# 4T Shunt tuning switch, $R_{ON}$=0.5Ω, $V$=100 V

## Features

- Full integrated solution, single $V_{DD}$=2.6 V – 5.25 V
- Frequency Range 1 MHz to 1000 MHz
- $R_{ON} = 0.5\,\Omega$
- Throws grounded inside the package
- $V_{PEAK} = 100$ V
- Highest pulse power in the industry
- No sudden voltage breakdown compared to SOI
- Switch time = 5.9 $\mu$s, no power derating
- Low power consumption, less than 1 mW
- No need to supply negative voltages

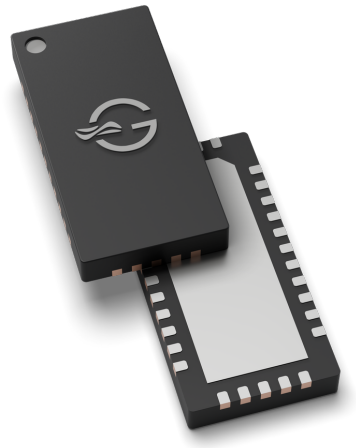


Figure 1: TS63432D in 6.0 x 3.0 mm$^2$ QFN 32-pin package.

## Applications

- Tactical radio
- Tunable filters
- Antenna tuning
- Medical - Ultrasound
- Medical - MRI

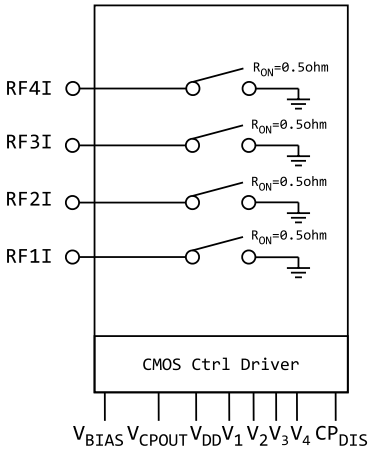



Figure 2: TS63432D functional diagram

## General Description

The TS63432D is a fully integrated 4-throw (4T) shunt tuning switch based on GaN technology, designed for high power tunable antenna and filter applications in the HF, VHF, UHF, and L bands. Covering 1 MHz to 1 GHz, it combines low on-resistance ($R_{ON} = 0.5\,\Omega$) with high linearity in a small package size. The TS63432D is the TS63430D with the outputs of the four throws bonded to the ground pad inside the package: each throw switches its RFxI pin to ground with a short, low-inductance ground connection. The peak voltage capability is 100 V. The TS63432D operates from a single standard $V_{DD}$ supply; no external negative or high voltages are required, as bias generation is fully integrated.

The TS63432D is packaged into a compact Quad Flat No lead (QFN) 6.0x3.0 mm$^2$ 32 leads plastic package.

RoHS

RoHS10/REACH/Halogen free

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# Ordering information

Table 1: Ordering Information

| Device Part Number | Package Type | Notes |
|---|---|---|
| TS63432D | 32 Pin 6.0x3.0x0.75 $mm^3$ QFN | Core part number |
| TS63432D-EVB | Evaluation Board | |
| TS63432DMTRPBF[1] | 330 mm reel, 3 000 pcs | Full reel |

[1] MTRPBF - M: Manufacturing, TR: Tape and Reel, and PBF: lead free.

Table 2: Tape and Reel Information

| Form | Quantity | Reel Diameter | Reel Width |
|---|---|---|---|
| Tape and Reel | 3 000 | 13” (330mm) | 18mm |


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## Pin Assignment

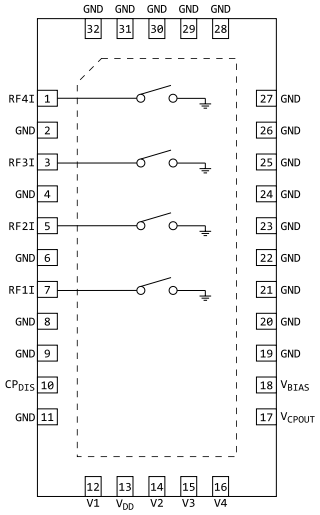



Figure 3: TS63432D pin assignment [top view]

