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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

### 3. Applications

- Microwave Radio Link
- Radar Systems

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5. System Diagram

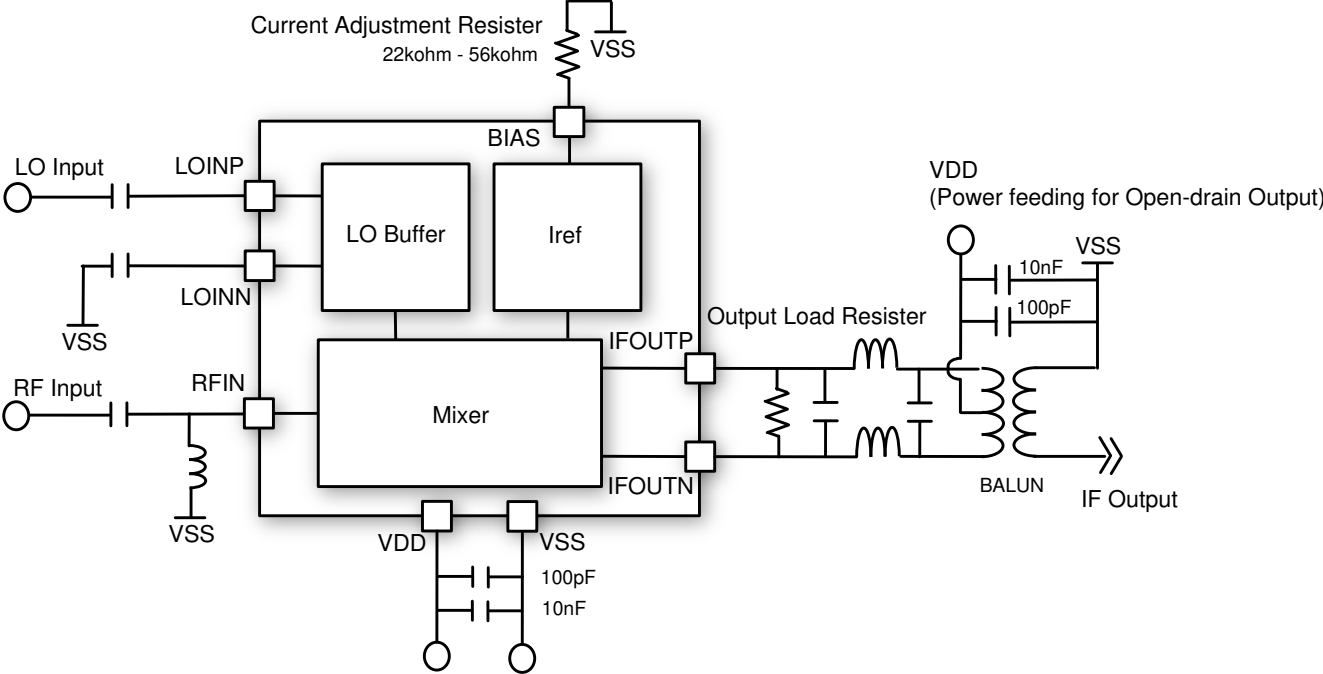


Figure 1. System Diagram

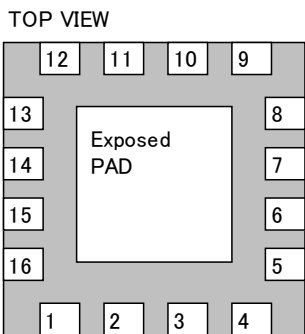
**6. Pin Functional Description**

**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	



**Figure 2. Package Pin Layout**

## 7. 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.

## 8. 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).

## 9. Electrical Characteristics

### 1. Analog Circuit Characteristics

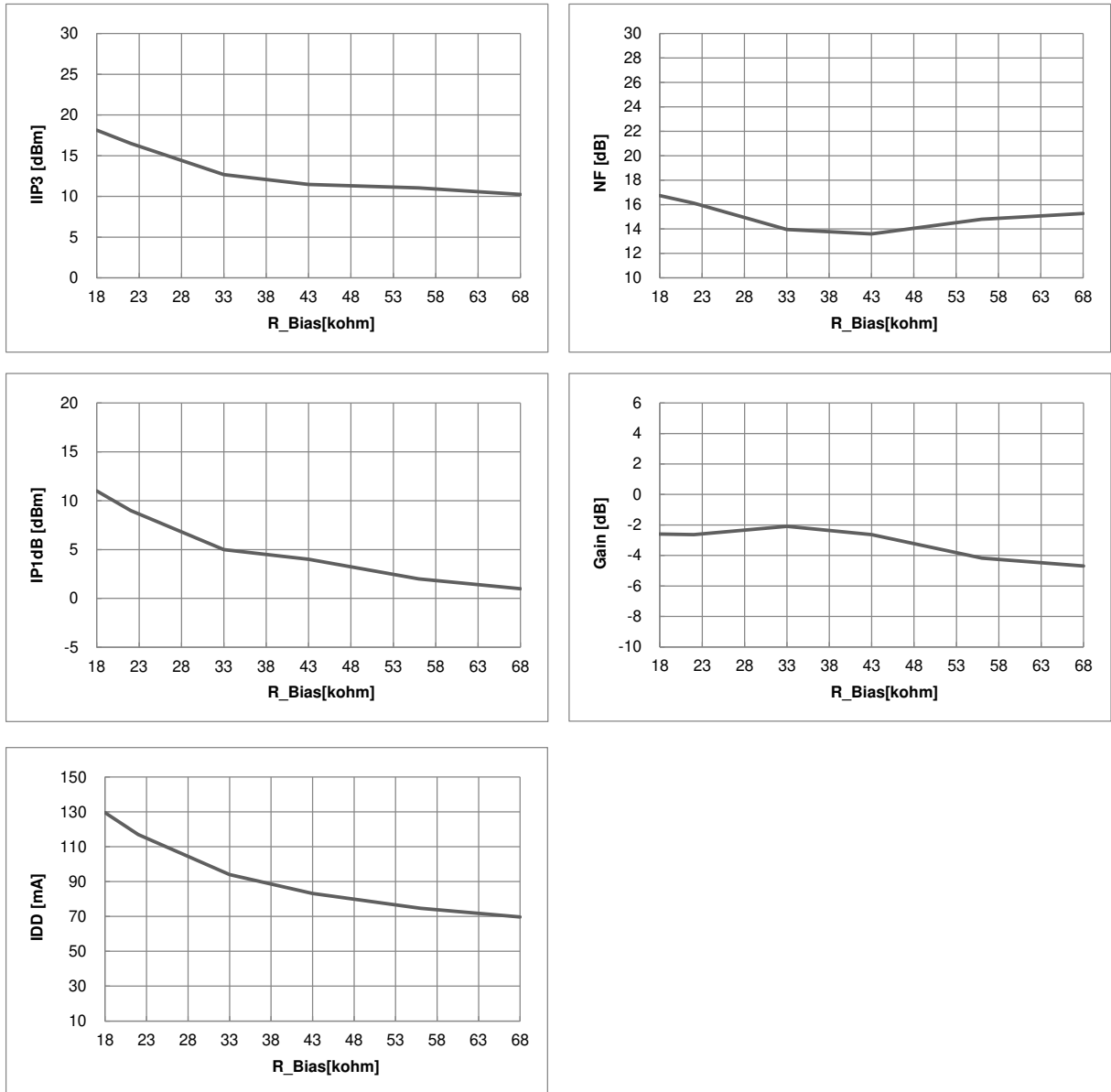
Unless otherwise noted IF output=1000MHz, Lo Input Level=-5dBm to +5dBm,  
Output Load Resistor (RLoad)=270Ω, VDD=4.75 to 5.25V, Ta=-40°C to 85°C

