

Measuring Motor Inductance and Impedance using an AC Source



Introduction

The inductance or impedance of a motor can be a key parameter during the manufacture and servicing of both AC and DC motors. The inductance of both AC and DC motors can be measured using a low voltage AC source. This application note discusses how this can be accomplished.

Application

A low voltage AC signal can be applied to measure the inductance. The voltage should be low enough so as not to apply enough current to damage the motors windings.

For a DC motor the AC source is connected to the armature winding. For an AC motor the AC source is connected to each stator winding. An AC signal from the source is applied and both the voltage and current is measured. The following equations can then be used to calculate the inductance from the measured voltage and current.

Calculate the impedance of the winding using the formula below and the measured voltage and current from the AC source. The QuadTech 31000 Series has sense leads to eliminate resistance and inductance in the leads from the AC source to the motor winding. This feature should be used to minimize errors in this measurement.

$$\text{Impedance (Z)} = \frac{\text{Voltage (V)}}{\text{Current (i)}} \quad \text{Ohms}$$

The impedance of the winding is a vector summation of the DC resistance and reactance of the winding. The DC resistance can be measured as indicated below. Some AC sources also have the capability of producing DC voltages. The use of DC can also be used to determine the resistance using the same formula for impedance only using DC.

$$\text{Impedance (Z)} = \sqrt{\text{Resistance}^2 + \text{Reactance}^2}$$

We can solve for reactance using the formula for impedance being made up of DC resistance and reactance.

$$\text{Reactance} = \sqrt{\text{Impedance}^2 - \text{Resistance}^2} \quad \text{Ohms}$$

The reactance of a winding is shown in the formula below. The frequency is normally 60Hz and can be programmed on the AC source.

$$\text{Reactance} = 2 * \pi * \text{Frequency} * \text{inductance} \quad \text{Ohms}$$

We can solve for inductance using the formula for reactance plugging in frequency and solving for inductance in henries.

$$\text{Inductance (L)} = \frac{\text{Reactance}}{2 * \pi * \text{Frequency}} \quad \text{Henry}$$

Measurement of DC Motor Resistance

For the winding resistance use an ohmmeter, such as the QuadTech LR2000 Milliohmmeter. For a dc motor measure the resistance between the 2 armature wires.