Table 3: Pin Definition

| Pin Number | Pin Name | Description |
|---|---|---|
| 1 | RF4I | RF port 4, throw 4 to ground |
| 3 | RF3I | RF port 3, throw 3 to ground |
| 5 | RF2I | RF port 2, throw 2 to ground |
| 7 | RF1I | RF port 1, throw 1 to ground |
| 18 | $V_{BIAS}$ | Bias voltage input, -18 V...-20 V, either from external source or internal charge pump |
| 17 | $V_{CPOUT}$ | Internal charge pump voltage output. |
| 13 | $V_{DD}$ | DC Power Supply |
| 10 | $CP_{DIS}$ | Disable Internal Charge Pump[3] |
| 12 | $V_1$ | Switch control input 1 (RF1I – GND) |
| 14 | $V_2$ | Switch control input 2 (RF2I – GND) |
| 15 | $V_3$ | Switch control input 3 (RF3I – GND) |
| 16 | $V_4$ | Switch control input 4 (RF4I – GND) |
| 2,4,6,8,9,11,19,20,21,22, 23,24,25,26,27,28,29,30,31,32 | GND | Connect to ground[2] |
| 33 [1] | GND | Ground thermal pad, please connect to GND |

[1] 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.
[2] These pins are NC pins inside the package (pins 21, 23, 25 and 27 are the RF outputs of the TS63430D; on the TS63432D the throw outputs are bonded to the ground pad). To avoid floating pins around RF lines, we request these to be connected to ground.
[3] Feeding $V_{DD}$ to this pin disables the internal charge pump. In this case, ground $V_{CPOUT}$ and feed -18 V...-20 V to $V_{BIAS}$.


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# Absolute Maximum Ratings

Table 4: Absolute Maximum Ratings $T_A = +25$°C unless otherwise specified[1].

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| **Electrical Ratings** | | | |
| Power Supply Voltage | $V_{DD}$ | 5.5 | V |
| Storage Temperature Range | $T_{st}$ | −55 – 125 | °C |
| Operating Temperature Range | $T_{op}$ | −40 – 85 | °C |
| Maximum Junction Temperature | $T_j$ | +140 | °C |
| Maximum RF CW input power | RFxI | tbd | dBm |
| Maximum RF peak input power, 1% duty cycle, 10$\mu$s pulse | RFxI | tbd | dBm |
| Maximum RF peak voltage | RFxI | tbd | V |
| Maximum (min) bias voltage | $V_{BIAS}$ | -21 | V |
| **Thermal Ratings** | | | |
| Thermal Resistance (junction-to-case) – Bottom side | $R_{\theta jc}$ | tbd | °C/W |
| Thermal Resistance (junction-to-top) | $R_{\theta jt}$ | tbd | °C/W |
| Soldering Temperature | $T_{solder}$ | +260 | °C |
| **ESD Ratings** | | | |
| Human Body Model (HBM) | Level 1B | 500 – $<$1000 | V |
| Charged Device Model (CDM) | Level C3 | $\geq$1000 | V |
| **Moisture Rating** | | | |
| Moisture Sensitivity Level[2] | MSL | 1 | |

[1] Maximum ratings are absolute ratings. Exposure to absolute maximum rating conditions for extended periods may affect device reliability and can cause permanent damage to the device. Exceeding one or a combination of the absolute maximum ratings may cause permanent and irreversible damage to the device and/or to surrounding circuit. Functional operation of the device is not implied in any conditions above those indicated in the Electrical Specifications section.

[2] Tagore recommends to store parts in moisture barrier bags to preserve solderability.


