HIGH POWER SP4T SWITCH GaAs MMIC

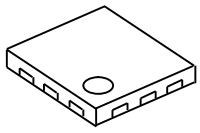
■ GENERAL DESCRIPTION

The NJG1684ME2 is a GaAs SP4T switch MMIC suitable for LTE/UMTS/CDMA/GSM applications.

The NJG1684ME2 features very low insertion loss, high isolation and excellent linearity performance down to 1.8V control voltage at high frequency up to 2.7GHz. In addition, this switch is able to handle high power signals.

The NJG1684ME2 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 ultra small & ultra thin EQFN12-E2 package is adopted.

■ PACKAGE OUTLINE



NJG1684ME2

■ APPLICATIONS

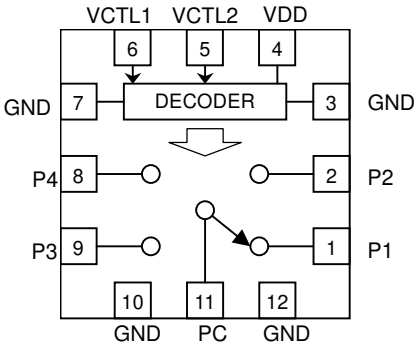
LTE, UMTS, CDMA, GSM applications
Post PA Switching, Antenna Switching and Bands Switching applications
General Purpose Switching applications

■ FEATURES

● Low voltage logic control	$V_{CTL(H)}$=1.8V typ.
● Low voltage operation	V_{DD}=2.7V typ.
● Low distortion	IIP3=+70dBm typ. @f=829+849MHz, P_{IN}=24dBm
	IIP3=+69dBm typ. @f=1870+1910MHz, P_{IN}=24dBm
	2nd harmonics=-80dBc typ. @f=0.9GHz, P_{IN}=35dBm
	3rd harmonics=-77dBc typ. @f=0.9GHz, P_{IN}=35dBm
● Low insertion loss	0.25dB typ. @f=0.9GHz, P_{IN}=35dBm, V_{DD}=2.7V
	0.30dB typ. @f=1.9GHz, P_{IN}=33dBm, V_{DD}=2.7V
	0.35dB typ. @f=2.7GHz, P_{IN}=27dBm, V_{DD}=2.7V
● $P_{-0.1dB}$	36dBm min.
● Ultra small & ultra thin package	EQFN12-E2 (Package size: 1.8 x 1.8 x 0.397mm)
● RoHS compliant and Halogen Free, MSL1	

■ PIN CONFIGURATION

(TOP VIEW)



Pin connection

1. P1	7. GND
2. P2	8. P4
3. GND	9. P3
4. VDD	10. GND
5. VCTL2	11. PC
6. VCTL1	12. GND

Exposed PAD: GND

■ TRUTH TABLE

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

VCTL1	VCTL2	Path
L	L	PC-P1
H	L	PC-P2
L	H	PC-P3
H	H	PC-P4

NOTE: Please note that any information on this catalog will be subject to change.

■ ABSOLUTE MAXIMUM RATINGS

T_a=+25°C, Z_s=Z_l=50ohm

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNITS
RF Input Power	P_{IN}	V_{DD} =2.7V, V_{CTL}=0/1.8V	37	dBm
Supply Voltage	V_{DD}	VDD terminal	5.0	V
Control Voltage	V_{CTL}	VCTL1, VCTL2 terminal	5.0	V
Power Dissipation	P_D	Four-layer FR4 PCB with through-hole (101.5x114.5mm), Tj=150°C	1200	mW
Operating Temp.	T_{opr}		-40~+85	°C
Storage Temp.	T_{stg}		-55~+150	°C

■ ELECTRICAL CHARACTERISTICS 1 (DC)

(General conditions: T_a=+25°C, Z_s=Z_l=50ohm, 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	2.375	2.7	5.0	V
Operating Current	I_{DD}	No RF input	-	180	400	μA
Control Voltage (LOW)	$V_{CTL(L)}$	VCTL1, VCTL2 Terminal	0	-	0.45	V
Control Voltage (HIGH)	$V_{CTL(H)}$	VCTL1, VCTL2 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=50ohm, 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=0.9GHz, P_{IN}=35dBm	-	0.25	0.40	dB
Insertion Loss 2	LOSS2	f=1.9GHz, P_{IN}=33dBm	-	0.30	0.45	dB
Insertion Loss 3	LOSS3	f=2.7GHz, P_{IN}=27dBm	-	0.35	0.50	dB
Isolation 1	ISL1	f=0.9GHz, P_{IN}=35dBm	30	37	-	dB
Isolation 2	ISL2	f=1.9GHz, P_{IN}=33dBm	25	29	-	dB
Isolation 3	ISL3	f=2.7GHz, P_{IN}=27dBm	22	25	-	dB
Input Power at 0.1dB Compression Point	$P_{-0.1dB}$	f=0.9GHz, 1.9GHz, 2.7GHz	36	-	-	dBm
2nd Harmonics 1	2fo(1)	f=0.9GHz, P_{IN}=35dBm	-	-80	-70	dBc
2nd Harmonics 2	2fo(2)	f=1.9GHz, P_{IN}=33dBm	-	-80	-70	dBc
2nd Harmonics 3	2fo(3)	f=2.7GHz, P_{IN}=27dBm	-	-90	-70	dBc
3rd Harmonics 1	3fo(1)	f=0.9GHz, P_{IN}=35dBm	-	-77	-70	dBc
3rd Harmonics 2	3fo(2)	f=1.9GHz, P_{IN}=33dBm	-	-77	-70	dBc
3rd Harmonics 3	3fo(3)	f=2.7GHz, P_{IN}=27dBm	-	-90	-70	dBc
Input 3rd order intercept point1	IIP3(1)	f=829+849MHz, P_{IN}=24dBm each *1	+65	+70	-	dBm
Input 3rd order intercept point2	IIP3(2)	f=1870+1910MHz, P_{IN}=24dBm each *1	+63	+69	-	dBm
VSWR	VSWR	On-state ports, f=2.7GHz	-	1.2	1.4	
Switching time	T_{SW}	50% V_{CTL} to 10/90% RF	-	1.0	5.0	μs

