# NX3P2902B

## Logic controlled high-side power switch

Rev. 2 — 22 February 2018 Product data sheet

## 1. General description

The NX3P2902B is a high-side load switch which features a low ON resistance P-channel MOSFET. The MOSFET supports more than 500 mA of continuous current and an integrated output discharge resistor to discharge the output capacitance when disabled. Designed for operation from 1.1 V to 3.6 V, it is used in power domain isolation applications to reduce power dissipation and extend battery life. The enable logic includes integrated logic level translation making the device compatible with lower voltage processors and controllers. The NX3P2902B is ideal for portable, battery operated applications due to low ground current and OFF-state current.

## 2. Features and benefits

- Wide supply voltage range from 1.1 V to 3.6 V
- Very low ON resistance:
  - 95 mΩ at a supply voltage of 1.8 V
- High noise immunity
- Low OFF-state leakage current (600 nA maximum)
- 1.2 V control logic at a supply voltage of 3.6 V
- High current handling capability (500 mA continuous current)
- Internal output discharge resistor
- Turn-on slew rate limiting
- ESD protection:
  - HBM JESD22-A114F Class 3A exceeds 4000 V
  - CDM AEC-Q100-011 revision B exceeds 500 V
- Specified from −40 °C to +85 °C

## 3. Applications

- Cell phone
- Digital cameras and audio devices
- Portable and battery-powered equipment

# 4. Ordering information

**Table 1. Ordering information**

| Type number | Topside marking | Package | | |
|---|---|---|---|---|
| | | Name | Description | Version |
| NX3P2902BUK | x2 | WLCSP4 | wafer level chip-scale package; 4 bumps; 0.77 × 0.77 × 0.51 mm. (Backside coating included) | NX3P2902B |

## 4.1 Ordering options

**Table 2. Ordering options**

| Type number | Orderable part number | Package | Packing method | Minimum order quantity | Temperature |
|---|---|---|---|---|---|
| NX3P2902BUK | NX3P2902BUKZ | WLCSP4 | Reel 7" Q1/T1 in Drypack | 3000 | $T_{amb}$ = −40 °C to +85 °C |

# 5. Functional diagram

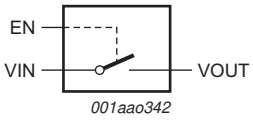



**Fig 1. Logic symbol**

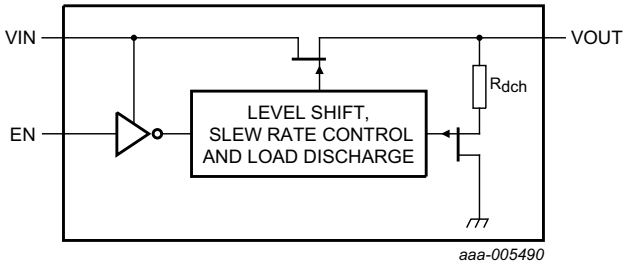
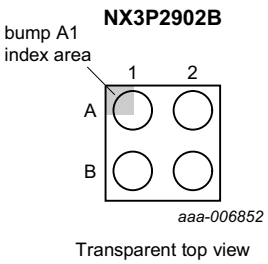



**Fig 2. Logic diagram (simplified schematic)**

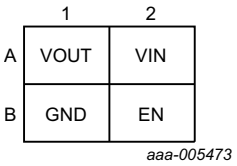
# 6. Pinning information

## 6.1 Pinning




Transparent top view

**Fig 3. Pin configuration for WLCSP4**




Transparent top view

**Fig 4. Ball mapping for WLCSP4**

### 6.2 Pin description

**Table 3. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| VOUT | A1 | output voltage |
| GND | B1 | ground (0 V) |
| VIN | A2 | input voltage |
| EN | B2 | enable input (active HIGH) |

## 7. Functional description

**Table 4. Function table[1]**

| Input EN | Switch |
|---|---|
| L | switch OFF |
| H | switch ON |

[1] H = HIGH voltage level; L = LOW voltage level.

