TS8029N - 100W CW, 631W Peak GaN RF Switch

1.0 Features

- Low TX insertion loss: 0.20dB @ 800MHz
- High isolation: 51dB @ 800MHz
- 631W Peak Power Handling
- Versatile 2.6-5.5V power supply
- Operating frequency: 700MHz to 5.0GHz

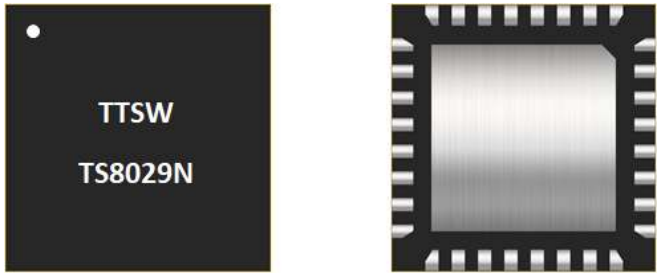


Figure 1 Device Image
(32 Pin 5×5×0.85mm QFN Package)

2.0 Applications

- Cellular infrastructure
- Small cells
- Macrocells
- ADS-B, IFF Systems

RoHS/REACH/Halogen Free Compliance

3.0 Description

The TS8029N is an asymmetrical reflective Single Pole Dual Throw (SPDT) switch designed for broadband, high power switching applications. With a simple broadband match, the TS8029N can cover 700MHz to 5.0GHz bandwidth and provide low insertion loss, high isolation and high linearity within a small package size. TS8029N is an excellent switch for all applications requiring low insertion loss, high isolation and high linearity within a small package size.

The TS8029N is packaged into a compact Quad Flat No lead (QFN) 5x5mm 32 leads plastic package.

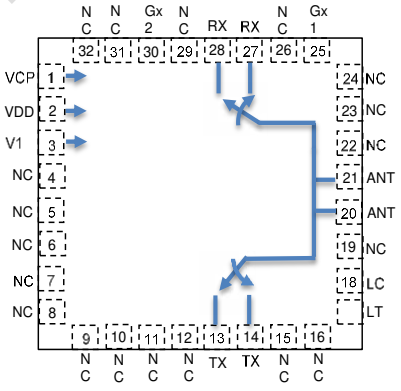


Figure 2 Function Block Diagram
(Top View)

4.0 Ordering Information

Table 1 Ordering Information

Base Part Number	Package Type	Form	Qty	Reel Diameter	Reel Width	Orderable Part Number
TS8029N	32 Pin 5×5×0.85mm QFN	Tape and Reel	1000	13” (330mm)	18mm	TS8029NMTRPBF
Evaluation Board						TS8029N-EVB

5.0 Pin Description

Table 2 Pin Definition

Pin Number	Pin Name	Description
1	VCP	Internal charge pump voltage output. Connect a 1nF capacitor to GND on this pin to improve switching time.
2	VDD	DC power supply
3	V1	Switch control input 1
4,5,6,7,8,9,10,11,16,23,24,31,32	NC	No internal connection, can be grounded
12,15,19, 22,26,29	NC	No internal connection. Must be left Open
13,14	TX	TX Port
17,18	LT, LC	Tuning Inductor
25,30	Gx1, Gx2	Tuning Capacitors for isolation
20,21	ANT	Antenna Port
27,28	RX	RX Port

Note: The backside ground (thermal) pad of the package must be grounded directly to the ground plane of PCB with multiple vias and adequate heat sinking must be used to ensure proper operation and thermal management.

6.0 Absolute Maximum Ratings

Table 3 Absolute Maximum Ratings @T_A=+25°C Unless Otherwise Specified

Parameter	Symbol	Value	Unit
Electrical Ratings			
Power Supply Voltage	VDD	2.6 to 5.5	V
Storage Temperature Range	T_{st}	-55 to +125	°C
Operating Temperature Range	T_{op}	-40 to +85	°C
Maximum Junction Temperature	T_J	+140	°C
RF Input Power CW, Tcase=+85°C, 800MHz	TX, ANT	80	W
RF Input Power Peak, Tcase=+85°C, 800MHz, 10% duty cycle, 10msec pulse width	TX, ANT	400	W
RF Input Power CW, Tcase=+85°C, 2.6GHz	TX, ANT	70	W
RF Input Power Peak, Tcase=+85°C, 2.6GHz, 1% duty cycle, 10usec pulse width	TX, ANT	500	W
Thermal Ratings			
Thermal Resistance (junction-to-case) – Bottom side	$R_{\theta JC}$	3.5	°C/W
Soldering Temperature	T_{SOLD}	260	°C
ESD Ratings			
Human Body Model (HBM)	Level 1B	500 to <1000	V
Charged Device Model (CDM)	Level C3	≥1000	V
Moisture Rating			
Moisture Sensitivity Level	MSL	1	-

Attention:

Maximum ratings are absolute ratings. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Exceeding one or a combination of the absolute maximum ratings may cause permanent and irreversible damage to the device and/or to surrounding circuit.

7.0 Electrical Specifications

Table 4 Electrical Specifications @T_A=+25°C Unless Otherwise Specified; VDD=+2.7V; 50Ω Source/Load.

