

ABB wind turbine converters

# Supplement ACS800-67 slide-out frame (+P919)



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# List of related manuals

## ACS800-67 manuals

## Code (English)

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<i>ACS800-67 wind turbine converters for asynchronous slip ring generators hardware manual</i>	<a href="#">3AFE68392454</a>
<i>ACS800-67 wind turbine converters system description and start-up guide</i>	<a href="#">3AUA0000095094</a>

## Firmware manuals

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<i>ACS800 IGBT supply control program firmware manual</i>	<a href="#">3AFE68315735</a>
<i>ACS800 grid-side control program firmware manual</i>	<a href="#">3AUA0000075077</a>
<i>ACS800-67(LC) doubly-fed induction generator control program firmware manual</i>	<a href="#">3AUA0000071689</a>

## Option manuals

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*Manuals for fieldbus adapters, etc.*

You can find manuals and other product documents in PDF format on the Internet. See section [Document library on the Internet](#) on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

# Supplement

ACS800-67 slide-out frame (+P919)

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1. Safety instructions





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## 1

# Safety instructions

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## What this chapter contains

This chapter contains safety instructions which you must follow when installing, operating and servicing the slide-out frame of the ACS800-67 wind turbine converter. For the complete safety instructions, see *ACS800-67 wind turbine converters for asynchronous slip ring generators hardware manual* [3AFE68392454 (English)]. If ignored, physical injury or death may follow, or damage may occur to the converter, the generator or driven equipment. Read the safety instructions before you work on the slide-out frame.

## Use of warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment, and advise on how to avoid the danger. Notes draw attention to a particular condition or fact, or give information on a subject. The warning symbols are used as follows:



**Electricity warning** warns of hazards from electricity which can cause physical injury and/or damage to the equipment.



**General warning** warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.



**Electrostatic sensitive devices warning** warns of electrostatic discharge which can damage the equipment.



**Hot surface warning** warns about hot surfaces. Some parts inside the converter cabinet remain hot for a while after the disconnection of main power.

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## Safety in installation and maintenance

### ■ Electrical safety

These warnings are intended for all who work on the slide-out frame of the ACS800-67 wind turbine converter.

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**WARNING!** Ignoring the instructions can cause physical injury or death, or damage to the equipment:

- Only qualified electricians are allowed to install and maintain the slide-out frame of the ACS800-67 wind turbine converter.
  - Obey the local wind turbine manufacturer's instructions.
  - Do not work on the control cables when main power is applied to the converter or to the external control circuits. Externally supplied control circuits (eg, UPS) may carry dangerous voltage even when the main power of the converter is switched off.
  - Live parts inside the cabinet are protected against direct contact. However, pay special attention when handling metallic shrouds.
  - Depending on the external wiring, dangerous voltage (115 V or 230 V) may be present on the relay outputs of the converter system.
- 



### ■ General safety



**WARNING!**

- Beware of hot surfaces. Some parts inside the converter cabinet, such as charging resistor, remain hot for a while after the disconnection of main power.
- Pay attention to rotating cooling fans. The cooling fans may continue to rotate for a while after the disconnection of the electrical supply.
- Make sure that dust from drilling does not enter the cabinet when installing. Electrically conductive dust inside the cabinet may cause damage or lead to malfunction.

### Printed circuit boards

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**WARNING!** The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily.

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### Fiber optic cables

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**WARNING!** Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt. The minimum allowed bend radius is 35 mm (1.38 in.).

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## Safe start-up and operation

### ■ General safety

These warnings are intended for all who plan the operation or operate the converter. Ignoring the instructions can cause physical injury or death or damage to the equipment.

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#### **WARNING!**

- Do not operate breakers, contactors, switches or other equipment inside the cabinet when the power is applied. Electric shock may occur also in case of faulty component.
  - Do not stand behind the converter cabinet when the power is applied. In the event of possible arc inside the cabinet the arc fumes and pressure exit through the backside filters.
  - Keep the converter doors locked when the converter is in operation.
- 



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# 2

## Introduction to the supplement

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### What this chapter contains

This chapter describes the intended audience and contents of the supplement.

