



# STK820

N-channel 25 V - 0.0058  $\Omega$  - 21 A - PolarPAK<sup>®</sup>  
STripFET<sup>™</sup> 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>
STK820	25 V	<0.0073 $\Omega$	63 nC*m $\Omega$	5.2 W

- 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<sup>®</sup> 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.

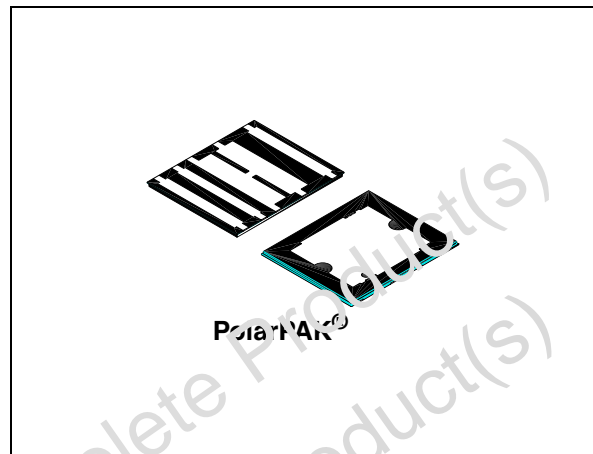


Figure 1. Internal schematic diagram

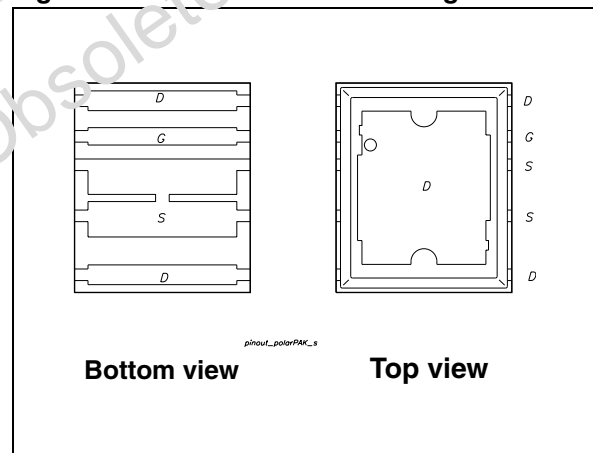


Table 1. Device summary

Order code	Marking	Package	Packaging
STK820	K820	PolarPAK <sup>®</sup>	Tape and reel

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	25	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 $T_A = 25\text{ }^\circ\text{C}$	21	A
$I_D^{(4)}$	Drain current (continuous) at $T_A = 100\text{ }^\circ\text{C}$	13	A
$I_{DM}^{(3)}$	Drain current (pulsed)	84	A
$P_{TOT}^{(4)}$	Total dissipation at $T_A = 25\text{ }^\circ\text{C}$	$\pm 2$	W
	Derating factor	0.0416	W/ $^\circ\text{C}$
$E_{AS}^{(5)}$	Single pulse avalanche energy	600	mJ
$T_{stg}$	Storage temperature	-55 to 150	$^\circ\text{C}$
$T_j$	Max. operating junction temperature	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  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 11\text{ A}$ ,  $V_{DD} = 25\text{ V}$

**Table 3 Thermal data**

Symbol	Parameter	Typ.	Max.	Unit
$R_{thj-amb}^{(1)}$	Thermal resistance junction-amb	20	24	$^\circ\text{C/W}$
$R_{thj-c}^{(2)}$	Thermal resistance junction-case (top drain)	1	1.2	$^\circ\text{C/W}$
$R_{thj-c}^{(3)}$	Thermal resistance junction-case (source)	2.8	3.4	$^\circ\text{C/W}$

