SIEMENS

ICs for Communications

MIXER

PMB 2331 Version 1.2

Preliminary Data Sheet 02.96

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MIXER **PMB 2331**

Version 1.2 **Bipolar IC**

1 Overview

P-DSO-8-1

1.1 Functional Description

- New B6HF bipolar techology, 25 GHz f_T
- Reduced external components
- Frequency range up to 2.0 GHz
- 2.7-4.5 V 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

Type	Ordering Code	Package
PMB 2331		P-DSO-8-1

1.3 Pin Configuration
(top view)

P-DSO-8-1

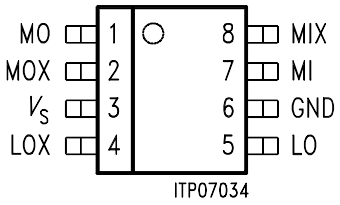


Figure 1

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

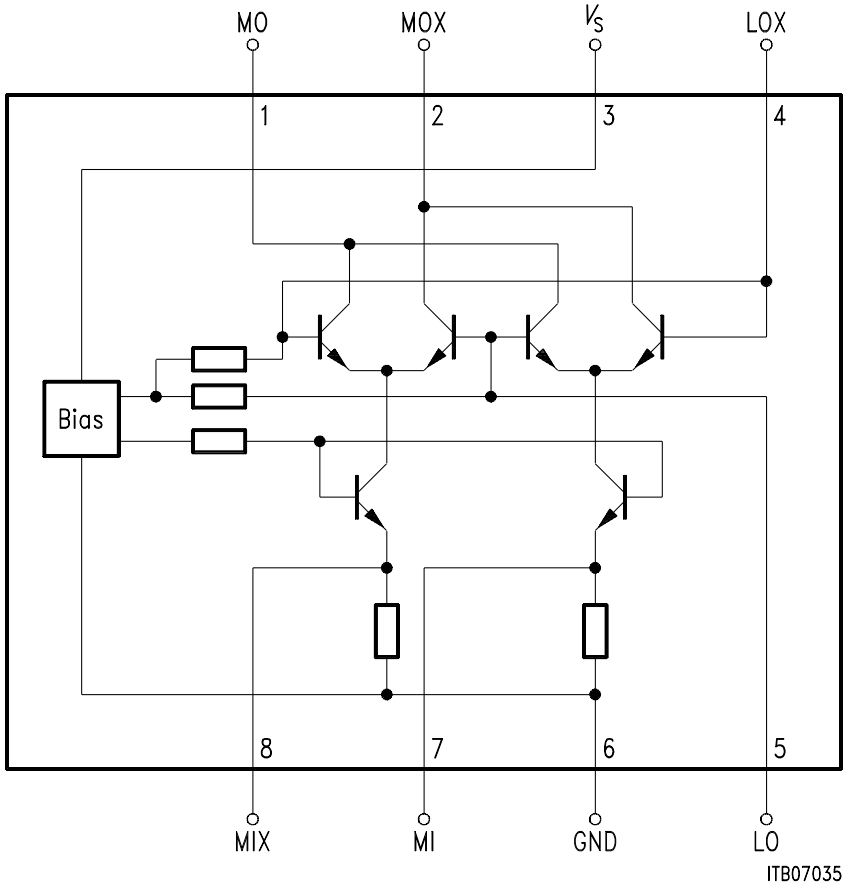


Figure 2

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

T_A = – 40 ˚C to + 85 ˚C

#	Parameter	Symbol	Limit Values		Unit	Remarks
			min.	max.		
1	Supply voltage	V_S	– 0.3	5.5	V	
2a	Input voltage MI/MIX	$V_{MI/MIX}$	– 0.3	1.9	V	V_S = 0 V
2b	Input voltage LO/LOX	$V_{LO/LOX}$	0.6	V_S + 0.3	V	
3	Open collector output voltage	$V_{MO/MOX}$	1.3	V_S + 0.3	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	

Note: Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

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.

V_{VCC} = 2.7 V...4.5 V, T_A = – 40 ˚C to 85 ˚C

#	Parameter	Symbol	Limit Values		Unit	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 Ω impedance.
In the operating range the functions given in the circuit description are fulfilled.

