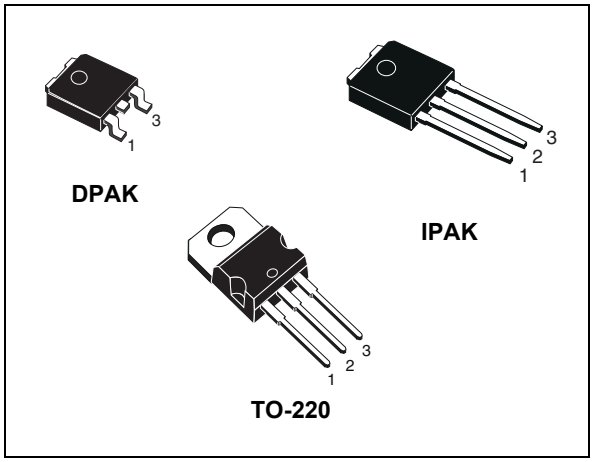
# STD95N2LH5
# STP95N2LH5, STU95N2LH5

N-channel 25 V, 0.0038 Ω, 80 A, DPAK, IPAK, TO-220
STripFET™ V Power MOSFET

## Features

| Type | $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|---|
| STD95N2LH5 | 25 V | < 0.0045 Ω | 80 A |
| STP95N2LH5 | 25 V | < 0.0049 Ω | 80 A |
| STU95N2LH5 | 25 V | < 0.0049 Ω | 80 A |

- $R_{DS(on)}$ * $Q_g$ industry benchmark
- Extremely low on-resistance $R_{DS(on)}$
- High avalanche ruggedness
- Low gate drive power losses




## Application

- Switching applications

## Description

This STripFET™V Power MOSFET technology is among the latest improvements, which have been especially tailored to achieve very low on-state resistance providing also one of the best-in-class FOM (figure of merit).

**Figure 1. Internal schematic diagram**

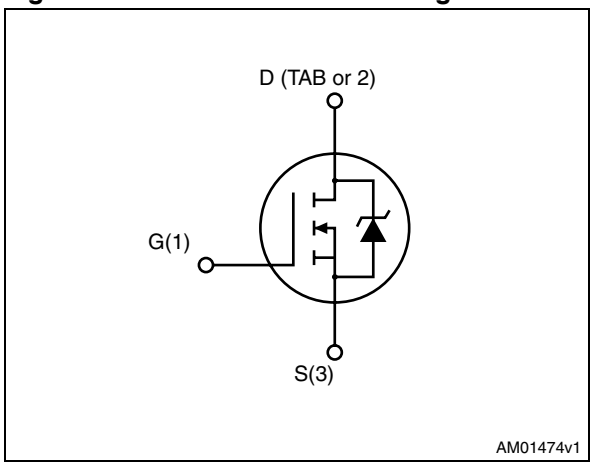



**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|---|---|---|---|
| STD95N2LH5 | 95N2LH5 | DPAK | Tape and reel |
| STP95N2LH5 | 95N2LH5 | TO-220 | Tube |
| STU95N2LH5 | 95N2LH5 | IPAK | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | DPAK/IPAK | TO-220 | |
| $V_{DS}$ | Drain-source voltage ($V_{GS}$=0) | 25 | | V |
| $V_{GS}$ | Gate-Source voltage | ± 22 | | V |
| $I_D$ (1) | Drain current (continuous) at $T_C$ = 25°C | 80 | 95 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100°C | 67 | | A |
| $I_{DM}$ (2) | Drain current (pulsed) | 320 | 380 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25°C | 70 | 80 | W |
| | Derating factor | 0.47 | | W/°C |
| $E_{AS}$ (3) | Single pulse avalanche energy | 165 | | mJ |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature | -55 to 175 | | °C |

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. Starting Tj = 25°C, Id = 40 A, Vdd = 20 V

**Table 3. Thermal resistance**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 2.14 | °C/W |
| $R_{thj\text{-}amb}$ | Thermal resistance junction-case max | 100 | °C/W |
| $T_j$ | Maximum lead temperature for soldering purpose | 275 | °C |

# 2 Electrical characteristics

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

**Table 4. Static**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown Voltage | $I_D$ = 250 µA, $V_{GS}$= 0 | 25 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = 25 V<br>$V_{DS}$ = 25 V,Tc = 125°C | | | 1<br>10 | µA<br>µA |
| $I_{GSS}$ | Gate body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ± 22 V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$= $V_{GS}$, $I_D$ = 250 µA | 1 | | | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS}$= 10 V, $I_D$= 40 A SMD version | | 0.0038 | 0.0045 | Ω |
| | | $V_{GS}$= 10 V, $I_D$= 40 A | | 0.0044 | 0.0049 | Ω |
| | | $V_{GS}$= 5 V, $I_D$= 40 A SMD version | | 0.005 | 0.006 | Ω |
| | | $V_{GS}$= 5 V, $I_D$= 40 A | | 0.006 | 0.007 | Ω |