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 states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250 \mu A, V_{GS} = 0$	25			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 ( $V_{DS} = 0$ )	$V_{GS} = \pm 16 V$			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	$V_{GS} = 10 V, I_D = 10.5 A$ $V_{GS} = 4.5 V, I_D = 10.5 A$		0.0058 0.0066	0.0073 0.008	$\Omega$ $\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance			1425		pF
$C_{oss}$	Output capacitance	$V_{DS} = 25 V, f = 1 \text{ MHz}, V_{GS} = 0$		657		pF
$C_{rss}$	Reverse transfer capacitance			62		pF
$Q_g$	Total gate charge	$V_{DD} = 12.5 V, I_D = 21 A$		9.5		nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 4.5 V$		3.6		nC
$Q_{gd}$	Gate-drain charge	(see Figure 14)		3		nC
$Q_{gs1}$	Pre $V_{th}$ gate-to-source charge	$V_{DD} = 12.5 V, I_D = 12 A$ $V_{GS} = 4.5 V$		2		nC
$Q_{gs2}$	Post $V_{th}$ gate-to-source charge	(see Figure 19)		1.6		nC
$R_G$	Gate input resistance	$f = 1 \text{ MHz}$ Gate DC Bias = 0 Test signal level = 20 mV open drain		0.8		$\Omega$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on delay time Rise time	$V_{DD}= 12.5\text{ V}$ , $I_D= 10.5\text{ A}$ , $R_G= 4.7\ \Omega$ , $V_{GS}= 4.5\text{ V}$ (see Figure 16)		15 23		ns ns
$t_{d(off)}$ $t_f$	Turn-off delay time Fall time	$V_{DD}=12.5\text{ V}$ , $I_D= 10.5\text{ A}$ , $R_G= 4.7\ \Omega$ , $V_{GS}= 4.5\text{ V}$ (see Figure 16)		17 4		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)				21 84	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}= 21\text{ A}$ , $V_{GS}= 0$			1.2	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}= 21\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}= 20\text{ V}$ , $T_j= 150\text{ }^\circ\text{C}$ (see Figure 15)		25 17 1.4		ns nC A