## 8. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).*

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_I$ | input voltage | input EN [1] | −0.5 | +4.0 | V |
| | | input VIN [2] | −0.5 | +4.0 | V |
| $V_{SW}$ | switch voltage | output VOUT [2] | −0.5 | $V_{I(VIN)}$ | V |
| $I_{IK}$ | input clamping current | input EN: $V_{I(EN)} < -0.5$ V | −50 | - | mA |
| $I_{SK}$ | switch clamping current | input VIN: $V_{I(VIN)} < -0.5$ V | −50 | - | mA |
| | | output VOUT: $V_{O(VOUT)} < -0.5$ V | −50 | - | mA |
| | | output VOUT: $V_{O(VOUT)} > V_{I(VIN)} + 0.5$ V | - | 50 | mA |
| $I_{SW}$ | switch current | $V_{SW} > -0.5$ V | | | |
| | | $T_{amb}$ = 25 °C | - | ±1000 | mA |
| | | $T_{amb}$ = 85 °C | - | ±500 | mA |
| $T_{j(max)}$ | maximum junction temperature | | −40 | +125 | °C |
| $T_{stg}$ | storage temperature | | −65 | +150 | °C |
| $P_{tot}$ | total power dissipation | [3] | - | 300 | mW |

[1] The minimum input voltage rating may be exceeded if the input current rating is observed.

[2] The minimum and maximum switch voltage ratings may be exceeded if the switch clamping current rating is observed.

[3] The (absolute) maximum power dissipation depends on the junction temperature $T_j$. Higher power dissipation is allowed in conjunction with lower ambient temperatures. The conditions to determine the specified values are $T_{amb}$ = 85 °C and the use of a two layer PCB.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_I$ | input voltage | | 1.1 | 3.6 | V |
| $T_{amb}$ | ambient temperature | | −40 | +85 | °C |

## 10. Thermal characteristics

**Table 7. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Unit |
|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | [1][2] | 130 | K/W |

[1] The overall $R_{th(j-a)}$ can vary depending on the board layout. To minimize the effective $R_{th(j-a)}$, all pins must have a solid connection to larger Cu layer areas e.g. to the power and ground layer. In multi-layer PCB applications, the second layer should be used to create a large heat spreader area right below the device. If this layer is either ground or power, it should be connected with several vias to the top layer connecting to the device ground or supply. Try not to use any solder-stop varnish under the chip.

[2] Rely on the measurement data given for a rough estimation of the $R_{th(j-a)}$ in the application. The actual $R_{th(j-a)}$ value may vary in applications using different layer stacks and layouts.

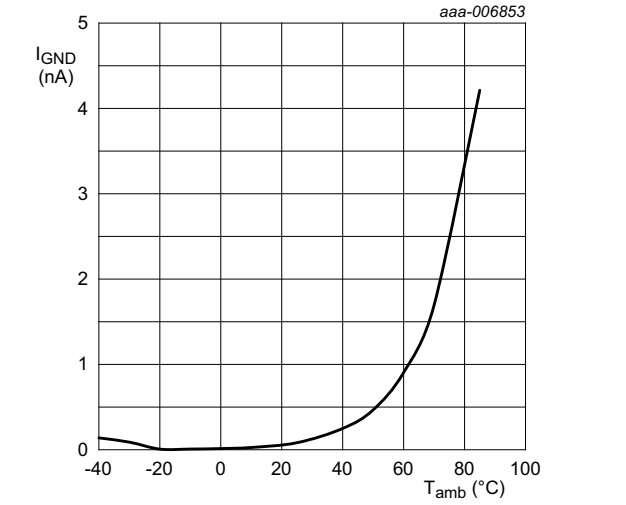
## 11. Static characteristics

**Table 8. Static characteristics**

*$V_{I(VIN)}$ = 0.9 V to 3.6 V, unless otherwise specified; Voltages are referenced to GND (ground = 0 V).*

