

Rittal – The System.

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**TopTherm LCP Rack CW
TopTherm LCP Inline CW
TopTherm LCP Inline flush CW**

**SK 3311.135/235/265
SK 3311.535/565
SK 3311.545**

**Montage-, Installations- und Bedienungsanleitung
Assembly and operating instructions
Notice d'emploi, d'installation et de montage
Montage- en bedieningshandleiding**

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Forward

Dear Customer!

Thank you for choosing a Rittal Liquid Cooling Package (referred to hereafter also as "LCP").

This documentation applies to the following two units in the LCP series:

- LCP Rack CW
- LCP Inline CW
- LCP Inline flush CW

Those sections where information only applies to one of the three units are labelled accordingly in the documentation.

Model No. RAL 9005
SK 3311.135
SK 3311.235
SK 3311.265
SK 3311.535
SK 3311.545
SK 3311.565

Please take the time to read this documentation carefully.

Please pay particular attention to the safety instructions in the text and to Chapter 2 "Safety instructions".

This is the prerequisite for:

- secure assembly of the Liquid Cooling Package
- safe handling and
- the most trouble-free operation possible.

Please keep the complete documentation readily available so that it is always on hand when needed.

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We are always happy to answer any technical questions regarding our entire range of products.

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1 Notes concerning the documentation

1.1 CE labelling

Rittal GmbH & Co. KG hereby confirms that the cooling units in the Liquid Cooling Package series are compliant with the EC EMC Directive 2004/108/EC. A corresponding declaration of conformity has been issued and enclosed with the documentation package supplied with the unit.

The cooling unit bears the following mark:



1.2 Storing the documents

The operating and maintenance instructions as well as all applicable documents are integral components of the product. They must be handed out to those persons who are engaged with the unit and must always be available and on hand for operating and maintenance personnel.

1.3 Symbols in these operating instructions

These following symbols are found in this documentation:



Danger!
Hazardous situation leading directly to death or serious injury if the instructions are not followed.



Warning!
Hazardous situation which may lead to death or serious injury if the instructions are not followed.



Caution!
Hazardous situation which may lead to (minor) injuries if the instructions are not followed.



Note:
Information concerning individual procedures, explanations, or tips for simplified approaches. Also indicates situations which may result in material damage.

- This symbol indicates an “Action Point” and shows that you should carry out an operation/procedure.

1.4 Other applicable documents

In conjunction with these operating and maintenance instructions, the superordinate system documentation (if available) also applies.

Rittal GmbH & Co. KG is not responsible for any damage which may result from failure to comply with these operating and maintenance instructions. The same applies to failure to comply with the valid documentation for accessories used.

1.5 Normative instructions

1.5.1 Legal information concerning the operating instructions

We reserve the right to make changes in content. Rittal GmbH & Co. KG will not be held liable for any mistakes in this documentation. Liability for indirect damages associated with the supply or use of this documentation is excluded to the extent allowable by law.

1.5.2 Copyright

The distribution and duplication of this document and the disclosure and use of its contents are prohibited unless expressly authorized.

Offenders will be liable for damages. All rights created by a patent grant or registration of a utility model or design are reserved.

1.5.3 Initial Release

11/16/2012

2 Safety instructions

The Liquid Cooling Packages produced by Rittal GmbH & Co. KG are developed and produced with due regard to all safety precautions. Nevertheless, the unit still causes a number of unavoidable dangers and risks. The safety instructions provide you with an overview of these dangers and the necessary safety precautions.

In the interest of your safety and the safety of others, please read these safety instructions carefully before assembly and commissioning of the Liquid Cooling Package.

Follow the user information found in these instructions and on the unit carefully.

2.1 Important safety instruction



Danger! Electric shock!
Contact with live electrical parts may be lethal. Before switching on, ensure that it is not possible to come into contact with live electrical parts. The unit has a high discharge current. For this reason, it is essential to make a 10mm² earth connection before connecting to the supply circuit (see chapter 15.4 "Circuit diagram").



Danger! Injury caused by fan impellers!
Keep persons and objects away from the fan impellers! Do not remove covers until the power supply is disconnected and impellers are not moving! Always use mechanical protection when working! Shut down the respective fan during maintenance work, if possible! Tie long hair back! Do not wear loose clothing! Fans start up automatically following power disruptions!



Danger! Cut wounds, especially through sharp edges of the fan module and heat exchanger modules! Put on protective gloves before beginning assembly or cleaning work!



Danger! Injury due to falling loads! Do not stand under suspended loads when transporting the unit with a hoist trolley, a forklift, or a crane.



Caution! Risk of malfunction or damage!
Do not modify the unit! Use only original spare parts!



Caution! Risk of malfunction or damage!
Proper and flawless unit operation can only be ensured when it is operated under the intended ambient conditions. As far as possible, be sure that the ambient conditions for which the unit is designed are complied with, e.g. temperature, humidity, air purity.



Caution! Risk of malfunction or damage!
All media necessary for the control system, e.g. cooling water, must be available during the entire operating time.



Caution! Risk of malfunction or damage!
It is vital that the manufacturer's consent is obtained before adding anti-freeze!



Caution! Risk of malfunction or damage!
During storage and transportation below freezing point, the water cycle should be drained completely using compressed air!



Caution! Risk of malfunction or damage!
Only set the temperature control set point as low as is strictly necessary, since the danger of condensation through under-cutting the dew point increases with a falling water inlet temperature! Ensure that the enclosure is sealed on all sides, particularly at the cable entry (condensation)!

As a general requirement, please observe the following five safety rules to DIN VDE 0105 when working in and on the Liquid Cooling Package, in order to avoid accidents:

1. Switch off!
Switch off the Liquid Cooling Package at the master switch.
2. Prevent reactivation!
3. Ensure that all poles are de energized!
4. Earth and short-circuit!
5. Cover or shield adjacent, live parts.

2.2 Service and technical staff

The installation, commissioning, maintenance and repair of this unit may only be carried out by qualified mechanical and electro-technical trained personnel. Only properly instructed personnel may carry out service on a unit while in operation.

2.3 RoHS compliance

The Liquid Cooling Package fulfils the requirements of EU directive 2002/95/EC on the Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) of 13 February, 2003.



Note:

Corresponding information concerning the RoHS directive is provided by our firm on the Internet at www.rittal.de/RoHS.

3 Device description

3.1 General functional description

The Liquid Cooling Package is essentially an air/water heat exchanger used to dissipate high heat losses from server enclosures or for the effective cooling of devices built into a server enclosure. The air routing in the Liquid Cooling Package supports the “front to back” cooling principle of the devices built into the server enclosure. The hot air expelled by the devices in the server enclosure is drawn in by the fans at the rear directly from the server enclosure (LCP rack) or from the hot aisle (LCP Inline and LCP Inline flush) and thus routed through the heat exchanger module.

In the heat exchanger module, the heated air is directed through an air/water heat exchanger, and its thermal energy (heat losses from the server) is transferred to a cold water system. As a result, the air is cooled to a freely selectable temperature within the authorised parameters and then routed directly in front of the 482.6 mm (19”) level in the server enclosure (LCP Rack) or into the cold aisle (LCP Inline and LCP Inline flush).

In its delivered state, the LCP Inline expels the cold air on both sides. By fitting a side panel or partition, this can be restricted to one side only.

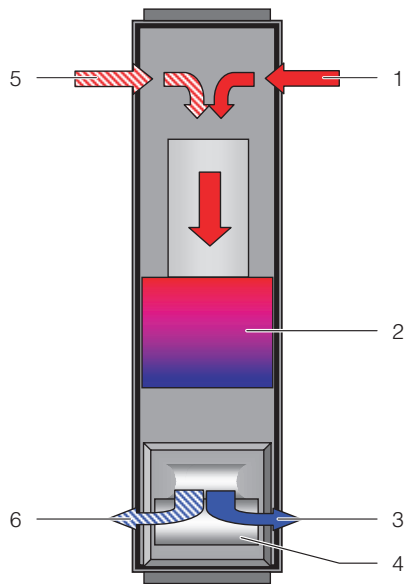


Fig. 1: Air routing on the LCP rack – Top view

Key

- 1 Air inlet
- 2 Heat exchanger
- 3 Air outlet
- 4 Fan module
- 5 2nd air inlet
- 6 2nd air outlet

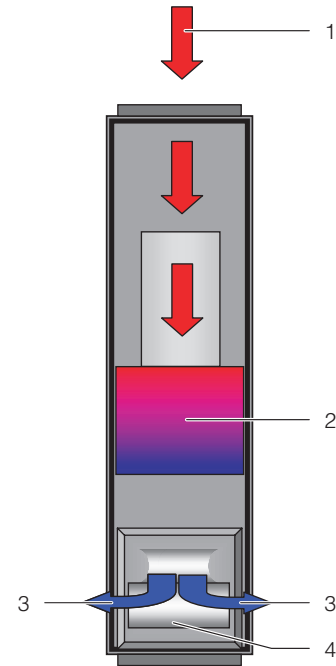


Fig. 2: Air routing on the LCP Inline – Top view

Key

- 1 Air inlet
- 2 Heat exchanger
- 3 Air outlet
- 4 Fan module

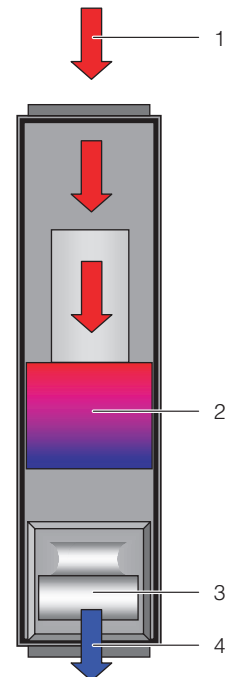


Fig. 3: Air routing on the LCP Inline flush – Top view

Key

- 1 Air inlet
- 2 Heat exchanger
- 3 Fan module
- 4 Air out

The temperature of the cold air intake is controlled via constant comparison of the actual temperature with the set point temperature set on the Liquid Cooling Package (default is +20°C).

If the server-in temperature exceeds the set point temperature, the control valve in the cooling water system opens (linear opening from 0 - 100%), and the heat exchanger is supplied with cold water.

The temperature differential between the set point and the warm air intake is used to determine and control the fan speed. The control unit attempts to keep the air temperature constant in front of the 482.6 mm (19") level (LCP Rack) or in the cold aisle (LCP Inline and LCP Inline flush) by activating the control valve.

Any condensate incurred is collected in the condensate collecting tray built into the water module of the Liquid Cooling Package, and from there is routed outside via a condensate discharge hose.



Note:

The water inlet temperature must always be selected (controlled) to be above the dew point for the existing ambient temperature and humidity in the data center. The dew point can be found in the Mollier h-x diagram (Fig. 4).

Furthermore, we advise compliance with the ASHRAE standard "ASHRAE TC 9.9, 2011 Thermal Guidelines for Data Processing Environments".

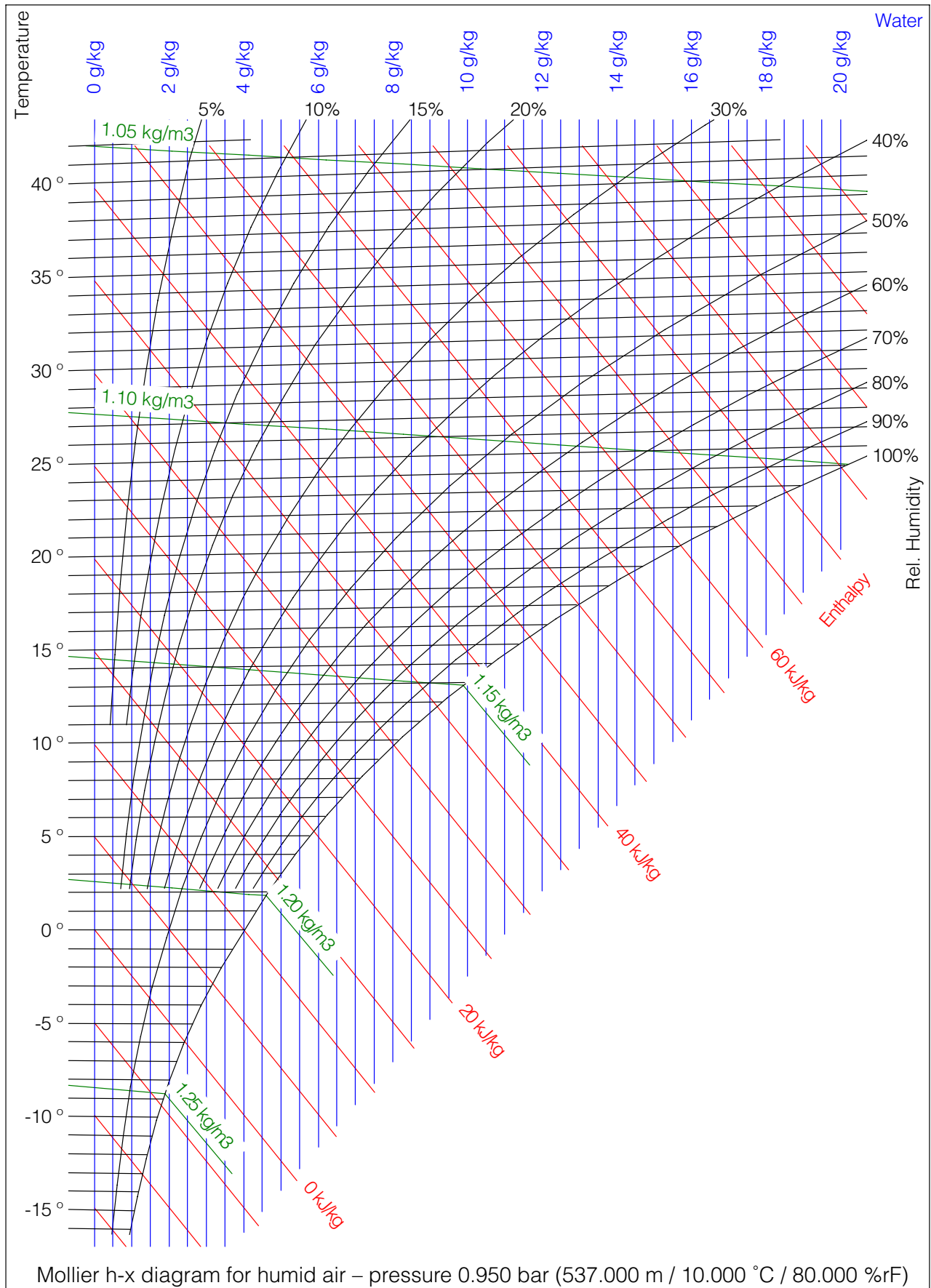


Fig. 4: Mollier h-x diagram for humid air

3.2 Air routing

3.2.1 General

In order to achieve sufficient cooling in the server enclosure, it is important to ensure that the cooling air passes through the interior of the built-in units and is unable to flow past at the sides.

Targeted air routing in the server enclosure has a major effect on the heat loss to be dissipated.

In order to ensure targeted air routing in the system, the server enclosure should be divided vertically into warm air and cold air sections. The division is accomplished in the front section of the server assembly to the left and right of the 482.6 mm (19") level using foam strips or air baffle plates which, depending on the enclosure width and the number of server enclosures to be cooled, can be ordered as an accessory (see Chapter 14 "Accessories").

If devices which require sideways air throughput are also built into the server enclosure (e.g. switches, router, etc.), these may be cooled by means of targeted placement of the foam strips or air baffle plates.



Note:

The 482.6 mm (19") level must likewise be completely sealed. This is already the case in a fully equipped server enclosure. If the server cabinet is partially equipped, the open height units (U) of the 482.6 mm (19") level must be sealed with blanking plates, which are available from Rittal Accessories (see chapter 14 "Accessories"). The more devices are installed in the server enclosure, the more important it becomes to follow this specification.

3.2.2 LCP Rack

The LCP Rack may be bayed on the right or left of a server enclosure, according to preference.

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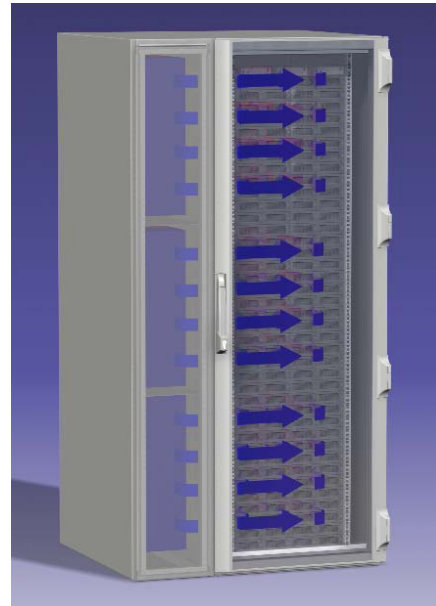


Fig. 5: LCP Rack on a server enclosure

The LCP Rack may also be bayed between two server enclosures.



Fig. 6: LCP Rack on two server enclosures

Together with the bayed server enclosure, the LCP Rack forms an airtight cooling system with horizontal air routing. It places no additional demands on the room's climate control system.

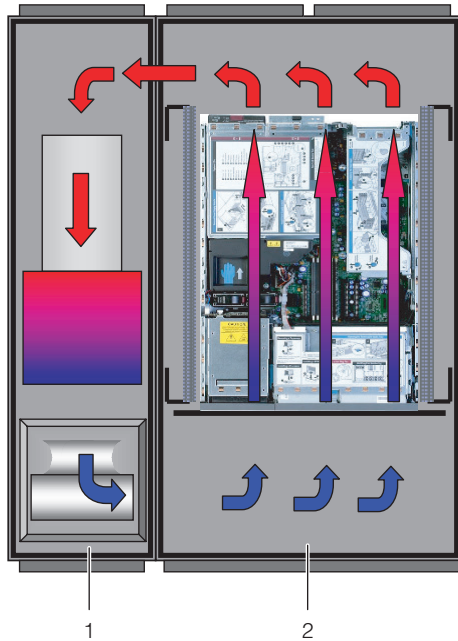


Fig. 7: Air routing with a bayed server enclosure – top view

Key

- 1 LCP Rack
- 2 Server enclosure

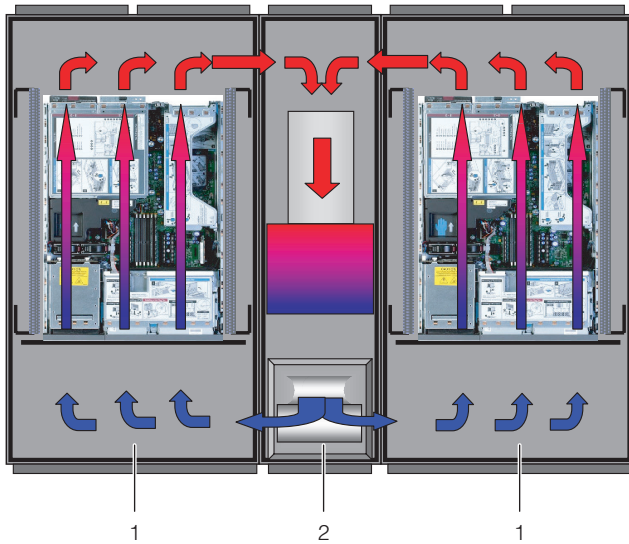


Fig. 8: Air routing with two bayed server enclosures – top view

Key

- 1 Server enclosure
- 2 LCP Rack

The system consisting of the LCP Rack and the server enclosure should be sealed as effectively as possible in order to prevent the loss of cooling air. To accomplish this, the enclosure is equipped with side panels, roof and gland plates. Any existing cable entries should be sealed e.g. using suitable brush strips. Whilst the system is in operation, both the front and the rear doors should be kept completely shut.



Note:

However, the system does not need to be completely airtight, thanks to the high, coordinated air throughputs of the server and LCP fans.

3.2.3 LCP Inline and LCP Inline flush

Targeted air routing by hot air extraction from the hot aisle and cold air blown into the cold aisle has a fundamental effect on the amount of heat to be dissipated.

In order to achieve sufficient cooling in the server enclosure, it is important to ensure that the cooling air passes through the interior of the built-in units and is unable to flow past at the sides.

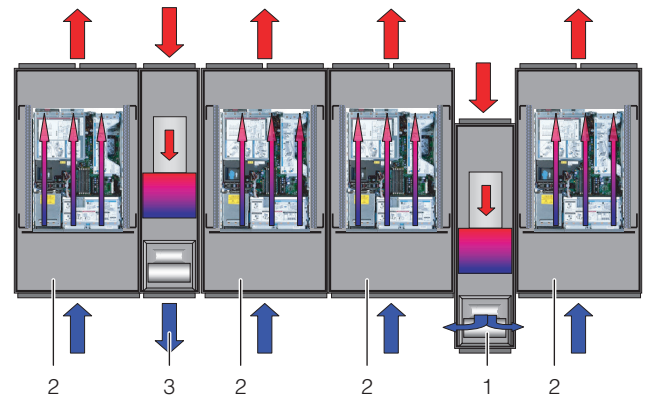


Fig. 9: Air routing with bayed server enclosures – top view

Key

- 1 LCP Inline
- 2 Server enclosure
- 3 LCP Inline flush

For this purpose, the system consisting of LCP Inline or LCP Inline flush, server enclosure and cold aisle containment should be sealed as effectively as possible in order to avoid a decrease in cooling capacity due to mixing of cold and hot air. This is achieved by sealing the cold aisle with doors at the beginning and end of the rack rows, and sealed against the ceiling with roof elements. Existing cable entry glands are additionally sealed e.g. with suitable brush strips.

3.3 Equipment assembly

3.3.1 Schematic design

The schematic design is illustrated below:

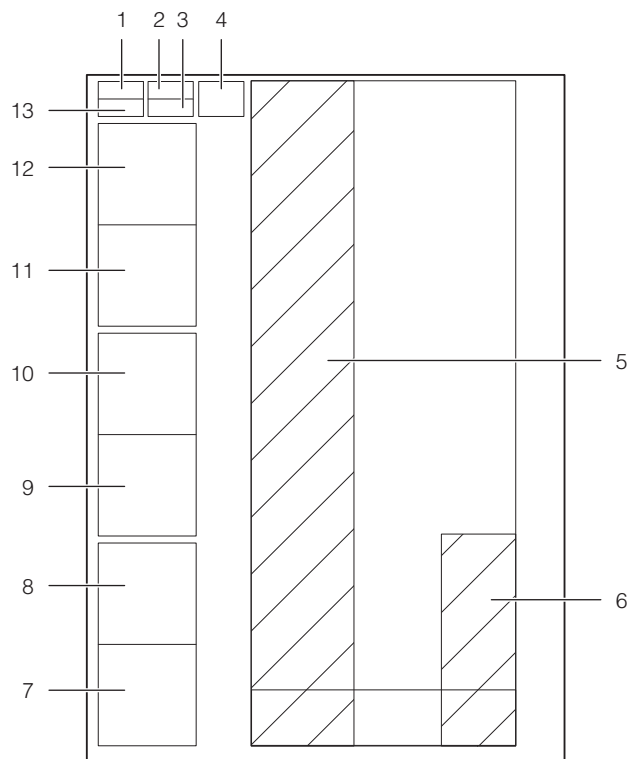


Fig. 10: Schematic design of a Liquid Cooling Package – right-hand side view

Key

- 1 Fuse box with master switch
- 2 Water PCB
- 3 Fan PCB
- 4 Startup current limitation
- 5 Air/water heat exchanger
- 6 Water module
- 7 Fan 6
- 8 Fan 5 (not with LCP Inline flush)
- 9 Fan 4
- 10 Fan 3
- 11 Fan 2 (not with LCP Inline flush)
- 12 Fan 1
- 13 Control unit (Basic CMC)

The Liquid Cooling Package consists of a fuse box, a superordinate control unit (Basic CMC), a water module, a heat exchanger, and the fan modules. In its supplied state, the following fan modules are built into the devices:

Device/cooling output	30 kW	55 kW
LCP Rack	1 module	4 modules
LCP Inline	1 module	4 modules
LCPInline flush	2 modules	–

Tab. 1: No. of fan modules in supplied state

The fan modules and the water module contain their own electronic controls (1 x RLCP fan and 1 x RLCP water), which are connected to the Basic CMC via an I2C bus. The fan modules are switched on sequentially from one to six via a startup current limitation once connected to the mains voltage.

3.3.2 Unit components

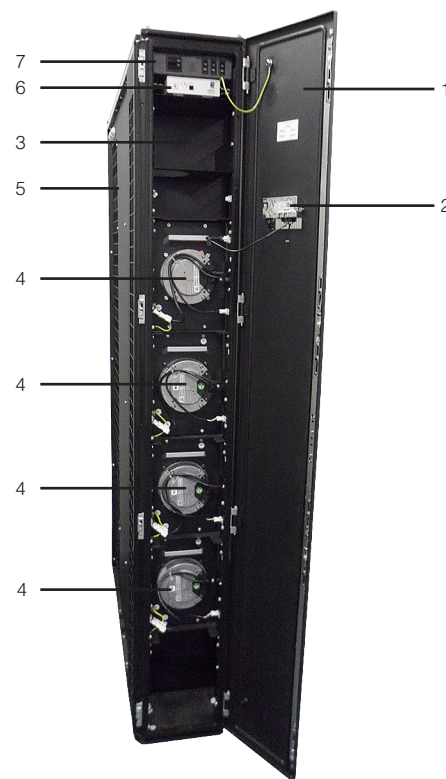


Fig. 11: Liquid Cooling Package front – open front door (60 kW variant)

Key

- 1 LCP door
- 2 Optional display with touch function (rear)
- 3 Blanking panel
- 4 Fans (in this instance, four)
- 5 Rack
- 6 Control unit (Basic CMC)
- 7 Fuse box with master switch

3 Device description

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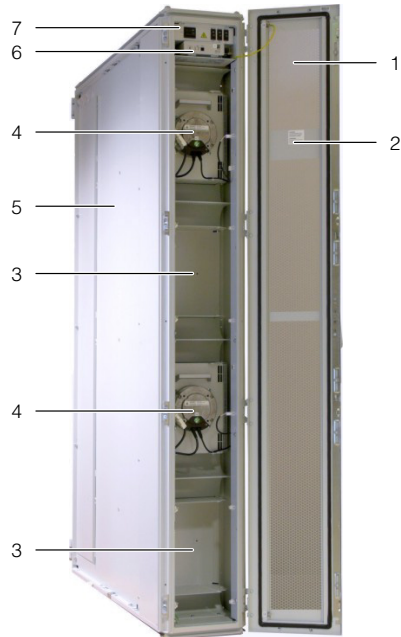


Fig. 12: LCP Inline flush front – open front door

Key

- 1 LCP door
- 2 Installation location for optional display with touch function
- 3 Blanking panel
- 4 Fans (in this instance, two)
- 5 Rack
- 6 Control unit (Basic CMC)
- 7 Fuse box with master switch

The fuse box is comprised of the following components:

- Thermally activated master switch
- 3 thermally activated switches for fan pairs 1/2, 3/4 and 5/6
- AC/DC power pack for Basic CMC supply
- EMC line filter

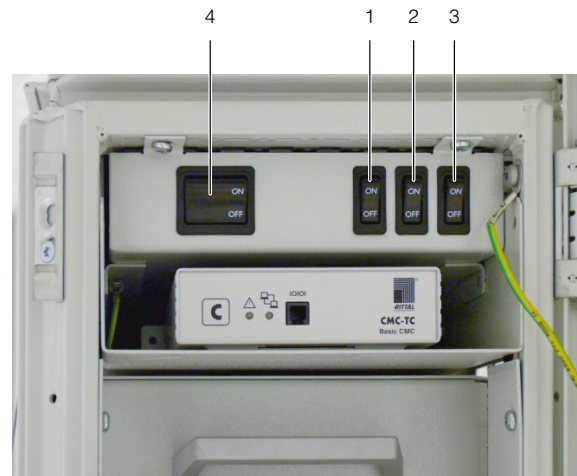


Fig. 13: Fuse box with master switch

Key

- 1 Thermally activated switch, fan pair 1/2
- 2 Thermally activated switch, fan pair 3/4
- 3 Thermally activated switch, fan pair 5/6
- 4 Thermally activated master switch

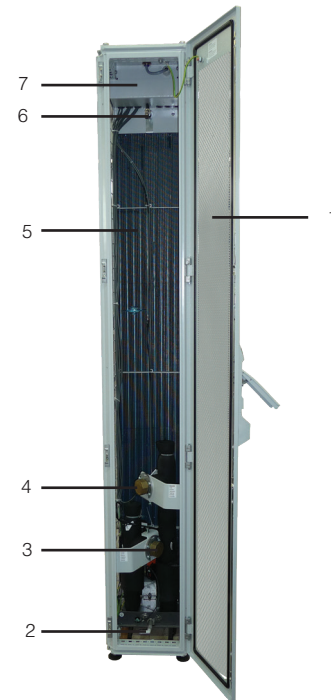


Fig. 14: LCP Rack rear – rear door open

Key

- 1 LCP rear door
- 2 Condensate collecting tray and condensate discharge
- 3 Water connection, return
- 4 Water connection, inlet
- 5 Air/water heat exchanger
- 6 Vent valve
- 7 Electrical access panel

**Note:**

In principle, the rears of the LCP Inline and the LCP Inline flush look exactly the same as the LCP Rack, except that they have a perforated door.

The Liquid Cooling Package consists of a solid welded frame in which the heat exchanger, fan modules, and the water module are installed.

One wide and one narrow wall plate are mounted on both the left and right sides. A vertical divider plate is positioned at the joint of the two plates, which separates the Liquid Cooling Package into warm and cold air sections.

The wide wall plates on right and left sides of the device form the cold air section together with the divider plate and the built-in air/water heat exchanger. The wall plates have been punched with air outlet openings along their entire height in the front section to ensure cold air supply to the server (LCP Rack) or to the cold aisle (LCP Inline).

The narrower wall plates close off the rear of the device and form the warm air section together with the divider plate. In the LCP Rack, the wall plates have been punched with air inlet openings along their entire height and width to ensure the dissipation of warm air from the server.

Seven shelves (or in the case of the LCP Inline flush, five shelves) are positioned between these wall plates that divide the front of the Liquid Cooling Package into several compartments of differing heights. The top shelf supports the fuse box, the control unit (Basic CMC), the fan and water PCB, and the startup current limitation. The compartments for the fans are below this. All components of the cooling water supply and condensate management are integrated into the water module on the floor of the Liquid Cooling Package.

