

# LMVP 12kV Indoor Switchgear

# Introduction To LMVP 12kV Switchgear

Vertically Isolated and horizontally withdrawable switchgear

The LMVP switchgear enables the easy distribution of Medium Voltage Electrical Power through Networks to the Consumer. There are 3 ratings of circuit breaker in the LMVP range: 630/800amp, 1250 amp and 2000/2500 amp

## General Description

The switchgear is housed in a Fixed Enclosure.

This is a rigid sheet steel cubicle consisting of four main sections:

### A. Busbar and Current Transformer Chamber

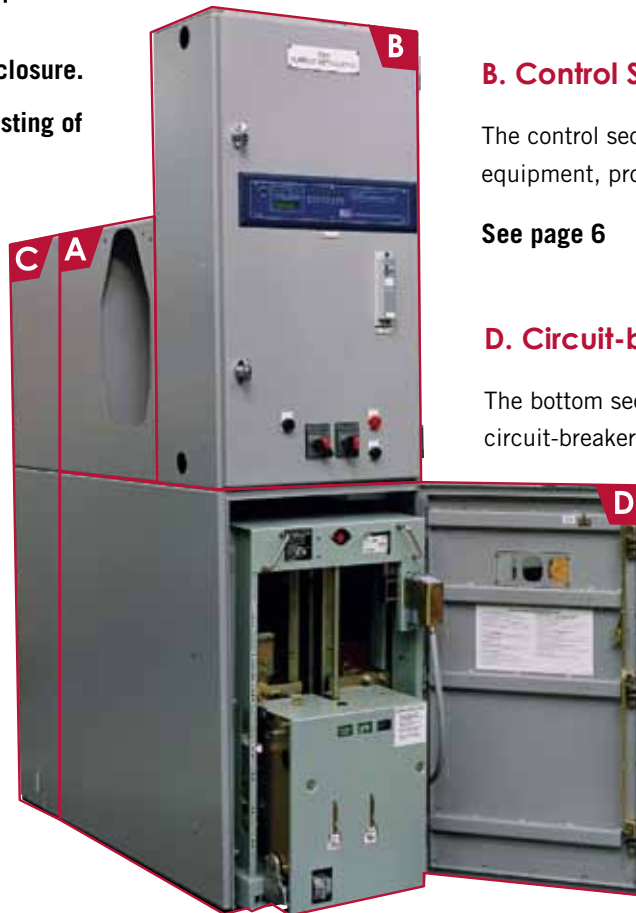
This chamber contains the three-phase copper busbars and the current transformers

See page 4

### C. Cable Box

Air insulated cable boxes for heat shrink cable termination.

See page 7



### B. Control Section

The control section houses the relays and control equipment, protection relays and instruments

See page 6

### D. Circuit-breaker Compartment

The bottom section houses the LMVP circuit-breaker.

Guide rails allow smooth, safe and easy entry and removal of circuit breakers ensuring accurate location in the correct position.

See page 8

LMVP Panel without voltage transformer, showing the circuit-breaker partially withdrawn.

The construction and design allows for complete interchangeability of compatible circuit breakers.

Other compatible complementary products include vacuum contactor (LMVC), Load Break Switch (LMLBS) and Fuse Switch (LMFS).

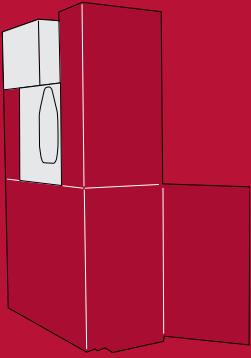
Please ask for our Complementary LM Switchgear brochure for further information.

## Ratings of Switchgear

<b>Rated Normal Current (Amps)</b>	630	800	1250	2000	2500
	3.6	3.6	3.6	3.6	3.6
<b>Rated Voltage (kV)</b>	7.2	7.2	7.2	7.2	7.2
	12	12	12	12	12
<b>Rated Short Circuit Breaking Current</b>	25	25	Up to 31.5	Up to 31.5	Up to 31.5
<b>Panel Width (mm)</b>	584	584	584	914	914

# A. Busbar And Current Transformer Chamber

## Transformer Chamber



### Busbar Chamber

**The busbar chamber contains three-phase copper busbars rated at 800A, 1250A, 1600A, 2000A, 2500A or 3000A.**

Busbars are fully insulated throughout their length with high dielectric strength sleeving.

Joints are shrouded on direct panel to panel busbar connections so there are no interconnecting links.

The busbar and feeder orifice insulators, which also incorporate the vertical connectors, are moulded in silica-filled epoxy resin which combines high mechanical strength with excellent insulating properties.

The connectors terminate in silver plated plug contacts which engage with the self-aligning sockets on the circuit-breaker.

Internal busbar end covers are fitted. This enables extension panels to be moved into their final position, fixed, cabled up and made ready before the existing switchgear is made dead. Outage time is therefore minimal.

The Mk II busbar arrangement eliminates cascade heating effects and allows for higher busbar ratings of 2000-3000A. Mk1 type is rated up to 2500A.



Mk 1 Busbar chamber with interconnecting busbars and associated busbar shrouds in position. Busbar connected VT risers can also be seen.



