SIEMENS

ICs for Communications

MIXER

PMB 2331 Version 1.2

Preliminary Data Sheet 09.97

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Ausgabe 09.97

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PMB 2331 **Revision History:**		**Current Version: 09.97**
Previous Version:		11.95
Page (in 11.95 Version)	Page (in 09.97 Version)	Subjects (major changes since last revision)
10	10	Supply Voltage -> 5.0V max.
10	10	Input Voltage $V_{LO/X}$ -> 5.0V max.
10	10	Open Collector Output Voltage $V_{MO/X}$ -> 1.7V min. / 5.0V max.
	10	ESD Integrity
21	21	General Application

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MIXER **PMB 2331**

Version 1.2 **Bipolar IC**

1 Overview

Plastic Package, P-DSO-8-1

1.1 Functional Description, Benefits

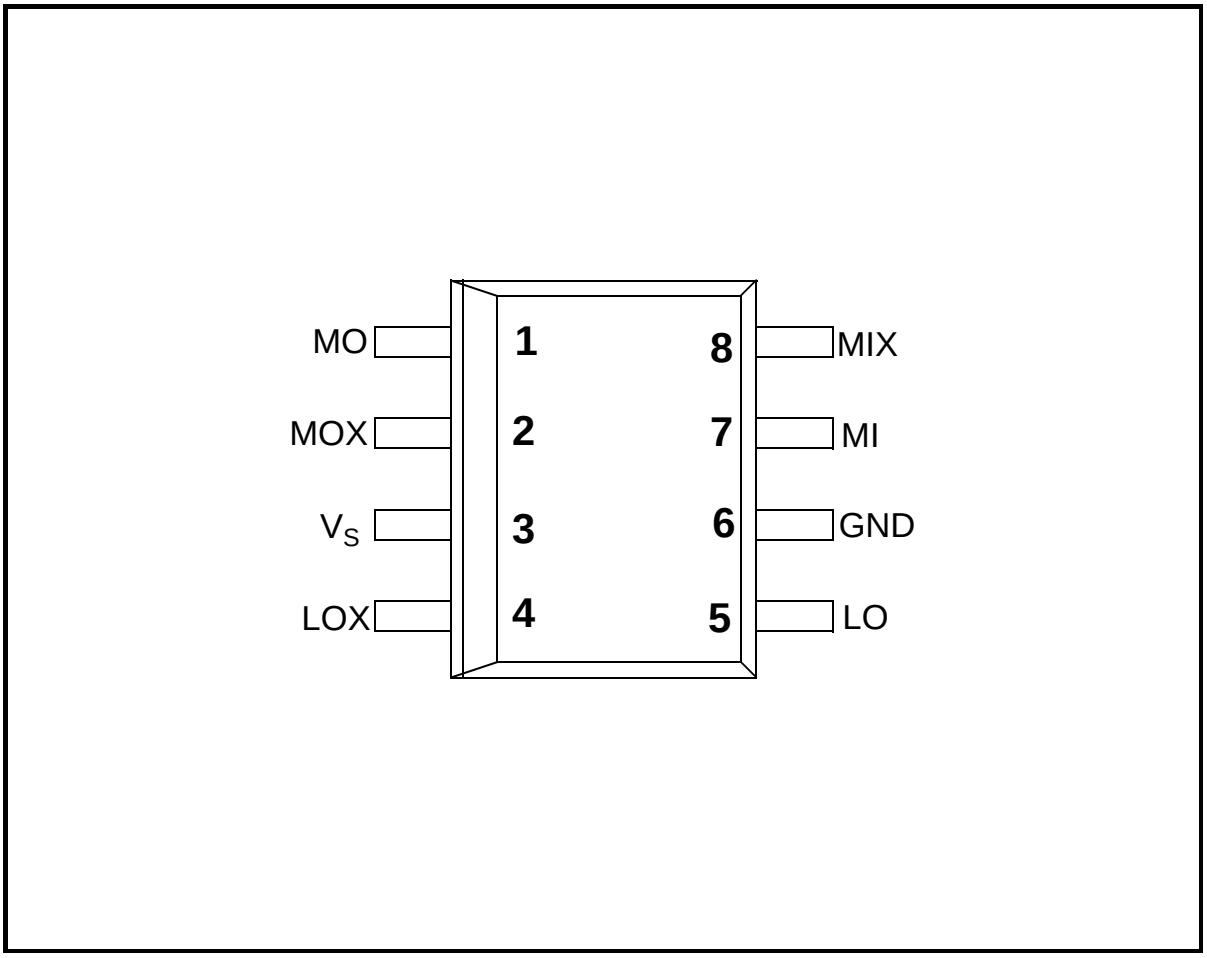
- New B6HF bipolar techology, 25GHz f_T
- Reduced external components
- Frequency range up to 2.0 GHz
- 2.7-4.5V supply voltage
- Mixer current adjustable with external resistors
- 1.6mA current consumption typical
  (no external resistors used)
- -40°C to +85°C operational temperature range
- Gilbert cell mixer
- Very highly isolated RF, LO and IF ports
- Good crosstalk performance
- Low noise
- Low spurious signal content

1.2 Applications:

- Cellular radio mixer
- Cordless telephone mixer
- UHF transceiver
- RF data links
- RF/VHF/UHF frequency conversion

1.3 Pin Configuration

(top view)

