SPDT Switch GaAs MMIC

■ GENERAL DESCRIPTION

The NJG1612HA8 is a SPDT switch IC featured extremely high speed switching.

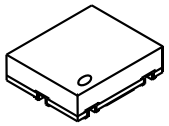
This device is suitable for high speed switching of Tx/Rx signals at sub-microwave applications.

This switch exhibits wide frequency range from 100MHz to 5.0GHz at low operating voltage of 2.5V, and is operated up to 20dBm at 3.0V operating voltage.

An ultra-small and ultra-thin package of USB6-A8 is adopted.

This product is RoHS directive compliant.

■ PACKAGE OUTLINE



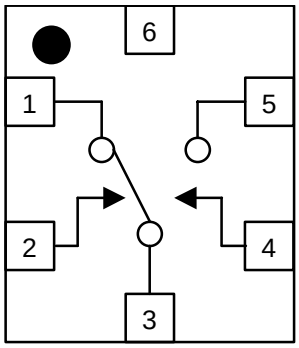
NJG1612HA8

■ FEATURES

●Low control voltage	+2.5~+6.5V
●High speed switching	3ns typ.
●Low insertion loss	0.45dB typ. @f=2.5GHz 0.8dB typ. @f=5.0GHz
●High isolation	21dB typ. @f=2.5GHz 14dB typ. @f=5.0GHz
●P-0.2dB	25dBm typ. @f=2.5GHz, V_{CTL}=3.0V
●Ultra-small & ultra-thin package	USB6-A8 (Package Size: 1.0x1.2x0.38mm typ.)

■ PIN CONFIGURATION

Top view



Pin connection

1.P2
2.VCTL2
3.PC
4.VCTL1
5.P1
6.GND

■ TRUTH TABLE

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

■ ABSOLUTE MAXIMUM RATINGS

(T_a=25℃, Z_s=Z_l=50Ω)

PARAMETER	SYMBOL	CONDITIONS	CONDITIONS	UNITS
RF Input Power	P_{IN}	$V_{CTL(L)}$=0V, $V_{CTL(H)}$=3V	29	dBm
Control Voltage	V_{CTL}	$V_{CTL(H)}$-$V_{CTL(L)}$	7.5	V
Power dissipation	P_D	At on PCB board Tjmax=150℃	150	mW
Operating Temp.	T_{opr}		-40~+85	℃
Storage Temp.	T_{stg}		-55~+150	℃

■ ELECTRICAL CHARACTERISTICS

(General conditions: $V_{CTL\ (L)}$=0V, $V_{CTL\ (H)}$=3V, Z_S=Z_l=50Ω, T_a=25℃, with application circuit)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Control Current	I_{CTL}	f=2.5GHz, P_{IN}=10dBm	-	5	10	μA
Control Voltage (LOW)	$V_{CTL\ (L)}$		-0.2	-	0.2	V
Control Voltage (HIGH)	$V_{CTL\ (H)}$		2.5	3.0	6.5	V
Insertion Loss 1	Loss1	f=1GHz	-	0.35	0.55	dB
Insertion Loss 2	Loss2	f=2GHz	-	0.40	0.60	dB
Insertion Loss 3	Loss3	f=2.5GHz	-	0.45	0.65	dB
Insertion Loss 4	Loss4	f=5GHz	-	0.8	1.2	dB
Isolation 1	ISL1	f=1GHz	25	28	-	dB
Isolation 2	ISL2	f=2GHz	20	23	-	dB
Isolation 3	ISL3	f=2.5GHz	18	21	-	dB
Isolation 4	ISL4	f=5GHz	11	14	-	dB
Input Power at 0.2dB Compression Point 1	P-0.2dB(1)	f=2.5GHz	22	25	-	dBm
Input Power at 0.2dB Compression Point 2	P-0.2dB(2)	f=5GHz	21	24	-	dBm
VSWR1	VSWR1	f=0.1~3GHz, ON state	-	1.2	1.4	
VSWR2	VSWR2	f=3~5GHz, ON state	-	1.5	1.7	
Switching time	T_{SW}	f=0.1~5GHz 50% VCTL to 10/90% RF	-	3	6	ns

