

SPDT SWITCH GaAs MMIC

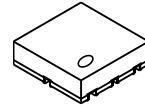
■ GENERAL DESCRIPTION

NJG1635AHB6 is a GaAs SPDT switch IC suited for mobile handset, WiBro and WiMAX devices. This switch features high power handling, low insertion loss, high isolation.

This switch includes logic decoder function, and can be operated by single bit control signal from 1.3V of logical high voltage. In addition, this switch includes ESD protection circuits.

The ultra-small & ultra-thin USB8-B6 package is adopted.

■ PACKAGE OUTLINE



NJG1635AHB6

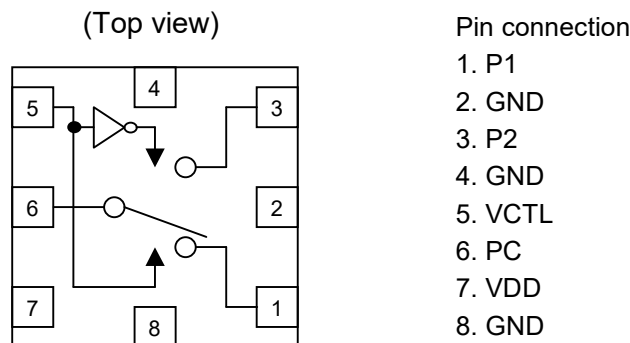
■ APPLICATIONS

- LTE, UMTS, CDMA and WiMAX applications
- Mobile phone, Data card, Tablet PC and Femtocell applications
- Antenna switching, Bands switching and Post PA switching applications
- General Purpose Switching application

■ FEATURES

- Single bit low voltage control +1.3V~+4.5V
- Operation supply voltage +2.5~+4.5V
- Low insertion loss 0.30dB typ. @f=0.9GHz, P_{IN}=30dBm, V_{DD}=2.7V
 0.35dB typ. @f=1.9GHz, P_{IN}=30dBm, V_{DD}=2.7V
 0.40dB typ. @f=2.7GHz, P_{IN}=30dBm, V_{DD}=2.7V
- High isolation 35dB typ. @f=0.9/1.9GHz, P_{IN}=30dBm, V_{DD}=2.7V
 33dB typ. @f=2.7GHz, P_{IN}=30dBm, V_{DD}=2.7V
- High power handling P_{-0.1dB}=32dBm min. @f=2.7GHz, V_{DD}=2.7V
- ESD protection circuit
- Small & thin package USB8-B6 (Package size: 1.5 x 1.5 x 0.55mm)

■ PIN CONFIGURATION



■ TRUTH TABLE

Control Voltage: "H"=V_{CTL (H)}, "L"=V_{CTL (L)}

VCTL	PATH
H	P1-PC
L	P2-PC

NOTE: Please note that any information on this datasheet will be subject to change

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■ ABSOLUTE MAXIMUM RATINGS

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

PARAMETER	SYMBOL	CONDITIONS	CONDITIONS	UNITS
RF Input Power	P_{IN}	$V_{DD}=2.7\text{V}$, $V_{CTL}=0/1.8\text{V}$	35	dBm
Supply Voltage	V_{DD}	VDD terminal	5.0	V
Control Voltage	V_{CTL}	VCTL terminal	5.0	V
Power Dissipation	P_D	on PCB board	160	mW
Operating Temp.	T_{opr}		-40~+95	$^{\circ}\text{C}$
Storage Temp.	T_{stg}		-55~+150	$^{\circ}\text{C}$