Mk II busbar chamber

## Current Transformer Chamber

This chamber houses the current transformers which may be:

- i. low voltage insulated mounted on an insulated primary bar
- ii. silica-filled epoxy resin insulated
- iii. either bar or wound primary type depending on the ratios and outputs required.

Current transformers comply with IEC 60044-1 and AS 60044-1.

One side of the primary connection is solidly connected to the vertical connectors, with silver plated contacts moulded into orifice insulators. The joints are shrouded. These plug into the second set of sockets on the circuit-breaker.

The current transformers have the specified output and accuracy under rated load conditions, but are also capable of withstanding, for a specified time, the effects of the shortcircuit fault current within the breaking capacity rating of the switchgear.

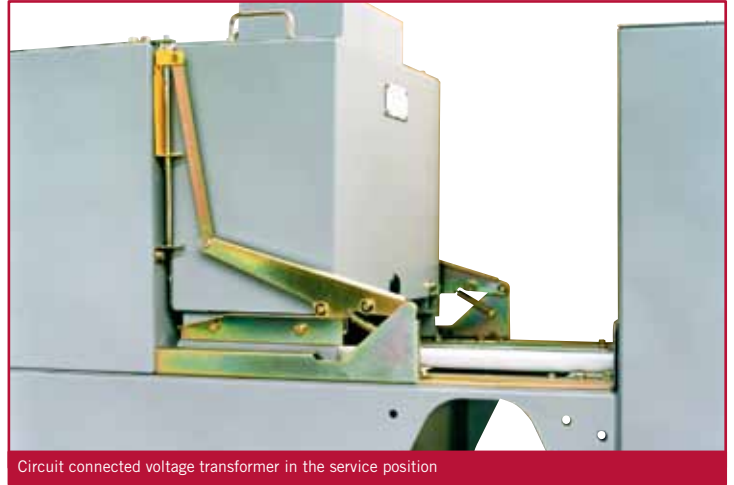
The minimum ratios available are largely dependent upon factors such as the short-circuit fault current, the type and timesetting of the protection specified, the total burden, and the number of current transformers to be accommodated.

Primary bars without current transformers fitted can also be supplied.



Current transformer chamber top view

# A. Voltage Transformer Chamber



## Voltage-Transformers

Voltage transformers with silica-filled epoxy resin encapsulated primary windings are available as either

- i. fixed units.
- ii. withdrawable units.

They can be connected to either the circuit or to the busbars. The voltage transformers comply with BS, AS and IEC standards.

### i. Fixed Voltage Transformers

The fixed voltage transformers are installed in sets of single phase units above the current transformer chamber.

Primary fuses are fitted and are accessible through a lockable shutter.

### ii. Withdrawable Voltage Transformers

The withdrawable voltage transformers are of the isolatable type and either single or 3-phase up to a maximum of 3 x 1 phase.

They can be mounted onto a withdrawable carriage for either busbar or circuit applications.

(Refer Technical Specifications, page 14.)

Padlocking facilities are provided in both the service and isolated positions.

A circuit connected voltage transformer is connected to the circuit side of the current transformers so that it is included in the zone of the protection equipment.

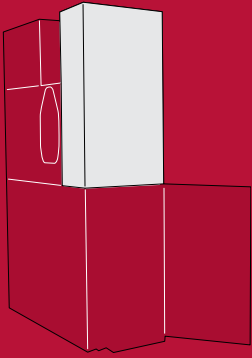
Busbar voltage transformer connectors are directly coupled to the busbars. Voltage transformers are in a three limb configuration for directional protection.

A positively driven shutter automatically covers the fixed isolating contacts when the voltage transformer is isolated and provision is made to allow padlocking the shutter in this position.

Busbar shutters are clearly labeled BUSBARS, and are painted signal red (BS381C colour 537). The circuit shutters are labeled CIRCUIT, and painted lemon (BS381C colour 355).

To protect the primary windings, high voltage cartridge type fuses are fitted into the primary bushings of the voltage transformer. These can be removed only when the transformer is isolated. Secondary HRC fuses are mounted on the top of the voltage transformer for easy access.

## B. Control Section



### Control Section

The height of the control section can be extended to suit customer requirements. Standard overall dimensions are shown on pages 12 and 13.

Control units, including the gear plate, can be removed if required.

Relays, instruments, control switches and indicator lamps are mounted on a removable hinged door which, when opened, allows access to the connections.

The fuses, terminals and other control equipment are located behind the door.

HRC fuses are fitted to control circuits as standard.

All secondary wiring is carried out in PVC insulated cable with numbered ferrules.

## Control & Indication Cable Terminal Blocks

Terminal blocks for external connections are located at the top of the control compartment.

The multicore terminal block can be used for interpanel wiring.

The cable gland plate is drilled on site at time of installation to suit the size of multicore cable (or cables) and glands.



