

# NX5P2924B

## Logic controlled high-side power switch

Rev. 1 — 24 February 2014

Product data sheet

### 1. General description

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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

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- Wide supply voltage range from 0.8 V to 5.5 V
- Very low ON resistance:
  - ◆ 14 m $\Omega$  (typical) at a supply voltage of 1.2 V
  - ◆ 14 m $\Omega$  (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  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$

### 3. Applications

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



## 4. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
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

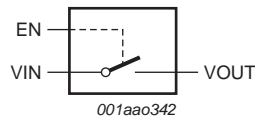


Fig 1. Logic symbol

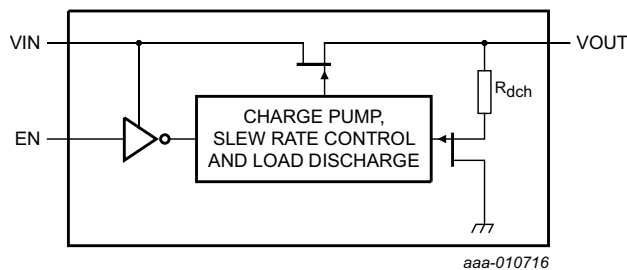
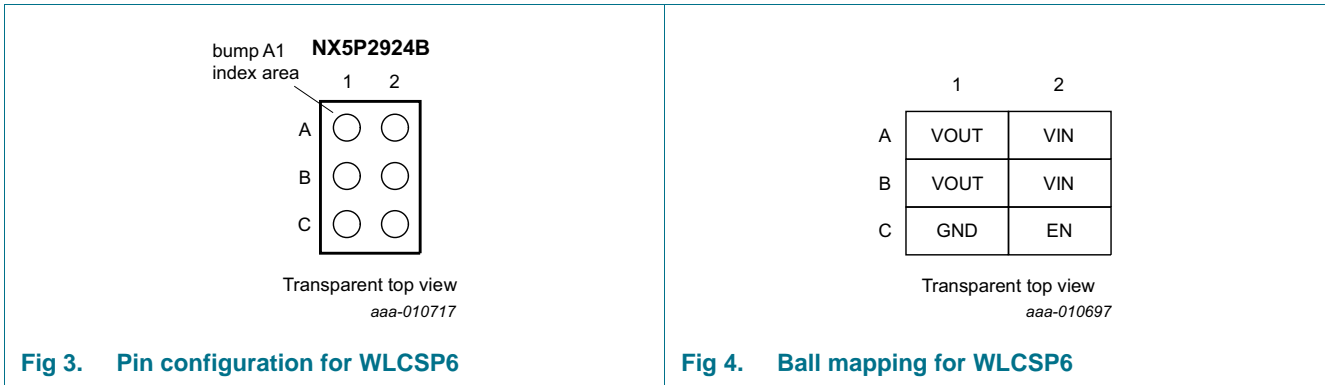


Fig 2. Logic diagram

## 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<sup>[1]</sup>**

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 <sub>I</sub>	input voltage	input EN	[1] -0.5	+6.0	V
		input VIN	[2] -0.5	+6.0	V
V <sub>SW</sub>	switch voltage	output VOUT	[2] -0.5	V <sub>I(VIN)</sub>	V
I <sub>IK</sub>	input clamping current	input EN: V <sub>I(EN)</sub> < -0.5 V	-50	-	mA
I <sub>SK</sub>	switch clamping current	input VIN: V <sub>I(VIN)</sub> < -0.5 V	-50	-	mA
		output VOUT: V <sub>O(VOUT)</sub> < -0.5 V	-50	-	mA
		output VOUT: V <sub>O(VOUT)</sub> > V <sub>I(VIN)</sub> + 0.5 V	-	50	mA
I <sub>SW</sub>	switch current	V <sub>SW</sub> > -0.5 V	-	±2500	mA
T <sub>j(max)</sub>	maximum junction temperature		-40	+125	°C
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	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<sub>j</sub>. Higher power dissipation is allowed with lower ambient temperatures. The conditions to determine the specified values are T<sub>amb</sub> = 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 <sub>I</sub>	input voltage		0.8	5.5	V
T <sub>amb</sub>	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 V to 5.5 V, unless otherwise specified; Voltages are referenced to GND (ground = 0 V).

