HIGH POWER SP3T SWITCH GaAs MMIC

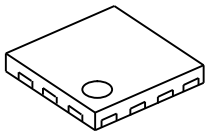
■ GENERAL DESCRIPTION

The NJG1682MD7 is a GaAs SP3T switch MMIC suitable for LTE/UMTS/CDMA/GSM applications.

The NJG1682MD7 features very low insertion loss, high isolation and excellent linearity performance down to 1.8V control voltage at high frequency up to 2.7GHz. In addition, this switch is able to handle high power signals.

The NJG1682MD7 has ESD protection devices to achieve excellent ESD performances. No DC Blocking capacitors are required for all RF ports unless DC is biased externally. And the ultra small & ultra thin EQFN14-D7 package is adopted.

■ PACKAGE OUTLINE



NJG1682MD7

■ APPLICATIONS

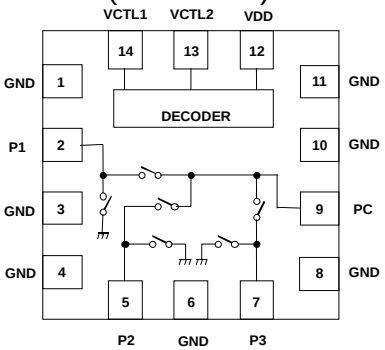
LTE, UMTS, CDMA, GSM applications
Post PA Switching, Antenna Switching and Bands Switching applications
General Purpose Switching applications

■ FEATURES

● Low voltage logic control	$V_{CTL(H)}$=1.8V typ.
● Low voltage operation	V_{DD}=2.7V typ.
● Low distortion	IIP3=+71dBm typ. @f=829+849MHz, P_{IN}=24dBm, IIP3=+70dBm typ. @f=1870+1910MHz, P_{IN}=24dBm, 2nd harmonics=-85dBc typ. @f=0.9GHz, P_{IN}=35dBm 3rd harmonics=-80dBc typ. @f=0.9GHz, P_{IN}=35dBm
● P-0.1dB	36dBm min.
● Low insertion loss	0.22dB typ. @f=0.9GHz, P_{IN}=35dBm 0.25dB typ. @f=1.9GHz, P_{IN}=33dBm 0.30dB typ. @f=2.7GHz, P_{IN}=27dBm
● Ultra small & ultra thin package	EQFN14-D7 (Package size: 1.6 x 1.6 x 0.397mm.)
● RoHS compliant and Halogen Free, MSL1	

■ PIN CONFIGURATION

(TOP VIEW)



Pin connection

1. GND	8. GND
2. P1	9. PC
3. GND	10. GND
4. GND	11. GND
5. P2	12. VDD
6. GND	13. VCTL2
7. P3	14. VCTL1

Exposed PAD: GND

■ TRUTH TABLE

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

VCTL1	VCTL2	Path
L	L	ALL OFF
H	L	P1-PC
L	H	P2-PC
H	H	P3-PC

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

■ ABSOLUTE MAXIMUM RATINGS

T_a=+25°C, Z_S=Z_I=50 ohm

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNITS
RF Input Power	P_{IN}	V_{DD} =2.7V	37	dBm
Supply Voltage	V_{DD}		5.0	V
Control Voltage	V_{CTL}		5.0	V
Power Dissipation	P_D	Four-layer FR4 PCB with through-hole (74.2x74.2mm), Tj=150°C	1300	mW
Operating Temp.	T_{opr}		-40~+85	°C
Storage Temp.	T_{stg}		-55~+150	°C

■ ELECTRICAL CHARACTERISTICS 1 (DC)

General conditions: T_a=+25°C, V_{DD}=2.7V, $V_{CTL(L)}$=0V, $V_{CTL(H)}$=1.8V

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{DD}		2.375	2.7	5.0	V
Operating Current	I_{DD}	No RF input, V_{DD}=2.7V	-	150	300	μA
Control Voltage (LOW)	$V_{CTL(L)}$		0	-	0.45	V
Control Voltage (HIGH)	$V_{CTL(H)}$		1.35	1.8	5.0	V
Control Current	I_{CTL}	$V_{CTL(H)}$=1.8V	-	4	10	μA

■ **ELECTRICAL CHARACTERISTICS 2 (RF)**

General conditions: T_a=+25°C, Z_s=Z_l=50 ohm, V_{DD}=2.7V, $V_{CTL(L)}$=0V, $V_{CTL(H)}$=1.8V

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Insertion Loss 1	LOSS1	f=0.9GHz, P_{IN}=35dBm	-	0.22	0.37	dB
Insertion Loss 2	LOSS2	f=1.9GHz, P_{IN}=33dBm	-	0.25	0.45	dB
Insertion Loss 3	LOSS3	f=2.7GHz, P_{IN}=27dBm	-	0.30	0.50	dB
Isolation 1	ISL1	f=0.9GHz, P_{IN}=35dBm	30	35	-	dB
Isolation 2	ISL2	f=1.9GHz, P_{IN}=33dBm	25	30	-	dB
Isolation 3	ISL3	f=2.7GHz, P_{IN}=27dBm	22	27	-	dB
Isolation 4	ISL4	f=0.9GHz, P_{IN}=10dBm, ALL OFF mode	30	35	-	dB
Isolation 5	ISL5	f=1.9GHz, P_{IN}=10dBm, ALL OFF mode	25	30	-	dB
Isolation 6	ISL6	f=2.7GHz, P_{IN}=10dBm, ALL OFF mode	21	25	-	dB
Input Power at 0.1dB Compression Point	$P_{-0.1dB}$	f=0.9GHz, 1.9GHz, 2.7GHz	36	-	-	dBm
2nd Harmonics 1	2fo(1)	f=0.9GHz, P_{IN}=35dBm	-	-85	-70	dBc
2nd Harmonics 2	2fo(2)	f=1.9GHz, P_{IN}=33dBm	-	-85	-70	dBc
2nd Harmonics 3	2fo(3)	f=2.7GHz, P_{IN}=27dBm	-	-90	-70	dBc
3rd Harmonics 1	3fo(1)	f=0.9GHz, P_{IN}=35dBm	-	-80	-70	dBc
3rd Harmonics 2	3fo(2)	f=1.9GHz, P_{IN}=33dBm	-	-80	-70	dBc
3rd Harmonics 3	3fo(3)	f=2.7GHz, P_{IN}=27dBm	-	-90	-70	dBc
Input 3rd order intercept point1	IIP3(1)	f=829+849MHz, P_{IN}=+24dBm each*1	+65	+71	-	dBm
Input 3rd order intercept point2	IIP3(2)	f=1870+1910MHz, P_{IN}=+24dBm each*1	+63	+70	-	dBm
VSWR	VSWR	on-state ports, f=2.7GHz	-	1.2	1.4	
Switching time	T_{SW}	50% V_{CTL} to 10/90% RF	-	1	5	μs

