

BFC – Control system

Instruction manual



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1 How to Contact Alfa LU-VE

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Visit alfa.luvegroup.com to get detailed contact information.

2 General Information

This instruction manual introduces you to the different situations you may encounter when using this equipment.

Read through this manual carefully and ensure that it is available for the personnel installing, operating and maintaining the equipment.

If you encounter a problem not reviewed in this manual, contact the closest Alfa LU-VE's representative.

2.1 System warranty and disclaimer

This equipment is designed to operate properly and produce rated capacity when installed in accordance with accepted industry standards. Failure to meet the following conditions may result in voiding of the system warranty:

- As standard the electrical connections must comply with the following conditions:
 - All voltages must not exceed $\pm 5\%$ of nameplate ratings. The frequency is 50-60 Hz.
- Factory installed wiring must not be changed without written approval from Alfa LU-VE



Caution: Follow these instructions to guarantee safe and correct installation, service and use of BFC™ control system. Do not change or repair the unit without the manufacturer's permission and instructions. The neglect to follow the instructions may result in warranty expiration.



Note: Do not remove the nameplate from the frequency converter or from motor protective switch panel (loss of warranty).



Disclaimer

This Instruction Manual applies to BFC™ control system and is supplied in combination with the Air Cooled Liquid Coolers Product Manual. Manuals must be carefully examined, and instructions should be followed up at all times. Alfa LU-VE does not accept liability for any damage resulting from non-compliance to the instructions as given in the manuals and order-related documents.

3 Safety

3.1 Terms used in the manual

 **Note:** Always read this manual before using the equipment.

Note types	
	Warning: Describes a potentially dangerous situation that may result in personal damage or fatal injury.
	Caution: Describes a situation that may result in damage to unit, environment, assembly or service.
	Note: Gives the user a piece of information of particular importance.

3.2 Warning symbols



General warning. Risk of malfunctioning and/or damage.



Overhead load. Never stand or walk below the load.



Forklift trucks and other logistic vehicles. Stay clear of working space.



Moving parts. Danger of injuries. Do not operate without protection guard mounted.



Hot surfaces.
Danger of burns. Wear adequate protection.



Automatic start-up.



Electric parts.
Switch off power before any handling or maintenance activities.



Sharp surfaces
Danger of cutting injuries. Wear adequate protection.



Crushing of hands
Hands and fingers can be crushed, pulled in or otherwise injured.

3.3 Prohibition symbols



Do not extinguish with water

Do not attempt to extinguish with water. Disconnect all voltages sources in the control panel.

3.4 Mandatory action symbols



Wear eye protection

Use eye protection: Protective cover, protective glasses or face protection.



Connect an earth terminal to the ground



Risk of injuries

Wear protective gloves.



Wear protective clothing

Personal protective clothing must be suitable for the working fluid used. It must have good heat insulation properties.



Disconnect before carrying out maintenance or repair

Inactivate the electrical system and secure against switching on accidentally before starting installation, maintenance or repair.



Risk of injuries. Wear safety footwear



Risk of injuries. Wear head protection



Wear ear protection

3.5 Operator qualification symbols



Unskilled worker, an operator without specific skills that is capable of performing simple tasks on qualified technicians' instructions.



Lifting and moving equipment operator, a qualified operator capable of using the lifting and moving equipment for the materials and machine (while scrupulously following the manufacturer's instructions) in compliance with laws in force in the nation of use.



Electrician, an authorized electrician how are capable of making electric connections.



Manufacturer's technician, a qualified technician provided by manufacturer to conduct operations of complex nature in particular situations of whenever agreed with the user. This person may master mechanical and/or electrician and/or hardware and/or software skills as required.

3.6 Other symbols

-

3.7 Residual risks



WARNING:

Lift and transport the package packed very carefully. Never place them on an inclined or uneven plane.

DANGER OF FALLING.



WARNING:

Before lifting the cabinet or frequency converter, check its weight from the delivery list or the nameplate and make sure that the lifting device is appropriate.



1. Only use lifting equipment that is equipped with appropriate labels.
2. Ensure that the belts or slings with hooks used for lifting keep the equipment balanced.



Do not stay under the unit when it is hanging.



WARNING:

Always install the units in a place with no entrance for outsiders.



WARNING:

Before switching on the unit always ensure that everyone is at a safe distance from the unit.



WARNING:

Only an authorized electrician may perform the electric connections.



WARNING:

Before starting the service operation make sure that the electrical supply is reliably isolated; use lock-out/tag-out system. Always check with voltmeter that the unit is electrically isolated and shut off.



WARNING:

Ensure free space in the front of the electrical cabinet according to local regulations.



WARNING:

Fans with Inverter: Terminals and connections have voltage even in a unit that is shut off. Electric shock. **Wait 15 minutes** after disconnecting the voltage at all poles before opening the device.



Never turn bypass when fans are running.

WARNING:


The ground leakage current from the frequency converter exceeds 3.5 mA. To ensure a good mechanical connection from the ground cable to the ground connection (the cable cross-section must be at least 10 mm² or 2 rated ground wires terminated separately).

WARNING:


Unintended rotation of optional permanent magnet fan motors can result in serious injury or equipment damage.

- Ensure that permanent magnet motors are blocked to prevent unintended rotation.

WARNING:


Depending on the installation and operating conditions a sound pressure level greater than 70 dB(A) may arise. Use appropriate ear protection.



WARNING:


Sharp edges. Use protection glasses, safety gloves, shoes and clothes.



WARNING:


When the frequency converter is connected to AC mains, may start at any time, causing risk of death, serious injury, equipment, or property damage. Fans can start by means of an external switch, a serial bus command, an input reference signal from the local control panel LCP, or after a cleared fault condition.

- Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended fan motor start.
- Press [Off] on the LCP, before programming parameters.
- The frequency converter, fan motor, and any driven equipment must be in operational readiness when the frequency converter is connected to AC mains.

WARNING:


An internal failure in the frequency converter can result in serious injury, when the frequency converter is not properly closed.

Before applying power, ensure all safety covers are in place and securely fastened.

WARNING:


Ensure that cabinets are electrically isolated and dead before discarding and demolishing it.



WARNING:


Use voltages suitable to PELV-system in the optional motor temperature protection system. Due to EMC-protection the cable is not wired through service switch of the fan/s. Instrument signal is not closed when power in service switch is OFF-position.

WARNING:


Before moving to the solution, ensure that the unit is in safe condition. See Residual risks in this manual.

-
- Cables may also carry voltage, even the unit is powered off.
 - The action service switch on/off shall also restart the machinery/fan, take appropriate precautions.
 - The stop/emergency stop device is not supplied by the manufacturer, because the total process risk may increase or new risk would be introduced by the action of an localized stop/e-stop system.

3.8 Additional remarks

4 General description

4.1 Description of the control system

BFC™ (Motor Protective Switch Panel and Frequency Converter) control system for energy and cost efficient stepless fan speed regulation and controlling of overall unit. The system is combination of a motor protective switch panel (B) and a frequency converter (FC).

Inverter control provides continuous fan speed control for the liquid coolers. Fan power supply cables are wired to the unit end. The fan motors are supplied via tripping circuit breakers measuring both over-current and short circuit current. Electrical panel is equipped with power main switch and manual bypass switch. All cables are EMC preferred type and all components are suitable for EMC installation.

Use this manual together with air cooled liquid cooler manual and FC operating instructions.

Code Description

BFC	T	-	K
1	2		3

- 1 Fan speed control with frequency converter
- 2 T = one temperature probe, T2= two temperature probe (Cascade)
- 3 Thermal overload protection for motor K = 'Klixon' bimetallic relays, P = PTC

Optional:

Temperature transmitter with sensor

Provides temperature control for the liquid coolers. The two transmitters with sensors option T2 provides two point 'cascade' control for the liquid coolers with two cooling circuits.

