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AK1223
8500MHz High Linearity Mixer

1. Overview

The AK1223 is high linearity mixer. RF and Lo frequency range coverage is from 3000 to 8500MHz and IF coverage is from 20 to 3000MHz. The RF input provides single-ended 50Ω interface. Lo ports are 50Ω matched and complementary input should be decoupled to the ground. IF output ports are differential open collector outputs. The linearity and power consumption performances can be optimized by the resistance connected to the BIAS Pin.

2. Feature

☐ Operating Frequency: 3000MHz to 8500MHz

☐ Linearity vs. Power selectable architecture

Power Consumption: 92mA, IIP3: +13dBm, Gain: -3dB, NF: 15dB

☐ Lo input level: 0dBm ±5dB

☐ Operating Supply Voltage: 4.75 to 5.25 V

☐ Package: 16pin UQFN (0.5mm pitch, 3mm × 3mm × 0.60mm)

☐ Operating Temperature Range: -40 to 85°C

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3. Table contents

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4. System Diagram

Current Adjustment Resister
22kohm - 56kohm

Fig. 1 System Diagram

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5. Pin Functional Description

Table 1   Pin Function

No.	Name	I/O	Pin Functions	Remarks
1	VSS	G	Ground pin	
2	VSS	G	Ground pin	
3	VSS	G	Ground pin	
4	VSS	G	Ground pin	
5	VSS	G	Ground pin	
6	LOINN	AI	Lo Input Negative	
7	LOINP	AI	Lo Input Positive	
8	VDD	P	Power Supply	
9	VDD	P	Power Supply	
10	VDD	P	Power Supply	
11	IFOUTN	AO	IF Output Negative	This pin is open collector output. It needs power feeding via an inductor.
12	IFOUTP	AO	IF Output Positive	This pin is open collector output. It needs power feeding via an inductor.
13	BIAS	AIO	Resistance pin for current adjustment	Connecting a resistor between this pin and ground.
14	RFIN	AI	RF Input	Connecting an inductor between this pin and ground.
15	VSS	G	Ground pin	
16	VSS	G	Ground pin	

Note)   The exposed pad at the center of the backside should be connected to ground.

| AI:Analog input pin	AO:Analog output pin	AIO:Analog I/O pin
P: Power supply pin	G: Ground pin	

TOP VIEW
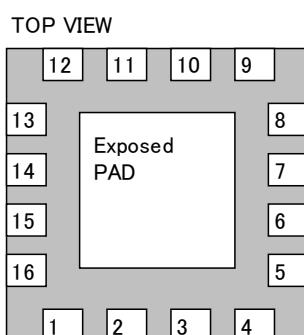
Fig. 2   Package Pin Layout

6. Absolute Maximum Ratings

Table 2 Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Remarks
Supply Voltage	VDD	-0.3	5.5	V	
RF Input Power	RFPOW		12	dBm	
LO Input Power	LOPOW		12	dBm	
IFOUTP, IFOUTN DC voltage	IFDC	VDD-1.5		V	
Storage Temperature	Tstg	-55	125	°C	

Exceeding these maximum ratings may result in damage to the AK1223. Normal operation is not guaranteed at these extremes. IFOUTP and IFOUTN should be connected to VDD via an inductor.

7. Recommended Operating Range

Table 3 Recommended Operating Range

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Operating Temperature	Ta	-40		85	°C	
Supply Voltage	VDD	4.75	5	5.25	V	

The specifications are applicable within the recommended operating range (supply voltage/operating temperature).

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8. Electrical Characteristics

1. Analog Circuit Characteristics

Unless otherwise noted IF output=1000MHz, Lo Input Level=-5dBm to +5dBm,

Output Load Resistor（RLoad）=270Ω, VDD=4.75 to 5.25V, Ta=-40°C to 85°C

Parameter		Min.	Typ.	Max.	Unit	Remarks
RF Input Frequency		3000		8500	MHz	
Lo Input Frequency		3000		8500	MHz	
IF output Frequency		20		3000	MHz	
Lo Input Power		-5		+5	dBm	Lo Input Frequency≤6GHz
		0		+5	dBm	Lo Input Frequency>6GHz
Current Adjustment Resistor(BIAS)		22		56	kΩ	
IDD	BIAS=22kΩ		114	174	mA	The total current of VDD
	BIAS=33kΩ		92	144	mA	pin, IFOUTP pin and
	BIAS=56kΩ		73	119	mA	IFOUTN pin.
RFIN=6000MHz, Current Adjustment Resistor =33kΩ						
Conversion Gain		-6	-3		dB	
SSB Noise Figure			15	18	dB	Design guarantee value
IP1dB		2	5		dBm	
IIP3		10	13		dBm	Design guarantee value

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9. Typical Performance

Unless otherwise noted, RF input =6000MHz, LO input =5000MHz, IF output =1000MHz,

