

10W High Power SPDT Switch

■ FEATURES

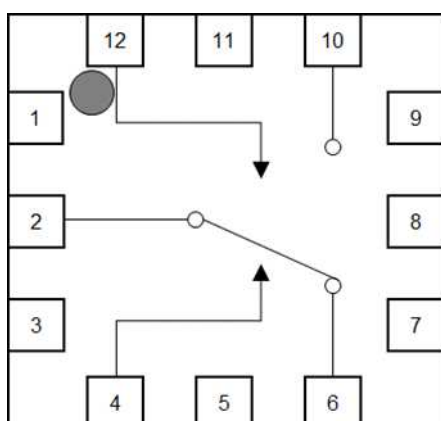
- Control voltage range 2.7 V to 5.0 V
- Low insertion loss
 - 0.35 dB typ. @ 3.85 GHz, $V_{CTL}(H) = 3.3\text{ V}$
 - 0.40 dB typ. @ 4.7 GHz, $V_{CTL}(H) = 3.3\text{ V}$
 - 0.45 dB typ. @ 6.0 GHz, $V_{CTL}(H) = 3.3\text{ V}$
- High isolation
 - 27dB typ. @ 3.85 GHz, $V_{CTL}(H) = 3.3\text{ V}$
 - 27dB typ. @ 4.7 GHz, $V_{CTL}(H) = 3.3\text{ V}$
 - 25dB typ. @ 6.0 GHz, $V_{CTL}(H) = 3.3\text{ V}$
- High linearity
 - $P_{-0.1dB} = +40\text{ dBm}$ typ. @ 6.0 GHz, $V_{CTL}(H) = 3.3\text{ V}$
- High switching speed 150 ns typ.
- Small & thin Package
 - EQFN12-E4 (2.0 mm x 2.0 mm x 0.397 mm typ.)
- RoHS compliant and Halogen Free, MSL1

■ APPLICATION

- 5G (Sub-6GHz) Small-cell base station
- Commercial radio application
- Transmit/receive switching, antenna switching and others switching applications

■ BLOCK DIAGRAM (EQFN12-E4)

(TOP VIEW)



■ GENERAL DESCRIPTION

The NJG1817ME4 is a high power SPDT switch GaAs MMIC suitable for 5G base station system, also is used commercial radio system requiring high power.

This switch has high power handing capability of +40dBm. Features are high linearity and low insertion loss up to 6GHz. Furthermore, high switching speed of the NJG1817ME4 is enough capable on 5G communications. Integrated ESD protection device on each RF port achieves excellent ESD robustness.

The NJG1817ME4 is packaged 2mm x 2mm EQFN12-E4 small size package despite its high power handling.

■ TRUTH TABLE

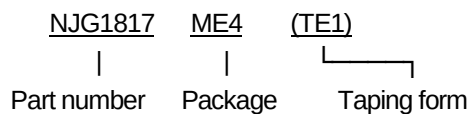
"H" = $V_{CTL}(H)$, "L" = $V_{CTL}(L)$

ON PATH	VCTL1	VCTL2
PC-P1	H	L
PC-P2	L	H

■ PIN CONFIGURATION

PIN NO.	SYMBOL	DESCRIPTION
1	NC(GND)	No connected terminal (Connect to ground)
2	PC	Common RF terminal
3	NC(GND)	No connected terminal (Connect to ground)
4	VCTL1	Control signal input terminal.
5	NC(GND)	No connected terminal (Connect to ground)
6	P1	RF terminal
7	GND	Ground terminal
8	GND	Ground terminal
9	GND	Ground terminal
10	P2	RF terminal
11	NC(GND)	No connected terminal (Connect to ground)
12	VCTL2	Control signal input terminal.
Exposed Pad		Ground terminal

■ PRODUCT NAME INFORMATION



■ ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJG1817ME4	EQFN12-E4	Yes	Yes	SnBi	1817	4.7	3,000

■ ABSOLUTE MAXIMUM RATINGS

(General conditions: $T_a = +25^{\circ}\text{C}$)

PARAMETER	SYMBOL	RATINGS	UNIT
RF input power	P_{IN}	+40 ⁽¹⁾	dBm
Control voltage	V_{CTL}	6.0	V
Power dissipation ⁽²⁾	P_D	1200	mW
Operating temperature	T_{opr}	-40 to +105	$^{\circ}\text{C}$
Storage temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

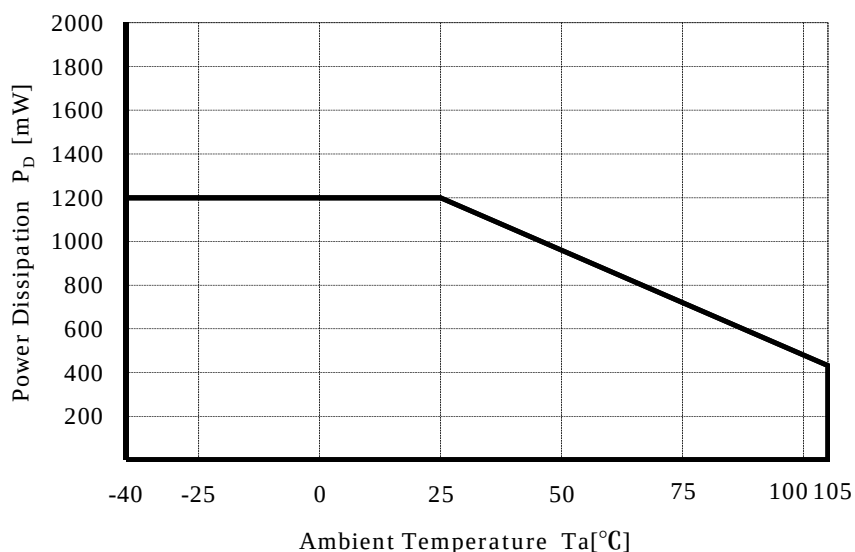
(1): $V_{CTL}(H) = 3.3\text{ V}$, $V_{CTL}(L) = 0\text{ V}$, on state port

(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 low 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 board



■ ELECTRICAL CHARACTERISTICS 1 (DC CHARACTERISTICS)

(General conditions: $T_a = +25^\circ\text{C}$, $Z_s = Z_l = 50\ \Omega$, with application circuit)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Control voltage (HIGH)	$V_{CTL}(H)$		2.7	3.3	5.0	V
Control voltage (LOW)	$V_{CTL}(L)$		-0.2	0	0.2	V
Control current	I_{CTL}	$V_{CTL}(H) = 3.3\text{V}$, $V_{CTL}(L) = 0\text{V}$	-	7	15	μA

■ ELECTRICAL CHARACTERISTICS 2 (RF CHARACTERISTICS)

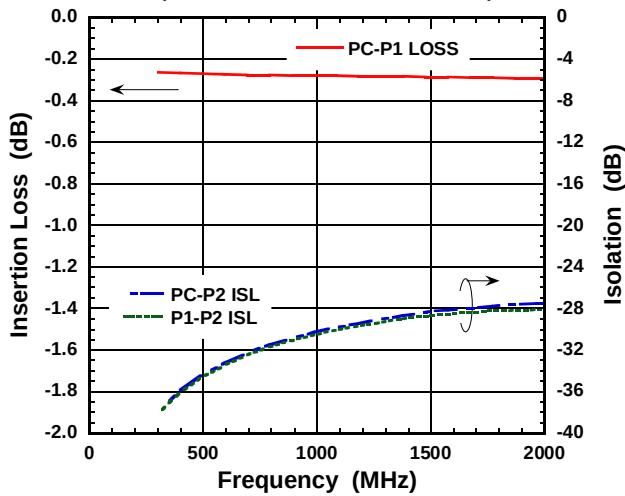
(General conditions: $V_{CTL}(H) = 3.3\text{ V}$, $V_{CTL}(L) = 0\text{ V}$, $T_a = +25^\circ\text{C}$, $Z_s = Z_l = 50\ \Omega$, with application circuit)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Insertion loss	LOSS	$f = 0.7\text{GHz}$	-	0.30	0.45	dB
		$f = 3.85\text{ GHz}$	-	0.35	0.50	
		$f = 4.7\text{ GHz}$	-	0.40	0.60	
		$f = 6.0\text{ GHz}$	-	0.45	0.65	
Isolation	ISL	$f = 0.7\text{ GHz}$	28	30	-	dB
		$f = 3.85\text{ GHz}$	25	27	-	
		$f = 4.7\text{ GHz}$	25	27	-	
		$f = 6.0\text{ GHz}$	22	25	-	
Input power at 0.1dB compression point	$P_{-0.1\text{dB}}$	$f = 6.0\text{ GHz}$	+39	+40	-	dBm
VSWR	VSWR	$f = 0.7\text{ GHz}$	-	1.1	1.3	-
		$f = 3.85\text{ GHz}$	-	1.1	1.3	
		$f = 4.7\text{ GHz}$	-	1.1	1.3	
		$f = 6.0\text{ GHz}$	-	1.2	1.4	
Switching time	T_{SW}	50% V_{CTL} to 10%/ 90% RF	-	150	350	ns

■ ELECTRICAL CHARACTERISTICS (With application circuit list 1, loss of external circuit are excluded.)