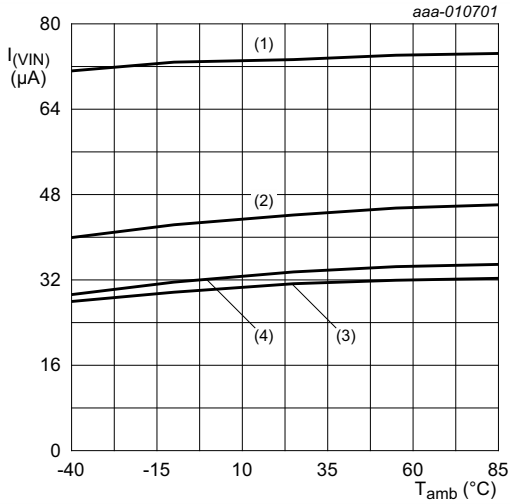
Symbol	Parameter	Conditions	$T_{amb} = 25\text{ °C}$			$T_{amb} = -40\text{ °C to }+85\text{ °C}$		Unit
			Min	Typ[1]	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	EN input; $V_{I(VIN)} = 0.8\text{ V}$	-	0.7	-	-	-	V
		EN input; $V_{I(VIN)} = 1.0\text{ V to }1.2\text{ V}$	0.9	-	-	0.9	-	V
		EN input;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

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

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

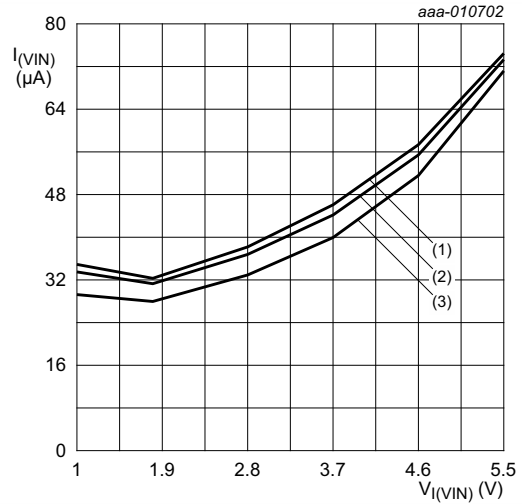
[1] All typical values are measured at  $V_{I(VIN)} = 3.6\text{ V}$  and  $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

12.1 Graphs



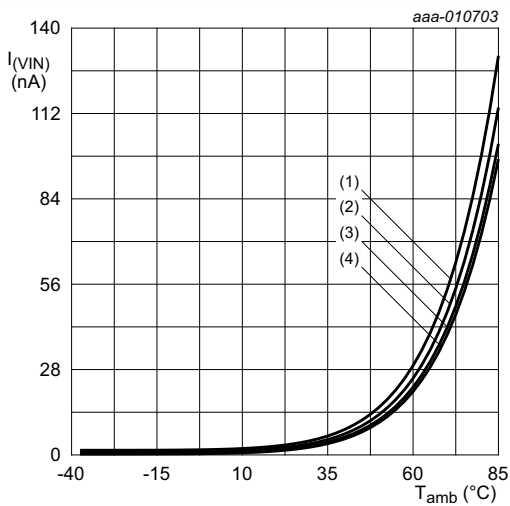
- $V_{I(EN)} = V_{I(VIN)}$
- (1)  $V_{I(VIN)} = 5.5 \text{ V}$ .
  - (2)  $V_{I(VIN)} = 3.6 \text{ V}$ .
  - (3)  $V_{I(VIN)} = 1.8 \text{ V}$ .
  - (4)  $V_{I(VIN)} = 1.0 \text{ V}$ .

Fig 5. Typical supply current versus temperature



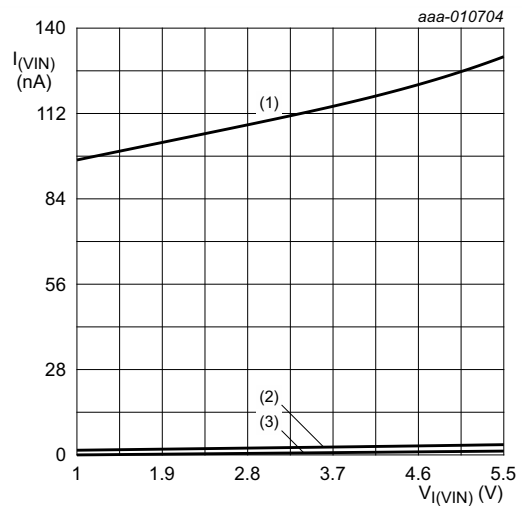
- $V_{I(EN)} = V_{I(VIN)}$
- (1)  $T_{amb} = 85 \text{ }^\circ\text{C}$ .
  - (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$ .
  - (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$ .

