# GPS LOW NOISE AMPLIFIER GaAs MMIC

## ■ GENERAL DESCRIPTION

NJG1130KA1 is a low noise amplifier GaAs MMIC designed for GPS application at the 1.575GHz. The LNA offers excellent low noise figure, high linearity and low current consumption.

Two stage amplifier and ESD protection circuit are integrated in the IC to achieve very high gain and high ESD tolerance.

An ultra-small and ultra-thin package of FLP6-A1 is adopted.

## ■ PACKAGE OUTLINE

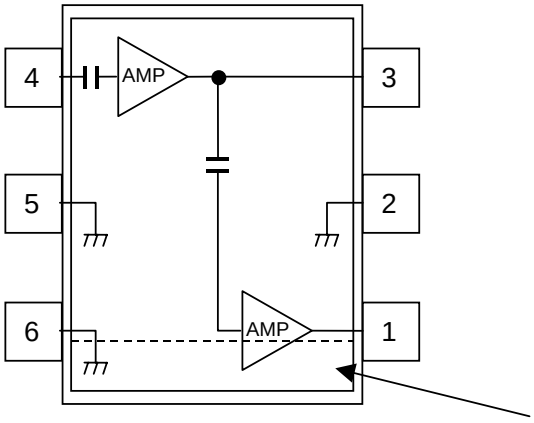
**NJG1130KA1**

## ■ FEATURES

| | |
|---|---|
| ● Low voltage operation | +2.85V typ. |
| ● Low current consumption | 5.0mA typ. |
| ● High gain | 29.0dB typ. @ f=1.575GHz |
| ● Low noise figure | 0.65dB typ. @ f=1.575GHz |
| ● 1dB gain compression output power | +11.0dBm typ. @ f=1.575GHz |
| ● High output IP3 | +14dBm typ. @ f=1.575+1.5751GHz, Pin=-35dBm |
| ● Ultra-small & ultra-thin package | FLP6-A1 (Package size: 1.6x1.6x0.6mm) |

## ■ PIN CONFIGURATION

**(Top View)**




Pin Connection

1. RF OUT
2. GND
3. VDD
4. RF IN
5. GND
6. GND

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

## ■ ABSOLUTE MAXIMUM RATINGS

$T_a$=+25°C, $Z_s$=$Z_l$=50ohm

| PARAMETERS | SYMBOL | CONDITIONS | RATINGS | UNITS |
|---|---|---|---|---|
| Drain Voltage | $V_{DD}$ | | 5.0 | V |
| Input power | Pin | $V_{DD}$=2.85V | +15 | dBm |
| Power dissipation | $P_D$ | on PCB board, at Tjmax=150°C | 170 | mW |
| Operating temperature | $T_{opr}$ | | -40~+85 | °C |
| Storage temperature | $T_{stg}$ | | -55~+150 | °C |

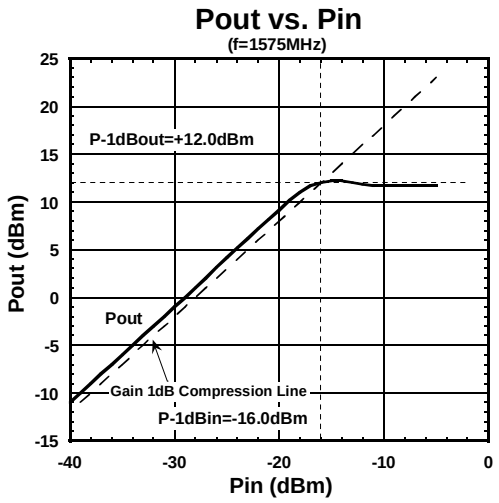
## ■ ELECTRICAL CHARACTERISTICS

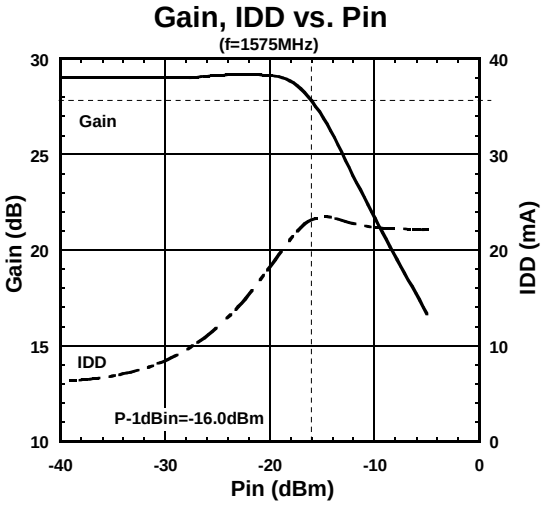
GENERAL CONDITIONS: $V_{DD}$=2.85V, freq=1.575GHz, $T_a$=+25°C, $Z_s$=$Z_l$=50ohm, with application circuit

