HIGH POWER DPDT SWITCH GaAs MMIC

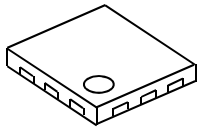
■ GENERAL DESCRIPTION

The NJG1812ME4 is a GaAs DPDT switch MMIC suitable for antenna swapping of LTE/UMTS/CDMA/GSM applications.

The NJG1812ME4 features very low insertion loss, low distortion and excellent linearity performance down to 1.8V 1bit control voltage at high frequency up to 3GHz. In addition, this switch is able to handle high power signals.

The NJG1812ME4 has ESD protection devices to achieve excellent ESD performances. No DC Blocking capacitors are required for all RF ports unless DC is biased externally. And the small & thin EQFN12-E4 package is adopted.

■ PACKAGE OUTLINE



NJG1812ME4

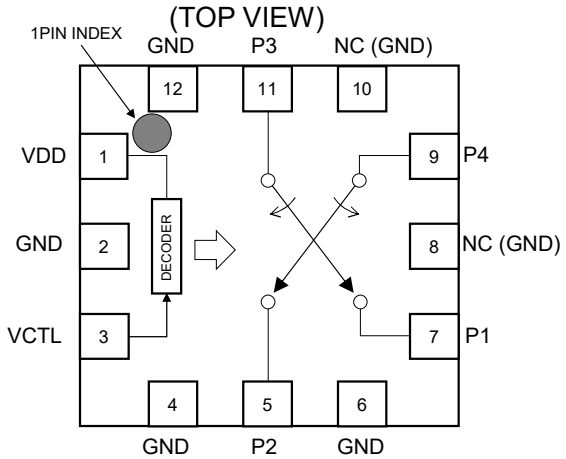
■ APPLICATIONS

Antenna swapping, General purpose switching applications
LTE, UMTS, CDMA, GSM systems

■ FEATURES

- Low voltage logic control — $V_{CTL(H)}$=1.35V to 5.0V
- Low voltage operation — V_{DD}=2.7V typ.
- Low insertion loss — 0.25dB typ. @f=900MHz, P_{IN}=+35dBm
  0.35dB typ. @f=1900MHz, P_{IN}=+33dBm
  0.45dB typ. @f=2700MHz, P_{IN}=+27dBm
- Low distortion — 2nd harmonics=-89dBm typ. @ f=786.5MHz, P_{IN}=+23dBm
  3rd harmonics=-89dBm typ. @ f=710MHz, P_{IN}=+23dBm
- $P_{-0.1dB}$ — +36 dBm min.
- Ultra-small and ultra-thin package — EQFN12-E4 (Package size: 2.0 x 2.0 x 0.397 mm typ.)
- RoHS compliant and Halogen Free, MSL1

■ PIN CONFIGURATION



Pin connection

1. VDD	7. P1
2. GND	8. NC(GND)
3. VCTL	9. P4
4. GND	10. NC(GND)
5. P2	11. P3
6. GND	12. GND

Exposed PAD: GND

■ TRUTH TABLE

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

VCTL	Path
L	P1-P4 P2-P3
H	P1-P3 P2-P4

■ ABSOLUTE MAXIMUM RATINGS

T_a=+25°C, Z_s=Z_l=50Ω

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNITS
RF Input Power	P_{IN}	V_{DD} =2.7V, V_{CTL}=0/1.8V	+38	dBm
Supply Voltage	V_{DD}	VDD terminal	5.0	V
Control Voltage	V_{CTL}	VCTL terminal	5.0	V
Power Dissipation	P_D	Four-layer FR4 PCB with through-hole (101.5 x 114.5mm), Tj=150°C	1200	mW
Operating Temp.	T_{opr}		-40 to +105	°C
Storage Temp.	T_{stg}		-55 to +150	°C

■ ELECTRICAL CHARACTERISTICS 1 (DC)

(General conditions: T_a=+25°C, Z_s=Z_l=50Ω, V_{DD}=2.7V, $V_{CTL(H)}$=1.8V, $V_{CTL(L)}$=0V, with application circuit)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{DD}	VDD Terminal	2.4	2.7	5.0	V
Operating Current	I_{DD}	No RF input	-	90	180	μA
Control Voltage (LOW)	$V_{CTL(L)}$	VCTL Terminal	0	-	0.45	V
Control Voltage (HIGH)	$V_{CTL(H)}$	VCTL Terminal	1.35	1.8	5.0	V
Control Current	I_{CTL}	$V_{CTL(H)}$=1.8V	-	4	10	μA

■ ELECTRICAL CHARACTERISTICS 2 (RF)

(General conditions: T_a=+25°C, Z_s=Z_l=50Ω, V_{DD}=2.7V, $V_{CTL(H)}$=1.8V, $V_{CTL(L)}$=0V, with application circuit)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Insertion Loss 1	LOSS1	f=900MHz, P_{IN}=+35dBm	-	0.25	0.45	dB
Insertion Loss 2	LOSS2	f=1900MHz, P_{IN}=+33dBm	-	0.35	0.55	dB
Insertion Loss 3	LOSS3	f=2700MHz, P_{IN}=+27dBm	-	0.45	0.65	dB
Isolation 1	ISL1	f=900MHz, P_{IN}=+35dBm	23	25	-	dB
Isolation 2	ISL2	f=1900MHz, P_{IN}=+33dBm	18	20	-	dB
Isolation 3	ISL3	f=2700MHz, P_{IN}=+27dBm	15	17	-	dB
Input Power at 0.1dB Compression Point	$P_{-0.1dB}$	f=900MHz, 1900MHz, 2700MHz	+36	-	-	dBm
VSWR	VSWR	P1 to P4 Terminal, f=2700MHz	-	1.1	1.5	-
Switching time	T_{SW}	50% V_{CTL} to 10/90% RF	-	1	5	μs

■ ELECTRICAL CHARACTERISTICS 2 (RF)

