

BGA524N6

Silicon Germanium Low Noise Amplifier
for Global Navigation Satellite Systems (GNSS)

Data Sheet

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Revision History

| Page or Item | Subjects (major changes since previous revision) |
|---------------------------------|--|
| Revision 3.5, 2021-08-31 | |
| 17 | Carrier Tape Drawing updated |
| Revision 3.4, 2020-07-01 | |
| 7 | Type code information updated |
| 15 | Type code information updated |
| Revision 3.3, 2018-04-10 | |
| 3 | Trademarks updated |
| 7, 12 | Package name TSNP-6-10 added |
| 9 | Maximum ratings comment updated |
| 14 | Package outline drawing for TSNP-6-10 added |
| 15 | Marking layout drawing for TSNP-6-10 added |
| 16 | Date code marking table added |
| 17 | Tape & reel dimensions for TSNP-6-10 added |
| Revision 3.2, 2014-10-15 | |
| 11-12 | Footnotes 3 and 5 added |

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Silicon Germanium Low Noise Amplifier for Global Navigation Satellite Systems (GNSS)

BGA524N6

Features

- High insertion power gain: 19.6 dB
- Out-of-band input 3rd order intercept point: -4dBm
- Input 1 dB compression point: -12 dBm
- Low noise figure: 0.55 dB
- Very low current consumption: 2.5 mA
- Operating frequencies: 1550 - 1615 MHz
- Supply voltage: 1.5 V to 3.3 V
- Digital on/off switch (1V logic high level)
- Ultra small TSNP-6-2 / TSNP-6-10 leadless package (footprint: 0.7 x 1.1 mm²)
- B7HF Silicon Germanium technology
- RF output internally matched to 50 Ω
- Only 1 external SMD component necessary
- 2kV HBM ESD protection (including AI-pin)
- Pb-free (RoHS compliant) package



Application

- Ideal for all Global Navigation Satellite Systems (GNSS) like GPS, GLONASS, Beidou, Galileo and others

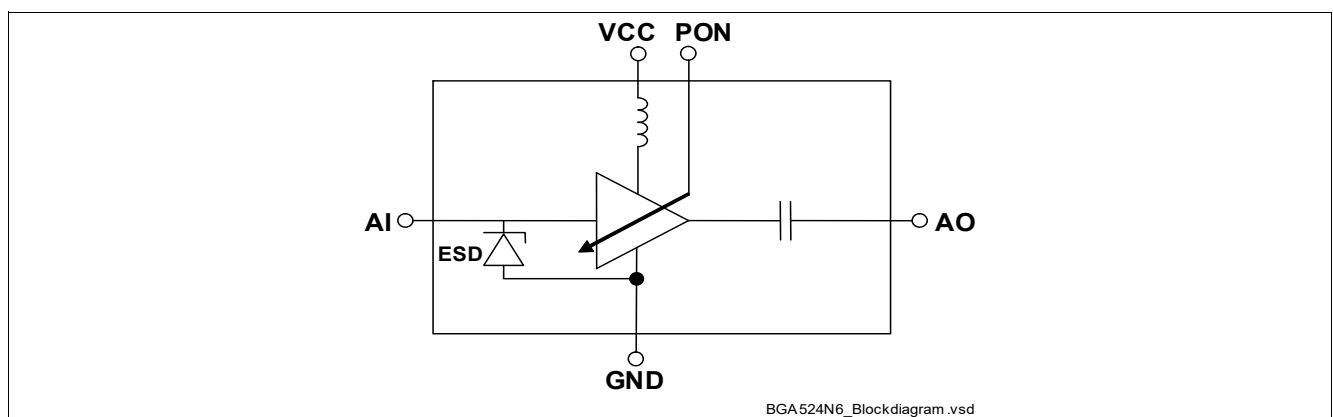


Figure 1 Block Diagram

| Product Name | Marking / Type Code | Package |
|--------------|---------------------|----------------------|
| BGA524N6 | H | TSNP-6-2 / TSNP-6-10 |

Description

The BGA524N6 is a front-end low noise amplifier for Global Navigation Satellite Systems (GNSS) from 1550 MHz to 1615 MHz like GPS, GLONASS, Beidou, Galileo and others. The LNA provides 19.6 dB gain and 0.55 dB noise figure at a current consumption of 2.5 mA in the application configuration described in [Chapter 3](#). The BGA524N6 is based upon Infineon Technologies' B7HF Silicon Germanium technology. It operates from 1.5 V to 3.3 V supply voltage.

