

# BUJD105AD

NPN power transistor with integrated diode

Rev. 02 — 29 July 2010

Product data sheet

## 1. Product profile

### 1.1 General description

High voltage, high speed, planar passivated NPN power switching transistor with integrated anti-parallel E-C diode in a SOT428 (DPAK) surface-mountable plastic package.

### 1.2 Features and benefits

- Fast switching
- High voltage capability
- Very low switching and conduction losses

### 1.3 Applications

- DC-to-DC converters
- Electronic lighting ballasts
- Inverters
- Motor control systems

### 1.4 Quick reference data

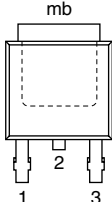
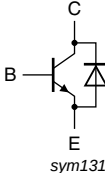
Table 1. Quick reference data

| Symbol                        | Parameter                      | Conditions                                                                                                                          | Min | Typ  | Max | Unit |
|-------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| $I_C$                         | collector current              | see <a href="#">Figure 1</a> ; see <a href="#">Figure 2</a> ; DC                                                                    | -   | -    | 8   | A    |
| $P_{tot}$                     | total power dissipation        | $T_{mb} \leq 25\text{ °C}$ ; see <a href="#">Figure 3</a>                                                                           | -   | -    | 80  | W    |
| $V_{CESM}$                    | collector-emitter peak voltage | $V_{BE} = 0\text{ V}$                                                                                                               | -   | -    | 700 | V    |
| <b>Static characteristics</b> |                                |                                                                                                                                     |     |      |     |      |
| $h_{FE}$                      | DC current gain                | $V_{CE} = 5\text{ V}$ ; $I_C = 4\text{ A}$ ; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a> | 8   | 12.5 | -   |      |



## 2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description              | Simplified outline                                                                | Graphic symbol                                                                      |
|-----|--------|--------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1   | B      | base                     |  |  |
| 2   | C      | collector <sup>[1]</sup> |                                                                                   |                                                                                     |
| 3   | E      | emitter                  |                                                                                   |                                                                                     |

**SOT428 (DPAK)**

[1] It is not possible to make a connection to pin 2 of the SOT428 (DPAK) package.

## 3. Ordering information

Table 3. Ordering information

| Type number | Package |                                                                                 |         |
|-------------|---------|---------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                     | Version |
| BUJD105AD   | DPAK    | plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped) | SOT428  |

## 4. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol     | Parameter                      | Conditions                                                      | Min | Max | Unit |
|------------|--------------------------------|-----------------------------------------------------------------|-----|-----|------|
| $V_{CESM}$ | collector-emitter peak voltage | $V_{BE} = 0\text{ V}$                                           | -   | 700 | V    |
| $V_{CBO}$  | collector-base voltage         | $I_E = 0\text{ A}$                                              | -   | 700 | V    |
| $V_{CEO}$  | collector-emitter voltage      | $I_B = 0\text{ A}$                                              | -   | 400 | V    |
| $I_C$      | collector current              | DC; see <a href="#">Figure 1</a> ; see <a href="#">Figure 2</a> | -   | 8   | A    |
| $I_{CM}$   | peak collector current         | see <a href="#">Figure 1</a> ; see <a href="#">Figure 2</a>     | -   | 16  | A    |
| $I_B$      | base current                   | DC                                                              | -   | 4   | A    |
| $I_{BM}$   | peak base current              |                                                                 | -   | 8   | A    |
| $P_{tot}$  | total power dissipation        | $T_{mb} \leq 25\text{ °C}$ ; see <a href="#">Figure 3</a>       | -   | 80  | W    |
| $T_{stg}$  | storage temperature            |                                                                 | -65 | 150 | °C   |
| $T_j$      | junction temperature           |                                                                 | -   | 150 | °C   |

