# BUJ303AD

## NPN power transistor

23 July 2018 Product data sheet

## 1. General description

High voltage, high speed planar passivated NPN power switching transistor in a SOT428 (DPAK) surface mountable plastic package.

## 2. Features and benefits

- Fast switching
- Low thermal resistance
- Surface mountable package
- Very high voltage capability
- Very low switching and conduction losses

## 3. Applications

- DC-to-DC converters
- High frequency electronic lighting ballasts
- Inverters
- Motor control systems

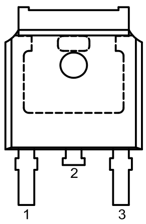
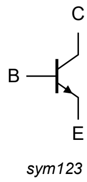
## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{CM}$ | peak collector current | Fig. 1; Fig. 2; Fig. 3 | | - | - | 10 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} \leq$ 25 °C; Fig. 4 | | - | - | 80 | W |
| $V_{CESM}$ | collector-emitter peak voltage | $V_{BE}$ = 0 V | | - | - | 1000 | V |
| **Static characteristics** | | | | | | | |
| $h_{FE}$ | DC current gain | $I_C$ = 5 mA; $V_{CE}$ = 5 V; $T_{mb}$ = 25 °C; Fig. 11 | | 10 | 22 | 30 | |
| | | $I_C$ = 500 mA; $V_{CE}$ = 5 V; $T_{mb}$ = 25 °C; Fig. 11 | | 14 | 25 | 35 | |

## 5. Pinning information

### Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | B | base |   DPAK (SOT428) |   |
| 2 | C | collector[1] | | |
| 3 | E | emitter | | |
| mb | C | mounting base; connected to collector | | |

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

## 6. Ordering information

### Table 3. Ordering information

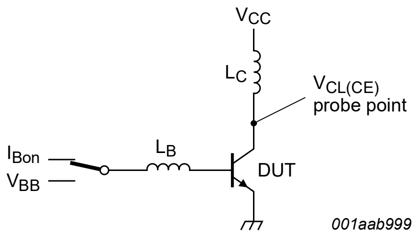
| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BUJ303AD | DPAK | plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped) | SOT428 |

# 7. Limiting values

**Table 4. Limiting values**

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

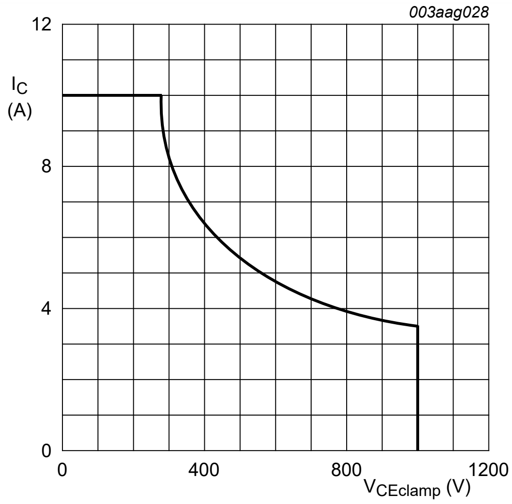
| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CESM}$ | collector-emitter peak voltage | $V_{BE}$ = 0 V | | - | 1000 | V |
| $V_{CEO}$ | collector-emitter voltage | $I_B$ = 0 A | | - | 500 | V |
| $I_C$ | collector current | Fig. 1; Fig. 2; Fig. 3 | | - | 5 | A |
| $I_{CM}$ | peak collector current | | | - | 10 | A |
| $I_B$ | base current | | | - | 2 | A |
| $I_{BM}$ | peak base current | | | - | 4 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} \leq$ 25 °C; Fig. 4 | | - | 80 | W |
| $T_{stg}$ | storage temperature | | | -65 | 150 | °C |
| $T_j$ | junction temperature | | | - | 150 | °C |