Parameter	Condition	Minimum	Typical	Maximum	Unit
Operating frequency		700		5000	MHz
Insertion loss, TX	800MHz		0.23		dB
	1400MHz		0.27		
	2400MHz		0.41		
	3300MHz		0.45		
	3800MHz		0.48		
	4200MHz		0.58		
	5000MHz		0.78		
Insertion loss, RX	800MHz		0.52		dB
	1400MHz		0.61		
	2400MHz		0.62		
	3300MHz		0.69		
	3800MHz		0.70		
	4200MHz		0.71		
	5000MHz		0.88		
Isolation ANT-TX	800MHz		21		dB
	1400MHz		37		
	2400MHz		36		
	3300MHz		23		
	3800MHz		27		
	4200MHz		24		
	5000MHz		22		
Isolation ANT-RX	800MHz		53		dB
	1400MHz		46		
	2400MHz		40		
	3300MHz		38		
	3800MHz		36		
	4200MHz		34		
	5000MHz		33		
Return Loss RX	800MHz		21		dB
	1400MHz		19		
	2400MHz		19		
	3300MHz		22		
	3800MHz		23		
	4200MHz		26		
	5000MHz		30		
Return Loss TX	800MHz		19		dB
	1400MHz		21		
	2400MHz		14		
	3300MHz		17		
	3800MHz		20		
	4200MHz		16		

	5000MHz		15		
H2	800MHz, Pin=35dBm		TBD		dBc
H3	800MHz, Pin=35dBm		TBD		dBc
IIP3	800MHz		TBD		dBm
P0.1dB CW	0.1dB compression point, 800MHz		100		W
P0.1dB Peak	Duty Cycle 1% with 10usec pulse width, 800MHz		600		W
P0.1dB Peak	Duty Cycle 20% with 2.0msec pulse width, 800MHz		TBD		W
P0.1dB CW	0.1dB compression point, 2600MHz		100		W
P0.1dB Peak	Duty Cycle 1% with 10usec pulse width, 2600MHz		TBD		W
Switching time	50% ctrl to 10/90% of the RF value is settled. CP=1nF to ground on VCP pin.		1.2	1.6	μs
	800MHz				
	1400MHz				
	2400MHz				
	3300MHz				
	3800MHz				
	4200MHz				
Control voltage	Power Supply VDD	2.6	3.3	5.5	V
	All control pins high, V_{ih}	1.0	3.3	5.25	V
	All control pins low, V_{il}	-0.3		0.5	V
Control current	All control pins low, I_{il}		0		μA
	All control pins high, I_{ih}			7.5	μA
Current consumption, IDD	Active mode (VDD on)		160	200	μA

Note:

[1] P0.1dB is a figure of merit.

[2] No external DC blocking capacitors required on RF pins unless DC voltage is applied on a RF pin.

8.0 Switch Truth Table

Table 5 Switch Truth Table

V1	Active RF Path
0	ANT-RX
1	ANT-TX

Attention:
[1] VDD should be applied first before V1, otherwise may cause damage to the device.
[2] There is an internal pull-down to ground on V1 control pin, the state at start-up without any control voltage applied will be ANT-RX.

9.0 Evaluation Board

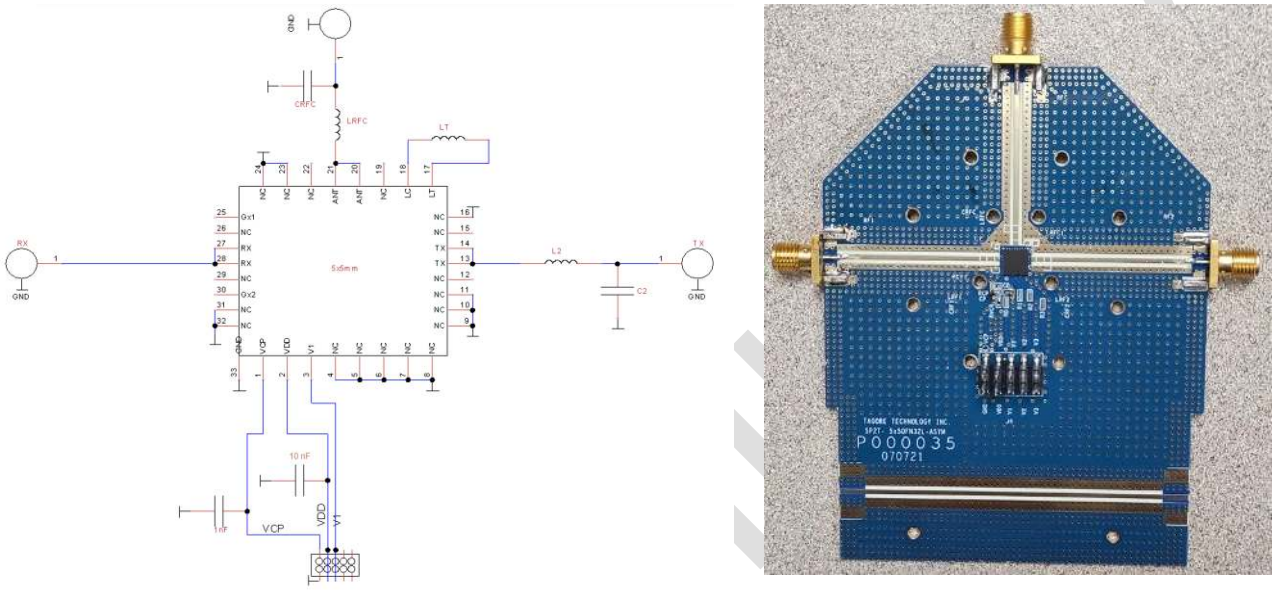


Figure 3 Evaluation Board Schematic and picture

Attention:
[1] **33 refers to the center pad of the device. Multiple Plugged through hole vias should be added on this Ground Pad and adequate heat sinking should be added.**
[2] The purpose of connection between VCP and connector N1 is to monitor VCP, do not apply external voltage to VCP.

