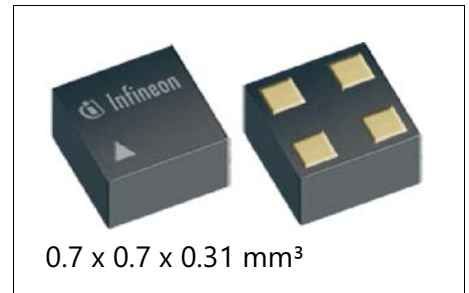


BGA123L4

Small Footprint Ultra Low Current Low Noise Amplifier for Global Navigation Satellite Systems (GNSS)

Features

- Operating frequencies: 1550 - 1615 MHz
- Ultra low current consumption: 1.1 mA
- Wide supply voltage range: 1.1 V to 3.6 V
- High insertion power gain: 18.2 dB
- Low noise figure: 0.75 dB
- 2 kV HBM ESD protection (including AI pin)
- Ultra small TSLP-4-11 leadless package (footprint: 0.7 x 0.7 x 0.31 mm³)
- RF output internally matched to 50 Ohm
- Only one external SMD component necessary
- Pb-free (RoHS complaint) package



Application

BGA123L4 is designed to enhance GNSS signal sensitivity especially in wearables and mobile cellular IoT devices. With 18.2 dB gain and only 0.75 dB noise figure it ensures high system sensitivity. The current needed is only 1.1 mA which means just 1.3 mW power consumption, which is critical to help to conserve batteries. The wide supply voltage range of 1.1 V to 3.6 V ensures flexible design and high compatibility. It supports all GNSS systems including GPS, GLONASS, Beidou and Galileo.

Product Validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22.

Block diagram

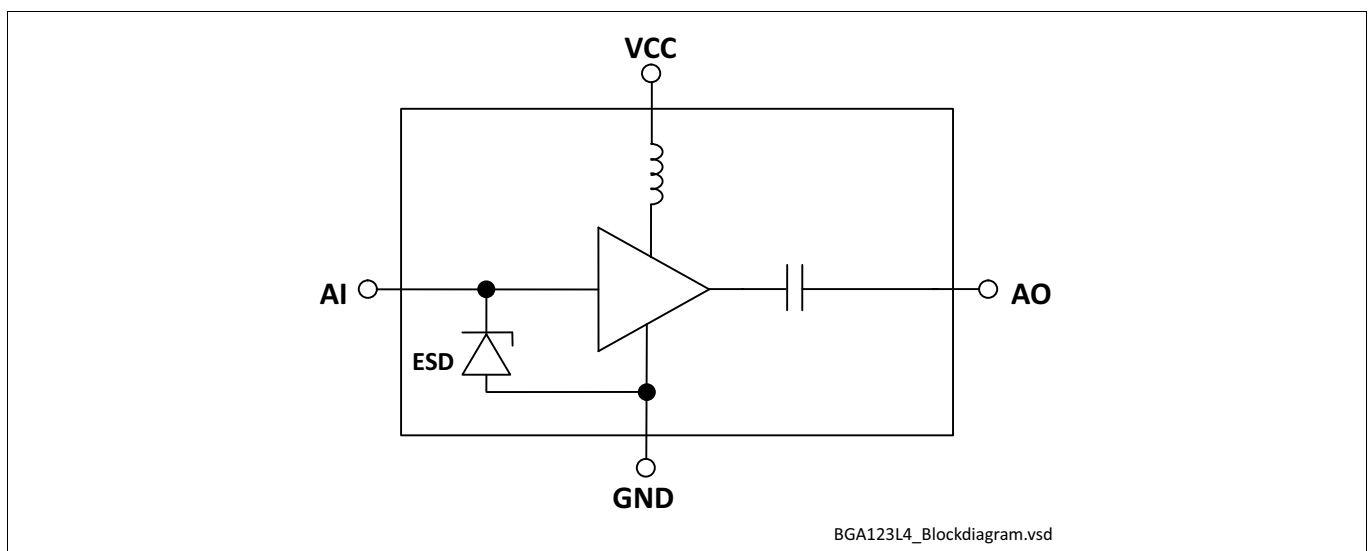




Table of Contents

Table of Contents

	Table of Contents	2
1	Features	3
2	Maximum Ratings	5
3	Electrical Characteristics	6
4	Application Information	9
5	Package Information	10

