

Altivar 1200

IL Inrush Current Limitation Cabinet

Installation, Operation and Maintenance Manual

02/2017



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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Qualification Of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used. All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

Intended Use

This product is a drive for three-phase synchronous and asynchronous motors and intended for industrial use according to this manual. The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data. Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented. Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design). Any use other than the use explicitly permitted is prohibited and can result in hazards. Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

Product Related Information

Read and understand these instructions before performing any procedure with this drive.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Apply appropriate personal protective equipment (PPE).
- Many components of the product, including the printed circuit boards, operate with mains voltage. Do not touch. Use only electrically insulated tools.
- Do not touch unshielded components or terminals with voltage present.
- Motors can generate voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors of the motor cable.
- Do not short across the DC bus terminals or the DC bus capacitors or the braking resistor terminals.
- Before performing work on the drive system:
 - Always verify that red LED of each power cell is ON when mains voltage is present. LED status can be checked when doors are locked through the holes of the doors. If one or more of the red power cell LEDs is OFF, contact your local Schneider Electric representative.
 - Disconnect all power, including external control power that may be present.
 - Place a **Do Not Turn On** label on all power switches.
 - Lock all power switches in the open position.
 - Wait 20 minutes to allow the DC bus capacitors of the power cells to discharge. The DC bus LEDs located on each power cell are not an indicator of the absence of DC bus voltage.
- If one or more of the red power cell LEDs remains ON 20 minutes after the mains voltage has been disconnected:
 - Do not repair or operate the product.
 - Contact your local Schneider Electric representative.
- Always use a properly rated voltage sensing device to confirm power is off.
- Install and close all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

WARNING

UNEXPECTED MOVEMENT

Drive systems may perform unexpected movements because of incorrect wiring, incorrect settings, incorrect data or other errors.

- Carefully install the wiring in accordance with the EMC requirements.
- Do not operate the product with unknown or unsuitable settings or data.
- Perform a comprehensive commissioning test.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Damaged products or accessories may cause electric shock or unanticipated equipment operation.

 **DANGER**

ELECTRIC SHOCK OR UNANTICIPATED EQUIPMENT OPERATION

Do not use damaged products or accessories.

Failure to follow these instructions will result in death or serious injury.

Contact your local Schneider Electric sales office if you detect any damage whatsoever.

 **WARNING**

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines (1).
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control and to NEMA ICS 7.1 (latest edition), Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.

NOTICE

DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE

Before switching on and configuring the product, verify that it is approved for the mains voltage

Failure to follow these instructions can result in equipment damage.

 **WARNING**

HOT SURFACES

- Ensure that any contact with hot surfaces is avoided.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces.
- Verify that the heat dissipation is sufficient by performing a test run under maximum load conditions.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

About the Book



At a Glance

Document Scope

The purpose of this document is to:

- Give mechanical and electrical information relating to the inrush current limitation cabinets with the rated voltage of 12kV or less.
- Describe how to do wiring and maintenance for the grounding cabinets.

Validity Note

NOTE: The products listed in the document are not all available at the time of publication of this document online. The data, illustrations and product specifications listed in the guide will be completed and updated as the product availabilities evolve. Updates to the guide will be available for download once products are released on the market.

This document applies to the inrush current limitation cabinets matched with medium-voltage VSDs (Variable Speed Drive).

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page www.schneider-electric.com .
2	In the Search box type the reference of a product or the name of a product range. <ul style="list-style-type: none">• Do not include blank spaces in the reference or product range.• To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the Product Datasheets search results and click on the reference that interests you. If you entered the name of a product range, go to the Product Ranges search results and click on the product range that interests you.
4	If more than one reference appears in the Products search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click Download XXX product datasheet .

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Use your tablet or your PC to quickly access detailed and comprehensive information on all our products on www.schneider-electric.com

The internet site provides the information you need for products and solutions

- The whole catalog for detailed characteristics and selection guides
- A large quantity of White Papers, Environment documents, Application solutions, Specifications... to gain a better understanding of our electrical systems and equipment or automation
- And finally all the User Guides related to your drive, listed below:

Title of Documentation	Reference Number
ATV1200 Configuration guide	MVD03002 (English)
ATV1200 Installation manual	MVD01002 (English), MVD01003 (French), MVD01004 (Spanish)
ATV1200 Programming manual	MVD02002 (English), MVD02003 (French), MVD02004 (Spanish)

You can download these technical publications and other technical information from our website at <http://www.schneider-electric.com/en/download>

Standards and Terminology

The technical terms, terminology, and the corresponding descriptions in this manual normally use the terms or definitions in the relevant standards.

In the area of drive systems this includes, but is not limited to, terms such as **error, error message, failure, fault, fault reset, protection, safe state, safety function, warning, warning message**, and so on.

Among others, these standards include:

- IEC 61800 series: Adjustable speed electrical power drive systems
- IEC 61508 Ed.2 series: Functional safety of electrical/electronic/programmable electronic safety-related
- EN 954-1 Safety of machinery - Safety related parts of control systems
- EN ISO 13849-1 & 2 Safety of machinery - Safety related parts of control systems.
- IEC 61158 series: Industrial communication networks - Fieldbus specifications
- IEC 61784 series: Industrial communication networks - Profiles
- IEC 60204-1: Safety of machinery - Electrical equipment of machines – Part 1: General requirements

Chapter 1

Before Starting - Information and procedure

Basic Procedure for Safe Operation

Please take the below safety protection measures during operation:

Step	Action
1	Apply appropriate personal protective equipment (PPE).
2	Live parts must be verified with a high-voltage live indication device and procedure operation should not start until everything is OK.
3	Insulation pad must be paved on the equipment site and the equipment must be operated only after relevant inspections pass.
4	Operation by a single person is prohibited; an accompanying person is necessary during operation.

About operation and usage:

Step	Action
1	Do electrified operation after the doors of the equipment are closed; Forbid opening the door in any case during running.
2	Strictly operate as per the operation regulations in this installation, operation and maintenance manual.
3	Forbid touching the live component when the power is on.

Perform inspections before the first power on to ensure that:

Step	Action
1	The busbar among each cabinet part, which is separated due to transportation, is correctly and tightly connected.
2	The screws of the connection terminals of input and output cables are tightened as well as the connecting screws of the main circuit of the equipment.
3	All the control wires are connected correctly and all the screws are tightened.
4	All the system grounding cables among cabinet parts which are separated due to transportation are connected reliably with the grounding busbar of the site and system grounding cables are connected with suitable grounding points as specified in local electrical regulations.
5	The input voltage of the equipment matches with the voltage marked on the equipment's nameplate.
6	The rated capacity on the nameplate of the inrush current limitation cabinet matches with that of the VSD.

