

## PDC DUAL BAND MIXER GaAs MMIC

### ■ GENERAL DESCRIPTION

NJG1558PB1 is a dual band mixer IC with build-in local amplifier for 800MHz and 1.5GHz dual band digital cellular phone.

One of the two Mixers of NJG1558PB1 is selected by single control signal. The IF signal of both is output to the port.

NJG1558PB1 features low noise figure and low current consumption.

The ultra small and thin FFP12 (Flip-Chip Fine Package) is applied.

### ■ PACKAGE OUTLINE

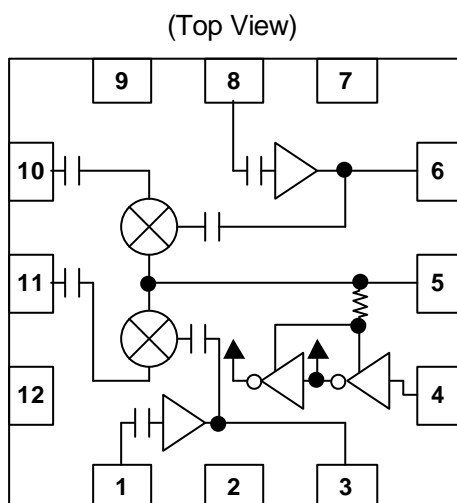


NJG1558PB1

### ■ FEATURES

- Low voltage operation +2.8V typ.
- High conversion gain 11dB typ. @  $V_{CTL2}=0V$ ,  $f_{RFIN1}=810\sim 843MHz$ , 870~885MHz  
11dB typ. @  $V_{CTL1}=2.8V$ ,  $f_{RFIN2}=1470\sim 1510MHz$
- High input IP3 +2dBm typ. @  $V_{CTL2}=0V$ ,  $f_{RFIN1}=810\sim 843MHz$ , 870~885MHz  
-1dBm typ. @  $V_{CTL1}=2.8V$ ,  $f_{RFIN2}=1470\sim 1510MHz$
- Low noise figure 5dBm typ. @  $V_{CTL2}=0V$ ,  $f_{RFIN1}=810\sim 843MHz$ , 870~885MHz  
6dBm typ. @  $V_{CTL1}=2.8V$ ,  $f_{RFIN2}=1470\sim 1510MHz$

### ■ PIN CONFIGURATION



#### Pin Connection

- |                       |                   |
|-----------------------|-------------------|
| 1. LOIN1 (800MHz)     | 7. GND            |
| 2. GND                | 8. LOIN2(1.5GHz)  |
| 3. $V_{LO1}$ (800MHz) | 9. GND            |
| 4. $V_{CTL}$          | 10. RFIN2(1.5GHz) |
| 5. IFOUT              | 11. RFIN1(800MHz) |
| 6. $V_{LO2}$ (1.5GHz) | 12. GND           |

Note: the specifications and description listed in this catalog are subject to change without prior notice.

# NJG1558PB1

## ■ABSOLUTE MAXIMUM RATINGS

GENERAL CONDITIONS:  $T_a=25^{\circ}\text{C}$ ,  $Z_s=Z_l=50\Omega$

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNITS
Drain Voltage	$V_{DD}$	IFOUT, $V_{LO}$ 1, $V_{LO}$ 2 ports	5.0	V
Control Voltage	$V_{CTL}$	$V_{CTL}$ port	5.0	V
Input Power	$P_{in}$	RFIN1, RFIN2, LOIN1, LOIN2 ports	+10	dBm
Power Dissipation	$P_D$		400	mW
Operating Temp.	$T_{opr}$		-40~+85	$^{\circ}\text{C}$
Storage Temp.	$T_{stg}$		-55~+125	$^{\circ}\text{C}$

## ■ELECTRICAL CHARACTERISTICS 1 (DC)

GENERAL CONDITIONS:  $T_a=25^{\circ}\text{C}$ ,  $V_{MIX}=V_{LO1}=V_{LO2}=2.8\text{V}$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Mixer voltage	$V_{MIX}$	IFOUT port	2.5	2.8	4.5	V
Local amplifier voltage	$V_{LO}$	$V_{LO}$ 1, $V_{LO}$ 2 ports	2.5	2.8	4.5	V
Mixer Current	$I_{MIX}$	IFOUT port, PRF, PLO OFF $V_{CTL}=0\text{V}$ or $2.8\text{V}$	-	4.9	6.4	mA
Local Amplifier Current 1	$I_{LO1}$	$V_{LO}$ 1 port, $V_{CTL}=V_{CTL(L)}$ , PRF, PLO OFF	-	1	1.2	mA
Local Amplifier Current 2	$I_{LO2}$	$V_{LO}$ 2port, $V_{CTL}=V_{CTL(H)}$ , PRF, PLO OFF	-	1	1.2	mA
Operating Voltage (LOW)	$V_{CTL(L)}$	$V_{CTL}$ port	0	0	0.8	V
Operating Voltage (HIGH)	$V_{CTL(H)}$	$V_{CTL}$ port	2.0	2.8	$V_{MIX}$	V
Control Current	$I_{CTL}$	$V_{CTL}=2.8\text{V}$	-	40	100	$\mu\text{A}$

## ■ELECTRICAL CHARACTERISTICS 2 (800MHz BAND RF)

GENERAL CONDITIONS:  $T_a=+25^{\circ}\text{C}$ ,  $V_{\text{MIX}}=V_{\text{LO1}}=2.8\text{V}$ ,  $V_{\text{CTL}}=V_{\text{CTL(L)}}$ ,  $f_{\text{RFIN1}}=810\sim 843\text{MHz}$ ,  
 $870\sim 885\text{MHz}$ ,  $P_{\text{RFIN1}}=-30\text{dBm}$ , LOWER LOCAL,  $P_{\text{LOIN1}}=-15\text{dBm}$ ,  
 $f_{\text{IF}}=130\text{MHz}$ ,  $Z_s=Z_l=50\Omega$ , with test circuit

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating frequency1	freq1		810	-	885	MHz
Conversion gain 1	Gain1		10.0	11.0	12.0	dB
Noise figure1	NF1	SSB NF	-	5.0	6.0	dB
Input 3rd order Intercept point 1	IIP3_1	2 tone offset frequency=100kHz	-1.0	2.0	-	dBm
Pin at 1dB gain Compression point 1	$P_{-1\text{dB(IN) } 1}$		-11	-9	-	dBm
RFIN1 port VSWR	VSWR1		-	1.5	2.5	
LOIN1 port VSWR	VSWR2		-	1.5	2.5	

