

## P-channel 30 V, 0.024 $\Omega$ typ., 12 A, STripFET™ VI DeepGATE™ Power MOSFET in a DPAK package

Datasheet - production data

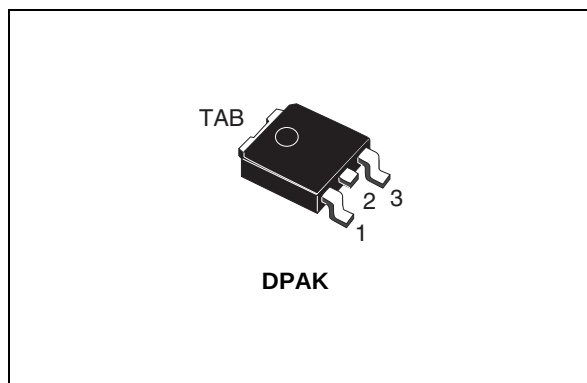
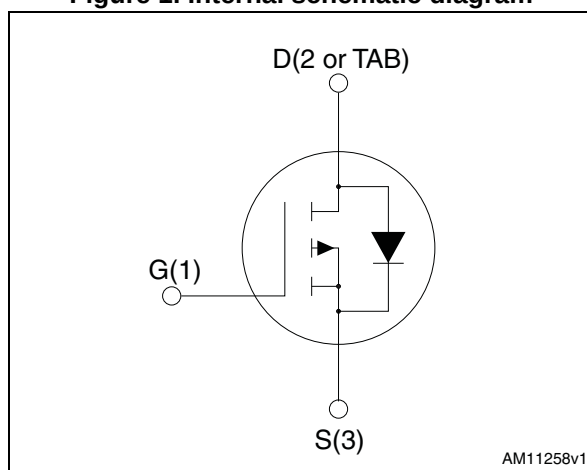


Figure 1. Internal schematic diagram



### Features

| Order code  | V <sub>DSS</sub> | R <sub>DS(on)</sub><br>max    | I <sub>D</sub> | P <sub>TOT</sub> |
|-------------|------------------|-------------------------------|----------------|------------------|
| STD26P3LLH6 | 30 V             | 0.030 $\Omega$ <sup>(1)</sup> | 12 A           | 40 W             |

1. @ V<sub>GS</sub> = 10 V

- R<sub>DS(on)</sub> \* Q<sub>g</sub> industry benchmark
- Extremely low on-resistance R<sub>DS(on)</sub>
- High avalanche ruggedness
- Low gate input resistance

### Applications

- Switching applications
- LCC converters, resonant converters

### Description

This device is a P-channel Power MOSFET developed using the 6<sup>th</sup> generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFET exhibits the lowest R<sub>DS(on)</sub> in all packages

Table 1. Device summary

| Order code  | Marking  | Package | Packaging     |
|-------------|----------|---------|---------------|
| STD26P3LLH6 | 26P3LLH6 | DPAK    | Tape and reel |

**Note:** For the P-channel Power MOSFETs the actual polarity of the voltages and the current must be reversed.

Contents

1      **Electrical ratings** ..... 3

2      **Electrical characteristics** ..... 4

      2.1    **Electrical characteristics (curves)** ..... 6

3      **Test circuits** ..... 8

4      **Package mechanical data** ..... 9

5      **Packaging mechanical data** ..... 13

6      **Revision history** ..... 15



# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol            | Parameter                                                       | Value      | Unit             |
|-------------------|-----------------------------------------------------------------|------------|------------------|
| $V_{DS}$          | Drain-source voltage                                            | 30         | V                |
| $V_{GS}$          | Gate-source voltage                                             | $\pm 20$   | V                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$  | 12         | A                |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$ | 8.5        | A                |
| $I_{DM}^{(1)(2)}$ | Drain current (pulsed)                                          | 48         | A                |
| $P_{TOT}^{(1)}$   | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$           | 40         | W                |
| $T_{stg}$         | Storage temperature                                             | -55 to 175 | $^\circ\text{C}$ |
| $T_j$             | Max. operating junction temperature                             | 175        | $^\circ\text{C}$ |

1. Limited by wire bonding.

2. Pulse width limited by safe operating area.

**Table 3. Thermal data**

| Symbol         | Parameter                            | Value | Unit               |
|----------------|--------------------------------------|-------|--------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 3.75  | $^\circ\text{C/W}$ |

**Table 4. Avalanche characteristics**

| Symbol   | Parameter                                                                                                                                                              | Value | Unit |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|
| $E_{AS}$ | Single pulse avalanche energy<br>(starting $T_J=25\text{ }^\circ\text{C}$ , $I_D=6\text{ A}$ , $I_{AS}=12\text{ A}$ , $V_{DD}=25\text{ V}$ ,<br>$V_{gs}=10\text{ V}$ ) | 350   | mJ   |

*Note:* For the P-channel Power MOSFETs the actual polarity of the voltages and the current must be reversed.