The front and rear of the Liquid Cooling Package are each closed with a door with 4-point locking.

In the LCP Rack these doors seal the unit completely. In the LCP Inline and LCP Inline flush, the rear door is perforated to ensure the dissipation of hot air from the hot aisle. In the LCP Inline flush, the front door is additionally perforated to ensure the supply of cooling air into the cold aisle.

The optional display with touch function for operation in stand-alone mode is located on the front.

3.3.3 Air/water heat exchanger

The air/water heat exchanger is installed in the center section of the Liquid Cooling Package between the two wall plates. In 30kW units (SK 3311.135/235/535/545), the heat exchanger is covered with a spray eliminator on the air outlet side that catches any condensate and directs it to the condensate collecting tray at the bottom of the Liquid Cooling Package.

Three temperature sensors are mounted on the rear of the spray eliminator at the level of the fan modules. The sensors record the temperature of the cold air intake and send it to the control unit.

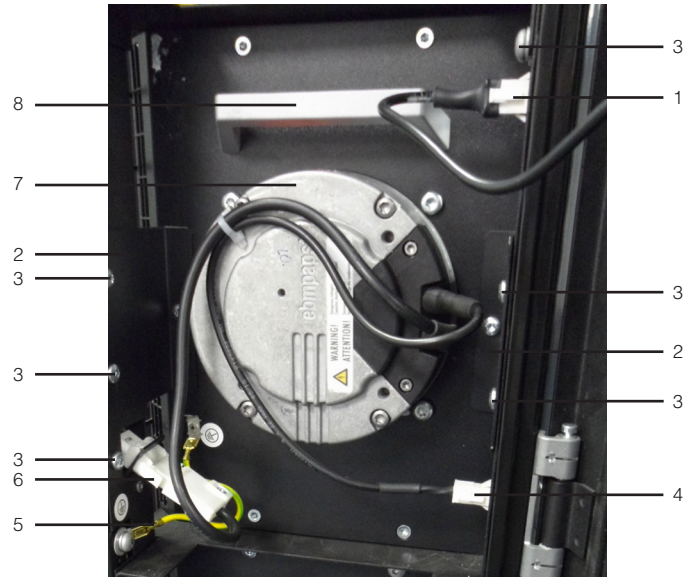
3.3.4 Fan module

Fig. 15: Fan module in fan tray – LCP Inline and LCP Rack version

Key

- 1 Connection cable for graphic display
- 2 Mounting bracket
- 3 Assembly screws
- 4 Connector DC
- 5 Earth connection
- 6 Connector AC
- 7 Fan
- 8 Handle

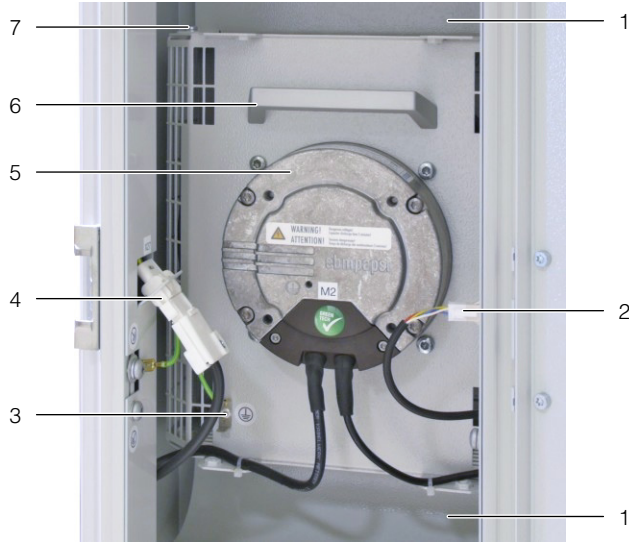


Fig. 16: Fan module in fan tray – LCP Inline flush version

Key

- 1 Air baffle plate
- 2 Connector DC
- 3 Earth connection
- 4 Connector AC
- 5 Fan
- 6 Handle
- 7 Assembly screws (4)

A fan module is essentially comprised of the fan itself. All fan modules are controlled by a shared control unit (RLCP fan). The fans may be operated with linear control from 0%–100% (whereby all fans continuously operate with the same output). The fan modules are installed on rack mounted shelves in the front section of the Liquid Cooling Package.

The control unit of the fan modules is fitted in the upper section of the Liquid Cooling Package. The two connection cables for the power supply and pilot wire are routed out of the underside of the fan. In the LCP Rack and LCP Inline, the intake end of the fan module lies against a sealing section mounted on the left and right of the rack, which forms an effective seal. In the LCP Inline flush, the fans lie directly against the rack. This means that in the installed state, the fans are connected directly to the unit's air/water heat exchanger, enabling the air from the air/water heat exchanger to be routed directly and without interruption to the fan module.

Because the individual fan modules are located on separate bases, it is possible to remove a single fan module and replace it easily during operation. It takes about 2 minutes to replace a fan module (see Chapter 5.3 "Fan installation").

3.3.5 Water module with cold water connection

A significant component of the water module is the stainless steel condensate collecting tray, on which a leak sensor and a condensate discharge are located.

In addition to the leak sensor, the condensate tray is also equipped with a pressureless condensate discharge. This directs the condensate out of the Liquid Cooling Package to the rear. The hose must be connected to an external discharge (see chapter 6.1.3 "Connecting the condensate discharge"). The pipe work for the Liquid Cooling Package's cooling water connection (inlet and return) runs above the condensate collecting tray. The lines connect the rear-mounted cooling water connection with the air/water heat exchanger built into the front of the device. The lines are insulated to avoid the formation of condensation. A motorized control valve is located in the cooling water inlet line to control the cooling water flow.

The control unit of the water module is fitted in the upper section, below the power supply to the Liquid Cooling Package.

The cooling water connection is connected to the main inlet and return connections by two 1½" externally threaded pipes for flange gaskets. The connection nozzles are positioned horizontally to the rear.

The cooling water connection to the cold water network can be made by either rigid pipe work or flexible hoses, which are available from the Rittal accessory range (Model No. SK 3311.040).

3.4 Proper and improper usage

The Liquid Cooling Package is used to dissipate high heat losses and effectively cool devices built into a server enclosure. The unit is designed solely for stationary use in sealed rooms. The unit is state of the art and built according to recognized safety regulations. Nevertheless, improper use can present a hazard to life and limb of the user or third parties, or result in possible damage to the system and other property.

Consequently, the unit must only be used properly and in a technically sound condition. Any malfunctions which impair safety should be rectified immediately. Follow the operating instructions!

Proper use also includes following the operating instructions and fulfilling the inspection and maintenance conditions.

Inappropriate use may result in danger. Inappropriate use may include:

- Use of impermissible tools.
- Improper use.
- Improper rectification of malfunctions.
- Use of replacement parts which are not authorized by Rittal GmbH & Co. KG.
- Failure to observe the required water quality.
- Use of a coolant other than water.
- Expelling the cold air into an air duct system.
- Use in an industrial environment.
- Non-stationary use, e.g. on moving or vibrating machines.

3.5 Supply scope of a Liquid Cooling Package

The Liquid Cooling Package supply includes:

Qty.	Parts
1	Liquid Cooling Package, ready for connection
	Accessories:
1	Condensate hose (white)
1	Vent hose (blue)
2	Sealing strips
2	Cable ties and spreading anchors (strain relief for connection cables)
1	Strain relief
1	Instruction manual

Tab. 2: Supply scope of a Liquid Cooling Package

3.6 Unit-specific instructions

3.6.1 Creation of redundancy in the LCP

Rack cooling redundancies are easily achieved via the previously described baying possibilities. Separation of the server enclosure from the Liquid Cooling Package makes it possible to achieve differing levels of redundancy.

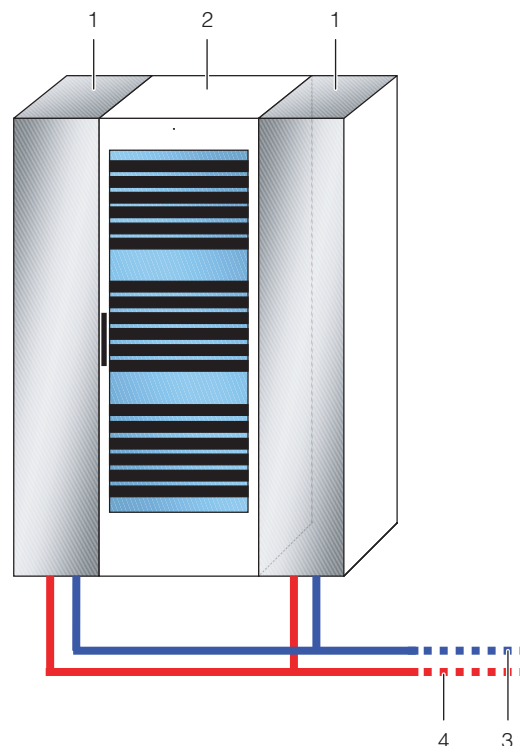


Fig. 17: Redundant or double cooling with two LCP Racks

Key

- 1 LCP Rack
- 2 Server enclosure
- 3 Cold water system inlet
- 4 Cold water system return

Two server enclosures may be cooled with 3 LCP Racks. Depending on the cooling output, the device bayed in the middle, between the server enclosures, forms the redundancy for the respective left and right server enclosure.

3 Device description

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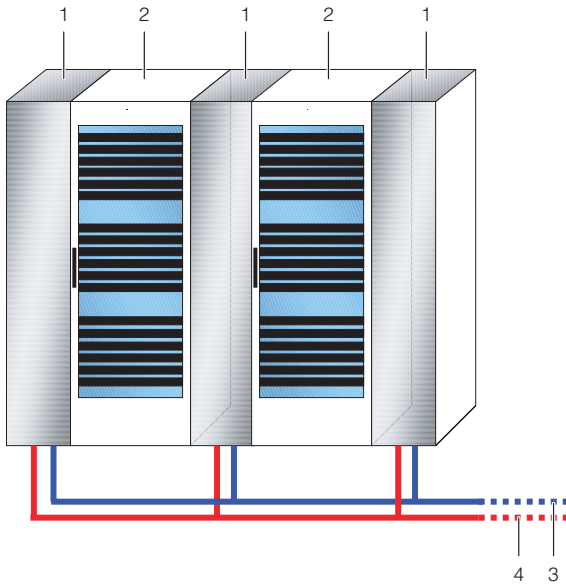


Fig. 18: Redundant cooling with three LCP Racks

Key

- 1 LCP Rack
- 2 Server enclosure
- 3 Cold water system inlet
- 4 Cold water system return

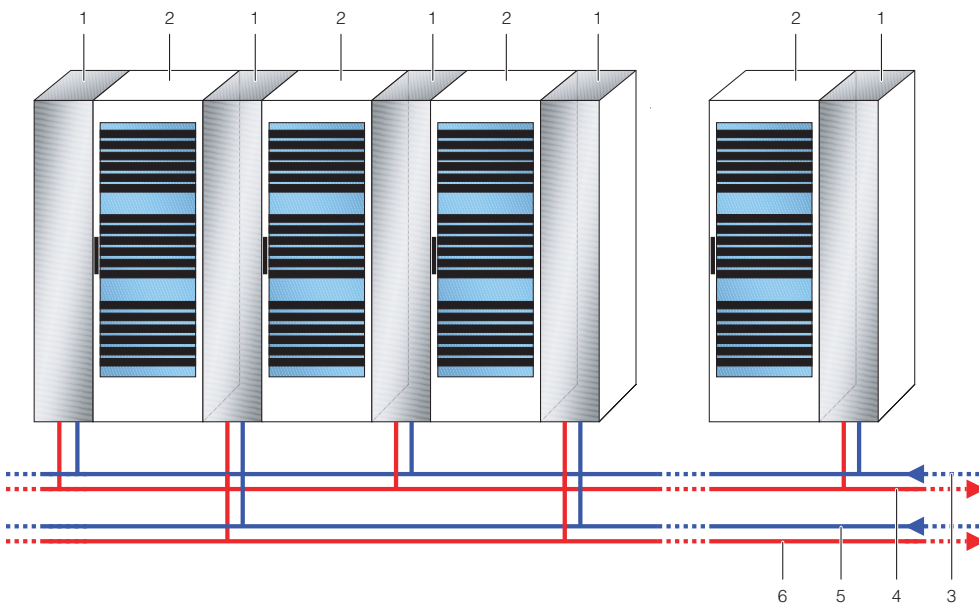


Fig. 19: Redundant cooling and double alternating water supply

Key

- 1 LCP Rack
- 2 Server enclosure
- 3 Cold water system inlet 1
- 4 Cold water system return 1
- 5 Cold water system inlet 2
- 6 Cold water system return 2

3.6.2 Dewpoint control

A dew point control must be installed on the LCP Inline (SK3311.535/565), the LCP Inline flush (SK 3311.545) and on the 60kW version of the LCP Rack (SK3311.265).

This form of control depends on the components and settings of the complete facility and therefore varies from case to case. If there already is a cooling unit that controls the air humidity of the room, additional dew-point control is not necessary in the majority of cases, since this cooling unit already regulates the humidity according to the recommendations of the ASHRAE standard “ASHRAE TC9.9, 2011 Thermal Guidelines for Data Processing Environments”. If the dew point is to be regulated by the LCP Inline or the LCP Inline flush itself, there are two regulation types available with the same additional scope of installations. First, a humidity sensor (DK 7320.510) needs to be installed into the outlet side of the LCP Inline or LCP Inline flush. It is easily mounted on the TS 8 frame and effortlessly connected to the Basic CMC of the LCP Inline or LCP Inline flush. The alert triggering range for a humidity of $\leq 95\%$ should then be set via the integrated software.

Generally speaking, the dew point monitor should be installed on the outlet side of the unit. Upon approaching the dew point, it must be capable of raising the inlet temperature of the cold water or deactivating the cooling via a controller.

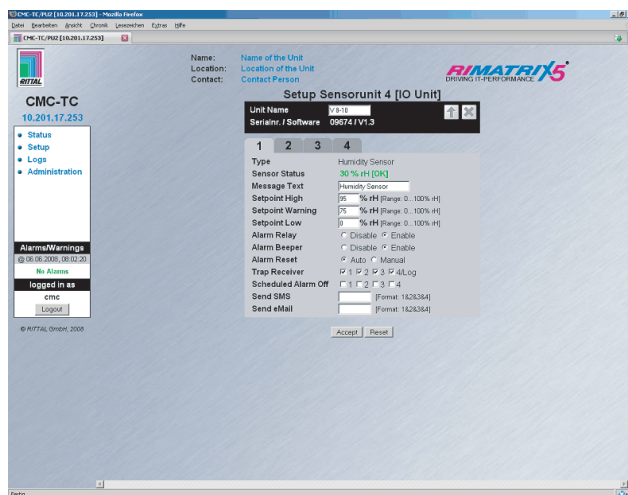


Fig. 20: Humidity sensor settings

The following can be selected in the “Combinations” section in case of an alarm: either the fans are switched off (Attention! Cooling capacity is no longer guaranteed), or the integrated regulating valve is closed, thereby raising the temperature of the heat exchanger above the dew point. These solutions may, however, cause a failure or decrease in cooling capacity.

The facility must have an independent dew point monitor if you do not opt for internal control.

A dew point regulator installed in the plant mainly depends on the way in which the LCP Inline or LCP Inline flush is supplied with cold water.

4 Transportation and handling

EN

4 Transportation and handling

4.1 Transport

The Liquid Cooling Package is delivered shrink-wrapped on a pallet.



Caution!

Because of its height and small base, the Liquid Cooling Package is subject to tipping. Risk of toppling, especially after the unit is removed from the pallet!



Caution!

Transport of the Liquid Cooling Package without a pallet: Use only suitable and technically sound lifting gear and load-bearing devices with sufficient load capacity.

4.2 Unpacking

- Remove the unit's packaging materials.



Note:

After unpacking, the packaging materials must be disposed of in an environmentally friendly way. They are comprised of the following materials:
Wood, polyethylene film (PE film), strap, edge protectors.

- Check the unit for damages occurring in transport.



Note:

Damage and other faults, e.g. incomplete delivery, should immediately be reported to the shipping company and to Rittal GmbH & Co. KG in writing.

- Place the unit in its intended location.

5 Assembly and siting

5.1 General

5.1.1 Installation site requirements

In order to ensure problem-free operation of the Liquid Cooling Package, the following conditions for the installation location should be observed:

Supply connections required at the installation site

Type of connection	Connection description:
Power connection:	230V, 1~, 50/60 Hz 20A, 400V, 3~, N, PE, 50/60 Hz 16A, 3~
Cooling water connection:	15°C inlet temperature 6 bar permissible operating pressure Volumetric flow: depending on design (see Chapter 15.2 "Characteristic curves") 1½" threaded pipe connection

Tab. 3: Supply connections required at the installation site



Note:

Please see the notes and data regarding the cold water connection in Chapter 6.1.2 "Cooling water connection" and in Chapter 15.1 "Hydrological information".



Recommendation:

For easier servicing of the Liquid Cooling Package, maintain a distance of at least 1m between the front and rear of the device and the nearest wall.

Floor conditions

- The floor of the installation space should be rigid and level.
- Choose the installation site so that the unit is not situated on a step, unlevel location, etc.



Recommendation:

Room temperature +22°C at 50% relative air humidity, according to ASHRAE guidelines.

Electromagnetic interference

- Interfering electrical installations (high frequency) should be avoided.

5.1.2 Prepare the room for installation of the LCP Inline and LCP Inline flush

The installation site of the LCP Inline and LCP Inline flush

must be divided into one cold air zone and one hot air zone. This ensures that no cooling capacity is lost due to mixing of cold and hot air.

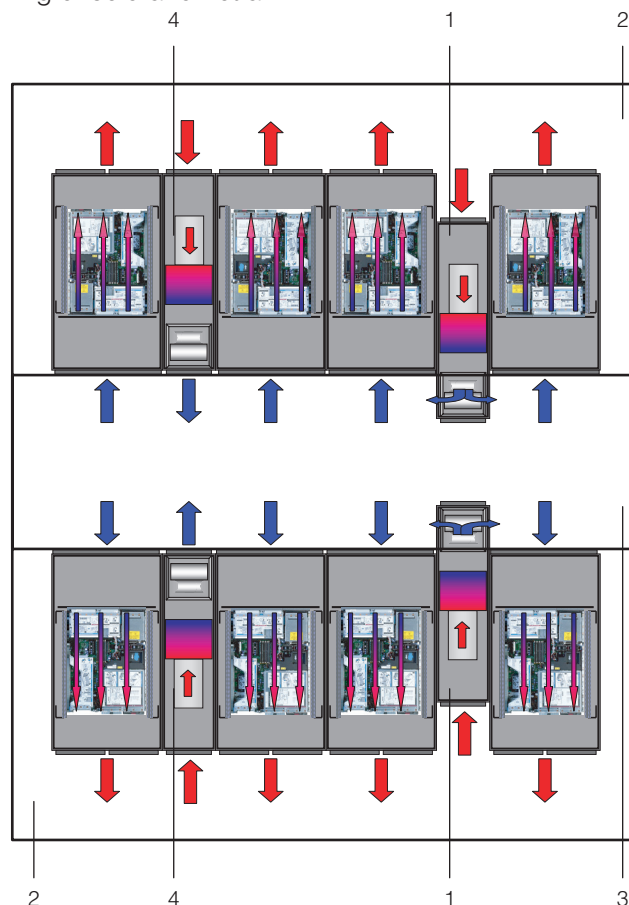


Fig. 21: Installation room with cold aisle compartmentalization

Key

- 1 LCP Inline
- 2 Hot aisle
- 3 Cold aisle
- 4 LCP Inline flush



Note:

All components required to install suitable cold aisle containment are available from Rittal as accessories.

5.1.3 Installation regulations for the LCP Inline and LCP Inline flush

The positioning in the rack aisles must be considered when planning the layout. The following points are to be considered:

- Heat loss in the adjacent server racks
- Air throughput in the adjacent server racks
- Distances from the adjacent server racks

Heat losses in the adjacent server racks

If the LCP Inline or LCP Inline flush is used in combination with server racks with high heat losses, the number of LCP Inline or LCP Inline flush units must be adapted according to the characteristic curves (see Chapter 6.2 “Cooling operation and control characteristics”). The air temperature difference between server inlet and server outlet, which is determined by the equipment used, is of particular interest. As a rule of thumb, a temperature difference of 15 K can be expected. There may, however, be greater differences.

Air throughput in the adjacent server racks

Due to the containment of the hot and cold zones, it is important to ensure that the LCP Inline or LCP Inline flush delivers a sufficient amount of cold air into the cold zone. From there, the cold air is drawn back into the server enclosures by the equipment. A small surplus of air should generally be provided in order to compensate for any short-term demands of the equipment.

Distances from the adjacent server racks

In small applications and short aisles, the above points will not have a major impact on properties or cooling capacity provided the hot zone is thoroughly sealed off from the cold zone. For larger applications and long aisles, however, even distribution of the cooling units should be ensured, due to the loss of air throughput caused by pressure changes and convection or radiation heat of the equipment. Other factors, such as high-temperature rooms adjacent to the cold zone or exterior walls warmed by the sun, can also occur.

5.2 Assembly procedure

5.2.1 General

Before the Liquid Cooling Package can be bayed onto the server enclosure, the following work should be carried out.

- Dismantle the side panels,
- Seal the server enclosure and
- Dismantle the server enclosure door.

5.2.2 Dismantle the side panels



Caution! Risk of injury!

The side panel holders have sharp-edged teeth, which enable earthing of the server enclosure's side panel.

If there is a side panel or partition mounted on the server enclosure side to which the Liquid Cooling Package is to be bayed, this must be removed first.

- Loosen and remove the 8 assembly screws found on each side panel of the server enclosure.
- Remove all side panel securing elements from the side of the server enclosure onto which the Liquid Cooling Package is to be bayed.
- Dismantle both side panel mountings from the upper mounting rail of the server enclosure, using an appropriate lever.
- Loosen and remove the screws on both of the side panel mounting brackets (top and bottom) in the middle of the mounting rail.
- Loosen and remove the screws from the 6 side panel holders on the side mounting rails.

5.2.3 Seal the server enclosure

In order to ensure targeted air routing in the system, the server enclosure is vertically divided into hot air and cold air zones by sealing the 482.6 mm (19") level. Proceed as follows to seal the 482.6 mm (19") level:

- If the server enclosure is only partially configured, seal the open sections of the 482.6 mm (19") level using blanking plates. Screw these tightly into the server rack from the front side.



Note:

Blanking plates in the various height units (U), together with both narrow and wide foam strips and air baffle plates, are available as Rittal accessories (see chapter 14 “Accessories”).

- Fasten the wider (Model No. SK 3301.370 / 3301.320) of the two foam strips from the Liquid Cooling Package accessories from outside onto one of the front supports of the server rack (Fig. 22).

Make sure to install this strip on the side of the server enclosure onto which the Liquid Cooling Package is to be bayed.

■ **If you are only buying the Liquid Cooling Package on one side:** Fasten the narrower (Model No. SK 3301.380/3301.390) of the two foam strips from the Liquid Cooling Package accessories from outside onto one of the front supports of the server rack (Fig. 22). Make sure to install this strip on the side of the server enclosure which will again be sealed by a side panel.

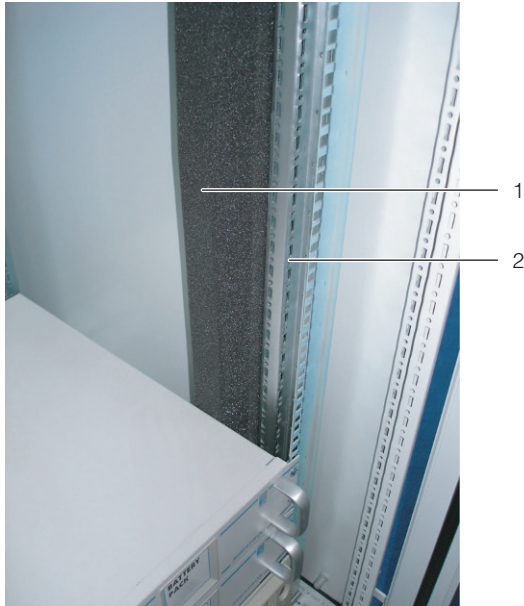


Fig. 22: Foam strip on a server rack support

Key

- 1 Foam strip
- 2 Server rack

If the server enclosure contains devices which require cooling via sideways air throughput (e.g. switches, router, etc.), cut-outs must be incorporated into the foam strips.

- To do this, cut out a piece of the foam strip with a sharp knife.
- If several devices which require sideways air throughput are included, cut out several pieces of the foam strip, as is appropriate, so that, ultimately, there is a cut-out in the foam to the left or right at the height of each such device in the server rack. Ensure that there are no gaps on the hot air side of the device (Fig. 23, item 3).
- Using a sharp knife, cut additional pieces from the foam strips that are at least as long as the height of the built-in devices.
- Attach the foam strips to the cold air side of the devices set back towards the rear (Fig. 23, item 4), making sure that all fans built into the devices can draw air and that none of them are blocked.



Note:

The foam strips can be attached between the front and rear supports of the server rack along the entire depth of the devices with sideways air throughput (Fig. 23, item 5).

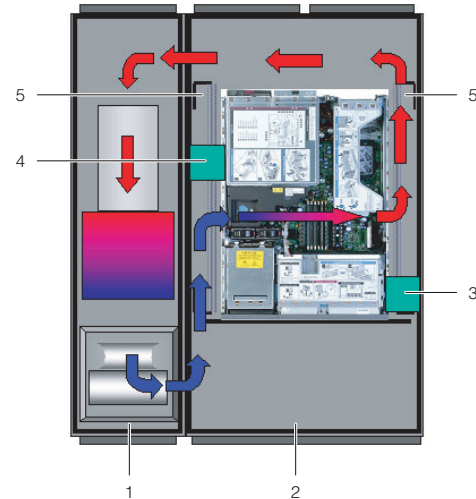


Fig. 23: Placement of foam strips for devices with sideways air throughput (top view) – LCP Rack

Key

- 1 LCP Rack
- 2 Server enclosure
- 3 Foam strips on hot air side
- 4 Foam strips on cold air side
- 5 Area in which the foam strips can be positioned

- If there is any surplus length of the foam strip on the server rack, cut it off at the top edge of the rack.



Note:

The Liquid Cooling Package may optionally be bayed onto a server enclosure with a width of either 600 mm or 800 mm. For this reason, the Liquid Cooling Package accessories include a total of four foam strips or corresponding air baffle plates with differing dimensions (see chapter 14 "Accessories").

- On the side of the server enclosure opposite the Liquid Cooling Packing, mount a side panel on the two side panel mountings. Align it with the front and rear side of the enclosure.
- Using the 8 assembly screws, screw the side panel firmly onto the side panel holders and the side panel mounting brackets.
- Seal off any cable entries which may be present with corresponding brush strips or similar.

5.2.4 Dismantle the server enclosure door

Before buying a Liquid Cooling Package, at least one of the two server enclosure doors must be dismantled so that the attachment points for the baying connectors are accessible and are not covered by a door edge.



Note:

It is only necessary to dismantle a server enclosure door when the Liquid Cooling Package is to be bayed onto a previously erected server enclosure. Otherwise, this work is not necessary. If the Liquid Cooling Package is to be installed together with a new server enclosure, proceed according to the enclosure's assembly instructions and bay the Liquid Cooling Package onto the server enclosure before assembling the server enclosure doors.

Proceed as follows to dismantle a server enclosure door:

- Remove the sealing bungs from the four door hinges with an appropriate tool (e.g. screwdriver).
- Release and open the server enclosure door.
- Loosen the hinge bolts from the four door hinges by raising them with an appropriate tool (e.g. screwdriver). Pull the bolts out of the hinge pin holding fixture as far as they will go (see Fig.24, Step A). Begin with the lowest door hinge.

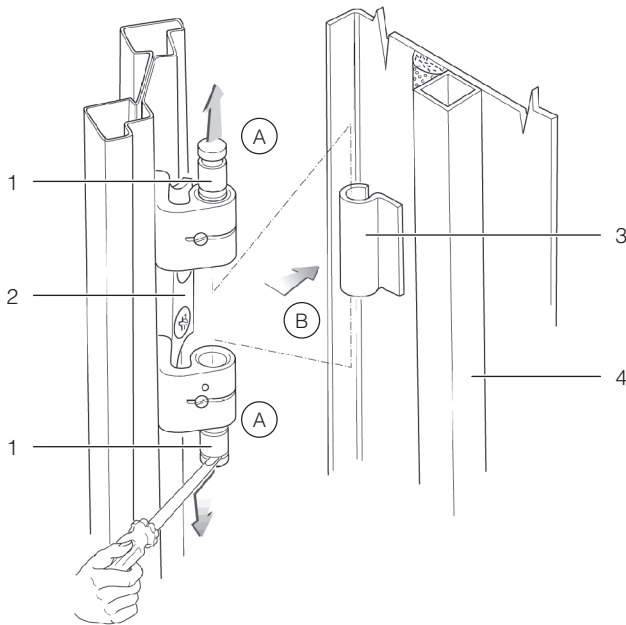


Fig. 24: Removing a door hinge

Key

- 1 Door hinge
- 2 Hinge pin holding fixture
- 3 Hinge joint
- 4 Server enclosure door



Note:

Support the server enclosure door so that it will not fall as the door hinges are loosened. If necessary, work with a second person.

- Remove the server enclosure door (Fig. 24, Step B).

5.2.5 Fit the rear adaptor on the LCP Inline

In order to achieve an even finish for the LCP Inline and the server enclosure fronts at the rear, a corresponding enclosure extension may be installed on the LCP Inline (see chapter 14 "Accessories").

- Dismantle the rear door of the LCP Inline in the same way as the server enclosure (see chapter 5.2.4 "Dismantle the server enclosure door").
- Dismantle the hinge pin holding fixtures (Fig. 25, item 1) and corresponding fixing components (Fig. 25, item 2) from the LCP Inline and reassemble at the rear of the adaptor in the same way.



Fig. 25: Assembly components on the Liquid Cooling Package – Rear view

Key

- 1 Hinge pin holding fixture
- 2 Fixing component

- Attach the adaptor (Fig. 26, item 2) to the rear opening of the LCP Inline using four of the supplied screws (Fig. 26, item 1) each on the left and right.