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 pin, IFOUTP pin and IFOUTN pin.
	BIAS=33kΩ		92	144	mA	
	BIAS=56kΩ		73	119	mA	
<b>RFIN=6000MHz, Current Adjustment Resistor =33kΩ</b>						
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

**10. Typical Performance**

Unless otherwise noted, RF input =6000MHz, LO input =5000MHz, IF output =1000MHz,  
Output Load Resistor (R<sub>Load</sub>)=270Ω

**1. Current Adjustment Resistor vs. IIP, NF, P1dB, Gain, IDD**



**Figure 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

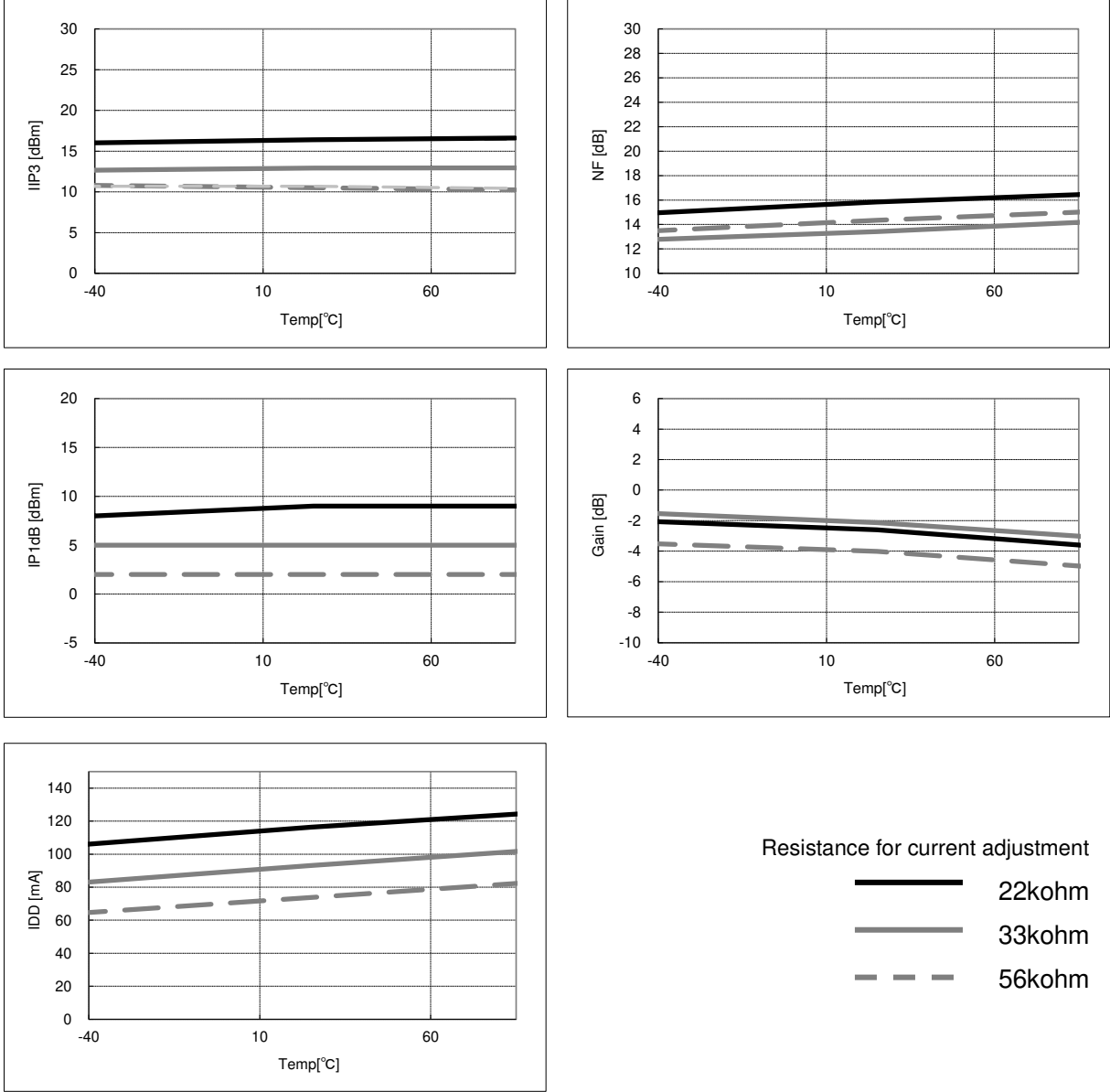


Figure 4. Over temperature vs. IIP3, NF, IP1dB, Gain, IDD

3. Over temperature vs. IIP3, NF, P1dB, Gain, IDD

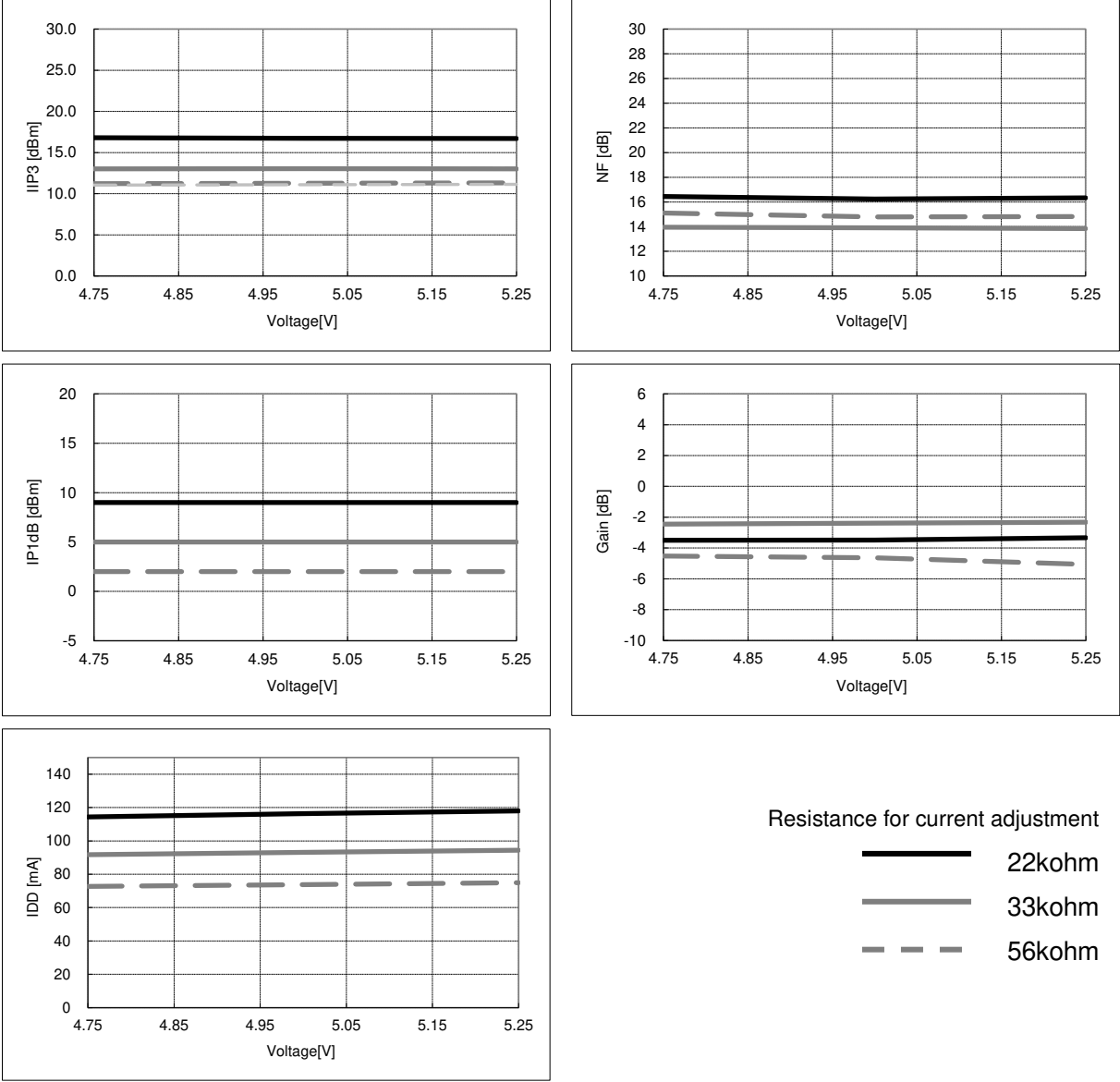
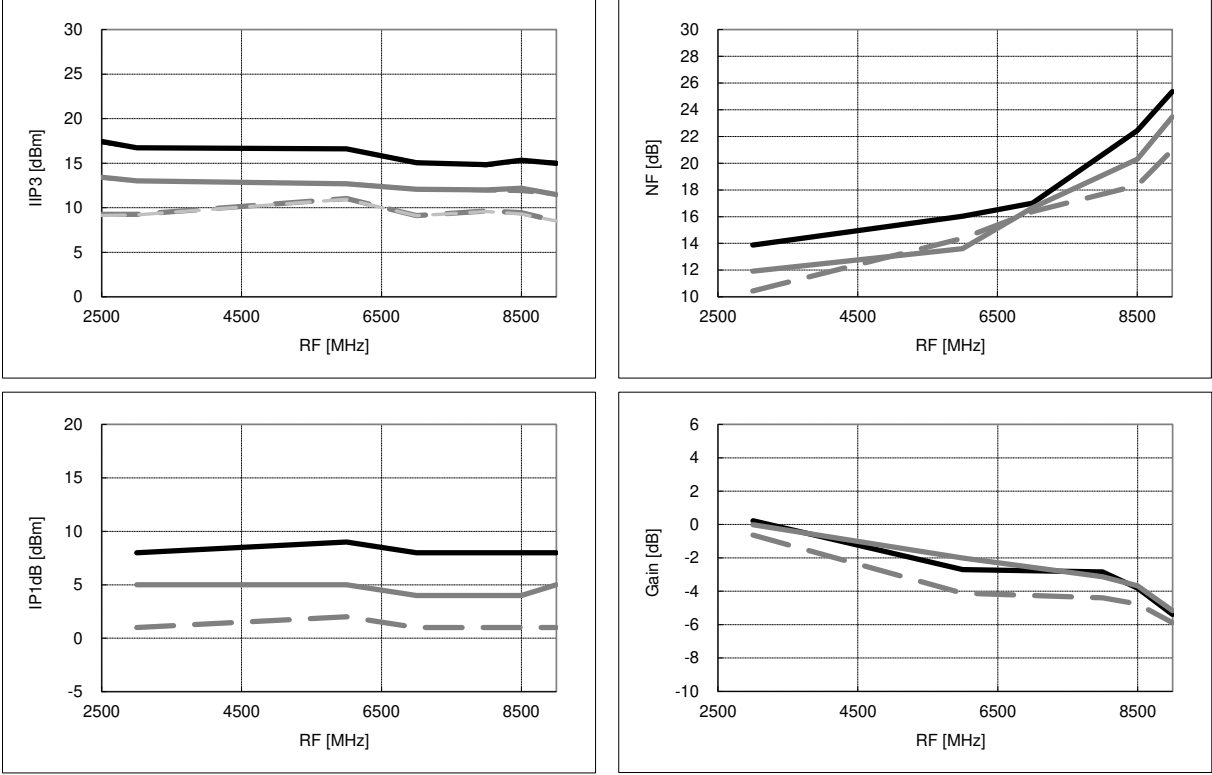


