Perform speed control of DC motor using thyristors/DC drive

Objectives : At the end of this exercise you shall be able to
- **read and interpret the name plate details of DC drive**
- **connect the input/ output terminals of DC drive to motor operate the load**
- **control the motor speed by using DC drive and operate motor with 1/4th, 1/2th, 3/4th, load.**

Requirement

Tools/Instruments

- Insulated combination pliers 150 mm - 1 No.
- Screw driver 200 mm - 1 No.
- Connector screw driver 100 mm - 1 No.
- Electrician's knife 100 mm - 1 No.
- Round nose plier 150 mm - 1 No.
- MC voltmeters - 0 - 250 V - 1 No.

Equipment/Machines

- DC motor 3 HP, 220V coupled with DC generator 2KW, 220V - 1 No.
- Lamp load : 2000 W (500W x 4) - 1 No.
- DC drive 3HP, 220V - 1 No.

Materials

- PVC insulated standard copper cable 1.5 sq.mm, 660V - 15 m.
- PVC insulated flexible cable 14/0.2 mm - 3 m.
- Insulation tape - 1 No.

PROCEDURE

TASK 1: **Connect the input/ output terminals of DC drive to DC motor to operate the load**

1 Note down name plate details of the given motor DC drive and lamp load. Table 1

2 Check and identify terminals of the DC motor and DC drive.

Lamp load

Connect with main switch/MCB, 4 Nos of 500 W clear lamps fitted in a enclosure having individual ON - OFF facility.

Table 1

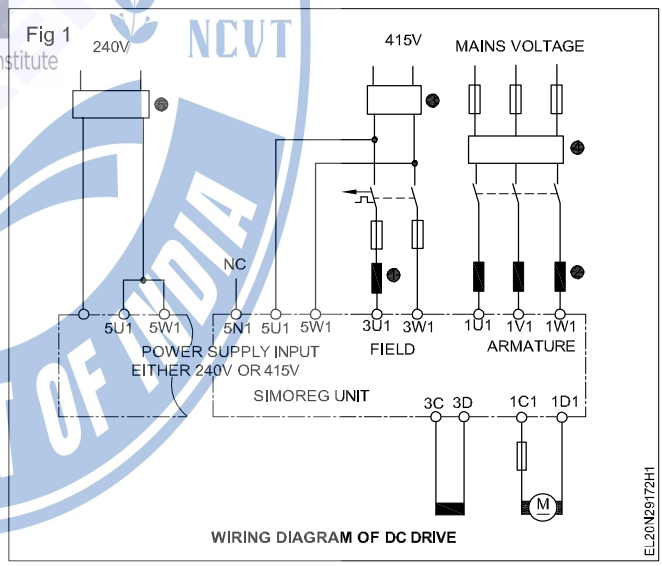
Make & Sl.No		
Rated Mains	V	
Rated Power	KW	

3 Remove the drive cover. Identify and trace the internal connection and get it approved by the instructor.

4 Select the ICTP switch /MCB, cables and fuse - wire according to the rating of the motor.

5 Draw the circuit diagram and connect the ICTP, MCB, drive and the motor, and get it approved by the instructor.(Fig 1)

Fig 1



6 Connect double earth independently for the main switch, DC drive and the motor.

7 Check the supply and ensure for proper rating of fuses main switch according to the motor rating.

Improper connection of DC drives leads to shock and material damage.

TASK 2 : **Control the speed by setting the parameter of different load and speed**

1 Select the suitable type of model DC drive with code. (Fig 1)

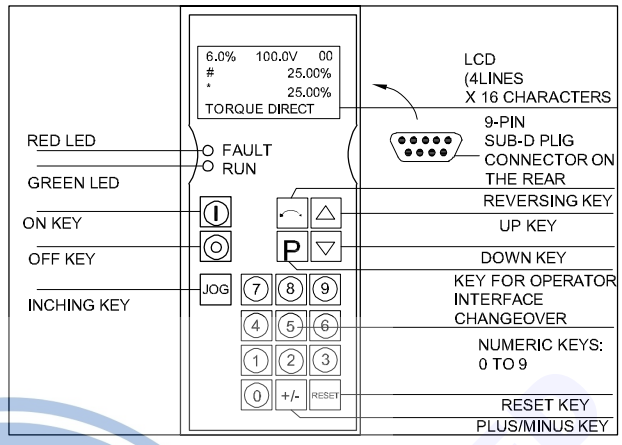
2 Connect MCB, DC drive, M.G set and lamp load. (Fig 2)

3 Switch ON power supply.

4 Press ON button and measure the speed of the motor by using the Tachometer before loading. Record the readings in Table 1.