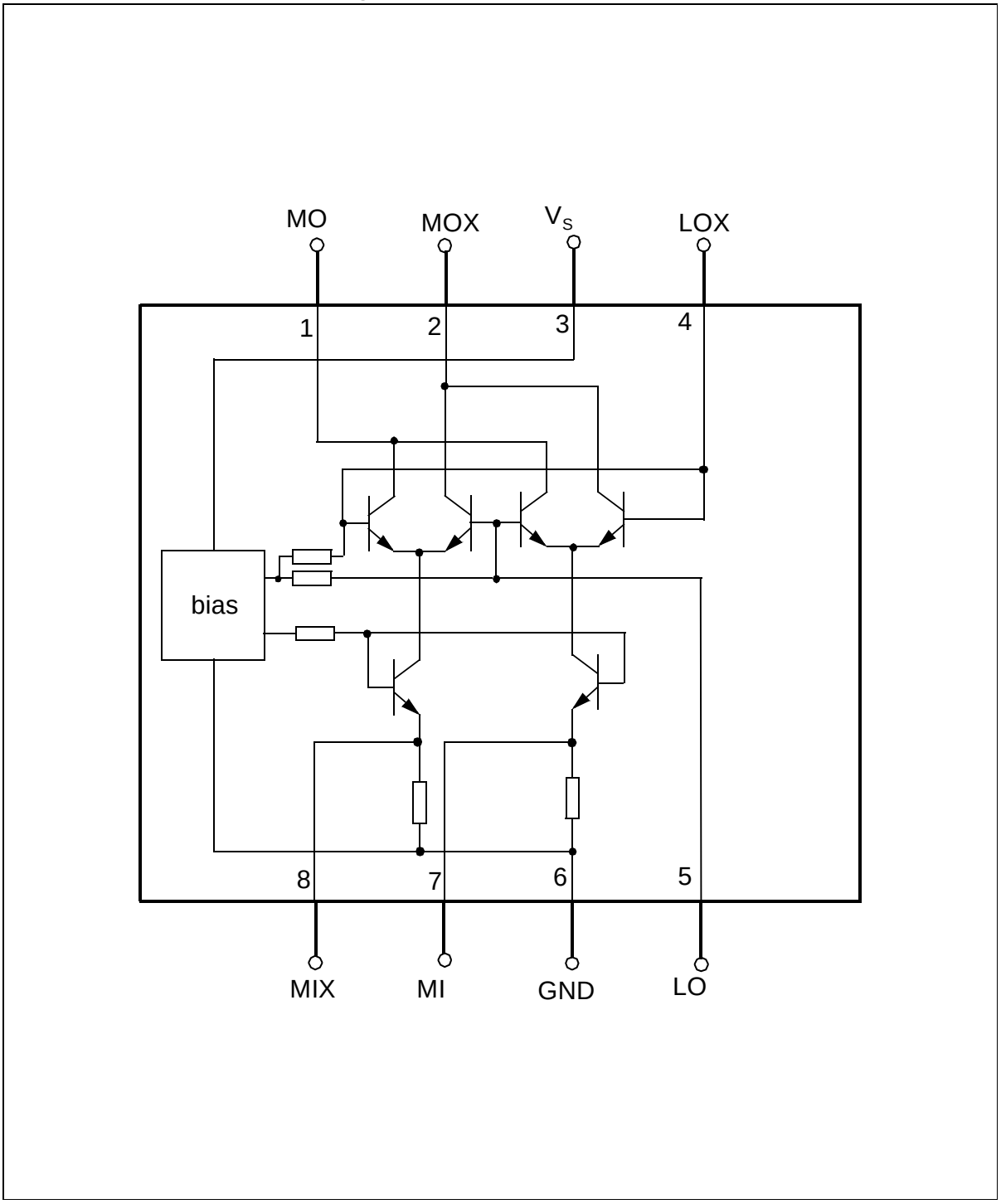


P-DSO-8-1

1.4 Pin Definitions and Functions

Pin No.	Symbol	Function
1	MO	Mixer signal output, open collector, not inverted
2	MOX	Mixer signal output, open collector, inverted
3	V_S	Mixer voltage supply
4	LOX	Mixer local oscillator signal base input, inverted
5	LO	Mixer local oscillator signal base input, not inverted
6	GND	Mixer ground
7	MI	Mixer signal emitter input, not inverted
8	MIX	Mixer signal emitter input, inverted

1.5 Functional Block Diagram



1.6 Circuit Description

The mixer used in this design is a general purpose up-/downconversion gilbert cell mixer. An amplified and filtered RF signal enters the IC via the pins MI/MIX. Using an external supplied local oscillator at LO/LOX a converted output signal is created at the open collector output pins MO/MOX, which have to be connected to an external voltage supply. The RF connections to the mixer inputs may be single ended or balanced, capacitive or inductive coupled.
Voltage supply for the mixer has to be connected to the pins V_S and GND. To increase the mixer current resistors need to be connected between the pins MI and GND, and between the pins MIX and GND.

Differential signals and symmetrical circuits are used throughout the IC.
An internal bias driver generates supply voltage and temperature compensated reference voltages.
All pins with the exception of GND are ESD protected.

2 Electrical Characteristics

2.1 Absolute Maximum Ratings

The maximum ratings may not be exceeded under any circumstances, not even momentarily and individually, as permanent damage to the IC will result.