■ ELECTRICAL CHARACTERISTICS

(General conditions: $V_{DD}=2.7\text{V}$, $V_{CTL(L)}=0\text{V}$, $V_{CTL(H)}=1.8\text{V}$, $Z_s=Z_l=50\Omega$, $T_a=+25^{\circ}\text{C}$, with application circuit)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Voltage	V_{DD}		2.5	2.7	4.5	V
Operating Current	I_{DD}	$P_{IN}=30\text{dBm}$	-	25	50	μA
Control Voltage (LOW)	$V_{CTL(L)}$		0	-	0.4	V
Control Voltage (HIGH)	$V_{CTL(H)}$		1.3	1.8	4.5	V
Control Current	I_{CTL}		-	5	10	μA
Insertion Loss 1	LOSS1	$f=0.9\text{GHz}$, $P_{IN}=30\text{dBm}$	-	0.30	0.45	dB
Insertion Loss 2	LOSS2	$f=1.9\text{GHz}$, $P_{IN}=30\text{dBm}$	-	0.35	0.50	dB
Insertion Loss 3	LOSS3	$f=2.7\text{GHz}$, $P_{IN}=30\text{dBm}$	-	0.40	0.60	dB
Isolation 1	ISL1	$f=0.9\text{GHz}$, $P_{IN}=30\text{dBm}$	32	35	-	dB
Isolation 2	ISL2	$f=1.9\text{GHz}$, $P_{IN}=30\text{dBm}$	30	35	-	dB
Isolation 3	ISL3	$f=2.7\text{GHz}$, $P_{IN}=30\text{dBm}$	25	33	-	dB
Input Power at 0.1dB Compression	$P_{-0.1\text{dB}}$	$f=2.7\text{GHz}$	32	-	-	dBm
2nd Harmonics 1	$2f_o(1)$	$f=0.9\text{GHz}$, $P_{IN}=26\text{dBm}$	-	-75	-65	dBc
2nd Harmonics 2	$2f_o(2)$	$f=1.9\text{GHz}$, $P_{IN}=26\text{dBm}$	-	-75	-65	dBc
3rd Harmonics 1	$3f_o(1)$	$f=0.9\text{GHz}$, $P_{IN}=26\text{dBm}$	-	-80	-65	dBc
3rd Harmonics 2	$3f_o(2)$	$f=1.9\text{GHz}$, $P_{IN}=26\text{dBm}$	-	-80	-65	dBc
Input 3rd Order Intercept Point 1	IIP3(1)	$f=0.9\text{GHz}+0.901\text{GHz}$ $P_{IN}=25\text{dBm}$ each	58	64	-	dBm
Input 3rd Order Intercept Point 2	IIP3(2)	$f=1.9\text{GHz}+1.901\text{GHz}$ $P_{IN}=25\text{dBm}$ each	58	62	-	dBm
VSWR (PC, P1, P2)	VSWR	$f=2.7\text{GHz}$, ON State	-	1.2	1.4	
Switching time	T_{sw}	PC-P1, PC-P2 port switching time	-	2	5	μs

The input 3rd order intercept point is defined as following equation, $IIP3 = (3 \times P_{out} - IM3)/2 + LOSS$

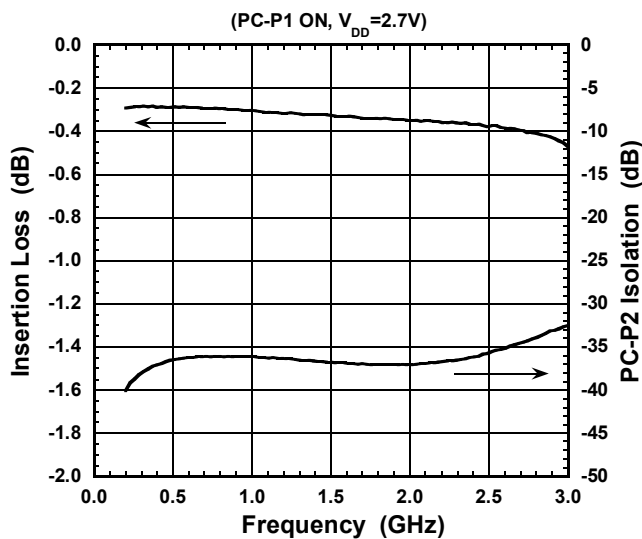
■ TERMINAL INFORMATION

No.	SYMBOL	DESCRIPTION
1	P1	This port is connected to PC port by control voltage of +1.3~4.5V($V_{CTL(H)}$) to 5th pin. An external capacitor is required to block the DC bias voltage of internal circuit.
2	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
3	P2	This port is connected to PC port by control voltage of +0.0~0.4V($V_{CTL(L)}$) to 5th pin. An external capacitor is required to block the DC bias voltage of internal circuit.
4	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
5	VCTL	Control port. This terminal is set to +1.3V~4.5V of logical high level for ON state between PC and P1 RF ports, and set to +0.0~0.4V of logical low level for ON state between PC and P2 RF ports.
6	PC	Common RF port. This PC port is connected to P1 or P2 by logical control voltage of VCTL. In order to block DC bias voltage of internal circuit, an external capacitor is required.
7	VDD	A supply voltage terminal (+2.5~+4.5V). Please place a bypass capacitor between this and GND for avoiding RF noise from outside.
8	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.

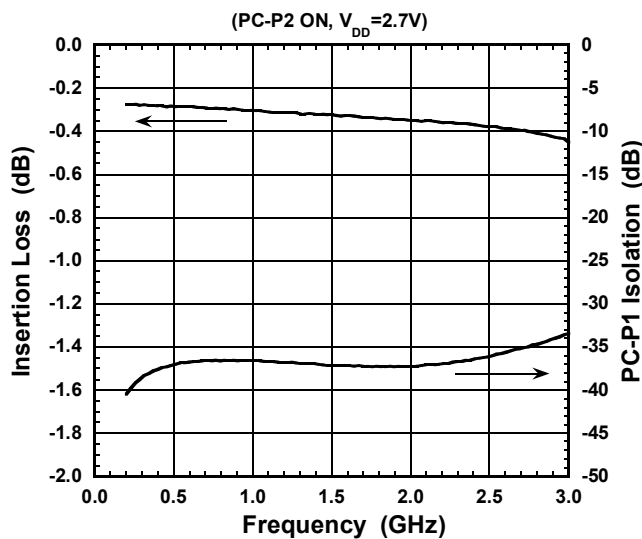
NJG1635AHB6

■ ELECTRICAL CHARACTERISTICS (with Application circuit, Loss of external circuit are excluded)

