

## Turbo 2 ultrafast high voltage rectifier

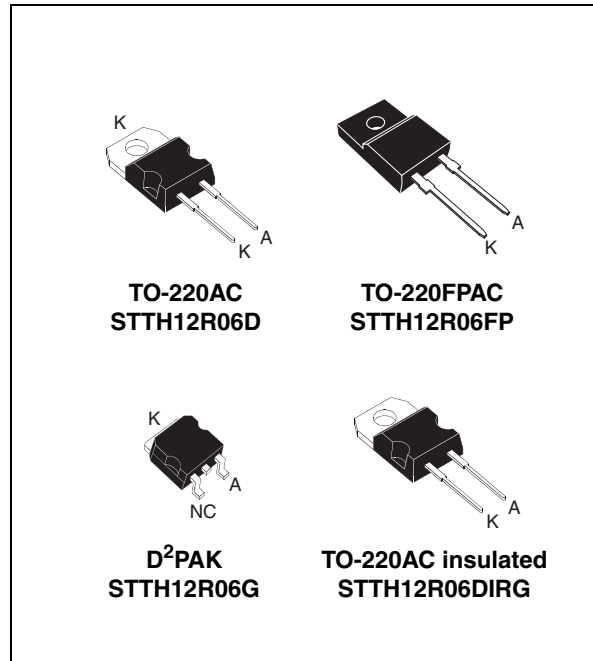
### Features

- Ultrafast switching
- Low reverse recovery current
- Low thermal resistance
- Reduces switching losses
- Package insulation voltage:  
TO220AC ins: 2500 V<sub>RMS</sub>  
TO-220FPAC: 2000 V<sub>DC</sub>

### Description

The STTH12R06 uses ST Turbo 2 600V technology and is specially suited as a boost diode in continuous mode power factor corrections and hard switching conditions.

This device is also intended for use as a free wheeling diode in power supplies and other power switching applications.



**Table 1. Device summary**

| Symbol         | Value  |
|----------------|--------|
| $I_{F(AV)}$    | 12 A   |
| $V_{RRM}$      | 600 V  |
| $I_{RM} (typ)$ | 7 A    |
| $T_j$          | 175 °C |
| $V_F (typ)$    | 1.4 V  |
| $t_{rr} (max)$ | 25 ns  |

# 1 Characteristics

**Table 2. Absolute ratings (limiting values)**

| Symbol              | Parameter                              |                                            |                                   | Value        | Unit |
|---------------------|----------------------------------------|--------------------------------------------|-----------------------------------|--------------|------|
| V <sub>RRM</sub>    | Repetitive peak reverse voltage        |                                            |                                   | 600          | V    |
| I <sub>F(RMS)</sub> | Forward rms current                    | TO-220AC / TO-220FPAC / D <sup>2</sup> PAK |                                   | 30           | A    |
|                     |                                        | TO-220AC ins.                              |                                   | 24           |      |
| I <sub>F(AV)</sub>  | Average forward current δ = 0.5        | TO-220AC / D <sup>2</sup> PAK              | T <sub>c</sub> = 125 °C           | 12           | A    |
|                     |                                        | TO-220FPAC                                 | T <sub>c</sub> = 50 °C            |              |      |
|                     |                                        | TO-220AC ins.                              | T <sub>c</sub> = 80 °C            |              |      |
| I <sub>FSM</sub>    | Surge non repetitive forward current   |                                            | t <sub>p</sub> = 10 ms sinusoidal | 100          | A    |
| T <sub>stg</sub>    | Storage temperature range              |                                            |                                   | -65 to + 175 | °C   |
| T <sub>j</sub>      | Maximum operating junction temperature |                                            |                                   | 175          | °C   |

**Table 3. Thermal resistance**

| Symbol        | Parameter        |                               | Value (max) | Unit |
|---------------|------------------|-------------------------------|-------------|------|
| $R_{th(j-c)}$ | Junction to case | TO-220AC / D <sup>2</sup> PAK | 1.7         | °C/W |
|               |                  | TO-220FPAC                    | 4.4         |      |
|               |                  | TO-220AC ins.                 | 3.3         |      |

