GaAs SPDT SWITCH IC

■ GENERAL DESCRIPTION

NJG1509F is a GaAs SPDT switch IC operating from 100MHz to 3GHz.

This Switch features low loss, high isolation and low voltage operation from +2.5V. It is suited for the T/R switch of digital cordless phone.

A very small package is adopted.

■ PACKAGE OUTLINE

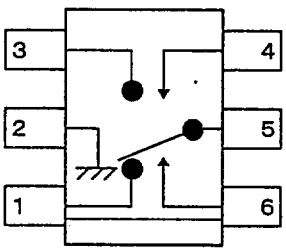
NJG1509F

■ FEATURES

- Only positive and low control voltage +2.5V ~ +5.5V
- Low insertion loss 0.5dB Typ. @f=2GHz, P_{in}=22dBm.
- Passing power 27dBm Max. @f=2GHz V_{CTR}=3V
- High Isolation 25dB Typ. @f=2GHz, P_{in}=22dBm
- Low control current 5 μ A Typ. @f=0.1 ~ 2.5GHz, Pin=22dBm
- Small package MTP6

■ PIN CONFIGURATION

(Top View)



MTP6: TOP VIEW

Pin Connection

1. P1
2. GND
3. P2
4. V_{CTR2}
5. PC
6. V_{CTR1}

■ TRUTH TABLE

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

V_{CTR1}	H	L	L	H
V_{CTR2}	L	H	L	H
P1-PC	OFF	ON	Loss =15dB P_1 Return Loss =-3dB	Loss =16dB P_1 Return Loss =-2dB
P2-PC	ON	OFF	Loss =15dB P_2 Return Loss =-3dB	Loss =16dB P_2 Return Loss =-2dB

Note) The values of "Loss" and "Return Loss" are typical values.

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Input Power	P_{in}	31	dBm
Control Voltage	V_{CTR}	6	V
Power Dissipation	P_D	300	mW
Operating Temperature	T_{opr}	-30～+85	℃
Storage Temperature	T_{stg}	-40～+150	℃

■ ELECTRICAL CHARACTERISTICS

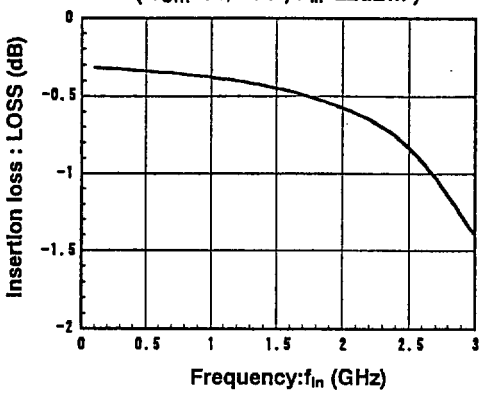
($V_{CTR(L)}$=0V、$V_{CTR(H)}$=2.7V、Z_S=Z_O=50ohm、Ta=25℃)

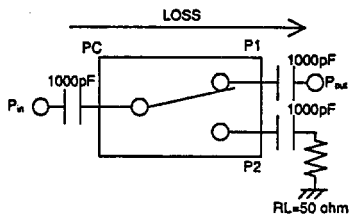
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Control Voltage(L)	$V_{CTR(L)}$	f=0.1～2.5GHz,P_{in}=10dBm	-0.2	0	0.2	V
Control Voltage(H)	$V_{CTR(H)}$	f=0.1～2.5GHz,P_{in}=10dBm	2.5	2.7	5.5	V
Control Current	I_{CTR}	f=0.1～2.5GHz,P_{in}=10dBm	-	5.0	8.0	uA
Insertion Loss 1	LOSS1	f=1GHz,P_{in}=22dBm	-	0.4	0.7	dB
Insertion Loss 2	LOSS2	f=2GHz,P_{in}=22dBm	-	0.5	0.8	dB
Isolation 1 (PC-P1,PC-P2,P1-P2)	ISL1	f=1GHz,P_{in}=22dBm	23	28	-	dB
Isolation 2 (PC-P1,PC-P2,P1-P2)	ISL2	f=2GHz,P_{in}=22dBm	20	25	-	dB
Input Power at 1dB Compression 1	P_{-1dB1}	f=2GHz	26	28	-	dBm
Input Power at 1dB Compression 2	P_{-1dB2}	$V_{CTR(H)}$=3.0V,f=2GHz	27	30	-	dBm
VSWR (PC,P1,P2)	VSWR	f=0.1～2.5GHz,ON State	-	1.3	1.6	
Switching Time	T_{SW}	f=0.1～2.5GHz	-	15	-	ns

■ TYPICAL CHARACTERISTICS

(PC-P1) Insertion loss vs. Frequency

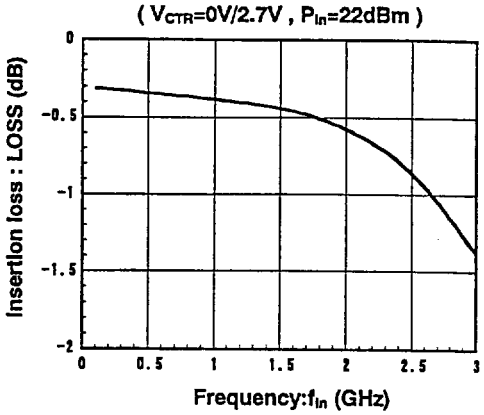
(V_{CTR}=0V/2.7V , P_{in}=22dBm)

