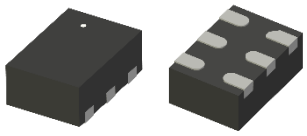
ALND-WB-0013

Ultra-Low Noise Amplifier for High-Precision GNSS Applications

Description



The ALND-WB-0013 is an ultra-low noise amplifier (LNA) designed in advanced GaAs E/D-pHEMT process, featuring wideband operation from 1165MHz to 1610MHz. For GNSS, it provides simultaneous, uncompromised performance across all frequency bands of all major constellations including GPS, GLONASS, Beidou, Galileo, and NavIC from 1176 to 1610MHz with a single, simple matching network. The device is housed in an ultra-compact 1.45 x 1.0 mm 6-Lead DFN (Dual Flat No-Lead) package, provides 0.5dB noise figure (GNSS High-Band), and the industry's highest-class input P_{1dB} and IIP3/IIP2, with adjustable current as low as sub-2mA for 1.2V to 3.6V operation. ALND-WB-0013 has integrated ESD protection on all pins and requires only one external inductor and capacitor for conventional GNSS bands from 1550 to 1610MHz.

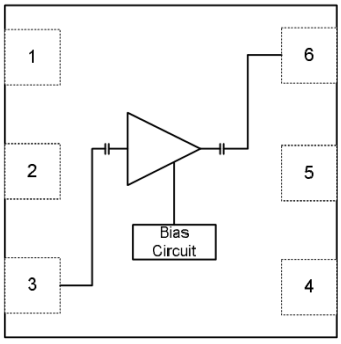
Key Features

- Advanced GaAs E/D-pHEMT Process
- GNSS L1/L2/L5/L6 Support (1165-1610MHz)
- Low Noise Figure: 0.5~0.7dB (GNSS Full Band)
- Power Gain: 15/16dB (High/Low-Band)
- High Input P_{1dB}: -6dBm at 1575MHz
- Adjustable Current 1.5 ~ 7mA at 1.2 ~ 3.6V
- Integrated ESD for 1KV HBM & >2KV CDM
- Ultra-Small DFN-6L Package: 1.45mm x 1.0mm
- RoHS Compliant | MSL Level 1

Typical Applications

- High-Precision GNSS Modules
- GNSS for Smart Watches, Wearables
- UAVs and Drones
- Robotics and Autonomous Driving
- Real-Time Kinematic (RTK)
- Intelligent Transportation
- Precision Land Survey Positioning

Functional Block Diagram



Ordering Information

Part No.	Description
ALND-WB-0013	Ultra-Low Noise Amplifier on Cut Tape
ALND-WB-0013-T	Ultra-Low Noise Amplifier on Tape & Reel
ALND-WB-0013-EVB	Ultra-Low Noise Amplifier EVB

Absolute Maximum Ratings

Parameter	Symbol	Absolute Maximum			Unit
Supply Voltage	V_{DD}	5			V
Enable Voltage	V_{EN}	3.6			V
Max Input Power	$P_{IN, MAX}$	10			dBm
Maximum Current	-	25			mA
Junction Temperature	-	150			℃
Operating Temperature	T_{OP}	-40	-	85	℃
Storage Temperature	T_{STG}	-40	-	150	℃
Moisture Sensitivity Level	-	MSL1			-
ESD capability all pins	V_{ESD_HBM}	-1000	-	+1000	V
	V_{ESD_CDM}	-2000	-	+2000	V

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
V_{DD}	1.2	3.3	3.6	V
V_{EN}	1.2	3.3	3.6	V

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications (GNSS Full-Band: L1/L2/L5/L6)

Parameters	Condition	Specification			Unit
		Minimum	Typical	Maximum	
Operating Frequency	-	1165	1575	1610	MHz
Operating Voltage	-	1.2	3.3	3.6	V
Quiescent Current	V_{DD}=V_{EN}=3.3V, No RF Input	4	6	10	mA
Shutdown Current	V_{DD}=3.3V, V_{EN}=0	-	0.3	-	uA
Small-Signal Gain	Low-Band, P_{in}=-30dBm	-	16	-	dB
Small-Signal Gain	High-Band, P_{in}=-30dBm	-	15	-	dB
Noise Figure	-	-	0.7	-	dB
Input Return Loss	-	-	10	-	dB
Output Return Loss	-	-	10	-	dB
Isolation	-	-	24	-	dB
Input P_{1dB}	@ V_{DD}=V_{EN}=3.3V	-	-6	-	dBm
In-Band IIP3 (Low-Band)	f1/f2=1176/1177MHz, -30dBm per Tone, 3.3V	-	2	-	dBm
In-Band IIP3 (High-Band)	f1/f2=1575/1576MHz, -30dBm per Tone, 3.3V	-	3	-	dBm
Out-of-band input 3rd-order intercept point	f1/f2=1712.7/1850MHz, -30dBm per Tone, 3.3V	-	4		dBm

