

# BGM781N11

GPS Front-End Module

RF & Protection Devices



Never stop thinking

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Oct. 2010

Revision History: GPS Front-End Module, Rev.3.2

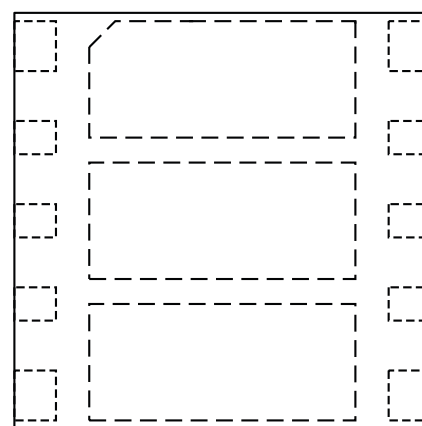
Previous Version: 2009-10-30, Rev.3.1

| Page | Subjects (major changes since last revision)     |
|------|--------------------------------------------------|
| 10   | Package pin tolerances changed from 35µm to 50µm |
|      |                                                  |
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## 1 GPS Front-End Module

### Features

- Operating frequency: 1575.42 MHz
- High Gain: 18.6 dB
- Low Noise Figure: 1.7 dB
- Low current consumption: 3.3 mA
- Out-of-band rejection in cellular bands: 80 dBc
- Input compression point in cellular bands: 20 dBm
- Supply voltage: 1.5 V to 3.6 V
- Tiny TSNP-11-2 leadless package
- RF input internally pre-matched to 50  $\Omega$
- RF output internally matched to 50  $\Omega$
- HBM ESD capability of all pins: 2 kV
- IEC ESD contact discharge of RF input pin: 8 kV
- Only 2 external SMD parts
- RoHS compliant package (Pb-free)

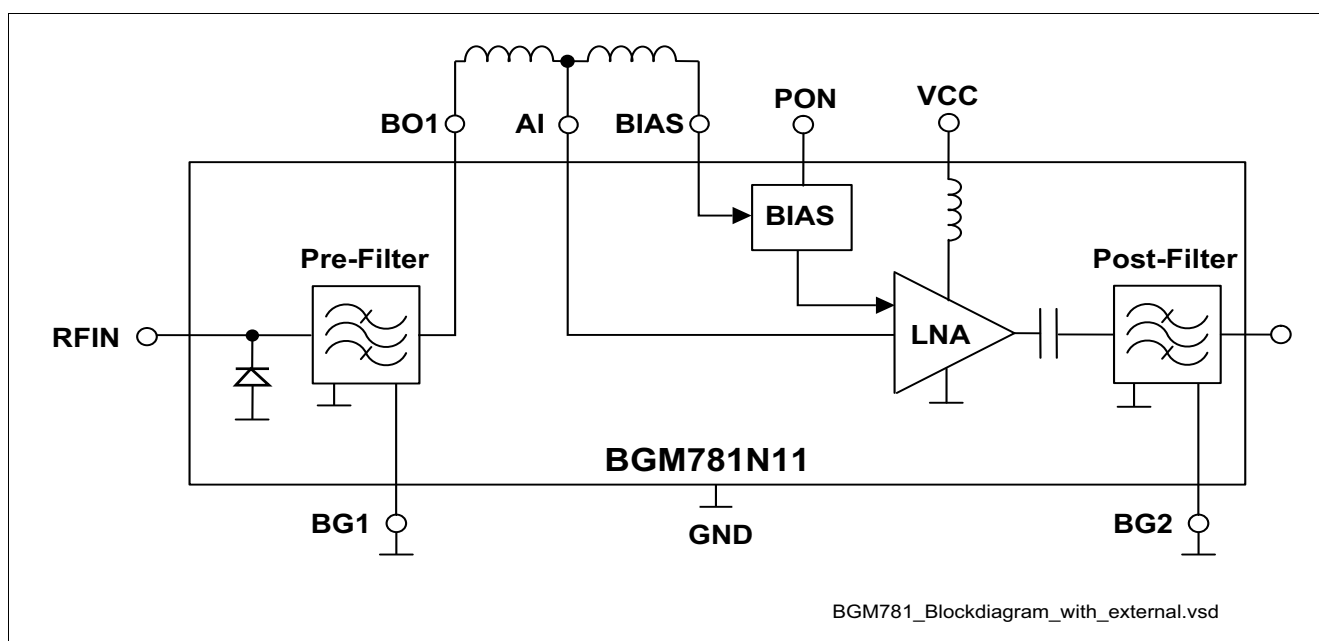


TSNP11-2.vsd

**TSNP-11-2 Package top view**  
(2.5 x 2.5 x 0.73 mm<sup>3</sup>)

### Application

- 1575.42 MHz GPS, Galileo, GPS phones, personal navigation devices



**Figure 1** Blockdiagram with main external components

## 2 Description

The BGM781N11 is a combination of a low-insertion-loss pre-filter with Infineon's high performance low noise amplifier (LNA) and a high-attenuation post-filter for Global Positioning System (GPS) applications. Through the low insertion loss of the filters, the BGM781N11 provides 18.6 dB gain, 1.7 dB noise figure and high linearity performance. In addition BGM781N11 provides very high out-of-band attenuation in conjunction with a high input compression point. Its current consumption is as low as 3.3 mA. It operates over the 1.5 V to 3.6 V supply voltage range.

