Ultra low current consumption SPDT switch

■FEATURES

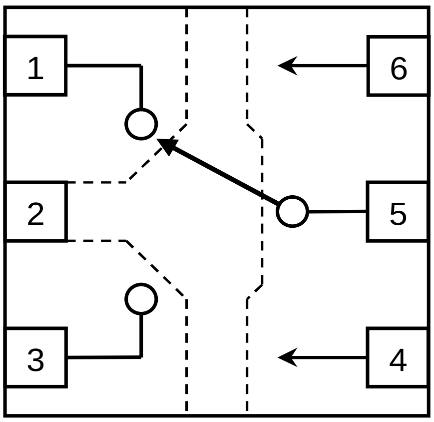
- Low control voltage 1.6 V min.
- Low current consumption 0.1 μA typ.
- Low insertion loss
  0.45 dB typ. @ f = 920 MHz
  0.50 dB typ. @ f = 2.4 to 2.5 GHz
- High isolation
  30 dB typ. @ f = 920 MHz
  22 dB typ. @ f = 2.4 to 2.5 GHz
- High linearity
  $P_{-0.1dB}$ = +30 dBm typ. @ f = 920 MHz, 2.4 to 2.5 GHz
- Small package 1.0 mm x 1.0 mm, t = 0.375 mm
- RoHS compliant and Halogen Free, MSL1

■APPLICATION

- LPWA (SIGFOX, LoRaWAN, Wi-SUN) applications
- 2.4 GHz Wireless LAN (802.11b/g/n/ax), Bluetooth
- Antenna switching, path switching, general purpose switching applications

■BLOCK DIAGRAM (DFN6-75)

(Top view)



■GENERAL DESCRIPTION

The NJG1816K75 is a 2-bit control SPDT switch with 0.1 μA ultra-low current consumption.

The NJG1816K75 features high linearity and low insertion loss at 1.8 V operating voltage up to 3 GHz. This switch is suitable for wireless communication devices with low power consumption such as wearable and mobile terminals.

The small and thin package of DFN6-75 offers small mounting area.

■FUNCTIONAL DESCRIPTION

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

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

■PIN CONFIGURATION

PIN NO.	SYMBOL	DESCRIPTION
1	P1	RF terminal
2	NC(GND)	Ground terminal
3	P2	RF terminal
4	VCTL2	Control signal input terminal
5	PC	RF terminal
6	VCTL1	Control signal input terminal

■ PRODUCT NAME INFORMATION

NJG1816 K75 (TE1)

Part Number — Package — Taping Form

■ ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJG1816K75	DFN6-75	Yes	Yes	Ni/Pd/Au	5	1.2	5,000

■ ABSOLUTE MAXIMUM RATINGS

T_a = 25°C, Z_s = Z_l = 50 Ω

PARAMETER	SYMBOL	RATINGS	UNIT
RF input power (1)	P_{IN}	+30	dBm
Control voltage	V_{CTL}	4.5	V
Power dissipation (2)	P_D	380	mW
Operating temperature	T_{opr}	-40 to +105	°C
Storage temperature	T_{stg}	-55 to +150	°C

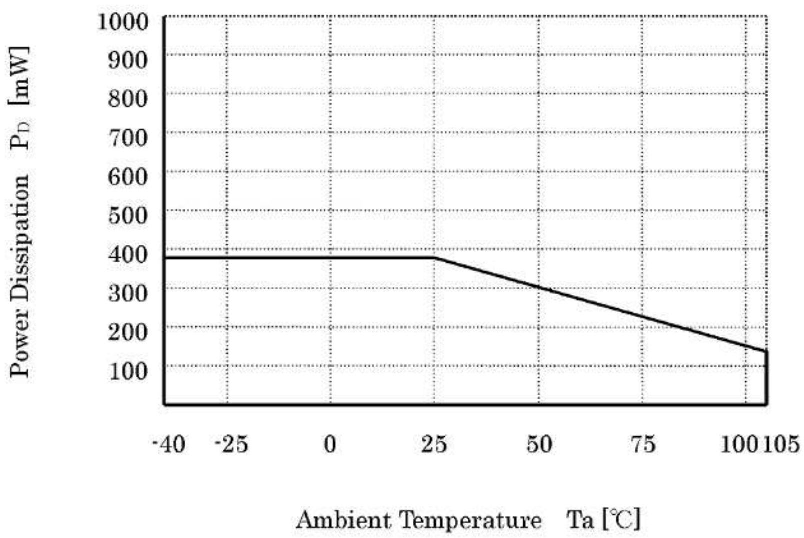
(1): V_{CTL}(L) = 0 V, V_{CTL}(H) = 1.8 V, on state port

(2): Mounted on four-layer FR4 PCB with through-hole (76.2 × 114.3 mm), T_j = 150 °C

■ POWER DISSIPATION VS.AMBIENT TEMPERATURE

Please, refer to the following Power Dissipation and Ambient Temperature.
(Please note the surface mount package has a small 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 board



■ ELECTRICAL CHARACTERISTICS (DC CHARACTERISTICS)

$V_{CTL}(H)$ = 1.8 V, $V_{CTL}(L)$ = 0 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Control voltage (HIGH)	$V_{CTL}(H)$	VCTL1, VCTL2 terminal	1.6	1.8	4.0	V
Control voltage (LOW)	$V_{CTL}(L)$	VCTL1, VCTL2 terminal	-0.2	-	0.2	V
Control current	I_{CTL}		-	0.1	2.0	µA

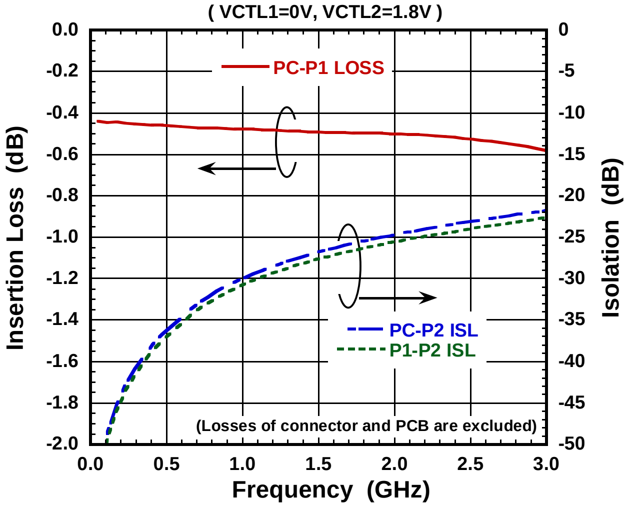
■ ELECTRICAL CHARACTERISTICS (RF CHARACTERISTICS)

