

# BGA915N7

Silicon Germanium GPS Low Noise Amplifier

## Data Sheet

Revision 4.0, 2011-03-23

**Edition 2011-03-23**

**Published by  
Infineon Technologies AG  
81726 Munich, Germany**

**© 2011 Infineon Technologies AG  
All Rights Reserved.**

### **Legal Disclaimer**

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

### **Information**

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

### **Warnings**

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

**Revision History**

Page or Item	Subjects (major changes since previous revision)
<b>Revision 4.0, 2011-03-23</b>	
all	"Preliminary" status removed
10, 11	Min/max limits specified for parameters $I_{CC}$ , $ S_{21} ^2$ and $NF$
12, 13	Application Board: Board inductance specified, Cross-section drawing updated
<b>Revision 3.0, 2010-12-07</b>	
all	Preliminary data sheet
7	New marking code defined
10, 11	Electrical Characteristics specified for frequency range $f = 1550 - 1615$ MHz

**Trademarks of Infineon Technologies AG**

AURIX™, C166™, CanPAK™, CIPOS™, CIPURSE™, EconoPACK™, CoolMOS™, CoolSET™, CORECONTROL™, CROSSAVE™, DAVE™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPIM™, EiceDRIVER™, eupec™, FCOS™, HITFET™, HybridPACK™, I<sup>2</sup>RF™, ISOFACE™, IsoPACK™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OptiMOS™, ORIGA™, PRIMARION™, PrimePACK™, PrimeSTACK™, PRO-SIL™, PROFET™, RASIC™, ReverSave™, SatRIC™, SIEGET™, SINDRION™, SIPMOS™, SmartLEWIS™, SOLID FLASH™, TEMPFET™, thinQ!™, TRENCHSTOP™, TriCore™.

**Other Trademarks**

Advance Design System™ (ADS) of Agilent Technologies, AMBA™, ARM™, MULTI-ICE™, KEIL™, PRIMECELL™, REALVIEW™, THUMB™,  $\mu$ Vision™ of ARM Limited, UK. AUTOSAR™ is licensed by AUTOSAR development partnership. Bluetooth™ of Bluetooth SIG Inc. CAT-iq™ of DECT Forum. COLOSSUS™, FirstGPS™ of Trimble Navigation Ltd. EMV™ of EMVCo, LLC (Visa Holdings Inc.). EPCOS™ of Epcos AG. FLEXGO™ of Microsoft Corporation. FlexRay™ is licensed by FlexRay Consortium. HYPERTERMINAL™ of Hilgraeve Incorporated. IEC™ of Commission Electrotechnique Internationale. IrDA™ of Infrared Data Association Corporation. ISO™ of INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. MATLAB™ of MathWorks, Inc. MAXIM™ of Maxim Integrated Products, Inc. MICROTEC™, NUCLEUS™ of Mentor Graphics Corporation. Mifare™ of NXP. MIPI™ of MIPI Alliance, Inc. MIPS™ of MIPS Technologies, Inc., USA. muRata™ of MURATA MANUFACTURING CO., MICROWAVE OFFICE™ (MWO) of Applied Wave Research Inc., OmniVision™ of OmniVision Technologies, Inc. Openwave™ Openwave Systems Inc. RED HAT™ Red Hat, Inc. RFMD™ RF Micro Devices, Inc. SIRIUS™ of Sirius Satellite Radio Inc. SOLARIS™ of Sun Microsystems, Inc. SPANSION™ of Spansion LLC Ltd. Symbian™ of Symbian Software Limited. TAIYO YUDEN™ of Taiyo Yuden Co. TEAKLITE™ of CEVA, Inc. TEKTRONIX™ of Tektronix Inc. TOKO™ of TOKO KABUSHIKI KAISHA TA. UNIX™ of X/Open Company Limited. VERILOG™, PALLADIUM™ of Cadence Design Systems, Inc. VLYNQ™ of Texas Instruments Incorporated. VXWORKS™, WIND RIVER™ of WIND RIVER SYSTEMS, INC. ZETEX™ of Diodes Zetex Limited.

