

MV Sulphur Hexafluoride Circuit-breakers for Outdoor Installation

Model OHB



ABB

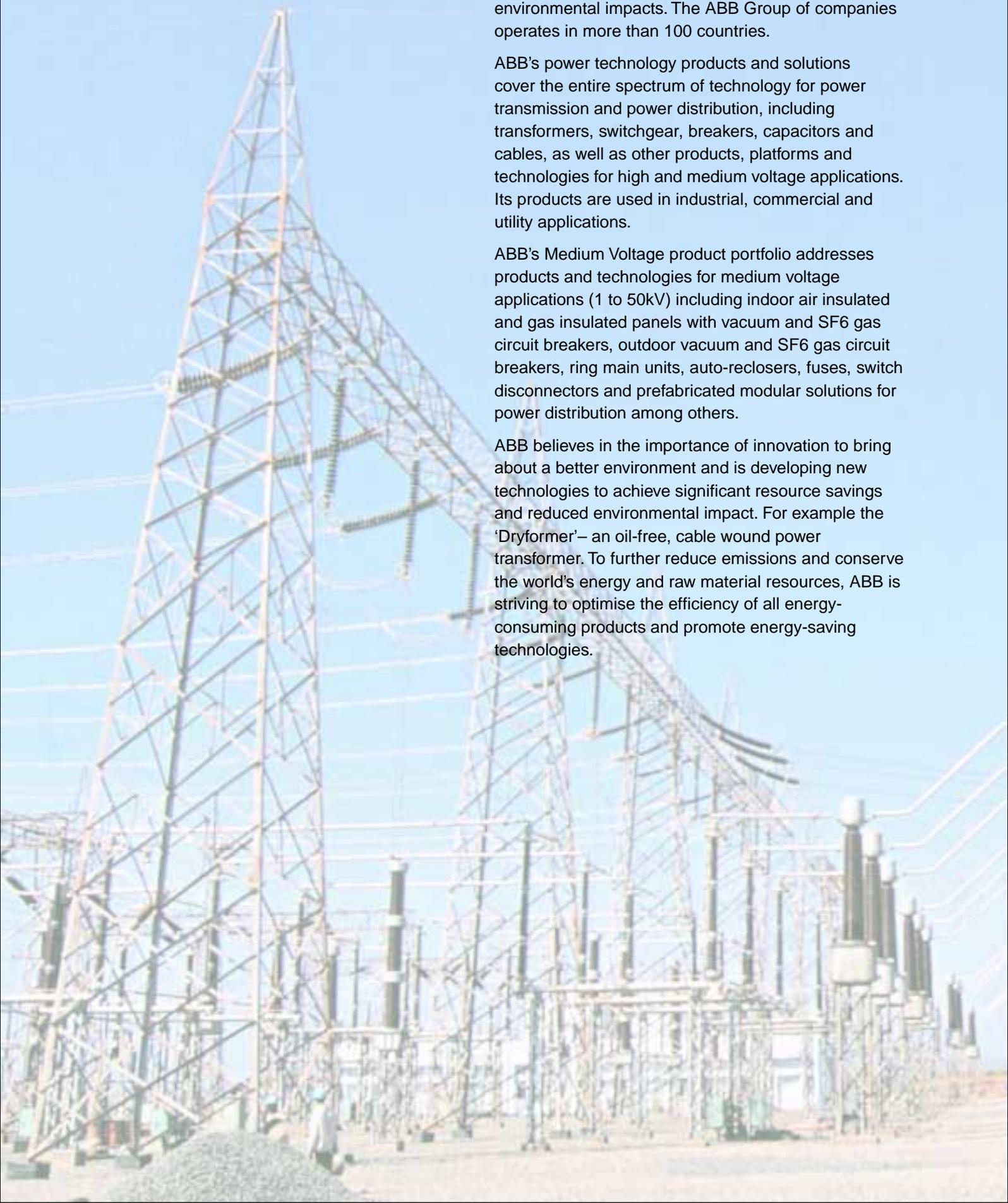
ABB - a global leader in power and automation technologies

ABB (www.abb.com) is a global leader in power and automation technologies that enable utility and industry customers to improve performance while lowering environmental impacts. The ABB Group of companies operates in more than 100 countries.

ABB's power technology products and solutions cover the entire spectrum of technology for power transmission and power distribution, including transformers, switchgear, breakers, capacitors and cables, as well as other products, platforms and technologies for high and medium voltage applications. Its products are used in industrial, commercial and utility applications.

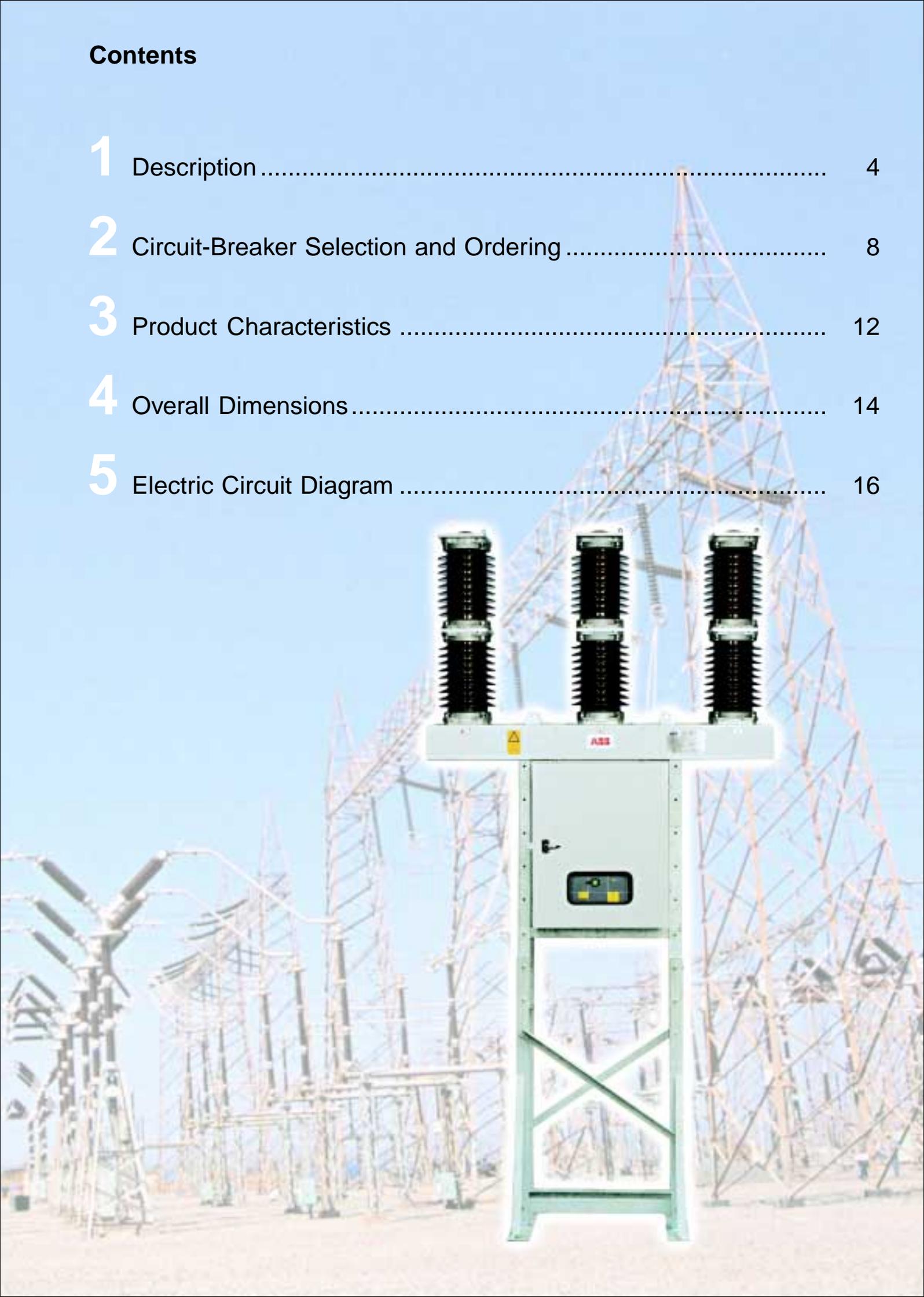
ABB's Medium Voltage product portfolio addresses products and technologies for medium voltage applications (1 to 50kV) including indoor air insulated and gas insulated panels with vacuum and SF6 gas circuit breakers, outdoor vacuum and SF6 gas circuit breakers, ring main units, auto-reclosers, fuses, switch disconnectors and prefabricated modular solutions for power distribution among others.

