



# STK850

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

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	R <sub>DS(on)</sub> *Q <sub>g</sub>	P <sub>TOT</sub>
STK850	30V	<0.0029Ω	71nC*mΩ	5.2W

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

## 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.

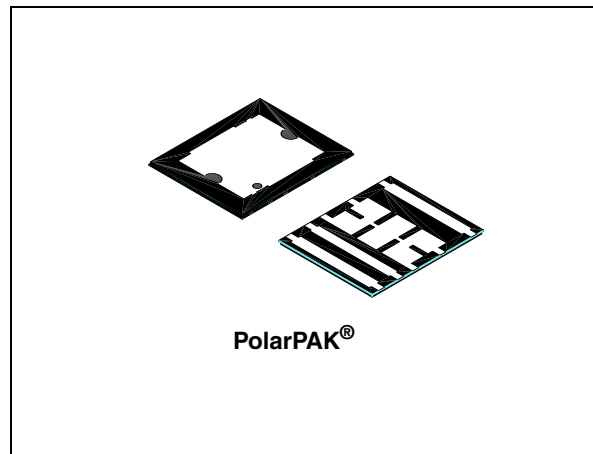


Figure 1. Internal schematic diagram

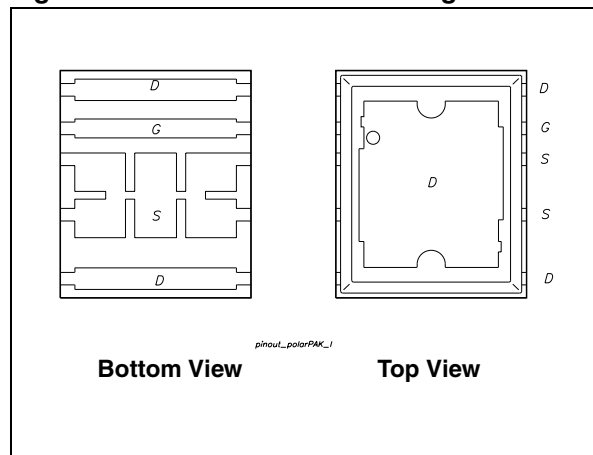


Table 1. Device summary

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

# Contents

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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
$V_{GS}^{(1)}$	Gate-source voltage	$\pm 16$	V
$V_{GS}^{(2)}$	Gate-source voltage	$\pm 18$	V
$I_D^{(4)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	30	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	18.75	A
$I_{DM}^{(3)}$	Drain current (pulsed)	120	A
$P_{TOT}^{(4)}$	Total dissipation at $T_C = 25^\circ\text{C}$	5.2	W
	Derating factor	0.0416	W/ $^\circ\text{C}$
$E_{AS}^{(5)}$	Single pulse avalanche energy	1.4	J
$T_J$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150	$^\circ\text{C}$

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

**Table 3. Thermal data**

Symbol	Parameter	Typ.	Max.	Unit
$R_{thj-amb}^{(1)}$	Thermal resistance junction-amb	20	24	$^\circ\text{C}/\text{W}$
$R_{thj-c}^{(2)}$	Thermal resistance junction-case (top drain)	0.8	1	$^\circ\text{C}/\text{W}$
$R_{thj-c}^{(3)}$	Thermal resistance junction-case (source)	2.2	2.7	$^\circ\text{C}/\text{W}$