Control & Indication Cable Terminal Blocks



Photo of interior view of control section

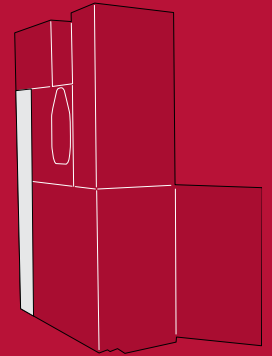
# Cable Box

## Cable Boxes

Circuit cable boxes are mounted to the back of the current-transformer chamber. Air insulated cable boxes for heat shrink cable termination, as used with proprietary terminations, are standard.

Modular construction means the air insulated cable boxes can be assembled to form single, double or triple arrangements simply by adding extra modules. All cable boxes can be supplied with gland arrangements to take cables of various types and sizes for bottom, top or angled entry.

Maximum size of paper or plastic insulated cables (vertically downwards or vertically upwards) for air insulated boxes with heat shrink terminations are as follows:



Single cable box with circuit connected voltage transformer housing fitted. (Covers removed to show internal details.)



Single Cable box without voltage transformer. (Covers removed to show internal details.)



Single top entry cable box

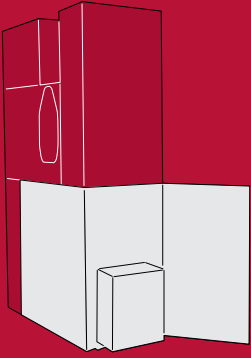
## Cable Box type and Cable Options

Rated Normal Current (Amps)	630, 800, 1250	2000, 2500
<b>Single box</b>	1x3 core up to 400mm <sup>2</sup> or 3x1 core up to 630mm <sup>2</sup>	6x1 core up to 630mm <sup>2</sup>
<b>Double box</b>	2x3 core up to 400mm <sup>2</sup> or 6x1 core up to 630mm <sup>2</sup>	Up to 3x3 core up to 400mm <sup>2</sup> or Up to 12x1 core up to 630mm <sup>2</sup>
<b>Triple box</b>	3x3 core up to 400mm <sup>2</sup> or 12x1 core up to 630mm <sup>2</sup>	

Note 1: Busbar end cable boxes, and 12x1 core cable boxes are available.

Note 2: Armoured cables can be accommodated up to:  
1000mm<sup>2</sup> for single core cable and 240mm<sup>2</sup> for 3 core cable.

# D. Circuit Breaker Compartment

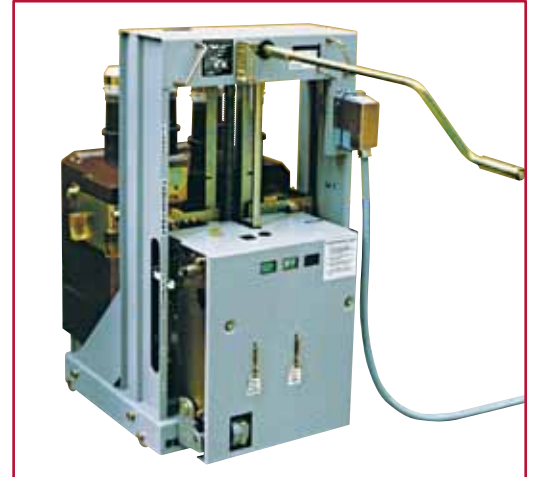


## LMVP Vacuum Circuit-Breaker

There are three ratings of circuit-breaker available: 630/800 Amp, 1250 Amp and 2000/2500 Amp.

The 2000/2500 Amp model has paralleled primary through bushings and a single interrupter per phase.

The circuit-breaker is mounted on a steel carriage, having four flanged wheels to facilitate location within the enclosure. A central screw mechanism operated by a removable handle is provided for raising and lowering the circuit-breaker.



Handle for raising and lowering the circuit-breaker



630/800 Amp LMVP vacuum circuit-breaker and integral carriage

## Safety Interlocks

Clearly labeled mechanical interlocks are provided to prevent the occurrence of:

**(a) A closed circuit-breaker from being withdrawn from or inserted into the isolating contacts.**

**(b) Tripping by attempted isolation**

Access to the raising and lowering mechanism is automatically prevented when the circuit-breaker is closed.

**(c) The closing of the circuit-breaker**

except when correctly located in the service, earth, or isolated position or alternatively when the circuit-breaker is withdrawn from the enclosure.

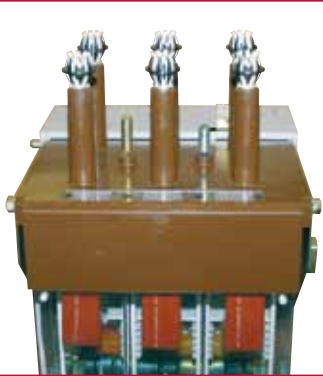
**(d) A circuit-breaker from being withdrawn or replaced**

except when it is isolated and in the appropriate location for withdrawal or replacement.

**(e) A circuit-breaker being closed in the service position**

when the secondary circuits between the fixed and moving portions are not completed.

(a), (b) and (c) are hand controlled by a lever at the front of the circuit-breaker, with positions labeled Isolating Mechanism "free" or "locked", and Locating Bolt "free" or "locked". This locating bolt mechanism cannot be raised except when the secondary circuits are complete.



