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Determination of Stray Losses Using myDAQ

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Abstract: DC machine is a versatile electrical machine. Its particular test is used for DC shunt motors and generators. It is arrived at the stray losses from measured values of armature losses and copper losses for given load current. Efficiency can be measured from these values. The machine is run up slightly beyond its normal speed and then supply is cut off from the armature while keeping the field excited. The armature slows down and its stored energy is used to meet therotational losses, i.e., friction. The required data of a machine are sensed by myDAQ and hence, the losses are determined. After determination of the losses, DC machine efficiency is determined while it is acting as motor. This study introduces automation of the machine to calculate the losses in a machine.

Key words: DC shunt motor, myDAQ, LabVIEW, efficiency, determination, DC machine

INTRODUCTION

Stray losses are normally taken as one percent of the output. This assumption is not suitable for smaller machines. For overcoming this problem the method is designed for measuring stray losses.

This new method takes into account, the cooling of the machine under light load conditions. More suitable theory is available to quantify this parameter. The proposed method gives good results and a test method that will predict the amount of stray losses and will help in future designs (Popescu, 2006; Bishop, 2004).

Since, DC machines are used for speed control and different load cycles, the commercial importance of these losses is not great, practically speaking. However, their increased demands an attempt is made to measure stray losses by an automatic switching and accurate time calculation using LabVIEW interfaced with myDAQ.

MATERIALS AND METHODS

Hardware implementation

Operation of hardware; Step 1: Initially, C1 and C2 are in ON position and motor is taken to the rated speed say 1000 rpm then proximity sensor detects the speed when speed crosses 1000 rpm and then automatically the contactor C1 gets OFF and C2 gets OFF. Then the time elapsed is noted till the instant speed reaches to 600 rpm.

Step 2: In the next step C1 and C2 are in ON position and motor is run to reach say 1000rpm then proximity sensor detects when speed crosses 1000 rpm and then automatically the contactor C1 gets ON and C2 gets OFF Then the time elapsed is noted up to the instant speed reaches to 600 rpm (Fig. 1-3).