Last Trademarks Update 2011-02-24

## Table of Contents

	<b>Table of Contents</b> .....	4
	<b>List of Figures</b> .....	5
	<b>List of Tables</b> .....	6
	<b>Features</b> .....	7
<b>1</b>	<b>Maximum Ratings</b> .....	9
<b>2</b>	<b>Electrical Characteristics</b> .....	10
<b>3</b>	<b>Application Information</b> .....	12
<b>4</b>	<b>Package Information</b> .....	14

## List of Figures

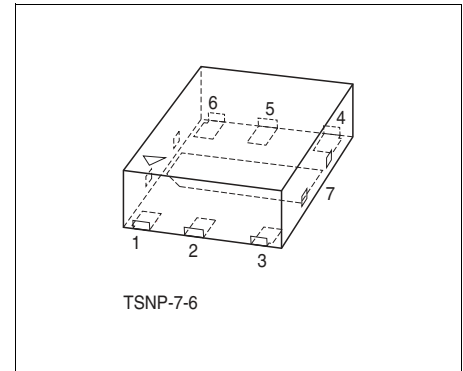
Figure 1	Block Diagram .....	7
Figure 2	Application Schematic BGA915N7 .....	12
Figure 3	Drawing of Application Board .....	13
Figure 4	Cross-section of Application Board .....	13
Figure 5	Package Outline TSNP-7-6 .....	14
Figure 6	Marking Layout (top view) .....	14
Figure 7	Tape & Reel Dimensions (Ø reel 180 mm, pieces/reel 7500) .....	14
Figure 8	Footprint TSNP-7-6 .....	15

## List of Tables

Table 1	Pin Definition and Function .....	8
Table 2	Maximum Ratings .....	9
Table 3	Thermal Resistance .....	9
Table 4	Electrical Characteristics: $T_A = 25\text{ °C}$ , $V_{CC} = 2.8\text{ V}$ , $V_{PON,ON} = 2.8\text{ V}$ , $V_{PON,OFF} = 0\text{ V}$ , $f = 1550 - 1615\text{ MHz}$ .....	10
Table 5	Electrical Characteristics: $T_A = 25\text{ °C}$ , $V_{CC} = 1.8\text{ V}$ , $V_{PON,ON} = 1.8\text{ V}$ , $V_{PON,OFF} = 0\text{ V}$ , $f = 1550 - 1615\text{ MHz}$ .....	11
Table 6	Bill of Materials .....	12