Features

1 Features

- Operating frequencies: 1550 - 1615 MHz
- Ultra low current consumption: 1.1 mA
- Wide supply voltage range: 1.1 V to 3.6 V
- High insertion power gain: 18.2 dB
- Low noise figure: 0.75 dB
- 2 kV HBM ESD protection (including AI pin)
- Ultra small TSLP-4-11 leadless package (footprint: 0.7 x 0.7 x 0.31 mm³)
- RF output internally matched to 50 Ohm
- Only one external SMD component necessary
- Pb-free (RoHS complaint) package
- B7HF Silicon Germanium technology

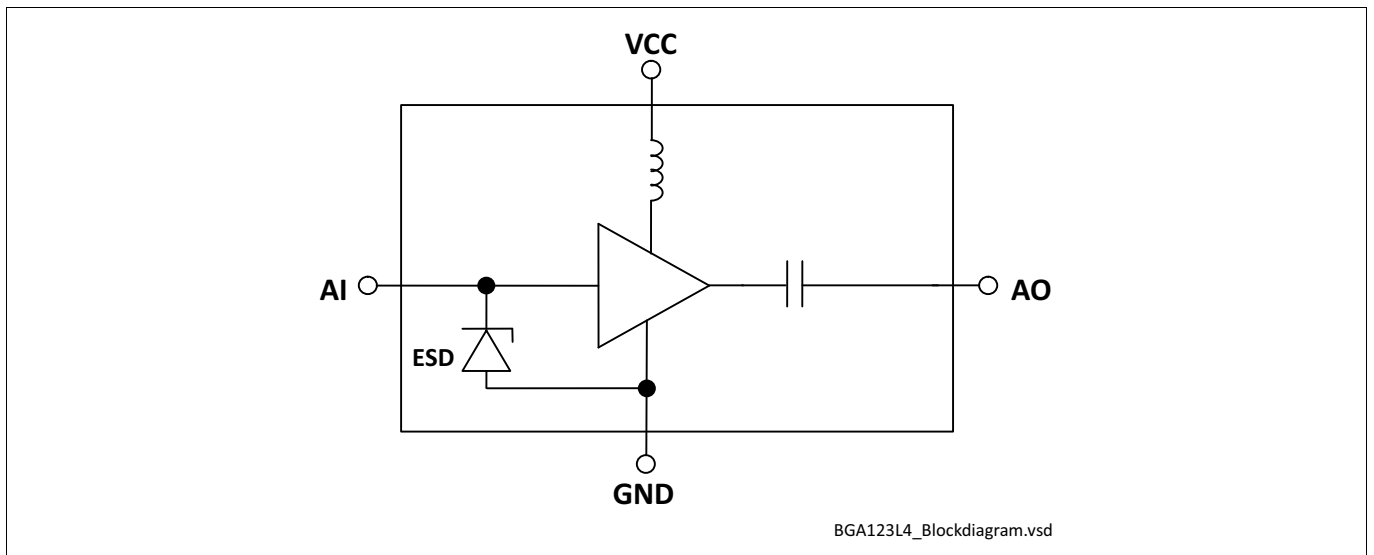


Figure 1 Block Diagram

Product Name	Marking	Package
BGA123L4	B	TSLP-4-11

Features**Description**

The BGA123L4 is a ultra low current low noise amplifier for Global Navigation Satellite Systems (GNSS) which covers all GNSS frequency bands from 1550 MHz to 1615 MHz like GPS, GLONASS, Beidou, Galileo and others. The LNA provides 18.2 dB gain and 0.75 dB noise figure at a current consumption of only 1.1 mA in the application configuration described in [Chapter 4](#). The BGA123L4 is based upon Infineon Technologies' B7HF Silicon Germanium technology. It operates from 1.1 V to 3.6 V supply voltage.