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## Electrical Specifications

Table 5: Electrical Specifications $T_A = +25°C; V_{DD} = +3.3V; 50\Omega$ Source/Load.

| Parameter | Condition | Minimum | Typical | Maximum | Unit |
|---|---|---|---|---|---|
| Operating frequency | $f$ | 1 | | 1000 | MHz |
| ON Resistance | $R_{ON}$ | | 0.50 | | $\Omega$ |
| OFF Resistance | $R_{OFF}$ | | 250 | | k$\Omega$ |
| OFF Capacitance | $C_{OFF}$ | | 500 | | fF |
| Insertion loss | 50 MHz | | tbd | | dB |
| throw OFF | 500 MHz | | tbd | | dB |
| RFxI | 1000 MHz | | tbd | | dB |
| Isolation | 50 MHz | | tbd | | dB |
| throw ON | 500 MHz | | tbd | | dB |
| RFxI | 1000 MHz | | tbd | | dB |
| Return Loss | 50 MHz | | tbd | | dB |
| | 500 MHz | | tbd | | dB |
| RFxI | 1000 MHz | | tbd | | dB |
| Isolation between | 50 MHz | | tbd | | dB |
| adjacent throws | 500 MHz | | tbd | | dB |
| RFxI – RFyI | 1000 MHz | | tbd | | dB |


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Table 6: Electrical Specifications $T_A = +25°C; V_{DD} = +3.3V; 50\Omega$ Source/Load.

| Parameter | Condition | Minimum | Typical | Maximum | Unit |
|---|---|---|---|---|---|
| Operating frequency | $f$ | 1 | | 1000 | MHz |
| **Harmonic Distortion** | | | | | |
| $H_2$ | 800 MHz, $P_{in}$ =35 dBm | | tbd | | dBc |
| $H_3$ | 800 MHz, $P_{in}$ =35 dBm | | tbd | | dBc |
| IIP3 | 800 MHz | | tbd | | dBm |
| **Power and Compression point** | | | | | |
| $P_{maxCW}$ | Max RF CW Power | | tbd | | dBm |
| $P_{maxpeak}$ | Max RF Peak Power 1% duty cycle | | tbd | | dBm |
| **Noise** | | | | | |
| CP switching noise | RBW=1 kHz | | -140 | | dBm |
| **Switching Time** | | | | | |
| $t_{ON}$[1] | Switch ON time | | 4.9 | | $\mu$s |
| $t_{OFF}$[1] | Switch OFF time | | 5.9 | | $\mu$s |
| $t_{RISE}$ | Switch RISE time | | 4.5 | | $\mu$s |
| $t_{FALL}$ | Switch FALL time | | 1.5 | | $\mu$s |
| $t_{startup}$, $C_{VCP} = 1$ nF | Start-up time | | 0.8 | | ms |
| **Power Supply, DC** | | | | | |
| Control voltage | Power Supply $V_{DD}$ | 2.6 | 3.3 | 5.25 | V |
| | All control pins high[3], $V_{ih}$ | 1.0 | 3.3 | 5.25 | V |
| | All control pins low, $V_{il}$ | -0.3 | 0 | 0.5 | V |
| Bias voltage[2] | Bias pin, $V_{BIAS}$ | -20 | | -18 | V |
| Control current | All control pins high, $I_{ih}$ | | | 7.5 | $\mu$A |
| | All control pins low, $I_{il}$ | | 0 | | $\mu$A |
| Current consumption | $I_{DD}$, active mode ($V_{DD}$ on) | | 220 | | $\mu$A |

[1] This switching time is complete switching time. Many industry solutions require external biasing and control circuitry, which is not taken into account in switching time. TS63430D switching time definition includes time of the internal biasing and control circuitry.
[2] Bias voltage can be fed externally, or use internal charge pump. Internal charge pump produces -18 V. Please connect output of internal charge pump $V_{CPOUT}$ to $V_{BIAS}$ and connect $CP_{DIS}$ to GND.
[3] Control voltage $V_{ih}$ cannot be higher than $V_{DD}$ (to avoid forward biasing of ESD diode).