*1: IIP3 are defined by the following equations.
IIP3=(3 x Pout-IM3)/2+LOSS

■ **TERMINAL INFORMATION**

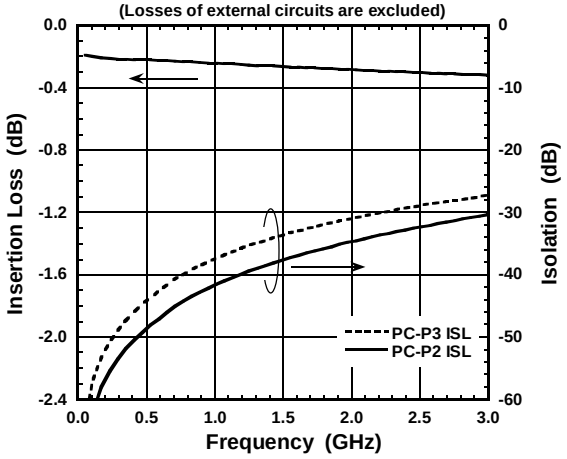
No.	SYMBOL	DESCRIPTION
1	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
2	P1	RF transmitting/receiving port. No DC blocking capacitor is required for this port unless DC is biased externally.
3	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
4	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
5	P2	RF transmitting/receiving port. No DC blocking capacitor is required for this port unless DC is biased externally.
6	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
7	P3	RF transmitting/receiving port. No DC blocking capacitor is required for this port unless DC is biased externally.
8	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
9	PC	RF transmitting/receiving port. No DC blocking capacitor is required for this port unless DC is biased externally. Please connect an inductor with GND terminal for ESD protection.
10	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
11	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
12	VDD	Positive voltage supply terminal. The positive voltage (+2.375~+5V) has to be supplied. Please connect a bypass capacitor with GND terminal for excellent RF performance.
13	VCTL2	Control signal input terminal. This terminal is set to High-Level (+1.35~+5.0V) or Low-Level (0~+0.45V).
14	VCTL1	Control signal input terminal. This terminal is set to High-Level (+1.35~+5.0V) or Low-Level (0~+0.45V).

■ **ELECTRICAL CHARACTERISTICS** (With application circuit)

Loss, ISL vs Frequency

(PC-P1 ON, V_{DD}=2.7V, V_{CTL}=0/1.8V)

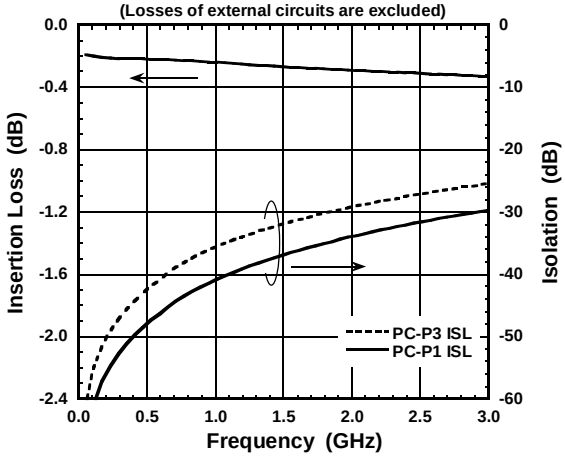
(Losses of external circuits are excluded)



Loss, ISL vs Frequency

(PC-P2 ON, V_{DD}=2.7V, V_{CTL}=0/1.8V)

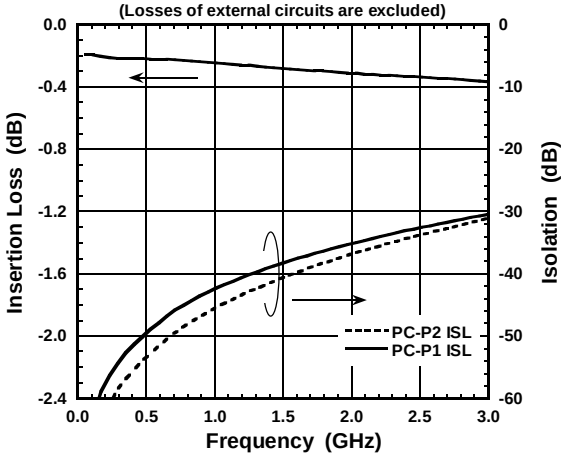
(Losses of external circuits are excluded)



Loss, ISL vs Frequency

(PC-P3 ON, V_{DD}=2.7V, V_{CTL}=1.8V)

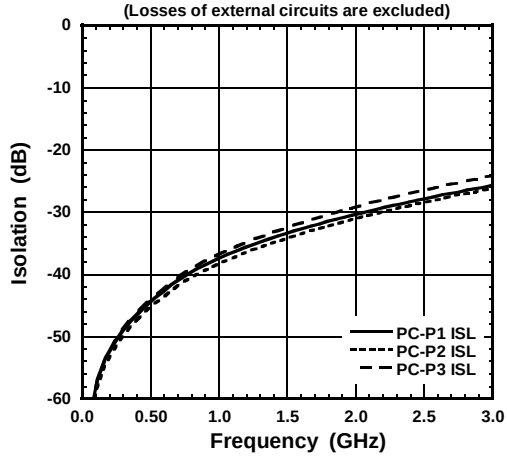
(Losses of external circuits are excluded)



ISL vs Frequency

(ALL OFF, V_{DD}=2.7V, V_{CTL}=0V)

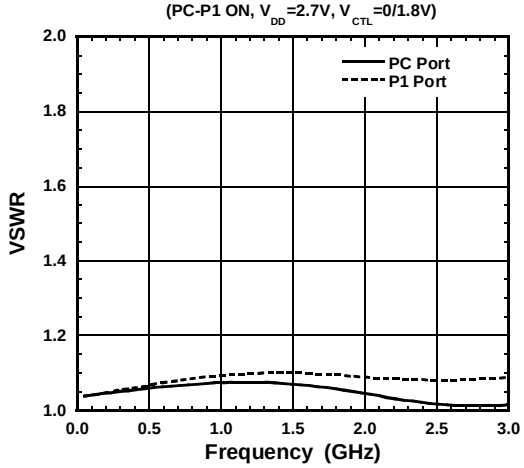
(Losses of external circuits are excluded)



■ **ELECTRICAL CHARACTERISTICS** (With application circuit)

