1.5GHz/1.9GHz MIXER GaAs MMIC

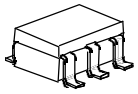
■GENERAL DESCRIPTION

NJG1553F is a mixer GaAs MMIC featured low distortion, high conversion gain and low noise figure.

This mixer includes a local amplifier, and ideally suitable for 1.5/1.9Hz band digital mobile phone and PHS handsets.

The very small MTP package is adopted.

■PACKAGE OUTLINE



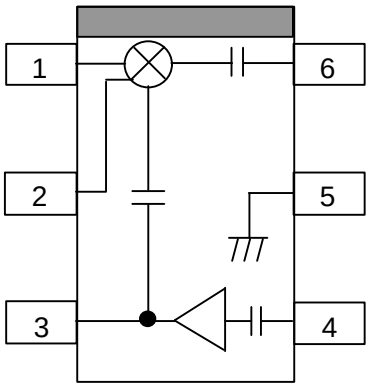
NJG1553F

■FEATURES

●Low voltage operation	+2.7V
●High conversion gain	9dB typ. @f_{RF}= 1489.0MHz, P_{LO}= -10dBm, P_{RF}= -30dBm
	7dB typ. @f_{RF}= 1900MHz, P_{LO}= -10dBm, P_{RF}= -30dBm
●High Input IP3	-1dBm typ. @f_{RF1}= 1489.0MHz, f_{RF2}= 1489.1MHz
	P_{LO}= -10dBm, P_{RF}= -30dBm
	4dBm typ. @f_{RF1}= 1900.0MHz, f_{RF2}= 1900.1MHz
	P_{LO}= -10dBm, P_{RF}= -25dBm
●Low noise figure	6dB typ. @f_{RF}= 1489.0MHz, P_{LO}= -10dBm
	9dB typ. @f_{RF}= 1900MHz, P_{LO}= -10dBm
●Package	MTP6 (Mount Size: 2.8 x 2.9 x 1.2mm)

■PIN CONFIGURATION

F Type
(Top View)



PIN Connection

1. IFOUT
2. BPC
3. VLO
4. LOIN
5. GND
6. RFIN

NOTE :The ▭ portion above shows orientation mark printed on the package surface.

■ABSOLUTE MAXIMUM RATINGS

(T_a=25°C, Z_s=Z_l=50Ω)

PARAMETERS	SYMBOL	CONDITIONS	RATINGS	UNITS
Mixer Supply Voltage	V_{MIX}		5	V
Local Amplifier Supply Voltage	V_{LO}		5	V
Mixer RF Input Power	P_{RFIN}	V_{MIX}=2.7V, V_{LO}=2.7V	10	dBm
Mixer LO Input Power	P_{LOIN}	V_{MIX}=2.7V, V_{LO}=2.7V	10	dBm
Power Dissipation	P_D		150	mW
Operating Temperature	T_{opr}		-30~+85	°C
Storage Temperature	T_{stg}		-40~+150	°C

■RECOMMENDED OPERATING RANGE

PARAMETER	SYMBOL		MIN	TYP	MAX	UNITS
Mixer Supply Voltage	V_{MIX}		2.5	2.7	4.5	V
Local Amplifier Supply Voltage	V_{LO}		2.5	2.7	4.5	V

■ELECTRICAL CHARACTERISTICS (DC)

(T_a=25°C, V_{MIX}=2.7V, V_{LO}=2.7V)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Mixer Current	I_{MIX}	P_{RF}=OFF, P_{LO}=OFF	-	5.0	7.0	mA
Local Amplifier Current	I_{LO}	P_{RF}=OFF, P_{LO}=OFF	-	2.0	3.2	mA

■ELECTRICAL CHARACTERISTICS (RF 1.5GHz band)

(T_a=25°C, V_{MIX}=2.7V, V_{LO}=2.7V, f_{IF}=130MHz, P_{LO}=-10dBm
Application 1.5GHz, f_{LO}=1619MHz)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Gain	G_C1	f_{RF}=1489MHz, P_{RF}=-30dBm	6.0	9.0	-	dB
3rd Order Intercept Point	IIP3_1	f_{RF}=1489.0MHz+1489.1MHz	-	-1.0	-	dBm
Noise Figure	NF1	f_{RF}=1489.0MHz	-	6.0	8.0	dB

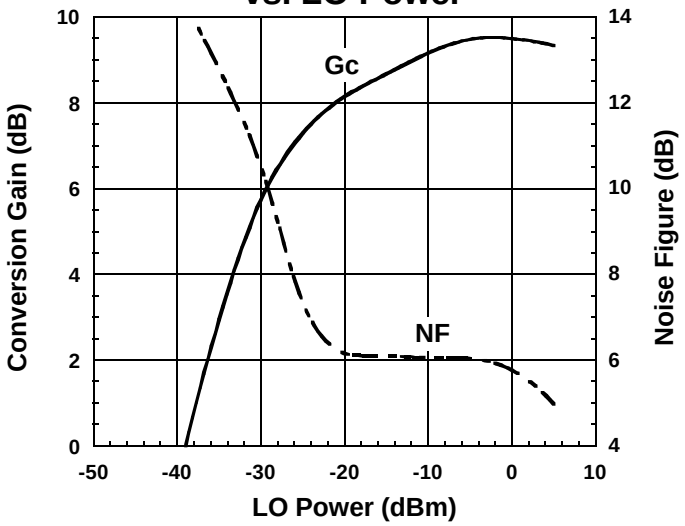
■ELECTRICAL CHARACTERISTICS (RF 1.9GHz band)

(T_a=25°C, V_{MIX}=2.7V, V_{LO}=2.7V, f_{IF}=240MHz, P_{LO}=-10dBm
Application 1.9GHz, f_{LO}=1660MHz)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Gain	G_C2	f_{RF}=1900MHz, P_{RF}=-30dBm	4.0	7.0	-	dB
3rd Order Intercept Point	IIP3_2	f_{RF}=1900.0MHz+1900.1MHz	-	4.0	-	dBm
Noise Figure	NF2	f_{RF}=1900.0MHz	-	9.0	11.0	dB

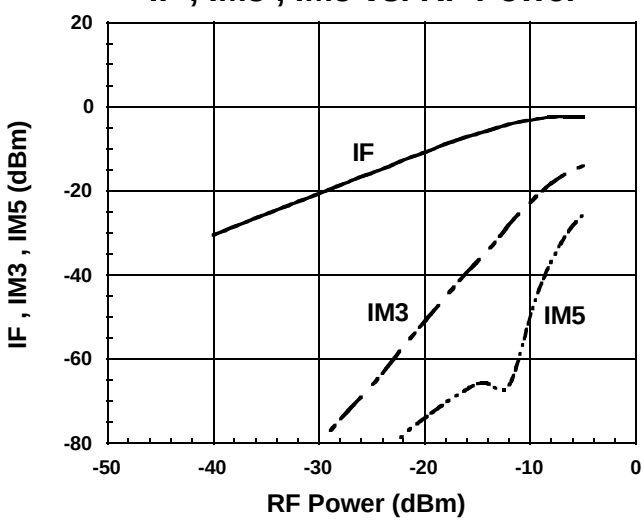
■**TYPICAL CHARACTERISTICS** (Application 1 1.5GHz, f_{LO}=1619MHz)

Conversion Gain , Noise Figure vs. LO Power



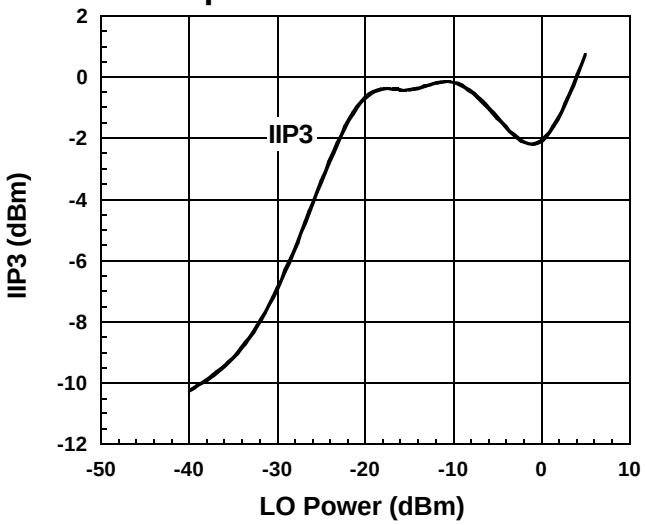
Condition
f_{IF}=130MHz
f_{RF}=1489MHz,P_{RF}=-30dBm
f_{LO}=1619MHz
V_{MIX}=V_{LO}=2.7V

IF , IM3 , IM5 vs. RF Power



Condition
f_{IF}=130MHz
f_{RF1}=1489.0MHz
f_{RF2}=1489.1MHz
f_{LO}=1619MHz,P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V