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

Pin No.	Name	Function
1	VCC	DC supply
2	AO	LNA output
3	GND	Ground
4	AI	LNA input

Maximum Ratings

2 Maximum Ratings

Table 2 Maximum Ratings

Parameter	Symbol	Values			Unit	Note or 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 AO	V_{AO}	-0.3	–	$V_{CC} + 0.3$	V	–
Voltage at pin GND	V_{GND}	-0.3	–	0.3	V	–
Current into pin VCC	I_{CC}	–	–	10	mA	–
RF input power	P_{IN}	–	–	0	dBm	–
Total power dissipation, $T_S < 148\text{ °C}^2)$	P_{tot}	–	–	40	mW	–
Junction temperature	T_J	–	–	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	–	2000	V	according to JS-001

1) All voltages refer to GND-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. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit. Exposure to conditions at or below absolute maximum rating but above the specified maximum operation conditions may affect device reliability and life time. Functionality of the device might not be given under these conditions.*

Electrical Characteristics

3 Electrical Characteristics

Table 3 Electrical Characteristics¹⁾ $T_A = 25\text{ °C}$, $V_{CC} = 1.2\text{ V}$, $f = 1550 - 1615\text{ MHz}$

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.1	1.8	3.6	V	ON-Mode
		0.0	–	0.4	V	OFF-Mode
Supply current	I_{CC}	–	1.05	1.55	mA	ON-Mode, $V_{CC}=1.2\text{V}$
		–	0.1	2	μA	OFF-Mode
Insertion power gain $f = 1575\text{ MHz}$	$ S_{21} ^2$	16.4	17.9	19.4	dB	ON-Mode
Noise figure ²⁾ $f = 1575\text{ MHz}$, $Z_S = 50\ \Omega$	NF	–	0.75	1.25	dB	ON-Mode, $Z_S = 50\ \Omega$
Input return loss ³⁾ $f = 1575\text{ MHz}$	RL_{IN}	7	9	–	dB	ON-Mode
Output return loss ³⁾ $f = 1575\text{ MHz}$	RL_{OUT}	10	16	–	dB	ON-Mode
Reverse isolation ³⁾ $f = 1575\text{ MHz}$	$1/ S_{12} ^2$	25	36	–	dB	ON-Mode
Transient time ⁴⁾⁷⁾	t_S	–	0.5	2	μs	ON- to OFF-Mode
		–	9	12	μs	OFF- to ON-Mode
Inband input 1dB-compression point, $f = 1575\text{ MHz}$ ³⁾	IP_{1dB}	-21	-17	–	dBm	ON-Mode
Inband input 3 rd -order intercept point ³⁾⁵⁾ $f_1 = 1575\text{ MHz}$, $f_2 = f_1 \pm 1\text{ MHz}$	IIP_3	-19	-14	–	dBm	ON-Mode
Out of band input 3 rd -order intercept point ³⁾⁶⁾ $f_1 = 1713\text{ MHz}$, $f_2 = 1851\text{ MHz}$	$OOB-IIP_3$	-14	-9	–	dBm	ON-Mode
Stability ⁷⁾	k	> 1	–	–		$f = 20\text{ MHz} \dots 10\text{ GHz}$

1) Based on the application described in chapter 4

2) PCB losses are subtracted

3) Verification based on AQL; not 100% tested in production

4) To be within 1 dB of the final gain

5) Input power = -30 dBm for each tone

6) Input power = -20 dBm at f_1 and -65 dBm at f_2

7) Guaranteed by device design; not tested in production

Electrical Characteristics

Table 4 Electrical Characteristics¹⁾ $T_A = 25\text{ }^\circ\text{C}$, $V_{CC} = 1.8\text{ V}$, $f = 1550 - 1615\text{ MHz}$

