

# BGS12S3N6

Wideband RF SPDT Switch in ultra small package with 0.64mm<sup>2</sup> footprint

## Data Sheet

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## Revision History

|  |   |
|--|---|
| <b>Document No.:</b> BGS12S3N6.pdf                               |   |
| <b>Previous Version:</b> Preliminary, Revision v1.3 - 2015-11-11 |   |
| <b>Page</b>  | <b>Subjects (major changes since last revision)</b> |
| 10-11  | Update RF Characteristics                           |
| 13-14  | Update and include Package Information              |
|  |   |

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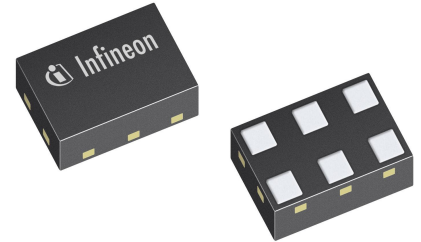
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## BGS12S3N6 Wideband RF SPDT Switch in ultra small package with 0.64mm<sup>2</sup> footprint

### 1 Features

- 2 high-linearity TRx paths with power handling capability of up to 30 dBm
- High switching speed, ideal for WLAN and Bluetooth applications
- All ports fully bi-directional
- Low insertion loss
- Low harmonic generation
- High port-to-port-isolation
- 0.05 to 6 GHz coverage
- High ESD robustness
- On-chip control logic
- Very small leadless and halogen free package TSNP-6-6 (0.65x0.98 mm<sup>2</sup>) with super low height of 0.375 mm
- No decoupling capacitors required if no DC applied on RF lines
- RoHS compliant package



### 2 Product Description

The BGS12S3N6 RF MOS switch is specifically designed for WLAN and Bluetooth applications. Any of the 2 ports can be used as termination of the diversity antenna handling up to 30 dBm.

This single supply chip integrates on-chip CMOS logic driven by a simple, single-pin CMOS or TTL compatible control input signal. The 0.1 dB compression point exceeds the switch's maximum input power level, resulting in linear performance at all signal levels. The RF switch has a very low insertion loss of 0.25 dB in the 1 GHz and 0.29 dB in the 2.5 GHz range.

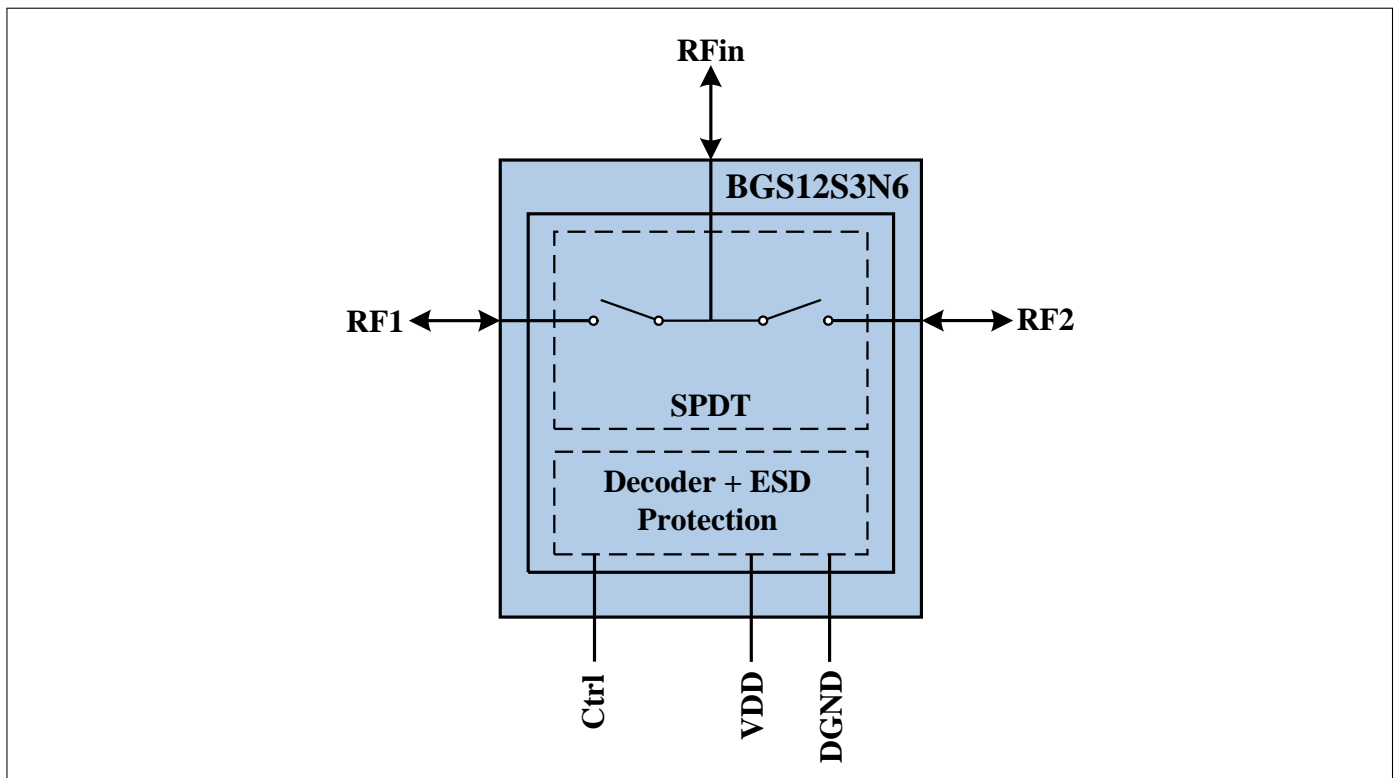
Unlike GaAs technology, external DC blocking capacitors at the RF ports are only required if DC voltage is applied externally.

