CDMA/AMPS RX FRONT-END GaAs MMIC

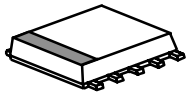
■DESCRIPTION

NJG1712KC1 is a front-end MMIC including a LNA, a local amplifier and a mixer, designed mainly for 800MHz band CDMA/AMPS.

The performance of mixer and the parts count of external circuits may be optimized during development.

The ultra small & ultra thin FLP10-C1 package is applied.

■PACKAGE OUTLINE

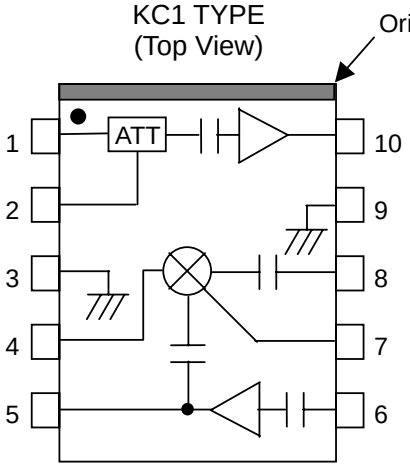


■FEATURES

●Low Voltage Operation	+2.8V typ.
●Low Current Consumption	15.0mA typ.
●Ultra Small & Ultra Thin package	FLP10-C1 (Mount Size: 2.8x3.0x0.75mm)
•LNA	
●High Small Signal Gain	18.0dB typ.
●Low Noise Figure	1.3dB typ.
●High Input IP3	+4.0dBm typ. @ V_{CONT}=1.9V +26dBm typ. @V_{CONT}=0.1V
•Mixer	
●High Conversion Gain	10.0dB typ.
●Low Nose Figure	6.5dB typ
●High Input IP3	+6.0dBm typ.

■PIN CONFIGURATION

KC1 TYPE
(Top View)



Pin Connection

1. LNAIN
2. VCONT
3. GND
4. IFOUT
5. VLO
6. LOIN
7. SOURCE
8. MIXIN
9. GND
10. LNAOUT

■ABSOLUTE MAXIMUM RATINGS

(T_a=+25°C, Z_s=Z_l=50Ω)

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNITS
LNA Voltage	V_{LNA}		6.0	V
Gain Control Voltage	V_{CONT}		4.0	V
Mixer Voltage	V_{MIX}		6.0	V
LOCAL Amplifier Voltage	V_{LO}		6.0	V
Input Power 1	P_{LNAIN}	V_{LNA}=2.85V	+20	dBm
Input Power 2	P_{MIXIN}	V_{MIX}=V_{LO}=2.8V	+10	dBm
Input Power 3	P_{LOIN}	V_{MIX}=V_{LO}=2.8V	+10	dBm
Power Dissipation	P_D		550	mW
Operating Temperature	T_{opr}		-40~+85	°C
Storage Temperature	T_{stg}		-55~+125	°C

■ELECTRICAL CHARACTERISTICS 1 (LNA)

GENERAL CONDITIONS: T_a=+25°C, V_{LNA}=2.8V, V_{MIX}=V_{LO}=0V, f_{RF}=850MHz
P_{RF}=-30dBm, Z_s=Z_l=50Ω, with the test circuit

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Frequency	Freq		830	850	870	MHz
LNA Voltage	V_{LNA}		2.7	2.8	4.5	V
Gain Control Range	V_{CONT}		0.0	1.9	3.0	V
LNA Operating Current	I_{LNA}	P_{RF} OFF	-	6.3	7.5	mA
Small Signal Gain	Gain	V_{CONT}=1.9V	14.0	15.0	16.0	dB
Gain Flatness	G_{flat}	f_{RF}=869~894MHz	-	0.5	1.0	dB
Dynamic Range	G_{CONT}	V_{CONT}=0.1 to 1.9V	21	24	-	dB
Noise Figure	NF_{LNA}	V_{CONT}=1.9V	-	1.3	1.6	dB
Pout at 1dB Gain Compression point	P_{-1dB}		+3.0	5.5	-	dBm
Input 3rd Order Intercept point	IIP3	V_{CONT}=1.9V [*1] V_{CONT}=0.1V [*1]	+2.0 +21.0	+4.0 +26.0	-	dBm dBm
RF IN VSWR	$VSWR_i$		-	2.0	2.5	
RF OUT VSWR	$VSWR_o$		-	1.5	2.0	

[*1] Two tones of –30dBm each, f=850.0+850.1MHz

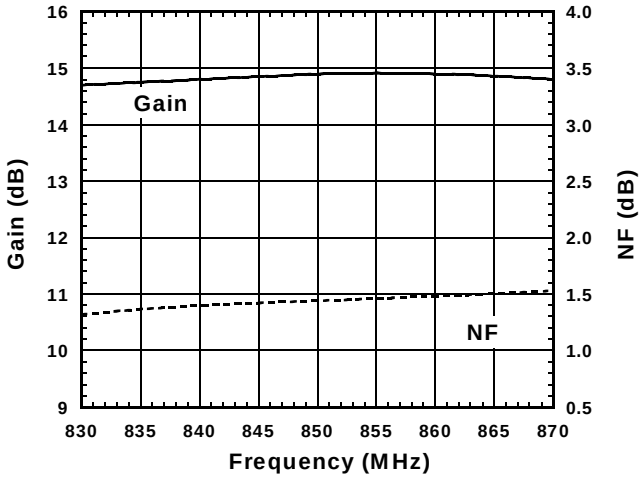
■**ELECTRICAL CHARACTERISTICS 2** (Mixer)

GENERAL CONDITIONS: T_a=+25°C, V_{MIX}=V_{LO}=2.8V, f_{RF}=850MHz, f_{LO}=740MHz
P_{RF}=-30dBm, P_{LO}=-10dBm, Z_s=Z_l=50Ω, with the test circuit

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Frequency	Freq		830	850	870	MHz
Mixer Voltage	V_{MIX}		2.7	2.8	4.5	V
Local Amplifier Voltage	V_{LO}		2.7	2.8	4.5	V
Mixer Current	I_{MIX}	P_{RF}, P_{LO}=OFF	-	7.5	9.1	mA
Local Current	I_{LO}	P_{RF}, P_{LO}=OFF		1.2	1.5	mA
Conversion Gain	G_c		8.5	10.0	-	dB
Noise Figure	NF_{MIX}		-	6.5	7.5	dB
Pout at 1dB Gain Compression point	P_{-1dB}		+0	+3.0	-	dBm
Input 3rd Order Intercept Point	IIP3	Two tone of -30dBm each f_{RF}=881.0+881.1MHz	+4.0	+6.0	-	dBm
Lo to RF Isolation	ISL1		5	10	-	dB
Lo to IF Isolation	ISL2		25	30		dB
MIXER IN VSWR	$VSWR_{MIX}$		-	1.5	2.0	
LOCAL IN VSWR	$VSWR_{LO}$		-	1.5	2.0	
IF OUT VSWR	$VSWR_{IF}$		-	1.5	2.0	

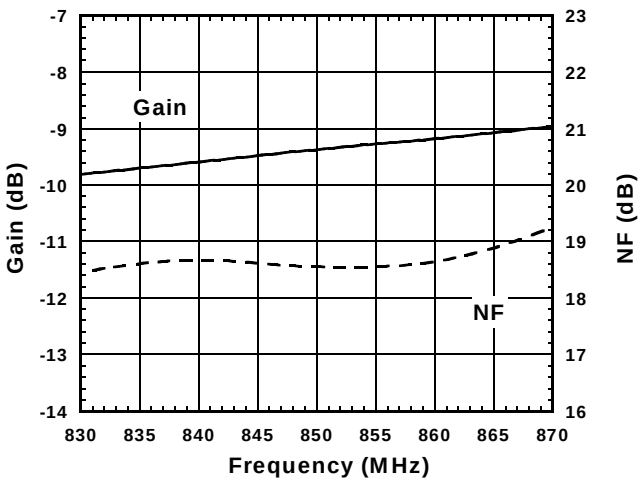
■ TYPICAL CHARACTERISTICS (LNA, with test circuit)

