2GHz BAND LOW NOISE AMPLIFIER

■ GENERAL DESCRIPTION

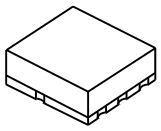
NJG1126HB6 is a low noise amplifier GaAs MMIC designed for 2GHz band application, and 1.7GHz to 3.8GHz operation with modified schematic.

This IC has the function which bypasses LNA, and high gain mode or low gain mode can be chosen high IIP3 and a low noise is achieved at the High gain mode.

And low current consumption can be achieved at the low gain mode because LNA enters the state of the standby.

An ultra-small and ultra-thin package of the USB8-B6 is adopted.

■ PACKAGE OUTLINE



NJG1126HB6

■ APPLICATIONS

W-CDMA and LTE application
W-LAN and WiMAX application

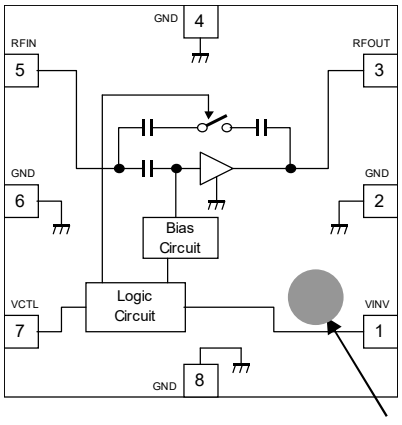
Note: Please check the Application Note for LTE, WLAN and WiMAX

■ FEATURES

● Operating frequency range	1.7GHz to 3.8GHz	
● Low voltage operation	+2.7V typ.	
● Low CTL voltage operation	+1.85V typ.	
● Low current consumption	2.2mA typ.	@V_{CTL}=1.85V
	1μA typ.	@V_{CTL}=0V
● High gain	16.5dB typ.	@V_{CTL}=1.85V, f_{RF}=2140MHz
● Low noise figure	1.4dB typ.	@V_{CTL}=1.85V, f_{RF}=2140MHz
● Pin at 1dB Gain Compression point	-12.0dBm typ.	@V_{CTL}=1.85V, f_{RF}=2140MHz
	+11.0dBm typ.	@V_{CTL}=0V, f_{RF}=2140MHz
● High input IP3	0dBm typ.	@V_{CTL}=1.85V, f_{RF}=2140MHz
	+16.0dBm typ.	@V_{CTL}=0V, f_{RF}=2140MHz
● Small package	USB8-B6 (Package size: 1.5mmx1.5mmx0.55mm typ.)	

■ PIN CONFIGURATION

(Top View)



1Pin INDEX

Pin Connection
1. VINV
2. GND
3. RF OUT
4. GND
5. RF IN
6. GND
7. VCTL
8. GND

Note: Specifications and description listed in this catalog are subject to change without prior notice.

■ ABSOLUTE MAXIMUM RATINGS

Ta=+25°C, Zs=Zl=50Ω

PARAMETERS	SYMBOL	CONDITIONS	RATINGS	UNITS
Supply voltage	V_{DD}		5.0	V
Inverter supply voltage	V_{INV}		5.0	V
Control voltage	V_{CTL}		5.0	V
Input power	Pin	V_{DD}=2.85V	+15	dBm
Power dissipation	P_D	on PCB board, Tjmax=150°C	135	mW
Operating temperature	T_{opr}		-40 to +85	°C
Storage temperature	T_{stg}		-55 to +150	°C

■ ELECTRICAL CHARACTERISTICS 1 (DC)

(General Conditions: V_{DD}=V_{INV}=2.85V, Ta=+25°C, Zs=Zl=50Ω)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating voltage	V_{DD}		2.5	2.85	3.6	V
Inverter supply voltage	V_{INV}		2.5	2.85	3.6	V
Control voltage (High)	V_{CTL}(H)		1.5	1.85	V_{INV}+0.3	V
Control voltage (Low)	V_{CTL}(L)		0	0	0.3	V
Operating current1 (LNA High Gain Mode)	I_{DD}1	RF OFF, V_{CTL}=1.85V	-	2.2	3.2	mA
Operating current2 (LNA High Gain Mode)	I_{DD}2	RFOFF, V_{CTL}=0V	-	1	5	μA
Inverter current1 (LNA High Gain Mode)	I_{INV}1	RF OFF, V_{CTL}=1.85V	-	90	150	μA
Inverter current2 (LNA High Gain Mode)	I_{INV}2	RF OFF, V_{CTL}=0V	-	16	50	μA
Control current	I_{CTL}	RF OFF, V_{CTL}=1.85V	-	5	20	μA

■ **ELECTRICAL CHARACTERISTICS 2 (LNA High Gain Mode)**

(General Conditions: V_{DD}=V_{INV}=2.7V, V_{CTL}=1.85V, f_{RF}=2140MHz, Ta=+25°C, Zs=Zl=50Ω)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Small signal gain1	Gain1	Exclude PCB & connector losses (IN: 0.09dB, OUT: 0.07dB)	15.0	16.5	19.0	dB
Noise figure1	NF1	Exclude PCB & connector losses (IN: 0.09dB)	-	1.4	1.7	dB
1dB gain compression output power1	$P_{-1dB(IN)}1$		-15.5	-12.0	-	dBm
3rd order Input Intercept Point1	IIP3_1	f1=f_{RF}, f2=f_{RF}+100kHz, Pin=-32dBm	-5.0	0	-	dBm
RF IN VSWR1	$VSWR_i$1		-	1.6	2.2	-
RF OUT VSWR1	$VSWR_o$1		-	1.5	2.2	-

■ **ELECTRICAL CHARACTERISTICS 2 (LNA Low Gain Mode)**

(General Conditions: V_{DD}=V_{INV}=2.7V, V_{CTL}=0V, f_{RF}=2140MHz, Ta=+25°C, Zs=Zl=50Ω)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Small signal gain2	Gain2	Exclude PCB & connector losses (IN: 0.09dB, OUT: 0.07dB)	-10.0	-7.0	-5.5	dB
Noise figure2	NF2	Exclude PCB & connector losses (IN: 0.09dB)	-	7.0	10.0	dB
1dB gain compression output power2	$P_{-1dB(IN)}2$		+4.5	+11.0	-	dBm
3rd order Input Intercept Point2	IIP3_2	F1=f_{RF}, f2=f_{RF}+100kHz, Pin=-16dBm	0	+16.0	-	dBm
RF IN VSWR2	$VSWR_i$2		-	1.5	2.0	-
RF OUT VSWR2	$VSWR_o$2		-	1.5	2.2	-

■ TERMINAL INFORMATION

No.	SYMBOL	DESCRIPTION
1	VINV	Inverter supply voltage terminal. Please place a bypass capacitor between this and GND for avoiding RF noise from outside.
2	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
3	RFOUT	RF output signal terminal. RF signal comes out from this terminal, and goes through an external matching circuit connected to this. This terminal doubles as the drain terminal of the LNA. Please connect this terminal to the power supply via inductor L3.
4	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
5	RFIN	RF input signal terminal. RF signal is input through external matching circuit connected to this terminal. This terminal integrates an input DC blocking capacitor.
6	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
7	VCTL	Control voltage terminal. Inputting a logic-high level, the LNA turn at high gain mode. Inputting a logic-low level, the LNA turn at Low gain mode.
8	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.

CAUTION

1) Ground terminal (No.2, 4, 6, 8) should be connected to the ground plane as close as possible for excellent RF performance, because distance to GND makes parasitic inductance.

