New Value for Control Panels

OMRON

Control Panel Basics Volume 1

plus
Value+

Basic Information on Control Panel Design

Know-how on Control Panel Design, from Safety Standards to Preventive Measures against Heat, High Humidity, and Ground Faults

Changes in the market require handling a wide variety of control panel issues.
Control Panel Basics describes OMRON's wealth of knowhow and information and provides easy-to-understand descriptions of the knowledge required to solve these issues through concrete examples.

Control Panel Basics | Volume 1

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Important Points on Control Panel Design

The IEC 60204-1 electrical safety standards related to machine control panels must be considered.

The power supply breakers, device locations, and electric-shock prevention for control panel design are described from the viewpoint of safety standards.

Power Supply Cutoff (Breaker) Devices

- ON " | " and OFF " ◯ " must be indicated.
- There must be an external operation means (e.g., handle).
- There must be a means to lock the device in the OFF position.
- There must be a suitable cutoff capacity. Etc.

Power Supply Cutoff (Breaker) Devices

Device Locations

(1) Power supply cutoff devices: 0.6 to 1.9 m, recommended max.: 1.7 m
(2) Manual operation devices: 0.6 m or higher
(3) Terminals: 0.2 m or higher
(4) Devices that must be approached for periodic maintenance or adjustments: 0.4 to 2.0 m

Enclosure Degree of Protection: IP22 or Better

Electric Shock Prevention

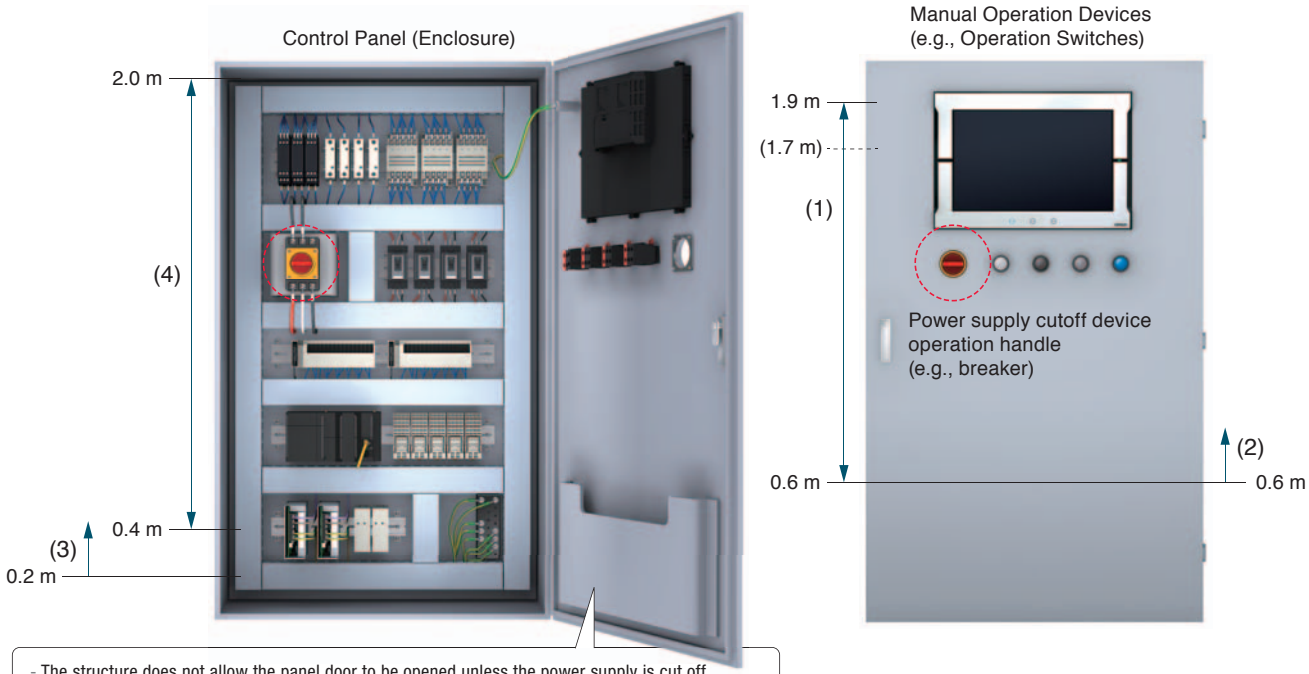
When Enclosure Is Opened:
- It must be possible to open the enclosure when charged sections are cut off.
- If the enclosure can be opened without cutting off a charged section, all charged sections must have IP2X or IPXXB protection. If a barrier is provided, a tool must be required to remove it or the charged section must be automatically cut off when it is removed.