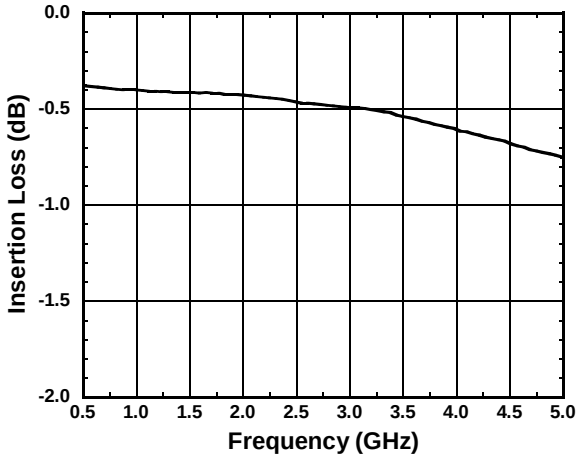
■TERMINAL INFORMATION

No.	SYMBOL	DESCRIPTION
1	P2	RF port. This port is connected with PC port by controlling 2nd pin ($V_{CTL\ (H)}$) to 2.5~6.5V and 4th pin ($V_{CTL(L)}$) to -0.2~+0.2V. An external capacitor is required to block the DC bias voltage of internal circuit. (0.1~0.5GHz: 1000pF, 0.5~3GHz: 56pF, 3~5GHz: 27pF)
2	VCTL2	Control port 2. The voltage of this port controls PC to P2 state. The 'ON' and 'OFF' state is toggled by controlling voltage of this terminal such as high-state (2.5~6.5V) or low-state (-0.2~+0.2V). The voltage of 4th pin has to be set to opposite state. The bypass capacitor has to be chosen to reduce switching time delay from 10pF~1000pF range.
3	PC	Common RF port. In order to block the DC bias voltage of internal circuit, an external capacitor is required. (0.1~0.5GHz: 1000pF, 0.5~3GHz: 56pF, 3~5GHz: 27pF)
4	VCTL1	Control port 1. The voltage of this port controls PC to P1 state. The 'ON' and 'OFF' state is toggled by controlling voltage of this terminal such as high-state (2.5~6.5V) or low-state (-0.2~+0.2V). The voltage of 2nd pin has to be set to opposite state. The bypass capacitor has to be chosen to reduce switching time delay from 10pF~1000pF range.
5	P1	RF port. This port is connected with PC port by controlling 4th pin ($V_{CTL(H)}$) to 2.5~6.5V and 2nd pin($V_{CTL(L)}$) to -0.2~+0.2V. An external capacitor is required to block the DC bias voltage of internal circuit(0.1~0.5GHz: 1000pF, 0.5~3GHz: 56pF, 3~5GHz: 27pF)
6	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.

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

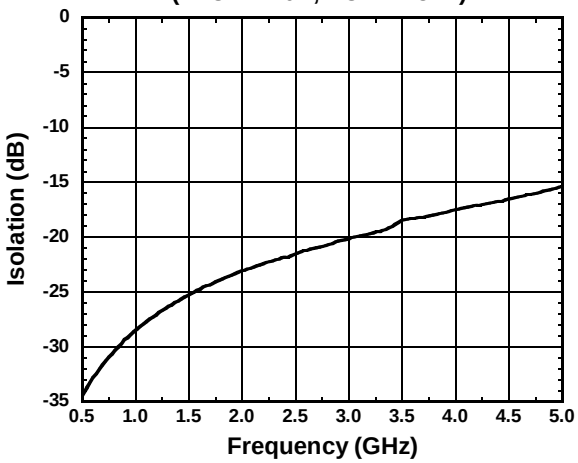
PC-P1 Insertion Loss vs. Frequency

(VCTL1=3V, VCTL2=0V)



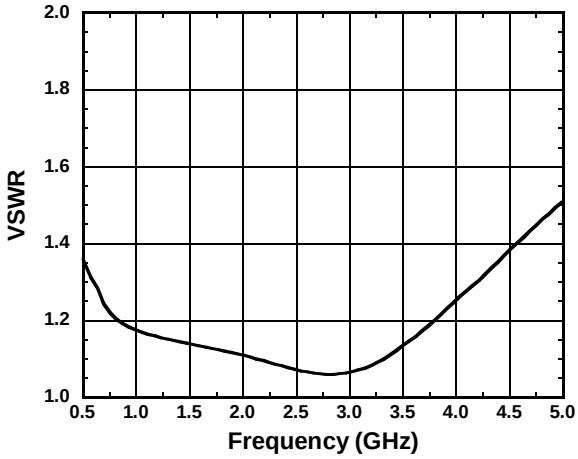
PC-P1 Isolation vs. Frequency

(VCTL1=0V, VCTL2=3V)



