

## **3 Description of the PCB Antenna**

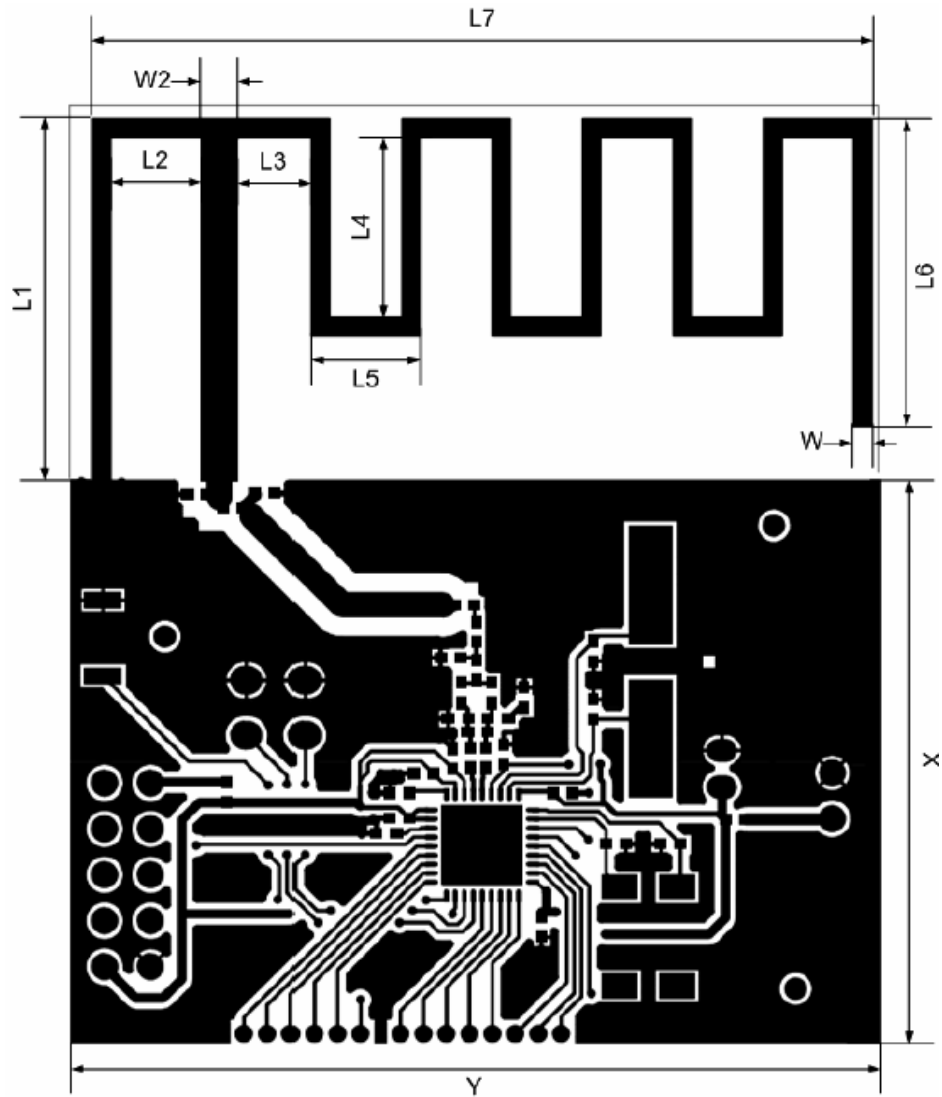
The antenna described in this document is an inverted F antenna. Since the impedance of this antenna is approximately matched to 50 ohm no external matching components are needed. The size of the ground plane affects the impedance of the antenna. This PCB antenna reference design has included the option for one series and two shunt components at the feed point of the antenna. These can be used to compensate for detuning caused by plastic encapsulation and other object in the vicinity of the antenna. For further information on impedance matching and impedance measurements, see DN001 Antenna Measurement with Network Analyzer [1] and ISM-Band and Short Range Device Antennas [2].

For test purpose the antenna has been implemented on an evaluation module equipped with two LEDs and a push button for running small test programs. The evaluation module can be connected to SmartRF04 via a 10-pin debug cable for programming. The module is also equipped with a two pin power connector (3 volt) and soldering points for the chip's I/O-ports. The external power must be disconnected when the module is connected to SmartRF04.

### **3.1 Implementation of the Inverted F Antenna**

To obtain optimum performance it is important to make an exact copy of the antenna dimensions. The antenna was implemented on a 0.8 mm thick, FR4 substrate. Since there is no ground plane beneath the antenna the PCB thickness is not critical, but if a different thickness is being used it might be necessary to tune the length of the antenna to obtain optimum performance.

One approach to implement the antenna in a PCB CAD tool is to import the antenna layout from a Gerber file. Such a file is included in the CC1110EM IIFA Reference Design [3], and is called "antenna.spl". If the antenna is implemented on a PCB that is wider than the antenna it is important to avoid placing components or having a ground plane close (minimum 5 mm) to each side of the antenna. If the CAD tool being used does not support import of Gerber files, Figure 2 and Table 1 can be used.

**Figure 2. Antenna Dimensions**

L1	20.0 mm	L7	43.0 mm
L2	4.5 mm	X	31.0 mm
L3	3.5 mm	Y	45.0 mm
L4	10.0 mm	W	1.0 mm
L5	6.0 mm	W2	2.0 mm
L6	17.0 mm		

**Table 1. Antenna Dimensions**

Optimum length for L6 is dependent on the geometry and size of the ground plane. With the ground plane shown here (31 x 45 mm) L6 should be approx. 9 mm for 868 MHz and 1 mm for 915 MHz. The antenna can also be used for 955 MHz but then the total length of the antenna has to be reduced more than the length specified for 915 MHz. Bigger ground planes might require additional tuning.