

## 800MHz BAND MIXER GaAs MMIC

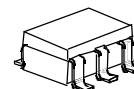
### ■GENERAL DESCRIPTION

NJG1550F is a mixer GaAs MMIC featured low power consumption, high conversion gain and low noise figure.

NJG1550F includes a mixer and a local amplifier, and ideally suitable for 800MHz band digital mobile phone handsets.

A small MTP package is adopted.

### ■PACKAGE OUTLINE

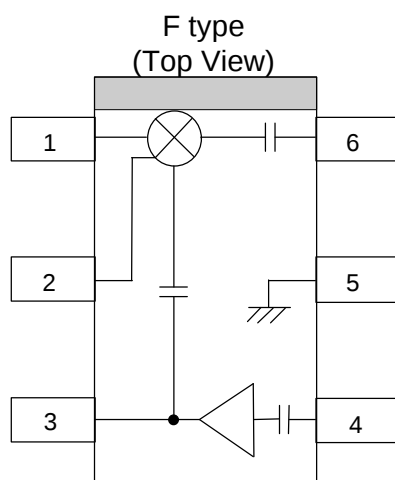


NJG1550F

### ■FEATURES

- Low voltage operation +2.7V
- Low current consumption 4.5mA typ.
- High conversion gain 14dB typ. @ $f_{RF}=820\text{MHz}$ ,  $P_{LO}=-10\text{dBm}$ ,  $P_{RF}=-30\text{dBm}$
- Low noise figure 5dB typ. @ $f_{RF}=820\text{MHz}$ ,  $P_{LO}=-10\text{dBm}$
- Package MTP6 (Mount Size: 2.8x2.9x1.2mm)

### ■PIN CONFIGURATION



Pin connection

1. IFOUT
2. BPC
3. VLO
4. LOIN
5. GND
6. RFIN

NOTE :The  portion above shows orientation mark printed on the package surface.

# NJG1550F

## ■ABSOLUTE MAXIMUM RATINGS

( $T_a=25^{\circ}\text{C}$ ,  $Z_s=Z_l=50\Omega$ )

| PARAMETERS                     | SYMBOL            | CONDITIONS                                                 | RATINGS  | UNITS              |
|--------------------------------|-------------------|------------------------------------------------------------|----------|--------------------|
| Mixer Supply Voltage           | $V_{\text{MIX}}$  |                                                            | 5        | V                  |
| Local Amplifier Supply Voltage | $V_{\text{DD}}$   |                                                            | 5        | V                  |
| Mixer RF Input Power           | $P_{\text{RFIN}}$ | $V_{\text{MIX}}=2.7\text{V}$ , $V_{\text{LO}}=2.7\text{V}$ | 10       | dBm                |
| Mixer LO Input Power           | $P_{\text{LOIN}}$ | $V_{\text{MIX}}=2.7\text{V}$ , $V_{\text{LO}}=2.7\text{V}$ | 10       | dBm                |
| Power Dissipation              | $P_{\text{D}}$    |                                                            | 150      | mW                 |
| Operating Temp.                | $T_{\text{opr}}$  |                                                            | -30~+85  | $^{\circ}\text{C}$ |
| Storage Tempe.                 | $T_{\text{stg}}$  |                                                            | -40~+150 | $^{\circ}\text{C}$ |

## ■RECOMMENDED OPERATING RANGE

| PARAMETER                      | SYMBOL           | MIN | TYP | MAX | UNITS |
|--------------------------------|------------------|-----|-----|-----|-------|
| Mixer Supply Voltage           | $V_{\text{MIX}}$ | 2.5 | 2.7 | 4.5 | V     |
| Local Amplifier Supply Voltage | $V_{\text{LO}}$  | 2.5 | 2.7 | 4.5 | V     |

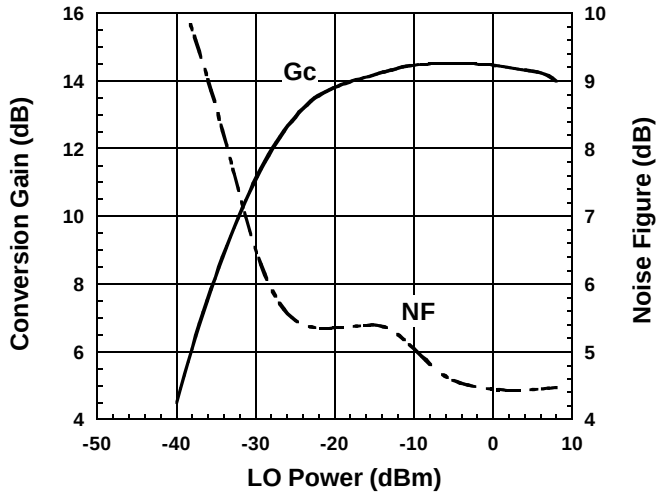
## ■ELECTRICAL CHARACTERISTICS

( $T_a=25^{\circ}\text{C}$ ,  $V_{\text{MIX}}=2.7\text{V}$ ,  $V_{\text{LO}}=2.7\text{V}$ ,  $f_{\text{IF}}=130\text{MHz}$ ,  $P_{\text{LO}}=-10\text{dBm}$ )

| PARAMETERS                      | SYMBOL           | CONDITIONS                                                                                     | MIN  | TYP  | MAX | UNITS |
|---------------------------------|------------------|------------------------------------------------------------------------------------------------|------|------|-----|-------|
| Mixer Current                   | $I_{\text{MIX}}$ | $P_{\text{RF}}=\text{OFF}$ , $P_{\text{LO}}=\text{OFF}$                                        | -    | 3.0  | 4.5 | mA    |
| Local Amplifier Current         | $I_{\text{LO}}$  | $P_{\text{RF}}=\text{OFF}$ , $P_{\text{LO}}=\text{OFF}$                                        | -    | 1.5  | 2.3 | mA    |
| Conversion Gain                 | $G_{\text{C}}$   | $f_{\text{RF}}=820\text{MHz}$ , $P_{\text{RF}}=-30\text{dBm}$<br>$f_{\text{LO}}=690\text{MHz}$ | 11.0 | 14.0 | -   | dB    |
| Input 3rd Order Intercept Point | IIP3             | $f_{\text{RF}}=820.0\text{MHz}+820.1\text{MHz}$<br>$f_{\text{LO}}=690\text{MHz}$               | -    | -6.0 | -   | dBm   |
| Noise Figure                    | NF               | $f_{\text{RF}}=820\text{MHz}$<br>$f_{\text{LO}}=690\text{MHz}$                                 | -    | 5.0  | 6.0 | dB    |

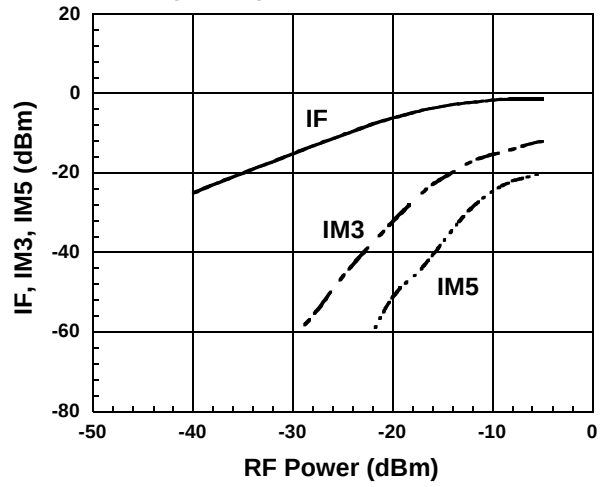
## ■ TYPICAL CHARACTERISTICS (Application 1, $f_{LO}=690\text{MHz}$ )

