

# DATA SHEET

## **PTB23001X; PTB23003X; PTB23005X** NPN microwave power transistors

Product specification  
Supersedes data of November 1994  
File under Discrete Semiconductors, SC15

1997 Feb 19

# NPN microwave power transistors

**PTB23001X; PTB23003X;  
PTB23005X**

## FEATURES

- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Interdigitated structure provides high emitter efficiency
- Multicell geometry gives good balance of dissipated power and low thermal resistance
- Localized thick oxide auto-alignment process and gold sandwich metallization ensure an optimum temperature profile and excellent performance and reliability.

## APPLICATIONS

Common-base, class B power amplifiers up to 4.2 GHz.

## DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a metal ceramic SOT440A flange package with base connected to the flange.

## MARKING

TYPE NUMBER	MARKING CODE
PTB23001X	2301X
PTB23003X	2303X
PTB23005X	2305X

## PINNING - SOT440A

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

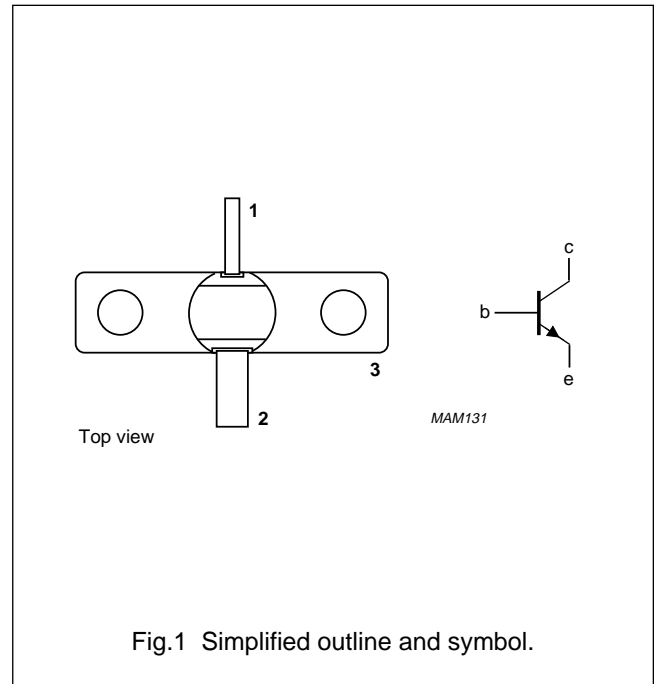


Fig.1 Simplified outline and symbol.

## QUICK REFERENCE DATA

Microwave performance up to  $T_{mb} = 25\text{ °C}$  in a common-base class B circuit.

TYPE NUMBER	MODE OF OPERATION	f (GHz)	V <sub>CC</sub> (V)	P <sub>L</sub> (W)	G <sub>po</sub> (dB)	η <sub>c</sub> (%)	Z <sub>i</sub> (Ω)	Z <sub>L</sub> (Ω)
PTB23001X	CW	2	24	≥1	≥7	≥45	8 + j14	8 + j20
PTB23003X	CW	2	24	≥3	≥8.75	≥45	2.5 + j14	8 + j6
PTB23005X	CW	2	24	≥5	≥9.2	≥50	1.9 + j12	7.5 + j3