| Type      | Package   | Marking |
|-----------|-----------|---------|
| BGM781N11 | TSNP-11-2 | M781    |

### Pin Definition and Function

**Table 1 Pin Definition and Function**

| Pin No. | Symbol | Function                   |
|---------|--------|----------------------------|
| 1       | BG2    | Optional Output-Filter GND |
| 2       | PON    | Power On/Off               |
| 3       | VCC    | Power Supply               |
| 4       | n.c.   | not used                   |
| 5       | RFIN   | RF Input                   |
| 6       | BG1    | Input-Filter GND           |
| 7       | BO1    | Input-Filter Output        |
| 8       | AI     | LNA Input                  |
| 9       | BIAS   | BIAS                       |
| 10      | RFOUT  | RF Output                  |
| 11      | GND    | Package Middle Island      |

### Maximum Ratings

**Table 2 Maximum Ratings**

| Parameter <sup>1)</sup>     | Symbol      | Value      | Unit | Note / Test Condition                                                            |
|-----------------------------|-------------|------------|------|----------------------------------------------------------------------------------|
| Voltage at pin BG2 to GND   | $V_{BG2}$   | -1...1     | V    |                                                                                  |
| Voltage at pin PON to GND   | $V_{PON}$   | -0.3...3.6 | V    |                                                                                  |
| Voltage at pin VCC to GND   | $V_{CC}$    | -0.3...3.6 | V    |                                                                                  |
| Voltage at pin RFIN to GND  | $V_{RFIN}$  | -3...3     | V    |                                                                                  |
| Voltage at pin BG1 to GND   | $V_{BG1}$   | -3...3     | V    |                                                                                  |
| Voltage at pin BO1 to GND   | $V_{BO1}$   | -3...3     | V    |                                                                                  |
| Voltage at pin AI to GND    | $V_{AI}$    | -0.3...0.9 | V    |                                                                                  |
| Voltage at pin BIAS to GND  | $V_{BIAS}$  | -0.3...0.9 | V    |                                                                                  |
| Voltage at pin RFOUT to GND | $V_{RFOUT}$ | -3...3     | V    |                                                                                  |
| Current into pin VCC        | $I_{VCC}$   | 25         | mA   |                                                                                  |
| RF input power inband       | $P_{IN}$    | 3          | dBm  | Continuous wave signal<br>$f = 1575.42$ MHz<br>50 ohm source and load impedances |

**Table 2 Maximum Ratings (cont'd)**

| Parameter <sup>1)</sup>                                                               | Symbol       | Value     | Unit | Note / Test Condition                                                                                                       |
|---------------------------------------------------------------------------------------|--------------|-----------|------|-----------------------------------------------------------------------------------------------------------------------------|
| RF input power out of band                                                            | $P_{IN,OOB}$ | 21        |      | Continuous wave signal<br>$f = 50 - 1460 \text{ MHz}$ and<br>$1710 - 4000 \text{ MHz}$<br>50 ohm source and load impedances |
| Total power dissipation                                                               | $P_{tot}$    | 90        | mW   |                                                                                                                             |
| Junction temperature                                                                  | $T_J$        | 150       | °C   |                                                                                                                             |
| Ambient temperature range                                                             | $T_A$        | -40... 85 | °C   |                                                                                                                             |
| Storage temperature range                                                             | $T_{STG}$    | -65... 85 | °C   |                                                                                                                             |
| ESD capability HBM of all pins, with pin 6 and GND middle island pin 11 tied together | $V_{ESD1}$   | 2         | kV   | according to JESD22A-114                                                                                                    |
| ESD contact discharge capability of RF input pin 5                                    | $V_{ESD2}$   | 8         | kV   | according to IEC61000-4-2                                                                                                   |

1) All voltages refer pin-to-pin, unless otherwise specified.

### 3 Electrical Characteristics

**Table 3** Electrical Characteristics:  $T_A = 25\text{ }^{\circ}\text{C}$ ,  $V_{CC} = 1.8\text{ V}$ ,  $V_{PON,ON} = 1.8\text{ V}$ ,  $V_{PON,OFF} = 0\text{ V}^{(1)}$

