

# GNSS LOW NOISE AMPLIFIER

## ■ GENERAL DESCRIPTION

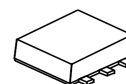
The NJG1144KA1 is a low noise amplifier GaAs MMIC designed for GNSS (Global Navigation Satellite Systems). This amplifier achieves high gain and a good balance between ultra-low noise figure and excellent VSWR, while low current consumption and high IP3, respectively.

The NJG1144KA1 operates from +1.5V to +3.6V supply voltage range and current consumes is as low as 3.5mA.

Also, the ESD protection circuit is integrated into the IC to achieve high ESD tolerance.

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

## ■ PACKAGE OUTLINE



NJG1144KA1

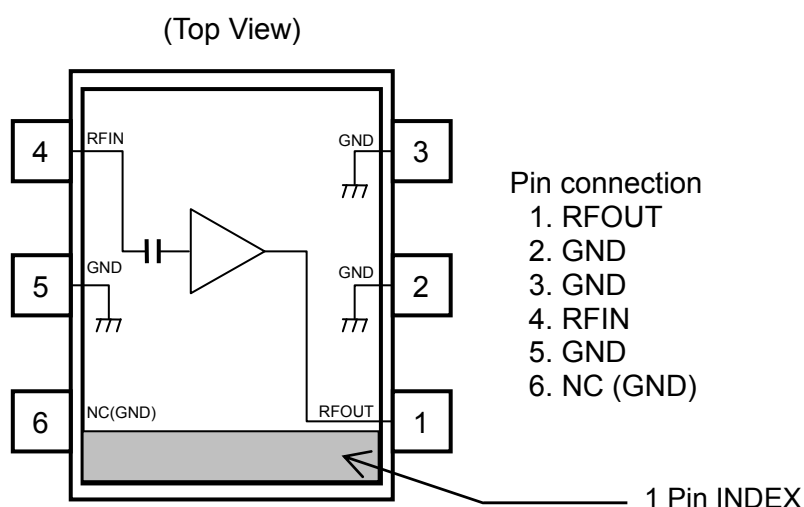
## ■ APPLICATIONS

GNSS applications, like GPS, Galileo, GLONASS and COMPASS.

## ■ FEATURES

- Low supply voltage 1.8V/2.85V
- Low current consumption 3.5mA typ. @  $V_{DD}=2.85V$   
1.8mA typ. @  $V_{DD}=1.8V$
- High gain 21.0dB typ. @  $f=1575MHz$ ,  $V_{DD}=2.85V$
- Low noise figure 0.65dB typ. @  $f=1575MHz$ ,  $V_{DD}=2.85V$
- High Input IP3 -2.0dBm typ. @  $f=1575MHz$ ,  $V_{DD}=2.85V$
- Small package FLP6-A1 (Package size: 1.6mm x 1.6mm x 0.55mm typ.)
- RoHS compliant and halogen free, MSL1

## ■ PIN CONFIGURATION



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

## ■ ABSOLUTE MAXIMUM RATINGS

Ta=+25°C, Zs=Zl=50Ω

| PARAMETERS            | SYMBOL           | CONDITIONS                                                               | RATINGS     | UNITS |
|-----------------------|------------------|--------------------------------------------------------------------------|-------------|-------|
| Supply voltage        | V <sub>DD</sub>  |                                                                          | 5.0         | V     |
| Input power           | P <sub>IN</sub>  | V <sub>DD</sub> =2.85V                                                   | +15         | dBm   |
| Power dissipation     | P <sub>D</sub>   | 4-layer FR4 PCB with through-hole (74.2mmx74.2mm), T <sub>j</sub> =150°C | 580         | mW    |
| Operating temperature | T <sub>opr</sub> |                                                                          | -40 to +85  | °C    |
| Storage temperature   | T <sub>stg</sub> |                                                                          | -55 to +150 | °C    |

## ■ ELECTRICAL CHARACTERISTICS 1 (DC CHARACTERISTICS)

General conditions: V<sub>DD</sub>=2.85V, Ta=+25°C

| PARAMETER        | SYMBOL            | CONDITIONS        | MIN | TYP | MAX | UNIT |
|------------------|-------------------|-------------------|-----|-----|-----|------|
| Supply voltage   | V <sub>DD</sub>   |                   | 1.5 | -   | 3.6 | V    |
| Supply current 1 | I <sub>DD</sub> 1 | RF OFF, VDD=2.85V | -   | 3.5 | 5.5 | mA   |
| Supply current 2 | I <sub>DD</sub> 2 | RF OFF, VDD=1.8V  | -   | 1.8 | 3.2 | mA   |

## ■ ELECTRICAL CHARACTERISTICS 2 (RF CHARACTERISTICS)

General conditions:  $V_{DD}=2.85V$ ,  $f_{RF}=1.575GHz$ ,  $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50\Omega$ , with application circuit

| PARAMETER                                   | SYMBOL     | CONDITIONS                                     | MIN   | TYP   | MAX  | UNIT |
|---------------------------------------------|------------|------------------------------------------------|-------|-------|------|------|
| Small signal gain                           | Gain1      |                                                | 18.0  | 21.0  | 23.5 | dB   |
| Noise figure                                | NF1        | Exclude PCB, Connector Losses(0.08dB)          | -     | 0.65  | 0.95 | dB   |
| Input power at 1dB gain compression point 1 | P-1dB(IN)1 |                                                | -19.0 | -16.5 | -    | dBm  |
| Input 3rd order intercept point 1           | IIP3_1     | $f1=f_{RF}$ , $f2=f1+100kHz$ , $P_{in}=-34dBm$ | -5.0  | -2.0  | -    | dBm  |
| RF input VSWR 1                             | VSWRi1     |                                                | -     | 1.5   | 2.0  | -    |
| RF output VSWR 1                            | VSWRo1     |                                                | -     | 1.5   | 2.0  | -    |

## ■ ELECTRICAL CHARACTERISTICS 2 (RF CHARACTERISTICS)

General conditions:  $V_{DD}=1.8V$ ,  $f_{RF}=1.575GHz$ ,  $T_a=+25^{\circ}C$ ,  $Z_s=Z_l=50\Omega$ , with application circuit

