NX3P190

Logic controlled high-side power switch

Rev. 5 — 14 January 2014 Product data sheet

1. General description

The NX3P190 is a high-side load switch which features a low ON resistance P-channel MOSFET that supports more than 500 mA of continuous current. 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 NX3P190 is ideal for portable, battery operated applications due to low ground current and ultra-low shutdown current.

2. Features and benefits

- 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)
- 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	Package			
	Temperature range	Name	Description	Version
NX3P190UK	–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
NX3P190UK	x0

6. Functional diagram

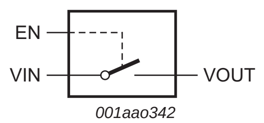


Fig 1. Logic symbol

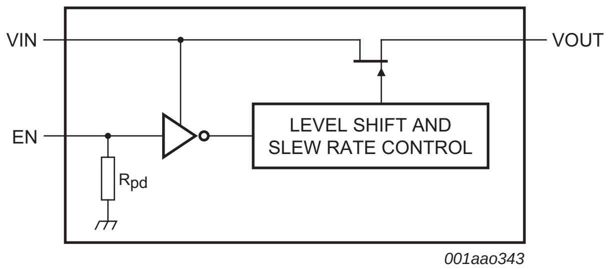


Fig 2. Logic diagram (simplified schematic)

7. Pinning information

7.1 Pinning

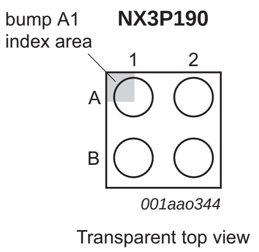


Fig 3. Pin configuration for WLCSP4

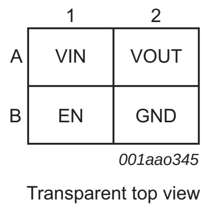


Fig 4. Ball mapping for WLCSP4

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[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	+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.

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

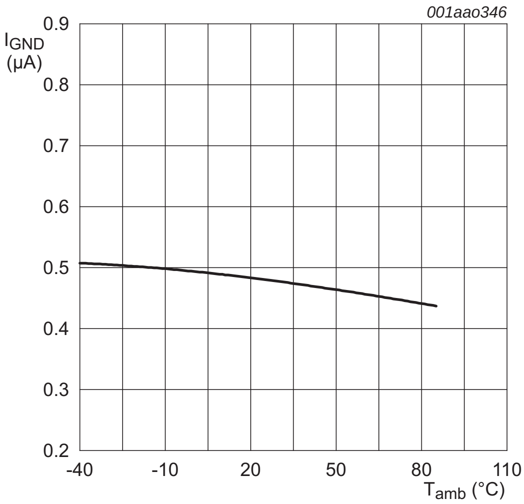
12. Static characteristics

Table 8. Static characteristics

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

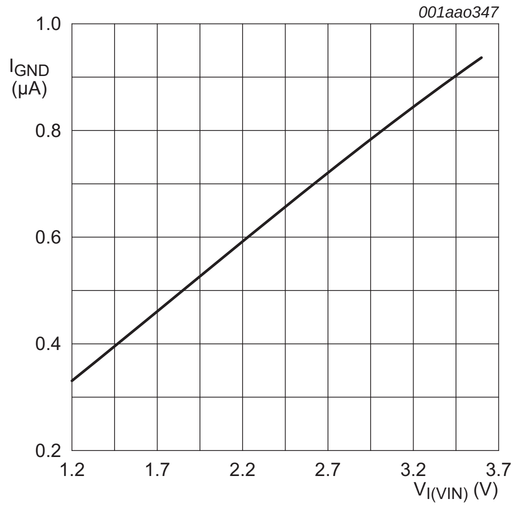
Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = –40 °C to +85 °C		Unit
			Min	Typ	Max	Min	Max	
V_{IH}	HIGH-level input voltage	EN input						
		$V_{I(VIN)}$ = 1.1 V to 1.3 V	-	-	-	1.0	-	V
		$V_{I(VIN)}$ = 1.3 V to 1.8 V	-	-	-	1.2	-	V
		$V_{I(VIN)}$ = 1.8 V to 3.6 V	-	-	-	1.2	-	V
V_{IL}	LOW-level 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
R_{pd}	pull-down resistance	EN input	-	4	-	-	-	MΩ
I_{GND}	ground current	$V_{I(VIN)}$ = 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; $V_{O(VOUT)}$ = GND; see Figure 8	-	0.1	-	-	2	µA

