Design layout of control cabinet, assemble control elements and wiring accessories for local and remote control of induction motor

Objectives: At the end of this exercise you shall be able to
- **draw the control and power circuit for remote control**
- **mark the layout on control panel wiring accessories remote control**
- **drill and tap for fixing accessories**
- **mount the DIN rail and accessories**
- **wire up the accessories**
- **arrange the wiring by routing, bunching and tying**
- **test the control panel for local and remote control of induction motor.**

Requirements

Tools/Instruments

• Trainees tool kit	- 1 No.
• Scriber 100 mm	- 1 No.
• Hacksaw frame with blade- 300 mm	- 1 No.
• Hand drilling machine 6mm capacity	- 1 No.
• HSS Drill bit 6mm & 4mm	- 1 No. each
• Round nose plier 150 mm	- 1 No.
• Crimping tool 200 mm	- 1 No.

Instruments/Equipments

• Digital multimeter	- 1 No.
• Megger 500V	- 1 No.
• Contactor 4 pole, 16A,240V	- 1 No.
• Thermal overload relay 10A, 415V	- 1 No.
• Remote station	- 1 No.
• Over load relay 15A, 415V	- 1 No.

Materials

• Push button red /green	- 1 each
• Indicator lamp with holder (red, yellow, blue)	- 1 each
• MCB 4 Pole 16A , 415V	- 1 No.
• Race ways	- 1 m
• DIN rail	- 1 m
• G - channel	- 2 m
• Wire clips	- as reqd.
• Terminal connectors	- as reqd.
• Wire ferrule	- as reqd.
• Grommets	- as reqd.
• Lug/thimble	- as reqd.
• Cable binding straps and buttons	- 10 m
• Nylon cable ties	- 15 Nos.
• PVC 1.5 sq mm copper cable 660V (red, black, yellow, blue, green)	- as reqd.
• Assorted size bolt & nut	- as reqd.

PROCEDURE

TASK 1 : **Identify the control accessories and wiring accessories used for control panel wiring**

Instructor must serially arrange the real items of control elements used for control panel wiring, If it is not possible provide the images without their names. He can explain how to identify them with specification and uses / types.

1 Identify the control elements from the real objects (or) from the images.

2 Write the name and type of the control elements against the space provided and also write their specification and purpose / application in Table 1.

3 Check the identified items with your instructor.

Table 1

Sl. No.	Names of control elements and wiring accessories (from real or image)	Types of the elements (whether protective / control etc.)	Specifications	Purpose / Application
1				
2				
3				
4				
5				
6				
7				
8				

TASK 2 : **Develop the layout and mark the layout in control panel**

Note : Instructor has to provide a blank control panel along with power and control circuit of the local and remote control of induction motor.

1 Draw the layout diagram

2 Select and check the accessories required.

3 Mark the layout inside the control panel by using steel rule and scriber.

4 Mark for fixing holes for isolators and control devices etc., as per layout diagram.

5 Mark and cut the DIN rail, 'G' channel and race ways as per layout. Mark the points of drills on it to fix them inside the control panel.

6 Mark the drill holes in the front door of the control panel to fix the indicator lamp and push button switches.

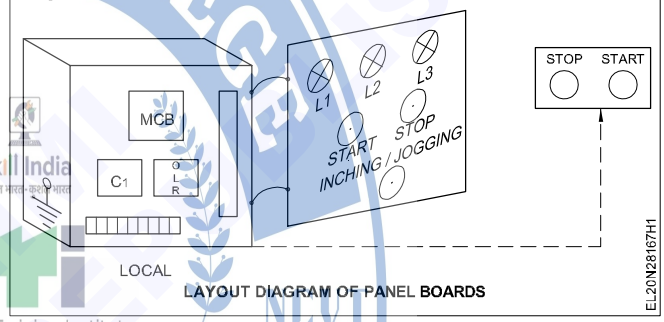
7 Mark the fixing holes for the wire clips in the control panel door to run the wires. (Fig 1)

8 Make the drills in side the control panel to fix control devices, DIN rails, 'G' channel and race ways as per marking.

2 Make the through holes in race ways, DIN rails and G channel.

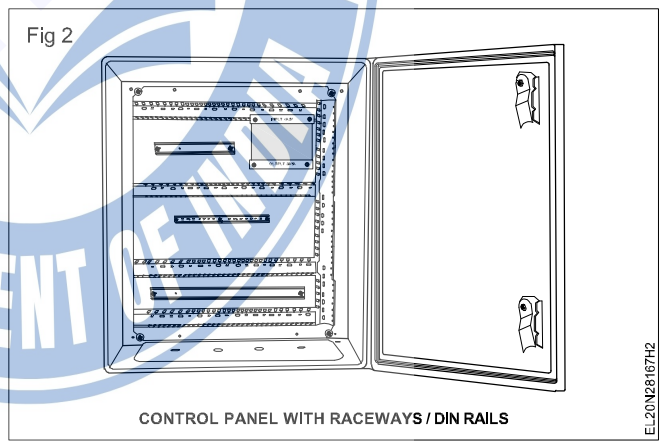
3 Fix the control accessories race ways, DIN rails and G channel using fixing screw, bolt and nuts.

Fig 1



4 Make the drills on the door of panel for indicator lamp, push button and wire clips as per marking. (Fig 2)

Fig 2



TASK 3 : **Draw and wire the control and power circuit for local and remote control of induction motor**

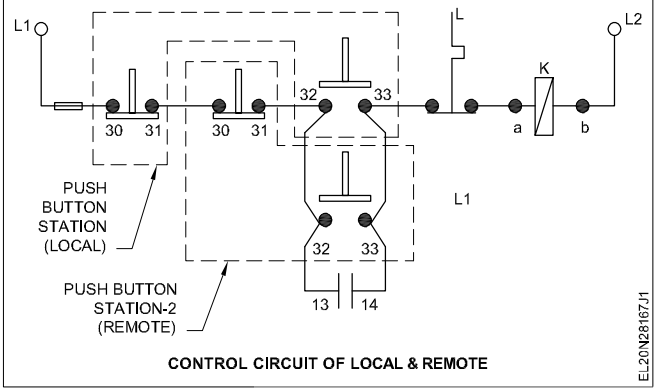
1 Draw the control circuit and power circuit and check and verify with your instructor. (Fig 1 and 2)

2 Label the Terminal number in the control and power circuit.

3 Measure and cut the cable as per layout.

4 Insert the ferrule Nos at the both ends of terminals as per layout and run the wires in the race ways one by one. Avoid the cross over of the wires.

