# TS8021N - 100W CW, Broadband SPDT GaN RF Switch

## 1.0 Features

- Low insertion loss: 0.5dB @ 4GHz
- High isolation: 42dB @ 0.8GHz, 20dB @ 4GHz
- 100W CW, 150W Peak Power
- No external DC blocking capacitors on RF lines
- All RF ports OFF state
- Versatile 2.6-5.25V power supply
- Operating frequency: 30MHz to 4GHz

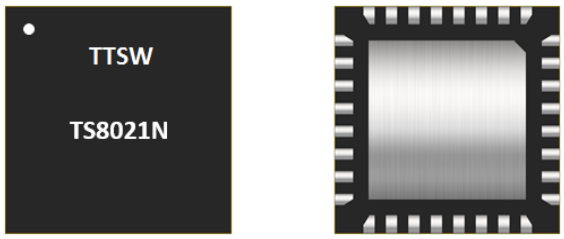


**Figure 1 Device Image**
(32 Pin 5×5×0.5mm QFN Package)

## 2.0 Applications

- Private mobile and military radios
- Public safety handsets
- Cellular infrastructure
- Small cells
- LTE relays and microcells
- Satellite terminals

**RoHS/REACH/Halogen Free Compliance**

## 3.0 Description

The TS8021N is a 2nd Generation symmetrical reflective Single Pole Dual Throw (SPDT) switch designed for broadband, high power switching applications. With a simple broadband match, the TS8021N can cover 30M to 4GHz bandwidth and provide low insertion loss, high isolation, and high linearity within a small package size. TS8021N is an excellent switch for all applications requiring low insertion loss, high isolation, and high linearity within a small package size.

The TS8021N is packaged into a compact Quad Flat No lead (QFN) 5x5mm 32 leads plastic package.

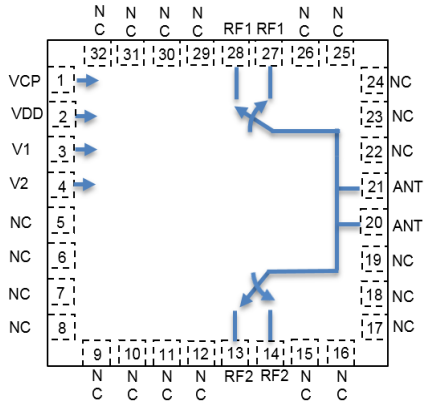


**Figure 2 Function Block Diagram**
(Top View)

## 4.0 Ordering Information

**Table 1a Ordering Information**

| Device Part Number | Package Type | Eval Board Part Number |
|---|---|---|
| TS8021N | 32 Pin 5×5×0.8mm QFN | TS8021N-EVB |

**Table 1b Tape and Reel Information**

| Form | Quantity | Reel Diameter | Reel Width |
|---|---|---|---|
| Tape and Reel | 5,000 | 13” (330mm) | 18mm |

## 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 | V2 | Switch control input 2 |
| 5,6,7,8,9,10,11,16,17, 18,23,24,25,30,31,32 | NC | No internal connection, can be grounded |
| 12,15,19,22,26,29 | NC | No internal connection. Do not connect to ground |
| 13,14 | RF2 | RF port 2 |
| 20,21 | ANT | Antenna port |
| 27,28 | RF1 | RF port 1 |

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 | 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 |
| **Thermal Ratings** | | | |
| Thermal Resistance (junction-to-case) – Bottom side | $R_{\theta JC}$ | 7.0 | °C/W |
| Thermal Resistance (junction-to-top) | $R_{\theta JT}$ | ≤ 26 | °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=+3.3V; 50Ω Source/Load.

| Parameter | Condition | Minimum | Typical | Maximum | Unit |
|---|---|---|---|---|---|
| Operating frequency | | 30 | | 4000 | MHz |
| Insertion loss, RFx | 800MHz | | 0.2 | 0.35 | dB |
| | 1.95GHz | | 0.3 | | |
| | 4.0GHz | | 0.5 | | |
| Isolation ANT-RFx | 800MHz | 38 | 42 | | dB |
| | 1.95GHz | | 32 | | |
| | 4.0GHz | | 20 | | |
| Return loss ANT, RFx | 800MHz | | 19 | | dB |
| | 1.95GHz | | 16 | | |
| | 4.0GHz | | 15 | | |
| **Harmonic distortion** | | | | | |
| H2 | 800MHz, Pin=45dBm | | -87 | | dBc |
| H3 | 800MHz, Pin=45dBm | | -95 | | dBc |
| IIP3 | 800MHz | | 71 | | dBm |
| P0.1dB[1] | 800MHz, CW | | 50 | | dBm |
| Peak P0.1dB[1] | 800MHz, 1% duty cycle, 1 mS period. | | 52 | | dBm |
| Switching time | 50% ctrl to 10/90% of the RF value is settled. CP=1nF to ground on VCP pin. | | 5.2 | | μs |
| Control voltage | Power Supply VDD | 2.6 | 3.3 | 5.25 | 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 | V2 | Active RF Path |
|---|---|---|
| 0 | 1 | All OFF |
| 0 | 0 | ANT-RF1 ON |
| 1 | 0 | ANT-RF2 ON |

