

# **Bonfiglioli** Vectron

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## Liquid cooling

Complement to the operating instructions

Frequency inverters ACTIVE CUBE

Frequency inverters ACTIVE NEXT GENERATION

Mains unit AEC





TABLE OF CONTENTS

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>General Information about the Documentation .....</b>                    | <b>5</b>  |
| 1.1      | <b>This document.....</b>   | <b>5</b>  |
| 1.2      | <b>Warranty and liability .....</b>   | <b>5</b>  |
| 1.3      | <b>Obligation .....</b>   | <b>6</b>  |
| 1.4      | <b>Copyright .....</b>  | <b>6</b>  |
| 1.5      | <b>Storage.....</b>   | <b>6</b>  |
| <b>2</b> | <b>General safety instructions and information on use .....</b>             | <b>6</b>  |
| 2.1      | <b>Designated use.....</b>  | <b>6</b>  |
| 2.2      | <b>Misuse.....</b>  | <b>7</b>  |
| 2.3      | <b>Residual risks.....</b>  | <b>7</b>  |
| 2.4      | <b>Safety and warning signs on device.....</b>                              | <b>8</b>  |
| 2.5      | <b>Warning information and symbols used in the Operating Instructions .</b> | <b>8</b>  |
| 2.5.1    | Hazard classes .....  | 8         |
| 2.5.2    | Hazard symbols.....   | 8         |
| 2.5.3    | Prohibition signs.....  | 8         |
| 2.5.4    | Personal safety equipment .....   | 9         |
| 2.5.5    | Recycling .....   | 9         |
| 2.5.6    | Grounding symbol .....  | 9         |
| 2.5.7    | ESD symbol.....   | 9         |
| 2.5.8    | Information signs .....   | 9         |
| 2.5.9    | Font style in documentation .....   | 9         |
| 2.6      | <b>Directives and guidelines to be adhered to by the operator .....</b>     | <b>9</b>  |
| 2.7      | <b>Operator's general plant documentation .....</b>                         | <b>10</b> |
| 2.8      | <b>Operator's/operating staff's responsibilities .....</b>                  | <b>10</b> |
| 2.8.1    | Selection and qualification of staff.....                                   | 10        |
| 2.8.2    | General work safety.....  | 10        |
| 2.8.3    | Ear protectors .....  | 10        |
| 2.9      | <b>Organizational measures .....</b>  | <b>10</b> |
| 2.9.1    | General .....   | 10        |
| 2.9.2    | Use in combination with third-party products .....                          | 10        |
| 2.9.3    | Handling and installation .....   | 11        |
| 2.9.4    | Electrical connections.....   | 11        |
| 2.9.4.1  | The five safety rules .....   | 11        |
| 2.9.5    | Safe operation.....   | 11        |
| 2.9.6    | Maintenance and service/troubleshooting .....                               | 12        |
| 2.9.7    | Final decommissioning .....   | 13        |

|          |  |           |
|----------|--|-----------|
| 2.10     | Safety Instructions on Function "Safe Torque Off" (STO)..... | 13        |
| <b>3</b> | <b>Device identification .....</b>                           | <b>15</b> |
| 3.1      | Identifier structure .....                                   | 15        |
| 3.2      | Available devices.....                                       | 15        |
| 3.3      | Cooling and installation types by assemblies.....            | 16        |
| 3.4      | Storage.....   | 16        |
| <b>4</b> | <b>Technical data .....</b>                                  | <b>16</b> |
| 4.1      | General technical data .....                                 | 16        |
| 4.2      | Technical data - Liquid Cooling, general .....               | 16        |
| 4.3      | Technical data - Liquid Cooling, assembly-specific .....     | 17        |
| 4.4      | Hydrological data .....                                      | 17        |
| 4.5      | Operation diagrams .....                                     | 18        |
| <b>5</b> | <b>Mechanical installation .....</b>                         | <b>19</b> |
| 5.1      | Size 5 (liquid-cooled) .....                                 | 20        |
| 5.2      | Size 6 (liquid-cooled) .....                                 | 22        |
| 5.3      | Size 7 and 8 (liquid-cooled) .....                           | 23        |
| <b>6</b> | <b>Coolant connection .....</b>                              | <b>24</b> |
| 6.1      | Size 6 .....   | 24        |
| 6.2      | Size 7 .....   | 25        |
| 6.3      | Size 8 .....   | 25        |
| 6.4      | Protection of heat sink against condensation .....           | 27        |
| 6.4.1    | Supply of temperature-controlled coolant .....               | 27        |
| 6.4.2    | Coolant supply control .....                                 | 28        |
| 6.5      | Measures against soiling of coolant and frost.....           | 28        |
| <b>7</b> | <b>Electrical installation .....</b>                         | <b>29</b> |
| <b>8</b> | <b>Commissioning of frequency inverter .....</b>             | <b>29</b> |
| <b>9</b> | <b>Maintenance .....</b>                                     | <b>29</b> |

## 1 General Information about the Documentation

The present documentation was prepared with great care and it was subjected to extensive and repeated reviews. For reasons of clarity, it was not possible to include all details of all types of the product in the documentation. Neither was it possible to consider all conceivable installation, operation or maintenance situations. If you require further information or if you meet with specific problems which are not dealt with in sufficient detail in the documentation, contact your local BONFIGLIOLI agent.

The present document was created in German. Other language versions are translations.

### 1.1 This document

This document complements the applicable Operating Instructions by providing information on assembly, installation, commissioning and operation of liquid-cooled devices.

Compliance with this document contributes to avoiding risks, minimizing repair cost and downtimes and increasing the reliability and service life of the device.

Read this document and the relevant Operating Instructions of the device carefully.

#### **IMPORTANT:**

**Compliance with the documentation is required to ensure safe operation of the frequency inverter. Bonfiglioli Vectron MDS GmbH shall not be held liable for any damage caused by any non-compliance with the documentation.**



In case any problems occur which are not covered by the documentation sufficiently, please contact the manufacturer.

This document contains additional information on liquid-cooled frequency inverters and mains units (in the following referred to as: devices) of the following series of devices:

- ACU 401
- ACU 410 / 510 / 610
- ANG 410 / 510 / 610
- AEC 401

### 1.2 Warranty and liability

Bonfiglioli Vectron MDS GmbH would like to point out that the contents of these Operating Instructions do not form part of any previous or existing agreement, assurance or legal relationship. Neither are they intended to supplement or replace such agreements, assurances or legal relationships. Any obligations of the manufacturer shall solely be based on the relevant purchase agreement which also includes the complete and solely valid warranty stipulations. These contractual warranty provisions are neither extended nor limited by the specifications contained in this documentation.

The manufacturer reserves the right to correct or amend the specifications, product information and omissions in these operating instructions without notice. The manufacturer shall not be liable for any damage, injuries or costs which may be caused by the aforementioned reasons.

Furthermore, Bonfiglioli Vectron MDS GmbH excludes any warranty/liability claims for any personal and/or material damage if such damage is due to one or more of the following causes:

- inappropriate use of the device,
- non-compliance with the instructions, warnings and prohibitions contained in the documentation,
- unauthorized modifications of the device,
- insufficient monitoring of parts of the machine/plant which are subject to wear,
- repair work at the machine/plant not carried out properly or in time,
- catastrophes by external impact and force majeure.

### **1.3 Obligation**

The Operating Instructions and this additional information must be read before commissioning liquid-cooled devices and complied with. Anybody entrusted with tasks in connection with the

- transport,
- assembly,
- installation and
- operation

of the device must have read and understood the Operating Instructions and additional information on liquid cooling, and especially the safety instructions. In this way, personal and material damage/losses can be avoided.

### **1.4 Copyright**

In accordance with applicable law against unfair competition, this document is a certificate. Any copyrights relating to it shall remain with

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This document is intended for the operator of the device. Any disclosure or copying of this document, exploitation and communication of its contents (as hardcopy or electronically) shall be forbidden, unless permitted expressly.