## ■ELECTRICAL CHARACTERISTICS 3 (1.5GHz BAND RF)

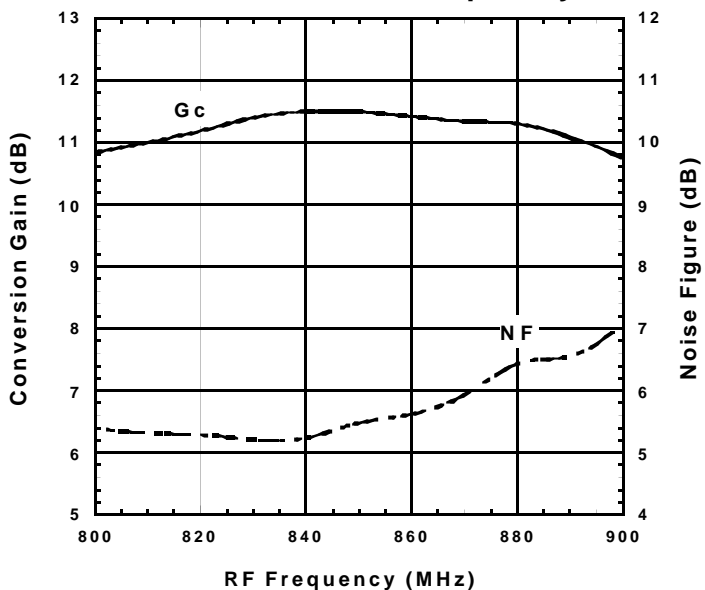
GENERAL CONDITIONS:  $T_a=+25^{\circ}\text{C}$ ,  $V_{\text{MIX}}=V_{\text{LO2}}=2.8\text{V}$ ,  $V_{\text{CTL}}=V_{\text{CTL(H)}}$ ,  $f_{\text{RFIN2}}=1470\sim 1510\text{MHz}$ ,  
 $P_{\text{RFIN2}}=-30\text{dBm}$ , UPPER LOCAL,  $P_{\text{LOIN2}}=-15\text{dBm}$ ,  $f_{\text{IF}}=130\text{MHz}$ ,  
 $Z_s=Z_l=50\Omega$ , with test circuit

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating frequency 2	freq2		1470	-	1510	MHz
Conversion gain 3	Gain2		10.0	11.0	12.0	dB
Noise figure 3	NF2	SSB NF	-	6.0	8.5	dB
Input 3rd order Intercept point 3	IIP3_2	2 tone offset frequency=100kHz	-4.0	-1.0	-	dBm
Pin at 1dB gain Compression point 3	$P_{-1\text{dB(IN) } 2}$		-17	-14	-	dBm
RFIN2 port VSWR	VSWR3		-	1.5	2.0	
LOIN2 port VSWR	VSWR4		-	1.5	2.0	

# NJG1558PB1

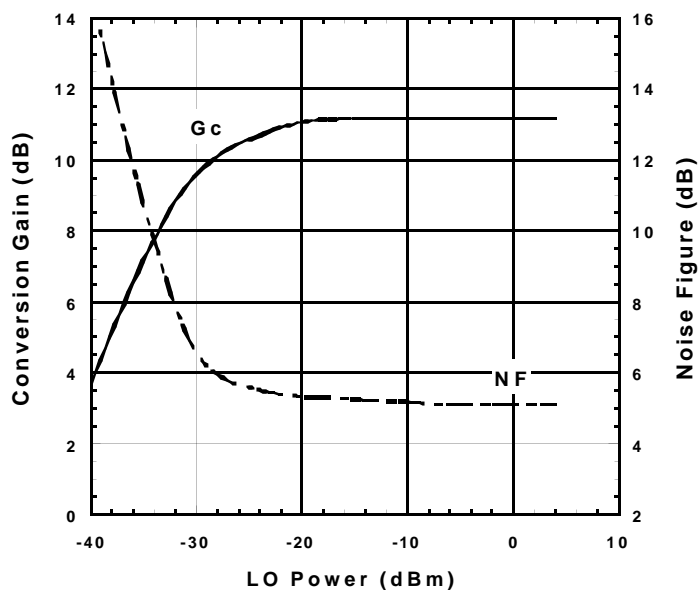
## ■ TYPICAL CHARACTERISTICS (800MHz BAND)

**NJG1558PB1 (800MHz Band)**  
Gc , NF vs. RF Frequency



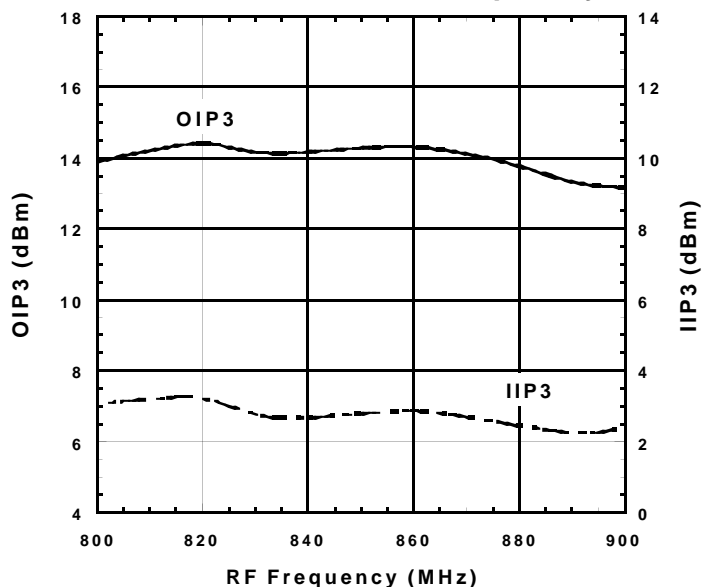
Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=800\sim 900\text{MHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=670\sim 770\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

**NJG1558PB1 (800MHz Band)**  
Gc , NF vs. LO Power



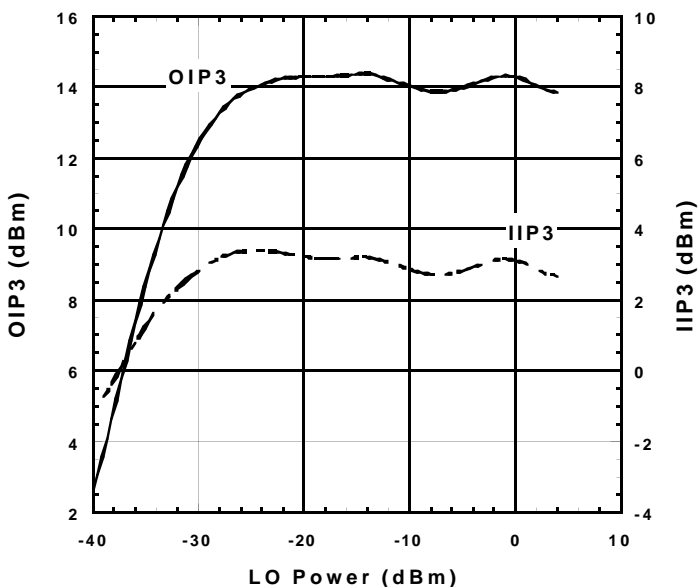
Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=820\text{MHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=690\text{MHz}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

**NJG1558PB1 (800MHz Band)**  
OIP3 , IIP3 vs. RF Frequency



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=800\sim 900\text{MHz}$   
 $f_{RF2}=f_{RF1}+100\text{kHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=670\sim 770\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

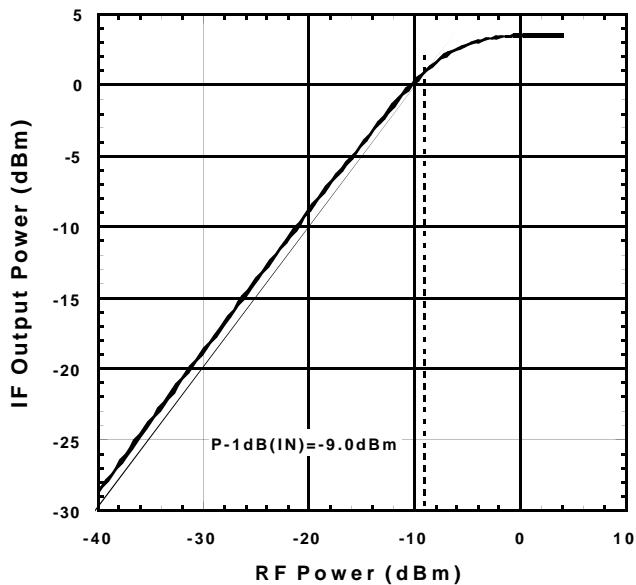
**NJG1558PB1 (800MHz Band)**  
OIP3 , IIP3 vs. LO Power



