

BGA735N16

High Linearity Tri-Band LTE/UMTS LNA
(2600/2300/2100, 1900/1800, 900/800/700 MHz)

Data Sheet

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BGA735N16 High Linearity Tri-Band LTE/UMTS LNA
(2600/2300/2100, 1900/1800, 900/800/700 MHz)

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| Page | Subjects (major changes since last revision) |
|-------|--|
| 13-14 | Added LTE bands 12, 13, 14, 17 |
| 21-22 | Added LTE bands 38, 40 |
| | |
| | |
| | |
| | |

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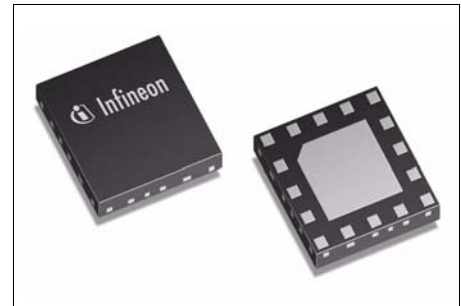
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1 Features

Main features:

- Gain: 16 (17) / -7.5 dB in high / low gain mode (all bands)
- Noise figure: 1.1 / 1.1 / 1.1 dB in high gain mode (800 MHz / 1900 MHz / 2100 MHz)
- Supply current: 3.4 (4.0) / 0.65 mA in high / low gain mode (all bands)
- Standby mode (< 2 μ A typ.)
- Output internally matched to 50 Ω
- Inputs pre-matched to 50 Ω
- 2kV HBM ESD protection
- Low external component count
- Small leadless TSNP-16-1 package (2.3 x 2.3 x 0.39 mm)
- Pb-free (RoHS compliant) package



Description

The BGA735N16 is a highly flexible, high linearity tri-band (2600/2300/2100, 1900/1800, 900/800/700 MHz) low noise amplifier MMIC for worldwide use. Based on Infineon's proprietary and cost-effective SiGe:C technology, the BGA735N16 uses an advanced biasing concept in order to achieve high linearity.

The device features dynamic gain control, temperature stabilization, standby mode, and 2 kV ESD protection on-chip as well as matching off chip. Because the matching is off chip, different LTE/UMTS bands can be easily applied. For example, the 1900 MHz path can be converted into a 2100 MHz path and vice versa by optimizing the input and output matching network.

Note: LTE/UMTS bands 1/ 2/ 5 is the standard band combination for this product requiring no external output matching network.

| Product Name | Package | Chip | Marking |
|--------------|-----------|-------|---------|
| BGA735N16 | TSNP-16-1 | T1530 | BGA735 |

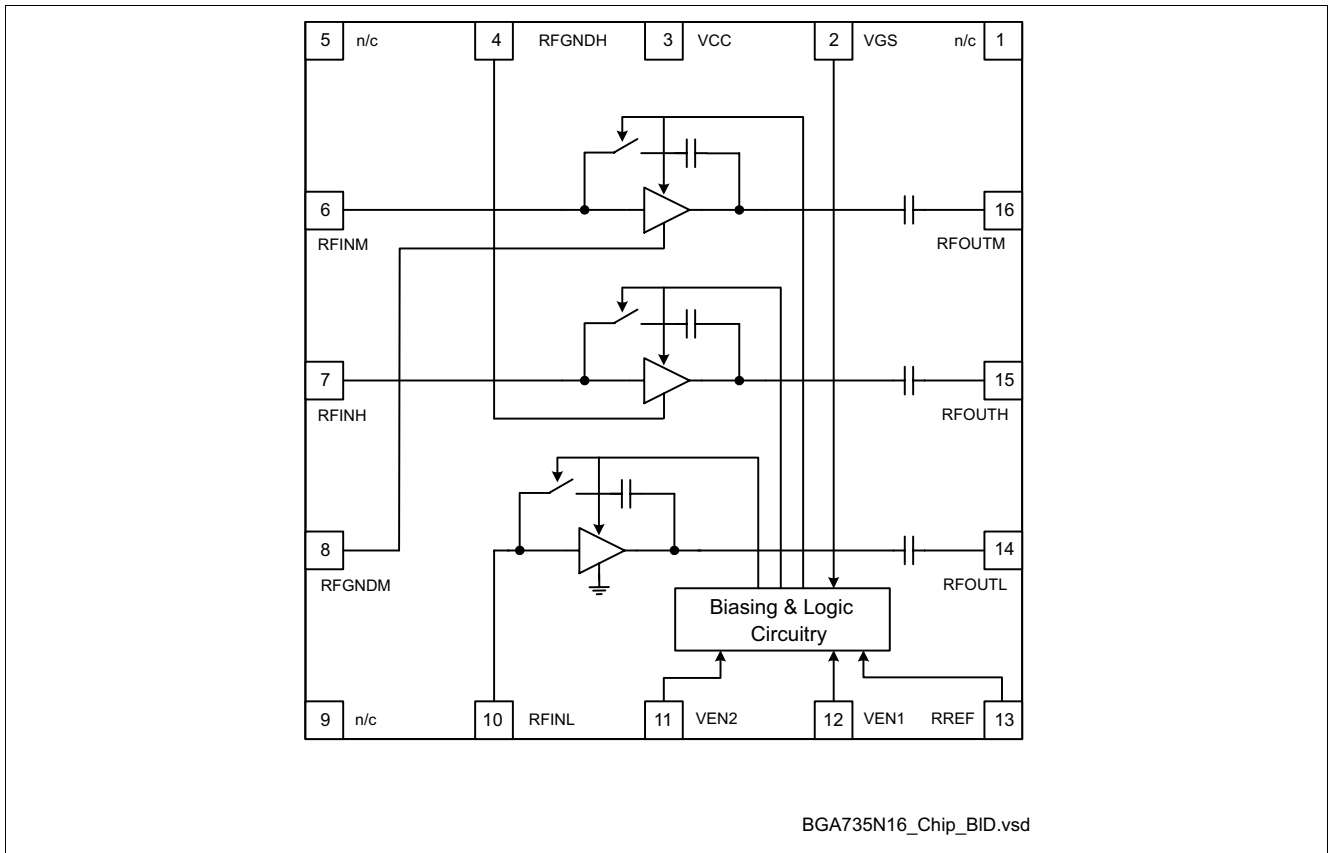


Figure 1 Block Diagram of Tri-Band LNA

2 Electrical Characteristics

2.1 Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---------------------------|------------|--------|------|--------------|------|--------------------------------|
| | | Min. | Typ. | Max. | | |
| Supply voltage | V_{CC} | -0.3 | – | 3.6 | V | – |
| Supply current | I_{CC} | – | – | 10 | mA | – |
| Pin voltage | V_{PIN} | -0.3 | – | $V_{CC}+0.3$ | V | All pins except RF input pins. |
| Pin voltage RF Input Pins | V_{RFIN} | -0.3 | – | 0.9 | V | – |
| RF input power | P_{RFIN} | – | – | 4 | dBm | – |
| Junction temperature | T_j | – | – | 150 | °C | – |
| Ambient temperature range | T_A | -30 | – | 85 | °C | – |
| Storage temperature range | T_{stg} | -65 | – | 150 | °C | – |

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.