Thermal overload protection

Motors provided with additional 'Klixon' bi-metallic contact / PTC (only for big motors), Use in situations when it is suspected that cooling of motors may be marginal (e.g. high levels of fouling and high ambient temperatures).

Unless specified otherwise, motors are supplied with circuit breakers for electrical overload protection.

- ❗ **Note:** BFC™ cabinets are available for the industrial Solar SR™ and FBL™ series. Mechanical mounting is not suitable for SR...-V models.
- ❗ **Note:** For details, see the product-specific documentation of BFC™ control system.
- ❗ **Note:** Both T2 option and PTC are not available at same time

4.2 Technical data

General

Storage/transport temperature:	-25 °C....65 °C
Max relative humidity	5%... 93%
Altitude:	<1000 m without derating
Power:	1.1...90 kW
Operation temperature:	
- Minimum:	-40 °C (FC must be ON)
- Maximum:	+40°C (up to +55 °C with derating mode)
Supply Voltage:	200-240 V ±10%
	380-480 V/525-600 V ±10%
	525-690 V ±10%

Supply frequency:	50/60 Hz $\pm 5\%$
Control signal:	U = 1-10 VDC, I = 4-20 mA or fieldbus

Frequency converter cabinet (FC)

Type:	Danfoss FC102
IP rating	IP66 / Type 4X (outdoor installation)
Weight	4.9 kg.... 65 kg
Graphical display:	std
Integrated PID	std
Integrated RFI filter	std
Standard fieldbus connections	BACnet (MSTP), Metasys N2 or Modbus RTU
Temperature transmitter with sensor	optional

Suitable for remote installation (maximum distance needed to be evaluated case by case).

Motor protective switch cabinet (B):

IP rating	IP65 inside IP20 finger protected
Cabinet material	steel, painted
Weight	20 kg....60 kg
Main switch	std
Manual by-pass switch	std
Fuses for frequency converter	std
○ Automatic fuses up to 63 A	
○ NH fuses over 63 A	
Motor protective switches (one for each fan)	std
Common alarm from motor protective switches	std
Common terminal/Alarm for Klixon/PTC	optional

Cables Internal cables (power and instrument) are EMC preferred

Service switch (for fan) EMC protected

Gable glands EMC-type at motors and service switch connections otherwise std gable glands

For installation is followed FC supplier's instructions to reached EMC protection level.







Note: See project-specific documentation for technical data.

4.3 Identification of the product

Check the identification data on the cabinet nameplate. The nameplate is located left bottom corner of the cabinet. The product nameplate includes contact information of the manufacturer, product designation, number of order acknowledgement, weight, month/year of manufacture and CE or EAC marking.

Product Labels

Table 1: Product labels

	<p>Centre of gravity When lifting the loose delivery package with forklift, always place the forks under the centre of gravity</p>										
	<p>Motor protective switch cabinet nameplate</p> <table border="1"> <tr> <td>Supplier</td><td>Cabinet manufacturer</td></tr> <tr> <td>Model</td><td>See code description</td></tr> <tr> <td>InA/A, Un/V</td><td>Electrical parameters</td></tr> <tr> <td>IP</td><td>IP rating</td></tr> <tr> <td>Type.no.</td><td>Manufacturing number</td></tr> </table> <p>For FC nameplate see FC supplier's Operating manual</p>	Supplier	Cabinet manufacturer	Model	See code description	InA/A, Un/V	Electrical parameters	IP	IP rating	Type.no.	Manufacturing number
Supplier	Cabinet manufacturer										
Model	See code description										
InA/A, Un/V	Electrical parameters										
IP	IP rating										
Type.no.	Manufacturing number										
	<p>Electrical warning Electrically powered component. Switch off power supply before any maintenance or installation operation</p>										
 <p>WARNING! The DC link capacitors remain charged after power has been disconnected. To avoid an electrical shock hazard, disconnect the from the mains before carrying out maintenance. Wait at least 15 minutes before doing service on the frequency converter. Never turn switch to by-pass when fans are running.</p> <p>VAROITUS! Odota, että kondensaattorit purkautuvat kokonaan ennen huolto- tai korjaustöiden tekemistä. Minimoidutusaika 15 minuuttia. Älä käänä kytintä ohitukselle, kun puhaltimet pyörivät.</p> <p>VARNING! Vänta tills kondensatorerna är helt urladdade innan underhåll eller reparationsarbete utförs. Minsta väntetid 15 minuter. Vrid aldrig brytaren till bypass när fläktarna körs.</p> <p>WARNUNG! Führen Sie Wartungs- oder Reparaturarbeiten erst nach vollständiger Entladung der Kondensatoren durch. Mindestwartzeit 15 Minuten. Den Schalter niemals in die Bypass-Stellung schalten, wenn die Lüfter laufen.</p> <p>ВНИМАНИЕ! Убедитесь также, прежде чем приступать к работам на преобразователе частоты, подождите не менее: 15 мин. Ни в коем случае не переключайте переключатель на байпас, если работают вентиляторы.</p>	<p>Option: Cabinet delivered with frequency converter Wait 15 min before opening. Never turn the switch by-pass when motors are running</p>										
<p>HT</p>	<p>Option T2: HT-label: Install marked transmitter with sensor to liquid outlet of HT-cooling circuit. Install temperature transmitter with sensor without label to LT-circuit.</p>										

Main components

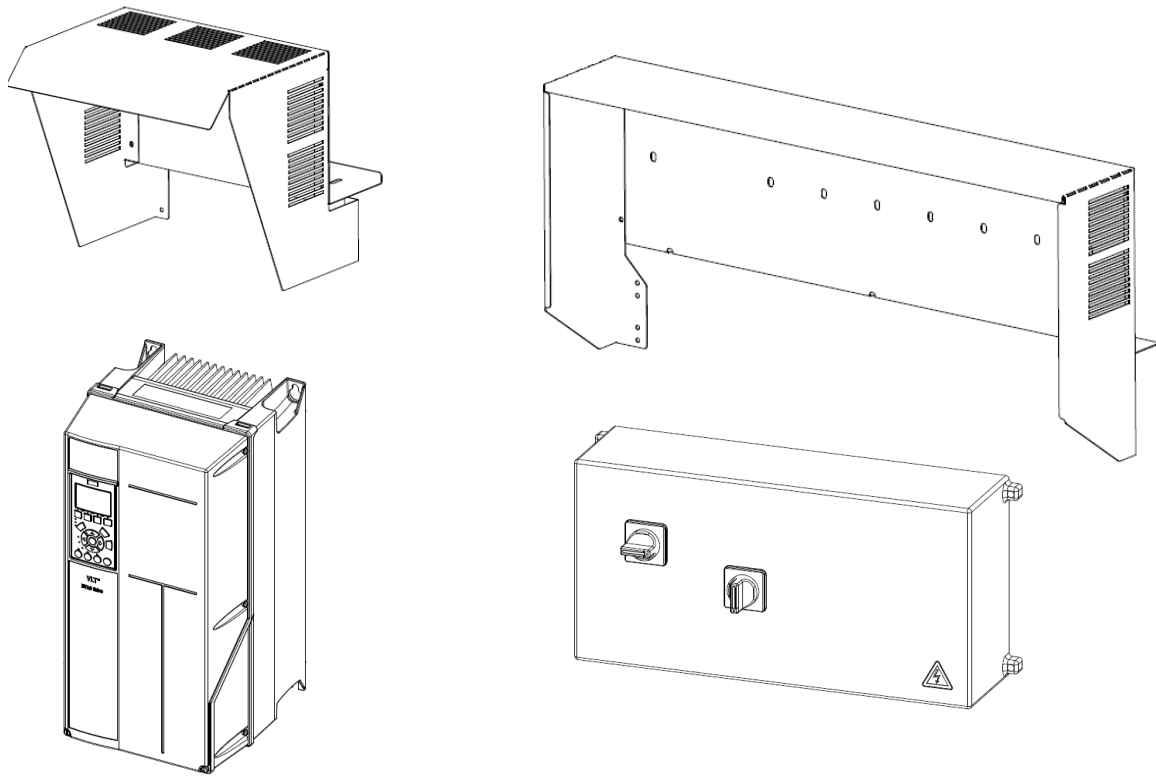


Figure 1: Left: Frequency Converter FC and its sun cover. Right: Motor protective switch cabinet B and its weather cover



Note: Manual bypass switch is included to delivery with std IEC fans when the operation without FC is permitted.