Any non-compliance will constitute an offense against the copyright law dated 09 September 1965, the law against unfair competition and the Civil Code and may result in claims for damages. All rights relating to patent, utility model or design registration reserved.

### **1.5 Storage**

The documentation forms an integral part of the device. It must be stored such that it is accessible to operating staff at all times. If the device is sold on to other users, then the documentation must also be handed over.

## **2 General safety instructions and information on use**

The chapter 2 "General safety instructions and information on use" contains general safety instructions for the Operator and the Operating Staff. At the beginning of certain main chapters, some safety instructions are included which apply to all work described in the relevant chapter. Special work-specific safety instructions are provided before each safety-relevant work step.

### **2.1 Designated use**

The frequency inverter is designed according to the state of the art and recognized safety regulations. The frequency inverters are electrical drive components intended for installation in industrial plants or machines. Commissioning and start of operation is not allowed until it has been verified that the machine meets the requirements of the EC Machinery Directive 2006/42/EC and DIN EN 60204-1.

The frequency inverters meet the requirements of the low voltage directive 2006/95/EEC and DIN EN 61800-5-1. CE-labeling is based on these standards. Responsibility for compliance with the EMC Directive 2004/108/EC lies with the operator. Frequency inverters are only available at specialized dealers and are exclusively intended for commercial use as per EN 61000-3-2.

No capacitive loads may be connected to the frequency inverter.

The technical data, connection specifications and information on ambient conditions are indicated on the rating plate and in the documentation and must be complied with in any case.

## 2.2 Misuse

Any use other than that described in "Designated use" shall not be permissible and shall be considered as misuse.

For, example, the machine/plant must not be operated

- by uninstructed staff,
- while it is not in perfect condition,
- without protection enclosure (e.g. covers),
- without safety equipment or with safety equipment deactivated,
- when general requirements, such as operating conditions and technical data, are not met.

The manufacturer shall not be held liable for any damage resulting from such misuse. The sole risk shall be borne by the operator.

## 2.3 Residual risks

Residual risks are special hazards involved in handling of the frequency inverter which cannot be eliminated despite the safety-compliant design of the device. Residual risks are not obviously identifiable and can be a potential source of injury or a health hazard.

Typical residual hazards include:

- Electrical hazard
- Danger of contact with energized components due to a defect, opened covers or enclosures or improper working on electrical equipment.
- Danger of contact with energized components in frequency inverter if no external disconnection device was installed by the operator.

During operation, all covers must be installed correctly, and all electrical cabinet doors must be closed to minimize electrical hazards.

When LEDs and other indicating elements on the frequency inverter go out, this does not necessarily mean that the device is deenergized. Before carrying out any work on the device where contact with energized parts might be possible, it must be checked in any case, i.e. irrespective of the status of any indicating elements that may be installed, if the device is deenergized.

### **Charged capacitors in DC link**

Sizes 1 through 7 (up to 132 kW): The DC-link may have dangerous voltage levels even up to 3 minutes after shutdown.

Size 8 (as from 160 kW): The DC-link may have dangerous voltage levels even up to 8 minutes after shutdown.

### **Electrostatic charging**

Touching electronic components entails the risk of electrostatic discharges.

### **Thermal hazards**

Risk of accidents by hot machine/plant surfaces, e.g. heat sink, transformer, fuse or sine filter.

### **Danger of equipment falling down/over, e.g. during transport**

Center of gravity may not lie in the middle of the electrical cabinet modules.

## 2.4 Safety and warning signs on device

- Comply with all safety instructions and danger information provided on the device.
- Safety information and warnings on the device must not be removed.

## 2.5 Warning information and symbols used in the Operating Instructions

### 2.5.1 Hazard classes

The following hazard identifications and symbols are used in the Operating Instructions to mark particularly important information:



#### DANGER

Identification of immediate threat holding a high risk of death or serious injury if not avoided.



#### WARNING

Identification of immediate threat holding a medium risk of death or serious injury if not avoided.



#### CAUTION

Identification of immediate threat holding a low risk of minor or moderate physical injury if not avoided.

#### NOTICE

Identification of a threat holding a risk of material damage if not avoided.

### 2.5.2 Hazard symbols



| Symbol | Meaning            | Symbol | Meaning        |
|--------|--------------------|--------|----------------|
|        | General hazard     |        | Suspended load |
|        | Electrical voltage |        | Hot surfaces   |
|        | Danger of crushing |        |                |

### 2.5.3 Prohibition signs


| Symbol | Meaning  |
|--------|--|
|        | No switching; it is forbidden to switch the machine/plant, assembly on |




## 2.5.4 Personal safety equipment

| Symbol  | Meaning              |
|---|----------------------|
|  | Wear body protection |
|  | Wear ear protectors  |


## 2.5.5 Recycling

| Symbol  | Meaning  |
|---|--|
|  | Recycling, to avoid waste, collect all materials for reuse |


## 2.5.6 Grounding symbol

| Symbol  | Meaning           |
|---|-------------------|
|  | Ground connection |

## 2.5.7 ESD symbol

| Symbol   | Meaning  |
|--|--|
|  | ESD: Electrostatic Sensitive Devices, i.e. components and assemblies sensitive to electrostatic energy |

## 2.5.8 Information signs

| Symbol  | Meaning  |
|---|--|
|  | Tips and information making using the frequency inverter easier. |

## 2.5.9 Font style in documentation

| Example          | Font style                         | Use  |
|------------------|------------------------------------|--|
| <b>1234</b>      | bold                               | Representation of parameter numbers                                |
| <i>Parameter</i> | inclined,<br>font: Times New Roman | Representation of parameter names                                  |
| <b>P.1234</b>    | bold                               | Representation of parameter numbers without name, e.g. in formulas |
| <b>Q.1234</b>    | bold                               | Representation of source numbers                                   |

## 2.6 Directives and guidelines to be adhered to by the operator

The operator must follow the following directives and regulations:

- Ensure that the applicable workplace-related accident prevention regulations as well as other applicable national regulation are accessible to the staff.
- An authorized person must ensure, before using the frequency inverter, that the device is used in compliance with its designated use and that all safety requirements are met.
- Additionally, comply with the applicable laws, regulations and directives of the country in which the frequency inverter is used.
- For liquid cooled frequency inverters, comply with the cooling water guideline VGB-R 455 P.
- Any additional guidelines and directives that may be required additionally shall be defined by the operator of the machine/plant considering the operating environment.

## **2.7 Operator's general plant documentation**

- In addition to the Operating Instructions, the operator should issue separate internal user manuals for the frequency inverter. The Operating Instructions of the frequency inverter must be included in the Operating Instructions of the whole plant.

## **2.8 Operator's/operating staff's responsibilities**

### **2.8.1 Selection and qualification of staff**

- Any work on the frequency inverter may only be carried out by skilled personnel. The staff must not be under the influence of any drugs. Note the minimum age required by law. Define the staff's responsibility pertaining to all work on the frequency inverter clearly.
- Work on the electrical components may only be performed by a qualified electrician according to the applicable rules of electrical engineering.
- The operating staff must be trained for the relevant work to be performed.

### **2.8.2 General work safety**

- In addition to the Operating Instructions of the machine/plant, any applicable legal or other regulations relating to accident prevention and environmental protection must be complied with. The staff must be instructed accordingly.  
Such regulations and/or requirements may include, for example, handling of hazardous media and materials or provision/use of personal protective equipment.
- In addition to this Operating Instructions, issue any additional directives that may be required to meet specific operating requirements, including supervision and reporting requirements, e.g. directives relating to work organization, workflow and employed staff.
- Unless approved of expressly by the manufacturer, do not modify the frequency inverter in any way, including addition of attachments or retrofits.
- Only use the frequency inverter if the rated connection and setup values specified by the manufacturer are met.
- Provide appropriate tools as may be required for performing all work on the frequency inverter properly.