12.1 Graphs



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

Fig 5. Waveform showing the ground current versus temperature



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

Fig 6. Waveform showing the ground current versus input voltage on pin VIN

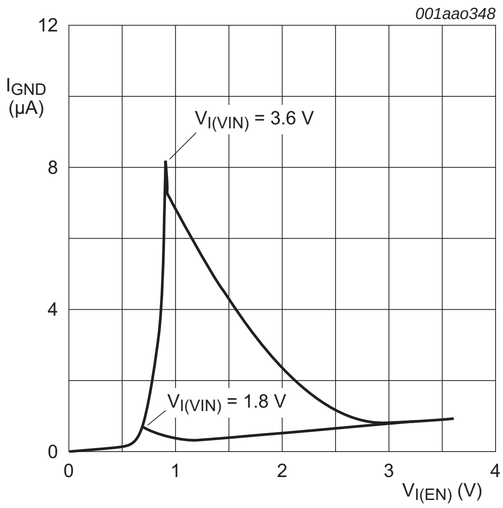
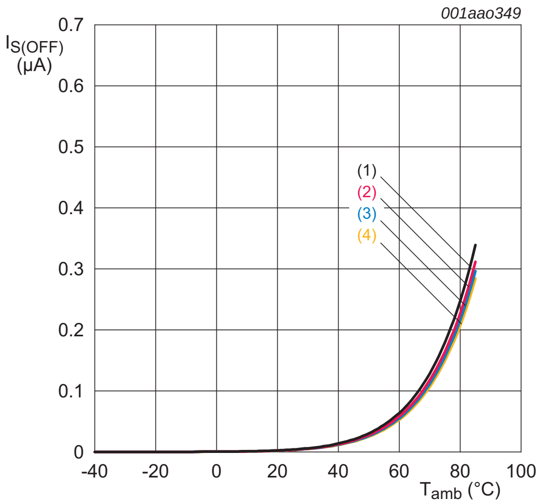


Fig 7. Waveform showing the additional ground current versus input voltage



$V_{I(EN)}$ = 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. Waveforms showing the OFF-state leakage current versus temperature

12.2 ON resistance

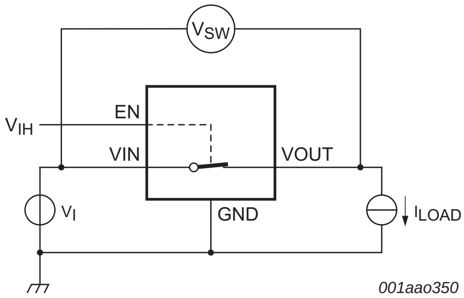
Table 9. ON resistance

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

Symbol	Parameter	Conditions	T_{amb} = 25 °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

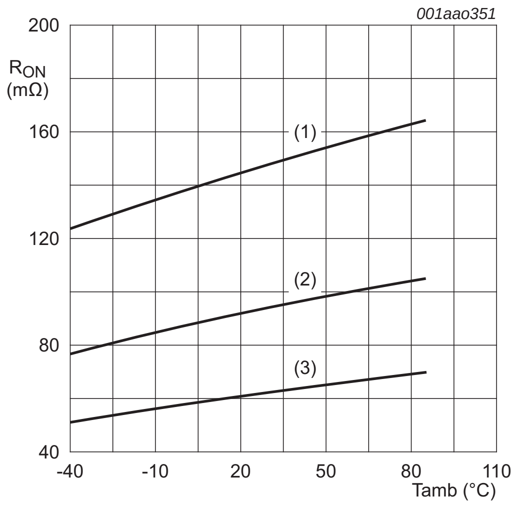
[1] Typical values are measured at T_{amb} = 25 °C.

12.3 ON resistance test circuit and waveforms



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

Fig 9. Test circuit for measuring ON resistance



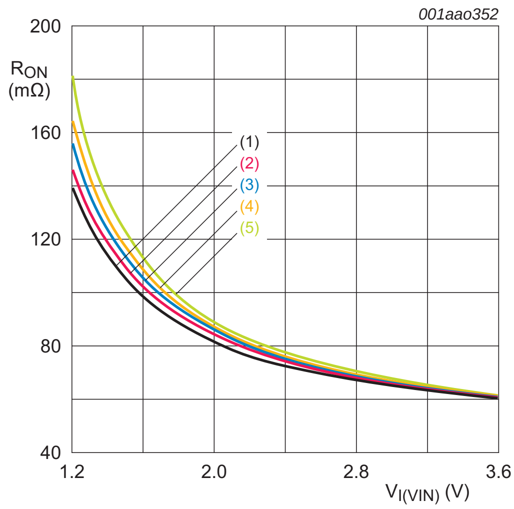
I_{LOAD} = 100 mA.

