

# BGS14AN16

RF SP4T Switch

## Data Sheet

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## Revision History

Previous Version: –

| Page | Subjects (major changes since last revision) |
|------|----------------------------------------------|
|      | Creation of Document                         |
|      |                                              |
|      |                                              |

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## **Contents**

|          |                                              |           |
|----------|----------------------------------------------|-----------|
| <b>1</b> | <b>Features</b>                              | <b>7</b>  |
| <b>2</b> | <b>Product Description</b>                   | <b>7</b>  |
| <b>3</b> | <b>Maximum ratings</b>                       | <b>9</b>  |
| <b>4</b> | <b>Operation Ranges</b>                      | <b>9</b>  |
| <b>5</b> | <b>RF Characteristics</b>                    | <b>10</b> |
| <b>6</b> | <b>Pin Configuration and Package Outline</b> | <b>12</b> |

## List of Figures

|   |                                         |    |
|---|-----------------------------------------|----|
| 1 | BGS14AN16 Block Diagram . . . . .       | 8  |
| 2 | Pin Configuration . . . . .             | 12 |
| 3 | Package Outline . . . . .               | 13 |
| 4 | Pin Marking . . . . .                   | 13 |
| 5 | Land Pattern and Stencil Mask . . . . . | 14 |
| 6 | Tape Drawing for TSNP-16-6 . . . . .    | 14 |

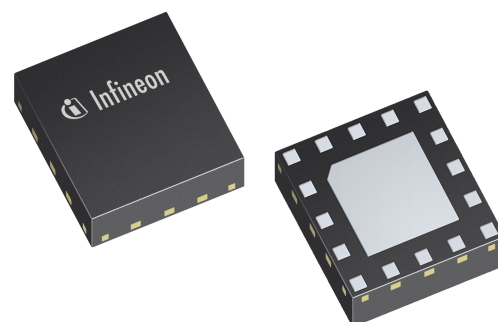
## List of Tables

|   |                                |    |
|---|--------------------------------|----|
| 1 | Ordering Information . . . . . | 7  |
| 2 | Truth Table . . . . .          | 8  |
| 3 | Maximum Ratings . . . . .      | 9  |
| 4 | ESD Ratings . . . . .          | 9  |
| 5 | Operation Ranges . . . . .     | 9  |
| 6 | RF Characteristics . . . . .   | 10 |
| 7 | Pin Description . . . . .      | 12 |

# BGS14AN16 RF SP4T Switch

## 1 Features

- 4 high-linearity Rx paths with power handling capability of up to 30 dBm
- All Ports fully symmetrical
- No external decoupling components required
- High ESD robustness
- Low harmonic generation
- Low insertion loss
- High port-to-port-isolation
- 0.1 to 3 GHz coverage
- Direct connect to battery
- Power down mode
- On-chip control logic supporting logic levels from 1.5 V to  $V_{dd}$
- Lead and halogen free package (RoHS and WEEE compliant)
- Small leadless package TSNP-16-6 with a size of 2.3 x 2.3 mm<sup>2</sup> and a maximum height of 0.77 mm.



## Applications

- CDMA/WCDMA Diversity
- Analog and Digital Tuner
- Band Switching
- LTE

## 2 Product Description

The BGS14AN16 RF MOS switch is specifically designed for WCDMA diversity applications. Any of the 4 ports can be used as termination of the diversity antenna handling up to 30 dBm.

This SP4T offers low insertion loss and high robustness against interferer signals at the antenna port and low harmonic generation in termination mode.

An integrated LDO allows to connect  $V_{dd}$  directly to battery, hence no regulated supply voltage is required. A power down mode is implemented to avoid current drain when the device is not in use.

