UHF BAND LOW NOISE AMPLIFIER GaAs MMIC

■ GENERAL DESCRIPTION

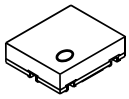
NJG1134HA8 is a low noise amplifier GaAs MMIC designed for mobile digital TV application (470~770 MHz).

This IC has a LNA pass-through function to select high gain mode or low gain mode by single bit control.

Also, this IC is integrated the ESD protection circuit.

An ultra-small and ultra-thin package of USB6-A8 is adopted.

■ PACKAGE OUTLINE



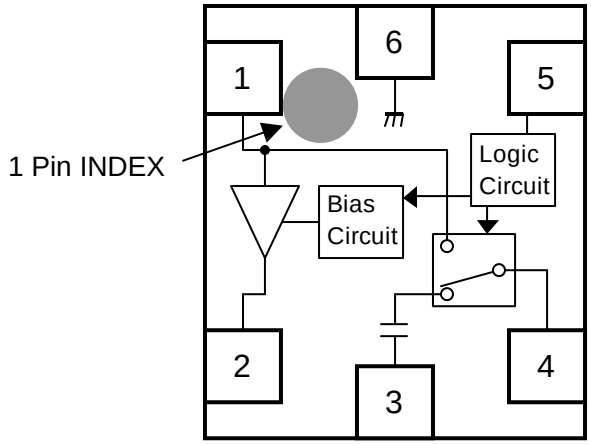
NJG1134HA8

■ FEATURES

● Low voltage operation	+2.8V typ.
● Low voltage control	+1.8V typ.
● Package	USB6-A8 (Package size: 1mm x 1.2mm x 0.38mm typ.)
[High gain mode]	
● Low current consumption	4.0mA typ.
● Gain	10.0dB typ.
● Low noise figure	1.2dB typ.@ f_{RF}=470~620MHz
● High input IP3	+5.0dBm typ.
[Low gain mode]	
● Low current consumption	10μA typ.
● Gain	-0.6dB typ.
● High input IP3	+23.0dBm typ.

■ PIN CONFIGURATION

(Top View)



Pin Connection

1. RFIN1
2. RFOUT1
3. RFIN2
4. RFOUT2
5. VCTL
6. GND

■ TRUTH TABLE

"H"=$V_{CTL(H)}$, "L"=$V_{CTL(L)}$

V_{CTL}	LNA Mode
H	High Gain mode
L	Low Gain mode

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=50 ohm

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNITS
Drain voltage	V_{DD}		5.0	V
Control voltage	V_{CTL}		5.0	V
Input power	P_{IN}	V_{DD}=2.8V	+15	dBm
Power dissipation	P_D	On PCB board, Tjmax=150°C	150	mW
Operating temperature	T_{opr}		-40~+95	°C
Storage temperature	T_{stg}		-55~+150	°C

■ ELECTRICAL CHARACTERISTICS1 (DC CHARACTERISTICS)

General conditions: V_{DD}=2.8V, T_a=+25°C, Z_s=Z_l=50 ohm, with application circuit.

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating voltage	V_{DD}		2.3	2.8	3.6	V
Control voltage (High)	$V_{CTL(H)}$	High Gain mode	1.3	1.8	3.6	V
Control voltage (Low)	$V_{CTL(L)}$	Low Gain mode	0	0	0.5	V
Operating current1	$I_{DD}1$	RF OFF, V_{CTL}=1.8V	-	4.0	5.6	mA
Operating current2	$I_{DD}2$	RF OFF, V_{CTL}=0.0V	-	10.0	25.0	μA
Control current	I_{CTL}	RF OFF, V_{CTL}=1.8V	-	6.0	10.0	μA

■ **ELECTRICAL CHARACTERISTICS2** (High Gain mode)

General conditions: V_{DD}= 2.8V, V_{CTL}=1.8V, T_a=+25°C, Z_s=Z_l=50 ohm, with application circuit.

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating frequency	f_{RF}		470	620	770	MHz
Small signal gain1	Gain1		9.0	10.0	12.5	dB
Gain flatness	G_{flat}		-	1.1	1.6	dB
Noise figure1	NF1	Exclude PCB & connector losses, f_{RF}=470~620MHz*1	-	1.20	1.45	dB
Noise figure2	NF2	Exclude PCB & connector losses, f_{RF}=620~710MHz*1	-	1.25	1.50	dB
Noise figure3	NF3	Exclude PCB & connector losses, f_{RF}=710~770MHz*1	-	1.30	1.55	dB
Input power at 1dB gain compression point1	P-1dB(IN)1		-9.0	-5.0	-	dBm
Input 3rd order intercept point1	IIP3_1	f1=f_{RF}, f2=f_{RF}+100kHz, P_{IN}=-28dBm	+0.0	+5.0	-	dBm
RF IN VSWR1	VSWRi1		-	2.7	3.3	
RF OUT VSWR1	VSWRo1		-	3.0	3.8	

■ **ELECTRICAL CHARACTERISTICS3** (Low Gain mode)

General conditions: V_{DD}= 2.8V, V_{CTL}=0V, T_a=+25°C, Z_s=Z_l=50 ohm, with application circuit.

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating frequency	f_{RF}		470	620	770	MHz
Small signal gain2	Gain2	Exclude PCB & connector losses*2	-1.8	-0.6	-	dB
Input power at 1dB gain compression point2	P-1dB(IN)2		-3.0	+4.0	-	dBm
Input 3rd order intercept point2	IIP3_2	f1=f_{RF}, f2=f_{RF}+100kHz, P_{IN}=-15dBm	+10.0	+23.0	-	dBm
RF IN VSWR2	VSWRi2		-	1.2	1.5	
RF OUT VSWR2	VSWRo2		-	1.2	1.5	

*1 Input PCB and connector losses: 0.036dB(at 470MHz), 0.053dB(at 770MHz)

*2 Input-output PCB and connector losses: 0.072dB(at 470MHz), 0.105dB(at 770MHz)

■TERMINAL INFORMATION

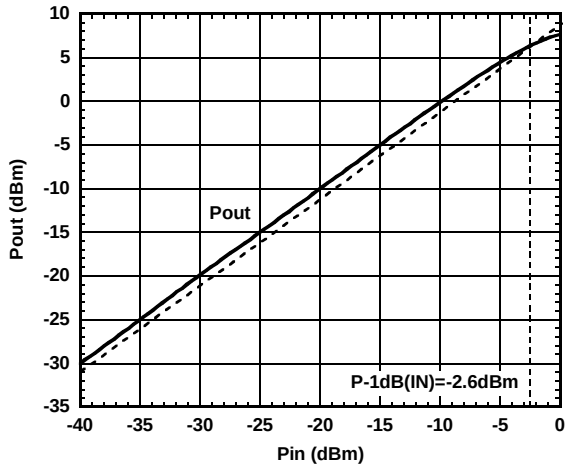
No.	SYMBOL	DESCRIPTION
1	RFIN1	RF input terminal. The RF signal is input through the external matching circuit. This terminal is connected with the ground through L1 shown in the application circuit.
2	RFOUT1	At the High gain mode, RF signal comes out from this terminal, and is input into RFIN2 terminal through L2. Please supply power through L3 shown in the application circuit since this terminal also function supply voltage terminal.
3	RFIN2	At the High gain mode, RF signal comes out from RFOUT1 terminal, and is input into this terminal. Please connect this terminal with RFOUT1 terminal through L2 shown in the application circuit.
4	RFOUT2	RF output terminal. External capacitor C3 is required to block the DC bias voltage of internal circuit.
5	VCTL	Control voltage supply terminal.
6	GND	Ground terminal.

* RF signal input terminal is RFIN1, and the RF signal output terminal is RFOUT2.

