



# RAJAT



## TECHNICAL MANUAL FOR

# SPEED CONTROL OF DC SHUNT MOTOR

Manufactured by :

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## SPEED CONTROL OF DC MOTOR (SHUNT TYPE)

### AIM

- (a) To study the speed control of DC motor below the normal range by armature resistance control and to plot speed Vs armature voltage, characteristic.
- (b) To study the speed control of DC motor above the normal range by field control and to plot speed Vs field current, characteristic.

### **Specifications : MOTOR**

- Type : SPDP (Screen Protected)
- Capacity : 2 or 3 HP, 230V, 1500 RPM (Approx.).
- Insulation : Class 'B'

### INSTRUMENTS REQUIRED

- MC Voltmeter 96 x 96 mm flush mounted – 1 No. (For Source/Armature Voltage)
- MC Ammeter 96 x 96 mm flush mounted – 1 No (For Load Current)
- MC Ammeter 96 x 96 mm flush mounted – 1 No (For Field Current)
- Tubular Rheostat – 1 No. (For Field Control)
- Tubular Rheostat – 1 No. (For Armature Control)
- Indicating light
- Educational type insulated terminals
- DPIC Switch
- DC Starter face plate type suitable for above motor.

### THEORY

The back emf for a DC motor is given by,

$$\text{Back emf, } E_b = \frac{P \phi NZ}{60 A}$$

The number of poles, P the armature conductors, Z and the number of parallel paths, A are constant for a particular machine. Thus the speed of DC motor is given by,

$$\text{Speed of the motor, } N = K \frac{E_b}{\phi} = K \frac{V - I_a R_a}{\phi}$$

The equation for the speed of the motor clearly indicates the following :-

- (i) Speed of the DC motor can be controlled above the normal range of speed by varying the resistance in the armature circuit included in the form of a rheostat as a variable resistance (armature control).
- (ii) Speed of the DC motor can be controlled above the normal range of speed by decreasing the flux  $\phi$  i.e by decreasing the current in the field circuit by including as external resistance in the form of a rheostat as variable resistance (field control).

### **ARMATURE CONTROL**

Let the external resistance in the armature circuit of DC shunt motor be R ohms, then the speed equation modifies to,

$$N = k \frac{V - I_a (R_a + R)}{\phi} \text{ RPM}$$

Hence the speed of the motor decreases with an increase in the value of external resistance R. Thus reduce speeds lower than the no load speed can be obtained by this method. However, there is an excessive wastage of power in the additional resistance, which lowers the efficiency of the motor considerably.

### **FIELD CONTROL**

The speed of the DC motor can be increased beyond the no load speed by inserting an external resistance in the shunt field circuit. The current in the external resistance is very low, hence the losses occurring in the additional resistance is quite small.

### **CIRCUIT DIAGRAM**

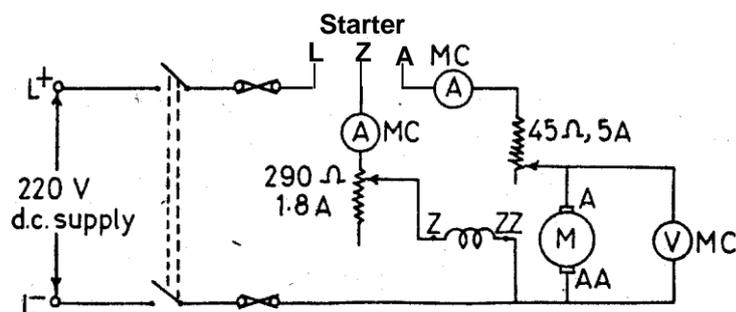
Fig 'A' shows the circuit diagram for speed control of DC motor. Instruments used in the circuit serve the function mentioned against each.

Rheostat (45  $\Omega$ , 5 A) – to vary the voltage applied to the armature winding of DC motor.

Voltmeter – to measure the applied voltage across the armature winding.

Rheostat (260  $\Omega$ , 1.4 A) – to vary the field current of DC motor.

Ammeter - to measure the field current.