*1: IIP3 are defined by the following equations.
IIP3=(3 x Pout-IM3)/2+LOSS

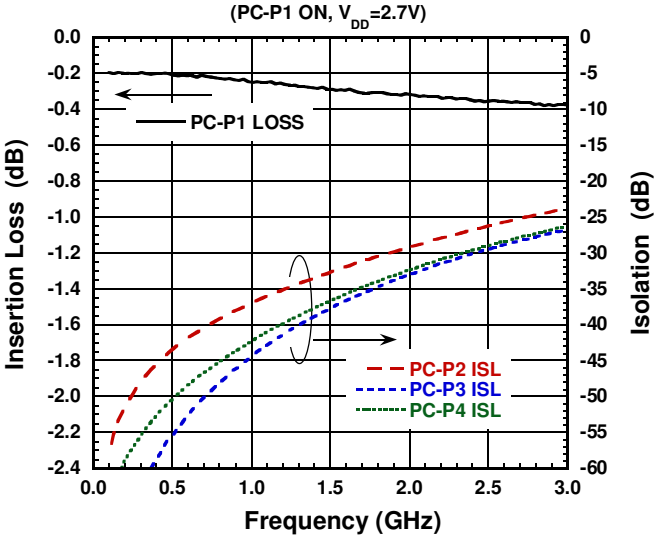
■ TERMINAL INFORMATION

No.	SYMBOL	DESCRIPTION
1	P1	RF transmitting/receiving port.
2	P2	RF transmitting/receiving port.
3	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
4	VDD	Positive voltage supply terminal. The positive voltage (+2.375~+5V) has to be supplied. Please connect a bypass capacitor with GND terminal for excellent RF performance.
5	VCTL2	Control signal input terminal. This terminal is set to High-Level (+1.35~+5.0V) or Low-Level (0~+0.45V).
6	VCTL1	Control signal input terminal. This terminal is set to High-Level (+1.35~+5.0V) or Low-Level (0~+0.45V).
7	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
8	P4	RF transmitting/receiving port.
9	P3	RF transmitting/receiving port.
10	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
11	PC	RF transmitting/receiving port. Please connect an inductor with GND terminal for ESD protection.
12	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
Exposed Pad	GND	Ground terminal.

■ **ELECTRICAL CHARACTERISTICS** (With Application circuit, Loss of external circuit are excluded)

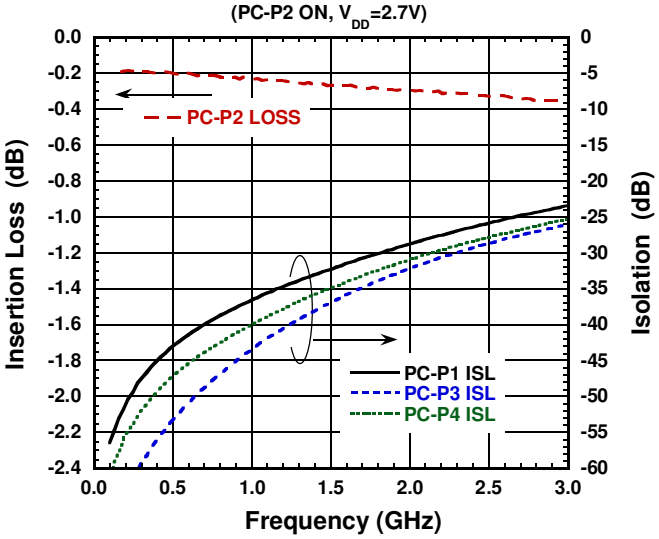
Loss, ISL vs Frequency

(PC-P1 ON, V_{DD}=2.7V)



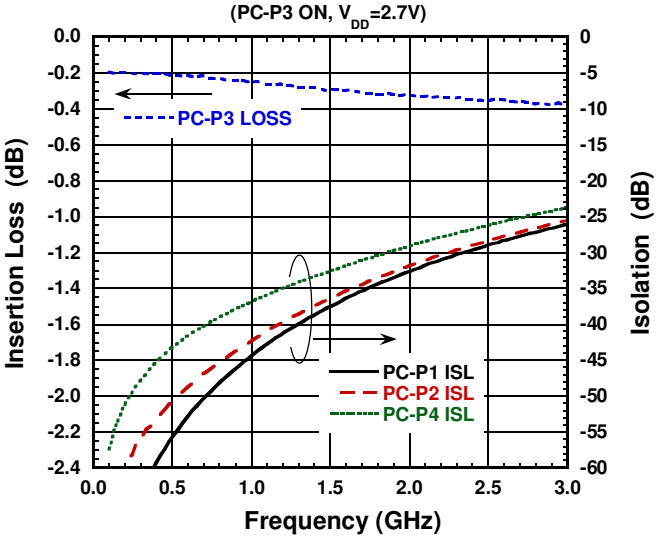
Loss, ISL vs Frequency

(PC-P2 ON, V_{DD}=2.7V)