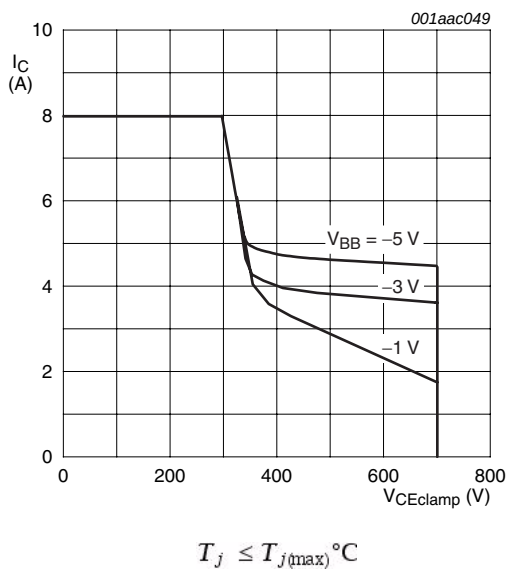
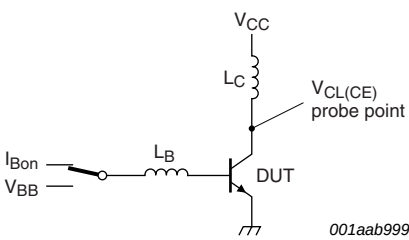
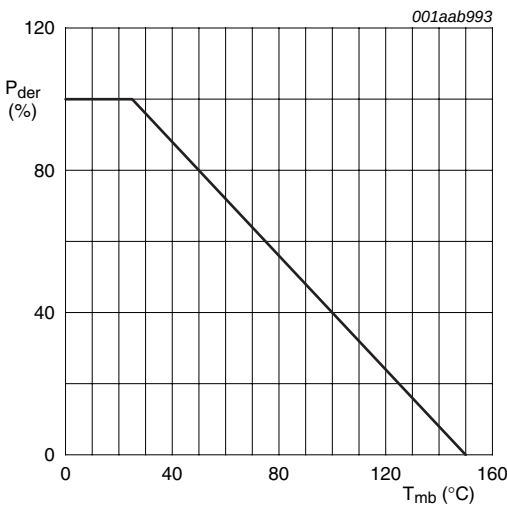


Fig 1. Reverse bias safe operating area



$V_{CL(CE)} \leq 1000\text{ V}; V_{CC} = 150\text{ V}; V_{BB} = -5\text{ V};$   
 $L_B = 1\text{ }\mu\text{H}; L_C = 200\text{ }\mu\text{H}$

Fig 2. Test circuit for reverse bias safe operating area



$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}\text{C})}} \times 100\%$$

Fig 3. Normalized total power dissipation as a function of mounting base temperature

5. Thermal characteristics

Table 5. Thermal characteristics

| Symbol         | Parameter                                         | Conditions                                                                     | Min | Typ | Max  | Unit |
|----------------|---------------------------------------------------|--------------------------------------------------------------------------------|-----|-----|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | see <a href="#">Figure 5</a>                                                   | -   | -   | 1.56 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | printed-circuit-board mounted; minimum footprint; see <a href="#">Figure 4</a> | -   | 75  | -    | K/W  |

