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

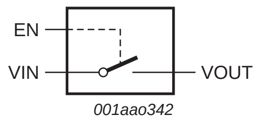


Fig 1. Logic symbol

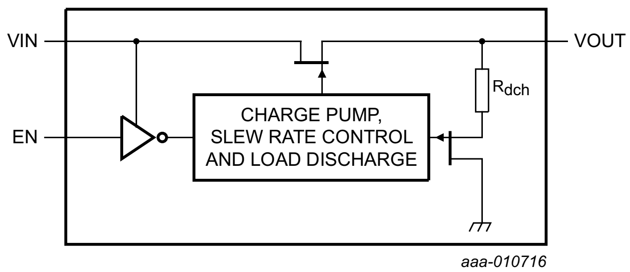


Fig 2. Logic diagram

7. Pinning information

7.1 Pinning

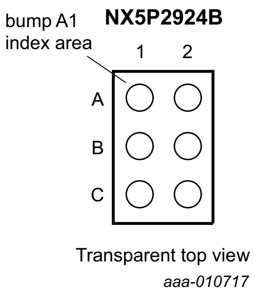


Fig 3. Pin configuration for WLCSP6

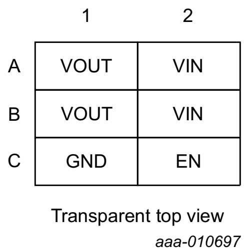


Fig 4. Ball mapping for WLCSP6

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 V to 5.5 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[1]	Max	Min	Max	
V_{IH}	HIGH-level input voltage	EN input; $V_{I(VIN)}$ = 0.8 V	-	0.7	-	-	-	V
		EN input; $V_{I(VIN)}$ = 1.0 V to 1.2 V	0.9	-	-	0.9	-	V
		EN input; $V_{I(VIN)}$ = 1.2 V to 2.5 V	1.2	-	-	1.2	-	V
		EN input; $V_{I(VIN)}$ = 2.5 V to 5.5 V	1.2	-	-	1.2	-	V
V_{IL}	LOW-level input voltage	EN input; $V_{I(VIN)}$ = 0.8 V	-	0.25	-	-	-	V
		EN input; $V_{I(VIN)}$ = 1.0 V to 1.2 V	-	-	0.3	-	0.3	V
		EN input; $V_{I(VIN)}$ = 1.2 V to 2.5 V	-	-	0.4	-	0.4	V
		EN input; $V_{I(VIN)}$ = 2.5 V to 5.5 V	-	-	0.6	-	0.6	V
I_I	input leakage current	EN input; $V_{I(EN)}$ = 0.9 V to 5.5 V	-	-	-	-	0.1	μA
R_{dch}	discharge resistance	VOUT output; $V_{I(VIN)}$ = 0.8 V	-	4.00	-	-	-	kΩ
		VOUT output; $V_{I(VIN)}$ = 1.0 V	-	1.40	-	-	-	kΩ
		VOUT output; $V_{I(VIN)}$ = 1.2 V	-	1.30	-	-	-	kΩ
		VOUT output; $V_{I(VIN)}$ = 1.8 V	-	1.27	1.50	-	-	kΩ
		VOUT output; $V_{I(VIN)}$ = 3.3 V	-	1.25	1.50	-	-	kΩ
		VOUT output; $V_{I(VIN)}$ = 5.5 V	-	1.25	1.50	-	-	kΩ

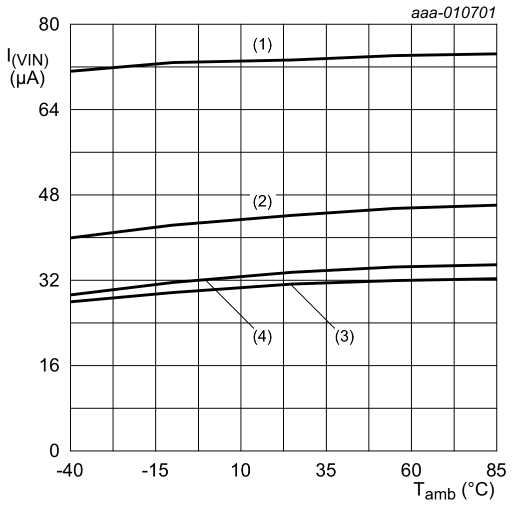
Table 8. Static characteristics *...continued*