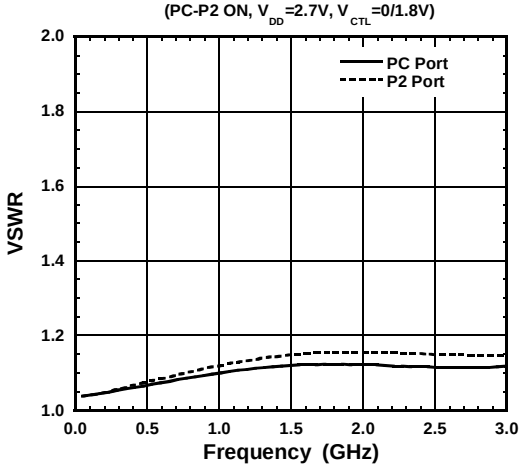
VSWR vs Frequency

(PC-P1 ON, V_{DD}=2.7V, V_{CTL}=0/1.8V)



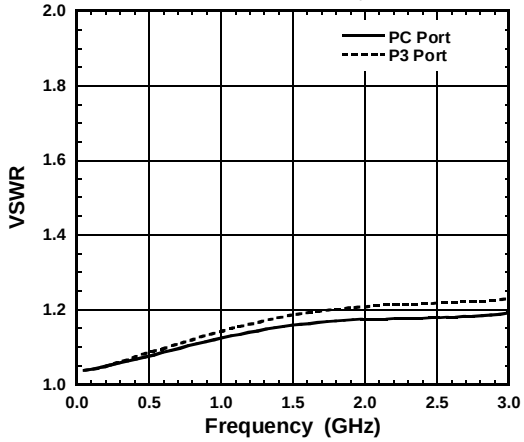
VSWR vs Frequency

(PC-P2 ON, V_{DD}=2.7V, V_{CTL}=0/1.8V)



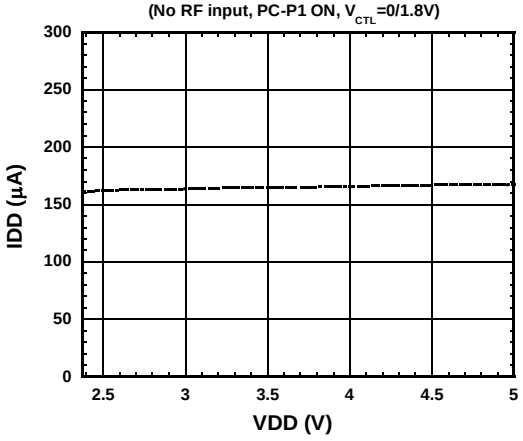
VSWR vs Frequency

(PC-P3 ON, V_{DD}=2.7V, V_{CTL}=1.8V)



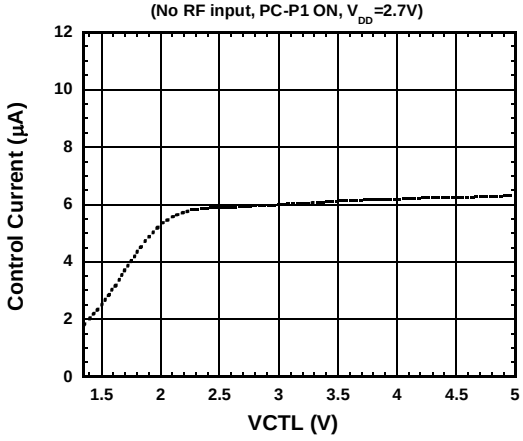
IDD vs. VDD

(No RF input, PC-P1 ON, V_{CTL}=0/1.8V)



Control Current vs. VCTL

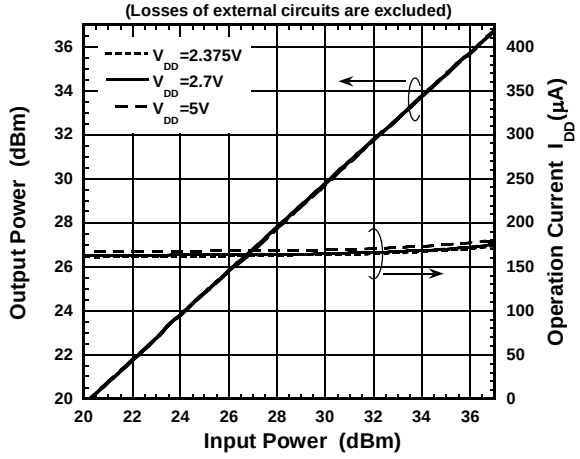
(No RF input, PC-P1 ON, V_{DD}=2.7V)



■ **ELECTRICAL CHARACTERISTICS** (With application circuit)

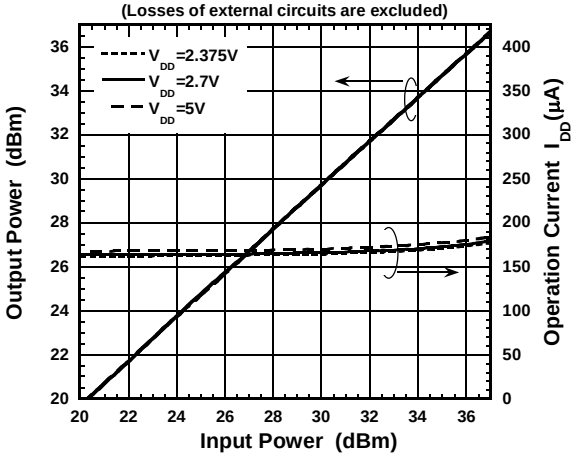
Output Power, I_{DD} vs Input Power

(f=0.9GHz, PC-P1 ON, V_{CTL}=0/1.8V)
(Losses of external circuits are excluded)



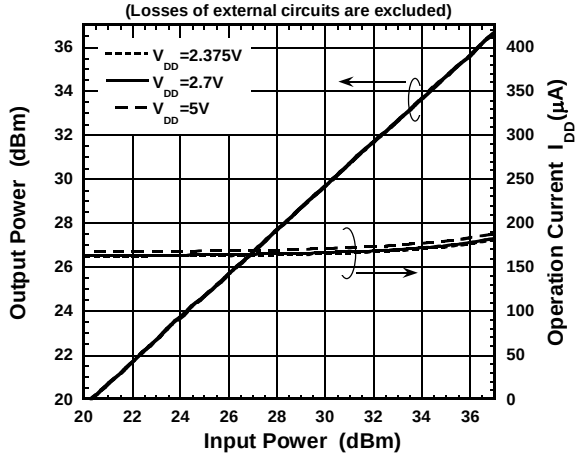
Output Power, I_{DD} vs Input Power

(f=1.9GHz, PC-P1 ON, V_{CTL}=0/1.8V)
(Losses of external circuits are excluded)



