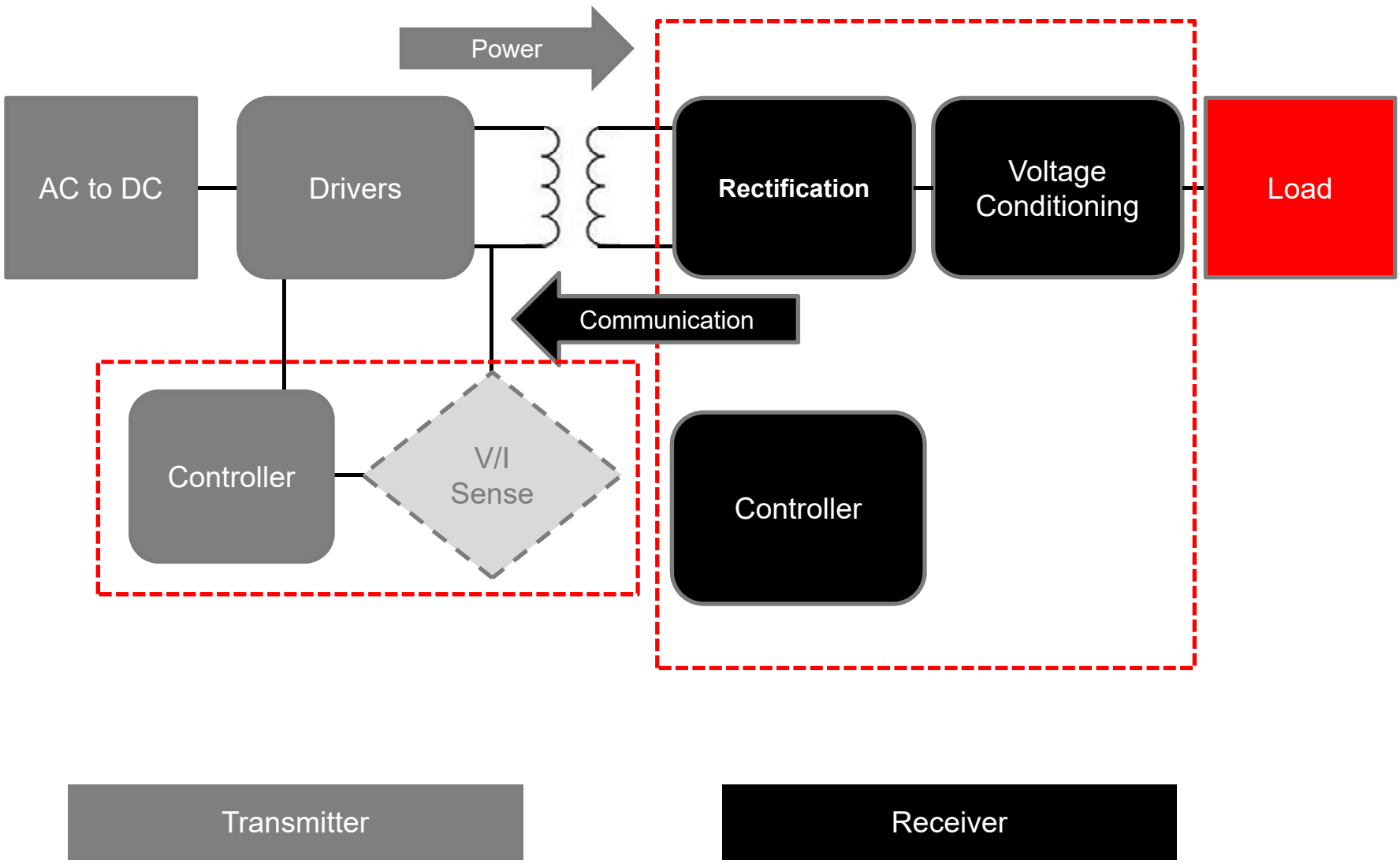
Wireless Power Receiver
RX Coil Tuning Guide