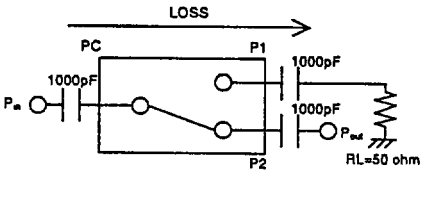




(PC-P2) Insertion loss vs. Frequency

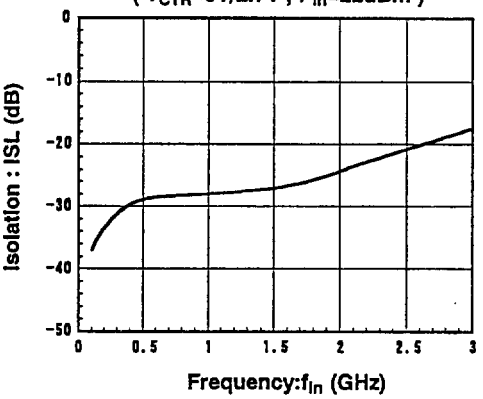
(V_{CTR}=0V/2.7V , P_{in}=22dBm)

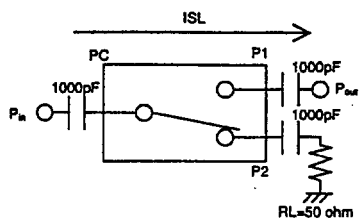




(PC-P1) Isolation vs. Frequency

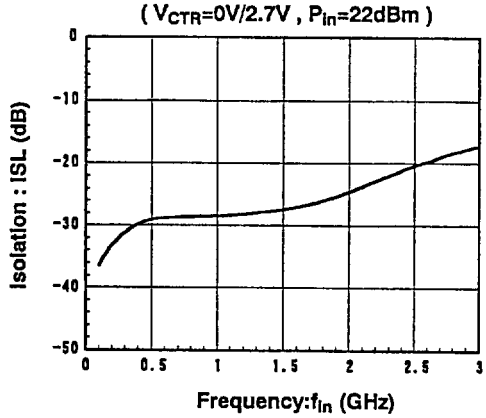
(V_{CTR}=0V/2.7V , P_{in}=22dBm)

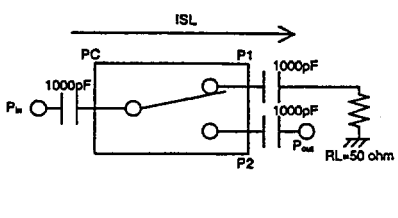




(PC-P2) Isolation vs. Frequency

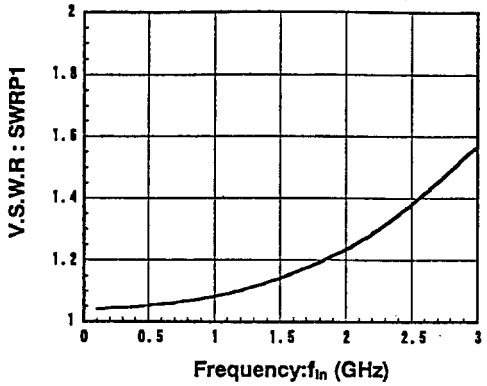
(V_{CTR}=0V/2.7V , P_{in}=22dBm)





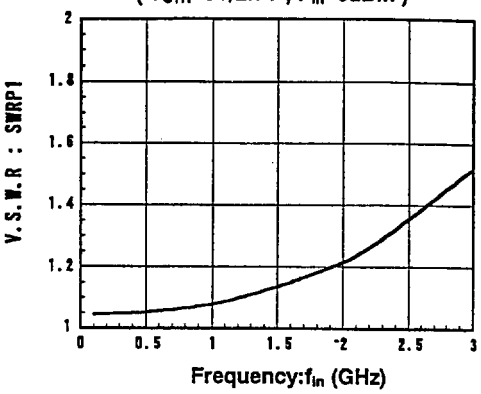
P1-PC(ON)V.S.W.R vs. Frequecny

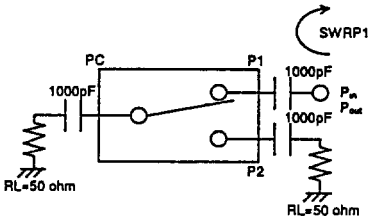
(V_{CTR}=0V/2.7V , P_{in}=0dBm)

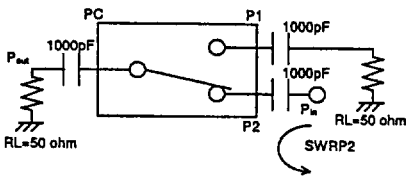


P2-PC(ON)V.S.W.R vs. Frequency

(V_{CTR}=0V/2.7V , P_{in}=0dBm)

