# BGT24LTR11N16

## Silicon Germanium 24GHz Radar Transceiver MMIC

## Data Sheet

Revision: 1.1

RF and Protection Devices

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**Data Sheet**
**Revision History: 2016-09-28**

**Previous Revision: Datasheet Rev. 1.0**

| Page | Subjects (major changes since last revision) |
|---|---|
| 8 | Minimum value for TX output power is changed to 2 dBm |
| 9 | Typical value for SSB noise figure is inserted |
| | |
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# 1 Introduction

## 1.1 Features

- 24GHz transceiver MMIC
- Fully integrated low phase noise VCO
- Built in temperature compensation circuit for VCO stabilization
- Homodyne quadrature receiver
- Frequency divider
- Low power consumption
- Fully ESD protected device
- Single ended RF and IF terminals
- 200 GHz bipolar SiGe:C technology b7hf200
- Single supply voltage 3.3V
- TSNP-16-9 plastic package
- Pb-free (RoHS compliant) package

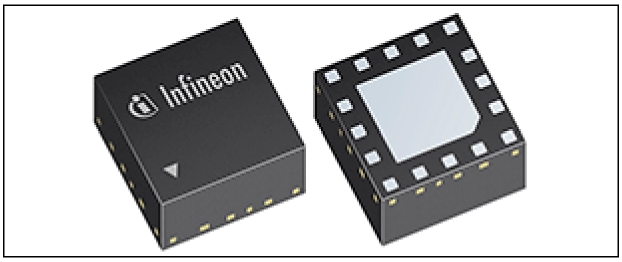


**Figure 1 BGT24LTR11N16 in TSNP-16-9**

**Description**

The BGT24LTR11 is a Silicon Germanium Transceiver MMIC operating from 24.0 GHz up to 24.25 GHz. It is based on a 24 GHz fundamental voltage controlled oscillator (VCO). A built in voltage source delivers a VCO tuning voltage (V_PTAT) which is proportional to absolute temperature. When connected to the VCO tuning pin (V_TUNE) it compensates for the inherent frequency drift of the VCO over temperature thus stabilizing the VCO within the ISM band eliminating the need for a PLL/Microcontroller. An integrated 1:16 frequency divider also allows for external phase lock loop VCO frequency stabilization.

The receiver section uses a low noise amplifier (LNA) in front of a quadrature homodyne down conversion mixer in order to provide excellent receiver sensitivity. Derived from the internal VCO signal, a RC polyphase filter (PPF) generates quadrature LO signals for the quadrature mixer. The I/Q IF outputs are available through a single ended terminal respectively.

The device is manufactured in a 0.18µm SiGe:C technology offering a cutoff frequency of 200 GHz. It is packaged in a 16 pin leadless RoHs compliant TSNP package.

| Product Name | Package | Chip | Marking |
|---|---|---|---|
| BGT24LTR11N16 | TSNP-16-9 | T1811 | LTR11 |