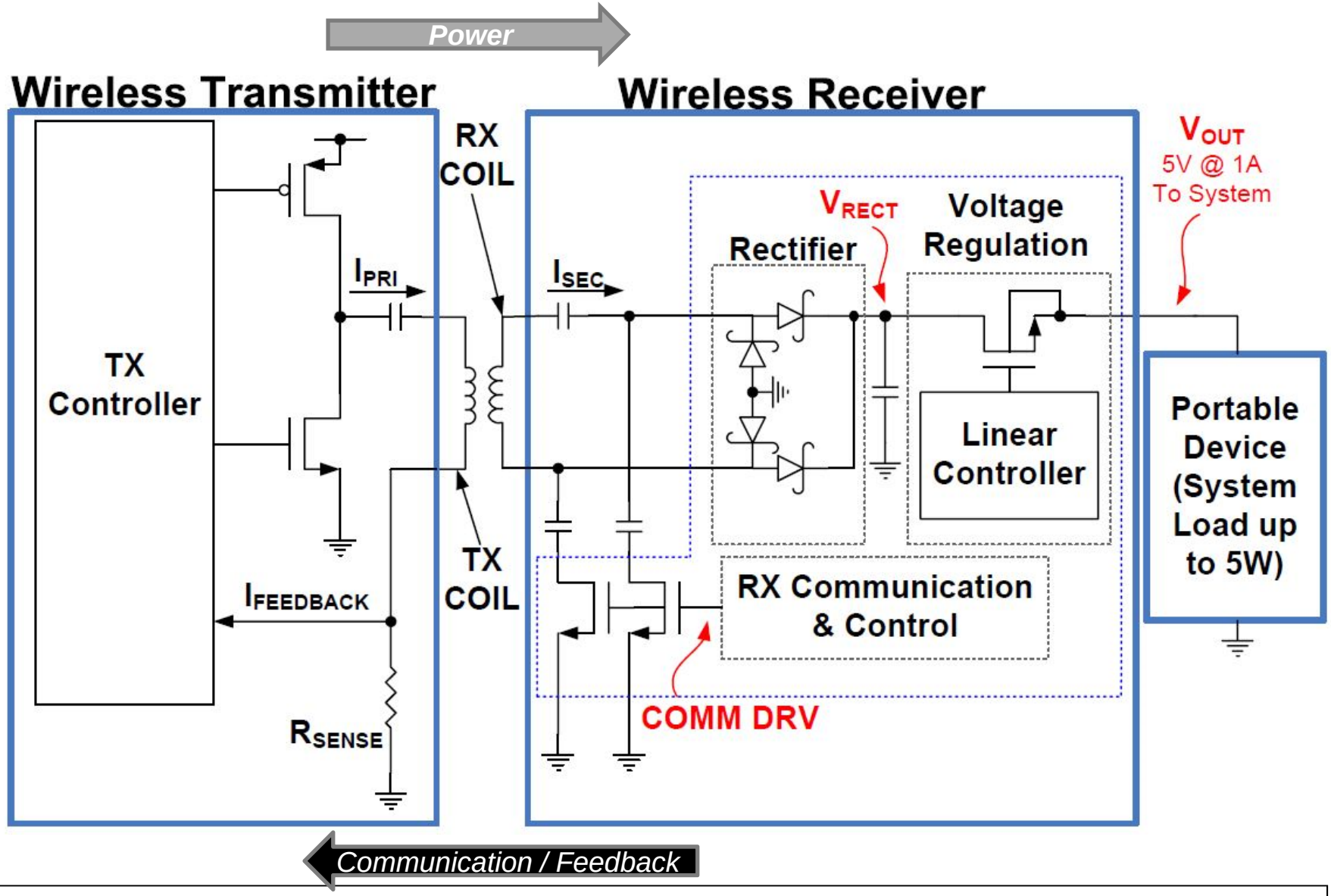
Version 1.0

April 2022

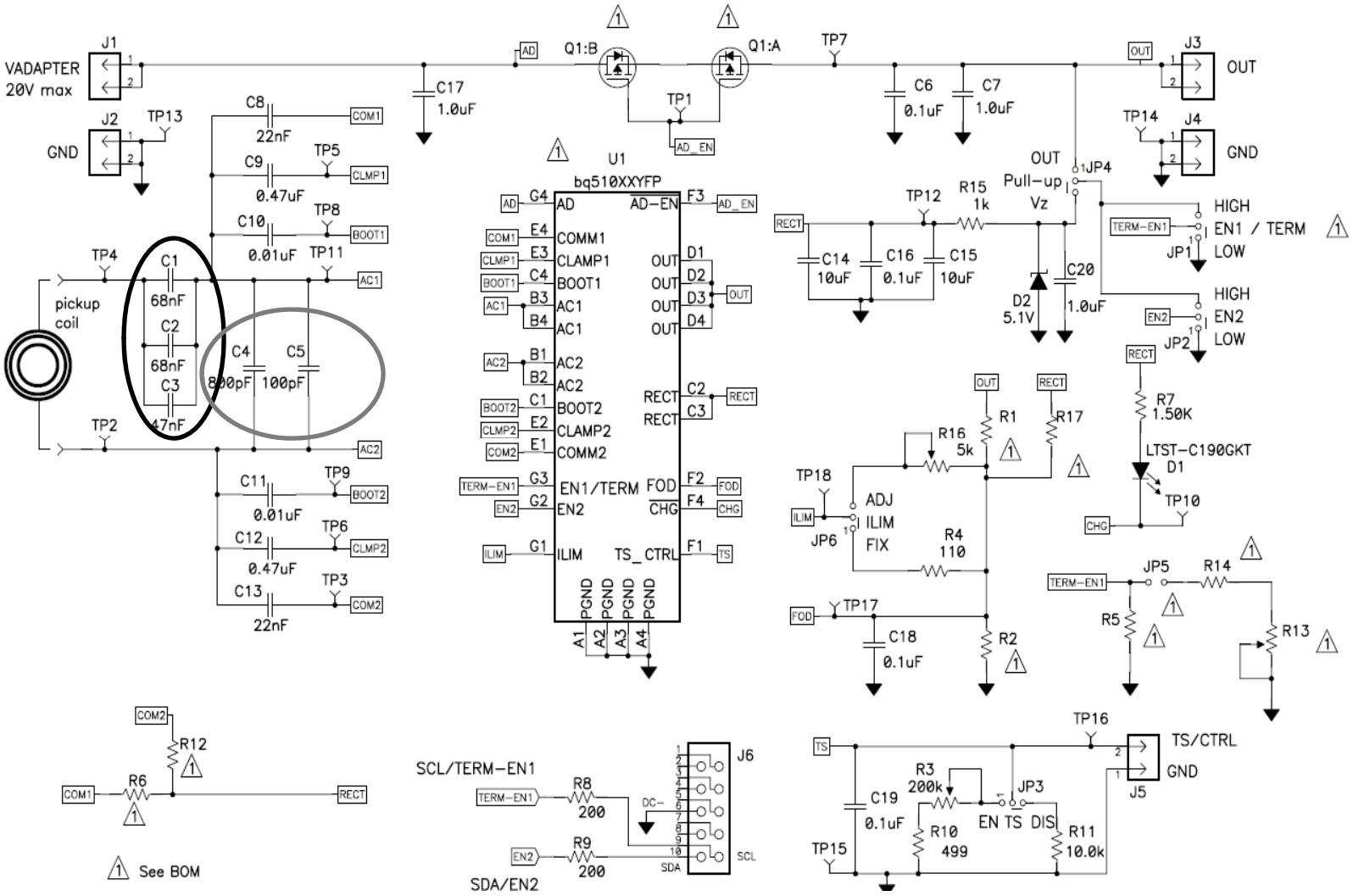
bqTESLA Wireless Solutions for WPC



Wireless Power System Diagram



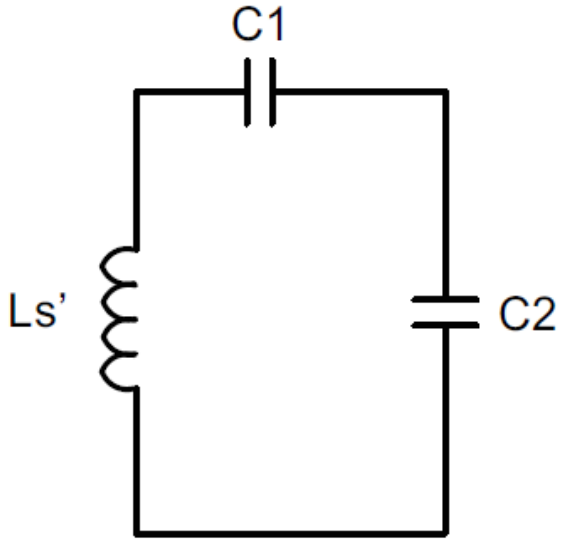
BQ510XX EVM/Reference Design



Series and Parallel Resonant Capacitor and Coil Inductor

Series and Parallel Resonant Capacitor and Coil Inductor

- The capacitors C1 (series) and C2 (parallel) make up the dual resonant circuit with the receiver coil
- These two capacitors must be sized correctly
- Ls is the coil inductor on the receiver