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS}$ =25 V, f=1 MHz, $V_{GS}$=0 | - | 1817<br>420<br>67 | - | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total gate charge<br>Gate-source charge<br>Gate-drain charge | $V_{DD}$=13 V, $I_D$ = 80 A<br>$V_{GS}$ =5 V<br>*Figure 18* | - | 13.4<br>6.7<br>4.1 | - | nC<br>nC<br>nC |
| $Q_{gs1}$<br>$Q_{gs2}$ | Pre $V_{th}$ gate-to-source charge<br>Post $V_{th}$ gate-to-source charge | $V_{DD}$=13 V, $I_D$ = 80 A<br>*Figure 21* | - | 3.5<br>3.2 | - | nC<br>nC |
| $R_G$ | Gate input resistance | f=1 MHz gate bias<br>Bias= 0 test signal level=20 mV<br>open drain | - | 1.1 | - | Ω |

**Table 6. Switching on/off (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$<br>$t_r$ | Turn-on delay time<br>Rise time | $V_{DD}$=12.5 V, $I_D$= 40 A,<br>$R_G$= 4.7 Ω, $V_{GS}$= 10 V<br>*Figure 17* | - | 7<br>38 | - | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off delay time<br>Fall time | $V_{DD}$=12.5 V, $I_D$= 40 A,<br>$R_G$= 4.7 Ω, $V_{GS}$= 10 V<br>*Figure 17* | - | 22<br>7 | - | ns<br>ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$<br>$I_{SDM}$(1) | Source-drain current<br>Source-drain current (pulsed) | | - | | 80<br>320 | A<br>A |
| $V_{SD}$(2) | Forward on voltage | $I_{SD}$= 35 A, $V_{GS}$=0 | - | | 1.1 | V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}$ = 80 A, $V_{DD}$= 20 V<br>di/dt =100 A/µs,<br>*Figure 19* | - | 32.4<br>27.1<br>1.7 | | ns<br>nC<br>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 DPAK, IPAK**