Gain, NF vs. Frequency



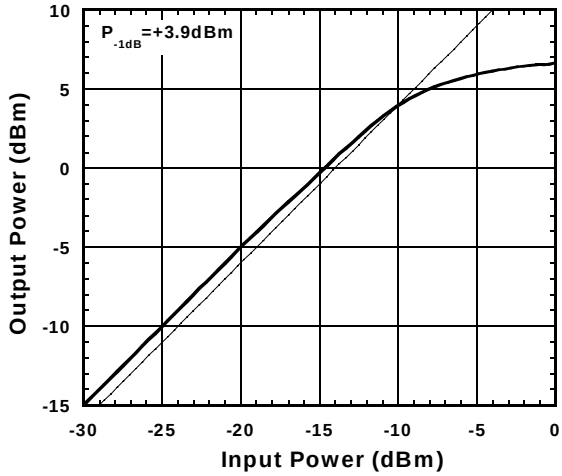
Condition
f=830~870MHz
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

Gain, NF vs. Frequency



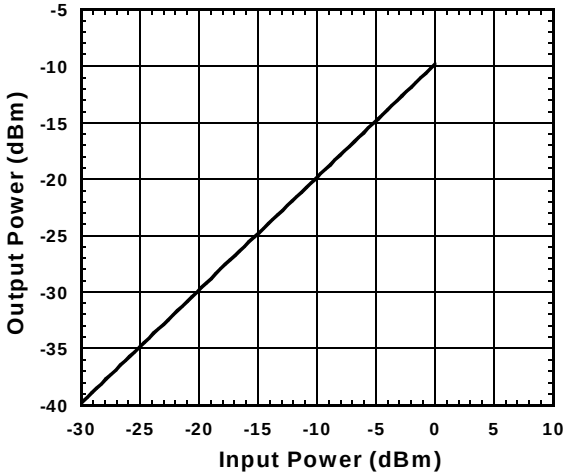
Condition
f=830~870MHz
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

Output Power vs. Input Power



Condition
f=850MHz
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

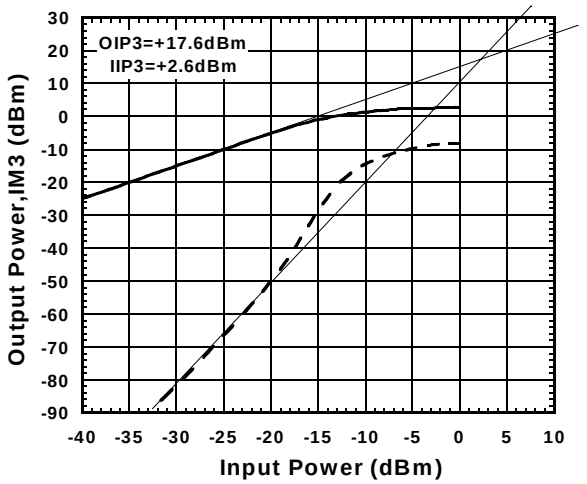
Output Power vs. Input Power



Condition
f=850MHz
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

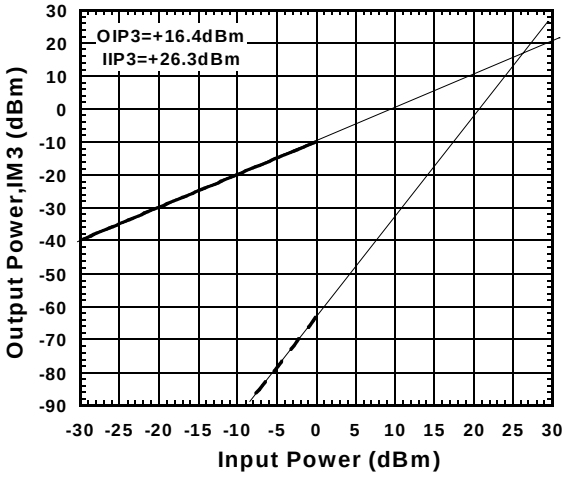
■ TYPICAL CHARACTERISTICS (LNA, with test circuit)

Output Power, IM3 vs. Input Power



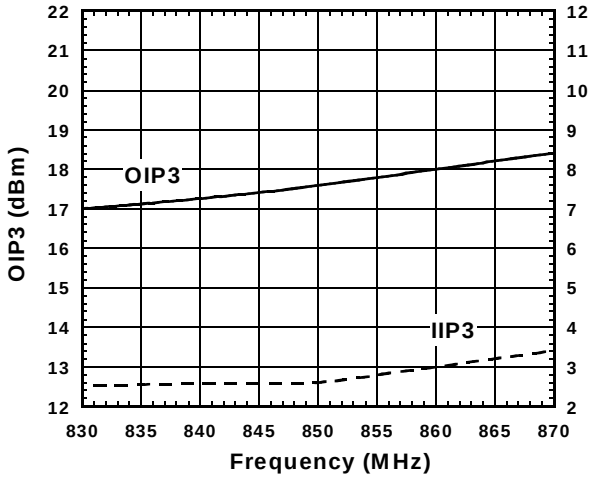
Condition
f=850+850.1MHz
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

Output Power, IM3 vs. Input Power



Condition
f=850+850.1MHz
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

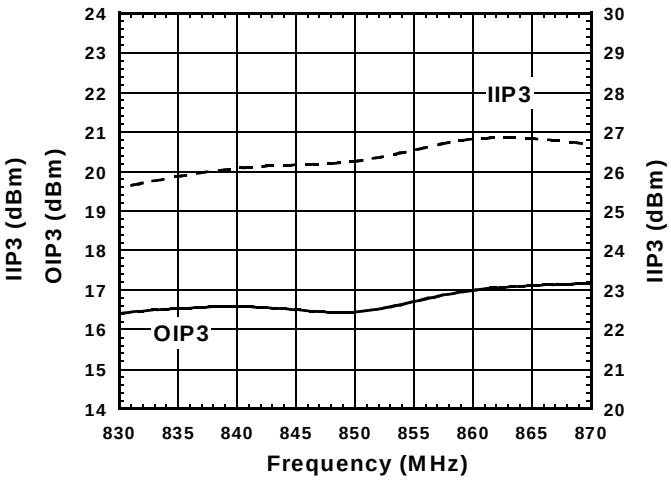
OIP3,IIP3 vs. Frequency



Condition
f=830~870MHz
f_{OFFSET}=100kHz
Pin=-30dBm
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