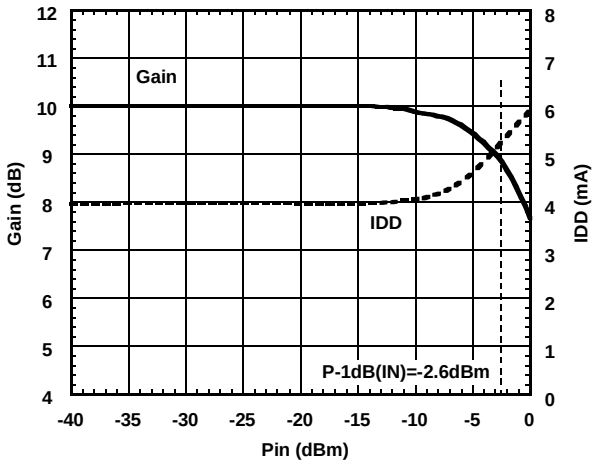
■ **ELECTRICAL CHARACTERISTICS** (High Gain mode)

Conditions: T_a=+25°C, V_{DD}=2.8V, V_{CTL}=1.8V, Z_s=Z_l=50 ohm, with application circuit.

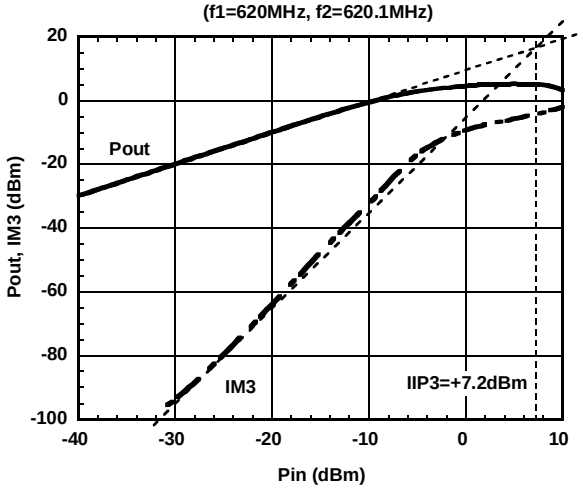
Pout vs. Pin
(f=620MHz)



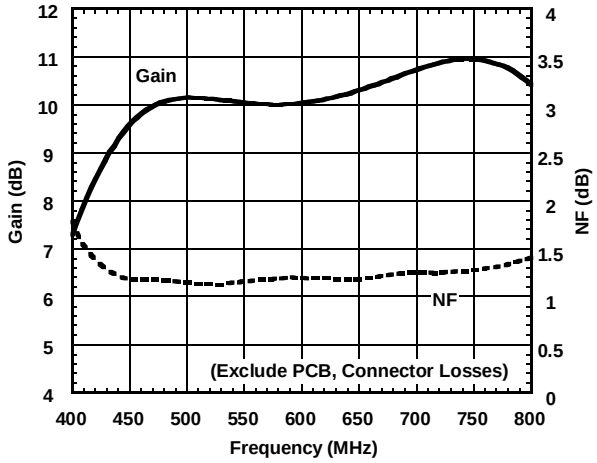
Gain, IDD vs. Pin
(f=620MHz)



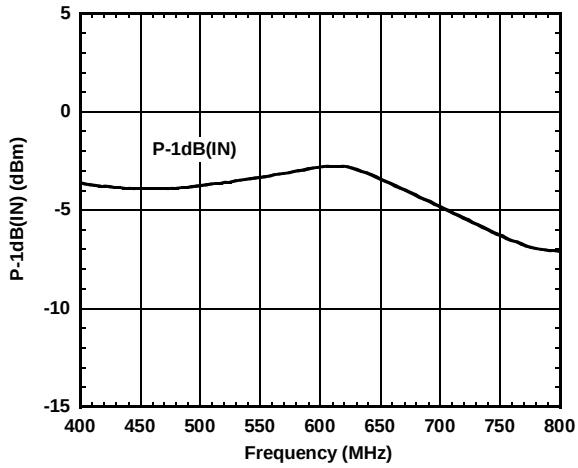
Pout, IM3 vs. Pin
(f1=620MHz, f2=620.1MHz)



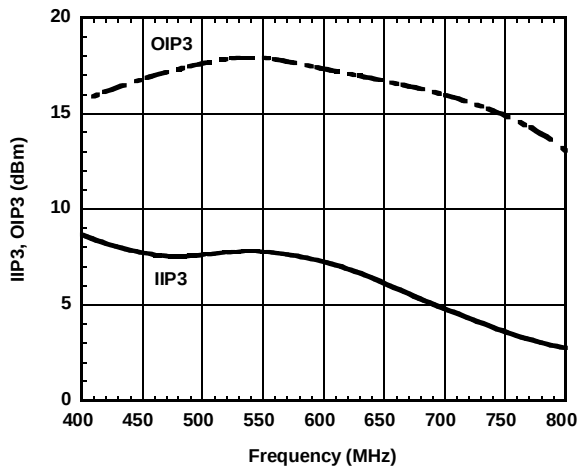
Gain, NF vs. Frequency



P-1dB(IN) vs. Frequency



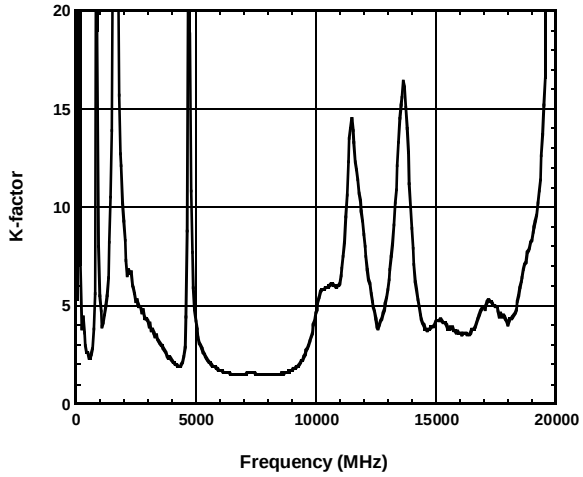
IIP3, OIP3 vs. Frequency
(f1=frequency, f2=f1+100kHz, Pin=-28dBm)



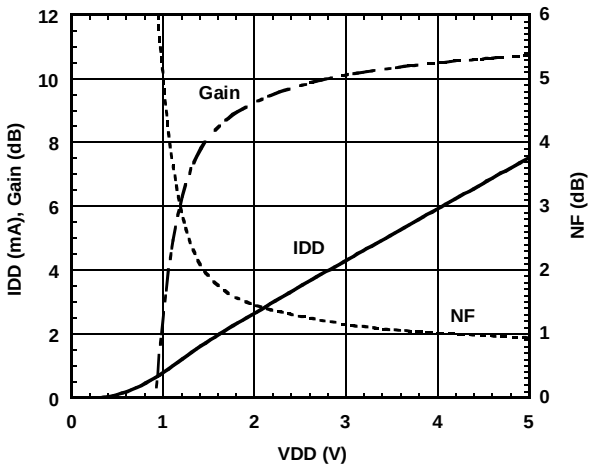
■ ELECTRICAL CHARACTERISTICS (High Gain mode)

Conditions: T_a=+25°C, V_{DD}=2.8V, V_{CTL}=1.8V, Z_s=Z_l=50 ohm, with application circuit.

