SPDT SWITCH GaAs MMIC

■ FEATURES

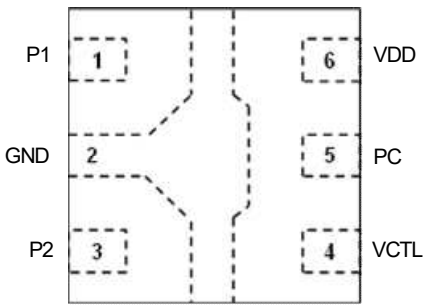
- AEC-Q100 grade 2 qualified
- Low voltage logic control V_{CTL} (H) = 1.8 V typ.
- Operation voltage V_{DD} = 3.3 V typ.
- Low insertion loss
  0.45 dB typ. @ 2.4 GHz to 2.5 GHz
  0.45 dB typ. @ 3.4 GHz to 3.8 GHz
  0.40 dB typ. @ 4.9 GHz to 6.0 GHz
- High isolation
  25dB typ. @ 2.4 GHz to 2.5 GHz
  25dB typ. @ 3.4 GHz to 3.8 GHz
  25dB typ. @ 4.9GHz to 6.0 GHz
- P_{-1dB} = +31 dBm typ. @ 2.4 to 6.0 GHz
- Ultra small & ultra-thin Package DFN6-75
  (Package Size: 1.0 x 1.0 x 0.375 mm typ.)
- RoHS compliant and Halogen Free, MSL1

■ APPLICATION

- 802.11 a/b/g/n/ac/ax networks applications
- Transmit/receive switching, antenna switching and others switching applications
- Automotive WiFi applications

■ BLOCK DIAGRAM (DFN6-75)

(TOP VIEW)



■ GENERAL DESCRIPTION

The NJG1815AK75-A is a 1bit control SPDT switch. This switch is used for WLAN system.

The switch features low insertion loss, high isolation for high frequency up to 6GHz, and high handing power performance at 1.8V control voltage. Integrated ESD protection device on each port achieves excellent ESD robustness.

Integrated DC blocking capacitors at all RF ports and the ultra-small package of DNF6-75 offer very small mounting area.

■ TRUTH TABLE

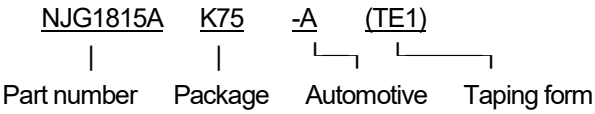
"H" = V_{CTL} (H), "L" = V_{CTL} (L)

ON PATH	VCTL
PC-P1	H
PC-P2	L

■PIN CONFIGURATION

PIN NO.	SYMBOL	DESCRIPTION
1	P1	RF terminal
2	GND	Ground terminal
3	P2	RF terminal
4	VCTL	Control signal input terminal.
5	PC	Common RF terminal
6	VDD	Voltage supply terminal

■ PRODUCT NAME INFORMATION



■ ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJG1815AK75-A	DFN6-75	Yes	Yes	Ni/Pd/Au	4	1.2	5,000

■ ABSOLUTE MAXIMUM RATINGS

(General conditions: T_a = +25°C, Z_s = Z_l = 50 Ω)

PARAMETER	SYMBOL	RATINGS	UNIT
RF input power	P_{IN}	+31(1)	dBm
Supply voltage	V_{DD}	6.0	V
Control voltage	V_{CTL}	6.0	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_{DD} = 3.3 V, ON port

(2): Four-layer FR4 PCB with through-hole (76.2 x 114.3 mm), Tj = 150°C

■ **ELECTRICAL CHARACTERISTICS 1 (DC CHARACTERISTICS)**

(General conditions: T_a = +25°C, Z_s = Z_l = 50Ω, with application circuit)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply voltage	V_{DD}		2.5	3.3	5.0	V
Operating current	I_{DD}	No RF input, VDD = 3.3 V	-	15	30	μA
Control voltage (LOW)	V_{CTL}(L)		0	-	0.45	V
Control voltage (HIGH)	V_{CTL}(H)		1.5	1.8	5.0	V
Control current	I_{CTL}	V_{CTL}(H) =1.8V	-	3	10	μA

■ **ELECTRICAL CHARACTERISTICS 2 (RF CHARACTERISTICS)**

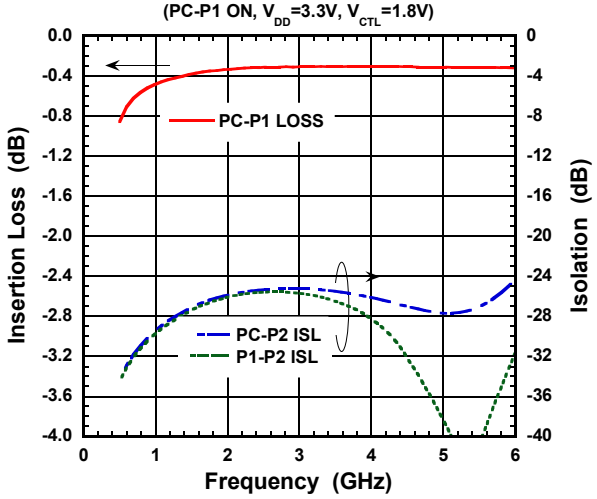
(General conditions: T_a = +25°C, Z_s = Z_l = 50 Ω, V_{DD} = 3.3 V, V_{CTL}(H) = 1.8V, V_{CTL}(L) = 0V, with application circuit)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Insertion loss	LOSS	f = 2.4 to 2.5 GHz	-	0.45	0.65	dB
		f = 3.4 to 3.8 GHz	-	0.45	0.65	
		f = 4.9 to 6.0 GHz	-	0.40	0.60	
Isolation	ISL	f = 2.4 to 2.5 GHz	23	25	-	dB
		f = 3.4 to 3.8 GHz	22	25	-	
		f = 4.9 to 6.0 GHz	22	25	-	
Return loss	RL	f = 2.4 to 2.5 GHz	13	16	-	dB
		f = 3.4 to 3.8 GHz	15	20	-	
		f = 4.9 to 6.0 GHz	15	20	-	
Input power at 1dB compression point	P_{-1dB}	f = 2.4 to 6.0 GHz	+28	+31	-	dBm
Switching time	T_{SW}	50% V_{CTL} to 10/90% RF	-	150	400	ns

