

## W-LAN/WiMAX Application

### 1. 2.4GHz BAND APPLICATION

#### 1-1 SUMMARY

The characteristics of 2.4GHz band have evaluated as follows. The evaluation circuit structure and measured data are reviewed.

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

General conditions:  $V_{DD}=V_{INV}=2.85V$ ,  $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50\Omega$

| Parameter              | Symbol       | Conditions              | Measurement data | Unit    |
|------------------------|--------------|-------------------------|------------------|---------|
| Operating Voltage      | $V_{DD}$     |                         | 2.85             | V       |
| Inverter Voltage       | $V_{INV}$    |                         | 2.85             | V       |
| Control Voltage (High) | $V_{CTL(H)}$ |                         | 1.85             | V       |
| Control Voltage (Low)  | $V_{CTL(L)}$ |                         | 0                | V       |
| Operating current      | $I_{DD1}$    | RF OFF, $V_{CTL}=1.85V$ | 2.31             | mA      |
| Operating current      | $I_{DD2}$    | RF OFF, $V_{CTL}=0V$    | 0.04             | $\mu A$ |
| Inverter current       | $I_{INV1}$   | RF OFF, $V_{CTL}=1.85V$ | 89.8             | $\mu A$ |
| Inverter current       | $I_{INV2}$   | RF OFF, $V_{CTL}=0V$    | 16.1             | $\mu A$ |
| Control current        | $I_{CTL}$    | RF OFF, $V_{CTL}=1.85V$ | 3.4              | $\mu A$ |

## 1-2-2 MEASURED DATA2 (LNA HIGH GAIN MODE)

General conditions:  $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=1.85V$ ,  $f_{RF}=2450MHz$ ,  $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50\Omega$   
with application circuit

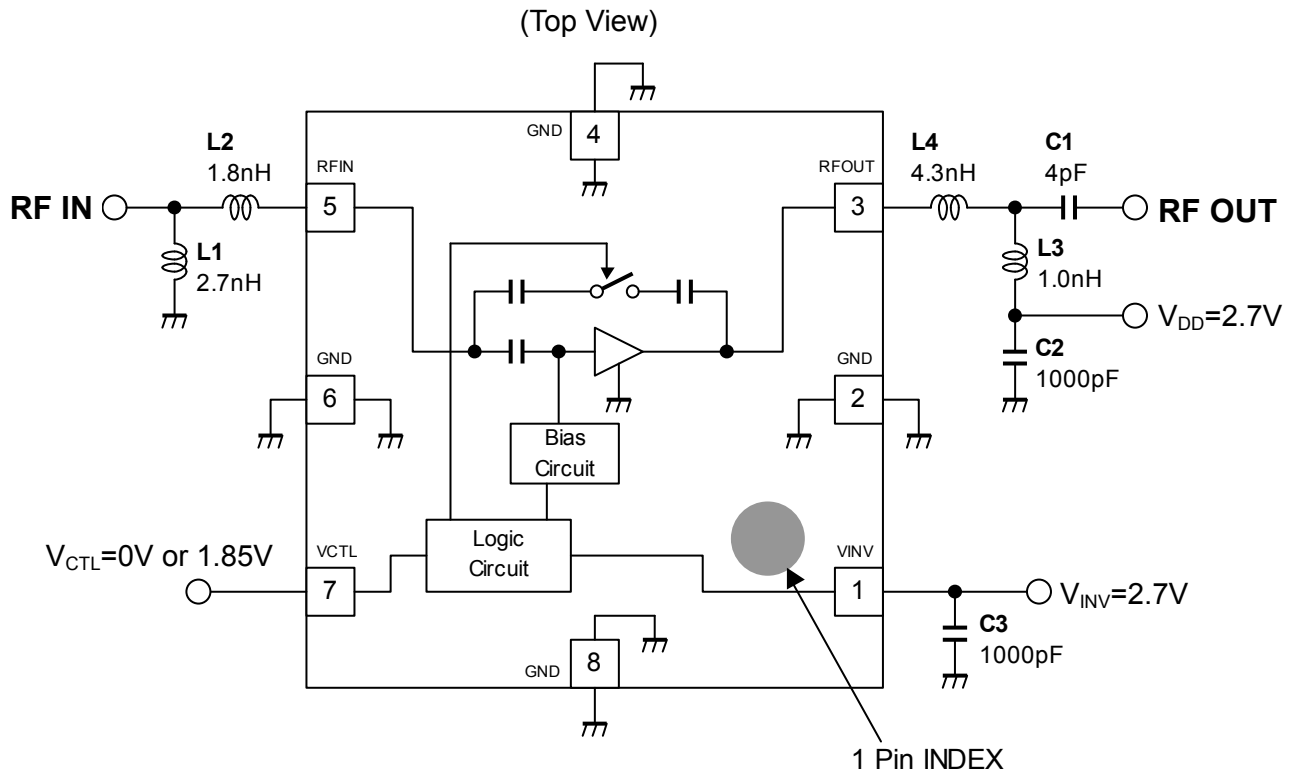
| Parameter                       | Symbol    | Conditions                                       | Measurement data | Unit |
|---------------------------------|-----------|--|------------------|------|
| Operating current               | $I_{DD}$  | RF OFF   | 2.21             | mA   |
| Small signal gain               | Gain      |  | 15.5             | dB   |
| Isolation                       | ISO       |  | -28.5            | dB   |
| Noise figure                    | NF        | Exclude PCB/Connector losses (0.11dB)            | 1.39             | dB   |
| Pin at 1dB compression point    | P-1dB(IN) |  | -8.5             | dBm  |
| Input 3rd order intercept point | IIP3      | $f1=f_{RF}$ , $f2=f_{RF}+100kHz$ ,<br>Pin=-32dBm | +2.3             | dBm  |
| RF Input port VSWR              | VSWRi     |  | 1.87             |      |
| RF Output port VSWR             | VSWRo     |  | 2.08             |      |

