# BGS15AN16

SP5T Antenna Switch

## Data Sheet

Revision 2.1, 2013-01-21

Power Management & Multimarket

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**BGS15AN16 SP5T Antenna Switch**

**Revision History: 2013-01-21, Revision 2.1**

**Previous Revision: 2011-05-08, Revision 2.0**

| Page | Subjects (major changes since last revision) |
|---|---|
| 8,9,10 | Updated drawings |
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Last Trademarks Update 2010-03-22

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# 1 Features

**Main Features**

- 5 high-linearity Rx ports 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 3.0 GHz coverage
- Direct connection to battery
- Power down mode
- On-chip control logic supporting logic levels from 1.5 V to Vdd
- Lead and halogen free package (RoHS and WEEE compliant)
- Small leadless package TSNP16 with the size of 2.3 x 2.3 mm² and a maximum height of 0.73 mm.

RoHS

**Applications**

- WCDMA diversity
- CDMA diversity
- Analog and Digital Tuner
- Band Switching
- LTE

**Description**

The BGS15AN16 RF MOS switch is specifically designed for WCDMA diversity applications. Any of the 5 ports can be used as termination of the diversity antenna handling up to 30 dBm.

This SP5T 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 Vdd. Unlike GaAs technology, external DC blocking capacitors at the RF Ports are only required if DC voltage is applied externally.

The BGS15AN16 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 mm² and a maximum height of 0.73 mm

| Product Name | Product Type | Package |
|---|---|---|
| SP5T RF Switch | BGS15AN16 | PG-TSNP-16-6 |

