



STD85N3LH5 STP85N3LH5, STU85N3LH5

N-channel 30 V, 0.0042 Ω , 80 A, DPAK, TO-220, IPAK
STripFET™ V Power MOSFET

Features

| Type | V _{DSS} | R _{DS(on)} max. | I _D |
|------------|------------------|--------------------------|----------------|
| STD85N3LH5 | 30 V | < 0.005 Ω | 80 A |
| STP85N3LH5 | | | |
| STU85N3LH5 | | | |

- 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 product utilizes the 5th generation of design rules of ST's proprietary STripFET™ technology. The lowest available R_{DS(on)} * Q_g, in the standard packages, makes this device suitable for the most demanding DC-DC converter applications, where high power density is to be achieved.

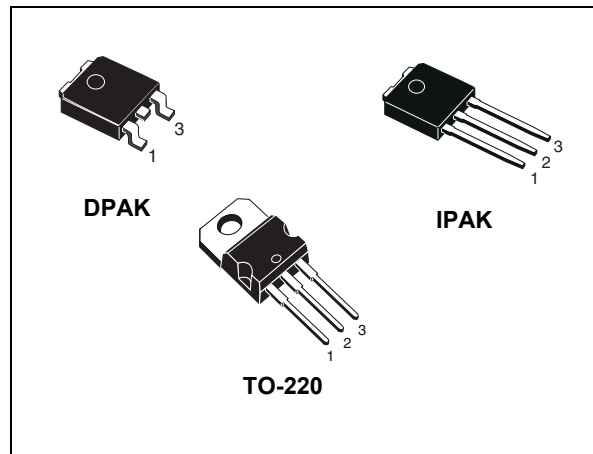


Figure 1. Internal schematic diagram

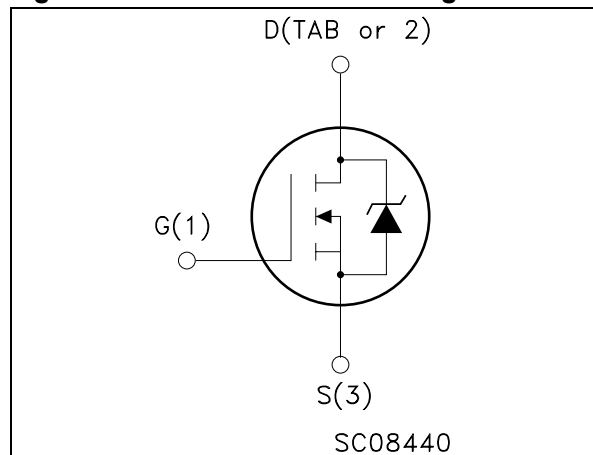


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|---------|---------------|
| STD85N3LH5 | 85N3LH5 | DPAK | Tape and reel |
| STP85N3LH5 | | TO-220 | Tube |
| STU85N3LH5 | | IPAK | |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|---------------------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 30 | V |
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) @ T_{JMAX} | 35 | V |
| V_{GS} | Gate-source voltage | ± 22 | V |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$ | 80 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 55 | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 320 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 70 | W |
| | Derating factor | 0.47 | W/ $^\circ\text{C}$ |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy | 165 | mJ |
| T_{stg} | Storage temperature | -55 to 175 | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | 175 | $^\circ\text{C}$ |

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = 40\text{ A}$, $V_{DD} = 25\text{ V}$

Table 3. Thermal resistance

| Symbol | Parameter | Value | | | Unit |
|----------------|--|--------|------|------|--------------------|
| | | TO-220 | DPAK | IPAK | |
| $R_{thj-case}$ | Thermal resistance junction-case max | 2.14 | | | $^\circ\text{C/W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-amb max | 62.5 | | 100 | $^\circ\text{C/W}$ |
| $R_{thj-pcb}$ | Thermal resistance junction-pcb max | | 100 | | $^\circ\text{C/W}$ |
| T_l | Maximum lead temperature for soldering purpose | 275 | | | $^\circ\text{C}$ |