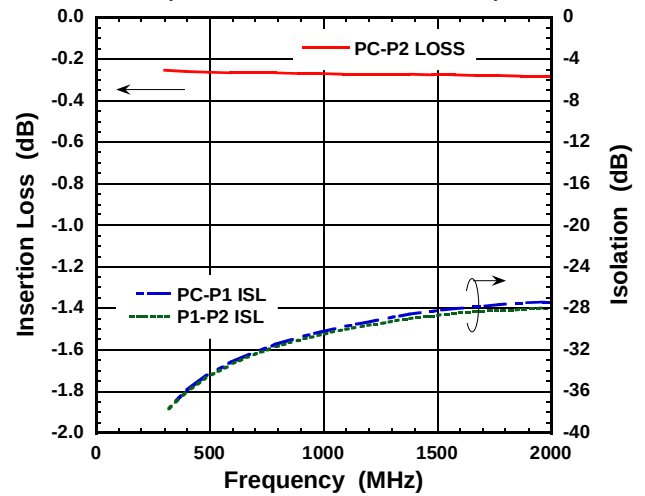
Loss, Isolation vs Frequency

(PC-P1 ON, VCTL1=3.3V, VCTL2=0V)



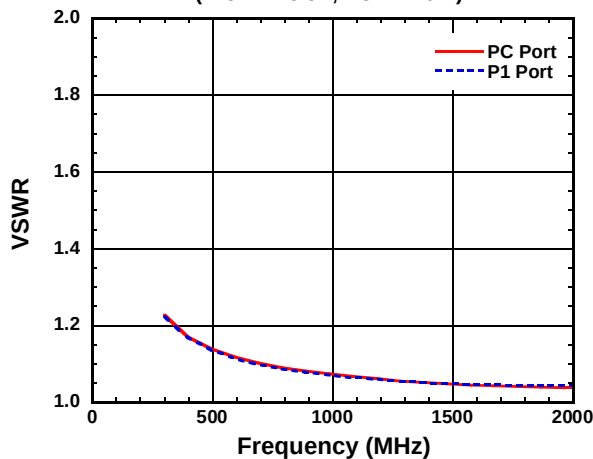
Loss, Isolation vs Frequency

(PC-P2 ON, VCTL1=0V, VCTL2=3.3V)



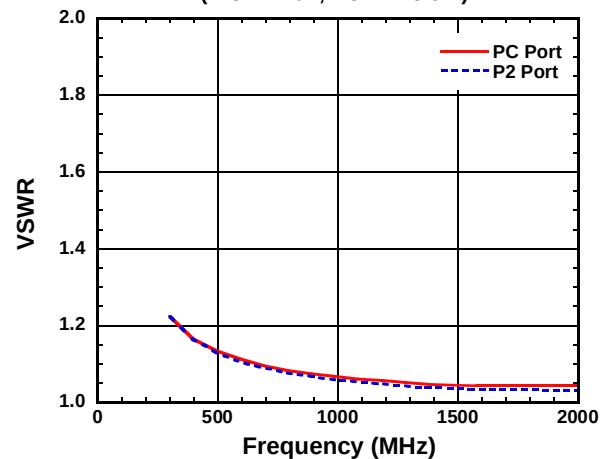
VSWR vs. Frequency

(VCTL1=3.3V, VCTL2=0V)



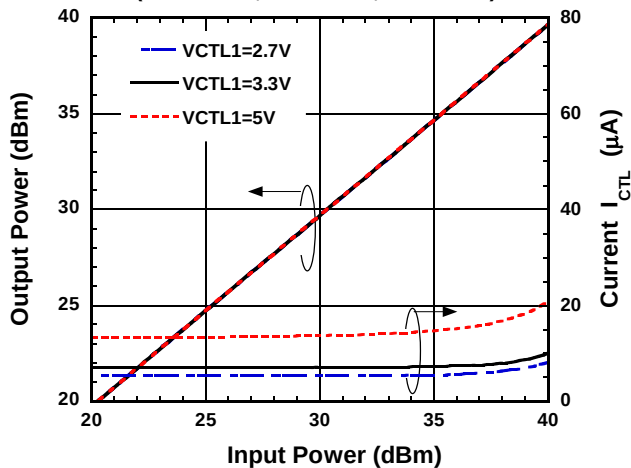
VSWR vs. Frequency

(VCTL1=0V, VCTL2=3.3V)



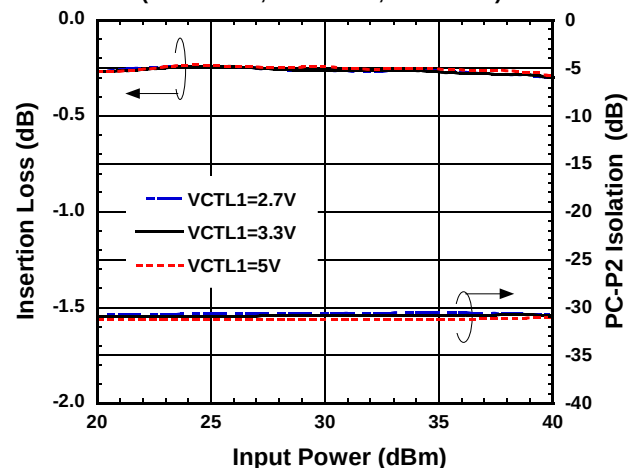
Output Power, Current vs. Input Power

(PC-P1 ON, VCTL2=0V, f=700MHz)



Loss, Isolation vs. Input Power

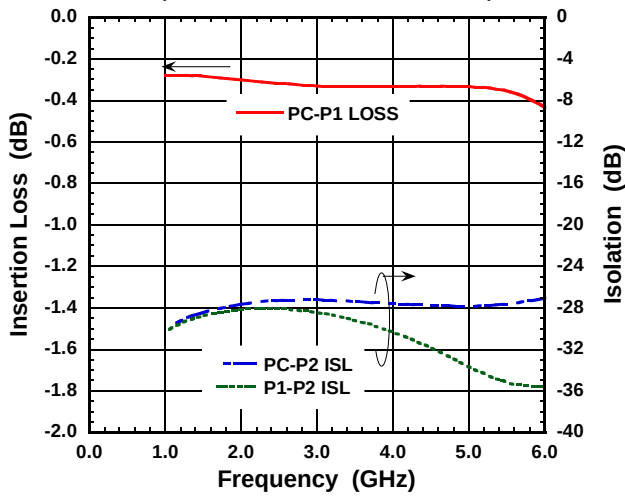
(PC-P1 ON, VCTL2=0V, f=700MHz)



■ ELECTRICAL CHARACTERISTICS (With application circuit list 2, losses of external circuit are excluded.)

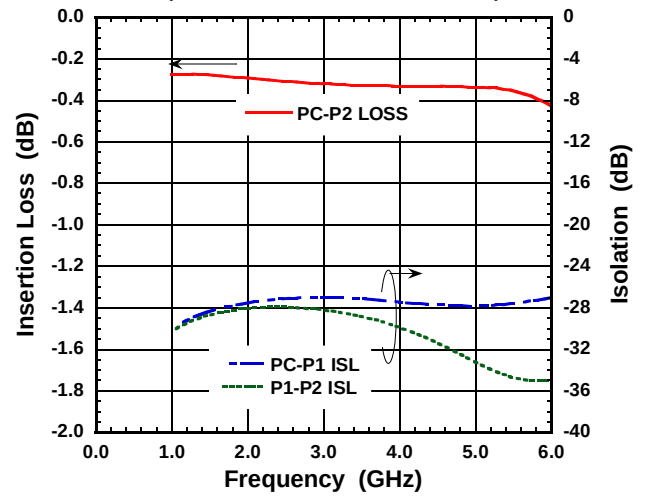
Loss, Isolation vs Frequency

(PC-P1 ON, VCTL1=3.3V, VCTL2=0V)



