Application Report
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Measuring R_p of an L-C Sensor for Inductive Sensing

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ABSTRACT

Three methods are introduced for the measurement of the R_P value of an L-C tank circuit using common lab equipment.

Contents

1 Introduction

When designing an application using TI's LDC series of inductive sensors, it is necessary to know the L-C sensor's equivalent parallel resistance R_P at the sensor's resonant frequency. The R_P value changes as the target is moved; the minimum R_P occurs when the metal target is closest to the sensor. The maximum R_P occurs when the target is at the farthest distance. Accordingly, both values should be measured to ensure that the R_P value is within the proper range as defined in the datasheets.

2 R_P Measurement Method 1 – Using a Network Analyzer

A vector network analyzer can measure the complex impedance of the inductor over a range of frequency. The X_L (reactance) and R_S (series loss resistance) values are displayed at a selected frequency. Then use the formula shown in the figure to calculate the R_P at desired frequency.

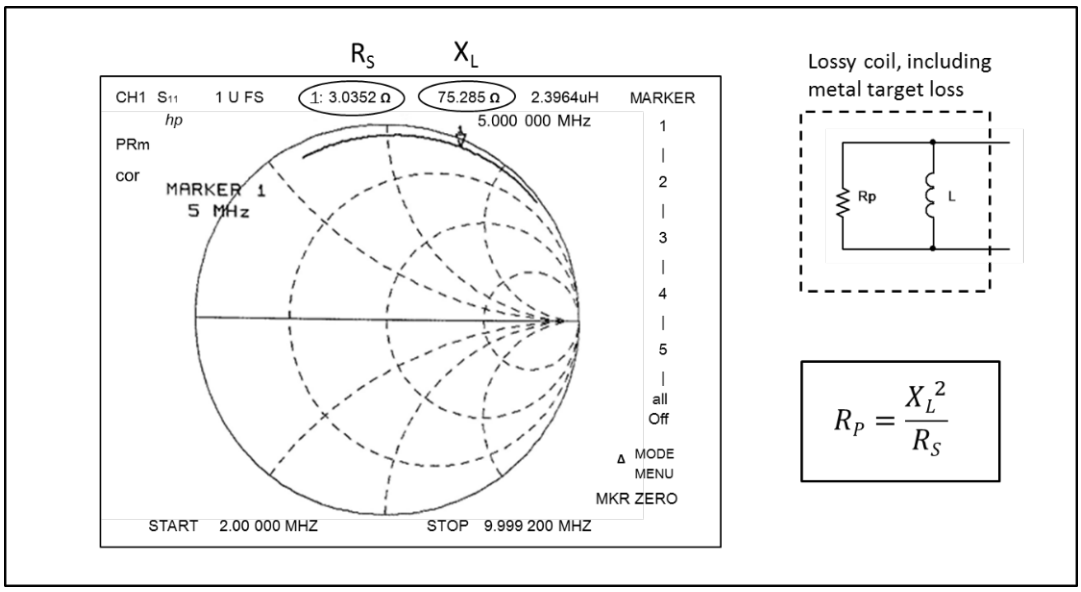

Figure 1. Using a Network Analyzer to Find R_P.

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3 R_P Measurement Method 2 – Using an Impedance Analyzer

An impedance analyzer can measure the impedance of the inductor over a range of frequency. Some impedance analyzer has built-in R_P measurement function. If not, the R_p value can be calculated using the L_S (Inductance) and R_S (series loss resistance). Use the formula shown in the figure to calculate the R_P at desired frequency.

