

ELLA-W1 Antenna trace designs

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	Date:	Name	Signature
Created	01-Jul-2016	Stefano Bianconi	sbia
Checked	01-Jul-2016	Igor Shevchenko	ishe
Released	06-Jul-2016	Daniel Dietterle	ddie

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1 Scope

This document defines the essential specifications necessary to implement the ELLA-W1 antenna reference designs. The information contained herein and its references should be sufficient to guide a skilled person in an attempt to implement the design on a host carrier. It will provide the designer with PCB layout details and expected performance specifications.

The document supports the four different PCB designs:

- Two connector-based designs for the use of external antennas (one for each antenna pin of the module)
- Two designs based on SMD antennas (one for each antenna pin of the module)

2 FCC/IC ID reference

Model ¹	FCC ID	IC ID
ELLA-W131	PV7-WIBEAR11N-SF1	7738A-WB11NSF1
ELLA-W133	PV7-WIBEAR11N-SF2	7738A-WB11NSF2
ELLA-W161	PV7-WIBEAR11N-DF1	7738A-WB11NDF1
ELLA-W163	PV7-WIBEAR11N-DF2	7738A-WB11NDF2

Table 1: FCC and IC IDs for different models of ELLA-W1 series

¹ The FCC and IC IDs are the same for professional and automotive grade variants of each ELLA-W1 model.

3 General description

When using the ELLA-W1 together with this antenna reference design, the circuit trace layout must be made in strict compliance with the instructions below.

All the components placed on each RF trace must be kept as indicated in the reference design, even if not used. The PCB areas of unused reference designs must be flooded with ground.

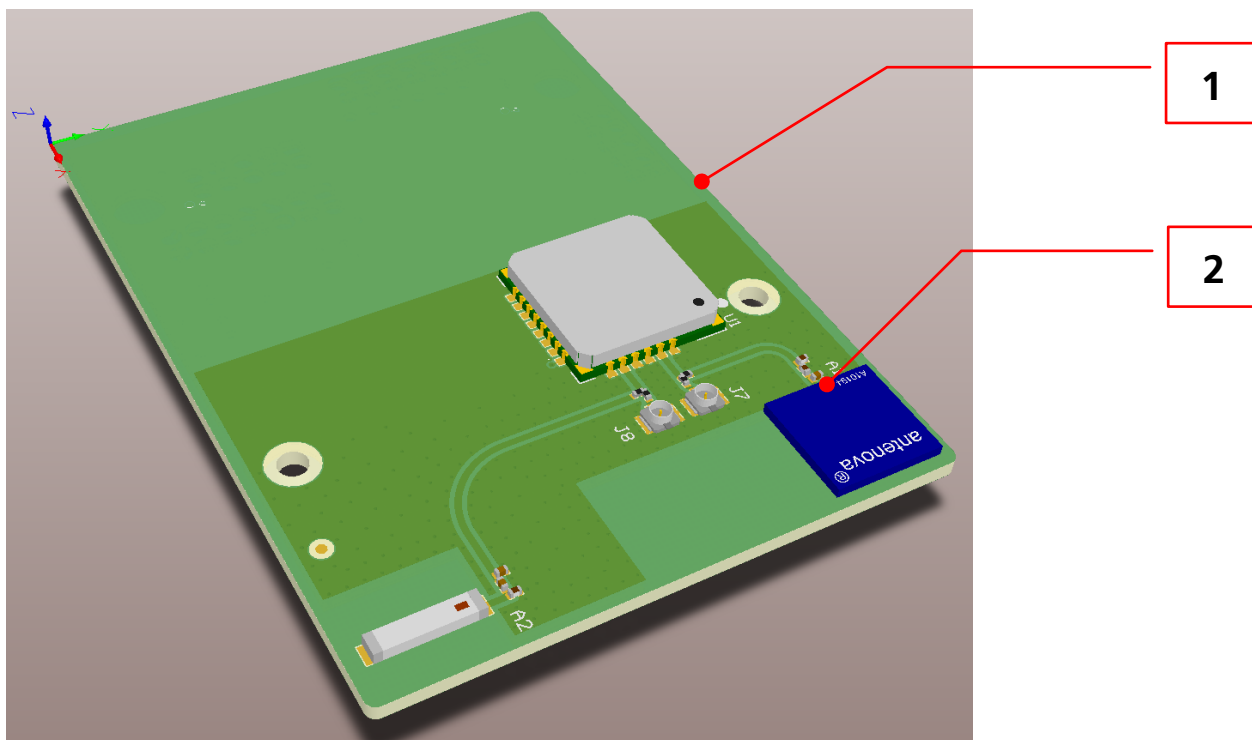


Figure 1: Antenna Reference design embedded in a host carrier PCB

Reference	Description
1	Host carrier PCB (light green)
2	Antenna reference design (dark green)

3.1 Floor plan and PCB stack-up

This section describes where the critical components are positioned on the reference design. It also presents the stack-up of the four layers of the PCB.