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

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

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

Fig 10. Waveform showing the 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. Waveform showing the ON resistance versus input voltage

13. Dynamic characteristics

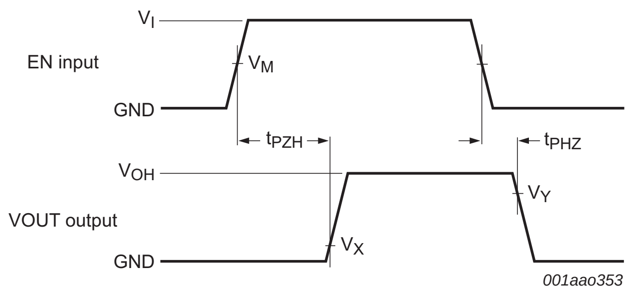
Table 10. Dynamic characteristics

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

Symbol	Parameter	Conditions		T_{amb} = 25 °C			Unit
				Min	Typ	Max	
t_{en}	enable time	EN to VOUT; see Figure 12	[1]				
		$V_{I(VIN)}$ = 1.8 V		-	2.5	-	µs
		$V_{I(VIN)}$ = 3.6 V		-	1.8	-	µs

[1] t_{en} is the same as t_{PZH}.

13.1 Waveform and test circuits



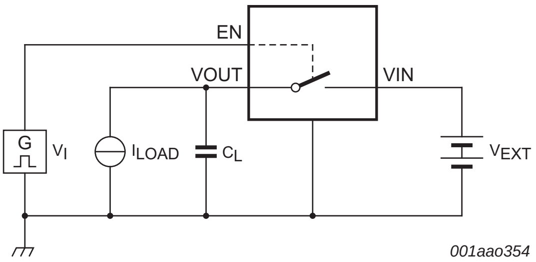
Measurement points are given in Table 11.

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	V_X	V_Y
1.1 V to 3.6 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.

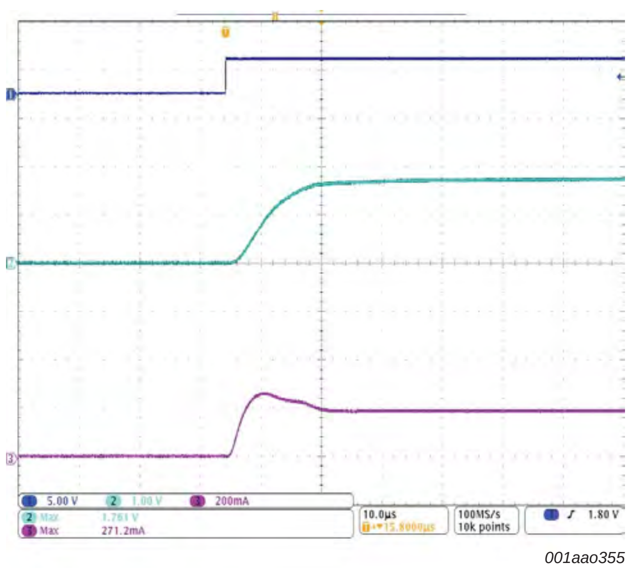
C_L = Load capacitance including jig and probe capacitance.

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

Fig 13. Test circuit for measuring switching times

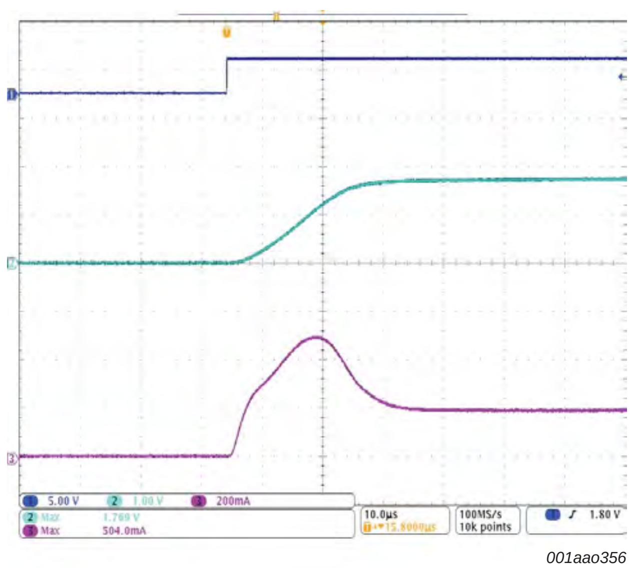
Table 12. Test data

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



$V_{I(VIN)}$ = 1.8 V; $V_{I(EN)}$ = 3.6 V; C_L = 1 μF; I_{LOAD} = 200 mA.

