BGA711L7

Single-Band UMTS LNA (2100, 1900 MHz)

RF & Protection Devices

Never stop thinking

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BGA711L7
Revision History: 2009-05-27, V3.2

Previous Version: 2008-11-05, V3.1	
Page	**Subjects (major changes since last revision)**
7	Updated DC Characteristics (added limits)
9, 10, 11	Updated footnotes
18	Updated value of C4 at Application Circuit Schematic for band II

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1 Description

The BGA711L7 is a low current single-band low noise amplifier MMIC for UMTS bands I, IV and X. The LNA is based upon Infineon's proprietary and cost-effective SiGe:C technology and comes in a low profile TSLP-7-1 leadless green package. Because the matching is off chip, the 2100 MHz path can be easily converted into a 1900 MHz path by optimizing the input and output matching network. This document specifies the electrical parameters, pinout, application circuit and packaging of the chip.

Features

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

TSLP-7-1 package

RoHS

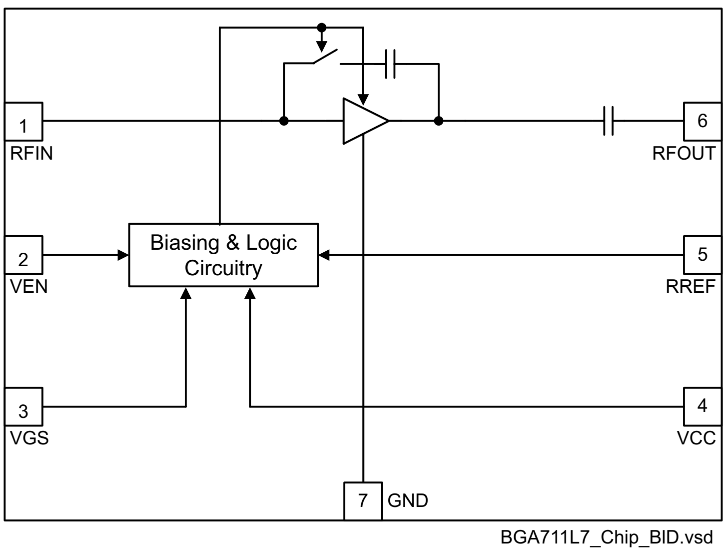


Figure 1 Block diagram of single-band LNA

Type	Package	Marking	Chip
BGA711L7	TSLP-7-1	B1	T1531

2 Electrical Characteristics

2.1 Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	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 pin
Pin voltage RF Input Pin	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	

2.2 Thermal Resistance

Table 2 Thermal Resistance

Parameter	Symbol	Value	Unit	Note / Test Conditions
Thermal resistance junction to soldering point	R_{thJS}	240	K/W	

2.3 ESD Integrity

Table 3 ESD Integrity

Parameter	Symbol	Value (typ.)	Unit	Note / Test Conditions
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 °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	
Supply current low gain mode	I_{CCLG}		500		µA	
Supply current standby mode	I_{CCOFF}		0.1	2.0	µA	
Logic level high	V_{HI}	1.5	2.8		V	VEN and VGS
Logic level low	V_{LO}	-0.2	0.0	0.5	V	
Logic currents VEN	I_{ENL}			0.1	µA	VEN
	I_{ENH}		5.0	6.0	µA	
Logic currents VGS	I_{GSL}			0.1	µA	VGS
	I_{GSH}		5.0	6.0	µA	

2.5 Gain Mode Select Truth Table

Table 5 Truth Table

Control Voltage		State	
		Bands I, II, IV and X	
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

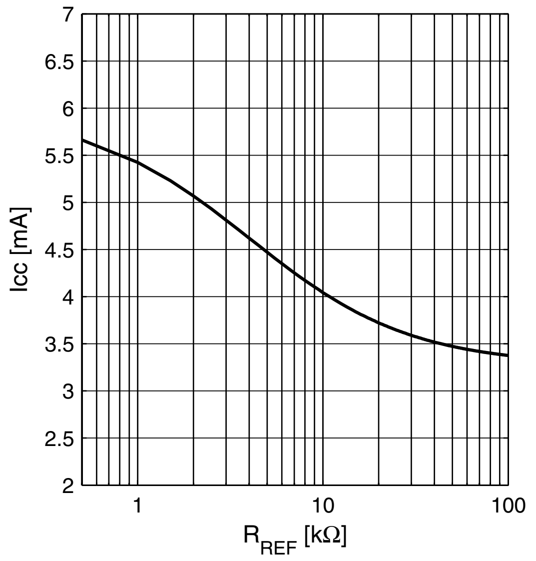
Table 6 Typical switching times; T_A = -30 ... 85 °C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Settling time gainstep	t_{GS}		1		µs	Switching LG ↔ HG

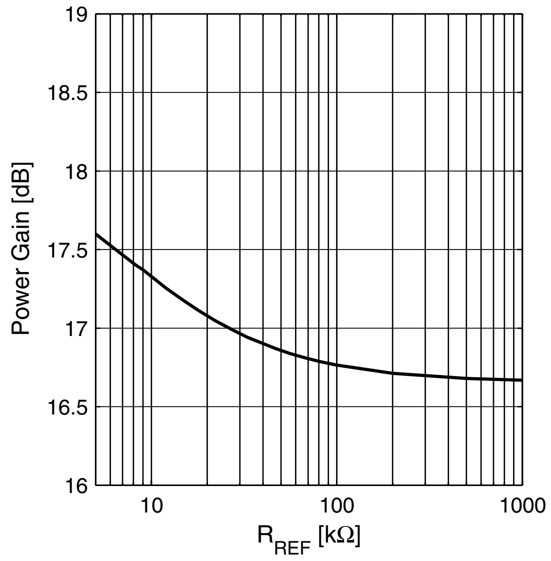
2.7 Supply current and Power gain characteristics; T_A = 25 °C

Supply current and Power gain high gain mode versus reference resistor R_{REF} (see **Figure 2 on page 17** for reference resistor; low gain mode supply current is independent of reference resistor).