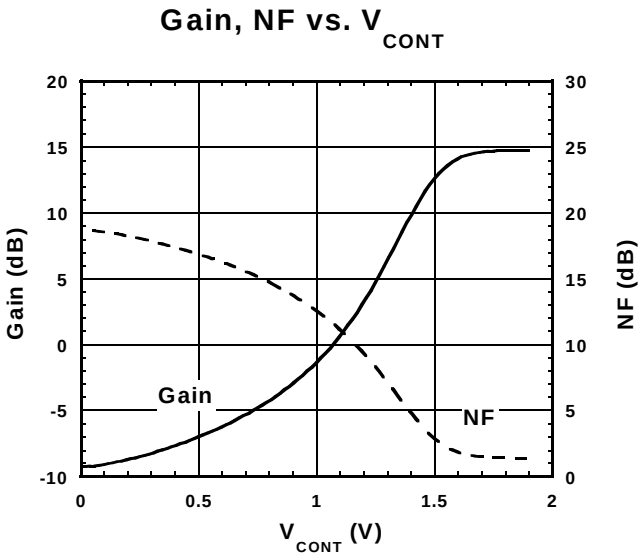
OIP3=(3xPout-IM3)/2
IIP3=OIP3-Gain

OIP3,IIP3 vs. Frequency

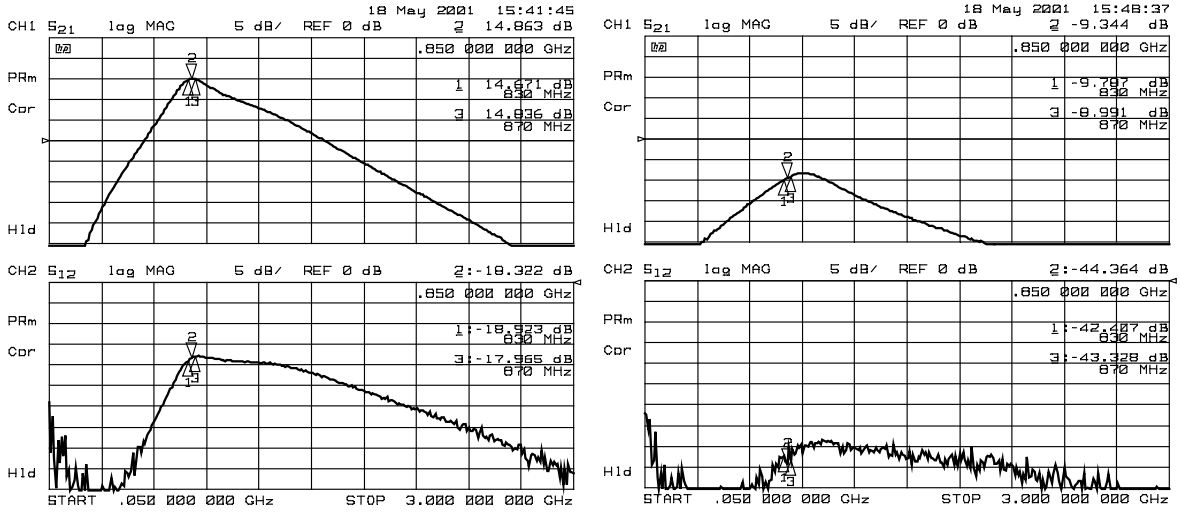


Condition
f=830~870MHz
f_{OFFSET}=100kHz
Pin=-10dBm
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

■ TYPICAL CHARACTERISTICS (LNA, with test circuit)



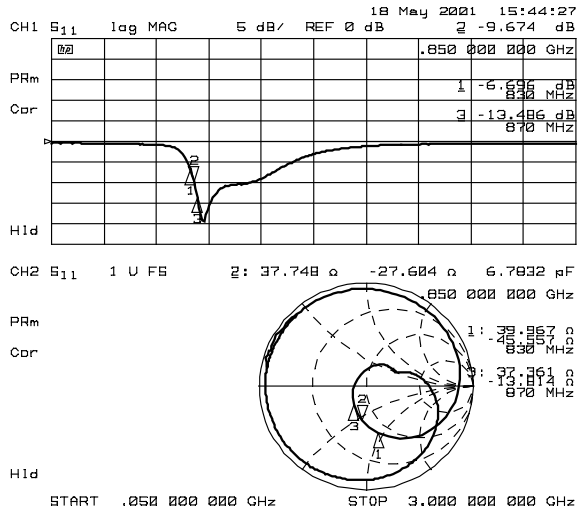
Condition
f=850MHz
V_{LNA}=2.8V
V_{MIX}=V_{LO}=0V



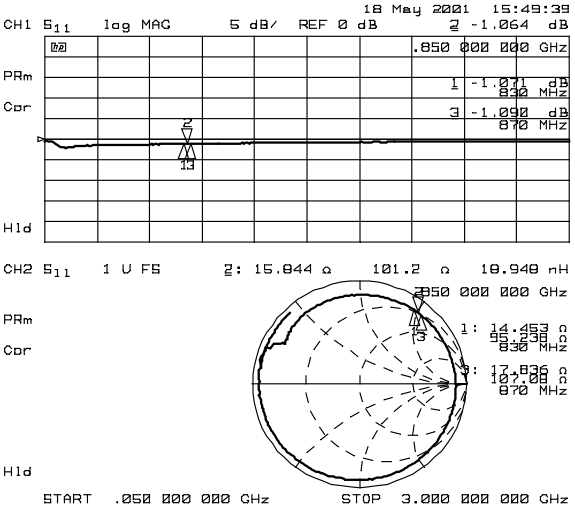
S21&S12
Condition
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

S21&S12
Condition
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

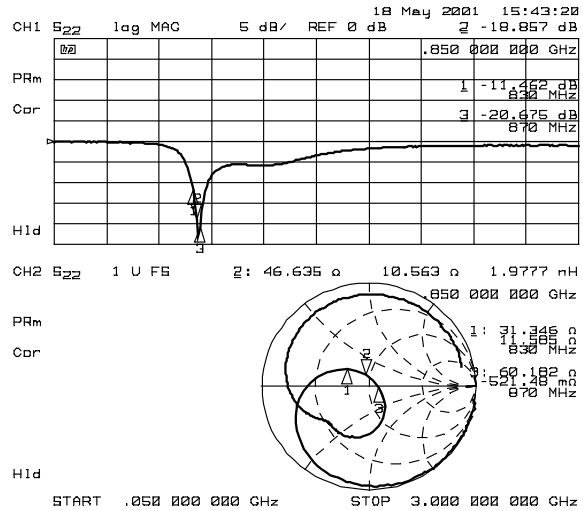
■ TYPICAL CHARACTERISTICS (LNA, with test circuit)



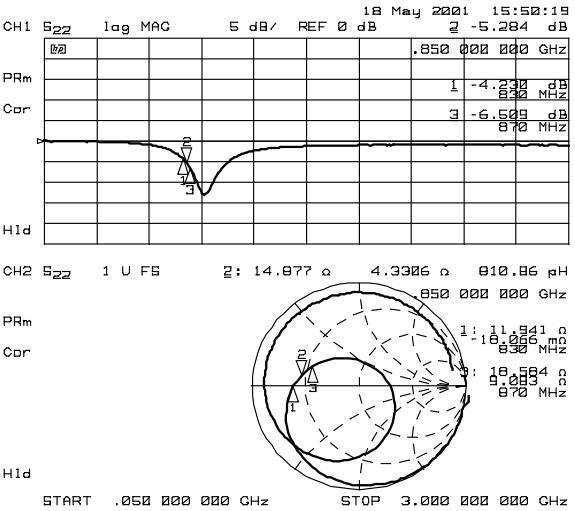
RF IN port Impedance
Condition
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V



RF IN port Impedance
Condition
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

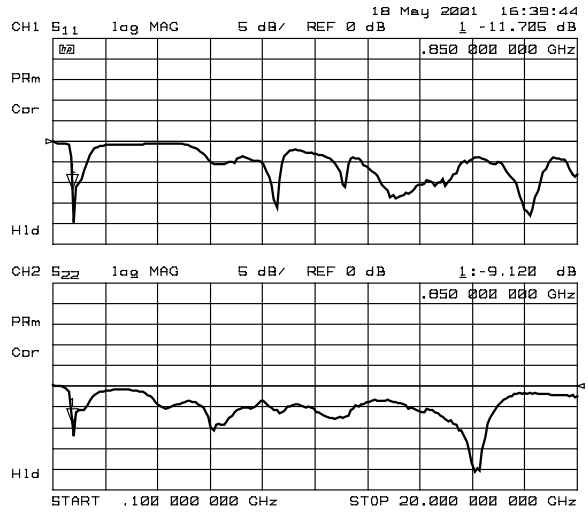


RF OUT port Impedance
Condition
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

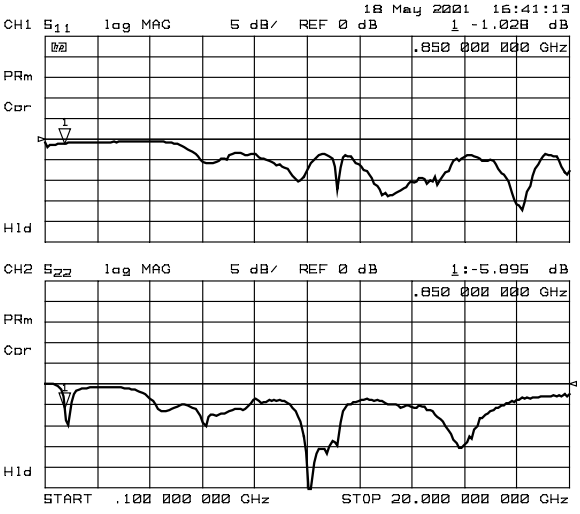


RF OUT port Impedance
Condition
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

