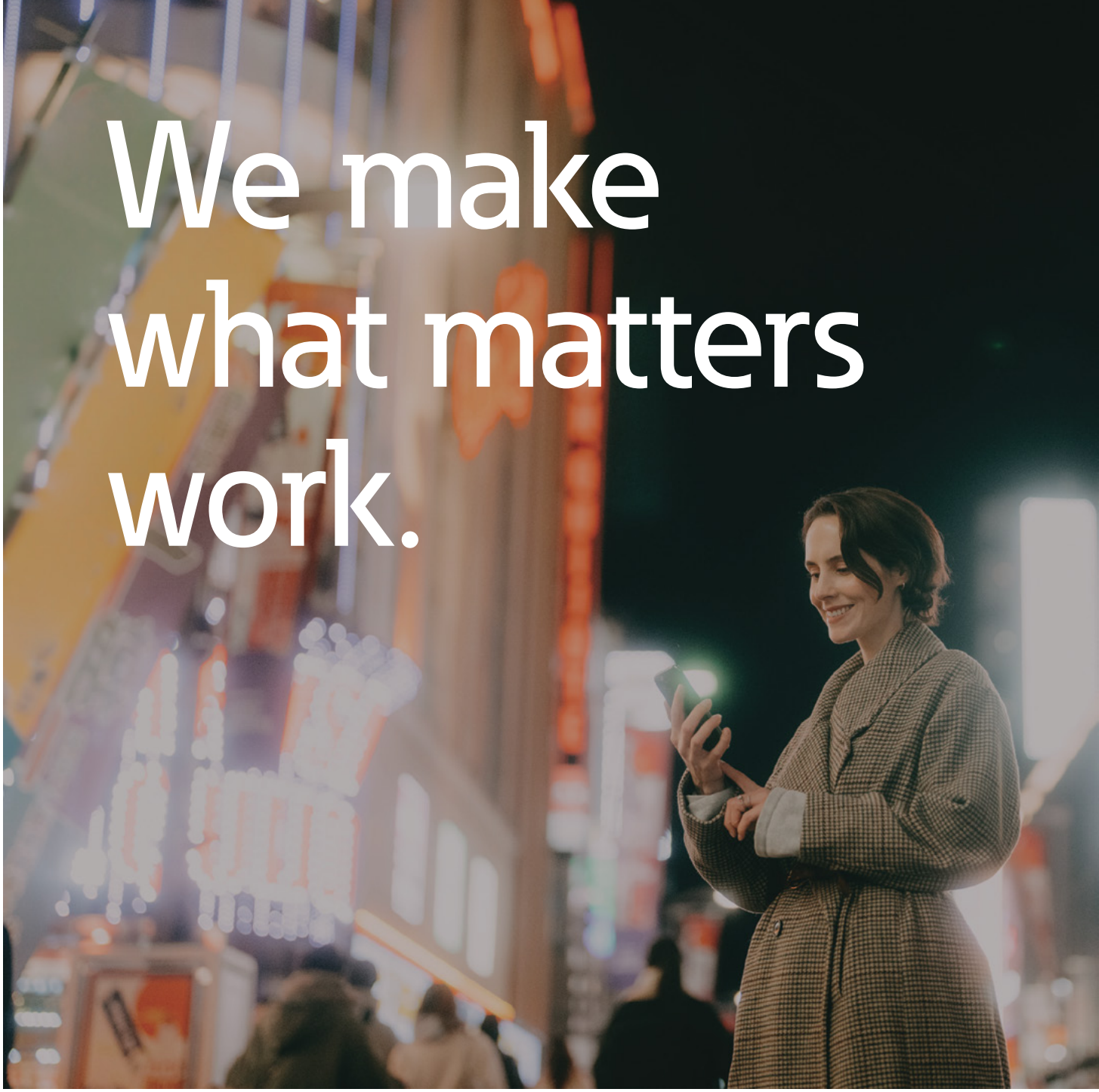


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At Eaton, we believe that power is a fundamental part of our world. That's why we're dedicated to helping our customers find sustainable solutions to manage power more efficiently, safely and reliably. To improve people's lives, the communities where we live and work, and the planet for future generations. Because this is what really matters. And we're here to make sure it works.

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Introduction

Components for cooling in data centers

As data center workloads evolve from enterprise IT to AI and HPC, cooling has become a strategic infrastructure priority. Rising rack densities, energy costs, and sustainability goals are accelerating the adoption of liquid cooling. Eaton provides the reliable electrical foundation that powers CDUs, pumps, drives, control panels, and safety systems, integrating power, protection, control, and monitoring to support uptime, efficiency, and future growth.



Why electrical infrastructure matters in cooling

Data center cooling systems increasingly rely on distributed, equipment-level thermal management rather than centralized room-level airflow. This shift places greater functional and availability requirements on the electrical infrastructure supporting cooling assets. Cooling performance and system uptime depend directly on:

- Continuous and resilient power supply to motors, compressors, fans, pumps, and drives
- Accurate control of temperature, pressure, and flow parameters
- Rapid fault detection, selective protection, and safe isolation for maintenance
- Tight integration with facility power architecture and monitoring systems

Any loss of power, control instability, or protection failure can propagate quickly and impact IT availability. As a result, the electrical system becomes a critical enabler of cooling reliability, efficiency, and maintainability. Eaton's portfolio addresses these requirements by providing:

- Robust power distribution and protection for cooling-critical loads
- Motor control and variable-speed solutions to match capacity with real-time demand
- Scalable control and automation architectures for chillers and coolant distribution equipment
- Functional safety, diagnostics, and monitoring to support safe operation and high availability

Eaton's role in cooling data centers

We provide the electrical backbone that allows cooling OEMs, system integrators, and data-center operators to design, deploy, and operate liquid-cooling infrastructures with confidence. Eaton solutions support cooling architectures ranging from traditional chilled-water plants to direct-to-chip and immersion cooling systems.
This brochure highlights how Eaton's components are applied across:

- Chillers – centralized heat rejection and cooling generation
- Coolant Distribution Units (CDUs) – controlled, localized liquid delivery to IT equipment

Together, these systems form the foundation of high-density, resilient, and future-ready data-center cooling.

Eaton enables data center cooling by delivering safe, efficient, and scalable electrical infrastructure for chillers and CDUs.

Industry collaboration

Eaton is a member of the Open Compute Project (OCP), collaborating with industry leaders to advance open, scalable and energy-efficient infrastructure for next-generation data centers.

OPEN Compute Project®

Understanding the data center cooling architecture

Modern liquid-cooled data centers rely on multiple interconnected cooling systems to transfer heat safely and efficiently from IT equipment to the external environment. Together, these systems create a layered cooling architecture that supports uptime, energy efficiency, and scalability for AI, HPC, and other high-density workloads.

Technology Cooling System (TCS)

The TCS provides cooling directly to IT equipment. Using liquid-cooling technologies such as direct-to-chip cooling and Coolant Distribution Units (CDUs), it captures heat from processors, GPUs, and other high-power components and transfers it to the facility cooling infrastructure.

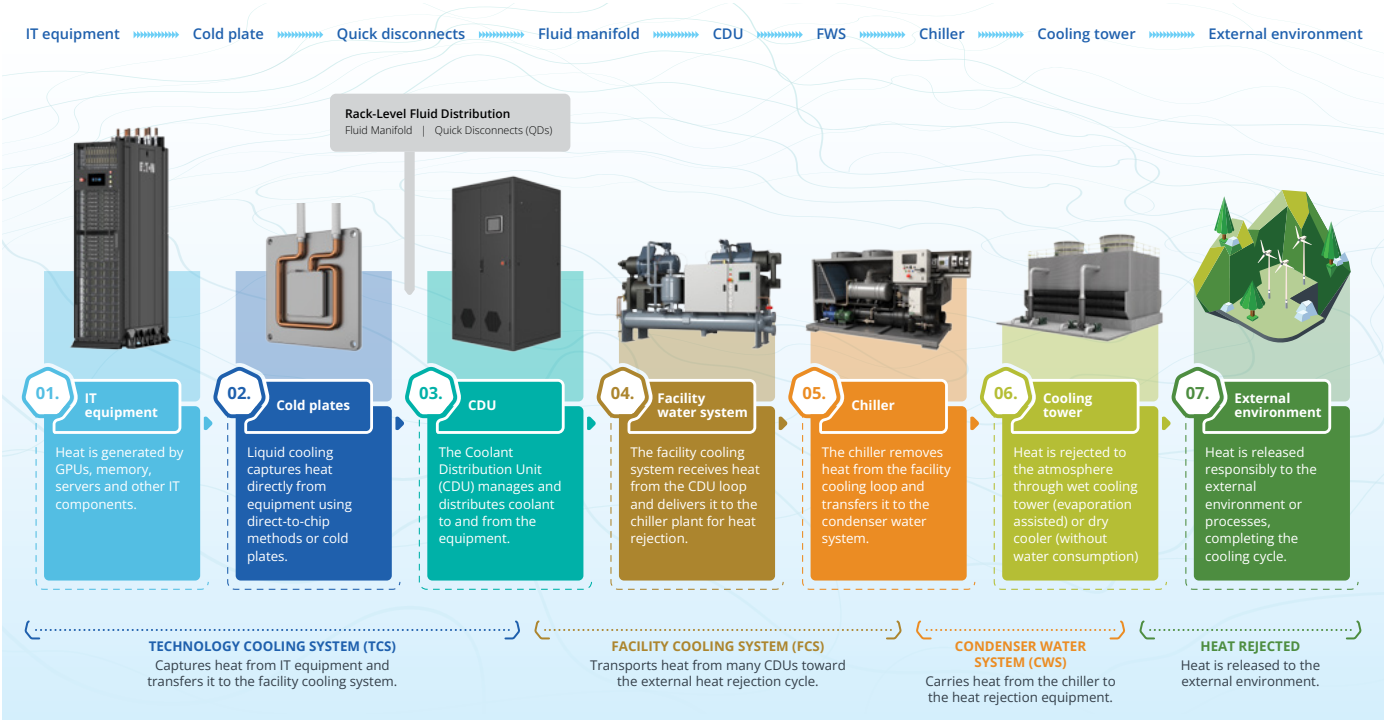
Facility Cooling System (FCS)

The FCS supplies cooling capacity to the data center. It includes chillers and associated infrastructure that remove heat from the cooling loops and maintain the temperature conditions required for reliable operation.

Condenser Water System (CWS)

The CWS forms part of the facility cooling infrastructure and transfers heat from the chiller plant to cooling towers, dry coolers, or other heat-rejection systems. By carrying heat away from the facility, the CWS enables continuous operation of the cooling system and helps maintain overall data center efficiency.

This heat flow map illustrates how thermal energy is transferred from IT equipment to the external environment through the Technology Cooling System (TCS), Facility Cooling System (FCS), and Condenser Water System (CWS). Together, these interconnected systems provide the reliable and efficient cooling required for high-density data centers.



Reliable operation of each cooling layer depends on efficient power distribution, motor control, automation, monitoring, and water quality management. Eaton provides the electrical infrastructure that enables these systems to operate safely, efficiently, and reliably at scale.

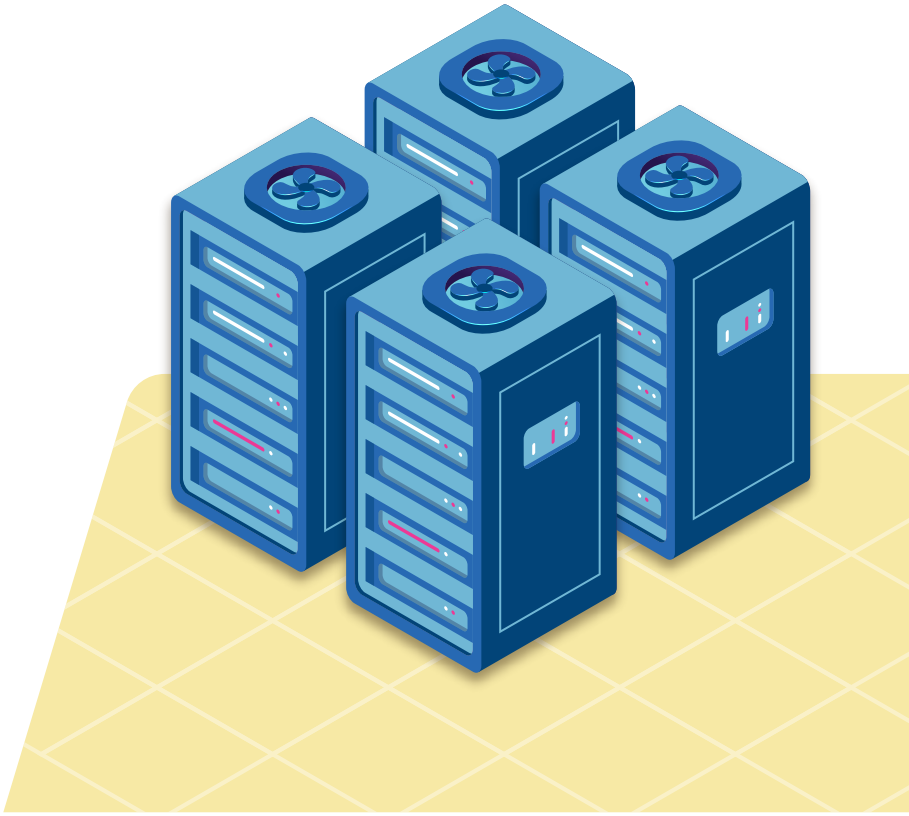
Data center cooling technologies

Modern data centers increasingly rely on a portfolio of cooling technologies to balance efficiency, scalability, and reliability.