2.3 AC/DC Characteristics

V_{VCC} = 2.7 V to 4.5V, T_A = 25 ˚C

#	Parameter	Symbol	Limit Values			Unit	Test Condition	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 [1](=180 Ω)	1a,b
MIXER, Signal Input MI/MIX, Down Conversion, $R_{1,2}$ = 180 Ω								
3	Input impedance	S_{11M}	Diagram 2a					
4	Max. input level, 1 db comp. at MO/MOX, IF = 45 MHz	P_{MI}		– 16		dBm	f = 0.9 GHz	1a
5	Input intercept point, Δf = 800 kHz, IF = 45 MHz	$IICP3_{MI}$		– 2		dBm	f = 0.9 GHz	1a
6	Blocking level Δf = 800 kHz, IF = 45 MHz	P_{BL}		– 16		dBm	f = 0.9 GHz	1a
7	Noise figure, ssb, ($NF_{SSB} \approx NF_{dsb}$ + 3 dB) IF = 45 MHz	F_{MI}		9.5		dB	f = 0.9 GHz [2]	1a
MIXER, Local Oscillator Input LO/LOX								
8	Input impedance	S_{11LO}	Diagram 2b					
9	Input level	P_{LO}		– 3		dBm	f = 0.9 GHz [3]	1a,b

Notes see page 10.

2.3 AC/DC Characteristics (cont'd)

V_{VCC} = 2.7 V to 4.5V, T_A = 25 °C

#	Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
			min.	typ.	max.			
MIXER, Signal Output MO/MOX, Down Conversion, $R_{1,2}$ = 180 Ω								
10	Output current	$I_{MO+ MOX}$		4.0		mA	including external resistors R1, R2	1a,b
11	Output resistance	R_{MODiff}		38		kΩ	IF = 45 MHz	1a
12	Output resistance	R_{MODiff}		24		kΩ	IF = 300 MHz	1b
13	Output capacitance	C_{MODiff}		0.34		pF	IF = 45 MHz	1a
14	Output capacitance	C_{MODiff}		0.38		pF	IF = 300 MHz	1b
15	Power gain, IF = 45 MHz	P_{MI}		14		dB	f = 0.9 GHz	1a
16	Power gain, IF = 300 MHz	P_{MI}		7		dB	f = 0.9 GHz	1b
MIXER, Isolation Between In-/Output, 0.9 GHz								
17	MI to MO	A_{MI-MO}		30		dB	f_{MI} = 945 MHz f_{LO} = 900 MHz	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

1) **Minimum value for R41 = R2 = 33 Ω.**

2) Matching network used.

3) Referenced for specified mixer performance.

Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at T_A = 25 °C and the given supply voltage.