**Table 4. Static electrical characteristics**

| Symbol | Parameter               | Test conditions       |                     | Min. | Typ. | Max. | Unit          |
|--------|-------------------------|-----------------------|---------------------|------|------|------|---------------|
| $I_R$  | Reverse leakage current | $T_j = 25\text{ °C}$  | $V_R = V_{RRM}$     |      |      | 45   | $\mu\text{A}$ |
|        |                         | $T_j = 125\text{ °C}$ |                     |      | 50   | 600  |               |
| $V_F$  | Forward voltage drop    | $T_j = 25\text{ °C}$  | $I_F = 12\text{ A}$ |      |      | 2.9  | V             |
|        |                         | $T_j = 125\text{ °C}$ |                     |      | 1.4  | 1.8  |               |

To evaluate the conduction losses use the following equation:

$$P = 1.16 \times I_{F(AV)} + 0.053 I_{F(RMS)}^2$$

Table 5. Dynamic Characteristics

| Symbol   | Parameter                | Test conditions                     |                                                                                               | Min. | Typ. | Max. | Unit |
|----------|--------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{rr}$ | Reverse recovery time    | $T_j = 25\text{ }^{\circ}\text{C}$  | $I_F = 0.5\text{ A}$ , $I_{rr} = 0.25\text{ A}$ ,<br>$I_R = 1\text{ A}$                       |      |      | 25   | ns   |
|          |                          |                                     | $I_F = 1\text{ A}$ ,<br>$di_F/dt = -50\text{ A}/\mu\text{s}$ ,<br>$V_R = 30\text{ V}$         |      |      | 45   |      |
| $I_{RM}$ | Reverse recovery current | $T_j = 125\text{ }^{\circ}\text{C}$ | $I_F = 12\text{ A}$ , $V_R = 400\text{ V}$ ,<br>$di_F/dt = -200\text{ A}/\mu\text{s}$         |      | 7.0  | 8.4  | A    |
| S factor | Softness factor          |                                     |                                                                                               |      | 0.2  |      |      |
| $Q_{rr}$ | Reverse recovery charges |                                     |                                                                                               |      | 180  |      | nC   |
| $t_{fr}$ | Forward recovery time    | $T_j = 25\text{ }^{\circ}\text{C}$  | $I_F = 12\text{ A}$ , $di_F/dt = 96\text{ A}/\mu\text{s}$ ,<br>$V_{FR} = 1.1 \times V_{Fmax}$ |      |      | 200  | ns   |
| $V_{FP}$ | Forward recovery voltage |                                     |                                                                                               |      |      | 5.5  | V    |

Figure 1. Conduction losses versus average current

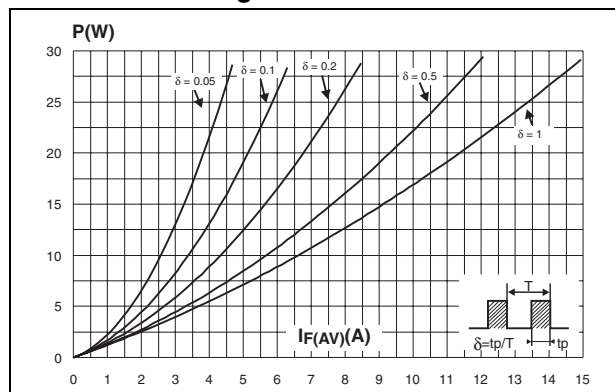


Figure 2. Forward voltage drop versus forward current

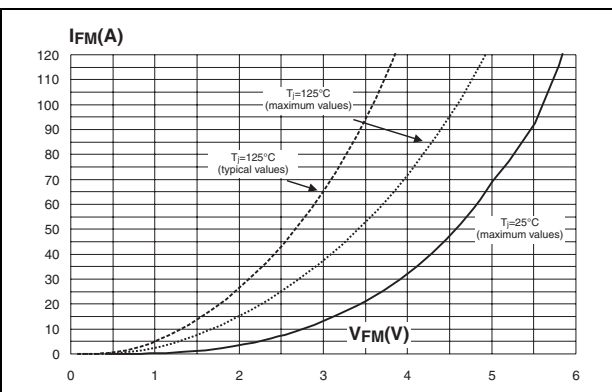


Figure 3. Relative variation of thermal impedance junction to case versus pulse duration