ABB believes in the importance of innovation to bring about a better environment and is developing new technologies to achieve significant resource savings and reduced environmental impact. For example the 'Dryformer'— an oil-free, cable wound power transformer. To further reduce emissions and conserve the world's energy and raw material resources, ABB is striving to optimise the efficiency of all energy-consuming products and promote energy-saving technologies.



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Description

General information

OHB medium voltage circuit-breakers for outdoor installation use sulphur hexafluoride gas (SF6) to extinguish the electric arc and as the insulating medium.

Breaking in SF6 gas takes place without current chopping or generation of overvoltages.

These characteristics guarantee a long electrical life for the circuit-breaker and limited dynamic, di-electric and thermal stresses on the installation.

The ESH type of stored energy and free release mechanical operating mechanism allows opening and closing operations through local and remote control.

The operating mechanism, the activating kinematics of the moving contacts and the anti-condensation heater are located inside a tight metal enclosure which also acts as the support for the poles.

The above-mentioned structure is supported by a frame made of telescopic metal sections which allow the height of the circuit-breaker terminal to be adapted from 2800 mm to 3700 mm.



The metal enclosure has IP 54(*) degree of protection and is fitted with a tight door with an inspection window.

The circuit-breaker is compact and ensures a high level of sturdiness and excellent mechanical reliability.

The enclosure is made out of a steel plate with adequate surface protection by a special metalising and painting process. The support structures are hot dip galvanised.

Fields of application

OHB circuit-breakers are used in power distribution for control and protection of lines and for control and protection of transformers, rectifier units, capacitor banks, etc.

Due to the SF6 autopuffer breaking technique, the OHB circuit-breakers do not generate overvoltage during switching, and are therefore also highly suitable for retrofitting, upgrading and enlarging older installations where the insulating materials of the cables and apparatus may have already been stressed during service.

(*) IP 54 is obtained by placing filters over the ventilation holes on the bottom of the casing (the filters are supplied on request)

- Breaking chamber identical to the type used for the HD4 series
- Mechanical operating mechanism identical to the type used for the HD4 series
- Upper and lower terminals with NEMA4 drilling
- Gas pressure control device for each pole
- Poles made with porcelain insulators, assembled by means of flanges with terminals
- Pole covers and cases made of aluminium
- Pole covers with safety valve
- Inspection window in the pole supporting casing near the operating mechanism signals
- Complete range of accessories
- Wide range of power supply voltages of the electrical accessories

Standards and approvals

The OHB circuit-breakers comply with the IEC 62271-100 standard as well as of other major industrialised countries. They have undergone the tests indicated below and ensure service safety and reliability of the apparatus in all installations.

Type tests:

- Temperature rise test
- Di-electric test
- Short circuit test duties
- Short time current test
- Mechanical endurance test

Routine tests:

- Power frequency voltage with stand test
- Insulation test on auxiliary and control circuits
- Measurement of main circuit resistance
- Mechanical and electrical operation test



Porcelain insulators

Service safety

The mechanical and electrical locking devices have been provided to prevent incorrect operations and to carry out inspection of the installations while guaranteeing maximum operator safety.



Lower terminals



Telescopic supports

Accessories

The OHB circuit-breakers have a complete range of accessories which means all installation requirements can be satisfied.

The operating mechanism is of the same type for the whole series and has a standardised range of accessories and spare parts which are easy to identify and order. Use, maintenance and service of the apparatus have been simplified and require limited use of resources.

ESH operating mechanism

- Single operating mechanism for the whole series
- The same accessories for all types of circuit-breakers
- Easy assembly and replacement of the accessories



ESH type of operating mechanism



Device for monitoring SF6 gas pressure



Detail of the supports for fixing to the floor

Quality Assurance System

Certified by an independent organisation as complying with ISO 9001 Standards.

Environmental Management System

Certified by an independent organisation as complying with ISO 14001 Standards.

Test laboratory

Accredited by an independent organisation as complying with ISO 45001 Standards.

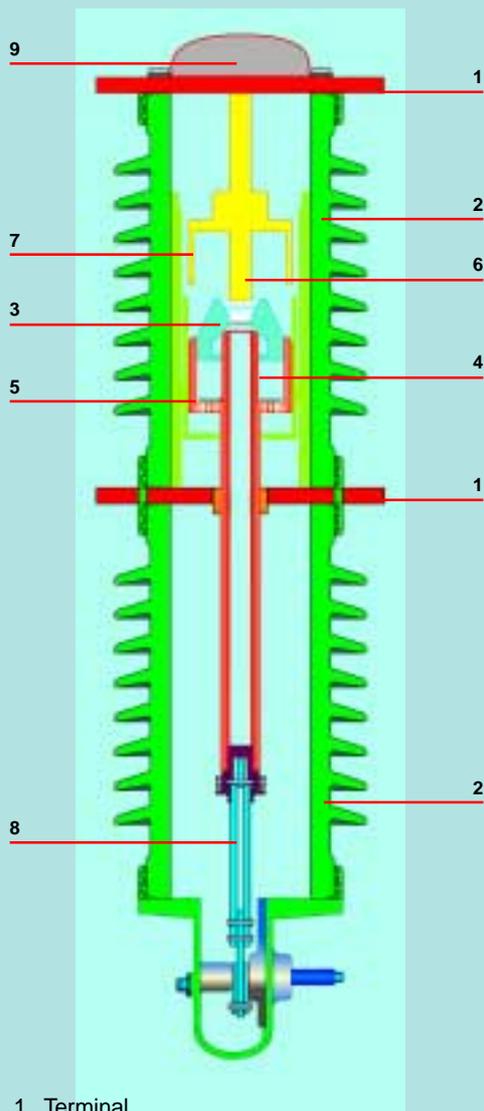
Electrical characteristics

Circuit-breaker		OHB 24		OHB 36		OHB 40	
Rated voltage	[kV]	24	24	36	36	40.5	40.5
Rated normal current	[A]	1250	2500	1250	2500	1250	2500
Rated breaking capacity	[kA]	25-31.5	25-31.5	25-31.5	25-31.5	25-31.5	25-31.5