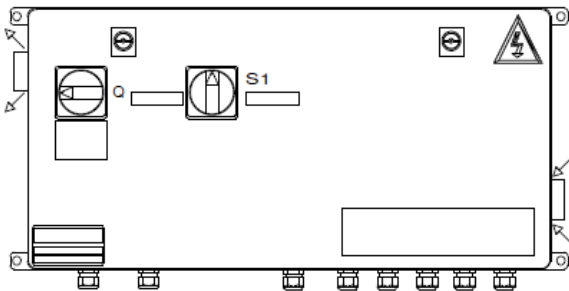


Figure 2: Left: The motor protective switch cabinet B. Main power switch for the system Q, Bypass switch S1

For details about the FC see supplier's Operating instructions. For details about the motor protective switch cabinet B see order specific electrical drawings.

The delivery includes the necessary documentation for the control system and electrical panel. The documentation is in the electrical motor protective switch cabinet B.

Enclosed technical material:

- Instruction manual for BFC
- Supplier's operating instructions for FC
- Order specific parameter list
- Electrical drawings
- Declaration of conformity related to liquid cooler installation

Standard delivery up to 1 m legs

Both cabinets (B and FC) are integrated to air cooled liquid cooler at the factory.

With FC enclosure types from C1....C4 converter is delivered loose integrated to liquid cooler delivery. End user install the converter and connects prewired power and instrument cables to motor protective switch cabinet B. Optional temperature transmitter/s with sensor/s is/are connected to unit and prewired (max 15 m) to FC terminal when possible.

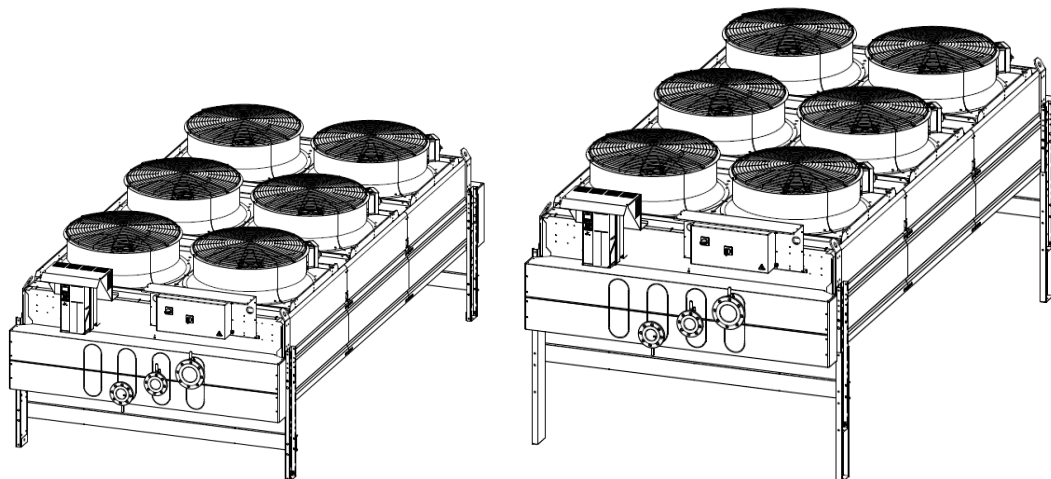


Figure 3: The Final installation of BFC cabinets. Left: with std legs. Right: with 1 m leg extensions.

Delivery with high legs (from 2 m legs) or remote installation

Both cabinets are delivered loose in own package. Both the liquid cooler unit cables and internal power cables between cabinets are prewired (max 3 m).

Optional temperature transmitter/s with sensor/s are connected to FC terminal with 8 m cables. Liquid outlet/s is/are equipped with pocket/s for temperature transmitter/s with sensor/s.

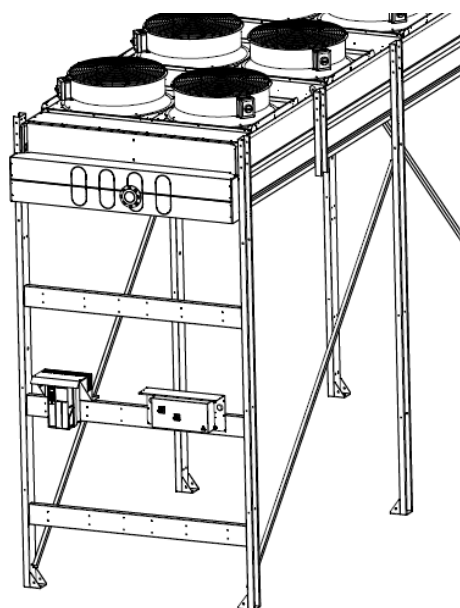


Figure 4: The final installation of BFC cabinets with high mounting legs (Cabinet opening position outside; reverse installation to legs is also allowed).

5 Transport and storage

5.1 Lifting package (loose cabinet delivery)



WARNING:

Lift and transport the package packed very carefully. Never place them on an inclined or uneven plane.
DANGER OF FALLING.



WARNING:

Sharp edges. Use protection glasses, safety gloves, shoes and clothes.



Before lifting the unit, check the weight marked on the delivery list or cabinet nameplate. Ensure that the lifting device is suitable for the task. Verify that the lifting supports at least the unit weight +10 %, when using a forklift. Lift the unit at the center of gravity. Position the forks to the maximum distance to support the pallet. Use a forklift with sufficient dimensions.

Before starting the lifting, make sure that	✓
Weight is to be checked from delivery list or from cabinet nameplate	
You have noted all transport and lifting signs and instructions from the unit and or packaging.	
Ensure that lifting devices are suitable for work and are in good condition	
The operator has the permission for lifting.	
Operators are trained to use a lifting device by safety instructions.	
No electric or other cables are near the lifting place.	
The working area of the lifting device is sufficient and safe.	
There are no obstacles or risks on the working area.	



Caution: Check that cabinets are supported and is tied tightly to prevent it from moving during transport. Ensure that the binding does not damage cabinets.

5.2 Packing

Items supplied may vary according to product configuration. Make sure the items supplied and the information on the nameplate correspond to the order confirmation. Check the packaging, electrical cabinet and the frequency converter visually for damage caused by inappropriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for clarification.

5.3 Lifting cabinet and/or frequency converter (loose delivery)

WARNING:



Before lifting the cabinet or frequency converter, check its weight from the delivery list or nameplate and make sure that the lifting device is appropriate.



1. Only use lifting equipment that is equipped with appropriate labels.
2. Ensure that the belts or slings with hooks used for lifting keep the equipment balanced.



Do not stay under the cabinet when it is hanging.



**WARNING:**

Sharp edges. Use protection glasses, safety gloves, shoes and clothes.



For lifting, use lifting eyes on the frequency converter and motor protective switch cabinet installation, when provided.

5.4 Storage

Store the cabinets in a dry location before installation. Keep the equipment sealed in its packaging until installation. Refer to chapter Technical Data: temperature for storage.



Caution: During long term storage, keep FC switched power on or store cabinets in a dry location before installation.

6 Installation instructions

Before starting installation see “Residual risks” in this instruction manual.

