SP6T Switch MMIC with MIPI RFFE

■FEATURES

- MIPI RFFE Serial control interface
- Low insertion loss 0.30 dB typ. @ f = 0.9 GHz
  0.40 dB typ. @ f = 1.9 GHz
  0.50 dB typ. @ f = 2.7 GHz
- High isolation 40 dB typ. @ f = 0.9 GHz
  30 dB typ. @ f = 1.9 GHz
  26 dB typ. @ f = 2.7 GHz
- External MIPI select pin
- Small QFN package: 14-pin, 2.0 x 2.0 mm
- RoHS compliant and Halogen Free
- Moisture Sensitivity Level 1 (MSL1)

■APPLICATION

- For TRx switching of LTE, UMTS, CDMA, and TD-SCDMA mode
- For Rx switching of LTE, UMTS, CDMA, TD-SCDMA and GSM mode

■GENERAL DESCRIPTION

The NJU1206MER is a SP6T switch MMIC with a Mobile Industry Processor Interface (MIPI).

The NJU1206MER features high isolation and low insertion loss, and these performance makes this switch an ideal choice for LTE, UMTS, CDMA2000, and EDGE applications.

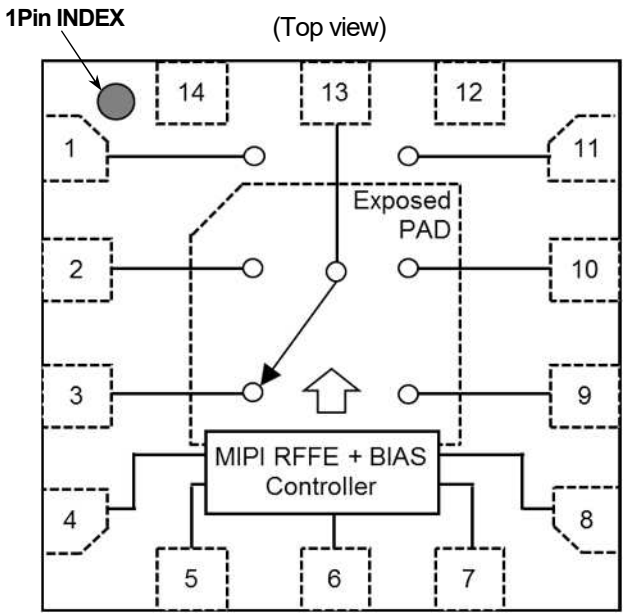
Switching is controlled by the MIPI decoder.

There is an external MIPI select pin that enables how the switch responds to triggers. When this pin is grounded, the switch responds to all of triggers. When this pin is left open, the switch responds to individual triggers.

It has integrated ESD protection circuits the IC to achieve high ESD tolerance.

The small and thin EQFN14-ER package is adopted.

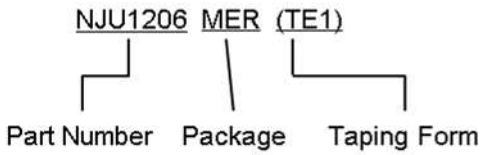
■BLOCK DIAGRAM (EQFN14-ER)



■PIN CONFIGURATION

PIN NO.	SYMBOL
1	P5
2	P3
3	P1
4	VDD
5	VIO
6	SDATA
7	SCLK
8	MIPI SELECT
9	P2
10	P4
11	P6
12	NC(GND)
13	PC
14	NC(GND)
Exposed pad	GND

■MARK INFORMATION



■ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJU1206MER	EQFN14-ER	Yes	Yes	Sn-Bi	001	4.7	3,000

■ABSOLUTE MAXIMUM RATINGS

T_a = 25°C, Z_s = Z_l = 50 Ω

PARAMETER	SYMBOL	RATINGS	UNIT
RF Input Power	P_{IN}	+34(1)	dBm
		+36(2)	
Supply Voltage(3)	V_{DD}	3.75	V
MIPI Control Voltage(4)	V_{IO}	3.2	V
SDATA, SCLK, MIPI SELECT Input Voltage(5)	V_{INDMAX}	V_{IO}+0.2	V
Power Dissipation(6)	P_D	1200	mW
Operating Temperature	T_{opr}	-40 to +105	°C
Storage Temperature	T_{stg}	-55 to +150	°C

(1): V_{DD} = 2.85 V, On state port, P1, P2, P3, and P4 terminals, CW

(2): V_{DD} = 2.85 V, On state port, P5 and P6 terminals, CW

(3): VDD terminal

(4): VIO terminal

(5): V_{IO}=1.65 to 1.95V

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

■ELECTRICAL CHARACTERISTICS 1 (DC CHARACTERISTICS)

V_{DD} = 2.85 V, V_{IO} = 1.8 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}	VDD terminal	2.50	2.85	3.15	V
Operating Current 1	$I_{DD}1$	Active mode, No RF input	-	70	200	μA
Operating Current 2	$I_{DD}2$	Low power mode	-	10	-	μA
Interface Supply Voltage	V_{IO}	VIO terminal	1.65	1.80	1.95	V
Interface Supply Current	I_{VIO}	V_{IO} = 1.8 V, No signal input, MIPI SELECT=Open	-	3.5	20	μA
SCLK Frequency	f_{SCLK}	Write frequency	-	-	26	MHz
SDATA Control Voltage High	V_{SDATAH}	Output Current = -2 mA	0.8 x V_{IO}	1.8	V_{IO}	V
SDATA Control Voltage Low	V_{SDATAL}	Output Current = 2 mA	0	0	0.2 x V_{IO}	V
MIPI RFFE Control Voltage (High)	V_{MIPIH}	SCLK, SDATA	0.8 x V_{IO}	-	V_{IO}	V
MIPI RFFE Control Voltage (Low)	V_{MIPIL}	SCLK, SDATA	0	-	0.2 x V_{IO}	V
MIPI SELECT Control Voltage High	V_{MSH}		1.3	1.8	V_{IO}	V
MIPI SELECT Control Voltage Low	VMS_L		0	0	0.4	V
MIPI SELECT Control Current	I_{MS}	MIPI SELECT = 0 V	-5	-2	-	μA

■ELECTRICAL CHARACTERISTICS 2 (RF CHARACTERISTICS)

V_{DD} = 2.85 V, V_{IO} = 1.8 V, T_a = 25°C, Z_s = Z_l = 50 Ω, with application circuit

