

# NX3P191

## Logic controlled high-side power switch

Rev. 5 — 14 January 2014

Product data sheet

### 1. General description

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The NX3P191 is a high-side load switch which features a low ON resistance P-channel MOSFET. It has input inrush current reduction that supports more than 500 mA of continuous current. It also has 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 NX3P191 is ideal for portable, battery operated applications due to low ground current and ultra-low shutdown current.

### 2. Features and benefits

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- Wide supply voltage range from 1.1 V to 3.6 V
- Very low ON resistance:
  - ◆ 95 mΩ (typical) at a supply voltage of 1.8 V
- High noise immunity
- Low-power mode when EN is LOW
- Low ground current (2 μA 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

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



## 4. Ordering information

Table 1. Ordering information

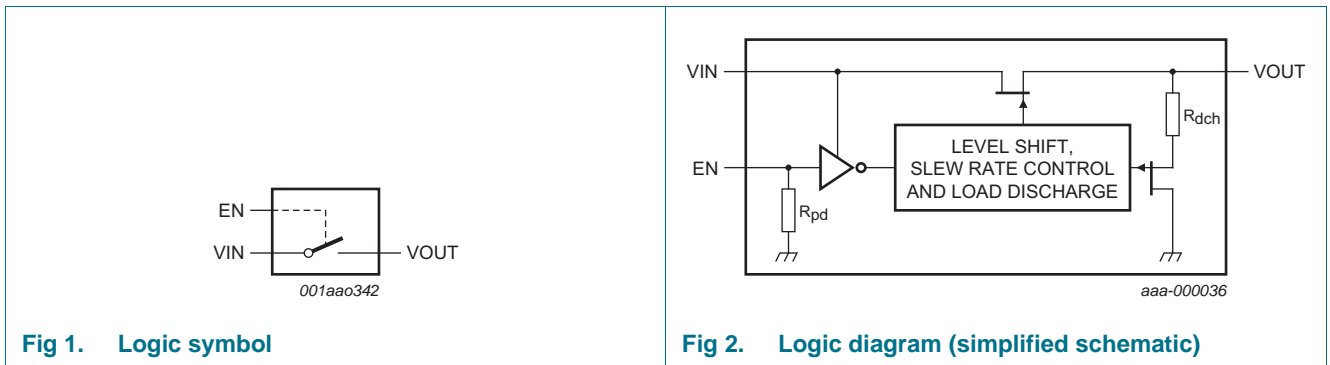
Type number	Package			Version
	Temperature range	Name	Description	
NX3P191UK	-40 °C to +85 °C	WLCSP4	wafer level chip-size package; 4 bumps; body 0.76 × 0.76 × 0.51 mm. (Backside Coating included)	NX3P190/NX3P191