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=820.0+820.1\text{MHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=690\text{MHz}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

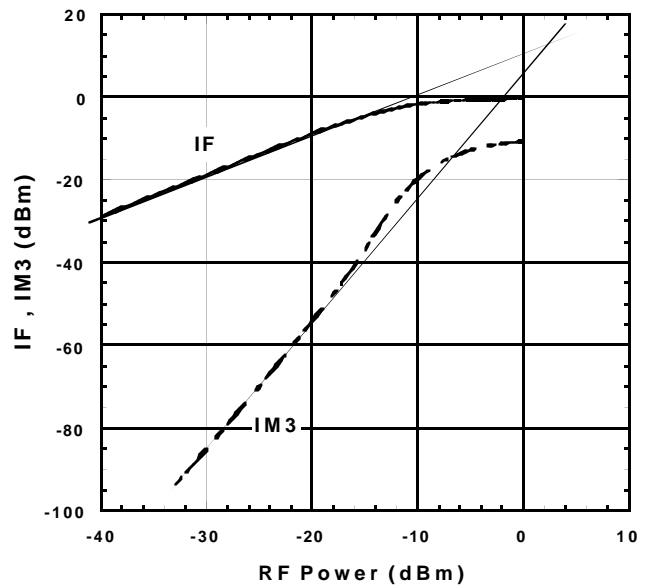
## ■ TYPICAL CHARACTERISTICS (800MHz BAND)

**NJG1558PB1 (800MHz Band)**  
**IF Output Power vs. RF Power**



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=820\text{MHz}$   
 $f_{LO}=690\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

**NJG1558PB1 (800MHz Band)**  
**IF , IM3 vs. RF Power**



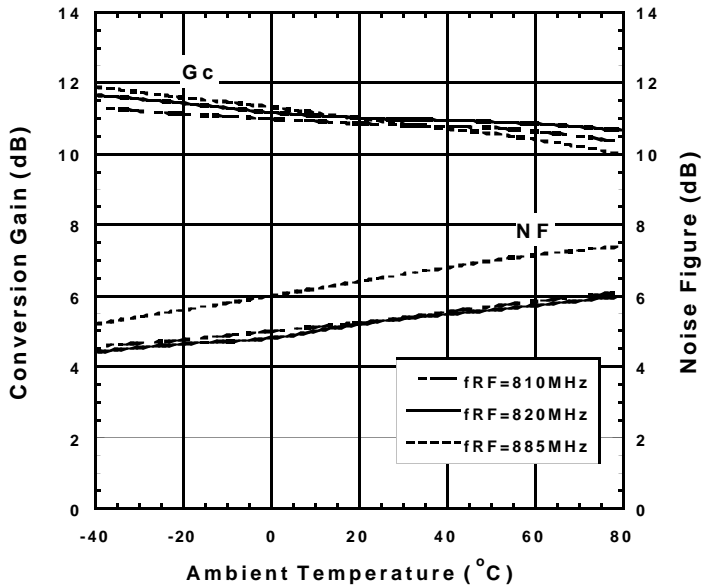
Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=820.0+820.1\text{MHz}$   
 $f_{LO}=690\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

# NJG1558PB1

## ■ TYPICAL CHARACTERISTICS (800MHz BAND)

### NJG1558PB1 (800MHz Band)

#### G<sub>c</sub> , NF vs. Ambient Temperature

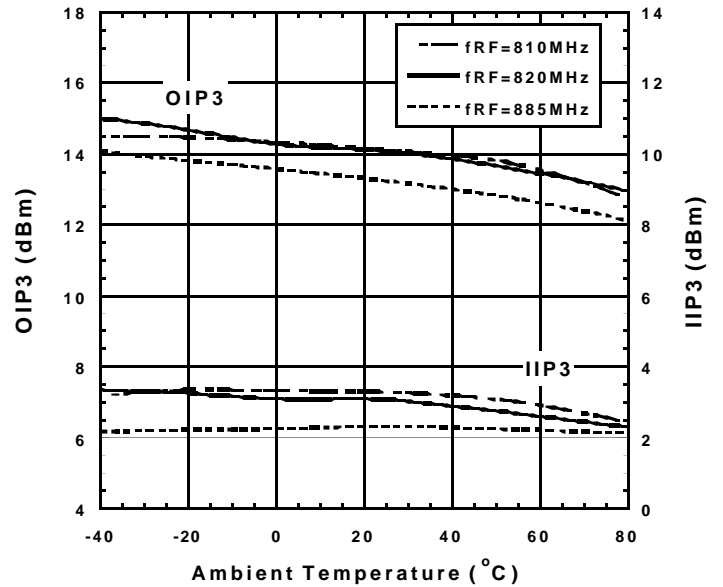


Condition

$f_{IF}=130\text{MHz}$   
 $f_{RF}=810\sim 885\text{MHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=680\sim 755\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

### NJG1558PB1 (800MHz Band)

#### OIP3 , IIP3 vs. Ambient Temperature

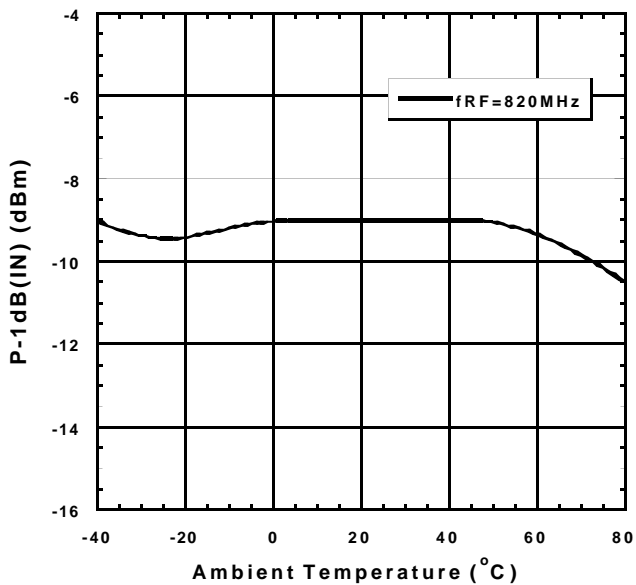


Condition

$f_{IF}=130\text{MHz}$   
 $f_{RF1}=810\sim 885\text{MHz}$ ,  
 $f_{RF2}=f_{RF1}+100\text{kHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=680\sim 755\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

