

## WiMAX Application

### 5. 3.5~3.7GHz BAND APPLICATION

#### 5-1 SUMMARY

The characteristics of 3.5~3.7GHz band have evaluated as follows. The evaluation circuit structure and measured data are reviewed.

#### 5-2-1 MEASURED DATA1 (DC)

General conditions:  $V_{DD}=V_{INV}=3.0V$ ,  $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50\Omega$

Parameter	Symbol	Conditions	Measurement data	Unit
Operating Voltage	$V_{DD}$		3.0	V
Inverter Voltage	$V_{INV}$		3.0	V
Control Voltage (High)	$V_{CTL(H)}$		1.85	V
Control Voltage (Low)	$V_{CTL(L)}$		0	V
Operating current	$I_{DD1}$	RF OFF, $V_{CTL}=1.85V$	2.27	mA
Operating current	$I_{DD2}$	RF OFF, $V_{CTL}=0V$	0.04	$\mu A$
Inverter current	$I_{INV1}$	RF OFF, $V_{CTL}=1.85V$	92.2	$\mu A$
Inverter current	$I_{INV2}$	RF OFF, $V_{CTL}=0V$	15.4	$\mu A$
Control current	$I_{CTL}$	RF OFF, $V_{CTL}=1.85V$	4.2	$\mu A$

## 5-2-2 MEASURED DATA2 (LNA HIGH GAIN MODE)

General conditions:  $V_{DD}=V_{INV}=3.0V$ ,  $V_{CTL}=1.85V$ ,  $f_{RF}=3.5\sim 3.7GHz$ ,  $T_a=+25^\circ C$ ,  $Z_s=Z_l=50\Omega$   
with application circuit

Parameter	Symbol	Conditions	Measurement data	Unit
Operating current1	$I_{DD1}$	RF OFF	2.27	mA
Small signal gain1	Gain1	Exclude PCB/Connector losses (0.49dB)	11.7 ~ 12.4	dB
Isolation1	ISO1	Exclude PCB/Connector losses (0.49dB)	-27.2 ~ -26.1	dB
Noise figure1	NF1	Exclude PCB/Connector losses (0.25dB)	1.73 ~ 1.95	dB
Pin at 1dB compression point1	P-1dB(IN)_1		-6.0 ~ -4.0	dBm
Input 3rd order intercept point1	IIP3_1	$f1=f_{RF}$ , $f2=f_{RF}+100kHz$ , Pin=-24dBm	+1.3 ~ +3.7	dBm
RF Input port VSWR1	VSWRi_1		1.62 ~ 2.06	
RF Output port VSWR1	VSWRo_1		2.06 ~ 2.70	

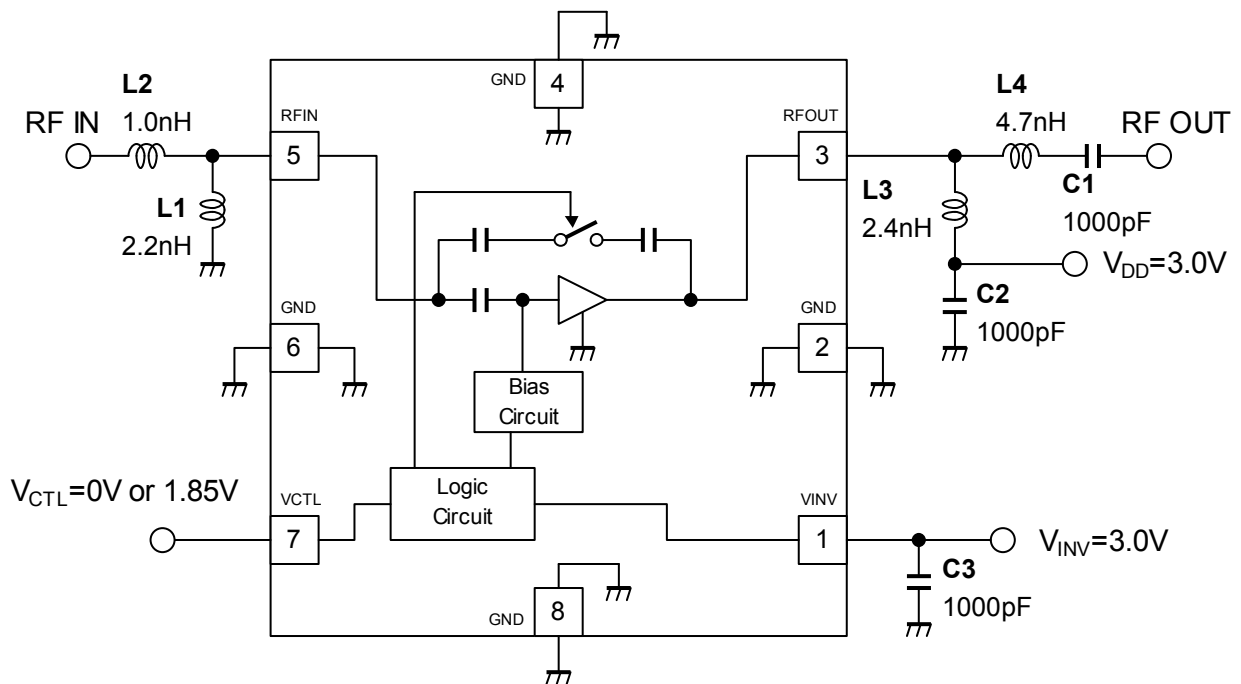
## 5-2-3 MEASURED DATA3 (LNA LOW GAIN MODE)