**Attention:**

[1] VDD should be applied first before V1 and V2, otherwise may cause damage to the device.

[2] There are internal pull-downs to ground on both V1 and V2 control pins, the state at start-up without any control voltage applied will be ANT-RF1 ON.

[3] If all OFF state is not used, the switch can be operated with single control pin V1.

## 9.0 Evaluation Board (matched)

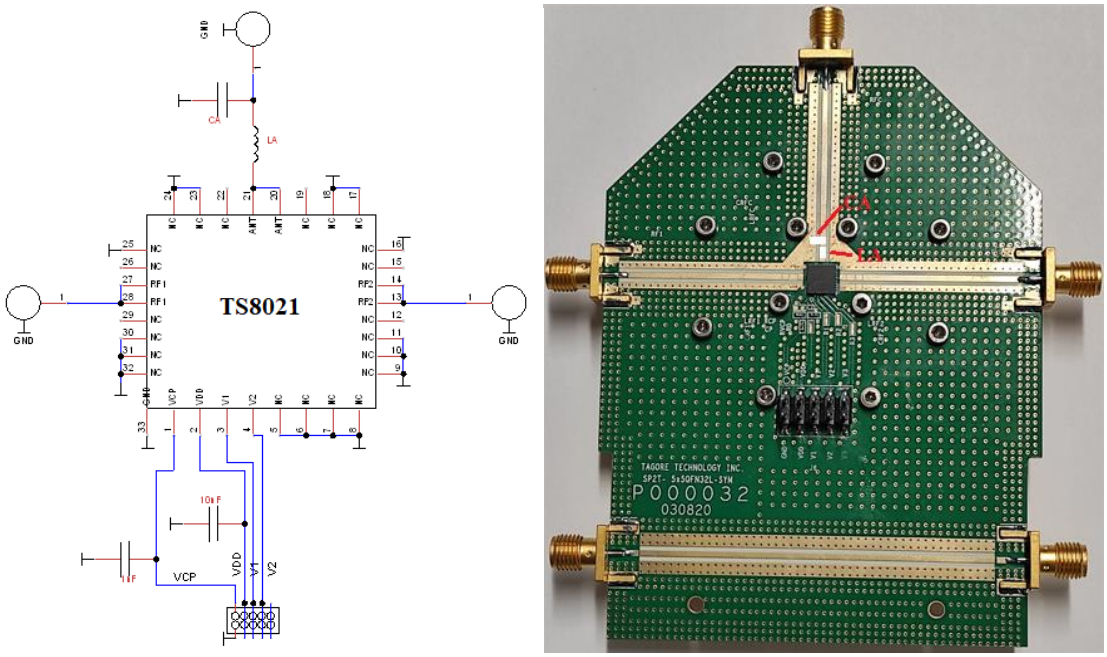


**Figure 3 Evaluation Board and Schematic**

**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 used.

[2] The purpose of connection between VCP and connector N1 is to monitor VCP, do not apply external voltage to VCP.

[3] Place matching components close to pin of the part.

**Table 6 Recommended Evaluation Board Component Values**

| Reference Designator | Value | Part # | Manufacturer |
|---|---|---|---|
| LA | 0.8nH | 0402DC-N80XJRU | Coilcraft |
| CA | 0.5pF | 0603 | |