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

## 2 Electrical characteristics

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

**Table 4. On/off**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\mu A, V_{GS} = 0$	30			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating},$ $V_{DS} = \text{Max rating}, T_c = 125^{\circ}C$			1 10	$\mu A$ $\mu A$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 16V$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	1		2.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 15A$ $V_{GS} = 4.5V, I_D = 15A$		0.0024 0.0029	0.0029 0.0035	$\Omega$ $\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance			3150		pF
$C_{oss}$	Output capacitance	$V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$		940		pF
$C_{rss}$	Reverse transfer capacitance			90		pF
$Q_g$	Total gate charge	$V_{DD} = 15V, I_D = 30A$		24.5	32.5	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 4.5V$		8		nC
$Q_{gd}$	Gate-drain charge	(see Figure 16)		8.2		nC
$Q_{gs1}$	Pre $V_{th}$ gate-to-source charge	$V_{DD} = 15V, I_D = 12A$		0.6		nC
$Q_{gs2}$	Post $V_{th}$ gate-to-source charge	$V_{GS} = 4.5V$ (see Figure 21)		7.2		nC
$R_G$	Gate input resistance	$f = 1 \text{ MHz}$ Gate DC Bias = 0 Test signal level = 20mV open drain		1.1		$\Omega$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on delay time Rise time	$V_{DD}=15V$ , $I_D=15A$ , $R_G=4.7\Omega$ , $V_{GS}=4.5V$ (see Figure 15)		20 57		ns ns
$t_{d(off)}$ $t_f$	Turn-off delay time Fall time	$V_{DD}=15V$ , $I_D=15A$ , $R_G=4.7\Omega$ , $V_{GS}=4.5V$ (see Figure 15)		31 13		ns ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)				30 120	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=15A$ , $V_{GS}=0$			1.2	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=30A$ , $di/dt=100A/\mu s$ , $V_{DD}=20V$ , $T_J=150^\circ C$ (see Figure 20)		39 39.8 2		ns nC A

1. Pulse width limited by package
2. Pulsed: pulse duration = 300 $\mu s$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