■ TRUTH TABLE

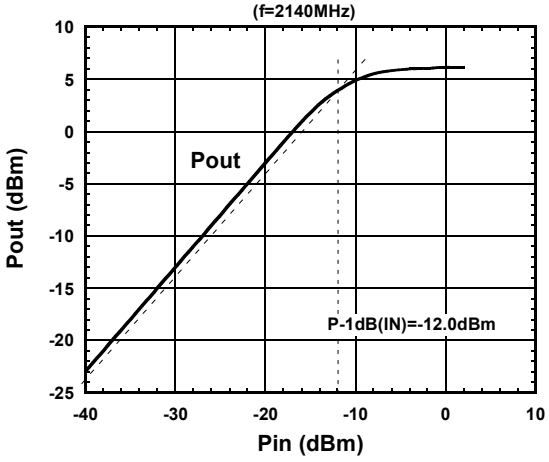
"H"=V_{CTL}(H), "L"=V_{CTL}(L)

V_{CTL}	LNA circuit	Bypass circuit	Mode select
L	OFF	ON	Low gain mode
H	ON	OFF	High gain mode

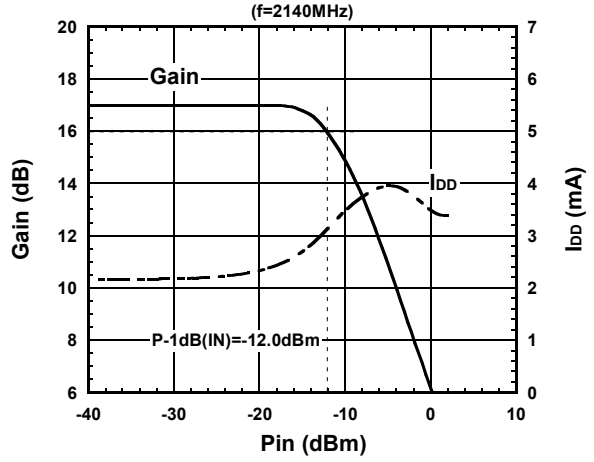
■ **ELECTRICAL CHARACTERISTICS (LNA High Gain Mode)**

General Conditions: Ta=+25°C, V_{DD}=V_{INV}=2.7V, V_{CTL}=1.85V, Zs=Zl=50Ω

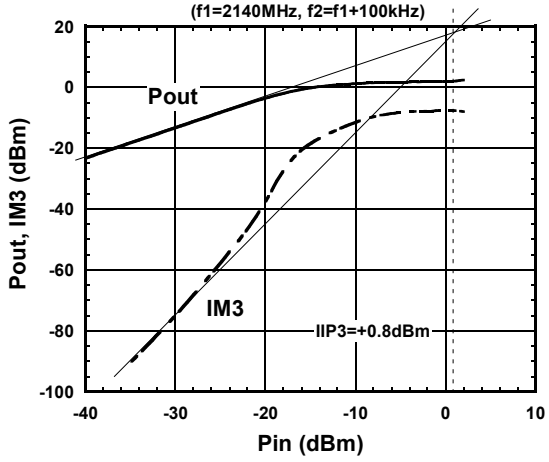
Pout vs. Pin



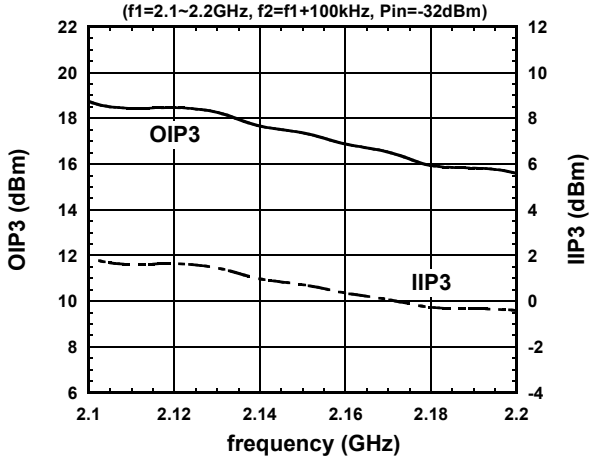
Gain, IDD vs. Pin



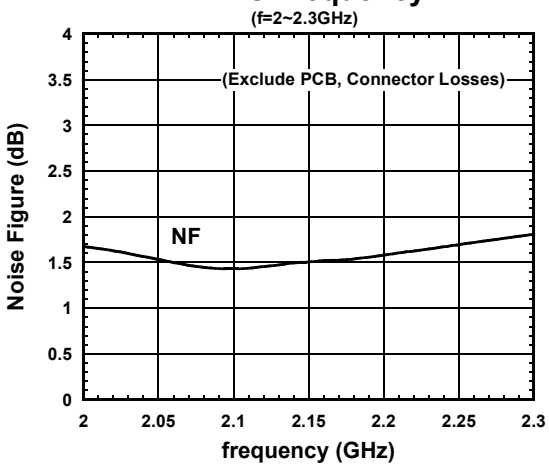
Pout, IM3 vs. Pin



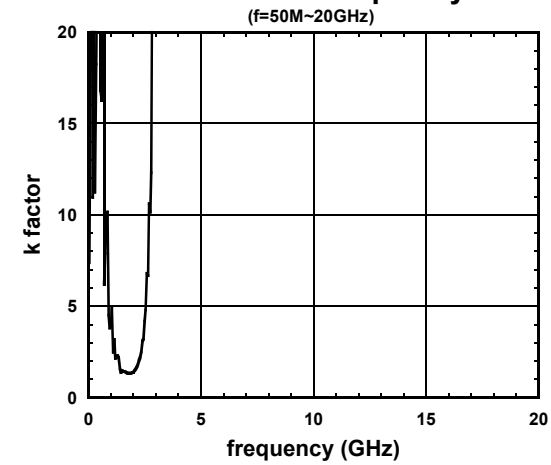
OIP3, IIP3 vs. frequency



NF vs. frequency



k factor vs. frequency

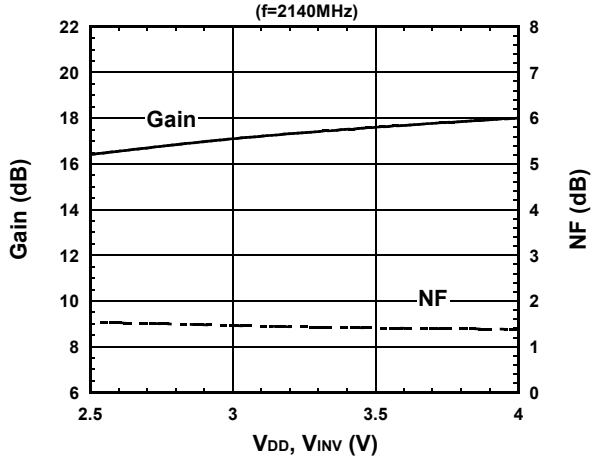


■ **ELECTRICAL CHARACTERISTICS (LNA High Gain Mode)**

General Conditions: Ta=+25°C, V_{DD}=V_{INV}=2.7V, V_{CTL}=1.85V, Zs=Zl=50Ω

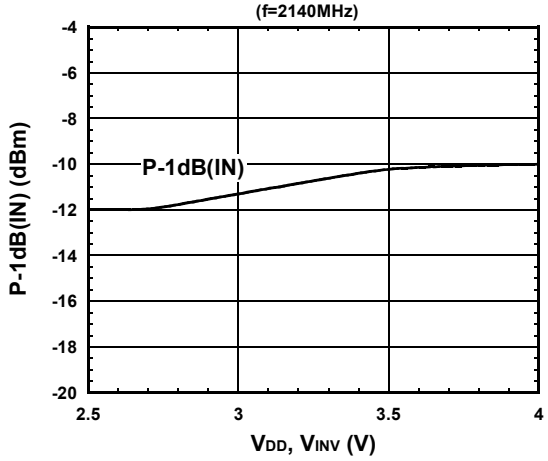
Gain, NF vs. VDD, VINV

(f=2140MHz)