2.4 Test Circuits

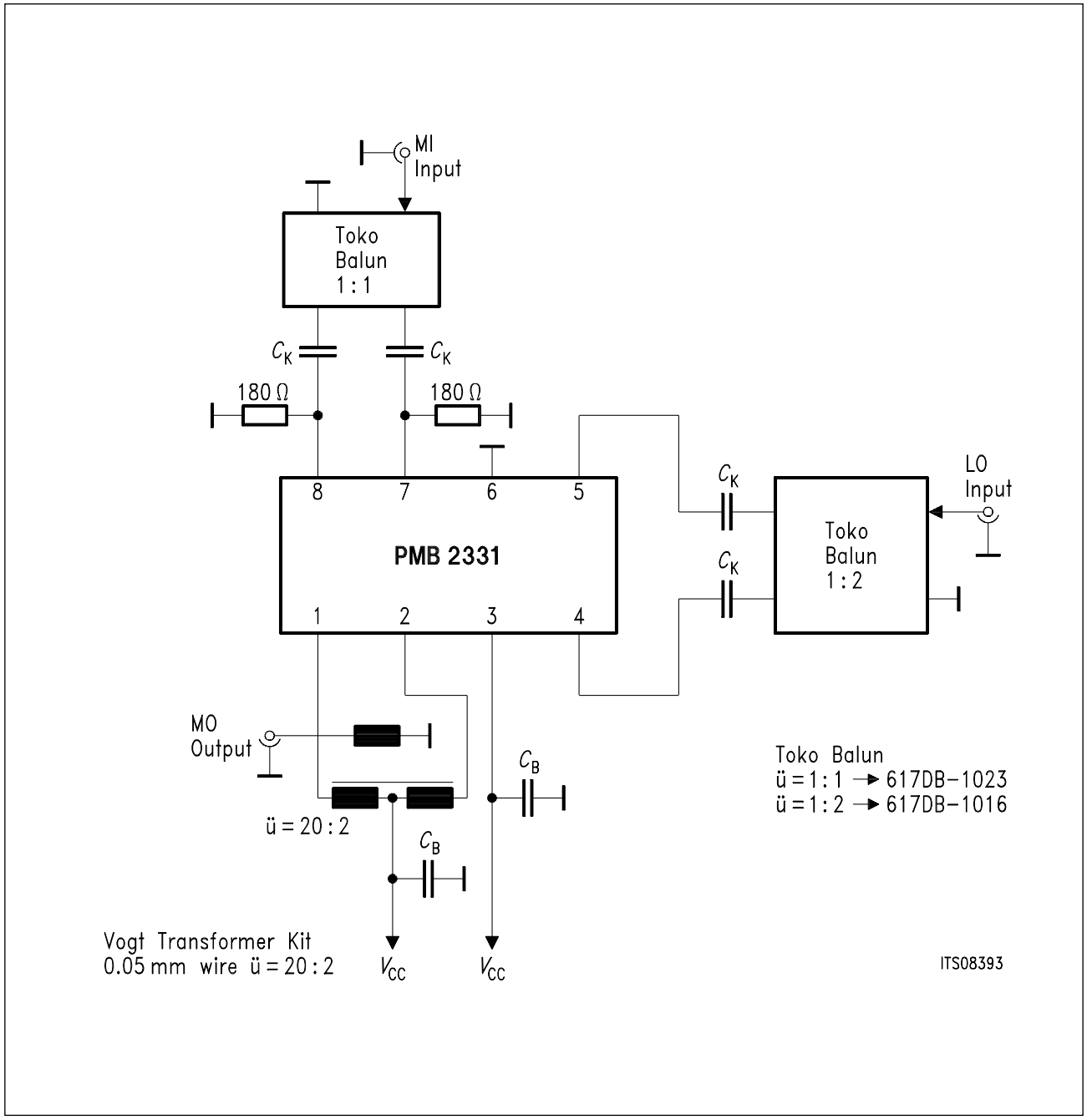


Figure 3
Test Circuit 1a

Test Circuit for 45 MHz Intermediate Frequency

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

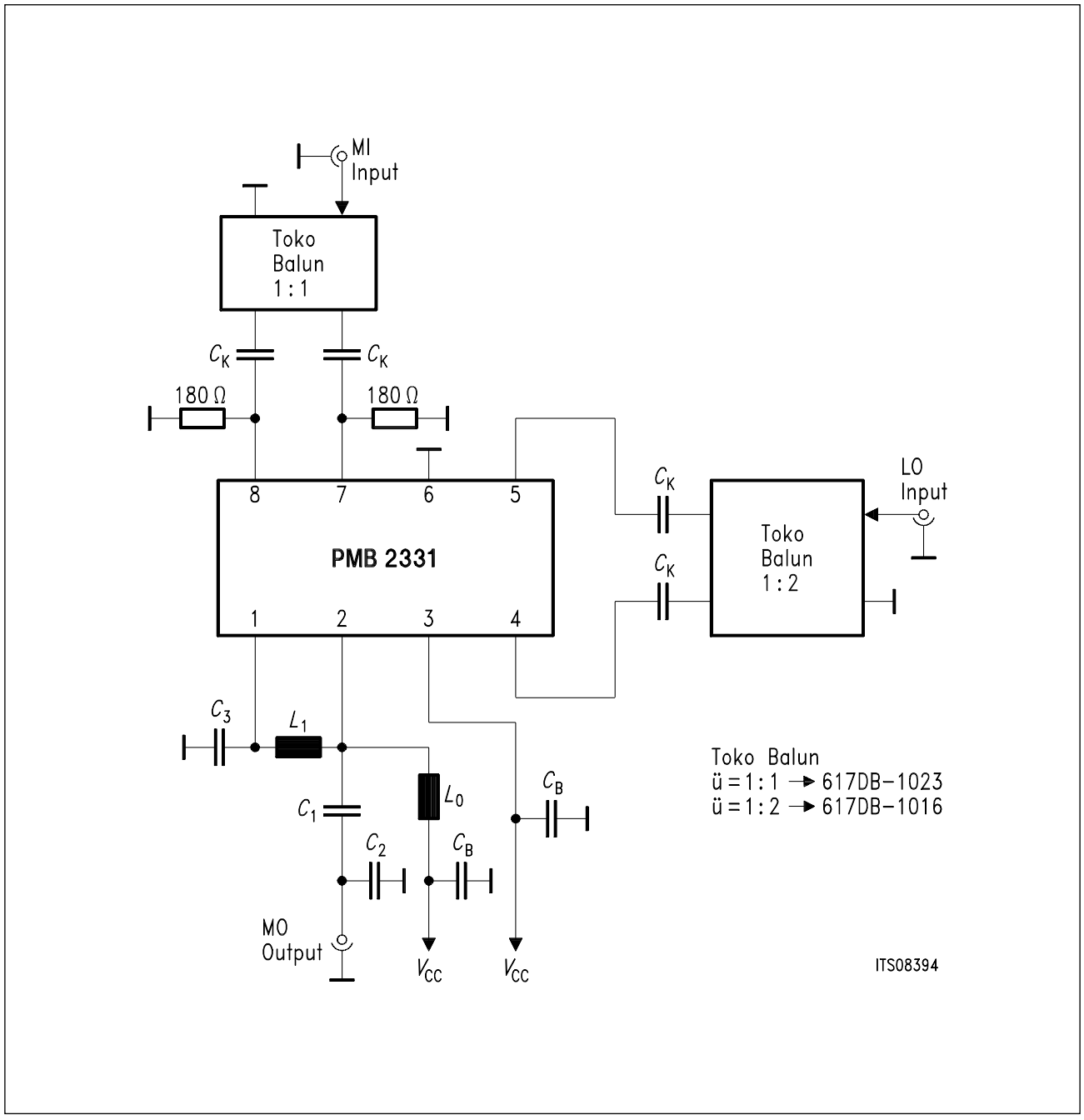


Figure 4
Test Circuit 1b

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

