5 GHz Low Noise Amplifier with Bypass function

■ FEATURES

- Operating frequency f = 4900 to 5925 MHz
- Operating voltage 2.5 to 5.5 V

[LNA active mode]

- High gain 16 dB typ.
- Low noise figure 0.95 dB typ.
- High IIP3 +9 dBm typ.
- Small package size 1.6 x 1.6 x 0.397 mm^3 typ.
- RoHS compliant and Halogen Free, MSL1

■ GENERAL DESCRIPTION

The NJG1175KG1 is a low noise amplifier for wireless receiver applications in the 4900 MHz to 5925 MHz. This LNA has a LNA pass-through function to select LNA active mode or bypass mode.

The NJG1175KG1 achieves High linearity, Low distortion, high gain, and low noise figure.

Integrated ESD protection device on each port achieves excellent ESD robustness.

The small and thin ESON6-G1 package is adopted.

■ APPLICATION

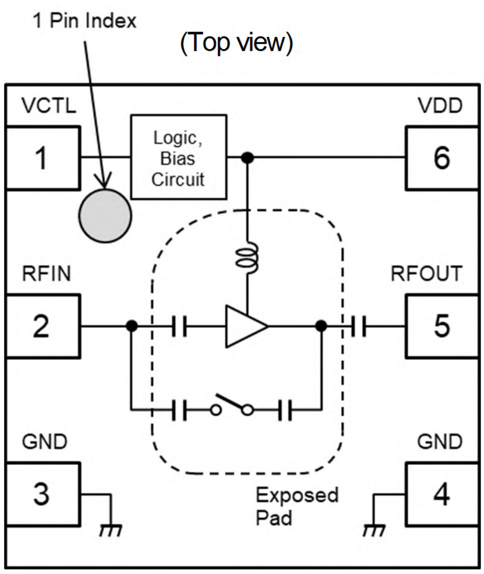
- LTE advanced in unlicensed spectrum (LTE-U/LAA)
- WLAN (IEEE 802.11 a/n/ac/ax)
- Small cell, CPE
- Access points, routers, gateways
- Wireless routers
- 5 GHz ISM radios

■ TRUTH TABLE

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

V_{CTL}	Mode
L	Bypass mode
H	LNA Active mode

■ BLOCK DIAGRAM (ESON6-G1)



■ PIN CONFIGURATION

PIN NO.	SYMBOL	DESCRIPTION
1	VCTL	Control signal input terminal
2	RFIN	RF input terminal
3	GND	Ground terminal
4	GND	Ground terminal
5	RFOUT	RF output terminal
6	VDD	Operating voltage supply terminal
Exposed pad	GND	Ground terminal

■ PRODUCT NAME INFORMATION

NJG1175 KG1 (TE3)

Part Number — NJG1175
Package — KG1
Taping Form — (TE3)

■ ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJG1175KG1	ESON6-G1	Yes	Yes	Sn-Bi	1175	3.5	3,000

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
RF Input Power(1)	P_{IN}	+15	dBm
Supply Voltage(2)	V_{DD}	6.0	V
Control Voltage(3)	V_{CTL}	6.0	V
Power Dissipation(4)	P_D	1200	mW
Operating Temperature	T_{opr}	-40 to +105	°C
Storage Temperature	T_{stg}	-55 to +150	°C

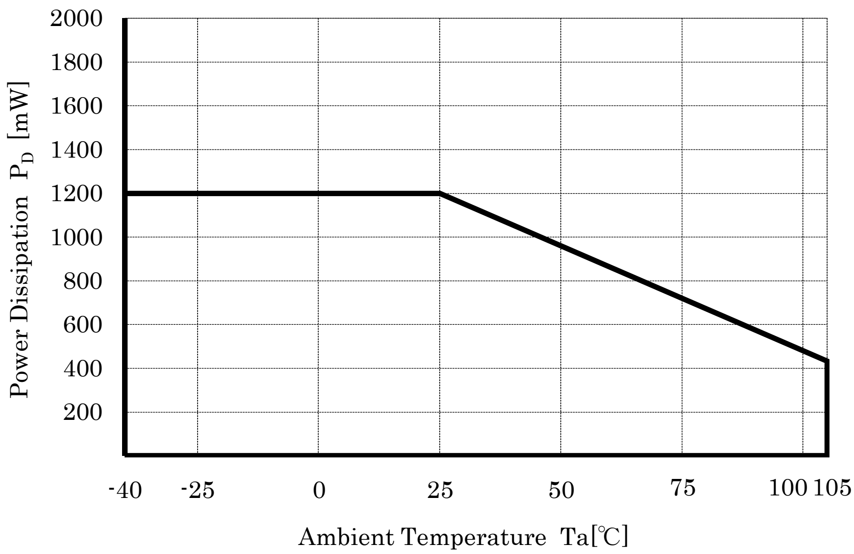
(1): V_{DD} = 3.3 V
(2): VDD port
(3): VCTL port
(4): Mounted on four-layer FR4 PCB with through-hole (101.5 × 114.5 mm), T_j = 150°C

■ POWER DISSIPATION VS.AMBIENT TEMPERATURE

Please, refer to the following Power Dissipation and Ambient Temperature.
(Please note the surface mount package has a small maximum rating of Power Dissipation [P_D], a special attention should be paid in designing of thermal radiation.)

Power Dissipation－Ambient Temperature Characteristic

Mounted on PCB



■ RECOMMENDED OPERATING CONDITIONS

T_a = 25°C

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}	2.5	3.3	5.5	V
Control Voltage (HIGH)	$V_{CTL(H)}$	1.3	3.3	5.5	V
Control Voltage (LOW)	$V_{CTL(L)}$	0	0	0.3	V

■ ELECTRICAL CHARACTERISTICS 1 (DC CHARACTERISTICS)

T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current 1 (LNA active mode)	$I_{DD}1$	RF OFF, V_{DD} = 3.3 V, V_{CTL} = 3.3 V	-	13	18	mA
Operating Current 2 (Bypass mode)	$I_{DD}2$	RF OFF, V_{DD} = 3.3 V, V_{CTL} = 0 V	-	20	100	µA
Control Current	I_{CTL}	RF OFF, V_{CTL} = 3.3 V	-	25	50	µA

■ ELECTRICAL CHARACTERISTICS 2 (RF CHARACTERISTICS: LNA active mode)

f_{RF} = 4900 to 5925 MHz, V_{DD} = 3.3 V, V_{CTL} = 3.3 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Small signal gain	Gain	Exclude PCB and connector losses *1	12	16	-	dB
Noise figure	NF	Exclude PCB and connector losses *2	-	0.95	1.6	dB
Input power at 1 dB gain compression point 1	P-1dB(IN)1		-14	-5	-	dBm
Input 3rd order intercept point 1	IIP3_1	f1 = f_{RF}, f2 = f_{RF} + 1 MHz, P_{IN} = -30 dBm	-3	+9	-	dBm
RF IN return loss 1	RLi1		6	13	-	dB
RF OUT return loss 1	RLo1		6	18	-	dB
Gain settling time 1	T_S1	Bypass to LNA active mode, To be within 1 dB of the final gain	-	0.5	2	µs
Gain settling time 2	T_S2	LNA active to bypass mode, To be within 1 dB of the final insertion loss	-	1	2	µs