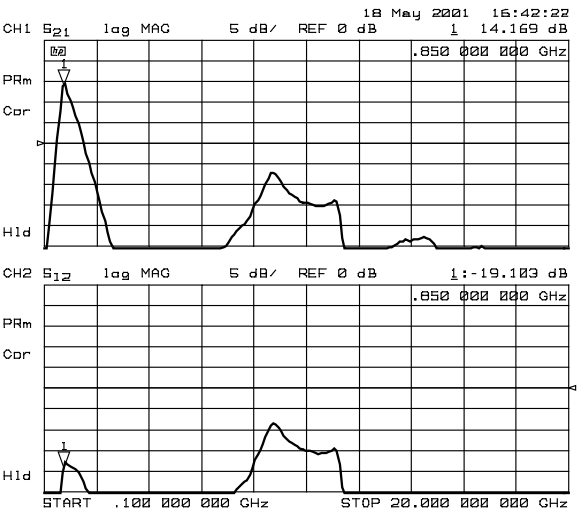
■ TYPICAL CHARACTERISTICS (LNA, with test circuit)



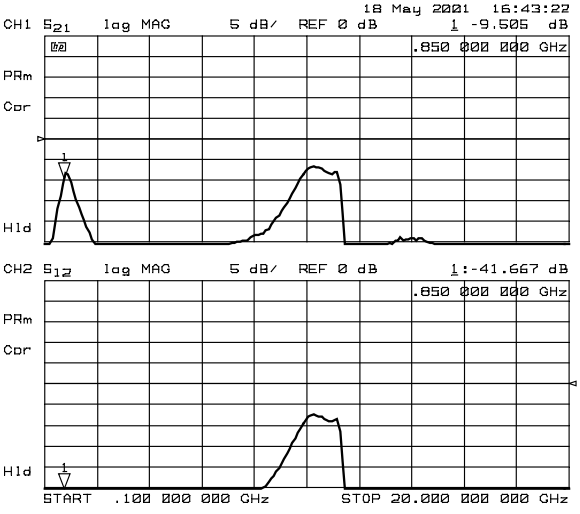
S11&S22 (~20GHz)
Condition
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V



S11&S22 (~20GHz)
Condition
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V



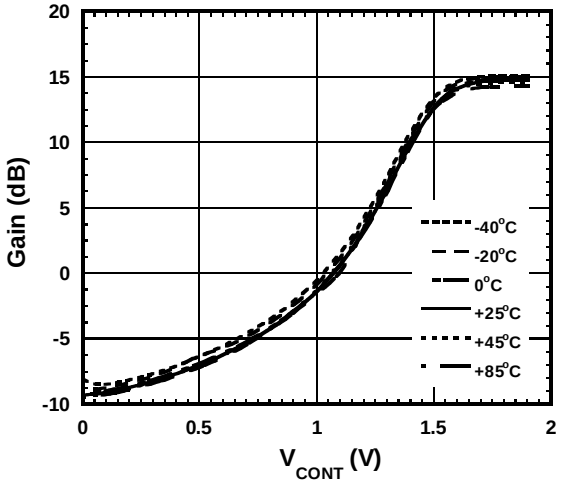
S21&S12 (~20GHz)
Condition
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V



S21&S12 (~20GHz)
Condition
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

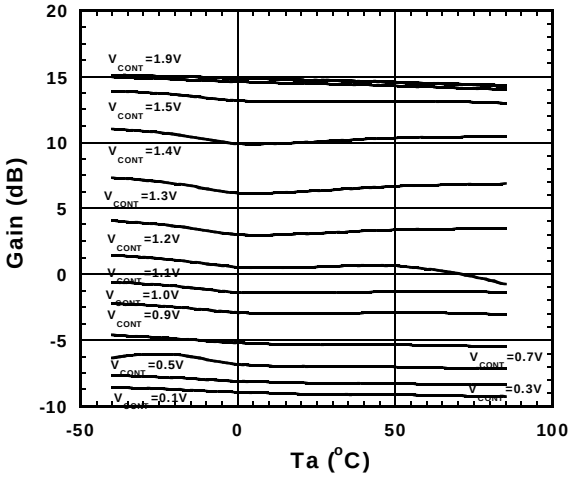
■ TYPICAL CHARACTERISTICS (LNA, with test circuit)

Gain vs. V_{CONT} (Variable Ta)



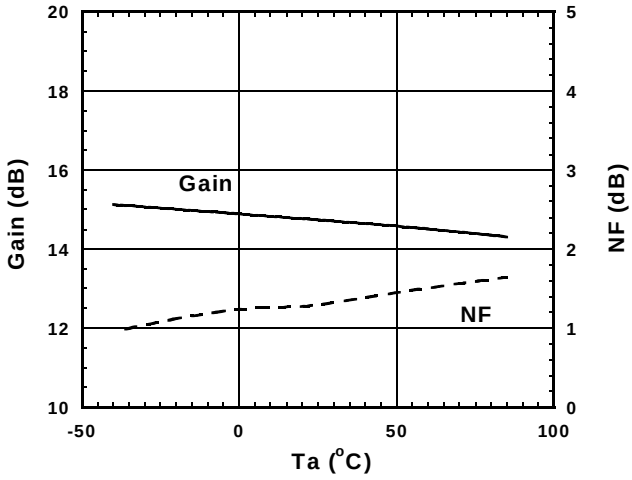
Condition
f=850MHz
V_{LNA}=2.8V
V_{MIX}=V_{LO}=0V

Gain vs. Ta (Variable V_{CONT})



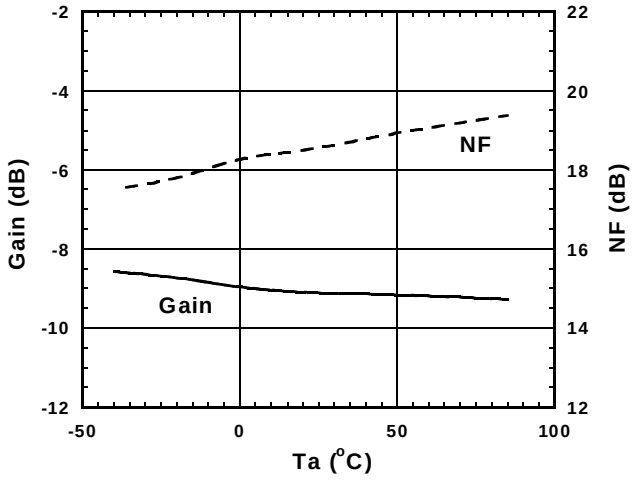
Condition
f=850MHz
V_{LNA}=2.8V
V_{MIX}=V_{LO}=0V

Gain, NF vs. Ta



Condition
f=850MHz
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

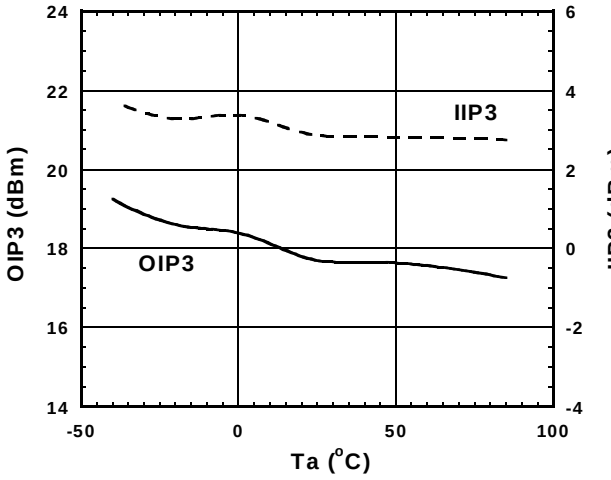
Gain, NF vs. Ta



Condition
f=850MHz
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

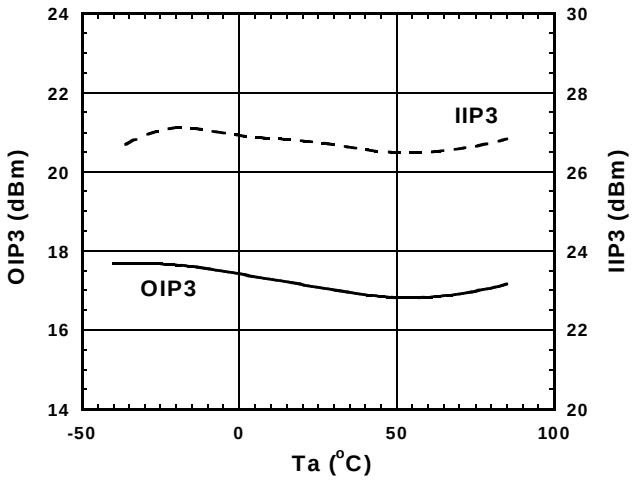
■ TYPICAL CHARACTERISTICS (LNA, with test circuit)