Perform inspections before normal power on to ensure that:

Step	Action
1	All the cables are connected correctly and reliably.
2	Remove all the temporary grounding cables.
3	The doors of the equipment are closed and locked and the grounding switch of upstream switchgear is opened.
4	Power on as per the power-on operating instruction.

Power off:

Step	Action
1	Inform each relevant station get prepared for power off.
2	Open the upstream main circuit breaker.
3	After power off is confirmed, close the grounding switch of upstream switchgear and put up warning label then locked.

Maintenance:

Take necessary measures during maintenance as follow:

Step	Action
1	Open the upstream main circuit breaker.
2	Make sure the high voltage live indicator is OFF.
3	close the grounding switch of upstream main circuit breaker
4	Put up warning label at the same time to avoid Power On by others during maintenance.

Step	Action
1	Always use a properly rated voltage sensing device to verify that the high/low power is Off. Apply personal protective equipment (PPE) and use electroscope with the corresponding high voltage level (with good quality) to verify live parts.
2	Make three-phase input terminals short circuited and grounded after confirming there is no power (to prevent unexpected power on) and connect grounding cable for each power source which may realize Power on of the equipment.
3	For installation of the ground cable, first connect the grounding terminal and then the input terminals, which is on the contrary to the sequence of removing the grounding cable. Apply personal protective equipment (PPE) during installation and removal of grounding cables.
4	Install the grounding cable at a place visible to workers at any time and put up a warning board label "Do Not Dismantle!" at the place of the grounding cable.

Temporary grounding:

Step	Action
1	Requirements for personnel: At least two persons are necessary to install temporary grounding cables, one for operation and the other for supervision; and the supervisor should stand at the side behind the operator; operation by a single person is prohibited. The operator must apply appropriate personal protective equipment (PPE).
2	Requirements for temporary grounding cables: <ul style="list-style-type: none"> ● Use stranded annealed copper wires with transparent sheath, sectional area no less than 50 mm². ● Confirm the annealed copper wires are not broken, the bolt joints are not loose, and the connection is reliable.
3	Open the upstream main circuit breaker: <ul style="list-style-type: none"> ● Before opening the inrush current limitation cabinet doors, open the upstream main circuit breaker and put up the warning label. ● Confirm the live indicator on the door of low-voltage compartment is OFF.
4	Verification of absence of voltage: Open the cable compartment door and utilize a qualified electroscope of the corresponding voltage level to verify there is no residual charge at input and output terminals.
5	Install temporary grounding cables: <ul style="list-style-type: none"> ● Connect the temporary grounding cables to grounding busbar in the inrush current limitation cabinet. ● Connect the other terminals of temporary grounding cables to three-phase input terminals.
6	Verify the installation of temporary grounding cables: Confirm the connection is reliable before maintenance.
7	Remove temporary grounding cables: <ul style="list-style-type: none"> ● Remove the temporary grounding cables from three-phase input terminals. ● Remove the other terminals of temporary grounding cables from grounding busbar in the inrush current limitation cabinet.

Chapter 2

Technical Data and Characteristics

What Is in This Chapter?

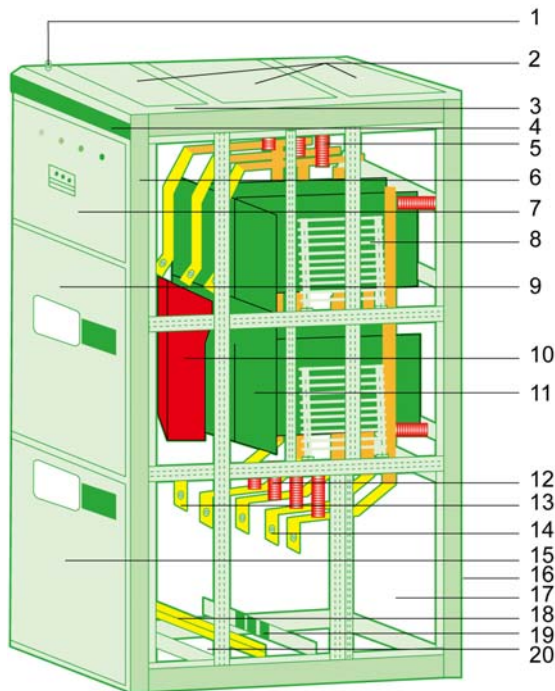
This chapter contains the following topics:

Topic	Page
Cabinet Design	14
Standards	16
Ambient and Operating Conditions	17
Technical Parameters	18
Inrush Current Limitation Cabinet Feature	19
Content of Nameplate	22
Disposal After Service Life	22

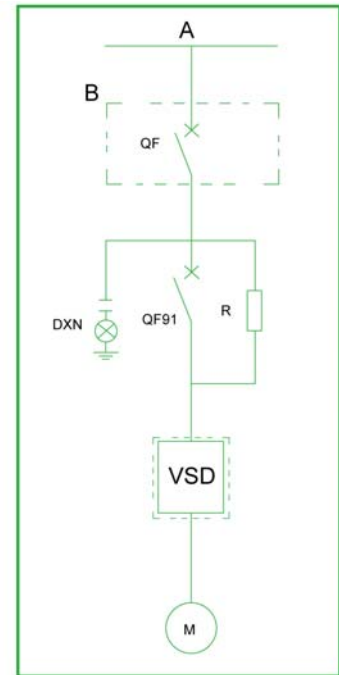
Cabinet Design

Structure introduction

The product is indoor box-type fixed A.C. metal-enclosed switchgear with body consisting of low-voltage compartment and main circuit compartment, and functional compartments are separated from each other by metal plate. The cabinet use interlock to achieve the function of opening the cabinet door after power-off. There is a pressure relief channel inside the cabinet, with a pressure relief device mounted on the top. In case of internal fault, gas pressure can be discharged from the exhaust dust for the pressure release. See the structure as shown below.

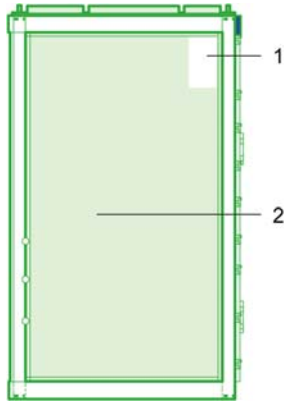


- 1 Handling device
- 2 Pressure relief cover plate for device compartments
- 3 Upper sealing plate of cabinet
- 4 Cabinet header
- 5 Busbar supporting insulator
- 6 Cabinet frame
- 7 Front top door of cabinet (for lowvoltage compartment)
- 8 Resistor
- 9 Front-middle door (for main circuit compartment)
- 10 Vacuum breaker or vacuum contactor
- 11 Insulating plate
- 12 Sensor
- 13 Busbar for load connection
- 14 Busbar for power connection
- 15 Front-lower door (for main circuit compartment)
- 16 Side sealing plate of cabinet frame
- 17 Rear sealing plate of cabinet frame
- 18 Main grounding busbar
- 19 Beam for cable fixing
- 20 Bottom sealing plate of cabinet frame



Compartments of the cabinet

- The Inrush Current Limitation cabinet compartment as shown below



- 1 Low-voltage compartment
- 2 Main circuit compartment

Standards

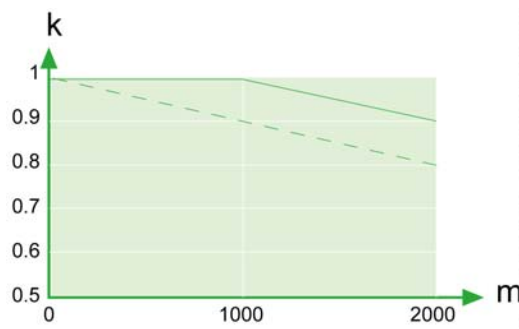
The product satisfies the below standards or the relevant articles specified in these standards. All the standards are valid versions.