1. Pulse width limited by package

2. Pulsed: pulse duration = 300 $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

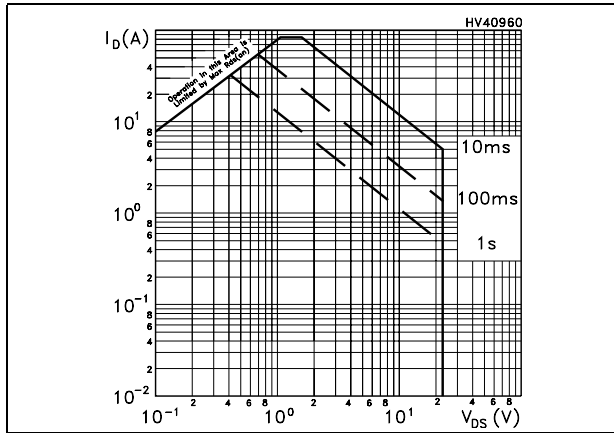


Figure 3. Thermal impedance

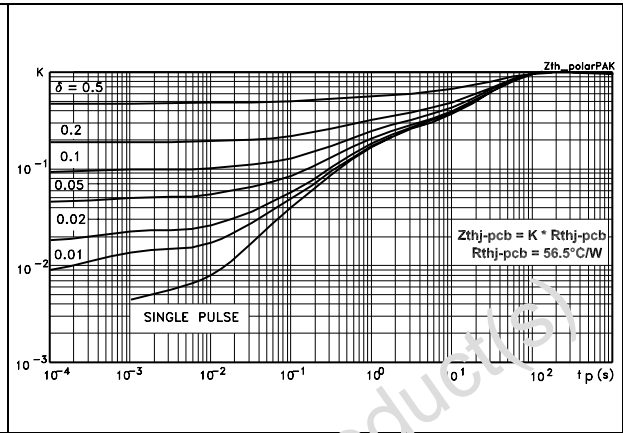


Figure 4. Output characteristics

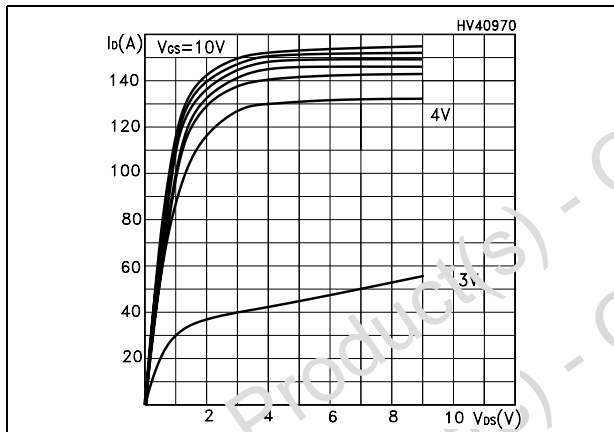


Figure 5. Transfer characteristics

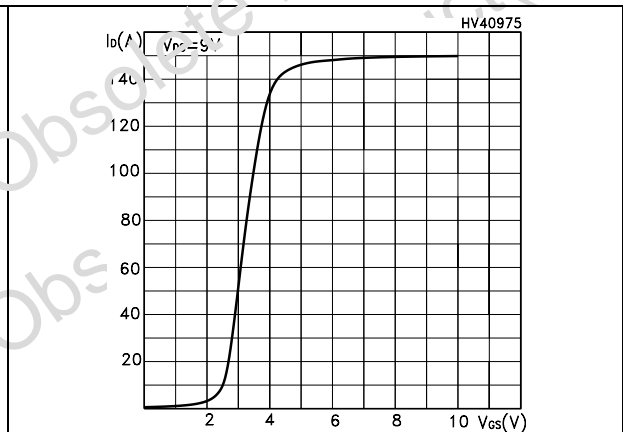