*1: PCB and connector losses: 0.60 dB @ 4900 MHz, 0.64 dB @ 5500 MHz, 0.69 dB @ 5925 MHz
*2: PCB and connector losses: 0.27 dB @ 4900 MHz, 0.30 dB @ 5500 MHz, 0.31 dB @ 5925 MHz

■ ELECTRICAL CHARACTERISTICS 3 (RF CHARACTERISTICS: Bypass mode)

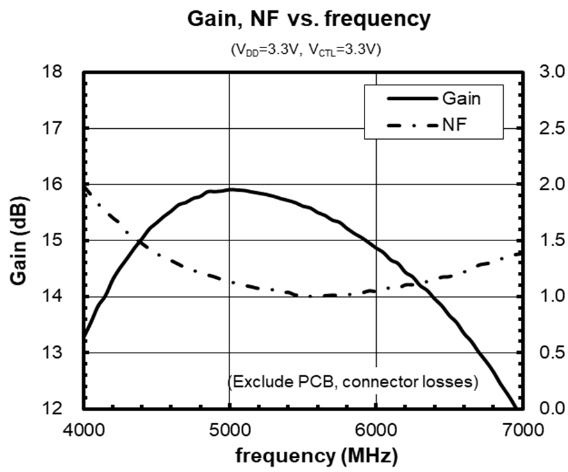
f_{RF} = 4900 to 5925 MHz, V_{DD} = 3.3 V, V_{CTL} = 0 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

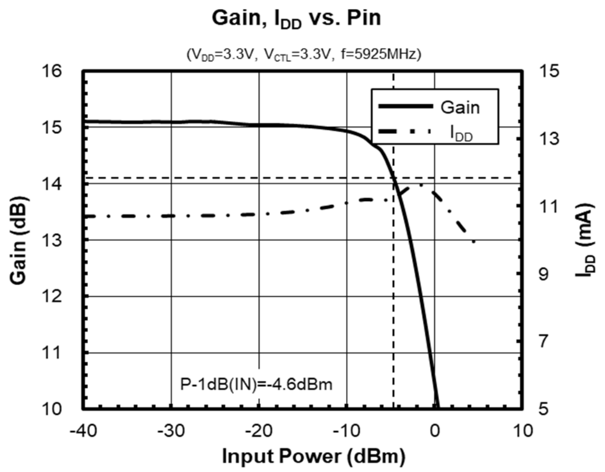
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Insertion loss	Loss	Exclude PCB and connector losses *1	-	5.5	9	dB
Input power at 1 dB gain compression point 2	P-1dB(IN)2		0	+9	-	dBm
Input 3rd order intercept point 2	IIP3_2	f1 = f_{RF}, f2 = f_{RF} + 1 MHz, P_{IN} = -15 dBm	0	+14	-	dBm
RF IN return loss 2	RLi2		4	10	-	dB
RF OUT return loss 2	RLo2		4	11	-	dB

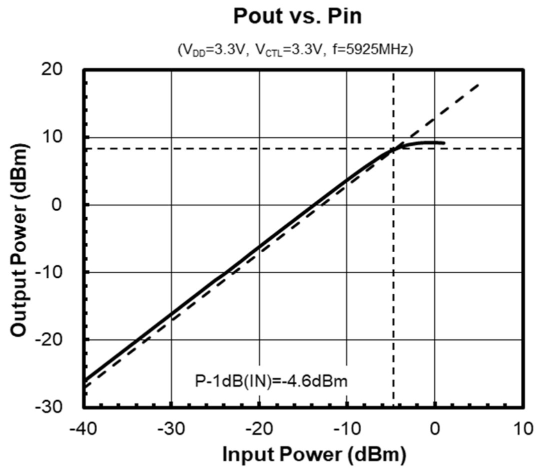
*1: PCB and connector losses: 0.60 dB @ 4900 MHz, 0.64 dB @ 5500 MHz, 0.69 dB @ 5925 MHz

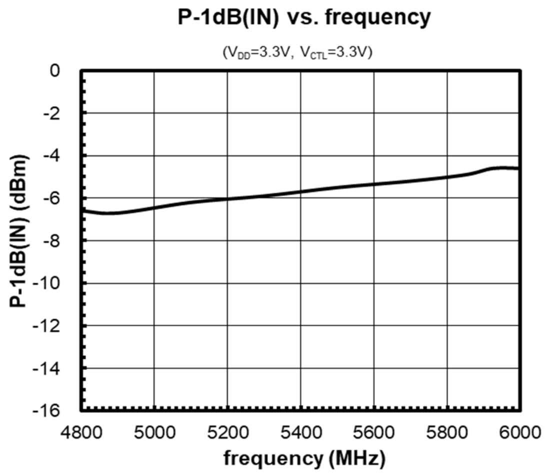
■ **ELECTRICAL CHARACTERISTICS (LNA active mode)**

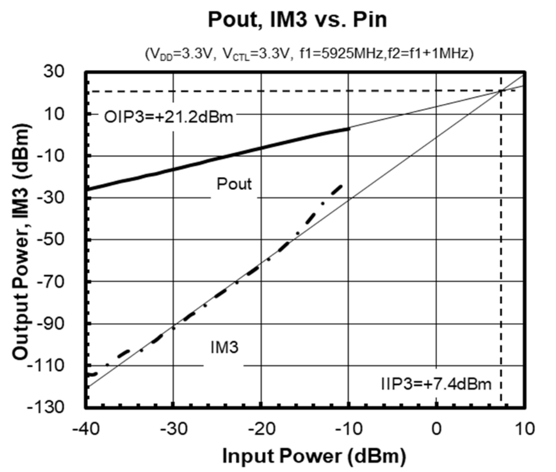
V_{DD} = 3.3 V, V_{CTL} = 3.3 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