Standard No.	Standard Name
GB3906-2006	A.C. metal-enclosed switchgear and Control Equipment for rated voltage above 3.6 kV and up to and including 40.5 kV.
GB/T11022-2011	General Technical Requirements for High-voltage AC Switchgear and Control Equipment Standards
GB1984-2003	High-voltage AC Circuit-breaker
GB/T14808-2001	High-voltage contactor and motor starter based on the contactor
GB4208-2008	IP Code of Enclosure Protection Level
GB/T311.6-2005	High Voltage Testing Technique
GB/T12325-2008	Power Quality Allowable Deviation of Supply Voltage
GB 12326-2008	Power Quality Voltage Fluctuation and Flicker
GB/T14549-1993	Power Quality Harmonics in Public Supply Network
GB/T 15543-2008	Power Quality Allowable Unbalance of Three-phase Voltage
IEC 62271-200	High-voltage switchgear and controlgear – Part 200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
IEC 60694	Corrigendum 1 – Common specifications for high voltage switchgear and controlgear standards
IEC 62271-100	High-voltage switchgear and controlgear – Part 100: High-voltage alternating-current circuit- breakers
IEC60470	High-voltage alternating current contactors and contactor-based motor-starters
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60445	Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals and of terminations of certain designated conductors, including general rules for an alphanumeric system

Ambient and Operating Conditions

Characteristics

Ambient air temperature	-10°C (lower limit)...+50°C (upper limit) With maximum daily temperature difference: 25K
Altitude	Not higher than 2000 m.
	When altitude is higher than 1000 m, the product current should be derated and used with a derated VSD and the derating standard is the same as that of the VSD.
	As a general rule, we have to derate by 1.25% Up every 100 m above 1000 m. This applies for the lightning impulse withstand voltage and the power frequency withstand voltage 50 Hz - 1 min.
Ambient relative humidity	Daily average value no more than 95% With monthly average value no more than 90%.
Pollution grade	Class II
Ambient air	Ambient air does not contain obvious pollutions like corrosive or flammable gas, and water vapor, without fire or explosion hazard or violent vibration.
Transportation and Storage temperature	In the range from -25°C to +55°C +70°C is allowable for a short time (no more than 24 hours).
	Under these limiting temperatures, no unrecoverable damage should be caused to the device which should be able to operate normally under normal conditions.



k Correction coefficient k
m Altitude in meters

NOTE: Contact manufacturer if the condition of the installation site is not within the specifications, special measures should be taken.

Technical Parameters

General Technical Data			
Voltage class	7.2kV, 12 kV		
Input frequency	50 / 60 Hz ±5%		
Rated current Rated dynamic current Rated thermal current/Time Rated breaking current	Rated current of equipment	Rated dynamic current	
		Major loop	Ground loop
	100 A	6.25 kA	5.4 kA
	160 A		
	250 A	10 kA	8.7 kA
	500 A	50 kA	43.5 kA
	640 A	80 kA	69.6 kA
	800 A		
	1000 A		
	Rated current of equipment	Rated thermal current/Time	
		Major loop	Ground loop
	100 A	2.5 kA/3 s	2.1 kA/2 s
	160 A		
	250 A	4 kA/3 s	3.5 kA/2 s
	500 A	20 kA/4 s	17.4 kA/2 s
	640 A	31.5 kA/4 s	27.4 kA/2 s
	800 A		
	1000 A		
	Rated current of equipment	Rated breaking current	
100 A	2.5 kA		
160 A			
250 A	4 kA		
500 A	20 kA		
640 A	31.5 kA		
800 A			
1000 A			
Rated insulating level	Voltage class of the equipment	Power frequency withstand voltage (effective value)	Lightning impulse withstand voltage (peak value)
	7.2 kV	30 kV/1 min	60 kV
	12 kV	42 k/1 min	75 kV
Control source	220 VAC		
Protection level	IP31, IP41, IP42		
Paint color	<ul style="list-style-type: none"> ● Standard: RAL7032 ● Optional: other RAL standard colors 		
Overall dimensions	2320 mm (height) X 1200 mm (width) X 1400 mm (depth)		
Package size	2500 mm (height) X 1300 mm (width) X 1600 mm (depth)		
Weight	<ul style="list-style-type: none"> ● Net weight: 450 kg ● Gross weight (including package): 500 kg 		

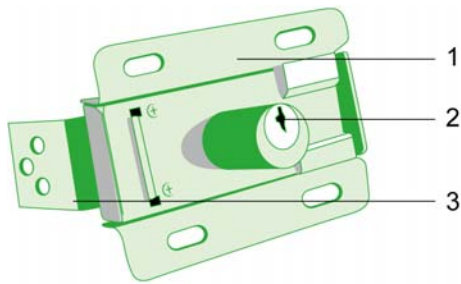
Inrush Current Limitation Cabinet Feature

Function of inrush current limitation cabinet.

Since the VSD system is equipped with a transformer and a great number of electrolytic capacitors inside, the inrush current can be 6-10 times the rated current at the beginning of the MV power on. The vacuum breaker/contactator and resistor in the inrush current limitation cabinet are specially designed to limit the inrush current, which will be less than 1.6 times of VSD rated current during MV power on.

- Reduce the impulse on the rectifying circuit upon energizing to improve the reliability and availability of VSD.
- Reduce the impulse on the power supply system upon energizing, in order to avoid the voltage dip upon energizing and disturb to other devices that properly operate within the power supply system.