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.1	1.8	3.6	V	ON-Mode
		0.0	–	0.4	V	OFF-Mode
Supply current	I_{CC}	–	1.1	1.6	mA	ON-Mode, $V_{CC}=1.8\text{V}$
		–	0.1	2	μA	OFF-Mode
Insertion power gain $f = 1575\text{ MHz}$	$ S_{21} ^2$	16.7	18.2	19.7	dB	ON-Mode
Noise figure ²⁾ $f = 1575\text{ MHz}$, $Z_S = 50\ \Omega$	NF	–	0.75	1.25	dB	ON-Mode, $Z_S = 50\ \Omega$
Input return loss ³⁾ $f = 1575\text{ MHz}$	RL_{IN}	7	9	–	dB	ON-Mode
Output return loss ³⁾ $f = 1575\text{ MHz}$	RL_{OUT}	10	16	–	dB	ON-Mode
Reverse isolation ³⁾ $f = 1575\text{ MHz}$	$1/ S_{12} ^2$	25	36	–	dB	ON-Mode
Transient time ⁴⁾⁷⁾	t_S	–	0.5	2	μs	ON- to OFF-Mode
		–	6	9	μs	OFF- to ON-Mode
Inband input 1dB-compression point, $f = 1575\text{ MHz}$ ³⁾	IP_{1dB}	-19	-15	–	dBm	ON-Mode
Inband input 3 rd -order intercept point ³⁾⁵⁾ $f_1 = 1575\text{ MHz}$, $f_2 = f_1 \pm 1\text{ MHz}$	IIP_3	-19	-14	–	dBm	ON-Mode
Out of band input 3 rd -order intercept point ³⁾⁶⁾ $f_1 = 1713\text{ MHz}$, $f_2 = 1851\text{ MHz}$	$OOB-IIP_3$	-14	-9	–	dBm	ON-Mode
Stability ⁷⁾	k	> 1	–	–		$f = 20\text{ MHz} \dots 10\text{ GHz}$

1) Based on the application described in chapter 4

2) PCB losses are subtracted

3) Verification based on AQL; not 100% tested in production

4) To be within 1 dB of the final gain

5) Input power = -30 dBm for each tone

6) Input power = -20 dBm at f_1 and -65 dBm at f_2

7) Guaranteed by device design; not tested in production

Electrical Characteristics

Table 5 Electrical Characteristics¹⁾ $T_A = 25\text{ °C}$, $V_{CC} = 2.8\text{ V}$, $f = 1550 - 1615\text{ MHz}$

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.1	1.8	3.6	V	ON-Mode
		0.0	–	0.4	V	OFF-Mode
Supply current	I_{CC}	–	1.2	1.7	mA	ON-Mode, $V_{CC}=2.8\text{V}$
		–	0.1	2	μA	OFF-Mode
Insertion power gain $f = 1575\text{ MHz}$	$ S_{21} ^2$	16.9	18.4	19.9	dB	ON-Mode
Noise figure ²⁾ $f = 1575\text{ MHz}$, $Z_S = 50\ \Omega$	NF	–	0.75	1.25	dB	ON-Mode, $Z_S = 50\ \Omega$
Input return loss ³⁾ $f = 1575\text{ MHz}$	RL_{IN}	7	9	–	dB	ON-Mode
Output return loss ³⁾ $f = 1575\text{ MHz}$	RL_{OUT}	10	15	–	dB	ON-Mode
Reverse isolation ³⁾ $f = 1575\text{ MHz}$	$1/ S_{12} ^2$	25	36	–	dB	ON-Mode
Transient time ⁴⁾⁷⁾	t_S	–	0.5	2	μs	ON- to OFF-Mode
		–	5	8	μs	OFF- to ON-Mode
Inband input 1dB-compression point, $f = 1575\text{ MHz}$ ³⁾	IP_{1dB}	-17	-13	–	dBm	ON-Mode
Inband input 3 rd -order intercept point ³⁾⁵⁾ $f_1 = 1575\text{ MHz}$, $f_2 = f_1 \pm 1\text{ MHz}$	IIP_3	-19	-14	–	dBm	ON-Mode
Out of band input 3 rd -order intercept point ³⁾⁶⁾ $f_1 = 1713\text{ MHz}$, $f_2 = 1851\text{ MHz}$	$OOB-IIP_3$	-14	-9	–	dBm	ON-Mode
Stability ⁷⁾	k	> 1	–	–		$f = 20\text{ MHz} \dots 10\text{ GHz}$