Table 6 Matching components for various frequency bands

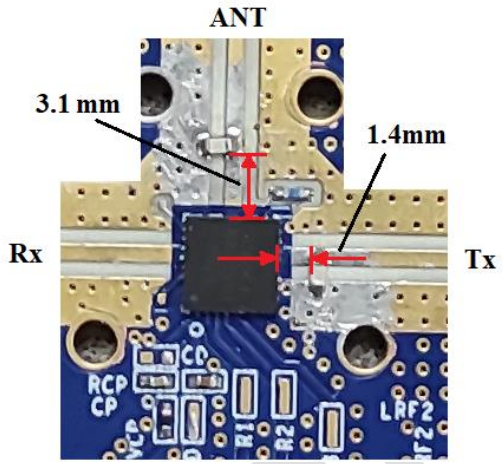
Freq	LT	LRFC	L2	CRFC	C2	CP	CDD
0.5 – 1.0GHz	DNP	DNP	DNP	DNP	DNP	1nF	10nF
1.2 – 1.4GHz	39.0nH	3.5nH	DNP	0.8	DNP	1nF	10nF
2.3 – 2.6GHz	12nH	1.7nH	DNP	0.5pF	DNP	1nF	10nF
3.3 – 3.8GHz	5.4nH	0.8nH	1.0nH	0.5pF	0.6pF	1nF	10nF
3.8 – 4.2GHz	5.4nH	0.6nH	1.0nH	0.5pF	0.6pF	1nF	10nF

4.4 – 5.0GHz	2.7nH	TL3.1mm	TL1.4mm	0.4pF	0.7pF	1nF	10nF

#Note:

Inductors: ATC 0402WL or Coilcraft 0402HP/DC series

Capacitors: Passive Plus 0603N series



TL length for 4.4-5.0GHz matching

11.1 Typical Characteristics (Tune 0.5 – 1.0GHz)

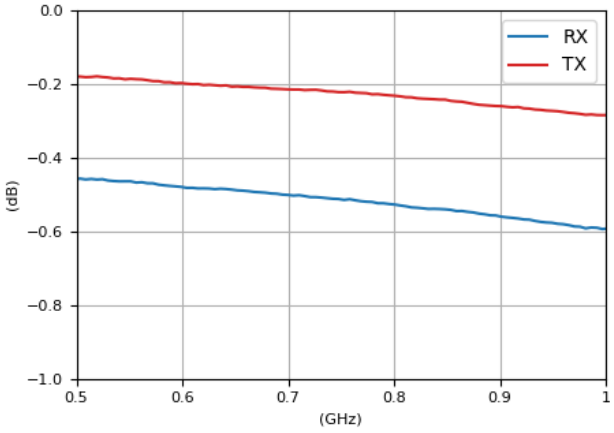


Figure 4 Insertion Loss

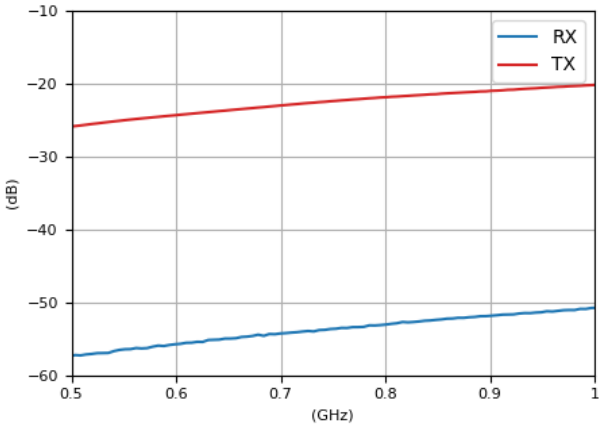


Figure 5 Isolation

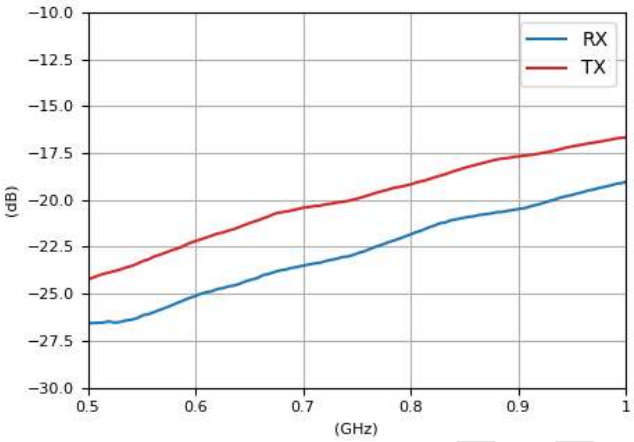


Figure 6 Return Loss

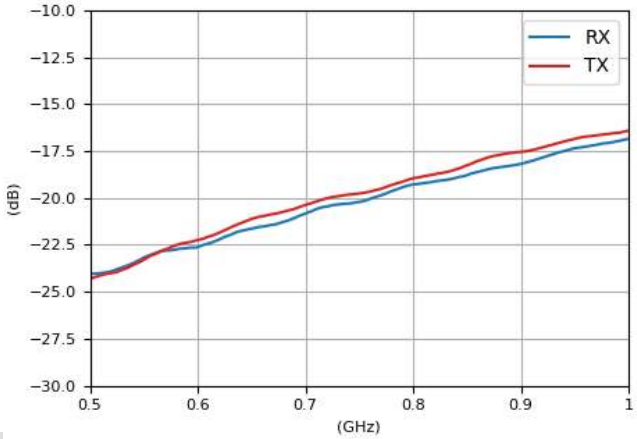


Figure 7 ANT Return Loss

11.2 Typical Characteristics (Tune 1.2 – 1.4GHz)

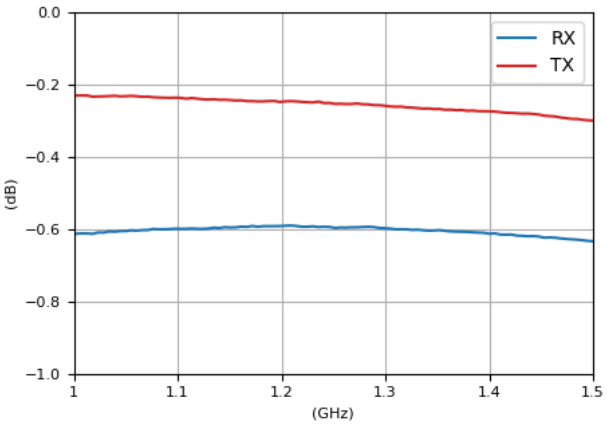


Figure 8 Insertion Loss

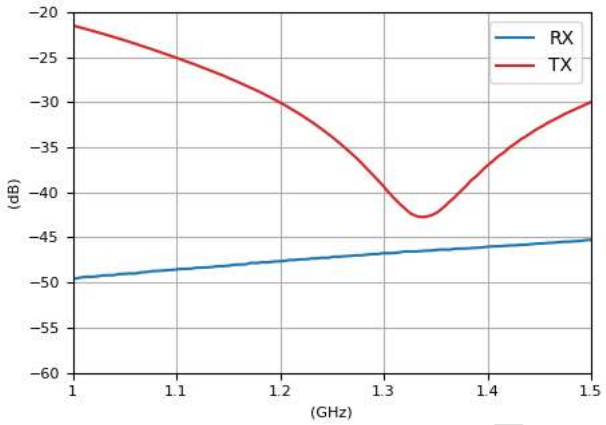


Figure 9 Isolation

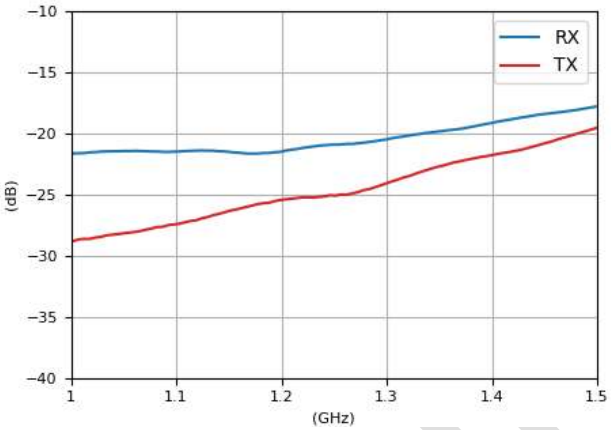


Figure 10 Return Loss

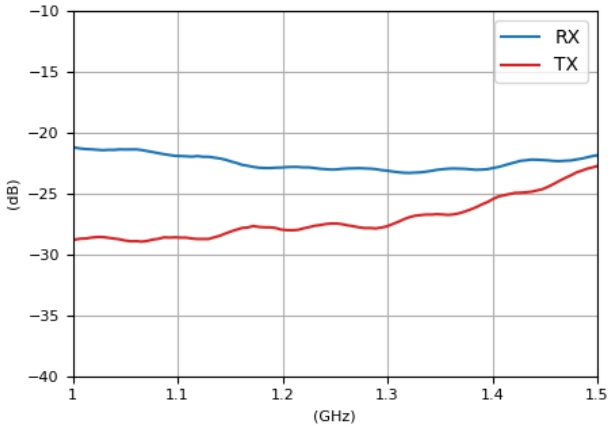


Figure 11 ANT Return Loss

11.3 Typical Characteristics (Tune 2.3 – 2.6GHz)

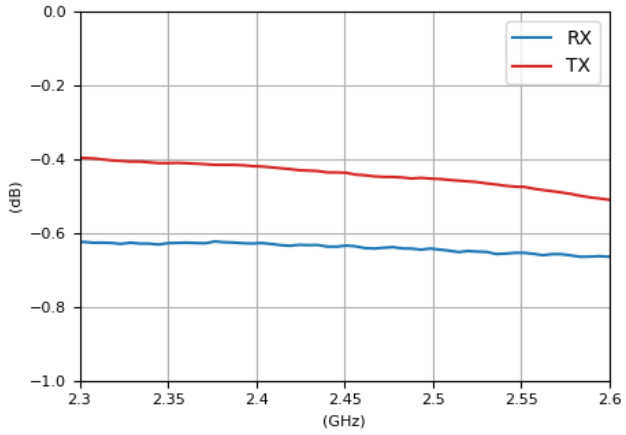


Figure 12 Insertion Loss