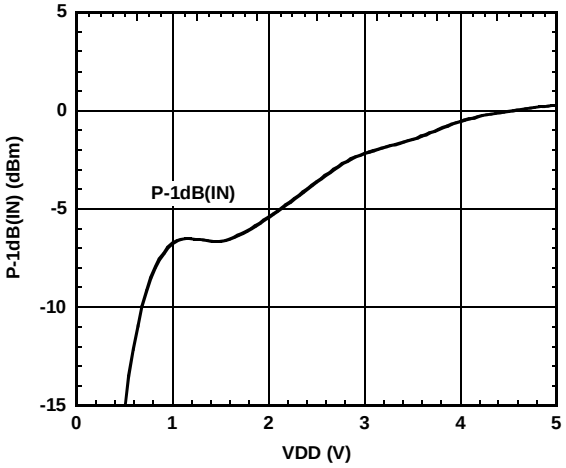
K-factor vs. Frequency



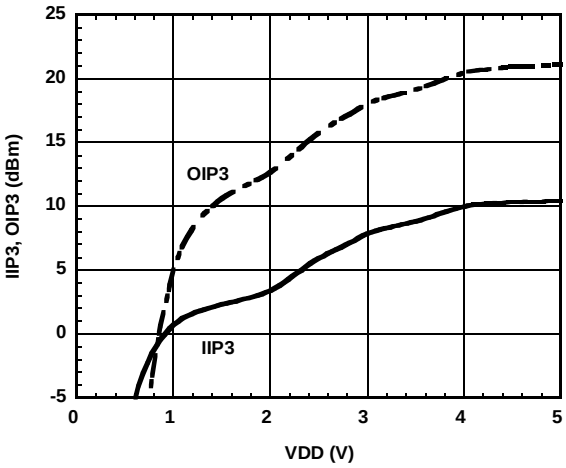
IDD, Gain, NF vs. VDD
(f=620MHz)



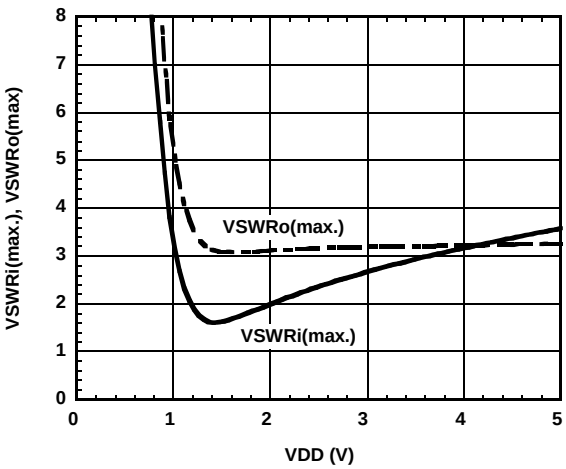
P-1dB(IN) vs. VDD
(f=620MHz)



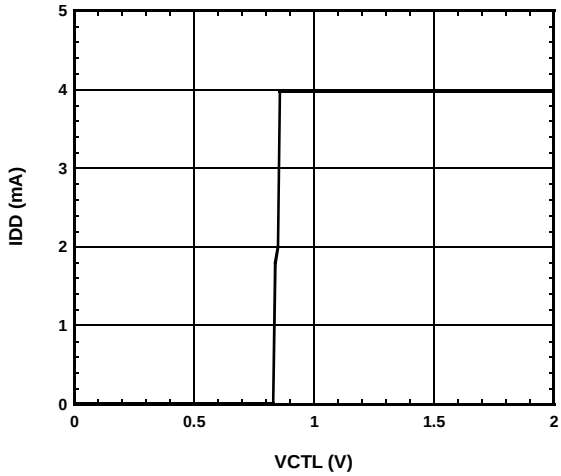
IIP3, OIP3 vs. VDD
(f1=620MHz, f2=620.1MHz, Pin=-28dBm)



VSWR vs. VDD



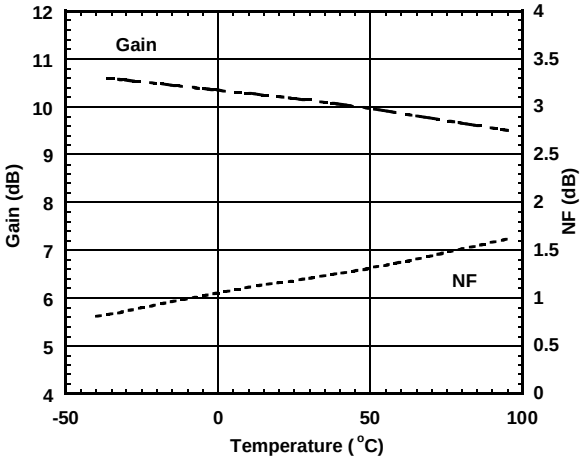
IDD vs. VCTL



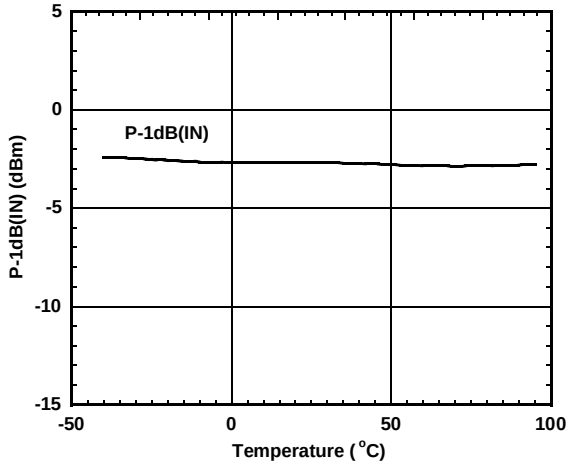
■ **ELECTRICAL CHARACTERISTICS** (High Gain mode)

Conditions: V_{DD}=2.8V, V_{CTL}=1.8V, Z_s=Z_l=50 ohm, with application circuit.

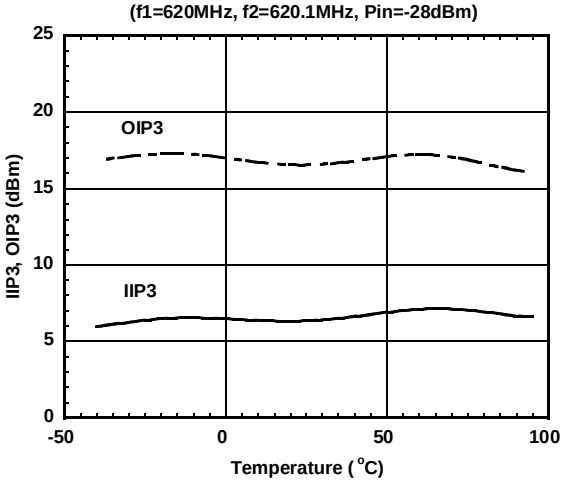
Gain, NF vs. Temp.
(fRF=620MHz)



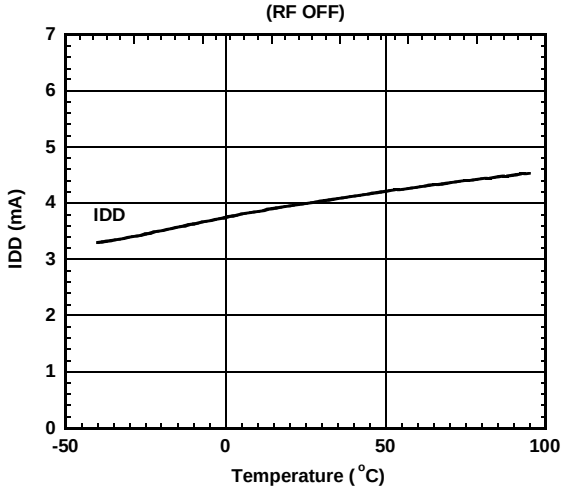
P-1dB(IN) vs. Temp.
(fRF=620MHz)



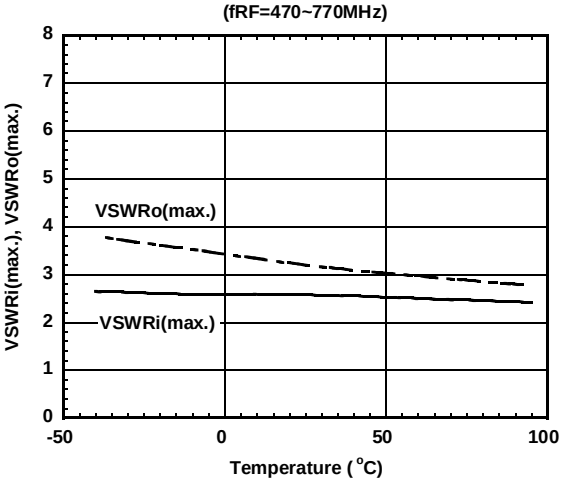
IIP3, OIP3 vs. Temp.
(f1=620MHz, f2=620.1MHz, Pin=-28dBm)