## WARNING1

### Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

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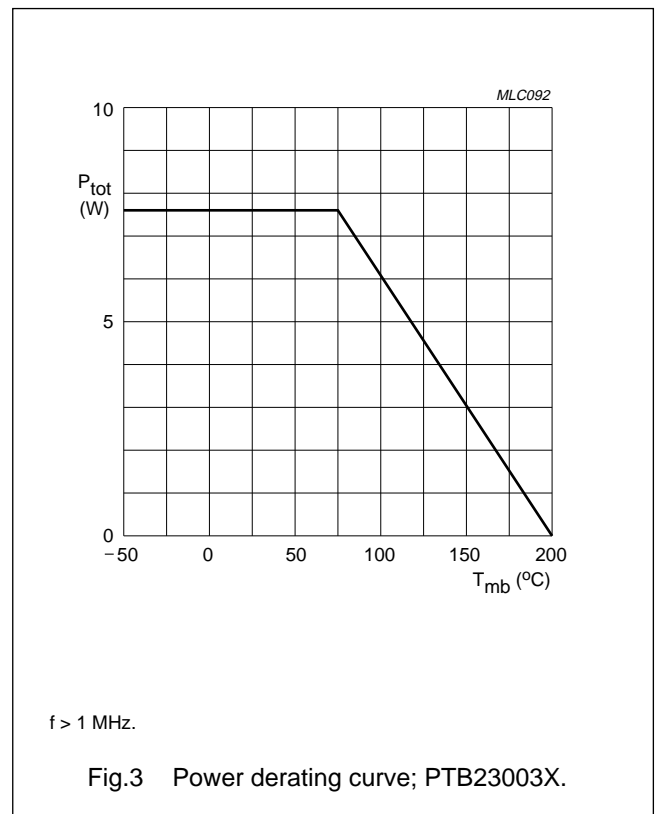
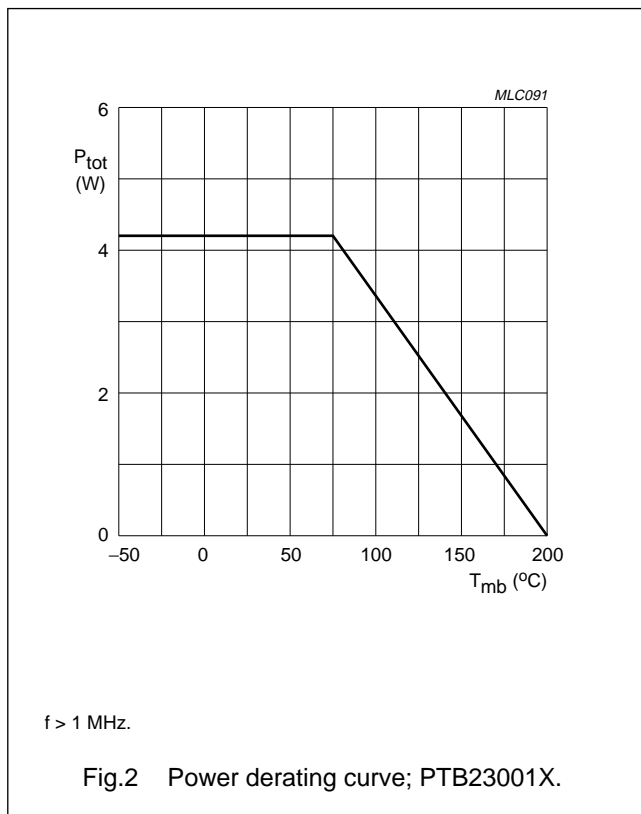
**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CBO}$	collector-base voltage	open emitter	–	40	V
$V_{CEO}$	collector-emitter voltage	open base	–	15	V
$V_{CES}$	collector-emitter voltage	$R_{BE} = 0 \Omega$	–	40	V
$I_C$	collector current (DC)				A
	PTB23001X		–	0.25	A
	PTB23003X		–	0.5	A
	PTB23005X		–	0.75	A
$P_{tot}$	total power dissipation	$T_{mb} = 75 \text{ }^\circ\text{C}; f > 1 \text{ MHz}$			W
	PTB23001X		–	4.2	W
	PTB23003X		–	7.6	W
	PTB23005X		–	8.7	W
$T_{stg}$	storage temperature		–65	+200	$^\circ\text{C}$
$T_j$	operating junction temperature		–	200	$^\circ\text{C}$
$T_{sld}$	soldering temperature	$t \leq 10 \text{ s}; \text{ note 1}$	–	235	$^\circ\text{C}$