Pin Definition and Function

Table 1 Pin Definition and Function

| Pin No. | Name | Function |
|---------|------|------------------|
| 1 | GND | Ground |
| 2 | VCC | DC supply |
| 3 | AO | LNA output |
| 4 | GND | Ground |
| 5 | AI | LNA input |
| 6 | PON | Power on control |

1 Maximum Ratings

Table 2 Maximum Ratings

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--|----------------|--------|------|----------------|------|--------------------------|
| | | Min. | Typ. | Max. | | |
| Voltage at pin VCC | V_{CC} | -0.3 | – | 3.6 | V | 1) |
| Voltage at pin AI | V_{AI} | -0.3 | – | 0.9 | V | – |
| Voltage at pin AO | V_{AO} | -0.3 | – | $V_{CC} + 0.3$ | V | – |
| Voltage at pin PON | V_{PON} | -0.3 | – | $V_{CC} + 0.3$ | V | – |
| Voltage at pin GNDRF | V_{GNDRF} | -0.3 | – | 0.3 | V | – |
| Current into pin VCC | I_{CC} | – | – | 16 | mA | – |
| RF input power | P_{IN} | – | – | 0 | dBm | – |
| Total power dissipation, $T_S < 148\text{ °C}^2)$ | P_{tot} | – | – | 60 | mW | – |
| Junction temperature | T_J | – | – | 150 | °C | – |
| Ambient temperature range | T_A | -40 | – | 85 | °C | – |
| Storage temperature range | T_{STG} | -65 | – | 150 | °C | – |
| ESD capability all pins | V_{ESD_HBM} | – | – | 2000 | V | according to JESD22A-114 |

1) All voltages refer to GND-Node unless otherwise noted

2) T_S is measured on the ground lead at the soldering point

Attention: Stresses above the max. values listed here may cause permanent damage to the device. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit. Exposure to conditions at or below absolute maximum rating but above the specified maximum operation conditions may affect device reliability and life time. Functionality of the device might not be given under these conditions.

Thermal Resistance

Table 3 Thermal Resistance

| Parameter | Symbol | Value | Unit |
|--|------------|-------|------|
| Junction - soldering point ¹⁾ | R_{thJS} | 25 | K/W |

1) For calculation of R_{thJA} please refer to Application Note Thermal Resistance

2 Electrical Characteristics

Table 4 Electrical Characteristics:¹⁾ $T_A = 25\text{ °C}$, $V_{CC} = 1.8\text{ V}$, $V_{PON,ON} = 1.8\text{ V}$, $V_{PON,OFF} = 0\text{ V}$,
 $f = 1550 - 1615\text{ MHz}$ (GPS / Glonass / Beidou / Galileo)

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|----------------|--------|------|-------------------|---------------|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | V_{CC} | 1.5 | – | 3.3 | V | – |
| Supply current | I_{CC} | – | 2.5 | 3.2 | mA | ON-mode |
| | | – | 2.5 | 3.5 ⁵⁾ | mA | ON-mode, $f_{IN} = 1575\text{ MHz}$, $P_{IN} \leq -40\text{ dBm}$ |
| | | – | 0.2 | 3 | μA | OFF-mode |
| Power On voltage | V_{pon} | 1.0 | – | V_{CC} | V | ON-mode |
| | | 0 | – | 0.4 | V | OFF-mode |
| Power On current | I_{pon} | – | 5 | 10 | μA | ON-mode |
| | | – | – | 1 | μA | OFF-mode |
| Insertion power gain | $ S_{21} ^2$ | 18.4 | 19.6 | 20.8 | dB | – |
| Noise figure ²⁾ | NF | – | 0.55 | 1.0 | dB | $Z_S = 50\ \Omega$ |
| Input return loss ³⁾ | RL_{in} | 8 | 11 | – | dB | – |
| Output return loss ³⁾ | RL_{out} | 12 | 20 | – | dB | – |
| Reverse isolation ³⁾ | $1/ S_{12} ^2$ | 32 | 37 | – | dB | – |
| Power gain settling time ^{4),5)} | t_S | – | 5 | 8 | μs | OFF- to ON-mode |
| | | – | 5 | 8 | μs | ON- to OFF-mode |
| Inband input 1dB-compression point ³⁾ | IP_{1dB} | -19 | -16 | – | dBm | – |
| Inband input 3 rd -order intercept point ^{6),3)} | IIP_3 | -12 | -9 | – | dBm | $f_1 = 1575\text{ MHz}$ $f_2 = f_1 \pm 1\text{ MHz}$ |
| Out-of-band input 3 rd -order intercept point ^{7),5)} | IIP_{3oob} | -8 | -5 | – | dBm | $f_1 = 1712.7\text{ MHz}$ $f_2 = 1850\text{ MHz}$ |
| Stability ⁵⁾ | k | > 2 | > 3 | – | | $f = 20\text{ MHz} \dots 10\text{ GHz}$ |