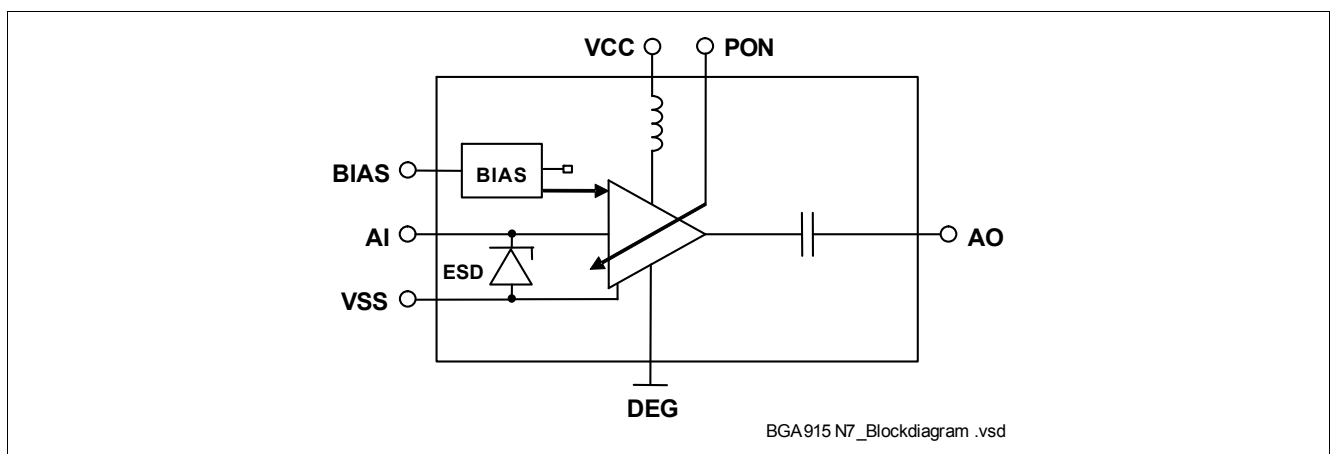
**Features**

- Insertion power gain: 15.5 dB
- High out of band input 3rd order intercept point: +10dBm
- High input 1 dB compression point: -5 dBm
- Low Noise Figure: 0.7 dB
- Low current consumption: 4.4 mA
- Operating frequencies: 1550 - 1615 MHz
- Supply voltage: 1.5 V to 3.6 V
- Digital on/off switch (1V logic high level)
- Very small TSNP-7-6 leadless package
- B7HF Silicon Germanium technology
- RF output internally matched to 50 Ω
- Only 3 external SMD components necessary
- 2 kV HBM ESD protection (including AI-pin)
- Pb-free (RoHS compliant) package



**Application**

- Suitable for all Global Navigation Satellite Systems (GNSS) like GPS, Galileo, GLONASS, COMPASS



**Figure 1 Block Diagram**

Product Name	Marking	Package
BGA915N7	BC	TSNP-7-6

**Description**

The BGA915N7 is a front-end low noise amplifier for Global Navigation Satellite Systems (GNSS) from 1550 MHz to 1615 MHz like GPS, Galileo, GLONASS and COMPASS. The LNA provides 15.5 dB gain and 0.7 dB noise figure at a current consumption of 4.4 mA in the application configuration described in [Chapter 3](#). The BGA915N7 is based upon Infineon Technologies' B7HF Silicon Germanium technology. It operates from 1.5 V to 3.6 V supply voltage.

**Pin Definition and Function****Table 1 Pin Definition and Function**

Pin No.	Name	Function
1	DEG	LNA emitter degeneration ground
2	AI	LNA input
3	BIAS	DC bias
4	AO	LNA output
5	VCC	DC Supply
6	PON	Power on control
7	VSS	Common on chip RF and DC ground



## 1 Maximum Ratings

**Table 2 Maximum Ratings**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Voltage at pin VCC	$V_{CC}$	-0.3	–	3.6	V	1)
Voltage at pin AI	$V_{AI}$	-0.3	–	0.9	V	–
Voltage at pin BIAS	$V_{BIAS}$	-0.3	–	0.9	V	–
Voltage at pin AO	$V_{AO}$	-0.3	–	$V_{CC} + 0.3$	V	–
Voltage at pin PON	$V_{PON}$	-0.3	–	$V_{CC} + 0.3$	V	–
Voltage at pin VSS	$V_{SS}$	-0.3	–	0.3	V	–
Current into pin VCC	$I_{CC}$	–	–	20	mA	–
RF input power	$P_{IN}$	–	–	0	dBm	–
Total power dissipation, $T_S < 129\text{ °C}^2)$	$T_J$	–	–	72	mW	–
Junction temperature	$P_{tot}$	–	–	150	°C	–
Ambient temperature range	$T_A$	-40	–	85	°C	–
Storage temperature range	$T_{STG}$	-65	–	150	°C	–
ESD capability all pins	$V_{ESD\_HBM}$	–	–	2000	V	according to JESD22A-114
ESD capability all pins	$V_{ESD\_MM}$	–	–	100	V	according to JESD22A-115

1) All voltages refer to VSS-Node unless otherwise noted

2)  $T_S$  is measured on the ground lead at the soldering point

**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.**

### Thermal Resistance

**Table 3 Thermal Resistance**

Parameter	Symbol	Value	Unit
Junction - soldering point <sup>1)</sup>	$R_{thJS}$	291	K/W

1) For calculation of  $R_{thJA}$  please refer to Application Note Thermal Resistance