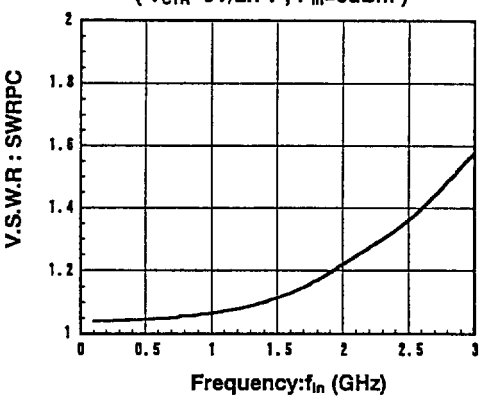


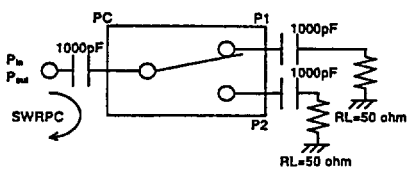




PC-P1(ON)V.S.W.R vs. Frequency

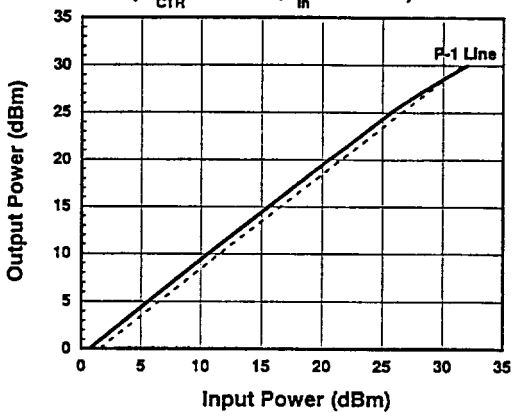
(V_{CTR}=0V/2.7V , P_{in}=0dBm)





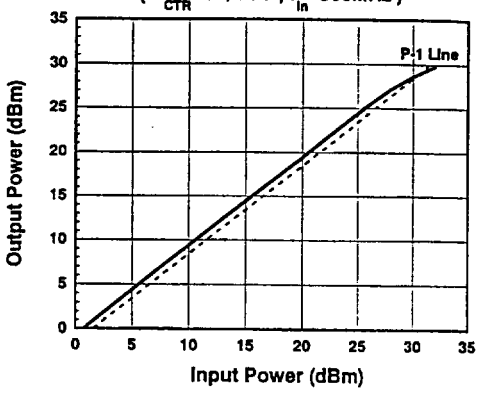
Output Power vs. Input Power

(V_{CTR}=0V/2.7V , f_{in}=300MHz)



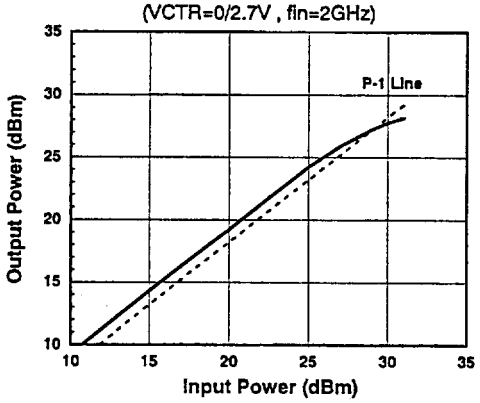
Output Power vs. Input Power

(V_{CTR}=0V/2.7V , f_{in}=900MHz)



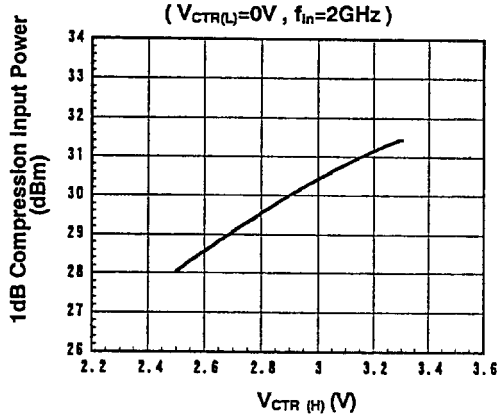
Output Power vs. Input Power

(VCTR=0/2.7V , fin=2GHz)



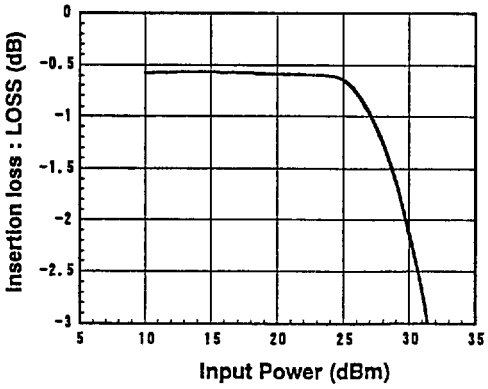
P-1dB vs. Control Voltage

($V_{CTR(L)}$=0V , f_{in}=2GHz)



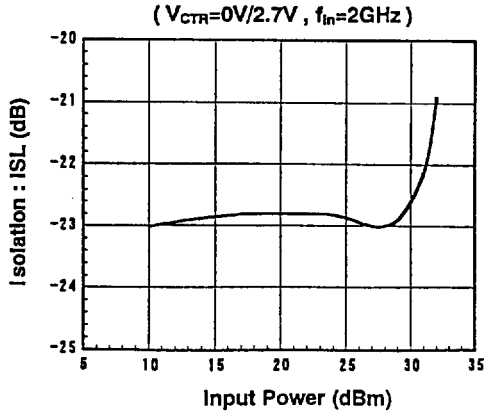
Insertion Loss vs. Input Power

(V_{CTR}=0V/2.7V , f_{in}=2GHz)

