

Broadband Low Noise Amplifier GaAs MMIC

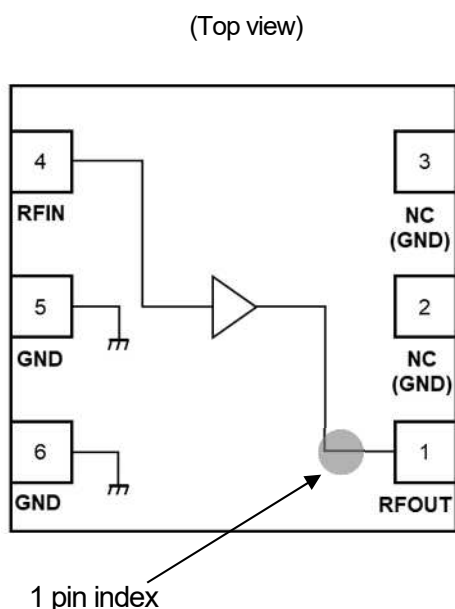
■ FEATURES

- Wide frequency range 950 to 3224 MHz
- Supply Voltage 3.0 to 5.5V
- Operating current 40 mA typ. @ $V_{DD} = 3.3\text{ V}$
- High gain 16.0 dB typ.
@ $f = 950\text{ to }3224\text{ MHz}$, $V_{DD} = 3.3\text{ V}$
- Low noise figure 2.5 dB typ.
@ $f = 950\text{ to }3224\text{ MHz}$, $V_{DD} = 3.3\text{ V}$
- High P-1dB (IN) +1.0 dBm typ.
- High Input IIP3 +15.0 dBm typ.
- Small package size 1.6 mm x 1.6 mm x 0.397 mm typ.
- RoHS compliant and Halogen Free, MSL1

■ APPLICATION

- BS/CS TV, TV Tuner Module, STB and others Broadcasting applications.
- Wide Band applications from 950MHz to 3224MHz

■ BLOCK DIAGRAM (ESON6-G1)



■ GENERAL DESCRIPTION

The NJG1188KG1 is a wide band low noise amplifier MMIC mainly intended BS/CS TV and others broadcasting system.

This LNA features low distortion, +15 dBm high linearity and 16 dB of high flat gain for wide bandwidth from 950 MHz to 3224 MHz, Integrated ESD protection device on each port achieves excellent ESD robustness.

The small and thin ESON6-G1 package is adopted.

■ PIN CONFIGURATION

PIN NO.	SYMBOL	DESCRIPTION
1	RFOUT	RF output and voltage supply terminal
2	NC(GND)	No connected terminal (Ground terminal)
3	NC(GND)	No connected terminal (Ground terminal)
4	RFIN	RF input terminal
5	GND	Ground terminal
6	GND	Ground terminal
Exposed pad	-	Ground terminal

■ PRODUCT NAME INFORMATION

NJG1188 KG1 (TE3)
 | | |
 Part number Package Taping form

■ ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJG1188KG1	ESON6-G1	Yes	Yes	Sn-Bi	1188	3.5	3,000

■ ABSOLUTE MAXIMUM RATINGS

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

PARAMETER	SYMBOL	RATINGS	UNIT
Supply voltage	V_{DD}	6.0	V
Input power	$P_{IN}^{(1)}$	+10	dBm
Power dissipation	$P_D^{(2)}$	1200	mW
Operating temperature	T_{opr}	-40 to +105	$^{\circ}\text{C}$
Storage temperature	T_{stg}	-40 to +150	$^{\circ}\text{C}$

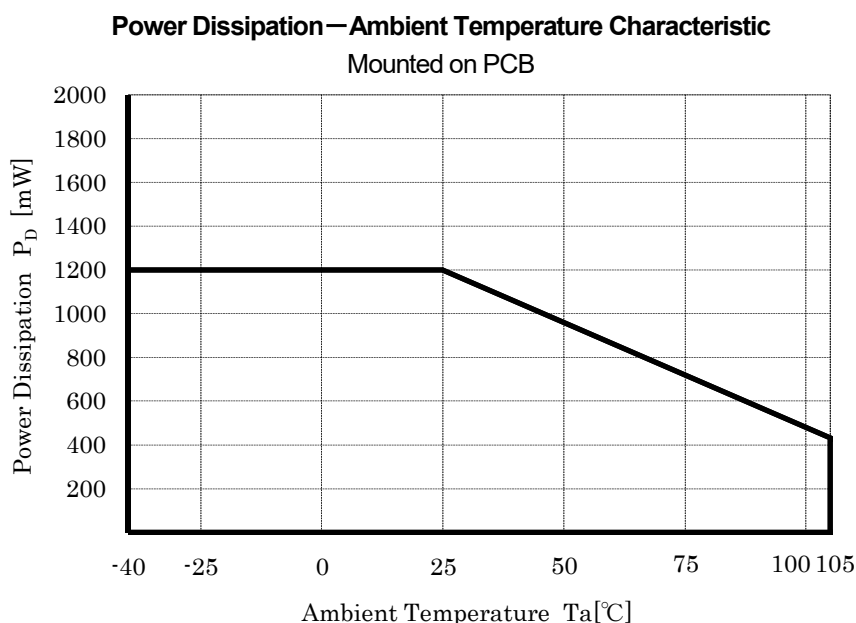
(1): $V_{DD} = 3.3\text{ V}$

(2): 4-layer FR4 PCB with through-hole (101.5 x 114.5 mm), $T_j = 150^{\circ}\text{C}$

■ 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.)



■ ELECTRICAL CHARACTERISTICS 1 (DC)

General conditions: $T_a = +25^{\circ}\text{C}$, with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply voltage	V_{DD}		3.0	3.3	5.5	V
Operating current	I_{DD}	RF OFF, $V_{DD} = 3.3\text{ V}$	-	40.0	60.0	mA

■ ELECTRICAL CHARACTERISTICS 2 (RF 1)

General conditions: $V_{DD} = 3.3\text{ V}$, $f_{RF} = 950\text{ to }3224\text{ MHz}$, $T_a = +25^{\circ}\text{C}$, $Z_s = Z_l = 50\ \Omega$, with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Small signal gain_1	Gain_1	Exclude PCB, Connector Losses*	13.0	16.0	19.0	dB
Noise figure	NF	Exclude PCB, Connector Losses*	-	2.5	3.0	dB
Input power at 1 dB gain compression point	P-1dB(In)		-5.0	+1.0		dBm
Input 2rd order intercept point_1	IIP2_1	$f_1 = 950\text{ to }3224\text{ MHz}$, $f_2 = f_1 + 1\text{ MHz}$ $P_{in} = -20\text{ dBm}$	+15.0	+22.0	-	dBm
Input 2rd order intercept point_2	IIP2_2	$f_1 = 1394.72\text{ MHz}$, $f_2 = 1433.08\text{ MHz}$ $P_{in} = -15\text{ dBm}$	+15.0	+22.0	-	dBm
Input 3rd order intercept point_1	IIP3_1	$f_1 = 950\text{ to }3224\text{ MHz}$, $f_2 = f_1 + 1\text{ MHz}$ $P_{in} = -20\text{ dBm}$	+6.5	+15.0	-	dBm
Input 3rd order intercept point_2	IIP3_2	$f_1 = 1394.72\text{ MHz}$, $f_2 = 1433.08\text{ MHz}$ $P_{in} = -15\text{ dBm}$	+8.0	+15.0	-	dBm
RF IN return loss_1	RLi_1		7.0	10.0	-	dB
RF OUT return loss_1	RLo_1		7.0	10.0	-	dB
k factor	K	$f = 0.05\text{ GHz to }10\text{ GHz}$	1.0	-	-	-

* Input & output PCB and connector losses : 0.05 dB (950MHz), 0.10 dB (1800MHz), 0.23 dB (3224MHz)

