# Wireless Components

## Dual LNA

## PMB 2362 Version 1.1

Specification  January 2000

preliminary

| **CONFIDENTIAL**<br>**Revision History: Current Version:** January 2000 | | |
|---|---|---|
| Previous Version:Data Sheet | | |
| Page (in previous Version) | Page (in current Version) | Subjects (major changes since last revision) |
| | | |
| | | |

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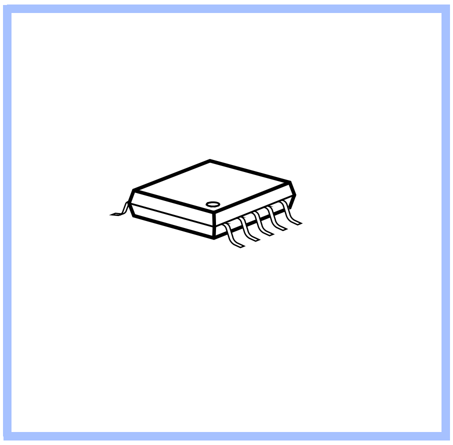
# Product Info

**General Description**

The PMB2362 is a dual band LNA circuit with excellent performance and minimum component count for GSM900 and GSM1800.

**Package**



**Features**

- Worldclass B6HF technology, $f_T$ = 25GHz
- Lowest external component count
- Extreme small outline P-TSSOP-10-2 package with heat sink for grounding
- Both LNAs with prematched input, only 2 external matching components required
- GSM900 LNA output matched to 50 Ohm
- Both LNAs with switchable gain, 20dB gain step
- LNA1: 17dB gain, 1.5dB noise figure @ 0.95GHz
- LNA2: 19dB gain, 2.0dB noise figure @ 1.85GHz
- Supply voltage range from 2.7V to 3.6V
- Power down function
- Temperature range -40° to 85°C

**Application**

- Dual band wireless frontends GSM900/1800
- Excellent combination with Infineon GSM single chip SMARTi PMB 6250

**Ordering Information**

| Type | Ordering Code | Package |
|---|---|---|
| PMB 2362 V1.1 | T2362-XV11-P1-7600 | P-TSSOP-10-2 |

# 1 Table of Contents

# 2

# Product Description

## Contents of this Chapter

## 2.1 General Description

The PMB2362 is a dual band LNA circuit with excellent performance and minimum component count for GSM900 and GSM1800.

## 2.2 Features

- Worldclass B6HF technology, $f_T$ = 25GHz
- Lowest external component count
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- Both LNAs with prematched input, only 2 external matching components required
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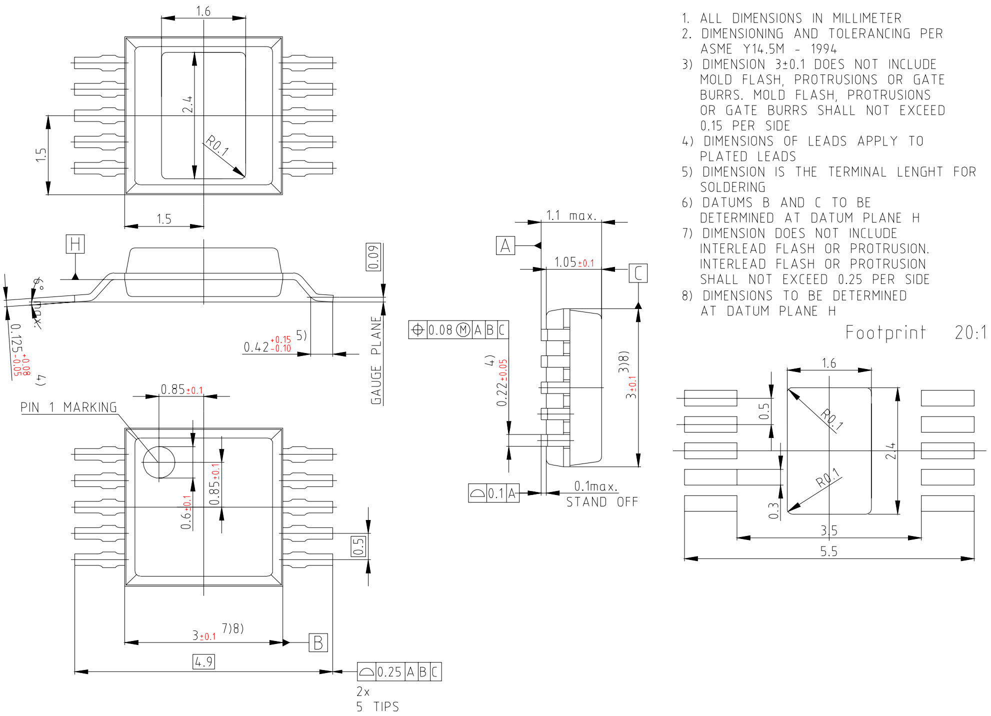
- Power down function
- Temperature range -40° to 85°C

## 2.3 Application

- Dual band wireless frontends GSM900/1800
- Excellent combination with Infineon GSM single chip SMARTi PMB6250

## 2.4 Package Outlines

P-TSSOP-10 (with Heat Sink):