■ ELECTRICAL CHARACTERISTICS

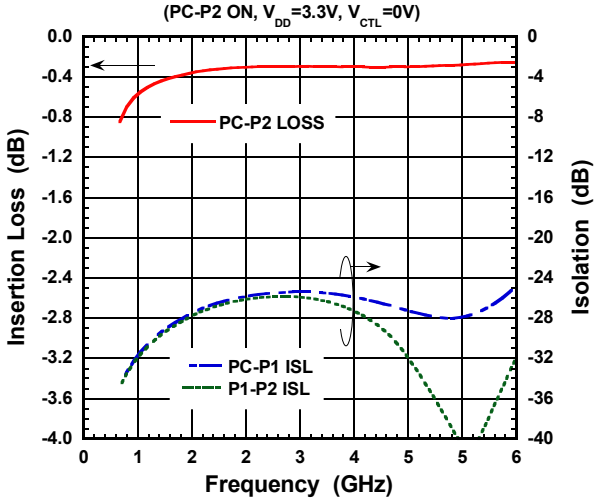
Loss, ISL vs Frequency

(PC-P1 ON, V_{DD}=3.3V, V_{CTL}=1.8V)



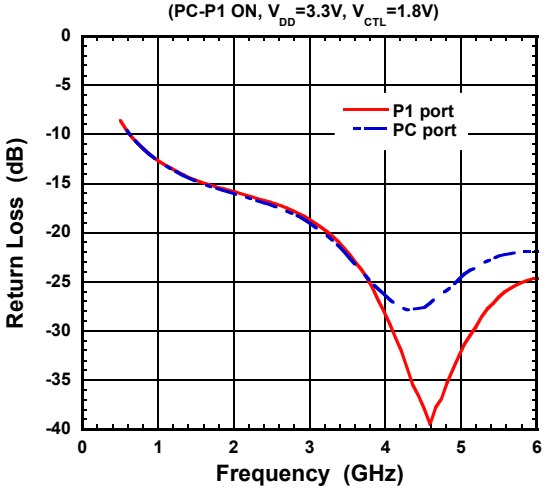
Loss, ISL vs Frequency

(PC-P2 ON, V_{DD}=3.3V, V_{CTL}=0V)



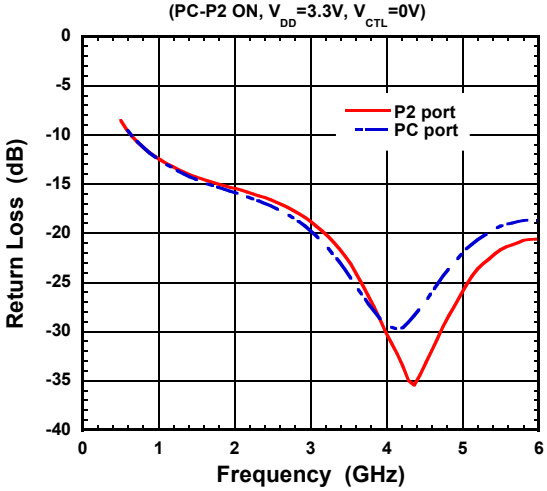
Return Loss vs Frequency

(PC-P1 ON, V_{DD}=3.3V, V_{CTL}=1.8V)



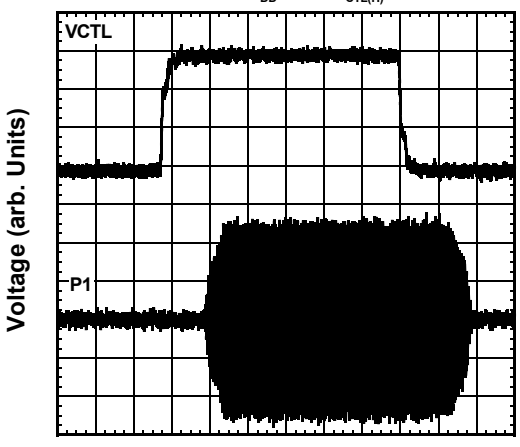
Return Loss vs Frequency

(PC-P2 ON, V_{DD}=3.3V, V_{CTL}=0V)



Switching Time

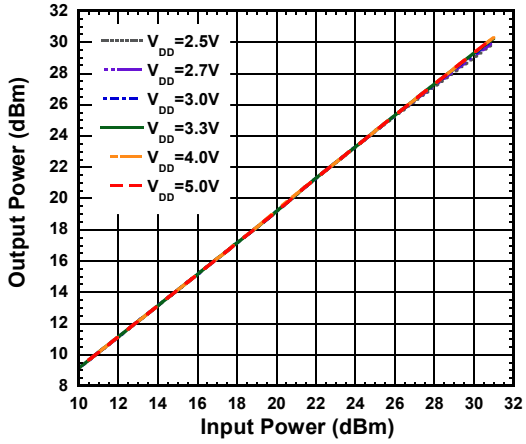
(PC-P1 path, V_{DD}=3.3V, $V_{CTL(H)}$=1.8V)



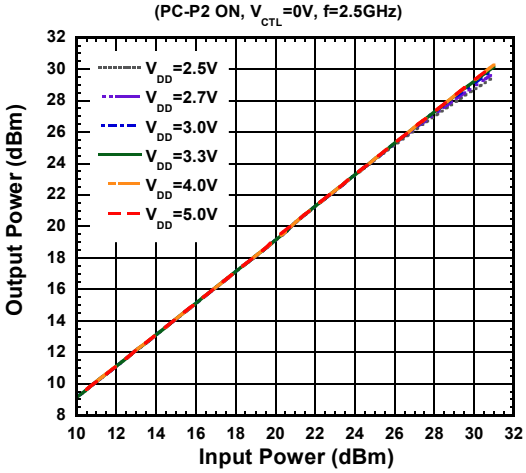
Time (100ns/div)