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

Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = –40 °C to +85 °C		Unit
			Min	Typ[1]	Max	Min	Max	
$I_{(VIN)}$	supply current	VOUT open						
		EN = HIGH; $V_{I(VIN)}$ = 1.0 V; see Figure 5 and Figure 6	-	25	-	-	35	µA
		EN = HIGH; $V_{I(VIN)}$ = 1.8 V; see Figure 5 and Figure 6	-	30	-	-	50	µA
		EN = HIGH; $V_{I(VIN)}$ = 3.6 V; see Figure 5 and Figure 6	-	45	-	-	65	µA
		EN = HIGH; $V_{I(VIN)}$ = 5.5 V; see Figure 5 and Figure 6	-	75	-	-	105	µA
		EN = LOW; $V_{I(VIN)}$ = 1.0 V; see Figure 7 and Figure 8	-	0.1	-	-	0.8	µA
		EN = LOW; $V_{I(VIN)}$ = 1.8 V; see Figure 7 and Figure 8	-	0.1	-	-	1.0	µA
		EN = LOW; $V_{I(VIN)}$ = 3.6 V; see Figure 7 and Figure 8	-	0.1	-	-	1.2	µA
		EN = LOW; $V_{I(VIN)}$ = 5.5 V; see Figure 7 and Figure 6	-	0.1	-	-	1.5	µA
$I_{S(OFF)}$	OFF-state leakage current	EN = LOW; $V_{I(VIN)}$ = 1.8 V; $V_{I(VOUT)}$ = 0 V; see Figure 9 and Figure 10	-	–0.5	-	–3.5	-	µA
		EN = LOW; $V_{I(VIN)}$ = 3.6 V; $V_{I(VOUT)}$ = 0 V; see Figure 9 and Figure 10	-	–0.5	-	–5.0	-	µA
		EN = LOW; $V_{I(VIN)}$ = 5.5 V; $V_{I(VOUT)}$ = 0 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 V and T_{amb} = 25 °C unless otherwise specified.

12.1 Graphs



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

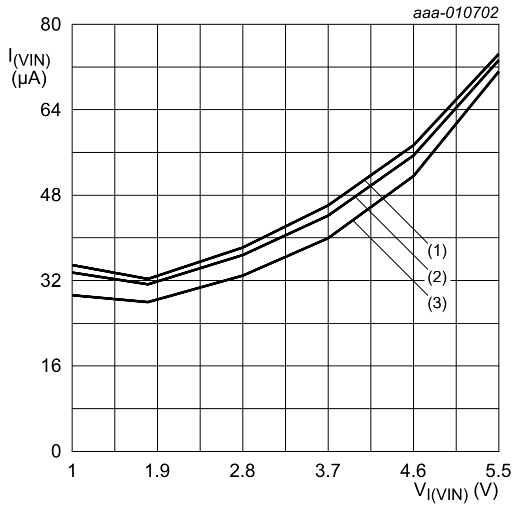
(1) $V_{I(VIN)} = 5.5$ V.

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

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

(4) $V_{I(VIN)} = 1.0$ V.

Fig 5. Typical supply current versus temperature



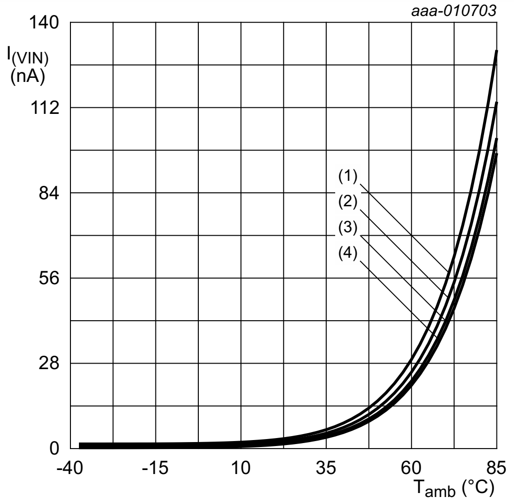
$V_{I(EN)} = V_{I(VIN)}$.