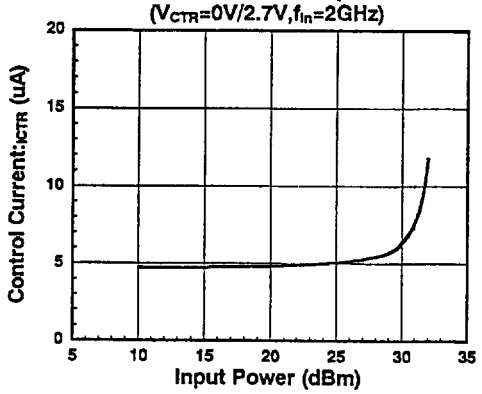


Isolation vs. Input Power

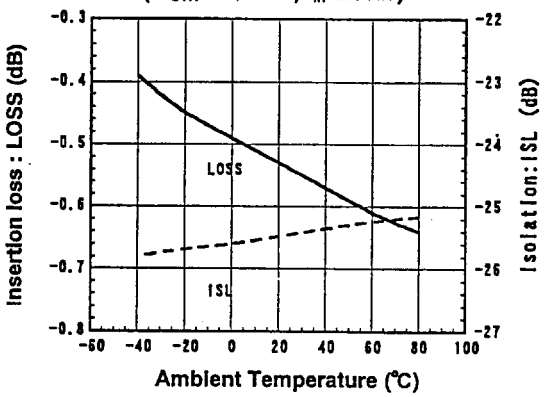
(V_{CTR}=0V/2.7V , f_{in}=2GHz)



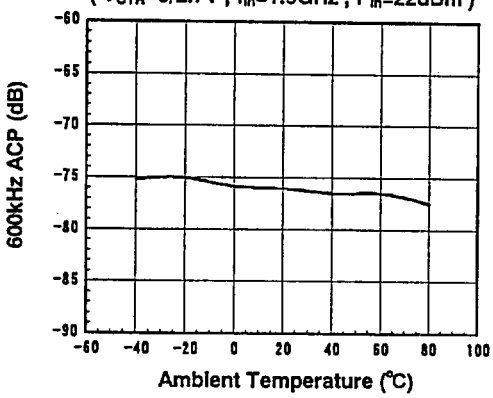
Control Current vs. Input Power
(V_{CTR}=0V/2.7V,f_{in}=2GHz)



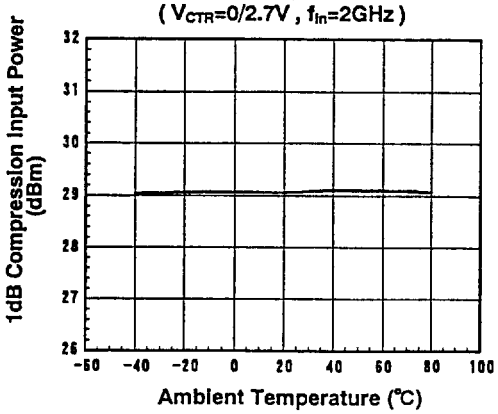
Loss/Isolation vs. Temperature
(V_{CTR}=0V/2.7V , f_{in}=2GHz)



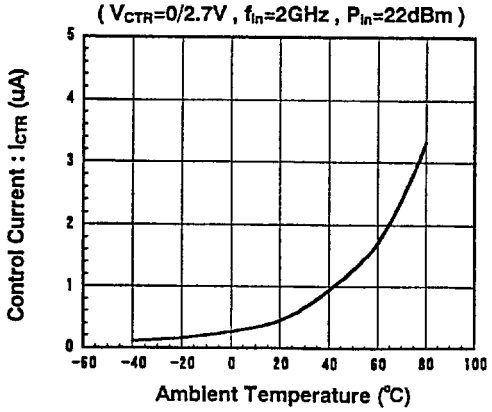
600kHz ACP vs. Temperature
(V_{CTR}=0/2.7V , f_{in}=1.9GHz , P_{in}=22dBm)



P-1dB vs. Temperature
(V_{CTR}=0/2.7V , f_{in}=2GHz)



Controll Current vs. Temperature
(V_{CTR}=0/2.7V , f_{in}=2GHz , P_{in}=22dBm)

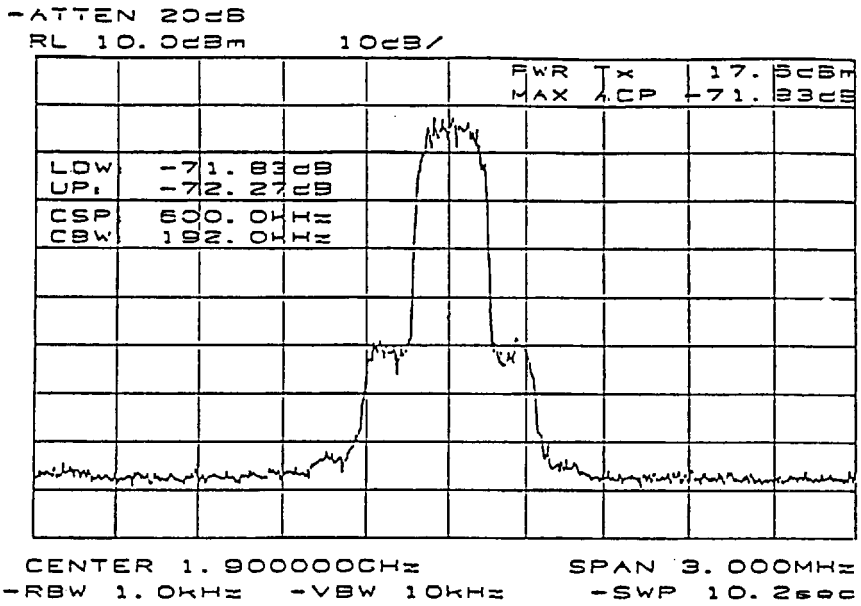


600kHz ACP CHARACTERISTICS (Ta=25°C)

