



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).

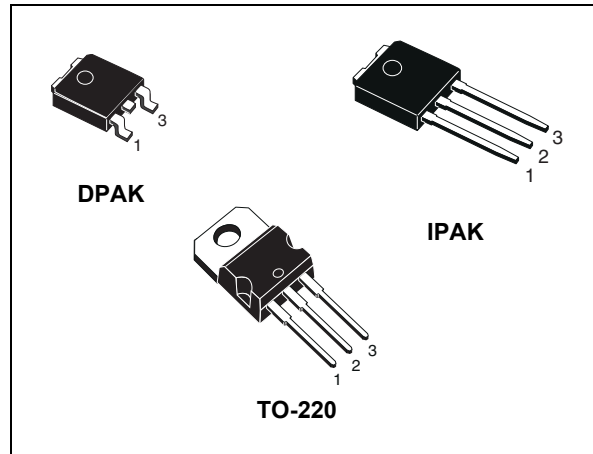


Figure 1. Internal schematic diagram

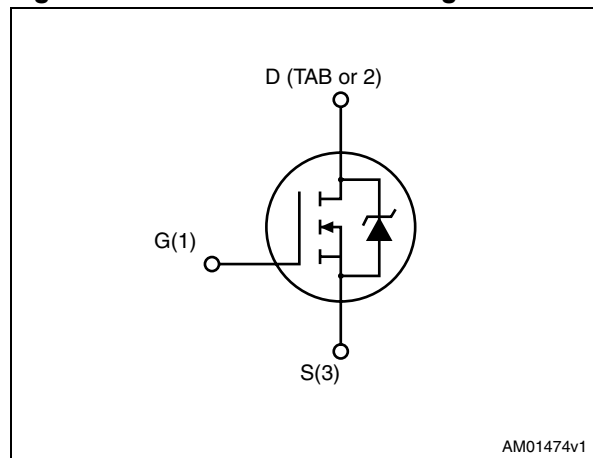


Table 1. Device summary

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

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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 $T_C = 25^\circ\text{C}$ | 80 | 95 | A |
| I_D | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 67 | | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 320 | 380 | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 70 | 80 | W |
| | Derating factor | 0.47 | | W/ $^\circ\text{C}$ |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy | 165 | | mJ |
| T_j T_{stg} | Operating junction temperature Storage temperature | -55 to 175 | | $^\circ\text{C}$ |

- Limited by wire bonding
- Pulse width limited by safe operating area
- Starting $T_j = 25^\circ\text{C}$, $I_d = 40\text{ A}$, $V_{dd} = 20\text{ V}$

Table 3. Thermal resistance

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

2 Electrical characteristics

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

Table 4. Static

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

Table 5. Dynamic

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

Table 6. Switching on/off (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------------------|--|------|---------|------|----------|
| $t_{d(on)}$ t_r | Turn-on delay time Rise time | $V_{DD}=12.5\text{ V}$, $I_D=40\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$ <i>Figure 17</i> | - | 7 38 | - | ns ns |
| $t_{d(off)}$ t_f | Turn-off delay time Fall time | $V_{DD}=12.5\text{ V}$, $I_D=40\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$ <i>Figure 17</i> | - | 22 7 | - | ns 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 | $I_{SD}=35\text{ A}$, $V_{GS}=0$ | - | | 1.1 | V |
| t_{rr} | Reverse recovery time | $I_{SD}=80\text{ A}$, $V_{DD}=20\text{ V}$ | - | 32.4 | | ns |
| Q_{rr} | Reverse recovery charge | $di/dt=100\text{ A}/\mu\text{s}$, | - | 27.1 | | nC |
| I_{RRM} | Reverse recovery current | <i>Figure 19</i> | - | 1.7 | | 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 DPAK, IPAK Figure 3. Thermal impedance for DPAK, IPAK