Supply Current I_{CC} = f (R_{REF})
V_{CC} = 2.8 V



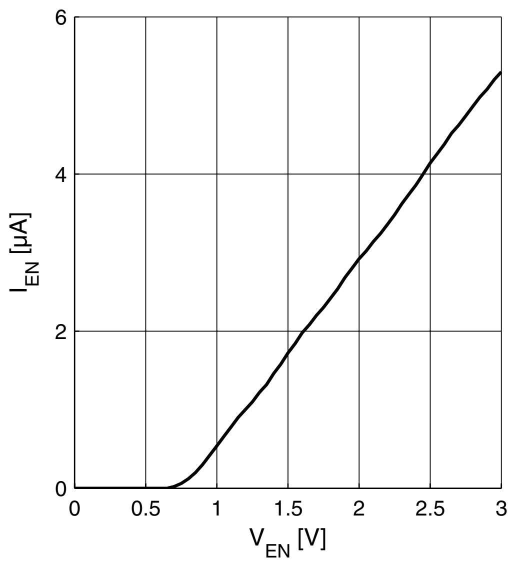
Power Gain $|S_{21}|$ = f (R_{REF})
V_{CC} = 2.8 V



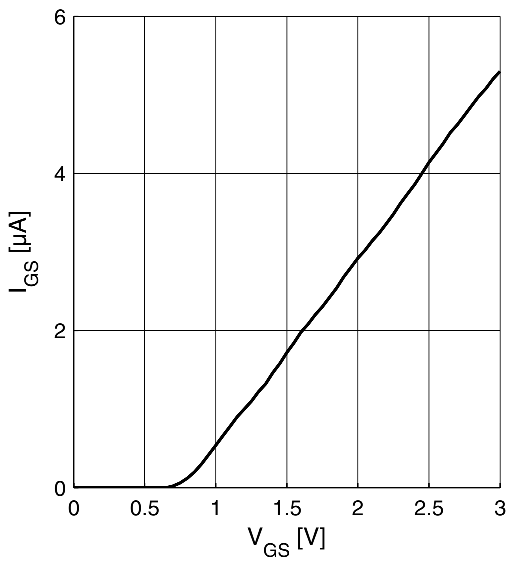
2.8 Logic Signal Characteristics; T_A = 25 °C

Current consumption of logic inputs VEN, VGS

Logic currents I_{EN} = f (V_{EN})
V_{CC} = 2.8 V



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



2.9 Measured RF Characteristics UMTS Bands I / IV / X (with reference resistor)

Table 7 Typical Characteristics 2100 MHz Band T_A = 25 °C, V_{CC} = 2.8 V, R_{REF} = 27 kΩ

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band I / X		2110		2170	MHz	
Pass band range band IV		2110		2155	MHz	
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[1)]	S_{12HG}		-36		dB	High gain mode
	S_{12LG}		-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[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[2)]	k		>2.3			DC to 10 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 MHz $P_{f1} = P_{f2}$ = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$		-2 7		dBm	High gain mode Low gain mode

1) Verification based on AQL; not 100% tested in production
2) Guaranteed by device design; not tested in production

2.10 Measured RF Characteristics UMTS Bands I / IV / X (without ref. resistor)

Table 8 Typical Characteristics 2100 MHz Band T_A = 25 °C, V_{CC} = 2.8 V, R_{REF} = n/c

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band I / X		2110		2170	MHz	
Pass band range band IV		2110		2155	MHz	
Current consumption	I_{CCHG}		3.3		mA	High gain mode
	I_{CCLG}		0.5		mA	Low gain mode
Gain	S_{21HG}		16.7		dB	High gain mode
	S_{21LG}		-7.7		dB	Low gain mode
Reverse Isolation[1]	S_{12HG}		-36		dB	High gain mode
	S_{12LG}		-8		dB	Low gain mode
Noise figure	NF_{HG}		1.1		dB	High gain mode
	NF_{LG}		8.1		dB	Low gain mode
Input return loss[1]	S_{11HG}		-21		dB	50 Ω, high gain mode
	S_{11LG}		-14		dB	50 Ω, low gain mode
Output return loss[1]	S_{22HG}		-19		dB	50 Ω, high gain mode
	S_{22LG}		-18		dB	50 Ω, low gain mode
Stability factor[2]	k		>2.3			DC to 10 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 MHz $P_{f1} = P_{f2}$ = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$		-2 7		dBm	High gain mode Low gain mode

1) Verification based on AQL; not 100% tested in production
2) Guaranteed by device design; not tested in production

2.11 Measured RF Characteristics UMTS Band II (with reference resistor)

Table 9 Typical Characteristics 1900 MHz Band T_A = 25 °C, V_{CC} = 2.8 V, R_{REF} = 27 kΩ

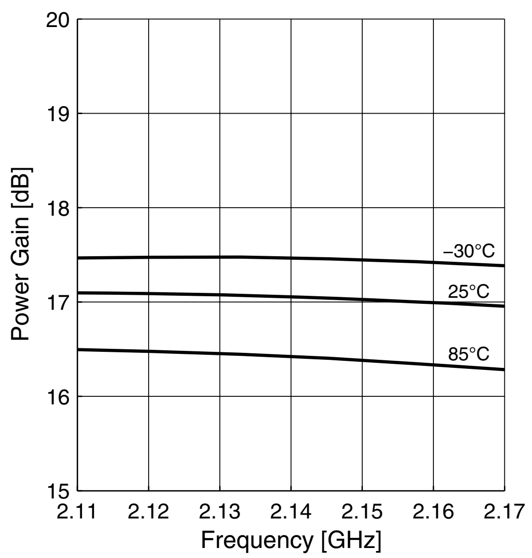
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Pass band range band II		1930		1990	MHz	
Current consumption	I_{CCHG}		3.6		mA	High gain mode
	I_{CCLG}		0.5		mA	Low gain mode
Gain	S_{21HG}		17.2		dB	High gain mode
	S_{21LG}		-9.2		dB	Low gain mode
Reverse Isolation[1)]	S_{12HG}		-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[2)]	k		>2.2			DC to 10 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 MHz $P_{f1} = P_{f2}$ = -37 dBm	$IIP3_{HG}$ $IIP3_{LG}$		-3 2		dBm	High gain mode Low gain mode

