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.

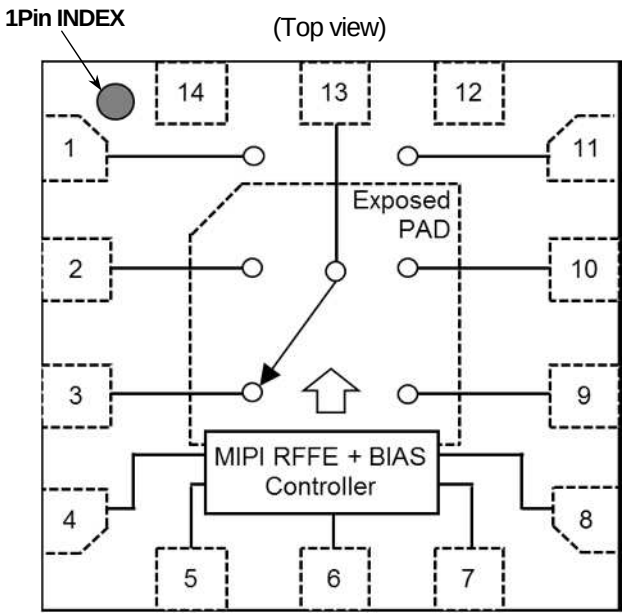
Switching is controlled by the MIPI decoder.

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.

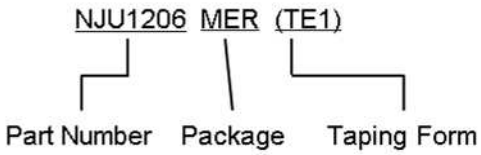
■BLOCK DIAGRAM (EQFN14-ER)



■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

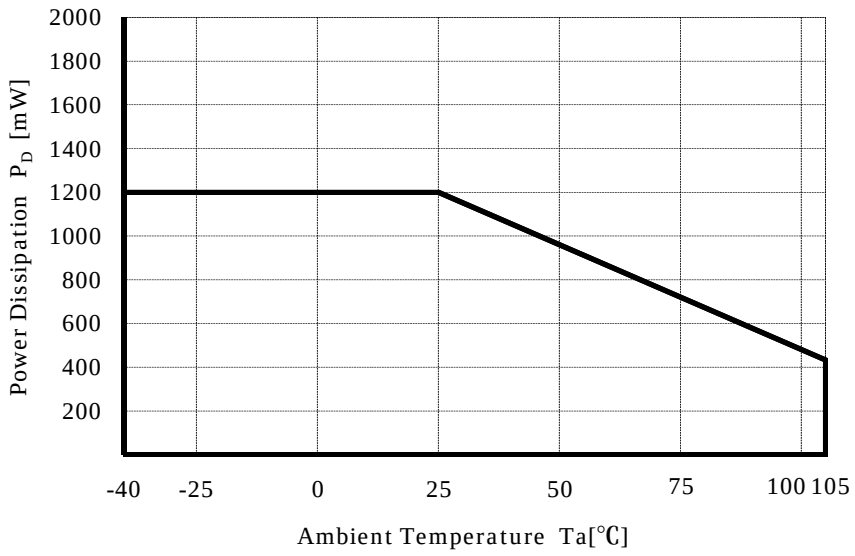
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Insertion Loss 1	LOSS 1	f = 0.9 GHz	-	0.30	0.45	dB
Insertion Loss 2	LOSS 2	f = 1.9 GHz	-	0.40	0.55	dB
Insertion Loss 3	LOSS 3	f = 2.7 GHz	-	0.50	0.65	dB
Isolation 1	ISL 1	f = 0.9 GHz, PC port to any RF ports	36	40	-	dB
Isolation 2	ISL 2	f = 1.9 GHz, 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