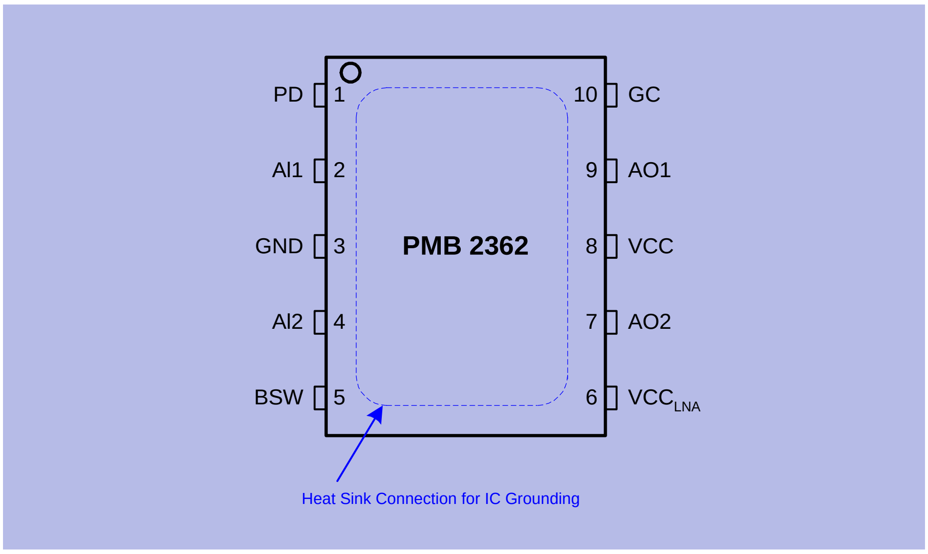


1. ALL DIMENSIONS IN MILLIMETER
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M - 1994
3) DIMENSION 3±0.1 DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE
4) DIMENSIONS OF LEADS APPLY TO PLATED LEADS
5) DIMENSION IS THE TERMINAL LENGHT FOR SOLDERING
6) DATUMS B AND C TO BE DETERMINED AT DATUM PLANE H
7) DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE
8) DIMENSIONS TO BE DETERMINED AT DATUM PLANE H

# 3 Functional Description

## Contents of this Chapter

## 3.1 Pin Configuration



Pin_config.wmf

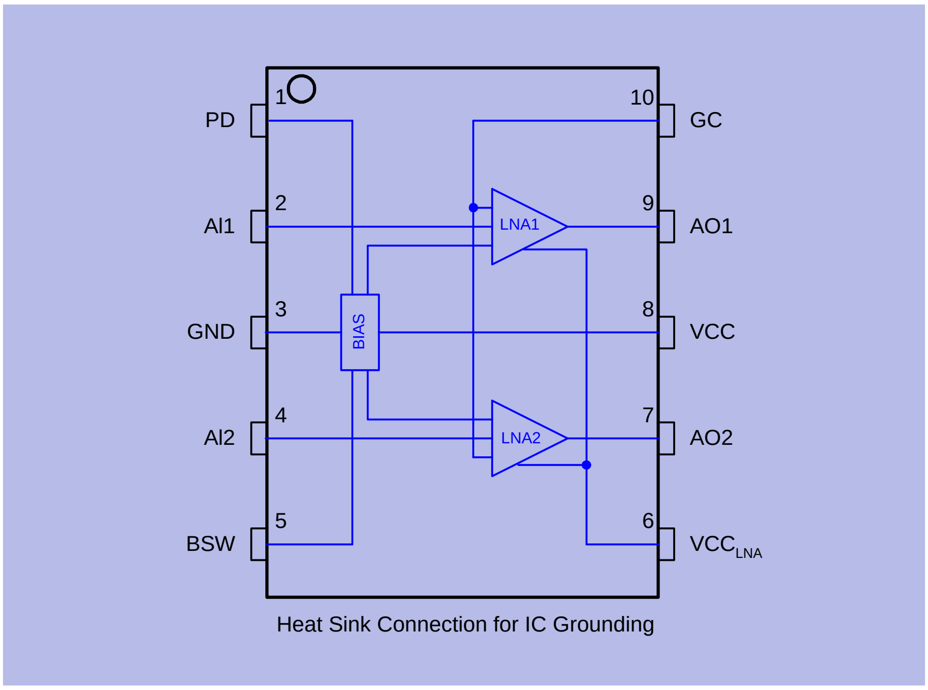
Figure 3-1 Pin Configuration

## 3.2 Pin Definition and Function

**Table 3-1 Pin Definition and Function**

| Pin No. | Symbol | Equivalent I/O-Schematic | Function |
|---|---|---|---|
| 1 | PD | | Power down total circuit |
| 2 | AI1 | | LNA1 GSM900 signal base input |
| 3 | GND | | Internal not connected, external GND connection recommended |
| 4 | AI2 | | LNA2 GSM1800 signal base input |
| 5 | BSW | | Band switch, LNA1/LNA2 |
| 6 | $VCC_{LNA}$ | | RF shunt open collector output LNA1/2 |
| 7 | AO2 | | LNA2 amplifier output, open collector |
| 8 | VCC | | Supply voltage total circuit |
| 9 | AO1 | | LNA1 amplifier output, matched |
| 10 | GC | | LNA1/2 gain control |
| Heat Sink | | | Ground total circuit |

## 3.3 Functional Block Diagram



Funct_block.wmf

Figure 3-2 Functional Block Diagram

## 3.4 Circuit Description

1. General Description

The PMB2362 is a dual band LNA circuit designed for dual band wireless frontends with excellent performance.