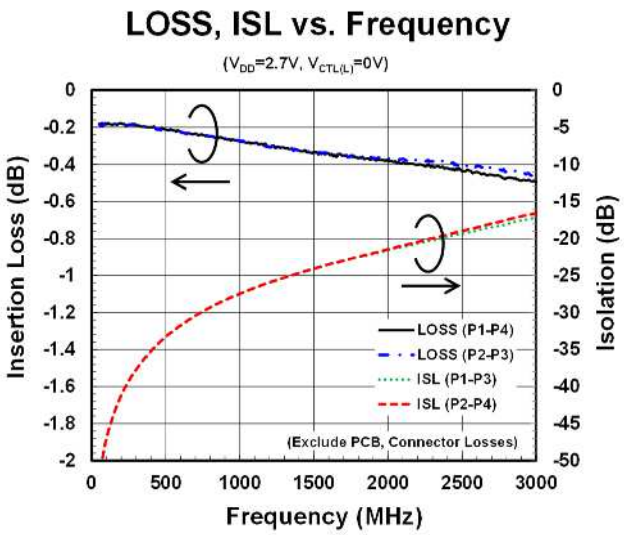
(General conditions: T_a=+25°C, Z_s=Z_l=50Ω, V_{DD}=2.7V, $V_{CTL(H)}$=1.8V, $V_{CTL(L)}$=0V, with application circuit)

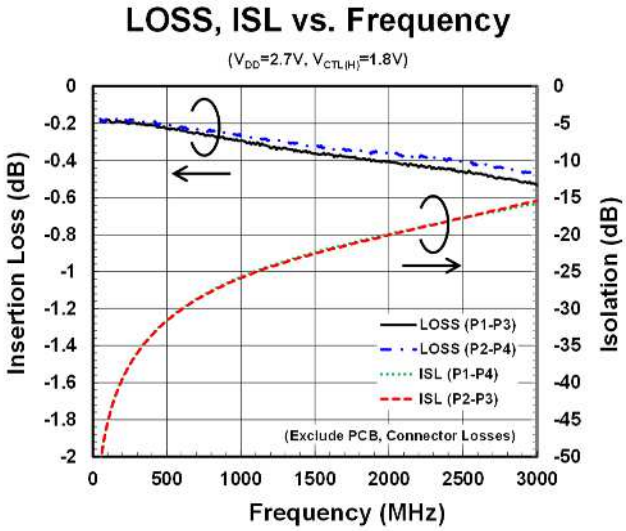
PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
2nd Harmonics 1	2fo(1)	f=900MHz, P_{IN}=+33dBm	-	-	-40	dBm
2nd Harmonics 2	2fo(2)	f=1900MHz, P_{IN}=+30dBm	-	-	-40	dBm
2nd Harmonics 3	2fo(3)	f=2700MHz, P_{IN}=+23dBm	-	-	-60	dBm
2nd Harmonics 4	2fo(4)	f=786.5MHz, P_{IN}=+23dBm		-89	-81	dBm
3rd Harmonics 1	3fo(1)	f=900MHz, P_{IN}=+33dBm	-	-	-40	dBm
3rd Harmonics 2	3fo(2)	f=1900MHz, P_{IN}=+30dBm	-	-	-40	dBm
3rd Harmonics 3	3fo(3)	f=2700MHz, P_{IN}=+23dBm	-	-	-60	dBm
3rd Harmonics 4	3fo(4)	f=710MHz, P_{IN}=+23dBm	-	-89	-81	dBm
2nd order intermodulation	IMD2	f_{TX}=835MHz, P_{TX}=+20dBm, f_{jam}=1715MHz,P_{jam}=-15dBm, f_{meas}=880MHz	-	-110	-105	dBm
3rd order intermodulation	IMD3	f_{TX}=835MHz, P_{TX}=+20dBm, f_{jam}=790MHz, P_{jam}=-15dBm, f_{meas}=880MHz	-	-110	-105	dBm
Triple Beat Ratio	TBR	f_{TX}1=835.5MHz, P_{TX}1=+21.5dBm, f_{TX}2=836.5MHz, P_{TX}2=+21.5dBm, f_{jam}=881.5MHz, P_{jam}=-30dBm, f_{meas}=881.5±1MHz	81	-	-	dBc

