SPDT SWITCH GaAs MMIC

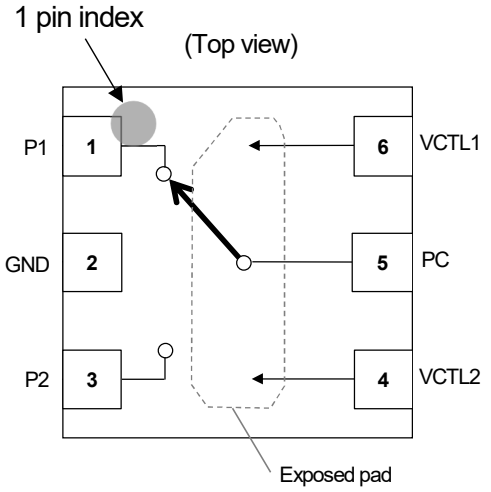
■ FEATURES

- AEC-Q100 grade 2 qualified
- Control voltage $V_{CTL(H)}$ = 3.0 V typ.
- Low insertion loss
  0.35 dB typ. @ f = 0.3 to 2.5 GHz
  0.45 dB typ. @ f = 4.9 to 5.9 GHz
  0.60 dB typ. @ f = 8.5 GHz
- High isolation
  28 dB typ. @ f = 0.3 to 2.5 GHz
  27 dB typ. @ f = 4.9 to 5.9 GHz
  18 dB typ. @ f = 8.5 GHz
- P_{-1dB} = +31 dBm typ. @ f = 0.3 GHz, 2.5 GHz, 5.9 GHz
- Package with wettable flank ESON6-GC
  (1.6 x 1.6 x 0.78 mm typ., pin pitch 0.5 mm)
- RoHS compliant and Halogen Free, MSL1

■ APPLICATION

- 802.11 a/b/g/n/ac/ax and BT networks applications
- UWB (ultra-wide band) applications
- RKE applications
- General purpose switching applications

■ BLOCK DIAGRAM (ESON6-GC)



■ GENERAL DESCRIPTION

The NJG1801AKGC-A is a GaAs SPDT switch MMIC suited for switching transmit/receive signals on sub GHz ISM band, Bluetooth, 802.11 a/b/g/n/ac/ax, and UWB applications.

This switch features low insertion loss, high isolation, high handling power, and ultra-wide frequency coverage up to 8.5 GHz.

ESON6-GC package with wettable flank structure corresponds to Automated Optical Inspection (AOI).

■ TRUTH TABLE

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

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

■ PIN CONFIGURATION

PIN NO.	SYMBOL	DESCRIPTION
1	P1	RF input/output
2	GND	Ground terminal
3	P2	RF input/output
4	VCTL2	Control signal input terminal
5	PC	RF input/output
6	VCTL1	Control signal input terminal
Exposed pad	GND	Ground terminal

■ PRODUCT NAME INFORMATION

NJG1801A KGC -A (TE3)

Part number	Package	Automotive	Taping form

■ ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJG1801AKGC-A	ESON6-GC	Yes	Yes	SnBi	1801A A	5.4	3,000

■ ABSOLUTE MAXIMUM RATINGS

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

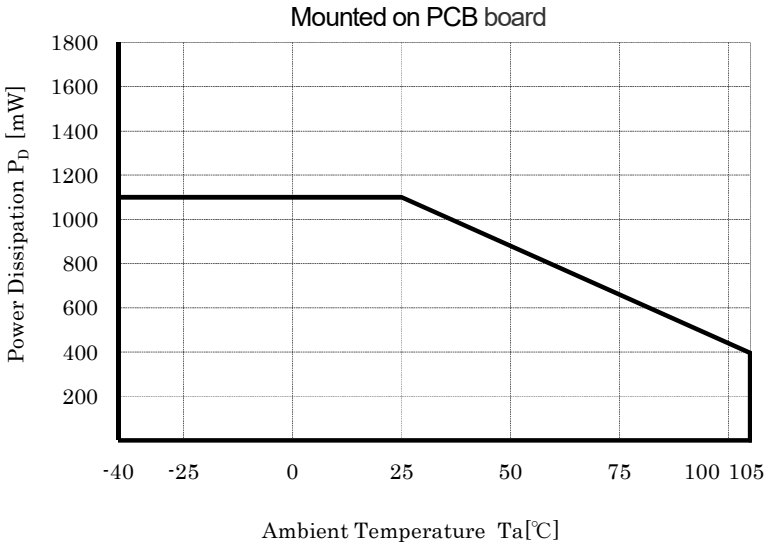
PARAMETER	SYMBOL	RATINGS	UNIT
RF Input Power	P_{IN}	+31(1)	dBm
Control Voltage	V_{CTL}	6.0	V
Power Dissipation(2)	P_D	1100	mW
Operating Temperature	T_{opr}	-40 to +105	°C
Storage Temperature	T_{stg}	-55 to +150	°C

(1): $V_{CTL(L)}$ = 0V, $V_{CTL(H)}$ = 3.0V, on state port
(2): 4-layer FR4 PCB with through-hole (101.5 x 114.5 mm), Tj = 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



■ ELECTRICAL CHARACTERISTICS 1 (DC CHARACTERISTICS)

(General conditions: T_a = +25°C, with application circuit)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Control Voltage (HIGH)	$V_{CTL(H)}$		1.8	3.0	5.0	V
Control Voltage (LOW)	$V_{CTL(L)}$		-0.2	-	0.2	V
Control Current	I_{CTL}		-	5	10	μA

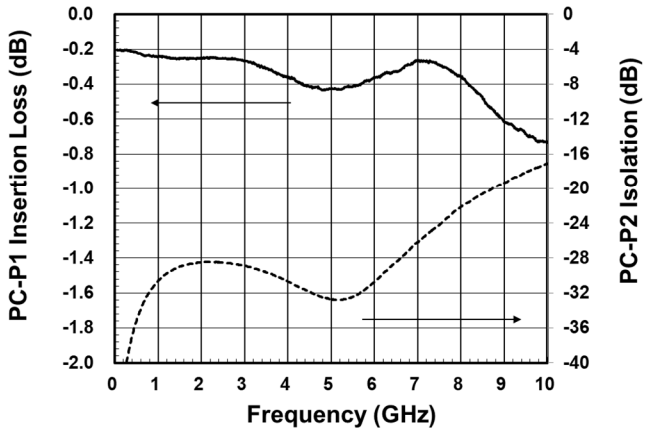
■ ELECTRICAL CHARACTERISTICS 2 (RF CHARACTERISTICS)