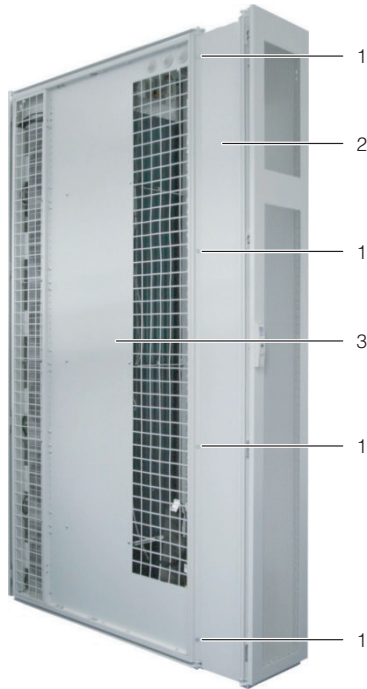


Fig. 26: Adaptor on the LCP Inline

Key

- 1 Assembly screws
- 2 Adaptor
- 3 LCP Inline

- Fit the door at the rear of the adaptor if you are securing the LCP Inline to the server enclosure with the aid of baying clamps.



Note:
If you are securing the LCP Inline to the server enclosure with the aid of baying clamps, do not fit the rear door yet.

5.2.6 Fit the trim panels if siting without a rear adaptor

If *no* rear adaptor is installed at the rear of the LCP Inline, with bayed server racks, a gap will appear when the side panels are removed.

- Fit a compensating panel (see chapter 14 “Accessories”) to the server racks in the rear section in order e.g. to prevent unauthorized access to the server racks.

5.2.7 Installation and baying of the Liquid Cooling Package

- Position the Liquid Cooling Package on the side of the server enclosure to which it is to be bayed.
- Pull the LCP Inline forwards until the air outlet holes on the side of the LCP Inline are completely in front of the front edge of the server enclosure.
- Align the Liquid Cooling Package with the server enclosure. Ensure that the Liquid Cooling Package is

aligned levelly and that both enclosures are adjusted to the same height and are vertically aligned to each other.

- Dismantle the door of the Liquid Cooling Package whose hinges are on the side on which the server enclosure is to be bayed. Proceed as described in Chapter 5.2.4 “Dismantle the server enclosure door”.



Note:
If the Liquid Cooling Package is to be bayed between two server enclosures, both doors of the Liquid Cooling Package must be dismantled before the baying connectors are installed so that the attachment points for the baying connectors are accessible.

Attachment of the LCP Rack and LCP Inline flush

- Using the corresponding assembly screws, fasten three baying connectors each (Fig. 27, item 2) onto the attachment points provided in the mounting strips on the front and rear of the LCP Rack or LCP Inline flush (Fig. 27, item 1).

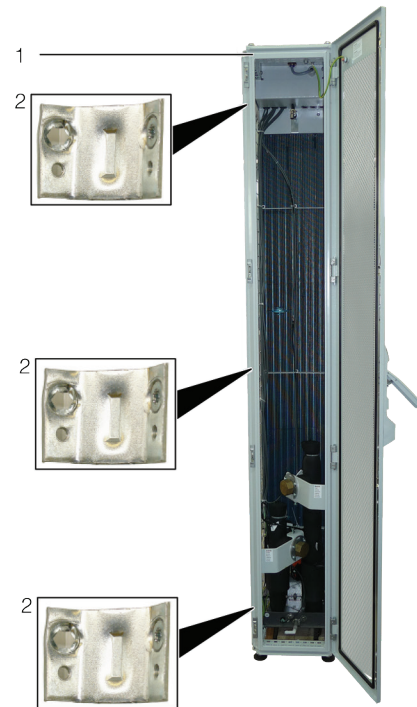


Fig. 27: LCP Rack – rear

Key

- 1 LCP Rack
- 2 Baying connector

- In the same way, fasten the baying connectors onto the attachment points provided in the mounting strips on the front and rear of the server enclosure. If necessary, press the LCP Rack or LCP Inline flush

lightly against the server enclosure in order to bring the baying connectors into alignment with the attachment points.

Attaching the LCP Inline

- Before baying the LCP Inline, dismantle any partitions or side panels that may be present on the server enclosure.
- In the front section, push out a baying clamp (Fig. 28, item 3) from the server enclosure (Fig. 28, item 2) through the corresponding notch in the side panel of the LCP Inline (Fig. 28, item 1).
- From the server enclosure, tighten the baying clamp (Fig. 28, item 4), so that the frames of the server enclosure and LCP Inline are firmly connected to one another.

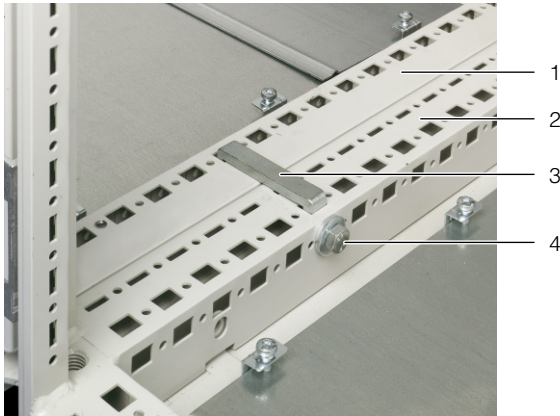


Fig. 28: Baying clamp

Key

- | | |
|---|--------------------------------|
| 1 | LCP Inline |
| 2 | Server enclosure |
| 3 | Baying clamp |
| 4 | Assembly screw of baying clamp |

- In the same way, insert a second baying clamp to connect the server enclosure and LCP Inline in the rear section.



Note:
If the rear frame is fitted on the LCP Inline, it may alternatively be fitted at the rear between the frame and the server enclosure, analogous to the LCP Rack, using three baying clamps (see the section on “Attaching the LCP Rack”).

All device versions:

- Where applicable, attach the rear door to the LCP Rack or to the rear adaptor of the LCP Inline.
- Finally, check the stability of the Liquid Cooling Package once again.

5.2.8 Mounting the side panel

If the Liquid Cooling Package is not bayed between two server enclosures, close it off with a side panel.



Caution! Risk of injury!

The side panel holders have sharp-edged teeth, to enable earthing of the side panel through the Liquid Cooling Package.

Proceed as follows to assemble the side panel:

- Remove the various assembly components from the optional side panel package (Model. No. SK 8100.235) or use those from a server enclosure which has already been dismantled.
- Using the assembly screws, mount the assembly components (2 side panel mountings, 2 side panel mounting brackets, 6 side panel holders) onto the side of the Liquid Cooling Package which is opposite to the server enclosure.
- Place both side panel mountings as symmetrically as possible onto the upper mounting rail of the Liquid Cooling Package and, using your hand, press them firmly in place.
- Screw down the two side panel mounting brackets top and bottom in the center of the mounting rail using one screw each.
- Screw down 3 side panel holders onto each of the two side mounting rails with one screw each.
- Mount a side panel onto the two side panel mountings of the Liquid Cooling Package and align them to the front and rear of the unit.
- Using the 8 assembly screws, screw the side panel firmly onto the side panel holders and the side panel mounting brackets.

5.3 Fan installation

As delivered, the Liquid Cooling Package contains the following number of fan modules as standard:

LCP Rack and LCP Inline:

- 30kW version (SK3311.135/235/535):
One fan module at position 3
- 60kW version (SK3311.265/565):
Four fan modules at positions 2, 3, 4 and 5

LCP Inline flush:

- 30kW version (SK3311.545):
Two fan modules at positions 1 and 4



Note:
The maximum of four fans in the LCP Inline flush are located in positions 1, 3, 4 and 6. Please take particular note of this when connecting the fans (see chapter 5.3 “Fan installation”).

Depending on the required cooling output and in order to form redundancies, up to a maximum of six fan modules in total may be installed with the LCP Rack and LCP Inline devices. With the LCP Inline flush, up to four fan modules may be installed (see chapter 15.2 “Characteristic curves”).



Note:

If more than three fans are installed in a Liquid Cooling Package type “30kW”, these are used to create redundancy or for lower power consumption by the individual fans. However, they will not lead to a further increase in the cooling output.

5.3.1 Removing a fan module

If a fan module is defective, it can be replaced quickly and easily with the unit operational. Proceed as follows to remove a fan module:

- Open the front door of the Liquid Cooling Package.
- Disconnect the thermally activated switch for the pair of fans from which one of the fans is to be removed at the fuse box.

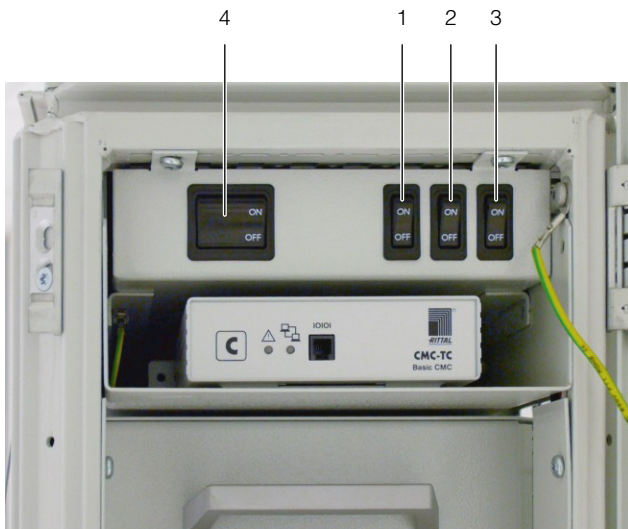


Fig. 29: Fuse box with master switch

Key

- 1 Thermally activated switch 1
- 2 Thermally activated switch 2
- 3 Thermally activated switch 3
- 4 Thermally activated master switch

The following assignment applies between the thermally activated switches and the fans:

LCP Rack and LCP Inline:

- Thermally activated switch 1: Fan positions 1 and 2)
- Thermally activated switch 2: Fan positions 3 and 4)
- Thermally activated switch 3: Fan positions 5 and 6)

LCP Inline flush:

- Thermally activated switch 1: Fan position 1
- Thermally activated switch 2: Fan positions 3 and 4
- Thermally activated switch 3: Fan position 6

Configuration with LCP Rack and LCP Inline:

- Should you wish to exchange fan 2 and if the optional graphics display is installed, please first disconnect connector X33 of the connection cable (Fig. 30, item 1).
- Release the two fan connectors DC and AC on the left and right (Fig. 30, items 4 and 6).
- Disconnect the earth connection on the fan (Fig. 30, item 5).
- Loosen the three screws (Fig. 30, item 3) on the fan mounting brackets on both the left and right.

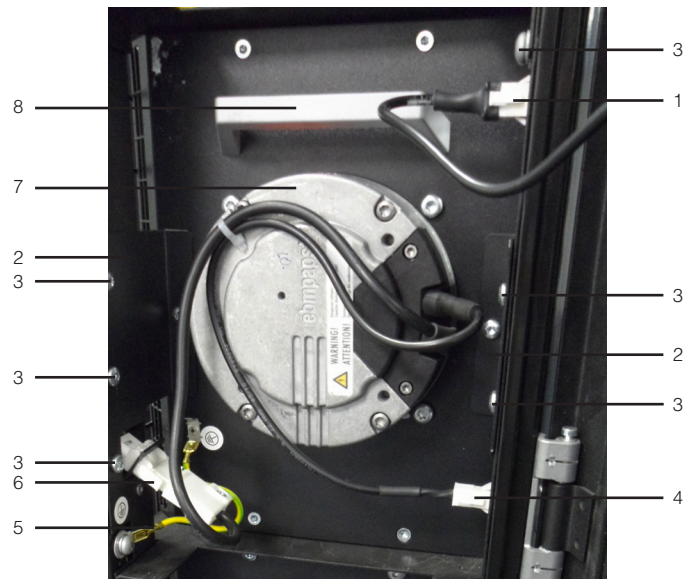


Fig. 30: Fan module in fan tray – LCP Inline and LCP Rack version

Key

- 1 Connection cable for graphic display
- 2 Mounting bracket
- 3 Assembly screws
- 4 Connector DC
- 5 Earth connection
- 6 Connector AC
- 7 Fan
- 8 Handle

- Remove the two mounting brackets (Fig. 30, item 2).
- Rotate the fan module in the rack by 90° in a clock-wise direction (Fig. 31).



Fig. 31: Rotated fan module in fan tray – LCP Inline and LCP Rack version

- Grasp the fan module with both hands on the left and right, and pull it out of the rack.

Configuration with LCP Inline flush:

- Should you wish to exchange fan 1 and if the optional graphics display is installed, please first disconnect connector X33 of the connection cable.
- Release the two fan connectors DC and AC on the left and right (Fig. 32, items 2 and 4).
- Disconnect the earth connection on the fan (Fig. 32, item 3).
- Loosen the three screws (Fig. 32, item 7) on the fan's air baffle plates at the top and bottom.



Fig. 32: Fan module in fan tray – LCP Inline flush version

Key

- | | |
|---|------------------|
| 1 | Air baffle plate |
| 2 | Connector DC |
| 3 | Earth connection |
| 4 | Connector AC |
| 5 | Fan |
| 6 | Handle |
| 7 | Assembly screws |

- Rotate the fan module in the rack by 90° in a clock-wise direction (Fig. 33).



Fig. 33: Rotated fan module in fan tray – LCP Inline flush version

- Grasp the fan module with both hands on the left and right, and pull it out between the upper and lower air baffle plate.

5.3.2 Installing a fan module



Note:
The installation site of individual fan modules may be varied according to the load.

As supplied, all rack mounts not fitted with a fan are sealed with a metal cover. For units not fully populated with fans, these metal covers ensure separation into a hot and cold air zone inside the device, for targeted air routing.



Caution! Risk of injury!
Before installing or removing a fan, be sure to remove the power from the relevant group of fans on the corresponding thermally activated switch.

Configuration with LCP Rack and LCP Inline:

- Release the earth connection on the metal cover.
- Loosen the two assembly screws on the left and right (Fig. 34, item 1) used to secure the metal cover in the rack mount.
- Remove the metal cover (Fig. 34, item 2) from the rack mount.



Fig. 34: Metal cover in small applications and short aisles – Version with LCP Rack and LCP Inline

Key

- 1 Assembly screws
- 2 Metal cover

- Place the fan module on the shelf rotated through 90° (Fig. 31) and push it into the rack mount.
- Rotate the fan module through 90° in a counter-clockwise direction so that the connection cables are pointing towards you.
- Secure a metal bracket using three screws each on the left and right.
- On the left and right, insert one of the fan connectors into the corresponding socket on the Liquid Cooling Package.
- Make the earth connection to the fan.

- At the fuse box, reconnect the thermally activated switch for the pair of fans of which one fan has been replaced.
- Activate the newly installed fan in the software (see Fig. 80).

Configuration with LCP Inline flush:

- Disconnect the earth connection on the metal cover (Fig. 35, item 3).
- Loosen the two assembly screws at the top and bottom (Fig. 35, item 1) used to secure the metal cover in the rack mount.
- Remove the metal cover (Fig. 35, item 2) from the rack mount.

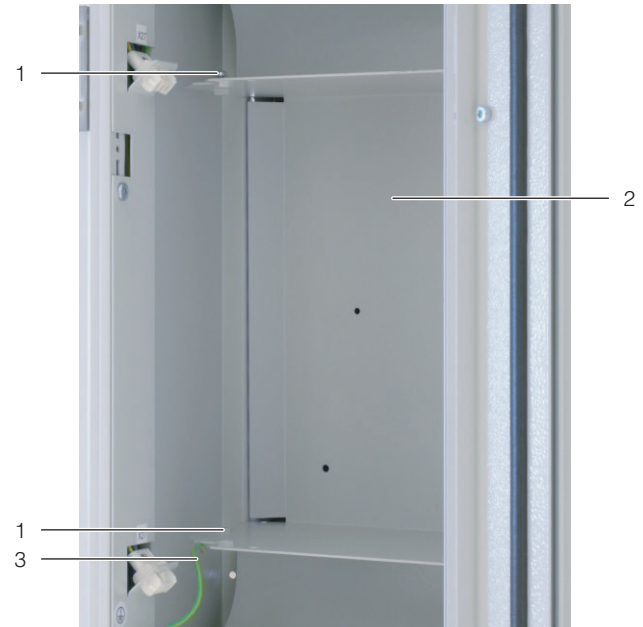


Fig. 35: Metal cover – LCP Inline flush version

Key

- 1 Assembly screws (4)
- 2 Metal cover
- 3 Earth connection

- Place the fan module rotated through 90° (Fig. 33) between the upper and lower air baffle plate and push the module into the rack mount.
- Rotate the fan module through 90° in a counter-clockwise direction so that the connection cables are pointing towards you.
- Attach the fan module with two screws each at the top and bottom to the air baffle plates.
- On the left and right, insert one of the fan connectors into the corresponding socket on the Liquid Cooling Package. Please note the following assignment between the fan module and the connection:

- Fan position 1: Connection position 1
- Fan position 2: Connection position 3
- Fan position 3: Connection position 4
- Fan position 4: Connection position 6

For AC connections the connection point opposite each DC connection should be used.

- Make the earth connection to the fan.
- At the fuse box, reconnect the thermally activated switch for the (pair of) fans of which one fan has been replaced.
- Activate the newly installed fan in the software (see Fig. 80).

5.4 Install the optional display (SK 3311.030)

In its delivered state, there is already a suitable opening provided in the front door of the Liquid Cooling Package for installing the optional display. This opening is sealed from the inside by a trim panel.

- Open the front door of the Liquid Cooling Package.
- Loosen the attachments of the trim panel.
- Remove the trim panel to the outside of the door.
- Insert the fastening clamps with screws (Fig. 36, item 2) on the left and right of the display.

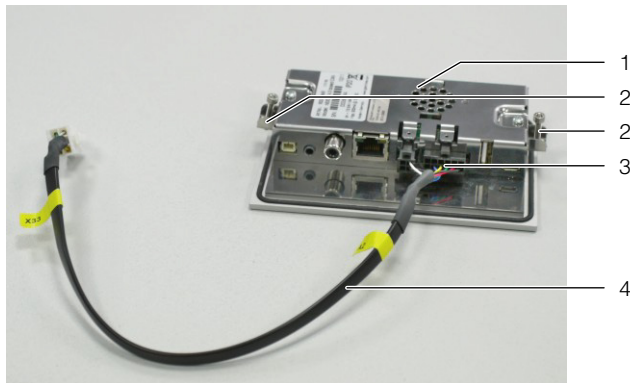


Fig. 36: Preparing the graphic display

Key

- | | |
|---|---|
| 1 | Graphic display |
| 2 | Fastening clamps |
| 3 | Connectors for graphic display (4- and 12-pole) |
| 4 | Connection cable |

- Insert the connection cable (Fig. 36, item 4) into the bottom of the display (Fig. 36, item 3).
- Push the display into the cut-out from the outside until it is in contact with the door (Fig. 37, item 1) of the Liquid Cooling Package at the front.
- Tighten the two assembly screws (Fig. 37, item 2) from the inside.



Fig. 37: Securing the graphic display

Key

- | | |
|---|---------------------------------|
| 1 | Inner view of door, LCP Inline |
| 2 | Assembly screws |
| 3 | Strain relief, connection cable |
| 4 | Connection socket in LCP Inline |

- Connect the connection cable of the graphic display to the corresponding socket in the Liquid Cooling Package (Fig. 37, item 4).
- Attach the strain relief (Fig. 37, item 3) to the connection cable to prevent accidental damage to the cable e.g. when opening the door.

After connection, the following display will appear:

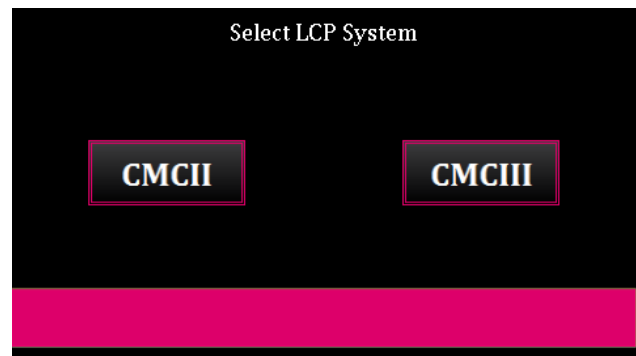


Fig. 38: Display after connecting

You must select which version of the control unit is installed in your Liquid Cooling Package.



Note:

If the control unit is incorrectly entered, operation via the display will not be possible. The display will first need to be reset by the Rittal service department.

- Open the front door of the Liquid Cooling Package.
- Select the point "CMCII" if a device with a grey front panel marked "CMC-TC" is installed, as shown in Fig. 29.
- Select the point "CMCII" if a device with a grey front panel marked "CMC II PU" is installed.

6 Installation

6.1 Connecting the Liquid Cooling Package

6.1.1 Electrical connection

General



Note:
Please keep this electrical documentation readily available so that it is always on hand when needed. This is the only documentation which is authoritative for the unit.



Caution!
Work on electrical systems or equipment may only be carried out by an electrician or by trained personnel guided and supervised by an electrician. All work must be carried out in accordance with electrical engineering regulations.

The unit may only be connected after the above named personnel have read this information.

Use only insulated tools.

The connection regulations of the appropriate electrical power company are to be followed.

The voltage values shown in the wiring plan or on the rating plate must match the mains voltage.

The pre-fuse specified in the wiring plan / rating plate has to be provided to protect the cable and equipment from short-circuits. The unit must be individually fused.

The unit has a high discharge current. For this reason, it is essential to make a 10mm² earth connection before connecting to the supply circuit (see chapter 15.4 "Circuit diagram").



Caution!
The unit must be connected to the mains via an isolating device which ensures at least 3mm contact opening when switched off.

No additional control equipment may be connected upstream of the device at the supply end.

Power to the Liquid Cooling Package is supplied via a separate 3-wire or 5-wire infeed, as desired. The device is always delivered with a 5-pole mains connection socket so that the operator can attach a connection cable with a mains plug (3-wire or 5-wire) depending on the his or her requirements.

Two of the fan modules installed in the Liquid Cooling Package are on separate phases.

If the Liquid Cooling Package is connected to the mains using a 3-wire, single-phase, 230 V connection cable (L, N, PE), one of the phases of this cable must be bridged to the other two. This is already implemented in the 5-pole plug of this cable.

If the Liquid Cooling Package is connected to the mains using a 5-wire connection cable (400 V, 3~, N, PE; DK 7856.025), three separate phases (L1, L2, and L3) are available. If one of the phases fails, the device will continue to be supplied with power and will remain operational as follows:

Failure in phase L1:

The fans at positions 1 and 2 switch off, while the fans at positions 3 to 6 remain operational.

Failure in phase L2:

The fans at positions 3 and 4 switch off, while the fans at positions 1 and 2 and 5 and 6 remain operational.

Failure in phase L3:

The control unit (basic CMC) is no longer supplied with power. The fans at positions 5 and 6 switch off. The fans at positions 1 to 4 go into so-called "fail-safe" mode with 100% fan speed, due to the absence of a set point from the control unit.



Note:
The voltage tolerance must not exceed a maximum of $\pm 10\%$ of the mains voltage specified on the rating plate.

6 Installation

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- In the supply line to the Liquid Cooling Package, please provide the fuse specified on the rating plate (for single-phase operation e.g. a 20 A pre-fuse), in order to maintain the necessary protection against short-circuits even if fully populated with four or six fans.



Note:

Both the fans in a group have a rated current of around 4.2 A and are protected in the device with a 6 A thermally activated switch. With 6 fans, therefore, this translates into 3 groups. The master switch, likewise with thermal fuse, is tailored to these groups.



Note:

Information on the cross-section of the connection cable may be found in Chapter 15.4 "Circuit diagram".



Danger!

Take utmost care not to short-circuit one of the phases with the zero conductor or the earth conductor. Otherwise, there is a risk of damage or injury.



Caution!

Only use copper supply wires.

- Remove the access panel (Fig. 39, item 1) by removing 2 Screws (Fig. 39, item 2) with a T25 Screwdriver.



Fig. 39: Access panel removal

Key

- | | |
|---|-------------------------|
| 1 | Access Panel |
| 2 | T25 Screw |
| 3 | Conduit Fitting (ø23mm) |
| 4 | Strain Relief |

- Install a suitable Conduit Fitting (Fig. 39, item 3 - not supplied) into the ø23mm knock-out hole at the top of the unit. Feed the Power Cable through the Conduit Fitting and into the existing Strain Relief (Fig. 39, item 4). Then follow the below wiring instructions.

230V/208V 3-wire, single phase connection



Caution!

With a 3-wire, single-phase connection, the conductor cross-section must be at least 2.5 mm².

To connect the Liquid Cooling Package to the mains using a 3-wire, single-phase connection cable, proceed as follows:

- Remove approximately 45 mm from the rubber sheathing of the flexible cable.
- Trim the neutral conductor (N) and the phase conductor (L) to a length of approximately 35 mm. Leave the length of the PE conductor at approximately 45 mm.
- Remove approximately 9 mm from the insulation of all conductors with a suitable tool.

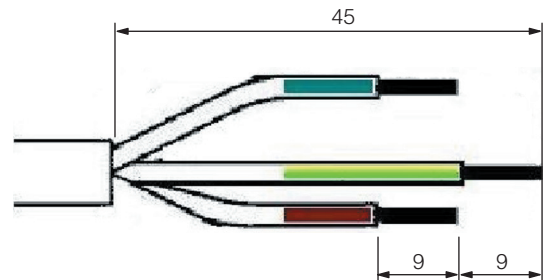


Fig. 40: Dimensions for removing the rubber sheathing and insulation



Note:

The example shows color coding to DIN VDE 0293:

blue = neutral conductor N
brown = phase conductor L
yellow/green = PE conductor

- Attach wire end ferrules without insulating collars to the ends of the conductors. To crimp the wire end ferrules, use a suitable crimping tool with an integral lock to prevent the tool from opening prematurely.
- Insert a suitable screwdriver (blade size 3.5 x 0.5 mm) into an activation opening (Fig. 41, item 1) and open the corresponding terminal connection of the conductor entry (Fig. 41, item 2).

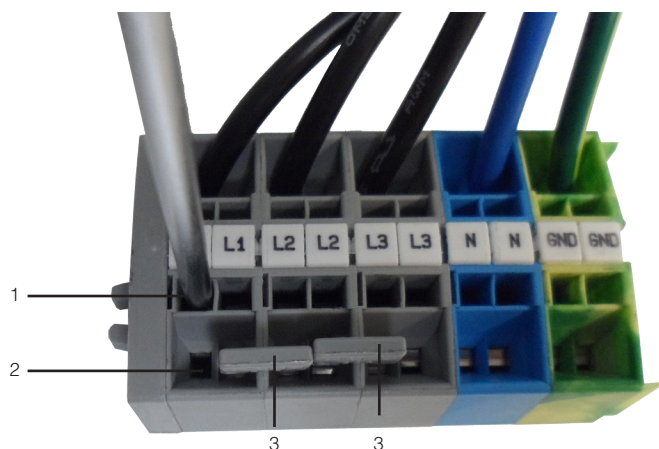


Fig. 41: Connector - rear

Key

- | | |
|---|--|
| 1 | Activation opening of the terminal connector for the conductor entry |
| 2 | Conductor entry |
| 3 | Jumper or bridge |

Electrical connection with the supplied 5-pole connector

5-wire, 3-phase connection

To connect the Liquid Cooling Package to the mains using a 5-wire, 3-phase connection cable, proceed as follows:

- Remove jumpers (Fig. 41, item 3).
- Remove approximately 45 mm from the rubber sheathing of the flexible cable.
- Trim the neutral conductor (N) and the three phase conductors (L1, L2, and L3) to a length of approximately 35 mm. Leave the length of the PE conductor at approximately 45 mm.
- Remove approximately 9 mm from the insulation of all conductors with a suitable tool.

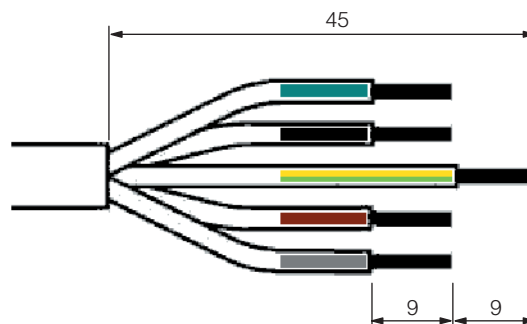


Fig. 42: Dimensions for removing the rubber sheathing and insulation

- Attach wire end ferrules without insulating collar to the ends of the cables, using a four-jaw pressing tool.

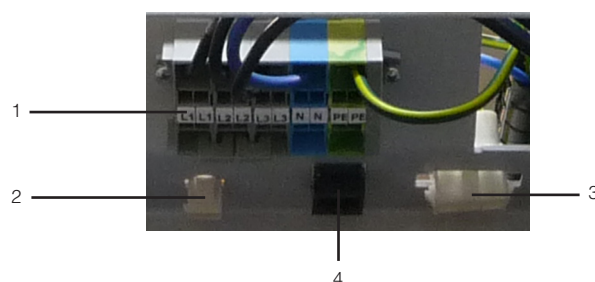


Fig. 43: At the rear of compartment, located on the top edge

Key

- | | |
|---|---|
| 1 | Jack X1 for mains connection |
| 2 | Jack X2 for optional condensate pump DC |
| 3 | Jack X3 for optional condensate pump AC |
| 4 | Jack X4 for network connection |

6.1.2 Cooling water connection

The Liquid Cooling Package is connected to the cold water network via two 1½" threaded pipe connections (external thread) on the inlet and return, located on the lower rear side of the unit. The connection nozzles are positioned horizontally to the rear.



Fig. 44: Cold water network connection:

Key

- 1 Cooling water return with 1½" external thread
- 2 Cooling water inlet with 1½" external thread

Connection is made in a downward direction into a raised floor (if available), or alternatively in an upward direction out of the device. The dimensions of the mounting openings required for connection are shown in the overview sketch in Chapter 15.3 "Overview drawings" (see Fig. 108).



Note:

If possible, use flexible hoses for the cooling water connection (see Chapter 14 "Accessories").



Note:

The cooling water connection must **always** be made with union nuts, even if you choose not to use the Rittal hose connection kit. This hose connection kit includes suitable union nuts in addition to the connection hoses.