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



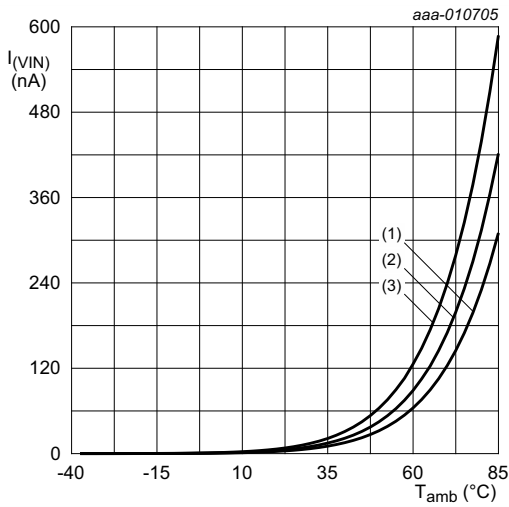
- $V_{I(EN)} = \text{GND}$
- (1)  $V_{I(VIN)} = 5.5 \text{ V}$ .
  - (2)  $V_{I(VIN)} = 3.6 \text{ V}$ .
  - (3)  $V_{I(VIN)} = 1.8 \text{ V}$ .
  - (4)  $V_{I(VIN)} = 1.0 \text{ V}$ .

Fig 7. Typical supply current versus temperature



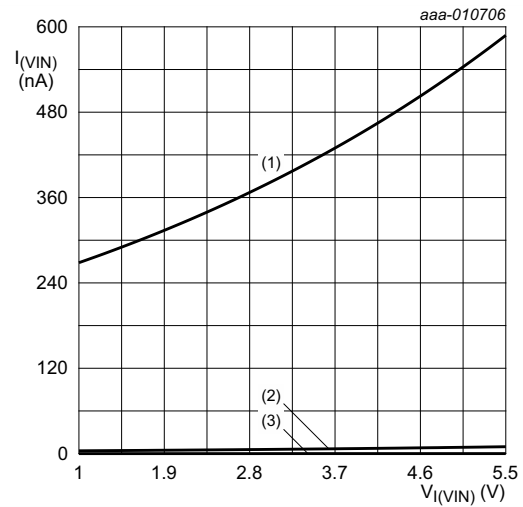
- $V_{I(EN)} = \text{GND}$
- (1)  $T_{amb} = 85 \text{ }^\circ\text{C}$ .
  - (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$ .
  - (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$ .

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

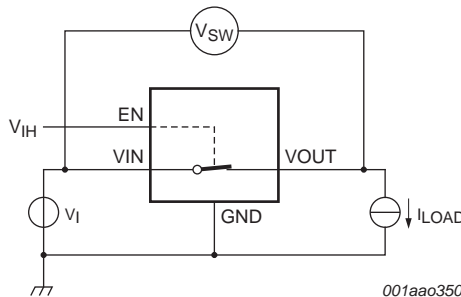
## 12.2 ON resistance

Table 9. ON resistance

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

Symbol	Parameter	Conditions	$T_{amb} = 25 \text{ °C}$			$T_{amb} = -40 \text{ °C to } +85 \text{ °C}$		Unit
			Min	Typ	Max	Min	Max	
$R_{ON}$	ON resistance	$V_{I(EN)} = 1.5 \text{ V}$ ; $I_{LOAD} = 200 \text{ mA}$ ; see <a href="#">Figure 11</a> , <a href="#">12</a> and <a href="#">13</a> $V_{I(VIN)} = 0.8 \text{ V to } 5.5 \text{ V}$	-	14	-	-	20	$m\Omega$

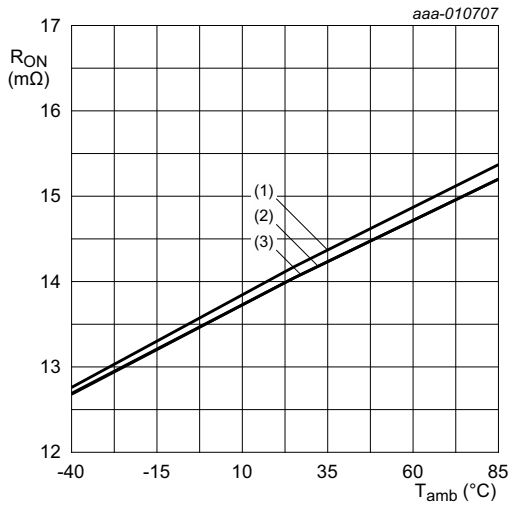
## 12.3 ON resistance test circuit and graphs



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

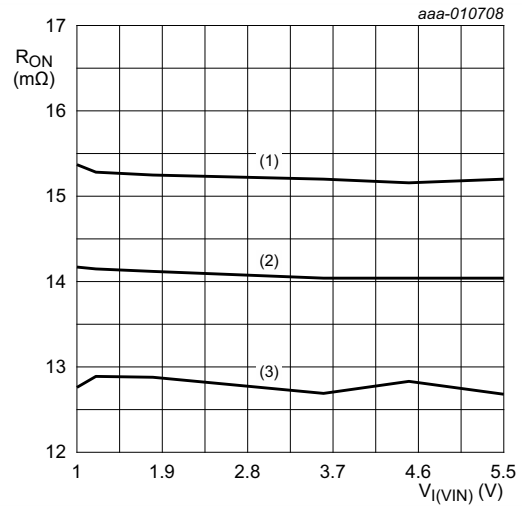
Fig 11. Test circuit for measuring ON resistance