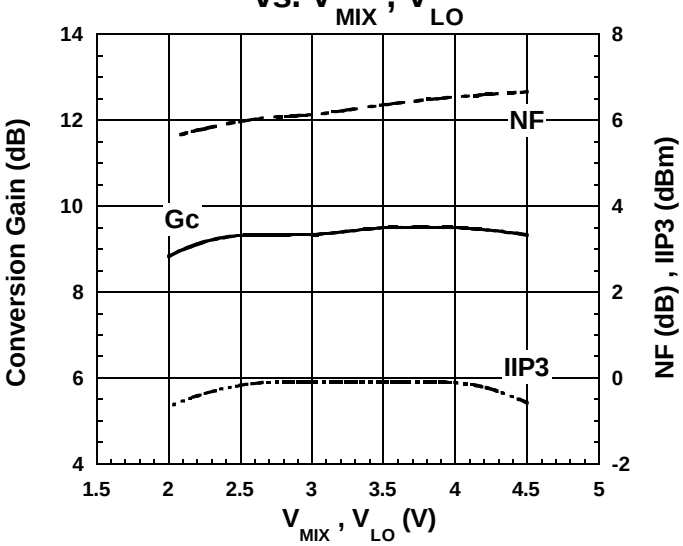
Input-IP3 vs. LO Power



Condition
f_{IF}=130MHz
f_{RF1}=1489.0MHz,P_{RF}=-30dBm
f_{RF2}=1489.1MHz
f_{LO}=1619MHz
V_{MIX}=V_{LO}=2.7V

$$IIP3=\frac{3IF-IM3}{2}-G_c$$
@P_{RF}=-30dBm

Conversion Gain , Noise Figure , Input-IP3 vs. V_{MIX} , V_{LO}

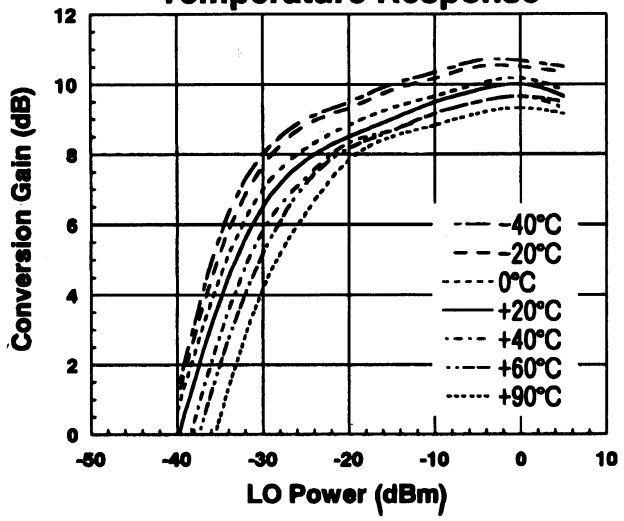


Condition
f_{IF}=130MHz
f_{RF1}=1489.0MHz,P_{RF}=-30dBm
f_{RF2}=1489.1MHz
f_{LO}=1619MHz,P_{LO}=-10dBm

$$IIP3=\frac{3IF-IM3}{2}-G_c$$
@P_{RF}=-30dBm

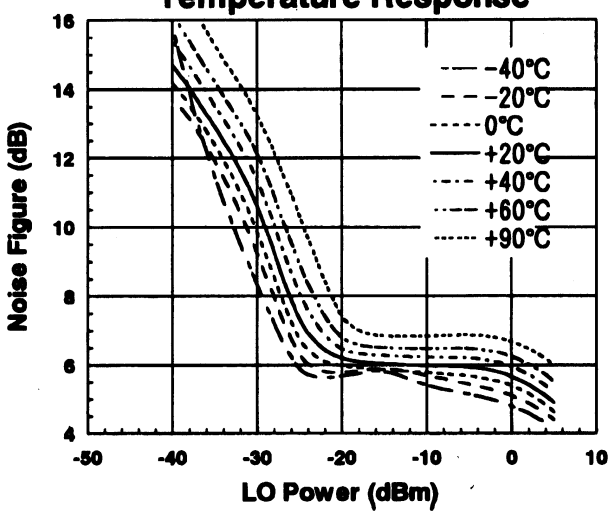
■TYPICAL CHARACTERISTICS (Continued)

Conversion Gain vs. LO Power Temperature Response



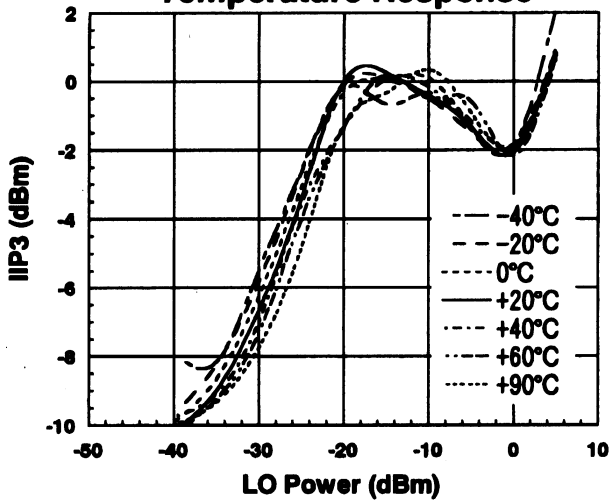
Condition
f_{IF}=130MHz
f_{RF}=1489MHz,P_{RF}=-30dBm
f_{LO}=1619MHz
V_{MIX}=V_{LO}=2.7V

Noise Figure vs. LO Power Temperature Response



Condition
f_{IF}=130MHz
f_{RF}=1489MHz
f_{LO}=1619MHz
V_{MIX}=V_{LO}=2.7V

Input-IP3 vs. LO Power Temperature Response

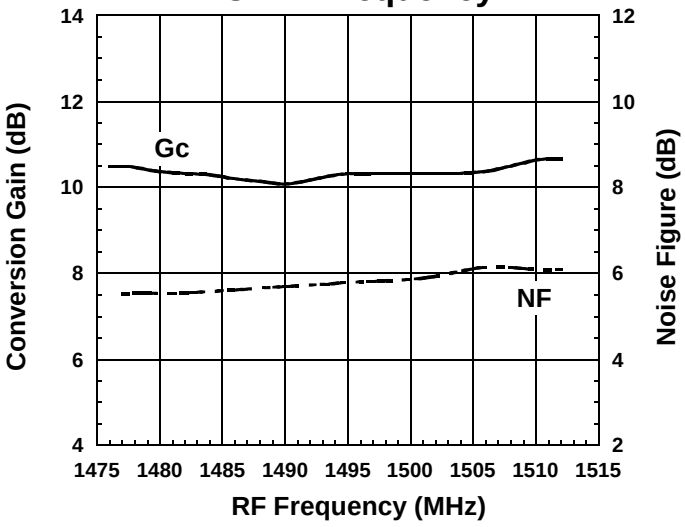


Condition
f_{IF}=130MHz
f_{RF1}=1489.0MHz,P_{RF}=-30dBm
f_{RF2}=1489.1MHz
f_{LO}=1619MHz
V_{MIX}=V_{LO}=2.7V

$$IIP3=\frac{3IF\text{-}IM3}{2}-G_c$$

@P_{RF}=-30dBm

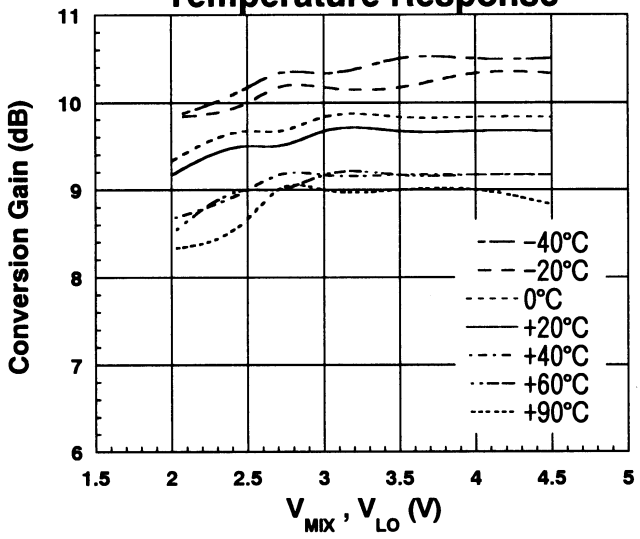
Conversion Gain , Noise Figure vs. RF Frequency



Condition
f_{IF}=130MHz
P_{RF}=-30dBm
P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V
Upper LOCAL

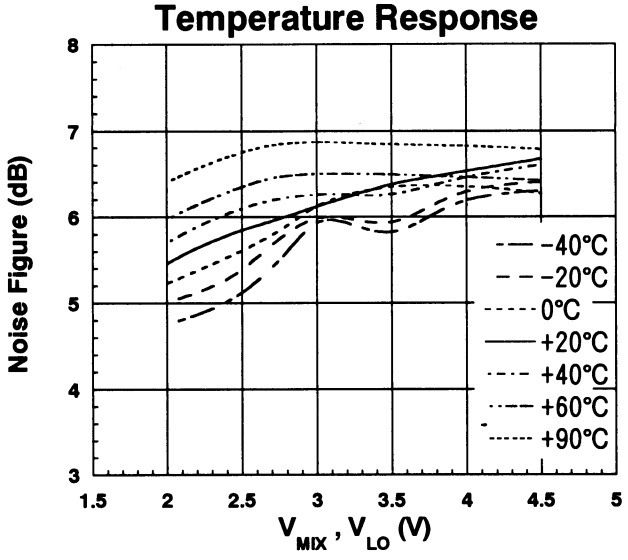
■**TYPICAL CHARACTERISTICS** (Continued)

Conversion Gain vs. V_{MIX} , V_{LO} Temperature Response



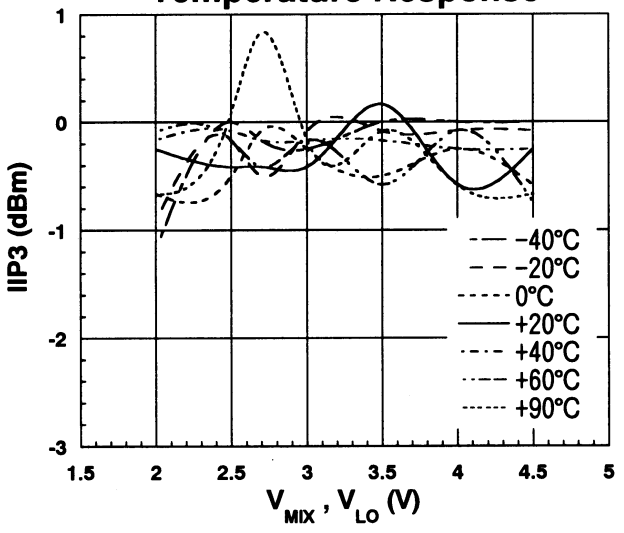
Condition
f_{IF}=130MHz
f_{RF}=1489MHz,P_{RF}=-30dBm
f_{LO}=1619MHz,P_{LO}=-10dBm