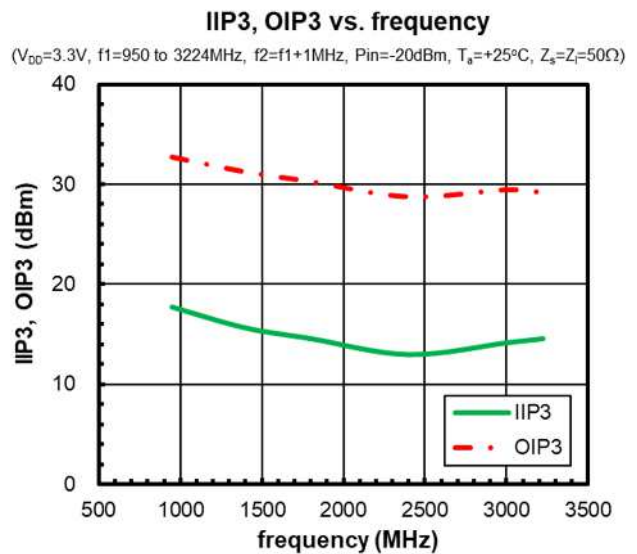
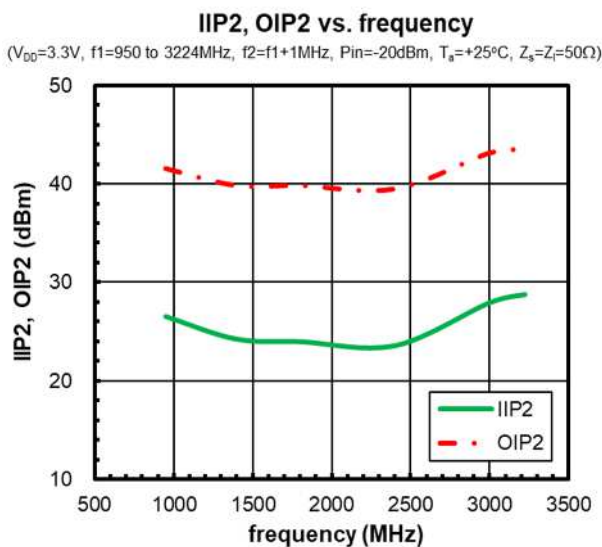
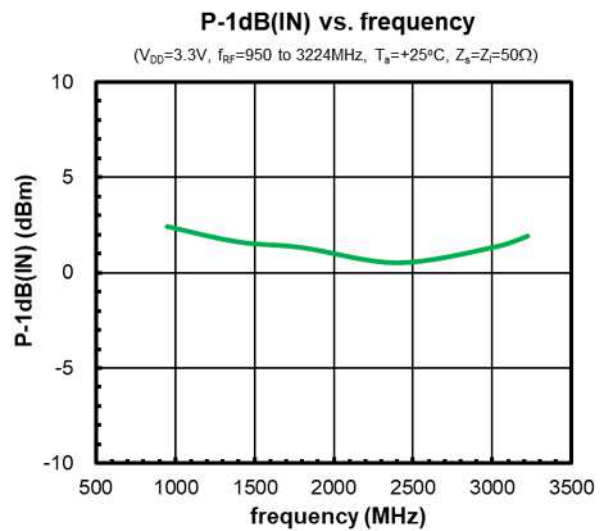
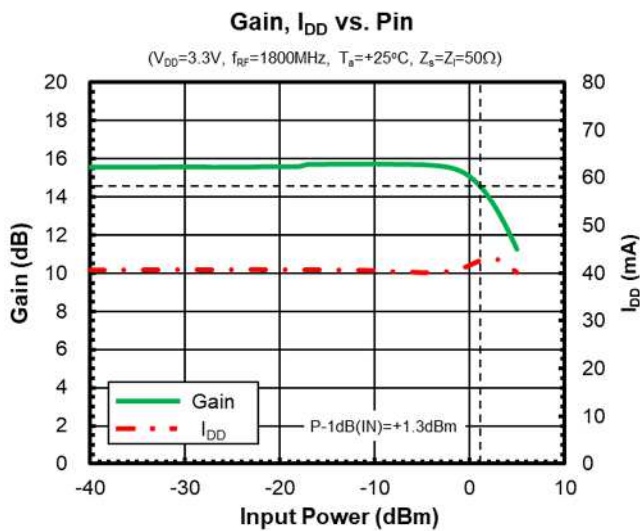
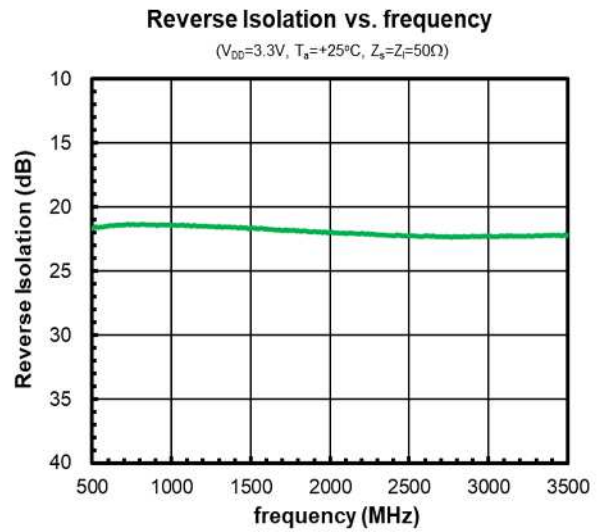
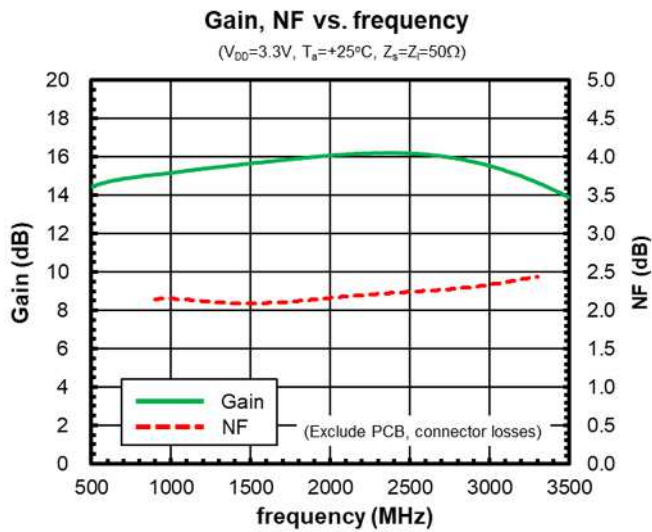
■ ELECTRICAL CHARACTERISTICS 2 (RF 2)

General conditions: $V_{DD} = 3.3\text{ V}$, $f_{RF} = 950\text{ to }3224\text{ MHz}$, $T_a = +25^{\circ}\text{C}$, $Z_s = Z_l = 75\ \Omega$, with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Small signal gain_2	Gain_2	Exclude PCB, Connector Losses	-	16.0	-	dB
RF IN return loss_2	RLi_2		-	10.0	-	dB
RF OUT return loss_2	RLo_2		-	10.0	-	dB

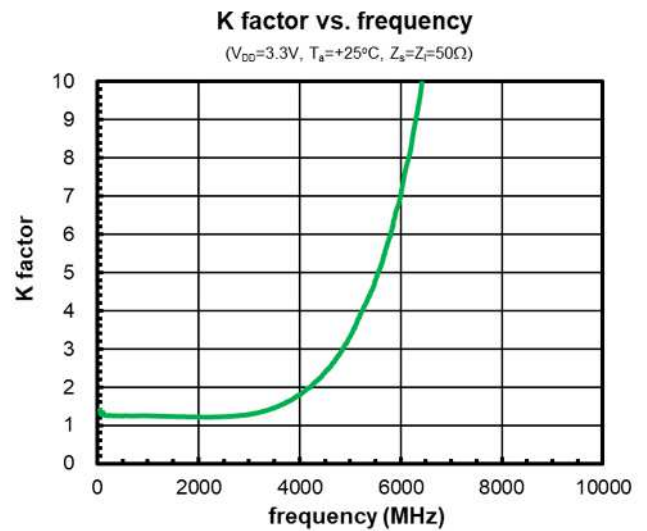
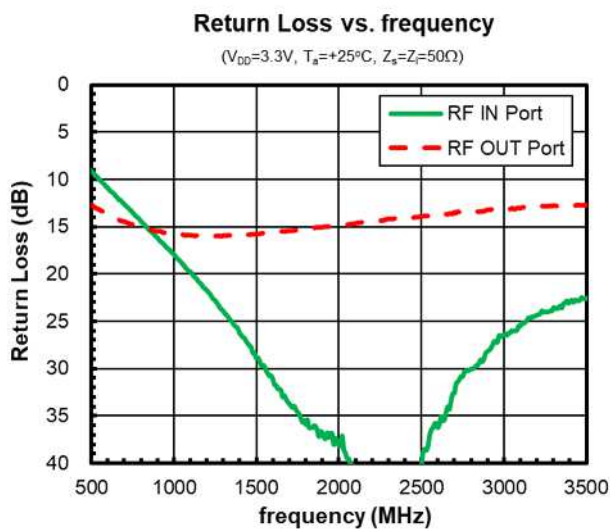
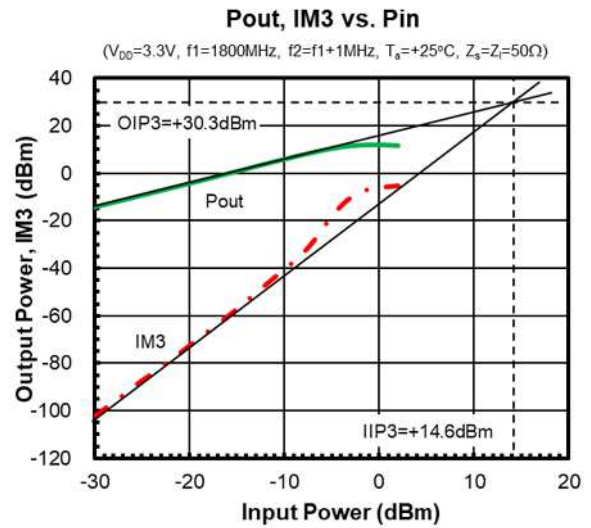
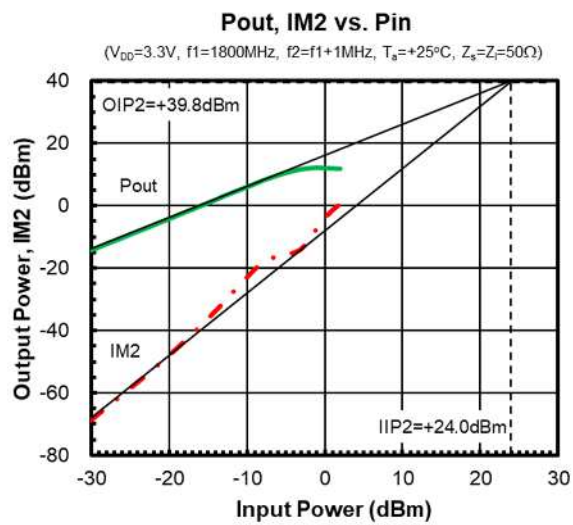
■ ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD} = 3.3\text{ V}$, $T_a = +25^\circ\text{C}$, $Z_s = Z_L = 50\ \Omega$, with application circuit