2 Electrical characteristics

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

Table 4. Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|--------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown Voltage | $I_D = 250\ \mu\text{A}$, $V_{GS} = 0$ | 30 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = 30\text{ V}$ $V_{DS} = 30\text{ V}$, $T_c = 125\text{ °C}$ | | | 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 | $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$ | 1 | 1.8 | 2.5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\text{ V}$, $I_D = 40\text{ A}$ SMD version | | 0.042 | 0.005 | Ω |
| | | $V_{GS} = 10\text{ V}$, $I_D = 40\text{ A}$ | | 0.0046 | 0.0054 | Ω |
| | | $V_{GS} = 5\text{ V}$, $I_D = 40\text{ A}$ SMD version | | 0.0052 | 0.0065 | Ω |
| | | $V_{GS} = 5\text{ V}$, $I_D = 40\text{ A}$ | | 0.0058 | 0.0071 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|-------------------------------------|---|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | | 1850 | | pF |
| C_{oss} | Output capacitance | | | 380 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 58 | | pF |
| Q_g | Total gate charge | $V_{DD} = 15\text{ V}$, $I_D = 80\text{ A}$ | | 14 | | nC |
| Q_{gs} | Gate-source charge | $V_{GS} = 5\text{ V}$ | | 6.8 | | nC |
| Q_{gd} | Gate-drain charge | Figure 16 | | 4.7 | | nC |
| Q_{gs1} | Pre V_{th} gate-to-source charge | $V_{DD} = 15\text{ V}$, $I_D = 80\text{ A}$ $V_{GS} = 5\text{ V}$ | | 2.3 | | nC |
| Q_{gs2} | Post V_{th} gate-to-source charge | Figure 16 | | 4.5 | | nC |
| R_G | Gate input resistance | $f = 1\text{ MHz}$ gate bias Bias = 0 test signal level = 20 mV open drain | | 1.2 | | Ω |

Table 6. Switching on/off (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD} = 15\text{ V}$, $I_D = 40\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 5\text{ V}$ <i>Figure 15</i> | | 6 | | ns |
| t_r | Rise time | | | 14 | | ns |
| $t_{d(off)}$ | Turn-off delay time | <i>Figure 15</i> | | 23.6 | | ns |
| t_f | Fall time | | | 10.8 | | 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 | $I_{SD} = 40\text{ A}$, $V_{GS} = 0$ | | | 1.1 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 80\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 20\text{ V}$ <i>Figure 17</i> | | 31.8 | | ns |
| Q_{rr} | Reverse recovery charge | | | 26.1 | | nC |
| I_{RRM} | Reverse recovery current | | | 1.6 | | 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