■ ELECTRICAL CHARACTERISTICS

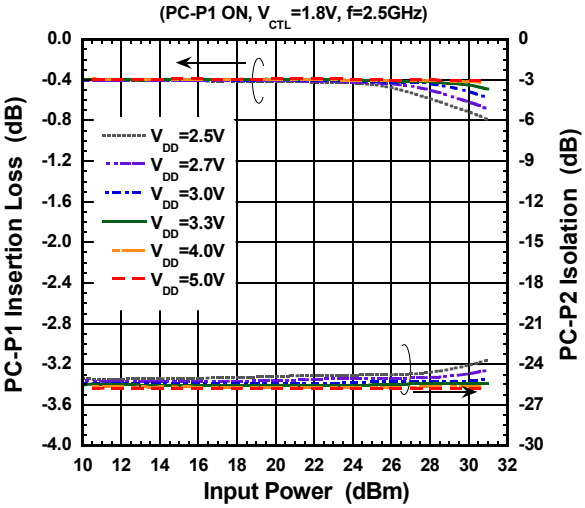
Output Power vs Input Power
(PC-P1 ON, V_{CTL}=1.8V, f=2.5GHz)



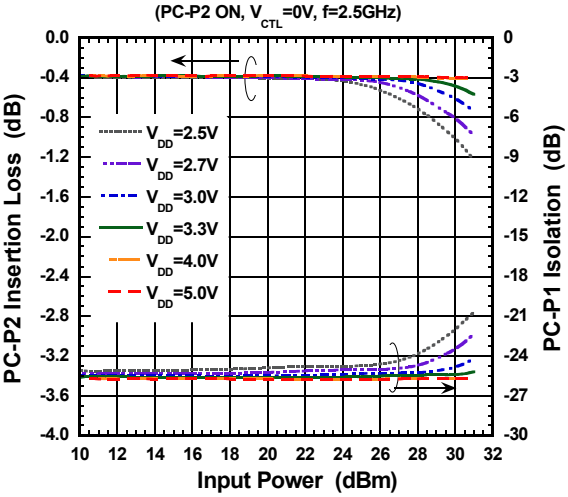
Output Power vs Input Power
(PC-P2 ON, V_{CTL}=0V, f=2.5GHz)



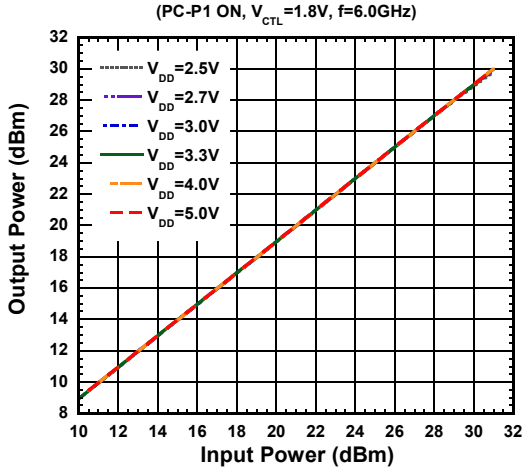
Loss, ISL vs Input Power
(PC-P1 ON, V_{CTL}=1.8V, f=2.5GHz)



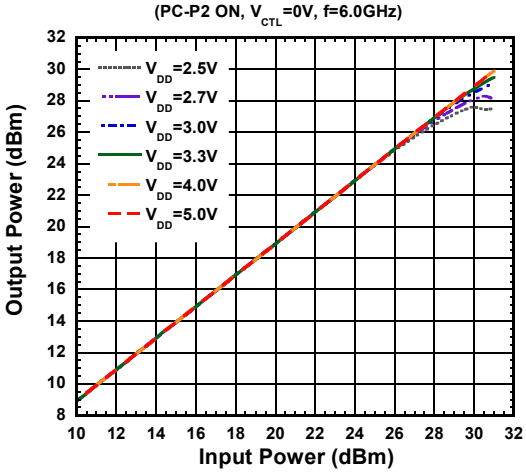
Loss, ISL vs Input Power
(PC-P2 ON, V_{CTL}=0V, f=2.5GHz)



Output Power vs Input Power
(PC-P1 ON, V_{CTL}=1.8V, f=6.0GHz)



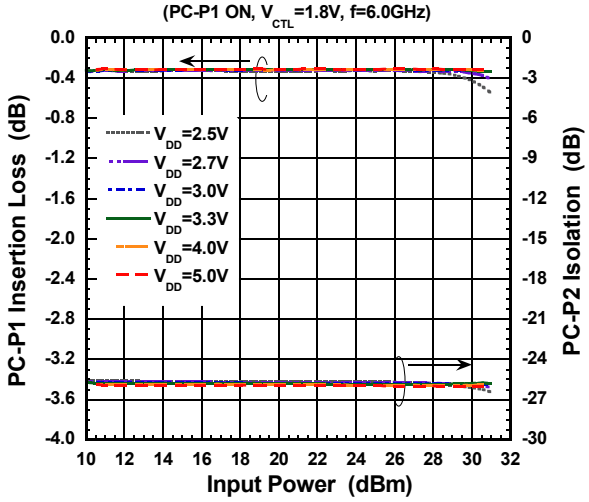
Output Power vs Input Power
(PC-P2 ON, V_{CTL}=0V, f=6.0GHz)



■ ELECTRICAL CHARACTERISTICS

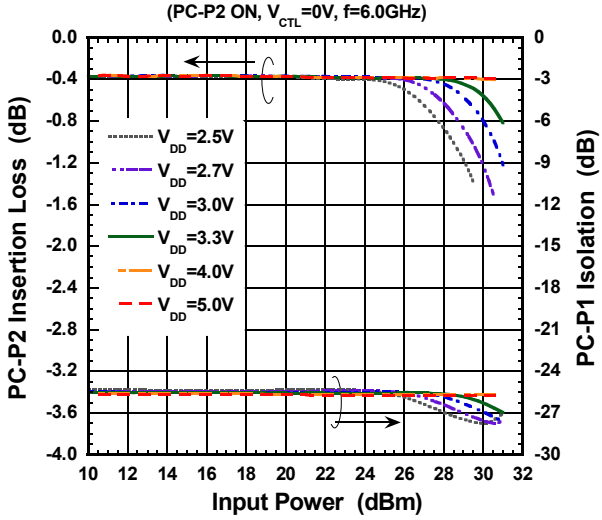
Loss, ISL vs Input Power

(PC-P1 ON, V_{CTL}=1.8V, f=6.0GHz)



