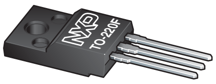



# BUJ302AX

NPN power transistor

Rev. 02 — 28 March 2011 | Product data sheet

## 1. Product profile

### 1.1 General description

High-voltage, high-speed planar-passivated NPN power switching transistor in a SOT186A (TO-220F) plastic package.

### 1.2 Features and benefits

- Fast switching
- High voltage capability
- Isolated package
- Low thermal resistance

### 1.3 Applications

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

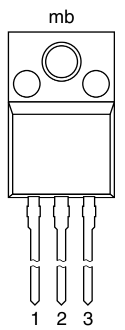
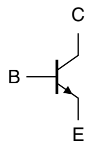
### 1.4 Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $I_C$ | collector current | see Figure 1; see Figure 2; see Figure 4 | - | - | 4 | A |
| $P_{tot}$ | total power dissipation | $T_h \leq 25$ °C; see Figure 3 | - | - | 26 | W |
| $V_{CESM}$ | collector-emitter peak voltage | $V_{BE} = 0$ V | - | - | 1050 | V |
| **Static characteristics** | | | | | | |
| $h_{FE}$ | DC current gain | $I_C = 0.1$ A; $V_{CE} = 5$ V; $T_h = 25$ °C; see Figure 11 | 48 | 66 | 100 | |
| | | $I_C = 0.8$ A; $V_{CE} = 3$ V; $T_h = 25$ °C; see Figure 12 | 25 | 42 | 50 | |

## 2. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | B | base |   SOT186A (TO-220F) |   |
| 2 | C | collector | | |
| 3 | E | emitter | | |
| mb | n.c. | isolated | | |

## 3. Ordering information

**Table 3. Ordering information**

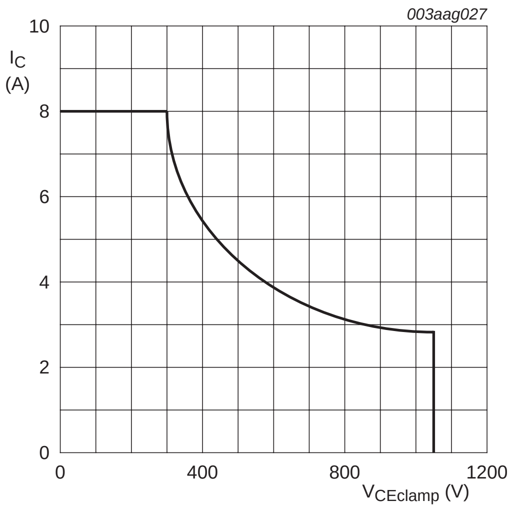
| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BUJ302AX | TO-220F | plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack" | SOT186A |

## 4. Limiting values

**Table 4. Limiting values**

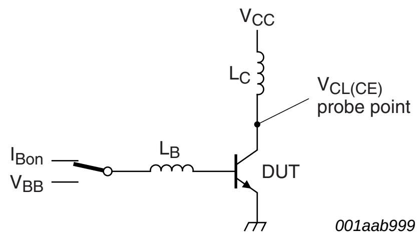
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CESM}$ | collector-emitter peak voltage | $V_{BE} = 0$ V | - | 1050 | V |
| $V_{CEO}$ | collector-emitter voltage | $I_B = 0$ A | - | 400 | V |
| $I_C$ | collector current | see Figure 1; see Figure 2; see Figure 4 | - | 4 | A |
| $I_{CM}$ | peak collector current | | - | 8 | A |
| $I_B$ | base current | DC | - | 2 | A |
| $I_{BM}$ | peak base current | | - | 4 | A |
| $P_{tot}$ | total power dissipation | $T_h \leq 25$ °C; see Figure 3 | - | 26 | W |
| $T_{stg}$ | storage temperature | | -65 | 150 | °C |
| $T_j$ | junction temperature | | - | 150 | °C |
| $V_{EBO}$ | emitter-base voltage | $I_C = 0$ A; $I_E = 2$ A; $t_p < 10$ ms | - | 24 | V |