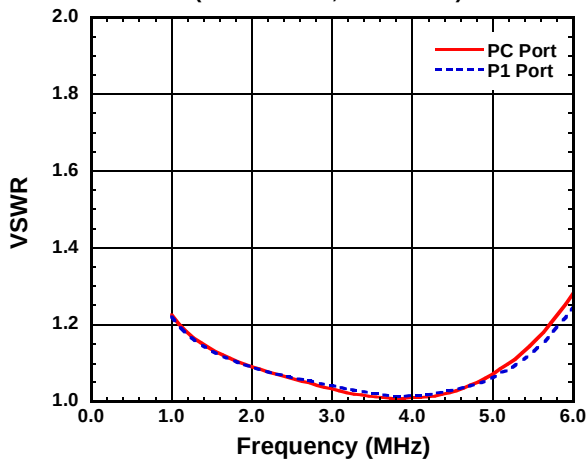
Loss, Isolation vs Frequency

(PC-P2 ON, VCTL1=0V, VCTL2=3.3V)



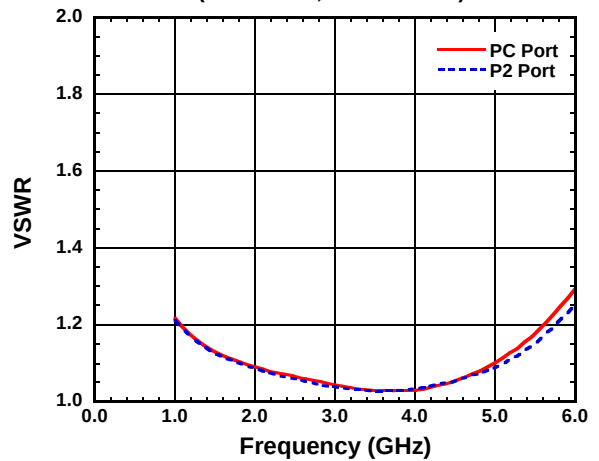
VSWR vs. Frequency

(VCTL1=3.3V, VCTL2=0V)



VSWR vs. Frequency

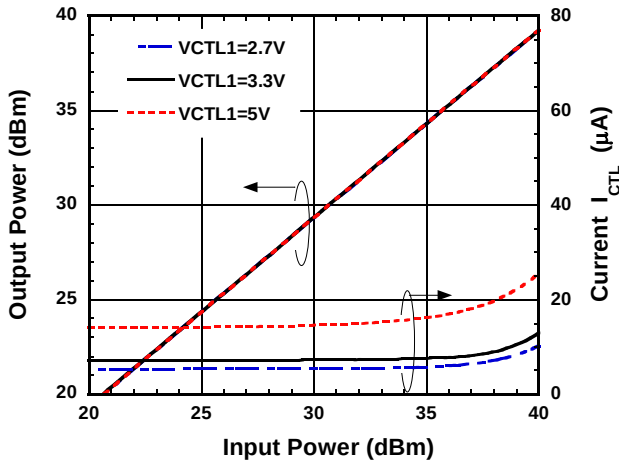
(VCTL1=0V, VCTL2=3.3V)



■ ELECTRICAL CHARACTERISTICS (With application circuit list 2, losses of external circuit are excluded.)

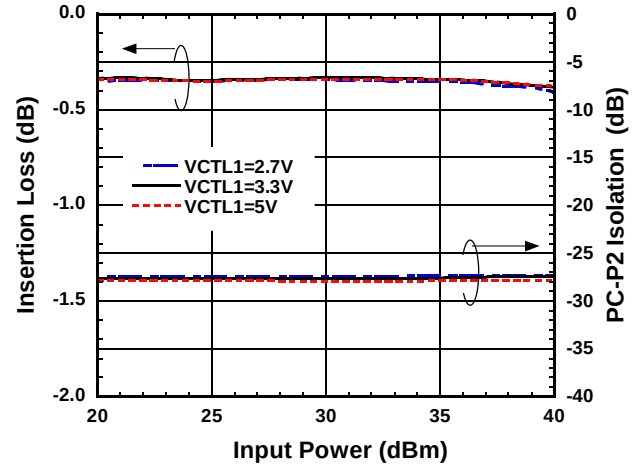
Output Power, Current vs. Input Power

(PC-P1 ON, VCTL2=0V, f=3.85GHz)



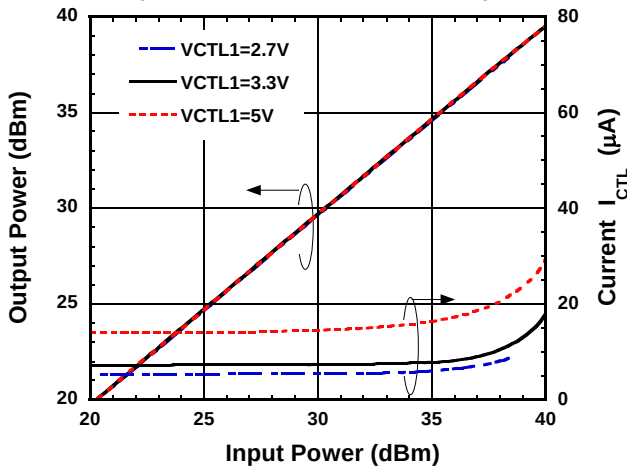
Loss, Isolation vs. Input Power

(PC-P1 ON, VCTL2=0V, f=3.85GHz)



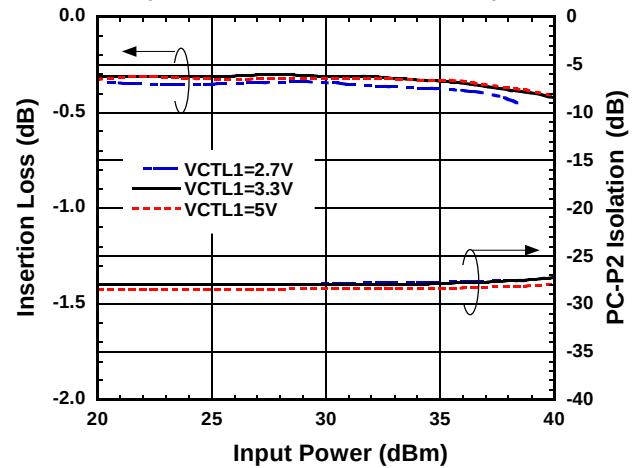
Output Power, Current vs. Input Power

(PC-P1 ON, VCTL2=0V, f=4.7GHz)



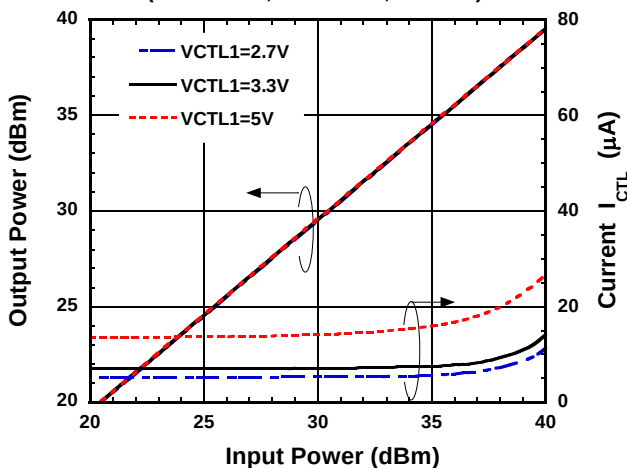
Loss, Isolation vs. Input Power

(PC-P1 ON, VCTL2=0V, f=4.7GHz)



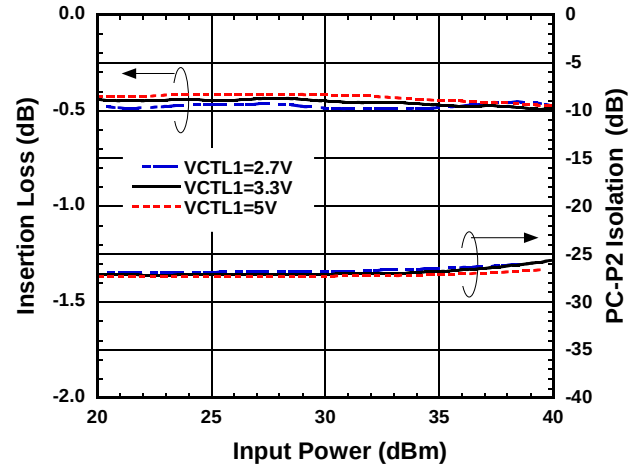
Output Power, Current vs. Input Power

(PC-P1 ON, VCTL2=0V, f=6GHz)



Loss, Isolation vs. Input Power

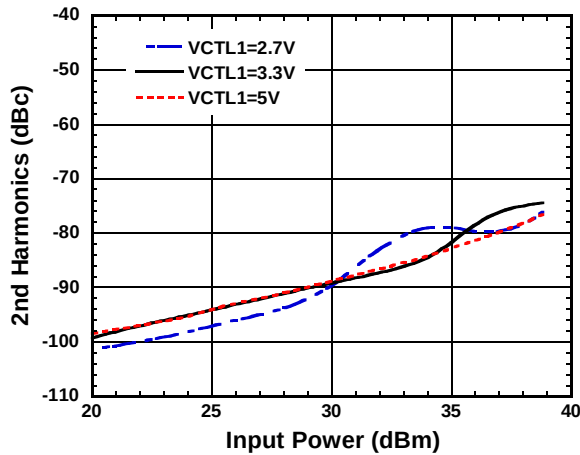
(PC-P1 ON, VCTL2=0V, f=6GHz)



■ ELECTRICAL CHARACTERISTICS (With application circuit list 2, losses of external circuit are excluded.)

