

NX5P2924B

Logic controlled high-side power switch

Rev. 1 — 24 February 2014

Product data sheet

1. General description

The NX5P2924B is a high-side load switch which features a low ON resistance N-channel MOSFET with controlled slew rate that supports 2.5 A of continuous current. Designed for operation from 0.8 V to 5.5 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 NX5P2924B is ideal for portable, battery operated applications due to low ground current.

2. Features and benefits

- Wide supply voltage range from 0.8 V to 5.5 V
- Very low ON resistance:
 - ◆ 14 mΩ (typical) at a supply voltage of 1.2 V
 - ◆ 14 mΩ (typical) at a supply voltage of 1.8 V
- High noise immunity
- High current handling capability (2.5 A continuous current)
- Turn-on slew rate limiting
- ESD protection:
 - ◆ HBM JESD22-A114F Class 3A exceeds 4000 V
 - ◆ CDM AEC-Q100-011 revision B exceeds 1000 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

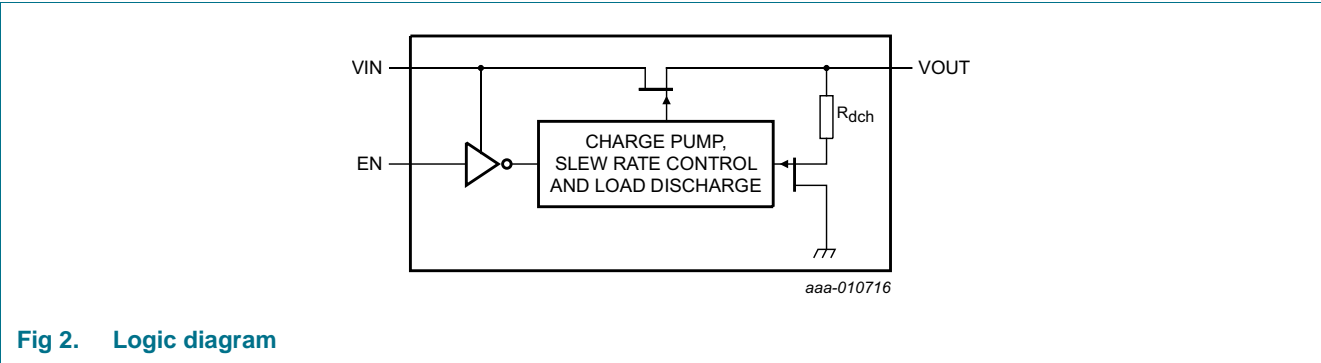
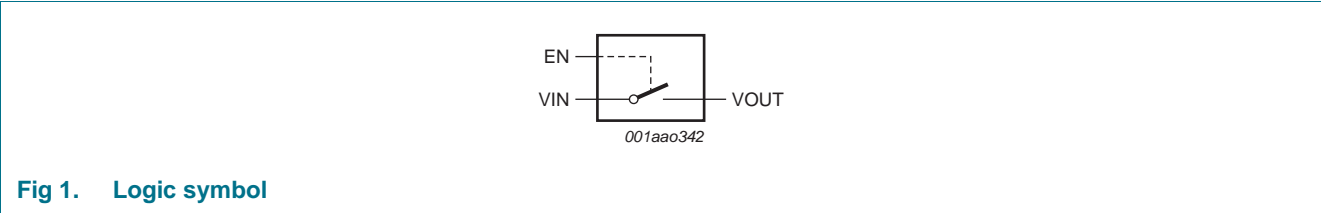
| Type number | Package | | | |
|-------------|-------------------|--------|--|-----------|
| | Temperature range | Name | Description | Version |
| NX5P2924BUK | −40 °C to +85 °C | WLCSP6 | wafer level chip-scale package; 6 bumps; 0.87 x 1.37 x 0.5 mm | NX5P2924B |

5. Marking

Table 2. Marking codes

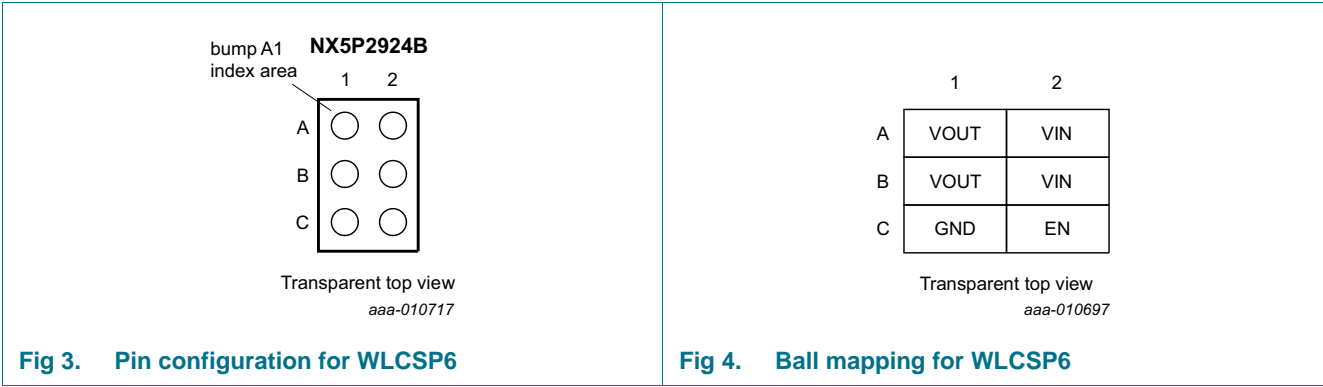
| Type number | Marking code |
|-------------|--------------|
| NX5P2924BUK | 4B |

6. Functional diagram



7. Pinning information

7.1 Pinning



7.2 Pin description

Table 3. Pin description

| Symbol | Pin | Description |
|--------|--------|----------------------------|
| VIN | A2, B2 | input voltage |
| GND | C1 | ground (0 V) |
| EN | C2 | enable input (active HIGH) |
| VOUT | A1, B1 | output voltage |

8. 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.