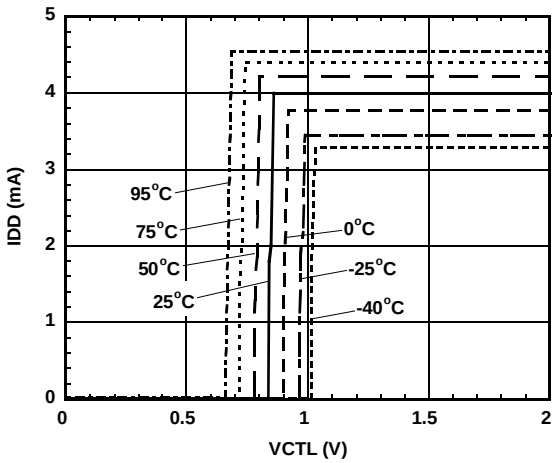
IDD vs. Temp.
(RF OFF)



VSWR vs. Temp.
(fRF=470~770MHz)

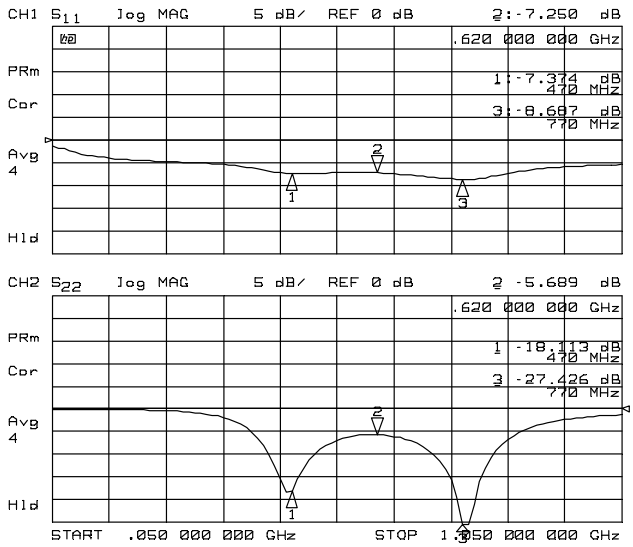


IDD vs. VCTL

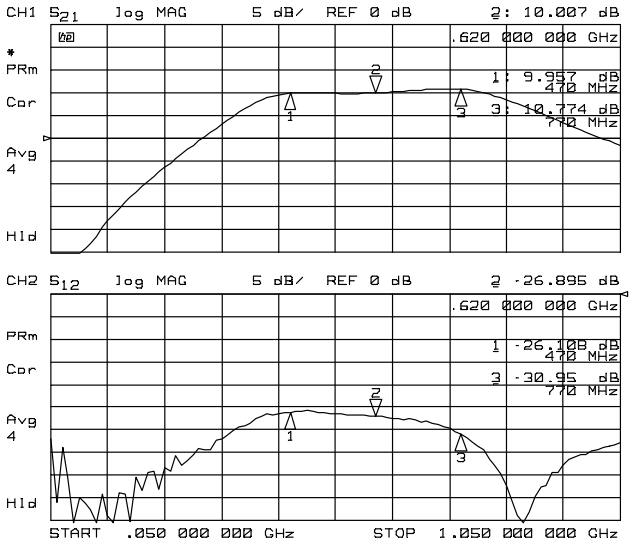


■ ELECTRICAL CHARACTERISTICS (High Gain mode)

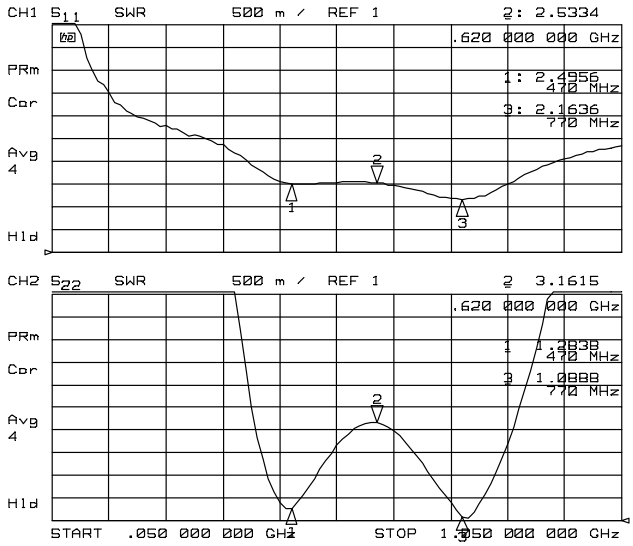
Conditions: T_a=+25°C, V_{DD}=2.8V, V_{CTL}=1.8V, Z_s=Z_l=50 ohm, with application circuit.



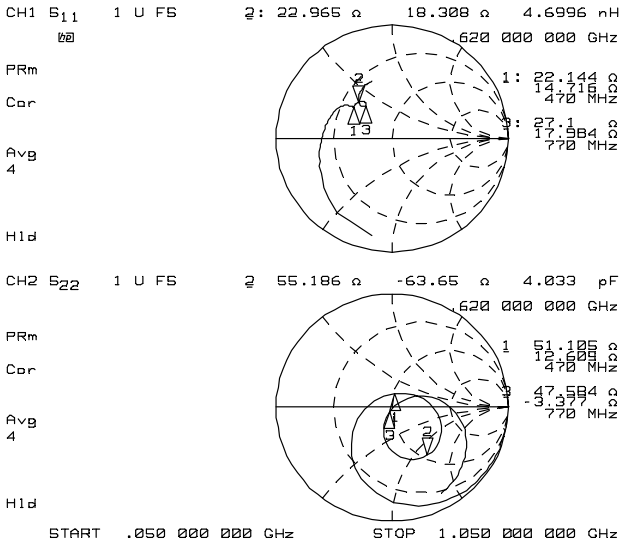
S11, S22



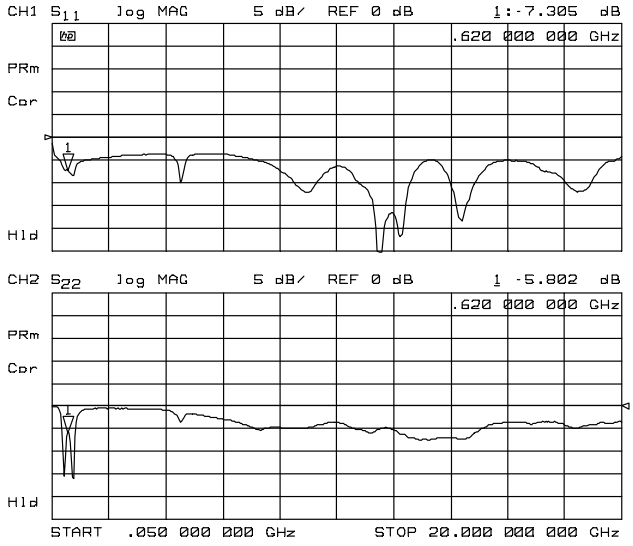
S21, S12



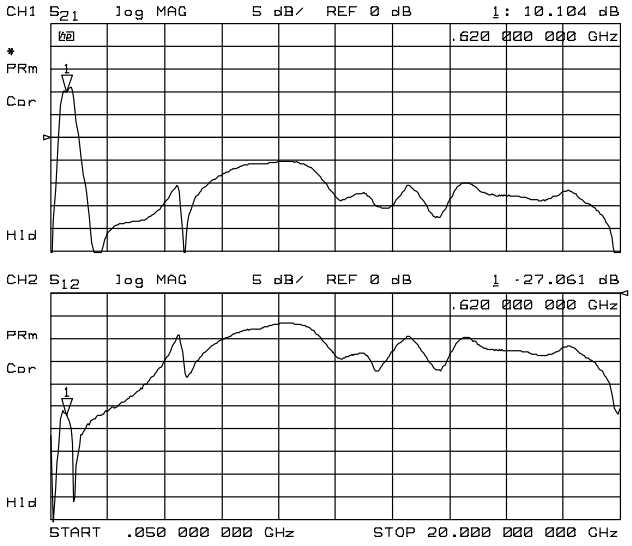
VSWR



Zin, Zout



S11, S22 (50MHz~20GHz)