## 5. Marking

Table 2. Marking codes

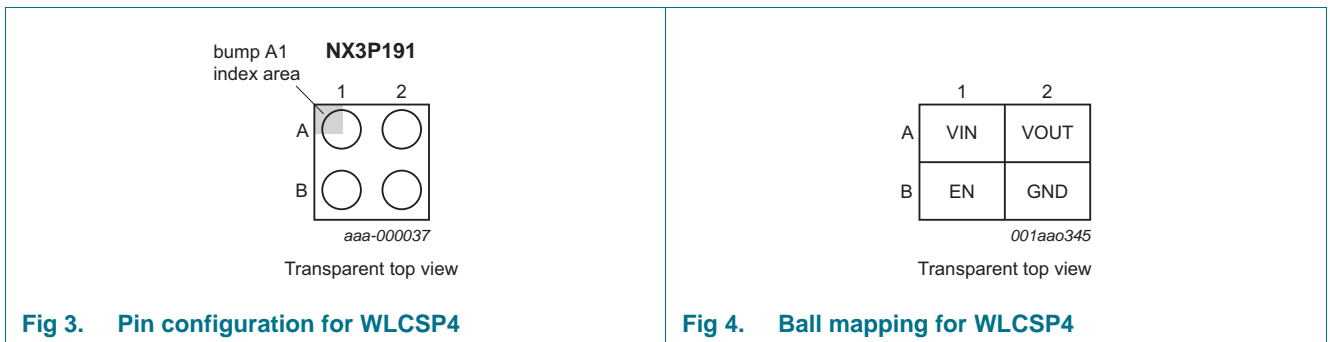
Type number	Marking code
NX3P191UK	x1

## 6. Functional diagram



## 7. Pinning information

### 7.1 Pinning



## 7.2 Pin description

**Table 3.** Pin description

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

## 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	+4.0	V
		input VIN	[2] -0.5	+4.0	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			
		T <sub>amb</sub> = 25 °C	-	±1000	mA
		T <sub>amb</sub> = 85 °C	-	±500	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] -	