

Smart Cooling Solutions Data Center

Solutions for a Future-proof Data Center



Core competencies:

- AC Power
- Connectivity
- DC Power
- Embedded Computing
- Embedded Power
- Infrastructure Management & Monitoring
- Outside Plant
- Power Switching & Controls
- Precision Cooling
- **Racks & Solutions**
- Services
- Surge Protection

Emerson Network Power

Business-Critical Continuity™ – so your success continues!

No company, no matter how big it is, can afford business-critical system failures.

Over the years we at Emerson Network Power have acquired unique know-how, and with our name we represent reliable rack systems, power supply, precision cooling, connectivity and integrated solutions. We can consequently ensure that you generate optimum benefits from your technology investments.

Thanks to Emerson Network Power's technology range and expansive competencies, the entire bandwidth of company-wide solutions is supported for today's critical business requirements.

Customers all over the world build on our support for future-proof investments, because they know that we offer globally specific innovations and optimized solutions from one single source – supported by reliable local service and support.

We can ensure the stable operation of your network infrastructure – regardless

of whether voice, data or multimedia content are transmitted.

This is based on a proven, comprehensive portfolio of products, services and systems which supports a multitude of computing, telecommunications, health care and industrial applications. This creates a foundation of trust that is only possible with a partnership with Emerson Network Power.

Our assignment is to prepare you for the unknown and the unexpected. We show you the way against the background of dynamic changes in your business environment.

And we help you to master the requirements this entails and avail of the greatest possible benefits from your technology investments. This is what we mean by Business-Critical Continuity.



*Availability, efficiency and future-proofing –
key issues for today's data center*

Planning requirements for data center infrastructure

No data center is exactly like another...

Data center plans vary greatly depending on

- The objectives to be achieved and what is viable financially.
- The background in terms of buildings, equipment and resources.
- The ranking of design criteria such as reliability, computing power, energy efficiency, security concept etc.

This is relatively clear for new "green-field" plans. However, most customers need to rely on existing data centers and their infra-

structure. They are faced with questions such as:

The temperature in this data center is too high.... or is it colder than necessary and that's why the bills are so high?

We need additional servers, but if only I knew exactly where and which.... I also need to increase the cooling capacity but I simply don't have room for a new unit!

Will the cooling for the servers still be sufficient if one of the units fails unexpectedly?

In our experience, customer requirements are determined by:

- Previous experience with existing facilities and their main causes of problems.
- The computing capacity required.
- The desired server equipment such as Pizza or Blade servers.
- The required power density.
- The space available.
- The features of the space available in terms of room height, load capacity and media routing.



Knürr CoolTherm® - the compact solution for rack cooling

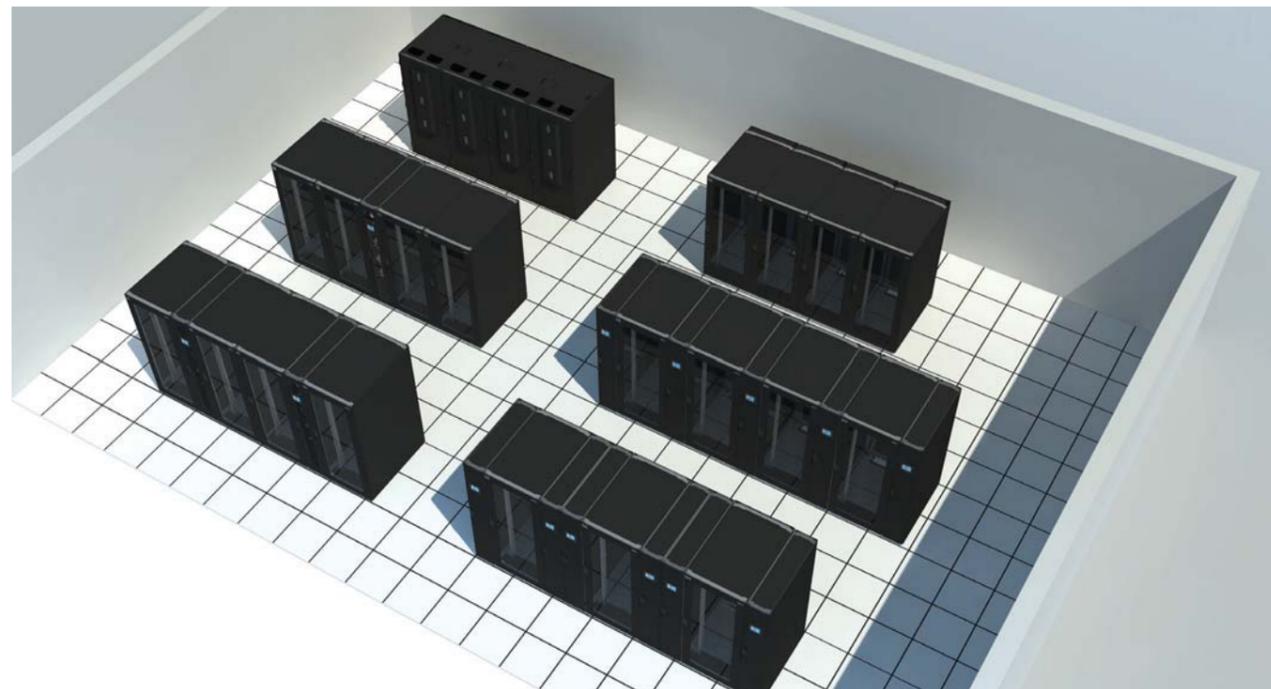


Emerson Network Power offers the perfect infrastructure solution for the widest variety of infrastructure:

1. Rack-based cooling in the cold room

This cooling version with closed circuits between the rack and cooling components or cooled air recirculation is ideal if

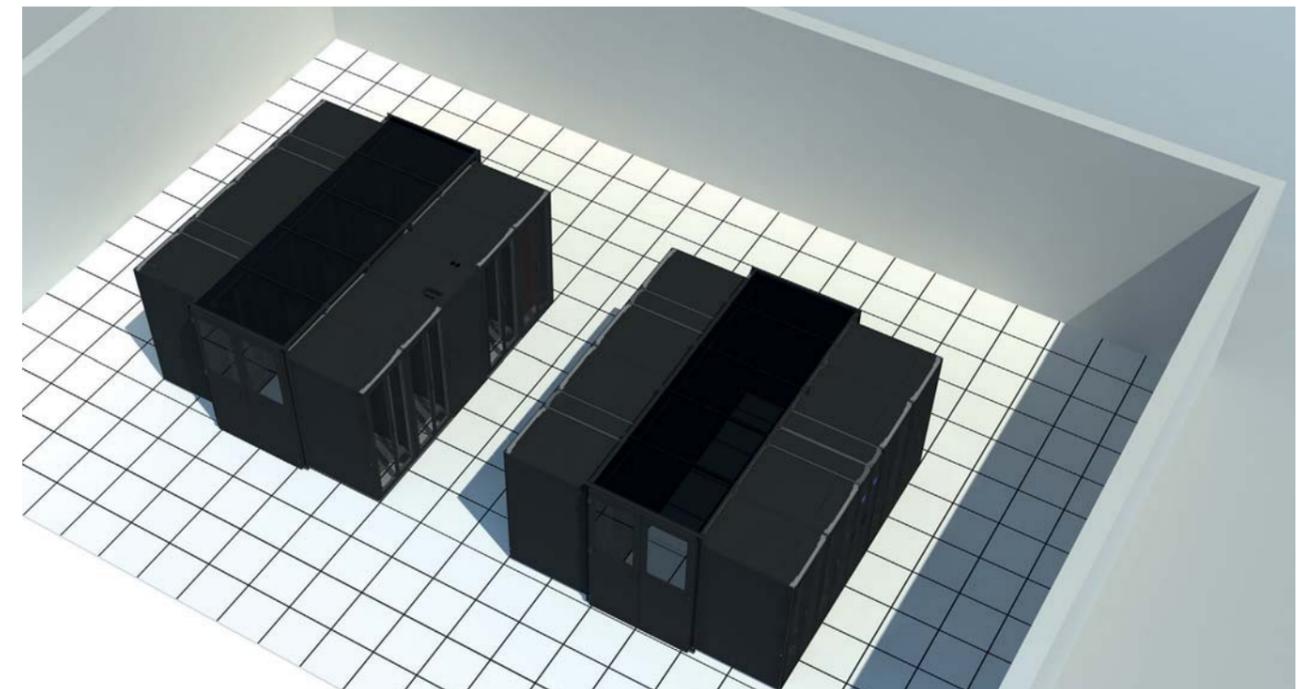
- High power dissipation in each rack needs to be cooled.
- Repercussions on the room climate need to be prevented otherwise the cooling capacity would be overloaded.
- There is only limited floor space for installation.
- Low noise emissions are required.
- High cooling efficiency is required and achieved by means of short air paths and high cold water supply temperature.
- Facilitates a backup for room cooling during conversion and maintenance.



2. Aisle-based cooling in the cold room

This cooling version with open air circuits and recirculation of the cooled ambient air in the cold aisle is ideal if

- Average power dissipation in each rack needs to be cooled.
- Installation on a suspended floor is not possible due to either a lack of height in the room or for cost reasons.
- The room height only allows adjacent units to achieve the cooling performance.
- High energy efficiency needs to be achieved by separating hot and cold air zones in the room using optimized quantities of cold air.
- The proportion of free cooling should be maximized by the dynamic control of the cold water supply temperature.
- A combination of devices for humidity control and sensitive cooling is required.

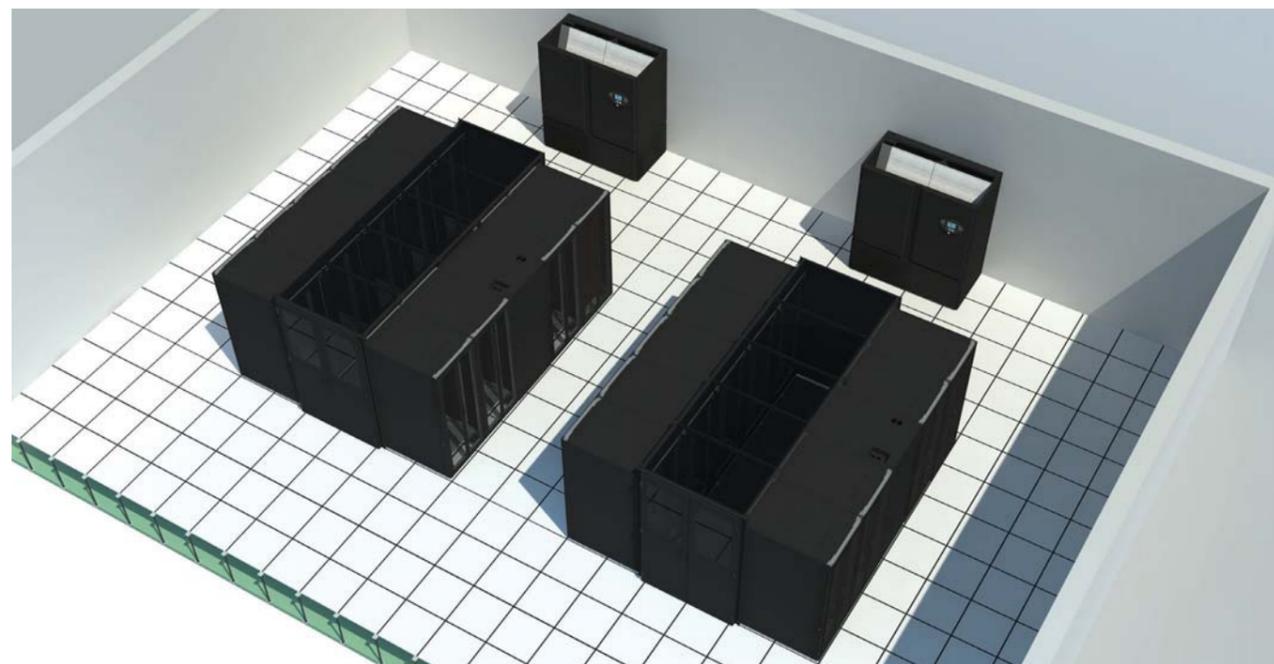


Emerson Network Power offers the perfect infrastructure solution for the widest variety of infrastructure:

3. Room-based cooling

This cooling version with open air circuits and recirculation of the cooled waste air from the room cooling equipment via the suspended floor into the cold aisles in the respective double aisle is ideal if

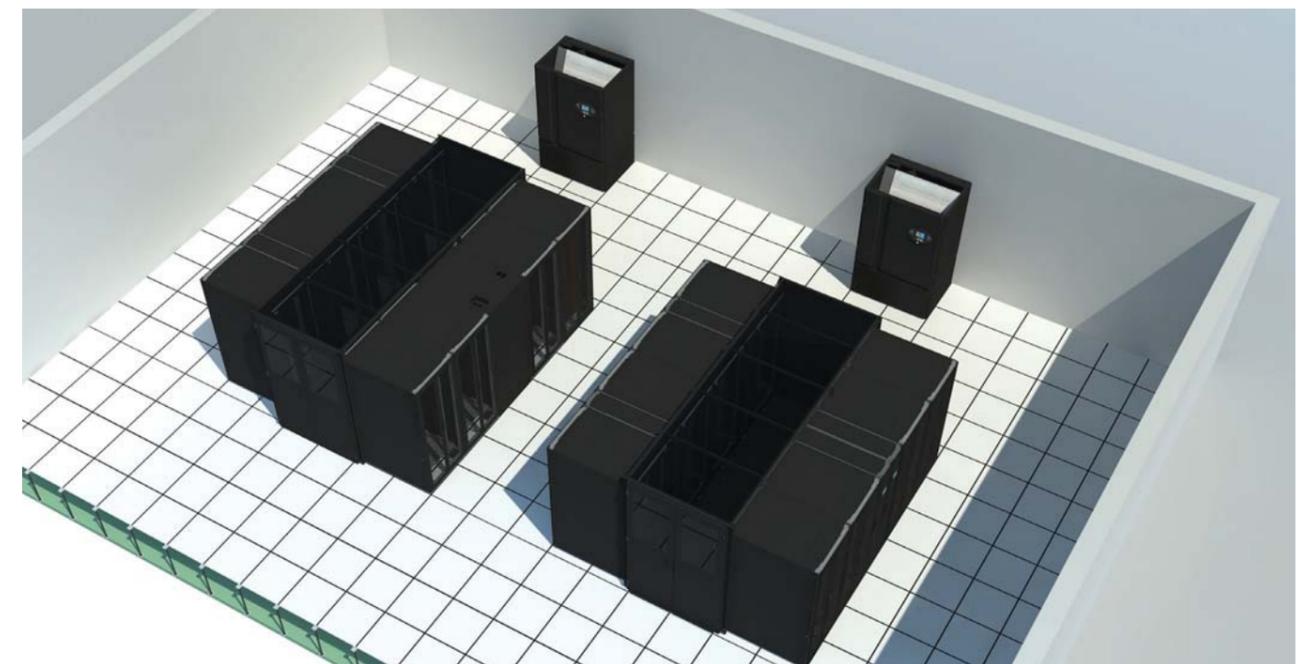
- Low to average power dissipation in each rack needs to be cooled.
- If increased requirements for computing power and capacity need to be met by upgrading or converting existing racks.
- Precision cooling independent of the rack with humidity control and air filtration should be used.
- High energy efficiency needs to be achieved by separating hot and cold air zones and recirculation cooling devices with dynamic control of fan speeds.
- The proportion of free cooling should be maximized by the dynamic control of the cold water supply temperature.



4. Combined aisle and room-based cooling

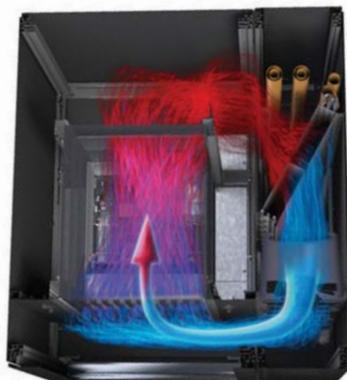
This combined solution of aisle and room cooling is ideal if

- Average power dissipation in each rack needs to be cooled.
- If increased requirements for computing power and capacity need to be met by upgrading or converting existing racks.
- Availability needs to be increased through improved redundancy.
- High energy efficiency by separating hot and cold air zones and recirculation cooling devices with patented control of fan speeds.
- The proportion of free cooling should be maximized by the dynamic control of the cold water supply temperature.
- A combination of devices for humidity control and sensitive cooling is required.

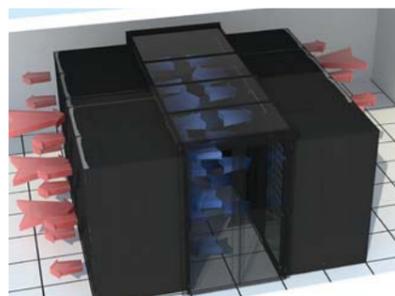


Cooling Solutions – Basic principles of efficient cooling

Three tried and tested basic principles



Air separation in rack cooling



Air separation in aisle cooling

1. Consistent air separation

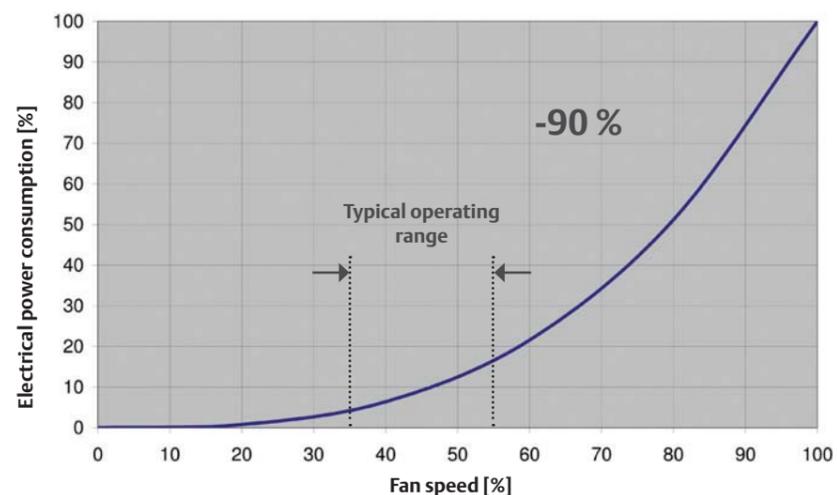
The separation of cooling air and hot waste air is a basic pre-requisite for efficient cooling of IT components. There are simple mechanical construction elements at rack and room level. These can usually be retrofitted.

- There is no mixing of hot and cold air. This means the temperature of the air recirculating to the cooling devices increases and their performance increases accordingly.
- The air separation enables the air supply to be controlled according to demand. Exactly the right amount of air needed by the IT components is always supplied.

2. Dynamic regulation of the cooling system

The regulation of the entire cooling chain facilitates reliable cooling of the IT components at all times whilst at the same time constantly optimizing energy efficiency. Cooling devices and cold water supply are adjusted dynamically to the current – usually highly variable – IT requirements.

- Electronically switched fans are particularly energy efficient even at full speed and allow infinitely adjustable speed regulation.
- A simple, patented regulation system means that the fan speed always precisely matches the current demand for cooling air – and hence facilitates a huge reduction in running costs.