Ambient temperature T_{amb} = -40°C...+85°C

#	Parameter	Symbol	Limit Values		Units	Remarks
			Min	Max		
1	Supply Voltage	V_S	-0.3	5.0	V	
2a	Input Voltage MI/MIX	$V_{MI/MIX}$	-0.3	1.9	V	V_S = 0V
2b	Input Voltage LO/LOX	$V_{LO/LOX}$	0.6	V_S+0.3 5.0 max.	V V	
3	Open Collector Output Voltage	$V_{MO/MOX}$	1.7	V_S+0.3 5.0 max.	V V	
4	Differential Input Voltage	V_{DIFF}		2.0	V_{PP}	
5	Junction Temperature	T_j		125	°C	
6	Storage Temperature	T_S	-40	125	°C	
7	Thermal Resistance	R_{thJA}		185	K/W	
8	ESD integrity	V_{ESD}	-1000	1000	V	1)

1) HBM according to MIL-STD 883D, methode 3015.7

2.2 Operational Range

Within the operational range the IC operates as described in the circuit description. The AC/DC characteristic limits are not guaranteed.

Supply voltage V_{VCC} = 2.7V...4.5V, Ambient temperature T_{amb} = -40°C...85°C

#	Parameter	Symbol	Limit Values		Units	Remarks
			Min	Max		
1	MI/X Input Frequency	f_{MI}		2000	MHz	
2	LO/X Input Frequency	f_{LO}		2000	MHz	
3	IF Intermediate Frequency	f_{IF}		2000	MHz	

Note: Power levels refer to 50 Ohms impedance

2.3 AC/DC Characteristics

AC/DC characteristics involve the spread of values guaranteed within the specified supply voltage and ambient temperature range. Typical characteristics are the median of the production.

Supply voltage V_{VCC} = 2.7V...4.5V, Ambient temperature T_{amb} = +25°C

#	Parameter	Symbol	Limit Values			Units	Test Conditions	Test Circuit
			Min	Typ	Max			
Supply Current								
1	Supply current, total IC	$I_{1,2,3}$		1.6		mA	without external resistors R1,2	1a,b
2	Supply current, total IC	$I_{1,2,3}$		4.6		mA	including external resistors R1,2 *(=180Ω)	1a,b
MIXER, Signal Input MI/MIX, Down conversion, $R_{1,2}$ = 180 Ohm								
3	Input impedance	S_{11M}	Diagram 2a					
4	Max. input level, 1 db comp. at MO/MOX, IF=45MHz	P_{MI}		-16		dBm	f=0.9GHz	1a
5	Input intercept point, Δf=800kHz, IF= 45MHz	$IICP3_{MI}$		-2		dBm	f=0.9GHz	1a
6	Blocking level Δf=800kHz, IF= 45MHz	P_{BL}		-16		dBm	f=0.9GHz	1a
7	Noise figure, ssb, ($NF_{SSB} \approx NF_{DSB}$+ 3dB) IF = 45MHz	F_{MI}		9.5		dB	f=0.9GHz **	1a
MIXER, Local Oscillator Input LO/LOX								
8	Input impedance	S_{11LO}	Diagram 2b					
9	Input level	P_{LO}		-3		dBm	f=0.9GHz, ***	1a,b

***minimum value for R1=R2=33Ohm**
**matching network used
***referenced for specified mixer performance

AC/DC Characteristics

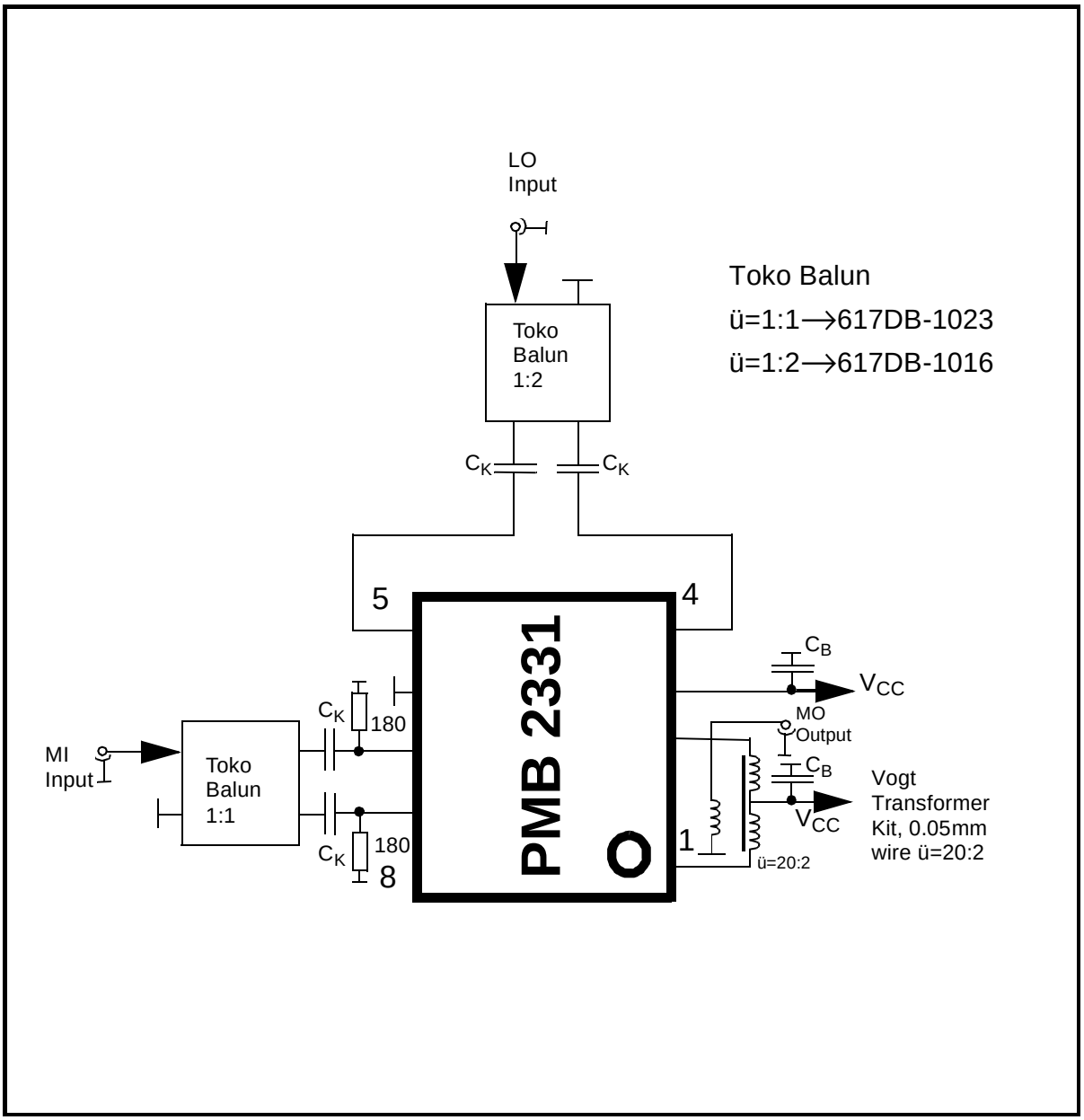
AC/DC characteristics involve the spread of values guaranteed within the specified supply voltage and ambient temperature range. Typical characteristics are the median of the production.