$V_{CTL}(H)$ = 1.8 V, $V_{CTL}(L)$ = 0 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

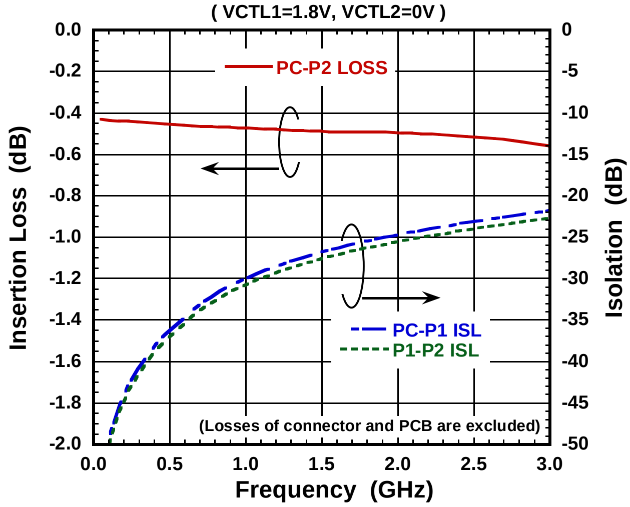
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Insertion loss	LOSS	f = 920 MHz	-	0.45	0.65	dB
		f = 2.4 to 2.5 GHz	-	0.50	0.70	
Isolation	ISL	f = 920 MHz	26	30	-	dB
		f = 2.4 to 2.5 GHz	18	22	-	
Input power at 0.1 dB compression point	$P_{-0.1dB}$	f = 920 MHz	+25	+30	-	dBm
		f = 2.4 to 2.5 GHz	+25	+30	-	
Input power at 1 dB compression point	P_{-1dB}	f = 920 MHz	+28	+30	-	dBm
		f = 2.4 to 2.5 GHz	+28	+30	-	
VSWR	VSWR	f = 920 MHz	-	1.1	1.4	-
		f = 2.4 to 2.5 GHz	-	1.2	1.4	
Switching time	T_{SW}	50% V_{CTL} to 10%/90% RF	-	100	300	ns

■ ELECTRICAL CHARACTERISTICS

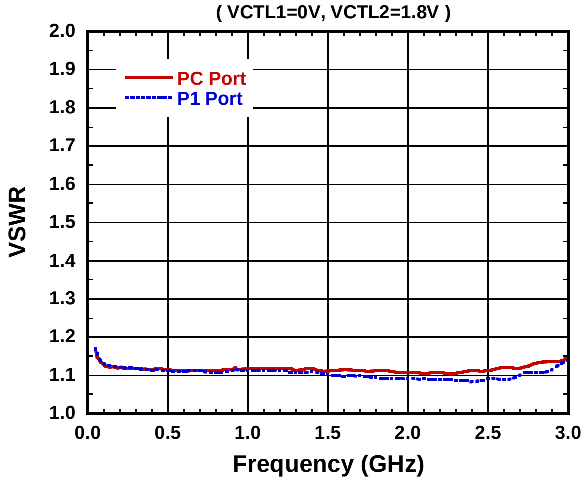
Loss, ISL vs Frequency
(VCTL1=0V, VCTL2=1.8V)



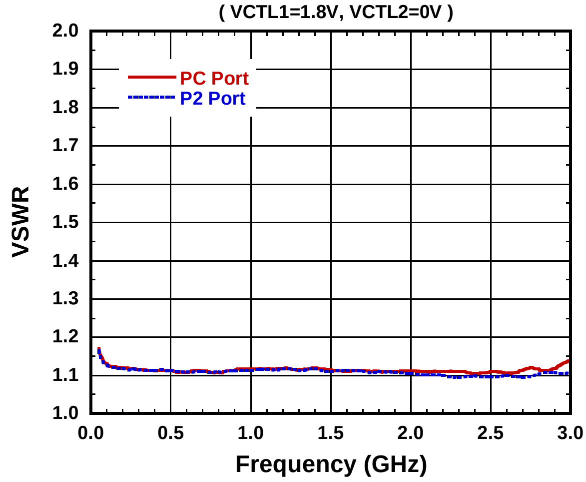
Loss, ISL vs Frequency
(VCTL1=1.8V, VCTL2=0V)



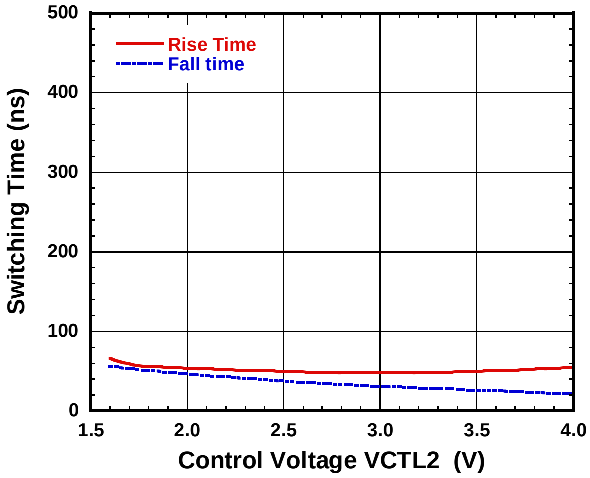
VSWR vs Frequency
(VCTL1=0V, VCTL2=1.8V)



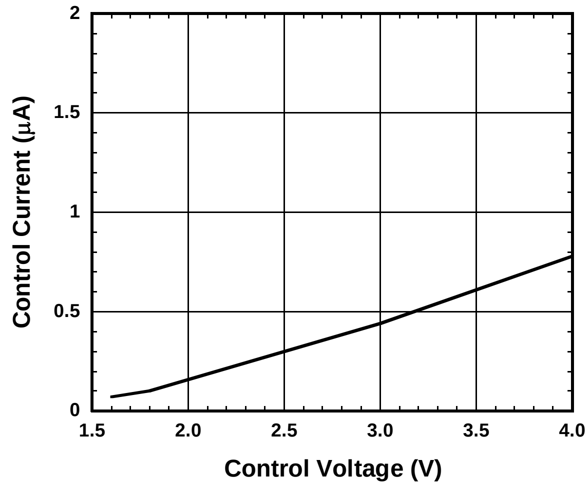
VSWR vs Frequency
(VCTL1=1.8V, VCTL2=0V)



