

Control elements, accessories - layout of control cabinet

Objectives: At the end of this lesson you shall be able to

- explain the layout marking methods and necessity
- state the methods of marking, cutting, drilling, fixing of accessories and components
- explain the methods of mounting and wiring the accessories
- state the various control elements used for control panel board
- list the different wiring accessories used in control panel wiring.

Introduction

Preparation of layout drawing and marking on control cabinet is very much essential, we must have a clear vision of mounting components and their location on panel board/ control cabinet.

There is no such important method in practice to make the layout on control cabinet. However a neat layout on control cabinet is very much required.

The display and indicating instruments should be selected on the top position of the cabinet. Heavy and rare operated devices such as fuse breaker etc; are to be fixed on the bottom of the cabinet.

The components and fixtures should have sufficient space in between to carry out future repair (or) replace requirements. But too much space should not be provided, that will increase the size of the cabinet unnecessarily. While finalising the layout plan the relevant IE rules to be followed for better result.

Layout marking

Wiring diagrams for power and control circuit should be developed for sequence of operation of automatic star - delta starter with forward and reverse. Types of protection, control, indication and measuring accessories needed should be finalized.

To wire up the above starter in a control panel the well designed and easily understandable layout should be finalized. Layout of the finalized wiring diagram should be developed keeping important features of the control panel in mind. While designing the control panel the outside dimensions, the swing area of cabinet doors and area required for maintenance and tools kit have to be considered.

Control panel may be often used near the process area with high temperature, humidity and dust hence the arrangement for cooling fan and dehumidifier along with filters and intake and exhaust vents should be needed.

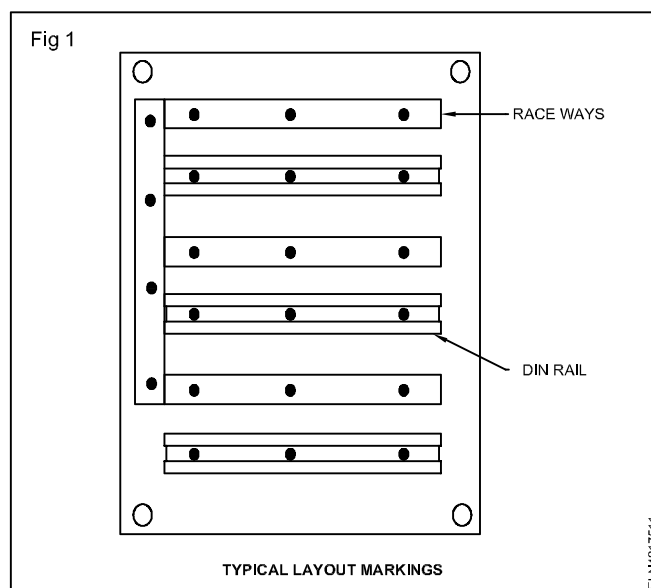
Suitable size of control panel which can accommodate all the controlling, protective, measuring, indicating and

wiring accessories required for said wiring should be obtained or fabricated.

While selecting the control and protective accessories of the control panel the full load current of the individual load, total load and duty cycle, simultaneous operation of the load and 25% additional load capacity of the motors have to be considered.

The over load and short circuit protection may be given either ahead of the control panel by calculating the highest rating of the branch circuit or individual motors depends on space available, cost factor and sensitiveness of the operation.

The finalized layout may vary depends the individual design and mind application. However a sample layout marking for the above starter is given in the Fig 1.



Once the panel layout is designed we must find out where and how to fit the accessories.

The finalized layout of accessories can be marked in the control panel using suitable marking device.

Cutting and drilling

The mounting or fixing holes along with necessary tap or die in suitable size (if any) can be prepared in the front door and inside of the control panel as in Fig 2.

Fig 2



CONTROL PANEL WITH RACEWAYS/DIN RAILS

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Fig 3



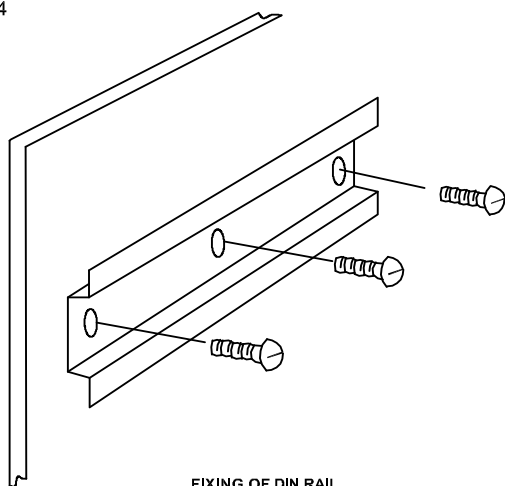
CONTROL PANEL WITH MOUNTING AND FIXING HOLES

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Din rail is a metal rail made from cold rolled carbon steel sheet with zinc plated or chromate bright surface finish used to mount the circuit breakers and control accessories without using screws as in Fig 2. DIN rail being fixed to the chassis before fitted the contactors and other accessories as in Fig 3.

The standard specification of widely available DIN rail is top hat rail EN 50022 which dimension is 35 mm width and a 15 mm or 7.5 mm depth. They can be cut in to the required length and then screwed or bolted inside the panel before mounting any accessories and wiring begins as in Fig 4.

Fig 4



FIXING OF DIN RAIL

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Race way is one form of cable ducting used to carry the wiring between components and keeping the wires neat. The leads wires and cables are laid inside the raceways brought out through the holes / slots in the sides and can be inspected by removing the cover of the raceways.