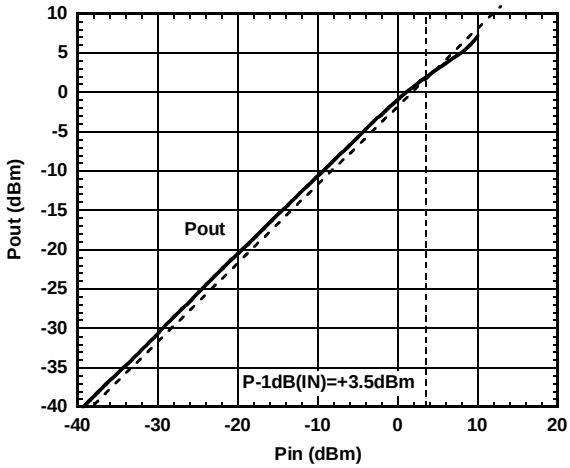


S21, S12 (50MHz~20GHz)

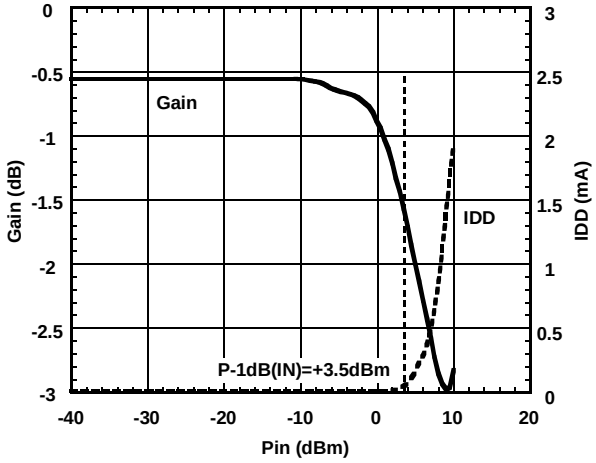
■ **ELECTRICAL CHARACTERISTICS** (Low Gain mode)

Conditions: T_a=+25°C, V_{DD}=2.8V, V_{CTL}=0V, Z_S=Z_I=50 ohm, with application circuit.

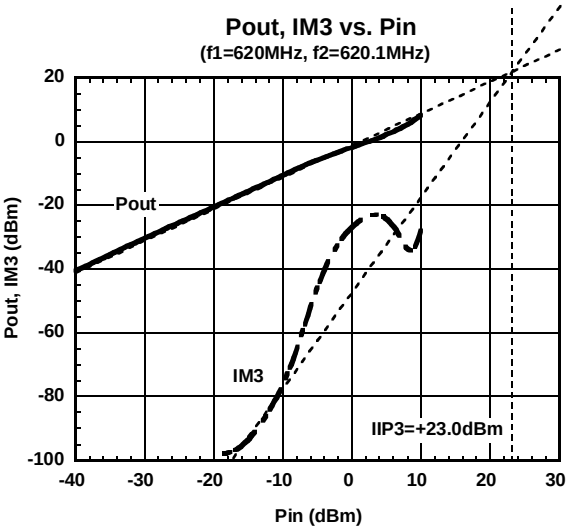
Pout vs. Pin
(f=620MHz)



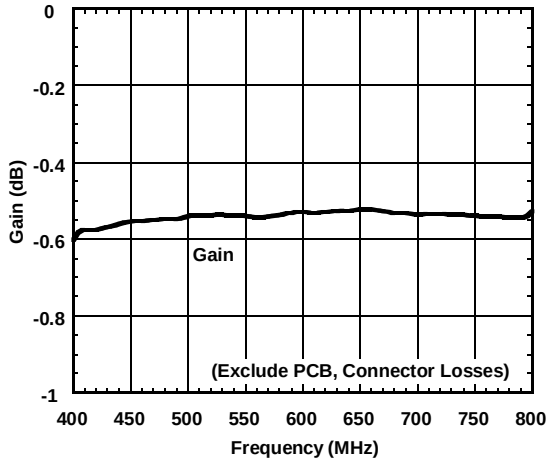
Gain, IDD vs. Pin
(f=620MHz)



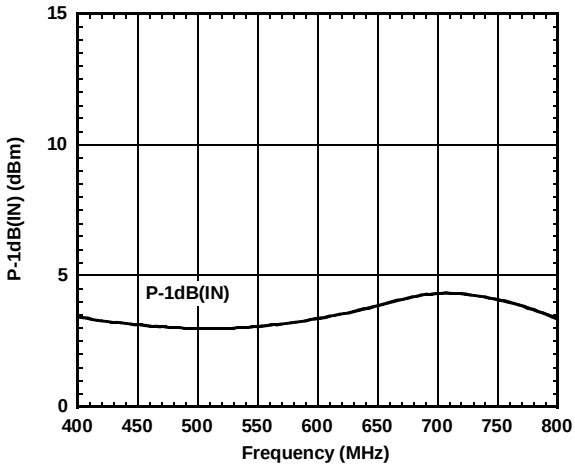
Pout, IM3 vs. Pin
(f1=620MHz, f2=620.1MHz)



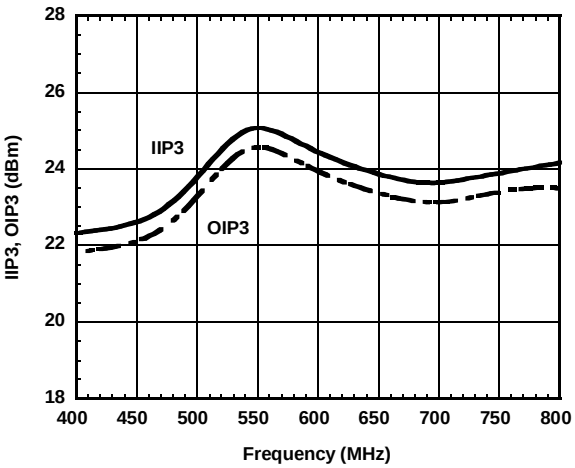
Gain vs. Frequency



P-1dB(IN) vs. Frequency

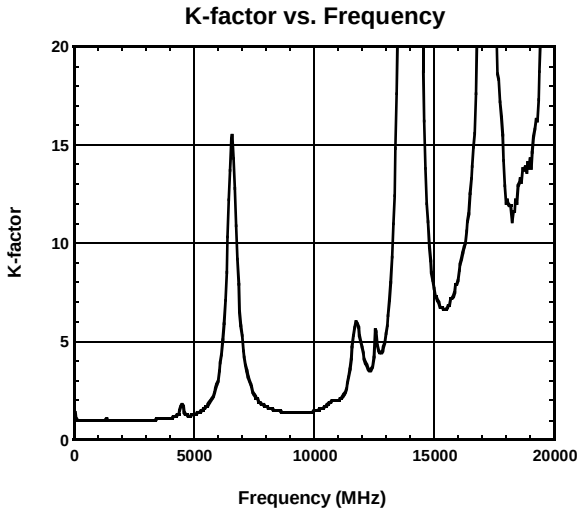


IIP3, OIP3 vs. Frequency
(f1=frequency , f2=f1+100kHz, Pin=-15dBm)



■ **ELECTRICAL CHARACTERISTICS** (Low Gain mode)

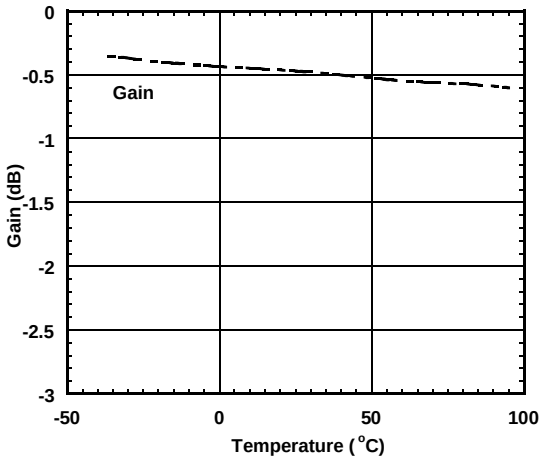
Conditions: T_a=+25°C, V_{DD}=2.8V, V_{CTL}=0V, Z_S=Z_I=50 ohm, with application circuit.