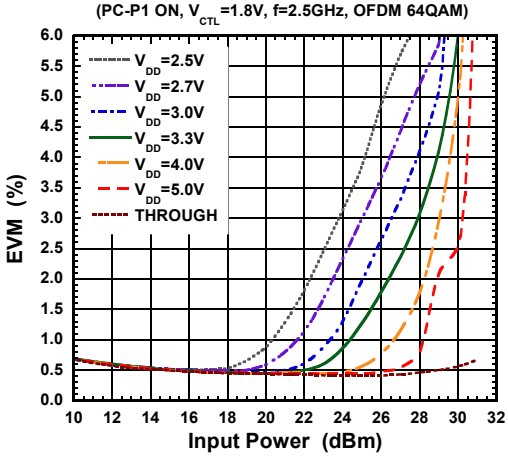
Loss, ISL vs Input Power

(PC-P2 ON, V_{CTL}=0V, f=6.0GHz)



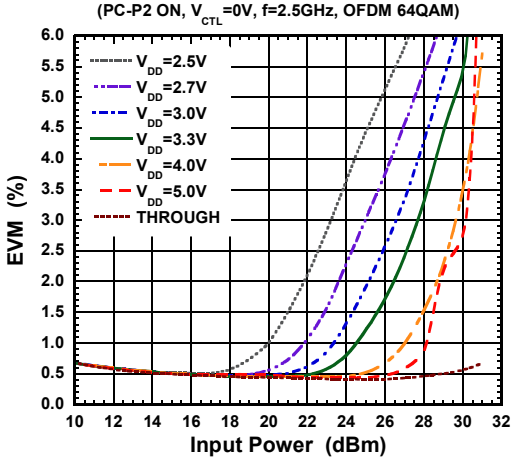
EVM vs Input Power

(PC-P1 ON, V_{CTL}=1.8V, f=2.5GHz, OFDM 64QAM)



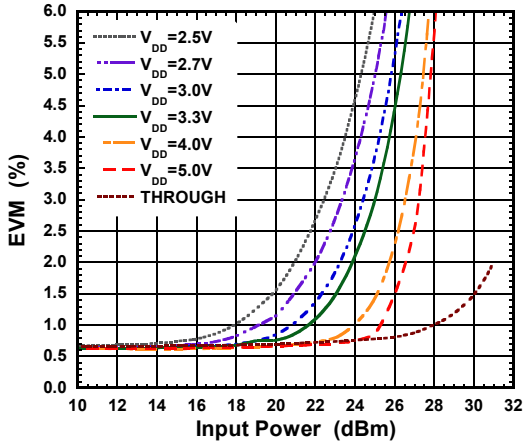
EVM vs Input Power

(PC-P2 ON, V_{CTL}=0V, f=2.5GHz, OFDM 64QAM)



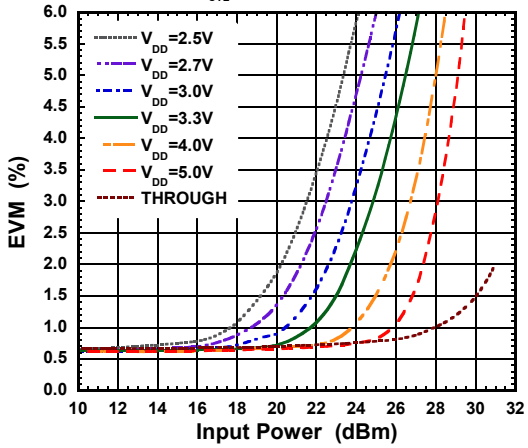
EVM vs Input Power

(PC-P1 ON, V_{CTL}=1.8V, f=6.0GHz, OFDM 64QAM)



EVM vs Input Power

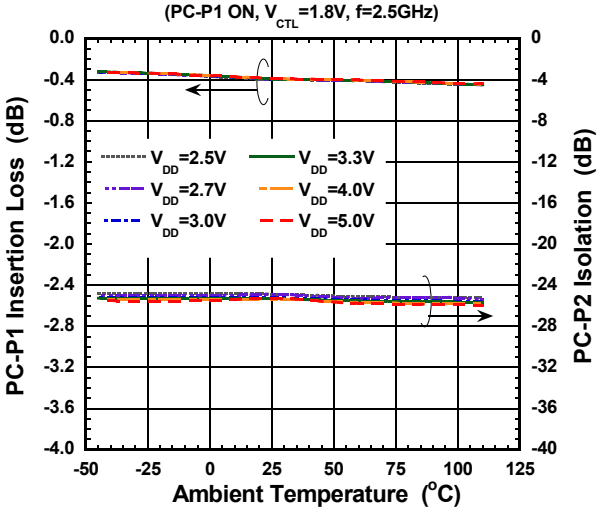
(PC-P2 ON, V_{CTL}=0V, f=6.0GHz, OFDM 64QAM)



■ ELECTRICAL CHARACTERISTICS

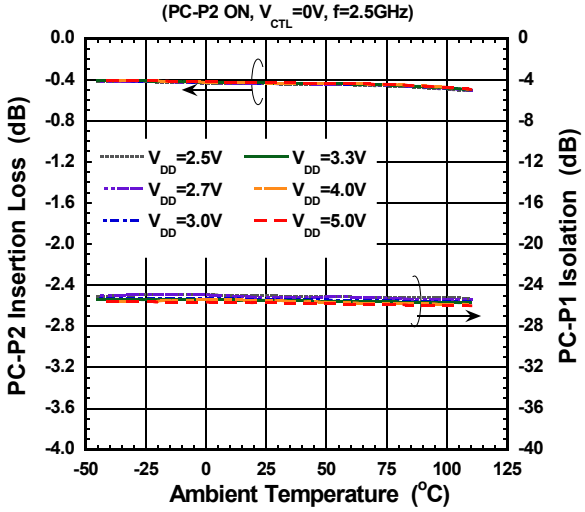
Loss, ISL vs Temperature

(PC-P1 ON, V_{CTL}=1.8V, f=2.5GHz)



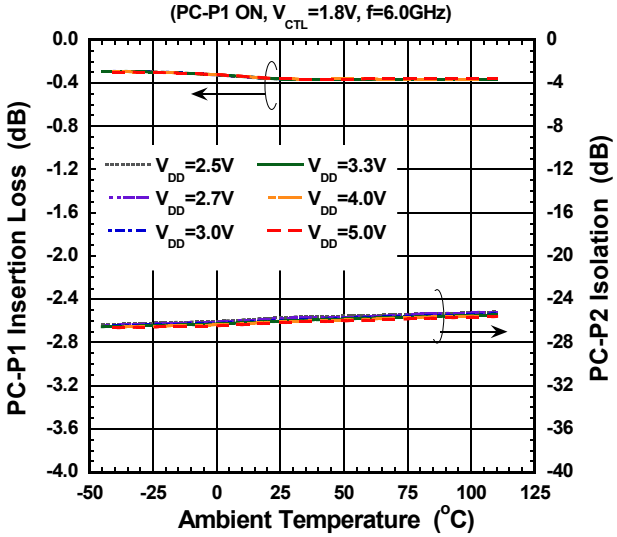
Loss, ISL vs Temperature

(PC-P2 ON, V_{CTL}=0V, f=2.5GHz)