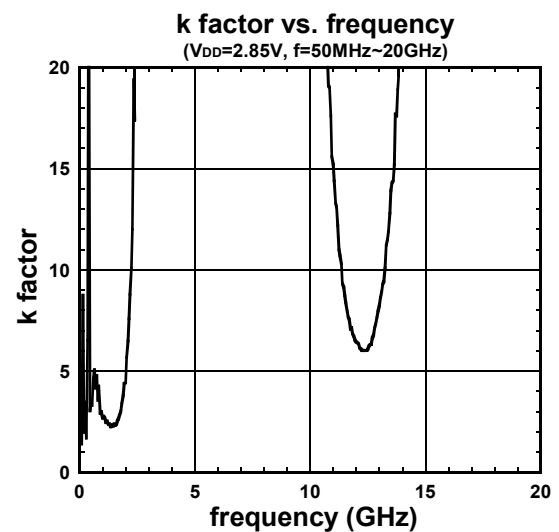
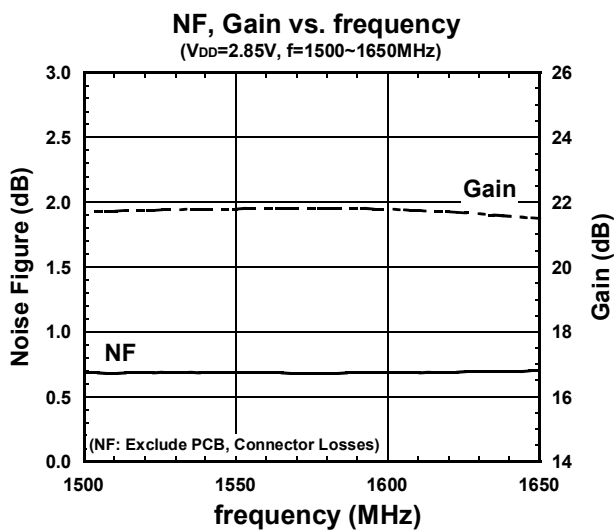
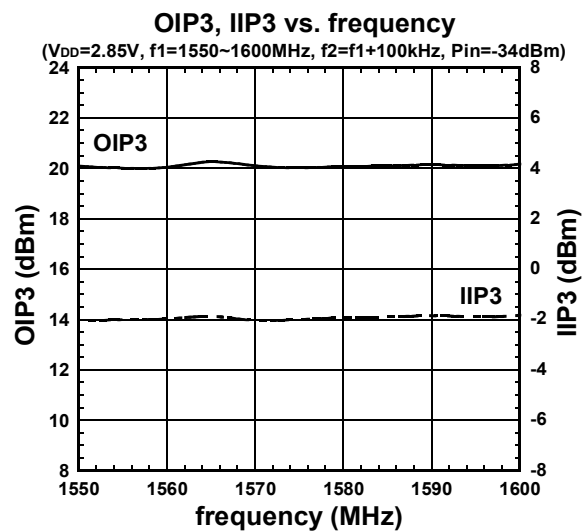
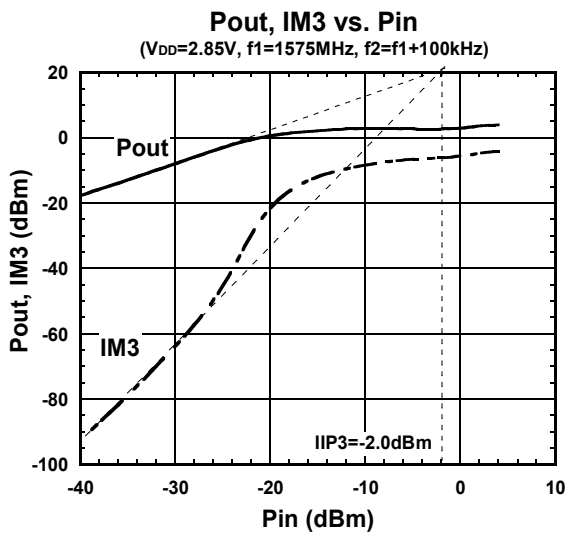
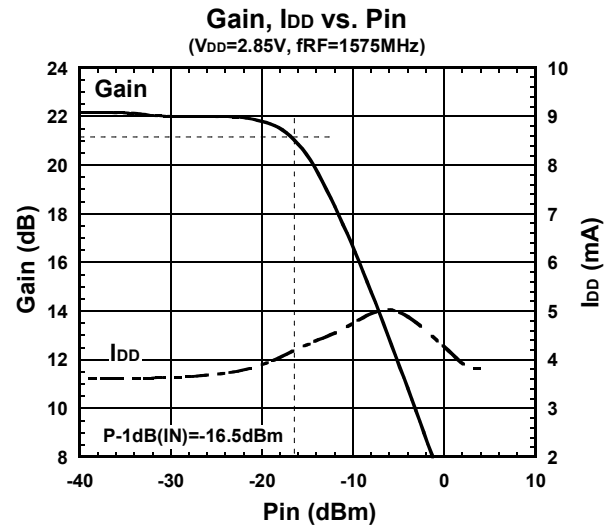
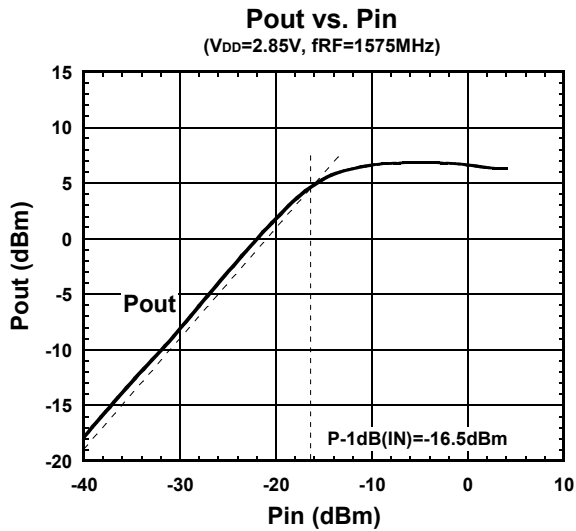
| PARAMETER                                   | SYMBOL     | CONDITIONS                                     | MIN | TYP   | MAX | UNIT |
|---------------------------------------------|------------|------------------------------------------------|-----|-------|-----|------|
| Small signal gain 2                         | Gain2      |                                                | -   | 18.0  | -   | dB   |
| Noise figure 2                              | NF2        | Exclude PCB, Connector Losses(0.08dB)          | -   | 0.85  | -   | dB   |
| Input power at 1dB gain compression point 2 | P-1dB(IN)2 |                                                | -   | -18.5 | -   | dBm  |
| Input 3rd order intercept point 2           | IIP3_2     | $f1=f_{RF}$ , $f2=f1+100kHz$ , $P_{in}=-34dBm$ | -   | -6.0  | -   | dBm  |
| RF input VSWR 2                             | VSWRi2     |                                                | -   | 1.8   | -   | -    |
| RF output VSWR 2                            | VSWRo2     |                                                | -   | 1.8   | -   | -    |

## ■ TERMINAL INFORMATION

| No. | SYMBOL  | DESCRIPTION                                                                                                          |
|-----|---------|----------------------------------------------------------------------------------------------------------------------|
| 1   | RFOUT   | RF output and voltage supply terminal.                                                                               |
| 2   | GND     | Ground terminal (0V), Connect to the PCB ground plane.                                                               |
| 3   | GND     | Ground terminal (0V), Connect to the PCB ground plane.                                                               |
| 4   | RFIN    | RF input terminal. DC blocking capacitor is not required. An external matching circuit is required.                  |
| 5   | GND     | Ground terminal (0V), Connect to the PCB ground plane.                                                               |
| 6   | NC(GND) | No connected terminal. This terminal is not connected with internal circuit. Please connect to the PCB ground Plane. |