## 1-2-3 MEASURED DATA3 (LNA LOW GAIN MODE)

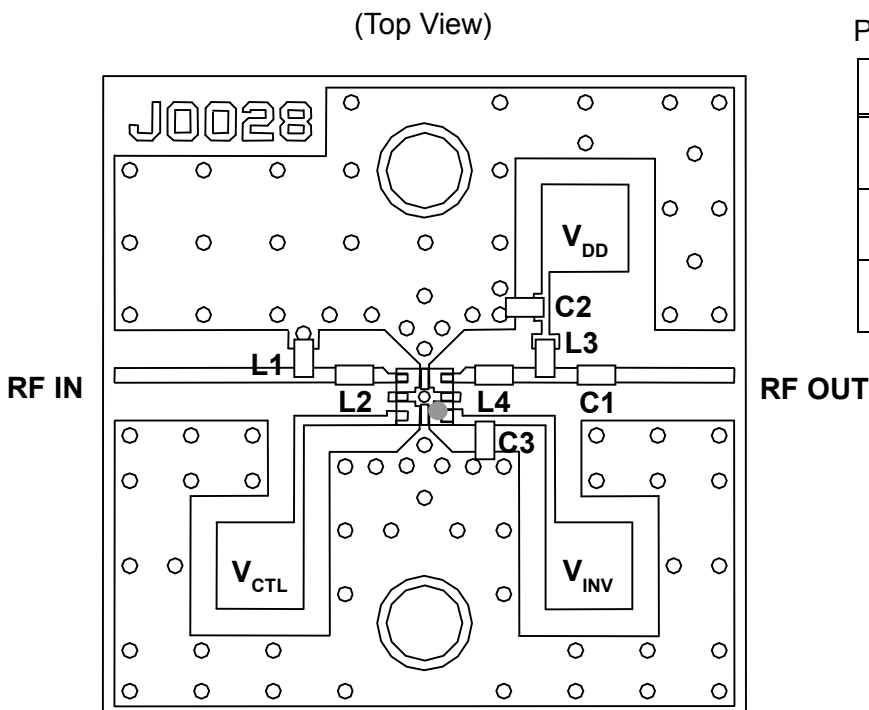
General conditions:  $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=0V$ ,  $f_{RF}=2450MHz$ ,  $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50\Omega$   
with application circuit

| Parameter                       | Symbol    | Conditions                                       | Measurement data | Unit |
|---------------------------------|-----------|--|------------------|------|
| Small signal gain               | Gain      |  | -6.9             | dB   |
| Isolation                       | ISO       |  | -6.9             | dB   |
| Noise figure                    | NF        | Exclude PCB/Connector losses (0.11dB)            | 6.7              | dB   |
| Pin at 1dB compression point    | P-1dB(IN) |  | +10.2            | dBm  |
| Input 3rd order intercept point | IIP3      | $f1=f_{RF}$ , $f2=f_{RF}+100kHz$ ,<br>Pin=-16dBm | +19.7            | dBm  |
| RF Input port VSWR              | VSWRi     |  | 1.34             |      |
| RF Output port VSWR             | VSWRo     |  | 1.12             |      |

## 1-3 APPLICATION CIRCUIT



## 1-4 PCB DESIGN



### Parts List

| Parts ID | Comment                     |
|----------|-----------------------------|
| L1~L3    | TAIYO-YUDEN (HK1005 Series) |
| L4       | MURATA (LQW15A Series)      |
| C1~C3    | MURATA (GRM15 Series)       |

PCB (FR-4):