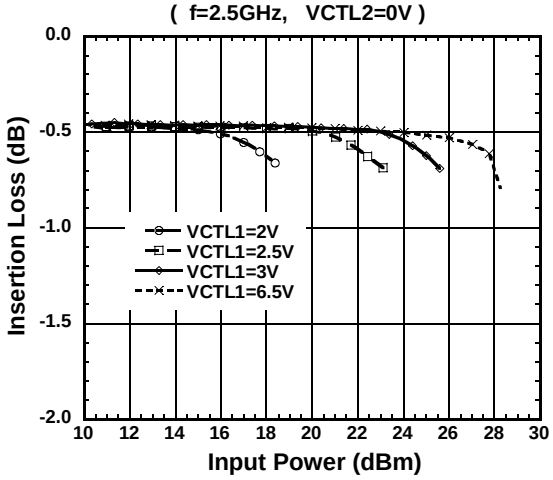
P1 VSWR vs. Frequency

(PC-P1 ON, VCTL1=3V, VCTL2=0V)



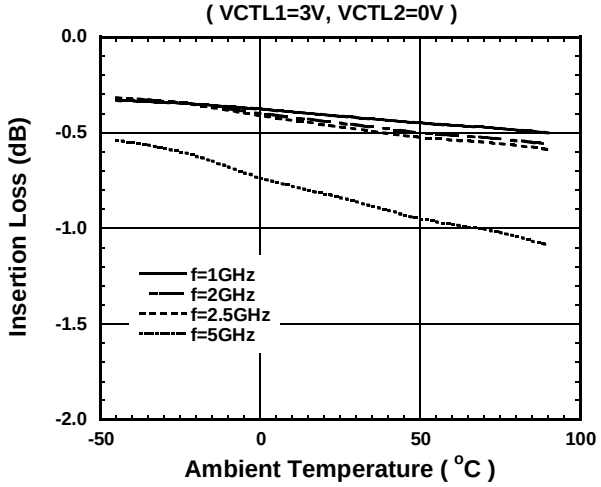
PC-P1 Insertion Loss vs. Input Power

(f=2.5GHz, VCTL2=0V)



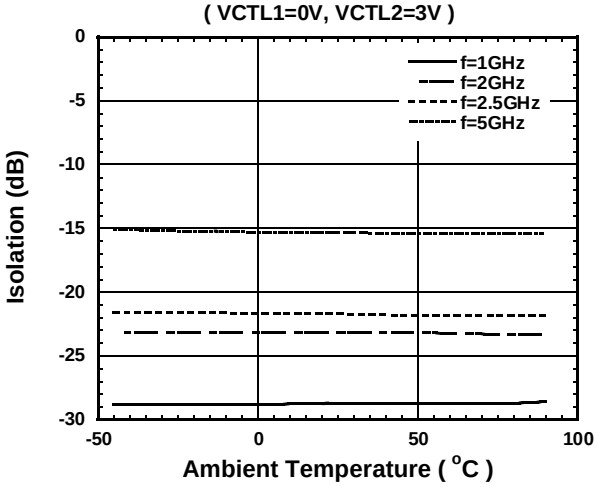
PC-P1 Loss vs. Ambient Temperature

(VCTL1=3V, VCTL2=0V)



PC-P1 Isolation vs. Ambient Temperature

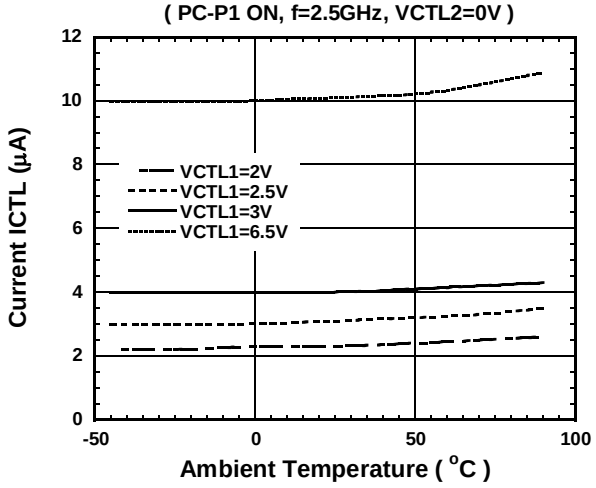
(VCTL1=0V, VCTL2=3V)