(General conditions: $V_{CTL(H)}$ = 3.0 V, $V_{CTL(L)}$ = 0 V, T_a = +25°C, Z_S = Z_I = 50 Ω, with application circuit)

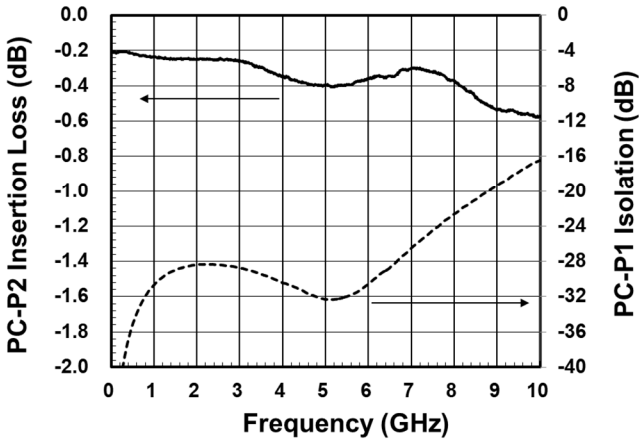
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Insertion loss1	LOSS1	f = 0.3 to 2.5 GHz	-	0.35	0.55	dB
Insertion loss2	LOSS2	f = 4.9 to 5.9 GHz	-	0.45	0.70	dB
Insertion loss3	LOSS3	f = 8.5 GHz	-	0.60	0.80	dB
Isolation1	ISL1	f = 0.3 to 2.5 GHz	25	28	-	dB
Isolation2	ISL2	f = 4.9 to 5.9 GHz	24	27	-	dB
Isolation3	ISL3	f = 8.5 GHz	16	18	-	dB
Return loss1	RL1	f = 0.3 to 2.5 GHz	18	28	-	dB
Return loss2	RL2	f = 4.9 to 5.9 GHz	10	15	-	dB
Return loss3	RL3	f = 8.5 GHz	10	14	-	dB
Input power at 1dB compression point1	$P_{-1dB}1$	f = 0.3 to 2.5 GHz	+29	+31	-	dBm
Input power at 1dB compression point2	$P_{-1dB}2$	f = 4.9 to 5.9 GHz	+28	+31	-	dBm
Input power at 1dB compression point3	$P_{-1dB}3$	f = 8.5 GHz	+11	-	-	dBm
Switching time	T_{SW}	50% V_{CTL} to 10%/90% RF	-	100	300	ns

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

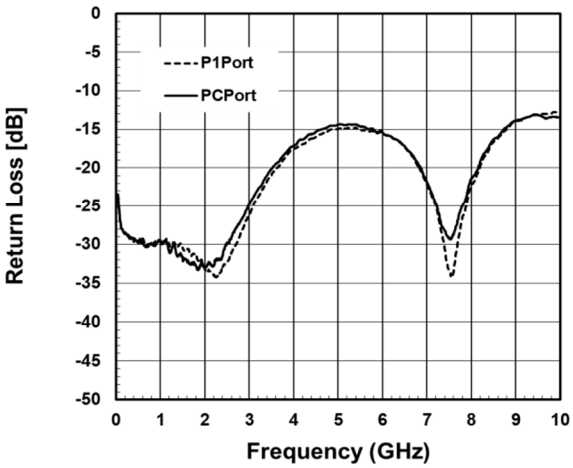
Loss, ISL vs Frequency
(PC-P1 ON, $V_{CTL(H)}$=3.0V, $V_{CTL(L)}$=0V)



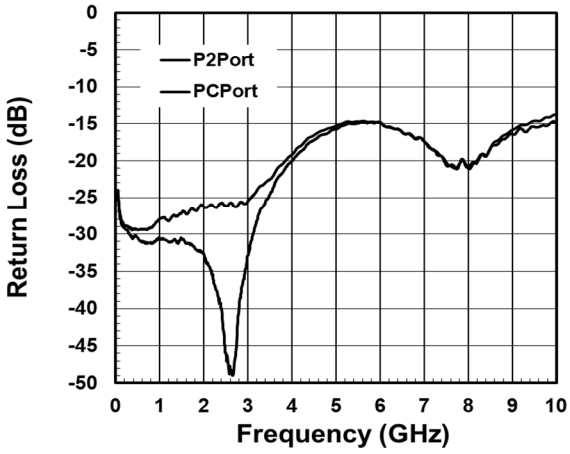
Loss, ISL vs Frequency
(PC-P2 ON, $V_{CTL(H)}$=3.0V, $V_{CTL(L)}$=0V)



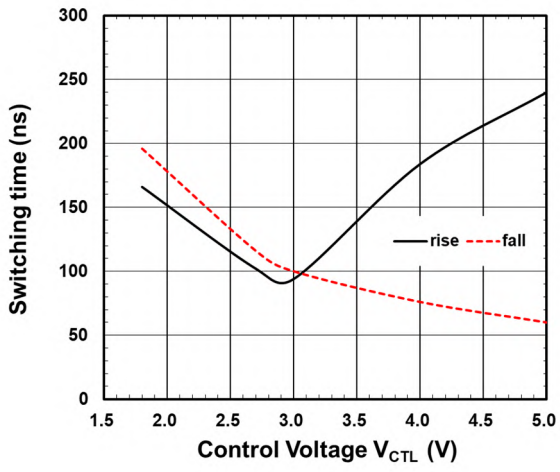
Return Loss vs Frequency
(PC-P1 ON, $V_{CTL(H)}$=3.0V, $V_{CTL(L)}$=0V)