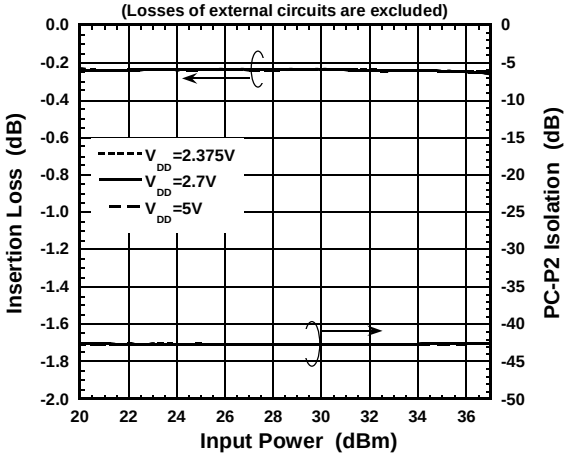
Output Power, I_{DD} vs Input Power

(f=2.7GHz, PC-P1 ON, V_{CTL}=0/1.8V)
(Losses of external circuits are excluded)



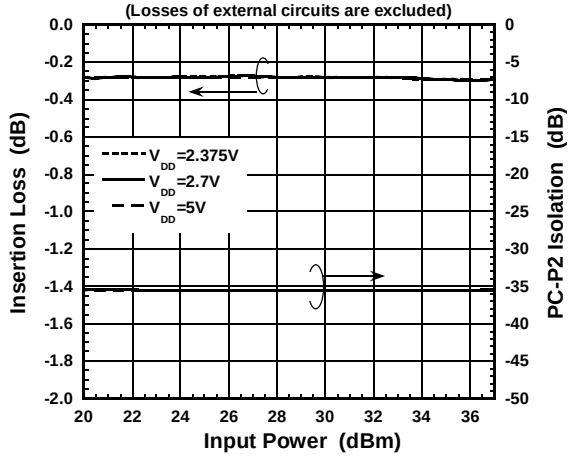
Loss, ISL vs Input Power

(f=0.9GHz, PC-P1 ON, V_{CTL}=0/1.8V)
(Losses of external circuits are excluded)



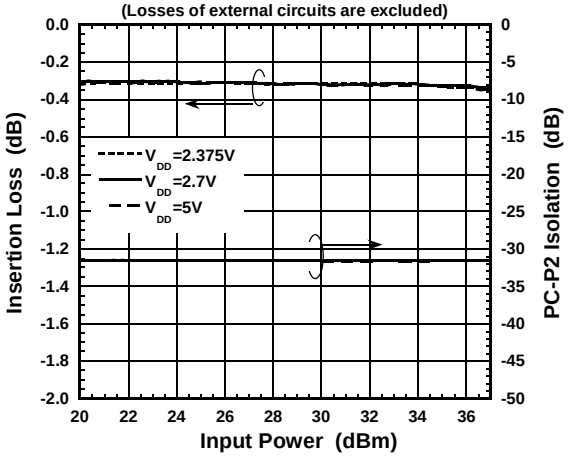
Loss, ISL vs Input Power

(f=1.9GHz, PC-P1 ON, V_{CTL}=0/1.8V)
(Losses of external circuits are excluded)



Loss, ISL vs Input Power

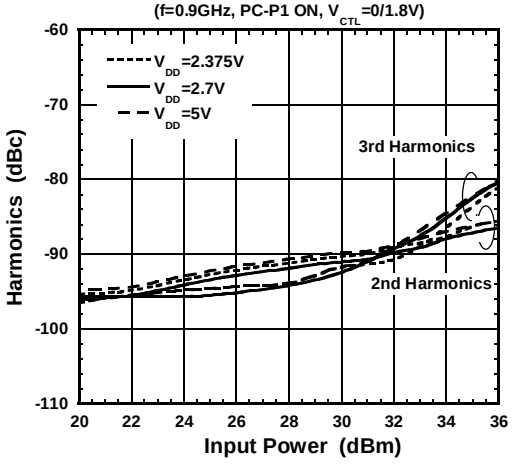
(f=2.7GHz, PC-P1 ON, V_{CTL}=0/1.8V)
(Losses of external circuits are excluded)



■ **ELECTRICAL CHARACTERISTICS** (With application circuit)

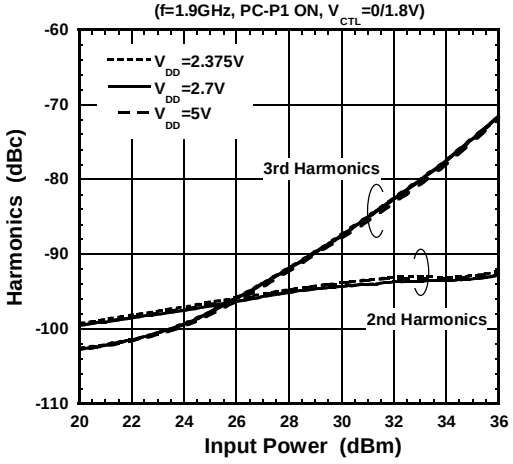
Harmonics vs Input Power

(f=0.9GHz, PC-P1 ON, V_{CTL}=0/1.8V)



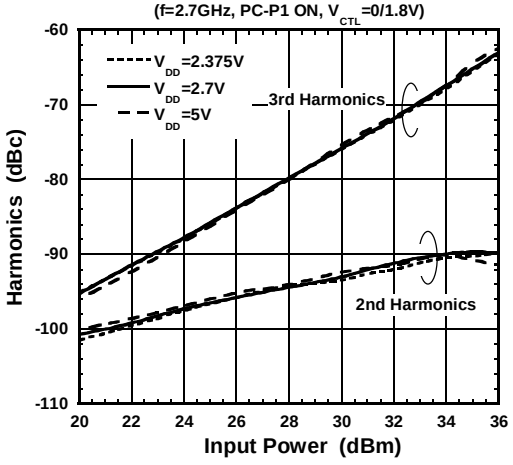
Harmonics vs Input Power

(f=1.9GHz, PC-P1 ON, V_{CTL}=0/1.8V)



Harmonics vs Input Power

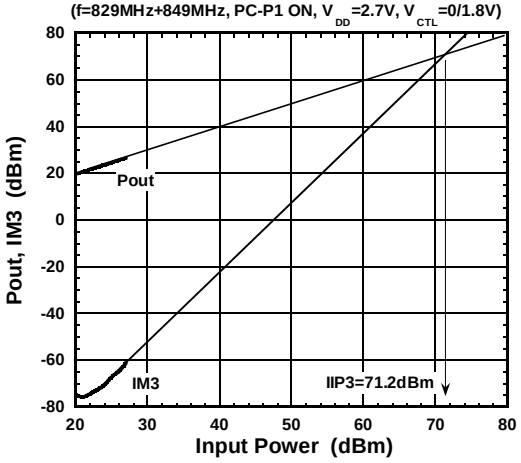
(f=2.7GHz, PC-P1 ON, V_{CTL}=0/1.8V)