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

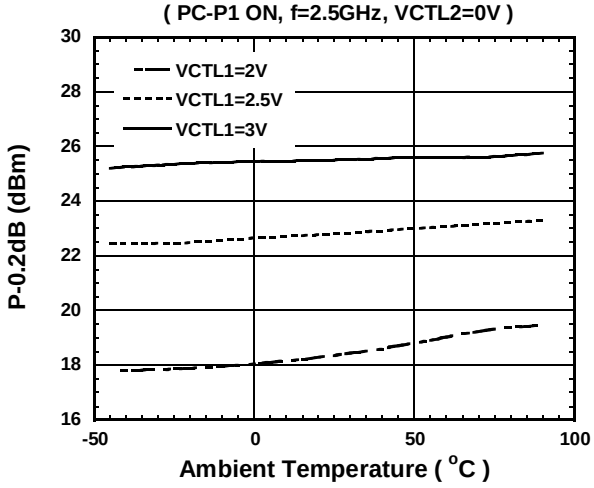
Current ICTL vs. Ambient Temperature

(PC-P1 ON, f=2.5GHz, VCTL2=0V)



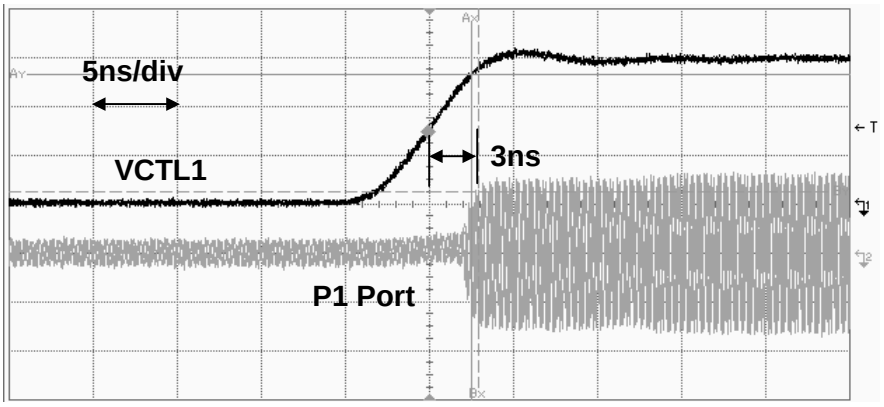
PC-P1 P-0.2dB vs. Ambient Temperature

(PC-P1 ON, f=2.5GHz, VCTL2=0V)



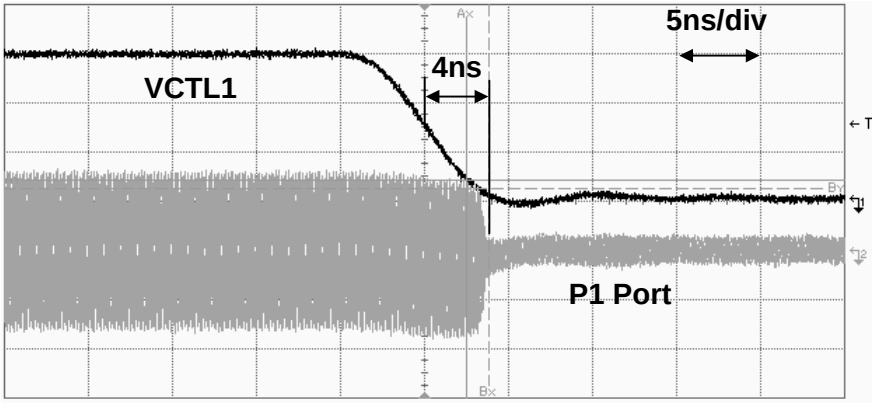
Switching Speed 1

(PC-P1 ON, 50% VCTL1 to 90% RF)

