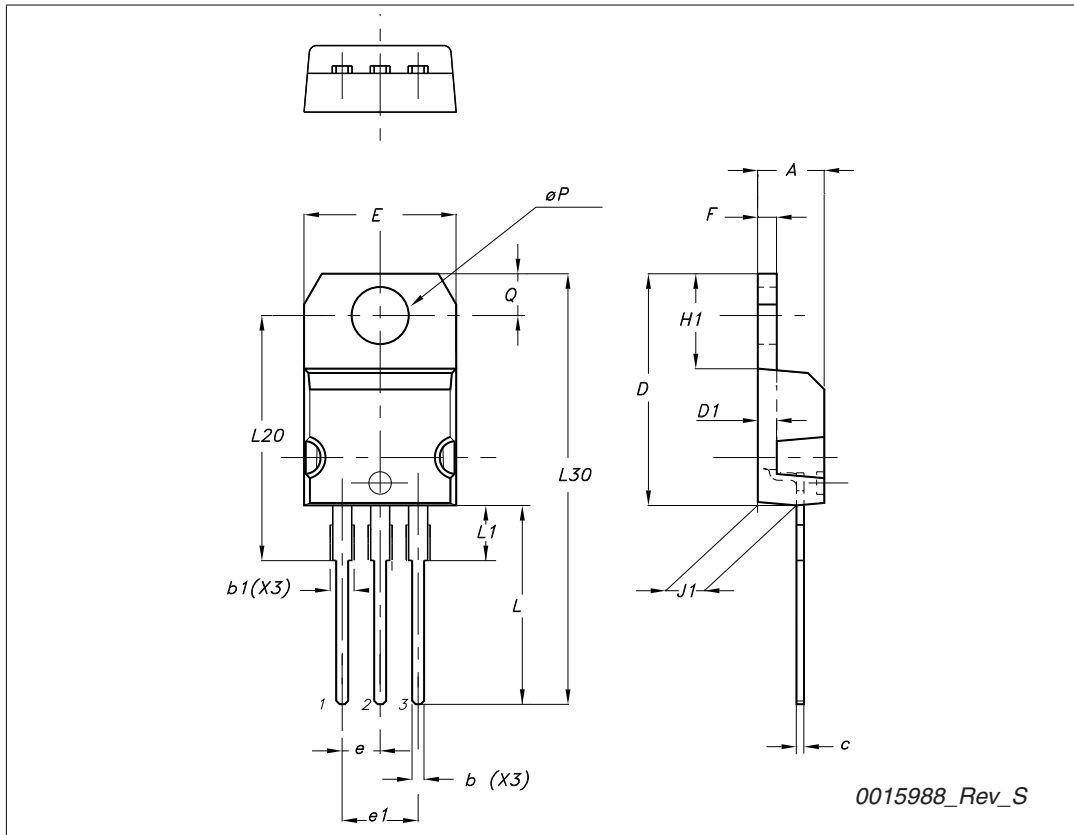
AM01473v1

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-220 type A mechanical data

| Dim | mm | | |
|-----|-------|-------|-------|
| | Min | Typ | Max |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 10.40 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| F | 1.23 | | 1.32 |
| H1 | 6.20 | | 6.60 |
| J1 | 2.40 | | 2.72 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| ∅P | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |



5 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 16-Dec-2004 | 1 | First version. |
| 17-Aug-2006 | 2 | The document has been reformatted. |
| 31-Jan-2007 | 3 | Typo mistake on Table 2 . |
| 19-Sep-2007 | 4 | Added DPAK. |
| 10-Nov-2010 | 5 | Removed DPAK. |

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2010 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com