### **2.8.3 Ear protectors**

- The frequency inverter produces noise. Due to noise development, frequency inverters should only be installed in normally unstaffed areas.
- Noise emission in operation is < 85 dB(A) in the case of sizes 1 through 7.
- Noise emission in operation is approx. 86 dB(A) in the case of size 8. Ear protectors must be used when staying near the frequency inverter.

## **2.9 Organizational measures**

### **2.9.1 General**

- Train your staff in the handling and use of the frequency inverter and the machine/plant as well as the risks involved.
- Use of any individual parts or components of the frequency inverter in other parts of the operator's machine/plant is prohibited.
- Optional components for the frequency inverter must be used in accordance with their designated use and in compliance with the relevant documentation.

### **2.9.2 Use in combination with third-party products**

- Please note that Bonfiglioli Vectron MDS GmbH will not accept any responsibility for compatibility with third-party products (e.g. motors, cables or filters).
- In order to enable optimum system compatibility Bonfiglioli Vectron MDS GmbH offers components facilitating commissioning and providing optimum synchronization of the machine/plant parts in operation.

- If you use the frequency inverter in combination with third-party products, you do so at your own risk.

### **2.9.3 Handling and installation**

- Do not commission any damaged or destroyed components.
- Prevent any mechanical overloading of the frequency inverter. Do not bend any components and never change the isolation distances.
- Do not touch any electronic construction elements and contacts. The frequency inverter is equipped with components which are sensitive to electrostatic energy and can be damaged if handled improperly. Any use of damaged or destroyed components will endanger the machine/plant safety and shall be considered as non-compliance with the applicable standards.
- Only install the frequency inverter in a suitable operating environment. The frequency inverter is exclusively designed for installation in industrial environments.
- If seals are removed from the case, this can result in the warranty becoming null and void.

### **2.9.4 Electrical connections**

- The five safety rules must be complied with.
- Never touch live terminals. In sizes 1 through 7, the DC-link may have dangerous voltage levels up to 3 minutes after shutdown. In size 8, the DC-link may have dangerous voltage levels up to 8 minutes after shutdown.
- When performing any work on/with the frequency inverter, always comply with the applicable national and international regulations/laws on work on electrical equipment/plants of the country in which the frequency inverter is used.
- The cables connected to the frequency inverters may not be subjected to high-voltage insulation tests unless appropriate circuitry measures are taken before.
- Only connect the frequency inverter to suitable supply mains. The frequency inverter may be operated in TN, TT and IT grid types. Precautions must be taken for operation in IT grids, see Chapter 7 "Electrical installation". Operation in a corner-grounded TN grid shall not be permissible.

#### **2.9.4.1 The five safety rules**

When working on/in electrical plants, always follow the five safety rules:

- 1 Isolate
- 2 Secure to prevent restarting
- 3 Check isolation
- 4 Earth and short-circuit
- 5 Cover or shield neighboring live parts

### **2.9.5 Safe operation**

- During operation of the frequency inverter, always comply with the applicable national and international regulations/laws on work on electrical equipment/plants.
- Before commissioning and the start of the operation, make sure to fix all covers and check the terminals. Check the additional monitoring and protective devices according to the applicable national and international safety directives.
- During operation, all covers must be installed correctly, and all electrical cabinet doors must be closed. During operation, never open the machine/plant.
- No connection work shall be carried out while power supply is on.
- The machine/plant holds high voltage levels during operation, is equipped with rotating parts (fan) and has hot surfaces. Any unauthorized removal of covers, improper use, wrong installation or operation may result in serious injuries or material damage.
- Some components, e.g. the heat sink or braking resistor, may be hot even some time after the machine/plant was shut down. Don't touch any surfaces directly after shutdown. Wear safety gloves where necessary.
- The frequency inverter may hold dangerous voltage levels until the capacitor in the DC link is discharged. After shutdown, wait for at least 3 minutes (sizes 1 through 7) and at least 8 minutes

(size 8) before starting any electrical or mechanical work on the frequency inverter. Even after this waiting time, make sure that the equipment is deenergized in accordance with the safety rules before starting the work.

- In order to avoid accidents or damage, only skilled personnel and electricians may carry out the work such as installation, commissioning or setup.
- In the case of a defect of terminals and/or cables, immediately disconnect the frequency inverter from mains supply.
- Persons not familiar with the operation of the frequency inverter and children must not have access to the device.
- Do not bypass nor decommission any protective devices.
- The frequency inverter may be connected to power supply every 60 s. This must be considered when operating a mains contactor in jog operation mode. For commissioning or after an emergency stop, a non-recurrent, direct restart is permissible.
- After a failure and restoration of the power supply, the motor may start unexpectedly if the Auto-Start function is activated.  
If staff are endangered, a restart of the motor must be prevented by means of external circuitry.
- Before commissioning and the start of the operation, make sure to fix all covers and check the terminals. Check the additional monitoring and protective devices according to EN 60204 and applicable the safety directives (e.g. Working Machines Act or Accident Prevention Directives).

### **2.9.6 Maintenance and service/troubleshooting**

- Visually inspect the frequency inverter when carrying out the required maintenance work and inspections at the machine/plant.
- Perform the maintenance work and inspections prescribed for the machine carefully, including the specifications on parts/equipment replacement.
- Work on the electrical components may only be performed by a qualified electrician according to the applicable rules of electrical engineering. Only use original spare parts.
- Unauthorized opening and improper interventions in the machine/plant can lead to personal injury or material damage. Any repair work may only be carried out by the manufacturer or persons approved/licensed by the manufacturer. Any repair work must be carried out by qualified electricians. Check protective equipment regularly.
- Before performing any maintenance work, the machine/plant must be disconnected from mains supply and secured against restarting. The five safety rules must be complied with.

## 2.9.7 Final decommissioning

Unless separate return or disposal agreements were made, recycle the disassembled frequency inverter components:

- Scrap metal materials
- Recycle plastic elements
- Sort and dispose of other component materials



Electric scrap, electronic components, lubricants and other utility materials must be treated as special waste and may only be disposed of by specialized companies.



In any case, comply with any applicable national disposal regulations as regards environmentally compatible disposal of the frequency inverter. For more details, contact the competent local authorities.

## 2.10 Safety Instructions on Function "Safe Torque Off" (STO)

The function „Safe Torque Off" (STO) is a functional safety feature, i.e. it protects staff from damage, provided that projecting, installation and operation are performed properly. This function does not disconnect the plant from power supply.

In order to disconnect the plant from power supply (e.g. for maintenance work), an "Emergency Stop" provision as per EN 60204 must be installed.



### WARNING

#### Uncontrolled Starting

Improper installation of the safety circuitry may result in uncontrolled starting of the drive. This may cause serious injuries and significant material damage or death.

- Safety functions may only be installed and commissioned by skilled personnel.
- The STO function is not suitable for emergency stop as per EN 60204. An emergency stop can be realized by installing a mains contactor.

An emergency stop according to EN 60204 must be functioning in all operation modes of the frequency inverter. Resetting of an emergency stop must not result in uncontrolled starting of the drive.

The drive is started again when the function STO is no longer triggered.

Without a mechanical brake, the drive will not stop immediately but coast to a standstill. If this might result in personal or material damage, additional safety measures must be taken.

- If persons may be endangered after disconnection of the motor power supply by STO, prevent access to the hazard areas until the drive has stopped.
- Check the safety function at regular intervals according to the results of your risk analysis. Bonfiglioli Vectron MDS GmbH recommends that the check be performed after one year, at the latest.

The STO function is fail-safe. However, on rare occasions, the occurrence of component defects may cause jerking of the motor shaft (max. 180°/pole pair, e. g. jerk by 90° with 4-pole motor, 180°/2).