## 2 Electrical characteristics

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

**Table 5. Static**

| Symbol        | Parameter                                        | Test conditions                                    | Min. | Typ.  | Max.      | Unit          |
|---------------|--------------------------------------------------|----------------------------------------------------|------|-------|-----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown Voltage                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$      | 30   |       |           | V             |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 30\text{ V}$                             |      |       | 1         | $\mu\text{A}$ |
|               |                                                  | $V_{DS} = 30\text{ V}$ , $T_C = 125\text{ °C}$     |      |       | 10        | $\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current                        | $V_{GS} = \pm 20\text{ V}$ , ( $V_{DS} = 0$ )      |      |       | $\pm 100$ | nA            |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$ | 1    |       | 2.5       | V             |
| $R_{DS(on)}$  | Static drain-source on-resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 6\text{ A}$        |      | 0.024 | 0.03      | $\Omega$      |
|               |                                                  | $V_{GS} = 4.5\text{ V}$ , $I_D = 6\text{ A}$       |      | 0.038 | 0.045     | $\Omega$      |

**Table 6. Dynamic**

| Symbol    | Parameter                    | Test conditions                                                                                             | Min | Typ. | Max. | Unit     |
|-----------|------------------------------|-------------------------------------------------------------------------------------------------------------|-----|------|------|----------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$                                               | -   | 1450 | -    | pF       |
| $C_{oss}$ | Output capacitance           |                                                                                                             | -   | 178  | -    | pF       |
| $C_{rss}$ | Reverse transfer capacitance |                                                                                                             | -   | 120  | -    | pF       |
| $Q_g$     | Total gate charge            | $V_{DD} = 24\text{ V}$ , $I_D = 12\text{ A}$<br>$V_{GS} = 4.5\text{ V}$<br>(see <a href="#">Figure 14</a> ) | -   | 12   | -    | nC       |
| $Q_{gs}$  | Gate-source charge           |                                                                                                             | -   | 4.4  | -    | nC       |
| $Q_{gd}$  | Gate-drain charge            |                                                                                                             | -   | 5    | -    | nC       |
| $R_g$     | Gate input resistance        | $f = 1\text{ MHz}$ , gate DC Bias = 0,<br>test signal level = 20 mV,<br>$I_D = 0$                           | -   | 1.8  | -    | $\Omega$ |

**Note:** For the P-channel Power MOSFETs the actual polarity of the voltages and the current must be reversed.

Table 7. Switching on/off (inductive load)

| Symbol       | Parameter           | Test conditions                                                                                                                     | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 24\text{ V}$ , $I_D = 1.5\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 13</a> ) | -    | 15   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                     | -    | 15   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                                     | -    | 24   | -    | ns   |
| $t_f$        | Fall time           |                                                                                                                                     | -    | 21   | -    | ns   |

Table 8. Source drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                | -    |      | 12   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                | -    |      | 48   | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 12\text{ A}$ , $V_{GS} = 0$                                                                                          | -    |      | 1.1  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 12\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 16\text{ V}$<br>(see <a href="#">Figure 15</a> ) | -    | 15   |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                | -    | 6.5  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                | -    | 0.9  |      | A    |

1. Pulse width limited by safe operating area

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

**Note:** For the P-channel Power MOSFETs the actual polarity of the voltages and the current must be reversed.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