- Ls and Ls' need to be measured



Series and Parallel Resonant Capacitors Calculation

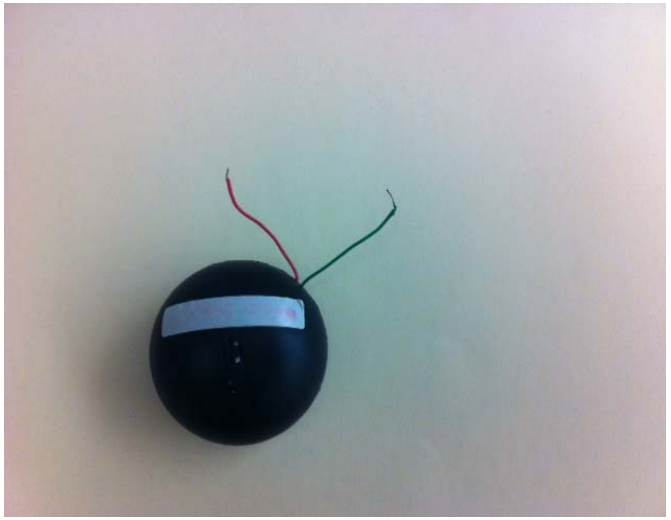
$$C1 = \left[\left(f_S \times 2\pi \right)^2 \times L_S' \right]^{-1}$$ Equation (01)

$$C2 = \left[\left(f_D \times 2\pi \right)^2 \times L_S - \frac{1}{C1} \right]^{-1}$$ Equation (02)

- Equation (01): Calculates C1 using the measured value of Ls'
- Equation (02): Calculates C2 using the measured value of Ls and the calculated value of C1
- f_S: is 100KHz +5%/-10%
- f_D: is 1MHz ±10%

Ls Coil Measurements