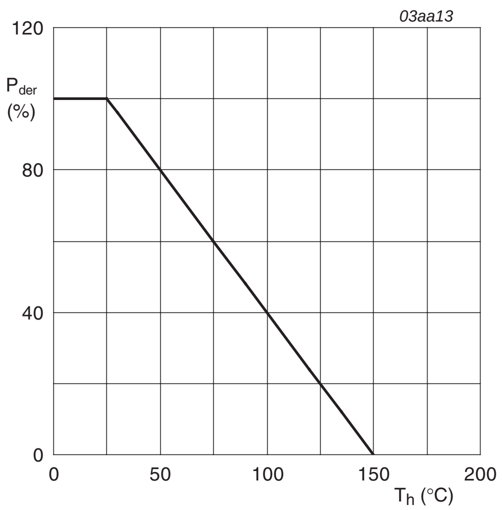

$T_j \leq T_{j(max)}$ °C

**Fig 1. Reverse bias safe operating area**



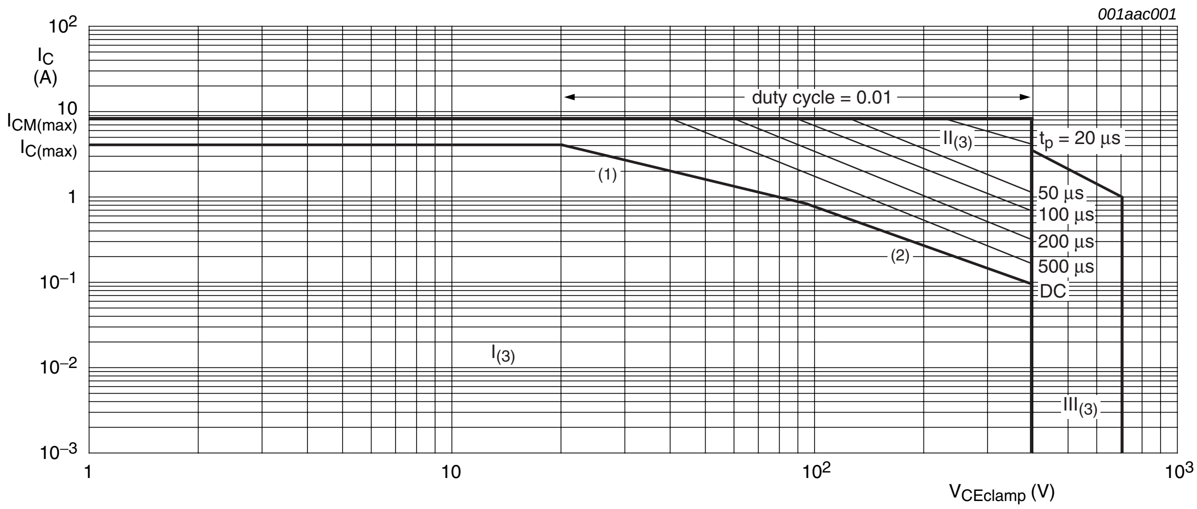

$V_{CL(CE)} \leq 1000\ V; V_{CC} = 150\ V; V_{BB} = -5\ V;$
$L_B = 1\ \mu H; L_C = 200\ \mu H$

**Fig 2. Test circuit for reverse bias safe operating area**




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

**Fig 3. Normalized total power dissipation as a function of heatsink temperature**




1)Ptot maximum and Ptot peak maximum lines

2)Second breakdown limits

3) I = Region of permissable DC operation

II = Extension for repetitive pulse operation

III = Extension during turn-on in single transistor converters provided that RBE ≤ 100 Ω and tp ≤ 0.6 µs