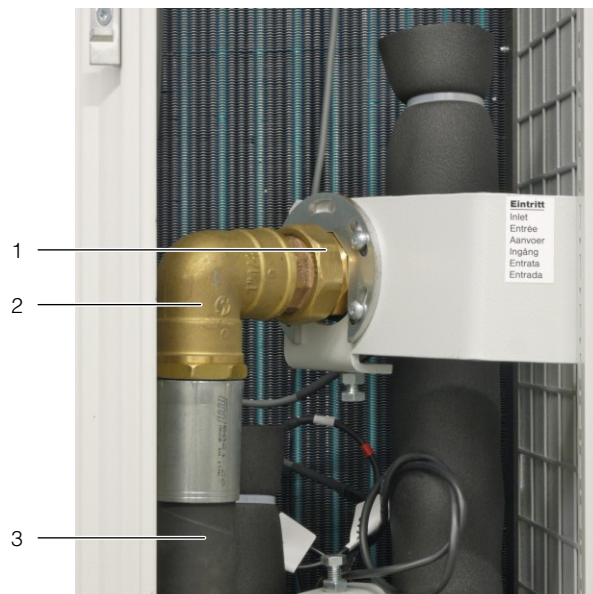


Fig. 45: Hose connection kit

Key

- 1 Union nut
- 2 90° bracket
- 3 Connection hose

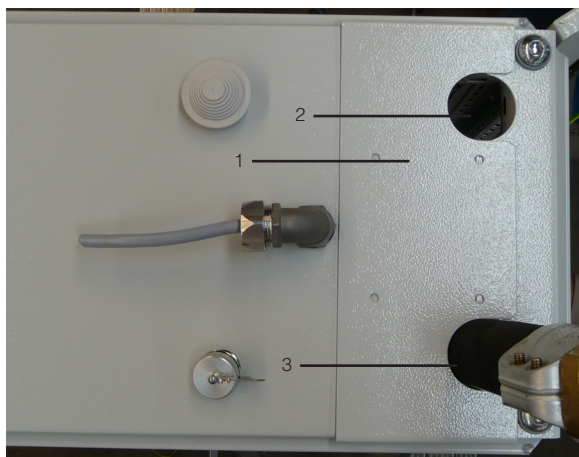


Fig. 46: Top feed connections

Key

- 1 Roof cover plate
- 2 Topfeed Access Hole (Inlet)
- 3 Hose (Outlet)

-To supply Topfeed Water connections to the LCP the Roof Cover Plate (Fig. 46, item 1) must be rotated 180° to expose the Topfeed Access Holes (Fig. 46, item 2). To do so remove 4 - T25 Screws and then reinstall them after both hoses have been feed through.



Caution!
When installing, observe the applicable specifications concerning water quality and water pressure.

In case of a low water inlet temperature ($<12^{\circ}\text{C}$), the inlet and return lines should be appropriately insulated. If this is not done, condensate may form on the supply lines.



Note:
Immediately after connecting the water circuit, the flow rate may be monitored by fitting the device with an optional display with touch function. To do this, first check whether the control valve is completely open (see Chapter 8.2.2 "Operation in stand-alone mode"). If the control valve is closed or only partially open, it can be opened in manual mode via a network connection using the setup screen (see Chapter 8.3.1 "Visualization").



Note:
The pipe work in the building should be designed according to the Tichelmann Principle in order to maintain a hydraulically balanced system. If this is not the case, the flow volume of each Liquid Cooling Package must be assured by using a flow quantity regulator.

Ideally, the Liquid Cooling Package is connected to the cooling water system using a water/water heat exchanger.

Pros:

- Reduction of water volumes in the secondary circuit,
- Setting of a defined water quality,
- Setting of a defined input temperature and
- Setting of a defined volumetric flow.

Notes on water quality

For safe operation, it is vital that the VBG guidelines on cooling water are observed (VGB R 455P). Cooling water must not contain any lime scale deposits or loose debris, and it should have a low level of hardness, particularly a low level of carbonate hardness. The carbonate hardness should not be too high, particularly for recooling within the plant. On the other hand, however, the water should not be so soft that it attacks the operating materials. When recooling the cooling water, the evaporation of large quantities of water must not lead to excessively high salt contents, since electrical conductivity increases as the concentration of dissolved substances rises, and the water thereby becomes more corrosive. For this reason, not only is it always necessary to add a corresponding quantity of fresh water, but also to remove part of the enriched water. Water with high gypsum content is unsuitable for cooling purposes because it has a tendency to form boiler scale that is particularly difficult to remove. Furthermore, cooling water should be free from iron and manganese, because deposits may occur which settle in the pipes and block them. At best, organic substances should only be present in small quantities, because otherwise sludge deposits and microbiological contamination may occur.



Note:
The Liquid Cooling Package is secured against excess pressure as regards a maximum permissible pressure (PS) of 8 bar if no cooling medium liquid is trapped. If shut-off valves that could cause cooling medium liquid to become trapped are installed on site, pressure relief vessels with safety valves (8 bar blow-off pressure) must be built into the coolant circuit of the recooling system.



Note:
Before commencing operation with water, all supply lines must be adequately flushed.



Note:
To avoid the loss of fluids due to diffusion (open and closed systems) or evaporation (open systems), the use of automatic filling is advisable.



Note:
The 2-way control valve used in the device is opened at zero current.

6.1.3 Connecting the condensate discharge

Any condensate which may develop is collected in the condensate collecting tray (Fig. 47, item 1) in the water module of the Liquid Cooling Package.



Fig. 47: Condensate discharge

Key

- 1 Condensate collecting tray
- 2 Leakage sensor
- 3 Condensate discharge

The Liquid Cooling Package is additionally equipped with a condensate discharge (Fig. 47, item 3) via which the condensate is pressurelessly routed out of the Liquid Cooling Package. The hose included with the supply ($\varnothing_i=9.5\text{mm}$, $\varnothing_a=15.5\text{mm}$) must be connected to the condensate discharge. This hose, in turn, must be routed to a drain with odor seal by the customer, so that cooling

fluid can be discharged from the device in the event of a leak. Upon reaching a defined condensate level in the collecting tray, the leakage sensor (Fig. 47, item 2) triggers a message. The status of the control valve may be set depending on this "leak message" (Fig. 79). If the option **Emergency Mode** is selected, the valve will close completely, whereas if the option **Only Alarm Message** is selected, only an alarm message is output.



Note:
In order to ensure safe condensate discharge, the following points should be observed:
–Lay the drainage hose so that it always runs downhill and without any kinks.
–Do not constrict the hose cross section.



Note:
In order to avoid increased condensation and to reduce energy use, the cooling water temperature should be adapted to match the required cooling output.

6.1.4 Bleeding the air from the heat exchanger

A vent valve is installed at the uppermost point of the heat exchanger package in the Liquid Cooling Package. The unit is delivered with the valve fully closed. However, the valve must be opened during commissioning. Proceed as follows:

- Open the rear LCP door.
- Connect the discharge hose included with the accessories to the top of the vent valve on the connector (Fig. 48, item 2).
- Route the other end of the hose into a container.
- Open the ball valve (Fig. 48, item 1).
- Close the ball valve again when no further air bubbles are visible in the collecting container. The heat exchanger has now been vented.



Fig. 48: Bleeding the air from the heat exchanger

Key

- 1 Ball valve
- 2 Connector for discharge hose

■ Then close the LCP door at the rear.



Note:
The system is usually bled during the course of commissioning. After bleeding, the ball valve should be closed again.

6.2 Cooling operation and control characteristics

When the Liquid Cooling Package is supplied with power, the control valve controls the cooling water flow according to the set point temperature. For more detailed explanations, please refer to Chapter 3.1 "General functional description". Detailed diagrams on cooling output and pressure loss may be found in chapter 15.2 "Characteristic curves".

7 Commissioning checklist

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7 Commissioning checklist

Rittal GmbH & Co. KG hopes that this checklist will help its customers and cooperation partners install and operate the products of the Liquid Cooling Package family successfully.

Before the installation:

Are shut-off valves installed in the flow and return?

These valves serve to facilitate exchange or maintenance of the Liquid Cooling Package without the need to shut off the entire cold water supply.



Is there a Taco-setter installed in the return of each Liquid Cooling Package?

The Taco-setter ensures a constant volumetric flow and helps to maintain the hydraulic balance of the system, especially when operating with other types of units, such as convectors.



Note:

If the pipe work for the Liquid Cooling Package is carried out according to the Tichelmann principle, a Taco-setter is not necessary.

Is the water supply properly insulated?

Proper insulation protects against condensate formation, especially on the parts of the cooling water flow.



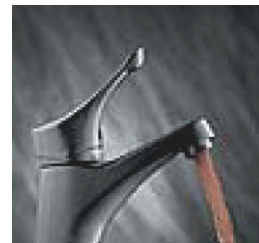
Are the allowable bend radii of the hoses adhered to?

The hoses must not be kinked too tightly, otherwise the flow volume may be impaired and the materials may fatigue prematurely.



Is there a good water supply available which meets the quality requirements?

Water quality determines the lasting reliability of the system. It ensures that no undesirable corrosion or harmful deposits will occur. The exact manufacturer's recommendations regarding water quality are found in Chapter 15.1 "Hydrological information" in the operating and maintenance instructions of your Liquid Cooling Package. The recommended water quality should be ensured even after the installation.



Was the pipe work sufficiently flushed before the Liquid Cooling Package was connected?

It is important to clean or flush the water circuits appropriately, especially for new installations. Experience has shown that there are often remnants of sealants, lubricants, and even metal chips in new systems, which may lead to a premature failure of the Liquid Cooling Package. Cleaning the cold water system carefully before connecting the Liquid Cooling Package ensures reliable operation later.



If the water quality of the primary cold water supply is inadequate, was a separate water circuit with a water/water heat exchanger installed?

If the cold water supply is strongly contaminated, it may make sense to install a second, high quality cold water circuit which is connected to the primary circuit via a water/water heat exchanger. Even in this case, the water circuit on the Liquid Cooling Package side must be carefully cleaned before connecting the device. Our recommendations regarding water quality in Chapter 15.1 "Hydrological information" in the operating and maintenance instructions of your Liquid Cooling Package apply in this case as well.

Was the water prepared/ treated with the appropriate additives?

In addition to our recommendations regarding water quality, we recommend that the water be enriched with corrosion inhibitor and/or antifreeze. Also, a treatment to prevent algae and biofilms may be expedient in some cases.



Photo: Clariant

Are unused height units in the bayed server enclosures sealed with vertical blanking plates, and are the side vertical foam strips installed?

In order to prevent undesired air short circuits and circulation patterns inside the server enclosure, all unused height units of the 482.6 mm (19") level should be closed off with blanking plates. Thus, the air will only enter the rear side of the server enclosure through the server itself, where it is drawn off by the Liquid Cooling Package. The blanking plates are available in various heights, e.g. Model No. SK 1931.200 for one height unit. The vertical foam sealing strips installed on each side of the server enclosure ensure that the cooled air cannot flow past the 482.6 mm (19") level at the sides. Sealing strips are available for 2 applications and 2 enclosure widths. The respective model numbers are found in Chapter 14 "Accessories" in the operating and maintenance instructions of your Liquid Cooling Package.

Are all electrical, water, and power connections correctly made?

Before water is admitted, and, ideally before the ball valves are opened, be sure to check that all connections are properly made. Take particular care to ensure that all quick release fasteners are fully snapped into place.

Is the TS/PS server enclosure equipped with suitable doors?

The LCP Rack operates with closed air circuits. Thus, the cooled server enclosure must largely be hermetically sealed and equipped with unperforated sheet steel or glass doors on the front and rear.

Exception when using the LCP Inline or the LCP Inline flush:

In this case, both the front / front door and the rear / rear door of the server enclosure must have unrestricted air permeability.

After admitting cold water:

Are all parts and connections water tight?

Please check to be sure that all parts and connections which carry water are water tight. The Liquid Cooling Package is subject to an individual, comprehensive factory test, which also includes checking for leaks. This additional check serves to locate problems, such as possible transport damage, and to prevent greater damage.

Venting of the Liquid Cooling Package

In order to ensure even water circulation through the circuit and effective heat transfer, the Liquid Cooling Package must be vented during commissioning.

7 Commissioning checklist

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After installation:

We recommend that the following selected parameters be gathered and documented within a short time after installation.

- Inlet temperature
- Return temperature
- Volumetric flow with opened 2-way control valve



Note:

Documenting these parameters helps with error analysis in case malfunctions occur during operation.

Please feel free to contact Rittal if you have further questions or problems:

For malfunctions and repairs
Rittal Service Department
Tel.: +49 (0) 27 72/50 5-18 55
E-mail: RSI@Rittal-Service.com

8 Operation

8.1 Description of operating and display components

8.1.1 Hardware of the control unit for the Liquid Cooling Package

A Basic CMC forms the control unit of the Liquid Cooling Package. Its job is to use the I2C bus to poll the measurements (such as the three server-in temperatures, three server-out temperatures, six fan speeds, flow rate, control valve position, inlet and return temperatures of the cooling water) from the control unit of the fan modules, the sensors on the heat exchanger, and from the control unit of the water module, to perform control functions, and to transfer the set points (such as the fan speed) to the individual units.

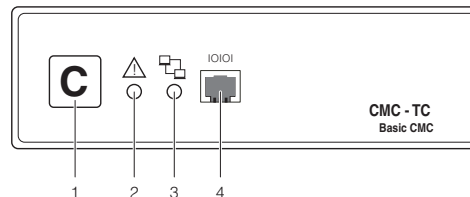


Fig. 49: Control unit Liquid Cooling Package (Basic CMC) – front

Key

- 1 Button “C”
- 2 Status LED (alarms and warnings)
- 3 Status LED (network status)
- 4 Serial interface for communication, e.g. via hyperterminal

The control circuit board is built into a standard CMC plastic housing. The following components are on the front side of the unit:

Control components	Explanation
Button “C”	Use this button to confirm warnings and alarms.
Status LED (alarms and warnings)	Displays the internal status of the control unit through a duo LED. Red: Alarm Yellow: Warning Flashing red/yellow/green: Configuration change Green: Other
Status LED (network status)	Displays the status of the network connection. The status LED flashes when the unit is polled by the network via the Ethernet interface. The colour (green or yellow) indicates the network speed.

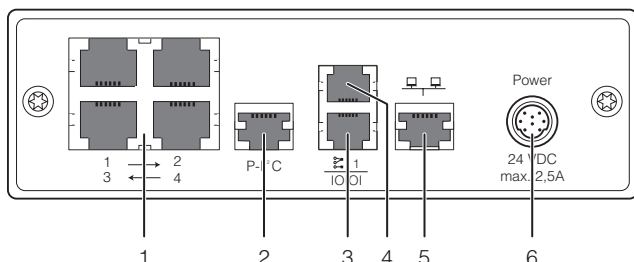


Fig. 50: Control unit Liquid Cooling Package (Basic CMC) – rear

Key

- 1 Sockets for additional sensors
- 2 I2C socket (X22)
- 3 Socket for controlling the graphical display (X24)
- 4 Alarm relay socket
- 5 Network connection (X23)
- 6 Power supply (X21)

Various sockets are found on the rear of the control unit.

Pin assignment of the sockets for additional sensors:

- 1 24V DC
- 2 GND
- 3 Sensor ID 1
- 4 Sensor ID 2
- 5 Analog input
- 6 Digital input/output

The 8-pole connector X225 contains the so-called Power-I2C bus.

Assignment of the I2C bus:

- 1 N/C
- 2 N/C
- 3 N/C
- 4 N/C
- 5 GND
- 6 24V DC
- 7 P-SDA
- 8 P-S

8 Operation

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The optional graphical display on the front door is controlled via an RS-232 connection with the RJ12 socket X24.

X24 pin assignment:

1	24V DC
2	GND
3	TxD
4	RxD
5	RTS
6	CTS

Alarm relay socket pin assignment:

1	24V DC
2	GND
3	N/C
4	Relay normally closed
5	Relay common
6	Relay normally open

Connection to an optional network is via an Ethernet connection using the RJ 45 socket X23 or the corresponding socket in the rear, upper section of the Liquid Cooling.

Package.X23 pin assignment:

1	Tx+
2	Tx-
3	Rx+
4	N/C
5	N/C
6	Rx-
7	N/C
8	N/C

Power supply pin assignment:

1	24V DC
2	GND
3	N/C

The control unit is supplied with power via a separate power pack (DK 7320.425) and a Kycon socket. All modules are supplied with 24VDC and are fed together with the I²C bus.

8.1.2 Hardware of the control unit for the fan module (RLCP fan)

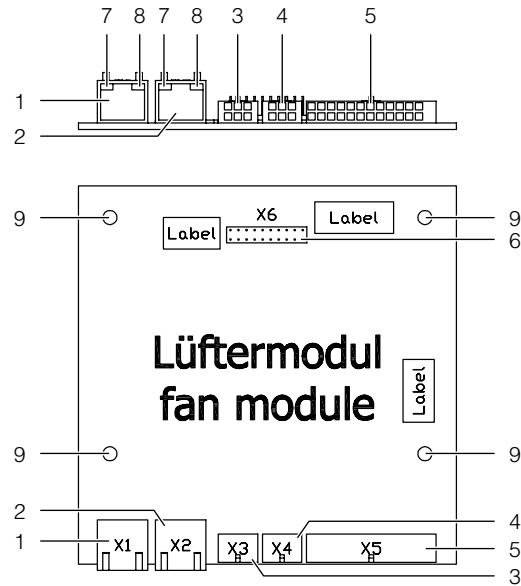


Fig. 51: Control unit fan module – rear/top view

Key

1	Control Interface socket (X1) – RJ45
2	Control Interface socket (X2) – RJ45
3	Temperature sensors, cold air socket (X3) – 6-pole
4	Temperature sensors, hot air socket (X4) – 6-pole
5	Fan set point sockets (X5) – 24-pole
6	Debugger
7	LED yellow (2x)
8	LED green (2x)
9	Earth (4x)

All fan modules are activated jointly by one control unit (RLCP fan). The control voltage is +24V and is fed together with the I²C bus through connectors X1 or X2 of the control unit (Basic CMC).

X1/X2 pin assignment:

1	CAN 1/2 high
2	CAN 1/2 low
3	+24V
4	GND
5	GND
6	+24V
7	SDA – I ² C8SCL – I ² C

The fans are equipped with linear control. All fans run with the same speed and are connected to the control unit (RLCP fan) via a 24-wire cable using a connector. The fans are equipped with a Hall sensor, which reports the speed signal to the control unit (socket X5).

X5 pin assignment:

1	SET_1 set point fan 1
2	10V from fan 1
3	SET_2 set point fan 2
4	10V from fan 2
5	SET_3 set point fan 3
6	10V from fan 3
7	SET_4 set point fan 4
8	10V from fan 4
9	SET_5 set point fan 5
10	10V from fan 5
11	SET_6 set point fan 6
12	10V from fan 6
13	SPD_1 actual value, fan 1
14	GND fan 1
15	SPD_1 actual value, fan 2
16	GND fan 2
17	SPD_3 actual value, fan 3
18	GND fan 3
19	SPD_4 actual value, fan 4
20	GND fan 4
21	SPD_5 actual value, fan 5
22	GND fan 5
23	SPD_6 actual value, fan 6
24	GND fan 6

Furthermore, the control unit has two sockets (X3 and X4) for connecting temperature sensors. One of these sensors is inside the fan module and one is on the rear of the heat exchanger. The air temperature in front of the fans (that is, the temperature of the cold air supplied to the server enclosure, X3) and the temperature behind the heat exchanger (that is, the temperature of the air drawn in from the server enclosure, X4) are measured.

X3 pin assignment:

1	GND temperature sensor 1 cold air
2	GND temperature sensor 2 cold air
3	GND temperature sensor 3 cold air
4	Temperature sensor 1 cold air
5	Temperature sensor 2 cold air
6	Temperature sensor 3 cold air

X4 pin assignment:

1	GND temperature sensor 1 hot air
2	GND temperature sensor 2 hot air
3	GND temperature sensor 3 hot air
4	Temperature sensor 1 hot air
5	Temperature sensor 2 hot air
6	Temperature sensor 3 hot air

The control unit's software continuously reads the analog values from the temperature sensors via the analog channel and establishes an average value for each sensor. Next, it reads the temperature value in °C from a table and writes this in the I2C transmission buffer. Furthermore, the software counts the speed pulses of the connected fans and also writes this into the I2C transmission buffer.

The fan set speed determined by the control unit is evaluated and the appropriate fan speed is set on the fans.

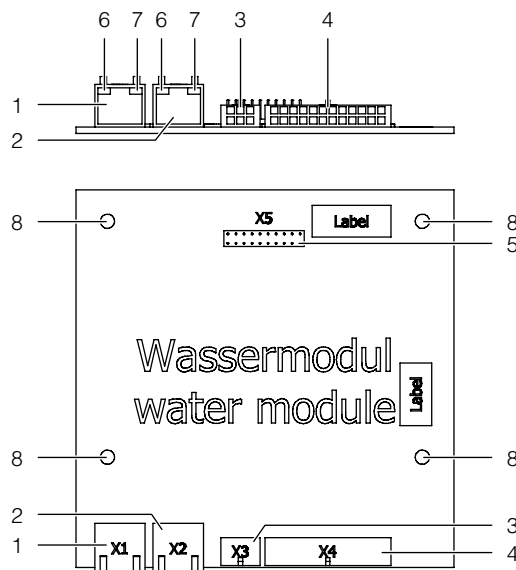
8.1.3 Hardware of the control unit for the water module (RLCP water)

Fig. 52: Control unit water module – rear/top view

Key

1	Control Interface socket (X1) – RJ45
2	Control Interface socket (X2) – RJ45
3	Condensate pump controller socket – 6-pole
4	Sensors and actuators socket – 24-pole
5	Debugger
6	LED yellow (2x)
7	LED green (2x)
8	Earth (4x)

The water module also contains a control unit (RLCP water). The control voltage is +24V and is fed together with the I2C bus through connectors X1 or X2 of the control unit (Basic CMC).

X 1/X2 pin assignment:

1	CAN 1/2 high
2	CAN 1/2 low
3	+24V
4	GND
5	GND
6	+24V
7	SDA – I2C
8	SCL – I2C

A condensate pump may optionally be connected to socket X3.

X3 pin assignment:

1	GND
2	GND
3	GND
4	+24V
5	Condensate pump output
6	Addressing input I2C

The sensors and actuators are connected to socket X4 via a 24-wire cable.

X4 pin assignment:

1	Temperature sensor, water inlet
2	Temperature sensor, water return
3	GND flow sensor
4	TxD flow sensor
5	GND optional flow meter
6	Output from flow meter
7	GND leakage sensor
8	+5V leakage sensor
9	GND condensate sensor
10	+5V condensate sensor
11	GND control valve
12	Input 0-10V control valve
13	Temperature sensor, water inlet
14	Temperature sensor, water return
15	RxD flow sensor
16	+5V flow sensor
17	Output from flow meter
18	+24V DF
19	Heating function, leakage sensor
20	Optosensor, leakage sensor
21	Heating function, condensate sensor
22	Optosensor, condensate sensor
23	Output 0-10V control valve
24	24V supply, control valve

The software of the water module's control unit continuously reads the analog values from the two temperature sensors for the inlet and return of the cooling water system via the analog channel of the CPU and establishes an average value for each sensor. Next, it reads the temperature value in °C from a table and writes this in the I2C transmission buffer. Furthermore, the software counts the pulses from the flow meter, reads the leakage sensor and the digital input, and also writes these values to the I2C transmission buffer. The position (opened/closed) of the 2-way control valve is determined by the control unit.

8.1.4 Hardware for startup current limitation

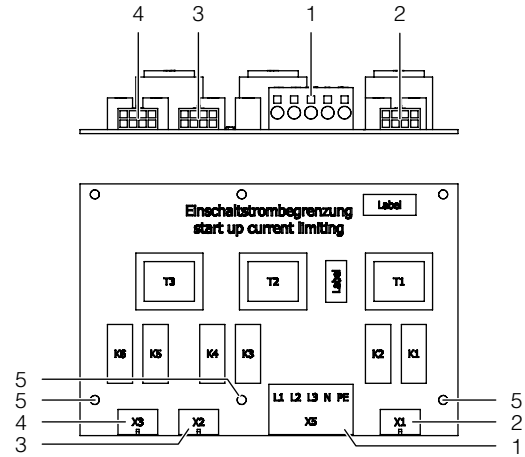


Fig. 53: Startup current limitation – rear/top view

Key

- 1 Terminals for infeed AC (X5) – 5-pole
- 2 Socket for fan 1, 2 (X1) – 8-pole
- 3 Socket for fan 3, 4 (X2) – 8-pole
- 4 Socket for fan 5, 6 (X3) – 8-pole
- 5 Earthing (3x)

The startup current limiter is supplied with voltage via terminal strip

X5X5 pin assignment:

- 1 Phase conductor L1 (1~ L1)
- 2 Phase conductor L2 (1~ L1')
- 3 Phase conductor L3 (1~ L1'')
- 4 Neutral conductor N5PE conductor



Note:
Fan positions 2 and 5 are not present in the LCP Inline flush.

Assignment of X1/X2/X3:

- 1 PE Fan
- 2 PE
- 3 PE
- 4 PE Fan
- 5 Neutral conductor fan
- 6 Phase fan
- 7 Neutral conductor fan
- 8 Phase fan

8.2 Description of operation

8.2.1 General

A Basic CMC forms the control unit of the Liquid Cooling Package. Its jobs are to:

- Retrieve all measurements via the I2C bus from the fan modules and the water module (temperatures, speeds, flow rates, etc.).
- Evaluate all measurements and generate alarm and warning signals.
- Calculate the thermal output of the inlet and return temperature as well as determine the water flow volume.
- Control air temperature in the server enclosure by regulating the fan speed and the water volume through the heat exchanger.
- Set the set point temperature for the cold air blown in (factory setting 20°C).
- Control an optional display with touch function via an RS-232 interface.
- Display the measurements and settings of parameters and set points via the web interface of the CMC.
- Poll the sensor and setting values over SNMP.



Note:
Further explanations concerning the various setting options and features are available in the Basic CMC system documentation.

The control unit cyclically polls all measurements from the connected fan modules and water module. This communication takes place via the I2C bus. The control unit thus serves as the master and polls the measurements from the slave units and returns the setting data to them.

The measurements supplied by the individual modules are evaluated by the control unit and possible warning and alarm signals are generated. If a new warning or alarm occurs, the internal beeper communicates this. At the same time, the alarm relay is switched. This acoustic alarm may be cleared by pressing down the clear button “C” briefly. The exact cause of malfunction can be displayed in plain text on the connected optional display with touch function. The following messages can be displayed:

Warning messages

- Speed of fan 1 faulty
- Speed of fan 2 faulty (not LCP Inline flush)
- Speed of fan 3 faulty
- Speed of fan 4 faulty
- Speed of fan 5 faulty (not LCP Inline flush)
- Speed of fan 6 faulty
- Flow faulty
- Control valve faulty

Alarm messages

- Temperature sensor 1 (server-in/server-out temperature) faulty
- Temperature sensor 2 (server-in/server-out temperature) faulty
- Temperature sensor 3 (server-in/server-out temperature) faulty
- Inlet temperature sensor faulty
- Return temperature sensor faulty
- Water module not present
- Leakage message
- No fan module detected



Note:
After turning on for the first time or after repair work, it is possible that the Liquid Cooling Package will operate in emergency operation mode. In order to switch the unit to normal operation (control operation), press down the “C” button (Fig. 49, item 1) once quickly.



Note:
In emergency operation, cooling of the device is ensured even with malfunctions inside the unit. All fans will then operate at 100% output, and the control valve will open completely.

Design of the temperature control circuit

The actual temperature values of the cold air on the air input side (server-in temperature) supplied by the three temperature sensors on the heat exchanger are used to control the air which is blown into the server enclosure. The average value is determined from the actual temperature values. The control unit constantly compares this (average) actual temperature with the set point temperature. If the set point temperature is exceeded, the control unit attempts to maintain a constant temperature by opening and closing the control valve. Only when the actual temperature falls below the value of “set point temperature” is the control valve kept closed, i.e. no cold water flows through the heat exchanger. Additionally, the necessary fan speed is determined and controlled by determining the temperature difference between the inlet and the outlet air (server-out temperature / also, in this case, an average value is determined via the fan modules.) The respective set point speed for the fans and the setting of the control valve is sent to the connected control units via the I²C bus.

Four additional standard sensors can be connected to the control unit (Basic CMC) to monitor additional physical parameters of the Liquid Cooling Package. The sensors must simply be connected to one of the four sockets on the rear of the control unit (Fig. 50, item 1) and configured via the Basic CMC.

8 Operation

EN

four sockets on the rear of the control unit (Fig. 50, item 1) and configured via the Basic CMC.

The following standard sensors can be connected in addition:

Sensor	Model No. DK	Max. quantity
Temperature sensor	7320.500	4
Humidity sensor	7320.510	4
Analog sensor input module "4 – 20mA"	7320.520	4
Access sensor	7320.530	4 x 5
Vandalism sensor	7320.540	4
Airflow sensor	7320.550	4
Smoke alarm	7320.560	4
Motion sensor	7320.570	4
Digital input module	7320.580	4
Digital relay output module	7320.590	4
Voltage monitor	7320.600	4
Voltage monitor with switch output	7320.610	2
Voltage monitor	7320.611	4
48 V voltage monitor	7320.620	4
Leakage sensor	7320.630	4
Leakage sensor cable	7320.631	4
Acoustic sensor	7320.640	4
Door control unit	7320.790	4

Tab. 4: List of standard sensors

8.2.2 Operation in stand-alone mode

In stand-alone mode, the Liquid Cooling Package can be operated via the touch panel of the optional display with touch function on the front door. The display with touch function may be ordered as an accessory (see Chapter 14 "Accessories").



Fig. 54: Graphical display

The user interface of the touch panel allows the user to navigate between the individual menu options of the Liquid Cooling Package controller using software-controlled buttons.