## 2 Electrical Characteristics

**Table 4** Electrical Characteristics:<sup>1)</sup>  $T_A = 25\text{ °C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $V_{PON,ON} = 2.8\text{ V}$ ,  $V_{PON,OFF} = 0\text{ V}$ ,  
 $f = 1550 - 1615\text{ MHz}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	1.5	–	3.6	V	–
Supply current	$I_{CC}$	3.3	4.4	5.7	mA	ON-mode
		–	0.2	3	$\mu\text{A}$	OFF-mode
Power On voltage	$V_{pon}$	1.0	–	$V_{CC}$	V	ON-mode
		0	–	0.4	V	OFF-mode
Power On current	$I_{pon}$	–	5	12	$\mu\text{A}$	ON-mode
		–	–	1	$\mu\text{A}$	OFF-mode
Insertion power gain	$ S_{21} ^2$	14.3	15.5	17.2	dB	
Noise figure <sup>2)</sup>	$NF$	–	0.7	1.2	dB	$Z_S = 50\ \Omega$
Input return loss	$RL_{in}$	–	11	–	dB	
Output return loss	$RL_{out}$	–	16	–	dB	
Reverse isolation	$1/ S_{12} ^2$	–	20	–	dB	
Power gain settling time <sup>3)</sup>	$t_S$	–	5	–	$\mu\text{s}$	OFF- to ON-mode
		–	5	–	$\mu\text{s}$	ON- to OFF-mode
Inband input 1 dB compression point	$IP_{1dB}$	–	-5	–	dBm	
Inband input 3rd order intercept point <sup>4)</sup>	$IIP_3$	–	+2	–	dBm	$f_1 = 1575\text{ MHz}$ $f_2 = f_1 \pm 1\text{ MHz}$
Out of band input 3rd order intercept point <sup>5)</sup>	$IIP_{3oob}$	–	+10	–	dBm	$f_1 = 1712.7\text{ MHz}$ $f_2 = 1850\text{ MHz}$
Stability	$k$	–	> 1	–		$f = 20\text{ MHz} \dots 10\text{ GHz}$

1) Based on the application described in chapter 3

2) PCB losses are subtracted

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

4) Input Power = -30 dBm for each tone

5) Input Power = -20 dBm for each tone

**Table 5 Electrical Characteristics:**<sup>1)</sup>  $T_A = 25\text{ °C}$ ,  $V_{CC} = 1.8\text{ V}$ ,  $V_{PON,ON} = 1.8\text{ V}$ ,  $V_{PON,OFF} = 0\text{ V}$ ,  
 $f = 1550 - 1615\text{ MHz}$ 

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{CC}$	1.5	–	3.6	V	–
Supply current	$I_{CC}$	3.3	4.4	5.7	mA	ON-mode
		–	0.2	3	μA	OFF-mode
Gain switch control voltage	$V_{pon}$	1.0	–	V <sub>cc</sub>	V	ON-mode
		0	–	0.4	V	OFF-mode
Gain switch control current	$I_{pon}$	–	5	12	μA	ON-mode
		–	–	1	μA	OFF-mode
Insertion power gain	$ S_{21} ^2$	14.3	15.5	17.2	dB	
Noise figure <sup>2)</sup>	$NF$	–	0.7	1.2	dB	$Z_S = 50\ \Omega$
Input return loss	$RL_{in}$	–	11	–	dB	
Output return loss	$RL_{out}$	–	16	–	dB	
Reverse isolation	$1/ S_{12} ^2$	–	20	–	dB	
Power gain settling time <sup>3)</sup>	$t_S$	–	5	–	μs	OFF- to ON-mode
		–	5	–	μs	ON- to OFF-mode
Inband input 1 dB compression point	$IP_{1dB}$	–	-8	–	dBm	
Inband input 3rd order intercept point <sup>4)</sup>	$IIP_3$	–	+1	–	dBm	$f_1 = 1575\text{ MHz}$ $f_2 = f_1 \pm 1\text{ MHz}$
Out of band input 3rd order intercept point <sup>5)</sup>	$IIP_{3oob}$	–	+10	–	dBm	$f_1 = 1712.7\text{ MHz}$ $f_2 = 1850\text{ MHz}$
Stability	$k$	–	> 1	–		$f = 20\text{ MHz} \dots 10\text{ GHz}$