**Fig 4. Forward bias safe operating area for Tmb ≤ 25 °C**

## 5. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $R_{th(j-h)}$ | thermal resistance from junction to heatsink | with heatsink compound; see Figure 5 | - | - | 4.8 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | - | 55 | - | K/W |

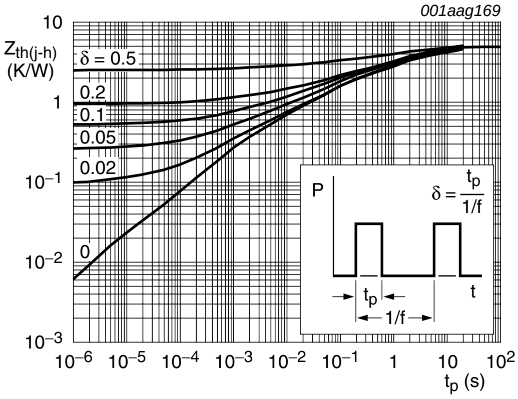



**Fig 5. Transient thermal impedance from junction to heatsink as a function of pulse duration**

## 6. Isolation characteristics

**Table 6. Isolation characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{isol(RMS)}$ | RMS isolation voltage | 50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; $T_h$ = 25 °C; from all terminals to external heatsink; clean and dust free | - | - | 2500 | V |
| $C_{isol}$ | isolation capacitance | from collector to external heatsink ; f = 1 MHz; $T_h$ = 25 °C | - | 10 | - | pF |

# 7. Characteristics

**Table 7. Characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | |
| $I_{CES}$ | collector-emitter cut-off current | $V_{BE}$ = 0 V; $V_{CE}$ = 1050 V; $T_j$ = 25 °C | - | 0.2 | 10 | µA |
| $I_{CEO}$ | collector-emitter cut-off current | $V_{CE}$ = 400 V; $I_B$ = 0 A; $T_h$ = 25 °C | - | 10 | 250 | µA |
| $V_{(BR)EBO}$ | open-collector emitter-base breakdown voltage | $I_B$ = 1 mA; $I_C$ = 0 A; $T_h$ = 25 °C | 15 | 19 | - | V |
| $V_{CEOsus}$ | collector-emitter sustaining voltage | $I_B$ = 0 A; $I_C$ = 10 mA; $L_C$ = 25 mH; $T_h$ = 25 °C; see Figure 6; see Figure 7 | 400 | 470 | - | V |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = 1 A; $I_B$ = 0.2 A; $T_h$ = 25 °C; see Figure 8; see Figure 9 | - | 0.15 | 0.5 | V |
| | | $I_C$ = 3.5 A; $I_B$ = 1 A; $T_h$ = 25 °C; see Figure 8; see Figure 9 | - | 0.6 | 1.5 | V |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C$ = 3.5 A; $I_B$ = 1 A; $T_h$ = 25 °C; see Figure 10 | - | 1.1 | 1.5 | V |
| $h_{FE}$ | DC current gain | $I_C$ = 0.1 A; $V_{CE}$ = 5 V; $T_h$ = 25 °C; see Figure 11 | 48 | 66 | 100 | |
| | | $I_C$ = 0.8 A; $V_{CE}$ = 3 V; $T_h$ = 25 °C; see Figure 12 | 25 | 42 | 50 | |
| **Dynamic characteristics** | | | | | | |
| $t_s$ | storage time | $I_C$ = 2.5 A; $I_{Bon}$ = 0.5 A; $I_{Boff}$ = -0.5 A; $R_L$ = 60 Ω; $V_{BB}$ = -5 V; $T_h$ = 25 °C; resistive load; $t_p$ = 300 µs; see Figure 13; see Figure 14 | - | - | 3.5 | µs |
| $t_f$ | fall time | | - | - | 500 | ns |