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## Switch Control and Internal charge pump

Table 7: Switch Control Table

| $V_{DD}$[1] | $V_4$ | $V_3$ | $V_2$ | $V_1$ | **Switch state**[2] |
|---|---|---|---|---|---|
| 1 | x | x | x | 1 | RF1I – GND ON |
| 1 | x | x | 1 | x | RF2I – GND ON |
| 1 | x | 1 | x | x | RF3I – GND ON |
| 1 | 1 | x | x | x | RF4I – GND ON |
| 1 | 0 | 0 | 0 | 0 | RFnI – GND ALL RF switch throws OFF |
| 1 | 1 | 1 | 1 | 1 | RFnI – GND ALL switch throws are ON, ie. conducting |
| 0 | 0 | 0 | 0 | 0 | $V_{DD}$ OFF, RFnI – GND ALL switch throws are ON, ie. conducting |

[1] $V_{DD}$ should be applied first before $V_1$, $V_2$, $V_3$, and $V_4$, otherwise may cause damage to the device.
[2] x means any state, so all switch throws can be controlled independently.

### Internal Charge Pump

TS63432D has an internal charge pump, which can be disabled with the $CP_{DIS}$ pin by connecting it to $V_{DD}$. Using the internal charge pump, please connect $V_{CPOUT}$ to $V_{BIAS}$ and $CP_{DIS}$ to GND.

As there might be some noise from the charge pump below 250 MHz, it is recommended for frequencies below 250 MHz to disable the charge pump by connecting the $CP_{DIS}$ pin to $V_{DD}$ and to feed -18 V...-20 V to the $V_{BIAS}$ pin. This ensures noise free operation below 250 MHz.

#### Option 1: Use internal charge pump

- Connect $CP_{DIS}$ pin to GND.
- Connect $V_{CPOUT}$ to $V_{BIAS}$.

#### Option 2: Use external negative voltage -18 V...-20 V, charge pump OFF

- Connect $CP_{DIS}$ pin to $V_{DD}$.
- Connect $V_{CPOUT}$ pin to GND.
- Feed -18 V...-20 V to $V_{BIAS}$ pin.


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## Equivalent Circuit Model

Each throw of the TS63432D can be described with the equivalent circuit below. The output of each throw is bonded to the center ground pad inside the package. The bond wires are modelled as series inductances $L_{RFI}$ (to the RFxI pin) and $L_{RFO}$ (to ground, short bond wire), the die pads as $R_{PI} \parallel C_{PI}$ and $R_{PO} \parallel C_{PO}$ to ground, and the switch transistor as a resistor parallel to $C_{off}$ between the die pads. In the off state the resistor is $R_{off}$, in the on state it is $R_{on} = 0.5\,\Omega$; all other elements are the same in both states (Table 8). The model values have been fitted to measurements of the TS63430D in a shunt configuration.

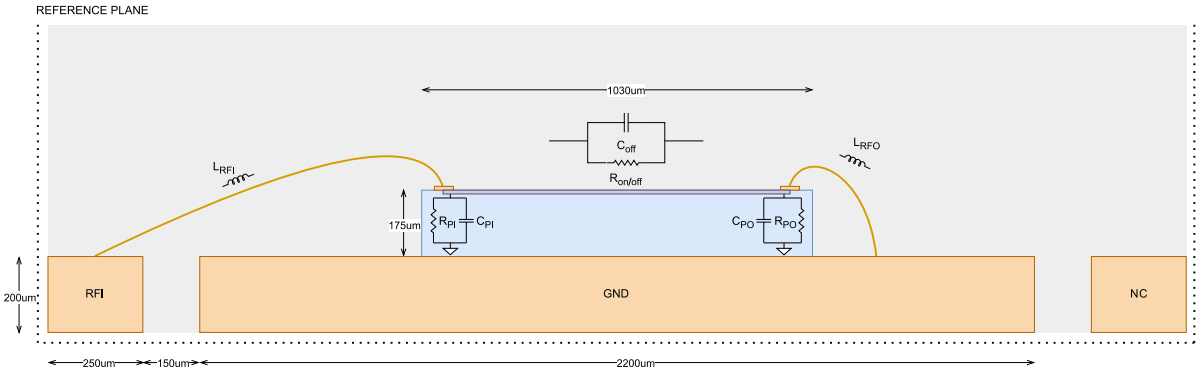



Figure 4: TS63432D cross section of the package with the elements of the equivalent circuit model, one throw.