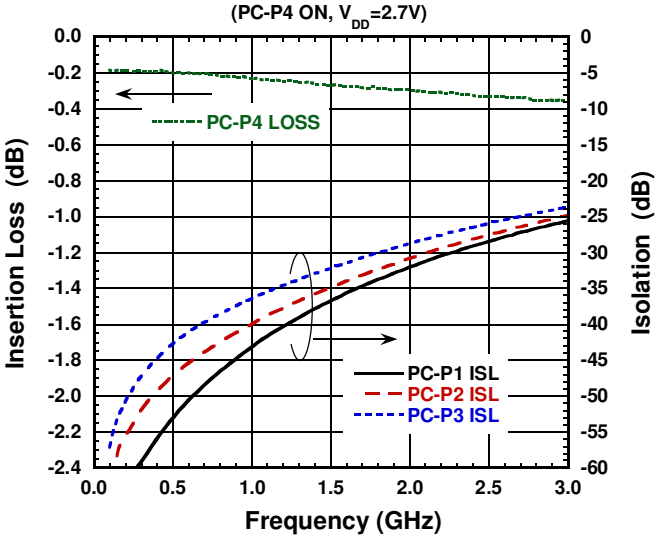
Loss, ISL vs Frequency

(PC-P3 ON, V_{DD}=2.7V)



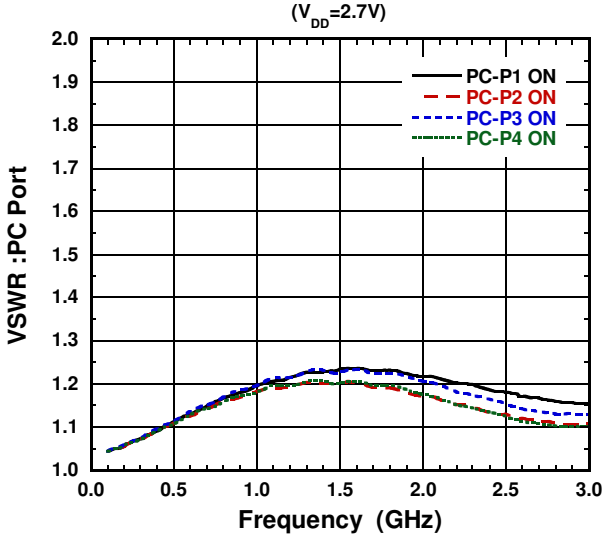
Loss, ISL vs Frequency

(PC-P4 ON, V_{DD}=2.7V)



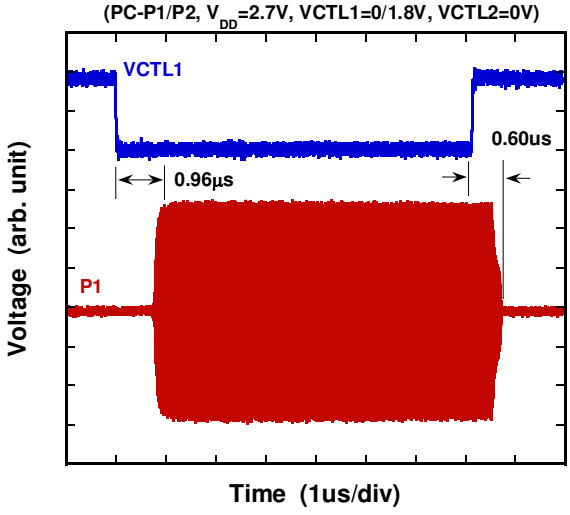
VSWR vs Frequency

(V_{DD}=2.7V)



Switching Time

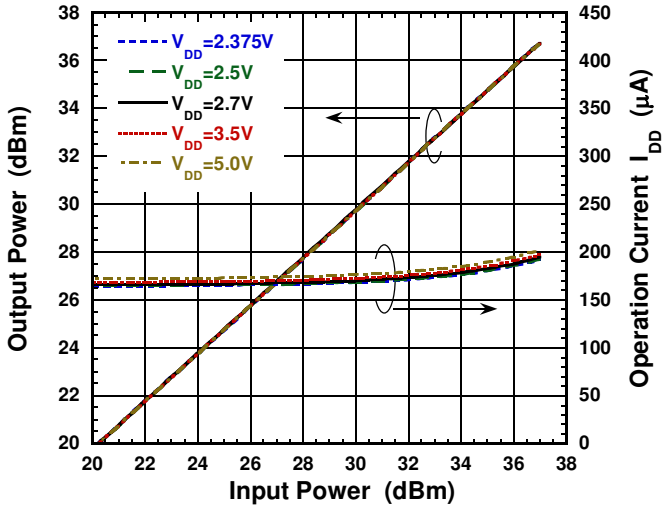
(PC-P1/P2, V_{DD}=2.7V, VCTL1=0/1.8V, VCTL2=0V)



■ **ELECTRICAL CHARACTERISTICS** (With Application circuit, Loss of external circuit are excluded)