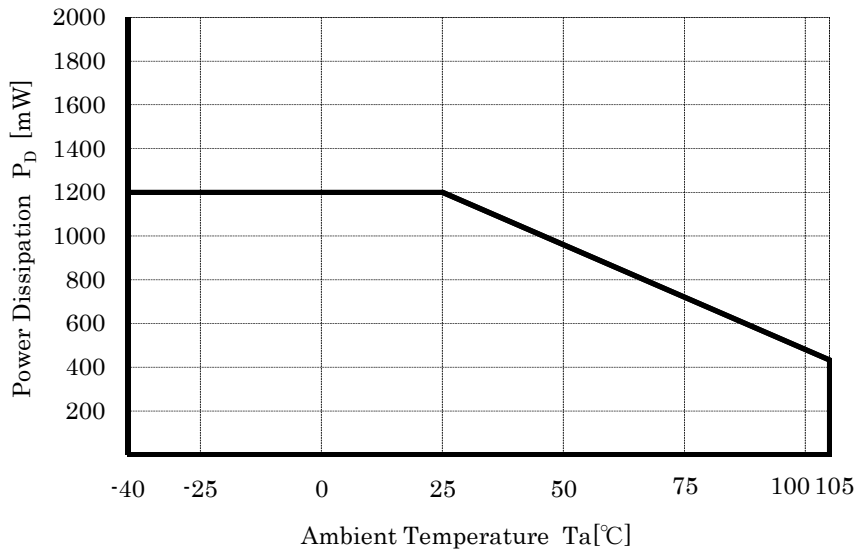
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Insertion Loss 1	LOSS 1	f = 0.9 GHz	-	0.30	0.45	dB
Insertion Loss 2	LOSS 2	f = 1.9 GHz	-	0.40	0.55	dB
Insertion Loss 3	LOSS 3	f = 2.7 GHz	-	0.50	0.65	dB
Isolation 1	ISL 1	f = 0.9 GHz, PC port to any RF ports	36	40	-	dB
Isolation 2	ISL 2	f = 1.9 GHz, PC port to any RF ports	27	30	-	dB
Isolation 3	ISL 3	f = 2.7 GHz, PC port to any RF ports	23	26	-	dB
2nd Harmonics 1	2fo (1)	f = 0.9 GHz, P_{IN} = +25 dBm	-	-69	-60	dBm
2nd Harmonics 2	2fo (2)	f = 1.9 GHz, P_{IN} = +25 dBm	-	-69	-60	dBm
2nd Harmonics 3	2fo (3)	f = 2.7 GHz, P_{IN} = +25 dBm	-	-69	-60	dBm
3rd Harmonics 1	3fo (1)	f = 0.9 GHz, P_{IN} = +25 dBm	-	-69	-60	dBm
3rd Harmonics 2	3fo (2)	f = 1.9 GHz, P_{IN} = +25 dBm	-	-69	-60	dBm
3rd Harmonics 3	3fo (3)	f = 2.7 GHz, P_{IN} = +25 dBm	-	-69	-60	dBm
2nd Order Intermodulation 1	IMD 2 (1)	Tone1:f_{TX} = 835 MHz, P_{TX} = +20 dBm Tone2:f_{JAM} = 1715 MHz, P_{JAM} = -15 dBm	-	-110	-102	dBm
2nd Order Intermodulation 2	IMD 2 (2)	Tone1:f_{TX} = 1950 MHz, P_{TX} = +20 dBm Tone2:f_{JAM} = 4090 MHz, P_{JAM} = -15 dBm	-	-110	-102	dBm
3rd Order Intermodulation 1	IMD 3 (1)	Tone1:f_{TX} = 835 MHz, P_{TX} = +20 dBm Tone2:f_{JAM} = 790 MHz, P_{JAM} = -15 dBm	-	-110	-105	dBm
3rd Order Intermodulation 2	IMD 3 (2)	Tone1:f_{TX} = 1950 MHz, P_{TX} = +20 dBm Tone2:f_{JAM} = 1760 MHz, P_{JAM} = -15 dBm	-	-110	-105	dBm
VSWR	VSWR	On-state ports, f = 2.7 GHz	-	1.1	1.5	
Switching time	T_{SW}		-	2	5	μs

■THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	VALUE	UNIT
Junction-to-ambient thermal resistance(7)	θja	101	°C/W
Junction-to-Top of package characterization parameter(6)	ψjt	26	°C/W

(7): Mounted on glass epoxy board. (114.5 ×101.5 x 1.6 mm: based on EIA/JEDEC standard, 4 Layers), internal Cu area: 99.5 x 99.5 mm

