



STD60N3LH5 STU60N3LH5

N-channel 30 V, 0.0072 Ω , 48 A - DPAK - IPAK
STripFET™ V Power MOSFET

Features

| Type | V _{DSS} | R _{DS(on)} Max | I _D |
|------------|------------------|-------------------------|----------------|
| STD60N3LH5 | 30V | 0.008 Ω | 48A |
| STU60N3LH5 | 30V | 0.0084 Ω | 48A |

- R_{DS(on)} * Q_g industry benchmark
- Extremely low on-resistance R_{DS(on)}
- Very low switching gate charge
- 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.

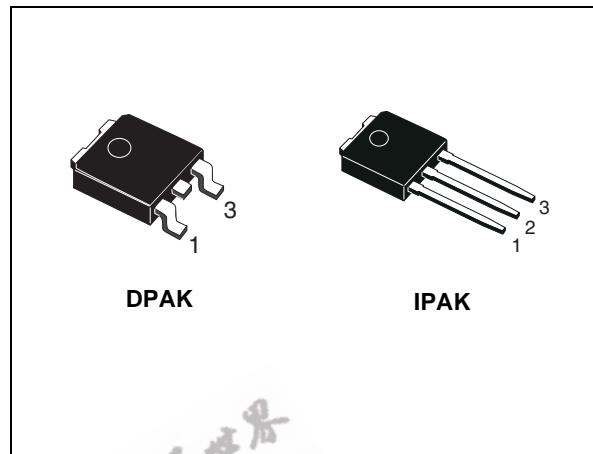


Figure 1. Internal schematic diagram

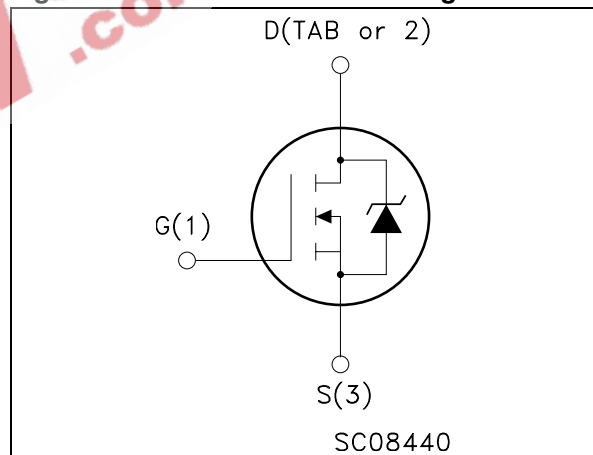


Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|---------|---------------|
| STD60N3LH5 | 60N3LH5 | DPAK | Tape and reel |
| STU60N3LH5 | 60N3LH5 | IPAK | Tube |

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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 $T_C = 25^\circ C$ | 48 | A |
| I_D | Drain current (continuous) at $T_C = 100^\circ C$ | 42.8 | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 192 | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ C$ | 60 | W |
| | Derating factor | 0.4 | W/°C |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy | 160 | mJ |
| T_j T_{stg} | Operating junction temperature Storage temperature | -55 to 175 | °C |

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. Starting $T_j = 25^\circ C$, $I_d = 24A$, $V_{dd} = 12V$

Table 3. Thermal resistance

| Symbol | Parameter | Value | Unit |
|----------------|--|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 2.5 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-case max | 100 | °C/W |
| T_j | Maximum lead temperature for soldering purpose | 275 | °C |

