Wireless Components

Mixer

PMB 2335 Version 1.1

Specification August 1999

target

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Productinfo

General Description

The mixer used in this design is a general purpose up-/downconversion gilbert cell mixer. An amplified and filtered RF signal enter 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.

Package

P-TSSOP-10-1

Features

- B6HF bipolar technology, 25GHz f_T
- Gilbert cell mixer
- Reduced external components
- Mixer current adjustable with external resistors
- 1.6 mA current consumption typical (no external resistors used)
- Excellent port isolation
- Low noise
- Low spurious signal content
- Power on pin
- Frequency range up to 3.0 GHz
- Supply voltage 2.7 - 4.5V
- -40°C to +85°C operational temperature range

Application

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

Ordering Information

Type	Ordering Code	Package
PMB 2335		P-TSSOP-10-1

1 Table of Contents

2 Product Description

Contents of this Chapter

2.1 Overview

The mixer used in this design is a general purpose up-/downconversion gilbert cell mixer. An amplified and filtered RF signal enter 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.

2.2 Features

- B6HF bipolar technology, 25GHz f_T
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2.3 Application

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- Cordless telephone mixer
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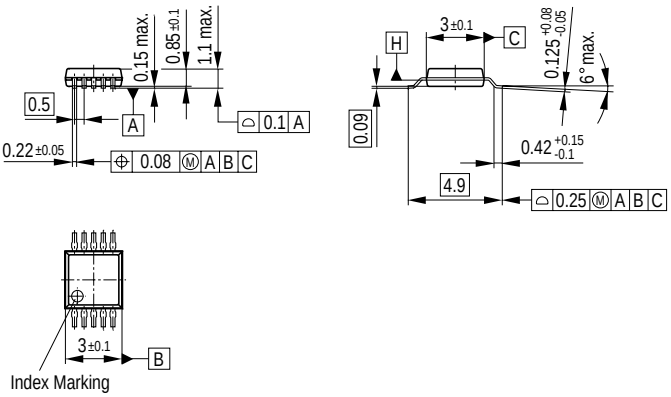
2.4 Package Outlines

P- TSSOP-10-1



3 Functional Description

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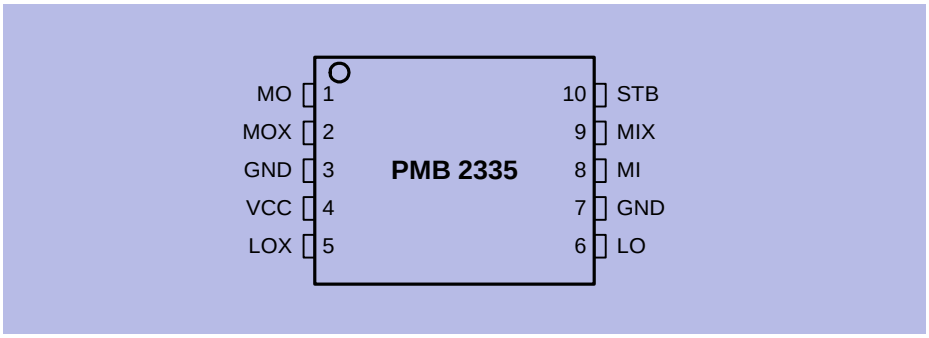
3.1 Pin Configuration



Pin_config.wmf

Figure 3-1 Pin Configuration

3.2 Pin Definition and Function

Table 3-1 Pin Definition and Function

Pin No.	Symbol	Equivalent I/O-Schematic	Function
1	MO		Mixer signal output, open collector, not inverted
2	MOX		Mixer signal output, open collector, inverted
3	GND		Ground
4	VCC		Mixer voltage supply
5	LOX		Mixer local oscillator signal base input, inverted
6	LO		Mixer local oscillator signal base input, not inverted
7	GND		Ground
8	MI		Mixer signal emitter input, not inverted
9	MIX		Mixer signal emitter input, inverted
10	STB		Mixer power down