DQPSK Modulation Signal (without D.U.T)

f_{in}=1.9GHz P_{in}=22dBm

MODULATION : 384Kbps RNYQ α=0.5 1/4 π DQPSK

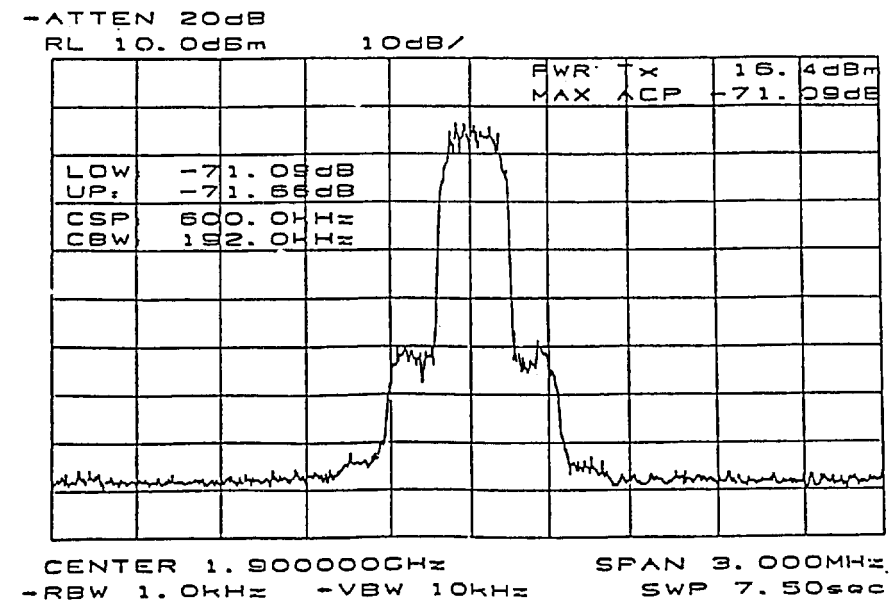


D.U.T Output Signal

Insertion PORT : PC → P1

f_{in}=1.9GHz P_{in}=22dBm V_{CTR}=0/2.7V

MODULATION : 384Kbps RNYQ α=0.5 1/4 π DQPSK



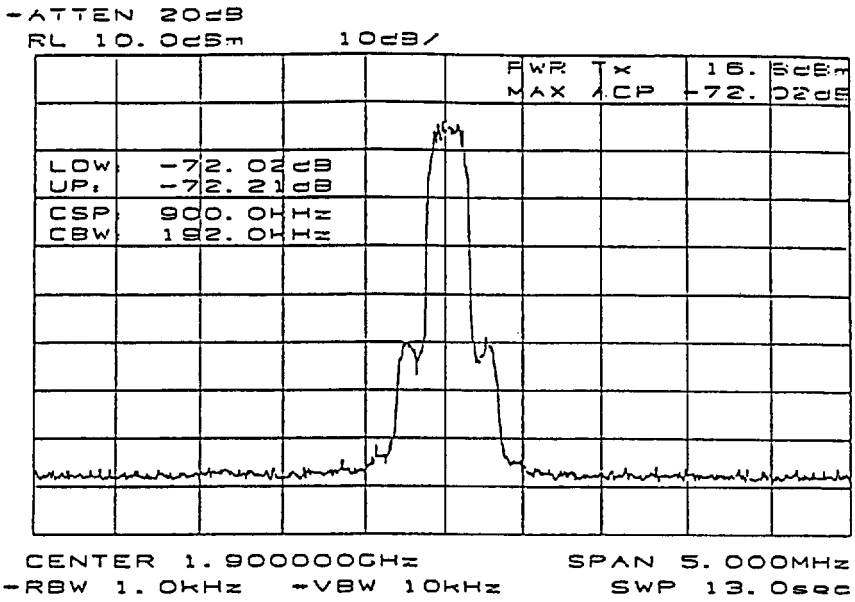
■ TYPICAL CHARACTERISTICS

900kHz ACP (Ta=25°C)