Conversion Gain , Noise Figure  
vs. LO Power



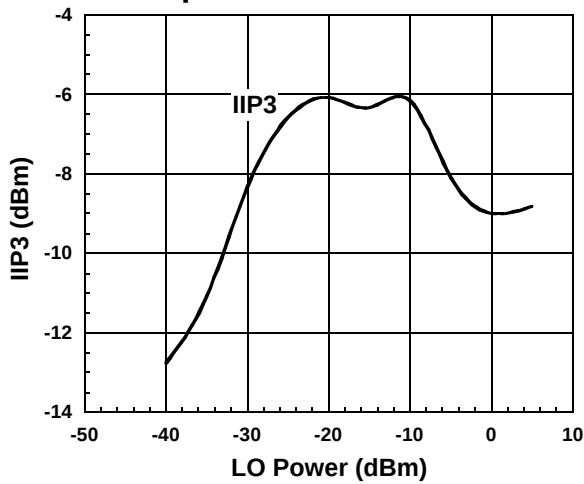
Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=820\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{LO}=690\text{MHz}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

IF , IM3 , IM5 vs. RF Power



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=820.0\text{MHz}$   
 $f_{RF2}=820.1\text{MHz}$   
 $f_{LO}=690\text{MHz}, P_{LO}=-10\text{dBm}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

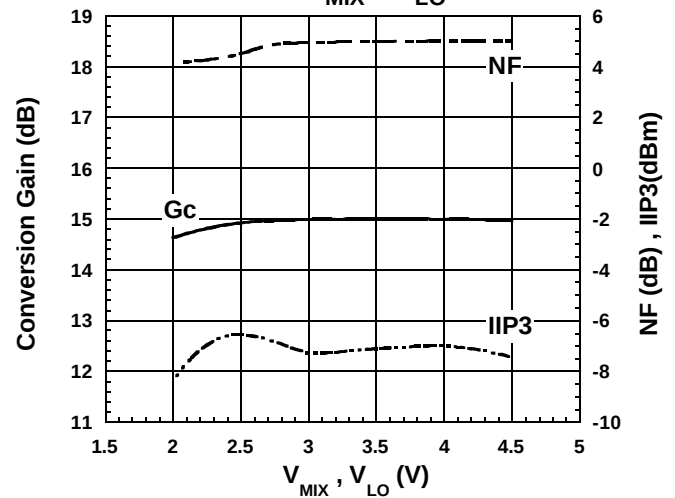
Input-IP3 vs. LO Power



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=820.0\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{RF2}=820.1\text{MHz}$   
 $f_{LO}=690\text{MHz}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$   

$$IIP3 = \frac{3IF - IM3}{2} - G_c$$
 @  $P_{RF} = -30\text{dBm}$

Conversion Gain , Noise Figure , Input-IP3  
vs.  $V_{MIX}$  ,  $V_{LO}$

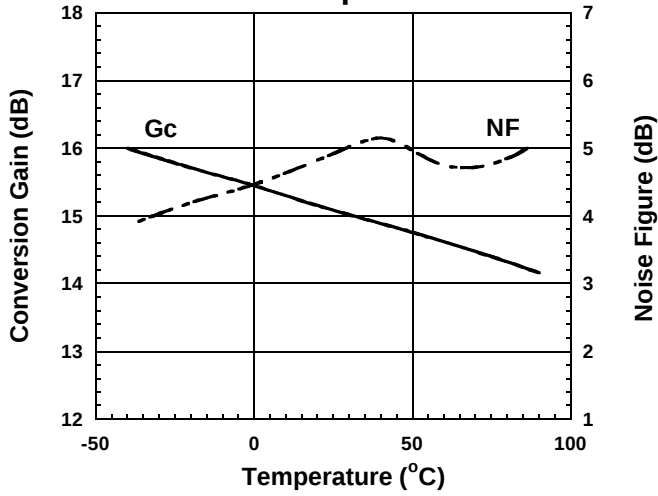


Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=820.0\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{RF2}=820.1\text{MHz}$   
 $f_{LO}=690\text{MHz}, P_{LO}=-10\text{dBm}$   

$$IIP3 = \frac{3IF - IM3}{2} - G_c$$
 @  $P_{RF} = -30\text{dBm}$

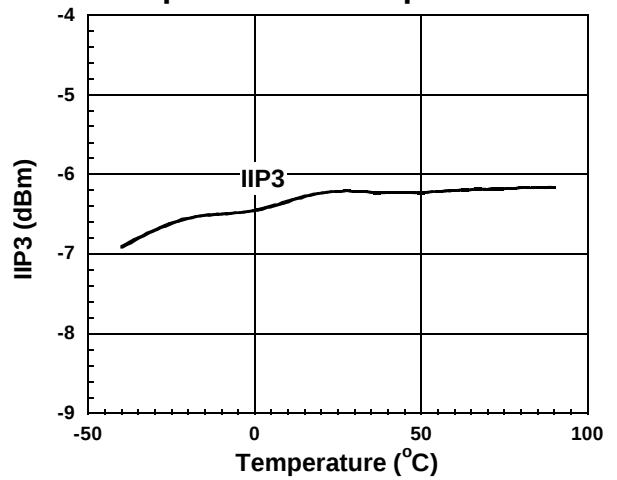
## ■ TYPICAL CHARACTERISTICS (Continued)

Conversion Gain , Noise Figure  
vs. Temperature



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=820\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{LO}=690\text{MHz}, P_{LO}=-10\text{dBm}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

Input-IP3 vs. Temperature

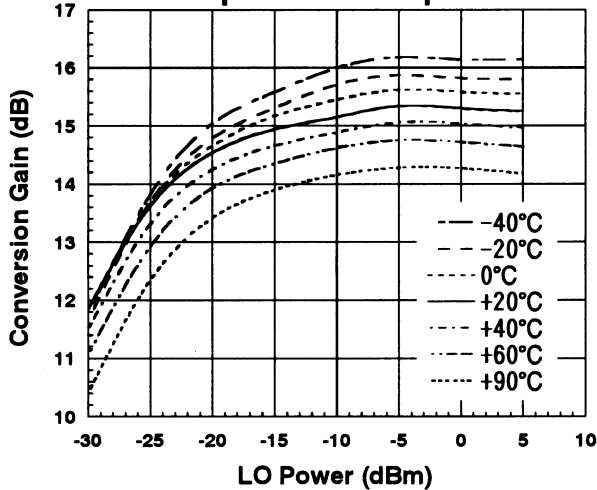


Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=820.0\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{RF2}=820.1\text{MHz}$   
 $f_{LO}=690\text{MHz}, P_{LO}=-10\text{dBm}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

