DPDT SWITCH GaAs MMIC

■FEATURES

- Low control voltage 1.8V min.
- Low current consumption 0.1μA typ.
- Low insertion loss 0.45dB typ. @f=920MHz
- High isolation 30dB typ. @f=920MHz
- $P_{-0.1dB}$ +30dBm typ. @f=920MHz
- Small package 1.6 x 1.6mm, t=0.397mm
- RoHS compliant and Halogen Free, MSL1

■GENERAL DESCRIPTION

The NJG1813KG1 is a 2bit control DPDT switch IC suited for LPWA applications.
The NJG1813KG1 is compatible with 1.8 V low control voltage and features low current consumption important for LPWA applications.
The small and thin ESON6-G1 package is adopted.

■APPLICATION

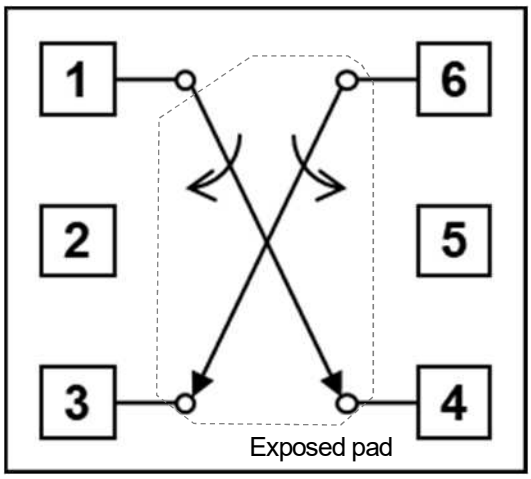
- LPWA (SIGFOX, LoRaWAN, Wi-SUN) applications
- Antenna switching, path switching, general purpose switching applications

■PIN CONFIGURATION

PIN NO.	SYMBOL	DESCRIPTION
1	ANT2	RF terminal
2	VCTL2	Control signal input terminal
3	OUT2	RF terminal
4	OUT1	RF terminal
5	VCTL1	Control signal input terminal
6	ANT1	RF terminal
Exposed pad	GND	Ground terminal

■BLOCK DIAGRAM (ESON6-G1)

(Top view)

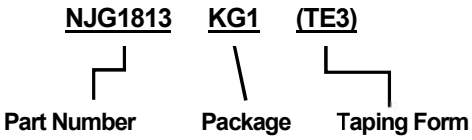


■FUNCTIONAL DESCRIPTION

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

通過経路	VCTL1	VCTL2
ANT1-OUT2 ANT2-OUT1	H	L
ANT1-OUT1 ANT2-OUT2	L	H

■ PRODUCT NAME INFORMATION



■ ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJG1813KG1	ESON6-G1	Yes	Yes	Sn-Bi	1813	3.5	3,000

■ ABSOLUTE MAXIMUM RATINGS

T_a=25°C, Z_S=Z_l=50Ω

PARAMETER	SYMBOL	RATINGS	UNIT
Control Voltage	V_{CTL}	4.5	V
RF Input Power	P_{IN}	+33	dBm
Power Dissipation (1)	P_D	1200	mW
Operating Temperature	T_{opr}	-40 to +105	°C
Storage Temperature	T_{stg}	-55 to +150	°C

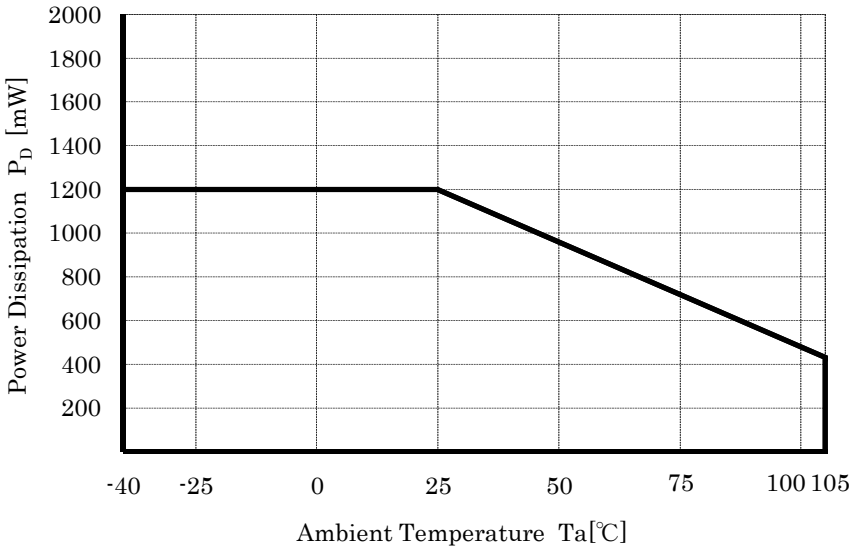
(1): Mounted on four-layer FR4 PCB with through-hole (101.5 × 114.5 mm), T_j = 150°C

■ 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 PCB



■ ELECTRICAL CHARACTERISTICS (DC CHARACTERISTICS)

$V_{CTL(H)}$=3.0V, $V_{CTL(L)}$=0V, T_a=25°C, Z_s=Z_l=50Ω, with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Control Voltage (HIGH)	$V_{CTL(H)}$		1.8	3.0	4.0	V
Control Voltage (LOW)	$V_{CTL(L)}$		-0.2	-	0.2	V
Control Current	I_{CTL}	RF OFF, $V_{CTL(H)}$=3.0V, $V_{CTL(L)}$=0V	-	0.1	2.5	μA