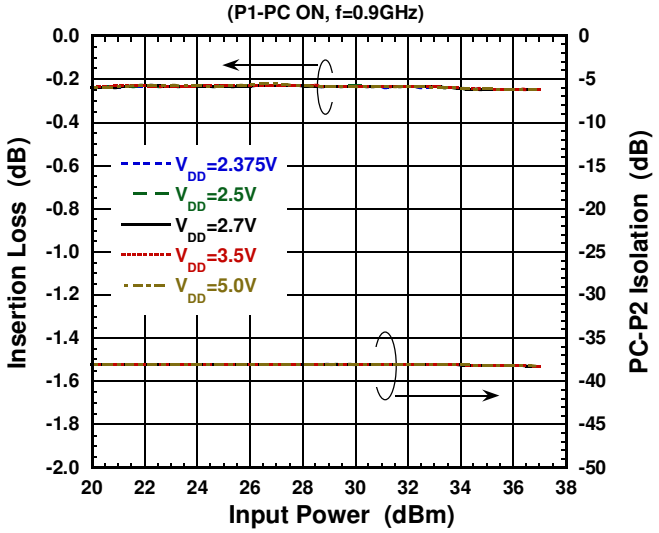
Output Power, I_{DD} vs Input Power

(P1-PC ON, f=0.9GHz)



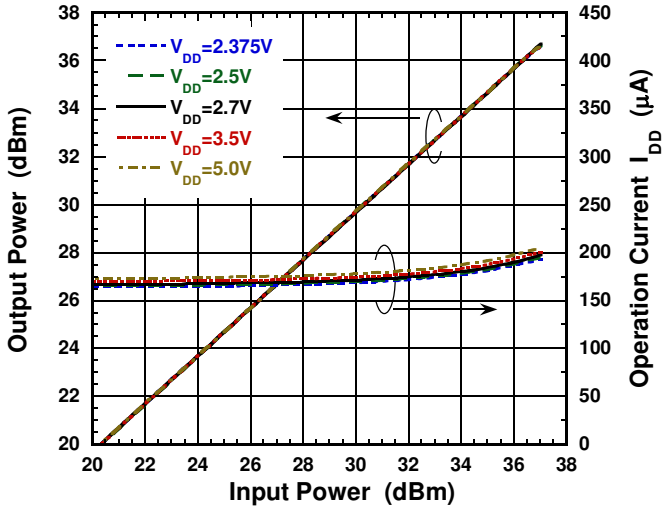
Loss, ISL vs Input Power

(P1-PC ON, f=0.9GHz)



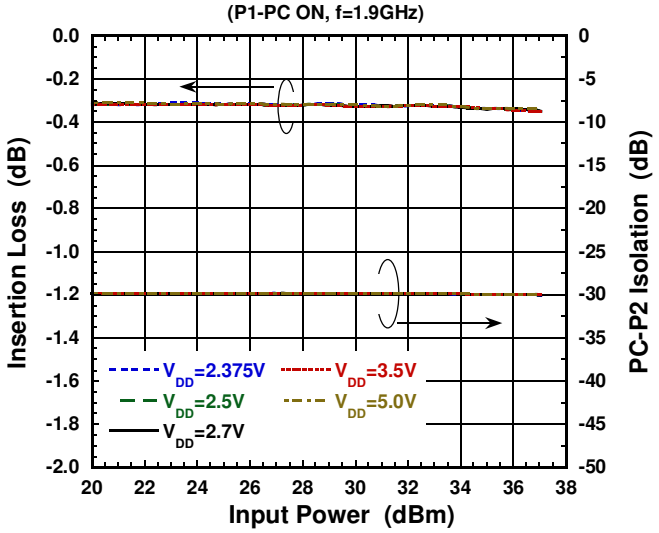
Output Power, I_{DD} vs Input Power

(P1-PC ON, f=1.9GHz)



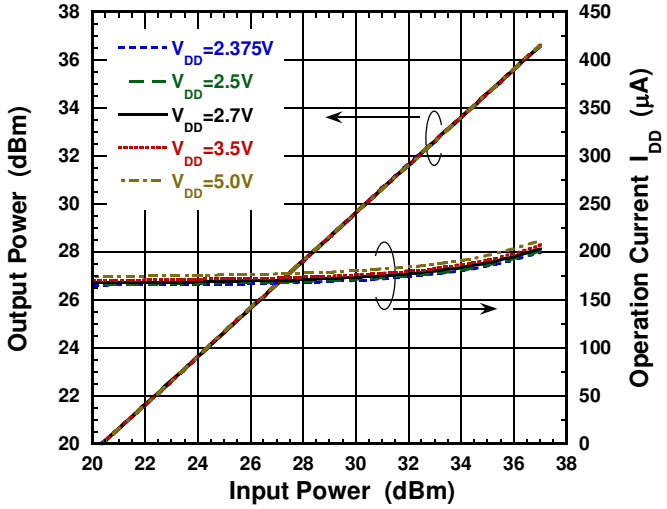
Loss, ISL vs Input Power

(P1-PC ON, f=1.9GHz)



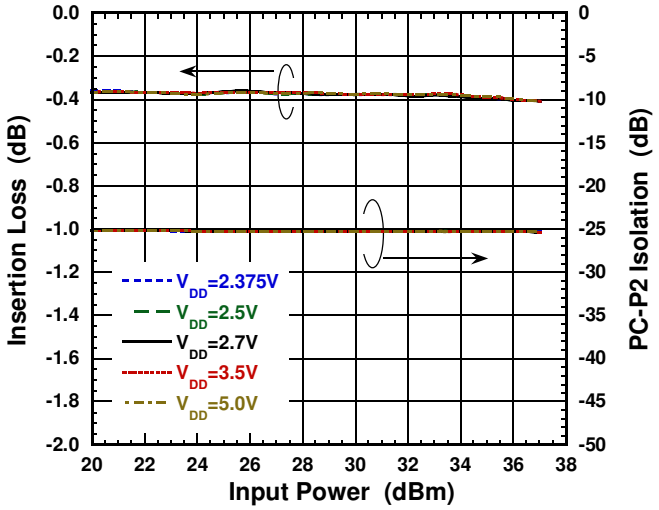
Output Power, I_{DD} vs Input Power

(P1-PC ON, f=2.7GHz)