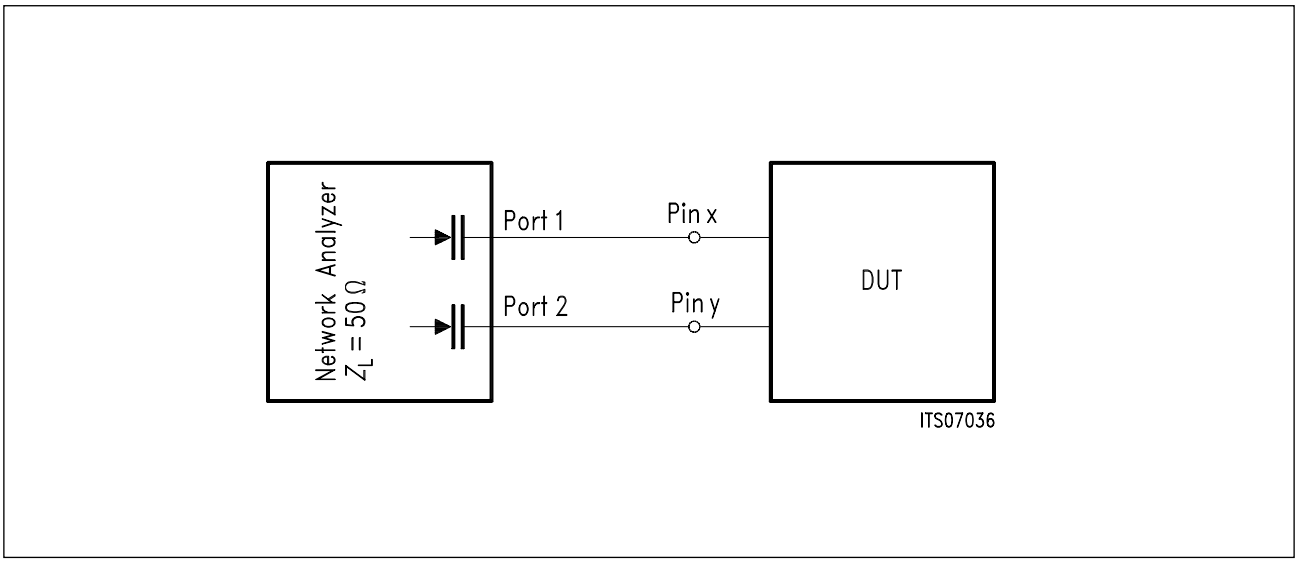


Figure 5
Test Circuit 2
S-Parameter Measurement of Mixer
S11, S12, S21, S2

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 V_{CC}. The output levels at port1 and 2 for pin x and y are – 30 dbm for MI and MO-impedances and – 5 dbm 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).