The BGS12S3N6 RF switch is manufactured in Infineon's patented MOS technology, offering the performance of GaAs with the economy and integration of conventional CMOS including the inherent higher ESD robustness.

The device has a very small size of only 0.65x0.98mm<sup>2</sup> and a maximum height of 0.375 mm.

**Table 1: Ordering Information**

| Type      | Package  | Marking |
|-----------|----------|---------|
| BGS12S3N6 | TSNP-6-6 | R       |



**Figure 1:** BGS12S3N6 Block Diagram

**Table 2: Truth Table**

| Switched Paths | Ctrl |
|----------------|------|
| RFin - RF1     | 0    |
| RFin - RF2     | 1    |



### 3 Maximum Ratings

**Table 3: Maximum Ratings** at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified

| Parameter                              | Symbol          | Values |      |       | Unit             | Note / Test Condition                      |
|--|-----------------|--------|------|-------|------------------|--|
|  |                 | Min.   | Typ. | Max.  |                  |  |
| Supply Voltage                         | $V_{dd}$        | -0.5   | –    | 3.6   | V                | –  |
| Maximum DC-Voltage on Other Pins       | $V_{DC}$        | 0      | –    | 0     | V                | No external DC voltage allowed             |
| Storage Temperature Range              | $T_{STG}$       | -65    | –    | 150   | $^\circ\text{C}$ | –  |
| RF Input Power                         | $P_{RF}$        | –      | –    | 32    | dBm              | –  |
| Junction Temperature                   | $T_j$           | –      | –    | 125   | $^\circ\text{C}$ | –  |
| <b>ESD Capability</b>                  |                 |        |      |       |                  |  |
| Human Body Model <sup>1)</sup>         | $V_{ESD\_HBM}$  | –1000  | –    | +1000 | V                | –  |
| ESD Capability RFin Port <sup>2)</sup> | $V_{ESD\_RFin}$ | –8     | –    | +8    | kV               | RFin versus GND, with 27 nH shunt inductor |

<sup>1)</sup> Human Body Model ANSI/ESDA/JEDEC JS-001-2012 ( $R = 1.5\text{ k}\Omega$ ,  $C = 100\text{ pF}$ ).

<sup>2)</sup> IEC 61000-4-2 ( $R = 330\text{ }\Omega$ ,  $C = 150\text{ pF}$ ), contact discharge.