- Check if this causes a dangerous movement of the machine.
- If the STO function is used, the special safety, installation and instructions on use instructions shall be complied with.



**WARNING!**

**Dangerous voltage!**

The safety function "Safe Torque Off" may only be used if mechanical work is to be performed on the driven machines, not for work on live components.

After disconnection of an external DC 24 V power supply, the DC link of the frequency inverter is still connected to mains supply.

Even if power supply to the motor is disconnected, and the motor is coasting to a standstill or has already stopped, high voltages may still be present on the motor terminals.

Before working (e. g. maintenance) on live parts, the plant must always be disconnected from mains supply (main switch). This must be documented on the plant.

When the function "Safe Torque Off" is triggered, the motor is not isolated from the DC link of the frequency inverter. High voltage levels may be present at the motor.

- Do not touch live terminals.

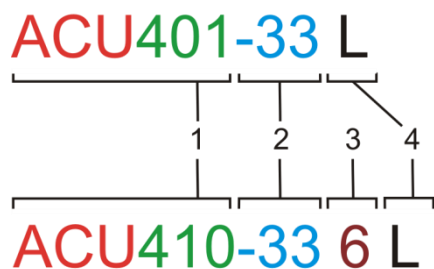


The application manual "Safe Torque Off STO" must be complied with, particularly if the safety function described there is used.

---

### 3 Device identification

#### 3.1 Identifier structure



#### Type key

|   |  |
|---|--|
| 1 | Device series, e.g. ACU401   |
| 2 | Identifier depending on rated power, e.g. -33                            |
| 3 | Device Size, e.g. 6<br>(only specified for device series Axx410/510/610) |
| 4 | Cooling and installation code, e.g. L for liquid cooling                 |

#### 3.2 Available devices

| 1               | 2               | 3                  |
|-----------------|-----------------|--------------------|
| Device series   | Type identifier | Size <sup>1)</sup> |
| ACU401 / AEC401 | -27...-49       | -                  |
| ACU410          | -27...-61       | 5...8              |
| ACU510          | -51...-61       | 8                  |
| ACU610          | -51...-61       | 8                  |
| ANG410          | -27...-61       | 5...8              |
| ANG510          | -51...-61       | 8                  |
| ANG610          | -51...-61       | 8                  |
| AEC410          | -27...-61       | 5...8              |
| AEC510          | -51...-61       | 8                  |
| AEC610          | -51...-61       | 8                  |

1) only specified in type key for device series Axx410/510/610

| 1               | 4                 |   |
|-----------------|-------------------|---|
| Device series   | Cooling and       | Installation method   |
| ACU401 / AEC401 | L:                | stainless steel, open cooling circuit (Size 5...8) standard installation    |
| ACU401 / AEC401 | N <sup>2)</sup> : | stainless steel, open cooling circuit (Size 7, 8) through-hole installation |
| ACU410          | L:                | stainless steel, open cooling circuit (Size 5...8) standard installation    |
| ACU510          | M:                | aluminum, closed cooling circuit (Size 8) standard installation             |
| ACU610          | N <sup>2)</sup> : | stainless steel, open cooling circuit (Size 7, 8) through-hole installation |
|                 | O:                | aluminum, closed cooling circuit (Size 8) through-hole installation         |
| ANG410          | L:                | stainless steel, open cooling circuit (Size 5...8) standard installation    |
| ANG510          | M:                | aluminum, closed cooling circuit (Size 8) standard installation             |
| ANG610          | N <sup>2)</sup> : | stainless steel, open cooling circuit (Size 7, 8) through-hole installation |
|                 | O:                | aluminum, closed cooling circuit (Size 8) through-hole installation         |
| AEC410          | L:                | stainless steel, open cooling circuit (Size 5...8) standard installation    |
| AEC510          | M:                | aluminum, closed cooling circuit (Size 8) standard installation             |
| AEC610          | N <sup>2)</sup> : | stainless steel, open cooling circuit (Size 7, 8) through-hole installation |
|                 | O:                | aluminum, closed cooling circuit (Size 8) through-hole installation         |

2) designation "N" only for size 7 and size 8 devices

### 3.3 Cooling and installation types by assemblies

|        | L | M | N | O |
|--------|---|---|---|---|
| Size 5 | x |   |   |   |
| Size 6 | x |   |   |   |
| Size 7 | x |   | x |   |
| Size 8 | x | x | x | x |

L, N: stainless steel, open cooling circuit, standard installation

M: aluminum, closed cooling circuit, standard installation

N: stainless steel, open cooling circuit, through-hole installation

O: aluminum, closed cooling circuit, through-hole installation

### 3.4 Storage

#### NOTICE

##### Damage caused by incorrect storage

Wrong or inappropriate storage may result in damage, e.g. due to moisture and dirt.

- Avoid major temperature variations and high air humidity.
- During storage, protect the device against moisture and dirt.

- The frequency inverters must be stored in an appropriate way. During storage, the devices must remain in their original packaging.
- The units may only be stored in dry rooms which are protected against dust and moisture and are exposed to small temperature deviations only. The requirements of DIN EN 60721-3-1 for storage, DIN EN 60721-3-2 for transport and labeling on the packaging must be met.
- The duration of storage without connection to the permissible nominal voltage may not exceed one year. After one year of storage, connect the device to mains voltage for 60 minutes.

#### NOTICE

##### Damage due to incorrect transportation

Liquid cooled devices may be transported only with the heat sink completely drained of the coolant.

- Use compressed air to drain the heat sink radiator.

## 4 Technical data

### 4.1 General technical data



For the general technical data of your device, refer to the relevant Operating Instructions.

### 4.2 Technical data - Liquid Cooling, general

|  |   |
|--|---|
| Cooling circuit  | Aluminum design: suitable for closed cooling circuits only<br>Stainless steel design: suitable for open and closed cooling circuits |
| Coolant quality  | according to Coolant Directive VGB-R 455 P,<br>hydrological data, see Chapter 4.4 "Hydrological data"                               |
| Coolant line connection  | Connection with threaded lock or PTFE sealing tape, 1/2" internal thread  |
| Coolant temperature (in)   | 5 ... 45°C, typical value: 25°C   |
| Coolant temperature (in) for open cooling circuit size 8 devices | 5 ... 35°C  |
| Coolant temperature (out)  | < 60°C  |



### 4.3 Technical data - Liquid Cooling, assembly-specific

|                                   | Unit                 |      | Size 5          | Size 6          | Size 7          | Size 8   | Size 8          |
|-----------------------------------|----------------------|------|-----------------|-----------------|-----------------|----------|-----------------|
| <b>Material</b>                   |                      |      | Stainless steel | Stainless steel | Stainless steel | Aluminum | Stainless steel |
| <b>Coolant flow rate</b>          | dm <sup>3</sup> /min | min. | 3               | 3               | 5               | 6        | 15              |
|                                   |                      | nom. | 6               | 6               | 8               | 8        | 20              |
|                                   |                      | max. | 10              | 10              | 10              | 12       | 30              |
| <b>coolant pressure</b>           | bar                  | min. | 1.5             | 1.5             | 1.5             | 1.5      | 1.5             |
|                                   |                      | nom. | 3               | 3               | 3               | 3        | 3               |
|                                   |                      | max. | 8               | 8               | 8               | 4        | 4               |
| <b>Pressure drop in heat sink</b> | bar                  |      | <0.5            | <0.5            | <0.5            | <1       | <1              |