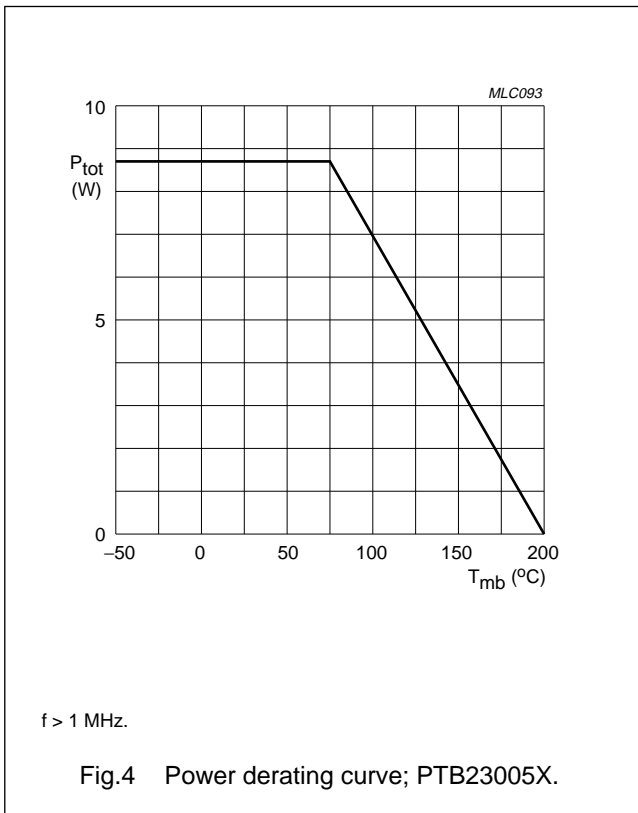
**Note**

- Up to 0.3 mm from ceramic.



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THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j-mb}$	thermal resistance from junction to mounting base	$T_j = 75\ ^\circ\text{C}$	22	K/W
	PTB23001X			
	PTB23003X			
	PTB23005X			
$R_{th\ mb-h}$	thermal resistance from mounting base to heatsink	$T_j = 75\ ^\circ\text{C}$ ; note 1	0.7	K/W

Note

- See "Mounting recommendations in the General part of handbook SC15".

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## CHARACTERISTICS

 $T_{mb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage					
	PTB23001X	$I_C = 1\text{ mA}; I_E = 0$	40	–	–	V
	PTB23003X	$I_C = 2\text{ mA}; I_E = 0$	40	–	–	V
	PTB23005X	$I_C = 3\text{ mA}; I_E = 0$	40	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 10\text{ mA}; R_{BE} = 0\text{ }\Omega$	40	–	–	V
$I_{CBO}$	collector cut-off current					
	PTB23001X	$V_{CE} = 24\text{ V}; I_E = 0$	–	–	10	$\mu\text{A}$
	PTB23003X	$V_{CE} = 24\text{ V}; I_E = 0$	–	–	20	$\mu\text{A}$
	PTB23005X	$V_{CE} = 24\text{ V}; I_E = 0$	–	–	30	$\mu\text{A}$
$I_{EBO}$	emitter cut-off current					
	PTB23001X	$V_{EB} = 1.5\text{ V}; I_C = 0$	–	–	0.2	$\mu\text{A}$
	PTB23003X	$V_{EB} = 1.5\text{ V}; I_C = 0$	–	–	0.4	$\mu\text{A}$
	PTB23005X	$V_{EB} = 1.5\text{ V}; I_C = 0$	–	–	0.6	$\mu\text{A}$
$C_{cb}$	collector-base capacitance					
	PTB23001X	$I_E = I_C = 0; V_{CB} = 24\text{ V}; V_{EB} = 1.5\text{ V}; f = 1\text{ MHz}$	–	2.2	–	pF
	PTB23003X	$I_E = I_C = 0; V_{CB} = 24\text{ V}; V_{EB} = 1.5\text{ V}; f = 1\text{ MHz}$	–	3	–	pF
	PTB23005X	$I_E = I_C = 0; V_{CB} = 24\text{ V}; V_{EB} = 1.5\text{ V}; f = 1\text{ MHz}$	–	3.8	–	pF
$C_{ce}$	collector-emitter capacitance					
	PTB23001X	$I_E = I_C = 0; V_{CB} = 24\text{ V}; V_{EB} = 1.5\text{ V}; f = 1\text{ MHz}$	–	0.3	–	pF
	PTB23003X	$I_E = I_C = 0; V_{CB} = 24\text{ V}; V_{EB} = 1.5\text{ V}; f = 1\text{ MHz}$	–	0.6	–	pF
	PTB23005X	$I_E = I_C = 0; V_{CB} = 24\text{ V}; V_{EB} = 1.5\text{ V}; f = 1\text{ MHz}$	–	0.9	–	pF