Noise Figure vs. V_{MIX} , V_{LO} Temperature Response



Condition
f_{IF}=130MHz
f_{RF}=1489MHz
f_{LO}=1619MHz,P_{LO}=-10dBm

Input-IP3 vs. V_{MIX} , V_{LO} Temperature Response

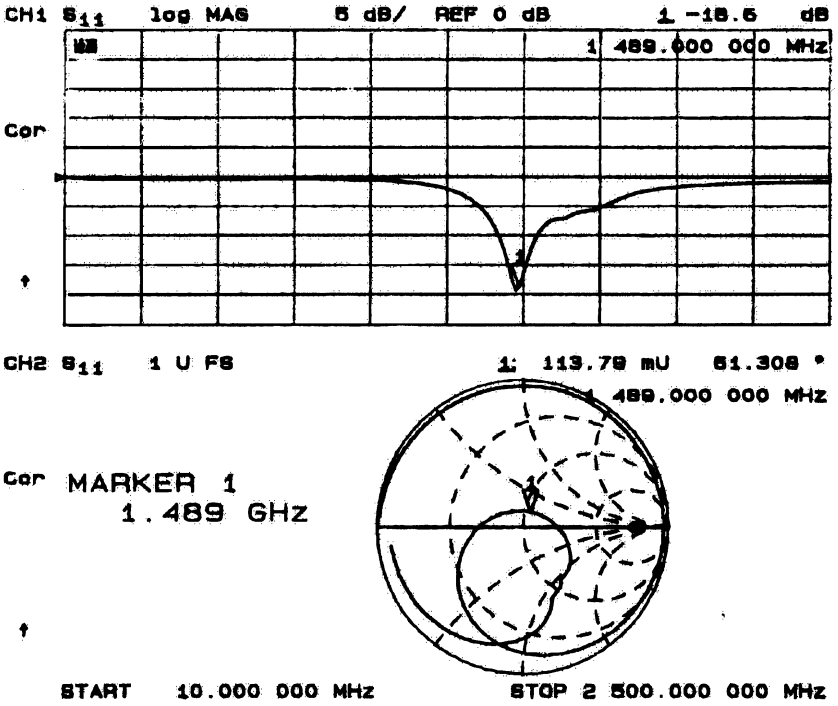


Condition
f_{IF}=130MHz
f_{RF1}=1489.0MHz,P_{RF}=-30dBm
f_{RF2}=1489.1MHz
f_{LO}=1619MHz,f_{LO}=-10dBm

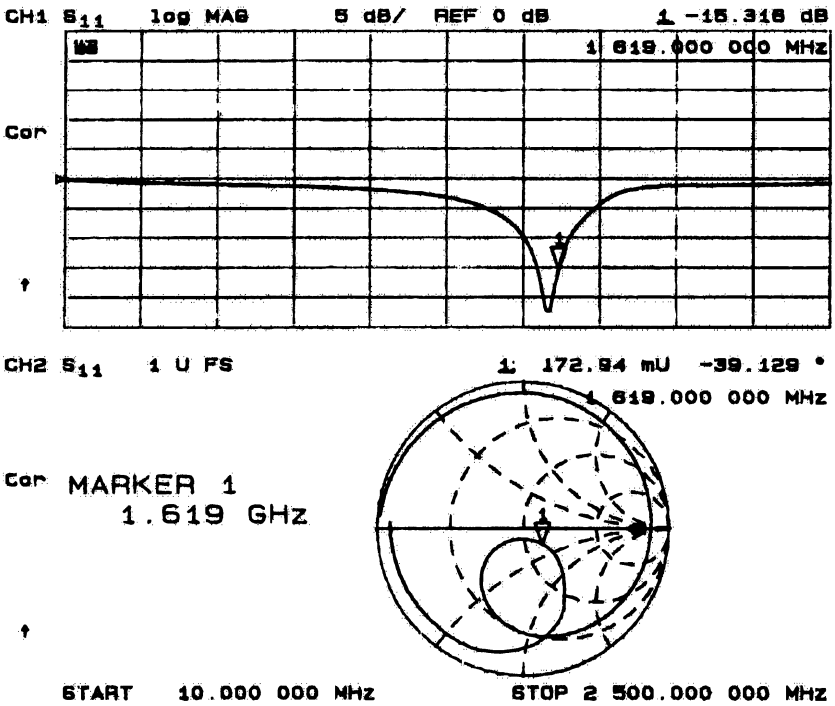
$$IIP3=\frac{3IF-IM3}{2}-G_c$$

@P_{RF}=-30dBm

■**TYPICAL CHARACTERISTICS** (Continued)

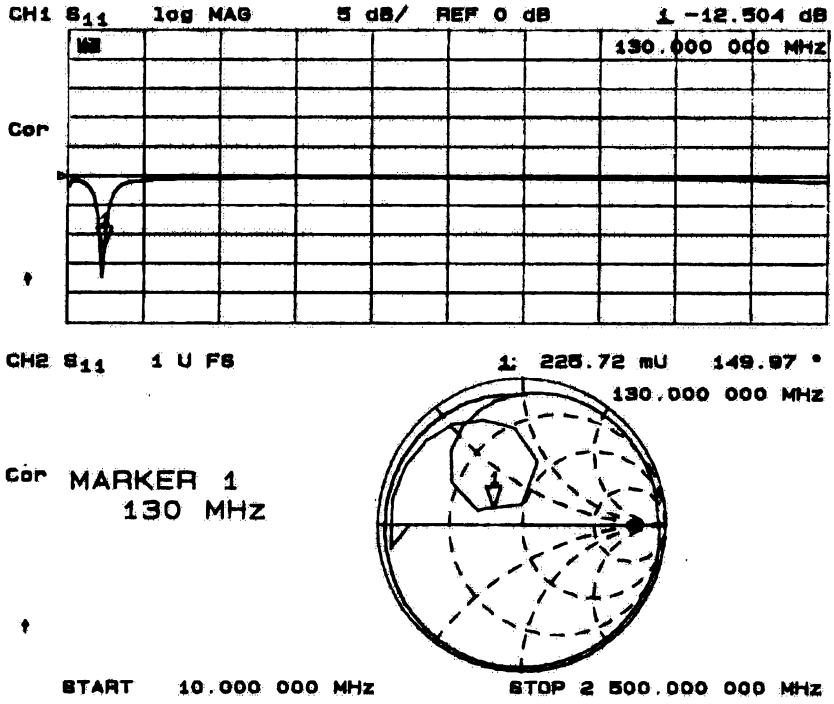


RFIN PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT



LOIN PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT

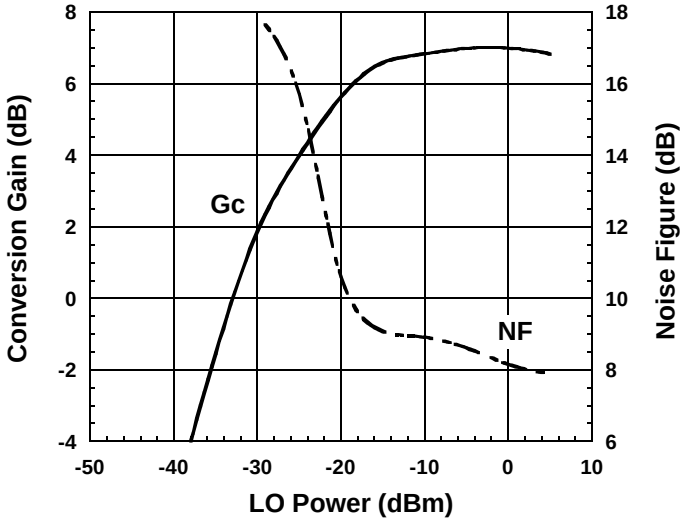
■**TYPICAL CHARACTERISTICS** (Continued)



IFOUT PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT

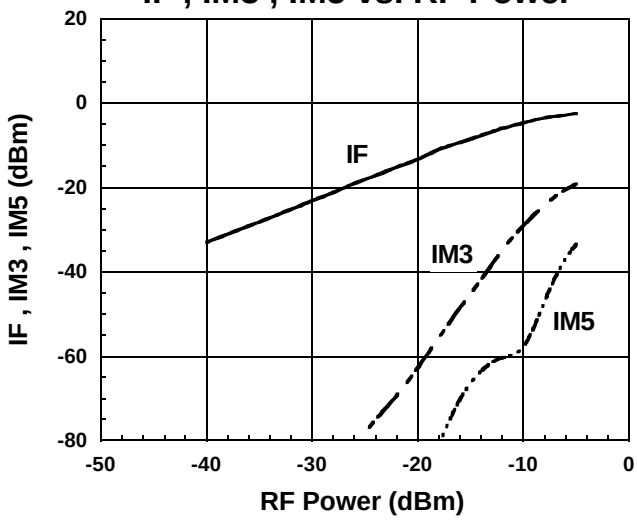
■**TYPICAL CHARACTERISTICS** (Application 1 1.9GHz, f_{LO}=1660MHz)

Conversion Gain , Noise Figure vs. LO Power



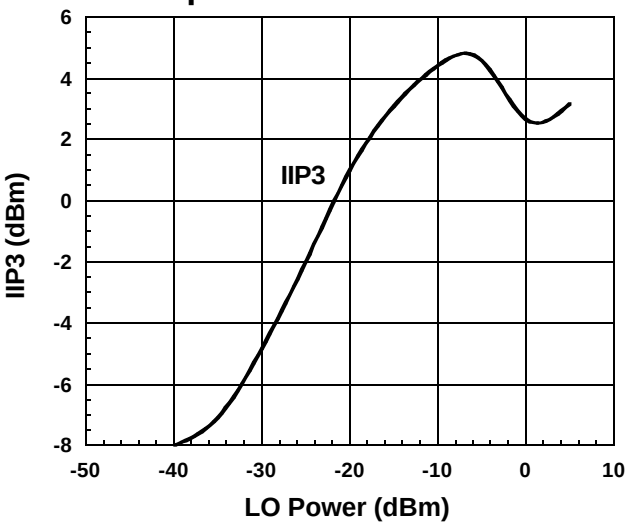
Condition
f_{IF}=240MHz
f_{RF}=1900MHz,P_{RF}=-30dBm
f_{LO}=1660MHz
V_{MIX}=V_{LO}=2.7V

IF , IM3 , IM5 vs. RF Power



Condition
f_{IF}=240MHz
f_{RF1}=1900.0MHz
f_{RF2}=1900.1MHz
f_{LO}=1660MHz,P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V