General conditions:  $V_{DD}=V_{INV}=3.0V$ ,  $V_{CTL}=0V$ ,  $f_{RF}=3.5\sim 3.7GHz$ ,  $T_a=+25^\circ C$ ,  $Z_s=Z_l=50\Omega$   
with application circuit

Parameter	Symbol	Conditions	Measurement data	Unit
Small signal gain2	Gain2	Exclude PCB/Connector losses (0.49dB)	-8.4 ~ -7.6	dB
Isolation2	ISO2	Exclude PCB/Connector losses (0.49dB)	-8.4 ~ -7.6	dB
Noise figure2	NF2	Exclude PCB/Connector losses (0.25dB)	4.2 ~ 11.7	dB
Pin at 1dB compression point2	P-1dB(IN)_2		+10.0 ~ +14.0	dBm
Input 3rd order intercept point2	IIP3_2	$f1=f_{RF}$ , $f2=f_{RF}+100kHz$ , Pin=-10dBm	+15.5 ~ +16.0	dBm
RF Input port VSWR2	VSWRi_2		2.01 ~ 2.05	
RF Output port VSWR2	VSWRo_2		1.22 ~ 2.25	

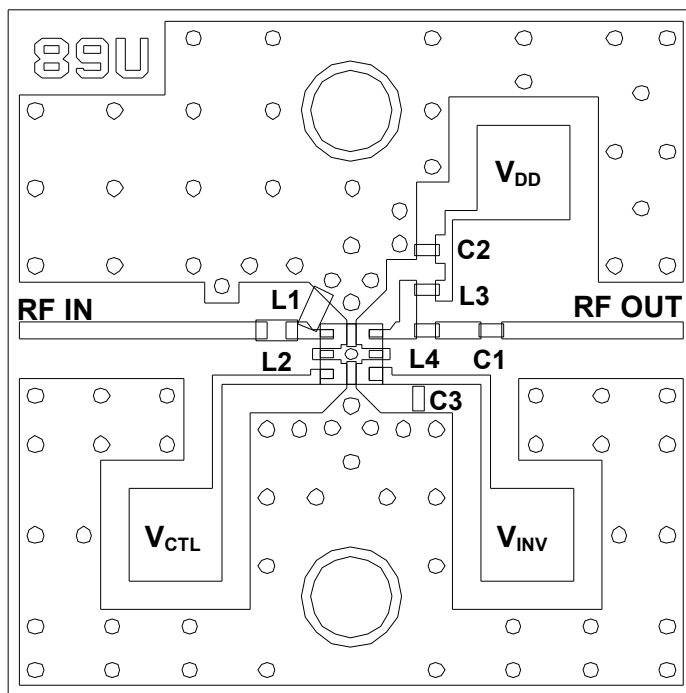
## 5-3 APPLICATION CIRCUIT

(Top View)



## 5-4 PCB DESIGN

(Top View)