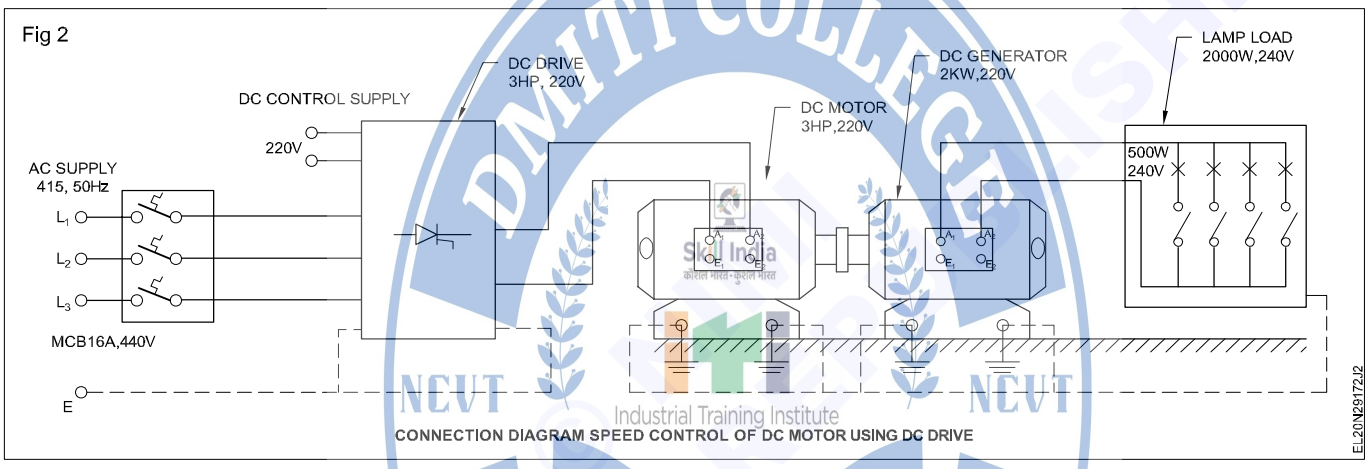
5 Load the motor by 1/4th load; by switching 'ON' one lamp. Record the current , voltage, frequency and voltage in load terminal, vary the speed and observe the readings.

Fig 1



CONTROL PANEL OF DC DRIVE

Fig 2



CONNECTION DIAGRAM SPEED CONTROL OF DC MOTOR USING DC DRIVE

Table 1

Sl.No	Load	Armature voltage in volt	Field voltage in volt	Load		Motor speed in RPM
				Voltage (Volts)	Current (Amp)	
1	1/4th					
2	1/2th					
3	3/4th					
4	Full					

6 Load the motor further and switch ON another lamp (Total load now (500 W + 500W=1000W). Record all the readings in Table 2. Vary the speed with 1/2th load and observe the readings and record in Table 1.

7 Load further to 3/4th load (500+ 500 + 500=1500W) and repeat step 5 and record the reading in Table 4.

Switch 'OFF' the motor instantly, if anything noticed irregular consult your Instructor.

8 If motor maintaining the rated frequency after loading 3/4th load. Load the motor to full load (500+ 500 + 500+500=2000W) condition and switch 'ON' all the four lamps . Record all readings and repeat step -5.

9 Press 'OFF' switch once it is over and check the readings you recorded.

If the frequency reduced considerably when the motor operates in higher loads; Do not run the motor. Consult with your instructor.

10 Remove all the connection and supply cables from the motor and supply.

Perform speed control and reversing the direction of rotation of AC motors by using thyristors/AC drive

Objectives: At the end of this exercise you shall be able to
- **read and interpret the name plate details of AC drive**
- **connect the input / output terminals of AC drive through AC motor**
- **identify the operating buttons on AC drive**
- **control the motors speed by using AC drive**
- **reverse the directions of rotation of 3 phase induction motor by using AC drive.**

Requirements

Tools/Instruments

- Insulated combination pliers 150 mm - 1 No.
- Screw driver 200 mm - 1 No.
- Connector 100mm - 1 No.
- Electrician's knife 100mm - 1 No.
- Round nose plier 150 mm - 1 No.