Fig 1



CONTROL CIRCUIT OF LOCAL & REMOTE

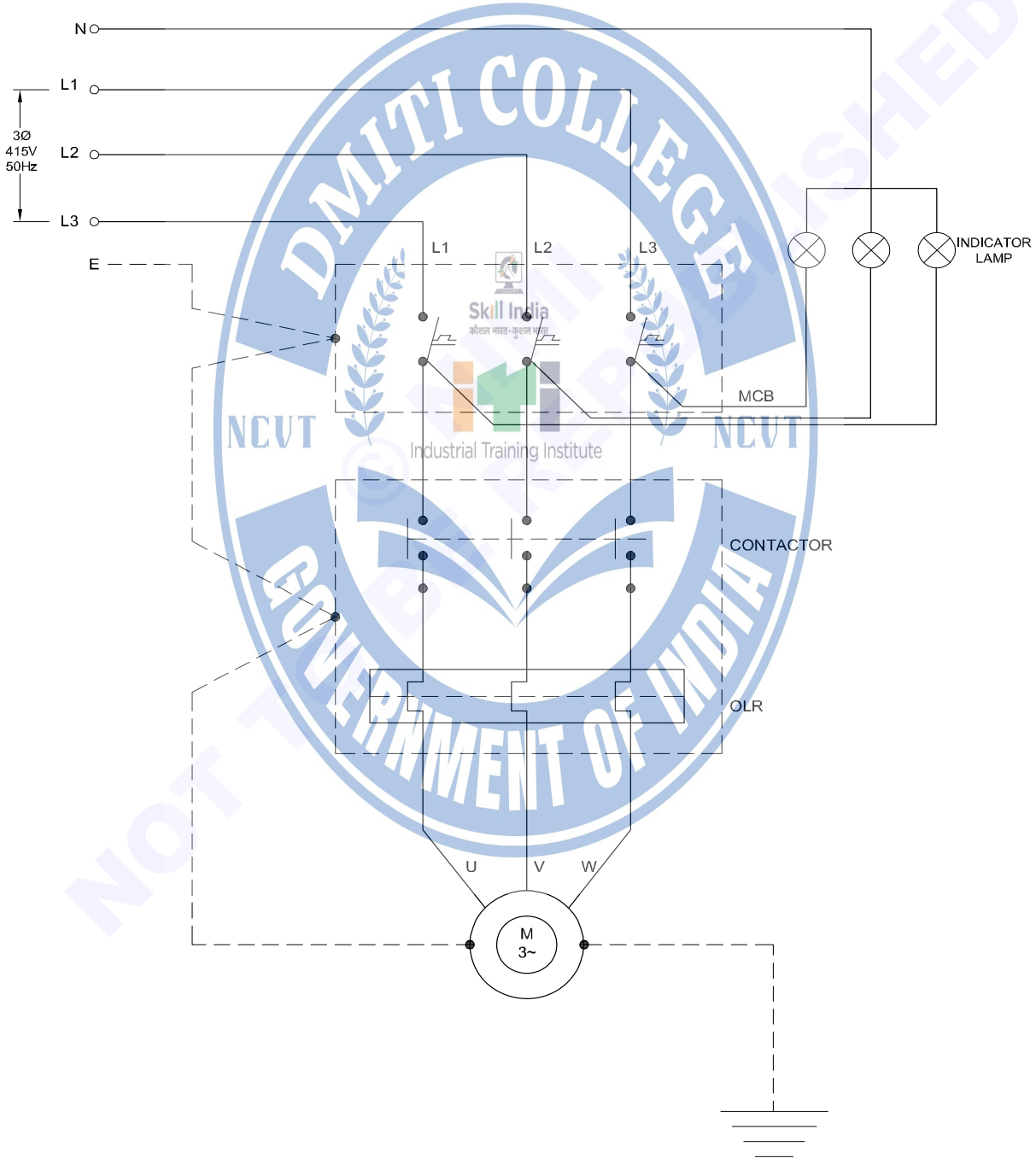
Leave some extra length of wires in the race ways for easy maintenance and repair.

To avoid the cross - over first the vertical wires can be run followed by horizontal run.

5 Skin the wire ends and crimp with suitable lugs/ thimbles.

6 Connect the control circuits wires as per the control circuit and terminals / ferrule table.

Fig 2



POWER CIRCUIT DIAGRAM

7 Connect the power circuit's wires as per the power circuit diagram and terminals / ferrule details.

Avoid the loose connection and over tightness.

8 Route the wires in the race ways. Punch and ties the wires in the race ways using cable binding straps and button.

9 Cover the PVC race ways over the wiring.

Take necessary care to avoid crushing of cable when cover the race ways.

10 Make the "U" loops of wires in the hinged doors. Bunch and tie the cable in the doors.

11 Fix the wire clips at suitable places to hold the cables in the panel door.

U loop should not disturb the movement and closing of the panel door.

12 Connect the incoming and out going terminals as per diagram and terminal details.

Use the grommets to avoid the strain in the cables.

13 Earth the panel and door.

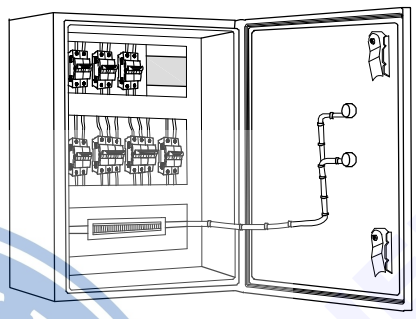
14 Measure the insulation resistance of the panel.

If the IR value is less than 1 Meg ohm, take suitable remedy action.

15 Set the OLR in accordance with the full load current of motor.

A typical control panel with complete wiring is shown in Fig 3.

Fig 3



CONTROL PANEL WITH COMPLETE WIRING

EL.20N28167J3

16 Test the local and remote control of motor.

17 Show and check the control operation with your instructor.

After removing the wiring, get it verified by the instructor and preserve all the fittings for subsequence exercises.

Design layout of control cabinet, assemble control elements and wiring accessories for forward and reverse operation of induction motor

Objectives: At the end of this exercise you shall be able to
- **draw the control and power circuit for forward and reverse operation of motor**
- **mark the layout on control panel**
- **wire up the accessories**
- **arrange the wiring by routing, bunching and tying**
- **test the control panel for forward and reverse of induction motor.**

Requirements

Tools/Instruments

• Trainees tool kit	- 1 No.
• Scriber 100 mm	- 1 No.
• Hacksaw frame with blade- 300 mm	- 1 No.
• Hand drilling machine 6mm capacity	- 1 No.
• HSS Drill bit 6mm & 3mm	- 1 No. each
• Round nose plier 150 mm	- 1 No.
• Crimping tool 200 mm	- 1 No.

Instruments/Equipments

• Digital multimeter	- 1 No.
• Megger 500V	- 1 No.
• Air break contactor 4pole, 16A, 240V	- 2 Nos.
• Overload relay 15A, 415V	- 1 No.

Materials

• Push button red /green/yellow	- 1 each
• Indicator lamp with holder	- 5 Nos.
• MCB 4 Pole 16A	- 1 No.
• Race ways	- 2 m
• Wire clips	- 4 Nos.
• DIN rail /G - channel	- 1 m
• 1.5 sq.mm copper cable 660V (red, black, yellow, blue, green)	- as reqd.
• Terminal connectors	- as reqd.
• Wire ferrule	- as reqd.
• Grommets	- as reqd.
• Lug/thimble	- as reqd.
• Cable binding straps and buttons	- as reqd.
• Nylon cable ties	- 10 Nos.
• Assorted size bolt and nut	- as reqd.

PROCEDURE

The control panel board used in the Ex.2.8.167 (i) has to be retained with accessories fitted to use for this Exercise.

TASK 1 : **Draw the layout and mark the layout in control panel**

1 Draw the layout diagram for the forward and reverse control of induction motor.

2 Select and check the accessories required.

3 Mark the layout inside the control panel by using steel rule and scriber for the additional accessories.

4 Mark holes for fixing control for accessories etc., as per layout diagram. (Fig 1)

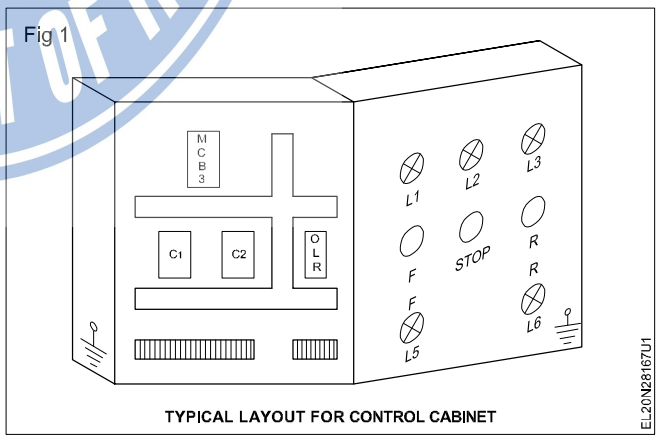
5 Mark and cut the DIN rail, 'G' channel and race ways as per layout. Mark the points of drills on it to fix them inside the control panel.