The power consumption of the fans is highly dependent on the speed – on n^3 , to be precise. In the typical operating range, the electrical power consumption is only around 10% of the value at full speed.



Liebert compact chiller with integrated free cooling

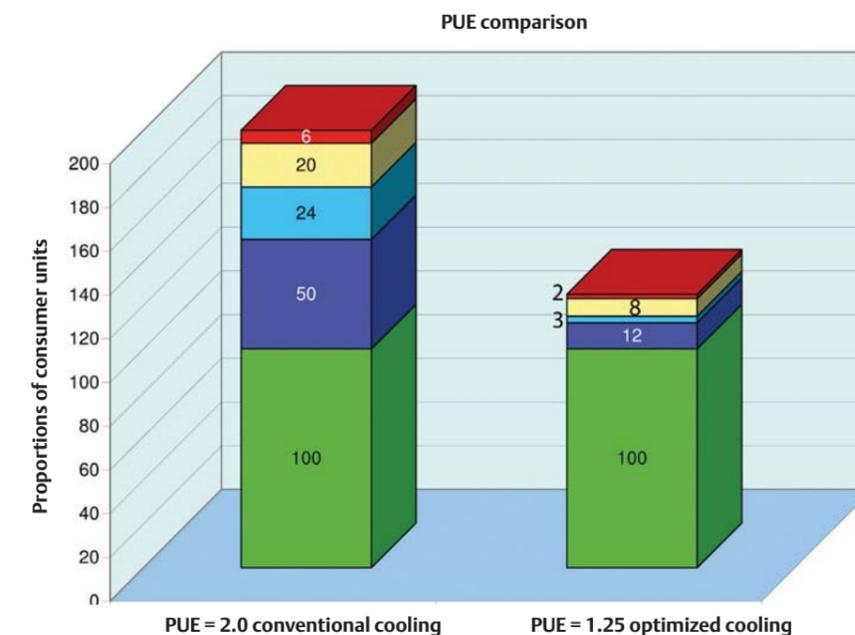
3. High temperature – maximum free cooling

Another effect of air separation is that it completely avoids hot spots and the cooling air temperature can be set to a relatively high value. Under the ASHRAE Guideline, the optimum value is currently around 25°C.

- This means a relatively high cooling water temperature is sufficient for

cooling. Most of the time, the cold water units run in free cooling mode, the compressors only run for a few hours a year. This also saves a great deal of energy in refrigeration.

- Generously proportioned heat exchangers and dynamic regulation of the cold water temperature lead to further optimization of the energy efficiency.



With optimized cooling and power supply, a PUE of 1.25 or even better can be achieved.

Main criteria for assessing data center infrastructure

All issues and arguments to date can be summarized under three main criteria for assessing data center infrastructure.

1. Availability

The key issue for all types and sizes of data center is the availability. Maximum computing power, fastest access or lowest costs are little use if the availability is plagued by uncertainties, breakdowns or even long downtime.

Users of data center services, either in-house or a customer that outsources its computing power, will only reward – and hence pay for – the finest computing technology at the cutting edge of tech-

nology right up to cloud computing if they can rely 100% on the availability of the data they need.

With data center infrastructure from Emerson Network Power, they are always in a position to achieve the degree of availability that matches their scope of work.

2. Efficiency

A customer who can rely on the availability will still be unhappy if this availability is bought at the price of a lack of efficiency. Efficiency must be seen as a multi-purpose term. Efficiency covers:

- The efficiency of the technical processes e.g. expressed in the efficiency of the cooling or power supply.
- Cost effectiveness in terms of both investment and running costs. When we talk about investment, it is not just the pure equipment investment that matters, but also in particular:
 - Building costs
 - Consequential costs for recirculation facilities and
 - Consequential costs for energy delivery.Crucial factors in the running costs include:
 - Capacity utilization of the area
 - Efficiency of the cooling and power supply facilities
 - Consumption values and hence costs for operating facilities
 - Monitoring, service and repair costs.

- Time efficiency in relation to processing speed and hence the period from data provision to output of the results.



Computing power with uninterrupted availability



Heat exchanger design to increase efficiency

3. Future-proofing and adaptability

Availability and efficiency are only sufficient if your planning, project management and implementation is short term rather than sustainable.

That is why, for Emerson Network Power, future-proofing and adaptability are another crucial factor in the development and delivery of data center infrastructure.

Future-proofing, for example, means that the data center infrastructure can still cope if

- There is demand for increased computing capacity or
- The heat loads caused by new server types or changes to the proportions of different server types are increased or redistributed or

- Current flow and speed, volume flow or the pressure ratios are changed.

Products from Emerson Network Power are future-proof so as to respond to this appropriately and efficiently.

Adaptability allows highly efficient results to be achieved even during planning and project management and is, naturally, also part of future-proofing.

Cooling Solutions – Product overview

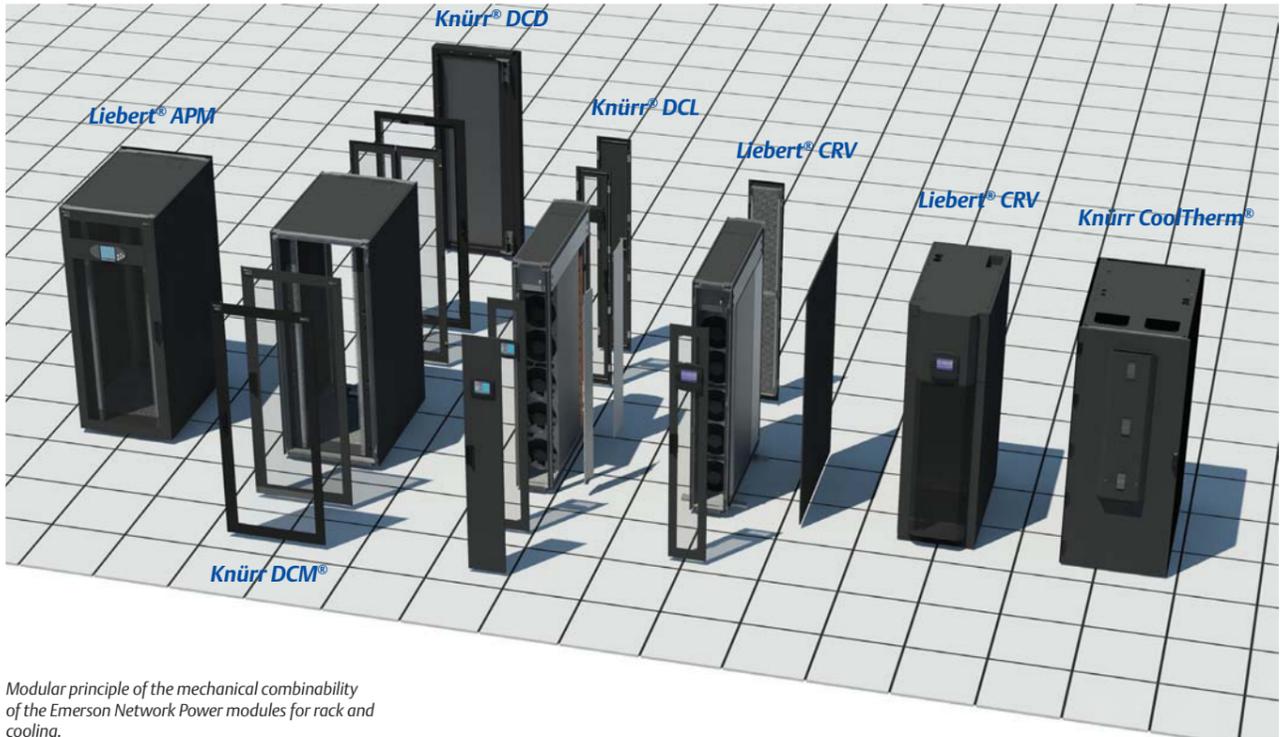
Adaptability is achieved by factors such as:

- The wide range of Emerson Network Power product families including both
 - Active components such as cooling facilities for air/air, air/water and air/compression refrigeration machines and uninterruptible power supplies (UPS) and
 - Passive components such as racks, enclosures and power distributors

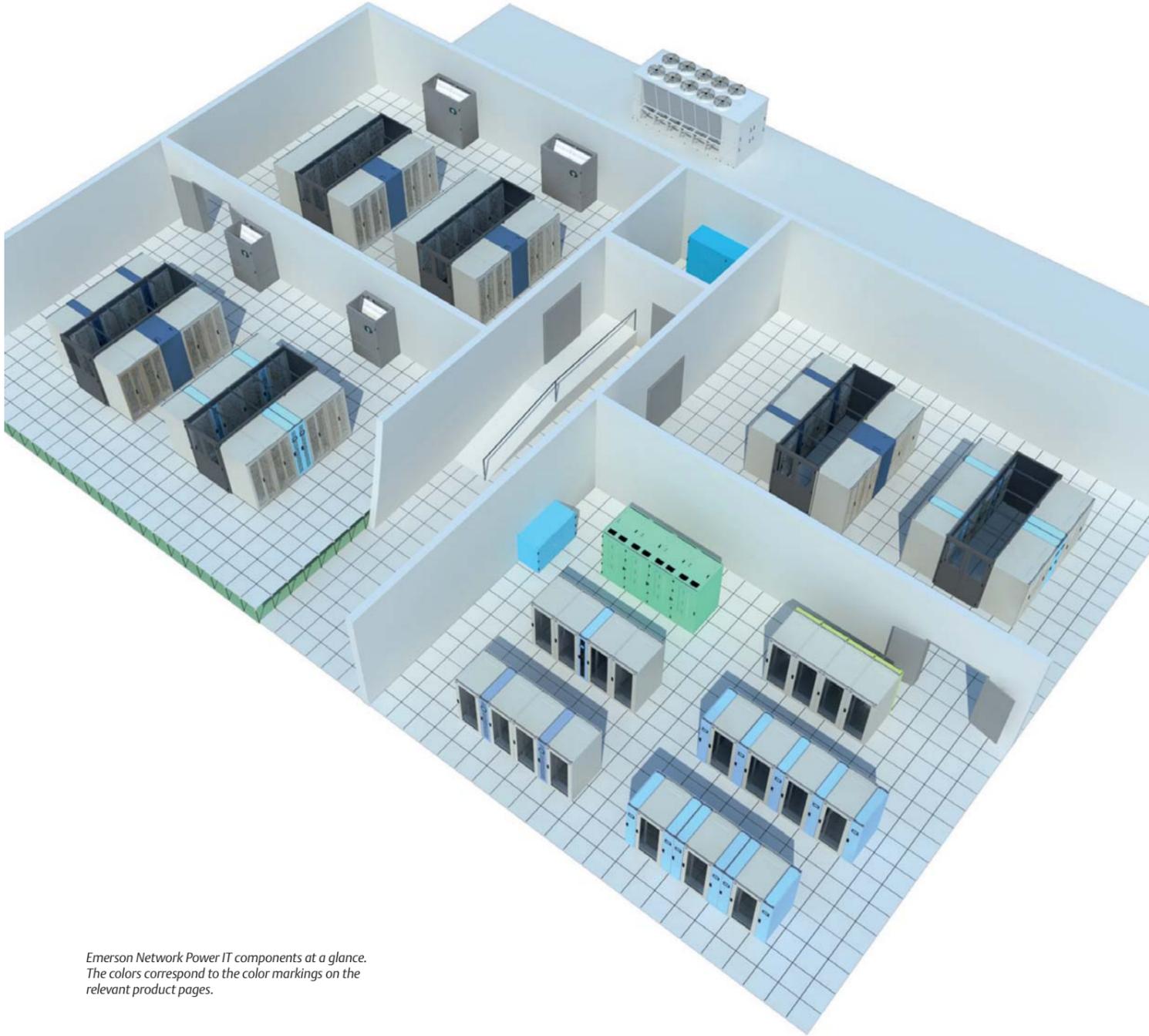
- The ability to combine different infrastructure components both
 - by means of mechanical interfaces and
 - by means of standardized communication between the operator and the device and between the devices themselves
- Sensible scaling of device dimensions and performance parameters.

The following sections with information about our data center infrastructure, here focusing on the Emerson Knürr and Liebert range, show how these three main criteria are implemented in each specific case.

UPS details, e.g. APM, can be found in separate brochures



Modular principle of the mechanical combinability of the Emerson Network Power modules for rack and cooling.



Emerson Network Power IT components at a glance. The colors correspond to the color markings on the relevant product pages.

Cooling Solutions – Emerson Network Power

Page 20-27

Knürr® DCL-L sidemount cooler:



- The Knürr® DCL facilitates non room-dependent cooling of server racks based on the Knürr DCM® in a closed architectures.
- Knürr® DCL is the highly efficient, cost-effective and

service-friendly solution for rack cooling in a sidemount model for full use of the installation height of the server racks.

- Cools up to 4 server racks with the installed cooling performance.

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Liebert® CRV aisle cooler product family:



- Emerson aisle chillers ensure efficient cooling specifically tailored to the respective heat loads, room geometry and building climate control.
- Liebert® CRV030 and CRV034 exclusively for cost-effective cooling of the ambient air.
- Liebert® CRV020, CEV035 and CRV040 also monitor and influence the ambient air humidity.

Page 28-33

DCL product variant Knürr® DCL-H:



- The new type of hybrid solution in the DCL variant DCL-H ensures in an open architecture that the server racks do not give off any heat load to the room.
- The hybrid solution enables the server performance to be

increased as required without investing to expand the cooling capacity for the server room.

- Cools up to 4 server racks with the installed cooling performance.

Page 44-53

Knürr® DCD cooling tower:



- Compact solution for newbuild and retrofitting.
- For full capacity utilization of the construction height of the server racks.
- For maximum energy efficiency since the airflow is driven by the server fans.
- Enables permanent piping of the water circuit through water-bearing hinges.
- Cooling of the hot server waste air in the rack prevents hot aisle formation and hot spots in the room.

Page 30

DCL product variant Knürr® DCL-R:



- With the DCL variant DCL-R, the DCL becomes an aisle chiller through the addition of closed side walls and the use of perforated doors.
- Especially for use in the Smart-Aisles concept.

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Knürr DCM® data center module:



- Cabinet platform from Emerson Network Power with global availability.
- Cooling racks, power racks and server racks based on the Knürr DCM® platform guarantee easy integration into the cabinet aisle.
- The right cabinet size for every application.
- Specifically designed for high load capacity and application-related cooling through special air separations.
- Earthquake-proof model available as an option.

Cooling Solutions – Emerson Network Power

Page 58-65

Knürr CoolTherm® integrated rack cooling:



- Compact solution for newbuild in the smallest space up to 35 kW.
- Energy-efficient EC radial fans, efficiently provide chilled air for the widest variety of server types.
- Ideal arrangement for pizza server slots.
- Developed V-shaped air/water heat exchanger.
- Also available as a redundant design.

Page 66-79

SmartAisle™ cold aisle cabinet:



- Standard range for encasing cabinet aisles to massively improve cooling efficiency.
- Special controller system communicates with the other active cooling components in the data center.
- Suitable for newbuild and retrofitting existing data centers.
- The adaptable, user-friendly components are ideal for various types of server rack.
- Excellent value for money through industrial production and minimum assembly work in the data center.

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Knürr CoolTrans® compact modular chilled water station:



- Guaranteed reliability of the water circuit through hydraulic separation from the building circuit.
- Modular design for scalable cooling power.
- Enables leak monitoring.
- Redundant components for continuous operation even during servicing.
- Basis for absolute leak-proofness with the Knürr CoolVac® System.

Page 86-89

Knürr CoolVac® leak-free chilled water supply



- Reliably prevents egress of chilled water by means of "System operating pressure < atmospheric pressure of air" technological regime.
- System is automatically blocked by valves in the event of a broken pipe or hose.
- With web-based monitoring functions.

Page 90-91

Liebert® PCW precision room cooler:



- Product family ranging from 25 to 161 kW cooling power.
- Universal cooling concepts can be achieved, ranging from compression refrigeration machines to water cooling up to combinations of large proportions of free cooling.
- Universal air supply allows use in all room and layout configurations.
- Highly cost-effective investment and operation.

Page 92-95

Liebert® HPC chilled water recirculating cooling:



- Product family ranging from 40 to 1600 kW cooling power.
- Universal cooling concepts ranging from compression refrigeration machines to water and air cooling.
- High proportion of free cooling facilitates exceptional energy efficiency and extends the service life of the active components.
- High reliability even at very low external temperatures.
- Very compact.
- Very quiet.

Knürr® DCL – sidemount cooler for maximum performance

Rack cooling enables you to expand server performance with no intervention in existing room cooling. Knürr offers 3 basic solutions for this:

1. Knürr® DCL-L

Server rack cooling with closed chilled air circuit independent of the ambient air.

2. Knürr® DCL-H

Aisle cooling solution for cold room applications with enclosed hot air gen assembly.

3. Knürr® DCL-R

Aisle cooling with open flow of chilled air for cold aisle applications.

- Sidemount cooler for server racks with full capacity utilization of the construction height.
- Chilled air supply for up to 4 server racks for low power requirement.
- Energy-efficient EC auxiliary fans and high-performance heat exchangers deliver the chilled air required for a wide variety of server types.
- Future-proof as the same base unit for use in aisle cooling can also be used for rack cooling.



Knürr DCL – Sidemount cooler cools up to four server racks

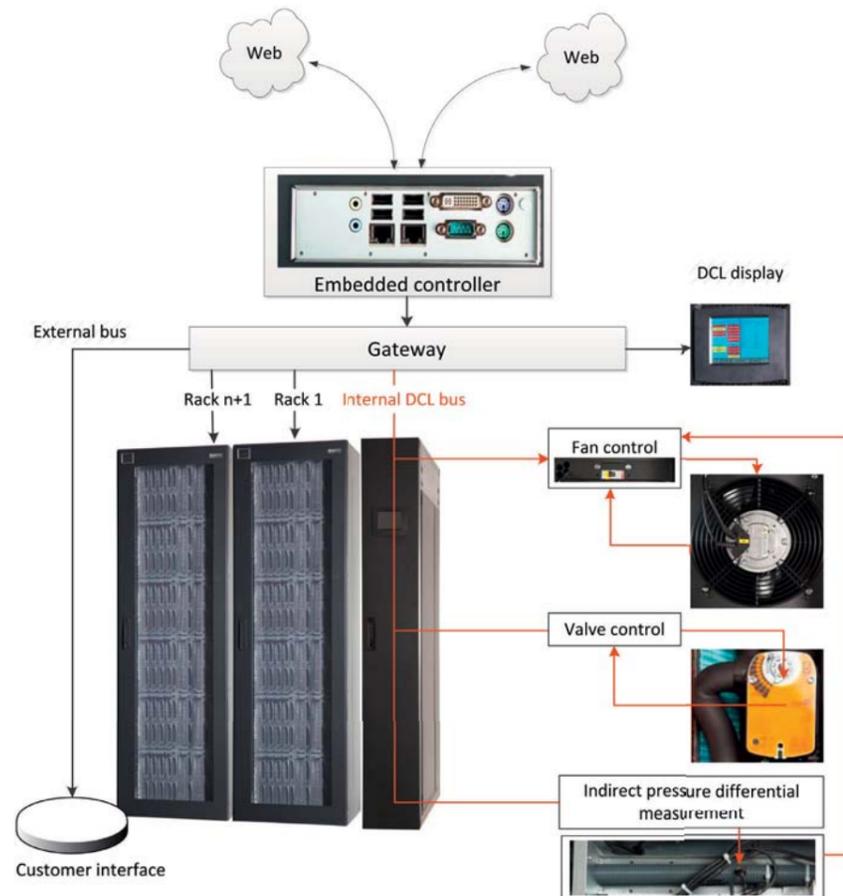


Dynamic air supply through high-performance EC fans

1. Availability

An essential requirement for data center operators is to ensure uninterrupted availability. Knürr guarantees this by means of

- "Fail-safe" function ("safe despite faults") of the control valve: in the event of a power failure or interruption in the control cable, the control valve switches the full volume of the chilled water flow to heat exchangers.
- Embedded controller hardware guarantees autonomous continued operation of the control in the event of a component failure. The actors on the faulty component continue to operate in a controlled way in "fail-safe" mode.
- Access control and data security guaranteed by means of HTTPS and SNMP V3.
- Alarm management can be integrated into DCIM (Data Center Infrastructure Management).
- Embedded controller implements the patented concept of regulating the fan speeds based on indirect differential pressure measurement.
- Embedded controller ensures traceability of all settings changes by means of login logging and event logging.