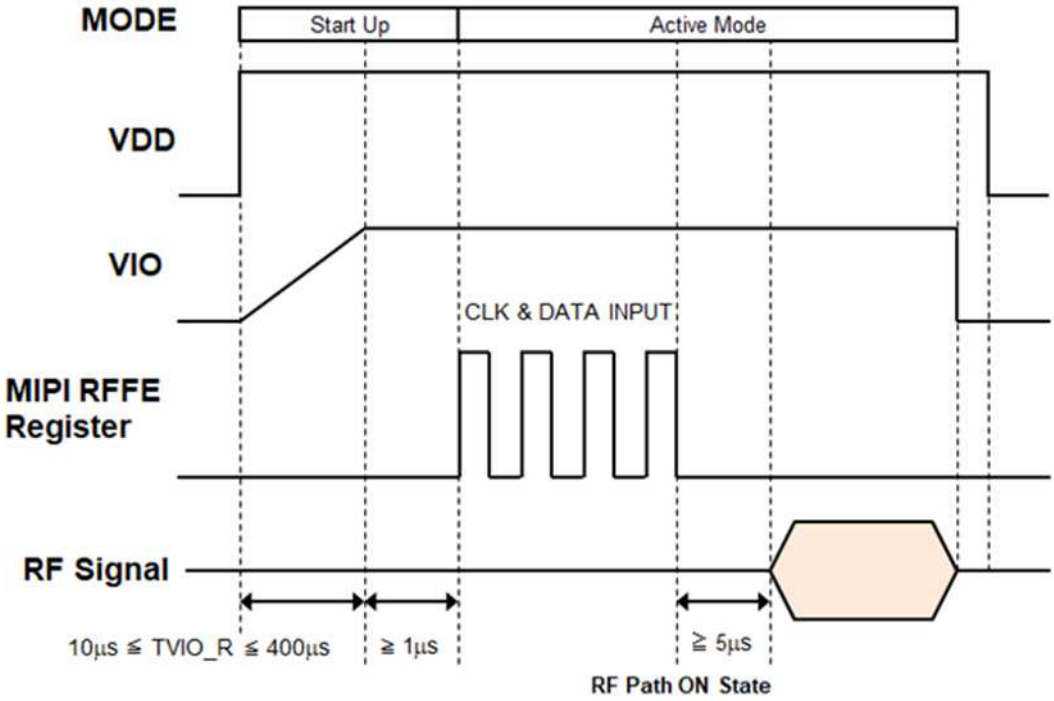
■MIPI RFFE REGISTER DEFINITION TABLE

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

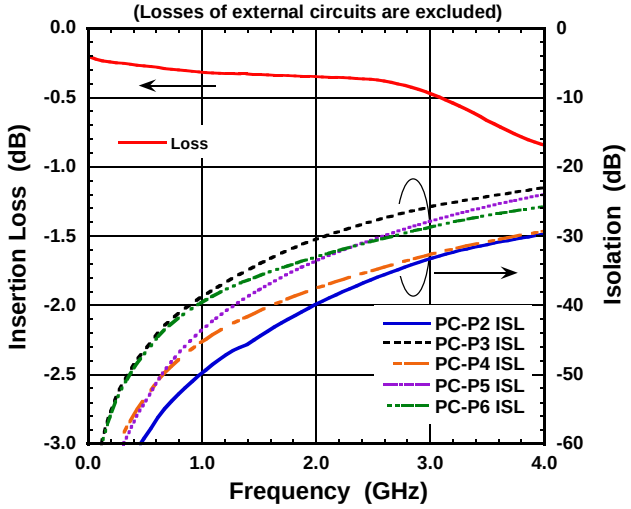


■PIN CONFIGURATION

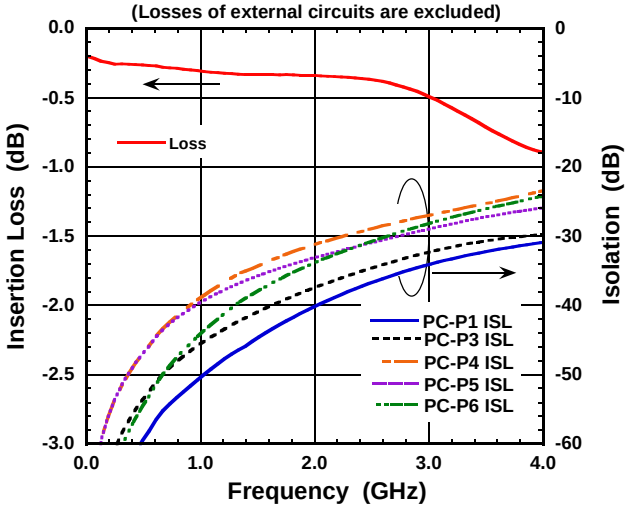
PIN NO.	SYMBOL	DESCRIPTION
1	P5	RF transmitting/receiving port. With this port ON state, power of 36 dBm or less can be applied with matching state of 50 Ω.
2	P3	RF transmitting/receiving port. With this port ON state, power of 34 dBm or less can be applied with matching state of 50 Ω.
3	P1	RF transmitting/receiving 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

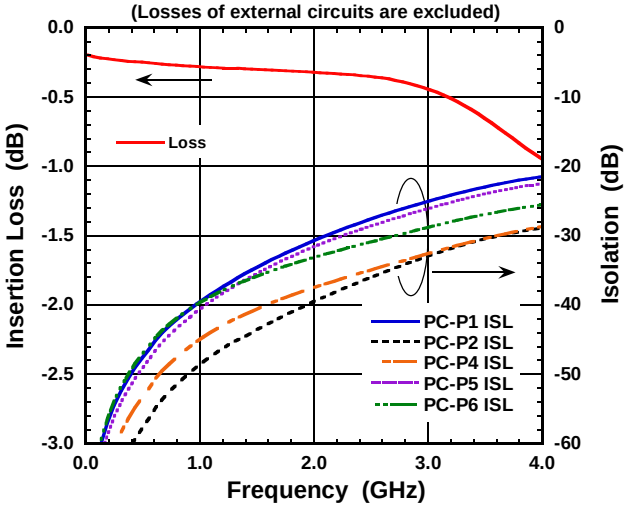
Loss, ISL vs. Frequency
(PC-P1 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)