Insertion PORT : PC → P1

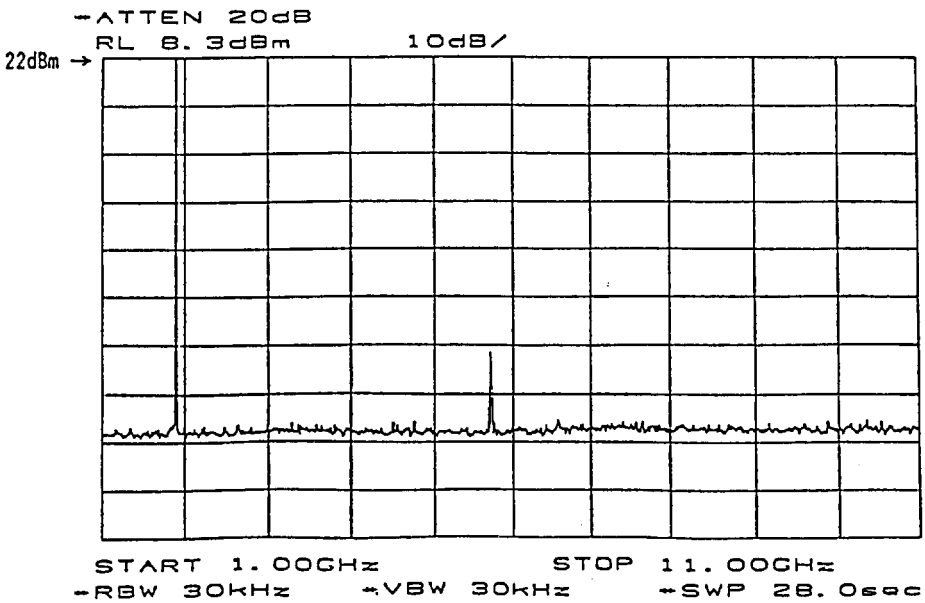
f_{in}=1.9GHz P_{in}=22dBm V_{CTR}=0/2.7V

MODULATION : 384Kbps RNYQ α=0.5 1/4 π DQPSK



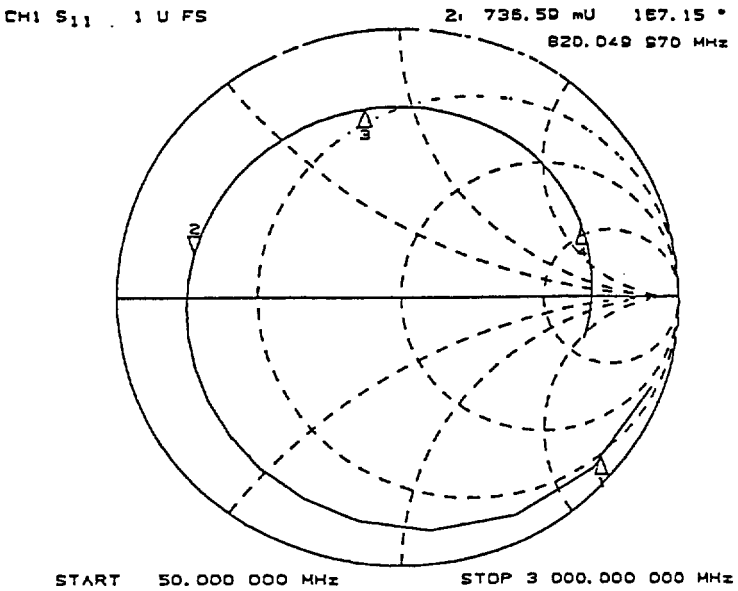
Harmonics (Ta=25°C)

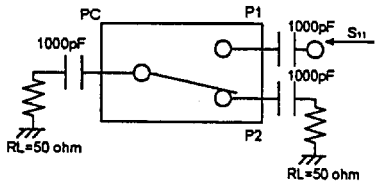
f_{in}=1.9GHz P_{in}=22dBm $V_{CTR(H)}$=2.7V



■ TYPICAL CHARACTERISTICS

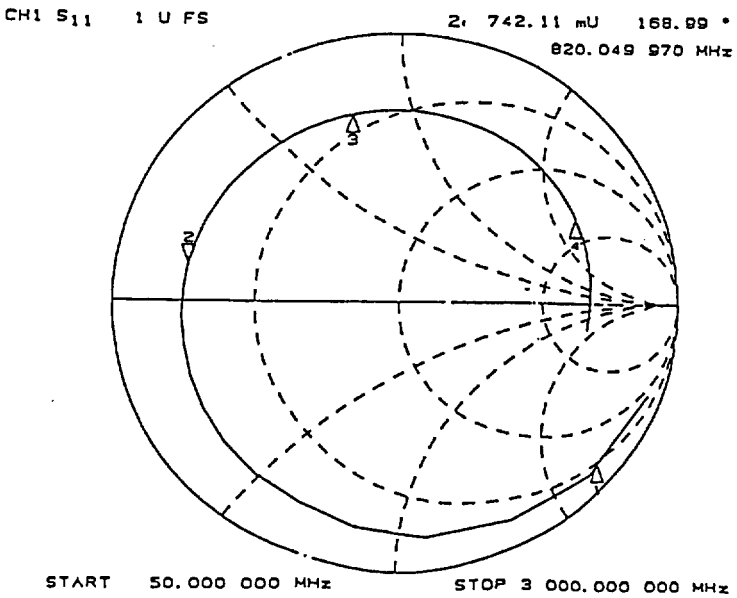
P1 PORT IMPEDANCE (OFF STATE)

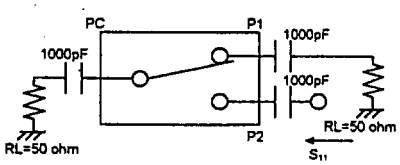




MARKER	f (MHz)	Mag.	Ang. (∠°)
1	50	0.954	-15.4
2	800	0.755	-172.5
3	1500	0.716	113.6
4	2000	0.710	72.3
5	3000	0.693	1.4

P2 PORT IMPEDANCE (OFF STATE)