■ **ELECTRICAL CHARACTERISTICS** (With application circuit)

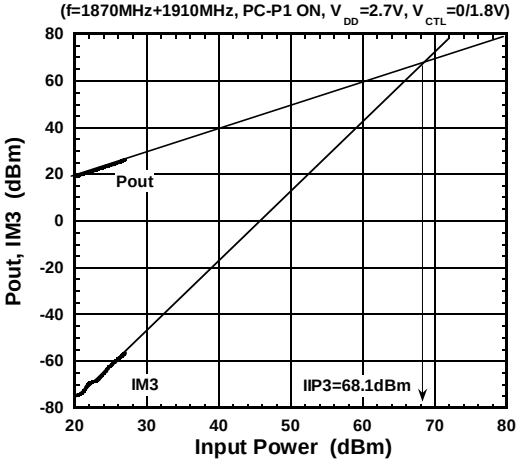
Output Power, IM3 vs Input Power

(f=829MHz+849MHz, PC-P1 ON, V_{DD}=2.7V, V_{CTL}=0/1.8V)



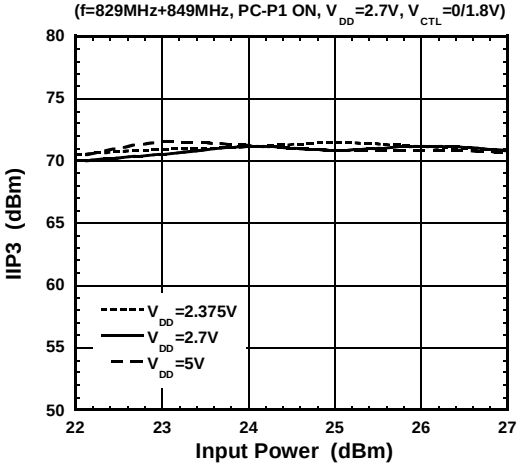
Output Power, IM3 vs Input Power

(f=1870MHz+1910MHz, PC-P1 ON, V_{DD}=2.7V, V_{CTL}=0/1.8V)



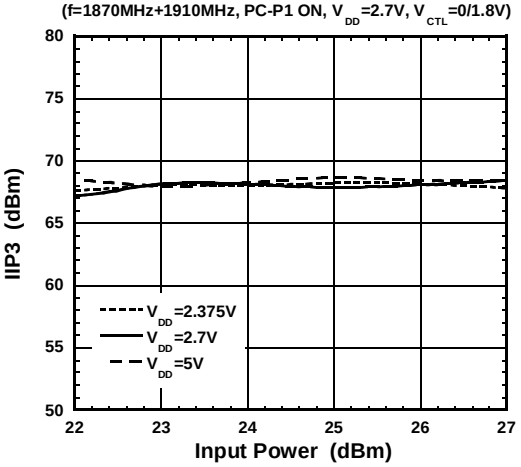
IIP3 vs Input Power

(f=829MHz+849MHz, PC-P1 ON, V_{DD}=2.7V, V_{CTL}=0/1.8V)



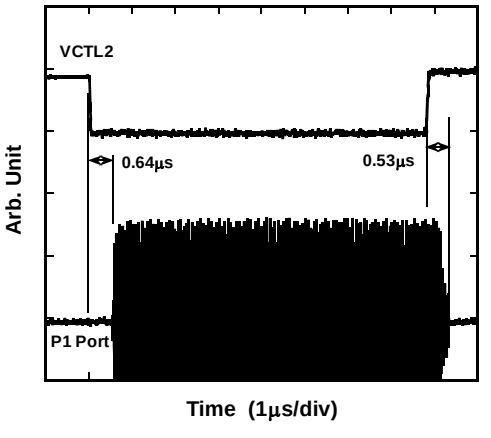
IIP3 vs Input Power

(f=1870MHz+1910MHz, PC-P1 ON, V_{DD}=2.7V, V_{CTL}=0/1.8V)

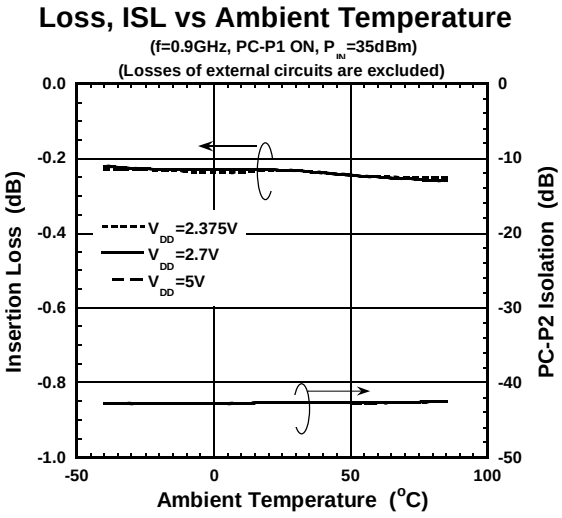


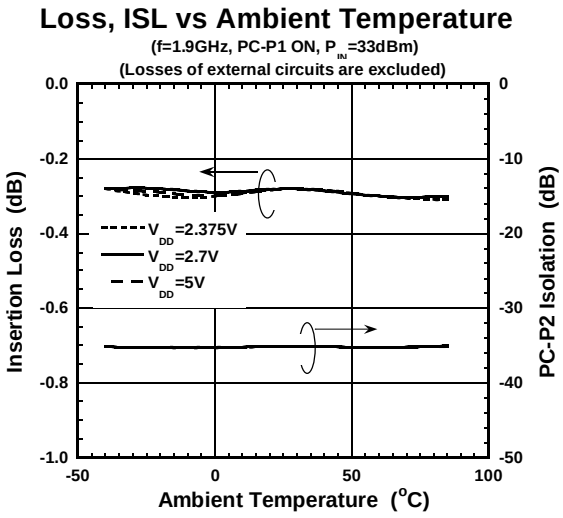
Switching Time

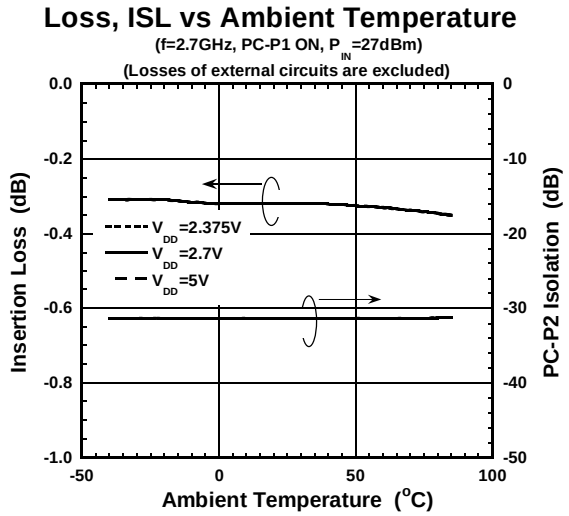
(V_{DD}=2.7V, VCTL1=1.8V, VCTL2=0/1.8V)