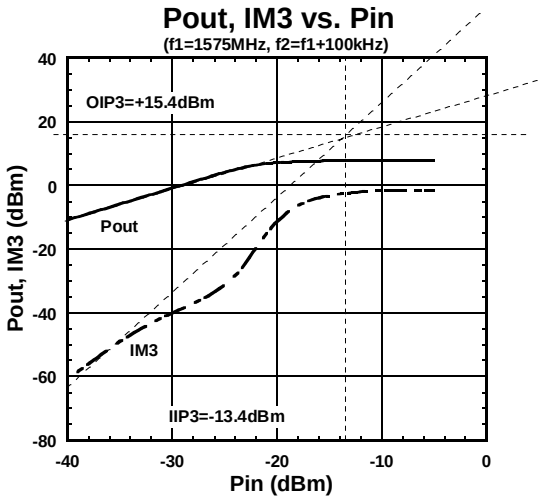
| PARAMETERS | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Operating voltage | $V_{DD}$ | | 2.5 | 2.85 | 3.3 | V |
| Operating current | $I_{DD}$ | RF OFF | - | 5.0 | 8.5 | mA |
| Small signal gain | Gain | | 26.0 | 29.0 | 31.5 | dB |
| Noise figure | NF | Exclude PCB & connector losses (0.10dB) | - | 0.65 | 0.95 | dB |
| 1dB gain compression output power | $P_{-1dB(out)}$ | | +5.0 | +11.0 | - | dBm |
| 3rd order output intercept point | OIP3 | f=1.575+1.5751GHz, Pin=-35dBm | +7.0 | +14.0 | - | dBm |
| RF IN VSWR | VSWRi | | - | 2.4 | 2.8 | |
| RF OUT VSWR | VSWRo | | - | 1.6 | 2.0 | |

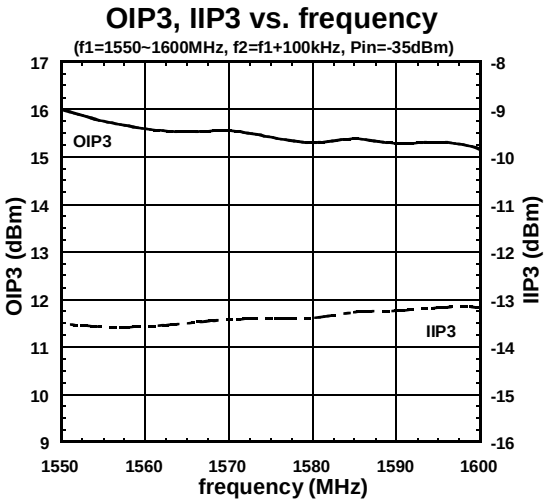
## ■ ELECTRICAL CHARACTERISTICS

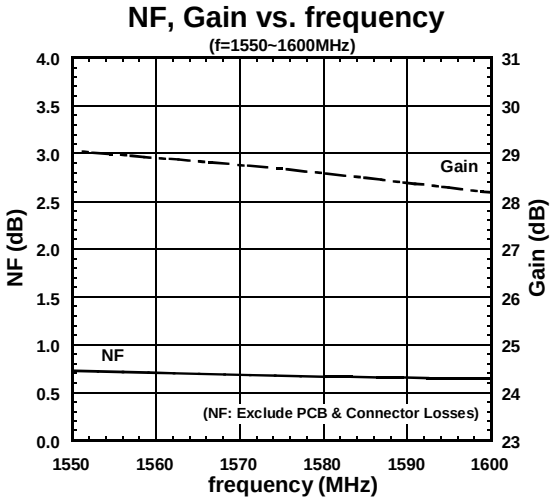
(Condition :Ta=+25℃,$V_{DD}$=2.85V,Zs=Zl=50ohm with application circuit)