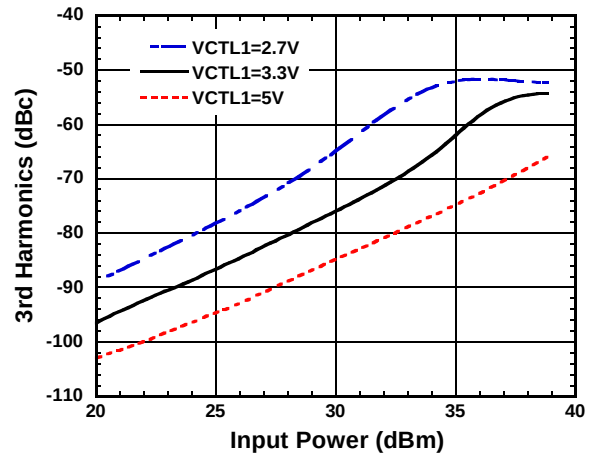
2nd Harmonics vs. Input Power

($f=3.85\text{GHz}$, $V_{CTL2}=0\text{V}$, PC-P1 ON)



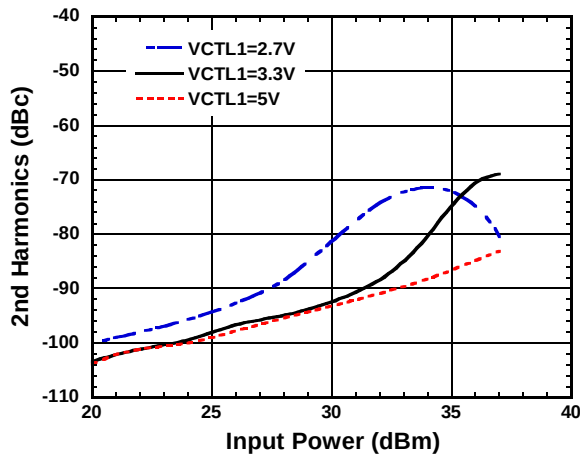
3rd Harmonics vs. Input Power

($f=3.85\text{GHz}$, $V_{CTL2}=0\text{V}$, PC-P1 ON)



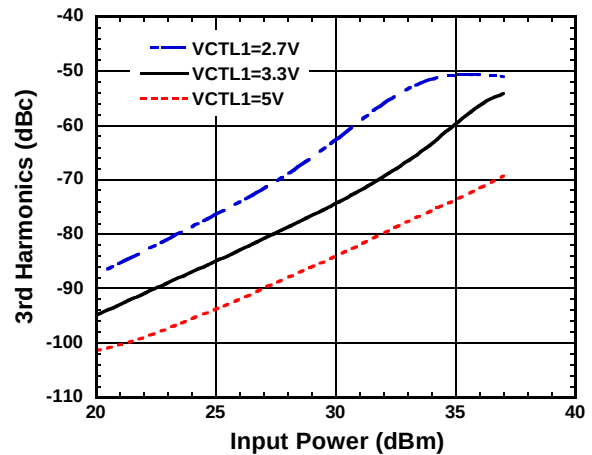
2nd Harmonics vs. Input Power

($f=4.7\text{GHz}$, $V_{CTL2}=0\text{V}$, PC-P1 ON)



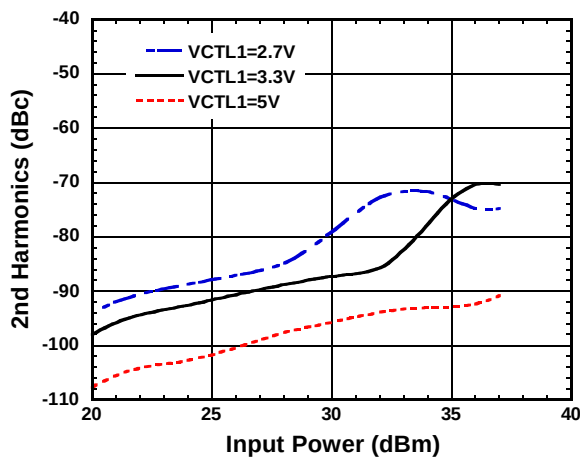
3rd Harmonics vs. Input Power

($f=4.7\text{GHz}$, $V_{CTL2}=0\text{V}$, PC-P1 ON)



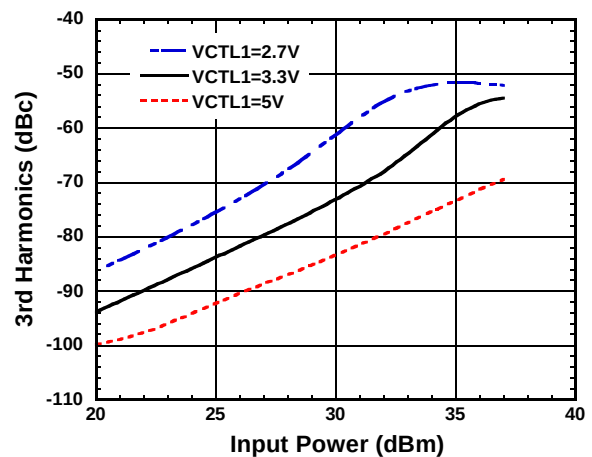
2nd Harmonics vs. Input Power

($f=6\text{GHz}$, $V_{CTL2}=0\text{V}$, PC-P1 ON)



3rd Harmonics vs. Input Power

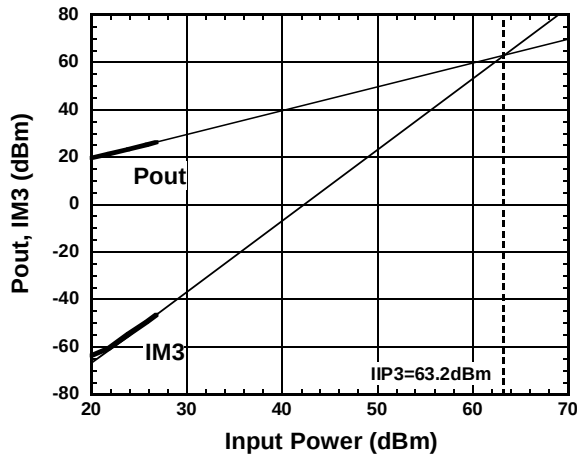
($f=6\text{GHz}$, $V_{CTL2}=0\text{V}$, PC-P1 ON)



■ ELECTRICAL CHARACTERISTICS (With application circuit list 2, losses of external circuit are excluded.)

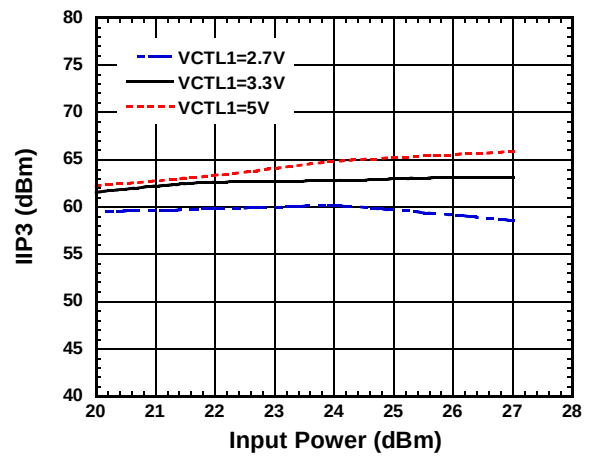
Pout, IM3 vs. Input Power

(VCTL1=3.3V, VCTL2=0V, f=3850+3851MHz)



