

# NXP BT136S-600E 4Q Triac datasheet

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Planar passivated sensitive gate four quadrant triac in a SOT428 (DPAK) surfacemountable plastic package intended for use in general purpose bidirectional switching and phase control applications. This sensitive gate "series E" triac is intended to be interfaced directly to microcontrollers, logic integrated circuits and other low power gate trigger circuits.

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# BT136S-600E

4Q Triac

30 September 2013

Product data sheet

## 1. General description

Planar passivated sensitive gate four quadrant triac in a SOT428 (DPAK) surface-mountable plastic package intended for use in general purpose bidirectional switching and phase control applications. This sensitive gate "series E" triac is intended to be interfaced directly to microcontrollers, logic integrated circuits and other low power gate trigger circuits.

## 2. Features and benefits

- Direct triggering from low power drivers and logic ICs
- High blocking voltage capability
- Low holding current for low current loads and lowest EMI at commutation
- Planar passivated for voltage ruggedness and reliability
- Sensitive gate
- Surface-mountable package
- Triggering in all four quadrants

## 3. Applications

- General purpose motor control
- General purpose switching

## 4. Quick reference data

Table 1. Quick reference data

| Symbol                 | Parameter                            | Conditions                                                                                                                           | Min | Typ | Max | Unit |
|------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $V_{DRM}$              | repetitive peak off-state voltage    |                                                                                                                                      | -   | -   | 600 | V    |
| $I_{TSM}$              | non-repetitive peak on-state current | full sine wave; $T_{j(init)} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>  | -   | -   | 25  | A    |
| $I_{T(RMS)}$           | RMS on-state current                 | full sine wave; $T_{mb} \leq 107\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a> | -   | -   | 4   | A    |
| Static characteristics |                                      |                                                                                                                                      |     |     |     |      |
| $I_{GT}$               | gate trigger current                 | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_2 + G+$ ; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a>                | -   | 2.5 | 10  | mA   |
|                        |                                      | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_2 + G-$ ; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a>                | -   | 4   | 10  | mA   |

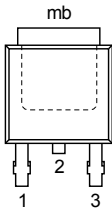
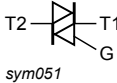


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| Symbol | Parameter       | Conditions                                                                                                          |  | Min | Typ | Max | Unit |
|--------|-----------------|---------------------------------------------------------------------------------------------------------------------|--|-----|-----|-----|------|
|        |                 | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-;<br>$T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a> |  | -   | 5   | 10  | mA   |
|        |                 | $V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G+;<br>$T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 7</a> |  | -   | 11  | 25  | mA   |
| $I_H$  | holding current | $V_D = 12\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 9</a>                                   |  | -   | 2.2 | 15  | mA   |

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                    | Simplified outline                                                                                  | Graphic symbol                                                                                |
|-----|--------|--------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1   | T1     | main terminal 1                | <br>DPAK (SOT428) | <br>sym051 |
| 2   | T2     | main terminal 2                |                                                                                                     |                                                                                               |
| 3   | G      | gate                           |                                                                                                     |                                                                                               |
| mb  | T2     | mounting base; main terminal 2 |                                                                                                     |                                                                                               |

6. Ordering information

Table 3. Ordering information

| Type number | Package |                                                                                 |         |
|-------------|---------|---------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                     | Version |
| BT136S-600E | DPAK    | plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped) | SOT428  |