1) Based on the application described in chapter 3

2) PCB losses are subtracted

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

4) Input Power = -30 dBm for each tone

5) Input Power = -20 dBm for each tone

### 3 Application Information

#### Application Board Configuration

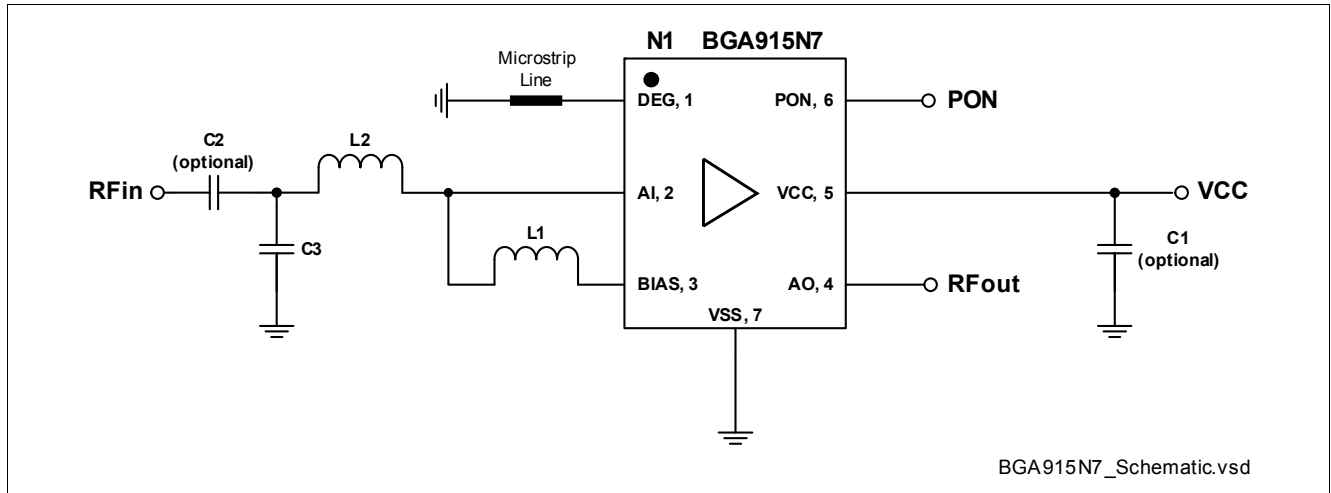


Figure 2 Application Schematic BGA915N7

Table 6 Bill of Materials

Name	Value	Package	Manufacturer	Function
C1 (optional)	1 uF	0402	Various	RF block
C2 (optional)	33 pF	0402	Various	DC block
C3	1 pF	0402	Various	Input matching
L1	82 nH	0402	Murata LQW type	Bias feed and RF choke
L2	7.3 nH	0402	Murata LQW type	Input matching
Microstrip Line	550pH <sup>1)</sup>	-	-	Board inductance from pin DEG to common GND
N1	BGA915N7	TSNP-7-6	Infineon	SiGe LNA

1) Total board inductance = inductance of the microstrip line (~500pH) + inductance of via (~50pH)  
Please refer to application note AN258 for more details on “realization of small inductor values on a PCB by using microstriplines”.

A list of all application notes is available at <http://www.infineon.com/gpslna.appnotes>.