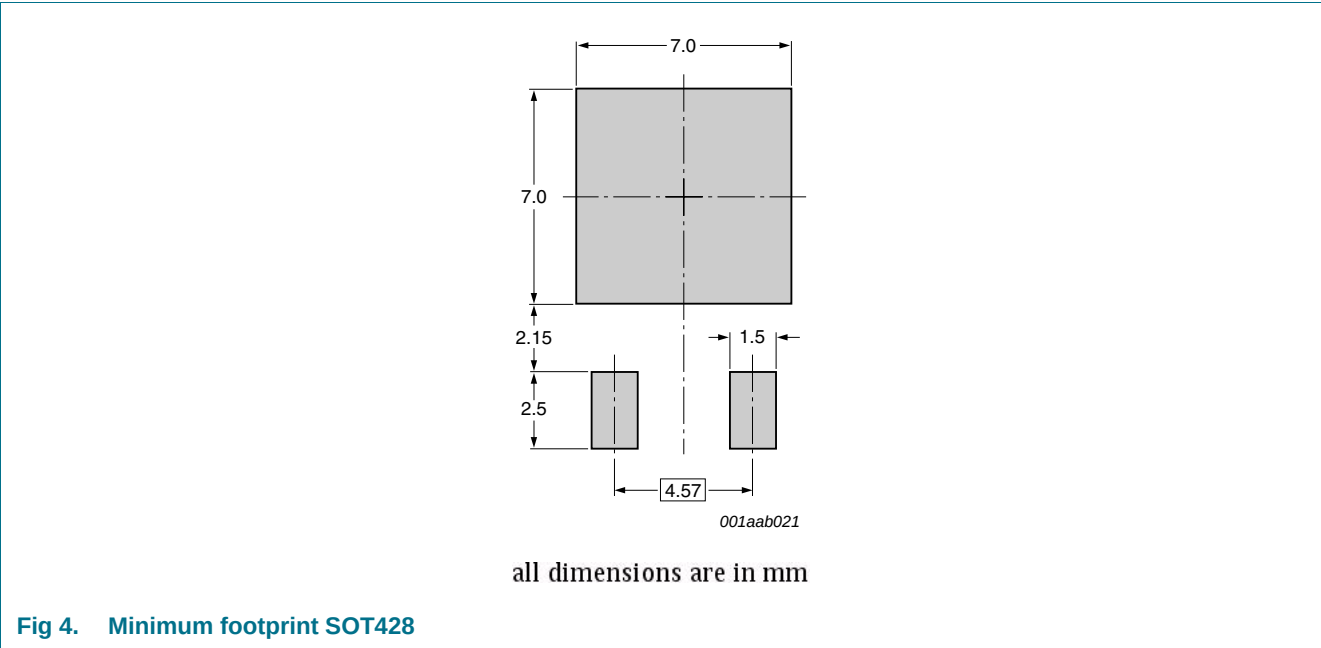


Fig 4. Minimum footprint SOT428

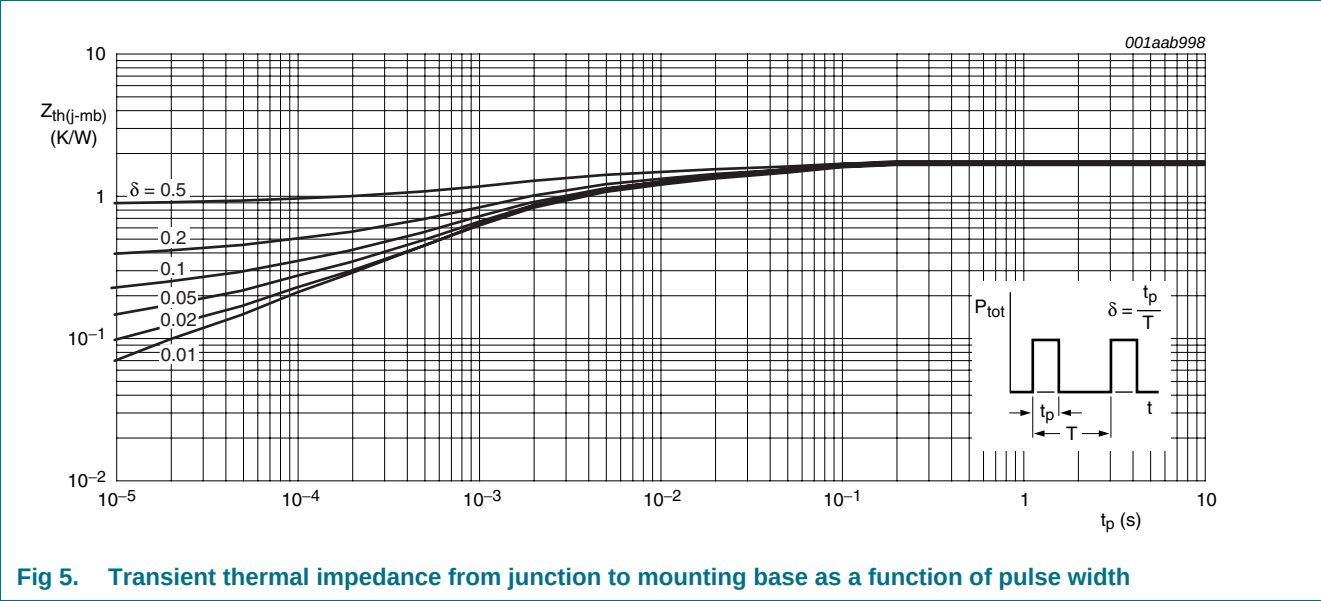


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse width

## 6. Characteristics

Table 6. Characteristics

| Symbol                  | Parameter                            | Conditions                                                                                                                                                                                           | Min | Typ   | Max  | Unit   |
|-------------------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|------|--------|
| Static characteristics  |                                      |                                                                                                                                                                                                      |     |       |      |        |
| I <sub>CES</sub>        | collector-emitter cut-off current    | V <sub>BE</sub> = 0 V; V <sub>CE</sub> = 700 V; T <sub>j</sub> = 25 °C                                                                                                                               | [1] | -     | -    | 0.2 mA |
|                         |                                      | V <sub>BE</sub> = 0 V; V <sub>CE</sub> = 700 V; T <sub>j</sub> = 125 °C                                                                                                                              | [1] | -     | -    | 0.5 mA |
| I <sub>CBO</sub>        | collector-base cut-off current       | V <sub>CB</sub> = 700 V; I <sub>E</sub> = 0 A                                                                                                                                                        | [1] | -     | -    | 0.2 mA |
| I <sub>CEO</sub>        | collector-emitter cut-off current    | V <sub>CE</sub> = 400 V; I <sub>B</sub> = 0 A                                                                                                                                                        | [1] | -     | -    | 0.1 mA |
| I <sub>EBO</sub>        | emitter-base cut-off current         | V <sub>EB</sub> = 9 V; I <sub>C</sub> = 0 A                                                                                                                                                          | -   | -     | -    | 10 mA  |
| V <sub>CEsat</sub>      | collector-emitter saturation voltage | I <sub>C</sub> = 4 A; I <sub>B</sub> = 0.8 A; see <a href="#">Figure 6</a> ; see <a href="#">Figure 7</a>                                                                                            | -   | 0.35  | 1    | V      |
| V <sub>BEsat</sub>      | base-emitter saturation voltage      | I <sub>C</sub> = 4 A; I <sub>B</sub> = 0.8 A; see <a href="#">Figure 8</a>                                                                                                                           | -   | 1     | 1.5  | V      |
| V <sub>F</sub>          | forward voltage                      | I <sub>F</sub> = 4 A; T <sub>j</sub> = 25 °C                                                                                                                                                         | -   | 1.07  | 1.5  | V      |