$V_{CL(CE)} \leq 1000\ V; V_{CC} = 150\ V; V_{BB} = -5\ V;$

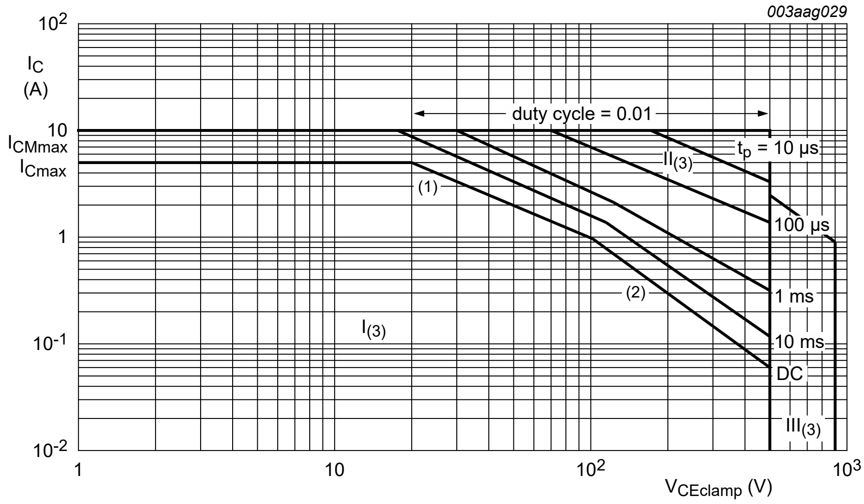
$L_B = 1\ \mu H; L_C = 200\ \mu H$

**Fig. 1. Test circuit for reverse bias safe operating area**



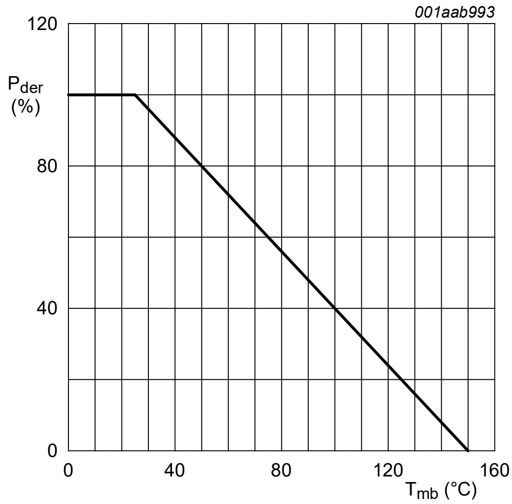

$T_j \leq T_{j(max)}$

**Fig. 2. Reverse bias safe operating area**




(1) $P_{tot}$ maximum and $P_{tot}$ peak maximum lines.
(2) Second breakdown limits.
(3) I = Region of permissible DC operation.
II = Extension for repetitive pulse operation.
III = Extension during turn-on in single transistor converters provided that $R_{BE} \leq 100\ \Omega$ and $t_p \leq 0.6$ μs.

**Fig. 3. Forward bias safe operating area for Tmb ≤ 25 °C**




$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

**Fig. 4. Normalized total power dissipation as a function of mounting base temperature**

## 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 | Fig. 5 | | - | - | 1.56 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient free air | printed circuit board (FR4) mounted; minimum footprint | | - | 75 | - | K/W |