### 4.4 Hydrological data

#### NOTICE

##### Device damage

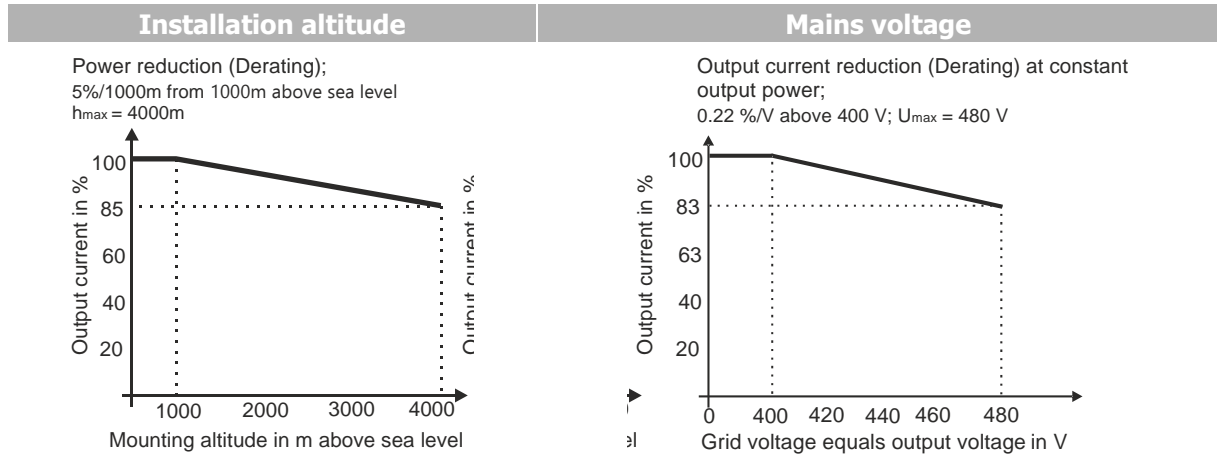
Do not use distilled water. The max. concentration of frost protection agent must not exceed the following values:

- 30% in the case of stainless steel design
- 50% other

|                           | Unit                 | Stainless steel                         | Aluminum    |
|---------------------------|----------------------|---|-------------|
|                           |                      | Value                                   | Value       |
| pH value                  | -                    | 7.0 ... 8.5                             |             |
| Carboxylic acid           | mmol/dm <sup>3</sup> | 0.2 ... 3.2                             | 0.5 ... 1.4 |
| free carbonic acid        | mg/dm <sup>3</sup>   | 1 ... 100                               | 8 ... 15    |
| aggressive carbonic acid  | mg/dm <sup>3</sup>   | 0 ... 400                               | 0           |
| oxygen                    | mg/dm <sup>3</sup>   | <10                                     |             |
| chloride ions             | mg/dm <sup>3</sup>   | <200                                    | <50         |
| sulphate ions             | mg/dm <sup>3</sup>   | <500                                    | <250        |
| nitrates and nitrites     | mg/dm <sup>3</sup>   | <100                                    | <10         |
| ammonia                   | mg/dm <sup>3</sup>   | <20                                     | <5          |
| conductivity              | μS/cm                | <300                                    | <200        |
| Suspended matters         | mg/dm <sup>3</sup>   | 15                                      |             |
|                           |                      | if >15: continuous cleaning recommended |             |
| soiling (max. grain size) | μm                   | 50                                      |             |

## 4.5 Operation diagrams

The technical data of the frequency inverters refer to the nominal point which was selected to enable a wide range of applications. A functionally and efficient dimensioning (derating) of the frequency inverters is possible based on the following diagrams.

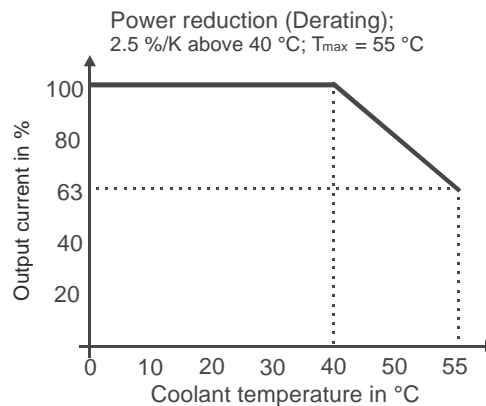


### Ambient temperature



The diagram shows the ambient temperature in the electrical cabinet.

For the coolant temperature, refer to the Technical Data, see Chapter 4.1 "General technical data".



## 5 Mechanical installation

By default, the frequency inverters of degree of protection IP20 are designed for stationary installation in electrical cabinets.



For details on the mechanical installation of your device, refer to the relevant Operating Instructions.

Below, installation is described only for those devices where mechanical installation of the liquid-cooled device deviates from the installation of the air-cooled device.

The description covers the standard installation variants for liquid-cooled devices. For through-hole installation, refer to "Installation Manual – Feed-through mounting".

During installation, both the installation and the safety instructions as well as the device specifications must be complied with.

### WARNING



**Inappropriate handling of the device** may result in serious physical injuries or major material damage.

- To avoid serious physical injuries or major material damage, only qualified persons are allowed to Work at the device.

### WARNING



#### **Risk of short circuit and fire!**

During assembly, make sure that no foreign particles (e.g. chips, dust, wires, screws, tools) can get inside the frequency inverter. Otherwise there is the risk of short circuits and fire.

- The frequency inverter complies with IP20 ingress protection rating only if the covers, components and terminals are mounted properly.
- Overhead installation or installation in horizontal position is not permissible.

### NOTICE

#### **Device damage**

Liquid-cooled devices also feature internal fans.

Mount the devices with sufficient clearance to other components so that the cooling air can circulate freely. Avoid soiling by grease and air pollution by dust, aggressive gases, etc.

- Do not cover fan inlet and outlet openings .