6 Mark the drill holes in the front door of the control panel to fix the indicator lamp and push button switches.

7 Mark the holes for fixing the wire clips in the control panel door to run the wires. (Fig 1)

8 Fix the control accessories, race ways, DIN rails and 'G' channel using fixing screw and bolt nuts.

Fig 1



TYPICAL LAYOUT FOR CONTROL CABINET

9 Make the drills on the door of panel for indicator lamp, push button and wire clips.

TASK 2 : **Wire the control and power circuit for forward and reverse (F/R) control of induction motor**

1 Draw the control and power circuit and check the correctness. (Fig 1 & 2)

2 Label the Terminal number in the control and power circuit.

3 Measure and cut the cable as per layout.

A typical control panel fitted with race ways, DIN rails, control transformer and isolator etc.

4 Insert the ferrule Nos at the both ends of terminals as per layout.

Leave some extra length of wires in the race ways for easy maintenance and repair.

5 Run the wires in the race ways one by one. Avoid the cross over of the wires.

To avoid the cross-over, run the vertical wire first, followed by horizontal runs.

6 Skin the wire ends and crimp with suitable lugs/ thimbles

7 Connect the control and power circuits as per circuit diagram. (Fig 1 & 2)

8 Route the wires in the race ways. Punch and ties the wires in the race ways using cable binding straps and button.

Leave the excess wires if any in the bends or in the race ways.

9 Cover the PVC race ways over the wiring.

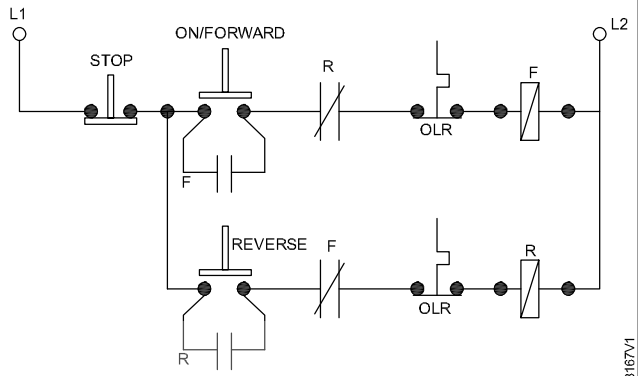
Take the necessary care to avoid the crushing of cable when cover the race ways.

10 Make the "U" loops of wires in the hinged doors. Bunch and tie the cable on the doors.

11 Fix the wire clips at suitable places to hold the cables in the panel door.

Ensure the 'U' loop should not disturb the movement and closing of the panel door.

Fig 1



CONTROL CIRCUIT FOR FORWARD AND REVERSE OPERATION

12 Connect the incoming and out going terminals as per diagram and terminal details.

Use the grommets to avoid the strain in the cables.

13 Earth the panel, door and metal devices.

14 Measure the insulation resistance of the panel.

If the IR value is less than 1 Meg ohm, take suitable remedial action.

15 Set the Over Load Relay (OLR) in accordance with the full load current of motor.

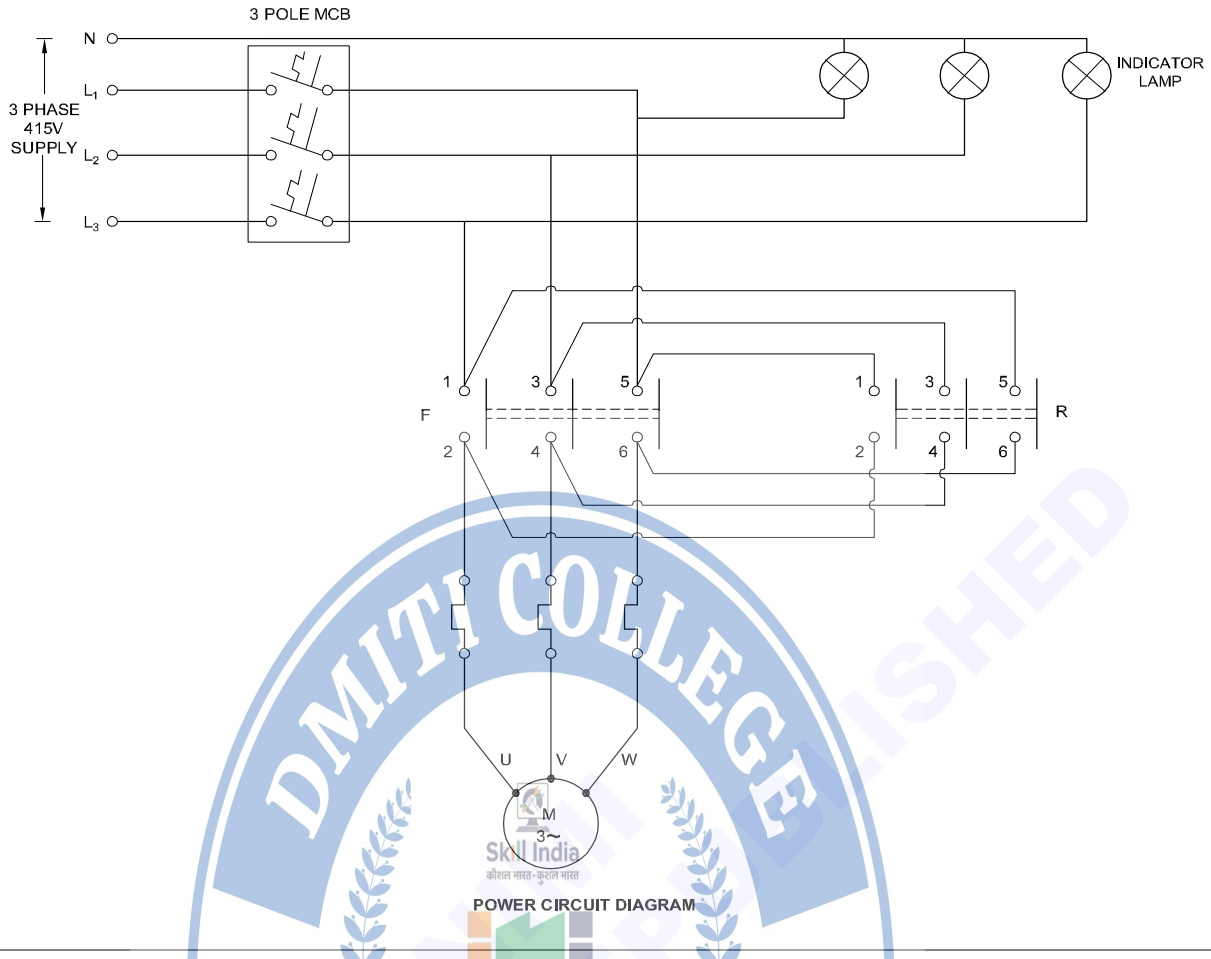
16 Test the control panel for forward and reverse of induction motor operation.