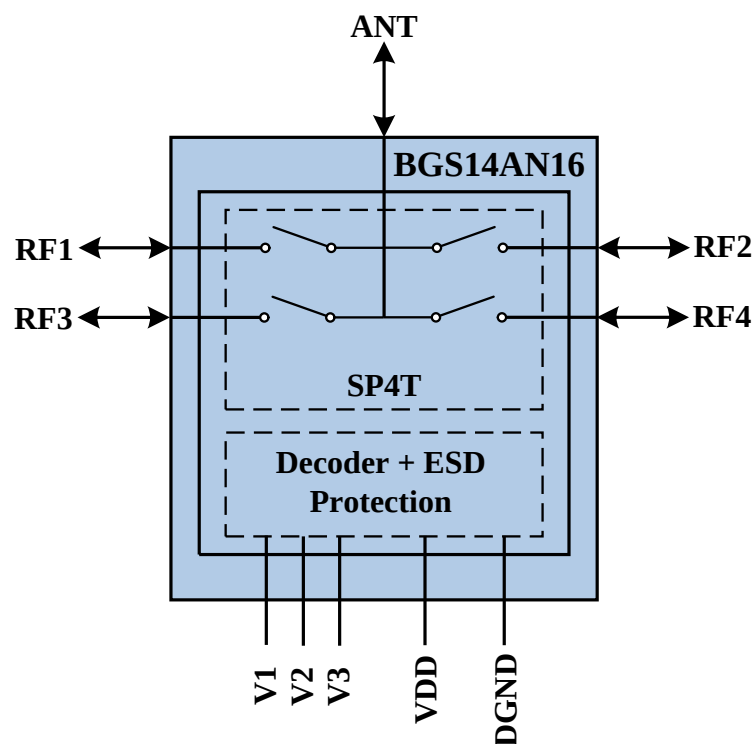
The on-chip controller integrates CMOS logic and level shifters, driven by control inputs from 1.5 V to  $V_{dd}$ . Unlike GaAs technology, external DC blocking capacitors at the RF Ports are only required if DC voltage is applied externally.

The BGS14AN16 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 2.3 x 2.3 mm<sup>2</sup> and a maximum height of 0.77 mm.

**Table 1: Ordering Information**

| Product Name | Product Type   | Package      | Marking |
|--------------|----------------|--------------|---------|
| BGS14AN16    | SP4T RF Switch | PG-TSNP-16-6 | 14A     |



**Figure 1:** BGS14AN16 Block Diagram

**Table 2: Truth Table**

| Function        | V1 | V2 | V3 |
|-----------------|----|----|----|
| Ant → RF1       | 1  | 0  | 0  |
| Ant → RF2       | 0  | 1  | 0  |
| Ant → RF3       | 0  | 0  | 1  |
| Ant → RF4       | 1  | 0  | 1  |
| Power Down Mode | 0  | 0  | 0  |
| All Off         | 1  | 1  | 0  |
| All Off         | 0  | 1  | 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. |                    |                              |
| Storage Temperature Range                     | $T_{STG}$        | -55    | –    | 150  | $^{\circ}\text{C}$ | –                            |
| DC Voltage on $V_{DD}$ Pin to GND             | $V_{DD}$         | –      | –    | 5.5  | V                  | –                            |
| DC Voltage on All Other Pins to GND           | $V_{DC}$         | –      | –    | 3.6  | V                  | –                            |
| Max, RF Power at Antenna Port, Any RF Port On | $P_{Ant_{nMax}}$ | –      | –    | +32  | dBm                | 50 $\Omega$                  |
| Max, Input (Reverse) Power at Antenna Pin     | $P_{Rev_{nMax}}$ | –      | –    | +30  | dBm                | 50 % Duty Cycle, 50 $\Omega$ |

**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.

**Table 4: ESD Ratings**

| Parameter                                  | Symbol         | Values |      |      | Unit | Note / Test Condition       |
|--------------------------------------------|----------------|--------|------|------|------|-----------------------------|
|                                            |                | Min.   | Typ. | Max. |      |                             |
| ESD HBM, All Ports                         | $V_{ESD\_HBM}$ | 1000   | –    | –    | V    | All GND Ports Connected     |
| ESD CDM, All Ports                         | $V_{ESD\_CDM}$ | 2000   | –    | –    | V    | –                           |
| ESD MM, All Ports                          | $V_{ESD\_MM}$  | 100    | –    | –    | V    | –                           |
| ESD Robustness IEC-61000-4-2, antenna port | $V_{ESD\_Ant}$ | 8000   | –    | –    | V    | With external 27nH Inductor |

