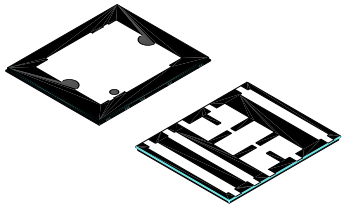
# STK850

## N-channel 30V - 0.0024Ω - 30A - PolarPAK® STripFET™ Power MOSFET

## Features

| Type | $V_{DSS}$ | $R_{DS(on)}$ | $R_{DS(on)}$*$Q_g$ | $P_{TOT}$ |
|---|---|---|---|---|
| STK850 | 30V | <0.0029Ω | 71nC*mΩ | 5.2W |

- Ultra low top and bottom junction to case thermal resistance
- Very low capacitances
- 100% Rg tested
- Fully encapsulated die
- 100% Matte tin finish (in compliance with the 2002/95/EC european directive)
- PolarPAK® is a trademark of VISHAY



PolarPAK®

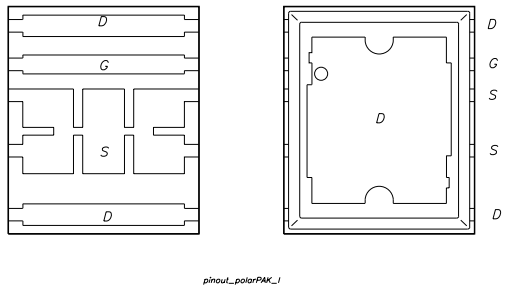
## Application

- Switching applications

## Description

This 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, moreover the double sides cooling package with ultra low junction to case thermal resistance allows to handle higher levels of current.

**Figure 1. Internal schematic diagram**




Bottom View Top View

**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STK850 | K850 | PolarPAK® | Tape & reel |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage ($V_{GS}$ = 0) | 30 | V |
| $V_{GS}$ (1) | Gate-source voltage | ± 16 | V |
| $V_{GS}$(2) | Gate-source voltage | ± 18 | V |
| $I_D$ (4) | Drain current (continuous) at $T_C$ = 25°C | 30 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100°C | 18.75 | A |
| $I_{DM}$ (3) | Drain current (pulsed) | 120 | A |
| $P_{TOT}$ (4) | Total dissipation at $T_C$ = 25°C | 5.2 | W |
| | Derating factor | 0.0416 | W/°C |
| $E_{AS}$ (5) | Single pulse avalanche energy | 1.4 | J |
| $T_J$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature | -55 to 150 | °C |

1. Continuous mode
2. Guaranteed for test time ≤ 15ms
3. Pulse width limited by package
4. When mounted on FR-4 board of 1inch$^2$, 2 oz. Cu. and ≤10sec
5. Starting $T_J$ = 25°C, $I_D$ = 15A, $V_{DD}$ = 25V

**Table 3. Thermal data**

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| Rthj-amb(1) | Thermal resistance junction-amb | 20 | 24 | °C/W |
| Rthj-c(2) | Thermal resistance junction-case (top drain) | 0.8 | 1 | °C/W |
| Rthj-c(3) | Thermal resistance junction-case (source) | 2.2 | 2.7 | °C/W |

1. When mounted on FR-4 board of 1inch$^2$, 2 oz. Cu. and ≤10sec
2. Steady State
3. Measured at Source pin when the device is mounted on FR-4 board in steady state

# 2 Electrical characteristics

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

**Table 4. On/off**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D$ = 250µA, $V_{GS}$= 0 | 30 | | | V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = Max rating,<br>$V_{DS}$ = Max rating,Tc=125°C | | | 1<br>10 | µA<br>µA |
| $I_{GSS}$ | Gate body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ±16V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$= $V_{GS}$, $I_D$ = 250µA | 1 | | 2.5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS}$= 10V, $I_D$= 15A<br>$V_{GS}$= 4.5V, $I_D$= 15A | | 0.0024<br>0.0029 | 0.0029<br>0.0035 | Ω<br>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 | $V_{DS}$ =25V, f=1 MHz, $V_{GS}$=0 | | 3150<br>940<br>90 | | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total gate charge<br>Gate-source charge<br>Gate-drain charge | $V_{DD}$=15V, $I_D$ = 30A<br>$V_{GS}$ =4.5V<br>*(see Figure 16)* | | 24.5<br>8<br>8.2 | 32.5 | 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 | $V_{DD}$=15V, $I_D$ = 12A<br>$V_{GS}$ =4.5V<br>*(see Figure 21)* | | 0.6<br>7.2 | | nC<br>nC |
| $R_G$ | Gate input resistance | f=1 MHz Gate DC Bias = 0<br>Test signal level = 20mV<br>open drain | | 1.1 | | Ω |