Common cooling approaches include:

- Air cooling
- Liquid cooling
- Hybrid cooling

Air cooling



Room based air cooling A reliable foundation for traditional data centers

Room based air cooling is a long established approach that conditions the entire data hall. Cooling units located around the perimeter supply cold air through raised floors or overhead distribution systems, while warm air is returned for re-cooling.

Best suited for

- Low to moderate rack power densities
- Conventional enterprise and legacy IT environments
- Facilities prioritizing simplicity and familiarity

Key benefits

- Straightforward design and operation
- Broad industry experience and proven reliability
- Compatible with existing data center layouts

Room based cooling remains an effective baseline solution and is often combined with more targeted technologies as cooling requirements increase.

Closed coupled air cooling Improved efficiency through targeted airflow

Closed coupled air cooling brings cooling closer to the IT equipment by applying it at the row or rack level. By separating hot and cold air paths and minimizing air mixing, this approach improves thermal control and energy efficiency.

Best suited for

- Medium to higher rack densities
- Retrofit and modular data center designs
- Environments seeking better airflow management

Key benefits

- Reduced hot spots and temperature variability
- More efficient use of cooling capacity
- Improved scalability compared to room based cooling

Closed coupled air cooling is widely used in modern data centers as a step toward higher efficiency without introducing liquid into the IT space.

Liquid cooling

Direct-to-chip liquid cooling - Efficient cooling for high density computing

Direct-to-chip liquid cooling removes heat directly from processors and accelerators using liquid cold plates. By targeting the hottest components, this method provides significantly higher heat transfer efficiency than air cooling alone.

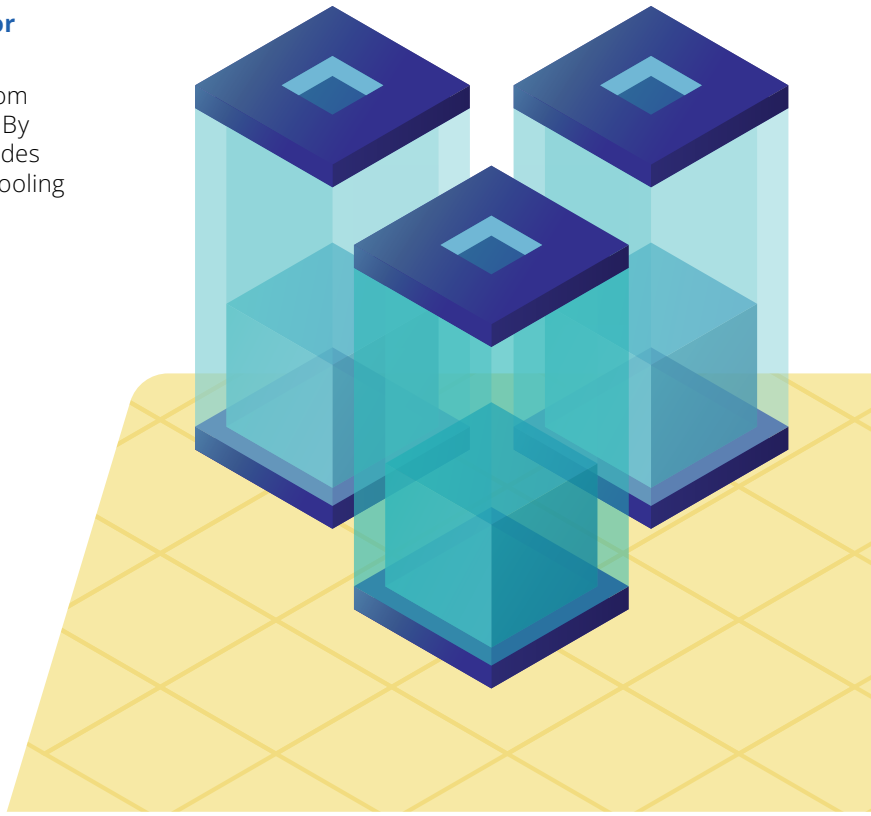
Best suited for

- High density racks
- AI, machine learning, and HPC workloads
- Performance sensitive computing environments

Key benefits

- Supports higher power densities per rack
- Improved thermal stability and system performance
- Reduced reliance on high volume airflow

Direct-to-chip cooling enables data centers to scale computing capacity while maintaining efficiency and operational control.



Immersion cooling - advanced cooling for extreme power density

Immersion cooling submerges servers in a non conductive liquid that absorbs heat directly from electronic components. This approach eliminates the need for traditional air cooling and internal server fans.

Best suited for

- Ultra high density computing
- Space constrained facilities
- Specialized or next generation workloads
- Applications with low maintenance requirements

Key benefits

- Exceptional heat removal capability
- Reduced mechanical complexity
- Enables very high compute density per square meter

Immersion cooling is an emerging solution for organizations pushing the boundaries of performance and efficiency.

Designing with flexibility in mind

There is no single cooling approach that fits all data centers. Increasingly, operators adopt hybrid cooling strategies, combining air and liquid technologies to match different workload zones within the same facility.

A flexible cooling architecture helps organizations:

- Adapt to evolving workload requirements
- Optimize energy efficiency and sustainability
- Extend the usable life of data center infrastructure

Importance of chillers and Coolant Distribution Units (CDUs) in Data Centers cooling infrastructure

Role and importance of chillers within the FCS

Within the Facility Cooling System (FCS), chillers are responsible for removing heat from the facility water loop and rejecting it to the external environment. By supplying a reliable source of chilled water, they enable continuous heat removal from the Technology Cooling System (TCS), helping maintain stable operating conditions, improve energy efficiency, and support the scalability of high-density data center environments.

Key reasons chillers are important:



Reliable heat rejection:

Chillers provide a stable and continuous source of chilled water that absorbs heat from IT equipment via air handling units, in row coolers, or liquid cooling systems.



Support for high density environments:

As rack densities rise, the total heat load increases. Chillers enable data centers to scale cooling capacity to match growing IT demand without compromising reliability.



Temperature stability:

Precise temperature control from the chiller plant ensures that IT equipment operates within recommended thermal limits, protecting hardware and maintaining predictable performance.



Energy efficiency and sustainability:

Modern chillers can operate with high efficiency, especially when combined with free cooling, variable speed compressors, or optimized control strategies. Efficient chillers directly contribute to lower Power Usage Effectiveness (PUE) and reduced operational costs.



Redundancy and resilience:

Chillers are typically designed with redundancy (N+1 or 2N), ensuring that cooling remains available even during equipment failure, which is critical for high availability data centers.

Definitions: N+1 Redundancy: Installing one more unit than is necessary to meet the maximum load. For example, if 3 chillers are needed, a 4th is installed as a standby.

2N Redundancy: A fully redundant, fault-tolerant system where the entire cooling infrastructure is duplicated.

Role and importance of coolant distribution units (CDUs) within the TCS

A coolant distribution unit (CDU) is a key component of the Technology Cooling System (TCS) for high-density liquid-cooled data centers. The CDU acts as the interface between the Facility Cooling System (FCS) (primary chiller water loop) and the IT-level liquid cooling loop, transferring heat from the TCS to the FCS through a heat exchanger.

Why CDUs are essential:



Thermal isolation and protection:

CDUs create a secondary, isolated cooling loop for IT equipment. This separation protects sensitive servers from fluctuations in the facility water system and reduces the risk of leaks or contamination.



Precise control of coolant conditions:

CDUs regulate coolant temperature, pressure, and flow rate, ensuring optimal heat removal from CPUs, GPUs, and other high power components.



Condensation prevention:

By maintaining coolant temperatures above the data center dew point, CDUs help prevent condensation, which could otherwise cause corrosion, short circuits, or false leak detection alarms.



Scalability and modularity:

CDUs can be deployed at the rack, row, or room level, allowing data centers to incrementally add liquid cooling capacity as compute density increases.



Efficiency for advanced workloads:

Liquid cooling enabled by CDUs removes heat far more efficiently than air. This makes it possible to support AI, HPC, and accelerator based workloads that would be impractical or inefficient with air cooling alone.

How chillers and CDUs work together

Chillers and CDUs function as complementary components of a unified cooling architecture:

- The TCS captures heat from liquid-cooled servers and transfers it to the CDU
- The CDU transfers heat from the TCS to the FCS through a heat exchanger
- The FCS removes heat from the facility loop and provides chilled water

This layered architecture enables centralized heat rejection combined with precise, localized cooling at the rack level.

In modern data centers, chillers and Coolant Distribution Units are no longer optional, they are foundational infrastructure. Chillers provide efficient, reliable heat rejection at the facility level, while CDUs enable precise, scalable liquid cooling at the IT level.

Together, they ensure that data centers can meet today's performance requirements while remaining resilient, energy efficient, and future ready.

Anatomy of a chiller and Coolant Distribution Unit

Anatomy of a chiller

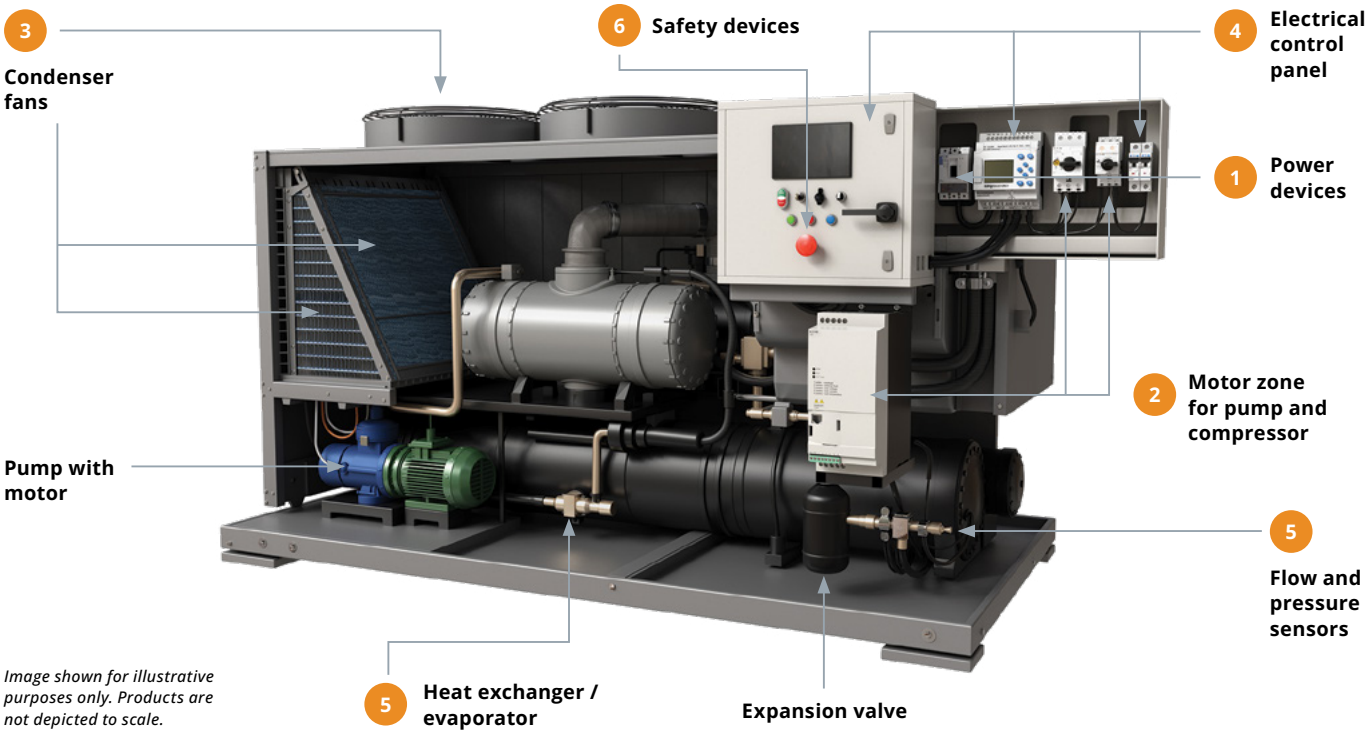


Image shown for illustrative purposes only. Products are not depicted to scale.