Output Load Resistor (RLoad)=270Ω

1. Current Adjustment Resistor vs. IIP, NF, P1dB, Gain, IDD
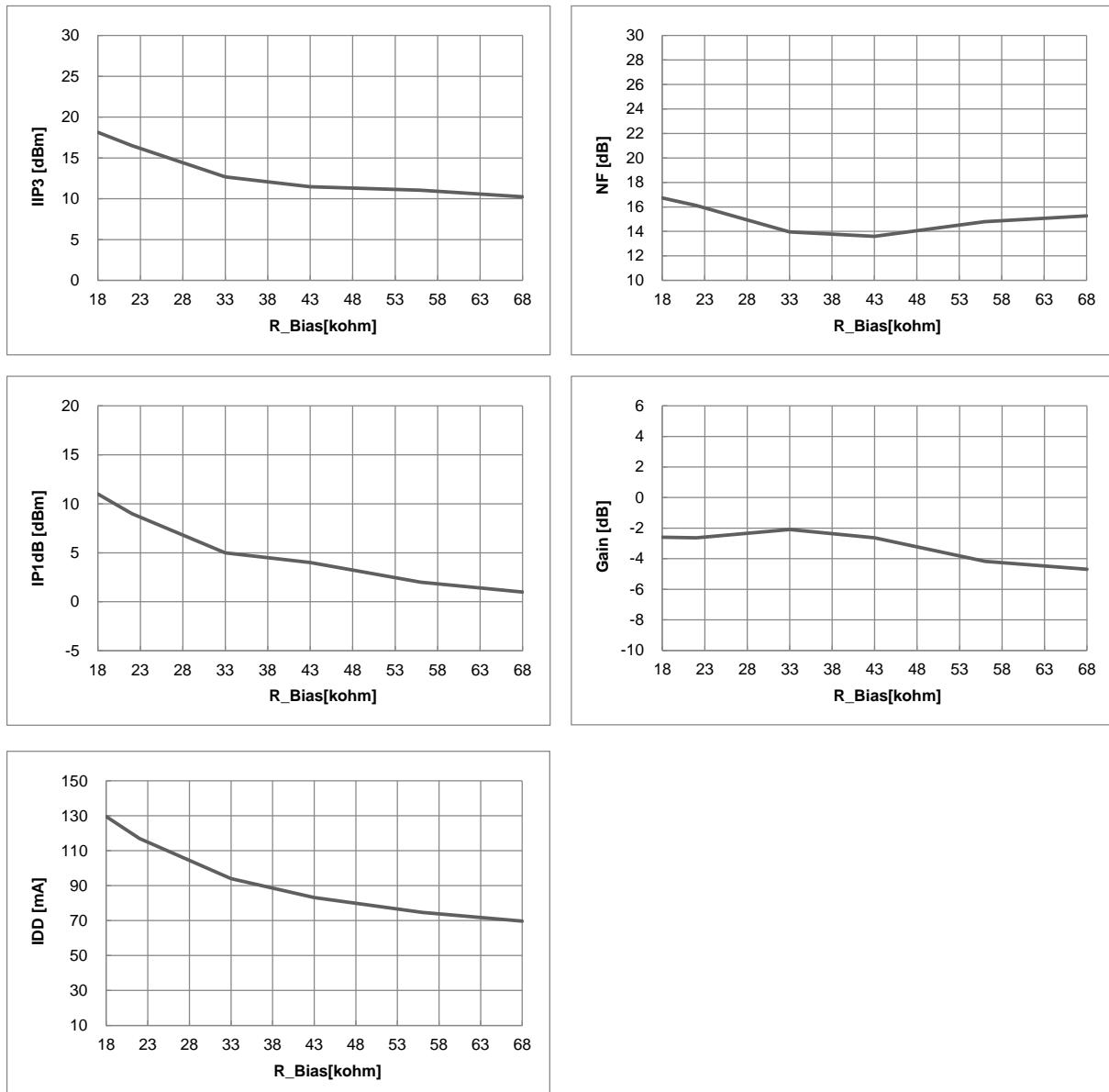
Fig. 3 Current Adjustment Resistor vs. IIP3, NF, P1dB, Gain, IDD

Note) A resistor with 5% tolerance are used.