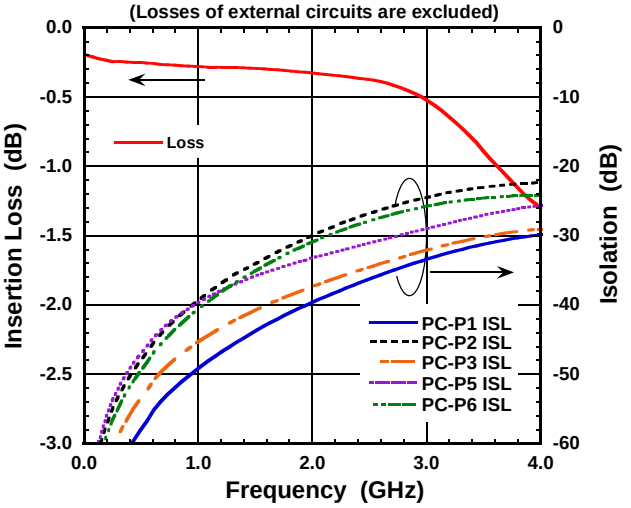
Loss, ISL vs. Frequency
(PC-P2 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)



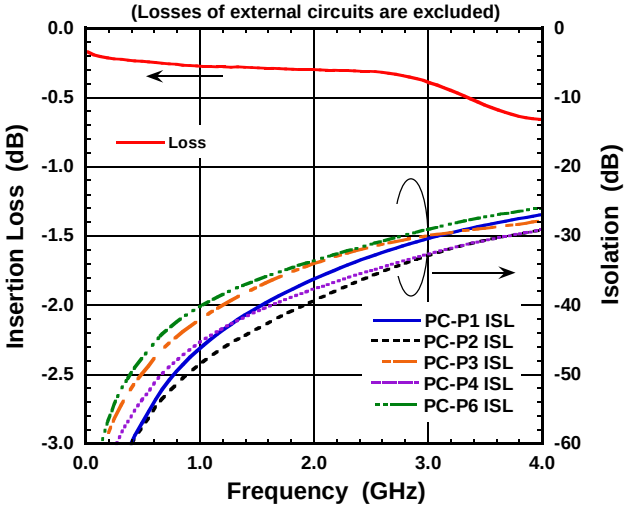
Loss, ISL vs. Frequency
(PC-P3 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)



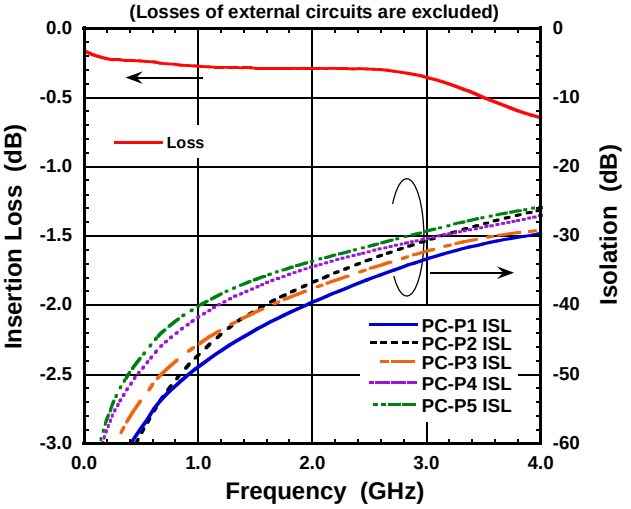
Loss, ISL vs. Frequency
(PC-P4 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)



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

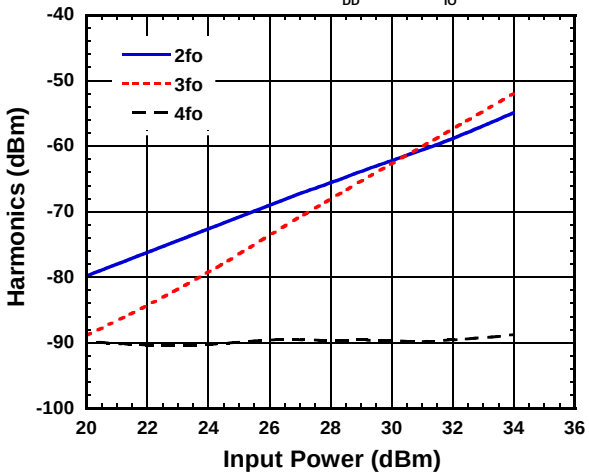


Loss, ISL vs. Frequency
(PC-P6 ON, V_{DD}=2.85V, V_{IO}=1.80V)
(Losses of external circuits are excluded)