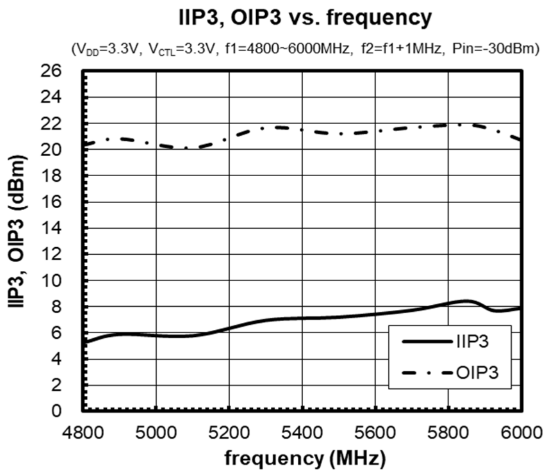






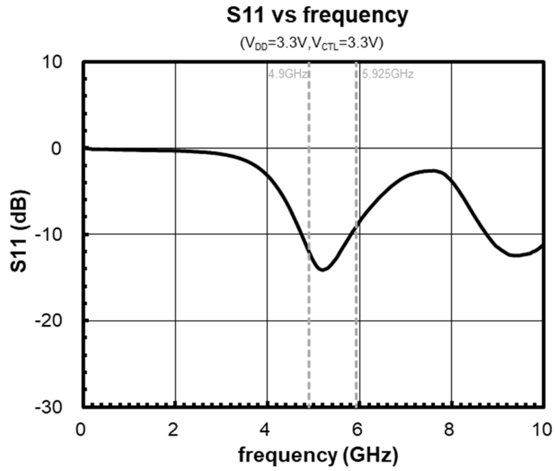


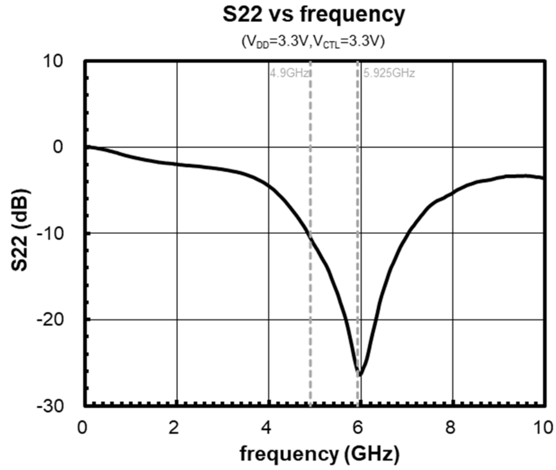


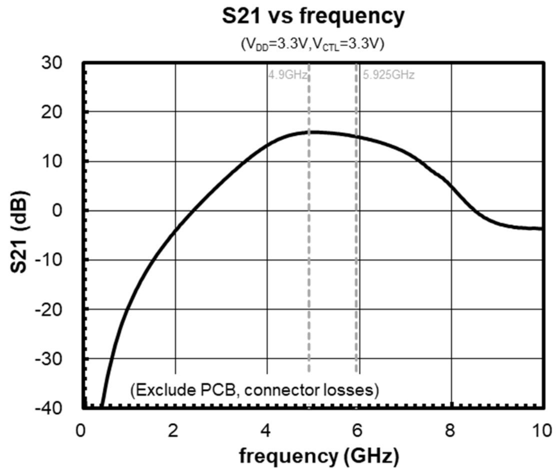


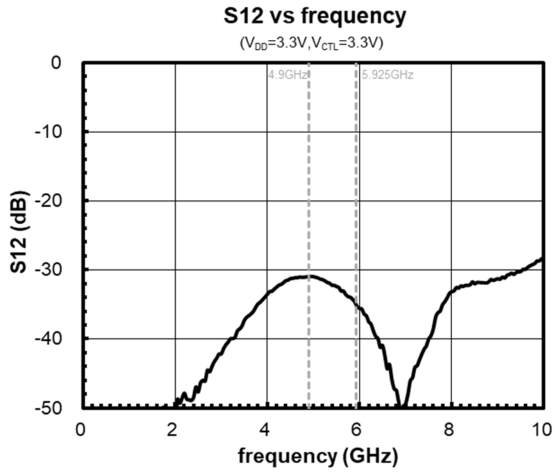
■ **ELECTRICAL CHARACTERISTICS (LNA active mode)**

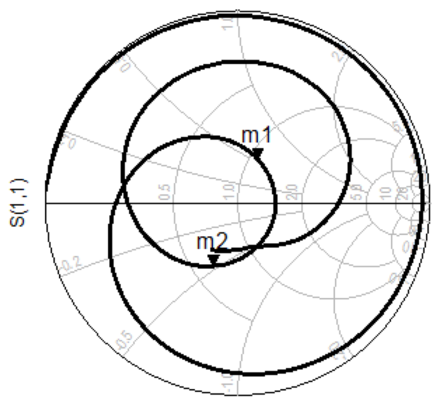
V_{DD} = 3.3 V, V_{CTL} = 3.3 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit









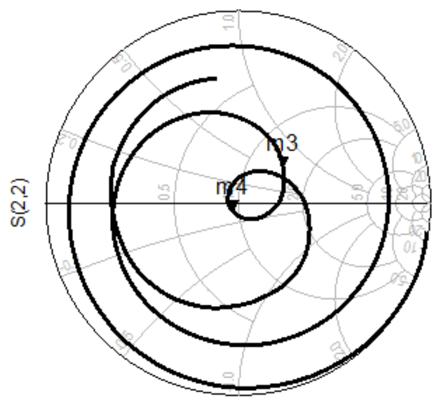


freq (50.00MHz to 10.00GHz)

m1
freq=4.900GHz
S(1,1)=0.251 / 65.532
impedance = Z0 * (1.096 + j0.533)

m2
freq=5.925GHz
S(1,1)=0.351 / -111.177
impedance = Z0 * (0.637 - j0.476)

Zin



freq (50.00MHz to 10.00GHz)

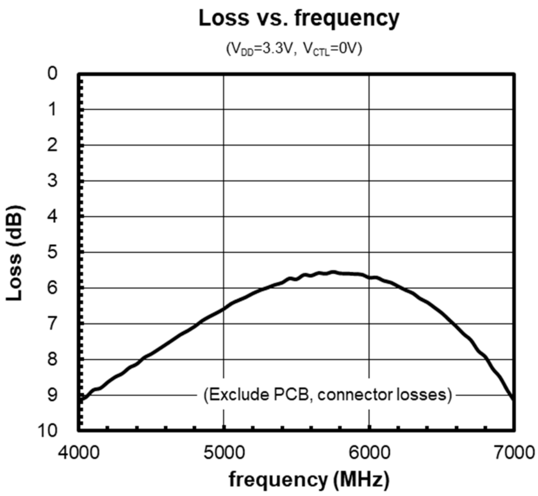
m3
freq=4.900GHz
S(2,2)=0.298 / 38.736
impedance = Z0 * (1.460 + j0.597)

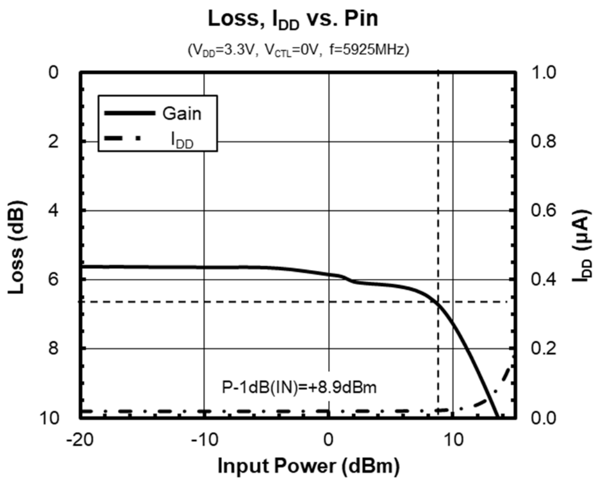
m4
freq=5.925GHz
S(2,2)=0.051 / -125.265
impedance = Z0 * (0.940 - j0.078)