(1) $T_{amb} = 85$ °C.

(2) $T_{amb} = 25$ °C.

(3) $T_{amb} = -40$ °C.

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



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

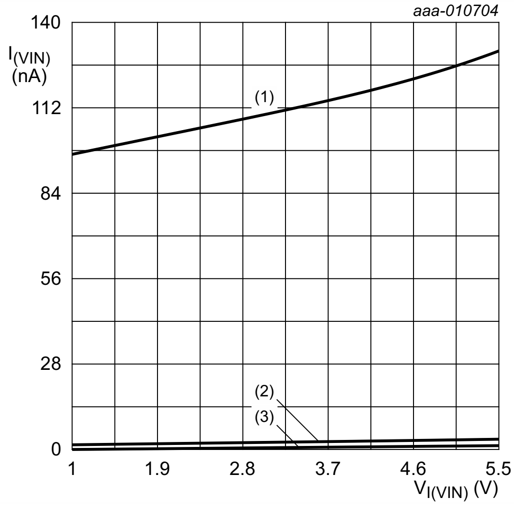
(1) $V_{I(VIN)} = 5.5$ V.

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

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

(4) $V_{I(VIN)} = 1.0$ V.

Fig 7. Typical supply current versus temperature



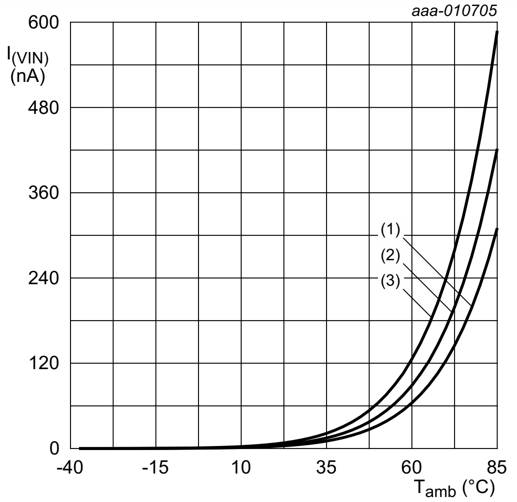
$V_{I(EN)}$ = GND.

(1) $T_{amb} = 85$ °C.

(2) $T_{amb} = 25$ °C.

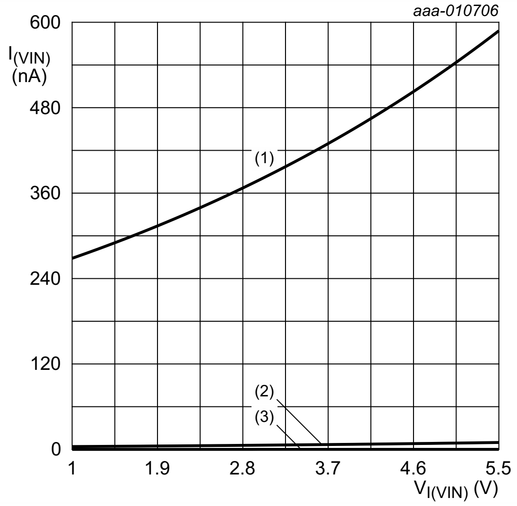
(3) $T_{amb} = -40$ °C.

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



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

Fig 9. Typical OFF-state leakage current versus temperature



(1) T_{amb} = 85 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = −40 °C.