### Parts List

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

PCB (FR-4):

t=0.2mm

MICROSTRIP LINE WIDTH

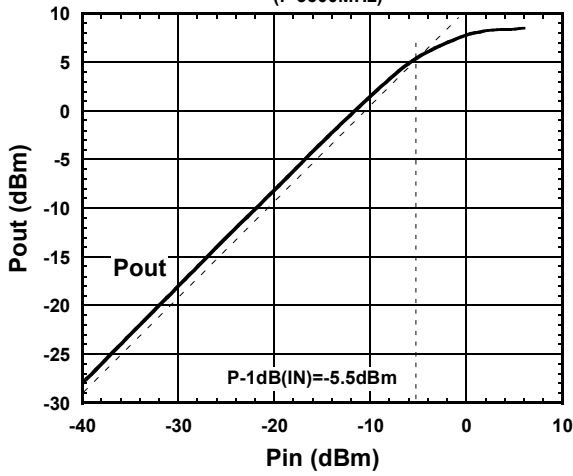
=0.4mm ( $Z_0=50\Omega$ )

PCB SIZE=17.0mm x 17.0mm

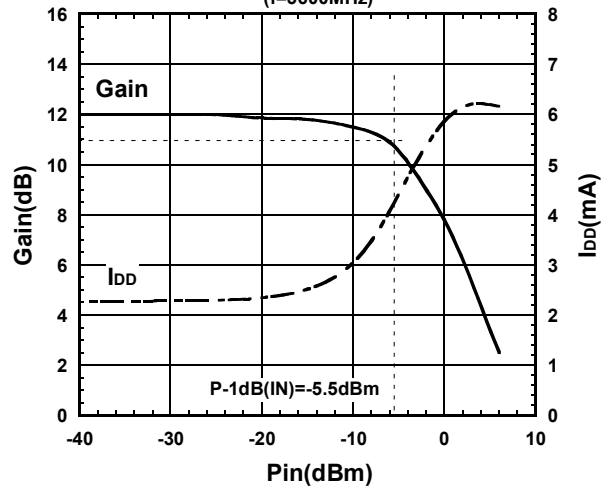
## 5-5-1 TYPICAL CHARACTERISTICS (LNA HIGH GAIN MODE)

Condition:  $T_a=+25^{\circ}\text{C}$ ,  $V_{DD}=V_{INV}=3.0\text{V}$ ,  $V_{CTL}=1.85\text{V}$ ,  $Z_s=Z_l=50\Omega$

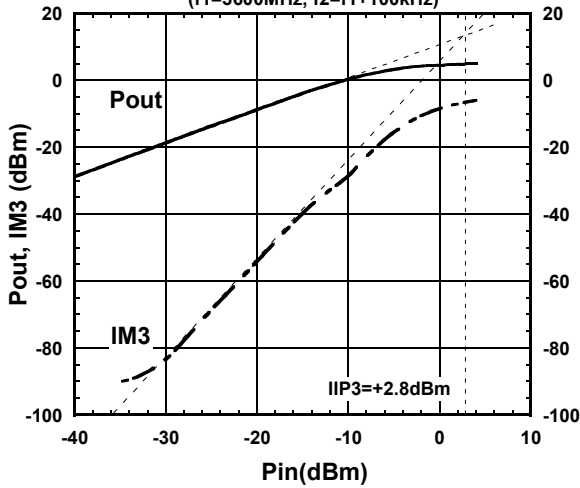
**NJG1126HB6 @High Gain**  
Pout vs. Pin  
(f=3600MHz)



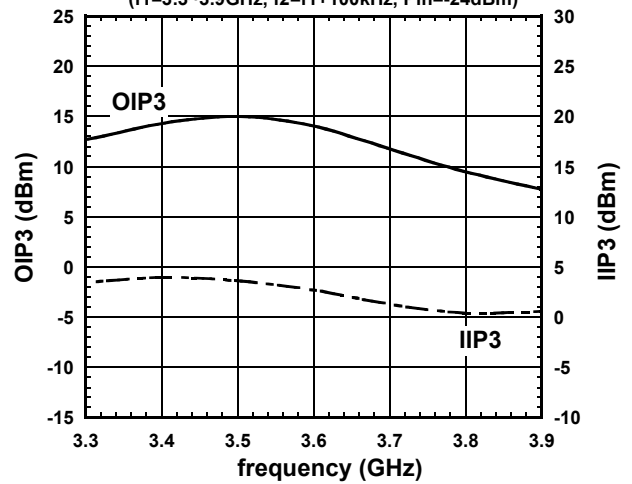
**NJG1126HB6 @High Gain**  
Gain, I<sub>DD</sub> vs. Pin  
(f=3600MHz)