$$IIP3 = \frac{3IF-IM3}{2} - G_c$$

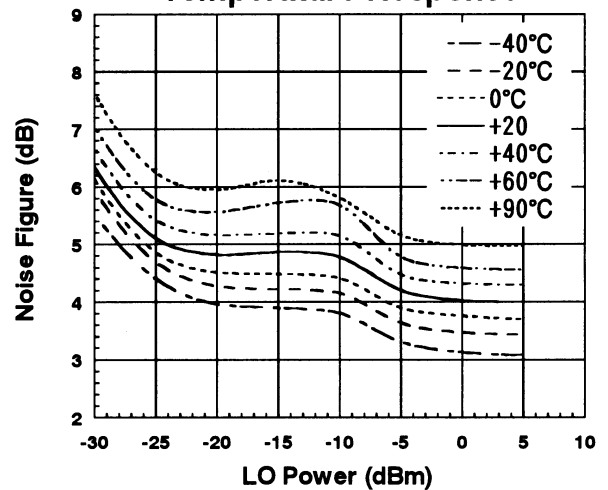
@  $P_{RF}=-30\text{dBm}$

Conversion Gain vs. LO Power  
Temperature Response



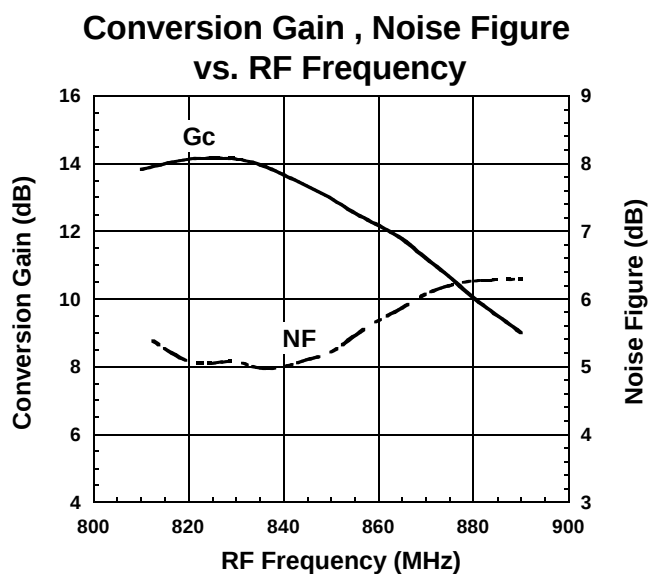
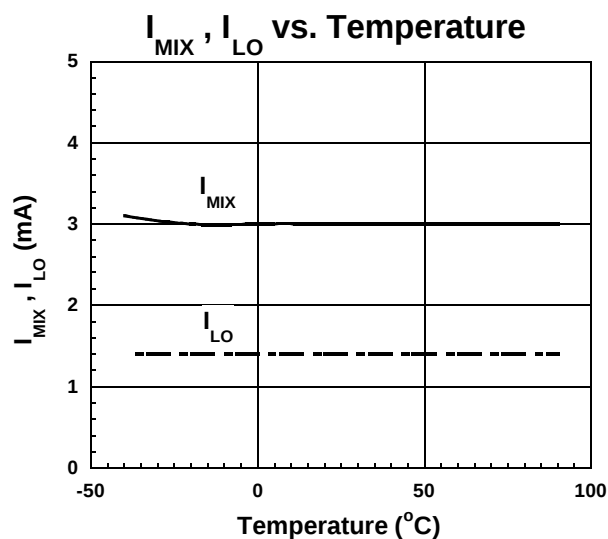
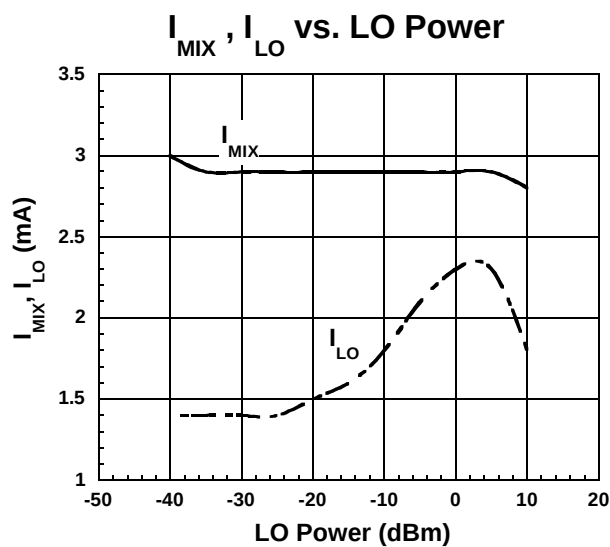
Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=820\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{LO}=690\text{MHz}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

Noise Figure vs. LO Power  
Temperature Response

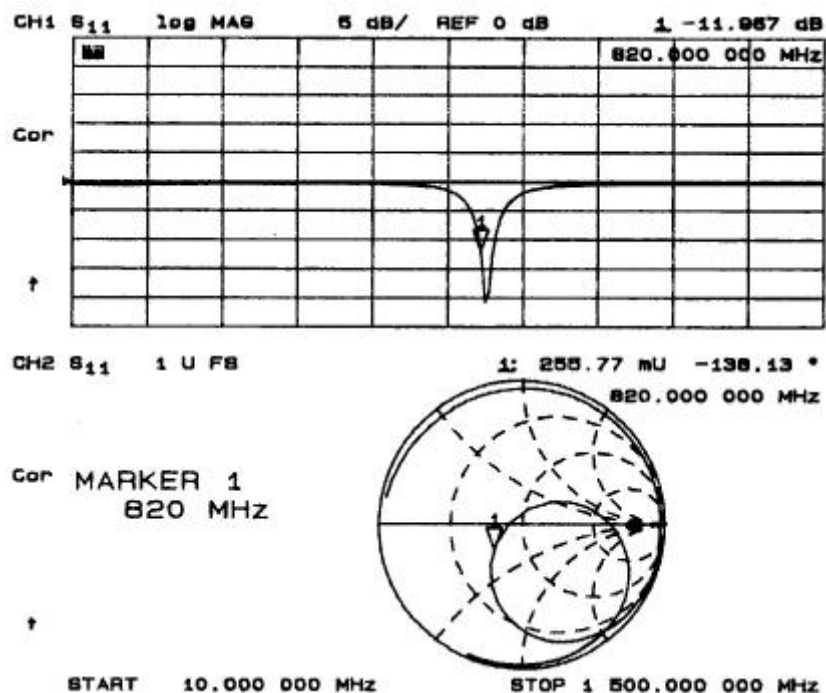


Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=820\text{MHz}$   
 $f_{LO}=690\text{MHz}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