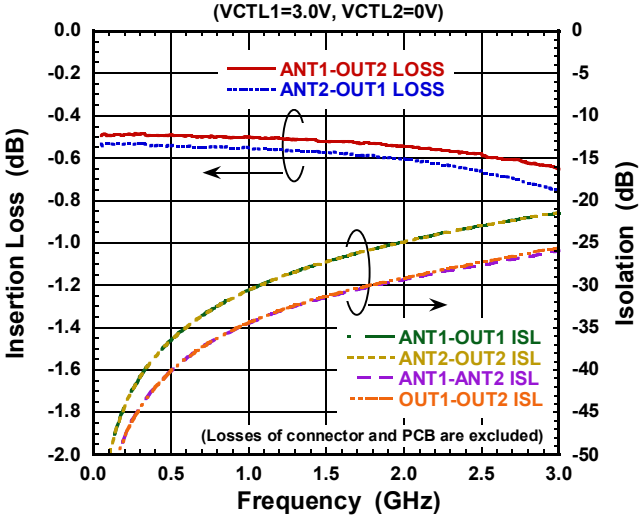
■ ELECTRICAL CHARACTERISTICS (RF CHARACTERISTICS)

$V_{CTL(H)}$=3.0V, $V_{CTL(L)}$=0V, T_a=25°C, Z_s=Z_l=50Ω, with application circuit

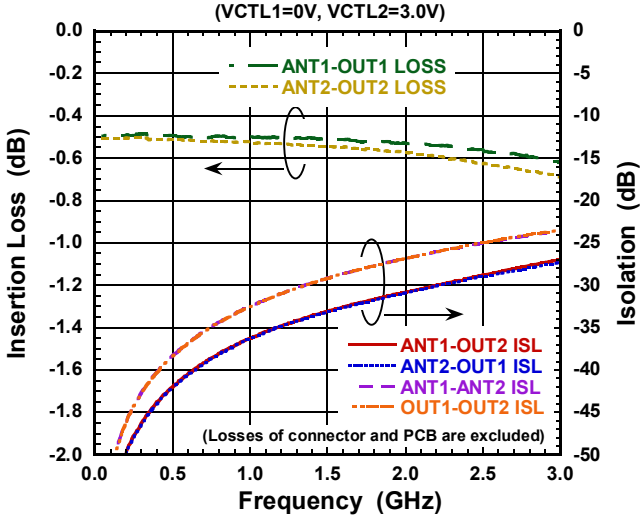
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Insertion loss	LOSS	f=920MHz	-	0.45	0.68	dB
Isolation1	ISL1	f=920MHz, ANT1/2 to OUT1/2	26	30	-	dB
Isolation2	ISL2	f=920MHz, ANT1 to ANT2, OUT1 to OUT2	26	30	-	dB
Input power at 0.1dB compression point	$P_{-0.1dB}$	f=920MHz	+27	+30	-	dBm
VSWR	VSWR	f=920MHz	-	1.1	1.5	-
Switching time	T_{SW}	50% VCTL to 10%/90% RF	-	100	300	ns

■ ELECTRICAL CHARACTERISTICS

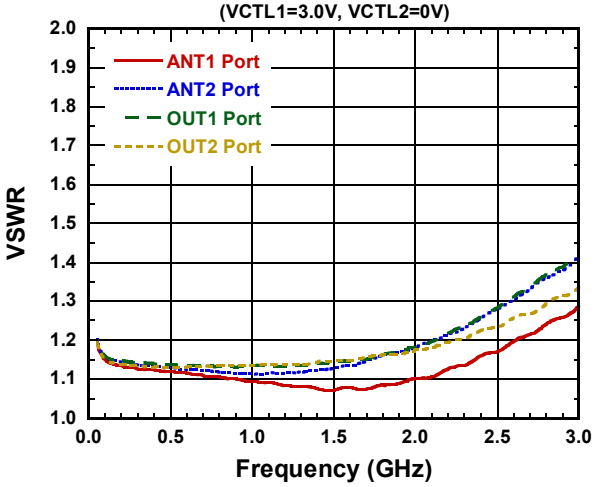
Insertion Loss vs Frequency
(VCTL1=3.0V, VCTL2=0V)



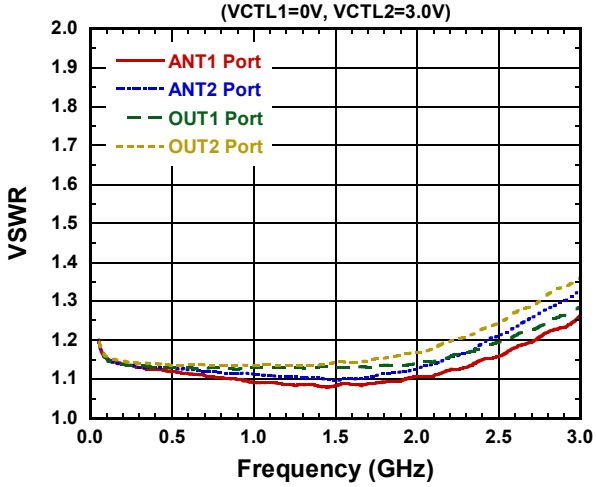
Insertion Loss vs Frequency
(VCTL1=0V, VCTL2=3.0V)