Figure 5. Supply voltage vs. IIP3, NF, IP1dB, Gain, IDD

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

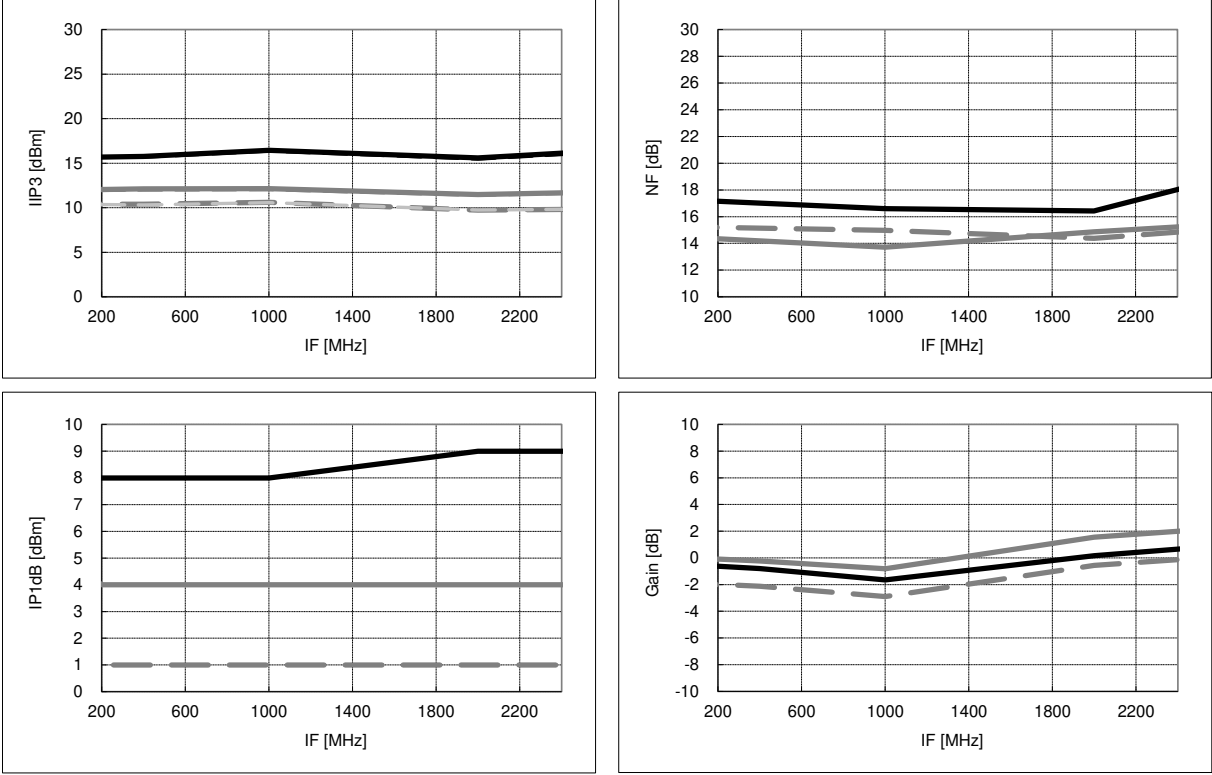


Resistance for current adjustment

- 22kohm
- 33kohm
- - - 56kohm

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

5. IF input frequency vs. IIP3, NF, Gain

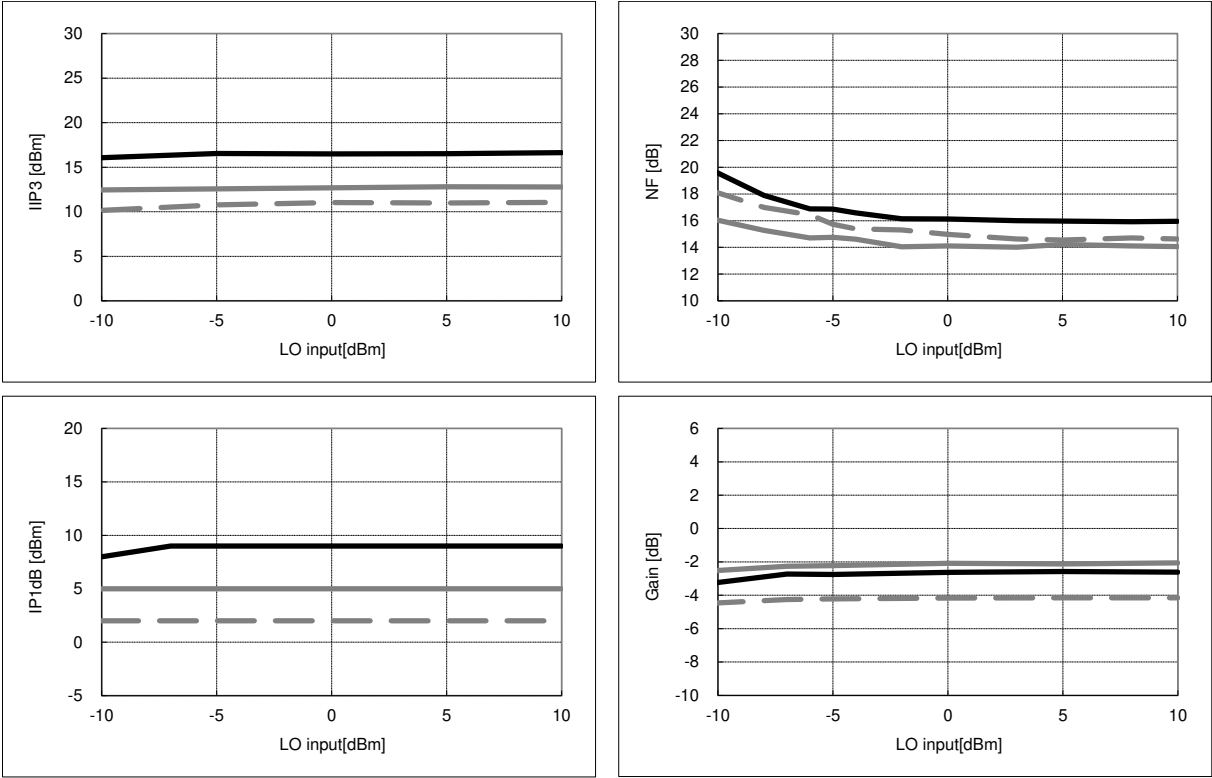


Resistance for current adjustment