2.2 Thermal Resistance

Table 2 Thermal Resistance

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--|------------|--------|------|------|------|-----------------------|
| | | Min. | Typ. | Max. | | |
| Thermal resistance junction to soldering point | R_{thJS} | – | – | ≤ 37 | K/W | – |

2.3 ESD Integrity

Table 3 ESD Integrity

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--------------------------------|---------------|--------|------|------|------|-----------------------|
| | | Min. | Typ. | Max. | | |
| ESD hardness HBM ¹⁾ | $V_{ESD-HBM}$ | – | 2000 | – | V | All pins |

1) According to JESD22-A114

2.4 DC Characteristics

Table 4 DC Characteristics, $T_A = -30 \dots 85 \text{ }^\circ\text{C}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------|-------------|--------|------------|------|---------------|-------------------------------|
| | | Min. | Typ. | Max. | | |
| Supply voltage | V_{CC} | 2.6 | 2.8 | 3.0 | V | – |
| Supply current high gain mode | I_{CCHG} | – | 4.0 3.4 | – | mA | High band Mid and low band |
| Supply current low gain mode | I_{CCLG} | – | 650 | – | μA | All bands |
| Supply current standby mode | I_{CCOFF} | – | 0.1 | 2.0 | μA | – |
| Logic level high | V_{HI} | 1.5 | 2.8 | – | V | VEN1, VEN2 and VGS |
| Logic level low | V_{LO} | – | 0.0 | 0.5 | V | |
| Logic currents VEN | I_{ENL} | – | 0.1 | – | μA | VEN1 and VEN2 |
| | I_{ENH} | – | 10.0 | – | μA | |
| Logic currents VGS | I_{GSL} | – | 0.1 | – | μA | VGS |
| | I_{GSH} | – | 5.0 | – | μA | |

2.5 Band Select / Gain Control Truth Table

Table 5 Band Select Truth Table, $V_{CC} = 2.8 \text{ V}$

| | High band | Mid band | Low band | Power Down |
|------|-----------|----------|----------|------------|
| VEN1 | H | H | L | L |
| VEN2 | H | L | H | L |

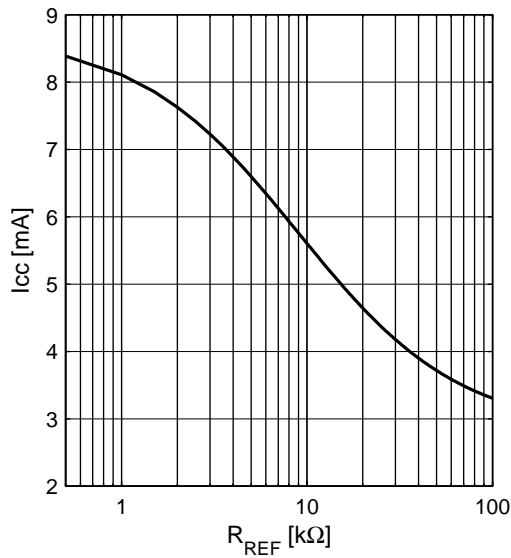
Table 6 Gain Control Truth Table, $V_{CC} = 2.8 \text{ V}$

| | High Gain | Low Gain |
|-----|-----------|----------|
| VGS | H | L |

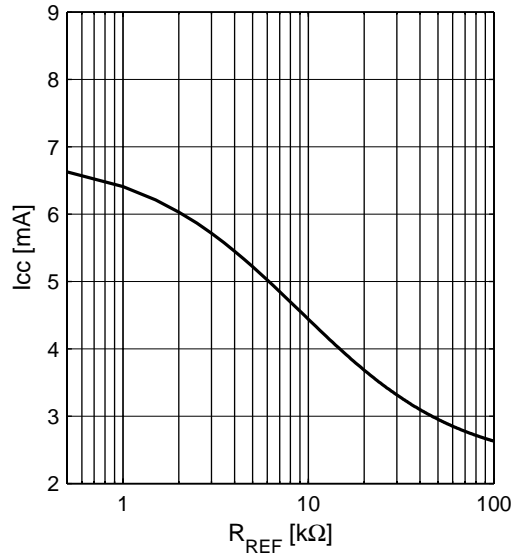
2.6 Supply Current Characteristics; $T_A = 25\text{ }^\circ\text{C}$

Supply current high gain mode versus resistance of reference resistor R_{REF} (see Figure 2 on Page 24; low gain mode supply current is independent of reference resistor).

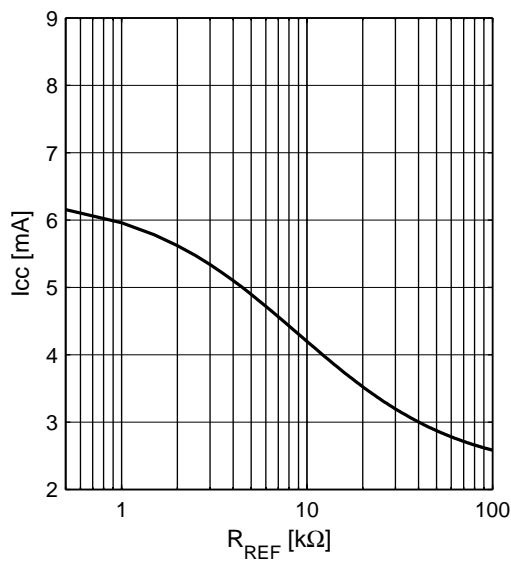
Supply Current Highband $I_{CC} = f(R_{REF})$
 $V_{CC} = 2.8\text{ V}$