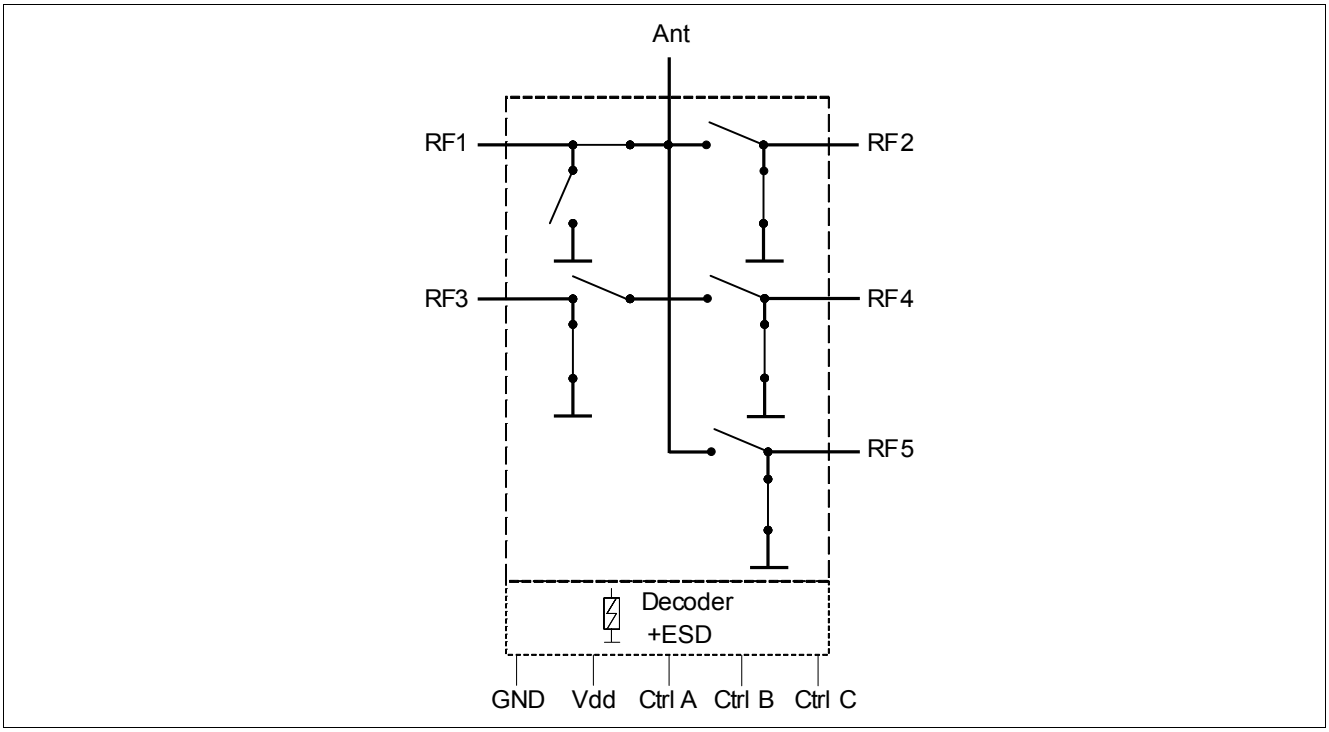


**Figure 1 Functional Diagram**

# 2 Signals Description

**Table 1 Pin Description (top view)**

| Pin No. | Name | Pin Type | Buffer Type | Function |
|---|---|---|---|---|
| 1 | RX5 | RX5 | | **Rx RF port 5** |
| 2 | RX4 | I/O | | **Rx RF port 4** |
| 3 | GND | GND | | **Ground** |
| 4 | RX3 | I/O | | **Rx RF port 3** |
| 5 | GND | GND | | **Ground** |
| 6 | RX2 | I/O | | **Rx RF port 2** |
| 7 | GND | GND | | **Ground** |
| 8 | RX1 | I/O | | **Rx 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** |

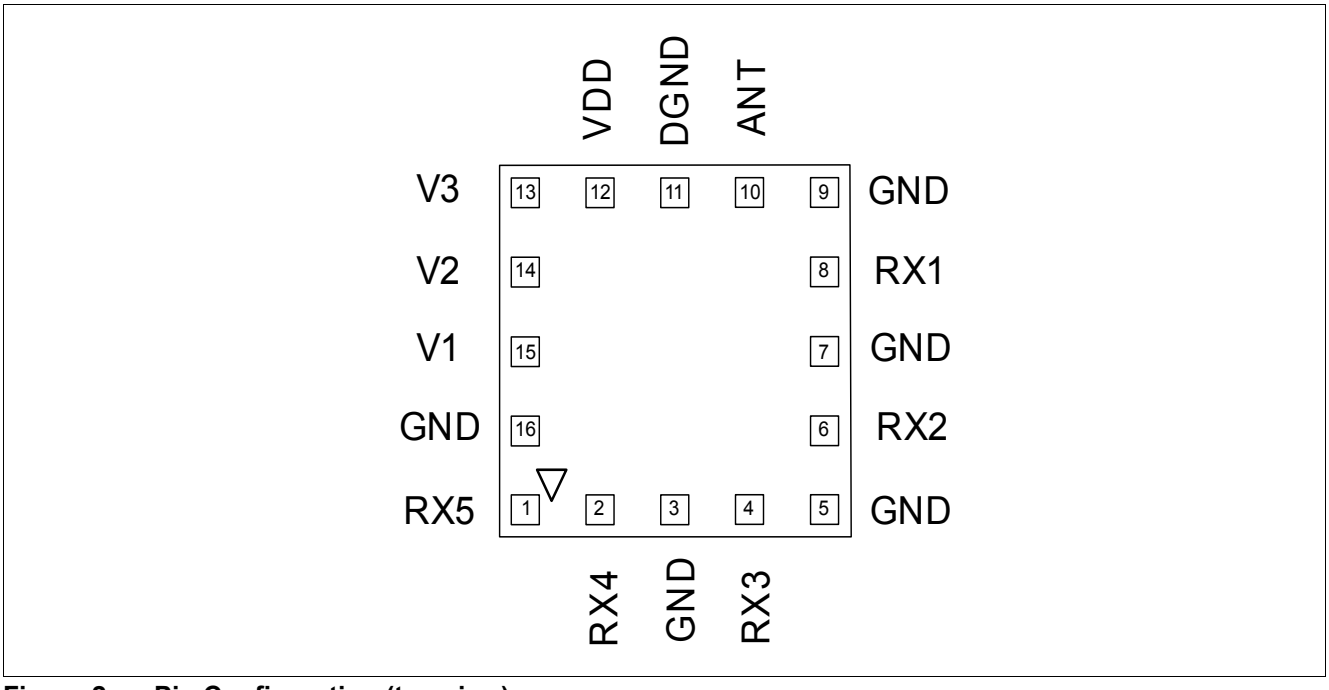


**Figure 2 Pin Configuration (top view)**

**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 |
| Ant → RF5 | 1 | 1 | 1 |
| Power down mode | 0 | 0 | 0 |
| All off | 1 | 1 | 0 |
| All off | 0 | 1 | 1 |