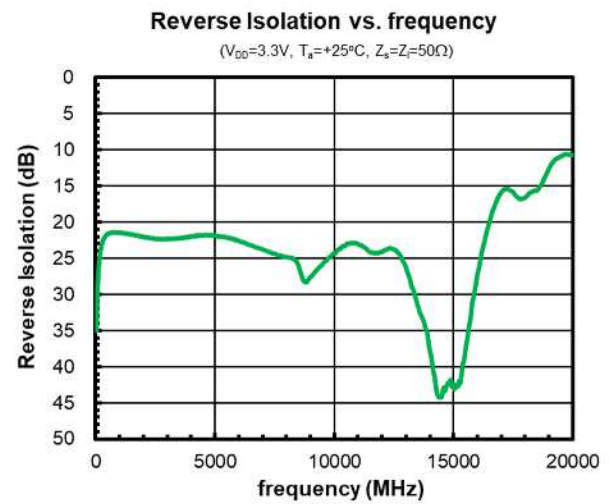
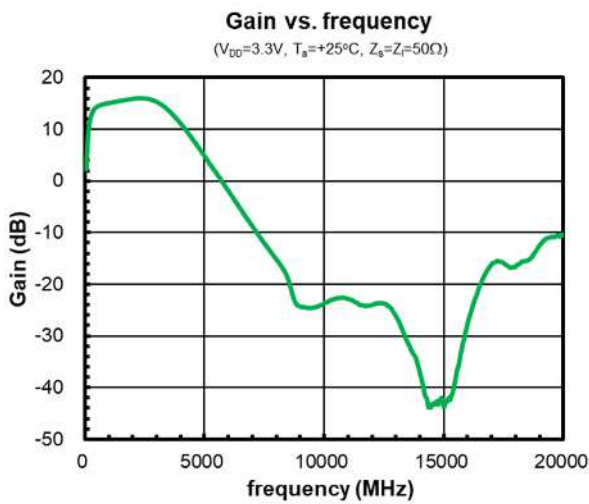
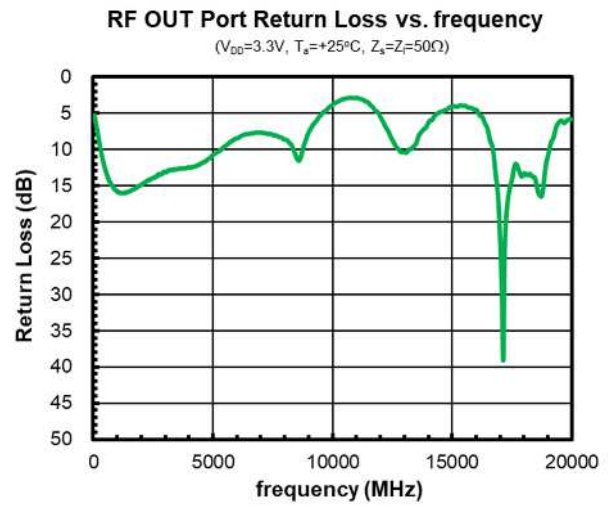
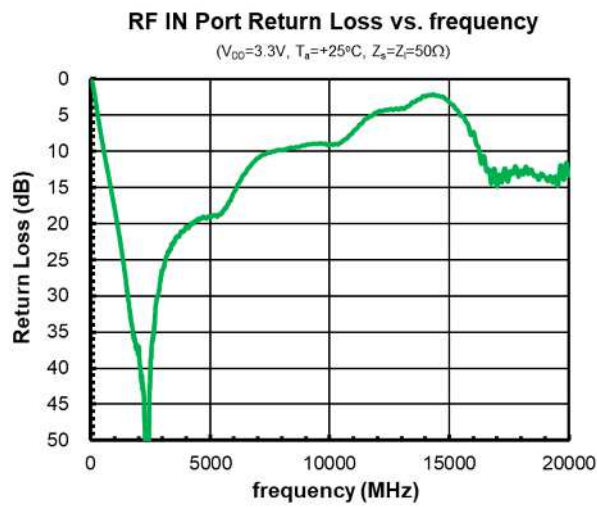
■ ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD} = 3.3\text{ V}$, $T_a = +25^\circ\text{C}$, $Z_s = Z_L = 50\ \Omega$, with application circuit



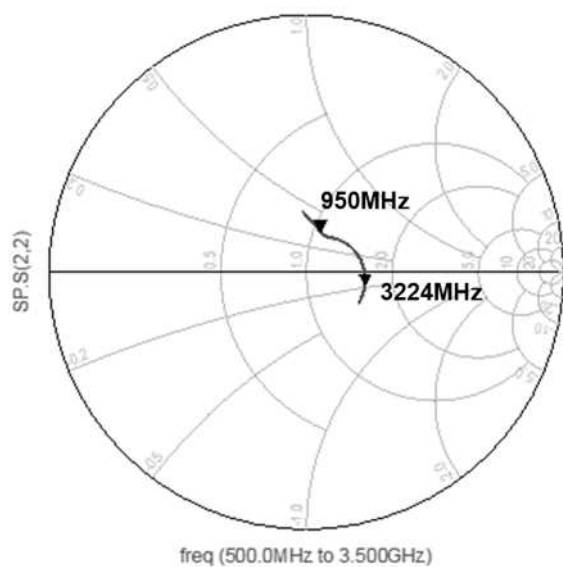
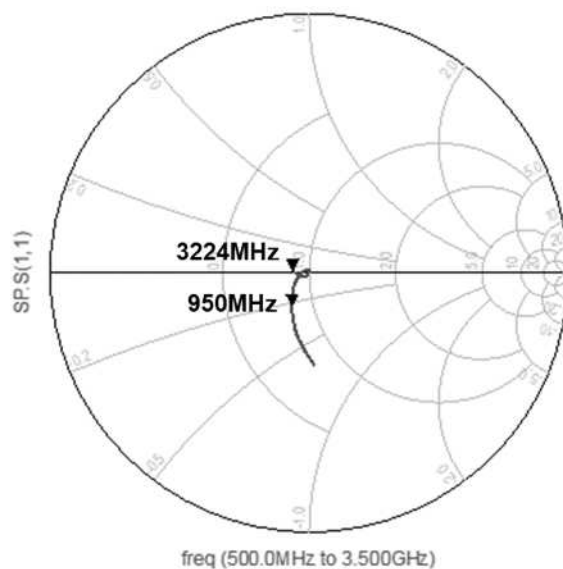
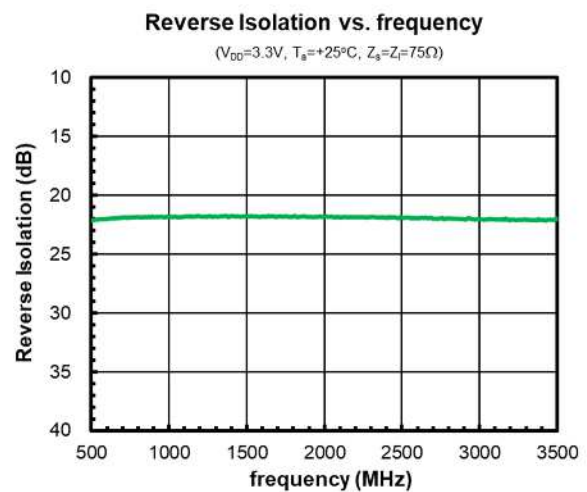
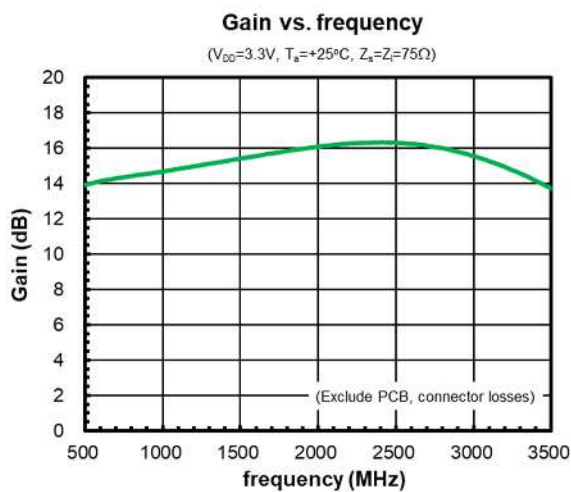
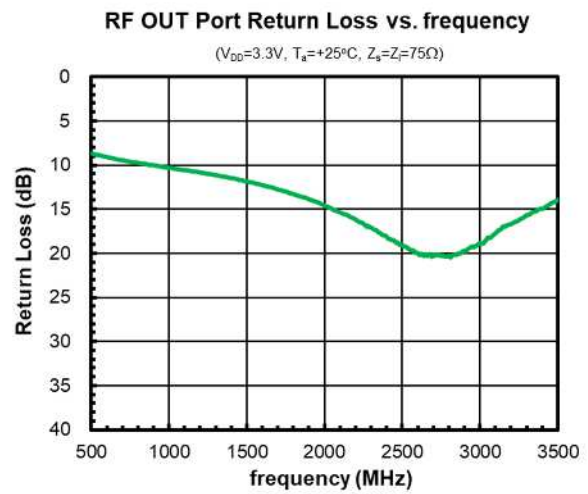
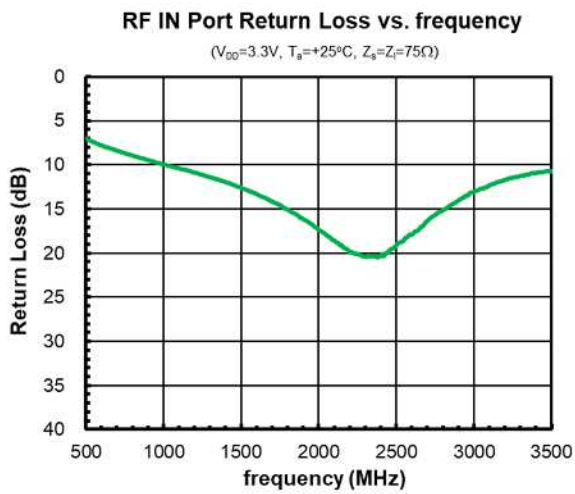
■ ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD} = 3.3\text{ V}$, $f_{RF} = 50\text{ MHz} \sim 20\text{ GHz}$, $T_a = +25^\circ\text{C}$, $Z_s = Z_l = 50\ \Omega$, with application circuit



