MODEL

AL-P
The AL-P low-voltage switchgear conforms to the latest IEC 60439-1 standard and is designed and manufactured utilising Mitsubishi Electric state-of-the-art technology, fully taking into account present and future power system requirements. Mitsubishi Electric has manufactured more than a hundred thousand low-voltage switchgear panels over more than 50 years. With this experience Mitsubishi Electric has gained a reputation of manufacturing up to date and reliable metal enclosed switchgear with a significant supply record to customers all of the world.
1 FEATURES

HIGH RELIABILITY
- Heat stress analysis of the switchgear structure has led to a heat-resistant design in which circuit breakers up to 6000A are self-cooled (i.e., cooling fans not required).
- All components, such as current transformers, voltage transformers, relays and meters, are made of the highest quality materials.
- AL-P low-voltage switchgear are designed with the benefit of Mitsubishi’s vast switchgear and circuit breaker production experience of in excess of one hundred thousand panels over the last 50 years.
- The reduced number of parts reduces the chance of failure.

SAFETY
- Partitions between compartments and an automatic shutter system completely isolate live parts.
- The pressure relief device which is installed optionally releases hot gas upwards in the event of an internal arc fault for operator’s safety.

EASY HANDLING
- Control switches are installed at a height appropriate for easy viewing and operation.
- Installation and testing duration are considerably reduced as the switchgear is tested and adjusted in the factory and then delivered as a complete unit.

FLEXIBLE DESIGN
- Panels with main circuit and control cable entry from either top or bottom are available.
- The AL-P is readily combined with Mitsubishi Electric’s Motor Control Center (MCC). The combined arrangement has many advantages such as compact size and a simplified overall structure. As the MCC utilizes a double-front design, a larger number of motor starter units can also be accommodated. The AL-P is the perfect complement for Mitsubishi’s MCCs. (Further information regarding Mitsubishi’s MCCs can be found in a separate publication.)

2 APPLICATIONS

- AL-P low-voltage switchgear, with withdrawable circuit breakers, provide control and protection of the power supply to motors, transformers, capacitors and other feeder circuits.
- AL-P low-voltage switchgear is available at rated voltages up to 630V, with rated short-circuit breaking capacities up to 10kA.
- AL-P low-voltage switchgear is designed for indoor use and is particularly suitable for electric power utility systems, unit substations, industrial plants, commercial buildings, pumping stations, transportation systems and pipeline stations.

3 STANDARD RATINGS

1. LOW-VOLTAGE SWITCHGEAR

<table>
<thead>
<tr>
<th>Standard</th>
<th>EC 60439-1, Low-voltage switchgear and controlgear assemblies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Insulation voltage</td>
<td>1000VAC</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>690VAC</td>
</tr>
<tr>
<td>System</td>
<td>1p+N (4p ACB or 3p ACB with removable 4p N) Phase bus is half capacity</td>
</tr>
<tr>
<td>Rated busbar current (Horizontal)</td>
<td>690~1000A</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50/60Hz</td>
</tr>
<tr>
<td>Short-time withstand current (Horizontal bus)</td>
<td>50, 65, 75, 85, 100kA 1~3s</td>
</tr>
<tr>
<td>Withstand voltage</td>
<td>Main circuit: 3500V Control circuit: 1500V</td>
</tr>
</tbody>
</table>

2. AIR CIRCUIT BREAKER

<table>
<thead>
<tr>
<th>Standard</th>
<th>EC 60439-2, Low-voltage switchgear and controlgear Part 2: Circuit breakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Insulation voltage</td>
<td>1000V AC</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>690V AC</td>
</tr>
<tr>
<td>NOS pole</td>
<td>3P/4P</td>
</tr>
<tr>
<td>Connection type</td>
<td>Main circuit: Automatic connection Control circuit: Automatic connection</td>
</tr>
<tr>
<td>Kinds of position</td>
<td>Connect/Teach/Disconnect</td>
</tr>
</tbody>
</table>

Figure 1-1: AL-P and Motor control center

Figure 3-1: AL-P panel
4 CONSTRUCTION

1. ENCLOSURE AND PARTITIONS
- The All metal enclosure is completely earthed. Each compartment (control, air circuit breaker, busbar and cable) is segregated from other compartments by earthed metal partitions (up to Form 4b).
- The front of AL-P low-voltage switchgear is divided into upper and lower compartments. The upper compartment is the control compartment, and the lower one is the circuit breaker compartment. (See Figure 4-1.)
- Meters, control switches, etc. are semi-flush mounted on the door of the control circuit compartment.