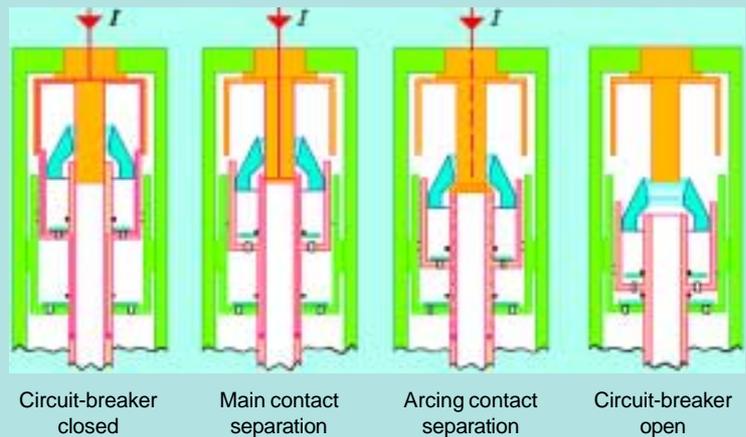
Breaking technique

The breaking principle of OHB circuit-breakers is based on compression and self-blast technique to obtain top performances at all breaking current values, with minimum arc times, gradual arc extinction without chopping, and no restriking or switching overvoltages.

This breaking technique - already widely appreciated and used in high voltage circuit-breakers, has been introduced into medium voltage with the HD4 series circuit-breakers for indoor installation.



- 1 Terminal
- 2 Insulating enclosure
- 3 Blasting nozzle
- 4 Moving arcing contact
- 5 Moving contact
- 6 Fixed arcing contact
- 7 Fixed contact
- 8 Insulating tie-rod
- 9 Cap with bursting valve



Main contact separation

No electric arc is struck because the current flows through the arcing contacts. During its run downwards, the moving apparatus compresses the gas in the lower chamber. The compressed gas flows from the lower to the upper chamber, thereby taking both the chambers to the same pressure.

Arcing contact separation

The current flows due to the electric arc which has struck between the arcing contacts. The gas cannot escape through the nozzle because the hole is still closed by the fixed arcing contact and cannot even escape through the inside of the arcing contact, because of the clogging effect of the electric arc.

- **at low current values**, the arc is extinguished when the current passes through its natural zero and the gas flows through the contacts. The low pressure level cannot chop the current and the modest amount of gas which "escapes" is sufficient to restore di-electric resistance between the two contacts, preventing restriking on the rising front of the recovery voltage.
- **at high short-circuit values**, the pressure wave generated by the electric arc closes the valve between the two chambers so that the circuit-breaker starts to operate as "pure self-blast" apparatus. The pressure increases in the upper volume due to the gas heating and molecular dissociation due to the high temperature. The pressure increase is proportional to the arc current and ensures arc extinction during the first passage through zero current.

Circuit-breaker open

The arc has been extinguished, the self-generated pressure in the upper volume decreases because the gas is flowing through the contacts. The valve re-opens and a new jet of fresh gas flows in and "washes" the chamber. This means the apparatus is immediately ready to close and trip again up to its maximum breaking capacity.

Circuit-Breaker Selection and Ordering

General characteristics

Circuit-breaker on column		OHB 24		OHB 36		OHB 40	
Standards	IEC 62271-100	■		■		■	
Rated voltage	Ur [kV]	24		36		40.5	
Rated insulation voltage	Us [kV]	24		36		40.5	
Withstand voltage at 50 Hz	Ud (1 min) [kV]	70 (dry) / 60 (wet)		95 (dry) / 80 (wet)		95 (dry) / 80 (wet)	
Impulse withstand voltage	Up [kV]	150		200		200	
Rated frequency	fr [Hz]	50-60		50-60		50-60	
Rated normal current (40°C)	Ir [A]	1250	2500	1250	2500	1250	2500
Rated breaking capacity	Isc [kA]	25 31.5	25 31.5	25 31.5	25 31.5	25 31.5	25 31.5
Rated short-time withstand current (3 s)	Ik [kA]	25 31.5	25 31.5	25 31.5	25 31.5	25 31.5	25 31.5
Making capacity	Ip [kA]	63 80	63 80	63 80	63 80	63 80	63 80
Operation sequence	[O-0, 3s-CO-15s-CO]	■		■		■	
Opening time	[ms]	45±10		45±10		45±10	
Arcing time	[ms]	10-15		10-15		10-15	
Total breaking time	[ms]	55-60		55-60		55-60	
Closing time	[ms]	75±10		75±10		75±10	
Overall dimensions	on frame						
	H [mm]	3090 – 3840		3090 – 3840		3090 – 3840	
	L [mm]	900		900		900	
	P [mm]	686		686		686	
Weight	[Kg]	900		900		900	
SF6 gas absolute pressure	Rated service value [kPa]	500		500		500	
Operating temperature ⁽¹⁾	[°C]	-25...+40		-25...+40		-25...+40	
Tropicalisation	IEC: 60068-2-30, 721-2-1	■		■		■	
Electromagnetic compatibility	IEC: 60694, 61000-6-2, 61000-6-4	■		■		■	
Solar radiation	[W/m ²]	1000		1000		1000	
Presence of pollution	IEC 815 - table 1	Level III		Level III		Level III	
Creepage distance	[cm/kV]	2.5		2.5		2.75	
Ice coating	[mm]	10		10		10	
Wind speed	[m/s]	34		34		34	
Earthquake resistance	[g]	0.3		0.3		0.3	
Static force on the terminals	Longitudinal [N]	750		750		750	
	Transversal [N]	500		500		500	
	Vertical [N]	750		750		750	

(1) For lower operating temperatures, please consult us.