! **Note:** Before starting installation, see Residual risks on page 6.

During installation, wear appropriate personal protection equipment (PPE).

The customer is responsible for the use of the most suitable PPE.

Only qualified personnel may carry out the installation.

6.1 Installation checklist

Erection	✓
Ensure that motor wiring and control wiring are separated or screened conduits for high-frequency interference isolation.	
Control wiring: -Check that control wiring is isolated from power and motor wiring for noise immunity -Check the voltage source of the signals, if necessary -The use of screened cable or twisted pair is recommended. Ensure that the shield is terminated correctly.	
Check that all fuses are inserted firmly and are in operational condition and that all circuit breakers are in the open position.	
Check for sufficient ground connections that are tight and free of oxidation. Grounding to conduit, or mounting the back panel to a metal surface, is not a suitable grounding	
Check that the cabinets are mounted on an unpainted, metal surface (= contact to end plates)	
Inspect that the interior is free of dirt, metal chips, moisture, and corrosion	
Ensure that fans' rotation direction is correct.	
Check for loose connections.	

6.2 Tightening torques

FC

See tightening torques from the operating instructions of FC.

Motor protective switch cabinet B

Use tightening torques from the operating instructions of air cooled liquid cooler.

6.3 Positioning

See typical installation positions from the figures 3 and 4 on page 12.



Note: In exceptional cases, contact the product supplier or manufacturer.

6.4 Mechanical installation



WARNING:

Sharp edges. Use protection glasses, safety gloves, shoes and clothes.



WARNING:

Ensure free space in the front of the electrical cabinet according to local regulations.



WARNING:

Always install the units in a place with no entrance for outsiders.

Mechanical installation is required if FC and/or motor protective switch panel B is delivered loose.

Std delivery to unit with max 1 m legs.

Install loose delivered FC to end of unit near motor protective switch panel B. For lifting use installed lifting lugs. Adapters for mounting is preinstalled to cooler unit. See figure 3 on page 12.

Std delivery to unit with high mounting legs.

Mount both FC and motor protective switch panel B to horizontal support installed on the legs. For lifting use installed lifting lugs if installed. See figure 4 on page 12.

Remote installation of FC

Ensure that top and bottom clearance for air cooling is provided. See details from FC supplier's Instruction manual.



Note: Improper FC mounting can result in overheating and reduced performance.



Caution: Confirm the acceptable cable lengths from Alfa LU-VE before installation.

6.5 Grounding



WARNING:

The ground leakage current from the frequency converter exceeds 3.5 mA. To ensure a good mechanical connection from the ground cable to the ground connection (the cable cross-section must be at least 10 mm² or 2 rated ground wires terminated separately).



Dry Cooler is grounded by the legs and motors. Ensure the unit grounding by separate earth connection when vibration dampers are in use, the casing is painted or the basement is not conductive.

For electrical safety

- Ground the frequency converter in accordance with applicable standards and directives.
- Use a dedicated ground wire for input power, motor power and control wiring.

6.6 Electrical installation

WARNING:

Only an authorized electrician may perform the electric connections.



WARNING:

Ensure free space in the front of the electrical cabinet according to local regulations.



WARNING:

Fans with Inverter: Terminals and connections have voltage even in a unit that is shut off. Electric shock. **Wait 15 minutes** after disconnecting the voltage at all poles before opening the device.

Never turn bypass when fans are running.



**WARNING:**

The ground leakage current from the frequency converter exceeds 3.5 mA. To ensure a good mechanical connection from the ground cable to the ground connection (the cable cross-section must be at least 10 mm² or 2 rated ground wires terminated separately).

**WARNING:**

Unintended rotation of optional permanent magnet fan motors can result in serious injury or equipment damage.

- Ensure that permanent magnet motors are blocked to prevent unintended rotation.

**WARNING:**

Use voltages suitable to PELV-system VDC in the optional motor temperature protection system. Due to EMC-protection the cable is not wired through service switch of the fan/s. Instrument signal is not closed when power in service switch is OFF-position.

Main power cable (customer)

Customer may use unscreened cable.



Caution: Do not use power main supply cables with N-wire.



Caution: Do not open cabinet door before switch off the main power.

Control cables (customer)



Note: Keep control wires as short as possible and separate from high power cables to minimize interference.

Operating permission

Operation permission for FC is given on terminal 18. Use screened instrument cable. Shield is to be grounded from both ends. For details see *7 Functional description*.

Common alarms

Common alarms for motor protective switches. The terminal is in the motor protective switch panel B. Use screened instrument cable. Shield is to be grounded from both ends.

Common alarms for optional Klaxons. The terminal is in the motor protective switch panel B. Use screened instrument cable. Shield is to be grounded from both ends.

Analog signal cables

Use screened instrument cable. Ground cable from FC side (minimum requirement).

Fieldbus cables

Use screened instrument cable. Ground cable from FC both side; preferred (minimum requirement).

General wiring diagrams



Note: EMC INTERFERENCE: Screened cables are used for motor and control wiring, and separate cables for input power, motor wiring and control wiring. Failure to isolate power, motor and control cables can result in unintended behavior or reduced performance. Minimum 200 mm (7.9 in) clearance between power, motor and control cables is required. Do not bind instrument cables and power cables together. Route Instrument cables as far as possible from the power cables to avoid disturbance of instrument signals.