### Target audience

This supplement is intended for people who work on the slide-out frame (option +P919) of the ACS800-67 wind turbine converter. Read the supplement before working on the slide-out frame. For other instructions, see *ACS800-67 wind turbine converters for asynchronous slip ring generators hardware manual* [3AFE68392454 (English)]. The reader of the supplement is expected to know the standard electrical wiring practices, electronic components and electrical schematic symbols.

### Purpose of the supplement

This supplement describes the operation and gives maintenance instructions for the slide-out frame of the ACS800-67 wind turbine converter.

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## Contents of the supplement

The chapters of this supplement are briefly described below.

*Safety instructions* gives safety instructions for the installation, operation and maintenance of the slide-out frame of the ACS800-67 wind turbine converter.

*Operation principle and hardware description* describes the operation and construction of the slide-out frame.

*Preventive maintenance* contains preventive maintenance instructions for periodical maintenance.

## Related documents

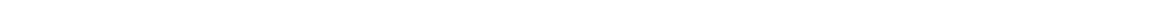
See *List of related manuals* inside of the front cover.

## Categorization by option code

The instructions and data which concern only certain optional selections are marked with plus codes (eg, +P919). The options included in the delivery can be identified from the plus codes visible on the type designation label.

## Terms and abbreviations

Term/Abbreviation	Explanation
AMC	Application and Motor Controller Board. Part of the NDCU Drive Control Unit
APBU	Optical branching unit for fiber links that use the PPCS protocol. The unit is used for connecting parallel-connected converter modules to the RDCU/NDCU.
Auxiliary control cubicle (ACU)	The cubicle with auxiliary devices such as auxiliary voltage circuit breakers, control electronics, measurement boards, etc. The slide-out frame is located in the auxiliary control cubicle.
Converter	Converts electric power from one form to another.
DDCS	Distributed Drives Communication System. Communication protocol used with fiber optic link.
DTC	Direct Torque Control
EMC	Electromagnetic compatibility
Grid-side converter	A converter that is connected to the electrical power network (grid) and is capable of transferring energy from the converter DC link to the grid and vice versa. The grid-side converter is also called ISU.
NAMU	Auxiliary Measuring Unit. Performs voltage measurement for IGBT supply unit RMIO board.
NCAN	CANopen® Adapter Module
NDCU	Drive Control Unit. Consists of a AMC board and NIOC board built into a metal housing. NDCU unit controls the rotor-side converter.
NDNA	DeviceNet™ Adapter Module
NETA	Ethernet Adapter Module
NIOC	Input/Output Board. Part of the NDCU Drive Control unit
NPBA	Profibus-DP® Adapter Module
NTAC	Pulse Encoder Interface Module
NUIM	Voltage and Current Measurement Unit. Performs voltage and current measurement for AMC board.
Power cabinet	Cubicle with grid and stator cable terminals, main switching and disconnecting devices, etc.
PPCS	Power Plate Communication System. Communication protocol used with optic fiber link which controls the power stage of the converter modules.
RDCO	DDCS Communication Option with optic fiber channels
RDCU	Drive Control Unit which contains an RMIO (Motor Control and I/O) board. An RDCU unit controls the grid-side converter.
RMIO	Motor Control and I/O Board. Part of the RDCU Drive Control Unit
Rotor-side converter	A converter that is connected to the generator rotor and controls its operation. The rotor-side converter is also called the inverter unit or INU.
UPS	Uninterruptible power supply





# 3

## Operation principle and hardware description

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### What this chapter contains

This chapter contains the hardware and functional description of the slide-out frame of the ACS800-67 wind turbine converter.