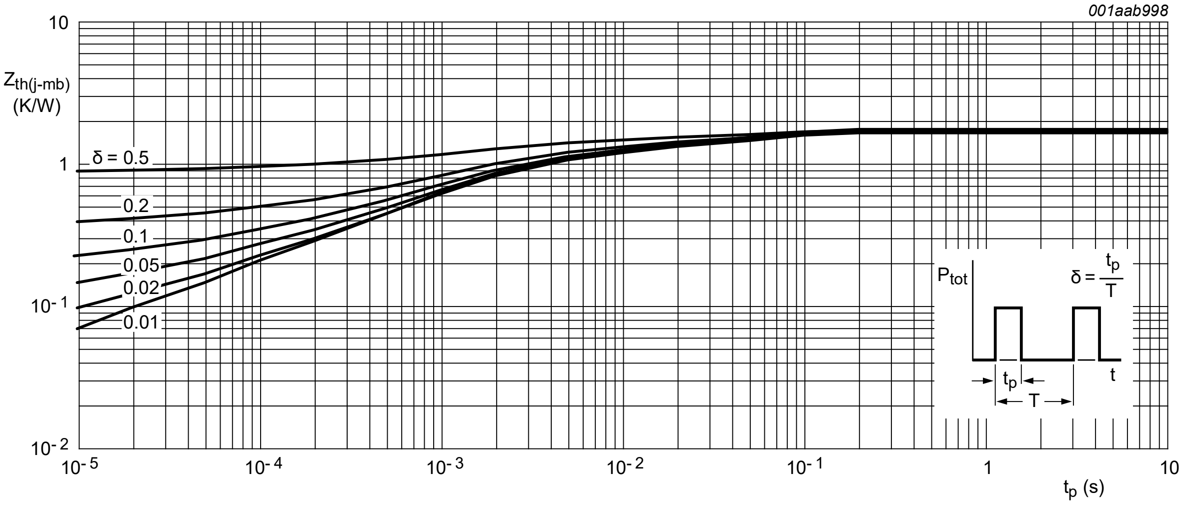



**Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse width**

# 9. Characteristics

**Table 6. Characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $I_{CES}$ | collector-emitter cut-off current (base shorted) | $V_{BE}$ = 0 V; $V_{CE}$ = 1000 V | [1] | - | - | 1 | mA |
| | | $V_{BE}$ = 0 V; $V_{CE}$ = 1000 V; $T_j$ = 125 °C | [1] | - | - | 2 | mA |
| $I_{CBO}$ | collector-base cut-off current (emitter open) | $V_{CB}$ = 1000 V; $I_E$ = 0 A; $T_{mb}$ = 25 °C | [1] | - | - | 1 | mA |
| $I_{CEO}$ | collector-emitter cut-off current (base open) | $V_{CE}$ = 500 V; $I_B$ = 0 A; $T_{mb}$ = 25 °C | [1] | - | - | 0.1 | mA |
| $I_{EBO}$ | emitter-base cut-off current (collector open) | $V_{EB}$ = 9 V; $I_C$ = 0 A; $T_{mb}$ = 25 °C | | - | - | 0.1 | mA |
| $V_{CEOsus}$ | collector-emitter sustaining voltage (base open) | $I_B$ = 0 A; $I_C$ = 100 mA; $L_C$ = 25 mH; $T_{mb}$ = 25 °C; Fig. 6; Fig. 7 | | 500 | - | - | V |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = 3 A; $I_B$ = 0.6 A; $T_{mb}$ = 25 °C; Fig. 8; Fig. 9 | | - | 0.25 | 1.5 | V |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C$ = 3 A; $I_B$ = 0.6 A; $T_{mb}$ = 25 °C; Fig. 10 | | - | 0.97 | 1.3 | V |
| $h_{FE}$ | DC current gain | $I_C$ = 5 mA; $V_{CE}$ = 5 V; $T_{mb}$ = 25 °C; Fig. 11 | | 10 | 22 | 30 | |
| | | $I_C$ = 500 mA; $V_{CE}$ = 5 V; $T_{mb}$ = 25 °C; Fig. 11 | | 14 | 25 | 35 | |
| $h_{FEsat}$ | DC saturation current gain | $I_C$ = 2.5 A; $V_{CE}$ = 5 V; $T_{mb}$ = 25 °C; Fig. 11 | | 10 | 13.5 | 17 | |
| | | $I_C$ = 3 A; $V_{CE}$ = 5 V; $T_{mb}$ = 25 °C; Fig. 11 | | - | 12 | - | |
| **Dynamic characteristics (switching times - resistive load)** | | | | | | | |
| $t_s$ | storage time | $I_C$ = 2.5 A; $I_{Bon}$ = 0.5 A; $I_{Boff}$ = -0.5 A; $R_L$ = 75 Ω; $T_{mb}$ = 25 °C; Fig. 12; Fig. 13 | | - | 3.4 | 4 | µs |
| $t_f$ | fall time | | | - | 0.33 | 0.45 | µs |
| **Dynamic characteristics (switching times - inductive load)** | | | | | | | |
| $t_s$ | storage time | $I_C$ = 2.5 A; $I_{Bon}$ = 0.5 A; $V_{BB}$ = -5 V; $L_B$ = 1 µH; $T_{mb}$ = 25 °C; Fig. 14; Fig. 15 | | - | 1.4 | 1.6 | µs |
| | | | | - | 1.7 | 1.9 | µs |
| $t_f$ | fall time | $I_C$ = 2.5 A; $I_{Bon}$ = 0.5 A; $V_{BB}$ = -5 V; $L_B$ = 1 µH; $T_j$ = 100 °C; Fig. 14; Fig. 15 | | - | 145 | 160 | ns |
| | | | | - | 160 | 200 | ns |