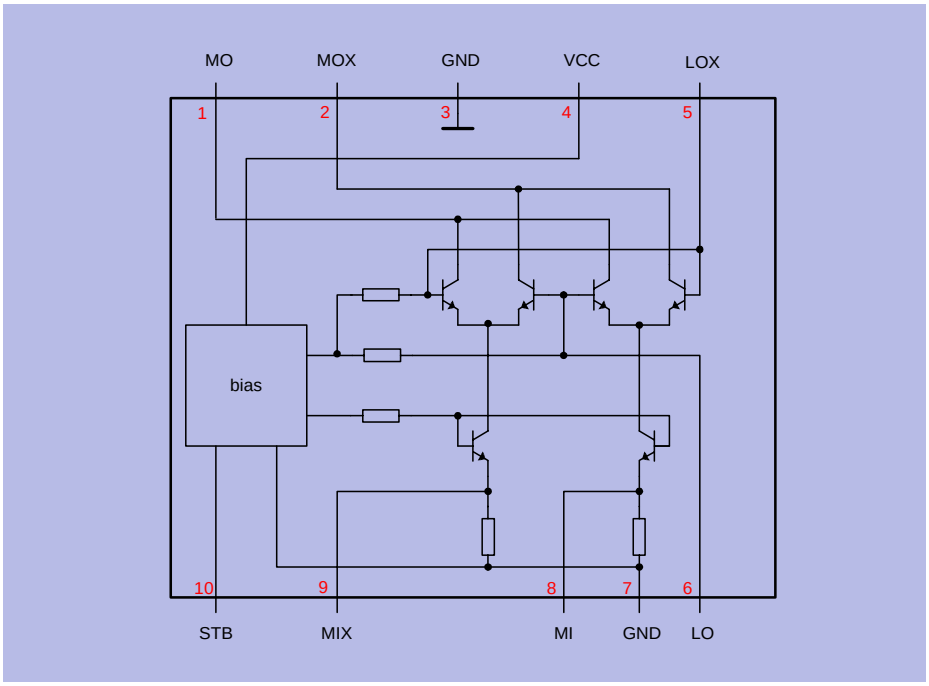
3.3 Circuit Description

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.

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.

3.4 Functional Block Diagram



Funct_block.wmf

Figure 3-2 Functional Block Diagram

4 Applications

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4.1 Test Circuit 1

Table 4-1

Test Circuit	f_{IF}[MHz]	L0 [nH]	L1 [nH]	C1 [pF]	C2 [pF]	C3 [pF]	C_K [pF]