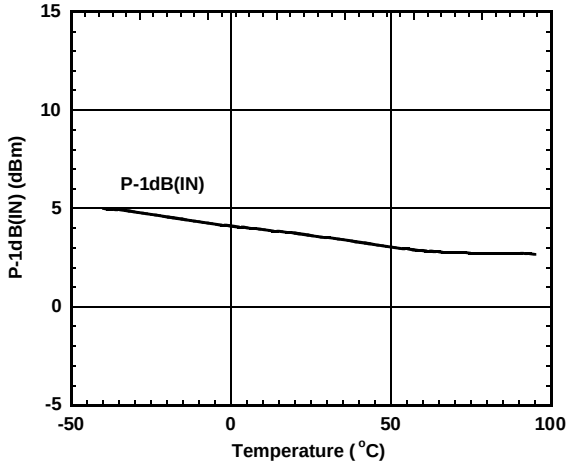
■ **ELECTRICAL CHARACTERISTICS** (Low Gain mode)

Conditions: V_{DD}=2.8V, V_{CTL}=0V, Z_s=Z_l=50 ohm, with application circuit.

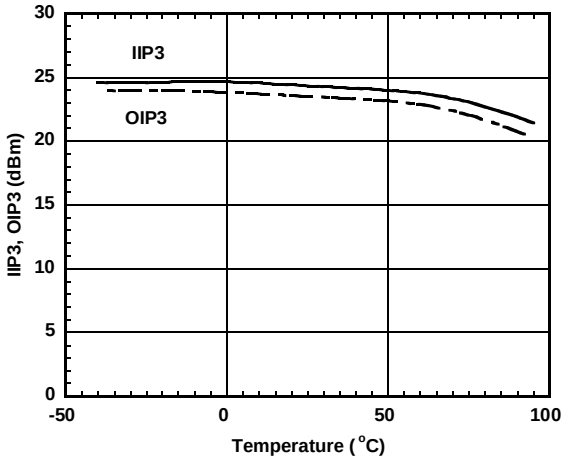
Gain vs. Temp.
(fRF=620MHz)



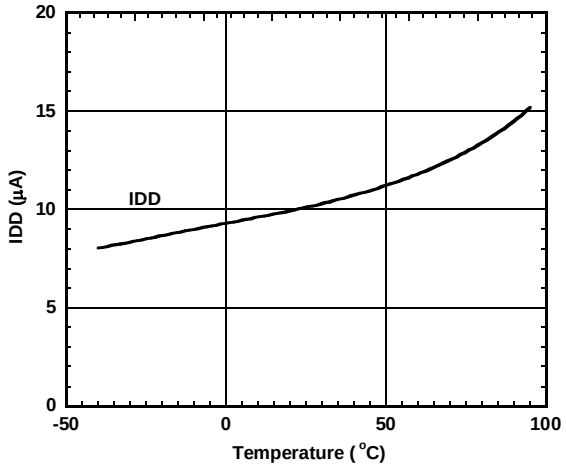
P-1dB(IN) vs. Temp.
(fRF=620MHz)



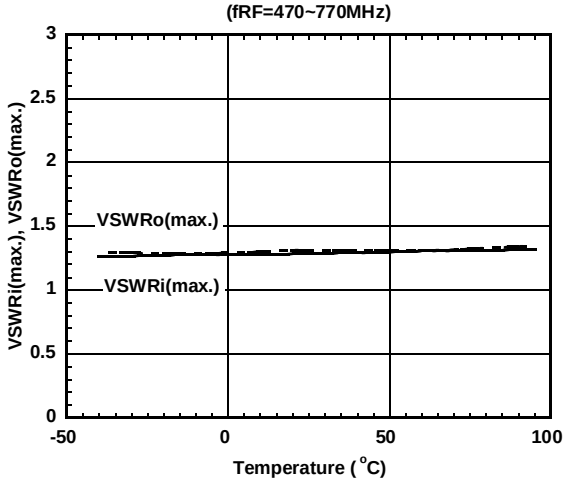
IIP3, OIP3 vs. Temp.
(f1=620MHz, f2=620.1MHz, Pin=-15dBm)



IDD vs. Temp.
(RF OFF)

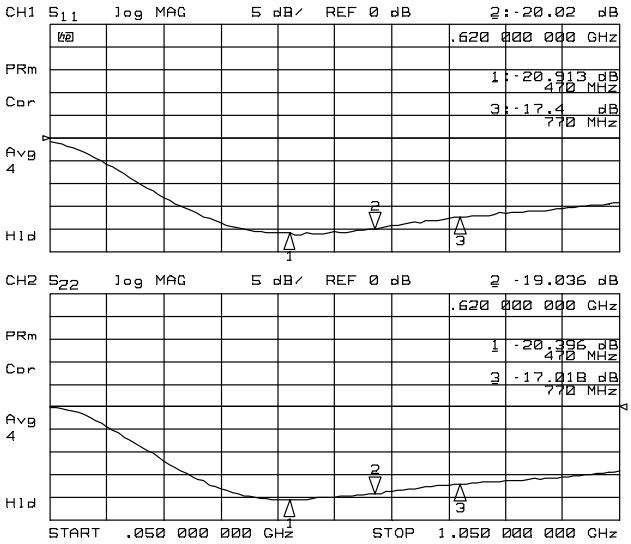


VSWR vs. Temp.
(fRF=470~770MHz)

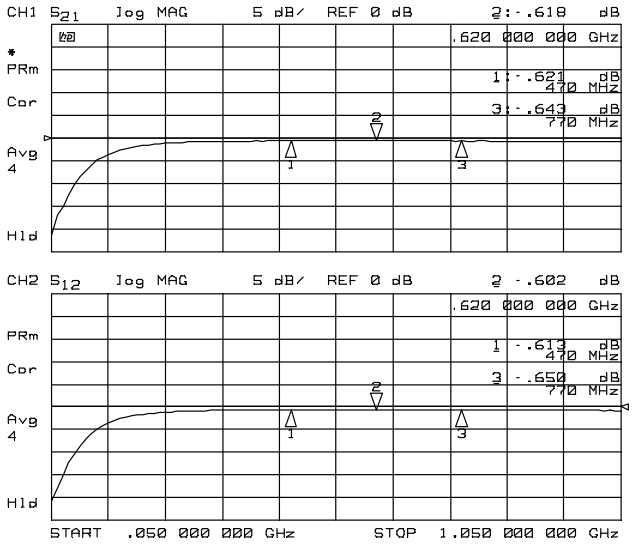


■ ELECTRICAL CHARACTERISTICS (Low Gain mode)

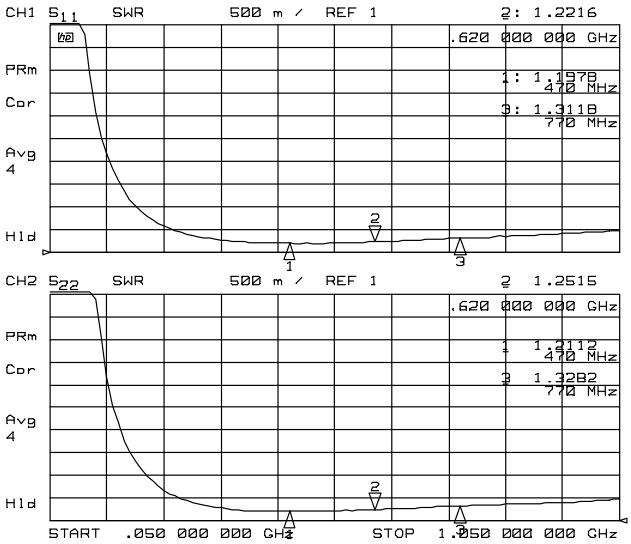
Conditions: T_a=+25°C, V_{DD}=2.8V, V_{CTL}=0V, Z_S=Z_l=50 ohm, with application circuit.