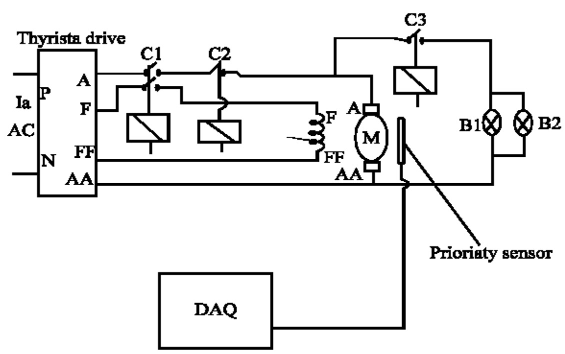

Fig. 1: Circuit diagram

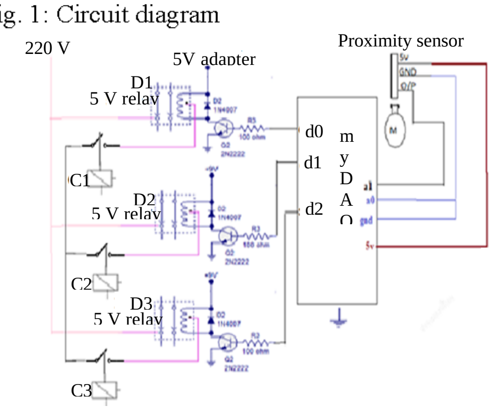

Fig. 2: Interfacing of myDAQ

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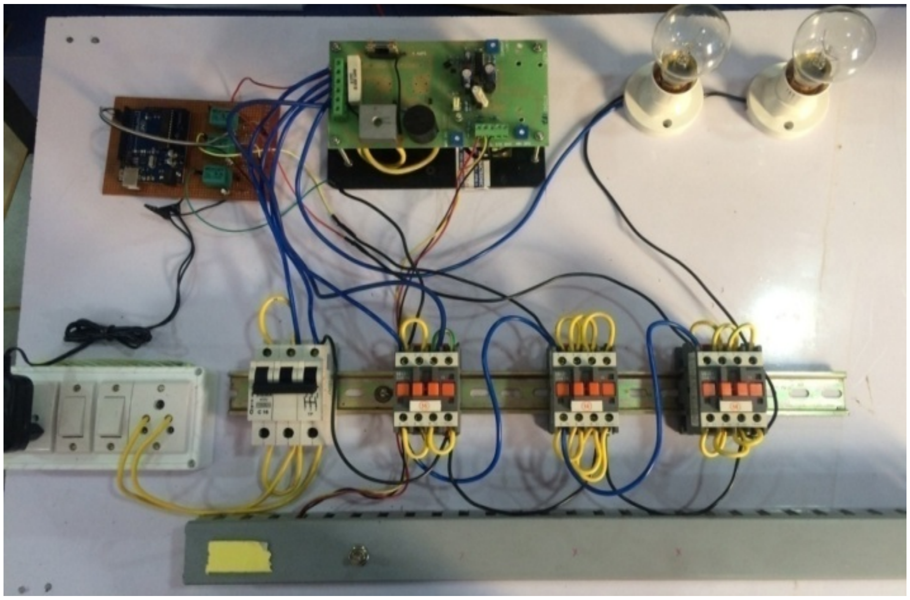

Fig. 3: Hardware setup

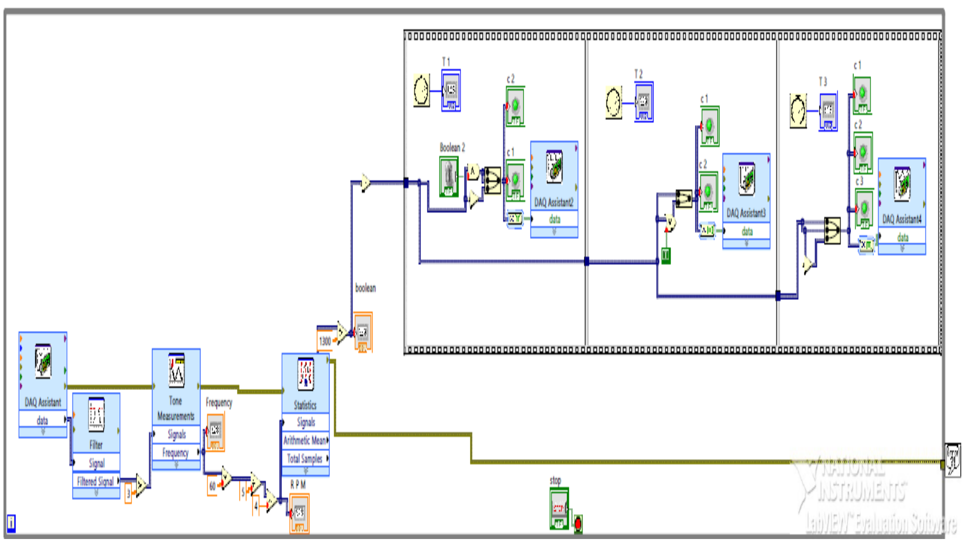

Fig. 4: Programming (Block diagram)

Step 3: Finally in the next step C1 and C2 are in ON and motor is run to reach position takes, till the rated speed say 1000rpm, then proximity sensor detects when speed crosses 1000 rpm and then automatically the contactor C1 gets and C2 gets OFF and C3 is in ON position. Then the time is noted till the instant speed reaches to 600 rpm. This all operation is automatically done by myDAQ by writing a program into LabVIEW and interfacing it with myDAQ (Erdelyi, 1960; Sieron and Grant, 1956).