1) Verification based on AQL; not 100% tested in production
2) Guaranteed by device design; not tested in production

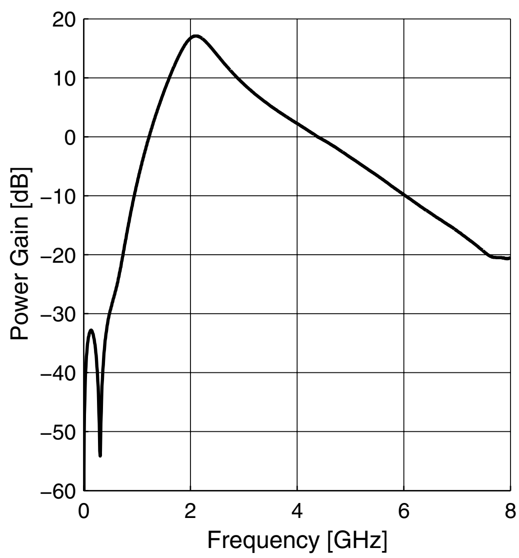
2.12 Measured Performance High Band (Band I) High Gain Mode vs. Frequency

T_A = 25 °C, V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN} = 2.8 V, R_{REF} = 27 kΩ

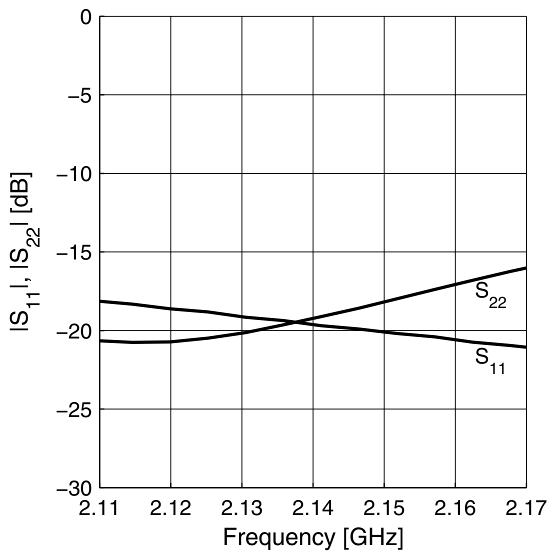
Power Gain $|S_{21}| = f(f)$



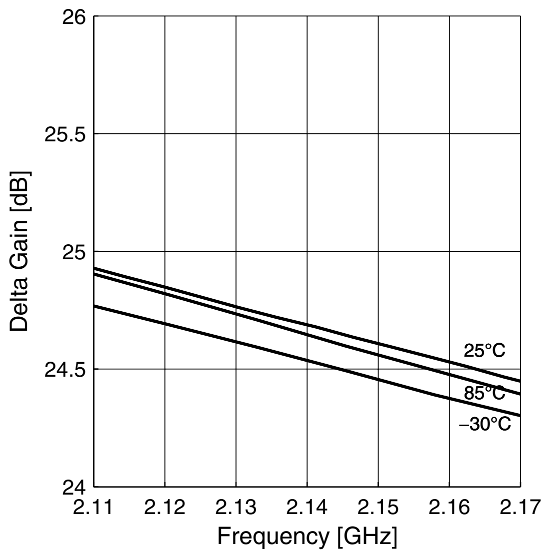
Power Gain wideband $|S_{21}| = f(f)$



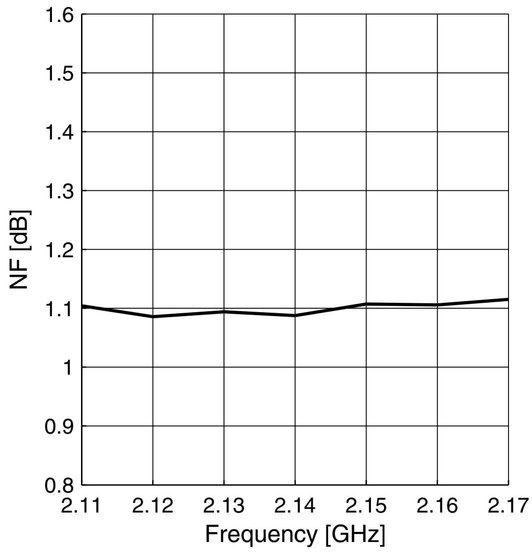
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



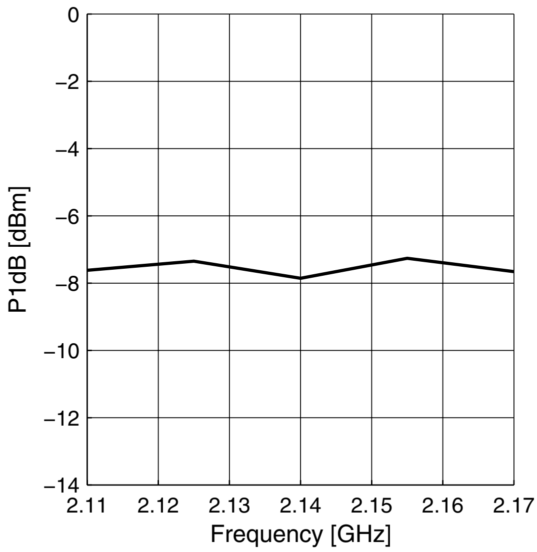
Gainstep HG-LG $|\Delta S_{21}| = f(f)$



Noise Figure NF = f (f)