17 Check the proper functioning of indicating lamps when motor is in operations.

18 Show the control panel (F/R) working to your instructor for approval.

Note : Remove the wiring you did in the Ex.2.8.167(i) and preserve the remaining devices fitted for the next Exercise 2.8.167(iii)

Fig 2



POWER CIRCUIT DIAGRAM

Design layout of control cabinet, assemble control elements and wiring accessories for automatic star-delta starter with change of direction of rotation

Objectives: At the end of this exercise you shall be able to
- **draw the control and power circuit of automatic star delta starter with change of direction of rotation**
- **mark the layout on control panel**
- **mount the DIN rail and accessories**
- **wire up the accessories**
- **arrange the wiring by routing, bunching and tying**
- **test the control panel for automatic star-delta starter with change of direction of rotation.**

Requirements

Tools/Instruments

- Trainees tool kit - 1 No.
- Scriber 100 mm - 1 No.
- Hacksaw frame with blade- 300 mm - 1 No.
- Hand drilling machine 6mm capacity - 1 No.
- HSS Drill bit 6mm & 3mm - 1 No.
- Round nose plier 150 mm - 1 No.
- Crimping tool 200 mm - 1 No.

Instruments/Equipments

- Digital multimeter - 1 No.
- Megger 500V - 1 No.
- Contactor 4 pole,16A,240V,2No+2NC - 5 Nos.
- Timer 1 No+ 1 INC relay - 1 No.

Materials

- Push button green/red/green - 1 each
- Indicator lamp with holder - 5 Nos.
- Overload relay 0-15A, 415V - 1 No.
- MCB 3 Pole 25A , 415V - 1 No.
- Race ways - 2 meter
- Wire clips - 4 Nos.
- 1.5 sq.mm copper cable 650V (red, black, yellow, blue, green) - as reqd.
- Terminal connectors - as reqd.
- Wire ferrule - as reqd.
- Grommets - as reqd.
- Lug/thimble - as reqd.
- Cable binding straps and buttons - as reqd.
- Nylon cable ties - 10 Nos.
- Assorted size bolt and nut - as reqd.

PROCEDURE

The control panel board used in the Ex.No. 2.8.167 (ii) has to be retained with accessories fitted to use for this exercise.

TASK 1 : **Draw the layout and mark the layout in control panel**

1 Draw the layout diagram for the automatic star delta starter with change of direction of rotation.

2 Select and check the accessories required.

3 Mark the layout inside the control panel by using steel rule and scriber.

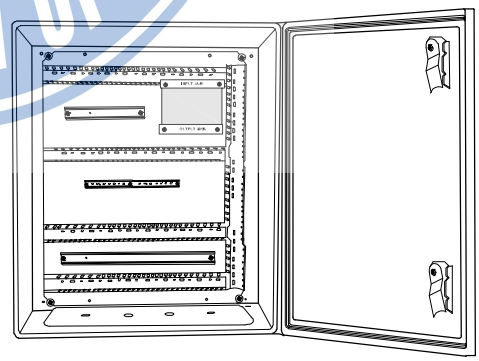
4 Mark for fixing holes for control accessories etc., as per layout diagram. (Fig 1)

5 Mark and cut the DIN rail, 'G' channel and race ways as per layout. Mark the points of drills on it to fix them inside the control panel.

6 Mark the drill holes in the front door of the control panel to fix the indicator lamp and push button switches.

7 Mark the fixing holes for the wire clips in the control panel door to run the wires. (Fig 1)

Fig 1



CONTROL PANEL WITH RACEWAYS / DIN RAILS

EL20N28167W1

8 Make the drills in side the control panel to fix control accessories, DIN rails, 'G' channel and race ways as per marking.

9 Make the through holes in race ways, DIN rails and G channel.

10 Fix the control accessories race ways, DIN rails and G channel using screws and bolt nut.

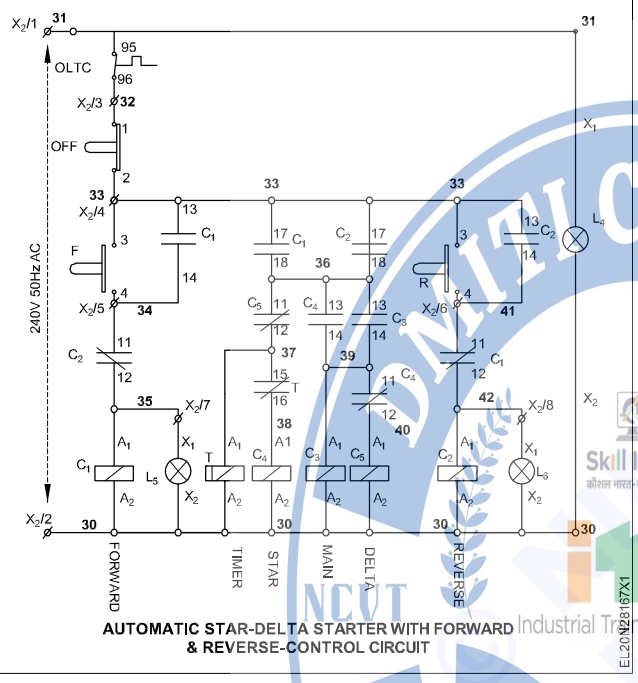
11 Make the drills on the door of panel for indicator lamp, push button and wire clips.

— — — — — — — —

TASK 2 : **Wire the control and Power circuit for automatic star delta starter with change of direction of rotation and test.**

1 Draw the control circuit and power circuit diagram and check with your Instructor. (Fig 1 & 2)

Fig 1



2 Label the Terminal number in the control and power circuit.

3 Measure and cut the cable as per layout.

A typical control panel fitted with race ways, DIN rails, control transformer and isolator.

4 Insert the ferrule Nos at the both ends of terminals as per layout.

Leave some extra length of wires in the race ways for easy maintenance and repair.

5 Run the wires in the race ways one by one. Avoid the cross over of the wires.

To avoid the cross - over first the vertical wires can be run followed by horizontal run.

6 Skin the wire ends and crimp with suitable lugs/ thimbles.

7 Connect the power and control circuits wires as per the control circuit diagram.

8 Route the wires in the race ways. Punch and ties the wires in the race ways using cable binding straps and button.

Leave the excess wires if any in bends or in the race ways.

9 Cover the PVC race ways over the wiring.

Take the necessary care to avoid the crushing of cable when cover the race ways.

10 Make the "U" loops of wires in the hinged doors. Bunch and tie the cable in the doors.

11 Fix the wire clips at suitable places to hold the cables in the panel door.

'U' loop should not disturb the movement and closing of the panel door.

12 Connect the incoming and out going terminals as per diagram and terminal details.

Use the grommets to avoid the strain in the cables.

13 Earth the panel, door, control devices.

14 Measure the insulation resistance of the panel.

If the IR value is less than 1 Meg ohm, take suitable remedial action.