Return Loss vs Frequency
(PC-P2 ON, $V_{CTL(H)}$=3.0V, $V_{CTL(L)}$=0V)

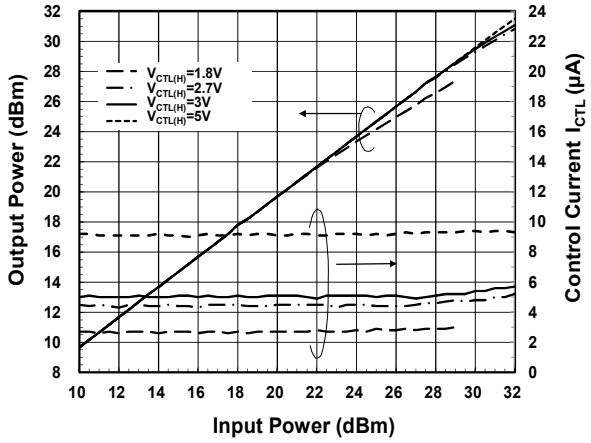


Switching Time vs Control Voltage
(PC-P1 path, Input:PC port, Monitor:P1 port, $V_{CTL(L)}$=0V)

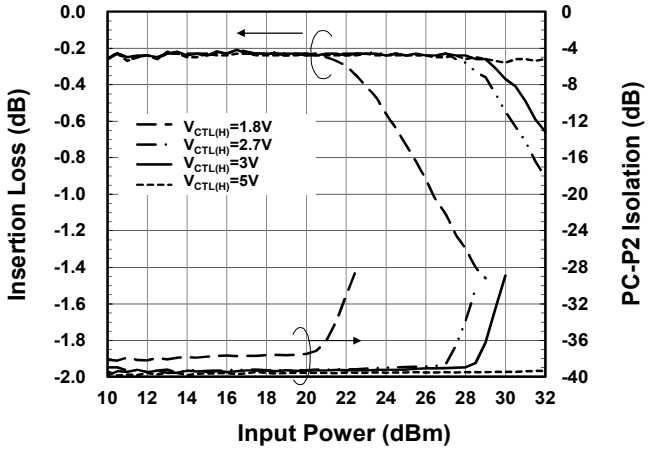


■ **ELECTRICAL CHARACTERISTICS** (With application circuit, loss of external circuit are excluded.)

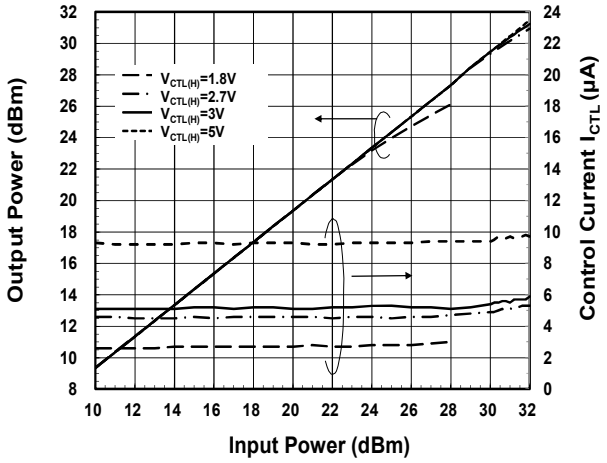
Output Power, I_{CTL} vs Input Power
(f=0.3GHz, PC-P1 ON, $V_{CTL(L)}$=0V)



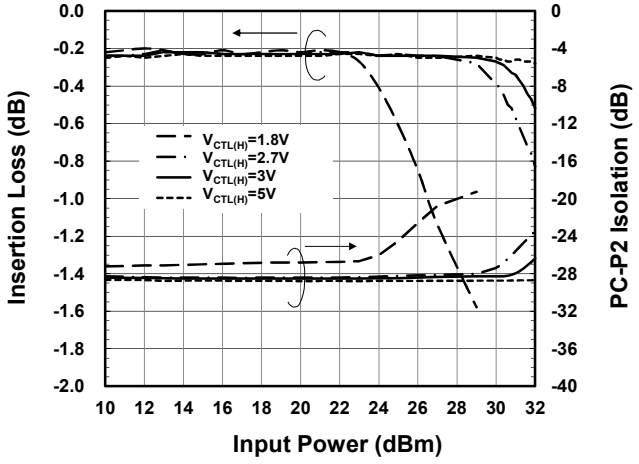
Loss, ISL vs Input Power
(f=0.3GHz, PC-P1 ON,$V_{CTL(L)}$=0V)



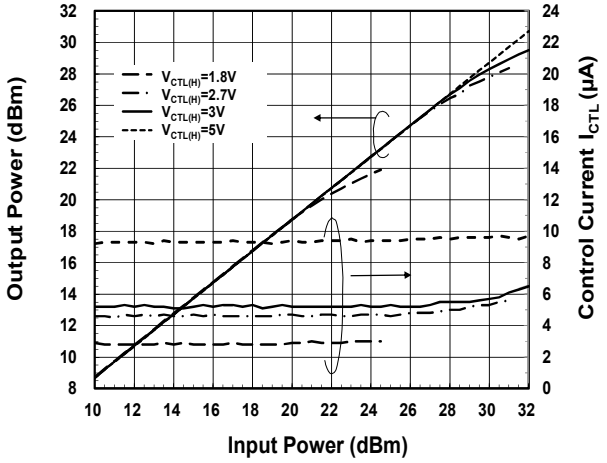
Output Power, I_{CTL} vs Input Power
(f=2.5GHz, PC-P1 ON, $V_{CTL(L)}$=0V)