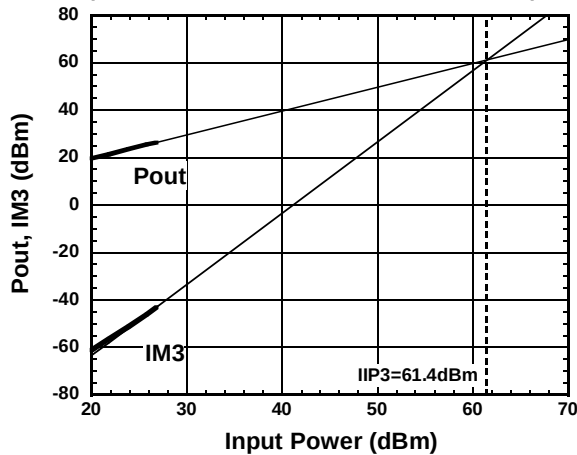
IIP3 vs. Input Power

(f=3850+3851MHz, VCTL2=0V, PC-P1 ON)



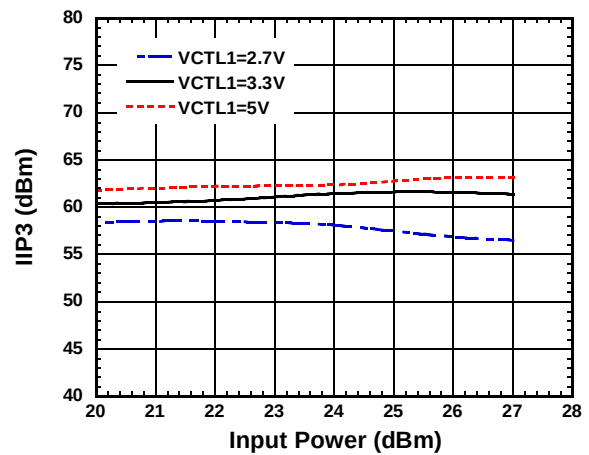
Pout, IM3 vs. Input Power

(VCTL1=3.3V, VCTL2=0V, f=4700+4701MHz)



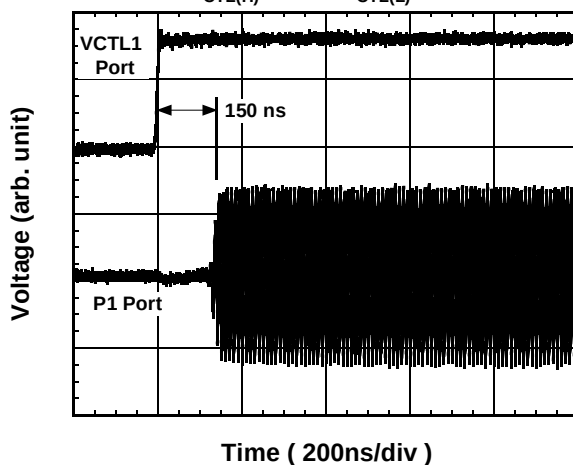
IIP3 vs. Input Power

(f=4700+4701MHz, VCTL2=0V, PC-P1 ON)



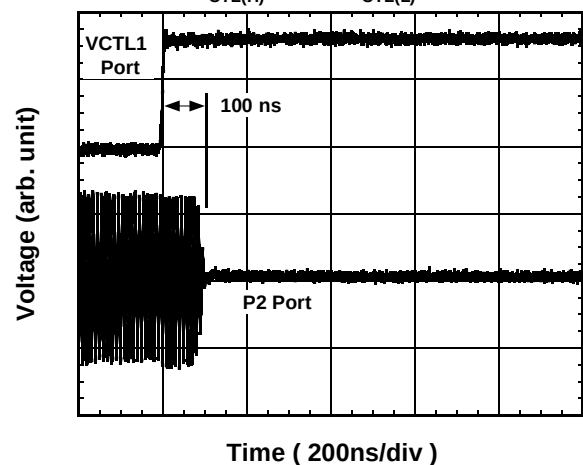
Switching Time

(V_{CTL(H)}=3.3V, V_{CTL(L)}=0V)

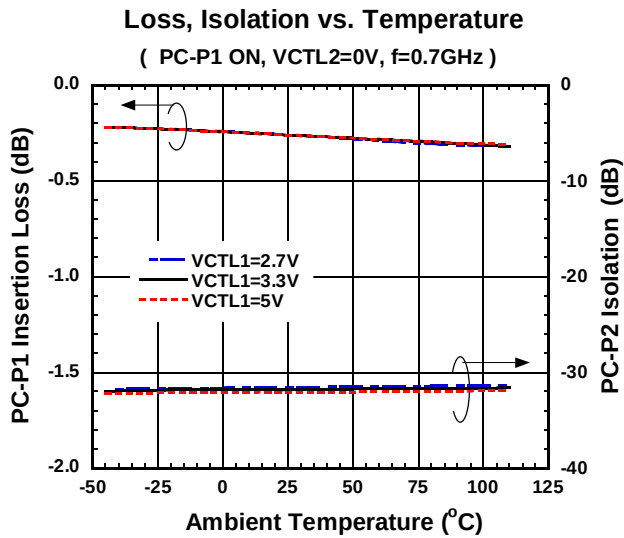
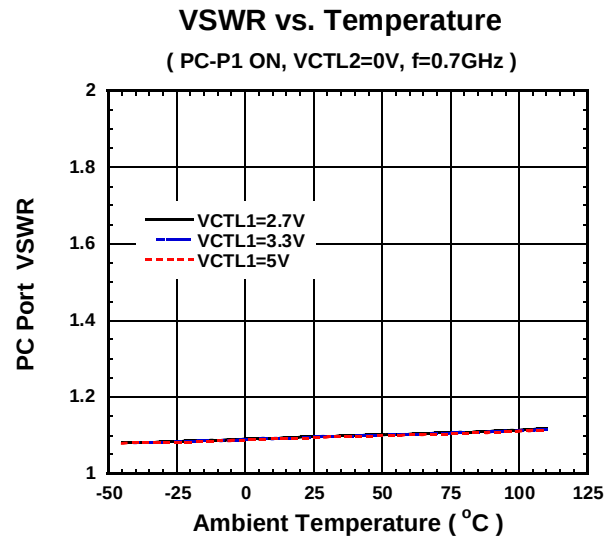
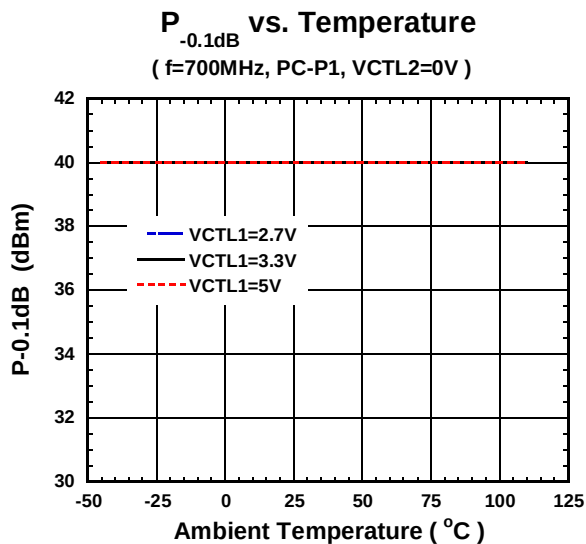


Switching Time

(V_{CTL(H)}=3.3V, V_{CTL(L)}=0V)

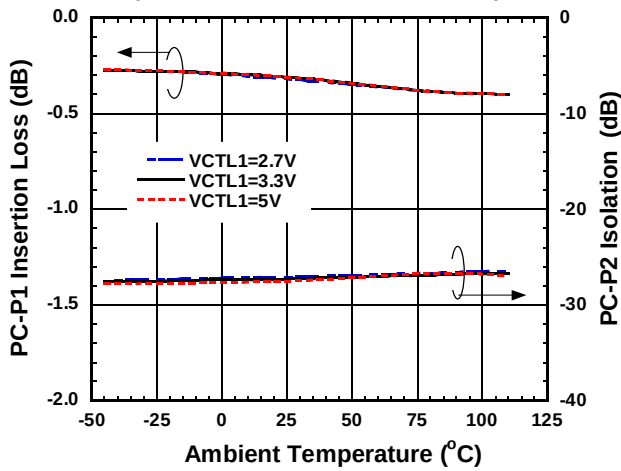


■ ELECTRICAL CHARACTERISTICS (With application circuit list 1, losses of external circuit are excluded.)