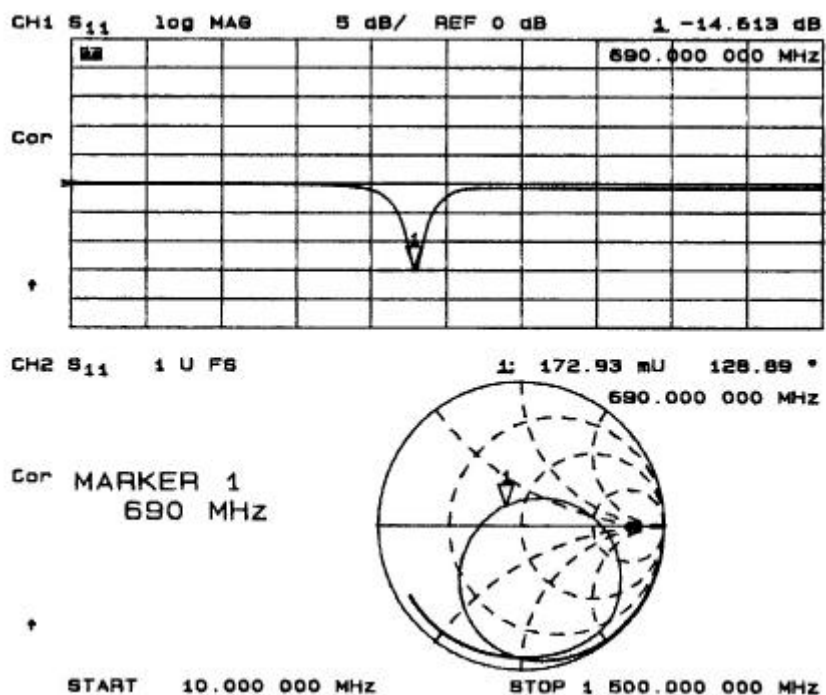
## ■ TYPICAL CHARACTERISTICS (Continued)



## ■TYPICAL CHARACTERISTICS (Continued)

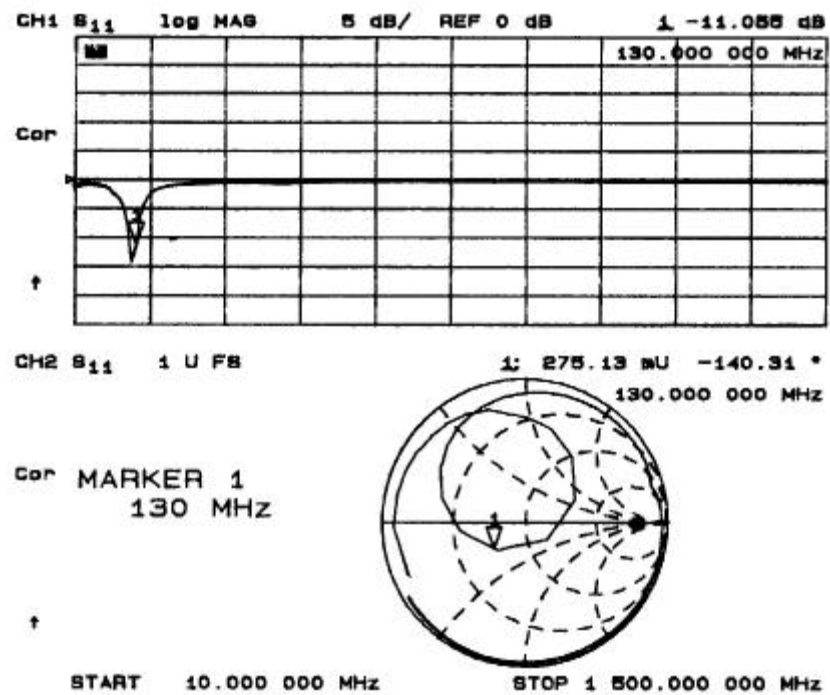


RF IN PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT



LO IN PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT

## ■TYPICAL CHARACTERISTICS (Continued)

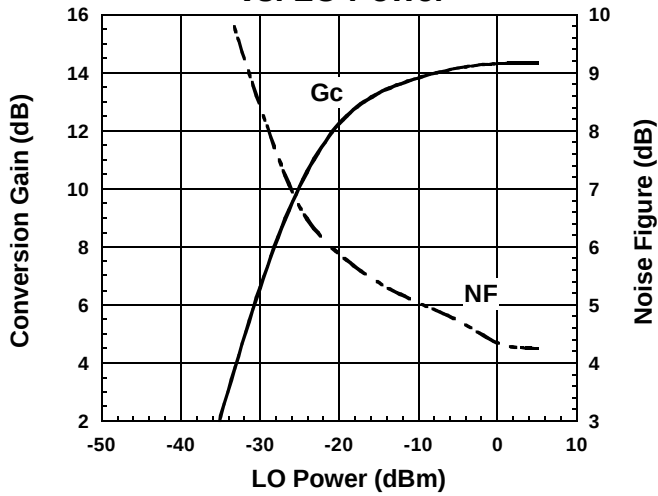


IFOUT PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT

# NJG1550F

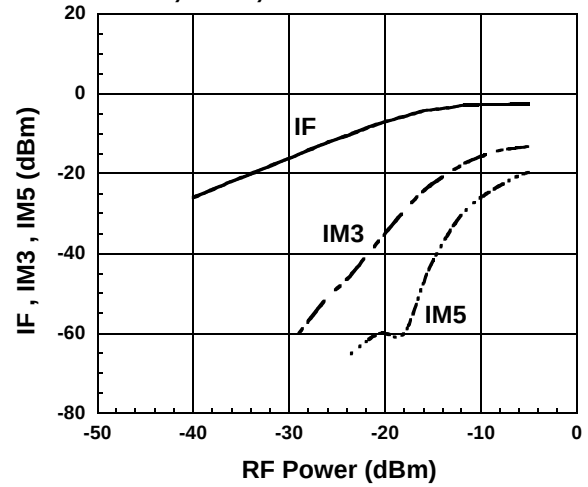
## ■ TYPICAL CHARACTERISTICS (Application 1, $f_{LO}=950\text{MHz}$ )

Conversion Gain , Noise Figure  
vs. LO Power



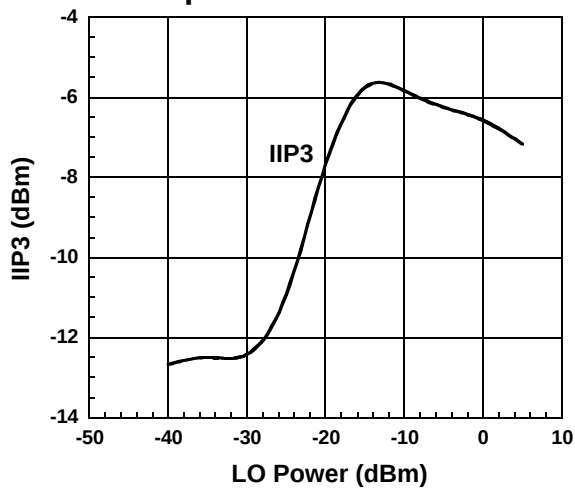
Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=820\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{LO}=950\text{MHz}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

IF , IM3 , IM5 vs. RF Power



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=820.0\text{MHz}$   
 $f_{RF2}=820.1\text{MHz}$   
 $f_{LO}=950\text{MHz}, P_{LO}=-10\text{dBm}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