2. LNA1

The LNA1 is designed for input frequencies between 0.9 and 1.0GHz. Entering the IC at the base input pin AI1 the RF input signal is amplified in the LNA1 stage. The gain of this LNA stage is controlled by the DC level at pin GC and can be adjusted in a 20 dB step. The LNA output is internal matched and at pin AO1 the amplified and matched signal is available for further use.

3. LNA2

The LNA2 is designed for input frequencies between 1.8 and 1.9GHz. Entering the IC at the base input pin AI2 the RF input signal is amplified in the LNA2 stage. The gain of this LNA stage is also controlled by the DC level at pin GC and can be adjusted in a fixed gain step. The open collector LNA output at pin AO2 has to be connected to VCC and external matching elements.

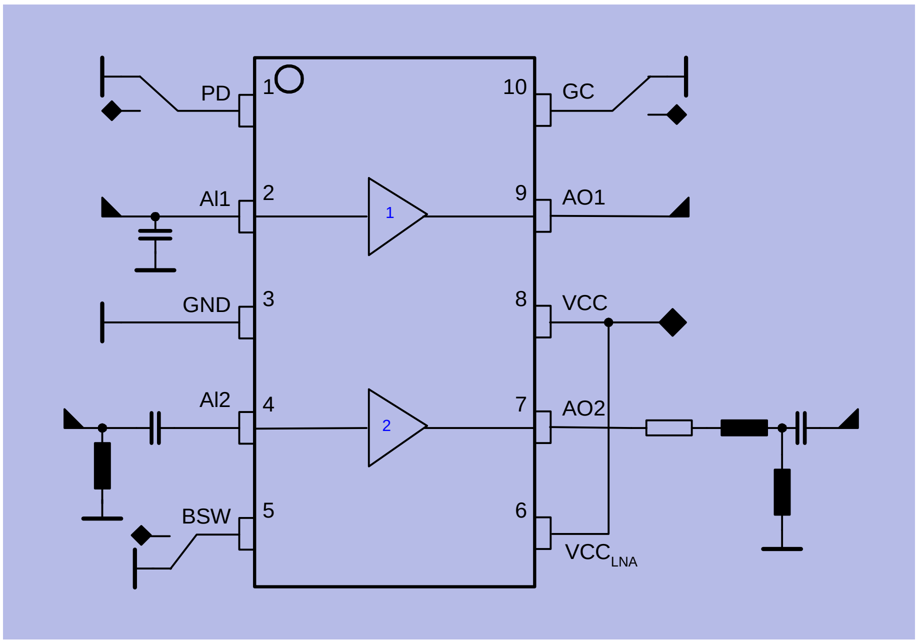
4. COMMON

VCC is the supply voltage for both LNAs. The grounding is done with the heat sink at the bottom side of the package. An internal bias driver generates supply voltage and temperature compensated reference voltages. The PD pin allows the circuit to be switched in a low power consuming (sleeping) mode. All pins with the exception of GND are ESD protected.

# 4 Applications

Contents of this Chapter

## 4.1 Circuits



Appl_circuit.wmf

Figure 4-1 Application Circuit

LNA 1:925 MHz - 960 MHz

LNA 2:1805 MHz - 1880 MHz

**Refer to PMB2362 Application Note**

# 5 Reference

## Contents of this Chapter

## 5.1 Absolute Maximum Range

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 Range, Ambient temperature $T_{AMB}$= -40°C ... + 85°C**

| Parameter | Symbol | Limit Values<br>min | <br>max | Unit | Remarks |
|---|---|---|---|---|---|
| Supply Voltage | $V_{VCC}$ | -0.3 | 5.0 | V | |
| Input Voltage | $V_{PD}$ | -0.3 | $V_S$ +0.3,<br>5.0max. | V | |
| Input Voltage | $V_{BSW}$ | -0.3 | $V_S$ +0.3,<br>5.0max. | V | |
| Input Voltage | $V_{GC}$ | -0.3 | $V_S$ +0.3,<br>5.0max. | V | $V_{PD}$>0.5V |
| Input Voltage | $V_{GC}$ | -0.3 | 3.8 | V | $V_{PD}$=0V |
| Input Voltage<br>(AC Peak, Freq.>1MHz) | $V_{AI1/2}$ | $V_S$ -5.5,<br>-2.0min. | | V | $V_{PD}$=0V<br>$I_{AI1/2}<nA$ |
| Open Collector Output Voltage | $V_{AO2/VCCLNA}$ | $V_S$ -5.5,<br>-0.3min | $V_S$ +2.0,<br>5.0max. | V | |
| Input Current | $I_{AI1/2}$ | | 6.0 | mA | DC and AC |
| Junction Temperature | $T_j$ | | 125 | °C | |
| Storage Temperature | $T_S$ | -40 | 125 | °C | |
| Thermal Resistance | $R_{thJA}$ | | 100 | K/W | Junction to Ambient |
| Thermal Resistance | $R_{thJL}$ | | 12 | K/W | *Junction to Lead |
| ESD integrity | $V_{ESD}$ | -1000 | +1000 | V | ** |