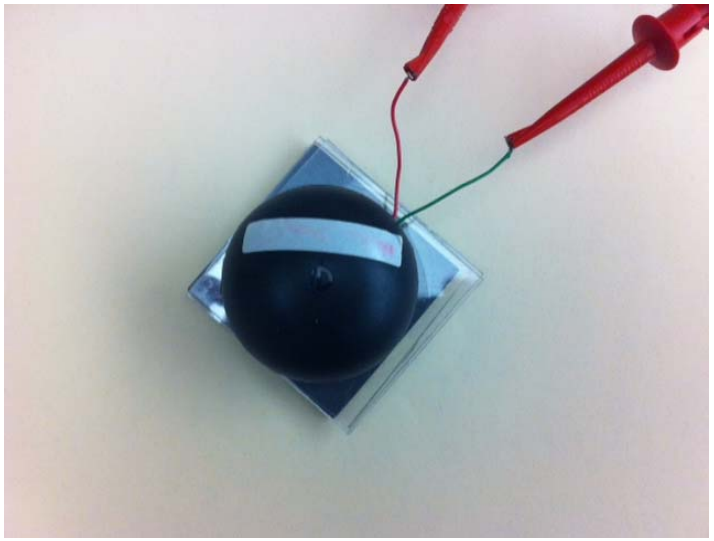
- Ls or the free-space inductance: Inductance of the secondary coil away from transmitter pad
- Inductance will change with distance and other objects around the coil.
- Measurement of coil inductance should be made in final configuration inside the case with shields and battery in place.
- RX coil is tuned to 100kHz
- Inductance is to be measured at 1-V RMS



Example: Inductance of the secondary coil away from transmitter pad and made in final configuration inside the case with shields and battery in place.

