BGM704N7

FM Radio LNA with Integrated RX/TX Switch

Data Sheet

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Preliminary

RF & Protection Devices

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BGM704N7 FM Radio LNA with Integrated RX/TX Switch

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Page	**Subjects (major changes since last revision)**
12-23	Updated performance values

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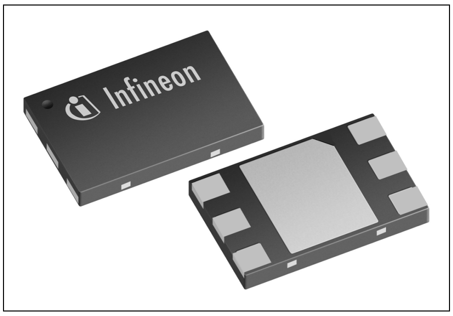
FM Radio LNA with Integrated RX/TX Switch **BGM704N7**

1 Features



Main features:

- High performance FM radio LNA with integrated biasing and RX/TX switch
- Worldwide FM band support (76-108 MHz)
- Designed for high ohmic antenna
- 2kV HBM ESD protection
- Very high gain at low current consumption
- High input compression point
- Integrated active biasing circuit enables stable operation point against temperature and process-variation
- Operation voltage: 1.8 V to 3.6 V
- Standby mode
- Very small and leadless package TSNP-7-1, 2.0 x 1.3 x 0.4 mm
- Pb-free (RoHS compliant) and halogen-free (WEEE compliant) package

RoHS

Description

The BGM704N7 is a high performance Silicon Germanium Carbon (SiGe:C) FM radio LNA with integrated RX/TX switch and active biasing in a very small TSNP-7-1 package for use in FM radio systems.

Product Name	Package	Chip	Marking
BGM704N7	TSNP-7-1	T1585	tbd

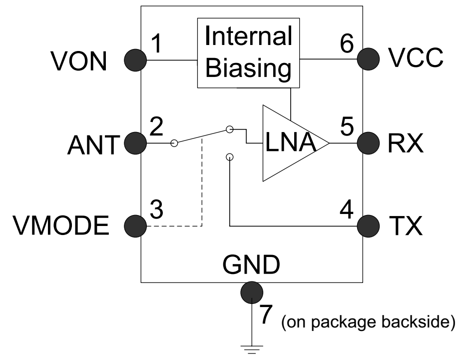


Figure 1 Block Diagram of FM Radio Module

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}	–	–	25	mA	–
Control voltage	V_{MODE}	-0.3	–	V_{CC} + 0.3	V	–
On / Off voltage	V_{ON}	-0.3	–	V_{CC} + 0.3	V	–
Pin voltage ANT Pin	V_{RFIN}	-0.3	–	0.9	V	–
RF input power	P_{RFIN}	–	–	tbd	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}	–	–	tbd	K/W	–

2.3 ESD Integrity

Table 3 ESD Integrity

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

1) According to JESD22-A114

2.4 DC Characteristics

Table 4 DC Characteristics, T_A = 25 °C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.8	3.0	3.6	V	–
Supply current RX mode	I_{CC}	–	3.6	–	mA	–
Supply current TX mode	I_{CC}	–	0.4	–	mA	–
Supply current standby mode	I_{CCOFF}	–	0.1	2	µA	–
Logic level high	V_{HI}	1.5	3.0	–	V	All logic pins
Logic level low	V_{LO}	–	0.0	0.5	V	
Logic currents	I_{LO}	–	0.1	–	µA	All logic pins
	I_{HI}	–	5.0	–	µA	

2.5 RX/TX Control Truth Table

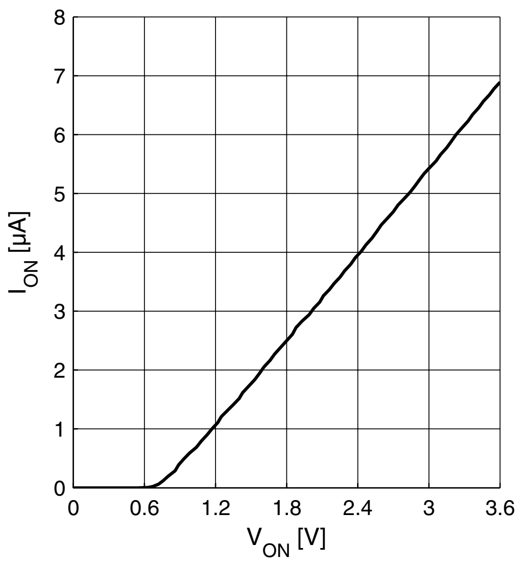
Table 5 Band Select Truth Table

	RX Mode	TX Mode	Standby
VON	H	H	L
VMODE	H	L	x

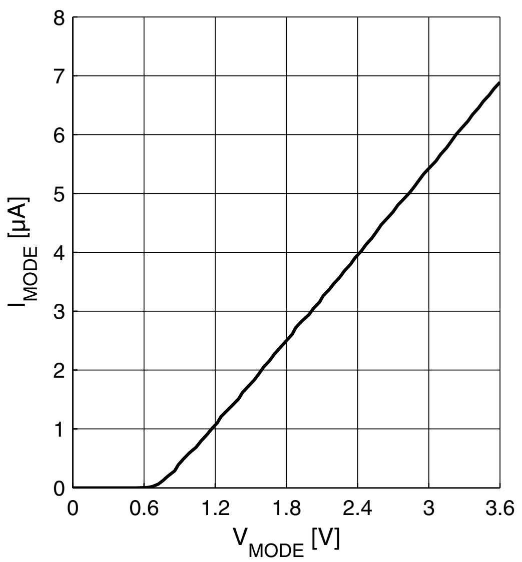
2.6 Logic Signal Characteristics

Current consumption of logic inputs VON, VMODE

Logic currents I_{ON} = f (V_{ON})
V_{CC} = 3.0 V, T_A = 25 °C



Logic currents I_{MODE} = f (V_{MODE})
V_{CC} = 3.0 V, T_A = 25 °C



2.7 Switching Times

Table 6 Typical Switching Times; T_A = -30 ... 85 °C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Control settling time	t_{MODE}	–	3	–	µs	Switching RX ↔ TX (pin VMODE)
Power on settling time	t_{ON}	–	5	–	µs	Switching from standby mode to ON mode (pin VON)

2.8 Measured RF Characteristics RX Mode in 50 Ω System, V_{CC} = 1.8 V

Table 7 Typical Characteristics 100 MHz, T_A = 25 °C, V_{CC} = 1.8 V, V_{ON} = 1.8 V, V_{MODE} = 1.8 V[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		76	–	108	MHz	–
Current consumption	I_{CC}	–	3.3	–	mA	–
Gain	S_{21}	–	12.0	–	dB	–
Reverse Isolation[2)]	S_{12}	–	-54	–	dB	–
Noise figure	NF	–	3.5	–	dB	–
Input return loss[2)]	S_{11}	–	-0.6	–	dB	50 Ω
Output return loss[2)]	S_{22}	–	-14	–	dB	50 Ω
Stability factor[3)]	k	–	>2.9	–	–	DC to 8 GHz
Input compression point[2)]	IP_{1dB}	–	-9	–	dBm	–
Inband IIP3[2)] $f_1 - f_2$ = 1 MHz	$IIP3$	–	-13	–	dBm	–