Equipments/Machines

- 3 Phase induction motor 5 H.P/415V - 1 No.
- AC drive 3 phase 415V, 2HP - 1 No.

Materials

- PVC insulated standard copper cable 1.5 sq.mm - 15 m
- PVC insulated flexible cable 14/0.2 mm - 2 m
- Insulated tape - 1 m
- Fuse wire - as reqd.

PROCEDURE

TASK 1 : **Connect the input/output terminals of AC drive through AC motor**

1 Note down the name plate details of the given motor and AC drive and enter them in Table 1 & 2.

2 Identify the terminals of the 3 - phase induction motor.

Table 1

AC motor name plate - details

Manufacturer	_____	Rated frequency	_____ Hz
Model	_____	Speed	_____ RPM
Power	_____ KW/HP	Insulation class	_____
Voltage	_____ Volt	Rated current	_____ A

Table 2

AC drive name plate - details

Manufacturer _____ Model : _____

I/P voltage _____ V

I/P frequency _____ Hz

O/P frequency _____ Hz

Serial Interface type _____

Output voltage _____ V

Power range _____ HP/KW

Control type _____

Braking type _____

3 Identify and trace the internal circuit of AC drive and get it approved by the instructor.

4 Check the switch /MCB , cables and fuse - wire rating and match with motor rating.

5 Draw the connection diagram of ICTP, drive, motor and get it approved by the instructor.

6 Connect the motor, AC drive, main switch as per approved diagram and get it checked the instructor. (Ref. Fig 1)

7 Connect double earth independently for the main switch, AC drive and the motor.

Improper connection of AC drive results shock and material damage.

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TASK 2 : **Connect, run the motor and setting the parameter of different speed**

1 Select the suitable type of model AC drive.

2 Connect and wire the AC drive input power supply with terminals R/L1, S/L2, T/L3, when the output terminals U/T1, V/T2, W/T3, are connected to the motor. (Fig.1)

3 Switch ON the power supply main.

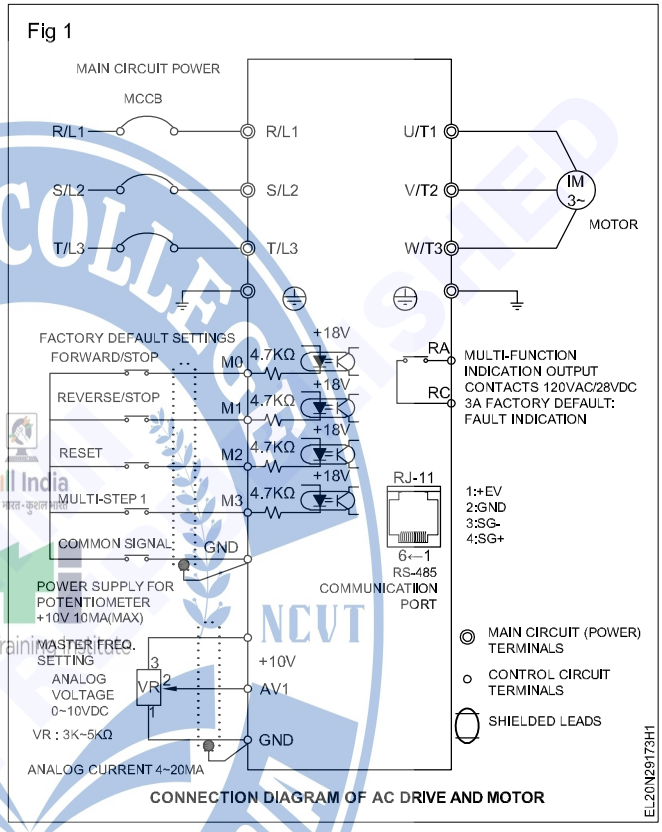
4 Press RUN/STOP button. The motor will run. (Ref. Fig 1 Measure the speed of motor by using the Tachometer and record it_____RPM.

5 Increase and decrease the frequency and check the change in speed of the motor.

6 Press 'STOP' button and turn 'OFF' main power supply to disconnect the supply.

Improper connection of AC drive results shock and material damage.