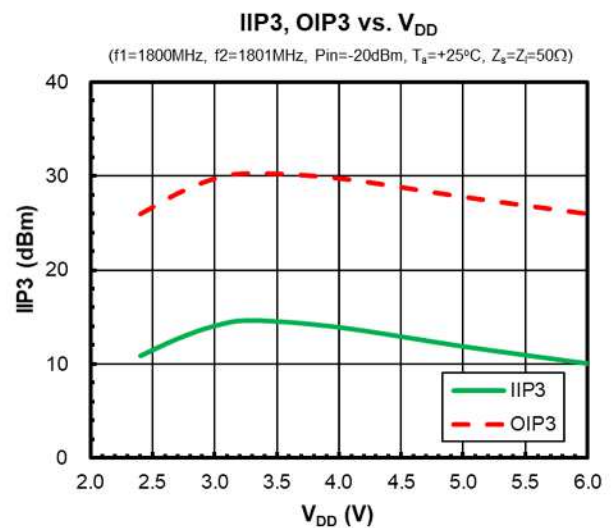
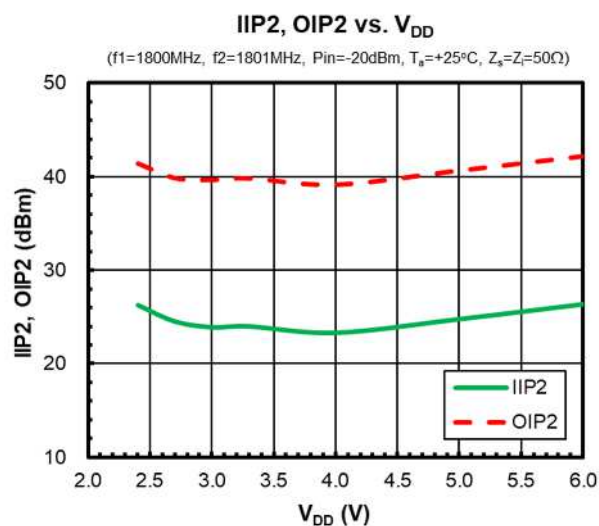
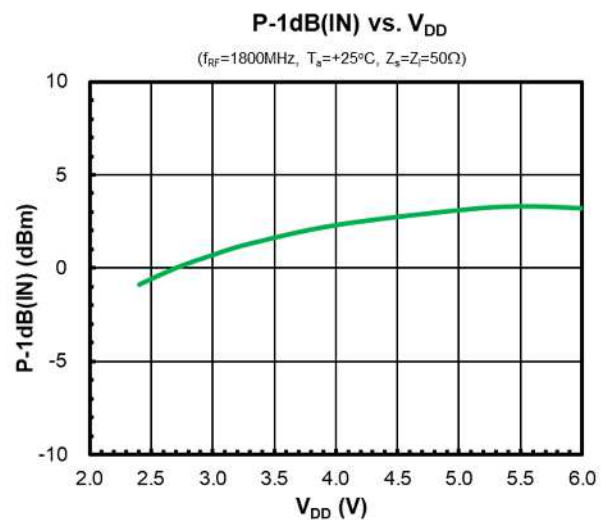
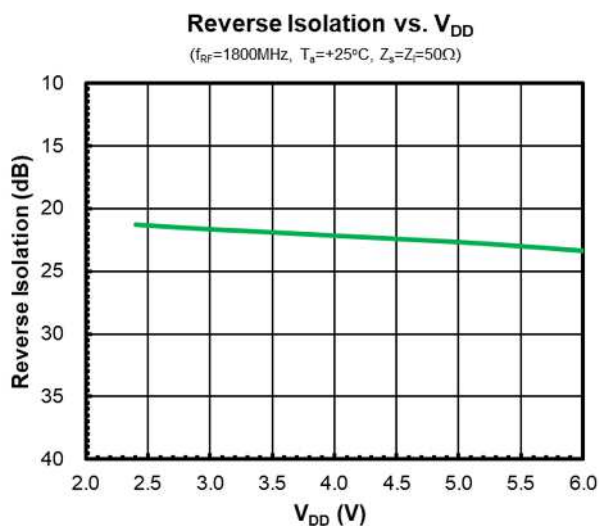
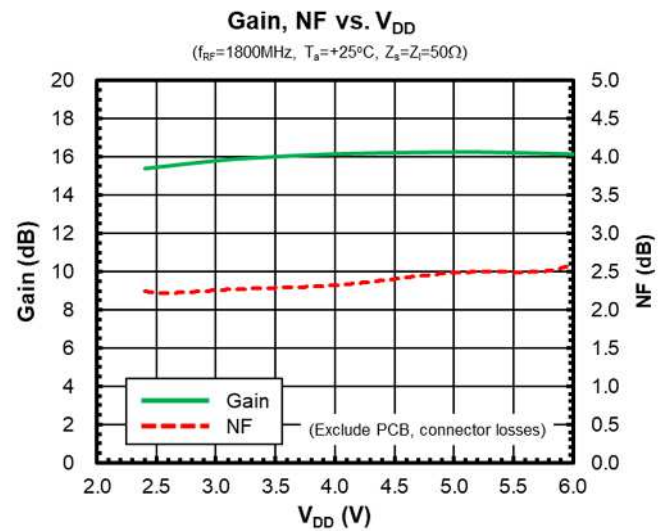
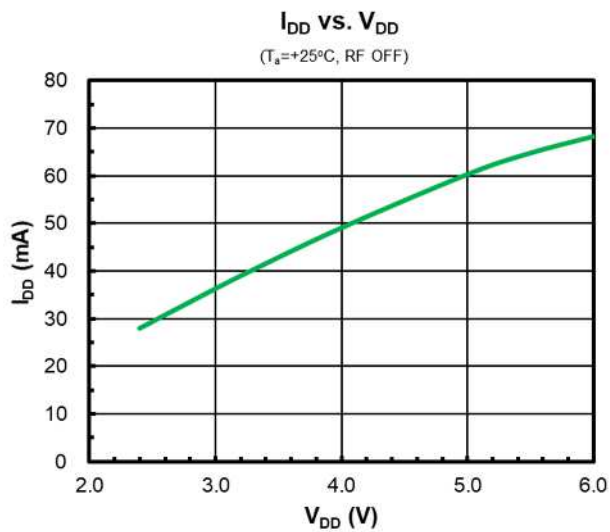
■ ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD} = 3.3\text{ V}$, $f_{RF} = 500\text{ to }3500\text{ MHz}$, $T_a = +25^\circ\text{C}$, $Z_s = Z_L = 75\ \Omega$, with application circuit



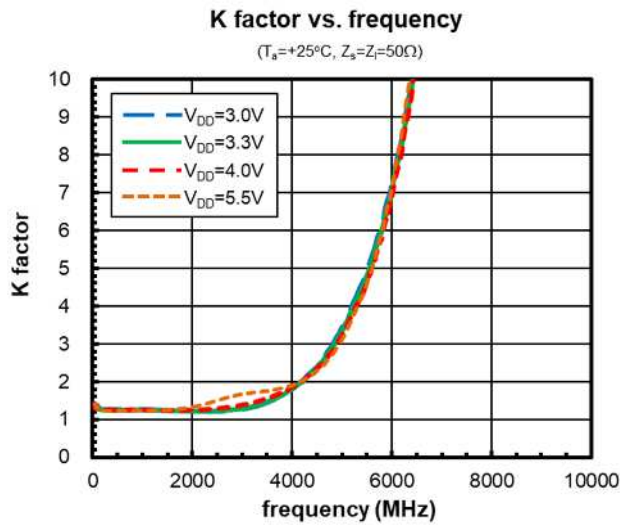
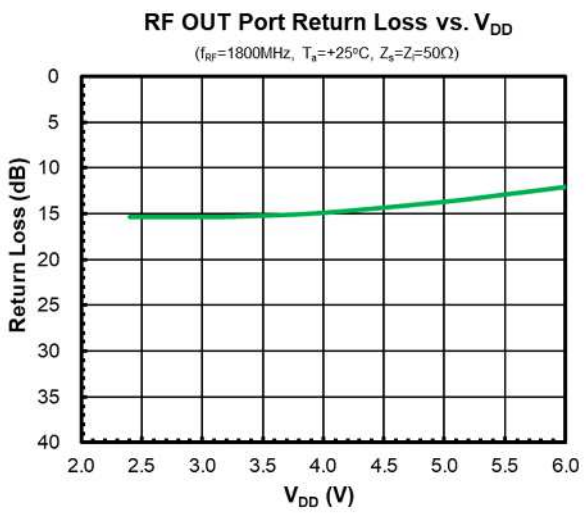
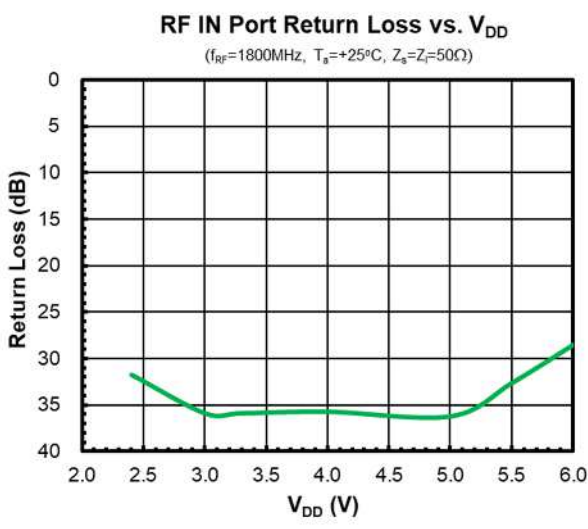
ELECTRICAL CHARACTERISTICS

Conditions: $T_a = +25^\circ\text{C}$, $Z_s = Z_L = 50\ \Omega$, with application circuit