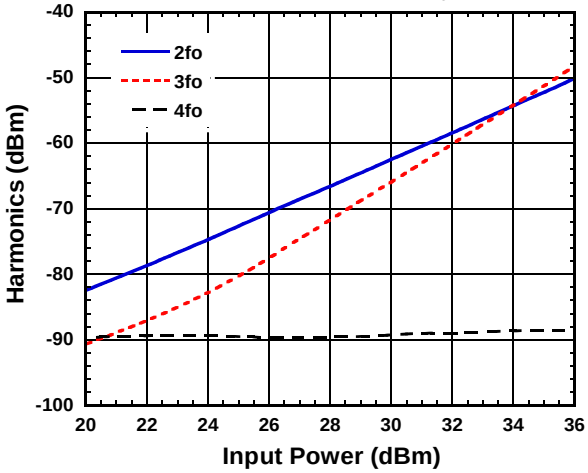


■ELECTRICAL CHARACTERISTICS

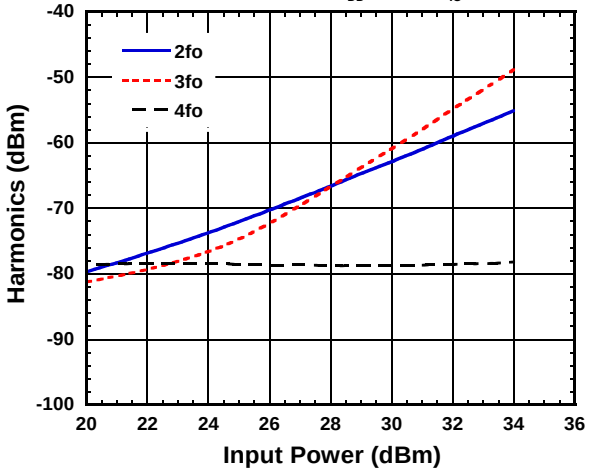
Harmonics vs. Input Power
(f=900MHz, PC-P1 ON, V_{DD}=2.85V, V_{IO}=1.80V)



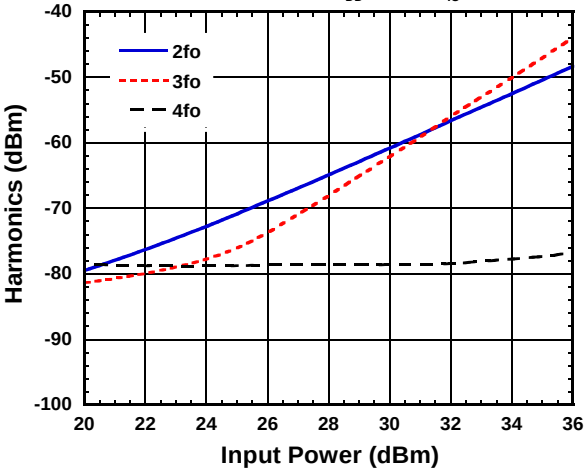
Harmonics vs. Input Power
(f=900MHz, PC-P5 ON, V_{DD}=2.85V, V_{IO}=1.80V)



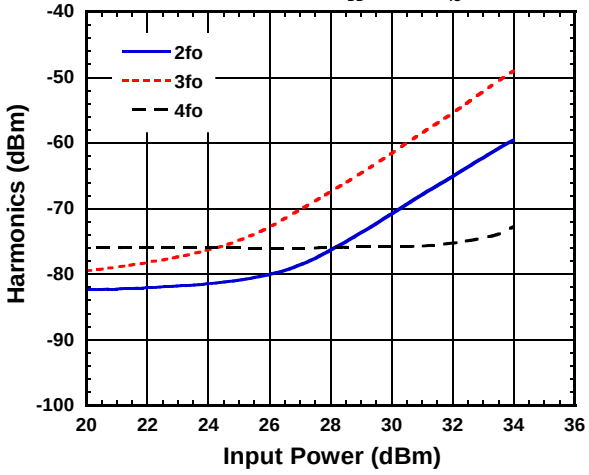
Harmonics vs. Input Power
(f=1900MHz, PC-P1 ON, V_{DD}=2.85V, V_{IO}=1.80V)



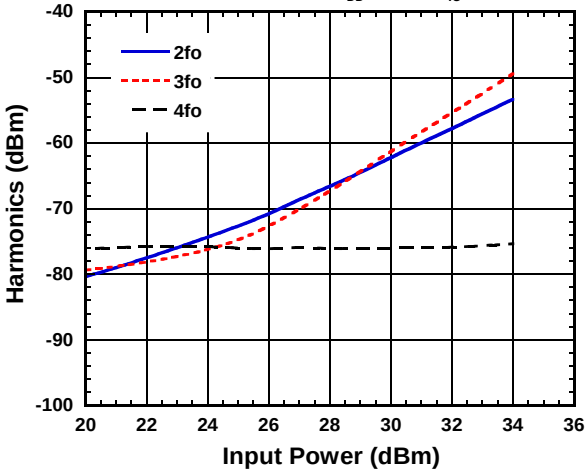
Harmonics vs. Input Power
(f=1900MHz, PC-P5 ON, V_{DD}=2.85V, V_{IO}=1.80V)