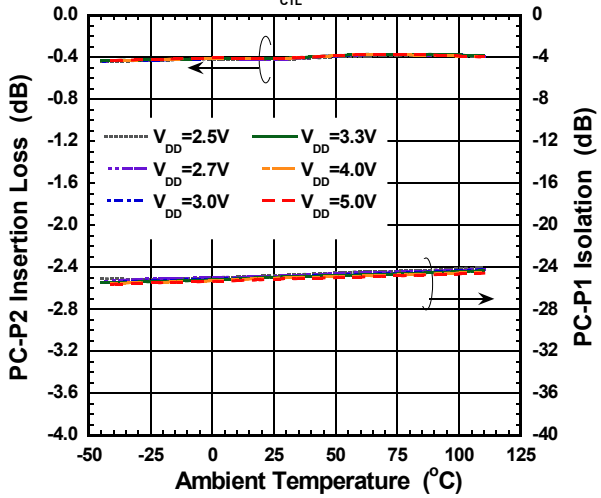
Loss, ISL vs Temperature

(PC-P1 ON, V_{CTL}=1.8V, f=6.0GHz)



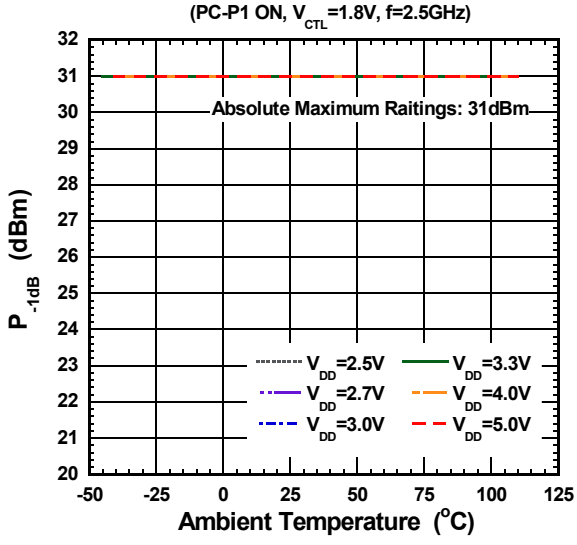
Loss, ISL vs Temperature

(PC-P2 ON, V_{CTL}=0V, f=6.0GHz)



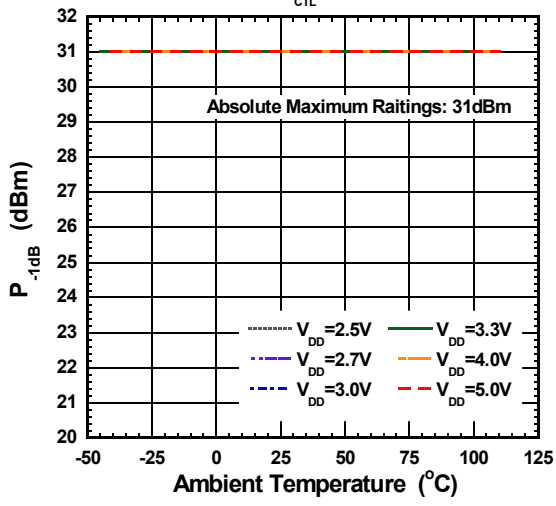
P_{-1dB} vs Temperature

(PC-P1 ON, V_{CTL}=1.8V, f=2.5GHz)

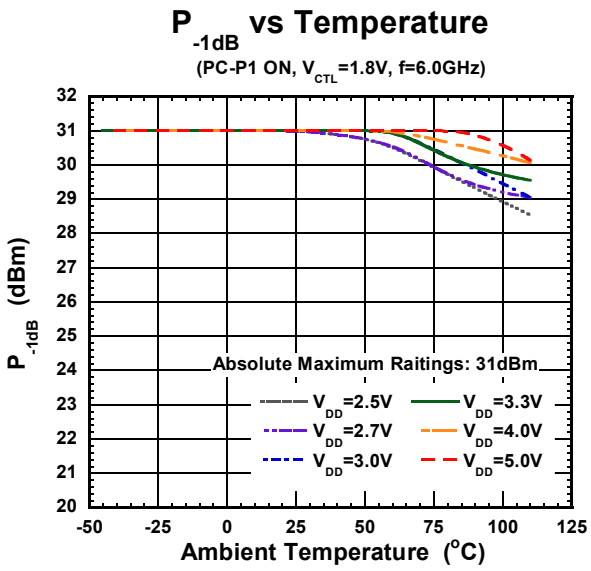


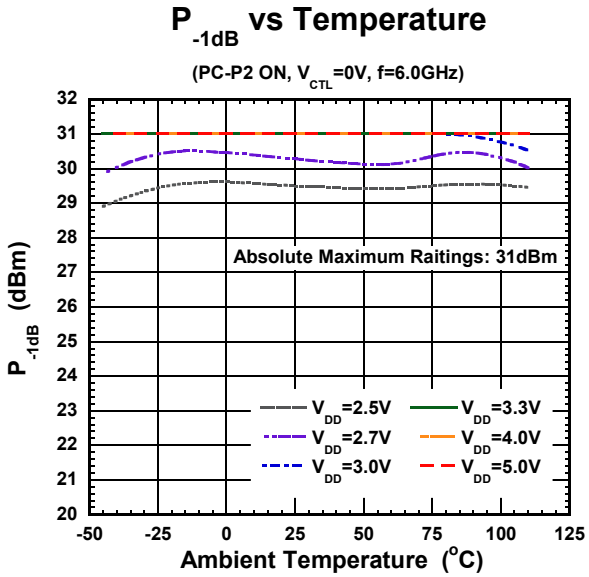
P_{-1dB} vs Temperature

(PC-P2 ON, V_{CTL}=0V, f=2.5GHz)