## APPLICATION INFORMATION

Microwave performance in a common-base class B selective amplifier circuit; see note 1.

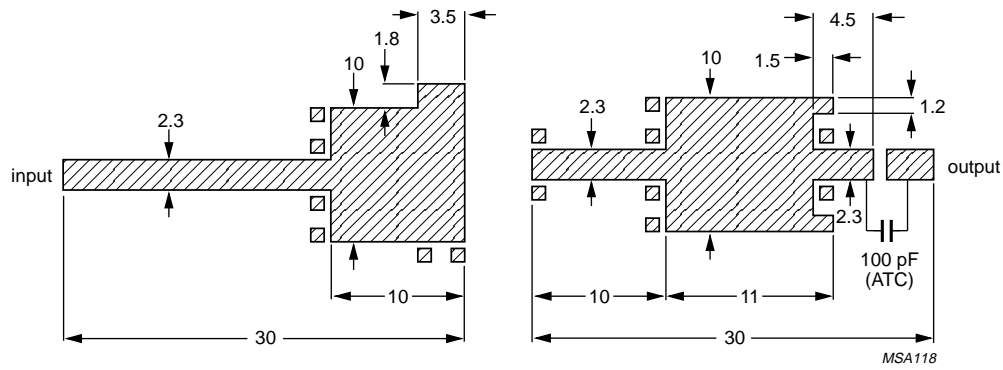
MODE OF OPERATION	TYPE NUMBER	f (GHz)	$V_{CC}$ (V)	$P_L$ (W)	$G_{po}$ (dB)	$\eta_c$ (%)
Class B (CW)	PTB23001X	2	24	>1; typ. 1.8	>7; typ. 9	>45; typ. 50
	PTB23003X	2	24	>3; typ. 4	>8.75; typ. 10	>45; typ. 50
	PTB23005X	2	24	>5; typ. 7	>9.2; typ. 11	>40; typ. 50

## Note

1. Circuit consists of prematching circuit board in combination with complementary input and output slug tuners.

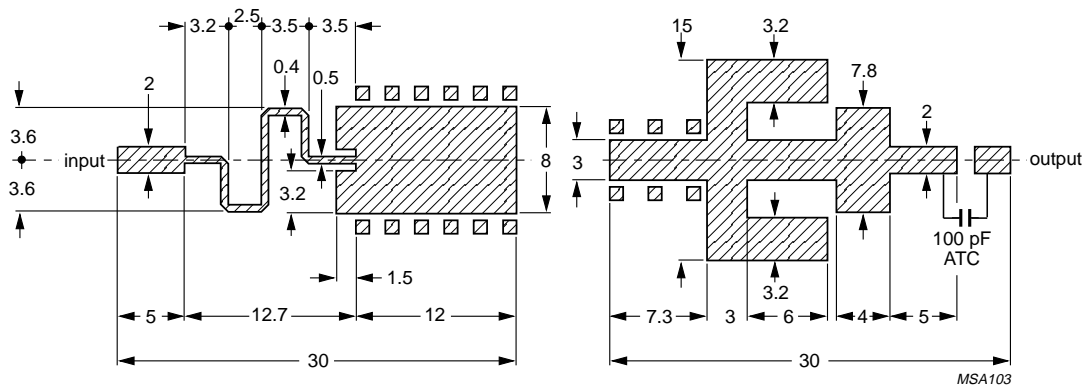
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Dimensions in mm.  
 Thickness: 0.8 mm.  
 Permittivity:  $\epsilon_r = 2.55$ .  
 Substrate: circuits on a double copper-clad printed board Teflon fibre glass dielectric.

