# 800MHz BAND MIXER GaAs MMIC

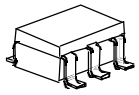
## ■GENERAL DESCRIPTION

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



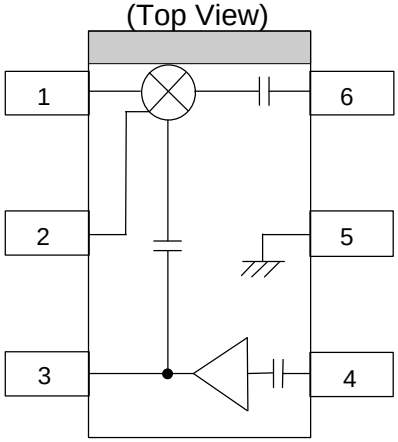
NJG1550F

## ■FEATURES

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

## ■PIN CONFIGURATION

F type
(Top View)




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.

## ■ABSOLUTE MAXIMUM RATINGS

($T_a$=25°C, $Z_s$=$Z_l$=50Ω)

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

## ■RECOMMENDED OPERATING RANGE

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

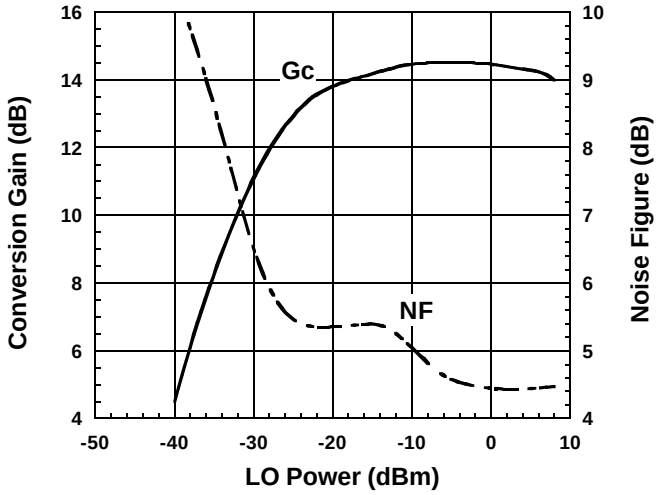
## ■ELECTRICAL CHARACTERISTICS

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

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

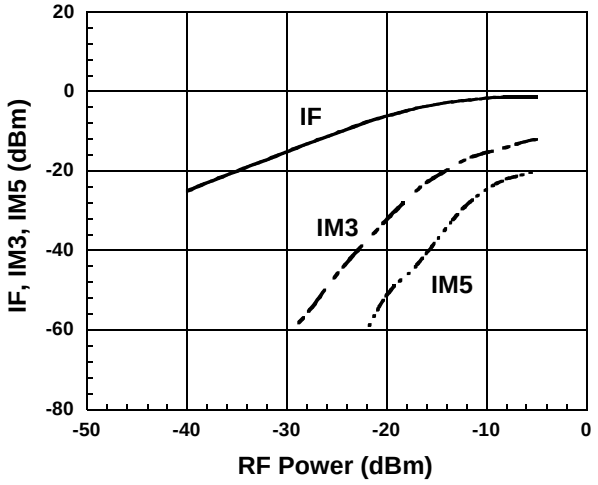
## ■TYPICAL CHARACTERISTICS (Application 1, $f_{LO}$=690MHz)

### Conversion Gain , Noise Figure vs. LO Power



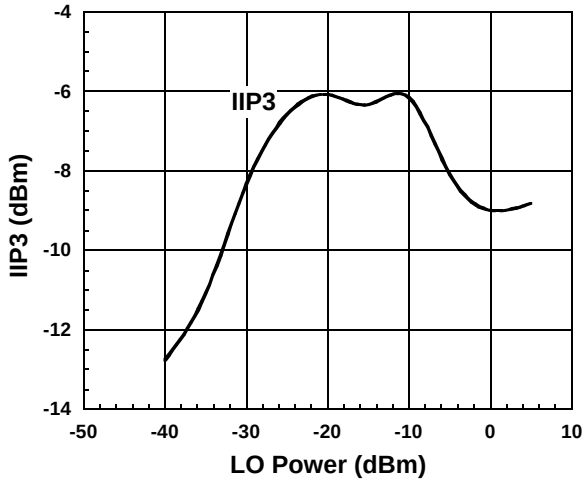

Condition
$f_{IF}$=130MHz
$f_{RF}$=820MHz,$P_{RF}$=-30dBm
$f_{LO}$=690MHz
$V_{MIX}$=$V_{LO}$=2.7V