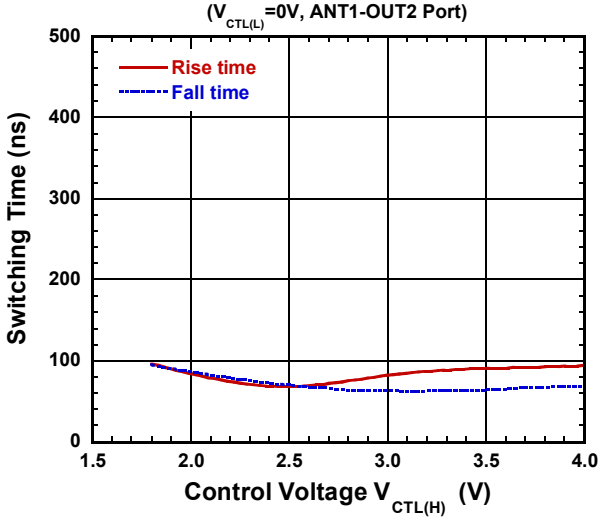
VSWR vs Frequency
(VCTL1=3.0V, VCTL2=0V)



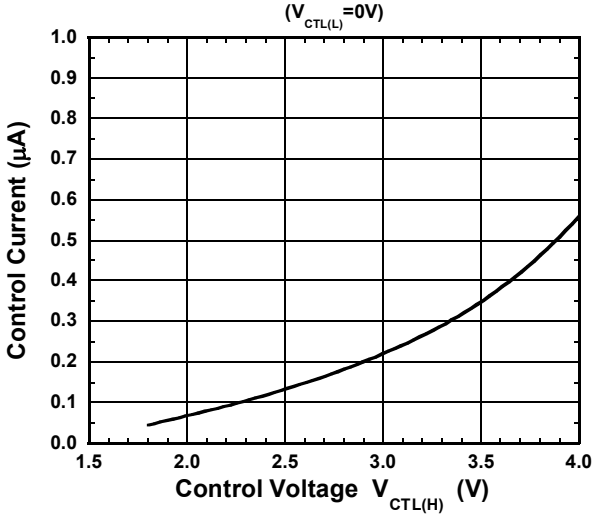
VSWR vs Frequency
(VCTL1=0V, VCTL2=3.0V)



Switching Time vs Control Voltage
($V_{CTL(L)}$=0V, ANT1-OUT2 Port)



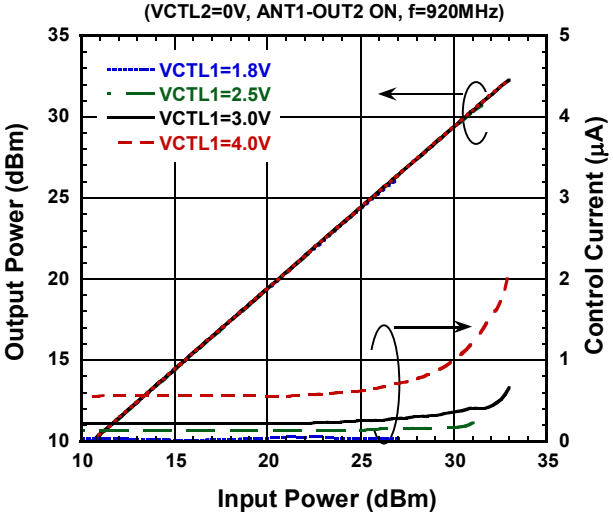
Control Current vs Control Voltage
($V_{CTL(L)}$=0V)



■ ELECTRICAL CHARACTERISTICS

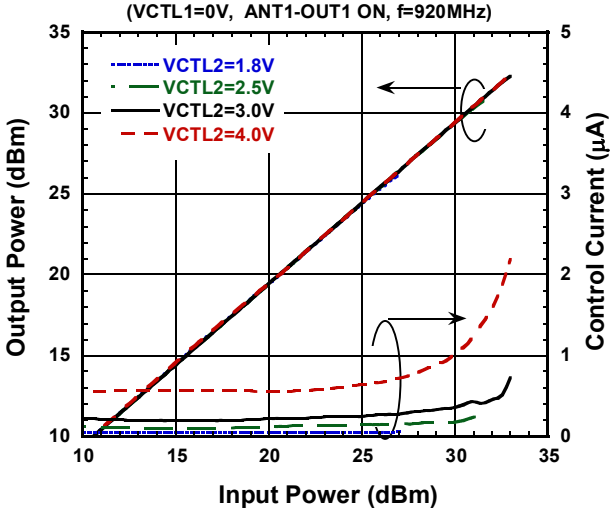
Output Power, Control Current vs Input Power

(VCTL2=0V, ANT1-OUT2 ON, f=920MHz)