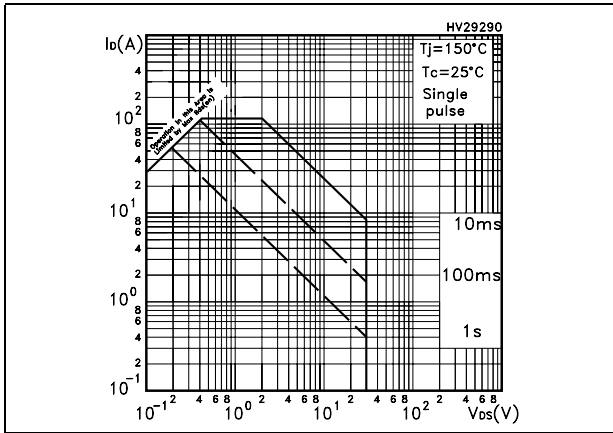


Figure 3. Thermal impedance

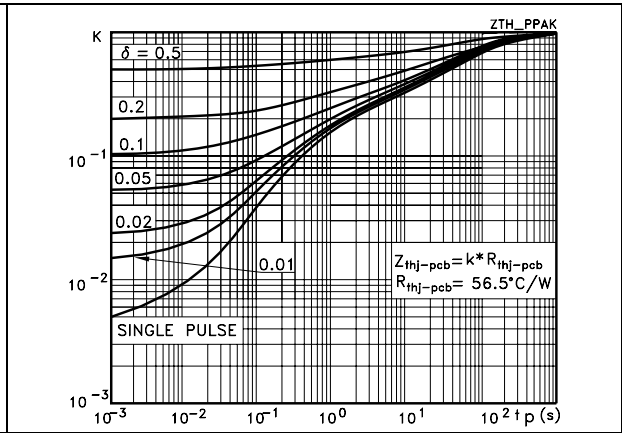


Figure 4. Output characteristics

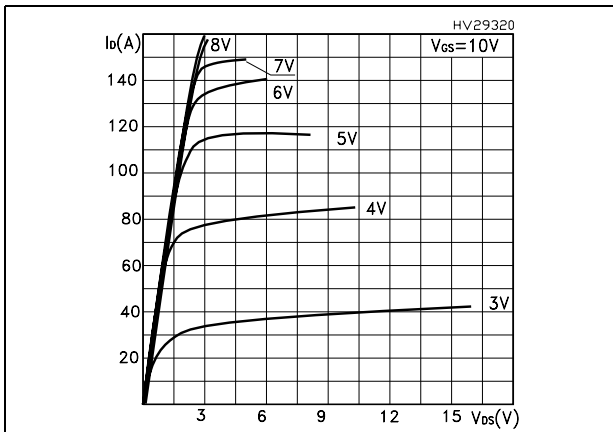


Figure 5. Transfer characteristics

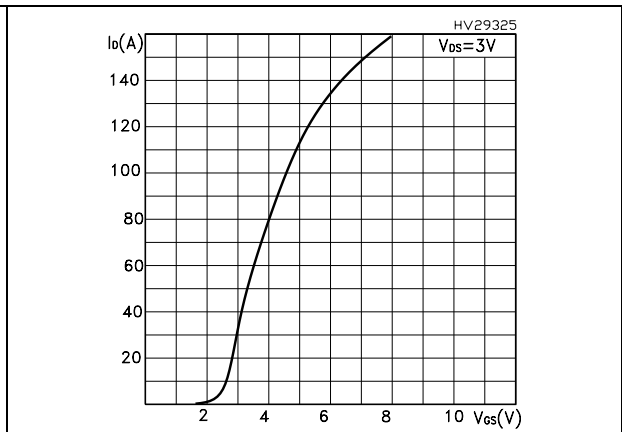