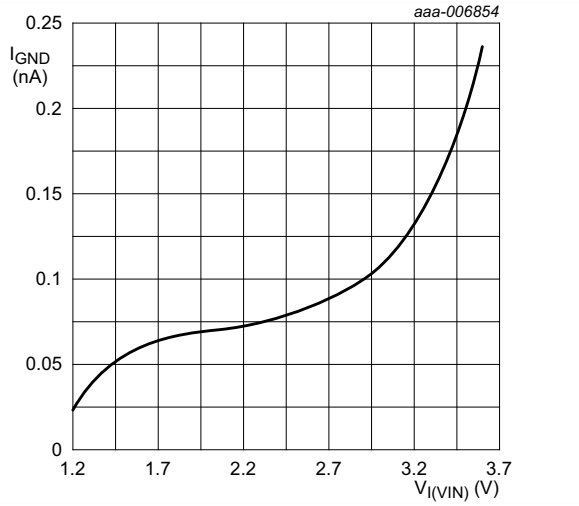
| Symbol | Parameter | Conditions | $T_{amb}$ = 25 °C | | | $T_{amb}$ = −40 °C to +85 °C | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | |
| $V_{IH}$ | HIGH-level input voltage | EN input | | | | | | |
| | | $V_{I(VIN)}$ = 1.1 V to 1.3 V | - | - | - | 1.0 | - | V |
| | | $V_{I(VIN)}$ = 1.3 V to 1.8 V | - | - | - | 1.2 | - | V |
| | | $V_{I(VIN)}$ = 1.8 V to 3.6 V | - | - | - | 1.2 | - | V |
| $V_{IL}$ | LOW-level input voltage | EN input | | | | | | |
| | | $V_{I(VIN)}$ = 1.1 V to 1.3 V | - | - | - | - | 0.3 | V |
| | | $V_{I(VIN)}$ = 1.3 V to 1.8 V | - | - | - | - | 0.4 | V |
| | | $V_{I(VIN)}$ = 1.8 V to 3.6 V | - | - | - | - | 0.45 | V |
| $I_I$ | input leakage current | $V_{I(EN)}$ = 0 V or 3.6 V | - | 0.1 | - | - | 500 | nA |
| $I_{GND}$ | ground current | $V_{I(EN)}$ = 0 V or 3.6 V; VOUT open; see Figure 5 and Figure 6 | - | - | - | −2 | - | µA |
| $I_{S(OFF)}$ | OFF-state leakage current | $V_{I(VIN)}$ = 3.6 V; $V_{I(EN)}$ = GND; $V_{I(VOUT)}$ = GND; see Figure 8 | - | 10 | - | - | 600 | nA |
| $R_{dch}$ | discharge resistance | VOUT output; $V_{I(VIN)}$ = 3.3 V | - | 90 | - | - | 120 | Ω |

## 11.1 Graphs




$V_{I(VIN)}$ = 1.8 V; $V_{I(EN)}$ = 1.8 V; $I_{LOAD}$ = 500 mA.

**Fig 5. Ground current versus temperature**




$V_{I(EN)} = V_{I(VIN)}$; $T_{amb}$ = 25 °C; $I_{LOAD}$ = 500 mA.

**Fig 6. Ground current versus input voltage on pin VIN**

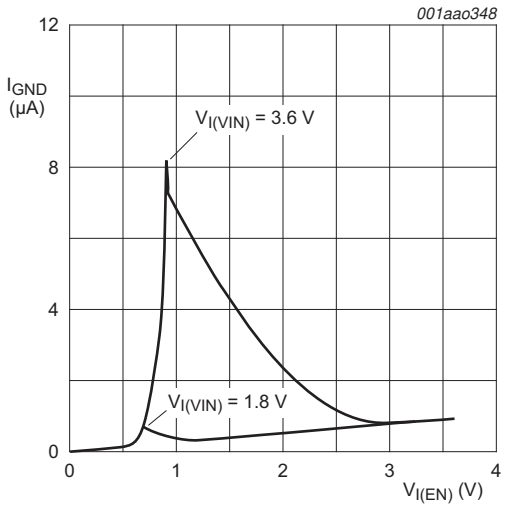
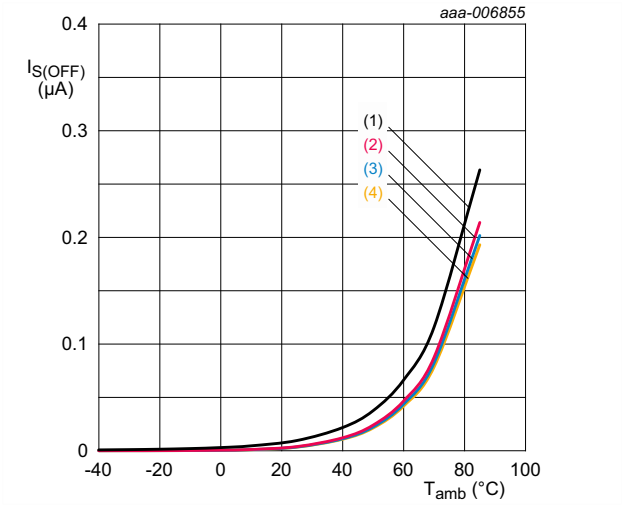