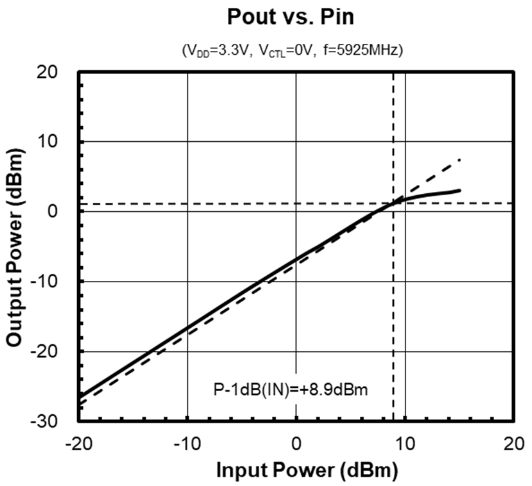
Zout

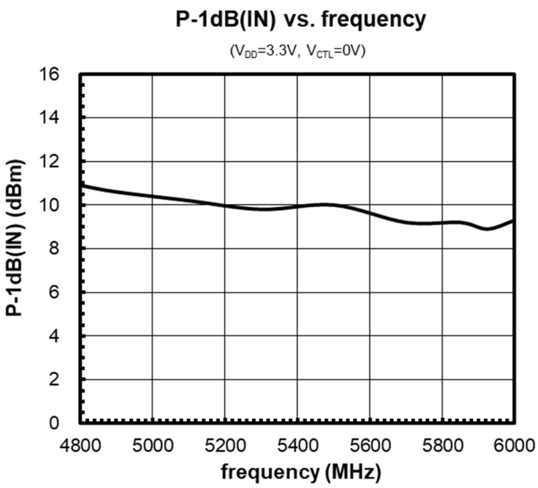
■ **ELECTRICAL CHARACTERISTICS (Bypass mode)**

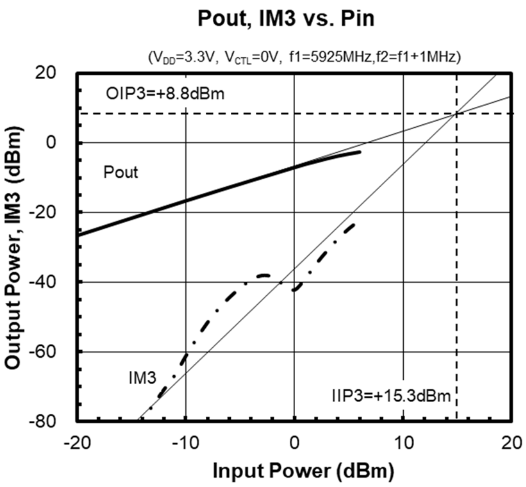
V_{DD} = 3.3 V, V_{CTL} = 0 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

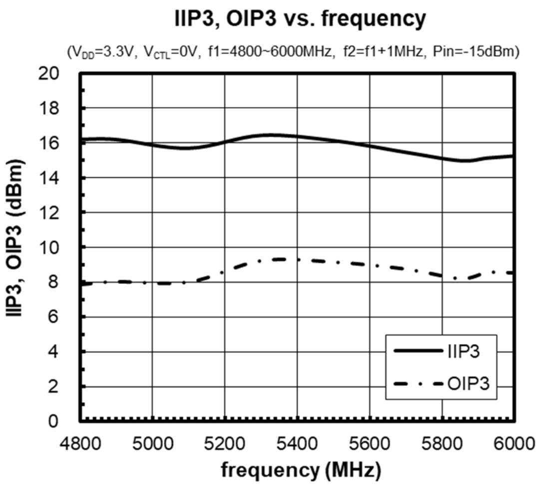






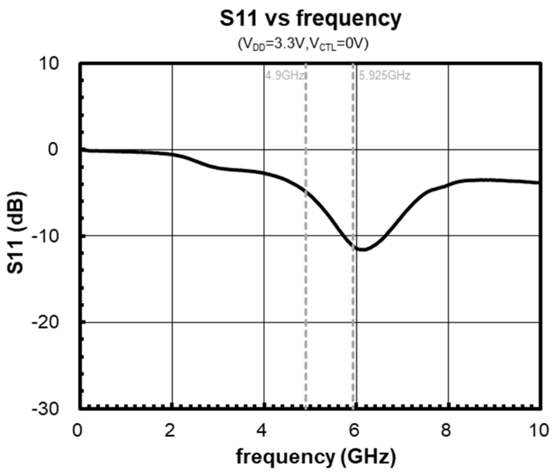


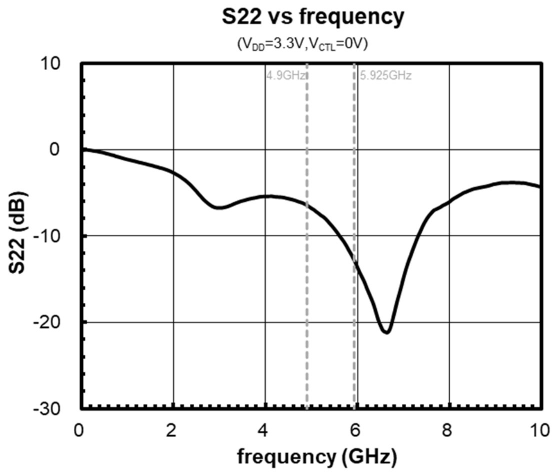


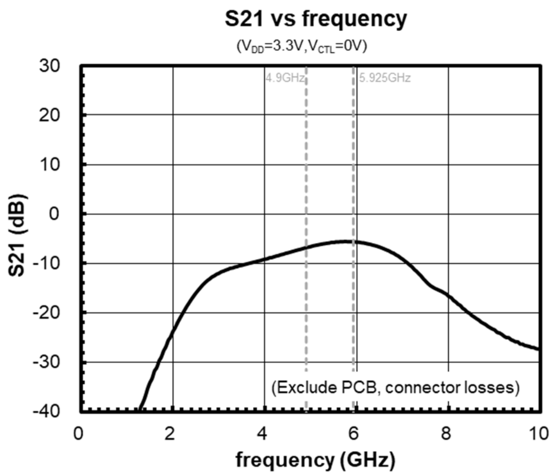


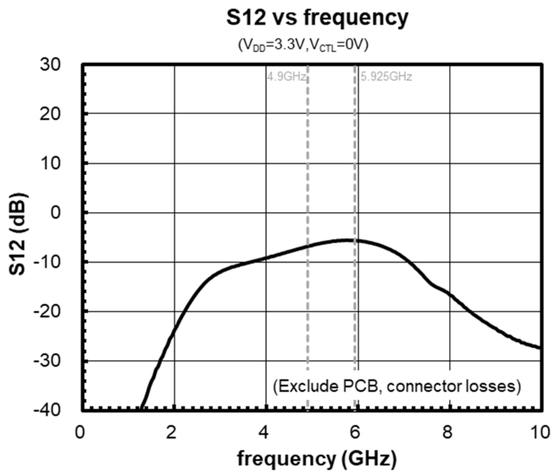
■ **ELECTRICAL CHARACTERISTICS (Bypass mode)**