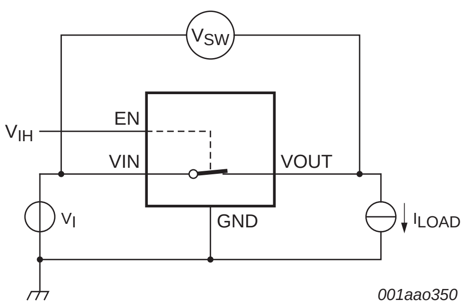
Fig 10. Typical OFF-state leakage current versus input voltage on pin VIN

12.2 ON resistance

Table 9. ON resistance
At recommended operating conditions; voltages are referenced to GND (ground = 0 V)

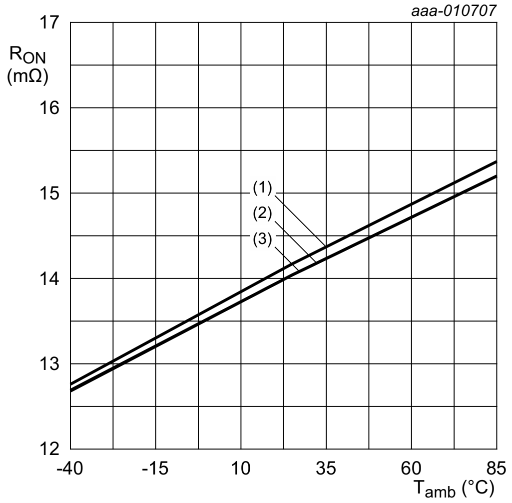
Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = −40 °C to +85 °C		Unit
			Min	Typ	Max	Min	Max	
R_{ON}	ON resistance	$V_{I(EN)}$ = 1.5 V; I_{LOAD} = 200 mA; see Figure 11, 12 and 13						
		$V_{I(VIN)}$ = 0.8 V to 5.5 V	-	14	-	-	20	mΩ

12.3 ON resistance test circuit and graphs



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

Fig 11. Test circuit for measuring ON resistance

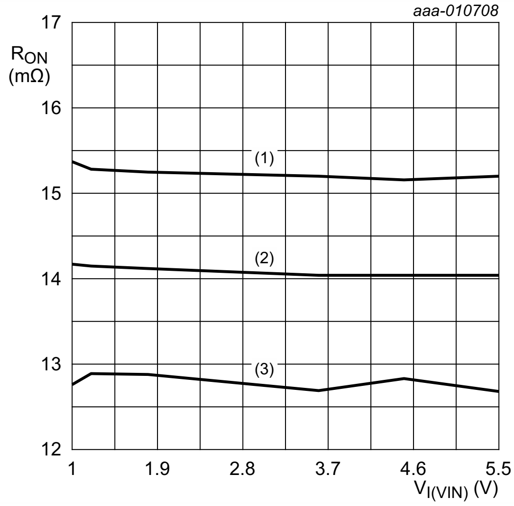


(1) $V_{I(VIN)}$ = 1.0 V.

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

(3) $V_{I(VIN)}$ = 5.5 V.

Fig 12. ON resistance versus temperature



(1) T_{amb} = 85 °C.

(2) T_{amb} = 25 °C.

(3) T_{amb} = −40 °C.

Fig 13. ON resistance versus input voltage

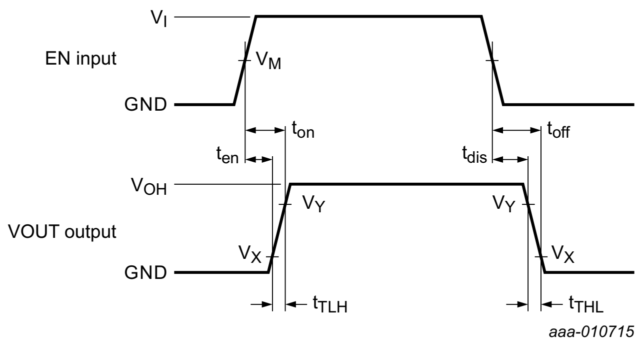
13. Dynamic characteristics

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



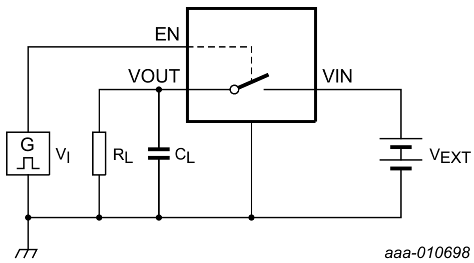
Measurement points are given in Table 11.