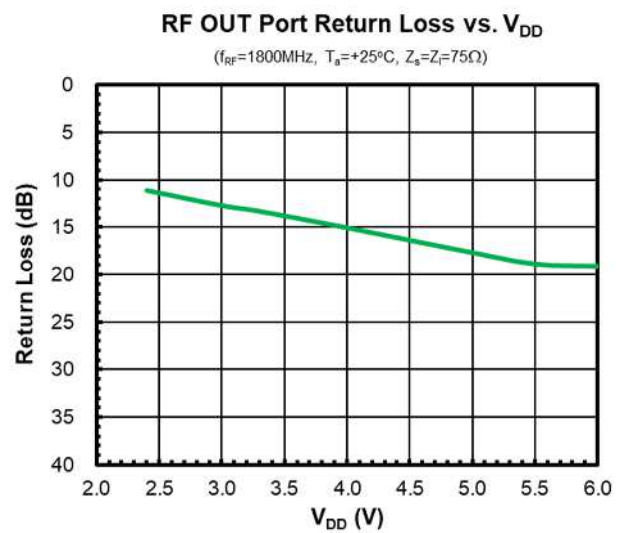
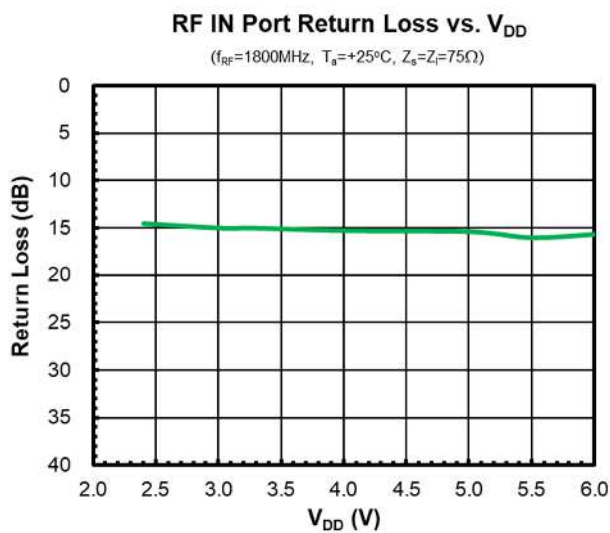
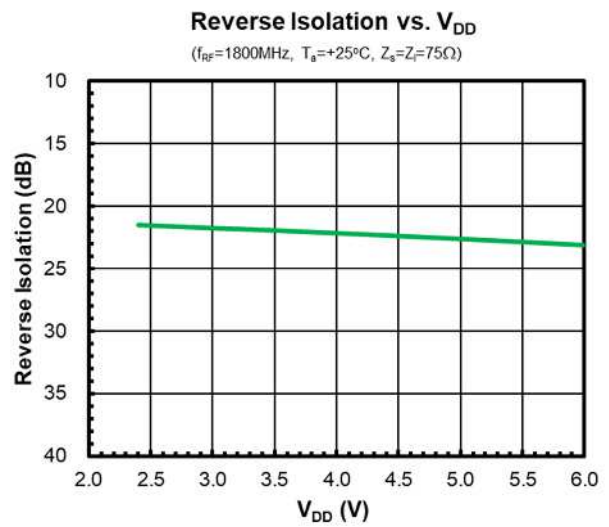
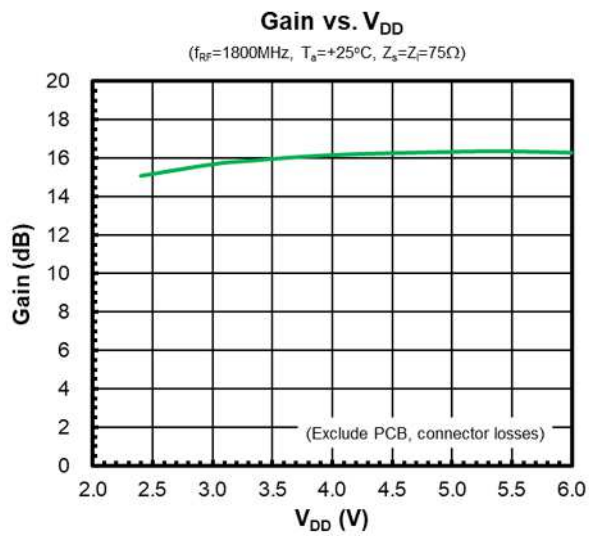
■ ELECTRICAL CHARACTERISTICS

Conditions: $T_a = +25^{\circ}\text{C}$, $Z_s = Z_L = 50\ \Omega$, with application circuit



■ ELECTRICAL CHARACTERISTICS

Conditions: $T_a = +25^\circ\text{C}$, $Z_s = Z_L = 75\ \Omega$, with application circuit

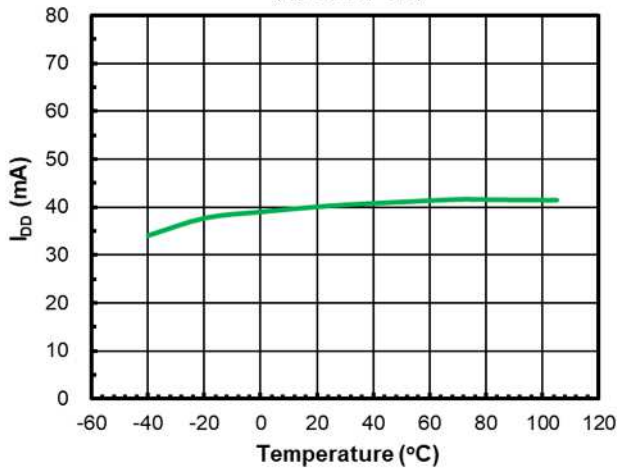


ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD} = 3.3\text{ V}$, $Z_s = Z_L = 50\ \Omega$, with application circuit

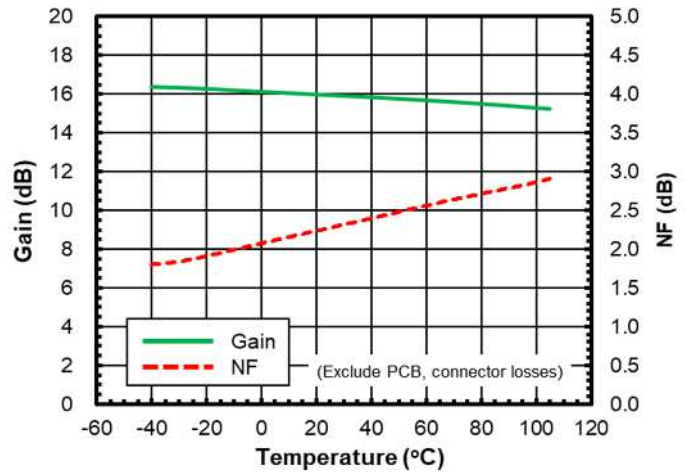
I_{DD} vs. Temperature

($V_{DD}=3.3\text{V}$, RF OFF)



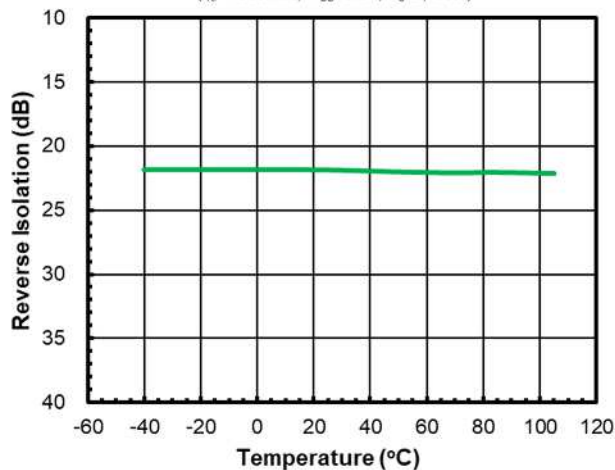
Gain, NF vs. Temperature

($f_{RF}=1800\text{MHz}$, $V_{DD}=3.3\text{V}$, $Z_s=Z_L=50\ \Omega$)



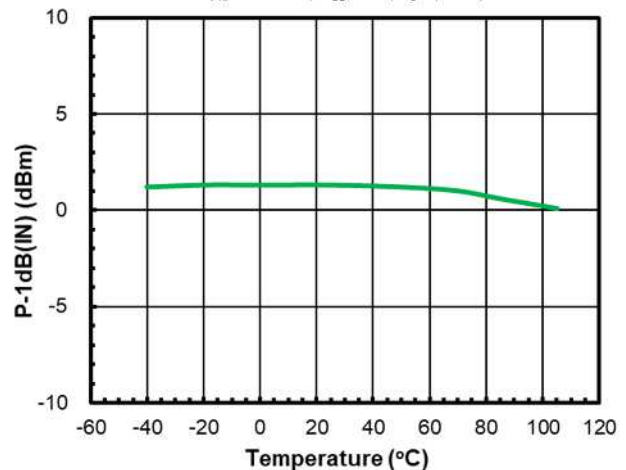
Reverse Isolation vs. Temperature

($f_{RF}=1800\text{MHz}$, $V_{DD}=3.3\text{V}$, $Z_s=Z_L=50\ \Omega$)



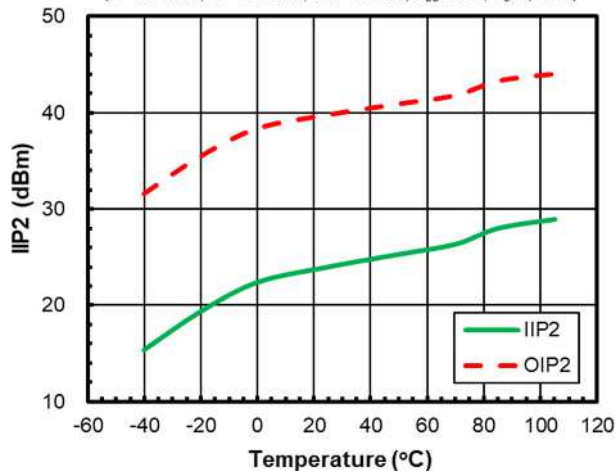
P-1dB(IN) vs. Temperature

($f_{RF}=1800\text{MHz}$, $V_{DD}=3.3\text{V}$, $Z_s=Z_L=50\ \Omega$)



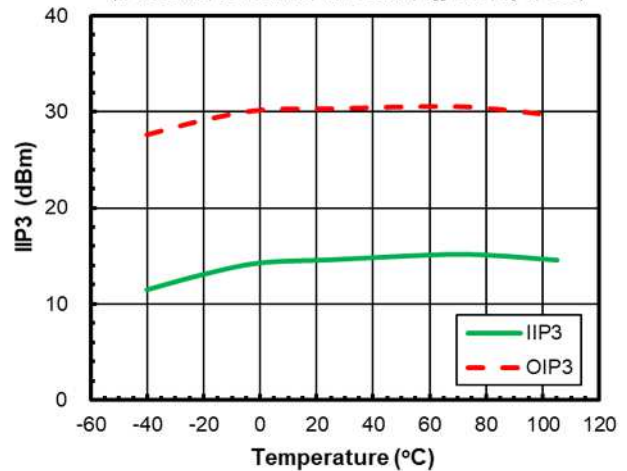
IIP2, OIP2 vs. Temperature

($f_1=1800\text{MHz}$, $f_2=1801\text{MHz}$, $P_{in}=-20\text{dBm}$, $V_{DD}=3.3\text{V}$, $Z_s=Z_L=50\ \Omega$)