1) Based on the application described in chapter 4

2) PCB losses are subtracted

3) Verification based on AQL; not 100% tested in production

4) To be within 1 dB of the final gain

5) Input power = -30 dBm for each tone

6) Input power = -20 dBm at f_1 and -65 dBm at f_2

7) Guaranteed by device design; not tested in production

Application Information

4 Application Information

Application Board Configuration

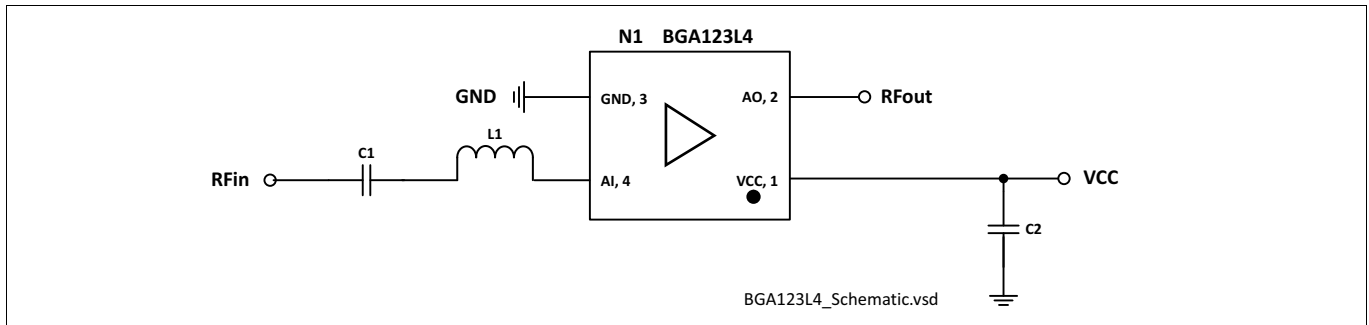


Figure 2 Application Schematic BGA123L4

Table 6 Bill of Materials

Name	Value	Package	Manufacturer	Function
C1 (optional)	1nF	0402	Various	DC block ¹⁾
C2	≥ 1nF ²⁾	0402	Various	RF bypass ³⁾
L1	10nH	0402	Murata LQW15 type	Input matching
N1	BGA123L4	TSLP-4-11	Infineon	SiGe LNA