Figure 6. Transconductance

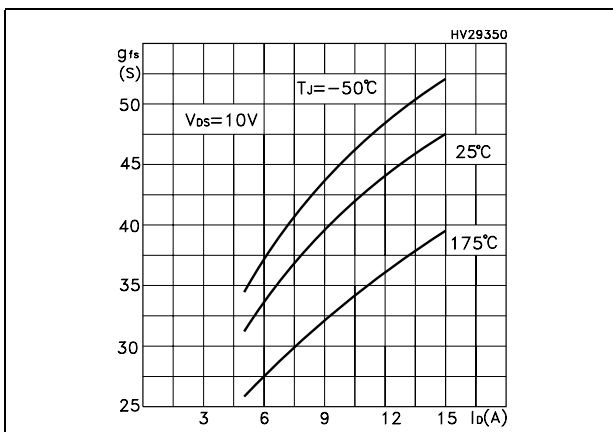


Figure 7. Static drain-source on resistance

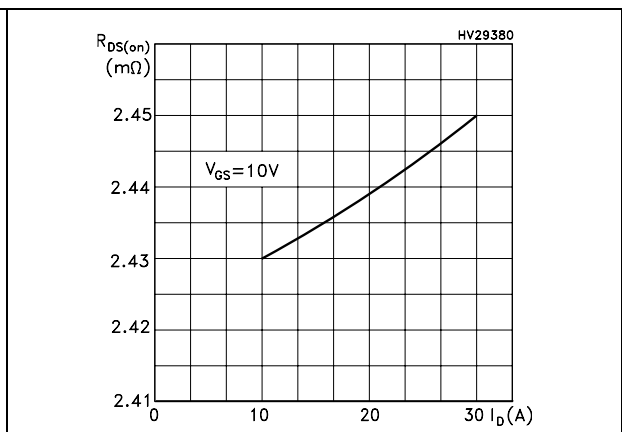


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

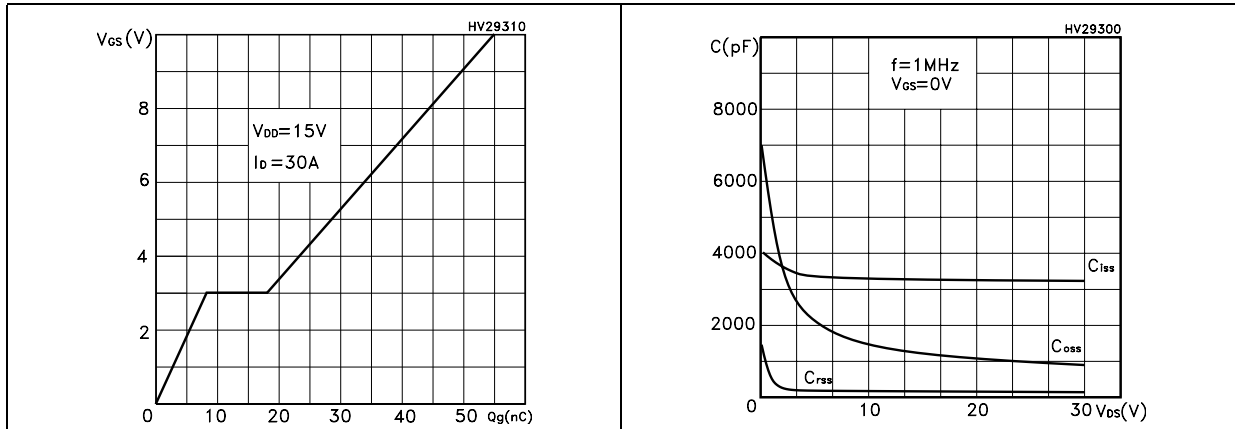