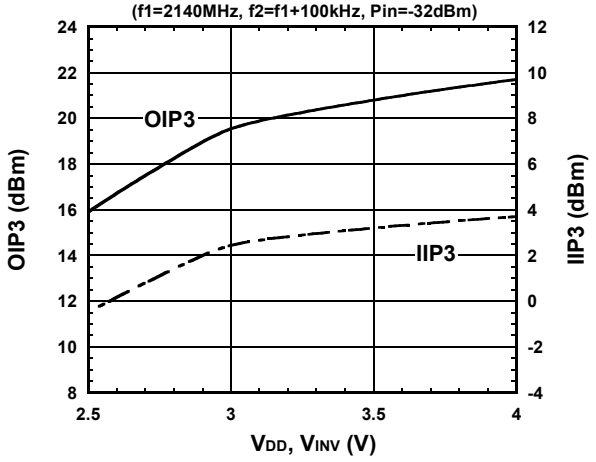
P-1dB(IN) vs. VDD, VINV

(f=2140MHz)



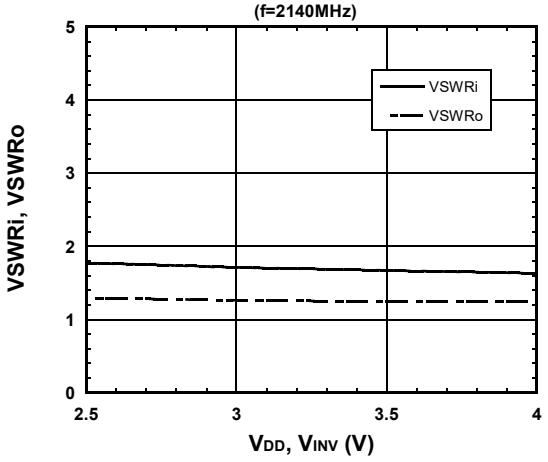
OIP3, IIP3 vs. VDD, VINV

(f1=2140MHz, f2=f1+100kHz, Pin=-32dBm)



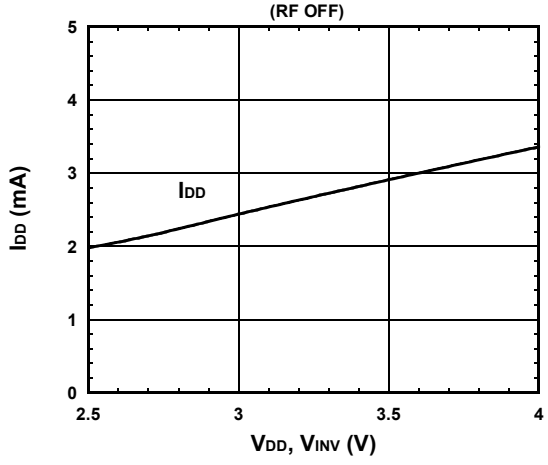
VSWR vs. VDD, VINV

(f=2140MHz)



IDD vs. VDD, VINV

(RF OFF)

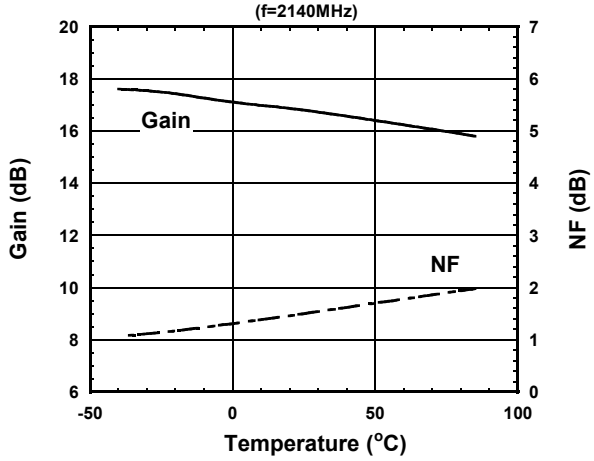


■ **ELECTRICAL CHARACTERISTICS (LNA High Gain Mode)**

General Conditions: Ta=+25°C, V_{DD}=V_{INV}=2.7V, V_{CTL}=1.85V, Zs=Zl=50Ω

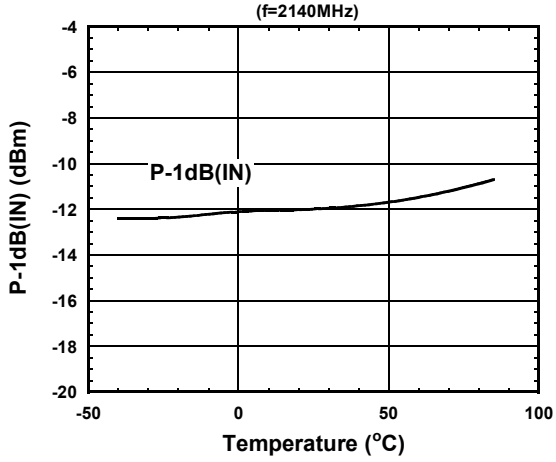
Gain, NF vs. Temperature

(f=2140MHz)



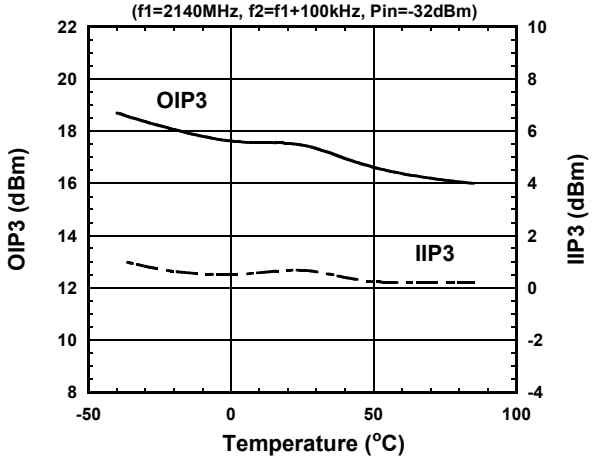
P-1dB(IN) vs. Temperature

(f=2140MHz)



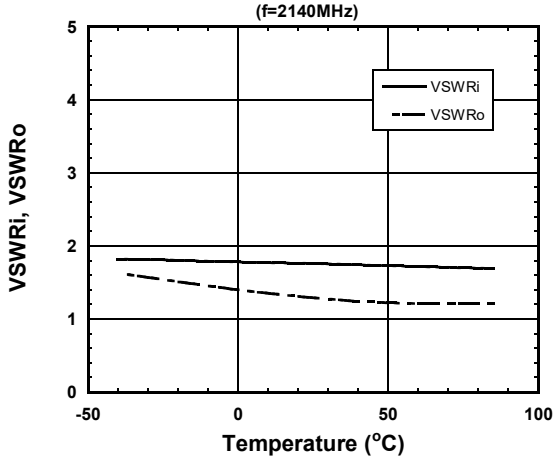
OIP3, IIP3 vs. Temperature

(f1=2140MHz, f2=f1+100kHz, Pin=-32dBm)



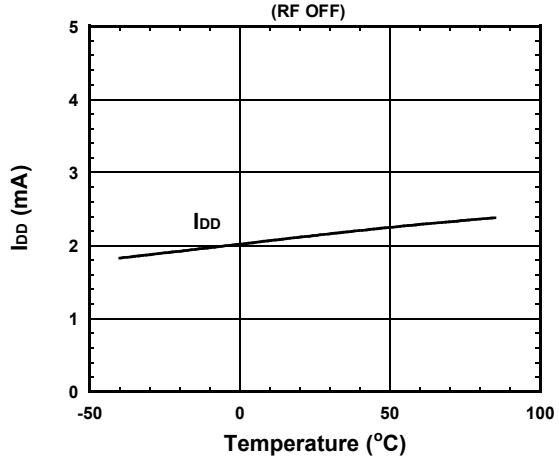
VSWR vs. Temperature

(f=2140MHz)



