

Short design guide of a external antenna for SkyeModule M1-mini

Procedure

1. Modifications on SkyeModule M1-mini
2. Design and calculation of inductivity L (antenna)
3. Determination of parallel capacity C_P
4. Determination of serial capacity C_S
5. Attach external antenna to SkyeModule M1-mini
6. Optimization of capacities

Modifications on SkyeModule M1-mini

C_{series} have to be solder out from PCB to “deactivate” the internal antenna.

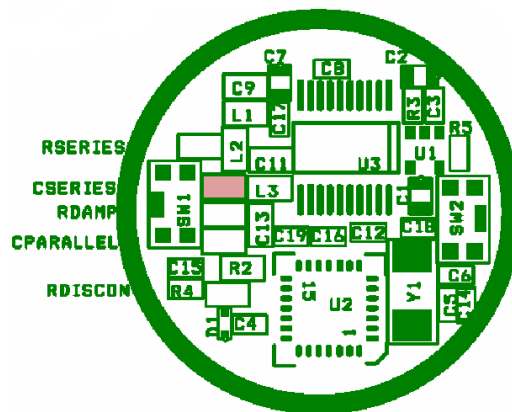


Figure 1: Component positions on M1-mini, C_{series} is red-marked

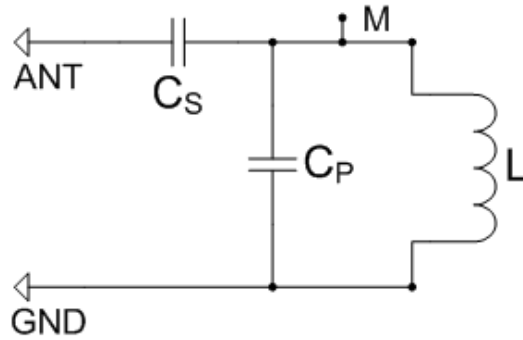


Figure 2: Electric schema of the external antenna

Design and calculation of inductivity L (antenna)

Formula: inductivity from coil/antenna:

$$L = N^2 \mu_r \mu_0 A / I \quad (1)$$

N , number of windings (normally: 1 – 3)

μ_r , relative permeability (approximately 1 (vacuum))

μ_0 , magnetic field constant ($1,257 * 10^{-6} Vs/(Am)$)

A , area (profile of coil)

I , current ($40mA$)

Current consumption is approximated over difference between 'active mode' ($50mA$) and 'idle mode' ($10mA$) (taken from 'M1 Mini Reference Guide').

Optional:

Direct measurement of inductivity from coil (without predesign)

Determination of parallel capacity C_P

Formula: resonance frequency from resonant circuit:

$$2\pi f = \frac{1}{\sqrt{L * C_P}} \quad (2)$$

$$C_P = \frac{1}{4\pi^2 f^2 L} \quad (3)$$

L , inductivity of coil/antenna
 f , resonance frequency (13,56MHz)

$$C_P \sim \frac{1}{L} \sim \frac{1}{A} \quad (4)$$

Determination of serial capacity C_S

Can be neglected at the moment (it should be quite a low value for C_s) and replaced with a short circuit.

Attach external antenna to SkyeModule M1-mini

Solder antenna to pin 1 (GND) and 2 (ANT), orientation is not relevant if capacities are bipolar.

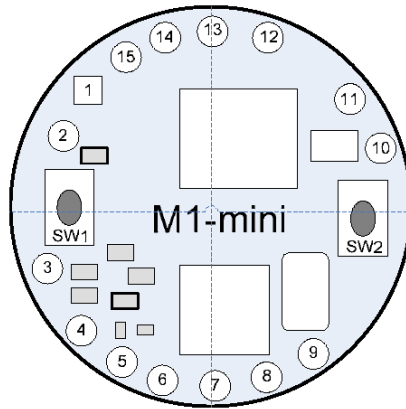


Figure 3: Pin locations on SkyeModule M1-mini

Optimization of capacities

Maximize at point M the amplitude of voltage by modifying the parallel capacity C_P . Next maximize at point M the amplitude of voltage by modifying the serial capacity C_S .