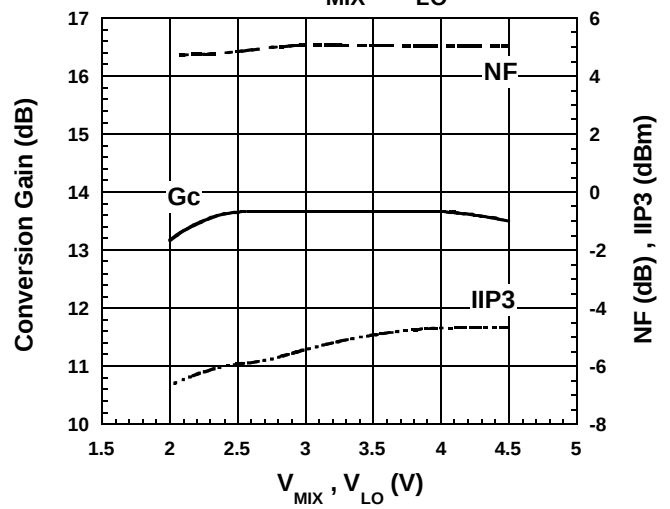
Input-IP3 vs. LO Power



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=820.0\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{RF2}=820.1\text{MHz}$   
 $f_{LO}=950\text{MHz}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$   

$$IIP3 = \frac{3IF - IM3}{2} - G_c$$
 @  $P_{RF}=-30\text{dBm}$

Conversion Gain , Noise Figure  
vs.  $V_{MIX}$  ,  $V_{LO}$

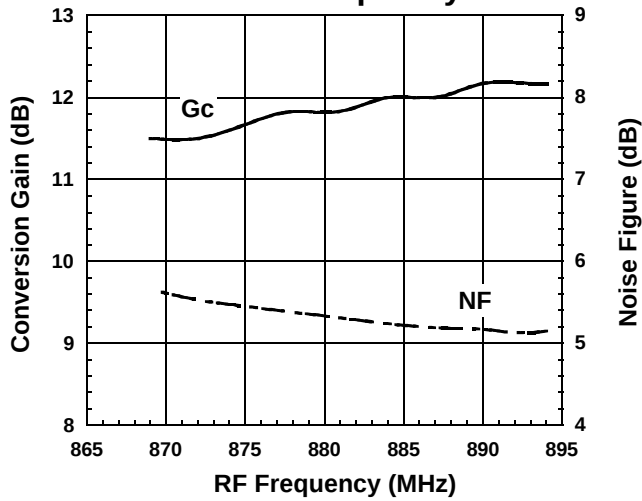


Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=820.0\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{RF2}=820.1\text{MHz}$   
 $f_{LO}=950\text{MHz}, P_{LO}=-10\text{dBm}$   

$$IIP3 = \frac{3IF - IM3}{2} - G_c$$
 @  $P_{RF}=-30\text{dBm}$

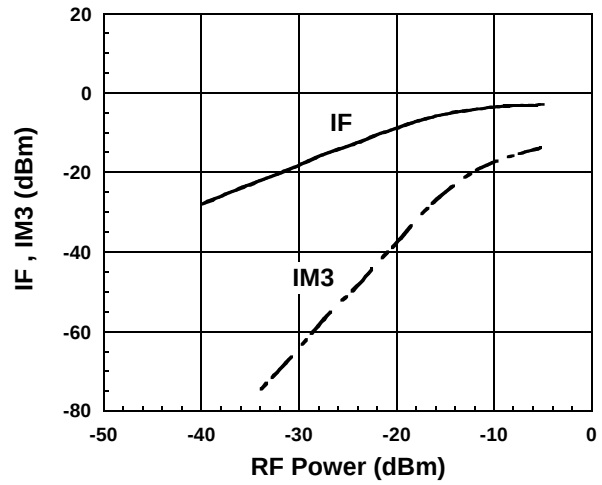
## ■TYPICAL CHARACTERISTICS (Application 1, $f_{LO}=964.66\text{MHz}$ )

Conversion Gain , Noise Figure  
vs. RF Frequency



Condition  
 $f_{IF}=83.16\text{MHz}$   
 $P_{LO}=-10\text{dBm}$   
 $P_{RF}=-30\text{dBm}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$   
 Upper LOCAL

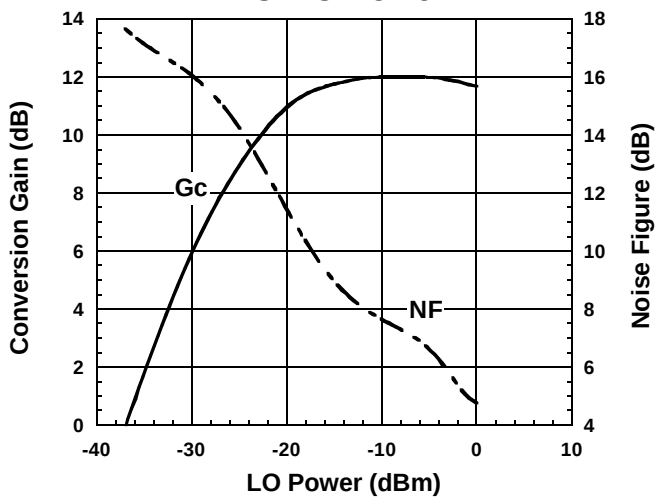
IF , IM3 vs. RF Power



Condition  
 $f_{IF}=83.16\text{MHz}$   
 $f_{RF1}=881.5\text{MHz}$   
 $f_{RF2}=881.6\text{MHz}$   
 $f_{LO}=964.66\text{MHz}, P_{LO}=-10\text{dBm}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

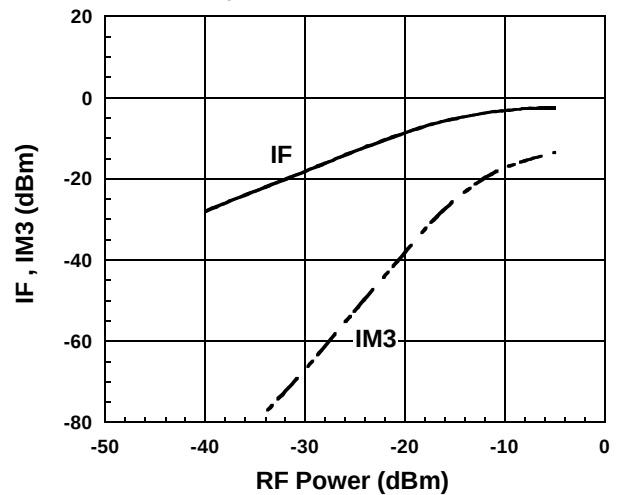
## ■TYPICAL CHARACTERISTICS (Application 1, $f_{LO}=926.5\text{MHz}$ )

Conversion Gain , Noise Figure  
vs. LO Power



Condition  
 $f_{IF}=45\text{MHz}$   
 $f_{RF}=881.5\text{MHz}, P_{RF}=-30\text{dBm}$   
 $f_{LO}=926.5\text{MHz}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