| Parameter                                                | Symbol                          | Values |      |      | Unit          | Note / Test Condition                                    |
|----------------------------------------------------------|---------------------------------|--------|------|------|---------------|----------------------------------------------------------|
|                                                          |                                 | Min.   | Typ. | Max. |               |                                                          |
| Supply Voltage                                           | $V_{\text{CC}}$                 | 1.5    | 1.8  | 3.6  | V             |                                                          |
| Supply Current                                           | $I_{\text{CC}}$                 | -      | 3.3  | -    | mA            | ON-Mode                                                  |
|                                                          |                                 | -      | 0.2  | 3    | $\mu\text{A}$ | OFF-Mode                                                 |
| Power On Control Voltage                                 | $V_{\text{pon}}$                | 1.0    | -    | Vcc  | V             | ON-Mode                                                  |
|                                                          |                                 | 0      | -    | 0.4  | V             | OFF-Mode                                                 |
| Power On Control Current                                 | $I_{\text{pon}}$                | -      | 5    | -    | $\mu\text{A}$ | ON-Mode                                                  |
|                                                          |                                 | -      | -    | 1    | $\mu\text{A}$ | OFF-Mode                                                 |
| Power Gain Settling Time <sup>2)</sup>                   | $t_{\text{S}}$                  | -      | 5    | -    | $\mu\text{s}$ | OFF- to ON-Mode                                          |
|                                                          |                                 | -      | 5    | -    | $\mu\text{s}$ | ON- to OFF-mode                                          |
| <b>Passband Parameters @</b><br>$f = 1575.42\text{ MHz}$ |                                 |        |      |      |               |                                                          |
| Insertion Power Gain                                     | $ S_{21} ^2$                    | 17.1   | 18.6 | -    | dB            |                                                          |
| Noise Figure <sup>3)</sup>                               | $NF$                            | -      | 1.7  | 2.3  | dB            | $Z_{\text{S}} = 50\ \Omega$                              |
| Input Return Loss                                        | $RL_{\text{in}}$                | -      | 12   | -    | dB            |                                                          |
| Output Return Loss                                       | $RL_{\text{out}}$               | -      | 15   | -    | dB            |                                                          |
| Reverse Isolation                                        | $1/ S_{12} ^2$                  | -      | 40   | -    | dB            |                                                          |
| Inband Input 3rd Order Intercept Point                   | $IIP_3$                         | -      | -7   | -    | dBm           | $f_1 = 1575.42\text{ MHz}$<br>$f_2 = f_1 + 1\text{ MHz}$ |
| Inband Input 1 dB Compression Point                      | $IP_{1\text{dB}}$               | -      | -15  | -    | dBm           | $f_1 = 1575.42\text{ MHz}$                               |
| Out-of-band Input 1 dB Compression Point                 | $IP_{1\text{dB\_}900\text{M}}$  | -      | 20   | -    |               | $f_1 = 900\text{ MHz}$                                   |
| Out-of-band Input 1 dB Compression Point                 | $IP_{1\text{dB\_}1710\text{M}}$ | -      | 20   | -    |               | $f_1 = 1710\text{ MHz}$                                  |
| <b>Stopband Parameters</b>                               |                                 |        |      |      |               |                                                          |
| Rejection <sup>4)</sup>                                  | $Rej_{900\text{M}}$             | -      | 90   | -    | dBc           | $f = 806\text{ MHz} - 928\text{ MHz}$                    |
| Rejection <sup>4)</sup>                                  | $Rej_{1800\text{M}}$            | -      | 80   | -    | dBc           | $f = 1710\text{ MHz} - 1980\text{ MHz}$                  |
| Rejection <sup>4)</sup>                                  | $Rej_{2400\text{M}}$            | -      | 72   | -    | dBc           | $f = 2400\text{ MHz} - 2500\text{ MHz}$                  |
| Stability                                                | $k$                             | -      | >1   | -    |               | $f = 20\text{ MHz} - 20\text{ GHz}$                      |

1) Specification based on performance as measured on BGM781N11 application board shown in Figure 3 and including PCB losses (unless noted otherwise)