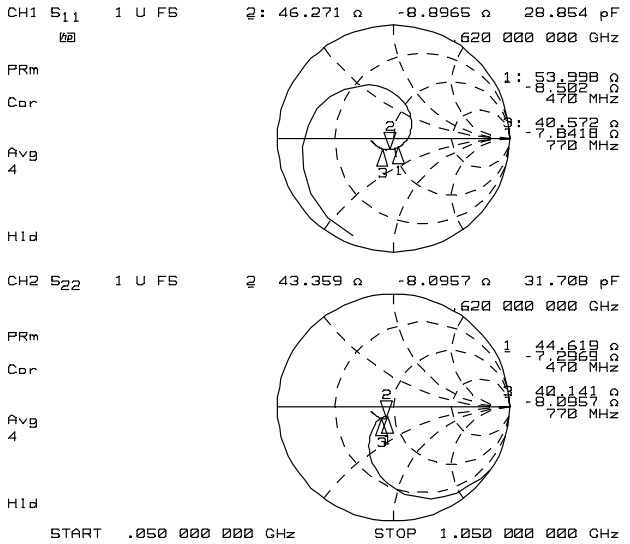
S11, S22



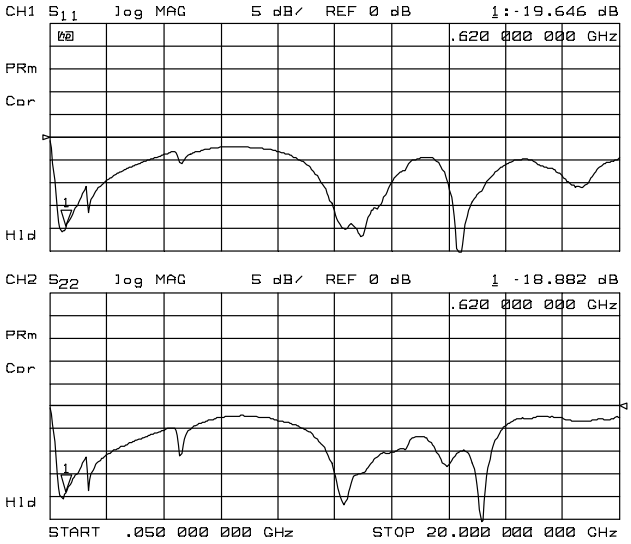
S21, S12



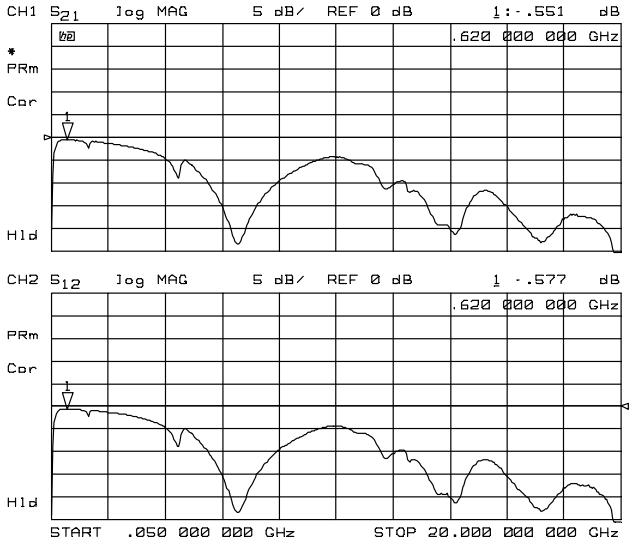
VSWR



Zin, Zout

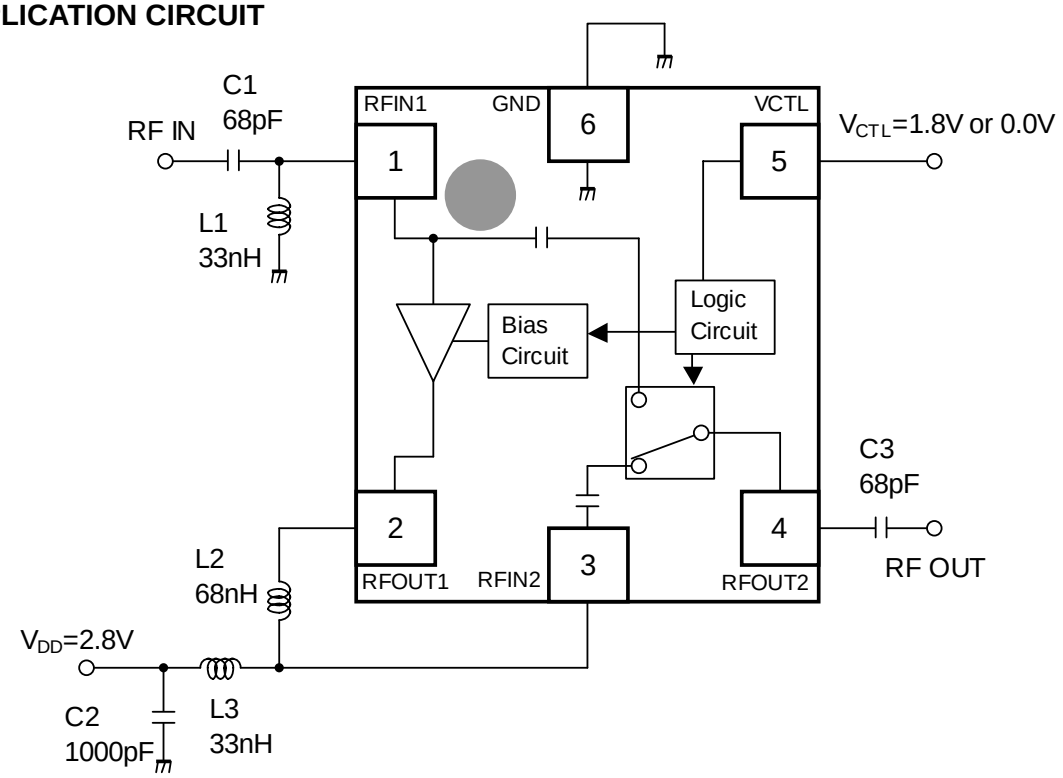


S11, S22 (50MHz~20GHz)

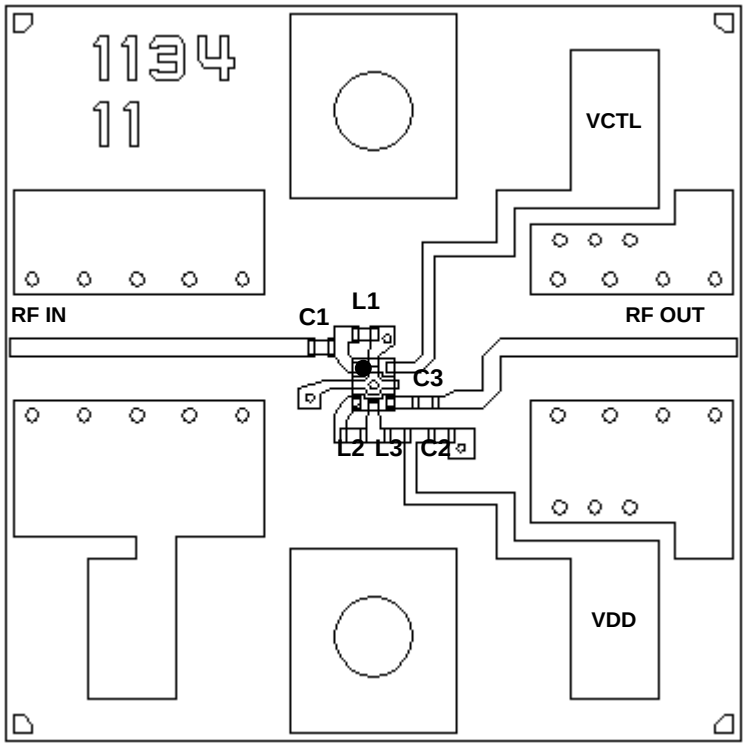


S21, S12 (50MHz~20GHz)