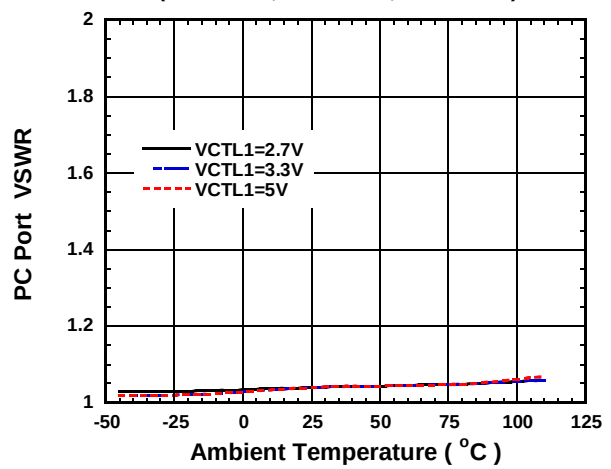


■ ELECTRICAL CHARACTERISTICS (With application circuit list 2, losses of external circuit are excluded.)

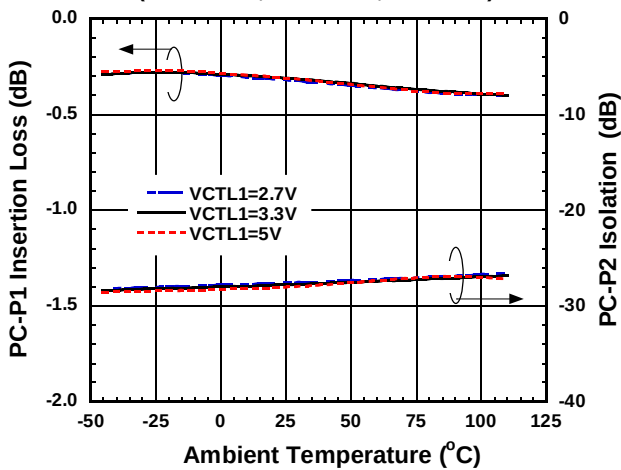
Loss, Isolation vs. Temperature
(PC-P1 ON, VCTL2=0V, f=3.85GHz)



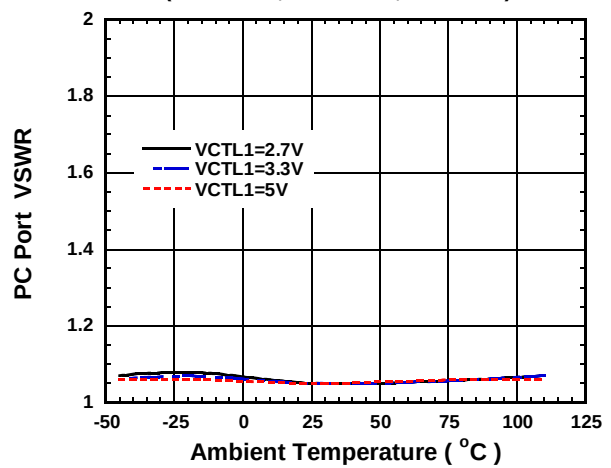
VSWR vs. Temperature
(PC-P1 ON, VCTL2=0V, f=3.85GHz)



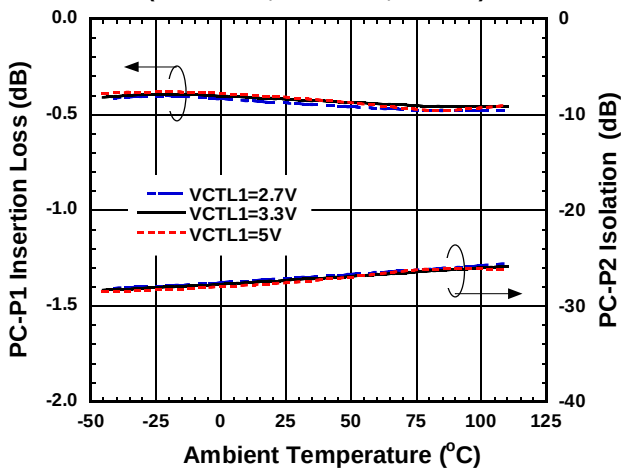
Loss, Isolation vs. Temperature
(PC-P1 ON, VCTL2=0V, f=4.7GHz)



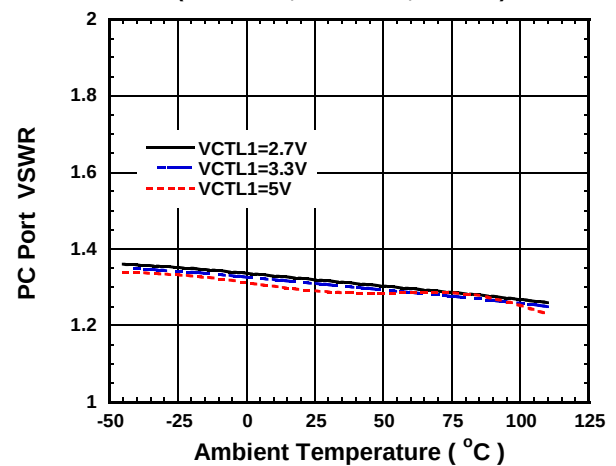
VSWR vs. Temperature
(PC-P1 ON, VCTL2=0V, f=4.7GHz)



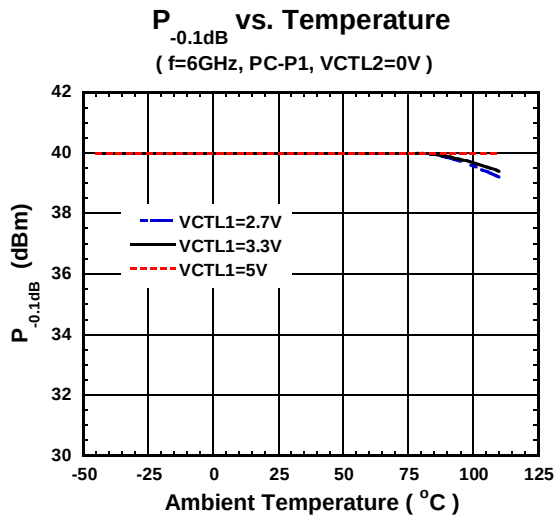
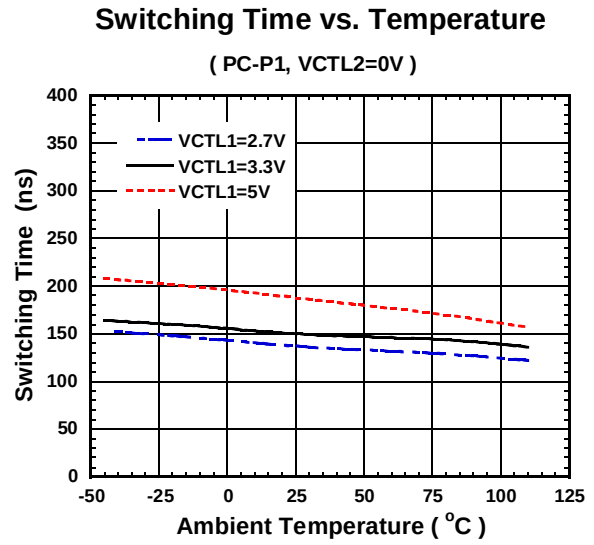
Loss, Isolation vs. Temperature
(PC-P1 ON, VCTL2=0V, f=6GHz)



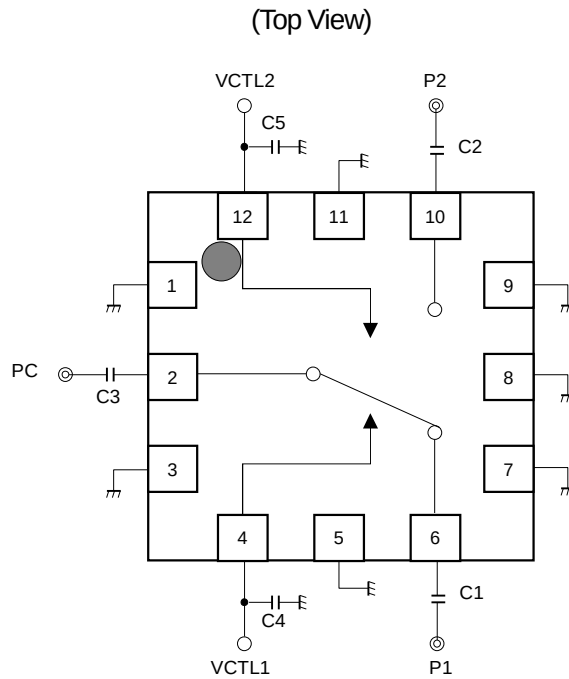
VSWR vs. Temperature
(PC-P1 ON, VCTL2=0V, f=6GHz)



■ ELECTRICAL CHARACTERISTICS (With application circuit list 2, losses of external circuit are excluded.)