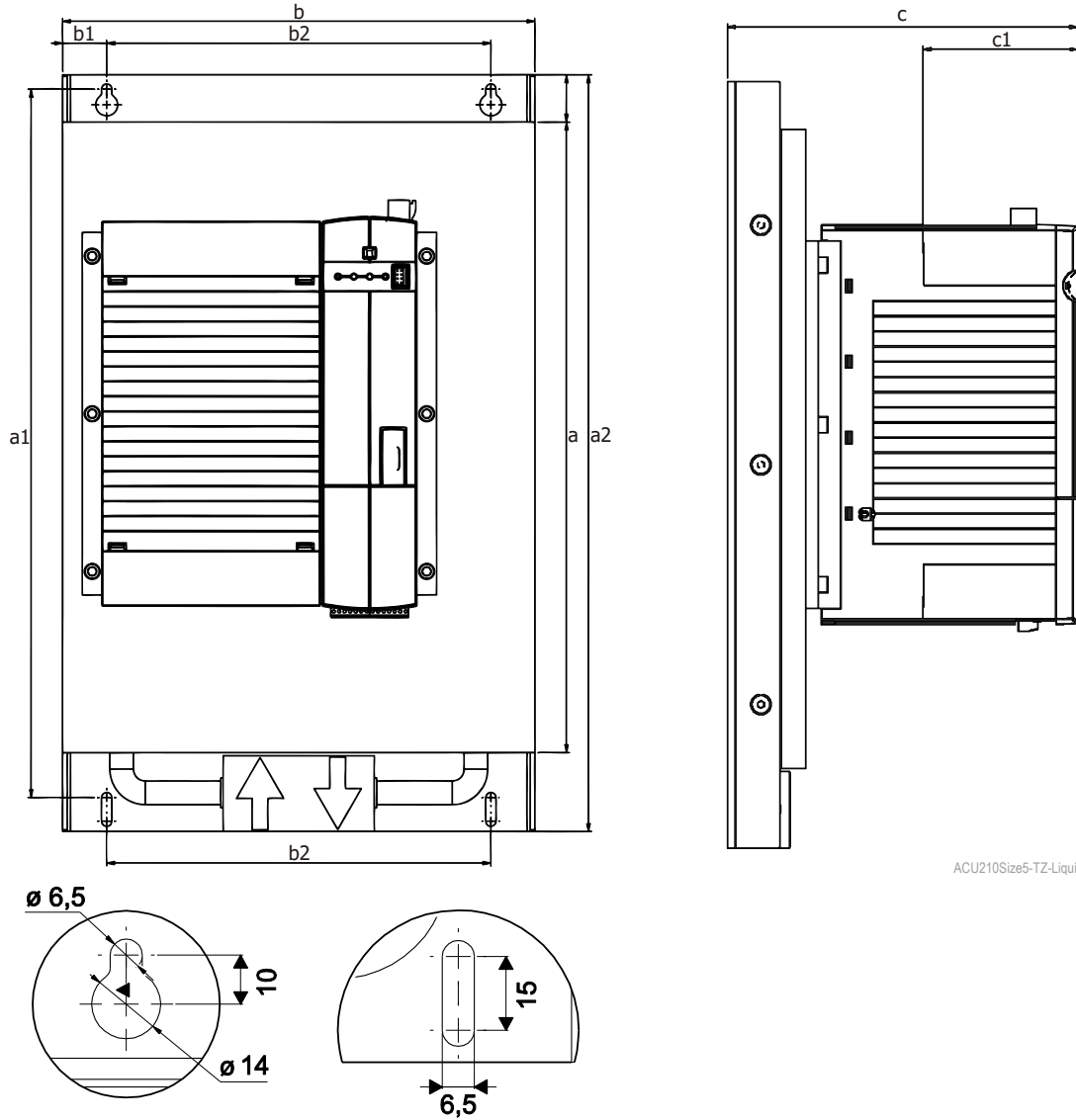


For devices with liquid cooling install the coolant pipes after mechanical installation.

## 5.1 Size 5 (liquid-cooled)

The frequency inverter is mounted in a vertical position on the assembly panel. The following illustration shows the standard fitting.

### Standard installation



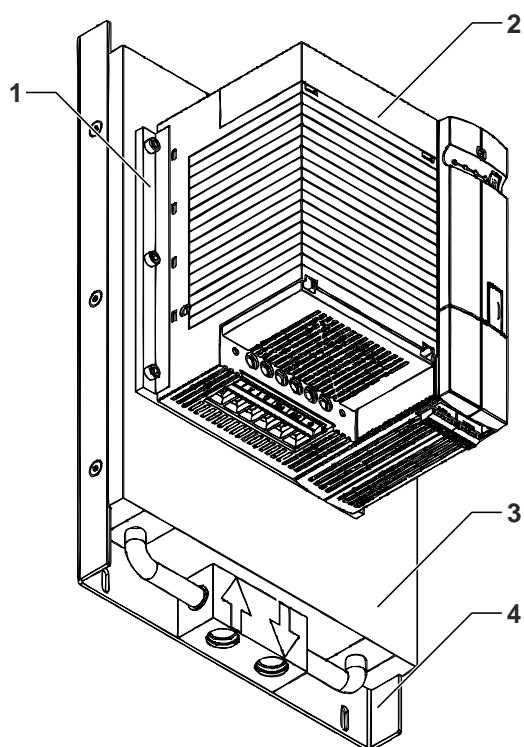
ACU210Size5-TZ-LiquidCooling\_01-V00

| Dimensions [mm] |     |     | Assembly dimensions [mm] |     |    |     |    |
|-----------------|-----|-----|--------------------------|-----|----|-----|----|
| a               | b   | c   | a1                       | a2  | b1 | b2  | c1 |
| 400             | 300 | 220 | 450 ... 464              | 480 | 28 | 244 | 97 |

Assembly is done by screwing the two fixing brackets to the heat sink of the frequency inverter and the assembly panel.

The frequency inverters are provided with fixing brackets, which are fitted using four thread-cutting screws. The dimensions of the device and the installation dimensions are those of the standard device without optional components and are given in millimeters.

Overview image

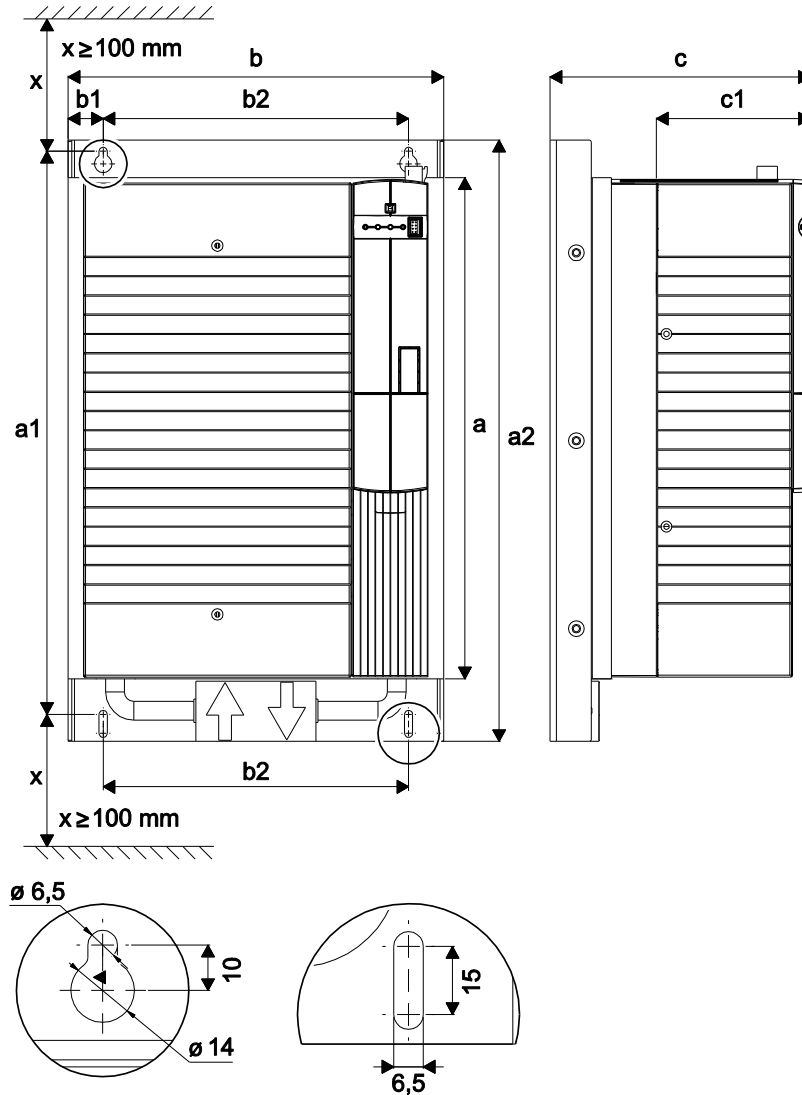


|   |                    |   |                |
|---|--------------------|---|----------------|
| 1 | Fixing bracket     | 3 | Heat sink      |
| 2 | Frequency inverter | 4 | Assembly panel |

## 5.2 Size 6 (liquid-cooled)

The frequency inverter is mounted in a vertical position on the assembly panel by means of the standard fittings. The following illustration shows the standard fitting.

### Standard installation



| Dimensions [mm] |     |     | Assembly dimensions [mm] |     |    |     |
|-----------------|-----|-----|--------------------------|-----|----|-----|
| a               | b   | c   | a1                       | a2  | b1 | c1  |
| 400             | 300 | 208 | 450 ... 464              | 480 | 28 | 123 |

Assembly is done by screwing the two fixing brackets to the heat sink of the frequency inverter and the assembly panel.

The frequency inverters are provided with fixing brackets, which are fitted using four thread-cutting screws. The dimensions of the device and the installation dimensions are those of the standard device without optional components and are given in millimeters.

### 5.3 Size 7 and 8 (liquid-cooled)



The mechanical installation of liquid-cooled devices of size 7 and 8 is done identically with the installation of air-cooled devices of the same size.

See the applicable operating instructions document.

---

## 6 Coolant connection

The permissible type of cooling system depends on the design of the liquid-cooled frequency inverter:

- Non-stainless steel designs are only suited for closed cooling circuits.
- Stainless steel designs can be used both for closed and open cooling circuits.