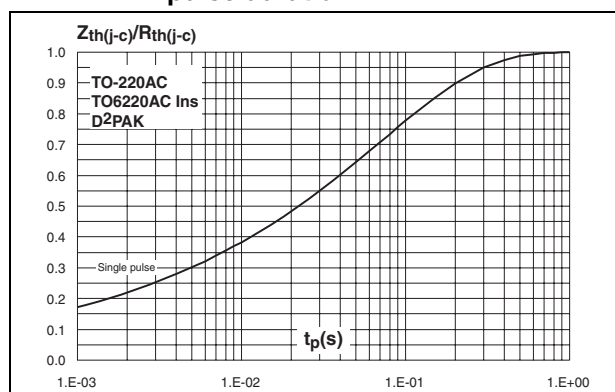
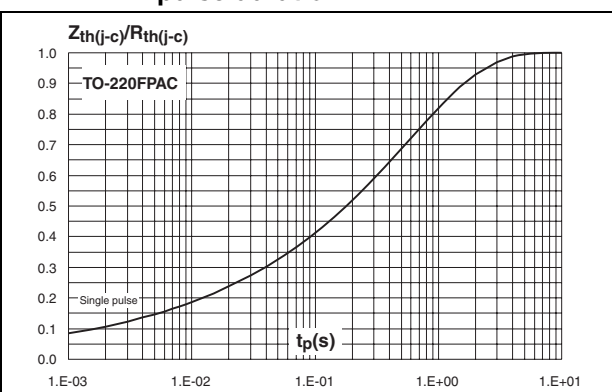
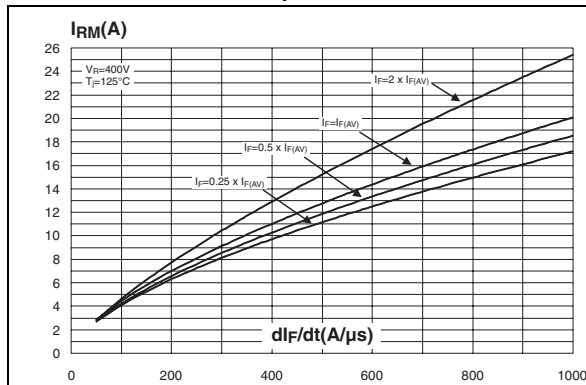


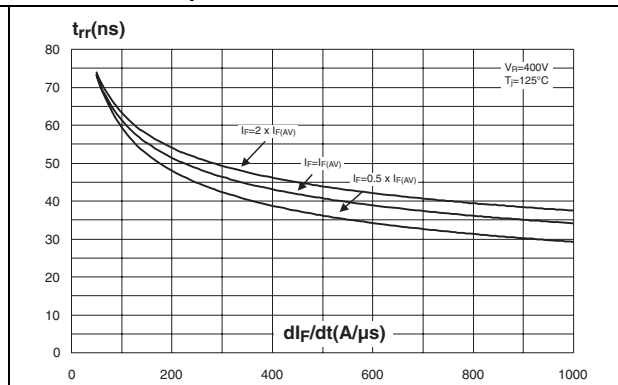
Figure 4. Relative variation of thermal impedance junction to case versus pulse duration



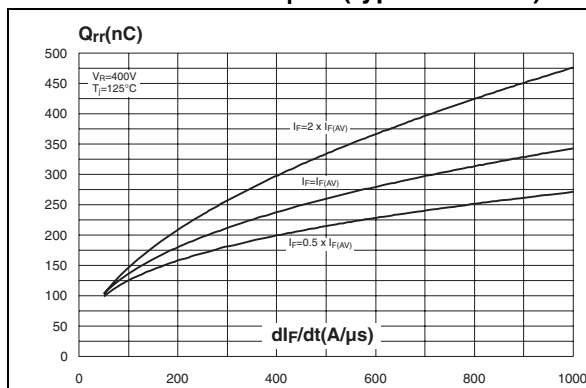
**Figure 5. Peak reverse recovery current versus  $dl_F/dt$  (typical values)**



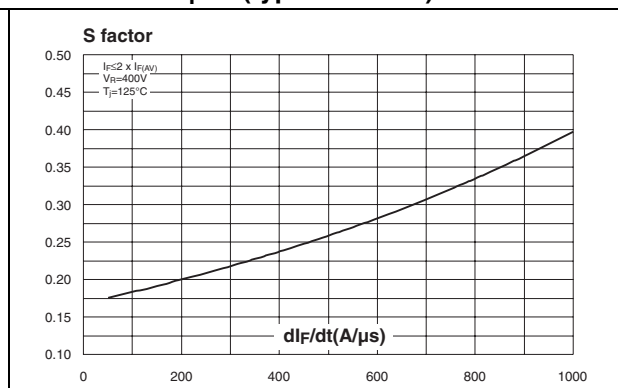
**Figure 6. Reverse recovery time versus  $dl_F/dt$  (typical values)**