t=0.2mm

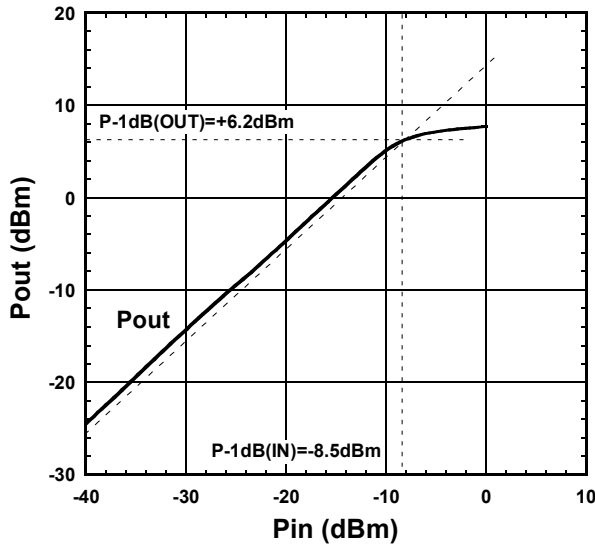
MICROSTRIP LINE WIDTH

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

PCB SIZE=17.0mm x 17.0mm

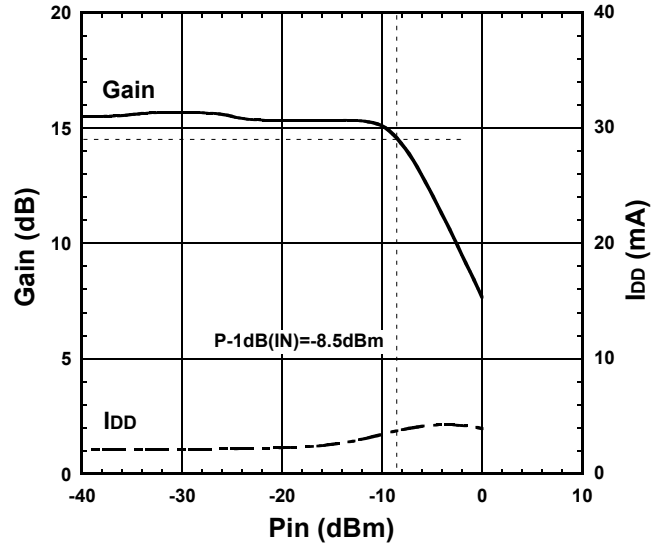
## 1-5-1 TYPICAL CHARACTERISTICS (LNA HIGH GAIN MODE)

**NJG1126HB6 @High Gain**  
Pout vs. Pin



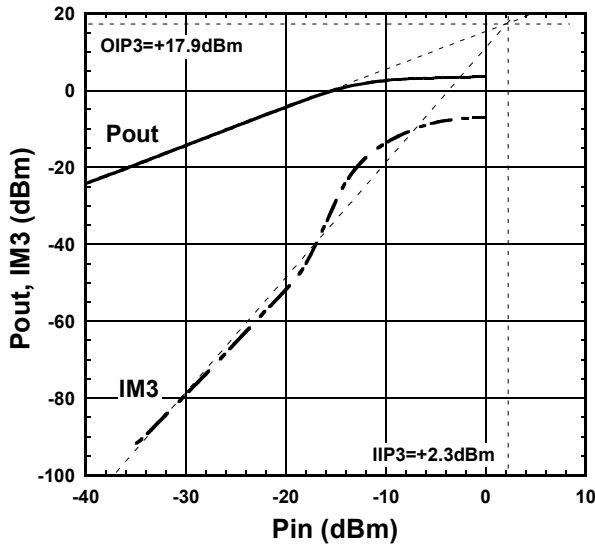
Condition  
 $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=1.85V$   
 $f_{RF}=2450MHz$ ,  $T_a=+25^{\circ}C$ ,  
 $Z_s=Z_l=50ohm$

**NJG1126HB6 @High Gain**  
Gain, I<sub>DD</sub> vs. Pin



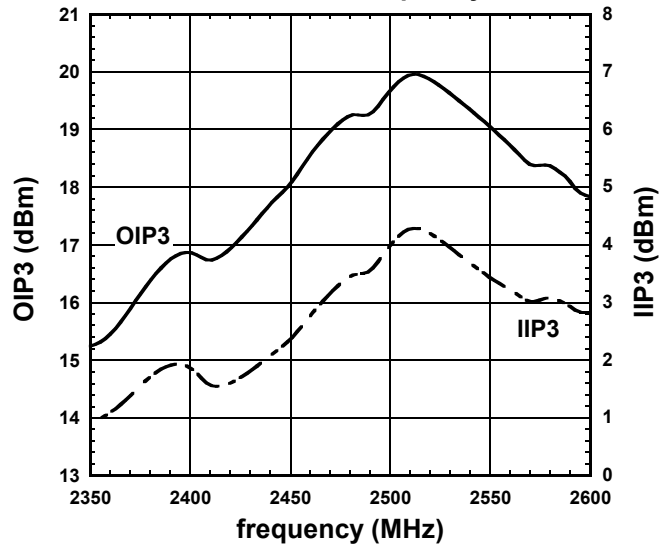
Condition  
 $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=1.85V$   
 $f_{RF}=2450MHz$ ,  $T_a=+25^{\circ}C$ ,  
 $Z_s=Z_l=50ohm$

**NJG1126HB6 @High Gain**  
Pout, IM3 vs. Pin



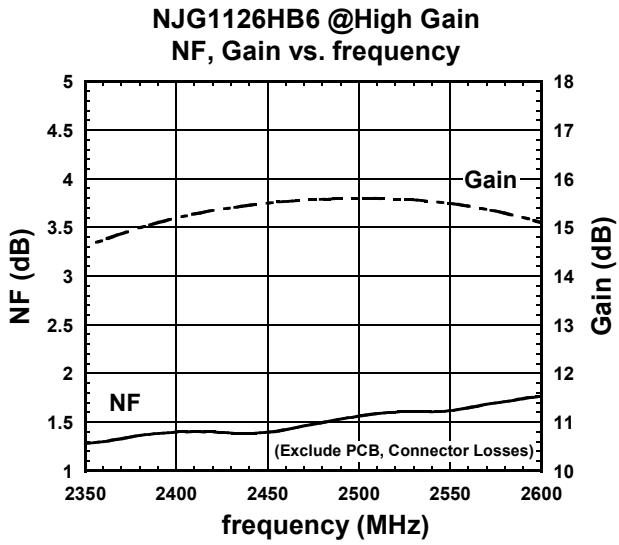
Condition  
 $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=1.85V$   
 $f_{RF}=2450+2450.1MHz$ ,  
 $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50ohm$