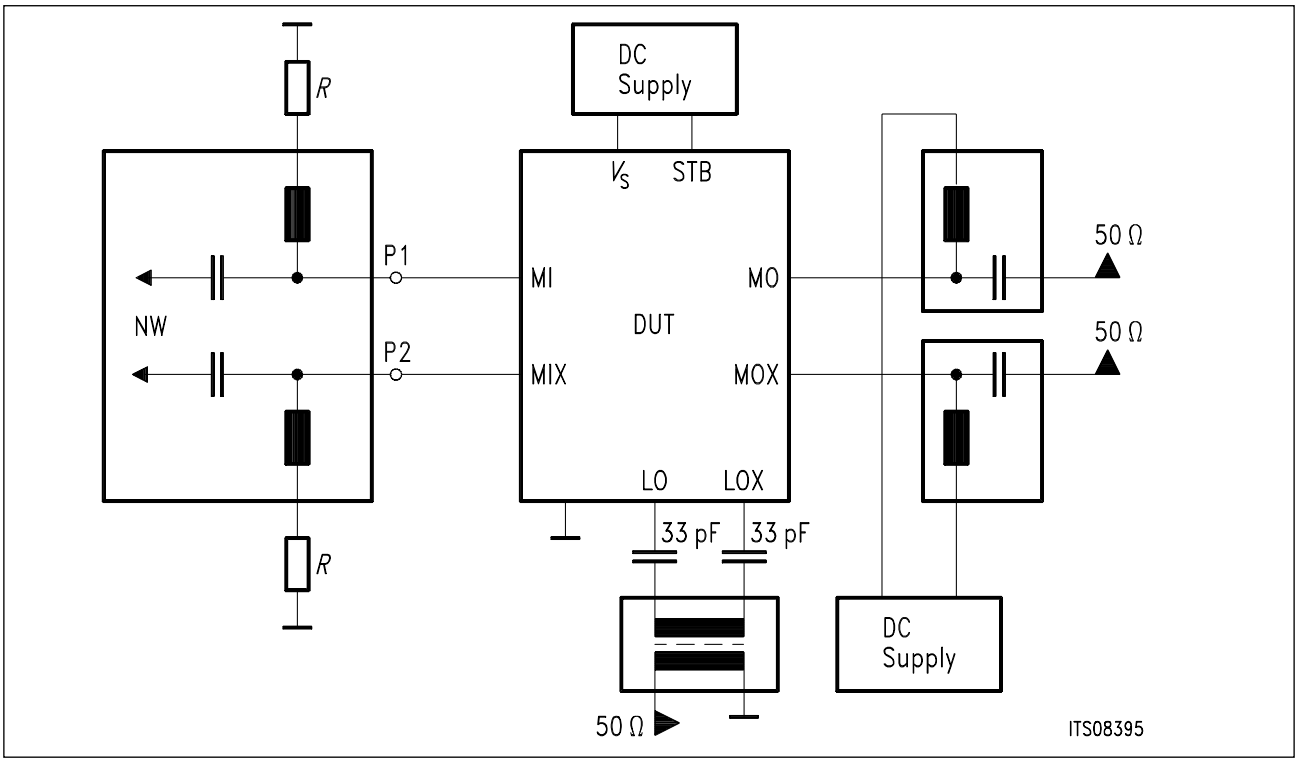


Figure 6
Test Circuit 2a
Mixer Input Impedance Measurement