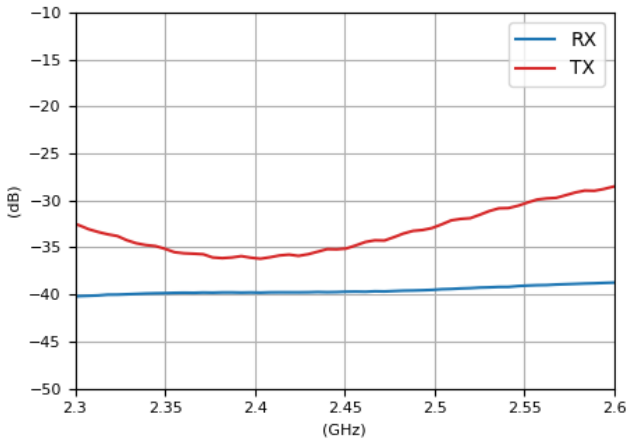


Figure 13 Isolation

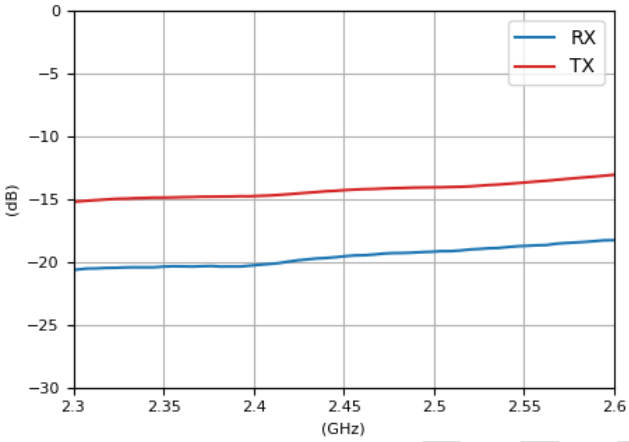


Figure 14 Return Loss

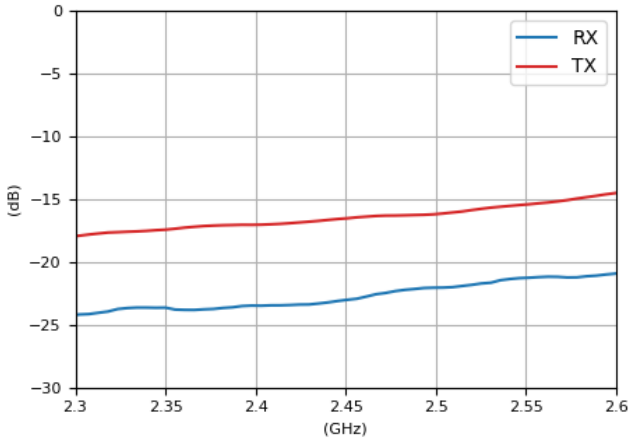


Figure 15 ANT Return Loss

11.4 Typical Characteristics (Tune 3.3 – 3.8GHz)

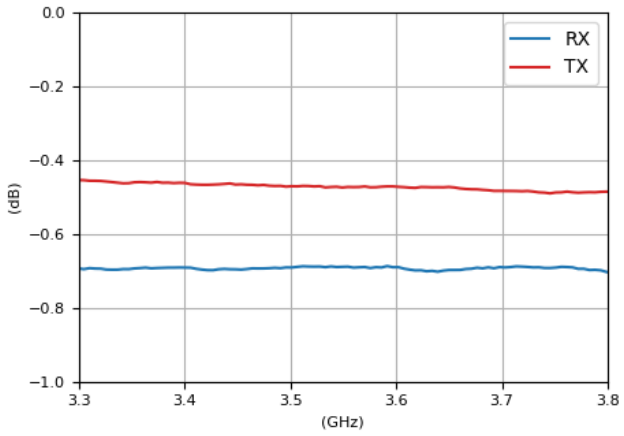


Figure 16 Insertion Loss

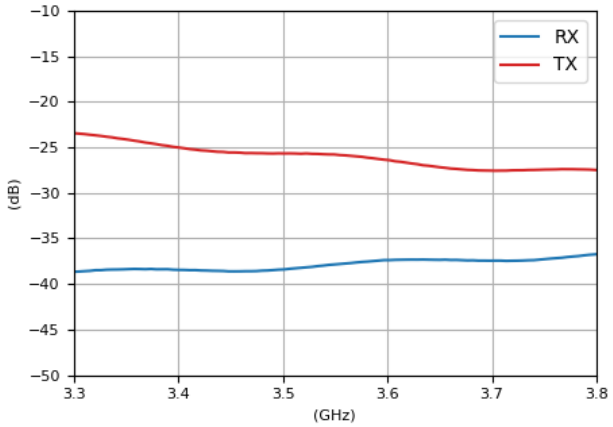


Figure 17 Isolation

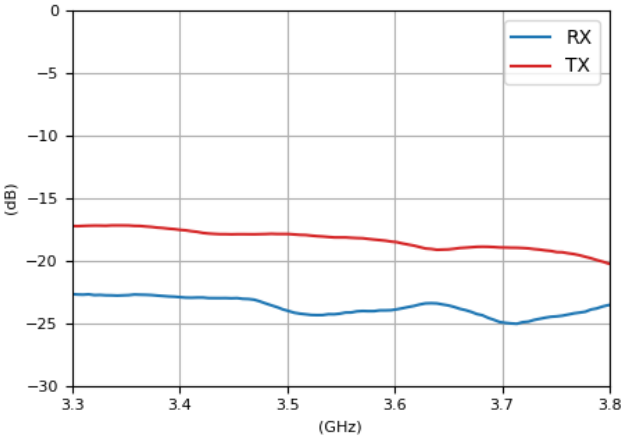


Figure 18 Return Loss

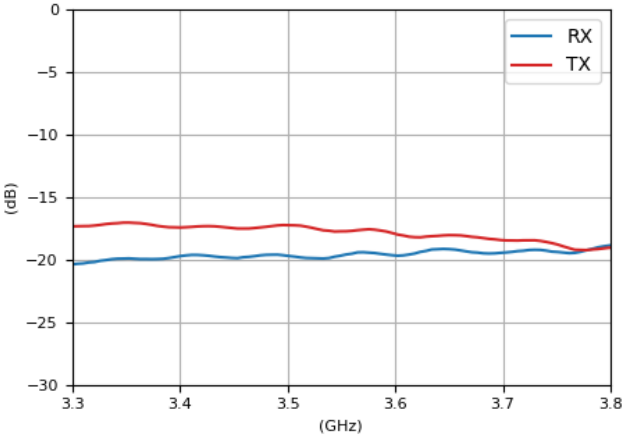


Figure 19 ANT Return Loss

11.5 Typical Characteristics (Tune 3.8 – 4.2GHz)

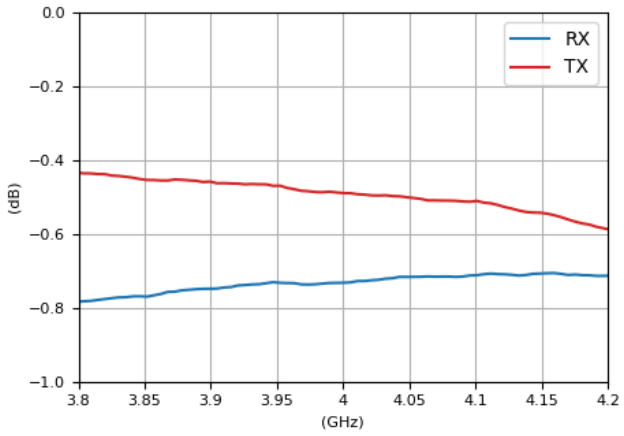


Figure 20 Insertion Loss

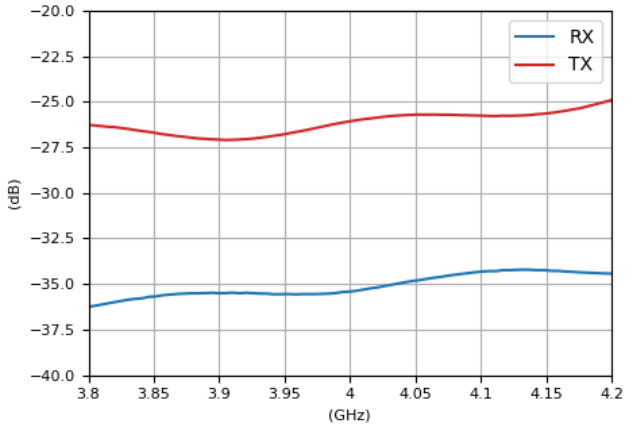


Figure 21 Isolation

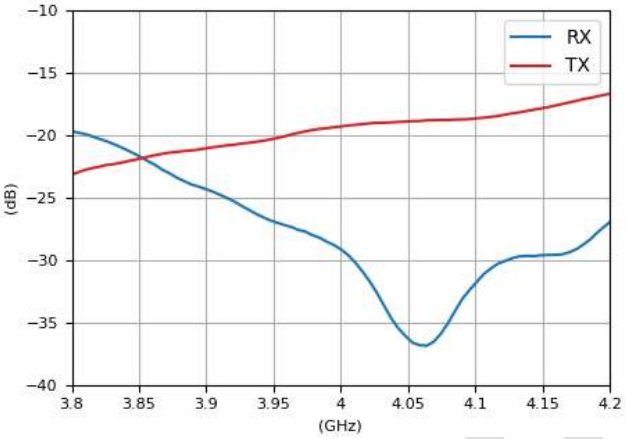


Figure 22 Return Loss

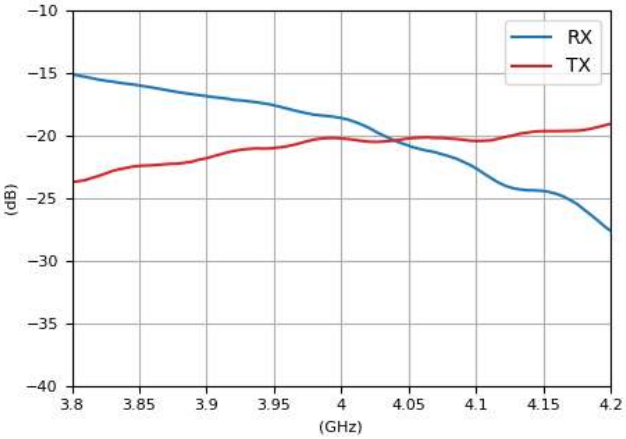


Figure 23 ANT Return Loss

11.6 Typical Characteristics (Tune 4.4 – 5.0GHz)