#### Attention:

Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

### 4 Operation Ranges

**Table 4: Operation Ranges**

| Parameter            | Symbol        | Values |      |          | Unit             | Note / Test Condition |
|----------------------|---------------|--------|------|----------|------------------|-----------------------|
|                      |               | Min.   | Typ. | Max.     |                  |                       |
| Ambient Temperature  | $T_A$         | -40    | 25   | 85       | $^\circ\text{C}$ | –                     |
| RF Frequency         | $f$           | 0.05   | –    | 6        | GHz              | –                     |
| Supply Voltage       | $V_{dd}$      | 1.8    | –    | 3.5      | V                | –                     |
| Control Voltage Low  | $V_{Ctrl\_L}$ | -0.3   | –    | 0.43     | V                | –                     |
| Control Voltage High | $V_{Ctrl\_H}$ | 1.35   | –    | $V_{DD}$ | V                | –                     |

**Table 5: RF Input Power**

| Parameter                     | Symbol   | Values |      |      | Unit | Note / Test Condition |
|-------------------------------|----------|--------|------|------|------|-----------------------|
|                               |          | Min.   | Typ. | Max. |      |                       |
| RF Input Power (50 $\Omega$ ) | $P_{In}$ | –      | –    | 30   | dBm  | –                     |

## 5 RF Characteristics

**Table 6: RF Characteristics**

Test Conditions (unless otherwise specified):

- Terminating port impedance:  $Z_0 = 50 \Omega$
- Temperature range:  $T_A = -40 \dots +85 \text{ }^\circ\text{C}$
- Supply voltage:  $V_{DD} = 1.8 \dots 3.4 \text{ V}$
- Input power:  $P_{IN} = 0 \text{ dBm}$

| Parameter                            | Symbol              | Values |      |      | Unit | Note / Test Condition |
|--------------------------------------|---------------------|--------|------|------|------|-----------------------|
|                                      |                     | Min.   | Typ. | Max. |      |                       |
| <b>Insertion Loss</b>                |                     |        |      |      |      |                       |
| All RF Ports                         | $IL$                | –      | 0.25 | 0.43 | dB   | 824-915 MHz           |
|                                      |                     | –      | 0.33 | 0.45 | dB   | 1710-1910 MHz         |
|                                      |                     | –      | 0.35 | 0.50 | dB   | 2170-2690 MHz         |
|                                      |                     | –      | 0.53 | 0.78 | dB   | 5000 MHz              |
|                                      |                     | –      | 0.70 | 0.90 | dB   | 6000 MHz              |
| <b>Insertion Loss<sup>1</sup></b>    |                     |        |      |      |      |                       |
| All RF Ports                         | $IL$                | –      | 0.25 | 0.35 | dB   | 824-915 MHz           |
|                                      |                     | –      | 0.33 | 0.40 | dB   | 1710-1910 MHz         |
|                                      |                     | –      | 0.35 | 0.45 | dB   | 2170-2690 MHz         |
|                                      |                     | –      | 0.53 | 0.70 | dB   | 5000 MHz              |
|                                      |                     | –      | 0.70 | 0.85 | dB   | 6000 MHz              |
| <b>Return Loss</b>                   |                     |        |      |      |      |                       |
| All RF Ports                         | $RL$                | 22     | 30   | –    | dB   | 824-915 MHz           |
|                                      |                     | 20     | 25   | –    | dB   | 1710-1910 MHz         |
|                                      |                     | 17     | 20   | –    | dB   | 2170-2690 MHz         |
|                                      |                     | 12     | 18   | –    | dB   | 5000 MHz              |
|                                      |                     | 12     | 16   | –    | dB   | 6000 MHz              |
| <b>Isolation</b>                     |                     |        |      |      |      |                       |
| RF <sub>in</sub> to RF1/RF2 Port     | $ISO_{RF_{in}-RFx}$ | 35     | 40   | –    | dB   | 824-915 MHz           |
|                                      |                     | 28     | 32   | –    | dB   | 1710-1910 MHz         |
|                                      |                     | 26     | 28   | –    | dB   | 2170-2690 MHz         |
|                                      |                     | 15     | 19   | –    | dB   | 5000 MHz              |
|                                      |                     | 15     | 18   | –    | dB   | 6000 MHz              |
| RF1 to RF2 Port /<br>RF2 to RF1 Port | $ISO_{Port-Port}$   | 42     | 45   | –    | dB   | 824-915 MHz           |
|                                      |                     | 34     | 38   | –    | dB   | 1710-1910 MHz         |
|                                      |                     | 30     | 33   | –    | dB   | 2170-2690 MHz         |
|                                      |                     | 18     | 21   | –    | dB   | 5000 MHz              |
|                                      |                     | 18     | 21   | –    | dB   | 6000 MHz              |