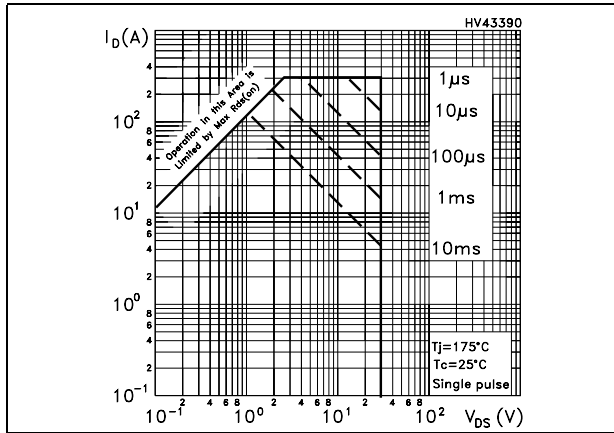


Figure 3. Thermal impedance

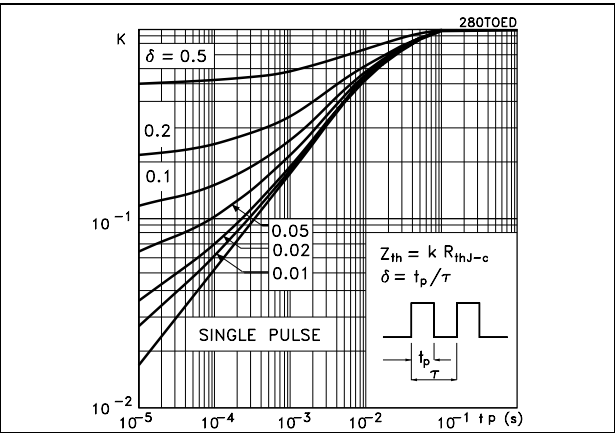


Figure 4. Output characteristics

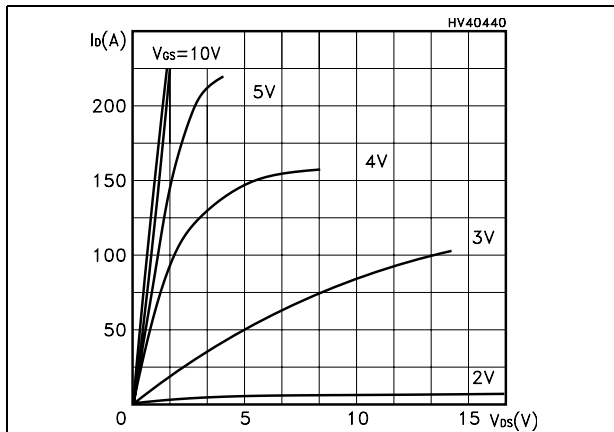


Figure 5. Transfer characteristics