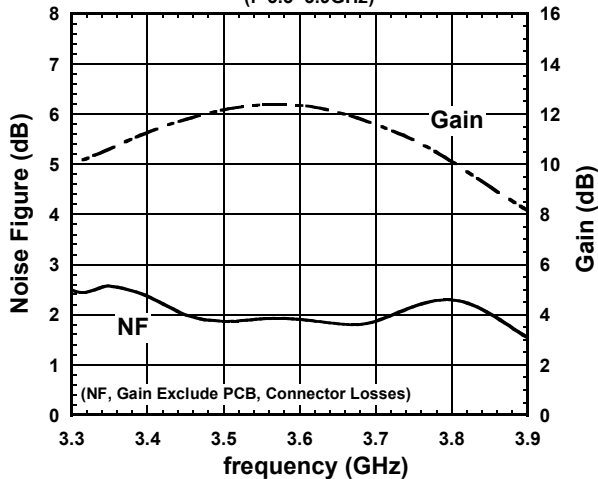
**NJG1126HB6 @High Gain**  
Pout, IM3 vs. Pin  
(f1=3600MHz, f2=f1+100kHz)



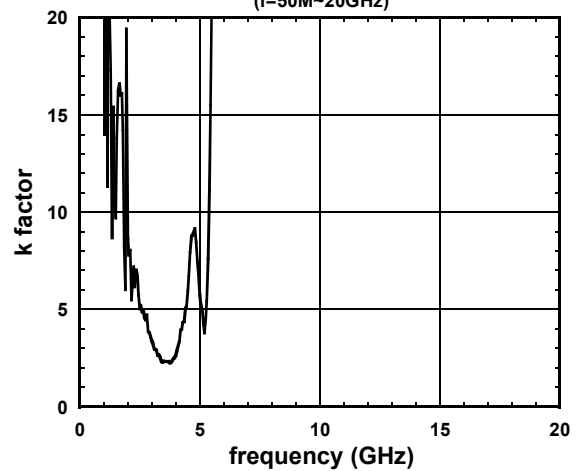
**NJG1126HB6 @High Gain**  
OIP3, IIP3 vs. frequency  
(f1=3.3~3.9GHz, f2=f1+100kHz, Pin=-24dBm)