Figure 6. Normalized  $B_{V_{DS}}$  vs. temperature

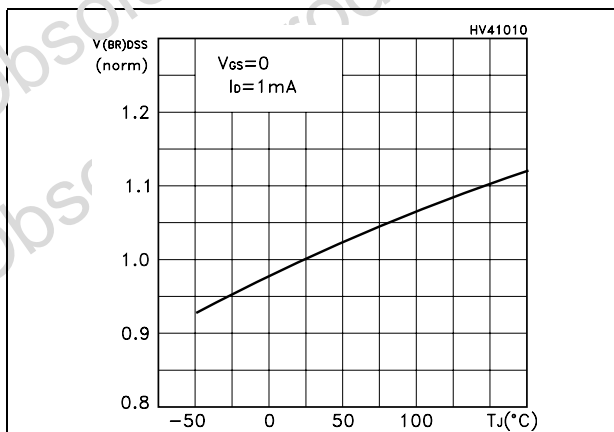


Figure 7. Static drain-source on resistance

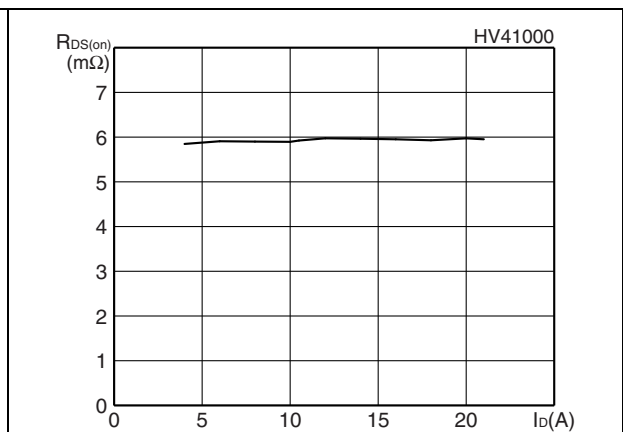


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

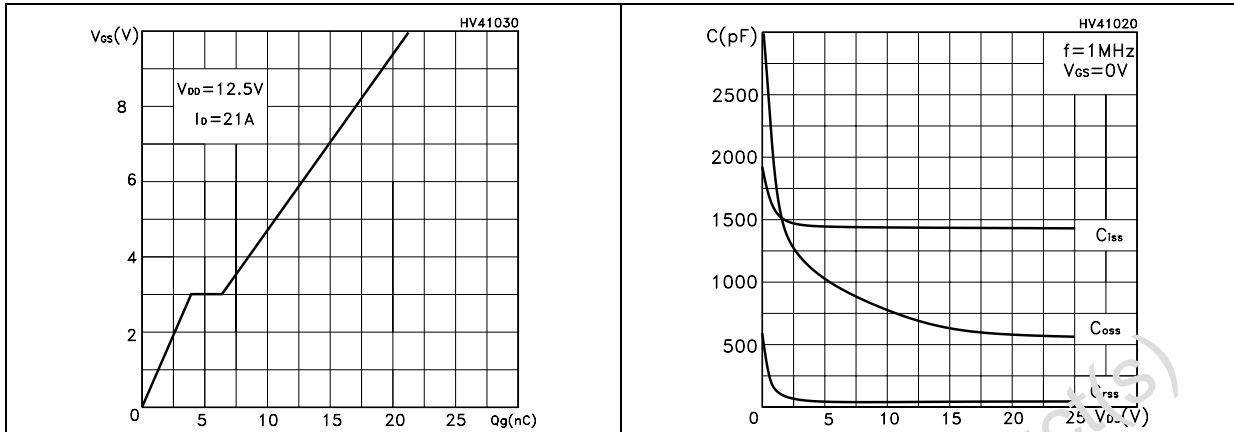


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

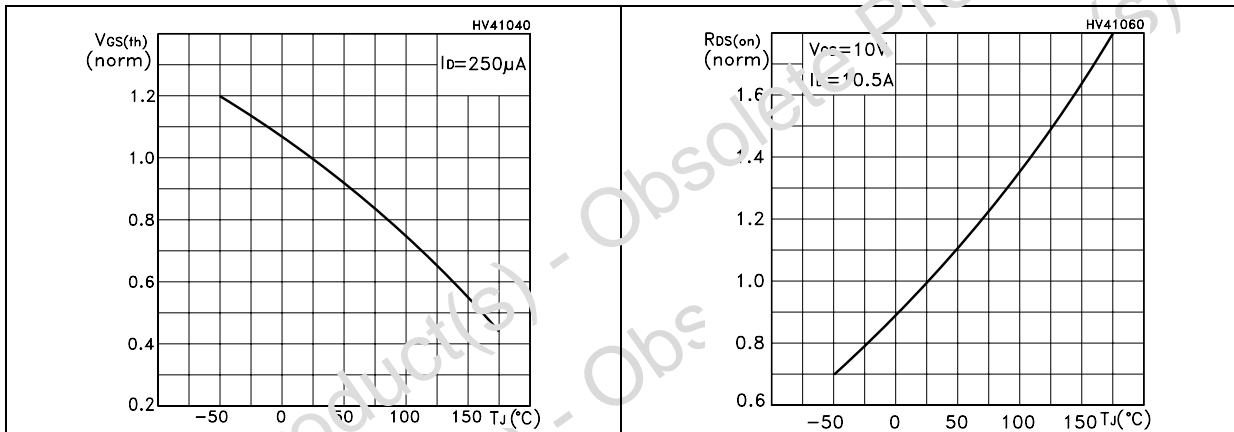
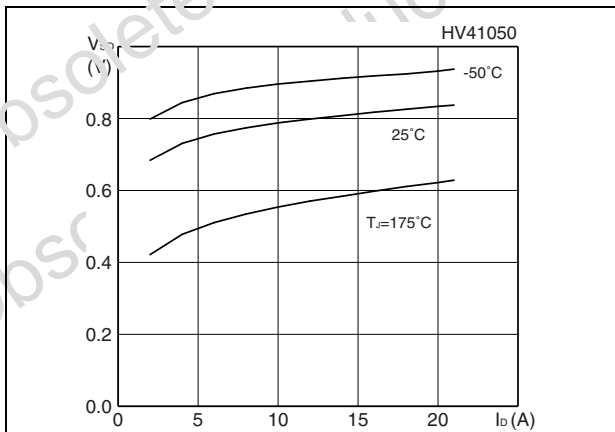