Fig.5 Prematching test circuit board for PTB23001X.

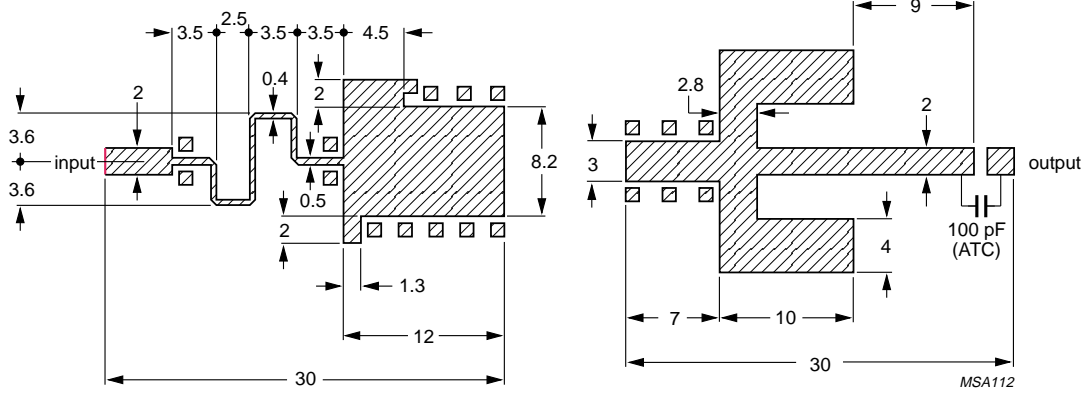


Dimensions in mm.  
 Thickness: 0.8 mm.  
 Permittivity:  $\epsilon_r = 2.55$ .  
 Substrate: circuits on a double copper clad printed-circuit board Teflon fibreglass dielectric.

Fig.6 Prematching test circuit board for PTB23003X.

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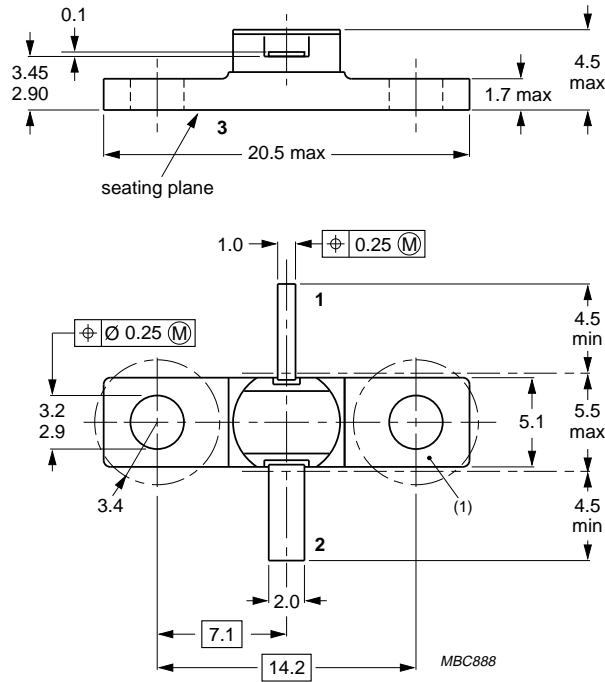
Dimensions in mm.  
 Thickness: 0.8 mm.  
 Permittivity:  $\epsilon_r = 2.55$ .  
 Substrate: circuits on a double copper clad printed-circuit board Teflon fibreglass dielectric.

Fig.7 Prematching test circuit board for PTB23005X.

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PACKAGE OUTLINE



(1) Flatness of this area ensures full thermal contact with bolt head.  
Dimensions in mm.  
Torque on screws: max. 0.5 Nm.  
Recommended screw: M2.5.

Fig.8 SOT440A.



## NPN microwave power transistors

PTB23001X; PTB23003X;  
PTB23005X**DEFINITIONS**

<b>Data sheet status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Limiting values</b>	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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 this specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

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These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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**NOTES**

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**NOTES**

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