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

2.9 Measured RF Characteristics RX Mode in 50 Ω System, V_{CC} = 3.0 V

Table 8 Typical Characteristics 100 MHz, T_A = 25 °C, V_{CC} = 3.0 V, V_{ON} = 3.0 V, V_{MODE} = 3.0 V[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		76	–	108	MHz	–
Current consumption	I_{CC}	–	3.6	–	mA	–
Gain	S_{21}	–	12.5	–	dB	–
Reverse Isolation[2)]	S_{12}	–	-55	–	dB	–
Noise figure	NF	–	2.9	–	dB	–
Input return loss[2)]	S_{11}	–	-0.6	–	dB	50 Ω
Output return loss[2)]	S_{22}	–	-14	–	dB	50 Ω
Stability factor[3)]	k	–	>2.4	–	–	DC to 8 GHz
Input compression point[2)]	IP_{1dB}	–	-7	–	dBm	–
Inband IIP3[2)] $f_1 - f_2$ = 1 MHz	$IIP3$	–	-14	–	dBm	–

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

2.10 Measured RF Characteristics TX Mode in 50 Ω System, V_{CC} = 1.8 V

Table 9 Typical Characteristics 100 MHz, T_A = 25 °C, V_{CC} = 1.8 V, V_{ON} = 1.8 V, V_{MODE} = 0 V[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		76	–	108	MHz	–
Current consumption	I_{CC}	–	0.30	–	mA	–
Gain	S_{21}	–	-2.5	–	dB	–
Reverse Isolation[2)]	S_{12}	–	-2.5	–	dB	–
Input return loss[2)]	S_{11}	–	-12	–	dB	50 Ω
Output return loss[2)]	S_{22}	–	-12	–	dB	50 Ω
Stability factor[3)]	k	–	>1	–	–	DC to 8 GHz
Input compression point[2)]	IP_{1dB}	–	6	–	dBm	–
Inband IIP3[2)] f_1 - f_2 = 1 MHz	$IIP3$	–	9	–	dBm	–

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

2.11 Measured RF Characteristics TX Mode in 50 Ω System, V_{CC} = 3.0 V

Table 10 Typical Characteristics 100 MHz, T_A = 25 °C, V_{CC} = 3.0 V, V_{ON} = 3.0 V, V_{MODE} = 0 V[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		76	–	108	MHz	–
Current consumption	I_{CC}	–	0.40	–	mA	–
Gain	S_{21}	–	-1.6	–	dB	–
Reverse Isolation[2)]	S_{12}	–	-1.6	–	dB	–
Input return loss[2)]	S_{11}	–	-14	–	dB	50 Ω
Output return loss[2)]	S_{22}	–	-14	–	dB	50 Ω
Stability factor[3)]	k	–	>1	–	–	DC to 8 GHz
Input compression point[2)]	IP_{1dB}	–	10	–	dBm	–
Inband IIP3[2)] f_1 - f_2 = 1 MHz	$IIP3$	–	15	–	dBm	–

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

2.12 Measured RF Characteristics RX Mode (ANT 5 kΩ -> RX 50 Ω), V_{CC} = 3.0 V

Table 11 Typical Characteristics 100 MHz, T_A = 25 °C, V_{CC} = 3.0 V, V_{ON} = 3.0 V, V_{MODE} = 3.0 V[1)]

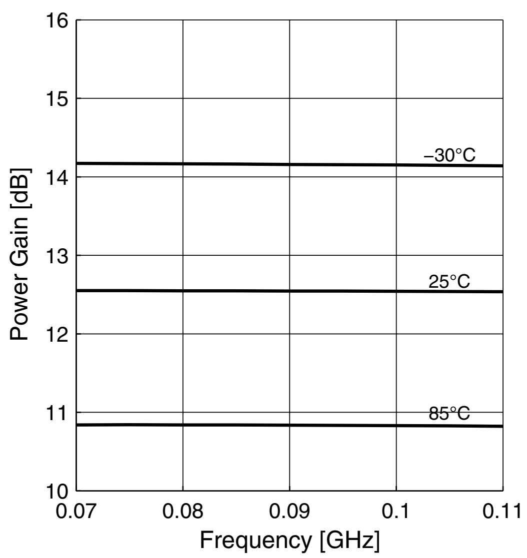
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range		76	–	108	MHz	–
Current consumption	I_{CC}	–	3.6	–	mA	–
Transducer gain[2)]	S_{21}	–	20.0	–	dB	Z_S = 5 kΩ Z_L = 50 Ω
Noise figure[2)]	NF	–	5.5	–	dB	Z_S = 5 kΩ Z_L = 50 Ω

1) Performance based on application circuit in Figure 3 on Page 25
2) Guaranteed by device design; not tested in production

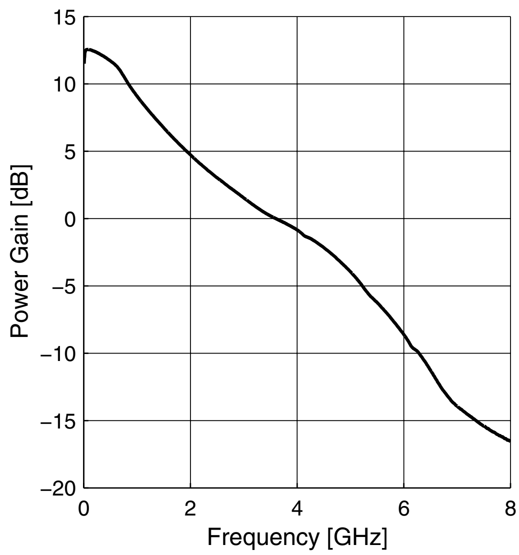
2.13 Measured Performance RX Mode in 50 Ω System vs. Frequency