### 4 Operation Ranges

**Table 5: Operation Ranges**

| Parameter            | Symbol        | Values |      |          | Unit               | Note / Test Condition   |
|----------------------|---------------|--------|------|----------|--------------------|-------------------------|
|                      |               | Min.   | Typ. | Max.     |                    |                         |
| Ambient Temperature  | $T_A$         | -30    | 25   | 85       | $^{\circ}\text{C}$ | –                       |
| RF Frequency         | $f$           | 0.1    | –    | 3        | GHz                | –                       |
| Control Voltage Low  | $V_{Ctrl\_L}$ | -0.3   | –    | 0.3      | V                  | –                       |
| Control Voltage High | $V_{Ctrl\_H}$ | 1.5    | –    | $V_{DD}$ | V                  | $V_{DD} < 3.3\text{ V}$ |
| Supply Voltage       | $V_{DD}$      | 2.85   | –    | 4.7      | V                  | –                       |

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## 5 RF Characteristics

**Table 6: RF Characteristics**

Test Conditions (unless otherwise specified):

- Terminating Port Impedance:  $Z_0 = 50 \Omega$
- Temperature Range:  $T_A = -30 \dots +85 \text{ }^\circ\text{C}$
- Supply Voltage:  $V_{DD} = 2.85 - 4.7 \text{ V}$
- Input Power:  $P_{IN} = 0 \text{ dBm}$
- Across Operating Range of Control Voltages:  $V_{Ctrl\_H} = 1.5 \dots 3.5 \text{ V}$
- Measured Using External Circuitry According Application Note AN259

| Parameter                                                | Symbol | Values |                   |      | Unit | Note /<br>Test Condition |
|----------------------------------------------------------|--------|--------|-------------------|------|------|--------------------------|
|                                                          |        | Min.   | Typ.              | Max. |      |                          |
| Insertion Loss                                           |        |        |                   |      |      |                          |
| 824 - 960 MHz                                            | IL     | —      | 0.34 <sup>1</sup> | 0.49 | dB   | —                        |
| 1710 - 1980 MHz                                          |        | —      | 0.55 <sup>1</sup> | 0.75 | dB   | RF1                      |
| 1710 - 1980 MHz                                          |        | —      | 0.50 <sup>1</sup> | 0.70 | dB   | RF2, RF3, RF4            |
| 1980 - 2170 MHz                                          |        | —      | 0.59 <sup>1</sup> | 0.79 | dB   | RF1                      |
| 1980 - 2170 MHz                                          |        | —      | 0.55 <sup>1</sup> | 0.75 | dB   | RF2, RF3, RF4            |
| 2170 - 2690 MHz                                          |        | —      | 0.69 <sup>1</sup> | 0.89 | dB   | RF1                      |
| 2170 - 2690 MHz                                          |        | —      | 0.65 <sup>1</sup> | 0.85 | dB   | RF2, RF3, RF4            |
| Inband Ripple Rx Ports (High Bands)                      |        | —      | 0.05              | 0.10 | dB   | —                        |
| Inband Ripple Rx Ports (Low Bands)                       |        | —      | 0.03              | 0.10 | dB   | —                        |
| Return Loss <sup>1)</sup>                                |        |        |                   |      |      |                          |
| All Ports @ 824 - 915 MHz                                | RL     | 25     | 30                | —    | dB   | —                        |
| All Ports @ 1710 - 2690 MHz                              |        | 14     | 20                | —    | dB   | —                        |
| Isolation Ant - RF1,2,3,4                                |        |        |                   |      |      |                          |
| 824 - 915 MHz                                            | ISO    | 35     | 40                | —    | dB   | —                        |
| 1710 - 1980 MHz                                          |        | 26     | 30                | —    | dB   | —                        |
| 1980 - 2170 MHz                                          |        | 24     | 30                | —    | dB   | —                        |
| 2170 - 2690 MHz                                          |        | 24     | 27                | —    | dB   | —                        |
| Isolation RF1,2,3 - RF1,2,3,4                            |        |        |                   |      |      |                          |
| 824 - 915 MHz                                            | ISO    | 32     | 35                | —    | dB   | —                        |
| 1710 - 1980 MHz                                          |        | 26     | 28                | —    | dB   | —                        |
| 1980 - 2170 MHz                                          |        | 25     | 28                | —    | dB   | —                        |
| 2170 - 2690 MHz                                          |        | 21     | 25                | —    | dB   | —                        |
| Isolation RF Ports - V <sub>DD</sub> , V <sub>Ctrl</sub> |        |        |                   |      |      |                          |
| 900 MHz                                                  | ISO    | 40     | 30                | —    | dB   | —                        |
| 2000 MHz                                                 |        | 20     | 20                | —    | dB   | —                        |