Fig 1



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TASK 3 : **Reverse the direction of rotation in AC motor by setting in AC drive**

1 Switch ON the power supply main.

2 Press key RUN/STOP button (Ref.Fig 1). The motor will run in forward direction.

3 Set the parameter for reverse direction. (Ref.Fig 1)

4 Press RUN / STOP, button key, The motor will run in reverse direction.

5 Press the STOP button to stop the motor.

Improper connection of AC drive results shock and material damage.

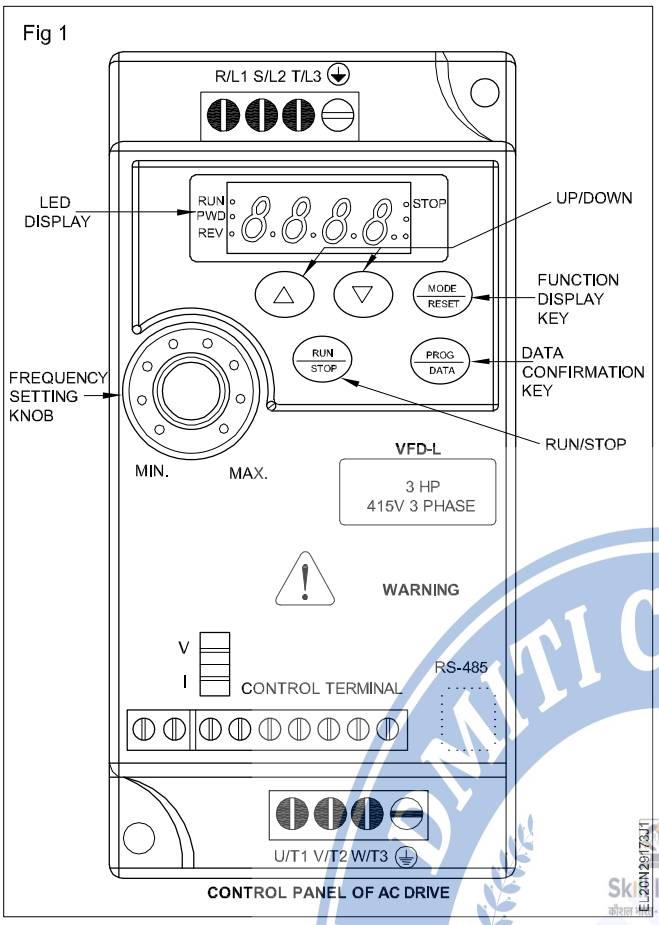
The motor will run as you press the key and will stop as you leave the key

6 Turn 'off' the power supply and disconnect the drive.

Do not run the motor at low speed for longer time. Because the motor cooling will not be effective due to low fan speed. So motor will heat up.

The programming procedure /keys may differ according to the make model of the drive in your institute. Refer to the drive instruction manual and take help of your instructor.

Fig 1



Construct and test a universal motor speed controller using SCR

Objectives : At the end of this exercise you shall be able to
- **wire an universal motor speed controller circuit on PCB and test it**
- **assemble the wired PCB along with POT and socket in a gang box and test**
- **test the speed controller with lamp, fan, electric drilling machine**
- **check possible minimum and maximum speed adjustment using contact type tachometer.**

Requirements

Tools/Equipments/Instruments

- Trainees tool kit - 1 Set
- Electric hand drilling machine - 1 No.
- Contact type tachometer with necessary attachments - 1 No.
- Wired lamp holder with lamp of 40W or less (Test Lamp) - 1 No.
- Main operated table fan of any make - 1 No.

