Linear Variable Difference Transformer (LVDT)

In this experiment, the characteristics of a Linear Variable Difference Transformer (LVDT) will be investigated. An LVDT is a position transducer. The LVDT is constructed by winding three coils of wire on a common tubular core as shown in Figure 2. The center coil is the primary winding and is driven by an external AC source. The other two coils are secondary windings. A plunger with a ferrite core is then fitted through the center of the tubular coils.

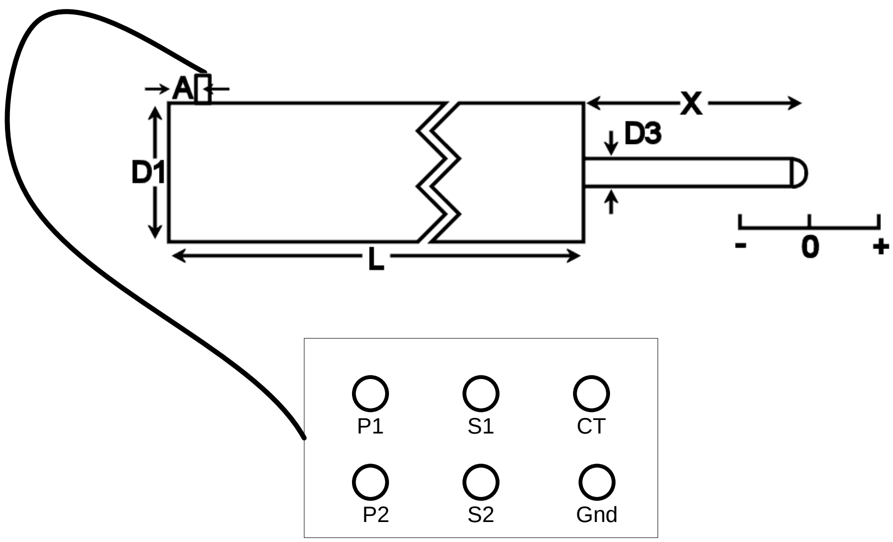

Figure 1. RDP, Model ACT, LVDT Displacement Transducer with connection box

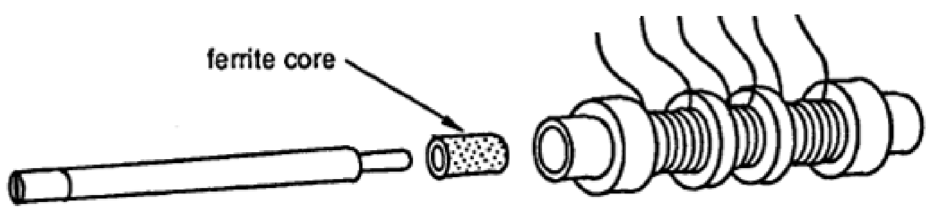

Figure 2. LVDT Basic Construction

Ferrite materials provide an excellent path for magnetic flux. The ferrite core is shorter than the axial length of the three coils as shown in Figure 3. As the ferrite core is moved within the coils, its position determines how well the primary is coupled to the secondaries. Whichever secondary winding is overlapped by the ferrite core will be better coupled to the primary and thus receive more energy from the primary than the other secondary winding. Therefore by measuring the relative output voltages of the secondary windings, the position of the plunger can be determined.

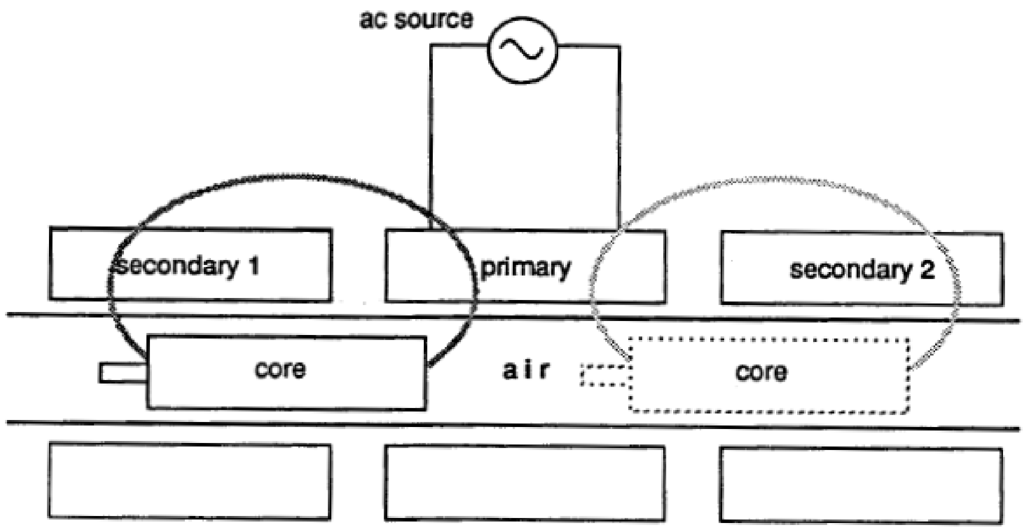

Figure 3. LVDT Cutaway View Showing Flux Paths

One method of utilizing the LVDT signals is to connect the secondaries in a series opposition connection as shown in Figure 4. Notice the polarity "Dotting" of the windings. In this configuration, the output voltage, Vout, will be zero when the ferrite core is in the center of the secondary windings. This is due to the secondary voltages being equal in magnitude but exactly 180º out of phase. As the ferrite core is moved through the windings, the secondary winding that is nearest the core will produce the greatest output voltage. If the output voltage is plotted as a function of core position, a characteristic curve similar to that shown in Figure 5 will result.