Embedded controller



Embedded controller display output



Automatic emergency door opening option for server rack

- The automatic emergency door opening for Knürr server racks ensures there is no risk of servers overheating.
- Cooling power and energy efficiency (fan/pump power consumption for cold water connection) confirmed by independent institutions.
- Even temperature profile in the air supply.
- n+1 fan redundancy means that the remaining fans support the volume flow required for cooling in the event of a fan failing.
- Non-return valves prevent recirculation in the event of a fan failure.
- In the event of
 - planned downtime for maintenance
 - or unnecessary cooling power, non-return valves ensure that hot air can flow from the hot aisle into the cold zone of the data center.

- Supports the SmartAisle™ concept
 - Even temperature profile in the air supply
 - Longer bridging time in the event of partial system failure
 - Higher redundancy
- Redundant power supply using A/B switching for the AC operating power supply as an option.
- Dual-circuit heat exchanger option ensures redundancy of the water supply if 2 independent cold water networks are installed at the user's premises for operation with more stringent availability demands.
- Optional integration into Knürr CoolVac® systems guarantees leak proofing (patent pending).

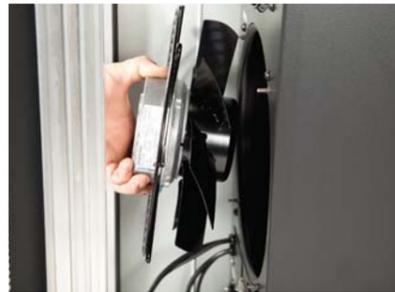


Non-return valve open



Non-return valve closed

2. Efficiency



Simple fan change



Knürr DCM® server rack for cooling with Knürr® DCL, Liebert® power distribution modules and integrated cable management.

In today's competition, no data center operator can leave the issue of costs to chance. Anyone who only thinks about the upfront costs or wants to cut costs at the expense of reliability will be in for unpleasant surprises later on. Clever decision-makers will consider Knürr's experience in ensuring lower running costs with maximum availability:

- Greater power density in the data center results in better use of space and reduced building costs.
- Minimum possible investment for cooling components through the ability to use up to 4 server racks per Knürr® DCL, especially for Knürr® DCL60L.
- Reduced running costs through customized operation.
- High cold water supply temperature increases the proportion of free cooling during refrigeration and improves the energy efficiency rating (EER) of the chiller.

- The control valve optimizes cold water volume flow for the current operational situation.
- Low water-side pressure loss leads to lower pump drive power.
- Energy cost savings by adjusting the fan speed to the real volume flow required using the embedded controller.
- Low air-side pressure loss leads to lower power consumption by the fans.
- Our EC fans guarantee energy-efficient operation with maximum performance across the entire range of fan speed.
- Operator support through the ability to display the "cooling power" efficiency value (ratio of electrical power consumption of the servers to fans).

3. Future-proofing / adaptability



Knürr® DCL-60L in the data center



2/3-way valve changeover

- Future-proof cooling solution because Knürr EC fans already comply with the energy efficiency requirements for CE approval that will apply from 2015.

- 2 power ranges:
 - Up to 34 kW
 - Up to 60 kW

- Can be adapted to different geometries
 - height 2000/2200 mm
 - Depth in 100mm increments from 1,000 to 1,300.

- Facilitates data center upgrade through gradual expansion of the data center with no new investment in different cooling infrastructure
 - Same base unit can be used for aisle cooling concepts and
 - rack cooling with minimum conversion.
- Simple switchover between 2 and 3-way valve by means of a ball valve in the bypass.



Knürr® DCL-60L in the test laboratory

Knürr® DCL – Combination variants

DCL-L facilitates efficient rack cooling for 1 to 4 server racks

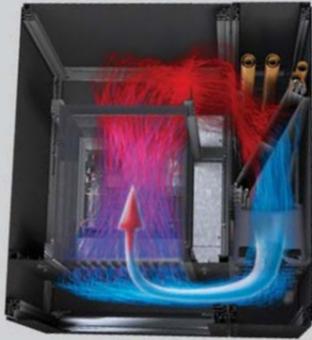


Knürr® DCL30L solo

Knürr® DCL-L



Knürr® DCL-L with one-sided connection Knürr DCM®

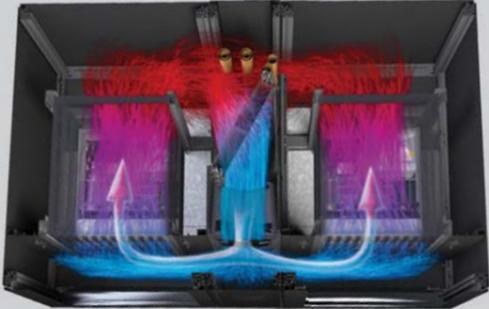


* Flow pattern

Knürr® DCL-L



2-1 combination mechanical



* Flow pattern

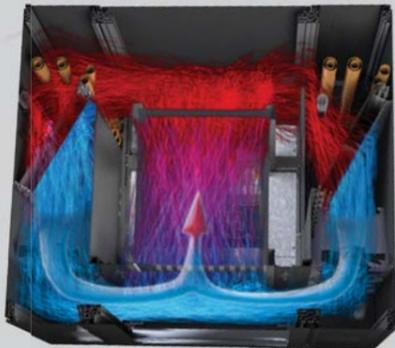


Knürr® DCL60L solo

Knürr® DCL



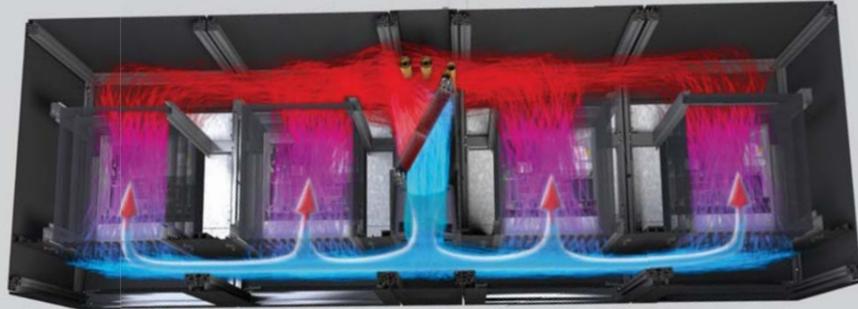
High Density Server Rack cooled by two Knürr® DCL-L



* Flow pattern



- with Knürr® DCL30L for cooling power up to approx. 6 kW/rack
- with Knürr® DCL60L for cooling power up to approx. 12 kW/rack



* Flow pattern

* The diagrams below of the schematic flow pattern show views from above, horizontally from the front across a plane of the server.

Knürr® DCL – Custom variants

Knürr® DCL-H hybrid solution Rack cooling, open architecture



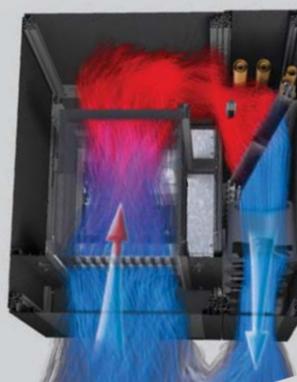
Knürr® DCL-H solo
back view

- Cold room concept.
- Heat losses are not fed into the ambient air.
- No suspended floor required.
- No heat concentration in the data center.
- High air input temperature at the heat exchanger.
- Best energy efficiency through high temperature differences.

Knürr® DCL-H



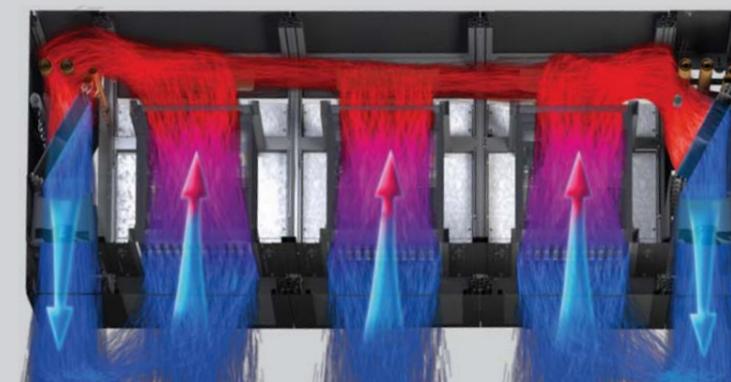
1-1 application mechanical Knürr® DCL H re



1-1 application flow pattern Knürr® DCL H re



1-3-1 combination mechanical

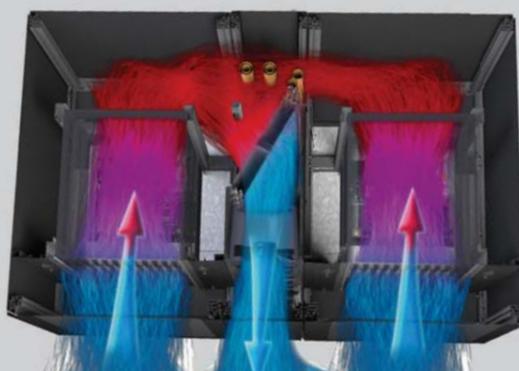


1-3-1 combination flow pattern

Knürr® DCL-H



2-1 combination mechanical Knürr® DCL H



- Aisle cooler Knürr® DCL-R prepared for conversion to Knürr® DCL-H or Knürr® DCL-L.
- Improved fail-safe with embedded controller, for SmartAisle™ applications too.
- Expanded rack monitoring for connected server racks.
- Supports SmartAisle™ Dynamic Intelligent Control.



Knürr® DCL 30 R
back view

Knürr® DCL – Basic specification / order table

Knürr® DCL basic specification

Cooling power levels/specification	Knürr® DCL 30 KW	Knürr® DCL 34 KW	Knürr® DCL 60 KW
Product name Knürr® DCL for rack cooling	Knürr® DCL30L	Knürr® DCL34L	Knürr® DCL60L
Product name Knürr® DCL for hybrid solution	Knürr® DCL30H	Knürr® DCL34H	-
Product name Knürr® DCL for aisle cooling	Knürr® DCL30R	Knürr® DCL34R	-
Nominal cooling power*	30 kW	34 kW	60 kW
Air flow	5,000 m³/h	6,000 m³/h	9,000 m³/h
Water flow	4.45 m³/h	5.02 m³/h	8.90 m³/h
Max. water pressure	10 bar (145 PSI)	10 bar (145 PSI)	10 bar (145 PSI)
Number of fans	5	6	4
Fans power consumption max.	5 x 170 W	6 x 170 W	4 x 680 W
Dimensions (WxDxH)	300x1000(1100)(1200) x2000 [mm]	300x1000(1100)(1200) x2200 [mm]	300x1000(1100)(1200) x2000 [mm]
Table 1: Knürr® DCL basic specification * sensible cooling, at 16°C / 22°C (61°F / 72°F) water temperature, and 43°C (109°F) air inlet temperature			

Knürr® DCL order table

Cooling power / cooling arrangement	Width (mm)	Height (mm)	Depth (mm)	Water connection	Door design/ number of fans	Order name	Product no.
30 kW Rack cooling	300	2000	1100	Ready for underneath	Front and back door closed 5 x axial fans	DCL30L 1100 mm cooling water connection underneath	DCL30LR02ZNY00010000PA001
			1200			DCL30L 1200 mm cooling water connection underneath	DCL30L202ZNY00010000PA001
			1300			DCL30L 1300 mm cooling water connection underneath	DCL30LH02ZNY00010000PA001
			1100	Ready for underneath or on top		DCL30L 1100 mm cooling water connection underneath or on top	DCL30LR029NY00010000PA001
			1200			DCL30L 1200 mm cooling water connection underneath or on top	DCL30L2029NY00010000PA001
			1300			DCL30L 1300 mm cooling water connection underneath or on top	DCL30LH029NY00010000PA001
30 kW Hybrid cooling	300	2000	1000	Ready for underneath	Front door perforated, back door closed 5 x axial fans	DCL30H 1000 mm cooling water connection underneath	DCL30H102ZNY00010000PA001
			1100			DCL30H 1100 mm cooling water connection underneath	DCL30HR02ZNY00010000PA001
			1200			DCL30H 1200 mm cooling water connection underneath	DCL30H202ZNY00010000PA001
			1000	Ready for underneath or on top		DCL30H 1200 mm cooling water connection underneath or on top	DCL30H1029NY00010000PA001
			1100			DCL30H 1100 mm cooling water connection underneath or on top	DCL30HR029NY00010000PA001
			1200			DCL30H 1200 mm cooling water connection underneath or on top	DCL30H2029NY00010000PA001
30 kW Aisle cooling	300	2000	1000	Ready for underneath	Front and back door perforated 5 x axial fans	DCL30R 1000 mm cooling water connection underneath	DCL30R102ZNY00010000PA001
			1100			DCL30R 1100 mm cooling water connection underneath	DCL30RR02ZNY00010000PA001
			1200			DCL30R 1200 mm cooling water connection underneath	DCL30R202ZNY00010000PA001
			1000	Ready for underneath or on top		DCL30R 0100 mm cooling water connection underneath or on top	DCL30R1029NY00010000PA001
			1100			DCL30R 1100 mm cooling water connection underneath or on top	DCL30RR029NY00010000PA001
			1200			DCL30R 1200 mm cooling water connection underneath or on top	DCL30R2029NY00010000PA001
34 kW Rack cooling	300	2200	1100	Ready for underneath	Front and back door closed 6 x axial fans	DCL34L 1100 mm cooling water connection underneath	DCL34LR02ZNY00010000PA001
			1200			DCL34L 1200 mm cooling water connection underneath	DCL34L202ZNY00010000PA001
			1300			DCL34L 1300 mm cooling water connection underneath	DCL34LH02ZNY00010000PA001
			1100	Ready for underneath or on top		DCL34L 1100 mm cooling water connection underneath or on top	DCL34LR029NY00010000PA001
			1200			DCL34L 1200 mm cooling water connection underneath or on top	DCL34L2029NY00010000PA001
			1300			DCL34L 1300 mm cooling water connection underneath or on top	DCL34LH029NY00010000PA001
34 kW Hybrid cooling	300	2200	1000	Ready for underneath	Front door perforated, back door closed 6 x axial fans	DCL34H 1000 mm cooling water connection underneath	DCL34H102ZNY00010000PA001
			1100			DCL34H 1100 mm cooling water connection underneath	DCL34HR02ZNY00010000PA001
			1200			DCL34H 1200 mm cooling water connection underneath	DCL34H202ZNY00010000PA001
			1000	Ready for underneath or on top		DCL34H 1200 mm cooling water connection underneath or on top	DCL34H1029NY00010000PA001
			1100			DCL34H 1100 mm cooling water connection underneath or on top	DCL34HR029NY00010000PA001
			1200			DCL34H 1200 mm cooling water connection underneath or on top	DCL34H2029NY00010000PA001
34 kW Aisle cooling	300	2200	1000	Ready for underneath	Front and back door perforated 6 x axial fans	DCL34R 1000 mm cooling water connection underneath	DCL34R102ZNY00010000PA001
			1100			DCL34R 1100 mm cooling water connection underneath	DCL34RR02ZNY00010000PA001
			1200			DCL34R 1200 mm cooling water connection underneath	DCL34R202ZNY00010000PA001
			1000	Ready for underneath or on top		DCL34R 1000 mm cooling water connection underneath or on top	DCL34R1029NY00010000PA001
			1100			DCL34R 1100 mm cooling water connection underneath or on top	DCL34RR029NY00010000PA001
			1200			DCL34R 1200 mm cooling water connection underneath or on top	DCL34R2029NY00010000PA001
60 kW Rack cooling	300	2000	1100	Ready for underneath	Front and back door closed 4 x radial fans	DCL60L 1100 mm cooling water connection underneath	DCL60LR02ZNY00010000PA001
			1200			DCL60L 1200 mm cooling water connection underneath	DCL60L202ZNY00010000PA001
			1300			DCL60L 1300 mm cooling water connection underneath	DCL60LH02ZNY00010000PA001

Knürr® DCL – Project example

Industry/customer:

Airport data center

Requirement:

To secure the increasing demands on room cooling. Necessary increase in computing power generates increased demand for cooling as it cannot be covered by the existing room cooling, alternative solutions were required.

Solution:

- Project with 16 Knürr® DCL together with 16 Knürr server racks.
- Closed architecture for rack cooling.
- Arranged specifically for the project in groups of four and 2 server cabinets each with two Knürr® DCL-L.
- Knürr® DCL equipped with embedded controller and touchscreen monitor as well as 3-way valve.



Liebert® CRV – Aisle cooler maximum power in minimum space

Aisle cooling enables you to expand server performance with no intervention in existing room cooling. Aisle-based control allows you to optimize temperature stability and running costs. Emerson Network Power offers you 2 basic solutions which are ideal particularly in the SmartAisle™ solutions.

1. Liebert® CRV 300 mm

Aisle cooler absorbs the hot room or aisle air and, once they have been chilled in the open circuit, emit them back to

the room or the cold aisle. This achieves maximum cooling in the minimum space.

2. Liebert® CRV 600 mm

Aisle cooler with air filtering and air humidity regulation supplements the Liebert® CRV 300 mm where conditions require.

Energy-efficient EC auxiliary fans and high-performance heat exchangers or, in the case of the CR040 compression coolers, deliver the chilled air required for a wide variety of server types.



Liebert® CRV: Aisle cooling –
simple, reliable and adaptable

1. Availability

An essential requirement for data center operators is to ensure uninterrupted availability. Liebert® CRV030/ CRV034 guarantees this by means of:

- n+1 fan redundancy means that the remaining fans support the volume flow required for cooling in the event of a fan failing.
- Non-return valves prevent recirculation in the event of a fan failure.
- In the event of planned downtime for maintenance
- Or unnecessary cooling power, non-return valves ensure that hot air can flow from the hot aisle into the cold zone of the data center.