Input-IP3 vs. LO Power

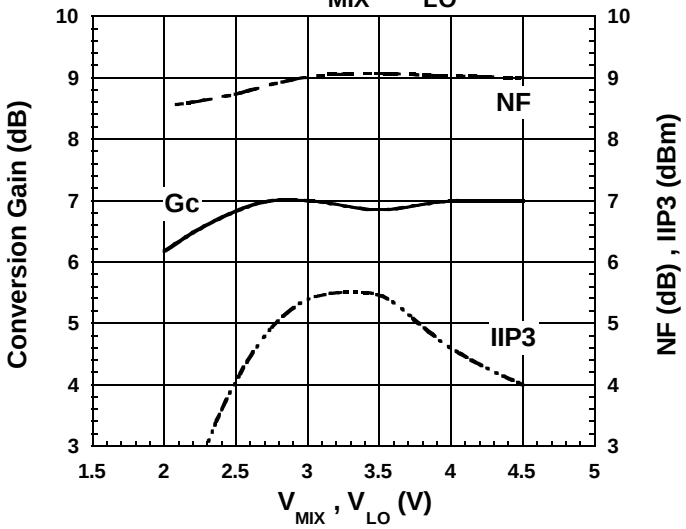


Condition
f_{IF}=240MHz
f_{RF1}=1900.0MHz,P_{RF}=-25dBm
f_{RF2}=1900.1MHz
f_{LO}=1660MHz
V_{MIX}=V_{LO}=2.7V

$$IIP3=\frac{3IF-IM3}{2}-G_c$$

@P_{RF}=-25dBm

Conversion Gain , Noise Figure , Input-IP3 vs. V_{MIX} , V_{LO}



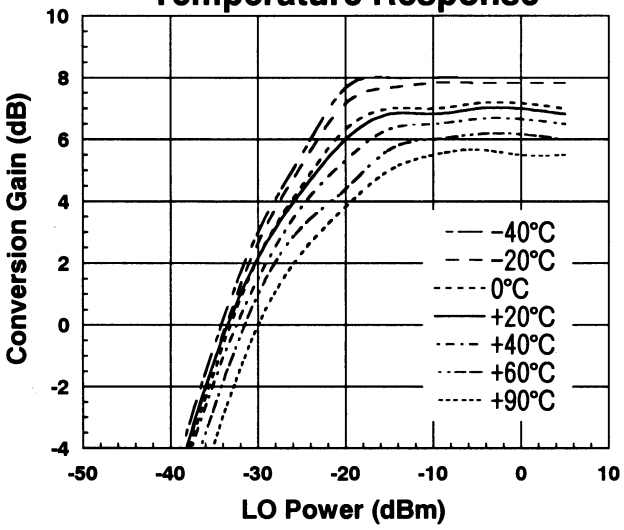
Condition
f_{IF}=240MHz
f_{RF1}=1900.0MHz,P_{RF}=-30dBm
f_{RF2}=1900.1MHz
f_{LO}=1660MHz,P_{LO}=-10dBm

$$IIP3=\frac{3IF-IM3}{2}-G_c$$

@P_{RF}=-25dBm

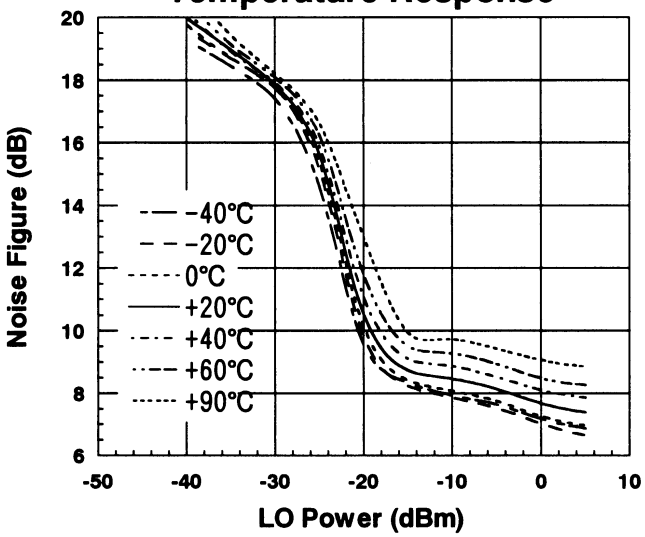
■TYPICAL CHARACTERISTICS (Continued)

Conversion Gain vs. LO Power Temperature Response



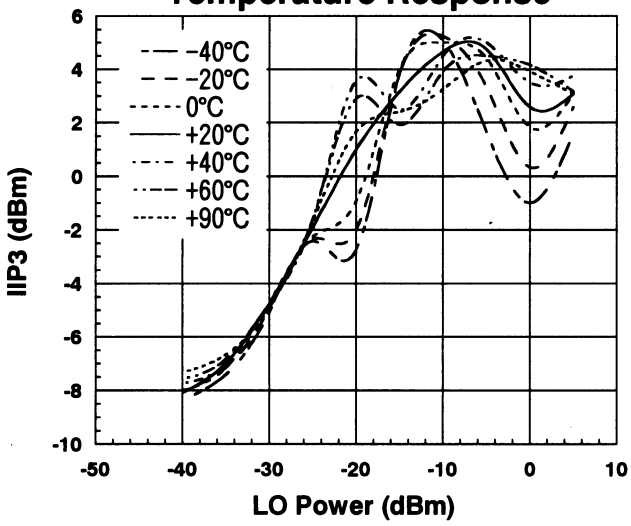
Condition
f_{IF}=240MHz
f_{RF}=1900MHz,P_{RF}=-30dBm
f_{LO}=1660MHz
V_{MIX}=V_{LO}=2.7V

Noise Figure vs. LO Power Temperature Response



Condition
f_{IF}=240MHz
f_{RF}=1900MHz
f_{LO}=1660MHz
V_{MIX}=V_{LO}=2.7V

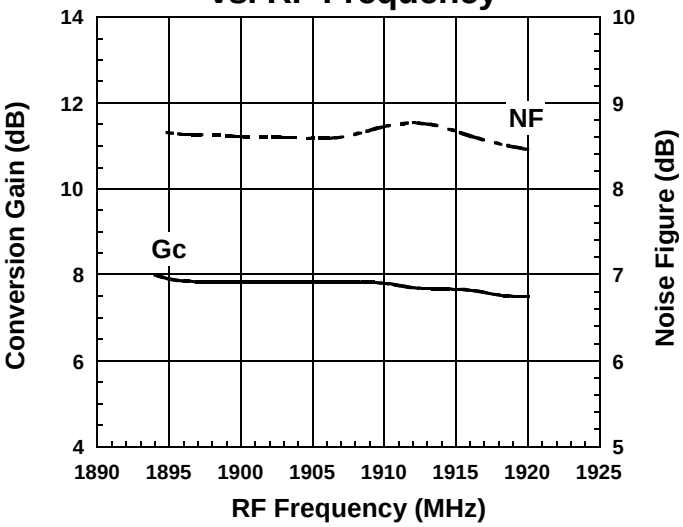
Input-IP3 vs. LO Power Temperature Response



Condition
f_{IF}=240MHz
f_{RF1}=1900.0MHz,P_{RF}=-25dBm
f_{RF2}=1900.1MHz
f_{LO}=1660MHz
V_{MIX}=V_{LO}=2.7V

$$IIP3=\frac{3IF\text{-}IM3}{2}-G_c$$
@P_{RF}=-25dBm

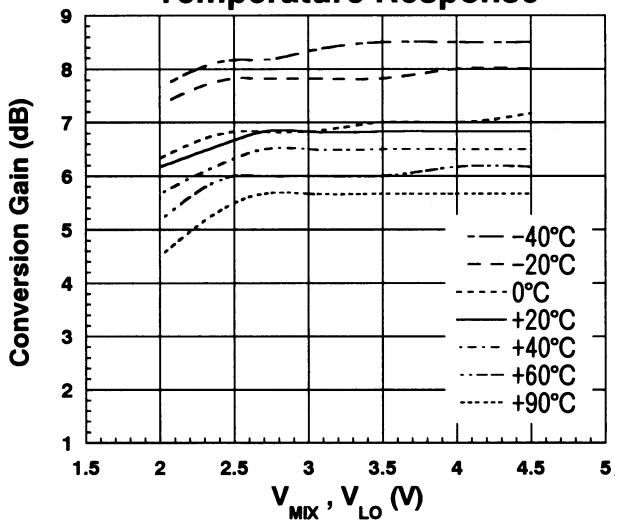
Conversion Gain , Noise Figure vs. RF Frequency



Condition
f_{IF}=240MHz
P_{RF}=-30dBm
P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V
Lower LOCAL

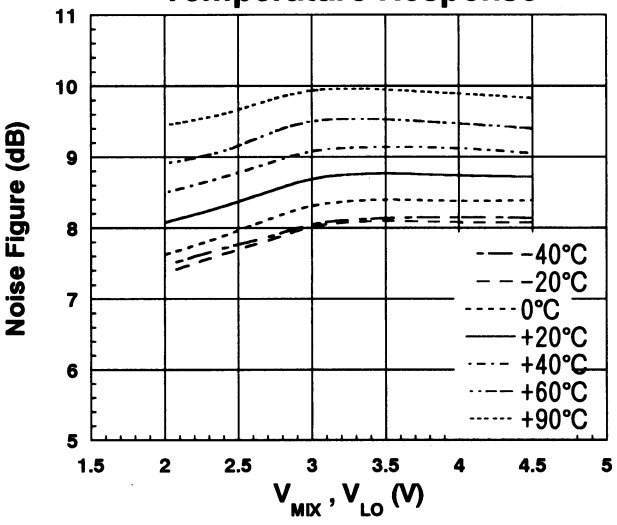
■TYPICAL CHARACTERISTICS (Continued)

Conversion Gain vs. V_{MIX} , V_{LO} Temperature Response



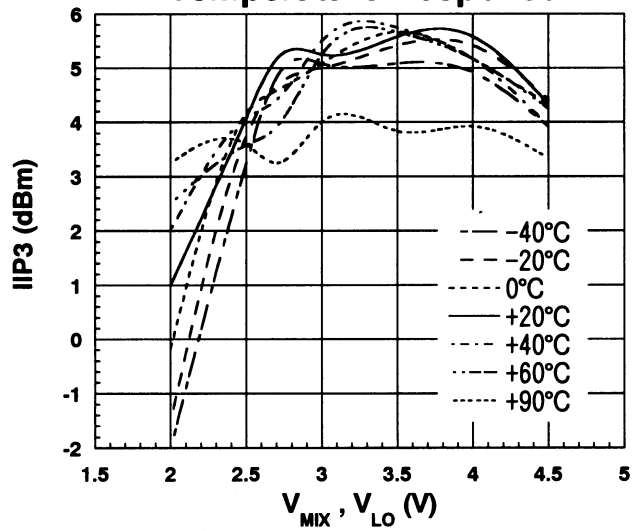
Condition
f_{IF}=240MHz
f_{RF}=1900MHz,P_{RF}=-30dBm
f_{LO}=1660MHz,P_{LO}=-10dBm