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<sub>j</sub>. Higher power dissipation is allowed in conjunction 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
$V_I$	input voltage		1.1	3.6	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][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] Please rely on the measurement data given for a rough estimation of the  $R_{th(j-a)}$  in your application. The actual  $R_{th(j-a)}$  value may vary in applications using different layer stacks and layouts

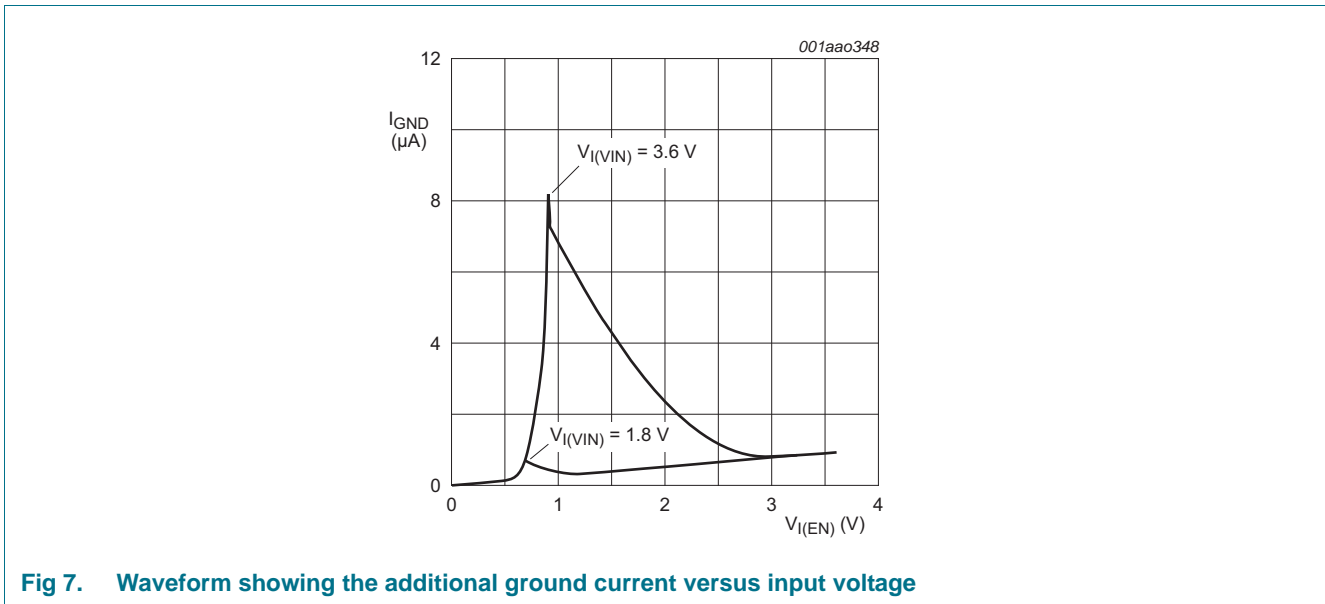
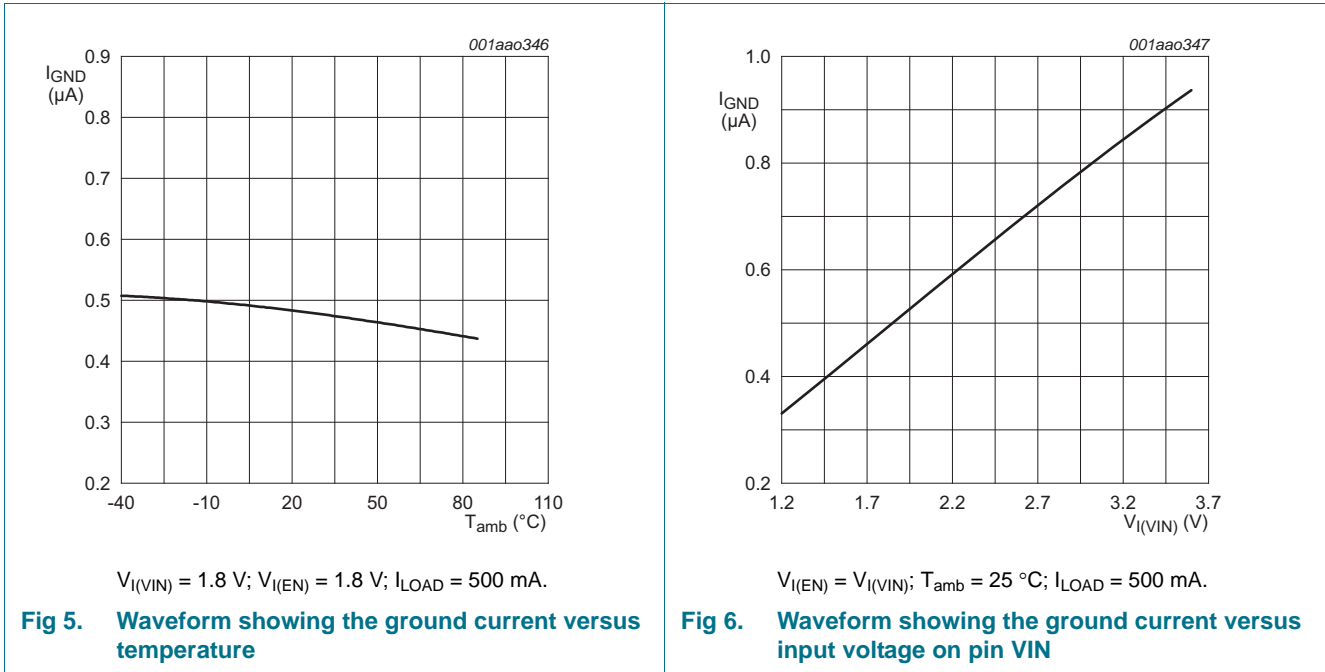
## 12. Static characteristics