**NJG1126HB6 @High Gain**  
OIP3, IIP3 vs. frequency



Condition  
 $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=1.85V$   
 $f_{RF}=2350\sim 2600MHz$ , Offset=+100kHz  
 $Pin=-32dBm$   
 $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50ohm$

## 1-5-2 TYPICAL CHARACTERISTICS (LNA HIGH GAIN MODE)



Condition

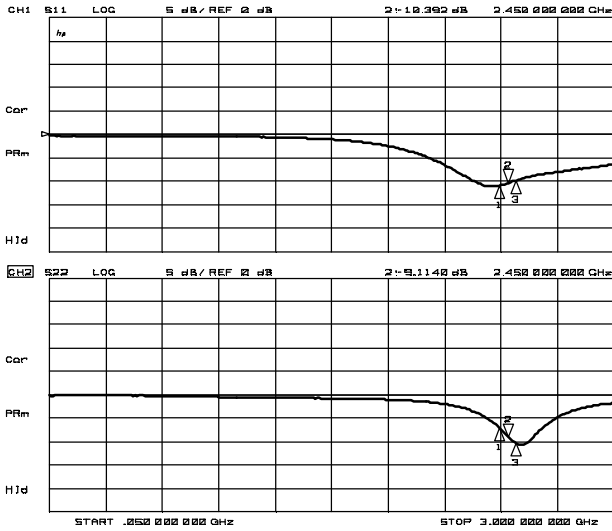
$V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=1.85V$

$f_{RF}=2350\sim 2600MHz$ ,  $T_a=+25^{\circ}C$ ,

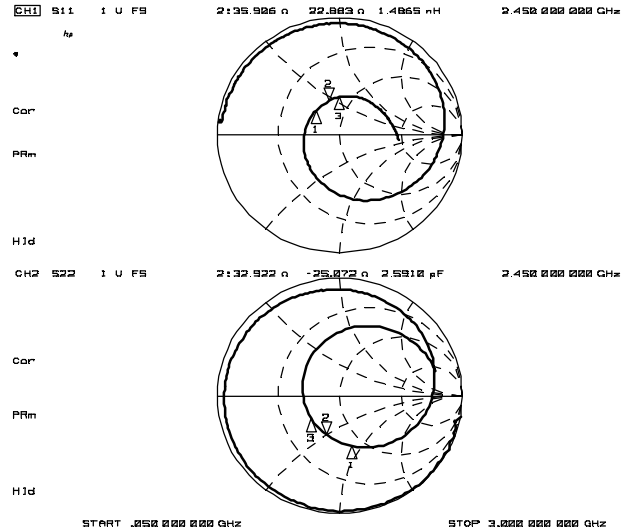
$Z_s=Z_l=50ohm$

## 1-5-3 TYPICAL CHARACTERISTICS (LNA HIGH GAIN MODE)

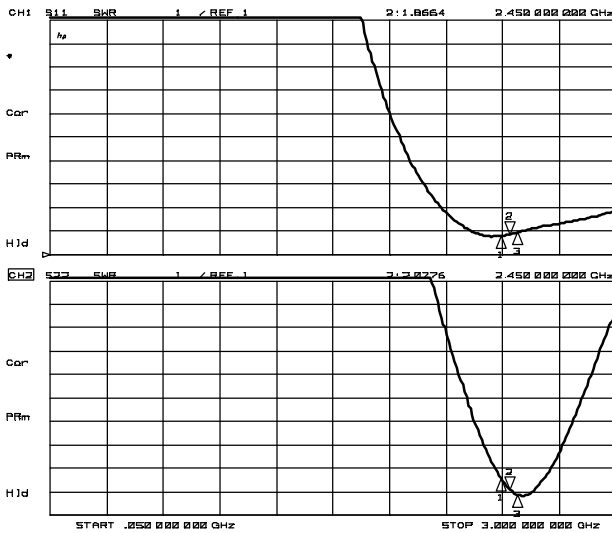
Condition:  $T_a = +25^\circ\text{C}$ ,  $V_{DD} = V_{INV} = 2.7\text{V}$ ,  $V_{CTL} = 1.85\text{V}$ ,  $Z_s = Z_l = 50\Omega$