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

<sup>1)</sup>  $T_A = +25 \text{ }^\circ\text{C}$ ,  $V_{DD} = 3.5 \text{ V}$

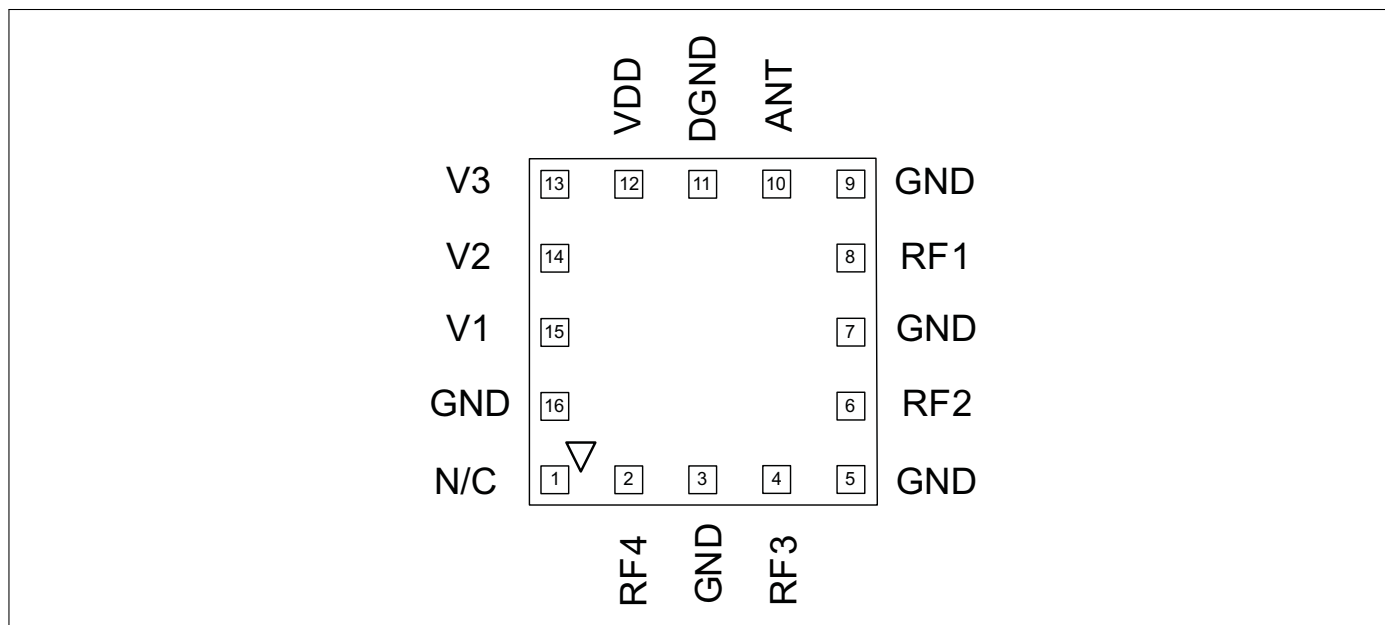
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| Parameter                                                       | Symbol          | Values |      |      | Unit    | Note /<br>Test Condition |
|-----------------------------------------------------------------|-----------------|--------|------|------|---------|--------------------------|
|                                                                 |                 | Min.   | Typ. | Max. |         |                          |
| Input Intercept Point Requirements - IMD2 <sup>1)</sup>         |                 |        |      |      |         |                          |
| Tx = 15dBm@Ant, Int = -15dBm@Ant<br>(Tx Freq = 824 - 915 MHz)   | $P_{IMD2}$      | —      | -110 | -104 | dB      | —                        |
| Tx = 10dBm@Ant, Int = -15dBm@Ant<br>(Tx Freq = 1710 - 1980 MHz) |                 | —      | -110 | -104 | dB      | —                        |
| Input Intercept Point Requirements - IMD3 <sup>1)</sup>         |                 |        |      |      |         |                          |
| Tx = 15dBm@Ant, Int = -15dBm@Ant<br>(Tx Freq = 824 - 915 MHz)   | $P_{IMD3}$      | —      | -110 | -104 | dB      | —                        |
| Tx = 10dBm@Ant, Int = -15dBm@Ant<br>(Tx Freq = 1710 - 1980 MHz) |                 | —      | -110 | -104 | dB      | —                        |
| Harmonic Generation RF Ports Up to 12.75 GHz <sup>1)</sup>      |                 |        |      |      |         |                          |
| 824 - 960 MHz                                                   | $P_{Harm}$      | —      | —    | -46  | dB      | —                        |
| 1920 - 1980 MHz                                                 |                 | —      | —    | -46  | dB      | —                        |
| Harmonic Generation RF Ports Up to 12.75 GHz <sup>1)</sup>      |                 |        |      |      |         |                          |
| 824 - 960 MHz, Third Harmonic                                   | $P_{Harm}$      | —      | -50  | -42  | dB      | —                        |
| 824 - 960 MHz, All Other Harmonics<br>Up to 12.75 GHz           |                 | —      | -50  | -44  | dB      | —                        |
| 1920 - 1980 MHz                                                 |                 | —      | -50  | -44  | dB      | —                        |
| Intermodulation Distortion in Rx Band <sup>1)</sup>             |                 |        |      |      |         |                          |
| IMD2_Low                                                        | $P_{IMD2\_L}$   | -125   | -115 | -110 | dBm     | —                        |
| IMD3                                                            | $P_{IMD3}$      | -125   | -115 | -110 | dBm     |                          |
| IMD2_High                                                       | $P_{IMD2\_H}$   | -125   | -115 | -110 | dBm     |                          |
| Switching Time and Current Consumption                          |                 |        |      |      |         |                          |
| On/Off Switching Time (10-90%) RF                               | $t_{10\%–90\%}$ | 0.3    | 1    | 3    | $\mu$ S | —                        |
| Boost Converter Settling Time                                   | $t_{Boost}$     | —      | 10   | 25   | $\mu$ S | After Power<br>Down Mode |
| Current Consumption at $V_{DD}$ Pin                             | $I_{DD}$        | 50     | 75   | 100  | $\mu$ A | —                        |
| Current Consumption at $V_{Ctrl}$ Pin                           | $I_{Ctrl}$      | 0.1    | 1    | 30   | $\mu$ A | —                        |
| Current Consumption at Power Down<br>Mode                       | $I_{PD}$        | —      | —    | 1    | $\mu$ A | —                        |