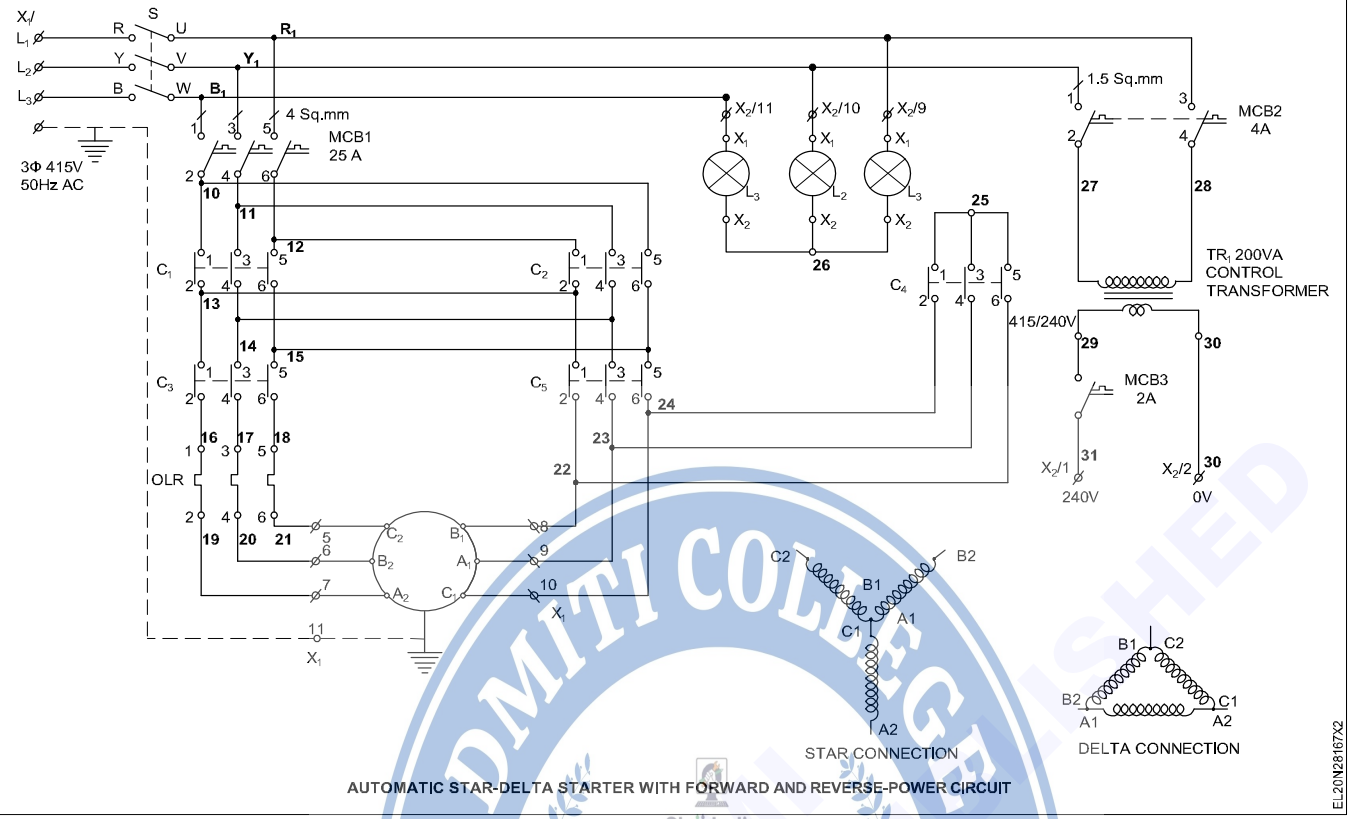
15 Set the OLR in accordance with the full load current of motor.

16 Connect the panel with motor and test the auto star delta starter with change of direction of rotation.

17 Show the control panel working to your instructor and get it approved.

Note: Remove the wiring as you did in the Ex.No.2.8.167(i) and preserve the remaining devices fitted for the next exercise 2.8.167(iv)

Fig 2



Design layout of control cabinet, assemble control elements and wiring accessories for sequential control of three motors

Objectives: At the end of this exercise you shall be able to
- **draw the control and power circuit for sequential control of three motors**
- **mark the layout on control panel**
- **mount the DIN rail and accessories**
- **wire up the accessories**
- **arrange the wiring by routing, bunching and tying**
- **test the control panel for sequential control of 3 motors.**

Requirements

Tools/Instruments

• Trainees tool kit	- 1 No.
• Scriber 100 mm	- 1 No.
• Hacksaw frame with blade- 300 mm	- 1 No.
• Hand drilling machine 6mm capacity	- 1 No.
• HSS Drill bit 6mm & 3mm	- 1 No. each
• Round nose plier 150 mm	- 1 No.
• Crimping tool 200 mm	- 1 No.

Instruments/Equipments

• Digital multimeter	- 1 No.
• Megger 500V	- 1 No.
• Air break contactor 4 pole,16A,240V	- 3 No.
• Thermal overload relay 0 -15A, 415V	- 3 Nos.
• Control transformer 415V/240V,200VA	- 1 No.
• Time control transformer 415V, 1 No + 1 NC	- 2 Nos.

Materials

• MCB 4 pole, 415V, 16A	- 1 No.
• Push button Red /Green	- 1 each
• Indicator lamp with holder	- 7 Nos.
• Limit switches 1NO+INC	- 2 Nos.
• Fuse base with carrier	- 9 No.
• MCB 2 Pole 4A	- 1 No
• MCB single pole 2A	- 1 No.
• Race ways	- 2 m
• Wire clips	- 4 Nos.
• DIN rail/ G channel	- 1 m
• 1.5 sq.mm copper cable 660V (red, black, yellow, blue, green)	- as reqd.
• Terminal connectors	- as reqd.
• Wire ferrule	- as reqd.
• Grommets	- as reqd.
• Lug/thimble	- as reqd.
• Cable binding straps and buttons	- as reqd.
• Nylon cable ties	- 10 Nos.
• Assorted size bolt and nut	- as reqd.

PROCEDURE

The control panel board used in the Ex.No.2.8.167 (iii) has to be retained with accessories, fitted, to use for this exercise.

TASK 1 : **Draw the layout and mark the layout in control panel**

Note : Instructors have to provide a blank control panel along with power and control circuit of the local and remote control of induction motor.

1 Draw the layout diagram for the sequential control of three motors.

2 Select and check the accessories required.

3 Mark the layout inside the control panel by using steel rule and scriber.

4 Mark for fixing holes for isolators and control transformer etc., as per layout diagram.

5 Mark and cut the DIN rail, 'G' channel and race ways as per layout. Mark the points of drills on it to fix them inside the control panel.

6 Mark the drill holes in the front door of the control panel to fix the indicator lamp and push button switches.

7 Mark the fixing holes for the wire clips in the control panel door to run the wires. (Fig 1)

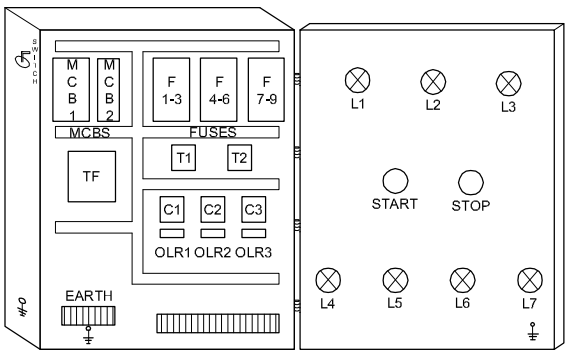
8 Make the drills in side the control panel to fix isolator, control transformer, DIN rails, 'G' channel and race ways as per marking.