Loss, ISL vs Input Power

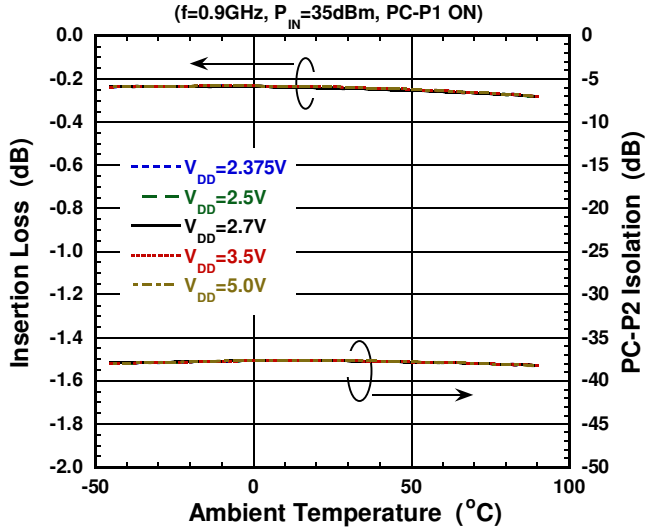
(P1-PC ON, f=2.7GHz)



■ **ELECTRICAL CHARACTERISTICS** (With Application circuit, Loss of external circuit are excluded)

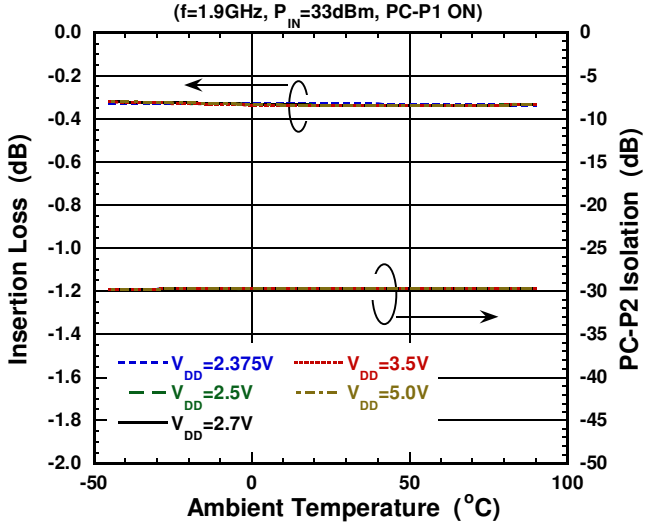
Loss, ISL vs Temperature

(f=0.9GHz, P_{IN}=35dBm, PC-P1 ON)



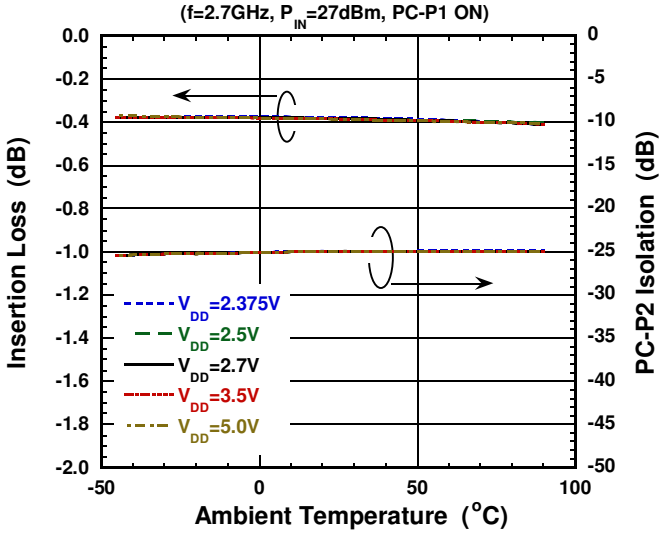
Loss, ISL vs Temperature

(f=1.9GHz, P_{IN}=33dBm, PC-P1 ON)



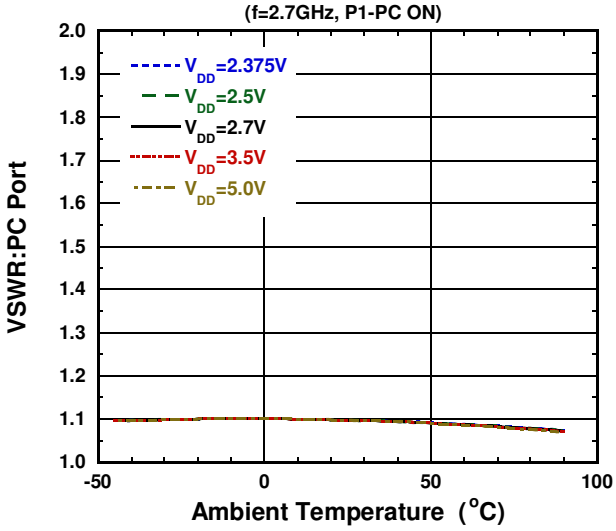
Loss, ISL vs Temperature

(f=2.7GHz, P_{IN}=27dBm, PC-P1 ON)