9. 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 | +6.0 | V |
| | | input VIN | [2] -0.5 | +6.0 | 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 | - | ± 2500 | mA |
| $T_{j(max)}$ | maximum junction temperature | | -40 | +125 | °C |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | | [3] - | 470 | 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 with lower ambient temperatures. The conditions to determine the specified values are $T_{amb} = 85$ °C and the use of a two layer PCB.

10. Recommended operating conditions

Table 6. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|---------------------|------------|-----|-----|------|
| V_I | input voltage | | 0.8 | 5.5 | V |
| T_{amb} | ambient temperature | | -40 | +85 | °C |

11. Thermal characteristics

Table 7. Thermal characteristics

| Symbol | Parameter | Conditions | Typ | Unit |
|---------------|---|------------|---------|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | | [1] 139 | K/W |

- [1] $R_{th(j-a)}$ is dependent upon board layout. To minimize $R_{th(j-a)}$, ensure that all pins have a solid connection to larger copper layer areas. In multi-layer PCBs, the second layer should be used to create a large heat spreader area below the device. Avoid using solder-stop varnish under the device.

12. Static characteristics

Table 8. Static characteristics

$V_{I(VIN)} = 1.0\text{ V to }5.5\text{ V}$, unless otherwise specified; Voltages are referenced to GND (ground = 0 V).

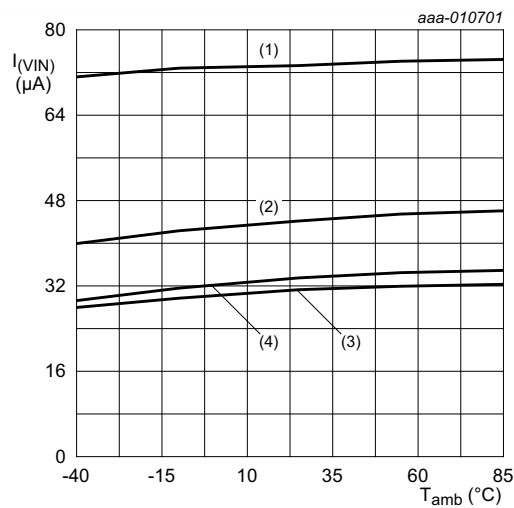
| Symbol | Parameter | Conditions | $T_{amb} = 25\text{ °C}$ | | | $T_{amb} = -40\text{ °C to }+85\text{ °C}$ | | Unit |
|-----------|--------------------------|---|--------------------------|---------|------|--|-----|------------------|
| | | | Min | Typ [1] | Max | Min | Max | |
| V_{IH} | HIGH-level input voltage | EN input; $V_{I(VIN)} = 0.8\text{ V}$ | - | 0.7 | - | - | - | V |
| | | EN input; $V_{I(VIN)} = 1.0\text{ V to }1.2\text{ V}$ | 0.9 | - | - | 0.9 | - | V |
| | | EN input; $V_{I(VIN)} = 1.2\text{ V to }2.5\text{ V}$ | 1.2 | - | - | 1.2 | - | V |
| | | EN input; $V_{I(VIN)} = 2.5\text{ V to }5.5\text{ V}$ | 1.2 | - | - | 1.2 | - | V |
| V_{IL} | LOW-level input voltage | EN input; $V_{I(VIN)} = 0.8\text{ V}$ | - | 0.25 | - | - | - | V |
| | | EN input; $V_{I(VIN)} = 1.0\text{ V to }1.2\text{ V}$ | - | - | 0.3 | - | 0.3 | V |
| | | EN input; $V_{I(VIN)} = 1.2\text{ V to }2.5\text{ V}$ | - | - | 0.4 | - | 0.4 | V |
| | | EN input; $V_{I(VIN)} = 2.5\text{ V to }5.5\text{ V}$ | - | - | 0.6 | - | 0.6 | V |
| I_I | input leakage current | EN input; $V_{I(EN)} = 0.9\text{ V to }5.5\text{ V}$ | - | - | - | - | 0.1 | μA |
| R_{dch} | discharge resistance | VOUT output; $V_{I(VIN)} = 0.8\text{ V}$ | - | 4.00 | - | - | - | $\text{k}\Omega$ |
| | | VOUT output; $V_{I(VIN)} = 1.0\text{ V}$ | - | 1.40 | - | - | - | $\text{k}\Omega$ |
| | | VOUT output; $V_{I(VIN)} = 1.2\text{ V}$ | - | 1.30 | - | - | - | $\text{k}\Omega$ |
| | | VOUT output; $V_{I(VIN)} = 1.8\text{ V}$ | - | 1.27 | 1.50 | - | - | $\text{k}\Omega$ |
| | | VOUT output; $V_{I(VIN)} = 3.3\text{ V}$ | - | 1.25 | 1.50 | - | - | $\text{k}\Omega$ |
| | | VOUT output; $V_{I(VIN)} = 5.5\text{ V}$ | - | 1.25 | 1.50 | - | - | $\text{k}\Omega$ |

