

# PHN210T

## Dual N-channel TrenchMOS intermediate level FET

Rev. 02 — 15 December 2010

Product data sheet

## 1. Product profile

### 1.1 General description

Dual intermediate 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

- Suitable for high frequency applications due to fast switching characteristics
- Suitable for logic level gate drive sources
- Suitable for low gate drive sources

### 1.3 Applications

- DC-to-DC converters
- Motor and relay drivers
- Logic level translators

### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$ ; Repetitive peak drain-source voltage	-	-	30	V
$I_D$	drain current	$T_{sp} = 25\text{ °C}$ ; Single device	[1]	-	3.4	A
$P_{tot}$	total power dissipation	$T_{sp} = 25\text{ °C}$	[2]	-	2	W
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}$ ; $I_D = 1\text{ A}$ ; $T_j = 25\text{ °C}$	-	120	200	m $\Omega$
		$V_{GS} = 10\text{ V}$ ; $I_D = 2.2\text{ A}$ ; $T_j = 25\text{ °C}$	-	80	100	m $\Omega$
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 10\text{ V}$ ; $I_D = 2.3\text{ A}$ ; $V_{DS} = 15\text{ V}$ ; $T_j = 25\text{ °C}$	-	0.7	-	nC

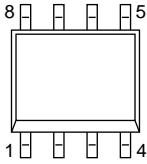
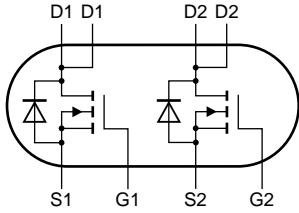
[1] Surface mounted on FR4 board,  $t \leq 10\text{ sec}$ .

[2] Surface mounted on FR4,  $t \leq 10\text{ sec}$ .



## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source1	 <p><b>SOT96-1 (SO8)</b></p>	 <p><i>mbk725</i></p>
2	G1	gate1		
3	S2	source2		
4	G2	gate2		
5	D	drain2		
6	D	drain2		
7	D	drain1		
8	D	drain1		

## 3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
PHN210T	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1

## 4. Limiting values

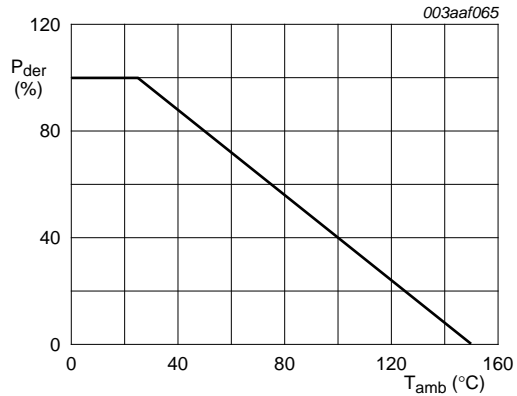
**Table 4. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	Continuous	-	30	V
		$T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$ ; Repetitive peak drain-source voltage	-	30	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	30	V
$V_{GS}$	gate-source voltage		-20	20	V
$I_D$	drain current	$T_{sp} = 70\text{ °C}$ ; Dual device <a href="#">[1]</a>	-	1.9	A
		$T_{sp} = 70\text{ °C}$ ; Single device <a href="#">[1]</a>	-	2.8	A
		$T_{sp} = 25\text{ °C}$ ; Dual device <a href="#">[1]</a>	-	2.4	A
		$T_{sp} = 25\text{ °C}$ ; Single device <a href="#">[1]</a>	-	3.4	A
$I_{DM}$	peak drain current	$T_{sp} = 25\text{ °C}$ ; pulsed	-	14	A
$P_{tot}$	total power dissipation	$T_{sp} = 25\text{ °C}$ <a href="#">[2]</a>	-	2	W
$T_{stg}$	storage temperature		-65	150	°C
$T_j$	junction temperature		-65	150	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{sp} = 25\text{ °C}$	-	2.2	A
$I_{SM}$	peak source current	$T_{sp} = 25\text{ °C}$ ; pulsed	-	14	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = 3.4\text{ A}$ ; $V_{DD} \leq 15\text{ V}$ ; unclamped; $R_{GS} = 50\text{ }\Omega$ ; $t_p = 0.2\text{ ms}$	-	13	mJ
$I_{AS}$	non-repetitive avalanche current	$V_{sup} \leq 15\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped	-	3.4	A

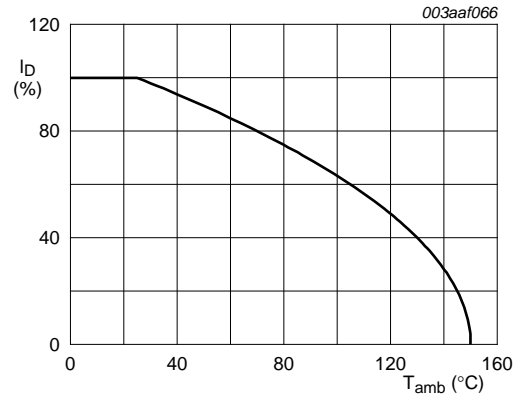
[1] Surface mounted on FR4 board,  $t \leq 10\text{ sec}$ .