- 22kohm
- 33kohm
- - - 56kohm

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

6. Lo input power vs. IIP3, NF, Gain

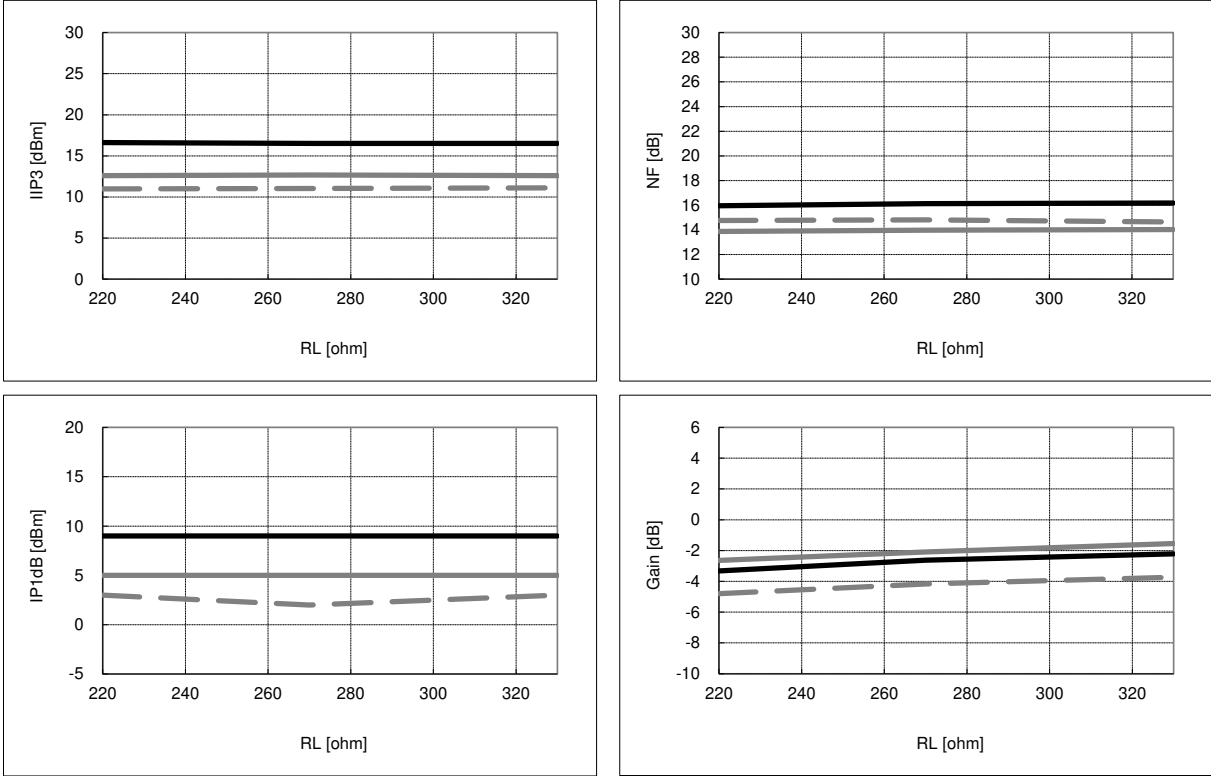


Resistance for current adjustment

- 22kohm
- 33kohm
- - - 56kohm

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

7. Output Load Resistor (R<sub>Load</sub>) vs. IIP3, NF, Gain