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## General

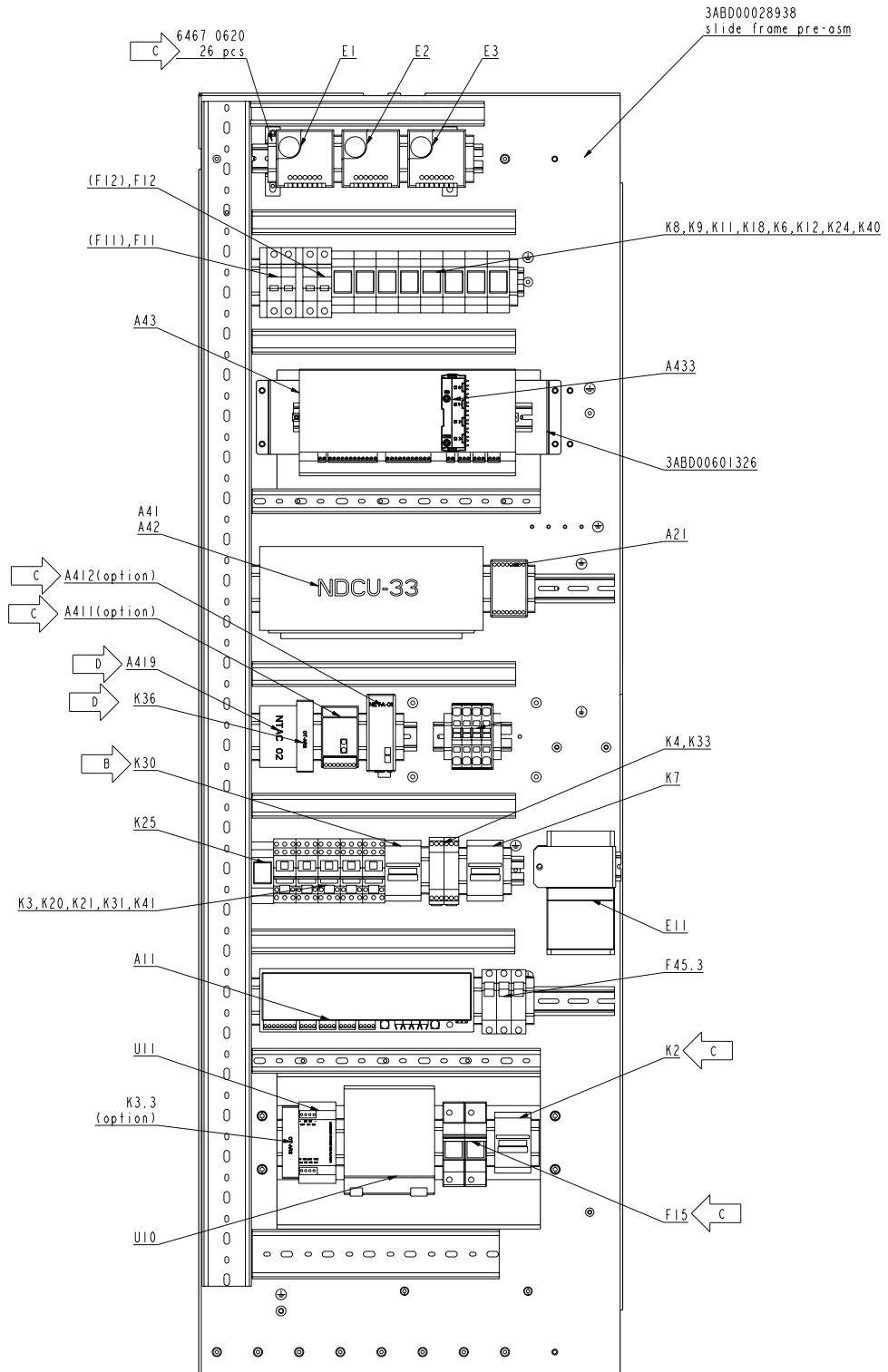
Slide-out frame is located in the auxiliary control unit (ACU) in ACS800-67 wind turbine converter cabinet (see the figure below). Slide-out frame contains heating, control, communication and power supply circuits.

Control logic consists of controller boards, relays, contactors and communication devices. Communication devices provide communication between different parts of the wind turbine converter and upper logic circuits. Heating and cooling circuit comprises heater, thermostats, hydrostat, relays and controller boards.