2. Over temperature vs. IIP3, NF, P1dB, Gain, IDD
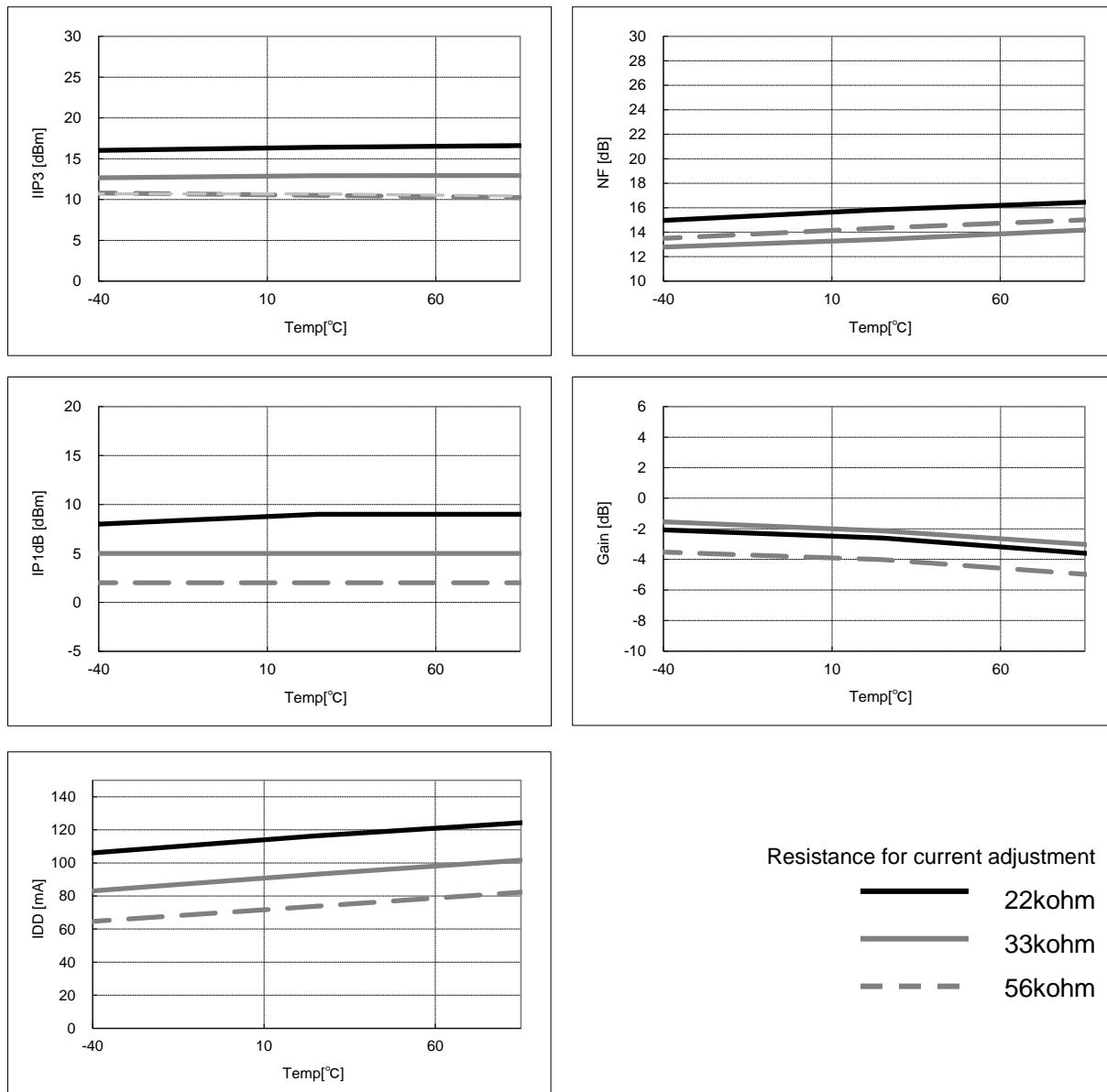
Fig. 4 Over temperature vs. IIP3, NF, IP1dB, Gain, IDD