1 Incoming power and protection

- Molded Case Circuit Breakers (MCCBs) – Power Defense, NZM
- Switch disconnectors – P switch / Dumeco
- Electrical fuses – Bussmann series
- Busbars
- Terminal blocks
- Energy / power meters - EMD3P

Role: Power entry, fault protection, isolation, and internal distribution across the chiller

2 Motor zone for pump and compressor

- Contactors - DILM
- Motor protective circuit breakers - PKZ, PKE
- Thermal overload relays
- Soft starters and star delta starters - DS7, S711, S811
- Variable frequency drives - PowerXL
- Harmonics mitigation

Role: Control, start, protect and optimize compressor operation while ensuring reliable coolant circulation and energy-efficient pump control

3 Condenser fans zone

- Motor protective circuit breakers - PKZ, PKE
- Contactors - DILM
- Soft starters - DS7, S711, S811
- Variable frequency drives - PowerXL
- Harmonics mitigation

Role: Drive and regulate airflow for heat rejection

4 Control panel (automation zone)

- PLCs – XC series
- Programmable relays – easyE4
- HMIs – XV series
- Control & monitoring I/O – XN300
- Miniature Circuit Breakers – FAZ
- Power supply - PSG
- Pilot devices - M22 and M30

Role: Coordinate chiller control, automation, monitoring, operator interface, and where "upwards" communication/data exchange happens (e.g. Energy monitoring, fault reporting, remote operation / monitoring, etc.)

5 Monitoring and sensors zone

- Temperature sensors
- Pressure transducers
- Flow switches
- Energy / power meters (EMD3P)

Role: Measure and monitor system performance (flow, pressure, temperature, energy)

6 Safety and interface

- Safety relays – ESR5
- Functional safety system – XN Safety
- Emergency stop devices
- Pilot devices – RMQ Titan

Role: Ensure safe operation, emergency shutdown, and local control

Anatomy of a Coolant Distribution Unit (CDU)



1 Incoming power and protection

- Air Circuit Breakers (ACBs) – IZMX
- Molded Case Circuit Breakers - Power defense, NZM
- Switch-disconnectors – P switch / Dumeco
- Electrical fuses – Bussmann series
- Busbars
- Terminal blocks

Role: Power entry, isolation, and fault protection for the CDU panel

2 Pump and motor zone

- Motor-protective circuit breakers - PKZ, PKE
- Contactors - DILM
- Thermal overload relays
- Soft starters - DS7, S711, S811
- Variable frequency drives - PowerXL

Role: Drive and protect coolant circulation pumps

3 Heat exchanger / coolant loop interface

- Pumps driven via VFDs / soft starters
- Control and protection (MPCBs, contactors)
- Monitoring sensors (see section 5)

Role: Transfer heat between IT loop and facility loop (core CDU function)

Note: The heat exchanger itself is mechanical, but all electrical components supporting it are listed above.

4 Control panel (automation zone)

- PLCs – XC100 / XC200 / XC300
- Programmable relays – easyE4
- HMIs – XV series / Industrial PCs
- Control & monitoring I/O – XN300
- Miniature Circuit Breakers (MCBs)

Role: Coordinate CDU control, automation, monitoring, operator interface and where "upwards" communication/data exchange happens (e.g. Energy monitoring, fault reporting, remote operation / monitoring, etc.)

5 Monitoring and sensors zone

- Temperature sensors
- Pressure sensors
- Flow sensors / switches
- Energy meters - EMD3P

Role: Measure and regulate cooling conditions

6 Safety and interface

- Safety relays – ESR5
- Functional safety system – XN Safety
- Emergency stop buttons
- Pilot devices - M22, M30

Role: Ensure safe operation and emergency handling

7 Power distribution inside CDU panel

- Busbars (compact internal distribution)
- Terminal blocks (structured wiring interfaces)

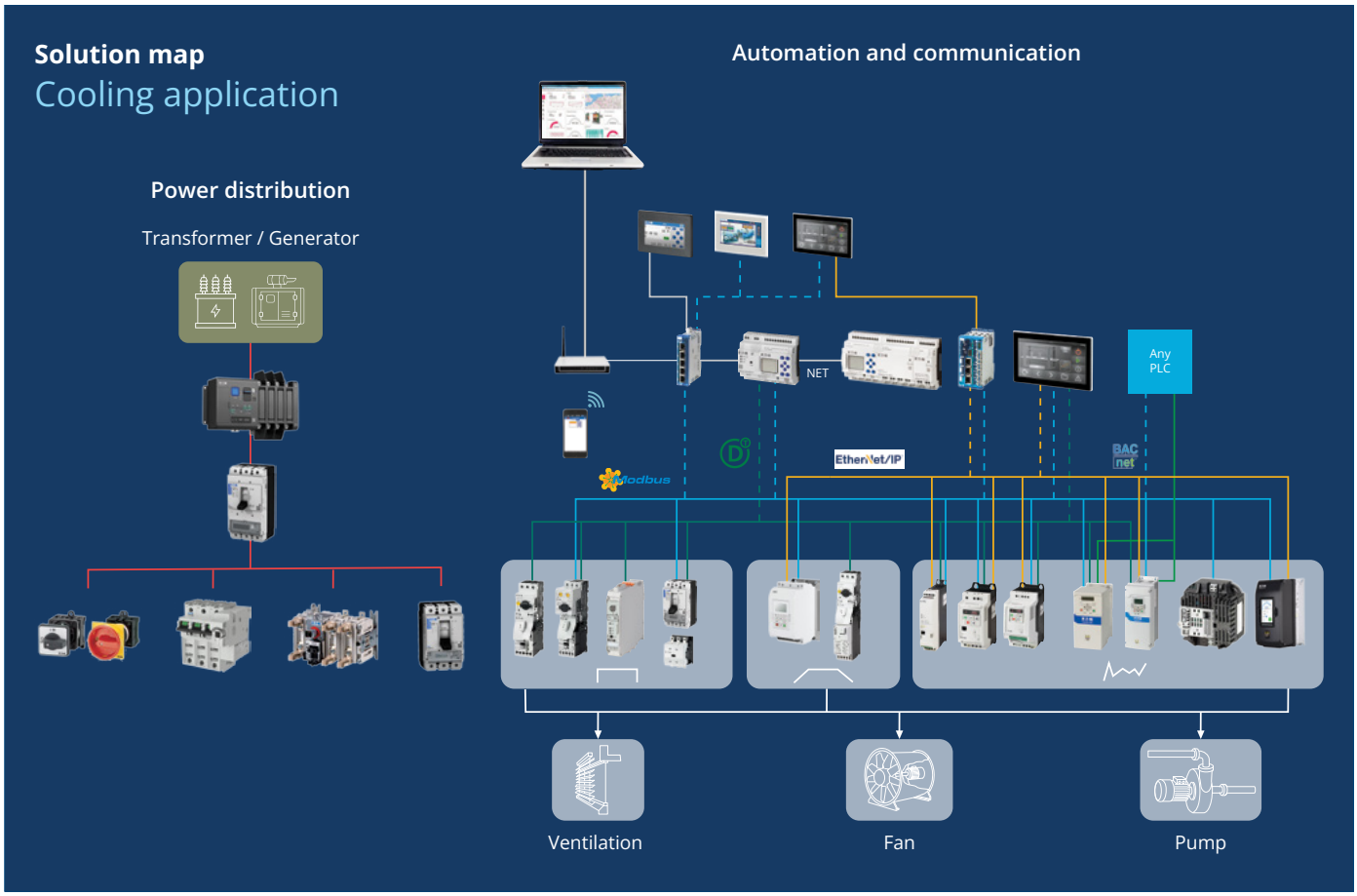
Role: Internal routing and structured wiring

8 Filtration

- Manual pipeline strainers (Angle strainers)
- Bag filter housings (SIDELINE, MAXILINE, HAYFLOW QDC)

Role: Protection of critical components in racks such as cold plates.

Eaton's solution map



Beyond products: engineering expertise and lifecycle support

Eaton supports cooling OEMs from design through operation with engineering expertise, testing, commissioning, and global technical support, helping ensure reliable cooling system performance throughout the machine lifecycle.

Design:
Application support, harmonics mitigation, thermal optimization.

Validate:
Testing and performance verification.

Deploy:
Commissioning and parameter setup.

Operate:
Global technical support and lifecycle services.

Find out more ▶

Need expert support?

From application engineering and harmonics mitigation to commissioning and optimization, Eaton experts help Cooling OEMs design, deploy, and operate reliable cooling systems.



Watch our Solutions for data center cooling OEMs video

Eaton's solutions overview

Cooling system area	Primary function	Product type	Eaton's solutions
Incoming power and protection	Isolation, short-circuit protection, and selectivity	Switch-disconnectors	P switches, and DMV Dumeco switches
		Fuse disconnect switch	CCP2
		Molded Case Circuit Breakers (MCCBs)	Power defense and NZM
		Electrical fuses	Bussmann™ series fuses
		Air Circuit Breakers (ACBs)	IZMX | NRX
		Automatic transfer switches	MATSN, ATS
		Energy meters	EMD3P
		Busbars, Terminal blocks	Busbars, Terminal blocks
Control, auxiliary and main protection	Protection of control circuits, PLCs, sensors, and auxiliaries	Miniature Circuit Breakers (MCBs)	xEffect FAZ and FAZ-NA
Power and drives	Pumps, compressors, and fans	Motor-Protective Circuit Breakers (MPCBs)	PKZ | XTPR, PKE | XTPE
		Thermal overload relays	ZEB | XTOE, ZB | XTOB, Z5 and ZW7
		Contactors	DILM | XTIEC
		Star-Delta contactor combinations	SDAINL
		Soft Starters	DS7, S711, S811+
		Variable Frequency Drives (VFDs)	PowerXL Drives
		Harmonics and power quality	Line reactors, passive harmonics filters, active harmonics filters, and engineered harmonics solution
Control and automation	Local and system-level control	Programmable control relays	easyE4
		Programmable Logic Controllers (PLCs)	easyE4 Nano, XC100, XC200 and XC300 PLCs
		Control and monitoring I/O	XN300 Standard I/O
		Human-Machine Interfaces (HMIs) and Industrial PCs	XV100, XV300 HMIs and XP500 Industrial PC
		Pilot devices	M22 and M30
Monitoring and safety	Fault detection, personnel safety	Functional safety systems	XN Safety
		Safety relays	ESR5
		Emergency stops	M22-PV and M30-PV
Liquid filtration	Remove particulates and debris	Manual pipeline strainer	Model 73, Model 510, Y and Angle strainers
		Bag filter housing with filter elements	SIDELINE™ or MAXILINE™ with HAYFLOW QDC

Incoming power and protection

How power enters, is protected and distributed inside cooling equipment.

Switch-disconnectors

Safe isolation for liquid-cooled data center infrastructure

Functional role in the cooling system:

Switch-disconnectors provide safe, visible electrical isolation for chillers and Coolant Distribution Units (CDUs). They allow incoming feeders, motors, and auxiliary circuits to be securely disconnected from the power supply for maintenance, commissioning, or emergency shutdown, without affecting upstream distribution.

Impact on cooling availability and risk:

In liquid-cooled data centers, cooling equipment operates continuously and often in close proximity to liquid circuits. Effective isolation is therefore critical to:

- Enable maintenance without shutting down adjacent cooling loops
- Provide visible isolation to protect personnel during service activities
- Support selective shutdown strategies in N+1 and modular cooling architectures
- Reduce operational risk during faults, upgrades, or expansions

Typical applications:

Chillers	CDUs
Main incoming isolation at the chiller panel	CDU Incoming feeders
Isolation of compressors, pumps and auxiliary circuits	Local isolation of pump motors and valve assemblies
Mechanical plant room and electrical skid applications	Rack-level, row-level or room-level CDU panels

Key benefits:

- Visible disconnection for clear and verifiable isolation
- High short-circuit withstand capability
- Compact, panel-friendly designs
- Robust switching of inductive loads
- Padlockable LOTO (Lock Out/Tag Out)

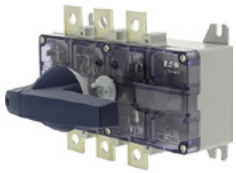
P Switch-disconnectors and Dumeco switch-disconnectors

	P Switch-disconnectors	DMV Dumeco switch-disconnectors
Typical role	Maintenance switches, inside chiller or CDU Panels, local motor, control panels	Maintenance switches, main incoming and heavy-duty isolation
Key characteristics	Compact design, IP Rated options, easy panel integration, padlockable	High current ratings, robust construction, inductive load switching
Rated operational voltage	690 VAC	690 VAC
Rated operational current	25 A to 315 A	160 A to 315 A
Standards	IEC 60947-1, IEC 60947-3, UL 508	IEC 60947-3, UL 60947-1, CCC Up to 1250 A
Certifications	CE, UKCA	CE, UKCA, KEMA-KEUR, Lloyd's Register
Eaton.com link	Eaton.com	Eaton.com

P Switch-disconnector



DMV Switch-disconnector



Market availability: Global IEC US UL

Fuse disconnect switch

Integrated isolation and current-limiting protection for cooling-critical circuits

CCP2

The Bussmann™ CCP2 Fuse Disconnect combines switch-disconnection and current-limiting fuse protection in a single compact device. It provides branch-circuit protection and local isolation for pumps, auxiliary motors, control transformers, VFDs, and other cooling-system loads used in chillers and Coolant Distribution Units (CDUs). By integrating the disconnect and fuse holder into one assembly, the CCP2 helps simplify panel design while providing high fault-current protection and visible isolation.