1) Based on the application described in chapter 3

2) PCB losses are subtracted

3) Verification based on AQL; not 100% tested in production

4) To be within 1 dB of the final gain OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode

5) Guaranteed by device design; not tested in production

6) Input power = -30 dBm for each tone

7) Input power = -20 dBm for each tone

Electrical Characteristics
Table 5 Electrical Characteristics:¹⁾ $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $V_{PON,ON} = 2.8\text{ V}$, $V_{PON,OFF} = 0\text{ V}$,
 $f = 1550 - 1615\text{ MHz}$ (GPS / Glonass / Beidou / Galileo)

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|----------------|--------|------|-------------------|---------------|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | V_{CC} | 1.5 | – | 3.3 | V | – |
| Supply current | I_{CC} | – | 2.6 | 3.3 | mA | ON-mode |
| | | – | 2.6 | 3.6 ⁵⁾ | mA | ON-mode, $f_{IN} = 1575\text{ MHz}$, $P_{IN} \leq -40\text{ dBm}$ |
| | | – | 0.2 | 3 | μA | OFF-mode |
| Power On voltage | V_{pon} | 1.0 | – | V_{cc} | V | ON-mode |
| | | 0 | – | 0.4 | V | OFF-mode |
| Power On current | I_{pon} | – | 10 | 15 | μA | ON-mode |
| | | – | – | 1 | μA | OFF-mode |
| Insertion power gain | $ S_{21} ^2$ | 18.4 | 19.6 | 20.8 | dB | – |
| Noise figure ²⁾ | NF | – | 0.55 | 1.0 | dB | $Z_S = 50\ \Omega$ |
| Input return loss ³⁾ | RL_{in} | 8 | 11 | – | dB | – |
| Output return loss ³⁾ | RL_{out} | 12 | 18 | – | dB | – |
| Reverse isolation ³⁾ | $1/ S_{12} ^2$ | 32 | 37 | – | dB | – |
| Power gain settling time ^{4),5)} | t_S | – | 5 | 8 | μs | OFF- to ON-mode |
| | | – | 5 | 8 | μs | ON- to OFF-mode |
| Inband input 1dB-compression point ³⁾ | IP_{1dB} | -15 | -12 | – | dBm | – |
| Inband input 3 rd -order intercept point ^{6),3)} | IIP_3 | -11 | -8 | – | dBm | $f_1 = 1575\text{ MHz}$ $f_2 = f_1 \pm 1\text{ MHz}$ |
| Out-of-band input 3 rd -order intercept point ^{7),5)} | IIP_{3oob} | -7 | -4 | – | dBm | $f_1 = 1712.7\text{ MHz}$ $f_2 = 1850\text{ MHz}$ |
| Stability ⁵⁾ | k | > 2 | > 3 | – | | $f = 20\text{ MHz} \dots 10\text{ GHz}$ |

1) Based on the application described in chapter 3

2) PCB losses are subtracted

3) Verification based on AQL; not 100% tested in production

4) To be within 1 dB of the final gain OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode

5) Guaranteed by device design; not tested in production

6) Input power = -30 dBm for each tone

7) Input power = -20 dBm for each tone

3 Application Information

Application Board Configuration

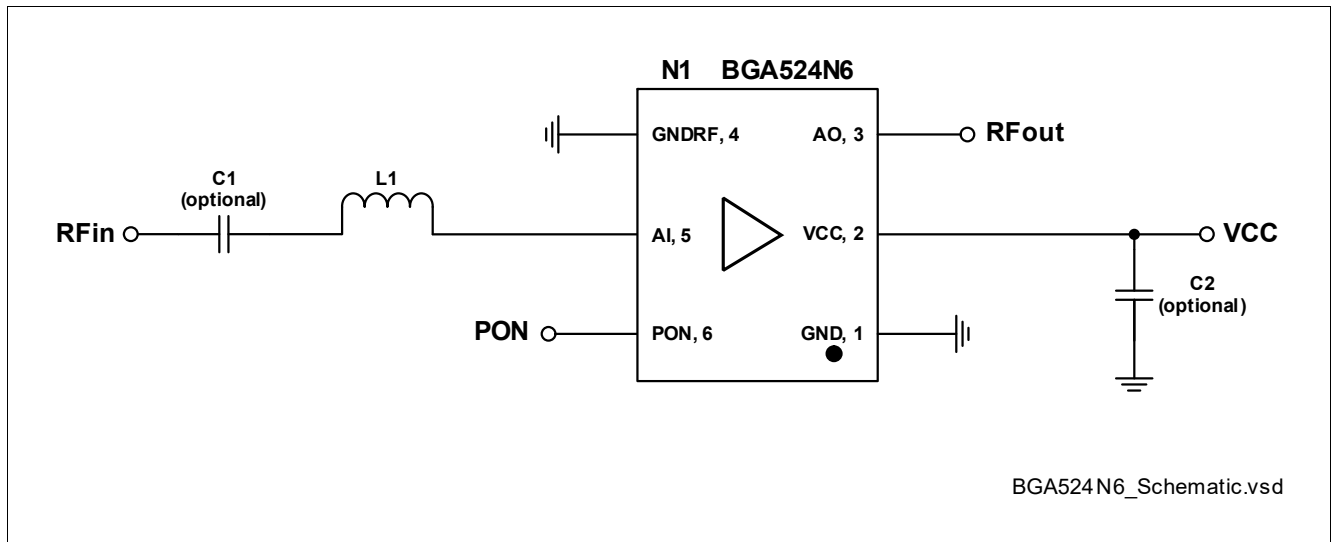


Figure 2 Application Schematic BGA524N6

Table 6 Bill of Materials

| Name | Value | Package | Manufacturer | Function |
|---------------|----------------------|----------------------|-----------------|-------------------------|
| C1 (optional) | 1nF | 0402 | Various | DC block ¹⁾ |
| C2 (optional) | > 10nF ²⁾ | 0402 | Various | RF bypass ³⁾ |
| L1 | 8.2nH | 0402 | Murata LQW type | Input matching |
| N1 | BGA524N6 | TSNP-6-2 / TSNP-6-10 | Infineon | SiGe LNA |

1) DC block might be realized with pre-filter in GNSS applications

2) For data sheet characteristics 1 μ F used

3) RF bypass recommended to mitigate power supply noise

A list of all application notes is available at <http://www.infineon.com/gpsIna.appnotes>.