| h <sub>FE</sub>         | DC current gain                      | I <sub>C</sub> = 4 A; V <sub>CE</sub> = 5 V; T <sub>mb</sub> = 25 °C; see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a>                                                                   | 8   | 12.5  | -    |        |
|                         |                                      | I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 5 V; T <sub>mb</sub> = 25 °C                                                                                                                                | 10  | 17    | 34   |        |
|                         |                                      | I <sub>C</sub> = 500 mA; V <sub>CE</sub> = 5 V; T <sub>mb</sub> = 25 °C                                                                                                                              | 13  | 22    | 36   |        |
| Dynamic characteristics |                                      |                                                                                                                                                                                                      |     |       |      |        |
| t <sub>on</sub>         | turn-on time                         | I <sub>C</sub> = 5 A; I <sub>Bon</sub> = 1 A; I <sub>Boff</sub> = -1 A;                                                                                                                              | -   | 0.65  | 1    | μs     |
| t <sub>s</sub>          | storage time                         | R <sub>L</sub> = 75 Ω; T <sub>j</sub> = 25 °C; resistive load; see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a>                                                                         | -   | 1.8   | 2.5  | μs     |
|                         |                                      | I <sub>C</sub> = 5 A; I <sub>Bon</sub> = 1 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>j</sub> = 25 °C; inductive load; see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>   | -   | 1.2   | 1.7  | μs     |
|                         |                                      | I <sub>C</sub> = 5 A; I <sub>Bon</sub> = 1 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>j</sub> = 100 °C; inductive load; see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>  | -   | 1.4   | 1.9  | μs     |
| t <sub>f</sub>          | fall time                            | I <sub>C</sub> = 5 A; I <sub>Bon</sub> = 1 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>mb</sub> = 25 °C; inductive load; see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>  | -   | 0.02  | 0.05 | μs     |
|                         |                                      | I <sub>C</sub> = 5 A; I <sub>Bon</sub> = 1 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>mb</sub> = 100 °C; inductive load; see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a> | -   | 0.025 | 0.1  | μs     |
|                         |                                      | I <sub>C</sub> = 5 A; I <sub>Bon</sub> = 1 A; I <sub>Boff</sub> = -1 A; R <sub>L</sub> = 75 Ω; T <sub>j</sub> = 25 °C; resistive load; see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a> | -   | 0.3   | 0.5  | μs     |

[1] Measured with half-sine wave voltage (curve tracer).