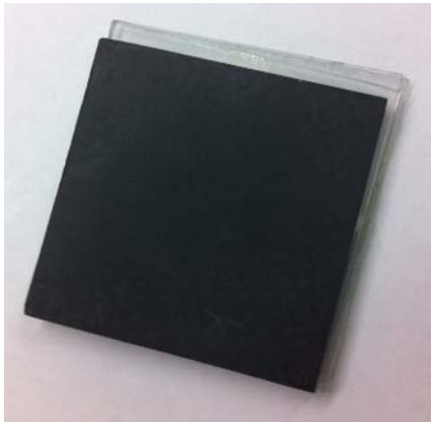
Ls' Coil Measurements

- Ls': Inductance of the secondary coil when placed on transmitter pad.
- The primary shield is to be 50 mm x 50 mm x 1 mm of Ferrite material PC44 from TDK Corp.
- The gap d_Z is to be 3.4 mm.
- The center of the Secondary Coil and the center of the primary Shielding shall be aligned.
- Inductance will change with distance and other objects around the coil.
- Measurement of coil inductance should be made in final configuration inside the case with shields and battery in place.
- RX coil is tuned to 100kHz
- Inductance is to be measured at 1-V RMS



Example: Secondary coil (made in final configuration inside the case with shields and battery in place) when placed on transmitter pad. Secondary Coil and the center of the primary Shielding shall be aligned.

The Primary Shielding

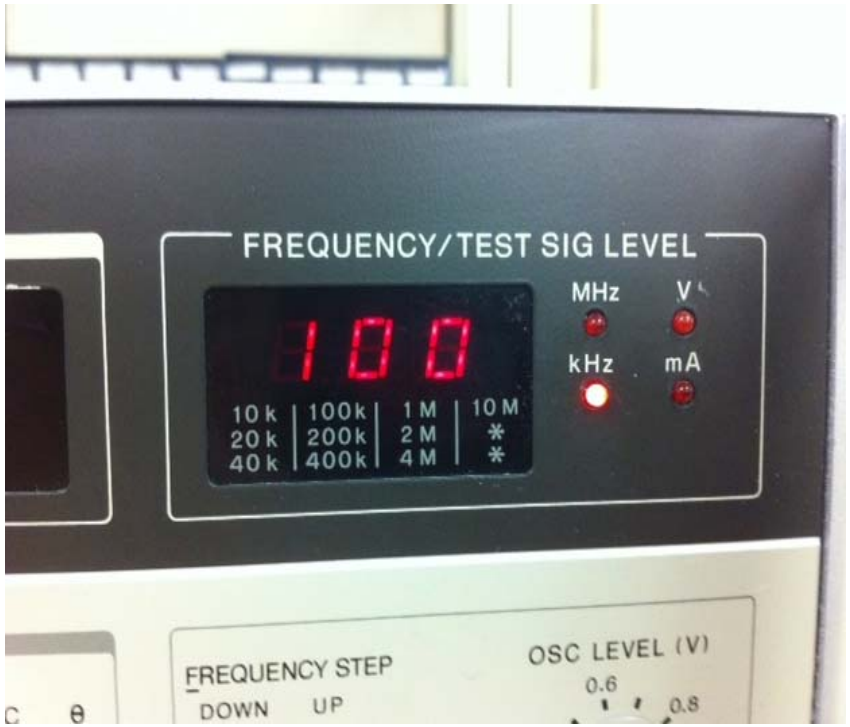


The primary shield is to be 50 mm x 50 mm x 1 mm of Ferrite material PC44 from TDK Corp.

The distance from the Receiver Interface Surface to the primary Shielding is 3.4 mm.

