



# PHM21NQ15T

TrenchMOS™ standard level FET

Rev. 02 — 11 September 2003

Product data

## 1. Product profile

### 1.1 Description

N-channel enhancement mode field-effect transistor in a plastic package using TrenchMOS™ technology.

### 1.2 Features

- SOT96 (SO8) footprint compatible
- Surface mounted package
- Low thermal resistance
- Low profile.

### 1.3 Applications

- DC-to-DC primary side
- Portable equipment applications.

### 1.4 Quick reference data

- $V_{DS} \leq 150 \text{ V}$
- $I_D \leq 22.2 \text{ A}$
- $P_{tot} \leq 62.5 \text{ W}$
- $R_{DSon} \leq 55 \text{ m}\Omega$

## 2. Pinning information

Table 1: Pinning - SOT685-1 (QLPAK), simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1,2,3	source (s)	[1]	<p>MBB076</p>
4	gate (g)	<p>Bottom view MBL585</p>	
5,6,7,8	drain (d)		
mb	mounting base connected to drain		

**SOT685-1(QLPAK)**

[1] Shaded area indicates pin 1 identifier.

### 3. Ordering information

Table 2: Ordering information

Type number	Package		Version
	Name	Description	
PHM21NQ15T	QLPAK	Plastic surface mounted package; no leads; 8 terminals	SOT685

### 4. Limiting values

Table 3: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 150\text{ °C}$	-	150	V
$V_{DGR}$	drain-gate voltage (DC)	$25\text{ °C} \leq T_j \leq 150\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	150	V
$V_{GS}$	gate-source voltage (DC)		-	$\pm 20$	V
$I_D$	drain current (DC)	$T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <b>Figure 2 and 3</b>	-	22.2	A
		$T_{mb} = 100\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <b>Figure 2</b>	-	14	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; <b>Figure 3</b>	-	60	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <b>Figure 1</b>	-	62.5	W
$T_{stg}$	storage temperature		-55	+150	°C
$T_j$	junction temperature		-55	+150	°C

#### Source-drain diode

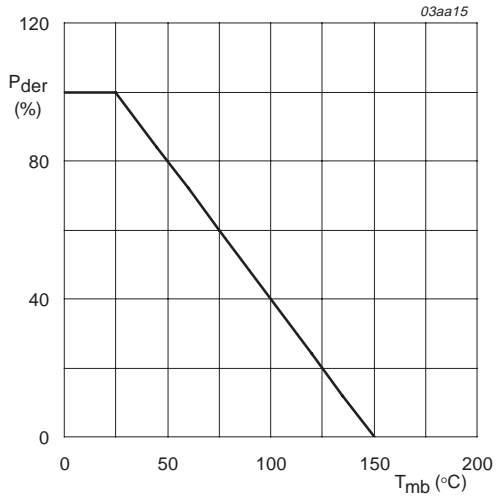
$I_S$	source (diode forward) current (DC)	$T_{mb} = 25\text{ °C}$	-	22.2	A
$I_{SM}$	peak source (diode forward) current	$T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	60	A

#### Avalanche ruggedness

$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 12\text{ A}$ ; $t_p = 0.21\text{ ms}$ ; $V_{DD} \leq 150\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; starting $T_j = 25\text{ °C}$	-	250	mJ
$E_{DS(AL)R}$	repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 1.2\text{ A}$ ; $t_p = 0.021\text{ ms}$ ; $V_{DD} \leq 100\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$	[1] - [2]	2.5	mJ

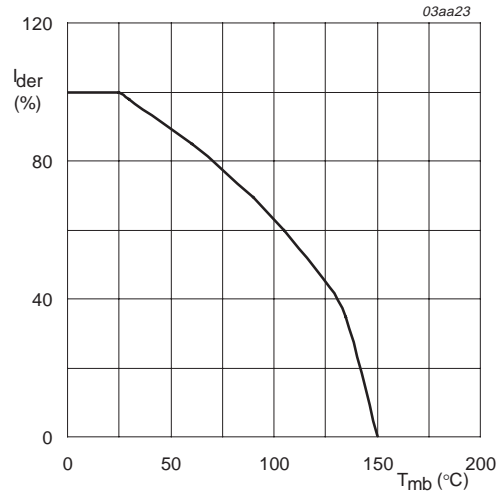
[1] Duty cycle limited by maximum junction temperature.