Table 8. Static characteristics ...continued $V_{I(VIN)} = 1.0\text{ V}$ to 5.5 V , unless otherwise specified; Voltages are referenced to GND (ground = 0 V). ...continued

| Symbol | Parameter | Conditions | $T_{amb} = 25\text{ °C}$ | | | $T_{amb} = -40\text{ °C to }+85\text{ °C}$ | | Unit |
|--------------|---------------------------|---|--------------------------|--------------------|-----|--|-----|---------------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| $I_{(VIN)}$ | supply current | VOUT open | | | | | | |
| | | EN = HIGH; $V_{I(VIN)} = 1.0\text{ V}$; see Figure 5 and Figure 6 | - | 25 | - | - | 35 | μA |
| | | EN = HIGH; $V_{I(VIN)} = 1.8\text{ V}$; see Figure 5 and Figure 6 | - | 30 | - | - | 50 | μA |
| | | EN = HIGH; $V_{I(VIN)} = 3.6\text{ V}$; see Figure 5 and Figure 6 | - | 45 | - | - | 65 | μA |
| | | EN = HIGH; $V_{I(VIN)} = 5.5\text{ V}$; see Figure 5 and Figure 6 | - | 75 | - | - | 105 | μA |
| | | EN = LOW; $V_{I(VIN)} = 1.0\text{ V}$; see Figure 7 and Figure 8 | - | 0.1 | - | - | 0.8 | μA |
| | | EN = LOW; $V_{I(VIN)} = 1.8\text{ V}$; see Figure 7 and Figure 8 | - | 0.1 | - | - | 1.0 | μA |
| | | EN = LOW; $V_{I(VIN)} = 3.6\text{ V}$; see Figure 7 and Figure 8 | - | 0.1 | - | - | 1.2 | μA |
| $I_{S(OFF)}$ | OFF-state leakage current | EN = LOW; $V_{I(VIN)} = 1.8\text{ V}$; $V_{I(VOUT)} = 0\text{ V}$; see Figure 9 and Figure 10 | - | -0.5 | - | -3.5 | - | μA |
| | | EN = LOW; $V_{I(VIN)} = 3.6\text{ V}$; $V_{I(VOUT)} = 0\text{ V}$; see Figure 9 and Figure 10 | - | -0.5 | - | -5.0 | - | μA |
| | | EN = LOW; $V_{I(VIN)} = 5.5\text{ V}$; $V_{I(VOUT)} = 0\text{ V}$; see Figure 9 and Figure 10 | - | -0.5 | - | -7.5 | - | μA |
| C_I | input capacitance | EN | - | 3 | - | - | - | pF |
| $C_{S(ON)}$ | ON-state capacitance | VIN; VOUT | - | - | 0.5 | - | 0.5 | nF |

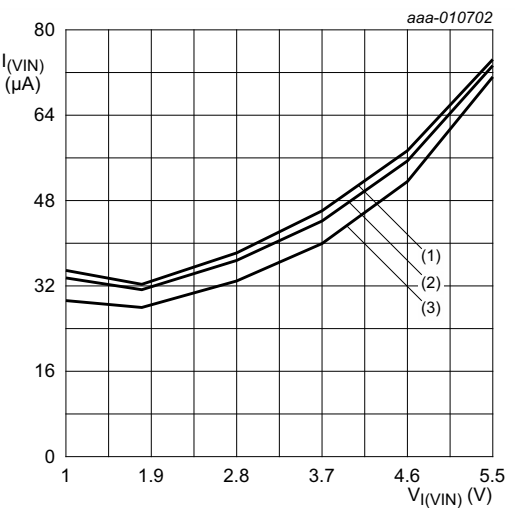
[1] All typical values are measured at $V_{I(VIN)} = 3.6\text{ V}$ and $T_{amb} = 25\text{ °C}$ unless otherwise specified.

12.1 Graphs



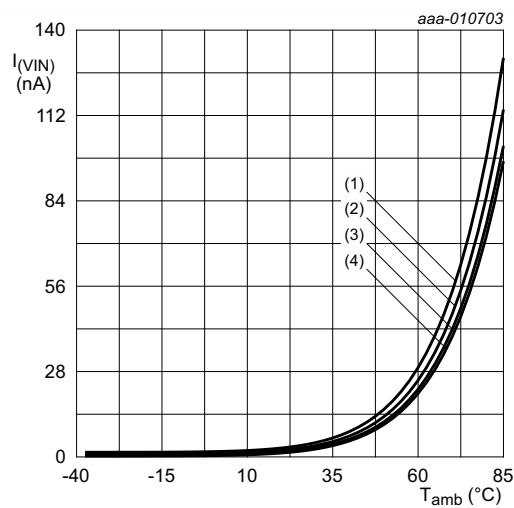
- $V_{I(EN)} = V_{I(VIN)}$.
- (1) $V_{I(VIN)} = 5.5\text{ V}$.
 - (2) $V_{I(VIN)} = 3.6\text{ V}$.
 - (3) $V_{I(VIN)} = 1.8\text{ V}$.
 - (4) $V_{I(VIN)} = 1.0\text{ V}$.

Fig 5. Typical supply current versus temperature



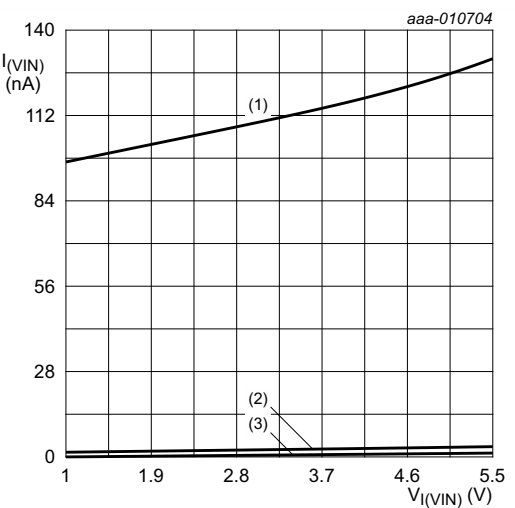
- $V_{I(EN)} = V_{I(VIN)}$.
- (1) $T_{amb} = 85\text{ }^{\circ}\text{C}$.
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$.
 - (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$.