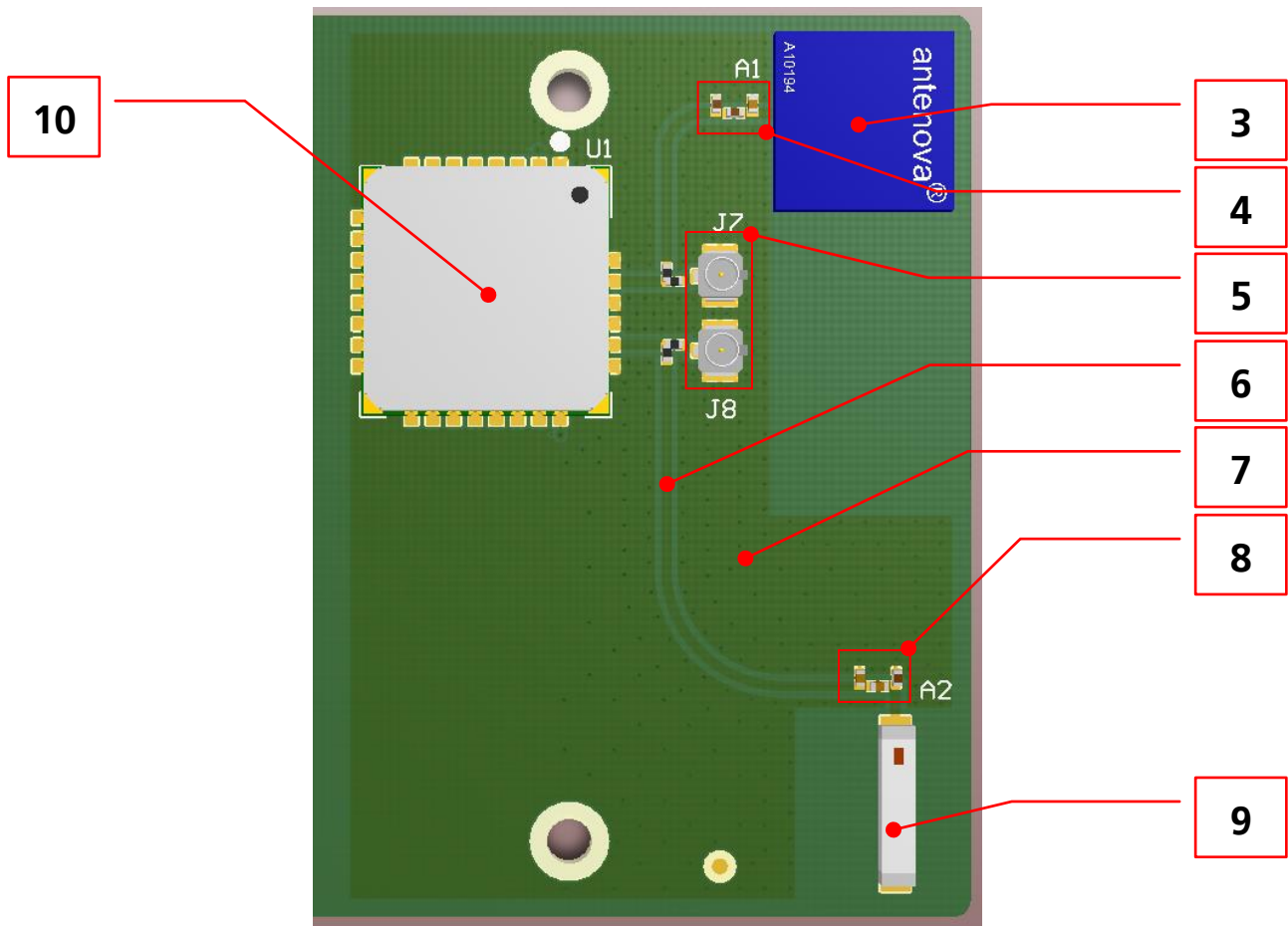


Figure 2: ELLA-W1 antenna reference design

Reference	Description
3	SMD antenna
4	Antenna impedance matching network
5	Connectors for external antenna
6	Antenna coplanar microstrip, matched to 50 Ω
7	Top layer GND-plane
8	Antenna impedance matching network
9	SMD antenna
10	ELLA-W1 module

3.2 PCB stack-up

The stack-up used in the reference design is specified in Table 2.