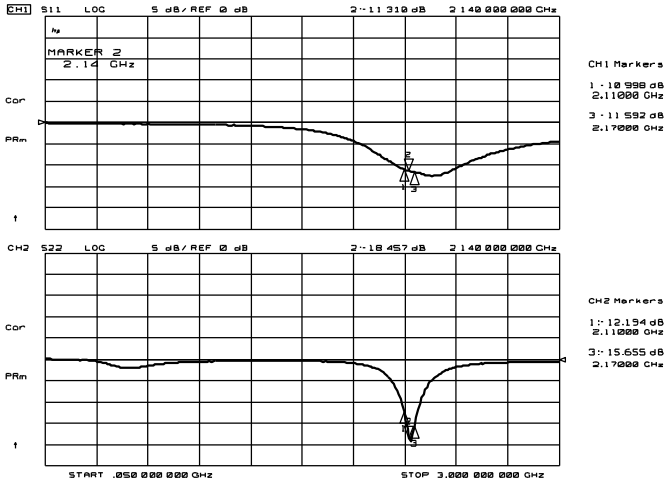
I_{DD} vs. Temperature

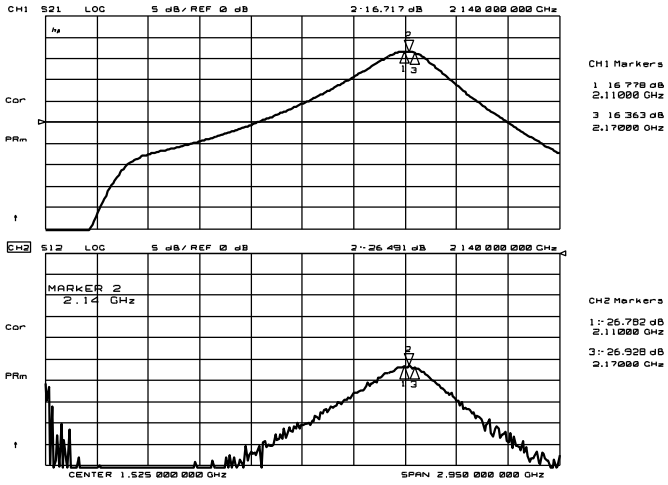
(RF OFF)

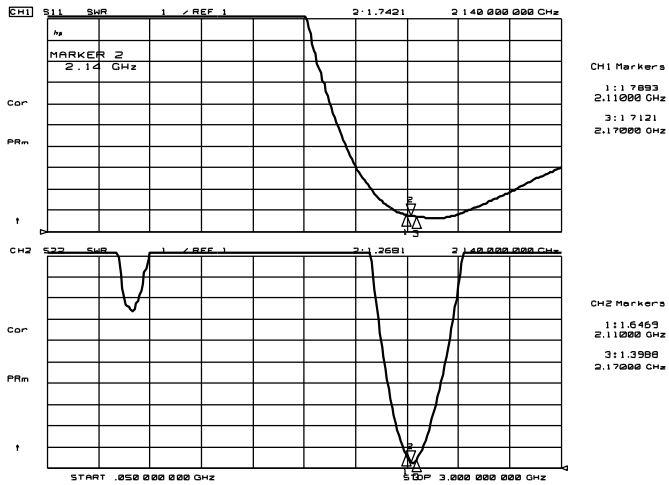


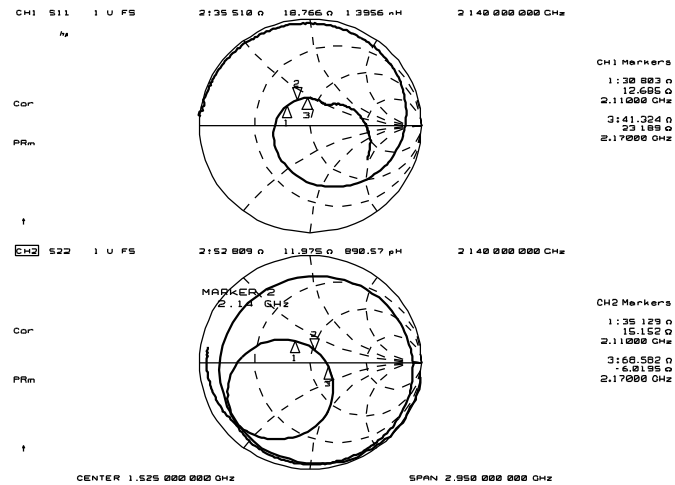
■ ELECTRICAL CHARACTERISTICS (LNA High Gain Mode)

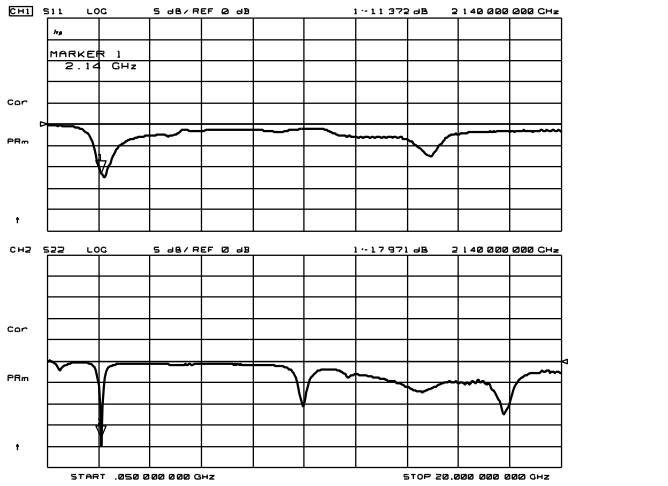
General Conditions: Ta=+25°C, V_{DD}=V_{INV}=2.7V, V_{CTL}=1.85V, Zs=Zl=50Ω