T_A= 25 °C, V_{CC} = 3.0 V, V_{ON} = 3.0 V, V_{MODE} = 3.0 V

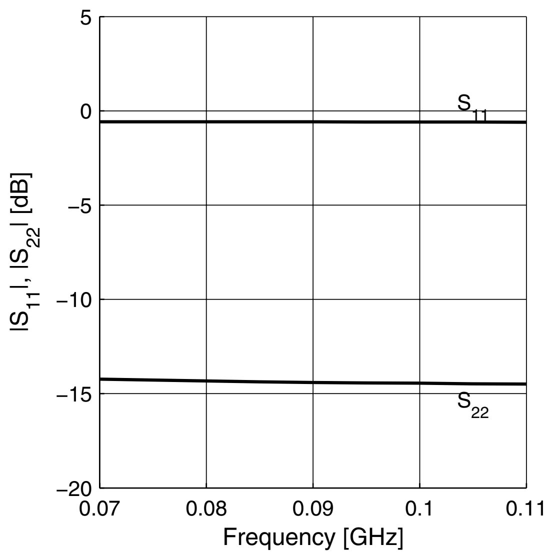
Power Gain $|S_{21}| = f(f)$



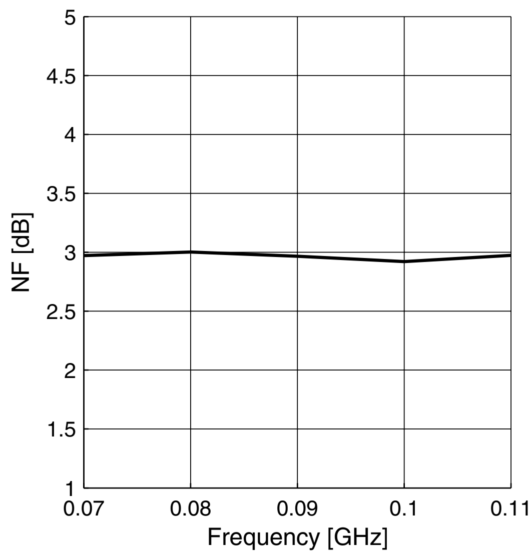
Power Gain wideband $|S_{21}| = f(f)$



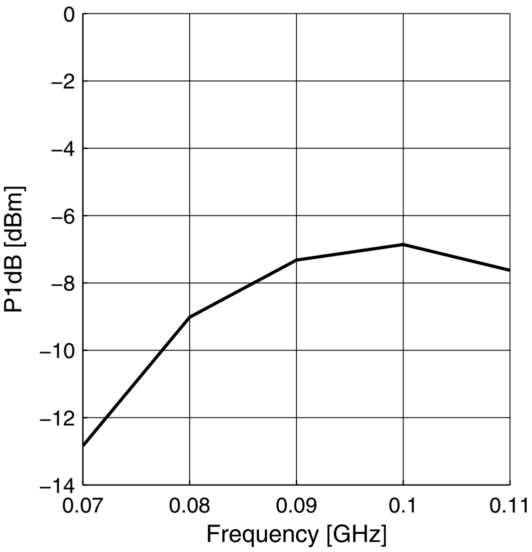
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



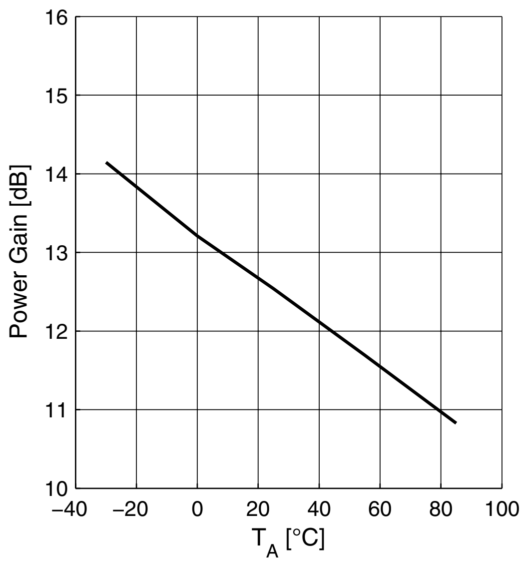
Input Compression $P1dB$ = f (f)



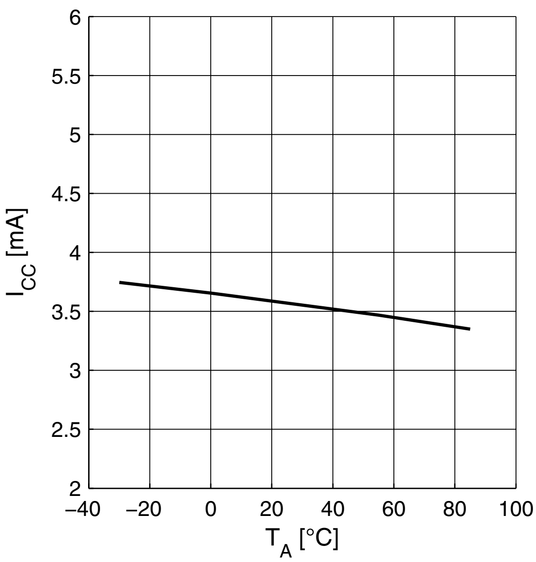
2.14 Measured Performance RX Mode in 50 Ω System vs. Temperature

V_{CC} = 3.0 V, V_{ON} = 3.0 V, V_{MODE} = 3.0 V, f = 100 MHz

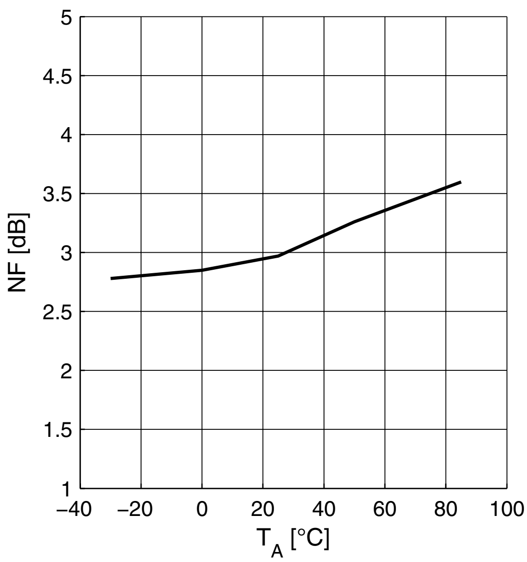
Power Gain $|S_{21}|$ = f (T_A)



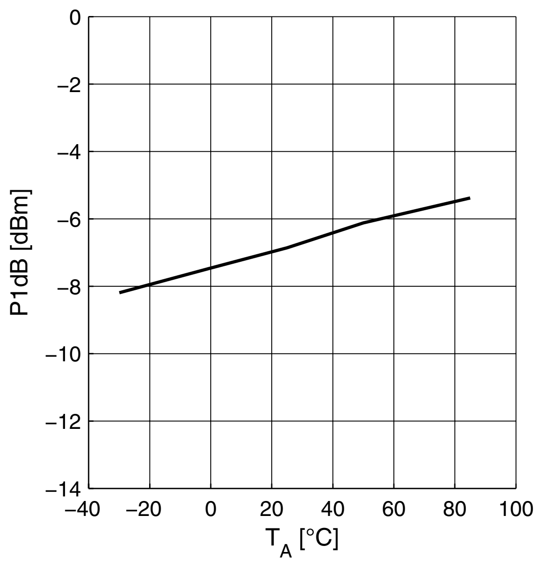
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



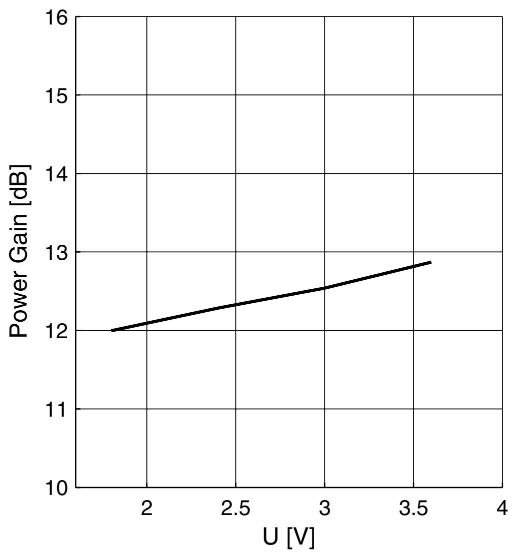
Input Compression $P1dB$ = f (T_A)