- Cooling power and energy efficiency (fan/pump power consumption for cold water connection) confirmed by independent institutions.
- Liebert iCOM control enables all the relevant parameters to be set and checked and displays the diagnostic results on the very large display (320x240 pixels, backlit).
- Recording the current air humidity and temperature at server level ensures that the actual volume of cold air required is delivered.
- Liebert iCOM control allows integration into the overall system and enables multiple Liebert cooling units to communicate and hence interact ideally to increase the effective cooling as a team.

- Supports the SmartAisle™ concept
 - Even temperature profile in the air supply.
 - Longer bridging time in the event of partial system failure.
 - Higher redundancy.
- Options to guarantee reliability even in unfavorable environmental conditions
 - Optional condensation pump
 - Optional air filter
- Electrical safety CE-certified by independent institutes.
- CB test certificate.
- EMC test in compliance with FCC regulations.
- CSA certificate "Equipment safety for IT equipment" for USA and Canada.
- Redundant power supply using A/B switching for the AC operating power supply as an option.
- Optional integration into Knürr CoolVac® systems guarantees leak proofing (patent pending).



Liebert® CRV 30 non-return valve open



Liebert® CRV 30 non-return valve closed



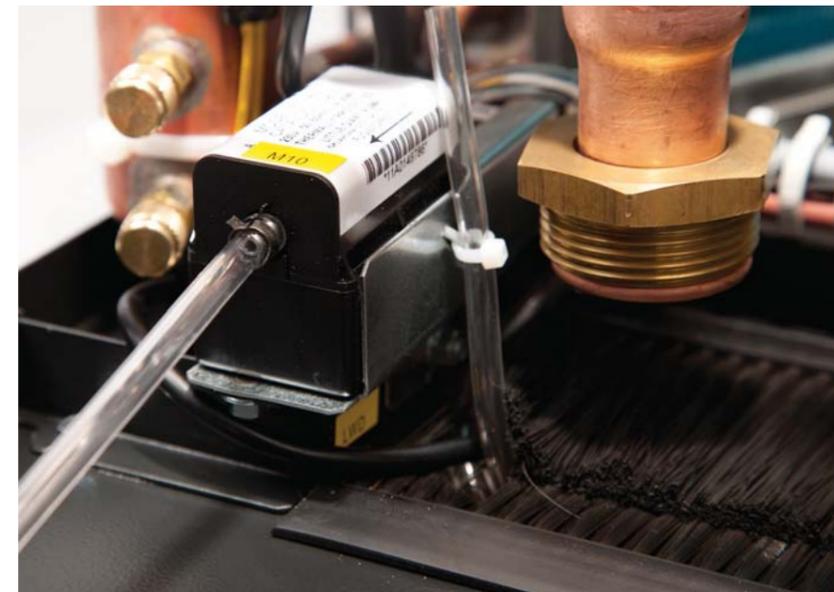
Air sensors at the server air input



iCom display



iCom interface



Option: condensation pump



Optional air filter

2. Efficiency



EC fans with fan control

The efficiency of aisle cooling is highly dependent on the room layout and its climate control equipment. Flexible aisle coolers arranged in conjunction with the aisle concept enables the data center operator to exert a great influence on the trend in running costs.

Anyone who only thinks about the upfront costs or wants to cut costs at the expense of reliability during project management will be in for unpleasant surprises later on. Clever decision-makers will consider Emerson's experience in ensuring lower running costs with maximum availability:

- Greater power density, particularly in the 300 mm wide Liebert® CRV results in better use of space and reduced building costs in the data center.
- Reduced running costs through customized operation.

- High cold water supply temperature increases the proportion of free cooling during refrigeration and improves the energy efficiency rating (EER) of the chiller.
- The control valve optimizes cold water volume flow for the current operational situation.
- Low water-side pressure loss leads to lower pump drive power.
- Energy cost savings by adjusting the fan speed to the real volume flow required using the iCom controller.
- Low air-side pressure loss leads to lower power consumption by the fans.
- Our EC fans guarantee energy-efficient operation with maximum performance across the entire range of fan speed.

3. Future-proofing / adaptability



Liebert® CRV034

- Future-proof cooling solution because Knürr EC fans already comply with the energy efficiency requirements for CE approval that will apply from 2015.
- 2-level scalable cooling:
 - up to 30 kW
 - up to 34 kW (height 2200)
- Depth: 1000 mm / 1100 mm / 1200 mm
- Height: 2000 mm, 2200 mm
- Simple switchover between 2 and 3-way valve by means of a ball valve in the bypass.
- Water supply and removal ready from underneath, on top or both.

- Liebert® CRV is ready for integration into a Tier IV data center.
- Air humidity influenced by the addition of a Liebert® CRV20/35 or 40.
- See separate publication "Liebert CRV™ Row-Based Cooling; Intelligent Precision Cooling For Data Center Equipment"
- **Liebert iCom control guarantees**
 - Unit-to-unit communication with other Liebert CRVs.
 - Expansion possibility for communication cards thanks to IntelliSlot housing included in the standard scope of delivery.
 - Liebert iCOM unit control uses Intelligent Control by means of "fuzzy logic" and "expert systems" methods.
 - User can choose proportionally adjustable PIs as an option.
 - Compatible with all Liebert remote monitoring and control devices.
 - Optional availability for BMS interface via MODbus, Jbus, BACNet, Profibus and SNMP.
 - User-friendly menu navigation through the three main menu sections: User Menu, Service Menu and Advanced Menu.



Liebert iCom controller

Liebert® CRV



Liebert® CRV034 - Solo



2-1 combination mechanical Liebert® CRV030

2-1 combination Liebert® CRV030 flow pattern



CR035RA/W

		DX Air Cooled / Water Cooled		Chilled Water
		CR020R/W	CR035RA/W	CR040RC
Net cooling capacity	kW	23	37	40
Dimensions	mm	width 600 – depth 1175 height 2000		

Basic specification CR020/035/040



Liebert® CRV030/034 basic specification

	Liebert® CRV030	Liebert® CRV034
Nominal cooling power *)	30 kW	34 kW
Dimensions (WxDxH)	300x1000(1100)(1200)x2000 [mm]	300x1000(1100)(1200)x2200 [mm]
Air flow	5,000 m³/h	6,000 m³/h
Volume flow	4.45 m³/h	5.02 m³/h
Max. water pressure	10 bar	10 bar
Number of fans	5	6
Fan power consumption max.	5 x 170 W	6 x 170W

* Standard operation
16/22°C (61°F / 72°F) water temperature and 43 °C (109°F) air inlet temperature (energy-optimised operation)

Liebert® CRV order table

Cooling power	Width (mm)	Height (mm)	Depth (mm)	Water connection	Number of fans	Order name	Product no.				
30 kW	300	2000	1000	Ready for underneath	5 x CE axial fans	CRV 030 1000 mm cooling water connection underneath	CR0301C19Z0D0NH1L000PA001				
						CRV 030 1100 mm cooling water connection underneath	CR030RC19Z0D0NH1L000PA001				
						CRV 030 1200 mm cooling water connection underneath	CR0302C19Z0D0NH1L000PA001				
			1100	Ready for underneath or on top / webcard		CRV 030 1000 mm cooling water connection underneath or on top	CR0301C1990D0CH15010PA001				
						CRV 030 1100 mm cooling water connection underneath or on top	CR030RC1990D0CH15010PA001				
						CRV 030 1200 mm cooling water connection underneath or on top	CR0302C1990D0CH15010PA001				
			1200	Ready for underneath or on top / webcard		CRV 030 1000 mm cooling water connection underneath or on top; packed suitably for sea freight	CR0301C1990D0CH15T10SA001				
						CRV 030 1100 mm cooling water connection underneath or on top; packed suitably for sea freight	CR030RC1990D0CH15T10SA001				
						CRV 030 1200 mm cooling water connection underneath or on top; packed suitably for sea freight	CR0302C1990D0CH15T10SA001				
			34 kW	300		2200	1000	Ready for underneath	6 x CE axial fans	CRV 034 1000 mm cooling water connection underneath	CR0341C19Z0D0NH1L000PA001
										CRV 034 1100 mm cooling water connection underneath	CR034RC19Z0D0NH1L000PA001
										CRV 034 1200 mm cooling water connection underneath	CR0342C19Z0D0NH1L000PA001
1100	Ready for underneath or on top / webcard	CRV 034 1000 mm cooling water connection underneath or on top			CR0341C1990D0CH15010PA001						
		CRV 034 1100 mm cooling water connection underneath or on top			CR034RC1990D0CH15010PA001						
		CRV 034 1200 mm cooling water connection underneath or on top			CR0342C1990D0CH15010PA001						
1200	Ready for underneath or on top; salt water resistant / webcard	CRV 034 1000 mm cooling water connection underneath or on top; packed suitably for sea freight			CR0341C1990D0CH15T10SA001						
		CRV 034 1100 mm cooling water connection underneath or on top; packed suitably for sea freight			CR034RC1990D0CH15T10SA001						
		CRV 034 1200 mm cooling water connection underneath or on top; packed suitably for sea freight			CR0342C1990D0CH15T10SA001						

Industry/customer:

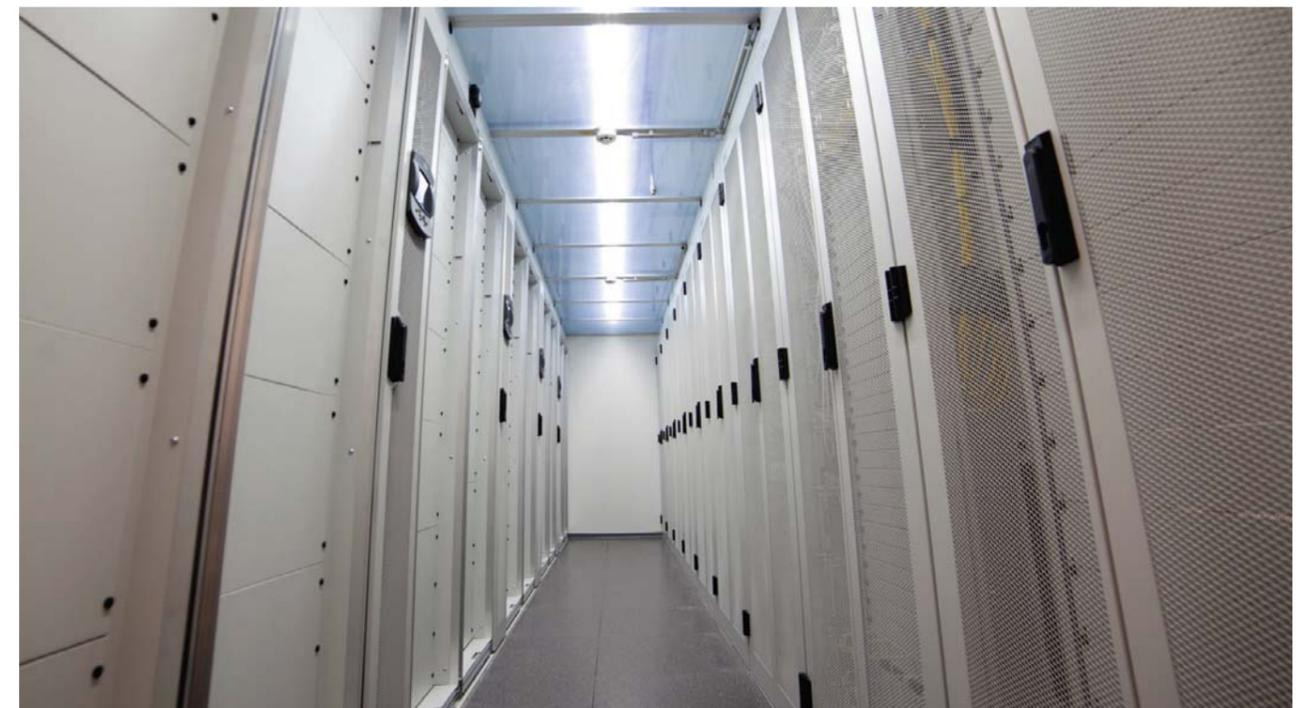
Bayerischer Rundfunk BR television and radio studio, Munich-Freimann.

Requirement:

- Future-proof design for expandable data center.
- Integration of studio and broadcast technology.
- Structure for medium-sized services.

Solution:

- 23 Liebert® CRV030 in 3 rooms, built into cold aisle enclosures.
- 4 to 6 Liebert® CRV030 per cold aisle
- Cold aisles integrate Knürr® DCL racks and special racks for broadcast technology.
- High energy efficiency: cold water supply at 16°C at 20 kW per Liebert® CRV.
- Electrical insulation between Liebert® CRV climate control technology and studio technology.
- Commissioning and iCOM teamwork integration by Knürr Service.



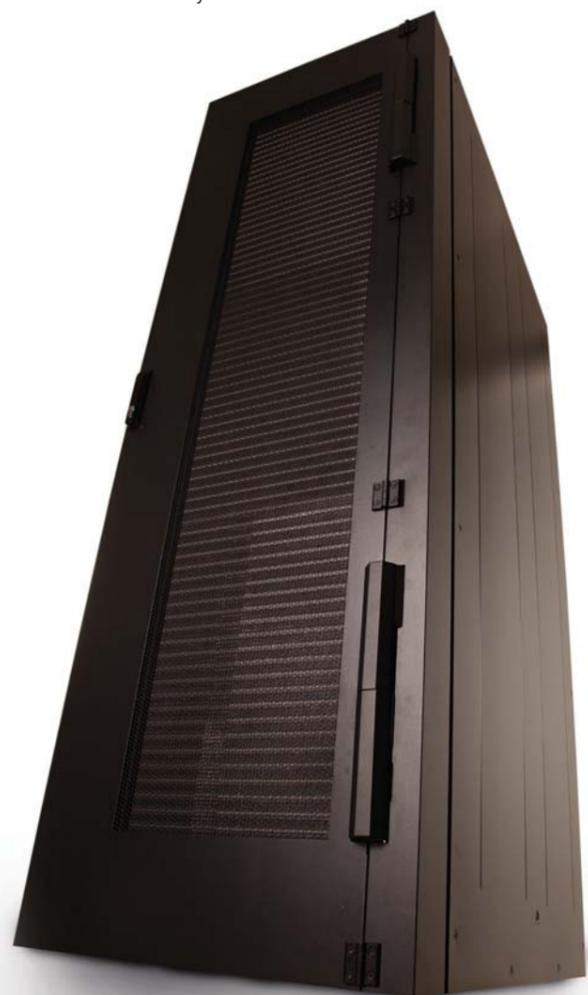
Liebert® CRV application at Bayerischer Rundfunk; Initial fitting out with generous spare capacity for server equipment.

Knürr® DCD – Cooling tower for maximum energy efficiency



open Knürr® DCD

- Compact solution for newbuild and retrofitting.
- Rack for retrofitting does not need to be a Knürr product.
- For full capacity utilization of the construction height of the server racks.
- For maximum energy efficiency since the airflow is driven by the server fans.
- Enables permanent piping of the water circuit through water-bearing hinges.
- Designed for cold room concept.
- Cooling of the hot server waste air in the rack prevents hot aisle formation and hot spots in the room.



Knürr® DCD: Efficient cooling coil –
server fans drive hot air flow

1. Availability



Special water-bearing hinge

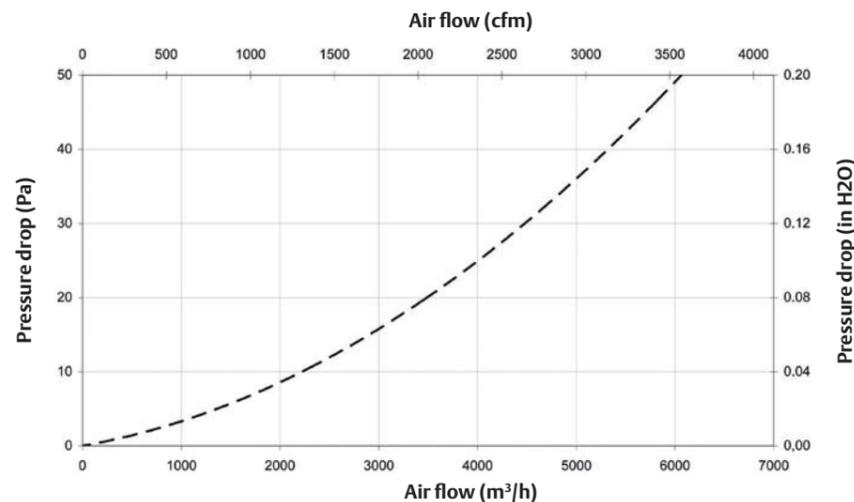


Top water connection supports



Condensation discharge supports Condensation pan supports

- Guaranteed 35kW cooling.
- System tolerates high air supply temperature.
- No additional fans required for cooling so no risk of failure.
 - Greater system reliability.
 - Fewer sources of failure.
 - No additional fans so no waste heat load on the room.
- Pressure loss for cooling air minimized.
- Special water-bearing hinges with a non-wear sealing ring prevent risk of loss of watertightness as a result of contact between the door and the cooling water connection:
 - Tested over 10,000 cycles
 - Hinges tested as standard with 25 bar at the manufacturer
- Condensation pipe and collector in the event that the temperature falls below the dew point; removed via 5/8" flexible hose on plug nipple.
- The risk of condensation being deposited on the cooling lamellae is eliminated by their generally vertical arrangement and sufficient distance between the lamellae.
- Fits perfectly with the Knürr DCM® rack; rack and cooling equipment are designed and manufactured from a single source.
- Can also be used as an ideal cooling solution for server racks already installed in your data center, regardless of their origin.



35 Pa is no problem for the typical fans in servers

2. Efficiency

PUE (Power Usage Effectiveness) optimized design

- No additional fans for cooling and the ability to use existing rack structures for minimized investment.
- Optimum space utilization through ultra compact design and hence very low room costs.

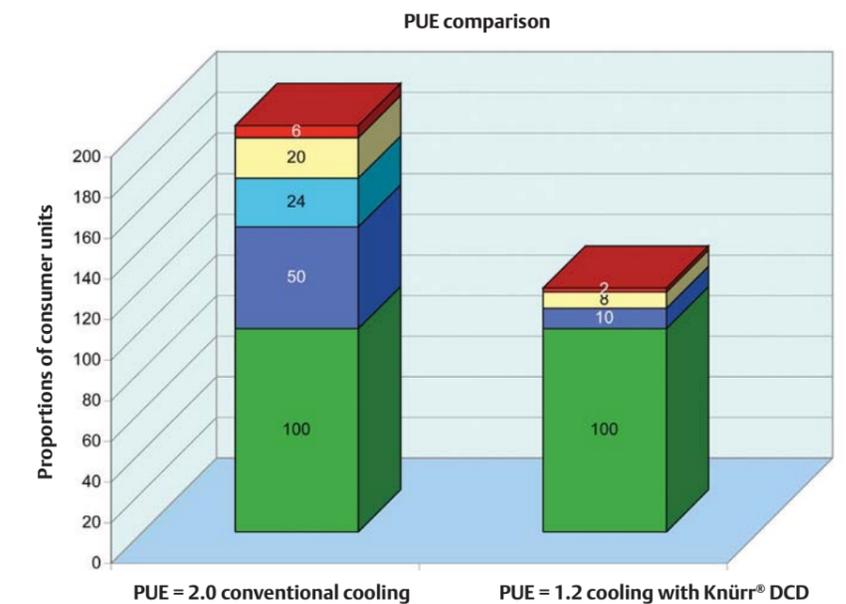
- Minimum pressure drop in the cooling water circuit. Just 54 kPa facilitates minimum energy consumption by the pumps.
- Minimum pressure drop in the air flow through optimized heat exchanger structure and linear air paths with no diversions: no energy costs from additional fans in the cooling unit.