3. Over temperature vs. IIP3, NF, P1dB, Gain, IDD
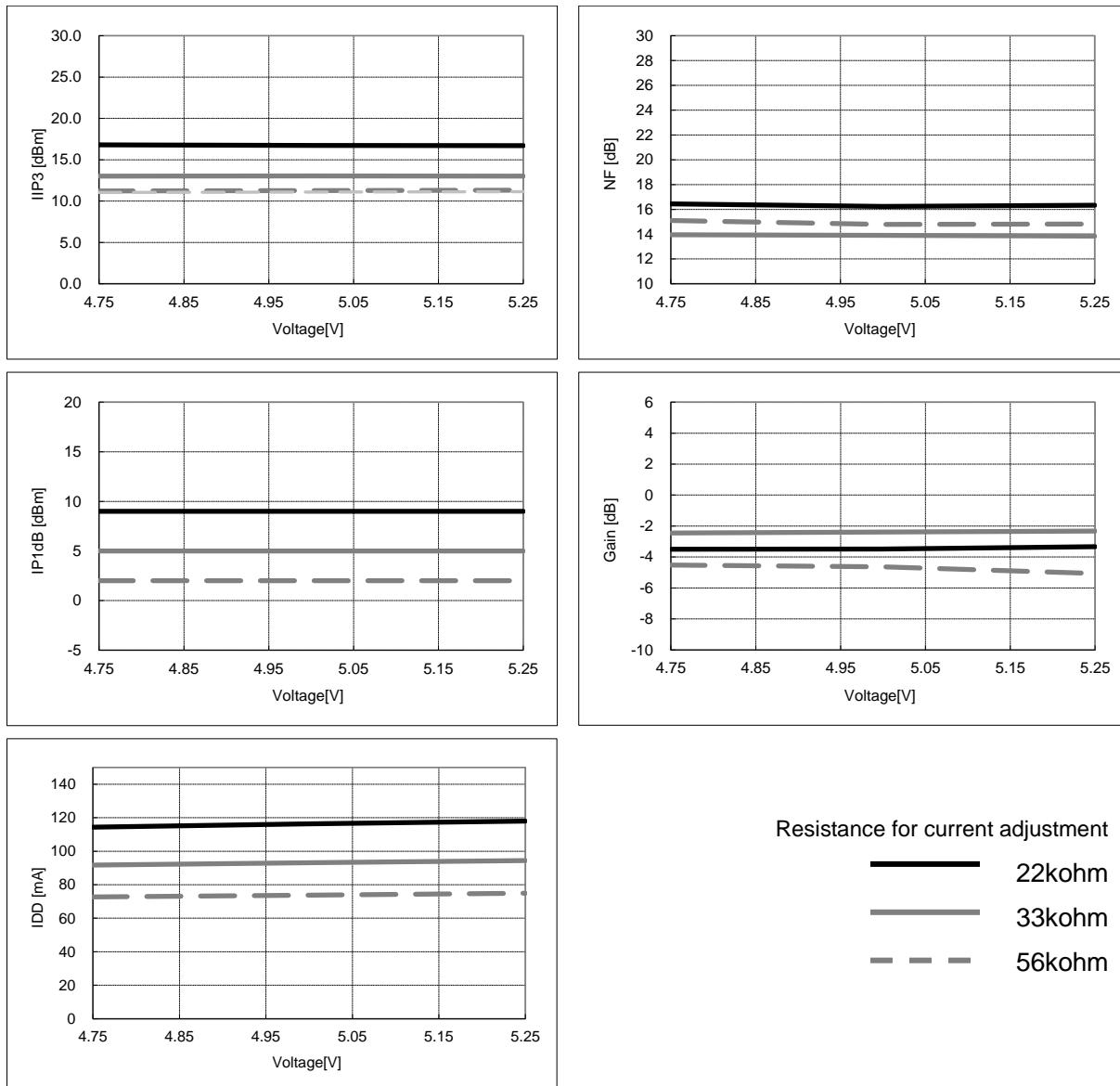
Fig. 5 Supply voltage vs. IIP3, NF, IP1dB, Gain, IDD