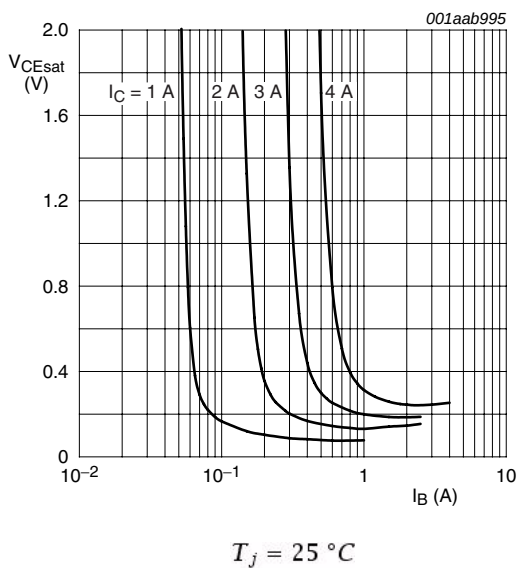


Fig 6. Collector-emitter saturation voltage as a function of base current; typical values

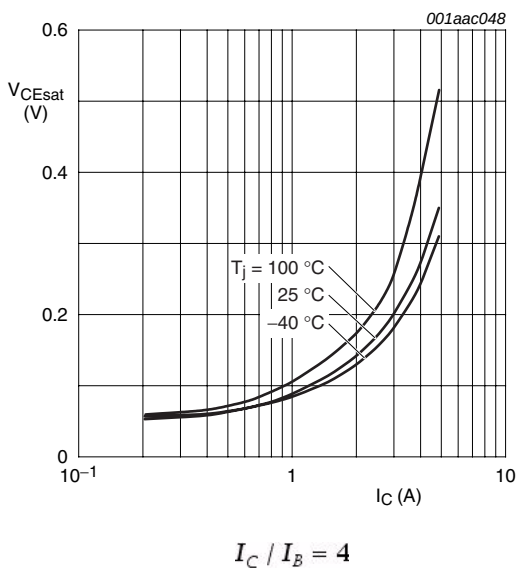


Fig 7. Collector-emitter saturation voltage as a function of collector current; typical values

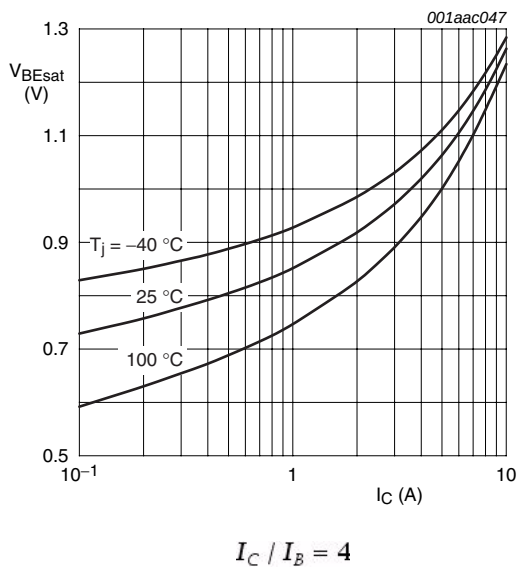


Fig 8. Base-emitter saturation voltage as a function of collector current; typical values

