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BGA711N7

SiGe Bipolar 3G/3.5G/4G Single-Band LNA

Data Sheet

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BGA711N7 SiGe Bipolar 3G/3.5G/4G Single-Band LNA

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|------|--|
| 41 | Footprint recommendation drawing added |
| 42 | Marking pattern drawing updated |
| | |
| | |
| | |

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Table of Contents

| | | |
|----------|--|----|
| | Table of Contents | 4 |
| | List of Figures | 5 |
| | List of Tables | 6 |
| 1 | Features | 7 |
| 2 | Electrical Characteristics | 9 |
| 2.1 | Absolute Maximum Ratings | 9 |
| 2.2 | Thermal Resistance | 9 |
| 2.3 | ESD Integrity | 9 |
| 2.4 | DC Characteristics | 10 |
| 2.5 | Gain Mode Select Truth Table | 10 |
| 2.6 | Switching Times | 10 |
| 2.7 | Supply Current Characteristics | 11 |
| 2.8 | Logic Signal Characteristics | 12 |
| 2.9 | Measured RF Characteristics 1800 MHz Band | 13 |
| 2.10 | Measured RF Characteristics 1900 MHz Band | 14 |
| 2.11 | Measured RF Characteristics 2000/2100 MHz Band | 15 |
| 2.12 | Measured RF Characteristics 2200/2300 MHz Band | 16 |
| 2.13 | Measured RF Characteristics 2400/2500 MHz Band | 17 |
| 2.14 | Measured RF Characteristics 2600 MHz Band | 18 |
| 2.15 | Measured RF Characteristics 2650 MHz Band | 19 |
| 2.16 | Measured Performance Band 1 Application High Gain Mode vs. Frequency | 20 |
| 2.17 | Measured Performance Band 1 Application High Gain Mode vs. Temperature | 22 |
| 2.18 | Measured Performance Band 1 Application Low Gain Mode vs. Frequency | 23 |
| 2.19 | Measured Performance Band 1 Application Low Gain Mode vs. Temperature | 25 |
| 2.20 | Measured Performance Band 7 Application High Gain Mode vs. Frequency | 26 |
| 2.21 | Measured Performance Band 7 Application High Gain Mode vs. Temperature | 28 |
| 2.22 | Measured Performance Band 7 Application Low Gain Mode vs. Frequency | 29 |
| 2.23 | Measured Performance Band 7 Application Low Gain Mode vs. Temperature | 31 |
| 3 | Application Circuit and Block Diagram | 32 |
| 3.1 | 1800 MHz Band Application Circuit Schematic | 32 |
| 3.2 | 1900 MHz Band Application Circuit Schematic | 33 |
| 3.3 | 2000/2100 MHz Band Application Circuit Schematic | 34 |
| 3.4 | 2200/2300 MHz Band Application Circuit Schematic | 35 |
| 3.5 | 2400/2500 MHz Band Application Circuit Schematic | 36 |
| 3.6 | 2600 MHz Band Application Circuit Schematic | 37 |
| 3.7 | 2650 MHz Band Application Circuit Schematic | 38 |
| 3.8 | Pin Definition | 38 |
| 3.9 | Application Board | 39 |
| 4 | Physical Characteristics | 41 |
| 4.1 | Package Footprint | 41 |
| 4.2 | Package Dimensions | 42 |
| 4.3 | Product Marking Pattern | 42 |

List of Figures

| | | |
|-----------|---|----|
| Figure 1 | Block Diagram of Single-Band LNA | 8 |
| Figure 2 | Application Circuit with Chip Outline (Top View) | 32 |
| Figure 3 | Application Circuit with Chip Outline (Top View) | 33 |
| Figure 4 | Application Circuit with Chip Outline (Top View) | 34 |
| Figure 5 | Application Circuit with Chip Outline (Top View) | 35 |
| Figure 6 | Application Circuit with Chip Outline (Top View) | 36 |
| Figure 7 | Application Circuit with Chip Outline (Top View) | 37 |
| Figure 8 | Application Circuit with Chip Outline (Top View) | 38 |
| Figure 9 | Application Board Layout on 3-layer FR4 | 39 |
| Figure 10 | Cross-Section View of Application Board | 39 |
| Figure 11 | Detail of Application Board Layout | 40 |
| Figure 12 | Footprint Recommendation 1 for the TSNP-7-1 Package | 41 |
| Figure 13 | Footprint Recommendation 2 for the TSNP-7-1 Package | 41 |
| Figure 14 | Package Outline (top, side and bottom view) | 42 |
| Figure 15 | Tape & Reel Dimensions | 42 |
| Figure 16 | Marking Pattern (top view) | 42 |

List of Tables

| | | |
|----------|---|----|
| Table 1 | Absolute Maximum Ratings | 9 |
| Table 2 | Thermal Resistance | 9 |
| Table 3 | ESD Integrity | 9 |
| Table 4 | DC Characteristics, $T_A = 25\text{ °C}$ | 10 |
| Table 5 | Truth Table | 10 |
| Table 6 | Typical switching times; $T_A = -30 \dots 85\text{ °C}$ | 10 |
| Table 7 | Typical Characteristics 1800 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $R_{REF} = n/c$ | 13 |
| Table 8 | Typical Characteristics 1900 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $R_{REF} = 27\text{ k}\Omega$ | 14 |
| Table 9 | Typical Characteristics 2000/2100 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $R_{REF} = 27\text{ k}\Omega$ | 15 |
| Table 10 | Typical Characteristics 2200/2300 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $R_{REF} = 8.2\text{ k}\Omega$ | 16 |
| Table 11 | Typical Characteristics 2400/2500 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $R_{REF} = 10\text{ k}\Omega$ | 17 |
| Table 12 | Typical Characteristics 2600 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $R_{REF} = 8.2\text{ k}\Omega$ | 18 |
| Table 13 | Typical Characteristics 2650 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $R_{REF} = 8.2\text{ k}\Omega$ | 19 |
| Table 14 | Bill of Materials | 32 |
| Table 15 | Bill of Materials | 33 |
| Table 16 | Bill of Materials | 34 |
| Table 17 | Bill of Materials | 35 |
| Table 18 | Bill of Materials | 36 |
| Table 19 | Bill of Materials | 37 |
| Table 20 | Bill of Materials | 38 |
| Table 21 | Pin Definition and Function | 38 |