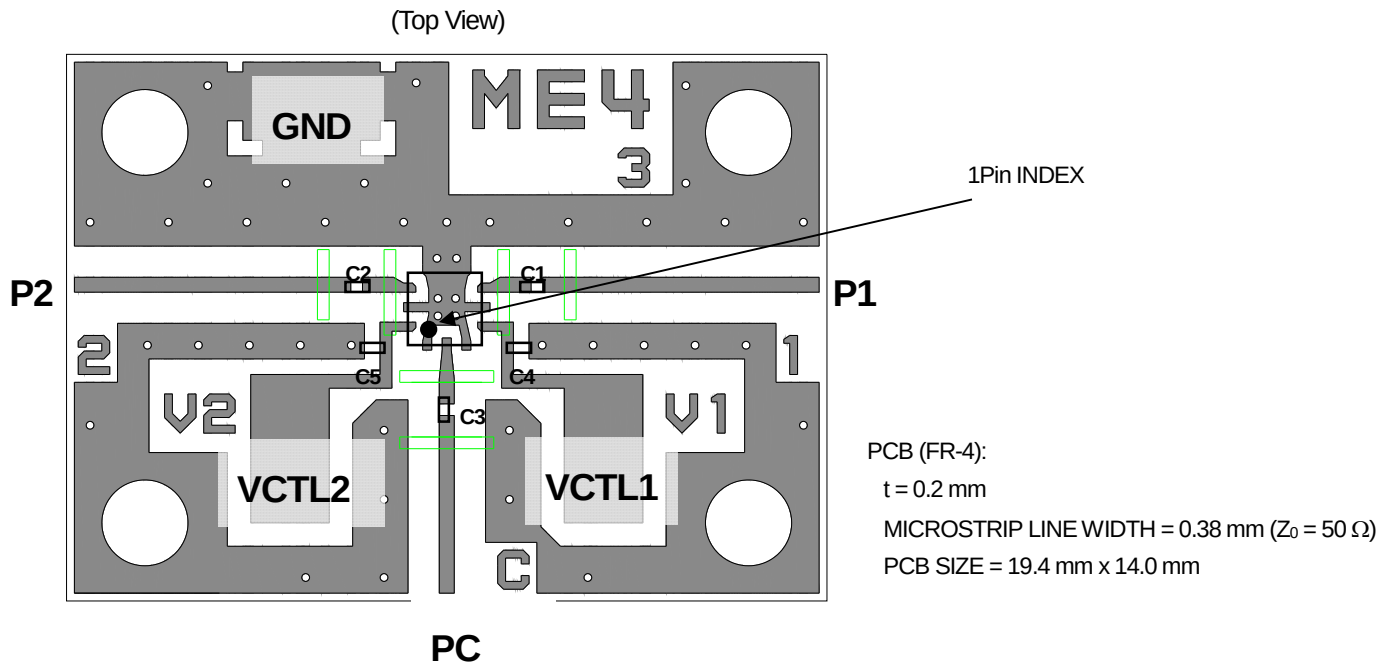
■ APPLICATION CIRCUIT



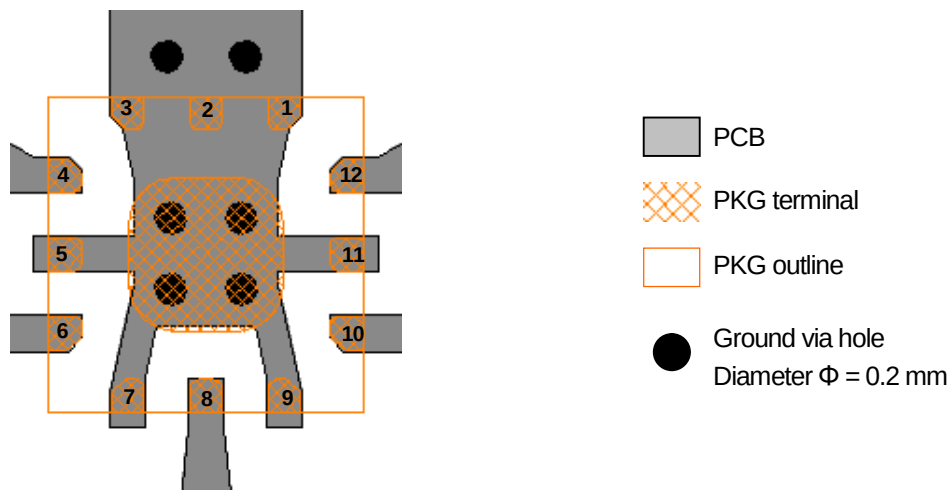
< PARTS LIST >

Part ID	Value		Notes
	List 1	List 2	
	f = 0.3 to 2.0 GHz	f = 2.0 to 6.0 GHz	
C1 to C3	100 pF	27 pF	MURATA (GRM03)
C4, C5	10 pF	10 pF	MURATA (GRM03)

■ EVALUATION BOARD



■ PCB LAYOUT GUIDELINE (EQFN12-E4)



PRECAUTIONS

- [1] The DC blocking capacitors should be placed at RF terminals. Please choose appropriate capacitance value at the application frequency.
- [2] For good RF performance, all GND terminals are must be connected to PCB ground plane of the substrate, and through - holes for GND should be placed near the IC.
- [3] Please connect Exposed PAD to PCB ground plane of substrate, and through - holes for ground should be placed under the IC.
- [4] Please place through holes under the IC as many as possible in order to improve thermal conduction.

RECOMMENDED FOOTPRINT PATTERN (EQFN12-E4 PACKAGE Reference)

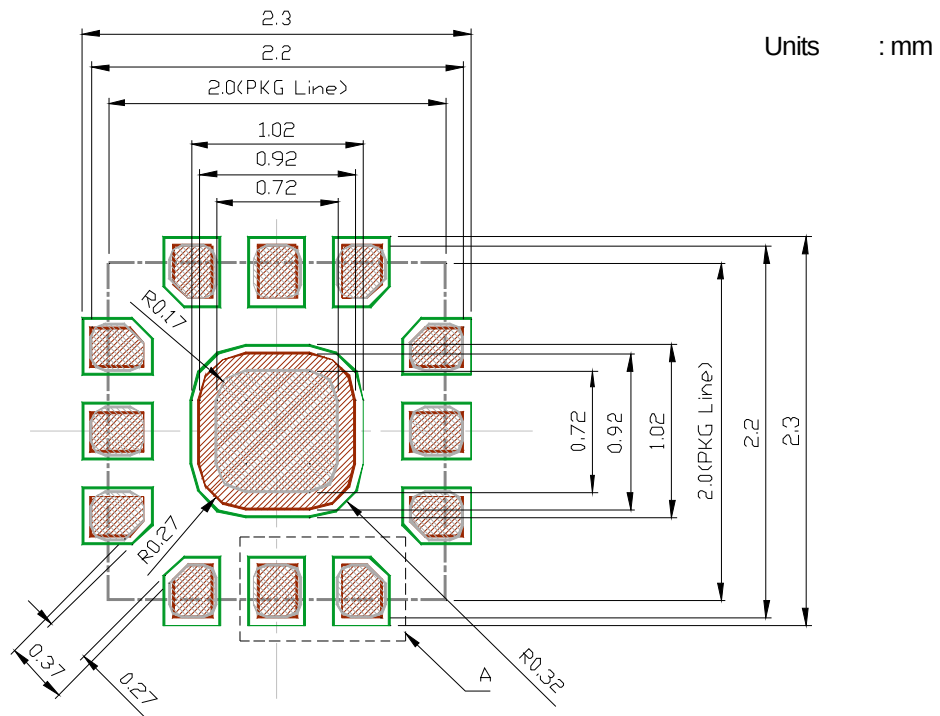
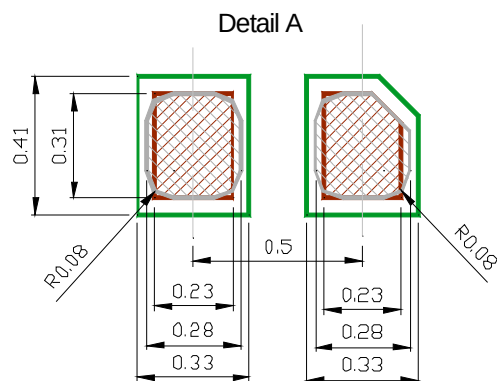
PKG: 2.0 mm x 2.0 mm

Pin pitch: 0.5 mm

: Land

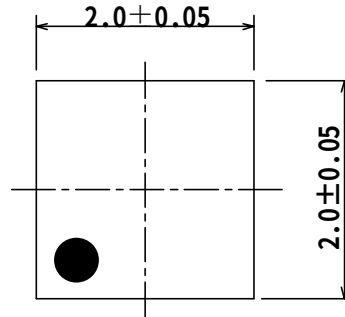
: Mask (Open area) *Metal mask thickness: 100 μm