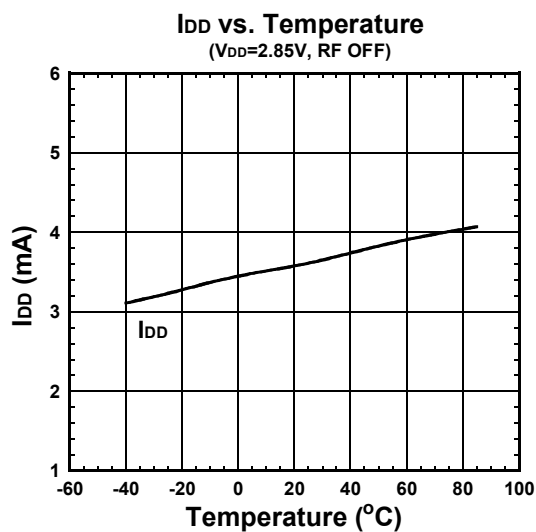
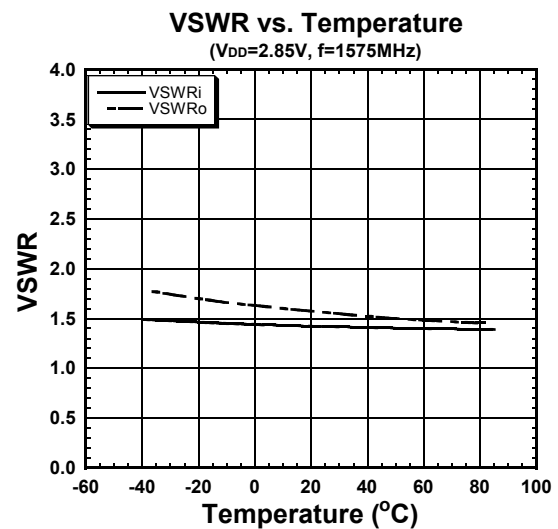
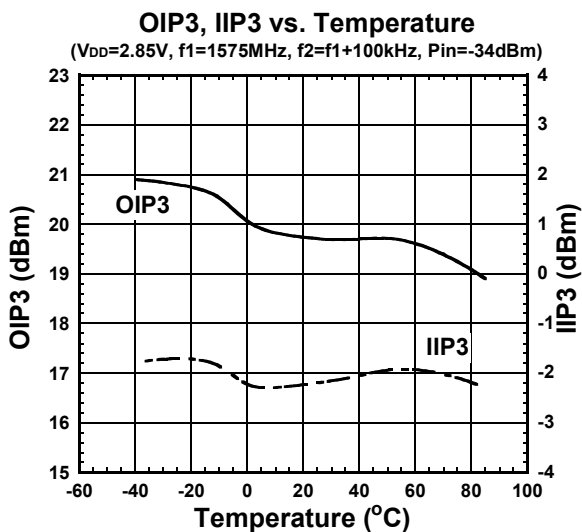
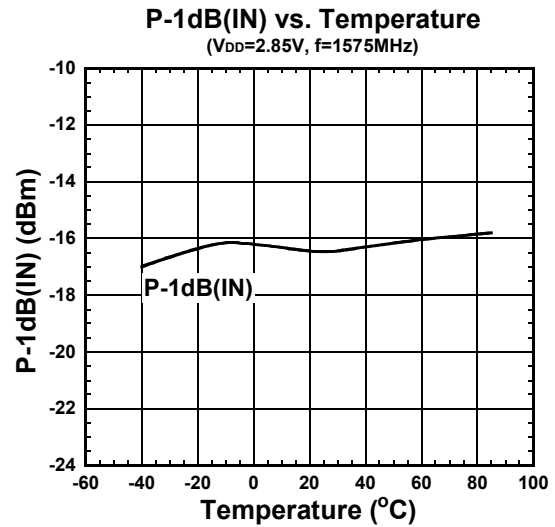
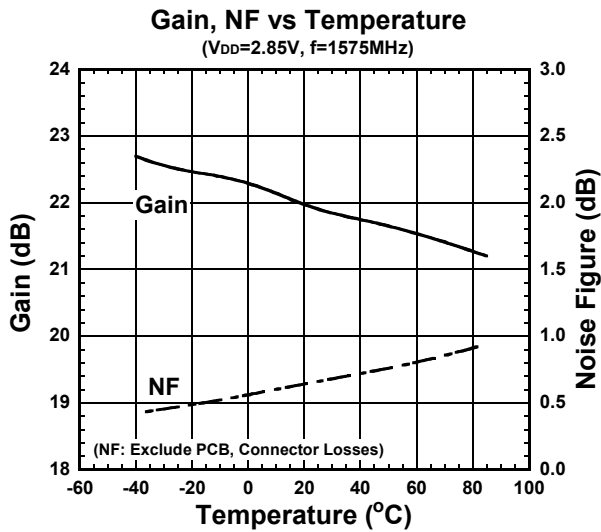
## ■ ELECTRICAL CHARACTERISTICS ( $V_{DD}=2.85V$ )

(Conditions:  $T_a=+25^{\circ}C$ ,  $V_{DD}=2.85V$ ,  $Z_s=Z_l=50\Omega$ , with application circuit.)



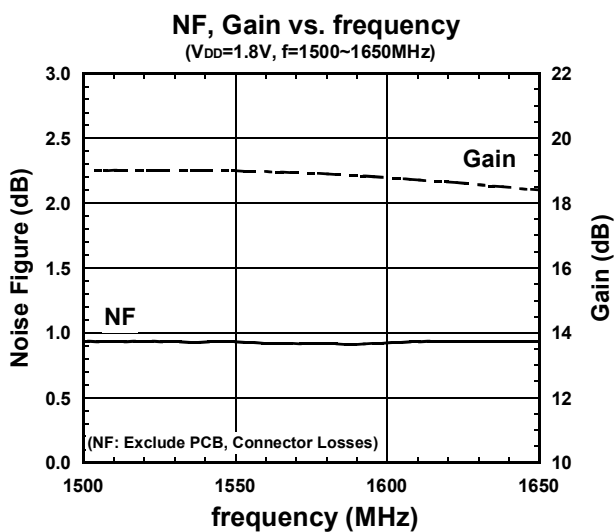
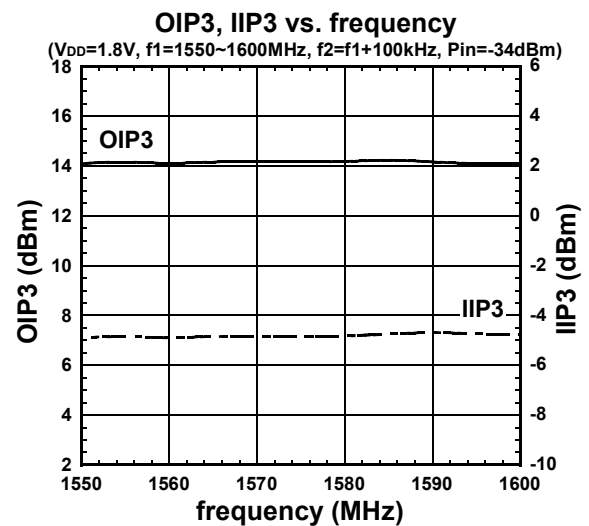
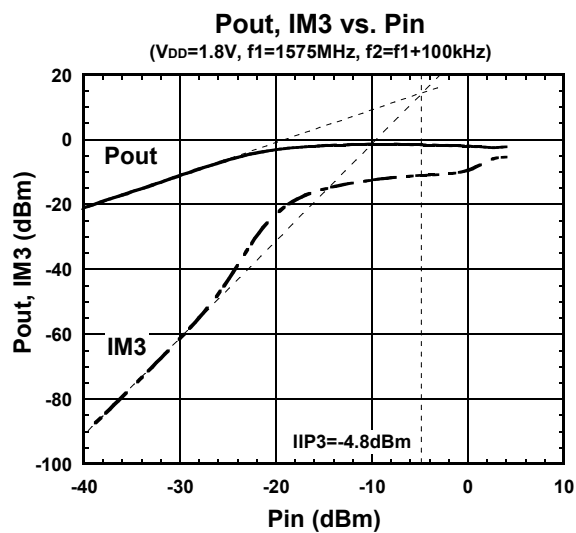
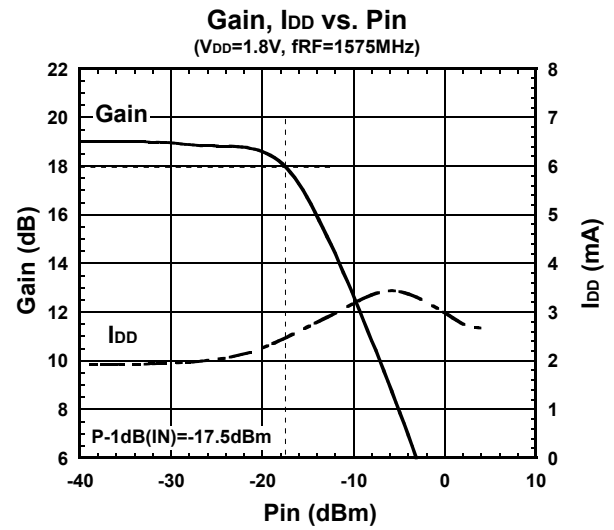
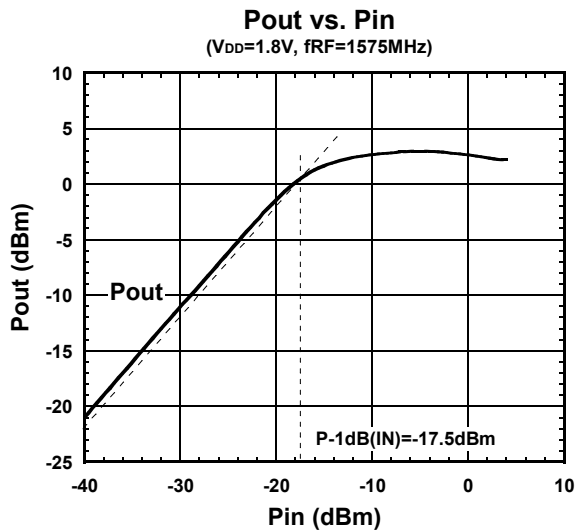
## ■ ELECTRICAL CHARACTERISTICS ( $V_{DD}=2.85V$ )