7. Limiting values

Table 4. Limiting values  
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol              | Parameter                            | Conditions                                                                                                            |  | Min | Max | Unit             |
|---------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--|-----|-----|------------------|
| V <sub>DRM</sub>    | repetitive peak off-state voltage    |                                                                                                                       |  | -   | 600 | V                |
| I <sub>T(RMS)</sub> | RMS on-state current                 | full sine wave; T <sub>mb</sub> ≤ 107 °C; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>    |  | -   | 4   | A                |
| I <sub>TSM</sub>    | non-repetitive peak on-state current | full sine wave; T <sub>j(init)</sub> = 25 °C; t <sub>p</sub> = 20 ms; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a> |  | -   | 25  | A                |
|                     |                                      | full sine wave; T <sub>j(init)</sub> = 25 °C; t <sub>p</sub> = 16.7 ms                                                |  | -   | 27  | A                |
| I <sup>2</sup> t    | I2t for fusing                       | t <sub>p</sub> = 10 ms; SIN                                                                                           |  | -   | 3.1 | A <sup>2</sup> s |
| dI <sub>T</sub> /dt | rate of rise of on-state current     | I <sub>T</sub> = 6 A; I <sub>G</sub> = 0.2 A; dI <sub>G</sub> /dt = 0.2 A/μs; T2+ G+                                  |  | -   | 50  | A/μs             |
|                     |                                      | I <sub>T</sub> = 6 A; I <sub>G</sub> = 0.2 A; dI <sub>G</sub> /dt = 0.2 A/μs; T2+ G-                                  |  | -   | 50  | A/μs             |
|                     |                                      | I <sub>T</sub> = 6 A; I <sub>G</sub> = 0.2 A; dI <sub>G</sub> /dt = 0.2 A/μs; T2- G-                                  |  | -   | 50  | A/μs             |
|                     |                                      | I <sub>T</sub> = 6 A; I <sub>G</sub> = 0.2 A; dI <sub>G</sub> /dt = 0.2 A/μs; T2- G+                                  |  | -   | 10  | A/μs             |
| I <sub>GM</sub>     | peak gate current                    |                                                                                                                       |  | -   | 2   | A                |
| P <sub>GM</sub>     | peak gate power                      |                                                                                                                       |  | -   | 5   | W                |
| P <sub>G(AV)</sub>  | average gate power                   | over any 20 ms period                                                                                                 |  | -   | 0.5 | W                |
| T <sub>stg</sub>    | storage temperature                  |                                                                                                                       |  | -40 | 150 | °C               |
| T <sub>j</sub>      | junction temperature                 |                                                                                                                       |  | -   | 125 | °C               |

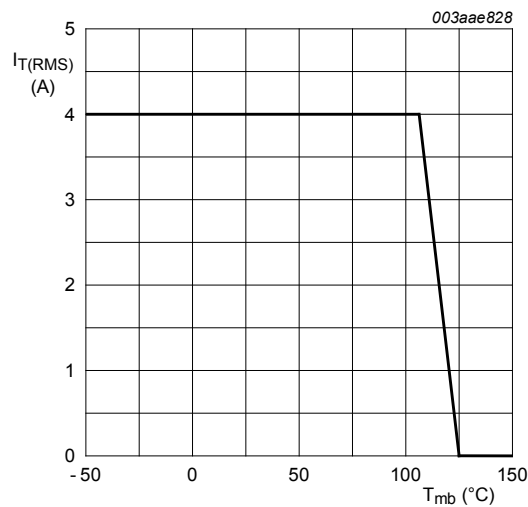
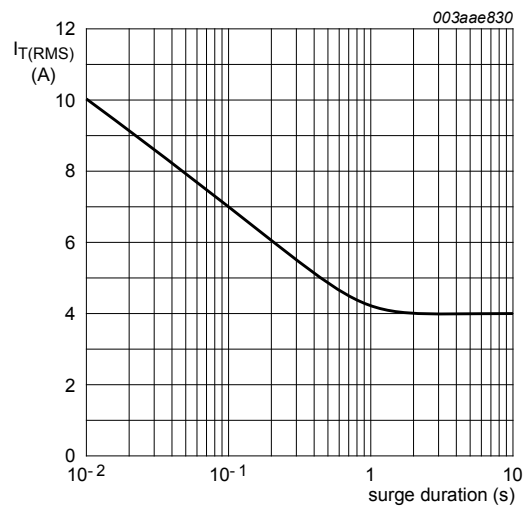


Fig. 1. RMS on-state current as a function of mounting base temperature; maximum values