9 Make the through holes in race ways, DIN rails and G channel.

10 Fix the race ways, DIN rails and G channel using fixing screw.

11 Make the drills on the door of panel for indicator lamp, push button and wire clips as per marking. (Fig 1)

Fig 1



TYPICAL LAYOUT FOR SEQUENTIAL CONTROL PANEL

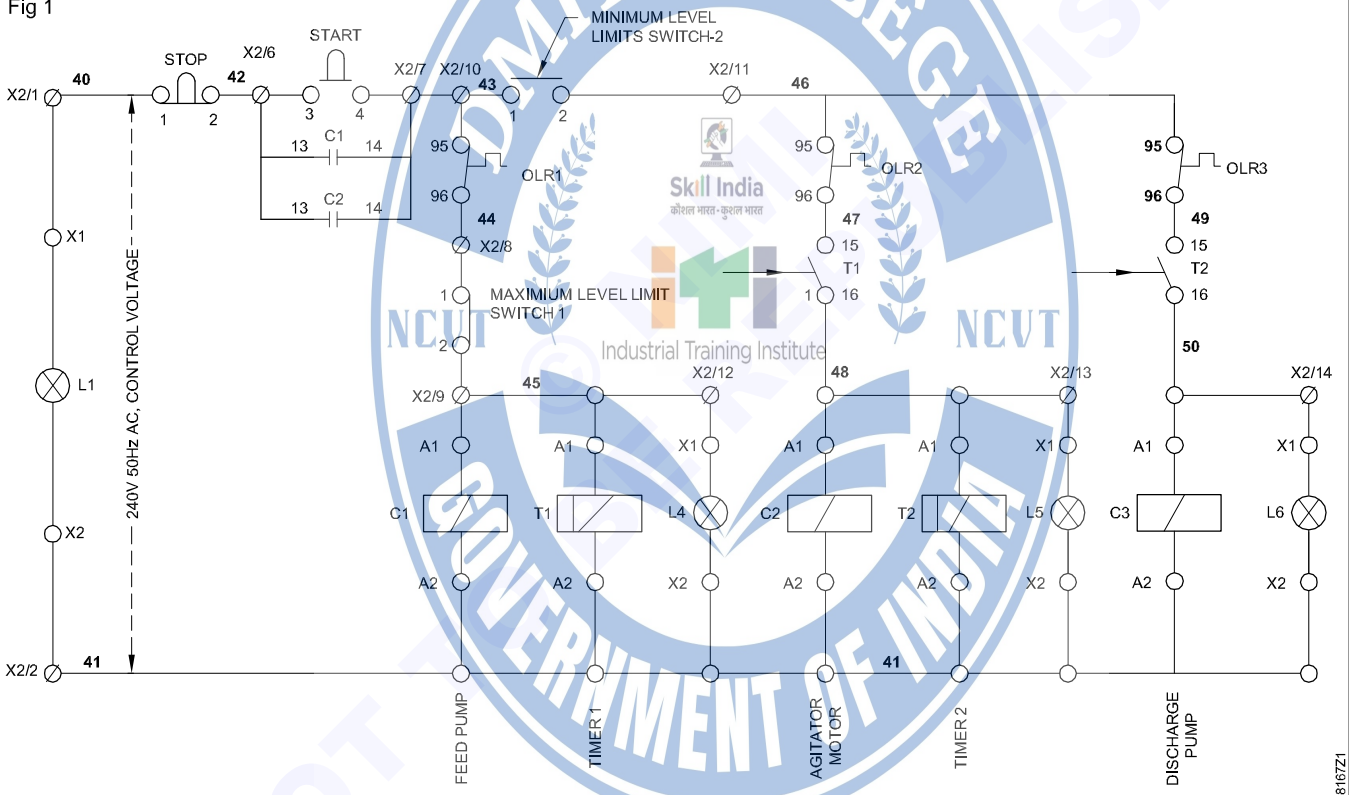
EL20N28167Y1

TASK 2 : **Wire the control and Power circuit for sequential control of three motors and test**

1 Draw the control and power circuit diagram and check with your Instructor. (Fig 1&2)

2 Label the Terminal number in the control and power circuit.

Fig 1



CONTROL CIRCUIT OF SEQUENTIAL CONTROL OF AGITATOR SYSTEM WITH THREE MOTORS

EL20N28167Z1

3 Measure and cut the cable as per layout.

4 Insert the ferrule Nos at the both ends of terminals as per layout.

Leave some extra length of wires in the race ways for easy maintenance and repair.

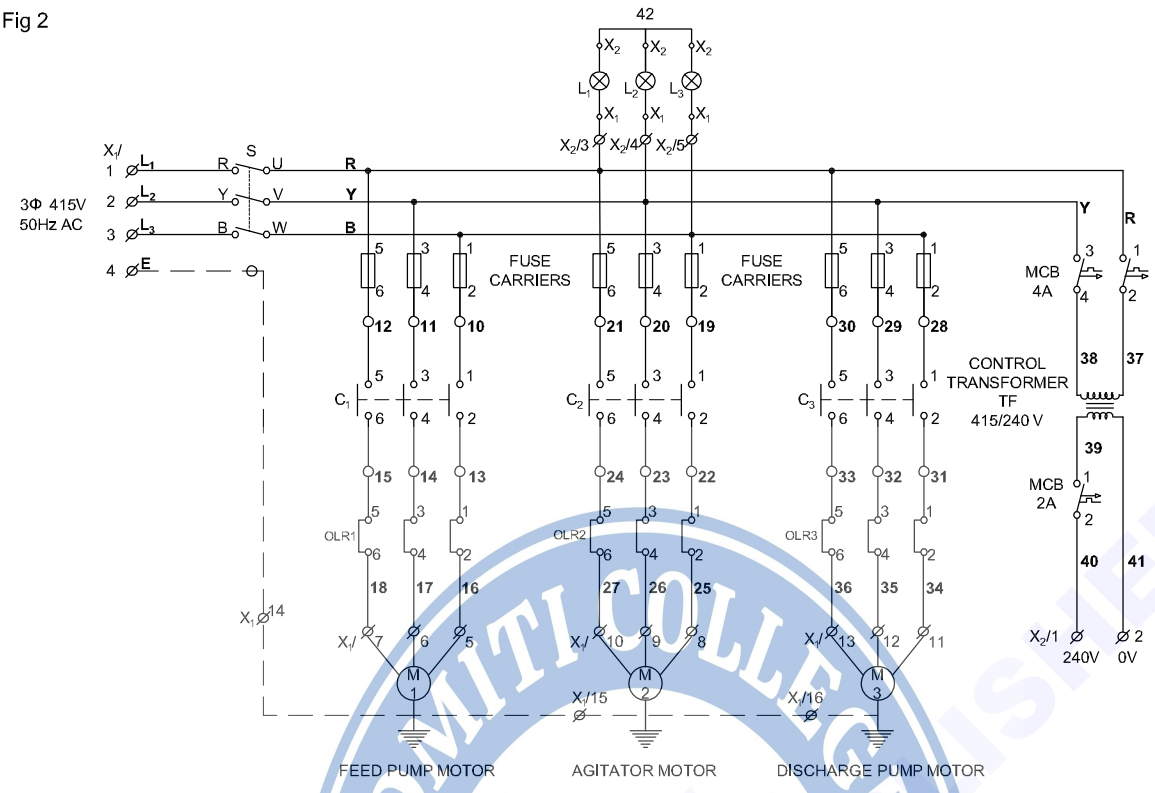
5 Run the wires in the race ways one by one. Avoid the cross over of the wires.

To avoid the cross - over the vertical wires can be run followed by horizontal run.

6 Skin the wire ends and crimp with suitable lugs/ thimbles.

7 Connect the power and control circuits wires as per the circuit diagram.

Fig 2



POWER CIRCUIT FOR SEQUENTIAL CONTROL OF THREE MOTORS

EL20N2816TZ2

8 Route the wires in the race ways. Punch and ties the wires in the race ways using cable binding straps and button.

Leave the excess wires if any in the bends or in the race ways.

9 Cover the PVC race ways over the wiring.

Take the necessary care to avoid the crushing of cable when covering the race ways.

10 Make the "U" loops of wires in the hinged doors. Bunch and tie the cable in the doors.

11 Fix the wire clips at suitable places to hold the cables in the panel door.

'U' loop should not disturb the movement and closing of the panel door.

12 Connect the incoming and out going terminals as per diagram and terminal details.

Use the grommets to avoid the strain in the cables.

13 Earth the panel, door, control transformer and motors.

If the multiple earths are used, use a common earth terminals and strips.