Supply voltage V_{VCC} = 2.7V to 4.5V, Ambient temperature T_{amb} = +25°

#	Parameter	Symbol	Limit Values			Unit	Test Conditions	Test Circuit
			Min	Typ	Max			
MIXER, Signal Output MO/MOX, Down conversion, $R_{1,2}$ = 180 Ohm								
10	Output current	$I_{MO+ MOX}$		4.0		mA	including external resistors R1, R2	1a,b
11	Output resistance	R_{MODiff}		38		kOhm	IF=45MHz	1a
12	Output resistance	R_{MODiff}		24		kOhm	IF=300MHz	1b
13	Output capacitance	C_{MODiff}		0.34		pF	IF=45MHz	1a
14	Output capacitance	C_{MODiff}		0.38		pF	IF=300MHz	1b
15	Power gain, IF=45MHz	P_{MI}		14		dB	f=0.9GHz	1a
16	Power gain, IF=300MHz	P_{MI}		7		dB	f=0.9GHz	1b
MIXER, Isolation Between In-/Output, 0.9GHz								
17	MI to MO	A_{MI-MO}		30		dB	f_{MI}=945MHz f_{LO}=900MHz	1a
18	LO to MO	A_{LO-MO}		50		dB	"	1a
19	LO to MI	A_{LO-MI}		50		dB	"	1a
20	MO to MI	A_{MO-MI}		50		dB	"	1a
21	MO to LO	A_{MO-LO}		60		dB	"	1a