$f = 50\text{ Hz}$   
 $T_{mb} \leq 107\text{ °C}$

Fig. 2. RMS on-state current as a function of surge duration; maximum values

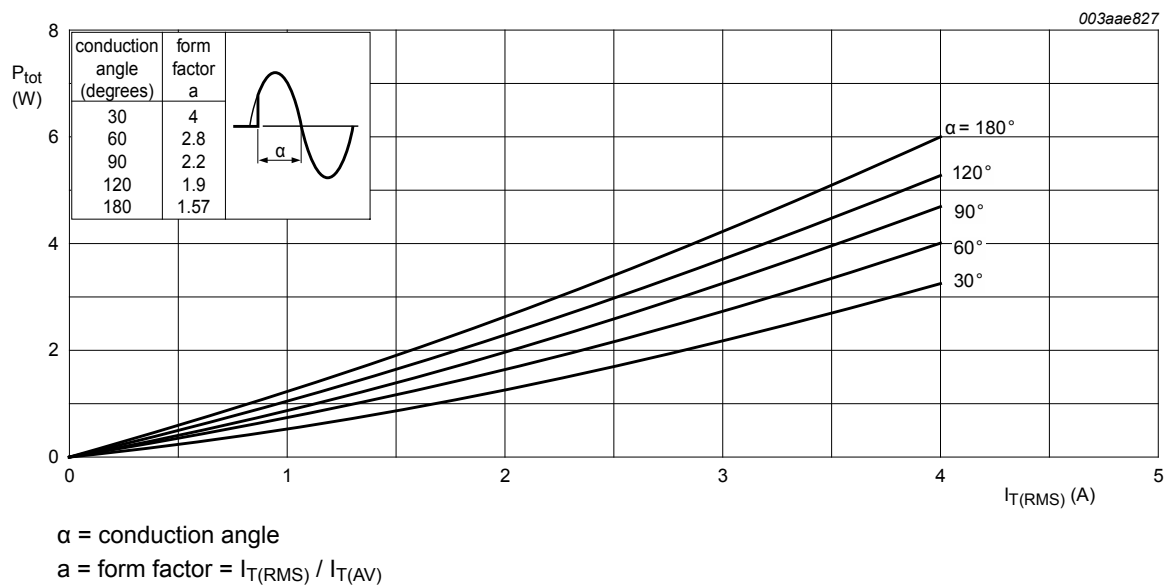


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

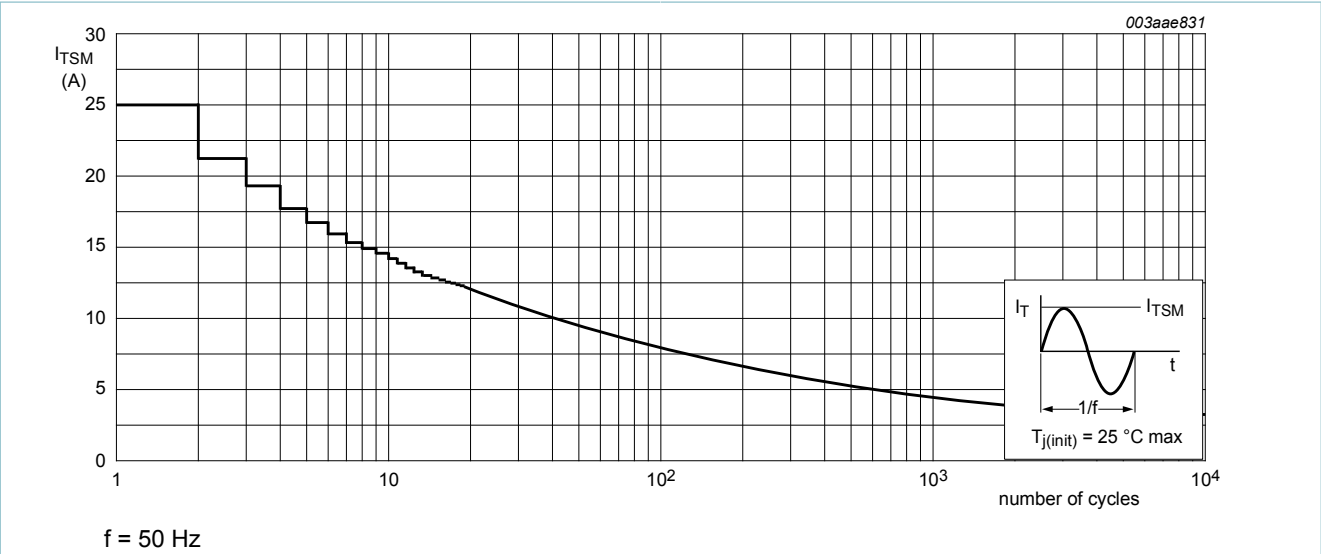


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

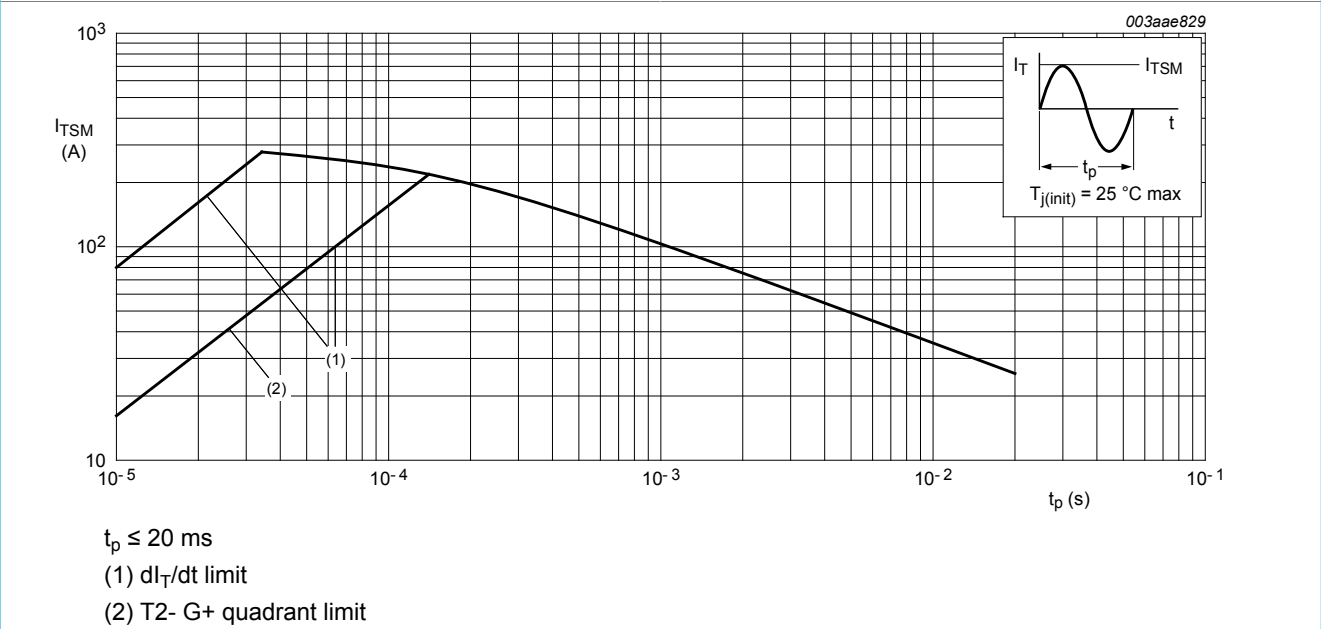


Fig. 5. Non-repetitive peak on-state current as a function of pulse width; maximum values

8. Thermal characteristics

Table 5. Thermal characteristics

| Symbol         | Parameter                                         | Conditions                                                                                            | Min | Typ | Max | Unit |
|----------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | half cycle; Fig. 6                                                                                    | -   | -   | 3.7 | K/W  |
|                |                                                   | full cycle; Fig. 6                                                                                    | -   | -   | 3   | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | in free air; printed circuit board (FR4) mounted; standard footprint, single-sided copper, tin-plated | -   | 75  | -   | K/W  |