Harmonics vs. Input Power
(f=2700MHz, PC-P1 ON, V_{DD}=2.85V, V_{IO}=1.80V)



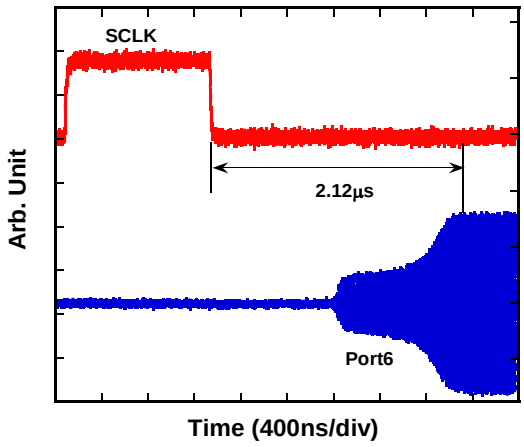
Harmonics vs. Input Power
(f=2700MHz, PC-P5 ON, V_{DD}=2.85V, V_{IO}=1.80V)



■ELECTRICAL CHARACTERISTICS

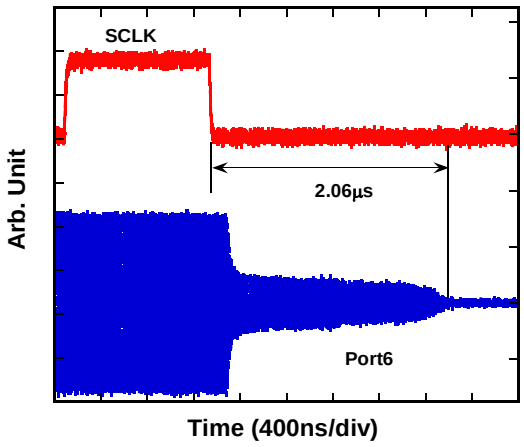
Switching Time

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



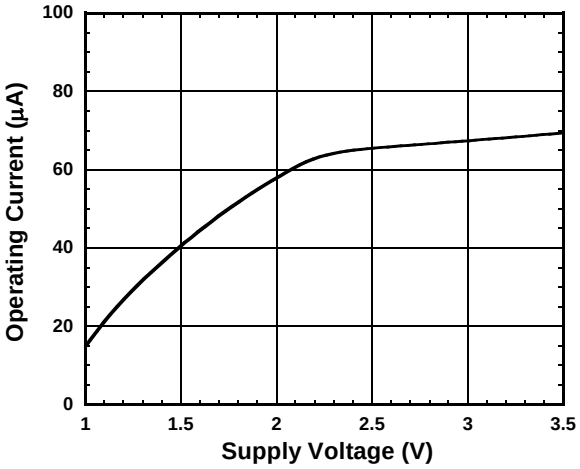
Switching Time