Switching Time vs Control Voltage
(VCTL1=0V)



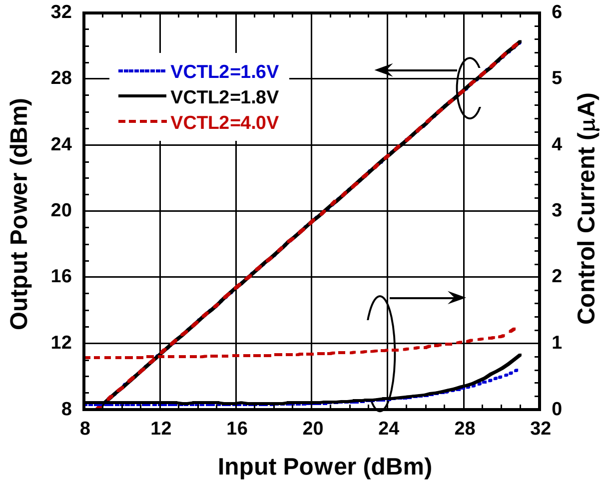
Control Current vs Control Voltage



■ ELECTRICAL CHARACTERISTICS

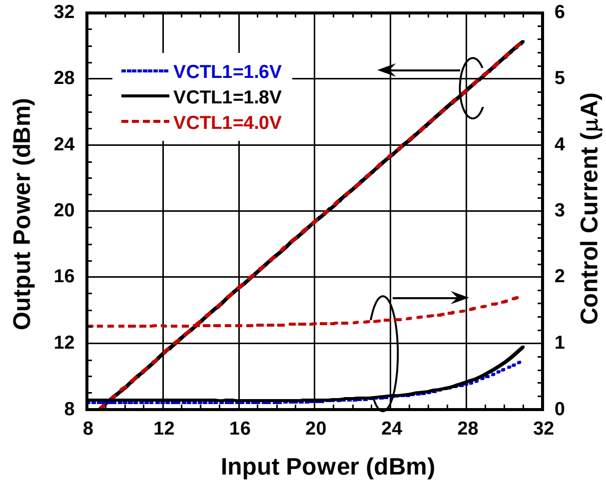
Output Power, ICTL vs Input Power

(VCTL1=0V, PC-P1 ON, f=920MHz)



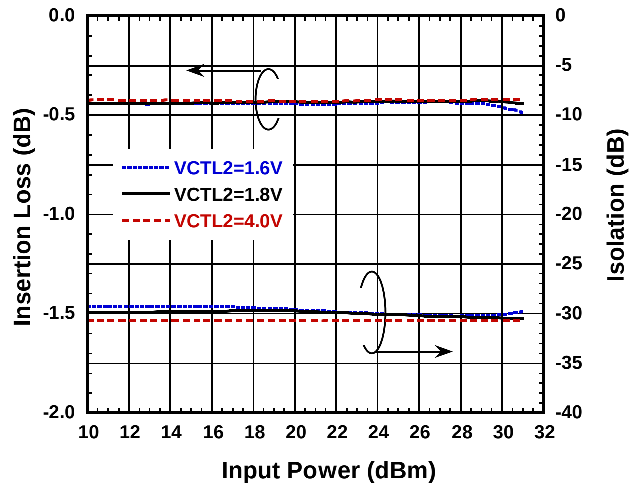
Output Power, ICTL vs Input Power

(VCTL2=0V, PC-P2 ON, f=920MHz)



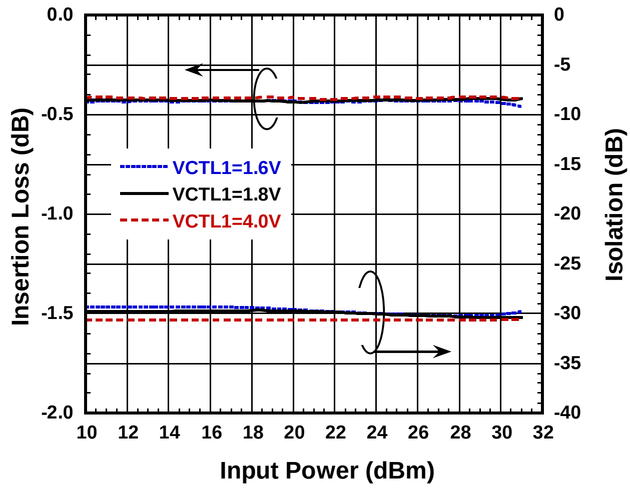
Insertion Loss, Isolation vs Input Power

(VCTL1=0V, PC-P1 ON, f=920MHz)



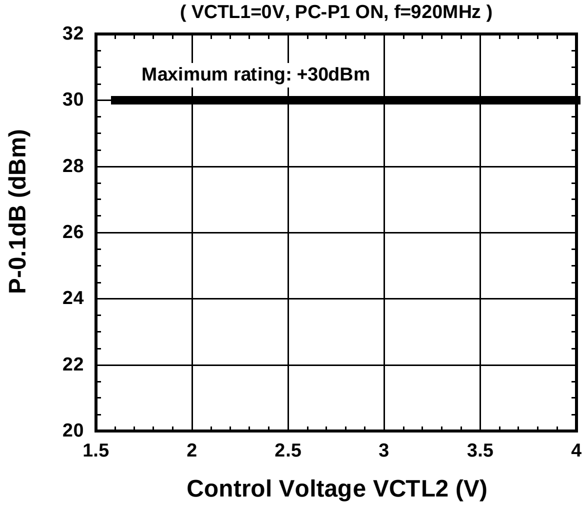
Insertion Loss, Isolation vs Input Power

(VCTL2=0V, PC-P2 ON, f=920MHz)



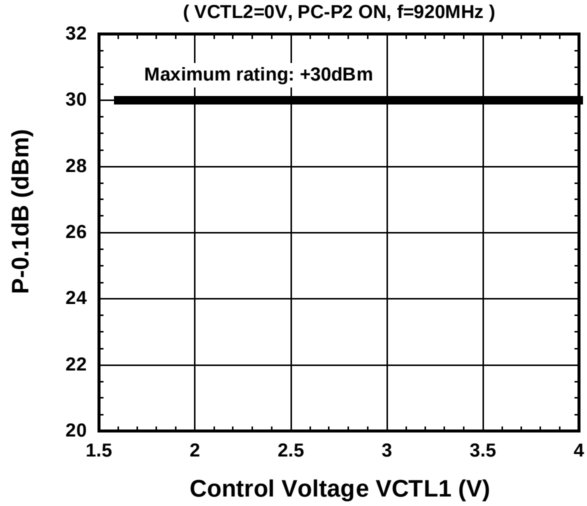
P-0.1dB vs Control Voltage

(VCTL1=0V, PC-P1 ON, f=920MHz)