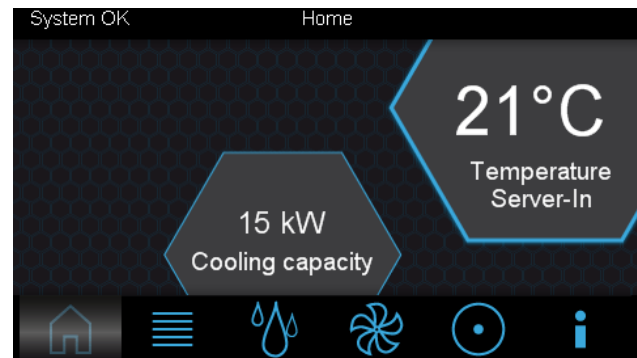


Fig. 55: Screen page

"Home" On the main screen, the mean of the 3 server-in temperatures of the sensors on the heat exchanger is displayed, together with the current cooling capacity. Depending on the current status of the Liquid Cooling Package, warnings (see Fig. 56) and alarm messages (see Fig. 57) may also be output here. Details of pending messages may be viewed on the screen page "Alarm list" (see Fig. 65).

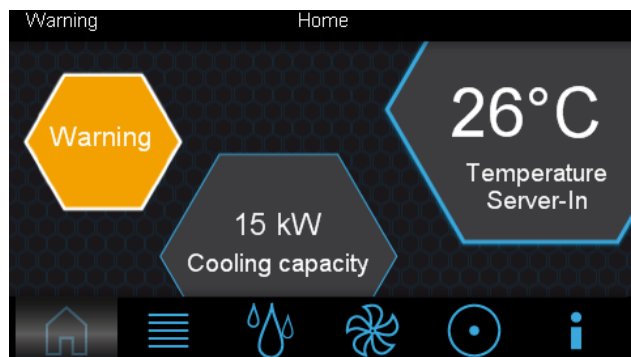


Fig. 56: Screen page "Home" with warning message

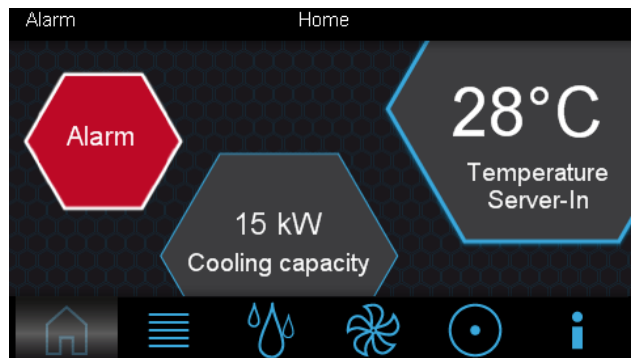


Fig. 57: Screen page "Home" with alarm message

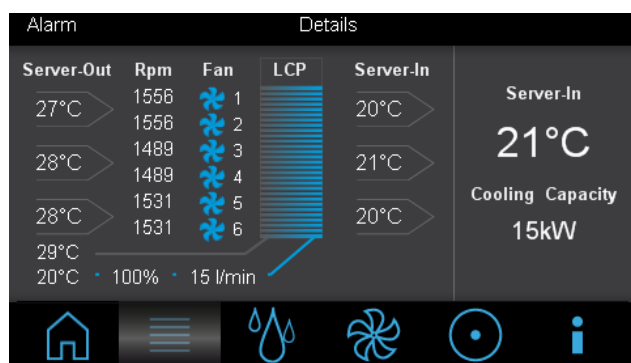


Fig. 58: Screen page "Details"

The following information is displayed on the screen page "Details"

- 3 x server-out temperature of sensors
- 3 x server-in temperature of sensors
- Speed of individual fan modules
- Water inlet and return temperature in °C
- Actual setting of control valve
- Cooling water flow rate in l/min

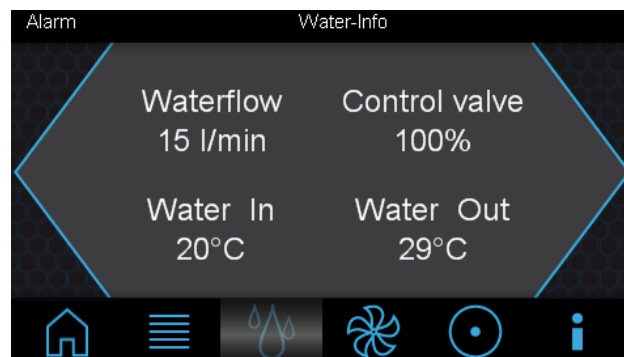


Fig. 59: Screen page "Water-Info"

The following information is displayed on the screen page "Water-Info"

- Cooling water flow rate in l/min
- Actual setting of control valve
- Water inlet and return temperature in °C

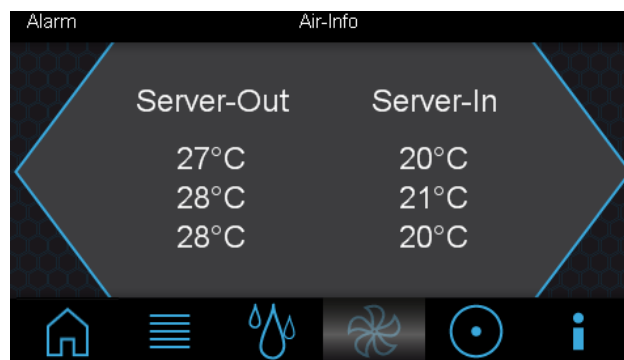


Fig. 60: Screen page "Air-Info"

The following information is displayed on the screen page "Air-Info"

- 3 x server-out temperature of sensors
- 3 x server-in temperature of sensors

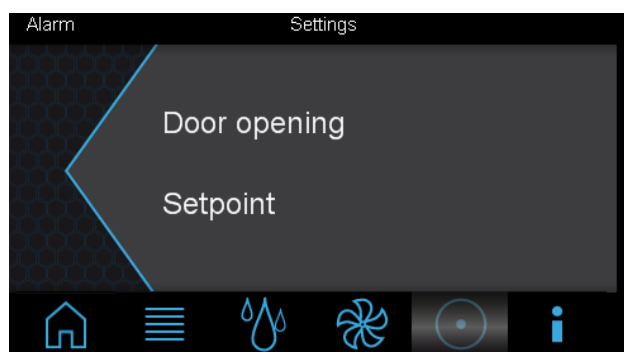


Fig. 61: Screen page "Settings"

The following selection options are available on the screen page "Settings":

- Door opening (with installed option "Automatic door opening")
- Set point

By selecting one of the points, a new screen page will open.

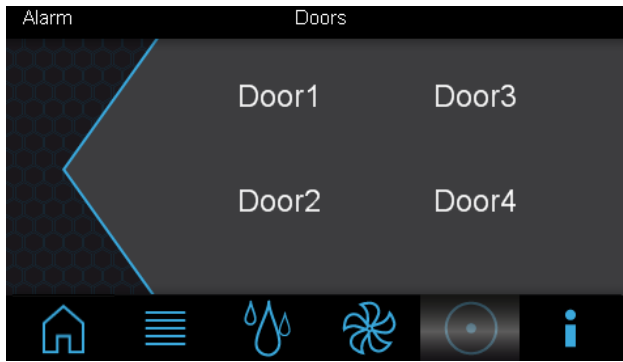


Fig. 62: Screen page "Doors"

The number of door exits that are defined is shown on the "Doors" screen page. By selecting an entry, e.g. "Door 1", the door magnets on this door output are deactivated for 10 seconds and the door opens. Once this period has expired, the magnet is reenergized.

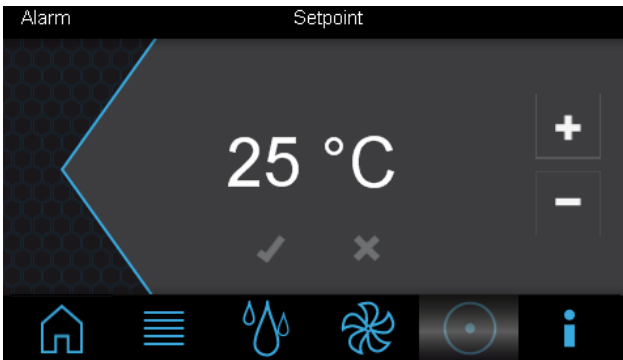


Fig. 63: Screen page "Set point"

On the screen page "Set point", you can define the set point for the server-in temperature.

- Increase the displayed value by pressing the "+" key, or reduce it by pressing the "-" key.
- Confirm the value by pressing the "✓" key.
- If you do not wish to accept the change, press the "X" key.



Note:
The input mode for the set point for the server-in temperature can be locked to prevent access by unauthorized personnel. Further information on this may be found in Chapter 8.3 "Extended options by connecting the Basic CMC to a network".

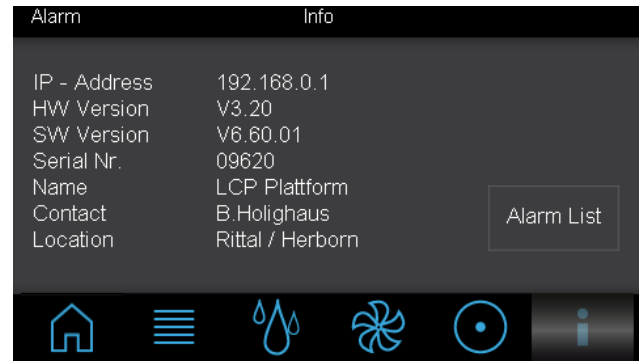


Fig. 64: Screen page "Info"

On the screen page "Info", detailed information such as version numbers of the Liquid Cooling Package is displayed.

By pressing the "Alarm List" key, the screen page "Alarm List" will appear. Here, all pending alarm messages are displayed in plain language.

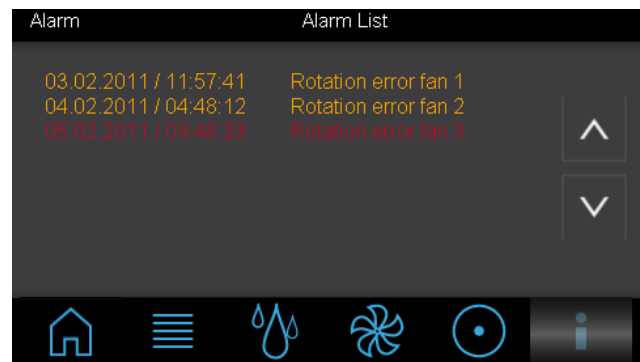


Fig. 65: Screen page "Alarm list"



Note:
Connect the Basic CMC to a network for extended setting options (see Chapter 8.3 "Extended options by connecting the Basic CMC to a network").

8.2.3 Automatic door opening LCP Rack

In conjunction with the LCP cooling systems, the automatic door-opening feature can be a wise choice under certain conditions. With this feature, the doors of the systems are kept closed under normal circumstances and are opened, if necessary, by a mechanism.

Possible reasons for use:

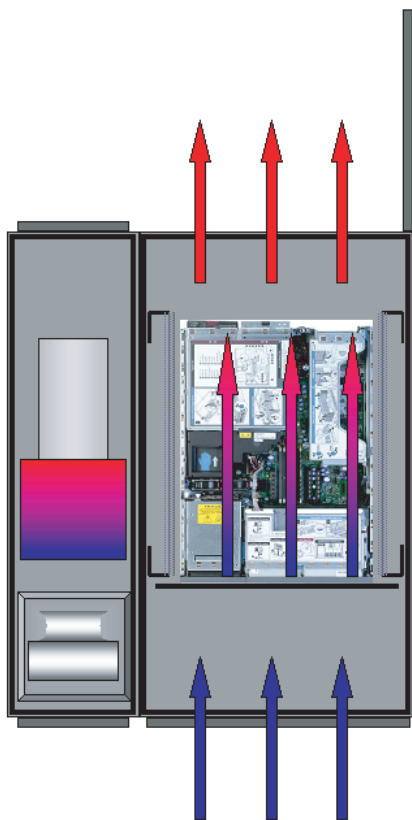
Fire extinguishing

Whole-room fire extinguishing systems are already installed in many existing data centers. However, when rack-based, high-density cooling is used in closed enclosures, the extinguishing gas cannot penetrate into the inside of the rack in the event of a fire. If the doors are automatically opened when needed, the extinguishing gas can flow into the enclosure.

Emergency cooling

In principle, redundancy with respect to the cooling can be achieved with the alternating installation of LCPs and racks (see Fig. 18). If this type of installation is not possible, the internal temperature of the enclosure can rise considerably within a short period of time, e.g. if the cooling water supply fails (e.g. at a power dissipation of 15kW, the temperature will rise from 22°C to 32°C in approximately 90 seconds). However, the rise in the air intake temperature depends greatly on how leak-tight the server rack is. Emergency cooling can be achieved by the automatic door opening feature. However, the installation location must have adequate air conditioning. The automatic door opening feature can be effected in several ways, as follows:

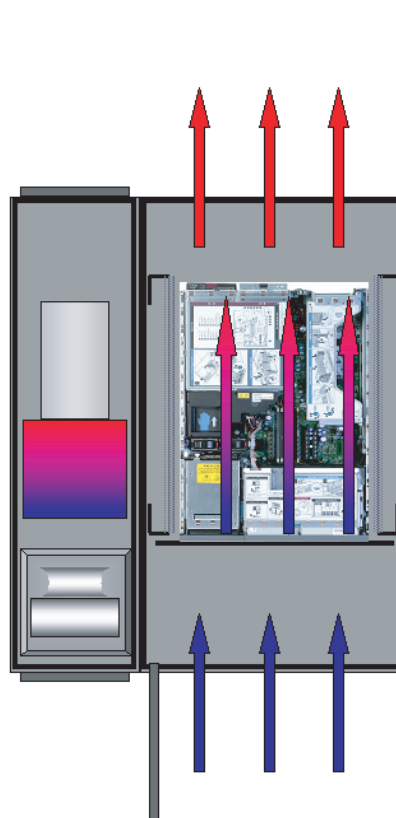
Perforated server rack front door in conjunction with a glass or sheet steel enclosure rear door



If the need arises, only the rear door of the enclosure is automatically opened. The air flows into the interior of the enclosure via the perforated front door, circulates around the installed equipment and exits the system via the open rear door of the enclosure. It is important to ensure that the LCP fans are switched off, otherwise hot air will be blasted in front of the 482.6 mm (19") level in the event of emergency cooling. If this method is used, whether for fire extinguishing purposes or for emergency cooling purposes, the installation location must be air-conditioned (ASHRAE conditions, 22°C, 50% rel. humidity). If this method is used for emergency cooling, even higher power dissipation in the server rack can be dissipated.

With this method, the escape route is only blocked at the back of the server rack. Unauthorized access, is however, possible through the open rear door. The separate partition between the cooling system and the rack is eliminated.

Solid front door (glass/sheet steel) in conjunction with a solid rear door (glass/sheet steel) of the server rack



If the need arises, both the front and the rear door are automatically opened. The air flows unhindered into the interior of the enclosure, circulates around the installed equipment and exits the system via the open rear door of the enclosure. It is important to ensure that the LCP fans are switched off, otherwise hot air will be blasted in front of the 482.6 mm (19") level in the event of emergency cooling. If this method is used, whether for fire extinguishing purposes or for emergency cooling purposes, the installation location must be air-conditioned (ASHRAE conditions, 22°C, 50% rel. humidity). If this method is used for emergency cooling, even higher power dissipation in the server rack can be dissipated. With this method, the escape route is blocked at both the front and back of the server rack. Unauthorized access is possible through the open front and rear doors. The separate partition between the cooling system and the rack is eliminated.

If the system used is equipped with an automatic door opening feature, the latter must be activated via the LCP software. The necessary settings are explained from page 48 on.

8.3 Extended options by connecting the Basic CMC to a network

By connecting the Liquid Cooling Package control unit (Basic CMC) to a network, you are able to call up various measurements and warning or alarm messages. These may then be further processed (e.g. via a Web browser, SNMP, etc.). Furthermore, various values can be set via the network and then sent to the control unit. If the control unit is connected to a network, the status LED (Fig. 49, item 3) flashes when the unit is polled by the network via the Ethernet interface.

The following values can be called up and processed via the network in the browser window of the Basic CMC software:

- Server-in temperature (actual temperature)
- Server-out temperature (hot air temperature; temperature measured behind the heat exchanger)
- Water-in temperature(values supplied by the heat exchanger module for the water inlet temperature)
- Water-out temperature(values supplied by the heat exchanger module for the water return temperature)
- Water flow (values supplied by the heat exchanger module for the water flow rate in l/min)
- Cooling capacity (calculated thermal output which is removed from the server enclosure)
- Set point (set target value)
- Operating mode (set operating mode either “auto” or “manual”)
- Fan speed(fan speed e.g. 20%)
- Control valve(the actual value for the control valve setting is displayed here)
- Leakage alarm(alarm indicating whether a leak is present)

The following values can be edited in the browser window of the Basic CMC software and then sent to the control unit.

- Set temperature (set point used by the control unit to regulate)

In the Liquid Cooling Package, the network connection for the BasicC MC is routed to a jack in the upper rear area of the device. To connect to a network, this jack should be connected to a free jack on a network access using a Category 5 patch cable. The Basic CMC is preset in the factory to IP address 192.168.0.190.

8.3.1 Visualization

The examples below explain how to set and change the values supplied by the Liquid Cooling Package control unit.



Note:

This documentation refers to the Basic CMC software with the provisional version 6.42. Further explanations concerning the operation and various setting options and features are available in the separate Basic CMC documentation. Firmware updates for the LCP software are available under www.rimatrix5.com.



Note:

This chapter contains a visualization of the LCP Rack by way of an example. For those areas where there are deviations from the LCP Inline, the modified/additional parameters are described accordingly.

Login page



Fig. 66: Login page of the Basic CMC

Fig. 66 shows the login page of the Basic CMC. A user with admin rights and up to 16 users with restricted rights can log in to the system here.

Status screen

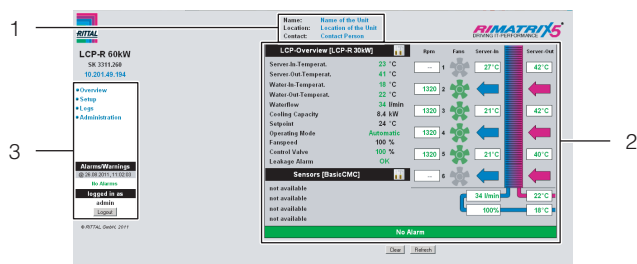


Fig. 67: Status screen of a Liquid Cooling Package

Key

- 1 Information display
- 2 Status window
- 3 Navigation display

Fig. 67 shows the status screen of the browser window of a Liquid Cooling Package. The screen is divided into three areas. At the left edge of the screen, under the Rittal logo, there is a navigation display which shows the current screen menu. The number and timing of the most recent alarms and warnings are also displayed here in the left-hand window.

The header of the screen contains an information display. This contains details of the connected units (Name/Liquid Cooling Package), the location of the unit (Location), and the responsible contact person (Contact).

Positioned underneath, in the middle of the status screen, is the status window, which is divided into four windows.

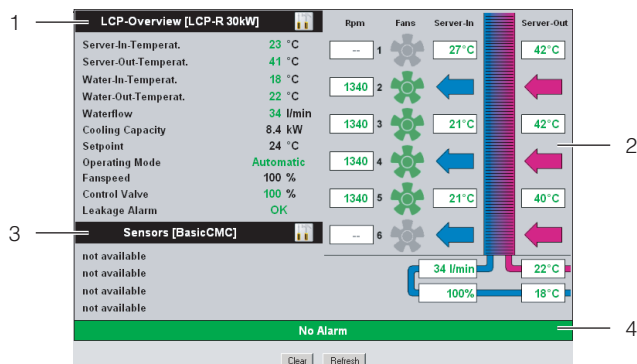


Fig. 68: Status window

Key

- 1 LCP overview
- 2 Graphical overview
- 3 Sensors
- 4 Status line

LCP overview

The following values are displayed in the LCP overview area:

Settings	Explanation
Server-in temperature	Displays the average of the three server-in temperatures from the fan modules.
Server-out temperature	Displays the average of the three server-out temperatures from the fan modules.
Water-in temperature	Displays the water supply temperature.
Water-out temperature	Displays the water return temperature.
Water flow	Displays the flow of the cooling medium, as also shown in the graphic overview.
Cooling capacity	Displays the calculated cooling output of the Liquid Cooling Package. The output is calculated from the inlet and return temperatures as well as from the flow values of the cooling water circuit (the value is calculated over approximately one to two minutes).
Set point	Displays the current set point for the server-in temperature. This set point is used to control the server-in temperature using the flow volume of the control valve.
Operating mode	Displays the current operating mode (Automatic, Manual or Combination (Combi.)) in which the Liquid Cooling Package is operating.
Fan speed	Displays the currently set fan speed in %: 0% = fan off 100% = maximum speed
Control valve	Displays the current set point for the position of the control valve in %: 0% = valve closed, 100% = valve open.
Leakage alarm	Status of the leakage sensor.

Tab. 5: Displays in the LCP overview display area

All displayed texts are provided as links, which refer you to the setup page of the respective sensor value.

Graphical overview

The following values are displayed in the graphical overview in an illustrated depiction of the Liquid Cooling Package:

Settings	Explanation
Server-in temperature (3x)	Displays the actual temperature and the status of each temperature sensor on the cold air side of the Liquid Cooling Package. The temperatures are displayed in real values in °C. The status of the temperature sensors is represented by the following colors: green = sensor o.k. red = sensor defective
Server-out temperature (3x)	Displays the actual temperature and the status of each temperature sensor on the warm air side of the Liquid Cooling Package. The temperatures are displayed in real values in °C. The status of the temperature sensors is represented by the following colors: green = sensor o.k. red = sensor defective
Fan speed (6x)	Displays the actual speed and the status of each fan. The temperatures are displayed in real values in rpm. The status of the temperature sensors is represented by the following colors: green = sensor o.k. orange = speed less than 400 rpm (with the fans operational). The arrangement and the numbering of the fans on the screen is equivalent to the real arrangement and numbering in the Liquid Cooling Package (fan 1, top/fan 6, bottom).
Flow rate	Displays the actual flow rate of the cooling medium in real values in l/min. The status of the temperature sensors is represented by the following colors: green = sensor o.k. orange = sensor defective
Control valve	Displays the actual value for the position of the control valve in %: 0% = valve closed, 100% = valve open.
Water temperature (2x)	Displays the actual temperature and the status of the temperature sensor at the cooling water inlet and return. The temperatures are displayed in real values in °C. The status of the temperature sensors is represented by the following colors: green = sensor o.k. red = sensor defective

Tab. 6: Measurements and display values in the graphical overview

Sensors

Four additional standard sensors can be connected to the control unit (Basic CMC) to monitor additional physical parameters of the Liquid Cooling Package. The status of these sensors is displayed in this window.

Status line

The status line displays whether or not the unit is functioning correctly or if a warning or alarm message is present. The following displays are possible:

- No alarm (green background)
- Warning (orange background)
- Alarm (red background)
- Configuration changed (status line flashes between red and orange)

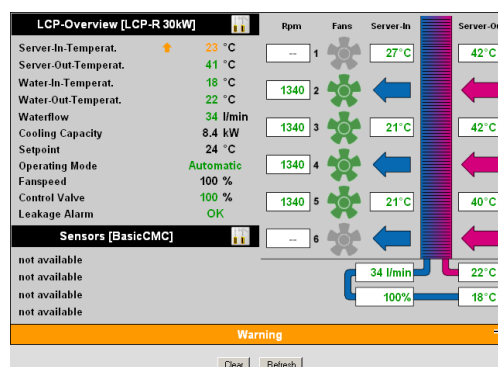


Fig. 69: Status screen with warning message

Key

- Warning message

A warning message is displayed in the status line of the status window in Fig. 69.

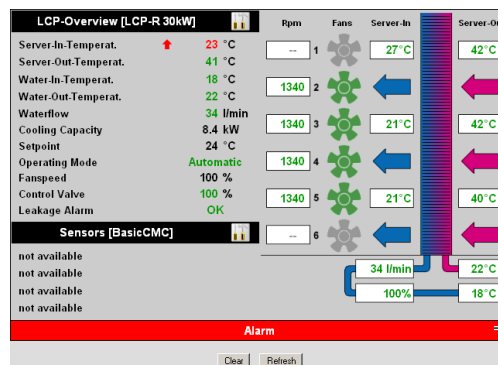


Fig. 70: Status screen with alarm message

Key

- Alarm message

An alarm message is displayed in the status line of the status window in Fig. 70. In this case, the server-out temperature has exceeded the upper limit.

You can acknowledge alarm and warning messages as well as the message "Configuration Changed" by pressing the "Clear" button. Acknowledgement of warning and alarm messages is only possible with the "Manual Reset" setting (Fig. 71 Alarm reset to "Manual"). You can refresh the overview diagram and sensor readings in the right-hand section of the window by pressing the "Refresh" button.

Setup screen

Setup LCP-R 60kW

Unit Name: LCP-R 30kW

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Type: Server-In-Temperat.

Sensor Status: 23 °C [OK]

Message: Server-In-Temperat.

Setpoint High: 65 °C [Range: 0...100°C]

Setpoint Warning: 55 °C [Range: 0...100°C]

Setpoint Low: 10 °C [Range: 0...100°C]

Alarm Delay: 0 s [Range: 0...999 s]

Alarm Relay: ☐ Disable ☒ Enable

Alarm Beeper: ☐ Disable ☒ Enable

Alarm Reset: ☒ Automatic ☐ Manual

Trap Receiver: ☒ 1 ☒ 2 ☒ 3 ☒ 4/Log

Scheduled Alarm Off: ☐ 1 ☐ 2 ☐ 3 ☐ 4

Send eMail: [Format: 1&2&3&4]

Accept Reset

Fig. 71: Setup screen for the server-in temperature

Fig. 71 shows the setup screen of the Liquid Cooling Package. The left edge of the screen and the header are not shown, because their layout is the same as that on the status screen.

The values which have to be set are shown on the set-up screen and can be input there. Beneath the setup window there are also two buttons, "Accept" and "Reset". These are used to either accept or reject the modified settings.

–The "Accept" button is used to accept the changed values.

–The "Reset" button is used to clear the changed values.

Fig. 71 shows the setup screen for the server-in temperature. Either the following values are displayed or the following settings may be changed in this screen:

Settings	Explanation
Unit name	Name of the Liquid Cooling Package unit (max. 10 characters)
Type	Message type
Sensor status	Temperature and status of the message are displayed in color.
Message	Text message which appears in the status window (may be edited)
Set point high	This set point may be used to generate and forward an alarm message in case of over-heating (temperature sensor).
Set point warning	This set point may be used to generate and forward a warning message if limits are exceeded.
Set point low	This set point may be used to generate and forward an alarm message in case of over-cooling (temperature sensor).
Alarm delay	Used to set a delay time of between 0 and 999 seconds. Any warnings or alarms that occur are only activated with the set delay time. Alarms or warnings which are shorter than the duration set here will not be displayed or logged. The status change to "OK" occurs immediately, independently of the value set here.
Alarm relay	Used to switch the Basic CMC alarm relay on and off.
Alarm beeper	Used to switch the Basic CMC acoustic alarm on and off.
Alarm reset	Determine whether activated alarms should be automatically deleted, or whether manual confirmation (with the "Clear" button or using the "C" key on the Basic CMC) is required.
Trap receiver	Choice as to which receiver a trap is sent when status is changed.
Scheduled alarm off	This point may be used to determine that no alarm should be reported for one or more timers. The time for the timer must be set in the timer menu.
Send e-mail	Select the recipients to whom an e-mail is to be sent if the status changes. The numbers of the respective e-mail addresses are linked to each other with the character "&".

8 Operation

EN

The settings for the following components are made on the tab panels 2 through 5:

- Tab panel 2: Server-out temperature
- Tab panel 3: Cooling water inlet temperature
- Tab panel 4: Cooling water return temperature
- Tab panel 5: Flow of the cooling medium



Note:
The flow limits on tab panel 5 should be set to the value that the system can supply at the maximum flow rate.

The reactions of the Liquid Cooling Package to warning and alarm messages from the respective components are set on tab panels 6 through 11.

- Tab panel 6: Fans. The fans are monitored for a minimum speed of approx. 400rpm.
- Tab panel 7: Air temperature sensor. The sensors are monitored for a viable temperature of between 0°C and 80°C.
- Tab panel 8: Water temperature sensor. The sensors are monitored for a viable temperature of between 0°C and 60°C.
- Tab panel 9: System warning. System warnings indicate a flow meter failure and a faulty control valve.
- Tab panel 10: Hardware module fault. Module faults relate to a non-identified fan assembly and a non-identified water assembly.
- Tab panel 11: Leakage alarm.



Note:
Tab panels 2 through 11 have the same layout as tab panel 1. Only a few parameters are missing. Therefore, a repeat, detailed description is not given here again.

The screenshot shows the 'Setup LCP-R 30kW' interface. At the top, the 'Unit Name' is 'LCP-R 30kW'. Below this is a row of 15 tabs, with tabs 1 through 11 highlighted in green. The main display area shows the following information: 'Type' is 'Cooling capacity', 'Sensor Status' is '8434 W [OK]', and 'Message' is 'Cooling Capacity'. Below this, the 'Setpoint' is set to '24 °C' with a range of '10...40 °C'. At the bottom, there are 'Accept' and 'Reset' buttons.

Fig. 72: Setup screen for cooling output and server-in temperature

Fig. 72 shows the setup screen for the cooling capacity display value. This shows how much cooling output is being delivered by the recooling systems to the system at the moment.

The set point for the server-in temperature may be changed in the lower part of the window. A password must be entered to call up the three setup screens for the operating data (tabs 13–15). This is done on a separate login screen. Furthermore, the logged-in user must have administrator rights.

The screenshot shows the 'Setup LCP-R 30kW' interface. At the top, the 'Unit Name' is 'LCP-R 30kW'. Below this is a row of 15 tabs, with tabs 1 through 11 highlighted in green. The main display area shows the following information: 'ATTENTION: To access the LCP service pages you have to login by password...'. Below this is a text input field labeled 'Enter Password:'. Below the input field, there is a red warning message: 'WARNING: Changes of the settings on one of the service pages may impair the cooling function and should only be performed by trained maintenance personnel!'. At the bottom, there are 'Accept' and 'Reset' buttons.

Fig. 73: Input password



Note:
 Password: RittalLcp+XXXXX
 The five-digit number at the end of the password (XXXXX) is the serial number of the Basic CMC (see table 13 “General settings for Liquid Cooling Package”). Access to the setup screens is only possible with full access rights. This must be set up via the hyperterminal in the Basic CMC of the unit. Refer to the operating manual for the Basic CMC for more detailed information.



