

# PHB20NQ20T

N-channel TrenchMOS standard level FET

Rev. 02 — 16 December 2010

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. This product is designed and qualified for use in computing, communications, consumer and industrial applications only.

### 1.2 Features and benefits

- Higher operating power due to low thermal resistance
- Low conduction losses due to low on-state resistance
- Suitable for high frequency applications due to fast switching characteristics

### 1.3 Applications

- DC-to-DC converters
- General purpose switching

### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25^\circ\text{C}; T_j \leq 175^\circ\text{C}$	-	-	200	V
$I_D$	drain current	$T_{mb} = 25^\circ\text{C}; V_{GS} = 10\text{ V}$	-	-	20	A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$	-	-	150	W
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 10\text{ A}; T_j = 25^\circ\text{C}$	-	120	130	$\text{m}\Omega$
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 10\text{ V}; I_D = 20\text{ A}; V_{DS} = 160\text{ V}; T_j = 25^\circ\text{C}$	-	22	-	nC



## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	D	drain <sup>[1]</sup>		
3	S	source		
mb	D	mounting base; connected to drain		
SOT404 (D2PAK)				

[1] It is not possible to make a connection to pin 2.

## 3. Ordering information

Table 3. Ordering information

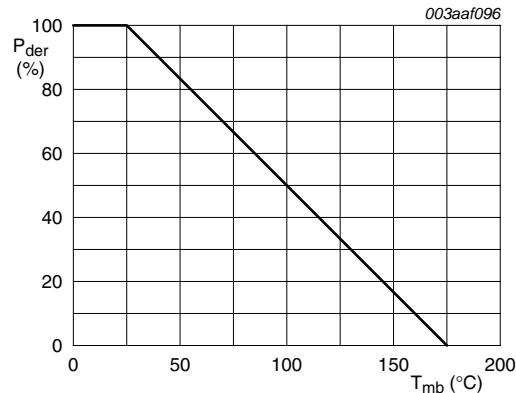
Type number	Package	Version	
		Name	Description
PHB20NQ20T	D2PAK		plastic lead-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)

## 4. Limiting values

Table 4. Limiting values

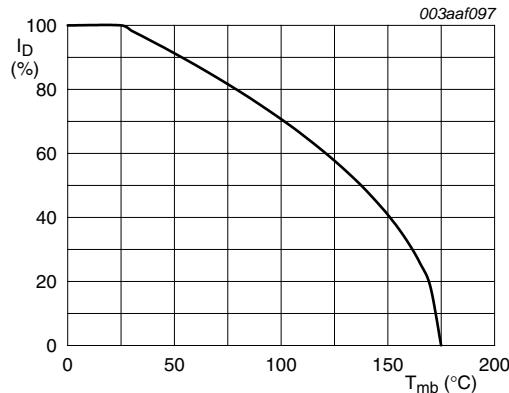
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25^\circ\text{C}$ ; $T_j \leq 175^\circ\text{C}$	-	200	V
$V_{DGR}$	drain-gate voltage	$T_j \geq 25^\circ\text{C}$ ; $T_j \leq 175^\circ\text{C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	200	V
$V_{GS}$	gate-source voltage		-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100^\circ\text{C}$	-	14	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25^\circ\text{C}$	-	20	A
$I_{DM}$	peak drain current	pulsed; $T_{mb} = 25^\circ\text{C}$	-	80	A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$	-	150	W
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25^\circ\text{C}$	-	20	A
$I_{SM}$	peak source current	pulsed; $T_{mb} = 25^\circ\text{C}$	-	80	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25^\circ\text{C}$ ; $I_D = 19\text{ A}$ ; $V_{sup} \leq 25\text{ V}$ ; unclamped; $t_p = 100\text{ }\mu\text{s}$ ; $R_{GS} = 50\text{ }\Omega$	-	252	mJ
$I_{AS}$	non-repetitive avalanche current	$V_{sup} \leq 25\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25^\circ\text{C}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped	-	20	A