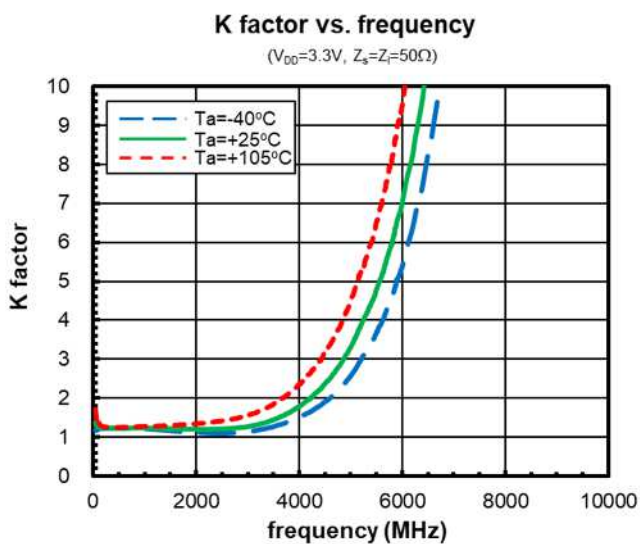
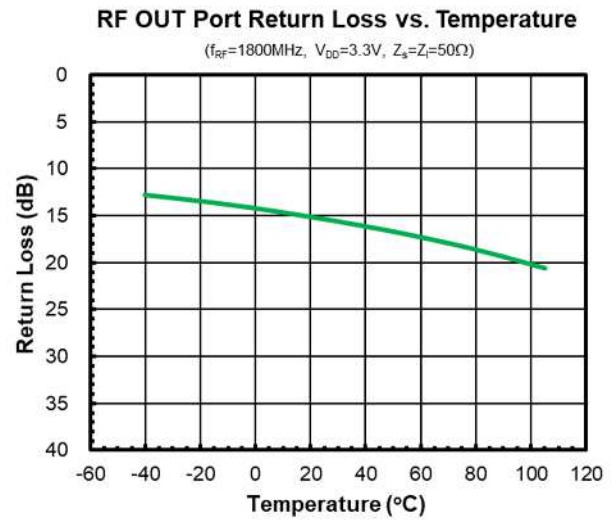
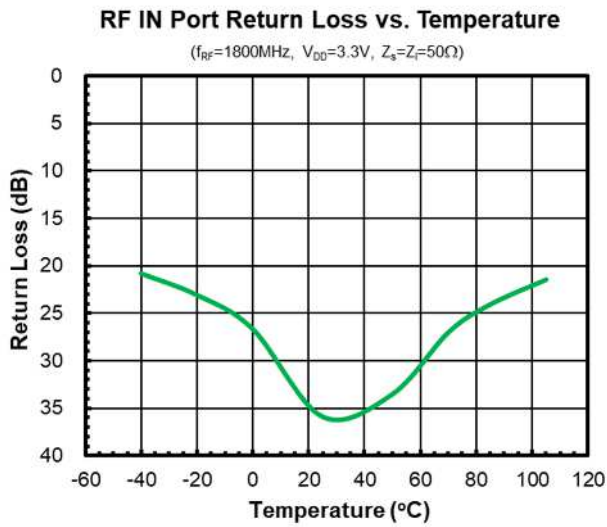
IIP3, OIP3 vs. Temperature

($f_1=1800\text{MHz}$, $f_2=1801\text{MHz}$, $P_{in}=-20\text{dBm}$, $V_{DD}=3.3\text{V}$, $Z_s=Z_L=50\ \Omega$)



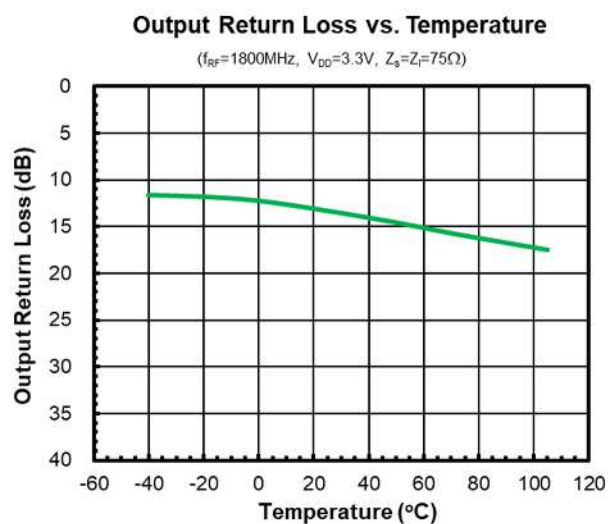
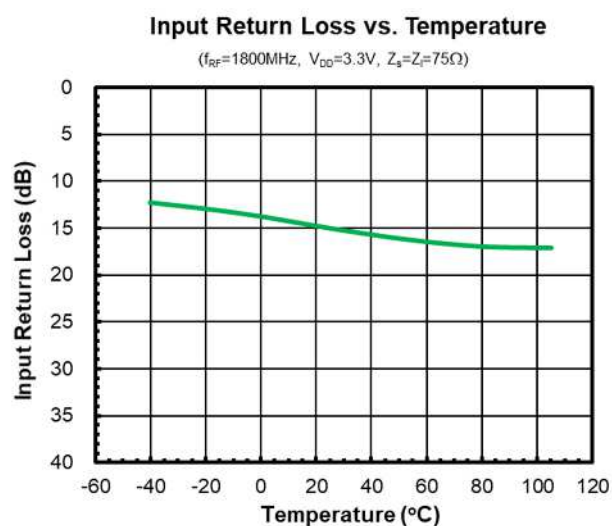
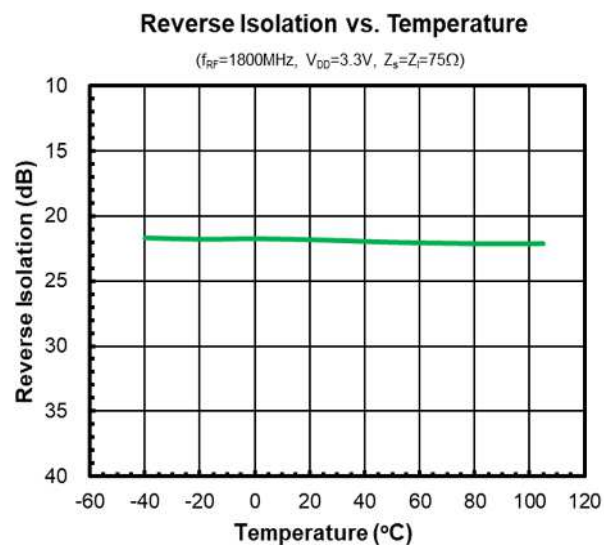
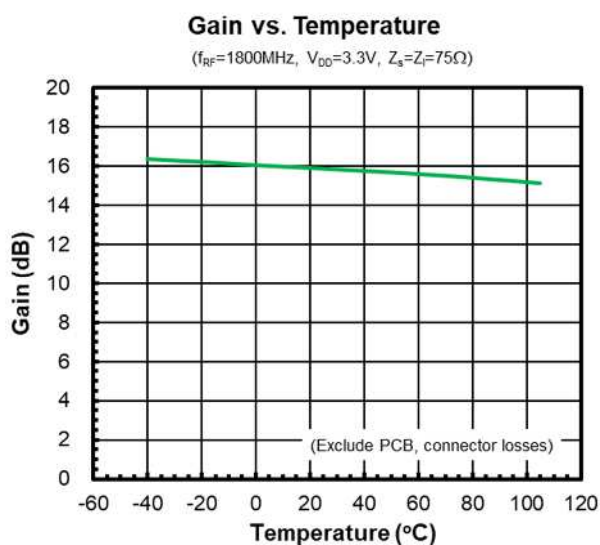
■ ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD} = 3.3\text{ V}$, $Z_s = Z_L = 50\ \Omega$, with application circuit

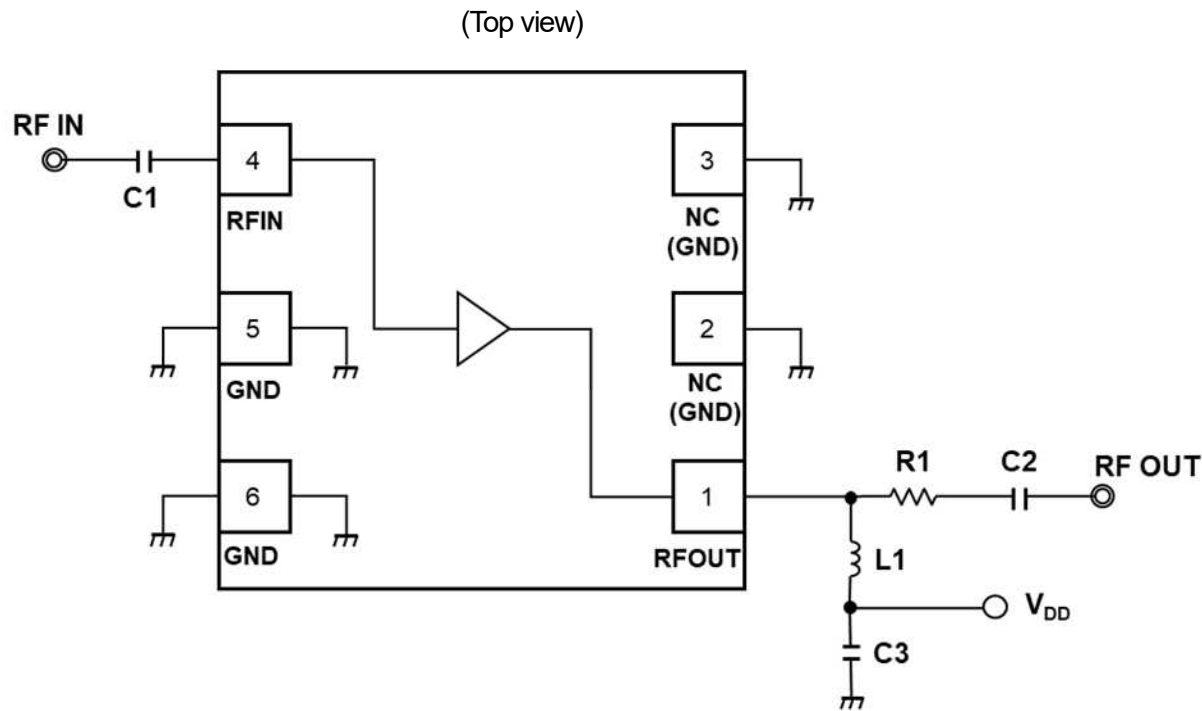


■ ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD} = 3.3\text{ V}$, $Z_s = Z_L = 75\ \Omega$, with application circuit