### IF , IM3 , IM5 vs. RF Power




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

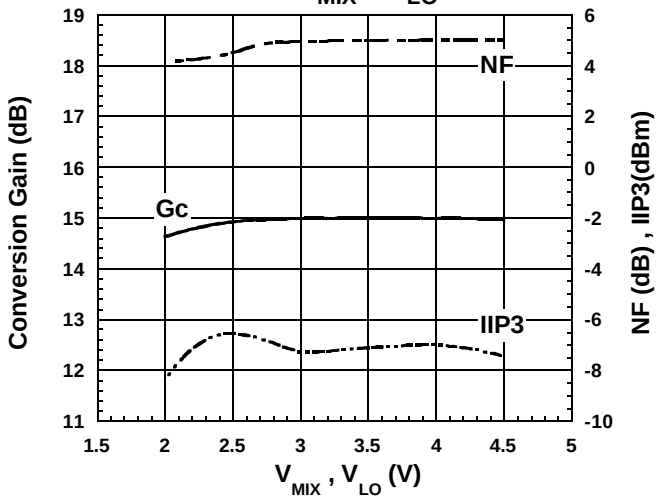
### Input-IP3 vs. LO Power




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

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

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

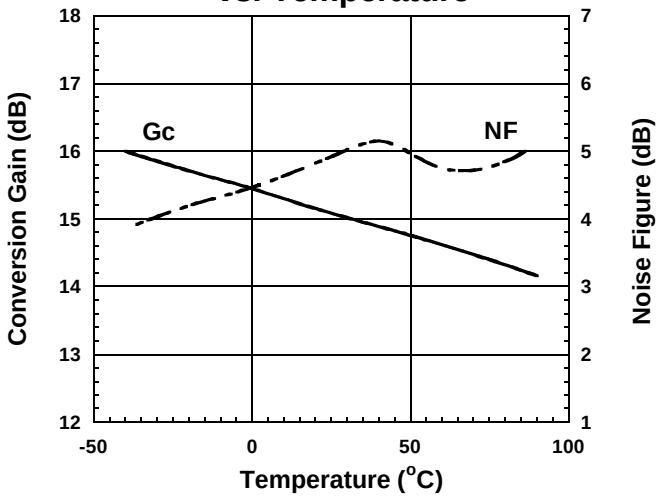



Condition
$f_{IF}$=130MHz
$f_{RF1}$=820.0MHz,$P_{RF}$=-30dBm
$f_{RF2}$=820.1MHz
$f_{LO}$=690MHz,$P_{LO}$=-10dBm

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

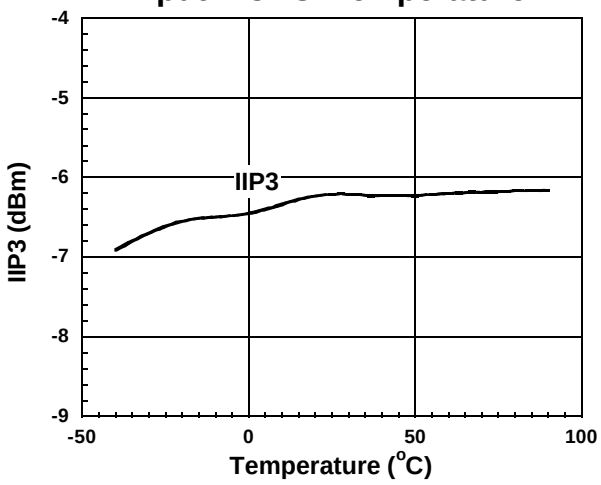
## ■TYPICAL CHARACTERISTICS (Continued)

**Conversion Gain , Noise Figure vs. Temperature**




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

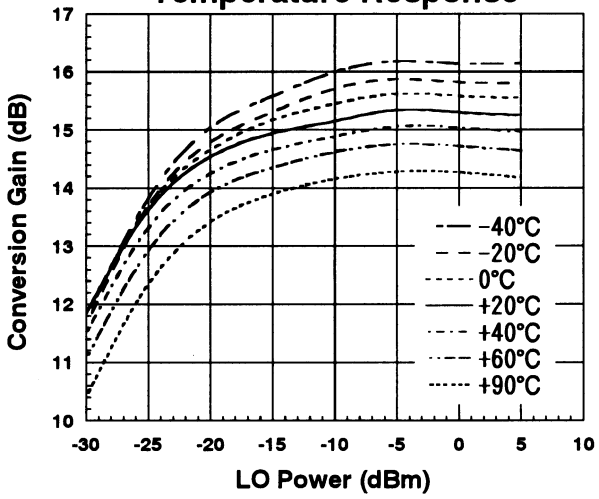
**Input-IP3 vs. Temperature**




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

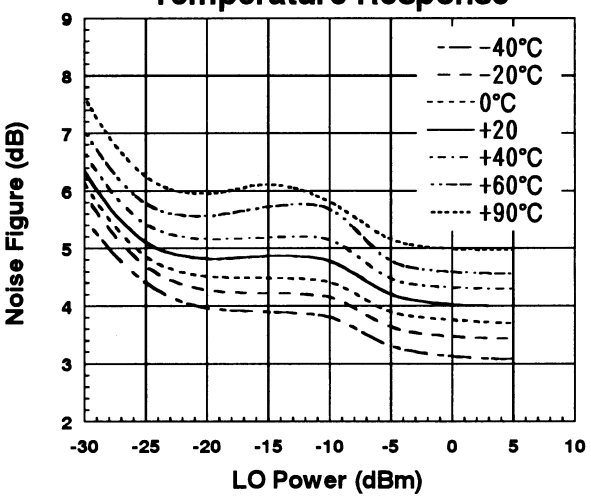
$$IIP3=\frac{3IF-IM3}{2}-G_c$$
@$P_{RF}$=-30dBm

**Conversion Gain vs. LO Power Temperature Response**




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

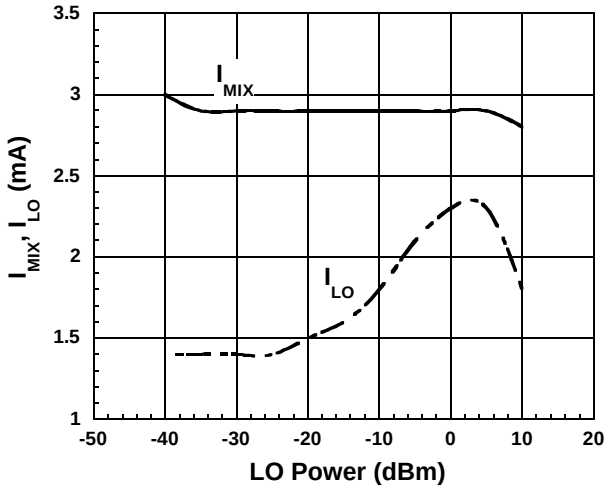
**Noise Figure vs. LO Power Temperature Response**