Additional Information

IP2X: Protection against foreign objects with a diameter of 12.5 mm or larger (equivalent to a finger)
IPX2: Protection against vertically falling water drops when enclosure tilted up to 15°
IPPXXB: Protection against an approaching finger

Reference Illustration

(Numbers 1 to 4 correspond to items 1 to 4 under Device Locations.)



- The structure does not allow the panel door to be opened unless the power supply is cut off.
- If the door can be opened without cutting off the power supply, charged sections must be protected, e.g., with covers, so that they cannot be touched with fingers or similar objects.

Note: The values are the heights from the working surface.

Control Panel Component Colors

It is important to correctly understand the meaning of the colors of indicators, operation parts, and wires.

		Machine status indicated by indicator color		General meaning of operation device (operation part) color		General rules	
Color	Meaning	Description	Operator action	Description	Application example	Human or environmental safety	Process status
Red	Emergency	Hazardous situation	Immediate action for the hazardous situation	Actuate in the event of a hazardous situation or emergency	●Emergency stop ●Stopping or turning OFF for emergency stop ●Initiation of emergency function	Hazard	Emergency
Yellow	Caution	Abnormal situation An impending critical situation	Monitoring and/or intervention	Actuate in the event of an abnormal condition	●Intervention to suppress abnormal condition ●Intervention to restart an interrupted automatic cycle	Caution	Abnormality
Green	Normal	Normal situation	No specific action required	Actuate to initiate normal conditions	●White is the most suitable color for a device (operation part) for starting or turning ON something, but green is also acceptable.	Safe	Normal
Blue	Mandatory	Indication of situation requiring operator action	Required action	Actuate for a condition requiring mandatory action	●Reset function	Mandatory	
White	Neutral	Other situations Situation in which the use of red, yellow, green, or blue does not seem appropriate	Monitoring	Initiation of functions	●White can be used for any function other than an emergency stop.	———	

Color Requirements for Emergency Stop Switches

Wire Colors (IEC 60204-1)

Applicable conductor	Color
Ground (earth) circuit	Green-yellow spiral
Power neutral circuits	Light blue
Primary power circuits	Black
DC control circuits	Blue
AC control circuits	Red
Excepted circuits (e.g., interlock circuits)	Orange

Note: Excerpt from IEC 60204-1

Recommended Operation Devices

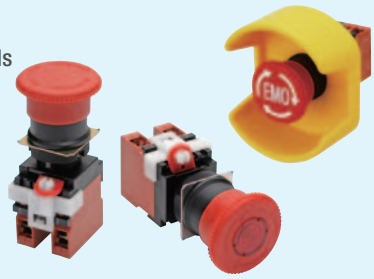
Globally applicable switches conceived for compactness, simplicity, and safety.

Pushbutton Switches
A22N

Search for OMRON A22N for details.

Emergency Stop Switches That Conform to Various Standards

Emergency Stop Switches
A22E



Search for OMRON A22E for details.

Heat Measures

The correct Fan must be selected to suppress temperature rise inside the panel.