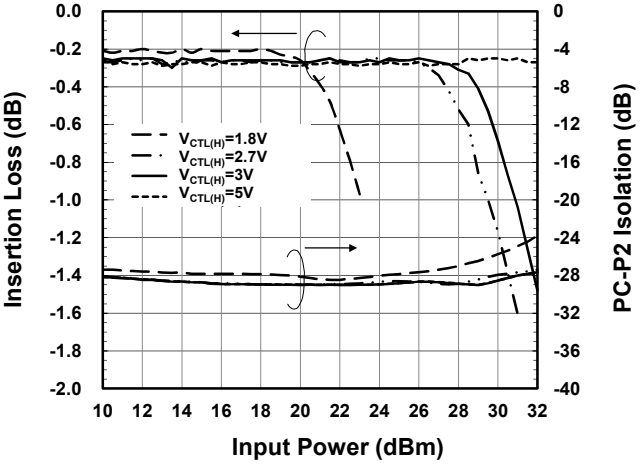
Loss, ISL vs Input Power
(f=2.5GHz, PC-P1 ON,$V_{CTL(L)}$=0V)



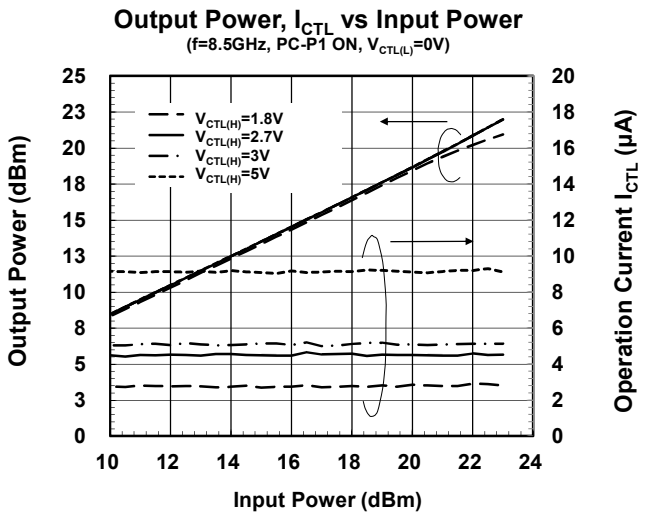
Output Power, I_{CTL} vs Input Power
(f=5.9GHz, PC-P1 ON, $V_{CTL(L)}$=0V)

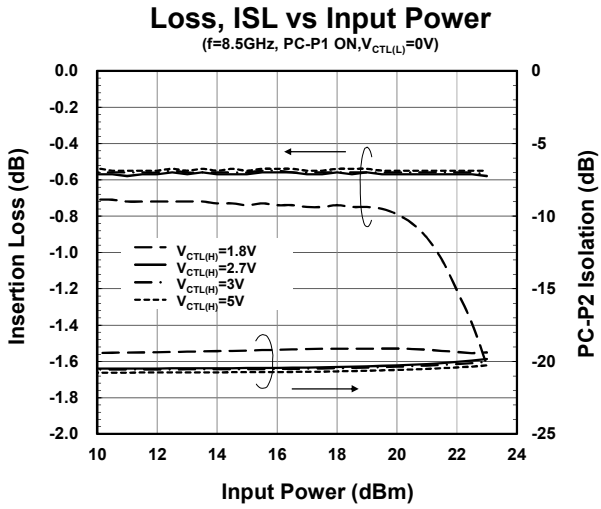


Loss, ISL vs Input Power
(f=5.9GHz, PC-P1 ON,$V_{CTL(L)}$=0V)



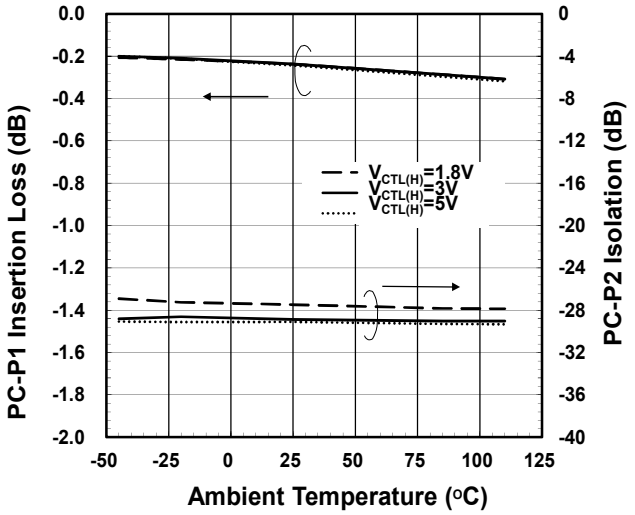
■ **ELECTRICAL CHARACTERISTICS** (With application circuit, loss of external circuit are excluded.)



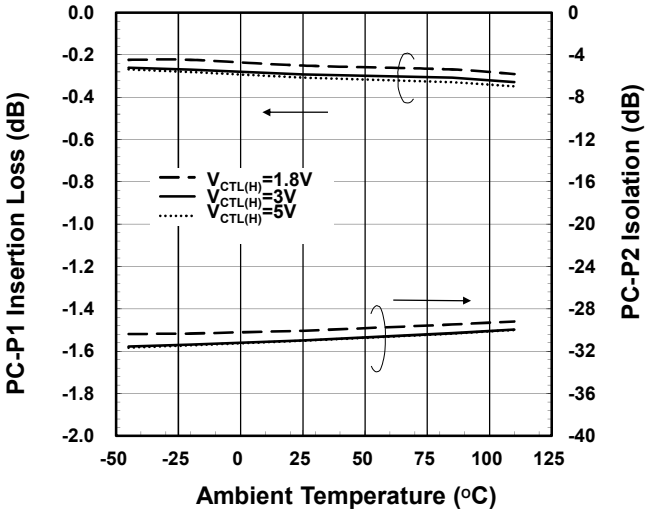


■ **ELECTRICAL CHARACTERISTICS** (With application circuit, loss of external circuit are excluded.)