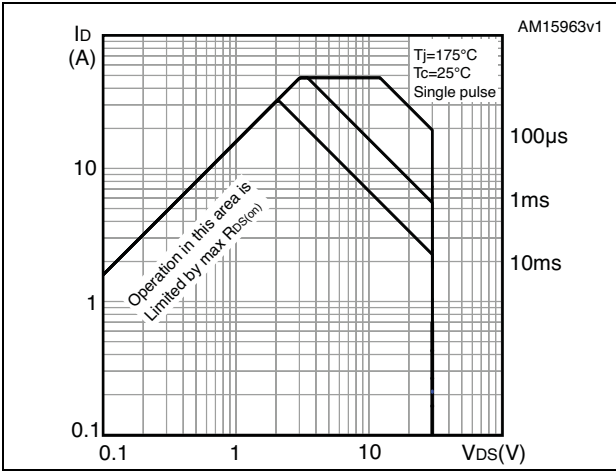


Figure 3. Thermal impedance

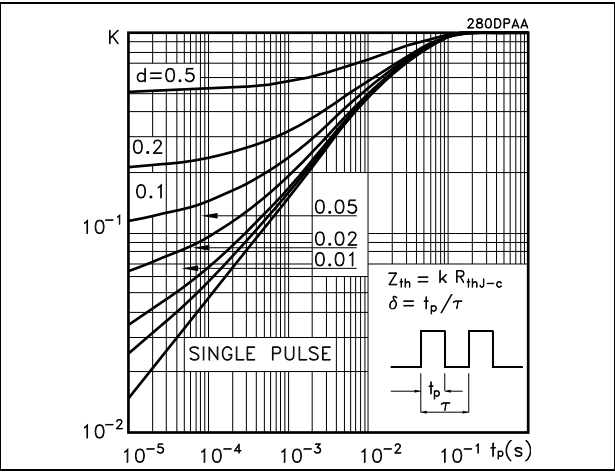


Figure 4. Output characteristics

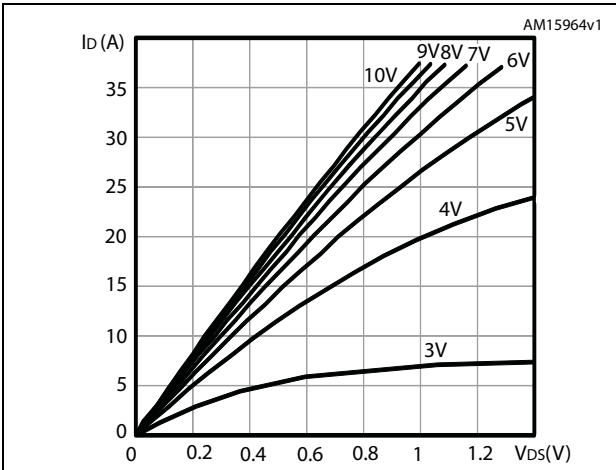


Figure 5. Transfer characteristics

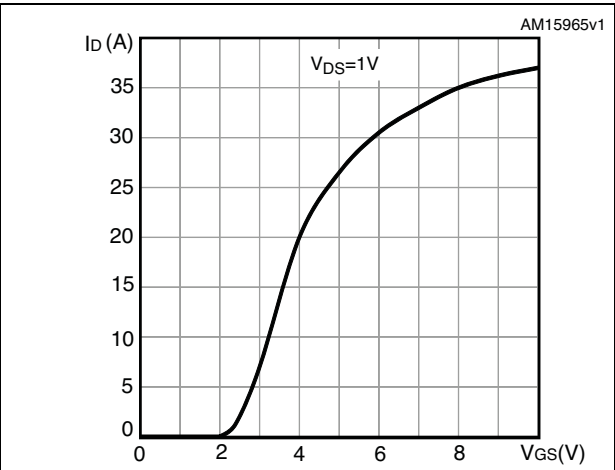


Figure 6. Gate charge vs gate-source voltage

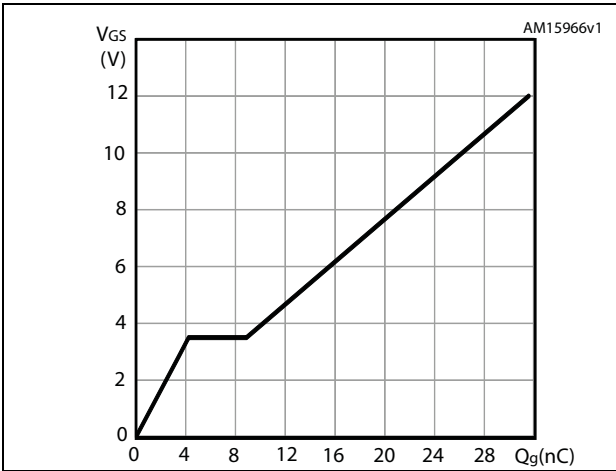


Figure 7. Static drain-source on-resistance

