THE LMVP RANGE

12kV INDOOR SWITCHGEAR

RPS SWITCHGEAR

Reliability and safety you can trust

INTRODUCTION TO LMVP 12KV SWITCHGEAR

VERTICALLY ISOLATED AND HORIZONTALLY WITHDRAWABLE SWITCHGEAR

The LMVP switchgear enables the distribution of Electrical Power through Networks to the Consumer at medium voltage. The circuit breakers are available of 5 current ratings, 630/800A, 630A cap switching, 1250A, 2000A and 2500A.

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).

Contact RPS Switchgear Ltd for more details.

RATINGS OF SWITCHGEAR

Rated Normal Current (Amps)	630	800	1250	2000	2500
	3.6	3.6	3.6	3.6	3.6
Rated Voltage (kV)	7.2	7.2	7.2	7.2	7.2
	12	12	12	12	12
			UP TO	UP TO	UP TO
Rated Short Circuit Breaking Current	25	25	31.5	31.5	31.5
Panel Width (mm)	584	584	584	914	914

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 houses the three-phase copper busbars in the front section and the current transformers at the rear section.

See page 4

B. CONTROL CUBICLE

The control cubicle houses the relays and control equipment, protection relays and instruments.

See page 6

C. CABLE BOX

Air insulated cable boxes for heat shrink cable termination.

See page 7

D. CIRCUIT BREAKER COMPARTMENT

The bottom section houses the 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 Arc Fault Panel

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A. BUSBAR/CURRENT TRANSFORMER CHAMBER

BUSBAR CHAMBER (FRONT SECTION)

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

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

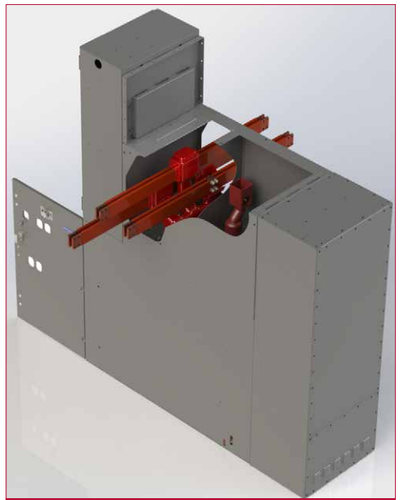
Joints are shrouded.

Busbar connections are direct panel to panel so there are no interconnecting links.

The busbar and feeder orifice insulators, are vertically disposed, less prone to dust deposition, 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 primary isolating contacts of 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.



Mk II busbar chamber

CURRENT TRANSFORMER CHAMBER
(REAR SECTION)

This chamber houses the current transformers which may be:

- Low voltage insulated, mounted on an earthed screened primary bushing, silica-filled epoxy resin insulated.
- Either bar or wound primary type depending on the specification.

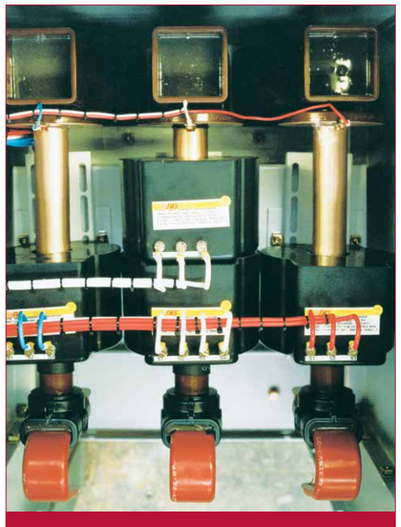
Current transformers comply with IEC 61869-1, IEC 61869-2.

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

The current transformers are custom engineered to meet the specified requirements and short time current withstand ratings of the switchgear.

The minimum ratios available are largely dependent upon factors such as the short-circuit fault current class, 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

VOLTAGE-TRANSFORMERS
(APPLICABLE FOR LMT, ICE 298 STYLE LMVP GEAR)

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

FIXED UNITS

WITHDRAWABLE UNITS

PRIMARY DISCONNECTABLE

They can be connected to either the circuit or to the busbars. The voltage transformers comply with IEC 61869-1, IEC 61869-3.

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 3 x 1 phase.

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

(Refer Technical Specifications, page 18.)

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.