1 Features

Main features:

- Gain: 17 / -8 dB in high / low gain mode (f.e. at 2.14GHz)
- Noise figure: 1.1 dB in high gain mode (f.e. at 2.14GHz)
- Supply current: 3.6 / 0.5 mA in high / low gain mode
- Standby mode (< 2 μ A typ.)
- Output internally matched to 50 Ω
- Inputs pre-matched to 50 Ω
- 2 kV HBM ESD protection
- Low external component count
- Small leadless TSNP-7-1 package (2.0 x 1.3 x 0.39 mm)
- Pb-free (RoHS compliant) package



Description

The BGA711N7 is a low current single-band low noise amplifier MMIC for 3G, 3.5G and 4G. The LNA is based upon Infineon's proprietary and cost-effective SiGe:C technology and comes in a low profile TSNP-7-1 leadless green package. Because the matching is off chip, the RF path can be easily converted into a 1.8GHz to 2.7GHz path by optimizing the input and output matching network. This document specifies the electrical parameters, pinout, application circuit and packaging of the chip.



| Product Name | Package | Chip | Marking |
|--------------|----------|-------|---------|
| BGA711N7 | TSNP-7-1 | T1531 | B1 |

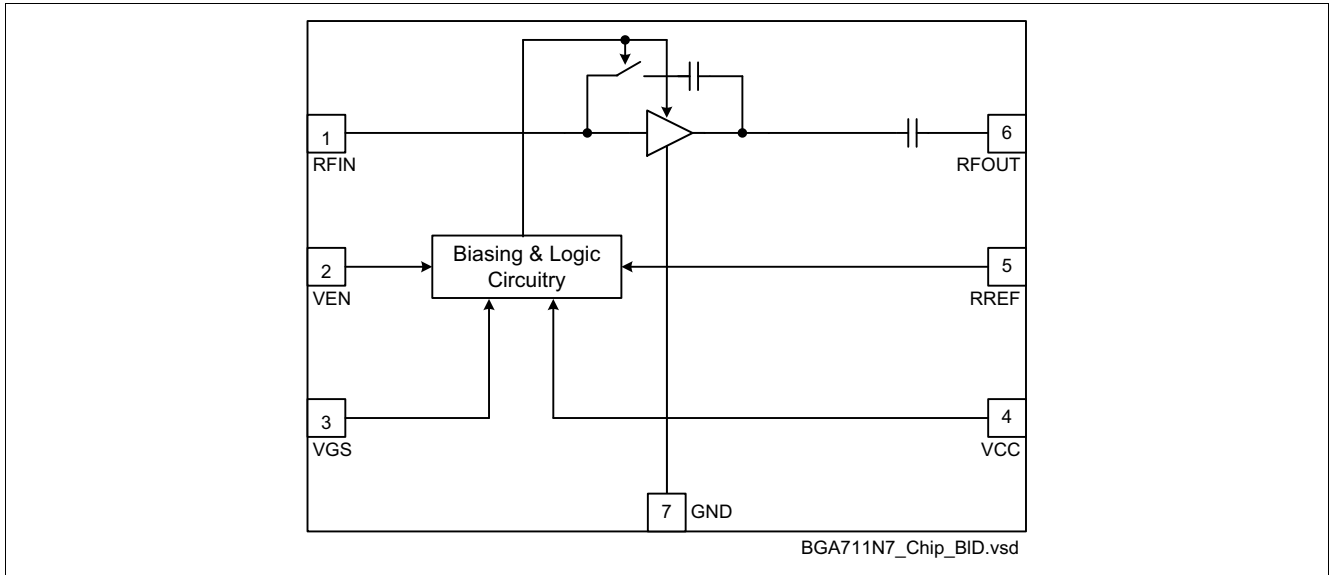


Figure 1 Block Diagram of Single-Band LNA

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} | – | 240 | – | 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, $T_A = 25\text{ °C}$

| 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} | – | 3.6 | – | mA | Typical value with 27k Ω reference resistor |
| Supply current low gain mode | I_{CCLG} | – | 0.5 | – | mA | |
| Supply current standby mode | I_{CCOFF} | – | 0.1 | 2.0 | μ A | – |
| Logic level high | V_{HI} | 1.4 | 2.8 | – | V | All logic pins |
| Logic level low | V_{LO} | -0.2 | 0.0 | 0.5 | V | |
| Logic currents | I_{LO} | – | – | 0.1 | μ A | All logic pins |
| | I_{HI} | – | 5.0 | 6.0 | μ A | |

2.5 Gain Mode Select Truth Table

Table 5 Truth Table

| Control Voltage | | State | |
|-----------------|-----|-----------------------|-----|
| | | All Bands | |
| VEN | VGS | HG | LG |
| H | L | OFF | ON |
| H | H | ON | OFF |
| L | L | STANDBY ¹⁾ | |
| L | H | | |

1) In order to achieve minimum standby current it is encouraged to apply logic low-level at the VGS pin in standby mode although this is not mandatory. Details see section 2.4.