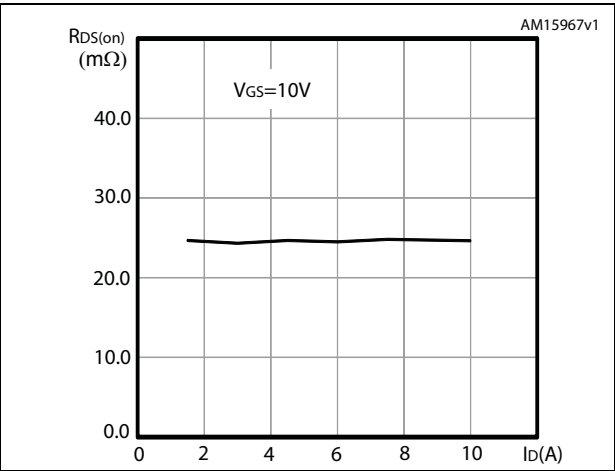


Figure 8. Capacitance variations

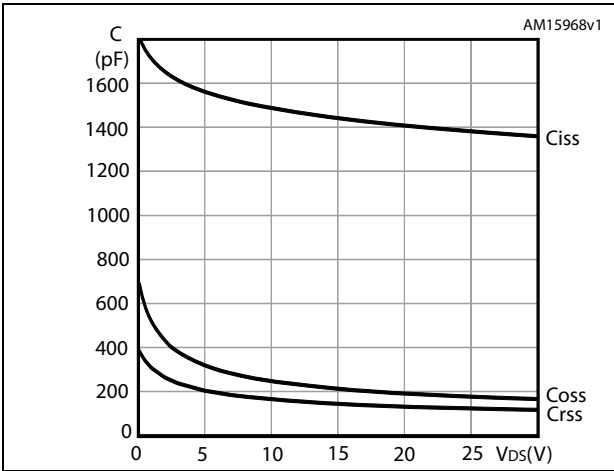


Figure 9. Normalized gate threshold voltage vs temperature

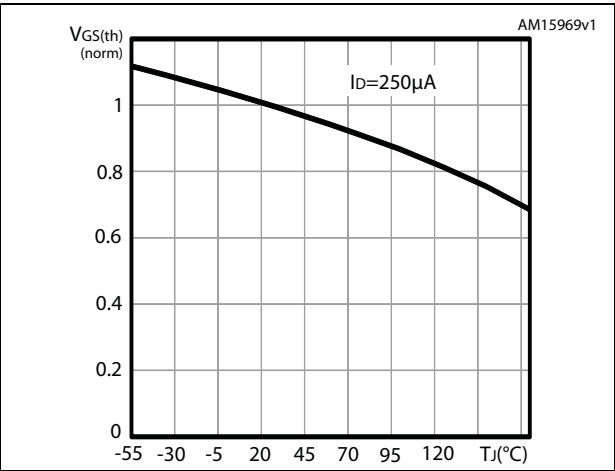


Figure 10. Normalized on-resistance vs temperature

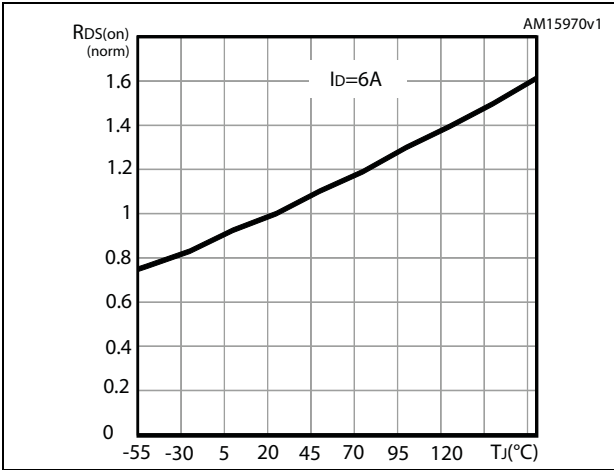


Figure 11. Normalized VDS vs temperature

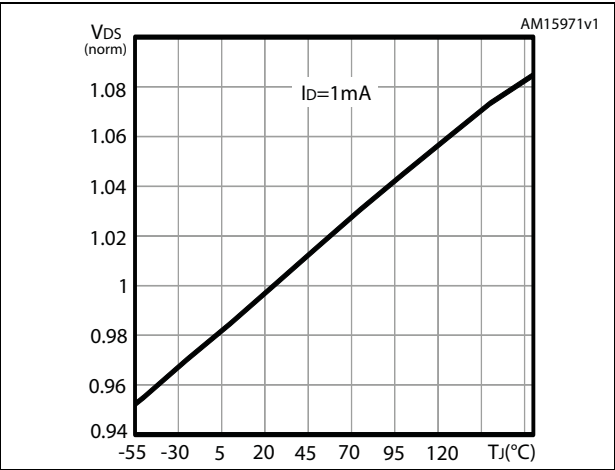
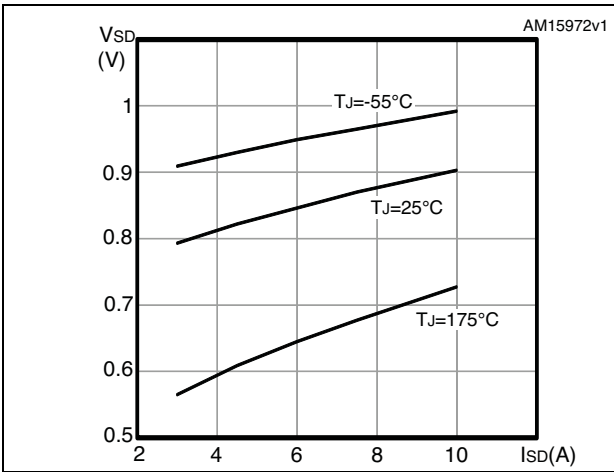


