



ESIE10-01



# *Service Manual*

**EWAD620-C17C-SS/SL/SR**

**EWAD740-C19C-XS/XL/XR**

**EWAD810-C14C-PS/PL/PR**

**Air-cooled chiller EWAD~CJ**

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# Part 1

## System Outline

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**Introduction**

This part contains an outline of all the relevant elements in the EWAD-CJ air-cooled units.

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**What is in this part?**

This part contains the following chapters:

Chapter	See page
1-General Outline	1-3

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**1**

# 1 General Outline

## 1.1 What Is in This Chapter?

### Introduction

This chapter contains the following information:

- Technical specifications
- Electrical specifications
- Capacity tables
- Correction factors
- Heat recovery ratings
- Wiring diagrams

### Overview

This chapter contains the following topics:

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**1**

<b>Topic</b>	<b>See page</b>
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## 1.2 Features

### Low operating cost

EWAD is the result of careful design, aimed to optimizing the energy efficiency of the chillers, with the objective of bringing down operating costs and improving profitability, effectiveness and economical management. The EWAD chillers use the New very high efficiency McQuay single rotor screw compressor design, large condenser coil surface area for maximum heat transfer and low discharge pressure, advanced technology condenser fans, a single-pass pure conterflow shell&tube direct-expansion evaporator with low refrigerant pressure drops.

### Low operating sound levels

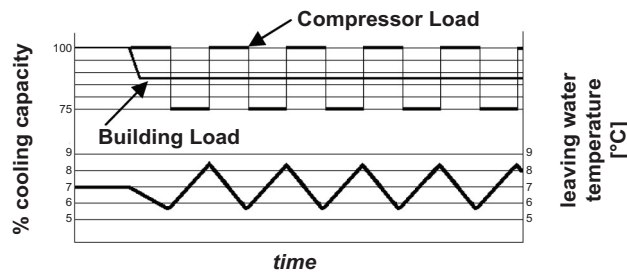
Very low noise levels both at full load and part load conditions are achieved by the latest compressor design that use a single main rotor with two adjacent rotating composite gaterotors making gas flow velocities and subsequent noise levels among the lowest available, by a unique new fan that moves large volume of air at exceptionally low sound levels and by the virtually vibration-free operation.

### Outstanding reliability

The EWAD chillers have two or three truly independent refrigerant circuits depending from the size, in order to assure maximum safety for any maintenance, whether planned or not. They are equipped with a rugged compressor design with advanced composite compressor gaterotors material, a proactive control logic and are full factory-run-tested to optimized trouble-free operation.

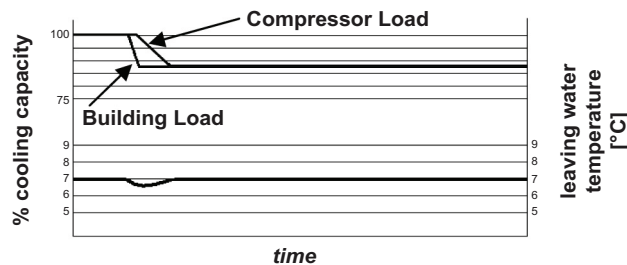
### Infinite capacity control

Cooling capacity control is infinitely variable by means of a single screw asymmetric compressor controlled by microprocessor system. Each unit has infinitely variable capacity control from 100% down to 12% (two compressor unit), down to 7% (three compressors units). This modulation allows the compressor capacity to exactly match the building cooling load without any leaving evaporator water temperature fluctuation. This chilled water temperature fluctuation is avoided only with a stepless control.



With a compressor load step control in fact, the compressor capacity, at partial loads, will be too high or too low compared to the building cooling load. The result is a decrease in chiller energy costs, particularly at the part-load conditions at which the chiller operates most of the time.

ELWT fluctuation with steps capacity control (4 steps)



Units with stepless regulation offer benefits that the units with step regulation are unable to match. The ability to follow the system energy demand at any time and the possibility to provide steady outlet water temperature without deviations from the set-point, are the two points that allow you to understand how the optimum operating conditions of a system can be met only through the use of a unit with step-less regulation.