2.4 Test Circuits

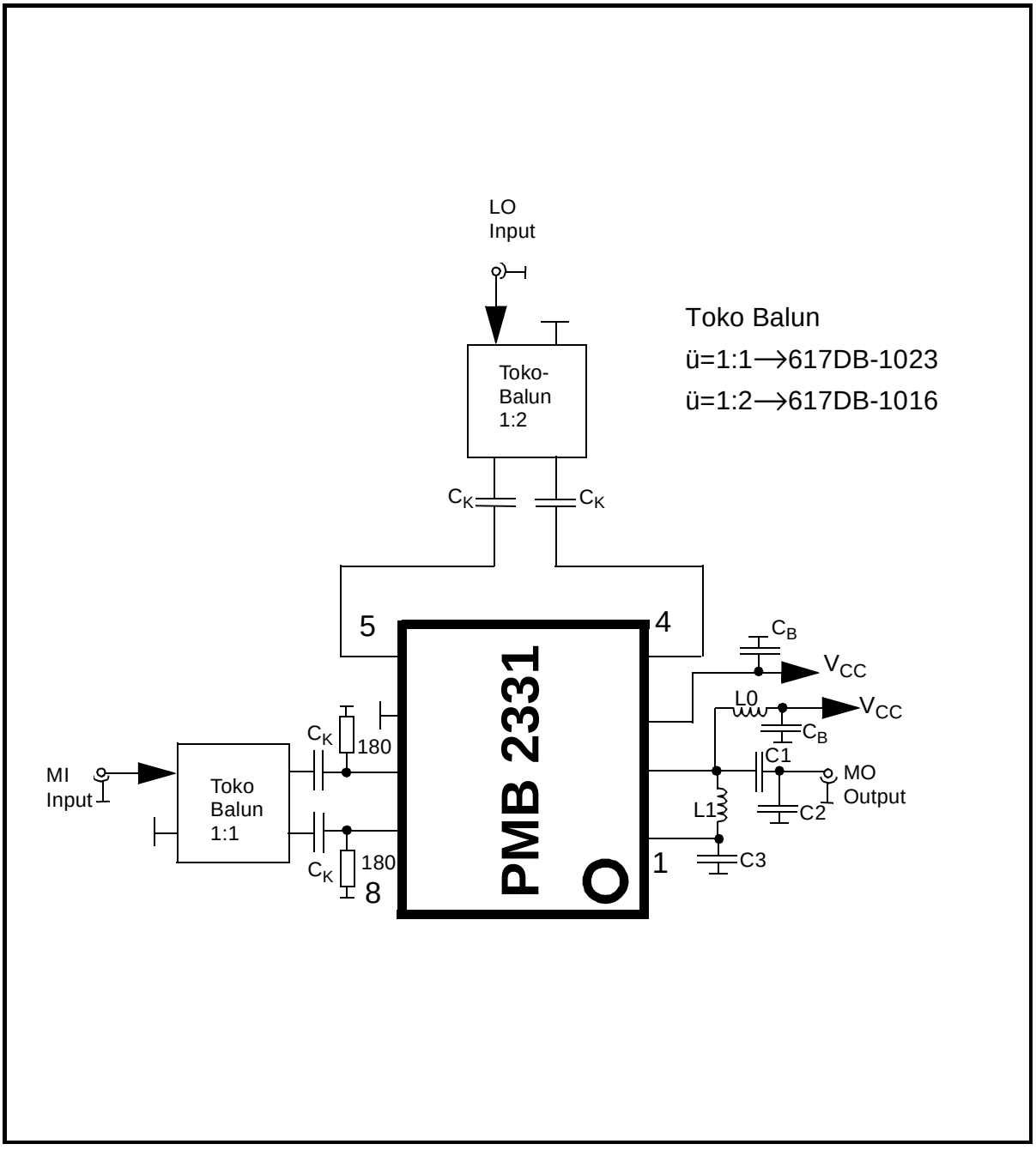
Test Circuit 1a



Test Circuit for 45 MHz Intermediate frequency

Test Circuit	f_{IF}[MHz]	C_B[pF]	C_K[pF]	X
1a	45	15p/100p	15p	X

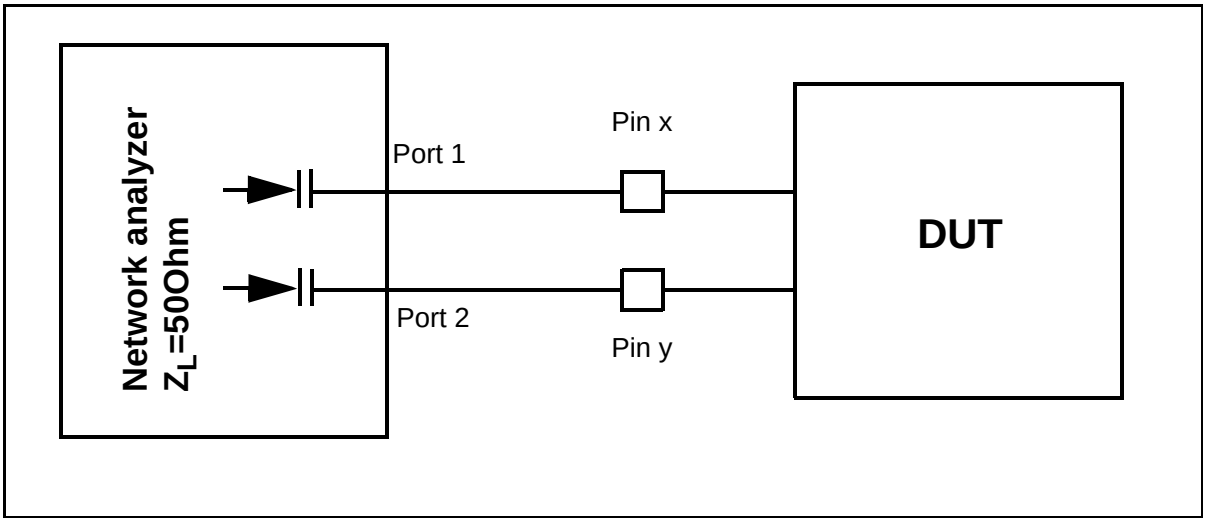
Test Circuit 1b



Test Circuit for 300 MHz intermediate frequency

Test Circuit	f_{IF}[MHz]	L0[nH]	L1[nH]	C1[pF]	C2[pF]	C3[pF]	C_K[pF]
1b	≈300	680	150	2.7	12	1.8	15p