(Conditions:  $V_{DD}=2.85V$ ,  $Z_s=Z_l=50\Omega$ , with application circuit.)



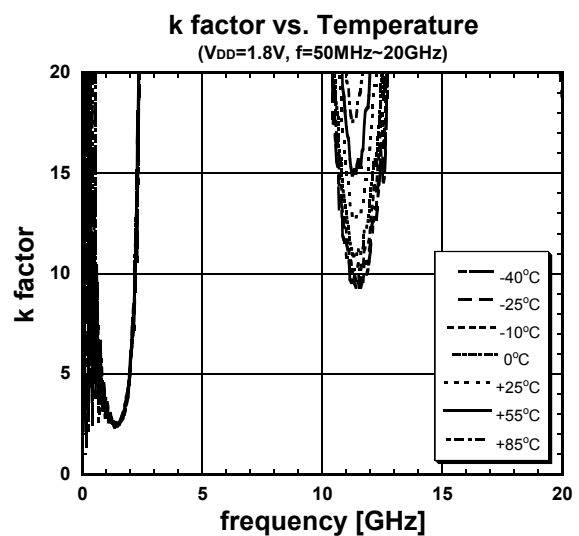
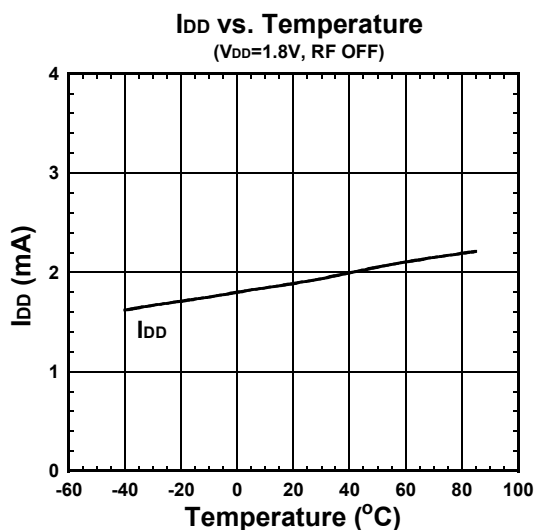
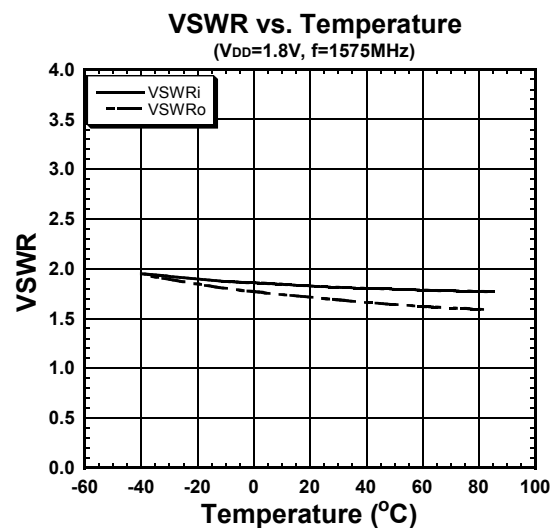
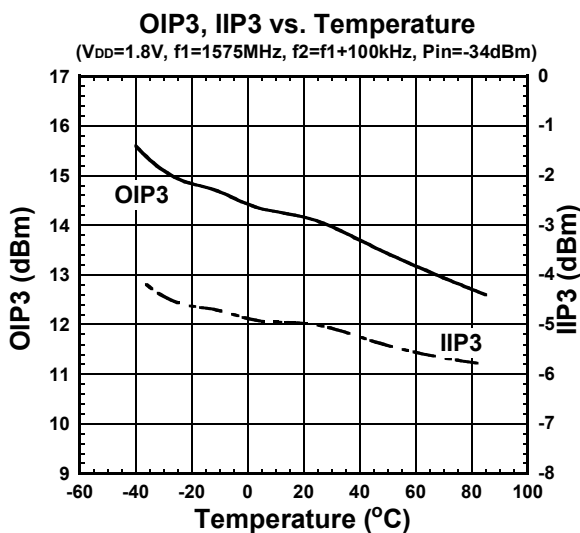
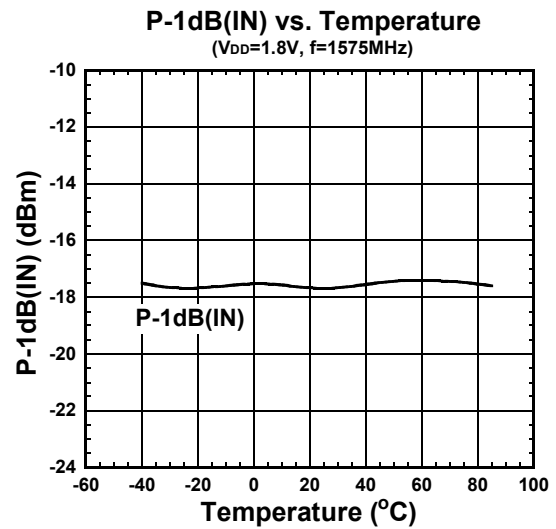
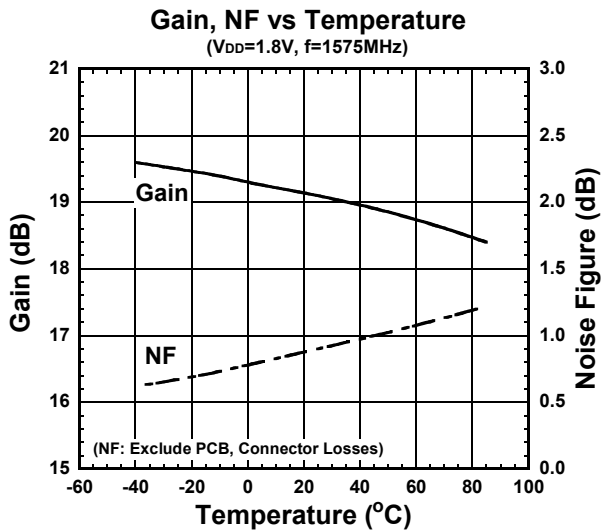
## ■ ELECTRICAL CHARACTERISTICS ( $V_{DD}=1.8V$ )

(Conditions:  $T_a=+25^{\circ}C$ ,  $V_{DD}=1.8V$ ,  $Z_s=Z_l=50\Omega$ , with application circuit.)