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

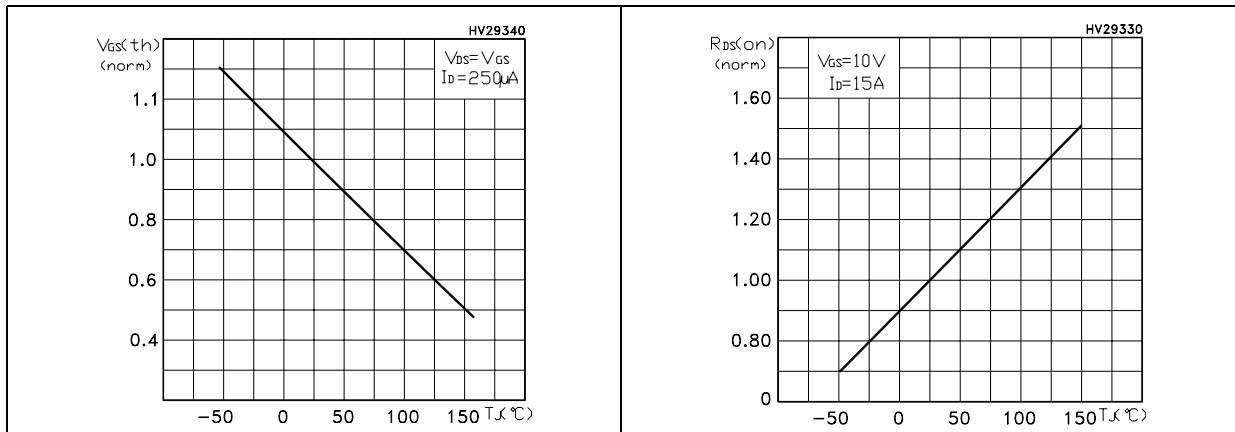


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized  $B_{VDSS}$  vs temperature

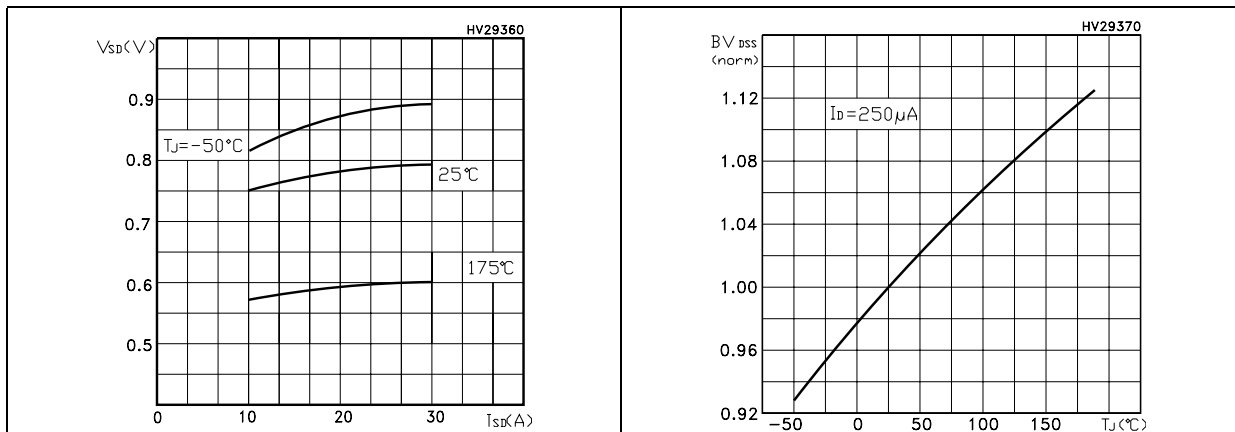
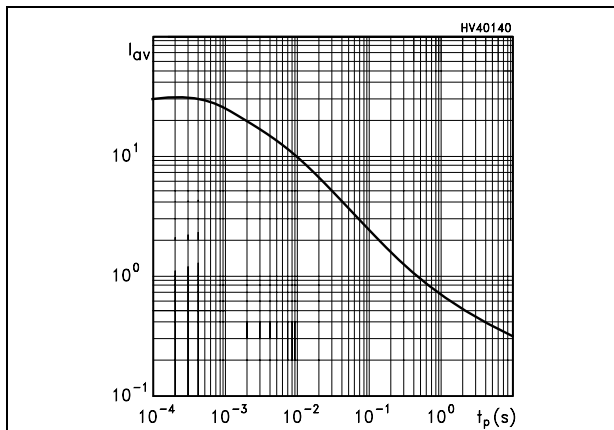