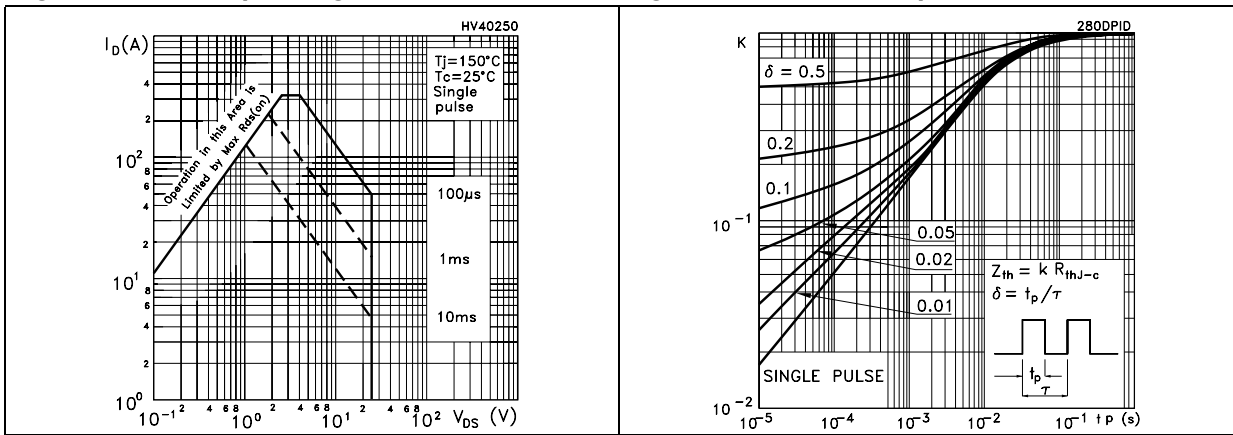


Figure 4. Safe operating area for TO-220 Figure 5. Thermal impedance for TO-220

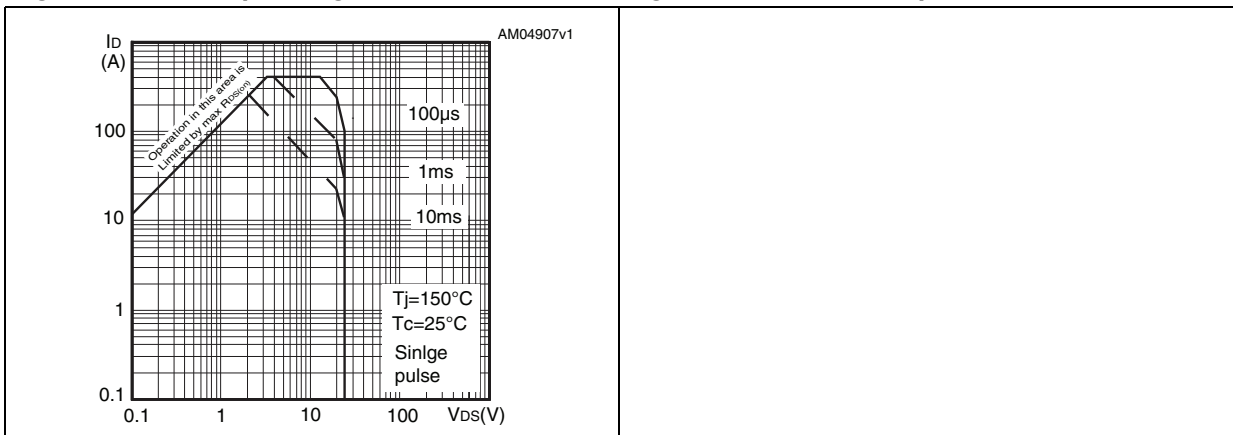


Figure 6. Output characteristics Figure 7. Transfer characteristics

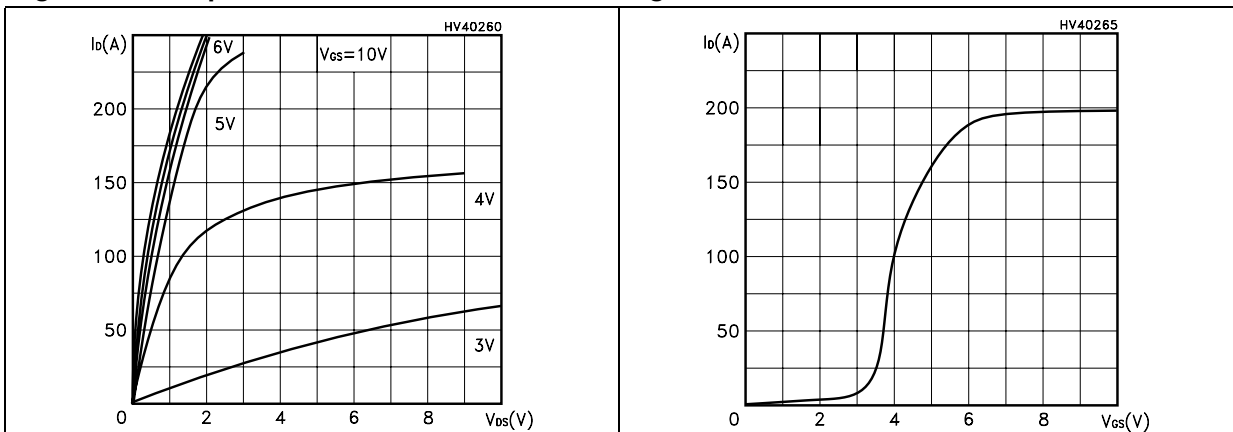