Fig 6. Typical supply current versus input voltage on pin VIN



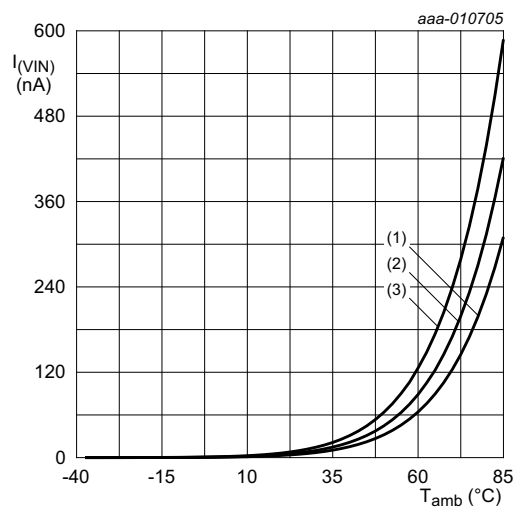
- $V_{I(EN)} = \text{GND}$.
- (1) $V_{I(VIN)} = 5.5\text{ V}$.
 - (2) $V_{I(VIN)} = 3.6\text{ V}$.
 - (3) $V_{I(VIN)} = 1.8\text{ V}$.
 - (4) $V_{I(VIN)} = 1.0\text{ V}$.

Fig 7. Typical supply current versus temperature



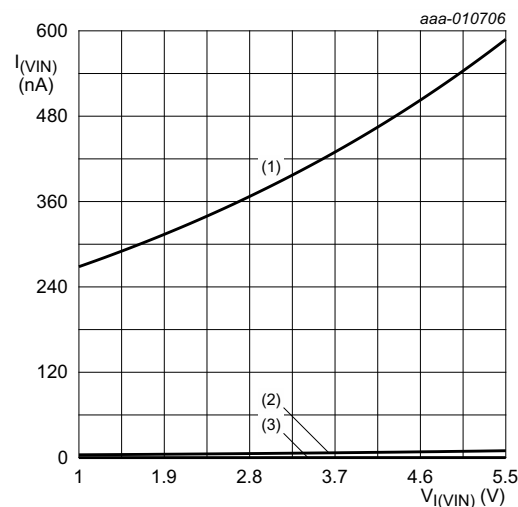
- $V_{I(EN)} = \text{GND}$.
- (1) $T_{amb} = 85\text{ }^{\circ}\text{C}$.
 - (2) $T_{amb} = 25\text{ }^{\circ}\text{C}$.
 - (3) $T_{amb} = -40\text{ }^{\circ}\text{C}$.

Fig 8. Typical supply current versus input voltage on pin VIN



- (1) $V_{I(VIN)} = 1.8\text{ V}$.
- (2) $V_{I(VIN)} = 3.6\text{ V}$.
- (3) $V_{I(VIN)} = 5.5\text{ V}$.

Fig 9. Typical OFF-state leakage current versus temperature



- (1) $T_{amb} = 85\text{ °C}$.
- (2) $T_{amb} = 25\text{ °C}$.
- (3) $T_{amb} = -40\text{ °C}$.

Fig 10. Typical OFF-state leakage current versus input voltage on pin VIN

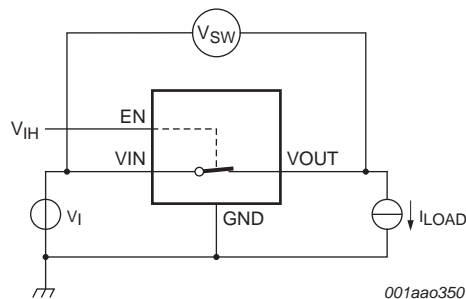
12.2 ON resistance

Table 9. ON resistance

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

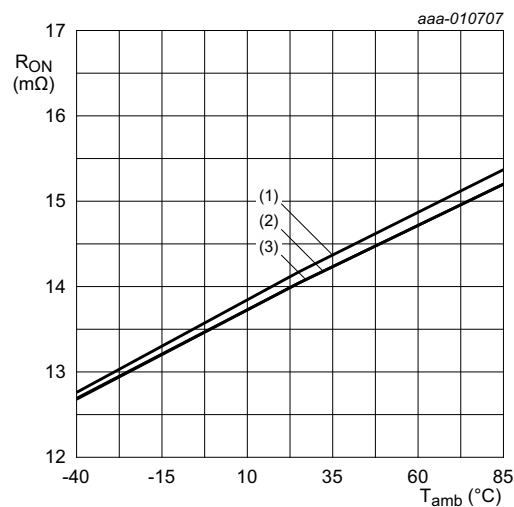
| Symbol | Parameter | Conditions | T _{amb} = 25 °C | | | T _{amb} = -40 °C to +85 °C | | Unit |
|-----------------|---------------|---|--------------------------|-----|-----|-------------------------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | |
| R _{ON} | ON resistance | $V_{I(EN)} = 1.5\text{ V}$; $I_{LOAD} = 200\text{ mA}$; see Figure 11 , 12 and 13 $V_{I(VIN)} = 0.8\text{ V to }5.5\text{ V}$ | - | 14 | - | - | 20 | mΩ |

12.3 ON resistance test circuit and graphs



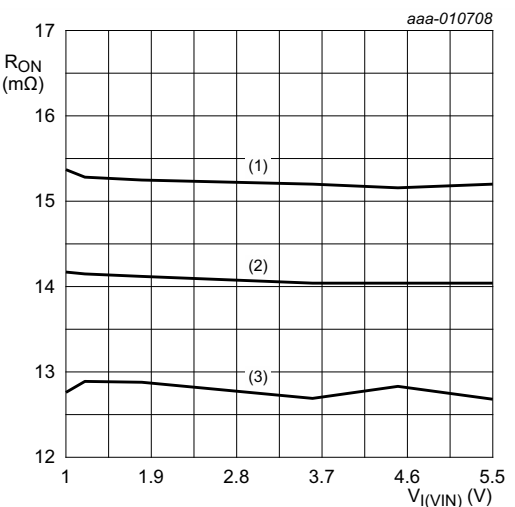
$R_{ON} = V_{SW} / I_{LOAD}$.

Fig 11. Test circuit for measuring ON resistance



- (1) $V_{I(VIN)} = 1.0\text{ V}$.
- (2) $V_{I(VIN)} = 3.6\text{ V}$.
- (3) $V_{I(VIN)} = 5.5\text{ V}$.