*

* Heat Sink Temperature Fixed At 25 ° Celsius

** According to MIL STD 883D, method 3015.7 and ESD Assn. Standard S5.1 - 1993.

## 5.2 Operating Ratings

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

Supply voltage $V_S$ = 2.7V...3.6V, Ambient temperature $T_{amb}$ = -40°C...85°C

**Table 5-2 Operating Ratings**

| Parameter | Symbol | Limit Values | | Unit | Test Conditions | L | Item |
|---|---|---|---|---|---|---|---|
| | | min | max | | | | |
| AI1 Input Frequency LNA1 | $f_{AI1}$ | 0.9 | 1.0 | GHz | | | |
| AI2 Input Frequency LNA2 | $f_{AI2}$ | 1.8 | 1.9 | GHz | | | |
| Total Circuit On | $V_{PD}$ | 1.5 | $V_S$ | V | | | |
| Total Circuit Off | $V_{PD}$ | 0 | 0.5 | V | | | |
| Gain Control Low Gain | $V_{GC}$ | 1.5 | $V_S$ | V | | | |
| Gain Control High Gain | $V_{GC}$ | 0 | 0.5 | V | | | |
| Bandswitch LNA1 On | $V_{BSW}$ | 0 | 0.5 | V | | | |
| Bandswitch LNA2 On | $V_{BSW}$ | 1.5 | $V_S$ | V | | | |

■ This value is guaranteed by design

*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.

Supply voltage $V_{VCC}$ = 2.7V...3.6V, Ambient temperature $T_{amb}$ = +25°C

**Table 5-3 AC/DC Characteristics**

| | **Symbol** | **Limit Values** | | | Unit | **Test Conditions** | **L** | **Item** |
|---|---|---|---|---|---|---|---|---|
| **Supply Current** | | min | typ | max | | | | |
| Supply current, 0.95GHz | $I_{6,8,9}$ | 6.6 | 9.5 | 13 | mA | $V_{PD}$ high, $V_{BSW}$ low | | 1.1 |
| Supply current, 1.85GHz | $I_{6,7,8}$ | 5.5 | 8.5 | 11.5 | mA | $V_{PD}$ high, $V_{BSW}$ high | | 1.2 |
| Supply current, sleep | $I_8$ | | <5 | <20 | µA | $V_{PD}$ low | | 1.3 |
| **LNA1, Signal Input AI1, high gain** | | | | | | | | |
| Input impedance vs. freq. | $S_{11}$ | | Table 1 | | | Diagramm1 | ■ | 2.1** |
| Max. input level, 1db comp. | $P_{AI1}$ | -20.5 | -18.5 | | dBm | f=0.95GHz | ■ | 2.2 |
| Input intercept, third order | $IICP_{AI1}$ | -12 | -10 | | dBm | f=0.95GHz | ■ | 2.3* |
| Noise figure | $F_{AI1}$ | | 1.5 | 2.2 | dB | f=0.95GHz | ■ | 2.4* |
| **LNA1, Signal Input AI1, low gain** | | | | | | | | |
| Input impedance vs. freq. | $S_{11}$ | | Table 1 | | | Diagramm1 | ■ | 2.5 |
| Max. input level, 1db comp. | $P_{AI1}$ | -20.5 | -18.5 | | dBm | f=0.95GHz | ■ | 2.6 |
| Input intercept, third order | $IICP_{AI1}$ | -12 | -10 | | dBm | f=0.95GHz | ■ | 2.7* |
| Noise figure | $F_{AI1}$ | | 8.0 | 10.0 | dB | f=0.95GHz | ■ | 2.8* |
| **LNA1, Signal Output AO1, high gain** | | | | | | | | |
| Output impedance | VSWR | | 1.5 | | | f=0.95GHz | | 2.9 |
| Output impedance vs. freq. | $S_{22}$ | | Table 1 | | | Diagramm1 | ■ | 2.10** |
| Power gain | $S_{21}$ | 16 | 17 | | dB | f=0.95GHz | ■ | 2.11* |
| **LNA1, Signal Output AO1, low gain** | | | | | | | | |
| Output impedance | VSWR | | 1.5 | | | f=0.95GHz | ■ | 2.12 |
| Output impedance vs. freq. | $S_{22}$ | | Table 1 | | | Diagramm1 | ■ | 13 |
| Power Gain | $S_{21}$ | -4 | -3 | | dB | f=0.95GHz | ■ | 2.14* |

■ This value is guaranteed by design.