2 Electrical characteristics

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

Table 4. Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|--------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown Voltage | $I_D = 250\mu A, V_{GS} = 0$ | 30 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = 30V$ $V_{DS} = 30V, T_c = 125^{\circ}C$ | | | 1 10 | μA μA |
| I_{GSS} | Gate body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 22V$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250\mu A$ | 1 | | | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10V, I_D = 24A$ SMD version | | 0.0072 | 0.008 | Ω |
| | | $V_{GS} = 10V, I_D = 24A$ | | 0.0076 | 0.0084 | Ω |
| | | $V_{GS} = 5V, I_D = 24A$ SMD version | | 0.0088 | 0.011 | Ω |
| | | $V_{GS} = 5V, I_D = 24A$ | | 0.0092 | 0.0114 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min | Typ. | Max. | Unit |
|-----------|-------------------------------------|--|-----|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 25V, f = 1MHz,$ $V_{GS} = 0$ | | 1350 | | pF |
| C_{oss} | Output capacitance | | | 265 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 32 | | pF |
| Q_g | Total gate charge | $V_{DD} = 15V, I_D = 48A$ | | 8.8 | | nC |
| Q_{gs} | Gate-source charge | $V_{GS} = 5V$ | | 4.7 | | nC |
| Q_{gd} | Gate-drain charge | (Figure 14) | | 2.2 | | nC |
| Q_{gs1} | Pre V_{th} gate-to-source charge | $V_{DD} = 15V, I_D = 48A$ | | 2.2 | | nC |
| Q_{gs2} | Post V_{th} gate-to-source charge | $V_{GS} = 5V$ (Figure 19) | | 2.5 | | nC |
| R_G | Gate input resistance | f=1MHz gate bias Bias= 0 test signal level=20mV open drain | | 1.1 | | Ω |

Table 6. Switching on/off (resistive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}=10V, I_D=24A,$ $R_G=4.7\Omega, V_{GS}=10V$ <i>(Figure 13 and Figure 18)</i> | | 6 | | ns |
| t_r | Rise time | | | 33 | | ns |
| $t_{d(off)}$ | Turn-off delay time | $V_{DD}=10V, I_D=24A,$ $R_G=4.7\Omega, V_{GS}=10V$ <i>(Figure 13 and Figure 18)</i> | | 19 | | ns |
| t_f | Fall time | | | 4.2 | | ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|--|---|------|------|------|------|
| I_{SD} | Source-drain current | | | | 48 | A |
| I_{SDM} | Source-drain current (pulsed) ⁽¹⁾ | | | | 192 | A |
| V_{SD} | Forward on voltage | $I_{SD}=24A, V_{GS}=0$ | | | 1.1 | V |
| t_{rr} | Reverse recovery time | $I_{SD}=48A, di/dt=100A/\mu s,$ $V_{DD}=20V, T_J=25^\circ C$ <i>(Figure 15)</i> | | 25 | | ns |
| Q_{rr} | Reverse recovery charge | | | 18.5 | | nC |
| I_{RRM} | Reverse recovery current | | | 1.5 | | A |