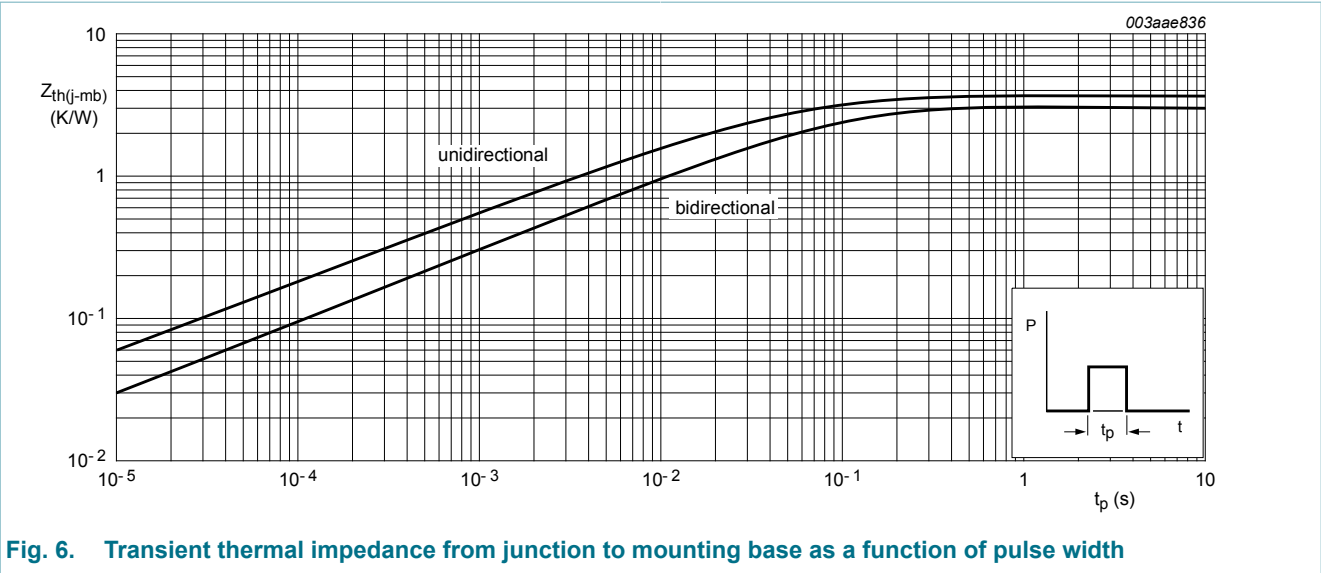
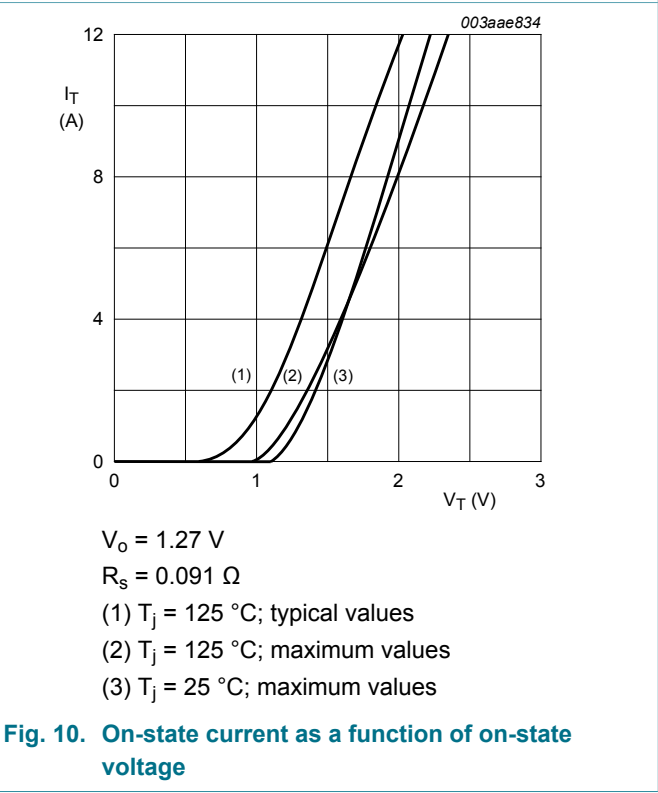
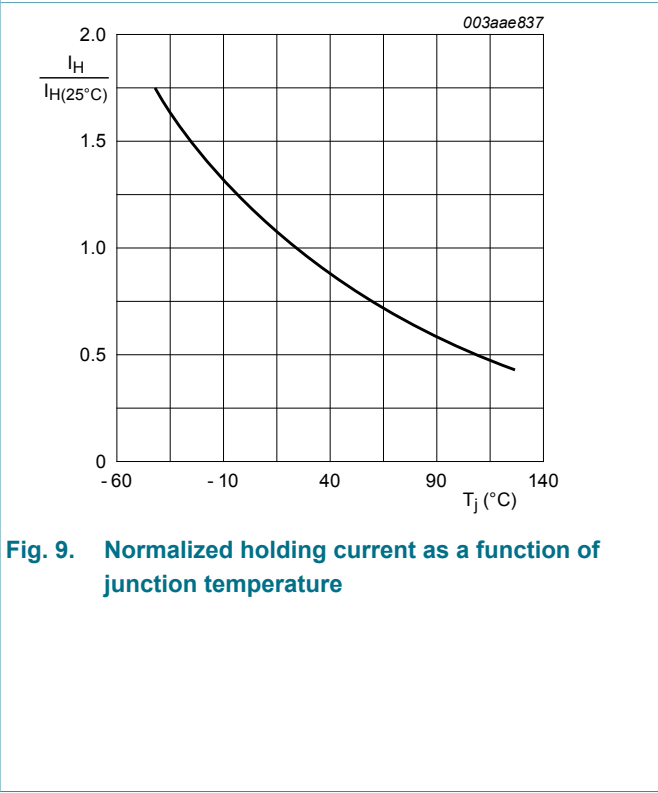