■ **ELECTRICAL CHARACTERISTICS** (With application circuit)

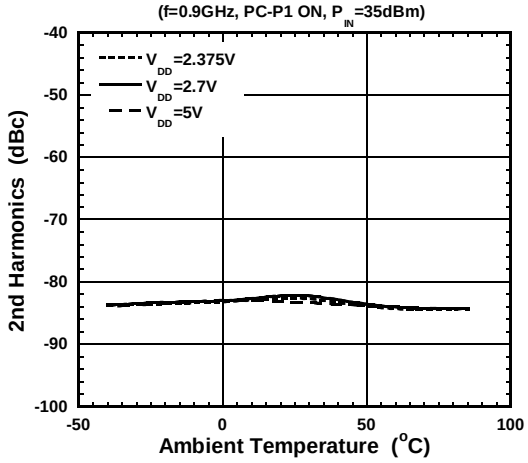




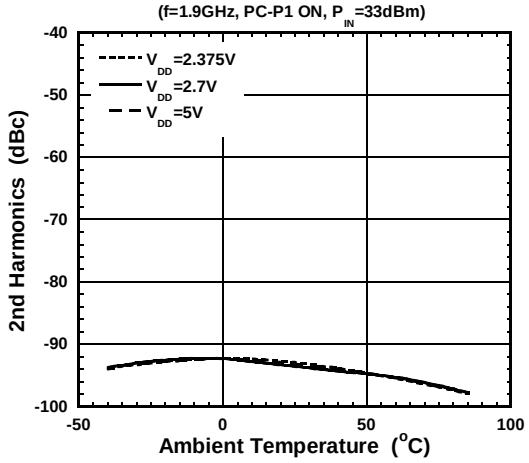


■ **ELECTRICAL CHARACTERISTICS** (With application circuit)