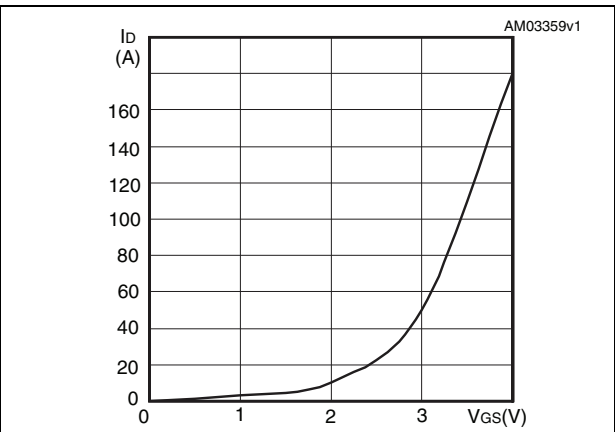


Figure 6. Normalized $B_{V_{DSS}}$ vs temperature

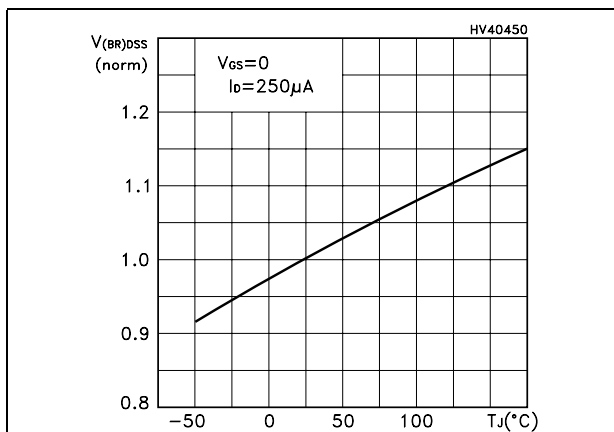


Figure 7. Static drain-source on resistance

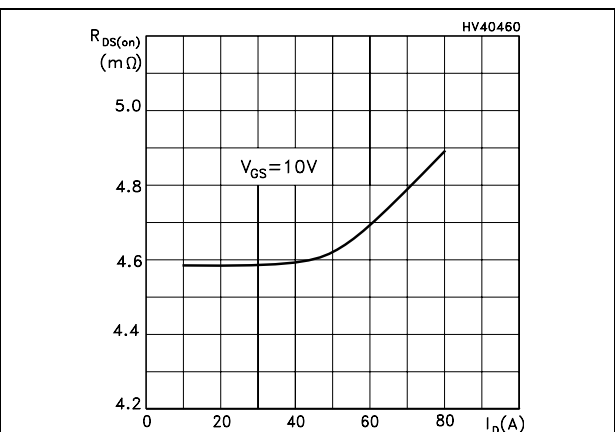


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