Vertical arrangement of the cooling fins



Knürr® DCD - most efficient water cooling



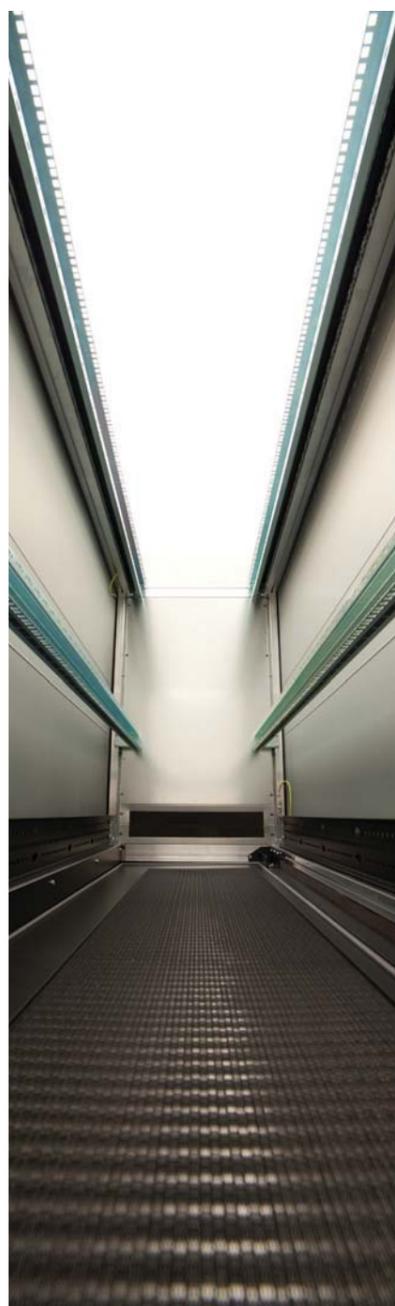
- Lighting
- Electrical losses
- Air circulation
- Cooling
- IT equipment

3. Future-proofing / adaptability

- Standard heights for 2000 and 2200 mm (41/47U).
- Standard heights for 600 and 800 mm; 700 as an option.
- Cooling water can be connected via the floor or lid.
- Doors can be hung left or right with lock.
- Door opens up to an angle of 180° to ensure clear access to the back of the server and cabling.
- Combination of Knürr® DCD cooling door with Knürr DCM® server rack. Perfect mechanical and thermal interaction between server rack and cooling solutions. This is the ideal solution

for a newbuild of server racks if the air conditioning in the room cannot cope with dissipating the heat loss from the servers.

- Combination of Knürr® DCD cooling door with server racks from other manufacturers. Knürr DCM® enables you to upgrade the climate control in existing active server racks from any manufacturer so that modern high-performance servers can be retrofitted or built in as replacements.
- Standard framework solution of customer-specific solution with adapter kit.
- Integration into SmartAisle™.



Door opens up to an angle of 180°



Knürr® DCD frame with adapter



Knürr® DCD with adapter frame to third-party rack



Knürr® DCD open without trim



Server rack cooling components with Knürr® DCD cooling door

Server rack air flow with Knürr® DCD (cross-section)

Knürr® DCD/DCM order table

Cooling power	Width (mm)	Height (mm)	Depth (mm)	Useful height (U)	Useful depth (mm)	Order name	Product no.
35 kW	600	2000	1165	42 U	740	Knürr DCD H2000 W600 D1000 Water connection bottom, hinge left	DCD35A6E3000000G0000PAXXX
		2000	1365	42 U	840	Knürr DCD H2000 W600 D1200 Water connection bottom, hinge left	DCD35A6G3000000G0000PAXXX
		2200	1165	42 U	740	Knürr DCD H2200 W600 D1000 Water connection bottom, hinge left	DCD35C6E3000000G0000PAXXX
		2200	1365	47 U	840	Knürr DCD H2200 W600 D1200 Water connection bottom, hinge left	DCD35C6G3000000G0000PAXXX
35 kW	700	2000	1165	42 U	740	Knürr DCD H2000 W700 D1000 Water connection bottom, hinge left	DCD35A7E3000000G0000PAXXX
		2000	1365	42 U	840	Knürr DCD H2000 W700 D1200 Water connection bottom, hinge left	DCD35A7G3000000G0000PAXXX
		2200	1165	42 U	740	Knürr DCD H2200 W700 D1000 Water connection bottom, hinge left	DCD35C7E3000000G0000PAXXX
		2200	1365	47 U	840	Knürr DCD H2200 W700 D1200 Water connection bottom, hinge left	DCD35C7G3000000G0000PAXXX
35 kW	800	2000	1165	42 U	740	Knürr DCD H2000 W800 D1000 Water connection bottom, hinge left	DCD35A8E3000000G0000PAXXX
		2000	1365	42 U	840	Knürr DCD H2000 W800 D1200 Water connection bottom, hinge left	DCD35A8G3000000G0000PAXXX
		2200	1165	42 U	740	Knürr DCD H2200 W800 D1000 Water connection bottom, hinge left	DCD35C8E3000000G0000PAXXX
		2200	1365	47 U	840	Knürr DCD H2200 W800 D1200 Water connection bottom, hinge left	DCD35C8G3000000G0000PAXXX

Knürr® DCD order table with adapter frame for easy fitting on any racks

Cooling power	Width (mm)	Height (mm)	Depth (mm)	Water connection	Hinge	Product no.
35 kW	600	2000	180	top	left	DCD35A631000000G0000PA001
					right	DCD35A632000000G0000PA001
		2000	180	bottom	left	DCD35A633000000G0000PA001
					right	DCD35A634000000G0000PA001
		2200	180	top	left	DCD35A631000000G0000PA001
					right	DCD35A632000000G0000PA001
		2200	180	bottom	left	DCD35A633000000G0000PA001
					right	DCD35A634000000G0000PA001
35 kW	700	2000	180	top	left	DCD35A731000000G0000PA001
					right	DCD35A732000000G0000PA001
		2000	180	bottom	left	DCD35A733000000G0000PA001
					right	DCD35A734000000G0000PA001
		2200	180	top	left	DCD35A731000000G0000PA001
					right	DCD35A732000000G0000PA001
		2200	180	bottom	left	DCD35A733000000G0000PA001
					right	DCD35A734000000G0000PA001
35 kW	800	2000	180	top	left	DCD35A831000000G0000PA001
					right	DCD35A832000000G0000PA001
		2000	180	bottom	left	DCD35A833000000G0000PA001
					right	DCD35A834000000G0000PA001
		2200	180	top	left	DCD35A831000000G0000PA001
					right	DCD35A832000000G0000PA001
		2200	180	bottom	left	DCD35A833000000G0000PA001
					right	DCD35A834000000G0000PA001

Knürr® DCD – Project example

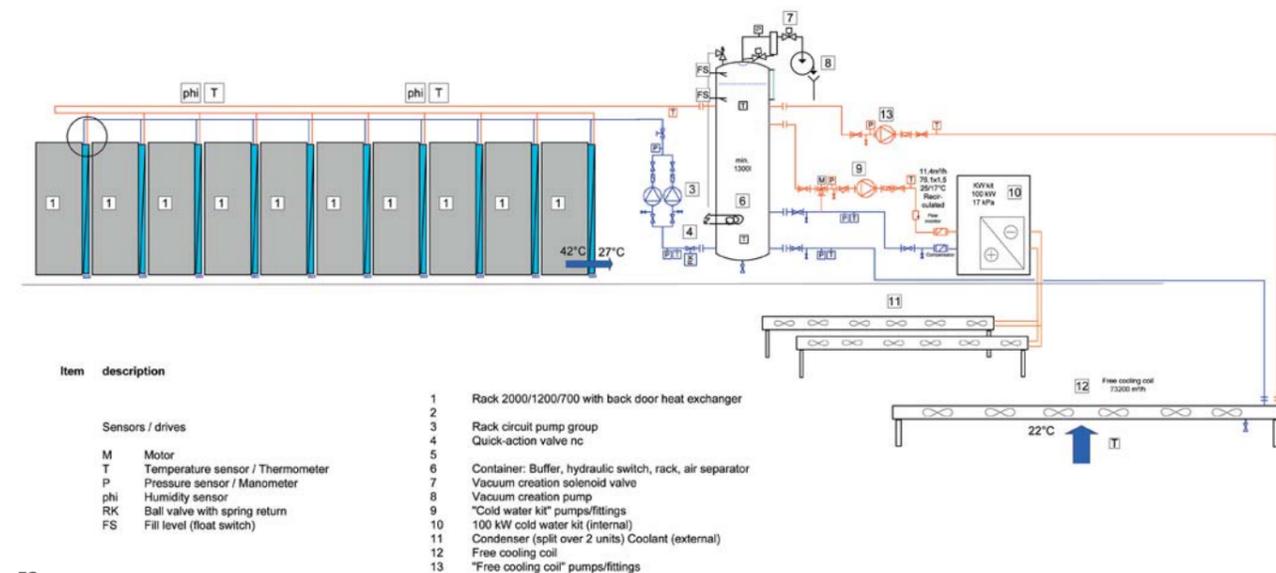
Industry/customer:
GSI Darmstadt

Requirement:

- █ Leak-free cold water supply.
- █ Fast implementation without having to build new rooms.
- █ Not possible to use existing rooms.
- █ Minimum space requirement as to be housed in an existing container.

Solution:

- █ Test container for mainframe.
- █ Max 100 kW effective cooling.
- █ Achieved the required cooling using 10 x Knürr® DCD.
- █ Knürr CoolVac®: cold water supply below atmospheric pressure
- █ High proportion of free cooling.



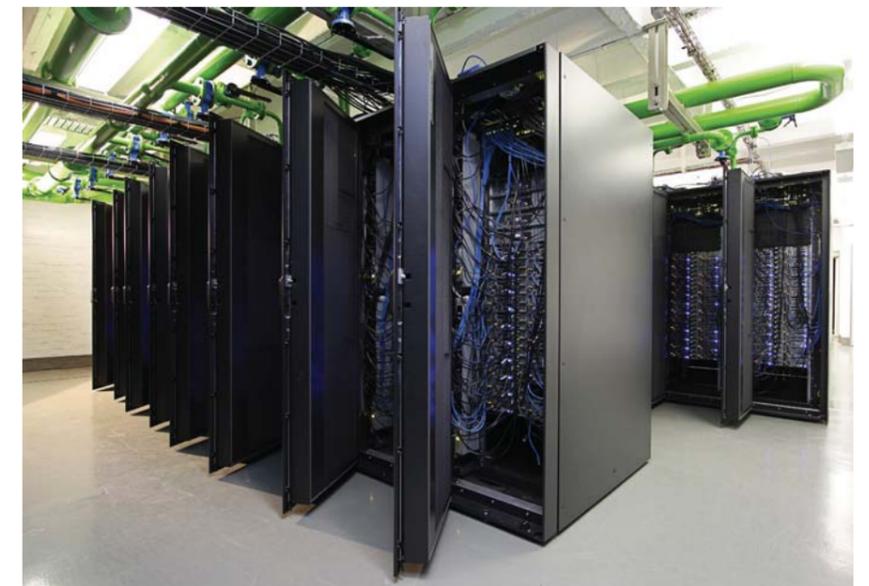
Industry/customer:
Goethe University, Frankfurt

Requirement:

- █ To achieve a good ranking in the Green Top 500 list.
- █ High room temperatures and high power densities.
- █ Largely free cooling.
- █ High cold water supply temperatures through refrigeration using adiabatic cooling (hybrid cooling tower).

Solution:

- █ 8th place in the Green Top 500 list was achieved by using 34 Knürr® DCDs combined with the overall concept.
- █ Measured PUE 1.06.
- █ Facilitates 20 kW power dissipation per server rack.
- █ Fastest GPU-based computer.
- █ 23rd place in Top 500 list www.top500.org.
- █ 660 kW effective cooling.
- █ 33 kW max. electrical power consumption for total cooling (adiabatic cooling with minimum cooling tower).



Knürr DCM® – The server rack solution with optimized cooling – Keystone of your IT solutions



The right cabinet size for every application, the right design for your cooling needs, around the world.

■ **Knürr Data Center Module**

The Knürr DCM® is the globally available cabinet system from Emerson Network Power for standardized data center planning. Cooling racks, power racks and server racks based on the Knürr DCM® platform guarantee easy integration into the cabinet aisle.

■ **Adaptable air ducting**

Air separation for all rack cooling solutions offered by Emerson Network Power.

■ **Metric dimensions**

For global use

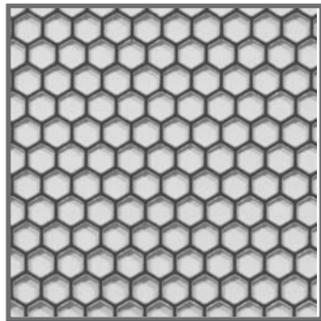
■ **Stable and safe**

An earthquake-tested version of the Knürr DCM® is available on request. Static load up to 1500 kg. Flexible use as a server or active network cabinet.



Knürr DCM® –
with integral power distribution

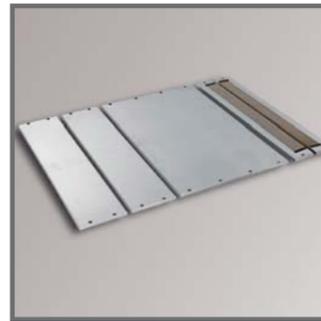
Knürr DCM® – The Knürr DCM® with optimized cooling gives you everything you need for security, cable management and easy assembly.



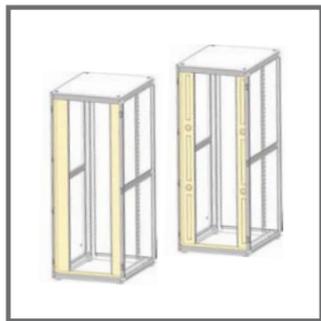
Better air passage
The doors can be assembled without tools and allow air to pass with minimum pressure drop through 83% perforation in the flow cross-section.



Modular floor panels
Modular floor panels close the rack ventilation and allow ventilation openings to the suspended floor to be positioned as required.



Universal cable inlet
Offers sufficient air separation for even the most varied cable harnesses.



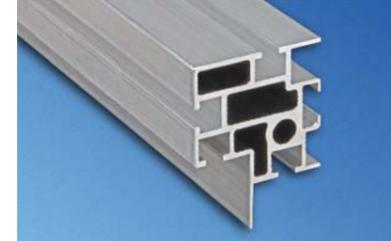
Depth-adjustable air separation
Hot-cold separation sealed to the side walls for easy depth adjustment. The standard air separation accessory (1U slot) can be used to expand the space utilization of your server rack up to 6 U.



42+6 effective U in 2000 mm / W 800 mm
More installation space with 6 U additional vertical space (48 U effective in the cabinet, width 800 / height 2000 mm)



Easy-fit PDU bracket
Vertical cable routing or PDU upgrade prepared



1 DCM20059



3 DCM20030

1 High-load cabinet

Static load of 1500 kg. Use of new-design, more stable profiles and new, high-load corners.

2 Screw design

The cabinet is easy to dismantle which guarantees ease of access to even the smallest spaces.

3 Lightweight aluminum frame

Lightweight for simpler and easier transport.

4 Convenient

Tool-free door assembly.

5 Low, heavy-duty casters

The cabinet is easy to move even when fully equipped.

6 Integral tip protection

Quick and easy to install and remove.

7 Easy-fit PDU bracket

ready for vertical cable routing option or PDU retrofitting.

8 Cable management

Guaranteed orderly and space-saving cable management.
Can be customized to the installation site, wide range of accessories for choice of cable routing.

For further details of this product, please request the separate DCM brochure.



2 DCM20008



4 DCM20006



5 DCM20028



6 DCM20026

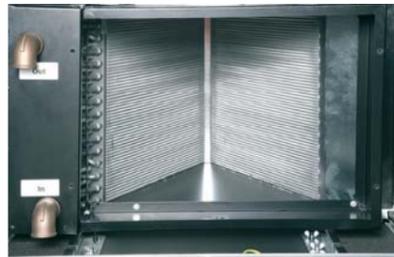


7 DCM20009



8 DCM20027

Knürr CoolTherm® – Water-cooled server rack



V-shaped heat exchanger, 35 kW

With this solution launched in 2002, Knürr was the first market player to facilitate efficient cooling of server racks, freeing customers from the nightmare of servers overheating. This is achieved by the arrangement of the water-bearing modules in the floor area of the rack, proving that chilled water in the data center does not pose an unpredictable risk. For over 10 years now, hundreds of Knürr CoolTherm® units have been providing reliable server cooling in the data centers of well known customers by means of:

- Compact solution for newbuild in the smallest space up to 35 kW.

- Energy-efficient EC radial fans, which deliver the chilled air required for a wide variety of server types.
- Ideal arrangement for pizza server slots.
- Developed V-shaped air/water heat exchanger.
- Also available as a redundant version.

The illustration of the flow profile shown below shows a view of the side with the side panel detached; horizontal section of the server plane.



Knürr CoolTherm® 35 kW

Knürr CoolTherm® air flow



Knürr CoolTherm® –
First water-cooled rack, frees customers from the
nightmare of server overheating

Knürr CoolTherm® – Water-cooled server rack

1. Availability



Alarm



Simple fan swap with the door closed



Knürr CoolTherm® emergency door opening



Optional 3-way valve

- Autonomous server cabinet, independent of ambient conditions.
- Safe and reliable cooling up to 35 kW per Knürr CoolTherm® (Blade Server).
- Broad scalability for best planning reliability.
- Strict separation of heat exchanger and server installations for maximum leak-proofing.
- Ducted air supply throughout the cabinet ensures autonomy from the environment and keeps pressure drops low.
- EC fans with temperature-dependent speed control and alarm.
- n+1 fan redundancy.
- Front and back door open automatically in the event of overheating in the cabinet and in the event of fire extinguishers being triggered at room level.
- Effective interventions possible in emergencies.
- Three-way valve to regulate the chilled water flow (optional).
- **Alarm management and Remote Monitoring System (RMS) for:**
 - Temperature trend / control
 - Fire detection
 - Air humidity detection
 - Leak detection
 - Fan operation
 - Door status
 - Vibration monitoring
- Redundant high-performance power distribution for the server power supply (optional).
- **Cold water supply**
Bypass control to influence the cold water flow for energy savings prevents excessively low temperatures under partial load, designed as a 3-way valve, optionally also with a 2-way function.
- Redundant A/B cold water supply for connection to two independent cold water supplies (optional).
- Easy to use and service.
- **Fire detection and extinguishing**
Independent and highly effective extinguishing systems at cabinet and aisle level available as an option.