**NJG1126HB6 @High Gain**  
NF, Gain vs. frequency  
(f=3.3~3.9GHz)

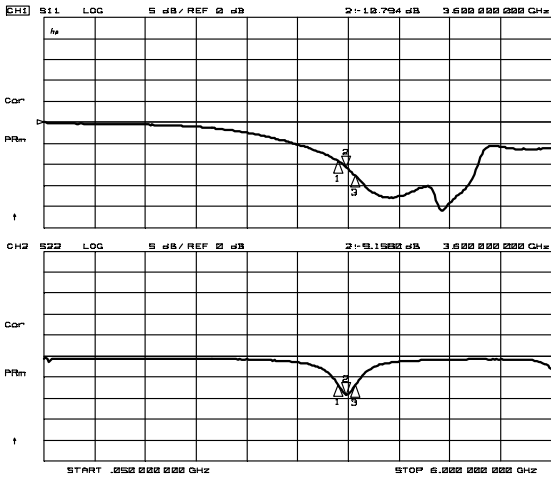


**NJG1126HB6 @High Gain**  
k factor vs. frequency  
(f=50M~20GHz)

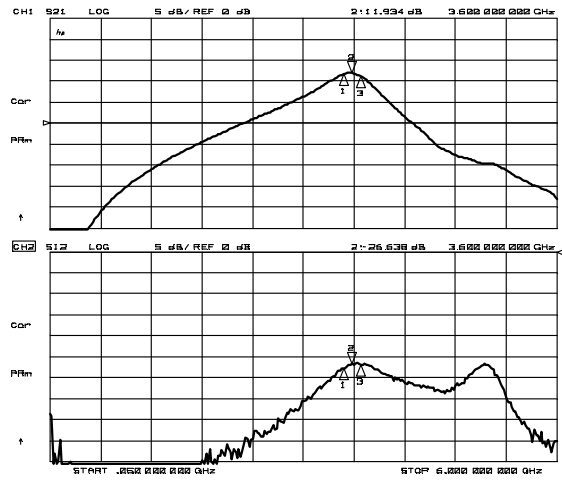


## 5-5-2 TYPICAL CHARACTERISTICS (LNA HIGH GAIN MODE)

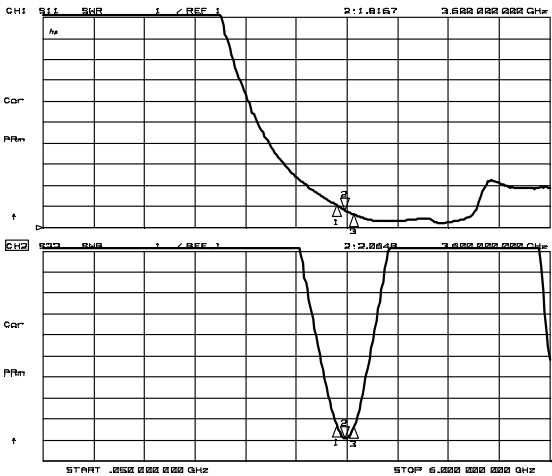
Condition:  $T_a = +25^\circ\text{C}$ ,  $V_{DD} = V_{INV} = 3.0\text{V}$ ,  $V_{CTL} = 1.85\text{V}$ ,  $Z_s = Z_l = 50\Omega$



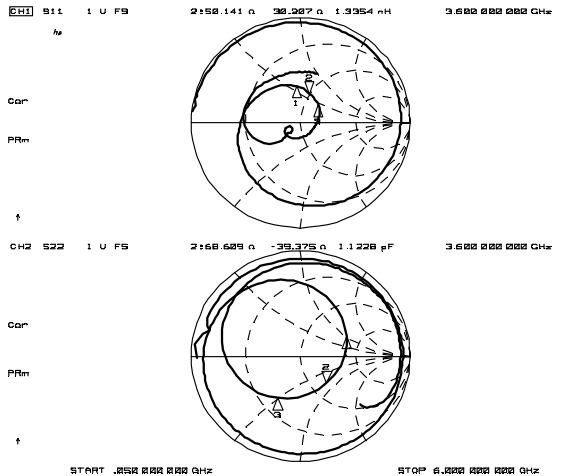
S11, S22



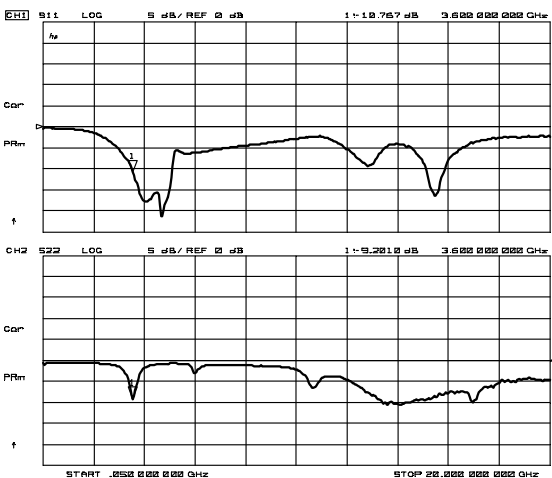
S21, S12



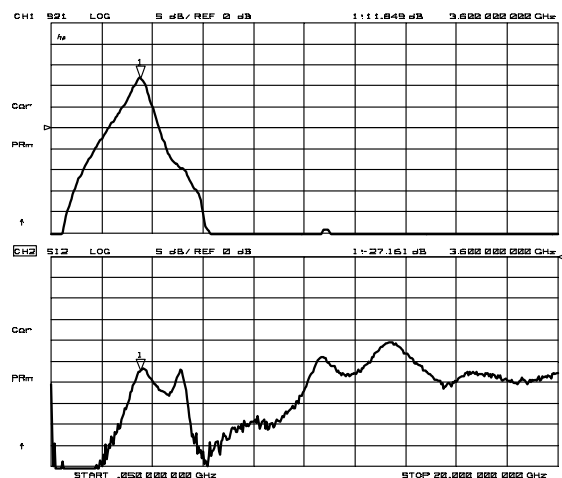
VSWR



Zin, Zout



S11, S22 (f=50MHz ~ 20GHz)