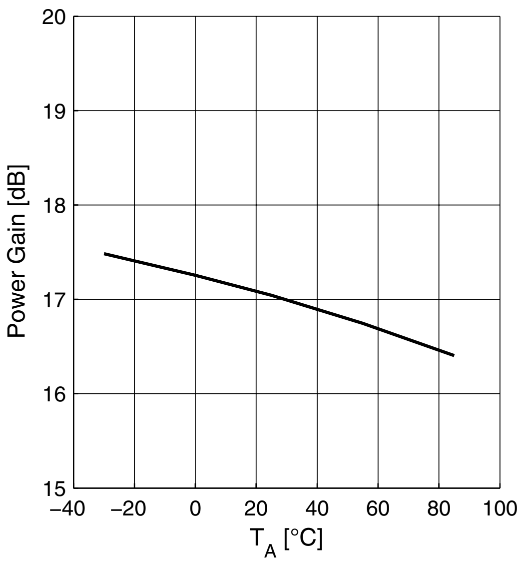
Input Compression $P1dB$ = f (f)



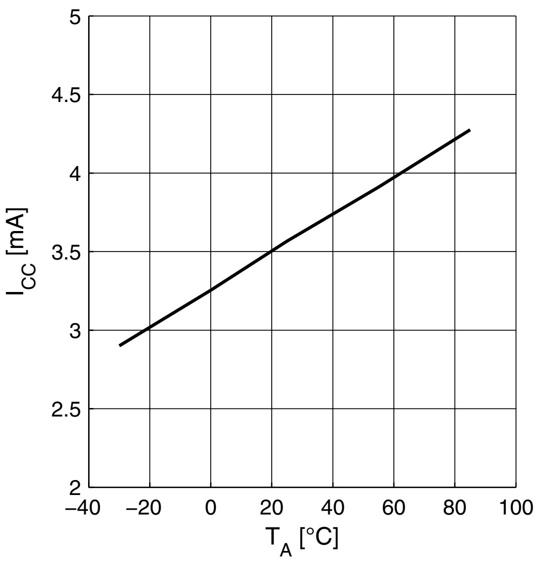
2.13 Measured Performance High Band (Band I) High Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 2.8 V, V_{EN} = 2.8 V, f = 2140 MHz, R_{REF} = 27 kΩ

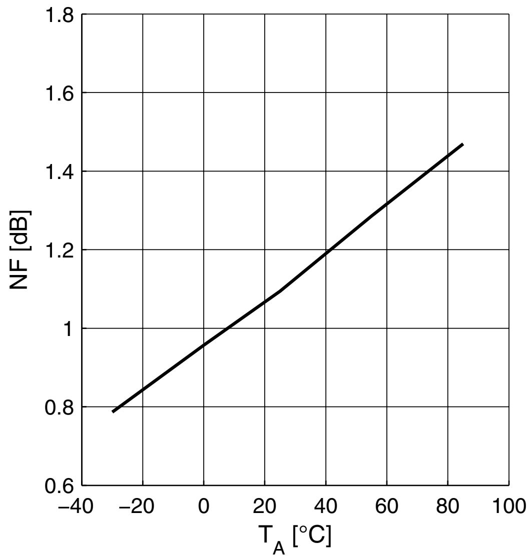
Power Gain $|S_{21}|$ = f (T_A)



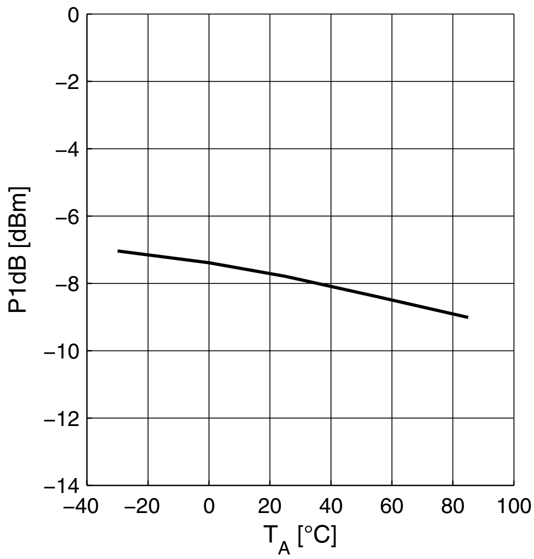
Supply Current I_{CC} = f (T_A)



Noise Figure NF = f (T_A)



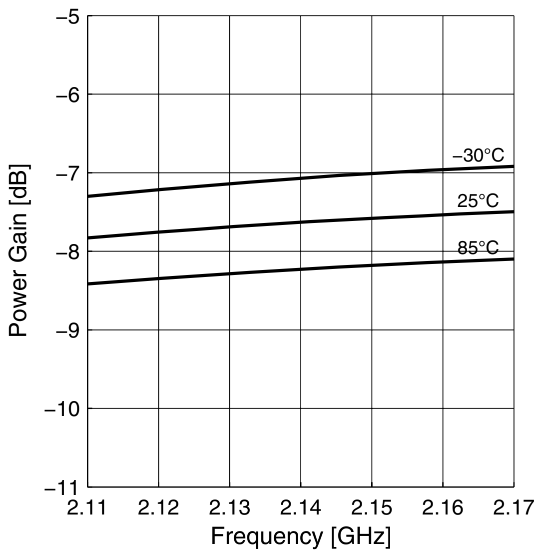
Input Compression $P1dB$ = f (T_A)



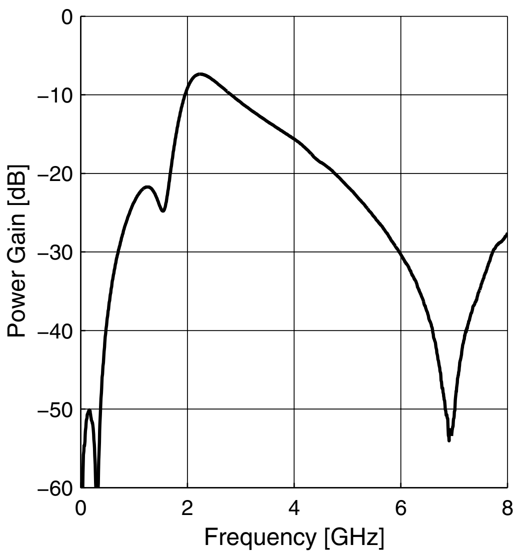
2.14 Measured Performance High Band (Band I) Low Gain Mode vs. Frequency