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

<sup>1)</sup>  $T_A = +25^\circ\text{C}$ ,  $V_{DD} = 3.5\text{ V}$

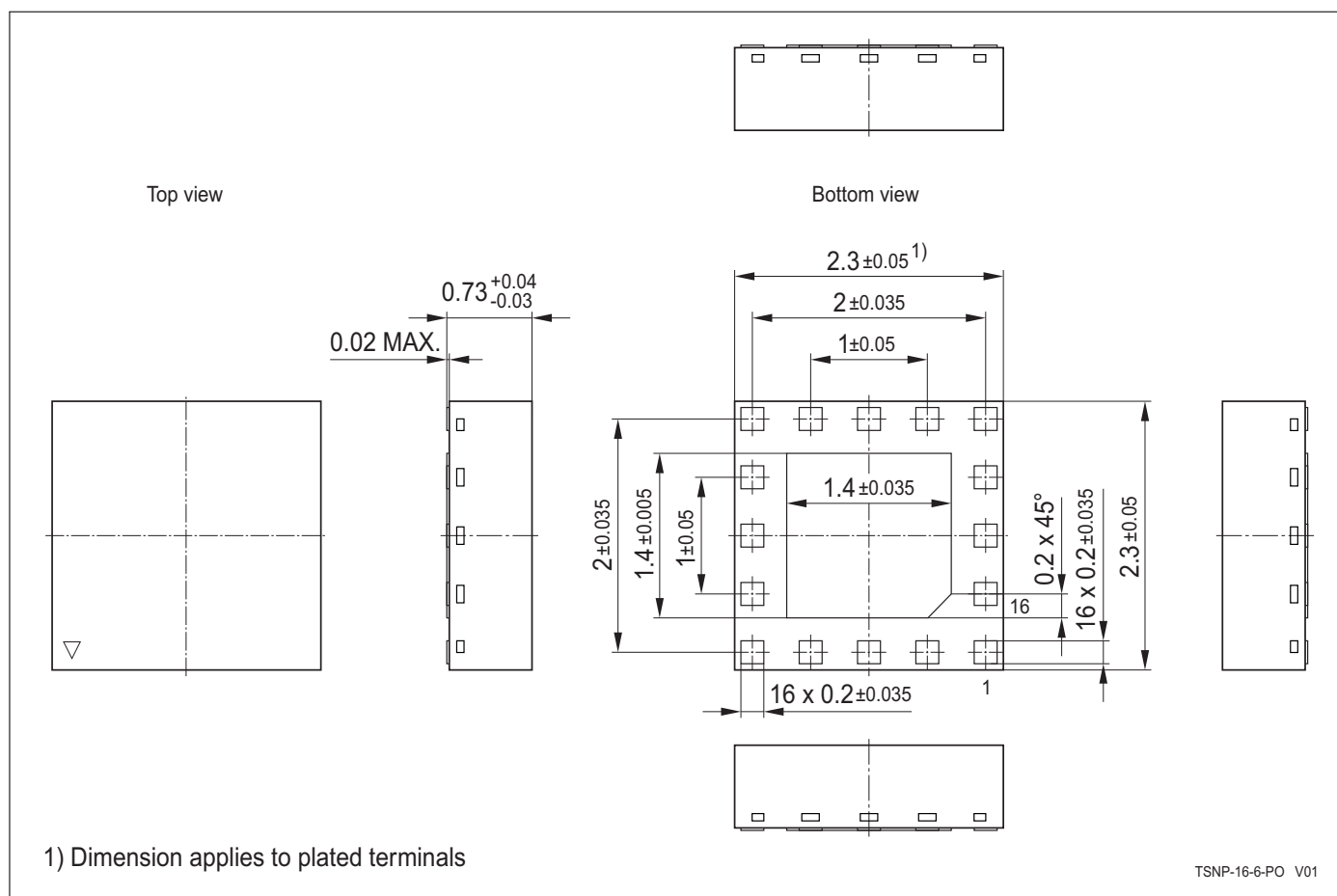
## 6 Pin Configuration and Package Outline