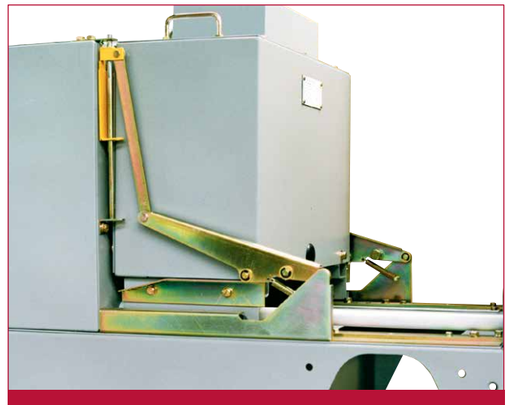
Busbar voltage transformer connectors are directly coupled to the busbars. Voltage transformers are in a three limb configuration for directional protection.

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.

Circuit connected voltage transformer in the isolated position showing the secondary isolating contacts in the safety shutter



Circuit connected voltage transformer in the service position

Photo of interior view of control section

B. CONTROL CUBICLE

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

Control cubicles, including the gear plate, can be removed if required (LMVP gear manufactured year 2000 onward).

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 AND INDICATION CABLE TERMINAL BLOCKS

Control and 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.

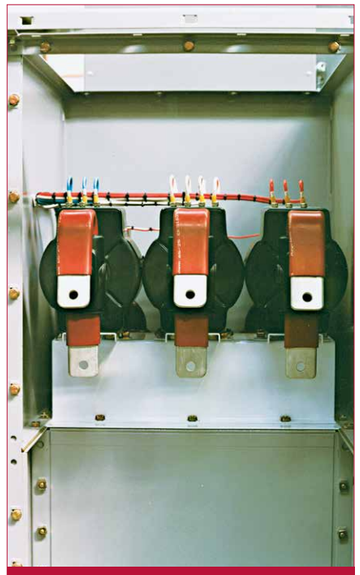
C.CABLE BOXES

Circuit cable boxe(s) 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)



Double cable box without voltage transformer.
(Covers removed to show internal details)

CABLE BOX TYPE AND CABLE OPTIONS

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

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

Note 2: Armoured cables can be accommodated up to:
1000mm^2 for single core cable and 240mm^2 for 3 core cable

D. CIRCUIT BREAKER COMPARTMENT

630/800 Amp LMVP vacuum circuit breaker and integral carriage

LMVP VACUUM CIRCUIT BREAKER

The circuit breakers of 5 current ratings are 630/800A, 630A cap switching 1250A, 2000A and 2500A.

The 2000/2500A model has two 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.

1250 Amp LMVP vacuum circuit breaker and integral carriage

2000/2500 Amp LMVP vacuum circuit breaker and integral carriage

SAFETY INTERLOCKS

Safety interlocking fully complies with IEC 62271-200 and includes the following extra features:

(a) Tripping by attempted isolation.

OPERATIONAL INTERLOCKS

Mechanical interlocks protect the operator and the equipment by preventing the following operations:

(a) Moving the circuit breaker into housing unless fully lowered.

(b) Raising the circuit breaker unless the secondary circuit plug is correctly inserted into the carriage socket and secured.

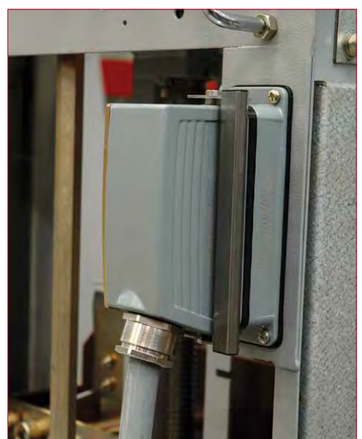
(c) Inserting or removing the secondary plug unless the circuit breaker is fully lowered and the locating bolt free.

(d) Closing the circuit breaker if the manual trip is pushed.

(e) Discharging the closing spring when the breaker is closed.

(f) Attempted isolation does not trip the circuit breaker in service.

Locating bolt and isolating mechanism



24 way plug and socket for secondary isolation

SECONDARY CONNECTIONS

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-engaging 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.

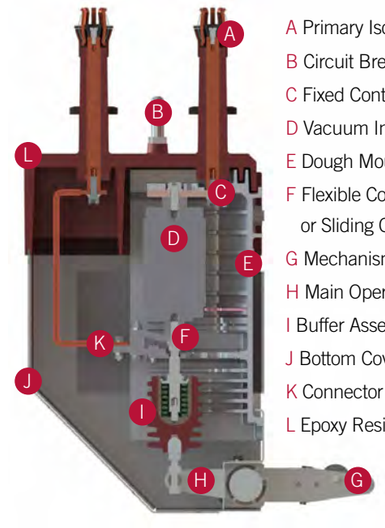
The trip circuit secondary isolating contacts are not connected in the busbar-earth or circuit earth positions on the enclosure so the circuit breaker cannot be electrically tripped during closing or when closed in either earthing position.