Electrical Specifications (GNSS High-Band: L1)(1)

Parameters	Condition	Specification			Unit
		Minimum	Typical	Maximum	
Operating Frequency	-	1550	1575	1610	MHz
Operating Voltage	-	1.2	3.3	3.6	V
Quiescent Current	V_{DD}=V_{EN}=3.3V, No RF Input	4	6	10	mA
Shutdown Current	V_{DD}=3.3V, V_{EN}=0	-	0.3	-	uA
Small-Signal Gain	Pin=-30dBm	-	15	-	dB
Noise Figure	-	-	0.5	-	dB
Input Return Loss	-	-	11	-	dB
Output Return Loss	-	-	15	-	dB
Isolation	-	-	24	-	dB
Input P_{1dB}	@ V_{DD}=V_{EN}=3.3V	-	-5.5	-	dBm
In-Band IIP3 (High-Band)	f1/f2=1575/1576MHz, -30dBm per Tone, 3.3V	-	3	-	dBm
Out-of-Band IIP3	f1/f2=1712.7/1850MHz, -30dBm per Tone, 3.3V	-	4	-	dBm

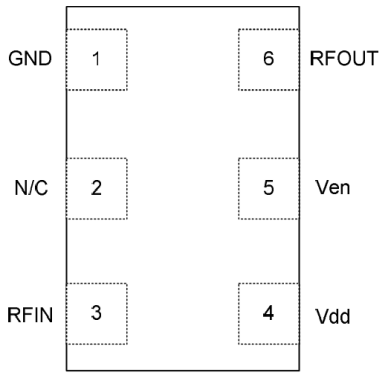
(1) As measured on ALND-WB-0013-EVB with 9.1nH input inductor (Murata LQW15 Series), VDD=VEN=3.3V.

Electrical Specifications (GNSS Low-Band: L2/L5/L6)(1)

Parameters	Condition	Specification			Unit
		Minimum	Typical	Maximum	
Operating Frequency	-	1164	1176	1300	MHz
Operating Voltage	-	1.2	3.3	3.6	V
Quiescent Current	V_{DD}=V_{EN}=3.3V, No RF Input	4	6	10	mA
Shutdown Current	V_{DD}=3.3V, V_{EN}=0	-	0.3	-	uA
Small-Signal Gain	Pin=-30dBm	-	16	-	dB
Noise Figure	-	-	0.9	-	dB
Input Return Loss	-	-	10	-	dB
Output Return Loss	-	-	12	-	dB
Isolation	-	-	26	-	dB
Input P_{1dB}	@ V_{DD}=V_{EN}=3.3V	-	-7	-	dBm
In-Band IIP3 (High-Band)	f1/f2=1176/1177MHz, -30dBm per Tone, 3.3V	-	1	-	dBm

(1) As measured on ALND-WB-0013-EVB with L1=12nH, L2=8.2nH, L3=9.1nH (Murata LQW15 Series inductors), VDD=VEN=3.3V.