<sup>1</sup>  $T_A = +25 \text{ }^\circ\text{C}$ ,  $V_{DD} = 2.6 \text{ V}$

| Parameter                                     | Symbol          | Values |      |      | Unit          | Note / Test Condition   |
|---|-----------------|--------|------|------|---------------|---|
|   |                 | Min.   | Typ. | Max. |               |   |
| <b>Harmonic Generation up to 12.75 GHz</b>    |                 |        |      |      |               |   |
| All RF Ports, 2 <sup>nd</sup> Harmonic        | $P_{Harm}$      | –      | -80  | -75  | dBc           | $V_{DD} = 2.85V, T_A = 25\text{ }^\circ\text{C},$<br>$f = 824\text{ MHz}, P_{in} = 27.5\text{ dBm},$<br>50% duty cycle, 50 $\Omega$ |
| All RF Ports, 3 <sup>rd</sup> Harmonic        |                 | –      | -95  | -85  | dBc           |   |
| <b>Compression Point 0.1dB</b>                |                 |        |      |      |               |   |
| P0.1dB  | $P_{0.1dB}$     | –      | –    | -34  | dBm           |   |
| <b>Intermodulation Distortion in Rx Band</b>  |                 |        |      |      |               |   |
| IMD2  | $IMD2$          | –      | -110 | -100 | dBm           | Tx = 10 dBm, Interferer = -15 dBm, 50 $\Omega$  |
| IMD3  | $IMD3$          | –      | -130 | -120 | dBm           |   |
| <b>Switching Time and Current Consumption</b> |                 |        |      |      |               |   |
| RF Rise Time                                  | $t_{10\%-90\%}$ | –      | 60   | 100  | ns            | 10% - 90% of RF Signal  |
| Ctrl to RF Time                               | $t_{Ctrl-RF}$   | –      | 400  | 500  | ns            | 50% of Ctrl Signal to 90% of RF Signal  |
| Power Up Settling Time                        | $t_{PUP}$       | –      | 5    | 15   | $\mu\text{s}$ | After power down  |
| Supply Current                                | $I_{dd}$        | –      | 100  | 180  | $\mu\text{A}$ | –   |
| Control Current                               | $I_{Ctrl}$      | –      | 1    | 10   | $\mu\text{A}$ | –   |

Note: All electrical characteristics are measured with all RF ports terminated by 50  $\Omega$  loads.

## 6 Pin Description

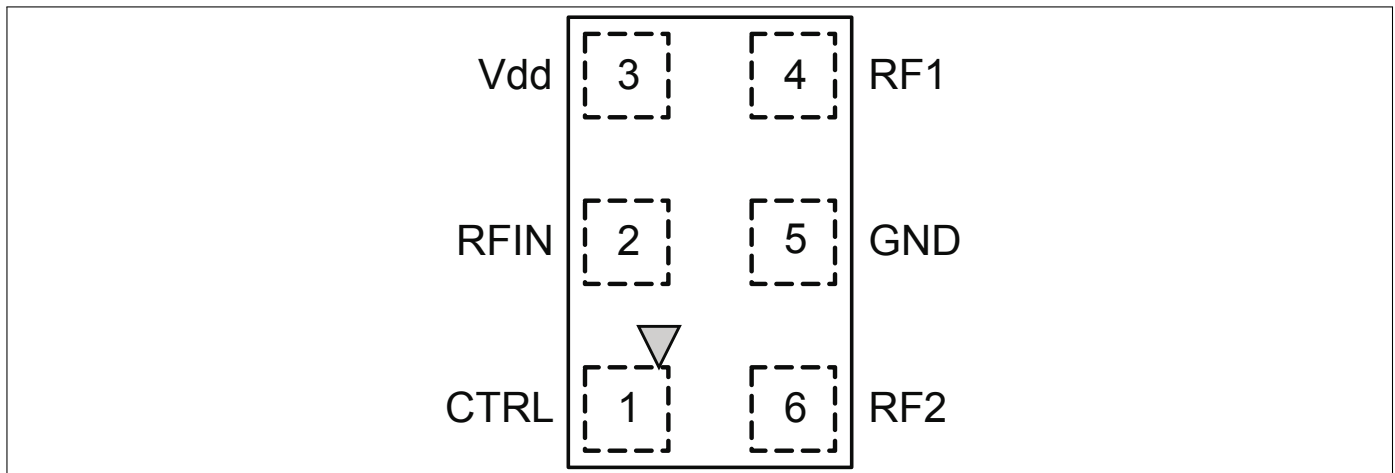


Figure 2: Pin Configuration

Table 7: Pin Description

| Pin No. | Name | Pin Type | Buffer Type | Function       |
|---------|------|----------|-------------|----------------|
| 1       | CTRL | I        |             | Control Pin    |
| 2       | RFIN | I/O      |             | RF Port In     |
| 3       | Vdd  | PWR      |             | Supply Voltage |
| 4       | RF1  | I/O      |             | RF Port 1      |
| 5       | GND  | GND      |             | Ground         |
| 6       | RF2  | I/O      |             | RF Port 2      |