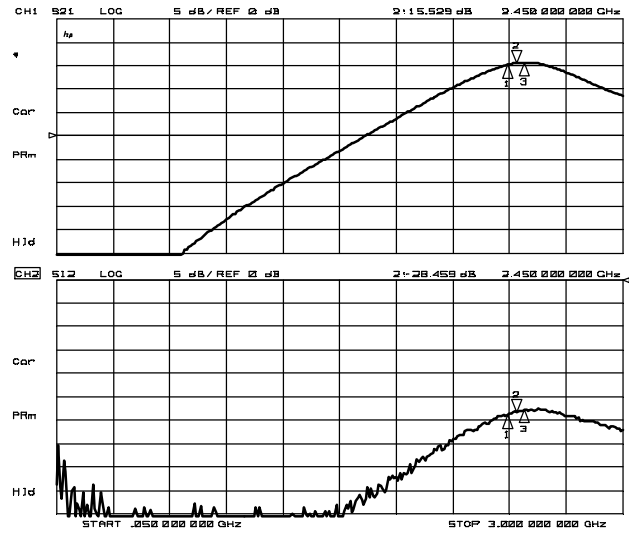
S11, S22



Zin, Zout



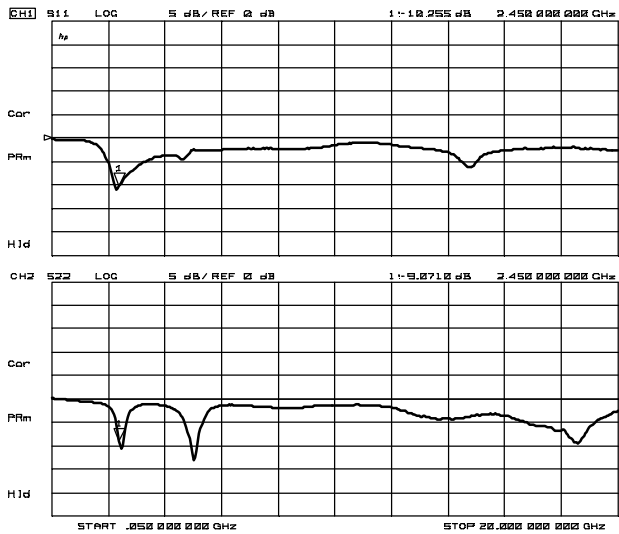
VSWRi, VSWRo



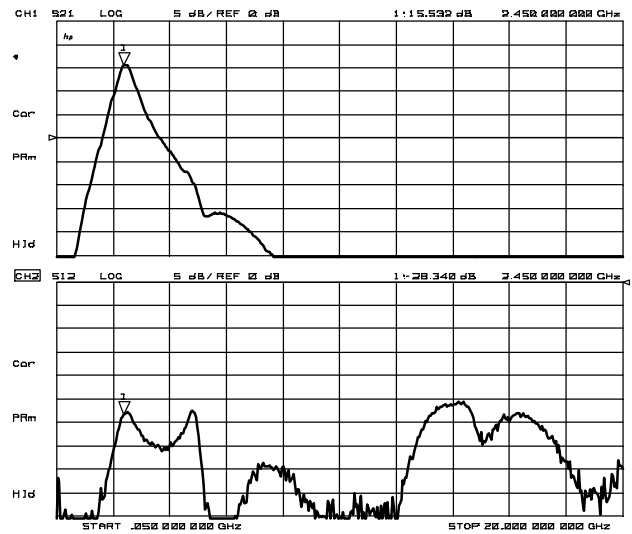
S21, S12

## 1-5-4 TYPICAL CHARACTERISTICS (LNA HIGH GAIN MODE)

Condition:  $T_a=+25^{\circ}\text{C}$ ,  $V_{DD}=V_{INV}=2.7\text{V}$ ,  $V_{CTL}=1.85\text{V}$ ,  $Z_s=Z_l=50\Omega$

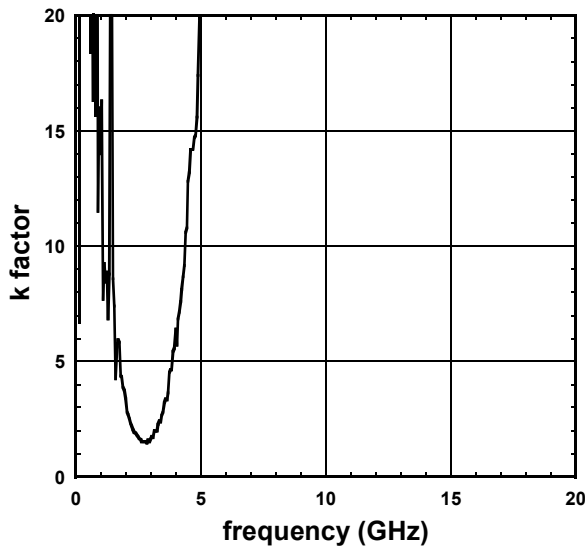


S11, S22(f=50MHz~20GHz)



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

### NJG1126HB6 @High Gain k factor vs. frequency



Condition

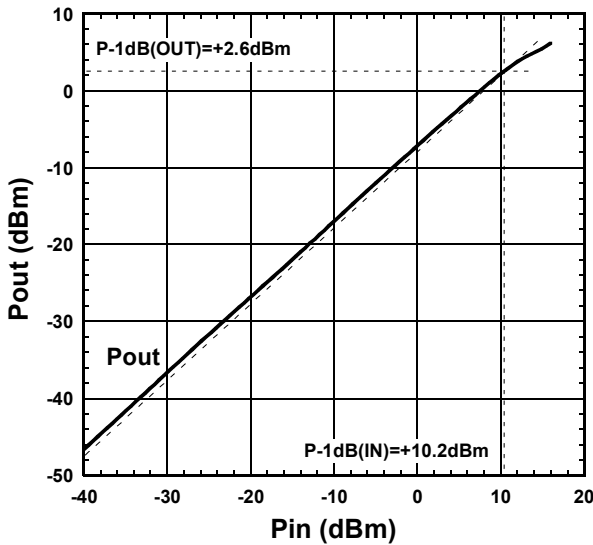
$V_{DD}=V_{INV}=2.7\text{V}$ ,  $V_{CTL}=1.85\text{V}$