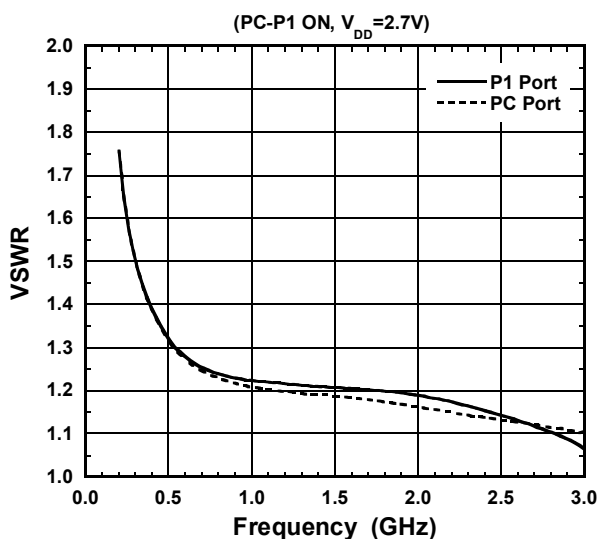
Loss, Isolation vs Frequency



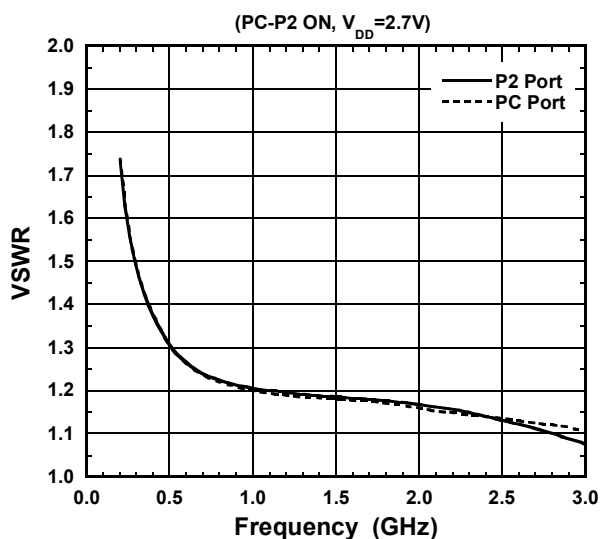
Loss, Isolation vs Frequency



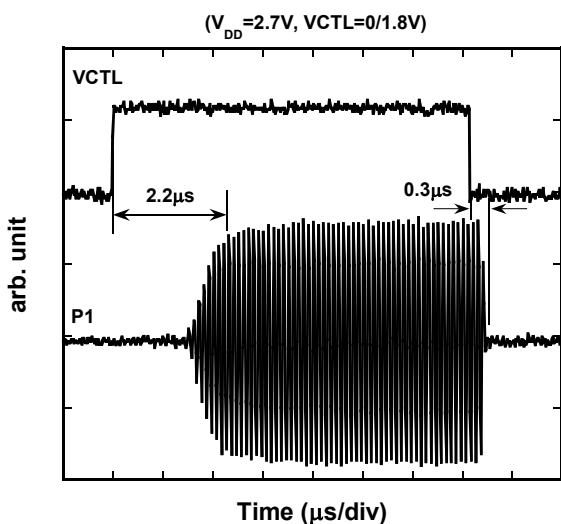
VSWR vs Frequency



VSWR vs Frequency

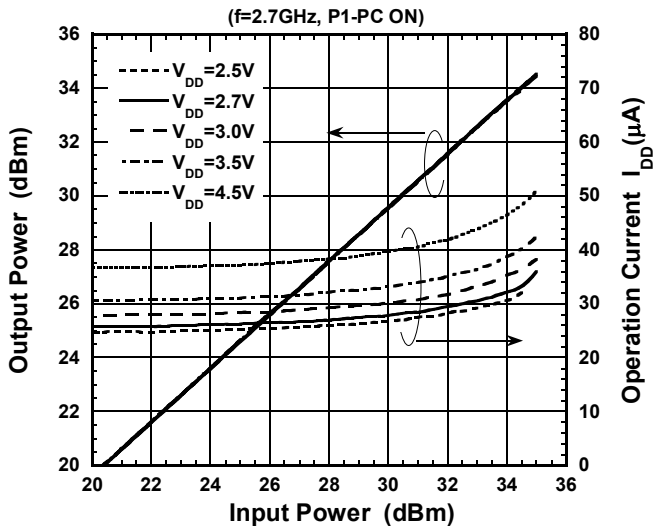


Switching Time

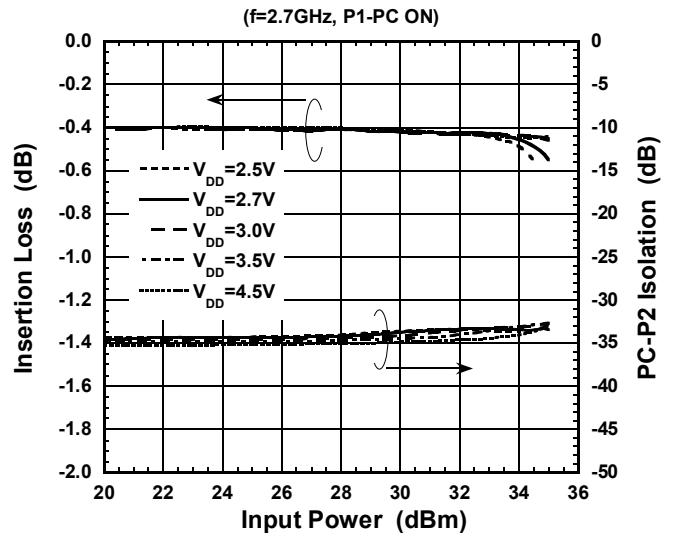


■ ELECTRICAL CHARACTERISTICS (with Application circuit, Loss of external circuit are excluded)