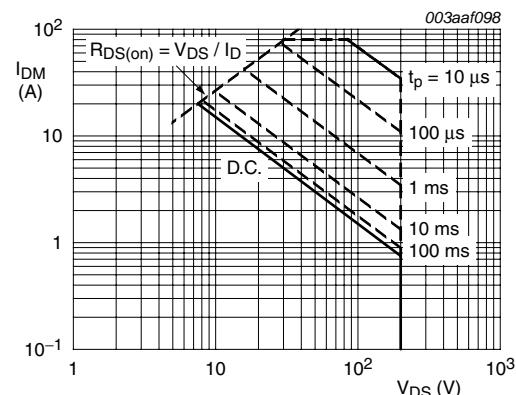
$$P_{der} = \frac{P_{tot}}{P_{tot}(25^\circ\text{C})} \times 100 \%$$

**Fig 1. Normalized total power dissipation as a function of mounting base temperature**



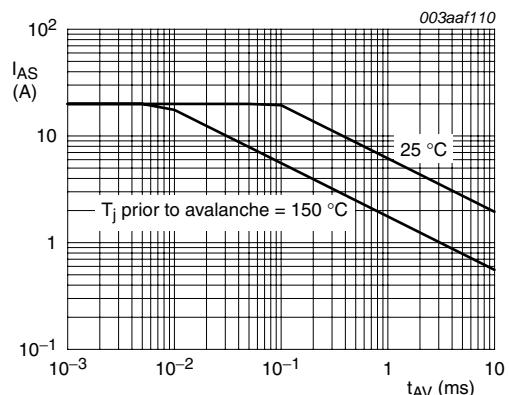
$$I_{der} = \frac{I_D}{I_D(25^\circ\text{C})} \times 100 \%$$

**Fig 2. Normalized continuous drain current as a function of mounting base temperature**



$T_{mb} = 25^\circ\text{C}$ ;  $I_{DM}$  is gle pulse

**Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**



unclamped inductive load

**Fig 4. gle-shot avalanche rating; avalanche current as a function of avalanche period**

## 5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j\text{-}mb)}$	thermal resistance from junction to mounting base		-	-	1	K/W
$R_{th(j\text{-}a)}$	thermal resistance from junction to ambient	mounted on printed-circuit board ; minimum footprint	-	50	-	K/W

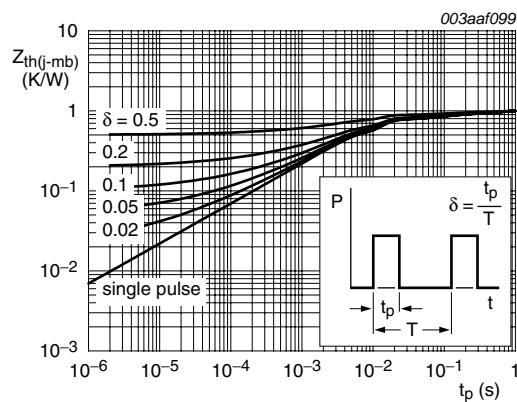
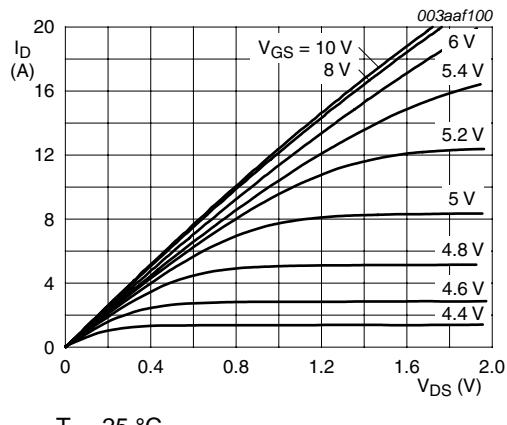