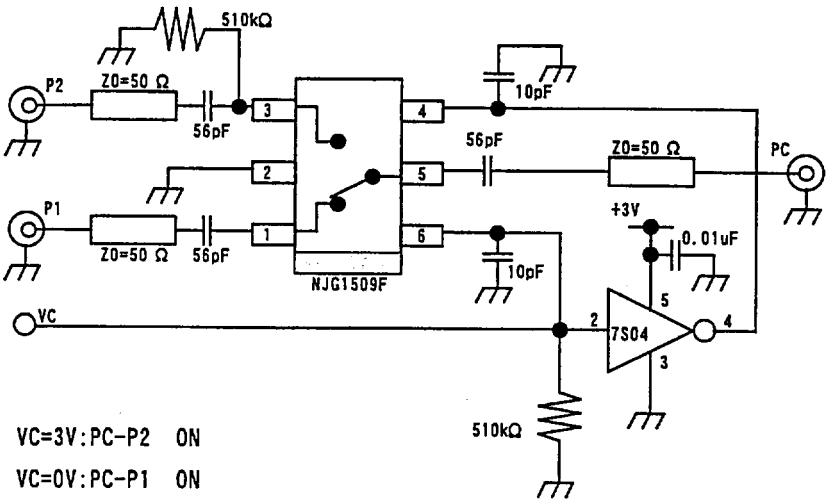
MARKER	f (MHz)	Mag.	Ang. (∠°)
1	50	0.952	-15.5
2	800	0.767	-173.6
3	1500	0.731	111.1
4	2000	0.723	68.7
5	3000	0.701	-4.8

Scattering Parameters : S11(OFF STATE)

(VCTR=0/2.7V , 50Ω System)

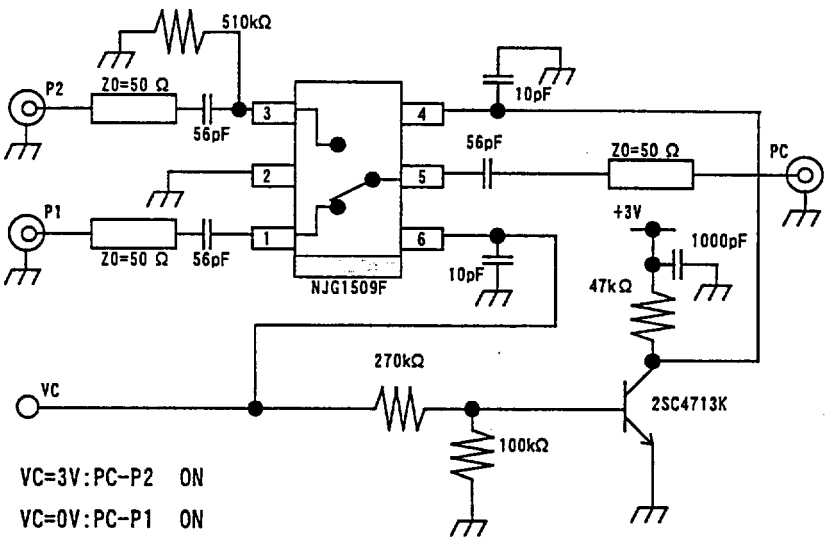
	P1 PORT		P2 PORT	
f(MHz)	Mag.	Ang.(∠°)	Mag.	Ang.(∠°)
50	0.954	-15.4	0.952	-15.5
100	0.945	-30.9	0.945	-31.0
200	0.909	-59.0	0.910	-59.2
300	0.872	-84.5	0.879	-84.9
400	0.837	-106.8	0.844	-107.2
500	0.809	-126.3	0.817	-127.1
600	0.783	-143.4	0.793	-144.3
700	0.766	-158.8	0.778	-159.8
800	0.755	-172.5	0.767	-173.6
900	0.743	174.9	0.758	173.4
1000	0.734	163.1	0.749	161.7
1100	0.722	151.5	0.736	150.0
1200	0.724	141.8	0.737	139.8
1300	0.722	132.0	0.733	129.9
1400	0.719	122.6	0.734	120.4
1500	0.716	113.6	0.731	111.1
1600	0.716	104.9	0.730	102.2
1700	0.714	96.7	0.726	93.7
1800	0.713	88.2	0.725	85.2
1900	0.712	80.2	0.723	76.9
2000	0.710	72.3	0.723	68.7
2100	0.710	65.0	0.723	61.2
2200	0.710	57.4	0.721	53.2
2300	0.708	49.9	0.716	45.5
2400	0.707	42.6	0.717	38.2
2500	0.705	35.4	0.714	30.7
2600	0.703	28.6	0.712	23.6
2700	0.703	21.9	0.711	16.7
2800	0.700	14.8	0.709	9.3
2900	0.696	8.0	0.707	2.3
3000	0.693	1.4	0.701	-4.8

■ APPLICATION CIRCUIT 1 : Single signal control circuit using C-MOS inverter.

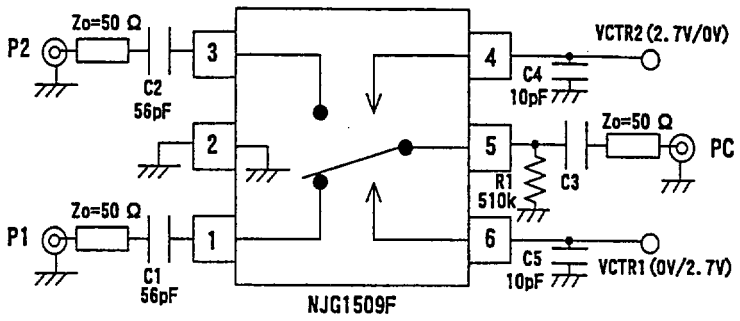


[1] Please connect the bypass capacitor to C-MOS inverter supply terminal.
[2] In order to the state of input impedance of inverter, please pull-down 510K Ω of resistor for C-MOS inverter input terminal.

