



# STK22N6F3

N-channel 60 V, 0.0055  $\Omega$ , 22 A, PolarPAK<sup>®</sup>  
STripFET<sup>™</sup> Power MOSFET

## Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub> max |
|-----------|------------------|-------------------------|
| STK22N6F3 | 60 V             | < 0.006 $\Omega$        |

- Ultra low top and bottom junction to case thermal resistance
- Extremely low on-resistance R<sub>DS(on)</sub>
- Very low switching gate charge
- Fully encapsulated die
- 100% matte tin finish (in compliance with the 2002/95/EC european directive)
- High avalanche ruggedness
- PolarPAK<sup>®</sup> is a trademark of VISHAY

## Application

- Switching applications

## Description

This STripFET<sup>™</sup> III Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance providing superior switching performances.

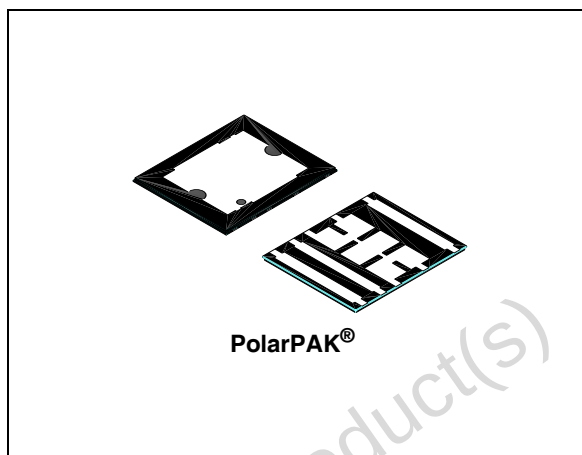


Figure 1. Internal schematic diagram

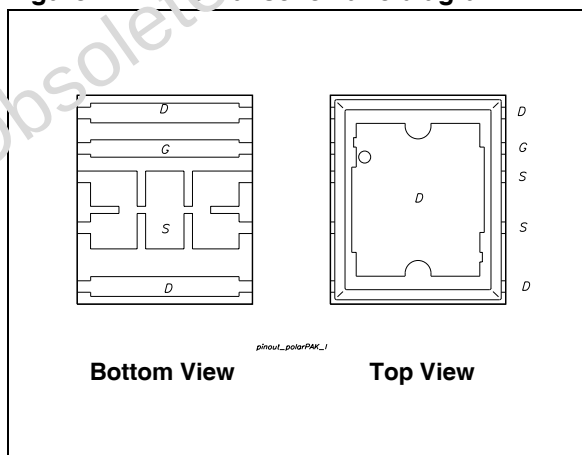


Table 1. Device summary

| Order code | Marking | Package               | Packaging     |
|------------|---------|-----------------------|---------------|
| STK22N6F3  | 2263    | PolarPAK <sup>®</sup> | Tape and reel |

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Obsolete Product(s) - Obsolete Product(s)



# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter                                               | Value      | Unit                |
|--------------------|---------------------------------------------------------|------------|---------------------|
| $V_{DS}$           | Drain-source voltage ( $V_{GS} = 0$ )                   | 60         | V                   |
| $V_{GS}$           | Gate-source voltage                                     | $\pm 20$   | V                   |
| $I_D^{(1)}$        | Drain current (continuous) at $T_C = 25^\circ\text{C}$  | 22         | A                   |
| $I_D$              | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 13.7       | A                   |
| $I_{DM}^{(2)}$     | Drain current (pulsed)                                  | 88         | A                   |
| $P_{TOT}^{(1)}$    | Total dissipation at $T_C = 25^\circ\text{C}$           | 5.2        | W                   |
|                    | Derating factor                                         | 0.0416     | W/ $^\circ\text{C}$ |
| $E_{AS}^{(3)}$     | Single pulse avalanche energy                           | 800        | mJ                  |
| $T_j$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature   | -55 to 150 | $^\circ\text{C}$    |

1. When mounted on FR-4 board of 1inch<sup>2</sup>, 2 oz Cu and  $\leq 10$  sec
2. Pulse width limited by package
3. Starting  $T_J = 25^\circ\text{C}$ ,  $I_D = 11$  A,  $V_{DD} = 48$  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) | 0.8  | 1    | $^\circ\text{C/W}$ |
| $R_{thj-c}^{(3)}$   | Thermal resistance junction-case (source)    | 2.2  | 2.7  | $^\circ\text{C/W}$ |