Figure 12. Source-drain diode forward characteristics



### 3 Test circuits

Figure 13. Switching times test circuit for resistive load

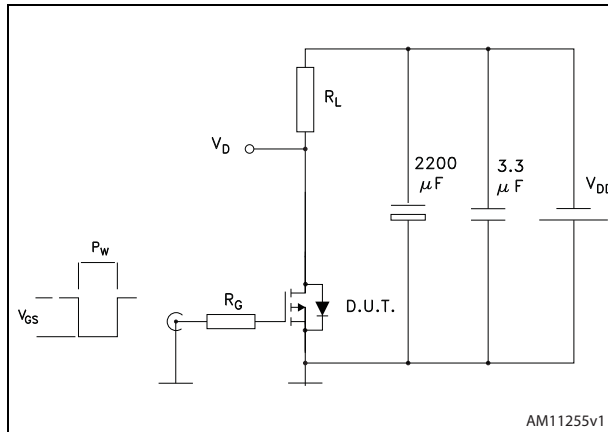


Figure 14. Gate charge test circuit

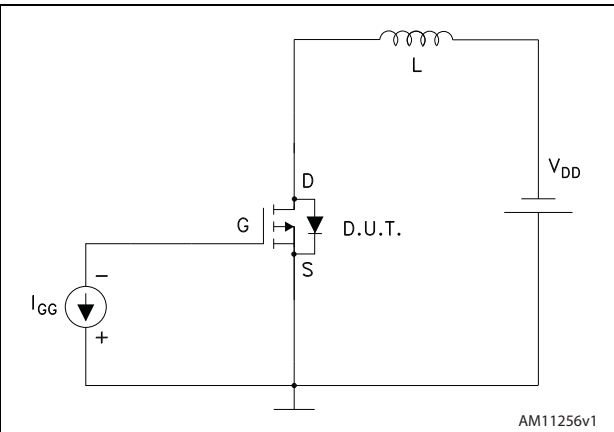


Figure 15. Test circuit for diode recovery behavior

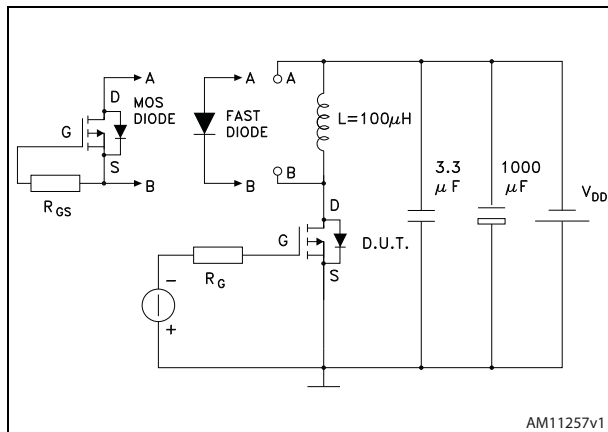


Figure 16. Unclamped inductive load test circuit

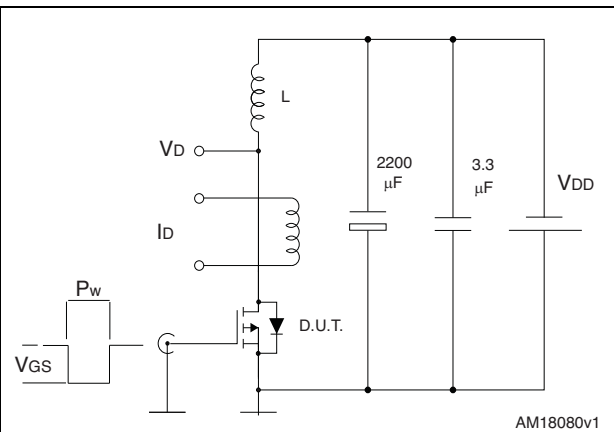


Figure 17. Unclamped inductive waveform

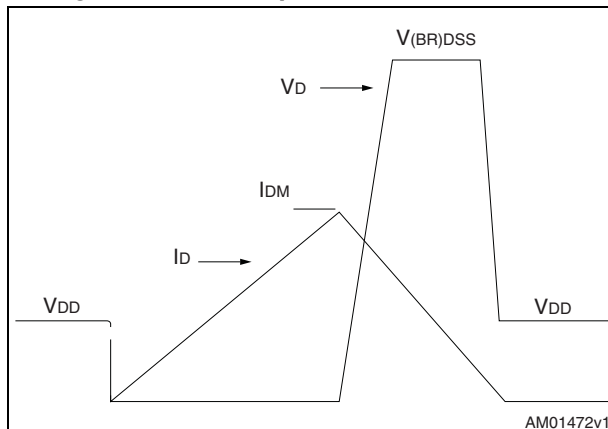
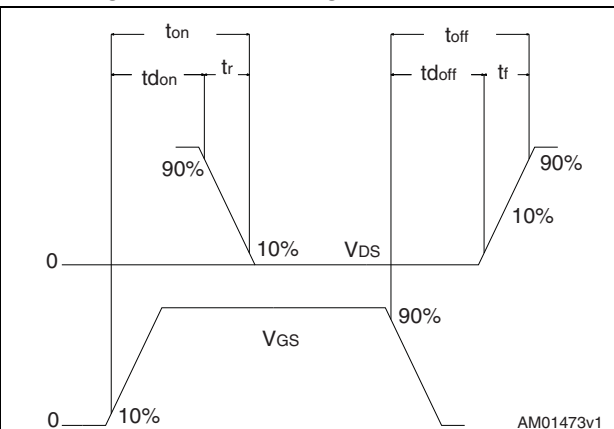


Figure 18. Switching time waveform



## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Figure 19. DPAK (TO-252) type A drawing