**Table 6. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$<br>$t_r$ | Turn-on delay time<br>Rise time | $V_{DD}$= 15V, $I_D$= 15A,<br>$R_G$=4.7Ω, $V_{GS}$=4.5V<br>*(see Figure 15)* | | 20<br>57 | | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off delay time<br>Fall time | $V_{DD}$=15V, $I_D$= 15A,<br>$R_G$=4.7Ω, $V_{GS}$=4.5V<br>*(see Figure 15)* | | 31<br>13 | | 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) | | | | 30<br>120 | A<br>A |
| $V_{SD}$ (2) | Forward on voltage | $I_{SD}$= 15A, $V_{GS}$=0 | | | 1.2 | V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}$= 30A, di/dt = 100A/µs,<br>$V_{DD}$=20V, $T_J$=150°C<br>*(see Figure 20)* | | 39<br>39.8<br>2 | | ns<br>nC<br>A |

1. Pulse width limited by package
2. Pulsed: pulse duration = 300µs, duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

**Figure 2. Safe operating area**

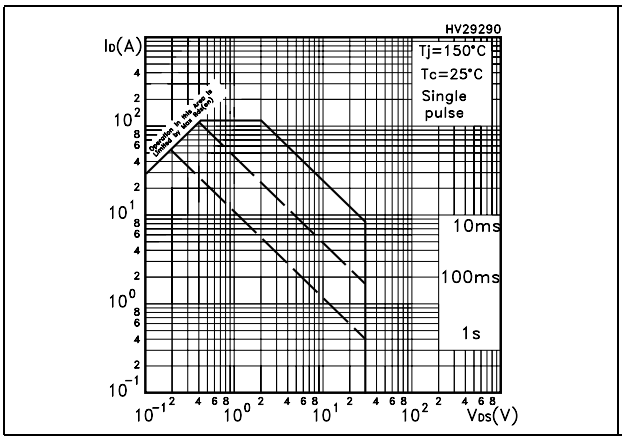



**Figure 3. Thermal impedance**

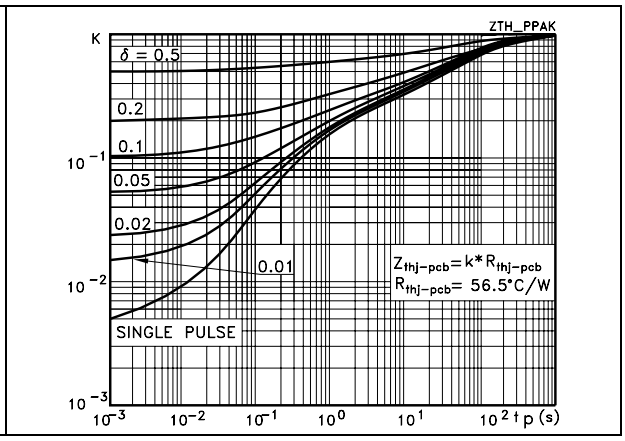



**Figure 4. Output characteristics**

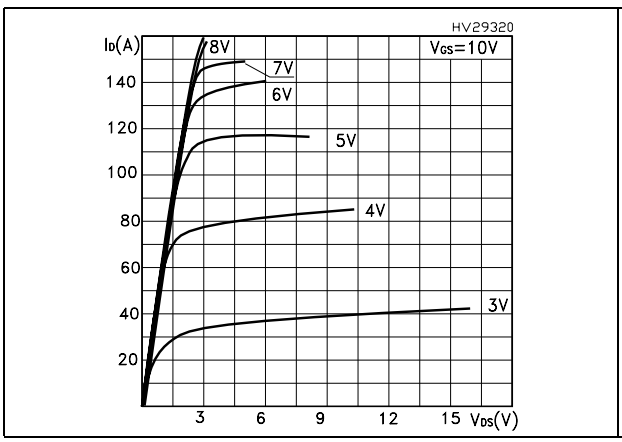



**Figure 5. Transfer characteristics**

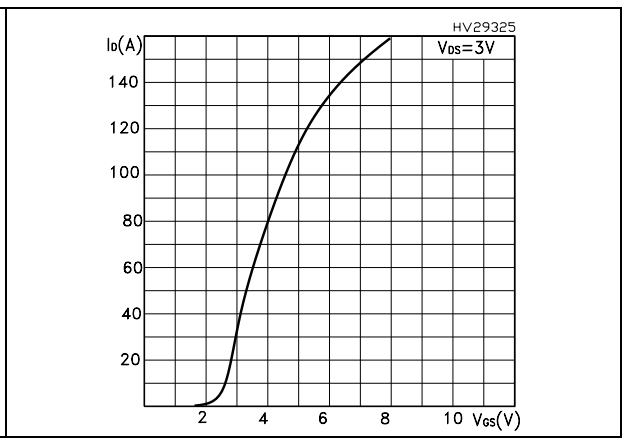



**Figure 6. Transconductance**

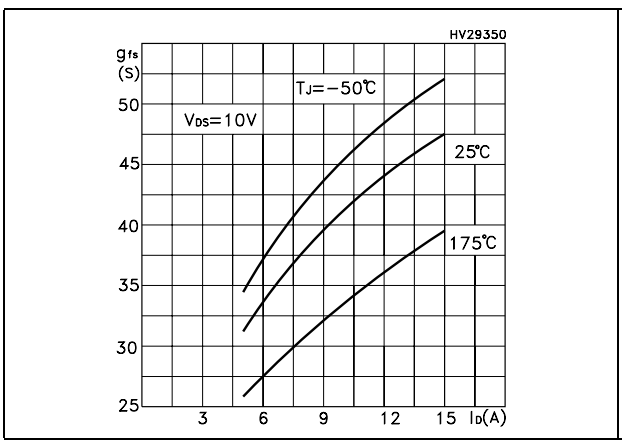



**Figure 7. Static drain-source on resistance**

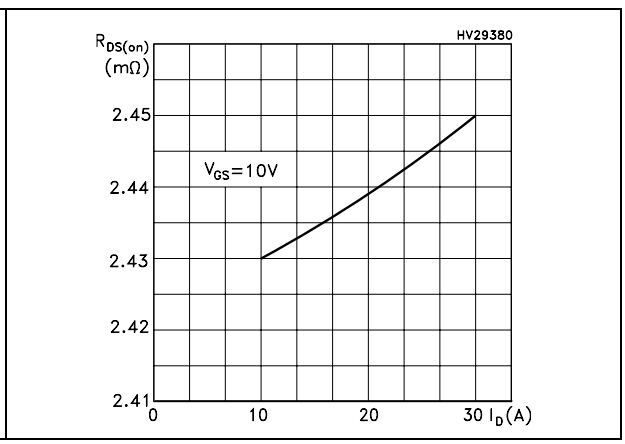


**Figure 8. Gate charge vs gate-source voltage**

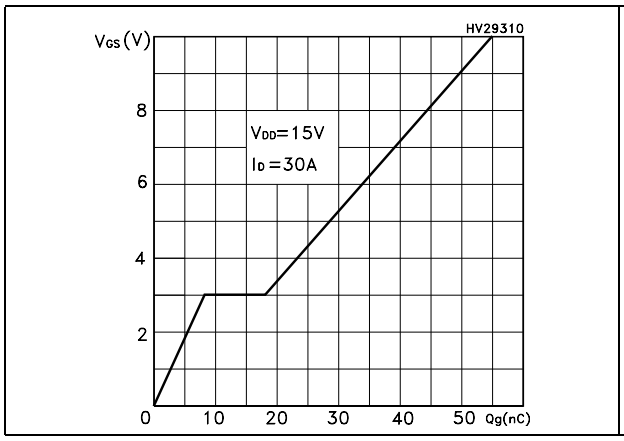



**Figure 9. Capacitance variations**

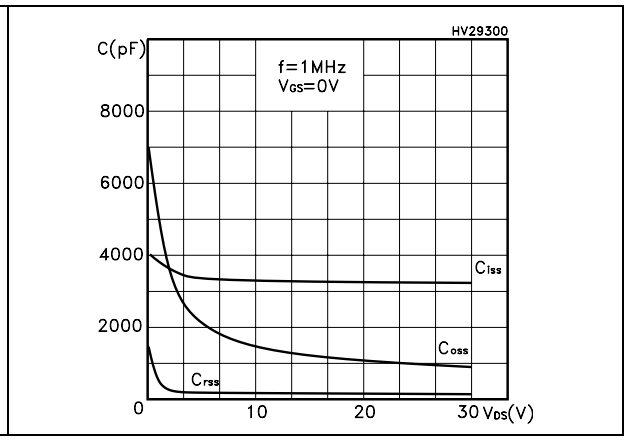



**Figure 10. Normalized gate threshold voltage vs temperature**

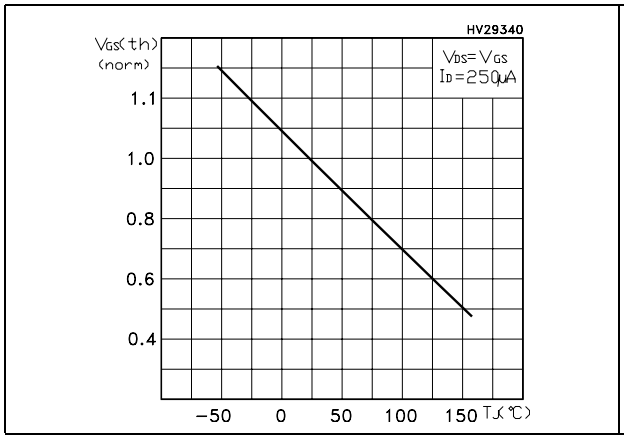