## 10.0 Typical Characteristics

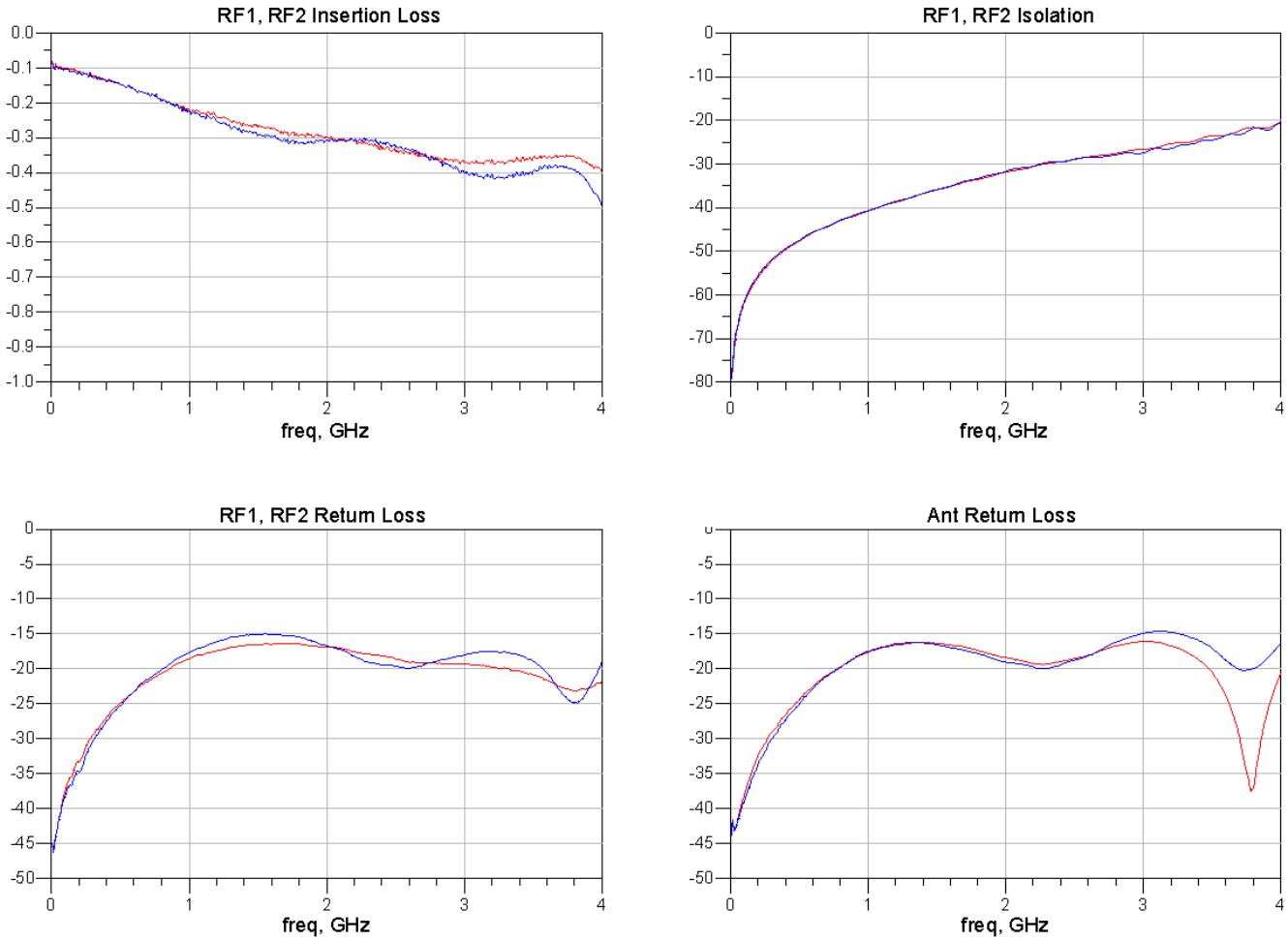


**Figure 4 Evaluation Board Typical Characteristics (Matched)**

## 11.0 Device Package Information

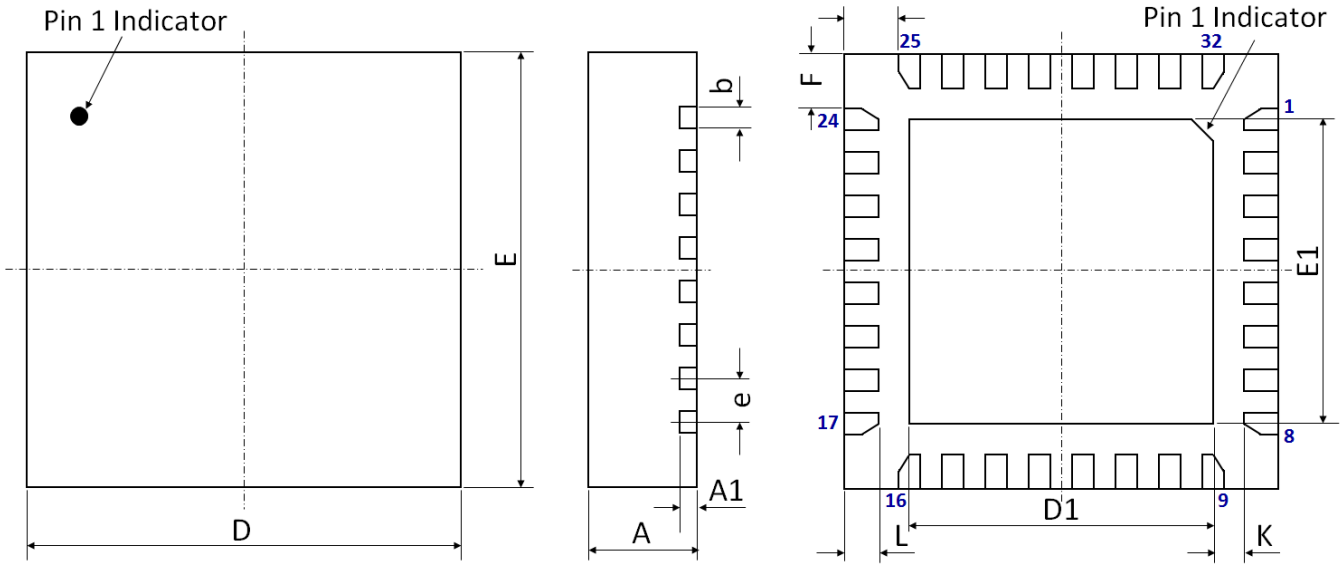


**Figure 5 Device Package Drawing**
(All dimensions are in mm)

**Table 7 Device Package Dimensions**

| **Dimension** (mm) | **Value** (mm) | **Tolerance** (mm) | **Dimension** (mm) | **Value** (mm) | **Tolerance** (mm) |
|---|---|---|---|---|---|
| A | 0.8 | ±0.05 | E | 5.00 BSC | ±0.05 |
| A1 | 0.203 | ±0.02 | E1 | 3.10 | ±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 | 3.10 | ±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-003* at http://www.tagoretech.com for PCB and soldering related guidelines.

## 12.0 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.

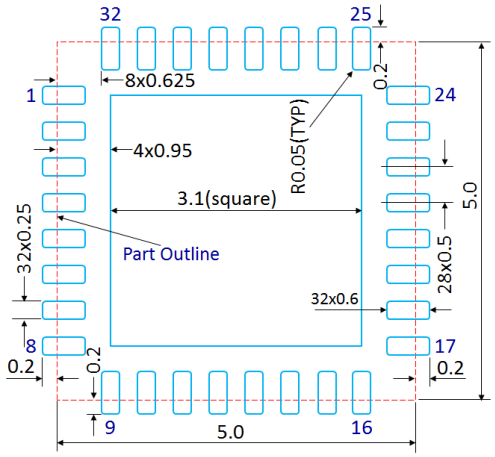


**Figure 6 PCB Land Pattern**
(Dimensions are in mm)


Non-Solder Mask Defined
(Preferred)