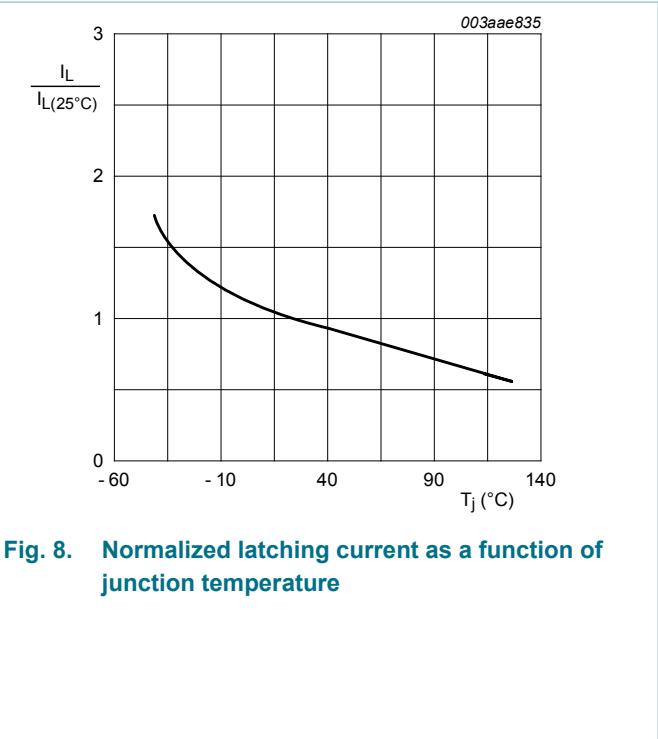
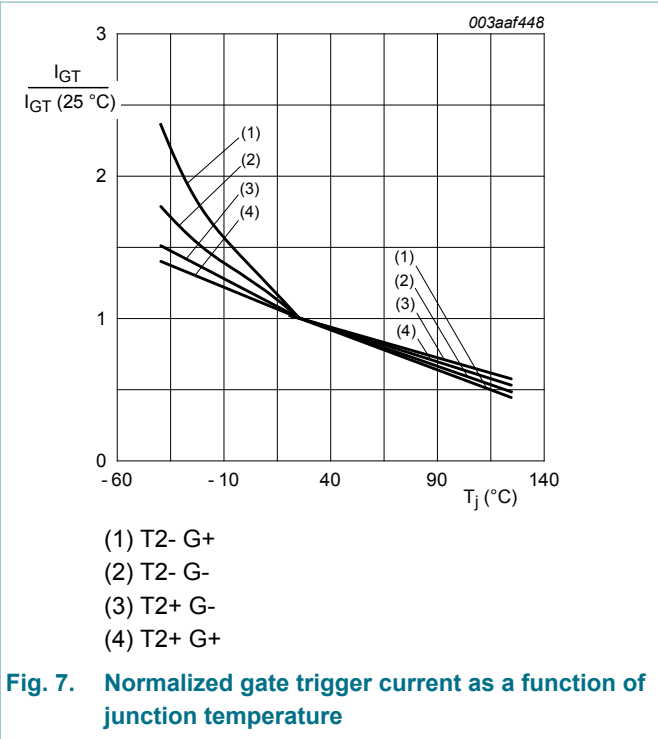


Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse width

9. Characteristics

Table 6. Characteristics

| Symbol                  | Parameter                         | Conditions                                                                                                                              |  | Min  | Typ | Max | Unit |
|-------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--|------|-----|-----|------|
| Static characteristics  |                                   |                                                                                                                                         |  |      |     |     |      |
| I <sub>GT</sub>         | gate trigger current              | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G+; T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>                                   |  | -    | 2.5 | 10  | mA   |
|                         |                                   | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2+ G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>                                   |  | -    | 4   | 10  | mA   |
|                         |                                   | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2- G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>                                   |  | -    | 5   | 10  | mA   |
|                         |                                   | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T2- G+; T <sub>j</sub> = 25 °C; <a href="#">Fig. 7</a>                                   |  | -    | 11  | 25  | mA   |
| I <sub>L</sub>          | latching current                  | V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2+ G+; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>                                   |  | -    | 3   | 15  | mA   |
|                         |                                   | V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2+ G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>                                   |  | -    | 10  | 20  | mA   |
|                         |                                   | V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2- G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>                                   |  | -    | 2.5 | 15  | mA   |
|                         |                                   | V <sub>D</sub> = 12 V; I <sub>G</sub> = 0.1 A; T2- G+; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>                                   |  | -    | 4   | 20  | mA   |
| I <sub>H</sub>          | holding current                   | V <sub>D</sub> = 12 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 9</a>                                                                   |  | -    | 2.2 | 15  | mA   |
| V <sub>T</sub>          | on-state voltage                  | I <sub>T</sub> = 5 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 10</a>                                                                   |  | -    | 1.4 | 1.7 | V    |
| V <sub>GT</sub>         | gate trigger voltage              | V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 11</a>                                          |  | -    | 0.7 | 1   | V    |
|                         |                                   | V <sub>D</sub> = 400 V; I <sub>T</sub> = 0.1 A; T <sub>j</sub> = 125 °C; <a href="#">Fig. 11</a>                                        |  | 0.25 | 0.4 | -   | V    |
| I <sub>D</sub>          | off-state current                 | V <sub>D</sub> = 600 V; T <sub>j</sub> = 125 °C                                                                                         |  | -    | 0.1 | 0.5 | mA   |
| Dynamic characteristics |                                   |                                                                                                                                         |  |      |     |     |      |
| dV <sub>D</sub> /dt     | rate of rise of off-state voltage | V <sub>DM</sub> = 402 V; T <sub>j</sub> = 125 °C; (V <sub>DM</sub> = 67% of V <sub>DRM</sub> ); exponential waveform; gate open circuit |  | -    | 50  | -   | V/μs |
| t <sub>gt</sub>         | gate-controlled turn-on time      | I <sub>TM</sub> = 6 A; V <sub>D</sub> = 600 V; I <sub>G</sub> = 0.1 A; dI <sub>G</sub> /dt = 5 A/μs                                     |  | -    | 2   | -   | μs   |