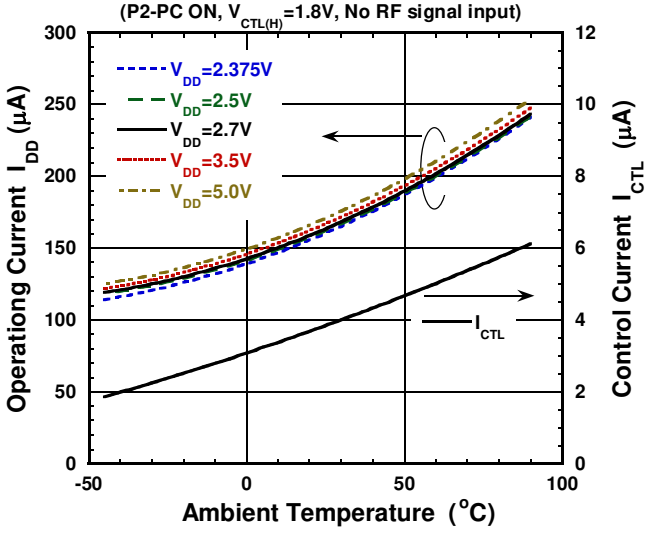
VSWR vs Temperature

(f=2.7GHz, P1-PC ON)



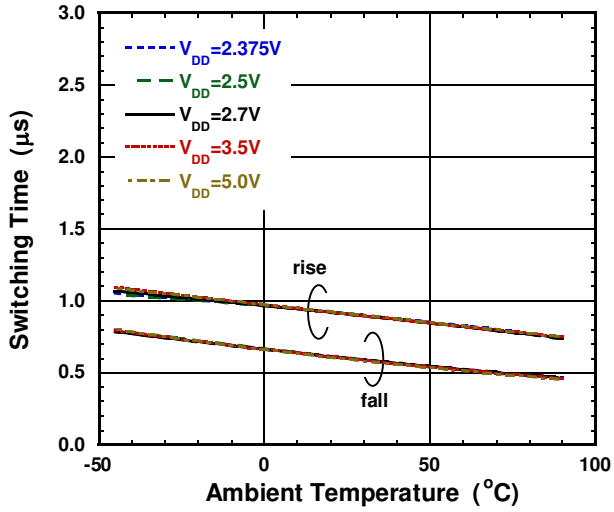
I_{DD}, I_{CTL} vs Temperature

(P2-PC ON, $V_{CTL(H)}$=1.8V, No RF signal input)



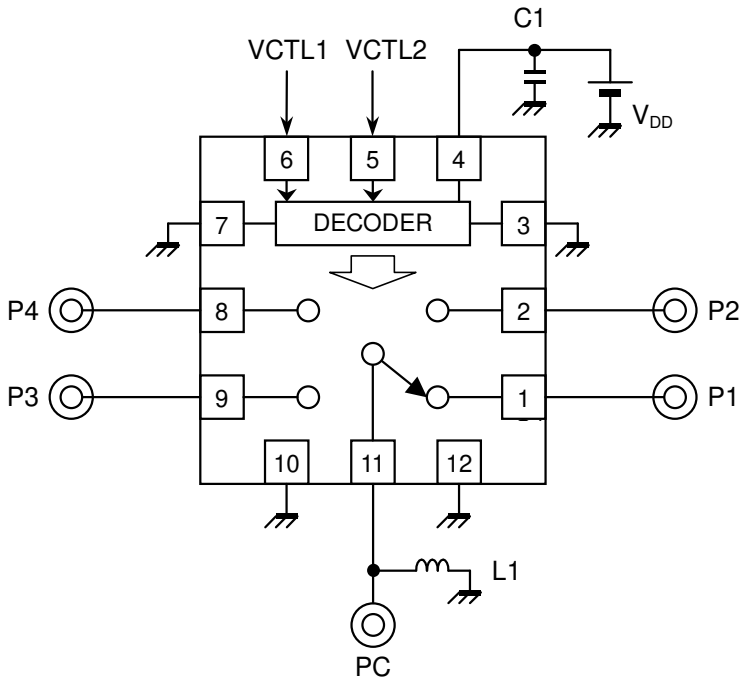
Switching Time vs Temperature

(PC-P1, VCTL1=H/L, VCTL2=L)



■ APPLICATION CIRCUIT

(TOP VIEW)



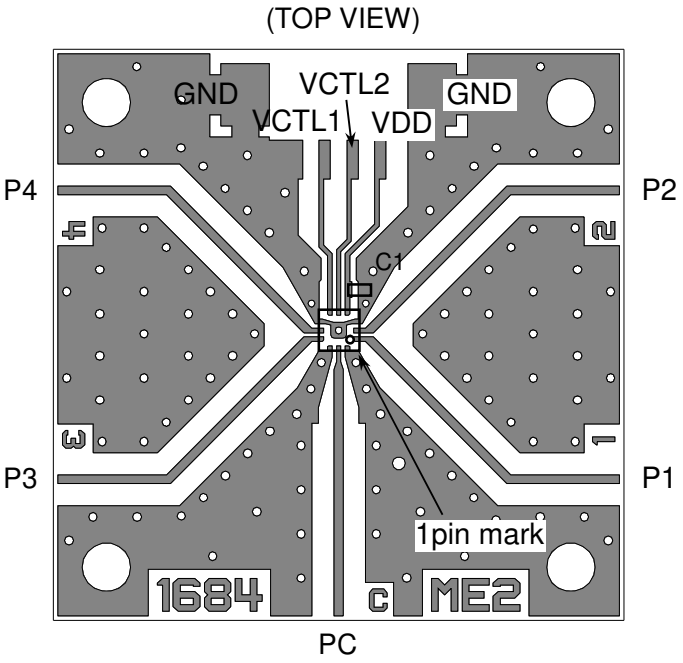
PRECAUTIONS

[1] The Inductor L1 is required for enhancing ESD protection level.
[2] All RF terminals are biased DC GND level.
[3] No DC block capacitors are required for RF ports unless DC is biased externally.