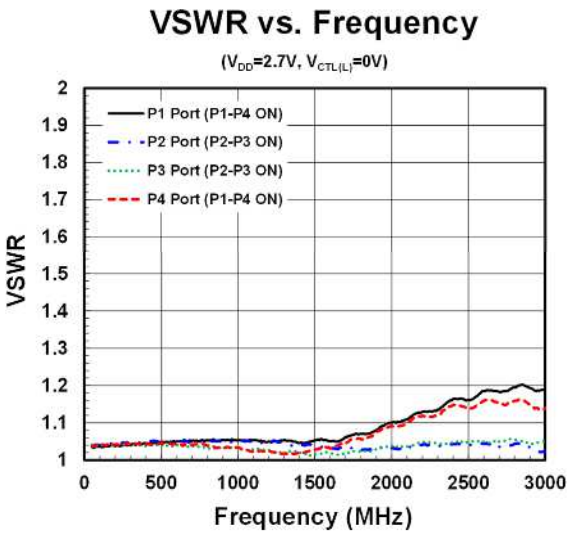
■ TERMINAL INFORMATION

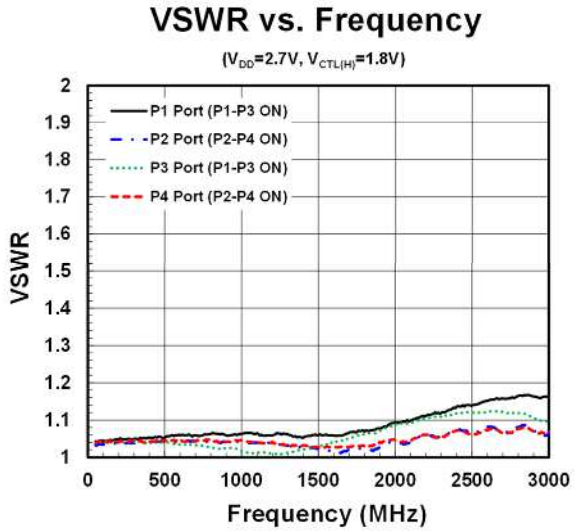
No.	SYMBOL	DESCRIPTION
1	VDD	Positive voltage supply terminal. The positive voltage (+2.4 to +5V) has to be supplied. Please connect a bypass capacitor with GND terminal for excellent RF performance.
2	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
3	VCTL	Control signal input terminal. This terminal is set to High-Level (+1.35 to +5.0V) or Low-Level (0 to +0.45V).
4	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
5	P2	RF transmitting/receiving port. No DC blocking capacitor is required for this port unless DC is biased externally. Please connect an inductor with GND terminal for ESD protection.
6	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
7	P1	RF transmitting/receiving port. No DC blocking capacitor is required for this port unless DC is biased externally. Please connect an inductor with GND terminal for ESD protection.
8	NC(GND)	No connected terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
9	P4	RF transmitting/receiving port. No DC blocking capacitor is required for this port unless DC is biased externally.
10	NC(GND)	No connected terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
11	P3	RF transmitting/receiving port. No DC blocking capacitor is required for this port unless DC is biased externally.
12	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
Exposed Pad	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.

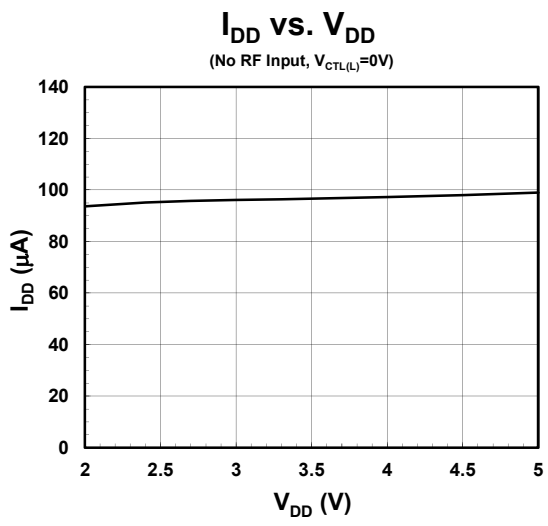
■ **ELECTRICAL CHARACTERISTICS** (With application circuit, loss of external circuit are excluded.)

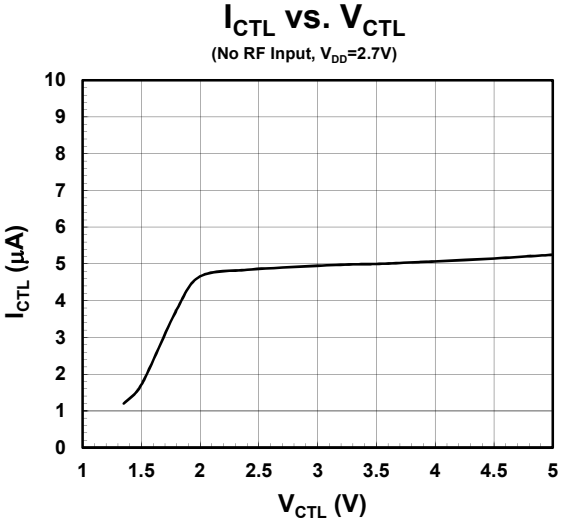












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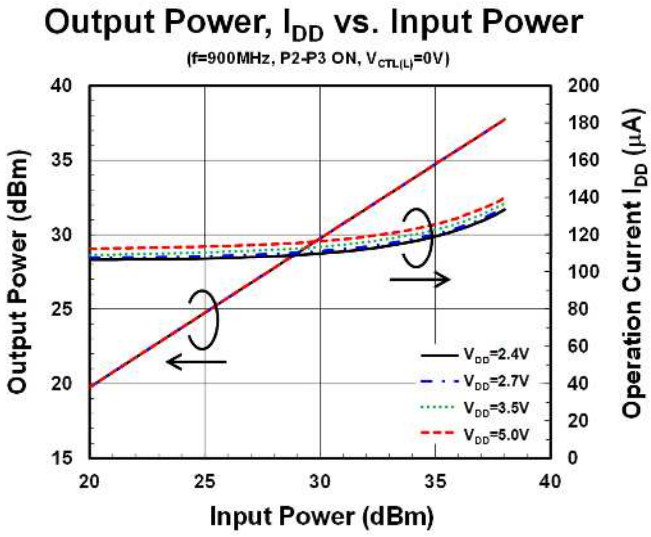