Impact on cooling availability and risk:

Liquid-cooled data centers depend on the continuous operation of pumps, drives, and control systems.

The CCP2 helps to

- Provide rapid current-limiting fault protection
- Reduce arc-flash energy through current-limiting fuse technology
- Support selective coordination with upstream protection devices
- Enable safe local isolation for maintenance and service
- Protect cooling-critical circuits from catastrophic fault damage

Typical applications:

Chillers	CDUs
Branch-circuit protection for pump motors	Pump and circulation motor protection
Variable frequency drive protection	Variable frequency drive protection
Compressor auxiliary circuits	Auxiliary cooling equipment
Control transformers and control panels	Control power distribution
Skid-mounted cooling equipment	Rack-, row- and skid-level CDU panels

Key strengths:

- Combines disconnect switch and fuse protection in one device
- Compact footprint for high-density control panels
- Current-limiting protection reduces equipment damage
- High interrupting rating for fault-rich environments
- Visible isolation for safe maintenance
- Touch-safe design and finger-safe fuse installation

CCP2 ●

	CCP2 Class CC	CCP2 Class CF
Fuse class	Class CC	Class CF
Rated current	Up to 30 A	Up to 100 A
Rated operational voltage	600 VAC/600 VDC	600 VAC/600 VDC
Short-circuit current rating	Up to 200 kA (depending on fuse selection)	Up to 200 kA (depending on fuse selection)
Standards	UL 98, UL 508	UL 98, IEC 60947-3 (30 A and 60 A)
Eaton.com link	Eaton.com	Eaton.com

CCP2 Class CC



CCP2 Class CF



Market availability: ● Global ● IEC ● US UL

Molded Case Circuit Breakers (MCCBs)

Feeder-level protection for chillers and CDUs

Power Defense MCCB

Functional role in the cooling system: Eaton's Power Defense MCCBs provide selective, intelligent protection for feeders supplying chillers, CDUs, pumps, and auxiliary cooling systems. They combine short-circuit and overload protection with advanced trip units, diagnostics, and communication capabilities.

Impact on cooling availability and risk:

Cooling availability in high-density data centers depends directly on electrical reliability. Power Defense MCCBs help operators and OEMs to:

- Maintain cooling uptime through fast, selective fault isolation
- Reduce arc-flash risk in dense electrical and mechanical plant rooms
- Support redundancy architectures (N+1, 2N) without nuisance tripping
- Enable safe maintenance while cooling systems remain operational

Typical applications:

Chillers	CDUs
Main and sub-distribution feeders	CDU incoming feeders
Compressor and pump protection	Internal panel protection
Secondary pump and skid protection	Secondary pump and skid protection

Key strengths:

- High interrupting capacity for fault-rich data-center environments
- Advanced electronic trip units (LSI, LSIG, ARMS) for precise protection
- Integrated arc-flash mitigation (ARMS) to improve personnel safety
- Built-in metering and diagnostics for operational visibility
- Native communications for integration with BMS, DCIM and energy platforms

Power Defense MCCB

Frame size range	PD-1 to PD-6
Rated operational current	15 A to 1600 A
Rated operational voltage	Up to 690 VAC (IEC)/600 VAC (UL)
Breaking capacity	Up to 100 kA
Trip unit option	Thermal-magnetic; electronic LSI, LSIG, ARMS
Arc flash mitigation	Integrated ARMS and ZSI
Metering and diagnostics	Advanced metering, diagnostics, event logs
Communications	Native Modbus, relays, Power Xpert integration
Standards	IEC/EN 60947-2, UL 489, CSA
Eaton.com link	Eaton.com



Market availability: Global IEC US UL

Molded Case Circuit Breakers (MCCBs)

Proven, robust protection for chiller and CDU power distribution

NZM MCCB

Functional role in the cooling system:

Eaton's NZM MCCBs provide robust, IEC-compliant protection for power distribution systems supplying cooling equipment. Their mechanical strength and wide rating range make them suitable for continuous-duty industrial environments.

Impact on cooling availability and risk:

Liquid-cooling systems place sustained electrical and thermal demands on distribution equipment. NZM MCCBs support:

- Stable protection of cooling feeders and sub-distribution
- Reliable operation of pumps and auxiliary motors under continuous load
- Selective fault isolation to avoid unnecessary cooling outages
- Long service life in continuous-duty cooling applications

Typical applications:

Chillers	CDUs
Incoming and sub-distribution protection	CDU internal power distribution
Pump and auxiliary motor feeders	Row-level and room-level CDU systems
Row-level and room-level CDU systems	

Key strengths:

- High breaking capacity for industrial cooling environments
- Robust mechanical design suited for continuous operation
- Thermal-magnetic and electronic trip options
- Wide current and frame size range
- IEC and UL compliance for global data-center projects

NZM MCCB Overview

Frame size range	NZM1 to NZM4
Rated operational current	20 A to 1600 A
Rated operational voltage	Up to 690 VAC (IEC)
Breaking capacity	Up to 150 kA
Trip unit option	Thermal-magnetic; electronic LSI
Arc flash mitigation	Optional
Metering and diagnostics	Available on Digital NZM
Communications	Optional
Standards	IEC/EN 60947-2, UL 489
Eaton.com link	Eaton.com



Market availability: Global IEC US UL

Electrical fuses

Fast fault isolation for cooling critical circuits

Functional role in the cooling system:

Electrical fuses provide fast, reliable short-circuit and overload protection for chillers, Coolant Distribution Units (CDUs), pumps, drives, and auxiliary systems in liquid-cooled data centers. Eaton's Bussmann™ series fuses are designed to safely interrupt very high fault currents while limiting energy let-through.

Impact on cooling availability and risk:

Liquid-cooled data centers operate with high available fault levels and large motor loads. In these conditions, protection devices must act predictably and extremely fast. Bussmann series fuses provide:

- Fast fault clearing to protect pumps, compressors, and drives
- High current limitation to reduce thermal and mechanical stress
- Selective coordination to maintain cooling availability
- Improved arc-flash safety through reduced incident energy

Typical applications:

Chillers	CDUs
Main incomers and large feeders	Pump motor protection
Compressor and high power motor circuits	Skid mounted equipment
Mechanical plant room distribution	Auxiliary and control circuits

Key strengths:

- Very high interrupting ratings (up to 300 kA, application-dependent).
- Excellent current-limiting performance
- Time-delay options to support motor starting
- Compact form factors for space-efficient panels
- IEC and UL fuse families for global data-center designs

IEC Bussmann™ series Fuses

Cooling application	IEC Utilization category	Eaton's Bussmann series IEC Fuses	Key characteristics	Typical role in data centers
Chiller main incomer / large feeders	gG (full range)	BS88 gG fuse links NH gG Fuse links	Full range protection (overload + short circuit), high breaking capacity, strong current limitation	Main incomer and feeder protection for large chillers and central cooling plants
Chiller compressors and large motors	aM (motor circuits)	BS88 aM / gM motor fuse links NH aM Fuse links	Short circuit protection for motors with high inrush currents; used with overload relays	Protection of compressor motors and high power pump motors in chiller systems
CDU pump motors and MCC Feeders	aM or gM	Cylindrical aM (10 x 38, 14 x 51, 22 x 58 mm) BS88 aM Fuse links	Designed for motor circuits; high inrush tolerance; compact form factors available	Branch circuit protection for CDU pumps, fans, and motor feeders
CDU auxiliaries and skid mounted equipment	gG	Cylindrical gG Fuse links BS88 gG Fuse links	General purpose protection covering overloads and short circuits; compact and modular	Protection of auxiliary loads, heaters, and skid mounted cooling equipment
Control circuits and small loads	gG (cylindrical)	Cylindrical gG fuse links (10 x 38, 14 x 51, 22 x 58 mm)	Compact IEC design, full range protection, compatible with modular fuse holders	Control transformers, instrumentation, sensors, and control power within CDUs

gG BS88 Fuse



aM cylindrical fuse



gG NH Fuse



Market availability: Global IEC US UL

UL Bussmann series Fuses

Cooling application	UL Fuse class	Eaton's Bussmann series UL Fuses	Key characteristics	Typical role in data centers
Chiller main incomer / large feeders	Class L	KRP C SP (Low Peak™), KLU, KTU	Very high interrupting rating (up to 300 kA), current limiting, time delay options to withstand high motor inrush	Protection of large chillers, compressors, and high capacity HVAC feeders
Chiller compressors and large motors	Class L	KRP C SP, KLU	High current limitation, supports selective coordination and motor starting requirements	Reliable protection of high power motors while minimising nuisance interruptions
CDU auxiliaries and skid mounted equipment	Class J	LPJ SP (Low Peak™), JKS	High interrupting rating (200 kA), compact footprint, time delay options	Protection of auxiliary loads and smaller motors within cooling skids
Control circuits and small loads	Class CC Class CF	LP CC, FNQ R, KTK R, CubeFuse Class CF	Very compact, high interrupting rating for size, fast or time delay options	Control transformers, PLCs, instrumentation, leak detection systems, sensors and auxiliary circuits in chillers and CDUs



Class L



Class J Fuses



Class CC



Class CF

Market availability: Global IEC US UL

Air Circuit Breakers (ACBs)

Main power protection for mission-critical liquid-cooled data centers.

Functional role in the cooling system:

Air Circuit Breakers provide high-capacity protection and isolation at the main incomer or critical distribution points supplying chillers, CDUs, and cooling plant infrastructure. They are designed to interrupt very high fault currents and coordinate with downstream protection devices.

Impact on cooling availability and risk:

In liquid-cooled data centers, a failure at the main distribution level can immediately affect cooling availability. ACBs help to:

- Protect large cooling feeders against high-energy electrical faults
- Prevent fault propagation into downstream MCCBs, fuses, and motor protection
- Support selective coordination across multi-tier cooling power architectures
- Enable safe maintenance and operational continuity

Typical applications:

Chillers	CDUs
Main incomers supplying chiller plants	Centralized distribution for CDU zones

Key strengths:

- Very high current ratings for large cooling infrastructures
- High short-circuit interruption capability
- Advanced electronic trip units for protection and metering
- Selective coordination with downstream MCCBs and fuses
- Integration with monitoring and power management systems

IZMX ACBs Overview

	IZMX ● | NRX ●
Rated operational current	630 A to 4000 A
Rated operational voltage	690 VAC
Utilization category	B
IP Protection	IP31, IP55 device with protection cover
Type of circuit breaker	B, N, H
Standards	IEC/EN 60947
Eaton.com link	Eaton.com



Market availability: ● Global ● IEC ● US UL

Automatic transfer switches

Main power protection for mission-critical liquid-cooled data centers

Functional role in the cooling system:

Automatic Transfer Switches automatically transfer cooling loads between power sources, such as utility and generator, without manual intervention. They are used to supply chillers, pumps, and CDUs from redundant power sources.

Impact on cooling availability and risk:

Liquid-cooling systems rely on continuously powered mechanical equipment. Even short power interruptions can rapidly lead to loss of heat removal. ATS help to:

- Maintain uninterrupted power to cooling infrastructure during outages
- Protect IT equipment from thermal shutdown
- Support resilient power-cooling architectures in AI and high-density environments
- Enable coordinated recovery of cooling systems after power events

Typical applications:

Chillers	CDUs
Central chiller plants supplied from utility and generator sources	Maintains continuous power to chillers during utility outages
Large compressors and condenser systems requiring uninterrupted operation	Automatic, fast transfer between power sources without manual intervention
Primary and secondary chilled-water pump systems	Prevents loss of cooling capacity during source transitions
Redundant power architectures (N+1, 2N) for cooling generation	Supports resilient power - cooling designs for mission-critical facilities
Cooling infrastructure where coordinated restart is required after power events	Monitoring, diagnostics, and event logging to support controlled recovery

Key strengths:

- Automatic transfer between power sources to maintain uninterrupted cooling
- Prevents loss of cooling during power outages or source failures
- Supports resilient power architectures (N+1, 2N) for mission-critical systems
- Fast, reliable source transfer without manual intervention
- Available with PC-class and electromechanical switching technologies
- Monitoring, diagnostics, and event logging to support coordinated recovery

MATSN and ATS Range overview





	MATSN	ATS-300	ATS-900
ATS Category	PC-class automatic transfer switch	UL 1008 automatic transfer switch	UL 1008 automatic transfer switch
Switching technology	Dedicated excitation drive (PC-class)	Electromechanical (contactor / breaker based)	
Transition type	Open transition	Open-delayed / in-phase / closed (config-dependent)	
Number of sources	2 sources	2 sources	2 or 3 sources (controller-dependent)
Rated current range	16 A – 4000 A (frame-dependent)	~40 A – 3000 A (frame-dependent)	~40 A – 5000 A (frame-dependent)
Rated voltage	400 V	400 V	400 V
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Controllers	Integrated (Type A / B / H)	ATC-300	ATC-900
Source monitoring	Voltage and frequency (controller dependent)	Voltage and frequency	Voltage, frequency, diagnostics
Communications	RS-485 / Modbus (variant-dependent)	Limited / optional	Ethernet, RS-485, Modbus
Diagnostics and logging	Basic	Standard	Advanced event logging and analytics
Maintenance intelligence	No	No	ATS Maintenance and maintenance watch™
Eaton.com link	Eaton.com	Eaton.com	Eaton.com

Market availability: Global IEC US UL

Energy meters

Real-time energy insight for optimized cooling performance

Functional role in the cooling system:

DIN-rail energy meters provide accurate measurement of electrical parameters such as voltage, current, power, and energy consumption within chiller and Coolant Distribution Unit (CDU) panels. Installed at feeder, motor, or subsystem level, they enable real-time visibility into how electrical power is used across cooling infrastructure.