# 3 Electrical Characteristics

**Table 3 Absolute Maximum Ratings**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Storage Temperature Range | $T_{stg}$ | -55 | – | 150 | °C | – |
| DC Voltage at $V_{dd}$ pin to GND | $V_{DC}$ | – | – | 5.5 | V | – |
| DC Voltage at all other pins to GND | $V_{DC}$ | – | – | 3.6 | V | – |
| Max RF power at antenna port, any RF port on | $P_{Ant\ IN\ max}$ | – | – | 32 | dBm | 50 Ω |
| Max. Input (Reverse) Power at antenna pin | $P_{in}$ | – | – | 30 | dBm | 50% duty cycle 50 Ω |

***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 Operating Ranges**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Ambient Temperature | $T_A$ | -30 | – | 85 | °C | – |
| RF Frequency | $f$ | 0.1 | – | 3 | GHz | – |
| Control Voltage low | $V_{CtrlL}$ | -0.3 | – | 0.3 | V | – |
| Control Voltage high | $V_{CtrlH}$ | 1.5 | – | $V_{dd}$ | V | $V_{dd}$ < 3.3V |
| Supply Voltage | $V_{dd}$ | 2.85 | – | 4.7 | V | – |

**Table 5 ESD Ratings**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| ESD HBM, all ports | $V_{max}$ | 1 | – | – | kV | all GND ports connected |
| ESD CDM, all ports | $V_{max}$ | 2 | – | – | kV | – |
| ESD MM, all ports | $V_{max}$ | 100 | – | – | V | – |
| ESD robustness IEC-61000-4-2, antenna port | $V_{max}$ | 8 | – | – | kV | with external 27nH inductor |

## 3.1 Electrical Specification

Test Conditions:

- Termination port impedance: $Z_0$ = 50 Ω
- Temperature range: $T_A$ = -30 °C...+85 °C
- Supply Voltage: $V_{dd}$ = 2.85 V...4.7 V
- $P_{in}$ = 0 dBm
- Across operating range of control voltages: $V_{CtrH}$ = 1.5...3.5 V
- Measured using external circuitry according application note AN259.

**Table 6 Electrical Characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| **Insertion Loss** | | | | | | |
| 824<f<960 MHz | | – | 0.34[1)] | 0.49 | dB | – |
| 1710<f<1980 MHz | | – | 0.55[1)] | 0.75 | dB | RX1, RX5 |
| 1710<f<1980 MHz | | – | 0.5[1)] | 0.7 | dB | RX 2-4 |
| 1980<f<2170 MHz | | – | 0.59[1)] | 0.79 | dB | RX1, RX5 |
| 1980<f<2170 MHz | | – | 0.55[1)] | 0.75 | dB | RX2-4 |
| 2170<f<2690 MHz | | – | 0.69[1)] | 0.89 | dB | RX1, RX5 |
| 2170<f<2690 MHz | | – | 0.65[1)] | 0.85 | dB | RX2-4 |
| Inband ripple Rx ports (high bands) | | – | 0.05 | 0.1 | dB | – |
| Inband ripple Rx ports (low bands) | | – | 0.03 | 0.1 | dB | – |
| **Return Loss[1)]** | | | | | | |
| All ports @ 824 - 915 MHz | | 25 | 30 | – | dB | – |
| All ports @ 1.71 - 2.69 GHz | | 14 | 20 | – | dB | – |
| **Isolation Ant – RF1,2,3,4,5** | | | | | | |
| 824 - 915 MHz | | 35 | 40 | – | dB | – |
| 1.71 - 1.98 GHz | | 26 | 30 | – | dB | – |
| 1.98 - 2.17 GHz | | 24 | 30 | – | dB | – |
| 2.17 - 2.69 GHz | | 24 | 27 | – | dB | – |
| **Isolation RF1,2,3 – RF1,2,3,4,5** | | | | | | |
| 824 - 915 MHz | | 32 | 35 | – | dB | – |
| 1.71 - 1.98 GHz | | 26 | 28 | – | dB | – |
| 1.98 - 2.17 GHz | | 25 | 28 | – | dB | – |
| 2.17 - 2.69 GHz | | 21 | 25 | – | dB | – |
| **Isolation RF Ports – $V_{dd}$, $V_{ctrl}$** | | | | | | |
| 0.9 GHz | | 40 | 30 | – | dB | – |
| 2 GHz | | 20 | 20 | – | dB | – |