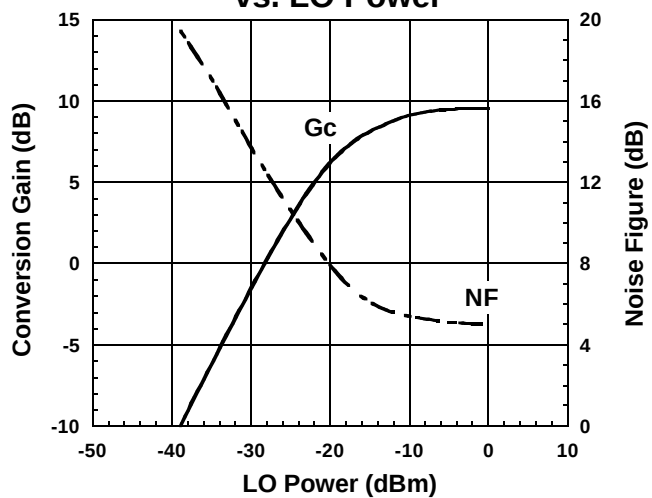
IF , IM3 vs. RF Power



Condition  
 $f_{IF}=45\text{MHz}$   
 $f_{RF1}=881.5\text{MHz}$   
 $f_{RF2}=881.6\text{MHz}$   
 $f_{LO}=926.5\text{MHz}, P_{LO}=-10\text{dBm}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

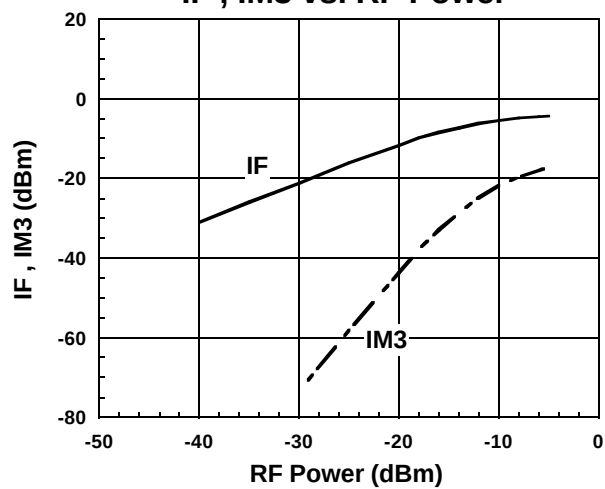
## ■ TYPICAL CHARACTERISTICS (Application 2, $f_{LO}=796.12\text{MHz}$ )

Conversion Gain , Noise Figure  
vs. LO Power



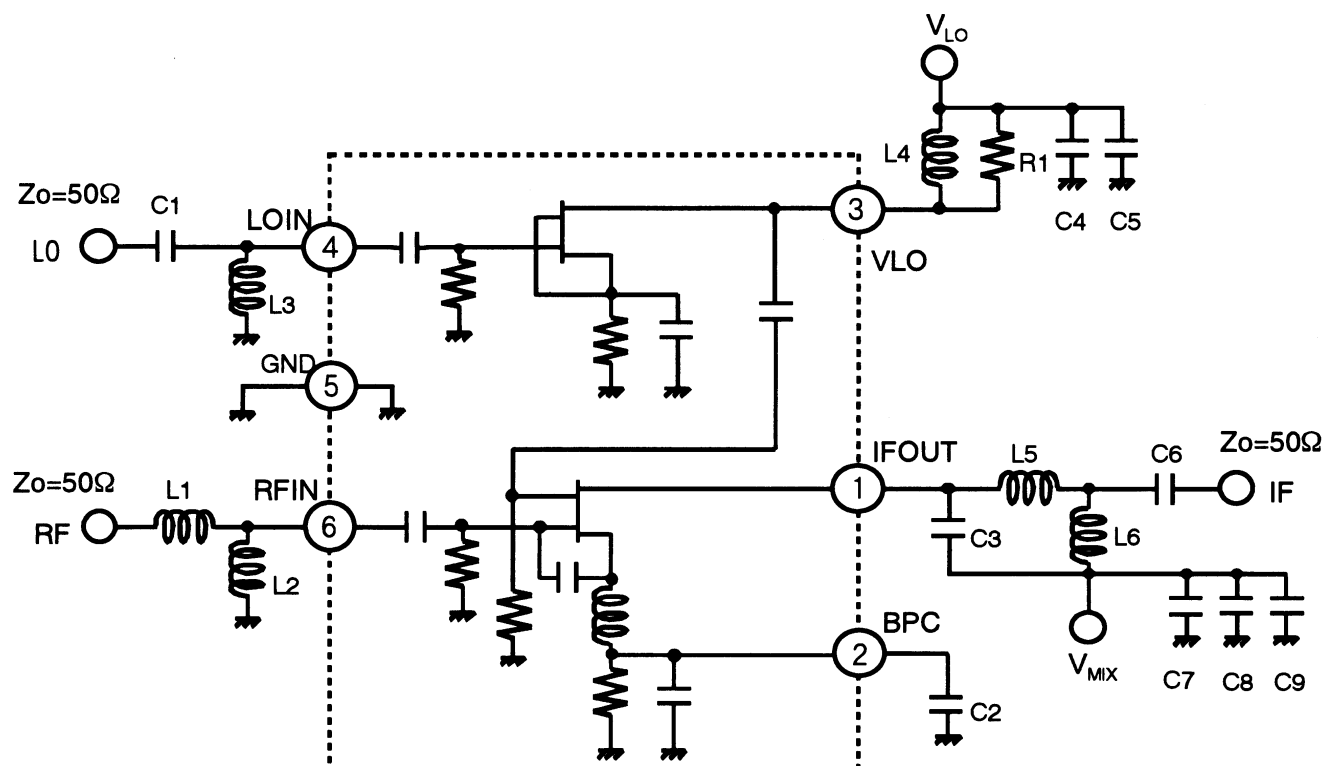
Condition  
 $f_{IF}=85.38\text{MHz}$   
 $f_{RF}=881.5\text{MHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=796.12\text{MHz}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

IF , IM3 vs. RF Power



Condition  
 $f_{IF}=85.38\text{MHz}$   
 $f_{RF1}=881.5\text{MHz}$   
 $f_{RF2}=881.6\text{MHz}$   
 $f_{LO}=796.12\text{MHz}$ ,  $P_{LO}=-10\text{dBm}$   
 $V_{MIX}=V_{LO}=2.7\text{V}$