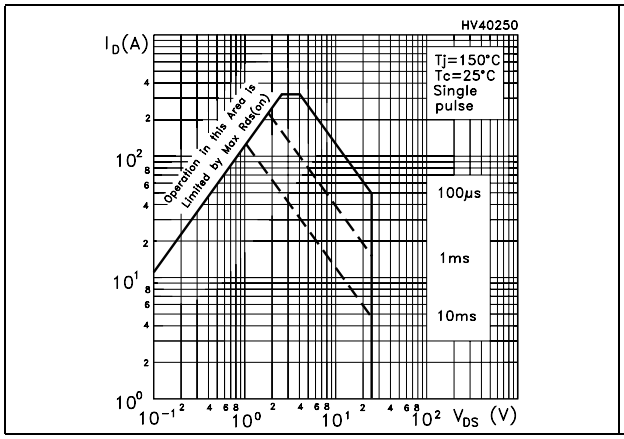



**Figure 3. Thermal impedance for DPAK, IPAK**

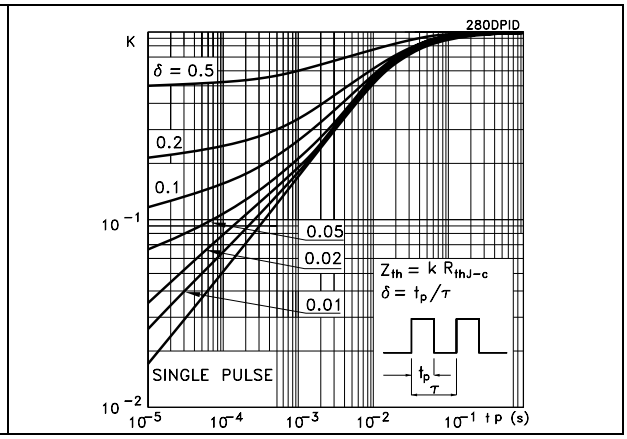



**Figure 4. Safe operating area for TO-220**

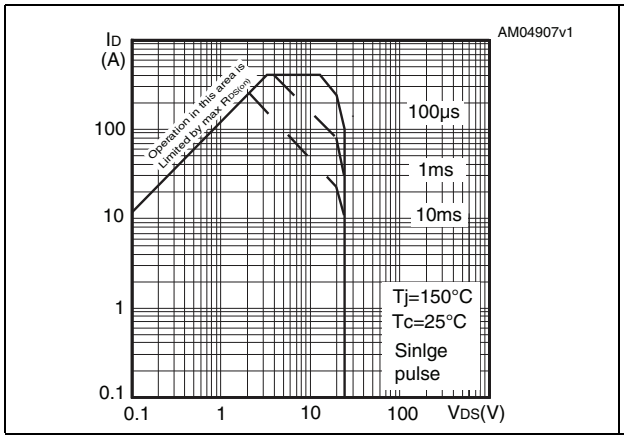



**Figure 5. Thermal impedance for TO-220**

**Figure 6. Output characteristics**

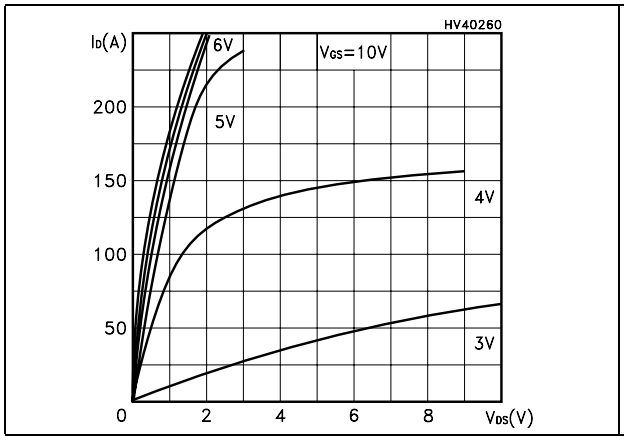



**Figure 7. Transfer characteristics**

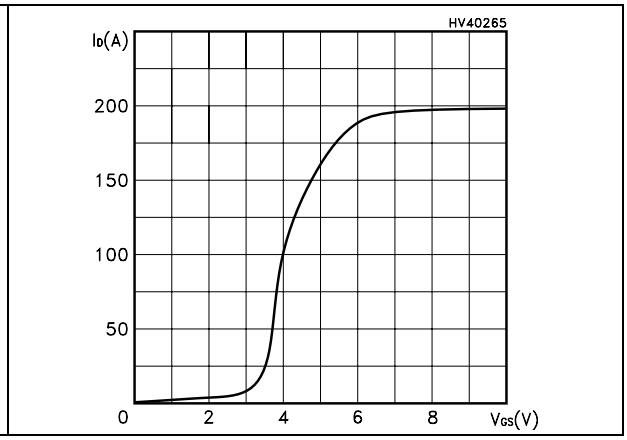


**Figure 8. Normalized $B_{VDSS}$ vs temperature**

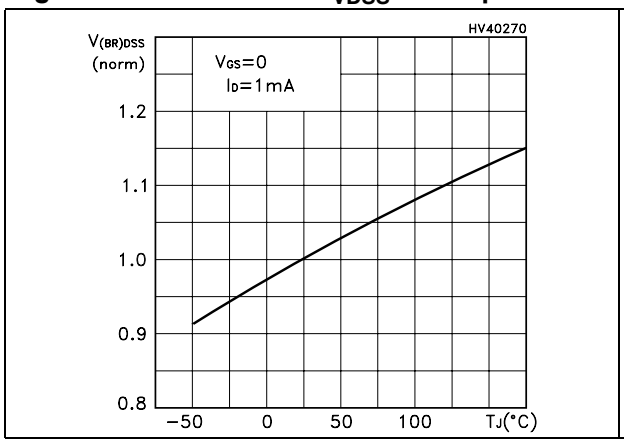