1

**Superior control logic**

The new MicroTech III controller provides an easy to use control environmental. The control logic is designed to provide maximum efficiency, to continue operation in unusual operating conditions and to provide a history of unit operation. One of the greatest benefits is the easy interface with LonWorks, Bacnet, Ethernet TCP/IP or Modbus communications.

**Code requirements – Safety and observant of laws/directives**

All EWAD units are designed and manufactured in accordance with applicable selections of the following:

Rating of chillers	EN 12055
Construction of pressure vessel	Pressure Equipment 97/23/EC (PED)
Machinery Directive	98/37/EC
Low Voltage	2006/95/EC
Electromagnetic Compatibility	2004/108/EC
Electrical & Safety codes	IEC 60204–1 / EN 60335-2-40
Manufacturing Quality Stds	UNI – EN ISO 9001:2000

**Certifications**

All units manufactured by McQuay Italia S.p.A. are CE marked, complying with European directives in force, concerning manufacturing and safety. On request units can be produced complying with laws in force in non European countries (ASME, GOST, etc.), and with other applications, such as naval (RINA, etc.).

**Versions**

EWAD is available in three different Efficiency Versions:

- **SE:** Standard Efficiency  
11 sizes to cover a range from 647 up to 1714 kW with an EER up to 2.93 and an ESEER up to 3.96 (data referred to Standard Noise).
- **XE:** High Efficiency  
14 sizes to cover a range from 756 up to 1858 kW with an EER up to 3.29 and an ESEER up to 4.23 (data referred to Standard Noise).
- **PR:** Premium Efficiency  
7 sizes to cover a range from 821 up to 1390 kW with an EER up to 3.64 and an ESEER up to 4.53 (data referred to Standard Noise).

The EER (Energy Efficiency Ratio) is the ratio of the Cooling Capacity to the Power Input of the unit. The Power Input includes: the power input for operation of the compressor, the power input of all control and safety devices, the power input for fans.

The ESEER (European Seasonal Energy Efficiency Ratio) is a weighed formula enabling to take into account the variation of EER with the load rate and the variation of air inlet condenser temperature.

$$ESEER = A \times EER_{100\%} + B \times EER_{75\%} + C \times EER_{50\%} + D \times EER_{25\%}$$

	A	B	C	D
Coefficient	0.03 (3%)	0.33 (33%)	0.41 (41%)	0.23 (23%)
Air inlet condenser temperature	35°C	30°C	25°C	20°C

**Sound Configuration**

EWAD is available in many different Sound level configurations:

- **ST:** Standard Noise  
Condenser fan rotating at 940 rpm, rubber antivibration on compressor.
- **LN:** Low Noise  
Condenser fan rotating at 940 rpm, rubber antivibration on compressor, compressor sound enclosure.