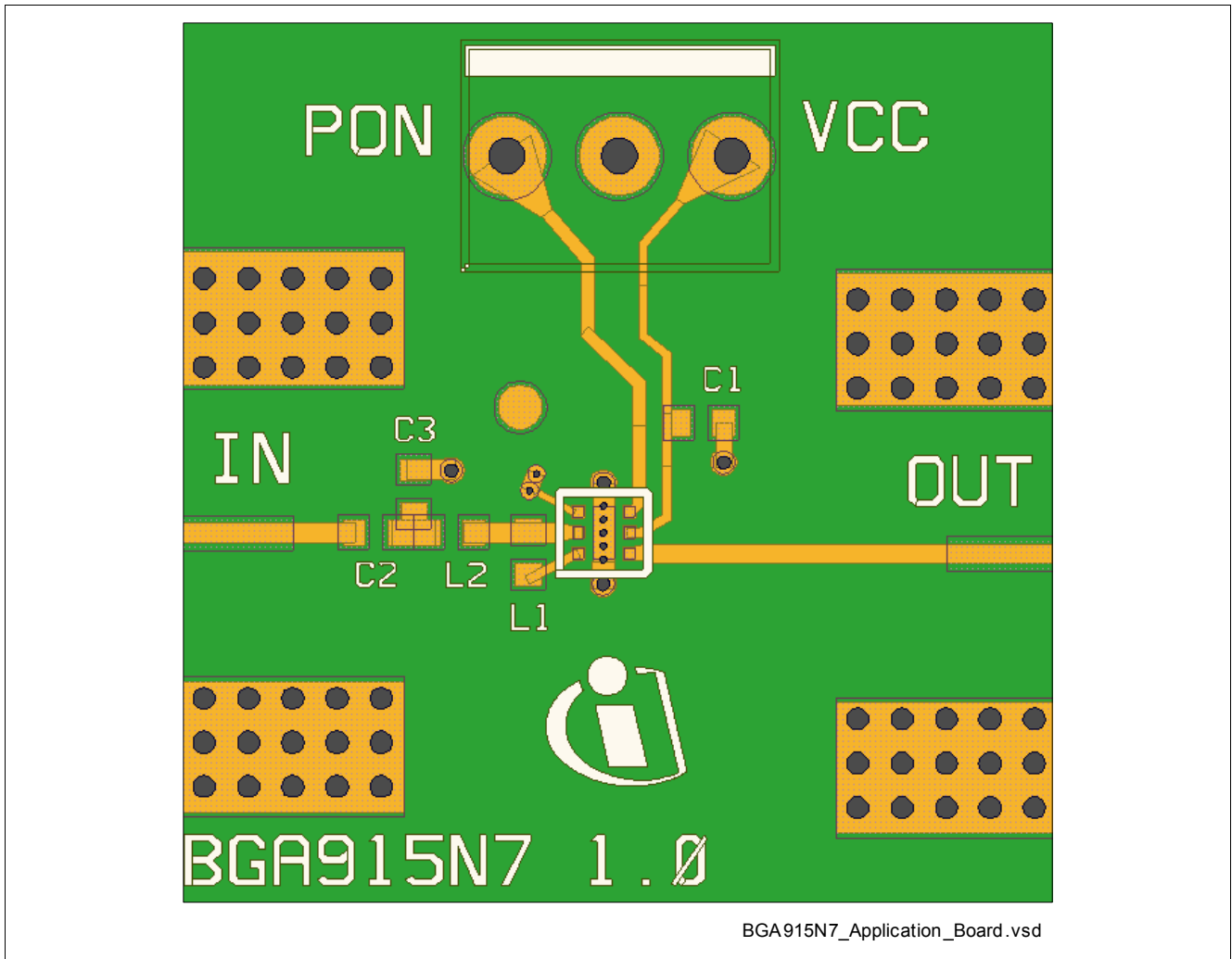


Figure 3 Drawing of Application Board

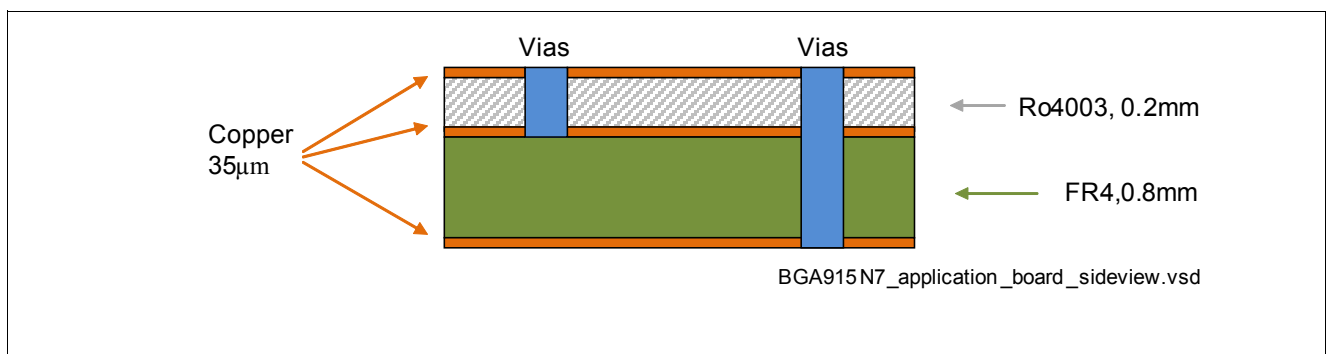


Figure 4 Cross-section of Application Board