[2] Repetitive avalanche failure is not determined simply by thermal effects. Repetitive avalanche transients should only be applied for short bursts, not every switching cycle.



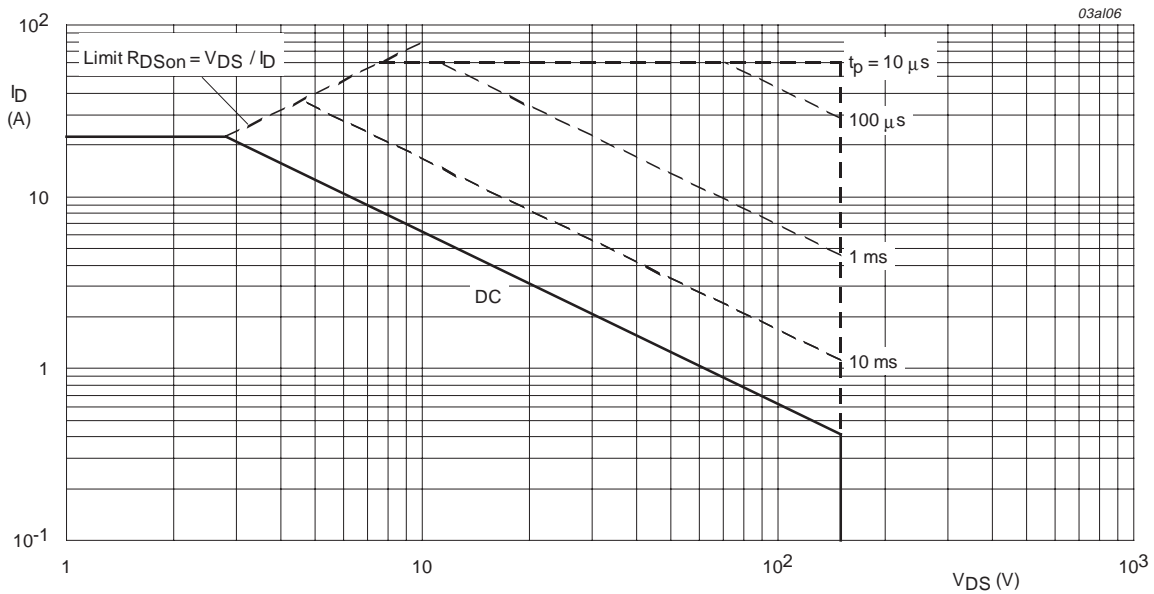
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