PCB Layer	Material	Thickness
Soldermask Top	Generic LPI Soldermask	25 μm
Top	Copper Foil	35 μm
Dielectric	Pre-preg 2x7628	360 μm
L2	Copper Foil	35 μm
Dielectric	Core	700 μm +/-10%
L3	Copper Foil	35 μm
Dielectric	Pre-preg 2x7628	360 μm
Bottom	Copper Foil	35 μm
Soldermask Bottom	Generic LPI Soldermask	25 μm

Table 2: Stack-up of EVK-ELLA-W1

3.2.1 RF trace specification

The 50 Ω coplanar micro-strip dimensions used in these reference designs are stated in Figure 2 and Table 3.

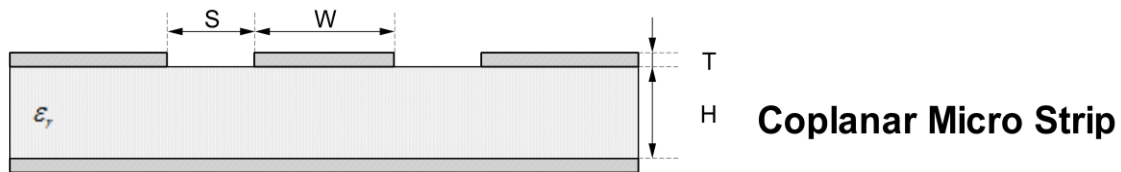


Figure 3: Coplanar micro-strip dimension specification

Item	Value
S	400 μm
W	600 μm
T	35 μm
H	360 μm

Table 3: Coplanar micro-strip specification

3.3 Mechanical dimensions

The mechanical dimensions and position of the components are specified in Figure 3.

The layers beneath the 'top layer' have the same dimensions and are filled with ground. No RF traces are routed in those layers.