P-0.1dB vs Control Voltage

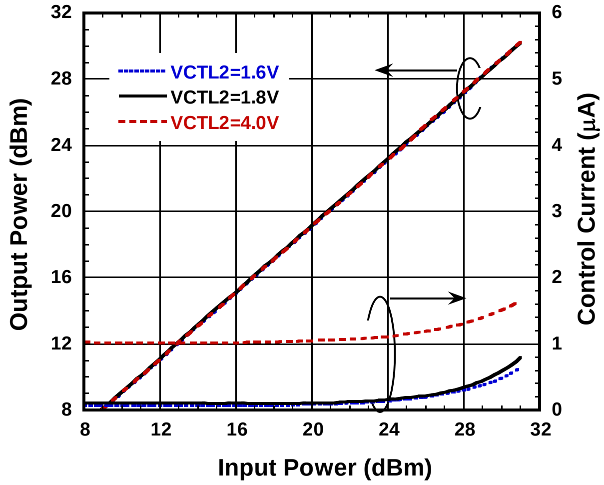
(VCTL2=0V, PC-P2 ON, f=920MHz)



■ ELECTRICAL CHARACTERISTICS

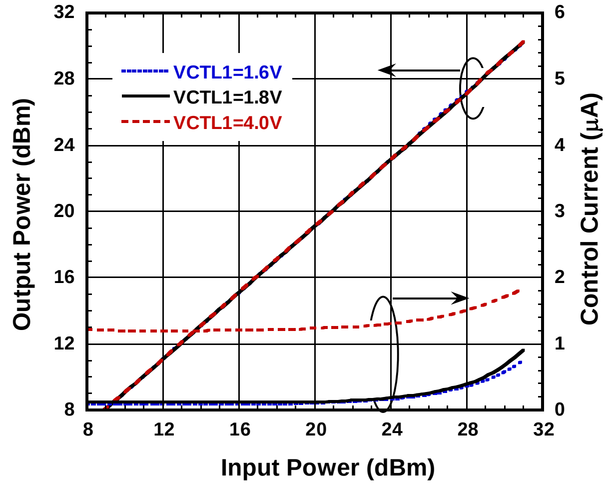
Output Power, ICTL vs Input Power

(VCTL1=0V, PC-P1 ON, f=2.5GHz)



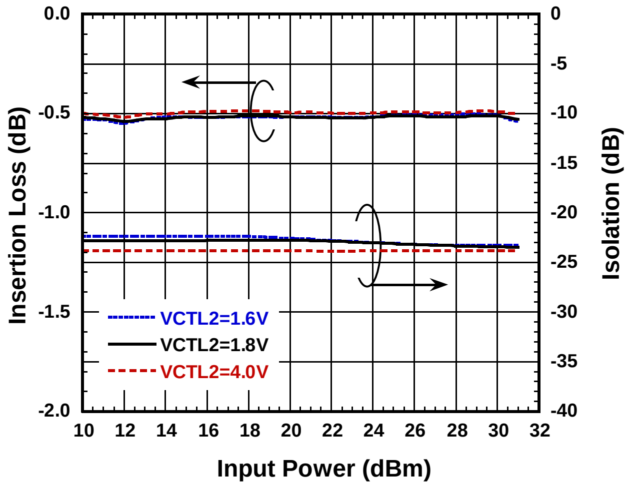
Output Power, ICTL vs Input Power

(VCTL2=0V, PC-P2 ON, f=2.5GHz)



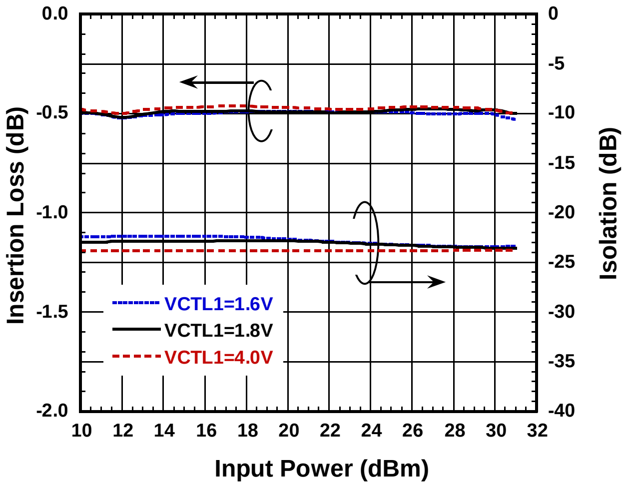
Insertion Loss, Isolation vs Input Power

(VCTL1=0V, PC-P1 ON, f=2.5GHz)



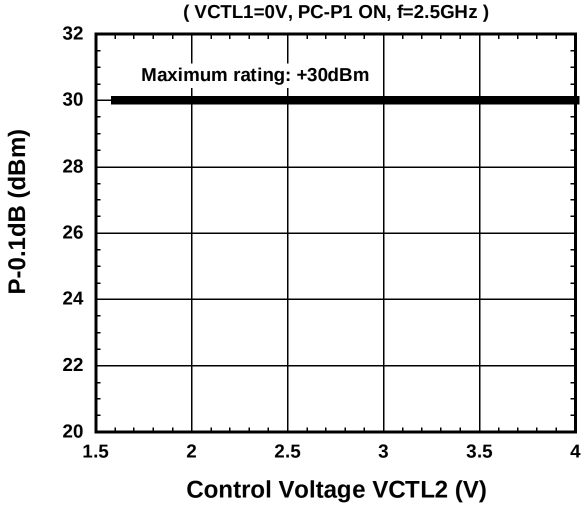
Insertion Loss, Isolation vs Input Power

(VCTL2=0V, PC-P2 ON, f=2.5GHz)