Test Circuit 2



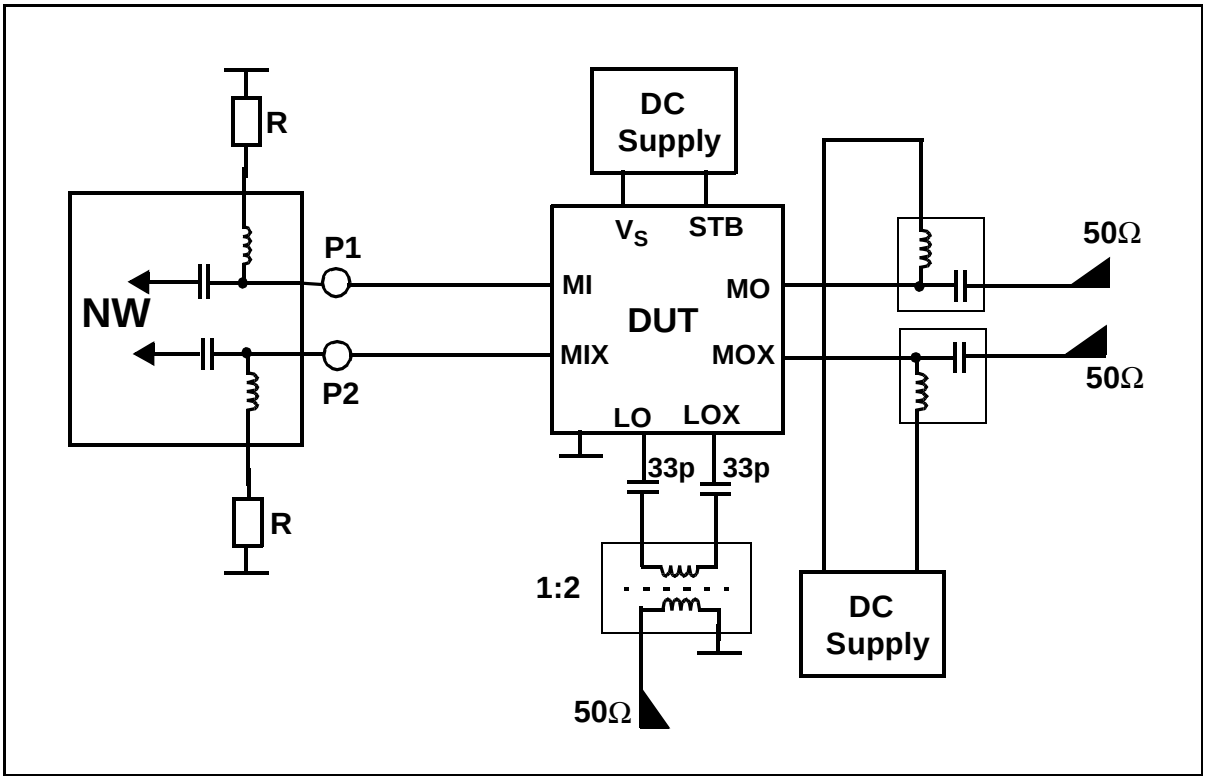
S-Parameter Measurement of Mixer
S11, S12, S21, S2

Test	Test Frequency [GHz]	Pin X	Pin Y
LO-Input impedance	.. - 3.0	4	5
Mi-Input impedance	.. - 3.0	7	8
MO-Output impedance	.. - 3.0	1	2

The S-Parameters are tested at the indicated frequency and the equivalent parallel or series circuit is calculated on this base.

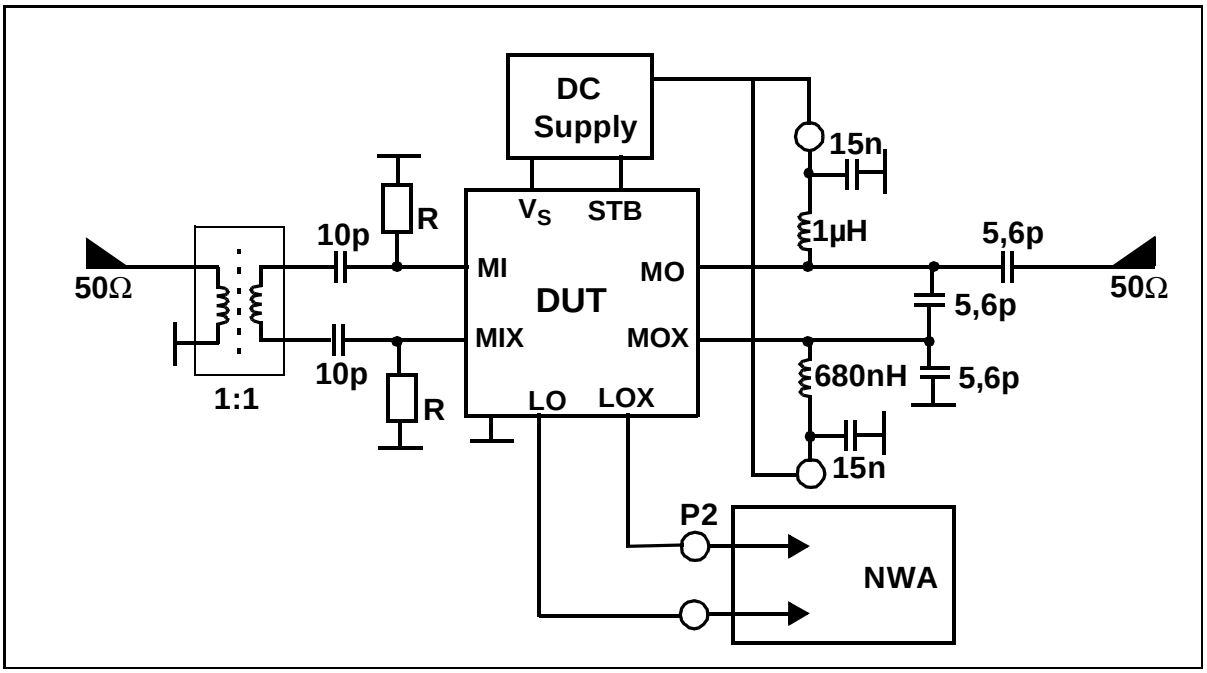
Via the NWA the capacitive coupling is done and the open collector pins are connected to VCC. The output levels at port1 and 2 for pin x and y are -30dbm for MI and MO-impedances and -5dbm for the LO impedance.S-Parameters have to be considered as design hints and are measured with SIEMENS testboards. (RT/Duroid 5880 Teflon, ε=2.2)