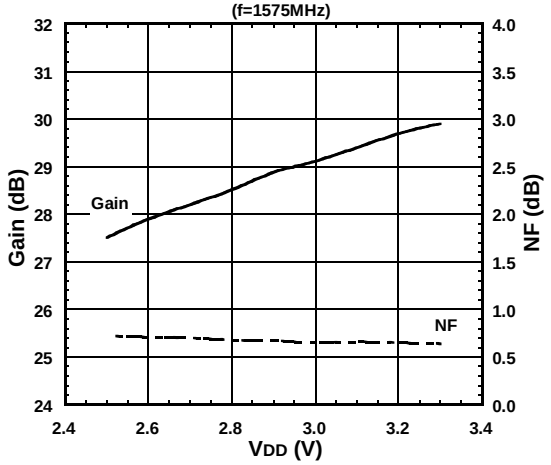



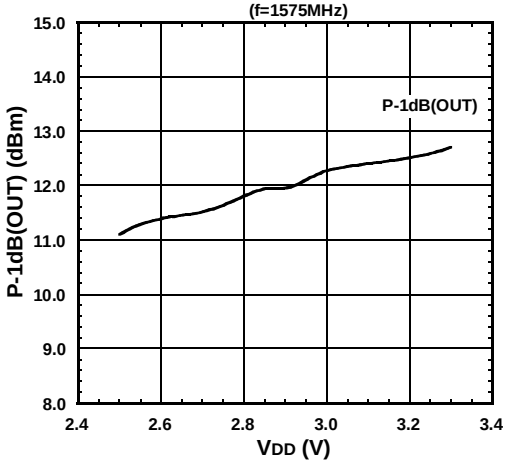
## ■ ELECTRICAL CHARACTERISTICS

(Condition :Ta=+25℃,Zs=Zl=50ohm with application circuit)

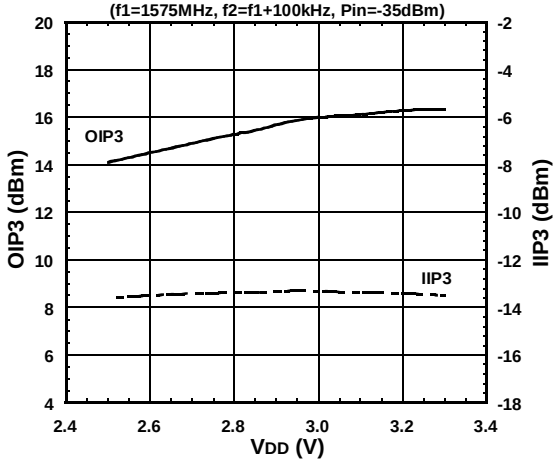
**Gain, NF vs. VDD**
(f=1575MHz)