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

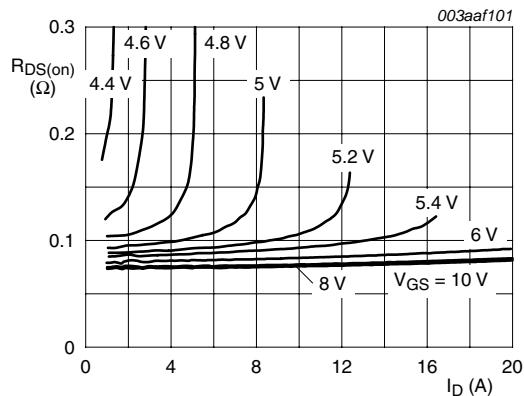
## 6. Characteristics

**Table 6. Characteristics**

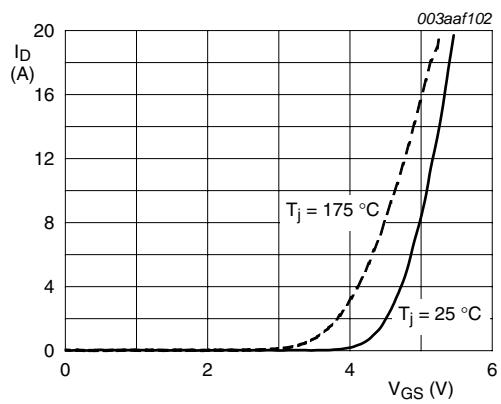
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	178	-	-	V
		$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	200	-	-	V
$V_{GS(\text{th})}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C}$	1	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C}$	-	-	6	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C}$	2	3	4	V
$I_{DSS}$	drain leakage current	$V_{DS} = 200 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.05	10	$\mu\text{A}$
		$V_{DS} = 200 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$	-	-	500	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.02	100	nA
		$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.02	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 10 \text{ A}; T_j = 175 \text{ }^\circ\text{C}$	-	-	377	$\text{m}\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 10 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	120	130	$\text{m}\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(\text{tot})}$	total gate charge	$I_D = 20 \text{ A}; V_{DS} = 160 \text{ V}; V_{GS} = 10 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	65	-	nC
$Q_{GS}$	gate-source charge	$T_j = 25 \text{ }^\circ\text{C}$	-	10	-	nC
$Q_{GD}$	gate-drain charge		-	22	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ\text{C}$	-	2470	-	pF
$C_{oss}$	output capacitance		-	207	-	pF
$C_{rss}$	reverse transfer capacitance		-	90	-	pF
$t_{d(\text{on})}$	turn-on delay time	$V_{DS} = 100 \text{ V}; R_L = 4.7 \text{ }\Omega; V_{GS} = 10 \text{ V}; R_{G(\text{ext})} = 5.6 \text{ }\Omega; T_j = 25 \text{ }^\circ\text{C}$	-	15	-	ns
$t_r$	rise time		-	46	-	ns
$t_{d(\text{off})}$	turn-off delay time		-	50	-	ns
$t_f$	fall time		-	38	-	ns
$L_D$	internal drain inductance	measured from tab to centre of die ; $T_j = 25 \text{ }^\circ\text{C}$	-	3.5	-	nH
$L_S$	internal source inductance	measured from source lead to source bond pad ; $T_j = 25 \text{ }^\circ\text{C}$	-	7.5	-	nH
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 20 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.95	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20 \text{ A}; dI_S/dt = -100 \text{ A}/\mu\text{s}; V_{GS} = -10 \text{ V}; V_{DS} = 25 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	124	-	ns
$Q_r$	recovered charge		-	0.74	-	$\mu\text{C}$



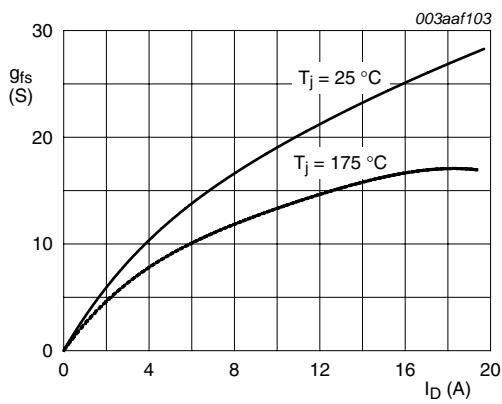
**Fig 6.** Output characteristics: drain current as a function of drain-source voltage; typical values