Supply Current Midband $I_{CC} = f(R_{REF})$
 $V_{CC} = 2.8\text{ V}$



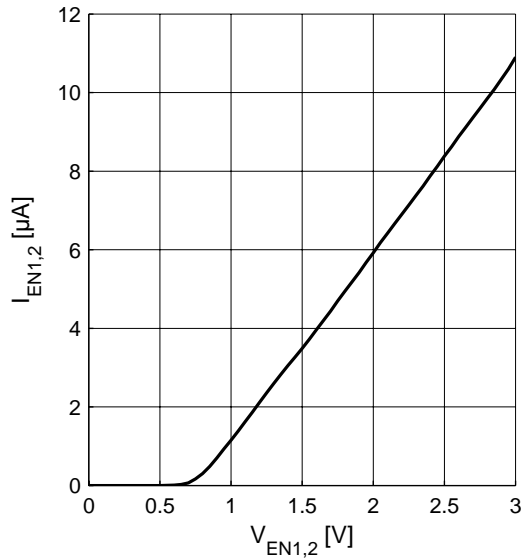
Supply Current Lowband $I_{CC} = f(R_{REF})$
 $V_{CC} = 2.8\text{ V}$



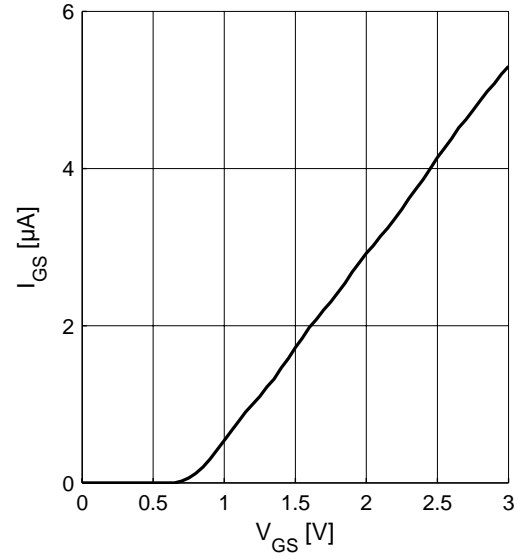
2.7 Logic Signal Characteristics; $T_A = 25\text{ °C}$

Current consumption of logic inputs VEN1, VEN2, VGS

Logic currents $I_{EN1,2} = f(V_{EN1,2})$
 $V_{CC} = 2.8\text{ V}$



Logic currents $I_{GS} = f(V_{GS})$
 $V_{CC} = 2.8\text{ V}$



2.8 Switching Times

Table 7 Typical Switching Times; $T_A = -30 \dots 85\text{ °C}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--------------------------|----------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Gainstep settling time | t_{GS} | – | 1 | – | µs | Switching LG ↔ HG all bands |
| Bandselect settling time | t_{BS} | – | 1 | – | µs | Switching from any band to a different band (pins VEN1,2) |

2.9 Measured RF Characteristics UMTS Bands 12 / 17

Table 8 Typical Characteristics 700 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 12 | | 728 | – | 746 | MHz | – |
| Pass band range band 17 | | 734 | – | 746 | MHz | – |
| Current consumption | I_{CCHG} | – | 3.4 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 15.2 | – | dB | High gain mode |
| | S_{21LG} | – | -9.2 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -39 | – | dB | High gain mode |
| | S_{12LG} | – | -9.2 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 9.2 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -15 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -16 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -19 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -12 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -6 | – | dBm | High gain mode |
| | $IP_{1dB LG}$ | – | -10 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -11 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | -1 | – | | Low gain mode |

1) Performance based on application circuit in Figure 4 on Page 26

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.10 Measured RF Characteristics UMTS Bands 13 / 14

Table 9 Typical Characteristics 700 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 13 | | 746 | – | 756 | MHz | – |
| Pass band range band 14 | | 758 | – | 768 | MHz | – |
| Current consumption | I_{CCHG} | – | 3.4 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 15.3 | – | dB | High gain mode |
| | S_{21LG} | – | -8.9 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -39 | – | dB | High gain mode |
| | S_{12LG} | – | -8.9 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 8.9 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -15 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -13 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -14 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -6 | – | dBm | High gain mode |
| | $IP_{1dB LG}$ | – | -10 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -11 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | -1 | – | | Low gain mode |

1) Performance based on application circuit in Figure 4 on Page 26

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.11 Measured RF Characteristics UMTS Band 20

Table 10 Typical Characteristics 800 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 20 | | 791 | – | 821 | MHz | – |
| Current consumption | I_{CCHG} | – | 3.4 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 15.3 | – | dB | High gain mode |
| | S_{21LG} | – | -7.8 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -38 | – | dB | High gain mode |
| | S_{12LG} | – | -7.8 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.2 | – | dB | High gain mode |
| | NF_{LG} | – | 7.8 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -14 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -15 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -13 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -20 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -6 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -10 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -10 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 1 | – | dBm | Low gain mode |

1) Performance based on application circuit in Figure 5 on Page 27

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.12 Measured RF Characteristics UMTS Bands 5 / 6

Table 11 Typical Characteristics 800 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 5 | | 869 | – | 894 | MHz | – |
| Pass band range band 6 | | 875 | – | 885 | MHz | – |
| Current consumption | I_{CCHG} | – | 3.4 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 16.0 | – | dB | High gain mode |
| | S_{21LG} | – | -7.5 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -36 | – | dB | High gain mode |
| | S_{12LG} | – | -7.5 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 7.5 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -16 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -17 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -17 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -13 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -6 | – | dBm | High gain mode |
| | $IP_{1dB LG}$ | – | -8 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -7 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 2 | – | | Low gain mode |

1) Performance based on application circuit in Figure 2 on Page 24

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.13 Measured RF Characteristics UMTS Band 8

Table 12 Typical Characteristics 900 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 8 | | 925 | – | 960 | MHz | – |
| Current consumption | I_{CCHG} | – | 3.4 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 16.1 | – | dB | High gain mode |
| | S_{21LG} | – | -7.1 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -36 | – | dB | High gain mode |
| | S_{12LG} | – | -7.1 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 7.1 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -16 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -15 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -15 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -16 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -5 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -8 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -6 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 2 | – | dBm | Low gain mode |

1) Performance based on application circuit in Figure 3 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.14 Measured RF Characteristics UMTS Bands 3 / 9

Table 13 Typical Characteristics 1800 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---------------|--------|------|--------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 3 | | 1805 | – | 1880 | MHz | – |
| Pass band range band 9 | | 1844.9 | – | 1879.9 | MHz | – |
| Current consumption | I_{CCHG} | – | 3.4 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 16.2 | – | dB | High gain mode |
| | S_{21LG} | – | -8.7 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -36 | – | dB | High gain mode |
| | S_{12LG} | – | -8.7 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 8.7 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -13 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -14 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -19 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -15 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.5 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -7 | – | dBm | High gain mode |
| | $IP_{1dB LG}$ | – | -6 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -6 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 3 | – | | Low gain mode |

1) Performance based on application circuit in Figure 3 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.15 Measured RF Characteristics UMTS Band 2