**Figure 9. Static drain-source on resistance**

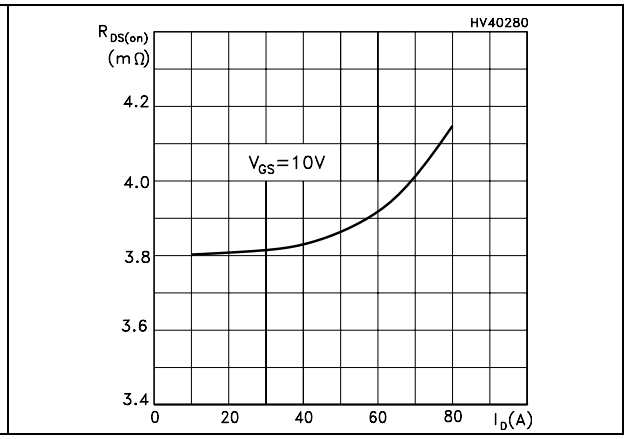



**Figure 10. Gate charge vs gate-source voltage**

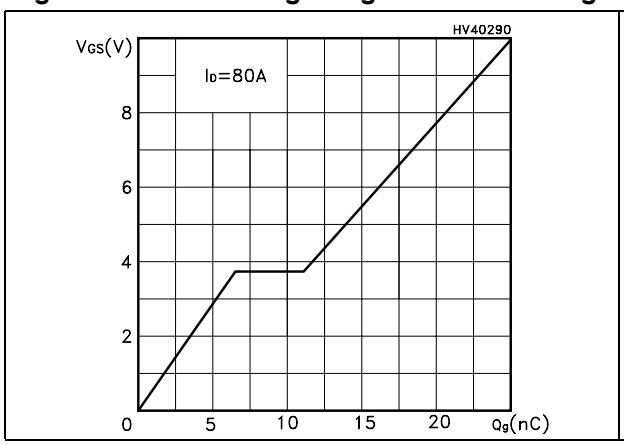



**Figure 11. Capacitance variations**

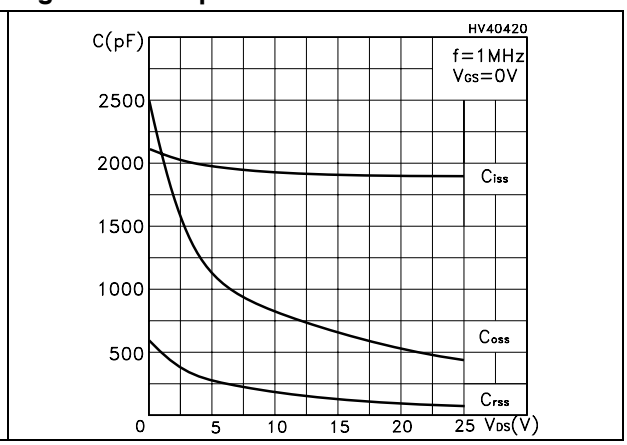



**Figure 12. Normalized gate threshold voltage vs temperature**

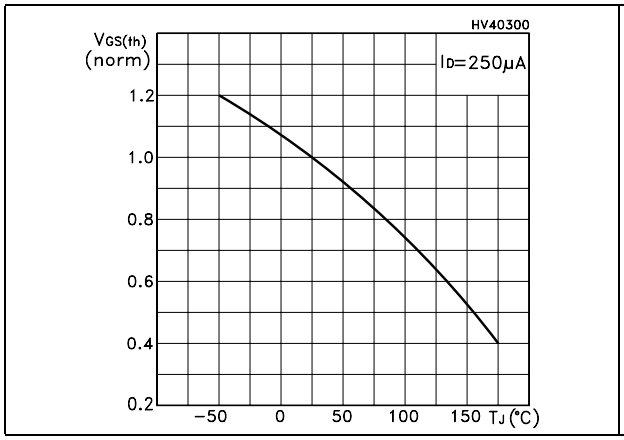



**Figure 13. Normalized on resistance vs temperature**

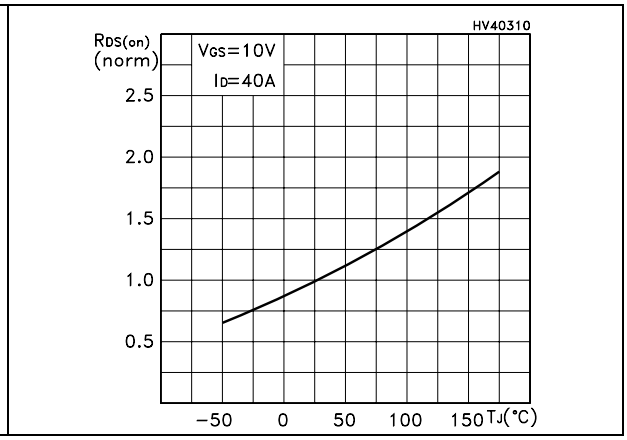
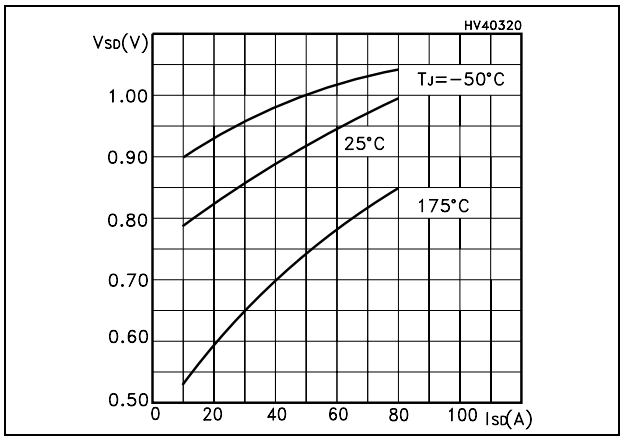