Figure 14. Allowable  $I_{AV}$  vs time in avalanche

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

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

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

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

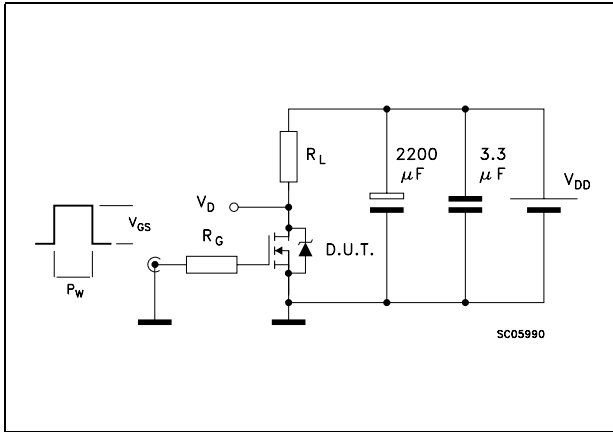


Figure 16. Gate charge test circuit

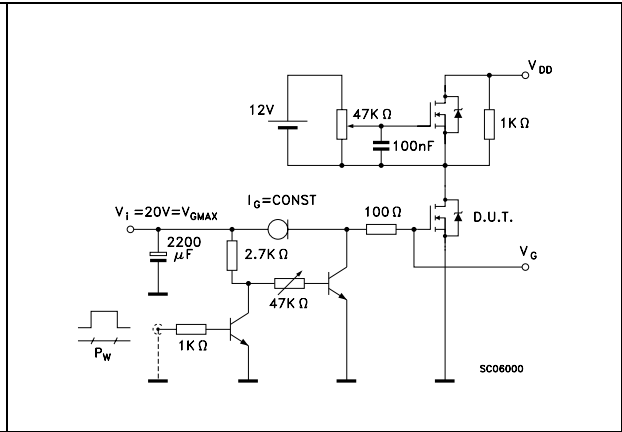


Figure 17. Test circuit for inductive load switching and diode recovery times



Figure 18. Unclamped inductive load test circuit



Figure 19. Unclamped inductive waveform



Figure 20. Switching time waveform

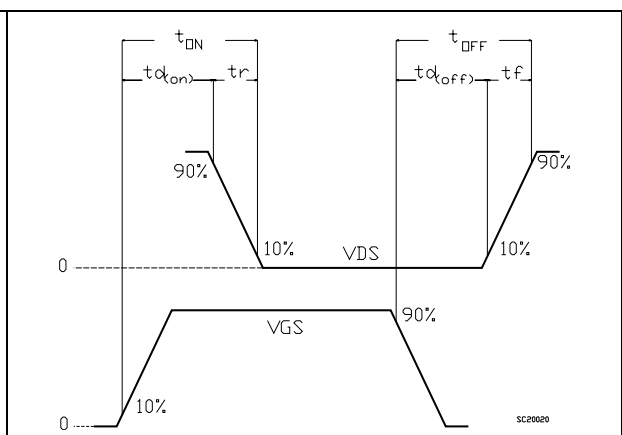
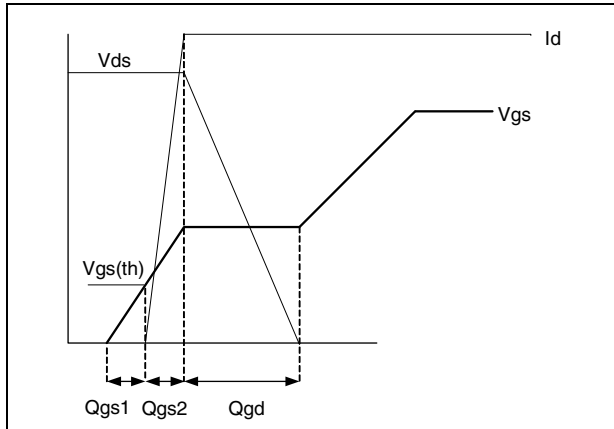