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

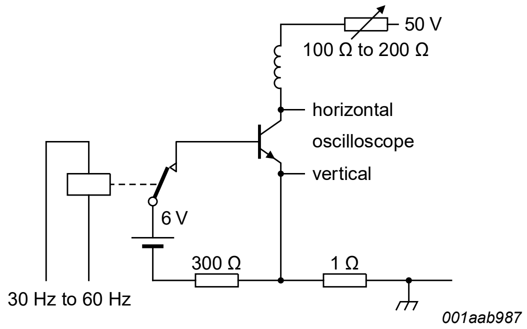



**Fig. 6. Test circuit for collector-emitter sustaining voltage**

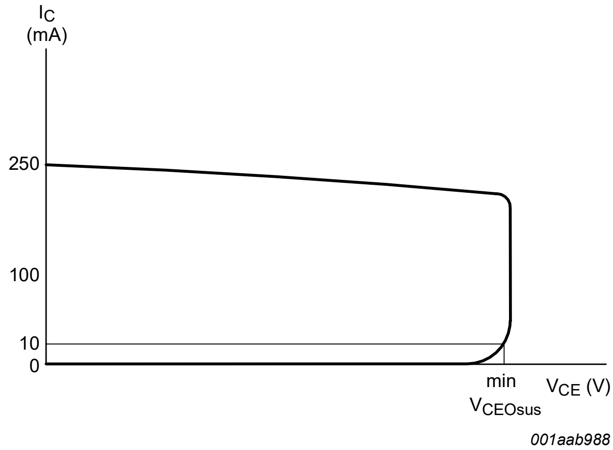



**Fig. 7. Oscilloscope display for collector-emitter sustaining voltage test waveform**

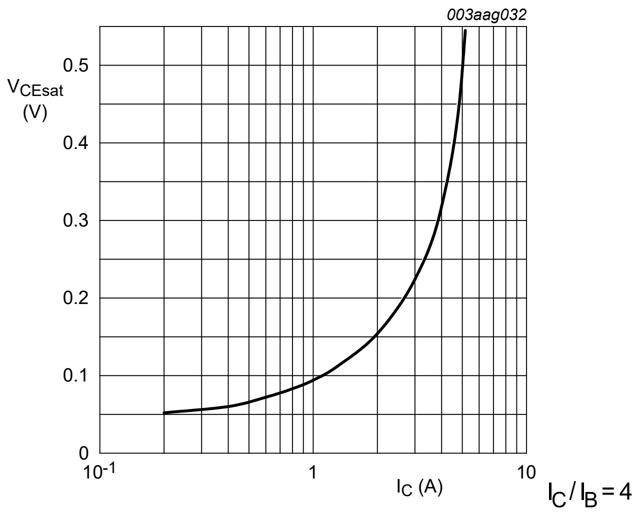



**Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values**

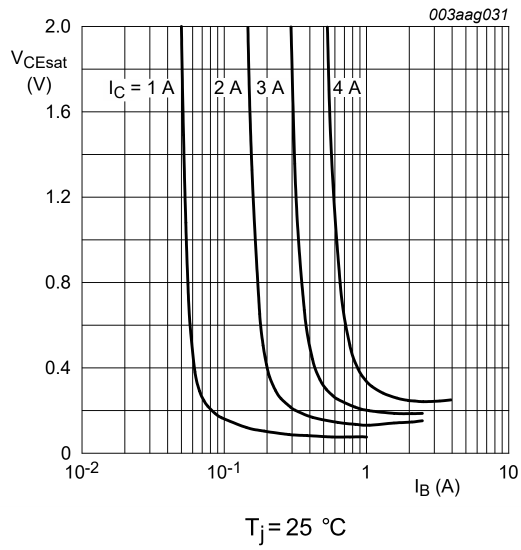
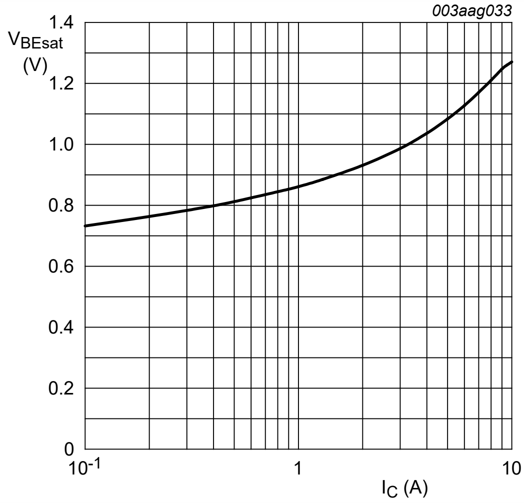
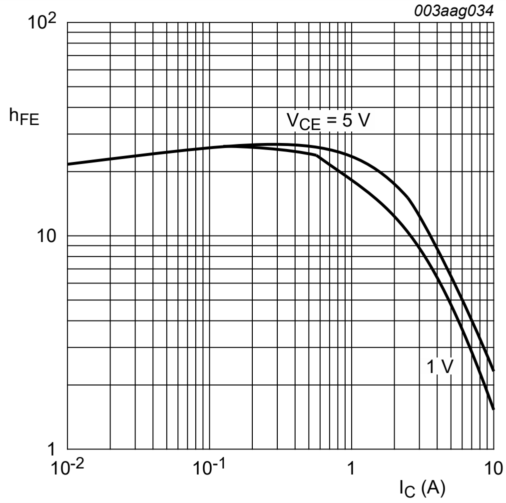