2.6 Switching Times

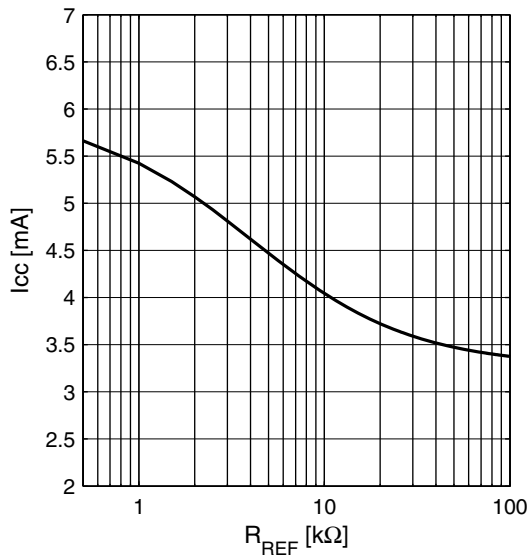
Table 6 Typical switching times; $T_A = -30 \dots 85\text{ °C}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|------------------------|----------|--------|------|------|---------|-----------------------------------|
| | | Min. | Typ. | Max. | | |
| Settling time gainstep | t_{GS} | – | 1 | – | μ s | Switching LG \leftrightarrow HG |

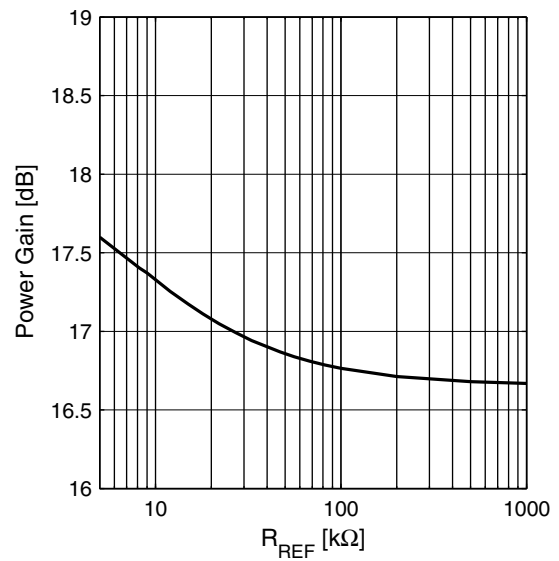
2.7 Supply Current Characteristics

Supply current and Power gain high gain mode versus reference resistor (resistor R1 in Figure 3.3 on Page 34); low gain mode supply current is independent of reference resistor).

Supply Current $I_{CC} = f(R_{REF})$
 $V_{CC} = 2.8\text{ V}$, $T_A = 25\text{ °C}$



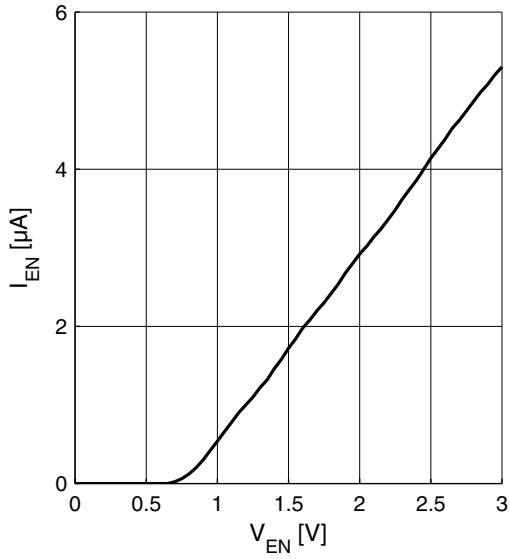
Power Gain $|S_{21}| = f(R_{REF})$
 $V_{CC} = 2.8\text{ V}$, $T_A = 25\text{ °C}$



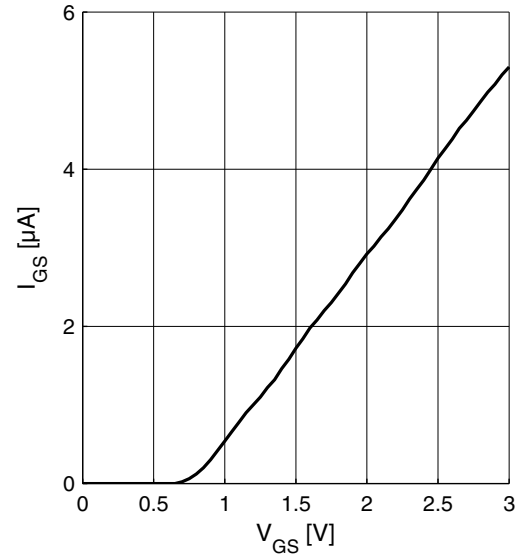
2.8 Logic Signal Characteristics

Current consumption of logic inputs VEN, VGS

Logic Current $I_{EN} = f(V_{EN})$
 $V_{CC} = 2.8 \text{ V}$, $T_A = 25 \text{ }^\circ\text{C}$



Logic Current $I_{GS} = f(V_{GS})$
 $V_{CC} = 2.8 \text{ V}$, $T_A = 25 \text{ }^\circ\text{C}$