Figure 21. Gate charge waveform



## 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](http://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

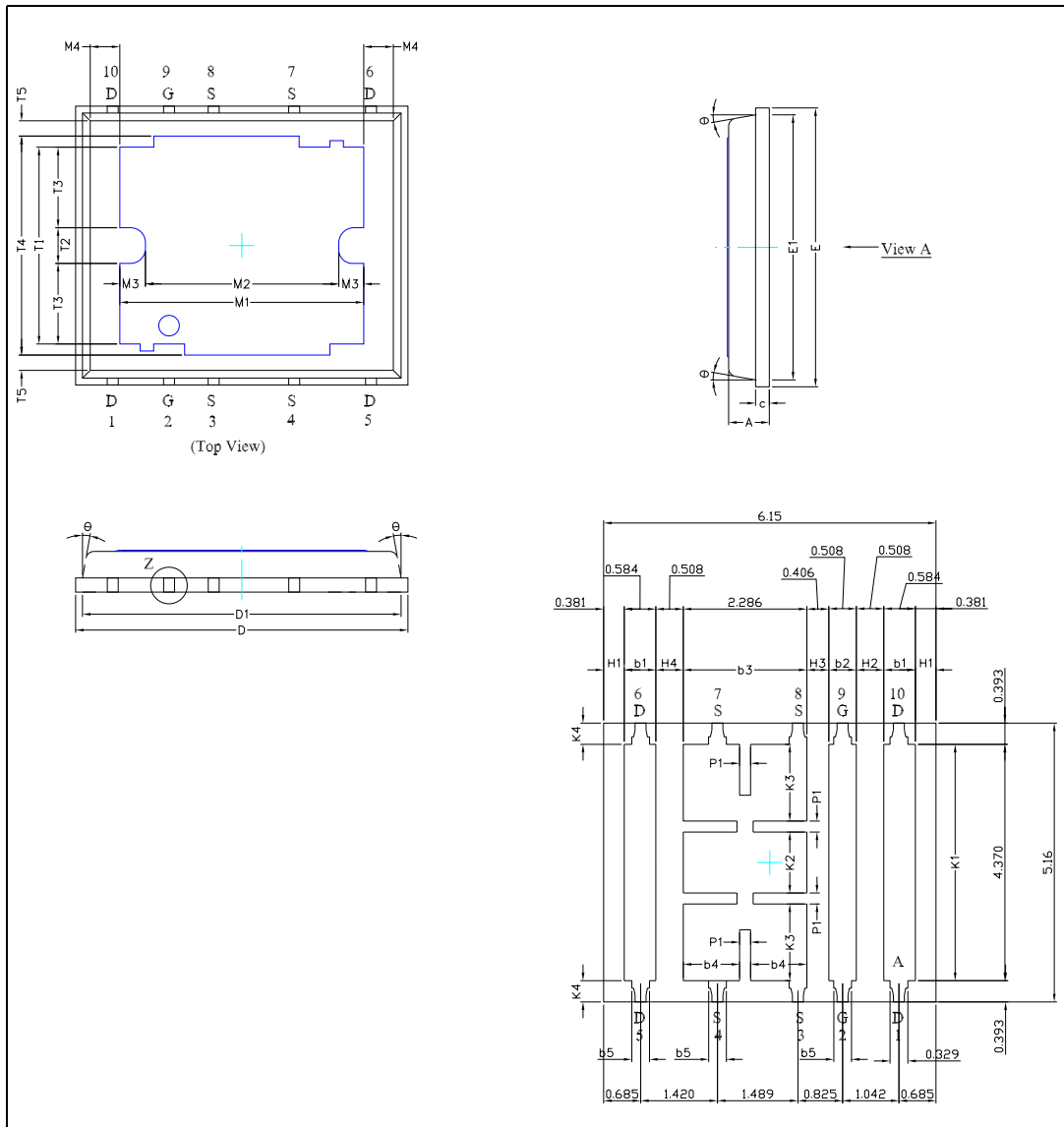
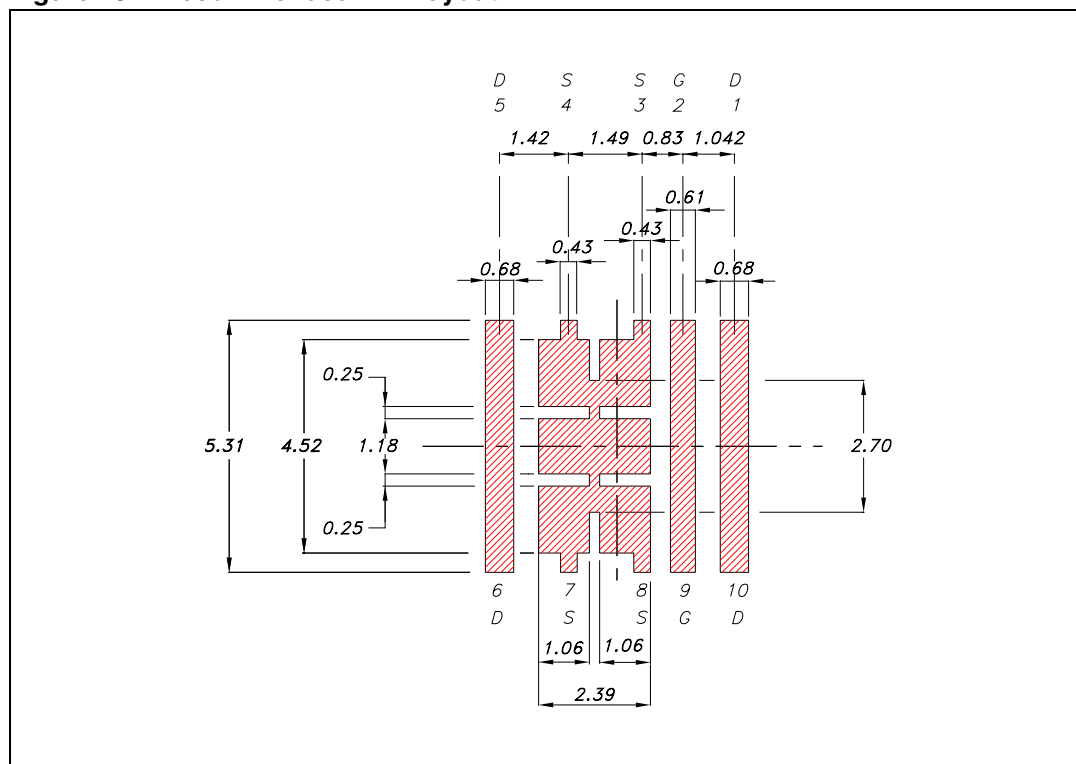


Figure 23. Recommended PAD layout



## 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 <a href="#">Table 2</a>
10-Oct-2006	6	Modified general features
08-May-2007	7	New data on <a href="#">Table 5</a> and new <a href="#">Figure 21</a>
03-Sep-2007	8	Updated mechanical data
01-Oct-2007	9	Inserted new <a href="#">Figure 23: Recommended PAD layout</a>

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