![Figure 4-1 Front view of AL-P](image)

1. Control circuit compartment
2. Busbar compartment
3. Air Circuit Breaker compartment
4. Cable compartment
5. Terminal Block compartment for control circuit

2. BUSBAR
- The main busbar is made of copper conductor.
- AL-P low-voltage switchgear has tin plated busbars as standard.
- However, when required, the busbar can be insulated with PVC. Also, the bus joints between adjacent panels can be shrouded with insulating covers, and the other connecting parts, such as those between busbars and circuit breaker bushings, or CB bushings and cable terminals, can be covered with insulating tape.

![Figure 4-2 Main busbars with PVC insulation and power cable compartment](image)

3. SAFETY AND SPACE SAVING LAYOUT
By adopting a duplex feeder arrangement, the following features are available with AL-P low-voltage switchgear.

**Safety**
- The chances of electric shock are minimized due to earthed metal barrier partitioning between all compartments. (Internal partitioning up to Form 4b, as defined in IEC 60439-1, is possible.)
- Pressure relief devices may be optionally installed to prevent explosion in the event of an internal arc fault.

**Space saving**
- The panel depth is 1000mm, 86% of its predecessor's 1500mm depth.
- A front-maintenance only version is also available for installations on or against a wall, and is particularly convenient in small installations such as pre-fabricated switching rooms.

![Cross section of AL-P low-voltage switchgear](image)

4. INTERNAL SEPARATION
- The partition class is up to Form 4b according to IEC 60439-1 by the two feeder in duplex layout with simple metal partition.
- By adopting a duplex (side-by-side) feeder structure, partitioning has been improved, and the highest possible internal separation of Form 4b is possible.
5. PRESSURE RELIEF DEVICE FOR THE INTERNAL ARC FAULT (IEC 61641)

- A pressure relief device can be optionally installed for a further improvement of safety.
- In the event of an internal arc fault, the pressure relief device, which is installed on the top of the cubicle, is forcibly operated by the rising internal pressure and the hot gases released.

6. COMPACT DESIGN

- Depth is reduced by approximately 35% compared to the previous model.
- In the previous model, feeders ACBs were arranged vertically in tiers. As the horizontal busbars were situated in the centre of the panel, the load cable from the top-mounted ACB was required to pass over the horizontal busbars, as well as the bottom-mounted ACB's load cable whilst always maintaining adequate clearance. In the current model, by re-positioning the horizontal busbars to the top-center of the switchgear and arranging the ACBs horizontally, the large clearances are avoided.
- By applying a side-by-side arrangement of feeder ACBs, the depth of the switchgear is reduced and distinct control circuit compartments become possible.
2. COMMON SPECIFICATION
- Standard: IEC 60439-1: Low-voltage switchgear and controlgear assemblies
- Specifications:
  1. Main busbar: Max. 5000A, Short-time current: 1000A/85kA/75kA/65kA/50kA 1-3s
  2. Structure: FR (Front operation, Rear and front maintenance)
  3. FF (Front operation, front maintenance)
  4. Internal separations: Form 3a (up to Form 4b as option)
  5. Channel base: 50mm (It shall be added to the panel height)

3. OUTLINE

<table>
<thead>
<tr>
<th>ACB frame size</th>
<th>630AF</th>
<th>1000AF</th>
<th>1250AF</th>
<th>1600AF</th>
<th>2000AF</th>
<th>2500AF</th>
<th>3200AF</th>
<th>4000AF</th>
<th>5000AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (mm)</td>
<td>600</td>
<td>1000</td>
<td>1000</td>
<td>1200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height (mm)</td>
<td>1934</td>
<td>1934</td>
<td>1934</td>
<td>1934</td>
<td>1934</td>
<td>1934</td>
<td>1934</td>
<td>1934</td>
<td>1934</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>705</td>
<td>1050</td>
<td>1050</td>
<td>1400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Width (mm)     | 800   | 1000   | 1000   | 1200   |        |        |        |        |        |
| Height (mm)    | 2500  | 2500   | 2500   | 2500   | 2500   | 2500   |        |        |        |
| Depth (mm)     | 1934  | 1934   | 1934   | 1934   | 1934   | 1934   | 1934   | 1934   | 1934   |
| Weight (kg)    | 800   | 1050   | 1050   | 1400   |        |        |        |        |        |