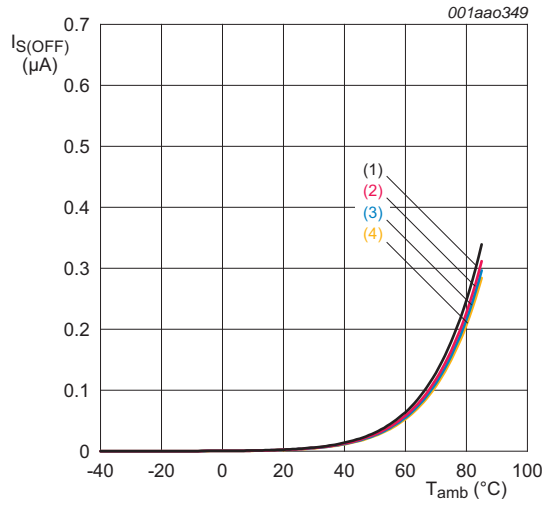
**Table 8. Static characteristics**

$V_{I(VIN)} = V_{I(EN)}$ , 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	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	EN input						
		$V_{I(VIN)} = 1.1\text{ V to }1.3\text{ V}$	-	-	-	1.0	-	V
		$V_{I(VIN)} = 1.3\text{ V to }1.8\text{ V}$	-	-	-	1.2	-	V
$V_{IL}$	LOW-level input voltage	EN input						
		$V_{I(VIN)} = 1.1\text{ V to }1.3\text{ V}$	-	-	-	-	0.3	V
		$V_{I(VIN)} = 1.3\text{ V to }1.8\text{ V}$	-	-	-	-	0.4	V
$R_{pd}$	pull-down resistance	EN input	-	4	-	-	-	MΩ
		$V_{I(VIN)} = 1.8\text{ V to }3.6\text{ V}$	-	-	-	1.2	-	V
		$V_{I(VIN)} = 1.8\text{ V to }3.6\text{ V}$	-	-	-	-	0.45	V
$I_{GND}$	ground current	$V_{I(VIN)} = 3.6\text{ V}$ ; VOUT open; see <a href="#">Figure 5</a> and <a href="#">Figure 6</a>	-	-	-	-2	-	μA
$I_{S(OFF)}$	OFF-state leakage current	$V_{I(VIN)} = 3.6\text{ V}$ ; $V_{I(EN)} = \text{GND}$ ; $V_{O(VOUT)} = \text{GND}$ ; see <a href="#">Figure 8</a>	-	0.1	-	-	2	μA
$R_{dch}$	discharge resistance	VOUT output	-	280	-	-	-	Ω

12.1 Graphs





- $V_{I(EN)} = \text{GND.}$   
 (1)  $V_{I(VIN)} = 3.6 \text{ V.}$   
 (2)  $V_{I(VIN)} = 2.5 \text{ V.}$   
 (3)  $V_{I(VIN)} = 1.8 \text{ V.}$   
 (4)  $V_{I(VIN)} = 1.2 \text{ V.}$

Fig 8. Waveforms showing the OFF-state leakage current versus temperature

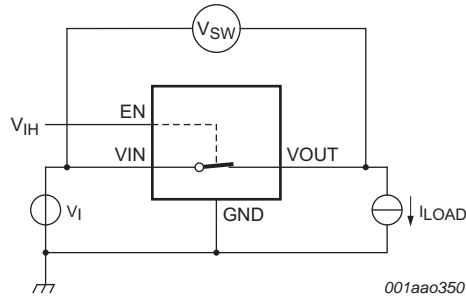
### 12.2 ON resistance

Table 9. ON resistance

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

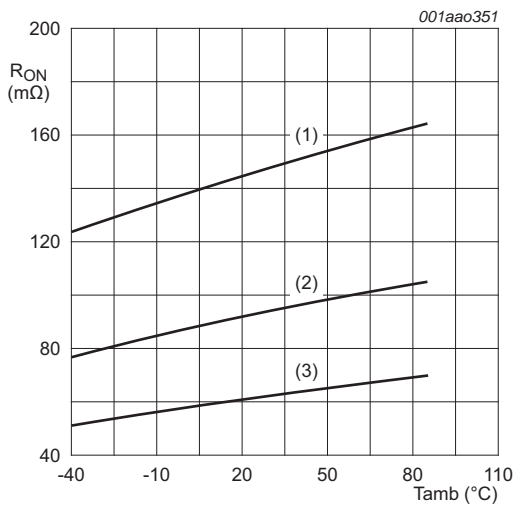
Symbol	Parameter	Conditions	$T_{\text{amb}} = 25 \text{ }^\circ\text{C}$			Unit
			Min	Typ	Max	
$R_{\text{ON}}$	ON resistance	$V_{I(EN)} = 1.5 \text{ V; } I_{\text{LOAD}} = 200 \text{ mA;}$ see <a href="#">Figure 9</a> , <a href="#">Figure 10</a> and <a href="#">Figure 11</a>				
		$V_{I(VIN)} = 1.2 \text{ V}$	-	150	-	$\text{m}\Omega$
		$V_{I(VIN)} = 1.5 \text{ V}$	-	110	-	$\text{m}\Omega$
		$V_{I(VIN)} = 1.8 \text{ V}$	-	95	130	$\text{m}\Omega$
		$V_{I(VIN)} = 2.5 \text{ V}$	-	75	-	$\text{m}\Omega$
		$V_{I(VIN)} = 3.6 \text{ V}$	-	65	-	$\text{m}\Omega$