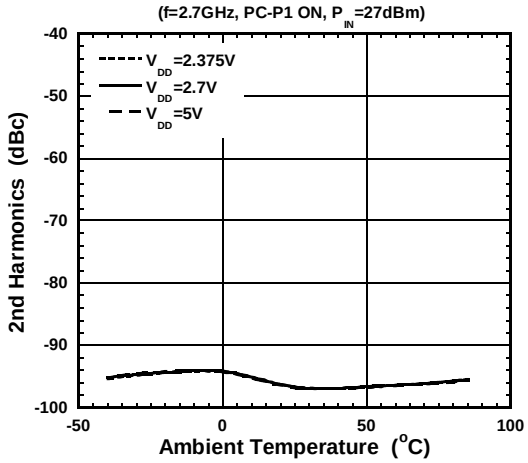
2nd Harmonics vs Ambient Temperature



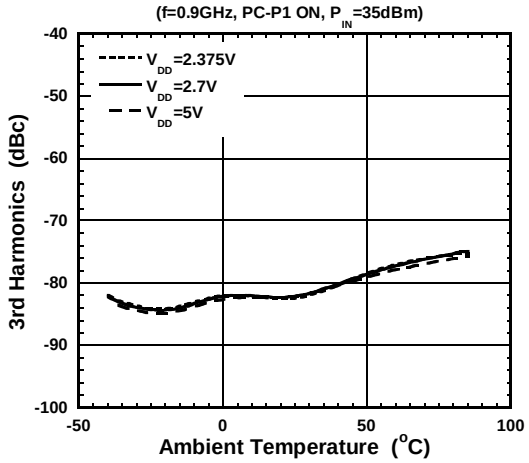
2nd Harmonics vs Ambient Temperature



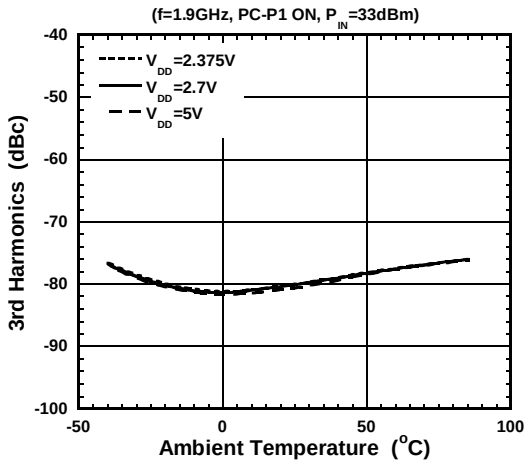
2nd Harmonics vs Ambient Temperature



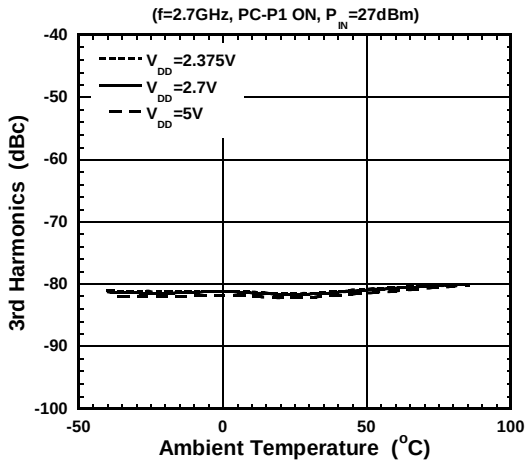
3rd Harmonics vs Ambient Temperature



3rd Harmonics vs Ambient Temperature

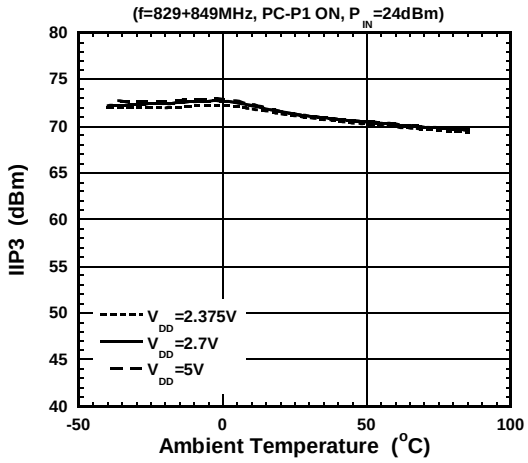


3rd Harmonics vs Ambient Temperature

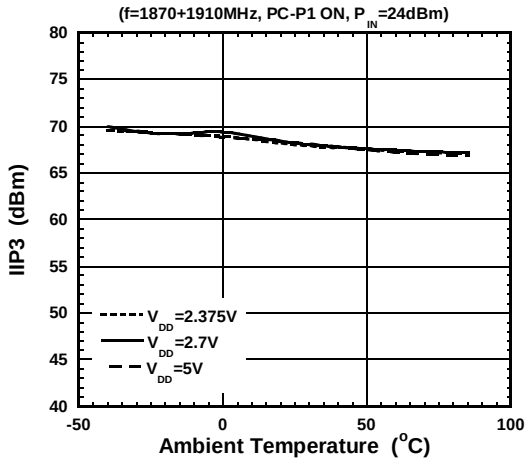


■ **ELECTRICAL CHARACTERISTICS** (With application circuit)

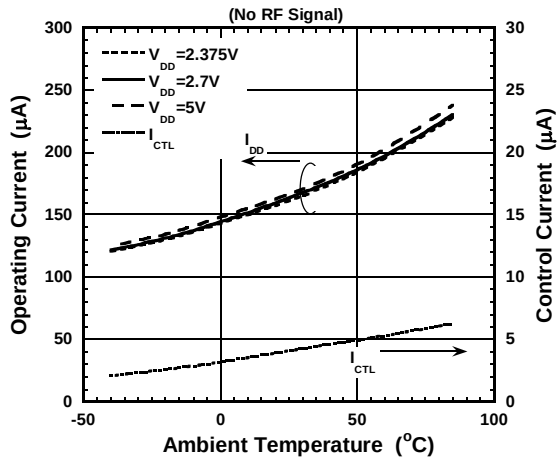
IIP3 vs Ambient Temperature



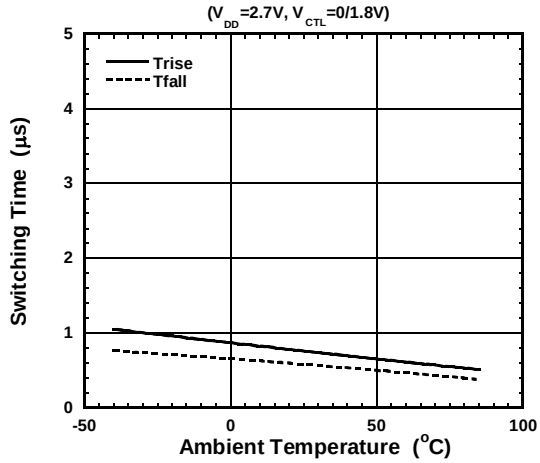
IIP3 vs Ambient Temperature



DC Current vs Ambient Temperature

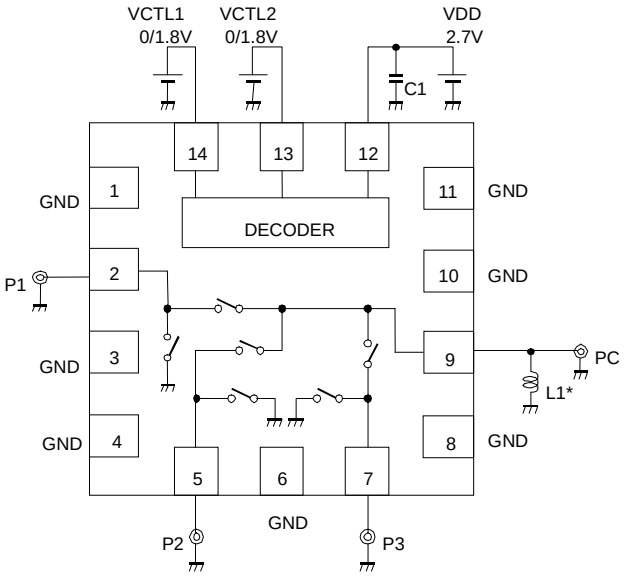


Switching Time vs Ambient Temperature



■ APPLICATION CIRCUIT

(TOP VIEW)



* The Inductor L1 is required for enhancing ESD protection level.

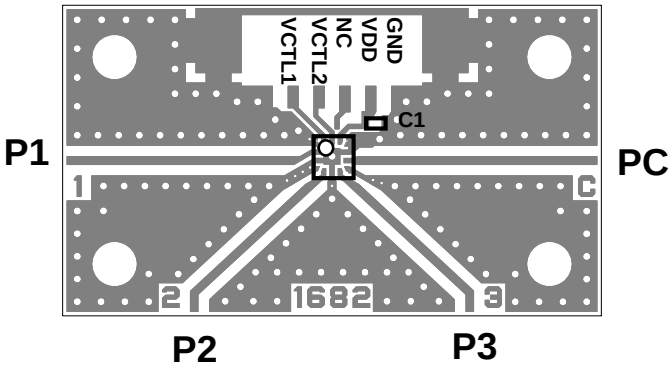
No DC blocking capacitors are required on all RF ports, unless DC is biased externally.

■ PARTS LIST

No.	Parameters	Note
C1	1000pF	MURATA(GRM15)
L1	68nH	TAIYO-YUDEN (HK1005)

■ PCB LAYOUT

(TOP VIEW)



PCB size: 26.0 x 15.0 mm
PCB: FR-4, t=0.2mm
Capacitor size: 1005
Microstrip line width: 0.38mm

Losses of PCB and connectors, Ta=+25°C

Path	Frequency (GHz)	Loss (dB)
PC-P1	0.9	0.18
	1.9	0.34
	2.7	0.42
PC-P2 PC-P3	0.9	0.17
	1.9	0.32
	2.7	0.40

■ PRECAUTIONS

[1] No DC blocking capacitors are required at each RF port normally. When the other device is biased at certain voltage and connected to the NJG1682MD7, a DC block capacitor is required between the device and the switch IC. This is because the each RF port of NJG1682MD7 is biased at 0 V (GND).

[2] For avoiding the degradation of RF performance, the bypass capacitor (C1) should be placed as close as possible to VDD terminal

[3] For good RF performance, all GND terminals are must be connected to PCB ground plane of substrate, and through - holes for GND should be placed the IC near.