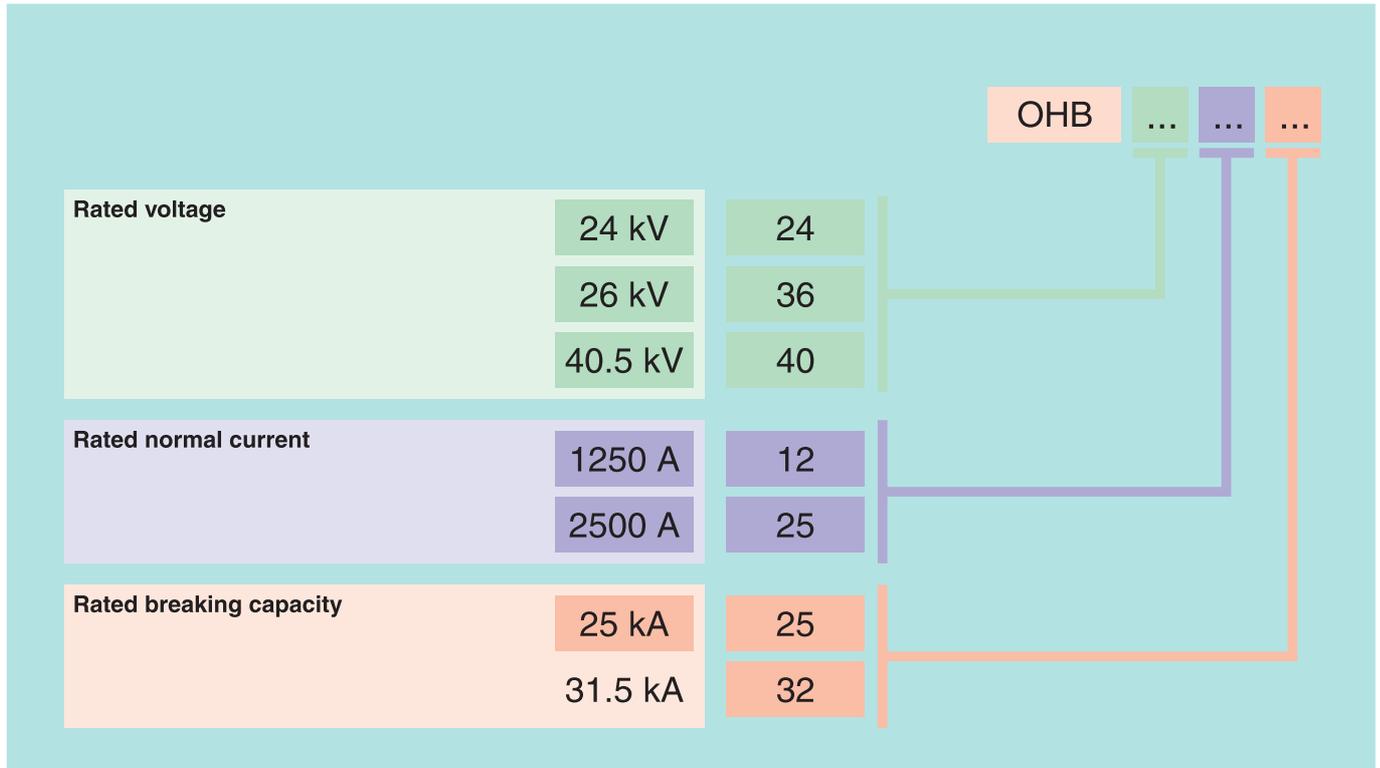
Identification of the circuit-breaker type

The identification code of a circuit-breaker is made up with the elements indicated in the table below. For correct identification of a circuit-breaker, please refer to the characteristics table on page 8. The circuit-breaker selected can then be completed with the optional accessories indicated on the following pages.

Example of identification: code **OHB 36.25.32** identifies a circuit-breaker for outdoor installation with 36 kV rated voltage, 2500 A rated normal current and 31.5 kA breaking capacity.

Standard equipment

- 1) ESH operating mechanism, complete with manual opening and closing push buttons, mechanical key lock in open position (key removed in the open position), mechanical indicators for circuit-breaker "open or closed" and for springs "charged or discharged", the mechanical indicators can be seen through the inspection window on the door
- 2) YO1 shunt opening release
- 3) YC shunt closing release
- 4) Spring-charging geared motor
- 5) Lever for manual spring charging
- 6) Pressure switch with two levels (one per pole); suitable for operation down to -25°C. For lower service temperatures, please contact us
- 7) Locking circuit for insufficient gas pressure (automatic opening with additional YO2 shunt opening release and lock in the open position by means of closing circuit interruption)
- 8) Electrical contacts signalling: springs charged (or alternatively springs discharged)
- 9) Auxiliary contacts (10 NC + 10 NO)
- 10) Automatic remote operation is not possible with the door open by means of a limit switch mounted on the door
- 11) Anti-condensation/heating circuit for low temperatures with armoured anti-condensation heating elements and thermostat; solution provided for operation down to -25°C
- 12) Support terminal box with isolation for YO1 shunt opening release, YC shunt closing release, M motor and YU undervoltage release (if requested)



- 13) The cabinet is fitted with cable gland plate for control, cables and with padlockable front door

The circuit-breaker is supplied with asymmetrical terminal connections on one side of the poles only and with 4 holes as per NEMA form 4 Standards. The lower terminal is turned towards the rear of the apparatus, the upper terminals are provided as standard turned towards the front of the apparatus but, on request, it can be turned towards the rear of the apparatus

The structures provided are:

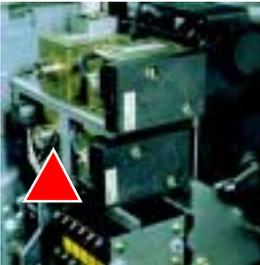
- T structures with telescopic supports adjustable in height
- The structure and framework are always made of hot galvanised steel

Equipment supplied on request

- 14) MCB for geared motor protection
- 15) Signalling lamps placed inside the cabinet, in a position visible from the inspection window on the door. A single solution with 4 lamps is provided for:
- signalling circuit-breaker closed (red lamp)
 - signalling circuit-breaker open (green lamp)

- signalling springs charged (or alternatively discharged) (yellow lamp)
- signalling insufficient gas pressure (white lamp)

- 16) Selector switch for local/remote control
- 17) Control switch for local ON/OFF electrical operation through shunt closing and opening releases
- 18) YU undervoltage release
- 19) Electrical signalling of YU undervoltage release energised (or de-energised)
- 20) Electronic time delay device for YU undervoltage release
- 21) Q0 Transient closing contact (NO contact which closes transiently during circuit-breaker opening)
- 22) 20 auxiliary switches contacts (10 NO + 10 NC)
- 23) Single-phase socket
- 24) Illumination lamp which automatically switches on by means of a limit switch when the door is opened
- 25) IP54 ventilation filters on the discharge holes located on the bottom of the casing
- 26) CT support structure units terminal connector



Shunt closing release



Shunt opening release



Undervoltage release



Auxiliary contacts with linkage



Spring charging geared motor

Characteristics of the electrical accessories of the ESH operating mechanism

Shunt opening release	Ps	= 125 W / VA x 45 ms (instantaneous service)				
	Un	= 24, 30, 48, 60, 110, 125, 220 V–				
	Un	= 48, 110, 127, 220, 230, 240 V~ 50 Hz				
	Un	= 110, 127, 220, 230, 240 V~ 60 Hz				
Shunt closing release	Ps	= 250 W / VA x 150 ms				
	Pc	= 5 W / VA (anti-pumping function - continuous service)				
	Un	= 24, 30, 48, 60, 110, 125, 220 V–				
	Un	= 48, 110, 127, 220, 230, 240 V~ 50 Hz				
	Un	= 110, 127, 220, 230, 240 V~ 60 Hz				
Undervoltage release	Ps	= 250 W / VA x 150 ms				
	Pc	= 5 W / VA (continuous service)				
	Un	= 24, 30, 48, 60, 110, 125, 220 V–				
	Un	= 48, 110, 127, 220, 230, 240 V~ 50 Hz				
	Un	= 110, 127, 220, 230, 240 V~ 60 Hz				
Spring charging geared motor	Ps	= 1500 W / VA x 100 ms				
	Pc	= 400 W / VA x 6 s				
	Un	= 24, 30, 48, 60, 110, 125, 220 V–				
	Un	= 48, 110, 127, 220, 230, 240 V~ 50 Hz				
	Un	= 110, 127, 220, 230, 240 V~ 60 Hz				
Signalling contacts	Un	= 110 V~	= 230 V~	= 400 V~	= 110 V–	= 220 V–
	Icu	= 4 A	= 3 A	= 1.5 A	= 0.25 A	= 0.13 A
	cosφ	= 0.3	= 0.3	= 0.3	= –	= –
	T	= –	= –	= –	= 10 ms	= 10 ms
Signalling contacts	Un	= 400 V~	= 220 V–			
	Icu	= 15 A	= 1.5 A			
	cosφ	= 0.4	= –			
	T	= –	= 10 ms			

Un Rated voltage

Cosφ Power factor

Icu Breaking capacity

Ps Inrush absorbed power

Pc Continuous service absorbed power

T Time constant

Product Characteristics

Resistance to vibrations

The OHB circuit-breakers are unaffected by mechanical vibrations.