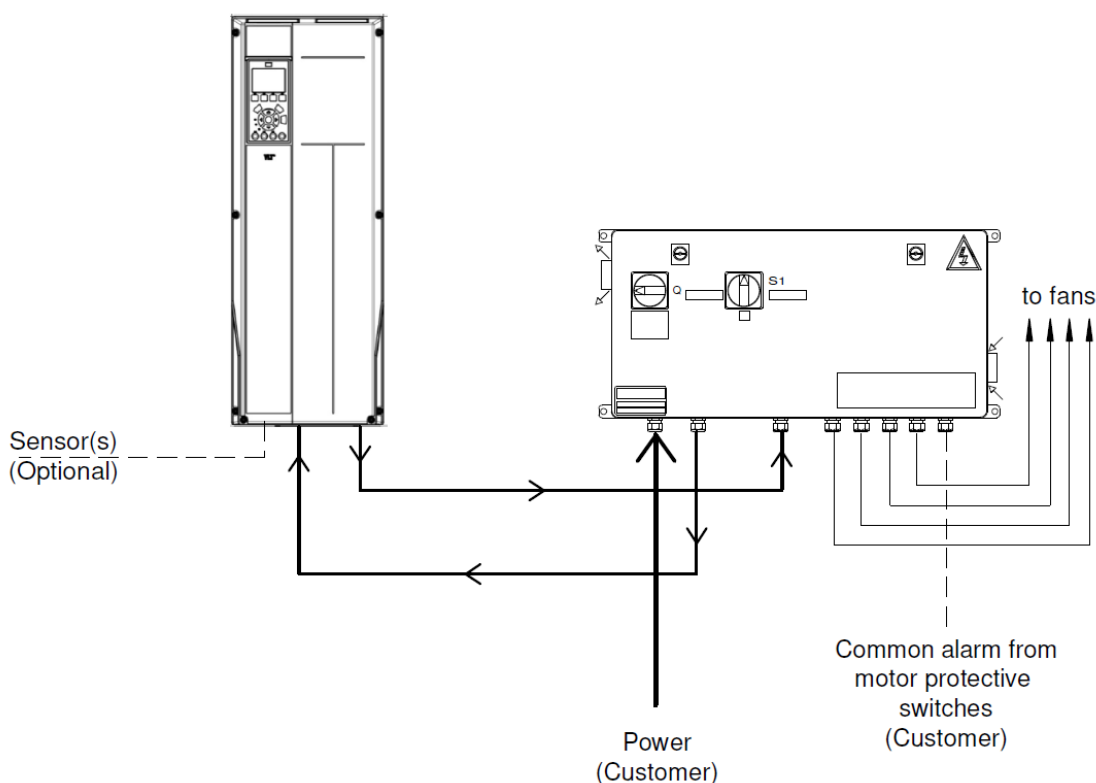


Figure 5: BFC™/BFCT™ general system wiring diagram

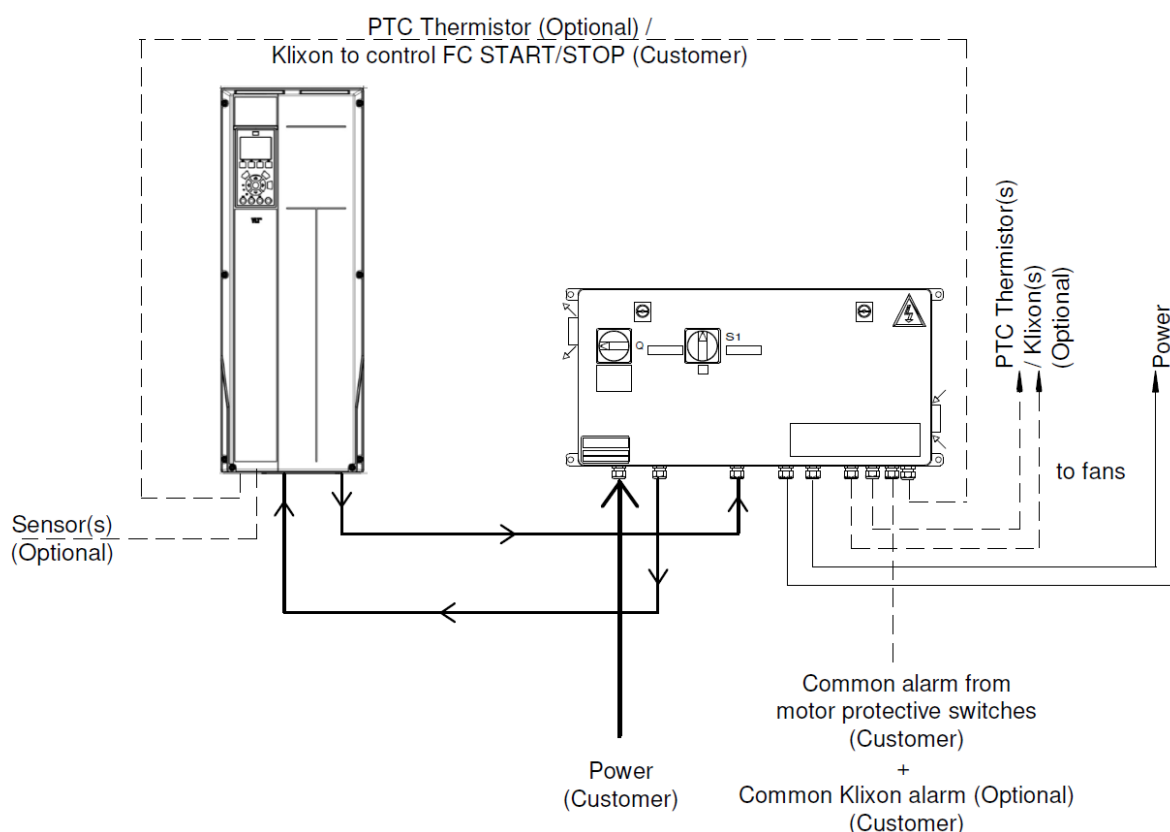


Figure 6: BFC™/BFCT™ general system wiring diagram with additional fan motor temperature protection
When FC is delivered loose prewired power cables are numbered both in the cable ends and in the motor protective switch panel B to ensure correct connection.

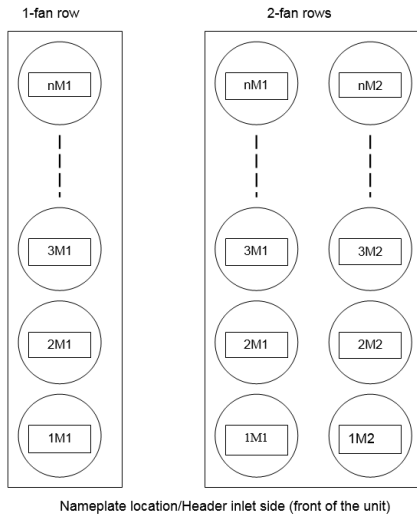


Fig 7: Fan/motor identification

For details see order specific electrical wiring diagram and supplier's FC-manual enclosed to delivery.

EMC-compliant installation

Establish electrical contact between cable screen and frequency converter enclosure by using metal EMC-cable glands (motor side) or by using the clamps provided on the electrical cabinet.

For details see electrical wiring diagram and FC-manual enclosed to delivery.



Note: POTENTIAL EQUALISATION: Risk of electrical interference, when the ground potential between the frequency converter and the system is different. Install equalizing cables between the system components. Recommended cable cross-section: 16 mm².

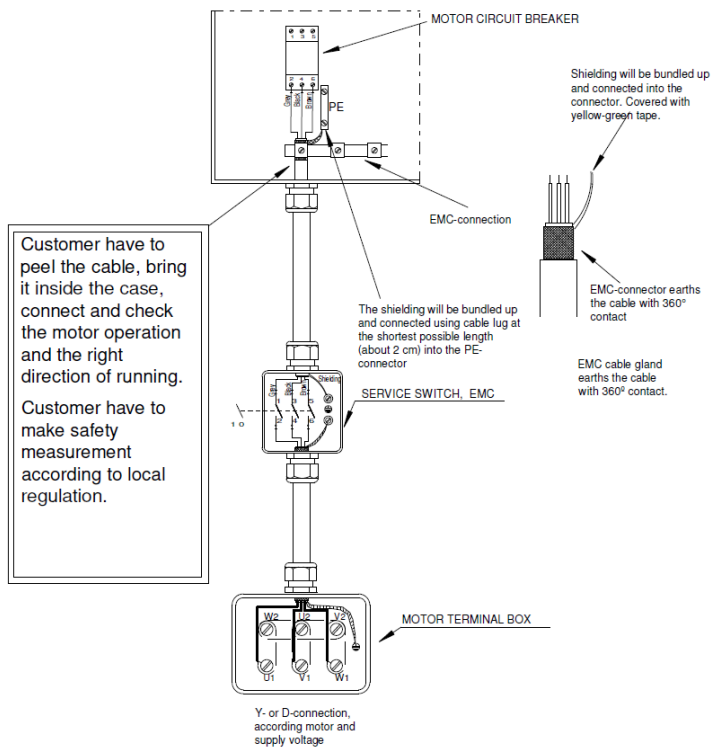


Figure 8: Correct motor cable FC-power outlet cable EMC-installation to motor circuit breaker cabinet B, when cabinet is delivered loose to site.

General wiring instructions with remote/high mounting leg installation

Separate instrument cables and power cables. Do not bind main power cables to other cables. Use separate motor power cable bunches, if the motor power cable amount exceed 7 pcs to ensure cable cooling.