1. When mounted on FR-4 board of 1inch<sup>2</sup>, 2 oz Cu and  $\leq 10$ sec
2. Steady state
3. Measured at source pin when the device is mounted on FR-4 board in steady state

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                                      | Min. | Typ.   | Max.      | Unit                           |
|---------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------|------|--------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$                                                        | 60   | -      | -         | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$ ,<br>$V_{DS} = \text{Max rating}$ , $T_c = 125\text{ }^{\circ}\text{C}$ | -    | -      | 10<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                                                           | -    | -      | $\pm 200$ | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                                   | 2    | -      | 4         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 11\text{ A}$                                                         | -    | 0.0055 | 0.006     | $\Omega$                       |

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions                                                             | Min. | Typ. | Max. | Unit     |
|-----------|------------------------------|-----------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$                  | -    | 2500 | -    | pF       |
| $C_{oss}$ | Output capacitance           |                                                                             |      | 536  |      | pF       |
| $C_{rss}$ | Reverse transfer capacitance |                                                                             |      | 44   |      | pF       |
| $Q_g$     | Total gate charge            | $V_{DD} = 48\text{ V}$ , $I_D = 22\text{ A}$                                | -    | 41   | -    | nC       |
| $Q_{gs}$  | Gate-source charge           | $V_{GS} = 10\text{ V}$                                                      |      | 12   |      | nC       |
| $Q_{gd}$  | Gate-drain charge            | <a href="#">Figure 14</a>                                                   |      | 10   |      | nC       |
| $R_G$     | Gate input resistance        | $f = 1\text{ MHz}$ Gate DC Bias = 0<br>Test signal level = 20 mV open drain | -    | 0.9  | -    | $\Omega$ |

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                                   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 30\text{ V}$ , $I_D = 11\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br><a href="#">Figure 13</a> | -    | 16   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                   |      | 14   |      | ns   |
| $t_{d(off)}$ | Turn-off delay time | $V_{DD} = 30\text{ V}$ , $I_D = 11\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br><a href="#">Figure 13</a> | -    | 28   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                   |      | 5    |      | 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<br>(pulsed)                     |                                                                                                                                                  | -    | -               | 22<br>88 | A<br>A        |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           | $I_{SD} = 22\text{ A}$ , $V_{GS} = 0$                                                                                                            | -    | -               | 1.2      | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD} = 22\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 30\text{ V}$ , $T_j = 150^\circ\text{C}$<br><a href="#">Figure 18</a> | -    | 49<br>91<br>3.7 | -        | ns<br>nC<br>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