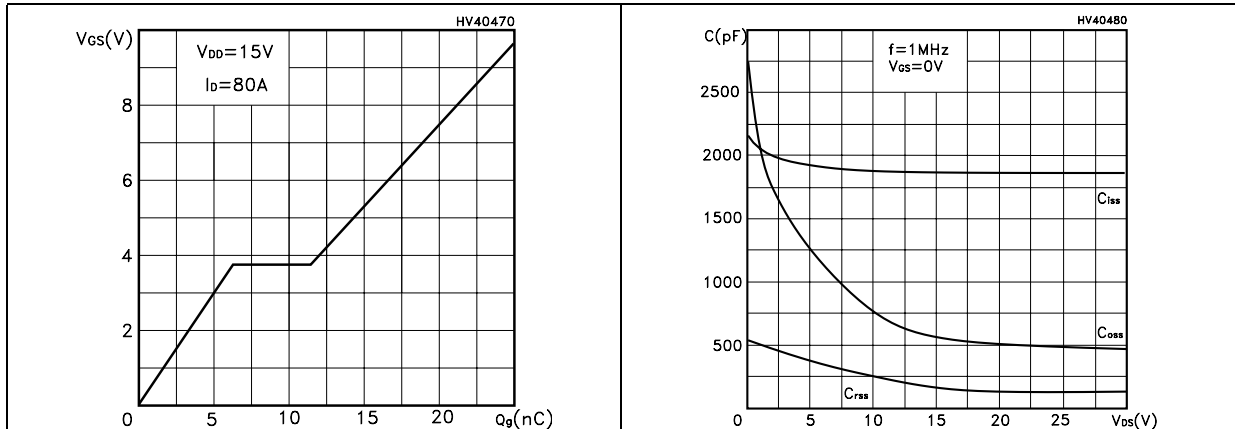


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

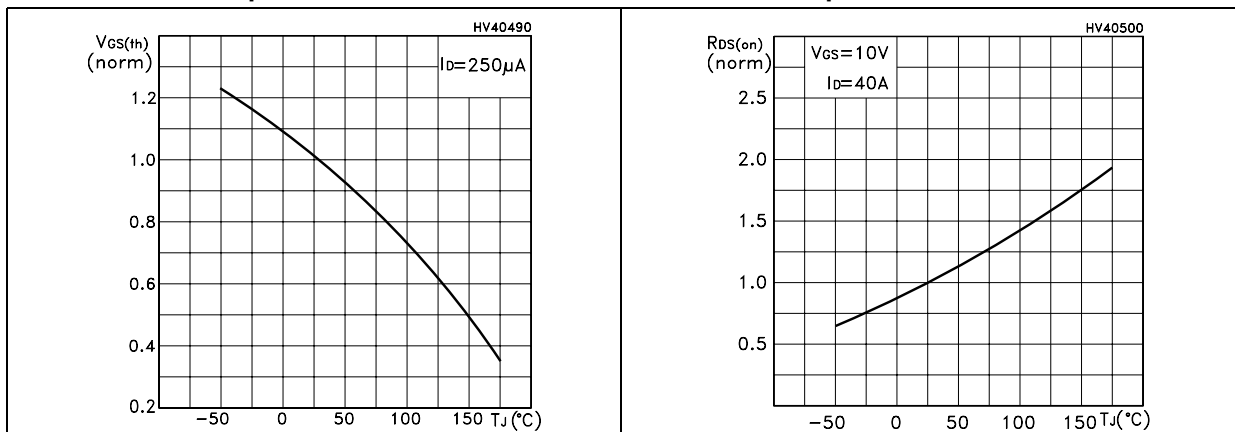
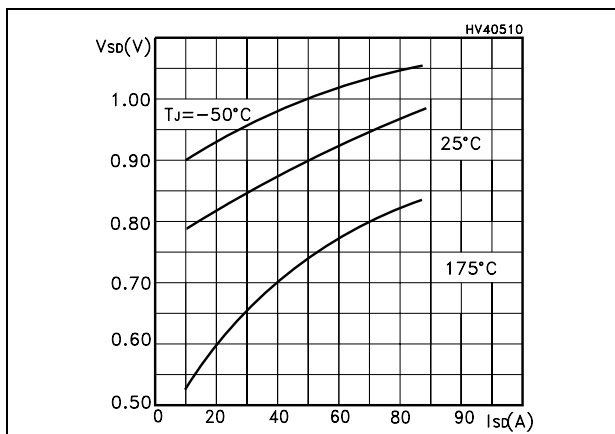
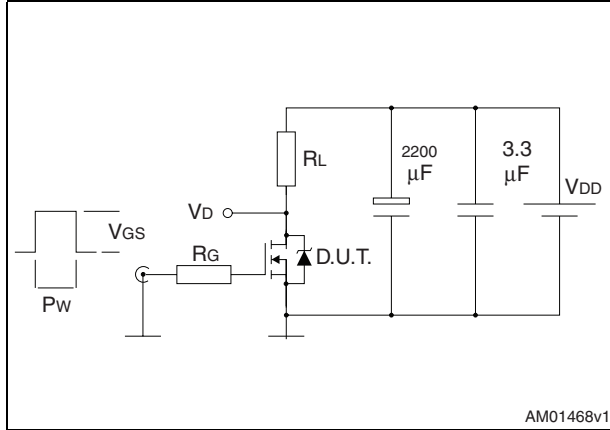