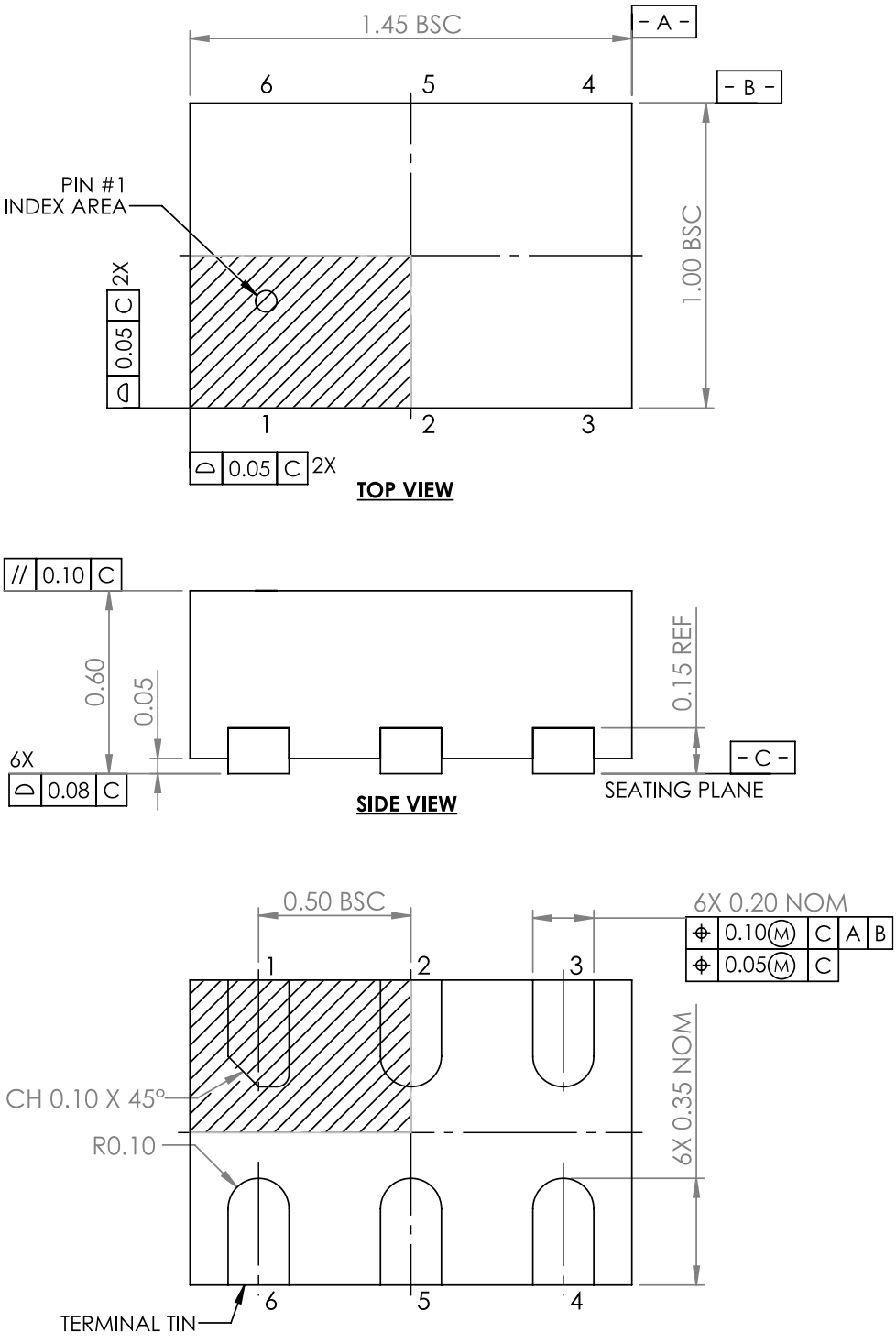
Pin Configuration



(Top "See-Through" View)

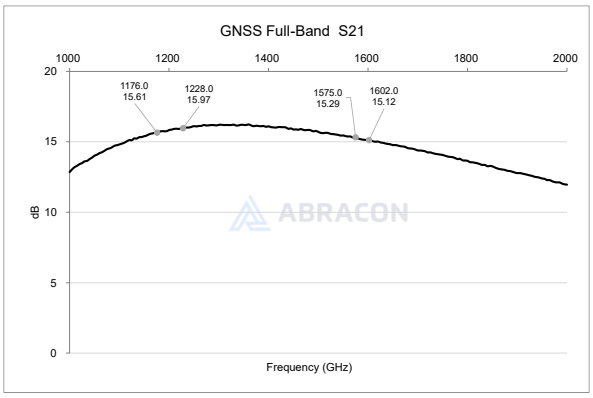
Pin	Name	Description
1	GND	Ground
2	N/C	No Connection. Can be connected to GND in PCB layout.
3	RF_{IN}	RF Input
4	V_{DD}	DC Voltage Supply
5	V_{EN}	LNA Enable Voltage
6	RF_{OUT}	RF Output