If the temperature inside the panel increases, the lives of devices and parts inside the panel will be reduced and malfunctions could result.
Particularly devices and parts that generate heat are greatly affected by heat.
Panel cooling and Fan selection are extremely important to long-term usage of the panel and parts inside the panel.

Selecting Fans

1 Check the heating values of devices and the panel (kW).

Check the heating value of each device located in the control panel and then find the total heating value.
Generally speaking, the heating value indicates the power consumption, so you can assume that the power consumption equals the heating value.

$$\text{Heating value (W)} = \text{Input power} - \text{Output power}$$

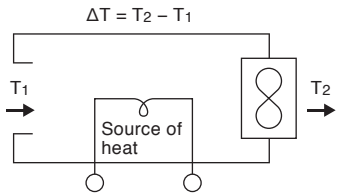
$$= \frac{\text{Output power}}{\text{Efficiency}} - \text{Output power}$$

2 ΔT of devices and panel: Allowable temperature rise (°C)

ΔT can be obtained by subtracting the device ambient temperature, T1 from the allowable internal temperature, T2.

Note: As a guideline, you can make the calculation with a value of 10°C. (Use the more severe condition.)

$\Delta T = 10°C$ (guideline)



3 Calculate Q, the required flow rate (m³/min).

$$Q = \frac{50 \times W}{\Delta T} \text{ m}^3/\text{min}$$

Q = Flow rate (m³/min)
ΔT = Allowable temperature rise (°C)
W = Heating value (kW)

4 Select the size of the required Fan based on the maximum flow rate.

Normally, select a Fan with a maximum flow rate of 1.3 to 2 times the calculated required flow rate (Q).
As the flow rate increases, noise increases. If the Fan is used in an environment where noise is a problem, select a Fan with a lower flow rate.

5 Selecting Options

If fine foreign matter may enter the Fan, select a Filter.
If slender objects such as fingers may enter the Fan, select a Finger Guard.

Note: Actually results may vary from calculations, so measurement and confirmation in the actual panel are required.

Calculation Example for a Control Panel with Two 100-W Power Supplies

Note: The S8JX-N10024C (output voltage: 24 VDC, output current: 4.5 A, efficiency: 83% min.) is used for the 100-W Power Supplies.

First, the heating value (power consumption) is calculated.

$$\text{Heating value (W)} = \frac{24\text{ (V)} \times 4.5\text{ (A)}}{83\text{ (\%)}} - 24\text{ (V)} \times 4.5\text{ (A)}$$

$$= \frac{108\text{ (W)}}{0.83} - 108\text{ (W)} = 22.120\ldots\text{ (W)}$$

Two Power Supplies are used, therefore,

$22.12\text{ (W)} \times 2 \approx 44.2\text{ (W)} \approx 0.04\text{ (kW)}$

$$\text{Q: Required flow rate} = \frac{50 \times 0.04\text{ (kw)}}{\Delta T\text{: 10[°C]}} \approx 0.2\ [\text{m}^3/\text{min}]$$

Maximum flow rate calculation: Q × 2 $0.2 \times 2 = 0.4\ [\text{m}^3/\text{min}]$

Therefore, one R87F-A□A83H is required from the table on the right.

Note: This calculation example assumes that the control panel contains only two Power Supplies.

Models and Maximum Flow rate

Model	Size (mm)	Maximum flow rate (m³/min) 50 Hz	60 Hz
R87F-A□A15HP	120 × 120 × t 38	2.7	3.1
R87F-A□A13HP	120 × 120 × t 25	1.9	2.2
R87F-A□A93HP	92 × 92 × t 25	0.9	1.0
R87F-A□A85HP	80 × 80 × t 38	0.8	0.9
R87F-A□A83H	80 × 80 × t 25	0.6	0.7

Point!