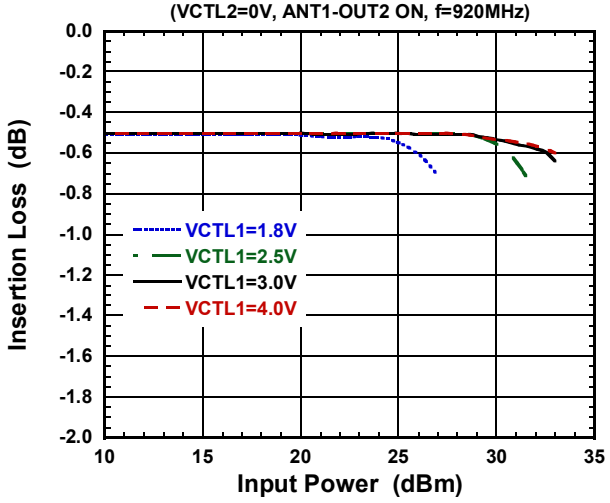
Output Power, Control Current vs Input Power

(VCTL1=0V, ANT1-OUT1 ON, f=920MHz)



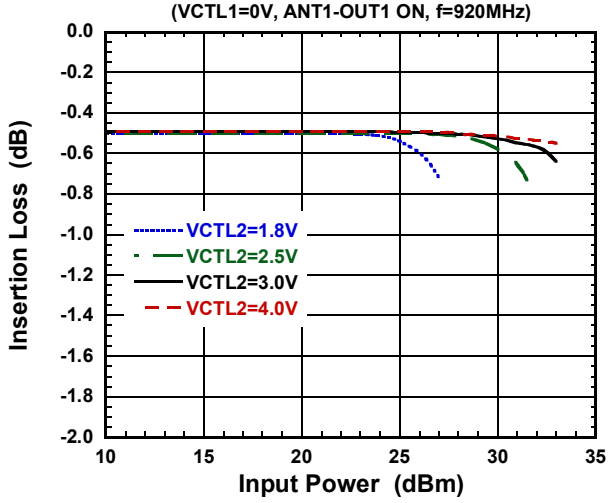
Insertion Loss vs Input Power

(VCTL2=0V, ANT1-OUT2 ON, f=920MHz)



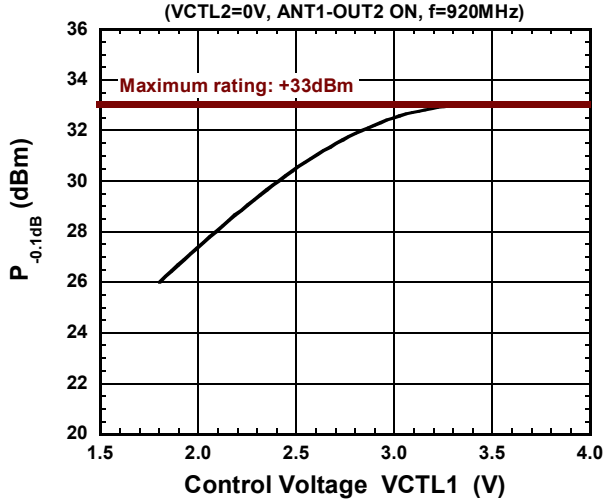
Insertion Loss vs Input Power

(VCTL1=0V, ANT1-OUT1 ON, f=920MHz)



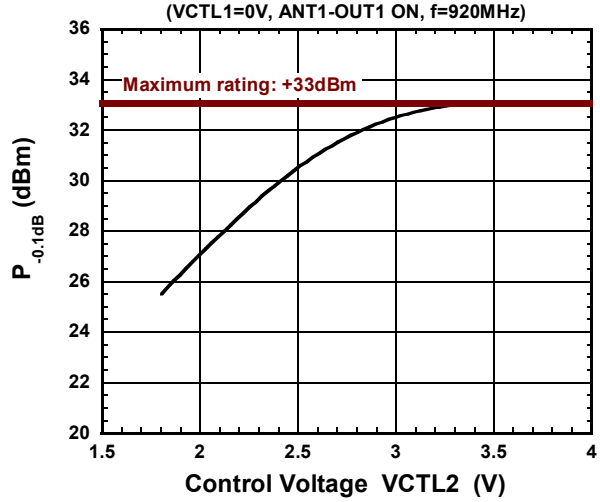
P-0.1dB vs Control Voltage

(VCTL2=0V, ANT1-OUT2 ON, f=920MHz)



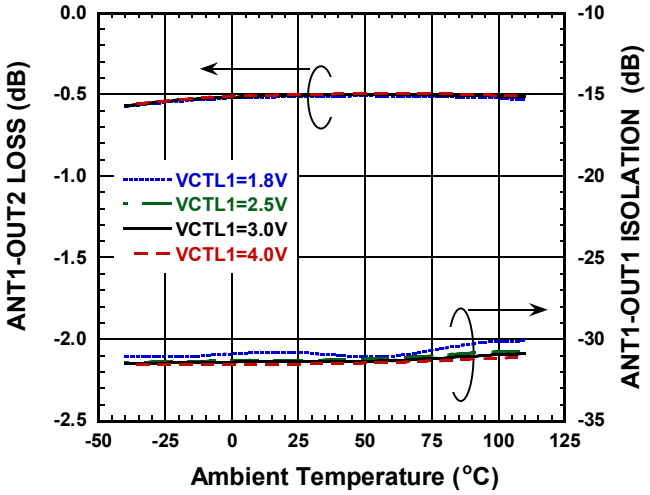
P-0.1dB vs Control Voltage

(VCTL1=0V, ANT1-OUT1 ON, f=920MHz)