## APPLICATION CIRCUIT 1 (Application 1)

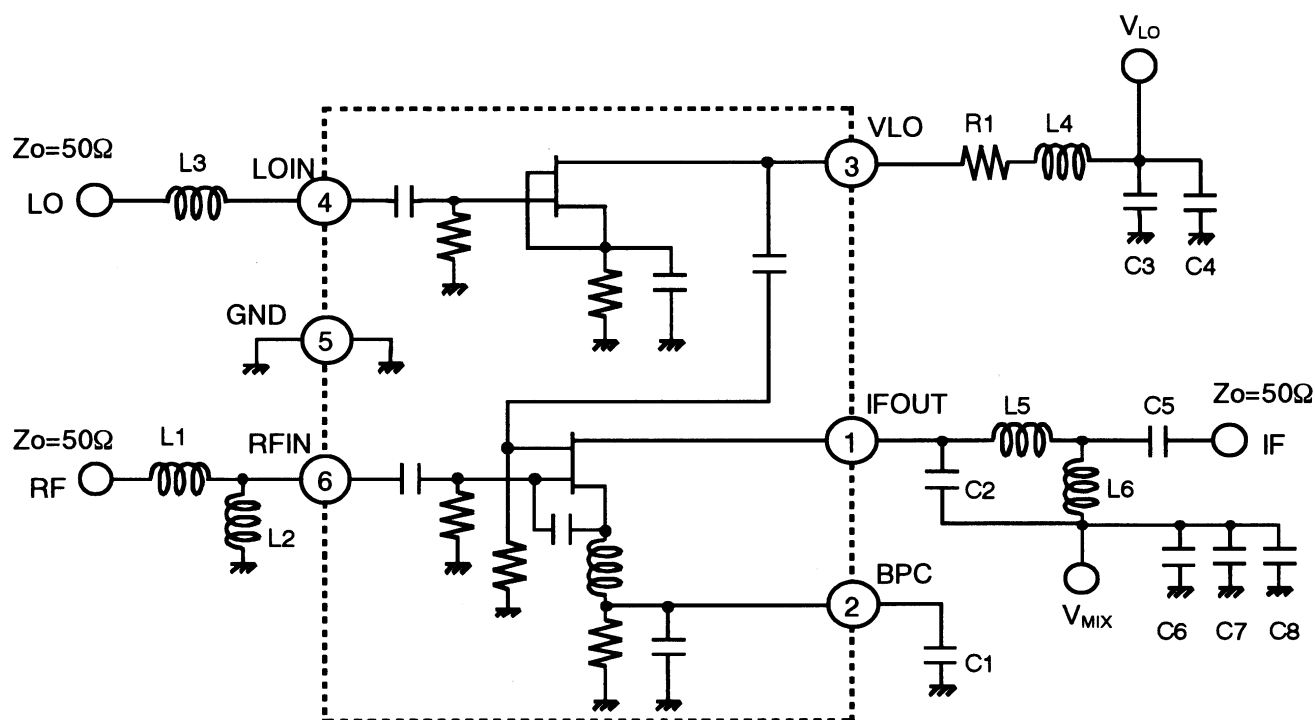


### PARTS LIST 1

| PART<br>ID | 800MHz Band                                      |                                                  |                                                       |                                                   | COMMENT                     |
|------------|--------------------------------------------------|--------------------------------------------------|-------------------------------------------------------|---------------------------------------------------|-----------------------------|
|            | Lower<br>LOCAL                                   | Upper<br>LOCAL                                   | Upper LOCAL                                           | Upper LOCAL                                       |                             |
|            | $f_{LO}=690\text{MHz}$<br>$f_{IF}=130\text{MHz}$ | $f_{LO}=950\text{MHz}$<br>$f_{IF}=130\text{MHz}$ | $f_{LO}=964.66\text{MHz}$<br>$f_{IF}=83.16\text{MHz}$ | $f_{LO}=926.5\text{MHz}$<br>$f_{IF}=45\text{MHz}$ |                             |
| L1         | 39nH                                             | 39nH                                             | 33nH                                                  | 39nH                                              | TAIYO-YUDEN(HK1608)         |
| L2         | 27nH                                             | 27nH                                             | 22nH                                                  | 22nH                                              | TAIYO-YUDEN(HK1608)         |
| L3         | 22nH                                             | 15nH                                             | 12nH                                                  | 15nH                                              | TAIYO-YUDEN(HK1608)         |
| L4         | 27nH                                             | 22nH                                             | 22nH                                                  | 18nH                                              | TAIYO-YUDEN(HK1608)         |
| L5         | 100nH                                            | 100nH                                            | 100nH                                                 | 150nH                                             | TAIYO-YUDEN(HK1608)         |
| L6         | 56nH                                             | 56nH                                             | 47nH                                                  | 120nH                                             | TAIYO-YUDEN(HK1608)         |
| C1         | 1pF                                              | 0.5pF                                            | 0.5pF                                                 | 0.5pF                                             | MURATA(GRM39)               |
| C2         | 470pF                                            | 470pF                                            | 470pF                                                 | 470pF                                             | MURATA(GRM39)               |
| C3         | 11pF                                             | 11pF                                             | 24pF                                                  | 39pF                                              | MURATA(GRM39)               |
| C4         | 100pF                                            | 100pF                                            | 100pF                                                 | 100pF                                             | MURATA(GRM39)               |
| C5         | 1000pF                                           | 1000pF                                           | 1000pF                                                | 1000pF                                            | MURATA(GRM39)               |
| C6         | 1000pF                                           | 1000pF                                           | 1000pF                                                | 47pF                                              | MURATA(GRM39)               |
| C7         | 10pF                                             | 10pF                                             | 10pF                                                  | 10pF                                              | MURATA(GRM39)               |
| C8         | 100pF                                            | 100pF                                            | 100pF                                                 | 100pF                                             | MURATA(GRM39)               |
| C9         | 1000pF                                           | 1000pF                                           | 0.1uF                                                 | 1000pF                                            | MURATA(GRM39)               |
| R1         | 560Ω                                             | 360Ω                                             | 360Ω                                                  | 470Ω                                              | TAMA<br>Electronics(CRG16G) |