## 7 Package Information

Table 8: Mechanical Data

| Parameter   | Symbol      | Value         | Unit            |
|-------------|-------------|---------------|-----------------|
| X-Dimension | <i>X</i>    | 0.65 ± 0.05   | mm              |
| Y-Dimension | <i>Y</i>    | 0.98 ± 0.05   | mm              |
| Size        | <i>Size</i> | 0.64          | mm <sup>2</sup> |
| Height      | <i>H</i>    | 0.375 ± 0.025 | mm              |

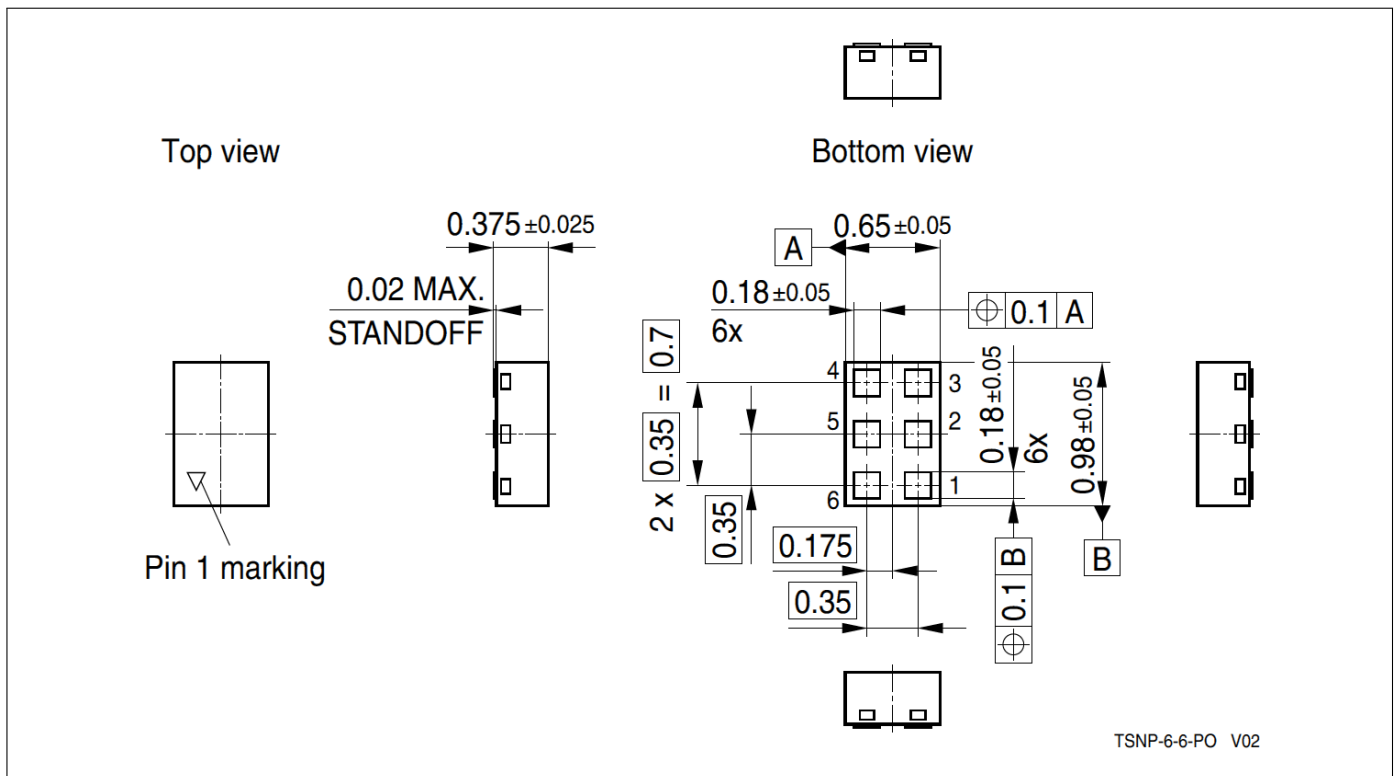


Figure 3: Package Outline