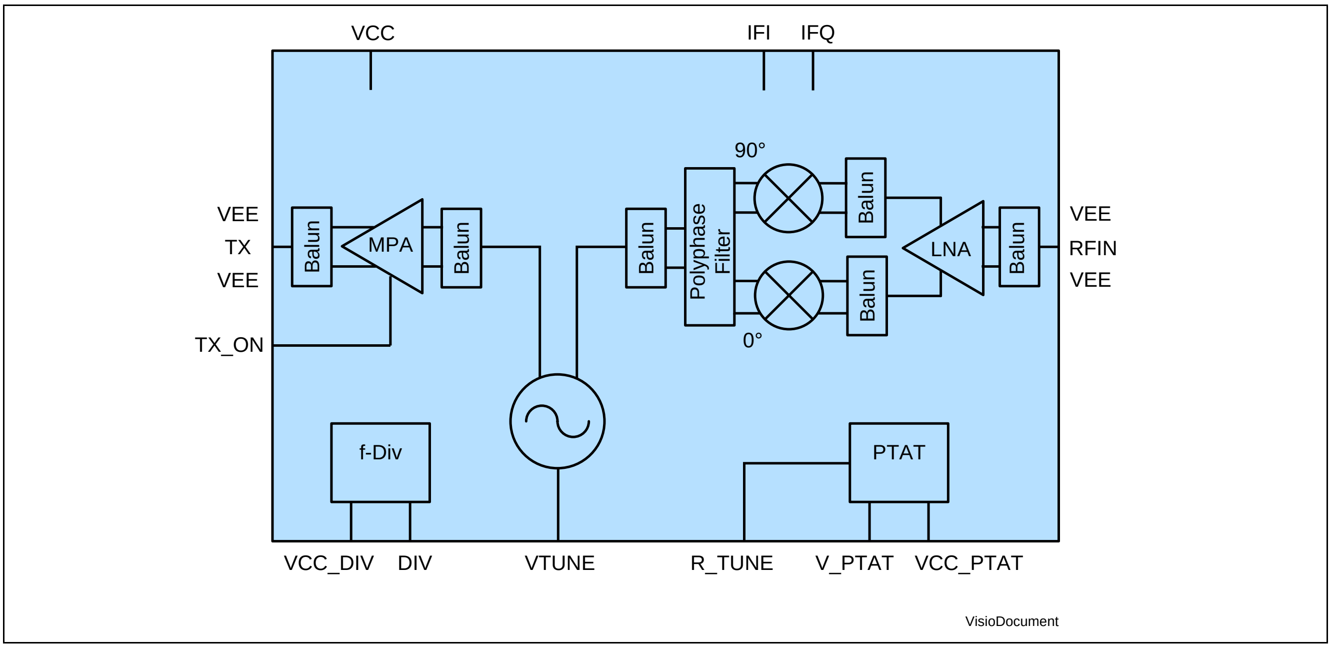


**Figure 2 BGT24LTR11N16 block diagram**

# 2 Electrical Characteristics

## 2.1 Absolute Maximum Ratings

**Table 1 Absolute maximum ratings: $T_A$ = -40 °C ... 85 °C; all voltages with respect to ground**

| Parameter | Symbol | Value | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | $V_{CC}$ | -0.3 | | 3.6 | V | |
| Supply voltage divider | $V_{CC\_DIV}$ | -0.3 | | 3.6 | V | |
| Supply voltage PTAT voltage source | $V_{CC\_PTAT}$ | -0.3 | | 3.6 | V | |
| DC voltage at RF pins | $V_{DC\_RF}$ | | | 0 | | MMIC provides short circuit to GND for RF_IN and TX_OUT |
| Voltage applied to none-RF I/O pins | $V_{DC\_I/O}$ | -0.3 | | $V_{CC}$ +0.3 | V | |
| Total power dissipation | $P$ | | | 300 | mW | |
| Ambient temperature range | $T_A$ | -40 | | 85 | °C | |
| Storage temperature range | $T_{STG}$ | -50 | | 125 | °C | |

## 2.2 ESD Integrity

**Table 2 ESD integrity**

| Parameter | Symbol | Value | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| ESD robustness HBM[1] | $V_{ESD\text{-}HBM}$ | -1 | | 1 | kV | |
| ESD robustness CDM[2] | $V_{ESD\text{-}CDM}$ | -500 | | 500 | V | |

1) According to ANSI/ESDA/JEDEC JS-001 (R = 1.5kOhm, C = 100pF) for Electrostatic Discharge Sensitivity Testing, Human Body Model (HBM)-Component Level

2) According to JEDEC JESD22-C101 Field-Induced Charged Device Model (CDM), Test Method for Electrostatic-Discharge-Withstand Thresholds of Microelectronic Components

Please note that this result is subject to:
- lot variations within the manufacturing process as specified by Infineon
- changes in the specific test setup

## 2.3 Power Supply

**Table 3 Power supply characteristics: $T_A$ = -40 °C … 85 °C**

| Parameter | Symbol | Value | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | $V_{CC}$ | 3.2 | 3.3 | 3.4 | V | |
| Supply current | $I_{CC}$ | | 45 | 55 | mA | |
| Duty cycle | | 1 : 1000 | | 1 | | |
| Pulse duration | $t_P$ | 1 | | | µs | |