2. Efficiency

- Maximum packing density for high-performance servers, saving up to 80% space in the data center.
- Reduced room and building requirements (climate control, suspended floor, room height).
- Up to 30% improvement in energy efficiency of the cooling system by adapting the speed to the current cooling requirement.
- Control valve allows pump output to be adjusted to the current cold water requirement.
- High-performance heat exchanger with low pressure drop!



V-shaped high-performance heat exchanger

3. Future-proofing / adaptability



High-performance power supply



- 3 sizes ranging from 1800 to 2400 mm for optimum customization to specified room heights.
- Depths of 1200 and 1300 mm guarantee optimum use of space for a wide variety of server types.
- Width of 800 mm ensures sufficient space for power distribution and cable routing without blocking the air passages.
- Plinth for IT rooms without a suspended floor.
- Racks can be fitted with a plinth to facilitate power and water supply from underneath if there is no suspended floor.
- Intelligent power distribution systems, unique cable management.
- uninterruptible power supplies from the Emerson product range.

Knürr CoolTherm® order table

Cooling (kW)	Width (mm)	Height (mm)	Depth (mm)	Useful height (U)	Useful depth (mm)	Product name (W)	Order no.
12 kW	700	1800	1200	29	740	CoolTherm 12 kW	08.006.001.x
				33		08.006.002.x	
				38		08.006.003.x	
	1800	1300	29	840	CoolTherm 12 kW	08.006.006.x	
			33		08.006.007.x		
			38		08.006.008.x		
17 kW	800	2000	1200	35	740	CoolTherm 17 kW	08.006.012.x
				40		08.006.013.x	
				44		08.006.014.x	
	2000	1300	35	840	CoolTherm 17 kW	08.006.022.x	
			40		08.006.023.x		
			45		08.006.024.x		
25 kW	800	2200	1200	37	740	CoolTherm 25 kW	08.006.033.x
				42		08.006.034.x	
	2200	1300	37	840	CoolTherm 25 kW	08.006.043.x	
			42		08.006.044.x		

Industry/customer:
Elite university TU Dresden

Requirement:

- High power density in minimum space.
- High cold water supply temperatures through refrigeration using an absorption refrigeration machine powered by district heating systems and an adiabatic cooling tower.

Solution:

- Use of 26 Knürr CoolTherm® server racks in the PC farm.
- Super Computer component at TU Dresden achieved 79th position in the Green Top 500 list
- Fifth fastest computer in Germany on commissioning.



Knürr CoolTherm® – Project example



Industry/customer:

Karlsruhe Institute of Technology scientific computer

Requirement:

- To use rack cooling with high power density to avoid building a new data center.
- Even distribution of air supply temperatures.
- High availability.

Solution:

- 2002 world's first data center with Knürr Cool-Therm water-cooled server racks.
- Continuous operation with this cooling technology since then incl. rack monitoring.
- Over 1 MW cooling at this site now installed with this technology.
- Cooling of 10 to 25 kW per rack.



SmartAisle™ – Customer-focused solutions for real customer benefits

Emerson Network Power system technology with solutions to meet the demands of IT operation.

SmartAisle™ ensures...

Availability

- Consistent temperature level for all IT components, no "hot spots", no temperature-related performance drop, no temperature-related failures.
- Resilient against the distribution of IT components, the cold air supply is guaranteed in any position in the cabinet aisle.
- Reliable detection of the power limit, fan speed of the cooling units is a direct measure of capacity utilization.
- Non-critical behavior in the event of failures in individual cooling units since sufficient and even cold air is maintained in any situation.
- Substantially longer bridging time in the event of failures in the cooling system compared with solutions without an enclosure.
- Redundancy gain when enclosures are retrofitted, the performance of the individual cooling units increases as a result of the high temperature of the recirculated air, fewer cooling units are needed to achieve the overall cooling required.

Efficiency

Operation

- Huge savings in power costs
 - as a result of dynamic fan speed control.
 - higher temperature of both cold air and cold water (free cooling).
- Savings on "penalty taxes" for CO₂ (e.g. UK Carbon Tax).
- Lower staff costs, the system behaves non-critically, predictably, simple monitoring.

Usage of buildings and components

- Higher power density for better use of space.
- Higher recirculated air temperature for better cooling per cooling unit.
- No over-capacity needed for a "safety reserve".
- Little data – hence few sensors – required to monitor operation and performance limits.

Planning and construction, upgrade capability

- Entirely predictable system behavior / performance parameters for simple and reliable planning.
- System design requires little work, no expensive simulations required.

- No laborious fine-tuning required during construction and commissioning.
- Quick and easy to upgrade existing data centers.

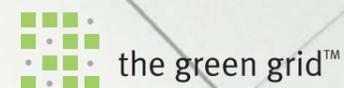
"Pay as you go"

- Since the system does not require any over-capacity of note and the distance from the performance limits is known, modular expansion is possible as cooling demands increase.

Future-proofing / adaptability

- Dynamic system control for constant adaptation to current cooling demands.
- Reliable, early detection of performance limits.
- Modular expansion concept, gradual equipping of racks/aisles with IT equipment, rooms with additional rack aisles and cooling units – with optimum efficiency at all times.
- Zone-by-zone data center expansion.
- Additional cooling with aisle coolers.
- Can be combined with rack cooling for maximum power densities.

Achieved through patented cold aisle enclosure in many projects (banks, insurance companies, industry etc.)

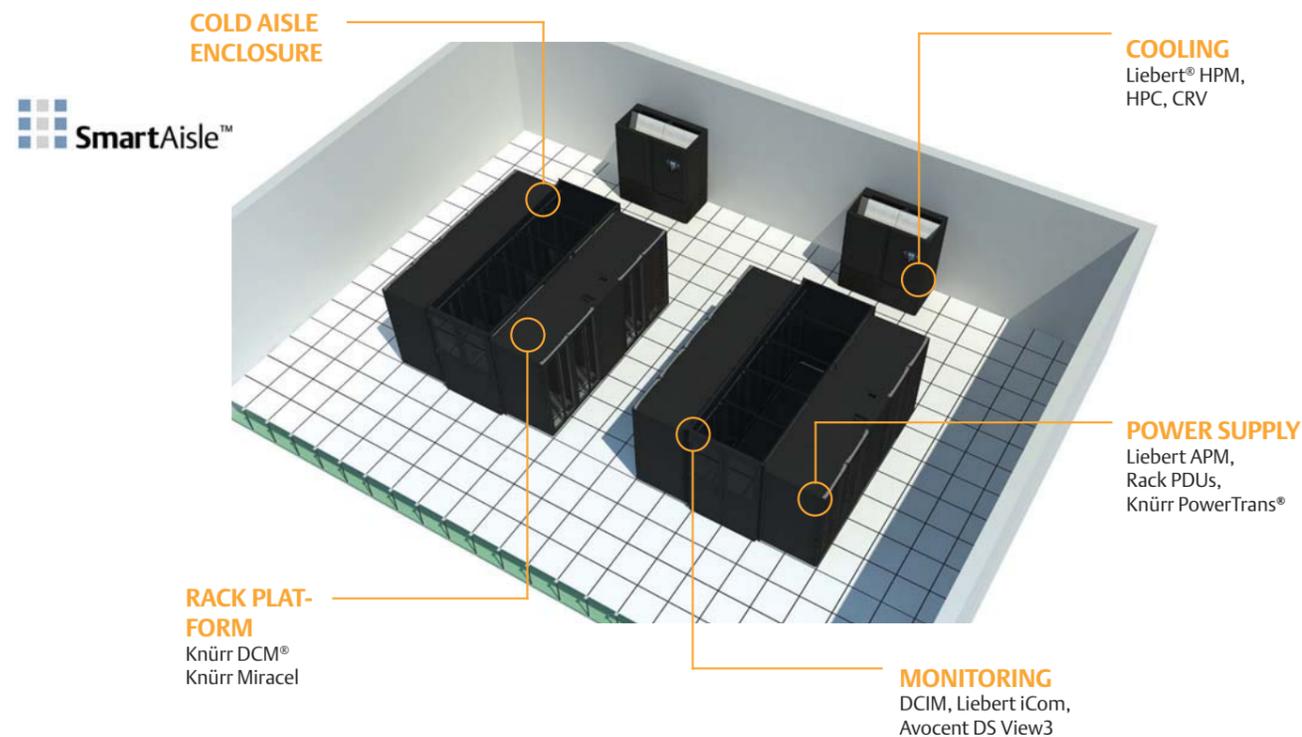


Green IT

- Reduction in CO₂ emissions through optimum energy efficiency.
- Very good PUE values are achieved, often better than 1.35.
- Compliance with the EU Code of Conduct.

SmartAisle™ – An enclosure proven to lead to substantial savings in energy costs

SmartAisle™ – the comprehensive data center solution



IT's most important response is the increasing independence of applications from the IT infrastructure. Virtualization and cloud computing are the current buzzwords. Energy-efficient IT components and their dynamic control according to the applications' current needs form the hardware basis for this.

The answer for the physical infrastructure is the SmartAisle™ from Emerson Network Power. In the data center, the SmartAisle™ forms the room, the power

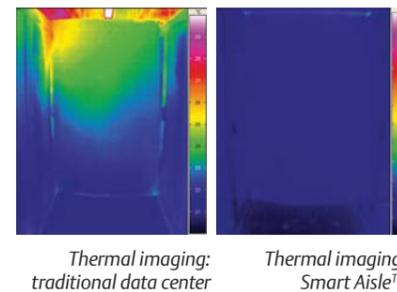
supply and the cooling for servers, storage and the network. Choosing a comprehensive range of components that are tailored to one another in every respect enables the physical infrastructure to be adapted to any conceivable need, since no data center is like any other and no data center remains unchanged for long. The main components are:

Complete solution

- Racks
- Rack PDUs
- Power distribution
- UPS
- Cooling with iCOM control

- Enclosure
- Cable management
- Monitoring Cabinet and aisle
- DataCenter Infrastructure Management (DCIM)
- Commissioning and maintenance
- Other services

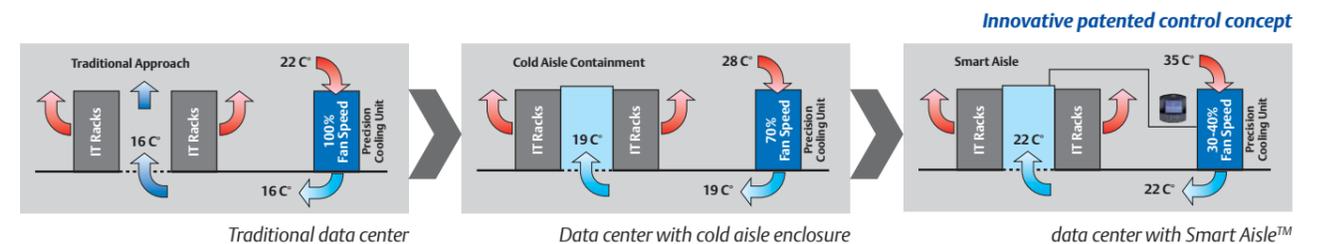
All have interfaces to a top-level infrastructure management system (trellis) which facilitates holistic monitoring, management and automation of the physical infrastructure



The example of cooling clearly shows how SmartAisle™ helps meet the high-level requirements for an energy-efficient data center infrastructure.

Best Practice

In a modern data center, the racks should be erected in accordance with the principle of cold aisle-hot aisle. Perforated suspended floor panels should only be placed where the cold air is needed i.e. in the cold aisle. The suspended floor should also be separated to be as airtight as possible (e.g. cable lead-through) so that no cold air is lost. All open areas must be closed off with 19" dummy panels to prevent recirculation in the rack.



Problems in conventional data centers

There is often no strict separation between cold and hot air in data centers, which means that the hot and cold air mix. This is partly because the hot air recirculates over the rack or over the ends of the aisles and partly because aisles are oversupplied with cold air. In order to ensure that all the racks and aisles are supplied with cold air up to the maximum height (U), recirculating coolers need to provide a very great deal of cold air under high pressure and at high speed. The fans in recirculating coolers run at full load (100%).

Features:

- Little failsafe capacity
- High power consumption
- Inevitable hot spots

Data center with cold aisle enclosure

With a cold aisle enclosure, "hot spots" (recirculation) are avoided. The cold air can no longer mix with the warm air. This reduces the cold air requirement i.e. the power required to cool the IT components. The recirculating coolers work more efficiently, as the difference between the feed air temperature and the return air temperature increases. The fans in recirculating coolers run at approximately 70%. The overall temperature level of the air and the water increases, which is why the chillers can work for longer per year with free cooling.

Features:

- Improved failsafe capacity
- Lower power consumption
- No hot spots

Data center with SmartAisle™

Until now, the speed of the fans in the room air conditioning units has been controlled by the temperature of the recirculated air i.e. the temperature in the hot zone. The feed air temperature that the servers reached was, however, extremely important. This control principle makes the data center energy-efficient. The recirculating coolers work at a low speed of approx. 30-40% and deliver the necessary volume of cold air. **The SmartAisle™ data center offers the best redundancy and failsafe reliability.**

Features:

- Best failsafe capacity
- Minimum power consumption
- No hot spots
- Easy to plan and run

SmartAisle™ – Solutions from Emerson Network Power

SmartAisle™ – Standard



STANDARD

Standard product range:

- Aisle width 1200 / 1500 and 1800 mm.
- Rack height 2000 / 1500 and 2200 mm.

Features:

- Ideal for new data centers and for retrofitting homogeneous cabinet aisles.
- Industrial prefabrication makes for a highly economic solution.
- Quick and easy to assemble on site.



CUSTOMIZED

Features:

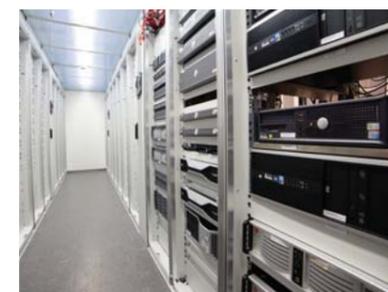
- Precisely fitted to cabinets and cabinet positions.
- Suitable for retrofitting heterogeneous data centers.
- Combination with SmartAisle™ standard.



FREE-STANDING

Features:

- Flexible fitting to cabinets with non-standard dimensions.
- For cabinets and applications that are swapped out on rotation.
- Combination with SmartAisle™ standard.



The SmartAisle™ standard product range consists of flexible, adaptable and user-friendly components.

The individual components equalize the tolerances of the racks, which are not usually installed with millimeter precision. The system fits not only onto Knürr racks but also onto most commercially available racks.

The racks do not need to be installed in pairs. The top panels are transparent so that the available room lighting can be used. The top panels are raised by 150 mm over the racks. This not only improves the regulation of the recirculating coolers but this area also enables sensors etc. to be installed and provides easier access for tall people.

The standard top elements are ready for the patented SmartAisle™ controller. The SensorBOXes can be fitted to the integrated air regulation openings.

The SmartAisle™ controller is much more efficient and safer than conventional pressure controllers. Different door systems are available – hinged doors and sliding doors. Hinged or swing doors are better in terms of safety and emergency exits. On the other hand sliding doors take up less space. Automatic mechanical closers are available for both door systems so that

the data center is always operated in an energy-efficient way.

If the doors always close automatically, almost no cold air is wasted and recirculation of hot air into the cold zone is prevented. An electric closer is also available for the sliding doors. This can be connected to the fire alarm so that the doors are opened for escape or for fire extinguishing in the event of an emergency. The automatic closers on the door systems have been chosen and adjusted to guarantee personal protection.

If there is an alarm, all the door systems can be easily opened with little strength in the event of panic. In the electric model, the sliding doors are also available with access control. This door has safety components fitted as standard such as emergency switches inside (for emergency exit) and outside (for recovery).

Features

- Ideal for new data centers and for retrofitting homogeneous cabinet aisles.
- Industrial prefabrication makes for a highly economic solution.
- Quick and easy to assemble on site.

SmartAisle™ – Project example



Industry/customer:

Public sector IT service provider

Requirement:

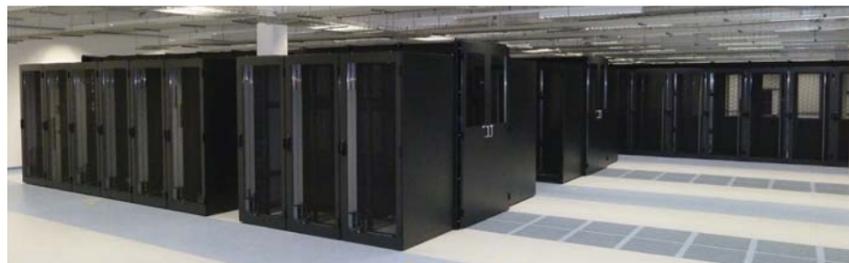
- Overarching project management and logistics concept for multiple affiliated companies.
- Data center operation with no staff on site; control of all IT processes from a different site.
- Individual monitoring and access control in the data center from the building entrance to the server cabinet.
- Monitoring of the IT equipment.
- Power concept customized to requirements.
- Technical support from Knürr during the concept and development phase (e.g. installation of cabinets in the customer's own test laboratory).
- Knürr acting as general contractor; everything from a single source for the

customer (cabinet – climate control – power – monitoring).

- Development and implementation of specific technical requirements.
- Energy-efficient data center through intelligent, speed-controlled cold aisle enclosure.
- Use of standard products and components that will still be available in the future.

Solution:

- Knürr Miracel® server cabinets and network cabinets with access control and alarm management.
- SmartAisle™ cold aisle enclosures with hinged doors.
- MPX Adaptive PDUs.
- Power management.
- HPM recirculating coolers with energy-efficient SmartAisle™ controller.



Industry/customer:

Puma AG – manufacturer of sports equipment

Requirement:

- Cold aisle enclosure with energy-efficient control.
- Integration of a gas extinguisher into the cold aisle enclosure.
- Modular and flexible power distribution in the cabinet for high performance, high cross-section of the neutral wire.

Solution:

- Cold aisle enclosure with 22 Miracel cabinets
- Gas extinguisher sensors and nozzles integrated into the cold aisle enclosure.
- Cold aisle doors with Puma logo.
- 24 MPX power rails



SmartAisle™ – Customized

SmartAisle™ – Project example



Customized solution

Customized – retrofitting solution from Emerson Net- work Power

Data centers are often the result of a structure that has grown up over the course of many years.

The cabinets have different dimensions and they are not always positioned in a line. Knürr offers this solution based on a profile construction that can be made on site to fit the data center precisely.

With the customized solution, the dimensions are recorded on site and the profiles and panels for the enclosure are cut and assembled according to need. The panels are normally cut outside the data center in a designated area.

If possible, the customized elements are combined with standard components. The standard sliding or hinged doors are generally used. The standard top element is also sometimes used since the customized elements are only used for the gaps between the cabinets.

Features

- Precisely fitted to cabinets and cabinet positions.
- Suitable for retrofitting heterogeneous data centers.
- combined with SmartAisle™ standard.

Industry/customer:

arvato Systems, systems integrator

Requirement:

- Energy saving
- Enclosure for a largely heterogeneous structure.
- Conversion during ongoing operation.