2.9 Measured RF Characteristics 1800 MHz Band

Table 7 Typical Characteristics 1800 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)2)}$, $R_{REF} = n/c$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---------------|--------|-------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range | | 1800 | – | 1900 | MHz | F.e. band 3 and 9 |
| Current consumption | I_{CCHG} | – | 3.2 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.5 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 16.5 | – | dB | High gain mode |
| | S_{21LG} | – | -11.2 | – | dB | Low gain mode |
| Reverse Isolation | S_{12HG} | – | -40.1 | – | dB | High gain mode |
| | S_{12LG} | – | -11.2 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 11.5 | – | dB | Low gain mode |
| Input return loss | S_{11HG} | – | -16.2 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -15.4 | – | dB | 50 Ω , low gain mode |
| Output return loss | S_{22HG} | – | -18.0 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -22.9 | – | dB | 50 Ω , low gain mode |
| Stability factor | k | – | >2.4 | – | | DC to 8 GHz; all gain modes |
| Input compression point | IP_{1dBHG} | – | -6.3 | – | dBm | High gain mode |
| | $IP_{1dB LG}$ | – | -3.0 | – | dBm | Low gain mode |
| Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -3.4 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 2.6 | – | | Low gain mode |

1) Performance based on application circuit in Figure 2 on Page 32

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

2.10 Measured RF Characteristics 1900 MHz Band

Table 8 Typical Characteristics 1900 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$, $R_{REF} = 27\text{ k}\Omega$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|-------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range | | 1900 | – | 2000 | MHz | F.e. band 2 |
| Current consumption | I_{CCHG} | – | 3.6 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.5 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 17.2 | – | dB | High gain mode |
| | S_{21LG} | – | -9.2 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -38.6 | – | dB | High gain mode |
| | S_{12LG} | – | -9.2 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.1 | – | dB | High gain mode |
| | NF_{LG} | – | 9.4 | – | dB | Low gain mode |
| Input return loss ¹⁾ | S_{11HG} | – | -14 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -15 | – | dB | 50 Ω , low gain mode |
| Output return loss ¹⁾ | S_{22HG} | – | -15 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -18 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.2 | – | | DC to 8 GHz; all gain modes |
| Input compression point ¹⁾ | IP_{1dBHG} | – | -7 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -3 | – | dBm | Low gain mode |
| Inband IIP3 ¹⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -3 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 2 | – | | Low gain mode |

1) Performance based on application circuit in Figure 3 on Page 33

2) Verification based on AQL; random production test.

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

2.11 Measured RF Characteristics 2000/2100 MHz Band

Table 9 Typical Characteristics 2000/2100 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)}$, $R_{REF} = 27\text{ k}\Omega$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range | | 2000 | – | 2200 | MHz | F.e. band 1, 4 and 10 |
| Current consumption | I_{CCHG} | – | 3.6 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.5 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 17.0 | – | dB | High gain mode |
| | S_{21LG} | – | -7.6 | – | dB | Low gain mode |
| Reverse Isolation ²⁾ | S_{12HG} | – | -36 | – | dB | High gain mode |
| | S_{12LG} | – | -8.0 | – | 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 ¹⁾ | S_{11HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -15 | – | dB | 50 Ω , low gain mode |
| Output return loss ¹⁾ | S_{22HG} | – | -19 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -17 | – | dB | 50 Ω , low gain mode |
| Stability factor ³⁾ | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point ¹⁾ | IP_{1dBHG} | – | -8 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -2 | – | dBm | Low gain mode |
| Inband IIP3 ¹⁾ $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -2 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 7 | – | | Low gain mode |

1) Performance based on application circuit in Figure 4 on Page 34

2) Verification based on AQL; random production test.

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

2.12 Measured RF Characteristics 2200/2300 MHz Band

Table 10 Typical Characteristics 2200/2300 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)2)}$, $R_{REF} = 8.2\text{ k}\Omega$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band XL | | 2200 | – | 2400 | MHz | F.e. band 40 |
| Current consumption | I_{CCHG} | – | 4.2 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.53 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 16.8 | – | dB | High gain mode |
| | S_{21LG} | – | -7.2 | – | dB | Low gain mode |
| Reverse Isolation | S_{12HG} | – | -35 | – | dB | High gain mode |
| | S_{12LG} | – | -7.0 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.2 | – | dB | High gain mode |
| | NF_{LG} | – | 7.0 | – | dB | Low gain mode |
| Input return loss | S_{11HG} | – | -23 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -12 | – | dB | 50 Ω , low gain mode |
| Output return loss | S_{22HG} | – | -15 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -12 | – | dB | 50 Ω , low gain mode |
| Stability factor | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point | IP_{1dBHG} | – | -11 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -2 | – | dBm | Low gain mode |
| Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -2 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 7 | – | dBm | Low gain mode |

1) Performance based on application circuit in Figure 5 on Page 35

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

2.13 Measured RF Characteristics 2400/2500 MHz Band

Table 11 Typical Characteristics 2400/2500 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)2)}$, $R_{REF} = 10\text{ k}\Omega$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band XL | | 2400 | – | 2600 | MHz | – |
| Current consumption | I_{CCHG} | – | 4.1 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.55 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 16.5 | – | dB | High gain mode |
| | S_{21LG} | – | -7.0 | – | dB | Low gain mode |
| Reverse Isolation | S_{12HG} | – | -35 | – | dB | High gain mode |
| | S_{12LG} | – | -7.0 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.2 | – | dB | High gain mode |
| | NF_{LG} | – | 7.1 | – | dB | Low gain mode |
| Input return loss | S_{11HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -14 | – | dB | 50 Ω , low gain mode |
| Output return loss | S_{22HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -12 | – | dB | 50 Ω , low gain mode |
| Stability factor | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point | IP_{1dBHG} | – | -6 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | 0 | – | dBm | Low gain mode |
| Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -2 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 6 | – | dBm | Low gain mode |