[2] Surface mounted on FR4,  $t \leq 10\text{ sec}$ .



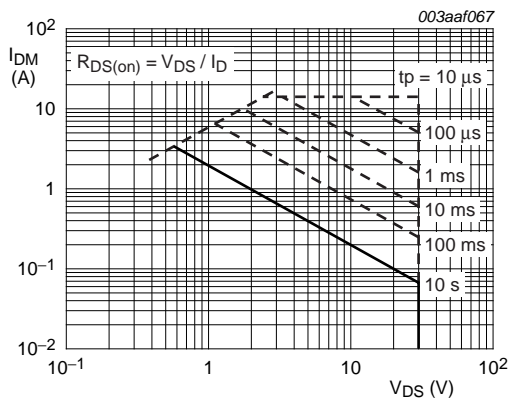
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



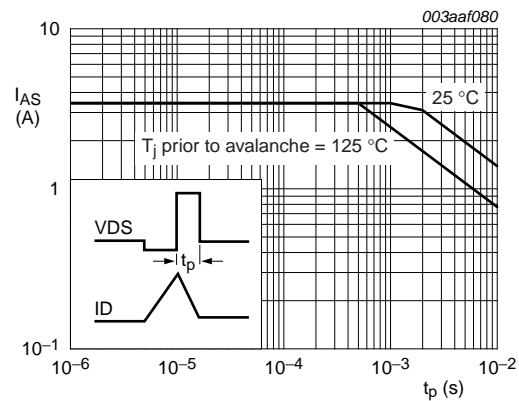
$$I_{der} = \frac{I_D}{I_{D(25^{\circ}C)}} \times 100\%$$

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



$T_a = 25^{\circ}C$ ;  $I_{DM}$  is single pulse

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



unclamped inductive load

**Fig 4. Single-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
$R_{th(j-a)}$	thermal resistance from junction to ambient	Surface mounted; FR4 board	-	150	-	K/W
		Surface mounted; FR4 board; $t \leq 10$ sec	-	-	62.5	K/W

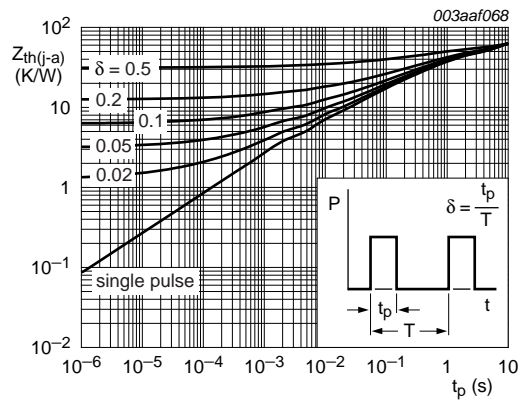
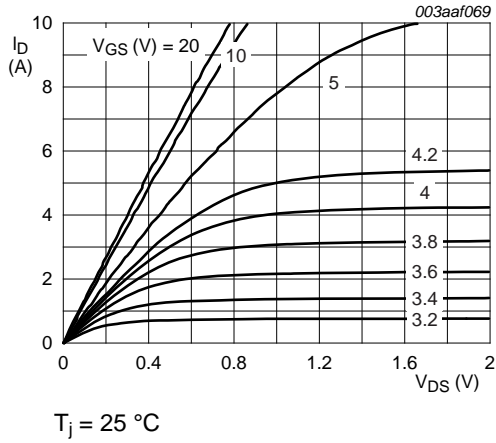


Fig 5. Transient thermal impedance from junction to ambient as a function of pulse duration