### NJG1558PB1 (800MHz Band)

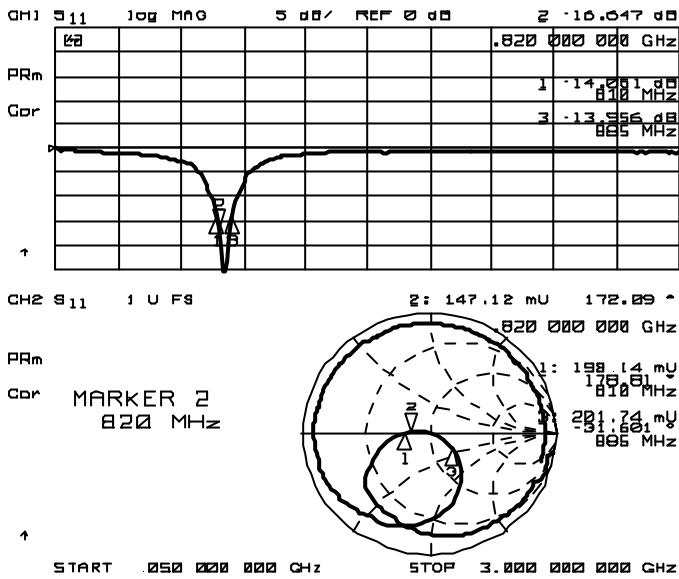
#### P-1dB(IN) vs. Ambient Temperature



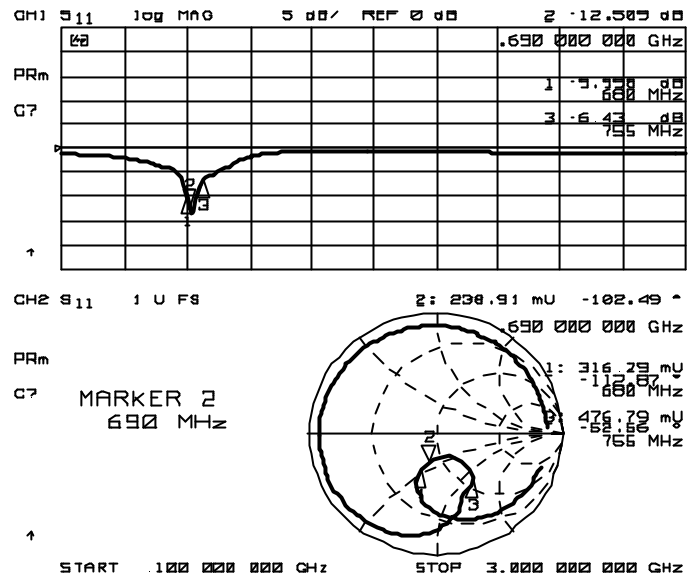
Condition

$f_{IF}=130\text{MHz}$   
 $f_{RF}=820\text{MHz}$   
 $f_{LO}=690\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=0\text{V}$

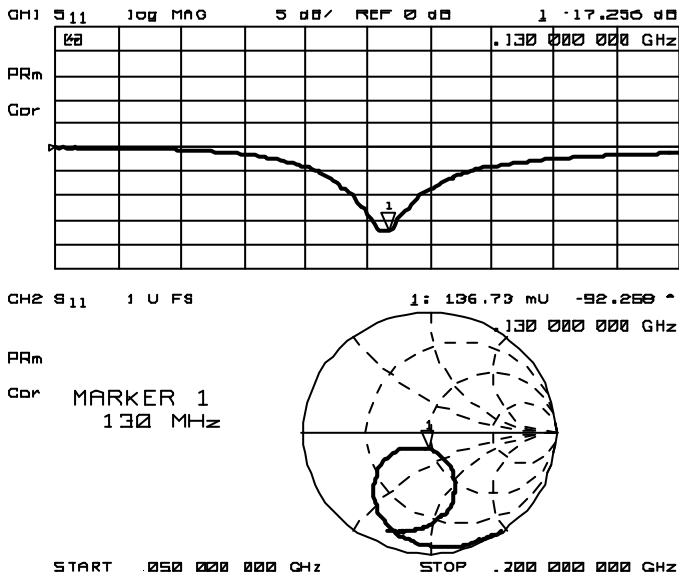
## TYPICAL CHARACTERISTICS (800MHz BAND)



RF IN1 Port Impedance  
 (LOCAL IN1 Port, IF OUT Port: 50Ω term.)



LOCAL IN1 Port Impedance  
 (RF IN1 Port, IF OUT Port: 50Ω term.)

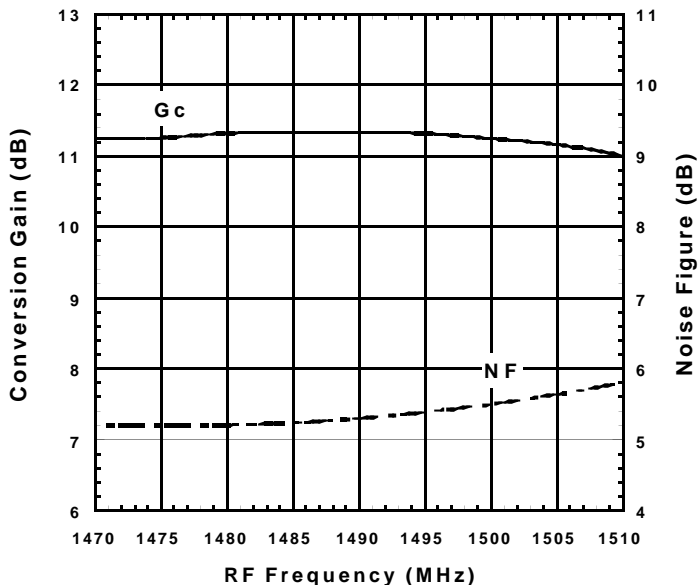


IF OUT Port Impedance  
 (RF IN1 Port, LOCAL IN1 Port: 50Ω term.)

# NJG1558PB1

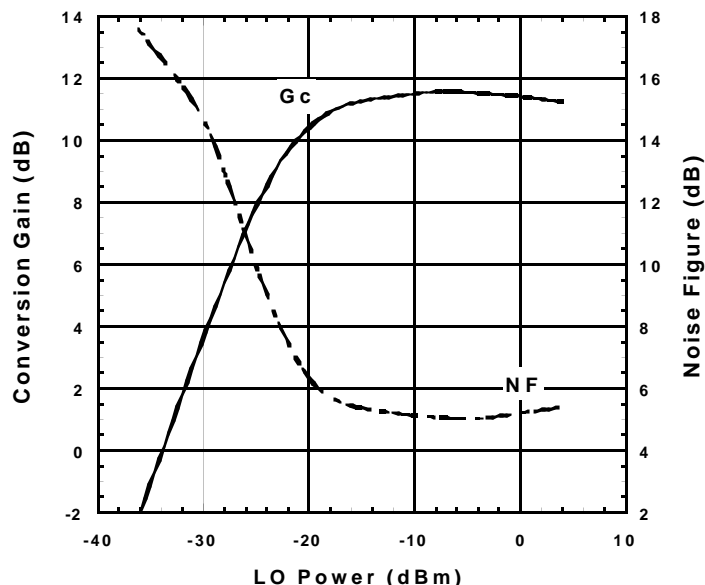
## ■ TYPICAL CHARACTERISTICS (1.5GHz BAND)

**NJG1558PB1 (1.5GHz Band)**  
**G<sub>c</sub> , NF vs. RF Frequency**



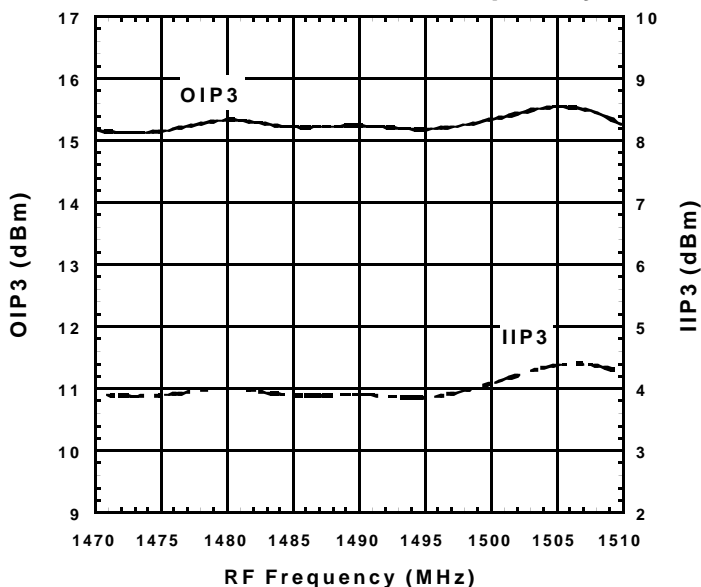
Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=1470\sim 1510\text{MHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=1340\sim 1380\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=2.8\text{V}$