1)$T_A$ = 25 °C and $V_{dd}$ = 3.5 V

**Table 7 Electrical Characteristics** (cont'd)

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| **Input Intercept Point Requirements - IMD2[1)]** | | | | | | |
| Tx=15 dBm@ ant port, Int= -15 dBm @ant port (TX Freq = 824 - 915 MHz) | | – | -110 | -104 | dBm | – |
| Tx=10 dBm@ ant port, Int= -15 dBm @ant port (TX Freq=1710 - 1980 MHz) | | – | -110 | -104 | dBm | – |
| **Input Intercept Point Requirements – IMD3[1)]** | | | | | | |
| Tx=15 dBm@ ant port, Int= -15 dBm @ant port(TX Freq = 824 - 915 MHz) | | – | -110 | -104 | dBm | – |
| Tx=10 dBm@ ant port, Int= -15 dBm @ant port (TX Freq=1710 - 1980 MHz) | | – | -110 | -104 | dBm | – |
| **Harmonic Generation RF ports up to 12.75 GHz[1)]** | | | | | | |
| Pin (UMTS) = 23 dBm, Duty Cyle = 100%, unused RF pins = any load, VSWR = 4:1 | | – | – | – | – | – |
| 824 to 960 MHz | | – | – | -46 | dBm | – |
| 1920 to 1980 MHz | | – | – | -46 | dBm | – |
| **Harmonic Generation RF port up to 12.75 GHz[1)]** | | | | | | |
| Pin = 30 dBm at low band, 22 dBm at high band, Duty Cycle = 25% | | – | – | – | – | – |
| 824 to 960 MHz, Third Harmonic | | – | -50 | -42 | dBm | – |
| 824 to 960 MHz, all other Harmonics up to 12.75 GHz | | – | -50 | -44 | dBm | – |
| 1920 to 1980 MHz | | – | -50 | -44 | dBm | – |
| **Switching Time and Current Consumtion** | | | | | | |
| On/Off Switching Time (10-90%) RF | | 0.3 | 1 | 3 | µs | – |
| Boost Converter Settling Time | | – | 10 | 25 | µs | after power down mode |
| Current Consumption at Vdd Pin | | 50 | 75 | 100 | µA | – |
| Current Consumption at Vctrl Pins | | 0.1 | 1 | 30 | µA | – |
| Current Consumption at power down mode | | – | – | 1 | µA | – |