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

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 <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		Unit
			Min	Typ	Max	Min	Max	
t <sub>en</sub>	enable time	EN to VOUT; see <a href="#">Figure 14</a> , <a href="#">16</a> , <a href="#">17</a> , <a href="#">18</a> and <a href="#">20</a>						
		V <sub>I(VIN)</sub> = 0.8 V	-	600	-	-	-	µs
		V <sub>I(VIN)</sub> = 1.0 V	-	240	-	-	-	µs
		V <sub>I(VIN)</sub> = 3.6 V	-	90	-	-	-	µs
t <sub>dis</sub>	disable time	EN to VOUT; see <a href="#">Figure 14</a> , <a href="#">19</a> and <a href="#">21</a>						
		V <sub>I(VIN)</sub> = 0.8 V	-	210	-	-	-	µs
		V <sub>I(VIN)</sub> = 1.0 V	-	20	-	-	-	µs
		V <sub>I(VIN)</sub> = 3.6 V	-	5	-	-	-	µs
t <sub>on</sub>	turn-on time	EN to VOUT; see <a href="#">Figure 14</a> , <a href="#">16</a> , <a href="#">17</a> , <a href="#">18</a> and <a href="#">20</a>						
		V <sub>I(VIN)</sub> = 0.8 V	-	1000	-	-	-	µs
		V <sub>I(VIN)</sub> = 1.0 V	-	350	-	-	-	µs
		V <sub>I(VIN)</sub> = 3.6 V	-	240	-	-	-	µs
t <sub>off</sub>	turn-off time	EN to VOUT; see <a href="#">Figure 14</a> , <a href="#">19</a> and <a href="#">21</a>						µs
		V <sub>I(VIN)</sub> = 0.8 V	-	220.0	-	-	-	µs
		V <sub>I(VIN)</sub> = 1.0 V	-	22.3	-	-	-	µs
		V <sub>I(VIN)</sub> = 3.6 V	-	7.2	-	-	-	µs
t <sub>TLH</sub>	LOW to HIGH output transition time	VOUT; see <a href="#">Figure 14</a>						
		V <sub>I(VIN)</sub> = 0.8 V	-	400	-	-	-	µs
		V <sub>I(VIN)</sub> = 1.0 V	-	110	-	20	-	µs
		V <sub>I(VIN)</sub> = 3.6 V	-	150	-	50	-	µs
t <sub>THL</sub>	HIGH to LOW output transition time	VOUT; see <a href="#">Figure 14</a>						
		V <sub>I(VIN)</sub> = 0.8 V	-	10.0	-	-	-	µs
		V <sub>I(VIN)</sub> = 1.0 V	-	2.3	-	-	-	µs
		V <sub>I(VIN)</sub> = 3.6 V	-	2.2	-	-	-	µs
		V <sub>I(VIN)</sub> = 5.5 V	-	2.0	-	-	-	µs