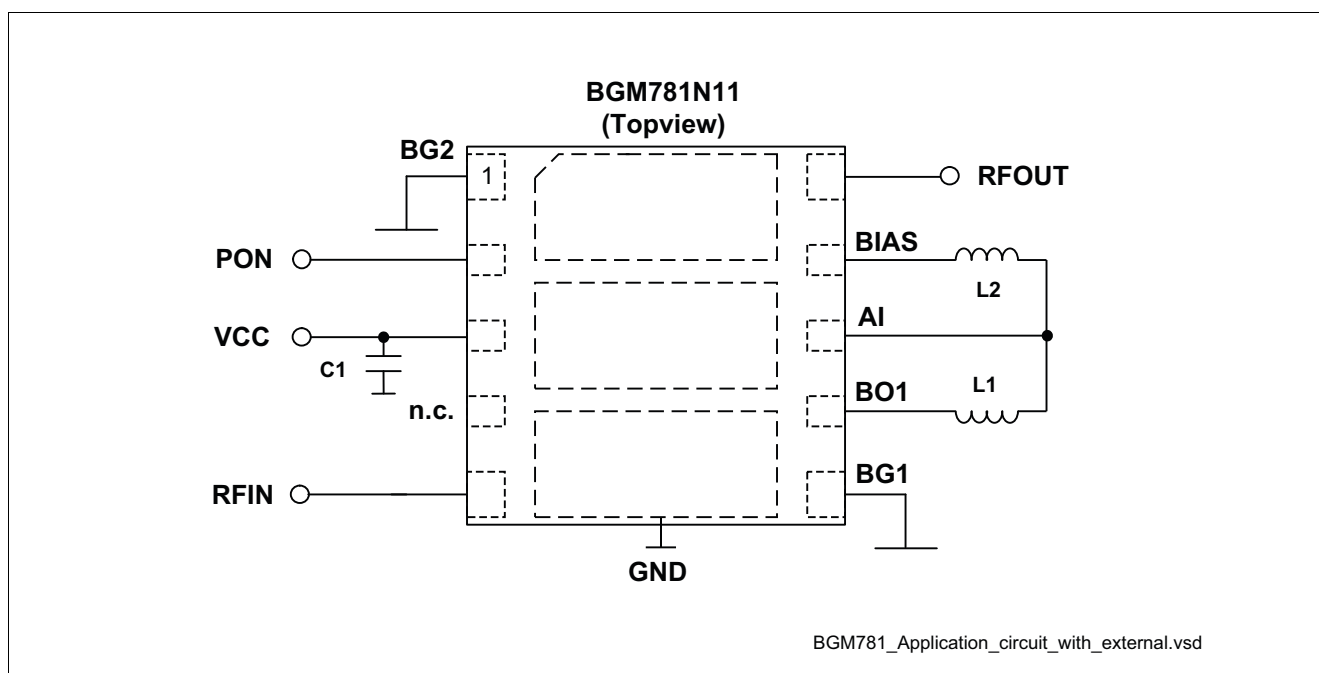
2) To be within 1 dB of the final gain OFF- to ON-mode; to be within 3 dB of the final gain ON- to OFF-mode

3) PCB and connector losses subtracted, verified on AQL base

4)  $\text{Rejection} = |(1/|S_{21}|^2 \text{ at stopband frequency})| + |(1/|S_{21}|^2 \text{ at } 1575.42\text{ MHz})|$

## 4 Application Information

### 4.1 Application Circuit



**Figure 2 Application circuit with external components**

**Table 4 Bill of Materials**

| Name | Value     | Package   | Manufacturer   | Function                            |
|------|-----------|-----------|----------------|-------------------------------------|
| C1   | 1 $\mu$ F | 0402      | Various        | Supply voltage filtering (optional) |
| L1   | 3.6 nH    | 0402      | muRata LQG15HS | Input matching                      |
| L2   | 33 nH     | 0402      | muRata LQG15HS | Bias                                |
| N1   | BGM781N11 | TSNP-11-2 | Infineon       | GPS FE Module                       |