**Fig 7. Additional ground current versus input voltage**




$V_{I(EN)}$ = GND.

(1) $V_{I(VIN)}$ = 3.6 V.

(2) $V_{I(VIN)}$ = 2.5 V.

(3) $V_{I(VIN)}$ = 1.8 V.

(4) $V_{I(VIN)}$ = 1.2 V.

**Fig 8. OFF-state leakage current versus temperature**

## 11.2 ON resistance

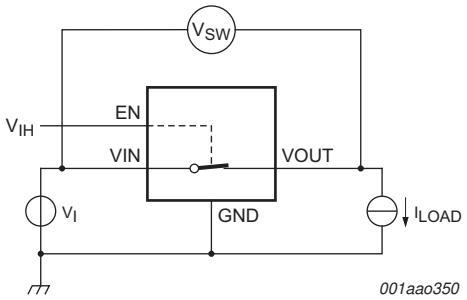
**Table 9. ON resistance**

*At recommended operating conditions; voltages are referenced to GND (ground = 0 V).*

| Symbol | Parameter | Conditions | $T_{amb}$ = −40 °C to +85 °C | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | |
| $R_{ON}$ | ON resistance | $V_{I(EN)}$ = 1.5 V; $I_{LOAD}$ = 200 mA; see Figure 9, Figure 10 and Figure 11 | | | | |
| | | $V_{I(VIN)}$ = 1.2 V | - | 150 | - | mΩ |
| | | $V_{I(VIN)}$ = 1.5 V | - | 110 | - | mΩ |
| | | $V_{I(VIN)}$ = 1.8 V | - | 95 | 130 | mΩ |
| | | $V_{I(VIN)}$ = 2.5 V | - | 75 | - | mΩ |
| | | $V_{I(VIN)}$ = 3.6 V | - | 65 | - | mΩ |

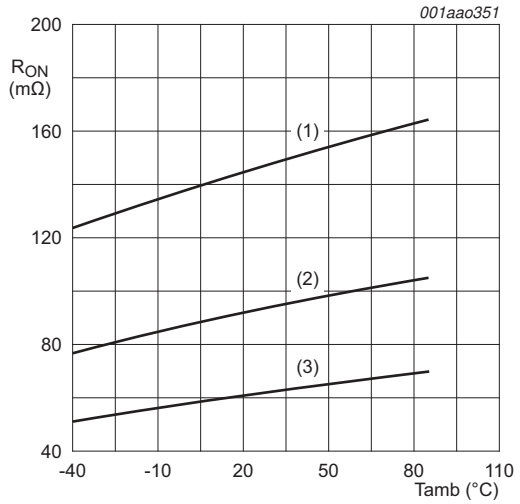
[1] Typical values are measured at $T_{amb}$ = 25 °C.

## 11.3 ON resistance test circuit and waveforms




$R_{ON} = V_{SW} / I_{LOAD}$.

**Fig 9. Test circuit for measuring ON resistance**



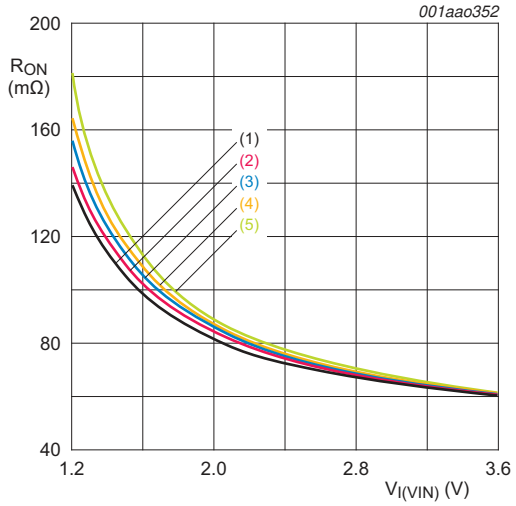

$I_{LOAD}$ = 100 mA.