**Fig. 9. Collector-emitter saturation voltage as a function of base current; typical values**



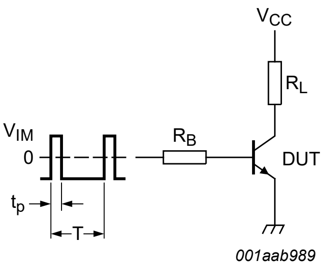

$I_C / I_B = 4$

**Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values**




$T_j = 25$ °C

**Fig. 11. DC current gain as a function of collector current; typical values**




$V_{IM} = -6$ to $+8$ V; $V_{CC} = 250$ V; $t_p = 20$ µs; $\delta = \frac{t_p}{T} = 0.01$

$R_B$ and $R_L$ calculated from $I_{Con}$ and $I_{Bon}$ requirements.

**Fig. 12. Test circuit for resistive load switching**

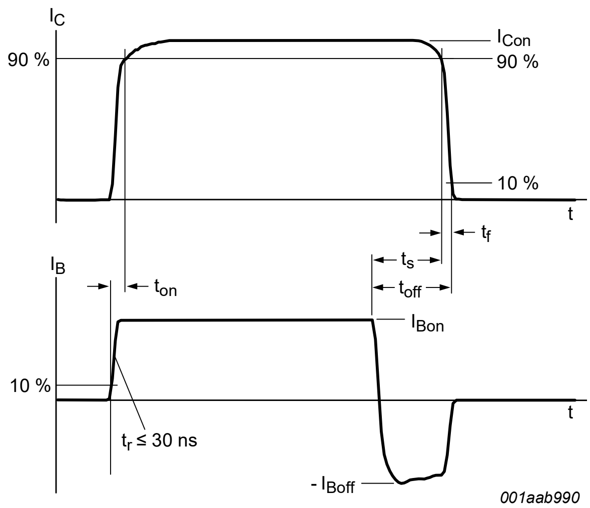
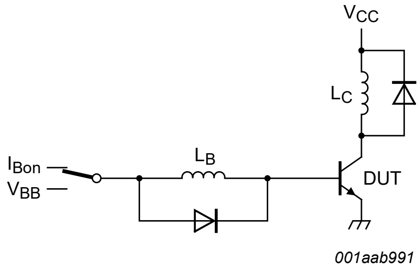