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



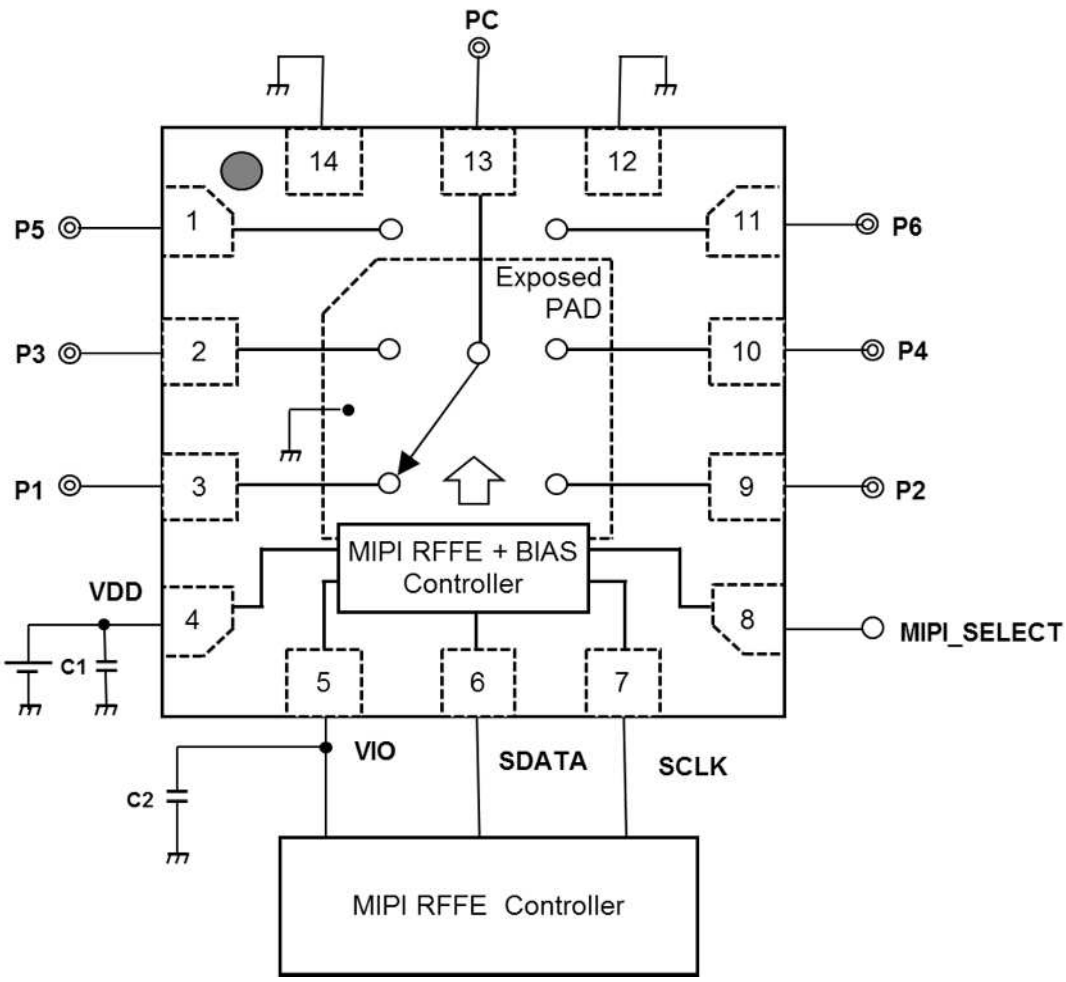
Operating Current vs. Supply Voltage

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



■APPLICATION CIRCUIT

(Top view)



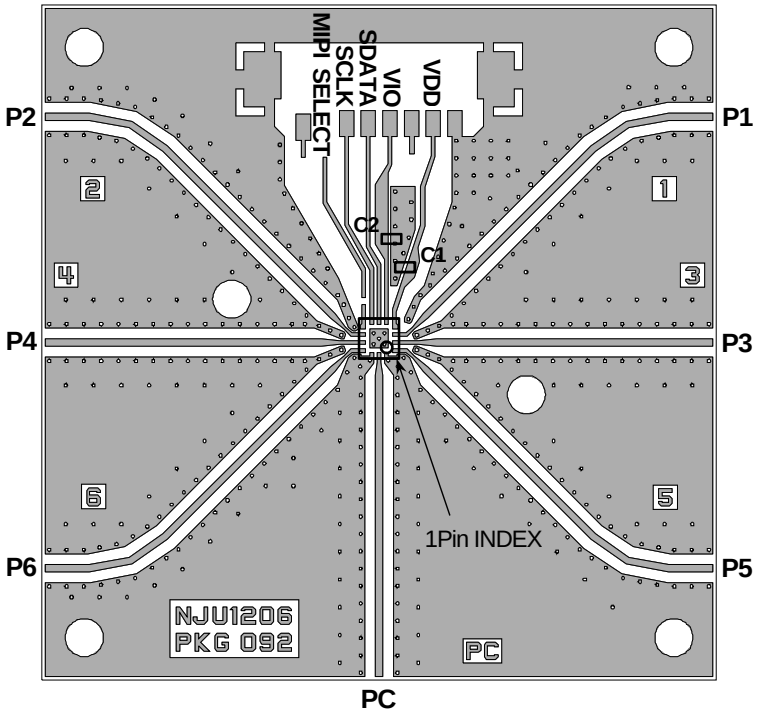
NOTE:
No DC blocking capacitors are required for all RF ports unless DC is biased externally.

■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)