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

Fig 14. Switching times

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 × $V_{I(EN)}$	0.1 × V_{OH}	0.9 × V_{OH}



Test data is given in Table 12.

Definitions test circuit:

R_L = Load resistance.

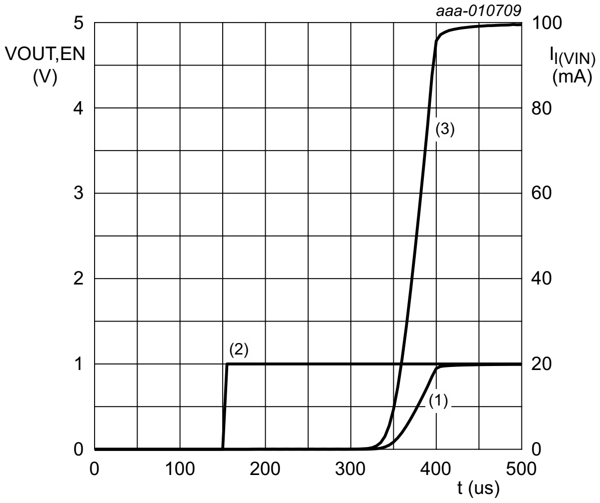
C_L = Load capacitance including jig and probe capacitance.

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

Fig 15. Test circuit for measuring switching times

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



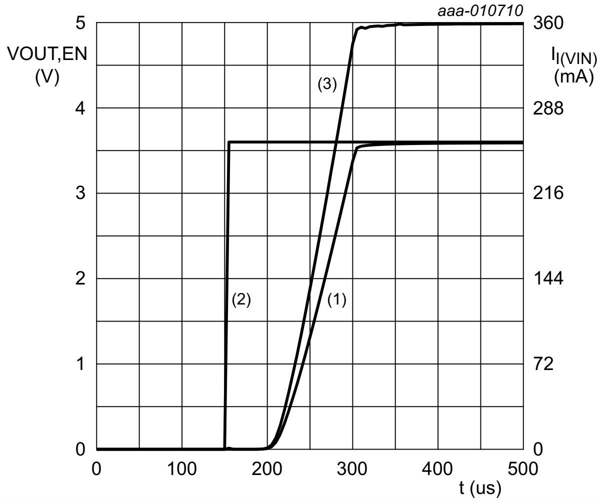
$V_{I(VIN)}$ = 1 V; R_L = 10 Ω; C_L = 0.1 μF; T_{amb} = 25 °C.

(1) VOUT

(2) EN

(3) $I_{I(VIN)}$

Fig 16. Typical enable time at $V_{I(VIN)}$ = 1 V; C_L = 0.1 μF



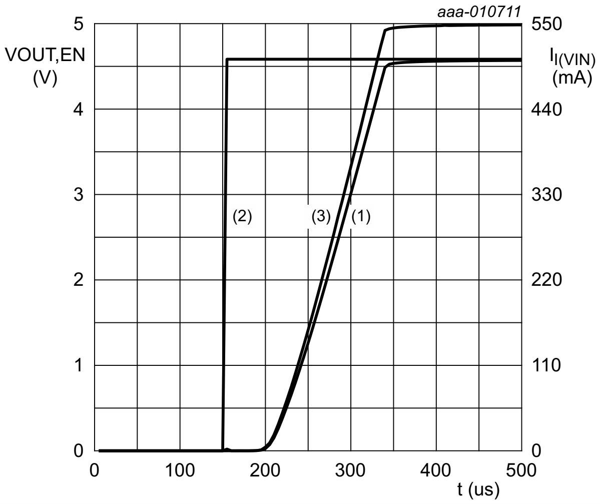
$V_{I(VIN)}$ = 3.6 V; R_L = 10 Ω; C_L = 0.1 μF; T_{amb} = 25 °C.