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

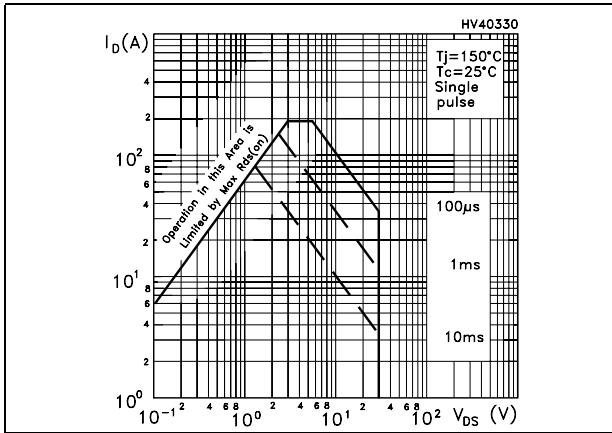


Figure 3. Thermal impedance

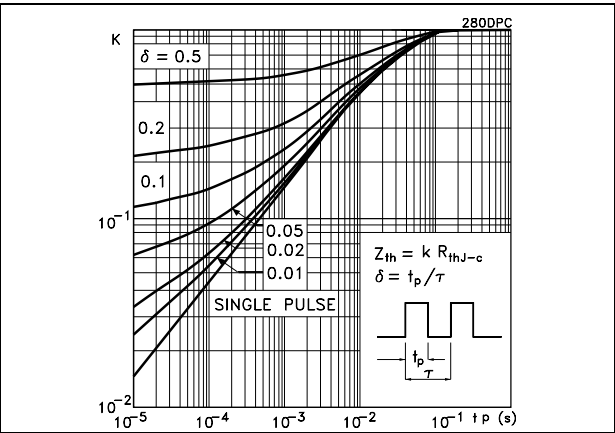


Figure 4. Output characteristics

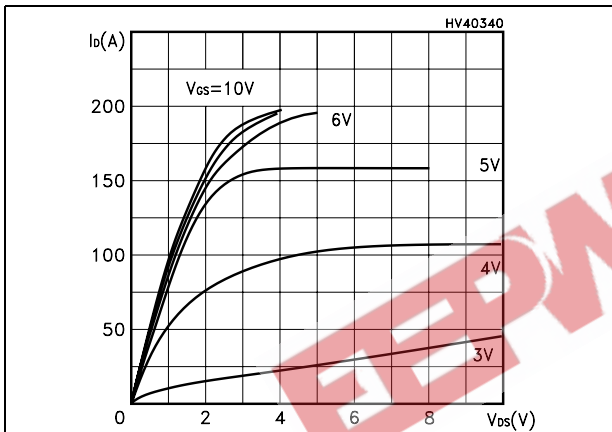


Figure 5. Transfer characteristics

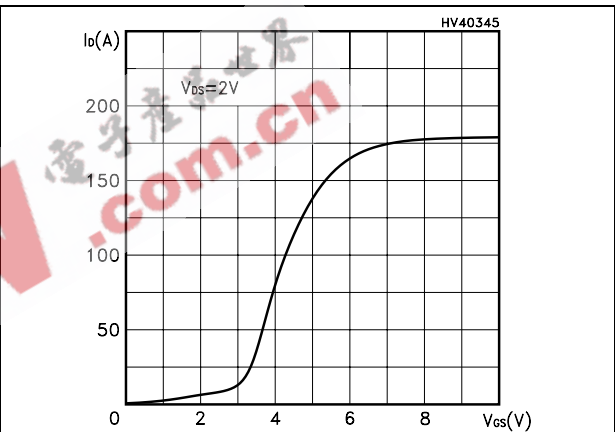


Figure 6. Normalized $B_{V_{DS}}$ vs temperature