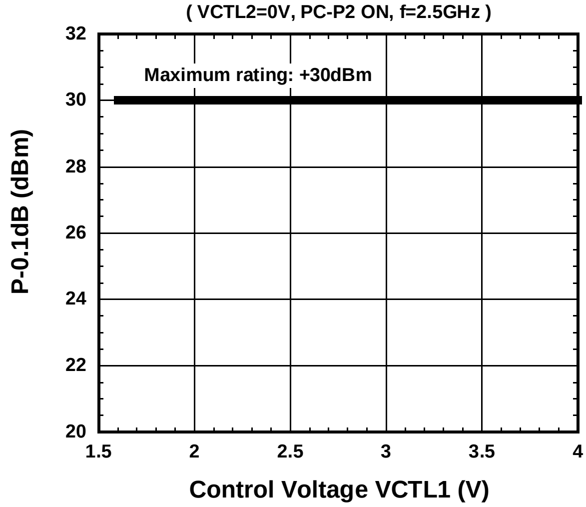
P-0.1dB vs Control Voltage

(VCTL1=0V, PC-P1 ON, f=2.5GHz)

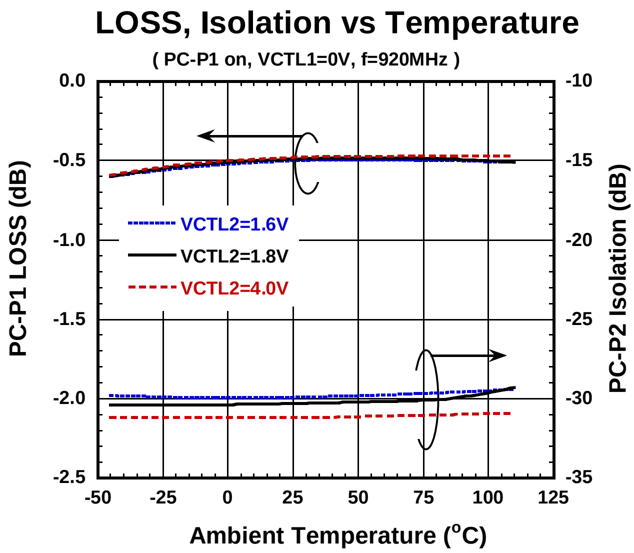


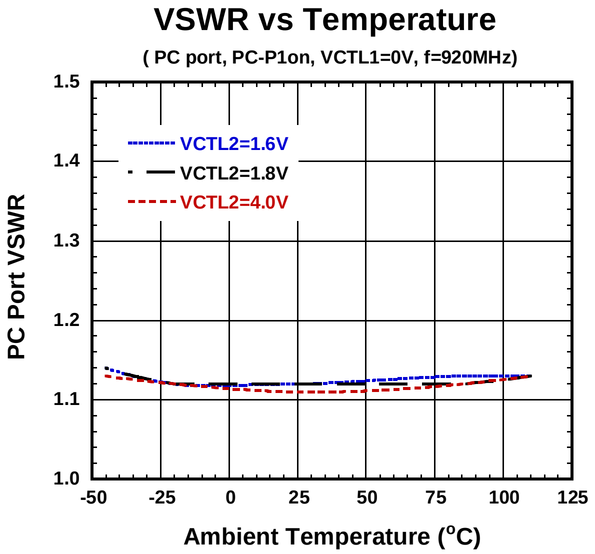
P-0.1dB vs Control Voltage

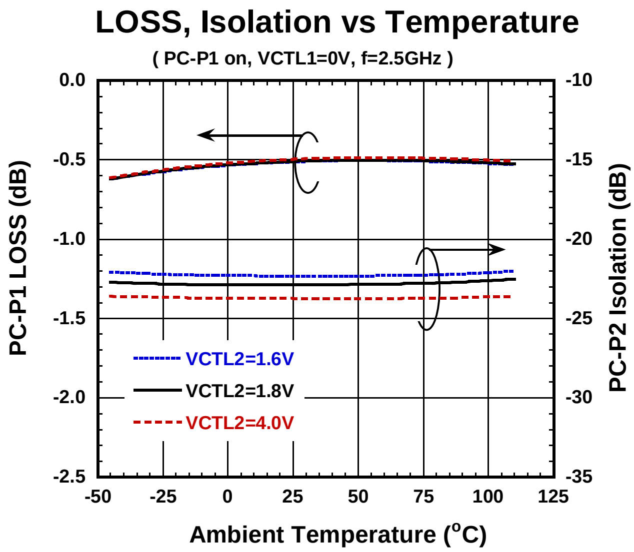
(VCTL2=0V, PC-P2 ON, f=2.5GHz)