4. RF input frequency vs. IIP3, NF, Gain

Resistance for current adjustment

— 22kohm
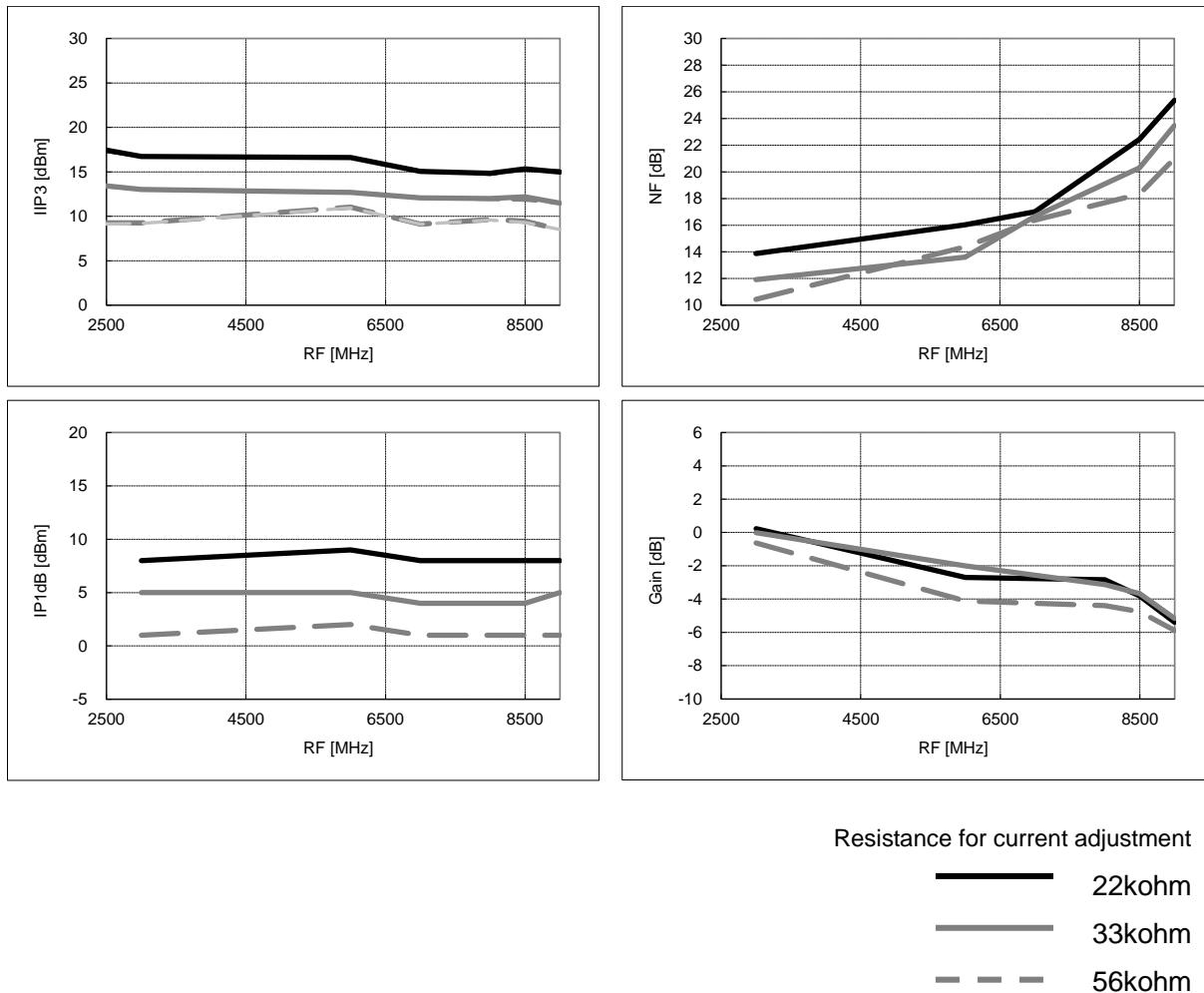
— 33kohm

-- 56kohm

Fig. 6 RF input frequency vs. IIP3, NF, Gain

5. IF input frequency vs. IIP3, NF, Gain
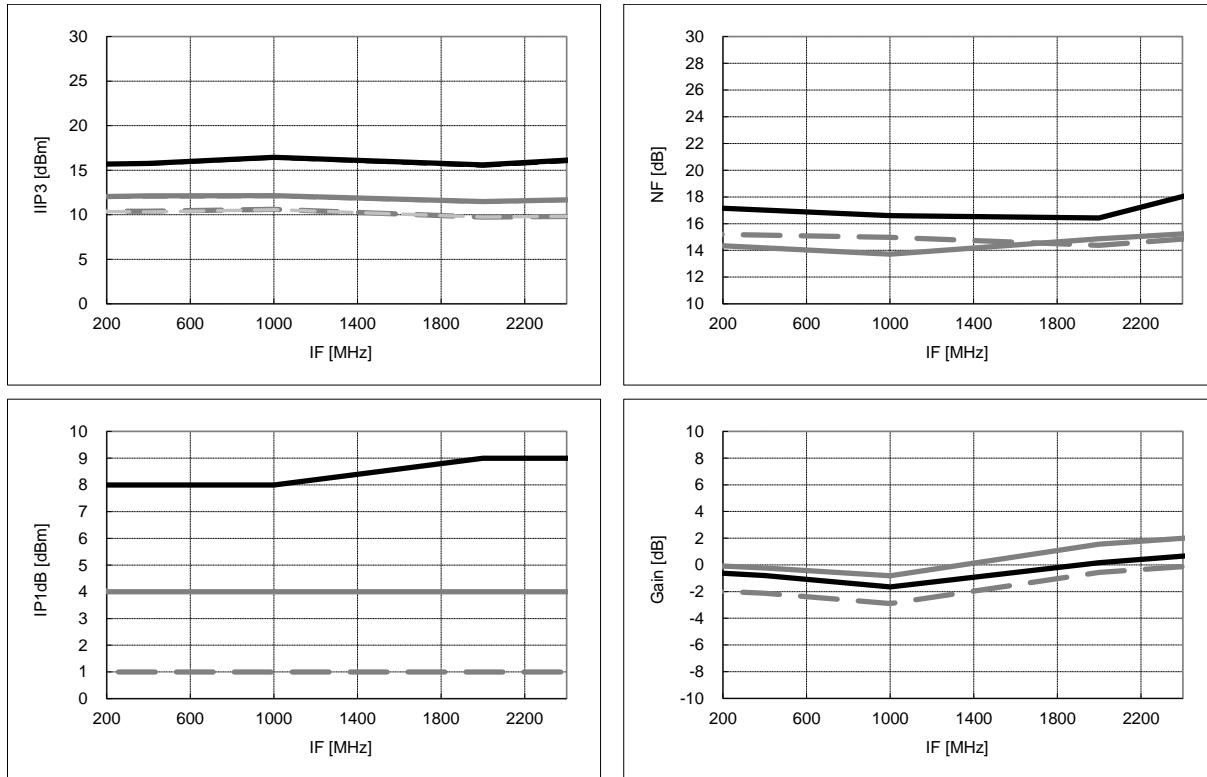
Resistance for current adjustment

——— 22kohm

——— 33kohm

– – – 56kohm

Fig. 7 IF input frequency vs. IIP3, NF, Gain