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

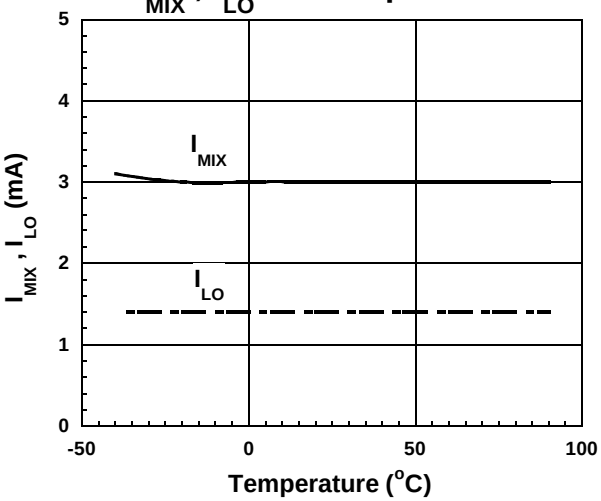
■**TYPICAL CHARACTERISTICS** (Continued)

**$I_{MIX}$ , $I_{LO}$ vs. LO Power**



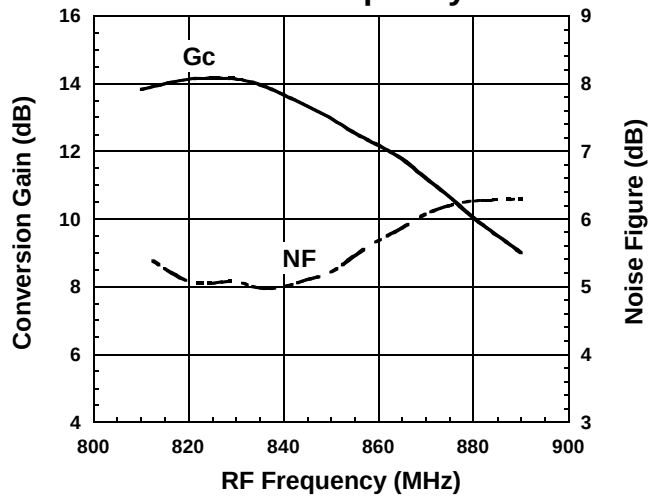

Condition
$f_{RF}$=820MHz
$P_{RF}$=-30dBm
$f_{LO}$=690MHz
$V_{MIX}$=$V_{LO}$=2.7V

**$I_{MIX}$ , $I_{LO}$ vs. Temperature**



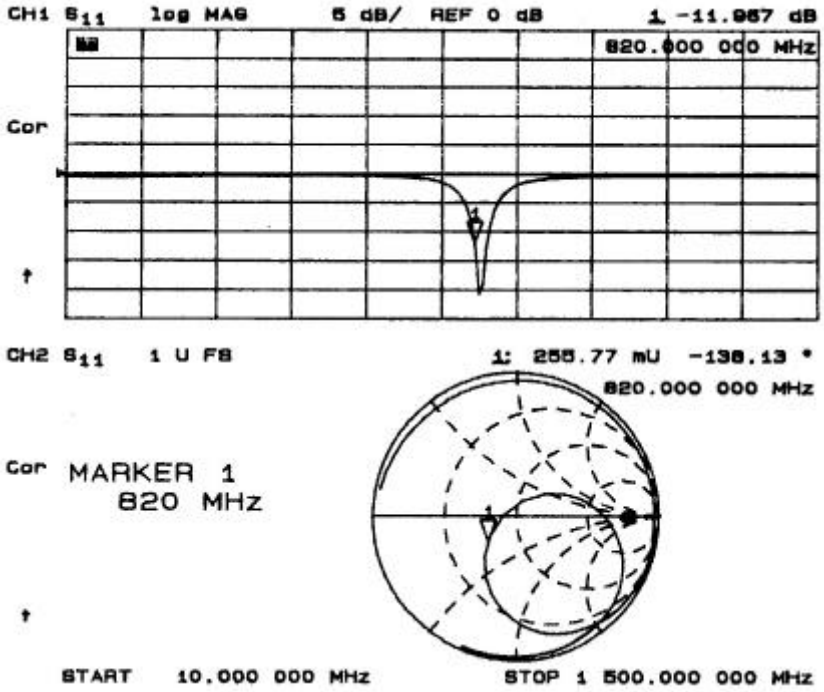

Condition
$P_{RF}$=OFF
$P_{LO}$=OFF
$V_{MIX}$=$V_{LO}$=2.7V

**Conversion Gain , Noise Figure vs. RF Frequency**

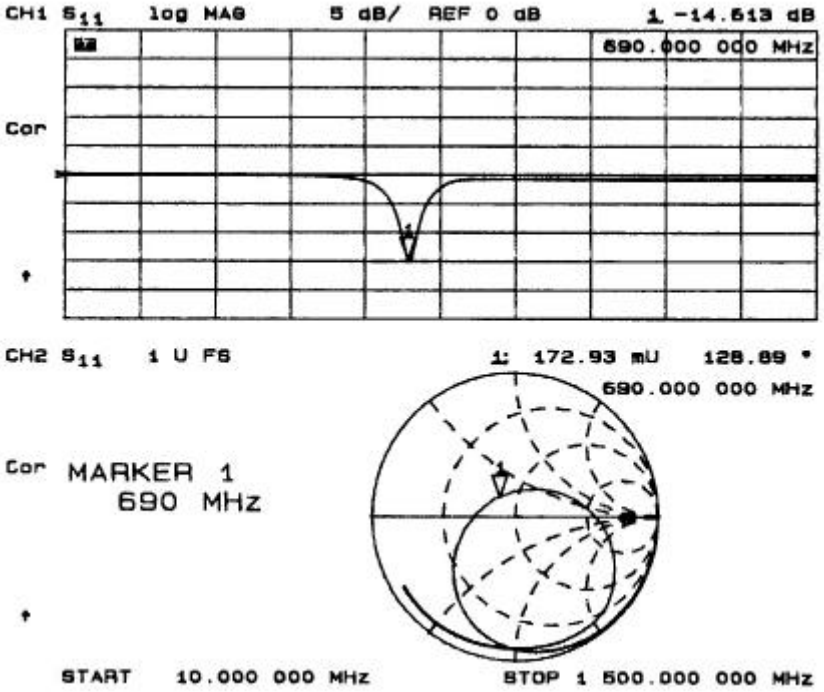



Condition
$f_{IF}$=130MHz
$P_{RF}$=-30dBm
$P_{LO}$=-10dBm
$V_{MIX}$=$V_{LO}$=2.7V
Lower LOCAL