## ■ ELECTRICAL CHARACTERISTICS ( $V_{DD}=1.8V$ )

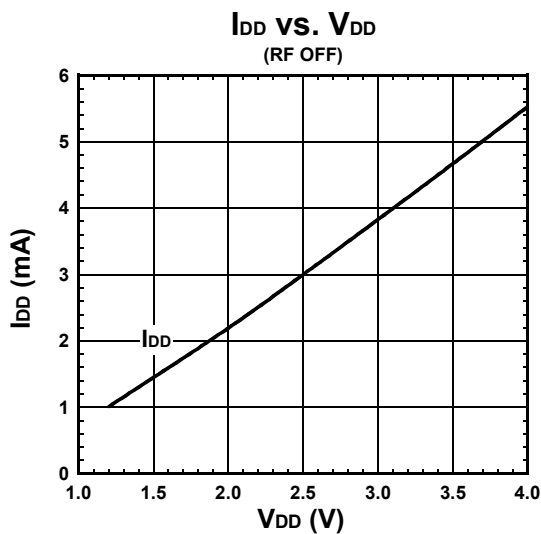
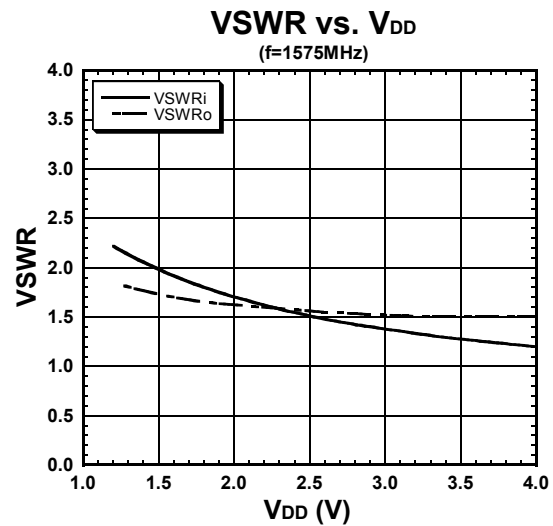
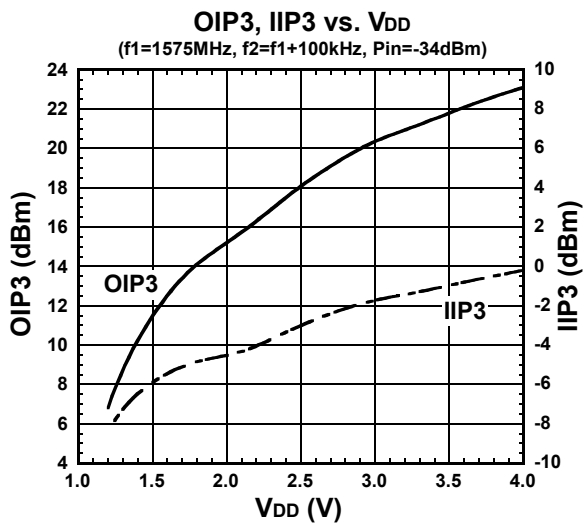
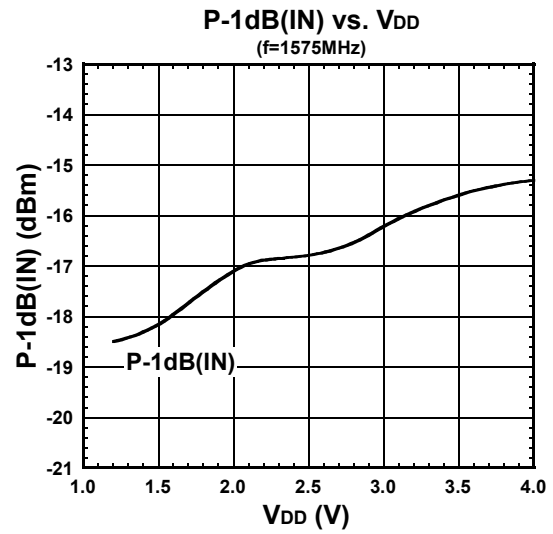
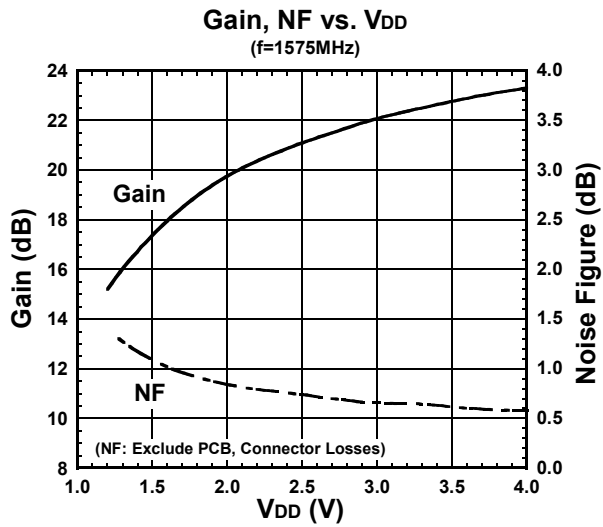
(Conditions:  $V_{DD}=1.8V$ ,  $Z_s=Z_l=50\Omega$ , with application circuit.)





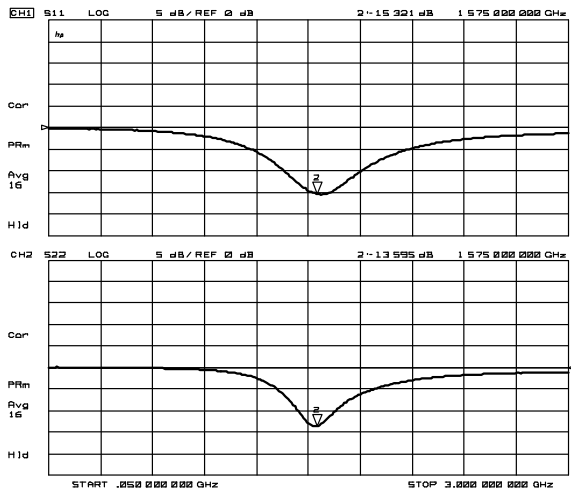
## ELECTRICAL CHARACTERISTICS

(Conditions:  $T_a = +25^\circ\text{C}$ ,  $Z_s = Z_L = 50\Omega$ , with application circuit.)