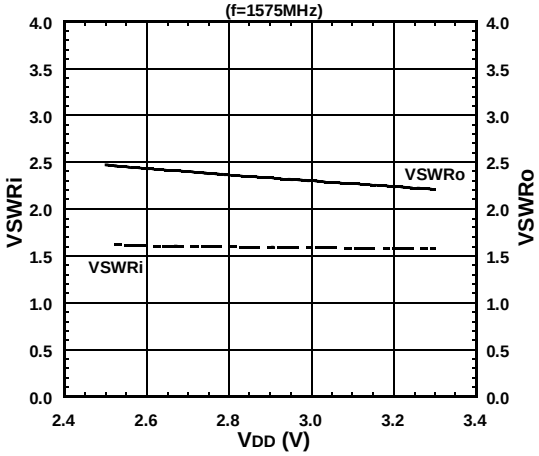

**P-1dB(OUT) vs. VDD**
(f=1575MHz)



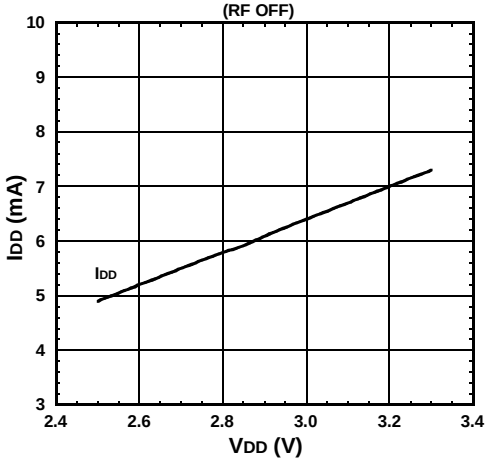

**OIP3, IIP3 vs. VDD**
(f1=1575MHz, f2=f1+100kHz, Pin=-35dBm)




**VSWRi, VSWRo vs. VDD**
(f=1575MHz)




**IDD vs. VDD**
(RF OFF)

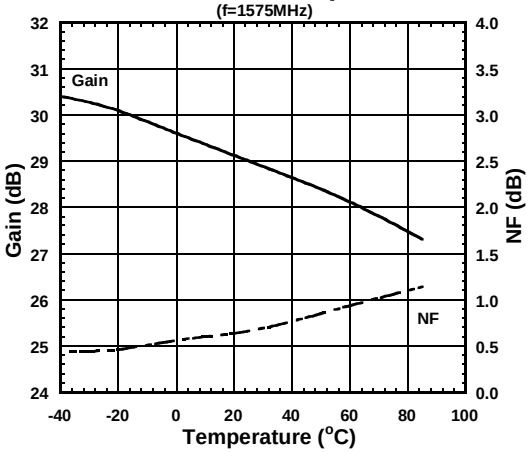


## ■ ELECTRICAL CHARACTERISTICS

(Condition :$V_{DD}$=2.85V,Zs=Zl=50ohm with application circuit)

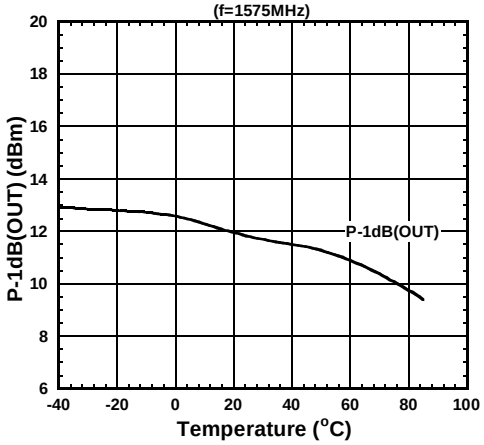
**Gain, NF vs. Temperature**

(f=1575MHz)



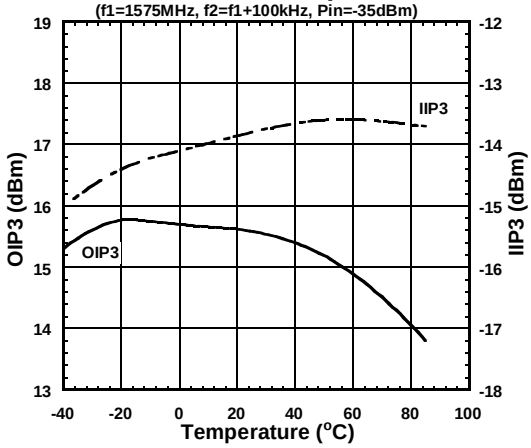

**P-1dB(OUT) vs. Temperature**

(f=1575MHz)



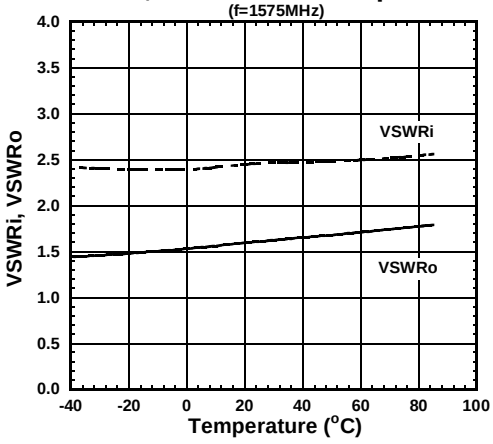

**OIP3, IIP3 vs. Temperature**

(f1=1575MHz, f2=f1+100kHz, Pin=-35dBm)