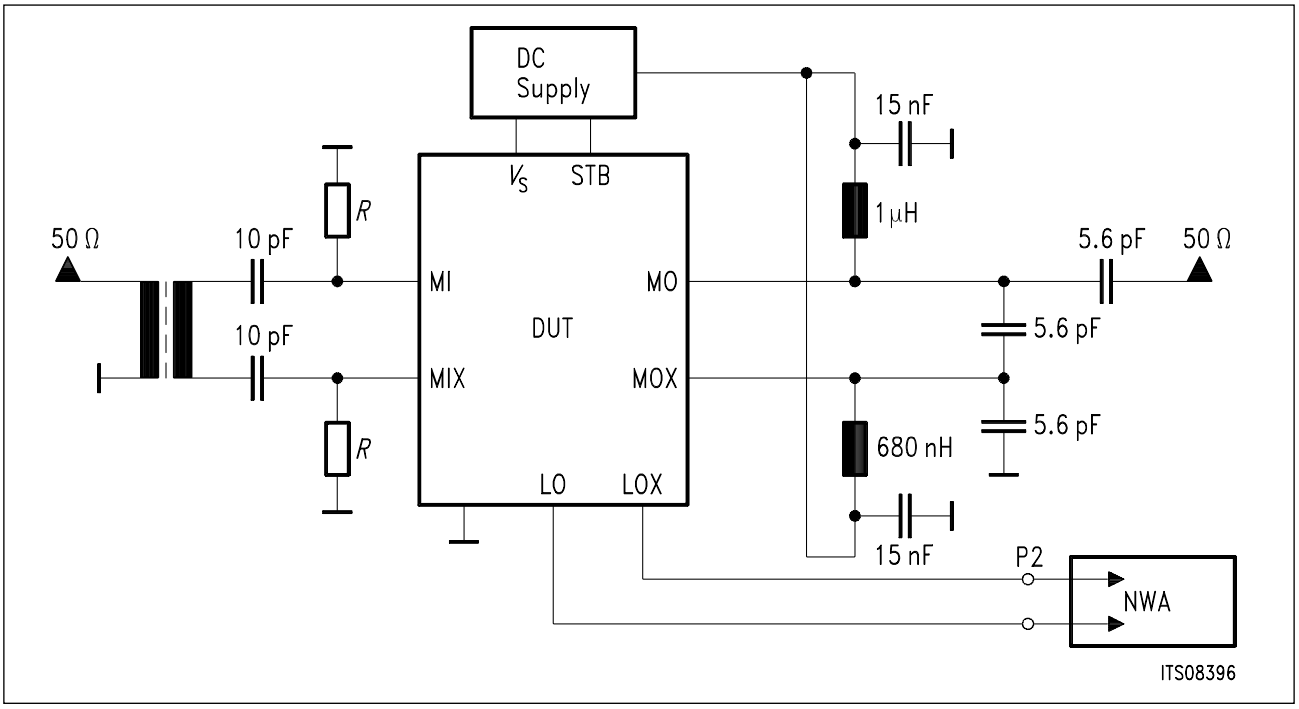


Figure 7
Test Circuit 2b
Mixer Local Oscilllator Impedance Measurement