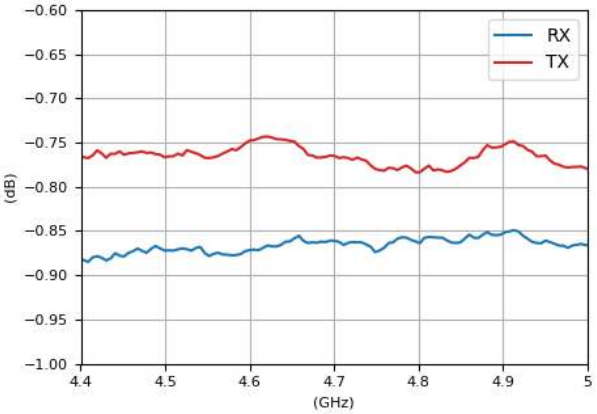


Figure 24 Insertion Loss

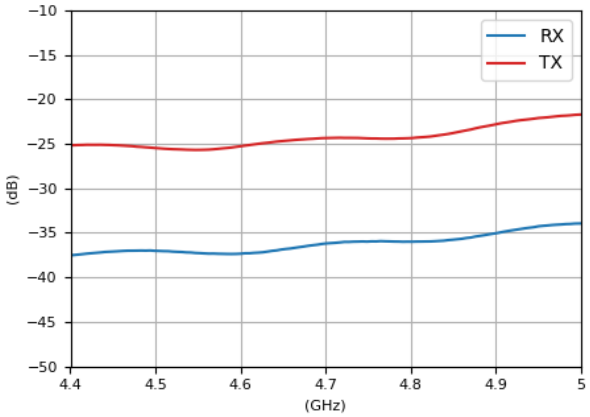


Figure 25 Isolation

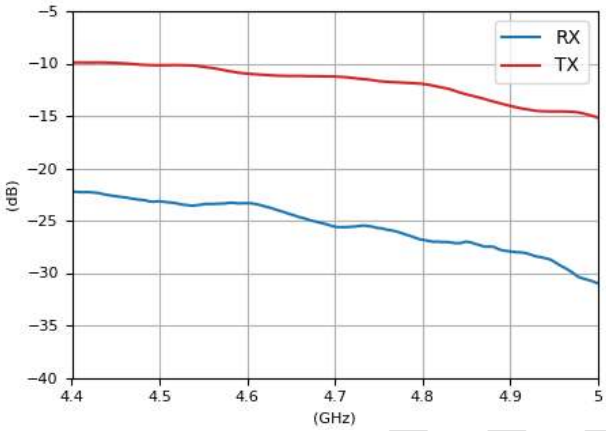


Figure 26 Return Loss

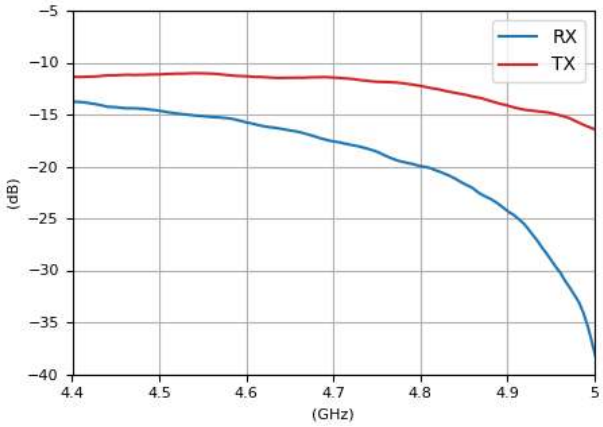


Figure 27 ANT Return Loss

12.0 Device Package Information

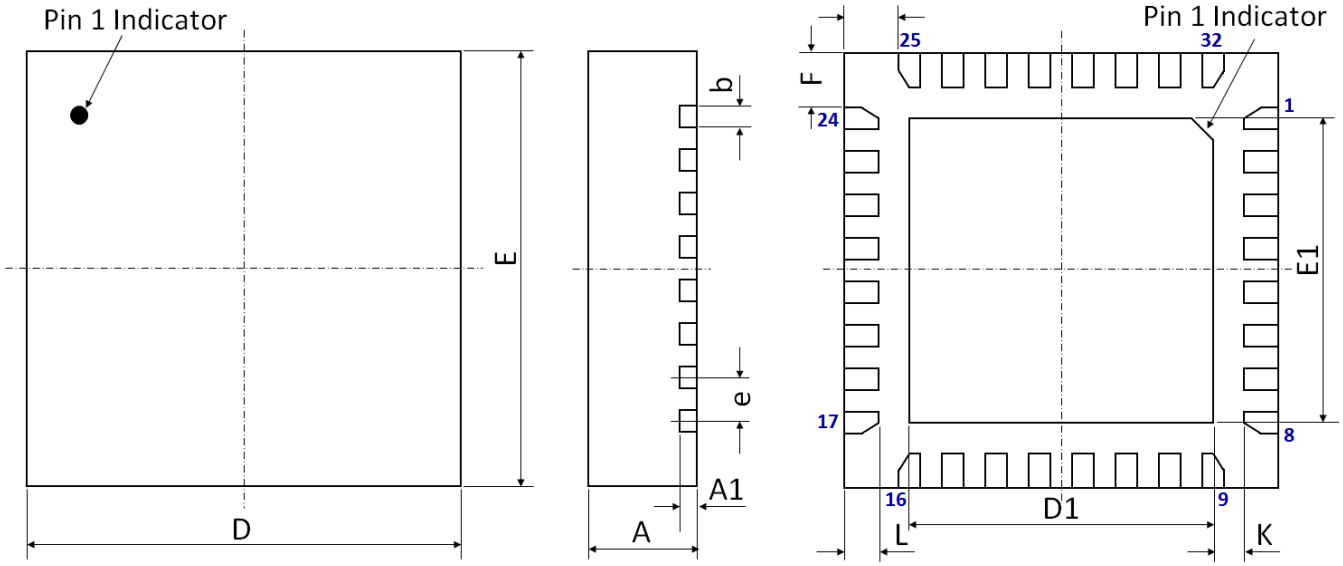


Figure 28 Device Package Drawing
(All dimensions are in mm)

Table 7 Device Package Dimensions

Dimension (mm)	**Value** (mm)	**Tolerance** (mm)	**Dimension** (mm)	**Value** (mm)	**Tolerance** (mm)
A	0.85	±0.05	E	5.00 BSC	±0.05
A1	0.203	±0.02	E1	3.20	±0.06
b	0.25	+0.05/-0.07	F	0.625	±0.05
D	5.00 BSC	±0.05	G	0.625	±0.05
D1	3.20	±0.06	L	0.40	±0.05
e	0.50 BSC	±0.05	K	0.50	±0.05

Note: Lead finish: Pure Sn without underlayer; Thickness: 7.5μm ~ 20μm (Typical 10μm ~ 12μm)

Attention:
Please refer to application notes *TN-001* and *TN-002* at http://www.tagoretech.com for PCB and soldering related guidelines.