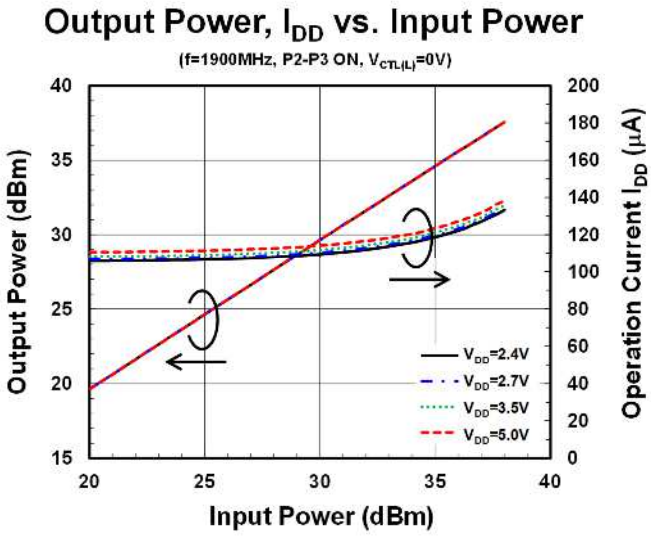

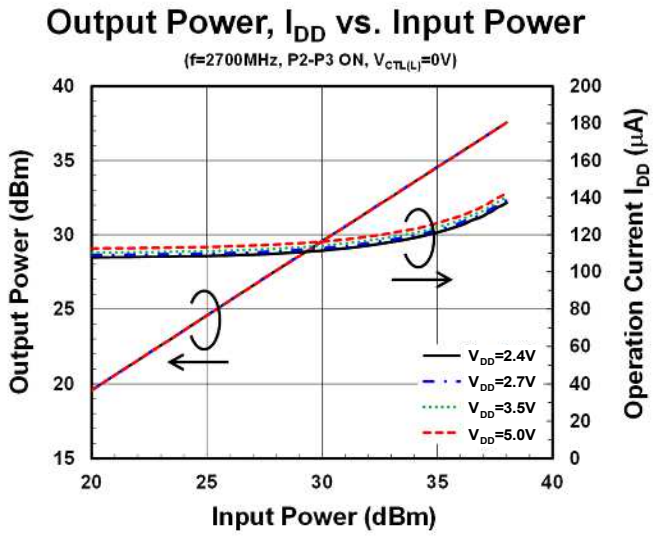

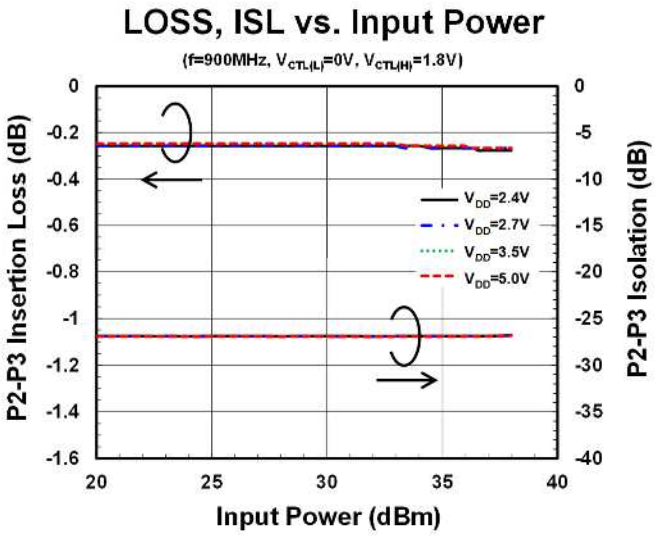

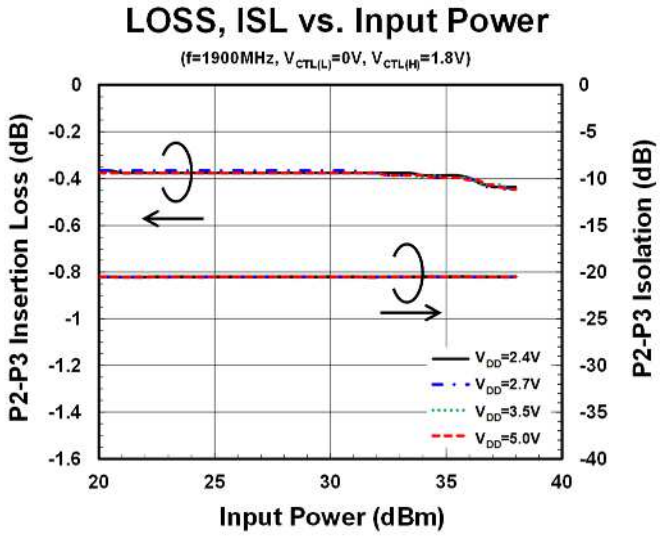

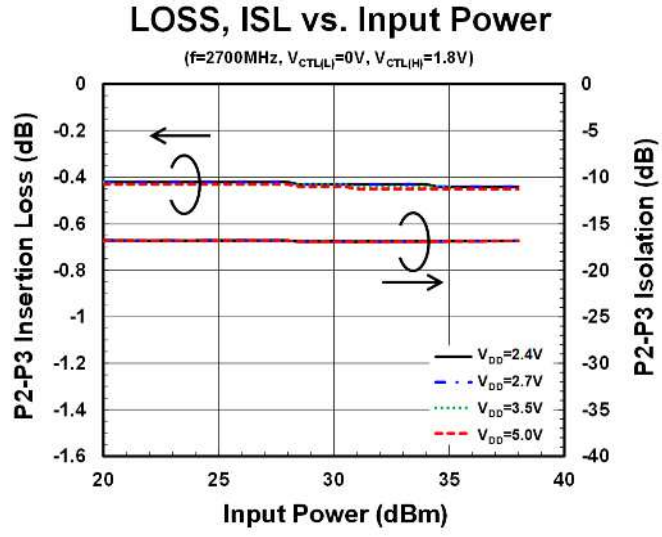

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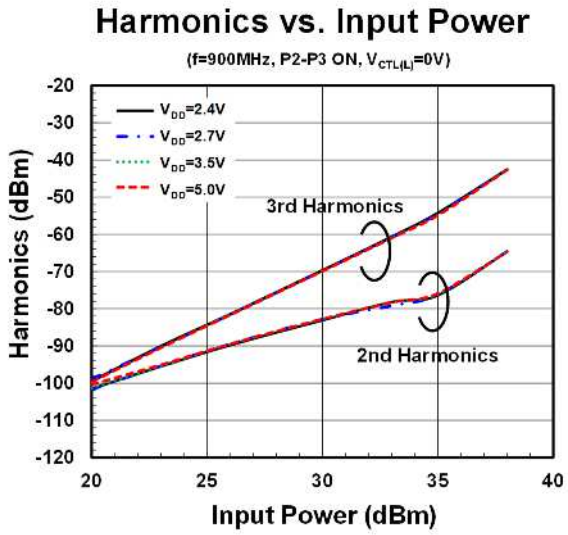