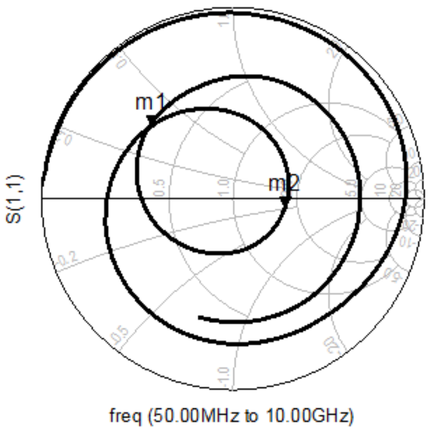
V_{DD} = 3.3 V, V_{CTL} = 0 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit







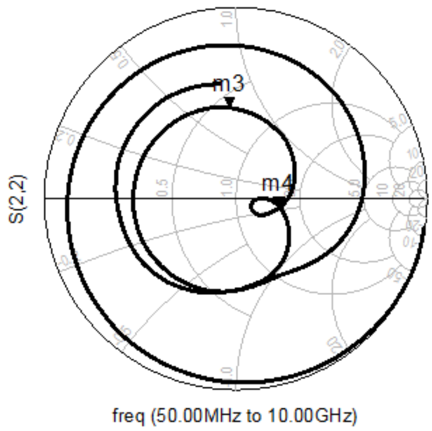




m1
freq=4.900GHz
S(1,1)=0.569 / 138.320
impedance = Z0 * (0.311 + j0.348)

m2
freq=5.925GHz
S(1,1)=0.276 / -10.176
impedance = Z0 * (1.734 - j0.183)

Zin



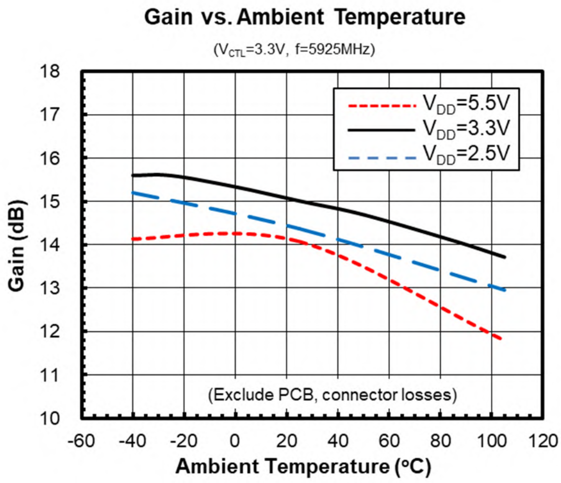
m3
freq=4.900GHz
S(2,2)=0.477 / 94.048
impedance = Z0 * (0.597 + j0.735)

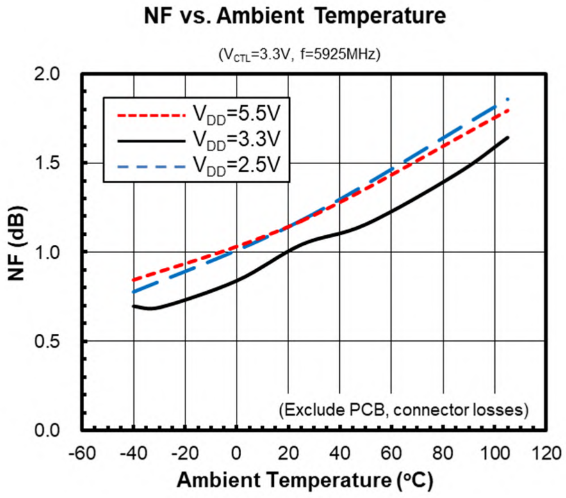
m4
freq=5.925GHz
S(2,2)=0.229 / -12.445
impedance = Z0 * (1.567 - j0.163)

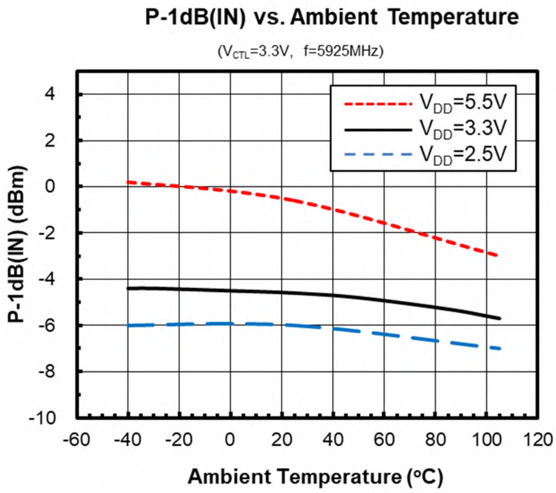
Zout

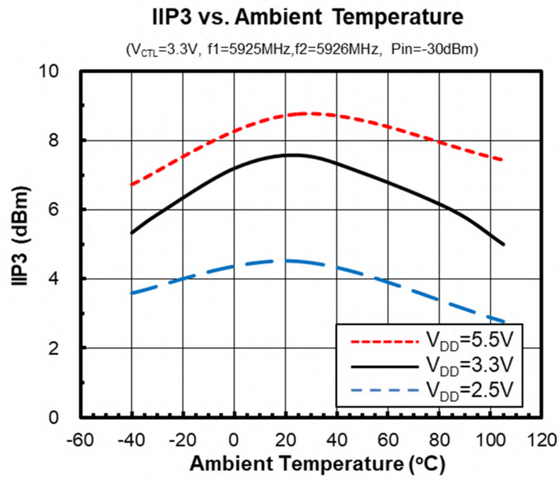
■ **ELECTRICAL CHARACTERISTICS (LNA active mode)**

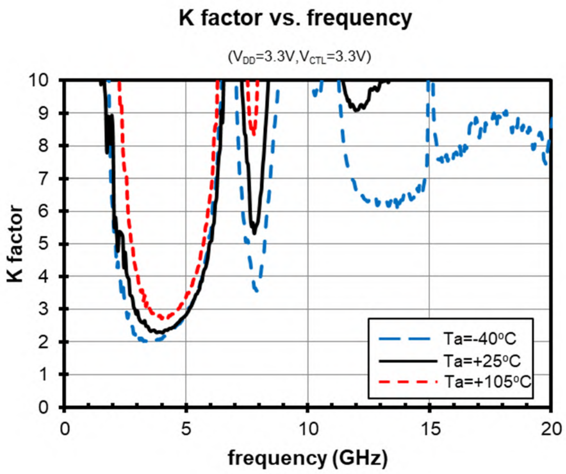
V_{CTL} = 3.3 V, Z_s = Z_l = 50 Ω, with application circuit