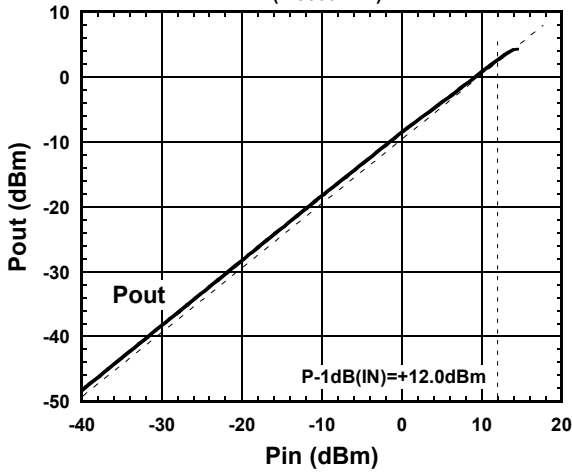


S21, S12 (f=50MHz ~ 20GHz)

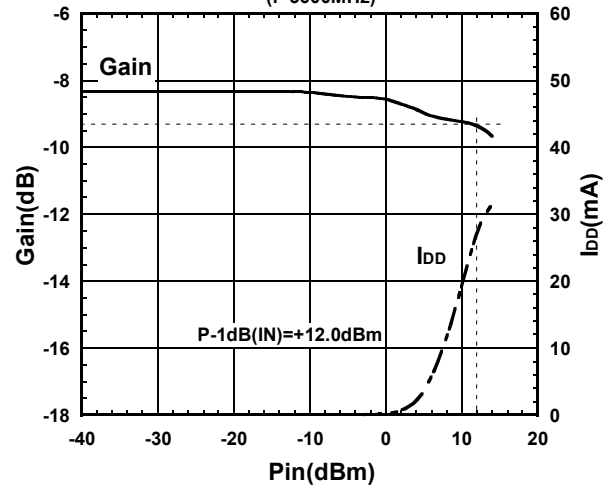
## 5-5-3 TYPICAL CHARACTERISTICS (LNA LOW GAIN MODE)

Condition:  $T_a=+25^{\circ}\text{C}$ ,  $V_{DD}=V_{INV}=3.0\text{V}$ ,  $V_{CTL}=0\text{V}$ ,  $Z_s=Z_l=50\Omega$

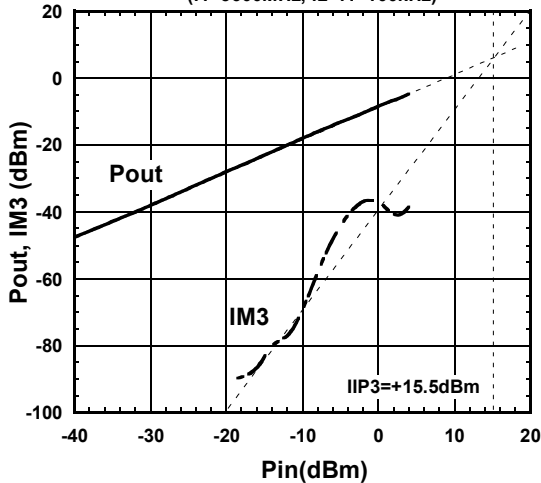
**NJG1126HB6 @Low Gain**  
**Pout vs. Pin**  
 (f=3600MHz)



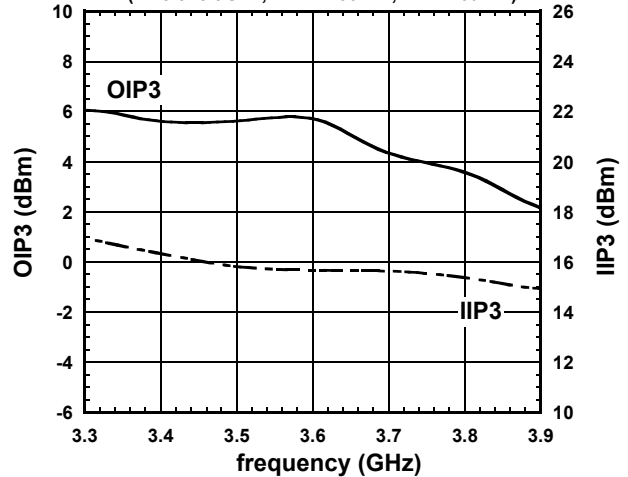
**NJG1126HB6 @Low Gain**  
**Gain, I<sub>DD</sub> vs. Pin**  
 (f=3600MHz)