Figure 12. Source-drain diode forward characteristics



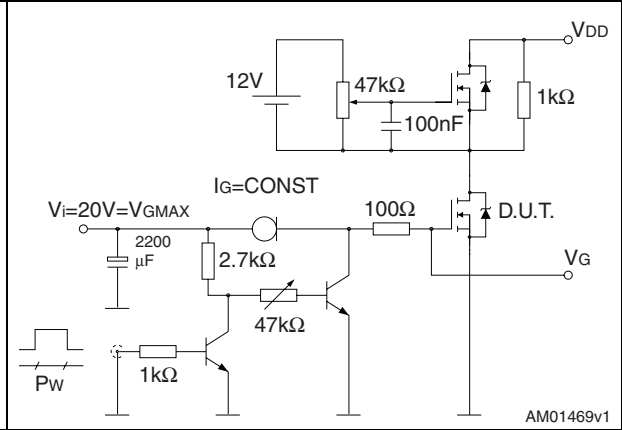
3 Test circuit

Figure 13. Switching times test circuit for resistive load



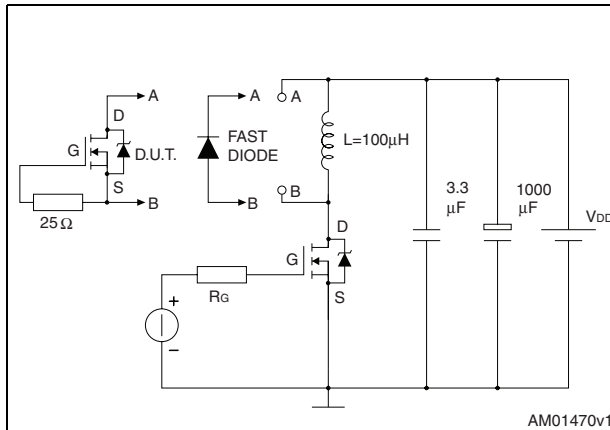
AM01468v1

Figure 14. Gate charge test circuit



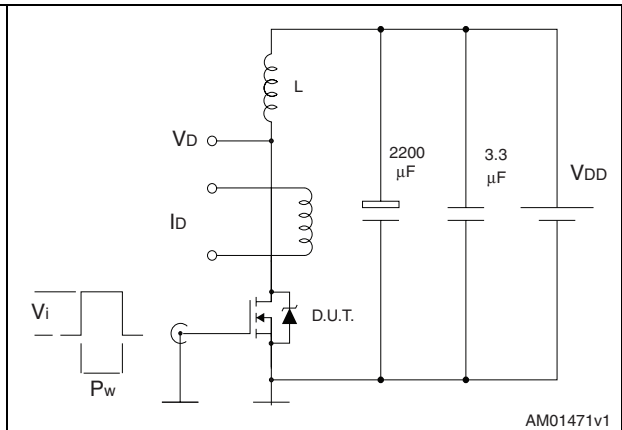
AM01469v1

Figure 15. Test circuit for inductive load switching and diode recovery times



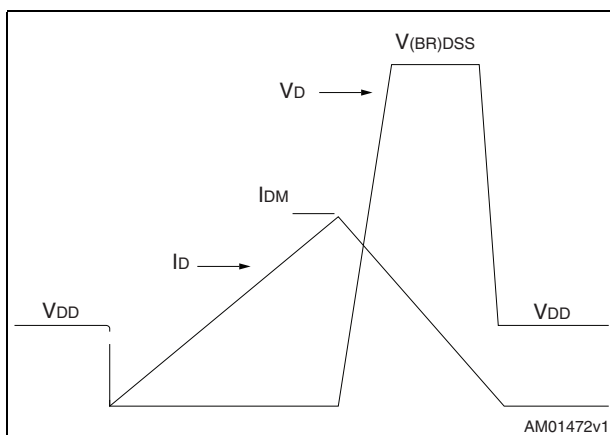