| Width (mm)     | 1100  | 1000   | 1000   | 1000   | 1000   |        |        |        |        |
| Height (mm)    | 2300  | 2300   | 2300   | 2300   | 2300   | 2300   |        |        |        |
| Depth (mm)     | 1934  | 1934   | 1934   | 1934   | 1934   | 1934   | 1934   | 1934   | 1934   |
| Weight (kg)    | 900   | 1150   | 1150   | 1400   |        |        |        |        |        |

| Width (mm)     | 500   |        |        |        |        |        |        |        |        |
| Height (mm)    | 2300  |        |        |        |        |        |        |        |        |
| Depth (mm)     | 1934  |        |        |        |        |        |        |        |        |
| Weight (kg)    | 800   |        |        |        |        |        |        |        |        |

| Width (mm)     | 1000  | 1200   |        |        |        |        |        |        |        |
| Height (mm)    | 2300  |        |        |        |        |        |        |        |        |
| Depth (mm)     | 1934  |        |        |        |        |        |        |        |        |
| Weight (kg)    | 950   |        |        |        |        |        |        |        |        |

| Width (mm)     | 800   | 1000   |        |        |        |        |        |        |        |
| Height (mm)    | 2100  |        |        |        |        |        |        |        |        |
| Depth (mm)     | 1934  |        |        |        |        |        |        |        |        |
| Weight (kg)    | 800   |        |        |        |        |        |        |        |        |

| Width (mm)     | 500   |        |        |        |        |        |        |        |        |
| Height (mm)    | 2100  |        |        |        |        |        |        |        |        |
| Depth (mm)     | 1934  |        |        |        |        |        |        |        |        |
| Weight (kg)    | 800   |        |        |        |        |        |        |        |        |

4. FOUNDATION

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Energizing current by ambient temperature

<table>
<thead>
<tr>
<th>ACB frame size</th>
<th>630AF</th>
<th>1000AF</th>
<th>1250AF</th>
<th>1600AF</th>
<th>2000AF</th>
<th>2500AF</th>
<th>3200AF</th>
<th>4000AF</th>
<th>5000AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient</td>
<td>40°C</td>
<td>630A</td>
<td>1000A</td>
<td>1250A</td>
<td>1600A</td>
<td>2000A</td>
<td>2500A</td>
<td>3200A</td>
<td>4000A</td>
</tr>
<tr>
<td>Temperature</td>
<td>40°C</td>
<td>475A</td>
<td>650A</td>
<td>650A</td>
<td>650A</td>
<td>700A</td>
<td>700A</td>
<td>700A</td>
<td>700A</td>
</tr>
<tr>
<td>60°C</td>
<td>630A</td>
<td>1000A</td>
<td>1250A</td>
<td>1600A</td>
<td>2000A</td>
<td>2500A</td>
<td>3200A</td>
<td>4000A</td>
<td>4000A</td>
</tr>
<tr>
<td>80°C</td>
<td>630A</td>
<td>1000A</td>
<td>1250A</td>
<td>1600A</td>
<td>2000A</td>
<td>2500A</td>
<td>3200A</td>
<td>4000A</td>
<td>4000A</td>
</tr>
</tbody>
</table>

Structure: FR (Front operation, Rear and front maintenance)

| Ambient | 40°C  | 630A  | 1000A  | 1250A  | 1600A  | 2000A  | 2500A  | 3200A  | 4000A  |
| Temperature | 40°C  | 875A  | 875A  | 875A  | 875A  | 875A  | 875A  | 875A  | 875A  |
| 60°C  | 630A  | 1000A  | 1250A  | 1600A  | 1945A  | 2100A  | 2770A  | 2770A  | 2770A  |
| 80°C  | 630A  | 1000A  | 1250A  | 1600A  | 1945A  | 2100A  | 2770A  | 2770A  | 2770A  |

Structure: FF (Front operation, front maintenance)

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* Double feeder rated current factor: 0.6
* More than 2000A: The welding device is necessary for the rear cover
6 STANDARD DESIGN

1. ENCLOSURE AND STRUCTURE
- Steel thickness is a minimum of 1.5mm
- Side cover (both ends of arrangement): Min. 2.0mm
- Frame: Min. 2.0mm
- Door: Min. 2.0mm, painted
- Ceiling plate: Min. 2.0mm
- Bottom plate: Min. 2.0mm
- Internal partitions: Min. 1.5mm
- Mounting plates: Min. 2.0mm
- Standard front door/rear cover