**Figure 11. Normalized on resistance vs temperature**

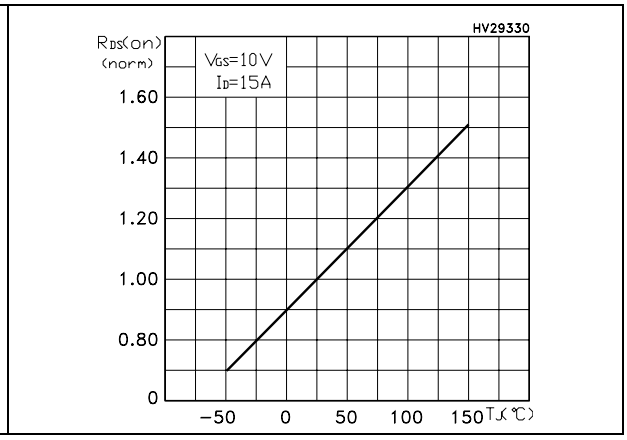



**Figure 12. Source-drain diode forward characteristics**

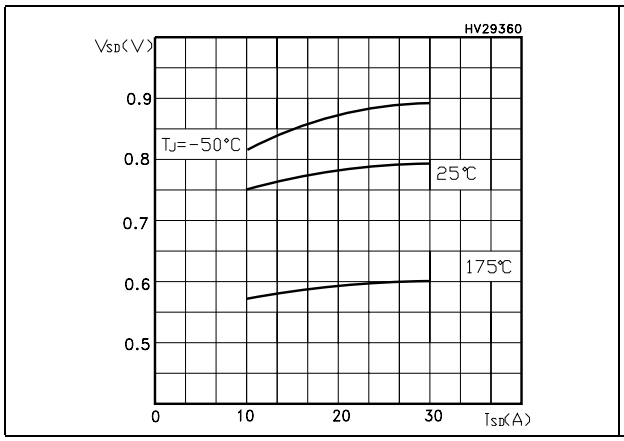



**Figure 13. Normalized $B_{VDSS}$ vs temperature**

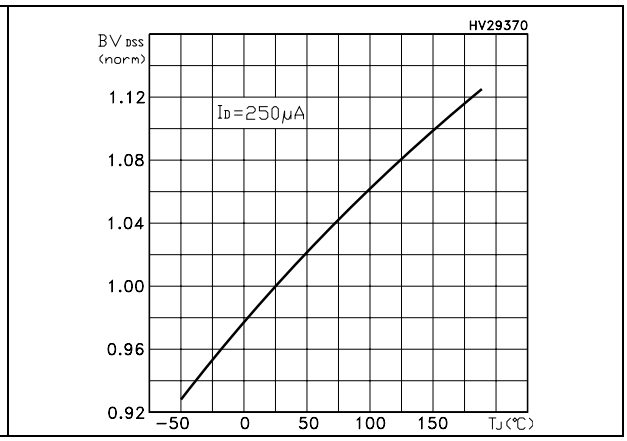
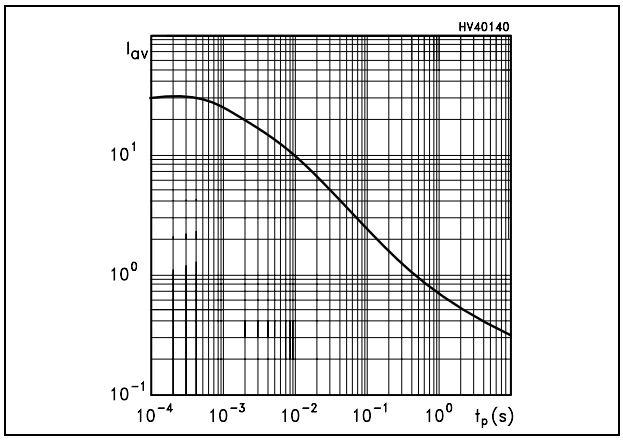


**Figure 14. Allowable $I_{AV}$ vs time in avalanche**




The previous curve gives the single pulse safe operating area for unclamped inductive loads, under the following conditions:

$P_{D(AVE)} = 0.5*(1.3*B_{VDSS} *I_{AV})$

$E_{AS(AR)} = P_{D(AVE)} *t_{AV}$

Where:

$I_{AV}$ is the allowable current in avalanche

$P_{D(AVE)}$ is the average power dissipation in avalanche (single pulse)