Impact on cooling availability and risk:

Liquid-cooled data centers rely on continuously operating motors, drives, and control systems. Lack of energy visibility can mask inefficiencies or developing faults. Energy meters help to:

- Monitor power consumption of pumps, compressors, and auxiliary systems in real time
- Detect abnormal conditions such as overload, imbalance, or inefficient operation early
- Support predictive maintenance by identifying deviations from normal operating profiles
- Improve energy efficiency and optimize cooling performance under varying load conditions
- Enable integration with BMS and DCIM systems for system-wide monitoring and alerts

Typical applications:

Chillers	CDUs
Monitor compressor and pump motor feeders	Monitoring pump and skid level energy usage
Tracking total chiller energy consumption	Measurement of rack, row or skid-level CDU consumption
Sub-metering for cooling plant optimization and reporting	Energy tracking for high-density liquid cooling zones (AI / HPC workloads)

Key strengths:

- Accurate, real-time measurements of key electrical parameters (V, I, kW, kWh)
- Compact DIN-rail design for easy integration into control panels
- Enables energy transparency across cooling-critical circuits
- Supports optimization of cooling efficiency and PUE performance
- Provides data for predictive maintenance and fault detection
- Communication capabilities for integration with monitoring systems (BMS / DCIM)
- Scalable for use from component level to full cooling system monitoring

EMD3P DIN-Rail meter with Modbus TCP/RTU

Supply inputs	Voltage input L1/N
Power consumption Pmax	2 W
Quantity	Voltage inputs: 4 (L, L2, L3, N) Current inputs: 3
Overvoltage category	CAT III
Power protection	16 A Type B
Measurement range	L-N 85...250 VAC L-L 147... 433 VAC
Frequency	50/60 Hz ± 5%
Connection type	Plug with push-in connector supplied
Connecting capacity	0.20 to 2.5 mm^2
Supported current transformers	CT63, SCT200, SCT600 (63 A to 600 A)
Interface	RS485, Ethernet
Eaton.com link	Eaton.com





Market availability: Global IEC US UL

Busbars and MSFS Feeder system

Compact, reliable power distribution inside cooling panels

Functional role in the cooling system:

Busbars and MSFS Motor Starter Feeder Systems provide efficient power distribution within chiller and CDU control panels. They distribute power from incoming feeders to motor starters, drives, pumps, fans, compressors, and auxiliary equipment, reducing wiring complexity while improving reliability, scalability, and ease of maintenance. Busbars support high-current distribution, while the modular MSFS system simplifies the integration and expansion of motor starter combinations.

Impact on cooling availability and risk:

Liquid cooled data center infrastructure is increasingly compact, modular, and high-density, especially in CDU and pump-skid designs. In these environments, internal power distribution must be robust, space-efficient, and easy to service. Busbars and MSFS help to:

- Improve reliability by providing structured, low-impedance power distribution
- Simplify maintenance and future system modifications
- Support compact panel designs where space is limited
- Improve safety through protected and touch-safe distribution solutions

Typical applications:

Chillers	CDUs
Power distribution inside chiller electrical cabinets and control panels	Internal power distribution in rack-, row-, or skid-level CDUs
Interconnection of incomers, ACBs/MCCBs, motor starters, and drives	Interconnection of incoming feeders, MCCBs/fuses, pumps, and auxiliaries
Distribution to compressors, condenser fans, and pump motors	Pump skids and auxiliary cooling assemblies
Centralized cooling plants with continuous-duty operation	High-density electrical cabinets located close to IT equipment
Large, space-constrained electrical panels in plant rooms	Scalable CDU architectures requiring structured internal distribution

Key strengths:

- Efficient power distribution from incoming feeder to motor starter
- Plug-and-play modular architecture for rapid panel assembly
- Reduced wiring, installation time, and risk of errors
- Flexible expansion and adaptation to changing system requirements

Busbars

Material	Copper Aluminum
Construction	Rigid busbars Flexible or laminated busbars

Feeder system - MSFS

Rated current	Up to 125 A
Installation	Supports up to 4 or 8 motor starters depending on the base module size Modular plug-in architecture for motor starter combination
IP Protection	IP20 Finger-safe design
Standard	IEC and UL
Eaton.com link	Eaton.com

Accelerate panel assembly with Push-in technology

Available across selected Eaton motor control, protection, safety and connection products, push-in technology enables tool-free wiring, reduces installation time, and supports compact, service-friendly chiller and CDU designs.

Market availability: Global IEC US UL

Terminal blocks

Structured, safe connection points for power and control wiring

Functional role in the cooling system:

Terminal blocks provide a secure, organized means of terminating and distributing electrical conductors inside chiller and Coolant Distribution Unit (CDU) panels. They are used to connect incoming and outgoing power cables, control wiring, sensor signals, and auxiliary circuits, creating clear and reliable electrical interfaces within control cabinets and skids. Terminal blocks support different conductor types and sizes and enable consistent, repeatable wiring layouts across modular cooling equipment.

Impact on cooling availability and risk:

Liquid-cooled data-center systems rely on dense electrical panels that combine power, control, and monitoring circuits in close proximity to pumps, drives, sensors, and safety devices. In these environments, wiring clarity and reliability are critical. Terminal blocks help to:

- Improve wiring organization and readability inside compact panels
- Reduce installation errors and commissioning time
- Support safe maintenance and troubleshooting by clearly separating circuits
- Enable modular, repeatable panel designs for OEM-built chillers and CDUs
- Accommodate expansion or reconfiguration without re-routing core wiring

Typical applications:

Chillers	CDUs
Termination of power, control, and auxiliary wiring inside chiller cabinets	Wiring termination inside rack-, row-, or skid-level CDU panels
Interfaces between PLCs, I/O modules, relays, and field wiring	Interfaces for pumps, auxiliaries, and CDU control circuits
Connection of temperature, pressure, and flow sensors for chiller control	Connection of sensors and leak-detection devices close to IT loads
Organized wiring in large, space-constrained plant-room panels	Structured wiring for compact, modular, repeatable CDU designs

Key strengths:

- Structured, clearly organized wiring for power, control, and signal circuits
- Improved safety and serviceability through clear circuit separation and secure terminations
- Reduced installation and commissioning time with repeatable, standardized layouts
- Compact designs suited to high-density chiller cabinets and CDU enclosures

Terminal blocks

Core function	• Provide secure electrical and mechanical termination of conductors • Enable structured distribution of power, control, and signal wiring • Support clear circuit separation and consistent panel layouts • Facilitate commissioning, testing, and maintenance activities
Conductor types	• Screw connection • Spring-clamp/push-in connections
Electrical and mechanical characteristics	• Defined current-carrying paths suitable for continuous-duty operation • High contact reliability, maintaining stable electrical performance over time • Strong mechanical retention to withstand vibration and handling • Compact form factors to support high wiring density in modern panels
Eaton.com link	Eaton.com

Market availability: Global IEC US UL

Control, auxiliary and main protection

Protecting power, control, and auxiliary circuits inside cooling equipment.

Miniature Circuit Breakers (MCBs)

Functional role in the cooling system:

Miniature Circuit Breakers protect control, instrumentation, and auxiliary circuits within chiller and CDU panels. They isolate local faults and protect sensitive electronics such as PLCs, sensors, and HMIs.

Impact on cooling availability and risk:

Loss of control power can be as disruptive as loss of motor power in liquid-cooling systems.

MCBs help to:

- Isolate faults in control and auxiliary circuits without impacting cooling-critical motor feeders
- Protect sensitive electronics such as PLCs, sensors, and HMIs from electrical damage
- Improve serviceability and troubleshooting by clearly identifying and isolating affected circuits
- Enable safe, standards-compliant panel design in electrically dense chiller and CDU environments

Typical applications:

Chillers	Coolant distribution unit
Protection of PLC and control power supplies	Protection of CDU PLCs, I/O modules, and HMIs
Branch protection for HMI panels and operator interfaces	Branch protection for flow, pressure, and temperature sensors
Protection of temperature, pressure, and flow sensor circuits	Protection of actuators, valves, and auxiliary devices
Auxiliary circuits such as valves, heaters, and control relays	Control power circuits within rack-, row-, or skid-level CDUs
Control and monitoring circuits within chiller electrical cabinets	Auxiliary loads supporting monitoring, alarms, and safety functions

Key strengths:

- Reliable overload and short-circuit protection
- Selective protection for sensitive circuits
- Compact and versatile design
- Standards-compliant for global use
- High resistance to mechanical and environmental stresses
- Suitable for use in A2L refrigerant environments

xEffect Miniature circuit breakers

	FAZ xEffect Miniature circuit breakers	FAZ-NA xEffect Miniature circuit breakers
Rated current	0.16 to 63 A	0.5 to 63 A
Rated voltage	230 / 400 V AC (50/60 Hz)	480Y/277 V
Tripping characteristics	B, C, D, K, S, Z	B, C, D
Pole configurations	Available in 1-, 2-, 3-, 4-, 1+N, 3+N pole versions	Available in 1-, 2-, 3-, 4-pole versions
Standards/Approvals	IEC/EN 60947-2, IEC/EN 60898-1, IEC 61373 UL 1077, EN 45545, UL 60335-1, UL 60335-2-40	UL489, IEC/EN 60947-2, EN 45545, IEC 61373, UL 60335-1, UL 60335-2-40
Eaton.com link	Eaton.com	Eaton.com





Market availability: Global IEC US UL

Power and drives

How power is converted into controlled motion for cooling systems

Motor-Protective Circuit Breakers (MPCBs)

Local motor protection for pumps and cooling equipment

Functional role in the cooling system:

Motor-Protective Circuit Breakers provide integrated overload and short-circuit protection for electric motors driving pumps, fans, and auxiliary equipment in chillers and Coolant Distribution Units (CDUs). They combine protection, switching, and isolation in a compact device installed close to the motor.

Impact on cooling availability and risk:

Liquid-cooling systems rely on continuously operating motor-driven equipment. Loss of a pump or fan can quickly disrupt coolant flow and thermal stability. MPCBs help to:

- Detect overloads accurately under continuous-duty conditions
- Respond rapidly to short-circuits
- Support selective coordination with upstream protection
- Enable safe local isolation for maintenance

Typical applications:

Chillers	Coolant distribution unit
Primary and secondary chilled water pumps	Internal pump motors
Condenser water pumps	Redundant and lead-lag pump sets
Auxiliary motors and services	Skid-mounted cooling assemblies

Key strengths:

- Integrated motor protection (overload + short-circuit)
- Compact footprint for space-efficient control panels
- Motor-rated switching and isolation
- Selective coordination with upstream MCCBs and fuses
- IEC and UL compliant solutions for global deployments

PKZ | XTPR, PKE | XTPE

	PKZ 🟢 | XTPR 🔴	PKE 🟢 | XTPE 🔴
Applications	Small motors, local pump and fan loads	Critical cooling motors, CDUs, redundancy paths
Protection level	Basic motor protection	Advanced electronic motor protection
Protection technology	Thermal magnetic	Electronic overload + magnetic short-circuit
Rated operational voltage	Up to 690 VAC	Up to 690 VAC
Rated operational current	Up to 32 A (PKZM0), higher with PKZM4 frames	Up to 65 A (with pluggable trip units)
Overload protection class	Fixed thermal characteristic	Adjustable class 5 / 10 / 15 / 20 (model dependent)
Short-circuit protection	Instantaneous magnetic trip	Instantaneous magnetic trip
Phase-failure protection	Yes (IEC 60947-4-1) magnetic trip	Yes, integrated
Standards	IEC 60947-4-1, IEC 60947-2 UL/CSA (Type E/F) IE3 motor compatible	IEC 60947-4-1, IEC 60947-2 UL/CSA IE3 motor compatible
Eaton.com link	PKZ | XTPR	PKE | XTPE



PKZ | XTPR



PKE | XTPE

Market availability: 🟢 Global 🟡 IEC 🔴 US UL

Thermal overload relays

Continuous motor protection for pumps and compressors

Functional role in the cooling system:

Overload relays provide motor-specific thermal protection by monitoring motor current and detecting overload, phase loss, or abnormal operating conditions. Installed with contactors or motor starters, they trip or signal when a motor operates outside its safe thermal limits, preventing damage caused by sustained overcurrent or imbalance.