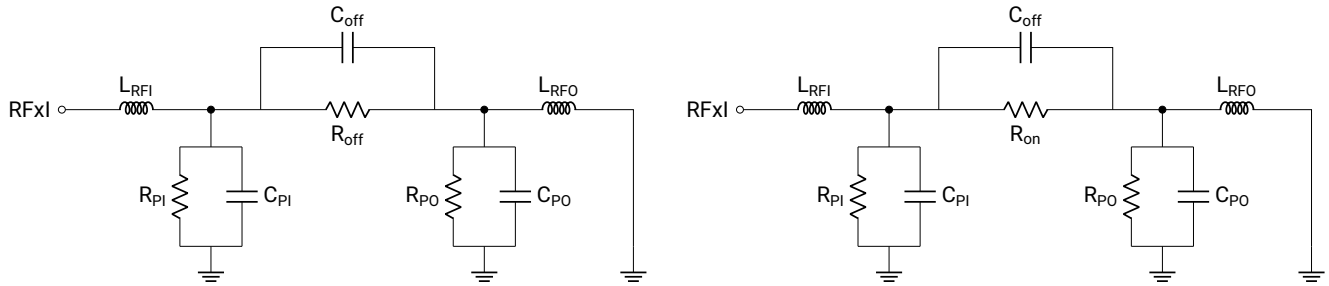



Figure 5: Equivalent circuit model of one throw, RFxI to ground.

Table 8: Equivalent circuit model values.

| Element | Off state | On state |
|---|---|---|
| Bond wire, $L_{RFI}$ | 0.3 nH | 0.3 nH |
| Bond wire to the ground pad, $L_{RFO}$ | 0.15 nH | 0.15 nH |
| Switch resistance, $R_{off}$ / $R_{on}$ | 248.32 kΩ | 0.5 Ω |
| Switch capacitance, $C_{off}$ | 0.3 pF | 0.3 pF |
| Pad capacitance, $C_{PI}$, $C_{PO}$ | 0.1 pF | 0.1 pF |
| Pad resistance, $R_{PI}$, $R_{PO}$ | 78.75 kΩ | 78.75 kΩ |


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## Device Package information

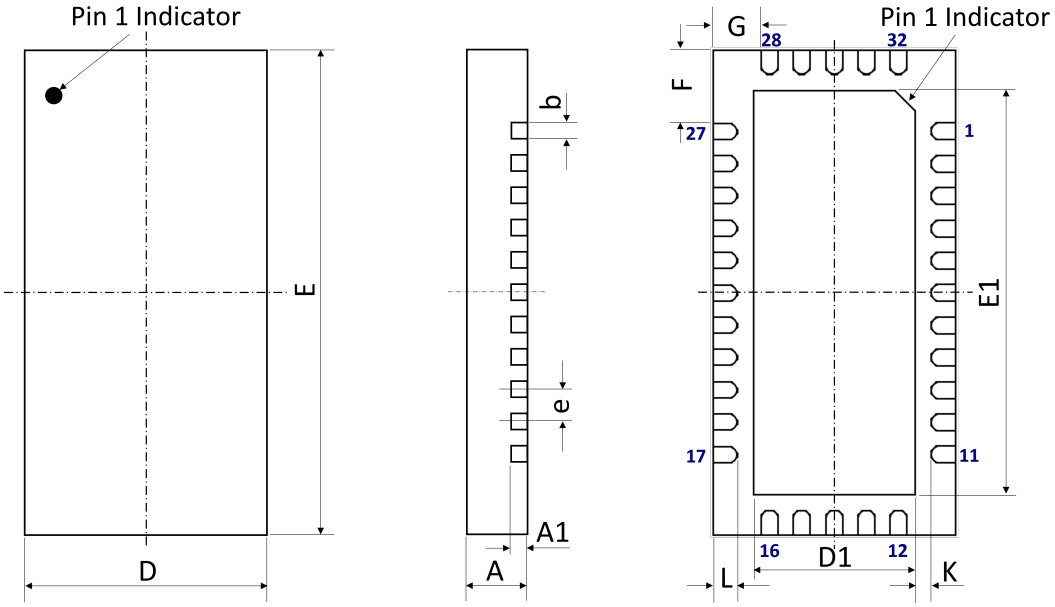
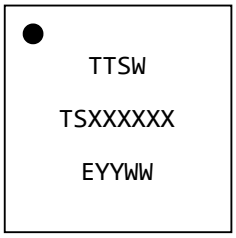



Figure 6: 32-pin QFN 3.0 x 6.0 x 0.75 $mm^3$ package drawing.