(1) $V_{I(VIN)}$ = 1.2 V.

(2) $V_{I(VIN)}$ = 1.8 V.

(3) $V_{I(VIN)}$ = 3.6 V.

**Fig 10. ON resistance versus temperature**




$V_{I(EN)} = V_{I(VIN)}$; $T_{amb}$ = 25 °C.

(1) $I_{LOAD}$ = 10 mA.

(2) $I_{LOAD}$ = 100 mA.

(3) $I_{LOAD}$ = 250 mA.

(4) $I_{LOAD}$ = 350 mA.

(5) $I_{LOAD}$ = 500 mA.

**Fig 11. ON resistance versus input voltage**

## 12. Dynamic characteristics

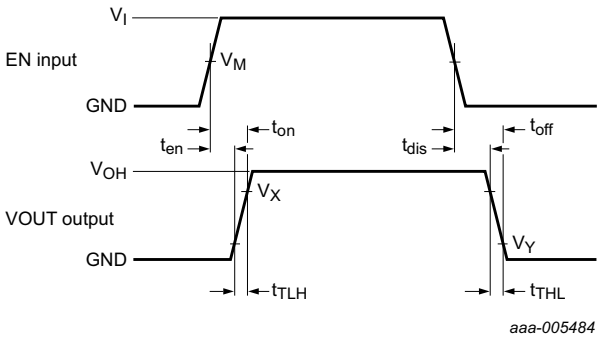
**Table 10. Dynamic characteristics**

*At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Figure 12 and Figure 13.*

| Symbol | Parameter | Conditions | $T_{amb}$ = −40 °C to +85 °C | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | |
| $t_{en}$ | enable time | EN to VOUT; see Figure 14 | | | | |
| | | $V_{I(VIN)}$ = 1.8 V | 175 | 310 | - | µs |
| | | $V_{I(VIN)}$ = 3.3 V | 80 | 135 | - | µs |
| $t_{dis}$ | disable time | EN to VOUT; see Figure 14 | | | | |
| | | $V_{I(VIN)}$ = 1.8 V | - | 10 | - | µs |
| | | $V_{I(VIN)}$ = 3.3 V | - | 8 | - | µs |
| $t_{on}$ | turn-on time | EN to VOUT; see Figure 14 and Figure 15 | | | | |
| | | $V_{I(VIN)}$ = 1.8 V | 285 | 570 | - | µs |
| | | $V_{I(VIN)}$ = 3.3 V | 150 | 280 | - | µs |
| $t_{off}$ | turn-off time | EN to VOUT; see Figure 16 and Figure 17 | | | | |
| | | $V_{I(VIN)}$ = 1.8 V | - | 200 | - | µs |
| | | $V_{I(VIN)}$ = 3.3 V | - | 180 | - | µs |
| $t_{TLH}$ | LOW to HIGH output transition time | VOUT | | | | |
| | | $V_{I(VIN)}$ = 1.8 V | 110 | 265 | - | µs |
| | | $V_{I(VIN)}$ = 3.3 V | 70 | 150 | - | µs |
| $t_{THL}$ | HIGH to LOW output transition time | VOUT | | | | |
| | | $V_{I(VIN)}$ = 1.8 V | - | 190 | - | µs |
| | | $V_{I(VIN)}$ = 3.3 V | - | 172 | - | µs |

[1] Typical values are measured at $T_{amb}$ = 25 °C.