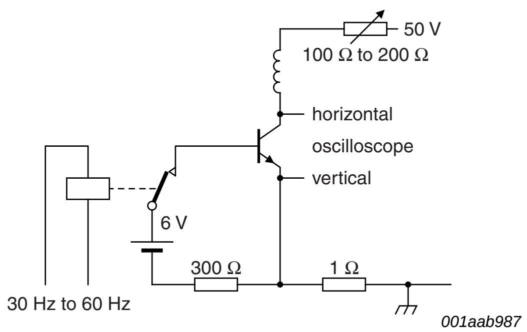



**Fig 6. Test circuit for collector-emitter sustaining voltage**

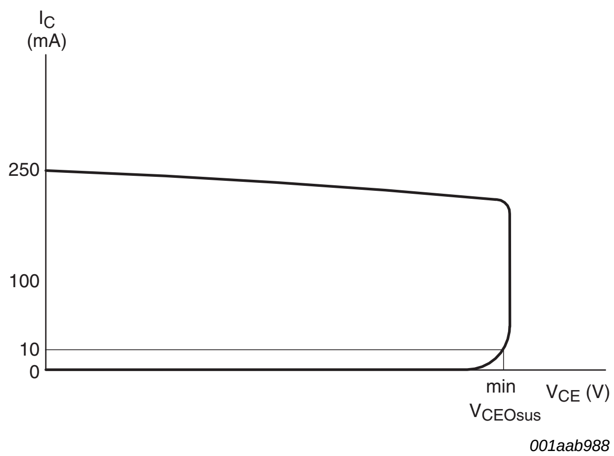
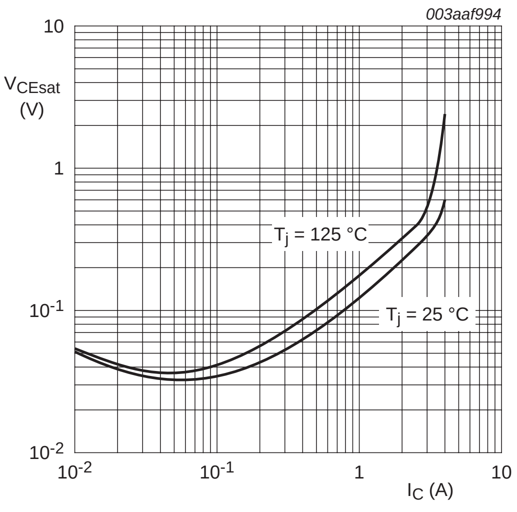



**Fig 7. Oscilloscope display for collector-emitter sustaining voltage test waveform**




$I_C / I_B = 3$

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

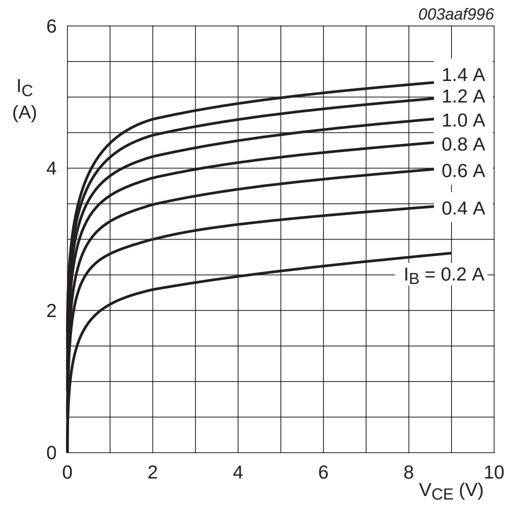
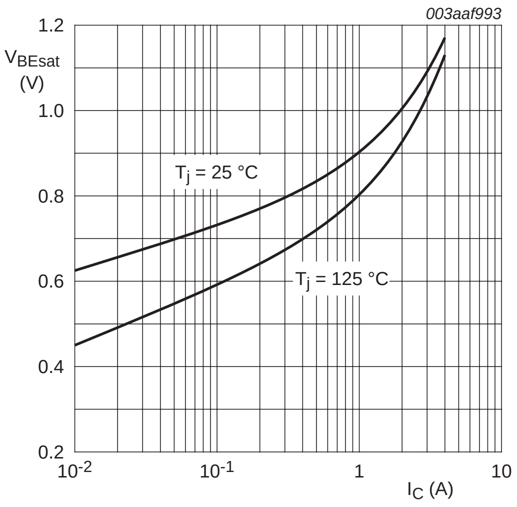