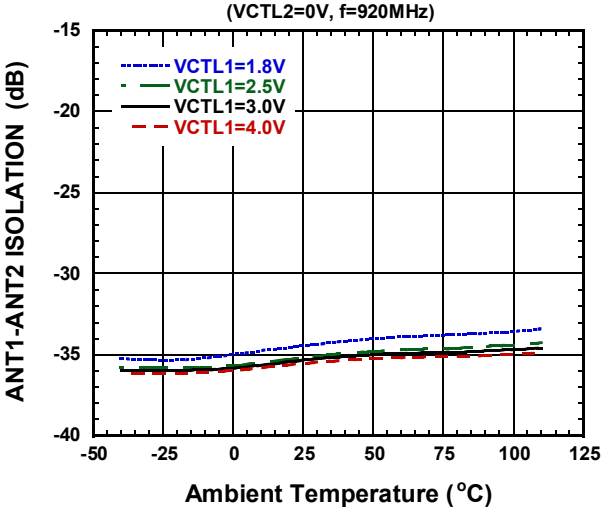


■ ELECTRICAL CHARACTERISTICS

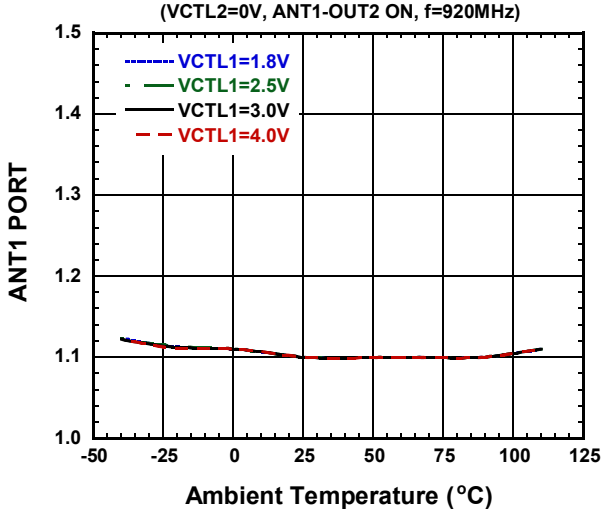
LOSS, ISL1 vs Temperature
(VCTL2=0V, ANT1-OUT2 ON, f=920MHz)



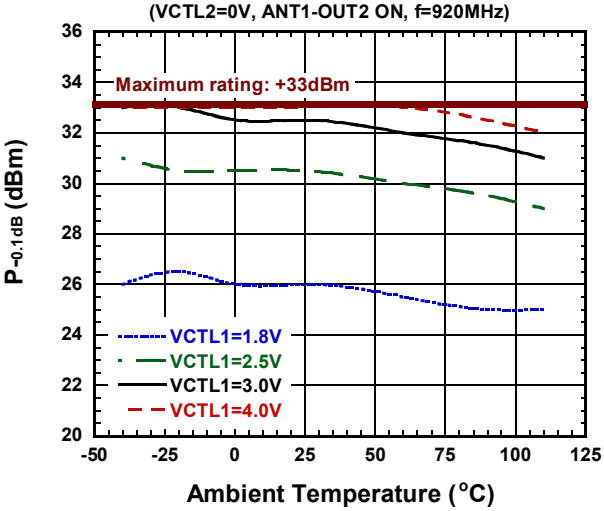
ISL2 vs Temperature
(VCTL2=0V, f=920MHz)



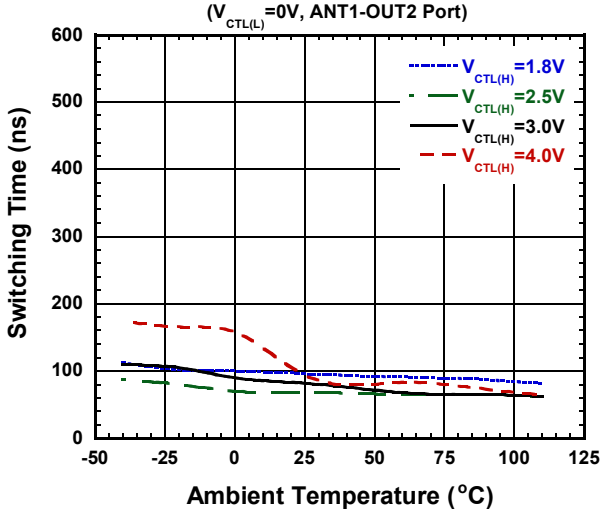
VSWR vs Temperature
(VCTL2=0V, ANT1-OUT2 ON, f=920MHz)



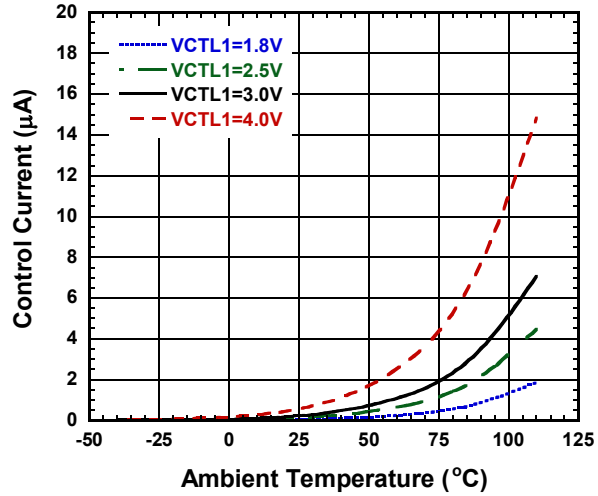
$P_{-0.1dB}$ vs Temperature
(VCTL2=0V, ANT1-OUT2 ON, f=920MHz)