### NOTICE

Device damage

Wrong coolant specifications can result in device damage.

- Note the design-specific requirements to be met by the coolant, see Chapter 4.4 "Hydrological data".

The coolant supply connection is implemented via 1/2 inch internal thread connections on the bottom or rear of the frequency inverter.

### NOTICE

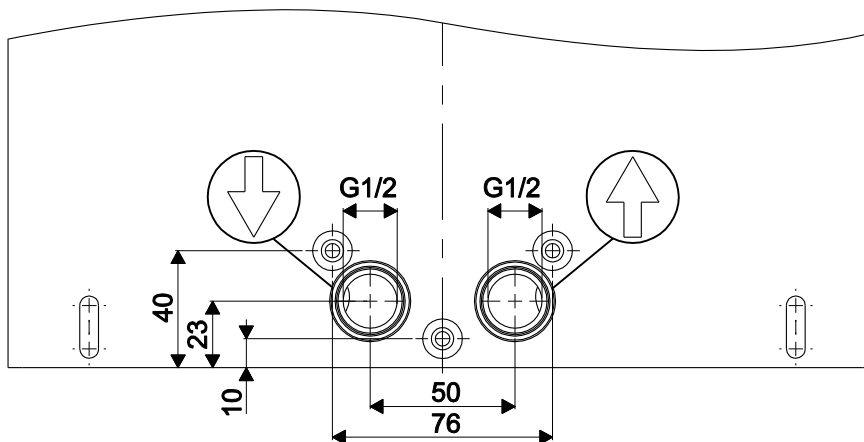
When connecting the coolant, note the specified flow direction.

- Close unused ports using the relevant plugs.
- Use thread-seals or PTFE sealing tape to seal all coolant connection ports.
- Install a solenoid valve in the coolant supply line, see Chapter 6.4.2 "Coolant supply control".
- After installation, verify tightness.

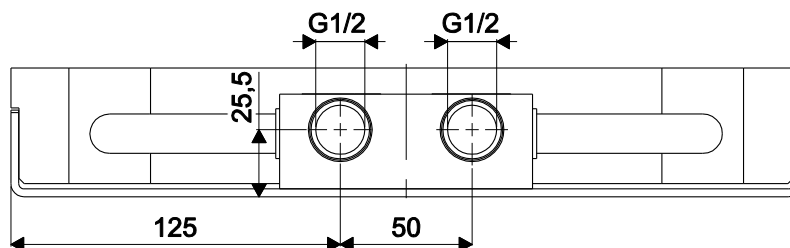
The following sub-chapters show the connection ports for the different sizes.

### 6.1 Size 6

Rear coolant connection ports:



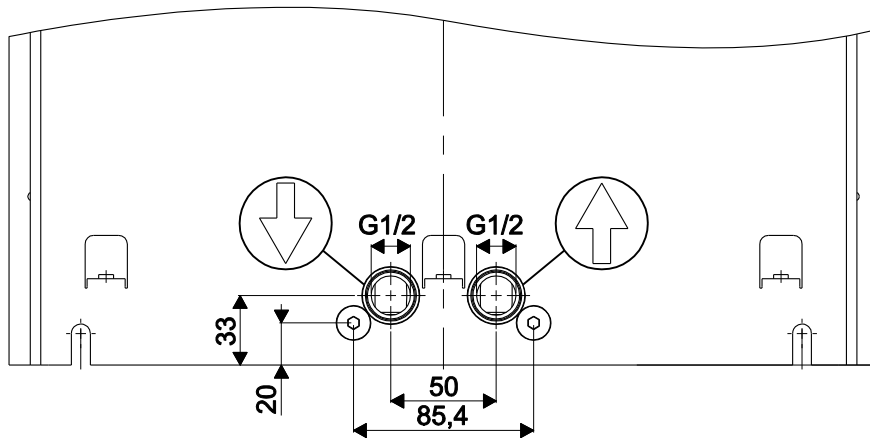
Bottom coolant connection ports:



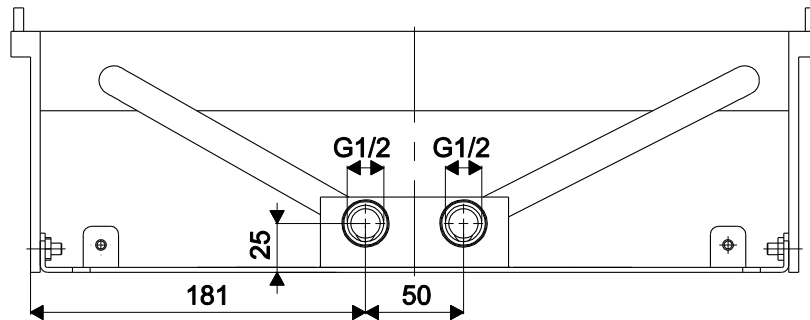


## 6.2 Size 7

Rear coolant connection ports:

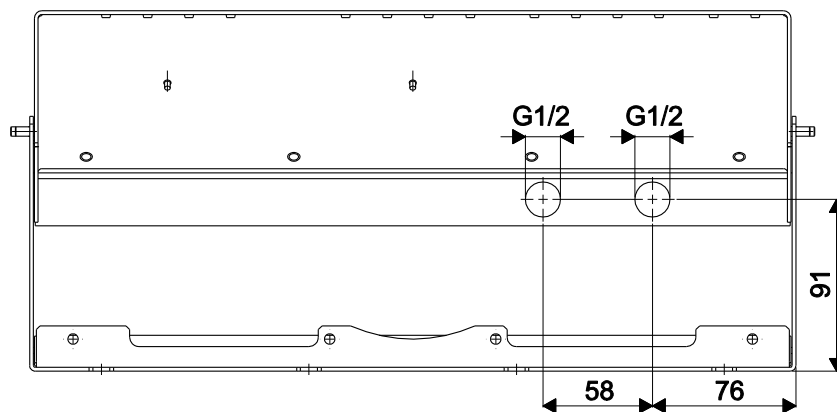


Bottom coolant connection ports:



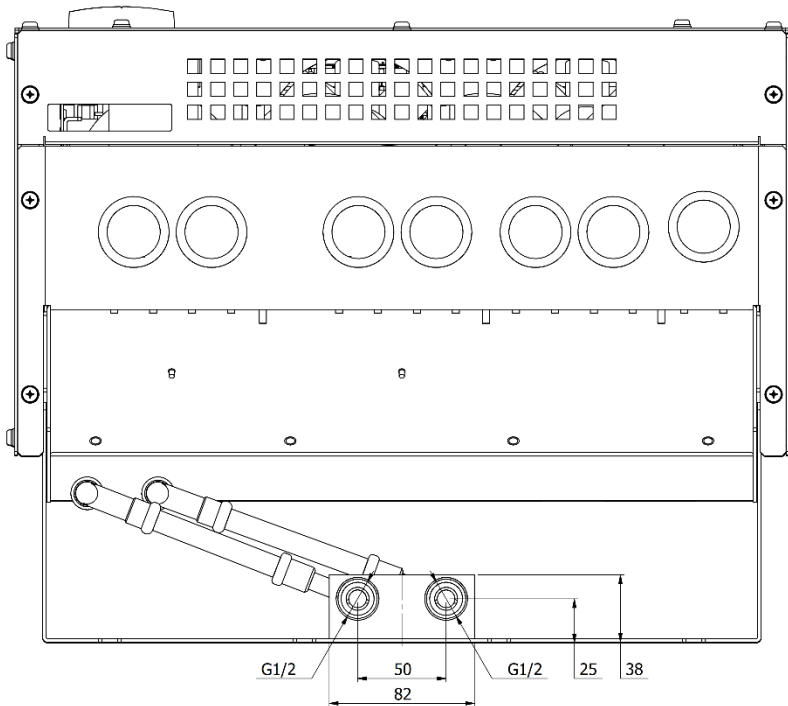
## 6.3 Size 8

Bottom coolant connection ports on an aluminum heat sink:



Bottom coolant connection ports on an stainless steel heat sink:

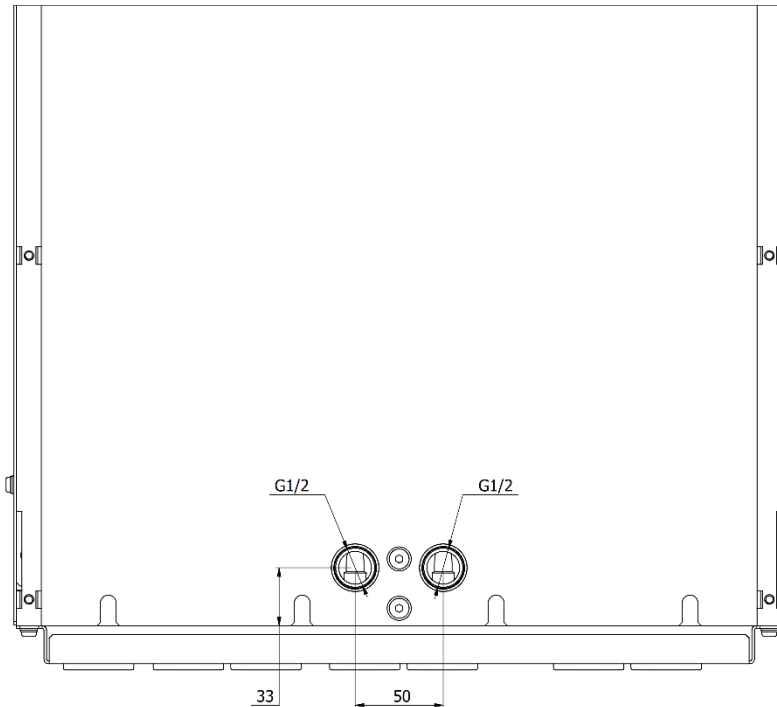
**Connection at the bottom**



**HINWEIS**

In this view the fluid entry port is on the left and the exit port on the right.

**Connection at the rear**



**HINWEIS**

In this view the fluid entry port is on the right and the exit port on the left.

## 6.4 Protection of heat sink against condensation

High atmospheric moisture at high exterior temperatures combined with a low coolant temperature can result in condensation in the heat sink and the frequency inverter electronic system.

### CAUTION



#### Condensation

Condensation can result in short-circuits in the frequency inverter and destruction of the frequency inverter, refer to Operating Instructions of device.

- Ensure that condensation is avoided by taking the precautions described below.

### 6.4.1 Supply of temperature-controlled coolant

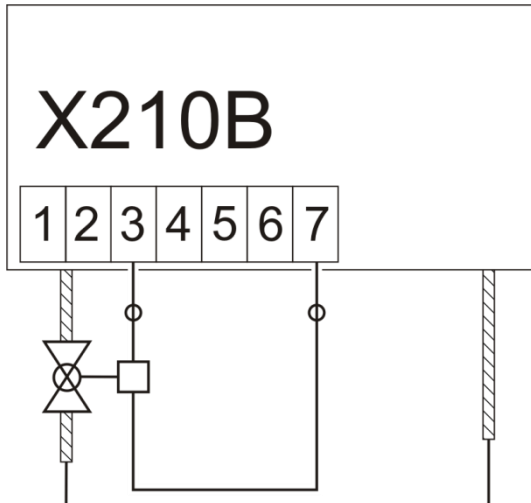
The table shows the minimum coolant inlet temperature as a function of the ambient temperature and relative humidity. The hatched areas at the bottom right represent the non-permissible range.

|                           |    | Relative humidity in % |     |     |     |    |    |    |    |    |    |     |
|---------------------------|----|------------------------|-----|-----|-----|----|----|----|----|----|----|-----|
|                           |    | 10                     | 20  | 30  | 40  | 50 | 60 | 70 | 80 | 90 | 95 | 100 |
| Ambient temperature in °C | 0  | -28                    | -20 | -16 | -12 | -9 | -7 | -5 | -3 | -1 | -1 | 0   |
|                           | 5  | -24                    | -16 | -11 | -7  | -5 | -2 | 0  | 2  | 3  | 4  | 5   |
|                           | 10 | -20                    | -12 | -7  | -3  | 0  | 3  | 5  | 7  | 8  | 9  | 10  |
|                           | 15 | -16                    | -8  | -2  | 2   | 5  | 7  | 10 | 12 | 13 | 14 | 15  |
|                           | 20 | -13                    | -4  | 2   | 6   | 9  | 12 | 14 | 16 | 18 | 19 | 20  |
|                           | 25 | -9                     | 0   | 6   | 10  | 14 | 17 | 19 | 21 | 23 | 24 | 25  |
|                           | 30 | -5                     | 5   | 11  | 15  | 18 | 21 | 24 | 26 | 28 | 29 | 30  |
|                           | 35 | -1                     | 9   | 15  | 19  | 23 | 26 | 29 | 31 | 33 | 34 | 35  |
|                           | 40 | 3                      | 13  | 19  | 24  | 28 | 31 | 33 | 36 | 38 | 39 | 40  |
|                           | 45 | 6                      | 17  | 23  | 28  | 32 | 35 | 38 | 41 | 43 | 44 | 45  |
|                           | 50 | 10                     | 21  | 28  | 33  | 37 | 40 | 43 |    |    |    |     |
|                           | 55 | 14                     | 25  | 32  | 37  | 41 | 45 |    |    |    |    |     |

If relative humidity cannot be measured, the inlet temperature must at least be the same as the ambient temperature. The coolant inlet temperature must not exceed 45°C.

### 6.4.2 Coolant supply control

The manufacturer recommends integrating a solenoid valve in the coolant supply line to control the volumetric flow rate. The solenoid valve is controlled via a digital output with transistor output or a multifunction output.



### 6.5 Measures against soiling of coolant and frost

The coolant must be chemically neutral and free from abrasive and other solids. It must not be aggressive on the material. For the coolant quality, refer to Chapter 4.4 "Hydrologische Daten".

The user shall take appropriate precautions against soiling and furring-up, e.g. by installing an inlet filter.

Typical soiling and common precautions include:

| Coolant soiling                                      | Remedy  |
|--|---|
| Mechanical soiling                                   | Use of the following filters: <ul style="list-style-type: none"> <li>- Sieve filter</li> <li>- Gravel filter</li> <li>- Cartridge filter</li> <li>- Precoat filter</li> </ul> |
| Excessive hardness                                   | Softening of coolant by ion exchange  |
| Moderate content of mechanical soiling and hardeners | Addition of stabilizers or dispersing agents to coolant   |
| Moderate content of chemical soiling                 | Addition of passivating or inhibiting agents to coolant   |
| biological impurities, mucous bacteria and algae     | Addition of biocides to coolant   |

If the heat sink or coolant are exposed to temperatures below 5°C, an appropriate frost protection agent must be added to the coolant.



#### CAUTION

##### Device damage

Insufficient coolant quality can result in clogging up and/or corrosion of the heat sink and impair the function of the frequency inverter cooling system. This can result in frequency inverter damage.

- Ensure sufficient coolant quality.

## 7 Electrical installation



The electrical installation is described in the device-specific Operating Instructions.

---

## 8 Commissioning of frequency inverter



Commissioning is described in the relevant Operating Instructions.

---

## 9 Maintenance



In order to perform maintenance the coolant must be drained.

- Cover neighboring electrical and electronic components and terminals or protect them from water.
  - Use a suitable vessel for the drained coolant.
  - Dispose of the coolant in an environmentally responsible manner.
  - Use compressed air to drain the heat sink.
-







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