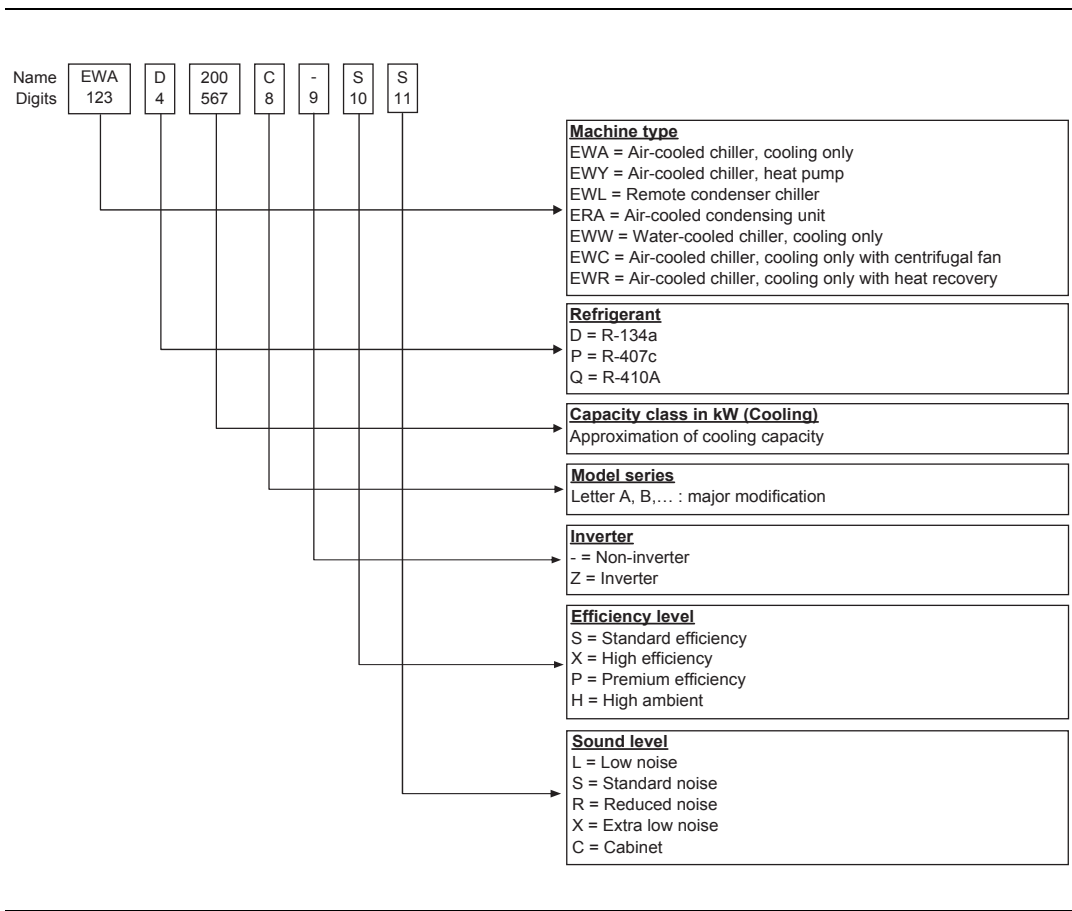


■ **XN:** Extra Low Noise

Condenser fan rotating at 710 rpm, rubber antivibration on compressor, compressor sound enclosure.

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### 1.3 Nomenclature



## 1.4 General Characteristics

<b>Cabinet and structure</b>	The cabinet is made of galvanized steel sheet and painted to provide a high resistance to corrosion. Colour Ivory White (Munsell code 5Y7.5/1) ( $\pm$ RAL7044). The base frame has eye-hook for lifting the unit with ropes for an easy installation. The weight is uniformly distributed along the profiles of the base and this facilitates the arrangement of the unit.
<b>Screw compressors with integrated oil separator</b>	The compressors are semi-hermetic, single-screw type with gate-rotor (with the latest high-strength fibre reinforced star material). Each compressor has an asymmetric slide regulation managed by the unit controller for infinitely modulating capacity. An integrated high efficiency oil separator maximizes the oil separation. Standard Start is Wye-delta (Y- $\Delta$ ) type.
<b>Ecological HFC 134a refrigerant</b>	The compressors have been designed to operate with R-134a, ecological refrigerant with zero ODP (Ozone Depletion Potential) and very low GWP (Global Warming Potential) that means low TEWI (Total Equivalent Warming Impact).
<b>Evaporator</b>	The units are equipped with a Direct Expansion shell&tube evaporator with copper tubes rolled into steel tubesheets. The evaporators are single-pass on both the refrigerant and water sides for pure counter-flow heat exchange and low refrigerant pressure drops. Both attributes contribute to the heat exchanger effectiveness and total unit's outstanding efficiency. The external shell is covered with a 20 mm closed cell insulation material. Each evaporator has 2 or 3 circuits, one for each compressor and is manufactured in accordance to PED approval. The evaporator water outlet connections are provided with Victaulic Kit (as standard).
<b>Condenser coils</b>	The condenser is manufactured with internally enhanced seamless copper tubes arranged in a staggered row pattern and mechanically expanded into lanced and rippled aluminium condenser fins with full fin collars. An integral sub-cooler circuit provides sub-cooling to effectively eliminate liquid flashing and increase in cooling capacity without increasing the power input.
<b>Condenser coil fans</b>	The condenser fans are propeller type with high efficiency design blades to maximize performances. The material of the blades is glass reinforced resin and each fan is protected by a guard. Fan motor is thermally protected (as standard) by internal thermal motor and protected by circuit breaker installed inside the electrical panel as a standard. The motors are IP54.
<b>Electronic expansion valve</b>	The unit is equipped with the most advanced electronic expansion valves to achieve precise control of refrigerant mass flow. As today's system requires improved energy efficiency, tighter temperature control, wider range of operating conditions and incorporate features like remote monitoring and diagnostics, the application of electronic expansion valves becomes mandatory. Electronic expansion valve proposes features that makes it unique: short opening and closing time, high resolution, positive shut-off function to eliminate use of additional solenoid valve, continuous modulation of mass flow without stress in the refrigerant circuit and corrosion resistance stainless steel body. Electronic Expansion Valves are typically working with lower $\Delta P$ between high and low pressure side, than a thermostatic expansion valve. The electronic expansion valve allows the system to work with low condenser pressure (winter time) without any refrigerant flow problems and with a perfect chilled water leaving temperature control.