OIP3, IIP3 vs. Ta



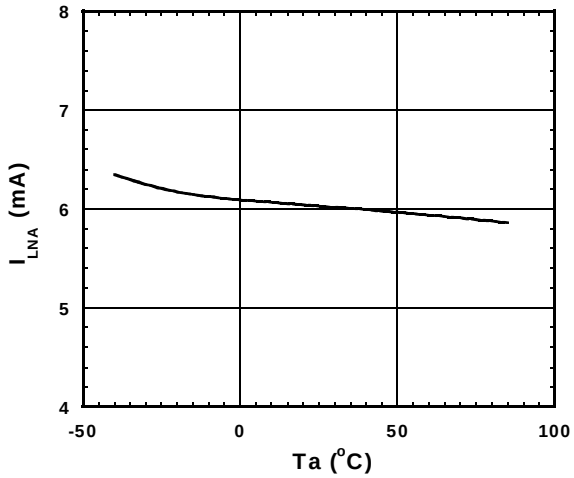
Condition
f=850+850.1MHz
Pin=-10dBm
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

OIP3, IIP3 vs. Ta



Condition
f=850+850.1MHz
Pin=-10dBm
V_{LNA}=2.8V, V_{CONT}=0.1V
V_{MIX}=V_{LO}=0V

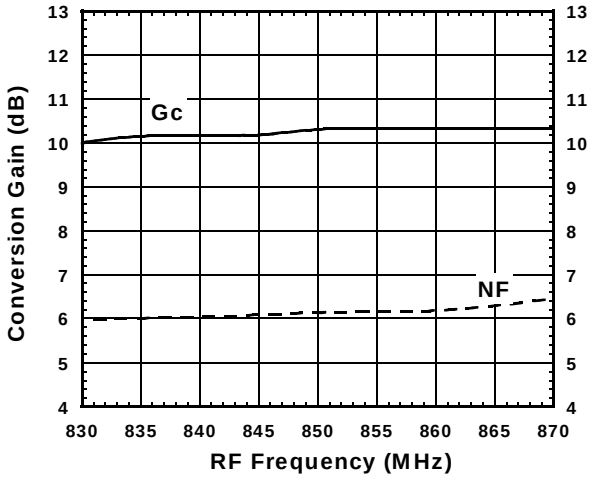
I_{LNA} vs. Ta



Condition
V_{LNA}=2.8V, V_{CONT}=1.9V
V_{MIX}=V_{LO}=0V

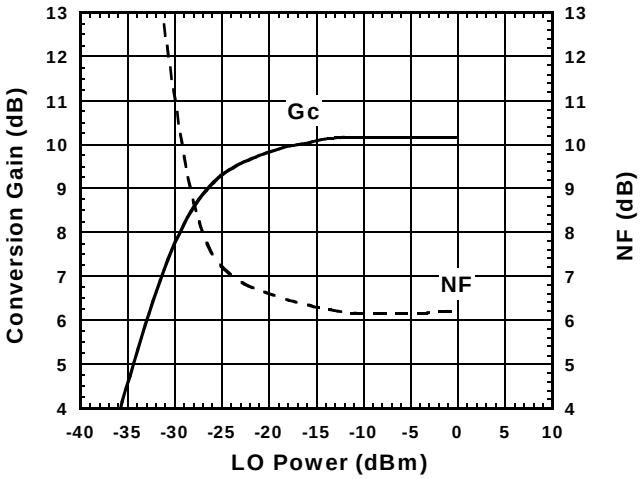
■TYPICAL CHARACTERISTICS (MIXER, with test circuit)

Gc, NF vs. RF Frequency



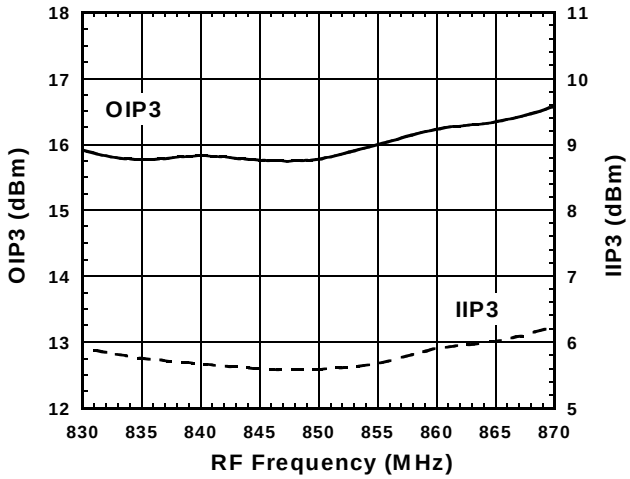
Condition
f_{IF}=110MHz
f_{RF}=830~870MHz, P_{RF}=-25dBm
Lower LOCAL, P_{LO}=-10dBm
$V_{LNA}=V_{CONT}$=0V
$V_{MIX}=V_{LO}$=2.8V

Gc, NF vs. LO Power



Condition
f_{IF}=110MHz
f_{RF}=850MHz, P_{RF}=-25dBm
f_{LO}=740MHz
$V_{LNA}=V_{CONT}$=0V
$V_{MIX}=V_{LO}$=2.8V

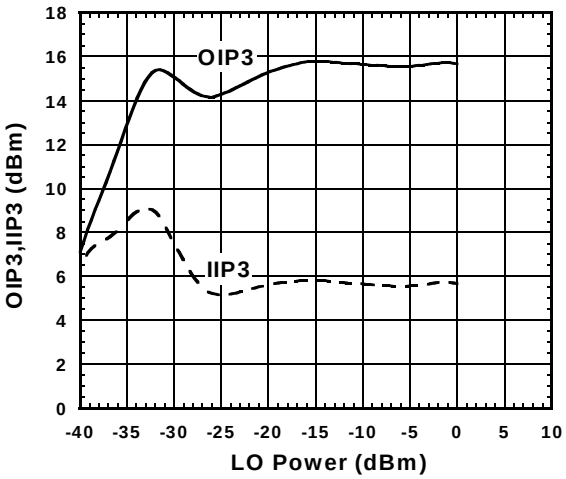
OIP3, IIP3 vs. RF Frequency



Condition
f_{IF}=110MHz
f_{RF}=830~870MHz, P_{RF}=-25dBm
$f_{RF\ OFFSET}$=100kHz
Lower LOCAL, P_{LO}=-10dBm
$V_{LNA}=V_{CONT}$=0V
$V_{MIX}=V_{LO}$=2.8V

OIP3=(3xIF-IM3)/2
IIP3=OIP3-Gc

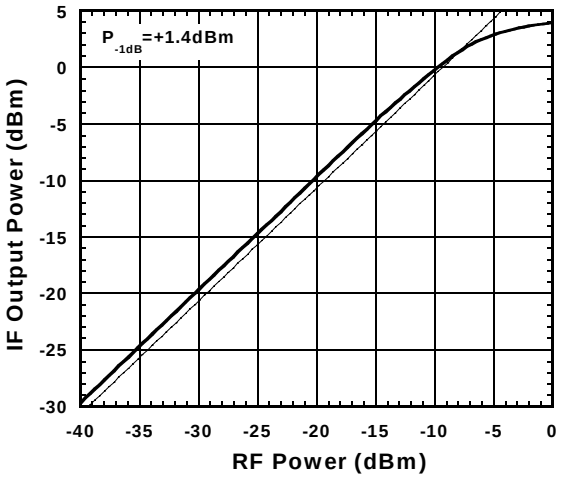
OIP3, IIP3 vs. LO Power



Condition
f_{IF}=110MHz
f_{RF}=850+850.1MHz, P_{RF}=-25dBm
f_{LO}=740MHz
$V_{LNA}=V_{CONT}$=0V
$V_{MIX}=V_{LO}$=2.8V