1250 Amp LMVP vacuum circuit-breaker and integral carriage



2000/2500 Amp LMVP vacuum circuit-breaker and integral carriage



Locating bolt and isolating mechanism

# D. Circuit Breaker Compartment

## Secondary Connections



24 Way Plug & Socket for secondary isolation

Secondary connections between the circuit breaker and the fixed portion are made by a plug and socket which is mounted on the right hand side of the circuit-breaker. Up to 24 pins can be used on this arrangement.

Safety interlocks ensure that the circuit-breaker cannot be raised into any operating position until the secondary plug is engaged in the socket. Electrical interlocks isolate the trip circuit when the circuit-breaker is raised into a busbar-earth or circuit-earth position.

Alternatively, self-aligning secondary isolating contacts can be fitted to the right hand side of the circuit-breaker compartment immediately below the selector gate. Depending on the requirement, 12, 18 or 24 contacts can be fitted. These contacts remain connected when the circuit-breaker is locked in either the raised or the lowered position.

The trip circuit secondary isolating contacts are not connected in the busbar-earth or circuit earth positions on the enclosure so the circuit-breaker cannot be automatically tripped during closing or when closed in either earthing position.

## Circuit Breaker Description

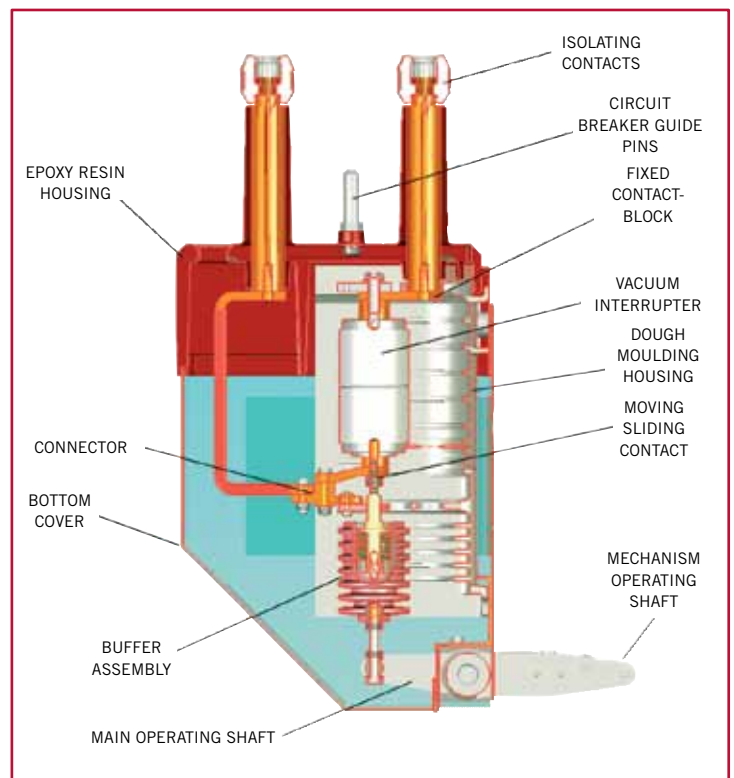


The RPM-series LMVP circuit-breaker has 3 separate dough moulded resin housings containing the three vacuum interrupters which are air insulated and separated by perspex phase barriers. Primary through bushings are also incorporated in the housing and at their upper end accommodate self-aligning multi-finger isolating contacts. Guide pins are fitted to the top plate to ensure correct location of the circuit-breaker,

and a copper contact provides positive earthing of the unit. The LMVP vacuum circuit-breaker is interchangeable with the Reyrolle Switchgear LMT oil circuit-breaker.

The housing has moulded inserts which provide accurate and simple location of components. The main operating shaft is coupled to the moving contacts of the interrupters through a drive insulator. Current transfer is through multi-laminated sliding contacts and the added contact load in the closed position is provided by disc springs.

Copper-chrome contact material is used in the interrupters to minimise contact erosion. The added contact load spring assembly gives indication that the erosion limit has been reached.



Cross section of a 1250A RPM Series vacuum circuit-breaker

The interrupters have a typical life expectancy of 10,000 mechanical operations, 10,000 load current operations, and up to 100 fully rated short-circuit operations.

Interrupter replacement and resetting are achieved without the need for special tools.



# D. Circuit Breaker Compartment

## Orifice Safety Shutters

Substantial safety shutters, actuated by the raising or lowering of the circuit-breaker, automatically expose or cover each 3-phase set of fixed isolating contacts. Each shutter may be individually operated and padlocked in the closed position. There is provision to allow either shutter to be fixed, but not padlocked, in the open position for testing. Insertion of the circuit-breaker into its enclosure cancels this feature, and automatically restores the normal operation of the shutters.



Circuit-breaker compartment showing the orifice safety shutters and associated operating mechanism.

Busbar shutters are clearly labeled BUSBARS, and are painted signal red (BS381C colour 537). The circuit shutters are labeled CIRCUIT, and painted lemon (BS381C colour 355).

## Closed Door Operation

This option provides additional operator safety during racking of the VCB.

Full behind closed door operation can be offered to include both racking and shooting bolt operation.