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

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



T<sub>mb</sub> = 25 °C; I<sub>DM</sub> is single pulse; V<sub>GS</sub> = 10 V

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

## 5. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	2	K/W

### 5.1 Transient thermal impedance

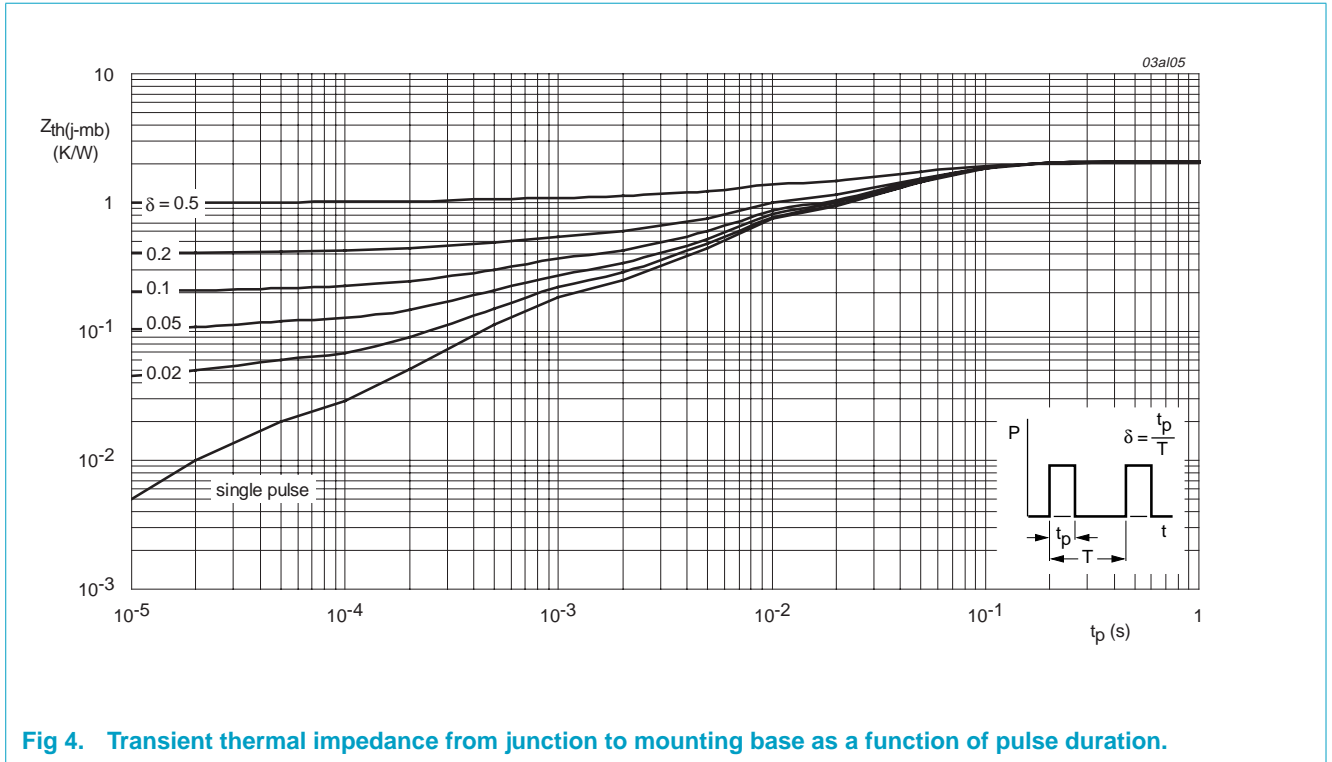


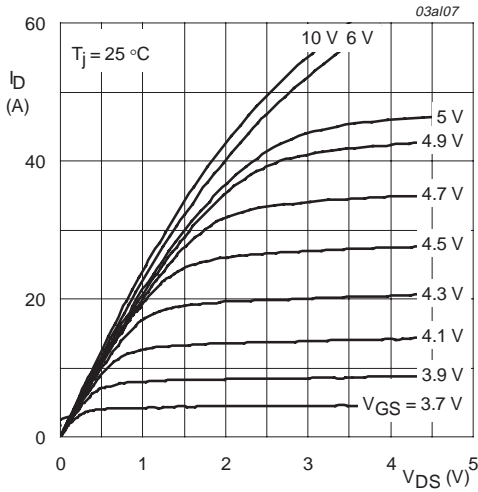
Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