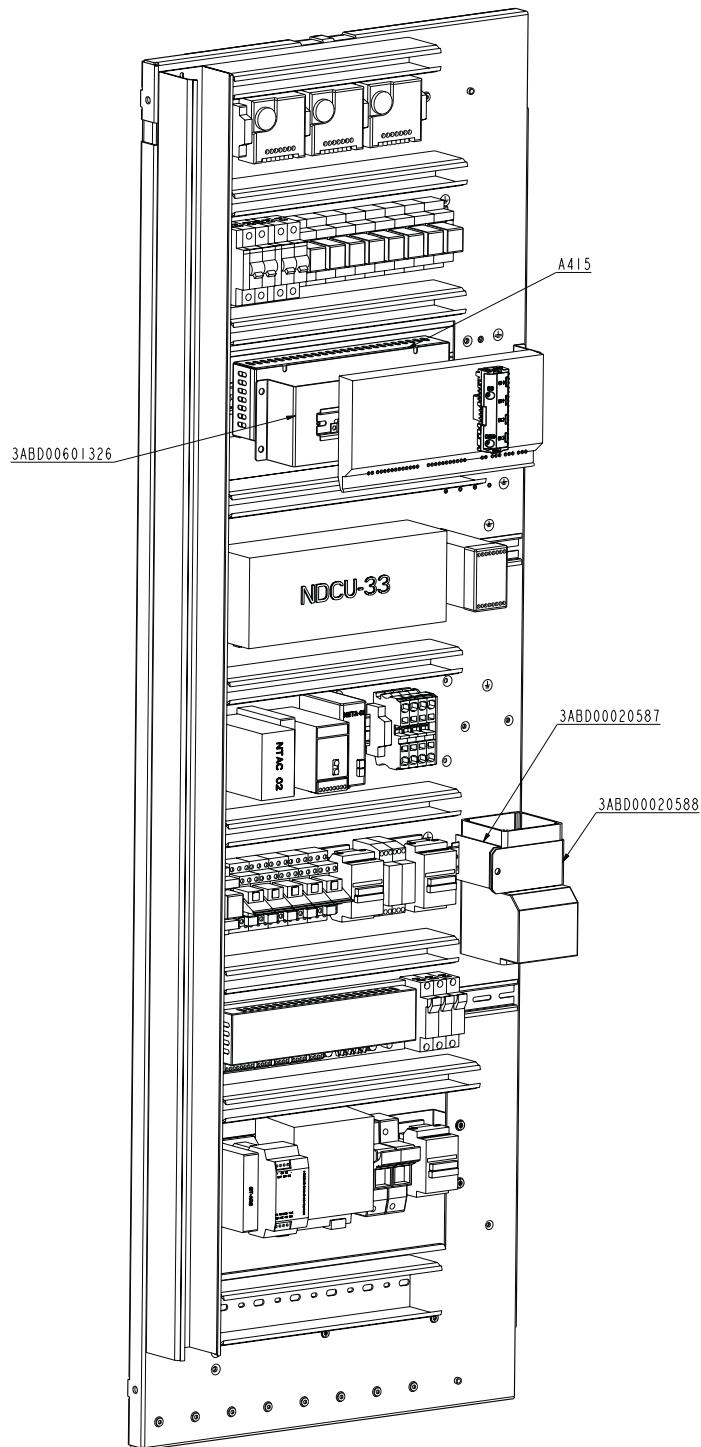


## Layout drawings



**Note:** Slide-out frame option +P919 excludes AC filter Z3.

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## Functional description

Devices on the slide-out frame are listed below.

Device	Description
K2	Capacitor charging contactor. Switches capacitor charging on/off.
K20	Grid MCB control. YC/YO changing, monitoring.
K21	Grid MCB status monitoring.
K24	Emergency switching-off of grid MCB, stator MCB and grid-side converter contactor.
K25	Common fault output.
K3	Grid-side converter contactor control.
K30	Stator contactor control.
K31	Stator contactor status monitoring.
K33	Switching-off monitoring of grid MCB, stator MCB and grid-side converter contactor. On-delay 2 s.
K3.3	Option for DC chopper, LCL module fan supply-off delay.
K36	Request for medium-voltage MCB switching-off in case grid MCB faults. Off-delay 1 s.
K4	Grid-side converter contactor safety function. Off-delay is 0.05...0.1 s.
K40	Safety relay ON/OFF status.
K41	Monitoring of grid-side converter contactor status.
K6	Stator cabinet and LCL overtemperature monitoring.
K7	Converter module and ACU heating control.
K8	Low temperature control, start-up temperature monitoring.
K9	Low temperature control, start-up temperature monitoring.
K11	Monitoring of power cabinet main fuses.
K12	Capacitor charging control auxiliary relay.
U10	230 V AC / 24 V DC power supply.
U11	24 V AC / $\pm 15$ V DC power supply.
F11	Circuit breaker for control circuit.
F12	Circuit breaker for heating and cooling fans.
E1	Hydrostat for humidity monitoring.
E2	Thermostat for low temperature control.
E3	Thermostat for overtemperature control.
F15	Charging circuit fuses.
R1	Charging resistor.
A21	Safety relay for safety functions.
A43	RDCU control unit with APBU branching unit (A415) under it.
A433	RDCO module.
A42	NDCU control unit.
A419	NTAC Pulse Encoder Interface module
A412	NETA Ethernet adapter module.
A11	NAMU measuring unit
A411	NCAN module