13.1 Waveforms, graphs and test circuit

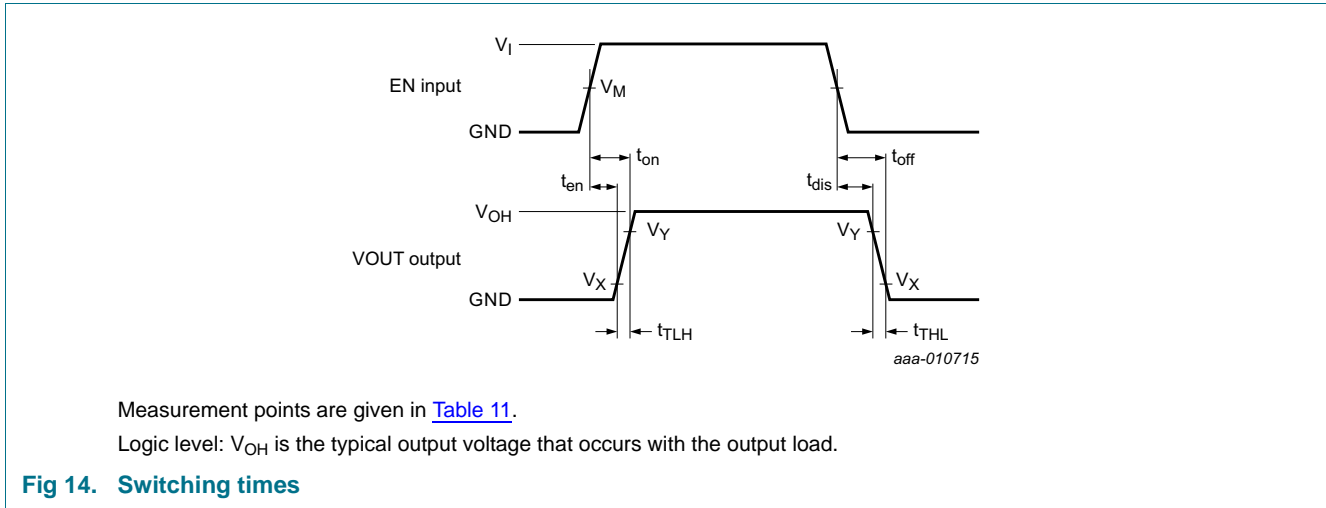


Table 11. Measurement points