14 Measure the insulation resistance of the panel.

If the IR value is less than 1 Meg ohm, take suitable remedial action.

15 Set the OLR in accordance with the full load current of motor.

15 Test the control panel for sequential operation of 3 motors.

Note: Remove the wiring and preserve the remaining control elements fitted with panel for the next exercise No. 2.8.168.

16 Report and get it checked with your instructor.

— — — — — — — —

Carryout wiring of control cabinet as per wiring diagram, bunching of XLPE cables channeling, tying and checking etc.

Objectives: At the end of this exercise you shall be able to
- **verify the wiring diagram panel board and wire up**
- **bunch the Cross Linked Polyethylene (XLPE) cables**
- **channel and tie the cables**
- **check the wiring.**

Requirements

Tools/Equipments/Instruments

- Trainees tool kit - 1 No.
- Multimeters - 1 No.
- Wire cutter/stripper - 1 No.

Materials

- Panel board - 3'x2'x1' - Metal box with winged front door - 1 No.
- DIN rails/race ways - as reqd.
- Screws, nuts and bolts - as reqd.
- Tying clips - as reqd.
- Ferrule - as reqd.
- PVC channel - as reqd.
- G channel - as reqd.
- Terminal connector - as reqd.
- Belt traps - as reqd.
- XLPE cable 1.5 sq.mm 600V - as reqd.
- 1 sq.mm cable (copper) - as reqd.
- Wire sleeves - as reqd.
- Wire clips - as reqd.
- Grommets - as reqd.
- Banana sockets (5 mm) - 1 No.

PROCEDURE

TASK 1 : **Wire up control cabinet as per diagram with bunching, channeling, typing and checking etc.**

The control panel board used in the Ex.No.2.8.167(iv) has to be retained with control accessories fitted is to used for this exercise. For the wiring XLPE cables to be used.

1 Draw the wiring diagram and wire up as per the diagram.

Follow the colour coding of cables used for line controller, neutral and ground connections.

Inter connections of devices may be used same colour. Supply line, load line should he colour coded and numbered using ferrule.

2 Bunch the XLPE cables by using the tie clips and wire clips.

3 Apply belt traps for excessive bunch of cables.

4 Make a U loop on the bunch of cables when it is connected to front door.

5 Cut excessive tie ends and other excessive parts to make a neat bunching of cables.

Clean the panel board and preserve for next Exercise No.2.8.169.

6 Show the work done on the panel board to your instructor and get approval.

7 Check the wiring for its correctness.

— — — — — — — —

TASK 2 : **Connect the control panel with 3 phase induction motor**

1 Draw the circuit diagram for the control panel with 3 phase induction motor. (Fig 1)

2 Wire up the control panel to the 3 phase motor in conduct wiring.

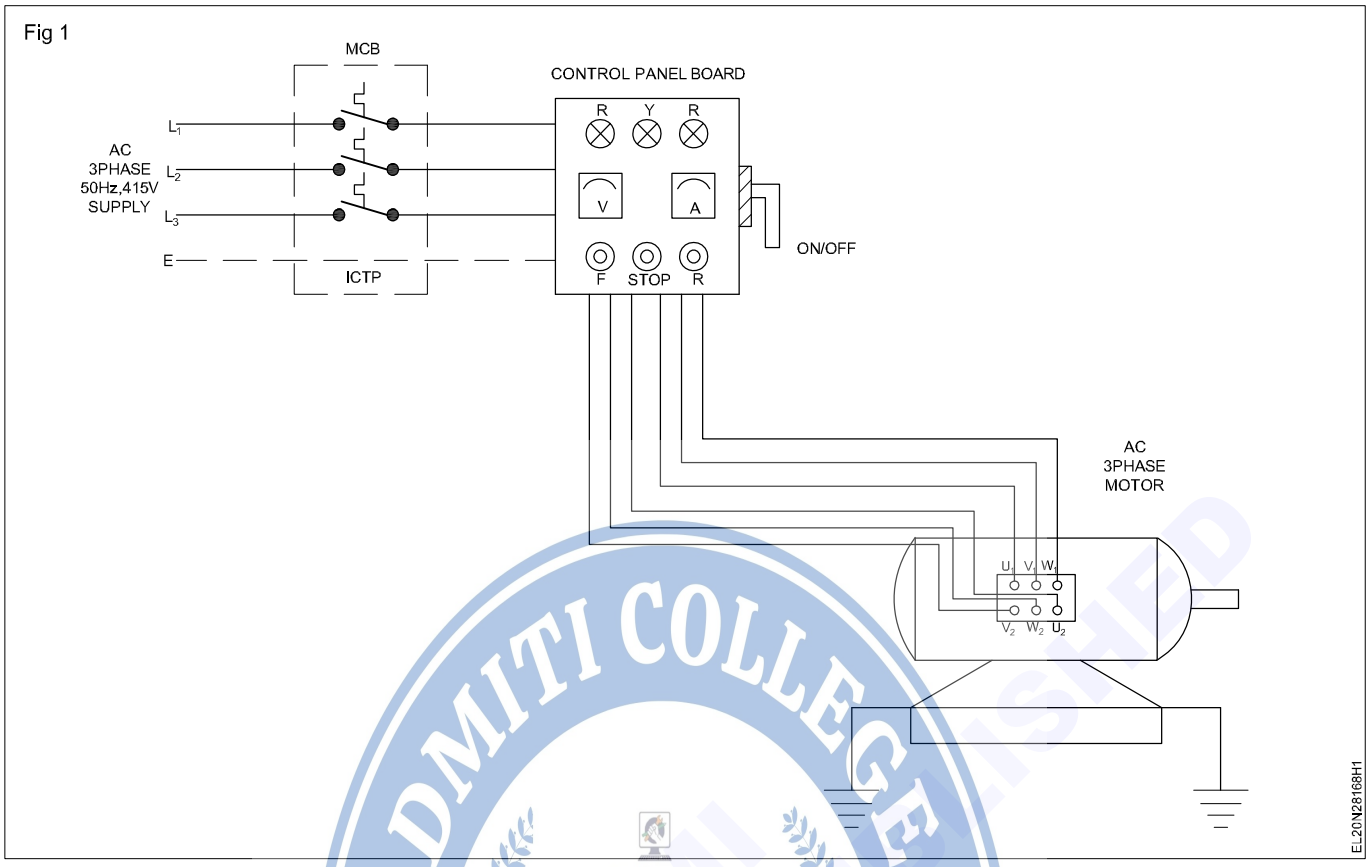
3 Provide double earthing for the motor.

4 Test the wiring for the proper operation of control panel controls with motor.

5 Check the controls of control panel for changing the direction of rotation of motor.

6 Get it checked with your instructor.

Fig 1



Mount various control elements (e.g) circuit breakers, relays, contactors and timers etc.

Objectives: At the end of this exercise you shall be able to
- **drill the holes in the marked places**
- **Mount the circuit breakers, relays, contactors and timer**
- **connect the cables to the control elements.**

Requirements

Tools/Equipments/Machines

- Trainees tool kit - 1 No.
- Multimeter - 1 No.
- Wire cutter/striper - 1 No.
- Needle file set - 1 Set.
- Round file set - 1 No.
- Hand drilling machine (electric) 6mm - 1 No.
- Half round file smooth-150 mm - 1 No.
- Flat file smooth-150 mm - 1 No.

Materials

- MCB 4 pole, 415V/16A - 1 No.
- OLR- 3 phase 415V/0-15A - 1 No.
- Contactors - 3 phase, 415V/16A 240V coil - 5 Nos.
- Timer - 1 phase, 10 sec - 2 Nos.
- Push button - 240V, NC/NO red & green - 4 Nos
- Indicating lamp with holder RYB - 3 Nos.
- Limit switch - 1 No.
- ON-OFF rotary switch 3 phase 32A - 1 No.