Figure 8. Normalized $B_{V_{DS}}$ vs temperature

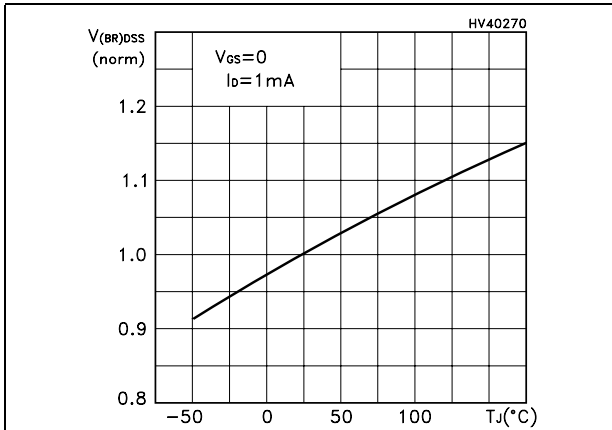


Figure 9. Static drain-source on resistance

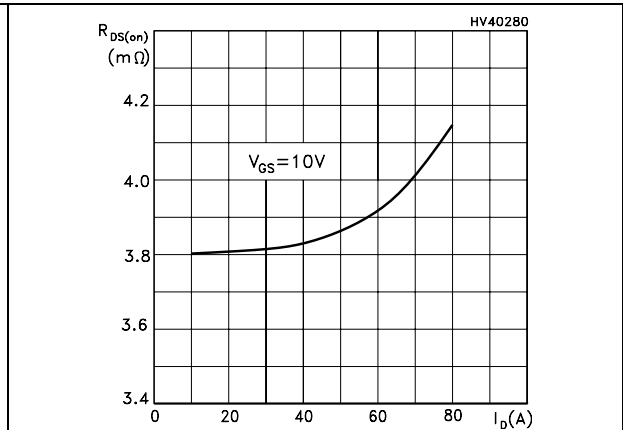


Figure 10. Gate charge vs gate-source voltage

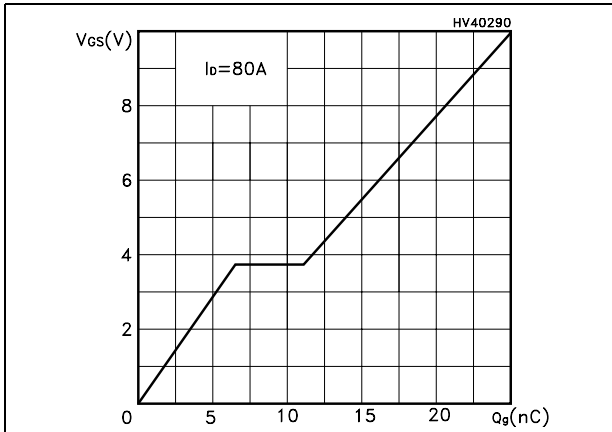


Figure 11. Capacitance variations