Noise Figure vs. V_{MIX} , V_{LO} Temperature Response



Condition
f_{IF}=240MHz
f_{RF}=1900MHz
f_{LO}=1660MHz,P_{LO}=-10dBm

Input-IP3 vs. V_{MIX} , V_{LO} Temperature Response

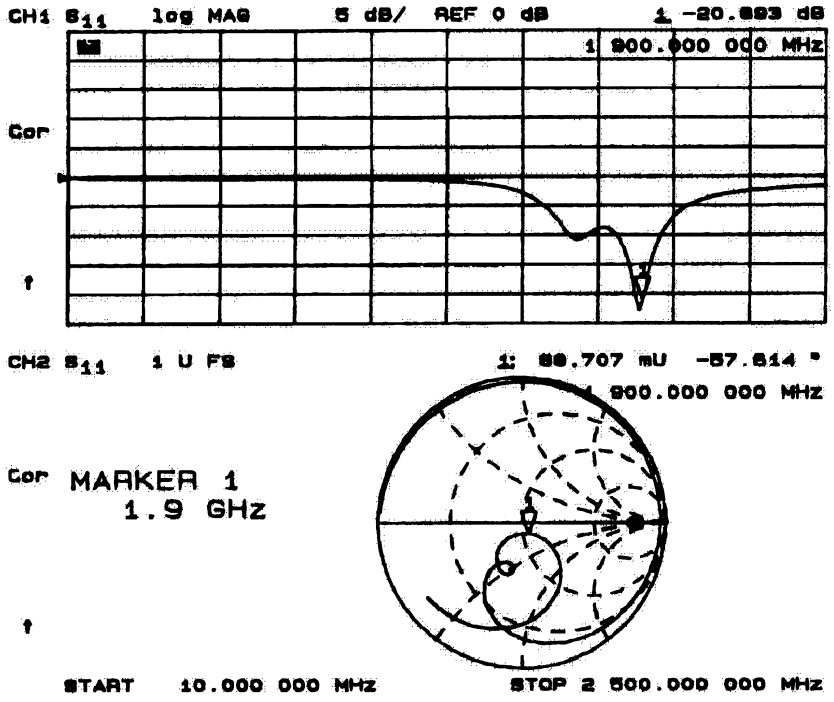


Condition
f_{IF}=240MHz
f_{RF1}=1900.0MHz,P_{RF}=-25dBm
f_{RF2}=1900.1MHz
f_{LO}=1660MHz,f_{LO}=-10dBm

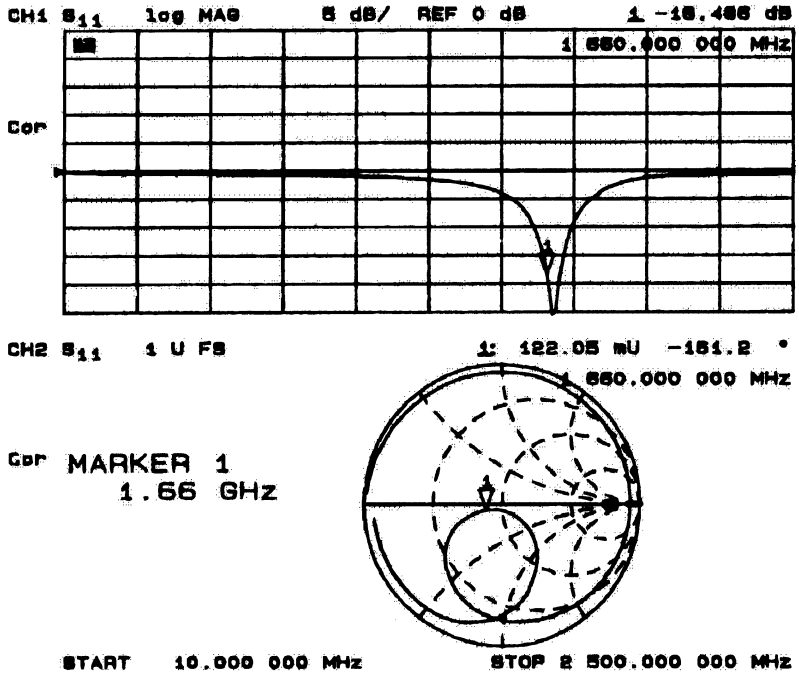
$$IIP3=\frac{3IF-IM3}{2}-G_c$$

@P_{RF}=-25dBm

■**TYPICAL CHARACTERISTICS** (Continued)

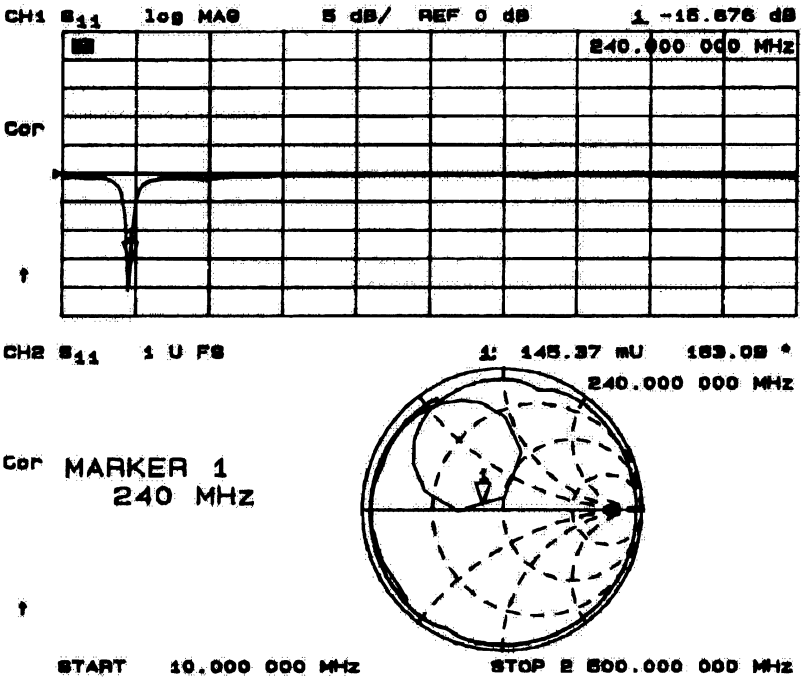


RFIN PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT



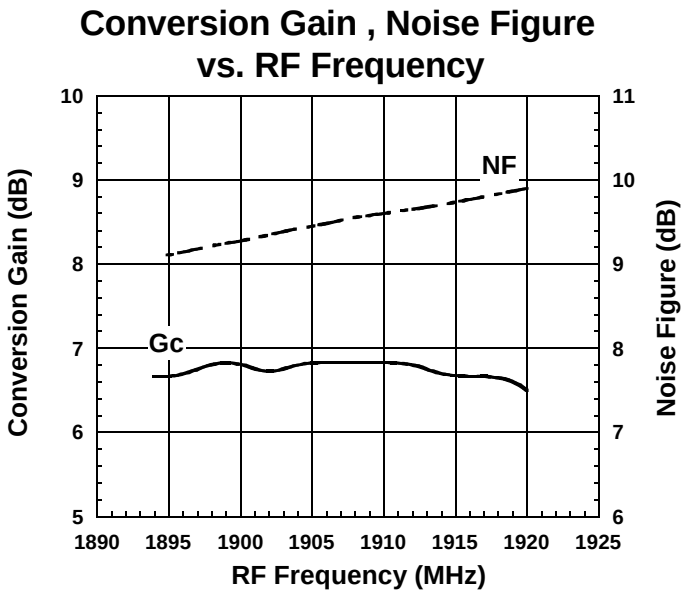
LOIN PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT

■**TYPICAL CHARACTERISTICS** (Continued)

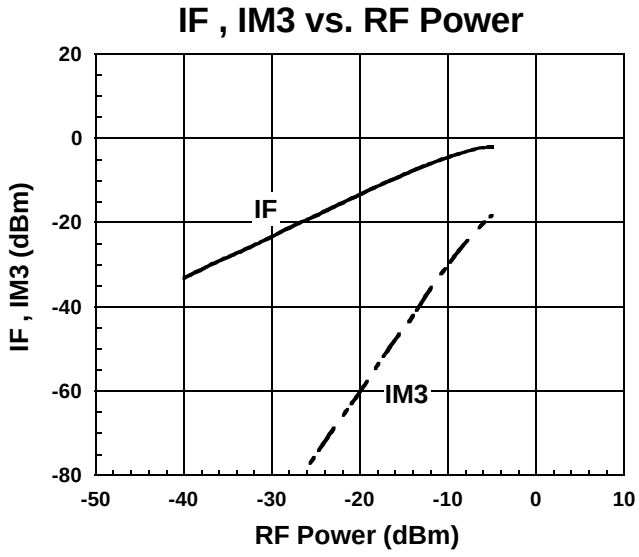


IFOUT PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT

■**TYPICAL CHARACTERISTICS** (Application 1 1.9GHz, f_{LO}=2110MHz)

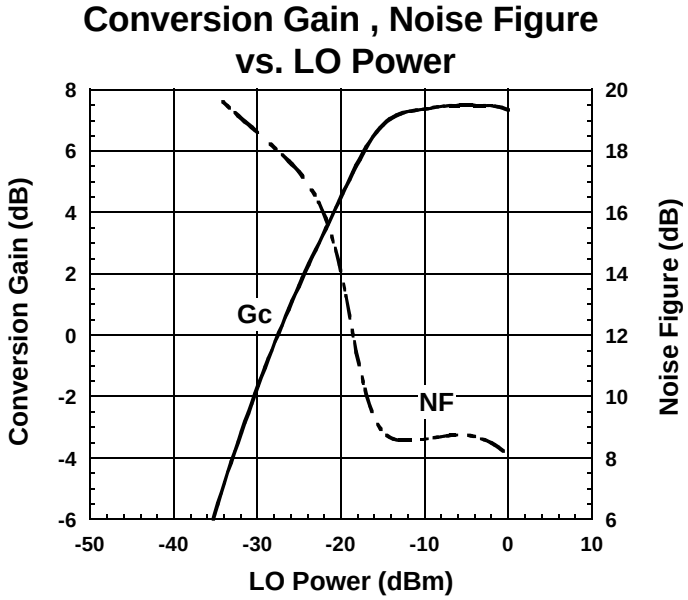


Condition
f_{IF}=210MHz
P_{RF}=-30dBm
P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V
Upper LOCAL