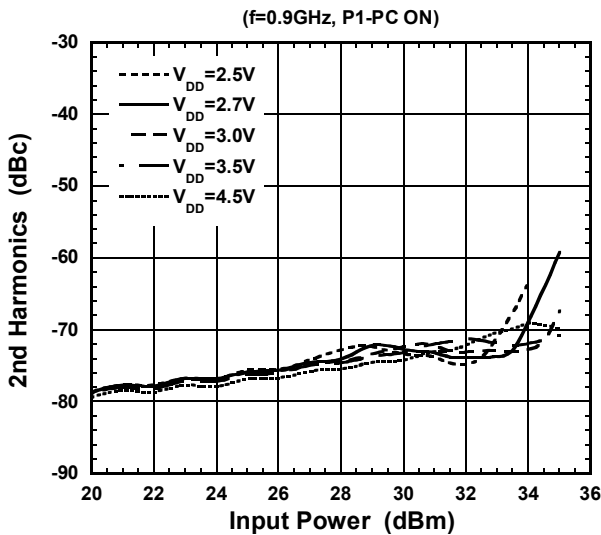
Output Power, I_{DD} vs Input Power



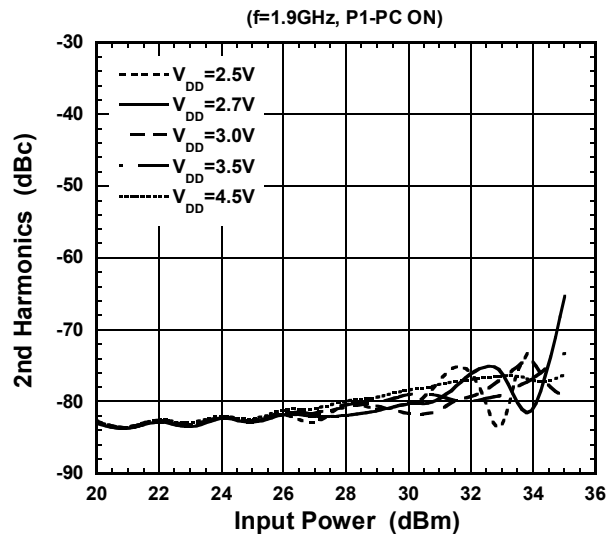
Loss, ISL vs Input Power



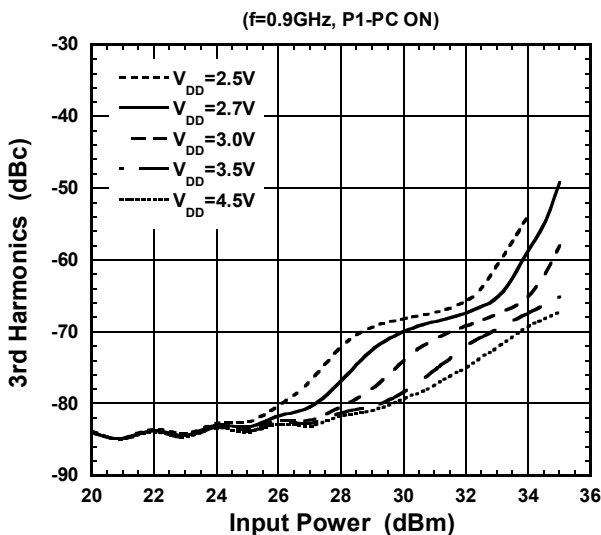
2nd Harmonics vs Input Power



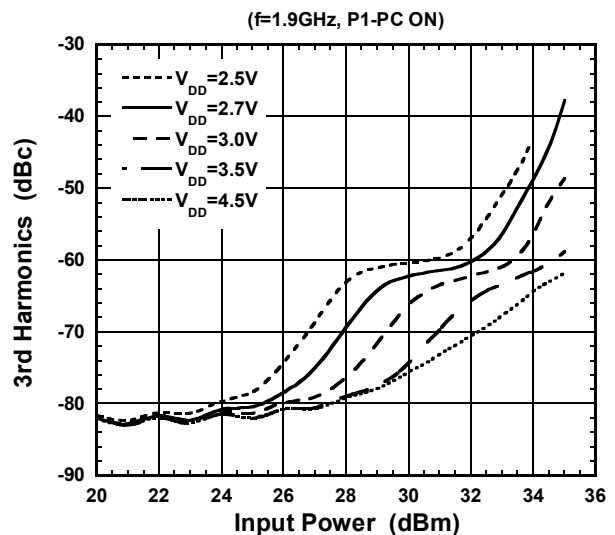
2nd Harmonics vs Input Power



3rd Harmonics vs Input Power



3rd Harmonics vs Input Power

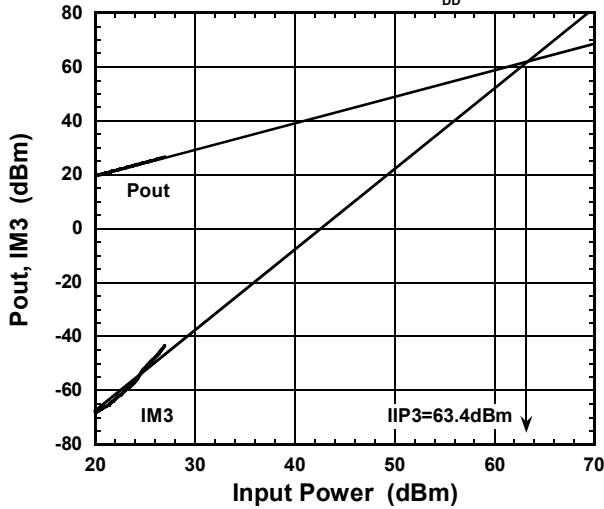