■**TYPICAL CHARACTERISTICS** (Continued)

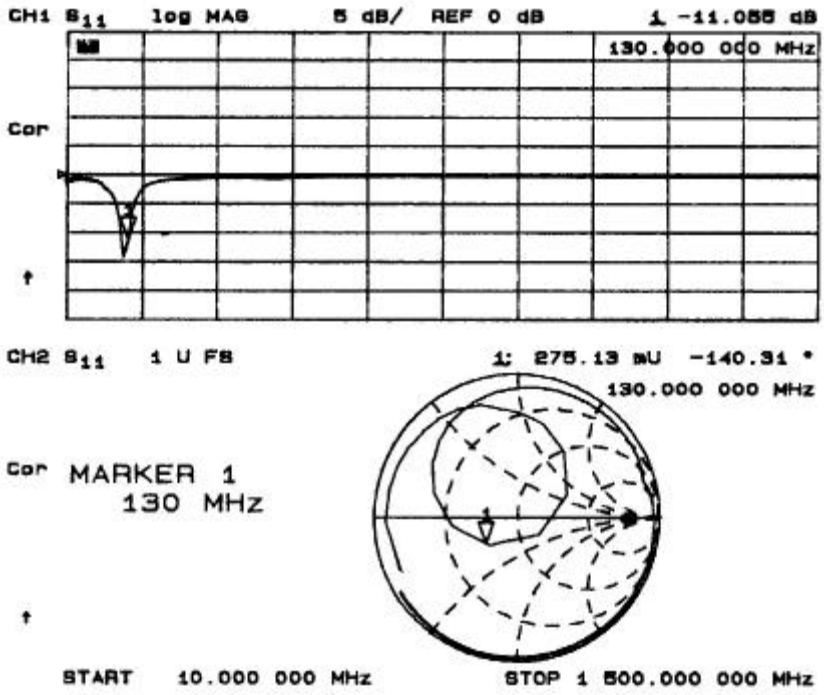



RFIN PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT




LOIN PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT

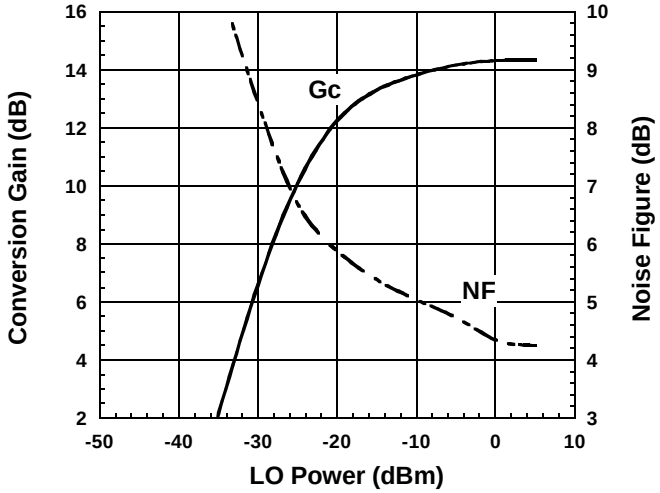
■**TYPICAL CHARACTERISTICS** (Continued)




IFOUT PORT EXTERNAL MATCHING NETWORK IMPEDANCE PLOT

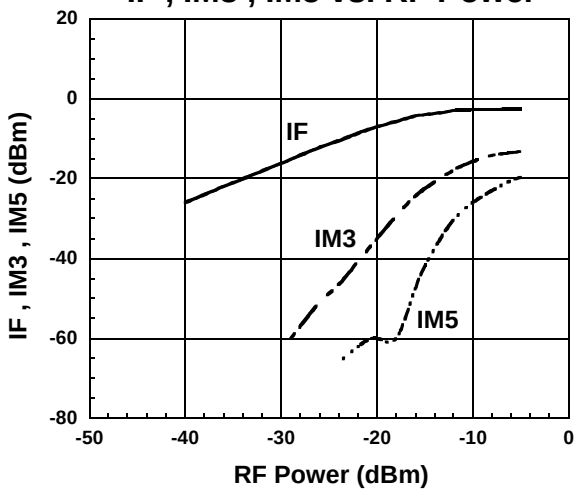
■**TYPICAL CHARACTERISTICS** (Application 1, $f_{LO}$=950MHz)

**Conversion Gain , Noise Figure vs. LO Power**



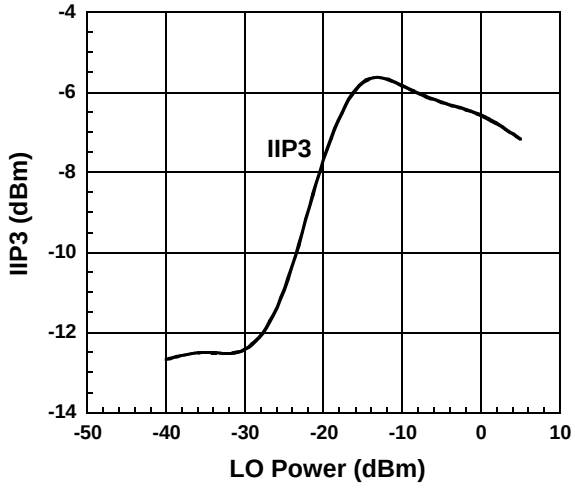

Condition
$f_{IF}$=130MHz
$f_{RF}$=820MHz,$P_{RF}$=-30dBm
$f_{LO}$=950MHz
$V_{MIX}$=$V_{LO}$=2.7V