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6. Lo input power vs. IIP3, NF, Gain
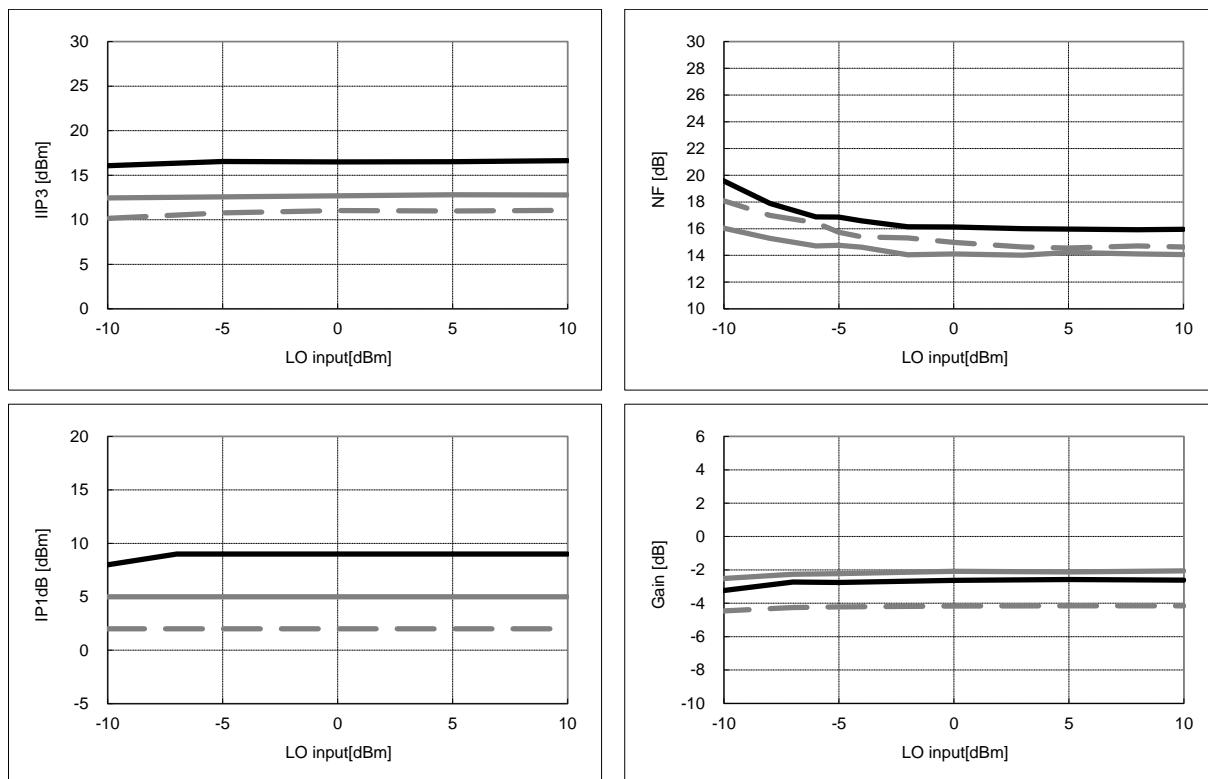
Resistance for current adjustment

————	22kohm
————	33kohm
– – – –	56kohm

Fig. 8 LO input power vs. IIP3, NF, Gain

7. Output Load Resistor（RLoad） vs. IIP3, NF, Gain
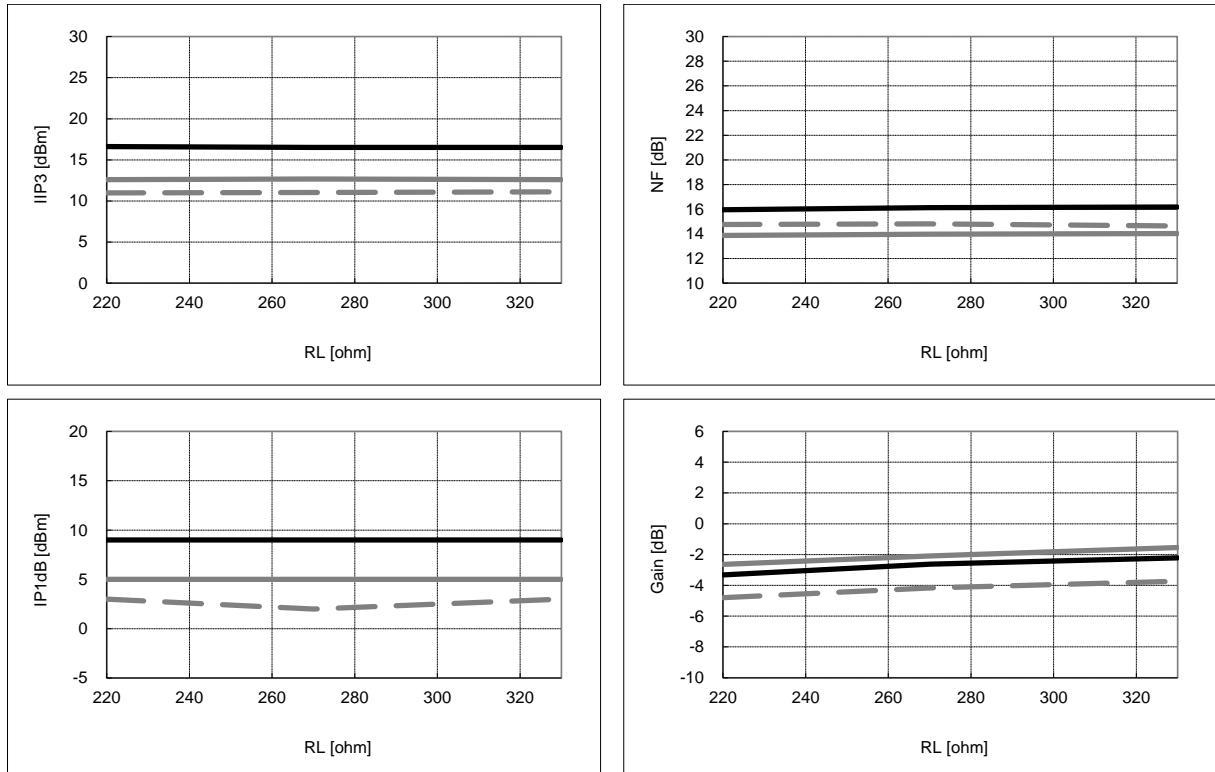
Resistance for current adjustment