Tropicalisation



The OHB circuit-breakers are manufactured in compliance with the strictest regulations for use in hot-humid-saline climates.

All the important metal components are treated against corrosion. The sheet metal components are

metalised with zinc and painted to ensure protection against corrosion. The support structures are hot dip galvanised. These construction characteristics mean the OHB circuit-breakers and their accessories comply with climate graph 8 of the IEC 60721-2-1 and IEC 60068-2-2 (Test B: Dry Heat) / IEC 60068-2-30 (Test Bd: Damp Heat, cyclic) Standards.

Altitude



The insulating property of air decreases as the altitude increases. This fact must therefore be taken into account for external insulation of the apparatus (the internal insulation does not undergo any variation because it is guaranteed by the SF6 gas).

The phenomenon must always be considered during the design stage of the insulating components of the apparatus which are to be installed over 1000 m above sea level.

In this case a correction coefficient must be considered, which can be taken from the graph at the side, built up on the basis of the indications in the IEC 60694 Standards.

The following example is a clear interpretation of the indications given above.

Example

- Installation altitude: 2000 m
- Service at 24 kV rated voltage
- Power frequency withstand voltage: 70 kVrms
- Impulse withstand voltage: 150 kVp
- Ka factor, which can be taken from the graph = 1.13

Considering the above parameters, the apparatus must withstand (on test at zero altitude, i.e. at sea level).

– power frequency withstand voltages:

$$70 \times 1.13 = 79.1 \text{ kVrms}$$

– impulse withstand voltage:

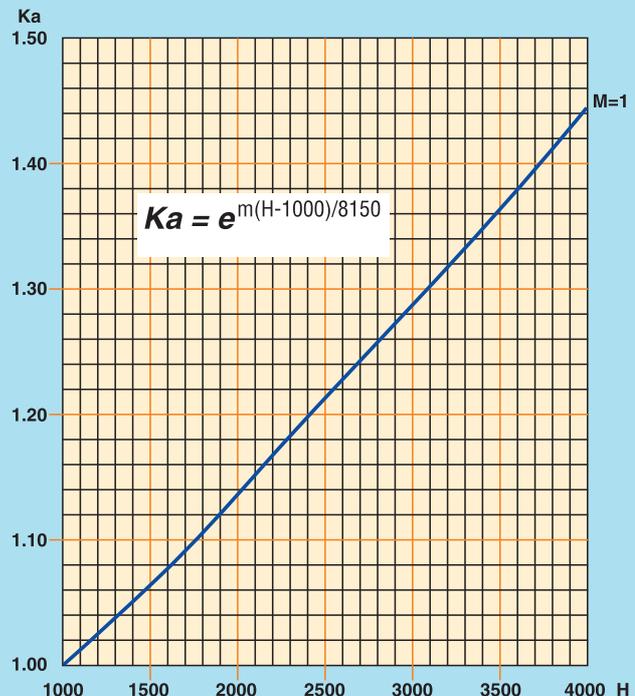
$$150 \times 1.13 = 169.5 \text{ kVp}$$

From the above, it can be deduced that for installations at an altitude of 2000 m above sea level, with 24 kV service voltage, apparatus must be provided with 36 kV rated voltage, characterised by insulation levels at power frequency of 95 kVrms with 200 kVp impulse withstand voltage.

Graph for determining the Ka correction factor according to the altitude

H = altitude in metres

m = value based on power frequency, impulse and phase to phase withstand voltage



Operation of special loads

The table shows the breaking capacities which can be guaranteed for operation of special loads.

Circuit-breaker		OHB	
Rated normal current	I_n [A]	1250	2500
No-load MV/LV transformer breaking	I_{sc} [A]	10	10
No-load line breaking	I_{sc} [A]	31.5	31.5
Capacitive current breaking (single bank)	I_{sc} [A]	400 (*)	400 (*)
Compensation reactance current breaking	I_{sc} [A]	630	1250



N.B. The maximum overvoltages found in all breaking, under the conditions considered, are < 2.5 PU

$$(PU = \text{Per Unit} = 2.5 \times \sqrt{2} \times \frac{V_n}{\sqrt{3}})$$

(*) Back-to-back: 400 A, 20 kA inrush current, 4.25 kHz inrush frequency; for higher values of capacitive currents, please consult us.

Environmental protection programme

The OHB circuit-breakers are manufactured in accordance with the ISO 14000 Standards (Guidelines for environmental management).

The production processes are carried out in compliance with the Standards for environmental protection in terms of reduction in energy consumption as well as in raw materials and production of waste materials. All this is due to the medium voltage apparatus manufacturing facility environmental management system, certified by an external independent organisation.

Assessment of the environment impact during the life cycle of the product (LCA - Life Cycle Assessment), is carried out during the design stage itself and materials, processes and packing methods are selected to minimise the same.

Production techniques which prepare the products for simple dismantling and separation of the components are used during manufacture of the circuit-breakers. This is to allow maximum recycling at the end of the useful life cycle of the apparatus.

Anti-pumping device

The ESH operating mechanism on OHB circuit-breakers (in all versions) is fitted with a mechanical anti-pumping device which prevents reclosing due to either electrical or mechanical commands.

Should both the closing command and any one of the opening commands be active at the same time, there would be a continuous succession of opening and closing operations. The anti-pumping device avoids this situation, ensuring that each closing operation is only followed by a single opening operation and that there is no closing operation after this. To obtain a further closing operation, the closing command must be released and then relaunched.

Furthermore, the anti-pumping device only allows circuit-breaker closure if the following conditions are present at the same time:

- operating mechanism springs fully charged
- opening push button and/or opening release (YO1) not enabled



Spare parts

- Opening springs ⁽¹⁾
- Closing springs ⁽¹⁾
- Complete pole ⁽¹⁾
- Basic operating mechanism ⁽¹⁾
- Spring charging geared motor ⁽¹⁾
- Geared motor limit contact
- Anti-condensation heater
- Shunt opening release
- Thermostat
- Operating mechanism auxiliary contacts ⁽¹⁾
- Undervoltage release ⁽¹⁾
- SF6 gas filling kit ⁽²⁾
- SF6 5-litre gas cylinder ⁽²⁾