** S21 low/high gain; S11, S22 @f = 950 MHz measured in production

**Table 5-3 AC/DC Characteristics (continued)**

| | Symbol | Limit Values | | | Unit | Test Conditions | L | Item |
|---|---|---|---|---|---|---|---|---|
| | | min | typ | max | | | | |
| **LNA2, Signal Input AI2, high gain** | | | | | | | | |
| Input impedance vs. freq. | *S*11 | Table 2 | | | | Diagramm2 | ■ | 3.1** |
| Max. input level, 1db comp. | *P*AI2 | -19 | -17 | | dBm | f=1.85GHz | ■ | 3.2 |
| Input intercept, third order | *IICP*AI2 | -9.5 | -7.5 | | dBm | f=1.85GHz | ■ | 3.3* |
| Noise figure | *F*AI2 | | 2.0 | 2.7 | dB | f=1.85GHz | ■ | 3.4* |
| **LNA2, Signal Input AI2, low gain** | | | | | | | | |
| Input impedance vs. freq. | *S*11 | Table 2 | | | | Diagramm | ■ | 3.5 |
| Max. input level, 1db comp. | *P*AI2 | -19 | -17 | | dBm | f=1.85GHz | ■ | 3.6 |
| Input intercept, third order | *IICP*AI2 | -9.5 | -7.5 | | dBm | f=1.85GHz | ■ | 3.7* |
| Noise figure | *F*AI2 | | 11 | 13 | dB | f=1.85GHz | ■ | 3.8* |
| **LNA2, Signal Output AO2, Open Collector, high gain** | | | | | | | | |
| Output impedance vs. freq. | *S*22 | Table 2 | | | | Diagramm | ■ | 3.9** |
| Power gain | *S*21 | 17 | 19 | | dB | f=1.85GHz | ■ | 3.10* |
| **LNA2, Signal Output AO2, Open Collector, low gain** | | | | | | | | |
| Output impedance vs. freq. | *S*22 | Table 2 | | | | Diagramm | ■ | 3.11 |
| Power gain | *S*21 | -3 | -3 | | dB | f=1.85GHz | ■ | 3.12* |

■ This value is guaranteed by design.

* Measured with Application Circuit (Matched In- and Output)

** S21 low/high gain; S11, S22 @f=1.85GHz measured in production

Remark: IICP3 Measured with 800kHz differential tone

## 5.4 Diagrams

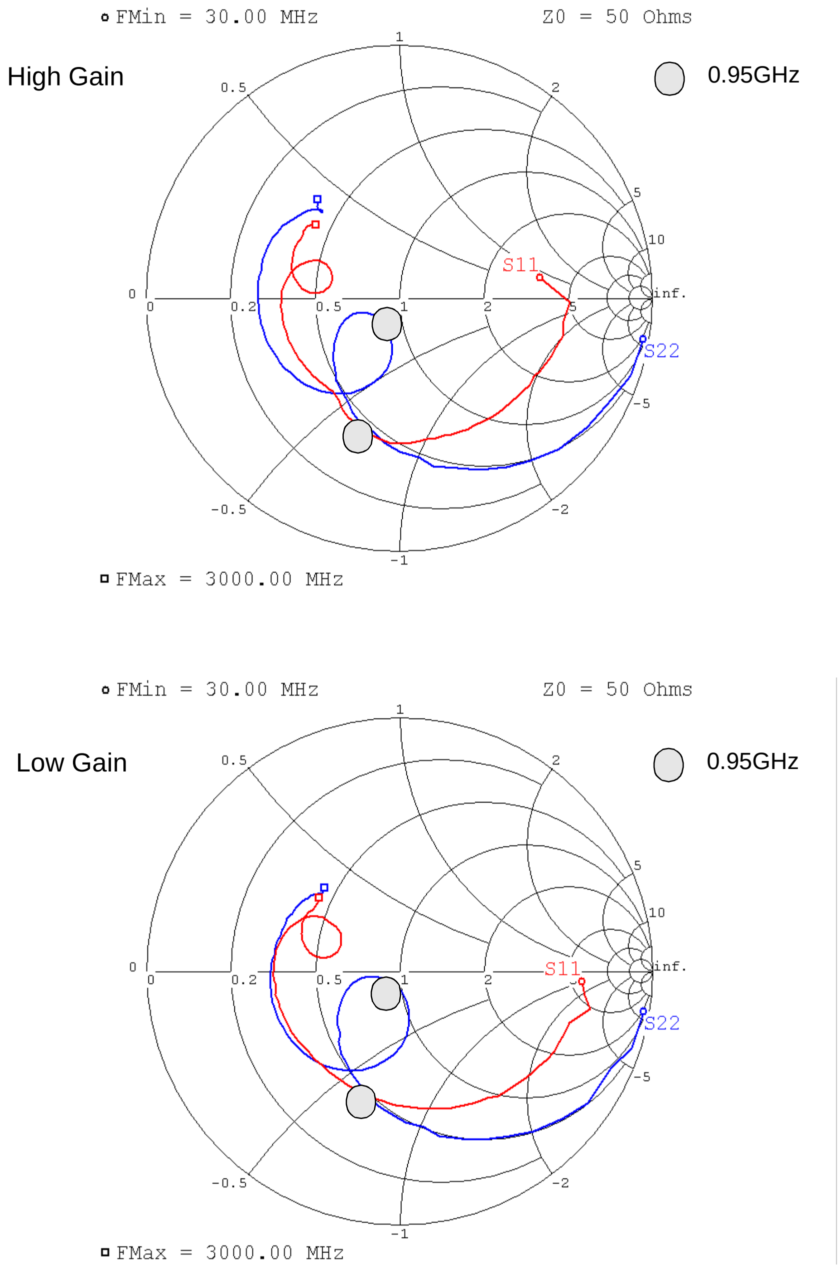
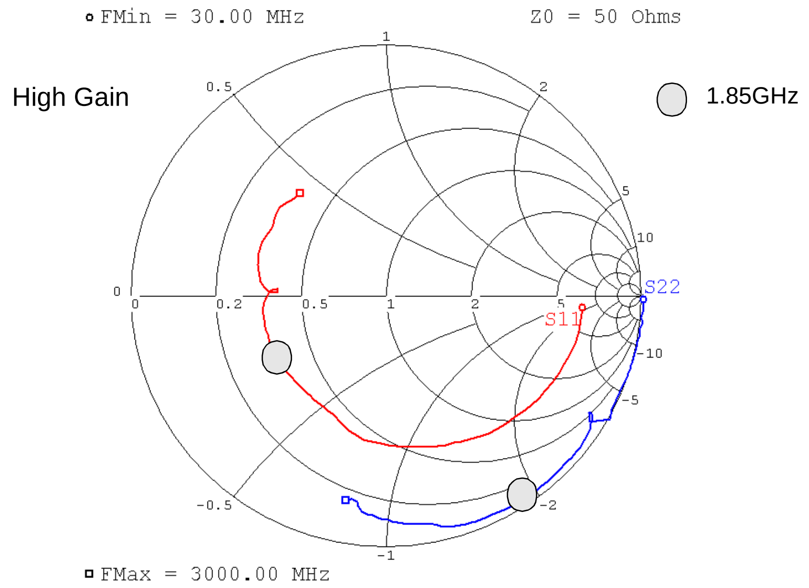