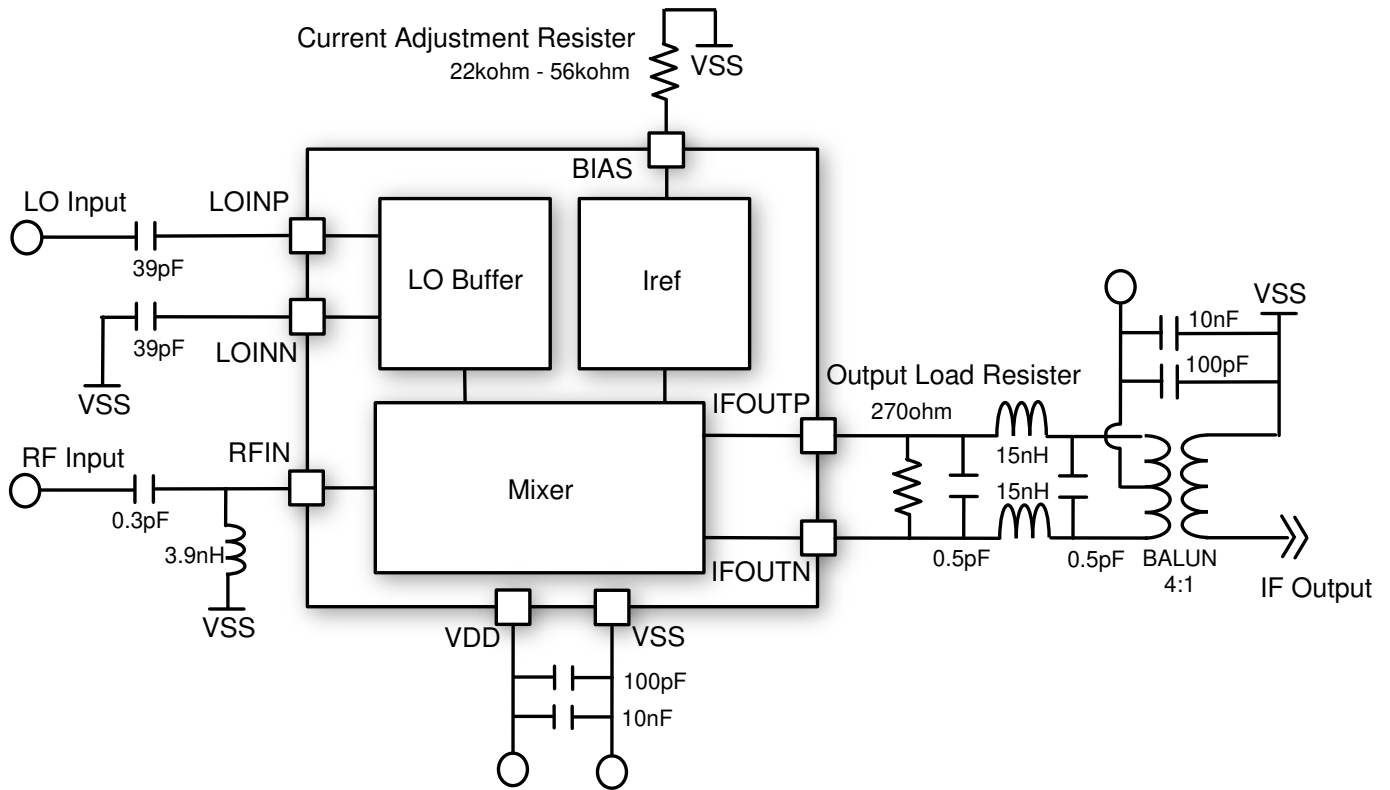


Resistance for current adjustment

- 22kohm
- 33kohm
- - - 56kohm

Figure 9. Output Load Resistor (R<sub>Load</sub>) vs. IIP3, NF, Gain

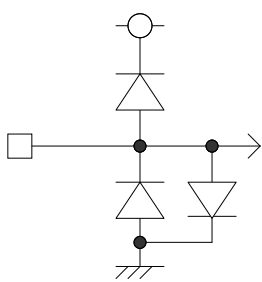
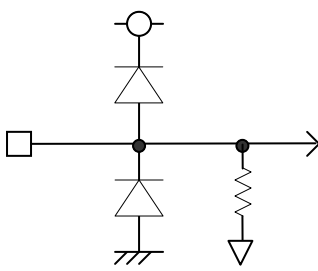
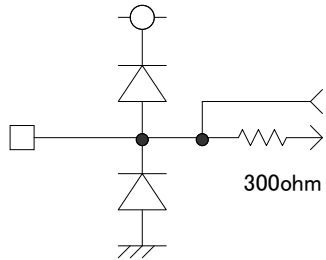
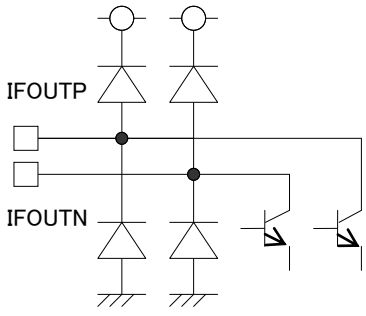
## 11. Typical Evaluation Board Schematic