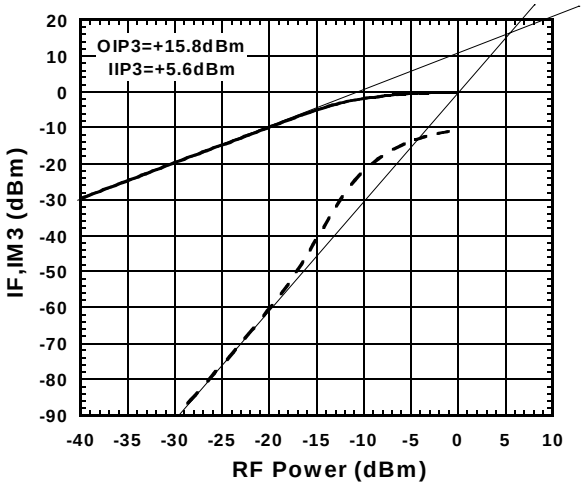
■TYPICAL CHARACTERISTICS (MIXER, with test circuit)

IF Output Power vs. RF Power



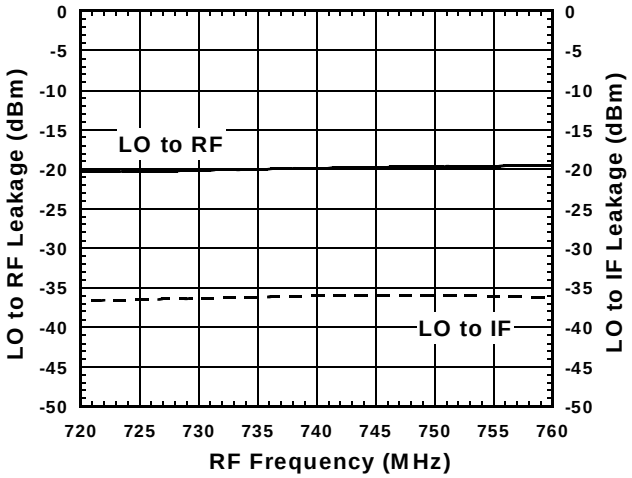
Condition
f_{IF}=110M Hz
f_{RF}=850MHz
f_{LO}=740MHz, P_{LO}=-10dBm
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

IF,IM3 vs. RF Power



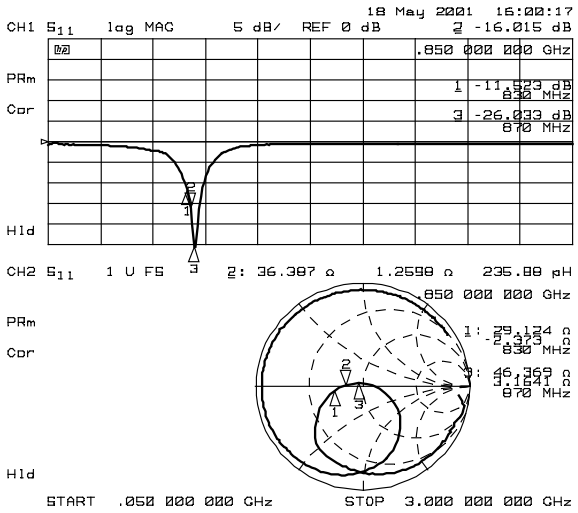
Condition
f_{IF}=110MHz
f_{RF}=850+850.1MHz
f_{LO}=740MHz, P_{LO}=-10dBm
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

LO Leakage vs. LO Frequency

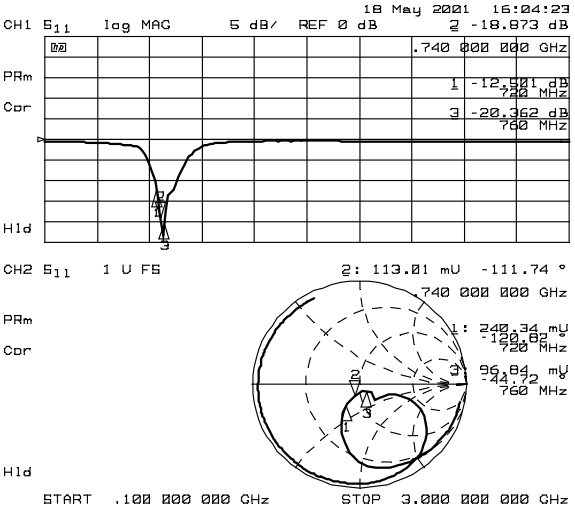


Condition
f_{LO}=720~760MHz, P_{LO}=-10dBm
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

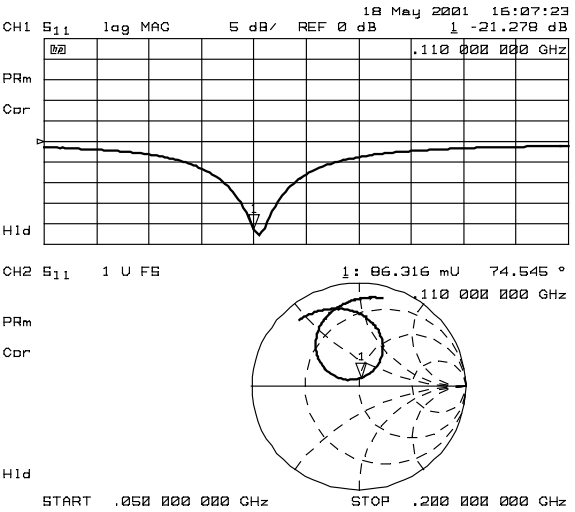
■TYPICAL CHARACTERISTICS (MIXER, with test circuit)



MIXER IN Impedance
Condition
LOCAL IN, IF OUT 50Ωterm.
$V_{LNA}=V_{CONT}=0V$
$V_{MIX}=V_{LO}=2.8V$



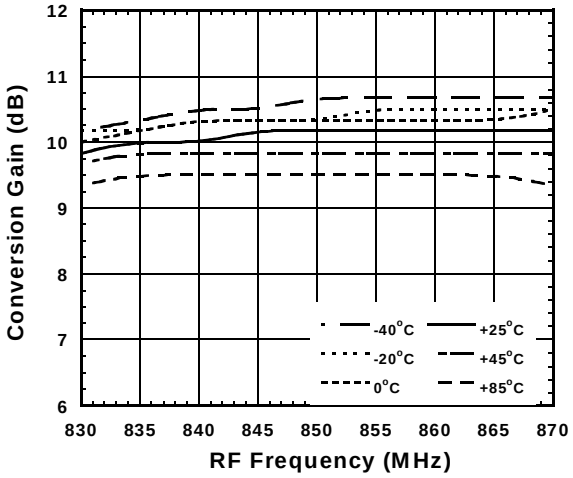
LOCAL IN Impedance
Condition
MIXER IN, IF OUT 50Ωterm.
$V_{LNA}=V_{CONT}=0V$
$V_{MIX}=V_{LO}=2.8V$



IF OUT Impedance
Condition
MIXER IN,LOCAL IN 50Ωterm.
$V_{LNA}=V_{CONT}=0V$
$V_{MIX}=V_{LO}=2.8V$

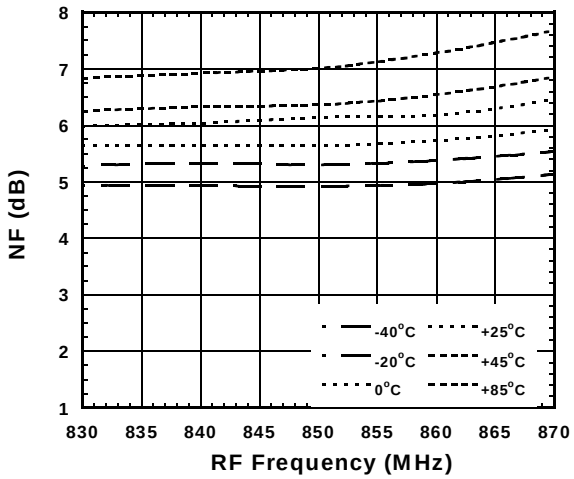
■TYPICAL CHARACTERISTICS (MIXER, with test circuit)