## 4.2 Application Board

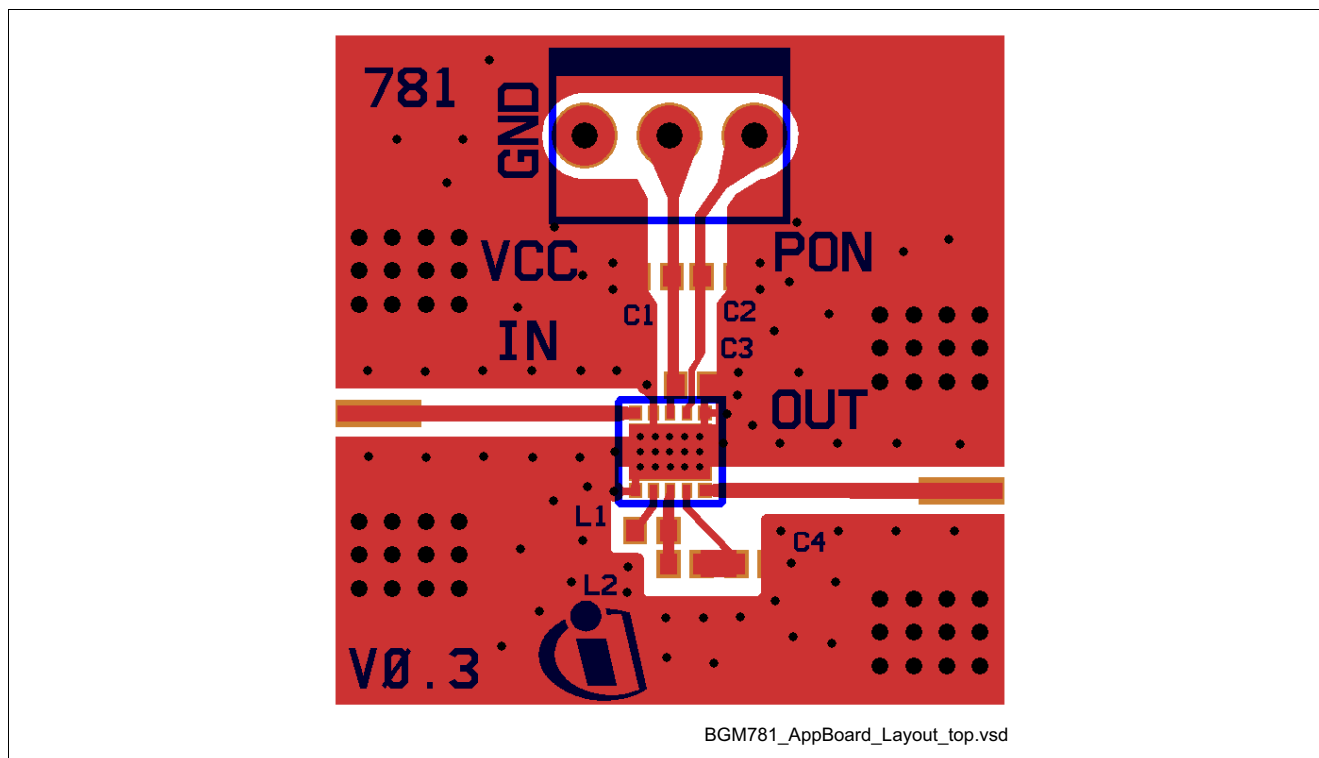


Figure 3 Top view of application board

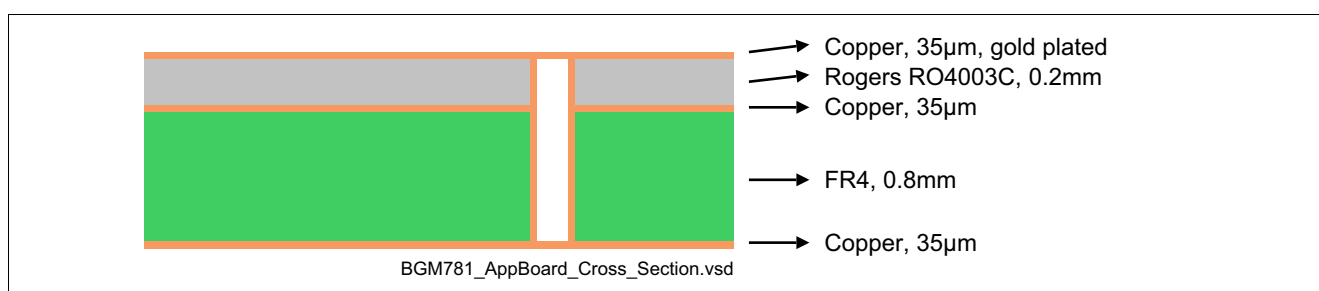