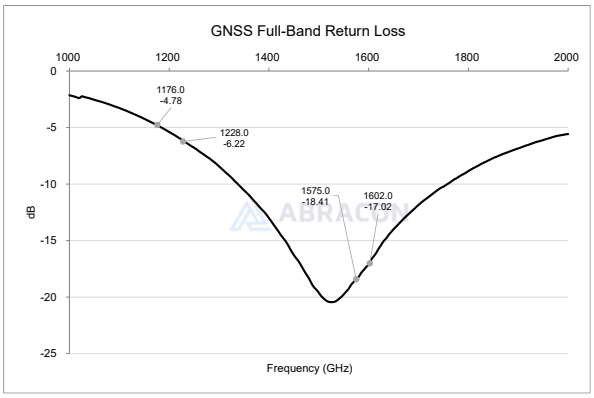
Product Dimensions

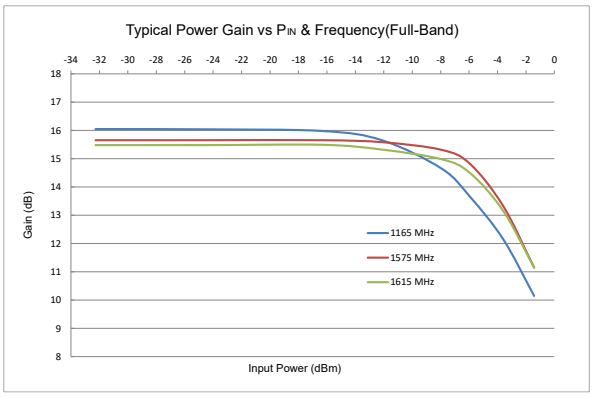


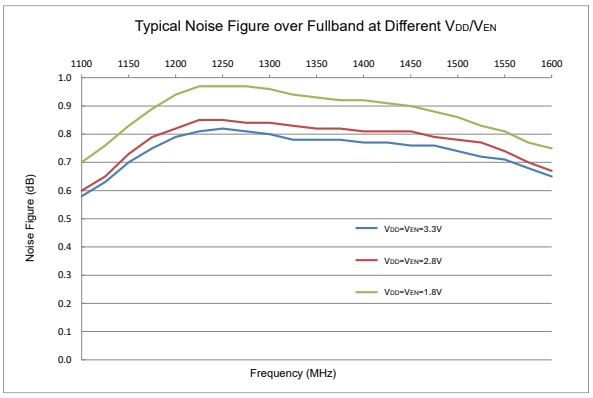
Unit: mm

Performance Plots (GNSS Full-Band: L1/L2/L5/L6)