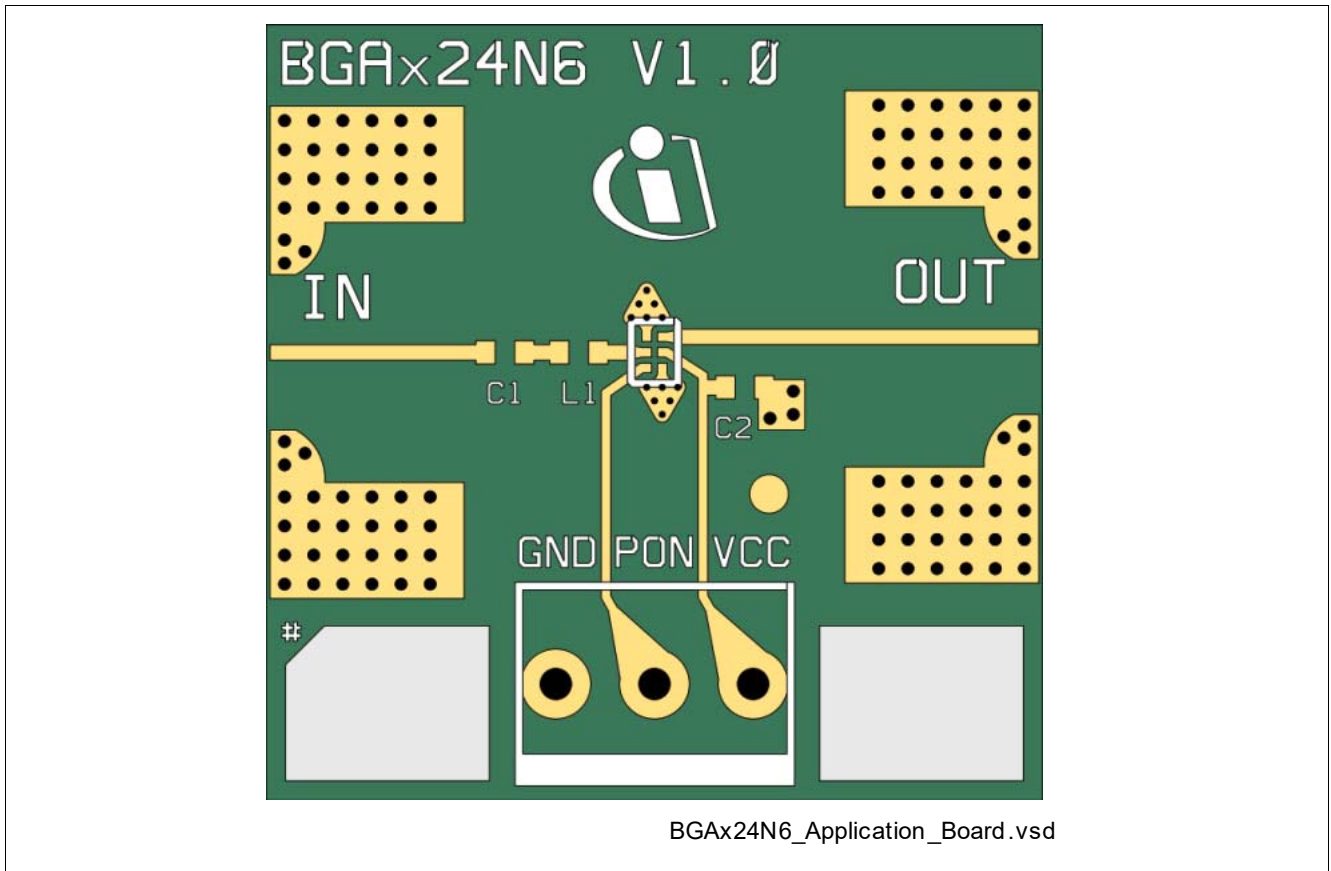


Figure 3 Drawing of Application Board

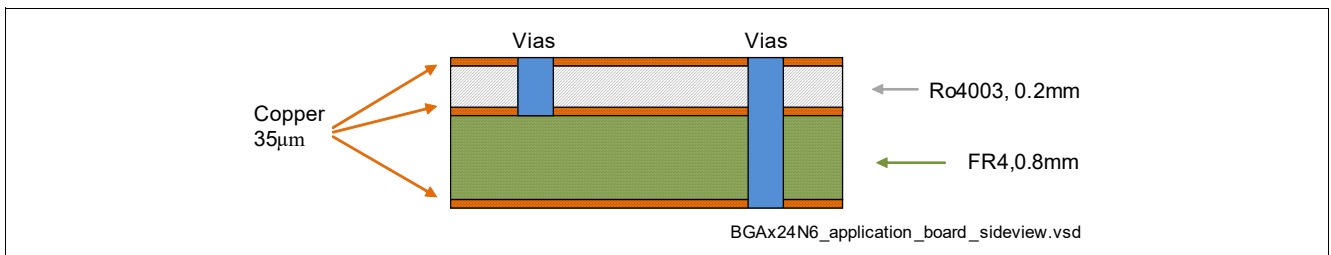


Figure 4 Application Board Cross-Section

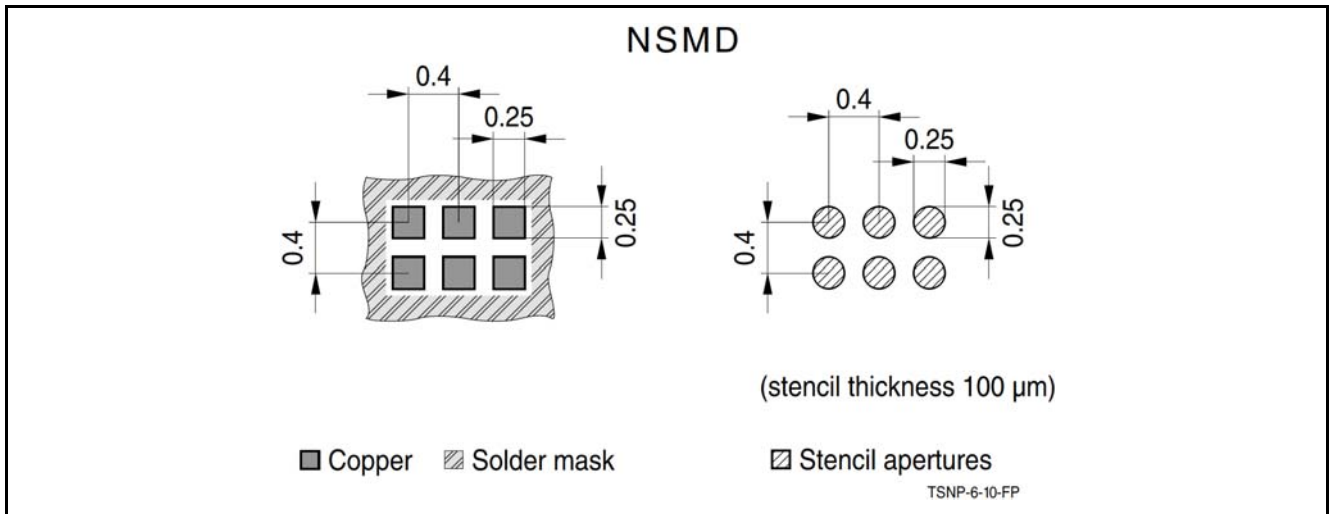