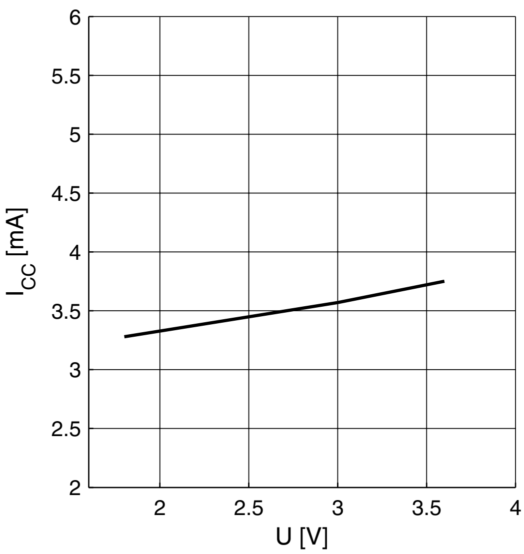
2.15 Measured Performance RX Mode in 50 Ω System vs. Voltage

V_{CC} = 3.0 V, V_{ON} = 3.0 V, V_{MODE} = 3.0 V, f = 100 MHz

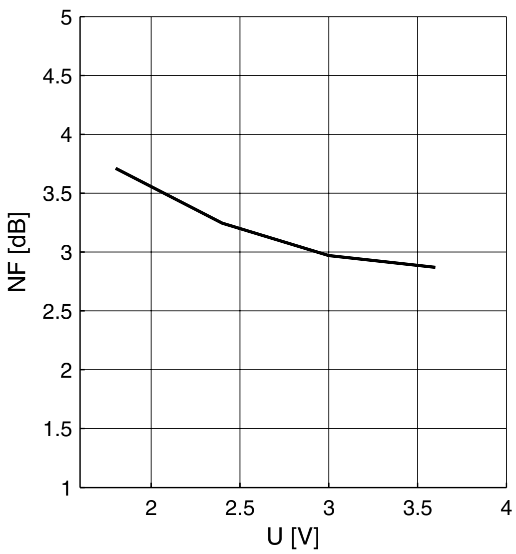
Power Gain $|S_{21}|$ = f (V)



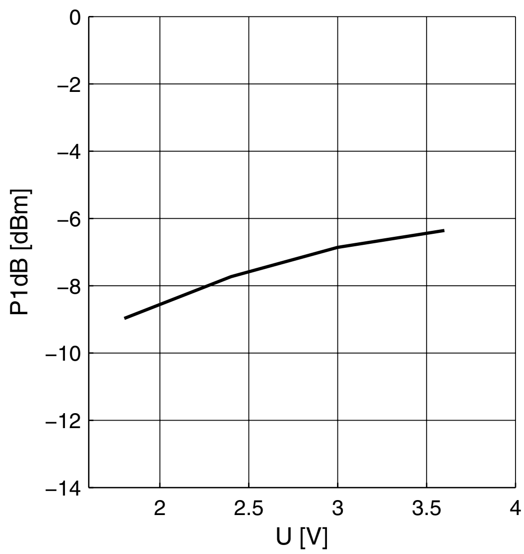
Supply Current I_{CC} = f (V)



Noise Figure NF = f (V)



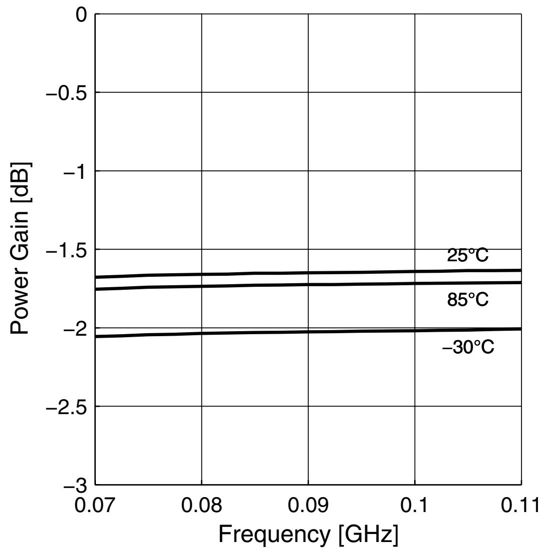
Input Compression $P1dB$ = f (V)



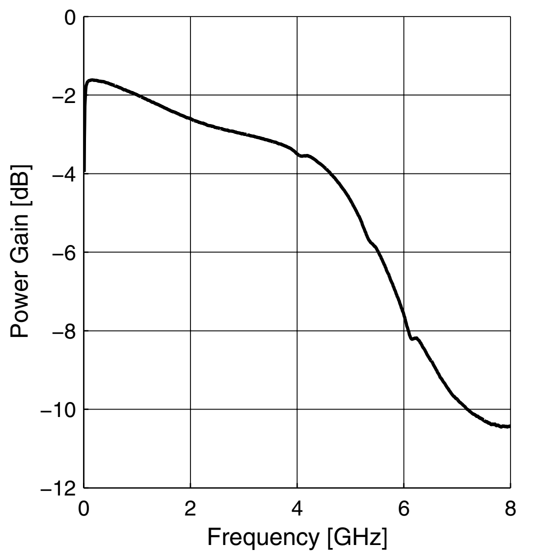
2.16 Measured Performance TX Mode in 50 Ω System vs. Frequency