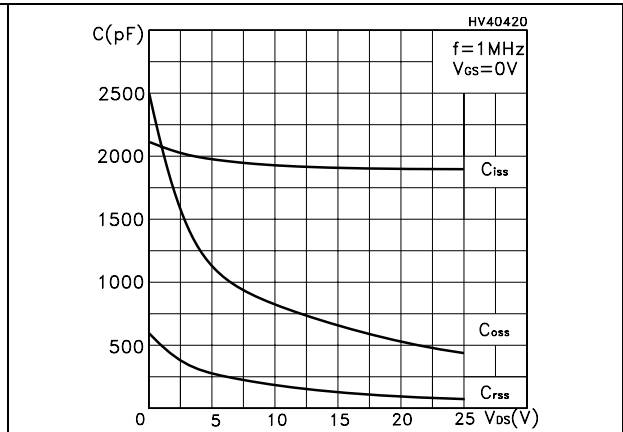


Figure 12. Normalized gate threshold voltage vs temperature

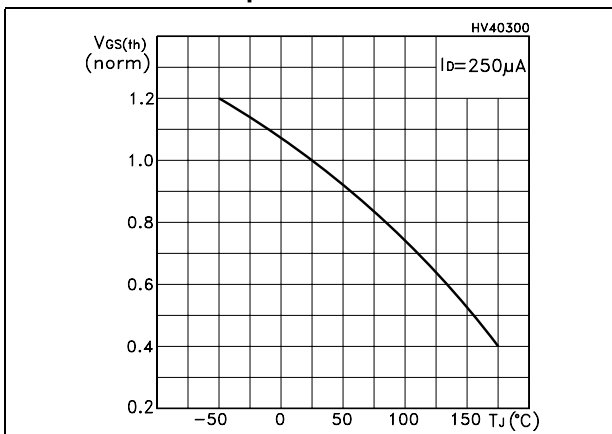


Figure 13. Normalized on resistance vs temperature

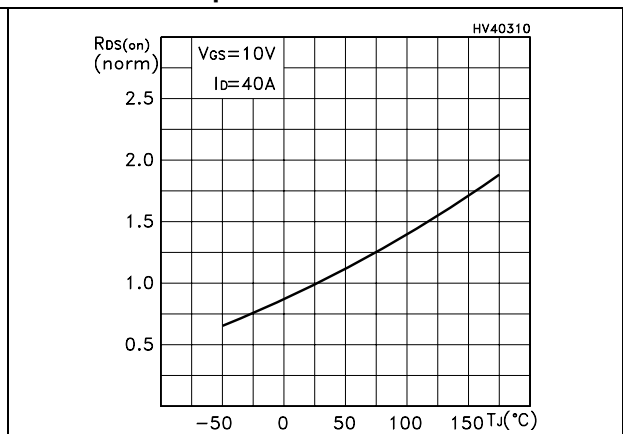
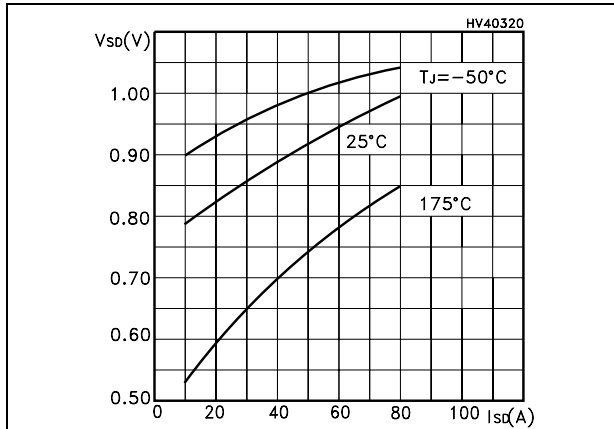