■POWER DISSIPATION vs. AMBIENT TEMPERATURE



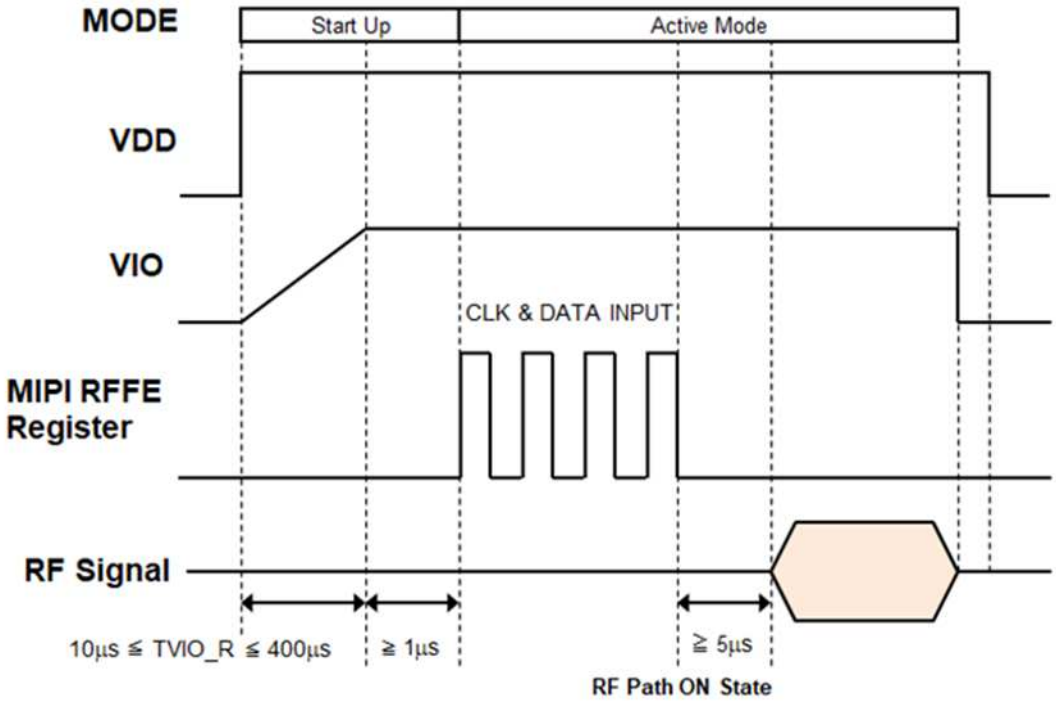
■MIPI RFFE REGISTER DEFINITION TABLE

Register Address	Register Name	Data bits	Function	Description	Default	BROADCAST ID/GSID support	Trigger support	R/W
0x0000	REGISTER 0	6:0	MODE_CTRL	Device control 0x00: Isolation 0x01: P5 - PC 0x02: P1 - PC 0x09: P6 - PC 0x0A: P2 - PC 0x0B: P4 - PC 0x0E: P3 - PC	0x00	No	Yes	R/W
0x001C	PM TRIG	7:6	PWR_MODE	00: Nomal Operation (Active) 01: Default settings (Start up) 10: Low power (Low Power Mode) 11: Reserved	00	Yes	No	R/W
		5	Trigger_Mask_2	If this bit is set, trigger 2 is disabled. When all triggers disabled, if writing to a register that is associated to trigger 2, the data goes directly to the destination register.	0	No	No	R/W
		4	Trigger_Mask_1	If this bit is set, trigger 1 is disabled. When all triggers disabled, if writing to a register that is associated to trigger 1, the data goes directly to the destination register.	0	No	No	R/W
		3	Trigger_Mask_0	If this bit is set, trigger 0 is disabled. When all triggers disabled, if writing to a register that is associated to trigger 0, the data goes directly to the destination register.	0	No	No	R/W
		2	Trigger_2	A write of a one to this bit loads trigger 2's registers	0	No	No	R/W
		1	Trigger_1	A write of a one to this bit loads trigger 1's registers	0	No	No	R/W
		0	Trigger_0	A write of a one to this bit loads trigger 0's registers	0	No	No	R/W
0x001D	PRODUCT ID	7:0	PRODUCT_ID	Read-only. During programming of USID, a write command sequence is performed on this register but does not change its value.	0x73	No	No	R

■MIPI RFFE REGISTER DEFINITION TABLE (cont'd)

0x001E	MANUFACTURE ID	7:0	MANUFACTURER _ID [7:0]	Read-only. During programming of USID, a write command sequence is performed on this register but does not change its value.	0x92	No	No	R
0x001F	MAN USID	7:6	SPARE	Read-only reserved bit.	00	No	No	R/W
		5:4	MANUFACTURER _ID [9:8]	Read-only. During programming of USID, a write command sequence is performed on this register but does not change its value.	0x2	No	No	R
		3:0	USID	Programmable USID. A write to these bits programs the USID.	0xB	No	No	R/W
0x001A	RFFE_STATUS	7	SOFTWARE RESET	0: Nomal operation 1: Software reset (reset of all configurable registers to default values except for USID, GSID, or PM_TRIG)	0	No	No	R/W
		6	COMMAND_FRAME _PARITY_ERR	Commnad sequence reserved with parity error - discard command.	0	No	No	R/W
		5	COMMAND _LENGTH_ERR	Commnad length error	0	No	No	R/W
		4	ADDRESS_FRAME _PARITY_ERR	Address frame parity error = 1	0	No	No	R/W
		3	DATA_FRAME _PARITY_ERR	Data frame with parity error	0	No	No	R/W
		2	READ_UNUSED _REG	Read command to an invaild address	0	No	No	R/W
		1	WRITE_UNUSED _REG	Write command to an invaild address	0	No	No	R/W
		0	RID_GID_ERR	Read command with a BROADCAST_ID or GROUP_SID	0	No	No	R/W
0x001B	GROUP_SID	7:4	RESERVED	Optional	0x0	-	-	-
		3:0	GROUP_SID	Group slave ID	0x0	Not applicable	Not required	R/W
0x0020	EXT _PRODUCT_ID	7:0	EXT_PROD_ID	This forms the extension of the PRODUCT_ID.	0x0	-	-	R