**IF , IM3 , IM5 vs. RF Power**




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

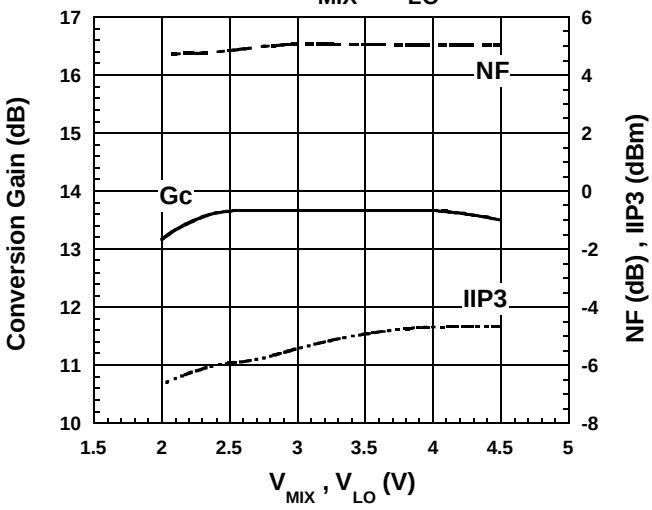
**Input-IP3 vs. LO Power**




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

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

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

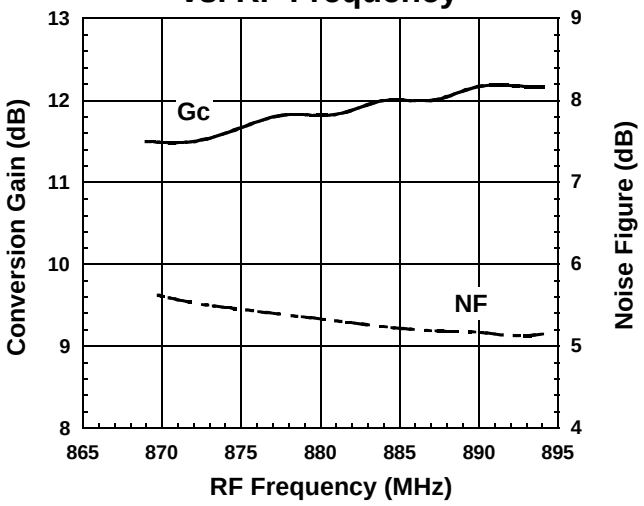



Condition
$f_{IF}$=130MHz
$f_{RF1}$=820.0MHz,$P_{RF}$=-30dBm
$f_{RF2}$=820.1MHz
$f_{LO}$=950MHz,$P_{LO}$=-10dBm

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

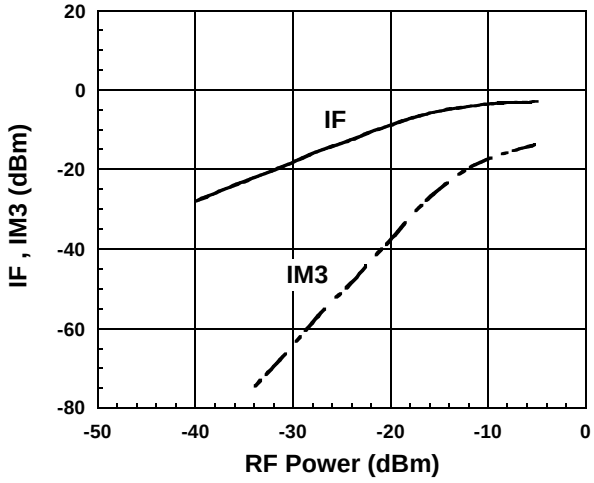
■**TYPICAL CHARACTERISTICS** (Application 1, $f_{LO}$=964.66MHz)

**Conversion Gain , Noise Figure vs. RF Frequency**




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

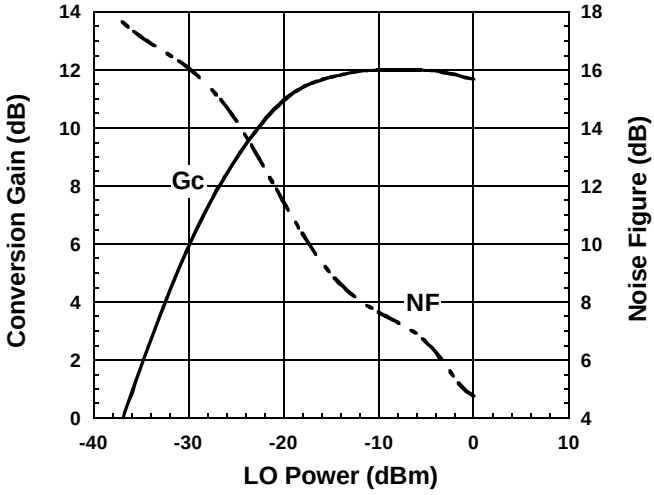
**IF , IM3 vs. RF Power**




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

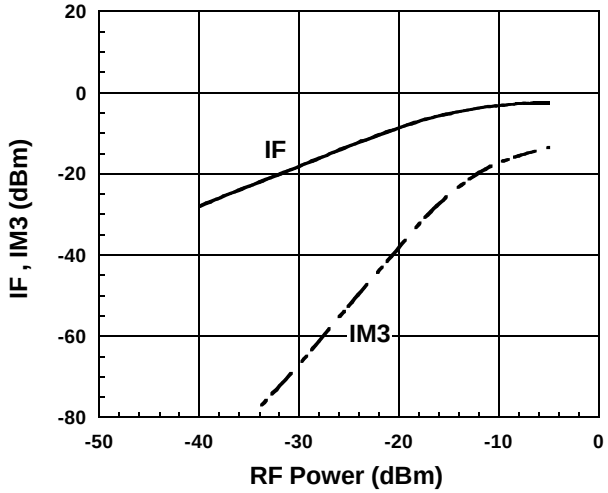
■**TYPICAL CHARACTERISTICS** (Application 1, $f_{LO}$=926.5MHz)