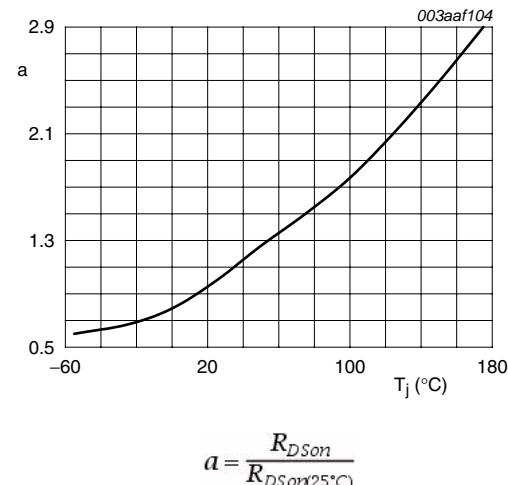
**Fig 7.** Drain-source on-state resistance as a function of drain current; typical values



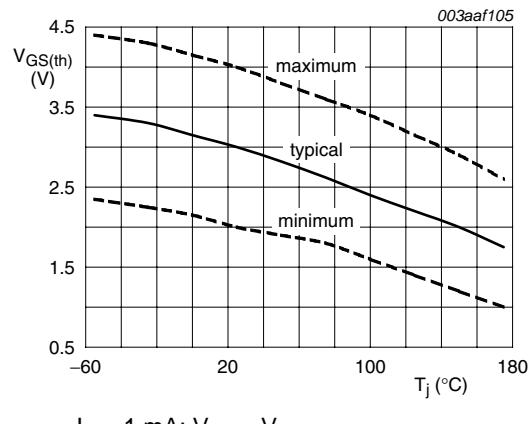
**Fig 8.** Transfer characteristics: drain current as a function of gate-source voltage; typical values



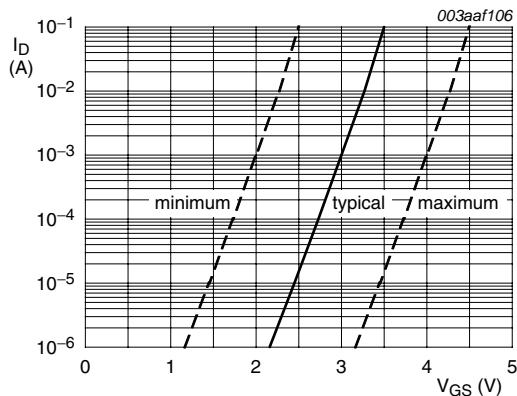
**Fig 9.** Forward transconductance as a function of drain current; typical values



**Fig 10.** Normalized drain-source on-state resistance factor as a function of junction temperature

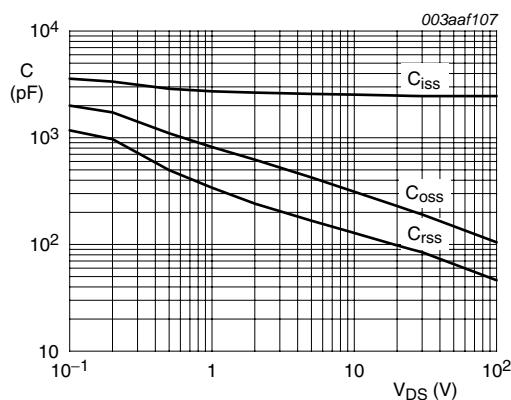


**Fig 11.** Gate-source threshold voltage as a function of junction temperature



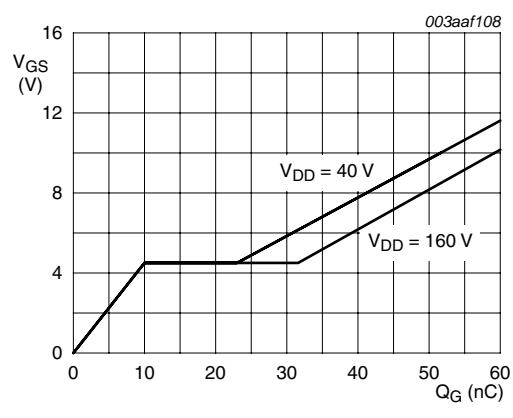
$T_j = 25^\circ\text{C}$ ;  $V_{DS} = V_{GS}$