Table 14 Typical Characteristics 1900 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 2 | | 1930 | – | 1990 | MHz | – |
| Current consumption | I_{CCHG} | – | 3.4 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 16.0 | – | dB | High gain mode |
| | S_{21LG} | – | -7.8 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -35 | – | dB | High gain mode |
| | S_{12LG} | – | -7.8 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 7.8 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -19 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -18 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -15 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.4 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -7 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -7 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -6 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 3 | – | | Low gain mode |

1) Performance based on application circuit in Figure 2 on Page 24

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.16 Measured RF Characteristics UMTS Bands 1 / 4 / 10

Table 15 Typical Characteristics 2100 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 1 | | 2110 | – | 2170 | MHz | – |
| Pass band range band 4 | | 2110 | – | 2155 | MHz | – |
| Pass band range band 10 | | 2110 | – | 2170 | MHz | – |
| Current consumption | I_{CCHG} | – | 4.0 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 17.2 | – | dB | High gain mode |
| | S_{21LG} | – | -7.8 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -35 | – | dB | High gain mode |
| | S_{12LG} | – | -7.8 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 7.8 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -16 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -17 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -23 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -12 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -10 | – | dBm | High gain mode |
| | $IP_{1dB LG}$ | – | -6 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -3 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 3 | – | | Low gain mode |

1) Performance based on application circuit in Figure 2 on Page 24

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.17 Measured RF Characteristics UMTS Band 40

Table 16 Typical Characteristics 2300 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 40 | | 2300 | – | 2400 | MHz | – |
| Current consumption | I_{CCHG} | – | 4.0 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 17.1 | – | dB | High gain mode |
| | S_{21LG} | – | 7.0 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -33 | – | dB | High gain mode |
| | S_{12LG} | – | -7.0 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 7.0 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -18 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -11 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.0 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -10 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -4 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -2 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 6 | – | dBm | Low gain mode |

1) Performance based on application circuit in Figure 4 on Page 26

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.18 Measured RF Characteristics UMTS Band 38

Table 17 Typical Characteristics 2600 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 38 | | 2570 | – | 2620 | MHz | – |
| Current consumption | I_{CCHG} | – | 3.4 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 15.5 | – | dB | High gain mode |
| | S_{21LG} | – | -6.5 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -33 | – | dB | High gain mode |
| | S_{12LG} | – | -6.5 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.2 | – | dB | High gain mode |
| | NF_{LG} | – | 6.5 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -14 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -13 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -13 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -13 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.0 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -7 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -2 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -3 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 7 | – | | Low gain mode |

1) Performance based on application circuit in Figure 3 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

2.19 Measured RF Characteristics UMTS Band 7

Table 18 Typical Characteristics 2600 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band 7 | | 2620 | – | 2690 | MHz | – |
| Current consumption | I_{CCHG} | – | 4.0 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.65 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 15.6 | – | dB | High gain mode |
| | S_{21LG} | – | -6.3 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -32 | – | dB | High gain mode |
| | S_{12LG} | – | -6.3 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.2 | – | dB | High gain mode |
| | NF_{LG} | – | 6.3 | – | dB | Low gain mode |
| Input return loss ²⁾ | S_{11HG} | – | -16 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -12 | – | dB | 50 Ω , low gain mode |
| Output return loss ²⁾ | S_{22HG} | – | -14 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -13 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.0 | – | | DC to 8 GHz; all gain modes |
| Input compression point ²⁾ | IP_{1dBHG} | – | -7 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -3 | – | dBm | Low gain mode |
| Inband IIP3 ²⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -2 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 9 | – | dBm | Low gain mode |

1) Performance based on application circuit in Figure 3 on Page 25

2) Verification based on AQL; random production test.

3) Guaranteed by device design; not tested in production.

3 Application Circuit and Block Diagram

3.1 UMTS Bands 1, 2, 4, 5, 6 and 10 Application Circuit Schematic

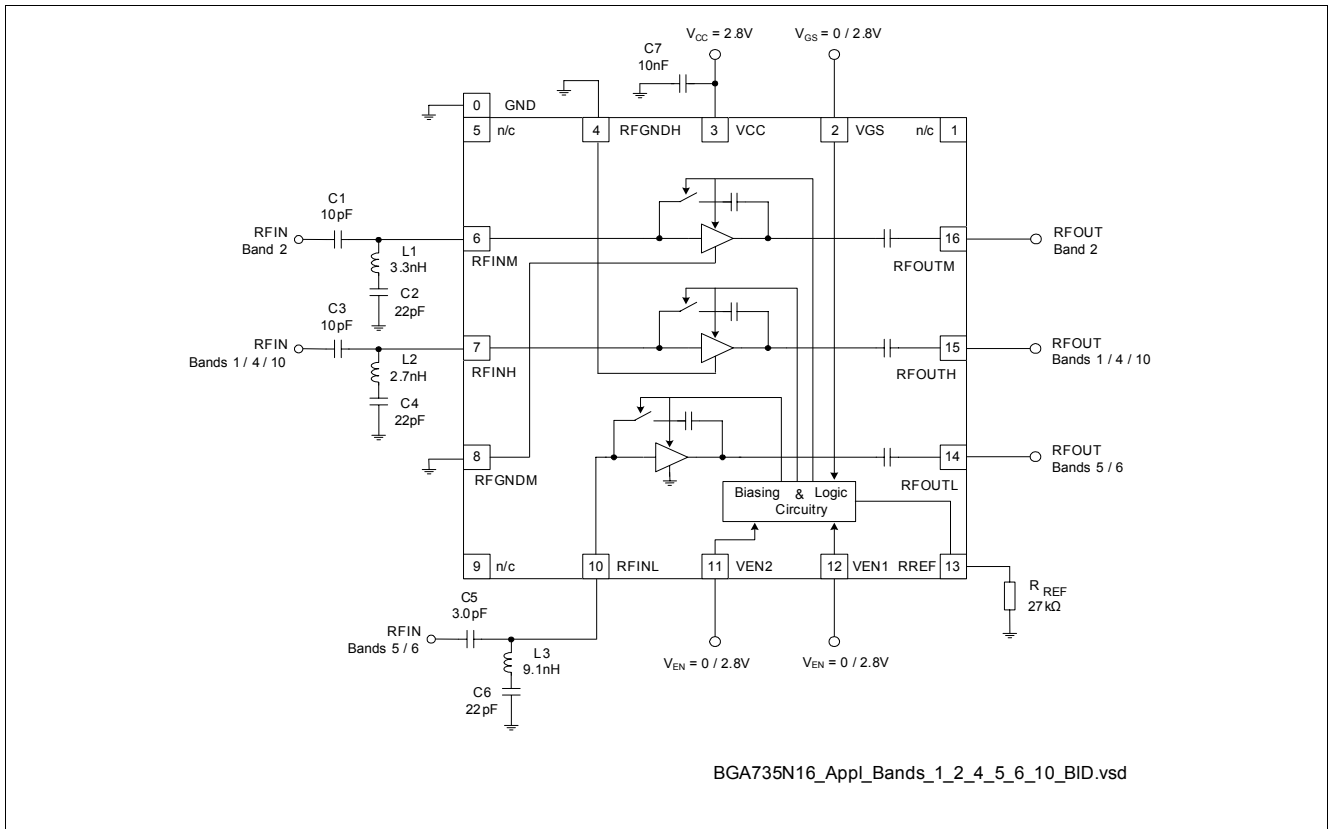


Figure 2 Application Circuit with Chip Outline (Top View)

Note: Package paddle (Pin 0) has to be RF grounded.