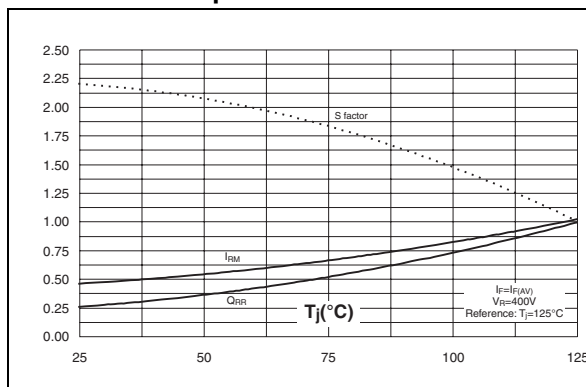
**Figure 7. Reverse recovery charges versus  $dl_F/dt$  (typical values)**



**Figure 8. Softness factor versus  $dl_F/dt$  (typical values)**



**Figure 9. Relative variations of dynamic parameters versus junction temperature**



**Figure 10. Transient peak forward voltage versus  $dl_F/dt$  (typical values)**

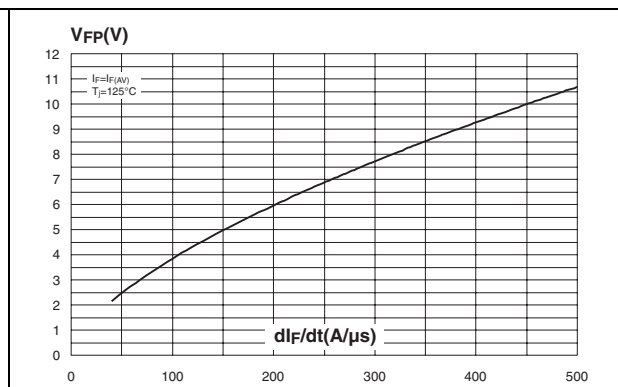


Figure 11. Forward recovery time versus  $dI_F/dt$  (typical values)

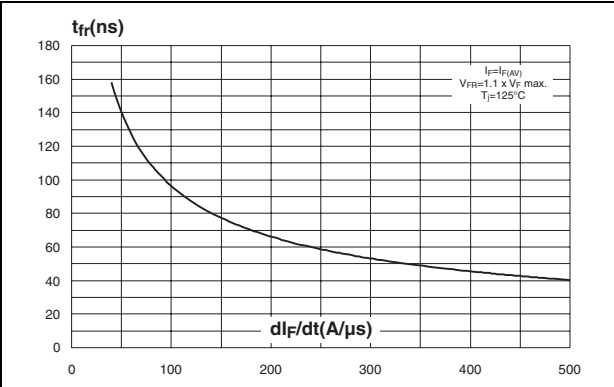


Figure 12. Junction capacitance versus reverse voltage applied (typical values)

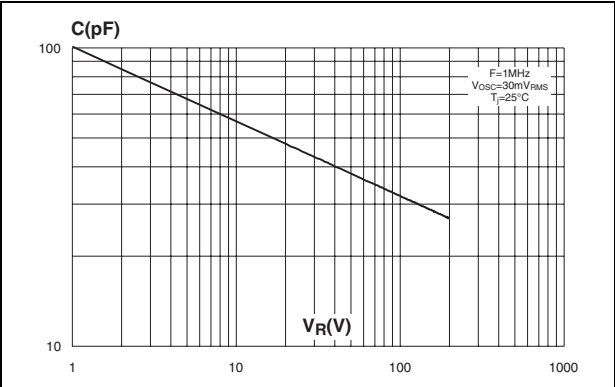
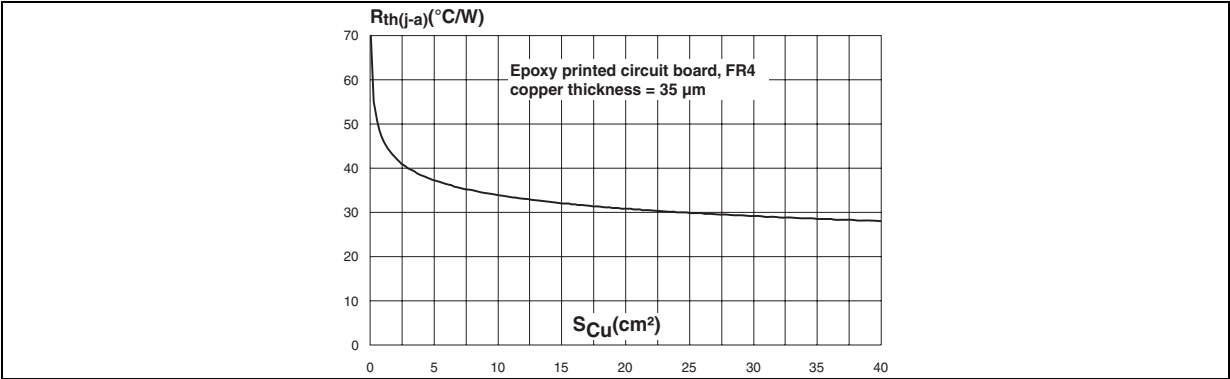