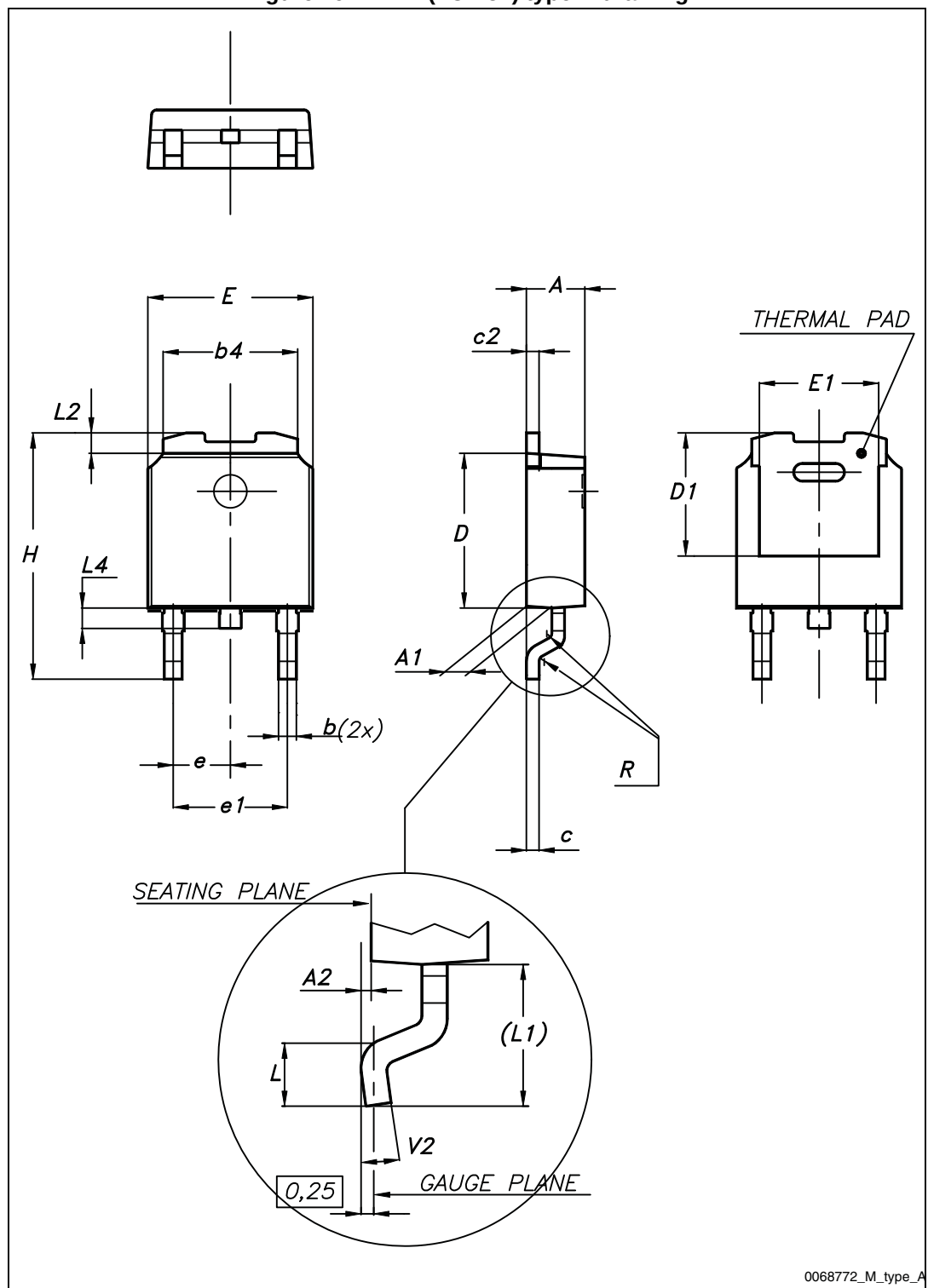
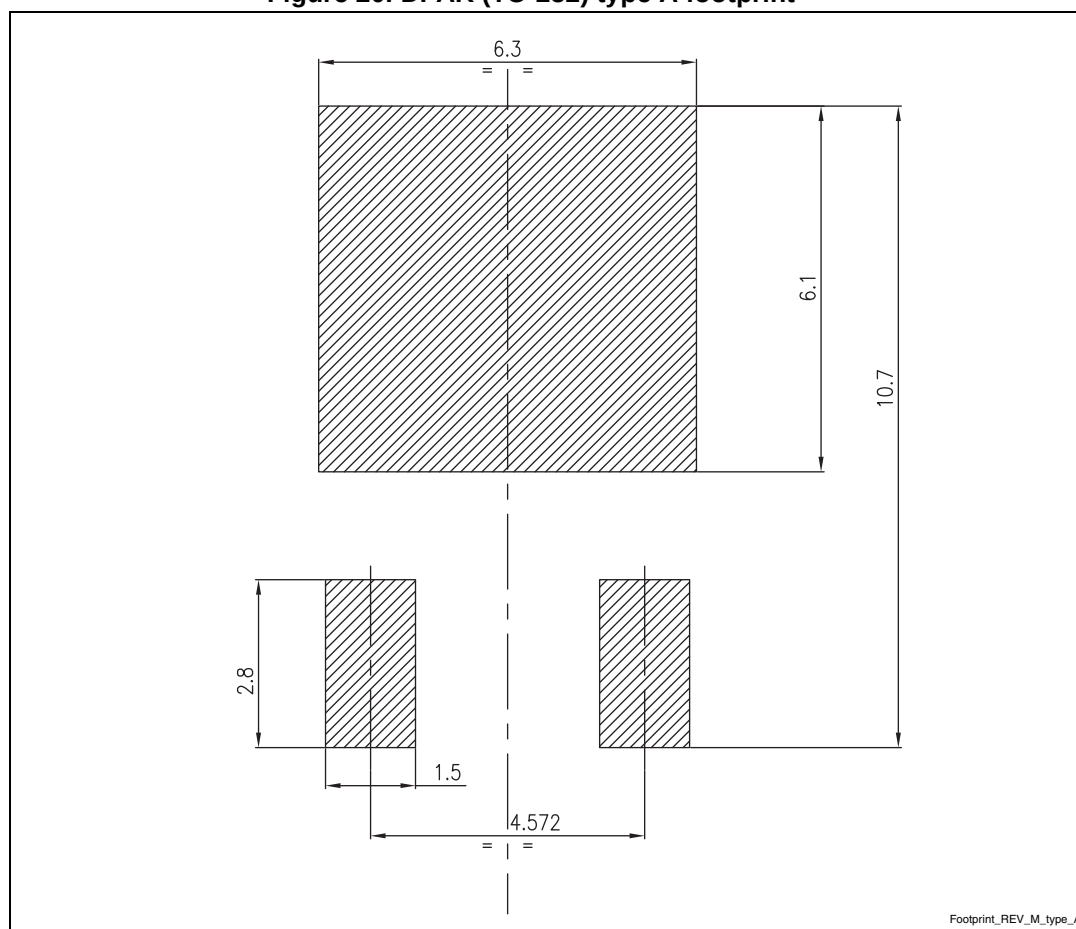