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■ ELECTRICAL CHARACTERISTICS (with Application circuit, Loss of external circuit are excluded)

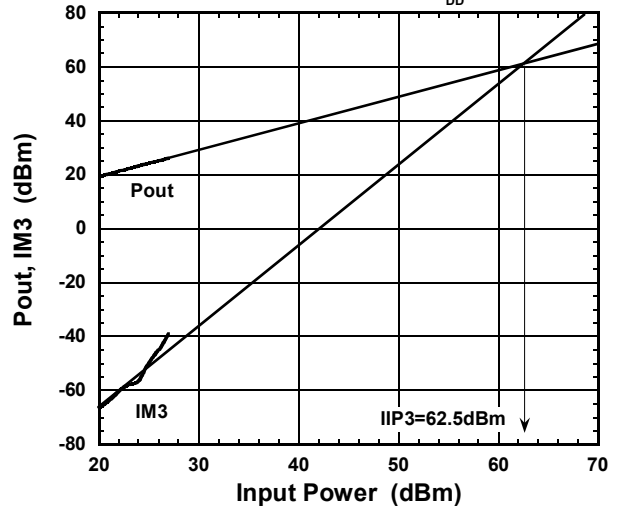
Pout, IM3 vs Input Power

(f=0.9+0.901GHz, P1-PC ON, V_{DD}=2.7V)



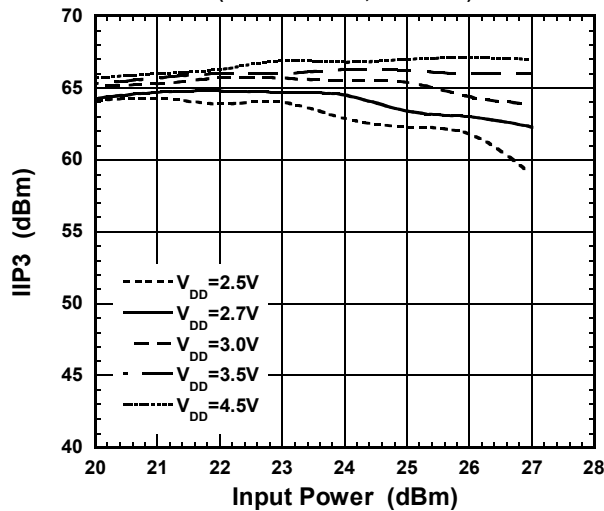
Pout, IM3 vs Input Power

(f=1.9+1.901GHz, P1-PC ON, V_{DD}=2.7V)



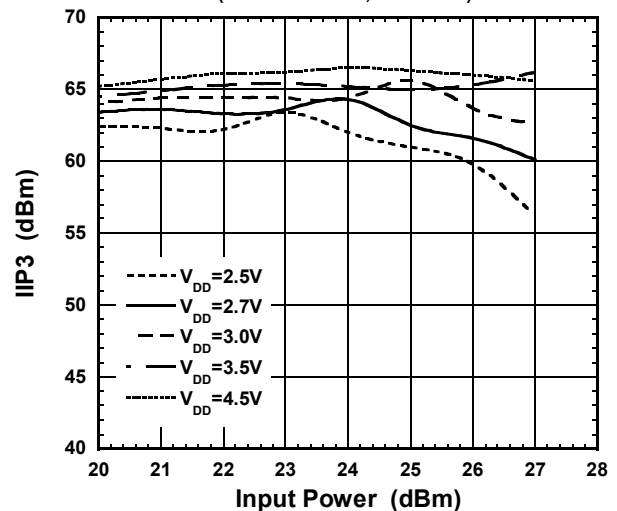
IIP3 vs Input Power

(f=0.9+0.901GHz, P1-PC ON)