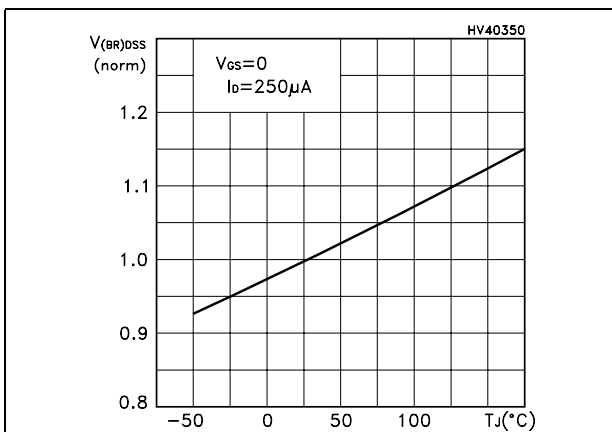


Figure 7. Static drain-source on resistance

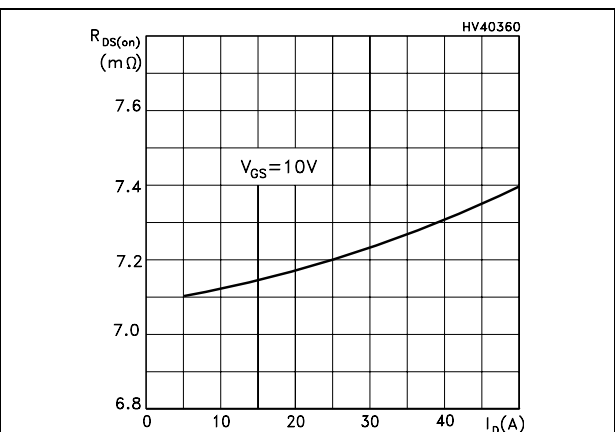


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

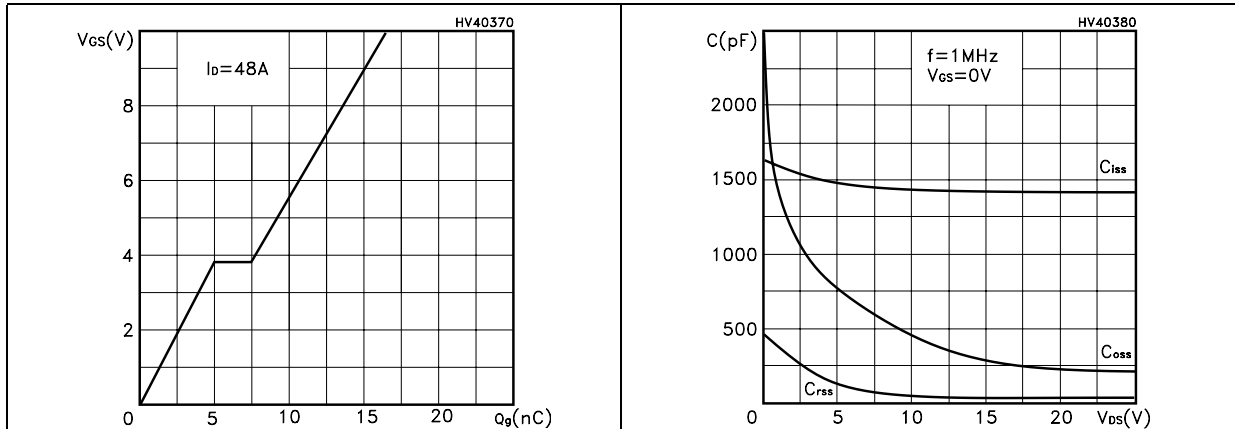


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

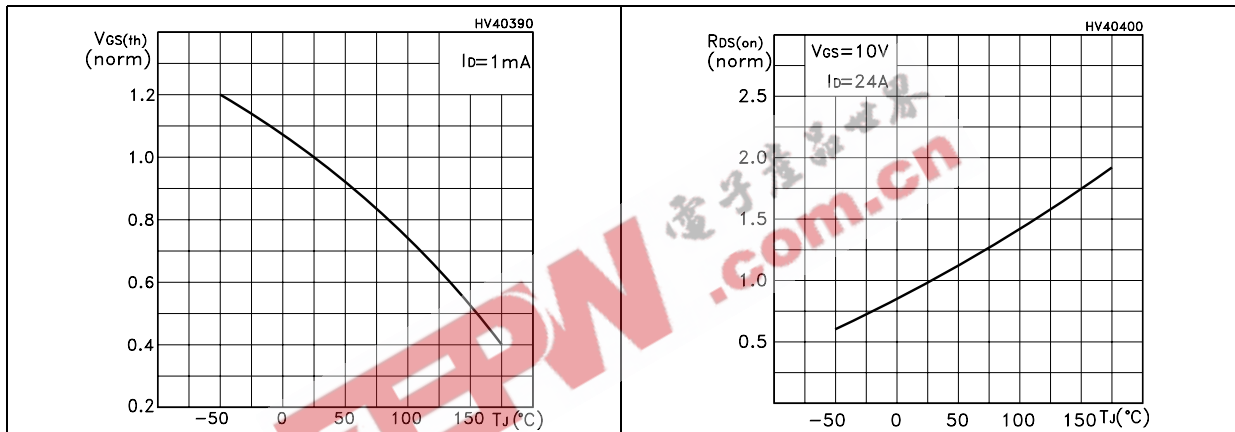
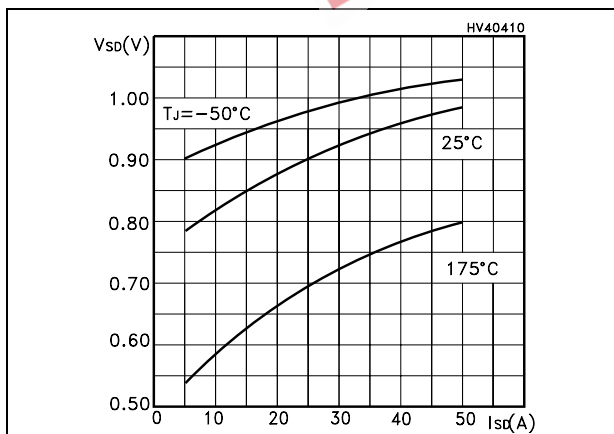