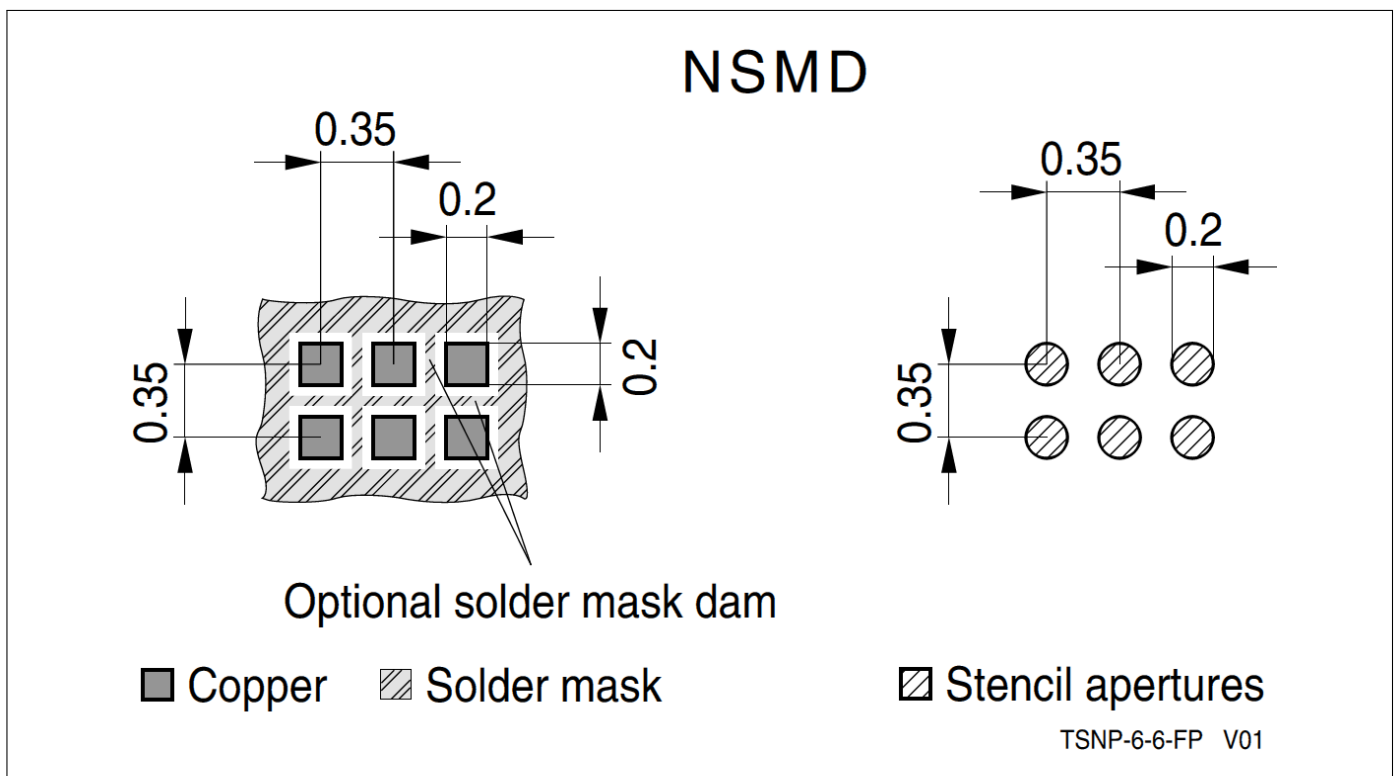


Figure 4: Footprint

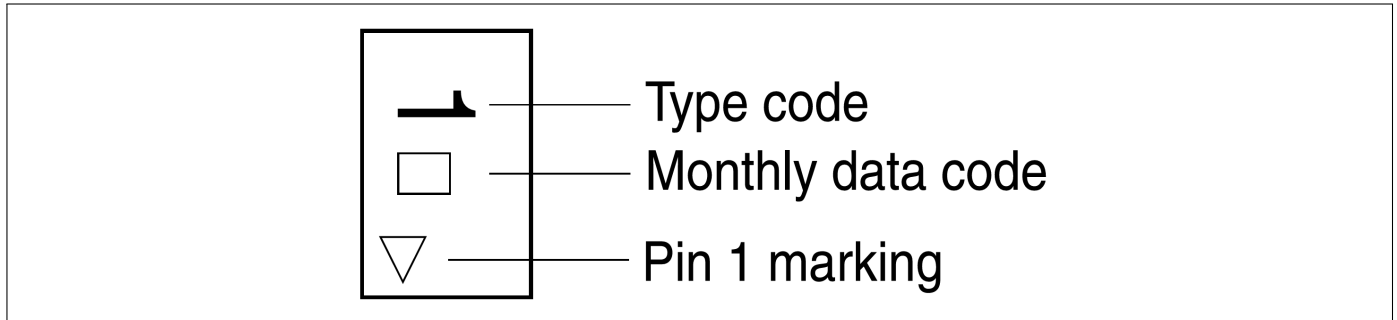


Figure 5: Pin 1 Marking (top view)

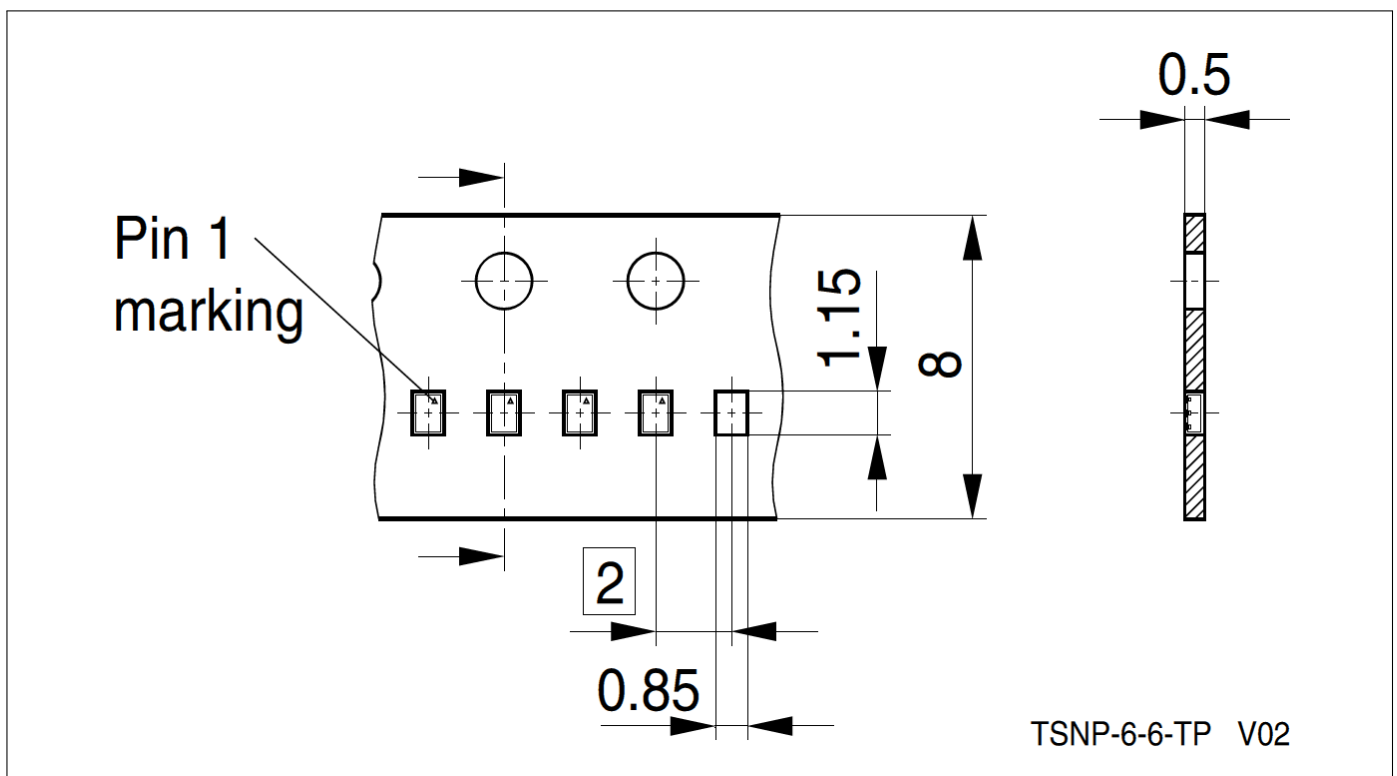


Figure 6: Tape Drawing for TSNP6-6

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