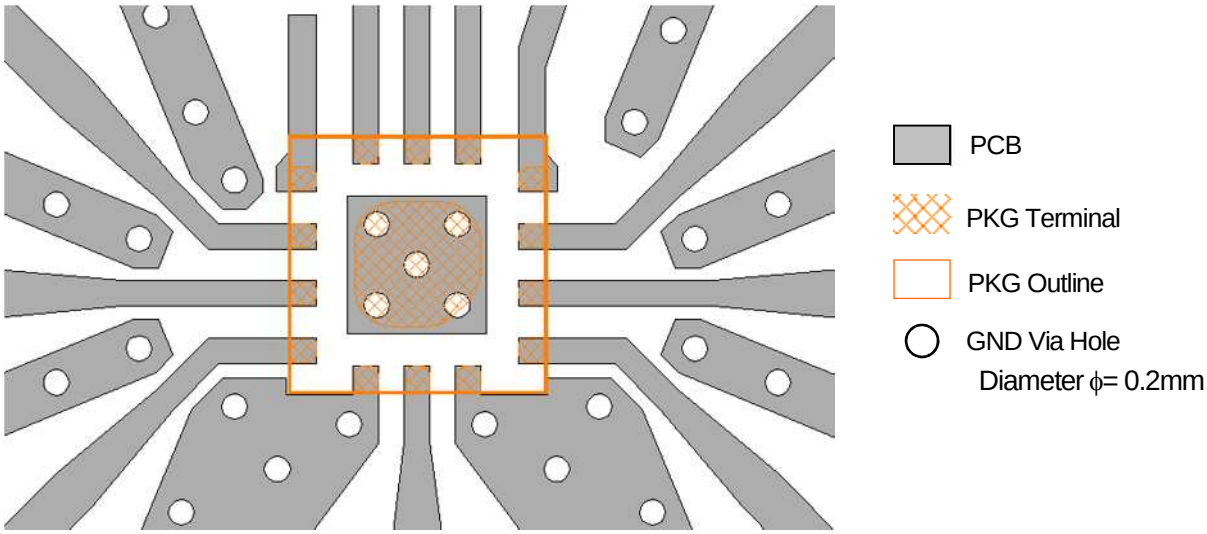
PCB Size=38.5 x 38.5mm

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.

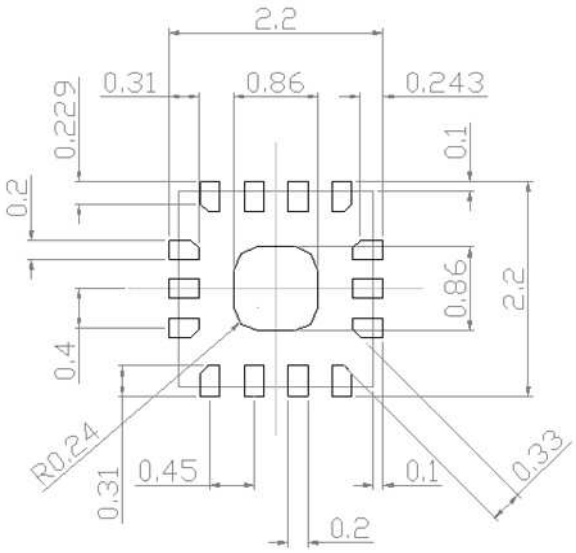
[2] To reduce strip line influence on RF characteristics, please locate the bypass capacitor C1 and C2 close to VDD and VIO terminal.

[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.

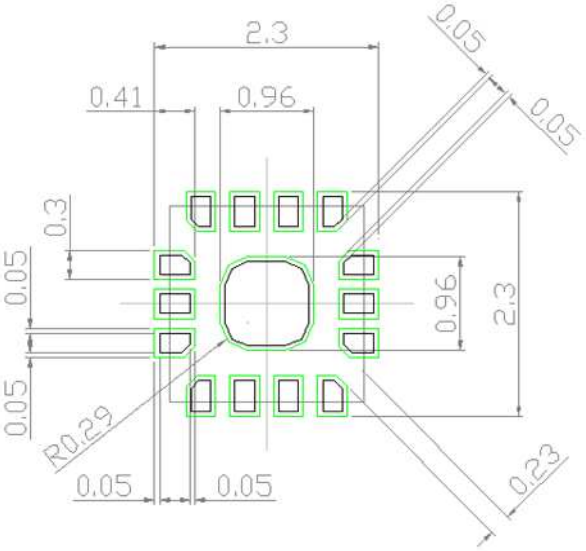
■RECOMMENDED FOOTPRINT PATTERN (EQFN14-ER PACKAGE Reference)