Test Circuit 2a



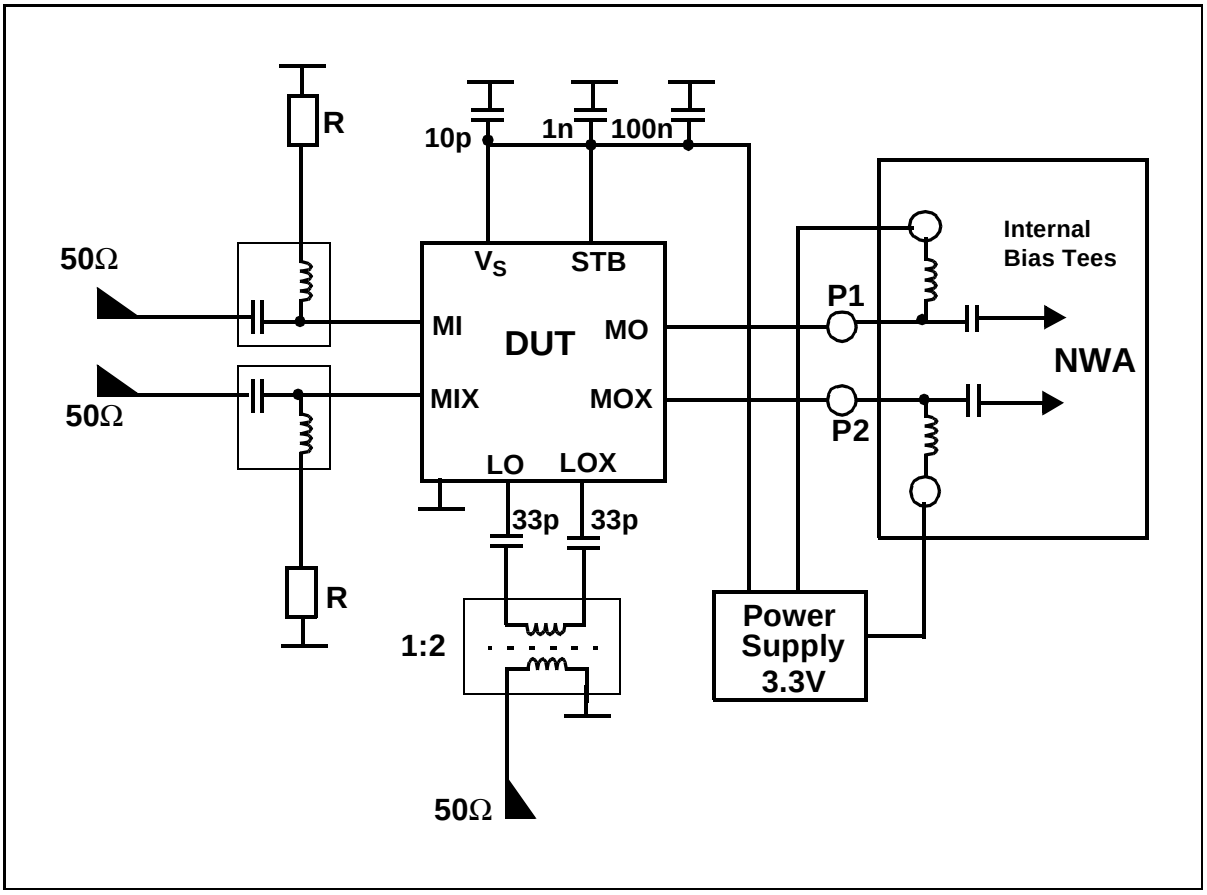
Mixer Input Impedance Measurement

Test Circuit 2b



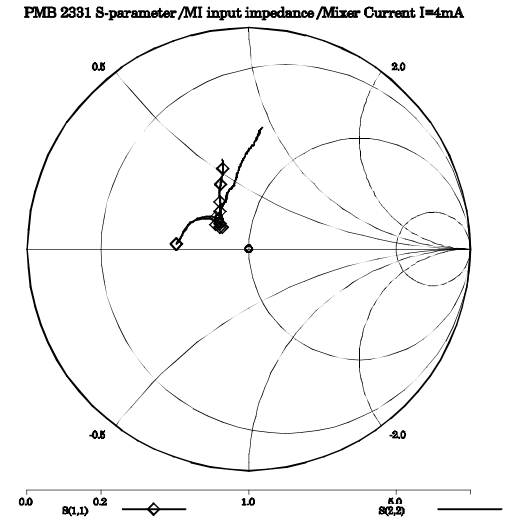
Mixer Local Oscilllator Impedance Measurement