(1) VOUT

(2) EN

(3) $I_{I(VIN)}$

Fig 17. Typical enable time at $V_{I(VIN)}$ = 3.6 V; C_L = 0.1 μF



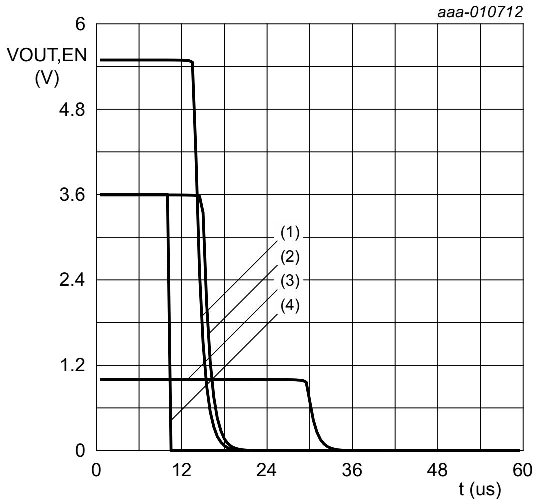
$V_{I(VIN)}$ = 5.5 V; R_L = 10 Ω; C_L = 0.1 μF; T_{amb} = 25 °C.

(1) VOUT

(2) EN

(3) $I_{I(VIN)}$

Fig 18. Typical enable time at $V_{I(VIN)}$ = 5.5 V; C_L = 0.1 μF



R_L = 10 Ω; C_L = 0.1 μF; T_{amb} = 25 °C

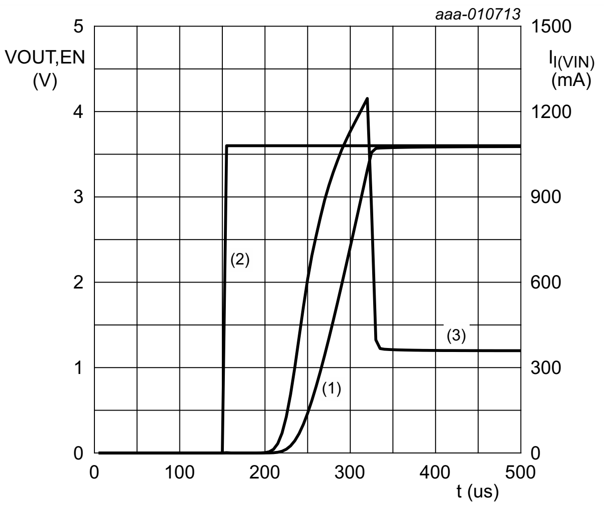
(1) $V_{I(VIN)}$ = 5.5 V

(2) $V_{I(VIN)}$ = 3.6 V

(3) $V_{I(VIN)}$ = 1.0 V

(4) EN

Fig 19. Typical disable time



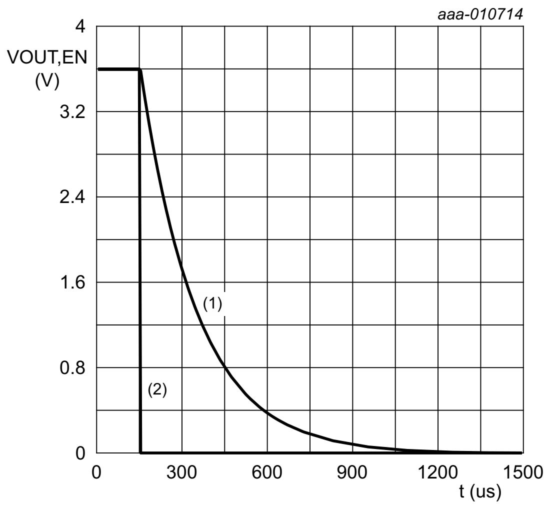
$V_{I(VIN)}$ = 3.6 V; R_L = 10 Ω; C_L = 20 µF; T_{amb} = 25 °C.