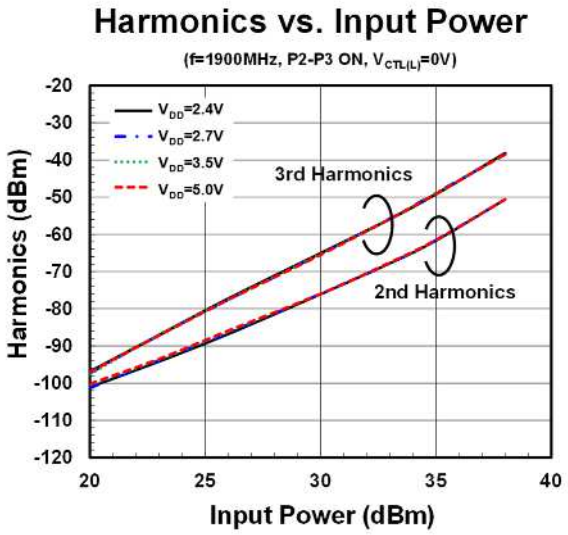

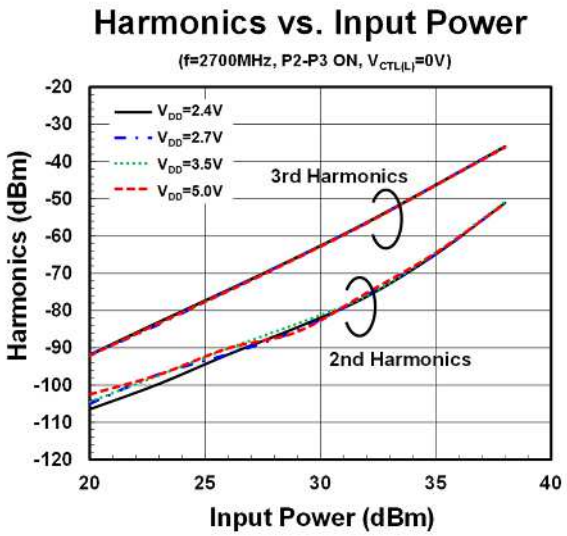

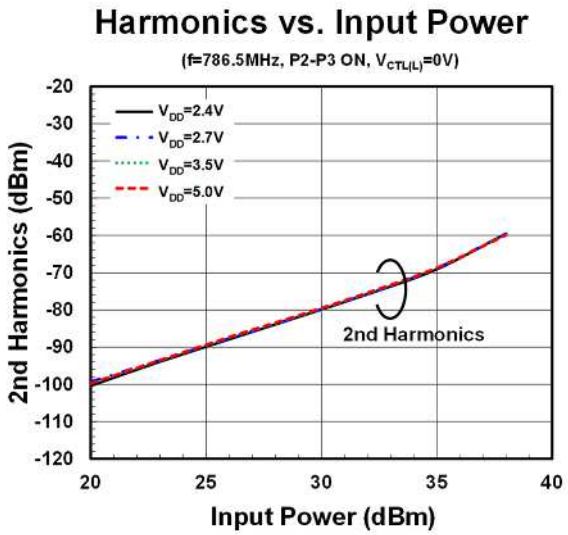

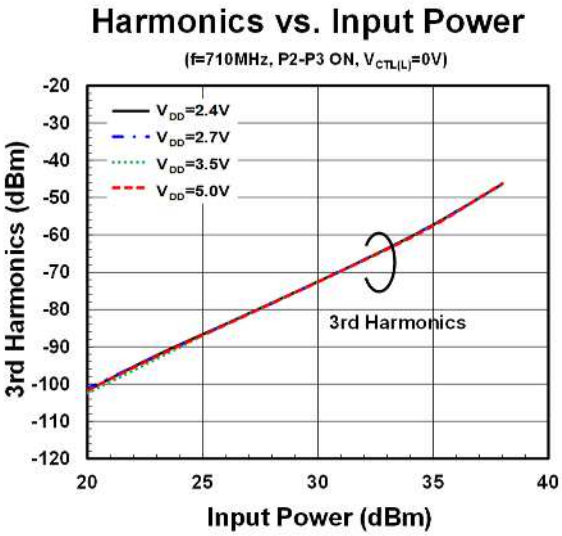

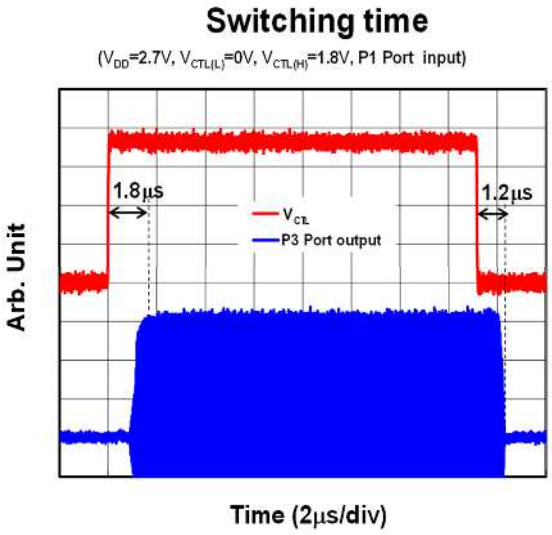

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