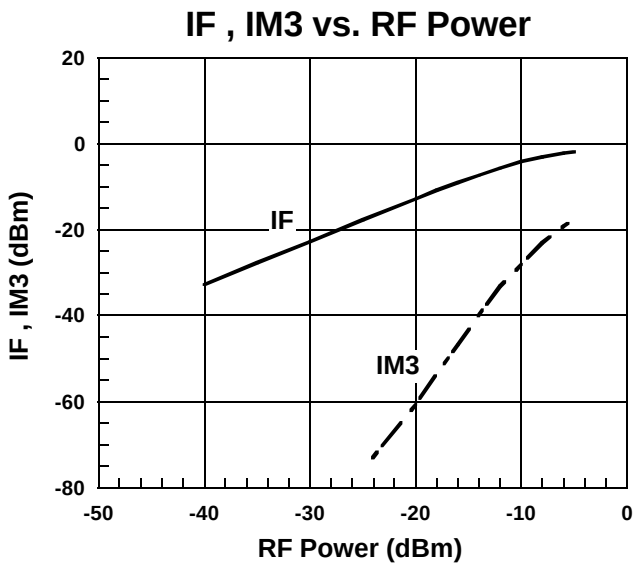


Condition
f_{IF}=210MHz
f_{RF1}=1900.0MHz
f_{RF2}=1900.1MHz
f_{LO}=2110MHz,P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V

■**TYPICAL CHARACTERISTICS** (Application 1 1.9GHz, f_{LO}=1634.62MHz)

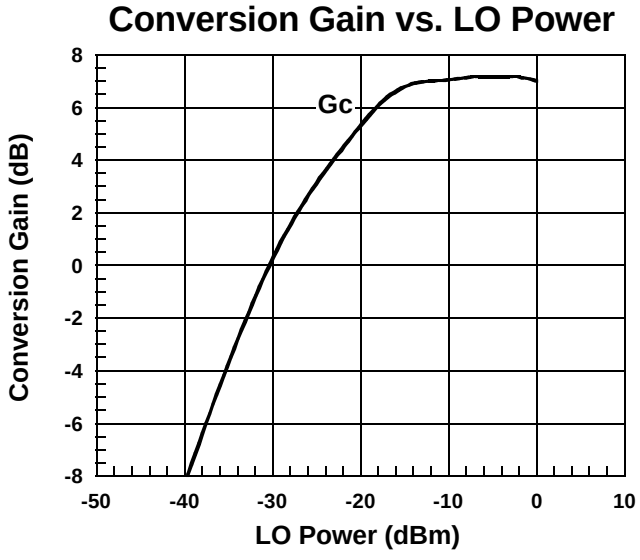


Condition
f_{IF}=220.38MHz
f_{RF}=1855MHz,P_{RF}=-30dBm
f_{LO}=1634.62MHz
V_{MIX}=V_{LO}=2.7V

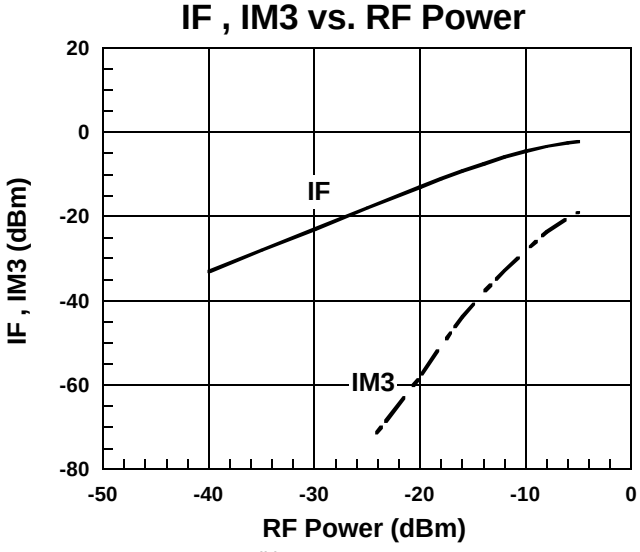


Condition
f_{IF}=220.38MHz
f_{RF1}=1855.0MHz
f_{RF2}=1855.1MHz
f_{LO}=1634.62MHz,P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V

■**TYPICAL CHARACTERISTICS** (Application 1 1.9GHz, f_{LO}=1749.62MHz)



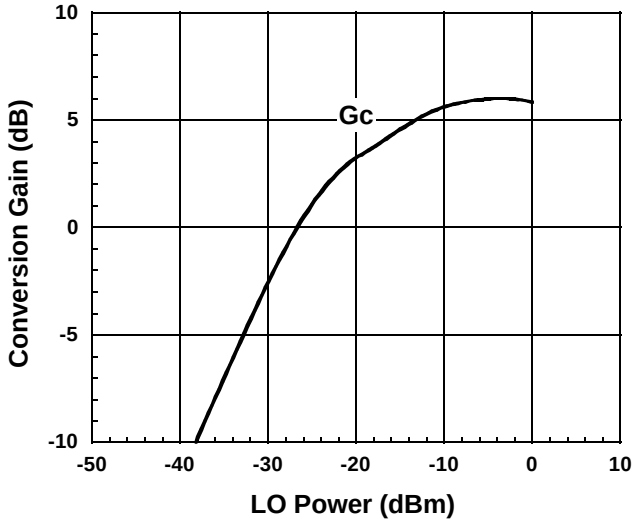
Condition
f_{IF}=210.38MHz
f_{RF}=1960MHz,P_{RF}=-30dBm
f_{LO}=1749.62MHz
V_{MIX}=V_{LO}=2.7V



Condition
f_{IF}=210.38MHz
f_{RF1}=1960.0MHz
f_{RF2}=1960.1MHz
f_{LO}=1749.62MHz,P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V

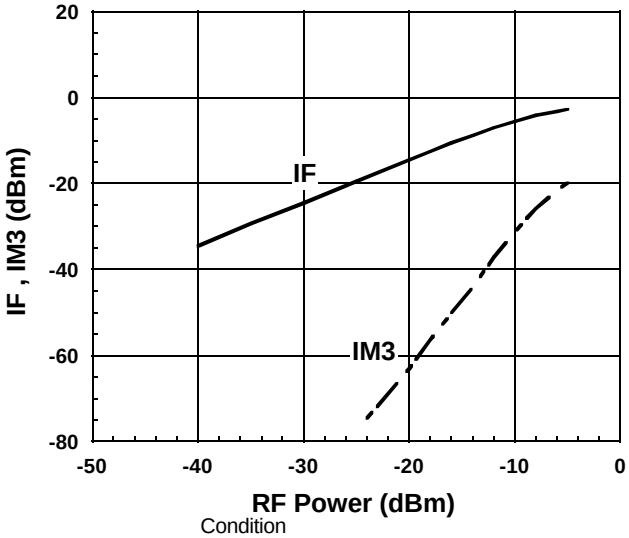
■**TYPICAL CHARACTERISTICS** (Application 1 2.1GHz, f_{LO}=1914.62MHz)

Conversion Gain vs. LO Power



Condition
f_{IF}=220.38MHz
f_{RF}=2135MHz,P_{RF}=-30dBm
f_{LO}=1914.62MHz
V_{MIX}=V_{LO}=2.7V

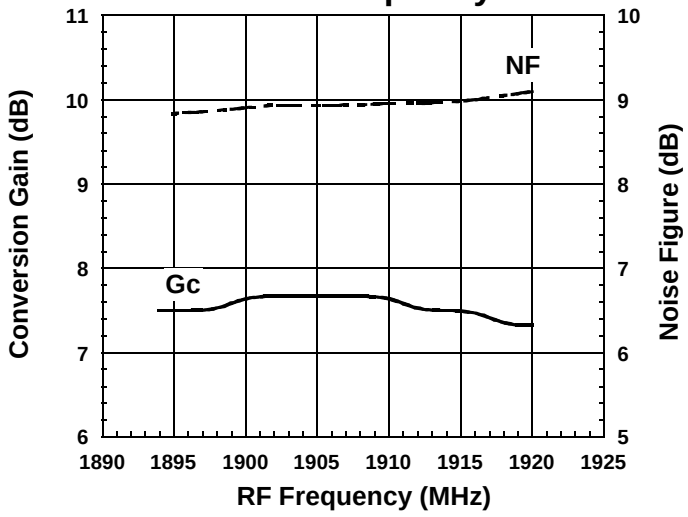
IF , IM3 vs. RF Power



Condition
f_{IF}=220.38MHz
f_{RF1}=2135.0MHz
f_{RF2}=2135.1MHz
f_{LO}=1914.62MHz,P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V

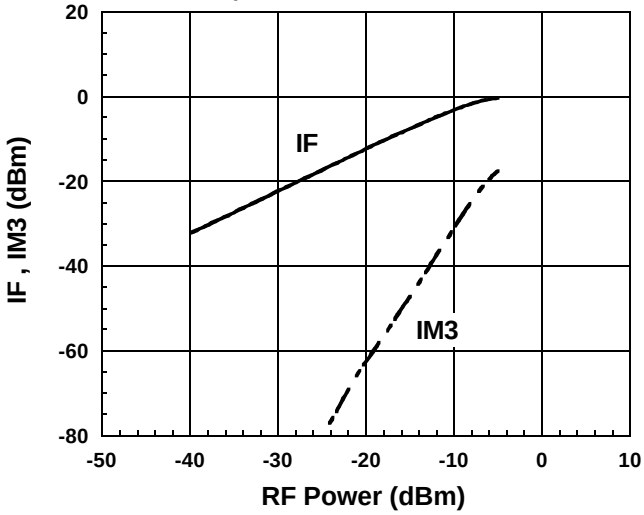
■**TYPICAL CHARACTERISTICS** (Application 2 1.9GHz, f_{LO}=2110MHz)