**Fig 12. Sub-threshold drain current as a function of gate-source voltage**



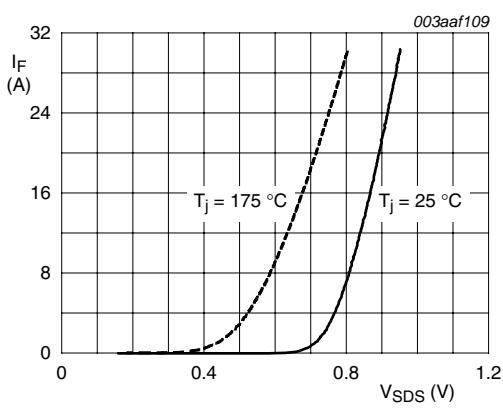
$V_{GS} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

**Fig 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



$T_j = 25^\circ\text{C}$ ;  $I_D = 20\text{ A}$

**Fig 14. Gate-source voltage as a function of gate charge; typical values**



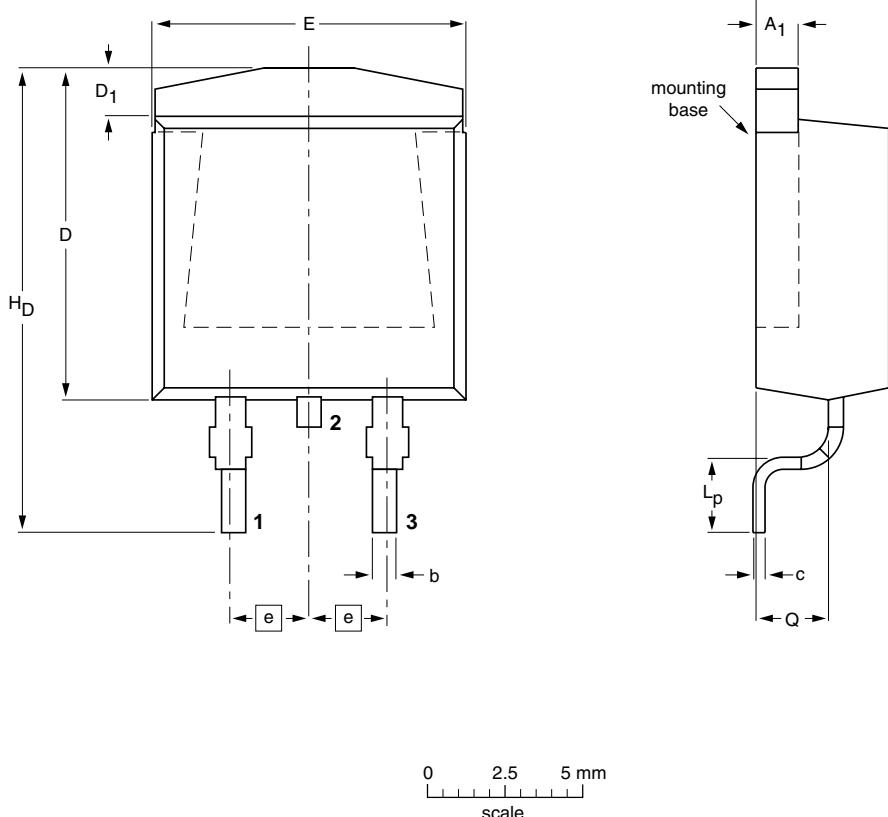
$V_{GS} = 0\text{ V}$

**Fig 15. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values**

## 7. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)

SOT404



### DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	c	D <sub>max.</sub>	D <sub>1</sub>	E	e	L <sub>p</sub>	H <sub>D</sub>	Q
mm	4.50 4.10	1.40 1.27	0.85 0.60	0.64 0.46	11	1.60 1.20	10.30 9.70	2.54	2.90 2.10	15.80 14.80	2.60 2.20

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT404						05-02-11 06-03-16

Fig 16. Package outline SOT404 (D2PAK)

## 8. Revision history

**Table 7. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHB20NQ20T v.2	20101216	Product data sheet	-	PHB_PHP20NQ20T v.1
Modifications:	<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li><li>• Type number PHB20NQ20T separated from data sheet PHB_PHP20NQ20T v.1.</li></ul>			
PHB_PHP20NQ20T v.1	19990801	Product specification	-	-

## 9. Legal information

### 9.1 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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