Fig 12. ON resistance versus temperature



- (1) $T_{amb} = 85\text{ °C}$.
- (2) $T_{amb} = 25\text{ °C}$.
- (3) $T_{amb} = -40\text{ °C}$.

Fig 13. ON resistance versus input voltage

13. Dynamic characteristics

Table 10. Dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit, see [Figure 15](#).

| Symbol | Parameter | Conditions | T _{amb} = 25 °C | | | T _{amb} = -40 °C to +85 °C | | Unit |
|------------------|--|--|--------------------------|-------|-----|-------------------------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | |
| t _{en} | enable time | EN to VOUT; see Figure 14 , 16 , 17 , 18 and 20 | | | | | | |
| | | V _{I(VIN)} = 0.8 V | - | 600 | - | - | - | µs |
| | | V _{I(VIN)} = 1.0 V | - | 240 | - | - | - | µs |
| | | V _{I(VIN)} = 3.6 V | - | 90 | - | - | - | µs |
| | | V _{I(VIN)} = 5.5 V | - | 90 | - | - | - | µs |
| t _{dis} | disable time | EN to VOUT; see Figure 14 , 19 and 21 | | | | | | |
| | | V _{I(VIN)} = 0.8 V | - | 210 | - | - | - | µs |
| | | V _{I(VIN)} = 1.0 V | - | 20 | - | - | - | µs |
| | | V _{I(VIN)} = 3.6 V | - | 5 | - | - | - | µs |
| | | V _{I(VIN)} = 5.5 V | - | 4 | - | - | - | µs |
| t _{on} | turn-on time | EN to VOUT; see Figure 14 , 16 , 17 , 18 and 20 | | | | | | |
| | | V _{I(VIN)} = 0.8 V | - | 1000 | - | - | - | µs |
| | | V _{I(VIN)} = 1.0 V | - | 350 | - | - | - | µs |
| | | V _{I(VIN)} = 3.6 V | - | 240 | - | - | - | µs |
| | | V _{I(VIN)} = 5.5 V | - | 290 | - | - | - | µs |
| t _{off} | turn-off time | EN to VOUT; see Figure 14 , 19 and 21 | | | | | | µs |
| | | V _{I(VIN)} = 0.8 V | - | 220.0 | - | - | - | µs |
| | | V _{I(VIN)} = 1.0 V | - | 22.3 | - | - | - | µs |
| | | V _{I(VIN)} = 3.6 V | - | 7.2 | - | - | - | µs |
| | | V _{I(VIN)} = 5.5 V | - | 6.0 | - | - | - | µs |
| t _{TLH} | LOW to HIGH output transition time | VOUT; see Figure 14 | | | | | | |
| | | V _{I(VIN)} = 0.8 V | - | 400 | - | - | - | µs |
| | | V _{I(VIN)} = 1.0 V | - | 110 | - | 20 | - | µs |
| | | V _{I(VIN)} = 3.6 V | - | 150 | - | 50 | - | µs |
| | | V _{I(VIN)} = 5.5 V | - | 200 | - | 70 | - | µs |
| t _{THL} | HIGH to LOW output transition time | VOUT; see Figure 14 | | | | | | |
| | | V _{I(VIN)} = 0.8 V | - | 10.0 | - | - | - | µs |
| | | V _{I(VIN)} = 1.0 V | - | 2.3 | - | - | - | µs |
| | | V _{I(VIN)} = 3.6 V | - | 2.2 | - | - | - | µs |
| | | V _{I(VIN)} = 5.5 V | - | 2.0 | - | - | - | µs |

13.1 Waveforms, graphs and test circuit

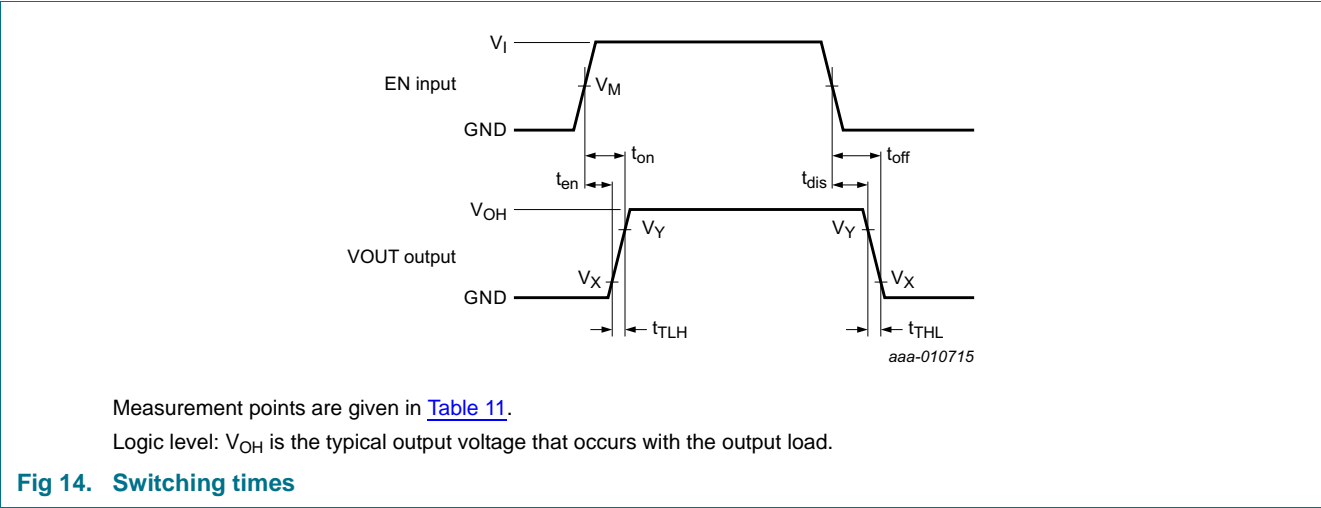


Table 11. Measurement points

| Supply voltage | EN Input | Output | |
|----------------|------------------------|---------------------|---------------------|
| $V_{I(VIN)}$ | V_M | V_X | V_Y |
| 1.0 V to 5.5 V | $0.5 \times V_{I(EN)}$ | $0.1 \times V_{OH}$ | $0.9 \times V_{OH}$ |