Figure 9: Left Uncorrect way to bunch cables (Centre cable does not have cooling). Right example about correct way to bunch cables

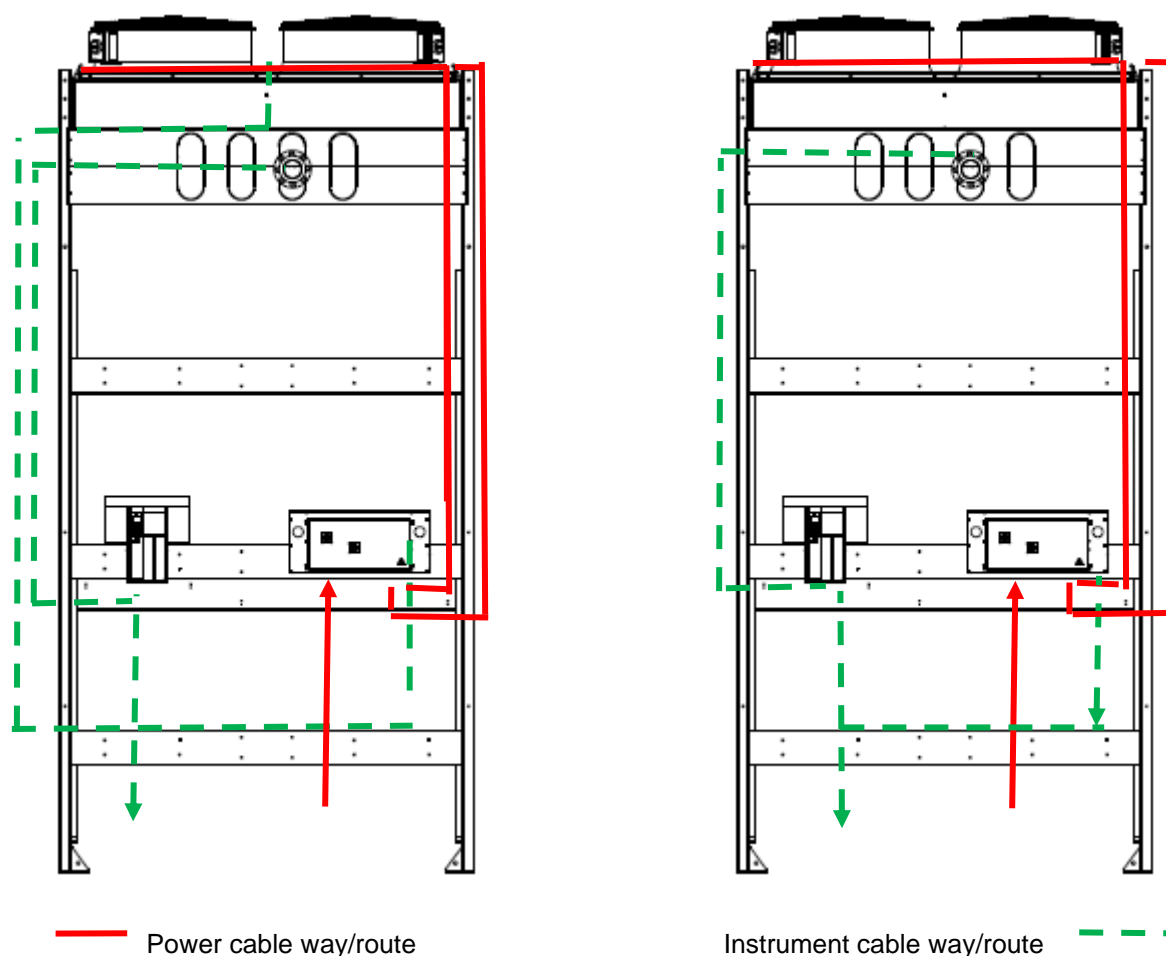


Figure 11: Left: Cable routing recommendation with optional temperature transmitter/s with sensor/s and fan motor thermal protection. Right; Cable routing recommendation with optional temperature transmitter with sensor.

Install/bind the cables with cable ties.

6.7 Options for BFC

6.7.1 Temperature transmitter with sensor

Provides temperature control for the liquid coolers. When FC-cabinet is delivered loose, the transmitter with sensor is to be installed to temperature sensor pocket in the liquid outlet (see Figure 10). The transmitter/s with sensor/s is/are prewired to FC.

At two temperature transmitter with sensors. In T2 installation the HT-transmitter with sensor is marked HT-label to identify which liquid circuit outlets transmitters with sensors are to be installed.

- ! **Note:** BFCT™: Ensure that instrument cable to temperature transmitter with sensor is cabled downward to avoid water penetration to transmitter through cable inlet.

Push the sensor to the bottom of pocket and tight it with key.

- ! **Note:** Do not bind instrument cables and power cables together. Route instrument cables as far as possible from the power cables to avoid disturbance of instrument signals.

For loose deliveries max 8 m EMC-protected instrument cable/temperature transmitter with sensor is included.

See details for electrical connections from electrical drawings enclosed to delivery.

FC is pre-programmed in the factory. See chapter parameterization to alter temperature set point/s

6.7.2 Thermal overheat protection for motors

Instrument cables are routed separately from power cables. When B cabinet is delivered loose, the instrument cables from the motor is to be connected to cabinet terminal, See details for electrical connections from electrical drawings enclosed to delivery.

- ! **Note:** Do not bind instrument cables and power cables together. Route instrument cables as far as possible from the power cables to avoid disturbance of instrument signals.

Bi-metallic contact

Common alarm from B-cabinet terminal.

PTC

FC is pre-programmed and additional PTC card is installed in the factory.

Wire instrument cable from terminal FC to B-cabinet terminal.

Common alarm via FC fieldbus.

See details for electrical connections from electrical drawings enclosed to delivery.

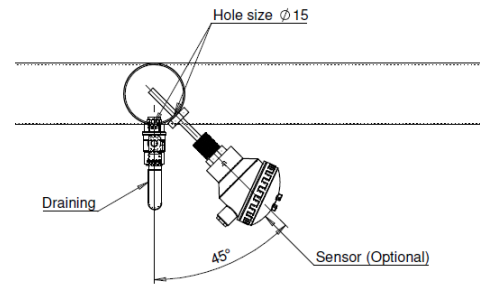


Figure 10 BFCT™: Temperature transmitter with sensor installation to liquid outlet connection

6.8 Checks before commissioning



WARNING:

An internal failure in the frequency converter can result in serious injury, when the frequency converter is not properly closed.

- Before applying power, ensure all safety covers are in place and securely fastened.

The electric safety checking includes the steady-state and insulation resistance measurement of the protecting cable. The customer conducts all the measurements and tests (including the grounding resistance measurement), which are required in the operating country.

Before starting the unit	✓
Ensure that none of the components are damaged.	
Ensure that the cabinets are firmly in position.	
Cables are not damaged.	
Check the fixing of the mechanical parts.	
Check for sufficient ground connections that are tight and free of oxidation.	
Fasten all the connection terminals correctly.	
Ensure that all switch and disconnect settings are in the proper positions	
Ensure that the fans rotate properly and that the air flow direction is correct.	

7 Functional description

Components

F1	Main circuit breaker/fuse	located to electric panel
1..nF1...m	Circuit breaker for motor	located to electric panel
1..nM1...m	IEC motor	
FC	Frequency converter	
PID	PID control/s	integrated to FC
PTC	Analog signal input	integrated to FC (optional, max for 6 motors)
PTC	PTC	integrated to motor (optional)
Klixon	bi-metallic contact	integrated to motor (optional)
Jumper	Operating permission	between terminals 12 & 18 in FC
T	Temperature sensor with transmitter	PT 100 (optional), set range 0-100°C
T2	Temperature sensor with transmitter	PT 100 (optional), set range 0-100°C
S1	Manual by-pass	located to electric panel
Q	Main power switch	located to electric panel
m	number of fan rows (1...2)	
n	number of fans in the fan row (1...7)	



Note: Both T2 option and PTC are not available at same time

Alarms

Common alarm for all circuit breaker switches of circuit breaker release.
FC operational status/failure.

Optional alarms

Motor Klixons or PTC Common alarm

7.1 Control functioning

Air cooled liquid coolers

BFC

The fan speed is controlled via I/O signal

- | | | |
|---|------------------------|---------------------------|
| • | milliamp; 4 mA...20 mA | terminals 53 and 55 in FC |
| • | voltage; 1V...10V | terminals 53 and 55 in FC |
| • | Fieldbus | terminals 68 and 69 in FC |

BFCT/T2 Options

T

milliamp; 4 mA...20 mA

The outlet temperature of the liquid is measured by a sensing element consisting of a PT100 sensor and a temperature transmitter (T). Required outlet temperature of the liquid is set in the frequency converter. PID control on the frequency converter (FC) defines – based on the difference between design value and actual value – all fans keeping speed (1M1...nMm) the outlet temperature of the liquid at set point.