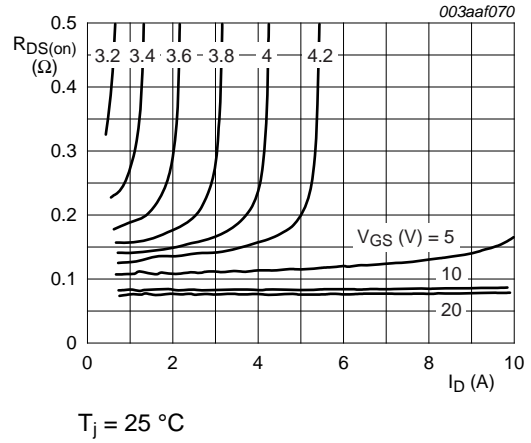
## 6. Characteristics

**Table 6. Characteristics**

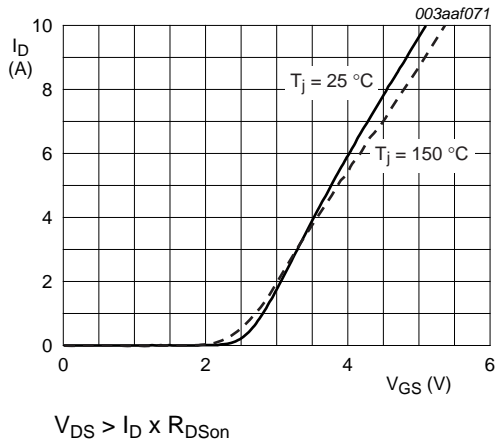
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 10 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	30	-	-	V
		$I_D = 10 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	27	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C}$	-	-	3.2	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 150 \text{ }^\circ\text{C}$	0.4	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C}$	1	2	2.8	V
$I_{DSS}$	drain leakage current	$V_{DS} = 24 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	10	100	nA
		$V_{DS} = 24 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$	-	0.6	10	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	10	100	nA
		$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5 \text{ V}; I_D = 1 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	120	200	m $\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 2.2 \text{ A}; T_j = 150 \text{ }^\circ\text{C}$	-	-	170	m $\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 2.2 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	80	100	m $\Omega$
$I_{DS(on)}$	on-state drain current	$V_{DS} = 1 \text{ V}; V_{GS} = 10 \text{ V}$	3.5	-	-	A
		$V_{DS} = 5 \text{ V}; V_{GS} = 4.5 \text{ V}$	2	-	-	A
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 2.3 \text{ A}; V_{DS} = 15 \text{ V}; V_{GS} = 10 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	6	-	nC
$Q_{GS}$	gate-source charge		-	0.7	-	nC
$Q_{GD}$	gate-drain charge		-	0.7	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ\text{C}$	-	250	-	pF
$C_{oss}$	output capacitance		-	88	-	pF
$C_{rss}$	reverse transfer capacitance		-	54	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20 \text{ V}; R_L = 18 \text{ } \Omega; V_{GS} = 10 \text{ V}; R_{G(ext)} = 6 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	6	-	ns
$t_r$	rise time		-	8	-	ns
$t_{d(off)}$	turn-off delay time		-	21	-	ns
$t_f$	fall time		-	15	-	ns
$g_{fs}$	transfer conductance	$V_{DS} = 20 \text{ V}; I_D = 2.2 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	2	4.5	-	S
$L_D$	internal drain inductance	measured from drain lead to centre of die; $T_j = 25 \text{ }^\circ\text{C}$	-	2.5	-	nH
$L_S$	internal source inductance	measured from source lead to source bond pad; $T_j = 25 \text{ }^\circ\text{C}$	-	5	-	nH
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 1.25 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.82	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 1.25 \text{ A}; dI_S/dt = -100 \text{ A}/\mu\text{s}; V_{GS} = 0 \text{ V}; V_{DS} = 25 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	69	-	ns
$Q_r$	recovered charge		-	55	-	nC



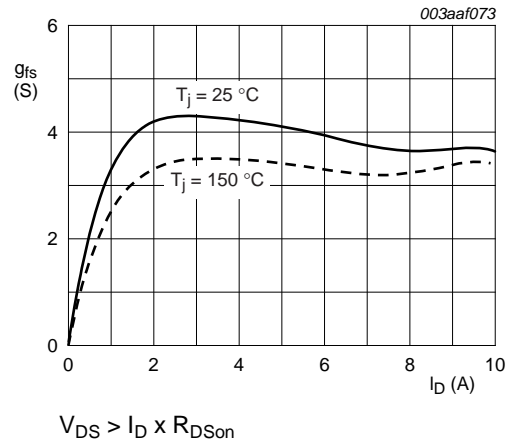
**Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