Materials/Components

- Resistors
  - R_1 = 10K.5W - 1 No.
  - R_2 = 470 ohms ± 5%, 1/4W - 1 No.
  - R_3 & R_4 = 1K ohms ± 5%, 1/4W - 2 Nos.
  - Potentiometer (RV_1) = 1K, 1W - 1 No.
- Capacitors
  - C_1 = 2U2, 63V - 1 No.
  - C_2 = 100 nf (Polyester) - 1 No.
- Semi-conductors
  - SCR - C106D or equivalent or any SCR of 400V and current rating greater than 3 Amp - 1 No.
  - Q_1 BD135 or equivalent - 1 No.
  - Q_2 BD136 or equivalent - 1 No.
  - (D_1,D_2) IN4004 - 2 Nos.
- Other items
  - PC board code to be made as in Fig 2 - 1 No.
  - 100 x 75 mm gang box used for conduit wiring - 1 No.
  - Hylam sheet 100 x 75mm x 3mm thick - 1 No.
  - Self threading screw 3mm x 10mm for fixing hylam sheet on gang box - 6 Nos.
  - 3mm x 20mm screw and nut (to fix PCB inside the gang box) - 4 Nos.
  - Spacers 3mm x 10mm (to separate PCB from gang box) - 4 Nos.
  - 5Amps, 3 core cable (Mains cord) - 2 m
  - 240V, 6 Amps flush type socket - 1 No.
  - 240V, 6 Amps, flush type SP switch - 1 No.
  - 240V, 6 Amps, 3 pin plug - 1 No.
  - Knob suitable for 16 mm plastic shaft pot - 1 No.
  - Heat sink for SCR (suitable size) - 1 No.
  - Terminal strip 3 way - 1 No.
  - Flexible wire, 5 Amps, 240V (Red, Blue, Green) - 0.5 m each
  - Hookup wire - 1 m
  - Resin core soldering lead - 20 cms

PROCEDURE

1 Prepare a PCB for the given dimensions (Fig 1). Check the sizes of the components with the soldering position on the PCB. If necessary slightly alter the dimensions of the PCB track.

2 Check the PCB tracks and clean PCB.

3 Test the components to confirm its working condition.

4 Wire the speed controller circuit on the PCB referring to the circuit schematic in Fig 2 and the PCB layout diagram (Fig 3). Get the wired circuit checked by your instructor.

5 Make connections for the POT, switch, 5A flush type socket, mains 3 core cable mains 3-pin top with the wired circuit on PCB by using suitable wires. Get the wiring checked by your instructor.

The wire connections are made is to test the wired speed controller circuit before assembling them in the gang box as in Fig 3. Therefore keep sufficient wire lengths in all connections made for the purpose of safety and ease of testing.

6 Test the working of wired circuit by connecting a test lamp load at the output of the speed controller circuit. Check the lamp glow bringing the two extreme positions of the speed.

If the lamp brightness is not varying , vary the position in the wired circuit/connections.

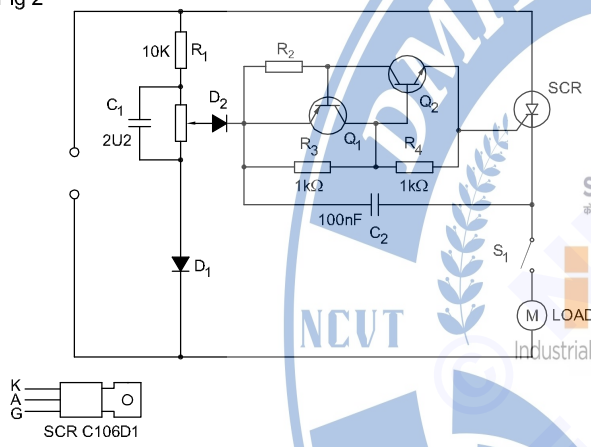
7 Test the speed controller using table fan as load and record your observation.

Fig 1

COPPER CLAD SIDE

EL20N29174H1

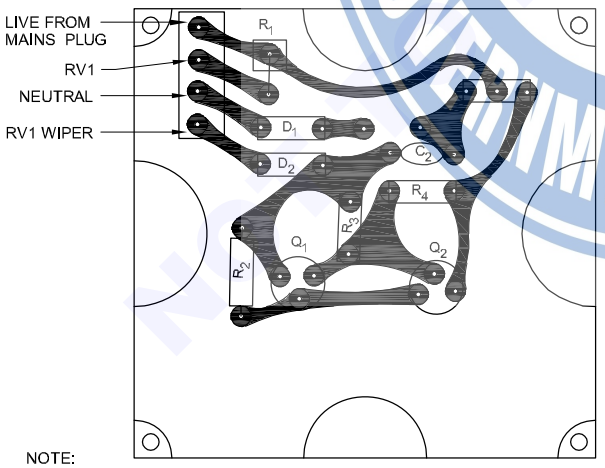
Fig 2



CIRCUIT DIAGRAM OF THE DRILL SPEED CONTROLLER

EL20N29174H2

Fig 3



NOTE:

C1 IS MOUNTED ACROSS RV1 TERMINALS

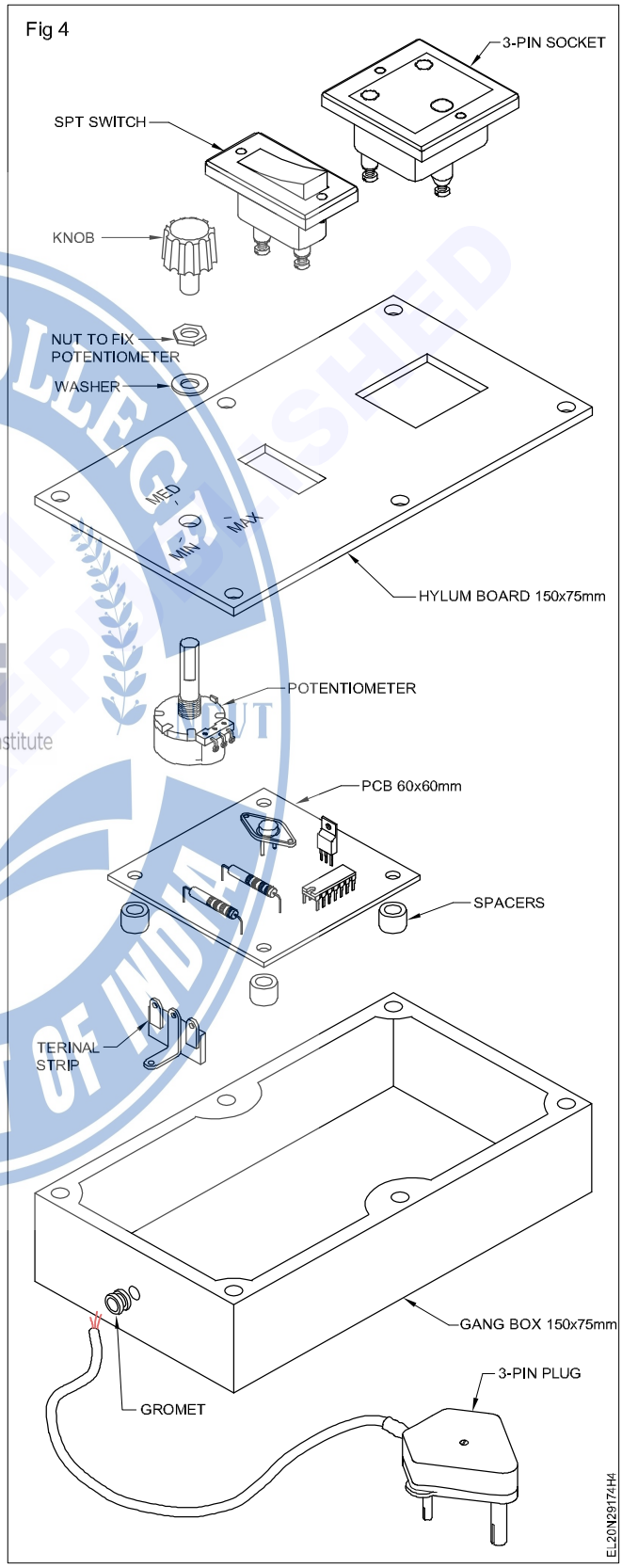
COMPONENT SIDE OF PCB

EL20N29174H3

8 Assemble the PCB and other associated items, so that the wired speed controller is ready for use as shown in Fig 4. Get it checked by your instructor before fixing the top hylam sheet on the gang box.

9 Repeat steps 5 and 6 after making final assembly of the speed controller unit to confirm that no errors are committed during assembly. Record observations made.

Fig 4



EL20N29174H4

10 Test the universal motor speed controller unit for its range of speed control by connecting an electric drill gun as load and measuring the speed of the gun at minimum, middle and maximum positions of the speed control POT.

11 Record the speed in Table 1. Use contact type tachometer to measure the speed of the electric drill gun at different speed control positions of the POT.

12 Get your work and recorded readings checked by your instructor.

Write the specifications of the wired speed controller on a paper and paste it at the back of the gang box in which the circuit is assembled.

13 Get it checked by your instructor.

The wired and tested universal motor speed controller can be effectively used for any practical applications. So preserve the project work made and use it whenever required.

Table 1

Position POT	Speed in RPM
Minimum	
Middle	
Maximum	