Table 19 Bill of Materials

| Part Number | Part Type | Manufacturer | Size | Comment |
|------------------|----------------|--------------|------|-------------------|
| L1 ... L3 | Chip inductor | Various | 0402 | Wirewound, Q ≈ 50 |
| C1 ... C7 | Chip capacitor | Various | 0402 | |
| R _{REF} | Chip resistor | Various | 0402 | |

3.2 UMTS Bands 3, 7, 8, 9 and 38 Application Circuit Schematic

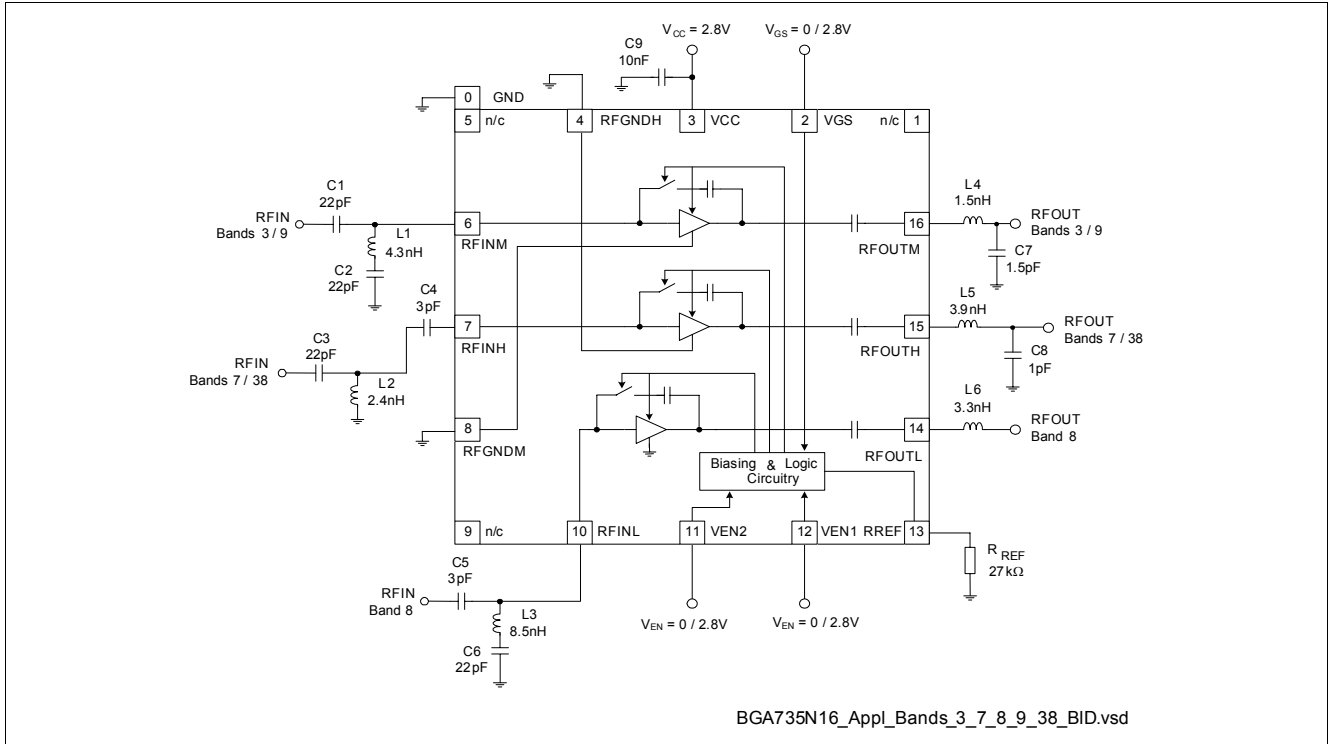


Figure 3 Application Circuit with Chip Outline (Top View)

Note: Package paddle (Pin 0) has to be RF grounded.

Table 20 Bill of Materials

| Part Number | Part Type | Manufacturer | Size | Comment |
|-------------|----------------|--------------|------|---------------------------|
| L1 ... L6 | Chip inductor | Various | 0402 | Wirewound, $Q \approx 50$ |
| C1 ... C9 | Chip capacitor | Various | 0402 | |
| R_{REF} | Chip resistor | Various | 0402 | |