1) $T_A$ = 25 °C and $V_{dd}$ = 3.5 V

# 4 Package Outline

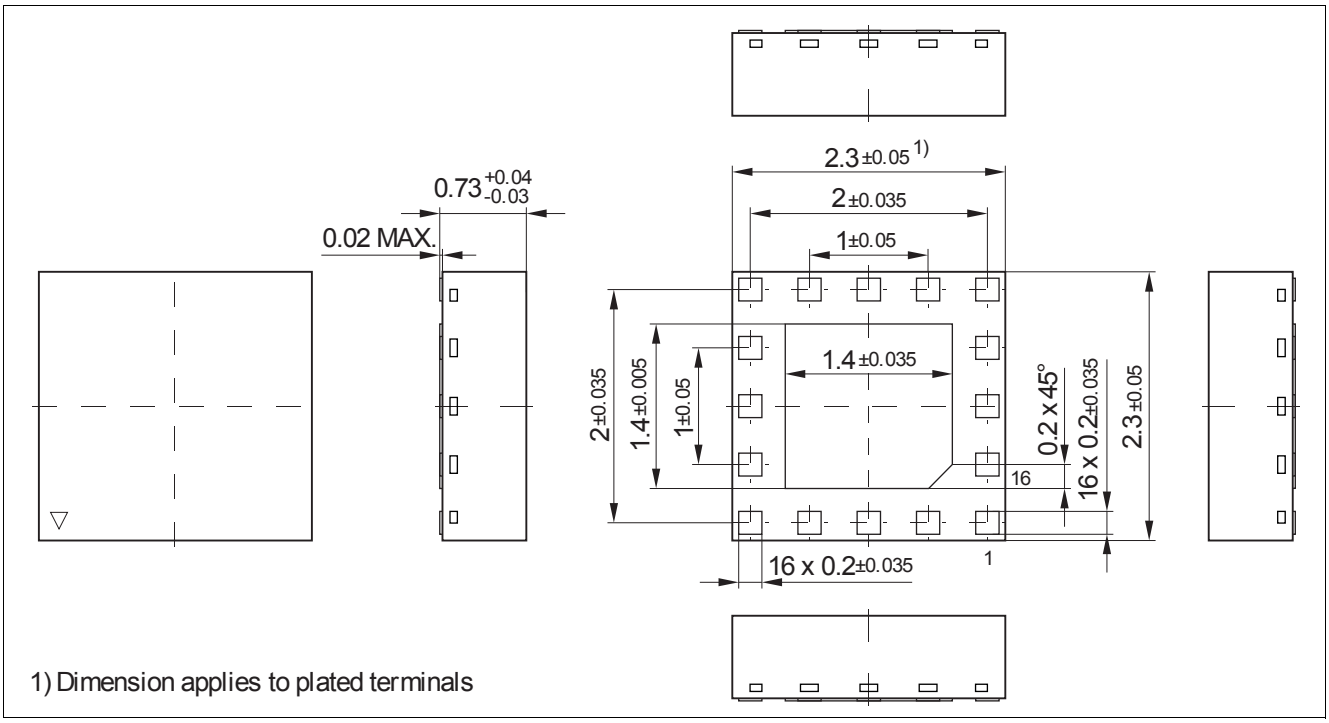


**Figure 3 Package Outline**

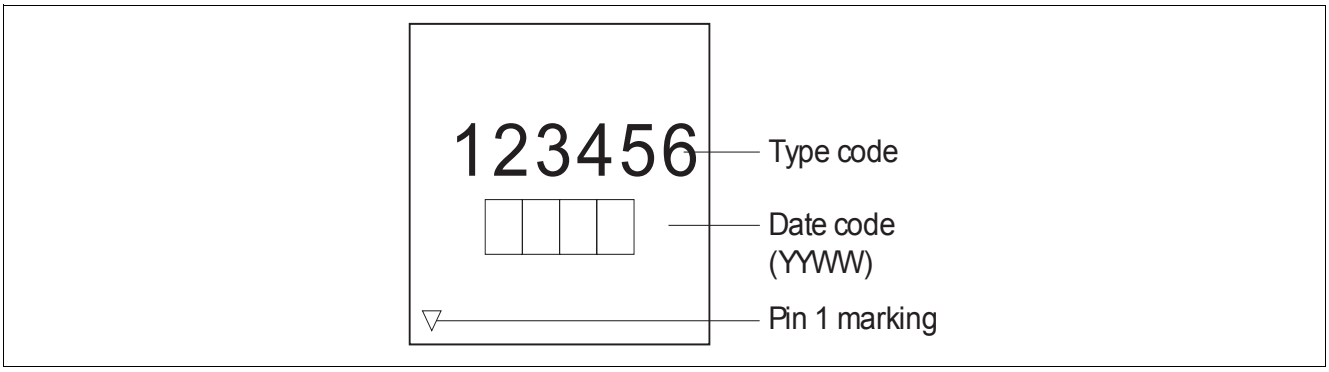


**Figure 4 Pin Marking**

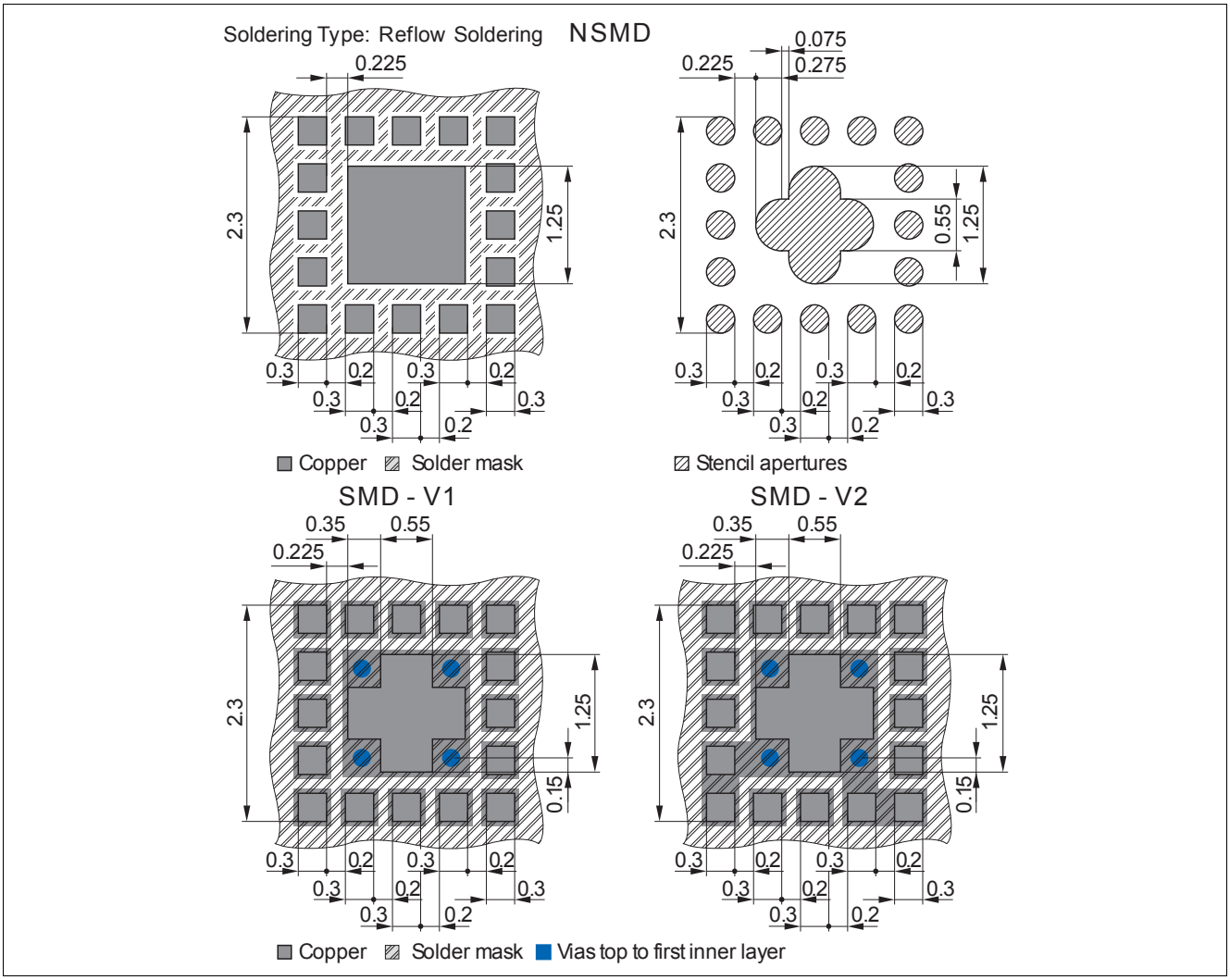