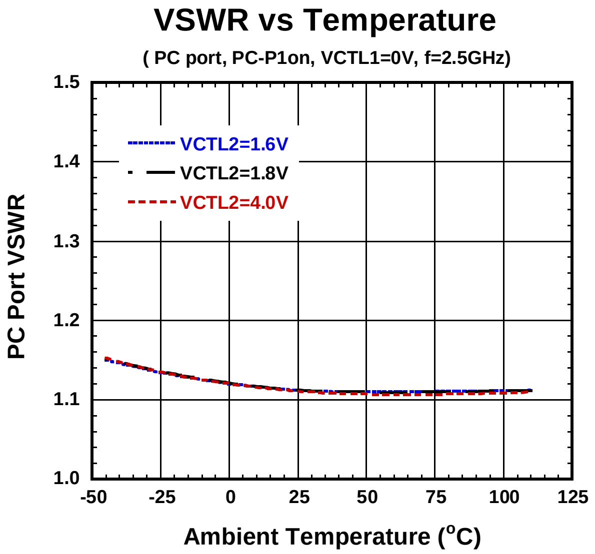


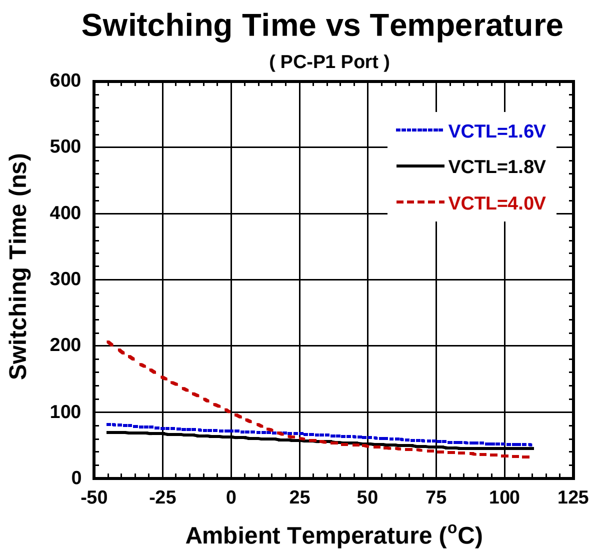
■ ELECTRICAL CHARACTERISTICS

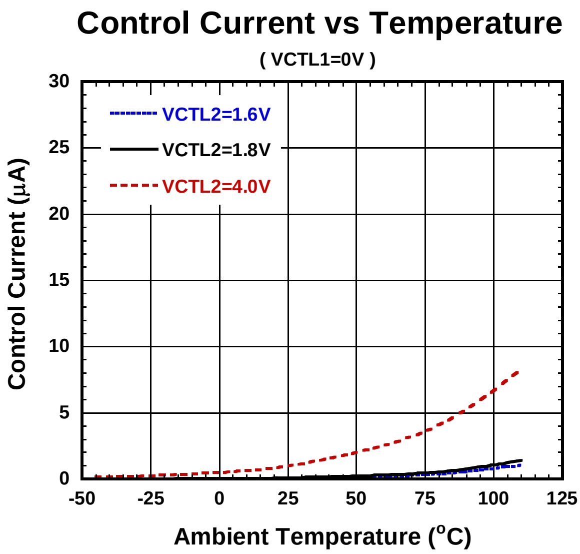




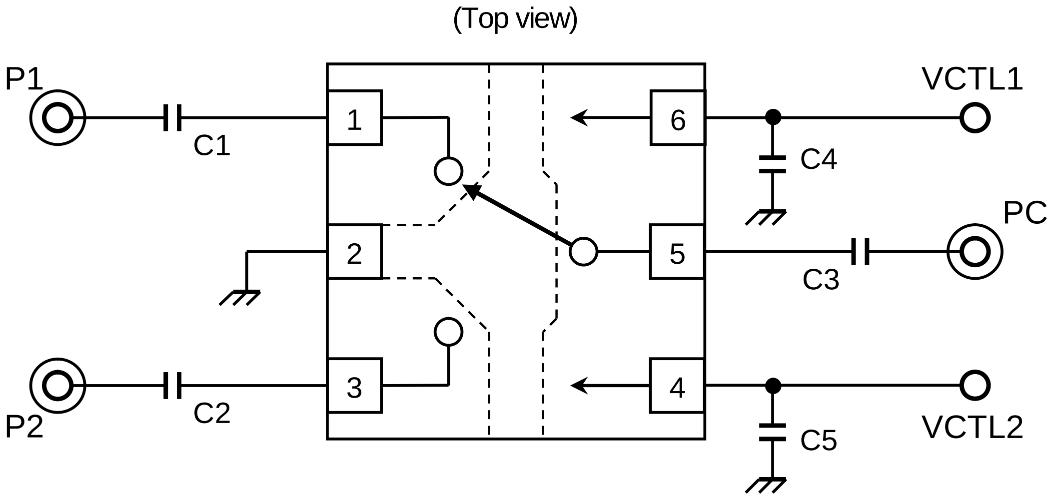








■ **APPLICATION CIRCUIT**

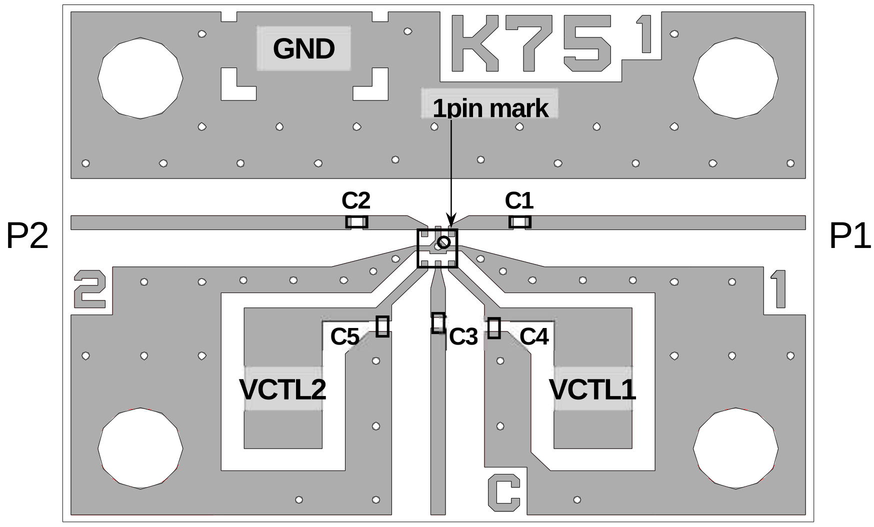


■ **PARTS LIST**

Part ID	Value	Notes
C1 to C3	1000 pF	MURATA (GRM03)
C4 to C5	10 pF	MURATA (GRM03)

■ EVALUATION BOARD

(Top view)



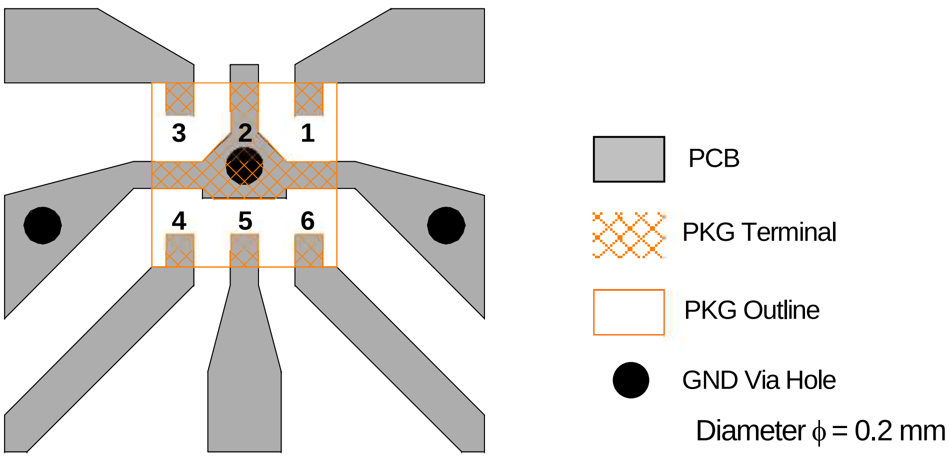
Losses of PCB and connectors, Ta = +25°C

Frequency (MHz)	Loss (dB)
920	0.22
2400	0.42
2500	0.42

PCB: FR-4
t = 0.2 mm
MICROSTRIP LINE WIDTH: 0.4 mm (Zo = 50 Ω)
PCB SIZE: 19.4 x 14.0 mm

■ PCB LAYOUT GUIDELINE

(Top view)



■ PRECAUTIONS

[1] The DC blocking capacitors (C1, C2, C3) should be placed at RF terminals. Please choose appropriate capacitance value at the application frequency.