With two circuit liquid coolers the LT-circuit outlet temperature as default is used for controlling fan speed.

T and T2

milliamp; 4 mA...20 mA

Two temperature transmitters with sensors (T and T2) control is also possible on request. The setup can be used two circuit air cooled liquid coolers. The outlet temperature of the liquid giving biggest deviation to set point is controlling the unit with PID control integrated to FC.

7.2 Motor protection

The fan motors are supplied with tripping circuit breakers (1F1...nFm), measuring both over-current and short circuit current.

Optional common alarm from Klixons or PTC, if motor is overheated.

7.3 Starting the frequency converter

The frequency converter is started and stopped by external control contact (Jumper on FC as standard). The minimum set point of the fan speed set in frequency converter is 5 Hz.

Starting on FC requires that main power switch is ON-position and manual by pass switch is on frequency converter position.

7.4 Operation permission to FC

As default the operation permission is handled with jumper between the terminals 18 and 12.

Operating permission is given in FC to terminal 18. The voltage for signal is 24 V DC. If customer is using own operation permission signal, the shielded instrument cable is to be used.

Terminal 27 is re-programmed (not in use).

7.5 Fan running instructions from FC

Fans are normally running at 5 Hz point with MIN signal. In order to protect both motors and cabinets when high moisture/low temperature conditions occurs.

Table 1 Normal operation

Signal	MIN	MAX
1...10VDC or 4...20 mA ¹⁾ or 0...100%	10%, min 5 Hz	max 100% ²⁾

Table 2 When signal line is broken

Signal	MIN	MAX
0...0.5 VDC 0...2 mA ¹⁾ fieldbus off	100%	max 100% ²⁾

¹⁾ Include options T and T2

²⁾ MAX point may limited according to customer specific specification or based directly on power supply frequency 50 Hz/60 Hz (100%).



Caution: Do not change MIN and MAX parameters without confirmation from Alfa LU-VE. The fan motors may damage.

7.6 Alarms and indications

In case of some defect on the frequency converter, the converter tries to recover 3 times

After that FC tries to run all the fans at maximum when:

- Signal failure from I/O (Voltage signal below 0.5 V or milliamp. signal below 2 mA) see Table 2

Operational status of running of the frequency converter is available, as also a separate alarm from the converter. There is a common alarm for all circuit breaker switches of circuit breaker release.

The manual bypass is possible to switch bypass position, if converter is damaged.

Optional common alarm from Klixons, if motor is overheated. Can be integrated on FC's running permit (terminal 18) to stop FC, if one fan is over heated on request.

There is an own potential-free contact for every above mentioned alarms and operational status, either on the terminal blocks of the control unit or on the terminals of the frequency converter.

FC operation condition indication to main automation system

The relay 2 in the frequency converter:

- Terminals 04 and 06 in contact : no electricity feed to FC, converter is standby or FC is tripped
- Terminals 04 and 05 in contact: FC is RUNNING [Auto-on] or [Hand-on] mode.

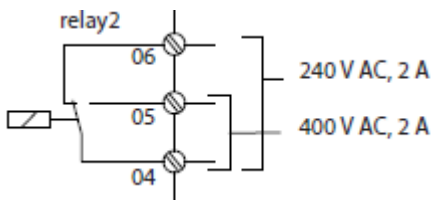


Figure 11: Relay 2 terminals of FC and max voltage and amp values for relay 2

8 Operation

Note: Before starting operation, see **Residual risks** on page 6 in this manual.

During operation, wear appropriate personal protection equipment (PPE).
The customer is responsible for the use of the most suitable PPE.
Only qualified personnel may operate the device.



WARNING:



When the frequency converter is connected to AC mains, may start at any time, causing risk of death, serious injury, equipment, or property damage. Fans can start by means of an external switch, a serial bus command, an input reference signal from the local control panel LCP, or after a cleared fault condition.

- Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended fan motor start.
- Press [Off] on the LCP, before programming parameters.
- The frequency converter, fan motor, and any driven equipment must be in operational readiness when the frequency converter is connected to AC mains.



WARNING:

An internal failure in the frequency converter can result in serious injury, when the frequency converter is not properly closed.

Before applying power, ensure all safety covers are in place and securely fastened.



Caution: When not operating the unit, the FC must be switched power on in order to keep the FC dry and ready for operating.



Caution: Do not open cabinet door before switch off the main power.



Caution: Never turn bypass when fans are operated and running.



Note: The display of LCP may freeze at low temperatures. Do not touch the screen, it may damage. LCP display is not break and it will recover, when the ambient temperature exceed +0 °C.

Prior to BFC startup/shutdown, follow the procedures of the main unit manual.

8.1 Startup (FC-operation)

1. The fan service switches at ON-position
2. Ensure that motor protective switches in the motor protective switch cabinet B are ON-position
1. Ensure that main (automatic) fuse is installed and ready for operating in the motor protective switch cabinet B.
3. Switch the by-pass switch S1 to FC-ON position
4. Switch the main power switch Q to ON-position
5. Ensure that the led indication of FC points [Auto on] If not push the [Auto-on] button in the LCP



Note: FC operation may require operation permission from the main operating system if FC is connected to main automation system. See 7 *Functional description* for details.

8.2 Shutdown (FC-operation)

- 1 Stop the FC by pushing the [Off] button in the LCP
- 2 When fans are stopped Switch the main switch Q to OFF-position
- 3 Switch manual by-pass switch S1 to OFF-position

- 4 Readiness for BFC Maintenance. See chapter 9 Service Instructions

8.3 Startup (Manual bypass-operation)

2. The fan service switches at ON-position
3. Ensure that motor protective switches in the motor protective switch cabinet B are ON-position
4. Ensure that main (automatic) fuse is installed and ready for operating in the motor protective switch cabinet B.
5. Switch the manual bypass switch S1 to BYPASS-ON position
6. Switch the main power switch Q to ON-position
7. Ensure that the power light indicates that FC is on (FC is powered)

8.4 Shutdown (Manual Bypass-operation)

- 1 Switch the main switch Q to OFF-position
- 2 Switch manual bypass switch S1 to OFF-position
- 3 Readiness for BFC Maintenance. See chapter 9 Service Instructions.

8.5 Change from FC-operation to Manual bypass-operation

- 1 Stop the FC by pushing the [Off] button in the LCP
- 2 When fans are stopped Switch the main power switch Q to OFF-position
- 3 Switch the manual by-pass switch S1 to BYPASS-ON position
- 4 Switch the main power switch Q to ON-position
- 5 Ensure that the power light indicates that FC is on (FC is powered)

8.6 Change from Manual bypass-operation to FC-operation

- 1 Switch the main switch Q to OFF-position
- 2 Wait that fans are stopped
- 3 Switch the manual by-pass switch S1 to FC-ON position
- 4 Switch the main power switch Q to ON-position
- 5 Ensure that the led indication of FC points [Auto on] If not push the [Auto-on] button in the LCP.

8.7 Alarms related to malfunctions

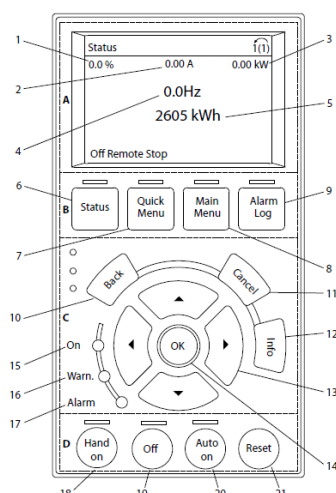
See details from System description and FC supplier's Operating instructions 7.3 Warning and Alarm Types.