PROCEDURE

The panel board used in the Ex.No.2.8.168 is to be used for this exercise.

TASK 1: **Mark and make holes for mounting devices**

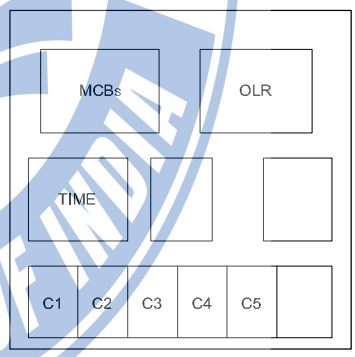
1 Measure the total area of base plate on four panel board, where devices are to be mounted.

2 Identify and check the area required to mount the devices like circuit breaker, contactor, push button, OLR, ON-OFF rotary switch, Timer, etc: as per the total quantity available.

3 Mark the plates where to fix the DIN rail and race ways to mount circuit breaker, contactors. (Fig 1)

While marking the layout for mounting devices, it is distributed equally to the whole area uniformly. Do not fix all the items in one end. Keep some space for future needs.

Fig 1



LAYOUT OF CONTROL DEVICES ON BASE PLATE

4 Make hole by electric drill to the size of nut and bolts. If the bolt is not free in through holes, use needle round file or bigger bits to make the bolt free going.

5 Fix the devices according to the layout on base plate check each devices for its rigidity and position correctness and get it checked.

— — — — — — — —

TASK 2: **Connect cables to control devices and checking the continuity**

1 Check the XLPE cables for continuity and tighten before connecting to the device.

2 Connect all the cable to the respective terminals and connecting points to the devices, fitted on the base plate.

3 Connect the relay coil, contactor coil, etc to a external source of working voltage and confirm the function especially in the Normally Close (NC) and Normally Open (NO) no contacts of push buttons and contactors.

4 Report to your instructor for approval.

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Identify and install required measuring instruments and sensors in control panel

Objectives: At the end of this exercise you shall be able to
- **identify and fix instruments to measure electrical quantities**
- **identify the sensors and fix it on the panel board.**

Requirements

Tools/Equipments/Machines

- Trainees tool kit - 1 No.
- Wire cutter/striper - 1 No.
- Hard drilling machine (electrical) 6mm - 1 No.
- Needle file set (set of 5) - 1 Set.
- Round file smooth - 150 mm - 1 No.
- Flat file smooth - 150 mm - 1 No.
- Tachometer - digital - 3 1/2 digit along with tacho generator set - 1 No.
- Single phase frequency meter digital - 3 1/2 digit - 1 No.
- Temperature indicator - digital 3 1/2 digit - along with thermistor sensor unit - 1 No.
- Voltmeter - 0-600V - digital - 1 No.
- Voltmeter - 0-300V - digital - 1 No.
- Ampere meter 0-30A digital 31/2 digit - 3 Nos.

Materials

- Nut and bolt (Assorted sizes) - as reqd.
- Washer (Ordinary & spring type) difficult sizes - as reqd.
- 1 sq.mm cable - as reqd.

PROCEDURE

The panel board used in the Ex.No.2.8.169 is to be used for this exercise with accessories.

TASK 1: **Fix panel meters and indicators on front panel**

1 Identify and select proper range of instruments (voltmeter, ammeter etc.,) suitable for this control panel.

2 Identify and select the required sensors (for temperature and speed) for this control panel.

The control devices are fitted on base cover and indicators are to be fitted on front panel. Wiring is terminated in respective points to be connected in the instruments. Proper sockets for terminating sensor outputs are to be provided on the front panel.

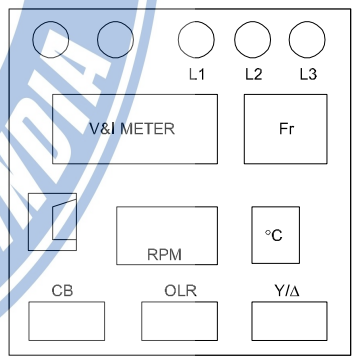
3 Mark the positions to fix the indicators on front panel (Line indicators, tripping indicators etc.)

4 Make holes for fixing the meters and other fixtures on front panel.

5 Fix the meters and indicators on front panel.

Distribution of gadgets on fixing in front panel should be uniform. Proper arrangement and distribution to have a good look on the front panel required. Do not crowed the devices at one places, and indicate devices like line indicator, trip indicator should be at top of the front panel as in Fig 1.

Fig 1



LAYOUT OF DEVICES ON FRONT PANEL

6 Wire the fitting in front panel using suitable cables.

Bunching or typing cables in front panel board is to be done if necessary.

7 Check the continuity of cables wired inside the panel board.

8 Report to your instructor.

Test the control panel for its performance

Objectives: At the end of this exercise you shall be able to
- **test the control panel for any short circuit earthing with fitted devices**
- **test the earthing points connections with connected control devices**
- **energise and test the panel board for its working condition.**

Requirements

Tools/Equipments/Machines

- Trainees tool kit - 1 No.
- Megger 1000V - 1 No.

Materials

- Connecting leads - as reqd.

PROCEDURE

The panel board used for the Ex.No. 2.8.170 is to be used for this Exercise with complete accessories and wiring.

The panel board with accessories and wiring is to be preserved for this Exercise No.2.8.171

1 Check the Insulation Resistance (IR) value of contactors circuit breakers etc, (Fig 1) enter the values in Table 1.

2 Check for any short circuit/open circuit fault.(Fig 1)

If any IR value shows abnormal or very low, consult with your instructor.

3 Switch 'ON' the supply to the panel board and verify the functions of line indicator, meters etc.

4 Test the contactor, push button switch, timer for its function. Enter the status in Table 1.

5 Switch 'ON' the motor and check the functions of sensors (speed and temperature)

If any control device found faulty replace new control devices and test it.

6 Complete your testing and show to your instructor for approval.

Fig 1

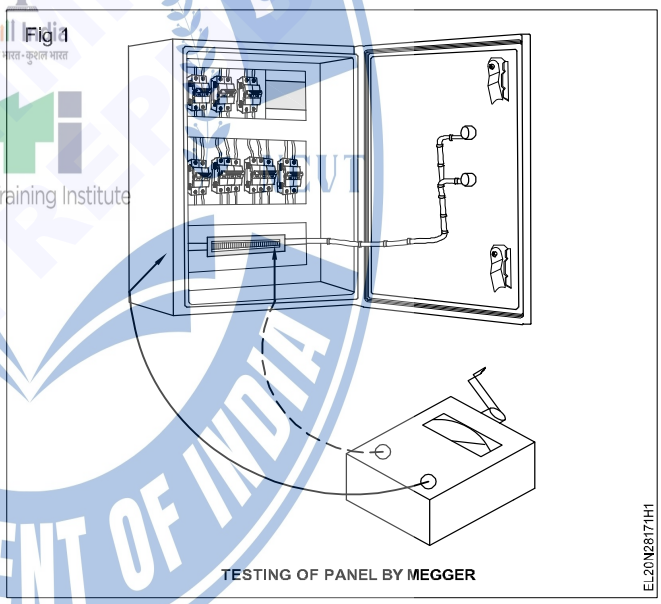


Table 1

Sl.No	Description of the items	Megger value in MΩ	Condition OK / not OK
1	Overload relay		
2	Contactor		
3	Circuit breaker		
4	Voltmeter		
5	Ammeter		
6	Frequency meter		
7	Temperature indicator		
8	Tachometer/revolution counter		
9	Indicators		