■ PARTS LIST

No.	Parameters	Note
C1	1000pF	MURATA (GRM15)
L1	68nH	TAIYO-YUDEN (HK1005)

■ PCB LAYOUT

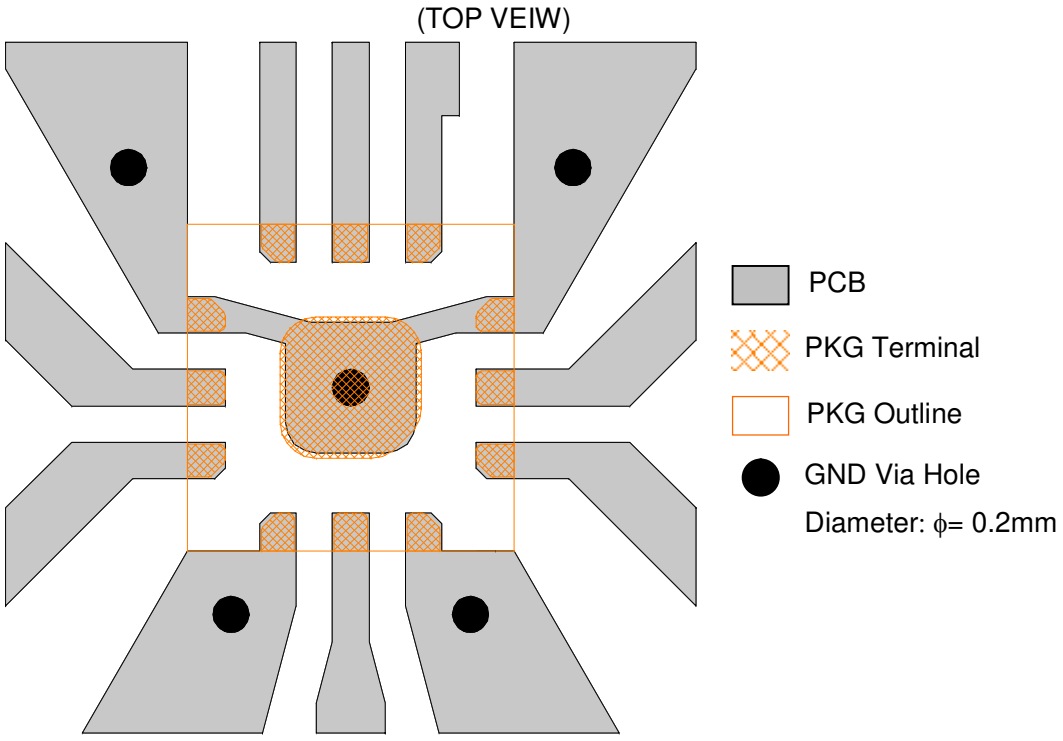


PCB: FR-4, t=0.2mm
Capacitor Size: 1005
Strip Line Width: 0.4mm
PCB Size: 26 x 26mm

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

Frequency (GHz)	Loss (dB)
0.9	0.27
1.9	0.50
2.7	0.61

<PCB LAYOUT GUIDELINE>



■ PRECAUTIONS

[1] No DC block capacitors are required for RF ports unless DC is biased externally. When the other device is biased at certain voltage and connected to the NJG1684ME2, a DC block capacitor is required between the device and the switch IC. This is because the each RF port of NJG1684ME2 is biased at 0 V (GND).

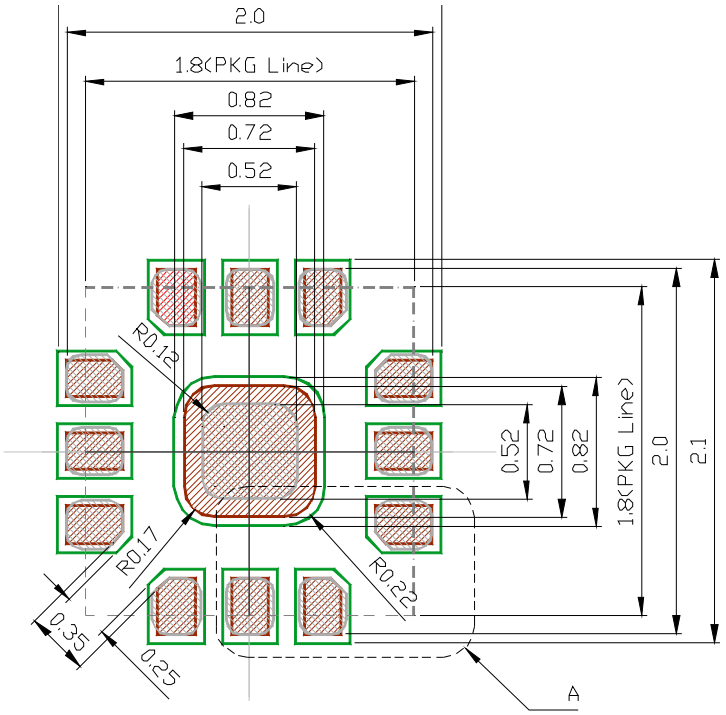
[2] For good RF performance, all GND terminals must be connected to PCB ground plane of substrate, and via-holes for GND should be placed near the IC.