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.



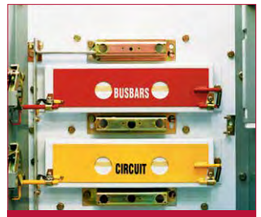
A Primary Isolating Contacts
B Circuit Breaker Guide Pins
C Fixed Contact-Block
D Vacuum Interrupter
E Dough Moulding Housing
F Flexible Connector or Sliding Contact
G Mechanism Operating Shaft
H Main Operating Shaft
I Buffer Assembly
J Bottom Cover
K Connector (Circuit)
L Epoxy Resin Housing

Cross section of a 630A RPM series vacuum circuit breaker

The circuit breakers have been type tested to mechanical endurance class M2 – IEC 62271-100.

D. CIRCUIT BREAKER COMPARTMENT

ORIFICE SAFETY SHUTTERS



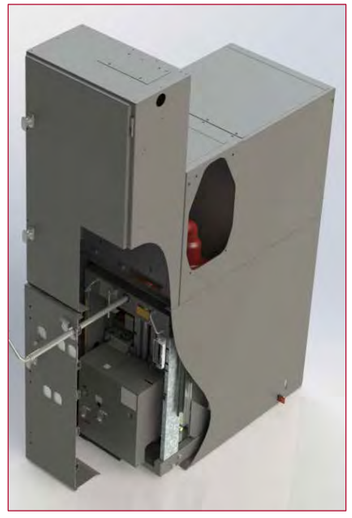
Circuit breaker compartment showing the orifice safety shutters and associated operating mechanism.

Metallic 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 held in the open position for testing. Insertion of the circuit breaker into its enclosure resets this feature, and automatically restores the normal operation of the shutters.

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 circuit and/or busbar earthing is available. The earthing requirements 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 when fully raised, is connected to the main isolating plugs of the side to be earthed and to the appropriate set of 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 opened 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.

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

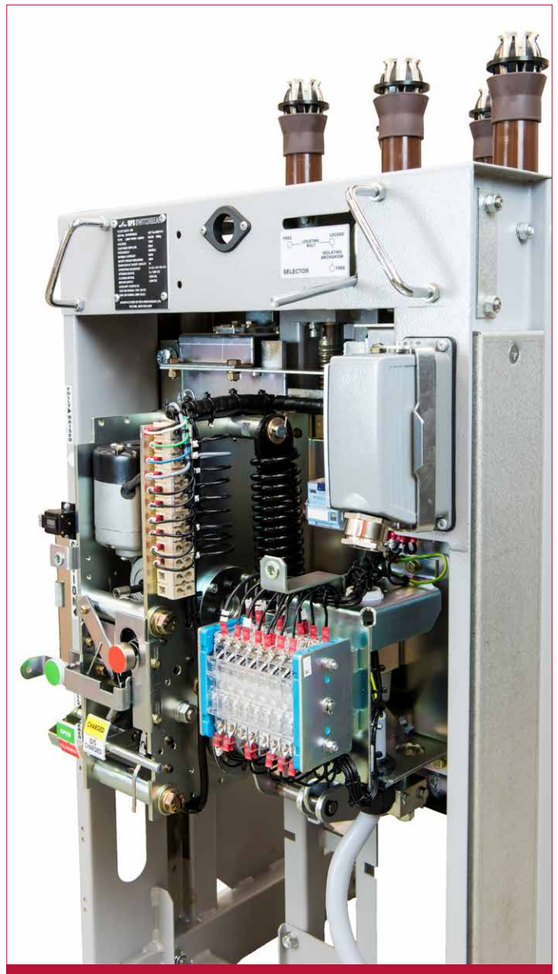
OPERATING MECHANISMS

LMVP Switchgear is supplied with the RPM series operating mechanism, which has superseded the former X series. There is full compatibility between circuit breakers with RPM mechanisms and those with X series.

The opening spring is charged following the closing operations. The circuit breaker is opened with a mechanical actuator or electrically with a shunt trip coil. Trip soleroid current transformer, a.c. or d.c. operated are available as required. Padlocking facilities are provided to prevent manual trip and close operations.