**Figure 5 Land Pattern and Stencil Mask**

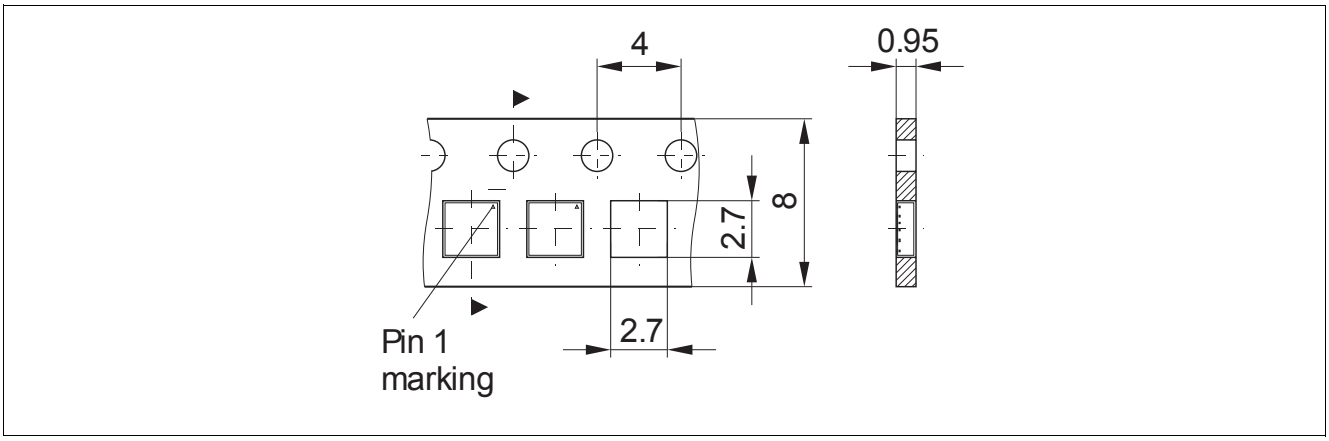


**Figure 6 Tape Drawing for PG-TSNP-16-6**

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