AM01470v1

Figure 16. Unclamped inductive load test circuit



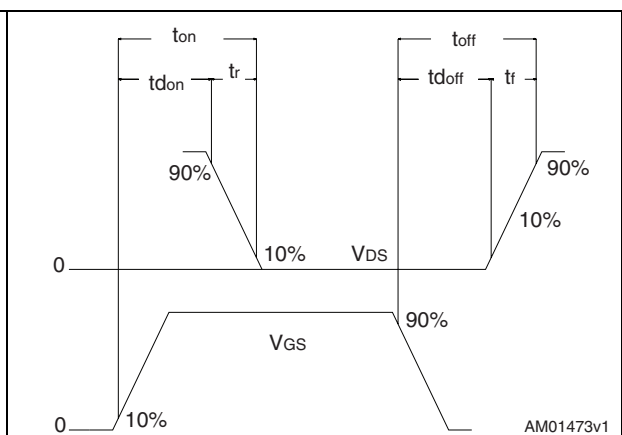
AM01471v1

Figure 17. Unclamped inductive waveform



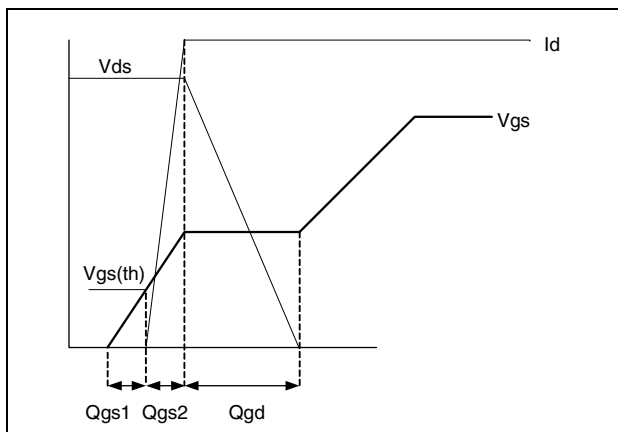
AM01472v1

Figure 18. Switching time waveform



AM01473v1

Figure 19. Gate charge waveform

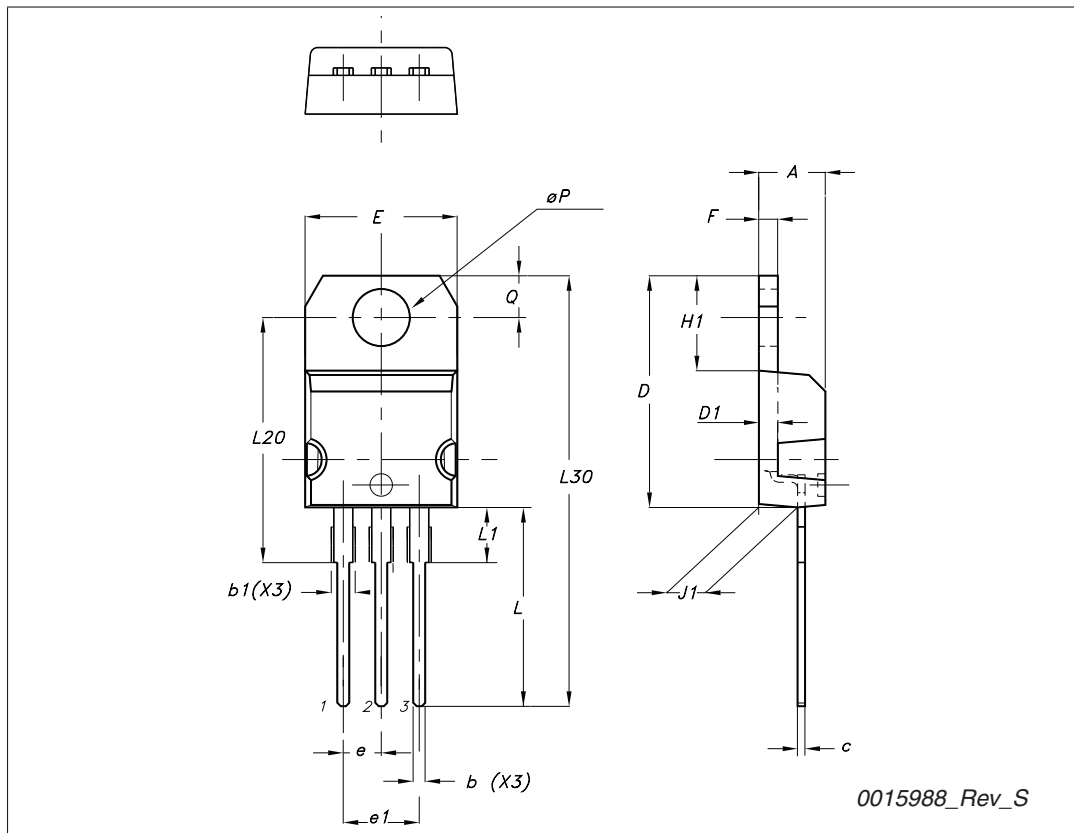


4 Package mechanical data

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.