Switching Time(rise) vs Temperature
($V_{CTL(L)}$=0V, ANT1-OUT2 Port)

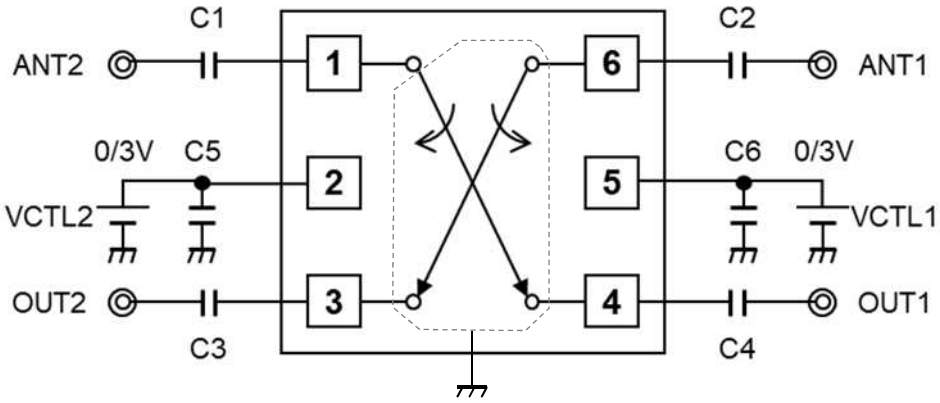


Control Current vs Temperature
(VCTL2=0V)



■ APPLICATION CIRCUIT

(Top View)

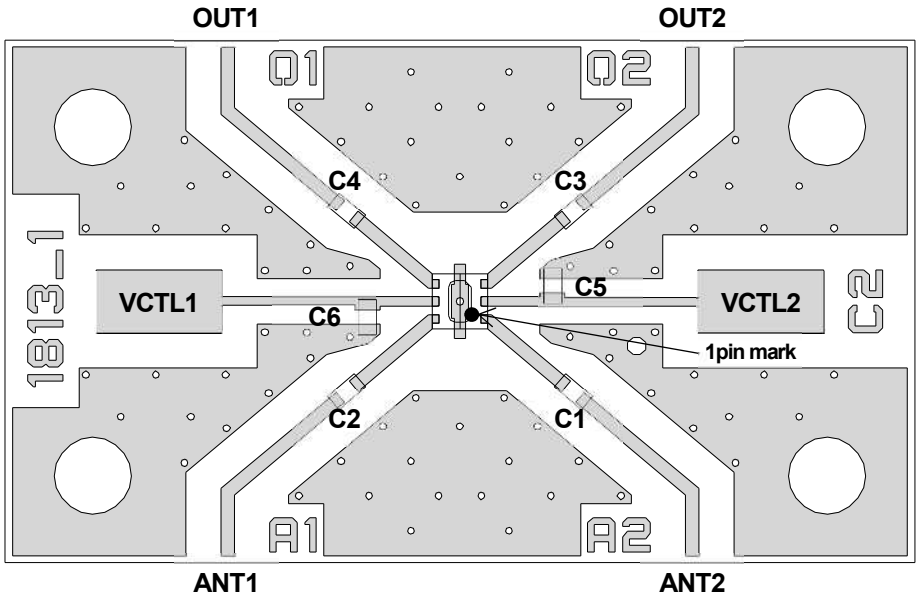


■ PARTS LIST

Part ID	Value	Notes
C1 to C4	1000pF	MURATA (GRM15)
C5 to C6	10pF	MURATA (GRM15)

■ EVALUATION BOARD

(TOP VIEW)



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

Frequency (MHz)	Loss (dB)
420	0.21
920	0.29
2000	0.48
2400	0.53
2700	0.56

PCB: FR-4
t=0.2mm
MICROSTRIP LINE WIDTH: 0.4mm (Zo=50Ω)
PCB SIZE: 26.0 x 15.0mm

■ PRECAUTIONS

[1] The DC blocking capacitors (C1, C2, C3, C4) 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 (C5, C6) should be placed as close as possible to VCTL terminals.