T_A = 25 °C, V_{CC} = 2.8 V, V_{GS} = 0 V, V_{EN} = 2.8 V, R_{REF} = 27 kΩ

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

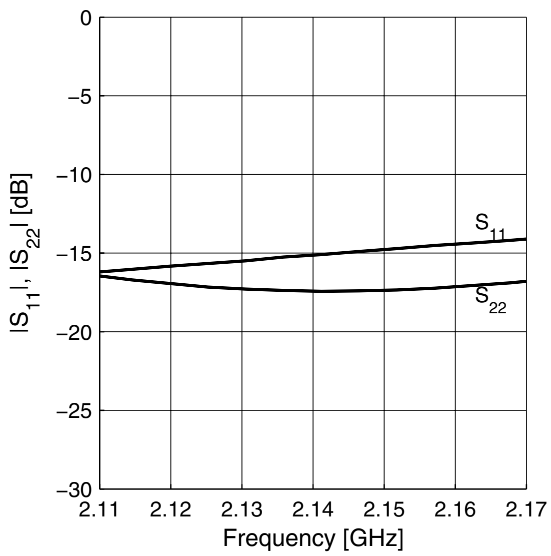


Power Gain wideband $|S_{21}|$ = f (f)

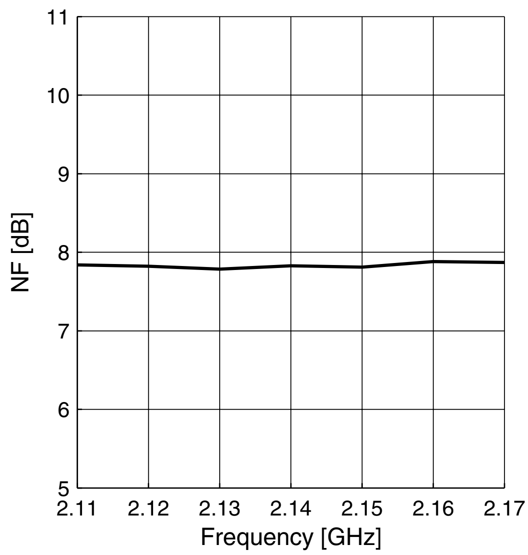


Measured Performance High Band (Band I) Low Gain Mode vs. Frequency

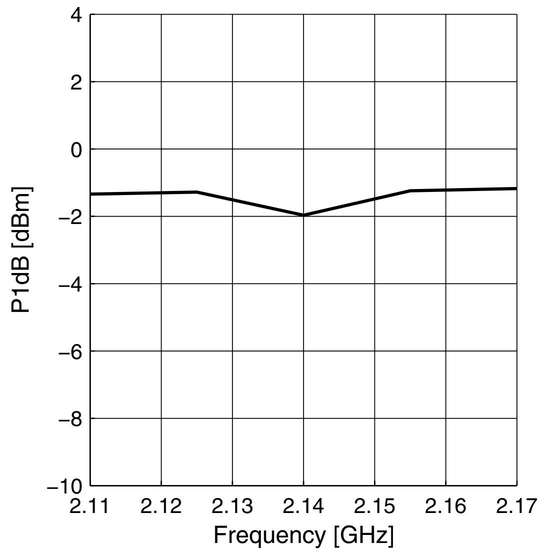
Matching $|S_{11}| = f(f)$, $|S_{22}| = f(f)$



Noise Figure $NF = f(f)$



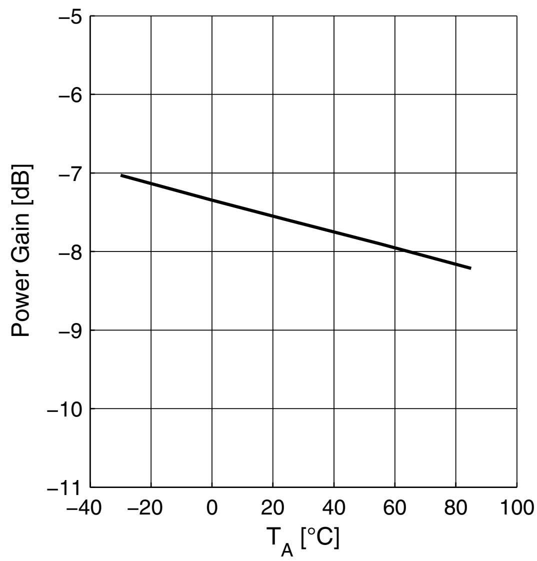
Input Compression $P1dB = f(f)$



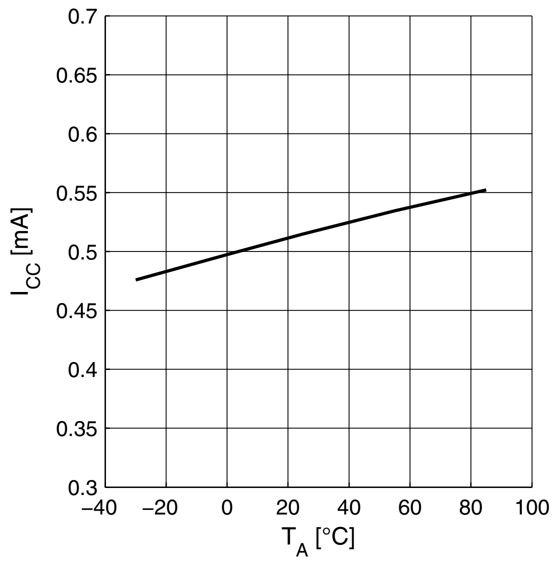
2.15 Measured Performance High Band (Band I) Low Gain Mode vs. Temperature