**Figure 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)

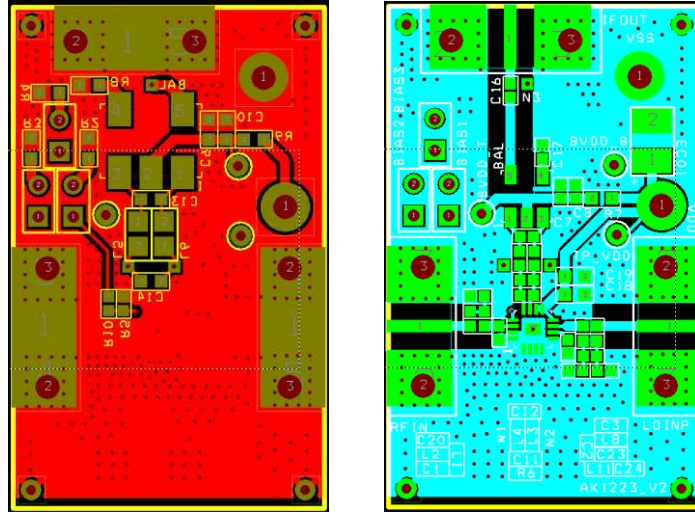
**12. LSI Interface Schematic**

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

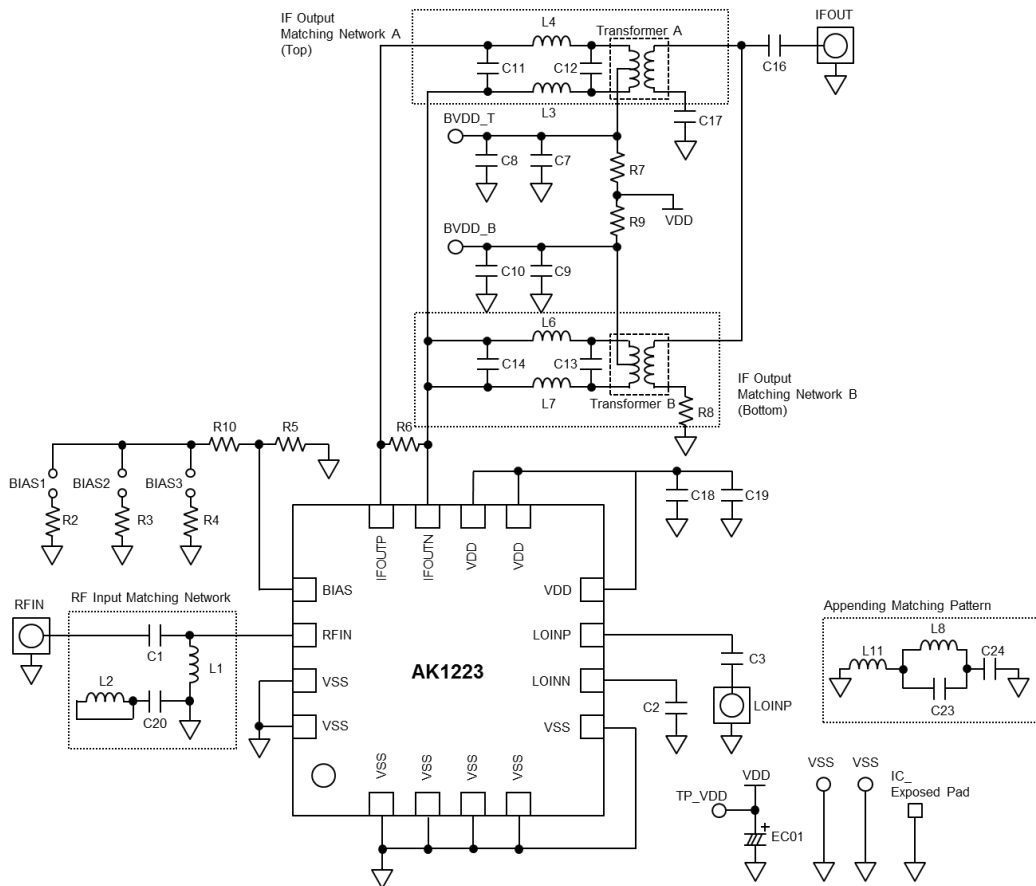


**13. Application Information**

•Evaluation Board



**Figure 11. AK1223 Evaluation Board**



**Figure 12. AK1223 Evaluation Board Schematic**

14. Outer Dimensions

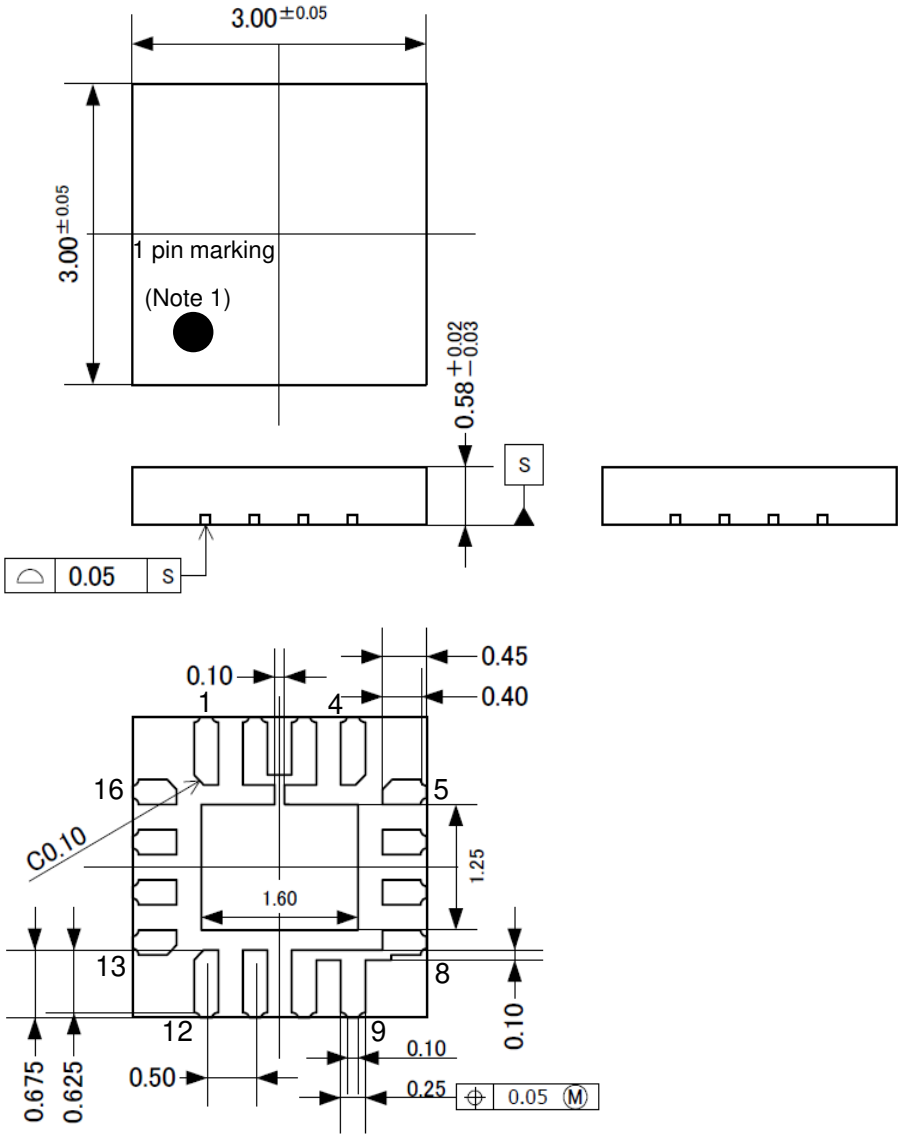
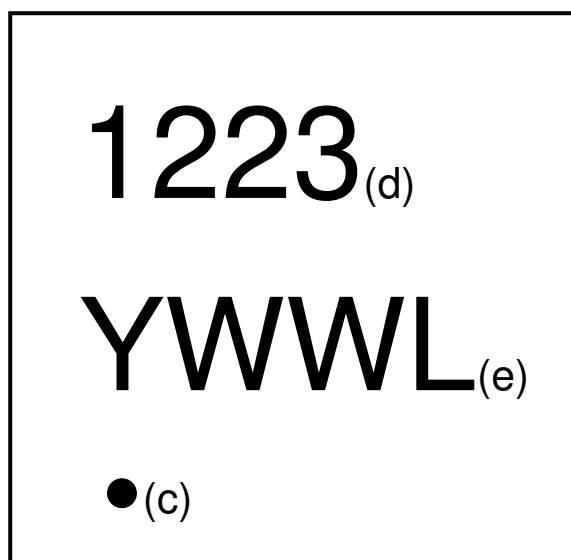


Figure 13. Outer Dimensions

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

**15. 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...).

**Figure 14. Marking**

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### •Related Parts

Part#	Discription	Comments
<b>Mixer</b>		
AK1220	100MHz~900MHz High Linearity Down Conversion Mixer	IIP3:+22dBm
AK1222	100MHz~900MHz Low Power Down Conversion Mixer	IDD:2.9mA
AK1224	100MHz~900MHz Low Noise, High Liniarity Down Conversion Mixer	NF:8.5dB, IIP3:+18dBm
AK1228	10MHz~2GHz Up/Down Conversion Mixer	3V Supply, NF:8.5dB
AK1221	0.7GHz~3.5GHz High Linearity Down Conversion Mixer	IIP3:+25dBm
AK1223	3GHz~8.5GHz High Linearity Down Conversion Mixer	IIP3:+13dB, NF:15dB
<b>PLL Synthesizer</b>		
AK1541	20MHz~600MHz Low Power Fractional-N Synthesizer	IDD:4.6mA
AK1542A	20MHz~600MHz Low Power Integer-N Synthesizer	IDD:2.2mA
AK1543	400MHz~1.3GHz Low Power Fractional-N Synthesizer	IDD:5.1mA
AK1544	400MHz~1.3GHz Low Power Integer-N Synthesizer	IDD:2.8mA