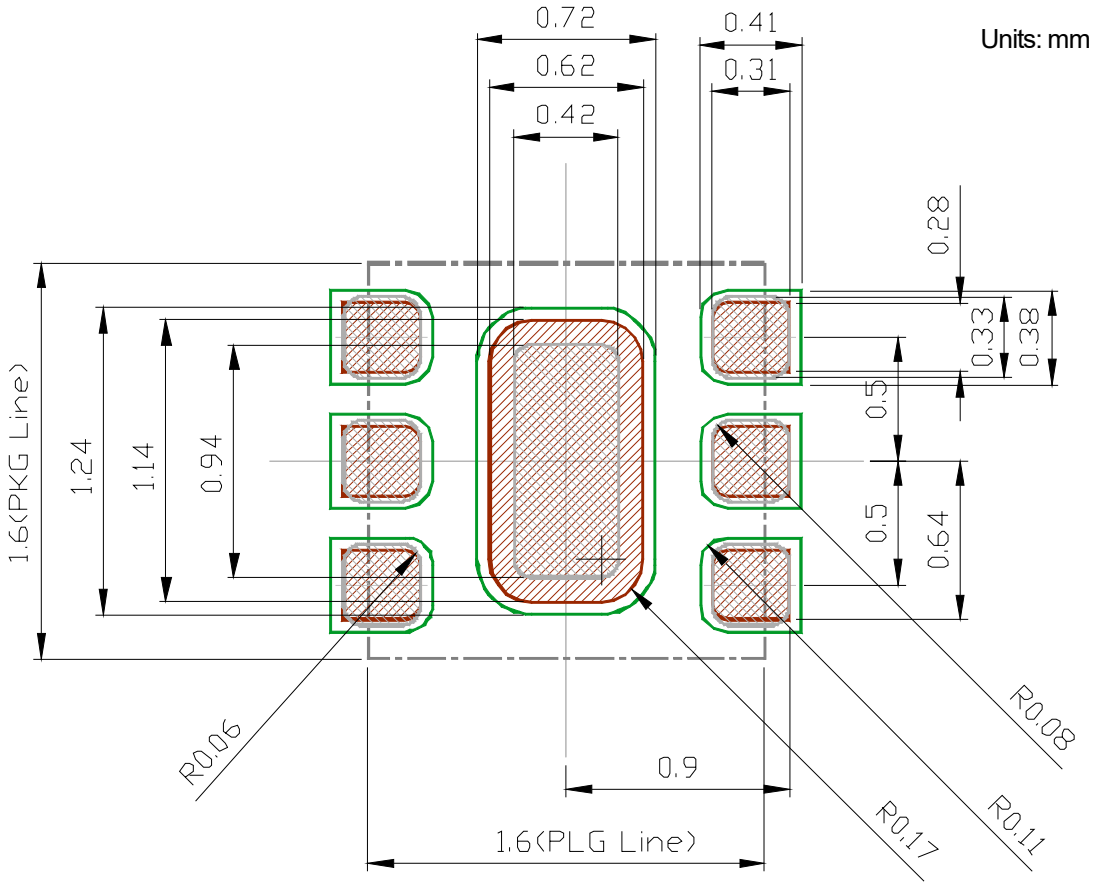
[3] For good RF performance, exposed pad should be connected to PCB ground plane of substrate, and through –holes should be placed near the IC.

■ RECOMMENDED FOOTPRINT PATTERN (ESON6-G1)