The auxiliary switches are positively driven in both directions and are readily accessible.

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. The mechanism is provided with mechanical and electrical releases for closing.



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

INTERNAL ARC COMPLIANCE
(IEC 62271-200)

LMVP SETS NEW SAFETY STANDARDS

Certified for two configurations:

- Exhaust ducted out of switch room
- Exhaust discharge in switch room with ceiling at 2.8m height

LMVP CERTIFICATION

Front, lateral and rear access, 25kA for 1 second:

- Certified to IEC 62271-200.
- Ducted and internally vented solutions.
- 4-sided access, category “A-FLR”.
- Vents safely into the substation via thermal control baffle system or externally.
- Ceiling height – down to 2.8m.
- Configurable for different substations.
- Excellent thermal profile around switchboard during fault, enhancing operator safety.

TWO ARC CONTAINMENT SOLUTIONS

Two arc containment solutions have been designed and been successfully certified to give customers maximum flexibility in the substation design.

Substantial operator safety is achieved by either ducting the arc exhaust outside the switchroom or by utilising our vented arc control system which safely vents into the substation.

Vented solution

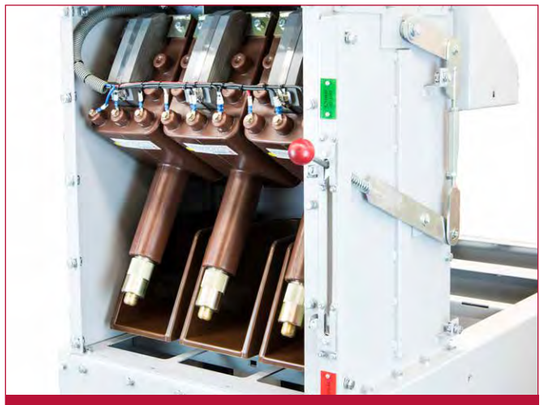
Ducted solution

LMVP TEST RESULTS

- Ducted and vented designs certified to IEC 62271-200.
- 25ka, 1s, ‘A-FLR’ for 2.8m ceiling, -- all chambers.
- Strength of LMVP demonstrated.
- Excellent thermal profile, (40ºC max temp rise).
- Venting via the temperature control unit enhances safety.

NON WITHDRAWABLE SWING VOLTAGE TRANSFORMER

In service position



Isolated position, (with access to VT Fuses)

This swing VT solution has been tested to IEC 62271-200 for internal arc withstand.

SEISMIC COMPLIANCE (1g)

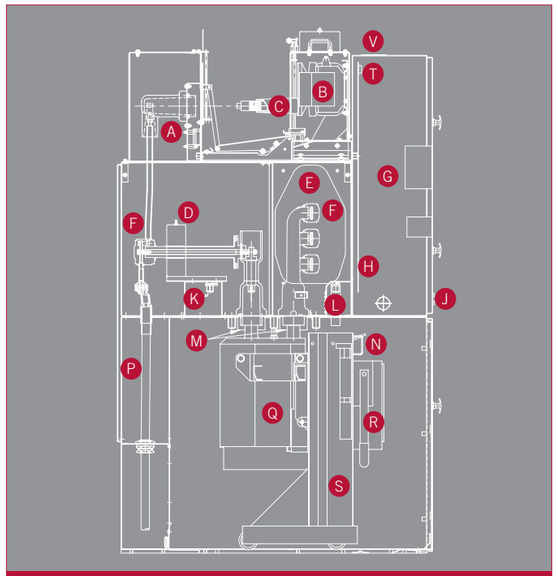
Recent earthquakes influenced requirements with customer specifications changing, RPS has tested to the highest qualification now specified.

The requirement is now for test level equivalent to 9.5 on the Richter scale.