● **PCB METAL LAND PATTERN**

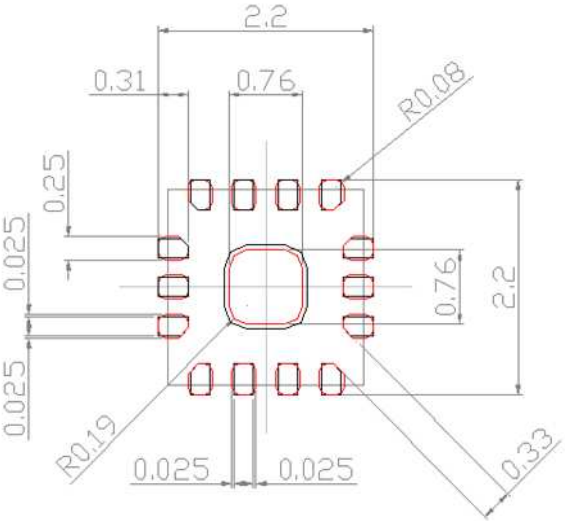
Unit : mm



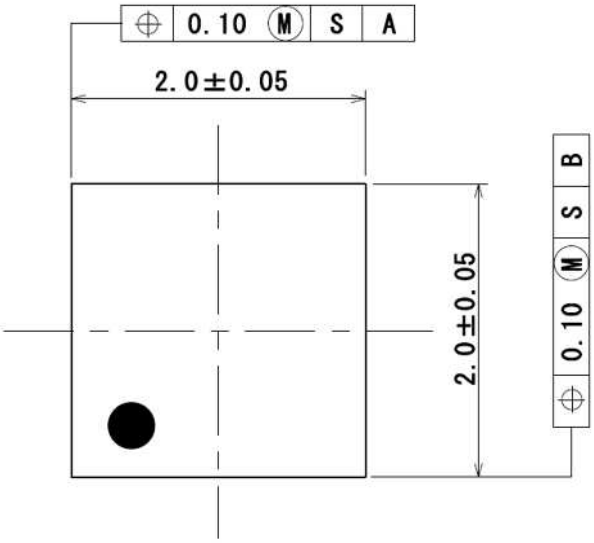
● **PCB SOLDER MASK PATTERN (SOLDER RESIST)** ■



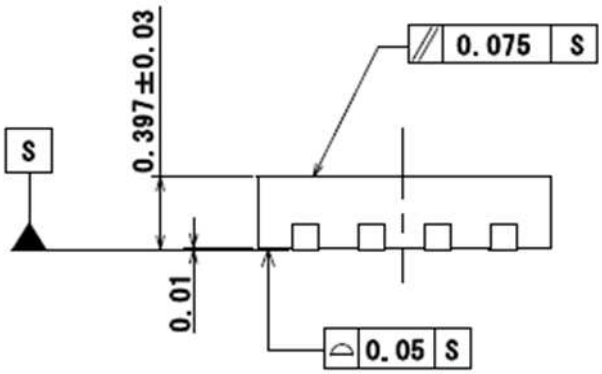
● **PCB STENCIL PATTERN (Metal mask thickness:100μm)** ■



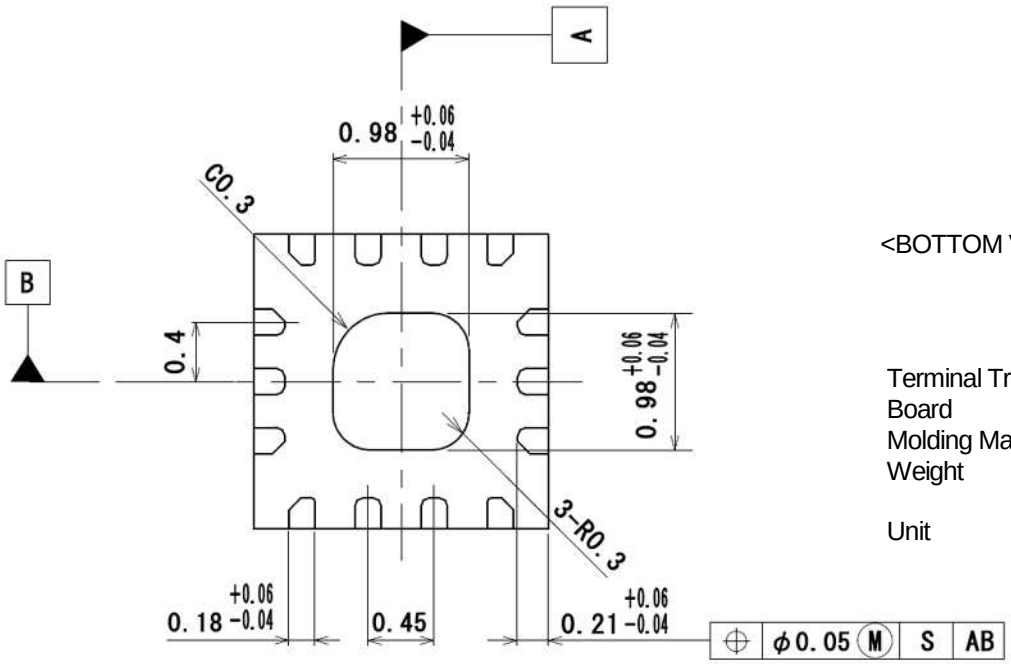
■PACKAGE OUTLINE



<TOP VIEW>



<SIDE VIEW>



<BOTTOM VIEW>

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

[CAUTION]

1. New JRC strives to produce reliable and high quality semiconductors. New JRC's semiconductors are intended for specific applications and require proper maintenance and handling. To enhance the performance and service of New JRC'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 rights.
All other trademarks mentioned herein are property of their respective companies.

3. To ensure the highest levels of reliability, New JRC 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. New JRC 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 New JRC's Sale's Office if you are uncertain about the products listed in this catalog.

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 the catalog 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)
   Life Maintenance Medical Equipment
   Fire Alarm/Intruder Detector
   Vehicle Control Equipment (airplane, railroad, ship, etc.)
   Various Safety devices

7. New JRC'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 catalog. Failure to employ New JRC products in the proper applications can lead to deterioration, destruction or failure of the products. New JRC shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of its products. 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). This Products uses 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, 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 catalog are subject to change at any time, without notice.