## 2.4 TX Section

**Table 4 TX characteristics: $T_A$ = -40 °C ... 85 °C**

| Parameter | Symbol | Value | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| VCO frequency range | $f_{VCO}$ | 24.050 | | 24.250 | GHz | V_PTAT connected to VTUNE; 16 kOhm resistor connected from R_TUNE to GND |
| VCO phase noise | $P_N$ | | | -55<br>-80 | dBc/ Hz | @ 10 kHz offset<br>@ 100 kHz offset |
| VCO AM noise | $P_{AM}$ | | | -135 | dBc/ Hz | @ 100 kHz offset |
| Tuning voltage to cover VCO frequency range | $VTUNE$ | 0.7 | | 2.5 | V | |
| VCO tuning sensitivity within VCO frequency range | | | 720 | 2000 | MHz/V | |
| Harmonic suppression | | 25 | | | dBc | |
| Non-harmonic suppression | | 62 | | | dBc | f>10 GHz; $D_{DIV}$=16 |
| Non-harmonic suppression | | 45 | | | dBc | f≤10 GHz; $D_{DIV}$=16 |
| TX output power | $P_{TX}$ | 2 | 6 | 10 | dBm | |
| TX load impedance | $Z_{TXOUT}$ | | 50 | | Ω | Single ended |
| TX_ON low level input voltage | $V_{TX\_ON\_low}$ | | | 0.8 | V | |
| TX_ON high level input voltage | $V_{TX\_ON\_high}$ | 2 | | | V | |
| TX_ON input voltage hysteresis | $V_{TX\_ON\_hys}$ | 50 | | | mV | |
| TX_ON input current | $I_{TX\_ON}$ | -100 | | 100 | µA | |
| TX_ON switching time | $t_{TX\_ON}$ | | | 2 | ns | |
| Power up TX settling time | $t_{TX\_Power\_up}$ | | | 100ns | | Defines the time TX section requires to settle after VCC supply voltage is within specified range |

## 2.5 RX Section (Measured with TX_ON=0V)

**Table 5 RX characteristics: $T_A$ = -40 °C … 85 °C**

| Parameter | Symbol | Value | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| RX frequency range | $f_{RX}$ | 24.0 | | 24.25 | GHz | |
| RX input impedance | $Z_{RXIN}$ | | 50 | | Ω | Single ended |
| Voltage conversion gain | $G_C$ | 15.5 | 20 | 26.5 | dB | |
| SSB noise figure | $NF_{SSB}$ | | 10 | 18 | dB | Single sideband @ $f_{IF}$ = 100 kHz |
| Input compression point | $IP_{1dB}$ | -28 | | | dBm | |
| Quadrat. phase imbalance | $\varepsilon_P$ | 0 | | 24 | deg | |
| Quadrat. amplitude imbalance | $\varepsilon_A$ | -1 | | 1 | dB | |
| IF output impedance | $Z_{IF}$ | | | 1 | kΩ | Single ended |

## 2.6 Frequency Divider

**Table 6 Frequency divider characteristics: $T_A$ = -40 °C ... 85 °C**

| Parameter | Symbol | Value | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Prescaler division ratio | $D_{DIV}$ | 16 | | 8192 | - | 16 if $V_{CC\_PTAT}$ = 0 V,<br>8192 if $V_{CC\_PTAT}$ = 3.3 V |
| Prescaler output voltage | $V_{DIV}$ | 60 | | 500 | mV | Peak to Peak voltage when DIV out is terminated with 50 Ohm and $D_{DIV}$=16 |
| Prescaler supply voltage | $V_{CC\_DIV}$ | 3.2 | 3.3 | 3.4 | V | |
| Prescaler supply current | $I_{CC\_DIV}$ | 13 | 19 | 25 | mA | |

## 2.7 Proportional to absolute temperature (PTAT) voltage source

**Table 7 PTAT voltage source characteristics: $T_A$ = -40 °C ... 85 °C**

| Parameter | Symbol | Value | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | $V_{CC\_PTAT}$ | 3.2 | 3.3 | 3.4 | V | |
| Supply current | $I_{CC\_PTAT}$ | | 1.5 | 2.5 | mA | |
| Output voltage | $V_{OUT\_PTAT}$ | 0.7 | 1.3 | 2 | V | |