Figure 14. Source-drain diode forward characteristics



3 Test circuits

Figure 15. Unclamped inductive load test circuit

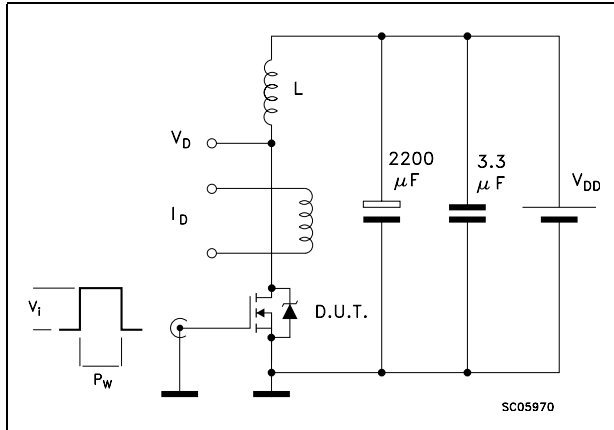


Figure 16. Unclamped inductive waveform

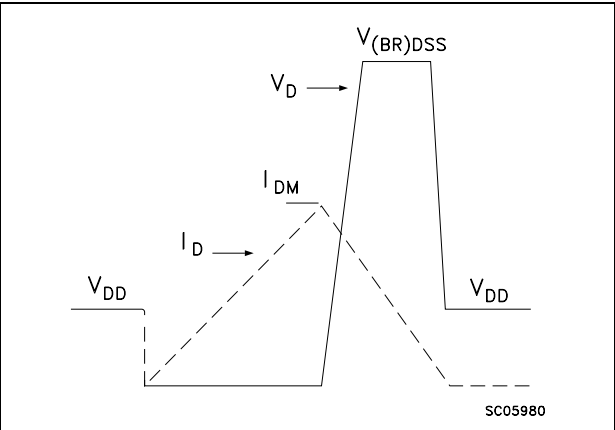


Figure 17. Switching times test circuit for resistive load

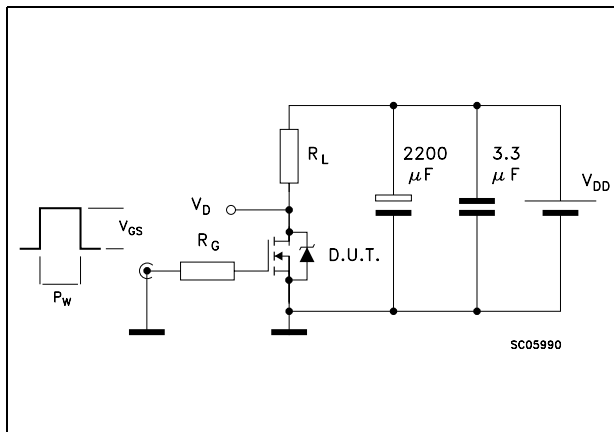


