


ESP8266EX

Hardware Matching Guide



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Espressif Systems
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About This Guide

This document introduces the frequency offset tuning and antenna impedance matching for ESP8266EX, which are necessary for achieving optimum RF performance.

Release Notes

Date	Version	Release notes
2016.06	V1.0	Initial release.
2018.11	V1.1	<ul style="list-style-type: none">Deleted "Modify Frequency Offset" in Section 2.2;Updated document format and Figure 3-1.

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1.

Overview

ESP8266EX is a highly integrated System-on-a-Chip (SoC) with only seven external components. In order to achieve the optimum performance of the chip, customers only need to tune the frequency offset and match the antenna impedance, according to the crystal oscillator and the antenna.

The lack of frequency offset tuning and antenna impedance matching may reduce the RF performance, resulting in AP-scanning issues, unstable connection and unstable data transmission.



2. Frequency Offset Tuning

2.1. Testing Frequency Offset

The frequency offset can be tested in one of the following ways:

1. GPIO0 outputs crystal oscillator clock signals by default. Customers can compare the calculated frequency to the standard frequency, and get the offset value.
2. Customers can use the AT command and send AT+CWLAP command. The last parameter is the offset value. However, it is a relative value. Customers can use a standard device for comparison.
3. Customers can use the FCC/CE test firmware to send a standard wave and get the offset value with an IQView equipment. The IQView equipment is shown in Figure 2-1. The FCC/CE certification and test document can be downloaded from:

<http://www.espressif.com/en/support/download/other-tools>.



Figure 2-1. IQView Equipment

2.2. Adjusting Frequency Offset

The frequency offset can be adjusted by adjusting the capacitors on both sides of the crystal oscillator:

- Increase the capacitance if the frequency offset is positive, for example +50 ppm;
- Decrease the capacitance if the frequency offset is negative, for example -50 ppm;
- Generally, the capacitances are the same, and should be adjusted simultaneously.



3. Impedance Matching

The impedance of the ESP8266EX PA output end is $(39+j6)\Omega$, so the matched impedance is $(39-j6)\Omega$ (from antenna to the chip).

To achieve best RF performance, the π -type impedance matching circuit of the external antenna should be as is shown in Figure 3-1.

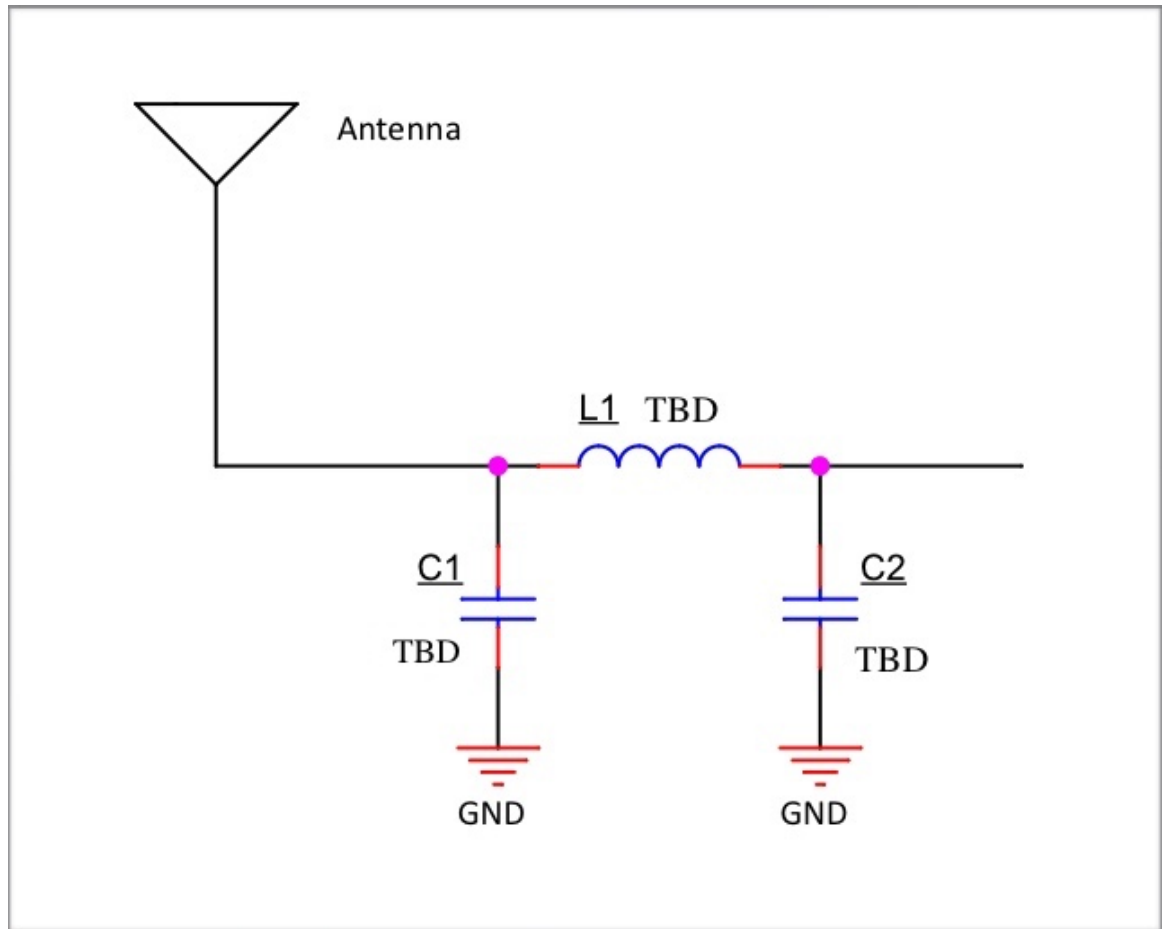


Figure 3-1. Antenna Impedance Matching

Notes:

- $C1$ must be a capacitor for filtering harmonics twice, and it is recommended to be 2.4 pF.
- $L1$, $C2$, along with $C1$, perform a $(39-j6)\Omega$ impedance matching for the antenna.
- $L1$ and $C2$ can be either inductors or capacitors, depending on different requirements.



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