Caution!
Only disclose the password to authorized personnel. The setup mode is only used for service purpose. Setting up of basic operating parameters should only be carried out by Rittal service personnel.

If no changes are entered or confirmed in the login window for more than 10 minutes, the password is reset and it must be entered again to call up the setup window for operation data.

Fig. 74: Setup screen 1 for operation parameters – “Automatic Mode”

Fig. 74 shows the setup screen 1 for the operating parameters of the Liquid Cooling Package for the functions in automatic mode. The following are parameters that are displayed or settings that may be made on this screen:

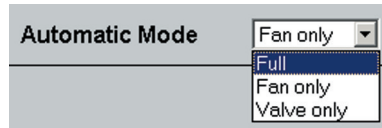
Settings	Explanation
Combination status	Displays the status of the combination.
Operating mode	Selection of the Liquid Cooling Package operating mode. Here, automatic mode is selected. The additional settings in manual mode are explained in Tab. 10.
Automatic mode	<p>Pull-down menu for setting the control of the fans and the control valve of the Liquid Cooling Package.</p>  <p>Full: In this mode, the fan speed and the position of the control valve are controlled automatically.</p> <p>Fan only: In this mode, only the fan speed is controlled automatically. The position of the control valve can be set to a fixed position using the function for manual operation. This position is saved and used again after the system is restarted.</p> <p>Valve only: In this mode, only the position of the control valve is controlled automatically. The fan speed can be set to a fixed speed using the function for manual operation. This speed is saved and used again after the system is restarted.</p>
Combinations	Call up the “Combinations” screen for setting the links of the sensor feedbacks for control of the fans.

Fig. 75: Setting options

Settings	Explanation
Fan control mode	<p>Pull-down menu for setting the calculation mode for automatic control of the fan speeds. The required fan speed for automatic control is determined from the difference of the server-out temperature and the set point for the server-in temperature (dT = server-out temperature – set point server-in temperature) and controlled directly.</p> <p>The following modes can be selected:</p> <div data-bbox="298 541 776 634"> <p>Fan Control Mode</p> <ul style="list-style-type: none"> maximum temperature average temperature maximum temperature </div> <p>average temperature: In this mode, the average value of the server-out temperatures is used to calculate the required fan speed.</p> <p>maximum temperature: In this mode, the highest value of the server-out temperatures is used to calculate the required fan speed.</p> <p>In addition, the automatic control of the fan speeds can be controlled using the values dT [min. fan speed] and dT [max. fan speed].</p>
dT [min. fan speed]	The fans operate at the lowest fan speed beneath this temperature difference.
dT [max. fan speed]	The fans operate at the highest fan speed above this temperature difference.
Min. fan speed	Minimum fan speed. In automatic mode, the fans will always run at this set speed as minimum.

Tab. 8: Operating parameters 1 for automatic mode

Fig. 77: Display after calling up the setup screen "Combinations"

This page is used to set the required responses of the fan and the control valve if the conditions of the "Combinations" are met.

To this end, the status of four sensors can be linked together. Both of these groups can then also be linked again with "and/or" (Fig. 77). The rules of "Boolean Algebra" should be taken into account when making such links.

The following selection options are available for the response of the fans and the control valve:

	Display	Fan response	Control valve response
1	Fans off & valve to 100%	Fans are deactivated	Valve is opened to 100%
2	Fans to full speed & valve to 100%	Fans are switched to highest speed (100%)	Valve is opened to 100%
3	Fans off & valve to minimum	Fans are deactivated	Valve is closed to minimum level
4	Fans to full speed & valve to minimum	Fans are switched to highest speed (100%)	Valve is closed to minimum level
5	Fans off & valve to automatic	Fans are deactivated	Fan control remains active
6	Fans to full speed & valve to automatic	Fans are switched to highest speed (100%)	Fan control remains active
7	Fans to automatic & valve to 100%	Fan control remains active	Valve is opened to 100%
8	Fans to automatic & valve to minimum	Fan control remains active	Valve is closed to minimum level.

Tab. 9: Selection options for response of the fans and control valve

**Caution!**

If one of the two settings is chosen as “valve to automatic” (no. 5 or no. 6), the setting for the “Automatic Mode” must be set to “Full” or “Valve Only” in order for valve control to continue to work. If one of the two settings is chosen as “fans to automatic” (no. 7 or no. 8), the setting for the “Automatic Mode” must be set to “Full” or “Fan Only” in order for fan control to continue to work.

Fig. 78 shows the setup screen for the operating parameters of the Liquid Cooling Package for the functions in manual mode. The following are parameters that are displayed or settings that may be made on this screen in addition to the functions in automatic mode:

Fig. 78: Setup screen 1 for operating parameters – “Manual Mode”

Settings	Explanation
Operating mode	Selection of the Liquid Cooling Package operating mode. Here, manual mode is selected.
Fan speed	Fan speed setting (0% = off / 100% = maximum speed). The last setting that was made is saved and used again after the system is restarted if the setting “Valve only” is selected in automatic mode. Otherwise, the fan modules are controlled automatically.
Enable fans	Switch off individual fan modules for testing. This function is only possible in manual mode. In automatic mode, all fan modules are activated.
Valve	Setting of the opening position of the control valve. This is set as a percentage [%] between 0 and 100%. The last setting that was made is saved and used again after the system is restarted if the setting “Fan only” is selected in automatic mode. Otherwise, the control valve is controlled automatically.

Tab. 10: Operating parameters for manual mode

**Note:**

After the Liquid Cooling Package is connected to the mains or restarted, the controller is always in automatic mode.

Setup LCP-R 30kW

Unit Name: LCP-R 30kW

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Service page 2: Control Values

Sampling Time: 20 s [Range: 10s...60 s]

PID components: 10 % 80 s 0 1/s

Cw value: 4187 [Range: 1000...9999 Ws/kgK]

Valve Min. Value: 45 % [Range: 0...50 %]

Leakage Mode: ☒ Emergency Mode ☐ Only Alarm Message

Setpoint by display: ☒ Enable ☐ Disable

Open by display: ☒ Enable ☐ Disable

Door Outputs: ☐ 1 ☐ 2 ☐ 3 ☐ 4

Measurement Interval: 30 s [Range: 10...600 s] --> 8 h : 32 m

Accept Reset

Fig. 79: Setup screen 2 for the operating parameters

Fig. 79 shows the setup screen 2 for the operating parameters of the Liquid Cooling Package for the functions in automatic mode. The following are parameters that are displayed or settings that may be made on this screen:

Settings	Explanation
Sampling time	Setting of the control interval for the control valve. In this interval, the actual temperature (average from the temperature sensors of the server-out temperature) is compared with the set point (server-in temperature). This is set in seconds [s] between 10 and 60s (preset to 20s).
PID components	<p>Values for setting the PID control algorithm integrated in the LCP software. The following settings can be made here:</p> <p>P amount: Parameter for setting the proportional amount. This is set as a percentage [%] between 1 and 30% (preset to 10%).</p> <p>I amount: Parameter for setting the integral amount. This is set in seconds [s] between 20 and 150s (preset to 80s).</p> <p>D amount: Parameter for setting the differential amount. This is set in amount per second [1/s] between 0 and 50/s (preset to 0/s).</p>
Cw value	Specific thermal capacity of the cooling liquid used.

Settings	Explanation
Valve min. value	Continuous opening of the control valve may be set here within the range of 0 to 50% (default value: 0%). This minimal valve setting is only active in "Automatic Mode"; the valve can still be manually closed to 0%. Similarly, in the event of a malfunction (e.g. leakage), depending on the setting, the valve is either closed completely ("close valve") or an alarm message is output ("alarm message only") (Fig. 79). This setting guarantees a minimum flow at all times, whereby the control can react more spontaneously to sudden capacity increases.
Leakage mode	<p>This sets the required response of the control valve in the event of a leakage:</p> <p>Emergency Mode: The valve closes completely in the event of a leakage.</p> <p>Only Alarm Message: Only an alarm message is sent in the event of a leakage. The Liquid Cooling Package continues controlling in the previously set mode.</p>
Set point by display	<p>Enable options for the set point entry of the server-in temperature using the display with touch function of the Liquid Cooling Package:</p> <p>Enable: Set point entry is possible.</p> <p>Disable: Set point entry is locked.</p>
Open by display	Activation or deactivation of door opening on the touch panel (optional).
Measurement interval	A log file "lcp_plus.csv" is stored in the download directory, in which measurements such as temperatures, set points, valve setting, output etc. are stored. The maximum number of entries is 1024; thereafter, "old" entries are overwritten. The interval between two entries may be set here at between 10...600s. The display also shows which time frame is covered by the time interval set here with the 1024 entries in the log file.

Tab. 11: Operating parameters 2 for automatic mode

**Caution!**

The preset values of the parameters "Sampling Time" and "PID Components" were calculated based on a series of experiments, and should only be changed for good reason, to improve the control performance.

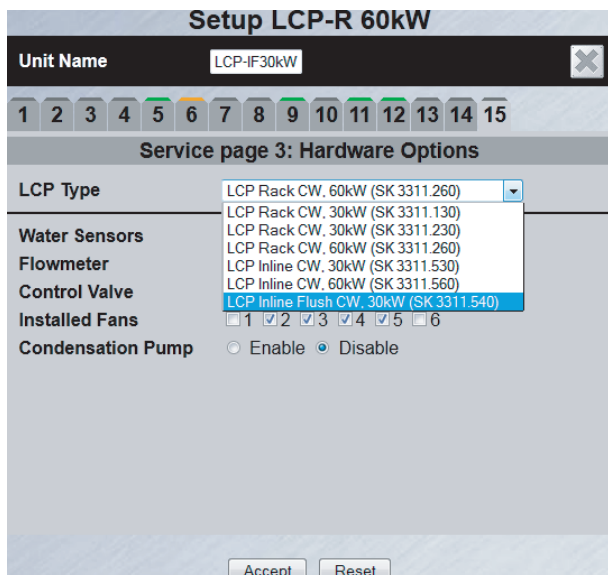


Fig. 80: Setup screen 3 for the hardware options

Fig. 80 shows setup screen 3 for setting the hardware options of the Liquid Cooling Package. The following are parameters that are displayed or settings that may be made on this screen:

Settings	Explanation
LCP type	Selection of the Liquid Cooling Package version. This value is preset in the factory and must not be altered.
Water sensors	“Disable Water Sensors” indicates the removal of the temperature sensors for water inlet and return from the visualization. Consequently, “Disable Flow Meter” and “Disable Control Valve” indicate the removal of the flow meter and control valve. If there are customer-specific control components connected upstream of the Liquid Cooling Package, the water sensors for inlet and return, the flow meter and the control valve must be physically removed from the unit. Otherwise, the internal control components will continue to be regulated.
Flow meter	
Control valve	
Condensation pump	If the optional condensate pump is installed in the Liquid Cooling Package, the setting “Enable Condensation Pump” will enable the “Cycles Condensation Pump” display to be flashed up in the visualization. With the setting “Disable Condensation Pump”, this display is masked out, but the condensate pump continues to be activated. As standard, there is no condensate pump installed in the Liquid Cooling Package.

Settings	Explanation
Installed fans	Following the installation of one or more fans, these fans need to be activated here. Allocation of the numbers 1-6 to the installation location can be viewed on the status screen (see Fig. 69). The position of the fans installed in the factory may be found in chapter 5.3 “Fan installation”.

Tab. 12: Settings for the hardware options



Note:

For components that have been disabled, the values are displayed highlighted in grey on the overview page (Fig. 81). Components that have been disabled also no longer deliver warning and/or alarm messages. For these components, no more set points can be entered, simulations can also no longer be carried out. The cooling capacity can also only be calculated when the water temperature sensors and flow meter are available and active.

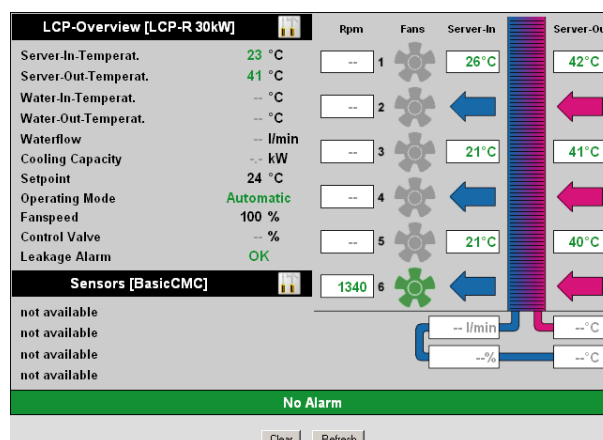


Fig. 81: Status screen after disconnection of the components of the water module

Setup General Configuration

Name	LCP-Plus / Entwicklung	
Location	FGE / Rittal-Herborn	
Contact	info@rittal.de	
Revision	SW: V6.42 HW: V3.01 SN: 00023	
Temperature Unit	<input checked="" type="radio"/> Celsius <input type="radio"/> Fahrenheit	
Measurement Unit	<input checked="" type="radio"/> Liter / min <input type="radio"/> US-Gallons / min	
Beeper	<input checked="" type="radio"/> Off <input type="radio"/> On	
Quit Alarm Relay	<input checked="" type="radio"/> Disable <input type="radio"/> Enable	
Language	<input checked="" type="radio"/> english <input type="radio"/> foreign	
Alarm Relay Options	Open	
Web Access	Full	
Background Color	White	
Actual Date	07.04.2009 [Format: dd.mm.yyyy]	
Actual Time	12:47:44 [Format: hh:mm:ss]	

Fig. 82: Setup screen "General Setup"

The setup screen "General Setup" is depicted in Fig. 82. All general settings for the Liquid Cooling Package are made here:

Settings	Explanation
Name	Name of the Liquid Cooling Package unit (max. 40 characters)
Location	Location of the Liquid Cooling Package unit (max. 40 characters)
Contact	Responsible contact person (max. 40 characters)
Revision	Revisions and serial numbers of the Liquid Cooling Package unit SW: Software revision HW: Hardware revision SN: Serial number
Temperature unit	Default setting for the unit of temperature. The following settings are possible: Degrees Celsius [°C] Degrees Fahrenheit [°F]
Measurement unit	Default setting for the unit of flow. The following settings are possible: Liters per minute [l/min] Gallons per minute [US-Gallons/min] With SNMP transmission, the value is only displayed in l/min.
Beeper	Used to switch the Basic CMC alarm beeper on and off.
Quit alarm relay	Here, you can set whether the alarm relay can be acknowledged using the C key on the Basic CMC.
Language	Used to change the language of the screen pages in the browser window (German and English).

Settings	Explanation
Alarm relay options	Used to set the switching position that generates an alarm message. The following settings are possible: Open: Message is generated when the relay opens. Close: Message is generated when the relay closes. Off: The relay does not switch, and therefore no message is generated.
Web access	Display of network access to the Liquid Cooling Package, as set via Telnet or via the serial interface. The following displays are possible: Full: Full access View only: read only access No Access: access prohibited
Background color	Used to set the background color of the screen pages in the browser window.
Actual date	Current date
Actual time	Current time

Tab. 13: General settings for Liquid Cooling Package

Setup eMail (SMTP)

IP SMTP-Server	192.168.1.1	
SMTP Authent.	<input checked="" type="radio"/> No <input type="radio"/> Yes	
Username Server		
Password Server		Retype
Sender Name	lcpplus@acme.com	
Reply to	webmaster@acme.com	
Unit Messages	<input checked="" type="radio"/> No <input type="radio"/> Yes	
E-Mail Address 1	user1@acme.com	
E-Mail Address 2	user2@acme.com	
E-Mail Address 3		
E-Mail Address 4		

Fig. 83: Setup screen "Setup eMail (SMTP)"

Fig. 83 shows the setup screen for "Setup eMail (SMTP)". All settings for sending e-mails via the CMC are made here:

Settings	Explanation
IP SMTP server	IP address of a mail server.
SMTP authentication	If authentication is necessary at the mail server, activate the option "Yes" here. Then enter the appropriate data in the fields "User-name Server" and "Password Server".

Settings	Explanation
Sender name	Sender name of the Liquid Cooling Package or Basic CMC for outgoing e-mails.
Reply to	Reply address for e-mail replies.
Unit messages	Activation or deactivation of e-mail sending in the event of faults at a unit.
E-mail address 1 – 4	Input of up to 4 addresses to which the e-mails are to be sent. Which of these destination addresses are to be contacted in the event of a fault can be selected on the tab panels for the individual sensor settings.

Tab. 14: Settings for sending e-mails

Setup Timer

1 2 3 4 5 6 7 8

Timer Control ☒ Disable ☐ Enable

Day of Week

Time Interval - [Format: hh:mm]

Timer Function

Timer Status inactive

Accept Reset

Fig. 84: Setup screen "Setup Timer"

The setup screen "Setup Timer" is depicted in Fig. 84. Here, all settings for eight timers may be made on the eight tab panels.

Settings	Explanation
Timer control	Activate (enable) or deactivate (disable) timer control.
Day of week	Reply address for e-mail replies.
Time interval	Input the time interval for which the timer remains active.
Timer function	Select the required timer function to be triggered at the specified time. Choose between the following four groups: Disable Trap Receiver X Alarm Scheduler X Disable E-Mail Receiver X Status E-Mail to Receiver X The individual Alarm Schedulers may be activated and deactivated on the respective tab panels of the individual sensors (Tab. 7).
Timer status	Display the timer status.

Tab. 15: Settings for the timers

Setup Server Shutdown

1 2 3 4

Group 1

If status of is

and status of is

Group 2

If status of is

and status of is

If Group 1 and Group 2 then shutdown

	Server-Name	IP-Address	Port	Delay	Enable
1	Server 01:01	0.0.0.0	6003	0 s	<input type="checkbox"/>
2	Server 01:02	0.0.0.0	6003	0 s	<input type="checkbox"/>
3	Server 01:03	0.0.0.0	6003	0 s	<input type="checkbox"/>
4	Server 01:04	0.0.0.0	6003	0 s	<input type="checkbox"/>
5	Server 01:05	0.0.0.0	6003	0 s	<input type="checkbox"/>
6	Server 01:06	0.0.0.0	6003	0 s	<input type="checkbox"/>
7	Server 01:07	0.0.0.0	6003	0 s	<input type="checkbox"/>
8	Server 01:08	0.0.0.0	6003	0 s	<input type="checkbox"/>
9	Server 01:09	0.0.0.0	6003	0 s	<input type="checkbox"/>
10	Server 01:10	0.0.0.0	6003	0 s	<input type="checkbox"/>

Accept Test Ping Reset

Fig. 85: Setup screen "Setup Server Shutdown"

The setup screen "Setup Server-Shutdown" is depicted in Fig. 85. All settings for the selective shutdown of servers may be made here. To this end, combinations may be set with up to four input conditions.

**Note:**

As a general rule, the setting of combinations for shutting down servers is similar to the approach used when setting the combinations for fan control.

In the lower part of the screen page, you define the individual servers (up to 10) which are to be shut down if the conditions of Group 1 and/or Group 2 are met. To this end, a shutdown client (RCCMD licence) must be installed on the respective server. The licence may be ordered under Rittal item number 7857.421. The "Test Ping" button is used to test whether the respective server for which the "Enable" check box has been selected is physically present and switched on.



Fig. 86: Navigation bar when there are alarms/warnings present

Via the navigation bar on the left-hand edge of the screen, the pages with the alarm messages and event messages may be retrieved.

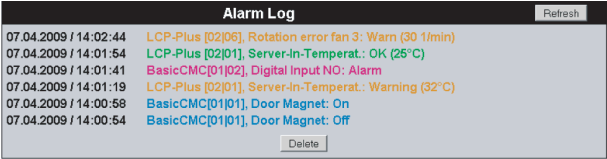


Fig. 87: Alarm messages

Fig. 87 shows the last alarm messages; up to a total of 150 messages may be stored. The individual alarms and warning messages are differentiated based on their cause (e.g. water-out temperature, failure flow meter, etc.). For quicker differentiation, the entries are also highlighted in color:

- Red: Alarm messages
- Orange: Warning messages
- Green: OK messages
- Blue: Information messages

The “Delete” button is only visible if a user with admin rights is logged in. By pressing this button, the list of alarm messages and the corresponding log files (alarm.csv, alarm.history) are deleted completely.

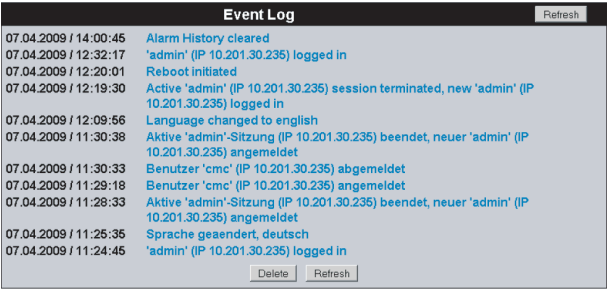


Fig. 88: Event messages



Note:
The overview of event messages will only appear if the user is logged in as “admin”. If not, the message “Access denied!” will appear in the window.

Fig. 88 shows an overview of the times when each user logged in or logged out. Here again, a total of 150 messages may be stored.
By pressing the “Delete” button, the list of messages and the corresponding log file (event.log) are deleted completely.
By pressing the “Refresh” button, the page with the log entries is updated and refreshed.

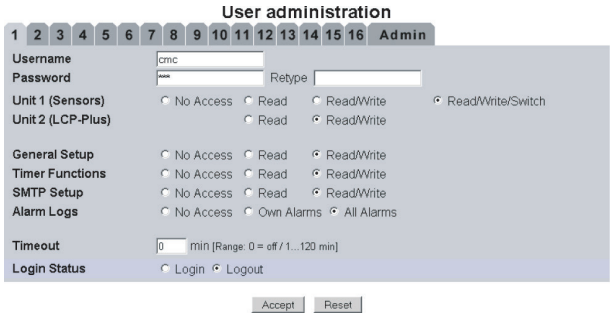


Fig. 89: “User administration” screen if the user logged in as “admin”

Fig. 89 shows the “User administration” screen if the user is logged in as “admin”. Settings for up to 16 users can be made on tab panels 1 through 16.

Settings	Explanation
User name	User name (min. 3 characters). The stated user name cannot be retrospectively altered. To do so, the user must first be deleted (save without entry) and then recreated.
Password	User password (min. 3 characters). The password must be entered a second time in the field “Retype”.
Unit 1 (Sensors)	Access right for the sensor values of the Basic CMC.
Unit 2 (LCP ...)	Access right for the sensor values of the Liquid Cooling Package.
General setup Timer functions SMTP setup	Access rights for the setup settings.
Alarm logs	Access rights for the various alarm log areas.

Settings	Explanation
Timeout	Time after which the user is automatically logged out when there has been no activity.
Login status	Here, the administrator can see which user is logged in.

Tab. 16: User settings

Change user password

Username

Password Retype

Fig. 90: "User administration" screen if the user is not logged in as "admin"

Fig. 90 shows the "User administration" screen if the user is not logged in as "admin". The user can change his password here.

User administration

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Admin

Username

Password Retype

Timeout min (Range: 0 = off / 1...120 min)

Fig. 91: "User administration" screen, "Admin" tab panel

Fig. 91 shows the "User administration" screen with the "Admin" tab panel in the foreground. Settings for the administrator can be made on this tab panel. In contrast to the other users, only the user name, password and time for automatic log-out appear here. In addition, the administrator can also call in the so called Alarm Simulation from this tab panel.

Alarm Simulation Menu

Server-In-Temperat. ☐ Too Low ☐ Warning ☐ Too High

Server-Out-Temperat. ☐ Too Low ☐ Warning ☐ Too High

Water-In-Temperat. ☐ Too Low ☐ Warning ☐ Too High

Water-Out-Temperat. ☐ Too Low ☐ Warning ☐ Too High

Waterflow ☐ Too Low ☐ Too High

Fan RPM Warnings

Temp. Sensor Alarms

Water Sensor Alarms

System Warnings

Controlmodule Alarms

Leakage Alarm

Fig. 92: "Alarm Simulation Menu" screen

Fig. 92 shows the "Alarm Simulation Menu" screen. Individual alarms and warnings can be simulated here. For messages requiring limits to be entered, the following options are available for selection: "Too Low", "Warning" and "Too High". When the appropriate "Simulation" button is then pressed, the respective alarm or warning is activated for 5 seconds. After that, the status is automatically reset to OK or to the original state.



Note:

Only one simulation can run at a time in the "Alarm Simulation Menu".



Note:

When the simulation is activated, all system reactions that are stored for the respective fault (alarm relay, beeper, traps, e-mail) are initiated. Any combinations entered for a controller or actuator (if connected) are also executed.

Setup Sensors

Unit Name

BasicCMC

1

2

3

4

Type

Door Magnet

Output Status

On

Message

Door Magnet

Trap Receiver

☒ 1 ☒ 2 ☒ 3 ☒ 4/Log

Send eMail

[Format: 1&2&3&4]

Combinations

Switch Output

☐ Off ☒ On

Accept

Reset

Fig. 93: "Setup Sensors" screen

Fig. 93 shows the "Setup Sensors" screen with the "1" tab panel in the foreground. Here, a "Door Magnet" sensor is connected at sensor port 1. Depending on the type of sensor connected, the input options on the individual tab panels may vary from one another.

By activating the "Combinations" button, you can carry out additional actions for the activated sensor dependent on the status of other sensors.

Combinations

Output 1/1: Door Magnet

Group 1

If status of

2/1: Server-In-Temperat

is

Too High

or

status of

2/5: Waterflow

is

Too Low

Group 2

If status of

2/11: Leakage

is

Alarm

or

status of

no sensor selected

is

OK

If Group 1

or

Group 2 then switch output

off

Accept

Reset

Fig. 94: Setup screen for the output "Door Magnet"

Fig. 94 shows the screen for setting the links for the output 1/1 (Door Magnet). Specifically, the two sensor signals for the server-in temperature and the status of the water sensors are linked here (Group 1). The leakage alarm is also checked (Group 2). Correspondingly, the output module is wired in such a way that in this particular example, the flow of electricity is interrupted and the magnets are therefore deactivated if either the conditions of group 1 or the conditions of group 2 are met. In this case, the front door will open. If output is to be switched, e.g. in the event of excess temperature, it is advisable to always use the alarm value (Too high) for this purpose.

If the output is already switched off when the warning value is reached, this reaction is reset when the actual value reaches the alarm value!

The same settings are made for the output 1/2 accordingly.

8.3.2 Backup and transfer of configuration files

With this function, the configuration of the Basic CMC can be backed up and then restored onto the system at a later time, if necessary.

In addition, the configuration can be transferred to other Basic CMC systems that are wired and set up in exactly the same way.



Note:
Caution, this function may only be used when the CMC-TC systems are exactly the same with respect to:
–The sensor types or ports that are used
–The sensor units or the ports and addresses that are used
–Software versions
No sensors or sensor units must be missing or in the wrong position. If this is not heeded, the configuration of the Basic CMC will not be accepted.

Back up configuration file

After initial start-up and installation have been completed and all texts, limits, links, network settings etc. are finalized, the information can be backed up to an external system (network PC).The **Download** directory in the Basic CMC may be accessed via the FTP or SFTP protocol. In this directory, the following three files can be loaded and saved to a network PC:

cmc.cfg	(non-editable) system data
cmc.user	(non-editable) user administration data
net.cfg	(editable) network settings



Note:
Caution, when editing the file "net.cfg", the format or the file layout must not be changed under any circumstances. Failure to comply with this instruction can lead to complete system failure.

Transfer of the configuration file

Condition:

The three configuration files have previously been saved/backed up. The **Upload** directory in the Basic CMC may be accessed via the FTP or SFTP protocol. Configuration files that are transferred to the destination unit:

cmc.cfg	(non-editable) system data
cmc.user	(non-editable) user administration data
net.cfg	(editable) network settings

The event log shows whether the individual configuration files have been correctly transferred.

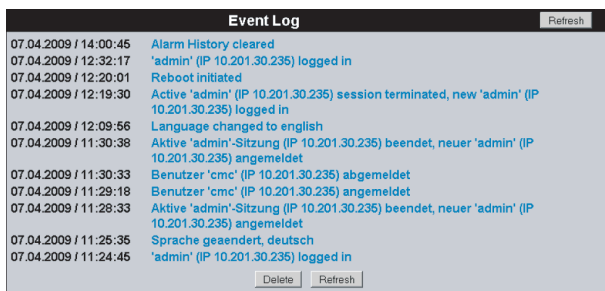


Fig. 95: Messages following the successful transfer of configuration files

9 Troubleshooting

Malfunction location	Malfunction	Cause of malfunction	Effect	Remedy
Control valve	The Basic CMC displays flow even though the control valve is displayed as closed	The control valve is dirty	The flow meter displays a value. There is a ΔT .	Use the Basic CMC to open and close the control valve several times; contaminants may be loosened. It is highly recommended that a filter be installed in the system to ensure the required water quality.
Flow meter	The Basic CMC displays no flow even though the control valve is displayed as open	Flow meter is dirty	The flow meter displays no value, even though the control valve is open and there is a ΔT .	The flow meter must be removed and cleaned or replaced by authorised personnel. It is highly recommended that a filter be installed in the system to ensure the required water quality.
Electronics/ Software	The electronics/ software do not respond	The system is hung up, e.g. through loose connection or incorrect operation	No response, display and control via the Basic CMC do not work correctly.	Disconnect power to the complete Liquid Cooling Package and restart. Also disconnect any existing network connections by removing the control unit network connector from the Basic CMC of the Liquid Cooling Package.
Liquid Cooling Package	The Liquid Cooling Package is not regulating temperature and is operating in emergency mode	After a power supply interruption or upon first installation, the Liquid Cooling Package may operate in emergency mode because of an alarm, e.g. because there is no water pressure	The 2-way control valve is open and the fans operate at full speed.	Press the "C" button on the Liquid Cooling Package control unit for approx. 2 seconds. The system will then enter regulating mode if all is properly connected and the unit is supplied with electricity and cold water.
	The unit is not providing the required cooling out-put	Air in the system	If there is air in the system, the water cannot circulate properly in the heat exchanger. Thus, it cannot remove heat.	Bleeding the air from the heat exchanger
		Increased pressure loss on the piping network side, e.g. through a clogged filter or incorrectly set flow limiter	The external pumps are not able to pump enough cold water through the Liquid Cooling Package.	Clean the filter, set the flow limiter correctly.
		Air routing not correct	The cooled air passes through unsealed openings past the equipment to the back of the enclosure.	Unused height units in the 482.6 mm (19") level as well as side slots and openings must be sealed using blanking plates or foam strips. Both are available as accessories.