Figure 18. Gate charge test circuit

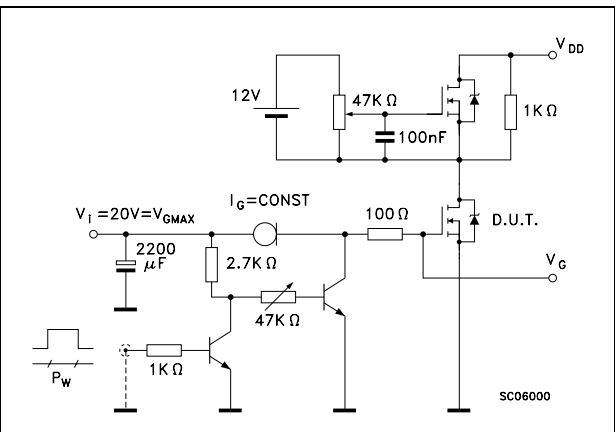


Figure 19. Test circuit for inductive load switching and diode recovery times

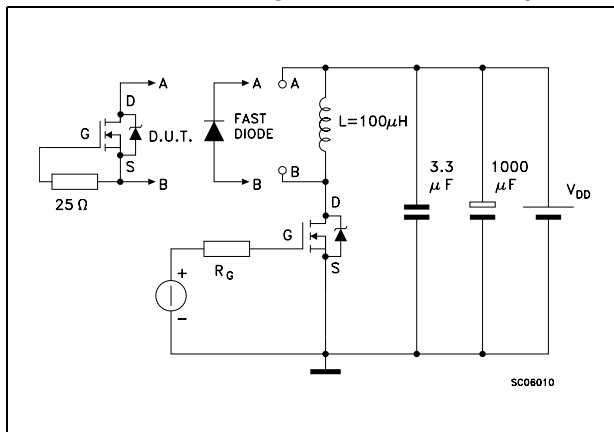


Figure 20. Switching time waveform

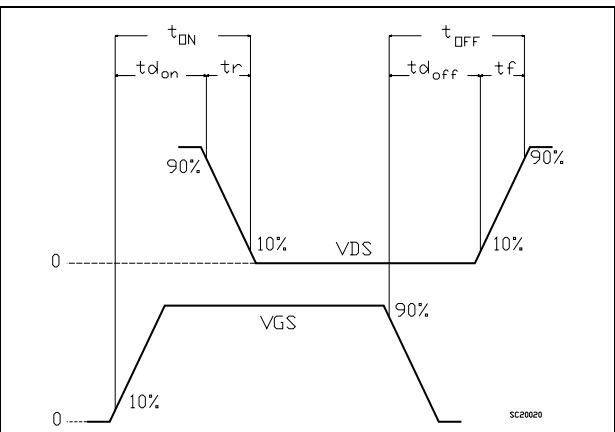
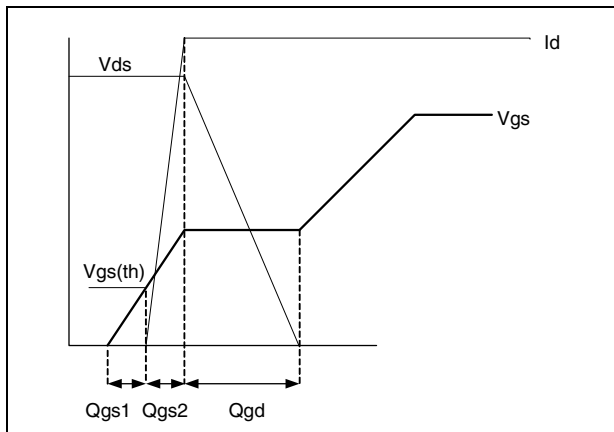