Solution:

- SmartAisle customized cold aisle enclosure for over 700 cabinets.
- Installation of energy-efficient EC fans in existing recirculating coolers.
- Power consumption in the data center was reduced by around 80%.



SmartAisle™ – Free-Standing



Free-standing solution

Free-Standing

In many data centers, what are known as "free-standing systems" are installed in addition to the server cabinets. These cabinets are often of non-standard dimensions and are regularly swapped out in a defined rotation (usually one to three years).

Free-standing systems may include storage cabinets, cluster applications (e.g. IBM, SUN) or server cabinets (e.g. IBM, HP, SUN etc.). The reasons for delivering these as a complete package including the cabinets vary. For storage applications, one of the main reasons is product liability, cluster applications are usually leased and for server applications the reasons are often related to marketing.

The challenge with "SmartAisle™ for

Free-Standing" is to construct a flexible cold aisle enclosure that allows fast and modular exchange of the free-standing systems.

The free-standing cold aisle enclosure solution is based on SmartAisle™ standard products and is used in combination with these. The panels for the free-standing solution can be customized in both dimensions (height and width) according to the cabinet dimensions.

Features

- Flexible fitting to cabinets with non-standard dimensions.
- For racks and applications that are swapped out on rotation.
- Combination with SmartAisle™ standard.

SmartAisle™ – Project example

Industry/customer:
Swiss bank

Requirement:

- Annual change of storage cabinets with different dimensions.
- Change should be simple and possible without external assistance.
- Design like standard enclosure.
- Combination with standard enclosure in the same cold aisle.

Solution:

- Use of SmartAisle™ Free-Standing.
- Integration of the free-standing elements into a standard cold aisle.
- Panels that can be customized vertically and horizontally.



SmartAisle™ – Dynamic Intelligent Control

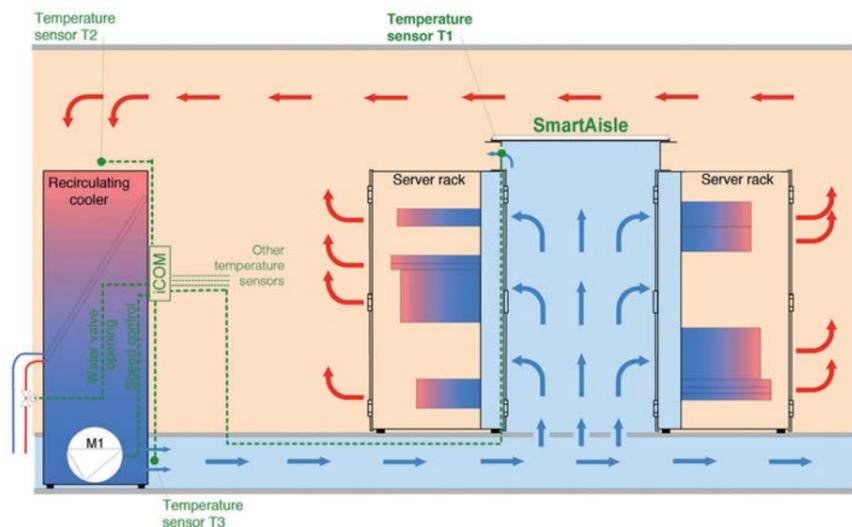
Control from Emerson Network Power

Due to rising power costs and increased environmental awareness, almost every operator's current objective is to operate their data center as energy efficiently as possible.

Many have already implemented the basic separation of cold air from warm air with dummy (blanking) panels, bushings for cable entry, cold aisle containment, etc. The data center can be further optimized by adjusting the fan

speed of the recirculated air devices. This is an essential and important factor for an energy-efficient data center. The operator can save enormous power costs by choosing the right type of control.

The right choice can also increase availability. The failure of a recirculated air device is compensated by increasing the speed of the other recirculated air devices. The are two main control principles in use – pressure control and control via the cold aisle temperature.



PATENTED

SmartAisle™ control using temperature

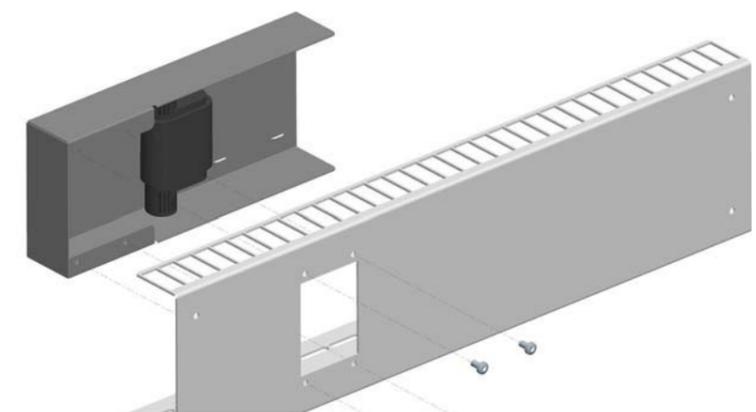
With the SmartAisle™ control principle, the cold aisle temperature, i.e. the temperature of the air supply to the servers, is used to control the fans in the room climate control equipment (see Figure 2). This control principle is patented.

The raised floor and cold aisles area is filled almost pressure-less with cold air. The servers suck in exactly the amount of air required for the cooling. A small amount of the cold air flows controlled through the air control opening of the angular extrusion of the cold aisle containment in which the T1 temperature sensor is positioned.

This temperature sensor controls the speed of the fans in the recirculated air devices. If the servers have a higher

air volume requirement than the recirculated air devices deliver, the flow direction on the T1 temperature sensor changes. Warm air flows into the cold aisle. The T1 temperature sensor measures this, and the control unit increases the speed of the fans in the recirculated air devices. The control usually takes place via the sensor with the highest temperature.

To ensure that the cold aisle is not over-supplied, the speed of the recirculated air devices is continuously reduced slowly, until some warm air flows from the warm zone to the temperature sensor. The speed is then increased again, and the amount of air increases. This cycle is continuously repeated. The control is performed in the "Partner Mode", i.e. all recirculated air devices run at the same speed.



SensorBOX with Liebert Sensor

Knürr CoolTrans® – Heat exchanger station for cold water with integrated temperature control

1. Availability

Compact modular cold water station with integrated dew point control

- Hydraulic separation of the cold water circuit in the building from the cold water in the data center for reliability.
- Facilitates leak detection through permanent monitoring of the system pressure in the secondary circuit.
- Prevents corrosion and fouling effects through a defined water quality on the secondary side.
- General use of components with regularly tested design for the controlled liquid cooling (pumps, valves, mixer, heat exchanger, expansion tank).
- Redundant components for reliability ensuring continuous operation even during servicing.
- Compact design of all pumps, valves and actuators.
- Recording and central monitoring of operating parameters, including warnings and alarms, for reliability.
- Emergency operation control possibly with the embedded controller.
- Dew point-based cold water supply temperature influences cold water temperature in the event of a condensation risk.
- Required temperature can be set for constant cold water temperature.
- Constant cold water volume irrespective of the hydraulic conditions in the building.
- Use of tried and tested, high-quality building technology components.



CTU 50
80



CTU 200



Knürr CoolTrans® – the distributor for
cold water flows also enables the integration of
alternative cooling sources.



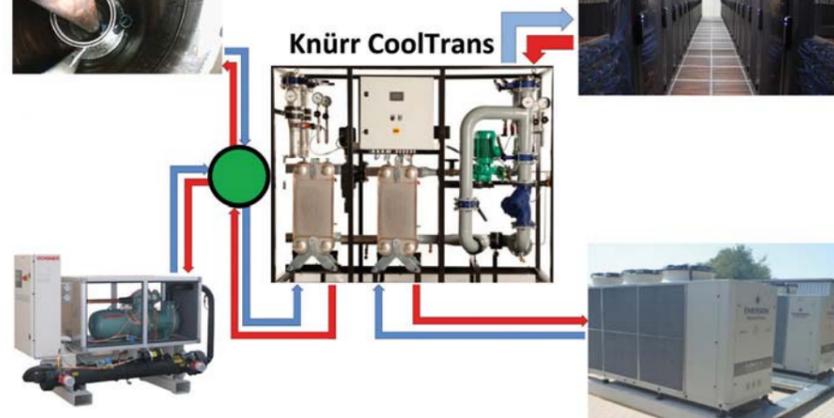
2. Efficiency

- Cost-effective as uses components that are used as standard in building technology.
- Modular design for adjusting cooling to daily needs from 100 kW.
- Modular design means the system only needs as much space as the performance required.
- Dynamic increase in cold water supply temperature facilitates a significant increase in the proportion of free cooling.
- Dew point-dependent cold water supply temperature increase reduces pipe insulation costs.
- Use of steam diffusion-proof insulation materials for insulation on the primary side saves energy.
- Intelligent control of the cold water system reduces cold water costs and energy costs for the pumps.
- Knürr CoolTrans® as a delivery station facilitates simple connection of additional energy saving sources such as use of secondary waste heat and additional cooling potential such as river or waste water.

Regenerative cooling with spring water/rain water/water reservoirs



Data centers



Heat pump for heat recovery

Primary cooling using cold water kit or existing cold water generation system

Cost savings through the option to connect alternative cooling sources or heat pumps to the Knürr CoolTrans®

3. Future-proofing / adaptability

- Knürr CoolTrans® can be integrated into the building's piping network and hence customized to the actual cooling requirement.
- Various cooling components such as Knürr® DCL, Knürr® DCD, Liebert® CRV and Knürr CoolTherm® can be connected to the Knürr CoolTrans®.
- Flexible parameters definition with the following values:
 - Temperature at the installation site: 5°C to 35°C.
 - Absolute humidity at the installation site: any
 - Primary water supply temperatures: 6°C – 12°C (others optional).
 - Primary water discharge temperatures: 12°C – 14°C (others optional).
 - Water temperature increase: 6K
 - Primary and secondary water connection possible from both sides of the unit.
 - Nominal voltage: 3 x 380 V / 16 A.
 - 50 Hz to 60 Hz.
 - Max. operating pressure: Primary 16 bar / Secondary 2.5 bar.
- Flexible and easy to connect with water connections underneath.
- Can be installed individually or with series switching and downstream Tichelmann ring.
- Easier transport and installation with the split design option.



Knürr CoolTrans® basic specification

Parameter	Detail Parameter	Unit	CT050	CT075	CT100	CT200	CT300
Cooling power		kW	50	75	100	200	300
Dimensions	Width	mm	820	1200	2500	2300	2960
	Depth	mm	450	450	800	800	810
	Height	mm	1115	1200	1840	1900	1860
Cold water flow	primary	m³/h	8.5	12.78	18.0	33.62	54.0
	secondary	m³/h	7.2	10.74	14.4	28.64	43.2
Nom. pressure	primary	bar	10.0	10.0	10.0	10.0	10.0
	secondary	bar	6.0	6.0	6.0	6.0	6.0
Internal differential pressure	primary	bar	1.0	1.0	1.0	1.1	1.5
External differential pressure	secondary	bar	1.1	1.1	1.1	1.0	1.1
Electrical connection values	Nominal voltage	V	230	400	400	400	400
	Frequency	Hz	50	50	50	50	50
	Power	kW	0.4	1.8	1.0	2.0	3.0
Housing	Available as an option		none	none	none	none	none

Knürr CoolTrans® order table

Name	Cooling (kW)	Width (mm)	Depth (mm)	Height (mm)	Electrical power input (kW)	Product no.
CTU 50	50	820	450	1115	0.4	CT050 10110100010010
CTU 75	75	1200	450	1200	1.8	CT075 00110100010010
CTU 100	100	2500	800	1840	1.0	CT100 00111301010000
CTU 200	200	2300	800	1900	2.0	CT200 00111300010000
CTU 300	300	2960	810	1860	3.0	CT300 00111300010000

Industry/customer:

Karlsruhe Institute of Technology
scientific computer

Requirement:

- Heat exchanger station for hydraulic separation of the secondary cold water circuit from the building cold water supply

Solution:

- Knürr CoolTrans® with high-performance stainless steel heat exchanger and efficient, energy-saving pumps.
- Control of the secondary cold water temperature via primary 2-way valve with emergency operation function.
- Multiple SNMP trap output possible.



Knürr CoolVac® – Leak-free cold water supply

Add-on module for maximum leak safety demands

Water in the data center

The constant increases in thermal losses mean that cold water systems are penetrating further and further into data centers. The closer the cooling comes to the heat source, the better the energy optimization and hence the more cost-effective the cooling. Recirculating coolers, aisle cooling systems and rack-based cooling solutions are everyday equipment in a data center and allow cold water pipes to get ever closer to IT equipment.

Examples:

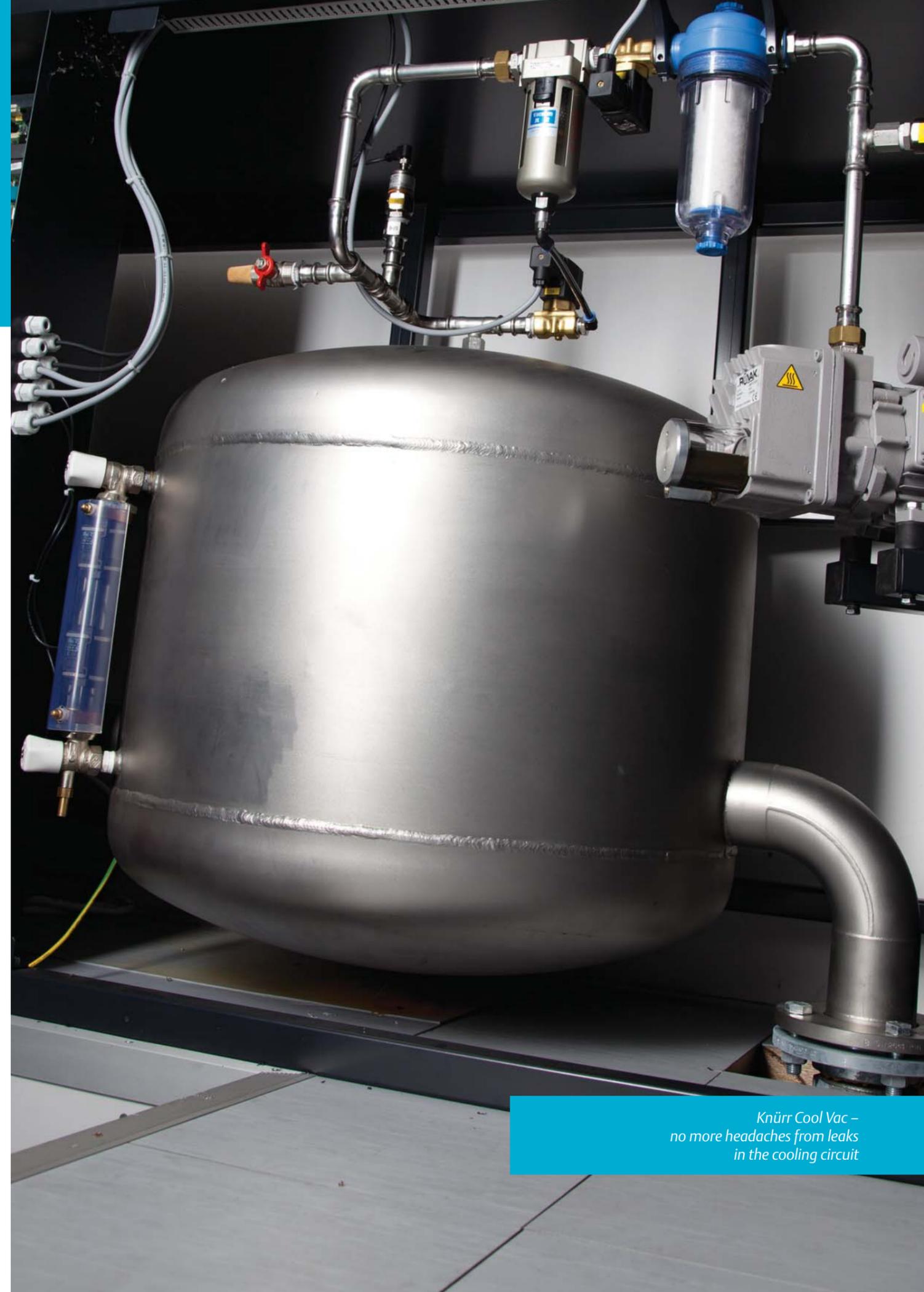
- Liebert® PCW
- Liebert® CRV
- Knürr® DCL
- Knürr CoolTherm®
- Knürr® DCD

Appropriate measures can be taken to prevent water from escaping from the pipe system because

- Escaping cold water can lead to major damage to servers, Blades and other IT components.
- Interrupted operation and data loss.
- Consequential damage due to short-circuits in the suspended floor.
- Increased fire risk.

State of the art

Until now, water damage could not be prevented if there was a leak in the server room. Only an expensive water alarm system for early detection of leaks occurring in the server room could prevent major damage in the data center.



Knürr Cool Vac –
no more headaches from leaks
in the cooling circuit

Knürr CoolVac® – Leak-free cold water supply

The Knürr solution

Operating the cold water system under system pressure that is lower than atmospheric air pressure prevents cold water escaping from the pipe system.

The system pressure is lower than the atmospheric pressure of the air meaning that any air penetrating via a leak is separated with an efficient air separator and hence removed from the system.

Alarms are emitted with even a minor leak. In the event of a broken pipe or connecting hose, the system is automatically blocked off by valves so that no damage can be caused in the suspended floor.

There is a floating contact to switch off pumps. If necessary, the system can also be run under over-pressure.



Liebert® PCW – Precision cooling for maximum energy savings



This universal new development facilitates a variety of options relating to airflow control, cooling type, installation conditions (room height, suspended floor) and communication.

Special EC radial fans achieve great energy savings through optimized electronics and minimum pressure drops, especially with suspended floor injection. When combined with recirculating cooling units in the Emerson Network Power HPC series, a very high proportion of free cooling is achieved.

- Liebert® PCW reduces the power consumption up to 70%.
- Liebert® PCW makes easier unit application, use and control thanks to its unique features (7 patents pending).
- Liebert® PCW gives 30% more cooling capacity in the same frame, thus reducing cooling space usage.
- Liebert® PCW adds to the product range new features and options:
 - Infrared humidifier, ultrasonic humidifier.
 - Fresh air economizer.
 - Energy and power meter.
 - Dual power supply options.