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

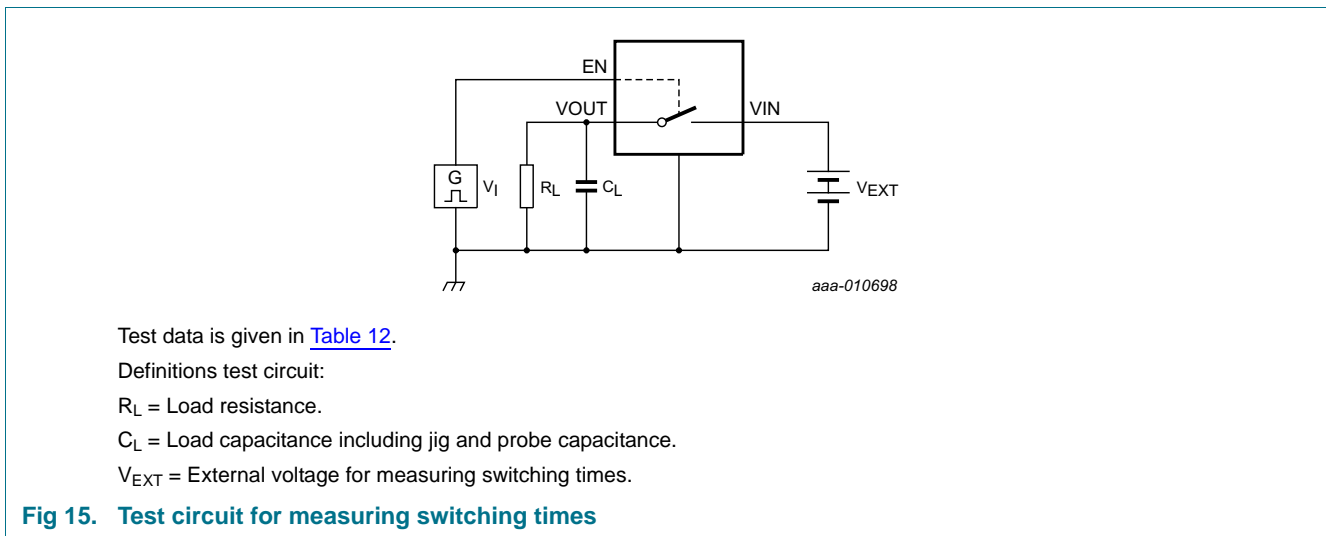
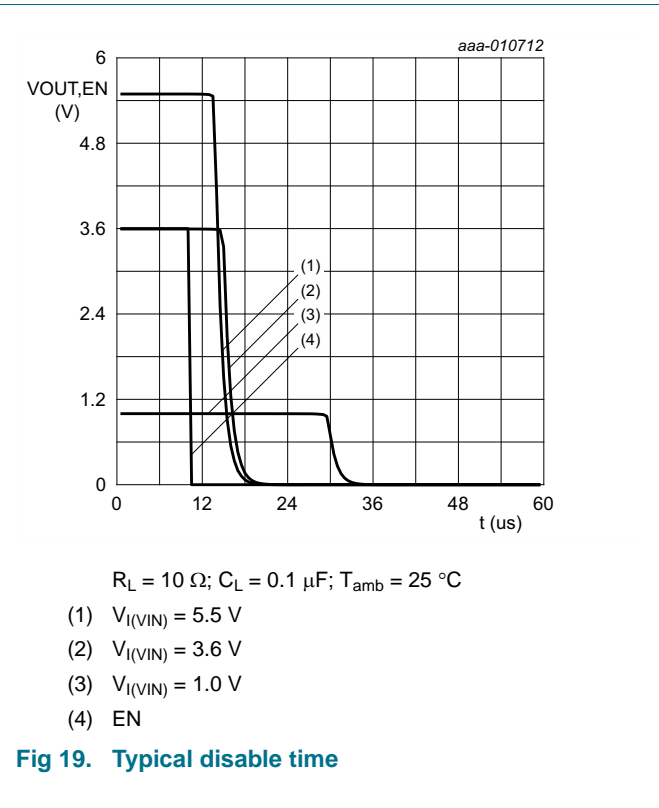
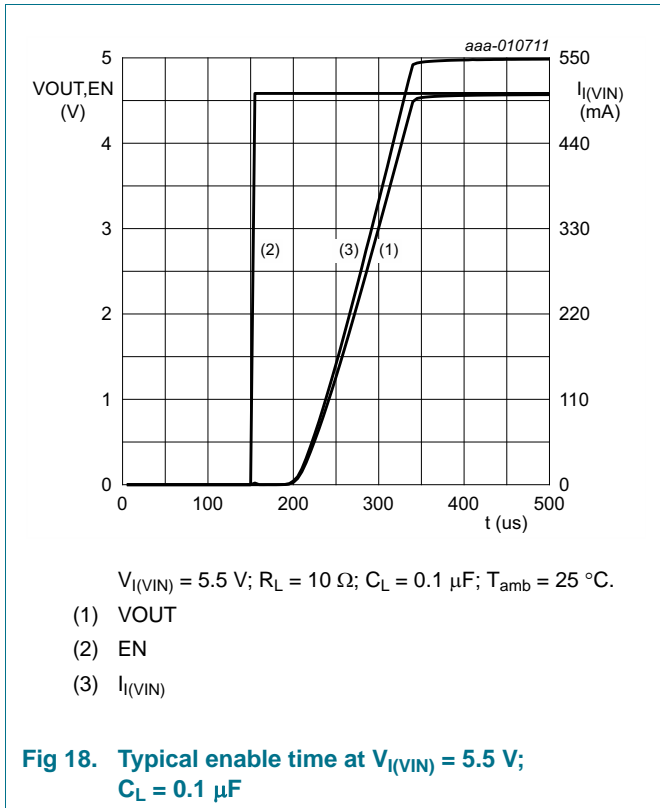