**Fig 9. Collector current as a function of collector-emitter voltage; typical values**




$I_C / I_B = 3$

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

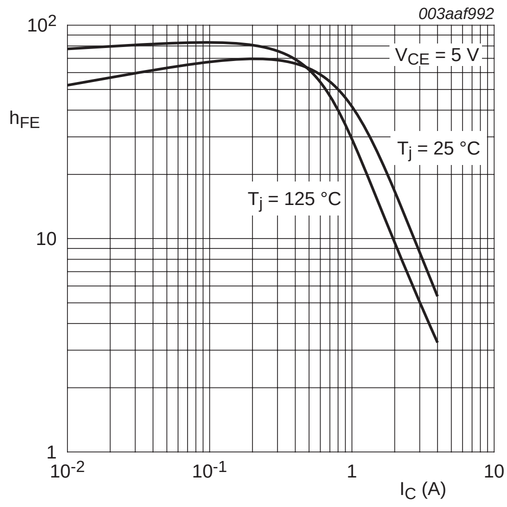



**Fig 11. DC current gain as a function of collector current; typical values**

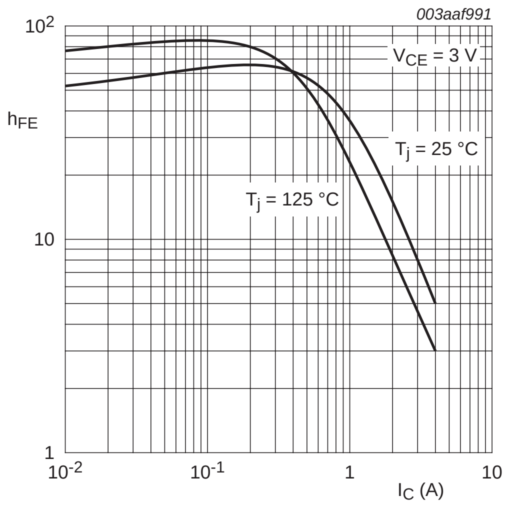
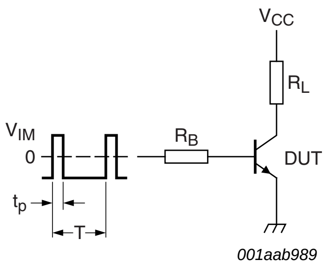