Figure 4 Cross section view of application board

## 5 Package Information

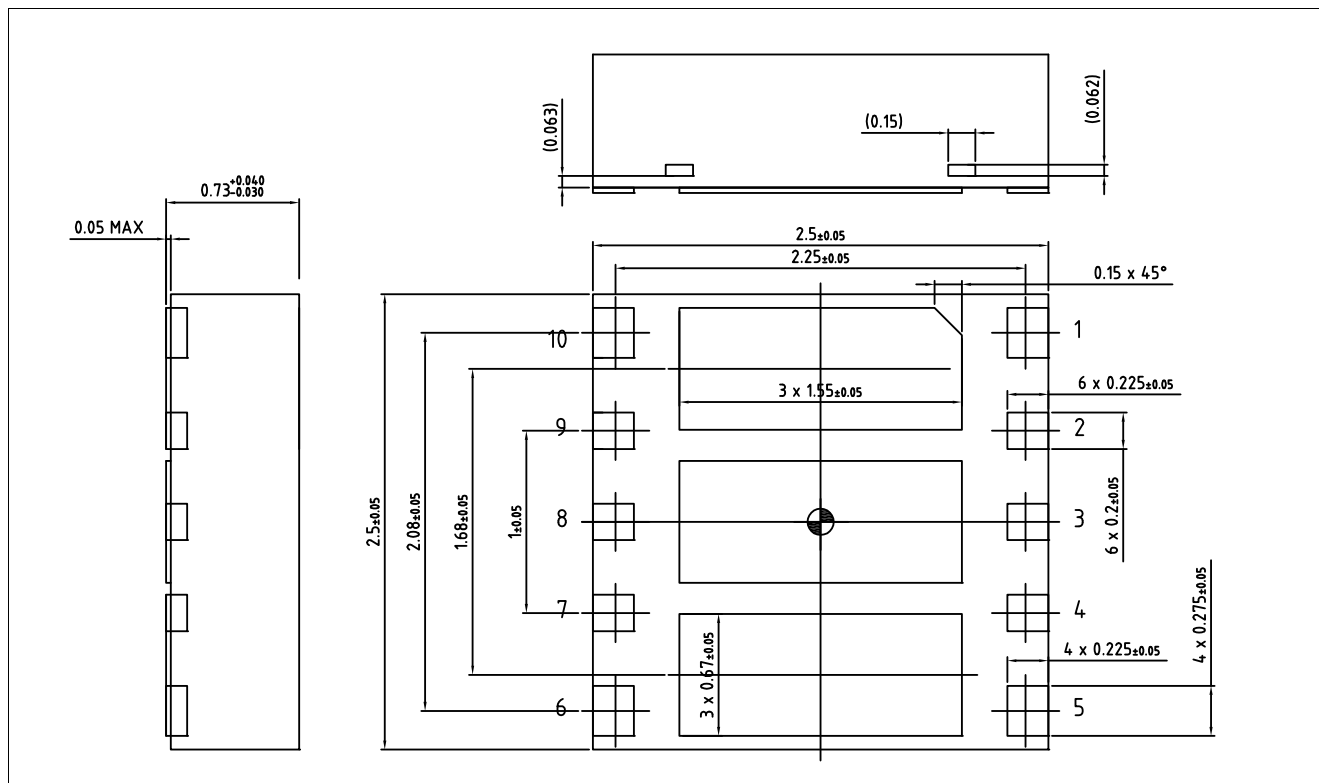


Figure 5 Side and bottom views