1) DC block might be realized with pre-filter in GNSS applications

2) For data sheet characteristics 1nF used

3) RF bypass recommended to mitigate power supply noise

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

Package Information

5 Package Information

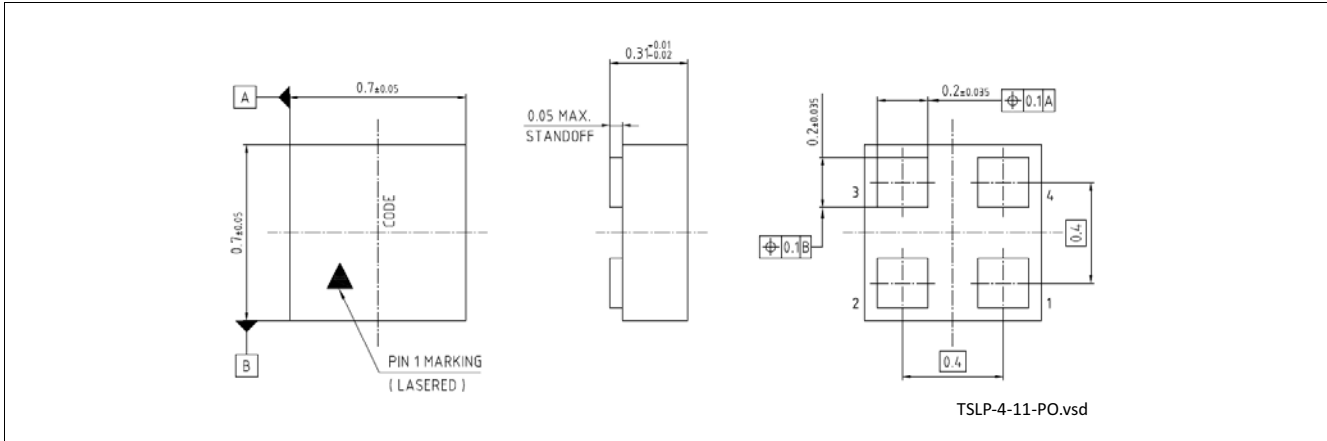


Figure 3 TSLP-4-11 Package Outline (top, side and bottom views)

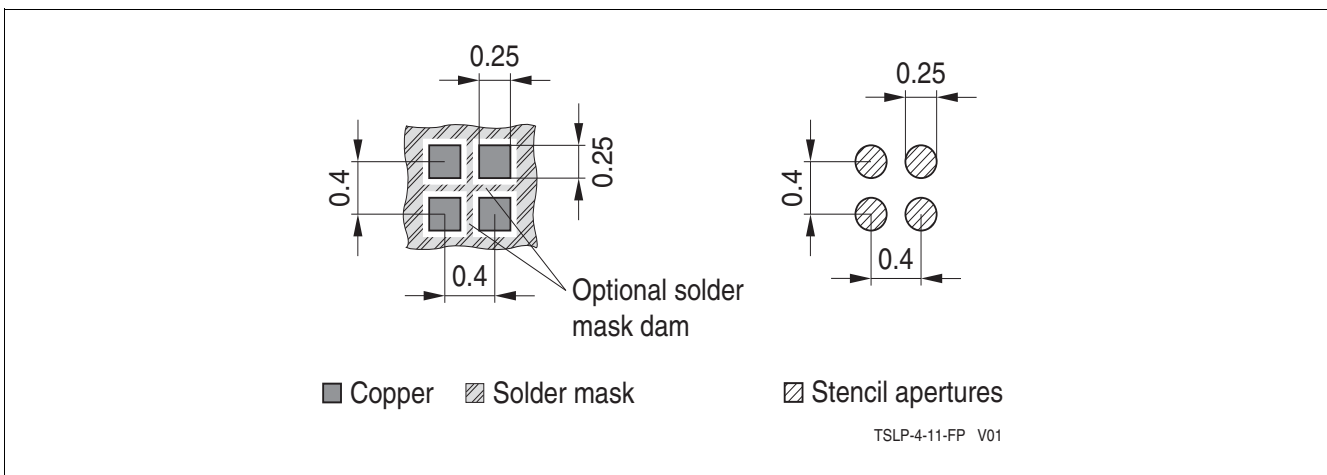


Figure 4 Footprint Recommendation TSLP-4-11

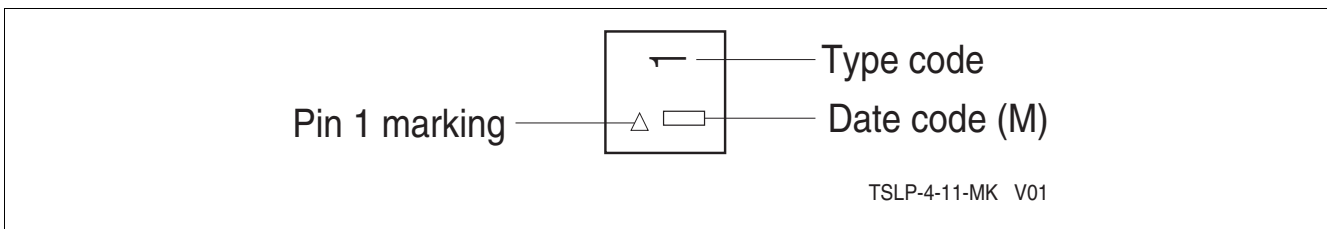


Figure 5 Marking Layout (top view)