(1) VOUT

(2) EN

(3) $I_{I(VIN)}$

Fig 20. Typical enable time at $V_{I(VIN)}$ = 3.6 V; C_L = 20 µF



$V_{I(VIN)}$ = 3.6 V; R_L = 10 Ω; C_L = 20 µF; T_{amb} = 25 °C

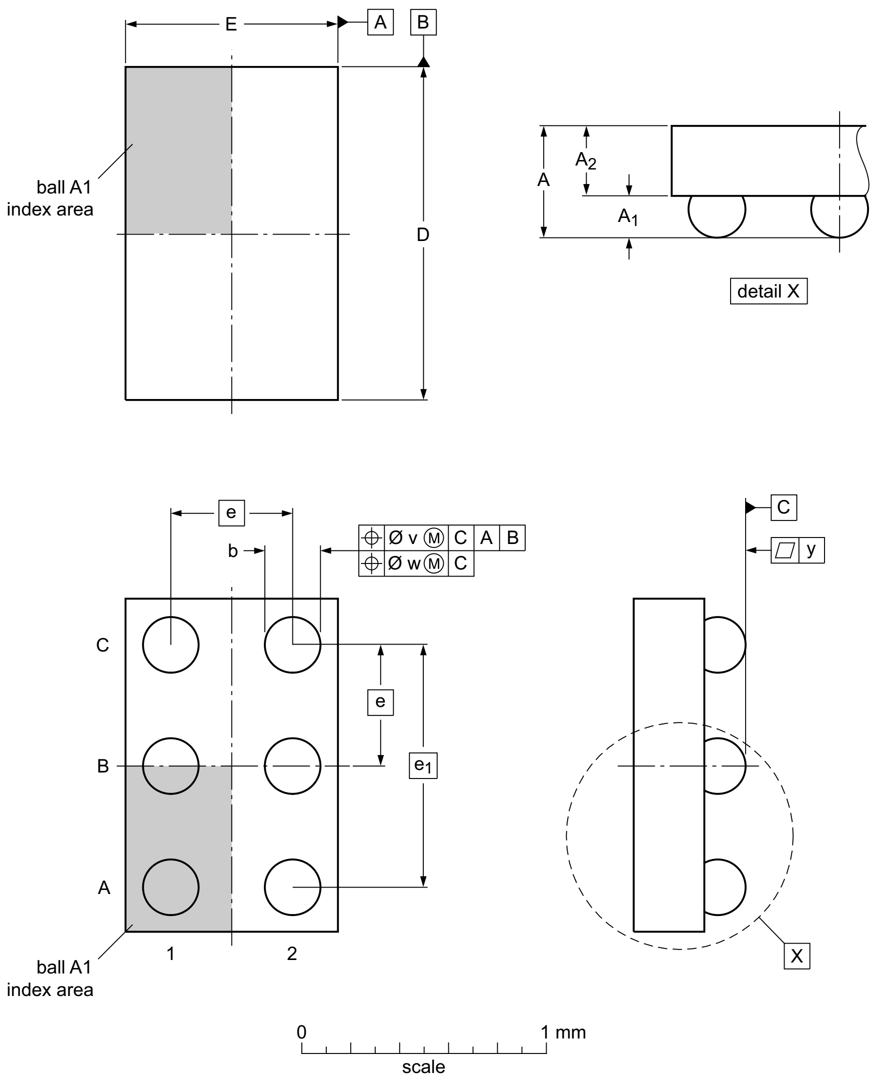
(1) VOUT

(2) EN

Fig 21. Typical disable time at $V_{I(VIN)}$ = 3.6 V; C_L = 20 µF

14. Package outline

WLCSP6: wafer level chip-scale package; 6 bumps; 0.87 x 1.37 x 0.50 mm **NX5P2924B**



Dimensions (mm are the original dimensions)

Unit		A	A_1	A_2	b	D	E	e	e_1	v	w	y
mm	max	0.50	0.19	0.315	0.25	1.40	0.90					
	nom		0.17	0.285	0.23	1.37	0.87	0.5	1.0	0.05	0.015	0.03
	min		0.15	0.255	0.21	1.34	0.84					

wlcsp6_nx5p2924b_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
NX5P2924B						~~13-07-08~~ 14-01-21

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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18. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

19. Contents

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Date of release: 24 February 2014
Document identifier: NX5P2924B