AK1590	60MHz~1GHz Fractional-N Synthesizer	IDD:2.5mA
AK1545	0.5GHz~3.5GHz Integer-N Synthesizer	16-TSSOP
AK1546	0.5GHz~3GHz Low Phase Noise Integer-N Synthesizer	Normalized C/N:-226dBc/Hz
AK1547	0.5GHz~4GHz Integer-N Synthesizer	5V Supply
AK1548	1GHz~8GHz Low Phase Noise Integer-N Synthesizer	Normalized C/N:-226dBc/Hz
<b>IFVGA</b>		
AK1291	100~300MHz Analog Signal Control IF VGA w/ RSSI	Dynamic Range:30dB
<b>integrated VCO</b>		
AK1572	690MHz~4GHz Down Conversion Mixer with Frac.-N PLL and VCO	IIP3:24dBm, -111dBc/Hz@100kHz
AK1575	690MHz~4GHz Up Conversion Mixer with Frac.-N PLL and VCO	IIP3:24dBm, -111dBc/Hz@100kHz
<b>IF Reciever (2nd Mixer + IF BPF + FM Detector)</b>		
AK2364	Built-in programmable AGC+BPF, FM detector IC	IFBPF:±10kHz ~ ±4.5kHz
AK2365A	Built-in programmable AGC+BPF, IFIC	IFBPF:±7.5kHz ~ ±2kHz
<b>Analog BB for PMR/LMR</b>		
AK2345	CTCSS Filter, Encoder, Decoder	24-VSOP
AK2360/ AK2360A	Inverted frequency(3.376kHz/3.020kHz) scrambler	8-SON
AK2363	MSK Modem/DTMF Receiver	24-QFN
AK2346B	0.3-2.55/3.0kHz Analog audio filter, Emphasis, Compandor, scrambler, MSK Modem	24-VSOP
AK2346A		24-QFN
AK2347B	0.3-2.55/3.0kHz Analog audio filter Emphasis, Compandor, scrambler, CTCSS filter	24-VSOP
AK2347A		24-QFN
<b>Function IC</b>		
AK2330	8-bit 8ch Electronic Volume	VREF can be selected for each channel
AK2331	8-bit 4ch Electronic Volume	VREF can be selected for each channel

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