**Fig. 13. Switching times waveforms for resistive load**




$V_{BB} = -5$ V; $L_C = 200$ μH; $L_B = 1$ μH

**Fig. 14. Test circuit for inductive load switching**

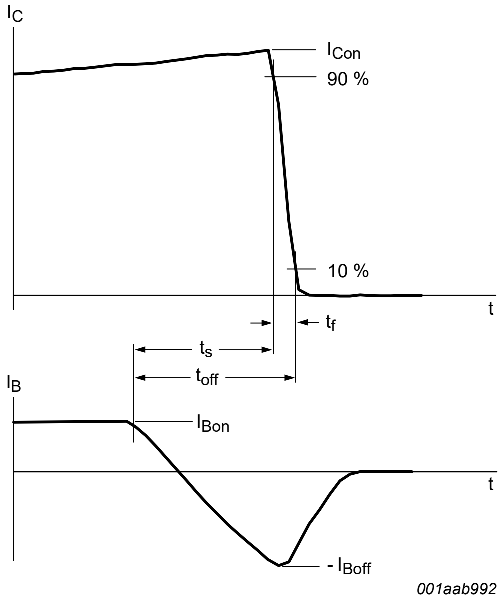
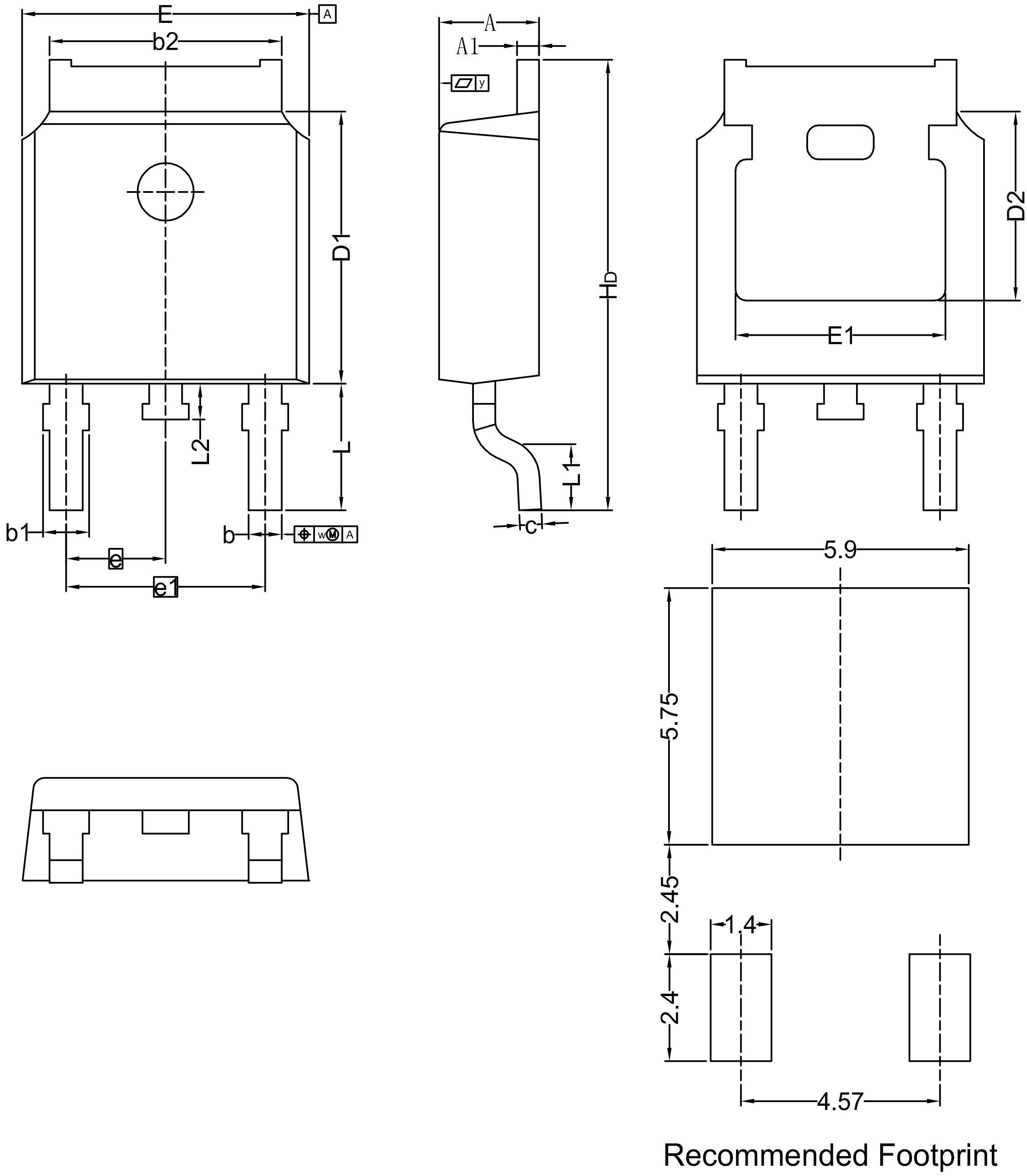



**Fig. 15. Switching times waveforms for inductive load**

## 10. Package outline

Plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped) TO252




| Unit | | A | A1 | b | b1 | b2 | c | D1 | D2 | E | E1 | e | e1 | $H_D$ | L | L1 | L2 | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | min | 2.22 | 0.46 | 0.71 | 0.72 | 5.00 | 0.20 | 5.98 | 4.00 | 6.47 | 4.45 | | | 9.60 | | 0.50 | 0.50 | | |
| | nom | | | | | | | | | | | 2.285 | 4.57 | | 2.90 (Ref.) | | | 0.20 | |
| | max | 2.38 | 0.93 | 0.89 | 1.10 | 5.46 | 0.56 | 6.22 | --- | 6.73 | --- | | | 10.40 | | --- | 0.90 | | 0.20 |

**Fig. 16. Package outline DPAK (SOT428)**

# 11. Legal information

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|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
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