## ■ Control boards and optional modules

### **RDCU-12C**

Grid-side converter is controlled by its own RDCU control unit (containing the RMIO-12C board). The RDCU is connected to the grid-side converter modules by a fiber optic link. For further information, see *RDCU drive control units hardware manual* [3AFE64636324 (English)].

### **NDCU-33CX**

Rotor-side converter is controlled by its own NDCU control unit (consisting of the NIOC-02C and AMC-33 boards). The NDCU is connected to the rotor-side converter modules by a fiber optic link, distributed through APBU optical branching unit.

### **RDCO-02C**

DDCS channel board (RDCO) is an option for the RMIO board. It provides optic fiber connection for PC tool, overriding controller, master-follower communication and additional I/O modules.

### **NTAC-02**

NTAC-02 pulse encoder interface module offers an interface for a digital pulse encoder connection. A pulse encoder can be used if accurate speed or position (angle) feedback from the motor shaft is required.

### **NCAN-02C**

NCAN-02 adapter module is an optional fieldbus adapter module. Wind turbine converter can be connected to a CANopen serial communication bus through NCAN-02 module.

### **NETA-01C**

NETA-01 Ethernet adapter module is an optional device for browser-based remote monitoring of the wind turbine converter via Ethernet. Multiple converters (up to 9) can be connected to the network through the DDCS branching unit (NDBU-85/95) or using a ring topology.

### **APBU-44C**

APBU-44C PPCS branching and datalogger unit is used to implement the parallel connection of multiple grid-side or rotor-side converter modules. The APBU-44C also contains a datalogger for collecting and storing real-time data from the module power stages to help fault tracing and analysis.

## ■ Charging circuit

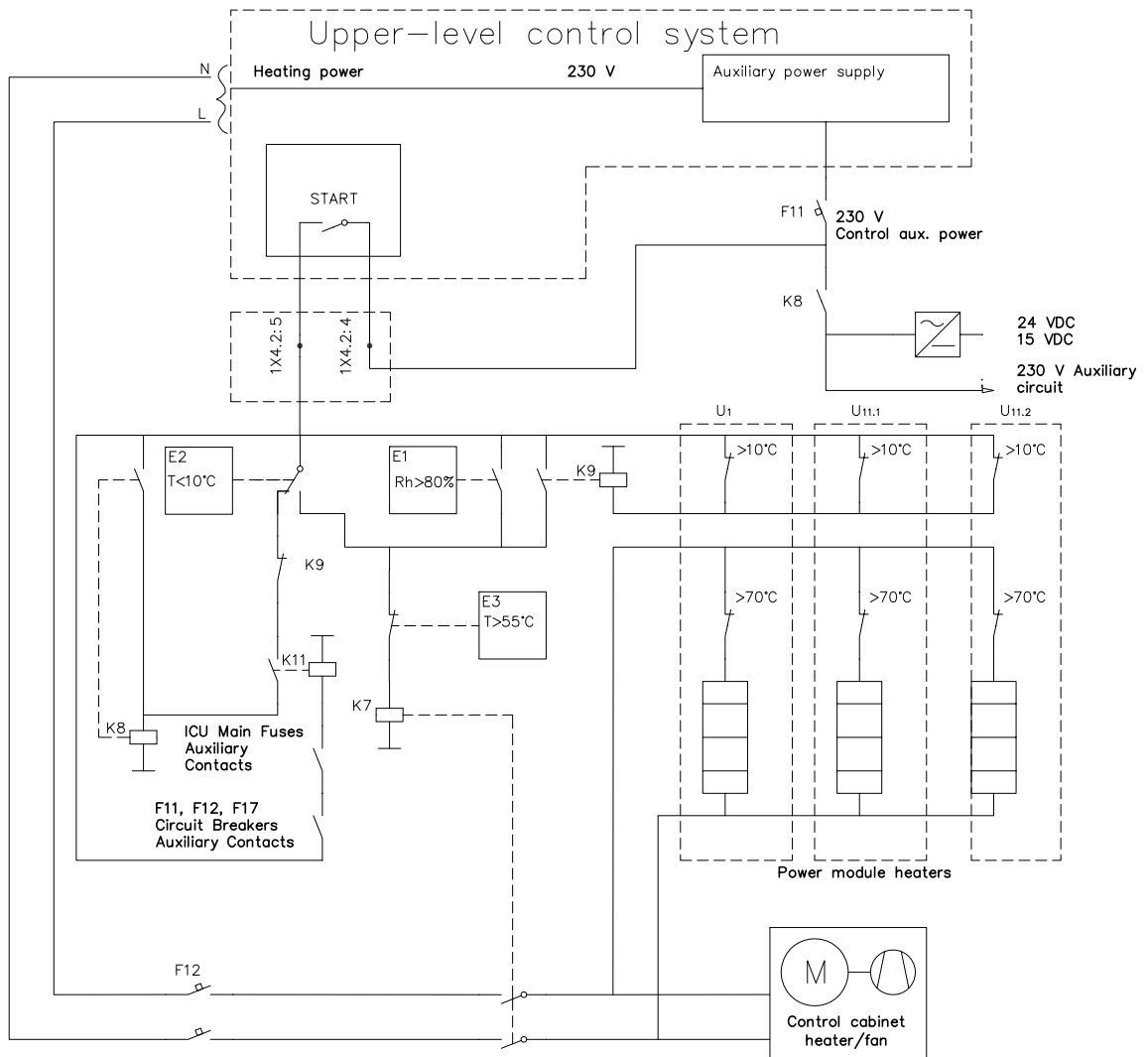
Resistor R1, fuses F15 and contactor K2 form a part of the charging circuit located on the slide-out frame. Charging circuit is required during the start-up procedure to avoid high in-rush current, which can be dangerous for wind turbine converter and its components. After receiving the start command, the grid-side converter closes the charging contactor which connects the intermediate DC link capacitors to the AC supply via the charging resistors. The intermediate DC link voltage rises and when it is high enough, the main contactor/breaker is closed and the charging contactor is opened. The contactors are controlled by the grid-side converter control board (RMIO) via relay outputs RO1 and RO3.