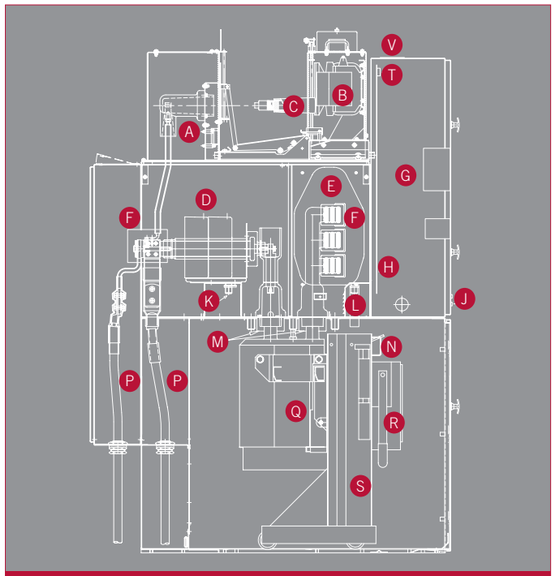
Tested to IEEE 693:

- Resonance frequency tested on 3 axes.
- Time history test on x,y,z axes at 1g for 30s.
- Auto re-close operation proved during test.
- Functional tests before and after seismic tests.

IEC 298 – PANEL VIEWS



630-1250A Panel



2000-2500A Panel

630-1250A PANEL

A Voltage transformer orifice housing
B Withdrawable type circuit 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 Busbar joint shrouds
G Control cubicle
H Gear plate
J Control gear mounted on control cubicle 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

2000/2500A PANEL

A Voltage transformer housing
B Withdrawable type circuit connected voltage transformer
C Voltage transformer HV fuses
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E Busbar chamber
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Q Circuit breaker
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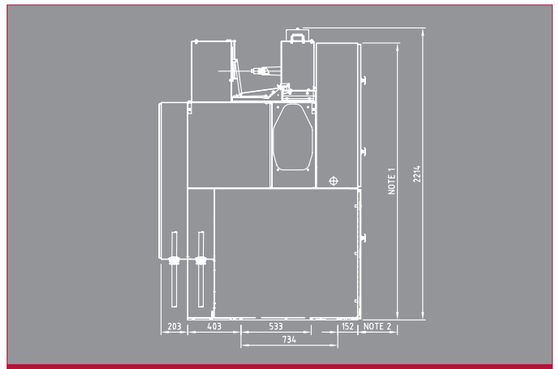
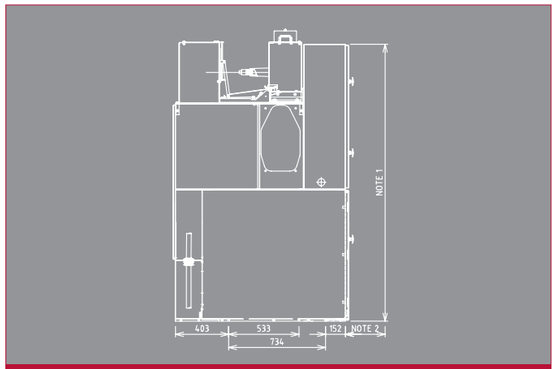
T Multicore terminal block
V Multicore cable gland plate

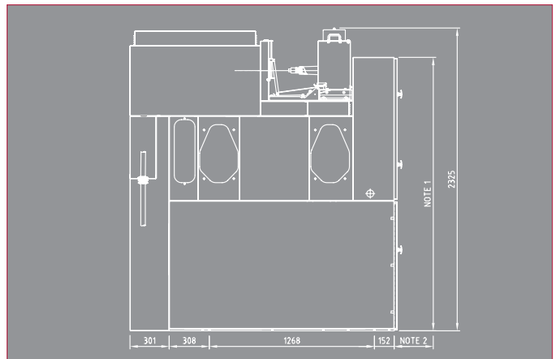
IEC 298 – PANEL DRAWINGS



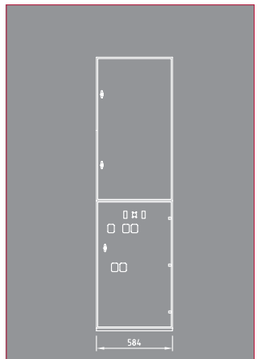
Single Busbar – Double Cable Box

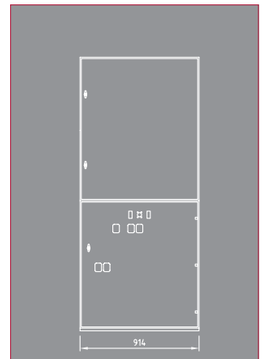


Single Busbar – Single Cable Box



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 630-1250A circuit breaker
1,200mm for 2000-2500A circuit breaker

NOTE 3:

Rear access 600mm minimum distance is recommended

RPS SWITCHGEAR
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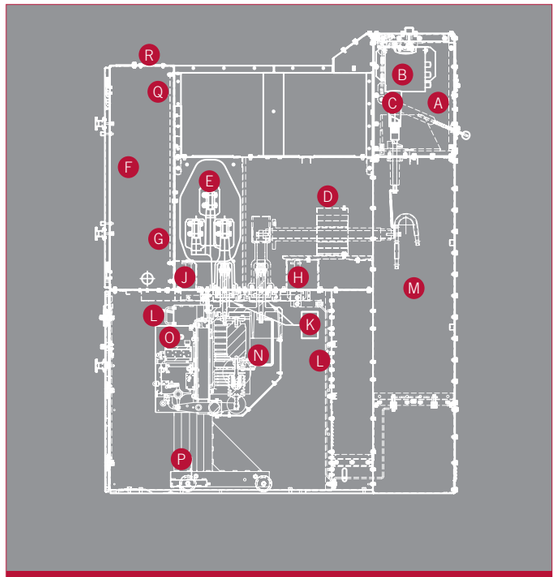
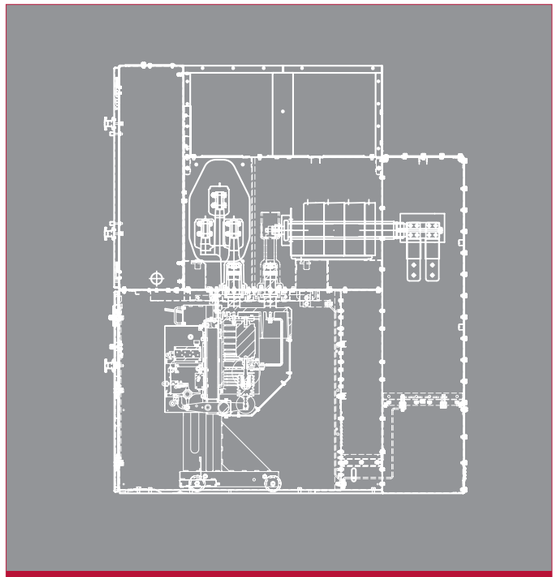
IEC 62271 – PANEL VIEWS