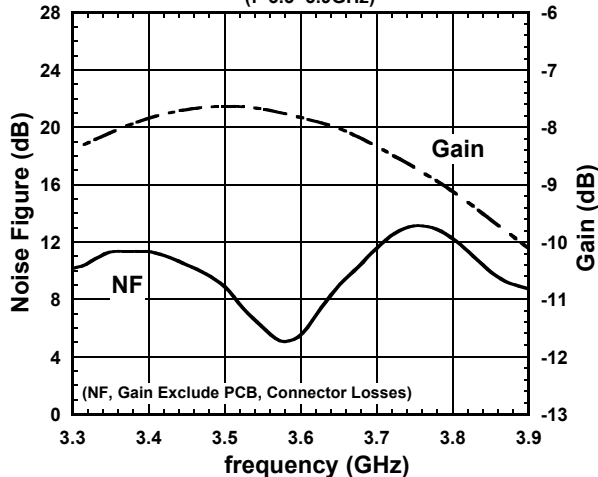
**NJG1126HB6 @Low Gain**  
**Pout, IM3 vs. Pin**  
 (f1=3600MHz, f2=f1+100kHz)



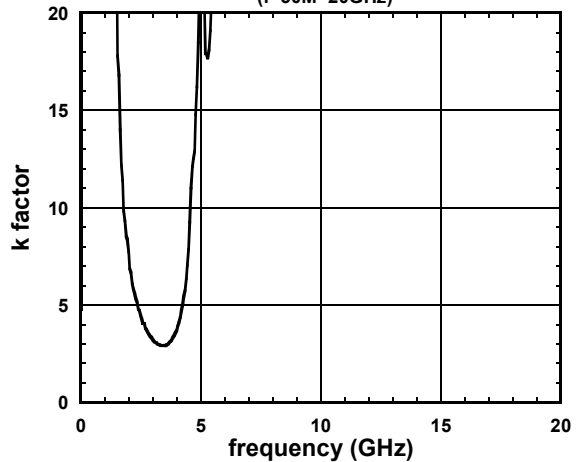
**NJG1126HB6 @Low Gain**  
**OIP3, IIP3 vs. frequency**  
 (f1=3.3~3.9GHz, f2=f1+100kHz, Pin=-10dBm)