Package Information

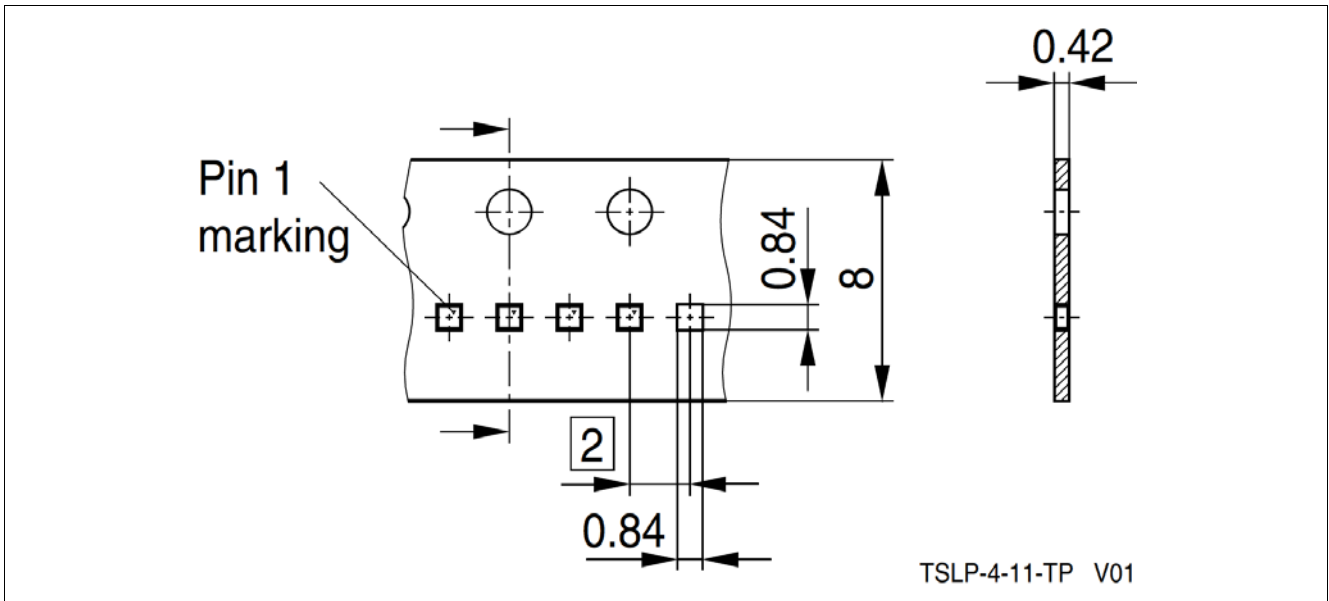


Figure 6 Tape & Reel Dimensions (reel diameter 180 mm, pieces/reel 15000)

Revision History

Page or Item	Subjects (major changes since previous revision)
---------------------	---

Revision 2.0 (min/max), 2017-09-14

1, 3, 4, 6, 7, 8	Update Electrical Characteristics
------------------	-----------------------------------

13	Update Trademark Information
----	------------------------------

Other Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2017-09-14

Published by

Infineon Technologies AG

81726 Munich, Germany

© 2017 Infineon Technologies AG.

All Rights Reserved.

Do you have a question about any aspect of this document?

Email: erratum@infineon.com

Document reference

Doc_Number

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, 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.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

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

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.