Please refer to application notes TN-001 PCB Design guideline and TN-002 Solder Rework at TagoreTech web page for PCB and soldering guidelines.

Table 9: Device Package Dimensions

| Dimension | Value [mm] | Tolerance [mm] | Dimension | Value [mm] | Tolerance [mm] |
|---|---|---|---|---|---|
| A | 0.75 | ±0.05 | E | 6.00 BSC | ±0.05 |
| A1 | 0.203 | ±0.02 | E1 | 5.00 | ±0.05 |
| b | 0.20 | +0.05/-0.07 | F | 0.90 | ±0.05 |
| D | 3.00 BSC | ±0.05 | G | 0.60 | ±0.05 |
| D1 | 2.00 | ±0.05 | L | 0.25 | ±0.05 |
| e | 0.40 BSC | ±0.05 | K | 0.25 | ±0.05 |




| | |
|---|---|
| ● | Pin 1 indicator |
| TTSW | TagoreTech SWitch |
| TSXXXXXX | Part number (8 digits max) |
| E | Fixed letter before date code |
| YY | Last two digits of assembly year |
| WW | Assembly work week |

Figure 7: Part marking specification.


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## PCB Land Design

**Notes:**

- 4-layer PCB is recommended.
- Via diameter is recommended to be 0.3mm to prevent solder wicking inside the vias.
- Thermal vias shall only be placed on the center pad.
- The maximum via number for the center pad is 11(X)×11(Y)=121.

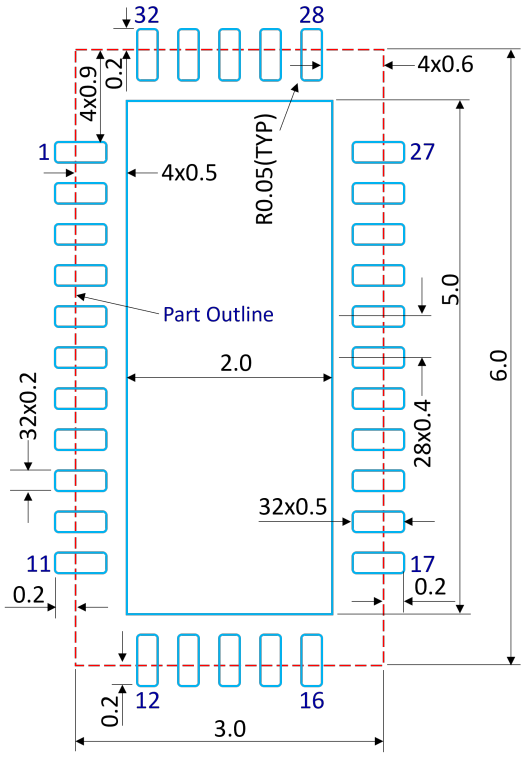



Figure 8: PCB land pattern, dimensions in [mm].

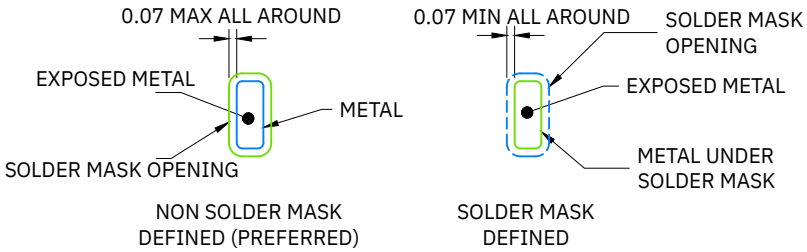



Figure 9: Solder mask opening, dimensions in [mm].