**Fig 12. DC current gain as a function of collector current; typical values**




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

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

**Fig 13. Test circuit for resistive load switching**

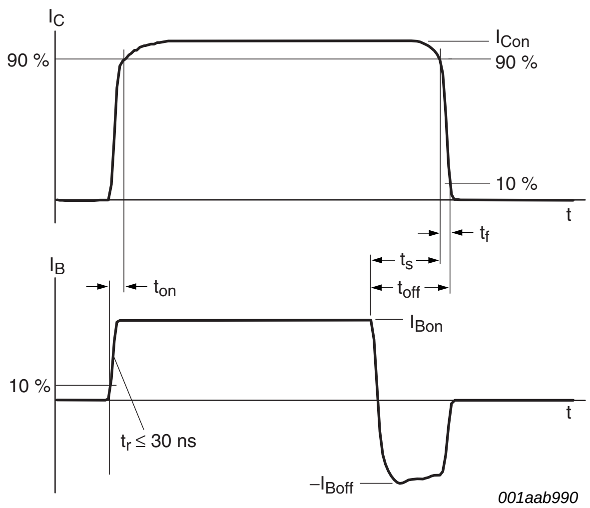
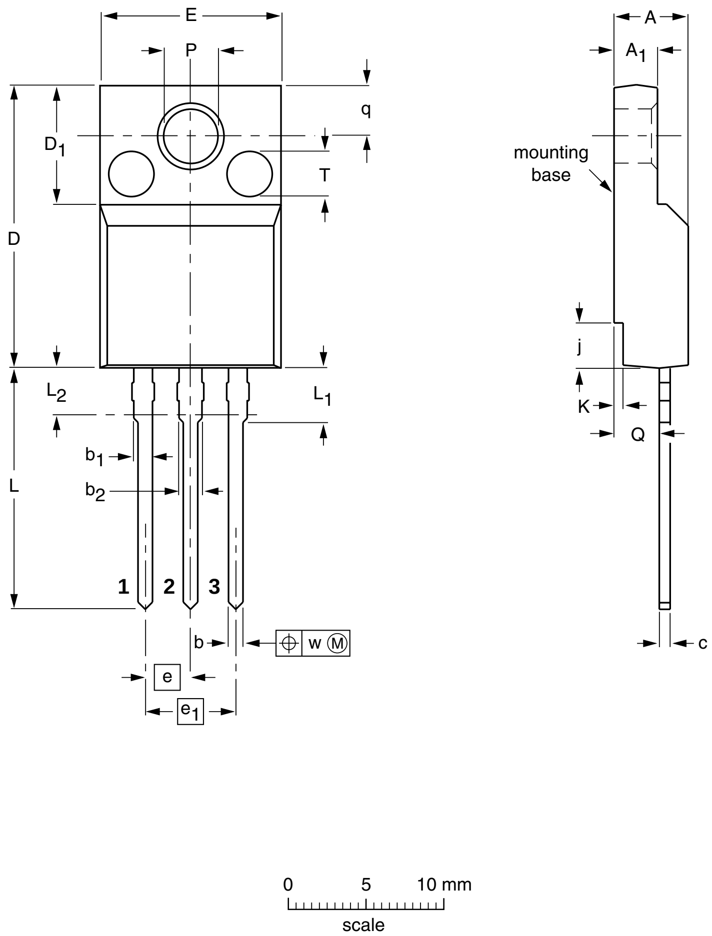



**Fig 14. Switching times waveforms for resistive load**

## 8. Package outline

**Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 'full pack'**

**SOT186A**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | b | $b_1$ | $b_2$ | c | D | $D_1$ | E | e | $e_1$ | j | K | L | $L_1$ | $L_2$(1) max. | P | Q | q | T(2) | w |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.6<br>4.0 | 2.9<br>2.5 | 0.9<br>0.7 | 1.1<br>0.9 | 1.4<br>1.0 | 0.7<br>0.4 | 15.8<br>15.2 | 6.5<br>6.3 | 10.3<br>9.7 | 2.54 | 5.08 | 2.7<br>1.7 | 0.6<br>0.4 | 14.4<br>13.5 | 3.30<br>2.79 | 3 | 3.2<br>3.0 | 2.6<br>2.3 | 3.0<br>2.6 | 2.5 | 0.4 |

**Notes**

1. Terminal dimensions within this zone are uncontrolled.
2. Both recesses are ∅ 2.5 × 0.8 max. depth

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT186A | | 3-lead TO-220F | | | | ~~02-04-09~~<br>06-02-14 |

Fig 15. Package outline SOT186A (TO-220F)

# 9. Revision history

Table 8. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BUJ302AX v.2 | 20110328 | Product data sheet | - | BUJ302AX v.1 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.<br>• Legal texts have been adapted to the new company name where appropriate. | | | |
| BUJ302AX v.1 | 19980801 | Objective specification | - | - |

# 10. Legal information

## 10.1 Data sheet status

| Document status [1] [2] | Product status [3] | 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.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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## 12. Contents





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