**NJG1558PB1 (1.5GHz Band)**  
**G<sub>c</sub> , NF vs. LO Power**



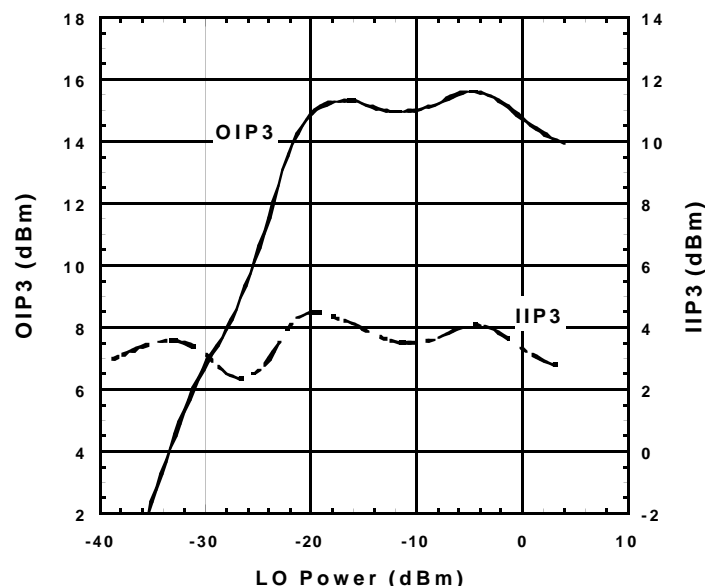
Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=1489\text{MHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=1359\text{MHz}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=2.8\text{V}$

**NJG1558PB1 (1.5GHz Band)**  
**OIP3 , IIP3 vs. RF Frequency**



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF1}=1470\sim 1510\text{MHz}$   
 $f_{RF2}=f_{RF1}+100\text{kHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=1340\sim 1380\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=2.8\text{V}$

**NJG1558PB1 (1.5GHz Band)**  
**OIP3 , IIP3 vs. LO Power**

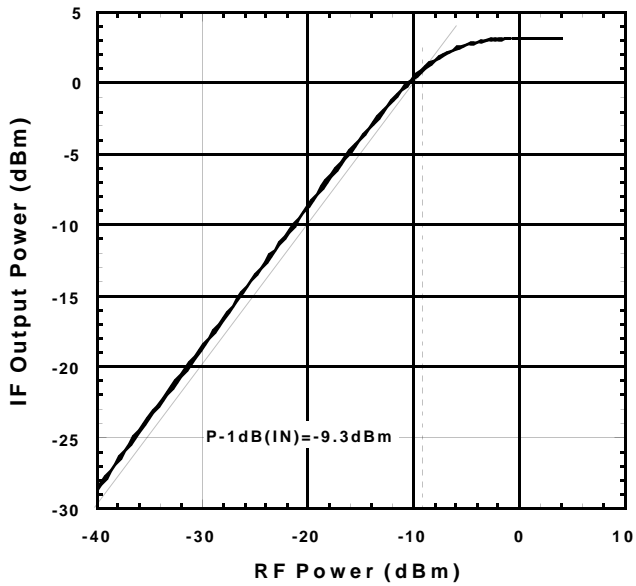


Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=1489.0+1489.1\text{MHz}$ ,  $P_{RF}=-30\text{dBm}$   
 $f_{LO}=1359\text{MHz}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=2.8\text{V}$



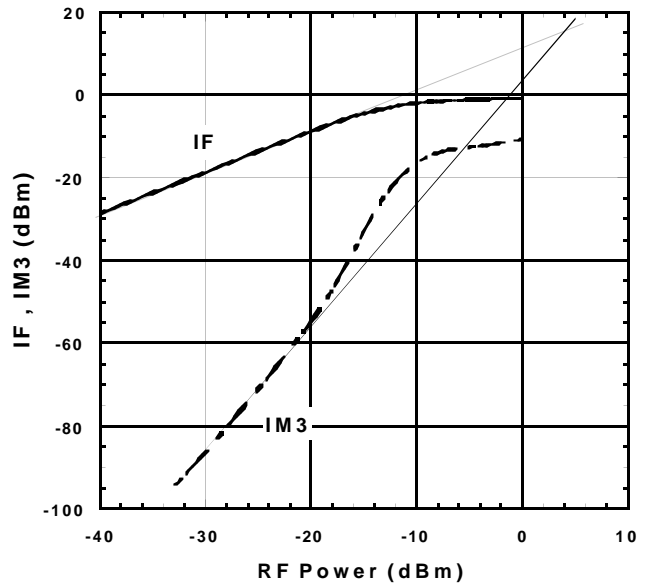
## ■ TYPICAL CHARACTERISTICS (1.5GHz BAND)

**NJG1558PB1 (1.5GHz Band)**  
**IF Output Power vs. RF Power**



Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=1489\text{MHz}$   
 $f_{LO}=1359\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=2.8\text{V}$

**NJG1558PB1 (1.5GHz Band)**  
**IF, IM3 vs. RF Power**

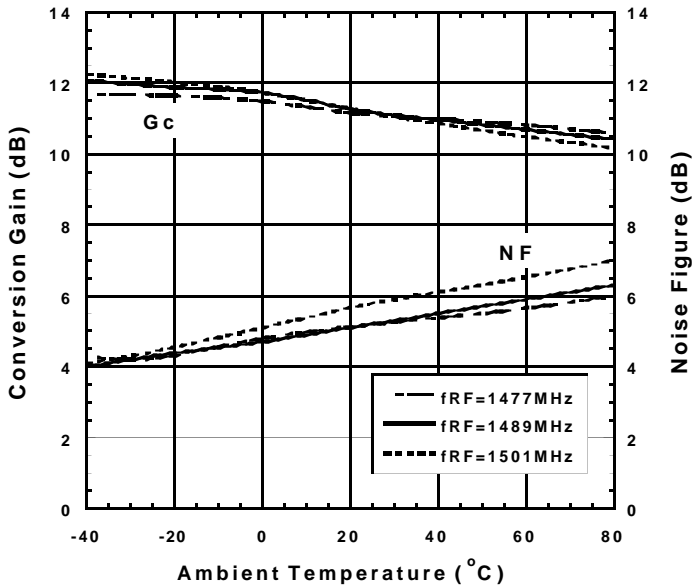


Condition  
 $f_{IF}=130\text{MHz}$   
 $f_{RF}=1489.0+1489.1\text{MHz}$   
 $f_{LO}=1359\text{MHz}$ ,  $P_{LO}=-15\text{dBm}$   
 $V_{MIX}=V_{LO}=V_{INV}=2.8\text{V}$   
 $V_{CTL}=2.8\text{V}$