**Conversion Gain , Noise Figure vs. LO Power**



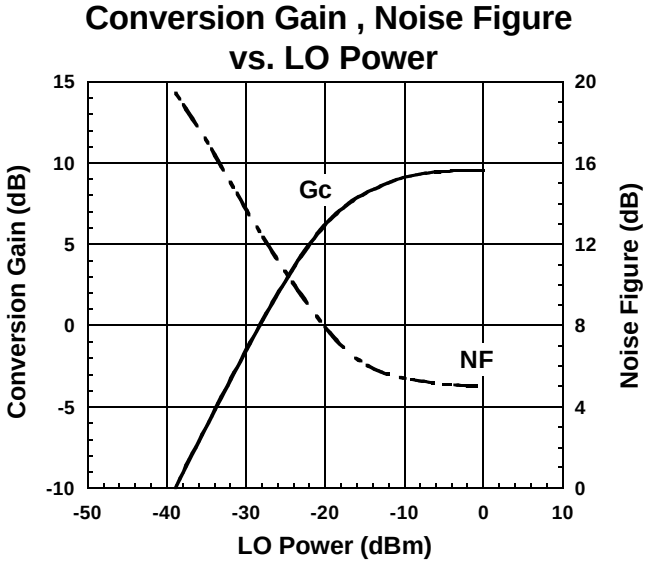

Condition
$f_{IF}$=45MHz
$f_{RF}$=881.5MHz,$P_{RF}$=-30dBm
$f_{LO}$=926.5MHz
$V_{MIX}$=$V_{LO}$=2.7V

**IF , IM3 vs. RF Power**

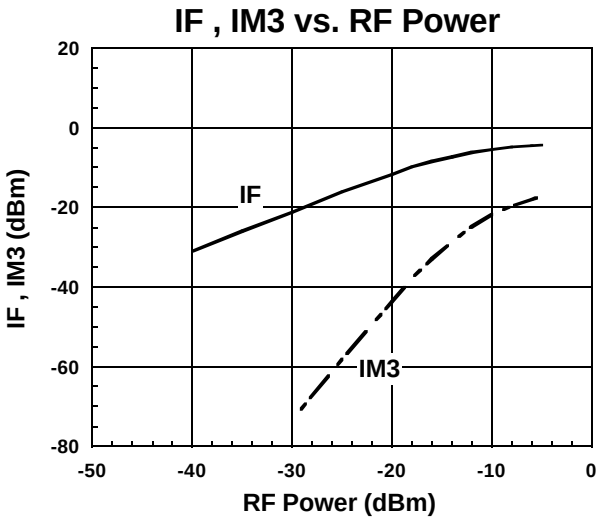



Condition
$f_{IF}$=45MHz
$f_{RF1}$=881.5MHz
$f_{RF2}$=881.6MHz
$f_{LO}$=926.5MHz,$P_{LO}$=-10dBm
$V_{MIX}$=$V_{LO}$=2.7V

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

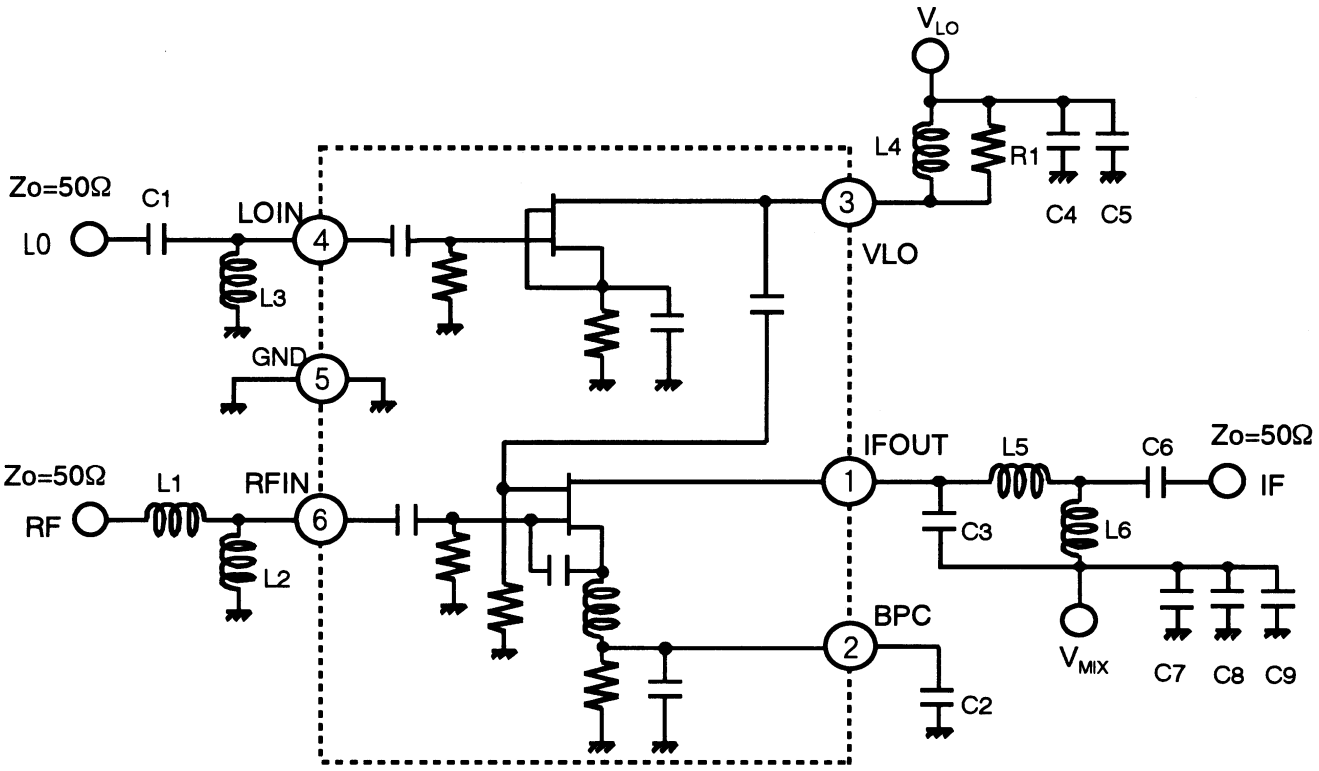



Condition
$f_{IF}$=85.38MHz
$f_{RF}$=881.5MHz, $P_{RF}$=-30dBm
$f_{LO}$=796.12MHz
$V_{MIX}$=$V_{LO}$=2.7V