[3] For good RF performance, through-holes for GND should be placed close to the GND pin 6 and pin 13. One of the ways to do this is to place a via-hole at the TAB pad under this IC.

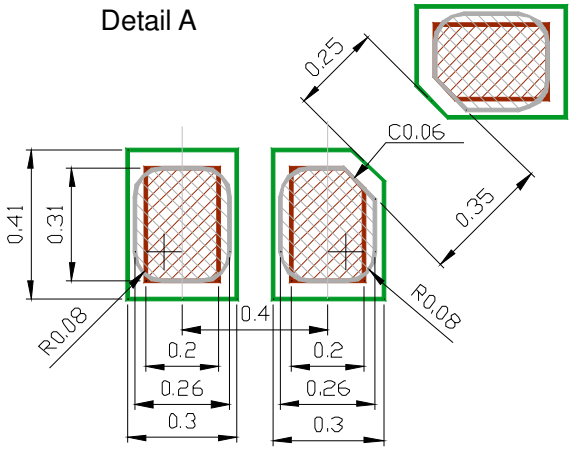
■ RECOMMENDED FOOTPRINT PATTERN (EQFN12-E2 PACKAGE Reference)

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

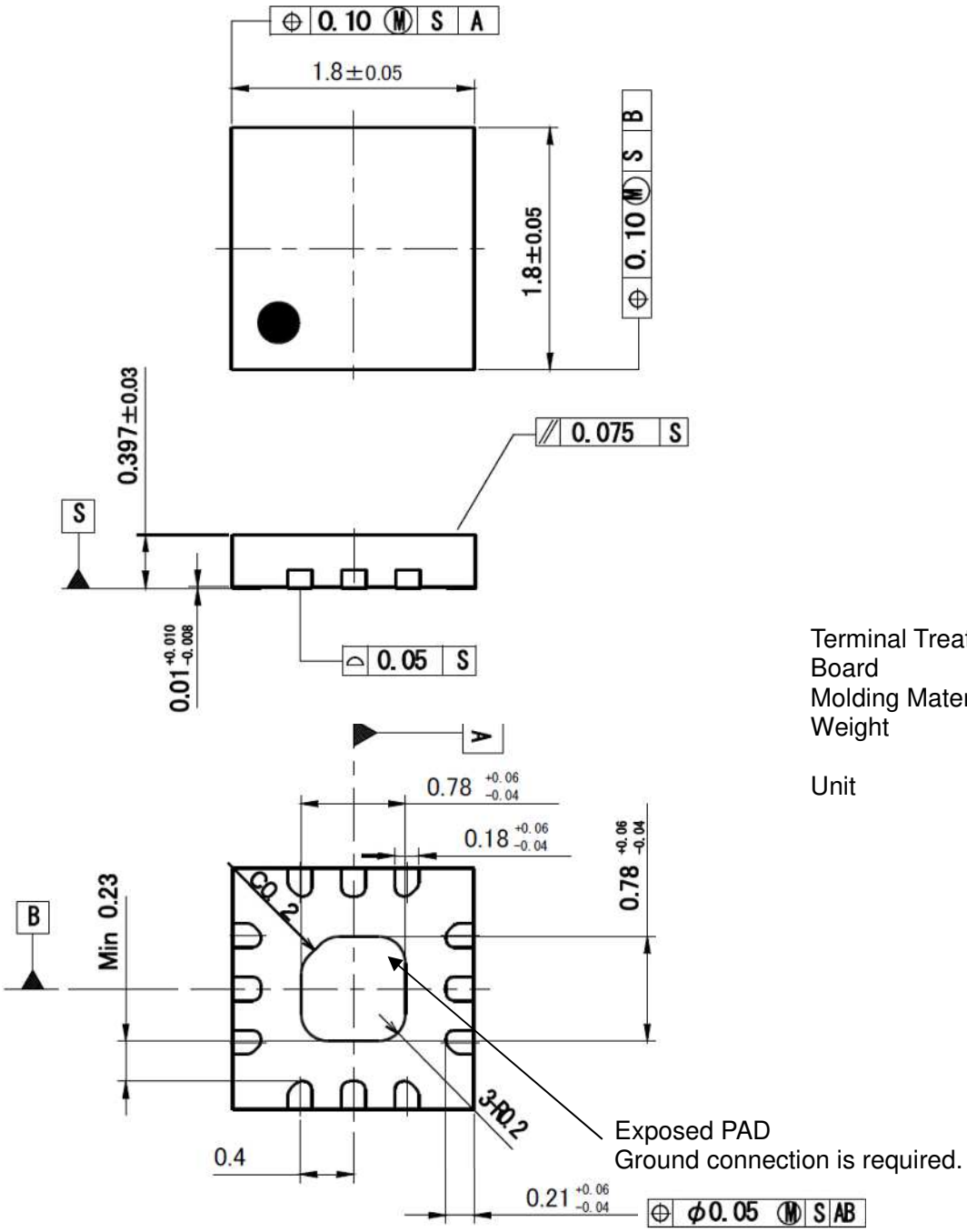
PKG : 1.8mm x 1.8mm
Pin pitch : 0.4mm



Detail A



■ PACKAGE OUTLINE (EQFN12-E2)



Terminal Treat	: SnBi
Board	: Copper
Molding Material	: Epoxy resin
Weight	: 3.7mg
Unit	: mm

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.

1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
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 use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). 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 (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

Nisshinbo Micro Devices Inc.

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

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