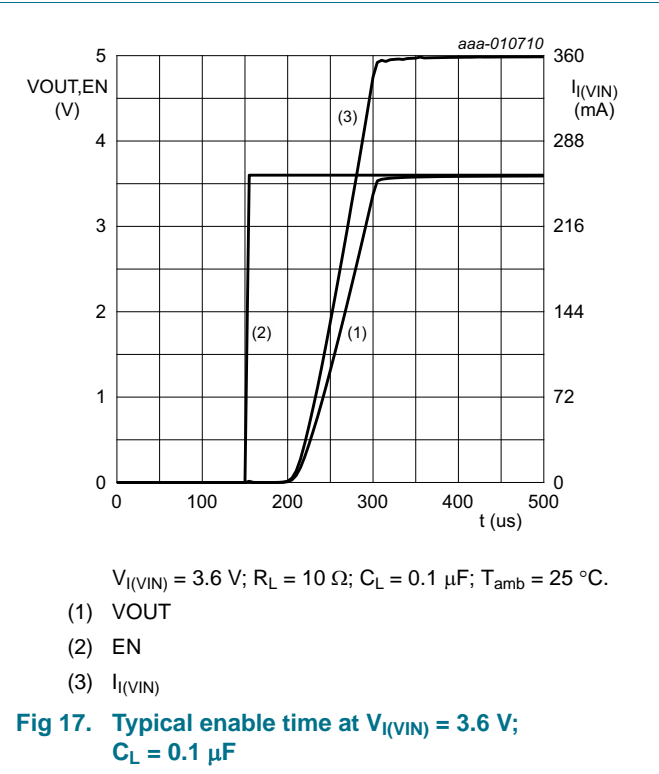
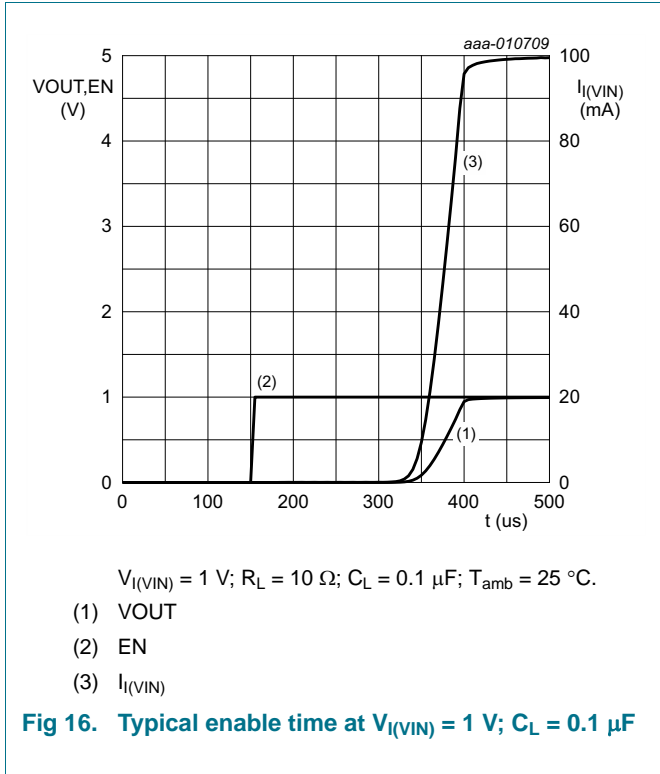
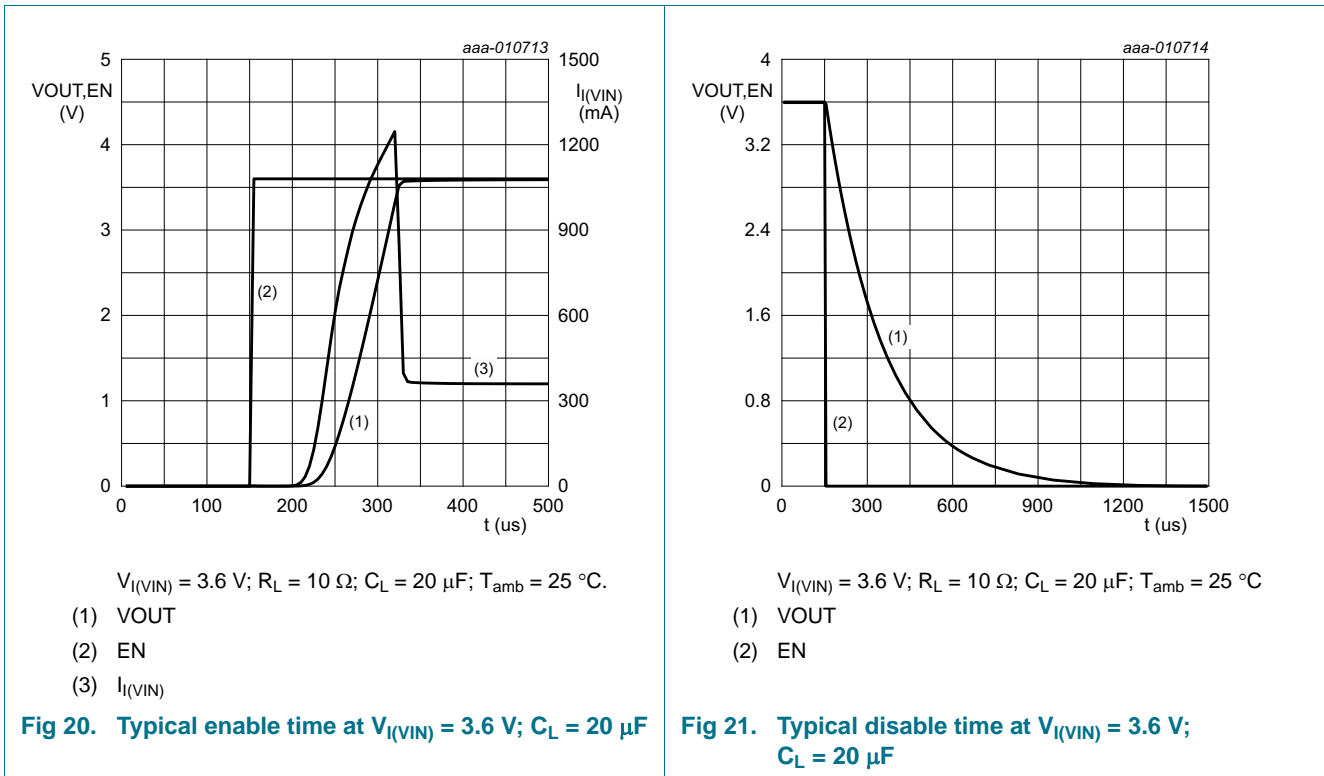