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

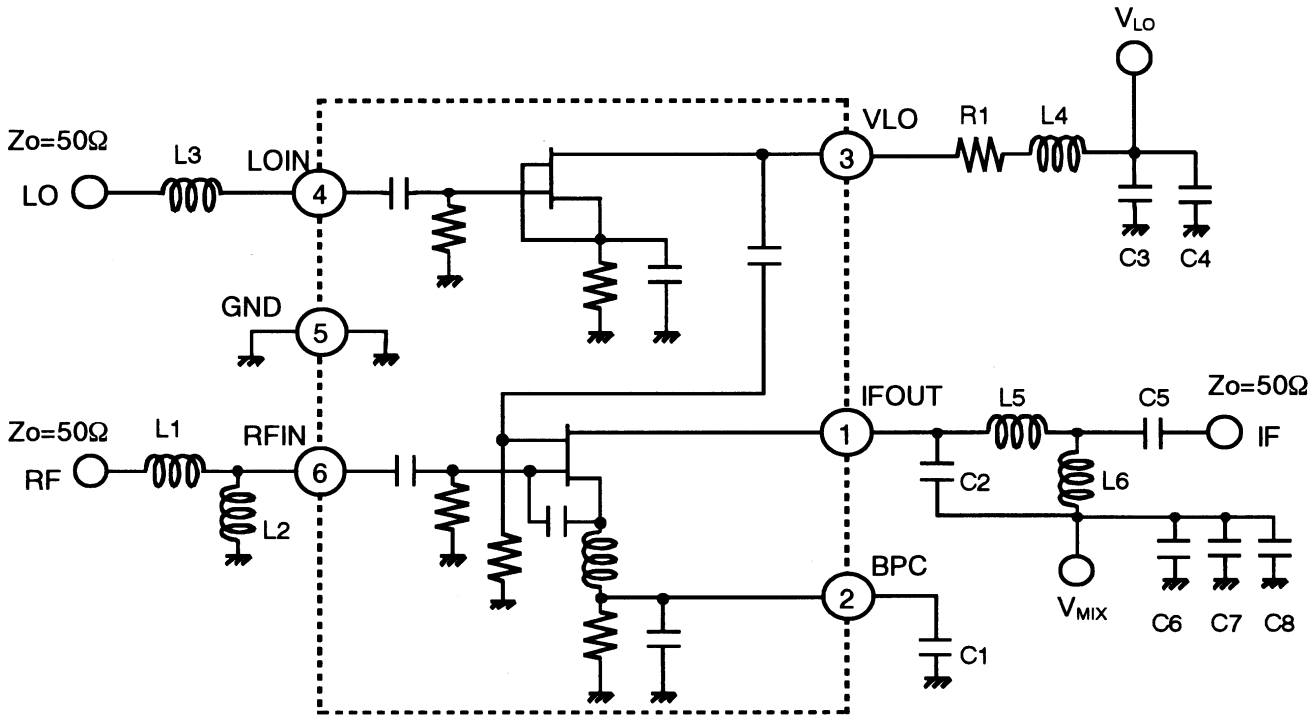
■**APPLICATION CIRCUIT 1** (Application 1)




**PARTS LIST 1**

| PART ID | 800MHz Band | | | | COMMENT |
|---|---|---|---|---|---|
| | Lower LOCAL | Upper LOCAL | Upper LOCAL | Upper LOCAL | |
| | $f_{LO}$=690MHz $f_{IF}$=130MHz | $f_{LO}$=950MHz $f_{IF}$=130MHz | $f_{LO}$=964.66MHz $f_{IF}$=83.16MHz | $f_{LO}$=926.5MHz $f_{IF}$=45MHz | |
| 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 Electronics(CRG16G) |

■**APPLICATION CIRCUIT 2** (Application 2)