# NJG1558PB1

## ■ TYPICAL CHARACTERISTICS (1.5GHz BAND)

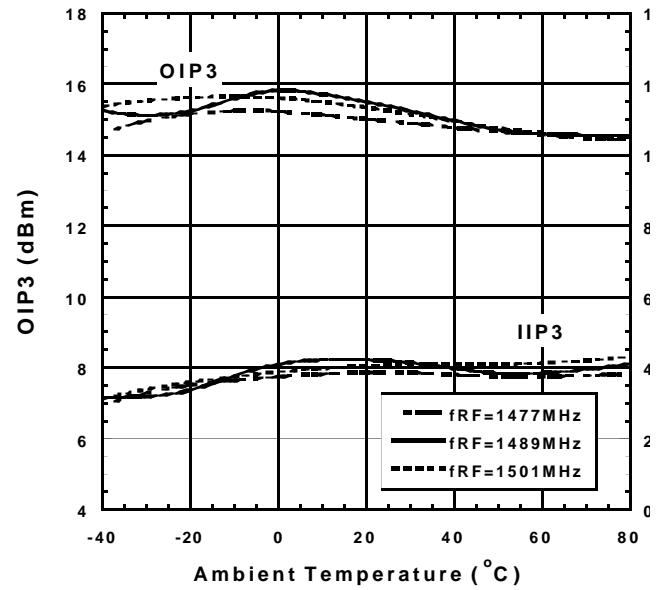
NJG1558PB1 (1.5GHz Band)  
Gc , NF vs. Ambient Temperature



Condition

f<sub>IF</sub>=130MHz  
f<sub>RF</sub>=1477~1501MHz, P<sub>RF</sub>=-30dBm  
f<sub>LO</sub>=1347~1471MHz, P<sub>LO</sub>=-15dBm  
V<sub>MIX</sub>=V<sub>LO</sub>=V<sub>INV</sub>=2.8V  
V<sub>CTL</sub>=2.8V

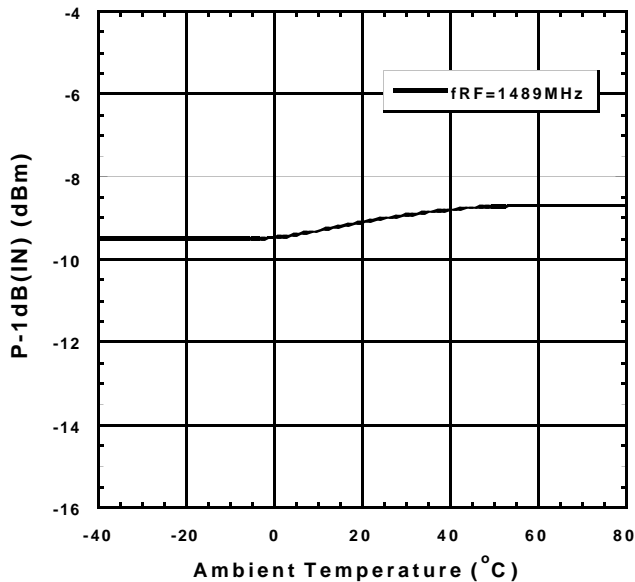
NJG1558PB1 (1.5GHz Band)  
OIP3 , IIP3 vs. Ambient Temperature



Condition

f<sub>IF</sub>=130MHz  
f<sub>RF1</sub>=1477~1501MHz,  
f<sub>RF2</sub>=f<sub>RF1</sub>+100kHz, P<sub>RF</sub>=-30dBm  
f<sub>LO</sub>=1347~1471MHz, P<sub>LO</sub>=-15dBm  
V<sub>MIX</sub>=V<sub>LO</sub>=V<sub>INV</sub>=2.8V  
V<sub>CTL</sub>=2.8V

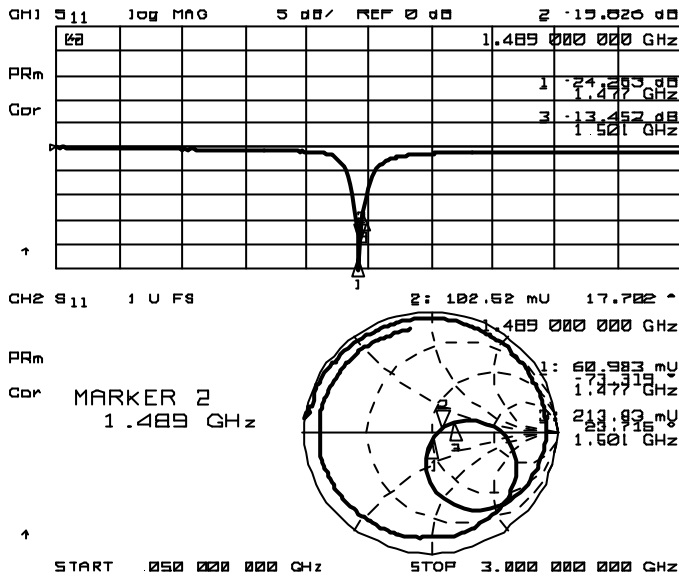
NJG1558PB1 (1.5GHz Band)  
P-1dB(IN) vs. Ambient Temperature



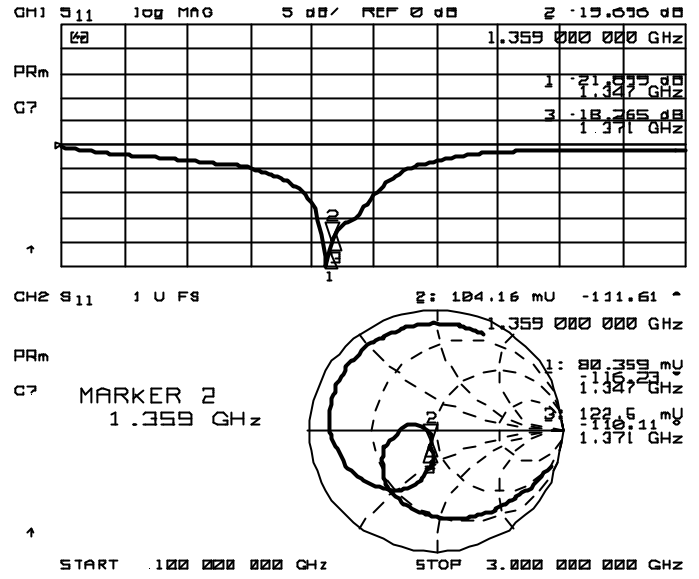
Condition

f<sub>IF</sub>=130MHz  
f<sub>RF</sub>=1489MHz  
f<sub>LO</sub>=1359MHz, P<sub>LO</sub>=-15dBm  
V<sub>MIX</sub>=V<sub>LO</sub>=V<sub>INV</sub>=2.8V  
V<sub>CTL</sub>=2.8V

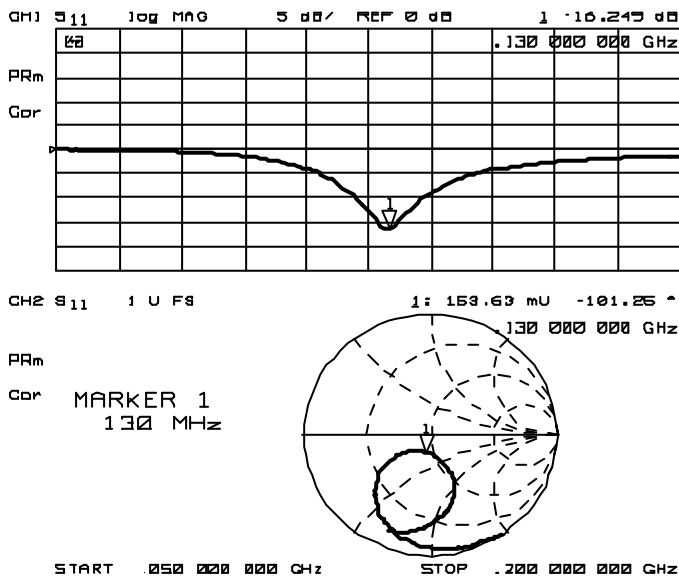
## TYPICAL CHARACTERISTICS (1.5GHz BAND)



RF IN2 Port Impedance  
(LOCAL IN2 Port, IF OUT Port: 50Ω term.)



