Application Note

AN001018

AS5715

How to Calculate the TX - LC Tank AC Conductance

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Content Guide

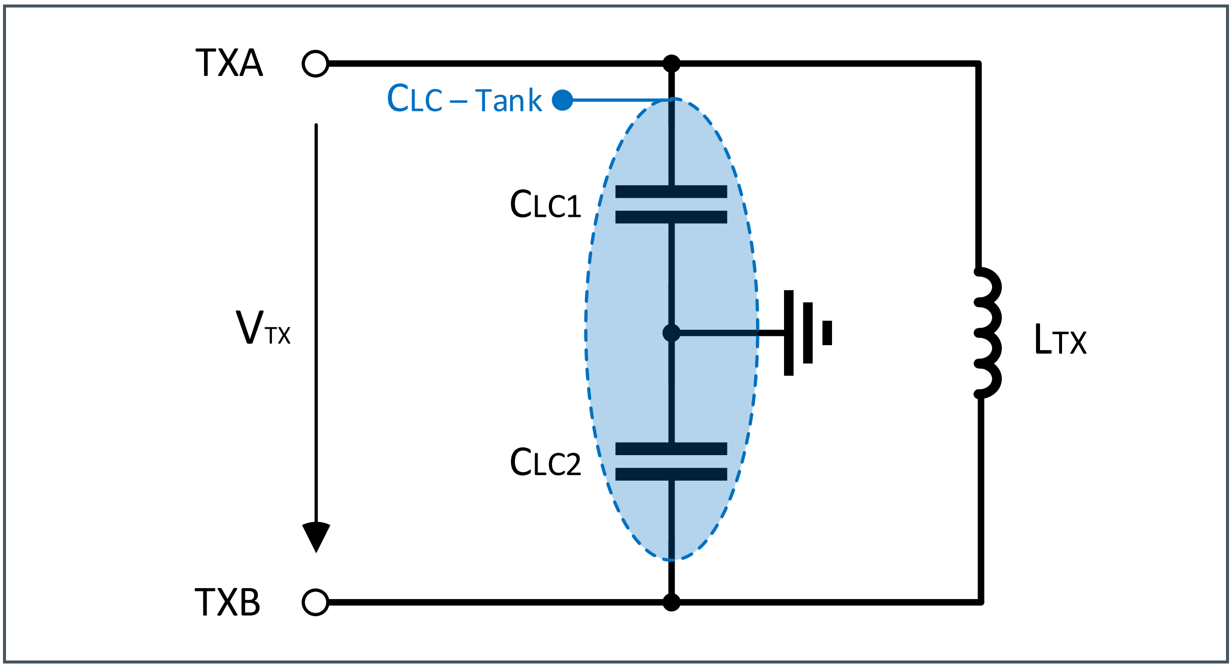
1 Introduction

The purpose of this document is, to give a description of how to calculate G_{TX}, the conductance of the LC – Tank relating to the **ams** inductive position sensor AS5715.

2 Resonance Frequency

2.1 Resonance Frequency of the LC – Oscillator

Figure 1:
LC – Tank



The oscillating frequency, f_{TX}, depends on the LC – Tank and can be calculated according to the following equations.

Equation 1:

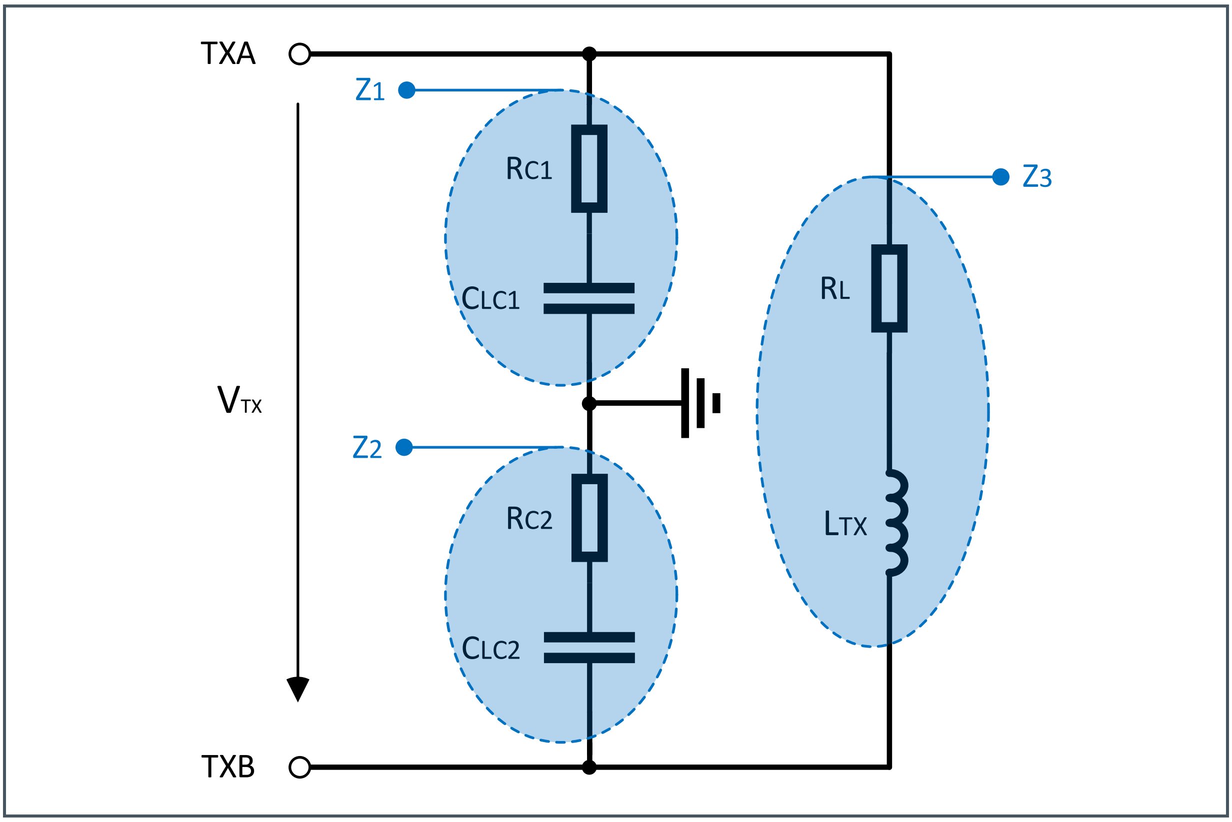
$$C_{LC-Tank} = \frac{C_{LC1} * C_{LC2}}{C_{LC1} + C_{LC2}}$$

Equation 2:

$$f_{TX} = \frac{1}{2 * \pi * \sqrt{L_{Tx} * C_{LC-Tank}}}$$

3 Real Parallel Resonant Circuit

Figure 2:
Equivalent Circuit Diagram of the Real PRC



For the real parallel resonant circuit, the parasitic effects of the components must be taken into account.

The circuit diagram above is one example of how the resistive losses of the capacitors and the coil can be considered.

3.1 Impedances of the LC – Tank

In the following chapter it is described, how to calculate the partial impedances, the total impedance and subsequently the conductance of the LC – Tank.

3.1.1 Partial Impedances of the LC – Tank

Equation 3: Partial Impedances Z_{12} and Z_3

$$Z_1 = R_{C1} - j * \frac{1}{\omega_0 * C_{LC1}}$$

$$Z_2 = R_{C2} - j * \frac{1}{\omega_0 * C_{LC2}}$$

$$Z_{12} = Z_1 + Z_2$$

$$Z_3 = R_L + j * \omega_0 * L_{Tx}$$

With $\omega_0 = 2 * \pi * f_{TX}$

3.1.2 Total Impedance of the LC – Tank

Equation 4: Total Impedance Z_0

$$Z_0 = \frac{Z_{12} * Z_3}{Z_{12} + Z_3} = Re\{Z_0\} + Im\{Z_0\}$$

3.2 Conductance of the LC – Tank

The LC – Tank Conductance is defined at *Im{* Z_0 *}=0*.

When *Im{* Z_0 *}=0*, then the system is in resonance and therefore:

Equation 5: G_{TX}, LC – Tank Conductance

$$G_{TX} = \frac{1}{Re\{Z_0\}}$$

4 Conclusion

The conductance determined by the given formulas is only an approximation.

Possible variations of the values for C_{LC1}, C_{LC2} and L_{TX} due to manufacturing tolerances or due to temperature changes are not taken into account.

It is recommended to measure the exact value of the LC – Tank conductance by using for example a network analyzer or a LCR Meter.

It must be ensured that the value of G_{TX} is within the specification over the entire temperature range of the application.

5 Revision Information

Changes from previous version to current revision v1-00	Page
Initial version	all

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

6 Legal Information

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