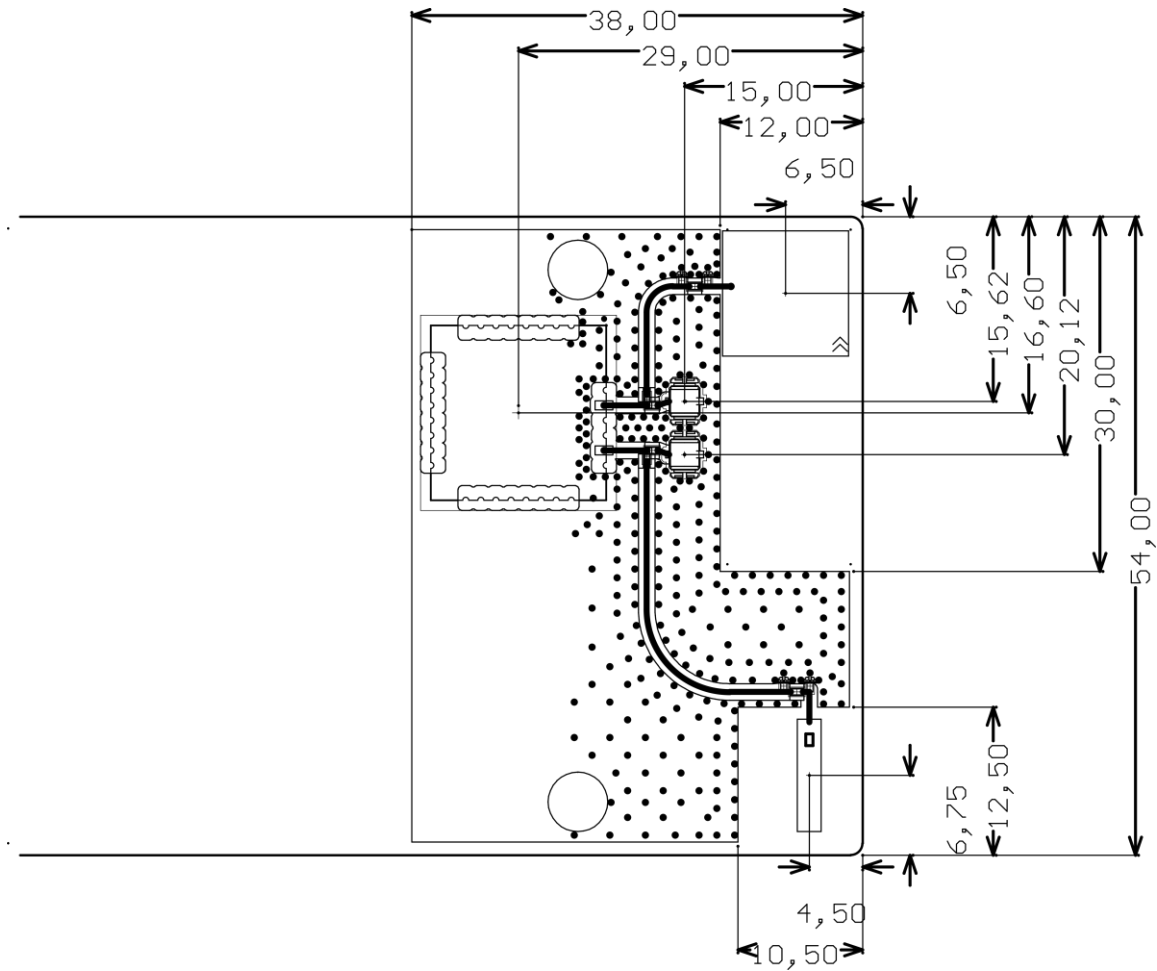


Figure 4: Mechanical dimensions of EVK-ELLA-W1, top layer

4 Reference designs for antenna pin 1

This section describes the available designs for the antenna pin 1 of the ELLA-W1 modules.

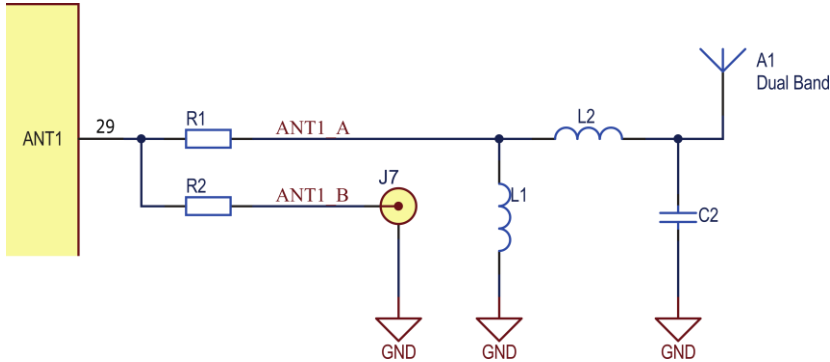


Figure 5: Reference schematic for antenna pin 1

4.1 Internal antenna

The reference design with internal antenna uses the SMD Antenna type A10194 dual-band antenna that is connected to the module RF-port via a coplanar micro-strip transmission line.

4.1.1 Bill of materials

Reference designator	Description	Manufacturer	P/N
A1	Antenna CHIP 2.45 & 5 GHz	Antenna	A10194
L1	IND, Multilayer Ceramic, 10nH, +/-5%, 300mA, SMD 0402	Johanson Technology	L-07C10NJV6ST
L2	IND, Multilayer Ceramic, 1nH, +/-0.3nH, 300mA, SMD 0402	Johanson Technology	L-07C1N0SV6T
C2	CAP, CER, 0.2pF, +/-0.1pF, COG, 50V, SMD 0402	Johanson Technology	500R07S0R2BV4
R1	0 Ω resistor, 0402	Generic	-
R2	Do not Assembly	-	-
J7	Do Not Assembly	-	-

4.1.2 Antenna characteristics

Parameter	Low band	High band	Unit
Frequency Range	2.4 – 2.5	4.9 – 5.875	GHz
Peak Gain	1.8	4.1	dBi
VSWR	< 1.4:1	< 1.8:1	-
Efficiency	>75	>60	%
Polarisation	Linear		-
Radiation pattern	Omnidirectional		-
Temperature range	-40 to +85		$^{\circ}\text{C}$
Impedance	50		Ω
Dimension (L x W x H)	10.0 x 10.0 x 0.9		mm

4.2 External antenna

The reference design with external antenna uses the micro coaxial connector that is connected to the external antenna via a 50 Ω pigtail. See section 0 for a list of available external antennas.

4.2.1 Bill of materials

Reference designator	Description	Manufacturer	P/N
A1	Do Not Assembly	-	-
L1	Do Not Assembly	-	-
L2	Do Not Assembly	-	-
C2	Do Not Assembly	-	-
R1	Do Not Assembly	-	-
R2	0 Ω resistor, 0402	Generic	-
J7	Coaxial Connector, 0 – 6 GHz, SMD	Hirose	U.FL-R-SMT-1(10)

5 Reference designs for antenna pin 2

This section describes the available designs for the antenna pin 2 of the ELLA-W1 modules. Note that only ELLA-W133 and ELLA-W163 use antenna pin 2, for Bluetooth transmission.