Note: For FC operation is required operation permission from the main operating system if FC is connected to main automation system.

9 Operation parameter setting

The FC is parameterized at Alfa LU-VE factory and it's ready for operating. The FC can be re-parameterized through local Control panel LCP.



Changing Parameter Settings

Parameter settings can be accessed and changed from the [Quick Menu] or from the [Main Menu]. The [Quick Menu] only gives access to a limited number of parameters.

Press [Quick Menu] or [Main Menu] on the LCP.

Press [▲] [▼] to browse through the parameter groups, press [OK] to select a parameter group.

Press [▲] [▼] to browse through the parameters, press [OK] to select a parameter.

Press [▲] [▼] to change the value of a parameter setting.

Press [◀] [▶] to shift digit when a decimal parameter is in the editing state.

Press [OK] to accept the change.

Press either [Back] twice to enter Status, or press [Main Menu] once to enter Main Menu.

New temperature set point for options T and T2

BFCT:

20-21 = temperature set point for liquid outlet temperature

BFCT2:

20-21 = temperature set point for liquid outlet temperature (LT-circuit)

20-22 = temperature set point for liquid outlet temperature (HT-circuit)

For more detailed parameter settings information see FC supplier's operating manual and supplied order specific parameter list.

10 Service instructions

Note: Before starting maintenance, see Residual risks on page 6.

During service work, wear appropriate personal protection equipment (PPE).
The customer is responsible for the use of the most suitable PPE.
Only qualified personnel may carry out maintenance procedures.

WARNING:

Only an authorized electrician may perform the electric connections.



WARNING:

Before starting the service operation, ensure that the electrical supply is reliably isolated; use the lockout/tag-out system. Always check with a voltmeter that the unit is electrically isolated and shut off.



WARNING:

Fans with Inverter: Terminals and connections have voltage even in a unit that is shut off.

Electric shock. Wait for 15 minutes after disconnecting the voltage at all poles before opening the device.

Never turn bypass when fans are running.



WARNING:

Ensure free space in the front of electrical cabinet according to local regulations.



WARNING:

When the frequency converter is connected to AC mains, may start at any time, causing risk of death, serious injury, equipment, or property damage. Fans can start by means of an external switch, a serial bus command, an input reference signal from the local control panel LCP, or after a cleared fault condition.

- Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended fan motor start.
- Press [Off] on the LCP, before programming parameters.
- The frequency converter, fan motor, and any driven equipment must be in operational readiness when the frequency converter is connected to AC mains.



WARNING:

Unintended rotation of optional permanent magnet fan motors can result in serious injury or equipment damage.

- Ensure that permanent magnet motors are blocked to prevent unintended rotation.



WARNING:

An internal failure in the frequency converter can result in serious injury, when the frequency converter is not properly closed.



Before applying power, ensure all safety covers are in place and securely fastened.



Caution: Do not open cabinet door before switch off the main power.

Under normal operating conditions and load profiles, the BFC™ is maintenance-free throughout its designed lifetime. To prevent breakdown, danger, and damage, examine the components of BFC™ at regular intervals depending on the operating conditions. Replace worn or damaged parts with original spare parts or standard parts.

9.1 Service inspection



WARNING:

Depending on the installation and operating conditions a sound pressure level greater than 70 dB(A) may arise. Use appropriate ear protection.



Alfa LU-VE gives the following guidelines for regular service inspection intervals and task:

Task	Inspection Interval
Check the cleanness and visual condition of the cabinets. Ensure that FC cooling fan intake is free from obstacles	1 week
Check the insulation of the wires for damage	6 month
Fasten all the connection terminals correctly.	1 year

9.2 Cleaning



WARNING:

Before starting the service operation, ensure that the electrical supply is reliably isolated; use the lockout/tag-out system. Always check with a voltmeter that the unit is electrically isolated and shut off.

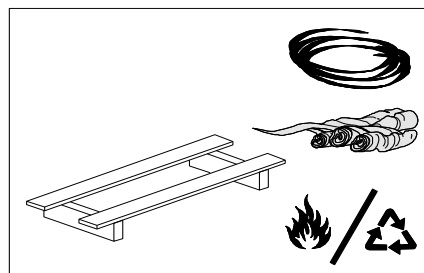


Do not use pressurized water. Use only wet or dry clothes without solvent. Ensure that the cabinets are not powered when you are cleaning cabinets.

10 Discharge and recycling

10.1 Discharge and recycling of packing materials

All packing materials are suitable for recycling or energy recovery. Wood material is according to the standard ISPM 15.



10.2 Demolishing unit

WARNING:

Ensure that cabinets are electrically isolated and dead before discarding and demolishing it.



1. Remove the unit from the installation site and transfer it to the place of demolishing
2. Remove/cut the cables.
3. Remove the installation plates.

10.3 Material recycling and discharging

Material	Recycling
Frequency converter	to electronic scrap (authorized contractor).
Cabinet	to electronic scrap (authorized contractor).
Cabinet covers	to steel scrap
Cables	recycling / scrapping (authorized contractor)

11 Troubleshooting

Problem	Possible cause	Solution
Fan does not start.	Missing start signal (Standby)	Apply valid start signal to start fans. See 7 <i>Functional description</i>
	LCP Stop.	Press [Auto On]
	Wrong reference signal source.	Check reference signal: detailed in the FC supplier's Operating Instructions
	The fuse blown out.	Replace the fuse
	Overload release / optional motor temperature sensor trip.	Check and reset the device from the overload release switch/Check if motor temperature is too high due to blocked coil/damaged motor.
	Wrong supply voltage.	Check that the supply voltage corresponds to the value marked on the nameplate. Restore power supply.
Fan/s is/are running wrong direction	Wrong motor phase connection.	Change phase connection
	Active reverse signal on the FC	Check if a reversing command is programmed for the terminal in parameter group 5-1* Digital inputs
The display of LCP may be frozen	Low ambient temperature	The display of LCP may be frozen at low temperatures. Do not touch the screen, it may damage. LCP display is not break and it will recover, when the ambient temperature exceeds +0 °C.
Fans are not reaching maximum speed.	Frequency limits set wrong	Check output limits and program correct limits see parameter list for details
	Reference input signal not scaled correctly.	Check reference input signal scaling. See parameter list for details.
Fan speed unstable.	Possible incorrect parameter settings.	Check the settings of all motor parameters, including all motor compensation settings. For closed-loop operation, check PID settings.
Fans are running at maximum speed.	One fan is tripped.	Repair the fan/Reset circuit breaker/Switch service switch of FAN to ON-position.
	FC Control signal from main automation system/ optional temperature transmitter/ lost	Check cable connection to main automation system/Check cable connection to temperature transmitter with sensor /Replace damaged temperature transmitter with sensor
Frequency converter deceleration problems.	Data for fan motors are entered incorrectly.	Check that motor data are entered correctly.
Open power fuses or circuit breaker trip.	Loose connections.	Tighten loose connections.
	Phase to phase short.	Eliminate any short circuits detected
	Fan motor is overloaded for the application.	Perform startup test and verify motor current is within specifications. If motor current is exceeding nameplate full load current, motor may run only with reduced load. Review the specifications.



WARNING:

Before moving to the solution, ensure that the unit is in safe condition. See Residual risks in this manual.

12 Spare parts

Item Description	Order
Frequency Converter	Unit order number_Frequency Converter
Motor circuit breaker	Unit order number_motor circuit breaker
PTC-card	Unit order number_PTC-card
Temperature transmitter with sensor	Unit order number_Temperature transmitter with sensor

For the unit order number, see the order or the identification number of the air cooled liquid cooler nameplate.