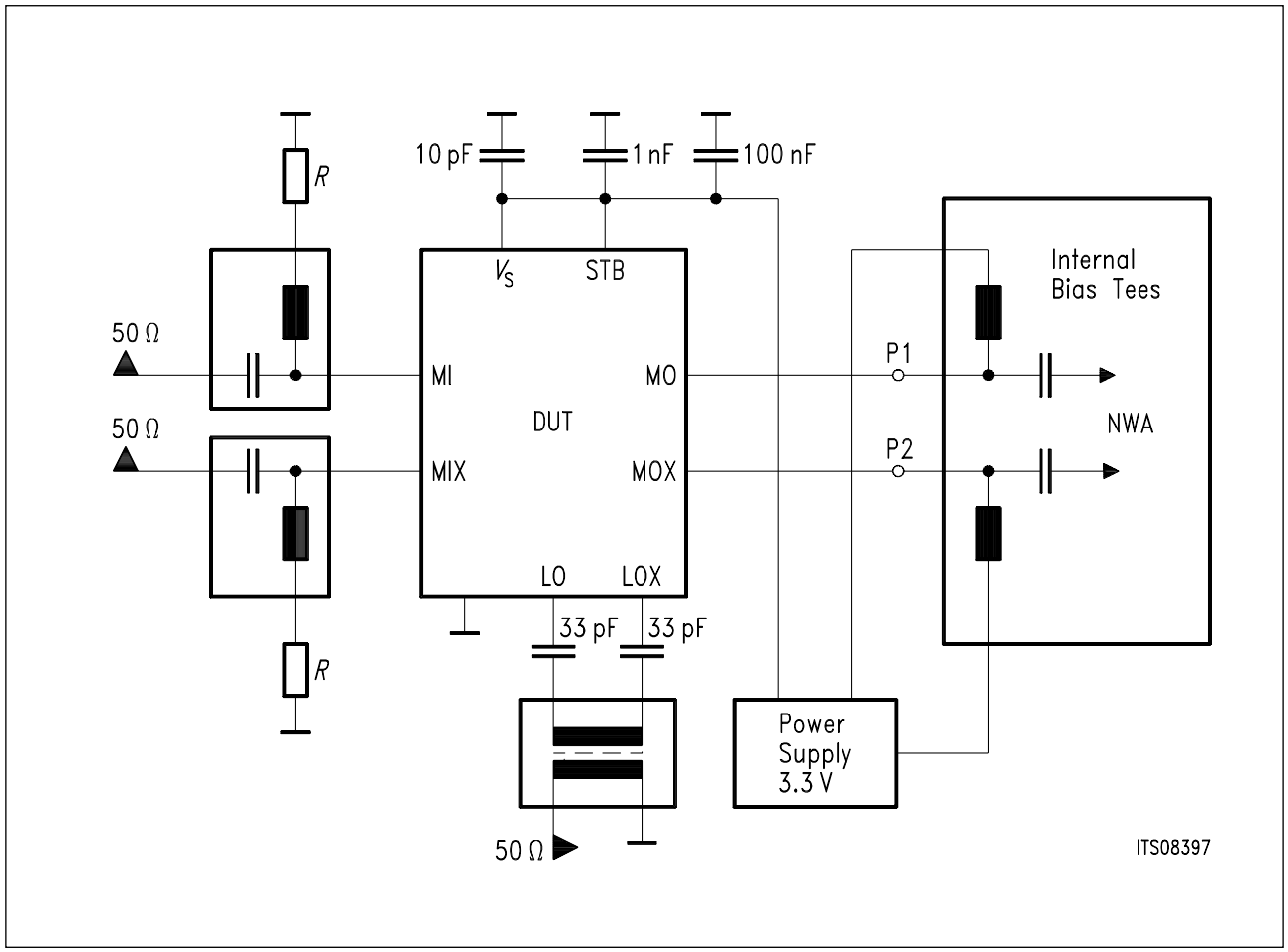
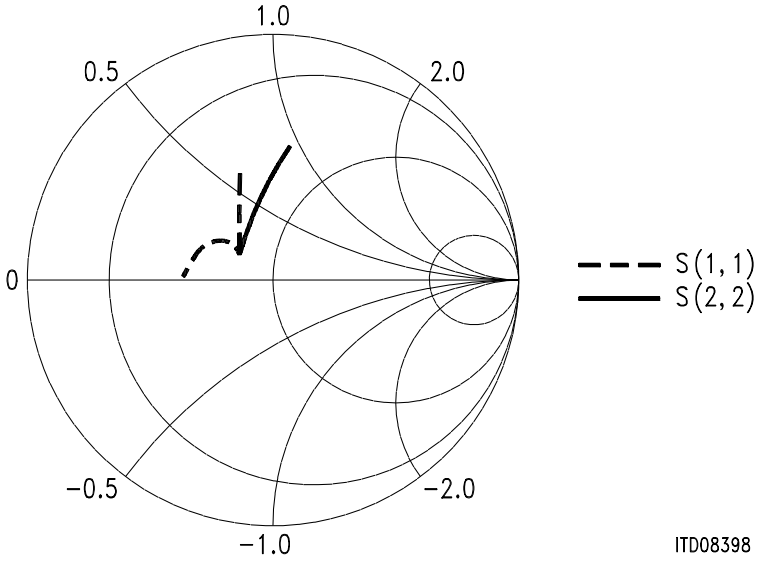
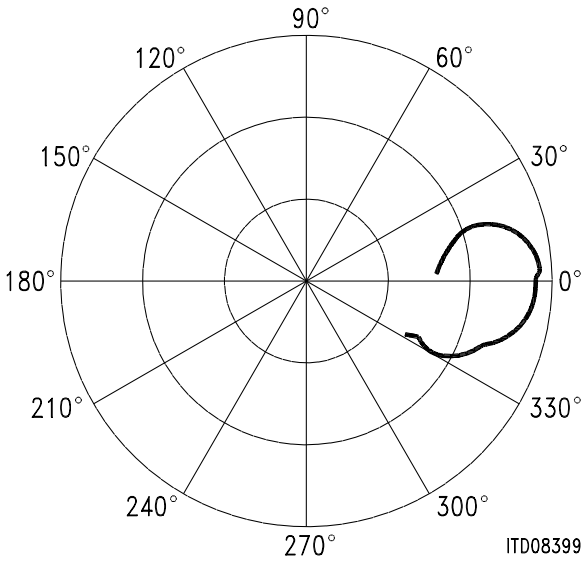