Table 12. Test data

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 $\mu$ F	10 $\Omega$

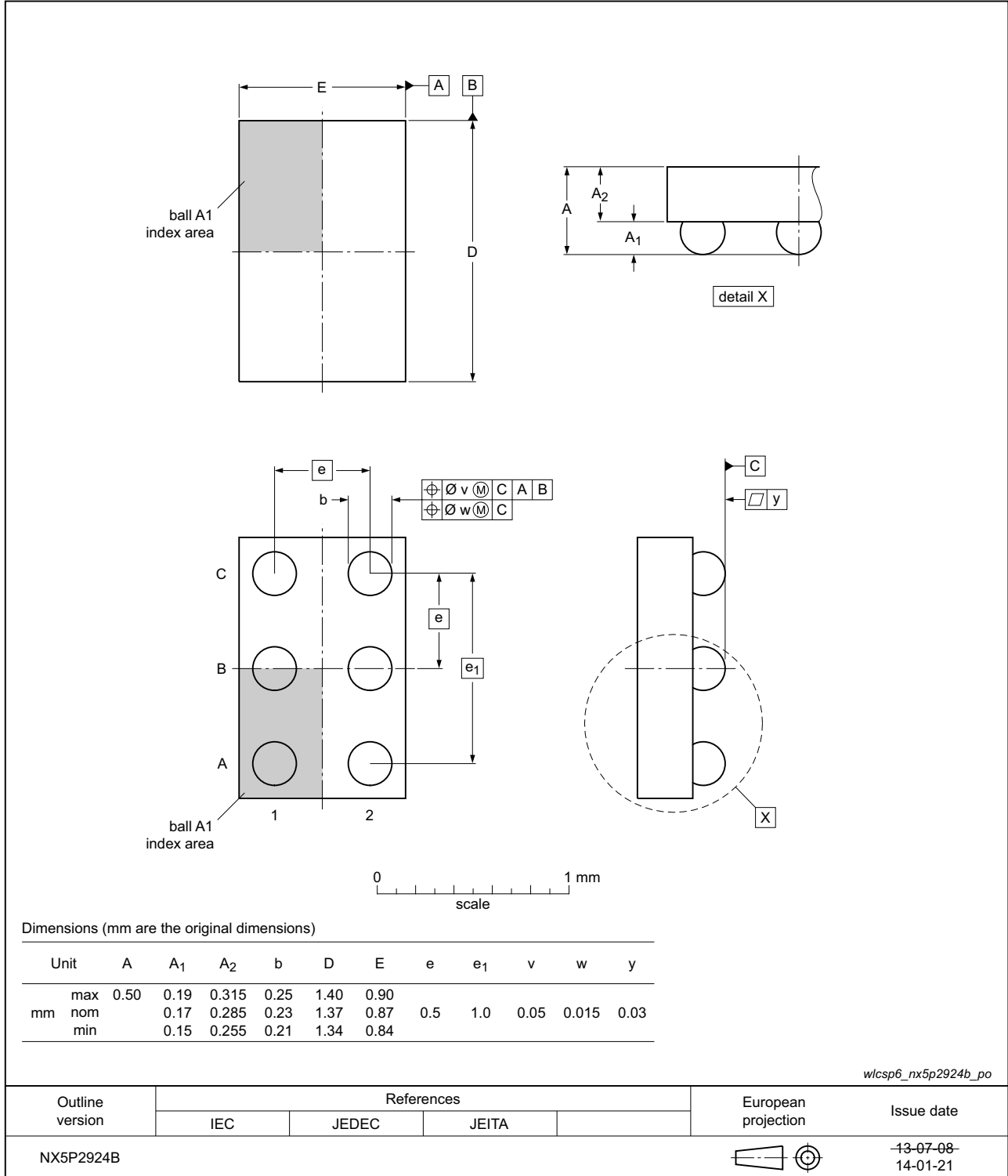




**14. Package outline**

WLCSP6: wafer level chip-scale package; 6 bumps; 0.87 x 1.37 x 0.50 mm

NX5P2924B



**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 <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.

[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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## 19. Contents

<b>1</b>	<b>General description</b> . . . . .	<b>1</b>
<b>2</b>	<b>Features and benefits</b> . . . . .	<b>1</b>
<b>3</b>	<b>Applications</b> . . . . .	<b>1</b>
<b>4</b>	<b>Ordering information</b> . . . . .	<b>2</b>
<b>5</b>	<b>Marking</b> . . . . .	<b>2</b>
<b>6</b>	<b>Functional diagram</b> . . . . .	<b>2</b>
<b>7</b>	<b>Pinning information</b> . . . . .	<b>3</b>
7.1	Pinning . . . . .	3
7.2	Pin description . . . . .	3
<b>8</b>	<b>Functional description</b> . . . . .	<b>3</b>
<b>9</b>	<b>Limiting values</b> . . . . .	<b>4</b>
<b>10</b>	<b>Recommended operating conditions</b> . . . . .	<b>4</b>
<b>11</b>	<b>Thermal characteristics</b> . . . . .	<b>5</b>
<b>12</b>	<b>Static characteristics</b> . . . . .	<b>5</b>
12.1	Graphs . . . . .	7
12.2	ON resistance . . . . .	8
12.3	ON resistance test circuit and graphs . . . . .	8
<b>13</b>	<b>Dynamic characteristics</b> . . . . .	<b>10</b>
13.1	Waveforms, graphs and test circuit . . . . .	11
<b>14</b>	<b>Package outline</b> . . . . .	<b>14</b>
<b>15</b>	<b>Abbreviations</b> . . . . .	<b>15</b>
<b>16</b>	<b>Revision history</b> . . . . .	<b>15</b>
<b>17</b>	<b>Legal information</b> . . . . .	<b>16</b>
17.1	Data sheet status . . . . .	16
17.2	Definitions . . . . .	16
17.3	Disclaimers . . . . .	16
17.4	Trademarks . . . . .	17
<b>18</b>	<b>Contact information</b> . . . . .	<b>17</b>
<b>19</b>	<b>Contents</b> . . . . .	<b>18</b>

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