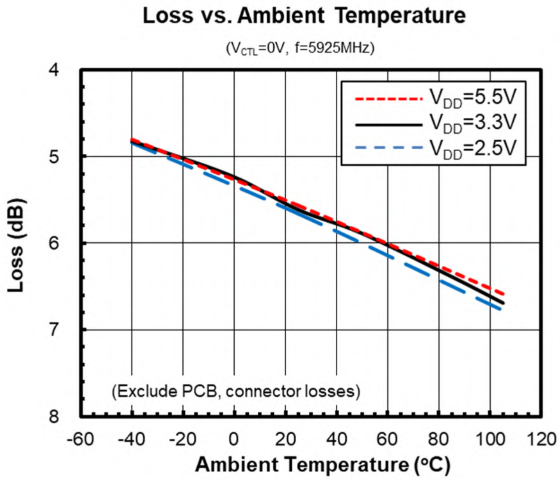


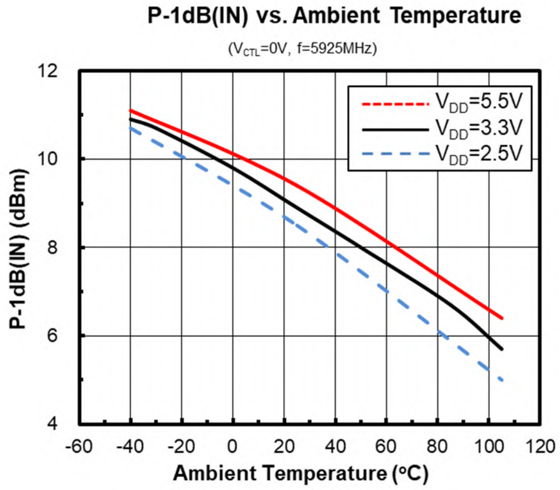


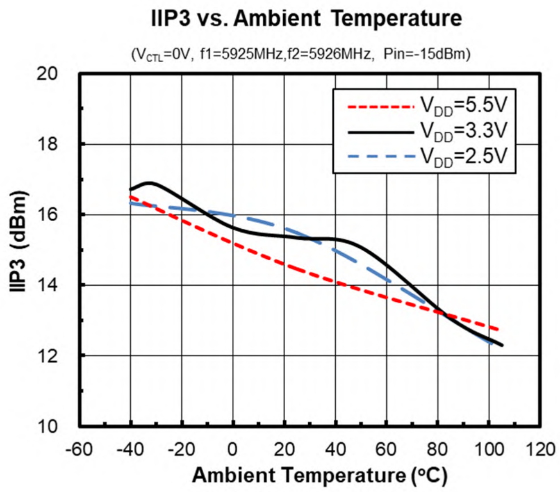


■ ELECTRICAL CHARACTERISTICS (Bypass mode)

V_{CTL} = 0 V, Z_s = Z_l = 50 Ω, with application circuit

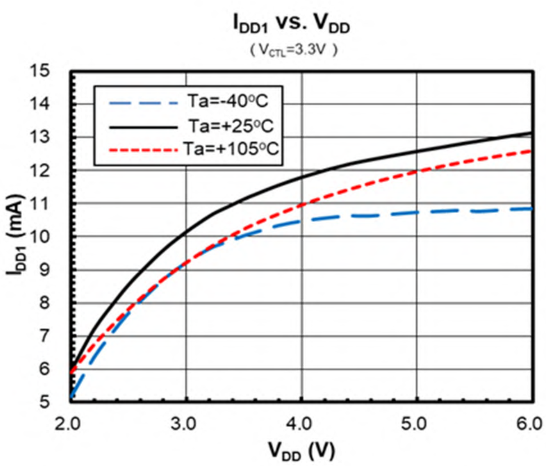


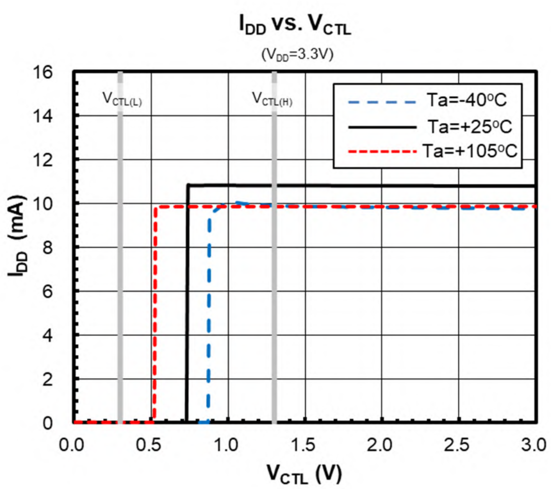




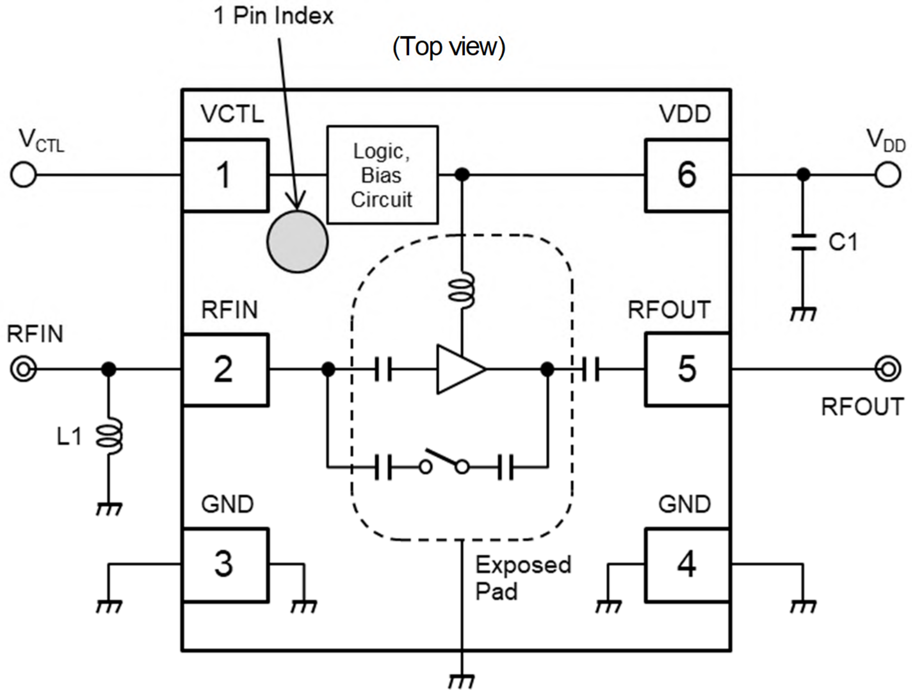
■ ELECTRICAL CHARACTERISTICS (DC)