Figure 12. Source-drain diode forward characteristics



3 Test circuit

Figure 13. Switching times test circuit for resistive load

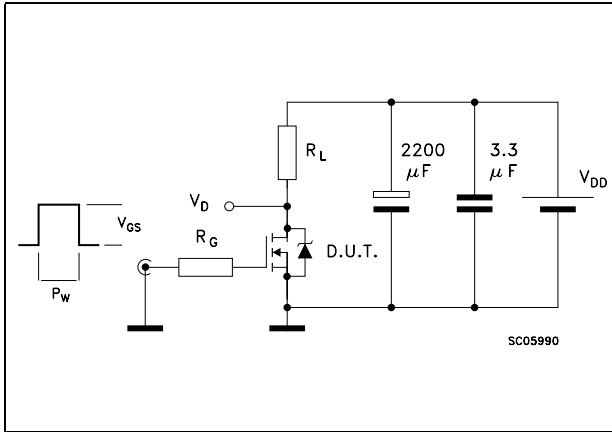


Figure 14. Gate charge test circuit

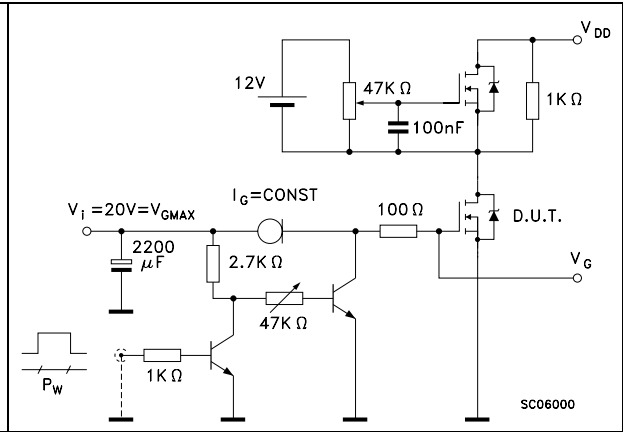


Figure 15. Test circuit for inductive load switching and diode recovery times