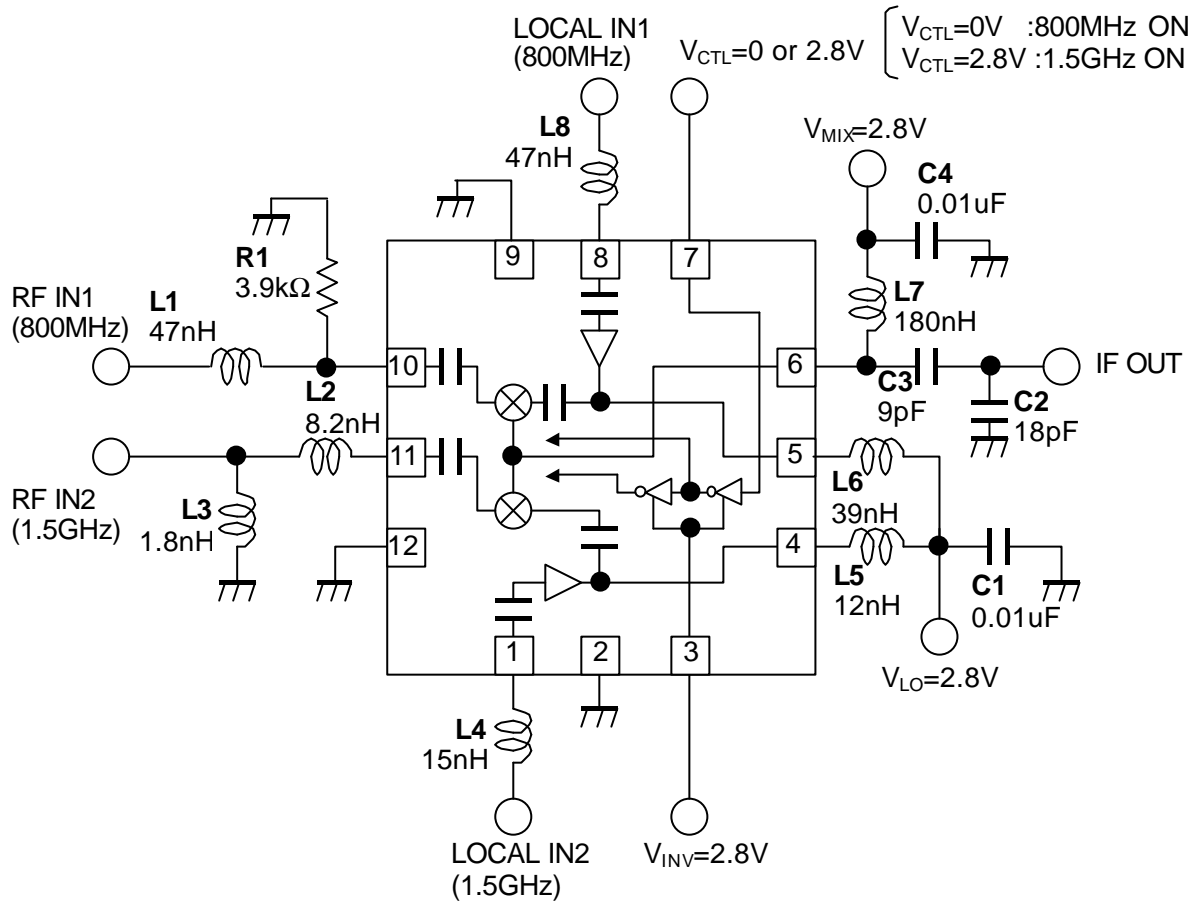
LOCAL IN2 Port Impedance  
(RF IN2 Port, IF OUT Port: 50Ω term.)



IF OUT Port Impedance  
(RF IN2 Port, LOCAL IN2 Port: 50Ω term.)