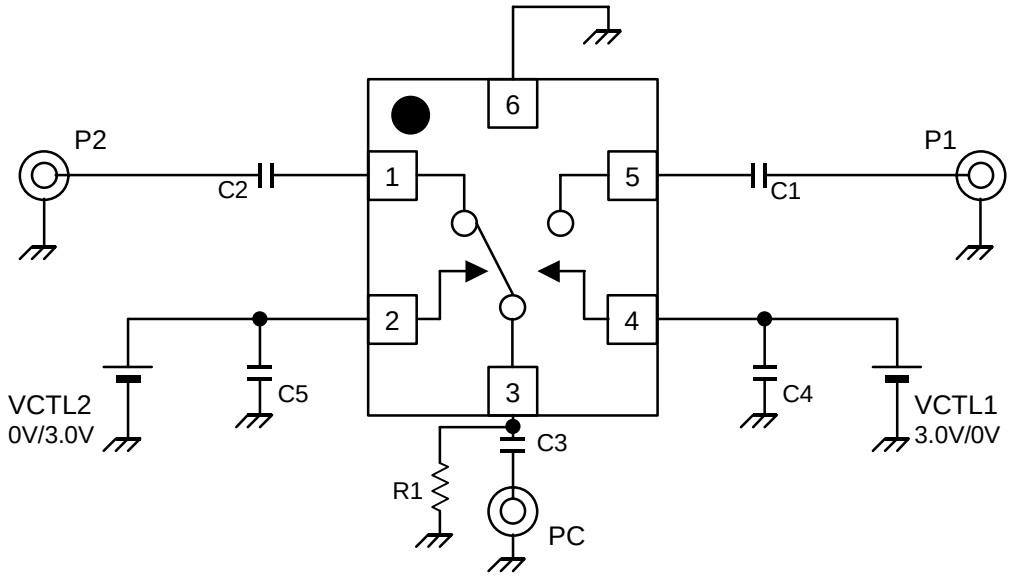


Switching Speed 2

(PC-P1 OFF, 50% VCTL1 to 10% RF)



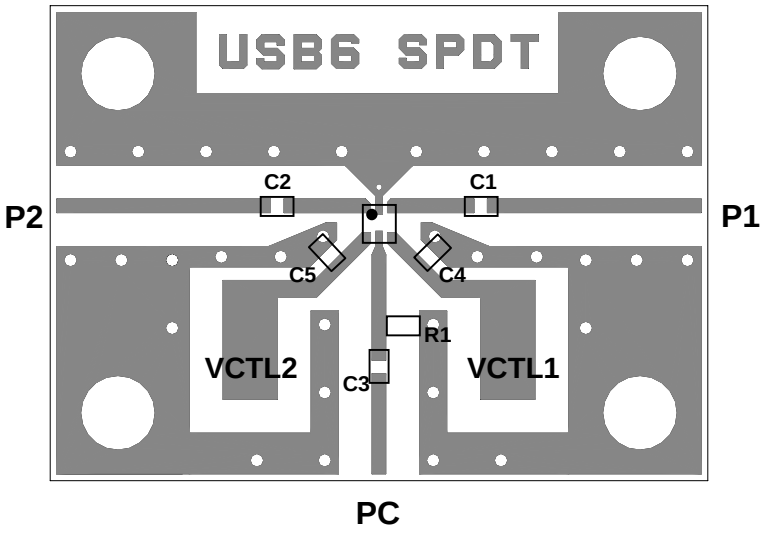
■ APPLICATION CIRCUIT



Parts List

Parts number	List 1	List 2	List 3	Notes
	fin=0.1~0.5GHz	fin=0.5~3GHz	fin=3~5GHz	
C1~C3	1000pF	56pF	27pF	GRM15 MURATA
C4, C5	10pF	10pF	10pF	GRM15 MURATA
R1	560kΩ	560kΩ	560kΩ	

■ TEST PCB LAYOUT



Circuit losses including losses of capacitor and connector.