**NJG1126HB6 @Low Gain**  
**NF, Gain vs. frequency**  
 (f=3.3~3.9GHz)

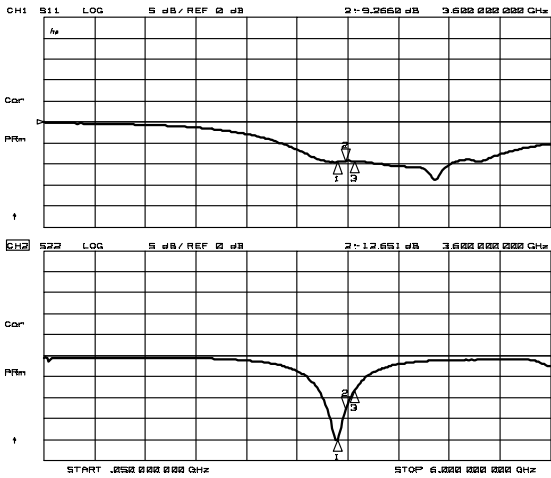


**NJG1126HB6 @Low Gain**  
**k factor vs. frequency**  
 (f=50M~20GHz)

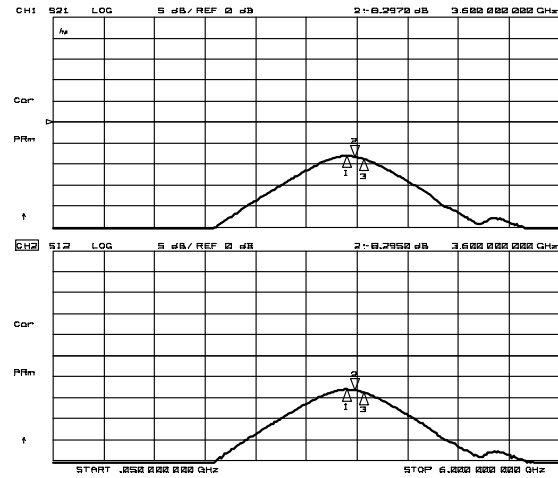


## 5-5-4 TYPICAL CHARACTERISTICS (LNA LOW GAIN MODE)

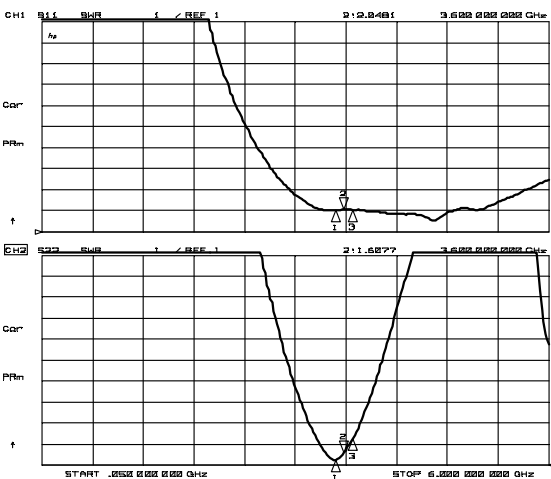
Condition:  $T_a = +25^\circ\text{C}$ ,  $V_{DD} = V_{INV} = 3.0\text{V}$ ,  $V_{CTL} = 0\text{V}$ ,  $Z_s = Z_l = 50\Omega$



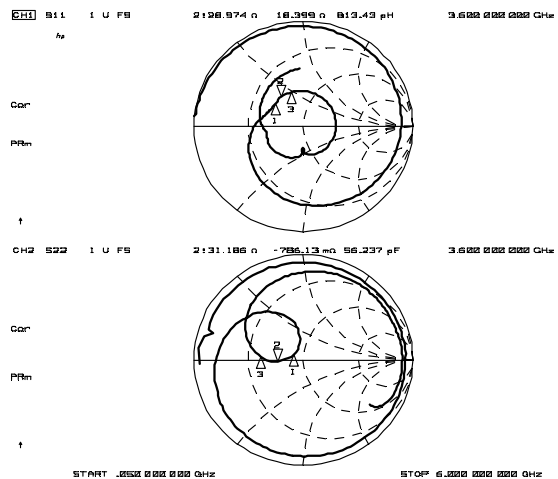
S11, S22



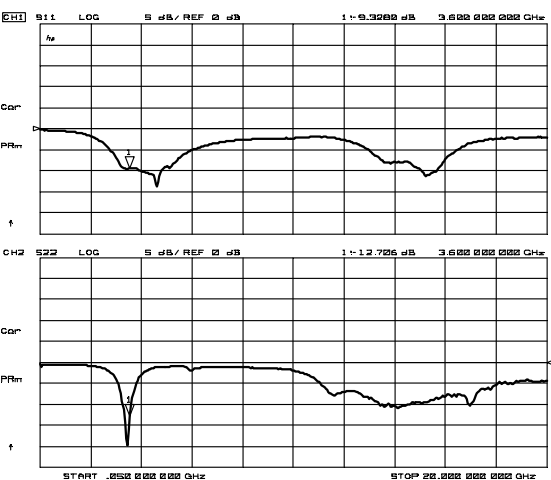
S21, S12



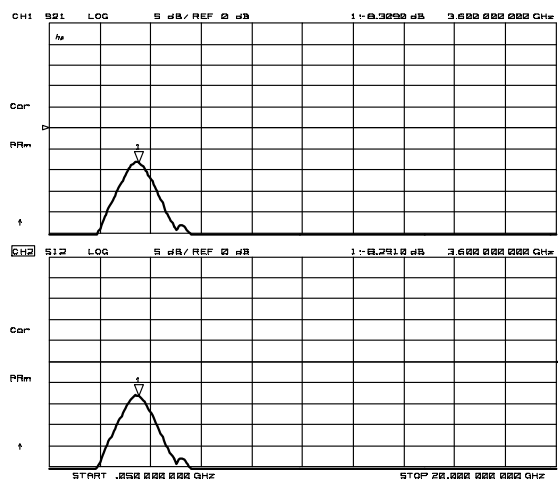
VSWR



Zin, Zout



S11, S22 (f=50MHz ~ 20GHz)



S21, S12 (f=50MHz ~ 20GHz)