T_A = 25 °C, V_{CC} = 3.0 V, V_{ON} = 3.0 V, V_{MODE} = 0 V

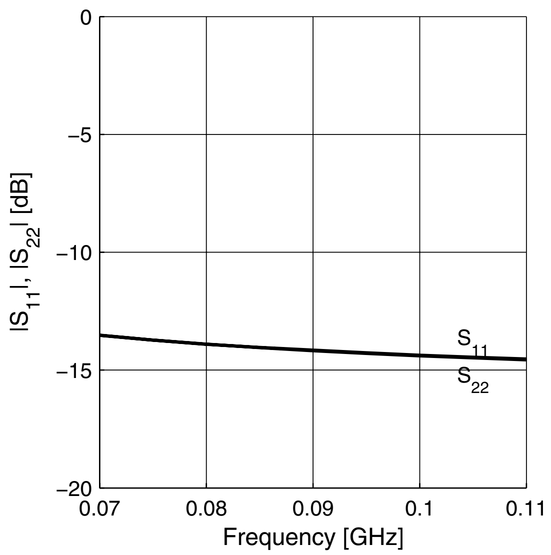
Power Gain $|S_{21}| = f(f)$



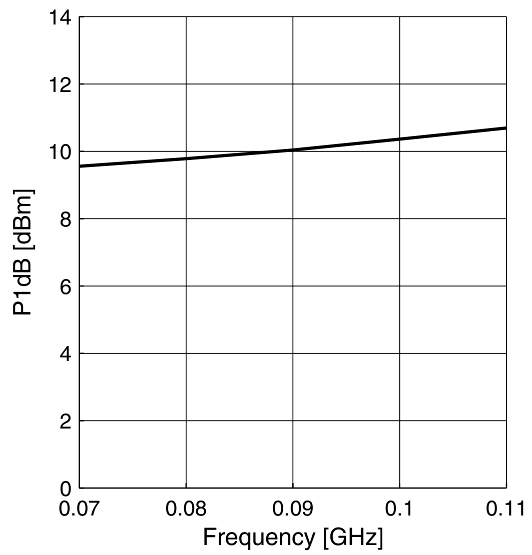
Power Gain wideband $|S_{21}| = f(f)$



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



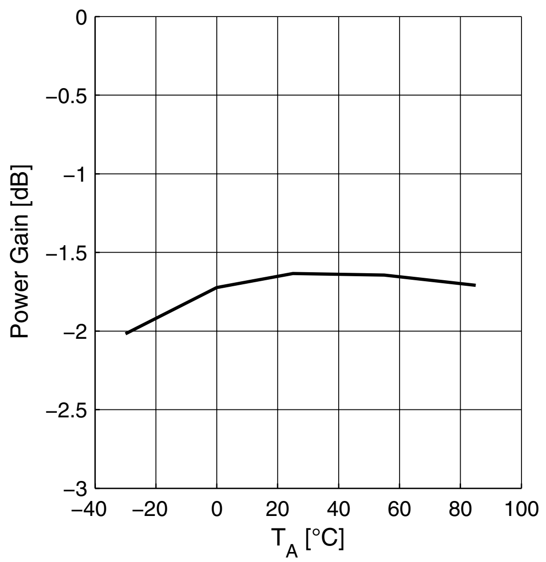
Input Compression $P1dB = f(f)$



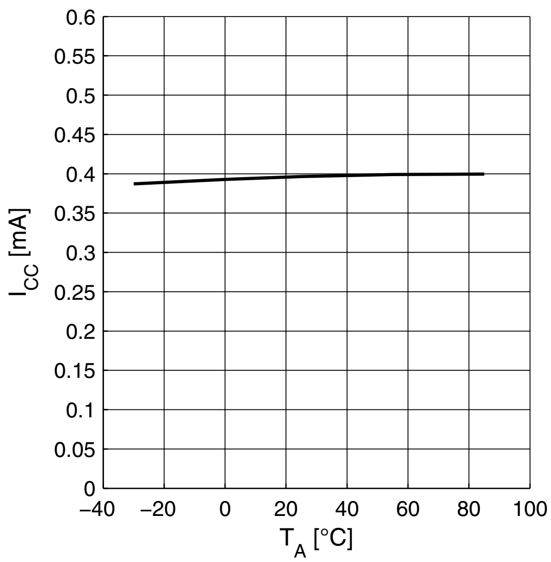
2.17 Measured Performance TX Mode in 50 Ω System vs. Temperature

V_{CC} = 3 V, V_{ON} = 3 V, V_{MODE} = 0 V, f = 100 MHz

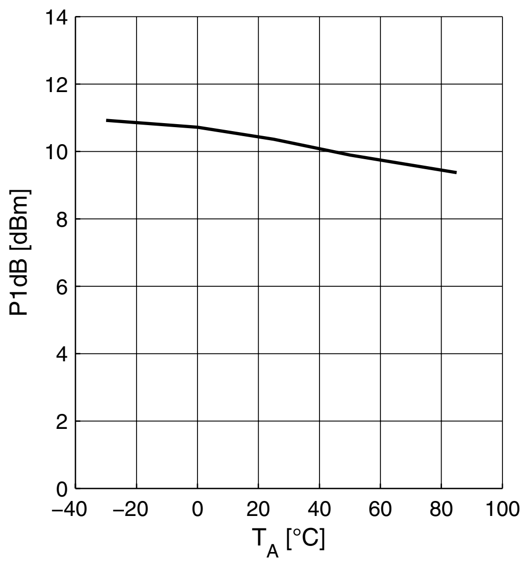
Power Gain $|S_{21}| = f(T_A)$



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



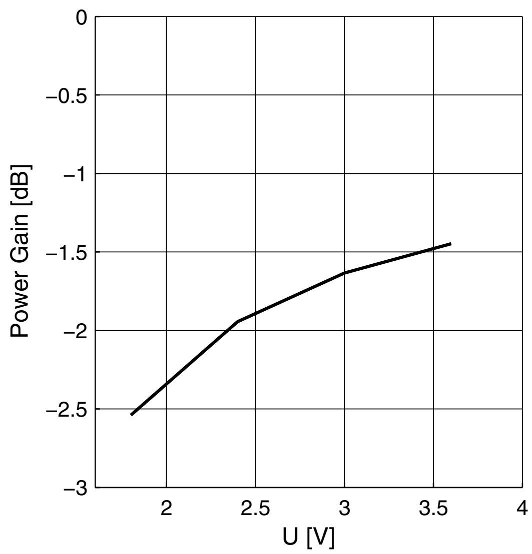
Input Compression $P1dB = f(T_A)$



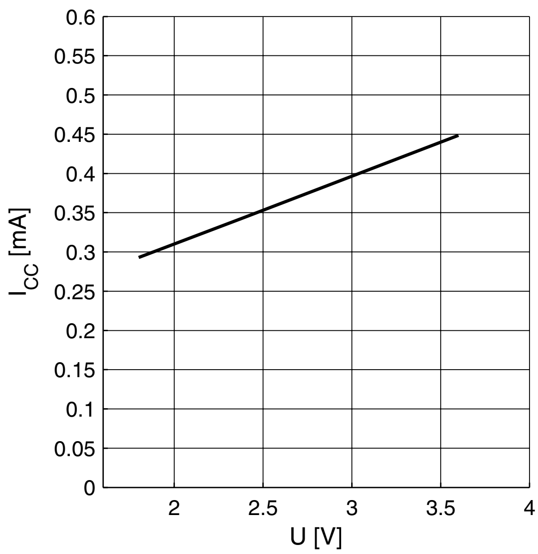
2.18 Measured Performance TX Mode in 50 Ω System vs. Voltage

V_{CC} = 3 V, V_{ON} = 3 V, V_{MODE} = 0 V, f = 100 MHz

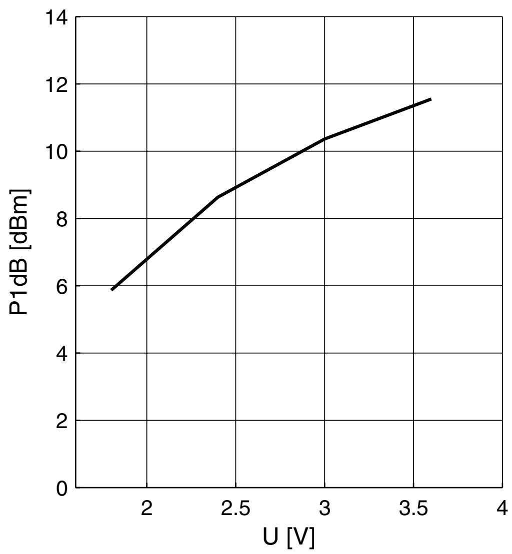
Power Gain $|S_{21}|$ = f (V)