of TSNP-11-2 package

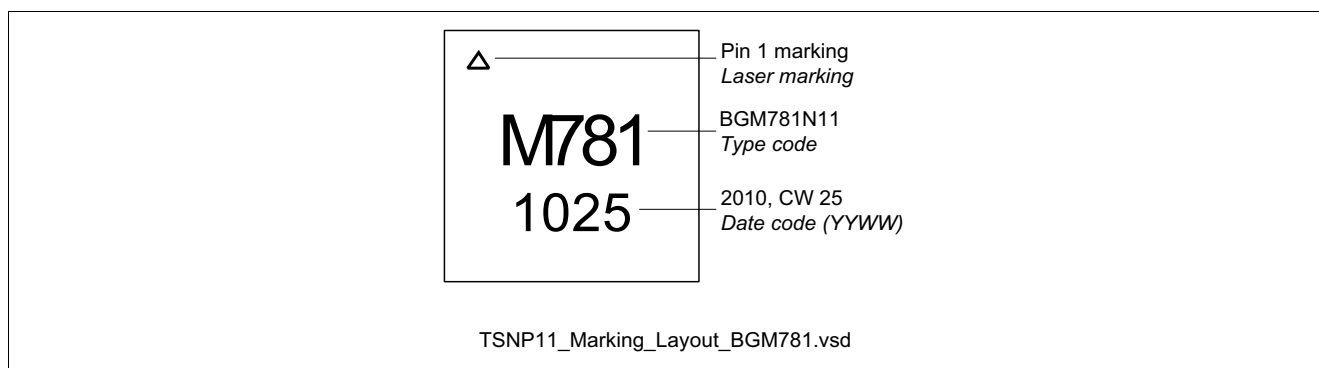
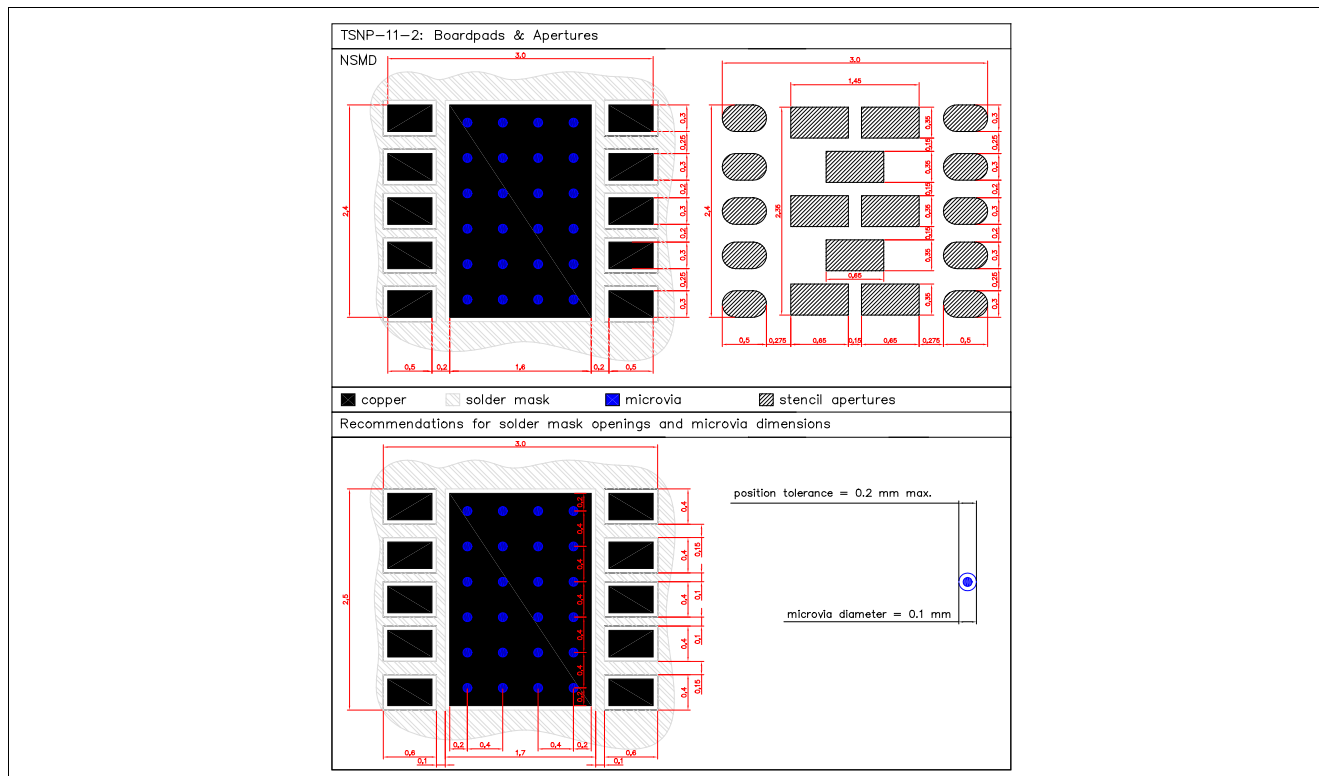
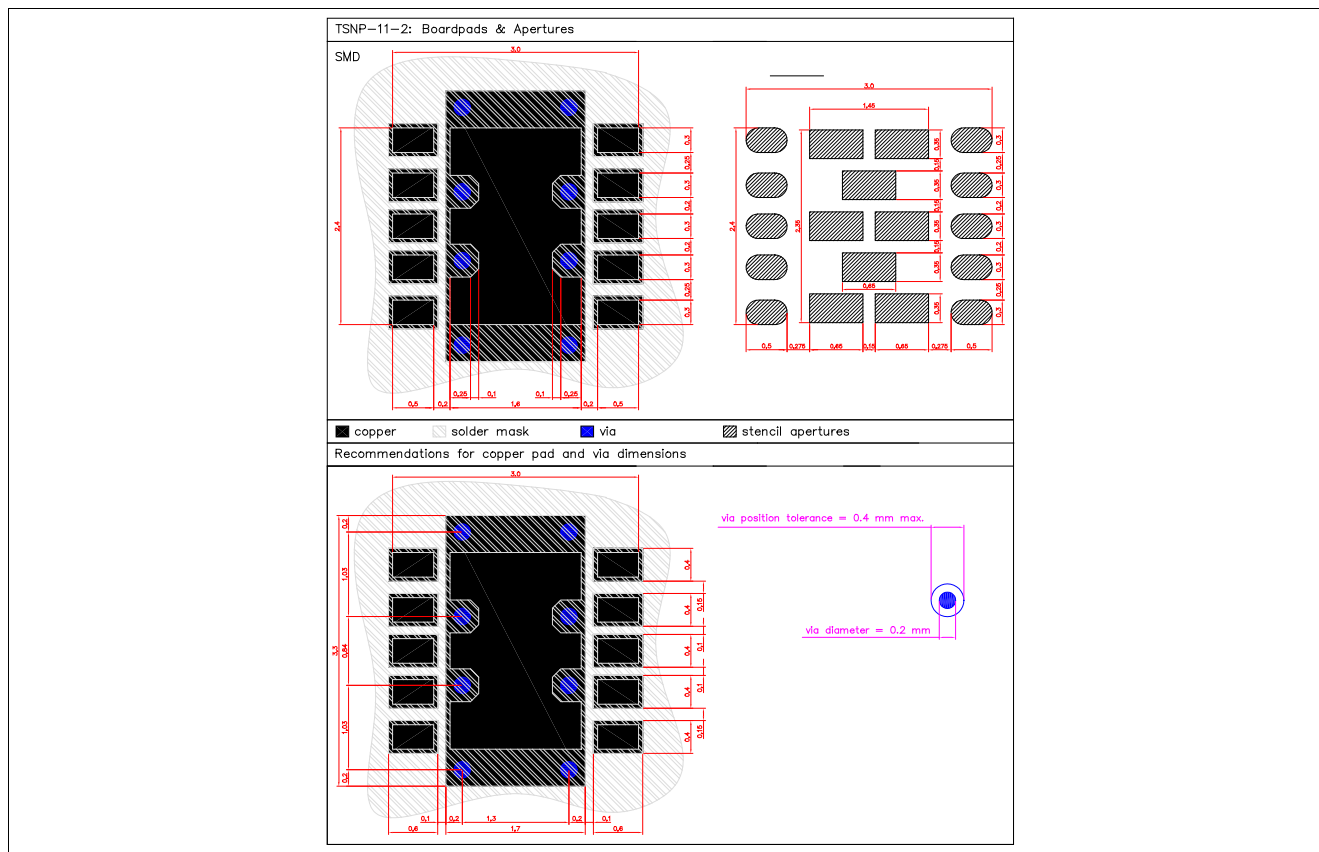