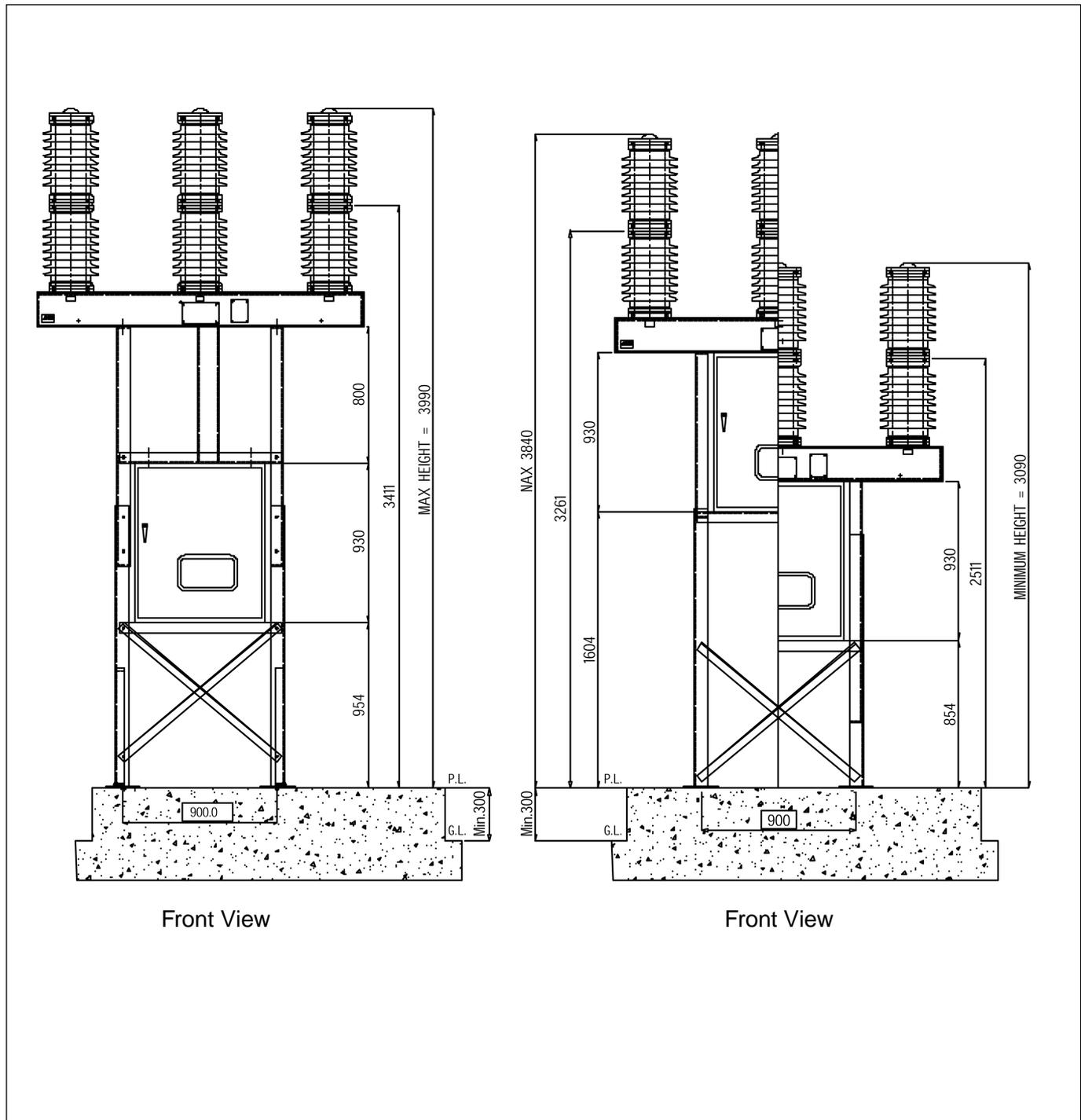
Ordering

For availability and ordering of spare parts, please contact the ABB Service, specifying the circuit-breaker serial number.

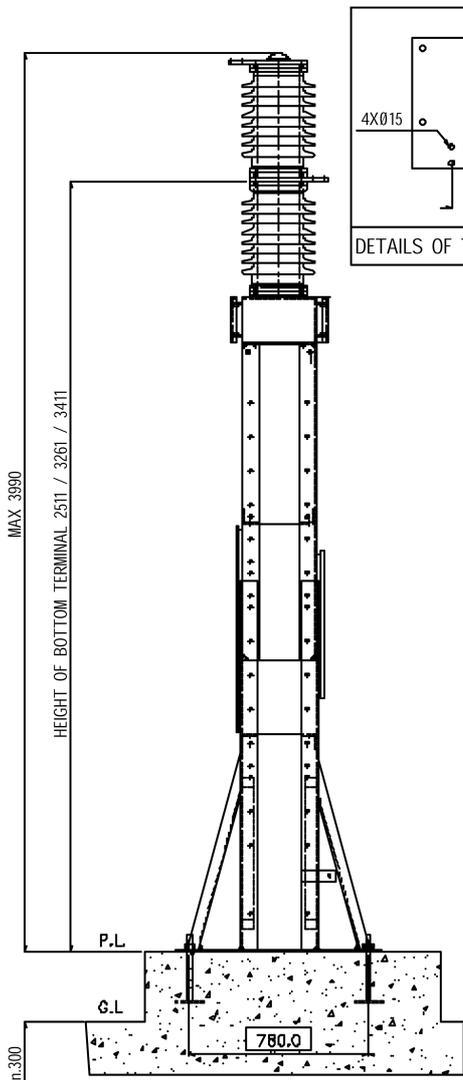
⁽¹⁾ Replacement can only be carried out by trained personnel and/or in our workshops.

⁽²⁾ Only to be used by trained personnel or at an ABB Service.

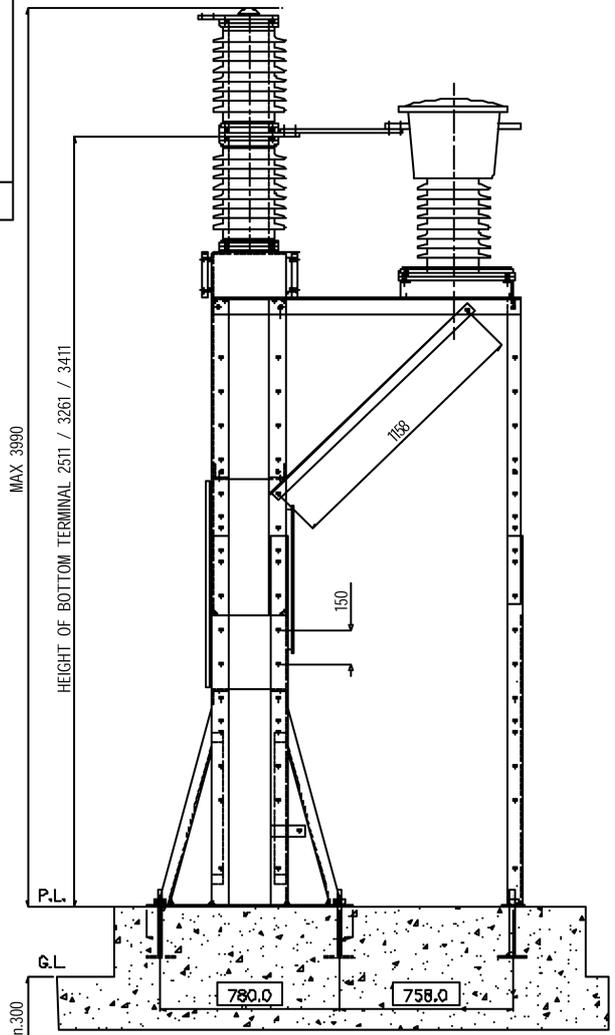
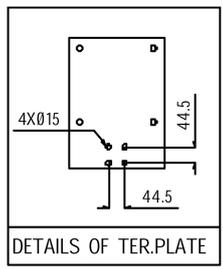
Overall Dimensions