Supply Current I_{CC} = f (V)



Input Compression $P1dB$ = f (V)



3 Application Circuit and Block Diagram

3.1 FM Radio in 50 Ω System Application Circuit Schematic

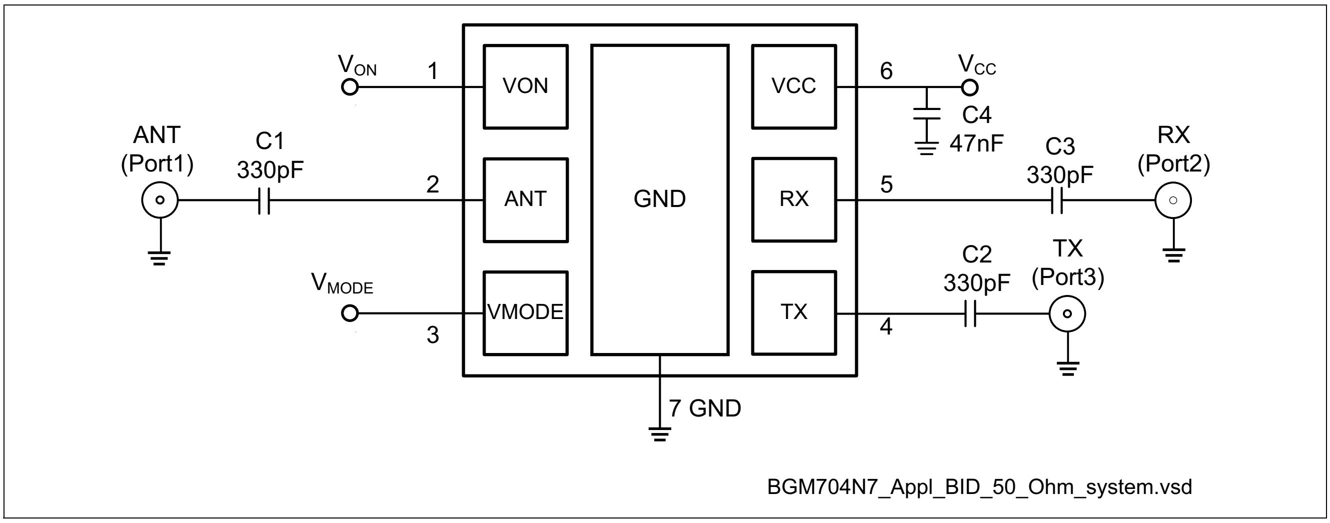


Figure 2 Application Circuit with Chip Outline (Top View)

Table 12 Bill of Materials 50 Ω Application

Part Number	Part Type	Manufacturer	Size	Comment
C1 ... C4	Chip capacitor	Various	0402	

3.2 FM Radio in High Ohmic System Application Circuit Schematic

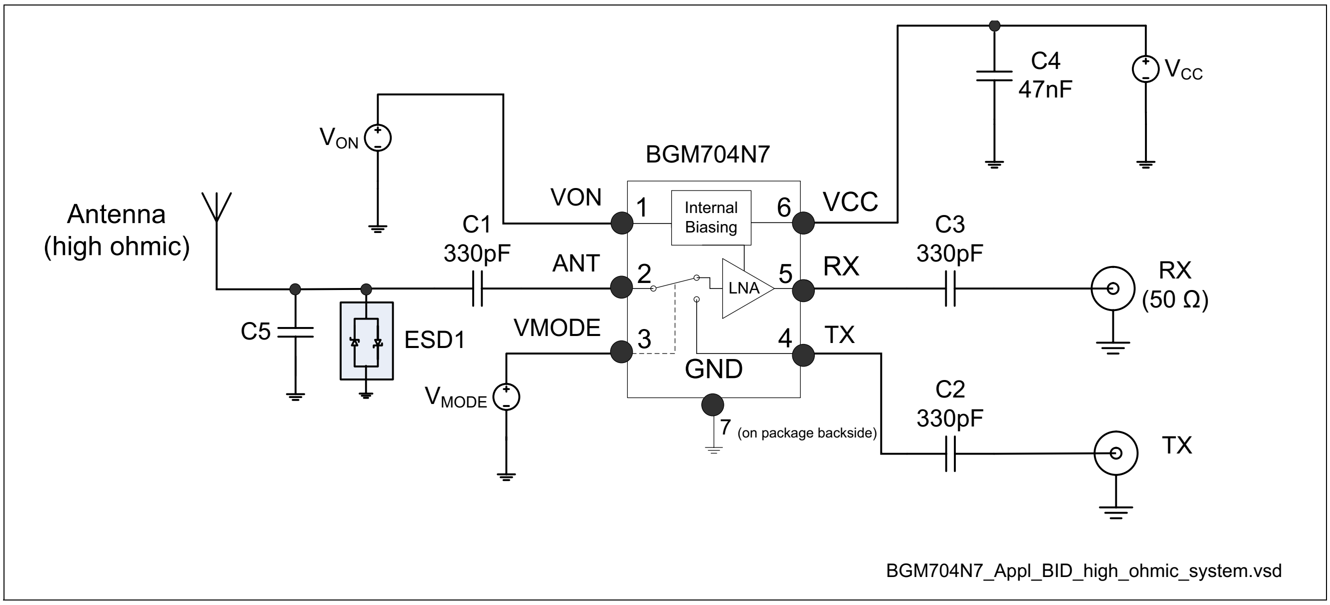


Figure 3 Application Circuit with Chip Outline High Ohmic (Top View)

Table 13 Bill of Materials High Ohmic Antenna Application

Part Number	Part Type	Manufacturer	Size	Comment
C1 ... C5	Chip capacitor	Various	0402	
ESD1	TVS diode ESD0P8RFL	Infineon	0402	Optional

3.3 Pin Description

Table 14 Pin Definition and Function

Pin No.	Name	Pin Type	Buffer Type	Function
1	VON	–	–	On / Off voltage
2	ANT	–	–	RF antenna (input / output)
3	VMODE	–	–	Control voltage
4	TX	–	–	RF input TX
5	RX	–	–	RF output RX
6	VCC	–	–	Supply voltage
7	GND	–	–	Ground connection for LNA and control circuitry (package paddle)