■ APPLICATION CIRCUITS 2 : Single signal control circuit using a transistor.

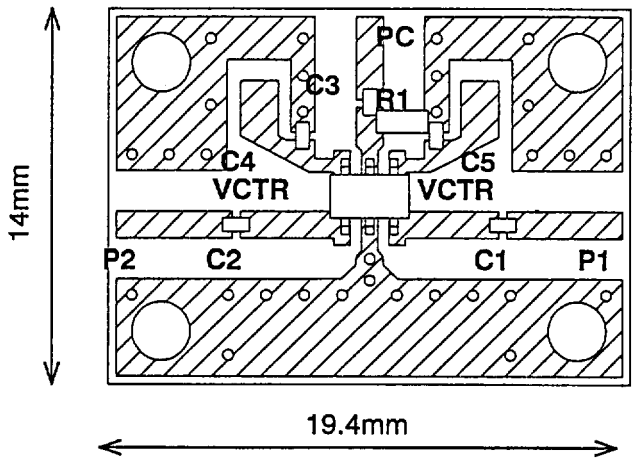


■ TEST CIRCUIT



■ RECOMENDED PCB

(TOP VIEW)



PCB:FR-4 t=0.5mm
CAPACITOR:size 1005
STRIP LINE WIDTH=1mm
C1~C3:56pF
C4,C5:10pF
R1:510k Ω

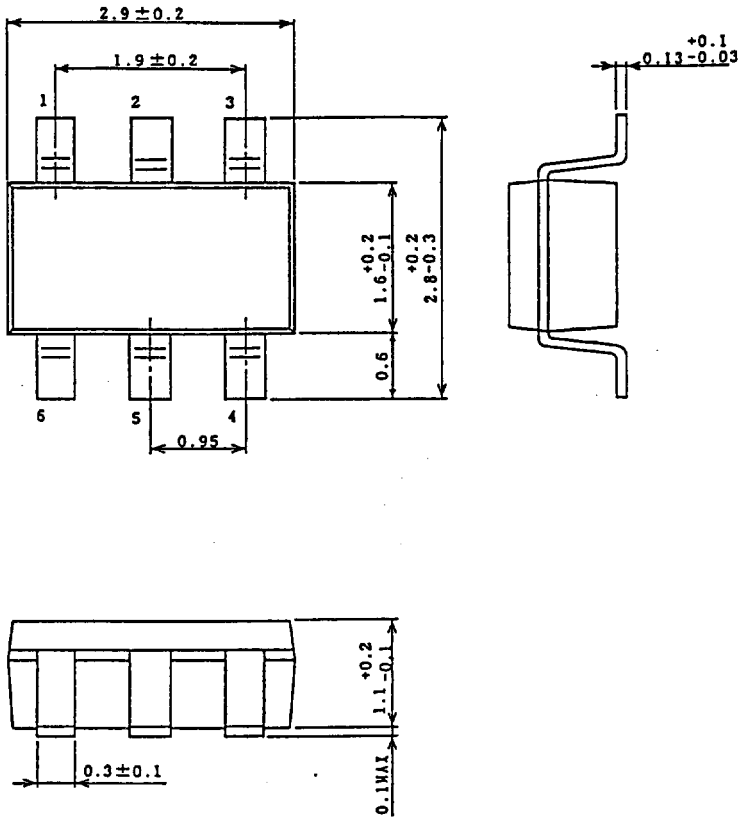
Usage precaution ondevices

[1] Outer capacitors should be connected to the input and output RF frequency terminal(P1,P2,PC)to block the DC current. The above figure is a circuit's example to a frequency at 1.9GHz. Please use a capacitor from 10pF to 1000pF to be suited for using band.

[2] Decoupling capacitors should be connected to the control terminals(V_{CTR1},V_{CTR2}) as near as possible. The values of these capacitors should be selected from 5pF to 100pF for using band. But take care of the switching time because the capacitor make the switching time late.

[3] In order to keep good isolation characteristics, the grand terminal (2pin)should be connected to ground pattern with relatively wide width as near as possible, and Though-hole in the ground plane should be placed as near as possible too.

■ PACKAGE OUTLINE



UNIT:mm

Caution on using the products

A GaAs is used in this product. A GaAs is a harmful material

- Don't eat or in the mouth.
- Don't dipose in fire or break up the this products.
- Don't make a gas or a powdered with the chemical reaction.
- In the case of wasting the products, please obey the relation rule in the each country.

This product may be broken with static electric discharge or serge voltage. Therefore, please note a handling.

The other caution item

- The product specifications and descriptions listed in this catalog are subject to change at any time, without notice.
- We don't take upon ourselves the responsibilities that infringe on other people's rights of a patents bringing about the information and drawing in this catalog.
- It is not purpose to be equipped with the system needs a high reliability as air system, submarine cable system, atomic energy control system and medical instrument for keeping life.
- If you think the above system, please ask for the sales office before.