Mechanical interlock



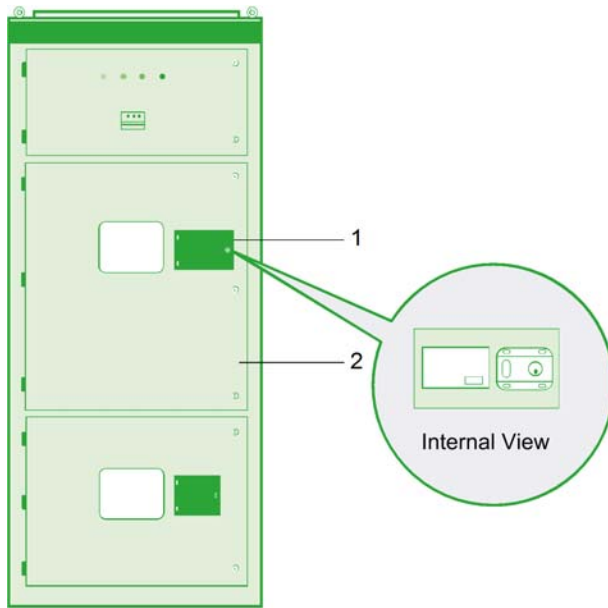
- 1 Mechanical interlock
- 2 Key to mechanical interlock
- 3 Interlocking device

Functions:

It acts as an interlock mechanism between the inrush current limitation cabinet door and the main lock of the key box of VSD. Only when the key to the interlock from the grounding switch of the upstream MV switchgear is inserted into the key-box of VSD's mechanical interlock, use a captive key can open the inrush current limitation cabinet door, thus ensuring that the inrush current limitation cabinet is kept in Power Off during maintenance process.

Installation position:

It is installed on the middle front door of the inrush current limitation cabinet, with two positions including "Key-Locked" and "Key-Free".

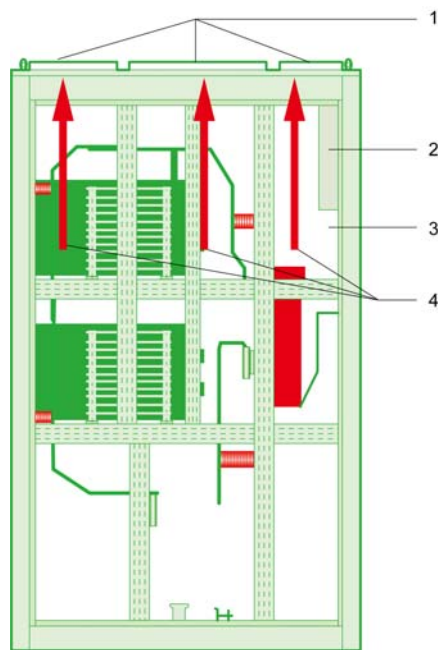


- 1 Installation site of the mechanical interlock
- 2 Front middle door of cabinet

Position	Key-Locked	Key-Free
Definition	It means that the mechanical interlock of the inrush current limitation cabinet door is opened, the key cannot be taken down and the inrush current limitation cabinet door can be opened.	It means that the mechanical interlock of the inrush current limitation cabinet door is locked, the key can be taken down and the inrush current limitation cabinet door cannot be opened.

Compartments and pressure relief channels

The inrush current limitation cabinet is set with two compartments, including low voltage compartment and main circuit compartment. The main circuit is provided with a pressure relief channel, when there is high-pressure gas generated in the inrush current limitation cabinet due to arcing, pressure can be released from the top of the inrush current limitation cabinet via the independent pressure relief channel.



- 1 Cover plate of pressure relief
- 2 Low-voltage compartment
- 3 Main circuit compartment
- 4 Pressure relief device channel

Content of Nameplate

Item	Abbreviation	Unit
Manufacturer	-	-
Type designation	-	-
Serial number	-	-
Year of manufacture	-	-
Applicable standard	-	-
Rated voltage	U_r	kV
Rated frequency	f_r	Hz
Rated lightning impulse withstand voltage	U_p	kV
Rated power frequency withstand voltage	U_d	kV
Rated normal current	I_r	A
Protection level	-	-
Rated short-time withstand current	I_k	kA
Rated peak withstand current	I_p	kA
Rated duration of short circuit	t_k	s

Disposal After Service Life

Waste equipment after service life should be disposed as per the local regulations and requirements.

Chapter 3

Packaging, Transportation and Storage

What Is in This Chapter?

This chapter contains the following topics:

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Packaging

Packaging for the cabinet should be adjusted as per specific circumstances; for example, cartons or wooden cases may be used. Especially for transportation by sea, the cabinet should be enclosed by plastic film bag as well even when it is packed in the container. Suitable drying agent should be packed with the product to prevent the product from being affected with damp. The equipment for export is equipped with a vacuum package.

Transportation

A transportation unit may be a single cabinet or a set of several cabinets which will be connected with each other and then fixed on a transportation base. The cabinet should be kept vertical during transportation and safety measures should be also taken to protect personnel and equipment.

⚠ WARNING

RISK OF LIFTING AND HANDLING

- Lifting and handling must be done by the qualified personnel in accordance with the requirements of the site and the equipment as well as the local relevant regulations.
- Suitable lifting and handling tools must be used and measures must be taken to avoid inclination.
- Forbid standing the working scope of lifting and handling tools.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Fig: Lifting and handling



Storage

This product should be stored as per the following regulations:

- The storeroom should be kept dry and well-ventilated.
- The temperature should be not less than -25 °C and there should not be any other harmful environmental effects.
- The cabinet should be stored vertically and no stacking is allowed.
- The package should not be removed or damaged.
- The unpackaged cabinet should be covered by a plastic film loosely to avoid being contaminated; ventilation should be kept to prevent corrosion.
Regular condensation inspection should be carried out until installation begins.

Chapter 4

Access Main Circuit Compartment

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Safety Measures and Important Information	28
Access Each Compartment	29
Access into Low-voltage Compartment	30

Safety Measures and Important Information

Before entering the compartment, the operator should carefully read this manual and follow the relevant regulations in Chapter “*Safety Information*” in this manual (*see page 5*). The operator must wear PPE, and verify that the power is Off before operation.

WARNING

HAZARD OF UNEXPECTED EQUIPMENT OPERATION

- National standards, industrial standards, local safety regulations and operating instructions in this manual must be strictly followed.
- Operation must be done by qualified personnel.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTICE

UNGUARDED MECHANICAL HAZARD

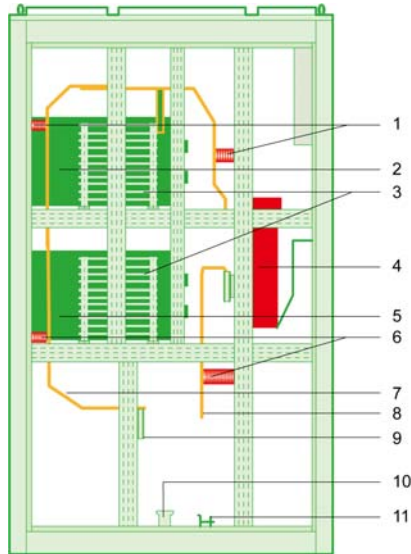
This switchgear maintenance is implemented by opening the front door. The front-middle door has a close mechanical interlocking with the cabinet. The cabinet door can be opened after unlocking.