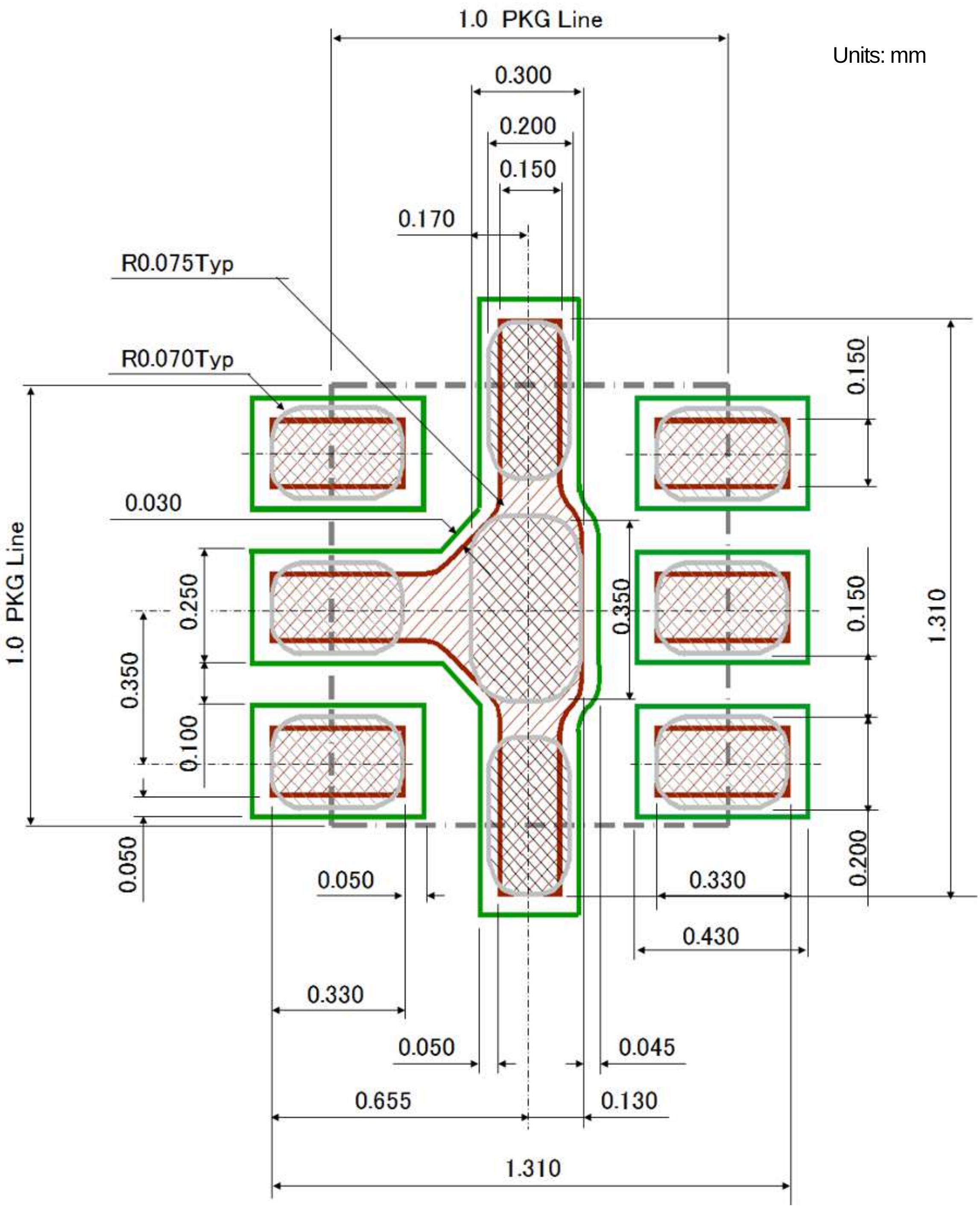
[2] For avoiding the degradation of RF performance, the bypass capacitors (C4, C5) should be placed as close as possible to VCTL terminals.

[3] For good RF performance, exposed pad should be connected to PCB ground plane of substrate, and through –holes should be placed near the IC.

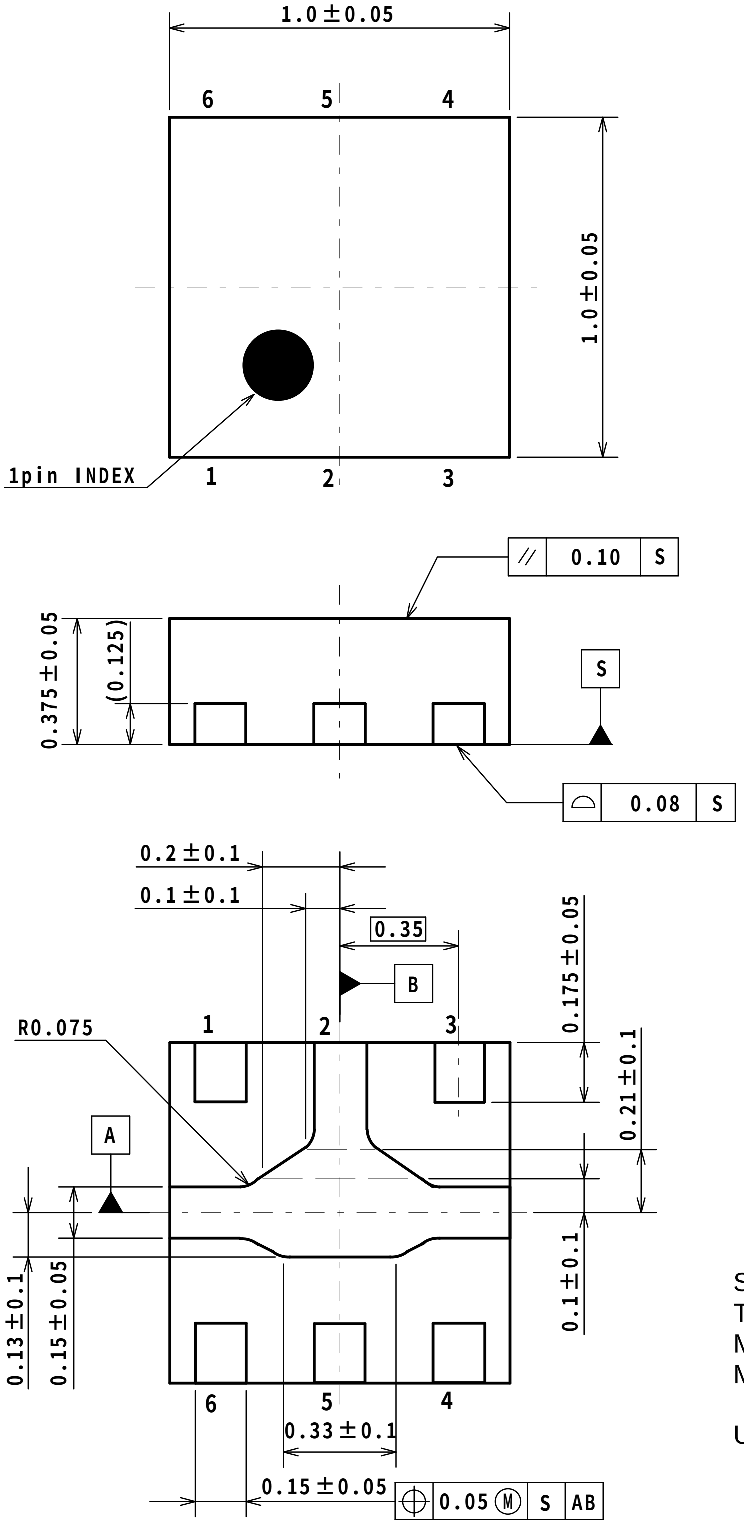
■ RECOMMENDED FOOTPRINT PATTERN (DFN6-75)