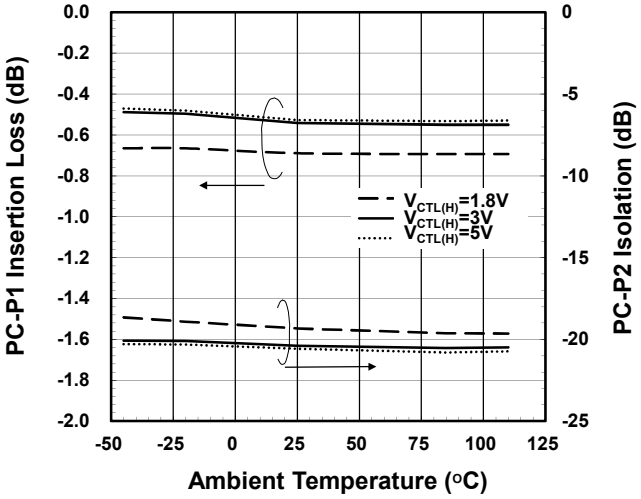
Loss, ISL vs Ambient Temperature
(f=2.5GHz, PC-P1 ON,$V_{CTL(L)}$=0)



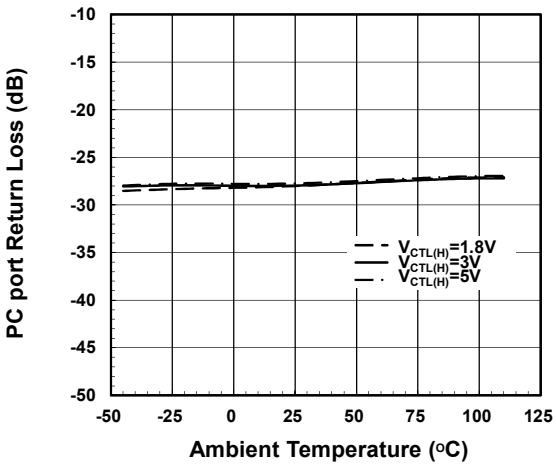
Loss, ISL vs Ambient Temperature
(f=5.9GHz, PC-P1 ON,$V_{CTL(L)}$=0)



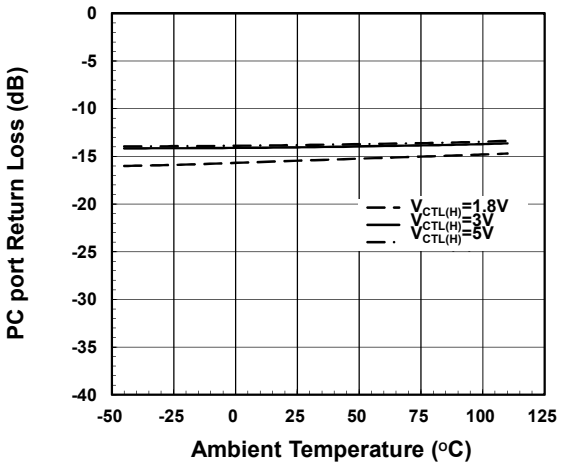
Loss, ISL vs Ambient Temperature
(f=8.5GHz, PC-P1 ON,$V_{CTL(L)}$ =0)



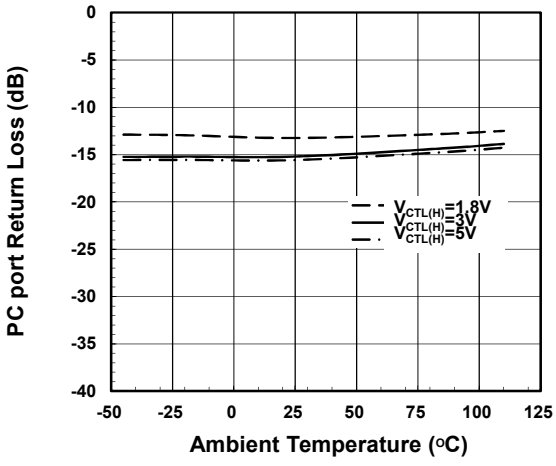
Return Loss vs Ambient Temperature
(f=2.5GHz, PC-P1ON, $V_{CTL(L)}$=0)



Return Loss vs Ambient Temperature
(f=5.9GHz, PC-P1 ON, $V_{CTL(L)}$=0)

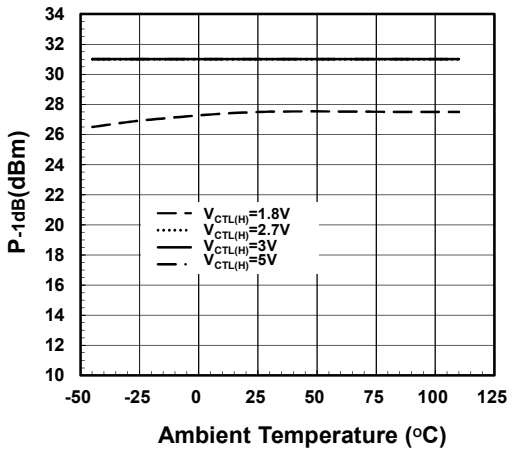


Return Loss vs Ambient Temperature
(f=8.5GHz, PC-P1 ON, $V_{CTL(L)}$=0)

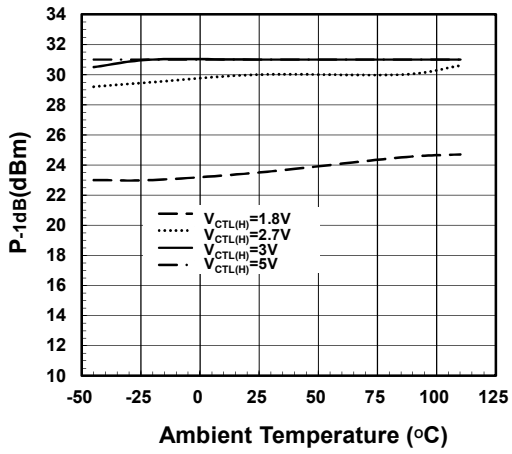


■**ELECTRICAL CHARACTERISTICS** (With application circuit, loss of external circuit are excluded.)