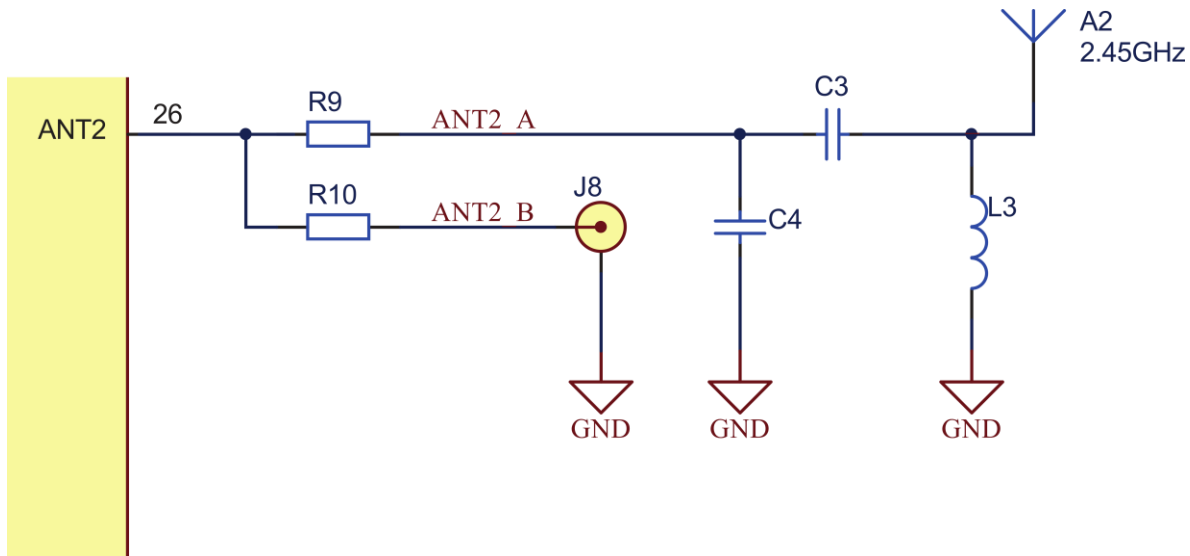


Figure 6: Reference schematic for antenna pin 2

5.1 Internal antenna

The reference design with internal antenna uses the SMD Johanson Technology type 2450AT45A100 antenna that is connected to the module RF-port via a coplanar micro-strip transmission line.

5.1.1 Bill of materials

Reference designator	Description	Manufacturer	P/N
A2	Antenna CHIP 2.4-2.5GHz	Johanson Technology	2450AT45A100
C3	CAP, CER, 2.2pF, +/-0.1pF, COG, 50V, SMD 0402	Johanson Technology	500R07S2R2BV4
C4	CAP, CER, 1.8pF, +/-0.1pF, COG, 50V, SMD 0402	Johanson Technology	500R07S1R8BV4
L3	IND, Multilayer Ceramic, 3.9nH, +/-0.3nH, 300mA, SMD 0402	Johanson Technology	L-07C3N9SV6T
R9	0 Ω resistor, 0402	Generic	-
R10	Do not Assembly	-	-
J8	Do Not Assembly	-	-

5.1.2 Antenna characteristics

Parameter	Low band	Unit
Frequency Range	2.4 – 2.5	GHz
Peak Gain	2.2	dBi
VSWR	< 2:1	-
Polarisation	Linear	-

Parameter	Low band	Unit
Radiation pattern	Omnidirectional	-
Temperature range	-40 to +125	°C
Impedance	50	Ω
Dimension (L x W x H)	9.5 x 2.0 x 1.2	mm

5.2 External antenna

The reference design with external antenna uses the micro coaxial connector that is connected to the external antenna via a 50 Ω pigtail. See section 0 for a list of available external antennas.

5.2.1 Bill of materials

Reference designator	Description	Manufacturer	P/N
A2	Do not Assembly	-	-
C3	Do Not Assembly	-	-
C4	Do not Assembly	-	-
L3	Do not Assembly	-	-
R9	Do Not Assembly	-	-
R10	0 Ω resistor, 0402	Generic	-
J8	Coaxial Connector, 0 – 6 GHz, SMD	Hirose	U.FL-R-SMT-1(10)