3.4 Application Board

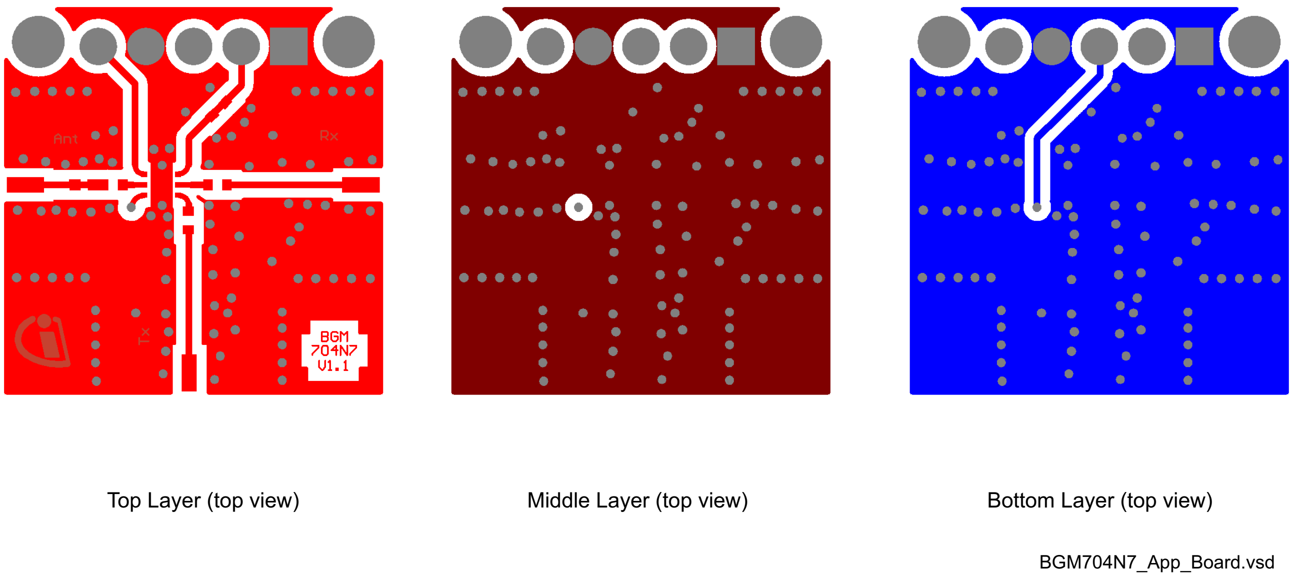


Figure 4 Application Board Layout on 3-layer FR4

Note: Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 17 mm Cu metallization, gold plated. Board size: 21 x 21mm.