Software implementation: The DAQ assistant represents myDAQ in the software. LabVIEW Software is graphical and resembles block diagram. Speed of the DC shunt motor is acquired using a proximity sensor. This sensor produces a pulse whenever a tooth of a gear comes near the sensor. Output signal of DAQ assistant is passed through a filter and applied to the measurement block which measures the frequency of the signal; the frequency is multiplied by suitable constant to get RPM (Phadke *et al*., 1983). It is checked whether the RPM crosses a set value. The sequence structure has three parts. Each part measures one times. T_1-T_3 in seconds. For each step the contactor changes as explained. Calculations are done manually utilizing the three time measurements (Fig. 4).

RESULTS AND DISCUSSION

Figure 5 shows the initial condition of the panel, i.e., about to simulate the hardware model. Contactors C1 and C2 are remained off initially. Figure 6 depicts that the C1 and C2 contactors are turned on. This also gives the time the motor takes to reach rotor or preset speed. The condition of proximity sensors is demonstrated in Fig. 7. Figure 8 shows that C1 and C2 are in ON position, during this period, the motor gains the rated speed. once the motor attains the rated speed. Once the motor attains the rated speed and the speed will be recorded by proximity sensor.

Once proximity sensor gives the preset speed of the motor it communicates C1 and C2 will become OFF to show that the motor reached preset speed, i.e., 600 rpm, this condition is demonstrated in Fig. 9. The time is also recorded reach 600 rpm.

Similarly, the motor is continued to reach 1000 rpm. This was demonstrates by C1 and C2 in OFF position. A new contactor C3 is introduced as shown in Fig. 10 and it will be communicate by proximity sensor of 1000 rpm. C3 contactor is in ON position the time to reach from 600-1000 rpm is noted as shown in Fig. 11.