12.3 ON resistance test circuit and waveforms



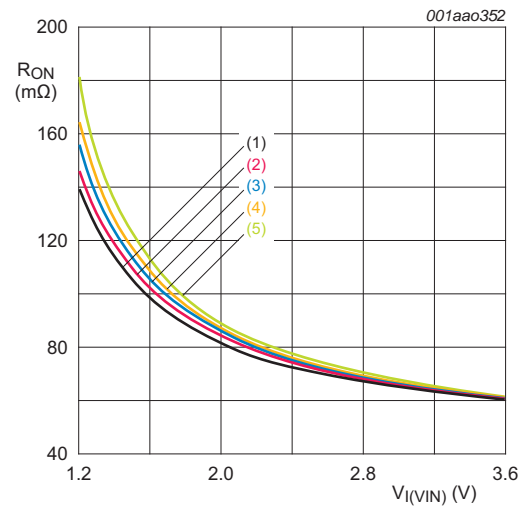
$$R_{ON} = V_{SW} / I_{LOAD}$$

Fig 9. Test circuit for measuring ON resistance



- $I_{LOAD} = 100 \text{ mA}$ .
- (1)  $V_{I(VIN)} = 1.2 \text{ V}$ .
  - (2)  $V_{I(VIN)} = 1.8 \text{ V}$ .
  - (3)  $V_{I(VIN)} = 3.6 \text{ V}$ .

Fig 10. Waveform showing the ON resistance versus temperature



- $V_{I(EN)} = V_{I(VIN)}$ ;  $T_{amb} = 25 \text{ °C}$ .
- (1)  $I_{LOAD} = 10 \text{ mA}$ .
  - (2)  $I_{LOAD} = 100 \text{ mA}$ .
  - (3)  $I_{LOAD} = 250 \text{ mA}$ .
  - (4)  $I_{LOAD} = 350 \text{ mA}$ .
  - (5)  $I_{LOAD} = 500 \text{ mA}$ .

Fig 11. Waveform showing the ON resistance versus input voltage

### 13. Dynamic characteristics

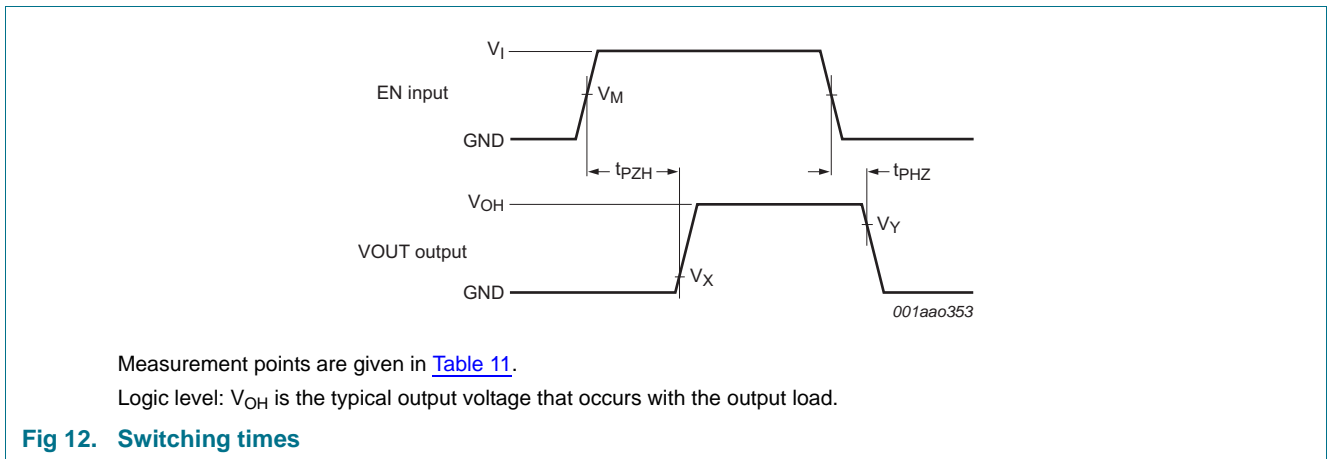
**Table 10. Dynamic characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 13](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			Unit
			Min	Typ	Max	
t <sub>en</sub>	enable time	EN to VOUT; see <a href="#">Figure 12</a> <span style="float:right">[1]</span>				
		V <sub>I(VIN)</sub> = 1.8 V	-	80	-	µs
		V <sub>I(VIN)</sub> = 3.6 V	-	40	-	µs

[1] t<sub>en</sub> is the same as t<sub>pZH</sub>.