Failure to follow these instructions can result in equipment damage.

Access Each Compartment

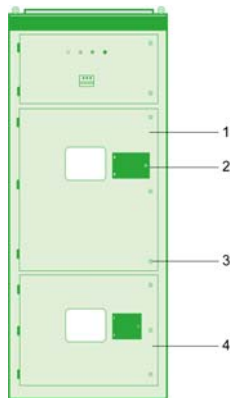
MV compartment

The MV vacuum switch, resistor, connection busbar for main circuit, busbar supporting MV stand-off and sensor are installed in the MV compartment. The flame resistant materials are used between resistors, or the resistor and MV vacuum switch for separation.



- 1 Busbar supporting MV stand-off
- 2 Insulating plate of flame resistant materials
- 3 Resistor
- 4 Medium-voltage vacuum switch
- 5 Insulating plate of flame resistant materials
- 6 Busbar supporting MV stand-off
- 7 Busbar to connecting power
- 8 Busbar to connecting load
- 9 Sensor
- 10 Beam for cables fixing
- 11 Main grounding busbar

Access into MV compartment

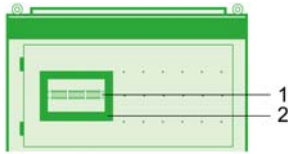


- 1 Front- middle door
- 2 Mechanical interlock
- 3 Cabinet door lock
- 4 Front-lower door

Step	Action
1	Power off the upstream power supply of inrush current limitation cabinet and confirm power is off.
2	Take the key to the interlock of the grounding switch of upstream MV switchgear to insert it into the captive lock of the VSD, and take a free key insert the inrush current limitation cabinet door lock to release interlocking.
3	Use the special tool to open the middle-front door.
4	Use the special tool to open the lower -front door to enter into the MV compartment.

Access into Low-voltage Compartment

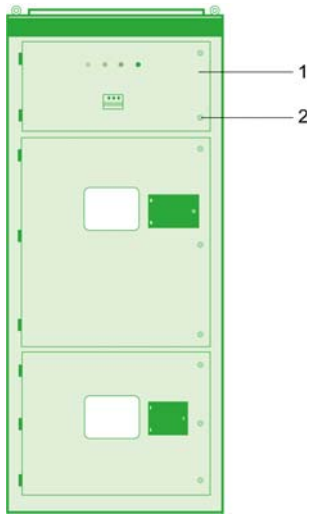
Low-voltage compartment



- 1 Terminal blocks
- 2 Wiring duct

The terminal blocks and wiring duct are installed in the low-voltage compartment for the connection of external control cables.

Access into low-voltage compartment



- 1 Front-upper door
- 2 Cabinet door lock

Use the dedicated key to open the front upper door, then enter into the low-voltage compartment.

Chapter 5

Electrical Wiring

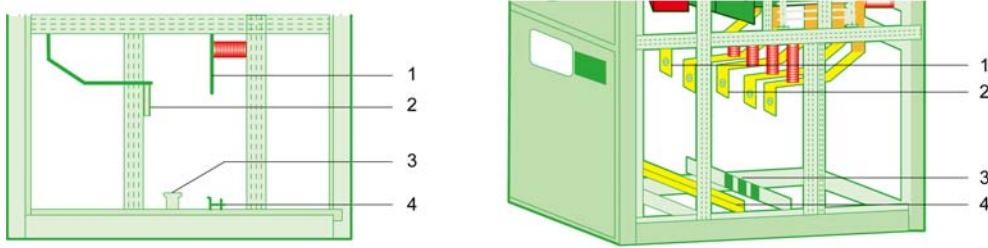
What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
High Voltage Cable Connection	32
Low-voltage Cable Connection	33
Grounding	34

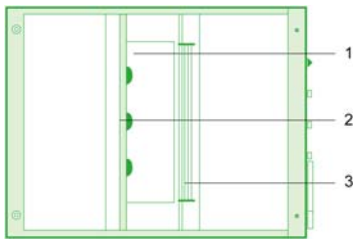
High Voltage Cable Connection

There are 2 sets of high-voltage cables in the main circuit compartment to be connected: including input cable from power supply, cable to load (VSD), which must be connected following the markings.



- 1 Branch busbar to cable of the VSD
- 2 Branch busbar to power supply
- 3 Beam for cable fixing
- 4 Main grounding busbar

The baseplate at the cable entry is a removable aluminium plate for easy onsite installation. Open proper size hole to fit diameter of the cable to prevent small animals go inside. Fireproofing mud or epoxy resin is needed for sealing the holes.



- 1 Removable aluminium plate at cable entry
- 2 Cable fixing beam
- 1 Main grounding busbar

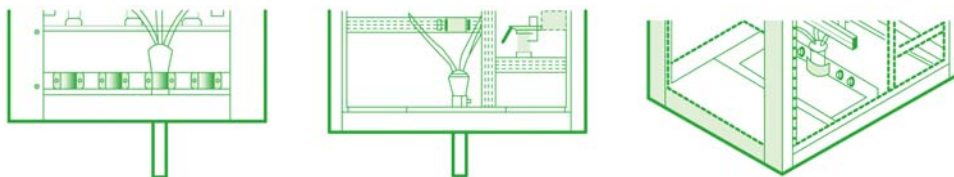
NOTICE

DESTRUCTION DUE TO INCORRECT WIRING

Before connecting high voltage cables to the terminals, the cables must be fixed as the figure shown below, in order to avoid mechanical stress from the weight of cables.

Failure to follow these instructions can result in equipment damage.

The grounding wires of cable must be fixed to grounding busbar of the cabinet.

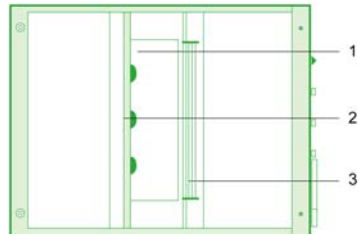


Cable must be connected in accordance with the cable construction requirements of national and local standards and regulations. The following procedures are only for reference:

Step	Action
1	Strip off the high voltage cables according to actual length, from bottom plate to terminals.
2	Connect cable terminal as specified in the instruction book provided by material supplier of cable terminal.
3	Open a proper size hole on the aluminum plate to fit the diameter of cable terminal.
4	Put the cable through the aluminum plate and clamp the cable with a cable clamp on the beam.
5	Install the aluminum plate and connect cable to the terminal.

The connecting bolt must be tightened with a torque spanner, with the torque value specified in **Annex A** (see page 51).