Figure 13. Thermal resistance junction to ambient versus copper surface under tab



## 2 Package information

- Epoxy meets UL94, V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.4 to 0.6 N·m

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.

**Table 6. TO-220AC dimensions**

| Ref.   | Dimensions  |       |            |       |
|--------|-------------|-------|------------|-------|
|        | Millimeters |       | Inches     |       |
|        | Min.        | Max.  | Min.       | Max.  |
| A      | 4.40        | 4.60  | 0.173      | 0.181 |
| C      | 1.23        | 1.32  | 0.048      | 0.051 |
| D      | 2.40        | 2.72  | 0.094      | 0.107 |
| E      | 0.49        | 0.70  | 0.019      | 0.027 |
| F      | 0.61        | 0.88  | 0.024      | 0.034 |
| F1     | 1.14        | 1.70  | 0.044      | 0.066 |
| G      | 4.95        | 5.15  | 0.194      | 0.202 |
| H2     | 10.00       | 10.40 | 0.393      | 0.409 |
| L2     | 16.40 typ.  |       | 0.645 typ. |       |
| L4     | 13.00       | 14.00 | 0.511      | 0.551 |
| L5     | 2.65        | 2.95  | 0.104      | 0.116 |
| L6     | 15.25       | 15.75 | 0.600      | 0.620 |
| L7     | 6.20        | 6.60  | 0.244      | 0.259 |
| L9     | 3.50        | 3.93  | 0.137      | 0.154 |
| M      | 2.6 typ.    |       | 0.102 typ. |       |
| Dia. I | 3.75        | 3.85  | 0.147      | 0.151 |

Table 7. TO-220FPAC dimensions

| Ref. | Dimensions  |      |           |       |
|------|-------------|------|-----------|-------|
|      | Millimeters |      | Inches    |       |
|      | Min.        | Max. | Min.      | Max.  |
| A    | 4.4         | 4.6  | 0.173     | 0.181 |
| B    | 2.5         | 2.7  | 0.098     | 0.106 |
| D    | 2.5         | 2.75 | 0.098     | 0.108 |
| E    | 0.45        | 0.70 | 0.018     | 0.027 |
| F    | 0.75        | 1    | 0.030     | 0.039 |
| F1   | 1.15        | 1.70 | 0.045     | 0.067 |
| G    | 4.95        | 5.20 | 0.195     | 0.205 |
| G1   | 2.4         | 2.7  | 0.094     | 0.106 |
| H    | 10          | 10.4 | 0.393     | 0.409 |
| L2   | 16 Typ.     |      | 0.63 Typ. |       |
| L3   | 28.6        | 30.6 | 1.126     | 1.205 |
| L4   | 9.8         | 10.6 | 0.386     | 0.417 |
| L5   | 2.9         | 3.6  | 0.114     | 0.142 |
| L6   | 15.9        | 16.4 | 0.626     | 0.646 |
| L7   | 9.00        | 9.30 | 0.354     | 0.366 |
| Dia. | 3.00        | 3.20 | 0.118     | 0.126 |

Table 8. TO-220AC (nins. and ins. 20-up) dimensions

| Ref. | Dimensions  |       |       |        |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | Millimeters |       |       | Inches |       |       |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| A    | 15.20       |       | 15.90 | 0.598  |       | 0.625 |
| a1   |             | 3.75  |       |        | 0.147 |       |
| a2   | 13.00       |       | 14.00 | 0.511  |       | 0.551 |
| B    | 10.00       |       | 10.40 | 0.393  |       | 0.409 |
| b1   | 0.61        |       | 0.88  | 0.024  |       | 0.034 |
| b2   | 1.23        |       | 1.32  | 0.048  |       | 0.051 |
| C    | 4.40        |       | 4.60  | 0.173  |       | 0.181 |
| c1   | 0.49        |       | 0.70  | 0.019  |       | 0.027 |
| c2   | 2.40        |       | 2.72  | 0.094  |       | 0.107 |
| e    | 4.80        |       | 5.40  | 0.189  |       | 0.212 |
| F    | 6.20        |       | 6.60  | 0.244  |       | 0.259 |
| ØI   | 3.75        |       | 3.85  | 0.147  |       | 0.151 |
| l4   | 15.80       | 16.40 | 16.80 | 0.622  | 0.646 | 0.661 |
| L    | 2.65        |       | 2.95  | 0.104  |       | 0.116 |
| l2   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| M    |             | 2.60  |       |        | 0.102 |       |