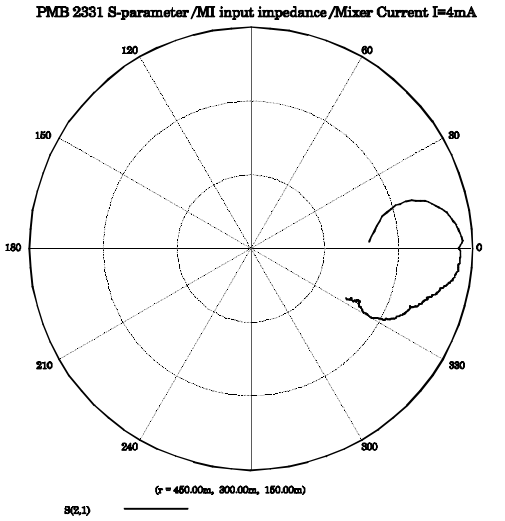
Test Circuit 2c



Mixer Output Impedance Measurement

Diagram 2a
S-Parameter Mixer Input MI Impedance, $I_{MO/MOX}$ = 4mA; f=..3GHz





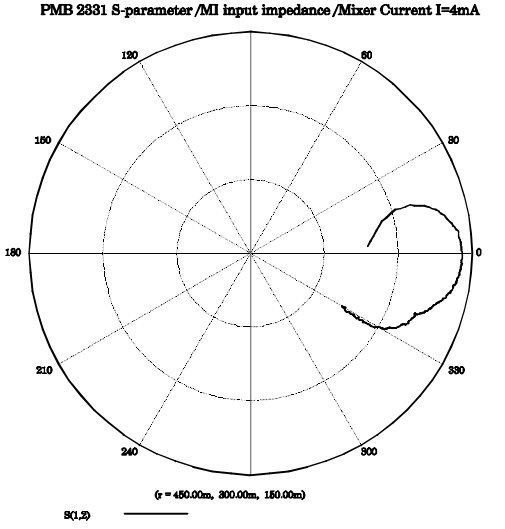
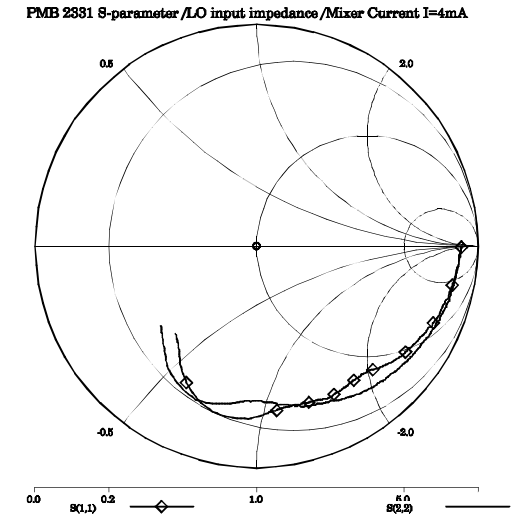
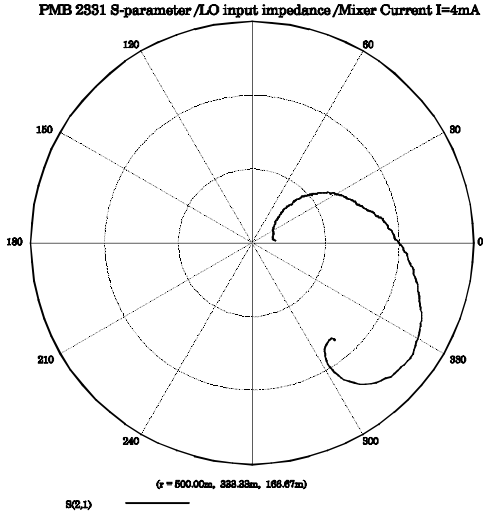
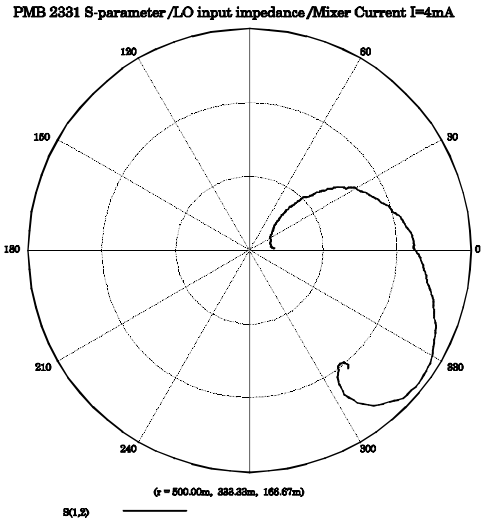


Diagram 2b
S-Parameter Mixer Input LO Impedance, $I_{MO/MOX}$ = 4mA; f=..3GHz



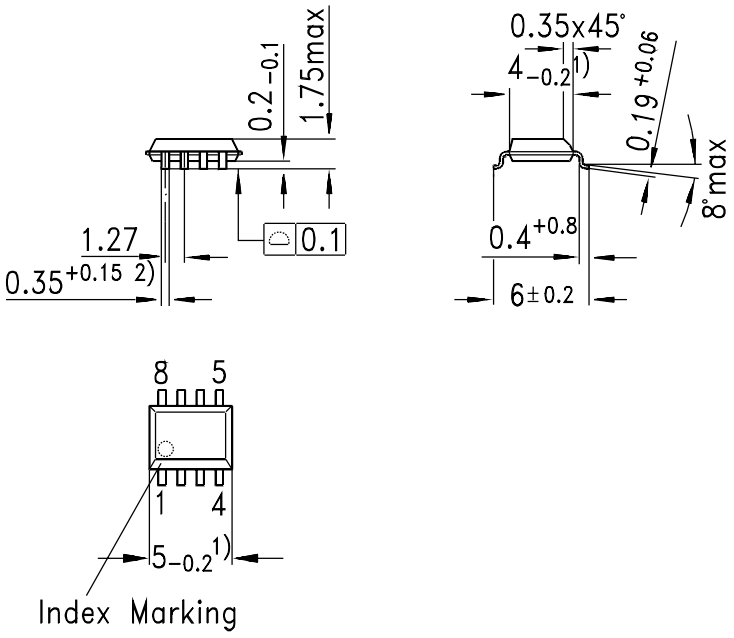




Application Circuit
General applications refer to the PMB 2330 application note (different values)

3 Package Outlines

Plastic Package, P-DSO-8-1
(Plastic Dual Small Outline)



1) Does not include plastic or metal protrusions of 0.15 max per side
2) Does not include dambar protrusion of 0.05 max per side

Sorts of Packing
Package outlines for tubes, trays etc. are contained in our Data Book “Package Information”.

SMD = Surface Mounted Device

Dimensions in mm