## 4 Package Information

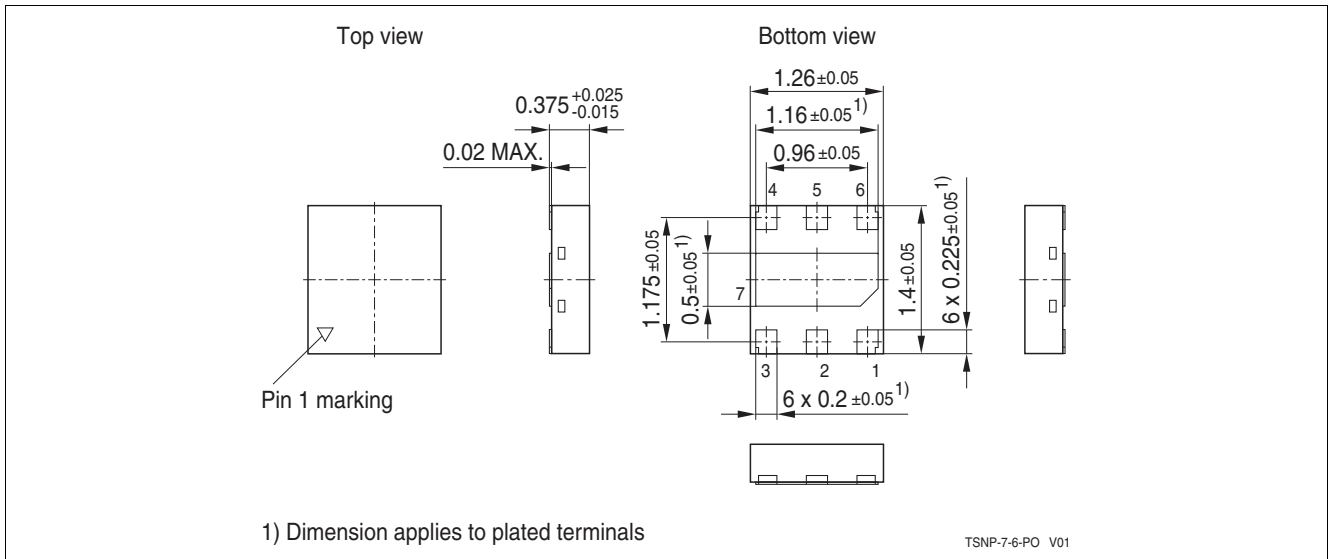


Figure 5 Package Outline TSNP-7-6

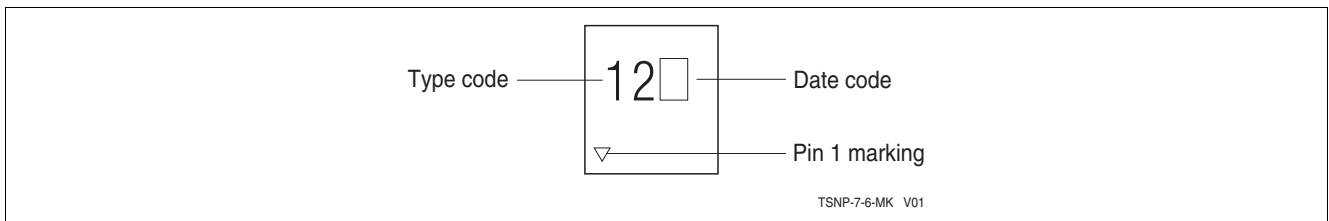


Figure 6 Marking Layout (top view)