$t_{AV}$ is the time in avalanche

# 3 Test circuits

**Figure 15. Switching times test circuit for resistive load**

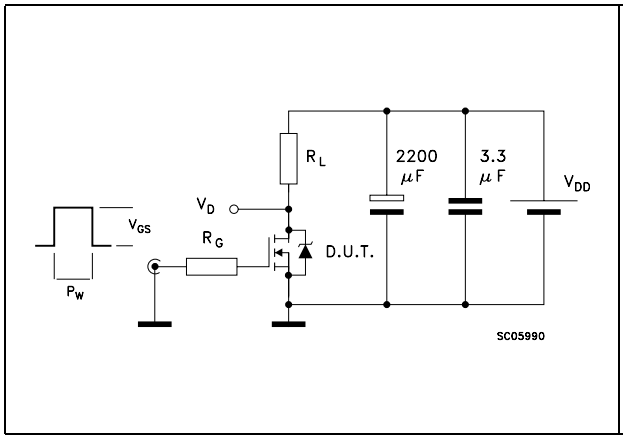



**Figure 16. Gate charge test circuit**

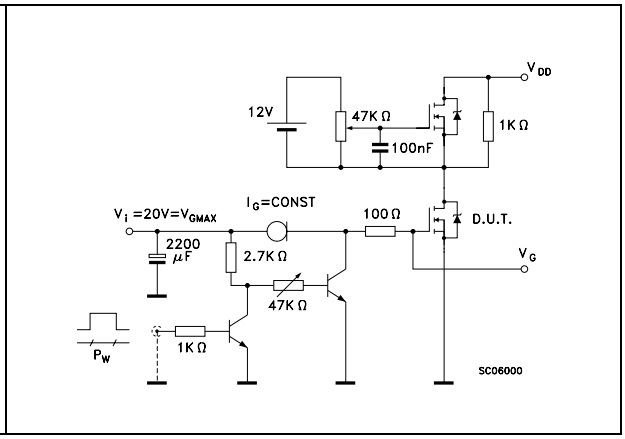



**Figure 17. Test circuit for inductive load switching and diode recovery times**

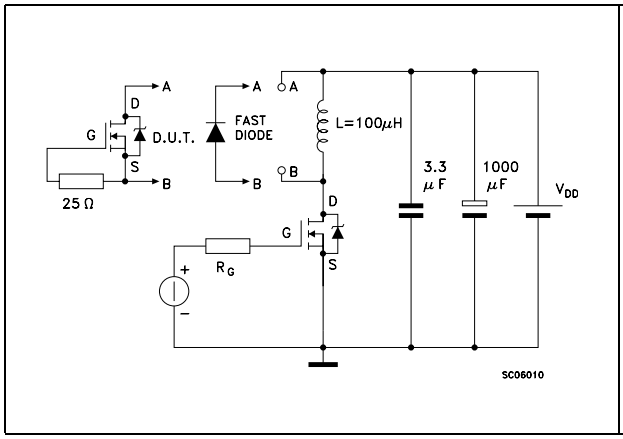