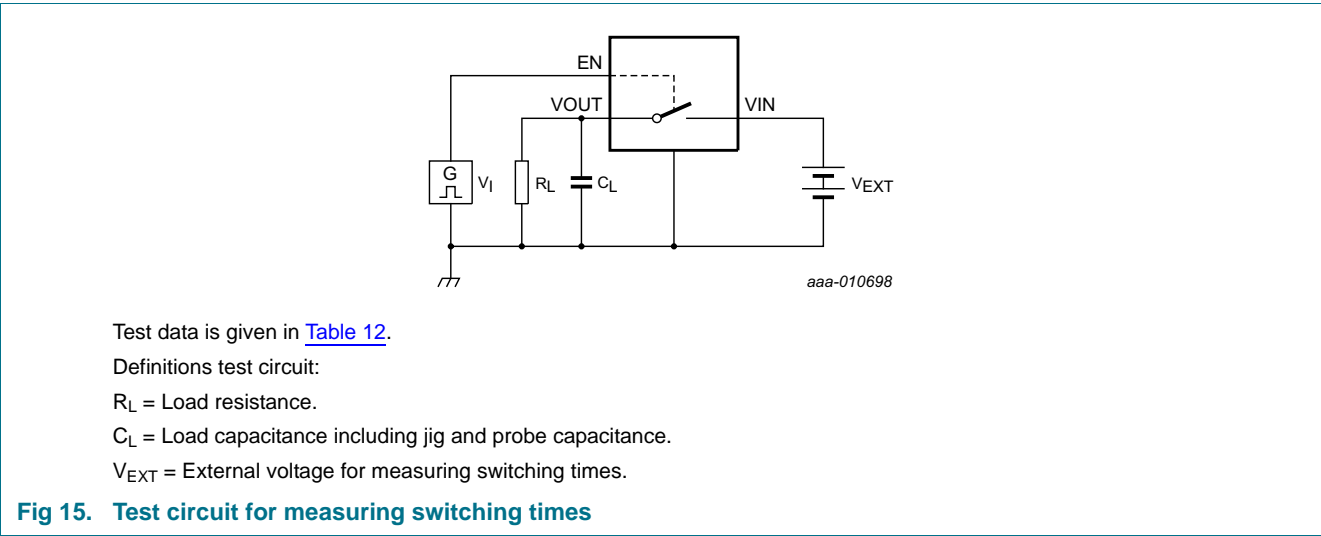
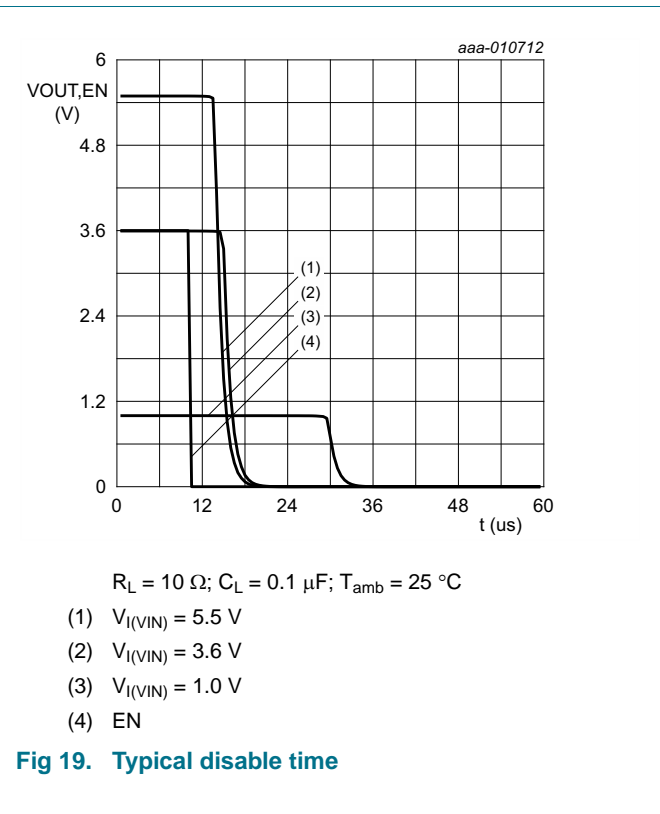
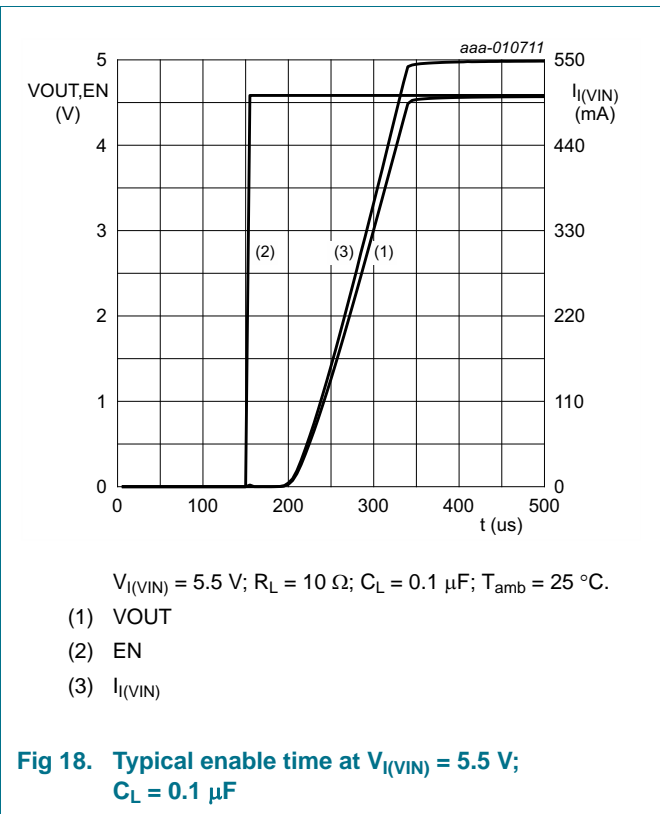