## 6. Characteristics

**Table 5: Characteristics**

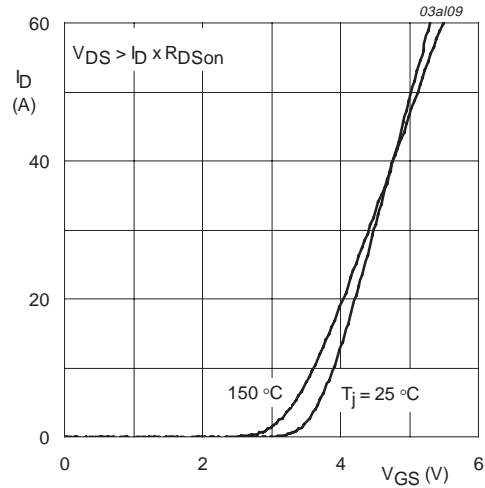
$T_j = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\ \mu\text{A}$ ; $V_{GS} = 0\ \text{V}$ $T_j = 25\text{ °C}$ $T_j = -55\text{ °C}$	150 134	- -	- -	V V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\ \text{mA}$ ; $V_{DS} = V_{GS}$ ; <b>Figure 9</b> $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$ $T_j = -55\text{ °C}$	2 1.2 -	3 - -	4 - 4.4	V V V
$I_{DSS}$	drain-source leakage current	$V_{DS} = 120\ \text{V}$ ; $V_{GS} = 0\ \text{V}$ $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$	- - -	- - -	1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	gate-source leakage current	$V_{GS} = \pm 20\ \text{V}$ ; $V_{DS} = 0\ \text{V}$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\ \text{V}$ ; $I_D = 15\ \text{A}$ ; <b>Figure 7 and 8</b> $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$ $V_{GS} = 5\ \text{V}$ ; $I_D = 3\ \text{A}$ ; <b>Figure 7 and 8</b>	- - -	40 92 42	55 127 -	$\text{m}\Omega$ $\text{m}\Omega$ $\text{m}\Omega$
<b>Dynamic characteristics</b>						
$Q_{g(tot)}$	total gate charge	$I_D = 20\ \text{A}$ ; $V_{DD} = 75\ \text{V}$ ; $V_{GS} = 10\ \text{V}$ ; <b>Figure 13</b>	-	36.2	-	nC
$Q_{gs}$	gate-source charge		-	8	-	nC
$Q_{gd}$	gate-drain (Miller) charge		-	11.6	-	nC
$C_{iss}$	input capacitance	$V_{GS} = 0\ \text{V}$ ; $V_{DS} = 25\ \text{V}$ ; $f = 1\ \text{MHz}$ ; <b>Figure 11</b>	-	2080	-	pF
$C_{oss}$	output capacitance		-	285	-	pF
$C_{rss}$	reverse transfer capacitance		-	90	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 75\ \text{V}$ ; $R_L = 75\ \Omega$ ; $V_{GS} = 10\ \text{V}$ ; $R_G = 5.6\ \Omega$	-	16	-	ns
$t_r$	rise time		-	12	-	ns
$t_{d(off)}$	turn-off delay time		-	50	-	ns
$t_f$	fall time		-	38	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain (diode forward) voltage	$I_S = 10\ \text{A}$ ; $V_{GS} = 0\ \text{V}$ ; <b>Figure 12</b>	-	0.83	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 10\ \text{A}$ ; $dI_S/dt = -100\ \text{A}/\mu\text{s}$ ; $V_{GS} = 0\ \text{V}$	-	150	-	ns
$Q_r$	recovered charge		-	215	-	nC



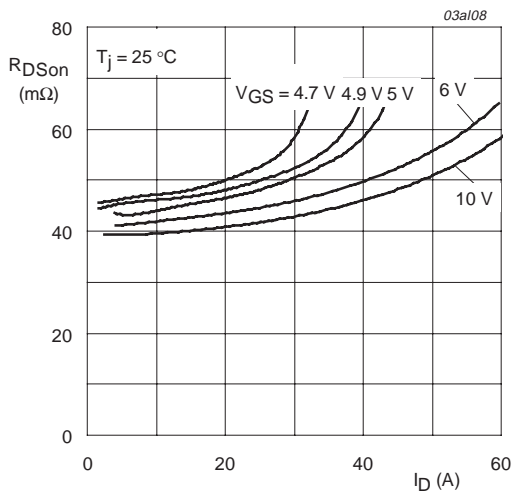
$T_j = 25\text{ }^\circ\text{C}$

Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values.



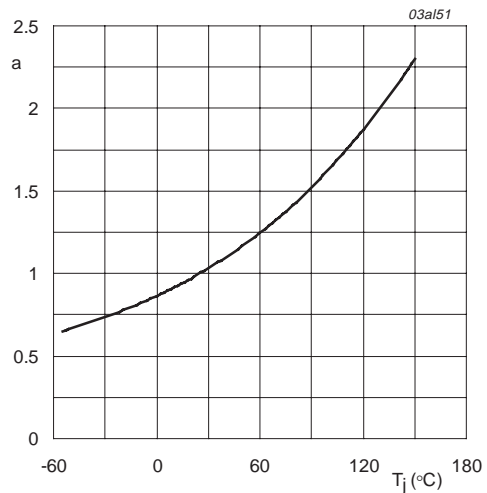
$T_j = 25\text{ }^\circ\text{C}$  and  $150\text{ }^\circ\text{C}$ ;  $V_{DS} > I_D \times R_{DSon}$