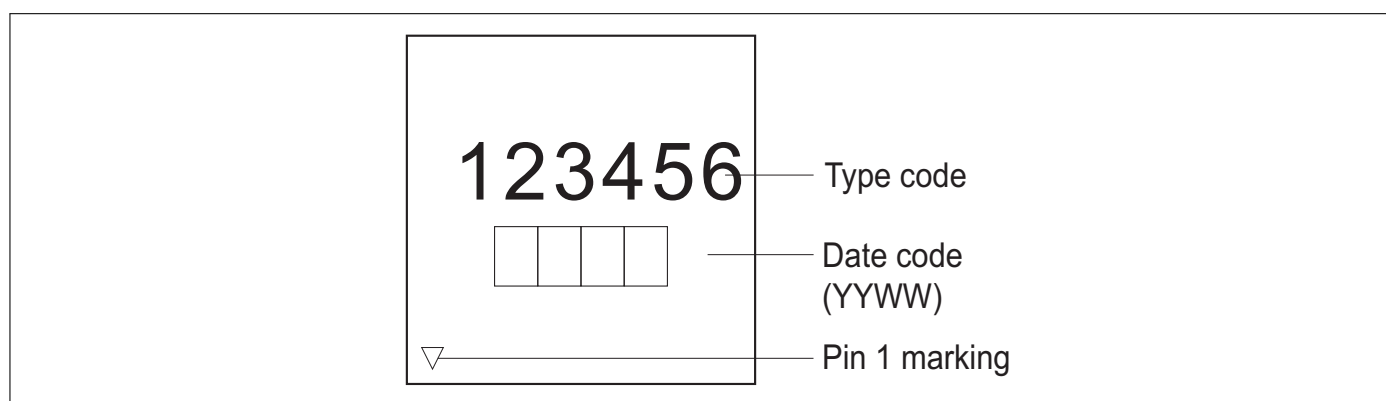
**Figure 2:** Pin Configuration

**Table 7: Pin Description**

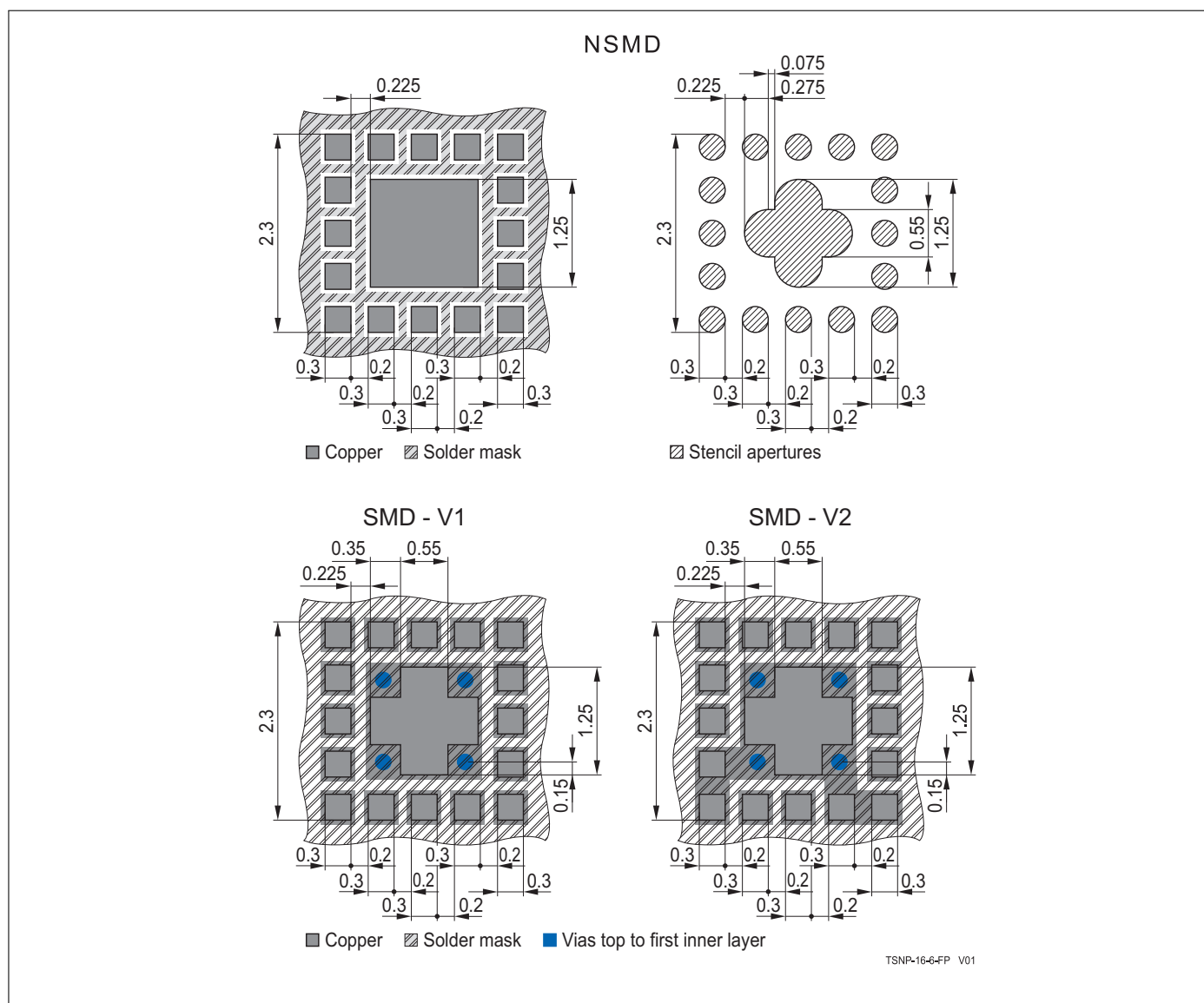
| Pin No. | Name | Pin Type | Buffer Type | Function      |
|---------|------|----------|-------------|---------------|
| 1       | N/C  | –        | –           | Not Connected |
| 2       | RF4  | I/O      | –           | RF Port 4     |
| 3       | GND  | GND      | –           | Ground        |
| 4       | RF3  | I/O      | –           | RF Port 3     |
| 5       | GND  | GND      | –           | Ground        |
| 6       | RF2  | I/O      | –           | RF Port 2     |
| 7       | GND  | GND      | –           | Ground        |
| 8       | RF1  | I/O      | –           | RF Port 1     |
| 9       | GND  | GND      | –           | Ground        |
| 10      | ANT  | I/O      | –           | Antenna Port  |
| 11      | DGND | GND      | –           | Ground        |
| 12      | VDD  | PWR      | –           | Vdd Supply    |
| 13      | V3   | I        | –           | Control Pin 3 |
| 14      | V2   | I        | –           | Control Pin 2 |
| 15      | V1   | I        | –           | Control Pin 1 |
| 16      | GND  | GND      | –           | Ground        |