**Figure 18. Unclamped inductive load test circuit**

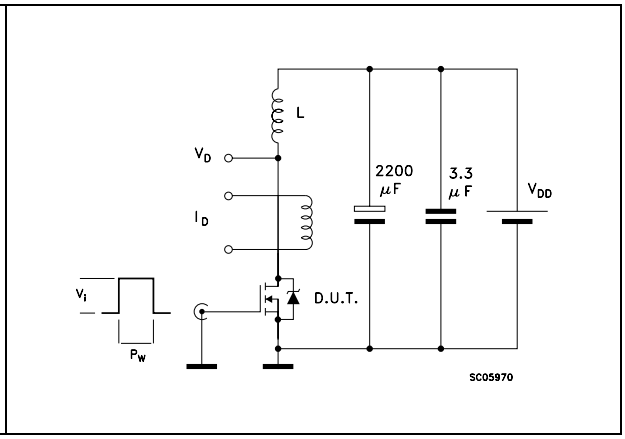



**Figure 19. Unclamped inductive waveform**

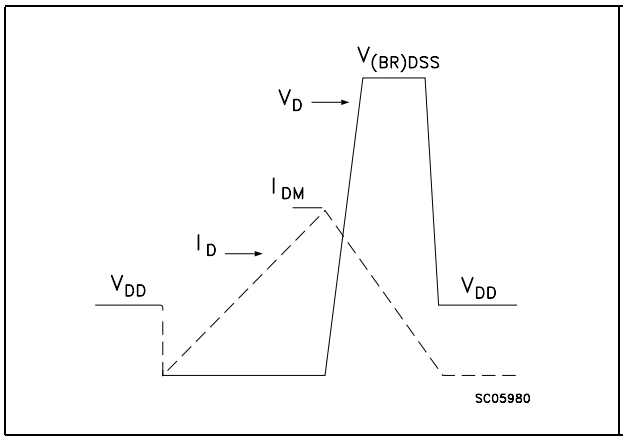



**Figure 20. Switching time waveform**

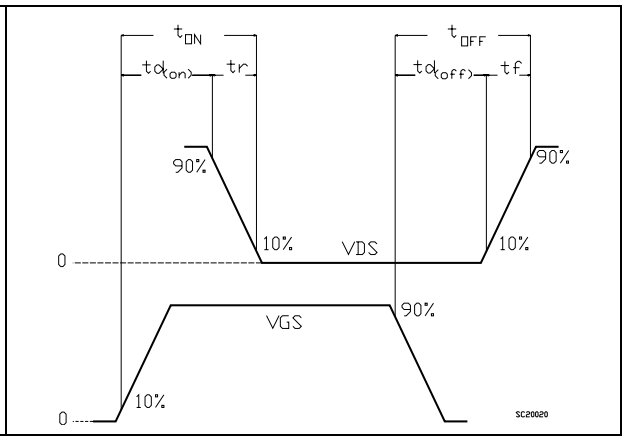
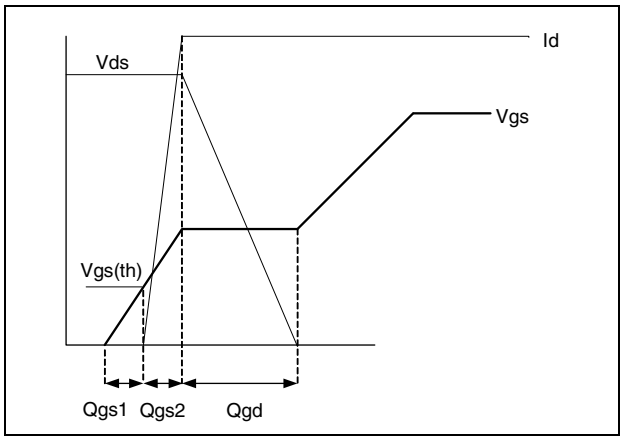