■MIPI RFFE POWER UP/DOWN SEQUENCE

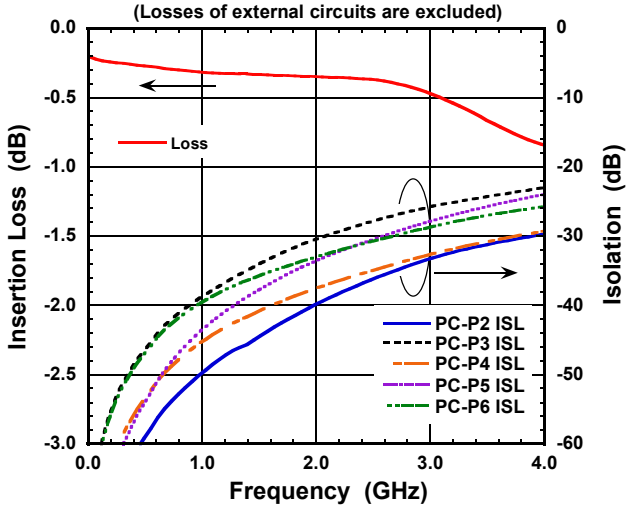


■PIN CONFIGURATION

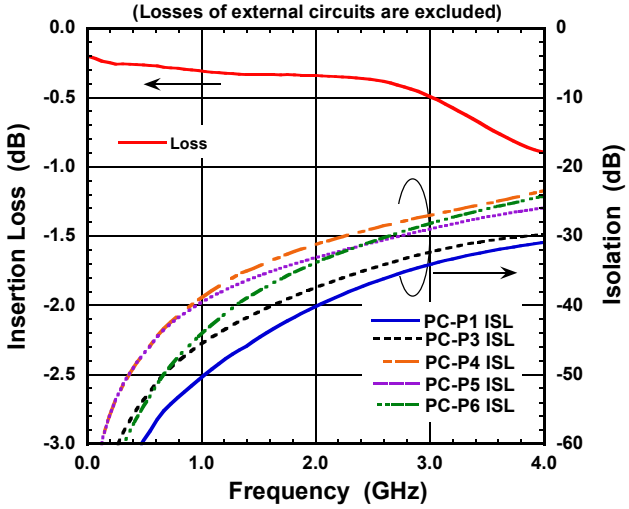
PIN NO.	SYMBOL	DESCRIPTION
1	P5	RF transmitting/receiving port. With this port ON state, power of 36 dBm or less can be applied with matching state of 50 Ω.
2	P3	RF transmitting/receiving port. With this port ON state, power of 34 dBm or less can be applied with matching state of 50 Ω.
3	P1	RF transmitting/receiving port. With this port ON state, power of 34 dBm or less can be applied with matching state of 50 Ω.
4	VDD	Positive voltage supply terminal. The positive voltage (+2.5 to +3.15V) has to be supplied. Please connect a bypass capacitor with GND terminal for excellent RF performance.
5	VIO	MIPI RFFE interface power supply voltage.
6	SDATA	MIPI RFFE interface data signal.
7	SCLK	MIPI RFFE interface clock signal.
8	MIPI SELECT	This is an external MIPI select terminal that enables how the switch responds to Triggers. When this terminal is connected to GND, all the Trigger _0/1/ 2 are linked, and individual Trigger_ 0/1/2 can be performed when this terminal is opened (no voltage applied).
9	P2	RF transmitting/receiving port. With this port ON state, power of 34 dBm or less can be applied with matching state of 50 Ω.
10	P4	RF transmitting/receiving port. With this port ON state, power of 34 dBm or less can be applied with matching state of 50 Ω.
11	P6	RF transmitting/receiving port. With this port ON state, power of 36 dBm or less can be applied with matching state of 50 Ω.
12	NC(GND)	No connected terminal. This terminal is not connected with internal circuit. Connect to the PCB ground plane.
13	PC	RF transmitting/receiving port.
14	NC(GND)	No connected terminal. This terminal is not connected with internal circuit. Connect to the PCB ground plane.
Exposed pad	GND	Ground terminal. Connect exposed pad to ground plane as close as possible for excellent RF performance.

■ELECTRICAL CHARACTERISTICS

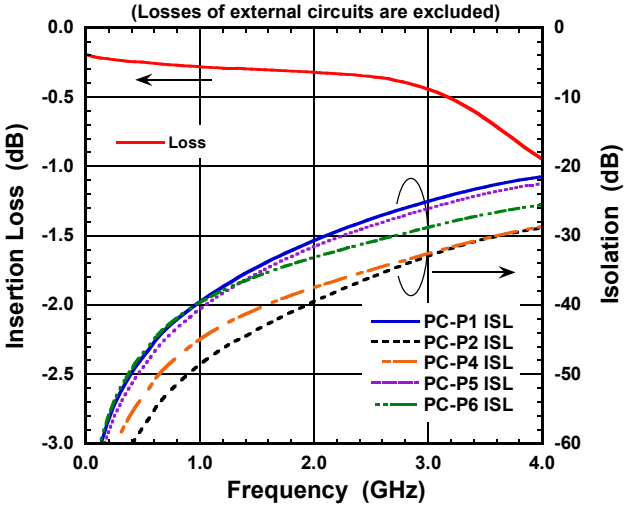
Loss, ISL vs. Frequency
(PC-P1 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)



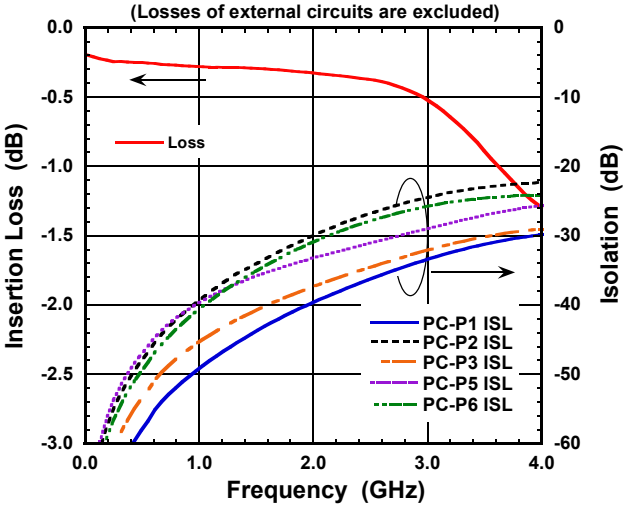
Loss, ISL vs. Frequency
(PC-P2 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)



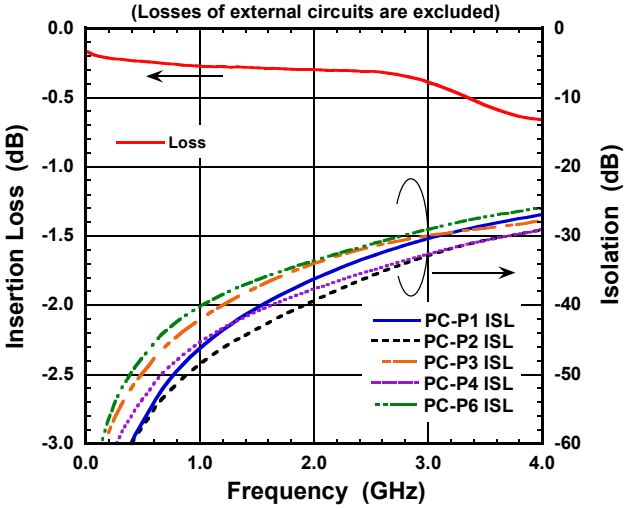
Loss, ISL vs. Frequency
(PC-P3 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)



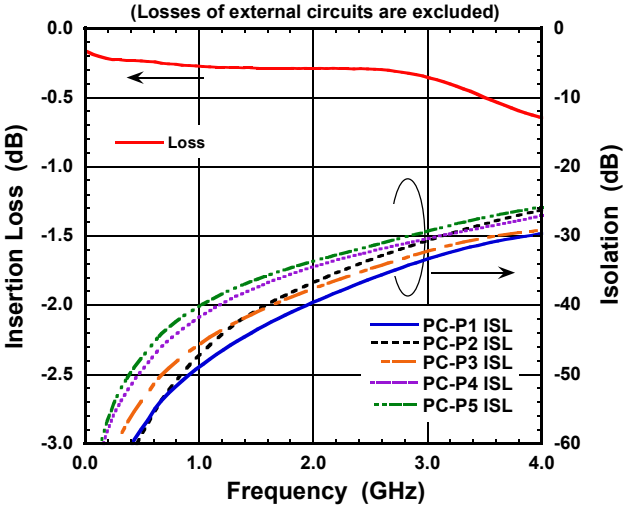
Loss, ISL vs. Frequency
(PC-P4 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)