Low-voltage Cable Connection



- 1 Removable aluminium plate at cable entry
- 2 Cable fixing beam
- 1 Main grounding busbar

Step	Action
1	<p>Connect the low-voltage control cable to the terminal block of the low-voltage compartment as per the electrical wiring drawing. The control cable is laid as the figure shown below.</p> <ul style="list-style-type: none"> 1 Wiring duct 2 Left frame column of cabinet 3 Control cabinet 4 Cable fixing beam 5 Removable aluminium plate
2	<p>Cable should be connected in accordance with the cable construction requirements of national and local standards and regulations. The following procedures are only for reference:</p> <ul style="list-style-type: none"> ● Open a proper size hole on the aluminum plate to fit the diameter of low voltage cables; ● Put the cable through the aluminum plate, fix the cable with a cable clamp and then install the aluminum plate; ● Put the control cable into the vertical slot of the left frame of the cabinet; ● Strip off the low voltage cables according to actual length, put it into the vertical slot of low voltage department; ● Connect the low voltage cable with the corresponding terminal on the terminal block as per the electrical wiring drawing delivered with the equipment.
3	<p>The connecting screw must be tightened, with the torque value specified in Annex A (<i>see page 51</i>)</p>

Grounding

The main grounding busbar of the cabinet must be connected with the grounding grid of the power distribution room by using cable. The grounding cable go through the removable aluminum plate to directly connect to the main grounding busbar by M12 bolt, with the tightening torque value specified in ***Annex A*** (*see page 51*).

Chapter 6

Commissioning

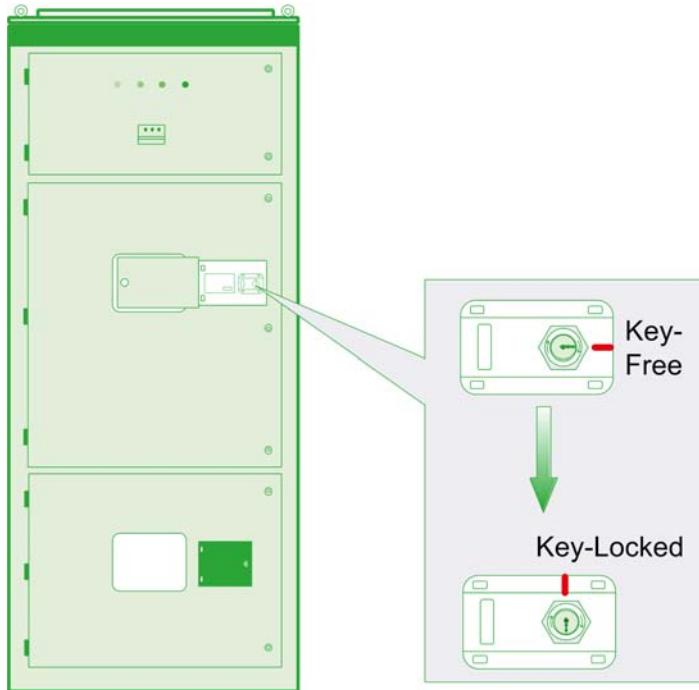
What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Functional Test of Interlock	36
Functional Test of Vacuum Switch, Switch On/ Switch Off	37

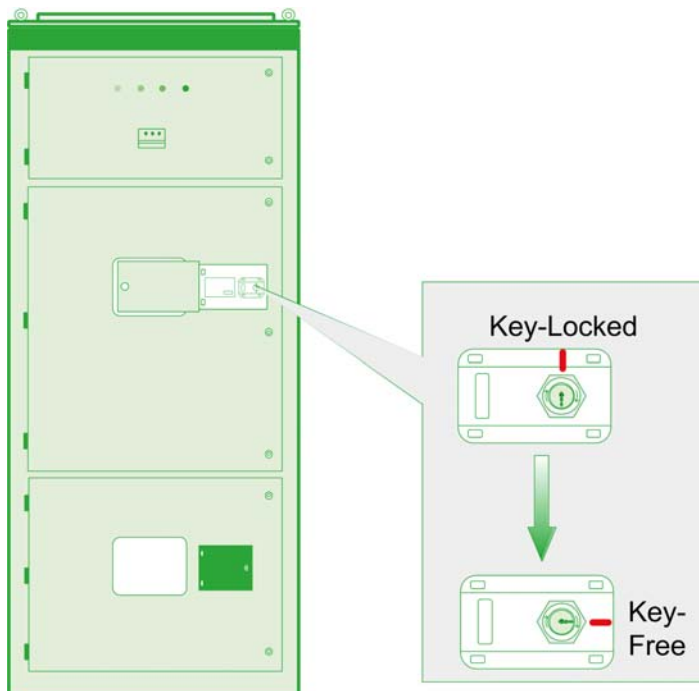
Functional Test of Interlock

Interlock at "Key-Locked" position



- Put the key of interlock into the interlock hole and rotate 180° to the "Key-Locked" position by anticlockwise to open the front middle door, but the key of interlock cannot be pulled out.
- The front lower door can be opened only after the front middle door is opened.

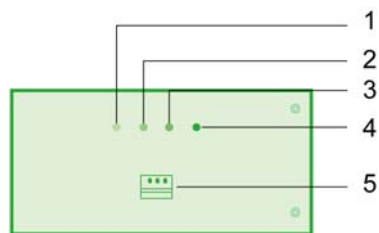
Interlock at "Key-Free" position



- Close the front lower door and front middle door successively. Rotate 180° to the "Key-Free" position by clockwise, the front middle door cannot be opened, but the key of interlock can be pulled out.
- The front lower door cannot be opened after the front middle door was closed.

Functional Test of Vacuum Switch, Switch On/ Switch Off

Vacuum breaker Switch On/ Switch Off function test



- 1 Energy storing switch (**SF**)
- 2 Energy storing indicator (**P93**)
- 3 Closed indicator (**P91**)
- 4 Opened indicator (**P92**)
- 5 Live display

Energy storing

- Power on the control circuit, and rotate **SF** energy storing switch (from “Key-Locked” to “Key-Free”) to run the energy storing motor of vacuum breaker and light **P93** energy storing indicator, thus completing the energy storing.

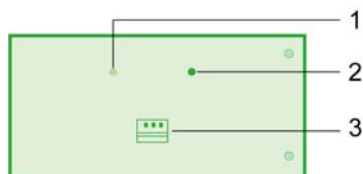
Switch On operation

- Power on the control circuit, the VSD will send out switching on command to vacuum breaker, and light **P91** closed indicator, switch on operation is completed.

Switch Off operation

- Power on the control circuit, the VSD will send out switching off command to vacuum breaker, and light **P92** opened indicator, switch off operation is completed.