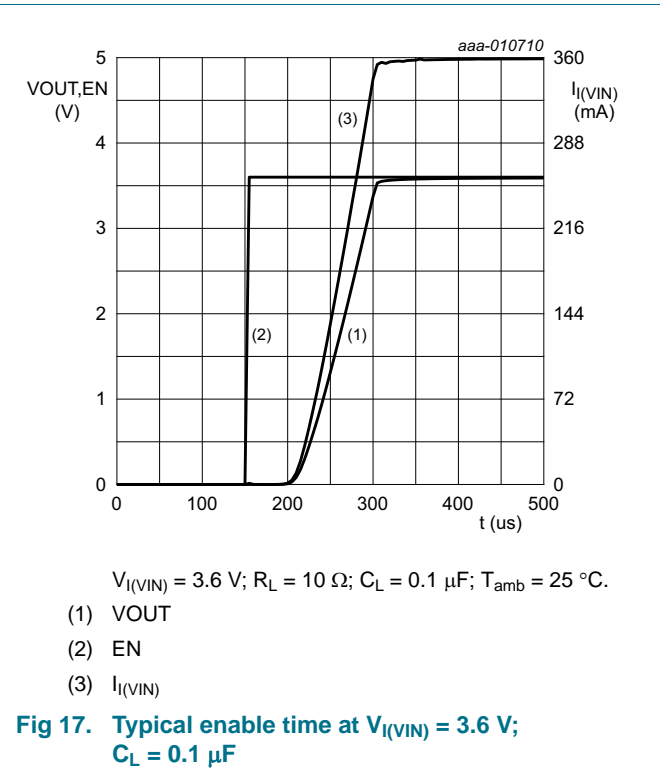
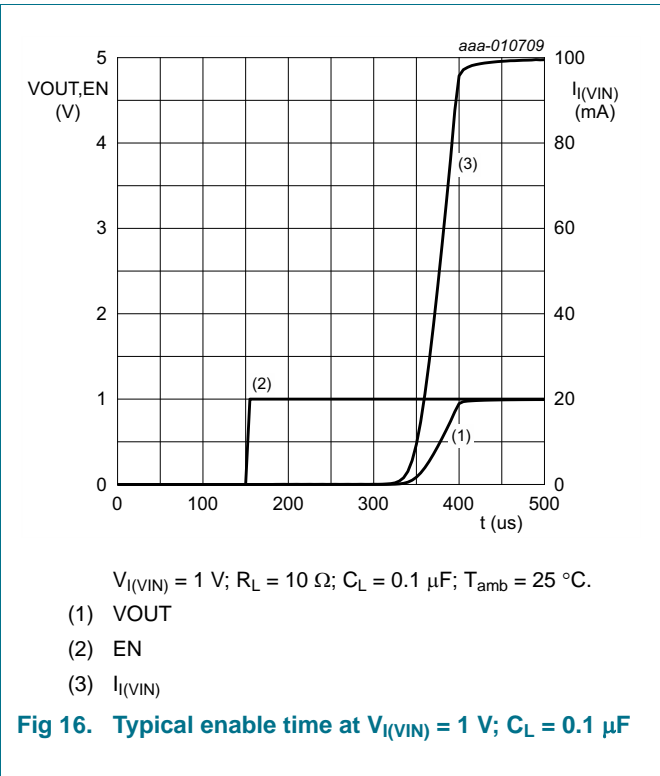
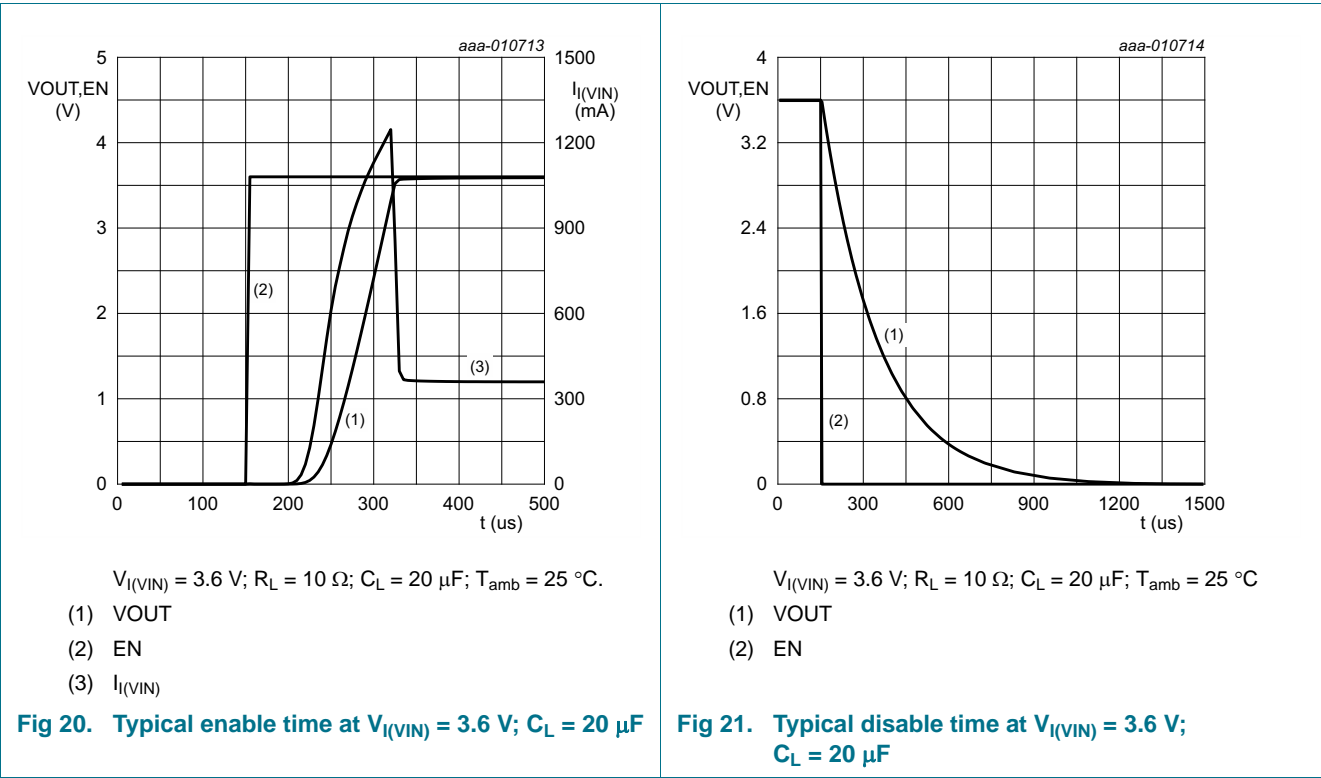