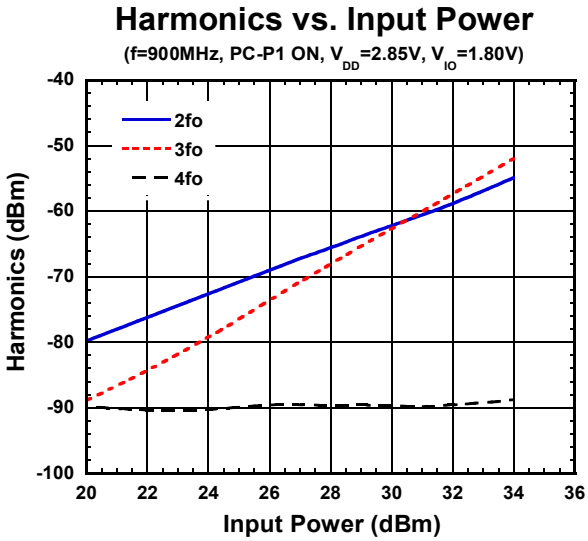
Loss, ISL vs. Frequency
(PC-P5 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)

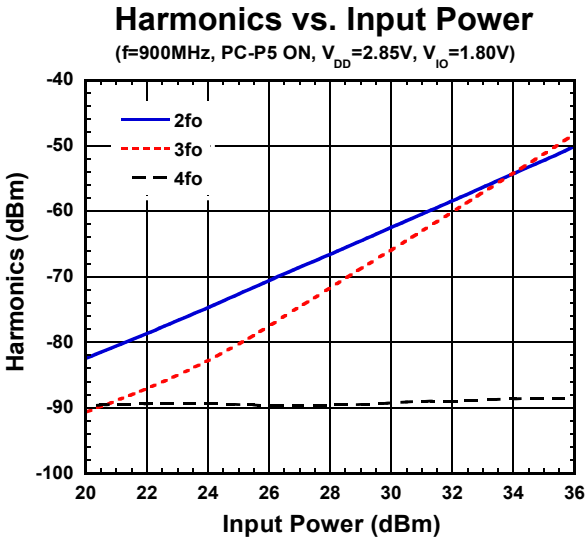


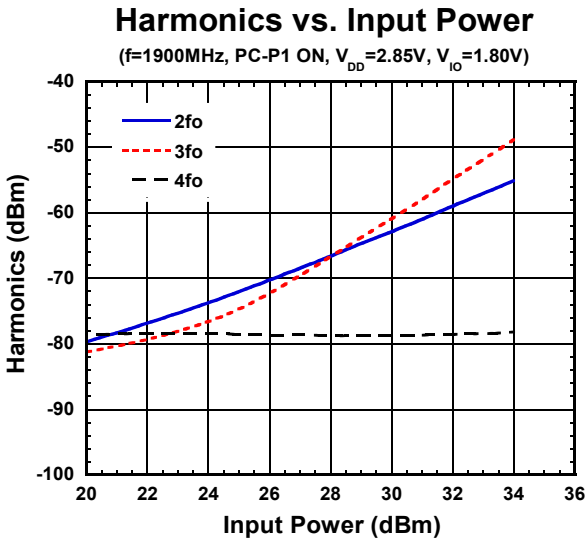
Loss, ISL vs. Frequency
(PC-P6 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)