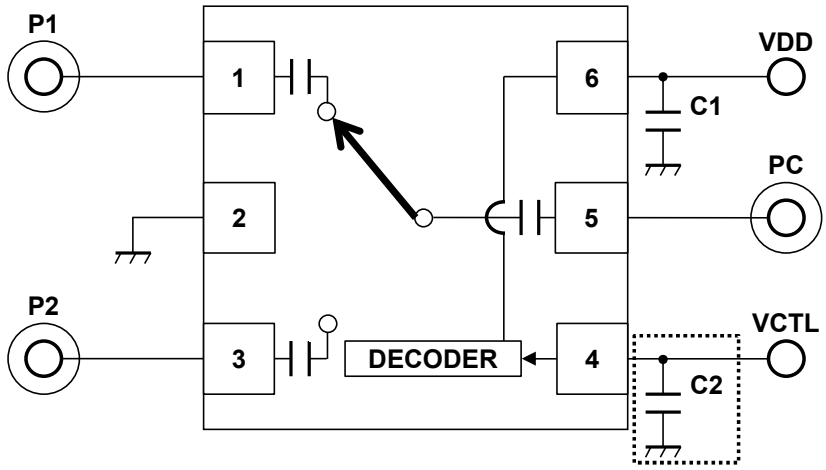
■ ELECTRICAL CHARACTERISTICS





■ APPLICATION CIRCUIT

(Top view)

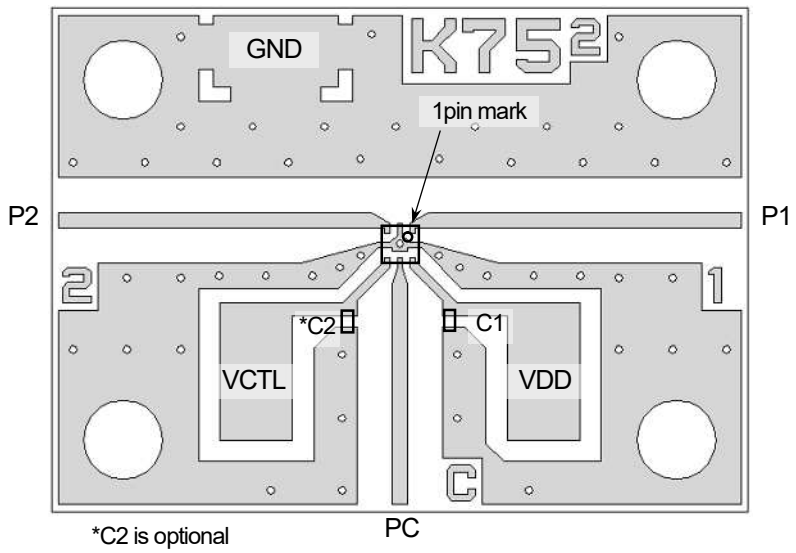


NOTE:

The bypass capacitor C2 is optional, and is recommended only when the control line is affected under noisy environment.

■ EVALUATION BOARD

(TOP VIEW)



PCB: FR-4, t = 0.2 mm
Capacitor size: 0603 (0.6 x 0.3 mm)
Strip line width: 0.4 mm
PCB size: 19.4 x 14.0 mm
Through hole diameter: 0.2 mm

■ Loss of PCB and connectors

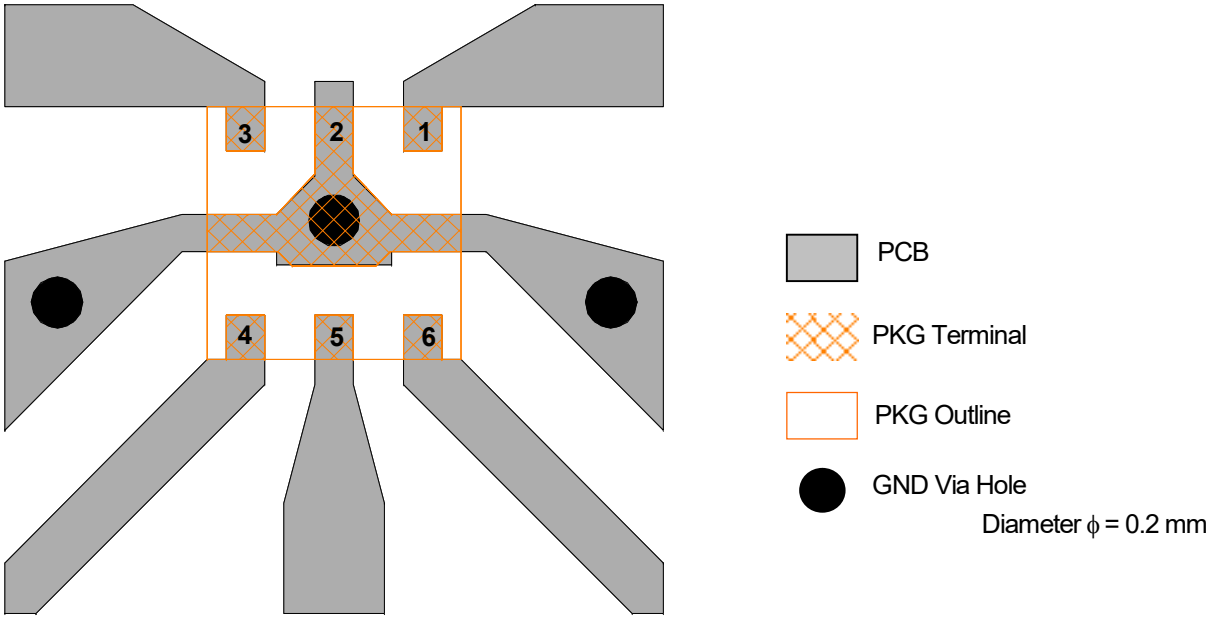
Frequency (GHz)	Loss (dB)
2.4	0.28
2.5	0.28
3.4	0.35
3.8	0.39
4.9	0.52
6.0	0.72

■ PARTS LIST

Part ID	Value	Notes
C1	1000 pF	MURATA MFG
C2	10 pF	(GRM03 Series)

■PCB LAYOUT GUIDELINE

(TOP VIEW)



PRECAUTIONS

For good RF performance, exposed pad should be connected to PCB ground plane as close as possible.