# 3 Pin description

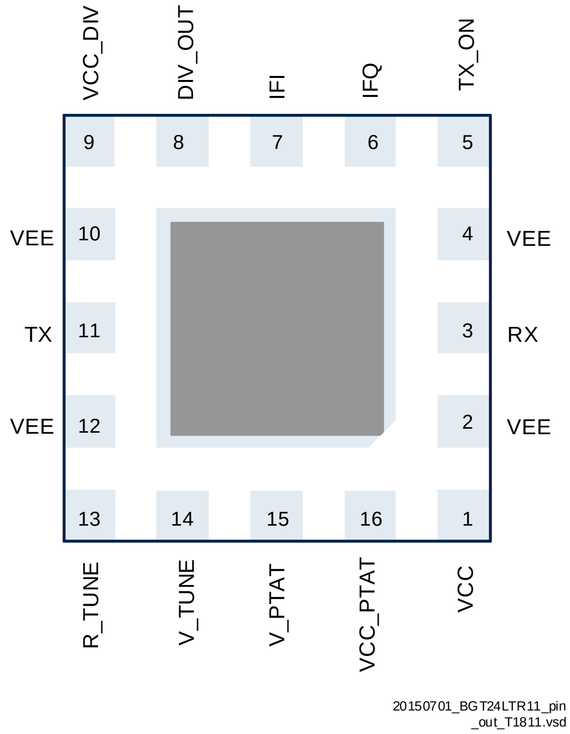


**Figure 3 Pin-out (top view)**

**Table 8 Pin definition and function**

| Pin Number | Name | Function |
|---|---|---|
| 1 | VCC | Supply voltage |
| 2 | VEE | Ground |
| 3 | RX | Receiver RF input |
| 4 | VEE | GND |
| 5 | TX_EN | Output power enable |
| 6 | IFQ | Quadrature phase down converter IF output |
| 7 | IFI | In phase down converter IF output |
| 8 | DIV_OUT | Frequency divider output |
| 9 | VCC_DIV | Supply voltage of prescaler |
| 10 | VEE | Ground |
| 11 | TX | Tranmitter RF output |
| 12 | VEE | Ground |
| 13 | R_TUNE | VCO operating frequency band select |
| 14 | V_TUNE | VCO frequency tuning input |
| 15 | V_PTAT | PTAT voltage source output |
| 16 | VCC_PTAT | PTAT voltage source power supply |