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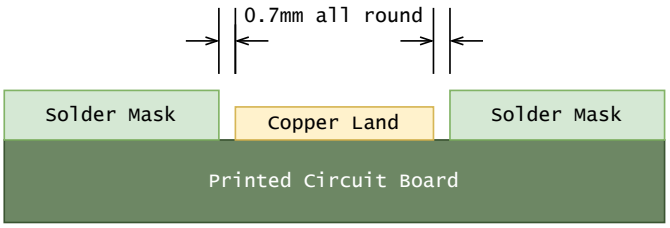



Figure 10: Preferred solder mask opening, side view, dimensions in [mm].

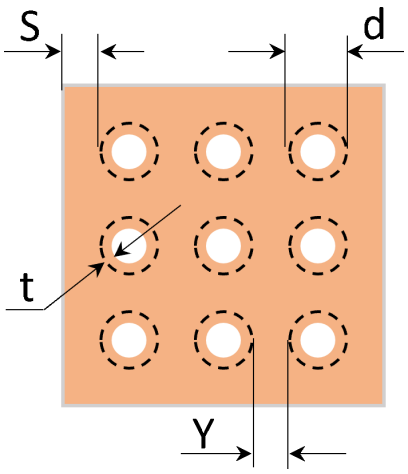



Figure 11: Thermal Via Pattern, Recommended Values: S≥0.15 mm; Y≥0.20 mm; d=0.2 mm; Plating Thickness t=25$\mu$m or 50$\mu$m.


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## PCB Stencil Design

**Notes:**

- Laser-cut, stainless steel stencil is recommended with electro-polished trapezoidal walls to improve the paste release.
- Stencil thickness is recommended to be 125 $\mu$m.

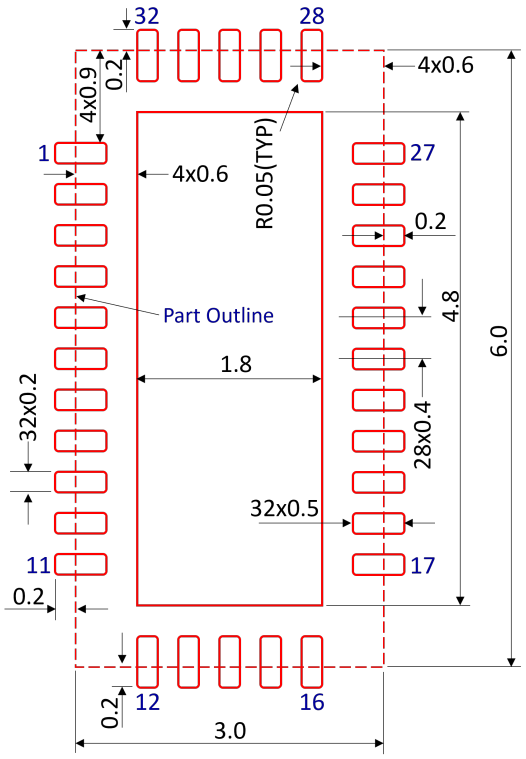



Figure 12: Stencil Openings, dimensions in [mm].