In order to prevent malfunctions caused by the cold water system, the following remedies should be implemented.

Malfunction location	Malfunction	Cause of malfunction	Effect	Remedy
Cold water system	Corrosion and contaminants in the cold water system	Insufficient cleaning after a new installation	Unclean and aggressive water leads to a weakening of the material and to improper function. The function of components such as the 2-way control valve and the flow meter is strongly impaired through contaminants.	During initial installation, the pipe network and the system parts should be flushed out before the installation of the Liquid Cooling Package.
		Improper treatment of the water with corrosion protection additives		Rittal GmbH & Co. KG recommends the installation of filters and the treatment of the water with appropriate corrosion and, if needed, antifreeze additives. The recommended notes regarding water quality are found in Chapter 15.1 "Hydrological information".
		Older systems with existing contaminants		Upon integration in existing cold water networks, the use of a water/water heat exchanger is recommended. This forms a second water cycle.

10 Inspection and maintenance

The Liquid Cooling Package is largely maintenance-free. An additional external filter should be used if the cooling water is contaminated. This should be cleaned regularly.

–The condensate discharge device should be checked regularly for proper function.

–Visually inspect for leaks regularly (annual cycle).



Note:

At an ambient temperature of 40°C, the nominal service life of the built-in fan is 40,000 operating hours. Fan module malfunctions are displayed on the optional display with touch function or on the status screen of the Basic CMC (if the Basic CMC is connected to a network). Furthermore, the built-in control that is responsible for two fan modules compensates fully in the event of a fan module failure.

11 Storage and disposal



Caution! Risk of equipment damage!
The air/water heat exchanger must not be subjected to temperatures above +70°C during storage.

During storage, the air/water heat exchanger must stand upright. Disposal can be performed at the Rittal plant. Please contact us for advice.

Emptying:

During storage and transportation below freezing point, the air/water heat exchanger should be drained completely.

To this end, with the Liquid Cooling Package, the valves in the lowest heat exchanger position should be opened so that the cooling liquid can run out.

12 Technical specifications

12.1 30 kW version

12.1.1 LCP Rack and LCP Inline

Technical specifications			
Description/Model No. SK	TopTherm LCP Rack 30 CW / 3311.235 (1200mm depth)		
Description/Model No. SK	TopTherm LCP Inline 30 CW / 3311.535 (1200mm depth)		
Dimensions and weight			
Dimensions Width x height x depth (mm)	300 x 2000 x 1200 (SK3311.235/535)		
Usable U	42		
Weight, max. [kg]	220		
Electrical connection			
Type of electrical connection	Permanently Connected		
Rated voltage [V, Hz]	208/1~ 50/60	230/1~ 50/60	400/3~/N/PE 50/60
Rated current [A] (1 fan)	2.3	2.0	0.8
Max. current [A] (6 fans)	13.5	12.3	4.1
Pre-fuse T [A] (EU, 4 Fans)	20	20	10
Max fuse [A] (US, 4 Fans)	15	15	10
Duty cycle [%]	100		
Cooling output			
Number of fans	1	2	3
Cooling output [kW]	10	20	30
Power consumption P _{el} [kW]	0.19	0.36	1.05
Air throughput, max. [m³/h]	4800		
Cooling circuit			
Cooling medium	Water (see Internet for specifications)		
Coolant inlet temperature [°C]	+15		
Operating pressure, PO [bar]	2 - 6		
Test pressure, PT [bar]	12		
Fill quantity [l]	7		
Water connection	1½" BSP, male		
Other information			
Temperature control	Linear fan control/2-way control valve		
Ambient temperature range [°C]	+6 to +35		
Noise level [dB(A)] (Open air above reflective flooring, distance 1m)	74.5		

12.1.2 LCP Inline flush

Technical specifications			
Description/Model No. SK	TopTherm LCP Inline flush / 3311.545		
Dimensions and weight			
Dimensions Width x height x depth (mm)	300 x 2000 x 1200		
Usable U	42		
Weight, max. [kg]	220		
Electrical connection			
Type of electrical connection	Permanently connected		
Rated voltage [V, Hz]	208/1~ 50/60	230/1~ 50/60	400/3~/N/PE 50/60
Rated current [A] (2 fans)	4.3	3.9	1.3
Max. current [A]	9.6	8.1	2.7
Pre-fuse T [A] (EU, 2 fans)	16	16	10
Max fuse [A] (US, 2 fans)	15	15	10
Duty cycle [%]	100		
Cooling output			
Number of fans	2	3	4
Cooling output [kW]	18	27	30
Power consumption P _{el} [kW]	0.8	1.3	1.8
Duty cycle [%]	100		
Air throughput, max. [m³/h]	4800		
Cooling circuit			
Cooling medium	Water (see Internet for specifications)		
Coolant inlet temperature [°C]	+15		
Operating pressure, PO [bar]	2 - 6		
Test pressure, PT [bar]	12		
Fill quantity [l]	7		
Water connection	1½” BSP, male		
Other information			
Temperature control	Linear fan control/2-way control valve		
Ambient temperature range [°C]	+6 to +35		
Noise level [dB(A)](Open air above reflective flooring, distance 1m)	74		

12.2 60 kW versions

Technical specifications			
Description/Model No. SK	TopTherm LCP Rack 60 CW / 3311.265		
Description/Model No. SK	TopTherm LCP Inline 60 CW / 3311.565		
Dimensions and weight			
Dimensions Width x height x depth (mm)	300 x 2000 x 1200		
Usable U	42		
Weight, max. [kg]	240		
Electrical connection			
Type of electrical connection	Permanently connected		
Rated voltage [V, Hz]	208/1~ 50/60	230/1~ 50/60	400/3~/N/PE 50/60
Rated current [A] (1 fan)	9	8.1	2.7
Max. current [A] (6 fans)	13.5	12.3	4.1
Pre-fuse T [A] (EU, 2 fans)	20	20	10
Max fuse [A] (US, 2 fans)	15	15	10
Duty cycle [%]	100		
Cooling output			
Number of fans	4	5	6
Cooling output [kW]	40	50	60
Power consumption P _{el} [kW]	1.7	2.2	2.8
Air throughput, max. [m³/h]	8000		
Cooling circuit			
Cooling medium	Water (see Internet for specifications)		
Coolant inlet temperature [°C]	+15		
Operating pressure, PO [bar]	2 - 6		
Test pressure, PT [bar]	12		
Fill quantity [l]	7		
Water connection	1½" BSP, male		
Other information			
Temperature control	Linear fan control/2-way control valve		
Ambient temperature range [°C]	+6 to +35		
Noise level [dB(A)](Open air above reflective flooring, distance 1m)	77		

12.3 External fuse/breaker sizes (US)

Number of Fans	208V 1~		230V 1~		400V 3~	
	MCA [A]	Max Fuse [A]	MCA [A]	Max Fuse [A]	MCA [A]	Max Fuse [A]
1	4.2	15	3.8	15	1.3	10
2	7.0	15	6.3	15	2.1	10
3	9.7	15	8.8	15	2.9	10
4	12.5	15	11.3	15	3.8	10
5	15.3	20	13.8	20	4.6	10
6	18.0	20	16.3	20	5.4	10

13 Spare parts

Item	Qty./Pack
Control unit	1
Water PCB	1
Fan PCB	1
Startup current limitation	1
Fan, single	1
Leakage sensor	1
Control valve	1
Flow meter 5-100	1
Flow meter 10-200	1
Temperature sensor, hot/cold air	1
Temperature sensor, water inlet	1
Temperature sensor, water return	1
Fuse box with breaker, EMC filter and power pack	1

Tab. 20: Spare parts list – Liquid Cooling Package

13 Spare parts

Item	Model No.	Qty./Pack	Comments
Vertical shielding (foam strips) for enclosure width 600mm, for mounting side panel	SK3301.380	1	
Vertical shielding (foam strips) for enclosure width 600mm, for mounting Liquid Cooling Package	SK3301.370	1	
Vertical shielding (foam strips) for enclosure width 800mm, for mounting side panel	SK3301.390	1	
Vertical shielding (foam strips) for enclosure width 800mm, for mounting Liquid Cooling Package	SK3301.320	1	
Air baffle plate for TS, for enclosure width 600mm	DK7151.206	2	
Air baffle plate for TS, for enclosure width 800mm	DK7151.208	2	
Add-on cover	SK3301.221	1	
Condensation pump	SK9971.164	1	
Connection hose bottom/top	SK3311.040	2	
Connection cable, three-phase	SK7856.025	1	EU-type
Touch panel display, color	SK3311.030	1	
Fan module for SK 3311.235/265 and SK3311.535/565	SK9967.527	1	For LCP Rack and LCP Inline
Fan module for SK 3311.545	SK9967.530	1	For LCP Inline flush
Rear adaptor for LCPInline	SK3311.080	1	
Server enclosure compensating panel for LCPInline	DK7067.200	1	

Tab. 21: Accessories list – Liquid Cooling Package

15 Further technical information

15.1 Hydrological information

To avoid system damage and to ensure safe operation, Rittal GmbH & Co KG recommends the use of system water or an additive whose composition does not differ from that presented in the following summary:

pH value	7 – 8.5
Calcium hardness	> 3 < 8 °dH
Free carbonic acid	8 – 15 mg/dm ³
Accompanying carbonic acid	8 – 15 mg/dm ³
Corrosive carbonic acid	0 mg/dm ³
Sulphides	Free
Oxygen	< 10 mg/dm ³
Chloride ions	< 50 mg/dm ³
Sulphate ions	< 250 mg/dm ³
Nitrates and nitrites	< 10 mg/dm ³
COD	< 7 mg/dm ³
Ammonia	< 5 mg/dm ³
Iron	< 0.2 mg/dm ³
Manganese	< 0.2 mg/dm ³
Conductivity	< 2200 µS/cm
Residue on evaporation	< 500 mg/dm ³
Potassium permanganate consumption	< 25 mg/dm ³
Suspended matter	< 3 mg/dm ³ > 3 < 15 mg/dm ³ Partial flow purification recommended > 15 mg/dm ³ Continuous purification recommended

Tab. 22: Hydrological data

15.2 Characteristic curves

15.2.1 Cooling output

All information in the diagrams refers to the use of pure water as a cooling medium. The cooling performance data when using a water-glycol mixture is available on request from Rittal.

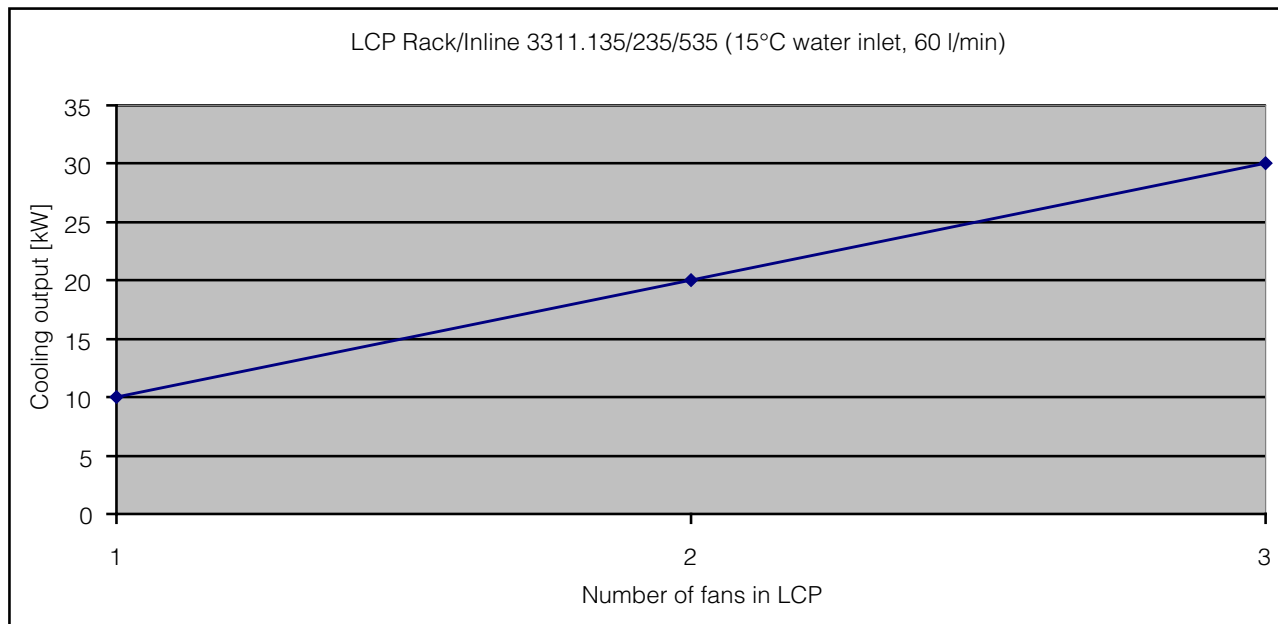


Fig. 99: Cooling output of the LCP Rack/Inline in the "30kW" version

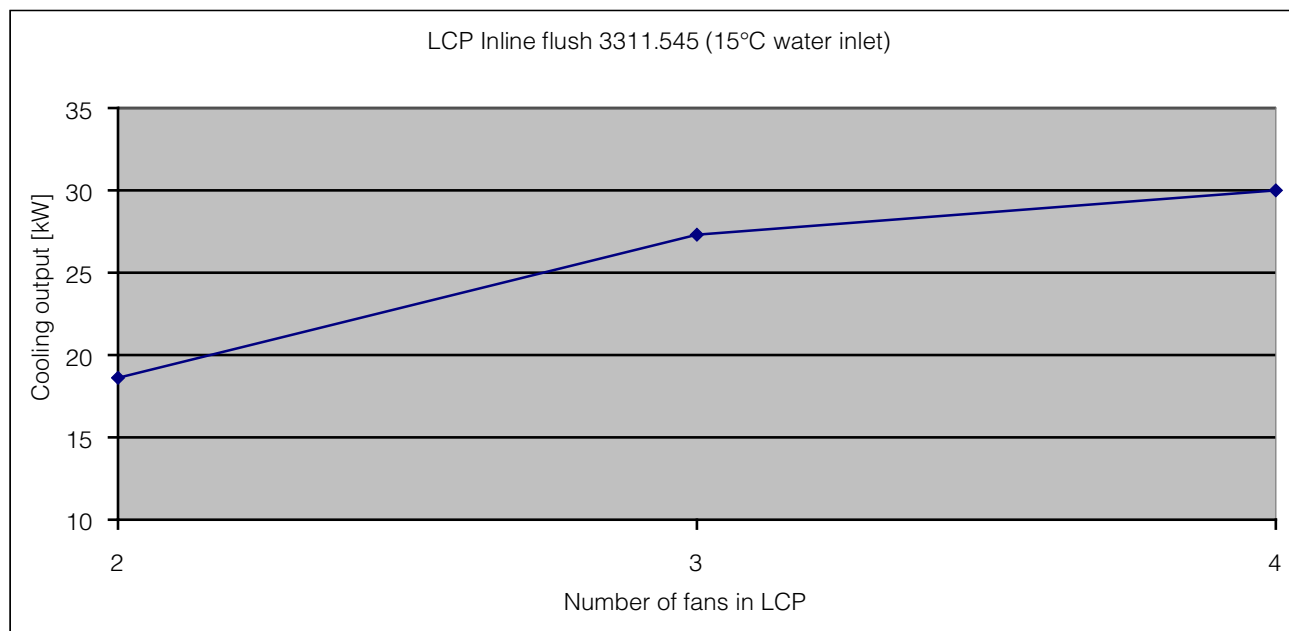


Fig. 100: Cooling output of the LCP Inline flush

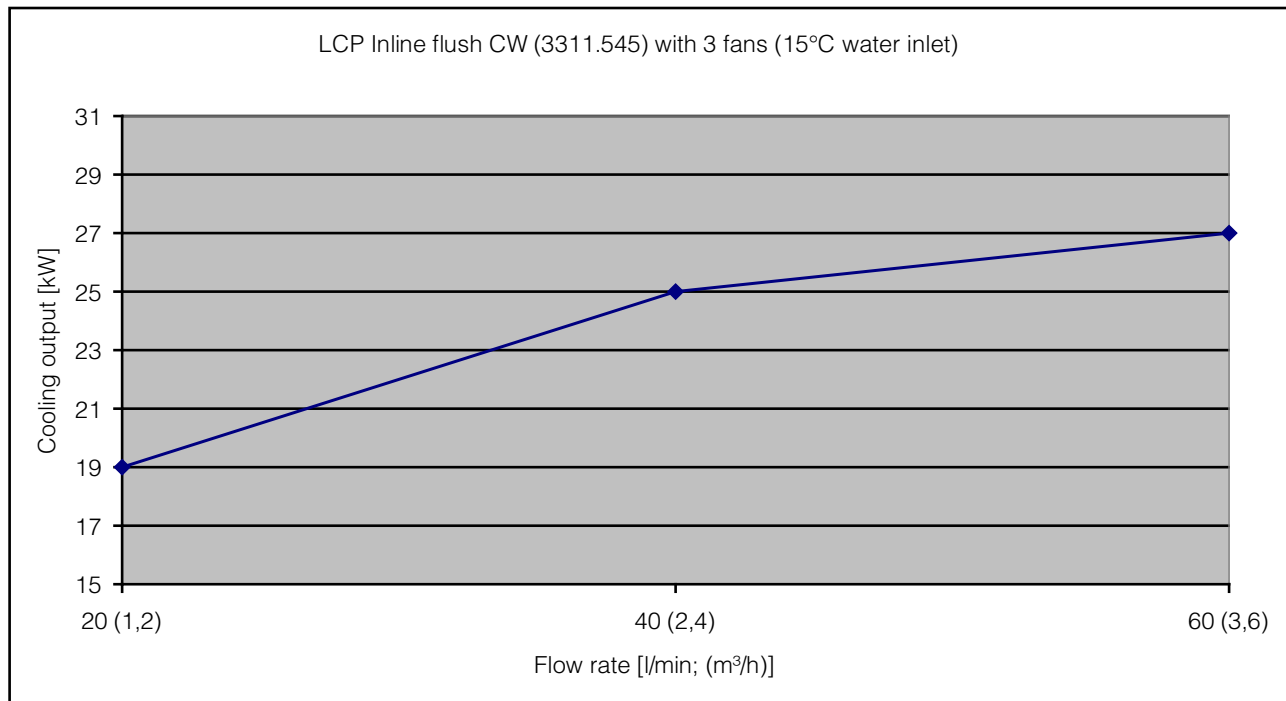


Fig. 101: Cooling output of the LCP Inline flush with three fans

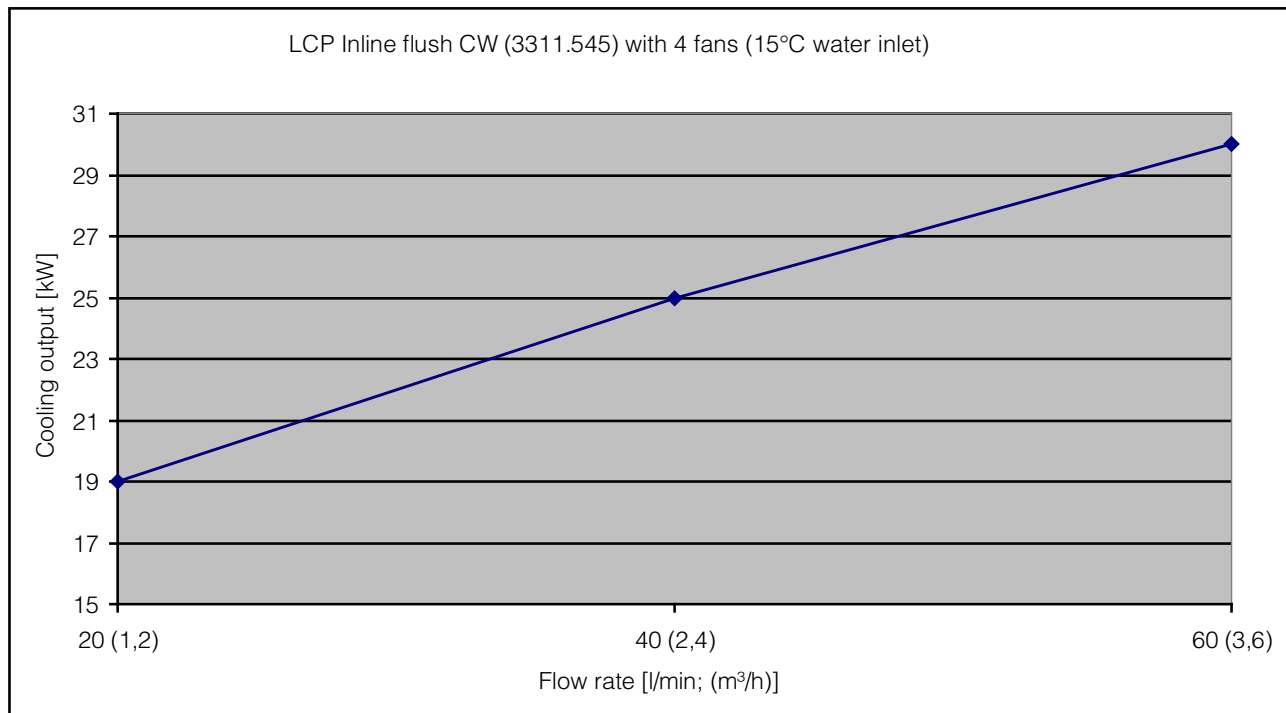


Fig. 102: Cooling output of the LCP Inline flush with four fans

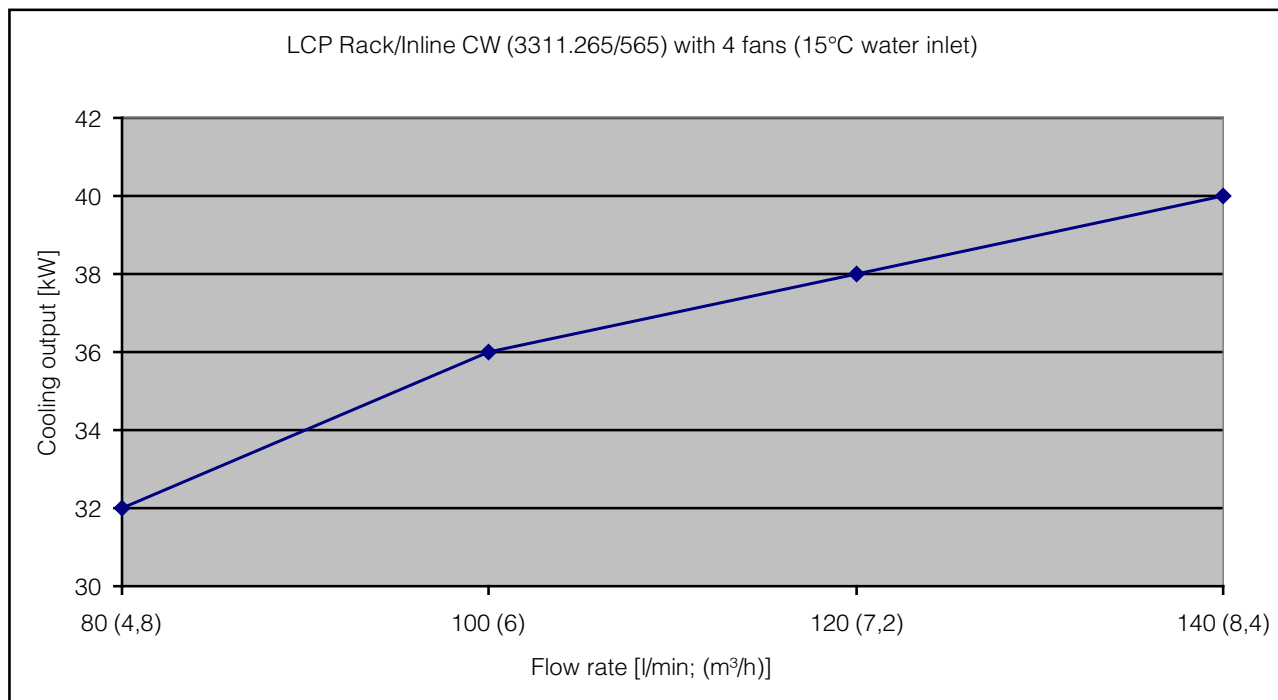


Fig. 103: Cooling output of the LCP Rack/Inline in the "60kW" version with four fans

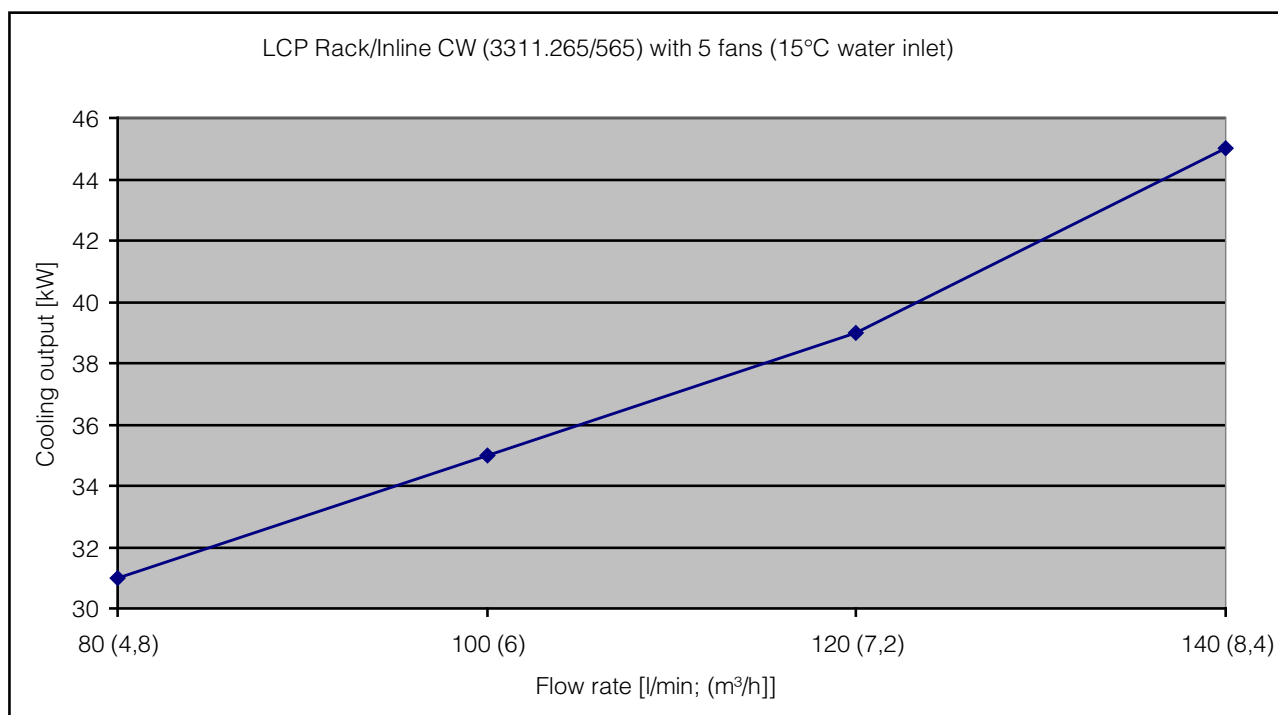


Fig. 104: Cooling output of the LCP Rack/Inline in the "60kW" version with five fans

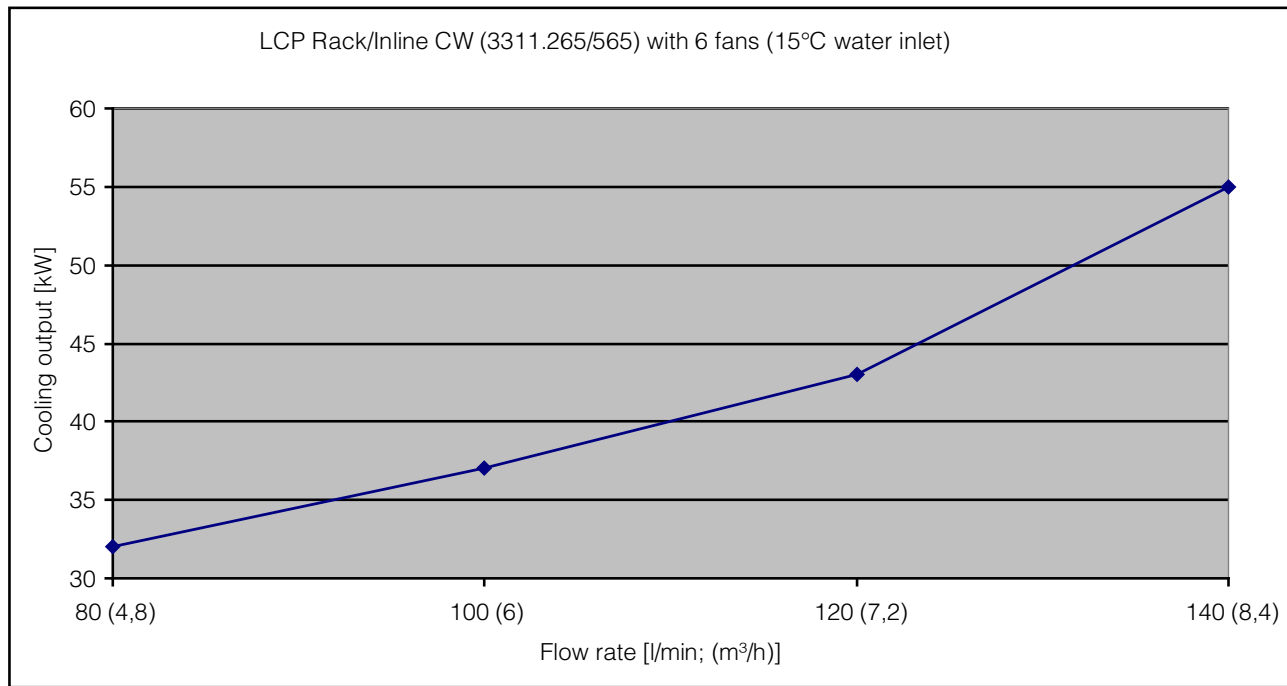


Fig. 105: Cooling output of the LCP Rack/Inline in the "60kW" version with six fans