## Circuit or Busbar Earthing

Circuit Breaker Transfer earthing is supplied as standard. The option of integral circuit and/or busbar earthing is available if required and details should be specified when ordering. These facilities are provided through the circuit breaker without the use of loose attachments.



The transfer-breaker method of earthing is used

whereby the circuit-breaker compartment, when fully raised, is connected to the main isolating plugs of the side to be earthed and to the appropriate set of three fixed copper plug contacts. These are solidly earthed by a common bonding strip. Closing the circuit-breaker completes the operation.

For dependent power operation, secondary connections for the closing circuit are available in both earthing positions, but the circuit-breaker can only be tripped manually.

Integral circuit earthing switching of the cable can also be achieved with an earthing switch situated between the rear cable box and circuit-breaker compartment. Its operation is managed by a rotating mechanical linkage assembly which extends to the front of the Circuit-Breaker Compartment for ease of use.

The integral circuit earthing is rated to 20kA/3s.

## Selector Gate

The position may be padlocked to permit only authorized access to change the circuit breaker position, and eliminate the risk of tampering.

(Note: user to supply padlocks)



Selector gate mechanism for circuit-breaker

# D. Circuit Breaker Compartment

## Operating Mechanisms

LMVP switchgear is supplied with either an RPM series or X series operating mechanism.

RPM is the latest generation. X series is widely used and fully supported

All RPM & X Series mechanisms are trip free. The opening spring is charged during the closing operations. The circuit-breaker is opened with a mechanical actuator or electrically with a trip coil. Current transformer, a.c. or d.c. operated trip coils are available as required. Padlocking facilities are provided to prevent manual trip and close operations.

Rotary spring loaded auxiliary switches are positively driven in both directions and are readily accessible to facilitate inspection and cleaning.

We use 3 types of operating mechanism for the 2 series:

### **Type QMRO: Stored energy, motor charged spring, manual or electrical release**

The closing spring of this mechanism is charged by a small geared motor, either a.c. or d.c. To facilitate immediate reclosure after tripping, the spring is recharged when the circuit-breaker is closed. Recharging of the spring is normally automatic with this arrangement, but provision is made for emergency hand charging in the event of failure of the motor supply. The mechanism is provided with mechanical and electrical releases for closing.



Motor charged spring mechanism – cover removed.  
(Type QMRO, RPM series circuit-breaker.)

### **Type QM: Stored energy, manually charged spring, manual or electrical release**

The closing spring is charged by hand with a single upward stroke of the operating handle, closing and tripping being effected by means of a mechanical actuator. The spring can be recharged with the circuit-breaker closed to permit an immediate reclosure after any subsequent tripping. An electrical release can also be provided.



Hand charged spring mechanism – cover removed.  
(Type QM, X Series circuit-breaker.)