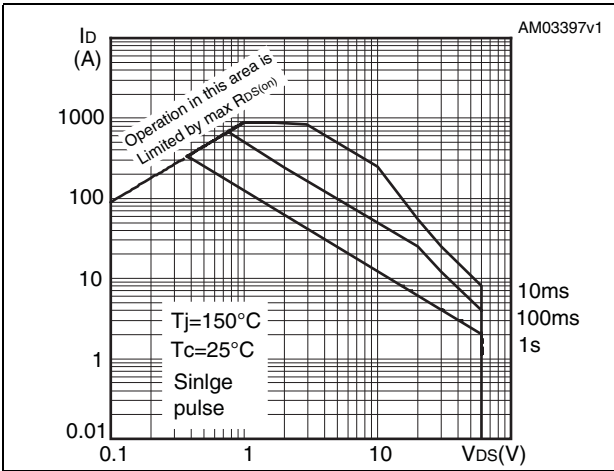


Figure 3. Thermal impedance

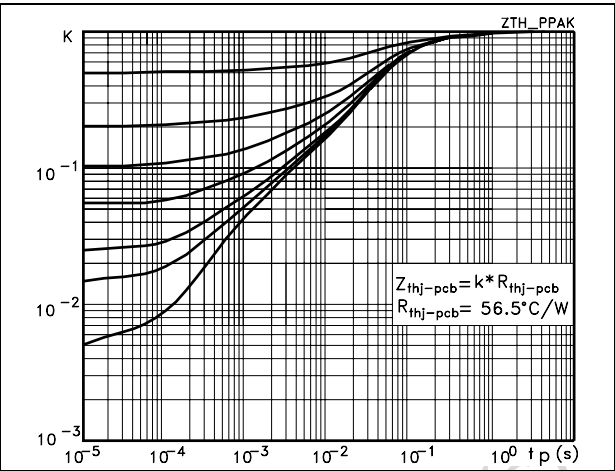


Figure 4. Output characteristics

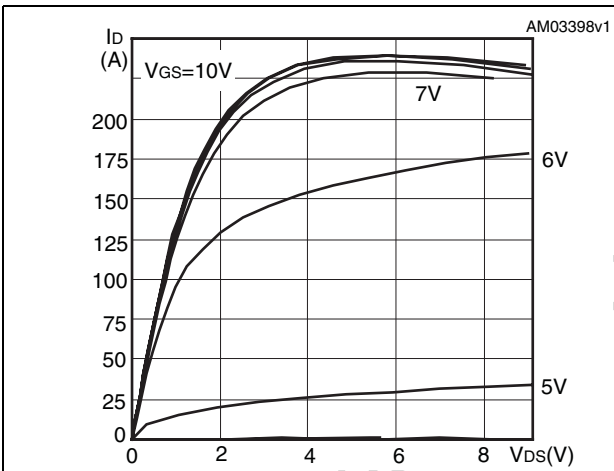


Figure 5. Transfer characteristics

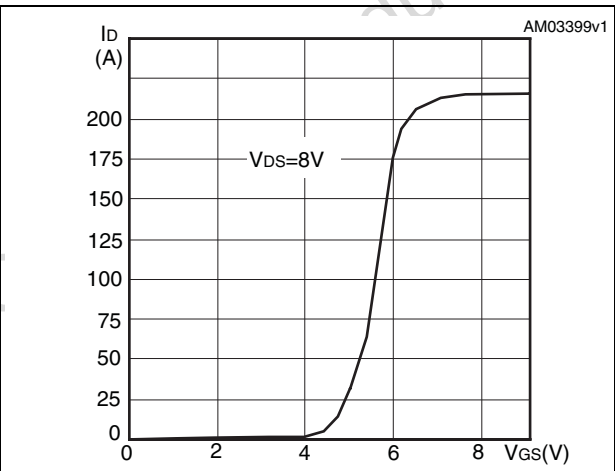


Figure 6. Normalized  $BV_{DSS}$  vs temperature

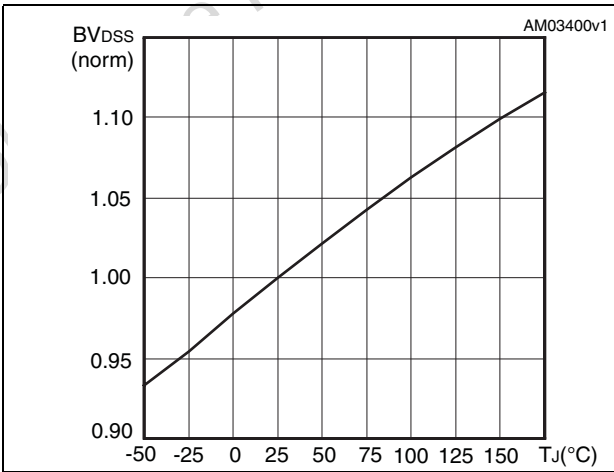