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## ■ Heating and cooling circuit

The temperature and humidity in the converter cabinet must be within allowed limits before the converter can be powered up. The converter cabinet is equipped with a heating logic which controls the cabinet heating system, allowing the converter to start only when the operating conditions are met.

Converter heating logic is shown in the figure below. Relays K8 and K9, and contactors K16 and K26 (in the power cabinet) have auxiliary contact connected to A43 digital input 4 to inform about low temperature.



## Safety functions

Slide-out frame contains special circuits for securing the start-up conditions and monitoring the shutdown process of the converter.

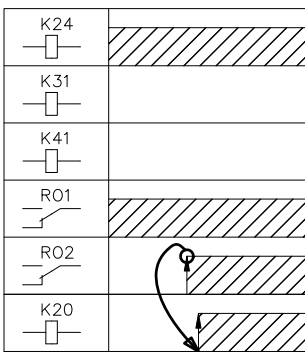
### Start-up order is:

1) Grid air-circuit breaker (MCB1), 2) Grid-side converter contactor (MCB2), 3) Stator air-circuit breaker/contactor (MCB3)

### Shutdown order is reversed:

1) Stator air-circuit breaker/contactor (MCB3), 2) Grid-side converter contactor (MCB2), 3) Grid air-circuit breaker (MCB1)

Grid air-circuit breaker (MCB1) closing (normal run-up)

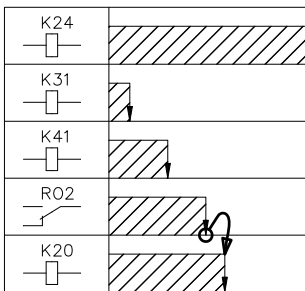


The conditions for closing grid air-circuit breaker (MCB1) are:

- No faults in the hardware monitoring circuit (K24 is closed)
- Stator air-circuit breaker/contactor is open (K31 is open)
- Grid-side converter contactor is open (K41 is open)
- No active fault in the converter (A42/X25:RO1 relay output is active)

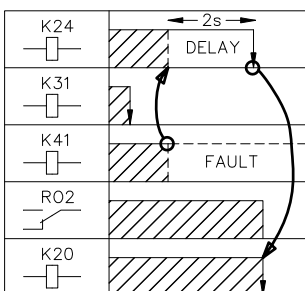
If all the conditions are fulfilled, switching on A42/X25:RO2 relay output will cause grid air-circuit breaker (MCB1) to close.