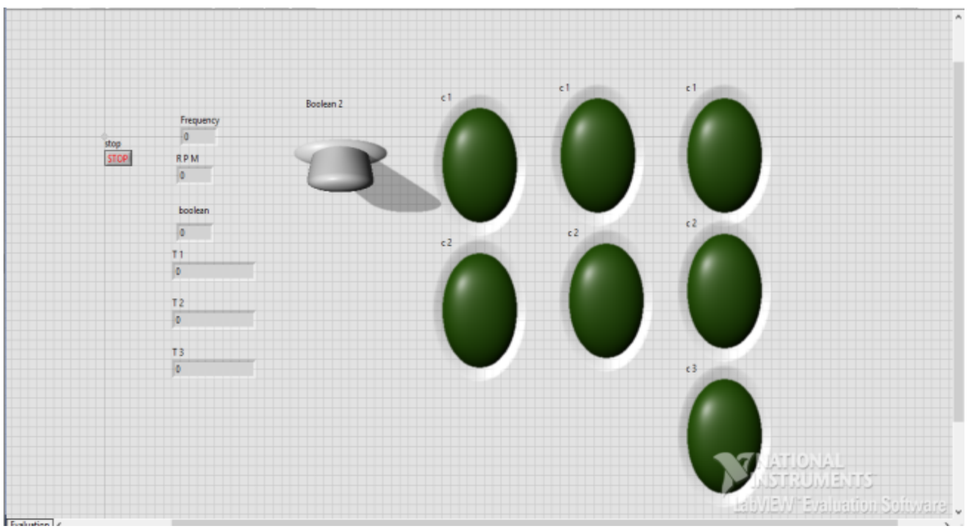

Fig. 5: Initial stage of front panel

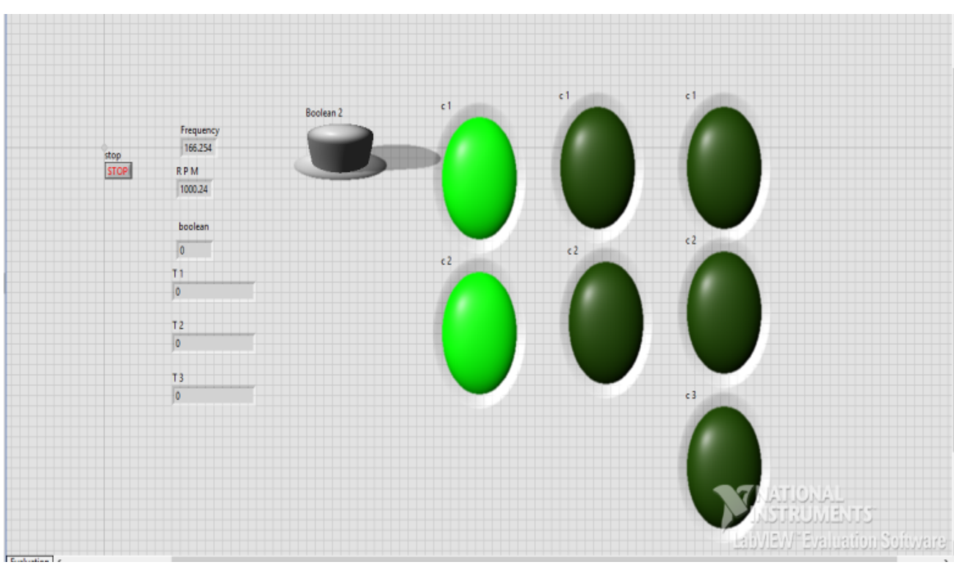

Fig. 6: C1 and C2 on

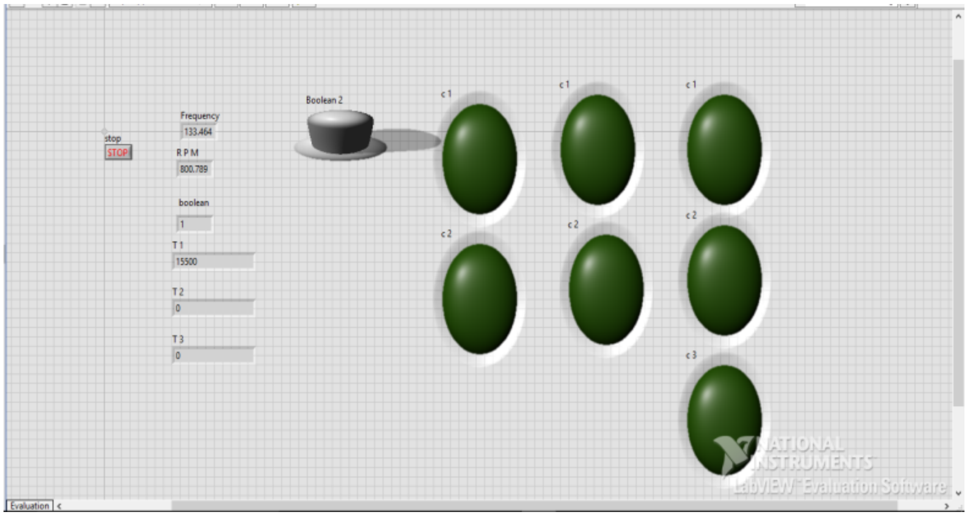

Fig. 7: C1 and C2 off

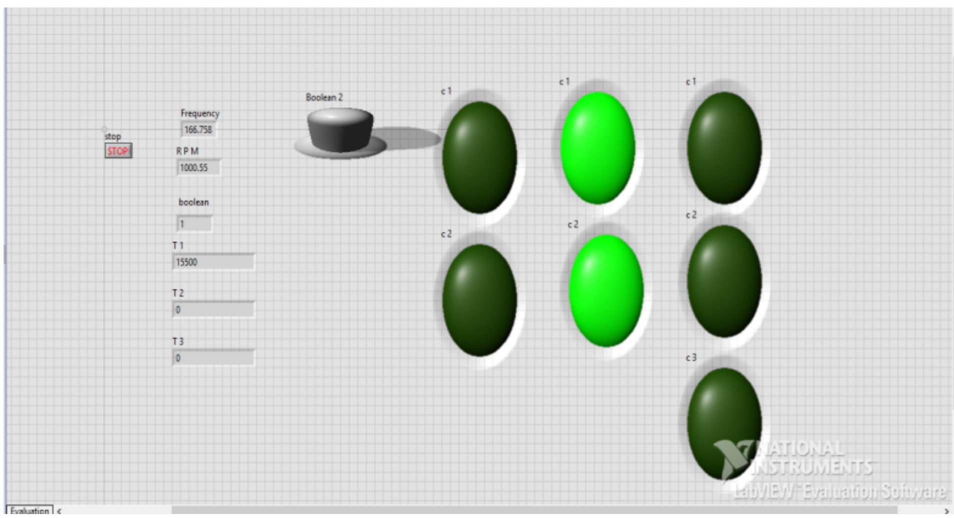

Fig. 8: C1 and C2 on

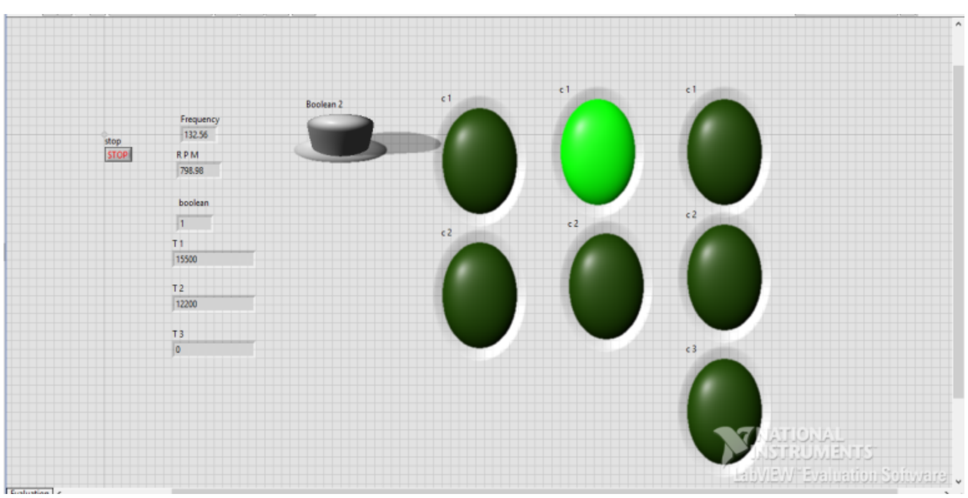

Fig. 9: Only C1 on

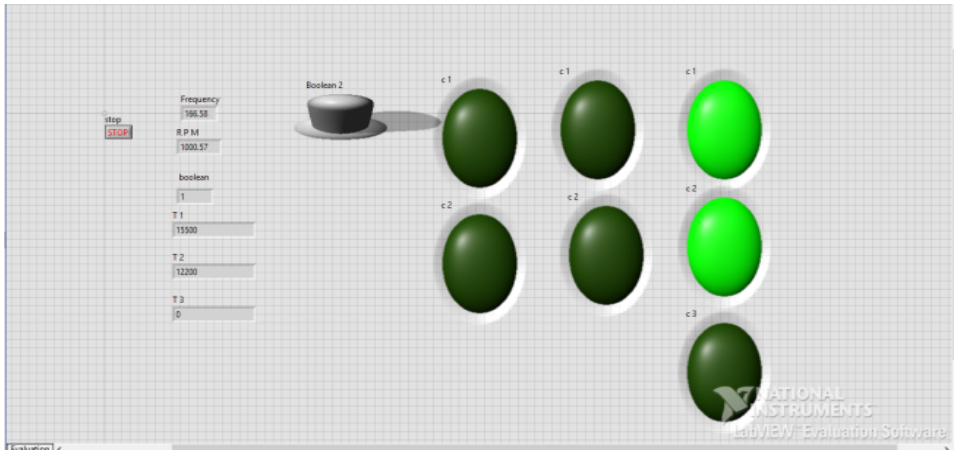

Fig. 10: C1 and C2 on

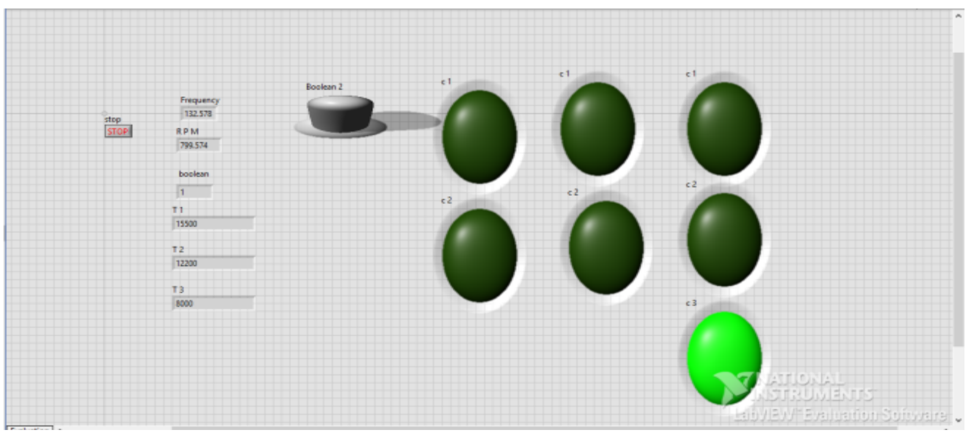

Fig. 11: Step 3 Only C3 on

Calculation:

- Rated Speed N = 1500 rpm
- Initial speed selected = 1600 rpm
- Final speed selected = 1400 rpm
- ΔN = 200 rpm
- ΔT_1 = 15.5 sec
- ΔT_2 = 12.2 sec
- ΔT_3 = 8 sec
- Field current in all the cases = 0.9 A
- In case III, at the instant the armature is disconnected from the supply
- Load voltage = 235 V
- Load current = 0.838 A
- At the instant when speed reaches 1400 rpm
- Load voltage = 196 V