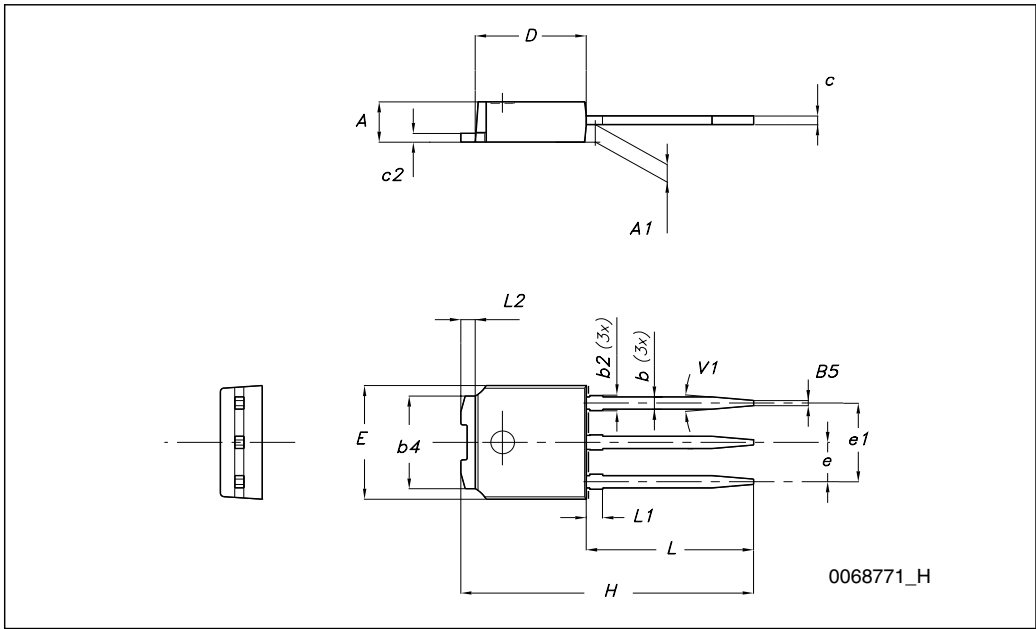
TO-220 type A mechanical data

| 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 |



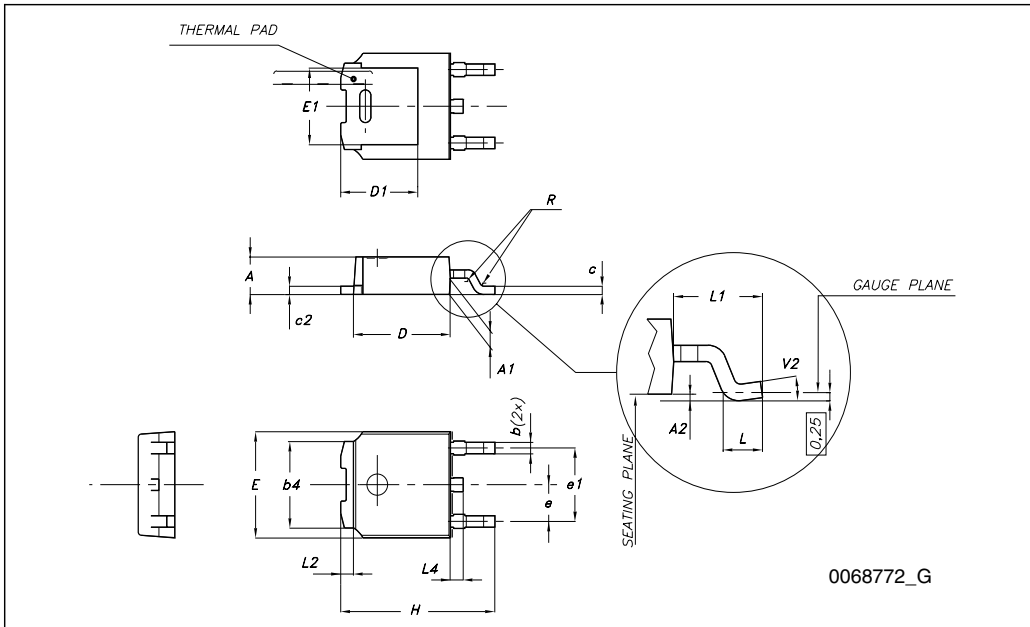
TO-251 (IPAK) mechanical data

| 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° | |



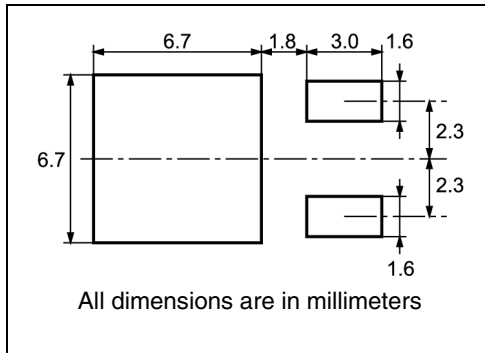
TO-252 (DPAK) mechanical data

| 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



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 |
|-------------|----------|--|
| 19-Oct-2007 | 1 | First release |
| 20-Feb-2008 | 2 | Minor text changes to improve readability |
| 21-Jul-2008 | 3 | <ul style="list-style-type: none">– Added new package, mechanical data: TO-220– Figure 2: Safe operating area has been corrected– Figure 7: Static drain-source on resistance updated– New value on Table 2: Absolute maximum ratings |
| 20-Aug-2008 | 4 | Added max value on $V_{GS(th)}$ (Table 4) |
| 25-Sep-2008 | 5 | V_{GS} values has been changed on Table 2 and Table 4 |
| 22-Jan-2009 | 6 | Corrected value on Table 3: Thermal resistance |
| 01-Jul-2010 | 7 | V_{DS} values has been changed on Table 4 |

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