Figure 7 Footprint Recommendation TSNP-6-2 and TSNP-6-10

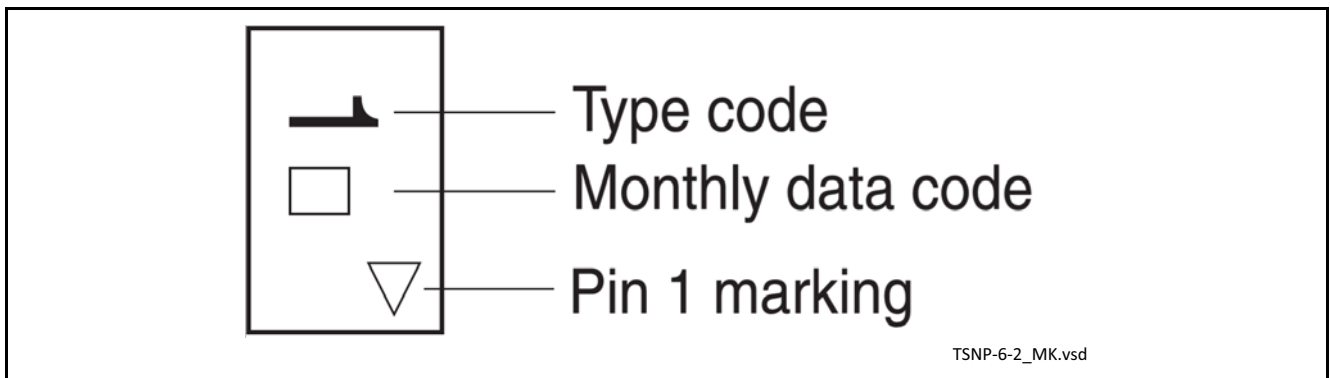


Figure 8 Marking Layout TSNP-6-2 (top view, product type code see [Page 7](#))