———	22kohm
———	33kohm
— — —	56kohm

Fig. 9 Output Load Resistor（RLoad） vs. IIP3, NF, Gain

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10. Typical Evaluation Board Schematic
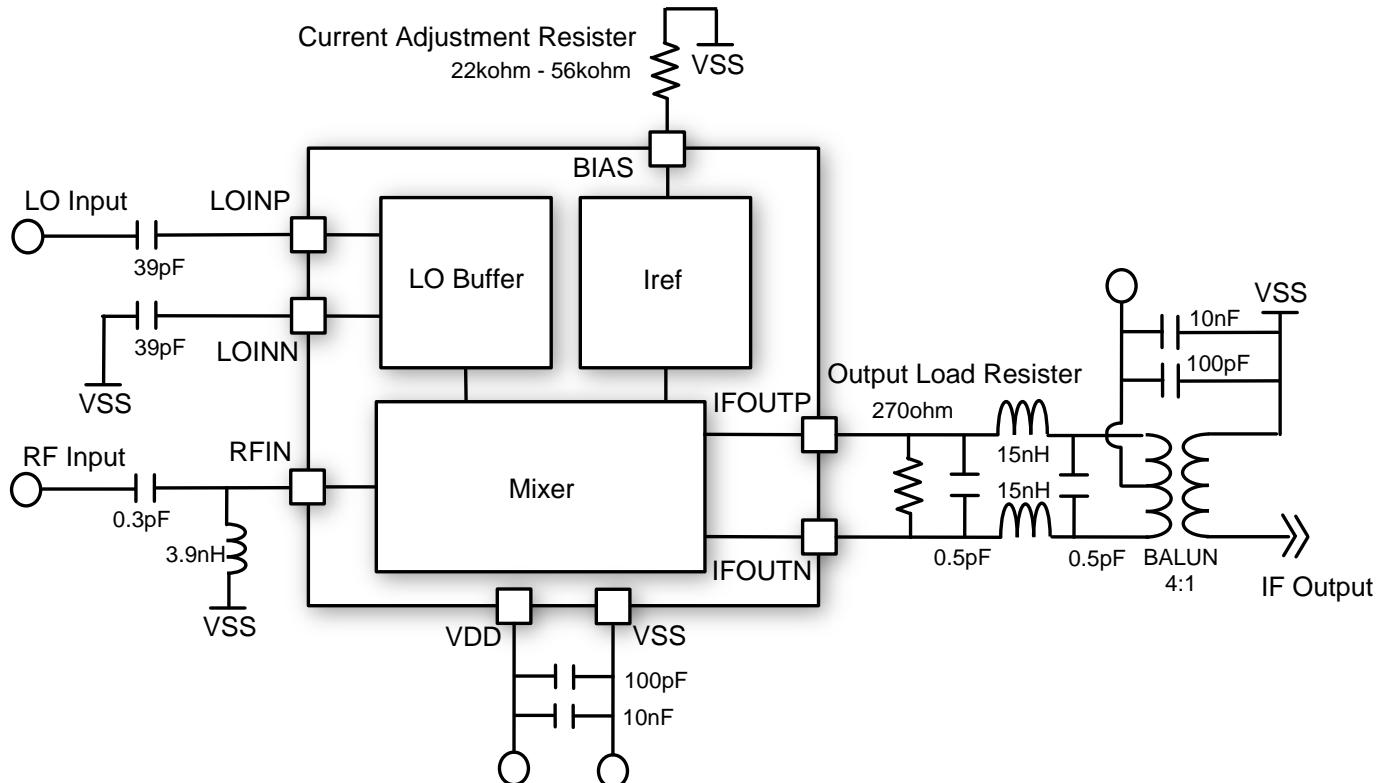
Fig.10 Typical Evaluation Board Schematic (RF:6GHz,IF:1GHz)

Note 1)   The exposed pad at the center of the backside should be connected to ground.