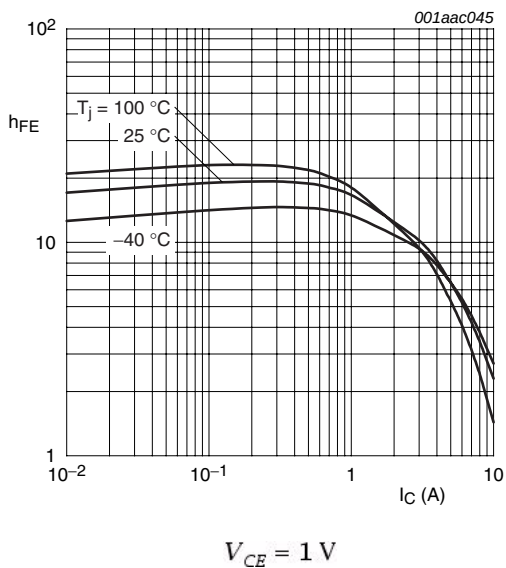


Fig 9. DC current gain as a function of collector current; typical values

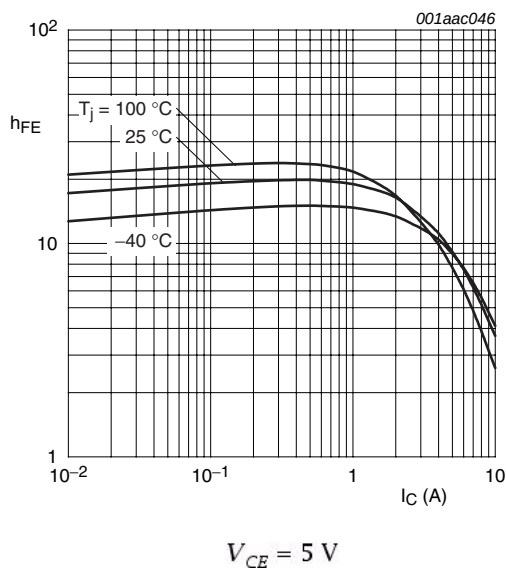
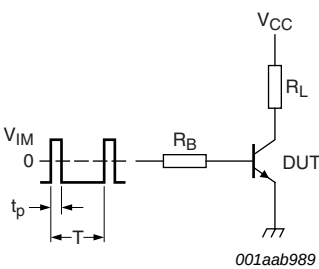


Fig 10. DC current gain as a function of collector current; typical values



$V_{IM} = -6\text{ to }+8\text{ V}$ ;  $V_{CC} = 250\text{ V}$ ;  $t_p = 20\text{ }\mu\text{s}$ ;  $\delta = \frac{t_p}{T} = 0.01$   
 $R_B$  and  $R_L$  calculated from  $I_{Con}$  and  $I_{Bon}$  requirements.

Fig 11. Test circuit for resistive load switching

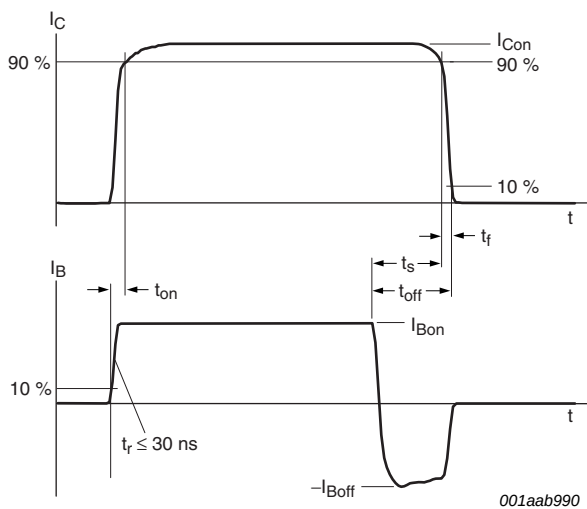
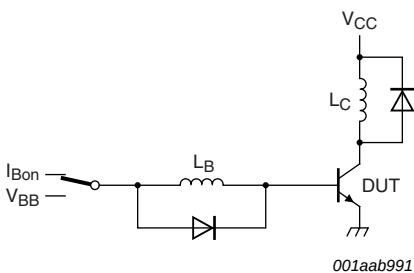


Fig 12. Switching times waveforms for resistive load



$V_{CC} = 300\text{ V}$ ;  $V_{BB} = -5\text{ V}$ ;  $L_C = 200\text{ }\mu\text{H}$ ;  $L_B = 1\text{ }\mu\text{H}$

Fig 13. Test circuit for inductive load switching

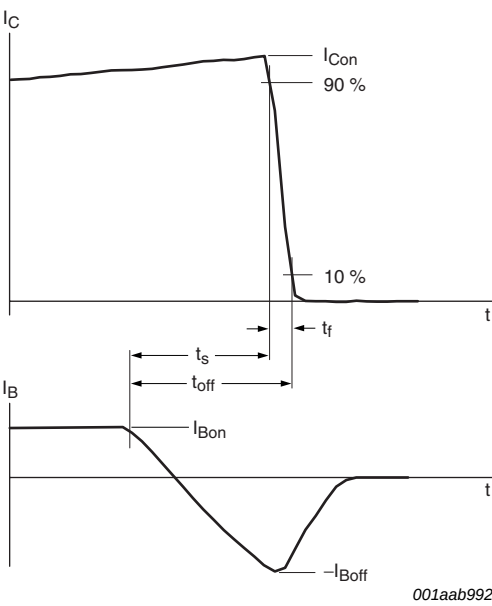


Fig 14. Switching times waveforms for inductive load



7. Package outline

Plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped)