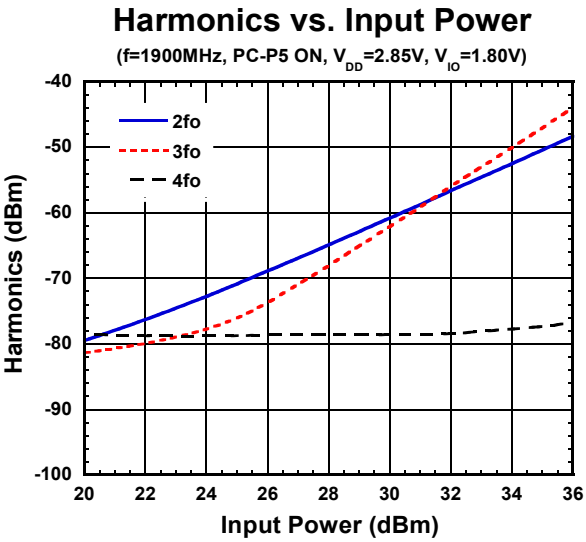


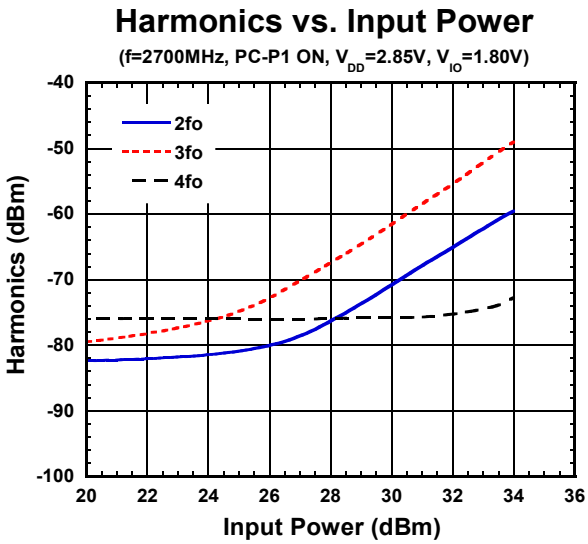
■ELECTRICAL CHARACTERISTICS

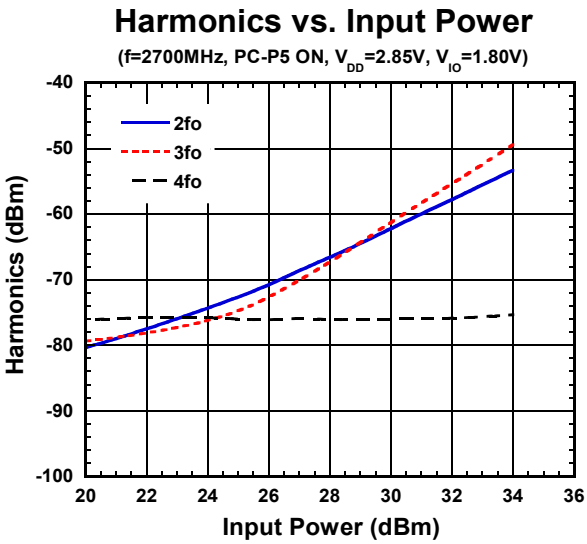








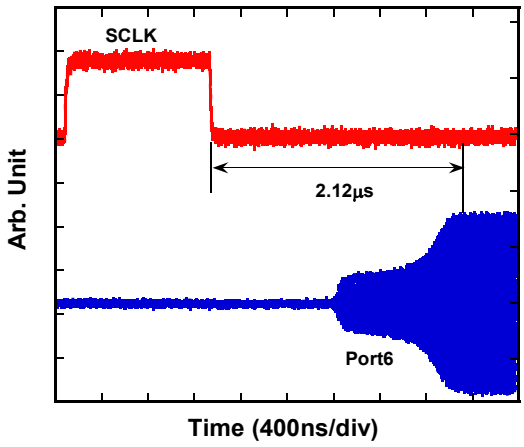




■ELECTRICAL CHARACTERISTICS

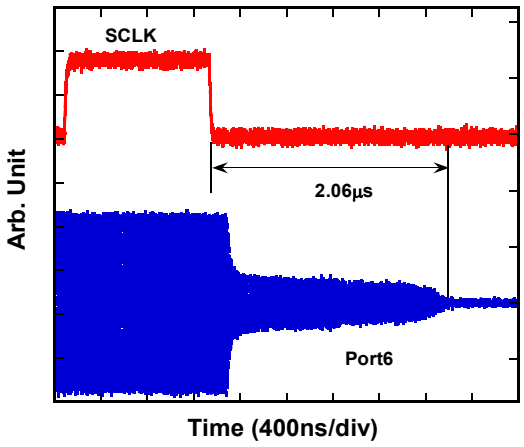
Switching Time

(V_{DD}=2.85V, V_{IO}=1.8V, PC-P6 Rising Edge)



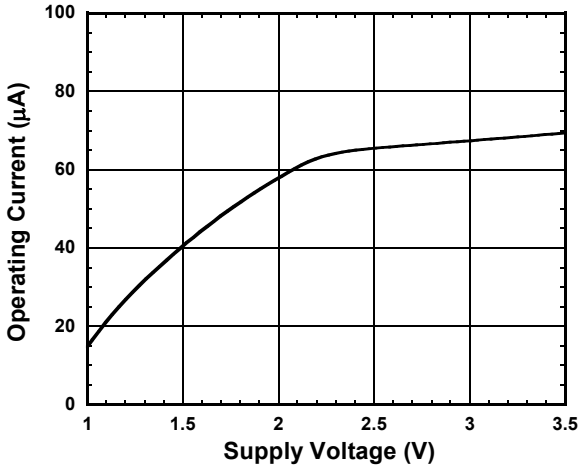
Switching Time

(V_{DD}=2.85V, V_{IO}=1.8V, PC-P6 Falling Edge)



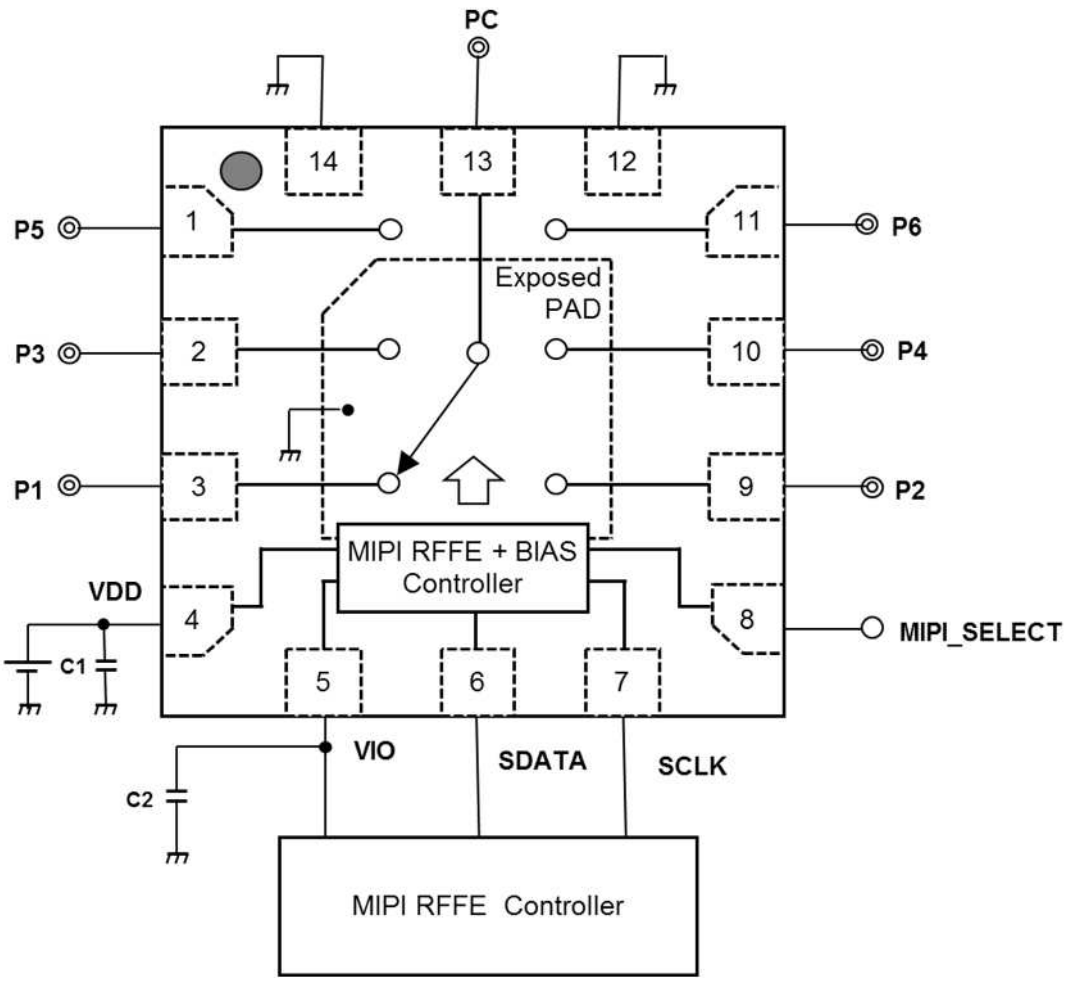
Operating Current vs. Supply Voltage

(No RF Signal Input, Active Mode, V_{IO}=1.80V)



■APPLICATION CIRCUIT

(Top view)