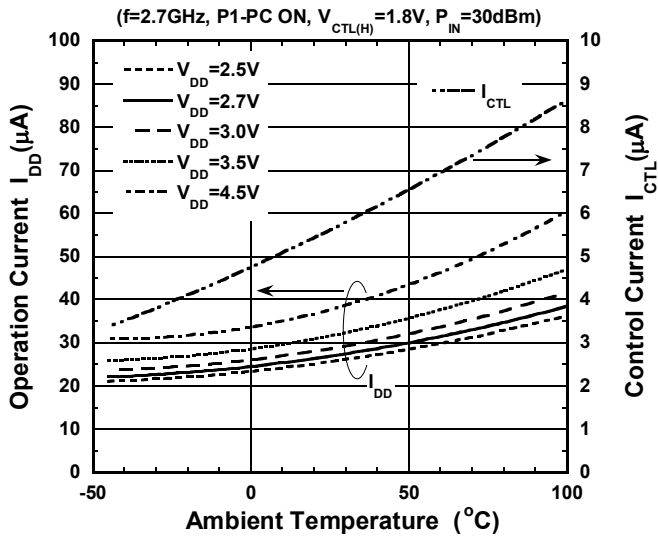
IIP3 vs Input Power

(f=1.9+1.901GHz, P1-PC ON)

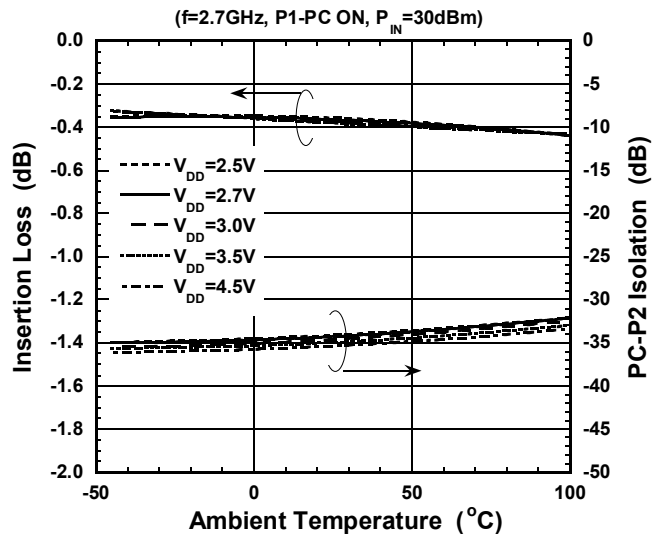


ELECTRICAL CHARACTERISTICS (with Application circuit, Loss of external circuit are excluded)