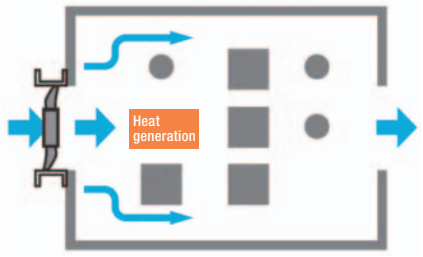
If the flow rate is insufficient, two Fans can be operated in parallel for approximately twice the flow rate.

$Q1 \times 2 \approx Q2$

Q1: Flow rate of one Fan
Q2: Flow rate for parallel operation

Airflow Direction and Inlet/Outlet Cooling Effect Differences

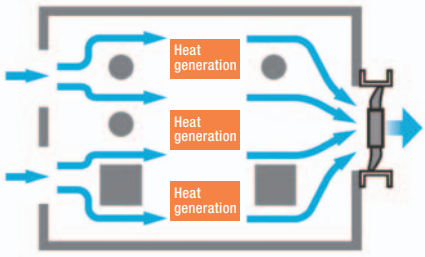
When the Heat-generating Portions Are Concentrated at One Location



Advantages of Inlet Installation

- You can concentrate cooling on the heat-generating portions.
- The pressure inside the box increases, which reduces dust entry from other openings.

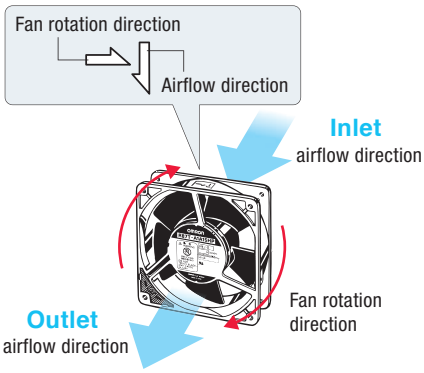
When the Heat-generating Portions Are at Many Locations



Advantages of Outlet Installation

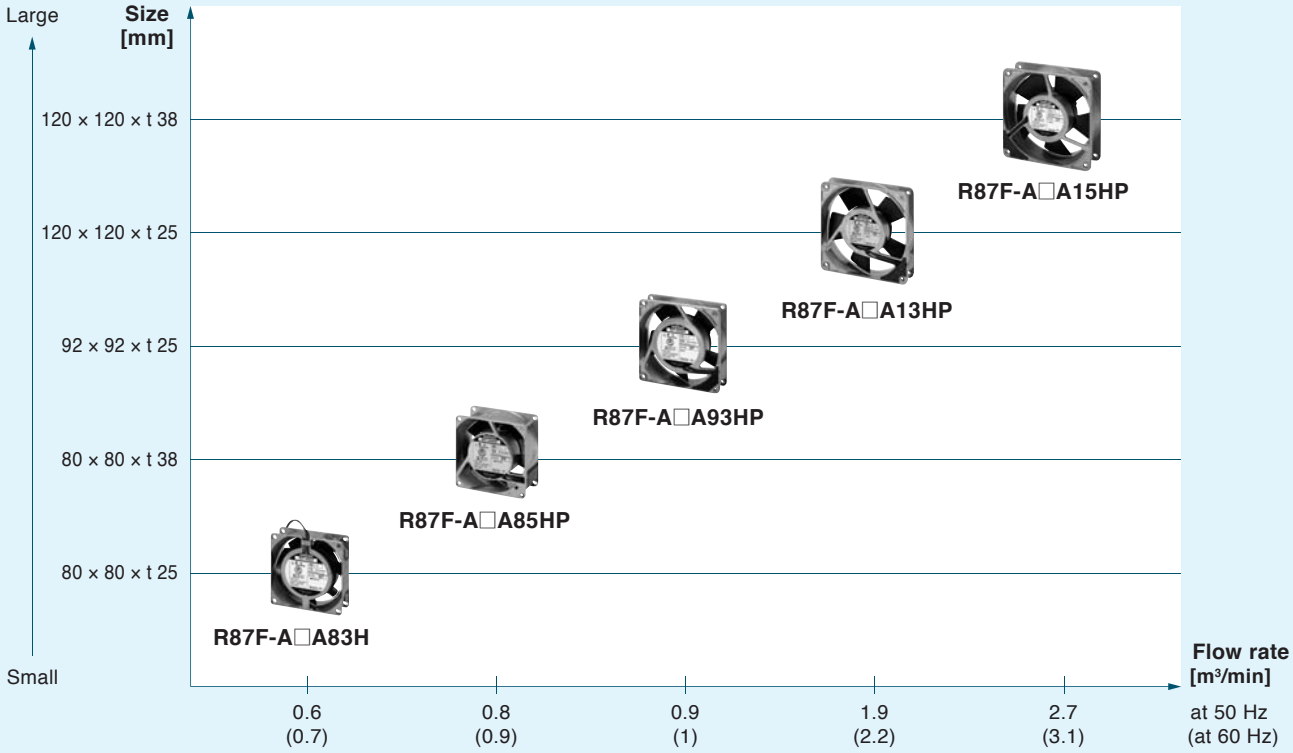
- A wide area can be cooled.