## 12.1 Waveforms and test circuits



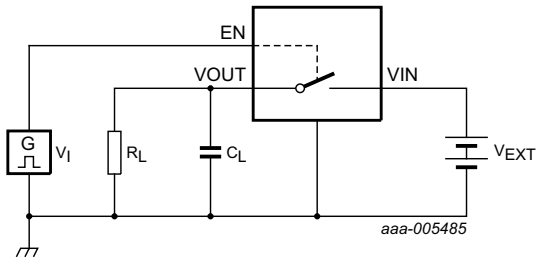

Measurement points are given in Table 11.

Logic level: $V_{OH}$ is the typical output voltage that occurs with the output load.

**Fig 12. Switching times**

**Table 11. Measurement points**

| Supply voltage | EN Input | | Output | | |
|---|---|---|---|---|---|
| $V_{I(VIN)}$ | $V_M$ | $t_r$, $t_f$ | $V_M$ | $V_X$ | $V_Y$ |
| 1.1 V to 3.6 V | 0.5 × $V_{I(EN)}$ | ≤ 100 ns | 0.5 × $V_{OH}$ | 0.9 × $V_{OH}$ | 0.1 × $V_{OH}$ |




Test data is given in Table 12.

Definitions test circuit:

$R_L$ = Load resistance.

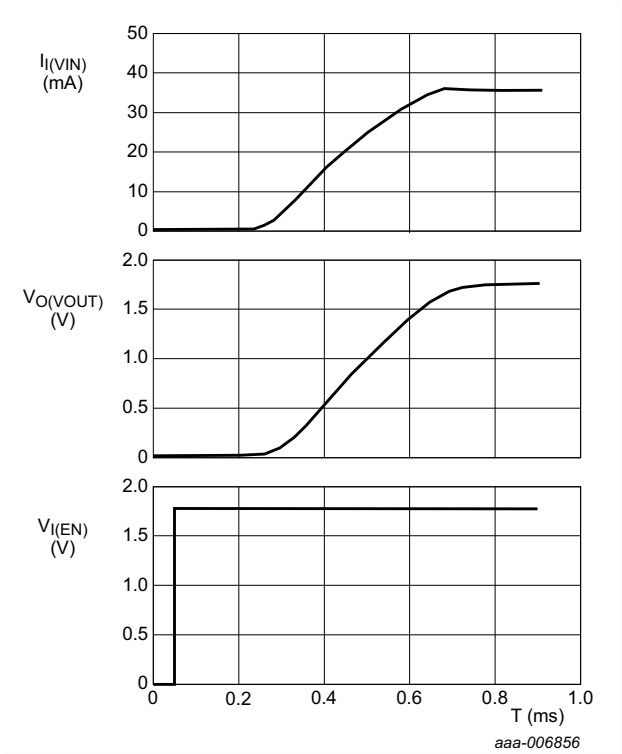
$C_L$ = Load capacitance including jig and probe capacitance.

$V_{EXT}$ = External voltage for measuring switching times.

**Fig 13. Test circuit for measuring switching times**

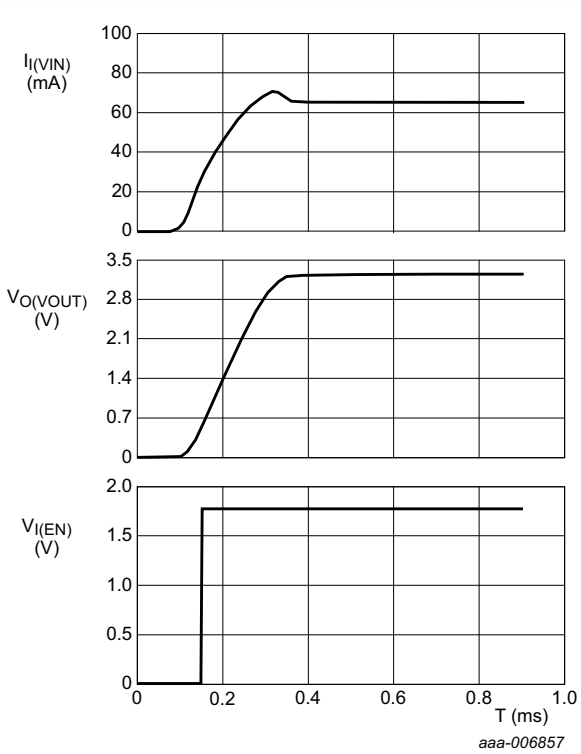
**Table 12. Test data**

| Supply voltage | EN Input | Load | |
|---|---|---|---|
| $V_{EXT}$ | $V_{I(EN)}$ | $C_L$ | $R_L$ |
| 1.1 V to 3.6 V | 1.8 V | 1 µF | 500 Ω |