# 4 Physical Dimension

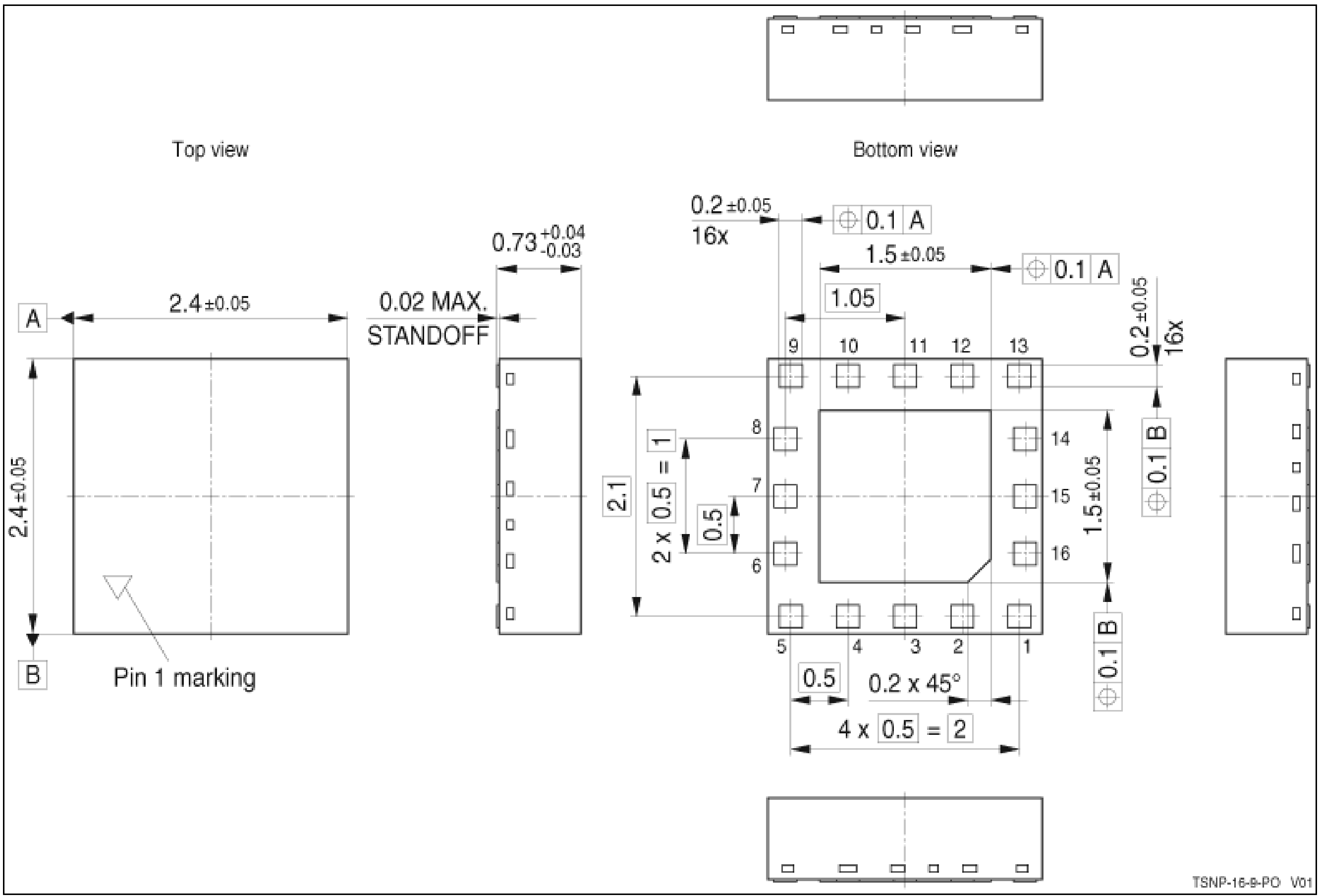


**Figure 4 Package Outline (top, side and bottom view) of TSNP-16-9**

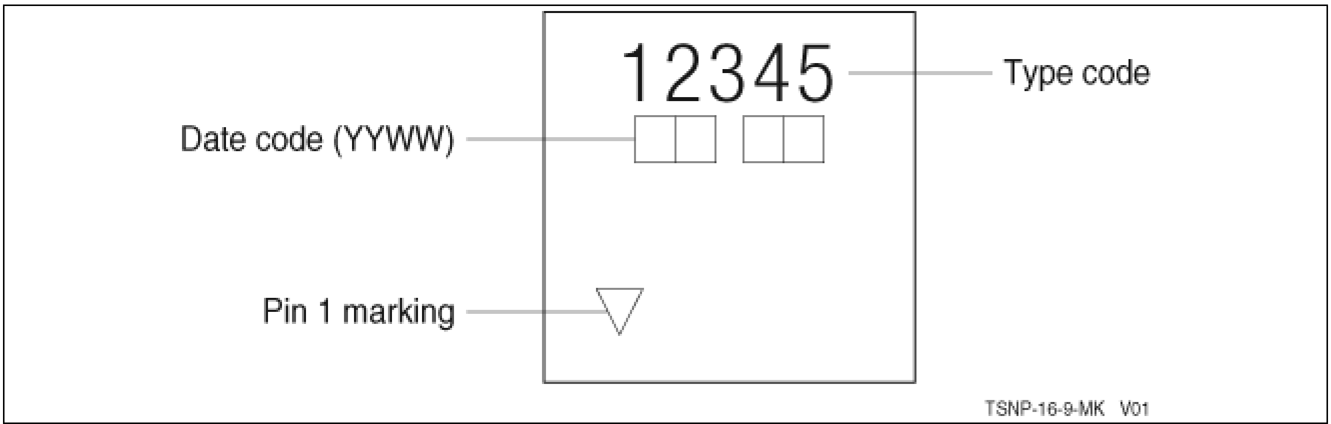


**Figure 5 Marking Layout of TSNP-16-9 (example)**

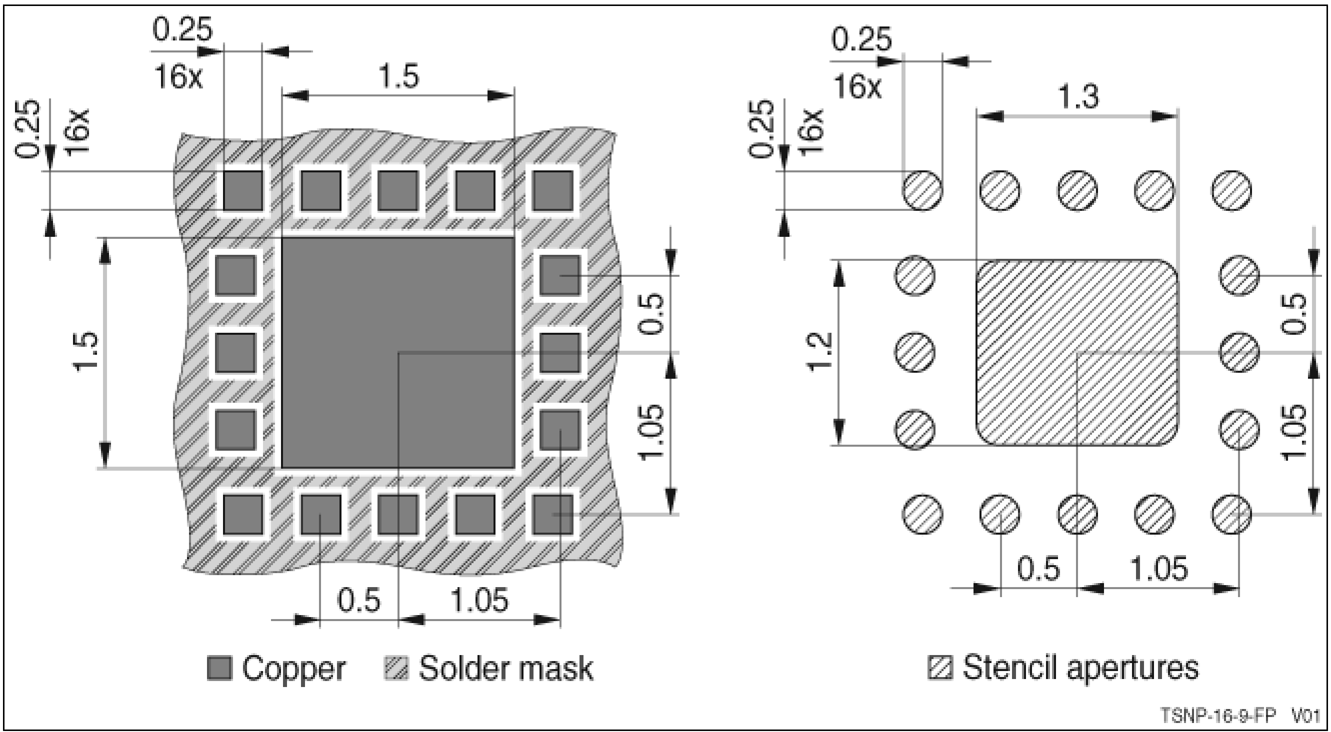