PKG: 1.0 mm x 1.0 mm
Pin pitch: 0.35 mm

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



■ PACKAGE OUTLINE (DFN6-75)

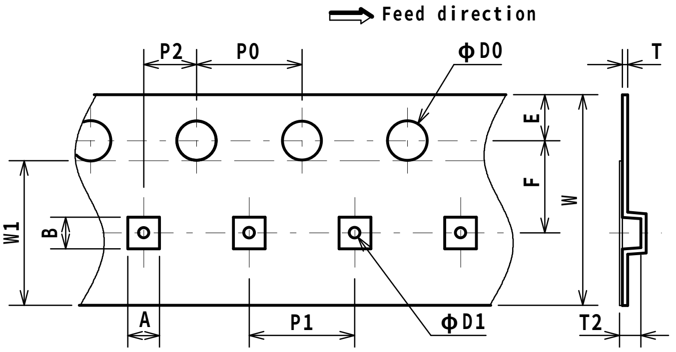


SUBSTRATE MATERIAL	: Copper
TERMINAL FINISH	: Ni/Pd/Au plating
MOLD MATERIAL	: Epoxy resin
MASS (TYP.)	: 1.2 (mg)
UNIT	: mm

■ PACKING SPECIFICATION (DFN6-75)

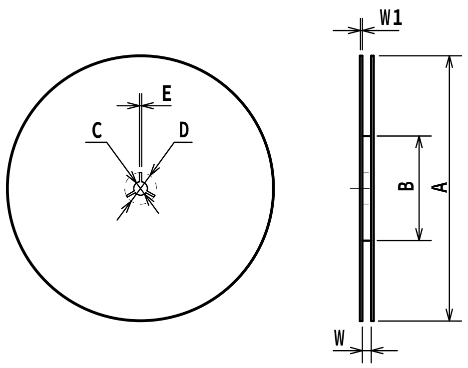
TAPING DIMENSIONS

Units: mm



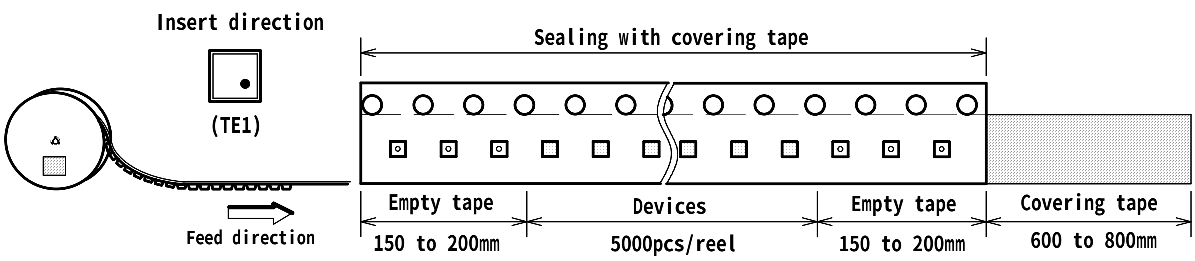
SYMBOL	DIMENSION	REMARKS
A	$1.19^{+0.04}_{-0.01}$	BOTTOM DIMENSION
B	$1.19^{+0.04}_{-0.01}$	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.18±0.05	
T2	0.69±0.1	
W	8.0±0.1	
W1	5.5±0.1	THICKNESS 60μmax

REEL DIMENSIONS

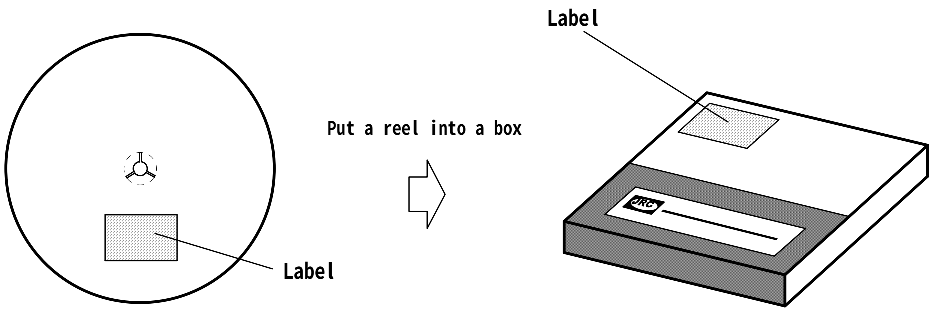


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-3}$
B	$\phi 60^{+1}_{0}$
C	ϕ 13±0.2
D	ϕ 21±0.8
E	2±0.5
W	9±0.3
W1	1.2

TAPING STATE



PACKING STATE



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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.

NISSHINBO

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