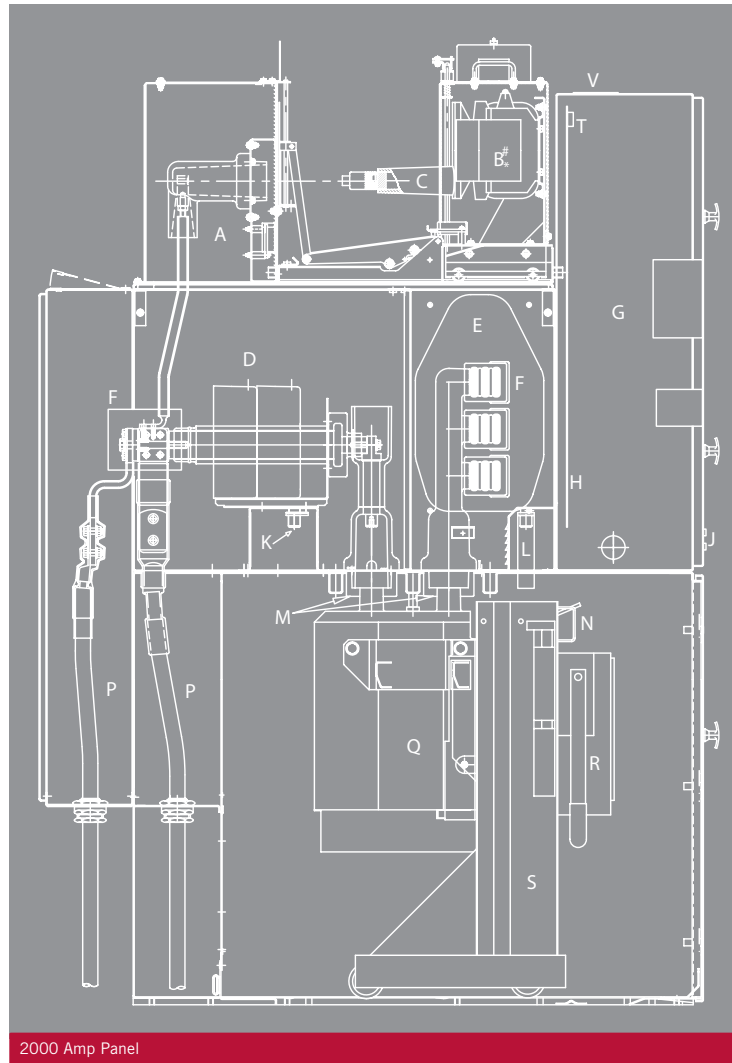
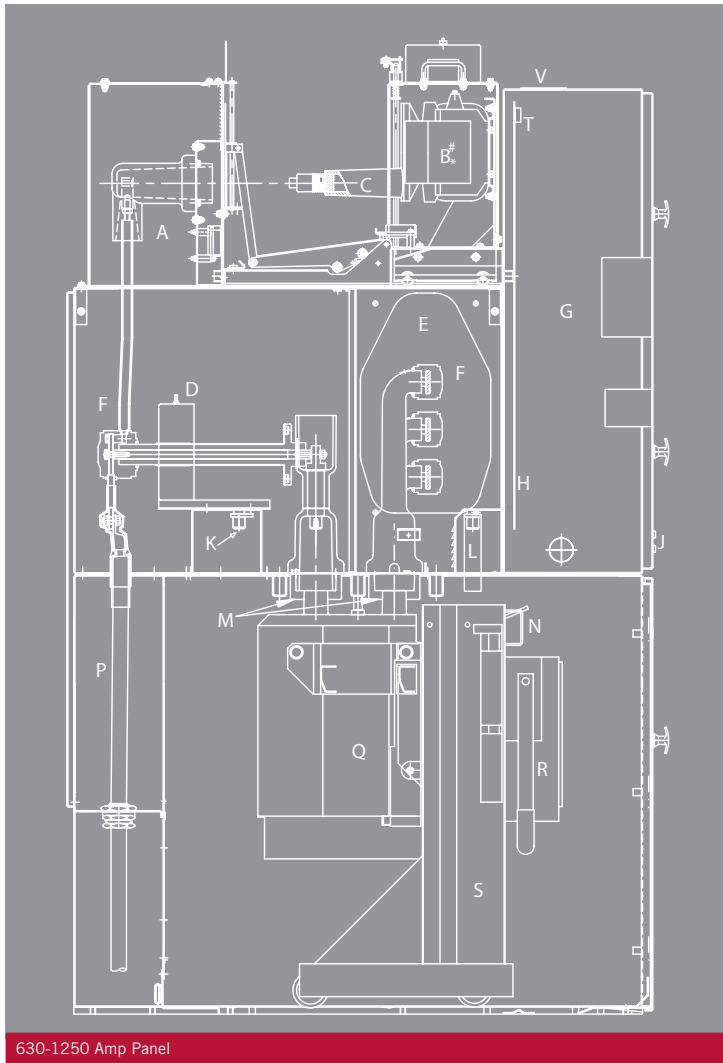
### **Type MO: Dependent power operation, solenoid closing**

The circuit-breaker is closed by a d.c. solenoid. Current for the solenoid is usually supplied from a battery or a metal rectifier. A silicon rectifier can be provided in the panel.



Solenoid closing mechanism – cover removed. (Type MO, X Series circuit-breaker.)

# Sectional Panel Views



## 630-1250 AMP PANEL

A Voltage transformer orifice housing

B Voltage transformer.

Withdrawable type

\* Also available with fixed type single phase voltage transformers (1, 2 or 3).

# Also available as busbar connected voltage transformer.

C Voltage transformer HV fuses

D Current transformer chamber (LV insulated for bar primary and epoxy resin encapsulated for wound primary CTs)

E Busbar Chamber

F Connection shrouds

G Control Section

H Gear plate

J Control gear mounted on control section door

K Circuit earthing contacts

L Busbar earthing contacts

M Orifice shutters

N Selector gate mechanism controlling circuit-breaker position

P Circuit cable box, air insulated

Q Circuit-breaker

R Circuit-breaker operating mechanism

S Circuit-breaker carriage

T Multicore terminal block

V Multicore cable gland plate

## 2000 AMP PANEL

A Voltage transformer housing

B Voltage transformer.

Fixed type 1, 2 or 3 x single phase.

\* Also available with withdrawable 3 phase voltage transformer, or 3 single phase assembly. Refer to 630/1250A panel drawing.