13.0 PCB Land Design

Guidelines:
[1] 4 layer PCB is recommended.
[2] Via diameter is recommended to be 0.2mm to prevent solder wicking inside the vias.
[3] Thermal vias shall only be placed on the center pad.
[4] The maximum via number for the center pad is 5(X)×5(Y)=25.

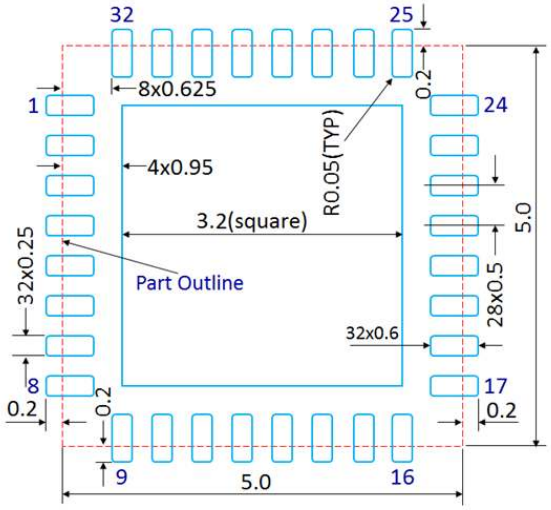


Figure 29 PCB Land Pattern
(Dimensions are in mm)

Non-Solder Mask Defined (Preferred)

Solder Mask Defined

Figure 30 Solder Mask Pattern
(Dimensions are in mm)

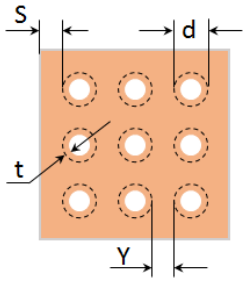


Figure 31 Thermal Via Pattern
(Recommended Values: S≥0.15mm; Y≥0.20mm; d=0.2mm; Plating Thickness t=25μm or 50μm)

14.0 PCB Stencil Design

Guidelines:

[1] Laser-cut, stainless steel stencil is recommended with electro-polished trapezoidal walls to improve the paste release.

[2] Stencil thickness is recommended to be 125μm.