1) Performance based on application circuit in Figure 6 on Page 36

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

2.14 Measured RF Characteristics 2600 MHz Band

Table 12 Typical Characteristics 2600 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)2)}$, $R_{REF} = 8.2\text{ k}\Omega$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range | | 2550 | – | 2650 | MHz | F.e. band 38 |
| Current consumption | I_{CCHG} | – | 4.2 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.53 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 15.5 | – | dB | High gain mode |
| | S_{21LG} | – | -6.9 | – | dB | Low gain mode |
| Reverse Isolation | S_{12HG} | – | -34 | – | dB | High gain mode |
| | S_{12LG} | – | -7.0 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.2 | – | dB | High gain mode |
| | NF_{LG} | – | 6.8 | – | dB | Low gain mode |
| Input return loss | S_{11HG} | – | -15 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -11 | – | dB | 50 Ω , low gain mode |
| Output return loss | S_{22HG} | – | -15 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -13 | – | dB | 50 Ω , low gain mode |
| Stability factor | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point | IP_{1dBHG} | – | -10 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -2 | – | dBm | Low gain mode |
| Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -2 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 7 | – | dBm | Low gain mode |

1) Performance based on application circuit in Figure 7 on Page 37

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

2.15 Measured RF Characteristics 2650 MHz Band

Table 13 Typical Characteristics 2650 MHz Band, $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}^{1)2)}$, $R_{REF} = 8.2\text{ k}\Omega$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|--------------|--------|------|------|------|------------------------------|
| | | Min. | Typ. | Max. | | |
| Pass band range band VII | | 2600 | – | 2700 | MHz | – |
| Current consumption | I_{CCHG} | – | 4.2 | – | mA | High gain mode |
| | I_{CCLG} | – | 0.53 | – | mA | Low gain mode |
| Gain | S_{21HG} | – | 15.7 | – | dB | High gain mode |
| | S_{21LG} | – | -7.1 | – | dB | Low gain mode |
| Reverse Isolation | S_{12HG} | – | -34 | – | dB | High gain mode |
| | S_{12LG} | – | -7.0 | – | dB | Low gain mode |
| Noise figure | NF_{HG} | – | 1.2 | – | dB | High gain mode |
| | NF_{LG} | – | 6.8 | – | dB | Low gain mode |
| Input return loss | S_{11HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{11LG} | – | -10 | – | dB | 50 Ω , low gain mode |
| Output return loss | S_{22HG} | – | -20 | – | dB | 50 Ω , high gain mode |
| | S_{22LG} | – | -11 | – | dB | 50 Ω , low gain mode |
| Stability factor | k | – | >2.3 | – | | DC to 8 GHz; all gain modes |
| Input compression point | IP_{1dBHG} | – | -10 | – | dBm | High gain mode |
| | IP_{1dBLG} | – | -2 | – | dBm | Low gain mode |
| Inband IIP3 $f_1 - f_2 = 1\text{ MHz}$ | $IIP3_{HG}$ | – | -2 | – | dBm | High gain mode |
| | $IIP3_{LG}$ | – | 7 | – | | Low gain mode |

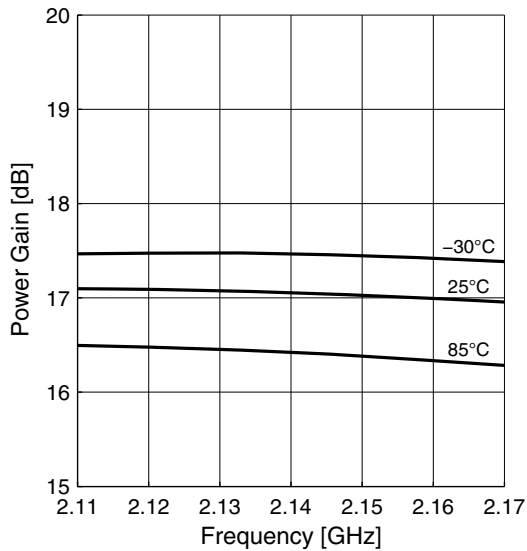
1) Performance based on application circuit in Figure 8 on Page 38

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

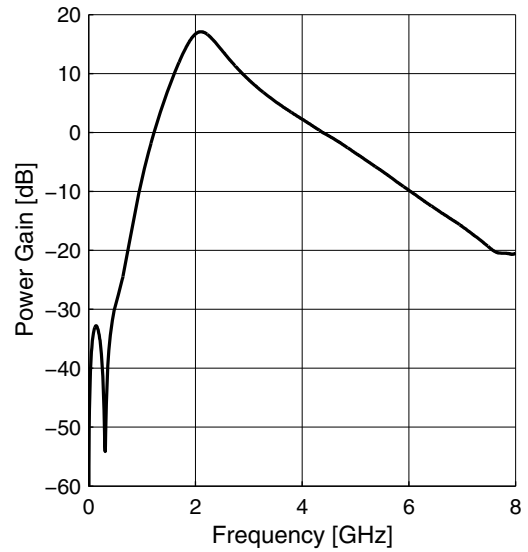
2.16 Measured Performance Band 1 Application High Gain Mode vs. Frequency

$T_A = 25\text{ }^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 2.8\text{ V}$, $V_{EN} = 2.8\text{ V}$