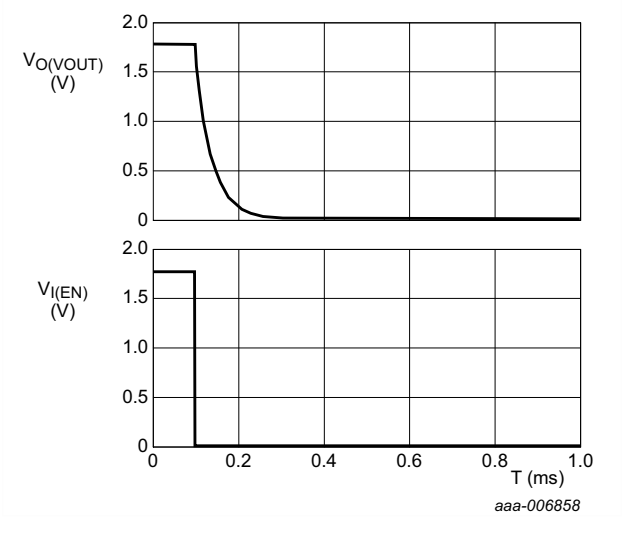

$V_{I(VIN)}$ = 1.8 V; $V_{I(EN)}$ = 1.8 V; $R_L$ = 50 Ω; $C_L$ = 1 µF.

**Fig 14. Turn-on time**



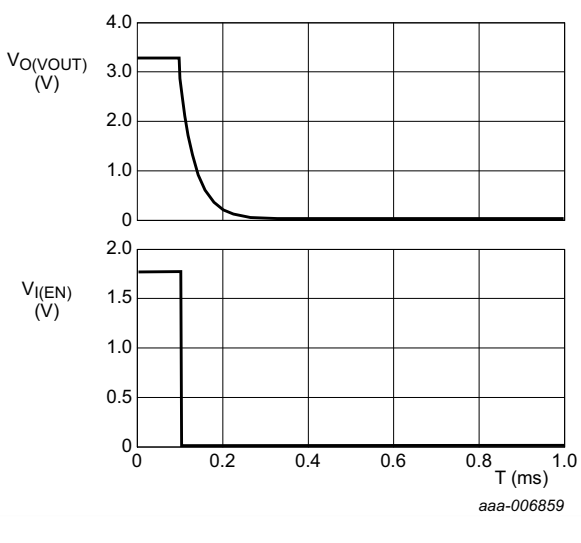

$V_{I(VIN)}$ = 3.3 V; $V_{I(EN)}$ = 1.8 V; $R_L$ = 50 Ω; $C_L$ = 1 µF.

**Fig 15. Turn-on time**




$V_{I(VIN)}$ = 1.8 V; $V_{I(EN)}$ = 1.8 V; $R_L$ = 50 Ω; $C_L$ = 1 µF.