# Also available as busbar connected voltage transformer.

C Voltage transformer HV fuses

D Current transformer chamber

E Busbar Chamber

F Connection shrouds

G Control Section

H Gear plate

J Control gear mounted on control section door

K Circuit earthing contacts

L Busbar earthing contacts

M Orifice shutters

N Selector gate mechanism controlling circuit-breaker position

P Circuit cable box, air insulated

Q Circuit-breaker

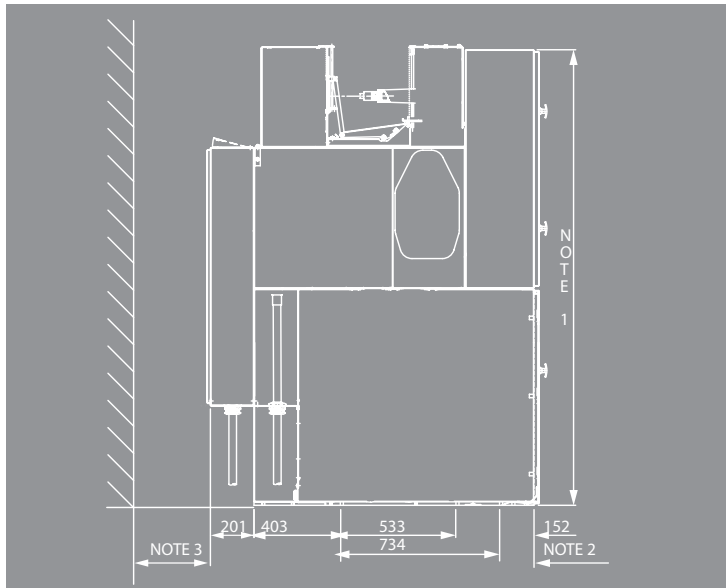
R Circuit-breaker operating mechanism

S Circuit-breaker carriage

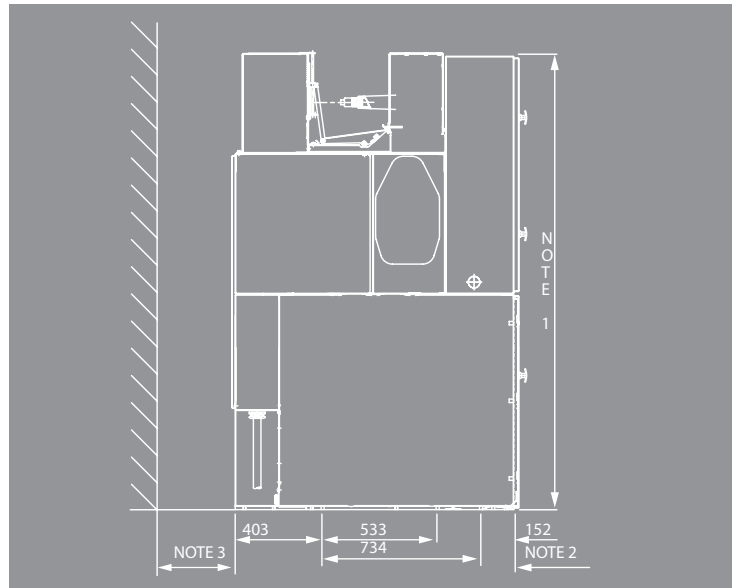
T Multicore terminal block

V Multicore cable gland plate

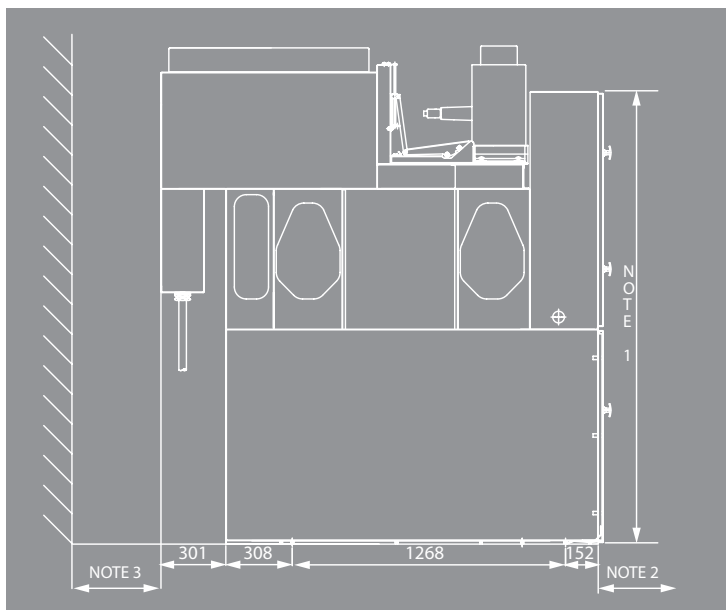
# Dimensional Drawings



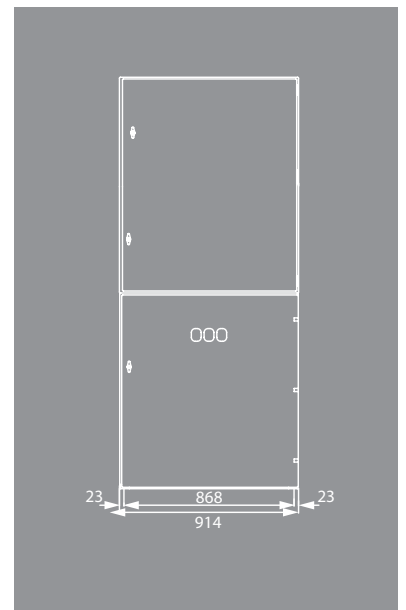
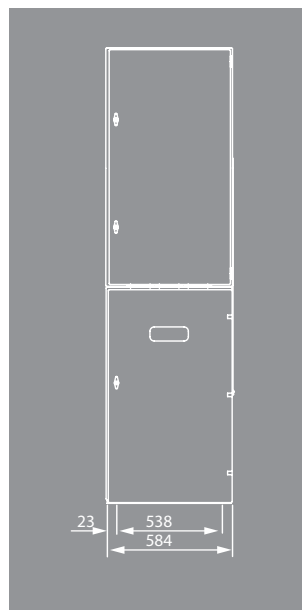
Single Busbar  
Double Cable Box



Single Busbar  
Single Cable Box



Double Busbar  
Single Cable Box



For special configurations of panels, refer to RPS Switchgear

## Overall Dimensions

Widths shown apply to both single and double busbar panels.