Conversion Gain vs. RF Frequency



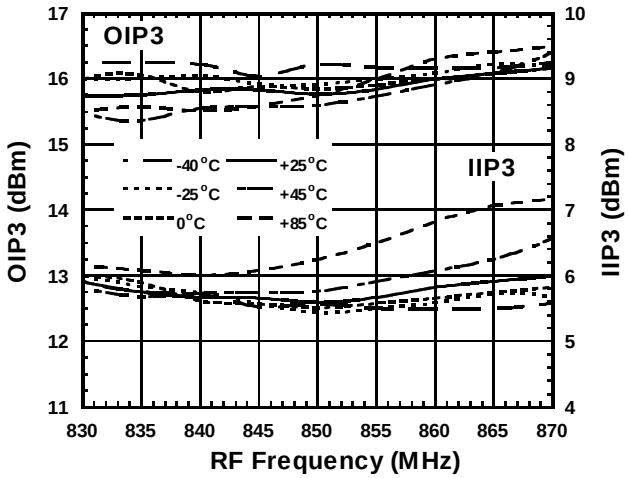
Condition
f_{IF}=110MHz
f_{RF}=830~870MHz, P_{RF}=-25dBm
Lower LOCAL, P_{LO}=-10dBm
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

NF vs. RF Frequency



Condition
f_{IF}=110MHz
f_{RF}=830~870MHz, P_{RF}=-25dBm
Lower LOCAL, P_{LO}=-10dBm
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

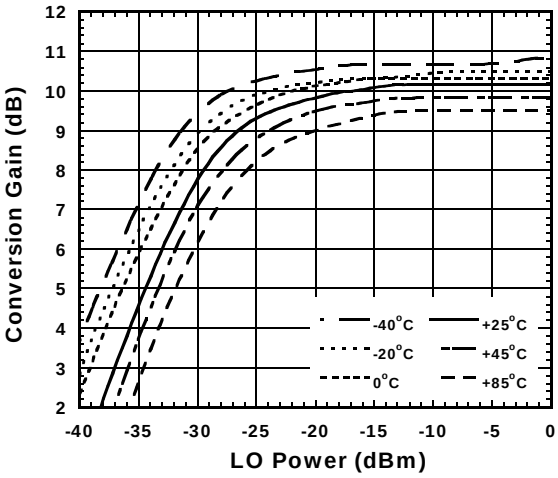
OIP3, IIP3 vs. RF Frequency



Condition
f_{IF}=110MHz
f_{RF}=830~870MHz, P_{RF}=-25dBm
$f_{RF\ OFFSET}$=100kHz
Lower LOCAL, P_{LO}=-10dBm
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

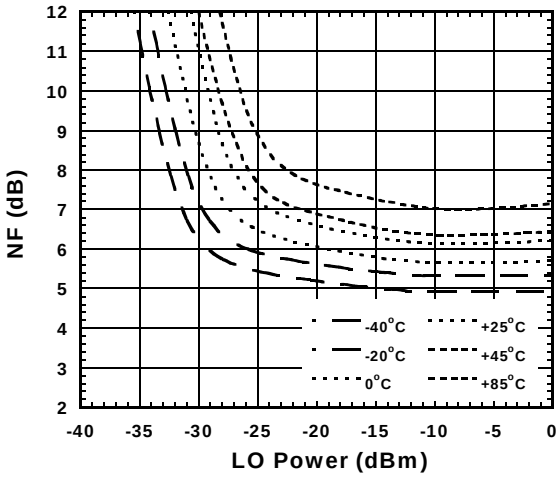
■TYPICAL CHARACTERISTICS (MIXER, with test circuit)

Conversion Gain vs. Lo Power



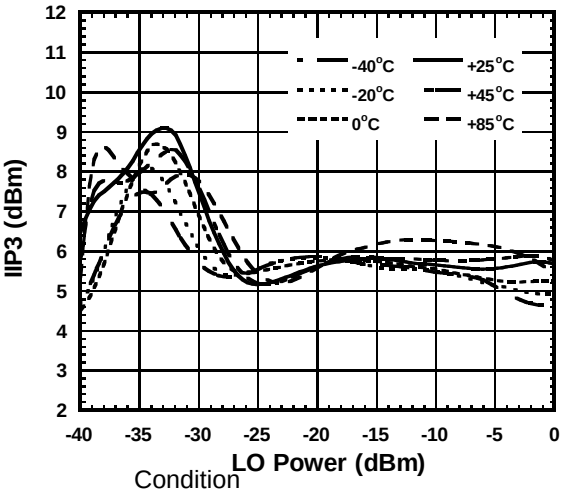
Condition
f_{IF}=110MHz
f_{RF}=850MHz, P_{RF}=-25dBm
f_{LO}=740MHz
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

NF vs. LO Power



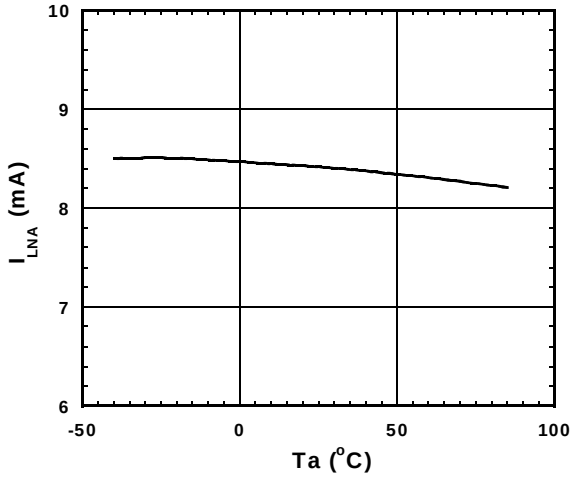
Condition
f_{IF}=110MHz
f_{RF}=850MHz, P_{RF}=-25dBm
f_{LO}=740MHz
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

IIP3 vs. LO Power



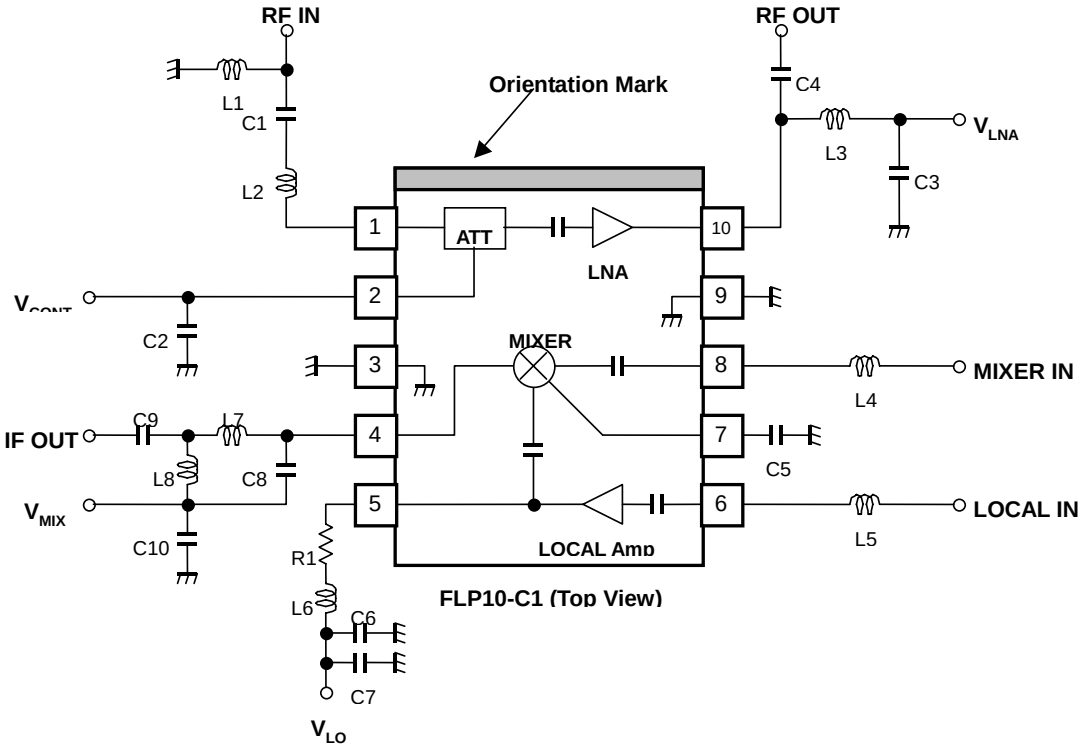
Condition
f_{IF}=110MHz
f_{RF}=850+850.1MHz, P_{RF}=-25dBm
f_{LO}=740MHz
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