<table>
<thead>
<tr>
<th>Position</th>
<th>Structure</th>
<th>Hinge location</th>
<th>Handle location</th>
<th>Handle lock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front</td>
<td>Three-hinged door</td>
<td>Left</td>
<td>Right</td>
<td>Optional</td>
</tr>
<tr>
<td>Rear</td>
<td>Bolted covers (x2)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

- Degree of protection
  - Enclosure: IP2X
  - Internal partitions: IPXXB

2. BUSBAR AND CONNECTING CONDUCTOR
- Busbar material: copper
- Busbar joints: tin plating

3. EARTHING BUSBAR
- Material: copper
- Surface treatment: none (bare)

4. CONTROL CIRCUIT WIRING
- Wiring system: duct or bundled
- Insulation: heat-resistant plastic (PVC)
- Size: 1.25mm²
- Colour: yellow, except for earth wire (green)
- Wire numbering: indicated by “tube” format

5. PHASE/POLARITY ARRANGEMENT AND COLOUR CODING
- Main circuit and control circuit arrangements are as follows:
  - AC
    - 1st phase: L1
    - 2nd phase: L2
    - 3rd phase: L3
  - DC
    - 1st wire: Positive
    - 2nd wire: Negative
- (Viewed from front to back, top to bottom, or left to right from front.)
- (As viewed from front to back, top to bottom, or left to right from the front.)
- Main circuit colour identification is achieved with vinyl tape or coloured label at bus end where main cables are connected.
  - AC
    - 1st phase: Red
    - 2nd phase: Yellow
    - 3rd phase: Blue
  - DC
    - Positive: Red
    - Negative: Blue
- Unless specially requested, the control circuit is not colour coded.
- Identifying colour tube markers, with the standard colours shown below, can be optionally installed:
  - AC 3-phase
    - 1st phase: Red
    - 2nd phase: Yellow
    - 3rd phase: Blue
  - Neutral: Black
  - AC 1-phase
    - 1st wire: Red
    - 2nd wire: Blue
    - Neutral: Black
  - DC
    - Positive: Red
    - Negative: Blue

6. WITHDRAWABLE EQUIPMENT

<table>
<thead>
<tr>
<th>Apparatus</th>
<th>Main circuit</th>
<th>Control circuit</th>
<th>Earthing circuit (Cartilage frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air circuit breaker</td>
<td>Automatic connection (self-acting)</td>
<td>Automatic connection (self-acting)</td>
<td>Automatic connection (earthing shoe)</td>
</tr>
</tbody>
</table>

7. AIR CIRCUIT BREAKER POSITIONS
- Main circuit and control circuit arrangements are as follows:
  - Connected: Main and control circuit = Connected
  - Test: Main circuit = Disconnected
  - Control circuit = Connected
  - Disconnected: Main and control = Disconnected
- The front door can be closed when the circuit breaker is in any position.
8. CIRCUIT BREAKER INTERLOCKS

<table>
<thead>
<tr>
<th>ACTION</th>
<th>CIRCUIT BREAKER INTERLOCK CONDITIONS</th>
<th>STATE Position</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>Insertion</td>
<td>X</td>
<td>◯</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>X</td>
<td>◯</td>
</tr>
<tr>
<td>Electrical</td>
<td>Cloe</td>
<td>Trip</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Cloe</td>
<td>Trip</td>
</tr>
</tbody>
</table>

| possible | X: cannot be performed | ACB already open |

9. PAINTING AND COLOUR

- Panel front door
  - The panel front door is cleaned and pretreated for rust, and then phosphate coated.
  - Two coats of paint are then applied.
- Panel frame and covers
  - The panel frame and internal covers are painted steel.
- Finish colour
  - Enclosure: light grey (Munsell No. 5Y 7/1).
  - Meter covers, control devices and protection relay cases: manufacturer’s standard.

10. NAMEPLATES

- Nameplates are of plastic with black lettering on white background, fastened by plastic rivets, and are the following sizes:
  - Panel arrangement name: 63 mm × 315 mm
  - Panel section name: 12 mm × 50 mm

7. ACCESSORIES

- AGB litter
- OCR checker
- AGB draw-out handle
- Test plug set for secondary circuit of CT & VT
Safety Precautions
Please read the instruction manual before using the device.