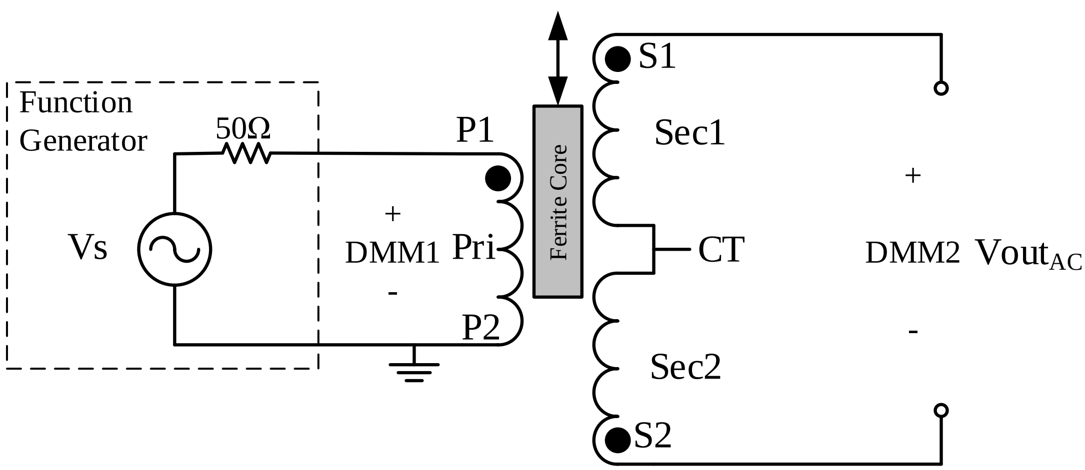

Figure 4. LVDT Series-Opposition Connections

As shown in Figure 5, there exists a region on either side of the center in which the characteristic curve is nearly linear and can be used for determining the position of the ferrite core within the LVDT. Due to the resistance of the signal source it is more accurate to plot the ratio of Vout to the primary voltage as the y-axis variable.

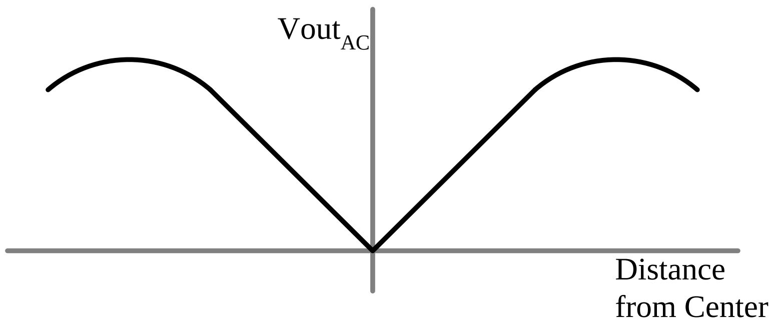

Figure 5. Transfer Characteristic for Series Opposition Connection

Procedure

1. The RDP-ACT, LVDT Transducer is already mounted on the TK294 Test Rig.
2. Construct the circuit shown in Figure 4.
3. Set the signal generator to output a 5kHz, $3V_{RMS}$ sine wave.
4. Connect a DMM to the input and output of the LVDT (DMM1 and DMM2 as shown in Figure 4.)
5. Set the micrometer to 0.0 mm and slide the micrometer assembly against the LVDT plunger. Continue to push the slider and the plunger to the 75mm (7.5cm) position on the Test Rig ruler. **Lock the slider at this position with the thumbscrew.**
6. Check the reading of DMM1 and adjust the amplitude of the signal generator until DMM1 reads 5 V_{RMS} +/-0.05 V_{RMS}.
7. Using the micrometer, move the plunger through the LVDT coils at 1mm steps from 0mm to 20mm. Record the position and the DMM voltages for each step.
8. By turning the micrometer knob only, carefully locate the position that produces the minimum Vout voltage. Record this position as the “Zero Position.” (It will probably NOT be exactly one of the 1mm increments). This zero position measurement will be subtracted from each of the measurements in step 6 to produce a centered position reading. Include this position and its associated DMM voltages in the table generated in step 7.

Results

1. Plot the ratio of the output RMS voltage (DMM2) to the primary RMS voltage (DMM1), as a function of the centered position reading. Determine the static sensitivity of the LVDT.
2. Compare the measured static sensitivity value to the value calculated from the data sheet. The LVDT data sheet is on Canvas. (Remember that the Sensitivity specification in the data sheet is for the full scale displacement.)