Figure 5-1 Diagramm1: S11 / S22 LNA1



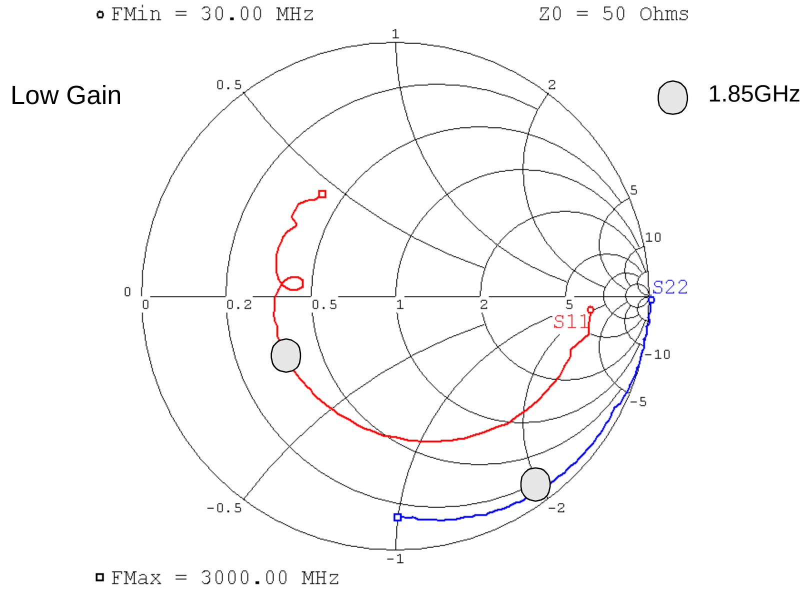
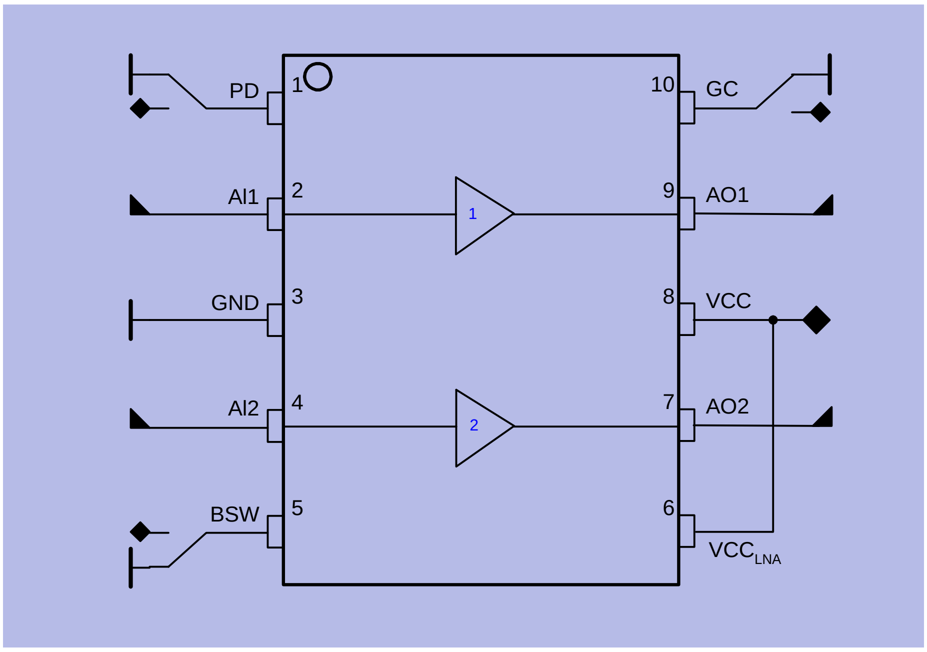