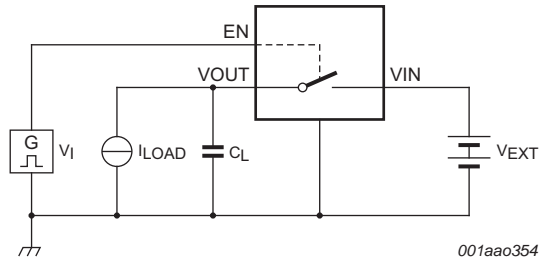
#### 13.1 Waveform and test circuits



**Table 11. Measurement points**

Supply voltage	EN Input	Output	
V <sub>I(VIN)</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>
1.1 V to 3.6 V	0.5 × V <sub>I(EN)</sub>	0.1 × V <sub>OH</sub>	0.9 × V <sub>OH</sub>





Test data is given in [Table 12](#).

Definitions test circuit:

$R_L$  = Load resistance.

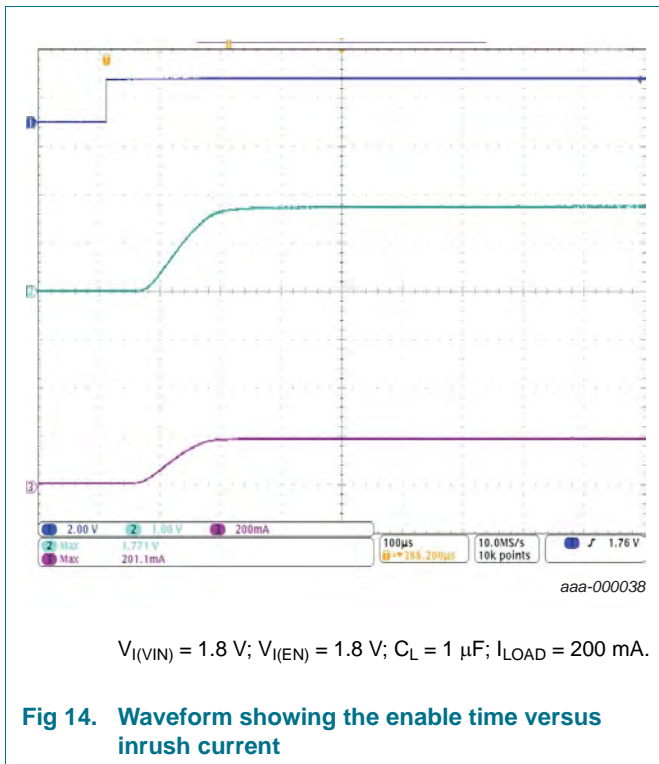
$C_L$  = Load capacitance including jig and probe capacitance.

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

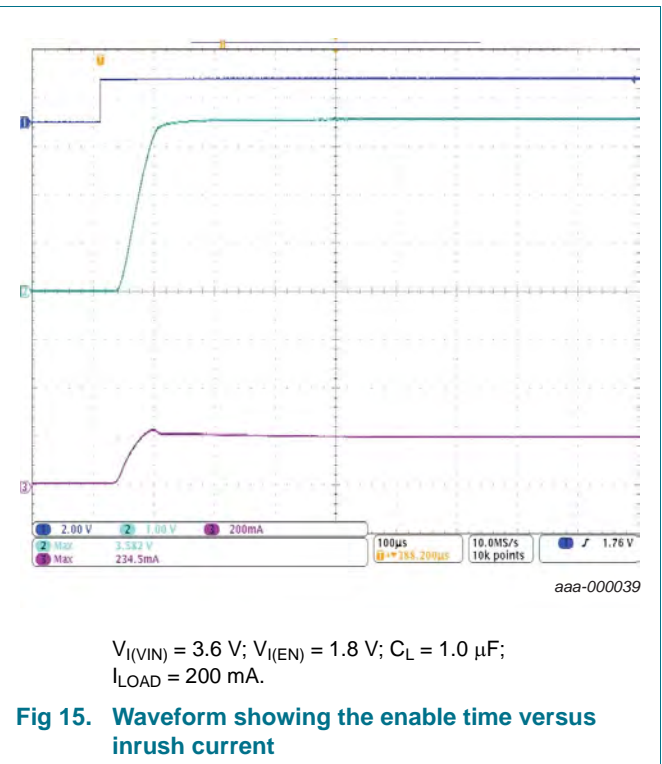
**Fig 13. Test circuit for measuring switching times**