Vacuum contactor Switch On/ Switch Off function test



- 1 Closed indicator (**P91**)
- 2 Opened indicator (**P92**)
- 3 Live display

Switch On operation

- Power on the control circuit, the VSD will send out switching on command to vacuum contactor, and light **P91** closed indicator, switch on operation is completed.

Switch Off operation

- Power on the control circuit, the VSD will send out switching off command to vacuum contactor, and light **P92** opened indicator, switch off operation is completed.

Chapter 7

Operation

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Operation for Cabinet Doors	40
Power-on Operation	41
Power off operation and maintenance	43
Switch On/Switch Off MV Vacuum Switch	44

Operation for Cabinet Doors

Low-voltage compartment door (front-top door of the cabinet)

The low-voltage compartment door is directly connected with the pillar of the cabinet by use of hinge and door lock. The cabinet door can be opened or closed when the door lock is opened with a special tool.

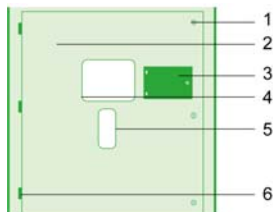


- 1 Low-voltage compartment (front-upper door)
- 2 Cabinet hinge
- 3 Cabinet door lock

The low-voltage compartment door is installed with live indication device and signal Indicator. When the vacuum breaker is equipped, the low-voltage compartment door is also provided with energy storing switch, energy storing operation is available to the vacuum breaker, and the working status can be observed. For details refer to **“Vacuum Breaker Switch On/Switch Off Function Test”** (see page 37)

Main circuit compartment door (front-middle door)

The main circuit compartment door is directly connected with the pillar of the cabinet by use of hinges and door locks. On the door there is sight glass, lighting device, mechanical interlock and Single line drawing.



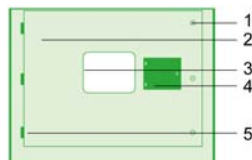
- 1 Cabinet door lock
- 2 Main circuit compartment door (front -middle door)
- 3 Lighting device and interlock
- 4 Sight glass
- 5 Single line drawing
- 6 Hinge

The lighting device and mechanical interlock are equipped with a small door which can be opened with the special key to the small door. The following operation is available:

- Switch on the lighting device and the internal condition of the main circuit compartment can be observed through the sight glass on the door.
- Put the key insert interlock hole and rotate it to “Key-Locked” or “Key-Free” position, then the cabinet door can be opened or not.

Main circuit compartment door (front-lower door)

The main circuit compartment door is directly connected with the pillar of the cabinet by use of hinges and door locks. On the door there are sight glass, lighting device.



- 1 Cabinet door lock
- 2 Main circuit compartment door (front-lower door)
- 3 Sight glass
- 4 Lighting device
- 5 Hinge

The lighting device is equipped with a small door which can be opened with the special key to the small door. Then switch on the lighting device and the internal condition of the main circuit compartment can be observed through the sight glass on the door.

Power-on Operation

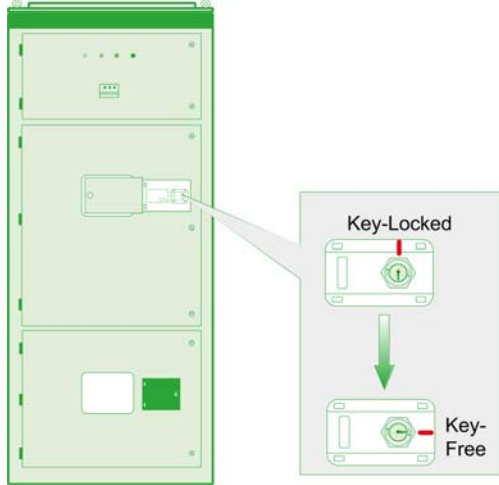
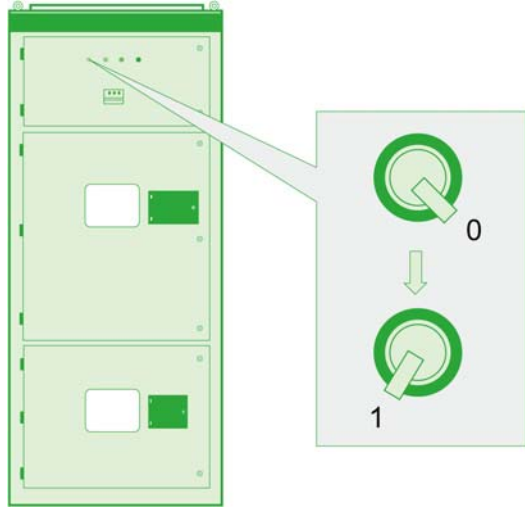
Power-On Operation

⚠ WARNING

HAZARD OF UNEXPECTED EQUIPMENT OPERATION

- National standards, industrial standards, local safety regulations and operating instructions in this manual must be strictly followed.
- Operation must be done by qualified personnel.
- The relevant regulations in Chapter "**Safety Information**" of this manual must be followed (*see page 5*).
- All cabinet doors must be closed and locked before power-on operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
1	<p>Close the lower-front door and middle-front door. Rotate the interlock key 180° clockwise to "Key-Free" position and pull it out, then insert into the key box of VSD.</p> 
2	<p>Use the special tool of cabinet door to lock the door up, making it closed completely.</p>
3	<p>Power on the control circuit, and rotate the energy storing switch from "Switch Off" to "Switch On" position, achieving energy storing of the vacuum breaker.</p>  <p> 0 Switch Off 1 Switch On </p>

Step	Action
4	Switch on the upstream breaker, and power on the control circuit. The current go through the resistor, and can be limited at the beginning of switching on; when the current is reduced, the VSD sends out switch on command to the vacuum breaker of cabinet, to short-circuit the resistors. Then the current go through the vacuum breaker and VSD is powered directly from power supply.
5	The vacuum breaker will re-do energy storing again automatically.

Power off operation and maintenance

Power off Operation and Maintenance

WARNING

HAZARD OF UNEXPECTED EQUIPMENT OPERATION

- National standards, industrial standards, local safety regulations and operating instructions in this manual must be strictly followed.
- Operation must be done by qualified personnel.
- The relevant regulations in Chapter "**Safety Information**" of this manual must be followed (*see page 5*).
- Before inspection operation, it shall be ensure that there is no any residual voltage in the main circuit and control circuit of inrush current limitation cabinet.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
1	Power off the upstream MV circuit breaker, close the grounding switch of upstream MV switchgear, and take out the interlock key.
2	Insert the interlock key into captive lock of the VSD's key-box.
3	Take a captive key to release the interlocking of inrush current limitation cabinet door.
4	Use the special tool to open the middle-front door and lower-front door.
5	Connect the temporary grounding cables for maintenance.