Figure 5-2 Diagramm2: S11 / S22 LNA2

## 5.5 Test Circuits

1. S-Parameter Test Circuit



Test_circuit_1_2.wmf

Figure 5-3 S-Parameter Test Circuit

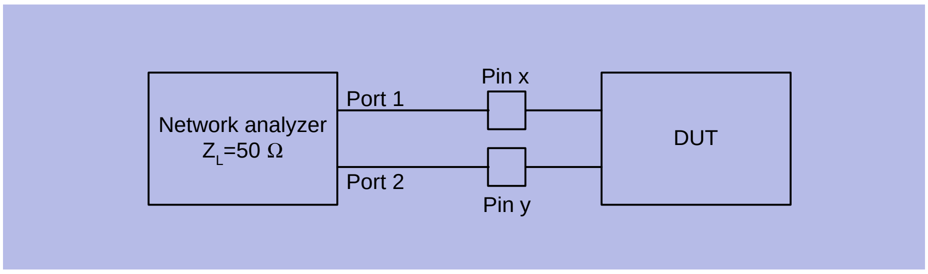
| | |
|---|---|
| Test Circuit 1: | 925 MHz - 960 MHz |
| Test Circuit 2: | 1805 MHz - 1880 MHz |

Component values for blocking capacitors 10p @ VCC, 27p else

Blocking capacitors at Pin: 1, 5, 6, 8 and 10

DC Biasing LNA2 via Network Analyzer

## 2. S-Parameter Measurement Conditions



Test_circuit_3.wmf

Figure 5-4 S-Parameter Measurement of LNA1/2 : S11, S12, S21, S22

The S-Parameters are tested at the indicated frequency on Duroid 5880 Teflon Boards.

Via the NWA the capacitive coupling is done.

The output levels at port1 and 2 for pin x and y are -30dbm.

S11 and S22 have to be considered as design hints and are measured with Infineon testboards

All S-Parameters are measured

**Table 5-4**

| Test | Test frequency [MHz] | Pin X | Pin Y |
|---|---|---|---|
| Amp. S11, S12, S21, S22 | 30 - 3000 | AI 1/2 | AO 1/2 |
| Amp. S11, S12, S21, S22 | 900 - 1000 | AI 1 | AO 1 |
| Amp. S11, S12, S21, S22 | 1800 - 1900 | AI 2 | AO 2 |

## 5.6 S-Parameters / Noise Parameters / Diagramms

1. Table 1: S-Parameter LNA1
   S-Parameters are available on 3.5” disk or by E-mail

**High Gain**

| Frequency [GHz] | S11 MAG | ANG | S21 MAG | ANG | S12 MAG | ANG | S22 MAG | ANG |
|---|---|---|---|---|---|---|---|---|
| 0.81 | 0.57468 | -89.9 | 6.91583 | 131.3 | 0.003029 | 108.8 | 0.19661 | -161 |
| 0.84 | 0.57036 | -94.4 | 7.13553 | 126.7 | 0.003754 | 109.1 | 0.16465 | -160.3 |
| 0.87 | 0.55963 | -98.7 | 7.29022 | 121.9 | 0.005167 | 91.5 | 0.13922 | -155.6 |
| 0.9 | 0.54796 | -103.2 | 7.39837 | 116.7 | 0.006071 | 78.7 | 0.12151 | -146.3 |
| 0.93 | 0.52863 | -106.7 | 7.45604 | 112 | 0.006278 | 88.5 | 0.11372 | -134.4 |
| 0.96 | 0.5219 | -109.5 | 7.40121 | 107 | 0.007097 | 82.7 | 0.12553 | -125.5 |
| 0.99 | 0.51085 | -113.3 | 7.32031 | 102.8 | 0.007674 | 71.5 | 0.13011 | -122.2 |
| 1.02 | 0.49465 | -116.4 | 7.25988 | 98.8 | 0.007487 | 66.2 | 0.13604 | -116.5 |
| 1.05 | 0.48186 | -118.7 | 7.21209 | 95.2 | 0.007213 | 65 | 0.14442 | -110.5 |
| 1.08 | 0.46918 | -120.9 | 7.21321 | 91.4 | 0.007444 | 55.4 | 0.15835 | -104.7 |
| 1.11 | 0.45961 | -122.8 | 7.2465 | 87.4 | 0.007427 | 61.9 | 0.17981 | -100.4 |