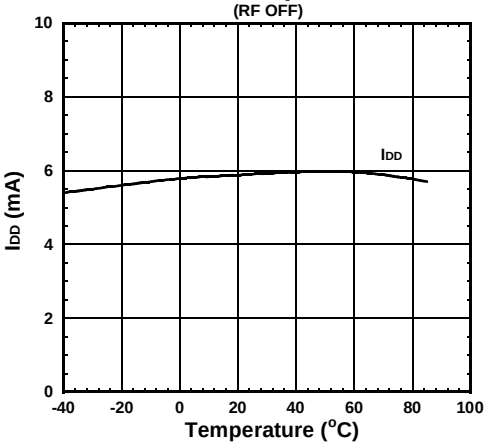

**VSWRi, VSWRo vs. Temperature**

(f=1575MHz)



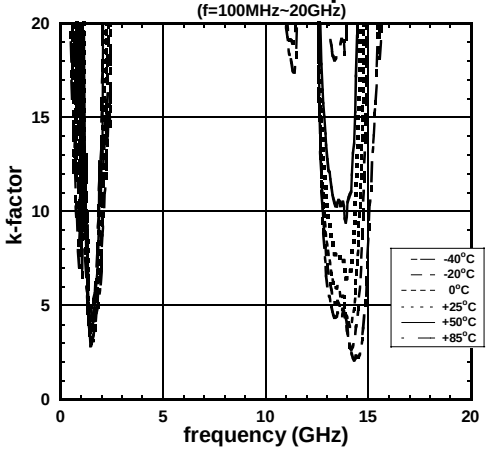

**$I_{DD}$ vs. Temperature**

(RF OFF)



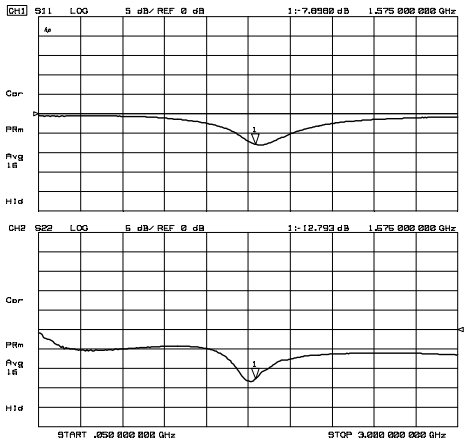

**k-factor vs. Temperature**

(f=100MHz~20GHz)

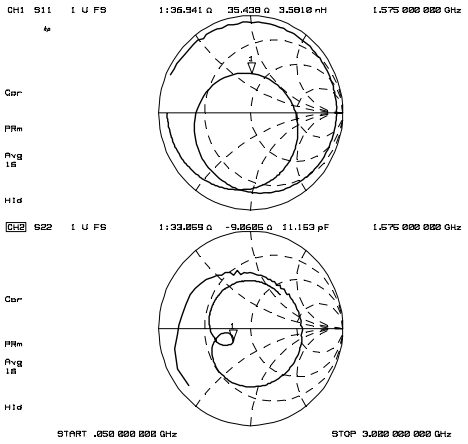


## ■ ELECTRICAL CHARACTERISTICS

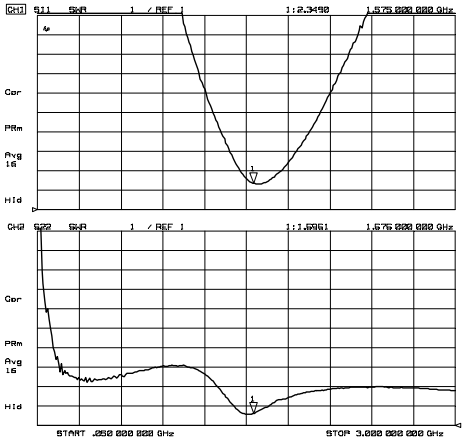
(Condition :Ta=+25℃,$V_{DD}$=2.85V,Zs=Zl=50ohm with application circuit)