**Note 1:**  
2,100mm small height control section  
2,400mm medium height control section

**Note 2:**  
Distance required for circuit-breaker removal:  
700mm for 630-1250 Amp panels  
1,200mm for 2000-2500 Amp panels

**Note 3:**  
Distance required for access depends on cabling requirements.

# Technical Specification

## Type LMVP Switchgear

<b>Standards</b>		IEC 62271-200, AS 62271-200
<b>Rated voltage</b>		up to 12kV (r.m.s.)
<b>Rated insulation level:</b>		
Lightning impulse withstand		95kVp
1 minute power-frequency withstand		28kV (r.m.s.)
Additional tests		42kV (r.m.s.)
<b>Rated frequency</b>		50Hz
<b>Rated short-time withstand current</b>		up to 31.5kA
<b>Rated peak withstand current</b>		up to 79 kAp
<b>Rated duration of short-circuit</b>		3 seconds
Additional test		4 seconds
<b>Internal fault (type tested)</b>		25kA/1.0 sec
<b>Construction</b>		Metal clad
<b>Degree of protection</b>	Standard	IP3X (approaching IP4X)
	Optional	IP4X or higher to suit specific requirements
<b>Normal service conditions</b>		Indoor
Ambient air temperatures:		
Maximum		40°C (without derating)
Average over 24 hours		Not exceeding 35°C
Minimum		-5°C
Altitude		Not exceeding 1,000m
Average relative humidity over 24 hours		Not exceeding 95%
<b>Finish</b>		Epoxy powder paint coating after derusting, degreasing and phosphating
<b>Colour</b>	Standard	Pipeline grey shade AS2700-N43

## Busbar Chamber

<b>Orifice insulators</b>		Silica-filled epoxy resin
<b>Busbars</b>		Tinned copper. Heat shrink insulated.
<b>Joints</b>		Shrouded. Epoxy filled or unfilled
<b>Rated normal current</b>		Up to 3000A

## Current Transformer

<b>Standards</b>		IEC 60044-1, AS 60044-1
<b>Orifice insulators</b>		Silica-filled epoxy resin
<b>Current transformers</b>	Either	a) Low voltage insulated type mounted on a screened silica-filled epoxy resin primary bar.
	Or	b) High voltage silica-filled epoxy resin encapsulated type including multi-turn primary designs for low ratios
<b>Joints</b>		Shrouded

## IOMS Manual

The Installation, Operation, Maintenance and Service manual is available on request in PDF format from RPS Switchgear.

## Voltage Transformer

<b>Standards</b>	IEC 60044-2, AS 60044-2
<b>Insulation</b>	Silica-filled epoxy resin
<b>Connected</b>	Busbar or circuit; withdrawable or fixed
<b>Types</b>	Up to 3x1 phase
<b>Burdens</b>	up to 200VA per phase
<b>Accuracy class</b>	0.2, 0.5 or 1.0
<b>Circuit Earthing</b>	By transfer circuit-breaker method
	Optional interlocked earthing switch

## Busbar Earthing

By transfer circuit-breaker method

## Testing

High voltage test bushings can be inserted into de-energised circuit or busbar orifices

## Type LMVP Vacuum Circuit-Breaker

<b>Standards</b>	IEC 62271-100, AS 62271-100
<b>Rated voltage</b>	12kV
<b>Rated lightning impulse withstand voltage</b>	95kVp
<b>Rated frequency</b>	50/60Hz
<b>Rated normal current</b>	630/800, 1250, 2000/2500A
<b>Rated duration of short-circuit</b>	3 seconds
Additional test	4 seconds
<b>Rated short-circuit breaking current</b>	25, 31.5kA
d.c. component	34%
<b>Rated short-circuit making current</b>	79kAp
<b>Rated out-of-phase breaking current</b>	6.25kA at 13.9kV
<b>Rated cable charging breaking current</b>	25A
<b>Rated single capacitor bank breaking current</b>	400A
<b>Rated transformer magnetising current</b>	6.3A
<b>Operating sequence</b>	0-0.3s-C0-15sec-C0

## Mass (kg)

<b>Rated normal current (Amp)</b>	<b>630</b>	<b>800</b>	<b>1250</b>	<b>2000</b>	<b>2500</b>
<b>Circuit-breaker on carriage</b>	200	200	230	315	315
<b>Enclosure complete with circuit-breaker</b>					
– Single busbar	520	550	580	930	940
<b>Enclosure complete with circuit-breaker</b>					
– Double busbar	700	730	760	1450	1460
<b>Extra for voltage transformer</b>					
including housing	3 phase			160	
	3 x 1 phase			90	

These masses are approximate as current transformers and relays can vary as much as 250kg.

A large grid of graph paper for taking notes, consisting of 30 columns and 40 rows of small squares.

# Contact Us



LMVP Switchboard Installation: Powerco – Main St Substation

Contact us at your nearest RPS Switchgear office

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