Note 2)   The collector drain output needs power feeding via a inductor.   (IFOUTP pin and IFOUTN pin)

Note 3)   It is necessary to adjust impedance matching as to its setting frequency. (RF input and IF output)

11. LSI Interface Schematic

Pin No.	Pin Name	I/O	Function
14	RFIN	I	**RF Input pin**
6	LOINN	I	**LO Input pins**
7	LOINP		
13	BIAS	I/O	**Analog I/O pin**
11	IFOUTN	O	**IF Output pins**
12	IFOUTP		

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12. Outer Dimensions
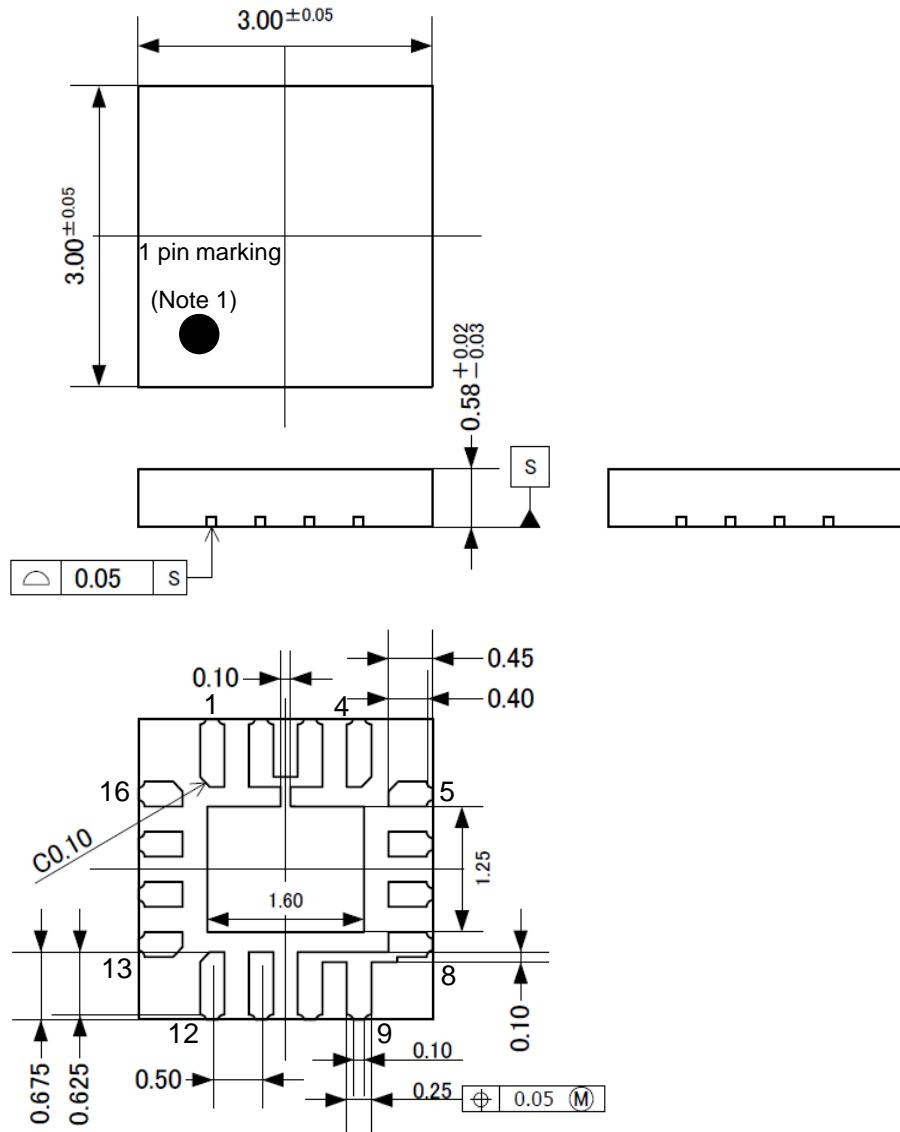
Fig.11　Outer Dimensions

Note 1. 1 pin marking is only a reference for the 1 pin location on the top of package.

13. Marking

(a) Style   :   UQFN

(b) Number of pins   :   16

(c) 1 pin marking: :   ○

(d) Product number   :   1223

(e) Date code   :   YWWL (4 digits)

                              Y :   Lower 1 digit of calendar year (Year 2012 → 2, 2013 → 3 ...)

                              WW :   Week

                              L :   Lot identification, given to each product lot which is made in a week

                                         → LOT ID is given in alphabetical order (A, B, C…).

Fig. 12 Marking

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IMPORTANT NOTICE