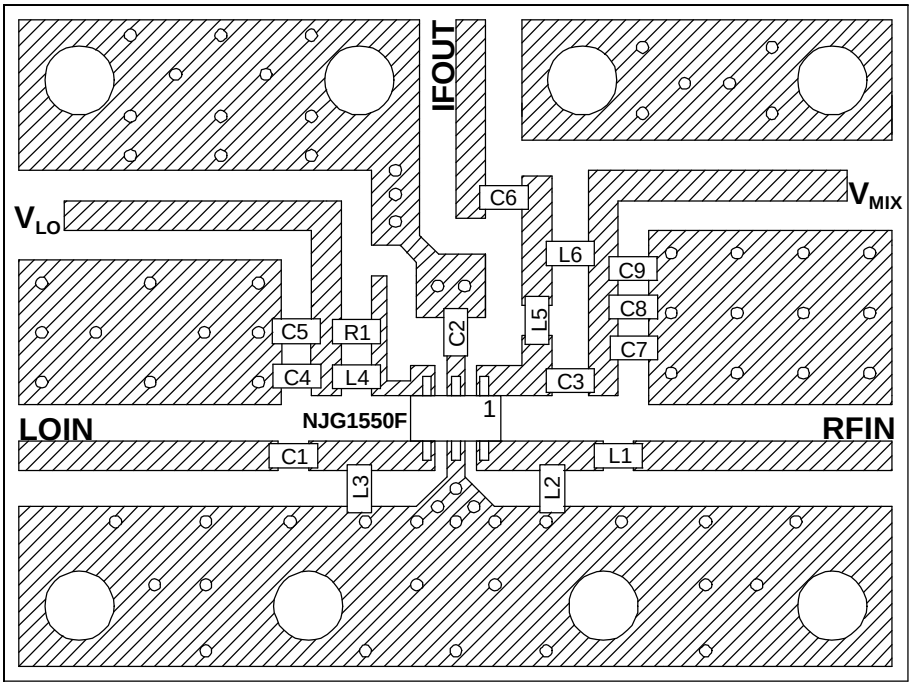



**PARTS LIST 2**

| PART ID | 800MHz Band | | COMMENT |
|---|---|---|---|
| | Lower LOCAL | | |
| | $f_{LO}$=796.12MHz<br>$f_{IF}$=85.38MHz | | |
| 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)



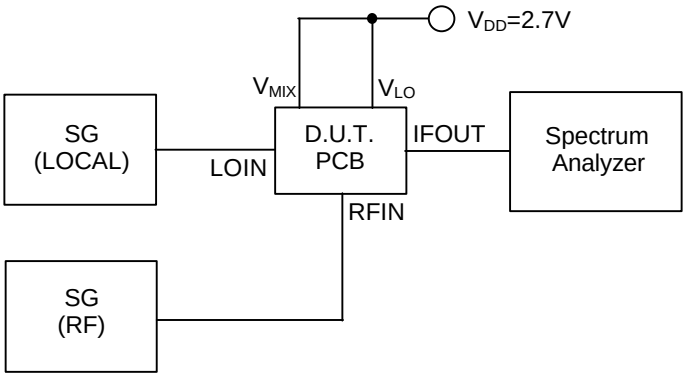

PCB: FR-4, t=0.5mm
STRIPLINE WIDTH=1mm
(Zo=50Ω)

(SIZE: 22.5mm x 30mm)

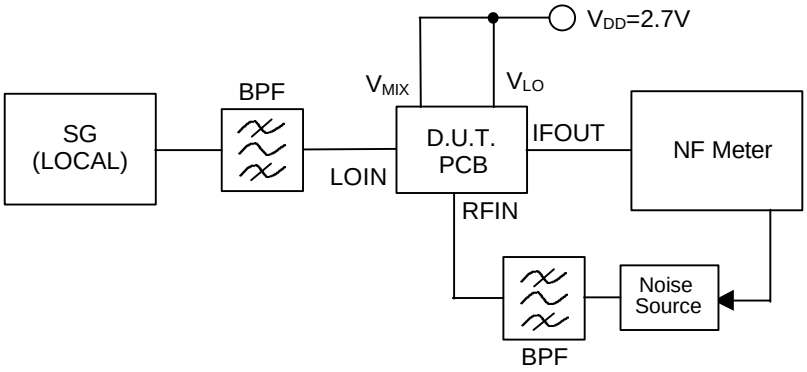
**PRECAUTIONS**

[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 C2close to BPC terminal (2).
[5] Please locate C7, C8, C9 close to C3, L6.
[6] Please locate C4, C5 close to R1, L4.

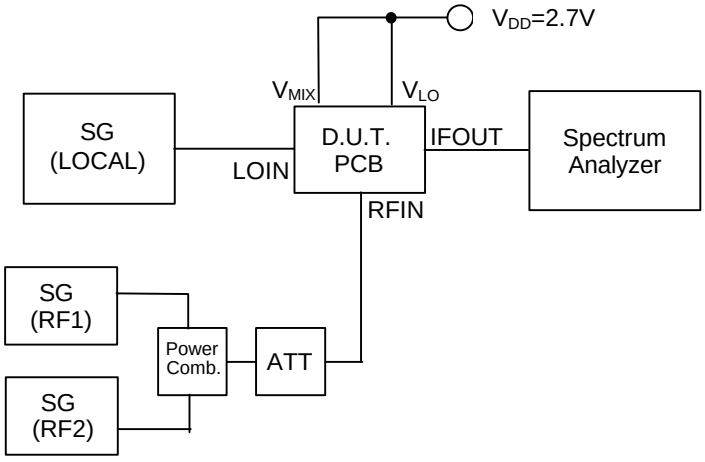
## ■MEASURING BLOCK DIAGRAM




Conversion Gain Measurement Block Diagram

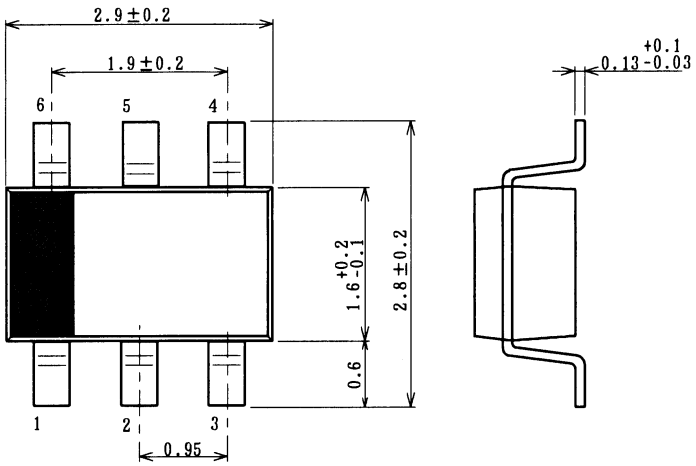


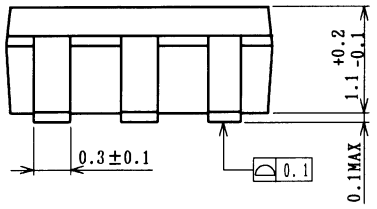

Noise Figure Measurement Block Diagram




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.

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