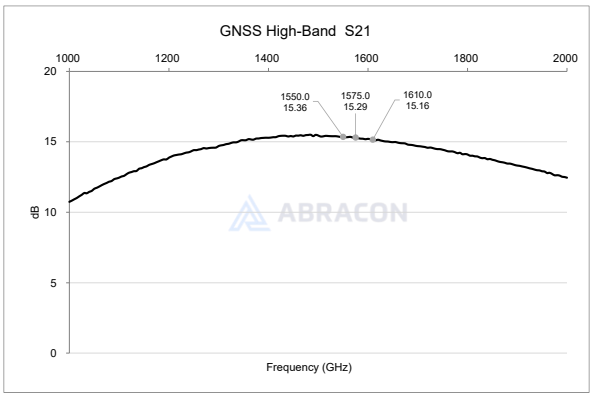


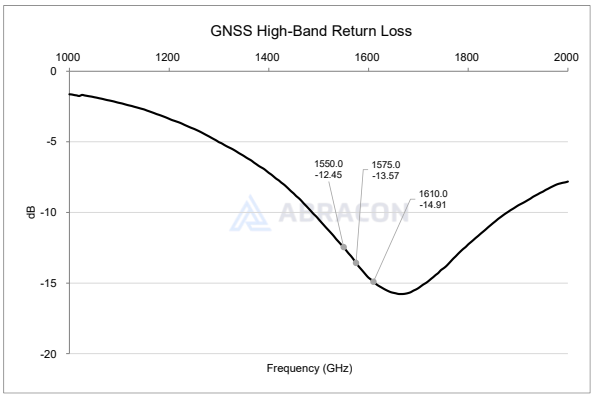


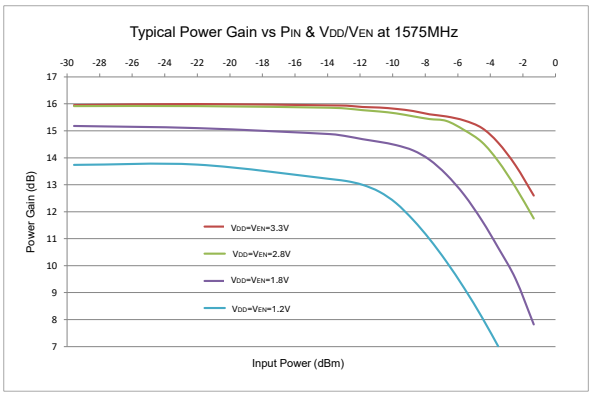


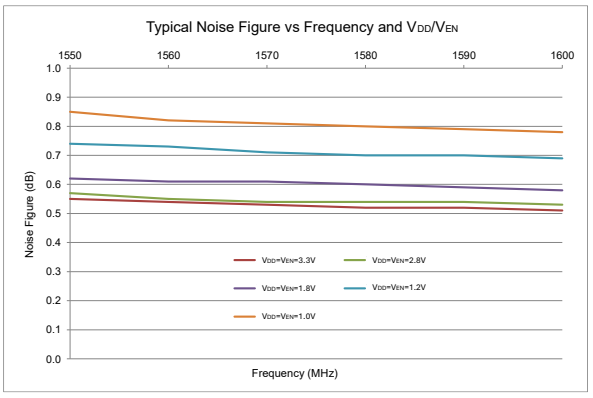


Performance Plots (GNSS High-Band: L1)

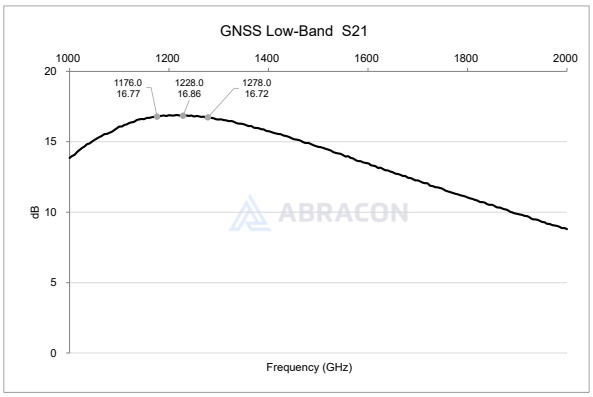


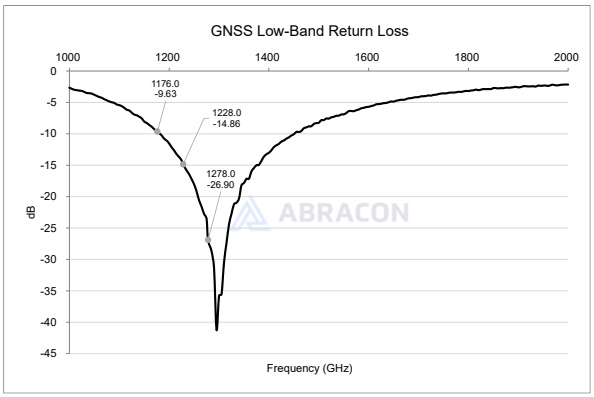


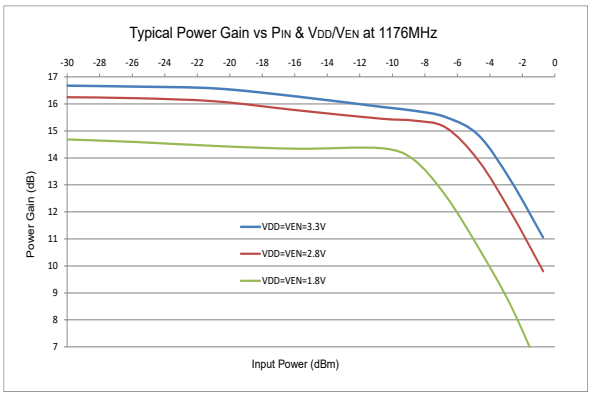


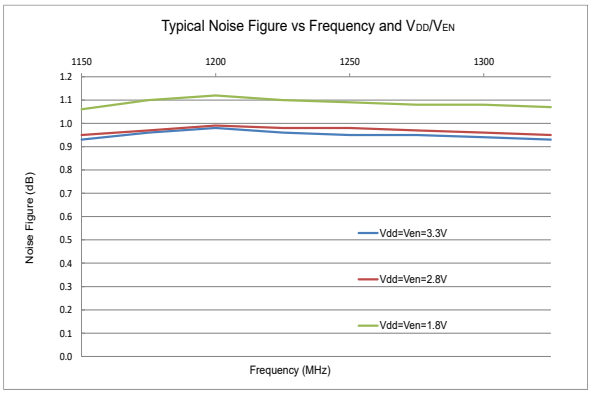


Performance Plots (GNSS Low-Band: L2/L5/L6)