Technical drawing of a 100mm x 100mm x 10mm plate. The drawing includes a top view, a side view, and a detail view of the corner. Dimensions are labeled as follows:

- Top View:** L (Overall Length), L2 (Distance from top edge to center of hole), L3 (Distance from bottom edge to center of hole), E (Overall Width), G (Distance from center of hole to edge), B (Distance from center of hole to edge), B2 (Distance from center of hole to edge).
- Side View:** A (Overall Height), C2 (Distance from top edge to center of hole), D (Distance from center of hole to edge), R (Radius of corner).
- Detail View:** A1 (Distance from top edge to center of hole), A2 (Distance from top edge to center of hole), M (Distance from center of hole to edge), V2 (Distance from center of hole to edge).

\* FLAT ZONE NO LESS THAN 2mm

| Ref. | Dimensions  |       |            |       |
|------|-------------|-------|------------|-------|
|      | Millimeters |       | Inches     |       |
|      | Min.        | Max.  | Min.       | Max.  |
| A    | 4.40        | 4.60  | 0.173      | 0.181 |
| A1   | 2.49        | 2.69  | 0.098      | 0.106 |
| A2   | 0.03        | 0.23  | 0.001      | 0.009 |
| B    | 0.70        | 0.93  | 0.027      | 0.037 |
| B2   | 1.14        | 1.70  | 0.045      | 0.067 |
| C    | 0.45        | 0.60  | 0.017      | 0.024 |
| C2   | 1.23        | 1.36  | 0.048      | 0.054 |
| D    | 8.95        | 9.35  | 0.352      | 0.368 |
| E    | 10.00       | 10.40 | 0.393      | 0.409 |
| G    | 4.88        | 5.28  | 0.192      | 0.208 |
| L    | 15.00       | 15.85 | 0.590      | 0.624 |
| L2   | 1.27        | 1.40  | 0.050      | 0.055 |
| L3   | 1.40        | 1.75  | 0.055      | 0.069 |
| M    | 2.40        | 3.20  | 0.094      | 0.126 |
| R    | 0.40 typ.   |       | 0.016 typ. |       |
| V2   | 0°          | 8°    | 0°         | 8°    |

Technical drawing of a rectangular block with dimensions and a stepped profile. The main block has a width of 16.90 and a height of 10.30. A smaller section on the right has a width of 3.70 and a height of 5.08. The distance between the main block and the smaller section is 8.90. The smaller section has a height of 1.30.

### 3 Ordering information

**Table 10. Ordering information**

| Order code    | Marking     | Package            | Weight | Base qty | Delivery mode |
|---------------|-------------|--------------------|--------|----------|---------------|
| STTH12R06D    | STTH12R06D  | TO-220AC           | 1.90 g | 50       | Tube          |
| STTH12R06G    | STTH12R06G  | D <sup>2</sup> PAK | 1.48 g | 50       | Tube          |
| STTH12R06G-TR | STTH12R06G  | D <sup>2</sup> PAK | 1.48 g | 1000     | Tape and reel |
| STTH12R06FP   | STTH12R06FP | TO-220FPAC         | 1.70 g | 50       | Tube          |
| STTH12R06DIRG | STTH12R06DI | TO-220AC ins.      | 1.86 g | 50       | Tube          |

### 4 Revision history

**Table 11. Document revision history**

| Date         | Revision | Changes                                                                       |
|--------------|----------|-------------------------------------------------------------------------------|
| January-2002 | 1        | Initial release.                                                              |
| 18-Oct-2004  | 2        | D <sup>2</sup> PAK and TO-220AC insulated packages added                      |
| 10-Aug-2006  | 3        | Reformatted to current standards. Added package insulation voltages on page 1 |
| 15-Feb-2010  | 4        | Corrected typographical error in order codes in <a href="#">Table 10</a> .    |

**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.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

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.

© 2010 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)