SOT428

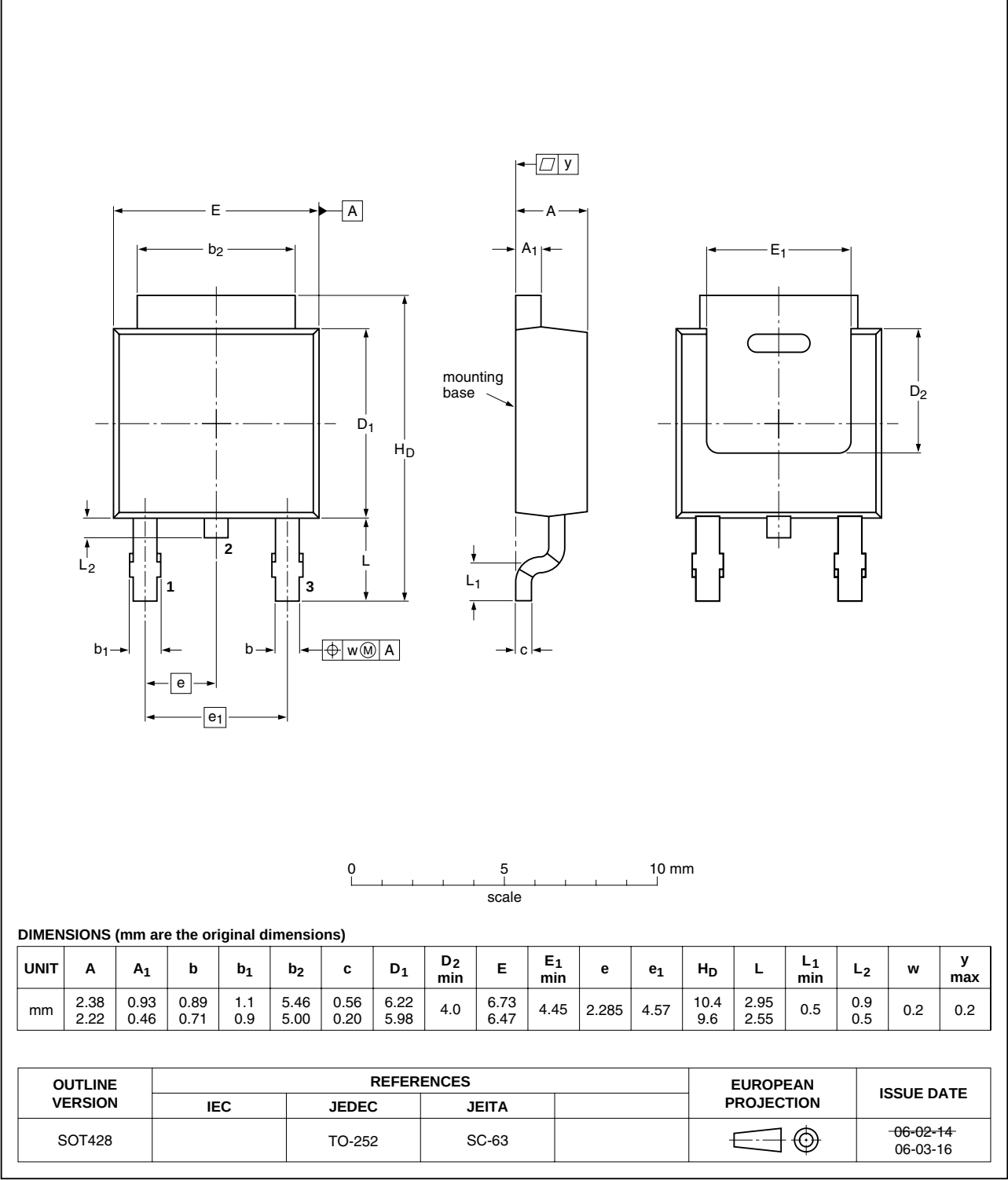


Fig 15. Package outline SOT428 (DPAK)

## 8. Revision history

Table 7. Revision history

| Document ID    | Release date                                                                  | Data sheet status  | Change notice | Supersedes    |
|----------------|-------------------------------------------------------------------------------|--------------------|---------------|---------------|
| BUJD105AD v.2  | 20100729                                                                      | Product data sheet | -             | BUJD105AD v.1 |
| Modifications: | <ul style="list-style-type: none"><li>• Various changes to content.</li></ul> |                    |               |               |
| BUJD105AD v.1  | 20090508                                                                      | Product data sheet | -             | -             |

## 9. Legal information

### 9.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition                                                                            |
|-----------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

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