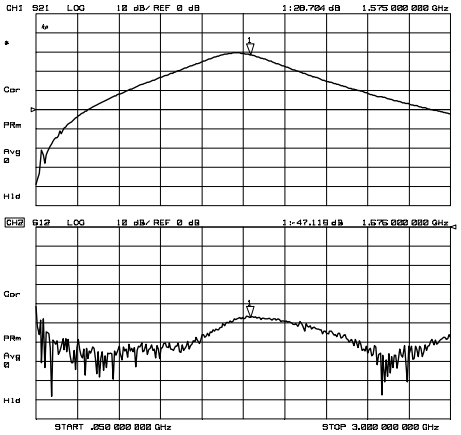
**S11, S22**



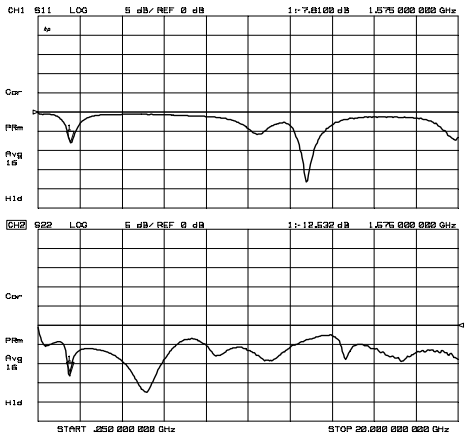
**Zin, Zout**



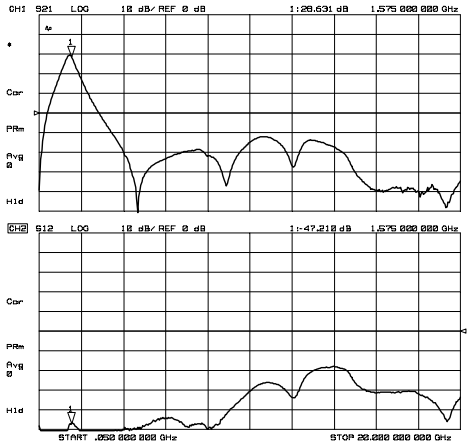
**VSWR**



**S21, S12**

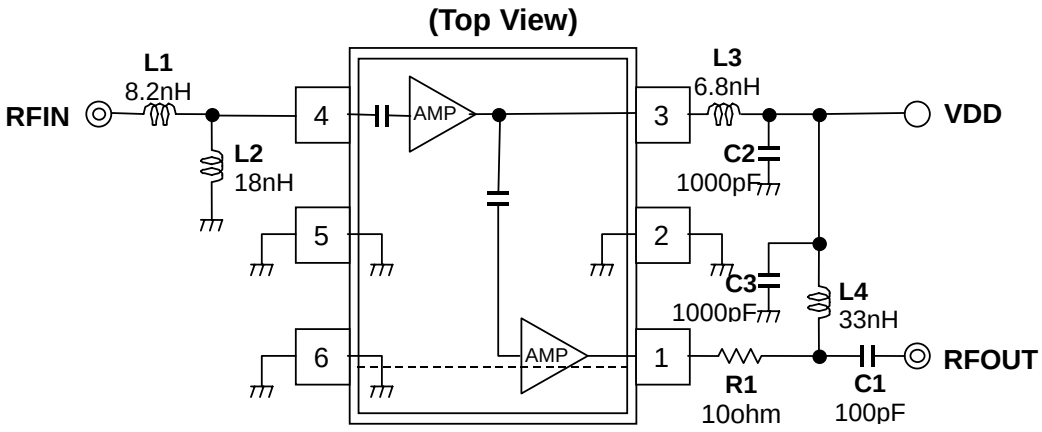


**S11, S22 (~20GHz)**



**S21, S12 (~20GHz)**

## ■ APPLICATION CIRCUIT

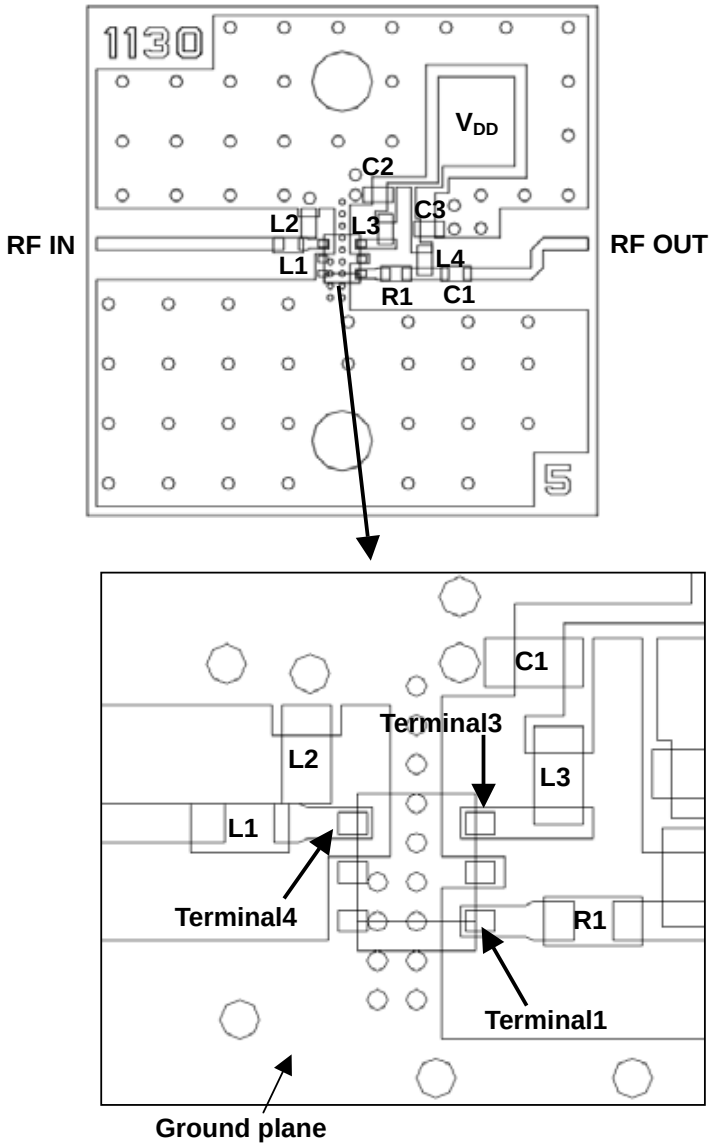



**NOTES:**

- L1 and L2 form the input matching circuit. The LNA has integrated coupling and DC-blocking capacitor at the input.
- L3 is a matching inductor of the integrated 1st amplifier and 2nd amplifier. It should be connected to the terminal3 as close as possible.
- L4 is an output matching inductor.
- C1 is a coupling and DC-blocking capacitor at the output.
- C2 and C3 are bypass capacitors. They should be connected between L3 and L4. C2 should be placed to the side of L3, and C3 should be placed to the side of L4, and should not be directly connected L3 and L4.
- R1 is a stability resistor at high frequency, and it should be connected to the terminal1.