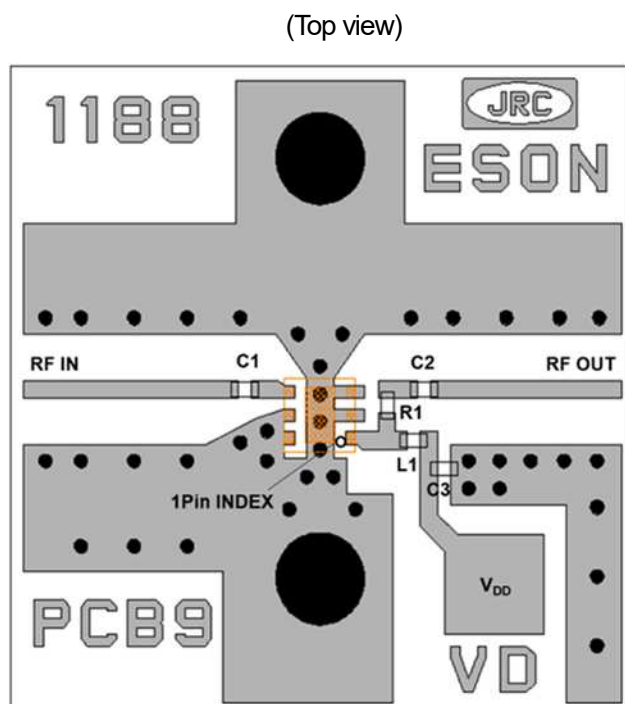
■ APPLICATION CIRCUIT



<PARTS LIST>

Part ID	Value	Notes
L1	47 nH	LQP03TN_02 Series (Murata)
C1	1000 pF	GRM03 Series (Murata)
C2		
C3		
R1	10 Ω	0603 size

■ EVALUATION BOARD



PCB

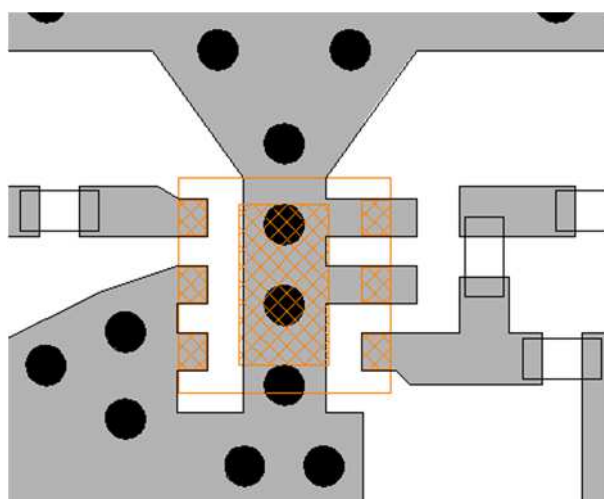
Substrate: FR-4

Thickness: 0.2 mm

Microstrip line width: 0.38 mm ($Z_0 = 50 \Omega$)

Size: 14.0 mm x 14.0 mm

<PCB LAYOUT GUIDELINE>



-  PCB
-  PKG Terminal
-  PKG Outline
-  GND Via Hole
Diameter $\phi = 0.2$ mm

PRECAUTIONS

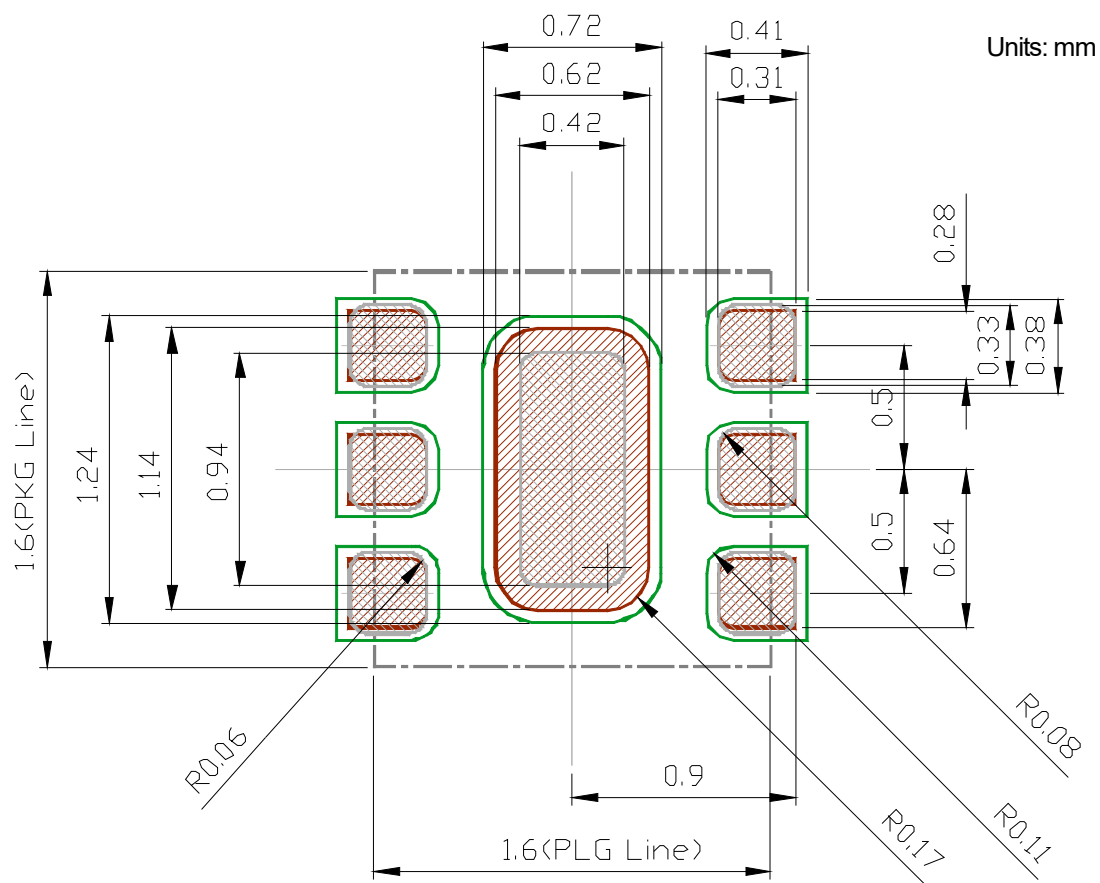
- All external parts should be placed as close as possible to the IC.
- For good RF performance, all GND terminals must be connected to PCB ground plane of substrate, and via-holes for GND should be placed near the IC.

■ 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)



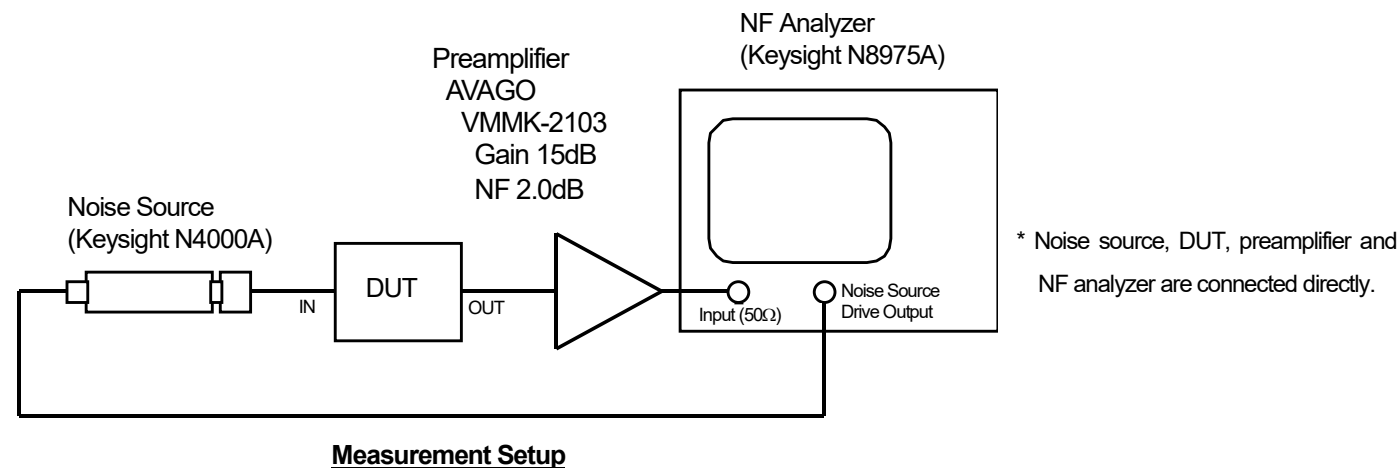
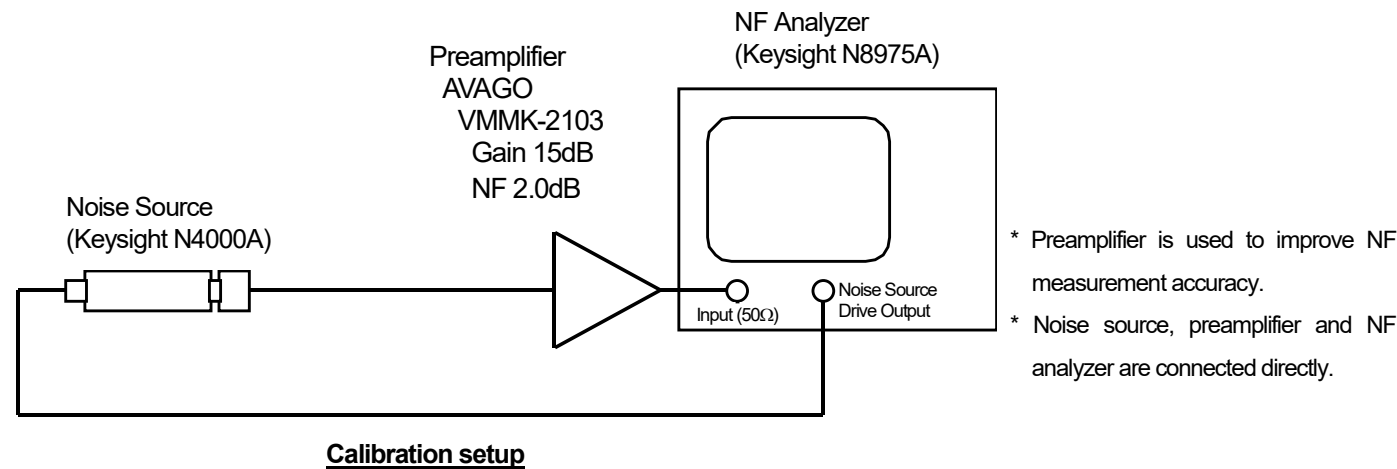
■ NOISE FIGURE MEASUREMENT BLOCK DIAGRAM