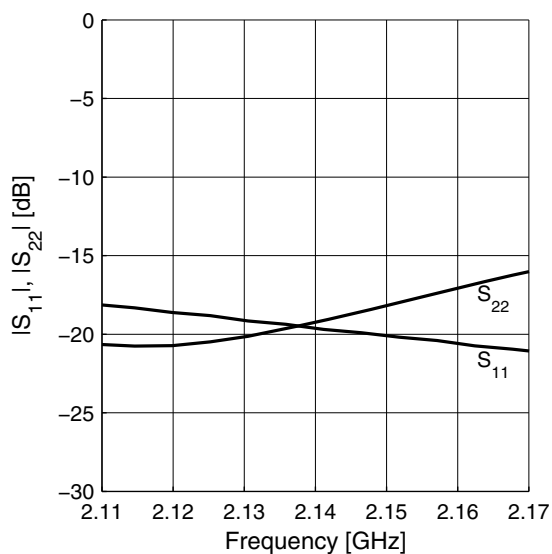
Power Gain $|S_{21}| = f(f)$



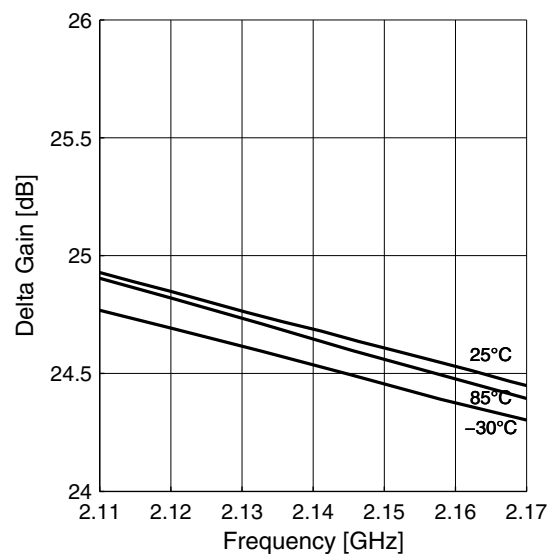
Power Gain wideband $|S_{21}| = f(f)$



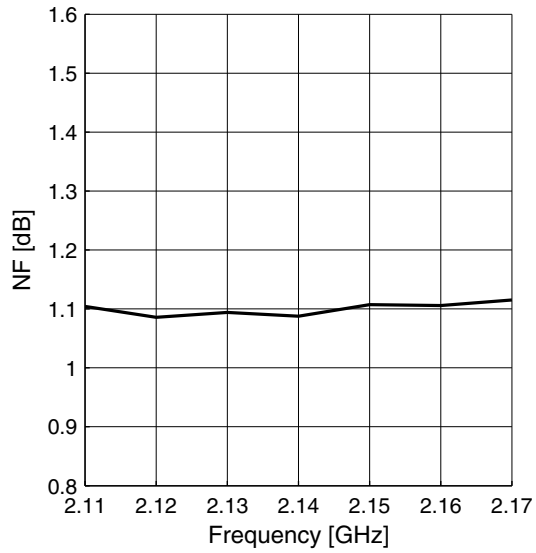
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



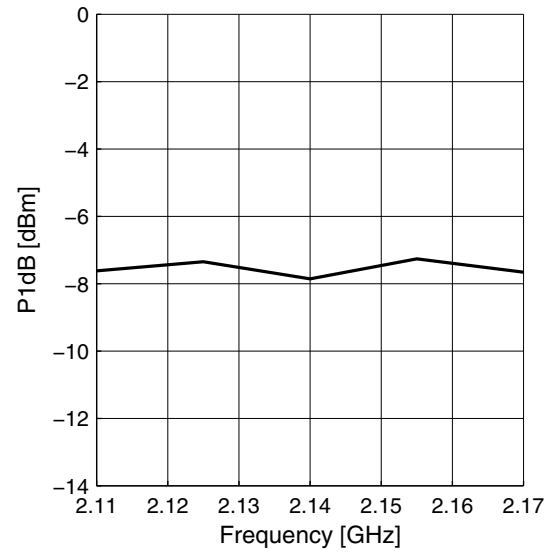
Gainstep HG-LG $|\Delta S_{21}| = f(f)$



Noise Figure $NF = f(f)$



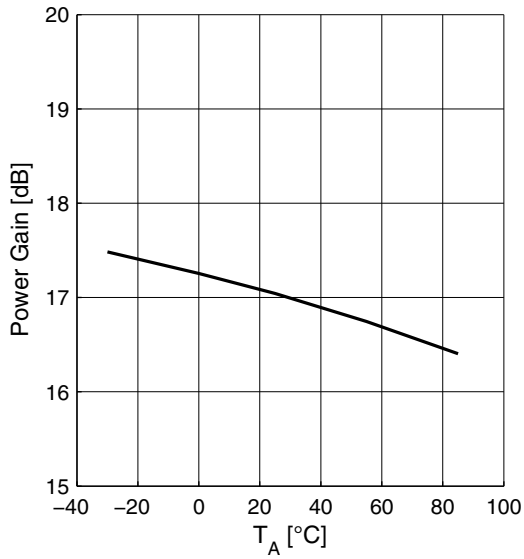
Input Compression $P1dB = f(f)$



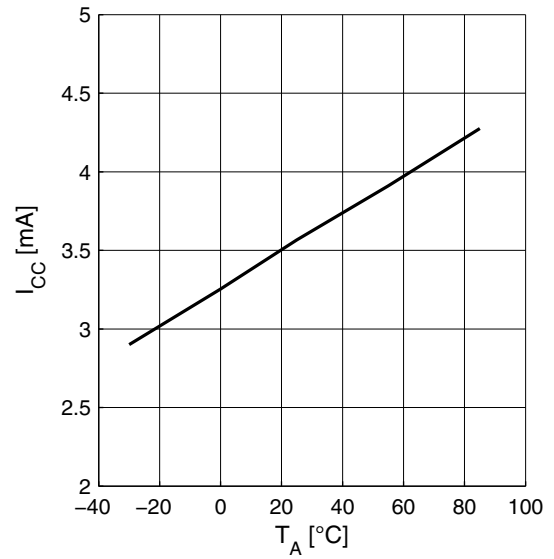
2.17 Measured Performance Band 1 Application High Gain Mode vs. Temperature