3.3 UMTS Bands 2, 12, 13, 14, 17 and 40 Application Circuit Schematic

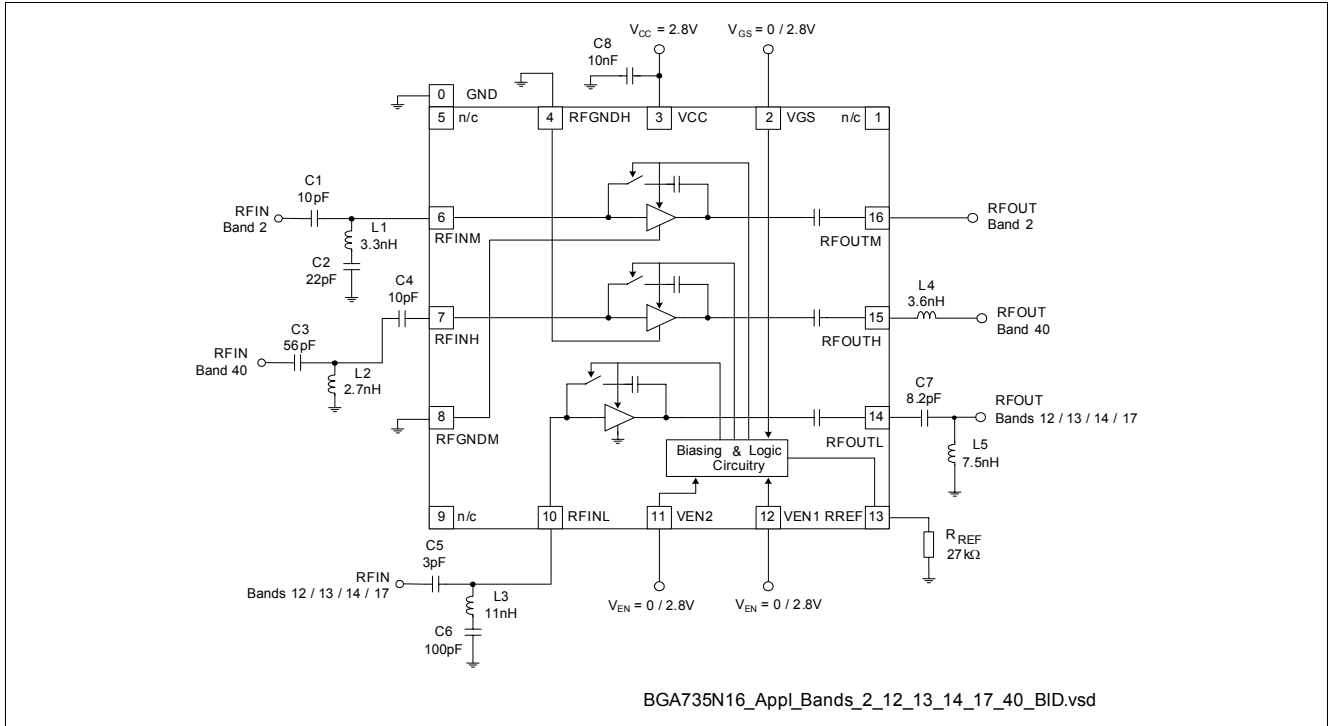


Figure 4 Application Circuit with Chip Outline (Top View)

Note: Package paddle (Pin 0) has to be RF grounded.

Table 21 Bill of Materials

| Part Number | Part Type | Manufacturer | Size | Comment |
|------------------|----------------|--------------|------|-------------------|
| L1 ... L5 | Chip inductor | Various | 0402 | Wirewound, Q ≈ 50 |
| C1 ... C8 | Chip capacitor | Various | 0402 | |
| R _{REF} | Chip resistor | Various | 0402 | |

3.4 UMTS Bands 1, 2, 4, 10 and 20 Application Circuit Schematic

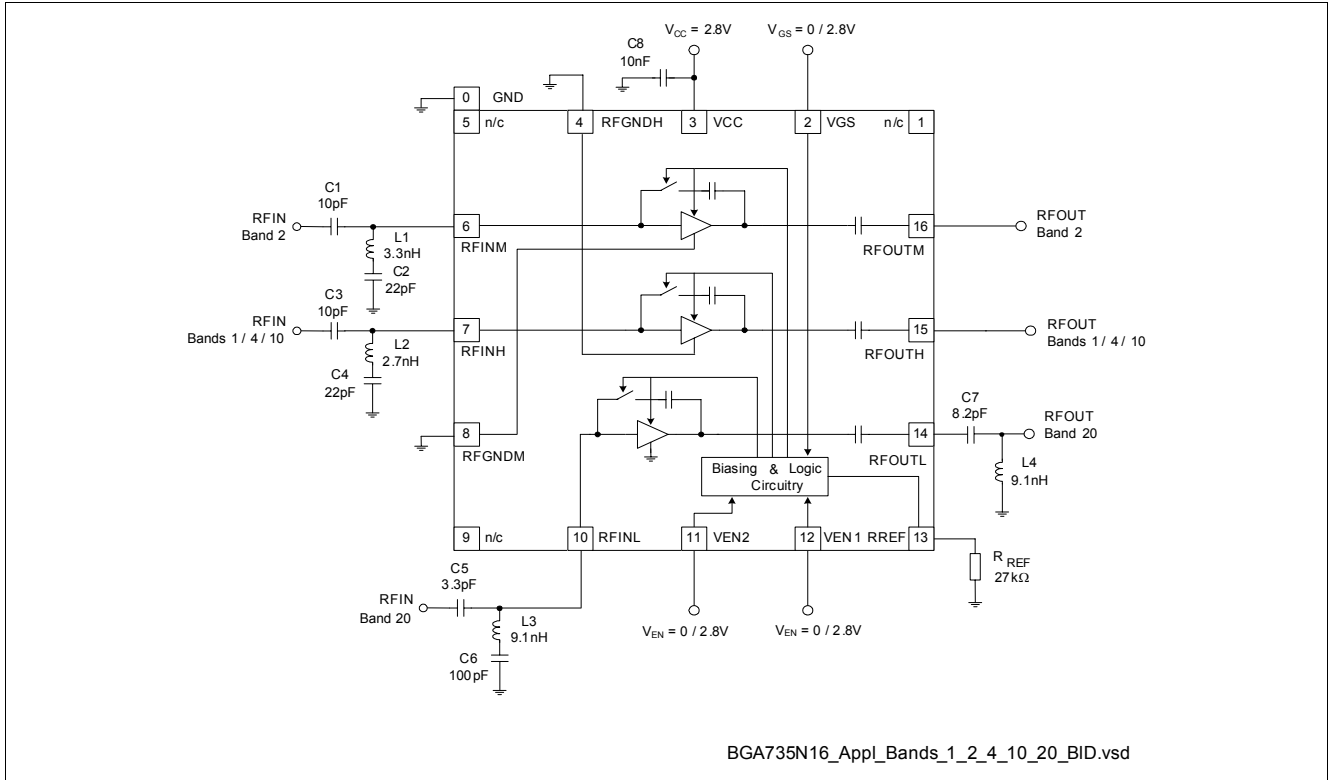


Figure 5 Application Circuit with Chip Outline (Top View)

Note: Package paddle (Pin 0) has to be RF grounded.