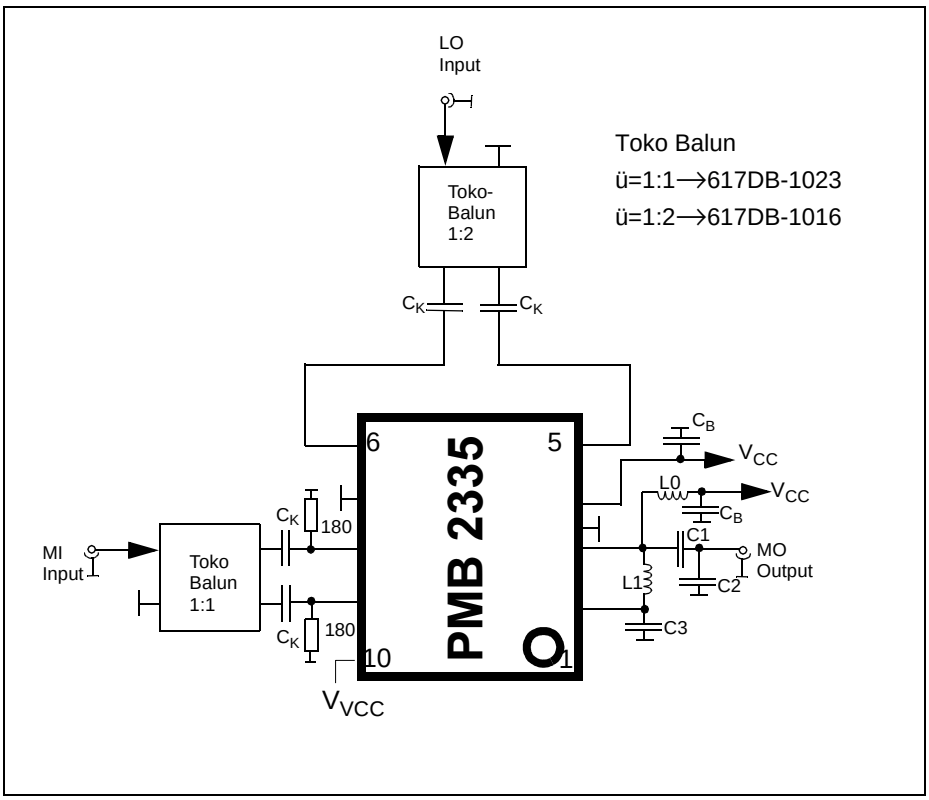

Figure 4-1 Test Circuit for 300 MHz intermediate frequency

4.2 Test Circuit 2

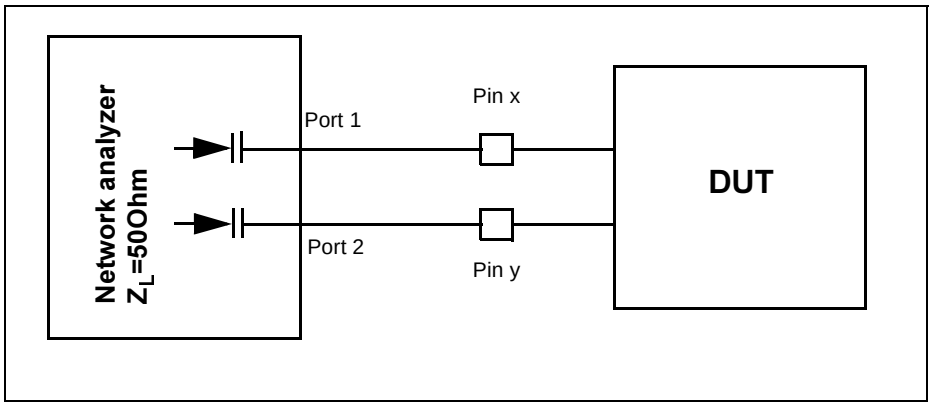

Figure 4-2 S-Parameter Measurement of Mixer S11, S12, S21, S22

Table 4-2

Test	Test Frequency [GHz]	Pin X	Pin Y
LO-Input impedance	.. - 3.0	5	6
Mi-Input impedance	.. - 3.0	8	9
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 Infineon testboards. (RT/Duroid 5880 Teflon, ε=2.2)