**Low Gain**

| Frequency [GHz] | S11 MAG | ANG | S21 MAG | ANG | S12 MAG | ANG | S22 MAG | ANG |
|---|---|---|---|---|---|---|---|---|
| 0.81 | 0.5257 | -92 | 0.67474 | 133.8 | 0.00148 | 129.6 | 0.19295 | -166.1 |
| 0.84 | 0.51998 | -94.9 | 0.69912 | 130.1 | 0.00291 | 152.6 | 0.15726 | -170.7 |
| 0.87 | 0.51502 | -97.9 | 0.70104 | 124.8 | 0.002866 | 142.9 | 0.12124 | -171.1 |
| 0.9 | 0.51035 | -100.7 | 0.70771 | 121.5 | 0.00296 | 127.3 | 0.08884 | -165.8 |
| 0.93 | 0.50507 | -103.5 | 0.71506 | 117.2 | 0.003721 | 129.3 | 0.06165 | -152.2 |
| 0.96 | 0.50343 | -106.5 | 0.71056 | 113 | 0.004777 | 127 | 0.05343 | -123.2 |
| 0.99 | 0.50052 | -109.4 | 0.70932 | 109 | 0.005215 | 115.4 | 0.06368 | -96.2 |
| 1.02 | 0.49629 | -112.1 | 0.70358 | 104.8 | 0.005844 | 112.1 | 0.08836 | -83 |
| 1.05 | 0.49323 | -114.9 | 0.69611 | 100.9 | 0.005821 | 107.1 | 0.11838 | -78 |
| 1.08 | 0.48924 | -117.4 | 0.69115 | 96.8 | 0.006178 | 102.7 | 0.1497 | -77.3 |
| 1.11 | 0.48684 | -120 | 0.68395 | 92.7 | 0.006651 | 97.5 | 0.18416 | -78.6 |

**Noise Parameters @ 920MHz:**

Fmin = 1.33dB    Rn = 6.17    Γopt: Mag: 0.132    Ang: 132.9

2. Table 2: S-Parameter LNA2
S-Parameters are available on 3.5” disk or by E-mail

### High Gain

| Frequency [GHz] | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 1.71 | 0.49242 | -152.6 | 6.88619 | 44 | 0.009319 | 106.7 | 0.97152 | -52.6 |
| 1.74 | 0.49159 | -154.5 | 6.78958 | 42.2 | 0.010126 | 112.5 | 0.97075 | -53.6 |
| 1.77 | 0.49287 | -156.5 | 6.67339 | 40.3 | 0.010619 | 107.5 | 0.96835 | -54.9 |
| 1.8 | 0.49257 | -158.1 | 6.54866 | 38.5 | 0.010952 | 103.6 | 0.96761 | -55.9 |
| 1.83 | 0.49122 | -160 | 6.44234 | 36.8 | 0.011616 | 109.8 | 0.97078 | -57.1 |
| 1.86 | 0.4897 | -161.9 | 6.35383 | 34.8 | 0.012092 | 100.5 | 0.97236 | -58.1 |
| 1.89 | 0.49049 | -163.8 | 6.22605 | 33 | 0.011617 | 104.6 | 0.97083 | -59.5 |
| 1.92 | 0.49163 | -165.6 | 6.11839 | 31.3 | 0.013675 | 102.4 | 0.96812 | -60.6 |
| 1.95 | 0.48904 | -167.1 | 6.01005 | 29.5 | 0.013032 | 101.7 | 0.96681 | -61.6 |
| 1.98 | 0.48789 | -169 | 5.90915 | 27.7 | 0.013869 | 99.9 | 0.96768 | -62.7 |
| 2.01 | 0.48725 | -171.3 | 5.81244 | 25.9 | 0.01401 | 99.3 | 0.96638 | -63.9 |

### Low Gain

| Frequency [GHz] | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 1.71 | 0.49151 | -156.7 | 0.61223 | 43.4 | 0.005883 | 137.2 | 0.95592 | -49.2 |
| 1.74 | 0.49043 | -158.9 | 0.59784 | 41.5 | 0.006472 | 130.3 | 0.95576 | -50.2 |
| 1.77 | 0.49071 | -161 | 0.58151 | 39.8 | 0.006974 | 127.6 | 0.95311 | -51.3 |
| 1.8 | 0.48723 | -162.9 | 0.56316 | 38.4 | 0.007237 | 127.7 | 0.95262 | -52.2 |
| 1.83 | 0.4821 | -164.6 | 0.5627 | 37.7 | 0.008687 | 123.6 | 0.95109 | -53.2 |
| 1.86 | 0.48296 | -166.4 | 0.5553 | 34.4 | 0.008648 | 126.1 | 0.94994 | -54.2 |
| 1.89 | 0.48488 | -168.5 | 0.53698 | 32.1 | 0.009628 | 121.2 | 0.94908 | -55.2 |
| 1.92 | 0.48525 | -170.6 | 0.52048 | 30.1 | 0.008635 | 119.8 | 0.94747 | -56.1 |
| 1.95 | 0.48228 | -172.4 | 0.50395 | 28 | 0.009701 | 116.5 | 0.94531 | -57 |
| 1.98 | 0.47885 | -174.6 | 0.48973 | 26.3 | 0.009804 | 117.5 | 0.94528 | -57.9 |
| 2.01 | 0.47693 | -177 | 0.47446 | 24.4 | 0.009466 | 111.3 | 0.94391 | -58.8 |

### Noise Parameters @ 1.82GHz:

Fmin = 1.86dB Rn = 6.76 Γopt: Mag: 0.197 Ang: -164.4