■ HANDLING PRECAUTIONS

PIN NO.	SYMBOL	ESD RATINGS		
		Human Body Model(1)		Charged Device Model(2)
Common terminal		Ground	I/O	
1	P1	Class 1C	Class 2	Class C6
2	GND	COM.	-	Class C6
3	P2	Class 1C	Class 2	Class C6
4	VCTL1	Class 1C	Class 1C	Class C6
5	PC	Class 2	Class 2	Class C6
6	VDD	Class 1C	-	Class C6

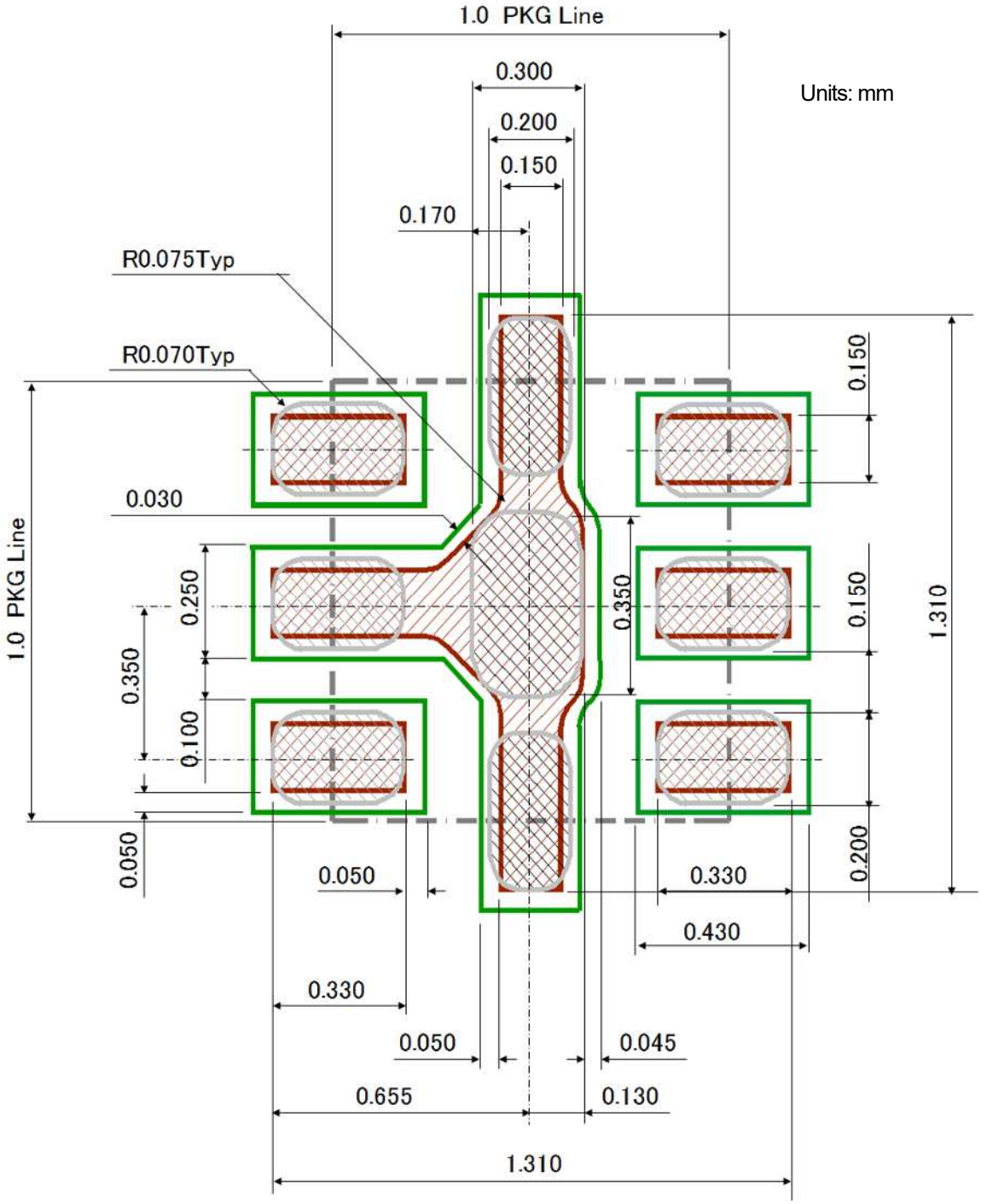
(1): According to JEDEC JS-001
(2): According to JEDEC JS-002

CAUTION:
This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.

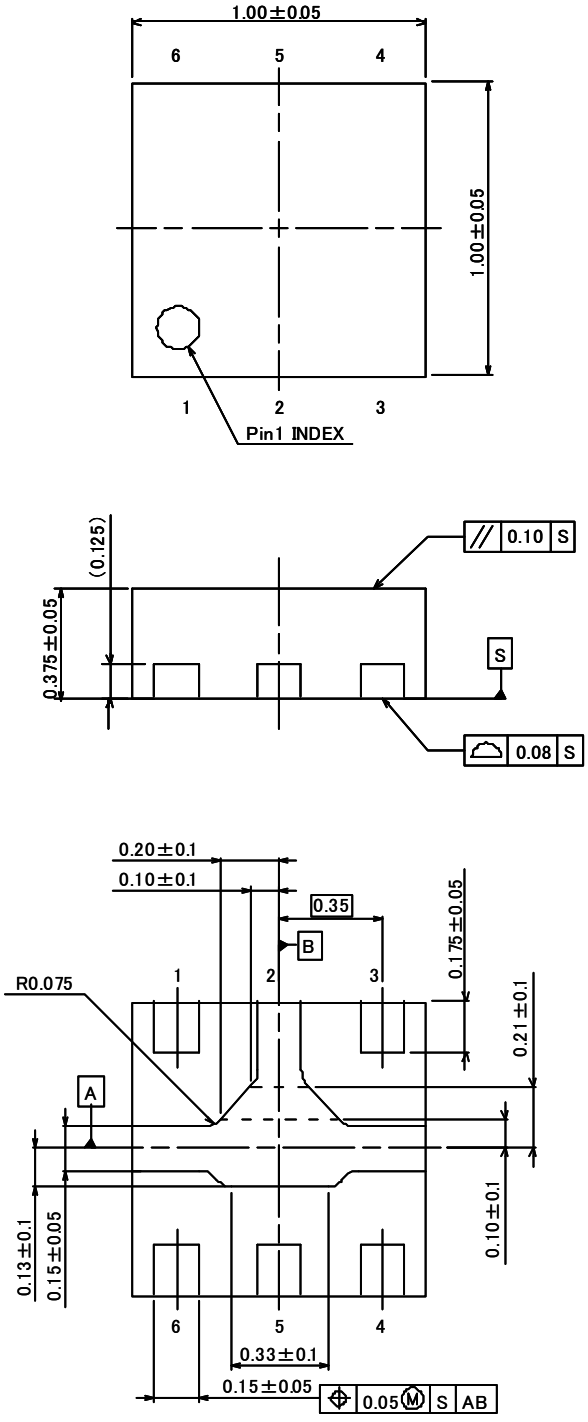
■ **RECOMMENDED FOOTPRINT PATTERN** (DFN6-75 PACKAGE) <Reference>