Table 22 Bill of Materials

| Part Number | Part Type | Manufacturer | Size | Comment |
|------------------|----------------|--------------|------|-------------------|
| L1 ... L4 | Chip inductor | Various | 0402 | Wirewound, Q ≈ 50 |
| C1 ... C8 | Chip capacitor | Various | 0402 | |
| R _{REF} | Chip resistor | Various | 0402 | |

3.5 Pin Description

Table 23 Pin Definition and Function

| Pin No. | Name | Pin Type | Buffer Type | Function |
|---------|--------|----------|-------------|---|
| 0 | GND | – | – | Ground connection for low band LNA and control circuitry (package paddle) |
| 1 | n/c | – | – | Not connected |
| 2 | VGS | – | – | Gain step control |
| 3 | VCC | – | – | Supply voltage |
| 4 | RFGNDH | – | – | High band LNA emitter ground |
| 5 | n/c | – | – | Not connected |
| 6 | RFINM | – | – | Mid band LNA input |
| 7 | RFINH | – | – | High band LNA input |
| 8 | RFGNDM | – | – | Mid band LNA emitter ground |
| 9 | n/c | – | – | Not connected |
| 10 | RFINL | – | – | Low band LNA input |
| 11 | VEN2 | – | – | Band select control |
| 12 | VEN1 | – | – | Band select control |
| 13 | RREF | – | – | Bias current reference resistor (high gain mode) |
| 14 | RFOUTL | – | – | Low band output |
| 15 | RFOUTH | – | – | High band LNA output |
| 16 | RFOUTM | – | – | Mid band LNA output |

3.6 Application Board

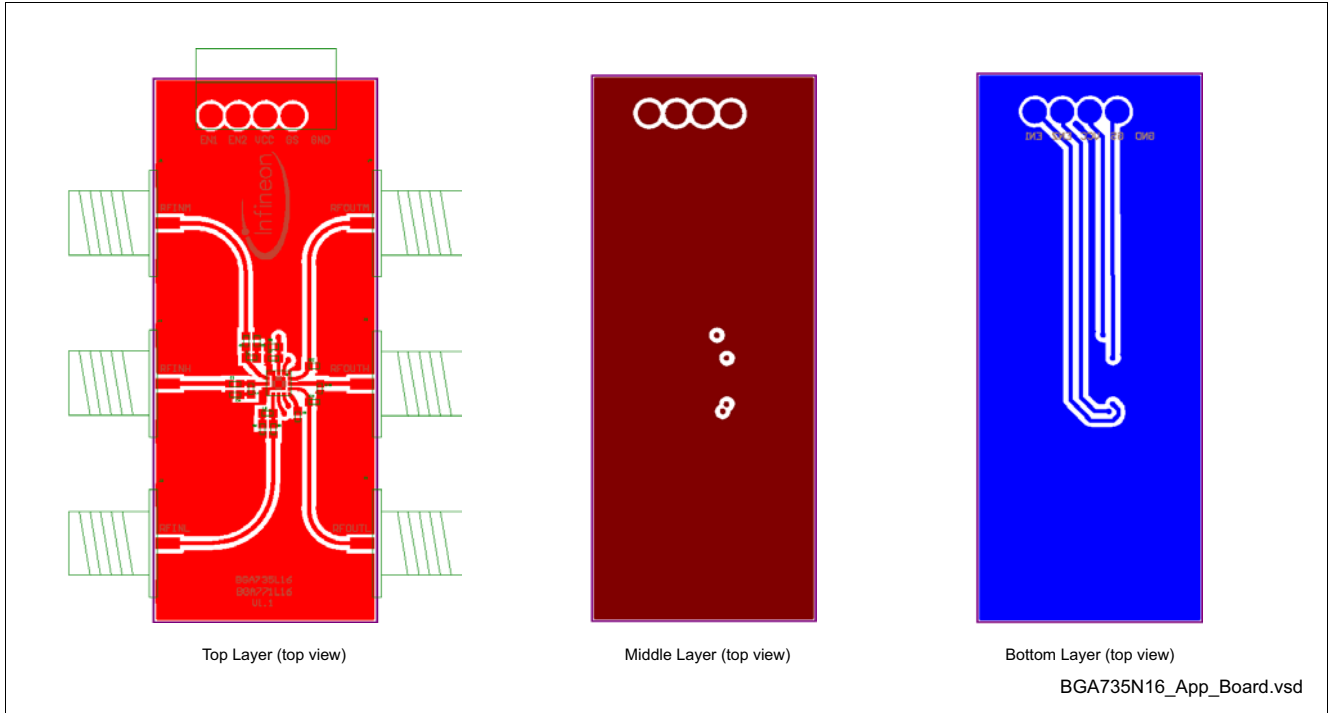


Figure 6 Application Board Layout on 3-layer FR4

Note: Top layer thickness: 0.2 mm, bottom layer thickness: 0.660 mm, 17 μ m Cu metallization, gold plated. Board size: 21mm x 50 mm.