- Ground terminal (No.2, 5, 6) should be connected to the ground plane as close as possible for good RF performance.
- For good performance, the terminal1,3 and 4 should not be coupled though floating-capacitance which exists between RF transmission lines.

## ■ TEST PCB LAYOUT

(Top View)




## ■Parts List

| Parts ID | Commment |
|---|---|
| L1～L4 | TAIYO-YUDEN<br>HK1005 Series |
| C1～C3 | MURATA<br>GRM15 Series |
| R1 | 1005 Size |

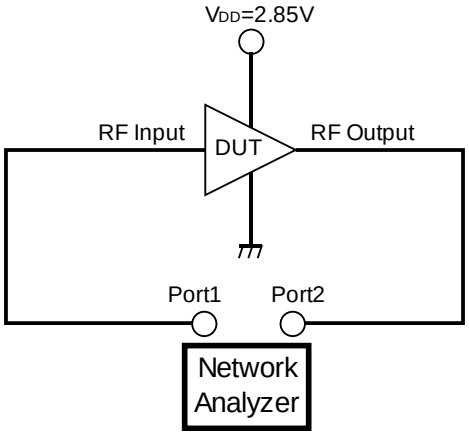
PCB (FR-4) :
t=0.2mm
MICROSTRIP LINE WIDTH
=0.4mm ($Z_0$=50Ω)
PCB SIZE
=17.0mm × 17.0mm

**PRECAUTION:**

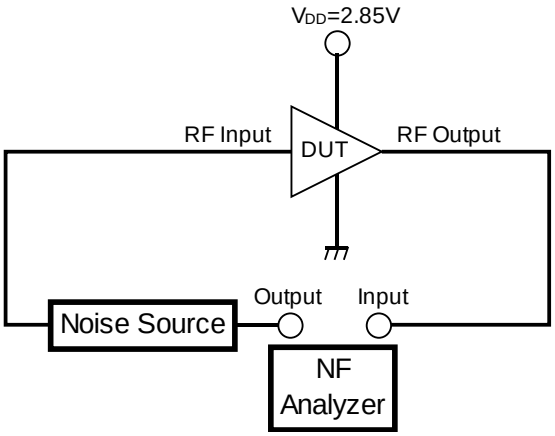
[1] For good performance, the terminal1, 3 and 4 should not be coupled though floating-capacitance which exists between RF transmission lines.
[2] In order not to couple with terminal 1, 3 and 4, please layout ground pattern under the IC.
[3] C2 should be placed to the side of L3, and C3 should be placed the side of L4. They should be connect between L3 and L4, should not be directly connected L3 and L4.