Package: 1.0 mm x 1.0 mm
Pin pitch: 0.35 mm

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



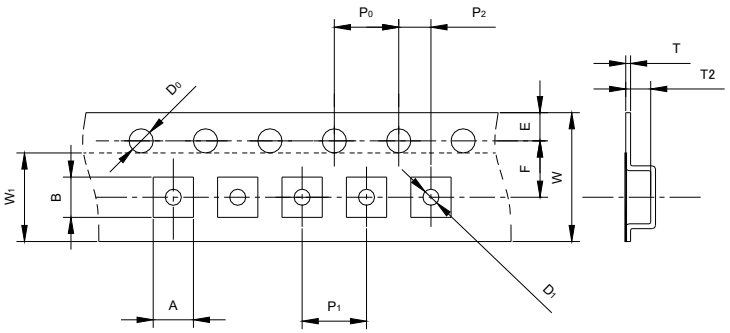
■PACKAGE OUTLINE (DFN6-75)



Unit	: mm
Board	: Cu
Terminal Treat	: Ni/Pd/Au
Molding Material	: Epoxy resin
Weight	: 1.2 mg

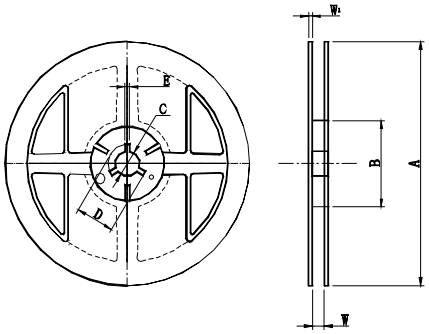
PACKING SPECIFICATION (DFN6-75)

TAPING DIMENSIONS



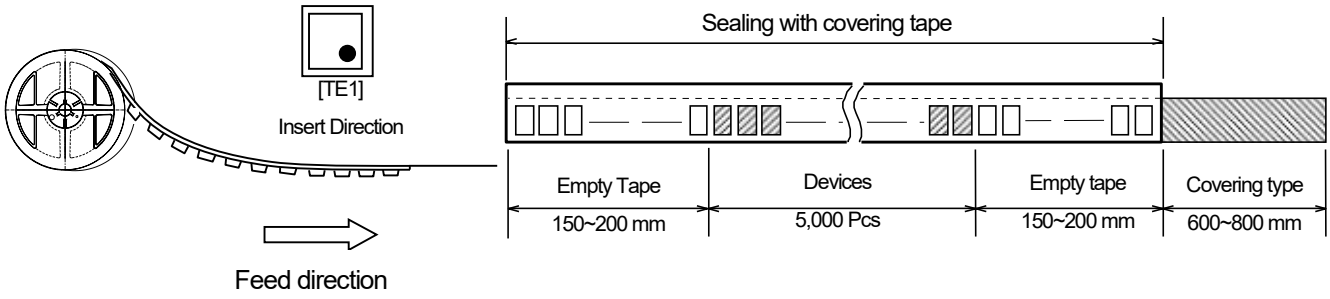
SYMBOL	DIMENSION	REMARKS
A	1.19 + 0.04/-0.01	BOTTOM
B	1.19 + 0.04/-0.01	BOTTOM
D0	1.5 + 0.1/-0.0	
D1	0.5 ± 0.05	
E	1.75 ± 0.1	
F	3.5 ± 0.05	
P0	4.0 ± 0.1	
P1	4.0 ± 0.1	
P2	2.0 ± 0.05	
T	0.18 ± 0.05	
T2	0.69 ± 0.10	
W	8.0 ± 0.1	
W1	5.5 ± 0.1	THICKNESS

REEL DIMENSIONS

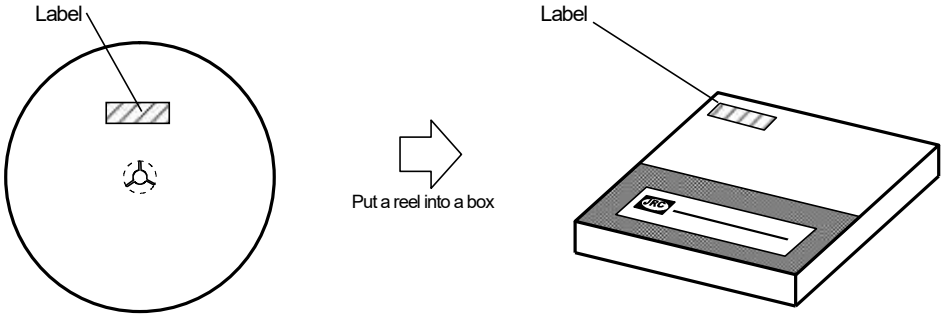


SYMBOL	DIMENSION
A	φ180 + 0/-3
B	φ 60 + 1/-0
C	φ 13 ± 0.2
D	φ 21 ± 0.8
E	2 ± 0.5
W	9.0 ± 0.3
W1	1.2

TAPING STATE



PACKING STATE



■ **REVISION HISTORY**

Date	Revision	Changes
25.Sep.2020	Ver.1.0	New Release

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3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
4. The technical information described in this document shows typical characteristics and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under our or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for automotive applications. Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death should first contact us.
    - 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 (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.

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Nisshinbo Micro Devices Inc.

Official website
https://www.nisshinbo-microdevices.co.jp/en/

Purchase information
https://www.nisshinbo-microdevices.co.jp/en/buy/