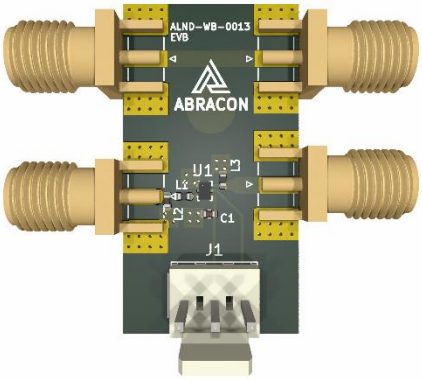




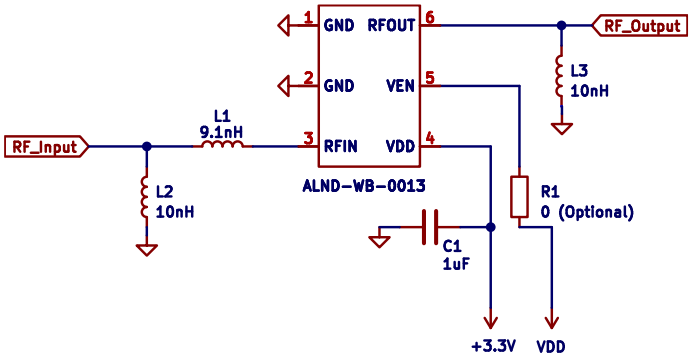




Evaluation Board ALND-WB-0013-EVB (GNSS Full-Band: L1/L2/L5/L6)



EVB



Schematic

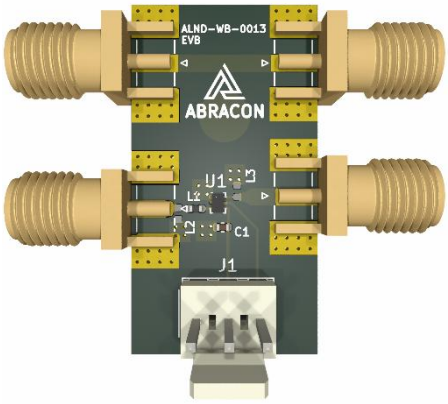
Bill of Material

Component	Description	Manufacturer	Manufacturer Part	QTY
U1	Ultra-Low Noise Amplifier for High-Precision GNSS Applications	Abracon	ALND-WB-0013	1
C1	1uF	Murata	GRM155R70J105KA12D	1
L1	9.1nH	Murata	LQW15AN9N1J00D	1
L2, L3	10nH	Murata	LQW15AN10NH00D	2
R1	0 ohm	Yageo	RC0402JR-07360KL	1

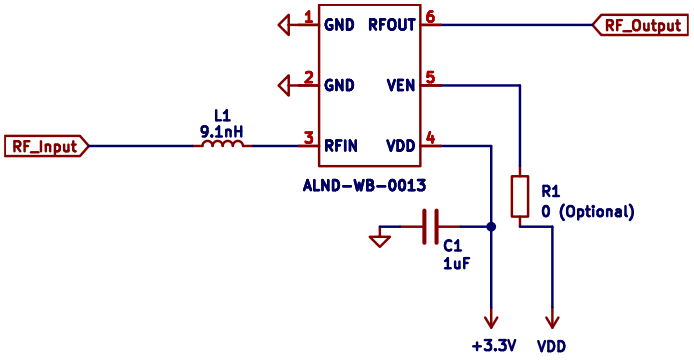
Transmission Line

The transmission line should be kept as short as possible and be designed to have a characteristic impedance of 50Ω. Abracon recommends using a Co-Planar Waveguide with Ground (CPWG), which dimensions can be derived by any trusted calculator, using the correct input for PCB materials and layer stack-up.

Evaluation Board ALND-WB-0013-EVB (GNSS High-Band: L1)



EVB



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U1	Ultra-Low Noise Amplifier for High-Precision GNSS Applications	Abracon	ALND-WB-0013	1
C1	1uF	Murata	GRM155R70J105KA12D	1
L1	9.1nH	Murata	LQW15AN9N1J00D	1
R1	0 ohm	Yageo	RC0402JR-07360KL	1

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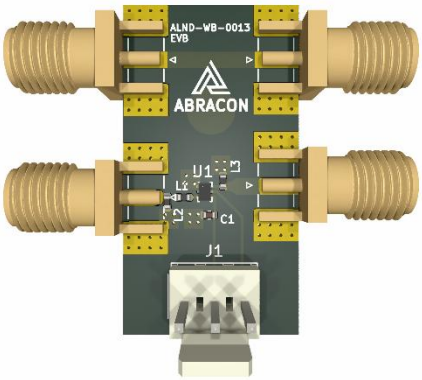
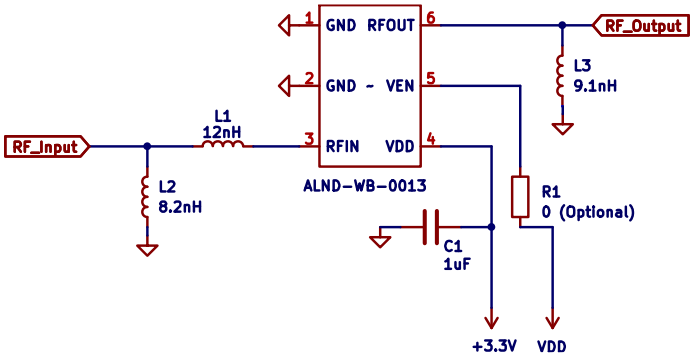
Evaluation Board ALND-WB-0013-EVB (GNSS Low-Band: L2/L5/L6)