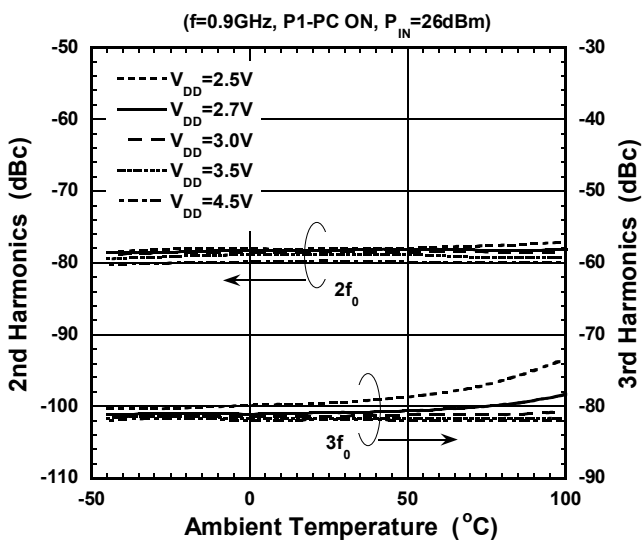
I_{DD} , I_{CTL} vs Ambient Temperature



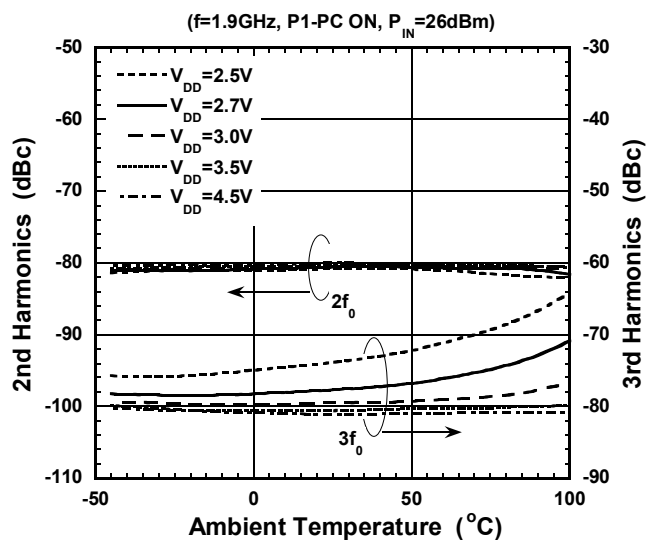
Loss, ISL vs Ambient Temperature



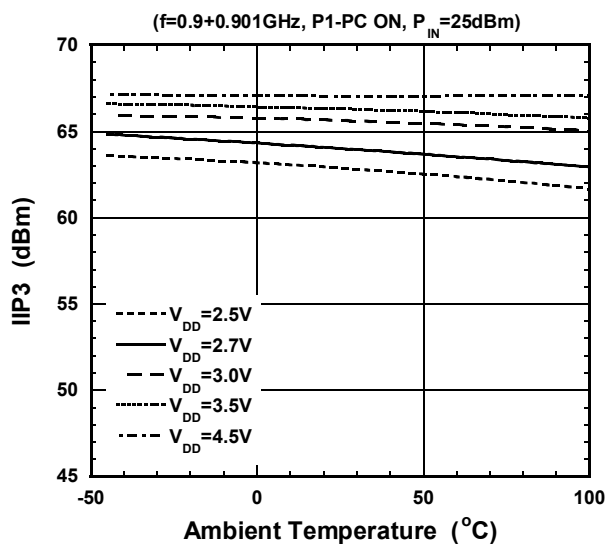
Harmonics vs Ambient Temperature



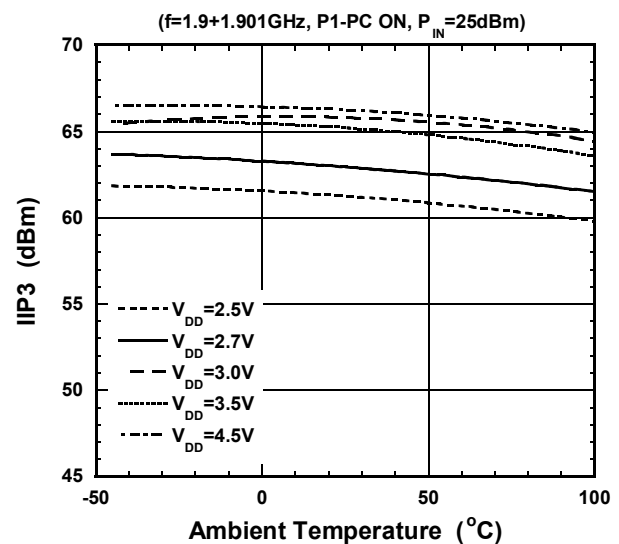
Harmonics vs Ambient Temperature



IIP3 vs Ambient Temperature

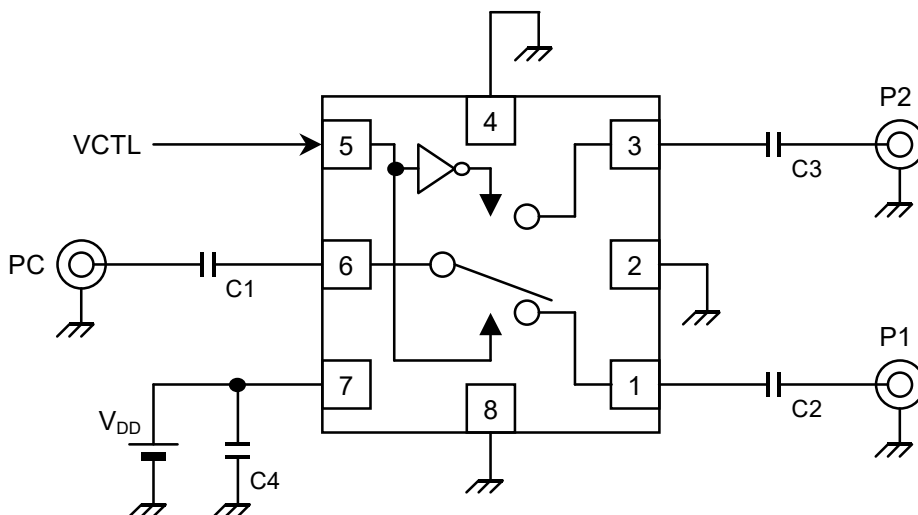


IIP3 vs Ambient Temperature



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APPLICATION CIRCUIT

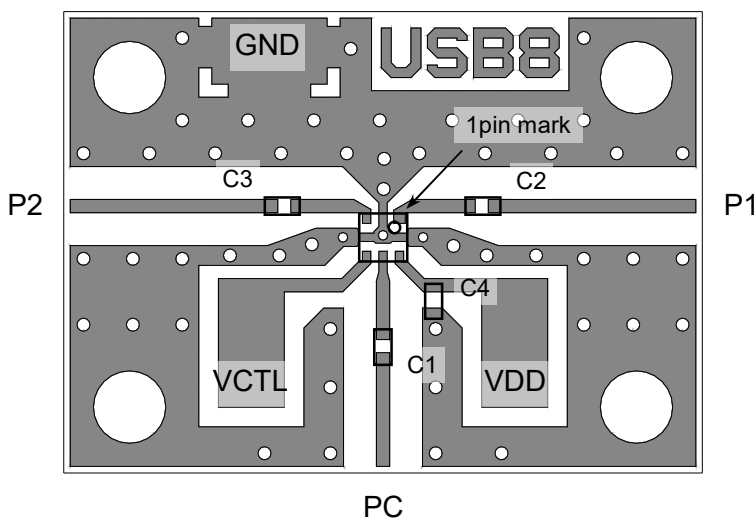


PARTS LIST

PART ID	Value	COMMENT
C1~C3	56pF	MURATA (GRM15)
C4	1000pF	

TEST PCB LAYOUT

(TOP VIEW)



PCB SIZE=19.4x14.0mm

PCB: FR-4, t=0.2mm

CAPACITOR: size 1005

STLPLINE=0.4mm

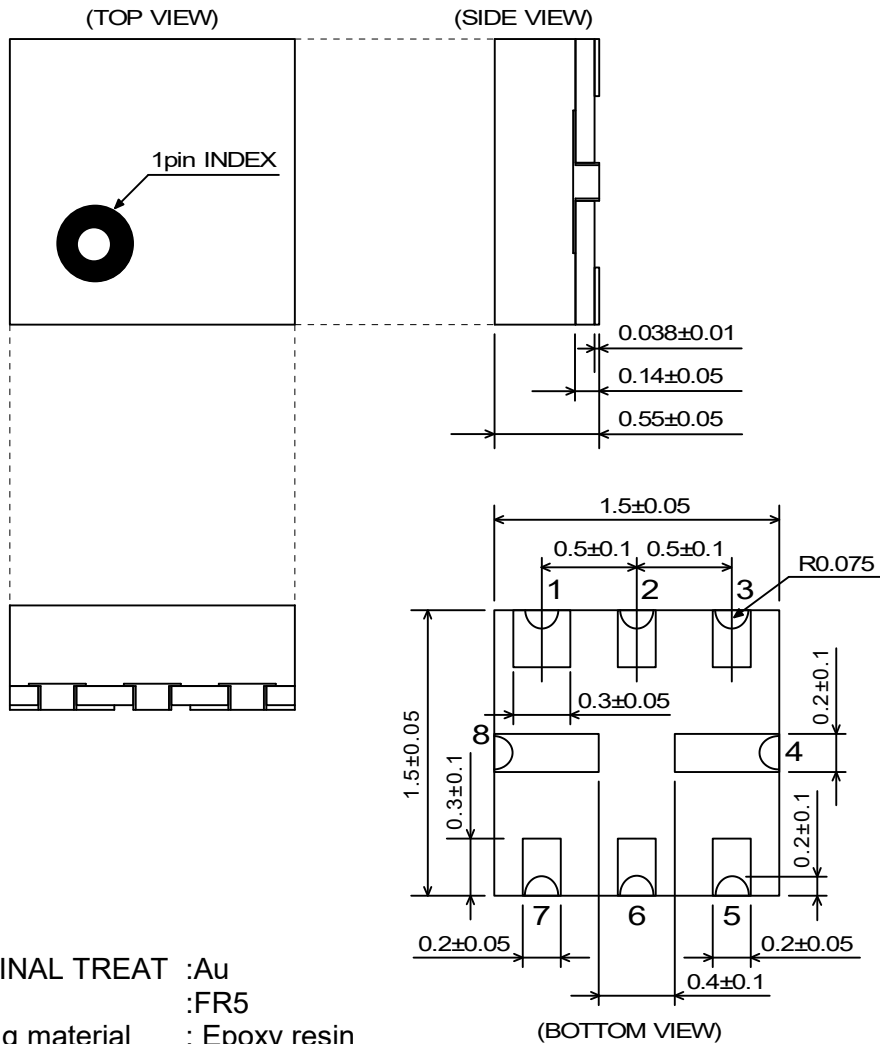
Losses of PCB, capacitors and connectors

Frequency (GHz)	Loss (dB)
0.9	0.21
1.9	0.30
2.7	0.38

PRECAUTIONS

- [1]The DC blocking capacitors have to be placed at RF terminal of P1, P2 and PC. Please choose appropriate capacitance values to the application frequency.
- [2]To reduce strip line influence on RF characteristics, please locate bypass capacitors(C4) as close as possible to each terminal.
- [3]For good isolation, the GND terminal (2nd pin) must be connected to the ground plane of substrate, and through-holes for GND should be placed near by the pin connection.

PACKAGE OUTLINE (USB8-B6)



TERMINAL TREAT :Au
 PCB :FR5
 Molding material : Epoxy resin
 UNIT :mm
 WEIGHT :2.4mg

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.

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 - 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.



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