$f_{RF}=50\text{MHz}\sim 20\text{GHz}$ ,

$T_a=+25^{\circ}\text{C}$ ,  $Z_s=Z_l=50\text{ohm}$

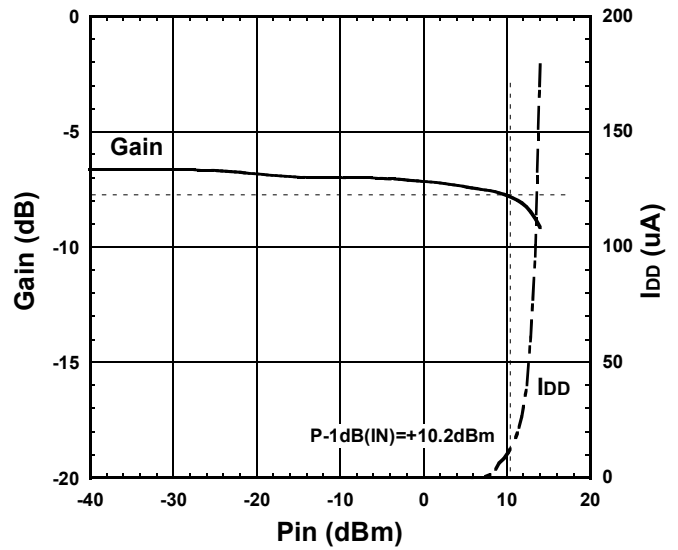
## 1-5-5 TYPICAL CHARACTERISTICS (LNA LOW GAIN MODE)

**NJG1126HB6 @Low Gain**  
Pout vs. Pin



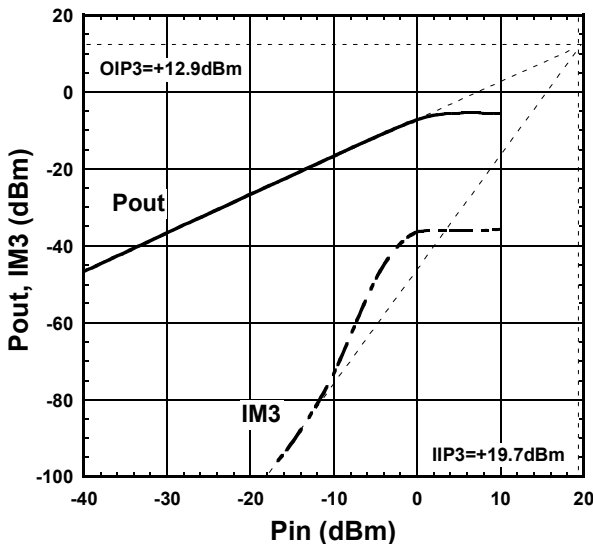
Condition  
 $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=0V$   
 $f_{RF}=2450MHz$ ,  $T_a=+25^{\circ}C$ ,  
 $Z_s=Z_l=50ohm$

**NJG1126HB6 @Low Gain**  
Gain, I<sub>DD</sub> vs. Pin



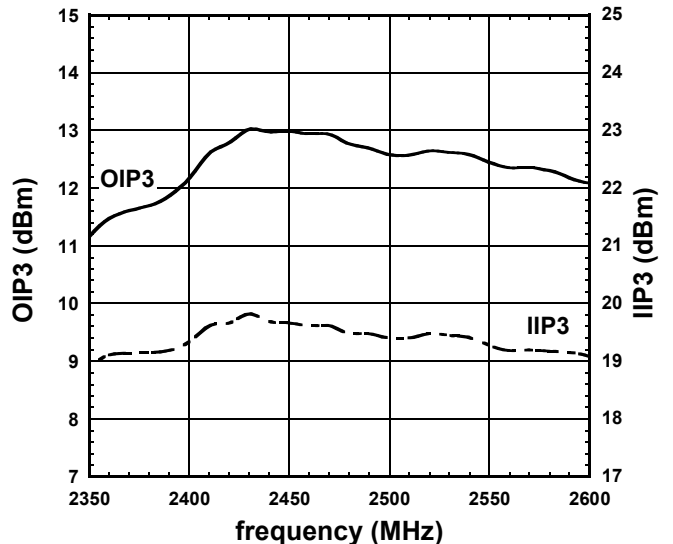
Condition  
 $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=0V$   
 $f_{RF}=2450MHz$ ,  $T_a=+25^{\circ}C$ ,  
 $Z_s=Z_l=50ohm$

**NJG1126HB6 @Low Gain**  
Pout, IM3 vs. Pin



Condition  
 $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=0V$   
 $f_{RF}=2450+2450.1MHz$ ,  
 $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50ohm$