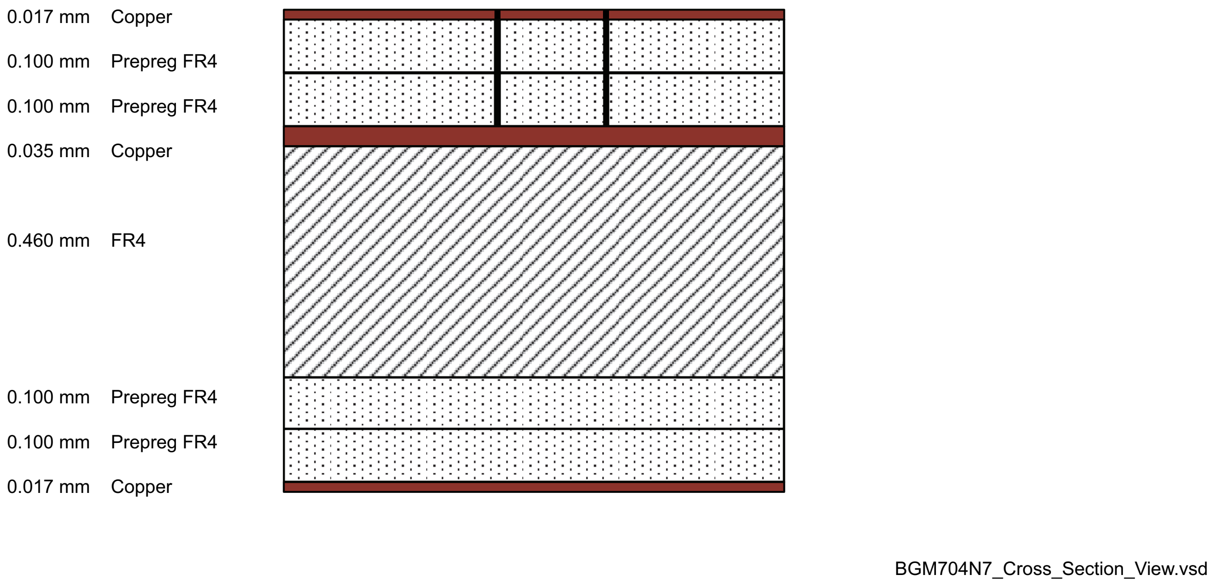


Figure 5 Cross-Section View of Application Board

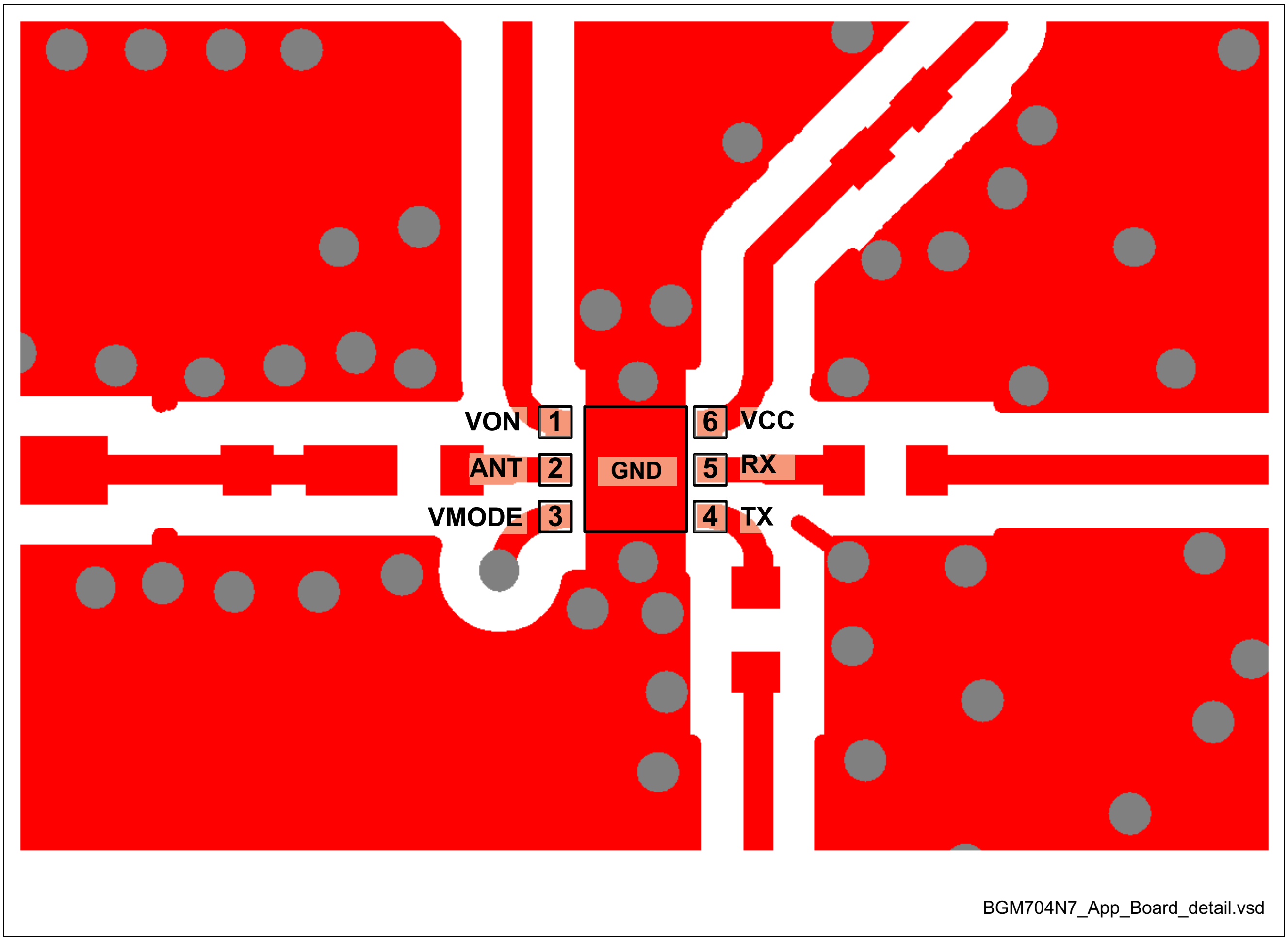


Figure 6 Detail of Application Board Layout

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 vias is critical for RF performance.

4 Physical Characteristics

4.1 Package Footprint

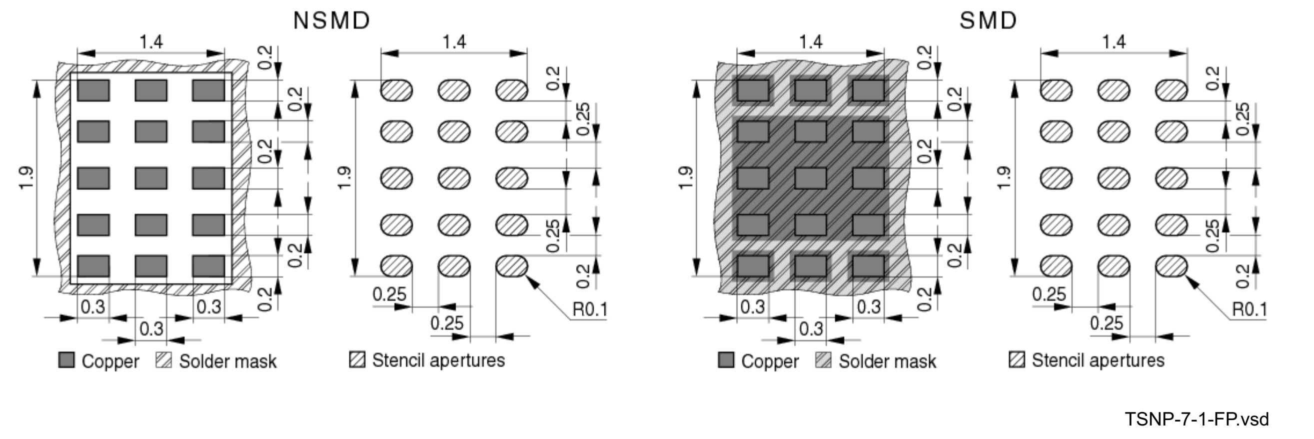


Figure 7 Recommended Footprint and Stencil Layout for the TSNP-7-1 Package

4.2 Package Dimensions

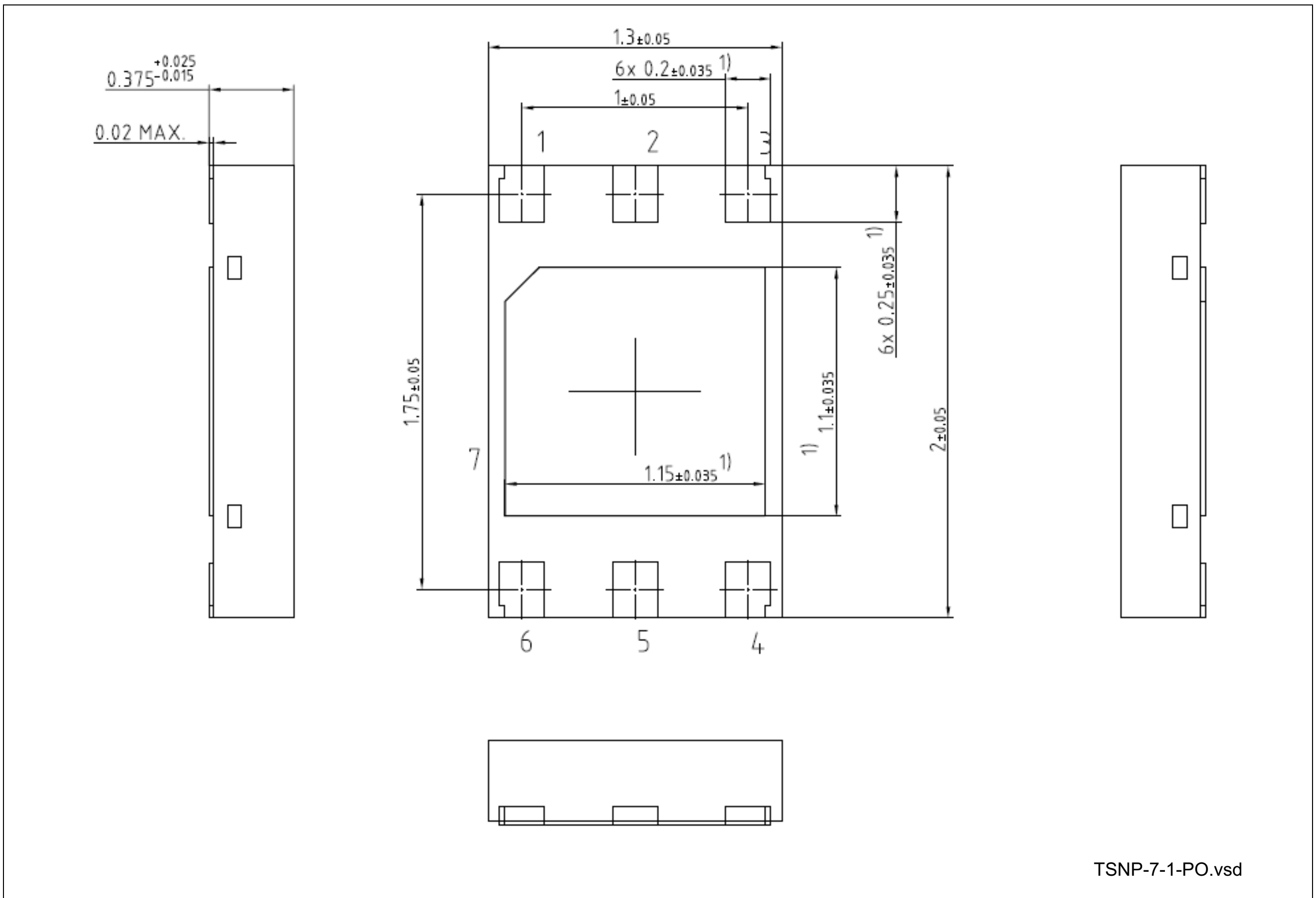


Figure 8 Package Outline (Top, Side and Bottom View)

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