Z_s = Z_l = 50 Ω, with application circuit





■ **APPLICATION CIRCUIT**

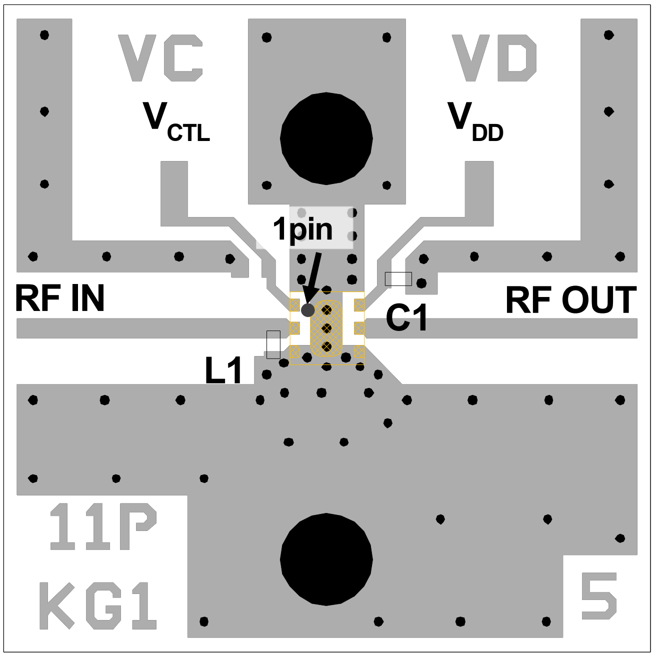


<PARTS LIST>

Part ID	Value	Notes
L1	1.3 nH	LQP03TN_02 Series (MURATA)
C1	1000 pF	GRM03 Series (MURATA)

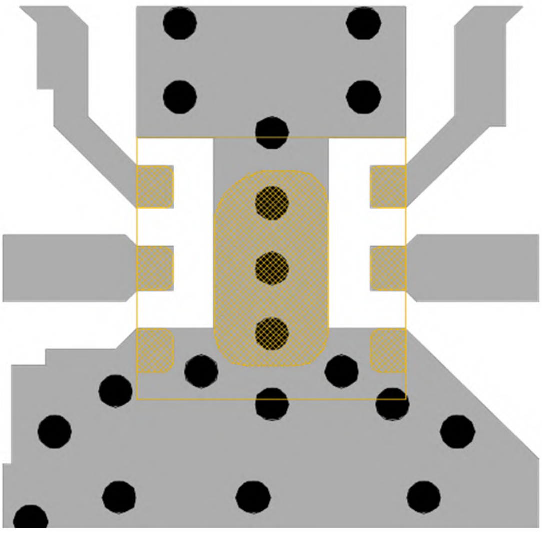
■ EVALUATION BOARD･PCB LAYOUT

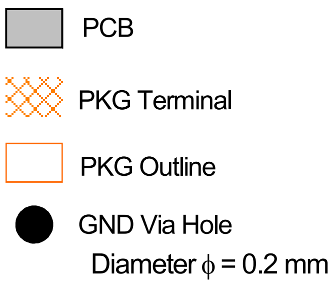
(Top view)



PCB Information
Substrate: FR-4
Thickness: 0.2mm
Microstrip line width: 0.4mm (Z_0=50Ω)
Size: 14.0mm x 14.0mm

<PCB LAYOUT GUIDELINE>





PRECAUTIONS

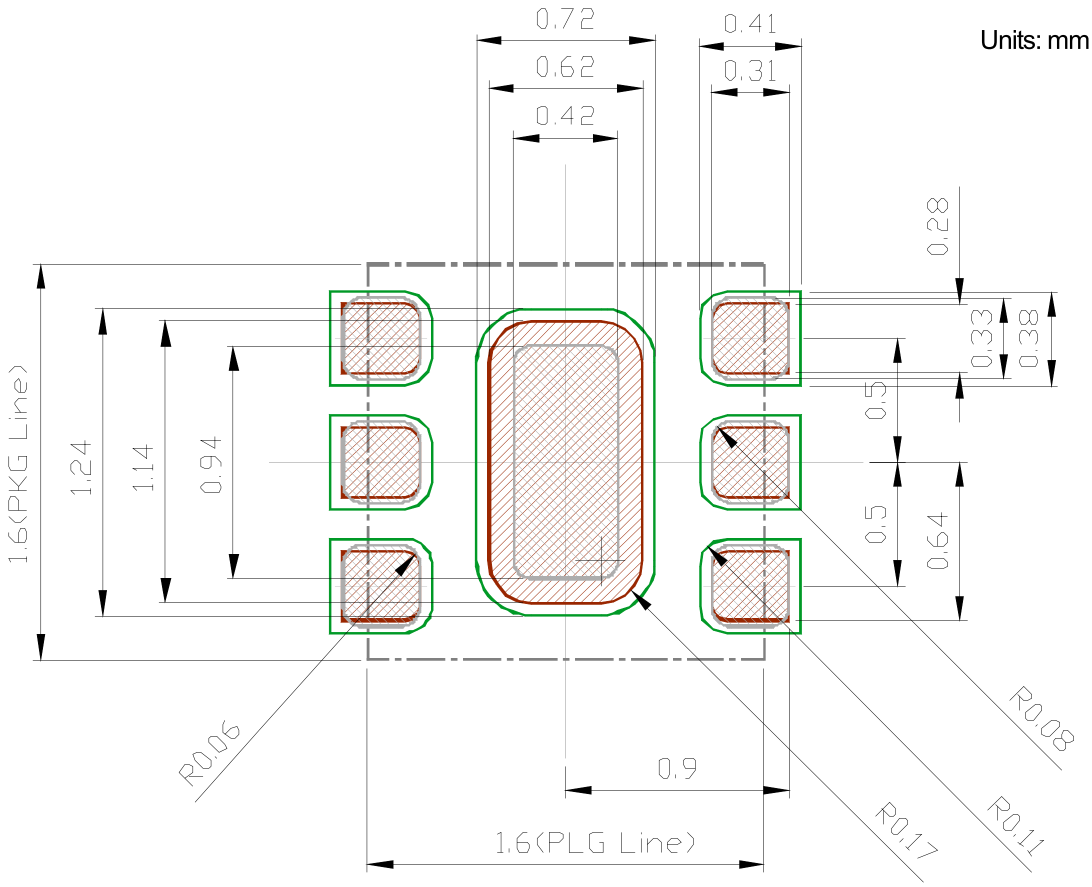
• All external parts should be placed as close as possible to the IC.

• For good RF performance, all GND terminals (include the exposed pad) must be connected to PCB ground plane of substrate, and via-holes for GND should be placed near the IC.