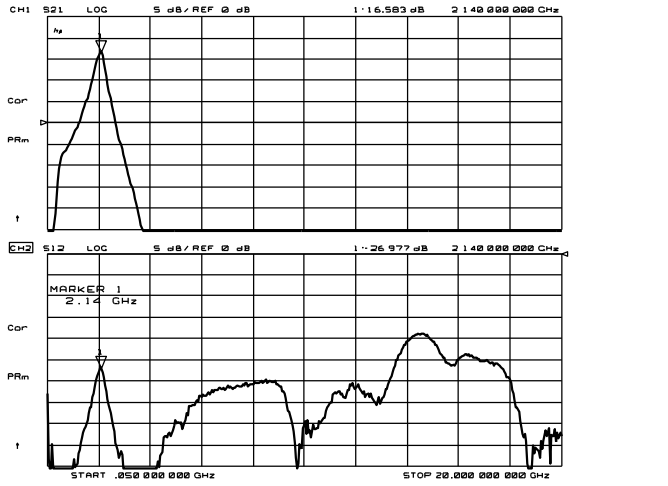










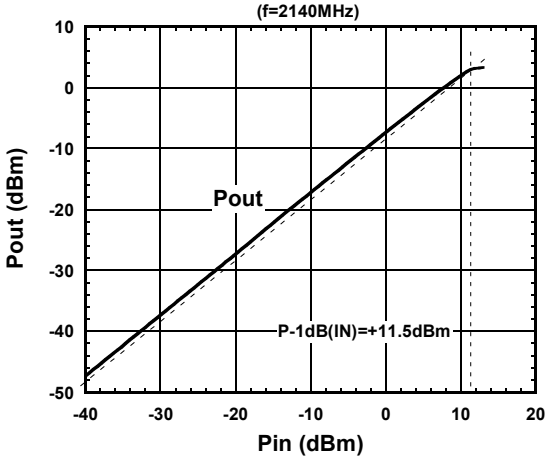


■ **ELECTRICAL CHARACTERISTICS (LNA Low Gain Mode)**

General Conditions: Ta=+25°C, V_{DD}=V_{INV}=2.7V, V_{CTL}=0V, Zs=Zl=50Ω

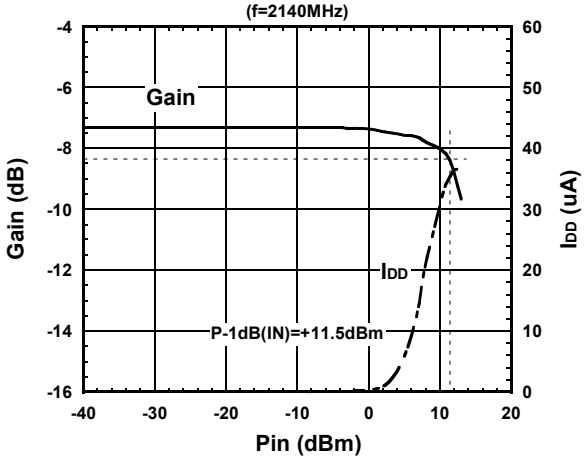
Pout vs. Pin

(f=2140MHz)



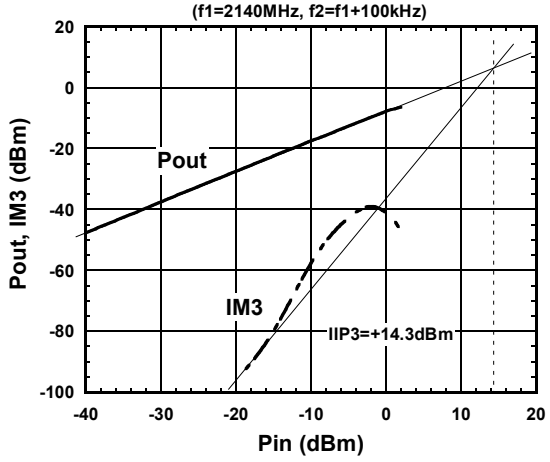
Gain, IDD vs. Pin

(f=2140MHz)



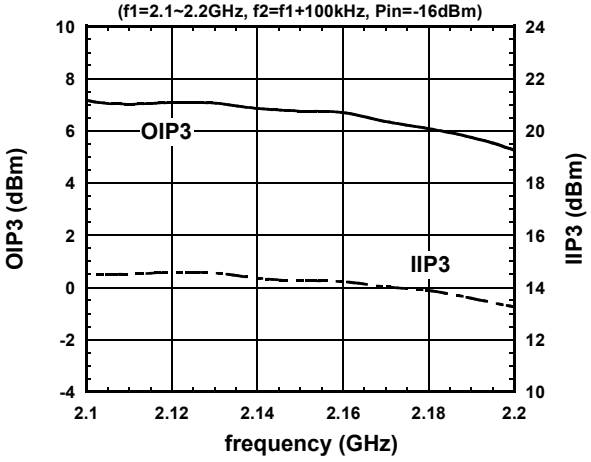
Pout, IM3 vs. Pin

(f1=2140MHz, f2=f1+100kHz)



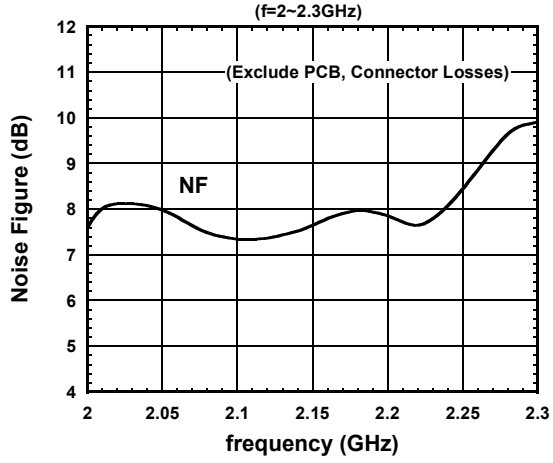
OIP3, IIP3 vs. frequency

(f1=2.1~2.2GHz, f2=f1+100kHz, Pin=-16dBm)



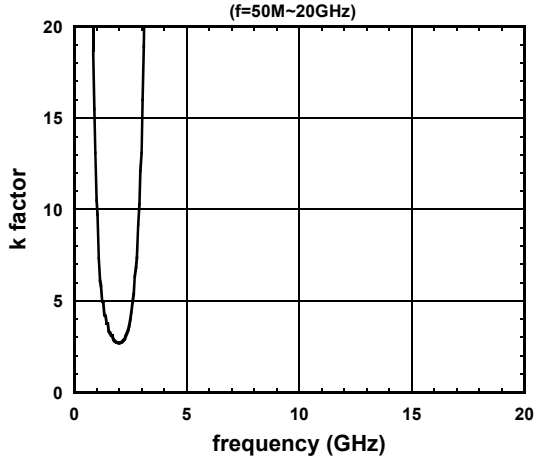
NF vs. frequency

(f=2~2.3GHz)



k factor vs. frequency

(f=50M~20GHz)

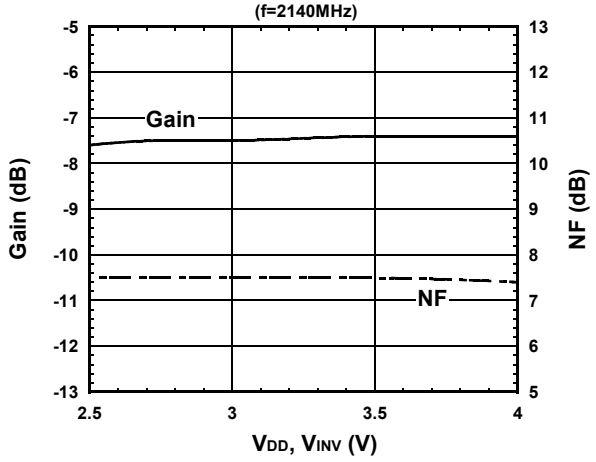


■ **ELECTRICAL CHARACTERISTICS (LNA Low Gain Mode)**

General Conditions: Ta=+25°C, V_{DD}=V_{INV}=2.7V, V_{CTL}=0V, Zs=Zl=50Ω

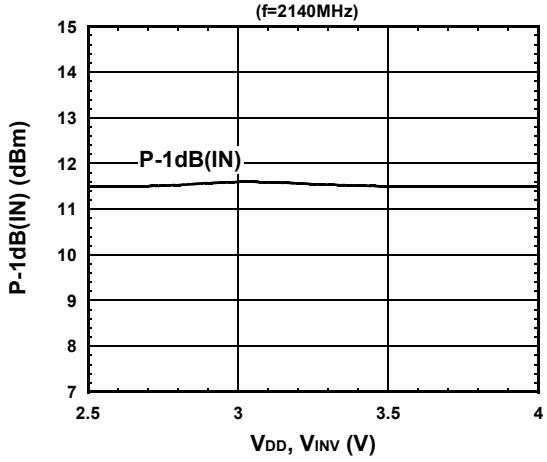
Gain, NF vs. VDD, VINV

(f=2140MHz)



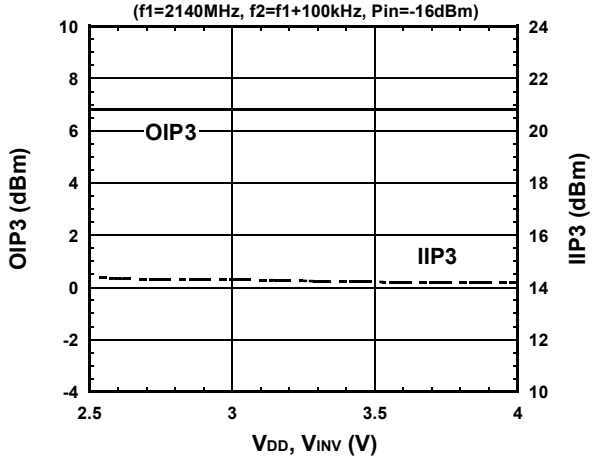
P-1dB(IN) vs. VDD, VINV

(f=2140MHz)