Conversion Gain , Noise Figure vs. RF Frequency



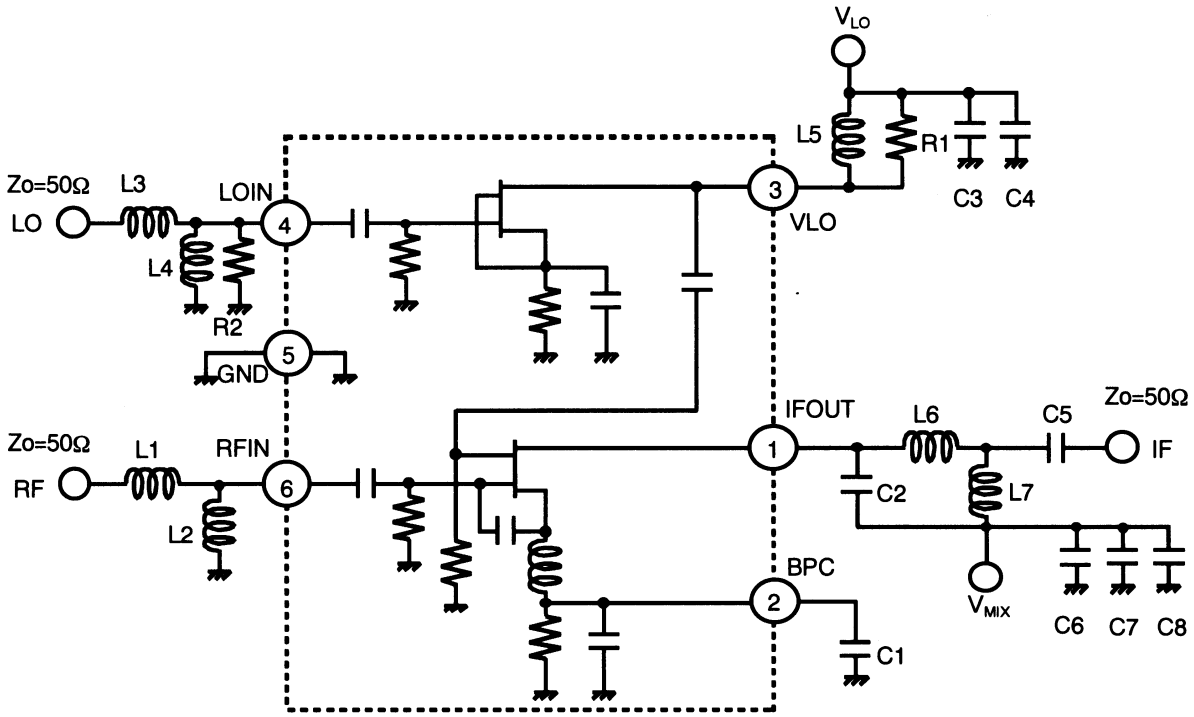
Condition
f_{IF}=210MHz
P_{RF}=-30dBm
P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V
Upper LOCAL

IF , IM3 vs. RF Power



Condition
f_{IF}=210MHz
f_{RF1}=1900.0MHz
f_{RF2}=1900.1MHz
f_{LO}=2110MHz,P_{LO}=-10dBm
V_{MIX}=V_{LO}=2.7V

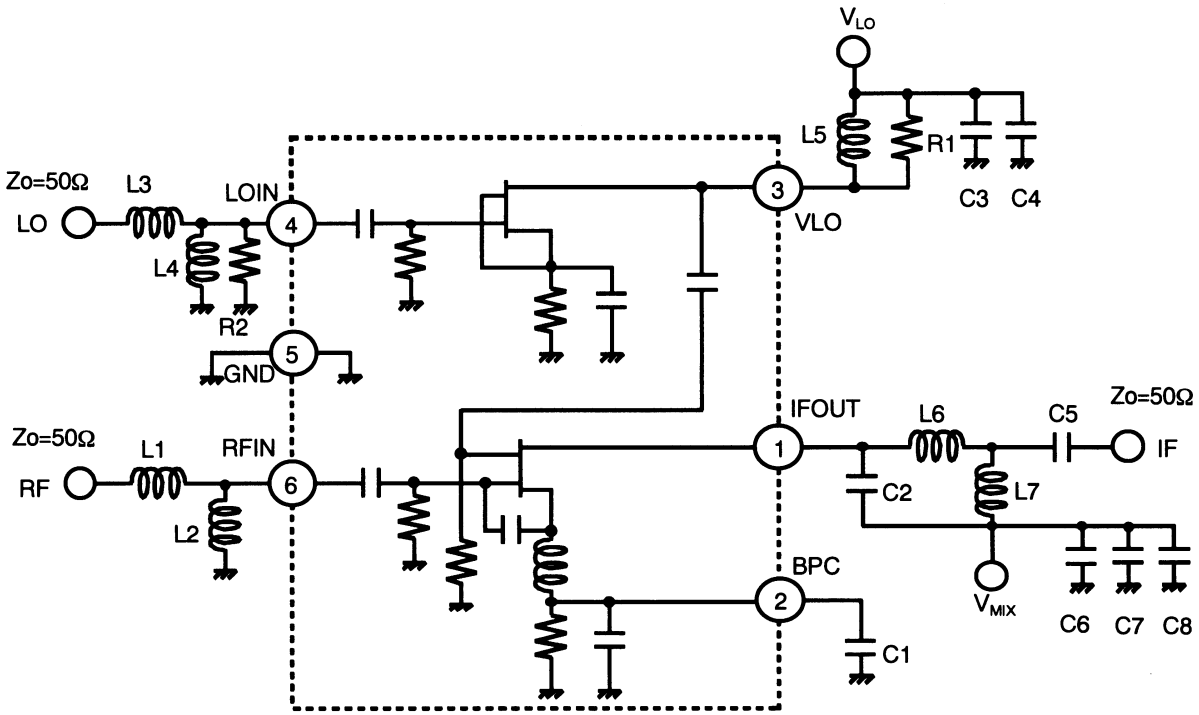
■APPLICATION CIRCUIT 1



PARTS LIST 1

PART ID	1.5GHz Band	1.9GHz BAND		COMMENT
	Upper LOCAL	Lower LOCAL	Upper LOCAL	
	f_{LO}=1619MHz f_{IF}=130MHz	f_{LO}=1660MHz f_{IF}=240MHz	f_{LO}=2110MHz f_{IF}=210MHz	
L1	10nH	6.8nH	4.7nH	TAIYO-YUDEN(HK1608)
L2	8.2nH	4.7nH	3.3nH	TAIYO-YUDEN(HK1608)
L3	12nH	12nH	6.8nH	TAIYO-YUDEN(HK1608)
L4	12nH	10nH	5.6nH	TAIYO-YUDEN(HK1608)
L5	6.8nH	5.6nH	3.9nH	TAIYO-YUDEN(HK1608)
L6	100nH	39nH	47nH	TAIYO-YUDEN(HK1608)
L7	47nH	15nH	27nH	TAIYO-YUDEN(HK1608)
C1	1000pF	560pF	560pF	MURATA(GRM39)
C2	11pF	8pF	8pF	MURATA(GRM39)
C3	100pF	100pF	100pF	MURATA(GRM39)
C4	100pF	100pF	100pF	MURATA(GRM39)
C5	1000pF	1000pF	1000pF	MURATA(GRM39)
C6	10pF	10pF	10pF	MURATA(GRM39)
C7	100pF	100pF	100pF	MURATA(GRM39)
C8	1000pF	1000pF	1000pF	MURATA(GRM39)
R1	270Ω	270Ω	240Ω	TAMA Electronics(CRG16G)
R2	270Ω	470Ω	430Ω	TAMA Electronics(CRG16G)

■APPLICATION CIRCUIT 1



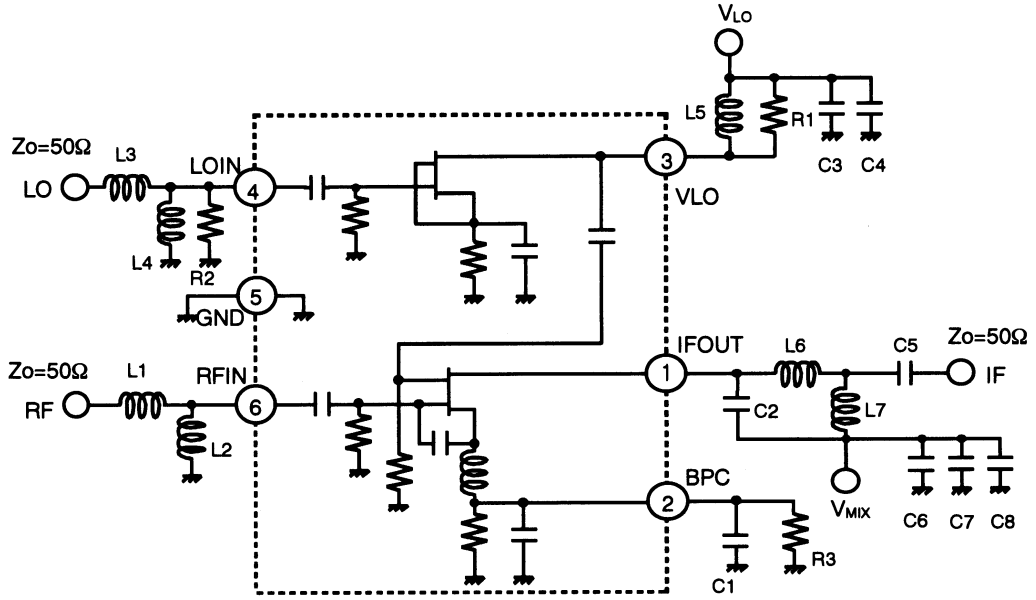
PARTS LIST 2

PART ID	1.9GHz Band		2.1GHz Band	COMMENT
	Lower LOCAL	Lower LOCAL	Lower LOCAL	
	f_{LO}=1634.62MHz f_{IF}=220.38MHz	f_{LO}=1749.62MHz f_{IF}=210.38MHz	f_{LO}=1914.62MHz f_{IF}=220.38MHz	
L1	6.8nH	6.8nH	4.7nH	TAIYO-YUDEN(HK1608)
L2	4.7nH	4.7nH	3.9nH	TAIYO-YUDEN(HK1608)
L3	12nH	12nH	10nH	TAIYO-YUDEN(HK1608)
L4	10nH	8.2nH	6.8nH	TAIYO-YUDEN(HK1608)
L5	6.8nH	5.6nH	4.7nH	TAIYO-YUDEN(HK1608)
L6	39nH	39nH	39nH	TAIYO-YUDEN(HK1608)
L7	22nH	22nH	22nH	TAIYO-YUDEN(HK1608)
C1	560pF	560pF	560pF	MURATA(GRM39)
C2	8pF	8pF	8pF	MURATA(GRM39)
C3	10pF	10pF	10pF	MURATA(GRM39)
C4	100pF	100pF	100pF	MURATA(GRM39)
C5	1000pF	1000pF	1000pF	MURATA(GRM39)
C6	10pF	10pF	10pF	MURATA(GRM39)
C7	100pF	100pF	100pF	MURATA(GRM39)
C8	1000pF	1000pF	1000pF	MURATA(GRM39)
R1	240Ω	270Ω	330Ω	TAMA Electronics(CRG16G)
R2	430Ω	390Ω	470Ω	MURATA(GRM39)

■APPLICATION CIRCUIT 2

This circuit is purposed for improving input IP3 performance by setting mixer current to around 10mA by adding external resistance to BPC terminal.