: Resist (Open area)



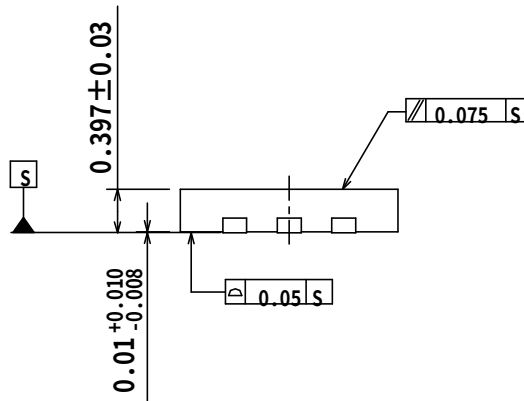
■ PACKAGE OUTLINE (EQFN12-E4)

TOP VIEW

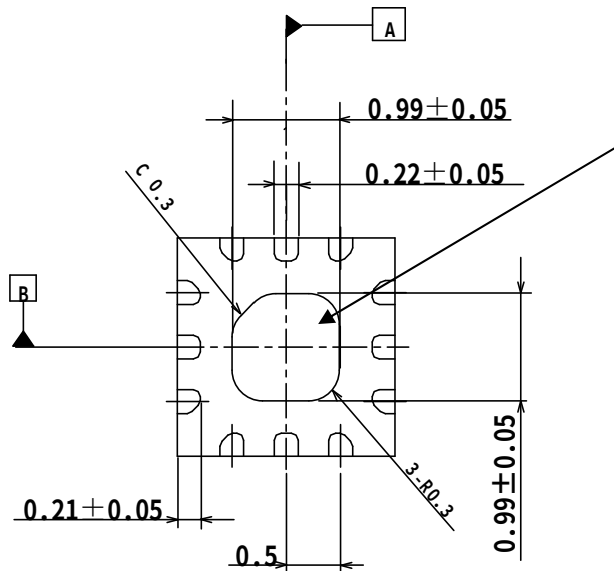


Units	: mm
Board	: Cu
Terminal treat	: SnBi
Molding material	: Epoxy resin
Weight	: 4.7mg

SIDE VIEW



BOTTOM VIEW

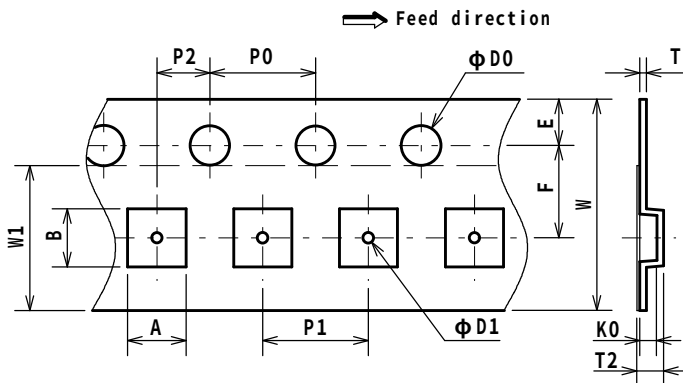


Ground connection is required.

PACKING SPECIFICATION

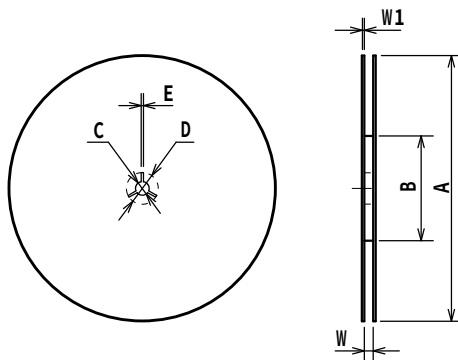
Unit: mm

TAPING DIMENSIONS



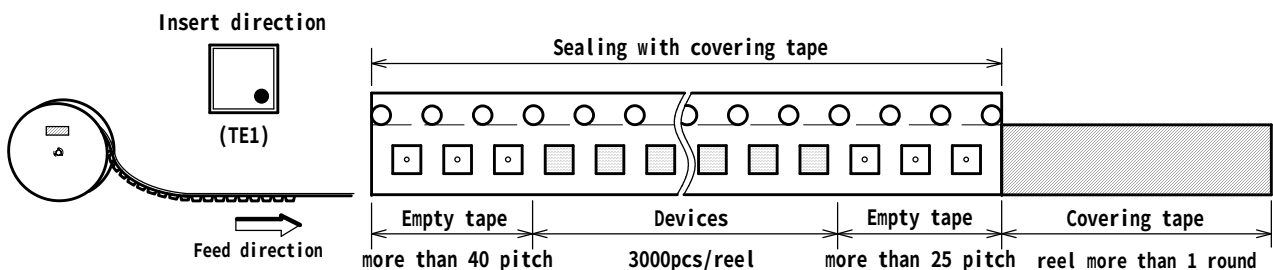
SYMBOL	DIMENSION	REMARKS
A	2.25 ± 0.05	BOTTOM DIMENSION
B	2.25 ± 0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_0$	
D1	0.5 ± 0.1	
E	1.75 ± 0.1	
F	3.5 ± 0.05	
P0	4.0 ± 0.1	
P1	4.0 ± 0.1	
P2	2.0 ± 0.05	
T	0.25 ± 0.05	
T2	1.00 ± 0.07	
K0	0.65 ± 0.05	
W	8.0 ± 0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

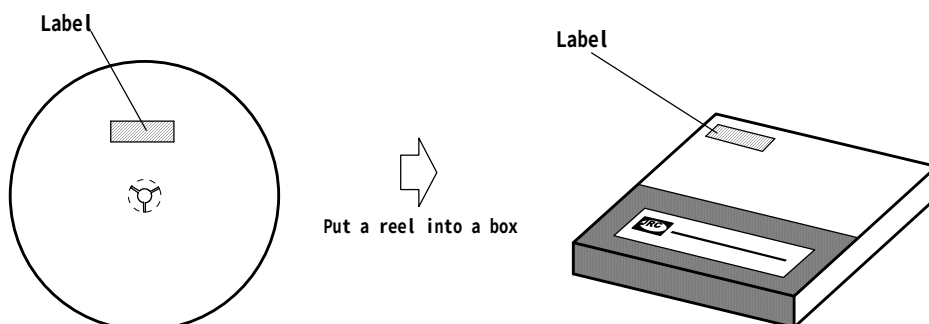


SYMBOL	DIMENSION
A	$\phi 180^{+0}_{-1.5}$
B	$\phi 60^{+1}_0$
C	$\phi 13 \pm 0.2$
D	$\phi 21 \pm 0.8$
E	2 ± 0.5
W	9^{+1}_0
W1	1.2

TAPING STATE



PACKING STATE



[CAUTION]

1. NJR strives to produce reliable and high quality semiconductors. NJR's semiconductors are intended for specific applications and require proper maintenance and handling. To enhance the performance and service of NJR's semiconductors, the devices, machinery or equipment into which they are integrated should undergo preventative maintenance and inspection at regularly scheduled intervals. Failure to properly maintain equipment and machinery incorporating these products can result in catastrophic system failures
2. The specifications on this datasheet are only given for information without any guarantee as regards either mistakes or omissions. The application circuits in this datasheet are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial property rights.
All other trademarks mentioned herein are the property of their respective companies.
3. To ensure the highest levels of reliability, NJR products must always be properly handled.
The introduction of external contaminants (e.g. dust, oil or cosmetics) can result in failures of semiconductor products.
4. NJR offers a variety of semiconductor products intended for particular applications. It is important that you select the proper component for your intended application. You may contact NJR's Sale's Office if you are uncertain about the products listed in this datasheet.
5. Special care is required in designing devices, machinery or equipment which demand high levels of reliability. This is particularly important when designing critical components or systems whose failure can foreseeably result in situations that could adversely affect health or safety. In designing such critical devices, equipment or machinery, careful consideration should be given to amongst other things, their safety design, fail-safe design, back-up and redundancy systems, and diffusion design.
6. The products listed in this datasheet may not be appropriate for use in certain equipment where reliability is critical or where the products may be subjected to extreme conditions. You should consult our sales office before using the products in any of the following types of equipment.
 - 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 (Automobile, Airplane, railroad, ship, etc.)
 - Various Safety Devices
7. NJR's 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. NJR 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. The products are sold without warranty of any kind, either express or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose.
8. 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.
9. The product specifications and descriptions listed in this datasheet are subject to change at any time, without notice.