- Load current = 0.706 A
- Armature resistance R_a = 1.8 Ω
- Average load voltage = 235+196/2 = 215.5 V
- Average load current = 0.838+0.706/2 = 0.772 A
- $W_{cu} = 215.3\times0.772+0.7722\times1.8 = 167.44$ W
- $W_{cu} = NJ\ 2\pi/60\ \Delta N/\Delta T2$
- From the above equation, J = 1.182 kg-m^2
- Mechanical losses at the rated speed = $J(\Delta T)1N(2\pi/60)^2$ = 251 W
- Mechanical losses+Iron losses at the rated speed and field current = $J(\Delta T)2N(2\pi/60)^2$ = 318.6 W
- Iron losses at rated speed and field current = 67.9 W

CONCLUSION

This study is useful to find out the moment of inertia 'J' of the rotor and also to calculate the mechanical and iron losses separately. This study program was developed to control the motor which ensures accuracy of the time measurement. The scope of the design was keep concise and simple to in order not to introduce unnecessary complexities and render it practical. The system does not have attached complex peripheral devices. Well thought out automatic operations are used to achieve accuracy, determination of stray Losses using LabVIEW with myDAQ detect the losses. In this study the various full adders like Static CMOS full adder, pass transistor full adder, dual domino logic full adder, high dual domino full adder and proposed single rail domino full adders are designed in 45nm technology using gpdk 45 package. The circuit is simulated and analyzed using Cadence Virtuoso tool. The functionality is verified and the full adders are analyzed for power, delay and power-delay product at different temperatures and various transistor types. The proposed system has less power and less power-delay product. The proposed full adder can be used in ALUs and MACs for low power.

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