**Figure 21. Gate charge waveform**



# 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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*

Table 8. PolarPAK® (option “L”) mechanical data

| Ref. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.75 | 0.80 | 0.85 | 0.030 | 0.031 | 0.033 |
| A1 | | | 0.05 | | | 0.002 |
| b1 | 0.48 | 0.58 | 0.68 | 0.019 | 0.023 | 0.027 |
| b2 | 0.41 | 0.51 | 0.61 | 0.016 | 0.020 | 0.024 |
| b3 | 2.19 | 2.29 | 2.39 | 0.086 | 0.090 | 0.094 |
| b4 | 0.89 | 1.04 | 1.19 | 0.035 | 0.041 | 0.047 |
| b5 | 0.23 | 0.33 | 0.43 | 0.009 | 0.013 | 0.017 |
| c | 0.20 | 0.25 | 0.30 | 0.008 | 0.010 | 0.012 |
| D | 6 | 6.15 | 6.30 | 0.236 | 0.242 | 0.248 |
| D1 | 5.74 | 5.89 | 6.04 | 0.226 | 0.232 | 0.238 |
| E | 5.01 | 5.16 | 5.31 | 0.197 | 0.203 | 0.209 |
| E1 | 4.75 | 4.90 | 5.05 | 0.187 | 0.193 | 0.199 |
| H1 | 0.23 | | | 0.009 | | |
| H2 | 0.45 | | 0.56 | 0.018 | | 0.022 |
| H3 | 0.31 | 0.41 | 0.51 | 0.012 | 0.016 | 0.020 |
| H4 | 0.45 | | 0.56 | 0.018 | | 0.022 |
| K1 | 4.22 | 4.37 | 4.52 | 0.166 | 0.172 | 0.178 |
| K2 | 1.08 | 1.13 | 1.18 | 0.043 | 0.044 | 0.046 |
| K3 | 1.37 | | | 0.054 | | |
| K4 | 0.24 | | | 0.009 | | |
| M1 | 4.30 | 4.50 | 4.70 | 0.169 | 0.177 | 0.185 |
| M2 | 3.43 | 3.58 | 3.73 | 0.135 | 0.141 | 0.147 |
| M3 | 0.22 | | | 0.009 | | |
| M4 | 0.05 | | | 0.002 | | |
| P1 | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| T1 | 3.48 | 3.64 | 4.10 | 0.137 | 0.143 | 0.161 |
| T2 | 0.56 | 0.76 | 0.95 | 0.022 | 0.030 | 0.037 |
| T3 | 1.20 | | | 0.047 | | |
| T4 | 3.90 | | | 0.154 | | |
| T5 | | 0.18 | 0.36 | | 0.007 | 0.014 |
| < | 0° | 10° | 12° | 0° | 10° | 12° |