Figure 7. Static drain-source on resistance

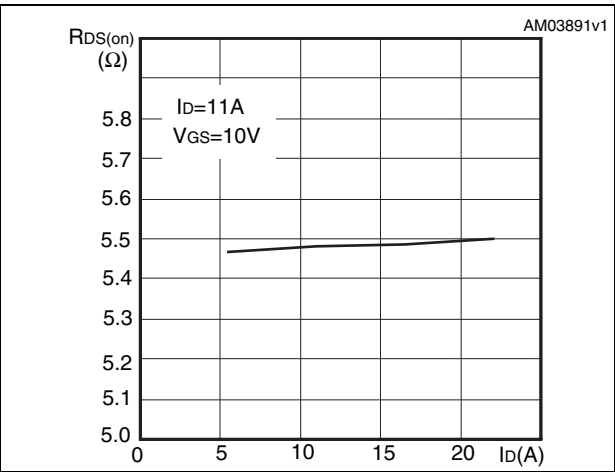


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

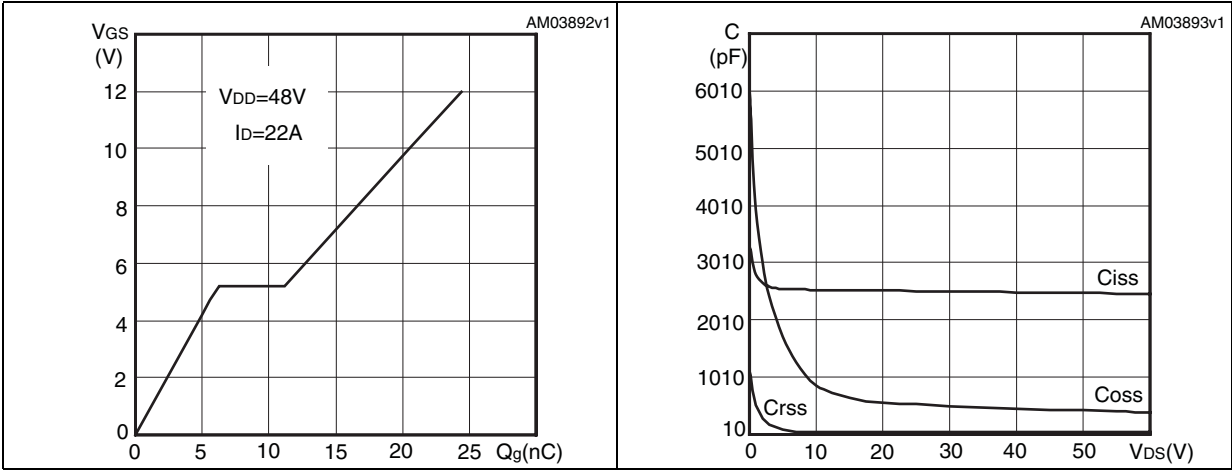


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

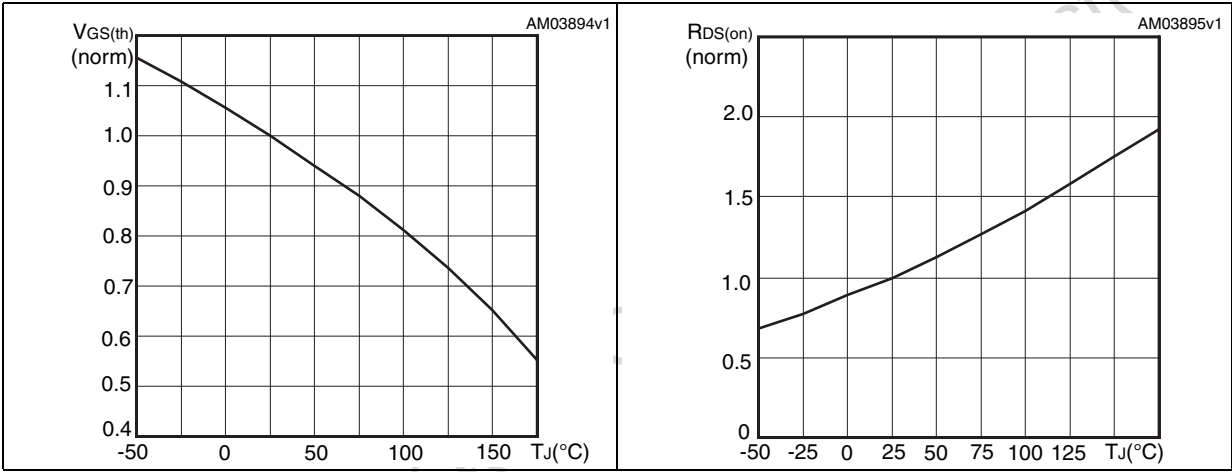
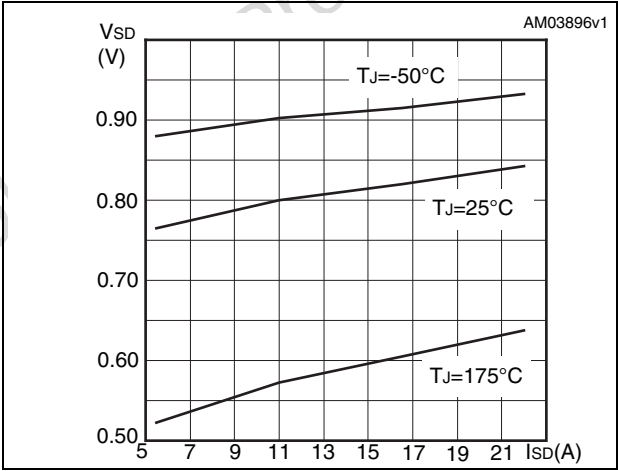
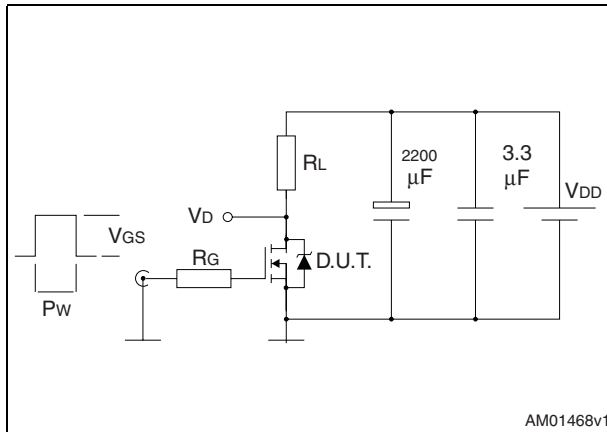