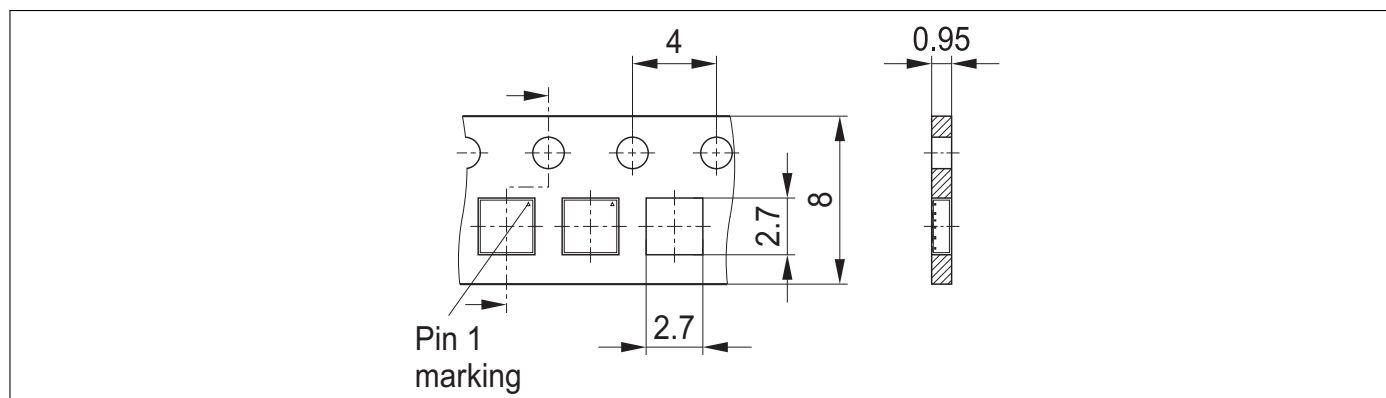
**Figure 3:** Package Outline



**Figure 4:** Pin Marking



**Figure 5:** Land Pattern and Stencil Mask



**Figure 6:** Tape Drawing for TSNP-16-6

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