**Figure 22. PolarPAK® (option "L") drawings**

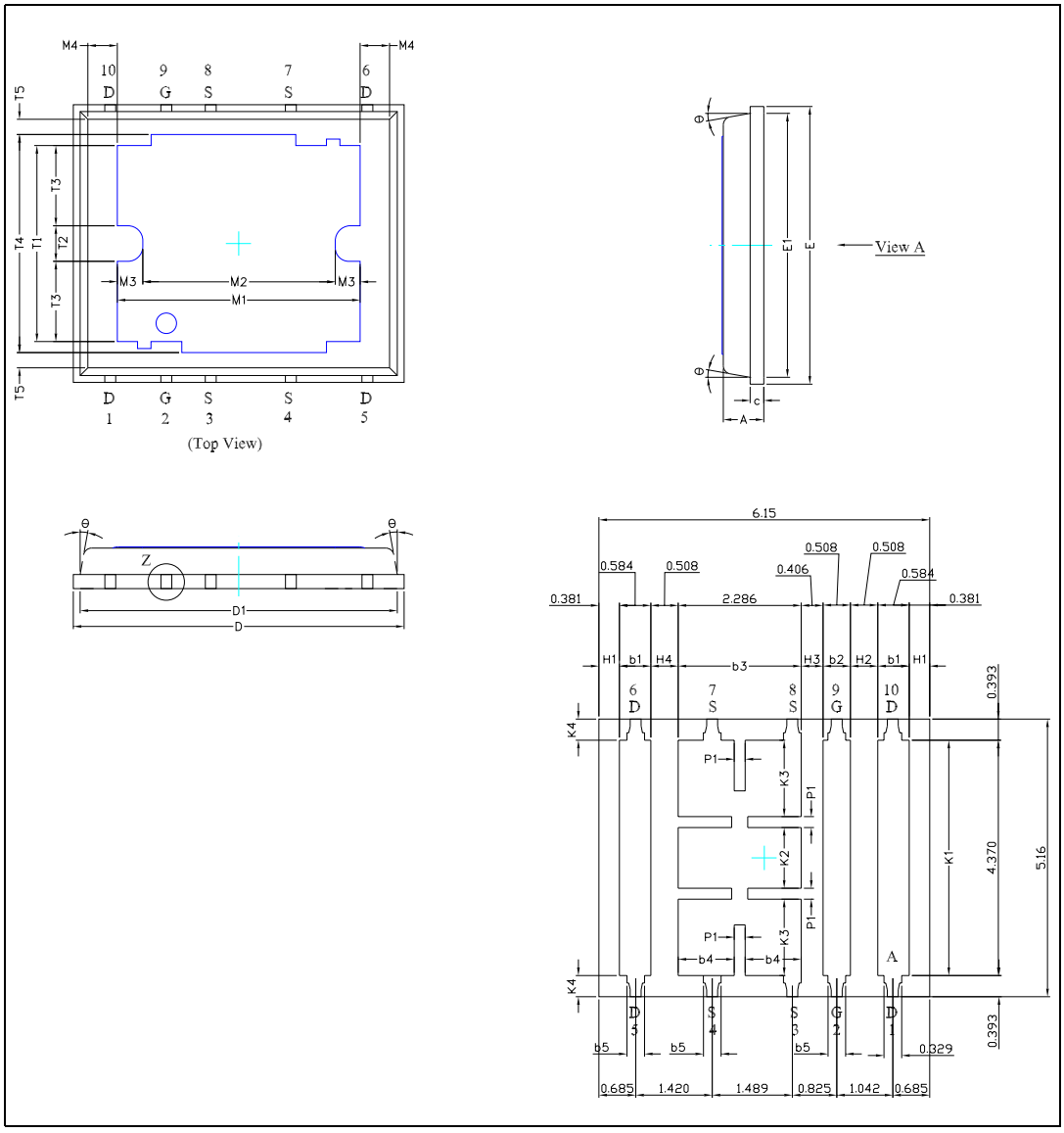
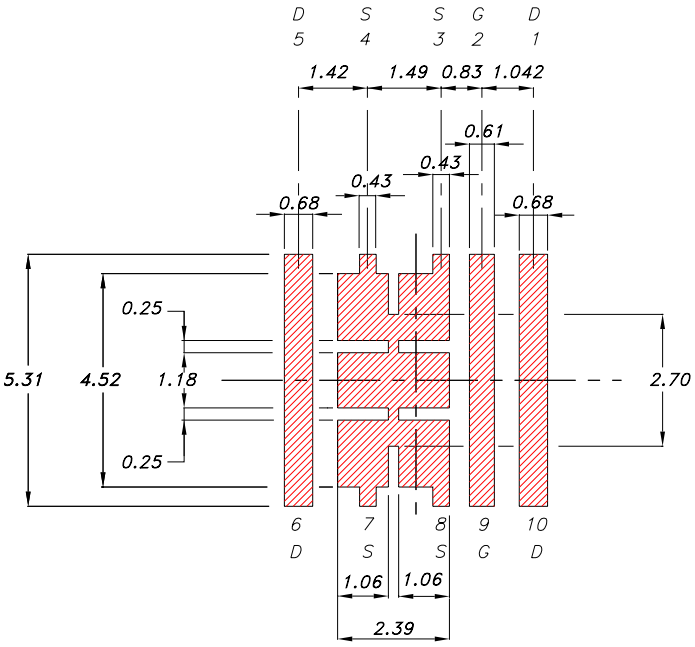


**Figure 23. Recommended PAD layout**



# 5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 10-Nov-2005 | 1 | First version |
| 19-Dec-2005 | 2 | Complete version |
| 30-Jan-2006 | 3 | Modified description on first page |
| 21-Mar-2006 | 4 | The document has been reformatted |
| 25-May-2006 | 5 | New note on *Table 2* |
| 10-Oct-2006 | 6 | Modified general features |
| 08-May-2007 | 7 | New data on *Table 5* and new *Figure 21* |
| 03-Sep-2007 | 8 | Updated mechanical data |
| 01-Oct-2007 | 9 | Inserted new *Figure 23: Recommended PAD layout* |

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