Impact on cooling availability and risk:

Cooling data-center systems rely on pumps and compressors that operate continuously and often under variable load conditions. Motor overheating can lead to sudden loss of coolant flow and rapid thermal excursions. Overload relays help to:

- Protect pumps and compressors from thermal damage during continuous duty
- Detect abnormal operating conditions before mechanical failure occurs
- Prevent unplanned cooling outages caused by motor burnout
- Support reliable operation of primary, secondary, and redundant cooling loops

Typical applications:

Chillers	Coolant distribution unit
Thermal protection of motor-driven cooling equipment	Thermal protection of motor-driven liquid-distribution equipment
Compressor auxiliary motors, condenser fans, chilled-water pumps	Primary and secondary coolant pumps, auxiliary circulation pumps
Sustained overcurrent, phase loss, blocked fans, abnormal load conditions	Sustained overcurrent, dry-run conditions, blocked pumps, abnormal hydraulic load
Installed with contactors or motor starters in chiller control panels	Installed with contactors or motor starters in CDU local control cabinets

Key strengths:

- Reliable motor overload protection
- Maintains cooling availability
- Well suited for continuous-operation motors
- Simple integration with motor starters and contactors

ZEB | XTOE, ZB | XTOB

	ZEB 🟢 | XTOE 🔴	ZB, Z5, ZW7 🟢 | XTOB 🔴
Protection technology	Electronic (solid-state thermal modeling)	Thermal (bimetallic)
Motor current sensing	Direct phase-by-phase electronic sensing	Via bimetal
Thermal overload protection	Yes	Yes
Load/pump protection	No	No
Voltage monitoring	No	No
Power energy monitoring	No	No
Diagnostics and events history	Basic status indication	None
Communication	Optional (via modules)	No
Trip class selection	Adjustable (e.g. Class 10, 20, 30)	Typically Class 10 / 10A
Rated operational voltage	690 VAC	
Overload release current setting	0.33 A to 175 A	ZB: 0.1 A to 175 A | Z5: 50 A to 300 A | ZW7: 42 A to 630 A
Standards	IEC/EN 60947-4-1, UL 508	IEC/EN 60947-4-1, UL 508
Certification	CE, UL, CSA, CCC	CE, UL, CSA, CCC
Eaton.com link	ZEB	ZB, Z5, ZW7



ZEB



ZB, Z5, ZW7

Market availability: 🟢 Global 🟡 IEC 🔴 US UL

Contactors

Reliable motor and power switching for cooling systems

Functional role in the cooling system:

Contactors provide reliable electrical switching of motors and inductive loads used in chillers and CDUs. They are designed for frequent switching, long service life, and safe operation when coordinated with upstream protection.

Impact on cooling availability and risk:

Cooling availability depends on predictable, continuous motor operation. Electrical switching devices must withstand frequent cycling without degradation. Contactors help to:

- Maintain stable pump and compressor operation
- Support redundant cooling architectures
- Suitable for applications using A2L refrigerants, where applicable and subject to product approvals

Typical applications:

Chillers	Coolant distribution unit
Chiller control panel	Primary and secondary pump control
Pump motor control panels	Redundant pump sets
Compressors (scroll, screw, centrifugal)	Skid-mounted cooling assemblies
	Row and room level CDUs
	Auxiliary cooling motors

Key strengths:

- IEC-rated motor switching up to 690 V AC
- High making and breaking capacity for inductive loads
- Long electrical and mechanical lifetime
- Wide control-voltage options (AC and DC)
- Push-in terminals for quick and easy wiring
- Broad range of accessories
- Compliant for specified A2L applications

DILM Contactors Overview

	DILM 🟢 | XTIEC 🔴
Rated operational voltage	Up to 690 VAC
Rated operational current	7 A to 170 A
Utilization categories	AC-1, AC-3
Load type suitability	Inductive loads, squirrel-cage motors, auxiliary power circuits
Poles	3-pole and 4-pole
Control voltage options	AC and DC operated coils
Power consumption	Low holding power, typically 0.9 W to 2.1 W, optimized for continuous operation.
PLC compatibility	DC-Operated versions suitable for direct PLC control (within ratings)
Standards	IEC/EN 60947-4-1, UL 60947-4-1
Certifications	CE, VDE 0660, CCC, UL, CSA
Eaton.com link	DILM | XT



DILM



XTIEC Contactors

Market availability: 🟢 Global 🟡 IEC 🔴 US UL

Star-Delta contactor combinations

Reduced-voltage motor starting for large pumps and compressors

Functional role in the cooling system:

Star-delta contactor combinations provide a pre-engineered reduced-voltage starting solution for three-phase induction motors. Motors start in star (Y) configuration and automatically transition to delta (Δ), reducing inrush current and mechanical stress during start-up.

Impact on cooling availability and risk:

Large pumps and compressors in liquid-cooling systems often start under load and operate continuously. Uncontrolled starting can stress both electrical and mechanical systems. Star-delta starters help to:

- Reduce starting current to approximately one-third of DOL
- Limit mechanical shock during motor start-up
- Improve system stability in cooling-critical power networks
- Extend motor and equipment lifetime

Typical applications:

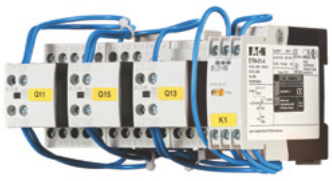
Chillers	Coolant distribution unit
Compressor motors	Large internal pump motors
Primary and secondary chilled water pumps	Lead-lag and N+1 pump configurations
Condenser water pumps	High-capacity, centralized CDU skids

Key strengths:

- Reduced-voltage motor starting for high-power motors
- Factory-assembled and pre-wired solution
- Integrated timing relay for star-to-delta transition
- Mechanical and electrical interlocking for safe operation
- IEC and UL compliant solutions for global deployments

SDAINL

Starting method	Star (Y) start with automatic transition to Delta (Δ) run
Inrush current reduction	Approx 1/3 of Direct-On-Line (DOL) starting current
Rated operational voltage	Up to 690 VAC
Supply frequency	50/60 Hz
Utilization category	AC-3
Motor power range (400 VAC)	5.5 kW to 132 kW
Integrated components	Mains contactor, star-delta contactor, delta contactor, star-delta timing relay
Interlocking	Mechanical and electrical interlocking between contactors
Coordination	Supports IEC coordination Type 1 and Type 2 (depending on upstream protection)
Mounting	DIN-Rail
Standards	IEC/EN 60947-4-1 / UL 60947-4-1
Certifications	CE, UL, CSA
Eaton.com link	Eaton.com



Market availability: Global IEC US UL

Soft Starters

Controlled motor starting for reliable, energy-efficient liquid cooling

Functional role in the cooling system:

Soft starters control motor start-up by gradually increasing voltage and torque, reducing inrush current and mechanical shock compared to direct-on-line starting. They are used for pumps, compressors, and fans in chillers and CDUs.

Impact on cooling availability and risk:

In liquid-cooled data centers, electrical and mechanical stability during motor starting directly affects cooling availability. Soft starters help to:

- Limit inrush current and voltage dips, helping maintain electrical stability in cooling-critical power networks
- Reduce mechanical stress on pumps, compressors, and pipework, extending equipment lifetime
- Improve reliability of continuous-duty cooling systems, particularly in high-density and AI environments
- Support redundancy architectures (N+1, lead-lag) without disturbing adjacent cooling loops
- Enable smoother commissioning and safer operation of chillers and CDUs

Typical applications:

Chillers	Coolant distribution unit
Auxiliary and primary pump motors	Primary and secondary pump control
Compressor motors (medium to large)	Redundant pump sets
Condenser and cooling fan motors	Skid-mounted cooling assemblies
	High-capacity centralized CDUs

Key strengths:

- Reduced inrush current and electrical stress
- Lower mechanical stress on cooling equipment
- Improved reliability for continuous-duty operation
- Support for redundancy and availability strategies
- Compact, panel-friendly integration
- Scalable across cooling applications

DS7, S711 and S811+ Soft starters

	DS7 Industrial micro	S711 Industrial general purpose	S811+ Industrial general purpose
Features	- 2-phase control - SmartWire-DT - Enhanced diagnostics - Integrated bypass - xStart compatible	- 3-phase control - Cybersecurity - Enhanced diagnostics - Integrated bypass - In-Delta connection	- 3-phase control - Cybersecurity - In-Delta connection
Control voltage	24 V AC/DC / 110-230 VAC	24 V DC /110-250 VAC	24 V DC
Rated operational voltage	200 - 480 VAC	200 -600 VAC	200 -690 VAC
Rated operational current	4 to 200 A	12 to 560 A	37 to 1000 A
Standards	EN/IEC 60947-4-2; UL 508 CSA File No.: 2511305 UL File No.: E251034	IEC/EN 60947-4-2 UL File No.: E251034	IEC/EN 60947-4-2 CSA-C22.2 No. 14 UL 508
Certifications	CE	CE	CE
Eaton.com link	Eaton.com	Eaton.com	Eaton.com



DS7



S711



S811+

Market availability: Global IEC US UL

Variable Frequency Drives (VFDs)

Dynamic speed control for efficient, responsive liquid cooling

Functional role in the cooling system:

Variable Frequency Drives provide precise variable-speed control of motors driving pumps, fans, and compressors. By adjusting motor speed in real time, VFDs match coolant flow and pressure to actual cooling demand.

Impact on cooling availability and risk:

Liquid-cooled data centers experience rapidly changing thermal loads driven by AI, HPC, and dynamic workloads. Fixed-speed operation can lead to inefficiency or instability. VFDs help to:

- Match coolant flow and pressure to real-time thermal demand, ensuring stable heat removal
- Improve energy efficiency by eliminating constant-speed motor operation
- Support continuous, reliable pump and compressor operation in cooling-critical systems
- Enable precise control of isolated liquid loops, helping manage dew-point constraints and condensation risk
- Support scalable cooling architectures, from small CDUs to central chiller plants

Typical applications:

Chillers	Coolant distribution unit
Primary and secondary pumps	Primary and secondary pumps
Condenser water pumps	Redundant and lead-lag pump configurations (N+1)
Compressor motors	Skid-mounted CDU assemblies

Key strengths:

- Precise variable-speed motor control for pumps, fans, and compressors
- Significant energy savings compared to constant-speed operation
- Stable coolant flow and pressure control across varying load conditions
- Support for multi-pump and redundancy architectures
- Compact, panel-friendly designs for CDUs and chiller control cabinets
- Integrated safety and protection functions (model-dependent)
- IEC and UL compliance for global data-center deployments

PowerXL Drives

	Positioning	Typical applications	Power	Key characteristics
DB1	OEM / Cold plate	Pumps, compact machinery	Up to 4 kW	Compact design, basic VFD functionality, optimized for OEM integration
DE1 DE11	Machinery micro	Pumps, low power fans	Up to 7.5 kW	Very compact, decentralized drive concept, basic speed control
DM1 DM1 Plus DM1 Pro	General purpose compact	Pumps, fans, compressors, HVAC	Up to 22 kW	Scalable platform design (DM1→ DM1 Plus → DM1 Pro) Field-configurable connectivity (Bluetooth for commissioning on DM1 Pro) Wired communication focus for secure environments (DM1, DM1 Plus) STO (SIL2) safety (DM1 Plus, DM1 Pro)
DH1	HVAC	Pumps, fans, compressors, HVAC	Up to 160 kW	Native HVAC communication (BACnet, Modbus, etc.), Integrated application features (PID, multi-pump)
DG1	General purpose	Pumps, fans, compressors, HVAC	Up to 160 kW	Multi-pump control, torque control, permanent-magnet motors, integrated safety (STO), web server, advanced diagnostics



DB1



DE1



DM1



DM1 Pro and Plus



DH1



DG1

Market availability: Global IEC US UL

Harmonics and power quality

Managing current distortion in liquid-cooled systems

Functional role in the cooling system:

Harmonic mitigation devices reduce current and voltage distortion generated by non-linear loads such as Variable Frequency Drives (VFDs), soft starters, and electronically controlled motors. Eaton solutions, including line reactors, passive harmonic filters, and active harmonic filters, are applied to limit harmonic currents, smooth current waveforms, and improve overall power quality within cooling electrical systems.