Figure 12. Source-drain diode forward characteristics



### 3 Test circuit

Figure 13. Switching times test circuit for resistive load

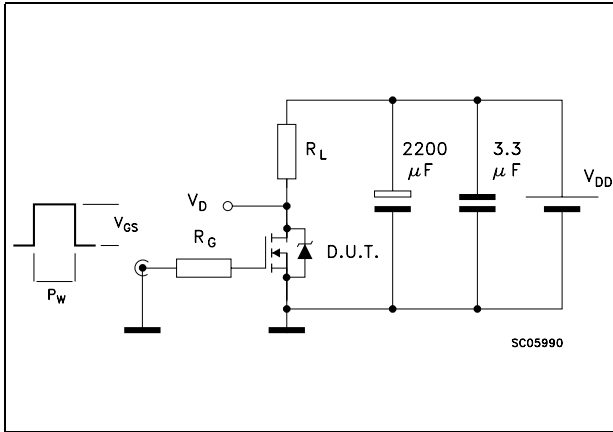


Figure 14. Gate charge test circuit

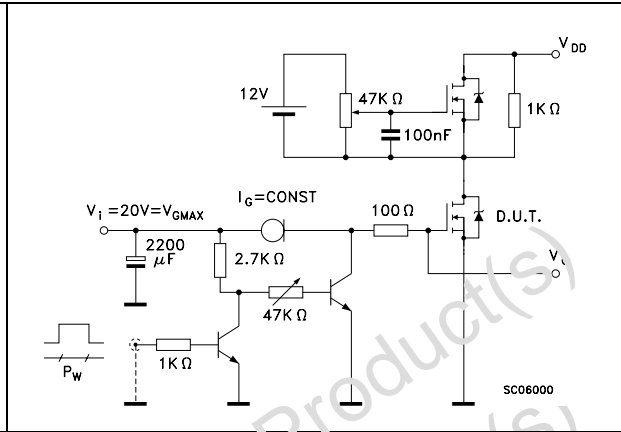


Figure 15. Test circuit for inductive load switching and diode recovery times

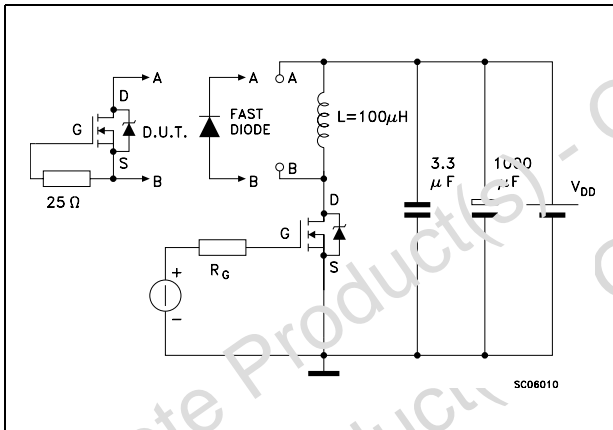


Figure 16. Unclamped inductive load test circuit

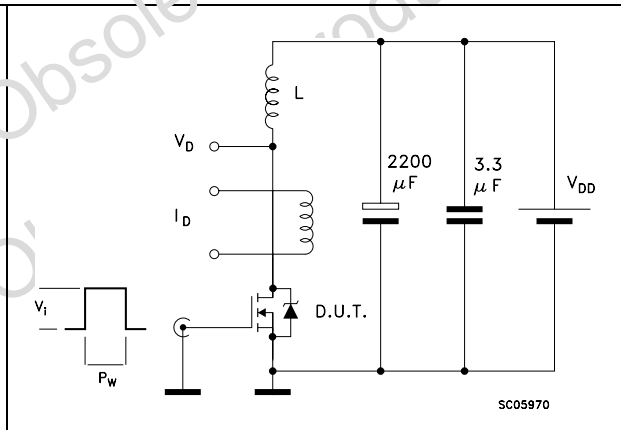


Figure 17. Unclamped inductive waveform

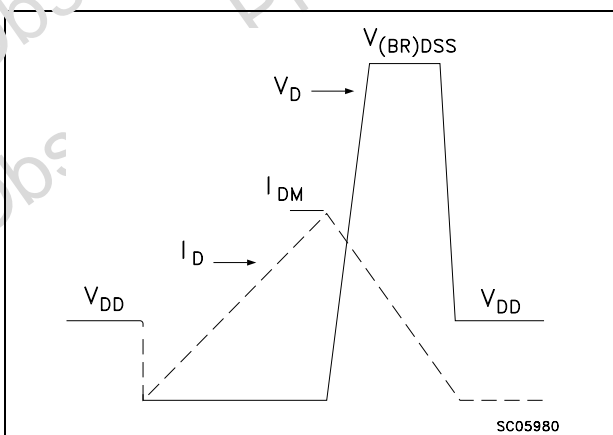


Figure 18. Switching time waveform

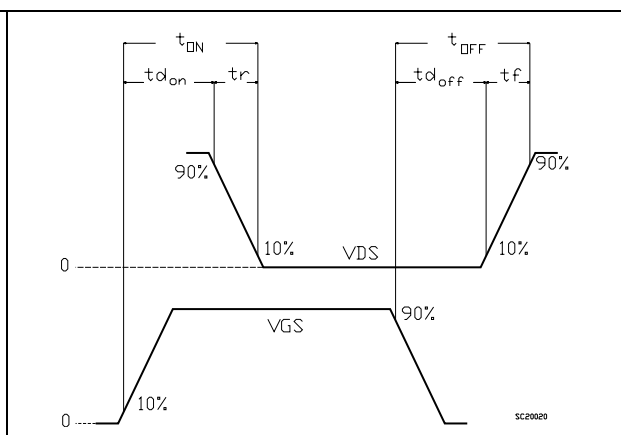
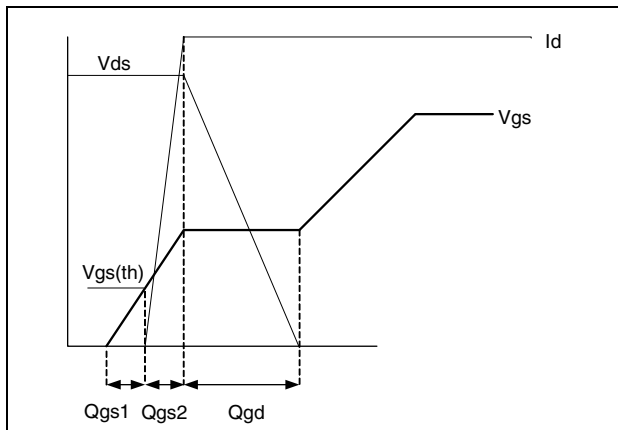




Figure 19. Gate charge waveform



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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](http://www.st.com)

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**Table 8. PolarPAK® (option “S”) 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
I1	1.92	1.97	2.02	0.075	0.077	0.079
J1	0.38	0.43	0.48	0.014	0.016	0.018
K1	4.22	4.37	4.52	0.166	0.172	0.178
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 20. PolarPAK® (option “S”) drawings