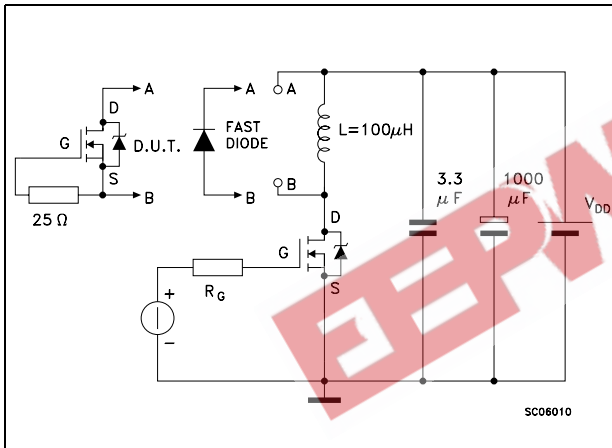


Figure 16. Unclamped Inductive load test circuit

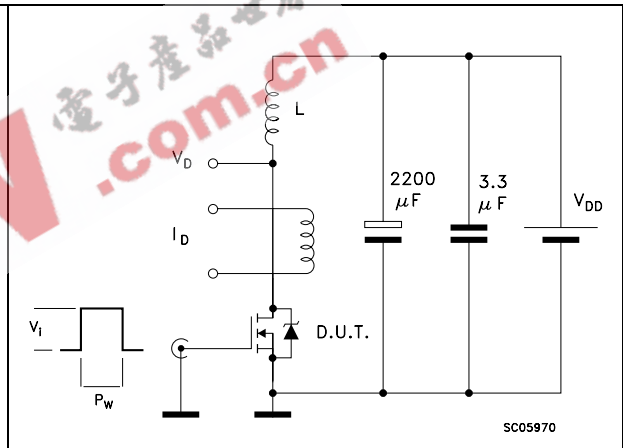


Figure 17. Unclamped inductive waveform

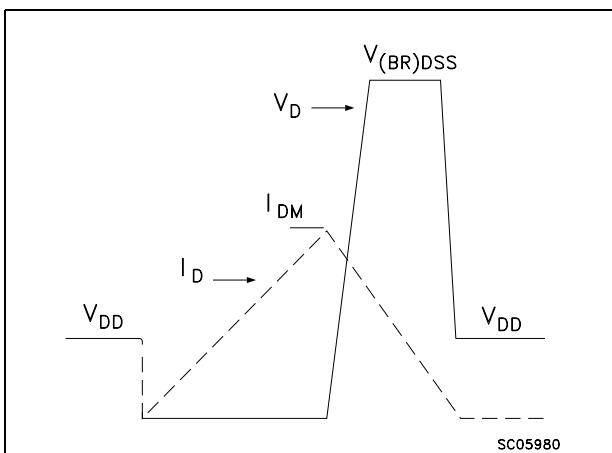


Figure 18. Switching time waveform

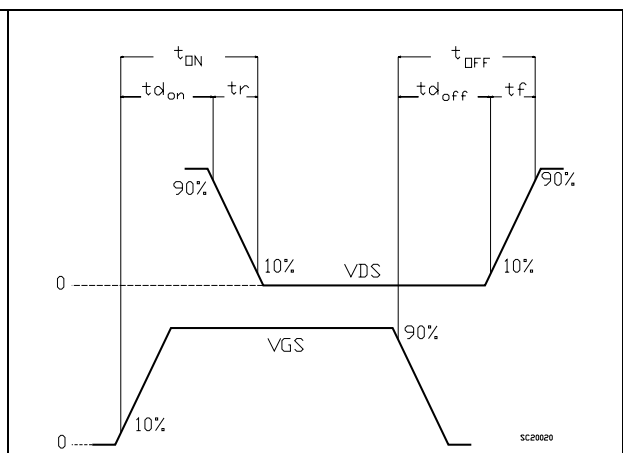
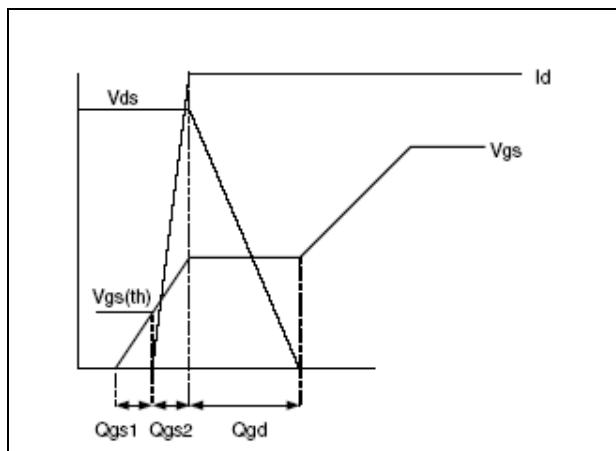