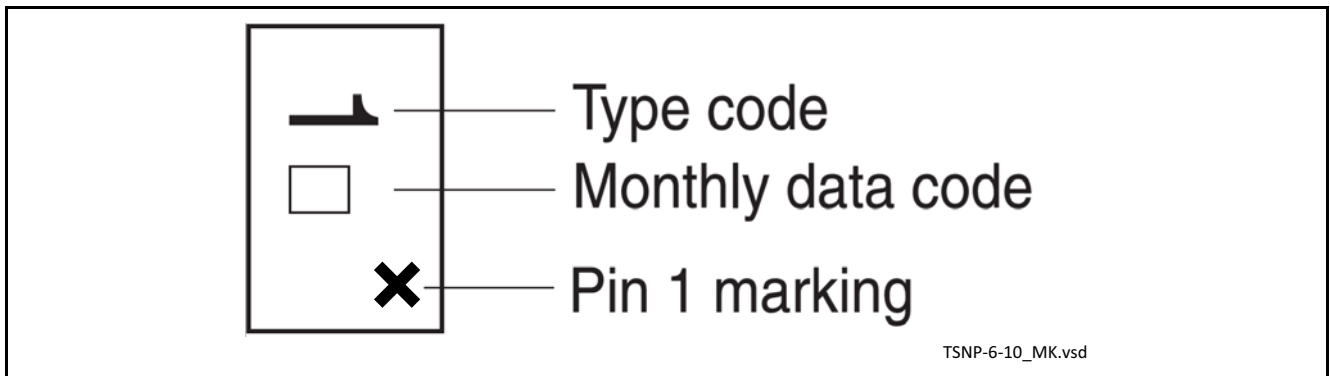


Figure 9 Marking Layout TSNP-6-10 (top view, product type code see [Page 7](#))

| Month | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| 01 | a | p | A | P | a | p | A | P | a | p | A | P |
| 02 | b | q | B | Q | b | q | B | Q | b | q | B | Q |
| 03 | c | r | C | R | c | r | C | R | c | r | C | R |
| 04 | d | s | D | S | d | s | D | S | d | s | D | S |
| 05 | e | t | E | T | e | t | E | T | e | t | E | T |
| 06 | f | u | F | U | f | u | F | U | f | u | F | U |
| 07 | g | v | G | V | g | v | G | V | g | v | G | V |
| 08 | h | x | H | X | h | x | H | X | h | x | H | X |
| 09 | j | y | J | Y | j | y | J | Y | j | y | J | Y |
| 10 | k | z | K | Z | k | z | K | Z | k | z | K | Z |
| 11 | l | 2 | L | 4 | l | 2 | L | 4 | l | 2 | L | 4 |
| 12 | n | 3 | N | 5 | n | 3 | N | 5 | n | 3 | N | 5 |