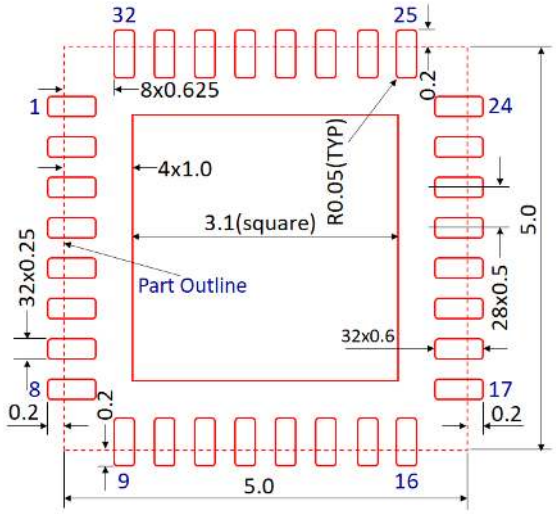


Figure 32 Stencil Openings
(Dimensions are in mm)

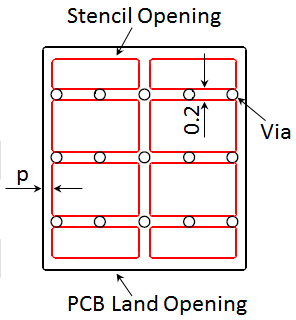


Figure 33 Stencil Openings Shall not Cover Via Areas If Possible
(Dimensions are in mm)

15.0 Tape and Reel Information

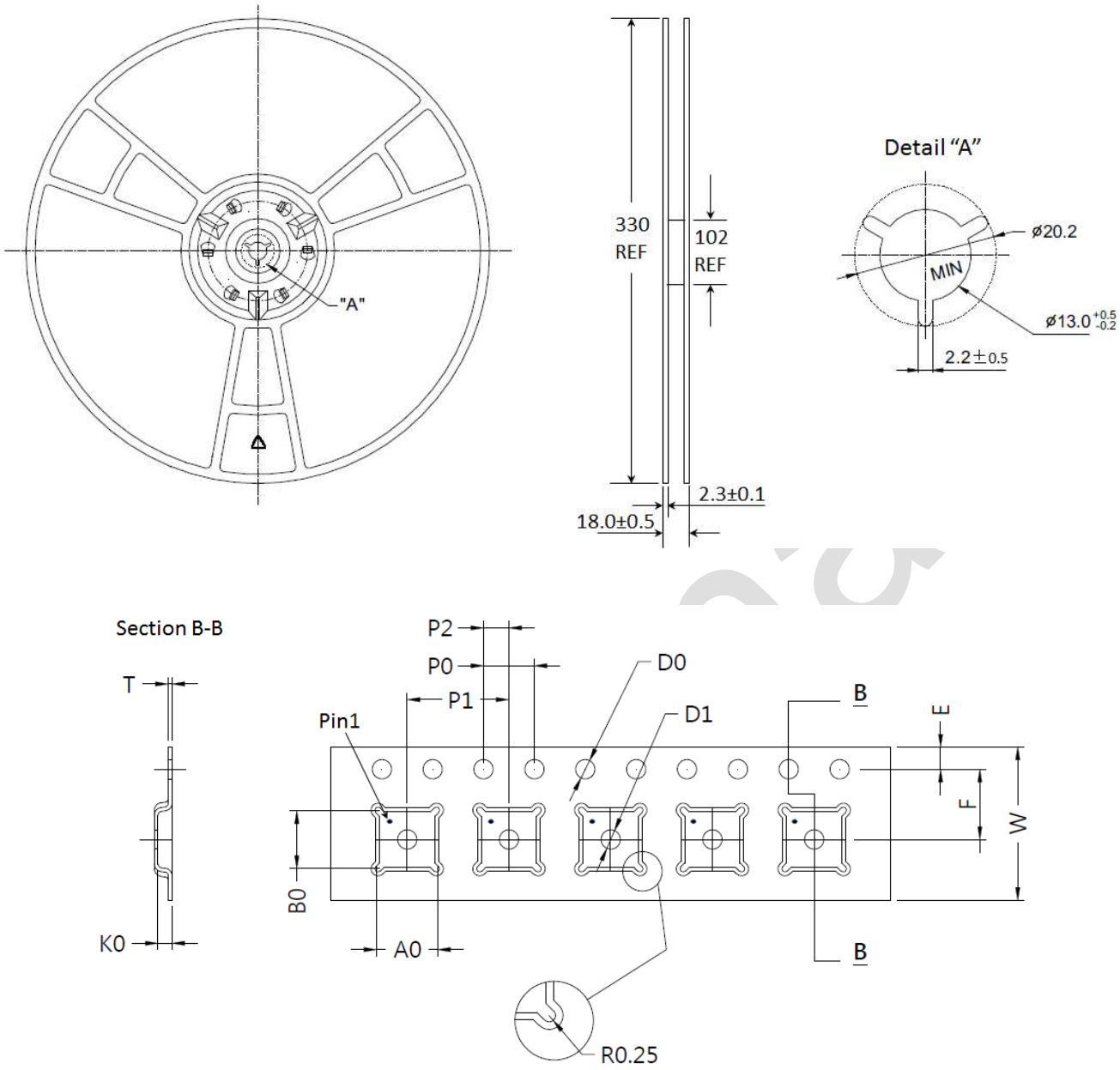


Figure 34 Tape and Reel Drawing

Table 8 Tape and Reel Dimensions

Dimension (mm)	**Value** (mm)	**Tolerance** (mm)	**Dimension** (mm)	**Value** (mm)	**Tolerance** (mm)
A0	5.35	±0.10	K0	1.10	±0.10
B0	5.35	±0.10	P0	4.00	±0.10
D0	1.50	+0.10/-0.00	P1	8.00	±0.10
D1	1.50	+0.10/-0.00	P2	2.00	±0.05
E	1.75	±0.10	T	0.30	±0.05
F	5.50	±0.05	W	12.00	±0.30

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