Impact on cooling availability and risk:

Liquid-cooled data centers rely heavily on VFD-driven pumps and compressors operating continuously and often at partial load. Without harmonic mitigation, distorted currents can negatively affect both electrical and cooling performance. Harmonic management helps to:

- Reduce overheating of transformers, cables, and switchgear supplying cooling systems
- Improve efficiency and reliability of pumps, compressors, and drives
- Minimize voltage distortion that can affect sensitive control and monitoring equipment
- Support stable operation of high-density cooling zones, including AI and HPC environments
- Maintain compliance with power-quality limits in shared electrical infrastructures

Typical applications:

Chillers	Coolant distribution unit
VFD-driven compressors, pumps, and condenser fans	VFD-driven pumps in rack-, row-, or skid-level CDUs
Centralized chiller plants with high installed motor power	High-density CDU zones serving AI and HPC workloads
Cooling systems operating continuously or at partial load	Electrical panels supplying multiple CDU skids or rows
Electrical rooms supplying multiple chiller feeders	Cooling systems with fluctuating or rapidly changing loads

Key strengths:

- Reduces harmonic current and voltage distortion from VFD-driven pumps, fans, and compressors
- Protects electrical infrastructure by preventing overheating of transformers, cables, and switchgear
- Improves reliability and efficiency of cooling equipment and drive systems
- Supports power-quality compliance and scalability in high-density, modular data-center architectures

Line reactors, passive harmonics filters and active harmonic filters (Harmonic Correction Units HCU)

	Line reactors	Passive harmonic filters	Active harmonic filters
Best suited for	Individual VFD-driven pumps or fans Distributed CDU architectures Applications where simplicity and footprint matter	Centralised chiller plants Cooling systems with well-defined, steady load profiles Installations designed around a fixed operating point	High-density CDU zones serving AI and HPC workloads Electrical rooms supplying multiple VFDs Cooling systems with fluctuating or expanding load profiles
What they deliver	Basic reduction of harmonic current generated by VFDs Additional protection for the drive rectifier against transients Improved robustness of individual motor feeders	Strong attenuation of specific harmonic orders Improved power quality for known load conditions Passive operation with no active control electronics	Real-time cancellation of harmonic currents across a wide spectrum Adaptation to changing operating conditions and redundancy states Additional benefits such as power-factor correction and load balancing
Design intent	A simple, passive solution applied at the drive level to moderate harmonic effects and protect equipment, without system-wide correction.	An engineered solution for environments where load behavior is well understood and unlikely to change significantly over time	A flexible, scalable solution that decouples harmonic performance from individual drives, protecting shared electrical infrastructure as cooling density increases
Eaton.com link	Eaton.com		

Engineered Harmonics Solution

Combines variable-speed motor control with integrated harmonic mitigation. By significantly reducing harmonic current distortion at the source, the EGP helps improve power quality, minimize electrical infrastructure stress, and support reliable operation of high-power chillers and pumping systems used in modern data centers.

PowerXL EGP 18-Pulse VFD

Market availability: Global IEC US UL

Control and automation

How cooling systems are controlled, monitored, and safely operated

Programmable control relays

Local control and monitoring for auxiliary cooling systems

Functional role in the cooling system:

Programmable relays provide compact, flexible control and monitoring for auxiliary systems in chillers and Coolant Distribution Units (CDUs). They are used to control pumps, valves, interlocks, and alarms, while collecting operational and electrical data at the equipment level.

Impact on cooling availability and risk:

Liquid-cooling architectures rely on many distributed subsystems operating reliably and in coordination. Local control relays help to:

- Execute control logic close to pumps, valves, and cooling auxiliaries
- Maintain operation even if higher-level systems are unavailable
- Improve fault response times by localizing control decisions
- Enable energy and operational monitoring for efficiency and diagnostics

Typical applications:

Chillers	Coolant distribution unit
Auxiliary and primary pump motors	Small skid based
Small packaged chillers	Entry-level PLC control
Medium chillers	System and skid-level control
Chiller plant coordination	Centralized / supervisory control

Key strengths:

- Compact local control platform for chillers and CDUs
- Integrated Ethernet and web server functionality
- Flexible communication with Modbus TCP, Modbus RTU and SmartWire-DT
- Expandable I/O architecture for evolving system requirements
- Simplified programming and commissioning
- IEC and UL compliant solution for global deployments

easyE4 Programmable relays

Applications	Pumps, valves, alarms, CDU auxiliaries, local control panels
Control level	Local machine and skid control
I/O expansion	Up to 11 expansion modules
Communication	Ethernet, Modbus TCP/RTU, SmartWire-DT
Visualization	Integrated display and web server
Programming	IEC-based logic programming
Standards	EN/IEC 61131-2
Certifications	CE, UL, cUL, NEMA
Eaton.com link	Eaton.com



Market availability: Global IEC US UL

Programmable Logic Controllers (PLCs)

Scalable control for chillers and CDUs

Functional role in the cooling system:

PLCs provide deterministic, industrial-grade control for chillers and CDUs, processing real-time inputs such as temperature, pressure, and flow to coordinate pumps, compressors, valves, and heat exchangers. The portfolio scales from compact local control to multi-system coordination.

Impact on cooling availability and risk:

Liquid-cooled data centers operate under rapidly changing thermal loads, particularly in AI and HPC environments. PLC-based control enables:

- Precise regulation of coolant temperature, pressure, and flow
- Stable operation of primary and secondary cooling loops
- Coordinated management of redundancy (N+1, lead-lag, standby pumps)
- Protection against thermal excursions, condensation, and flow loss

Typical applications:

Chillers	Coolant distribution unit
Auxiliary and primary pump motors	Small skid based
Small packaged chillers	Entry-level PLC control
Medium chillers	System and skid-level control
Chiller plant coordination	Centralized / supervisory control

Key strengths:

- Scalable control platform ranging from simple, local logic to high-performance system automation
- Modular and flexible architectures to match cooling system size and complexity
- Broad industrial communication support for integration with drives, HMIs, BMS, and SCADA
- Reliable, deterministic control for pumps, compressors, valves, and cooling processes
- Cyber Resilience Act (CRA) compliant for secure and resilient cooling system operation

easyE4 Nano, XC100, XC200 and XC300 PLCs

	easyE4 Nano PLC	XC100 PLC	XC200 PLC	XC300 PLC
Product class	Nano PLC / smart relay	Entry-level modular PLC	Mid-range modular PLC	High-performance modular PLC
Typical application size	Small, localized control	Simple automation tasks	Medium-complexity systems	Large and complex systems
Controller architecture	Integrated base with expansions	Modular CPU + snap-on I/O	Modular CPU + expanded I/O	Modular CPU + high-density I/O
Programming environment	easySoft	CODESYS 3 (IEC 61131-3)	CODESYS 3 (IEC 61131-3)	CODESYS 3 (IEC 61131-3)
Performance level	Basic sequencing & logic	Low to medium performance	Medium performance	High performance, fast cycle times
Base I/O (typical)	12 I/O (model dependent)	Integrated I/O on CPU	Integrated I/O on CPU	Integrated I/O on CPU
Supported protocols	Modbus TCP, Modbus RTU (optional)	Modbus TCP, OPC UA	Modbus TCP, OPC UA, CANopen	Modbus TCP, OPC UA, EtherNet/IP, CANopen, EtherCAT
Web visualization	Integrated web server	HTML5 web visualization	HTML5 web visualization	Advanced HTML5 web visualization
Eaton.com link	Eaton.com	Eaton.com	Eaton.com	Eaton.com



easyE4 Nano



XC100



XC200

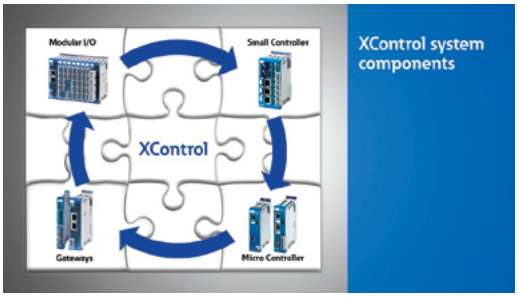


XC300

Market availability: Global IEC US UL

Control and monitoring I/O

Signal acquisition for cooling system operation



Click to play our Xcontrol video

Functional role in the cooling system:

I/O modules provide modular signal acquisition and output control for non-safety functions in chillers and CDUs. They interface sensors, actuators, and field devices with PLCs and control systems.

Impact on cooling availability and risk:

Reliable control depends on accurate, continuous data from the cooling process. Standard I/O systems help to:

- Monitor temperatures, pressures, and flow rates in real time
- Control pumps, valves, and drives with deterministic response
- Support modular and space-efficient control cabinet designs
- Maintain stable operation of cooling loops under continuous duty

Typical applications:

Chillers	Coolant distribution unit
Pump start/stop and operational feedback	Pump control and sequencing for coolant delivery
Monitoring of flow, pressure, and temperature signals	Continuous monitoring of flow, pressure, and temperature
Valve actuation and status feedback	Valve actuation for supply and return circuits
Alarm handling and system diagnostics	Alarm, diagnostics, and status monitoring for mission-critical operation
Interface between chiller subsystems and higher-level control systems	Data exchange with BMS/DCIM for operational visibility

Key strengths:

- Standard, non-safety I/O for operational control
- Modular, compact, slice-based design
- Seamless system integration
- Designed for continuous, mission-critical operation

XN300 Standard I/O



System type	Modular, slice-based standard I/O system (non-safety) with high channel density
Primary function	Acquisition and control of standard automation signals
I/O types available	Digital inputs and outputs, analog inputs and outputs, relay outputs, multi-I/O modules
Analog input modules	8-channel temperature inputs for PT1000 / KTY sensors
Analog output modules	4-channel analog outputs, 16-bit resolution, current or voltage
Relay output modules	5 relay outputs, 24 V DC / 6 A, change-over contacts
Pulse width modulation (PWM)	2-channel PWM output modules, 24 V, up to 20 kHz
Communication interfaces	Serial interface modules RS232 and RS485 available
System integration	Local I/O expansion for Eaton XC PLCs or remote I/O station via gateways and fieldbus interfaces
Installation and wiring	Plug-in connection system; supports pre-assembled I/O blocks
Engineering tools	Supported by XN300 Assist for engineering and commissioning
Eaton.com link	Eaton.com

Market availability: Global IEC US UL

Human-Machine Interfaces (HMIs) and Industrial PCs

Visualization, interaction, and diagnostics for cooling systems

Functional role in the cooling system:

HMIs and Industrial PCs provide local and supervisory visualization of chiller and CDU operation. They present real-time process data, alarms, trends, and system status, enabling operators and service personnel to interact with cooling equipment.

Impact on cooling availability and risk:

Visibility is critical in liquid-cooled environments, where issues can escalate quickly. Visualization platforms help to:

- Provide immediate insight into cooling system performance
- Support faster troubleshooting and fault resolution
- Enable safe commissioning and maintenance activities
- Integrate cooling equipment into higher-level monitoring or SCADA systems

Typical applications:

Chillers	Coolant distribution unit
Fitted on the front of the chiller	Fitted on the front of the CDU

Key strengths:

- Scalable visualization and interaction from basic HMI to high-performance industrial PC
- Clear operator insight and diagnostics to support reliable cooling system operation
- Flexible integration with PLCs, drives, and automation systems across chiller and CDU architectures
- The XV-100 and XV-300 are available as integrated HMI-PLCs, simplifying system design and saving space by eliminating the need for a separate PLC
- Industrial-grade design for continuous operation in demanding data-center environments

XV100, XV300 HMIs and XP500 Industrial PC

	XV100	XV300	XP500
Device category	HMI or HMI-PLC touch display	HMI or HMI-PLC touch display	Industrial PC / Panel PC
Primary role	Compact machine-level control & visualization	Advanced machine-level control & visualization	Supervisory visualization & industrial computing
Integrated PLC	Optional (HMI-PLC variant)	Optional (HMI-PLC variant)	No (external PLC required)
Operating system	Linux	Linux	Windows 10 Enterprise LTSC
Touch technology	Industrial touch (resistive / standard)	Capacitive multi-touch	Capacitive multi-touch
Screen size	3.5", 5.7", 7"	7", 10.1", 15"	Panel PC / terminal configurations (model-dependent)
User interaction	Single-touch operation	Multi-touch, gesture control	Multi-touch, gesture control
System performance	Standard HMI performance	High-performance HMI / HMI-PLC	High-performance industrial computing
Communication interfaces	Ethernet, serial, fieldbus	2 x Ethernet, CAN, RS232, RS485	Ethernet, USB, DisplayPort / HDMI
Peripheral interfaces	USB, SD-card (model-dependent)	USB host, SD-card slot	USB host, SD-card slot
Screen orientation	Fixed	Landscape/portrait	Landscape/portrait
Mounting options	Panel mounting	Front or rear mounting	Panel PC, terminal, extended / remote display
Eaton.com link	XV100	XV300	XP500



XV100



XV300



XP500

Market availability: Global IEC US UL

Pilot devices

Local operator control and status indication for cooling equipment

Functional role in the cooling system:

Pilot devices provide local manual control and visual status indication for chillers, Coolant Distribution Units (CDUs), pump skids, and auxiliary cooling equipment. They include pushbuttons, selector switches, indicator lights, and emergency-stop devices mounted on control panels and enclosures, enabling direct interaction with cooling systems at equipment level.