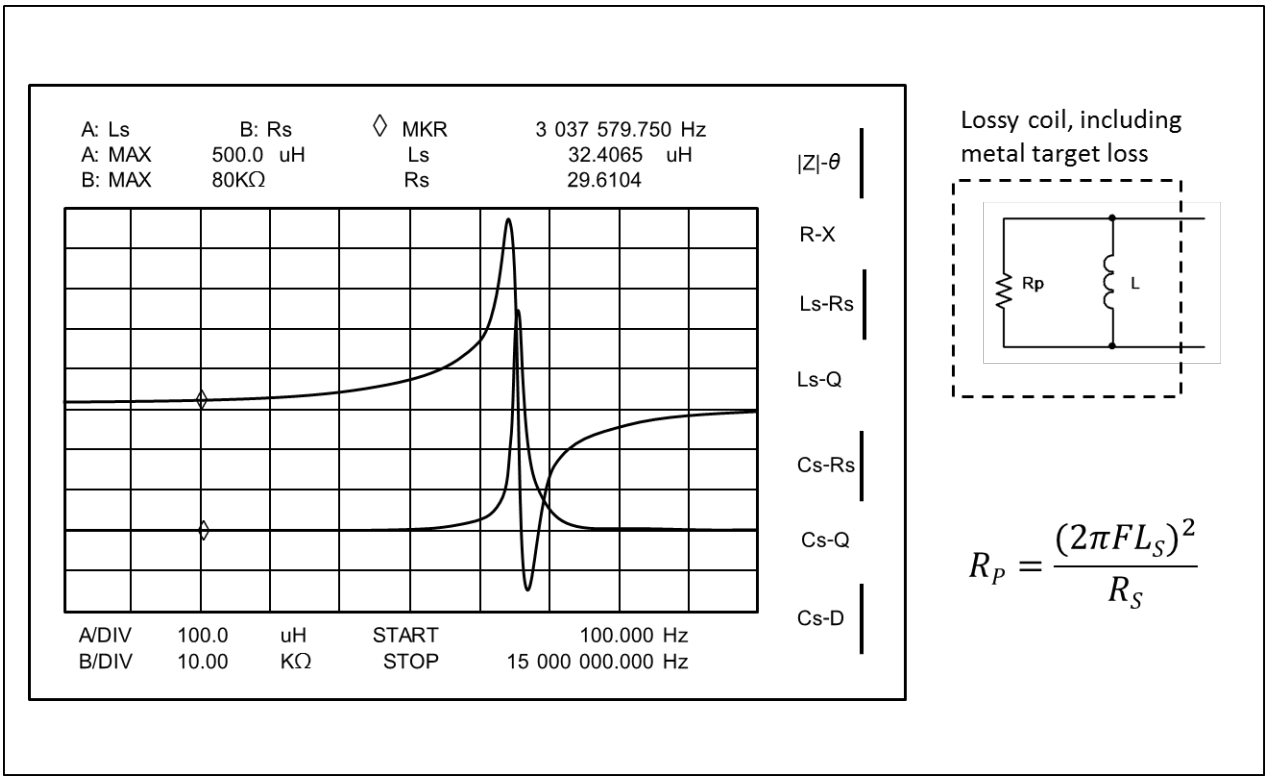

Figure 2. Using an Impedance Analyzer to Find R_P.

4 Measurement Method 3 – Using a Signal Generator and an Oscilloscope

Use a sine-wave signal generator and oscilloscope, as illustrated in Figure 3, below. Note that the LC sensor capacitor is required for this method, therefore the R_P value is measured at the resonant frequency only. Adjust the frequency so that the VPP1 reaches maximum value (resonance occurs). Adjust the R such that VPP2=2VPP1. Repeat the above steps if needed to get better accuracy. Then use an ohm meter to measure R. The value of R is the R_P of the LC sensor.

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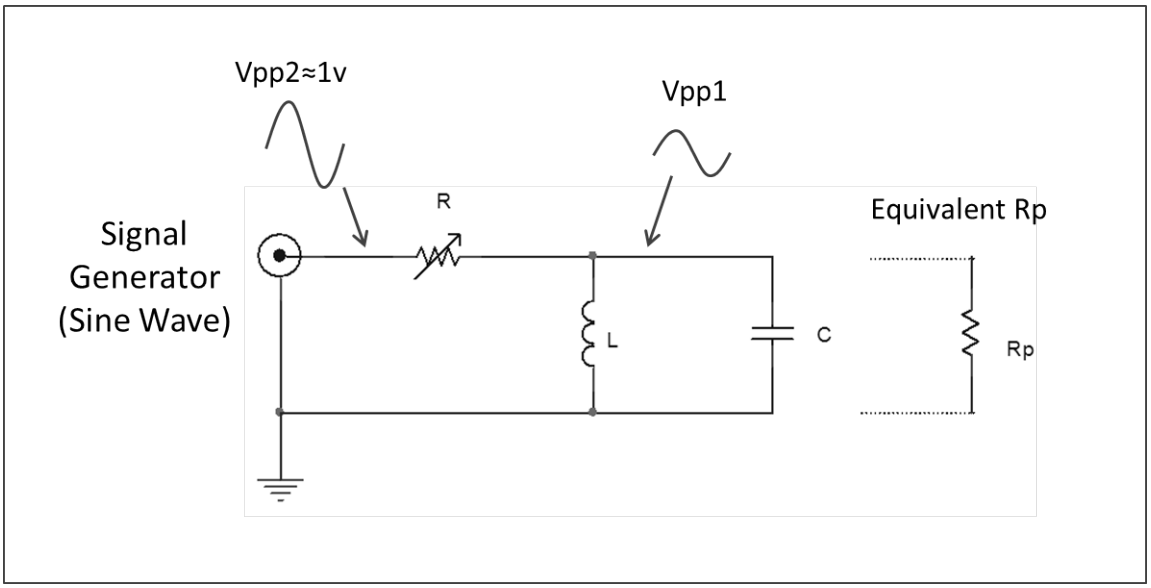

Figure 3. Using a Signal Generator and Oscilloscope to Find R_P.

5 Conclusion

To properly configure an LDC for optimum system operation, it is necessary to know the R_P range for the system. The methods described in this application note can be used to measure the expected R_P range, and combined with the guidance found in application note *Configuring Inductive-to-Digital-Converters for Parallel Resistance (R_P) Variation in L-C Tank Sensors*, enable the proper configuration of the relevant LDC device.

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