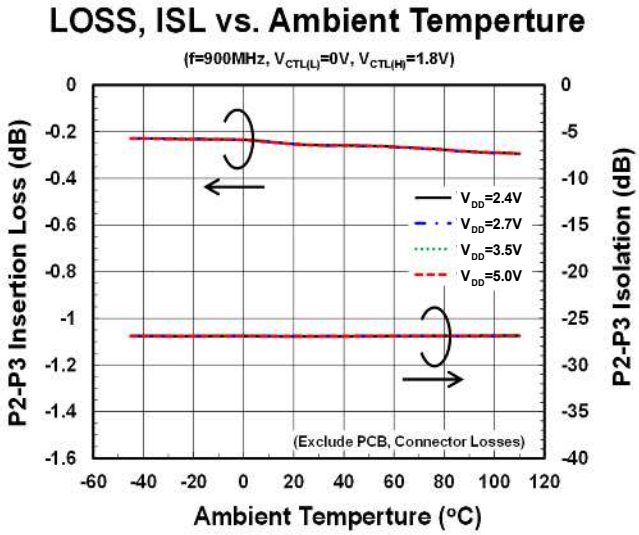
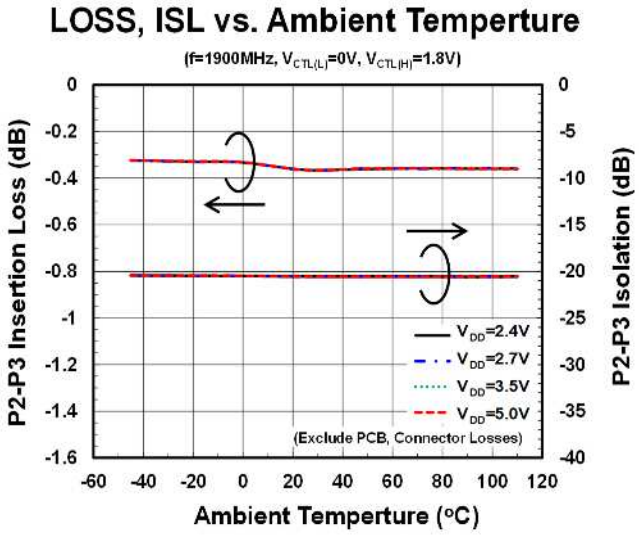
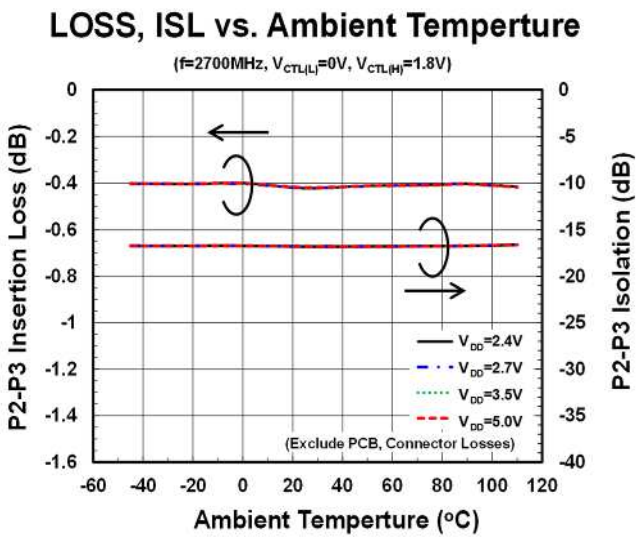
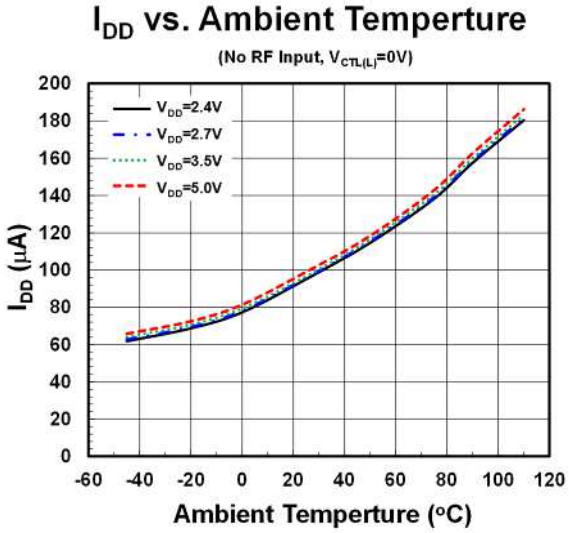
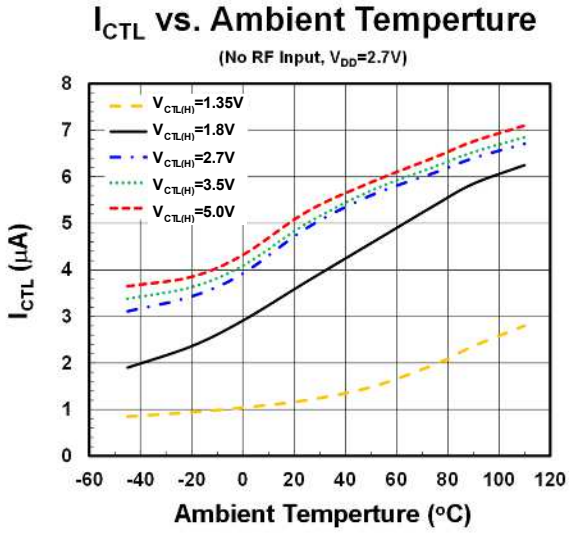
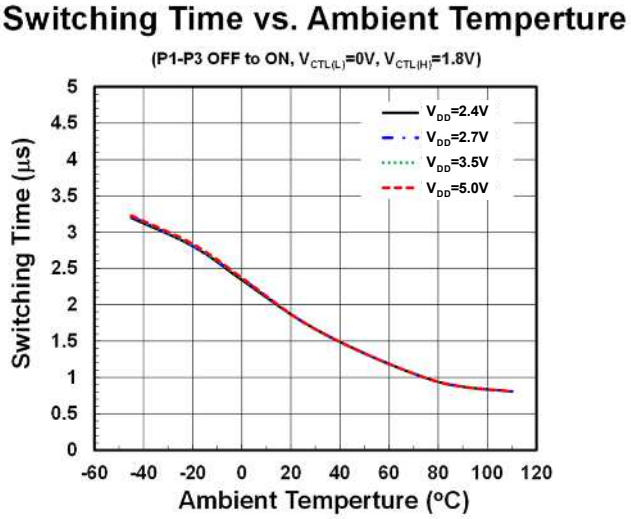