Table 9. DPAK (TO-252) type A mechanical data

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 2.20 |      | 2.40  |
| A1   | 0.90 |      | 1.10  |
| A2   | 0.03 |      | 0.23  |
| b    | 0.64 |      | 0.90  |
| b4   | 5.20 |      | 5.40  |
| c    | 0.45 |      | 0.60  |
| c2   | 0.48 |      | 0.60  |
| D    | 6.00 |      | 6.20  |
| D1   |      | 5.10 |       |
| E    | 6.40 |      | 6.60  |
| E1   |      | 4.70 |       |
| e    |      | 2.28 |       |
| e1   | 4.40 |      | 4.60  |
| H    | 9.35 |      | 10.10 |
| L    | 1.00 |      | 1.50  |
| (L1) |      | 2.80 |       |
| L2   |      | 0.80 |       |
| L4   | 0.60 |      | 1.00  |
| R    |      | 0.20 |       |
| V2   | 0°   |      | 8°    |

Figure 20. DPAK (TO-252) type A footprint (a)



a. All dimensions are in millimeters

## 5 Packaging mechanical data

Figure 21. Tape for DPAK (TO-252)

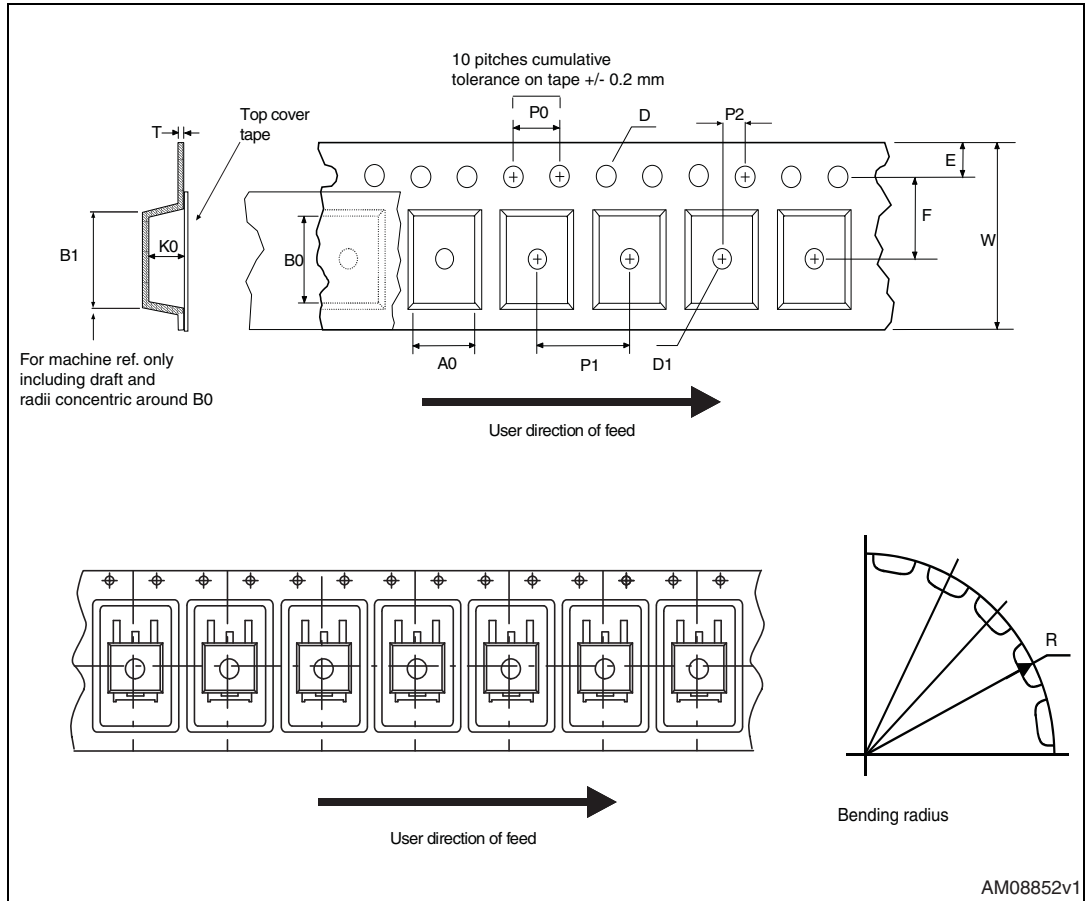


Figure 22. Reel for DPAK (TO-252)