# NJG1558PB1

## APPLICATION CIRCUIT

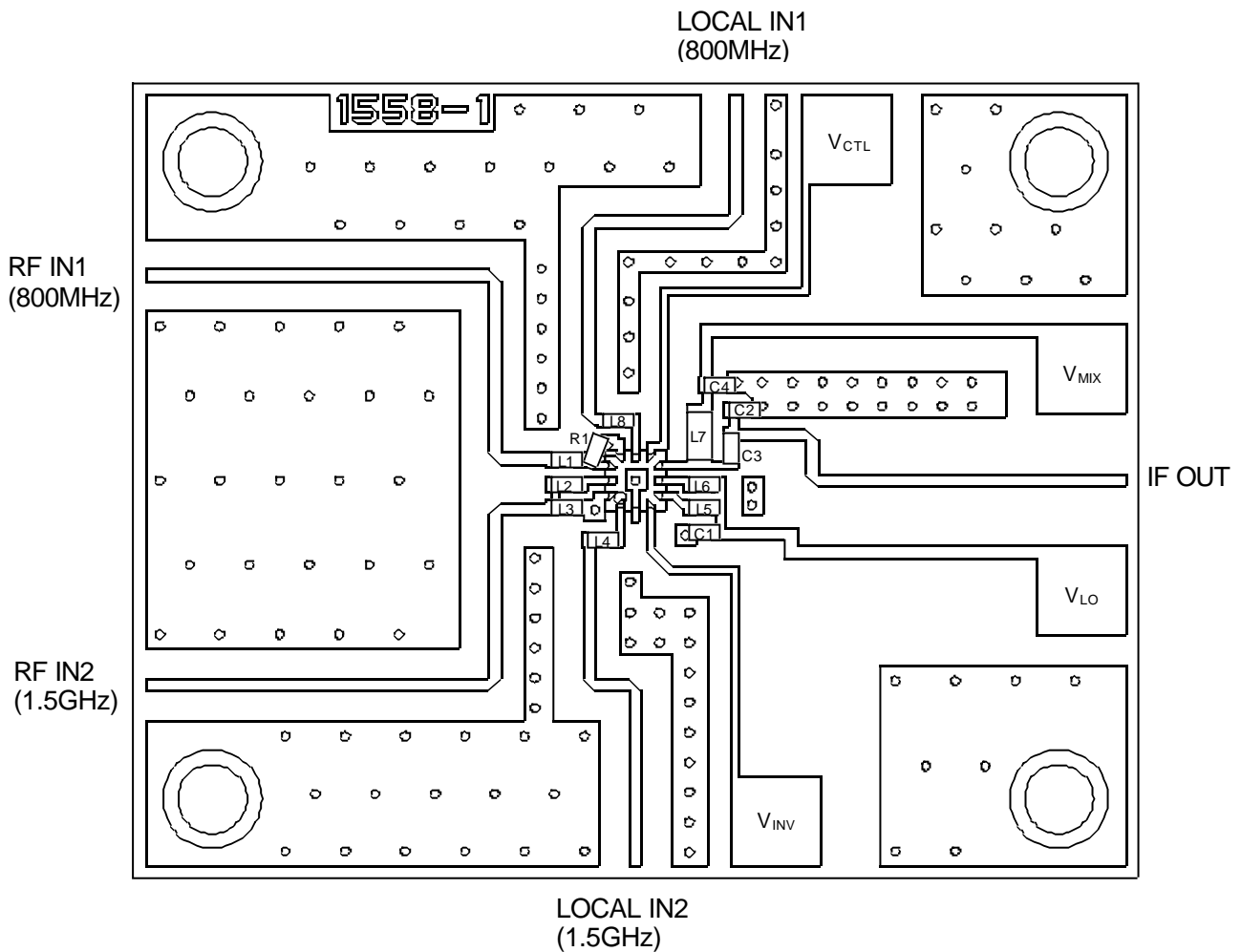


### PARTS LIST

PARTS ID	COMMENT
L1	MEC (ELJRF)
L2	MEC (ELJRF)
L3	MEC (ELJRF)
L4	TAIYO-YUDEN(HK1005)
L5	TAIYO-YUDEN(HK1005)
L6	TAIYO-YUDEN (HK1005)
L7	TAIYO-YUDEN (HK1608)
L8	TAIYO-YUDEN (HK1005)
C1	MURATA(GMR36)
C2	MURATA(GMR36)
C3	MURATA(GMR36)
C4	MURATA(GMR36)
R1	1005 Size

## RECOMMENDED PCB DESIGN

(Top View)



PCB(FR-4), t=0.2mm

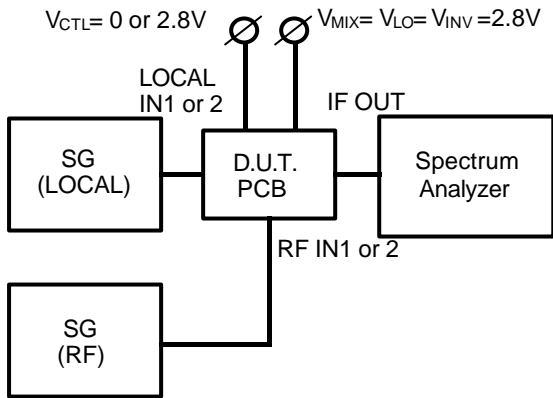
MICROSTRIP LINE WIDTH=0.4mm ( $Z_0=50\Omega$ )

### PRECAUTIONS

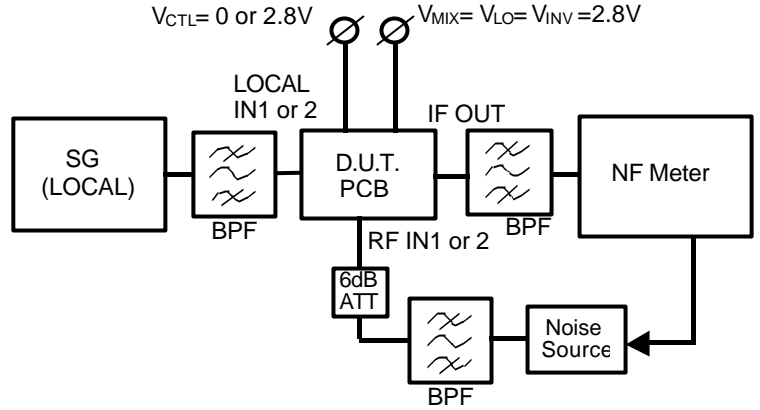
1. Please place L6 close to VLO1 terminal(5).
2. Please place L5 close to VLO1 terminal(4).
3. Please place C1 close to L5 and L6.
4. Please place C4 close to L7.

# NJG1558PB1

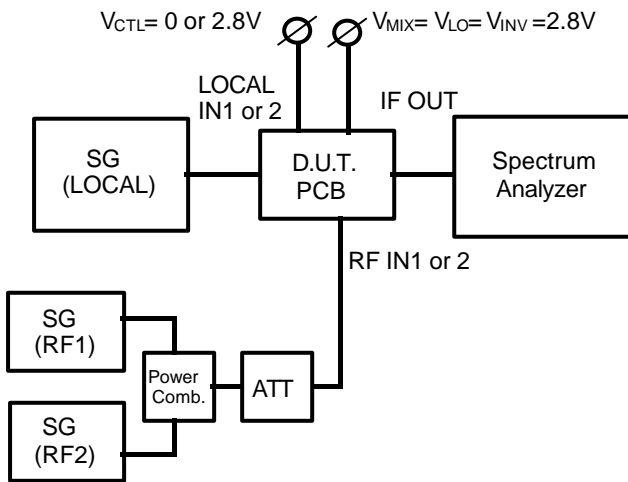
## MEASURING BLOCK DIAGRAM



Conversion Gain Measurement Block Diagram

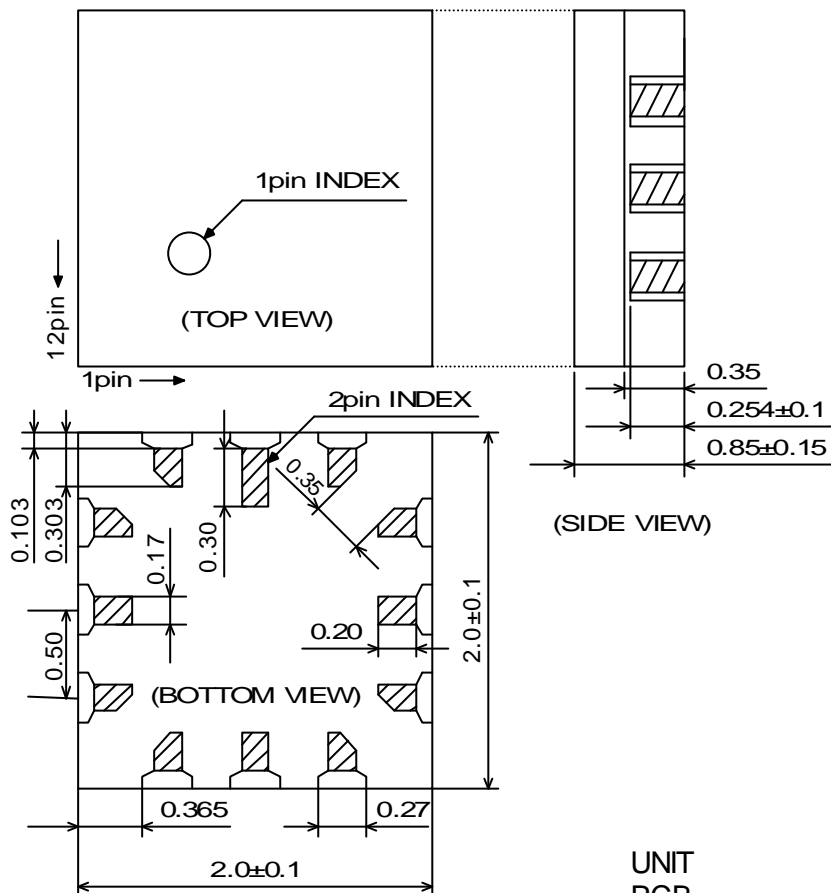


Noise Figure Measurement Block Diagram



OIP3, IIP3 Measurement Block Diagram

## PACKAGE OUTLINE (FFP12-B1)



UNIT	: mm
PCB	: Ceramic
OVER COAT	: Epoxy resin
TERMINAL TREAT	: Au
WEIGHT	: 15mg

### 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.