Figure 6 Marking layout



**Figure 7 Recommended TSNP-11-2 footprint for optimum RF performance**



**Figure 8 Alternative TSNP-11-2 footprint for low cost PCB designs**

## 6 Packing Information

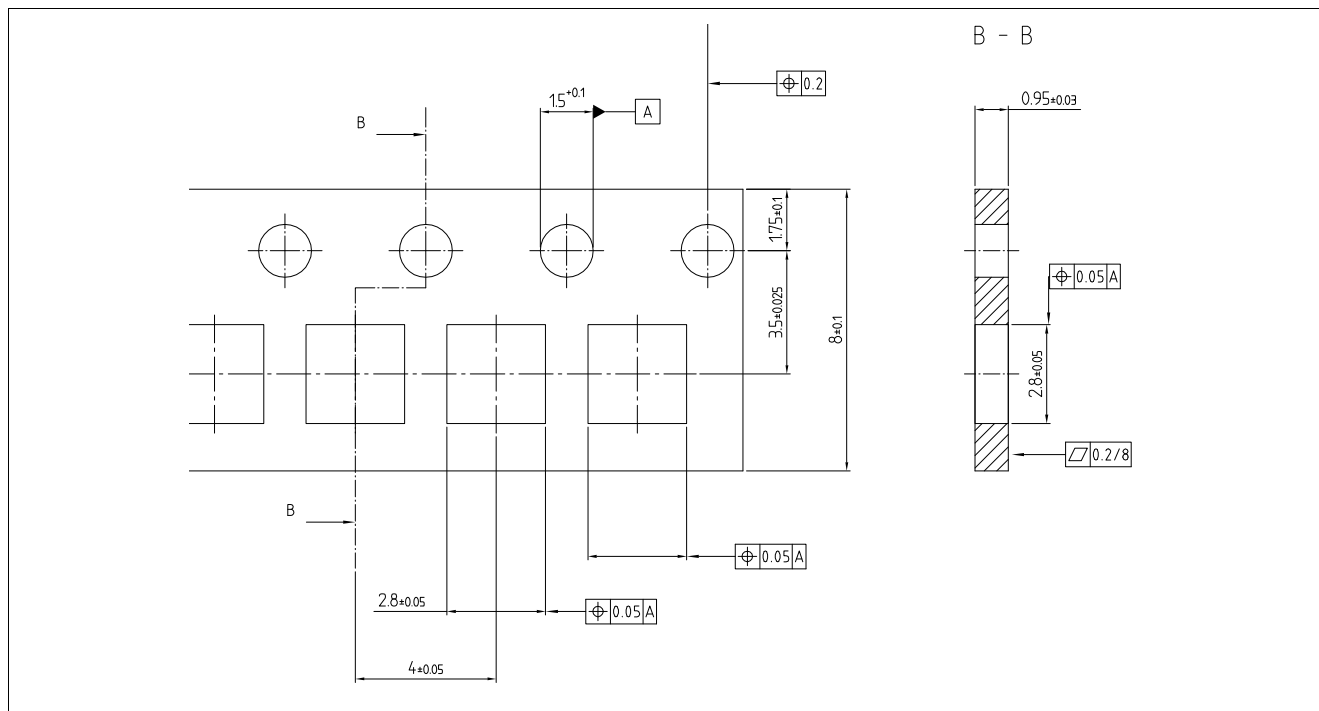


Figure 9 TSNP-11-2 carrier tape

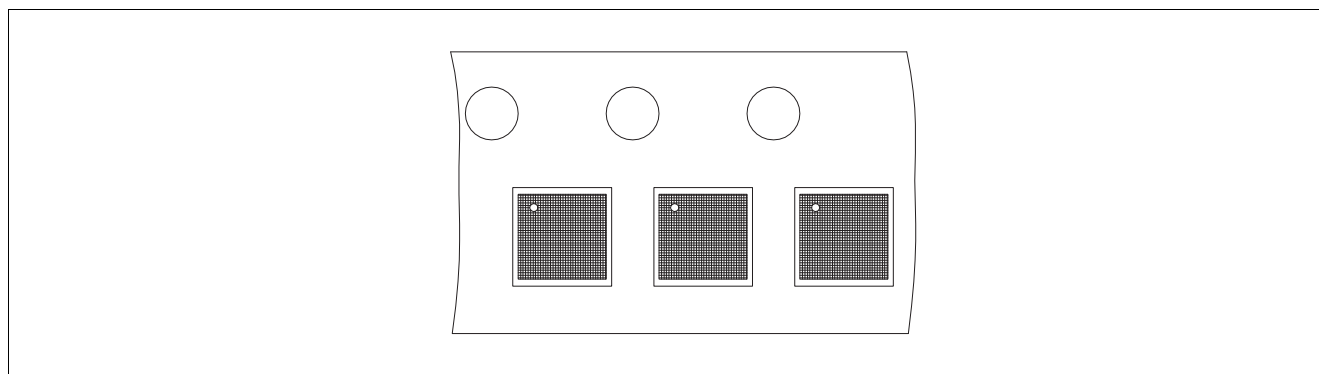


Figure 10 TSNP-11-2 pin 1 orientation in tape