$T_A = 25\text{ }^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 2.8\text{ V}$, $V_{EN} = 2.8\text{ V}$, $f = 2140\text{ MHz}$

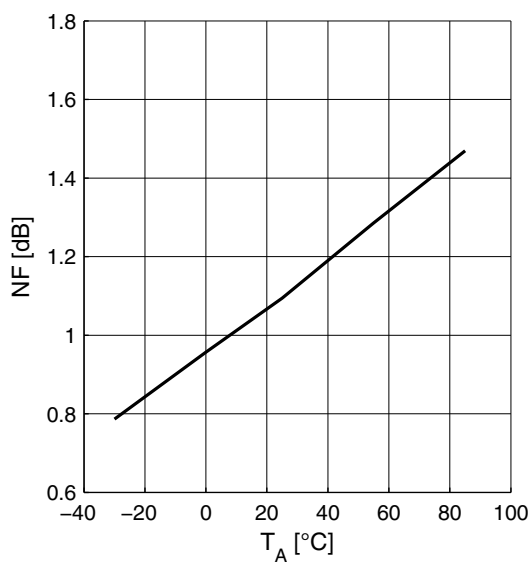
Power Gain $|S_{21}| = f(T_A)$



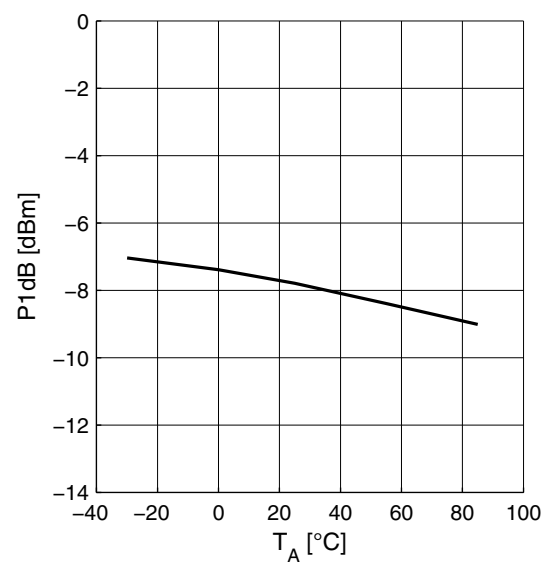
Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



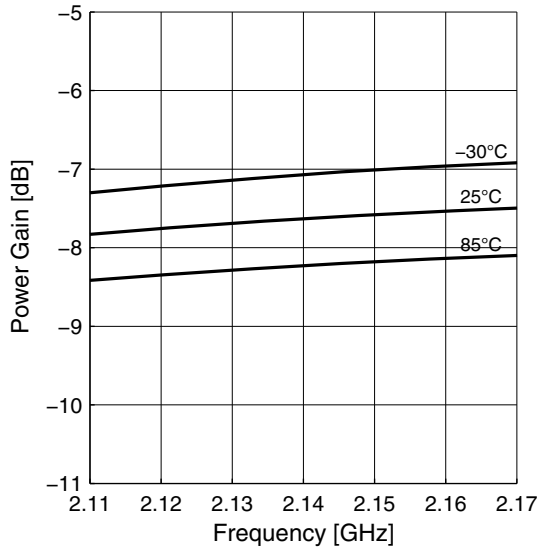
Input Compression $P1dB = f(T_A)$



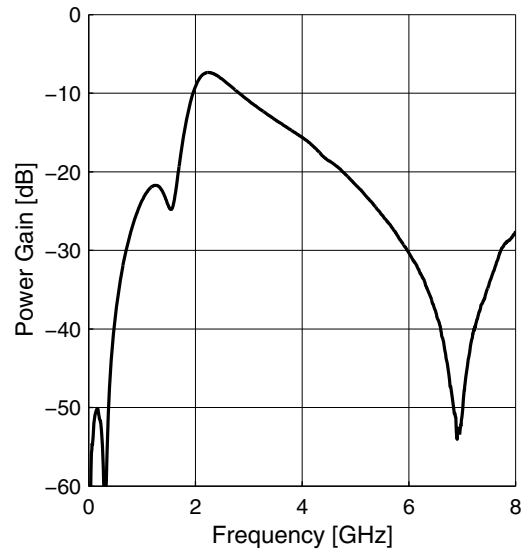
2.18 Measured Performance Band 1 Application Low Gain Mode vs. Frequency

$T_A = 25\text{ }^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 0\text{ V}$, $V_{EN} = 2.8\text{ V}$