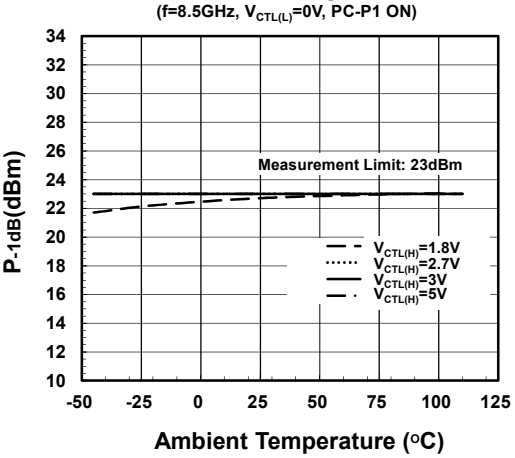
P-1dB vs Temperature
(f=2.5GHz, $V_{CTL(L)}$ =0V, PC-P1 ON)



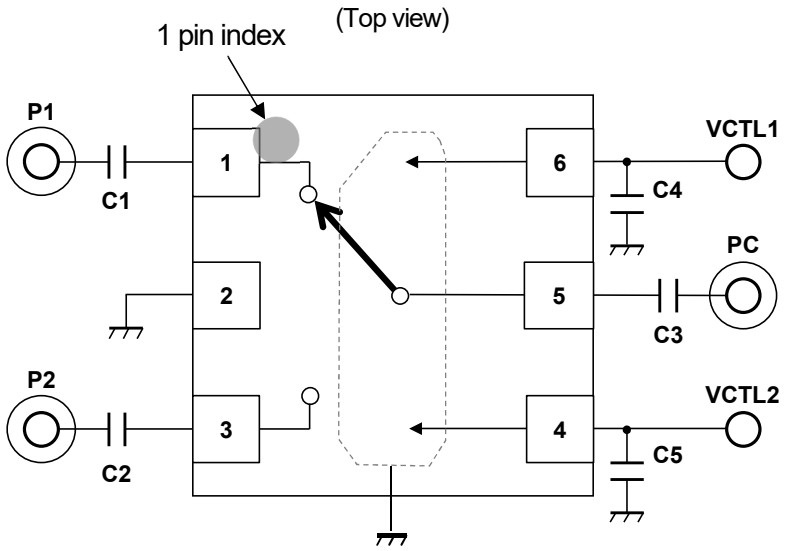
P-1dB vs Temperature
(f=5.9GHz, $V_{CTL(L)}$ =0V, PC-P1 ON)



P-1dB vs Temperature
(f=8.5GHz, $V_{CTL(L)}$=0V, PC-P1 ON)



■ APPLICATION CIRCUIT

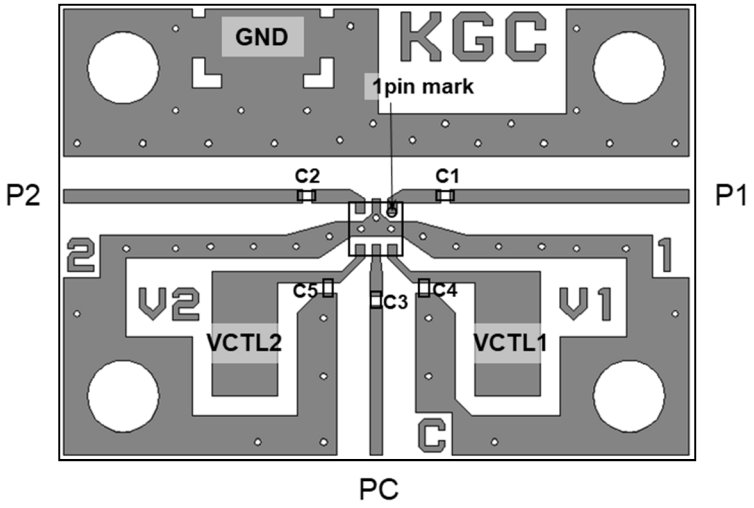


■ PARTS LIST

Part ID	Value	Notes
C1 to C3	1000 pF	GRM0335C1E102GA01D
C4 to C5	10 pF	GRM0335C1E100GA01D

■ RECOMMENDED PCB DESIGN

(Top View)

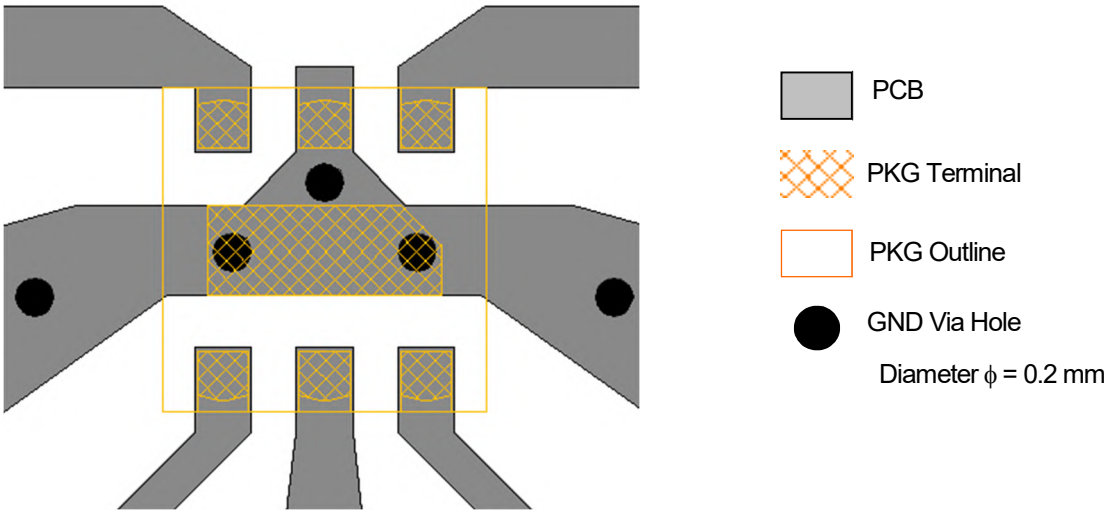


PCB (FR-4):
t = 0.2 mm
MICROSTRIP LINE WIDTH = 0.4 mm (Z_0 = 50 Ω)
PCB SIZE = 19.4 x 14.0 mm

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

Frequency [GHz]	Loss [dB]
0.3	0.14
2.4	0.38
2.5	0.39
4.9	0.59
5.9	0.73
8.5	0.91

<PCB LAYOUT GUIDELINE>



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, GND terminal must be connected to PCB ground plane of substrate, and through -holes should be placed near the IC.