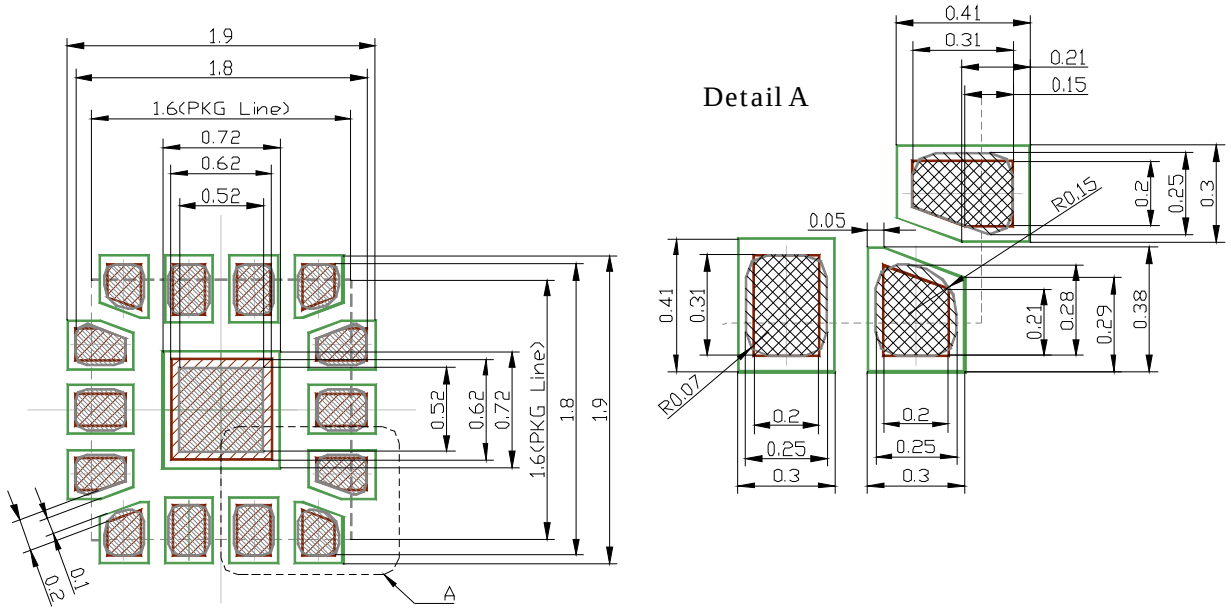
■ RECOMMENDED FOOTPRINT PATTERN (EQFN14-D7 PACKAGE Reference)

:Land

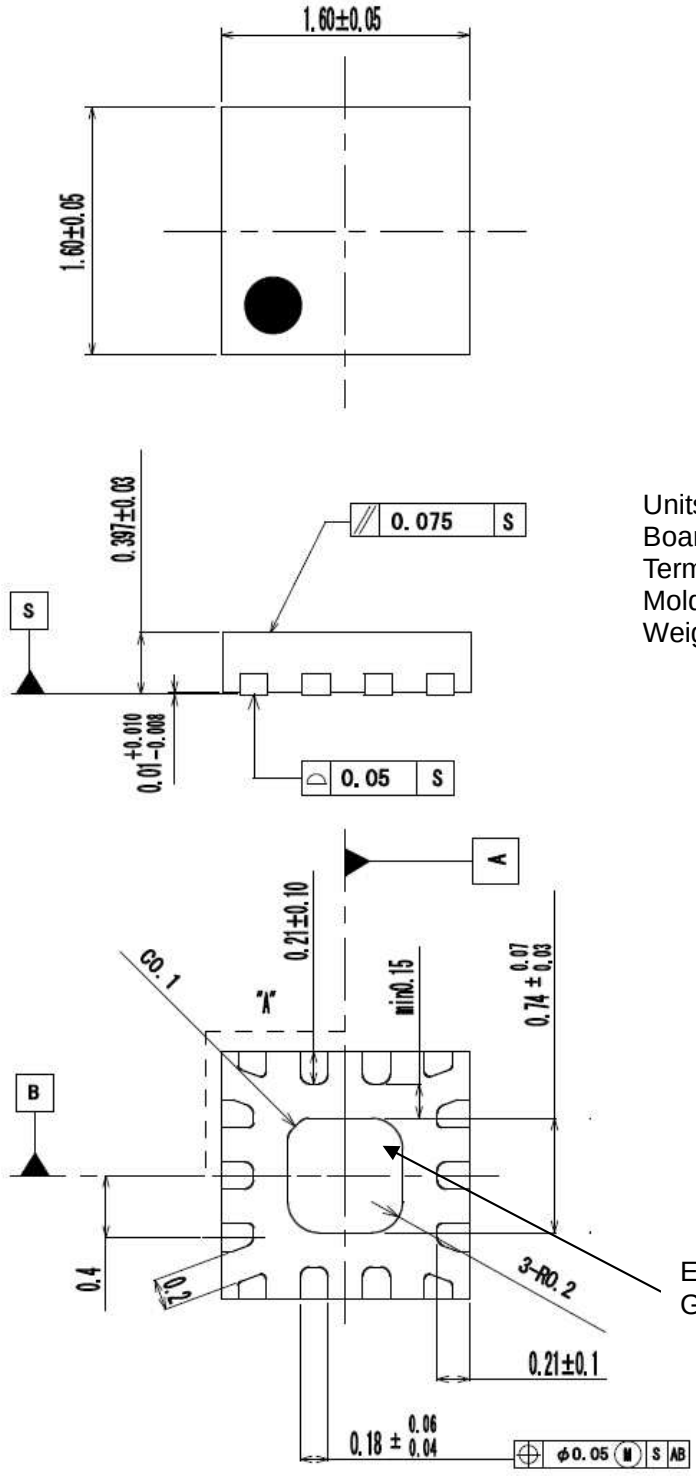
:Mask (Open area) *Metal mask thickness : 100um

:Resist(Open area)

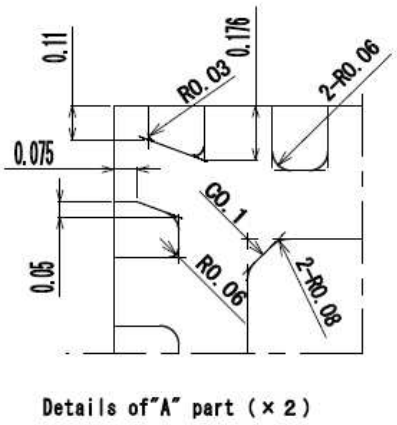
PKG: 1.6mm x 1.6mm
Pin pitch: 0.4mm



■ PACKAGE OUTLINE (EQFN14-D7)



Units	: mm
Board	: Cu
Terminal treat	: SnBi
Molding material	: Epoxy resin
Weight	: 3.4mg



Details of"A" part (×2)

Exposed PAD
Ground connection is required.

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.

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    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.
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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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