Table 12. Test data

| Supply voltage | Input | Load | |
|----------------|-------------|-------------|-------------|
| V_{EXT} | $V_{I(EN)}$ | C_L | R_L |
| 1.0 V to 5.5 V | 1.5 V | 0.1 μF | 10 Ω |





14. Package outline

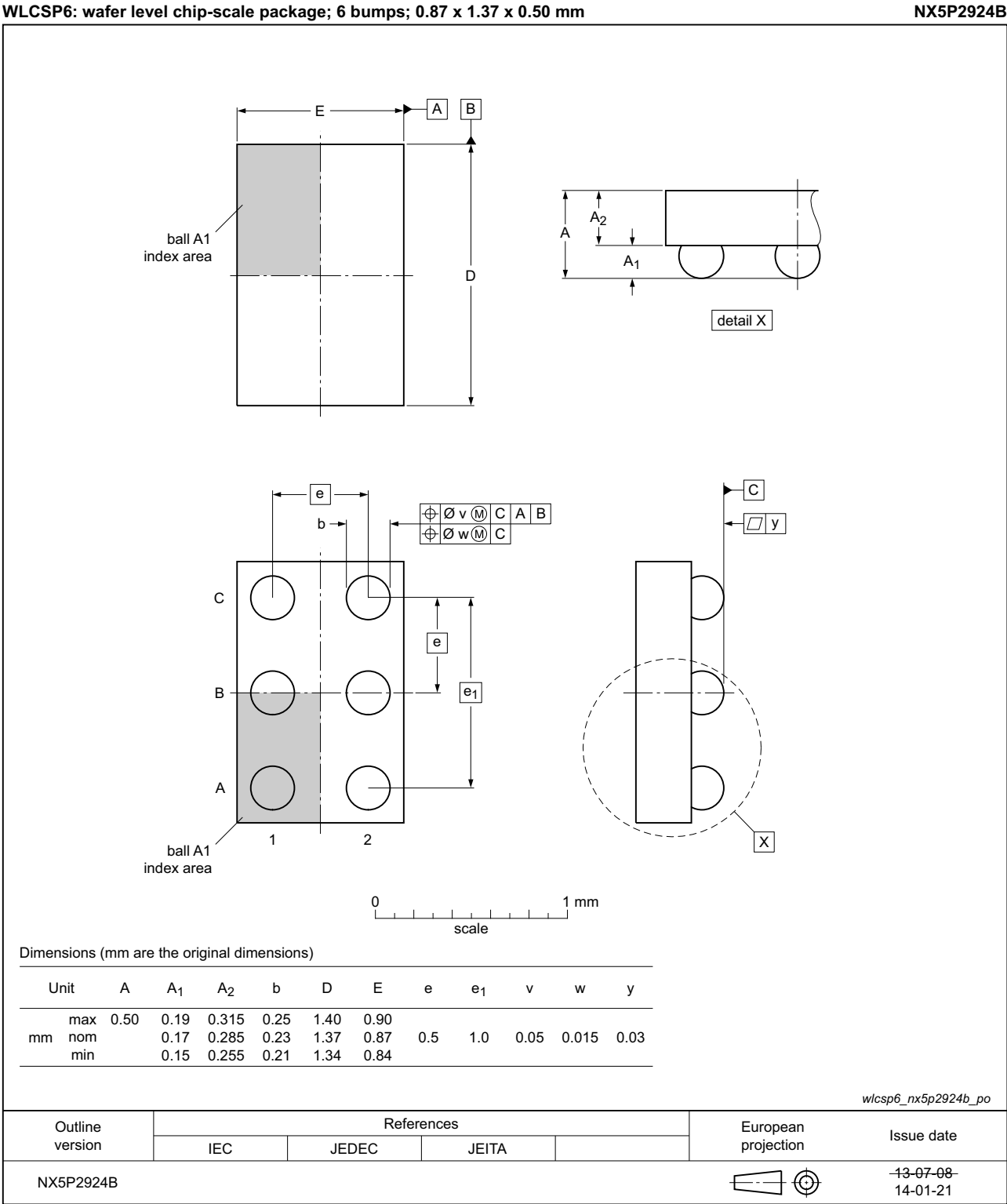


Fig 22. Package outline NX5P2924B

15. Abbreviations

Table 13. Abbreviations

| Acronym | Description |
|---------|---|
| CDM | Charged Device Model |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| IEC | International Electrotechnical Commission |
| MOSFET | Metal-Oxide Semiconductor Field Effect Transistor |

16. Revision history

Table 14. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| NX5P2924B v.1 | 20140224 | Product data sheet | - | - |

17. Legal information

17.1 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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