Solder Mask Defined

**Figure 7 Solder Mask Pattern**
(Dimensions are in mm)

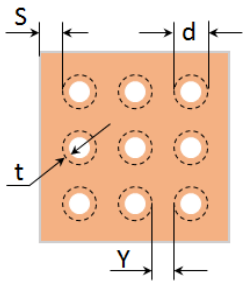


**Figure 8 Thermal Via Pattern**
(Recommended Values: S≥0.15mm; Y≥0.20mm; d=0.2mm; Plating Thickness t=25μm or 50μm)

## 13.0 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.

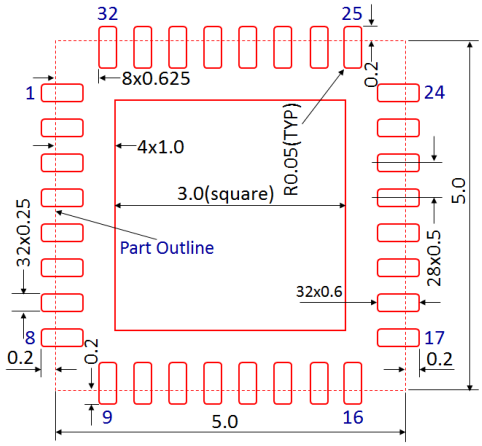


**Figure 9 Stencil Openings**
(Dimensions are in mm)

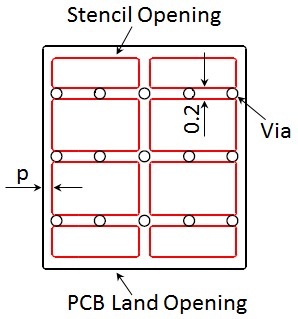


**Figure 10 Stencil Openings Shall not Cover Via Areas If Possible**
(Dimensions are in mm)

## 14.0 Tape and Reel Information

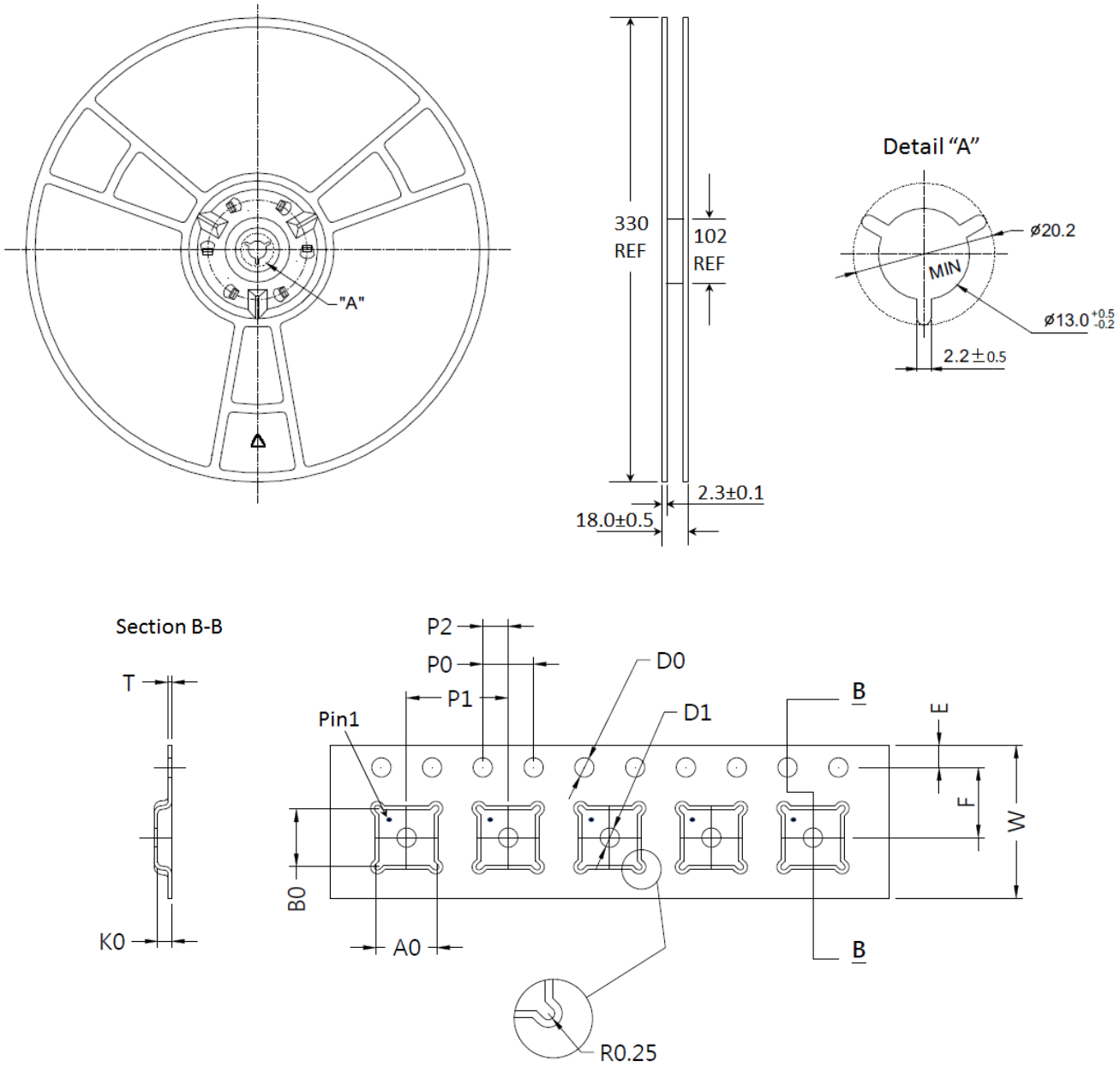


**Figure 11 Tape and Reel Drawing**

**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 |

**Edition Revision 1.0 - 2021-11-01**

**Published by**
Tagore Technology Inc.
5 East College Drive, Suite 200
Arlington Heights, IL 60004, USA



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