Figure 12. Source-drain diode forward characteristics



### 3 Test circuits

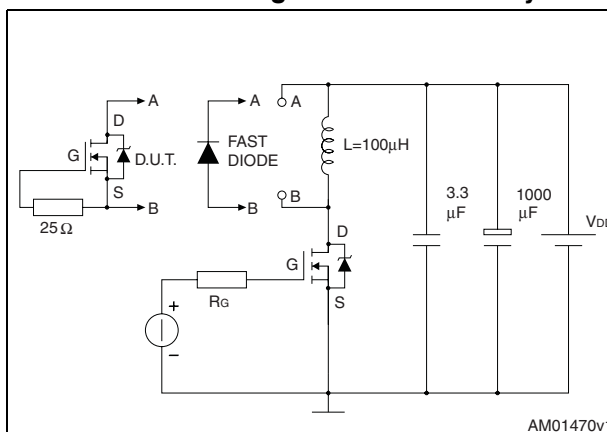
**Figure 13. Switching times test circuit for resistive load**



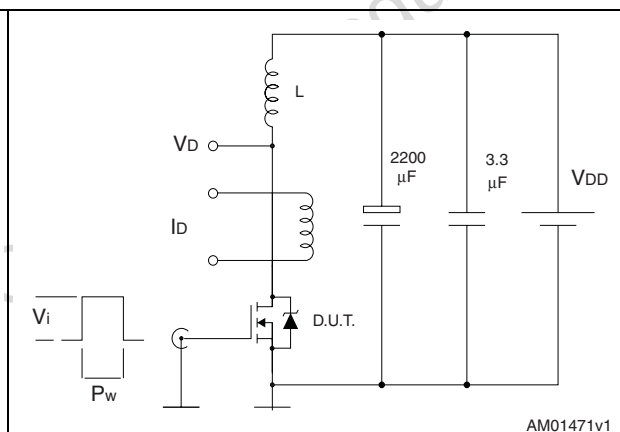
**Figure 14. Gate charge test circuit**



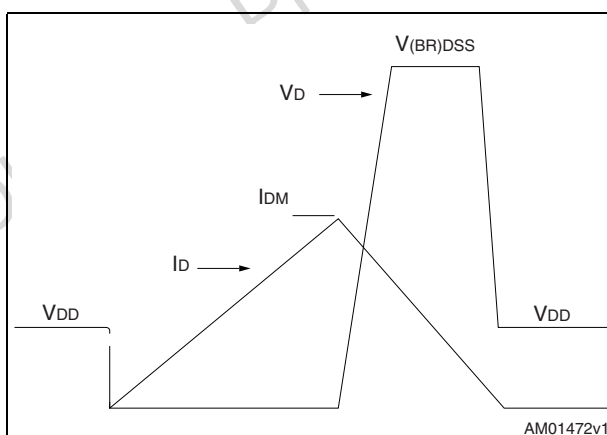
**Figure 15. Test circuit for inductive load switching and diode recovery times**