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

■ 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	VCTL2	Class 0B	Class 0B	Class C6
5	PC	Class 2	Class 2	Class C6
6	VCTL1	Class 0B	Class 0B	Class C6

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

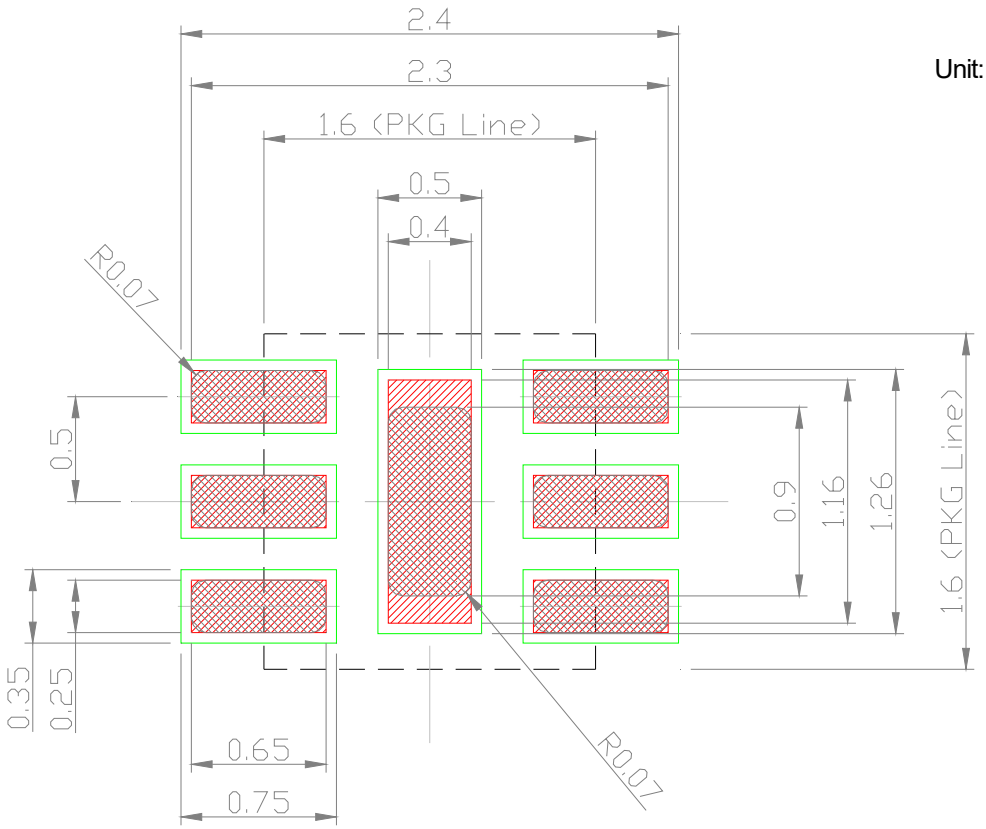
CAUTION: This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.