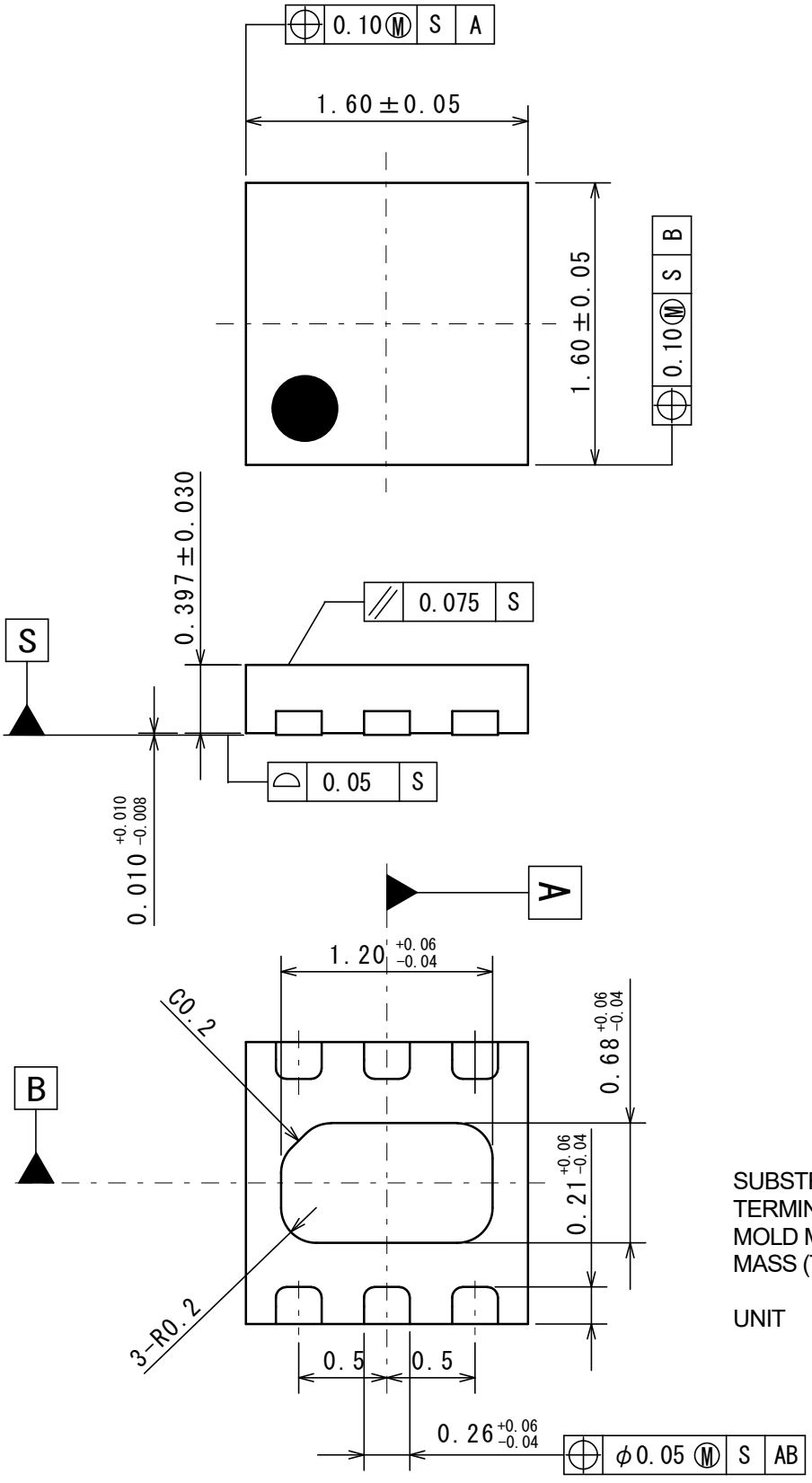
PKG: 1.6 mm x 1.6 mm
Pin pitch: 0.5 mm

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

Units: mm



■ PACKAGE OUTLINE

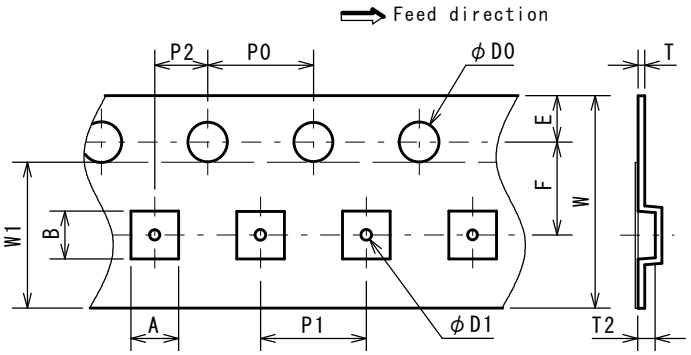


SUBSTRATE MATERIAL	: Copper
TERMINAL FINISH	: Solder plating
MOLD MATERIAL	: Epoxy resin
MASS (TYP.)	: 3.5 (mg)
UNIT	: mm

■ PACKING SPECIFICATION

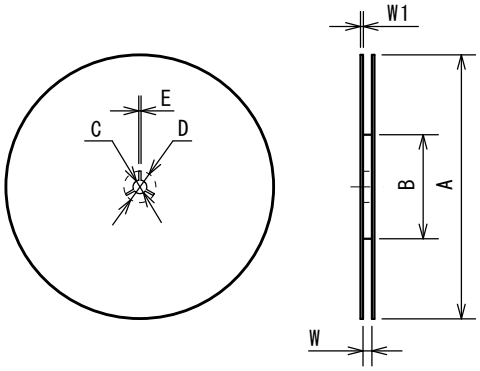
UNIT: mm

TAPING DIMENSION



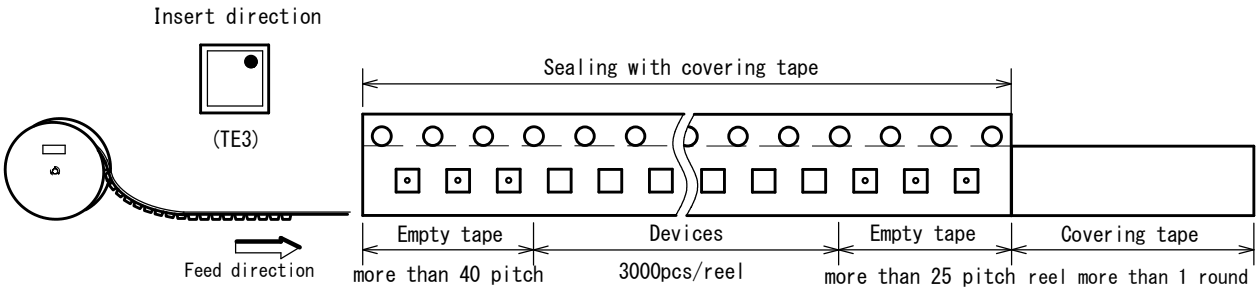
SYMBOL	DIMENSION	REMARKS
A	1.85±0.05	BOTTOM DIMENSION
B	1.85±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSION

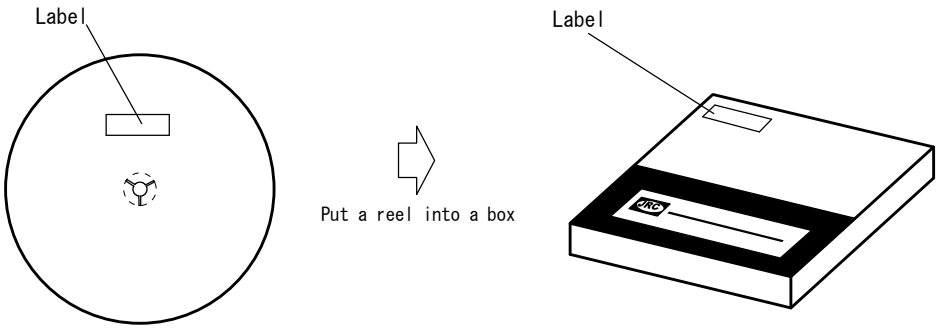


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



PACKING STATE



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    - Vehicle Control Equipment (automotive, airplane, railroad, ship, etc.)
    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

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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.
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