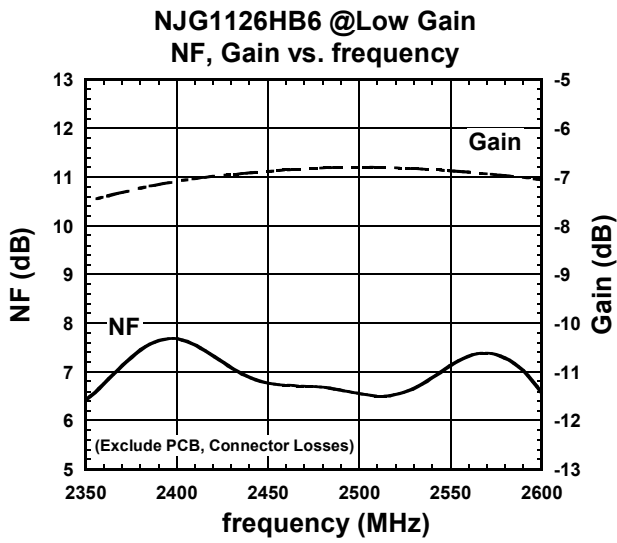
**NJG1126HB6 @Low Gain**  
OIP3, IIP3 vs. Pin



Condition  
 $V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=0V$   
 $f_{RF}=2350\sim 2600MHz$ , Offset=+100kHz  
 $Pin=-16dBm$   
 $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50ohm$



## 1-5-6 TYPICAL CHARACTERISTICS (LNA LOW GAIN MODE)



Condition

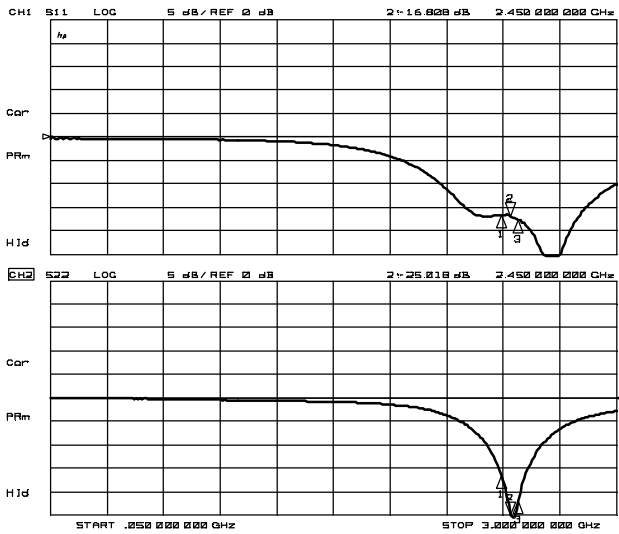
$V_{DD}=V_{INV}=2.7V$ ,  $V_{CTL}=0V$

$f_{RF}=2350\sim 2600MHz$ ,  $T_a=+25^{\circ}C$ ,

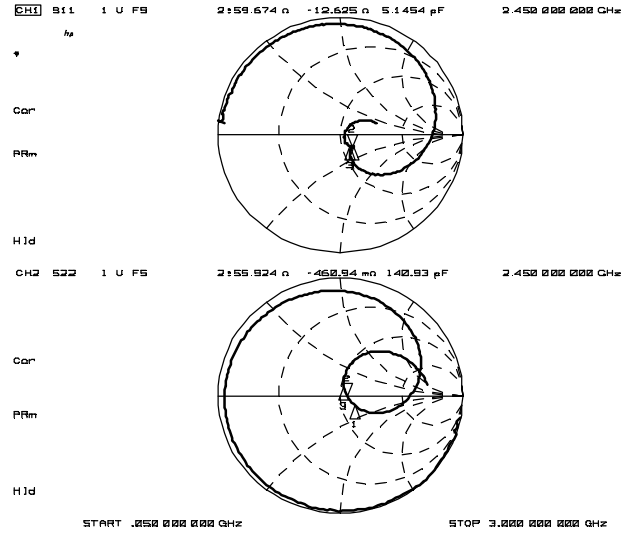
$Z_s=Z_l=50ohm$

## 1-5-7 TYPICAL CHARACTERISTICS (LNA LOW GAIN MODE)

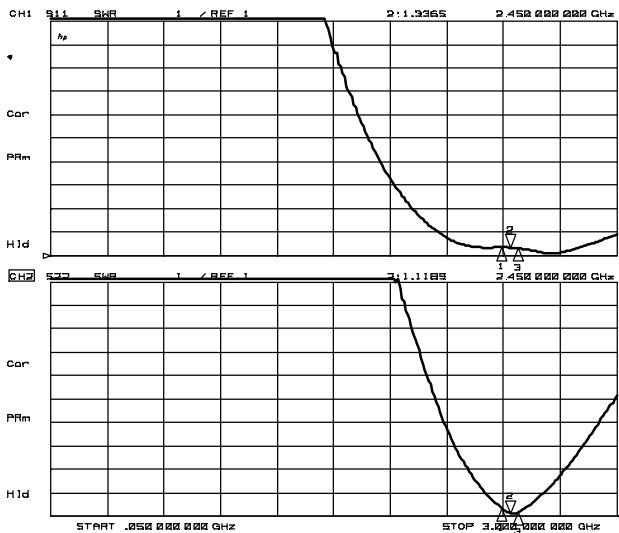
Condition:  $T_a = +25^\circ\text{C}$ ,  $V_{DD} = V_{INV} = 2.7\text{V}$ ,  $V_{CTL} = 0\text{V}$ ,  $Z_s = Z_l = 50\Omega$