Figure 19. Gate charge waveform



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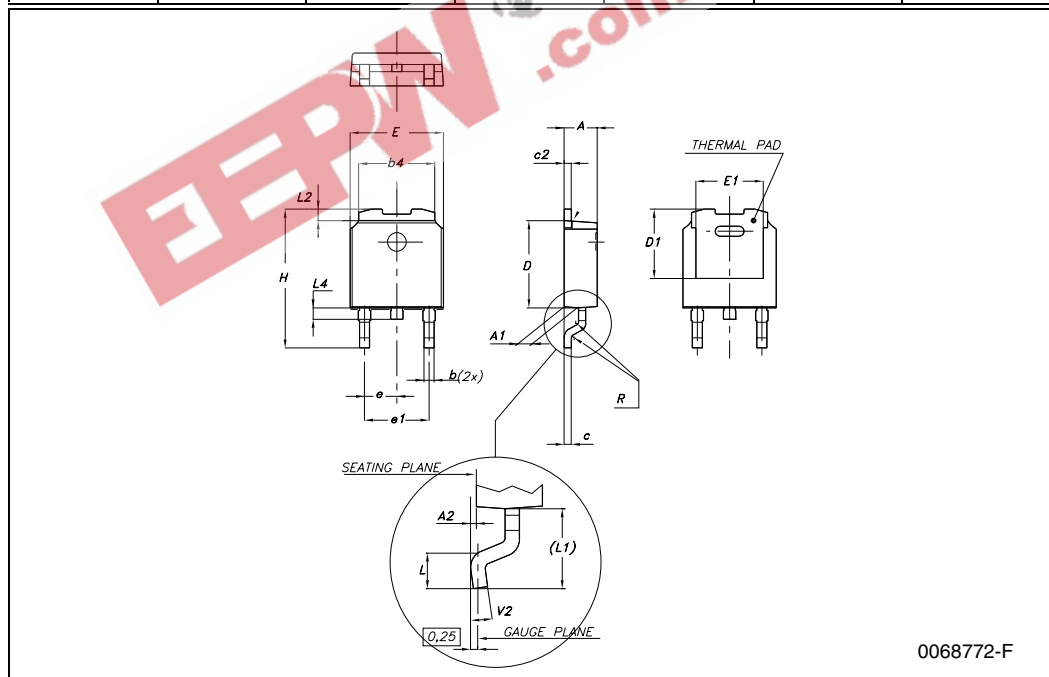
4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