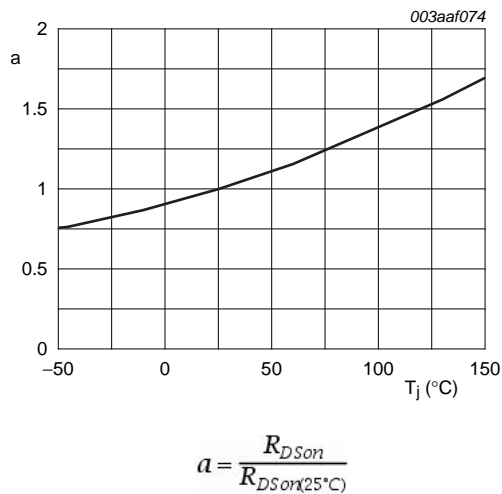
**Fig 7. Drain-source on-state resistance as a function of drain current; typical values**



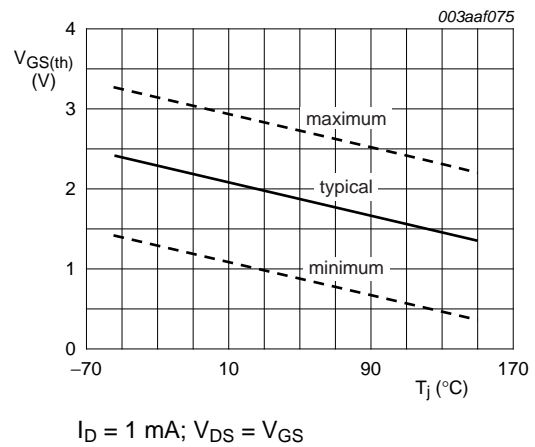
**Fig 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values**



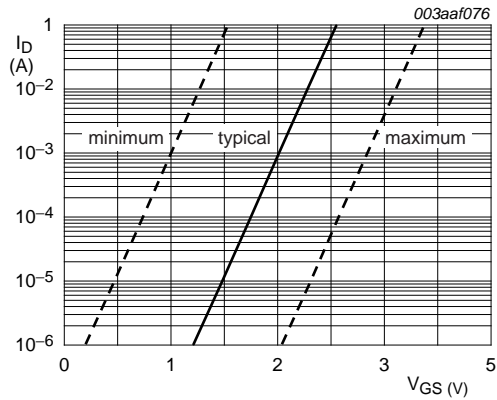
**Fig 9. Forward transconductance as a function of drain current; typical values**



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

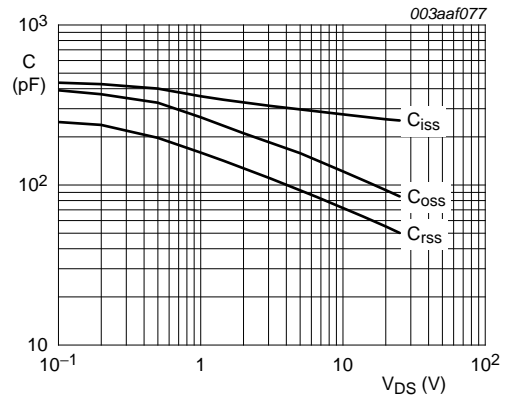


**Fig 11. Gate-source threshold voltage as a function of junction temperature**



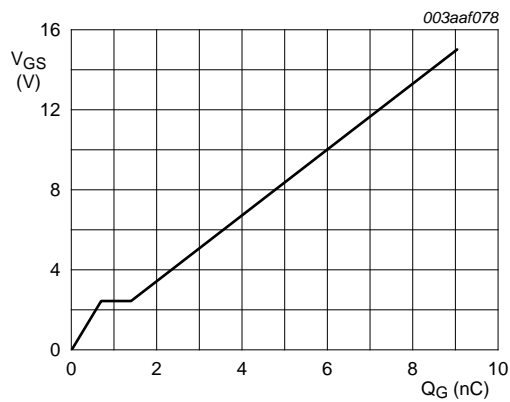
$T_j = 25\text{ }^\circ\text{C}$ ;  $V_{DS} = V_{GS}$

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



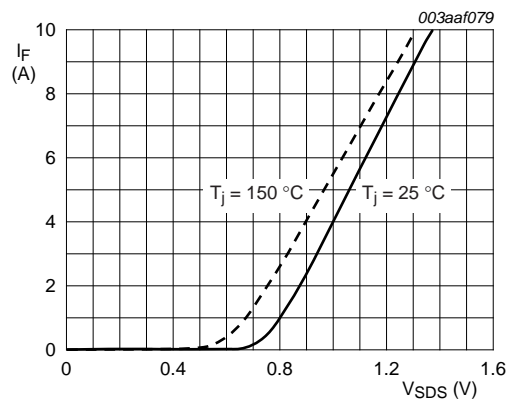
$V_{GS} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