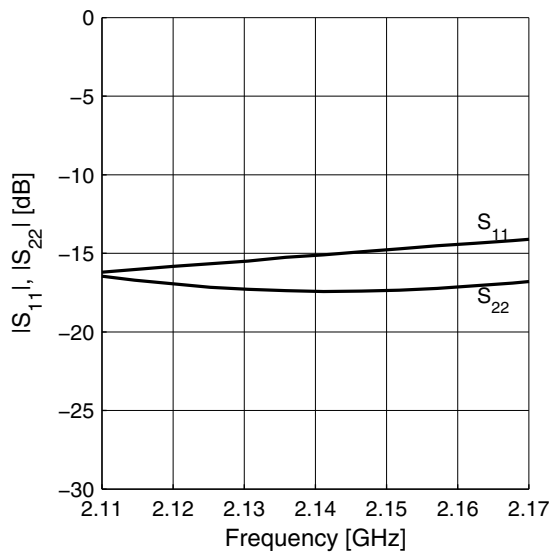
Power Gain $|S_{21}| = f(f)$



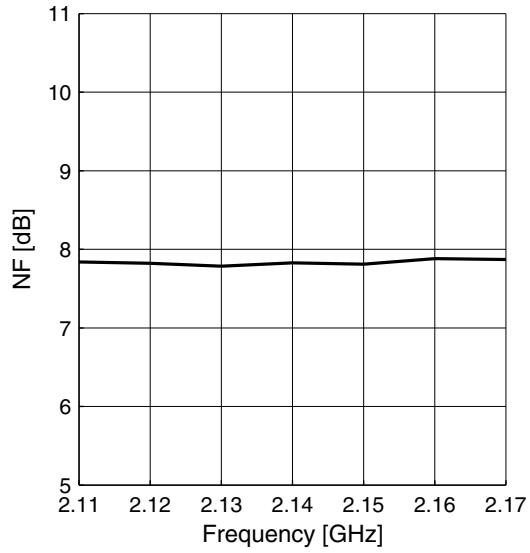
Power Gain wideband $|S_{21}| = f(f)$



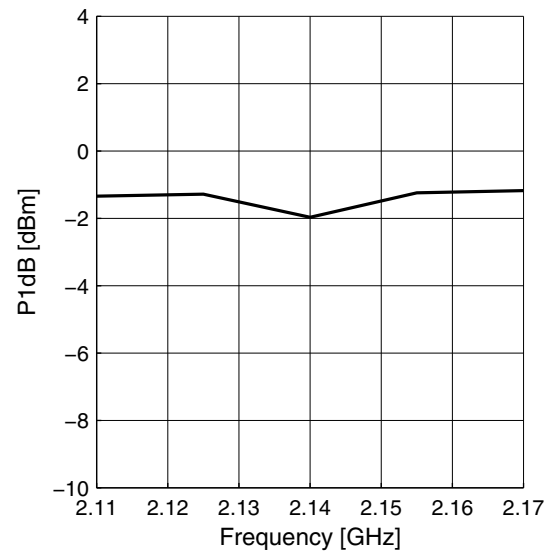
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



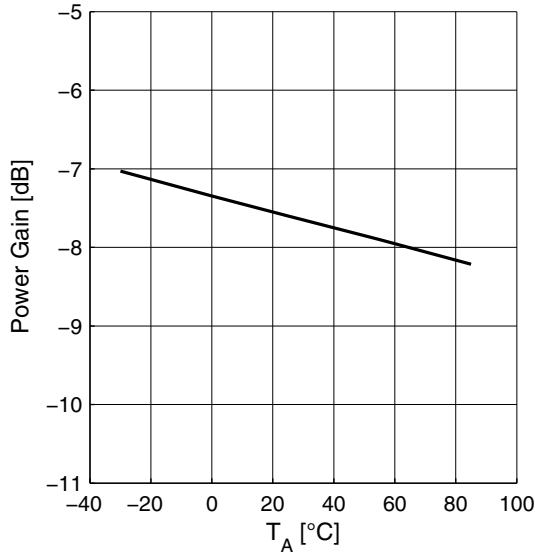
Input Compression $P1dB = f(f)$



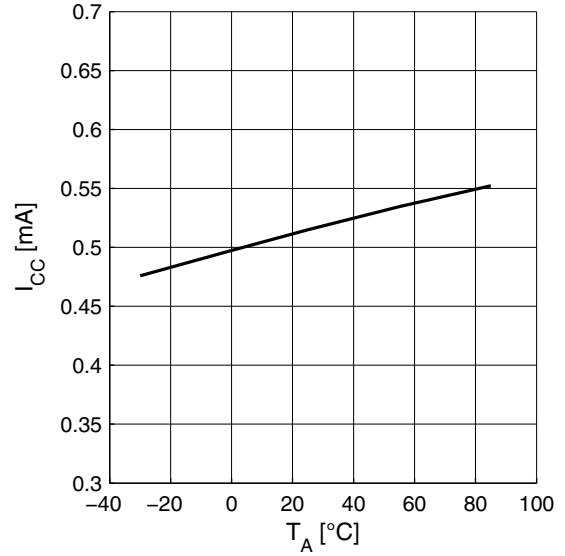
2.19 Measured Performance Band 1 Application Low Gain Mode vs. Temperature

$T_A = 25\text{ }^\circ\text{C}$, $V_{CC} = 2.8\text{ V}$, $V_{GS} = 0\text{ V}$, $V_{EN} = 2.8\text{ V}$, $f = 2140\text{ MHz}$

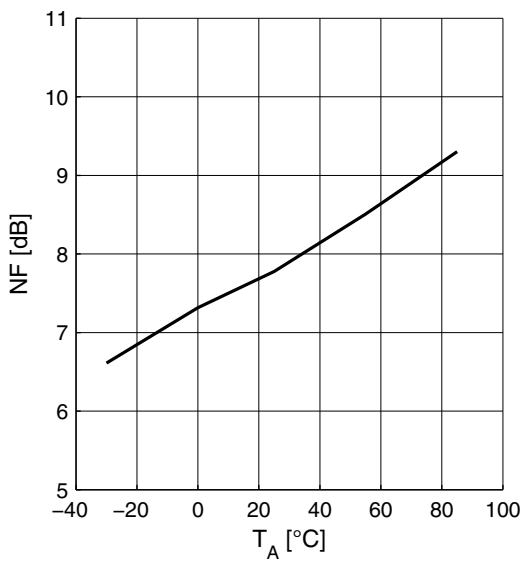
Power Gain $|S_{21}| = f(T_A)$



Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



Input Compression $P1dB = f(T_A)$