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



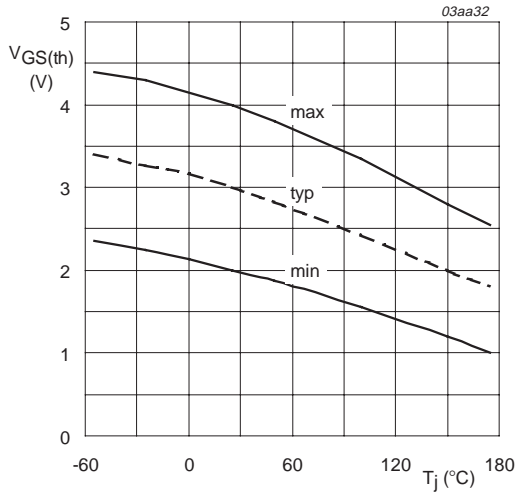
$T_j = 25\text{ }^\circ\text{C}$

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



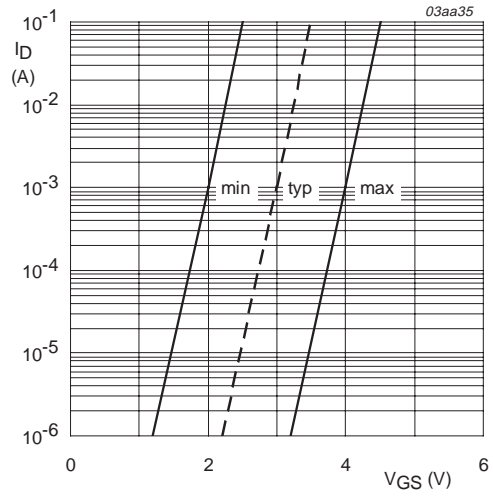
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature.



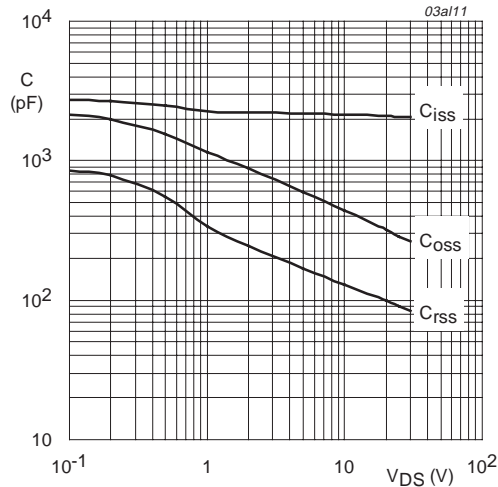
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

Fig 9. Gate-source threshold voltage as a function of junction temperature.



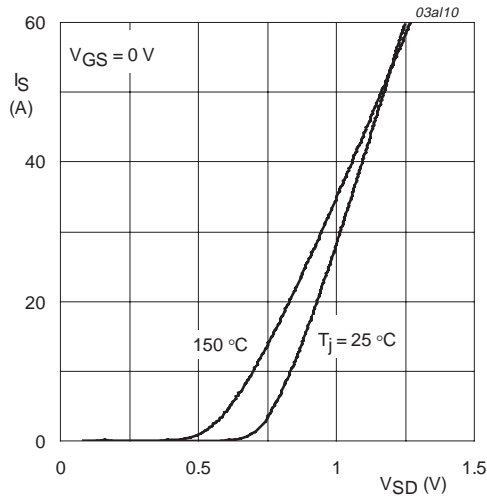
$T_j = 25 \text{ °C}$

Fig 10. Sub-threshold drain current as a function of gate-source voltage.



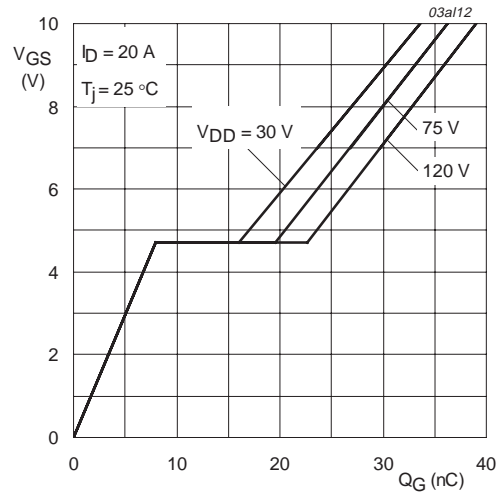
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

Fig 11. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values.