EVB



Schematic

Bill of Material

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C1	1uF	Murata	GRM155R70J105KA12D	1
L1	12nH	Murata	LQW15AN12NH00D	1
L2	8.2nH	Murata	LQW15AN8N2J00D	1
L3	9.1nH	Murata	LQW15AN9N1J00D	1
R1	0 ohm	Yageo	RC0402JR-07360KL	1

Transmission Line

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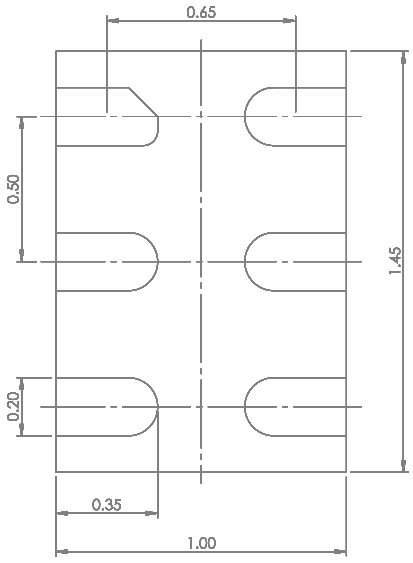
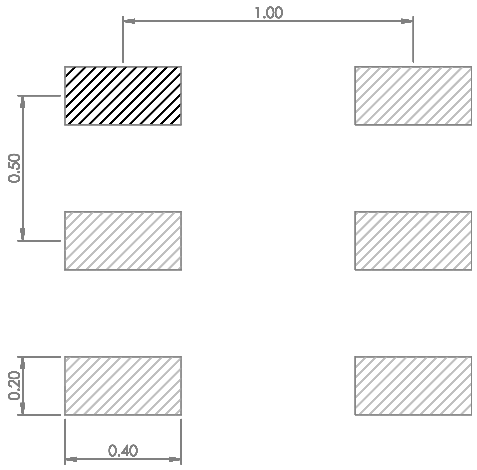
IC Footprint & PCB Land Pattern



Footprint



Land Pattern

Unit: mm

Reflow Profile [JEDEC J-STD-020]

Solder paste: Sn/3.0Ag/0.5Cu

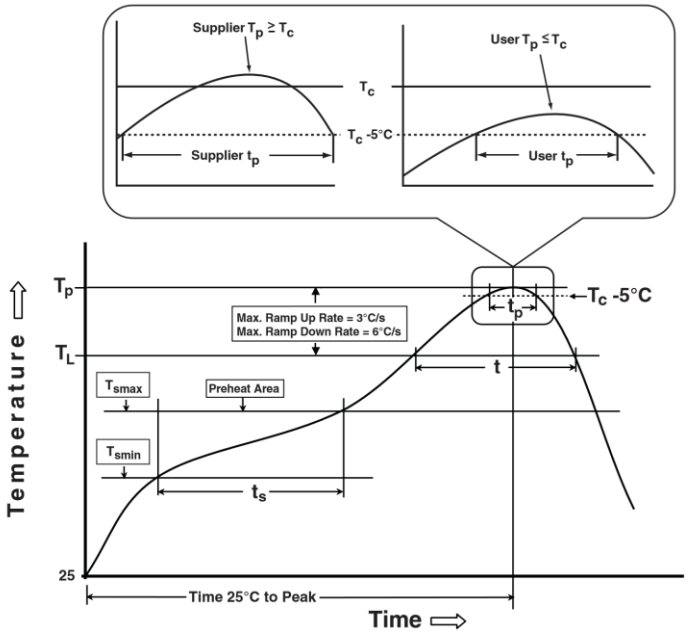


Table 1

SnPb Eutectic Process Classification Temperatures (T_c)		
Package Thickness	**Volume mm³ <350**	**Volume mm³ ≧350**
<2.5mm	235℃	220℃
≧2.5mm	220℃	220℃