**Table 12. Test data**

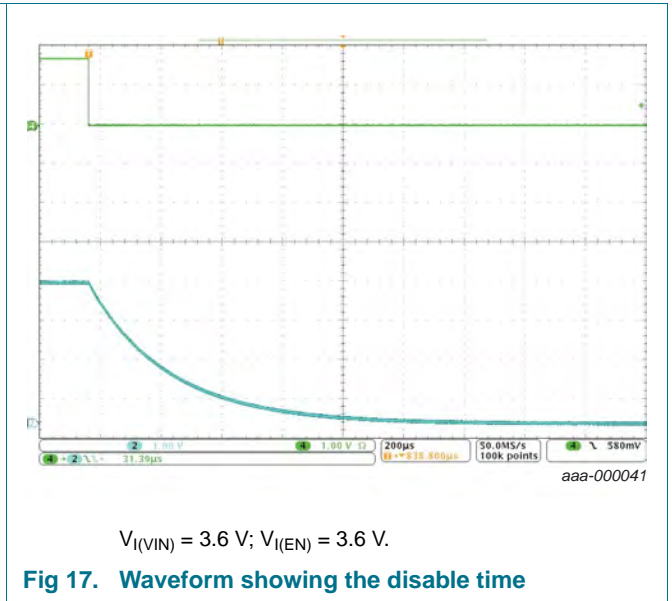
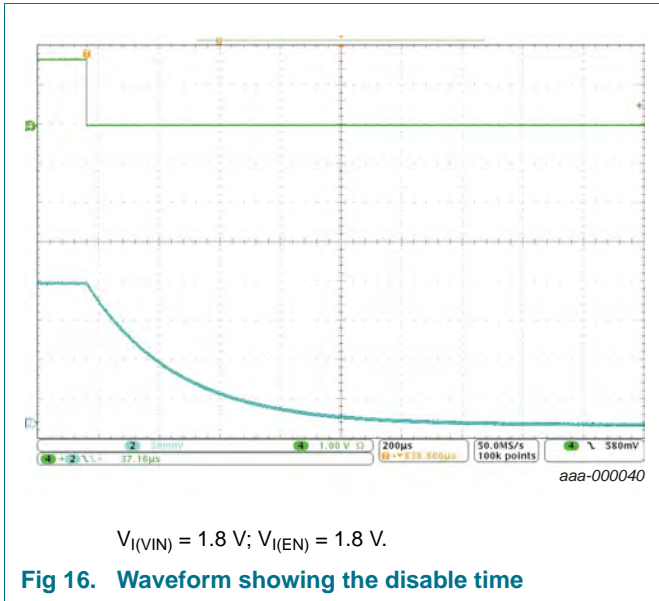
Supply voltage	Input	Load	
$V_{EXT}$	$V_{I(EN)}$	$C_L$	$I_{LOAD}$
1.1 V to 3.6 V	1.5 V	1 $\mu F$	200 mA



**Fig 14. Waveform showing the enable time versus inrush current**



**Fig 15. Waveform showing the enable time versus inrush current**



14. Package outline

WLCSP4: wafer level chip-size package.