Grid air-circuit breaker (MCB1) opening (normal shutdown)



Normally, grid air-circuit breaker (MCB1) opening is handled by firmware. When the converter is running, shutting down happens in a particular order. It starts by opening the stator air-circuit breaker/contactor (MCB3), relay K31 turns OFF. Then the converter de-energizes the grid-side converter contactor (MCB2), relay K41 turns OFF. Once both grid-side converter contactor (MCB2) and stator air-circuit breaker/contactor (MCB3) are OFF, grid air-circuit breaker (MCB1) can also be switched OFF by de-activating A42/X25:RO2 relay output.

Grid air-circuit breaker (MCB1) opening (emergency shutdown – grid-side converter contactor (MCB2) fault)

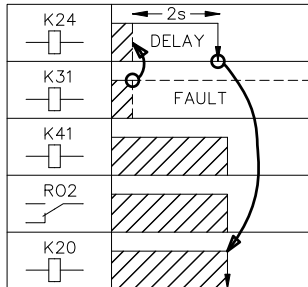


In emergency situations when the converter needs to be disconnected from the grid, the monitoring circuit of the converter shutdown process is used. Such situations happen if any of MCB devices fails during the converter shutdown:

#### 1. Grid-side converter contactor (MCB2) FAULT

If the monitoring circuit detects that status of the grid-side converter contactor is still closed (K41 relay is ON) after the converter tried to open the contactor and 2 sec time delay has elapsed, grid air-circuit breaker (MCB1) will be forced to open by de-energizing K24 relay to disconnect the converter from the grid.

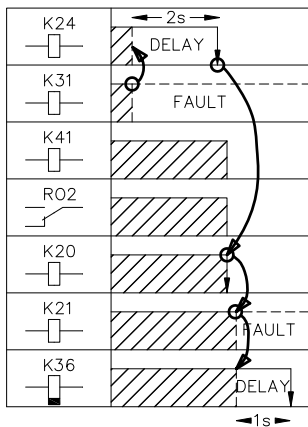
Grid air-circuit breaker (MCB1) opening (emergency shutdown – stator air-circuit breaker/contactors (MCB3) fault)



2. Stator air-circuit breaker/contactors (MCB3) FAULT

In case the stator air-circuit breaker/contactors does not obey OPEN command from the converter, the monitoring circuit will find that stator air-circuit breaker/contactors (MCB3) is still closed (K31 relay is ON) after the time delay of 2 sec. MCB1 will then be forced to open by de-energizing K24 relay to disconnect the converter from the grid.

Grid air-circuit breaker (MCB1) opening (emergency shutdown – eg, first stator air-circuit breaker/contactors (MCB3) fault, then grid air-circuit breaker (MCB1) fault)



3. Grid air-circuit breaker (MCB1) FAULT

The worst case is that the grid air-circuit breaker fails to open itself. In this case the monitoring circuit will find that grid air-circuit breaker (MCB1) is closed (K21 relay is ON) despite of OPEN command (K20 relay is OFF). After 1 sec delay K36 time relay will be de-energized. The contacts of K36 can be used to control medium-voltage grid disconnecting device (X60 control cable connector).

This example diagram describes a situation when stator air-circuit breaker/contactors (MCB3) and grid air-circuit breaker (MCB1) fail one after the other.





# 4

## Preventive maintenance

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### What this chapter contains

This chapter contains preventive maintenance instructions.

### Handling the slide-out frame

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Handle the slide-out frame with care. Pull the slide-out frame slowly out of the cabinet. If handled carelessly, it may fall. When the slide-out frame is inside the cabinet, the fastening screw on top of it must be tightened to keep the slide-out frame in place.

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### Lubrication

Lubricate the bearings of the slide-out frame when needed. Make sure that the slide-out frame moves freely when pulled out of the cabinet.

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## Further information

### Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to [www.abb.com/drives](http://www.abb.com/drives) and selecting *Sales, Support and Service network*.

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