The minimum spacing between components and raceways should be 100 mm for 415V systems and 50 to 75 mm for less than 415V system. The next stage is to clip the accessories to the rail and wire them.

Mounting and wiring the accessories in control panel

The accessories can be mounted on the DIN rails allowing sufficient space for easy maintenance, wiring and troubleshooting. The mounting should not move or lean in the DIN rail due to vibration or strain due to cables.

Contactor can be either flush mounted to the chassis or DIN rail - mounted. Contactor mounting type over load relay which have three pin connectors engage into the contactor terminals may be used to reduce the mounting and wiring time and labour.

To mount the contactor on rail first place the back top groove on the top of rail and turn it downwards against the lower rail which will cause the spring of the contactor to retract and snap into place behind the rail. There is a slot in the spring clip of the contactor so that the clip can be retracted using small screw driver or connector to remove the contactor if required. To avoid fouling the underneath of the accessories use screws with low profile heads.

The contactor arrangements and terminals are usually labeled which conforms to BS 5583. For example 1 and 2 for NC contacts, 3 and 4 for NO contacts, odd numbers like 1, 3 and 5 for incoming terminals and even numbers like 2, 4 and 6 for outgoing terminals of the main contacts of contactors and OLR.

The conductor should be trimmed OFF to that the conductor does not insert more than the half way through the connectors. Single strand wire should be folded back to give additional thickness. The over tightening of screw have to be avoided otherwise this can crush the strand and give a weak connection.

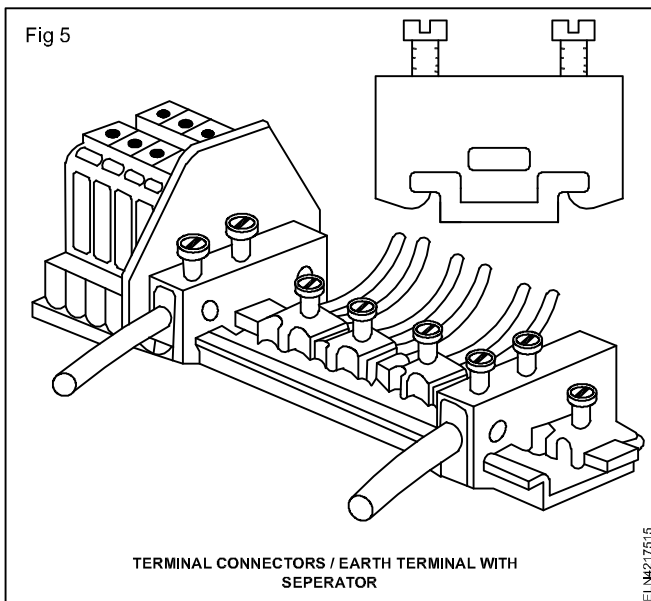
All the internal wiring should be terminated in the top and external wiring in the bottom of the connectors to avoid the crossover of both wirings. Flexible conduit and cables have to be installed in such a way that the liquid or water if any can drain away from the fitting and grommets.

An earth terminal usually green or green yellow to be clamped to the rail and ensure the cabinet and door are earthed properly.

An insulated separator can be used to isolate the high voltage connections from others. End stops are used to clamps the connectors together and close the open

terminals on one end, sometimes the earth terminal will do the same job as in Fig 5.

The control panel should be grounded properly so that control panel should have proper earthing bolts / nuts. If more ground points are used a common earth plate should be fixed inside the cabinet as in Fig 5.



U loops of the cables as long as possible facing down and anchored on each side of the hinged doors and panel with screws or bolts and do not use adhesive. Place the sleeve and spiral flexible conduits of suitable size over the cables running between the hinged doors and panel as in Fig 6.



The care to be given to the bundle of wires which is mounted on the hinged doors should not restrict the opening and closing of the door or the doors should not damage the wires.

Minimize the use of cable ties if the raceways are used. They may be cut OFF during troubleshooting and rarely replaced.

Routing and bunching

Routing

Conductors and cables should run from terminal to terminal without any intervening joins and cross over. Extra length should be left at connector / terminals where assembly needs to be disconnected for maintenance and servicing. Multi core cable terminations have to be adequately supported to avoid undue strain on the terminals.

Different colour may be used to aid identification of group of controls and functions.

The associated earth and neutral conductor should be routed close to the respective live conductors to avoid undue loop resistance.

Select the race ways to leave some slacks or looping of the cable inside it. The wires inside the race way should not more than the half fill.

Bunching and tying

Run the wires in horizontal and vertical lines avoid diagonal runs as possible. Do not run the wire over the other devices or race ways. Uses of spring cage terminals instead of standard screw terminals can reduce the termination error, the wiring and maintenance time which in turn reduce the cost and labour.

To connect the accessories, cut the individual control wires to the proper lengths, strips the insulation, mark wire identification, insert ferrules at the ends of wires, use suitable lugs or thimbles.

The wires should be neatly bundled, run in the race ways and routed with smooth radius bends.

All the terminals, wires and components should have identification marks and labels. A good labelling and identification will reduce the errors in termination, testing, maintenance and repairs. A legible and durable label in an efficient and cost effective manner may be chosen.

To the possible extent the power and control wiring should be run in separate race way or cable management which will reduce the radio interference, trouble shooting time and make the future alteration if any is easier.

By taking some extra cares like pest control, dust control, adequate terminal pressure, selection of proper wires and accessories, it can be ensured that the control panel has no failure time and with moderate maintenance it will be trouble free panel for entire life.

Where the multiple earths are used it is necessary to use a common earth terminal or connectors as in Fig 5.