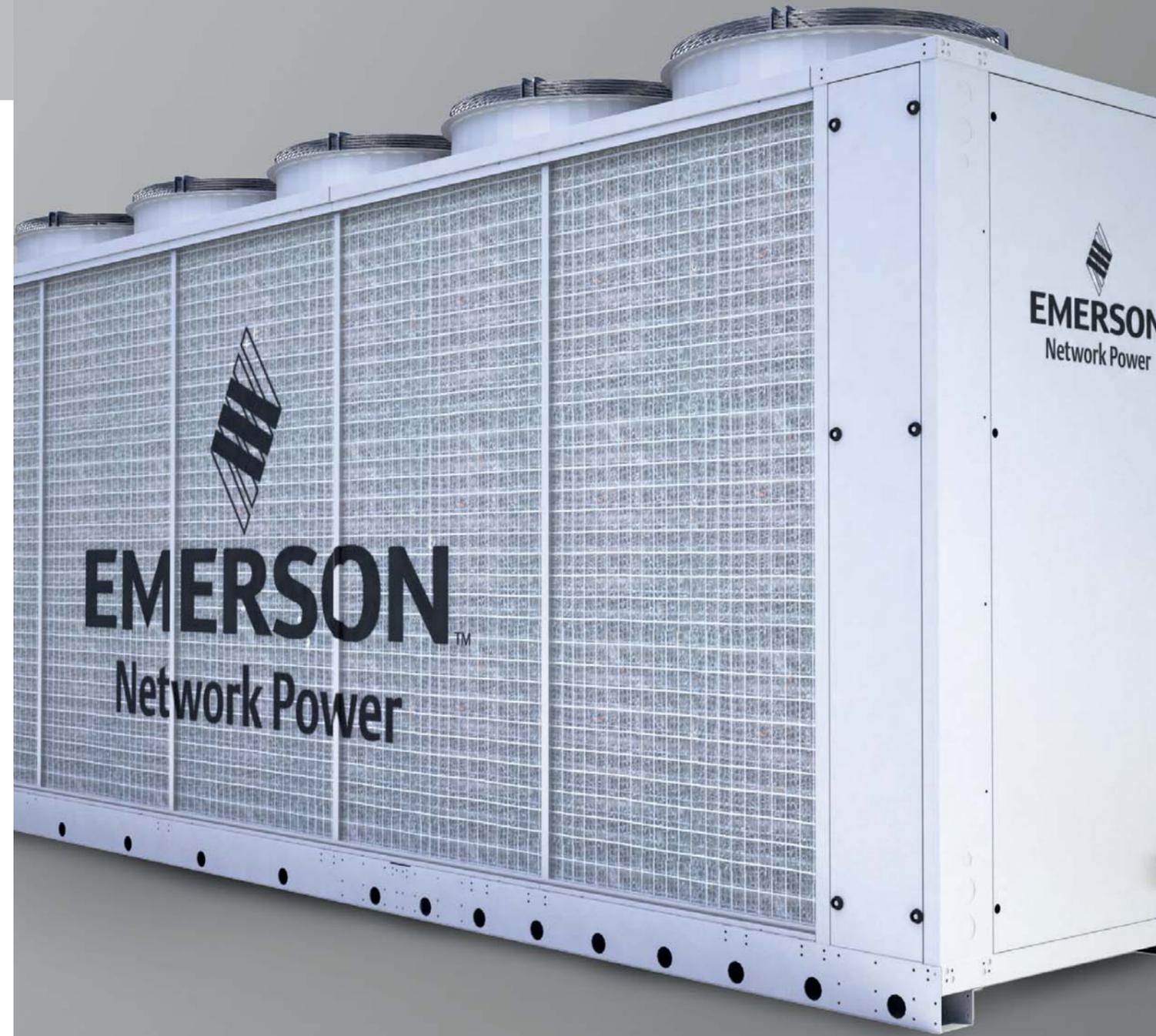
For more details of this product, please request the separate brochure!



Liebert® PCW – devised for minimum air resistance

The universal cold water delivery system

- The integrated free cooling section allows low external temperatures to be used for water cooling and hence to reduce the running time of the compressors.
- This saves energy costs, reduces wear and increases availability.
- Enables space-saving design.
- Further efficiency improvements from EC Fans and EEV.
- Greatest benefit: HPAC & industrial applications.
- Reliable operation even at very low external temperatures (e.g. -25/-30°C).
- iCOM – the universal control concept.
- Fan speed control.
- Cascading function.
- Quick-start function.
- 25 % to 100 % cooling capacity modulation.
- Insulated compressors, vibration isolators and sound absorbers for reduced noise emissions.
- Power factor correction.
- Weather-proof powder coating.



Liebert® HPC –
Recirculating cooling with extremely high
proportion of free cooling

Liebert® HPC

Liebert® HPC Product range



Liebert® HPC-S

Air-cooled 40-350 kW:

- R407C scroll compressors.
- 3 versions for noise emissions: B-L-Q.
- Chiller solo or with free cooling.



Liebert® HPC-L

Air-cooled 350-1600 kW:

- R407C-R134a screw compressors.
- 3 versions for noise emissions: A-B-L-Q.
- Chiller solo or with free cooling.



Liebert® HPC-R

Air-cooled 40-350 kW:

- R407C scroll compressors.
- Indoor use.
- Channeled radial fans.
- Chiller solo or with free cooling.



Liebert® HPC-W

Water-cooled 280-1200 kW:

- R407C-R134a screw compressors.
- 2 versions for noise emissions: Standard and Low Noise.
- Chiller partial/total heat recovery with heat pump.



Liebert® HPC-M

Air-cooled 350-700 kW:

- R407C-R134a screw compressors.
- 3 versions for noise emissions: B-L-Q.
- Chiller solo or with free cooling.



Emerson Network Power

Centers of Expertise

When you partner with **Emerson Network Power** for your *Business-Critical Continuity™* needs across your enterprise, you benefit from more than products to support and protect your technology infrastructure.

Developing such a wide range of technologies gives us in-depth industry knowledge and a “big-picture” understanding of how all systems must work together within any critical environment. We deliver this knowledge through Emerson Network Power’s Centers of Expertise, distinct areas of world-class products and services that help you determine what you need and where, depending on your application.

All so that you can keep your business moving forward for your customers.

■ AC Power

Sustaining critical operations that simply can’t go down. We deliver a full range of uninterruptible Liebert® and Chloride AC power systems plus STS devices, providing from individual products to integrated power protection solutions, that keep network closets, computer rooms and data centers up and running.

■ Infrastructure Management & Monitoring

Managing and monitoring critical environments at multiple sites around the clock. We make it easy in today’s ROI-driven business environment, with comprehensive infrastructure management and monitoring systems for both IT and facilities. Solutions and services that provide continuous oversight of data centers, computer rooms and network closets, as well as wireless, wireline and enterprise telecom applications.

■ Power Switching & Controls

Safeguarding facilities from operational disruption due to electrical power interruption. We provide ASCO® power-transfer switches, generator paralleling switchgear/power control systems, and touch screen SCADA for monitoring and control of the utility service and on-site backup power generators, helping ensure continuity of supply to essential and mission-critical communications, data-processing, life-safety, and other critical loads. Backed by the largest manufacturers, direct field based project management and service technicians in the industry.

■ Precision Cooling

Maintaining precise temperature for reliable equipment performance. We deliver “rack-to-roof” cooling, the most comprehensive range of Liebert® precision cooling solutions, which protect mission-critical applications from even the slightest increase in temperature, adopting cutting-edge technologies to achieve the highest efficiency.

■ Racks & Solutions

Optimizing technology and performance needs for indoor IT applications. We deliver standard and customized integrated cabinet solutions that meet unique and specific needs, from Knürr and Liebert® rack solutions for computer rooms of all sizes to integrated racks that include self-contained air conditioning, UPS and cable management in a sturdy, lockable cabinet.

■ Surge Protection

Defending power, voice and data moving through the network against grid irregularities and dangerous electrical disturbances. Depending on the application, we offer Liebert® and PowerSure™ AC Power Protection, Islatrol™ Active Tracking Filters and Edco™ data/signal surge protective devices, all of which provide power protection to reduce downtime, saving crucial man-hours and extending equipment life.

■ Services

Delivering assessment, testing and reliability programs backed by the largest global services organization in the industry. We encompass engineering, installation, startup services, project management, training, and total on-site operations management, preventive and predictive maintenance and energy consumption monitoring.

Service

Emerson Network Power supports Business-Critical Continuity™ with the largest global services organization in the industry and a service offering dedicated to entire critical infrastructure, delivering:

- Design, installation and startup
- Warranty service
- Preventive maintenance
- 24/7 remote monitoring
- Emergency service
- Site audits

Service contracts

Regular service of business critical infrastructure provides uptime assurance and reduces the total cost of ownership over the life of equipment. A service contract ensures that infrastructure is regularly maintained in order to avoid unexpected, costly downtime. Emerson Network Power service contracts cover all technologies and can be tailored to suit individual business needs.



LIFE™.net

Maximized system availability via real-time diagnosis and resolution of operating anomalies

- 24-hour real-time monitoring by expert engineers
- Monitoring and trending of system data
- Diagnosis through expert data analysis allowing effective proactive maintenance and prevention of future anomalies
- Alarm notification
- On-site corrective maintenance dispatching

Emerson Network Power

Data Center Infrastructure for Large Applications

Precision Cooling

- SmartAisle™**
 - Aisle containment.
 - Provides highest energy efficiency.
 - Works with any Liebert® Cooling Unit.
 - Control works with any Liebert® Coling Unit.
- Liebert® PCW/Liebert® HPM**
 - From 4 kW to 230 kW, DX-Digital Scroll-CW.
 - Premium energy efficiency.
 - Eurovent certified performance.
 - Unique control capabilities with iCOM.
- Liebert® HPC Freecooling Chiller**
 - Wide range of high-efficiency freecooling chillers from 40 kW to 1600 kW.
 - Designed specifically for data center applications and to work with SmartAisle™.
 - Premium energy efficiency version.
 - iCOM control featured.
- Liebert® CRV**
 - Row-based high efficiency precision cooling units available in DX or CW versions.
 - Decoupled control for airflow and cooling capacity.
 - Modulating cooling capacity with digital scroll.
 - iCOM control with remote rack sensors.
- Liebert® XD**
 - Refrigerant based high density cooling installed close to the server.
 - Hot spot management for up to 30 kW per rack.
 - On-demand upgrade with plug and play.
 - High efficiency and 100% sensible cooling.

AC Power

- Trinergy™**
 - Dynamic functioning modes (VFI, VI, VFD) with average working efficiency of 97.9%.
 - Three dimensions of modularity for optimum scalability (up to 9.6 MW).
 - Maximum availability as a result of internal redundancy and concurrent maintainability.
- Liebert® NXL**
 - UPS for critical high power applications.
 - Provides greater power capacity along with superior reliability.
 - Meets power requirements and energy efficiency in high availability data centers.



- Chloride CROSS**
 - Ensures redundant power for critical loads, switching between two independent power sources.
 - Solid-state transfer switch available as 2/3/4P versions with full PF range to guarantee compatibility with all load types.
 - Extremely reliable and flexible architecture.

Racks & Solutions



- Knürr CoolTherm® 4-35 KW**
 - Energy efficient server cabinet technology
 - Significant Total Cost of Ownership (TCO) reduction.
 - Autonomous server rack; independent from environmental conditions.
 - Up to 30% improved cooling system energy efficiency.



- Knürr DCD**
 - Passive chilled water heat exchanger
 - Cools up to 30 kW.
 - Neutralizes room heat.
 - Fits to Knürr and third party products.



- Knürr Miracel®/Knürr DCM®**
 - Global rack platform for data centers, networks and telecommunications
 - Lightweight aluminum frame.
 - T-slot system.
 - Simple cable management.
 - Holds up to 1,500 kg.



- Knürr DCL**
 - Up to 34kW in the row cooling unit
 - Design for rack and row cooling.
 - Fail save controller design.



- Knürr Power Distribution Rack**
 - Central connection unit for power supplies in individual server racks
 - Interface between the low voltage feed and PDU.
 - Individual plug-in units.
 - Up to 346 kVA/Rack.



- Rack PDU**
 - Rack-based power distribution units
 - Supports strip-level metering, outlet-level switching and outlet-level metering/switching for remote power management and control.
 - Horizontal and vertical models for a variety of rack configurations in branch and remote offices.

Surge Protection

- Liebert® TVSS**
 - Easily connected to UPS, to distribution panels or at the service entrance of facilities.
 - Surge Protective Devices (SPD) designed to protect sensitive equipment from damaging transient voltage surges.

Power Switching & Controls



- ASCO Series 7000 PCS**
 - Paralleling, synchronization and distribution of on-site Emergency Power
 - Integrated touch screen SCADA, redundant PLCs; control & monitor power distribution to critical loads.
 - Historical alarm recording, multi trending, Building Management System communication.

Infrastructure Management & Monitoring



- Avocent® MergePoint Unity™ Appliance**
 - Secure remote KVM over IP access to servers
 - Secure remote access to servers in data centers and branch offices.
 - Using both in-band and out-of-band tools together allows for a more flexible and complete, remote management solution.



- Avocent® Universal Management Gateway Appliance**
 - Infrastructure management appliance for IT and facilities
 - Real-time data collection and integrated monitoring for the Trellis Suite.
 - Access and control of IT equipment using KVM, serial, or embedded technology (auto-sensing ports).



- Avocent® ACS Advanced Console Server**
 - Secure remote serial over IP access to console devices
 - Remotely connect to servers, blades, routers.
 - Built in redundancy and configurable pin-outs for serial ports.



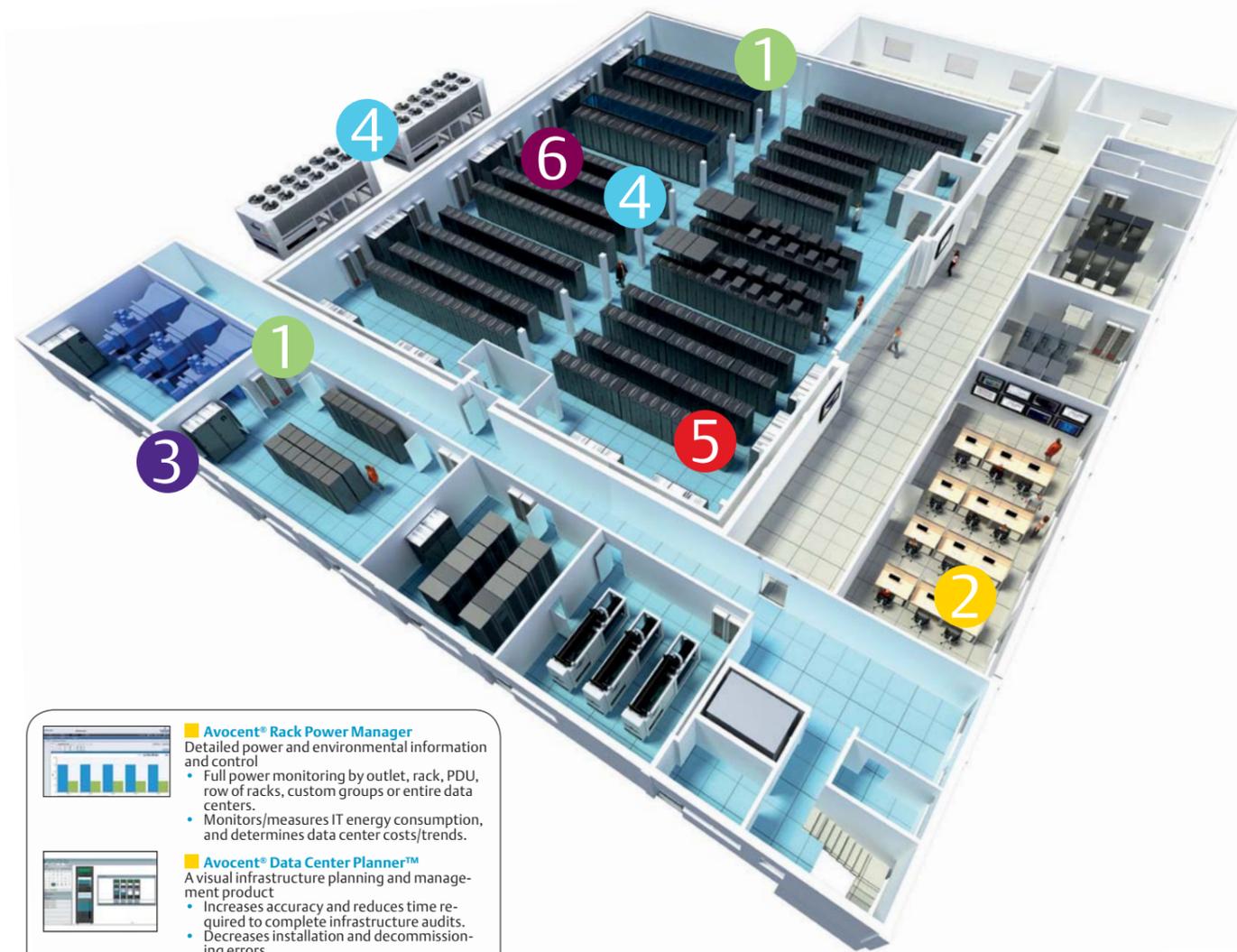
- Alber Battery Monitoring**
 - Monitors batteries and prevents premature battery failures.
 - Internal DC resistance test method to eliminate uncertainty.
 - Much like a battery ultrasound, it enables the user to assess the battery's true condition.



- Knürr Synergy®**
 - Supports monitoring in any control room with consoles, monitoring walls and mobile charts
 - Standards compliance and ergonomics.
 - Manual height selection, even in the basic version.
 - Modular construction.



- Avocent® DSView 4 Management Software**
 - Centralized data center management
 - Remote access and management of all physical and virtual data center assets.
 - Secure, out-of-band, centralized management of all connected IT and network devices in dispersed data centers.



- Avocent® Rack Power Manager**
 - Detailed power and environmental information and control
 - Full power monitoring by outlet, rack, PDU, row of racks, custom groups or entire data centers.
 - Monitors/measures IT energy consumption, and determines data center costs/trends.



- Avocent® Data Center Planner™**
 - A visual infrastructure planning and management product
 - Increases accuracy and reduces time required to complete infrastructure audits.
 - Decreases installation and decommissioning errors.
 - Reduces time to provision and install equipment.
 - Enables upfront analysis on impact of changes before committing resources.



- The Trellis™ platform**
 - The Trellis platform unifies facilities and IT infrastructure with real-time data and insights like no other solution on the market
 - Manages critical infrastructure in real-time by operating equipment at the optimal threshold and improving energy efficiency.
 - Increases operational efficiency across the business.
 - Single platform reduces administrative costs and provides faster ROI.
 - Defers/eliminates capital expenditures by operating equipment at the optimal threshold without compromising availability.

- 1 AC Power
- 2 Infrastructure Management & Monitoring
- 3 Power Switching & Controls
- 4 Precision Cooling
- 5 Racks & Solutions
- 6 Surge Protection

Emerson Network Power, a business of Emerson (NYSE:EMR), protects and optimizes critical infrastructure for data centers, communications networks, healthcare and industrial facilities.

The company provides new-to-the-world solutions, as well as established expertise and smart innovation in areas including AC and DC power and renewable energy, precision cooling systems, infrastructure management, embedded computing and power, integrated racks and enclosures, power switching and controls, and connectivity. Our solutions are supported globally by local Emerson Network Power service technicians. Learn more about Emerson Network Power products and services at

www.EmersonNetworkPower.com

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Emerson Network Power

The global leader in *Business-Critical Continuity™*.

- AC Power
- Connectivity
- DC Power
- Embedded Computing
- Embedded Power
- Infrastructure Management & Monitoring
- Outside Plant
- Power Switching & Controls
- Precision Cooling
- Racks & Solutions
- Services
- Surge Protection

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