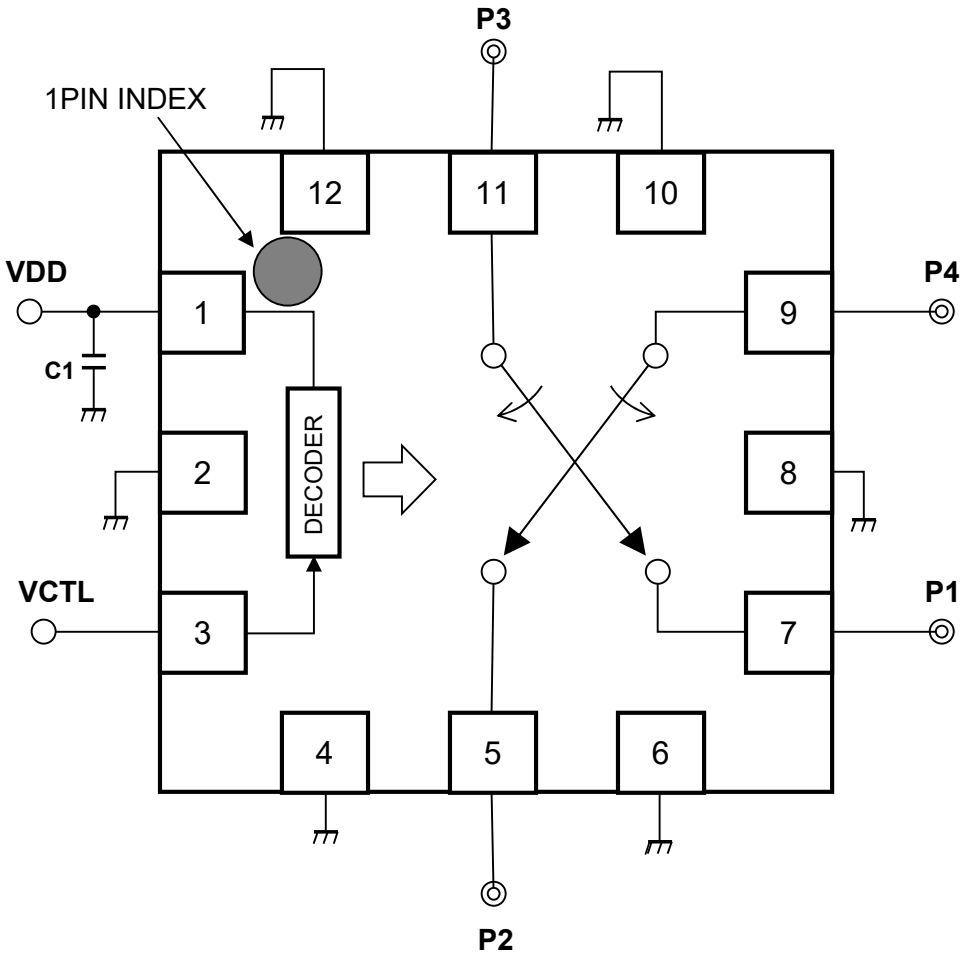






■ APPLICATION CIRCUIT

(TOP VIEW)

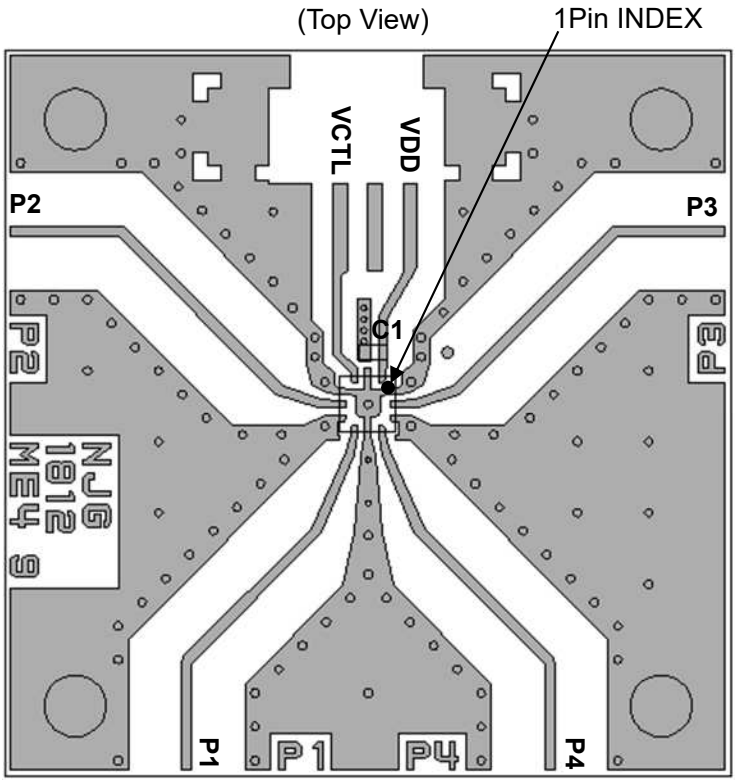


Note: No DC blocking capacitors are required on all RF ports, unless DC is biased externally.

■ PARTS LIST

No.	Parameters	Note
C1	1000pF	MURATA (GRM15)

■ EVALUATION BOARD

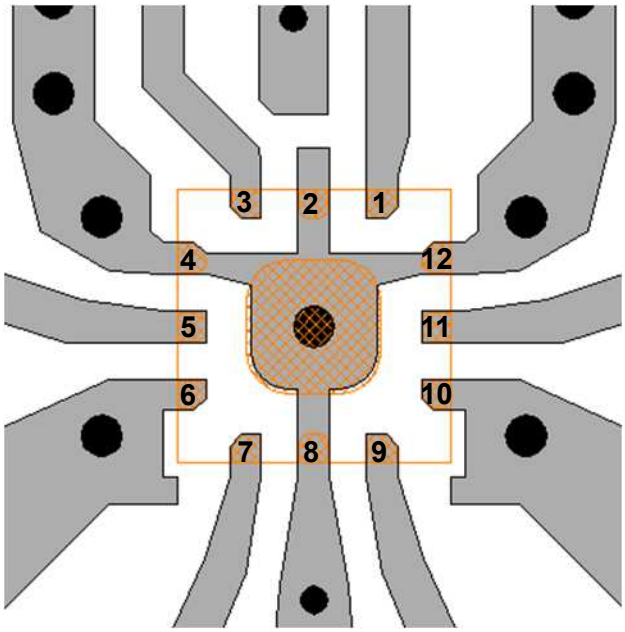


PCB (FR-4):
t=0.2mm
MICROSTRIP LINE WIDTH=0.37mm (Z_0=50Ω)
PCB SIZE=26mm x 26mm

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

Frequency [GHz]	Loss [dB]
0.9	0.23
1.9	0.43
2.7	0.55

■ PCB LAYOUT GUIDELINE (EQFN12-E4)



PCB
PKG Terminal
PKG Outline
GND Via Hole
Diameter ϕ =0.3mm
GND Via Hole
Diameter ϕ =0.2mm

PRECAUTIONS

[1] For avoiding the degradation of RF performance, the bypass capacitor (C1) should be placed as close as possible to VDD terminal

[2] For good RF performance, all GND terminals are must be connected to PCB ground plane of substrate, and through - holes for GND should be placed near the IC.