	OHB36	OHB40
Ur	36 kV	40.5 kV
Ir	1250 A 2500 A	1250 A 2500 A
Isc	25 kA 31.5 kA	25 kA 31.5 kA

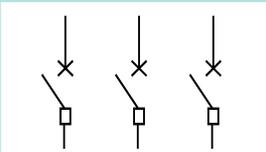
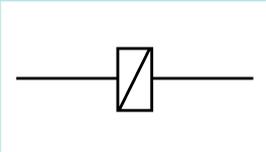
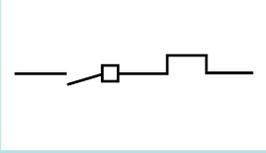
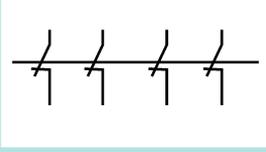
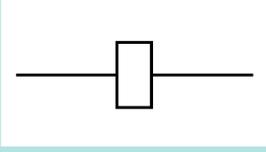
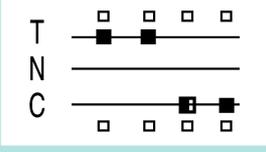
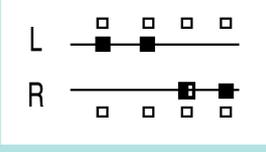


Side View w/o CT Structure

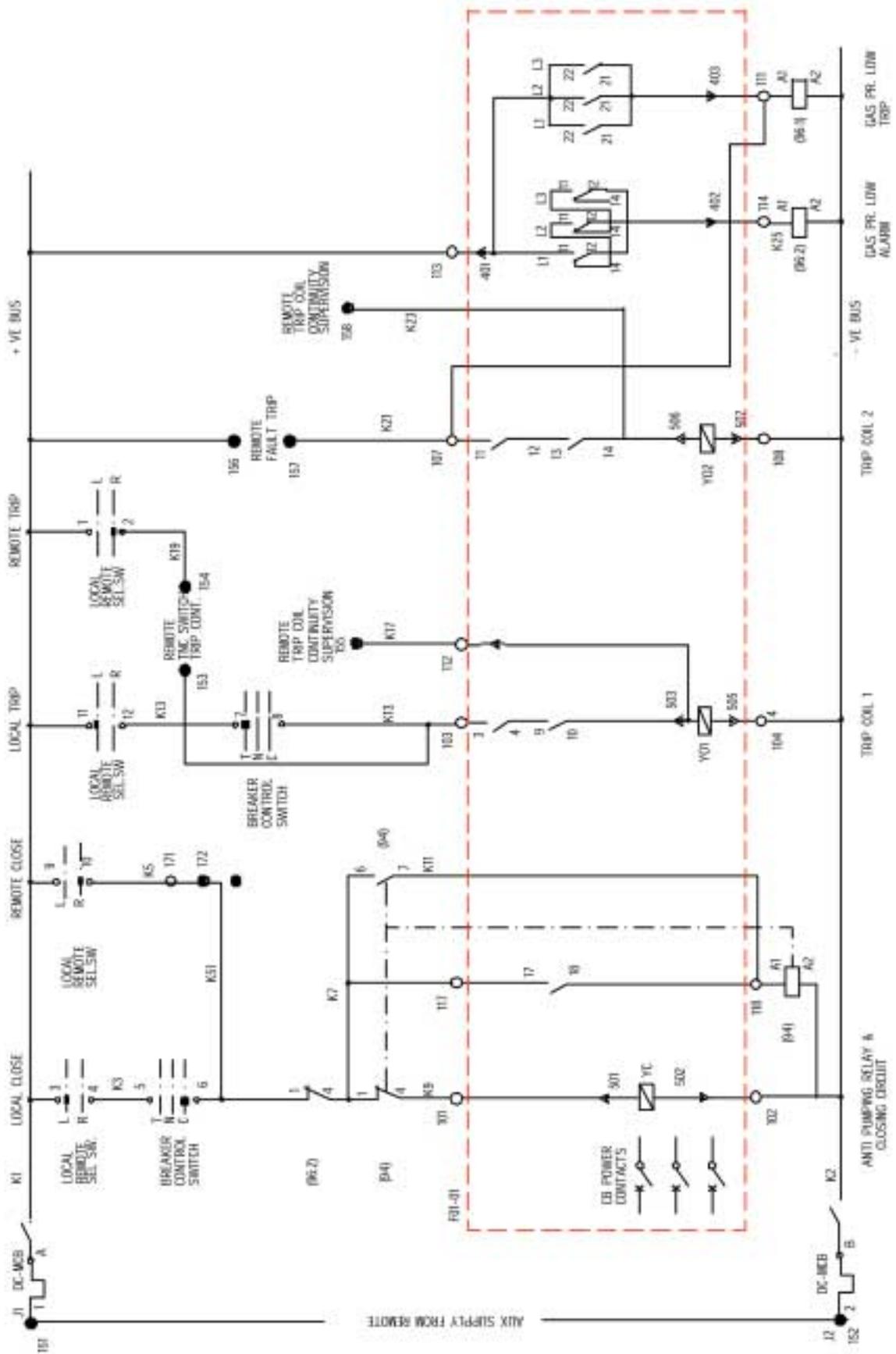


Side View with CT Structure (optional)