Figure 8
Test Circuit 2c
Mixer Output Impedance Measurement

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





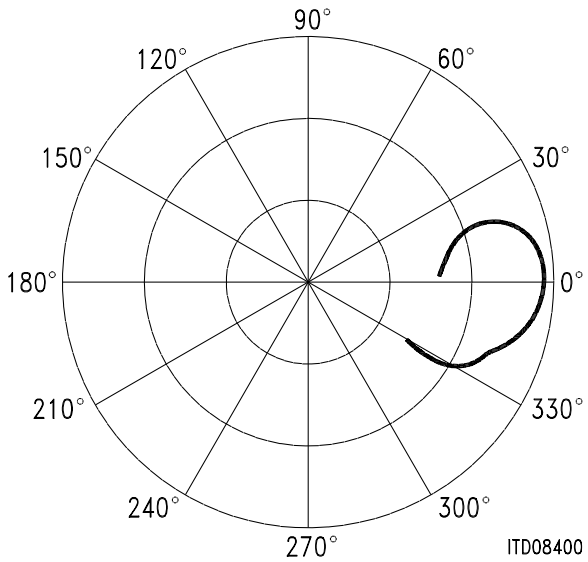
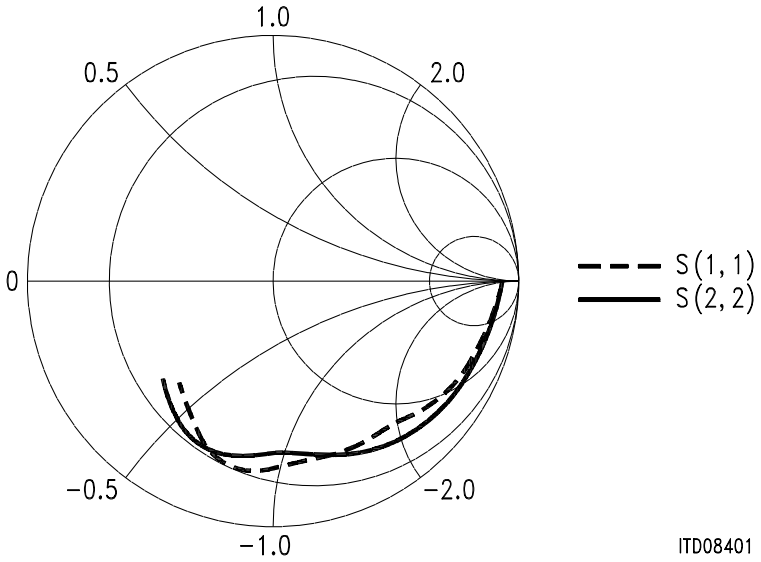
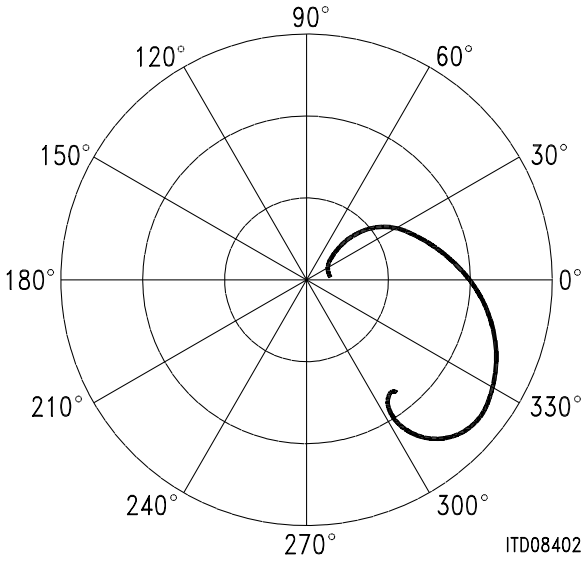
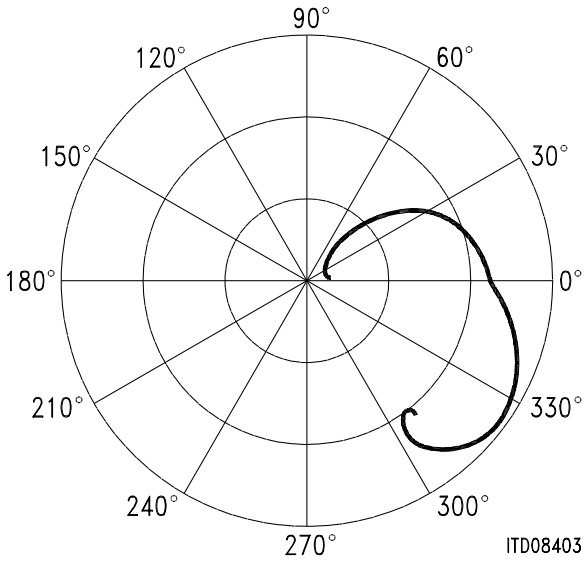


Diagram 2b
S-Parameter Mixer Input LO Impedance, $I_{MO/MOX}$ = 4 mA; f = .. 3 GHz





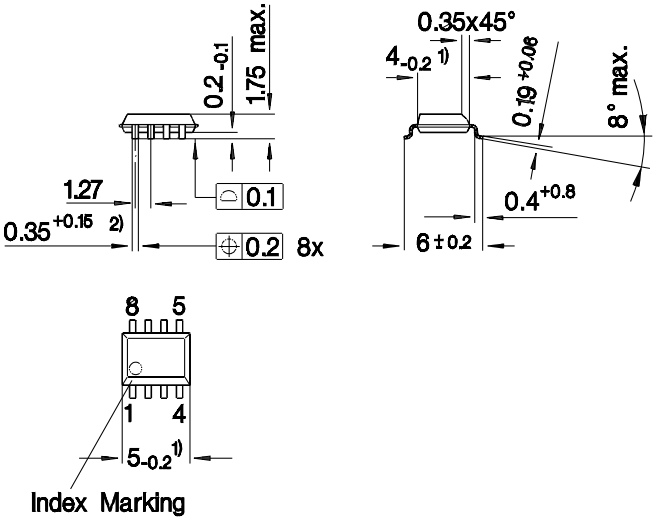


Application Circuit

Application circuit: In evaluation
General applications also refer to the PMB 2330 application note (different values)

3 Package Outlines

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



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

GPS05121

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

SMD = Surface Mounted Device

Dimensions in mm