■ **RECOMMENDED FOOTPRINT PATTERN** (ESON6-G1)

PKG: 1.6 mm x 1.6 mm
Pin pitch: 0.5 mm

: Land
: Mask (Open area) *Metal mask thickness : 100µm
: Resist (Open area)



■ NOISE FIGURE MEASUREMENT BLOCK DIAGRAM

Measuring instruments

NF Analyzer	: Keysight N8975A
Noise Source	: Keysight 346A

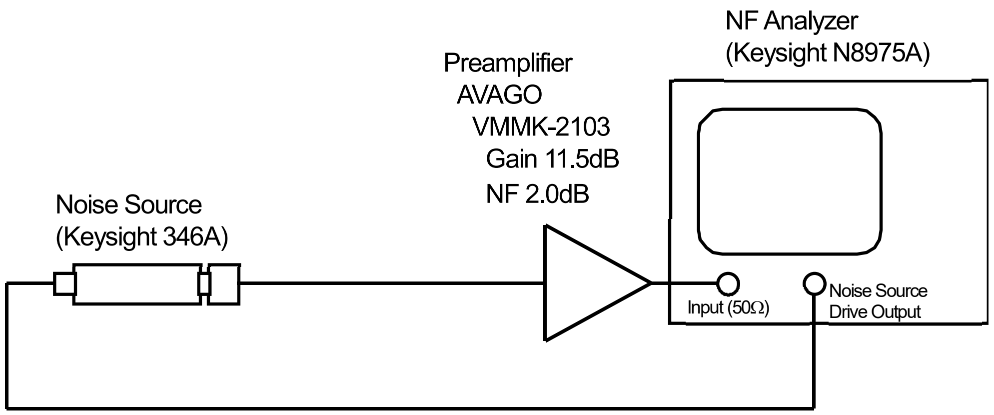
Setting the NF analyzer

Measurement mode form

Device under test	: Amplifier
System downconverter	: off

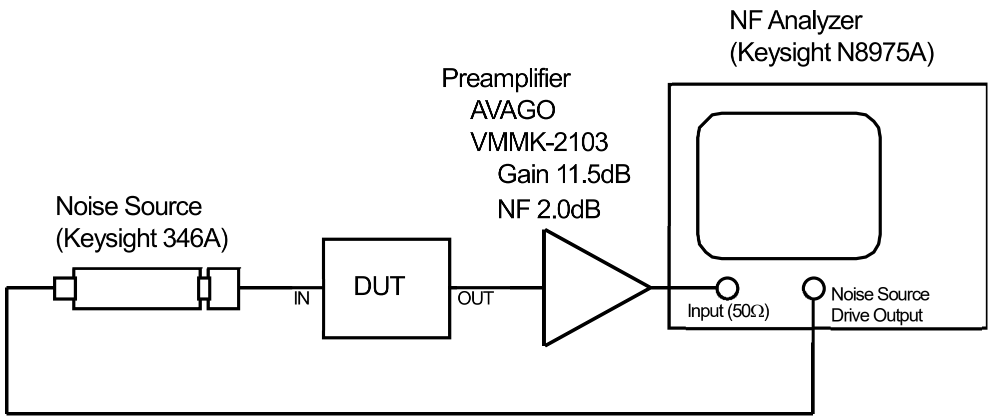
Mode setup form

Sideband	: LSB
Averages	: 8
Average mode	: Point
Bandwidth	: 4MHz
Loss comp	: off
Tcold	: setting the temperature of noise source (305.15K)



* Preamplifier is used to improve NF measurement accuracy.
* Noise source, preamplifier and NF analyzer are connected directly.

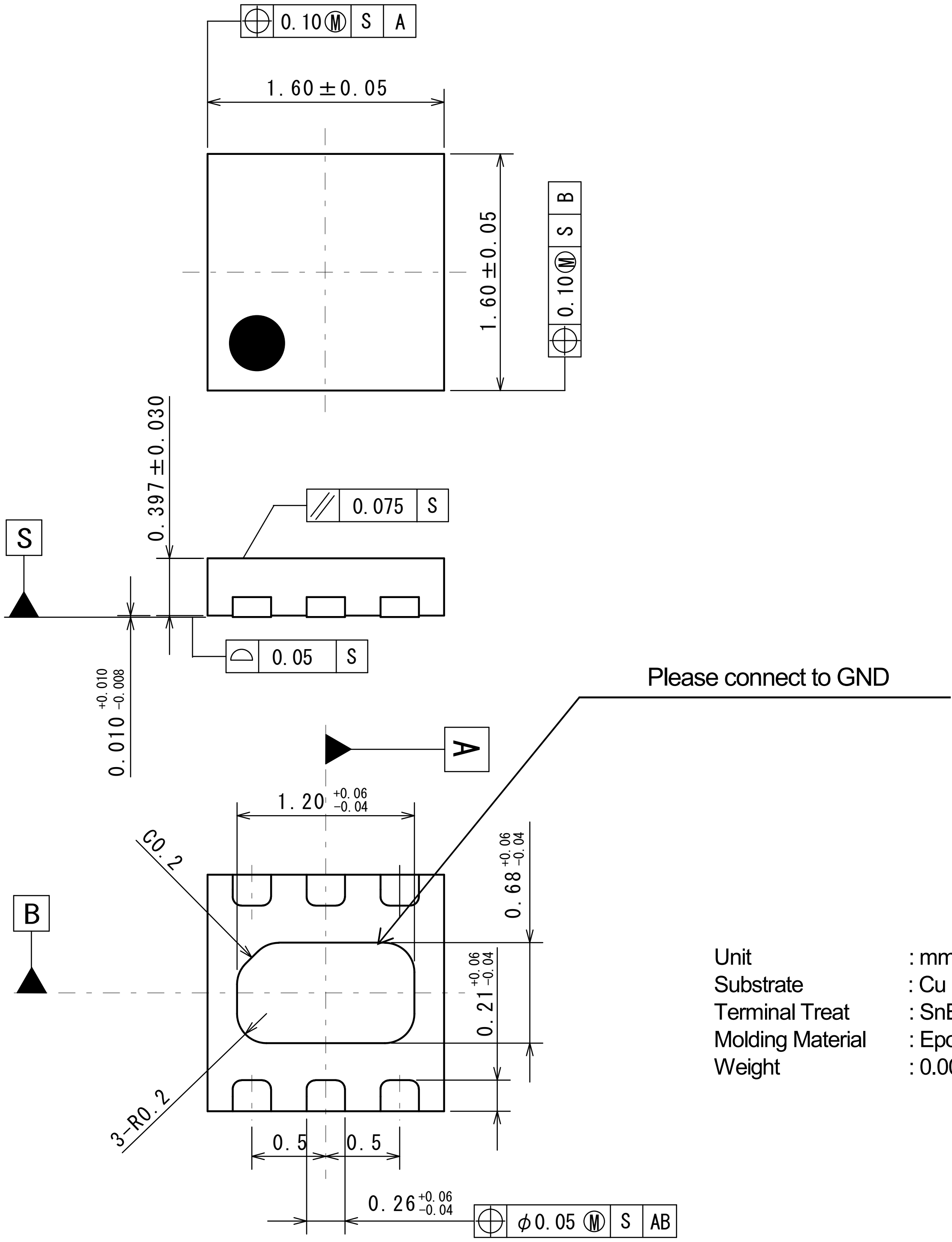
Calibration Setup



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

Measurement Setup

■ **PACKAGE OUTLINE**



Unit	: mm
Substrate	: Cu
Terminal Treat	: SnBi
Molding Material	: Epoxy Resin
Weight	: 0.0035 (g)

NISSHINBO

Nisshinbo Micro Devices Inc.

Official website
https://www.nisshinbo-microdevices.co.jp/en/

Purchase information
https://www.nisshinbo-microdevices.co.jp/en/buy/