Reference value Application 1 IIP3=+4dBm
Application 2 IIP3=+5.1dBm

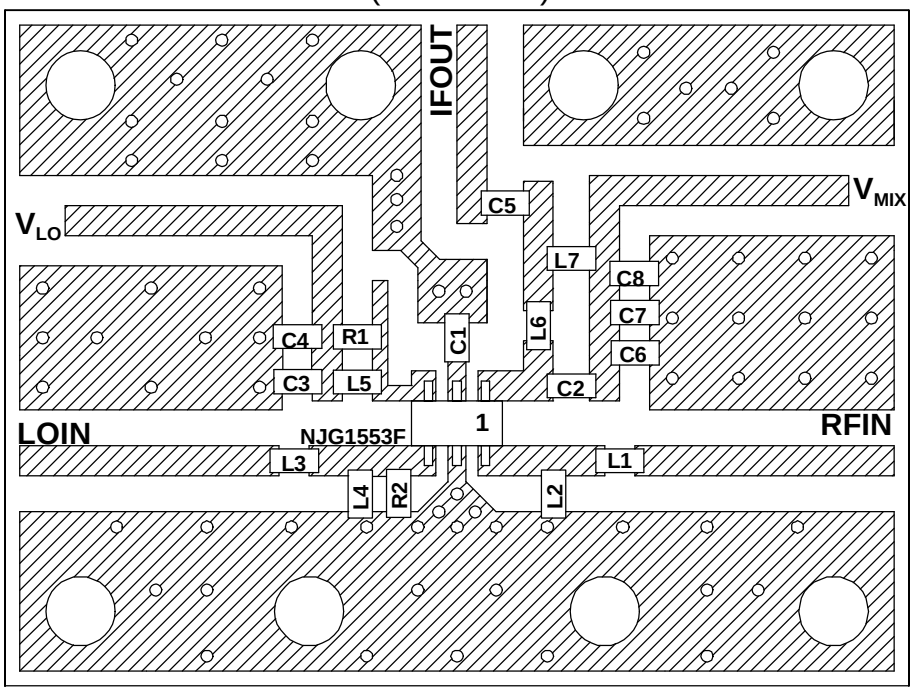


PARTS LIST

PART ID	1.9GHz Band Upper LOCAL f_{LO}=2110MHz f_{IF}=210MHz		COMMENT
L1	4.7nH		TAIYO-YUDEN(HK1608)
L2	3.3nH		TAIYO-YUDEN(HK1608)
L3	6.8nH		TAIYO-YUDEN(HK1608)
L4	4.7nH		TAIYO-YUDEN(HK1608)
L5	3.9nH		TAIYO-YUDEN(HK1608)
L6	47nH		TAIYO-YUDEN(HK1608)
L7	27nH		TAIYO-YUDEN(HK1608)
C1	560pF		MURATA(GRM39)
C2	8pF		MURATA(GRM39)
C3	100pF		MURATA(GRM39)
C4	1000pF		MURATA(GRM39)
C5	1000pF		MURATA(GRM39)
C6	10pF		MURATA(GRM39)
C7	100pF		MURATA(GRM39)
C8	1000pF		MURATA(GRM39)
R1	240Ω		TAMA Electronics(CRG16G)
R2	430Ω		TAMA Electronics(CRG16G)
R3	82Ω		TAMA Electronics(CRG16G)

■RECOMMENDED PCB DESIGN

(TOP VIEW)



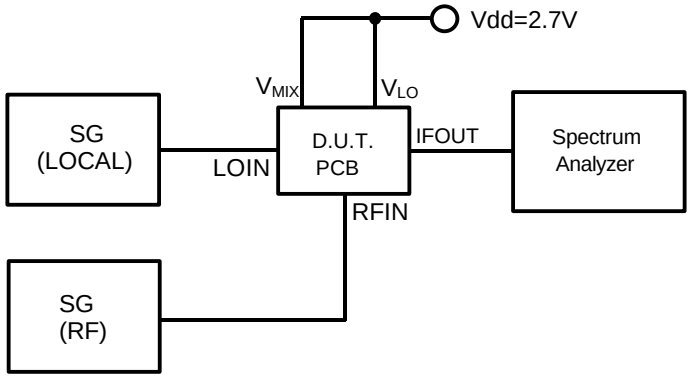
PCB : FR-4, t=0.5mm
STRIPLINE WIDTH=1mm
(Zo=50Ω)

(SIZE: 22.5mm x 30mm)

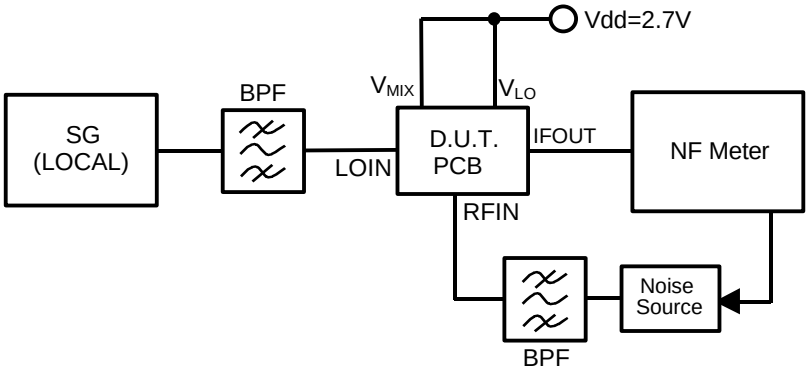
PRECAUTIONS

[1] Please locate L5 and R1 close to VLO terminal (3).
[2] Distance from L1 and RFIN terminal (6) is 3.5mm.
[3] Distance from L3 and LOIN terminal (4) is 3.5mm.
[4] Please locate C1 close to BPC terminal (2).
[5] Please locate C6, C7, C8 close to C2, L7.
[6] Please locate C3, C4 close to R1, L5.

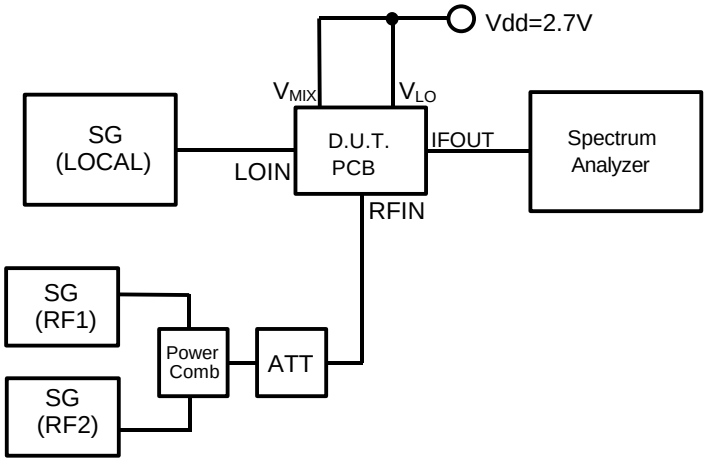
■MEASURING BLOCK DIAGRAM



Conversion Gain Measurement Block Diagram

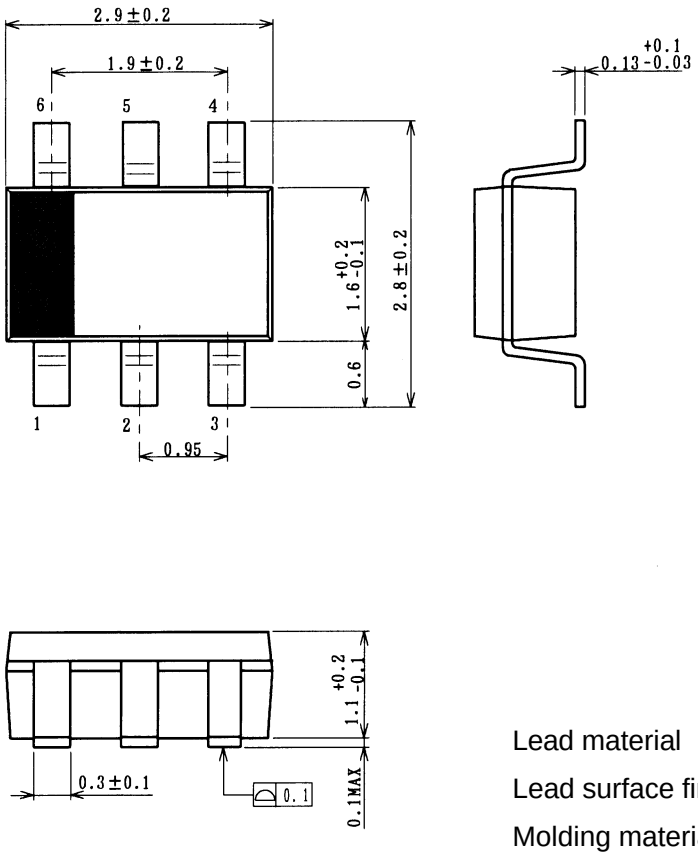


Noise Figure Measurement Block Diagram



IF , IM3 , IM5 Measurement Block Diagram

■PACKAGE OUTLINE (MTP6)



Lead material	: Copper
Lead surface finish	: Solder plating
Molding material	: Epoxy resin
Unit	: mm
Weight	: 14mg

Cautions on using this product

This product contains Gallium-Arsenide (GaAs) which is a harmful material.

- Do NOT eat or put into mouth.
- Do NOT dispose in fire or break up this product.
- Do NOT chemically make gas or powder with this product.
- To waste this product, please obey the relating law of your country.

This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.