Figure 21. Gate charge waveform

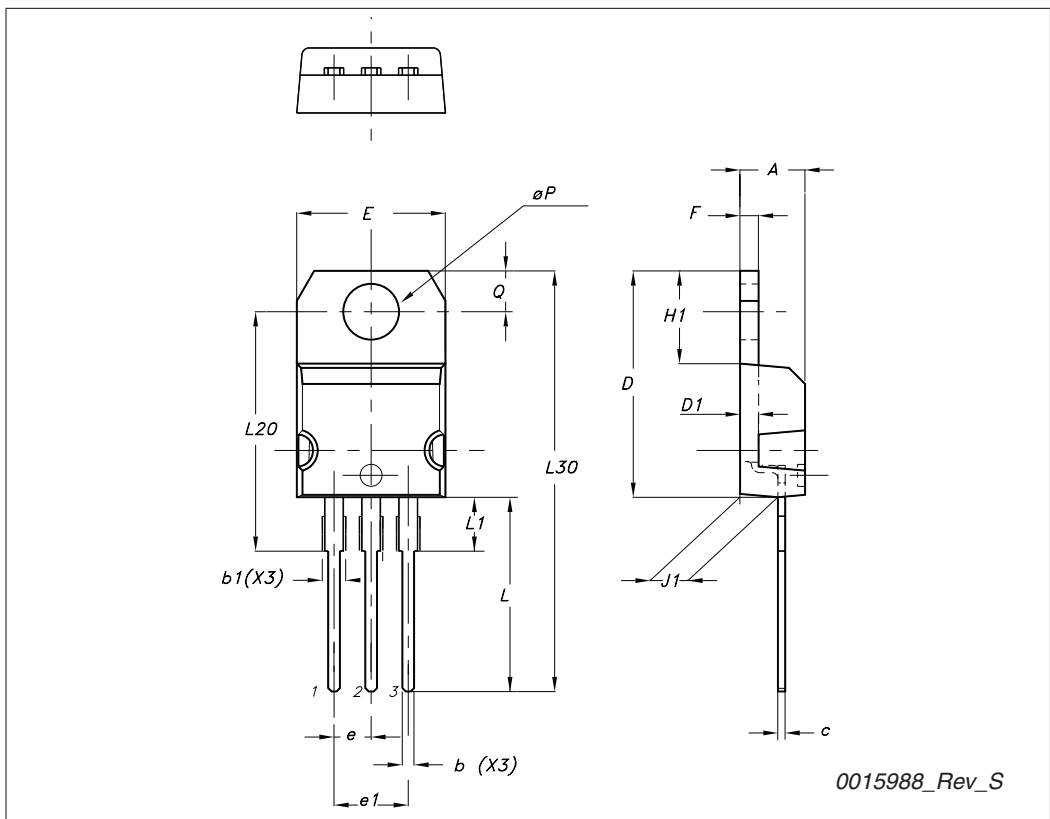


4 Package mechanical data

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.