**Figure 6 Soldering Footprint of TSNP-16-9**

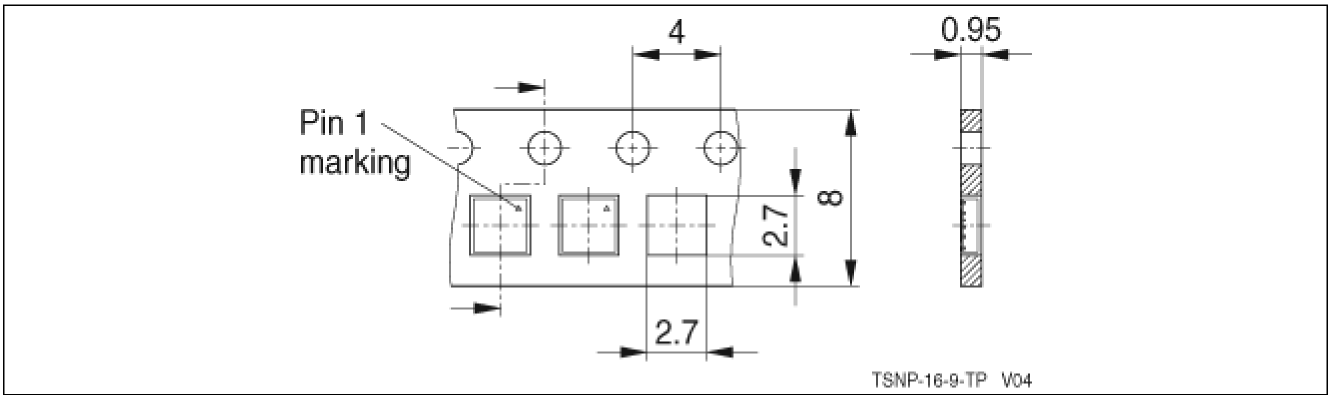


**Figure 7 Packing Description of TSNP-16-9; Ø Reel: 180 mm, Pieces / Reel: 3000, Reels / Box: 1**

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