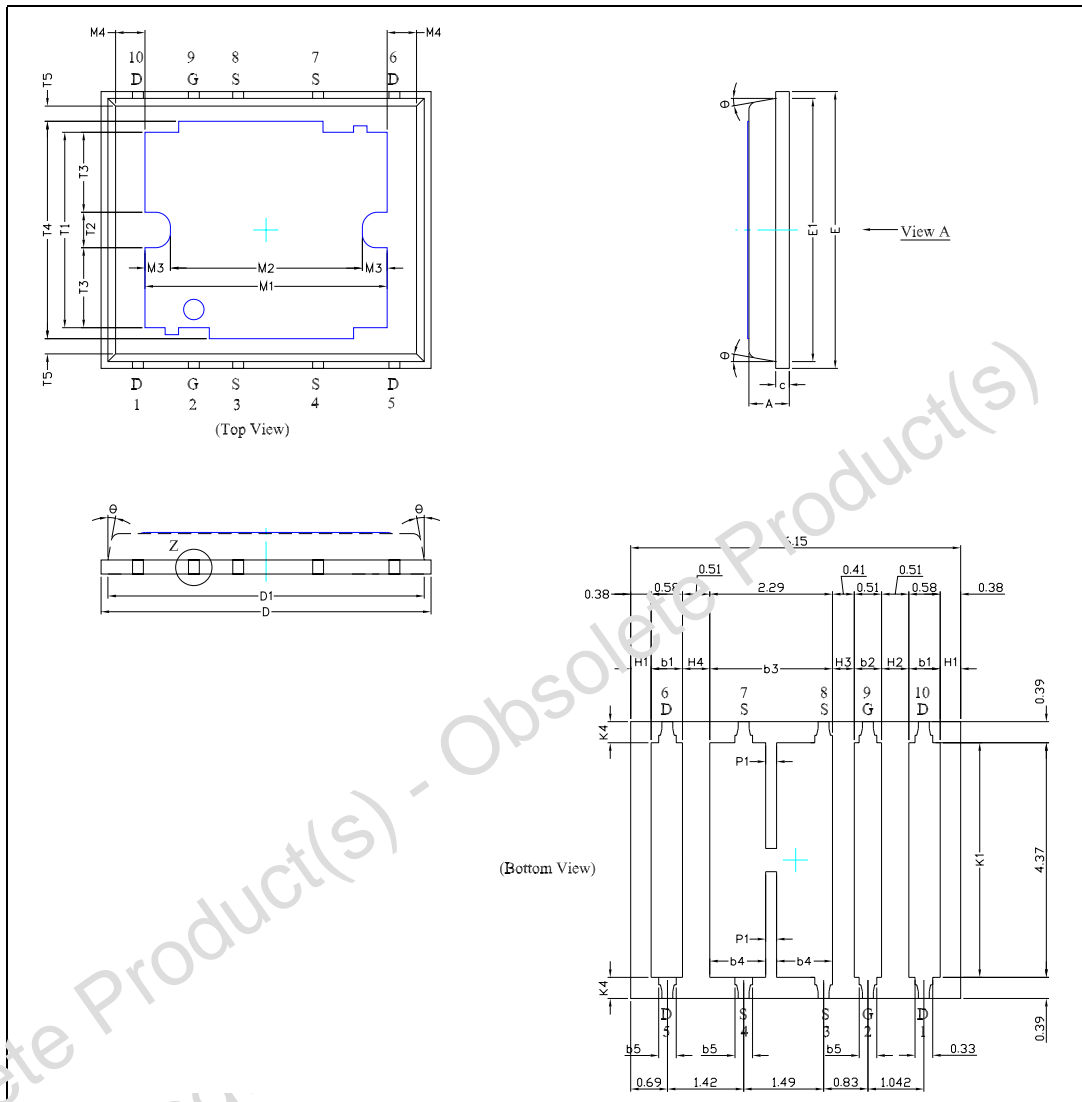
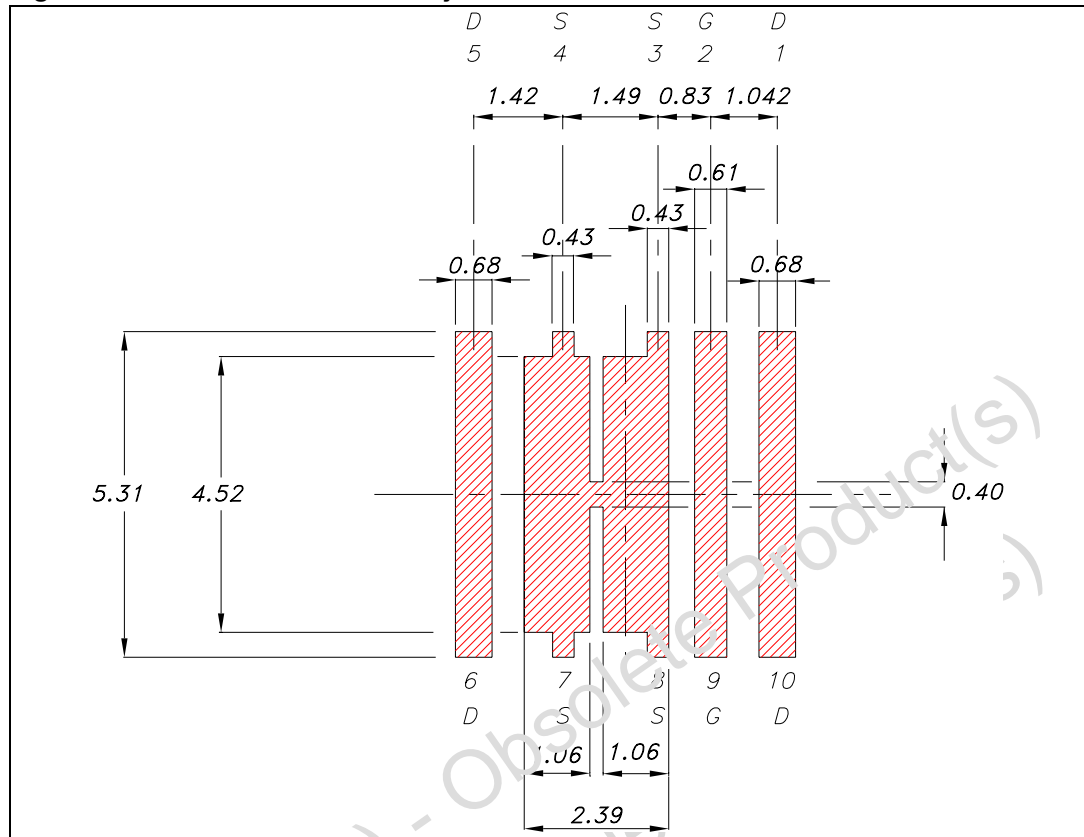


Figure 21. Recommended PAD layout



## 5 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
14-May-2007	1	First version
22-Jun-2007	2	V <sub>DSS</sub> value change in all document
03-Sep-2007	3	Updated mechanical data
19-Dec-2007	4	Document status promoted from preliminary data to datasheet.
14-Feb-2008	5	Updated <a href="#">Table 8</a> , <a href="#">Figure 20</a> and <a href="#">Figure 21</a>

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