**Figure 14. Source-drain diode forward characteristics**



# 3 Test circuits

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

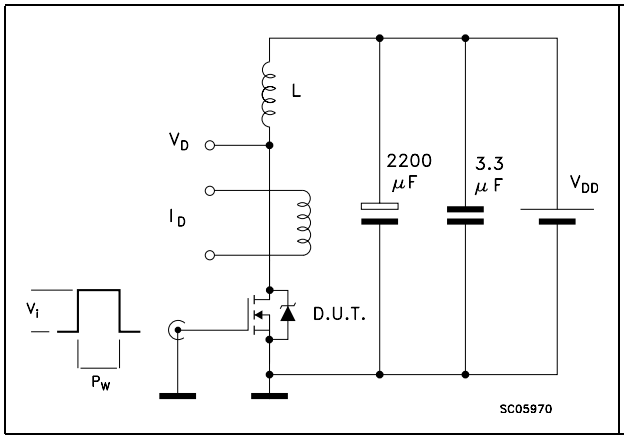



**Figure 16. Unclamped inductive waveform**

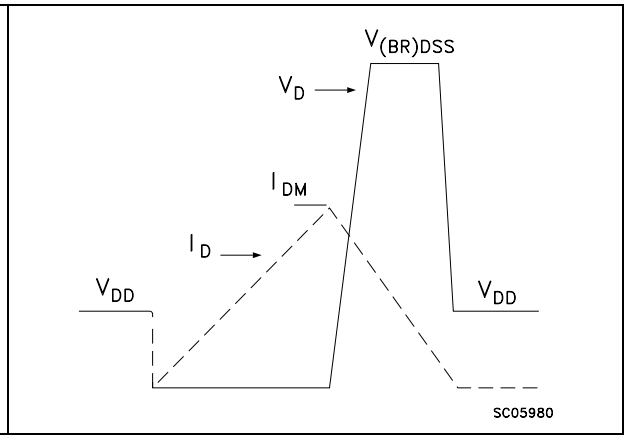



**Figure 17. Switching times test circuit for resistive load**

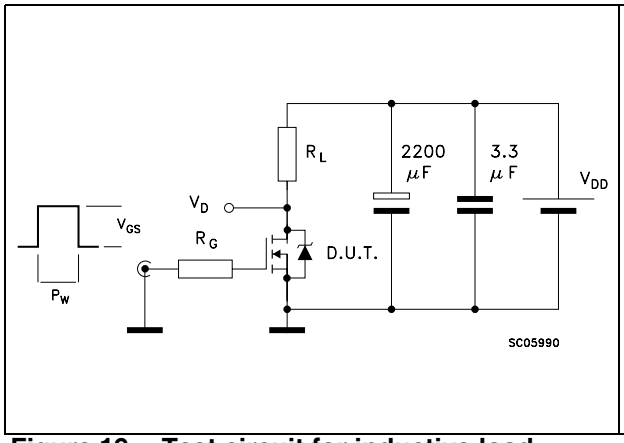



**Figure 18. Gate charge test circuit**

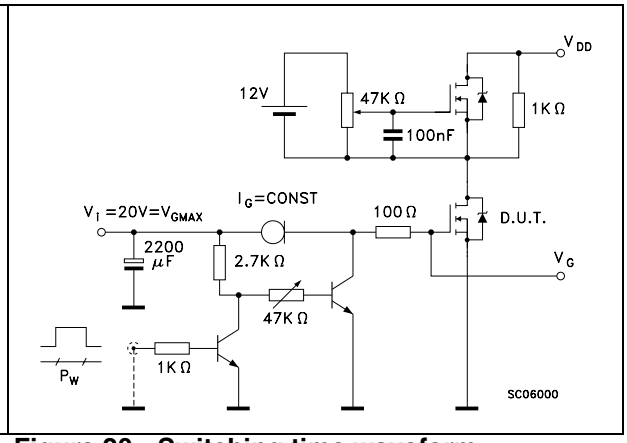



**Figure 19. Test circuit for inductive load switching and diode recovery times**

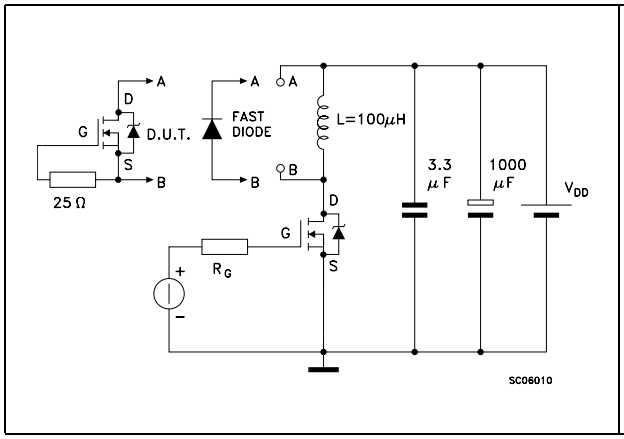



**Figure 20. Switching time waveform**

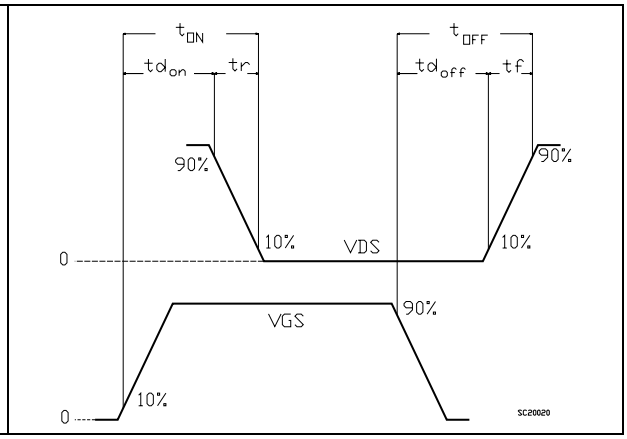
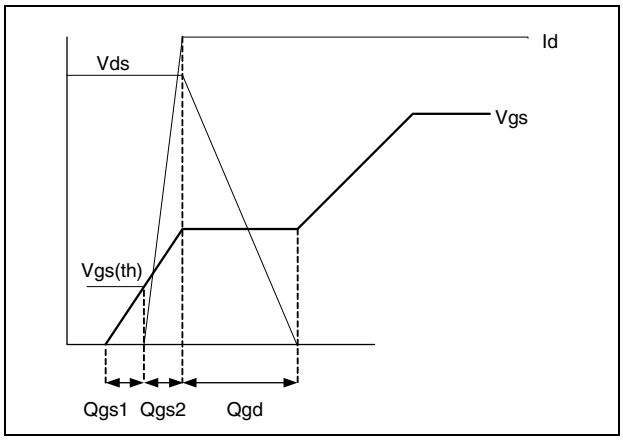