Fig 14. Waveform showing the enable time versus inrush current

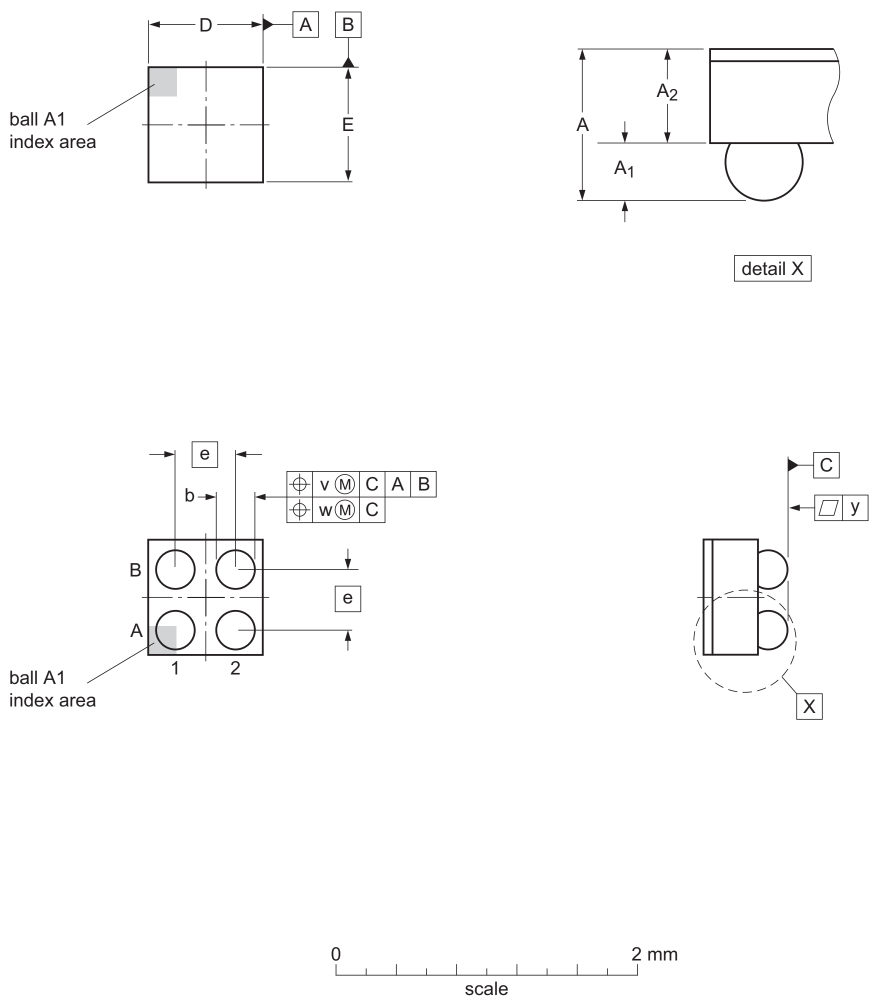


$V_{I(VIN)}$ = 1.8 V; $V_{I(EN)}$ = 3.6 V; C_L = 4.7 μF; I_{LOAD} = 200 mA.

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**



Dimensions

Unit		A	A_1	A_2	b	D	E	e	v	w	y
mm	max	0.54	0.22	0.32	0.29	0.81	0.81				
	nom	0.51	0.20	0.31	0.26	0.76	0.76	0.40	0.025	0.025	0.03
	min	0.48	0.18	0.30	0.23	0.71	0.71				

nx3p190_191_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
NX3P190/NX3P191						~~11-05-24~~ 11-06-09

Fig 16. Package outline WLCSP4 (NX3P190/NX3P191)

15. Abbreviations

Table 13. Abbreviations

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

16. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX3P190 v.5	20140114	Product data sheet	-	NX3P190 v.4
Modifications:	• Figure title row figure 7 corrected (errata).			
NX3P190 v.4	20121022	Product data sheet	-	NX3P190 v.3
NX3P190 v.3	20120903	Product data sheet	-	NX3P190 v.2
NX3P190 v.2	20111104	Product data sheet	-	NX3P190 v.1
NX3P190 v.1	20110822	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".

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19. Contents

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