CLASS A-FLR



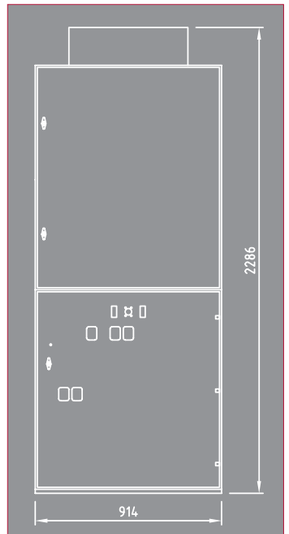
630-1250A Panel

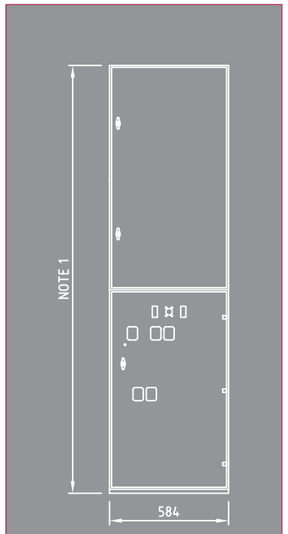


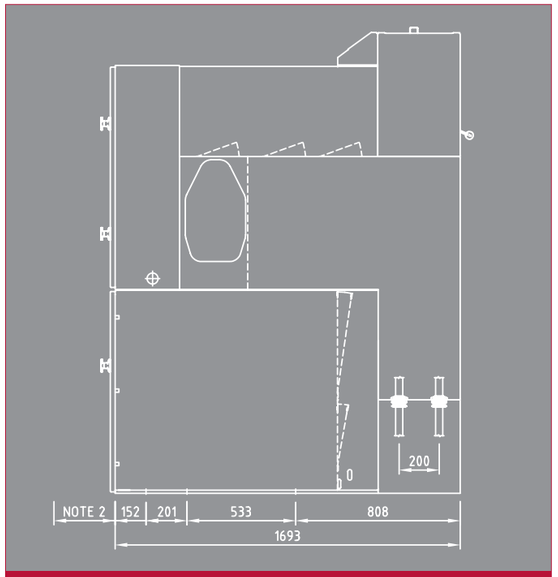
2000-2500A Panel

IEC 62271 – PANEL DRAWINGS

CLASS A-FLR







630-2500A Panel

FOR SPECIAL CONFIGURATIONS OF PANELS, REFER TO RPS SWITCHGEAR

630-1250A PANEL

A Voltage transformer housing
B Voltage transformer
3 x single phase disconnectable
C Voltage transformer HV fuses
D Current transformer chamber
E Busbar chamber
F Control cubicle
G Gear plate
H Circuit earthing contacts
J Busbar earthing contacts
K Orifice shutters
L Selector gate mechanism controlling circuit breaker position
M Circuit cable box, air insulated (Bottom entry standard)
N Circuit breaker
O Circuit breaker operating mechanism
P Circuit breaker carriage
Q Multicore terminal block
R Multicore cable gland plate

OVERALL DIMENSIONS

Widths shown apply to both single and double busbar panels.

NOTE 1:

2,100mm standard height control cubicle
2,400mm extended height control cubicle

NOTE 2:

Distance required for circuit breaker removal:
700mm for 630-1250A circuit breaker
1,200mm for 2000-2500A circuit breaker

NOTE 3:

Rear access 600mm minimum distance is recommended

TECHNICAL SPECIFICATION

TYPE LMVP SWITCHGEAR

Standards		IEC 62271-200, IEC 6227-1
Rated voltage		up to 12kV (r.m.s.)
Rated insulation level:		
Lightning impulse withstand		95kVp
1 minute power-frequency withstand		28kV (r.m.s.)
Additional tests		42kV (r.m.s.)
Rated frequency		50Hz / 60 Hz
Rated short-time withstand current		up to 31.5kA
Rated peak withstand current		up to 79 kAp
Rated duration of short-circuit		3 seconds
Internal fault (type tested)		25kA/1.0 sec A-FLR
Construction		Metal clad
Degree of protection	Standard	IP3X (approaching IP4X)
	Optional	IP4X or higher to suit specific requirements
Normal service conditions		Indoor
Ambient air temperatures:		
Maximum		40°C
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%
Finish		Epoxy powder paint
Colour	Standard	Pipeline grey shade AS2700-N43

BUSBAR CHAMBER

Orifice insulators	Epoxy resin silica-filled
Busbars	Tinned copper. Heat shrink insulated
Joints	Shrouded tubing; filled or unfilled
Rated normal current	Up to 3000A

CURRENT TRANSFORMER

Standards		IEC 61869-1, IEC 61869-2
Orifice insulators		Epoxy resin silica-filled
Current transformers	Either	a) Low voltage insulated type mounted on a screened silica-filled epoxy resin insulated primary bar
	Or	b) High voltage silica-filled epoxy resin encapsulated type including multi-turn primary designs for low ratios
Joints		Shrouded or encapsulated

IOMS MANUAL

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

VOLTAGE TRANSFORMER

Standards	IEC 61869-1, IEC 61869-3
Insulation	Epoxy resin silica-filled
Connected	Busbar or circuit; withdrawable, disconnectable or fixed
Types	3 x single phase
Burdens	up to 200VA per phase
Accuracy class	0.2, 0.5 or 1.0

EARTHING

Circuit Earthing	Circuit breaker transfer method or optional fault making earthing switch
Busbar Earthing	Circuit breaker transfer method

TESTING

	High voltage test bushings can be inserted into de-energised circuit or busbar orifices
Optional	Test point at cable dropper

TYPE LMVP VACUUM CIRCUIT BREAKER

Standards	IEC 62271-100
Rated voltage	12kV
Rated lightening impulse withstand voltage	95kVp
Rated frequency	50/60Hz
Rated normal current	630A Cap Switching 630/800A, 1250A, 2000A, 2500A
Rated duration of short-circuit	3 seconds
Rated short-circuit breaking current	25, 31.5kA
d.c. component	40%
Rated short-circuit making current	79kAp
Rated out-of-phase breaking current	6.25kA at 13.9kV
Rated cable charging breaking current	25A
Rated single capacitor bank breaking current	400A
Rated transformer magnetising current	6.3A
Operating sequence	O-0.3s-CO-15sec-CO

MASS (KG)

Rated normal current (Amp)	630	800	1250	2000	2500
Circuit breaker on carriage	160	160	180	280	310
Enclosure complete with circuit breaker – Single busbar	520	550	580	930	940
Enclosure complete with circuit breaker – Double busbar	700	730	760	1450	1460
Extra for voltage transformer including housing 3 x 1 phase			90		

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

NOTES

CONTACT US

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