Reference Information:
The Fan airflow is in one direction, which is indicated on the top of the Fan.

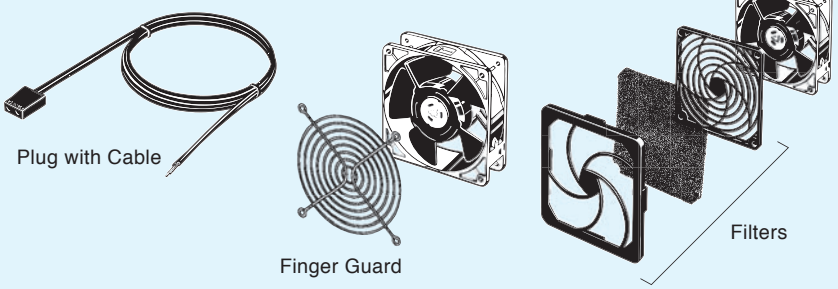


Recommended Axial Fans

R87F AC Axial Fans



Options



Models	
Plug with Cable ✻	R87F-PC
Finger Guards	R87F-FG□
Filters	R87F-FL□(S)

✻Not required for Fans with lead wires.

Search for OMRON R87F for details.

High Humidity Measures

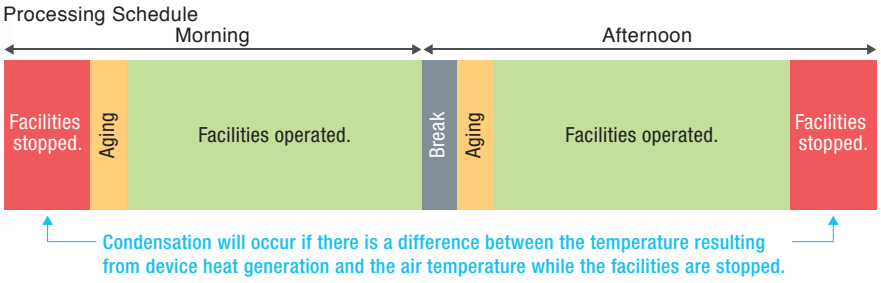
If a control panel is installed in a location with high humidity, measures against short-circuits are required.

Condensation will occur in the control panel as the result of a difference in the device temperature and external air temperature.
This condensation may adhere to a PCB and if condensation and dust repeatedly collect on the PCB, short-circuits will occur.