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DPAK MECHANICAL DATA

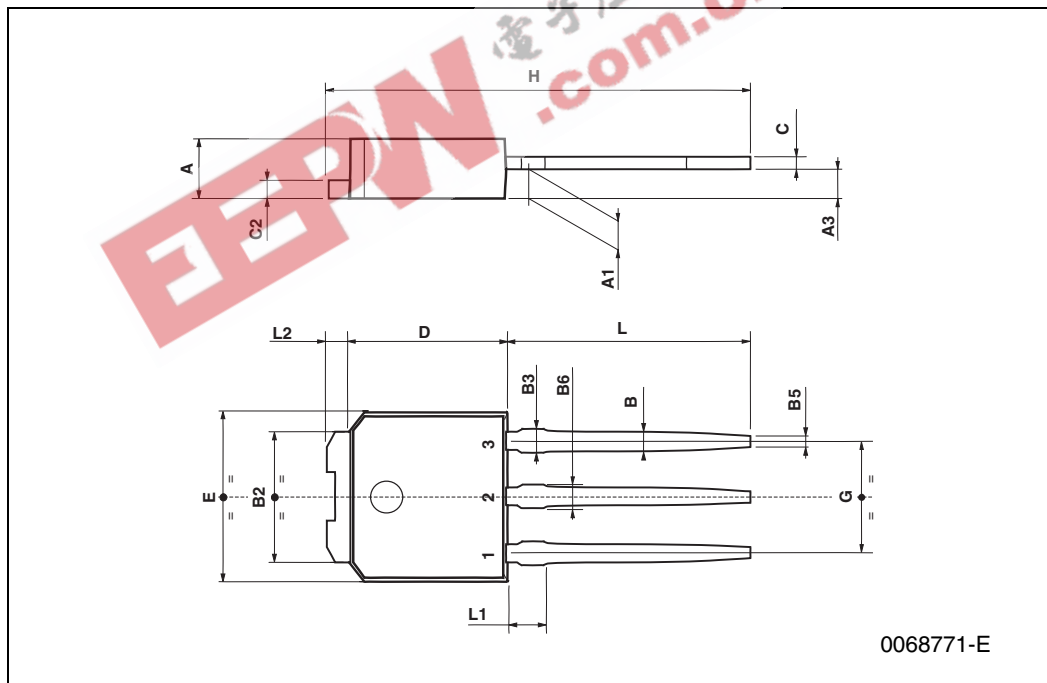
| DIM. | mm. | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 2.2 | | 2.4 | 0.086 | | 0.094 |
| A1 | 0.9 | | 1.1 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.64 | | 0.9 | 0.025 | | 0.035 |
| b4 | 5.2 | | 5.4 | 0.204 | | 0.212 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 0.48 | | 0.6 | 0.019 | | 0.023 |
| D | 6 | | 6.2 | 0.236 | | 0.244 |
| D1 | | 5.1 | | | 0.200 | |
| E | 6.4 | | 6.6 | 0.252 | | 0.260 |
| E1 | | 4.7 | | | 0.185 | |
| e | | 2.28 | | | 0.090 | |
| e1 | 4.4 | | 4.6 | 0.173 | | 0.181 |
| H | 9.35 | | 10.1 | 0.368 | | 0.397 |
| L | 1 | | | 0.039 | | |
| (L1) | | 2.8 | | | 0.110 | |
| L2 | | 0.8 | | | 0.031 | |
| L4 | 0.6 | | 1 | 0.023 | | 0.039 |
| R | | 0.2 | | | 0.008 | |
| V2 | 0° | | 8° | 0° | | 8° |



0068772-F

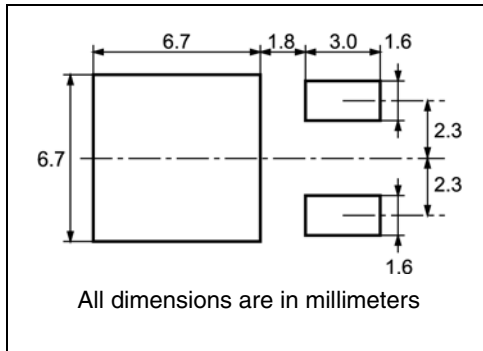
TO-251 (IPAK) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 2.2 | | 2.4 | 0.086 | | 0.094 |
| A1 | 0.9 | | 1.1 | 0.035 | | 0.043 |
| A3 | 0.7 | | 1.3 | 0.027 | | 0.051 |
| B | 0.64 | | 0.9 | 0.025 | | 0.031 |
| B2 | 5.2 | | 5.4 | 0.204 | | 0.212 |
| B3 | | | 0.85 | | | 0.033 |
| B5 | | 0.3 | | | 0.012 | |
| B6 | | | 0.95 | | | 0.037 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 0.48 | | 0.6 | 0.019 | | 0.023 |
| D | 6 | | 6.2 | 0.236 | | 0.244 |
| E | 6.4 | | 6.6 | 0.252 | | 0.260 |
| G | 4.4 | | 4.6 | 0.173 | | 0.181 |
| H | 15.9 | | 16.3 | 0.626 | | 0.641 |
| L | 9 | | 9.4 | 0.354 | | 0.370 |
| L1 | 0.8 | | 1.2 | 0.031 | | 0.047 |
| L2 | | 0.8 | 1 | | 0.031 | 0.039 |



5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

| 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 |

| 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 |
| 23-Sep-2008 | 2 | V_{GS} value has been changed on Table 2 and Table 5 |

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