Figure 10 Date Code Marking TSNP-6-2 and TSNP-6-10

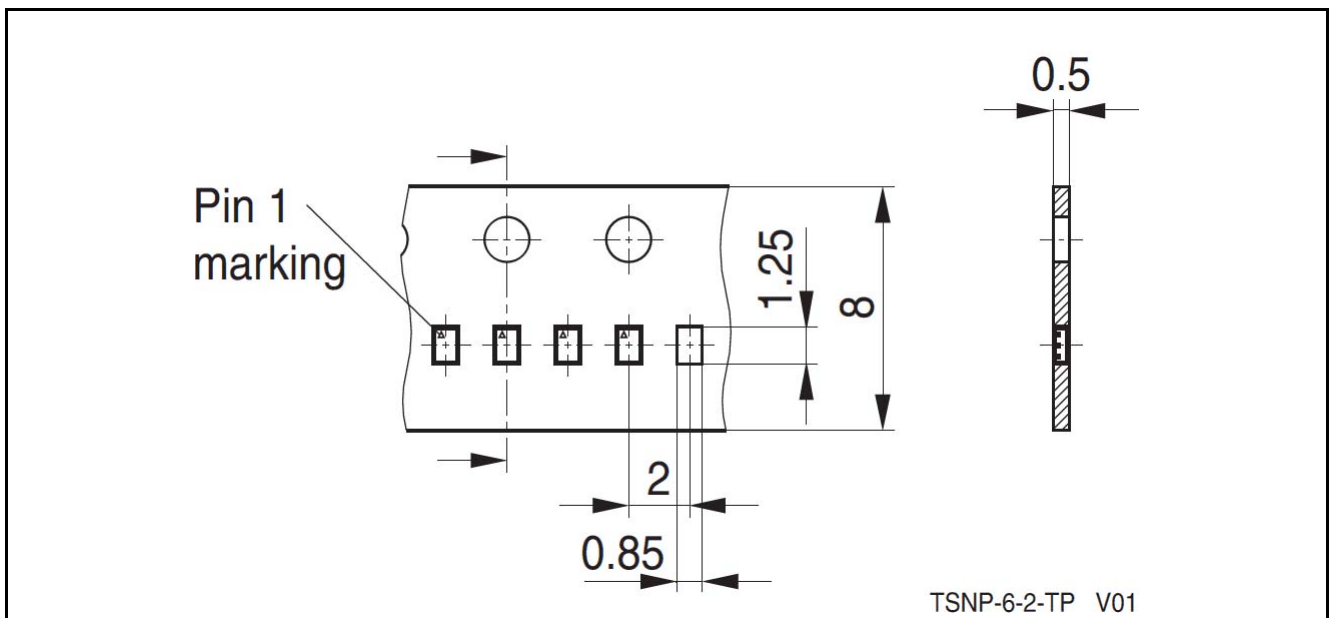


Figure 11 Tape & Reel Dimensions TSNP-6-2 (reel diameter 180 mm, pieces/reel 15000)

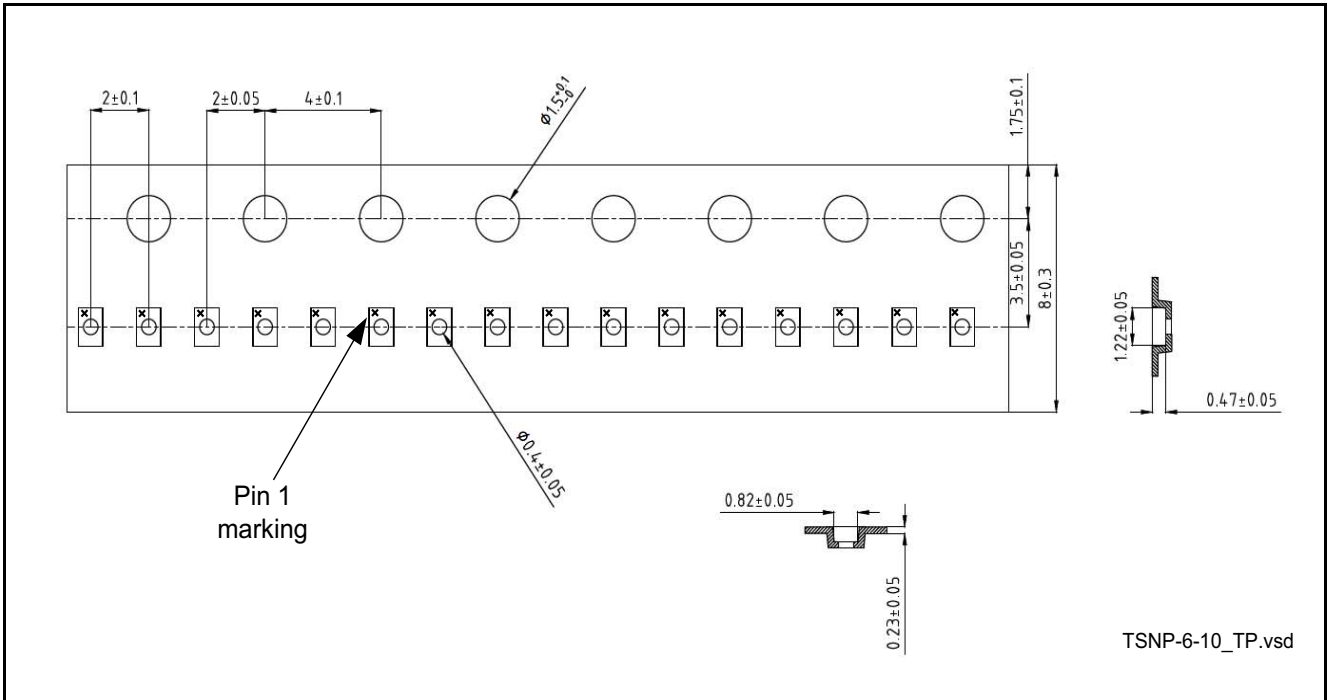


Figure 12 Tape & Reel Dimensions TSNP-6-10 (reel diameter 180 mm, pieces/reel 12000)

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