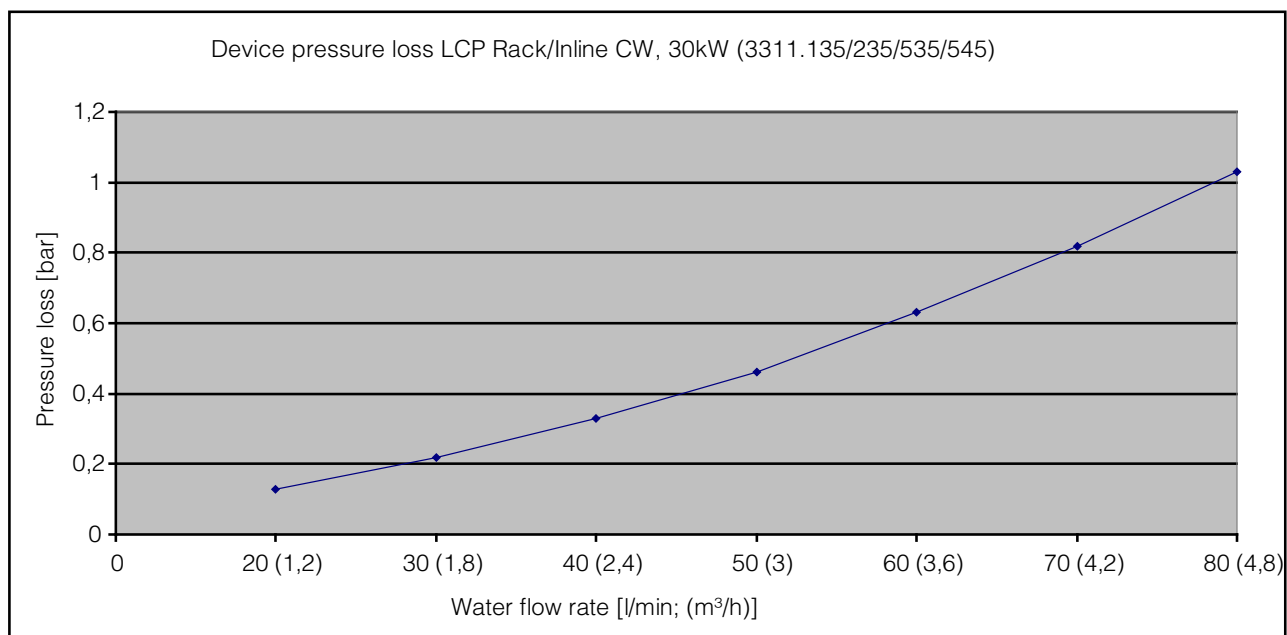


Fig. 106: Pressure loss of the Liquid Cooling Package in the "30kW" version

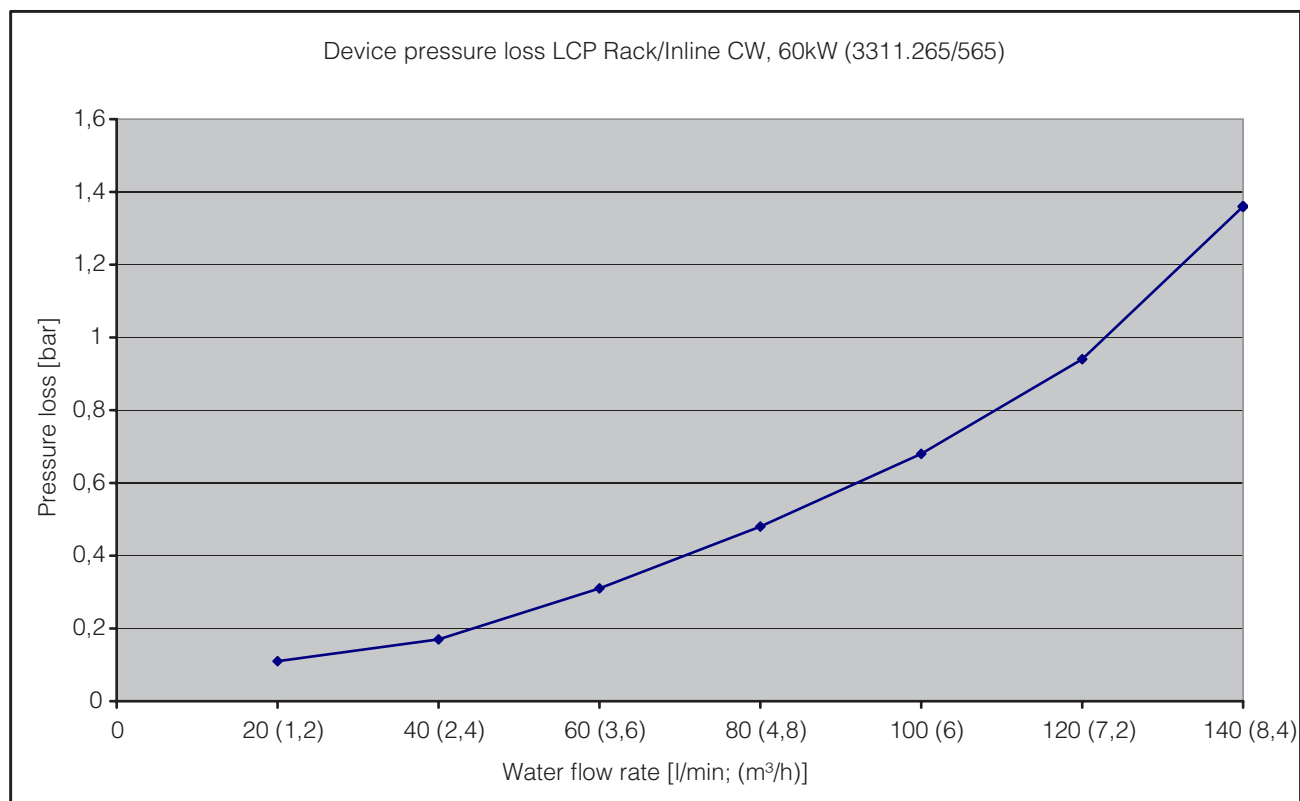


Fig. 107: Pressure loss of the LCP Rack/Inline in the "60kW" version

15.3 Overview drawings

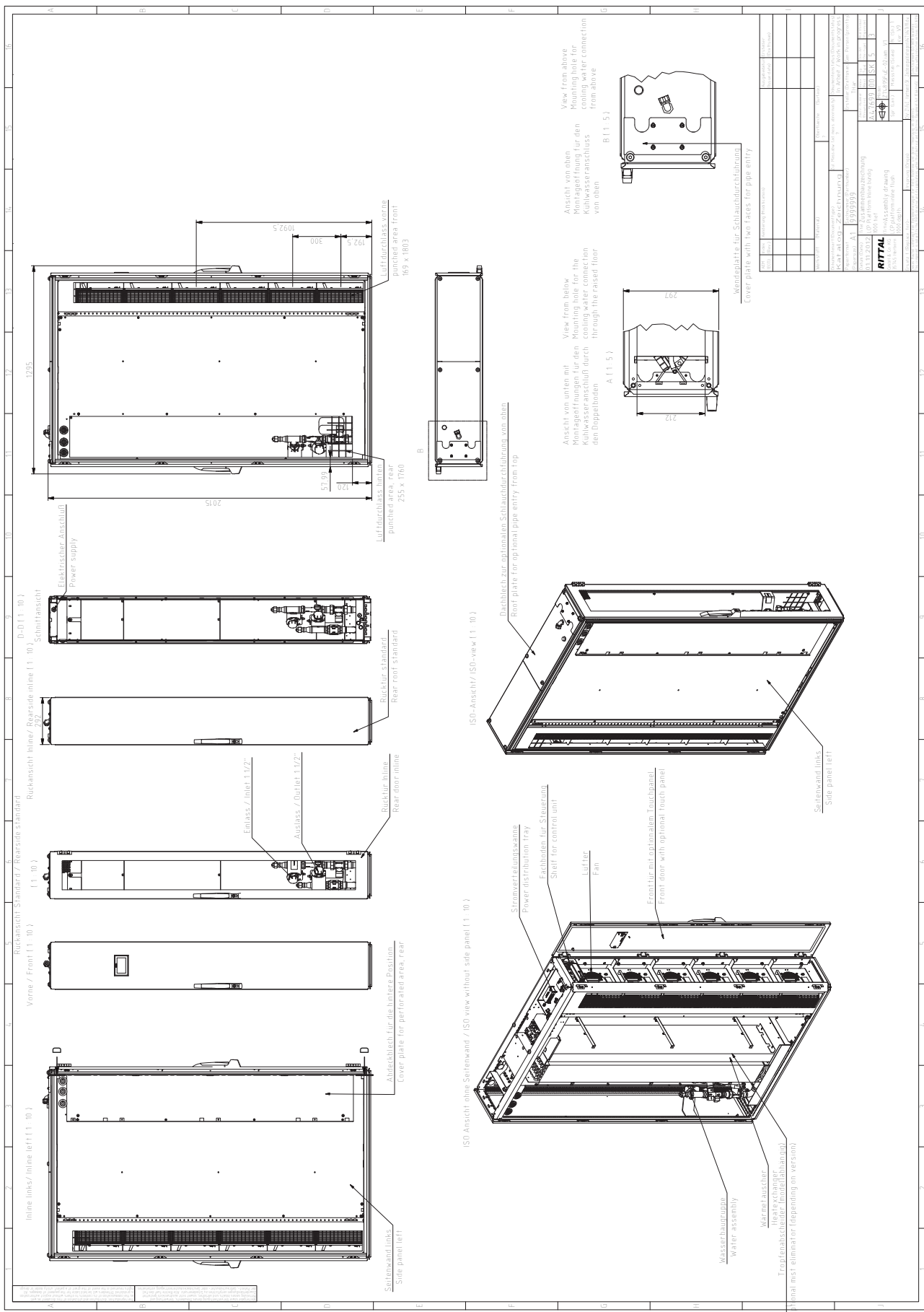


Fig. 108: Overview drawing of LCP Rack/Inline



15.4 Circuit diagram

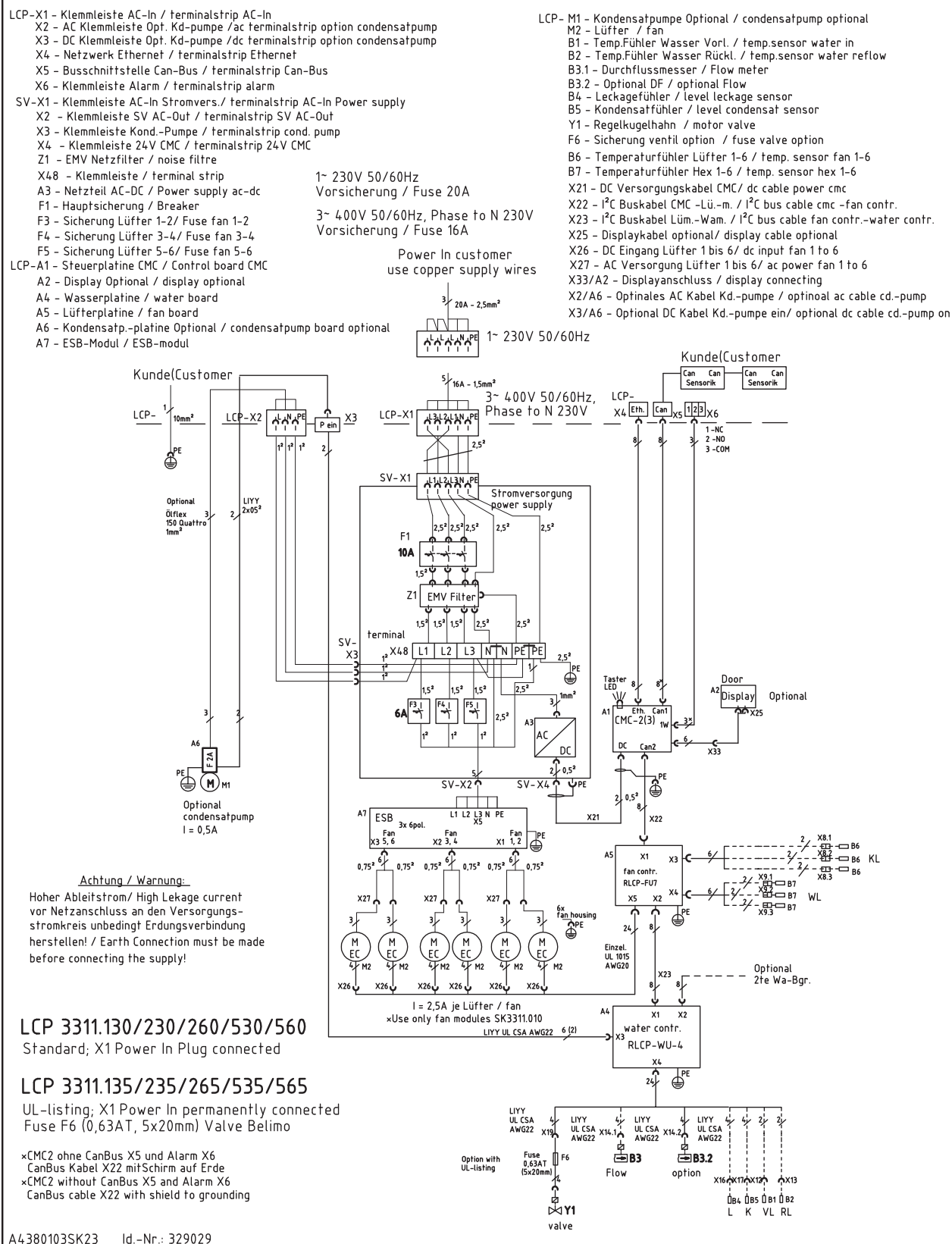


Fig. 110: Circuit diagram LCP Rack/Inline



15.5 Water circulation diagram

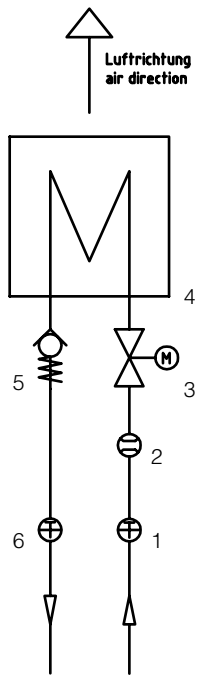


Fig. 112: Water circulation diagram

Key

- 1 Temperature sensor, inlet
- 2 Flow sensor, inlet
- 3 Control valve, inlet
- 4 Heat exchanger
- 5 Non-return valve, return
- 6 Temperature sensor, return

16 Preparation and maintenance of the cooling medium

Depending on the type of installation to be cooled, certain purity requirements are placed on the cooling water in a recooling system. According to the level of contamination and the size and design of the recooling systems, a suitable process is used to prepare and/or maintain the water. The most common types of contamination and frequently used techniques to eliminate them in industrial cooling are:

Type of impurity	Procedure
Mechanical contamination	Filter the water using: Mesh filter, sand filter, cartridge filter, pre coated filter, magnetic filter
Excessive hardness	Soften the water via ion exchange
Moderate content of mechanical contaminants and hardeners	Treat the water with stabilizers and/or dispersing agents
Moderate content of chemical contaminants	Treat the water with passivators and/or inhibitors
Biological contaminants, slime bacteria and algae	Treat the water with biocides

Tab. 23: Cooling water contaminants and treatment procedures



Note:

For the proper operation of a recooling system that uses water on at least one side, the composition of any additive used or system water should not deviate substantially from hydrological data presented in Chapter 15.1 "Hydrological information".

17 Frequently asked questions (FAQ)



Note:

This chapter contains only a selection of the frequently asked questions (FAQ). Further FAQs may be found on our website: www.rimatrix5.com

In what output ranges is the Rittal Liquid Cooling Package available?

The cooling output of an air/water heat exchanger is basically dependent on the inlet temperature and volumetric flow of the water as well as the air throughput achieved by the fans which are used. Up to 30kW of cooling output is possible. In correctly assessing the information, it is important to note at what ΔT (temperature differential between server air inlet and server air outlet) these values were reported. Modern servers such as 1U-Dual CPU systems or blade servers can have a ΔT of up to 25°C. Please note the recommendations of the server manufacturer.

Are special components required for use with the Liquid Cooling Package?

All components that follow the “front to back” cooling principle (99% of IT equipment) may be used without restriction in connection with the Liquid Cooling Package. Every Rittal server rack which was previously cooled conventionally may be cooled with a Liquid Cooling Package after changing to sealed doors. In other words, it is possible to retrofit standard racks and bay them onto the Liquid Cooling Package. The server enclosure remains unaffected by the side installation of the Liquid Cooling Package. All height units remain fully usable in their complete depth. Further, by locating the foam strips appropriately, sufficient cooling is also possible for devices which require sideways air throughput (e.g. switches).

Is the ambient air heated by additional heat coming out of these enclosures?

The cooling system in the enclosure works completely independently of the ambient air. All waste heat is transferred externally through the cooling water circuit.

May the quantity of heat removed be controlled dependent on the heat loss?

The controlled variable for the Liquid Cooling Package is the temperature of the air blown in in front of the 482.6 mm (19”) level. The values to be used here are available in the manufacturer’s instruction manual. Upon installation, the desired set-point temperature is set once on the

Liquid Cooling Package. This value will be kept constant, irrespective of the cooling output demands. This occurs through the corresponding automatic opening and closing of the 2-way control valve. Additionally, the necessary fan output is adjusted based on the difference between the server-out temperature and the target temperature. In this manner, the Liquid Cooling Package always cools only as much as is necessary without wasting energy. Further, this avoids problems arising from condensation and desiccation which results from overcooling.

How is the airflow in the enclosure achieved and what advantages does this have?

As a general rule, the “front to back” principle is used in server enclosures. Cold air is supplied to the front of the enclosure. The units built into the enclosure have their own fans, which draw in this air and use it internally for cooling. Thus heated, it is exhausted to the rear. The special horizontal air routing of the Liquid Cooling Package, which is adapted especially to this widespread cooling principle, evenly supplies cooled air to the complete height of the server enclosure. That means that all units, independent of their installation position in the enclosure and their charge state, receive sufficient cold air. Temperature gradients are avoided, so that an extremely high cooling output can be achieved for each enclosure.

Can the LCP Rack be operated with its doors open?

The response of the Liquid Cooling Package upon operation with opened doors depends chiefly upon the prevailing ambient conditions. If a front door is opened, the cool air is mixed marginally with the ambient air. Thus, no cooling problems are expected in air conditioned rooms. Overall, no heat is carried into the room. The back door should only be opened for a short while during operation, since this breaks the cooling air circuit, resulting that the waste heat is carried into the room. However, this does not influence the cooling of the units in the enclosure.

Why is the Liquid Cooling Package, as an air/water heat exchanger, installed on the side panel?

It was important to develop a high performance cooling system which would also meet the requirements of the coming years. This could only be achieved by routing the cooling air in a manner which was tailored to the needs of the devices. The main problem associated with cooling by air from the raised floor or with top or bottom heat exchangers is air routing. Cold air which is fed into the enclosure from below or above changes its temperature greatly because of recirculation. Temperature differentials of up to 20°C were measured from “below” to “above” in enclosures found in data centers. Thus, a server installed “below” in an enclosure may have temperature conditions

of up to 20°C “better” than one installed “above” in an enclosure. Because of this, in order to achieve sufficient cooling of all systems in the enclosure when using this sort of cooling, a significantly lower air temperature must be used. When cooling air is provided from the side, this problem does not arise. Cooling is more effective and more exact because the air supplied to the units can be held within 1-2°C. Because the system is built as its own enclosure, the system is protected against the risk of leaks. All water carrying parts are located outside the actual server enclosure. Connection to the cooling water network is made in the floor. Further, Rittal has many years of experience in the field of air/water heat exchangers. All of this experience is incorporated into the construction of the Liquid Cooling Package. Because of these precautionary measures, even in the very unlikely event of a leak, water cannot find its way into the area for electronic components. Because of its “thin” profile of just 300mm, the pattern achieved in the data center is not interrupted. Because the depth of the enclosures is not increased, the full width of the walkways in the data center is maintained.

How is water connected to the Liquid Cooling Package?

For easy installation, connection to the building or recooling system is made, as desired, from below or from the rear with 1½” threaded connections. Of course, these may be exchanged with quick-release couplings.

Can both air-cooled and water-cooled server enclosures operate side-by-side in a data center?

Of course. There must only be a water installation available for the water-cooled enclosures. The advantage of this is that the existing room air conditioning is not further burdened. Thereby, Liquid Cooling Package systems can be used to intercept hot spots in the data center without requiring the expansion of the air conditioning system.

Which dimensions are usable for the Liquid Cooling Package?

The Liquid Cooling Package itself has the dimensions W x H x D 300 x 2000 x 1000/1200mm. Every Rittal enclosure with the dimensions H x D 2000 x 1000/1200mm, independent of width, can be bayed. Other sizes available on request.

Does the Liquid Cooling Package require maintenance?

The Liquid Cooling Package is maintenance free. All components are designed with an extremely long lifespan. In case of a malfunction a message is generated through the alarm output of the control unit or through the Basic CMC.

What advantages does a water-cooled solution have over an air-cooled solution in a data center?

The use of water-cooled enclosures allows for controlled, efficient and cost-saving cooling of heat losses, which was not possible with conventional air conditioning. Thus, it is possible to fully use the space, which is physically available in the enclosures, instead of being forced to erect half-empty enclosures because of air conditioning problems. This achieves considerable savings in the investment and operating costs of a data center.

Is a raised floor necessary for installation? If yes, what height is required?

A raised floor is not required for routing the cooling water pipes. In principle, the pipes can also be laid in channels in the floor. A main cooling pipe requires approx. 150mm headroom in a raised floor; an enclosure supply line approx. 50mm. With high quality composite pipes, such as those used in under-floor heating, an extremely flexible routing of the cooling water pipelines is possible.

Can LCP-cooled enclosures also be bayed with one another?

Basically, the Liquid Cooling Package is just a “small” enclosure. That means that all accessories for baying may be used. Thus, LCP-cooled systems may be bayed without limitation.

How is condensate formation prevented in the Liquid Cooling Package?

Condensation can only occur when air is significantly cooled below the ambient temperature. Thus, its capacity to absorb or “hold” water is reduced. In the norm, the Liquid Cooling Package works with water temperatures above the dew point. Condensate formation is thus excluded. If the system is operated with lower temperatures, the control minimizes condensate formation. Any arising condensate is effectively hindered from leaving the Liquid Cooling Package through design measures. These measures include suitable air routing, wipe-off grids and condensate management.

How does the Liquid Cooling Package prevent desiccation?

At the same time that air is cooled, it is also dehumidified. Because of cable entry points, the system is not 100% sealed off from its surroundings. This small amount of exchange with external air is sufficient to hold the air's relative humidity above 30% and thus non-critical. At no time is there the danger of static charges arising in the enclosure.

Can the Liquid Cooling Package be operated together with the CPU cooling solution?

A combination of direct CPU cooling with water and the Liquid Cooling Package is always possible. Depending on the computer system, only up to 70% of the total heat loss is removed through the water heat sinks with direct CPU cooling. In cases of high cooling output requirements, this means that a combination of systems is even necessary. Please request our documentation for individual projects separately.

In case a pipe should break or burst, how is water entry into the server rack avoided?

Because the components are carefully chosen, it is practically impossible for a pipe to break. The base unit of each LCP serves as a collecting tray for water, and is capable of collecting either condensate or leaked water. Through the physical separation of the Liquid Cooling Package from the server enclosure, it is always ensured that no water can enter into the server area. Additionally, the integrated leakage sensor reports even the smallest leak volumes to allow for a rapid response.

Why does the LCP Rack offer the opportunity of cooling either one or two enclosures?

The most important design principle was a flexible cooling system which would correspond to the enormous volume of air required by a modern server. Because of the horizontal cooling possibility, options for "right", "left" or "both-sided" cooling arise in combination with the chosen fans. Cooling a server rack with two Liquid Cooling Packages has the advantage of complete system redundancy without further installation of the 482.6 mm (19") equipment (see Chapter 3.6.1 "Creation of redundancy in the LCP Rack").

In which applications and situations should an air/water heat exchanger system be used?

Whenever the cooling output of the room air conditioning system is not sufficient to handle the heat loads of current high performance servers. With an optimal design in a newly planned data center, this limit is at about 1,000 – 1,200W/m²; in older data centers, it is often significantly below that. At best, a maximum of 4kW per rack needs to be removed. By contrast, racks which are filled with blade servers reach up to 17kW. But the Liquid Cooling Package represents a possible solution even in applications where there is no existing air conditioning system. In combination with Rittal recooling systems, even climate control solutions for high performance cluster systems can be created.

What additional infrastructure is required to operate the system?

In addition to the Liquid Cooling Package, pipes to the individual enclosures and a system for generating the cooling water are required. With single enclosures, a direct connection with the cooling water is sufficient. With multiple enclosures, a cooling water distribution system, similar to a central heating distribution system, should be provided. To a great degree, this infrastructure corresponds to that which is already used in a conventionally air conditioned data center. The "cold" water is provided by water chillers (with adequate redundancy, especially in regard to the pumps). The water is distributed over a cooling water network in the data center to fan coil or ceiling cooling units.

What key disadvantages of today's air-cooled solutions are remedied by water cooling?

The chief problem of conventional cooling involves directing large amounts of cool air through raised floors, suspended ceilings and within the room. Often, because of complex flow conditions, the cold air does not reach the servers in sufficient quantities. There is actually enough cold produced; often, the cooling output from raised floor systems lies far above the electrically connected load of the unit, which needs to be cooled. In spite of this, the cooling is insufficient. This effect is explained by the fact that the cooling air is already warmed too much through recirculation on its way to the server. By using water to remove the heat out of the enclosure, an excellent separation between cold air and removed thermal energy is achieved. Because of its material characteristics, water can transport thermal energy almost 4,000 times "better" than air. Small pipes are capable of transporting very large quantities of heat.

Can accessories and other equipment from the 482.6mm (19") enclosures be used in conjunction with the Liquid Cooling Package?

The Liquid Cooling Package and the accompanying server enclosure are standard products within the Rittal family of enclosures. All components and accessory parts can be used without limitation.

Up to what depth may servers be installed?

Modern server systems may be up to 800 mm deep. Because of that, it is recommended that the 482.6mm (19") level in the enclosure be installed so that the same distance remains to the door in front and in back. In combination with the space on the side between the 482.6 mm (19") level and the Liquid Cooling Package, sufficient room for the air which is fed or emitted is achieved. The side openings do not need to be completely open throughout their depth.

How does the Liquid Cooling Package respond to an elevated ambient temperature or fire?

Because the closed design seals the system to the outside, even greatly increased ambient air temperatures are not a problem – as long as the cold water supply is functioning. This represents an effective protection against the effects of fire in case of a fire in the room. Smoke, corrosive gases, water steam and fire-fighting water are securely kept away. Only extremely high temperatures or direct exposure to flames would be critical, but the consequences of fire in the area or in the adjacent room are in any case restrained.

Does the maximum depth available for installed equipment correspond with the enclosure's depth?

Almost the entire depth of the enclosure can be used for installed equipment. No other space for installed mechanical equipment, e.g. fans, is required.

18 Glossary

1U server:

1U servers are very flat and deep, modern high performance servers, whose height corresponds to one height unit (1U = 44.54mm, the smallest standard height division). Typical dimensions are (WxD x H) 482.6 mm (19") x 800mm x 1U. These systems normally include 2 CPUs, many GB RAM and hard drives, so that they require up to 100m³/h cooling air at a maximum of 32°C.

482.6 mm (19") level:

The front sides of the devices built into the server enclosure form the 482.6 mm (19") level.

Blade server:

By orienting dual CPU systems vertically and placing up to 14 units on a common backplane to provide for signal routing and power supply, one has a so-called blade server. Blade servers can "generate" up to 4.5 kW heat loss per 7U and 700mm depth."

Front to back" cooling principle:

The devices built into the server enclosure are normally cooled according to the "front to back" cooling principle. Under this cooling principle, cold air supplied by external air conditioning is blown to the front of the server enclosure. The fans in the devices built into the server enclosure direct this air horizontally through the server enclosure. The air is warmed through this process and is exhausted out the rear of the enclosure.

Hotspot:

A hotspot is the concentration of thermal energy in a small area. Hotspots normally lead to local overheating and can cause system malfunctions.

Air/water heat exchanger:

Air/water heat exchangers operate according to the same principle as automobile radiators. A liquid (water) flows through the heat exchanger, while, at the same time, air is blown over its surface area (which is as large as possible), facilitating energy exchange. Depending on the temperature of the circulating liquid (water), an air/water heat exchanger may either heat or cool the circulated air.

Recooling system:

As an initial comparison, a recooling system is like a refrigerator – through an active cooling circuit, un-like a household refrigerator, a recooling system produces cold water. The thermal energy which is removed from the water is dissipated to the outside by fans. Because of this, it is normally advisable to locate recooling systems outside of buildings. Recooling systems and air/water heat exchangers form a normal cooling combination.

Switch:

Multiple servers normally communicate with one another and in the network using switches. Because as many inputs as possible are located on the front side of switches, they frequently have an airflow from the side, not "front to back" cooling.

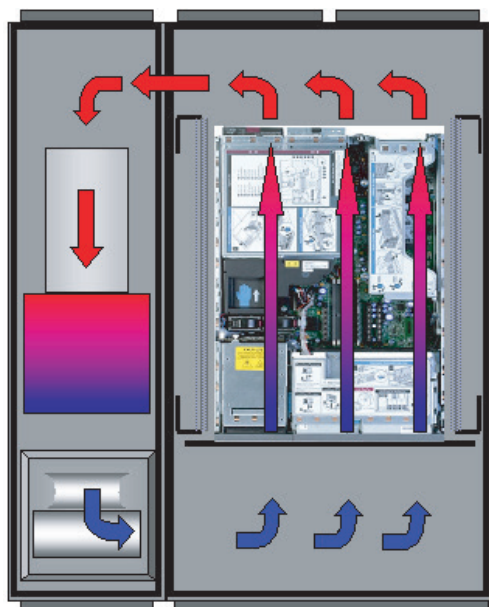


Fig. 113: "Front to back" cooling principle with bayed LCP Rack

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