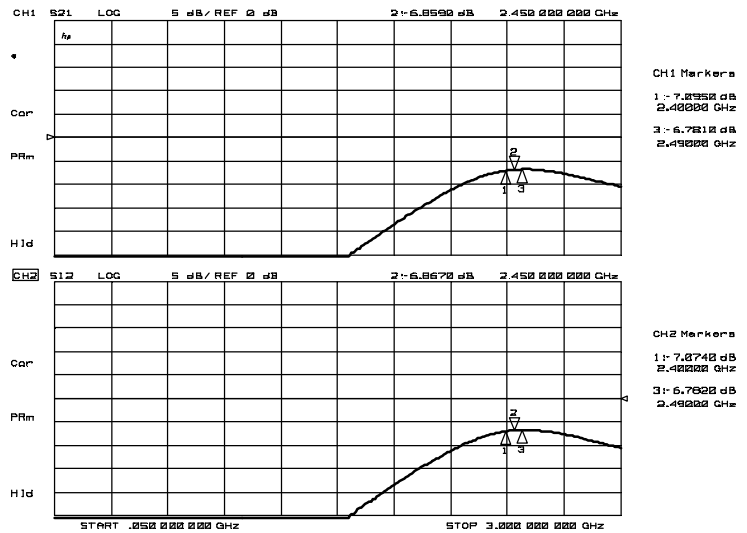
S11, S22



Zin, Zout



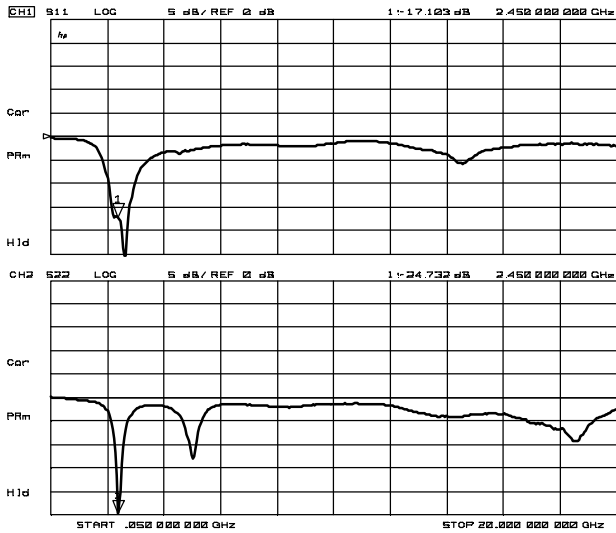
VSWRi, VSWRo



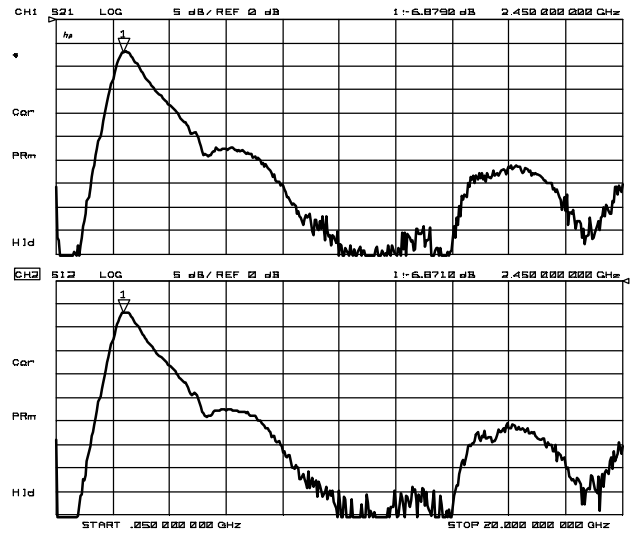
S21, S12

## 1-5-8 TYPICAL CHARACTERISTICS (LNA LOW GAIN MODE)

Condition:  $T_a=+25^{\circ}\text{C}$ ,  $V_{DD}=V_{INV}=2.7\text{V}$ ,  $V_{CTL}=0\text{V}$ ,  $Z_s=Z_l=50\Omega$

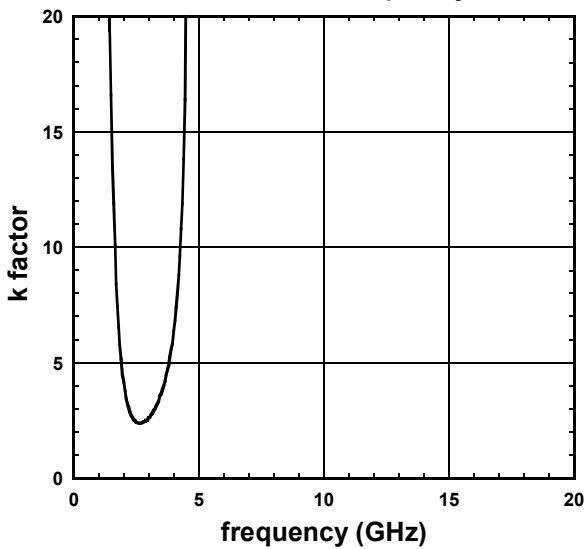


S11, S22(f=50MHz~20GHz)



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

### NJG1126HB6 @Low Gain k factor vs. frequency



Condition

$V_{DD}=V_{INV}=2.7\text{V}$ ,  $V_{CTL}=0\text{V}$

$f_{RF}=50\text{MHz}\sim 20\text{GHz}$ ,

$T_a=+25^{\circ}\text{C}$ ,  $Z_s=Z_l=50\text{ohm}$