**Figure 16. Unclamped inductive load test circuit**



**Figure 17. Unclamped inductive waveform**



**Figure 18. Switching time waveform**

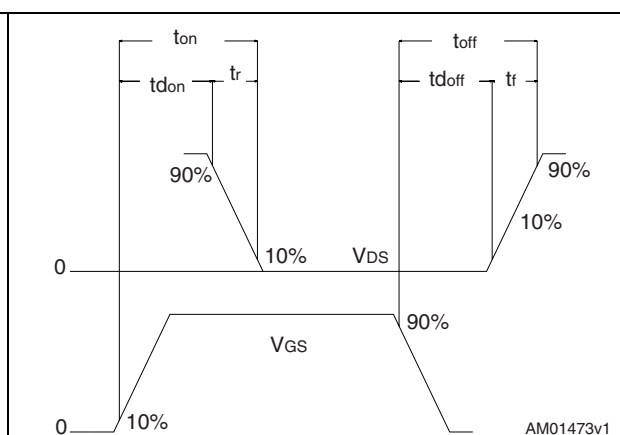
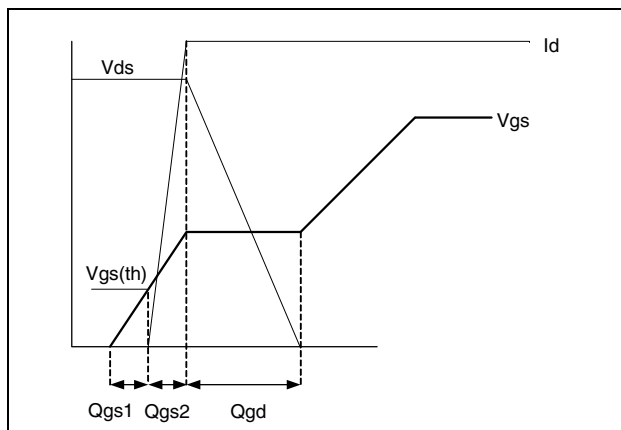


Figure 19. Gate charge waveform



## 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](http://www.st.com). ECOPACK is an ST trademark.

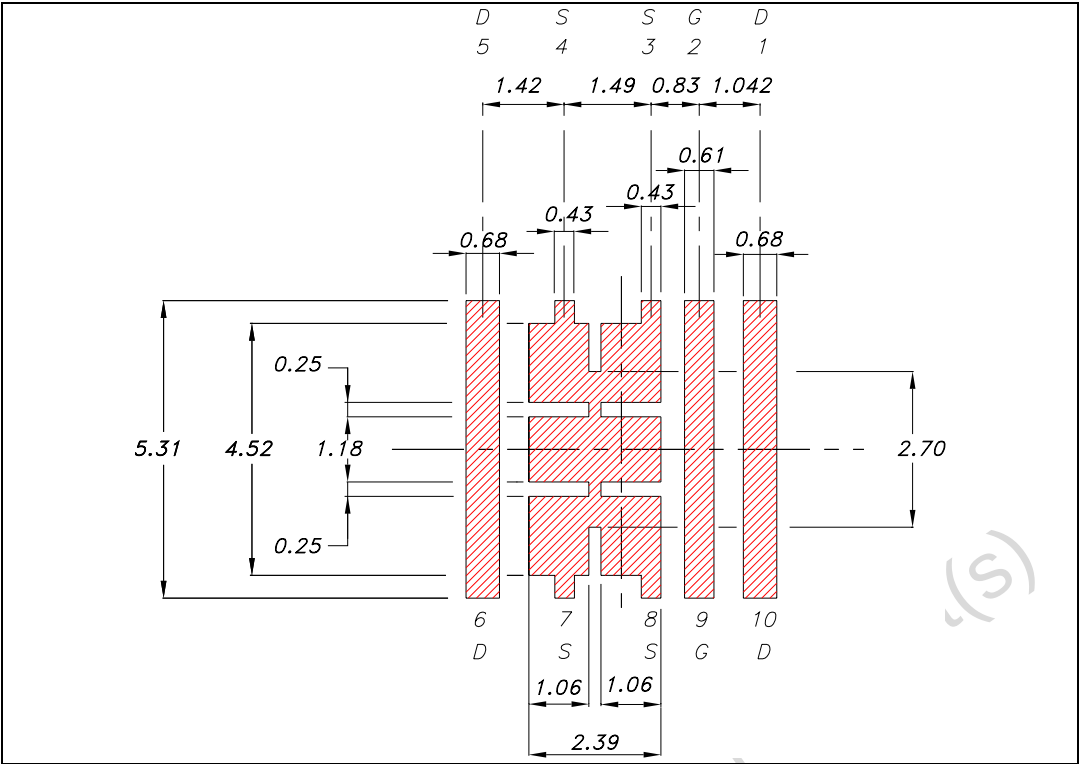
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Table 8. PolarPAK® (option “L”) mechanical data

| 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 21. Recommended PAD layout



## 5 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                     |
|-------------|----------|-------------------------------------------------------------|
| 01-Jul-2008 | 1        | First release                                               |
| 16-Apr-2009 | 2        | Document status promoted from preliminary data to datasheet |

Obsolete Product(s) - Obsolete Product(s)

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