**Figure 21. Gate charge waveform**

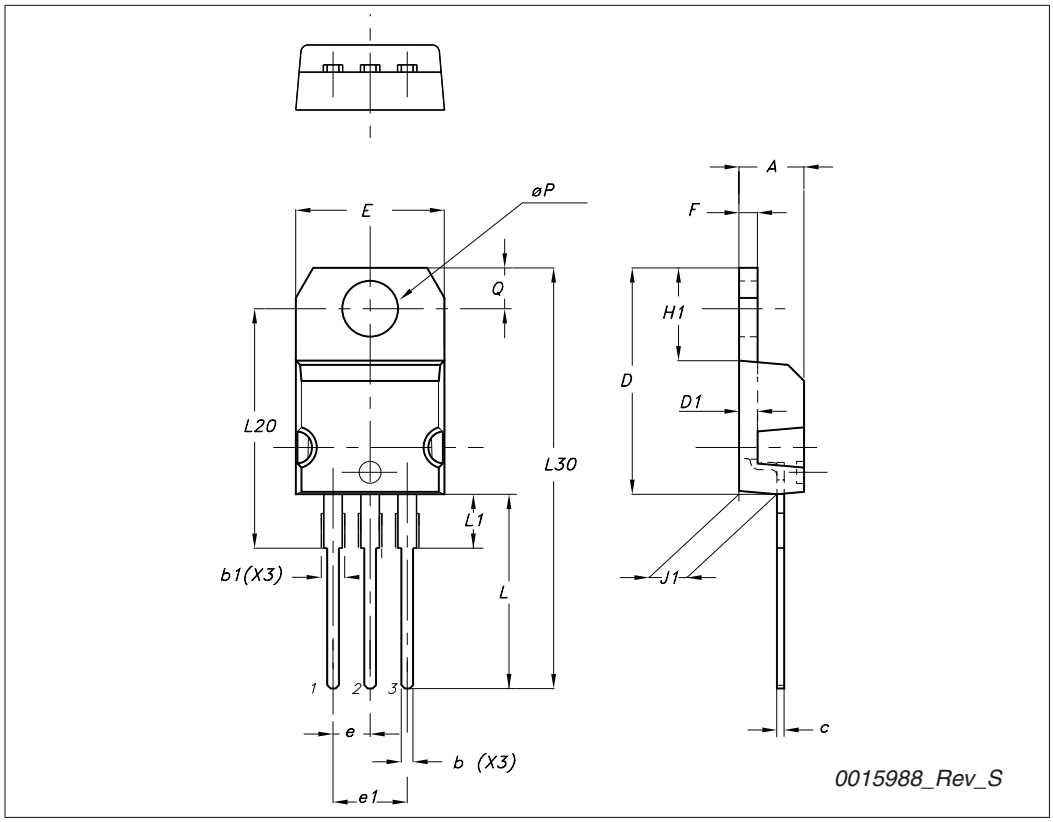


# 4 Package mechanical data

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.