V_{CC} = 2.8 V, V_{GS} = 0 V, V_{EN} = 2.8 V, f = 2140 MHz, R_{REF} = 27 kΩ

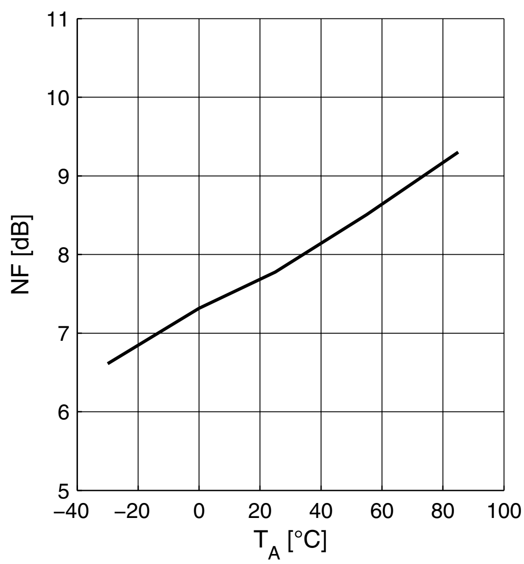
Power Gain $|S_{21}| = f(T_A)$



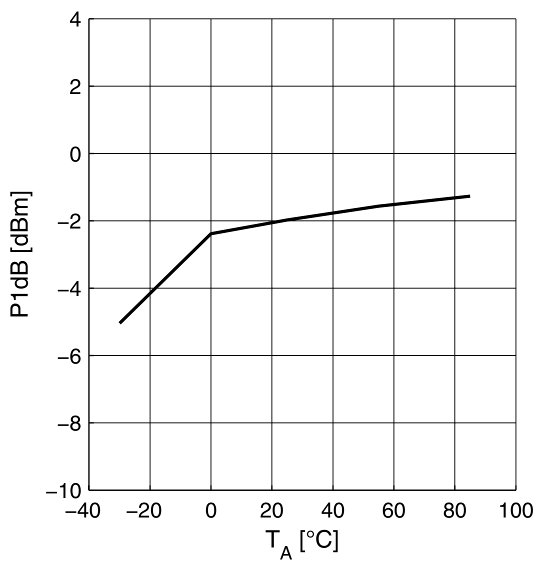
Supply Current $I_{CC} = f(T_A)$



Noise Figure $NF = f(T_A)$



Input Compression $P1dB = f(T_A)$



3 Application Circuit and Block Diagram

3.1 UMTS bands I, IV and X Application Circuit Schematic

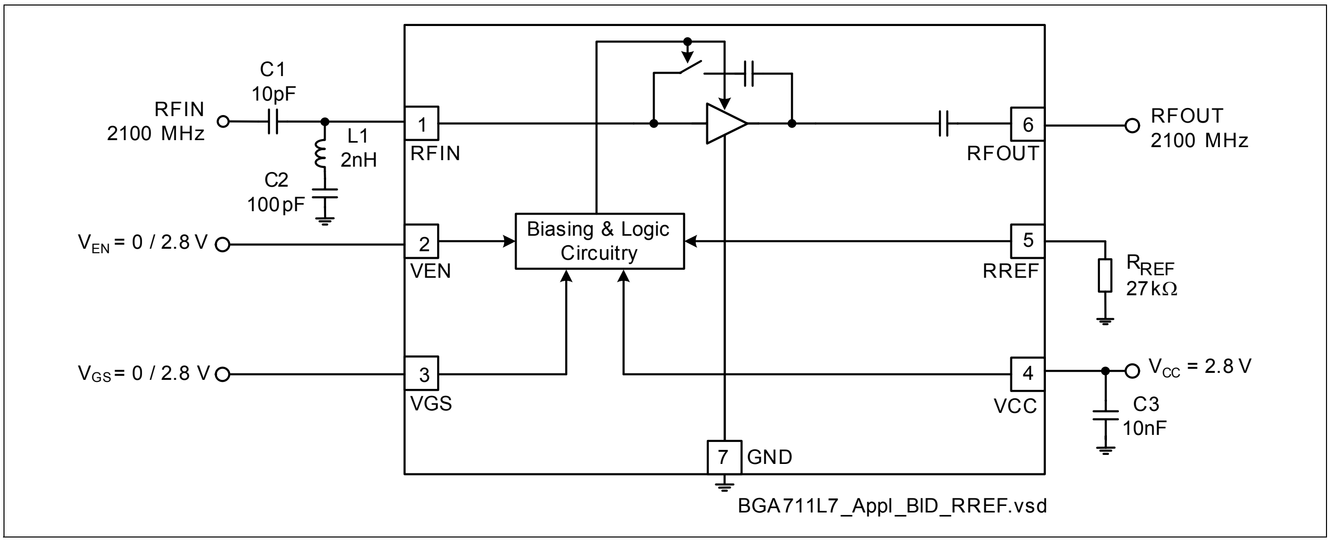


Figure 2 Application circuit with chip outline (top view)

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

Table 10 Parts List

Part Number	Part Type	Manufacturer	Size	Comment
L1	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C3	Chip capacitor	Various	0402	
R_{REF}	Chip resistor	Various	0402	