[3] Please connect Exposed PAD to PCB ground plane of substrate, and through - holes for GND should be placed under the IC.

■ RECOMMENDED FOOTPRINT PATTERN (EQFN12-E4 PACKAGE Reference)

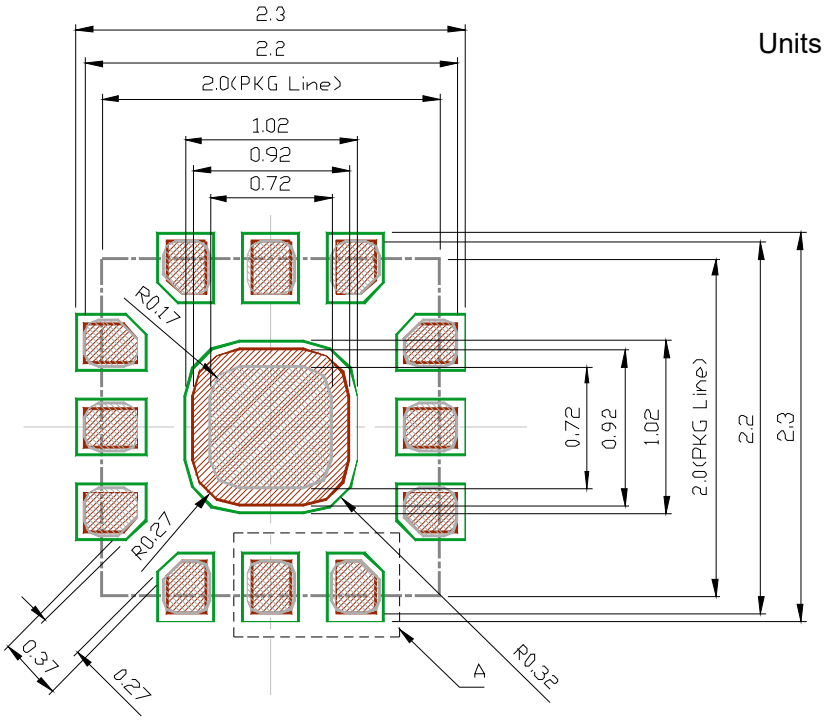
PKG: 2.0mm x 2.0mm
Pin pitch: 0.5mm

: Land

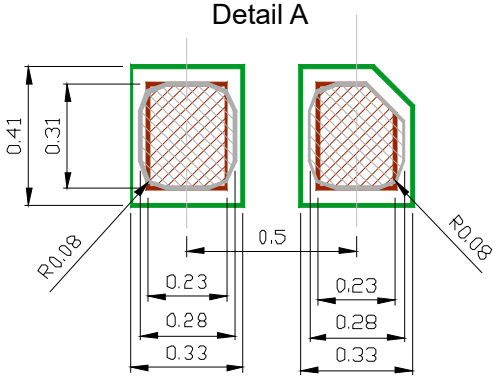
: Mask (Open area) *Metal mask thickness: 100μm

: Resist (Open area)

Units : mm

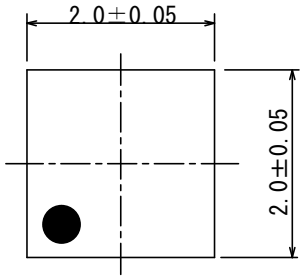


Detail A



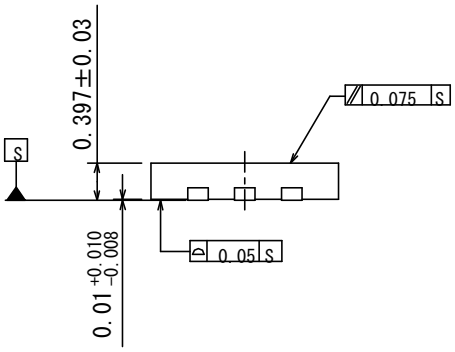
■ PACKAGE OUTLINE (EQFN12-E4)

TOP VIEW

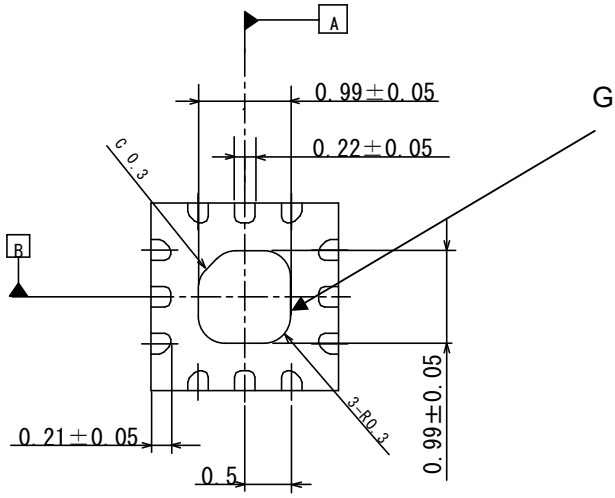


Units : mm
Board : Cu
Terminal treat : SnBi
Molding material : Epoxy resin
Weight : 4.7mg

SIDE VIEW



BOTTOM VIEW



Ground connection is required.

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.

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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.

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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/