Table 2

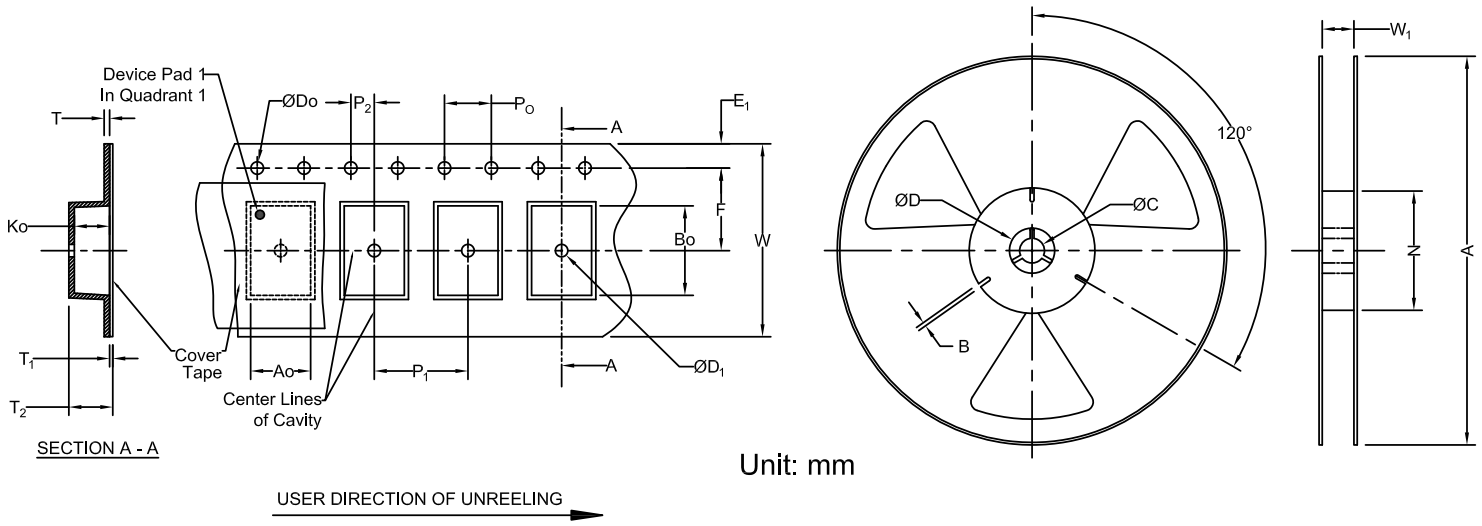
Pb-Free Process Classification Temperatures (T_c)			
Package Thickness	**Volume mm³ <350**	**Volume mm³ 350-2000**	**Volume mm³ >2000**
<1.6mm	260℃	260℃	260℃
1.6mm - 2.5mm	260℃	250℃	245℃
>2.5mm	250℃	245℃	245℃

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat / soak		
Temperature minimum (T_{smin})	100℃	150℃
Temperature maximum (T_{smax})	150℃	200℃
Time (T_{smin} to T_{smax}) (t_s)	60 – 120 sec.	60 – 120 sec.
Average ramp-up rate (T_{smax} to T_p)	3℃/sec. max	3℃/sec. max
Liquidous temperature (T_L)	183℃	217℃
Time at Liquidous (T_L)	60 – 90 sec.	60 – 90 sec.
Peak package body temperature (T_p)*	**See Table 1**	**See Table 2**
Time (T_p)** within 5℃ of the specified classification temperature (T_c)	20 sec.	10 sec.
Ramp-down rate (T_p to T_{smax})	3℃/sec. max	3℃/sec. max
Time 25℃ to peak temperature	6 min. max	8 min. max
Reflow cycles	2 max	2 max

*Tolerance for peak profile temperature (T_p) is defined as a supplier minimum and a user maximum.
**Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.

Packaging

Tape & Reel Dimension



Unit: mm

Carrier Tape Specifications (mm)										
E1	D0	P0	P2	F	P1	W	A0	B0	K_0	Reel Qty
1.75 ± 0.1	1.55 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	3.5 ± 0.05	4.0 ± 0.1	8.0 ± 0.1	1.2 ± 0.1	1.65 ± 0.1	0.7 ± 0.05	3,000

Reel Specifications (mm)					
A	W_1	N	B	C	D
180 ± 2.0	8.4 + 1.0/-0.0	60 ± 1.0	1.1+0.2/-0.0	13.1 ± 0.2	16.84+0.2/-0