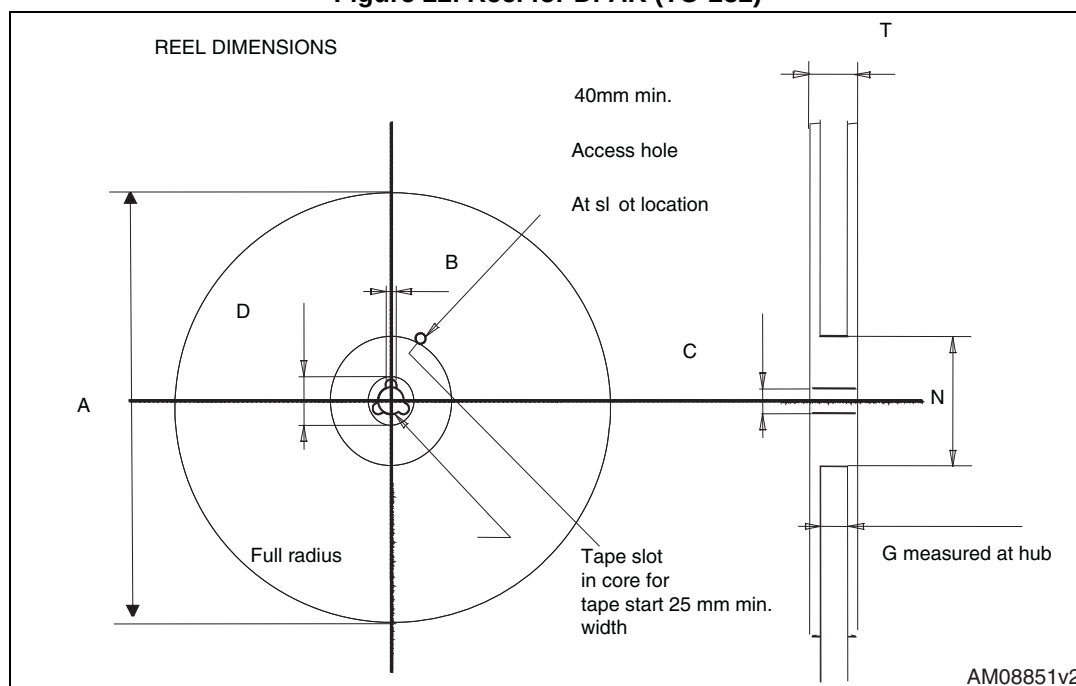


Table 10. DPAK (TO-252) tape and reel mechanical data

| Tape |      |      | Reel      |      |      |
|------|------|------|-----------|------|------|
| Dim. | mm   |      | Dim.      | mm   |      |
|      | Min. | Max. |           | Min. | Max. |
| A0   | 6.8  | 7    | A         |      | 330  |
| B0   | 10.4 | 10.6 | B         | 1.5  |      |
| B1   |      | 12.1 | C         | 12.8 | 13.2 |
| D    | 1.5  | 1.6  | D         | 20.2 |      |
| D1   | 1.5  |      | G         | 16.4 | 18.4 |
| E    | 1.65 | 1.85 | N         | 50   |      |
| F    | 7.4  | 7.6  | T         |      | 22.4 |
| K0   | 2.55 | 2.75 |           |      |      |
| P0   | 3.9  | 4.1  | Base qty. |      | 2500 |
| P1   | 7.9  | 8.1  | Bulk qty. |      | 2500 |
| P2   | 1.9  | 2.1  |           |      |      |
| R    | 40   |      |           |      |      |
| T    | 0.25 | 0.35 |           |      |      |
| W    | 15.7 | 16.3 |           |      |      |

## 6 Revision history

**Table 11. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22-Aug-2012 | 1        | First release                                                                                                                                                                                                                                                                                                                                                                                                            |
| 31-Jan-2013 | 2        | <ul style="list-style-type: none"> <li>– Modified: <math>R_{DS(on)}</math> on the title, <a href="#">Features table</a> and <a href="#">Table 5</a></li> <li>– Modified: typical values on <a href="#">Table 6</a>, <a href="#">7</a>, <a href="#">8</a></li> <li>– Modified: <math>V_{SD}</math> max value on <a href="#">Table 8</a></li> <li>– Updated: <a href="#">Section 4: Package mechanical data</a></li> </ul> |
| 16-Jul-2013 | 3        | <ul style="list-style-type: none"> <li>– Modified: <math>V_{GS}</math> and <math>I_D=100</math> °C values in <a href="#">Table 2</a></li> <li>– Modified: <math>R_{DS(on)}</math> max value in <a href="#">Table 5</a>, <a href="#">Figure 13</a>, <a href="#">14</a> and <a href="#">15</a></li> <li>– Inserted: <a href="#">Section 2.1: Electrical characteristics (curves)</a></li> </ul>                            |
| 10-Sep-2013 | 4        | <ul style="list-style-type: none"> <li>– Updated <math>Q_g</math> value in <a href="#">Table 6: Dynamic</a>.</li> </ul>                                                                                                                                                                                                                                                                                                  |
| 06-Feb-2014 | 5        | <ul style="list-style-type: none"> <li>– Added: <a href="#">Table 4: Avalanche characteristics</a></li> <li>– Modified: <a href="#">Figure 2</a>, <a href="#">5</a> and <a href="#">12</a></li> <li>– Updated: <a href="#">Section 4: Package mechanical data</a></li> <li>– Added: <a href="#">Figure 16</a>, <a href="#">17</a> and <a href="#">18</a></li> <li>– Minor text changes</li> </ul>                        |

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**ST PRODUCTS ARE NOT AUTHORIZED FOR USE IN WEAPONS. NOR ARE ST PRODUCTS DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2014 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

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