4.3 Test Circuit 2a

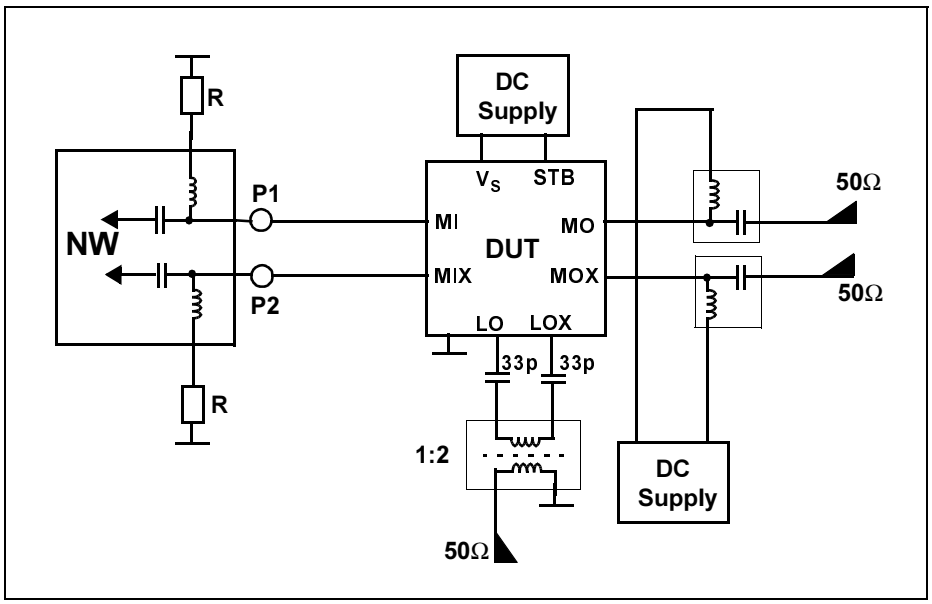

Figure 4-3 Mixer Input Impedance Measurement

4.4 Test Circuit 2b

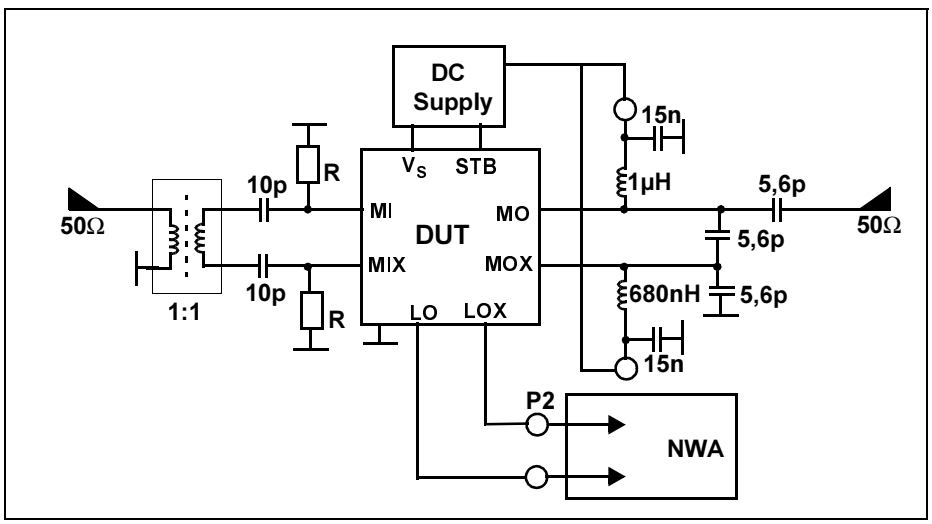

Figure 4-4 Mixer Local Oscilllator Impedance Measurement

4.5 Test Circuit 2c

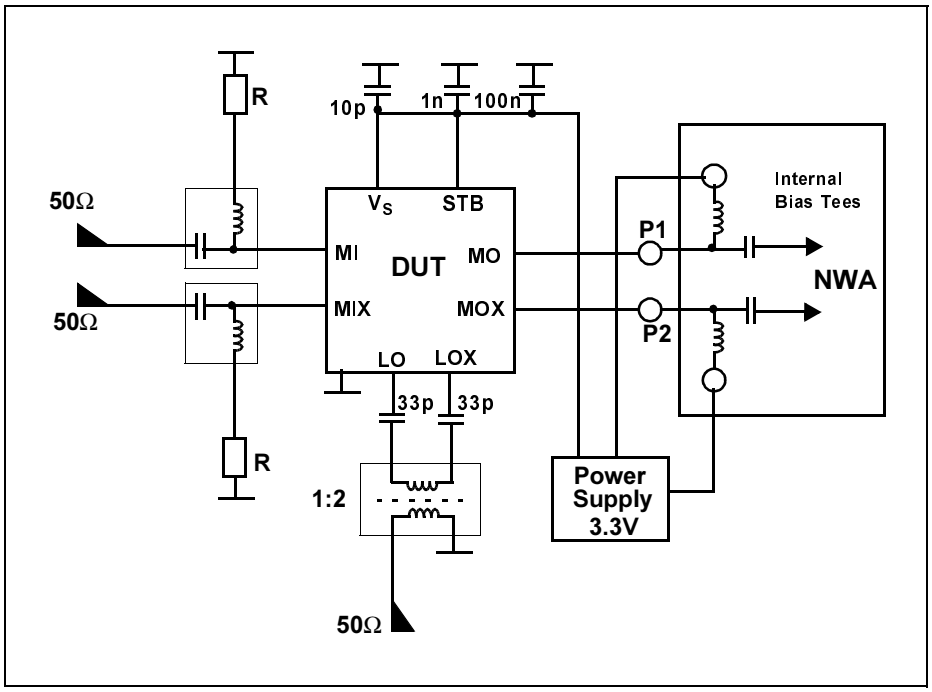

Figure 4-5 Mixer Output Impedance Measurement

5 Reference

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5.1 Absolute Maximum Ratings