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**Refrigerant circuit** Each unit has 2 or 3 independent refrigerant circuits and each one includes:

- Compressor with integrated oil separator.
- Air Cooled Condenser.
- Electronic expansion valve.
- Evaporator.
- Discharge line shut off valve.
- Liquid line shut off valve.
- Suction line shut off valve (optional).
- Sight glass with moisture indicator.
- Filter drier.
- Charging valves.
- High pressure switch.
- High and low pressure transducers.

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**Electrical control panel**

Power and control are located in two sections of the main panel that is manufactured to ensure protection against all weather conditions. The electrical panel is IP54 and (when opening the doors) internally protected with Plexiglas panel against possible accidental contact with electrical components (IP20). The main panel is fitted with a main switch interlocked door.

**Power Section**

The power section includes compressors fuses, fan circuit breaker, fan contactors and control circuit transformer.

**MicroTech III controller**

MicroTech III controller is installed as standard; it can be used to modify unit set-points and check control parameters. A built-in display shows chiller operating status plus temperatures and pressures of water, refrigerant and air, programmable values, set-points. A sophisticated software with predictive logic, selects the most energy efficient combination of compressors, EEXV and condenser fans to keep stable operating conditions to maximise chiller energy efficiency and reliability. The compressors are automatically sequenced to ensure equal operating hours and number of starts. MicroTech III is able to protect critical components based on external signs from its system (such as motor temperatures, refrigerant gas and oil pressures, correct phase sequence, pressure switches and evaporator). The input coming from the high pressure switch cuts all digital output from the controller in less than 50 ms, this is an additional security for the equipment. Fast program cycle (200 ms) for a precise monitoring of the system. Floating point calculations supported for increased accuracy in P/T conversions.

#### Control section - main features

- Management of the compressor stepless capacity and fans modulation.
- Chillers enabled to work in partial failure condition.
- Full routine operation at condition of:
  - high ambient temperature value.
  - high thermal load.
  - high evaporator entering water temperature (start-up).
- Display of evaporator entering/leaving water temperature.
- Display of Outdoor Ambient Temperature.
- Display of condensing-evaporating temperature and pressure, suction and discharge superheat for each circuit.
- Leaving water evaporator temperature regulation. Temperature tolerance = 0.1°C.
- Compressors and evaporator pumps hours counter.
- Display of Status Safety Devices.
- Number of starts and compressors working hours.
- Optimized management of compressors load.
- Fan management according to condensing pressure.
- Re-start in case of power failure (automatic / manual).
- Soft Load (optimized management of the compressors load during the start-up).
- Start at high evaporator water temperature.
- Return Reset (Set Point Reset based on return water temperature).
- OAT (Outside Ambient temperature) Reset.
- Set point Reset (optional).
- Application and system upgrade with commercial SD cards.
- Ethernet port for remote or local servicing using standard web browsers.
- Two different sets of default parameters could be stored for easy restore.

#### Safety device / logic for each refrigerant circuit

- High pressure (pressure switch).
- High pressure (transducer).
- Low pressure (transducer).
- Fans circuit breaker.
- High compressor discharge temperature.
- High motor winding temperature.
- Phase Monitor.
- Low pressure ratio.
- High oil pressure drop.
- Low oil pressure.
- No pressure change at start.

#### System security

- Phase monitor.
- Low Ambient temperature lock-out.
- Freeze protection.

**Regulation type**

- Proportional + integral + derivative regulation on the leaving water evaporator output probe.

**Condensing pressure**

- Condensing pressure can be controlled in according to the entering air temperature to the condenser coil. The fans can be managed either with steps, or with a 0/10 V modulating signal or with a mixed 0/10 V + Steps strategy to cover all possible operational conditions.