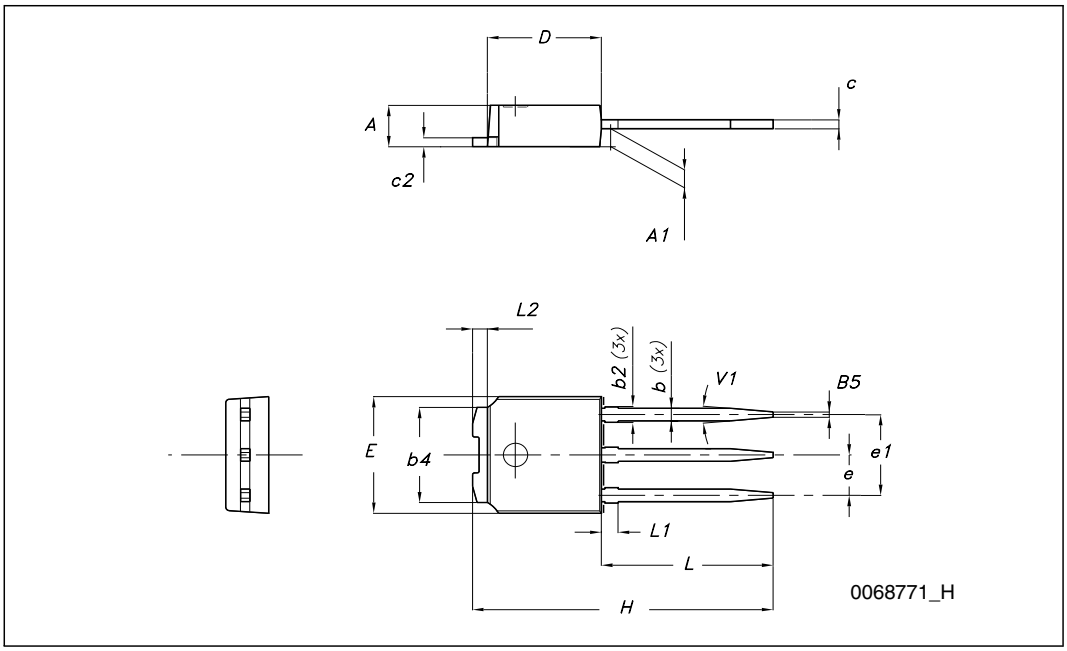
## TO-220 type A mechanical data

| 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 |



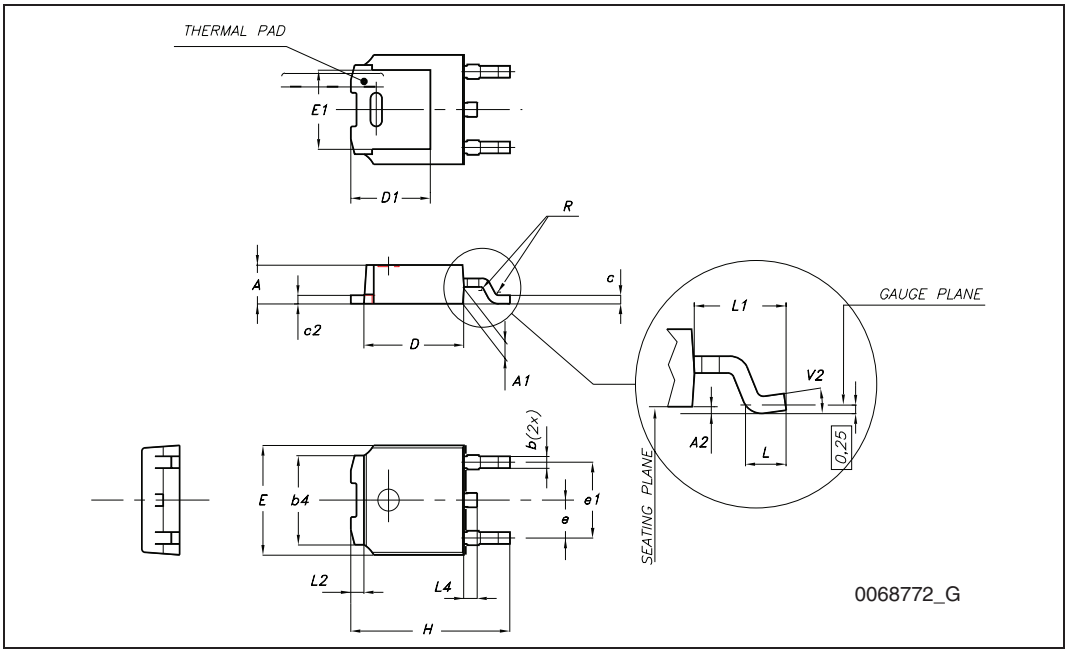
## TO-251 (IPAK) mechanical data

| 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 ° | |



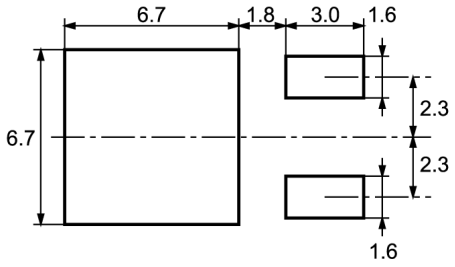
TO-252 (DPAK) mechanical data

| 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 ° |



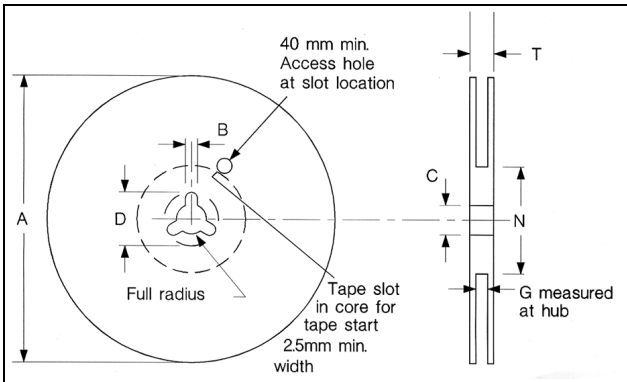
# 5 Packaging mechanical data

### DPAK FOOTPRINT




All dimensions are in millimeters

### TAPE AND REEL SHIPMENT



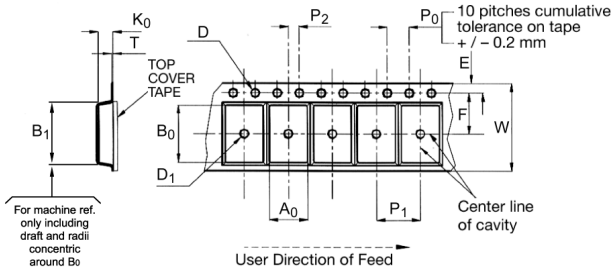

REEL MECHANICAL DATA

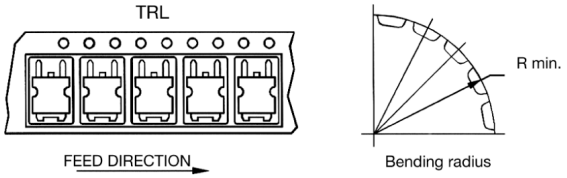
| DIM. | mm | | inch | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 16.4 | 18.4 | 0.645 | 0.724 |
| N | 50 | | 1.968 | |
| T | | 22.4 | | 0.881 |

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

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 |



# 6 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 16-Oct-2007 | 1 | First release |
| 20-Feb-2008 | 2 | Modified *Table 4.: Static* |
| 23-Sep-2008 | 3 | $V_{GS}$ value has been changed on *Table 2* and *Table 5* |
| 20-Apr-2009 | 4 | Added device in TO-220 |
| 26-Apr-2010 | 5 | – *Table 1: Device summary* has been corrected<br>– *Section 4: Package mechanical data* has been updated |

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