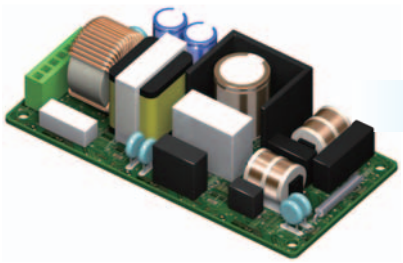
Examples of Short-circuits Caused by Condensation

Case 1: **Short-circuit** from Water Drops Generated by Condensation

Case 2: **Short-circuit** Caused by Repeated Condensation and Dust Collection

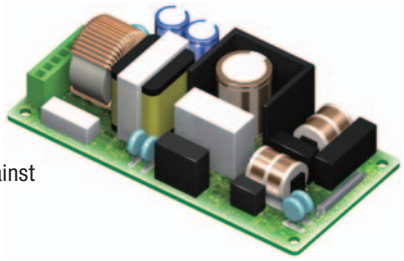


Preventing Short-circuits with Products with Coated PCBs or Modifications



Coating

PCBs can be coated to protect them against humidity and reduce the possibility of short-circuit accidents.



Recommended Products with Coated PCBs

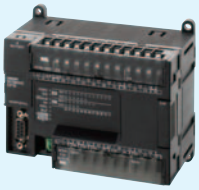
Ask your OMRON representative for more information on coating.

Switch Mode Power Supplies
S8VK-G

Timers
H3CR
H3Y
H5CX

Digital Temperature Controllers
E5□C
E5CB

Micro PLCs
CP1E
CP1L
CP1H
CP1W



Counters
H7CX
H7E□-N

Search for OMRON with the model name.

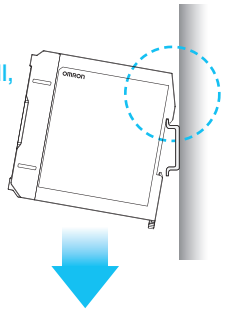
Control Panel Column

Why There Are Two Different DIN Track Heights

The two types of DIN Tracks are both made of aluminum, but the heights, which increase the mounting strength, are different.
Small, lightweight devices, such as Relay Sockets, can be mounted to the DIN Track with a height of 7.3 mm without concern. Large, heavy devices, such as Power Supplies, require more track strength, so the DIN Track with a height of 16 mm must be used.

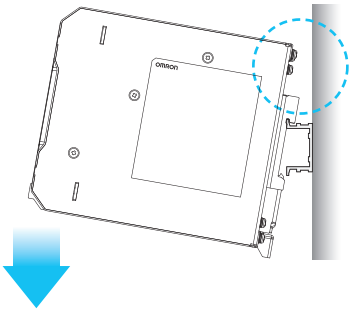
DIN Track with a Height of 7.3 mm Is OK for Mounting Small, Lightweight Objects

If a large device is mounted, the back of the device may interfere with the mounting surface.



Use DIN Track with a Height of 16 mm for Large, Heavy Objects

This type of DIN Track also provides more distance from the mounting surface, so interference with the mounting surface is less likely.

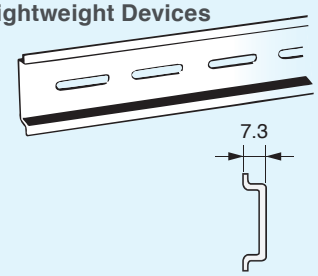


Recommended DIN Track

For Mounting Small, Lightweight Devices

DIN Track with 7.3-mm Height

PFP-100N/-50N

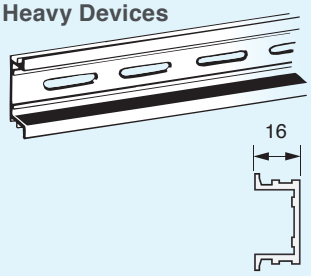


Search for OMRON PFP for details.

For Mounting Large, Heavy Devices

DIN Track with 16-mm Height

PFP-100N2



Search for OMRON PFP for details.

Let OMRON Solve Your Control Panel Challenges

plus
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New Value for Control Panels

A product and service catalog is available to help solve a wide range of control panel challenges, such as downsizing.
Ask your OMRON representative for details.

"Solutions to Downsize Control Panels" Catalog
(Cat. No. Y204)

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