Measuring instruments

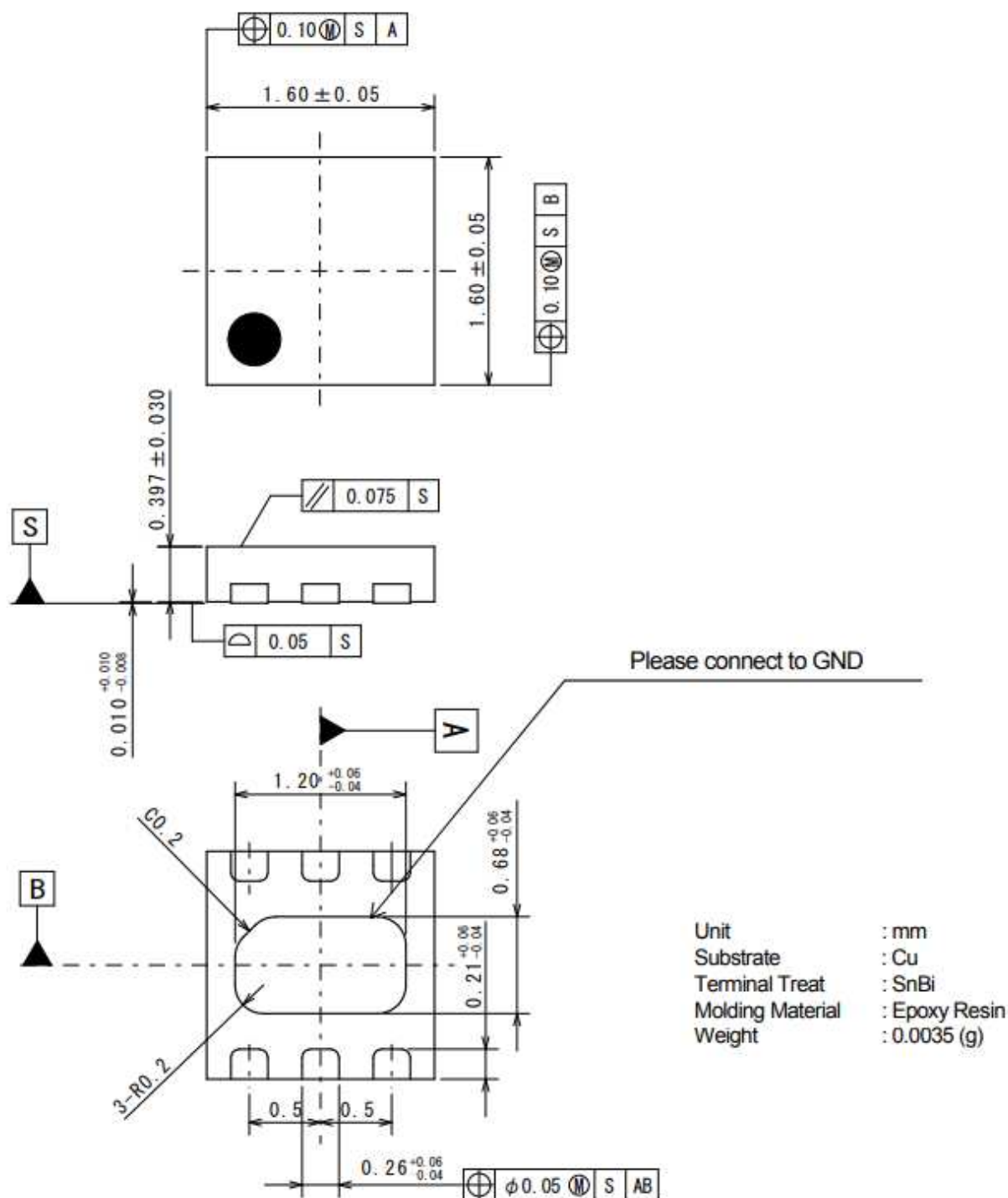
NF Analyzer	: Keysight N8975A
Noise Source	: Keysight N4000A

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	: 4 MHz
Loss comp	: off
Tcold	: Auto



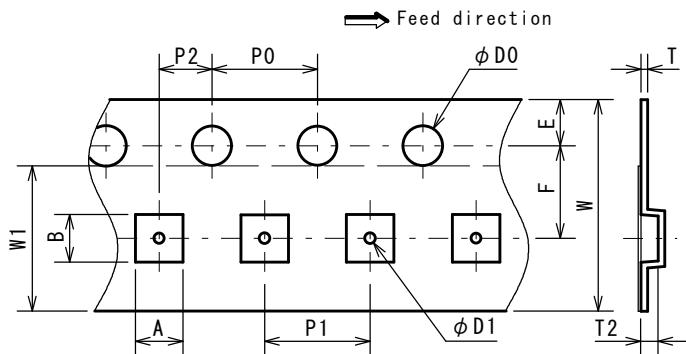
■ PACKAGE OUTLINE (ESON6-G1)



PACKING SPEC

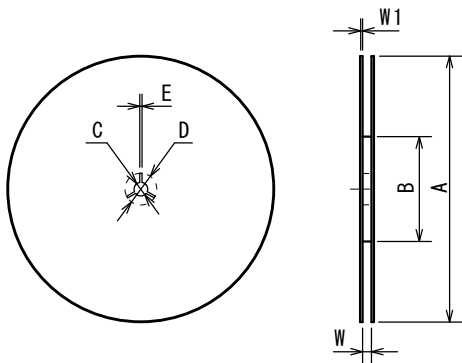
Unit: mm

TAPING DIMENSIONS



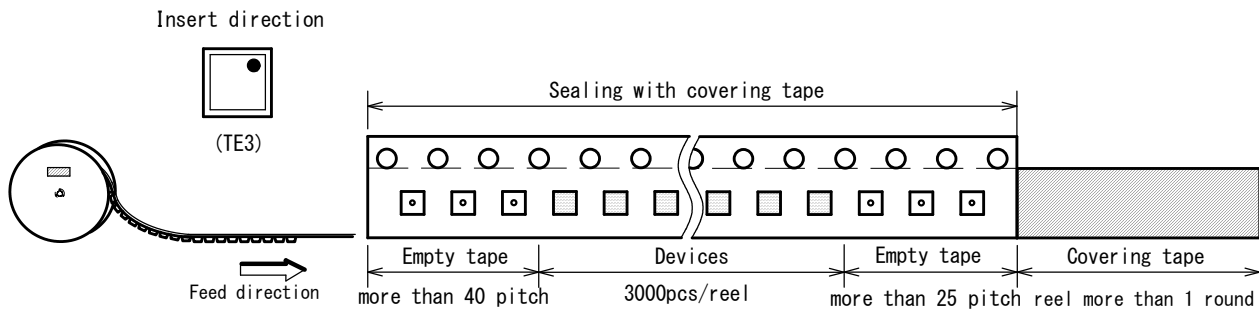
SYMBOL	DIMENSION	REMARKS
A	1.85±0.05	BOTTOM DIMENSION
B	1.85±0.05	BOTTOM DIMENSION
D0	1.5 ^{+0.1} ₀	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

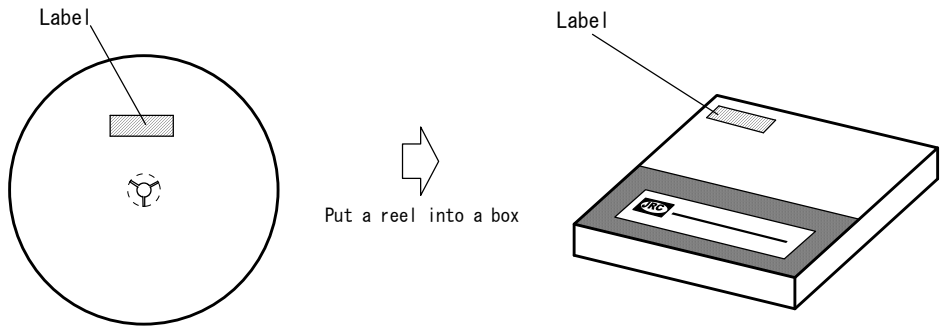


SYMBOL	DIMENSION
A	φ 180 ⁰ _{-1.5}
B	φ 60 ⁺¹ ₀
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9 ^{+0.3} ₀
W1	1.2

TAPING STATE



PACKING STATE



1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
4. The technical information described in this document shows typical characteristics and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under our or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death should first contact us.
 - Aerospace Equipment
 - Equipment Used in the Deep Sea
 - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
 - Life Maintenance Medical Equipment
 - Fire Alarms / Intruder Detectors
 - Vehicle Control Equipment (automotive, airplane, railroad, ship, etc.)
 - Various Safety Devices
 - Traffic control system
 - Combustion equipment

In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.

6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. **Quality Warranty**
 - 8-1. **Quality Warranty Period**

In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
 - 8-2. **Quality Warranty Remedies**

When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.

Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
 - 8-3. **Remedies after Quality Warranty Period**

With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.



Nisshinbo Micro Devices Inc.

Official website

<https://www.nisshinbo-microdevices.co.jp/en/>

Purchase information

<https://www.nisshinbo-microdevices.co.jp/en/buy/>