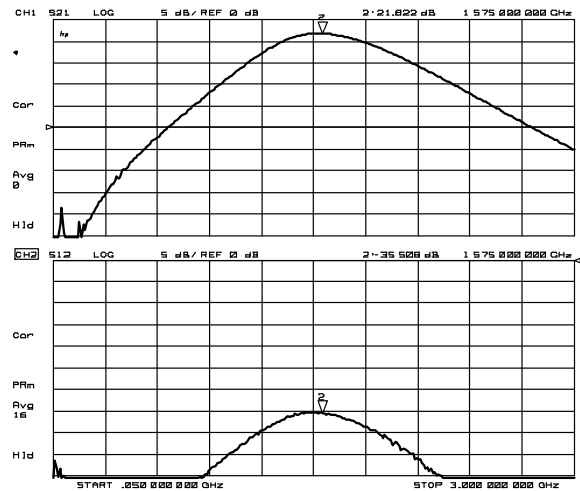


## ELECTRICAL CHARACTERISTICS ( $V_{DD}=2.85V$ )

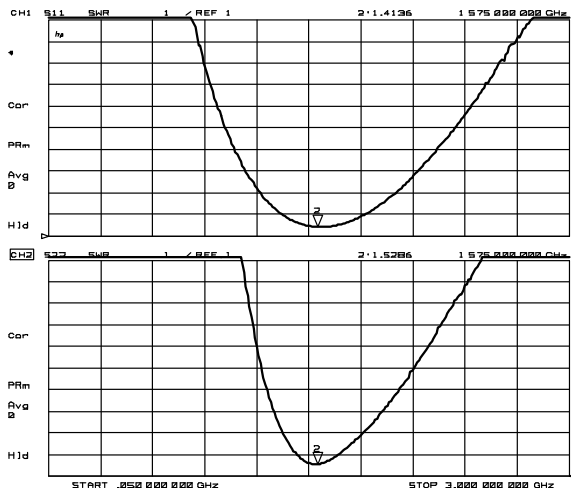
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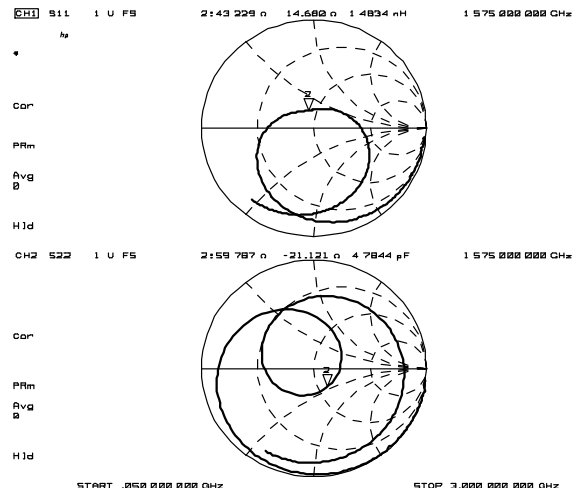
VSWR



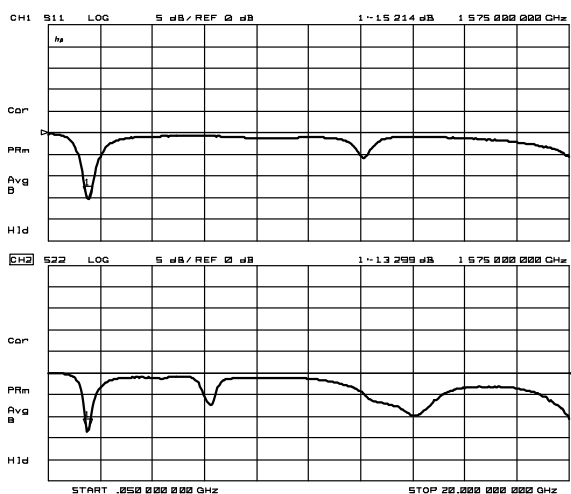
S21, S12



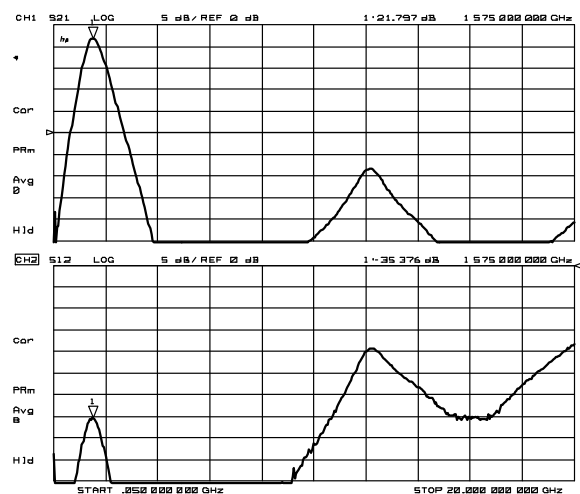
S11, S22



Zin, Zout



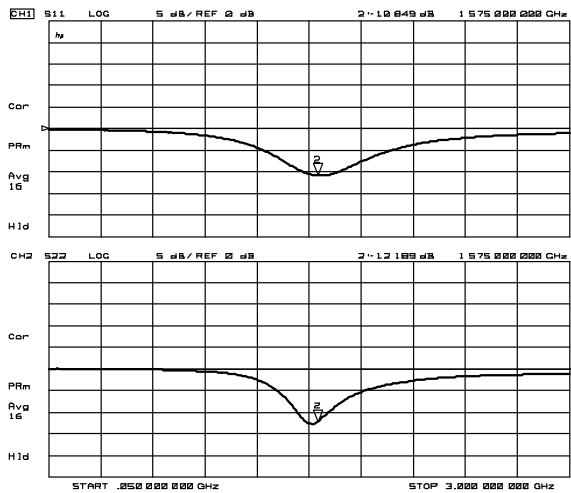
S11, S22 (50MHz to 20GHz)



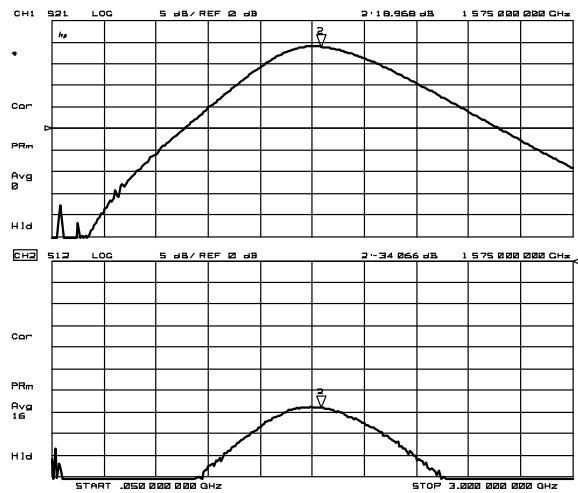
S21, S12 (50MHz to 20GHz)

## ELECTRICAL CHARACTERISTICS ( $V_{DD}=1.8V$ )

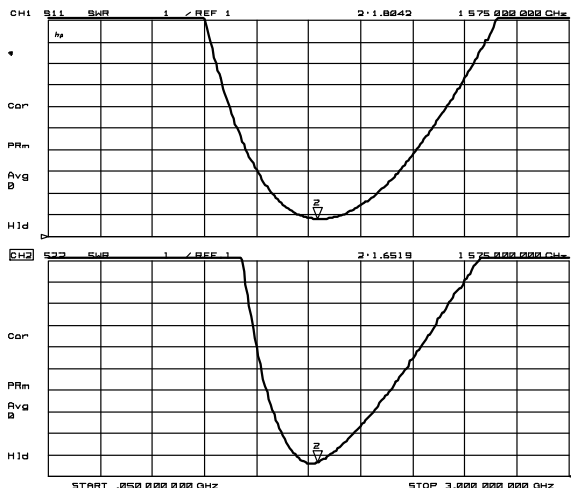
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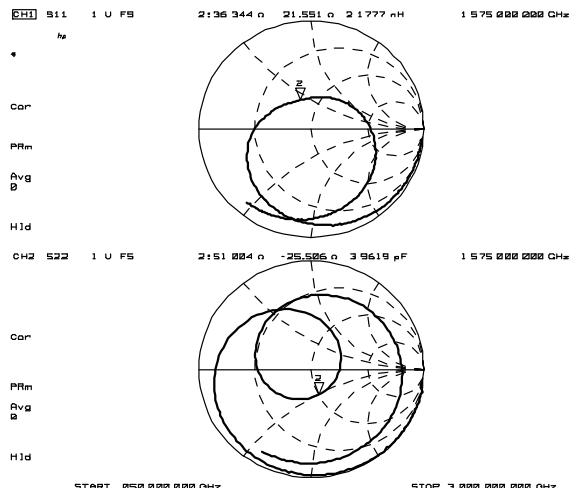
VSWR