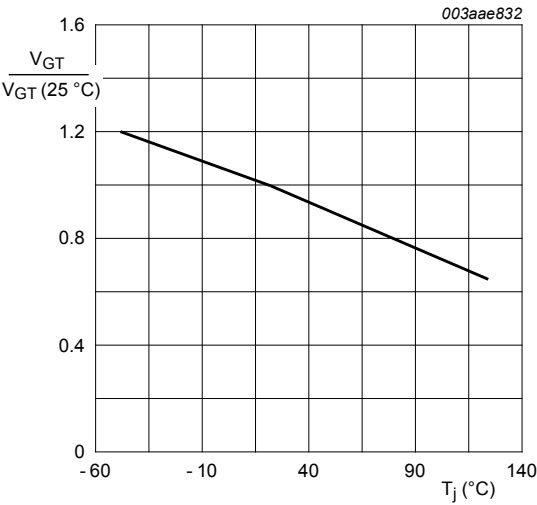


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

10. Package outline

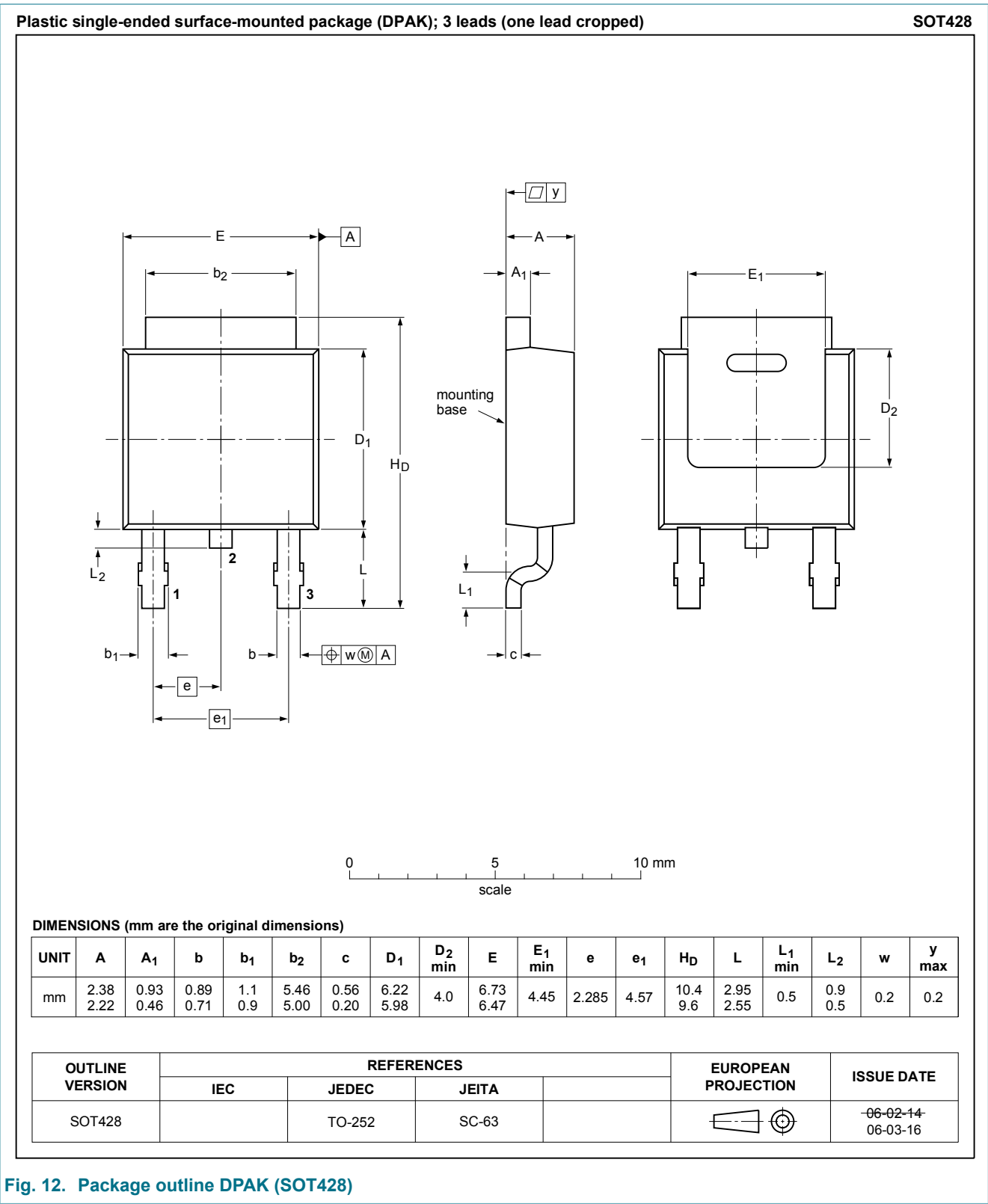


Fig. 12. Package outline DPAK (SOT428)