WARNING

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

Table 5-1 Absolute Maximum Ratings

Parameter	Symbol	Limit Values		Unit	Remarks
		min	max		
Supply Voltage	V_S	-0.3	5.0	V	
Input Voltage MI/MIX	$V_{MI/MIX}$	-0.3	1.9	V	V_S = 0V
Input Voltage LO/LOX	$V_{LO/LOX}$	0.6	V_S+0.3 5.0 max.	V	
Open Collector Output Voltage	$V_{MO/MOX}$	1.7	V_S+0.3	V	
Open Collector Output Current	I_{MO+MOX}		10	mA	
Differential Input Voltage	V_{DIFF}		2.0	V_{PP}	
Junction Temperature	T_j		125	°C	
Storage Temperature	T_S	-40	125	°C	
Thermal Resistance	R_{thJA}			K/W	
ESD integrity	V_{ESD}			V	

5.2 Operating Range

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

Table 5-2 Operating Range, Supply voltage V_{VCC} = 2.7V...4.5V, Ambient temperature T_{amb} = -40 .. 85°C

Parameter	Symbol	Limit Values		Unit	Test Conditions	L	Item
		min	max				
MI/X Input Frequency	f_{MI}		3000	MHz			
LO/X Input Frequency	f_{LO}		3000	MHz			
IF Intermediate Frequency	f_{IF}		3000	MHz			

Note: Power levels refer to 50 Ohms impedance

5.3 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.

Table 5-3 AC/DC Characteristics with Supply voltage V_{VCC} = 2.7V...4.5V, Ambient temperature T_{amb} = +25°C

	Symbol	Limit Values			Unit	Test Conditions	L	Item
		min	typ	max				
Supply Current								
Supply current, total IC	$I_{1,2,3}$		1.6		mA	without external resistors R1,2		1
Supply current, total IC	$I_{1,2,3}$		4.6		mA	including external resistors R1,2 (=180Ω)		1
MIXER, Signal Input MI/MIX, Down conversion, $R_{1,2}$ = 180 Ohm								
Input impedance	S_{11M}	Diagram 2a						
Max. input level, 1 db comp. at MO/MOX, IF=45MHz	P_{MI}		-16		dBm	f=0.9GHz		1
Input intercept point, Δf=800kHz, IF= 45MHz	$IICP3_{MI}$		-2		dBm	f=0.9GHz		1
Blocking level Δf=800kHz, IF= 45MHz	P_{BL}		-16		dBm	f=0.9GHz		1
Noise figure, ssb, ($NF_{SSB} \approx NF_{DSB}$+ 3dB) IF = 45MHz	F_{MI}		9.5		dB	f=0.9GHz *		1
MIXER, Local Oscillator Input LO/LOX								
Input impedance	S_{11LO}	Diagram 2b						
Input level	P_{LO}		-3	dBm		f=0.9GHz, **		1
MIXER, Signal Output MO/MOX, Down conversion, $R_{1,2}$ = 180 Ohm								
Output current	I_{MO+} MOX		4.0		mA	including external resistors R1, R2		1
Output resistance	R_{MODiff}		t.b.d.		kΩ	IF= 45 MHz		1
Output resistance	R_{MODiff}		t.b.d.		kΩ	IF= 300 MHz		1
Output capacitance	C_{MODiff}		t.b.d.		pF	IF= 45 MHz		1
Output capacitance	C_{MODiff}		t.b.d.		pF	IF= 300 MHz		1
Power gain, IF=45MHz	P_{MI}		14		dB	f=0.9GHz		1
Power gain, IF=300MHz	P_{MI}		7		dB	f=0.9GHz		1

Table 5-3 AC/DC Characteristics with Supply voltage V_{VCC} = 2.7V...4.5V, Ambient temperature T_{amb} = +25°C (continued)

	Symbol	Limit Values			Unit	Test Conditions	L	Item
		min	typ	max				
MIXER, Isolation Between In-/Output, 0.9GHz								
MI to MO	A_{MI-MO}		tbd.		dB	f_{MI}=945MHz f_{LO}=900MHz		1
LO to MO	A_{LO-MO}		tbd.		dB	f_{MI}=945MHz f_{LO}=900MHz		1
LO to MI	A_{LO-MI}		tbd.		dB	f_{MI}=945MHz f_{LO}=900MHz		1
MO to MI	A_{MO-MI}		tbd		dB	f_{MI}=945MHz f_{LO}=900MHz		1
MO to LO	A_{MO-LO}		tbd.		dB	f_{MI}=945MHz f_{LO}=900MHz		1

*) matching network used
**) referenced for specified mixer performance