■ APPLICATION CIRCUIT



■ TEST PCB LAYOUT



Parts List

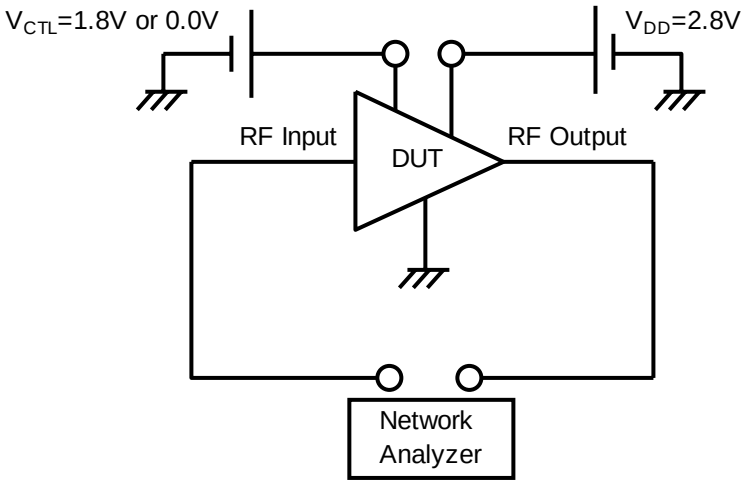
Parts ID	Notes
L1, L3	MURATA (LQP03T series)
L2	TAIYO-YUDEN (HK0603 series)
C1~C3	MURATA (GRM03 series)

PCB (FR-4):
t=0.2mm
MICROSTRIP LINE
WIDTH=0.4mm (Z_0=50 ohm)
PCB SIZE=16.8mmx16.8mm

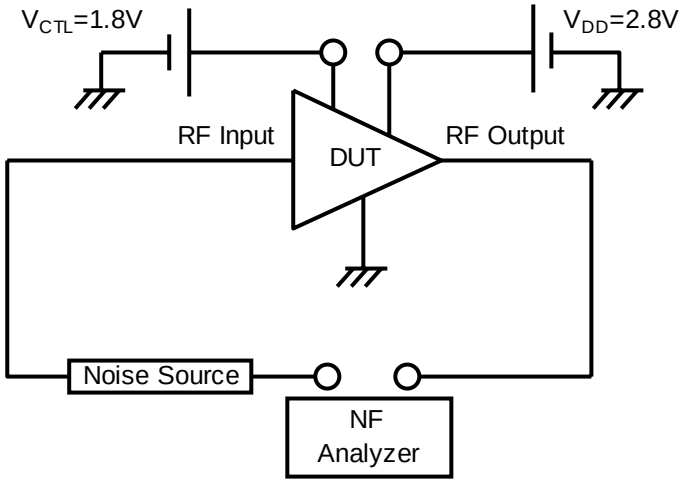
PRECAUTIONS

[1] C1 and C3 are DC-Blocking capacitors, and L1 is a DC-feed inductor.
[2] L2 and L3 formed the output matching circuit.
[3] C2 is a bypass capacitor.
[4] Ground terminals (6pin) should be connected with ground plane as close as possible in order to limit ground path induction.
[5] All external parts are placed as close as possible to the IC.

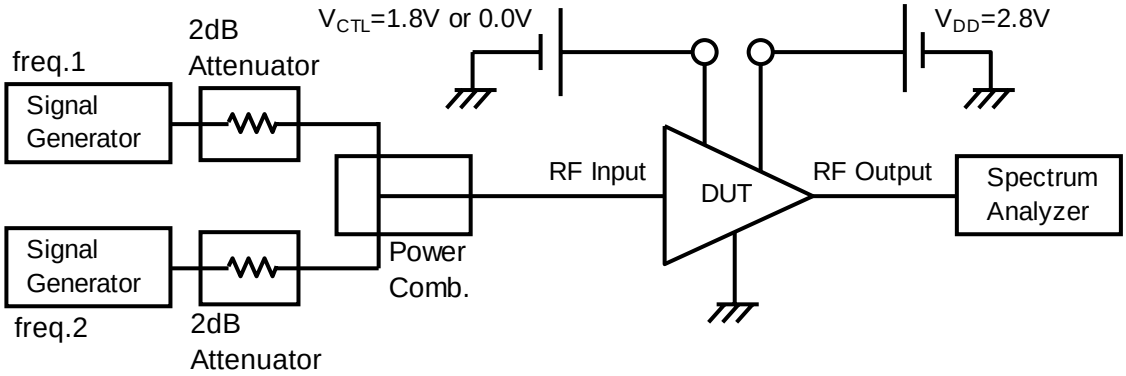
■ MEASUREMENT BLOCK DIAGRAM



S parameter Measurement Block Diagram

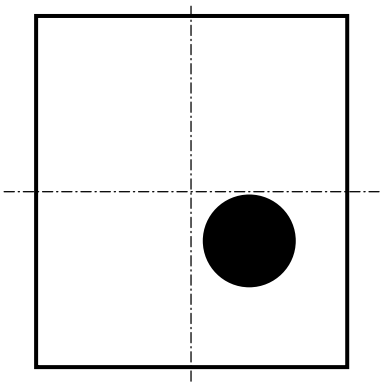


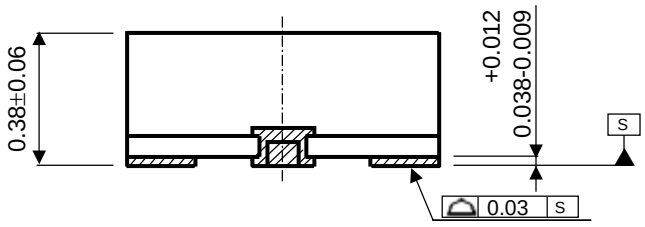
Noise Figure Measurement Block Diagram



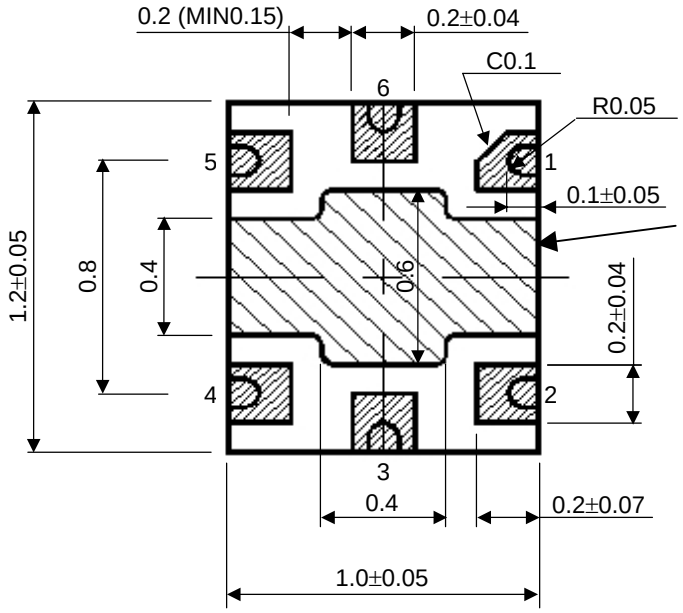
Input IP3 Measurement Block Diagram

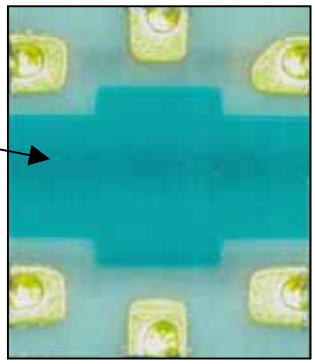
■PACKAGE OUTLINE (USB6-A8)





TERMINAL TREAT	:Au
Substrate	:FR5
Molding material	:Epoxy resin
UNIT	:mm
WEIGHT	:1.1mg





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.