■ RECOMMENDED FOOTPRINT PATTERN (ESON6-GC PACKAGE) <Reference>

Package: 1.6 mm x 1.6 mm
Pin pitch: 0.5 mm

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

Unit: mm

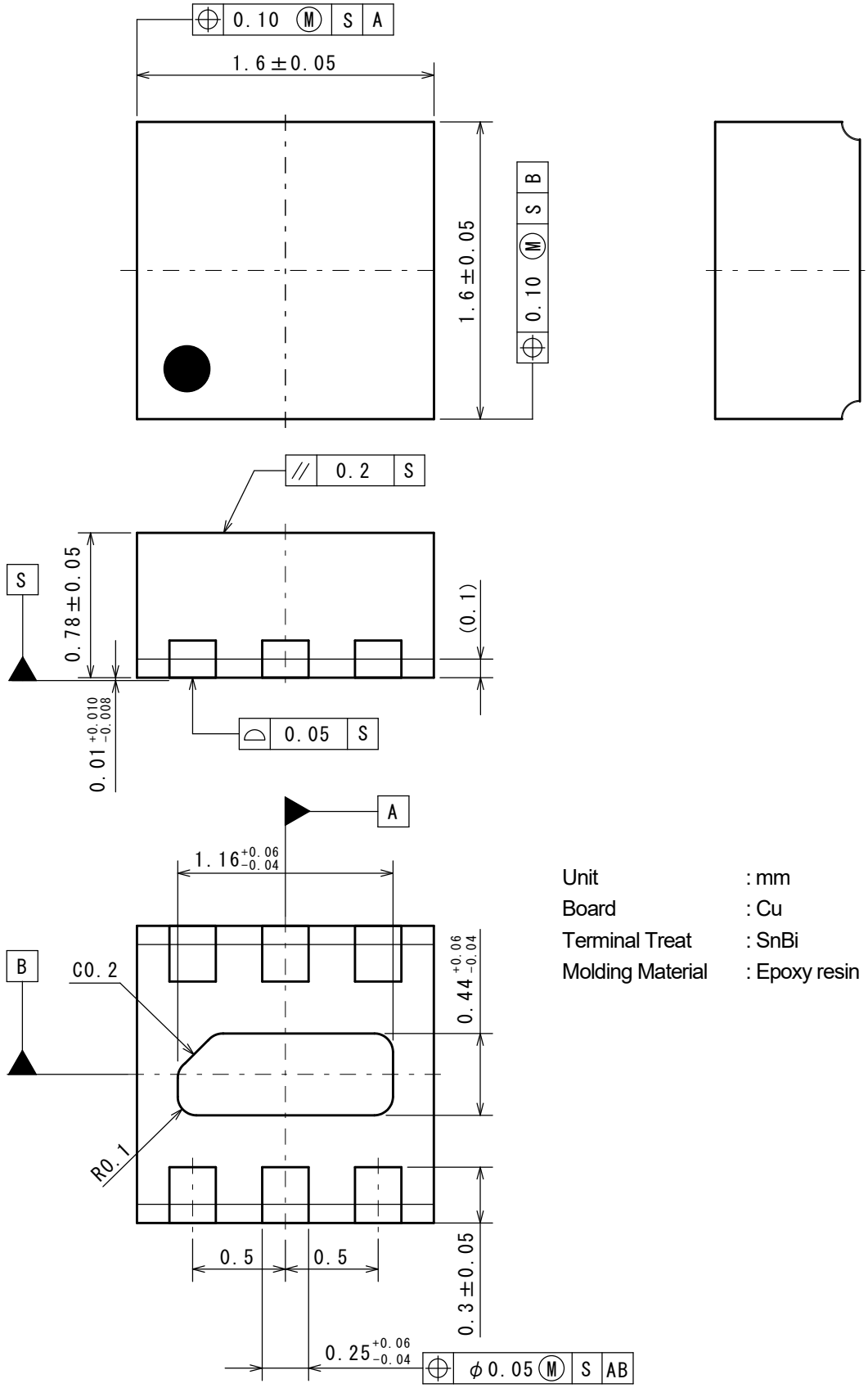


■ **PACKAGE OUTLINE (ESON6-GC)**

TOP VIEW

SIDE VIEW

BOTTOM VIEW

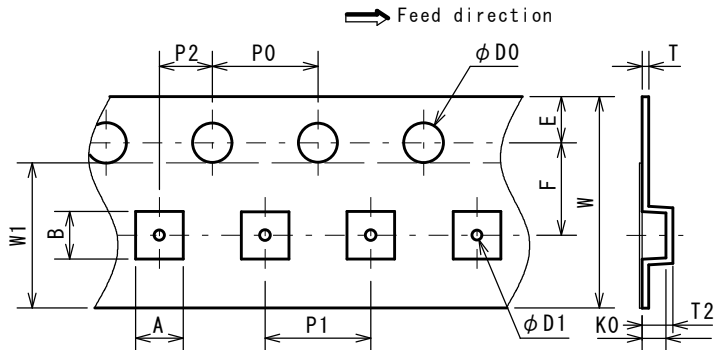


Unit	: mm
Board	: Cu
Terminal Treat	: SnBi
Molding Material	: Epoxy resin

■ PACKING SPECIFICATION (ESON6-GC)

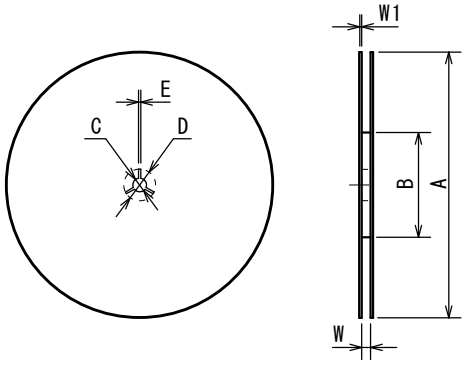
UNIT: mm

TAPING DIMENSIONS



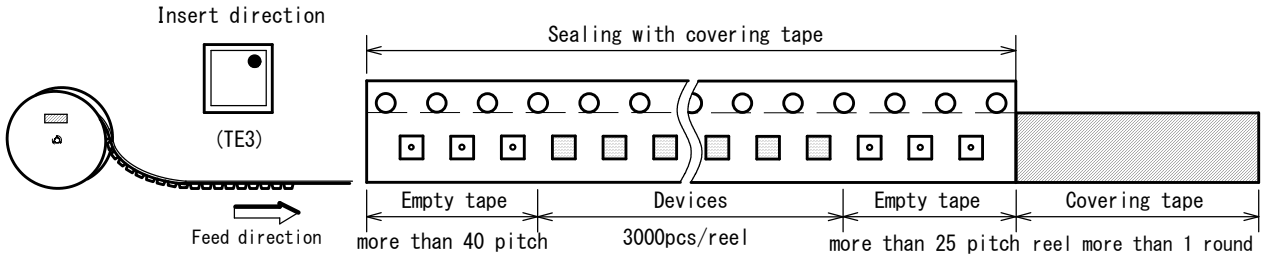
SYMBOL	DIMENSION	REMARKS
A	1.80±0.05	BOTTOM DIMENSION
B	1.80±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$0.5^{+0.1}_{0}$	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.28±0.07	
K0	0.93±0.05	
W	$8.0^{+0.3}_{-0.1}$	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

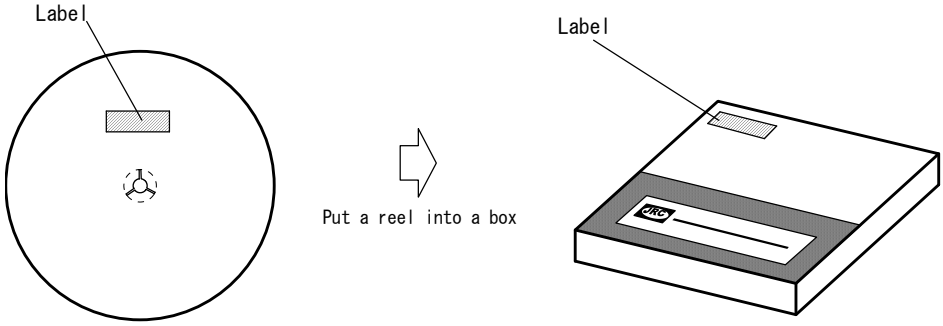


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



PACKING STATE



■ **REVISION HISTORY**

Date	Revision	Changes
17.Nov.2021	Ver.1.3	Revised ELECTRICAL CHARACTERISTICS 1 Revised RECOMMENDED PCB DESIGN
5.Nov.2021	Ver.1.2	Revised RECOMMENDED FOOTPRINT PATTERN
3.Sep.2021	Ver.1.1	Revised PARTS LIST
20.Aug.2020	Ver.1.0	New Release Automotive spec

[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 (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.