**Fig 16. Turn-off time**

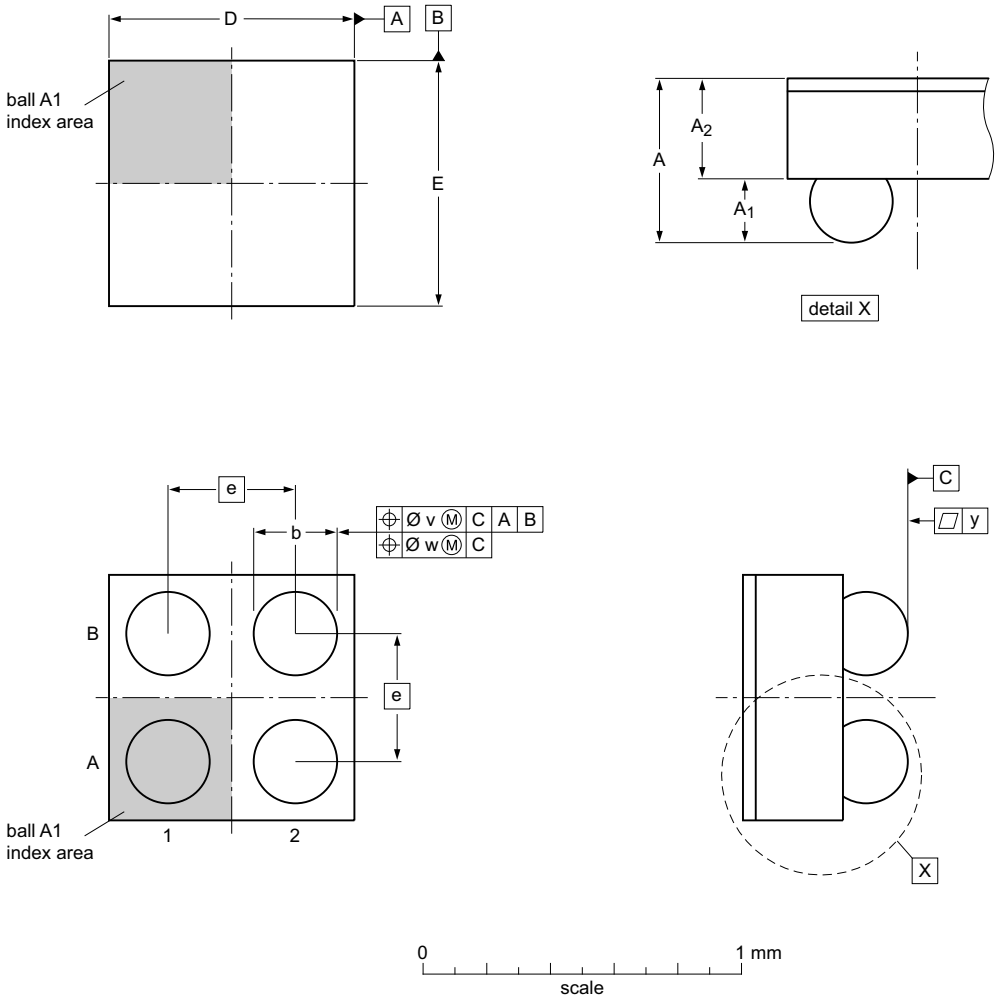



$V_{I(VIN)}$ = 3.3 V; $V_{I(EN)}$ = 1.8 V; $R_L$ = 50 Ω; $C_L$ = 1 µF.

**Fig 17. Turn-off time**

## 13. Package outline

**WLCSP4: wafer level chip-scale package; 4 bumps; 0.77 x 0.77 x 0.51 mm (Backside coating included)** **NX3P2902B**




Dimensions (mm are the original dimensions)

| Unit | | A | $A_1$ | $A_2$ | b | D | E | e | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.54 | 0.22 | 0.33 | 0.29 | 0.80 | 0.80 | 0.4 | 0.05 | 0.015 | 0.03 |
| | nom | 0.51 | 0.20 | 0.31 | 0.26 | 0.77 | 0.77 | | | | |
| | min | 0.48 | 0.18 | 0.29 | 0.23 | 0.74 | 0.74 | | | | |

*wlcsp4_nx3p2902b_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| NX3P2902B | | | | | | ~~13-03-04~~ 13-04-02 |

**Fig 18. Package outline WLCSP4 (NX3P2902B)**

# 14. Abbreviations

**Table 13. Abbreviations**

| Acronym | Description |
|---|---|
| CDM | Charged Device Model |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MOSFET | Metal-Oxide Semiconductor Field Effect Transistor |

# 15. Revision history

**Table 14. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| NX3P2902B v.2 | 20180222 | Product data sheet | - | NX3P2902B v.1.1 |
| Modifications: | • Updated Section 4 “Ordering information” | | | |
| NX3P2902B v.1.1 | 20161101 | Product data sheet | - | NX3P2902B v.1 |
| Modifications: | • Table 8: Updated OFF-state current specification | | | |
| NX3P2902B v.1 | 20130429 | Product data sheet | - | - |

# 16. Legal information

## 16.1 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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