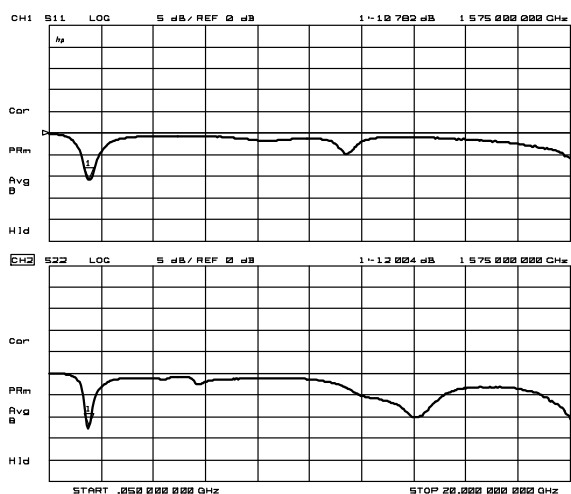
S21, S12



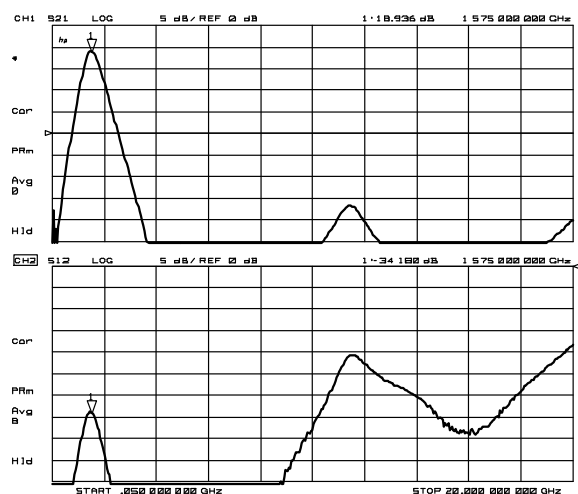
S11, S22



Zin, Zout

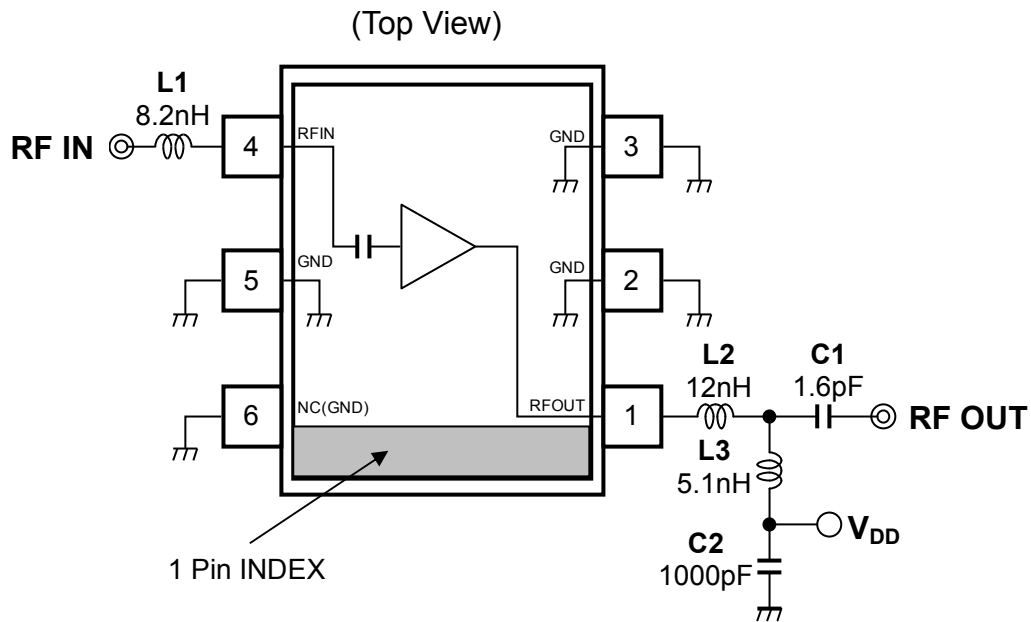


S11, S22 (50MHz to 20GHz)

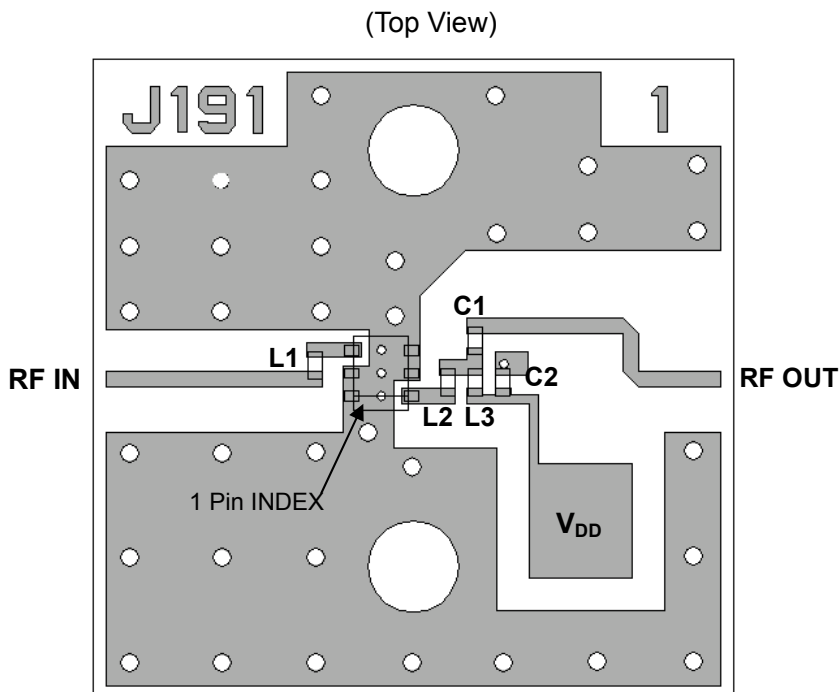


S21, S12 (50MHz to 20GHz)

## APPLICATION CIRCUIT



## TEST PCB LAYOUT



### Parts list:

| Parts ID | Comments                   |
|----------|----------------------------|
| L1 to L3 | MURATA<br>LQP03T_02 Series |
| C1, C2   | MURATA<br>GRM03 Series     |

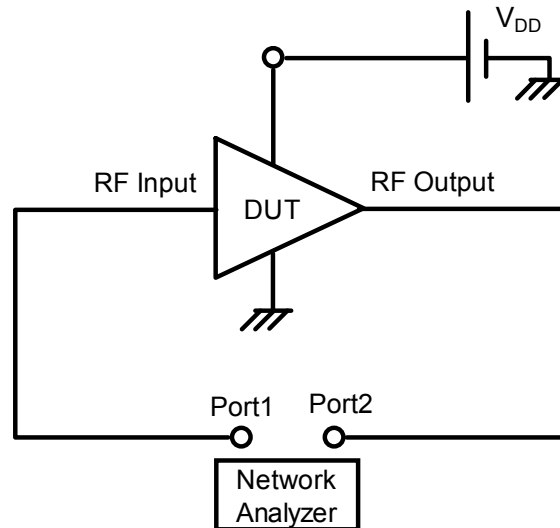
PCB (FR-4):  
 $t=0.2\text{mm}$   
 MICROSTRIP LINE WIDTH  
 $=0.34\text{mm}$  ( $Z_0=50\Omega$ )  
 PCB SIZE=14.0mm x 14.0mm

### Caution:

In order not to couple with terminal RFIN and RFOUT, please layout ground pattern under the IC.