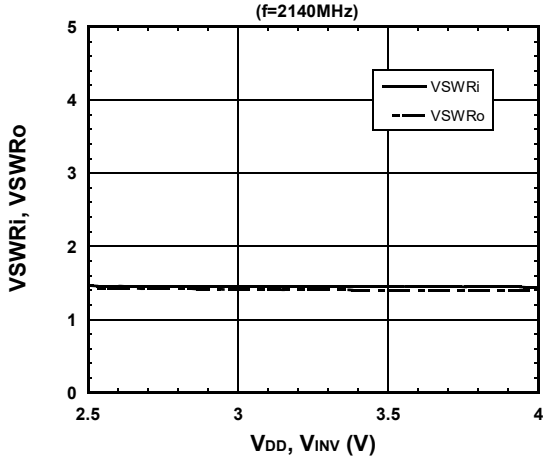
OIP3, IIP3 vs. VDD, VINV

(f1=2140MHz, f2=f1+100kHz, Pin=-16dBm)



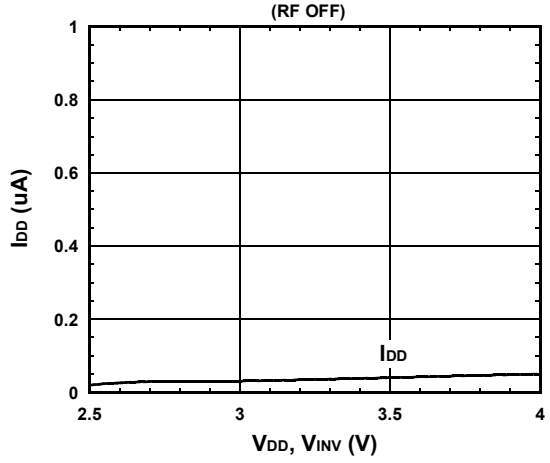
VSWR vs. VDD, VINV

(f=2140MHz)



IDD vs. VDD, VINV

(RF OFF)

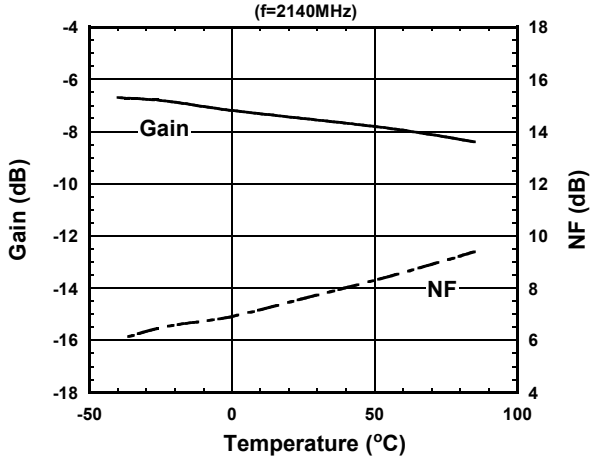


■ **ELECTRICAL CHARACTERISTICS (LNA Low Gain Mode)**

General Conditions: Ta=+25°C, V_{DD}=V_{INV}=2.7V, V_{CTL}=0V, Zs=Zl=50Ω

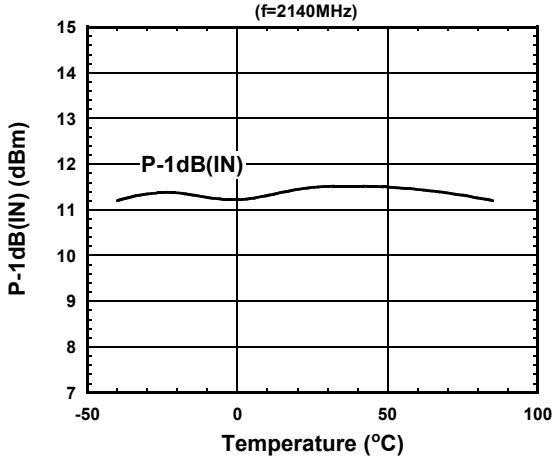
Gain, NF vs. Temperature

(f=2140MHz)



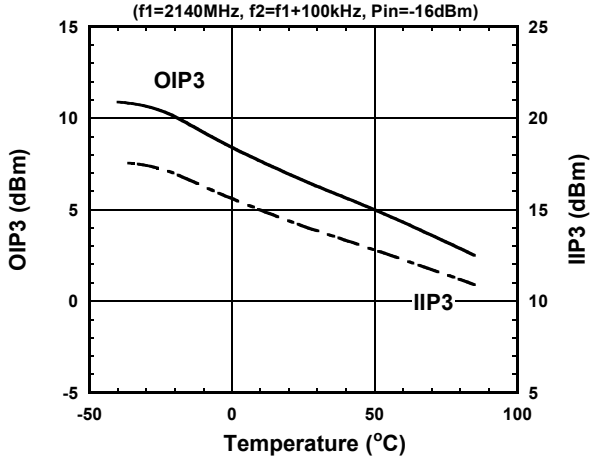
P-1dB(IN) vs. Temperature

(f=2140MHz)



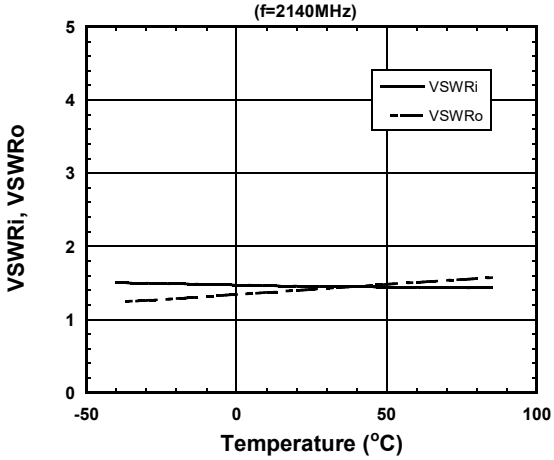
OIP3, IIP3 vs. Temperature

(f1=2140MHz, f2=f1+100kHz, Pin=-16dBm)



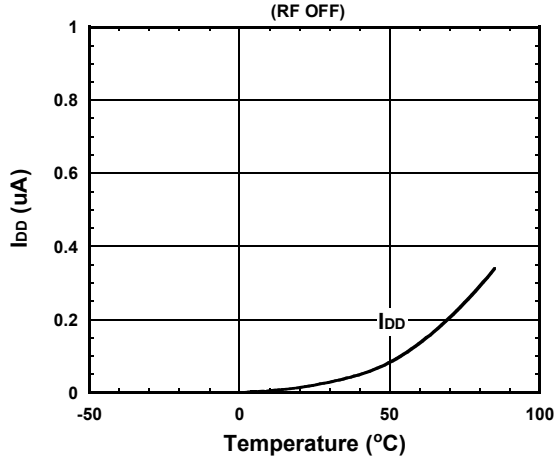
VSWR vs. Temperature

(f=2140MHz)