# NJG1550F

## APPLICATION CIRCUIT 2 (Application 2)

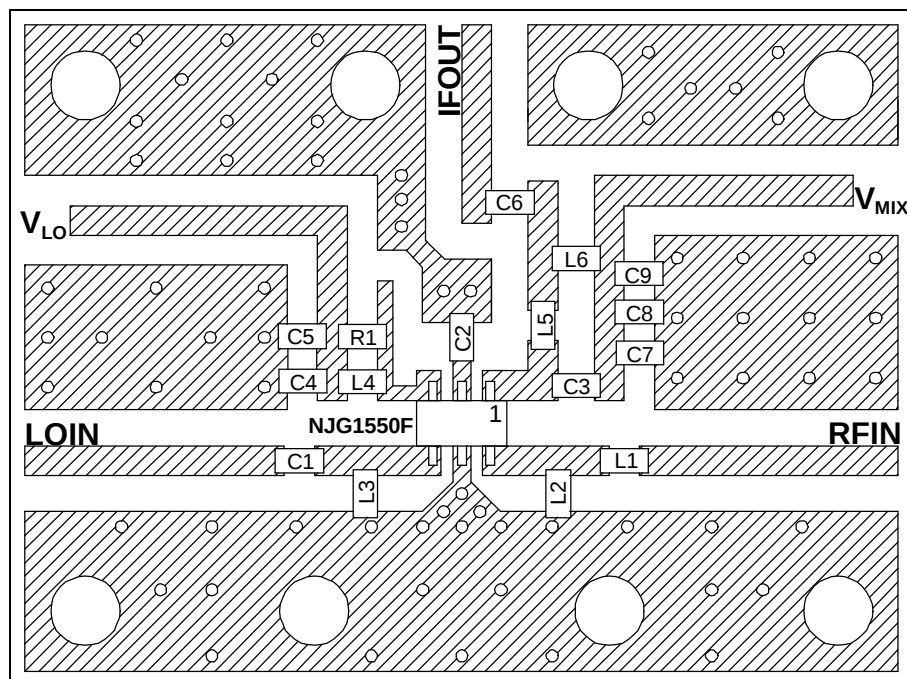


### PARTS LIST 2

| PART ID | 800MHz Band                                           |  | COMMENT                  |
|---------|-------------------------------------------------------|--|--------------------------|
|         | Lower LOCAL                                           |  |                          |
|         | $f_{LO}=796.12\text{MHz}$<br>$f_{IF}=85.38\text{MHz}$ |  |                          |
| L1      | 33nH                                                  |  | TAIYO-YUDEN(HK1608)      |
| L2      | 22nH                                                  |  | TAIYO-YUDEN(HK1608)      |
| L3      | 27nH                                                  |  | TAIYO-YUDEN(HK1608)      |
| L4      | 27nH                                                  |  | TAIYO-YUDEN(HK1608)      |
| L5      | 100nH                                                 |  | TAIYO-YUDEN(HK1608)      |
| L6      | 47nH                                                  |  | TAIYO-YUDEN(HK1608)      |
| C1      | 470pF                                                 |  | MURATA(GRM39)            |
| C2      | 24pF                                                  |  | MURATA(GRM39)            |
| C3      | 100pF                                                 |  | MURATA(GRM39)            |
| C4      | 1000pF                                                |  | MURATA(GRM39)            |
| C5      | 1000pF                                                |  | MURATA(GRM39)            |
| C6      | 10pF                                                  |  | MURATA(GRM39)            |
| C7      | 100pF                                                 |  | MURATA(GRM39)            |
| C8      | 1000pF                                                |  | MURATA(GRM39)            |
| R1      | 100Ω                                                  |  | TAMA Electronics(CRG16G) |

## RECOMMENDED PCB DESIGN

(TOP VIEW)



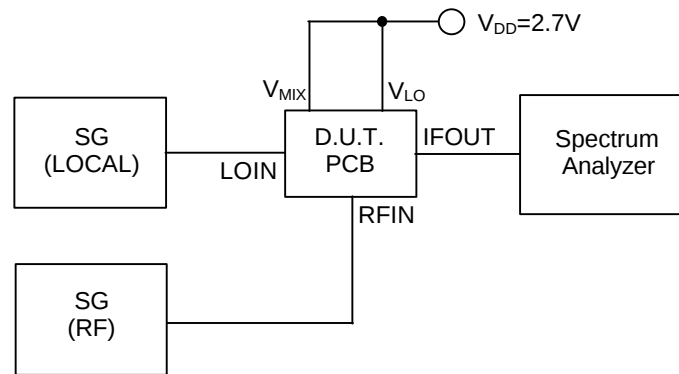
PCB: FR-4, t=0.5mm  
 STRIPLINE WIDTH=1mm  
 ( $Z_0=50\Omega$ )

(SIZE: 22.5mm x 30mm)

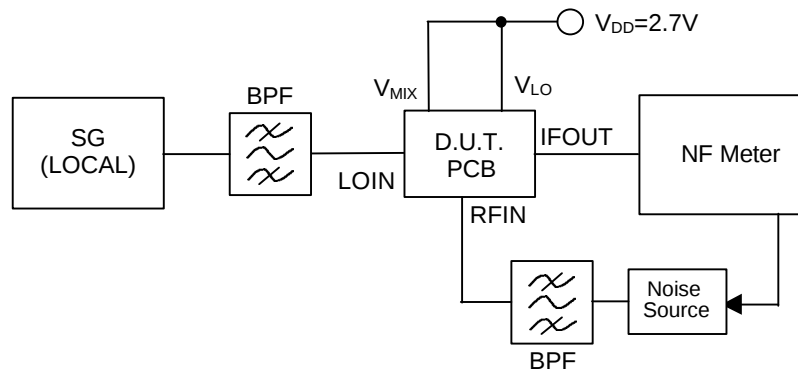
## PRECAUTIONS

- [1] Please locate L4 and R1 close to VLO terminal (3).
- [2] Distance from L1 and RFIN terminal (6) is 3.5mm.
- [3] Distance from C1 and LOIN terminal (4) is 3.5mm.
- [4] Please locate C2 close to BPC terminal (2).
- [5] Please locate C7, C8, C9 close to C3, L6.
- [6] Please locate C4, C5 close to R1, L4.

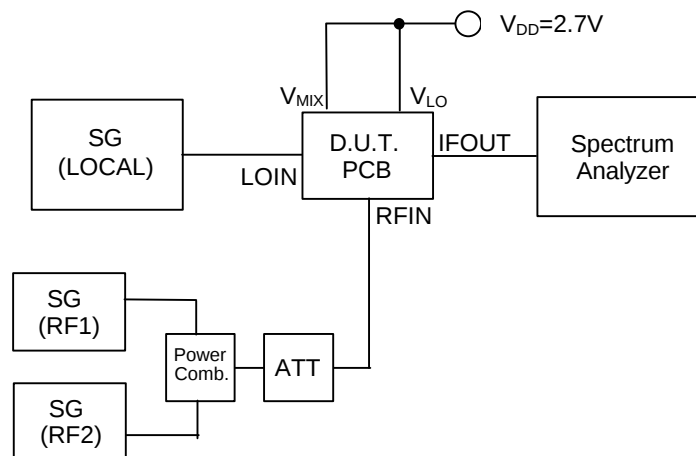
## MEASURING BLOCK DIAGRAM



Conversion Gain Measurement Block Diagram

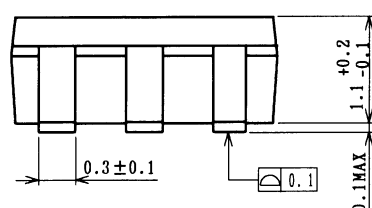
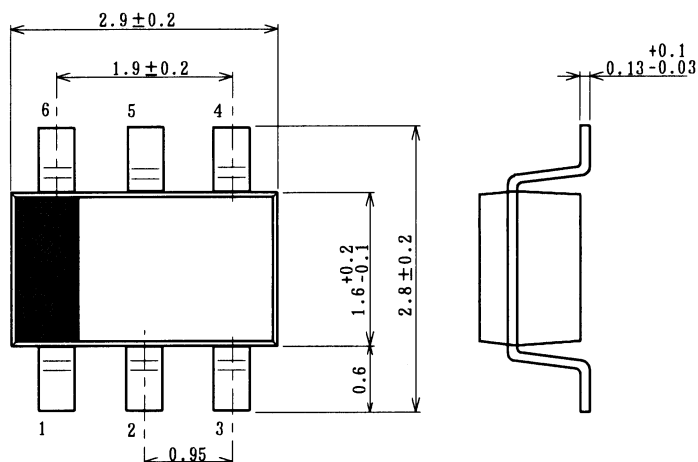


Noise Figure Measurement Block Diagram



IF, IM3, IM5 Measurement Block Diagram

## ■PACKAGE OUTLINE (MTP6)



|                     |                  |
|---------------------|------------------|
| Lead material       | : Copper         |
| Lead surface finish | : Solder plating |
| Molding material    | : Epoxy resin    |
| UNIT                | : mm             |
| Weight              | : 14mg           |

### 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.

### [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.

This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.