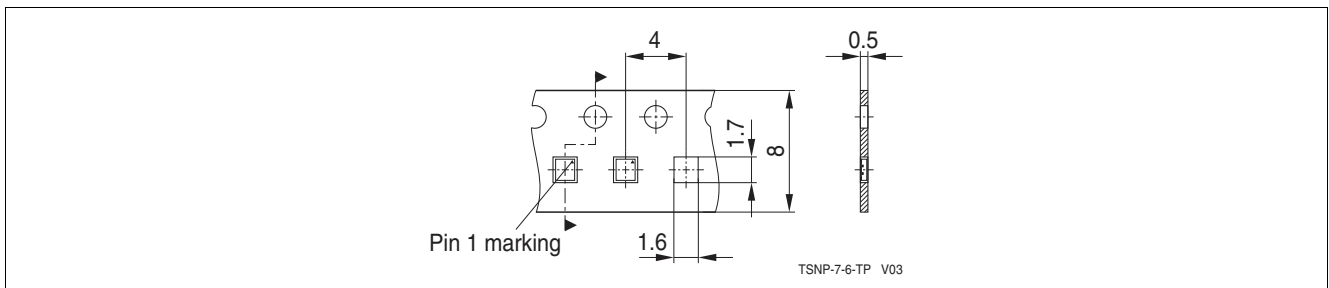


Figure 7 Tape & Reel Dimensions (Ø reel 180 mm, pieces/reel 7500)

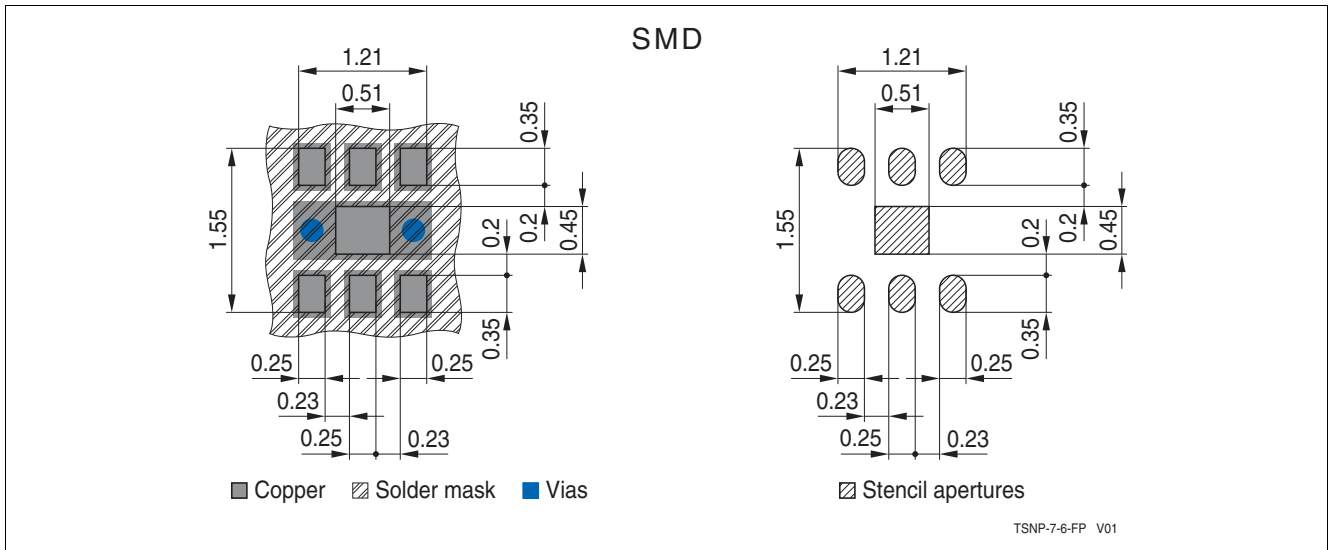


Figure 8 Footprint TSNP-7-6

[www.infineon.com](http://www.infineon.com)

Published by Infineon Technologies AG