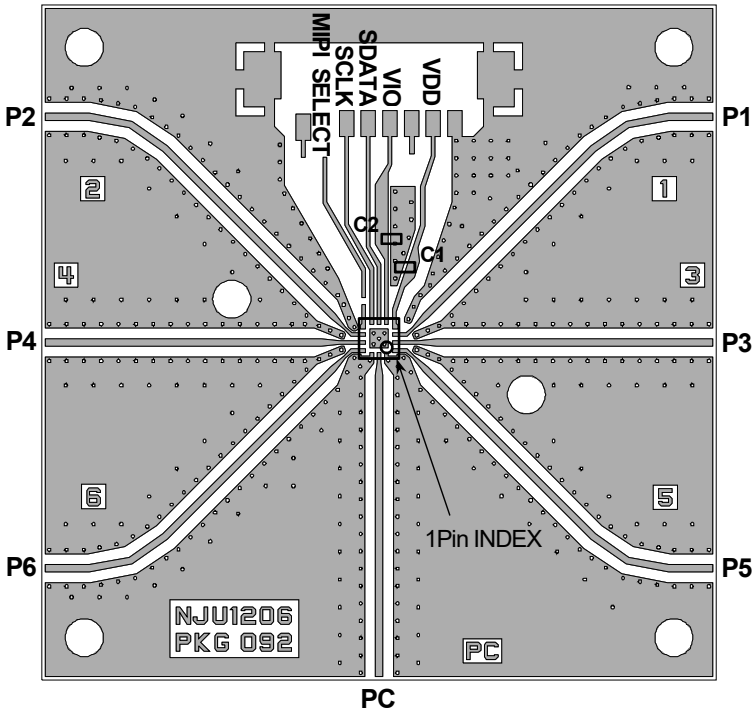
NOTE:
No DC blocking capacitors are required for all RF ports unless DC is biased externally.

■PARTS LIST

Part ID	Value	Notes
C1	1000 pF	MURATA (GRM15)
C2	1000 pF	MURATA (GRM15)

■EVALUATION BOARD

(Top view)



PCB: FR-4, t=0.2mm

Micro strip line width=0.38mm (Z_0=50Ω)

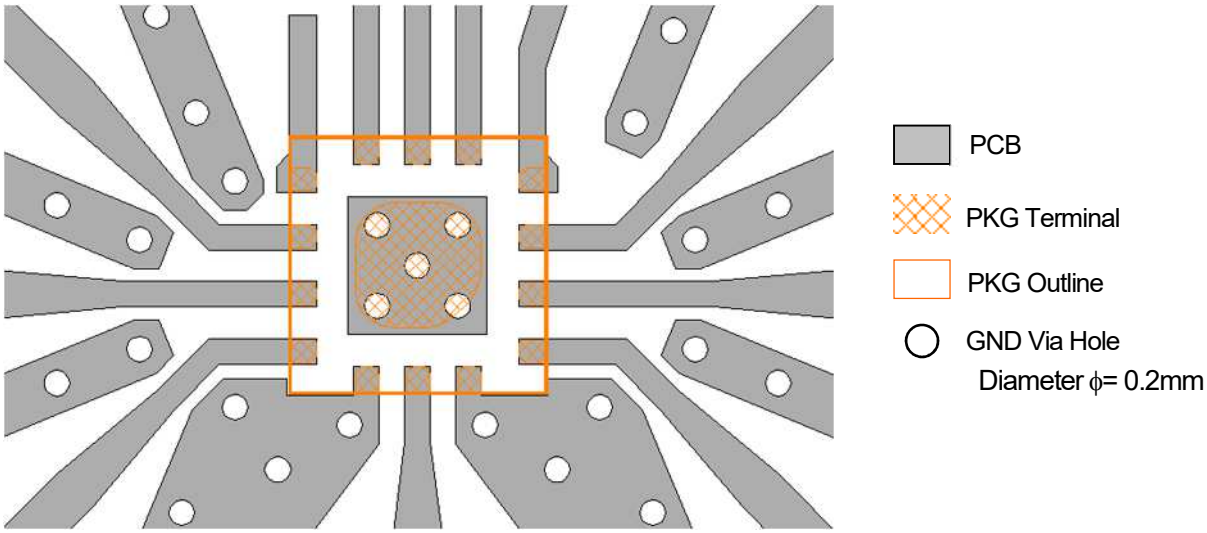
PCB Size=38.5 x 38.5mm

Through-hole diameter: 0.2mm

LOSS OF PCB AND CONNECTORS

Frequency(GHz)	Loss(dB)	
	P1, P2, P5, P6	P3, P4
0.9	0.34	0.33
1.9	0.61	0.57
2.7	0.81	0.75

< PCB LAYOUT GUIDELINE>



■PRECAUTIONS

[1] No DC blocking capacitors are required for all RF ports unless DC is biased externally.

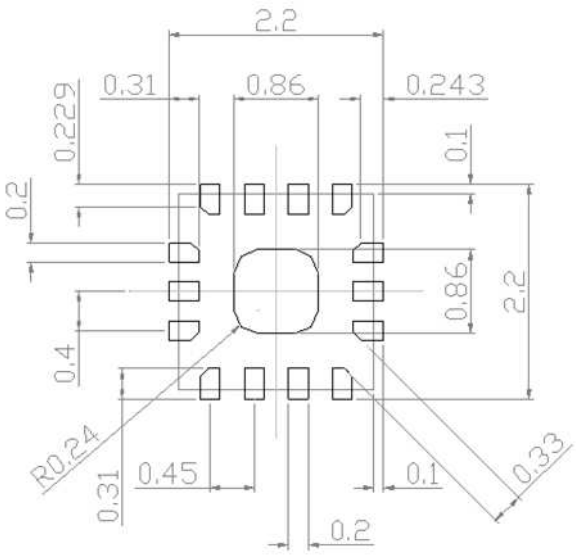
[2] To reduce strip line influence on RF characteristics, please locate the bypass capacitor C1 and C2 close to VDD and VIO terminal.

[3] For good isolation, the GND terminals must be connected to the PCB ground plane of substrate, and the through-holes connecting the backside ground plane should be placed near by the pin connection.