3.2 UMTS band II Application Circuit Schematic

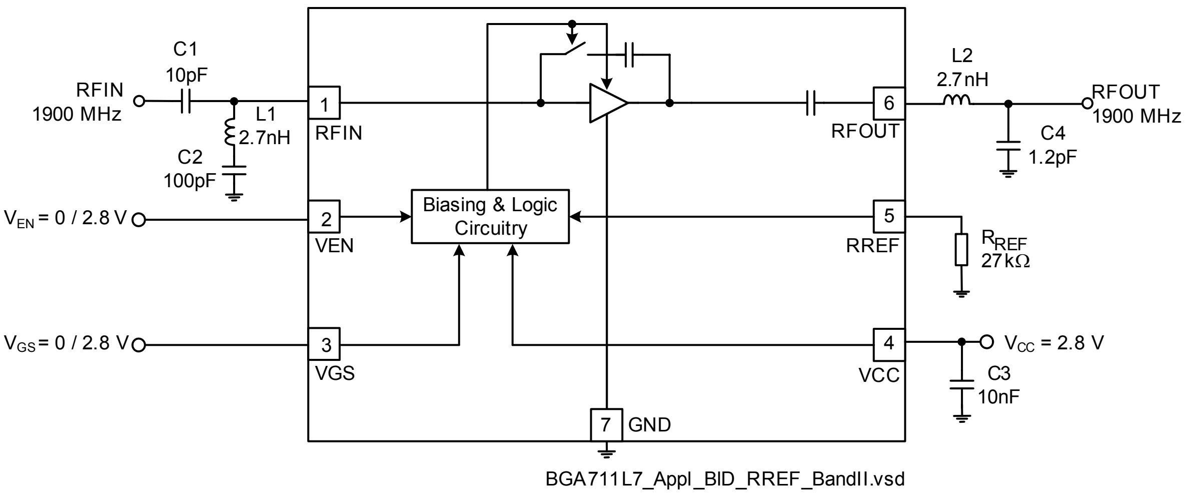


Figure 3 Application circuit with chip outline (top view)

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

Table 11 Parts List

Part Number	Part Type	Manufacturer	Size	Comment
L1, L2	Chip inductor	Various	0402	Wirewound, Q ≈ 50
C1 ... C4	Chip capacitor	Various	0402	
R_{REF}	Chip resistor	Various	0402	

3.3 Pin Definition

Table 12 Pin Definition and Function

Pin Number	Symbol	Function
1	RFIN	LNA input (2100/1900 MHz)
2	VEN	Band select control
3	VGS	Gain step control
4	VCC	Supply voltage
5	RREF	Bias current reference resistor (high gain mode)
6	RFOUT	LNA output (2100/1900 MHz)
7	GND	Package paddle; ground connection for LNA and control circuitry

3.4 Application Board

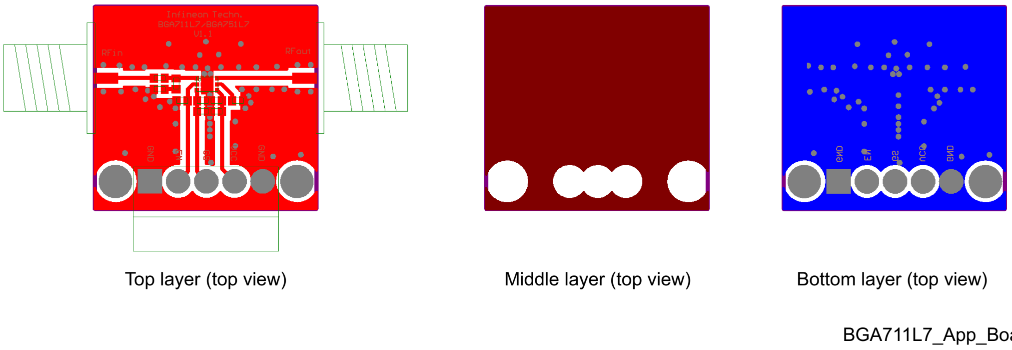


Figure 4 Application board layout on 3-layer FR4. Top layer thickness: 0.2 mm, bottom layer thickness: 0.8 mm, 17 µm Cu metallization, gold plated. Board size: 21 x 19 mm