Impact on cooling availability and risk:

Liquid-cooled data-center infrastructure combines electrical power, rotating machinery, and liquid circuits, making clear operator interaction essential. Pilot devices help to:

- Enable reliable local operation during commissioning, maintenance, and service
- Provide immediate visual feedback on system status, alarms, and operating modes
- Support manual control and override functions when automated systems are unavailable or inhibited
- Improve safety by providing clearly accessible emergency-stop functions at the equipment level

Typical applications:

Chillers	Coolant distribution unit
Fitted on the front of the electrical control panel	Front operator panel or enclosure door

Key strengths:

- Clear local operator control and status indication for cooling equipment
- Improved safety and usability during commissioning, operation, and maintenance
- Robust industrial design suitable for harsh mechanical and electrical environments
- Standardized, modular devices enabling consistent panel design across chillers and CDUs

Pilot devices

	Standard 22.5 mm M22 pilot devices	Flat 30 mm M30 pilot devices
Mounting holes	22.5 mm	30 mm
Function	Pushbuttons Mushroom head pushbuttons Indicating light Selector switches Double pushbuttons Four-way pushbuttons Bulkhead interface (USB Socket and RJ45 Socket) Joystick Potentiometer Acoustic device Advanced indicator	Pushbuttons Indicating light Selector switches Joystick Potentiometer Bulkhead interface (USB Socket and RJ45 Socket)
Eaton.com link	Standard 22 mm M22 pilot devices Advanced Indicator	Flat 30 mm M30 pilot devices



22.5 mm pilot device



Advanced Indicator



Flat 30 mm pilot device

Market availability: Global IEC US UL

Monitoring and safety

Monitoring system conditions and ensuring safe operation of cooling equipment

Functional safety systems

Independent safety layer for personnel and equipment protection

XN Safety

Functional role in the cooling system:

XN Safety systems provide a dedicated, safety-certified control layer for emergency stops, access interlocks, and safety shutdown functions in chillers and CDUs. They operate independently from standard control logic.

Impact on cooling availability and risk:

Cooling equipment combines electrical power, rotating machinery, and liquid circuits. Functional safety systems are essential to:

- Protect personnel during maintenance and service activities
- Ensure safe shutdown of pumps and drives during hazardous conditions
- Prevent unsafe operation when access panels or service doors are opened
- Maintain compliance with functional safety standards without compromising availability

Typical applications:

Chillers	Coolant distribution unit
Functional safety for chiller operation and maintenance	Functional safety for CDU operation and maintenance
Monitoring emergency stop buttons on chiller cabinets	Monitoring emergency stop buttons on CDU cabinets
Service-door and access-panel interlocks on chiller enclosures	Service access and panel interlocks on CDU cabinets
Safe shutdown of pumps, fans, and auxiliary drives during service	Immediate shutdown of pumps during maintenance activities
Controlled shutdown of rotating equipment during emergencies or service	Immediate pump shutdown to prevent coolant release and equipment damage

Key strengths:

- Provides an independent safety system for cooling equipment, operating separately from standard control logic
- Certified safety performance
- Targeted protection for cooling risk
- Flexible integration within cooling architectures

XN Safety overview

System type	Modular safety PLC system with safety-certified I/O
Primary function	Execution of safety-related control functions
I/O types available	Safety digital inputs, safety digital outputs, safety analog I/O, encoder inputs
Safety functions	Emergency stop, guard and door monitoring, safe shutdown functions
Safety integrity	Certified up to SIL 3 / PL e (application-dependent)
Safety logic	Executed independently from standard control logic
System integration	Standalone safety system or integrated with XC PLCs and XN300 via gateway
Installation and wiring	Push-in and plug technology for tool-free wiring
System capacity	Supports up to 16 safety I/O modules
Engineering tools	XN Safety Designer for safety logic configuration
Eaton.com link	Eaton.com



Market availability: Global IEC US UL

Safety relays

Local safety functions inside chiller and CDU panels

Functional role in the cooling system:

Safety relays provide local emergency stop and access protection, monitoring safety devices and disconnecting power to pumps, fans, or drives when a hazardous condition is detected.

Impact on cooling availability and risk:

In liquid-cooled data centers, rapid and reliable safety response is critical. Safety relays help to:

- Enable immediate shutdown of cooling equipment during emergencies
- Protect service personnel working on live cooling systems
- Provide simple, robust safety functions at the equipment level
- Complement higher-level safety PLC architectures

Typical applications:

Chillers	Coolant distribution unit
Monitoring emergency stop buttons on the chiller cabinet	Monitoring emergency stop buttons on CDU cabinets
Monitoring service doors or access panels	Monitoring service doors or access panels
Initiating safe shutdown of pumps, fans, or auxiliary drives via safety contactors	Immediate shutdown of pumps during maintenance or emergency conditions
Providing maintenance safety during service operations	Local safety functions independent of higher-level control systems

Key strengths:

- Reliable local emergency stop and access protection
- Fast safety response at equipment level
- Certified safety performance in a compact design
- Simple and robust safety solution

ESR5

Primary function	Emergency stop and access protection
Safety level	Up to PL e/SIL 3
Safety functions	E-stop, guard/door monitoring
Supply voltage	AC/DC/UC variants
Mounting	DIN-Rail
Standards	Functional safety (EN/ISO): EN ISO 13849-1 (up to PL e) Functional safety (IEC): IEC 62061 (up to SIL CL 3) North America: UL/cUL, CSA
Certifications	TÜV Rheinland
Eaton.com link	Eaton.com link



Market availability: Global IEC US UL

Emergency stop buttons

Immediate, safety-rated shutdown for cooling equipment

Functional role in the cooling system:

Emergency stop buttons provide a manually operated, safety-rated means to stop cooling equipment immediately in hazardous or abnormal situations. When actuated, they initiate a shutdown of pumps, compressors, drives, or associated machinery via the safety circuit, overriding normal control logic.

E-stop buttons are typically mounted on chiller panels, CDU enclosures, and pump skids to ensure they are clearly visible and easily accessible to operators and service personnel.

Impact on cooling availability and risk:

Liquid-cooled data-center infrastructure combines electrical power, rotating machinery, and pressurised liquid circuits. In such environments, rapid and unambiguous shutdown capability is essential. Emergency stop buttons help to:

- Protect personnel during maintenance, commissioning, or fault conditions
- Enable immediate response to leaks, mechanical failures, or unsafe operation
- Prevent escalation of incidents that could damage cooling equipment or IT loads
- Support safe servicing of distributed cooling assets such as CDUs and pump skids

Typical applications:

Chillers	Coolant distribution unit
Fitted on the front of the chiller	Fitted on the front of the CDU

Key strengths:

- Immediate, safety-rated shutdown of pumps, drives, and cooling equipment in hazardous situations
- Clear, highly visible actuation enabling fast operator response during emergencies
- Supports personnel and equipment protection during maintenance, commissioning, or fault conditions
- Standards-compliant, robust industrial design for reliable operation in chiller and CDU environments

Emergency stop buttons

	Standard 22.5 mm pilot devices	Flat 30 mm pilot devices
Button diameter	30 mm 38 mm 45 mm 60 mm	30 mm
Release	Twist release Pull-to-release Key release	Twist release Pull-to-release
Eaton.com link	Eaton.com link	



30 mm Ø
Small E-stop



38 mm Ø



45 mm Ø



60 mm Ø

Emergency stop buttons are shown for illustrative purposes only.
Products are not depicted to scale and may not reflect actual dimensional differences between models.

Market availability: Global IEC US UL

Liquid filtration

Protect coolant quality. Maximize cooling system reliability.

Functional role in the cooling system:

Liquid filtration products remove contaminants from cooling circuits, helping protect critical components, maintain thermal performance, reduce maintenance, and maximize system uptime. Effective filtration is an essential part of reliable liquid cooling infrastructures for data centers. It protects components like pumps, heat exchangers, valves, quick connectors, and cold plates from becoming blocked, thereby helping to ensure maximum data center uptime.

Typical applications:

- Data center liquid cooling systems
- Coolant Distribution Units (CDUs)
- Chillers and cooling plants
- Direct-to-chip cooling systems
- Peripheral cooling applications
- High performance computing (HPC) and AI Infrastructure

Key strengths:

- Maintains coolant quality and system cleanliness
- Protects pumps, cold plates, valves, heat exchangers, and cooling circuits
- Reduces wear, fouling, and component damage
- Supports reliable thermal performance and heat transfer efficiency
- Minimizes maintenance costs and downtime
- Extends the service life of cooling equipment
- Improves overall system reliability and availability

Manual pipeline strainers for condenser water system (CWS)

	Model 73	Model 510
Design	Simplex basket strainer with a convoluted (pleated) basket design	Simplex strainer with a four-basket design
Primary benefit	Reduces pressure loss in high-flow pipelines	Maximizes dirt-holding capacity and extends time between cleanings
Flow capacity	Designed for large pipelines and high flow rates	Designed for very large systems with flow rates up to 40,000 GPM (9,000 m^3/h)
Basket removal	Hand-removable basket; no lifting tackle required	Four smaller baskets; easier one-person maintenance despite larger strainer size
Pressure loss	Very low pressure loss due to the straight through flow and pleated basket design	Very low due to straight-through flow configuration but optimized primarily for capacity rather than minimum pressure drop
Typical sizes	10"–18"	8"–36"
Best suited for	High-flow systems where low pressure drop is the main requirement	High-flow systems with heavy contaminant loads that require longer service intervals
Eaton.com link	Eaton.com	Eaton.com



Model 73



Model 510

Y and Angle strainers for facility water system (FWS) or technology cooling system (TCS)

	Y- or Angle Strainers
Design	Compact stainless steel design with a sanitary tri-clamp connection, combining durability with fast and simple maintenance
Primary function	Removes unwanted solids to protect pumps, valves, heat exchangers, cold-plates, and other critical components in FWS and TCS applications
Available sizes	2" to 4", other sizes available upon request
Body materials	Stainless steel
Pressure rating	150 psi (10 bar)
Filtering element	Stainless steel sintered wire mesh or slotted wedge wire, with filtration ratings from 25 µm to 500 µm
Eaton.com link	Eaton.com



Bag filter housings for technology cooling system (TCS)

	SIDELINE™ Single bag filter housing	MAXILINE™ Multi-bag filter housing
Design	Single-bag filter housing	Multi-bag filter housing
Bag capacity	Limited to 1 filter bag per housing	From 3 to 24 filter bags per housing
Typical applications	Low to medium flow rates	Can be increased proportionally by the number of bags installed in the housing
Recommended filter bag range	HAYFLOW QDC filter element for lowest pressure drop at relatively high flow rates	HAYFLOW QDC filter element for lowest pressure drop at relatively high flow rates
Pressure drop	Lower at equivalent flow because the flow is distributed over several bags	One or more housings installed in parallel inside the CDU for low to medium flow rates
Construction materials	Stainless steel (304/316), various connection options	304 SS, 316 SS depending on model
Best suited for	Ideal for individual cooling loops, pilot installations, or lower-flow skid packages	Better suited for large chillers, centralized cooling systems, and data center CDUs where high flow rates, longer maintenance intervals, and reduced operating costs are critical
Eaton.com link	Eaton.com	Eaton.com



SIDELINE



MAXILINE

HAYFLOW™ QDC Filter Elements

High-capacity filtration designed to protect liquid cooling systems from particulate contamination. Combining the dirt-holding capability of a filter bag with the performance of a cartridge element, HAYFLOW™ QDC filters help maintain coolant quality while minimising pressure loss.

Eaton.com

Key strengths:

- High flow rates with low pressure drop
- Extended service life and reduced maintenance
- Protects pumps, valves and heat exchangers
- Supports coolant quality and thermal efficiency
- Suitable for SIDELINE™ and MAXILINE™ filtration systems

Market availability: Global IEC US UL

Powering the next generation of data centers

As data centers evolve to support AI, high-performance computing, and increasingly dense workloads, liquid cooling is becoming foundational infrastructure. Its success depends not only on thermal technology, but on the electrical systems that power, protect, control, and monitor it.

Eaton provides the electrical backbone that enables chillers and Coolant Distribution Units (CDUs) to operate safely, efficiently, and at scale. From incoming power and protection to motor control, automation, monitoring, and functional safety, Eaton solutions are designed to support continuous operation, simplify integration, and adapt as cooling architectures evolve.

By combining deep electrical expertise with a broad, globally available portfolio, Eaton helps cooling OEMs, system integrators, and data-center operators design liquid-cooled infrastructures that are resilient, energy-efficient, and future-ready.

We make what matters work, so high density data centers can perform, today and tomorrow.

Eaton is an intelligent power management company dedicated to protecting the environment and improving the quality of life for people everywhere. We make products for the data center, utility, industrial, commercial, machine building, residential, aerospace and mobility markets. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power - today and well into the future. By capitalizing on the global growth trends of electrification and digitalization, we're accelerating the planet's transition to renewable energy sources, helping to solve the world's most urgent power management challenges, and building a more sustainable society for people today and generations to come.

For more information, visit **www.eaton.com**

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