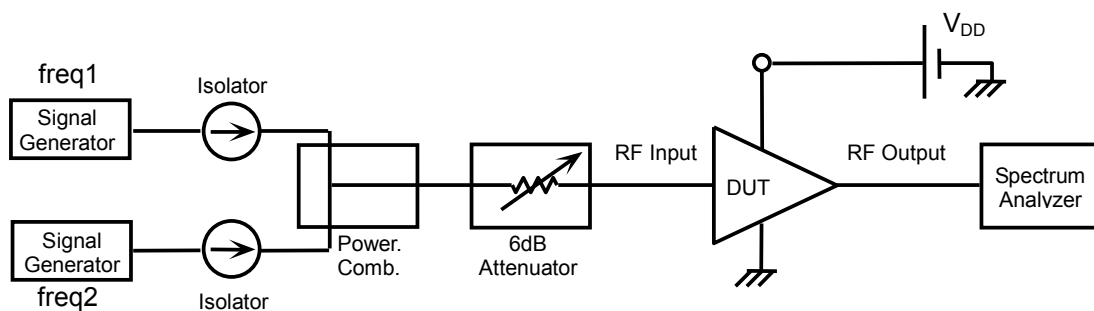
## ■ MEASUREMENT BLOCK DIAGRAM

- S parameter Measurements



S parameter Measurement Block Diagram

- IIP3 Measurements



IF and IM3 Measurement Block Diagram for IIP3

## • Noise Figure Measurements

### Measuring instruments

NF Analyzer : Agilent 8973A, 8975A  
Noise Source : Agilent 346A

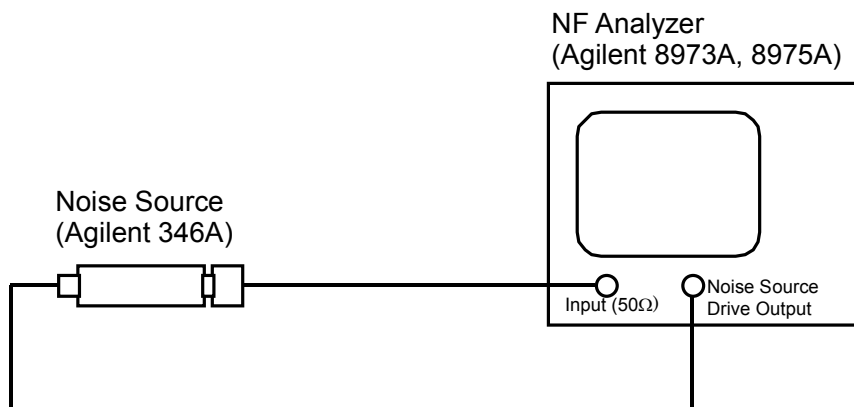
### Setting the NF analyzer

Measurement mode form

Device under test : Amplifier  
System downconverter : off

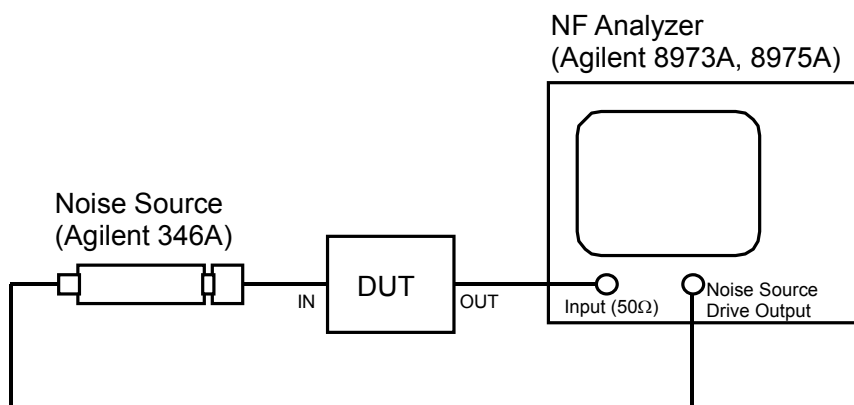
Mode setup form

Sideband : LSB  
Averages : 16  
Average mode : Point  
Bandwidth : 4MHz  
Loss comp : off  
Tcold : setting the temperature of noise source (303.15K)



\* Noise source and NF analyzer are connected directly.

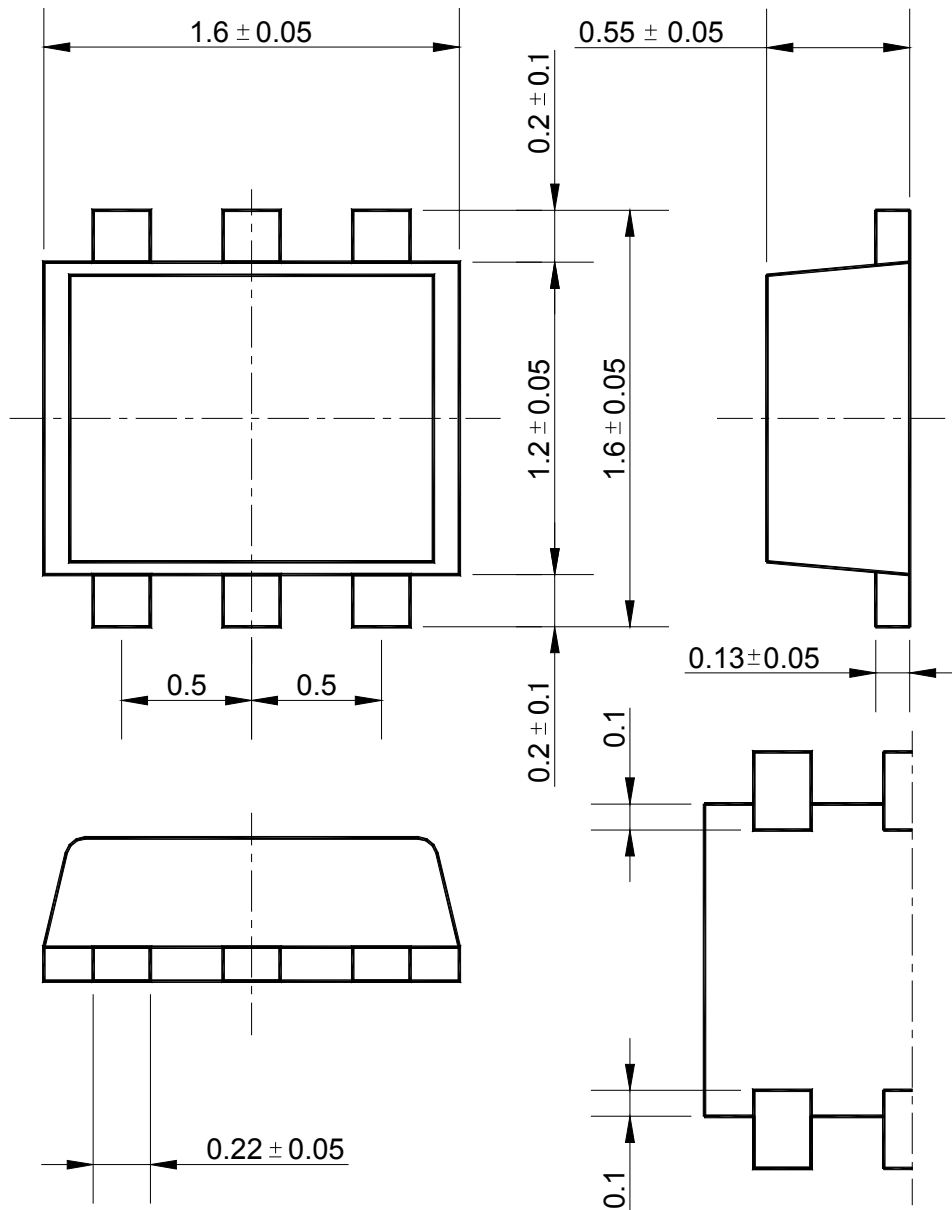
**Calibration Setup**



\* Noise source and DUT, DUT and NF analyzer are connected directly.

**Measurement Setup**

## ■ 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.

### [CAUTION]

The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.

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С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

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- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
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- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

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- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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