4 bumps; body 0.76 x 0.76 x 0.51 mm. (Backside Coating included)

NX3P190/NX3P191

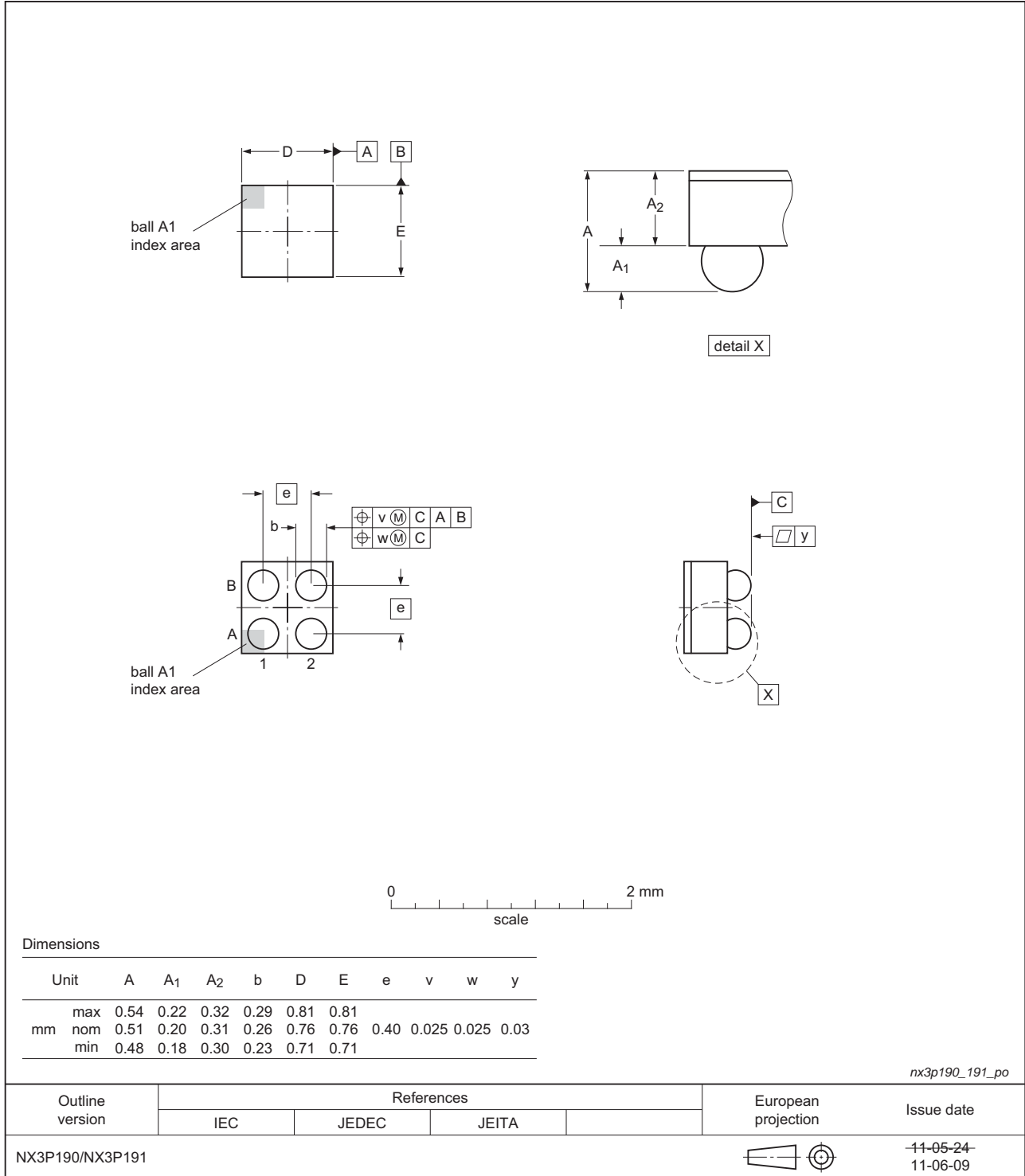


Fig 18. Package outline WLCSP4 (NX3P190/NX3P191)

## 15. Abbreviations

Table 13. Abbreviations

Acronym	Description
MOSFET	Metal-Oxide Semiconductor Field Effect Transistor

## 16. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX3P191 v.5	20140114	Product data sheet	-	NX3P191 v.4
Modifications:	• Figure title row figure 7 corrected (errata).			
NX3P191 v.4	20121022	Product data sheet	-	NX3P191 v.3
NX3P191 v.3	20120903	Product data sheet	-	NX3P191 v.2
NX3P191 v.2	20111104	Product data sheet	-	NX3P191 v.1
NX3P191 v.1	20110831	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".

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