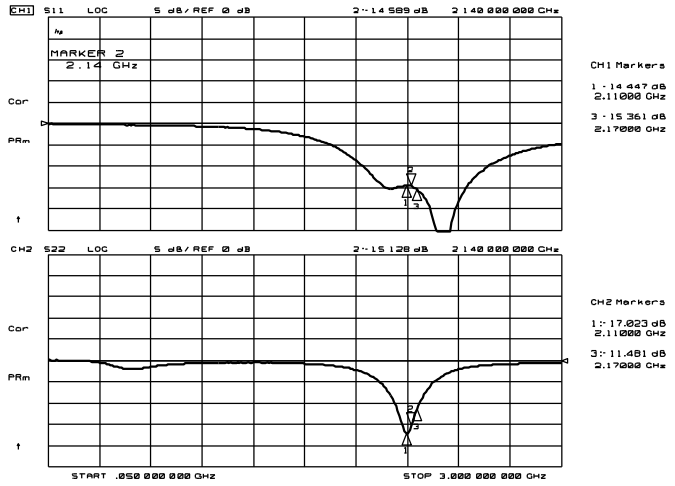
I_{DD} vs. Temperature

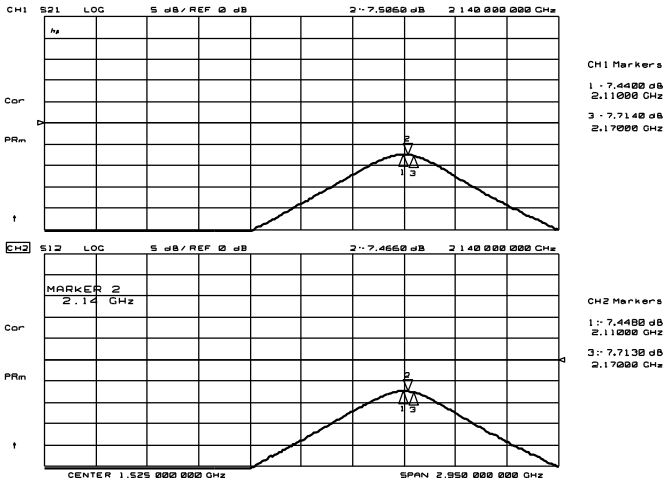
(RF OFF)

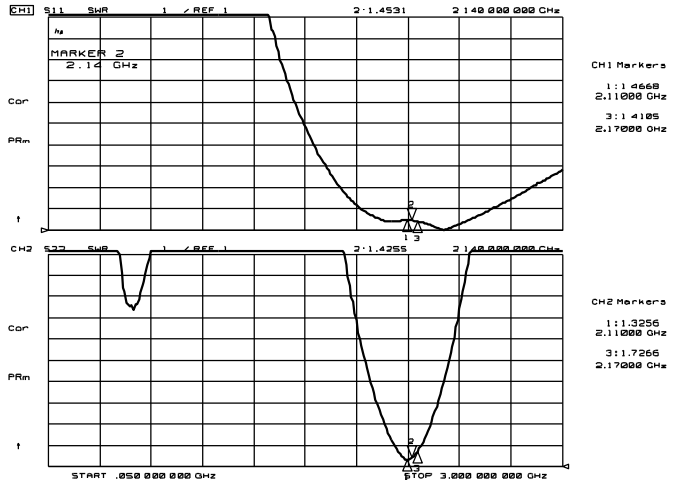


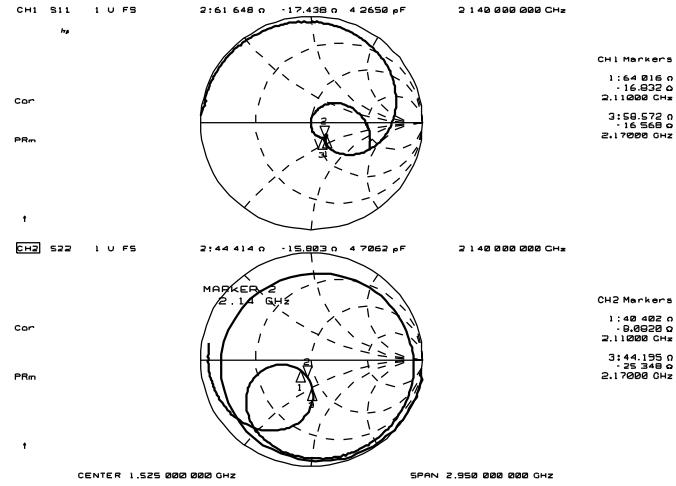
■ ELECTRICAL CHARACTERISTICS (LNA Low Gain Mode)

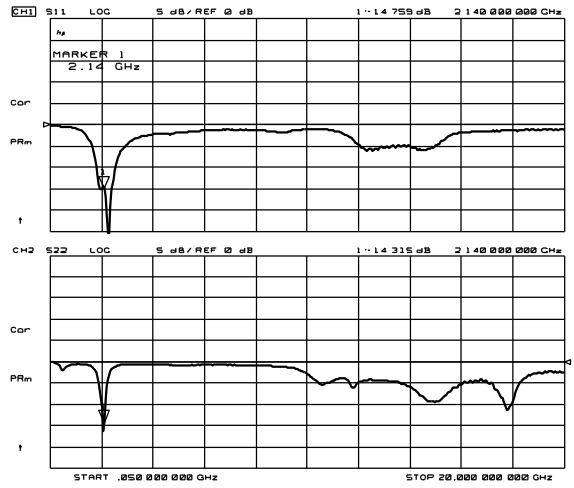
General Conditions: Ta=+25°C, V_{DD}=V_{INV}=2.7V, V_{CTL}=0V, Zs=Zl=50Ω