*Fig 'A' : Speed control of DC motor.*

### WORKING OF CONTROL PANEL

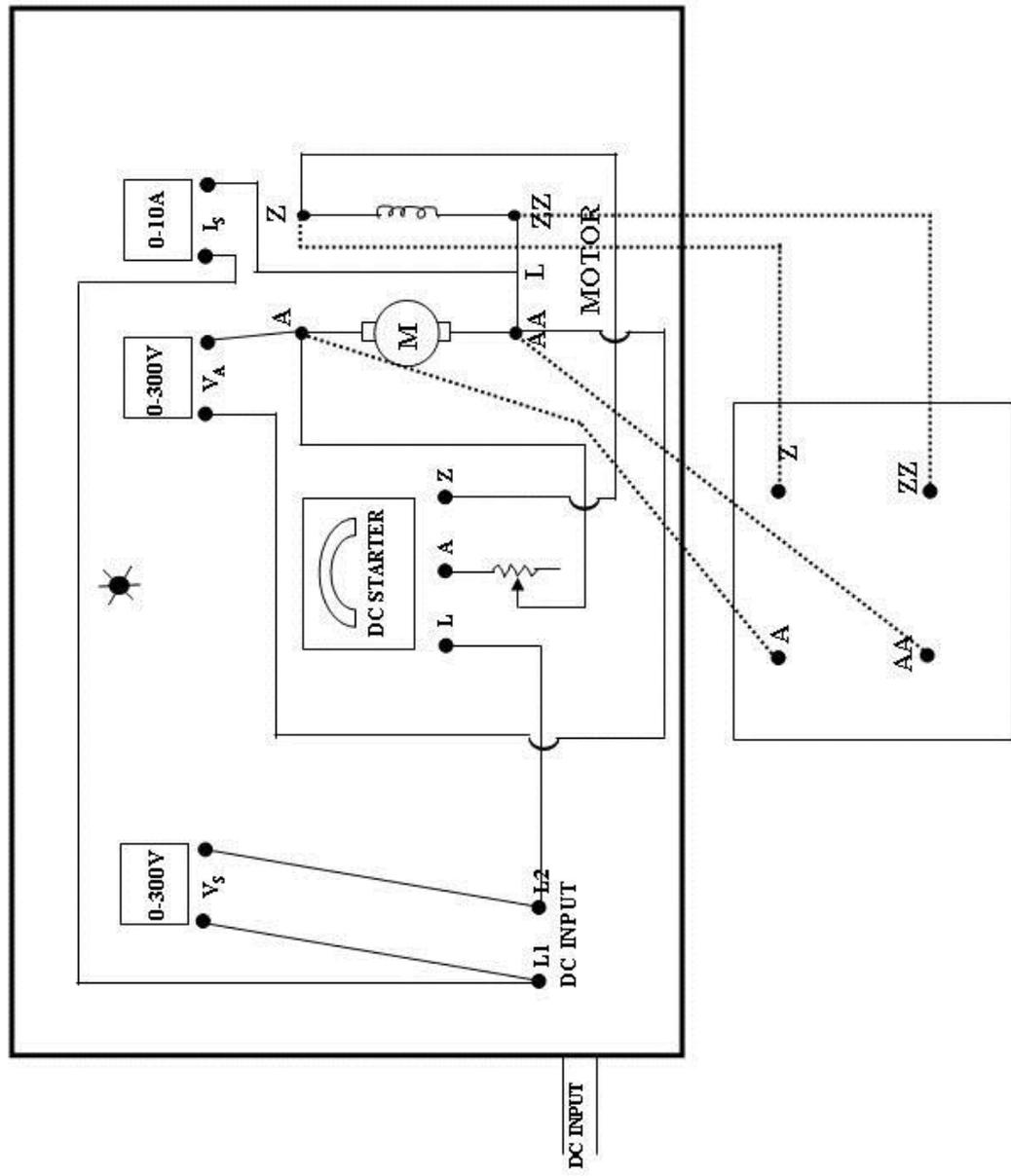
For the speed control through armature control and field control we will be using face plate type starter also (in order to limit the starting current, also otherwise higher capacity of armature control rheostat will be required).

1. Connect the DC motor for speed control as shown in Fig 'A' for armature and field control.
2. Rheostat use for armature control will be dual tube type. The respective connections are shown in the figure.
3. Before switching ON the DC power supply ensure that the FIELD RHEOSTAT RESISTANCE in ARMATURE circuit is MAXIMUM and FIELD RHEOSTAT RESISTANCE in FIELD circuit is MINIMUM.
4. After ensuring step 2 and 3 switch on the DC supply through DPIC, and start the motor through DC starter. At this point the motor will be running at very low speed. Not down the corresponding armature voltage (V2) and the speed of the motor.
5. Now for ARMATURE CONTROL METHOD the rider of the field rheostat is gradually moved from maximum to minimum side and corresponding variation in speed with armature voltage (V2) is noted. Till the armature voltage is of rated value. Thus by armature control we observe that the speed below the no load or the rated speed can be varied.
6. Now for FIELD CONTROL METHOD the field rheostat is gradually moved minimum to maximum side and corresponding speed variation is noted and also the variation (decrease) in the field current is noted. While performing the field control method ensure that the field current should not be made ZERO otherwise the field circuit will be open causing the damage to windings, tending the motor to operate at a dangerously high speed. Thus by field control we observed that speed above the no load can be varied with in certain limits.
7. Switch OFF the DC supply to stop the motor.

**OBSERVATIONS** : May be tabulated as follows.

Armature control			Field control		
S No.	Armature voltage (V <sub>2</sub> )	Speed	S. No.	Field current (I <sub>f</sub> )	Speed

**PANEL FOR SPEED CONTROL ON DC SHUNT MOTOR USING ARMATURE CONTROL**



**PANEL FOR SPEED CONTROL ON DC SHUNT MOTOR USING FIELD CONTROL**