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



$I_D = 2.3\text{ A}$ ;  $T_j = 25\text{ }^\circ\text{C}$ ;  $V_{DD} = 15\text{ V}$

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

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1

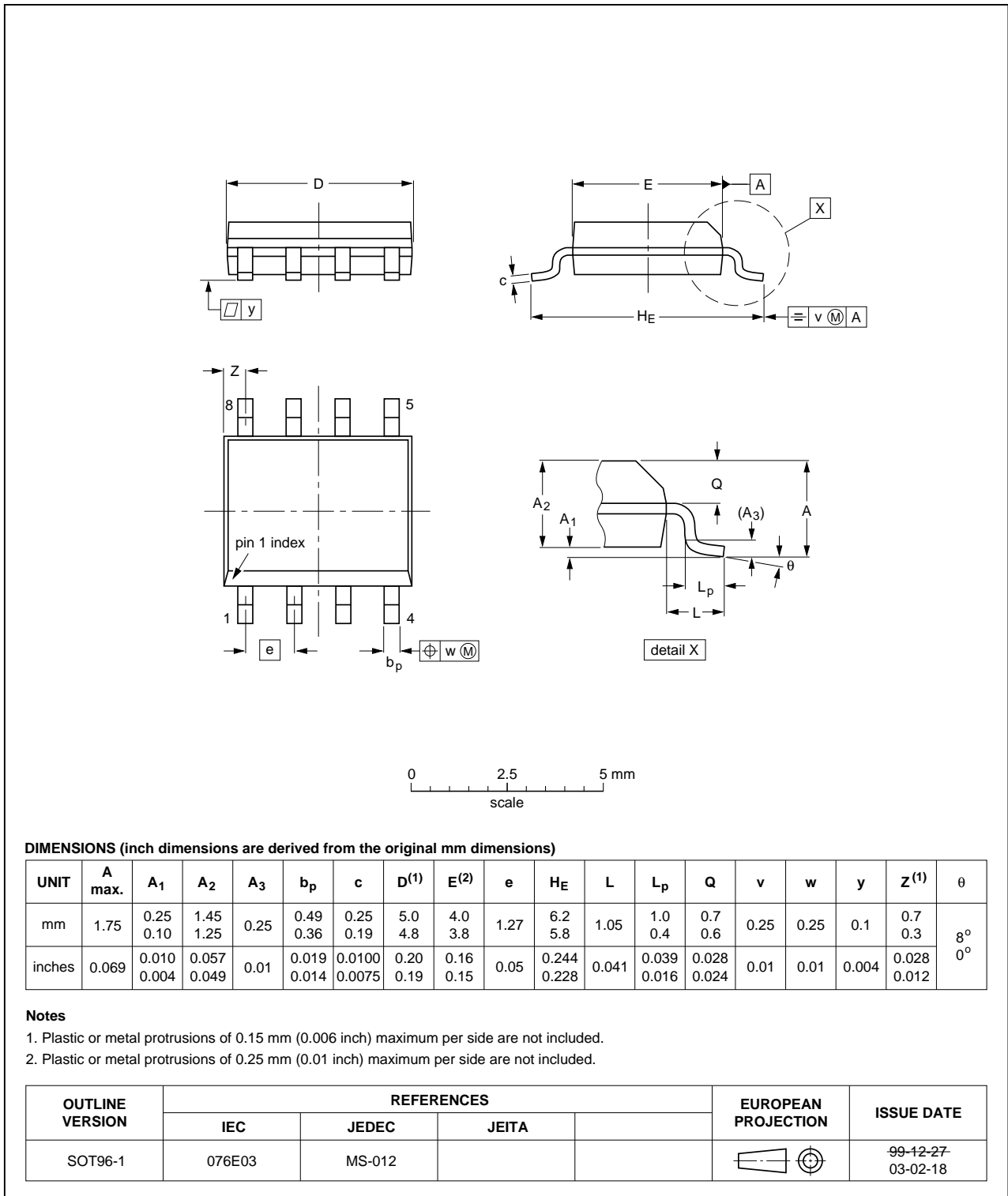


Fig 16. Package outline SOT96-1 (SO8)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHN210T v.2	20101215	Product data sheet	-	PHN210T 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></ul>			
PHN210T v.1	19990301	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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