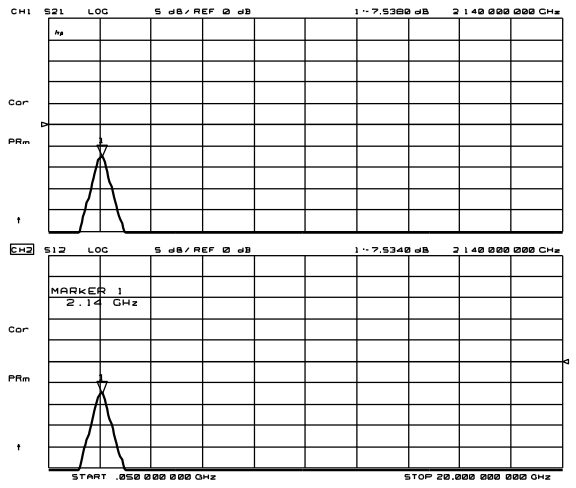




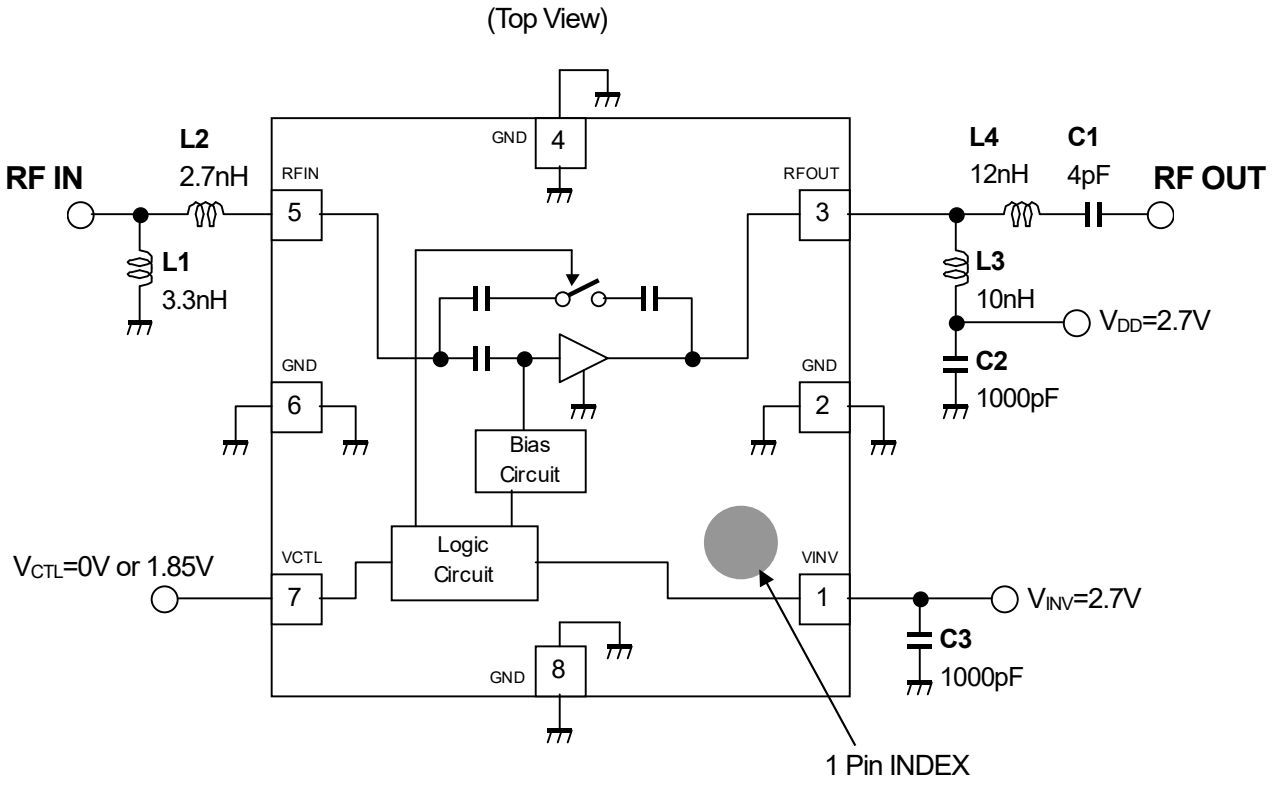




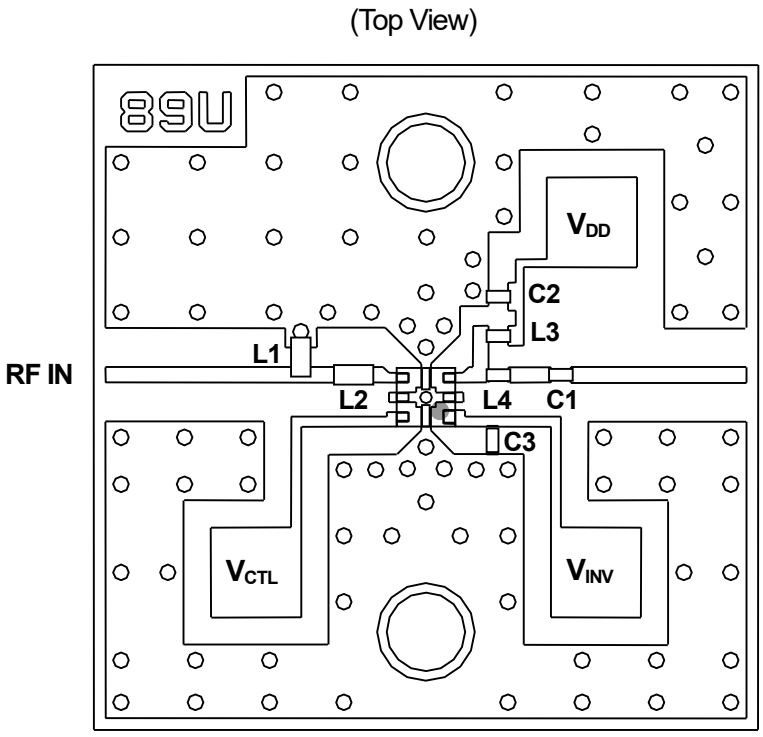




■ **APPLICATION CIRCUIT**



■ **TEST PCB LAYOUT**

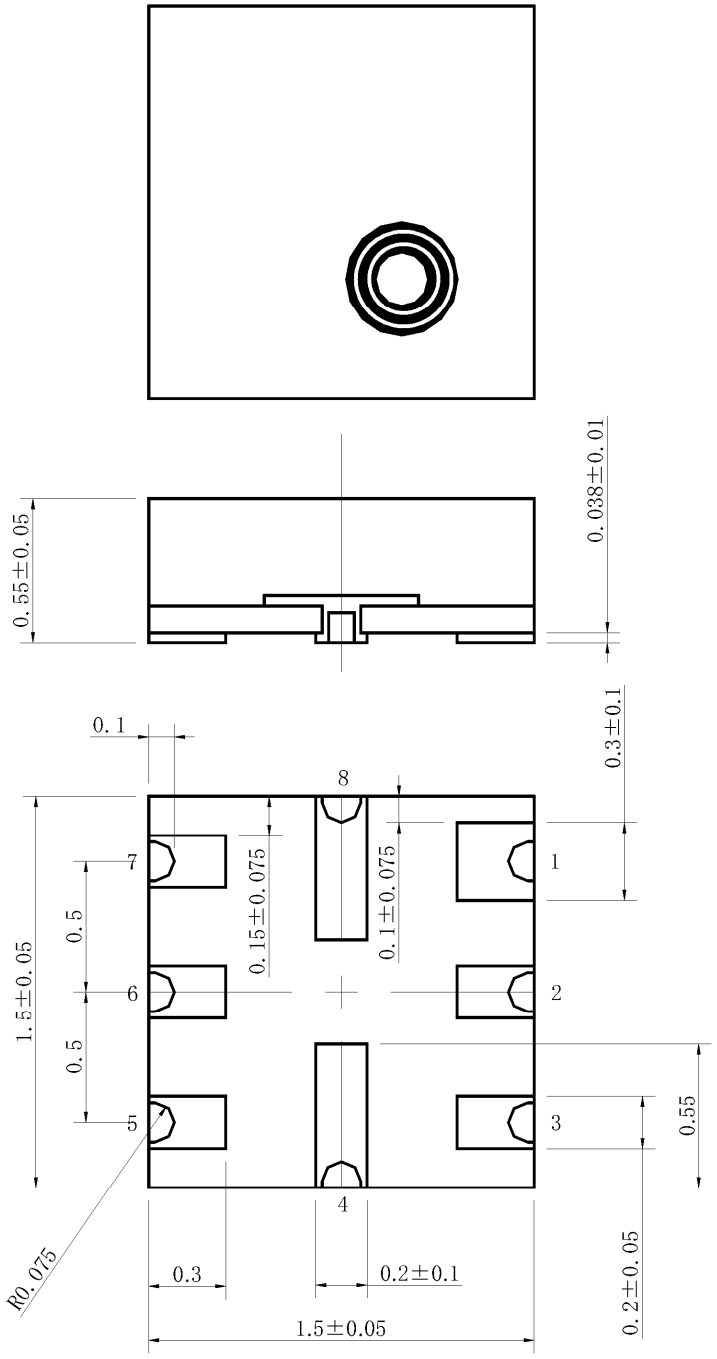


PARTS LIST

Parts ID	Comment
L1, L2	TAIYO-YUDEN (HK1005)
L3, L4	TDK (MLG0603Q)
C1 to C3	MURATA (GRM03)

PCB (FR-4)
t=0.2mm
MICROSTRIP LINE WIDTH
=0.4mm (Z_0=50Ω)
PCB SIZE=17.0mmx17.0mm

■ **PACKAGE OUTLINE** (USB8-B6)



UNIT : mm

SUBSTRATE MATERIAL: Glass epoxy board
TERMINAL FINISH: Au Plating (Cu/Ni/Au)
MOLD MATERIAL: Epoxy resin
MASS(TYP.): 2.4mg

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.

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8. Quality Warranty
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    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
    8-2. Quality Warranty Remedies
    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
    8-3. Remedies after Quality Warranty Period
    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
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