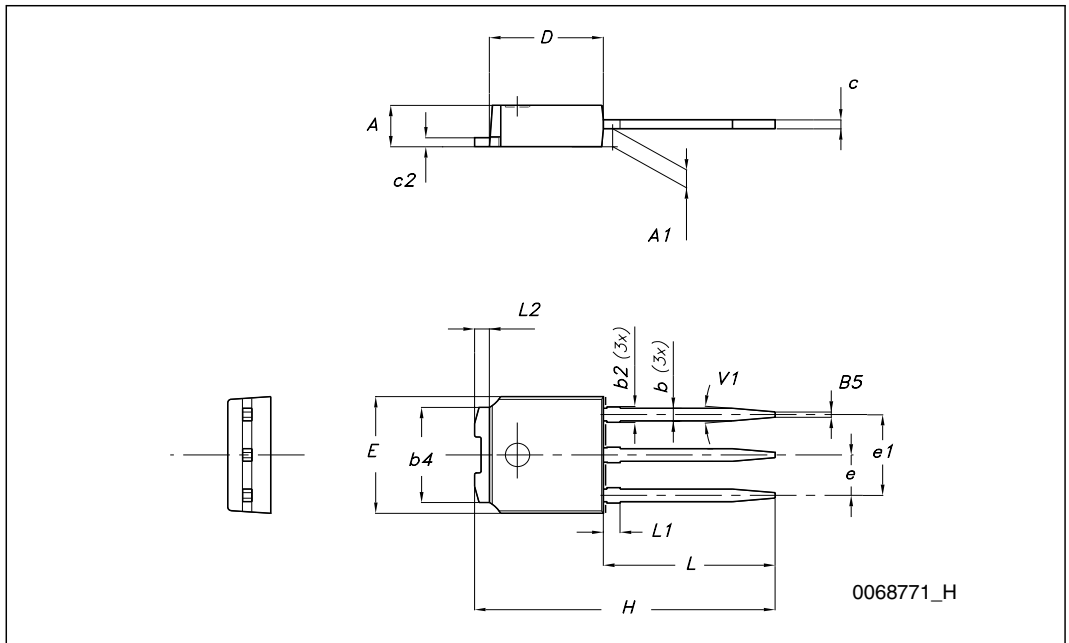
TO-220 type A mechanical data

| 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 |



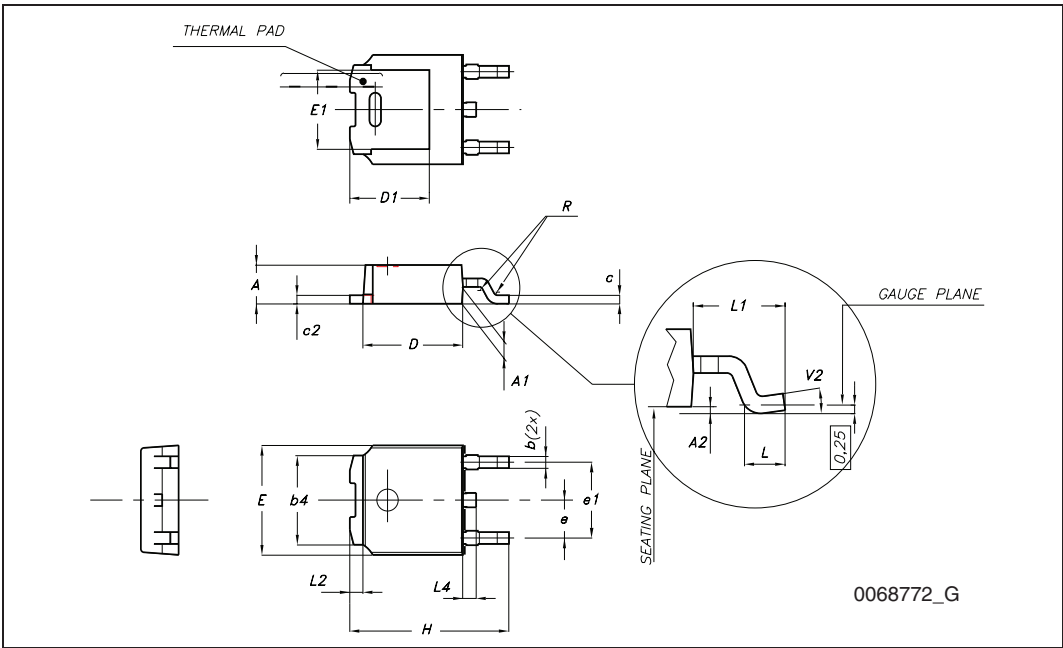
TO-251 (IPAK) mechanical data

| 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

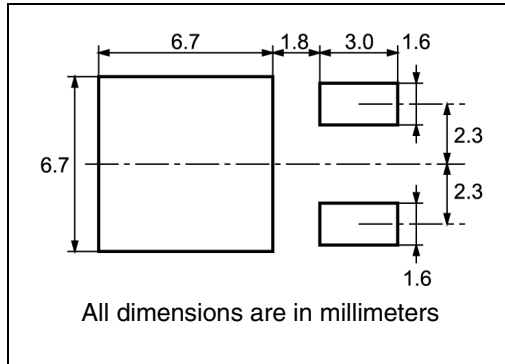
| DIM. | mm. | | |
|------|------|------|-------|
| | min. | typ | max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 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° |



0068772_G

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

| |
|------|
| 2500 |
|------|

BULK QTY

| |
|------|
| 2500 |
|------|

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 | <ul style="list-style-type: none">– Table 1: Device summary has been corrected– Section 4: Package mechanical data has been updated |

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