Example on Tuning Receiver Coil

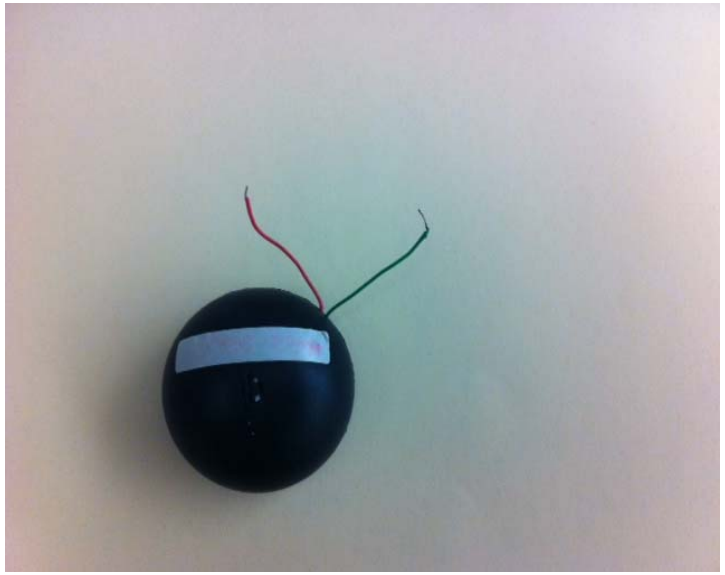
Example: Step by Step Tuning Receiver Coil



Step 01: Set the tuning frequency to 100KHz

Step 02: Set the tuning voltage to 1-V RMS

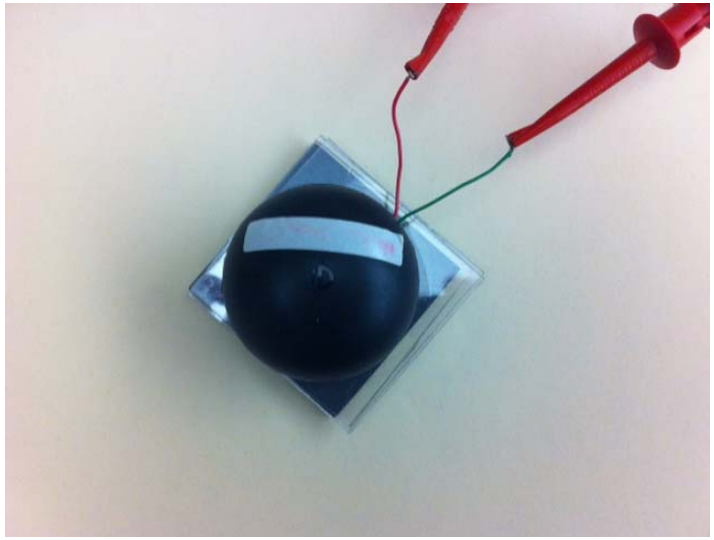
Example: Step by Step Tuning Receiver Coil



Step 03: Measure the inductance of the secondary coil away from transmitter pad and made in final configuration inside the case with shields and battery in place.

Step 04: Record Ls=10.791uH

Example: Step by Step Tuning Receiver Coil



Step 05: Measure the inductance of the secondary (made in final configuration inside the case with shields and battery in place) when placed on transmitter pad. Secondary Coil and the center of the primary Shielding shall be aligned.

Step 06: Record Ls'=15.606uH

Example: Step by Step Tuning Receiver Coil

$$C1 = \left[\left(f_S \times 2\pi \right)^2 \times L'_S \right]^{-1}$$

Equation (01)

Step 07: Use Equation (01) and calculated C1 Max and C1 Min.

fs: is 100KHz +5%/-10%

C1(min)=1/((105kHz*2π)^2*15.606uH)

C1(min)= 147.22nF

C1(max)=1/((90KHz*2π)^2*15.606uH)

C1(max)=200.38nF

Step 08: chose a value between 147.22nF and 200.38nF

For this example we chose a standard values

2x68nF+1x47nF=183nF

(68nF//68nF//47nF)

C1=183nF

Example: Step by Step Tuning Receiver Coil

$$C2 = \left[\left(f_D \times 2\pi \right)^2 \times L_S - \frac{1}{C1} \right]^{-1}$$

Equation (02)

Step 09: Use Equation (02) and value of C1 calculated in previous step and calculate C2 Max and C2 Min.

f_D: is 1MHz ±10%

C2(min)=1/((1.1MHz*2π)^2*10.791uH-1/183nF)

C2(min)= 1.96nF

C2(min)=1/((0.9MHz*2π)^2*10.791uH-1/183nF)

C2(max)=2.94nF

Step 10: chose a value between 1.96nF and 2.94nF

For this example we chose a standard values

1800pF+560pF=2.36nF

(1800pF//560pF)

C2=2.36nF

END