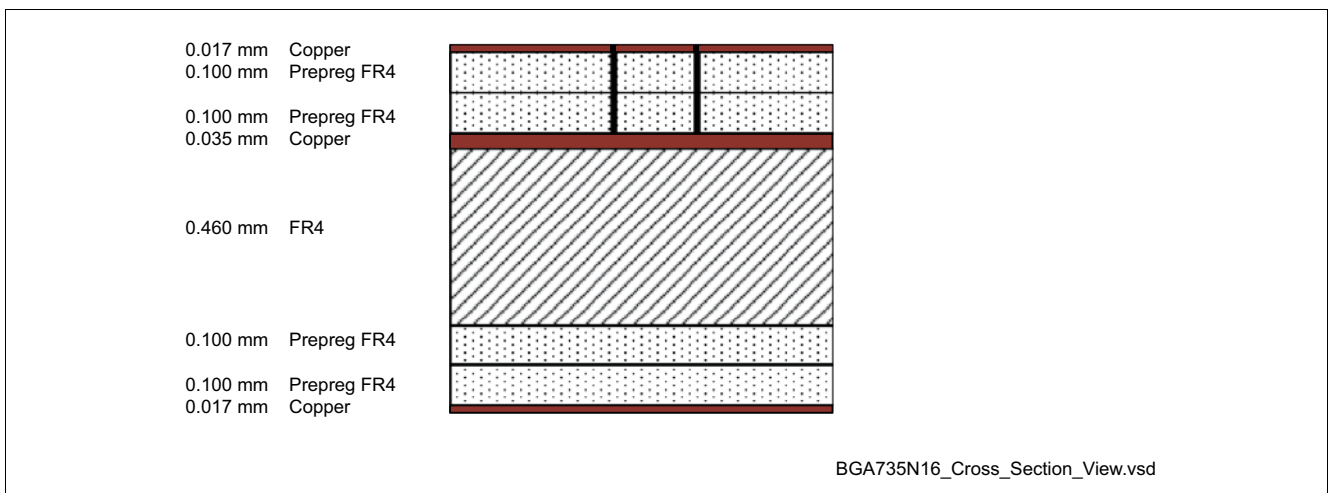


Figure 7 Cross-Section View of Application Board

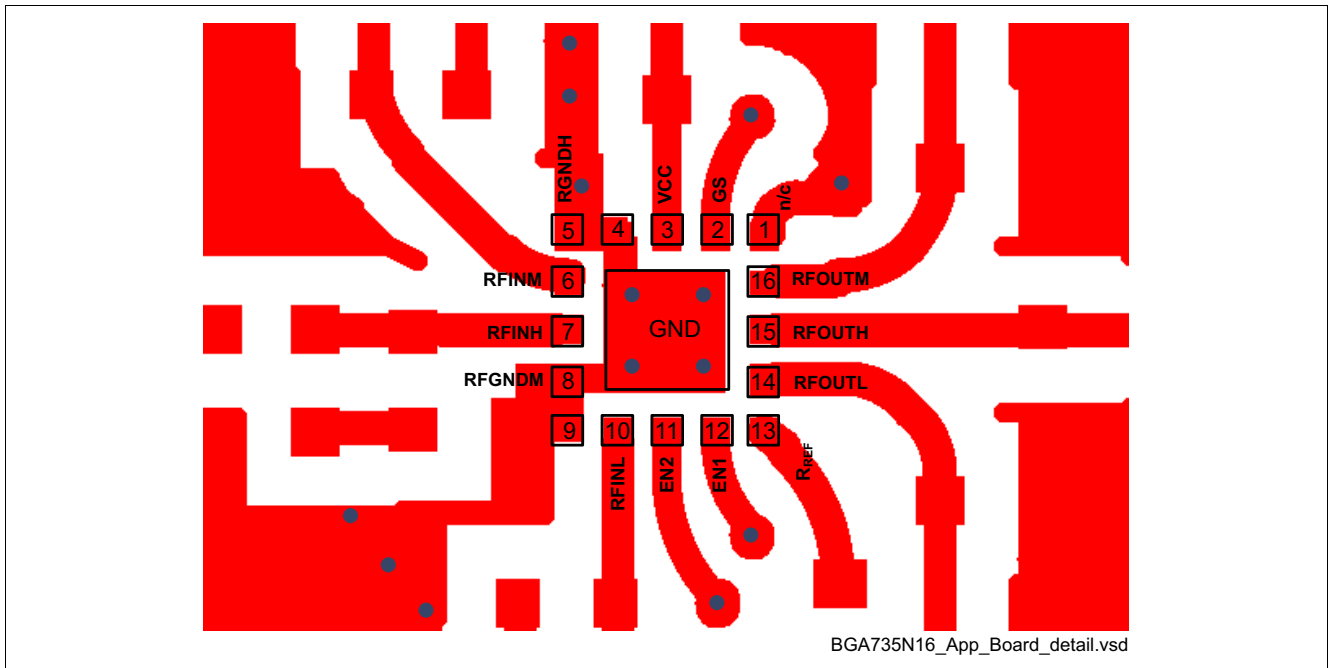


Figure 8 Detail of Application Board Layout

Note: In order to achieve the same performance as given in this datasheet please follow the suggested PCB-layout as closely as possible. The position of the GND via is critical for RF performance.

4 Physical Characteristics

4.1 Package Footprint

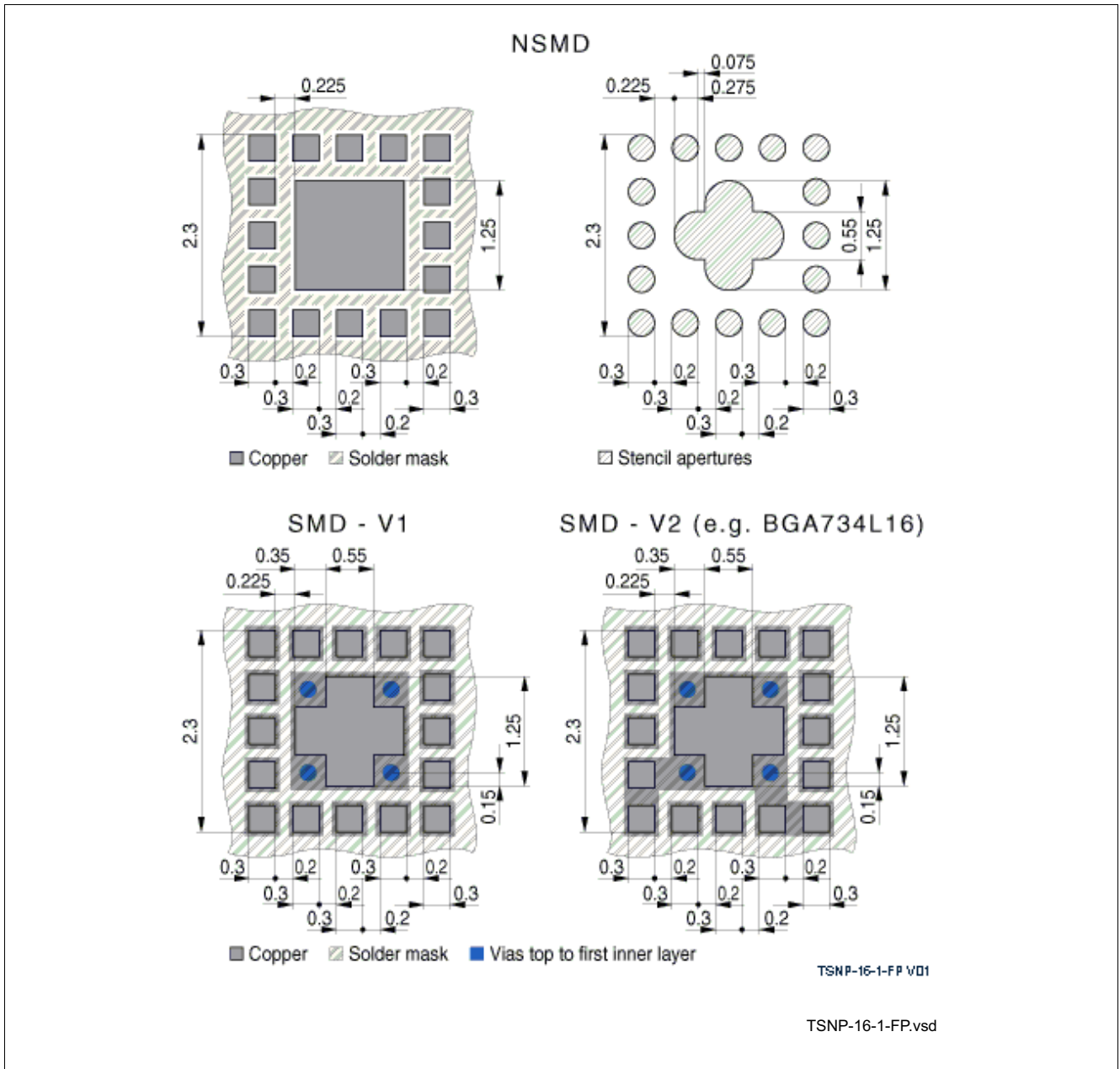


Figure 9 Recommended Footprint and Stencil Layout for the TSNP-16-1 Package

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