(DC blocking capacitor: 56pF)

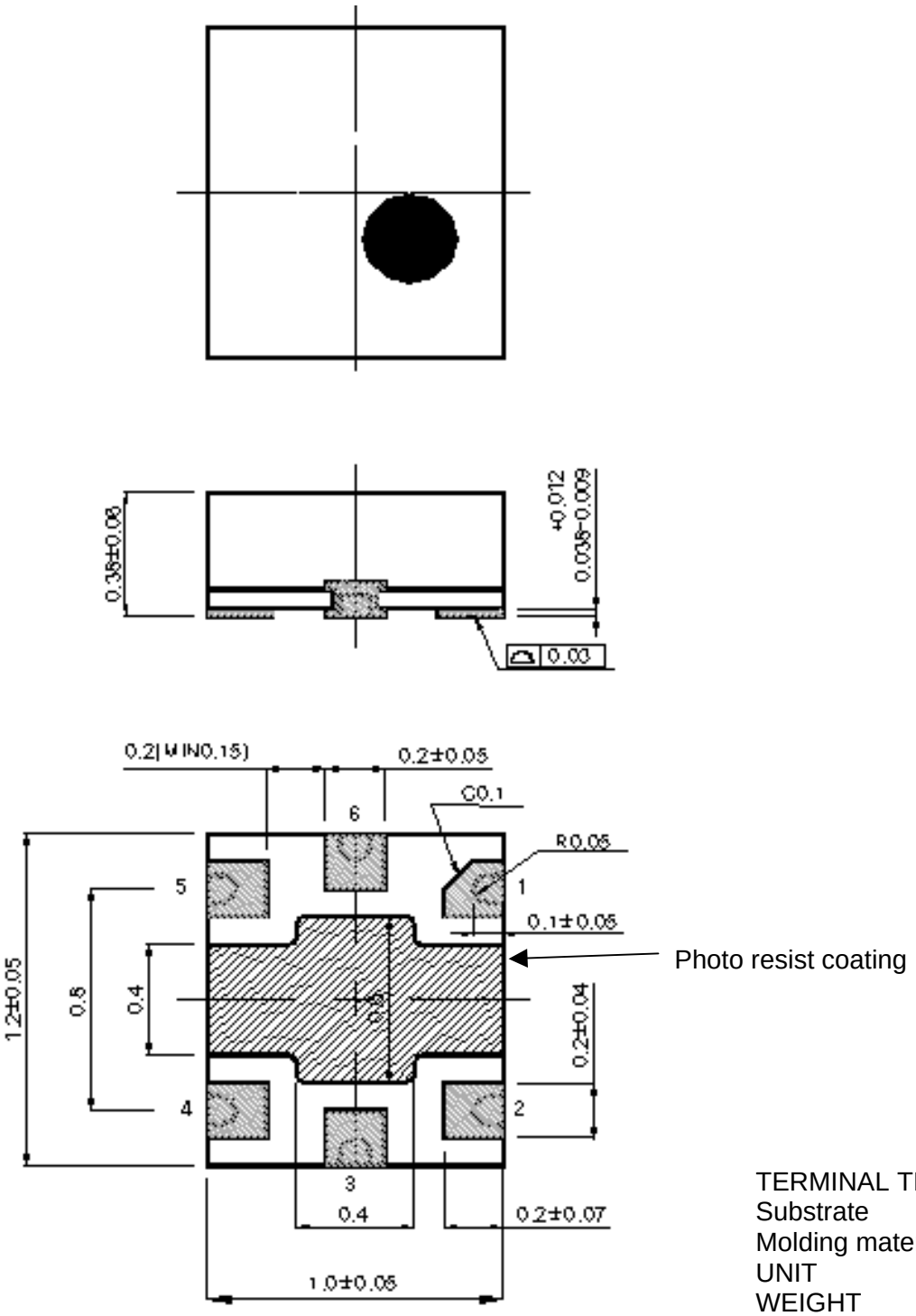
freq	Loss
1GHz	0.22dB
2GHz	0.34dB
2.5GHz	0.42dB
5GHz	0.78dB

PRECAUTIONS

[1] The DC blocking capacitors have to be placed at RF terminal of P1, P2 and PC.

[2] To reduce stripline influence on RF characteristics, please locate bypass capacitors (C4, C5) close to each terminal.

■**PACKAGE OUTLINE** (USB6-A8)



TERMINAL TREAT	: Au
Substrate	: FR5
Molding material	: Epoxy resin
UNIT	: mm
WEIGHT	: 1.1mg

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.