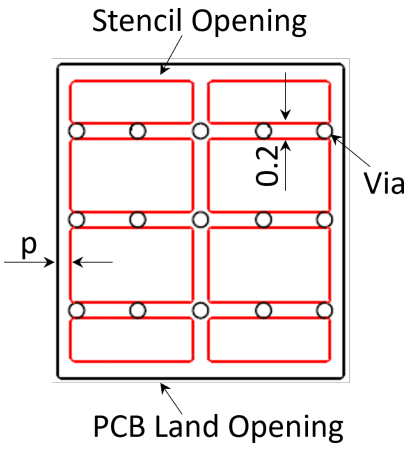
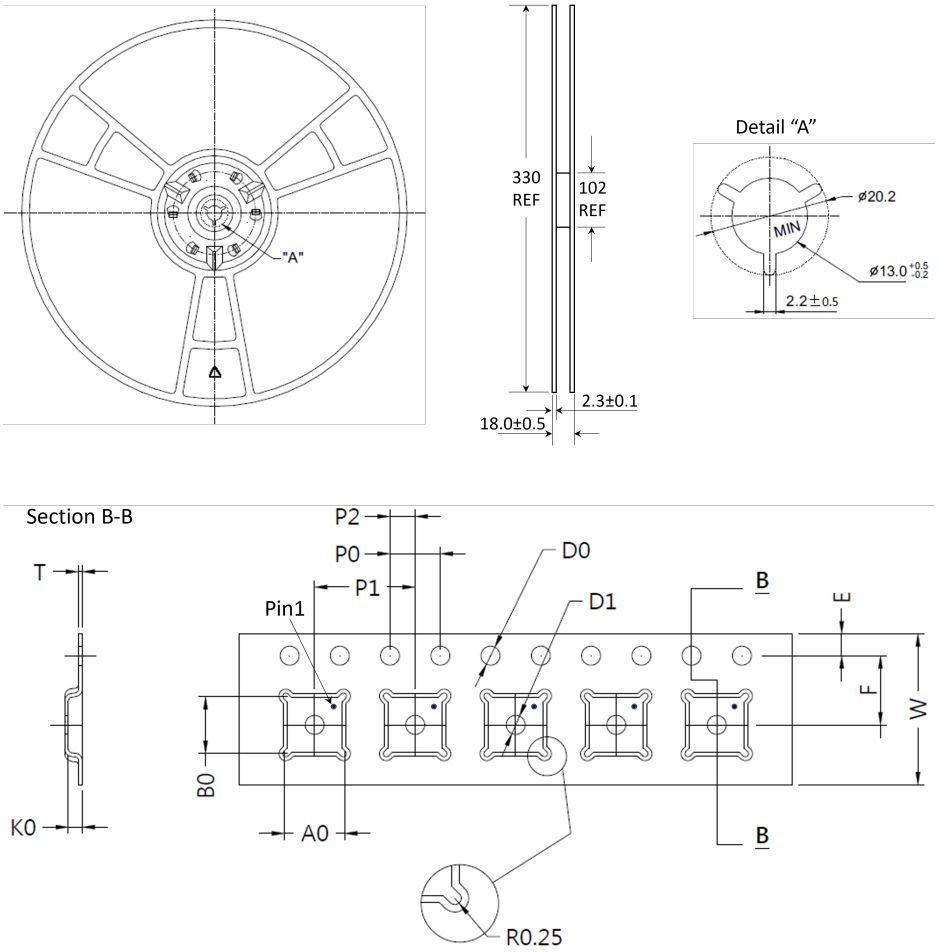



Figure 13: Stencil Openings Shall not Cover Via Areas If Possible, dimensions in [mm].


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## Tape and Reel Information




| A0[mm] | B0[mm] | D0[mm] | D1[mm] | E[mm] | F[mm] | K0[mm] | P0[mm] | P1[mm] | P2[mm] | T[mm] | W[mm] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.30 | 6.30 | 1.50 | 1.50 | 1.75 | 7.50 | 1.20 | 4.00 | 8.00 | 2.00 | 0.30 | 16.00 |


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# Glossary

| | |
|---|---|
| IL | Insertion loss |
| ISO | Isolation |
| RL | Return loss |
| VSWR | Voltage Standing Wave Ratio |
| $\mathrm{RFxI}$ | RF port of throw x (x = 1 ...4) |
| Throw | One shunt switch of the TS63432D, $\mathrm{RFxI}$ to ground, controlled by $\mathrm{V_x}$ |
| $R_{\mathrm{ON}}, C_{\mathrm{OFF}}$ | On-resistance and off-capacitance of a throw |
| $\mathrm{V_{BIAS}}$, $\mathrm{V_{CPOUT}}$, $\mathrm{CP_{DIS}}$ | Bias voltage input, charge pump output, charge pump disable |
| EVB | Evaluation board |

## Changelog

Table 10: Changelog

| Date | Revision | Notes |
|---|---|---|
| 11/07/2026 | 0.50 | Preliminary Datasheet, first publication. Derived from the TS63430D v0.50: outputs of the throws bonded to the center ground pad (shunt throws), pins 21/23/25/27 NC, functional diagram, pin assignment and cross section updated, equivalent circuit model with $L_{RFO}$ 0.15 nH; RF performance tbd. |


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# Legal Information

## Published by

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