11. Soldering

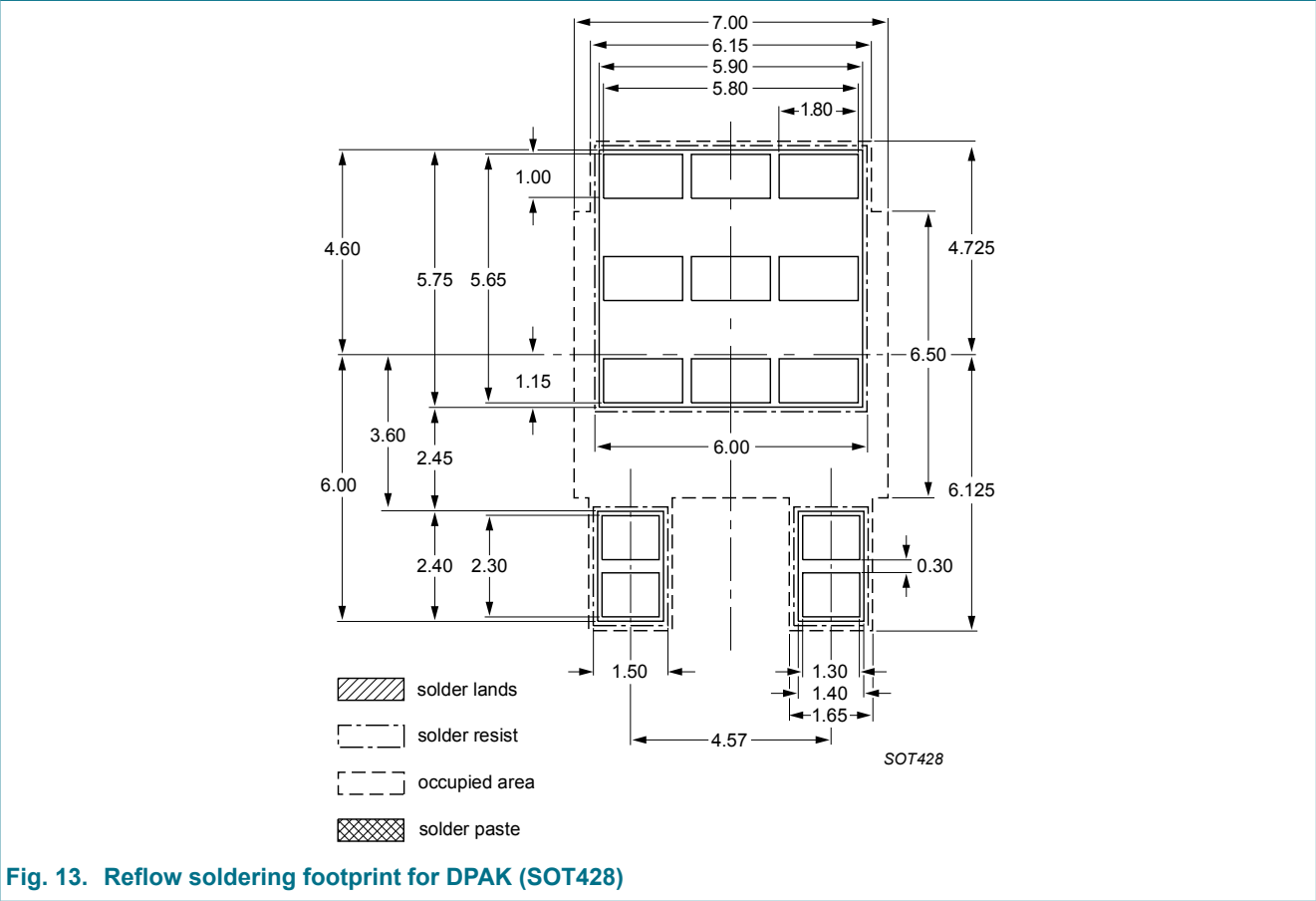


Fig. 13. Reflow soldering footprint for DPAK (SOT428)

12. Legal information

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| Document status [1][2]         | Product status [3] | Definition                                                                            |
|--------------------------------|--------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet   | Development        | This document contains data from the objective specification for product development. |
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