I_{TOTAL} vs. Ta



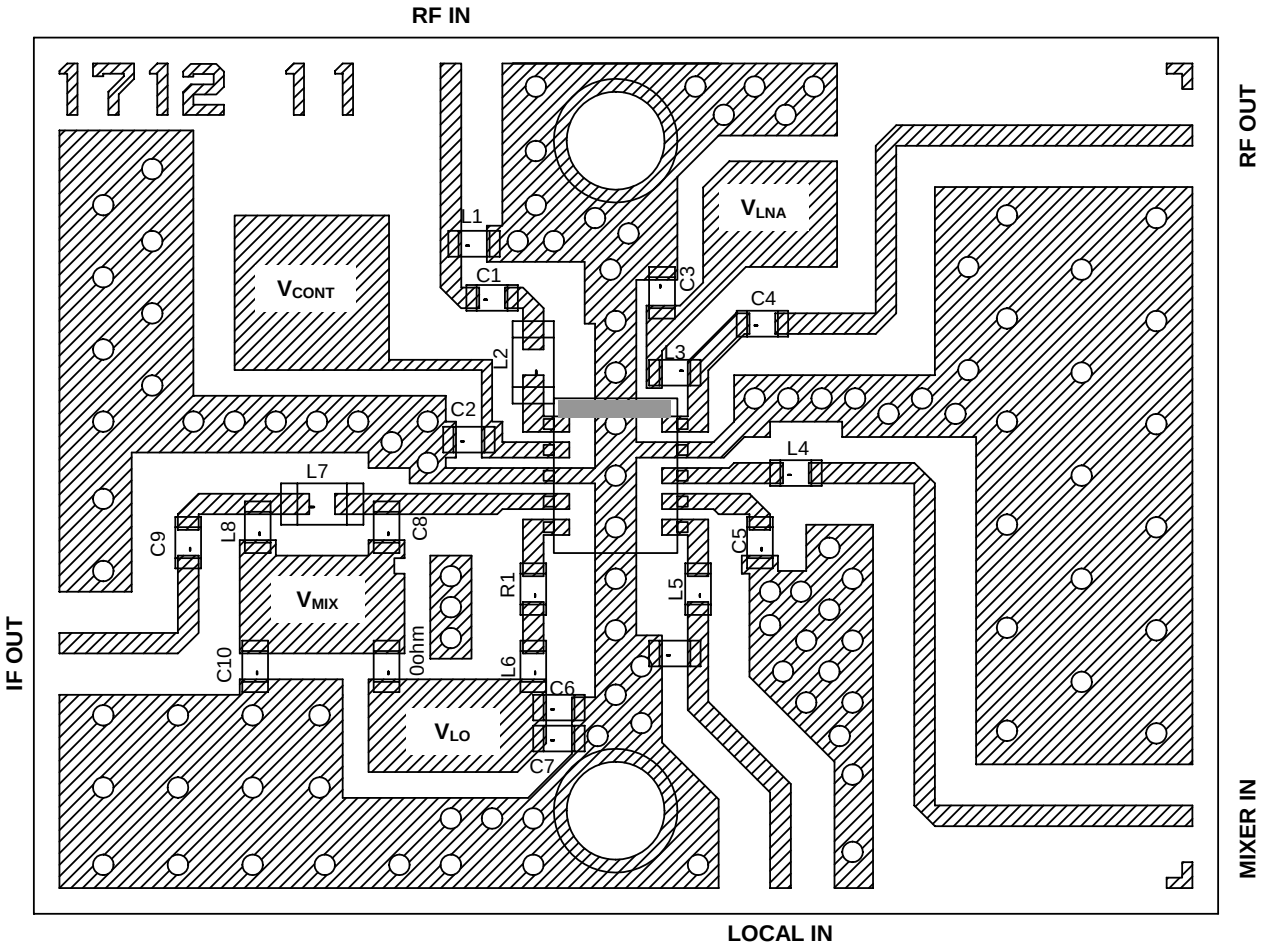
Condition
V_{LNA}=V_{CONT}=0V
V_{MIX}=V_{LO}=2.8V

■ TEST CIRCUIT



PART ID	850MHzBAND Lower LOCAL f_{LO}=740MHz, f_{IF}=110MHz	COMMENT
L1	12nH	TAIYO-YUDEN (HK1005)
L2	18nH	TAIYO-YUDEN (HK1608)
L3	12nH	TAIYO-YUDEN (HK1005)
L4	33nH	TAIYO-YUDEN (HK1005)
L5	47nH	TAIYO-YUDEN (HK1005)
L6	33nH	TAIYO-YUDEN (HK1005)
L7	150nH	TAIYO-YUDEN (HK1608)
L8	68nH	TAIYO-YUDEN (HK1005)
C1	1000pF	MURATA (GRM36)
C2	1000pF	MURATA (GRM36)
C3	0.01uF	MURATA (GRM36)
C4	1.5pF	MURATA (GRM36)
C5	100pF	MURATA (GRM36)
C6	100pF	MURATA (GRM36)
C7	0.01uF	MURATA (GRM36)
C8	8pF	MURATA (GRM36)
C9	1000pF	MURATA (GRM36)
C10	0.01uF	MURATA (GRM36)
R1	10Ω	1005 Size

■ RECOMMENDED PCB DESIGN

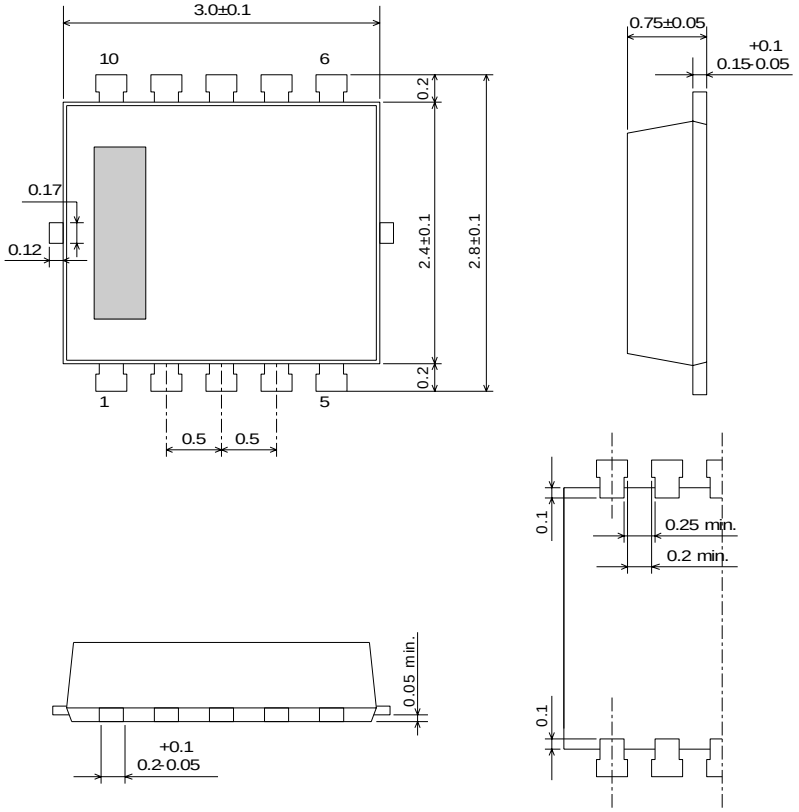


PCB (FR-4): t=0.2mm

MICRO STRIPLINE WIDTH=0.4mm (Z_0=50Ω)

PCB SIZE=23.0x17.0 mm

■PACKAGE OUTLINE (FLP10-C1)



Lead material : Copper
Lead surface finish : Solder plating
Molding material : Epoxy resin
UNIT : mm
Weight : 15mg

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.