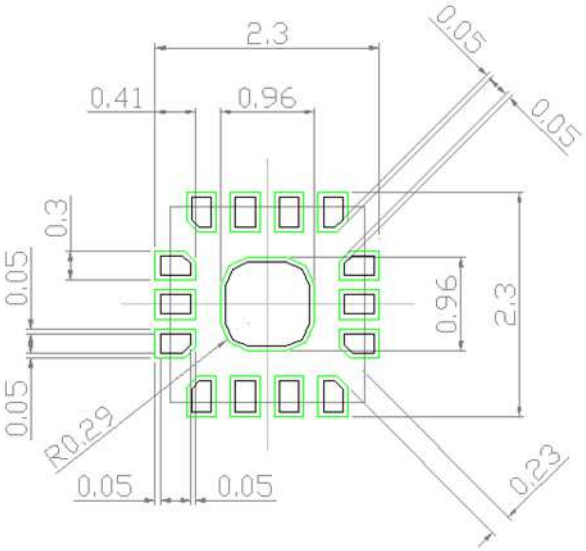
■RECOMMENDED FOOTPRINT PATTERN (EQFN14-ER PACKAGE Reference)

● PCB METAL LAND PATTERN

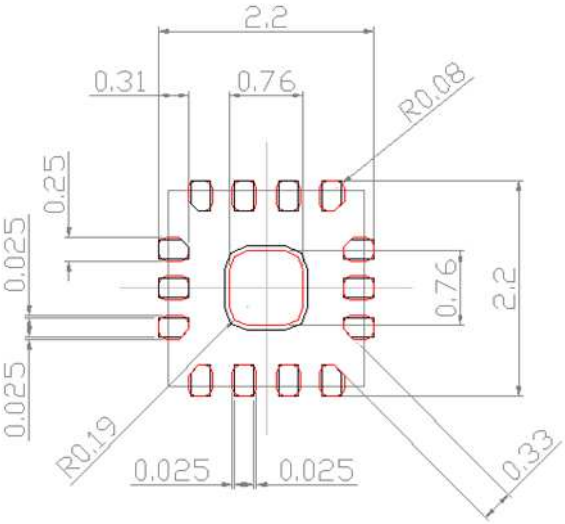
Unit : mm



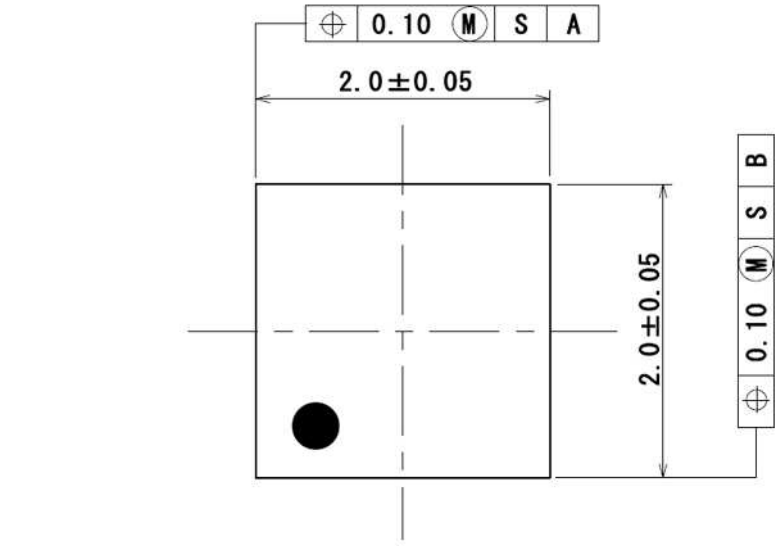
● PCB SOLDER MASK PATTERN (SOLDER RESIST) ■



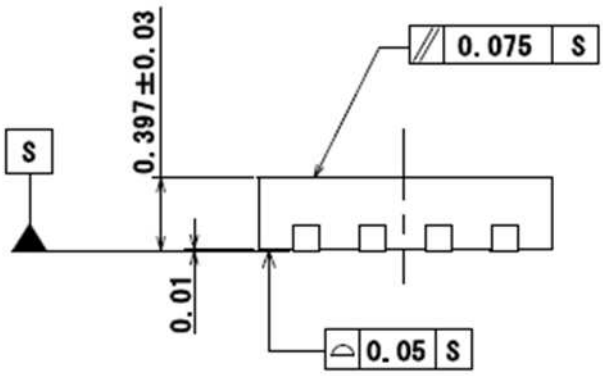
● PCB STENCIL PATTERN (Metal mask thickness:100μm) ■



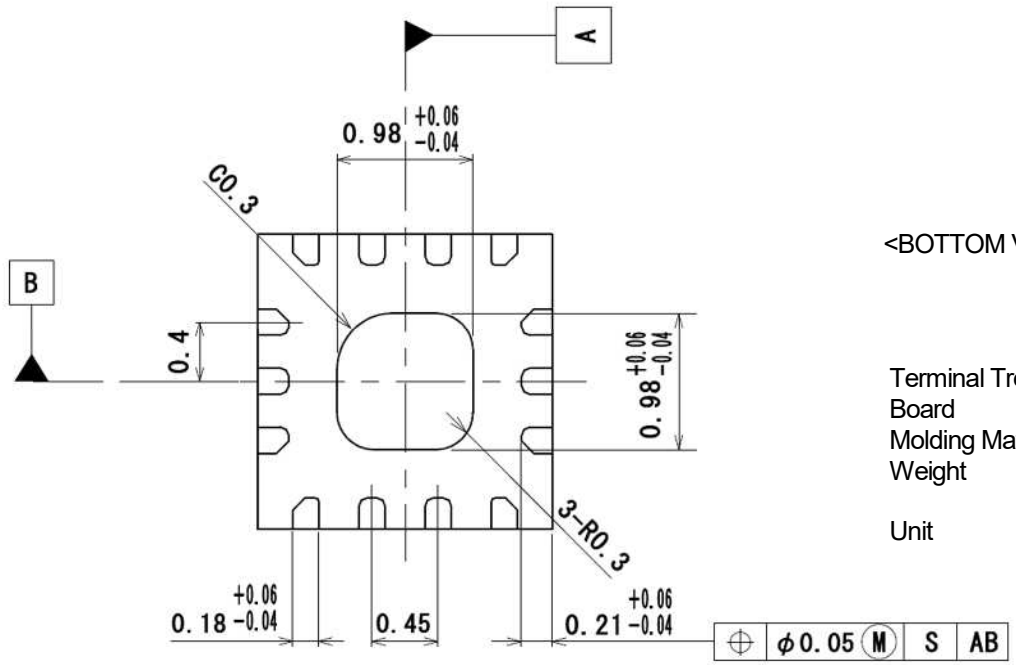
■PACKAGE OUTLINE



<TOP VIEW>



<SIDE VIEW>



<BOTTOM VIEW>

Terminal Treat	: SnBi
Board	: Copper
Molding Material	: Epoxy resin
Weight	: 4.7mg
Unit	: mm

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/