## ■ TEST CIRCUITS

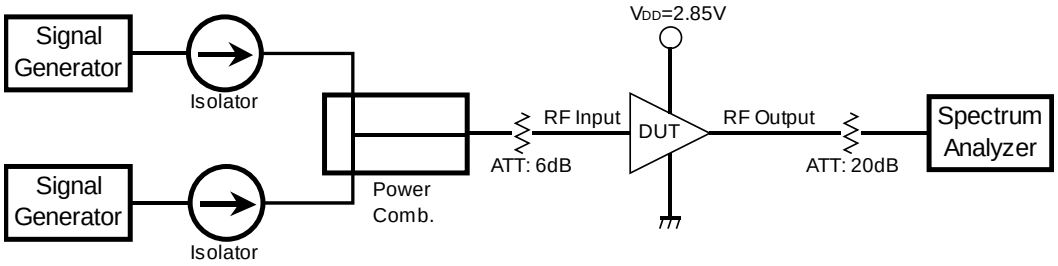
Test Circuits 1 to 3 define the test conditions used in the product electrical characteristics table.




**Test Circuit 1. S-Parameter**

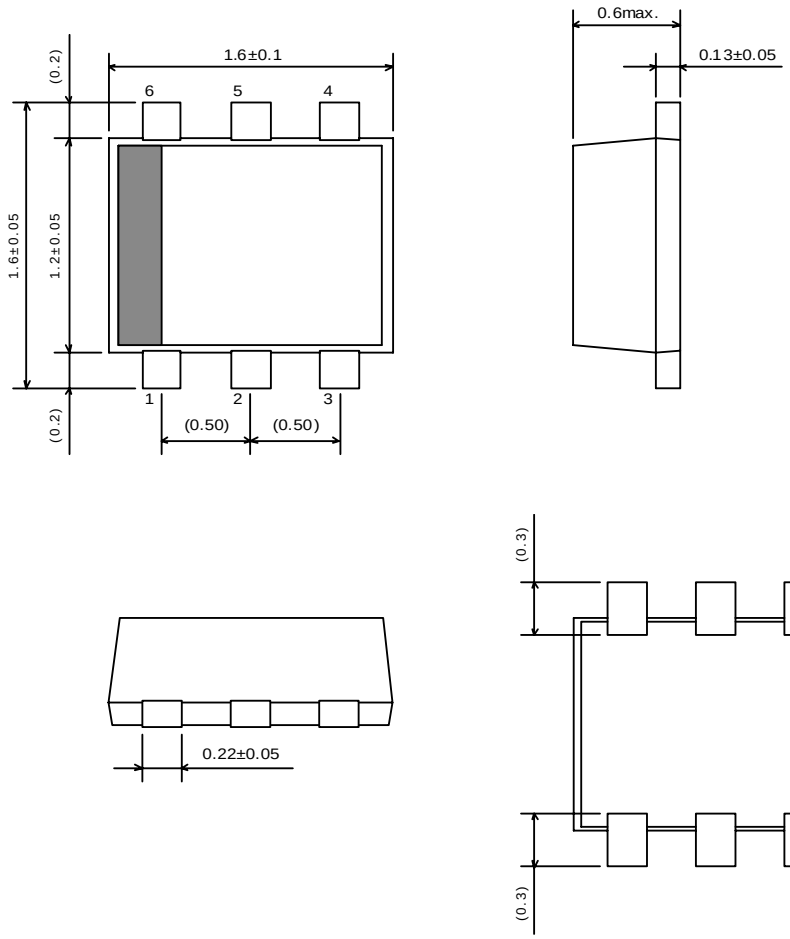



**Test Circuit 2. NF**




**Test Circuit 3. Third order output intercept point**

## ■ PACKAGE OUTLINE ( FLP6-A1 )




UNIT: mm

**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.