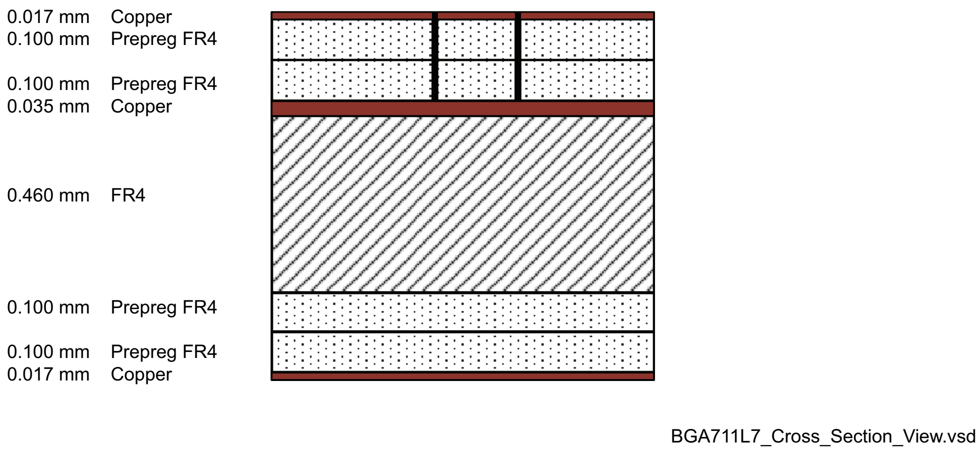


Figure 5 Cross-section view of application board

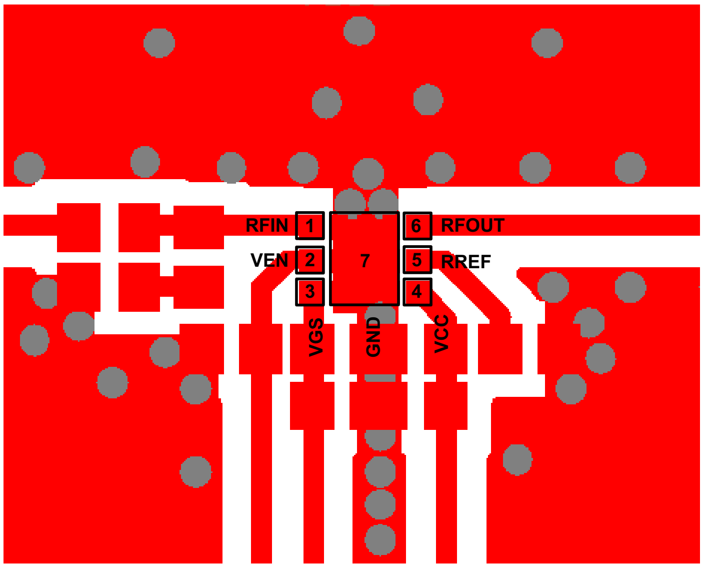


Figure 6 Detail of application board layout

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 Dimensions

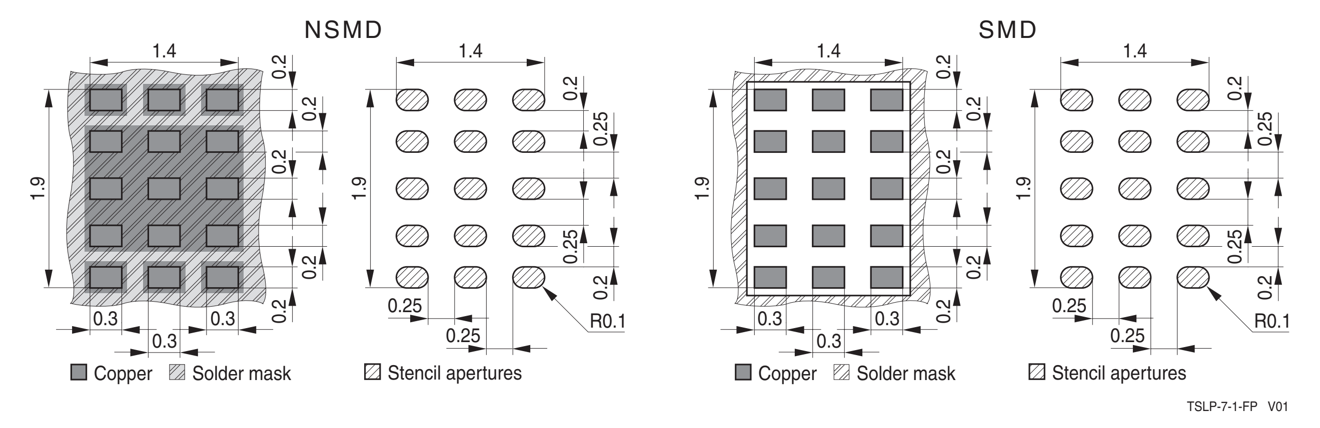


Figure 7 Recommended footprint and stencil layout for the TSLP-7-1 package

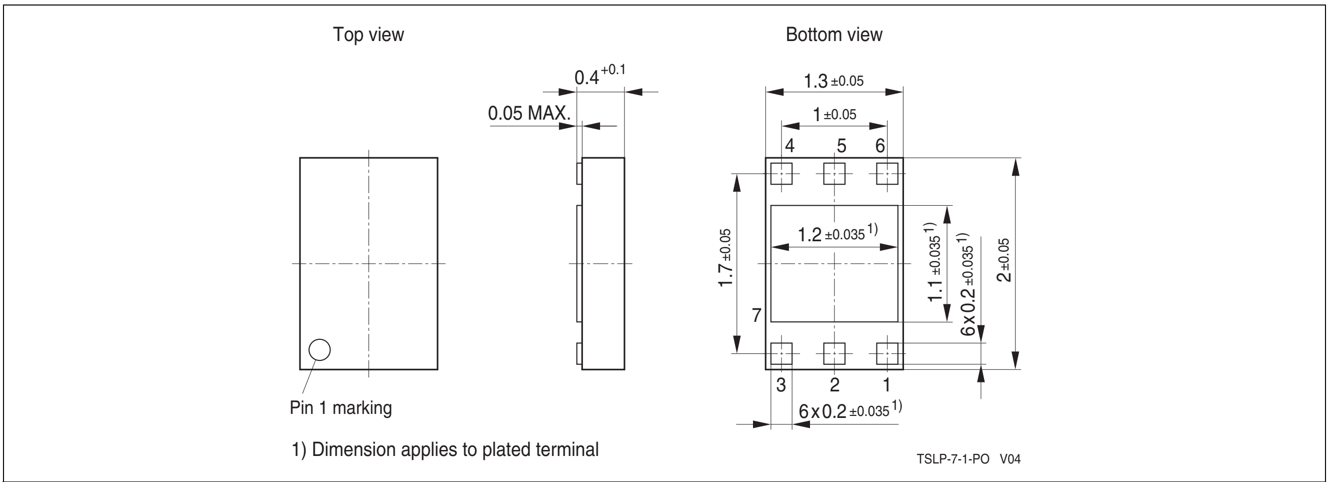


Figure 8 Package outline (top, side and bottom view)

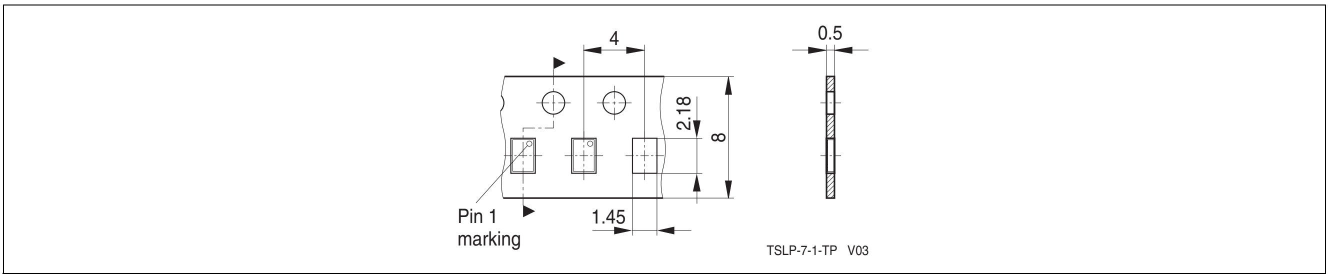


Figure 9 Tape & Reel Dimensions

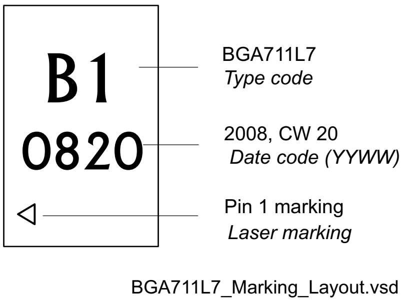


Figure 10 Marking Layout

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