NOTE: Install the temporary grounding cable and follow all local and national electrical code requirements as well as all other applicable regulations, including but not limited to the section "**Temporary grounding**" (*see page 12*) of this manual

Switch On/Switch Off MV Vacuum Switch

Working status of MV vacuum circuit breaker

Name	Working condition	
MV Vacuum circuit breaker	I	O

Close: I

Open: O

Operation for vacuum contactors:

The energy storing command of vacuum circuit breaker is sent out by the energy storing switch which on the low-voltage compartment door and the switch on command is sent out by the VSD automatically.

NOTE: For details refer to *"Functional Test of Vacuum Switch Switch On/ Switch Off"* in this manual (see page 37).

Chapter 8

Maintenance

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Safety Requirements	46
Maintenance Plan	47
Cleaning	49
Condensation/Corrosion Prevention	49
Replacement of Components and Cabinet	49

Safety Requirements

Maintenance personnel

- Only those who are qualified as well as are familiar with and understand the content in this manual and any other relevant product document are allowed to operate and use this product. Additionally, these people must accept safety training and be able to recognize and avoid involved hazards. These people must be provided with technical training, have knowledge and experience and be capable of foreseeing and detecting potential risks due to usage of this product or the mechanical, electrical/electronic equipment of this product or change of the settings.
- All the personnel that operate and use this product must be very familiar with all the applicable standards, instructions and accident prevention regulations.

Safety protection

- Maintenance personnel must apply appropriate personal protective equipment (PPE).
- Maintenance must be performed by at least two people, one for operation and the other for supervision; operation by a single person is prohibited.
- Necessary instruments and safety protection equipments for maintenance must pass quality inspection.

Maintenance

- Take necessary measures during maintenance as follow:
 - open the upstream main circuit breaker,
 - make sure the high voltage live indicator is OFF,
 - Close the grounding switches per the anti-misoperation,
 - put up warning label at the same time to avoid Power on by others during maintenance.
- Always use a properly rated voltage sensing device to verify that the high/low power is Off. Apply personal protective equipment (PPE) and use electroscope with the corresponding high voltage level (with good quality) to verify live parts.
- Make three-phase input terminals short circuited and grounded after confirming there is no power (to prevent unexpected power on) and connect grounding cable for each power source which may realize Power on of the equipment.
- For installation of the grounding cable, first connect the grounding terminal and then the input terminals, which is on the contrary to the sequence of removing the grounding cable. Apply personal protective equipment (PPE) during installation and removal of grounding cables.
- Install the grounding cable at a place visible to workers at any time and put up a warning label “**Do Not Dismantle!**” at the place of the grounding cable.

Maintenance Plan

Maintenance purpose

- The maintenance aims to maximize its service life. The below related work should be completed.
 - Inspection: Confirmation for the actual operation state
 - Service: Measure for keeping the specified operation state
 - Repair: Measure for regaining the specified operation state
- Inspection and service intervals (maintenance intervals) of some equipment/components (like wear-out parts) depend upon running time, operation frequency, and times of breaking by short-circuit fault. The maintenance intervals of some other components are determined by specific working, load, and environmental influence (including pollution and corrosive air).

NOTE: If necessary, our service personnel may provide assistance in maintenance of the cabinet.

Inspection and service

Inspection work includes (but is not limited to) the below items:

Step	Action
1	Check if the product is normal or affected by dust or other environmental factors.
2	Check the functions of product as well as control, interlocking, protection, signal, and other devices.
3	Check if the bolts of the busbar and the grounding system are tightened.
4	Make sure there is no external electric discharge phenomenon on the appearance of the equipment under the operating voltage, which can be confirmed through noise, peculiar smell, and arc flash.

Basic service and inspection are necessary, it is including:

Step	Action
1	When the device is found to be dirty (if in tropical climate, salt, mould, insects or conductive particles which are under frequent condensation may result in pollution), it (especially the surface of an insulating material) should be cleaned. Dust with a small adhesive force should be wiped away with a dry soft cloth. Viscous/greasing dirt should be wiped away with a soft cloth which is dipped into mild alkaline domestic detergent. Then clean with fresh water and dry. For insulating materials and seriously polluted components, halogen-free detergent should be used.
2	If there is an external electric discharge phenomenon, please contact us in time.
3	Movable contact surfaces of the product (like operating mechanism and contact of isolating switch) should be completely cleaned and coated with lubricant again.
4	When the product runs under abnormal conditions (including adverse climatic conditions) or is affected by harmful environmental factors (serious pollution and corrosive air), inspection and service intervals should be shortened.

Maintenance intervals

In the following table, the inspection and maintenance intervals which a factory needs to follow are listed. Maintenance in compliance with this plan may reduce the possibility of power off.

Task / Description	Intervals * [year]																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Starting up	S																				
Component aging																					
Vacumm circuit breaker		T	T	T	T	T	T	T	T	T	R	T	T	T	T	T	T	T	T	T	R
Vacuum contactor		T	T	T	T	T	T	T	T	T	R	T	T	T	T	T	T	T	T	T	R
Resistor		T	T	T	T	T	T	T	T	T	R	T	T	T	T	T	T	T	T	T	R
Live display		T	T	T	R	T	T	T	R	T	T	T	R	T	T	T	R	T	T	T	R
Indicator		T	T	T	R	T	T	T	R	T	T	T	R	T	T	T	R	T	T	T	R
Surroundings and cables																					
Cable connection (input/output)		T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Oxidation, corrosion, and dust		T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Temperature and humidity		T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Lubrication		T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Measurement & Test																					
Isolation measurement		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Electrical testing		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Spare parts		T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T

R: Replacement of components

T: Inspection (perform modification and/or replacement work according to inspection results)

S: Site service (commissioning, measurement, testing)

The intervals in the above table are recommended intervals under normal environmental conditions.

If the isolating switch or vacuum contactor operates in environmental conditions worse than the above, the interval should be shortened.

*) since commissioning date

Cleaning

When cleaning is done as per inspection and service requirements, trichloroethane, trichloro ethylene or tetrachloromethane is prohibited.

Condensation/Corrosion Prevention

The cabinet's environmental and operating conditions should meet the requirements in this manual. Usage out of specified environmental and operating conditions is prohibited.

Replacement of Components and Cabinet

For replacement of components and cabinet, please contact us.

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Chapter 9

Annex A

Tightening Torque Values

Bolt size	Carbon steel bolt		Copper bolt	
	N.m	lb.in	N.m	lb.in
M2.5	0.36	3.2	0.180	1.6
M3	0.63	5.6	0.315	2.8
M4	1.5	13.3	0.76	6.7
M5	3.00	26.6	1.5	13.3
M6	5.2	46	2.6	23
M8	12.5	111	6.2	55
M10	24.5	217	12.5	111
M12	42	372	21	186
M14	68	602	34	301
M16	106	938	53	469

- 1 N.m = 1 00 CN.m
- The maximum deviation of the torque applied should not exceed $\pm 10\%$.