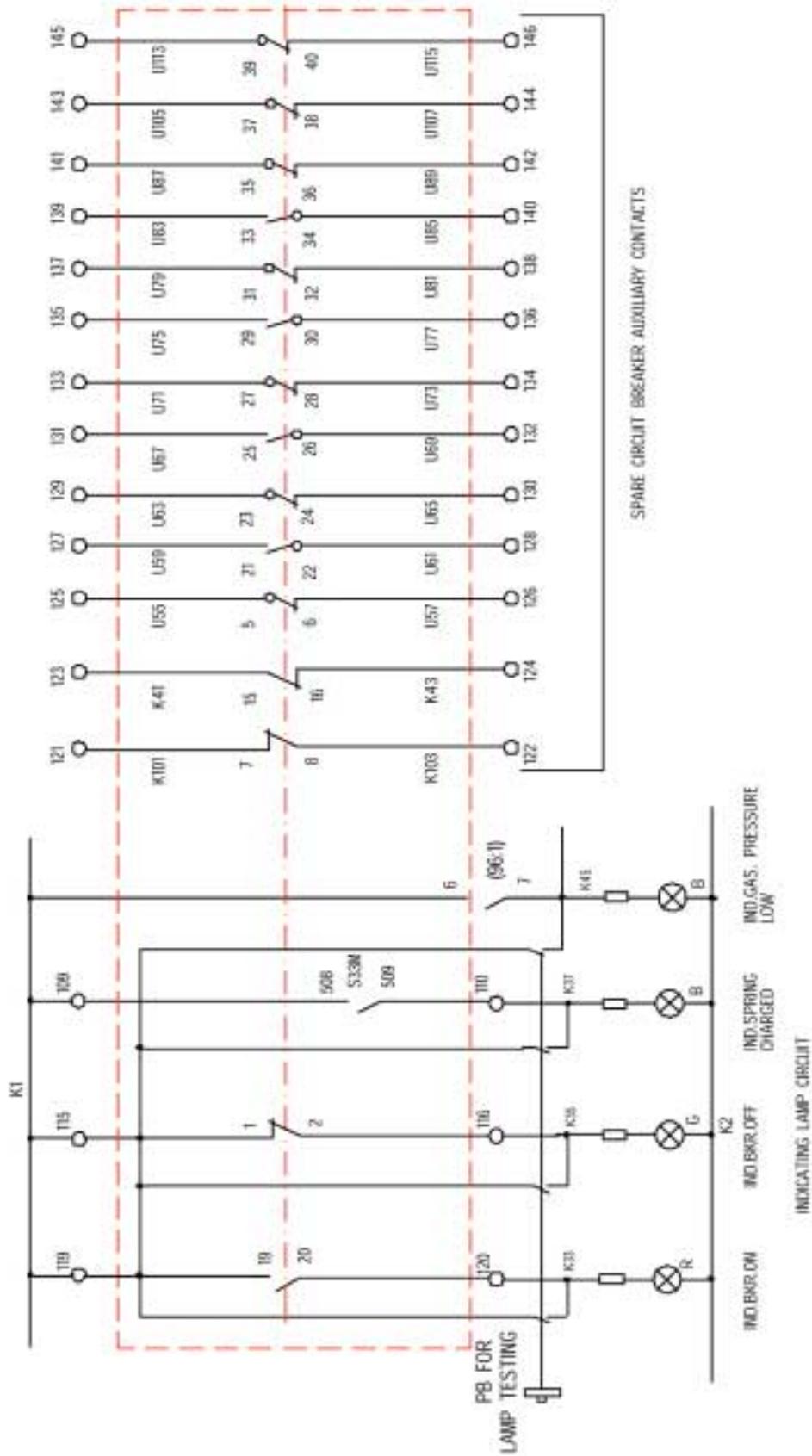
Electric Circuit Diagram

Legend	Description
	OHB Circuit Breaker
	Closing Coil (CC) YC Trip Coil (TC1) Y01 Trip Coil (TC2) Y02
	Spring Charge Motor
	MCB
	Indicating Lamp
	Breaker Aux. Contacts
	Anti-Pumping Relay Gas Pr. Low Alarm Relay Gas Pr. Low Trip Relay
	Breaker Control Switch
	Local Remote Switch

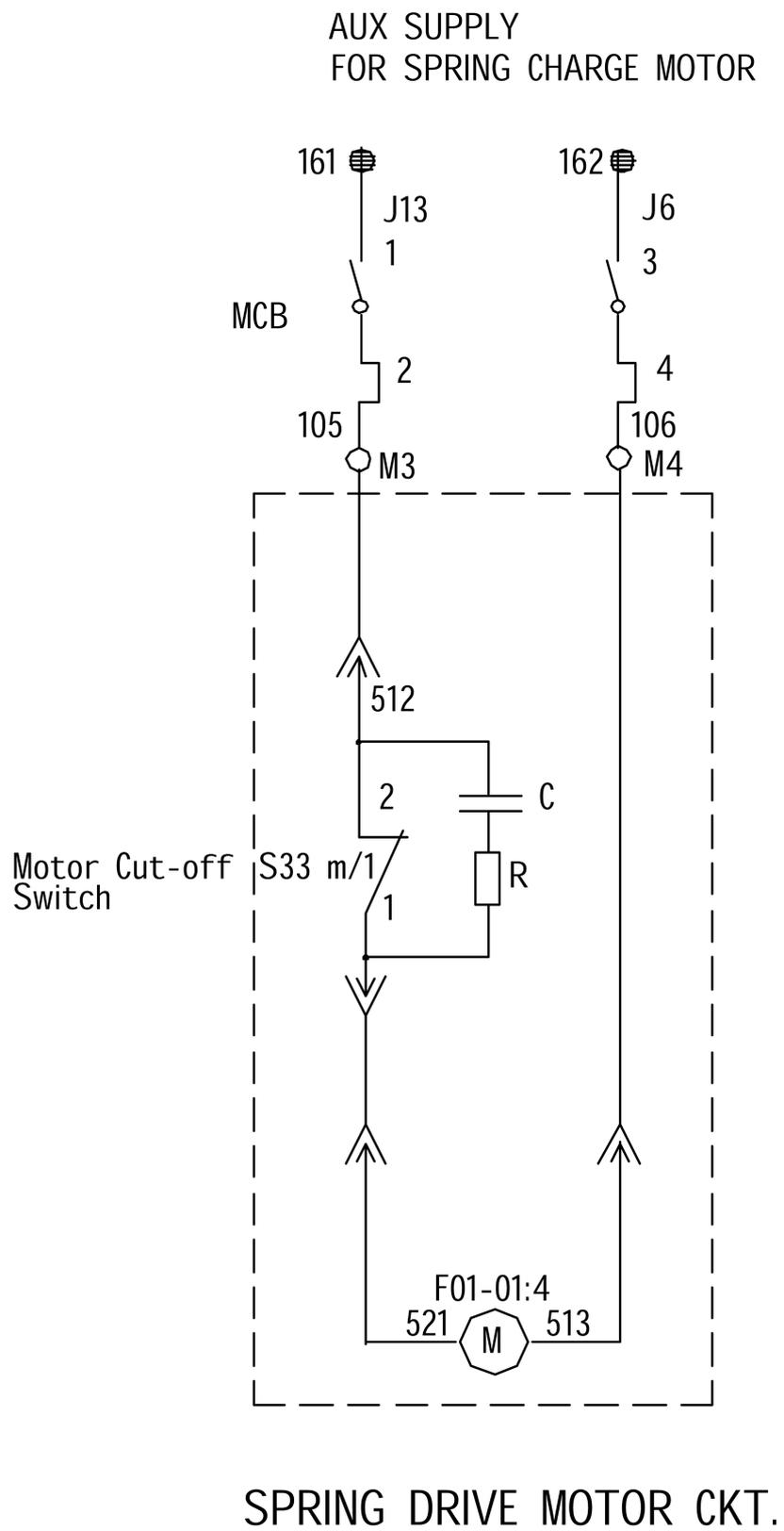
Control circuit



Auxiliary circuit and indication



Accessories and motor circuit





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Regional Marketing Offices:

North	East	West	Central	South
4th Floor NBCC Tower, No. 15 Bhikaji Cama Place New Delhi 110 066 Tel: +91 11-26186000 Fax: +91 11-26197592/84035	3rd Floor, No. 9, Lala Lajpat Rai Sarani (Elgin Road) Kolkata 700 020 Tel: +91 33-22479162/8015 Fax: +91 33-22472427	ABB House Dr. S B Path Ballard Estate Mumbai 400 038 Tel: +91 22-56318231 – 39 Fax: +91 22-56318276 – 77	Vandana House 1st Floor, G. E. Road Ramkund Raipur 492 001 Tel: +91 771-2660816 – 18 Fax: +91 771-2653391	4th Floor Sona Towers 71, Millers Road Bangalore 560 052 Tel: +91 80-2256315/16 Fax: +91 80-2254147 Nos. 3C, 3D and 3F 3rd Floor, "Century Plaza" 561 / 562, Anna Salai Teynampet Chennai 600 018 Tel: +91 44-4340201/203 Fax: +91 44-4340282