$T_j = 25\text{ °C}$  and  $150\text{ °C}$ ;  $V_{GS} = 0\text{ V}$

**Fig 12. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values.**



$I_D = 20\text{ A}$ ;  $V_{DD} = 30\text{ V}, 75\text{ V}, 120\text{ V}$

**Fig 13. Gate-source voltage as a function of gate charge; typical values.**



7. Package outline

HVSON8: plastic thermal enhanced very thin small outline package; no leads; 8 terminals; body 6 x 5 x 0.85 mm

SOT685-1

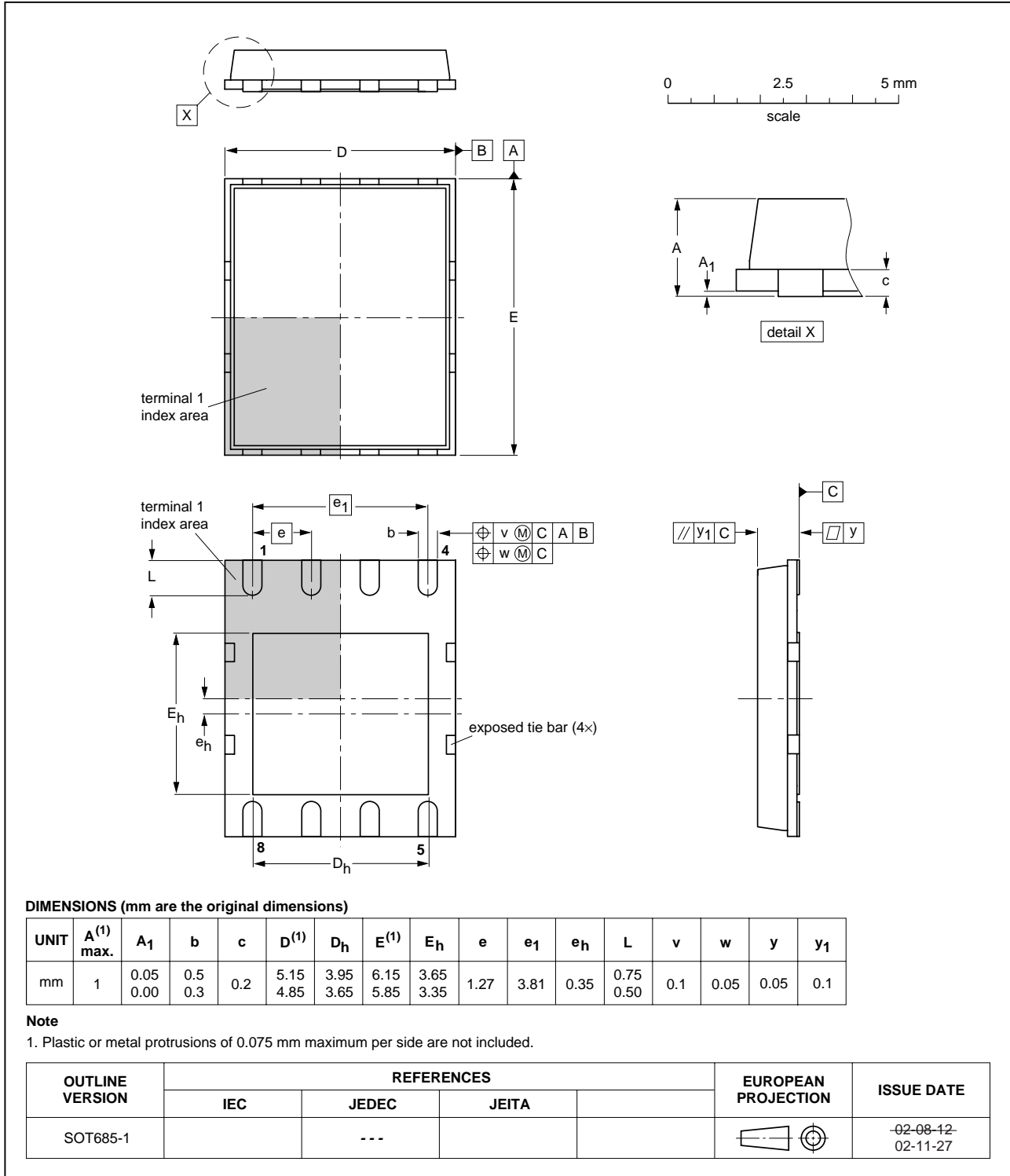
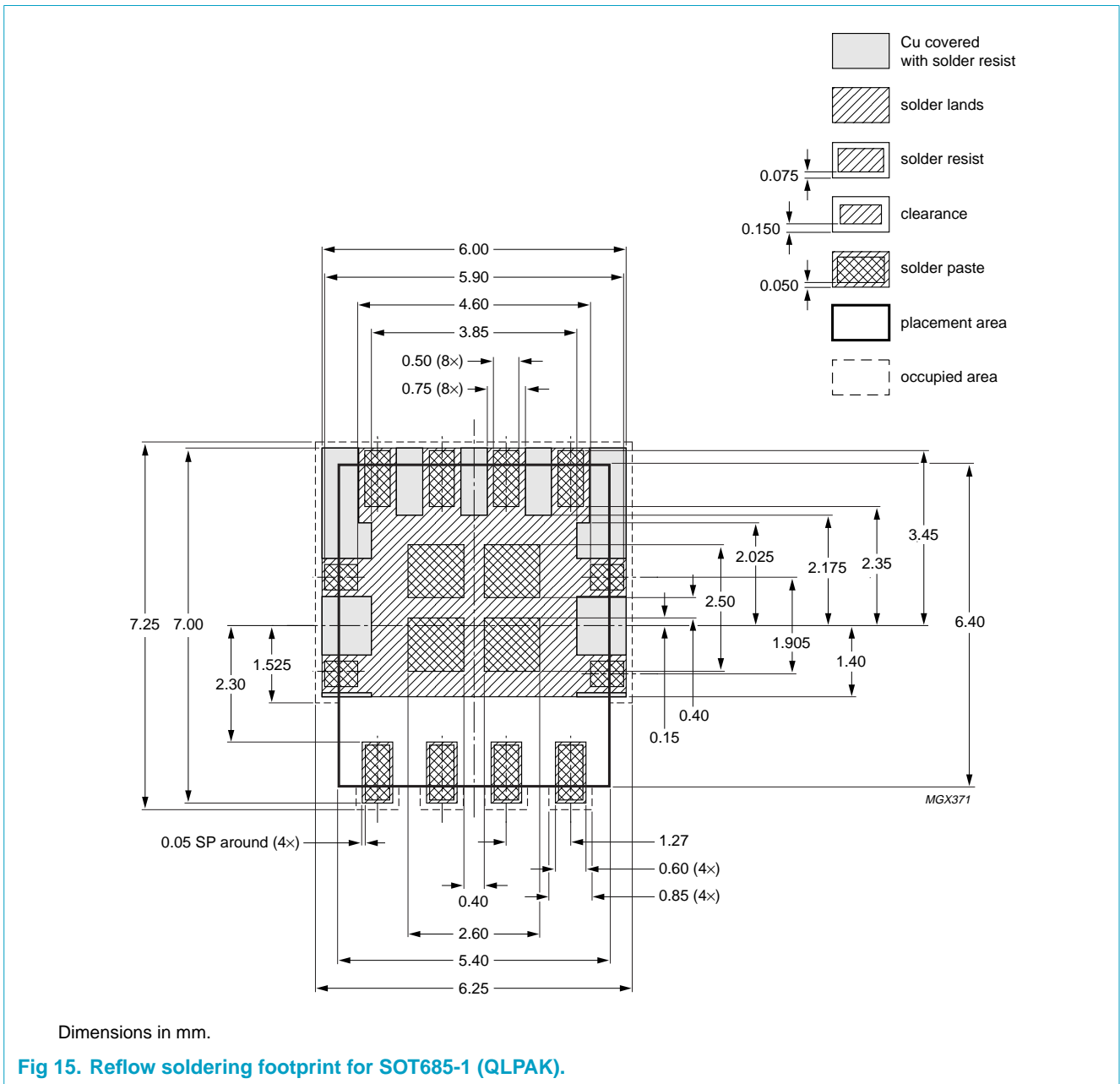


Fig 14. SOT685-1 (QLPAK).

8. Soldering



## 9. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
02	20030911	-	<b>Product data (9397 750 11844)</b> Modifications: <ul style="list-style-type: none"><li>• <b>Section 3 “Ordering information”</b> Addition of ordering information.</li><li>• <b>Section 4 “Limiting values”</b> Addition of <math>E_{DS(AL)S}</math>.</li><li>• <b>Section 4 “Limiting values”</b> Addition of <math>E_{DS(AL)R}</math>.</li><li>• <b>Section 8 “Soldering”</b> Addition of soldering footprint.</li></ul>
01	20030130	-	<b>Preliminary data (9397 750 10882); initial version.</b>

## 10. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2][3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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