**MicroTech III**

MicroTech III built-in terminal has the following features.

- 164x44 dots liquid crystal display with white back lighting. Supports Unicode fonts for multi-lingual.
- Key-pad consisting of 3 keys.
- Push'n'Roll control for an increased usability.
- Memory to protect the data.
- General faults alarm relays.
- Password access to modify the setting.
- Application security to prevent application tampering or hardware usability with third party applications.
- Service report displaying all running hours and general conditions.
- Alarm history memory to allow an easy fault analysis.

**Supervising systems (on request)****MicroTech III remote control**

MicroTech III is able to communicate to BMS (Building Management System) based on the most common protocols as:

- ModbusRTU.
- LonWorks, now also based on the international 8040 Standard Chiller Profile and LonMark Technology.
- BacNet BTP certified over IP and MS/TP (class 4) (Native).
- Ethernet TCP/IP.

**Standard accessories (supplied on basic unit)**

**Wye-Delta Compressors starter (Y-D)** - For low inrush current and reduced starting torque.

**Double set-point** - Dual leaving water temperature set-points.

**Fans thermal overload relays** - Safety devices against fan motor overloading in addition to the normal protection envisaged by the electrical windings.

**Phase monitor** - The phase monitor controls that phases sequence is correct and controls phase loss.

**Evaporator Victaulic kit on water connection** - Hydraulic joint with gasket for an easy and quick water connection.

**20 mm evaporator insulation.**

**Evaporator electric heater** - Electric heater controlled by a thermostat to protect the evaporator from freezing down to -28°C ambient temperature, providing the power supply is on.

**Electronic Expansion Valve.**

**Discharge line shut off valves** - Installed on the discharge port of the compressor to facilitate maintenance operation.

**Outside ambient temperature sensor and reset of leaving water temperature set-point.**

**Compressor hour run meter.**

**General fault** - Alarm relay.

**Set-point reset** - The leaving water temperature set-point can be overwritten with the following options: 4-20 mA from external source (by user); outside ambient temperature; evaporator water temperature  $\Delta t$ .

**Demand limit** - User can limit the load of the unit by 4-20 mA signal or by network system.

**Alarm from external device** - Microprocessor is able to receive an alarm signal from an external device (pump etc...). User can decide if this alarm signal will or will not stop the unit.

**Main switch interlock door.**

**Emergency stop.**

**Fans circuit breakers** - Safety device against motor overloading and short circuit.

**Options (on request)**

**Total heat recovery** - Produced with plate to plate heat exchangers to produce hot water.

**Partial heat recovery** - Produced with plate to plate heat exchangers installed between the compressor discharge and the condenser coil, allowing to produce hot water.

**Soft starter** - Electronic starting device to reduce the mechanical stress during compressor start-up.

**Brine version** - Allows the unit to operate down to  $-8^{\circ}\text{C}$  leaving liquid temperature (antifreeze required).

**Compressor thermal overload relays** - Safety devices against compressor motor overloading. This device together with internal motor protection (standard) guarantee the best safety system for compressor motor.

**Under/Over Voltage** - This device controls the voltage value of power supply and stops the chiller if the value exceeds the allowed operating limits.

**Ampere / Volt meter** - Device installed inside the control box showing ampere and volt values.

**Capacitors for power factor correction** - To increase the operating power factor of the unit at nominal operating conditions. The capacitors are "dry" self-regenerating type with over pressure disconnecting safety device insulated with a no toxic dielectric mix with no PCB or PCT.

**Current limit** - To limit maximum absorbed current of the unit whenever is required.

**Fan speed regulation** - To control the fan speed revolution for smooth operating control of the unit. This option improves the sound level of the unit during low ambient temperature operation.

**Speedtrol** - Continuous fan speed modulation on the first fan of each circuit. It allows the unit to work with air temperature down to  $-18^{\circ}\text{C}$ .

**Condenser coil guards.**

**Compressor and evaporator area guards.**

**Cu-Cu condensing coils** - To give better protection against corrosion by aggressive environments.

**Cu-Cu-Sn condensing coils** - To give better protection against corrosion in aggressive environments and by salty air.

**Alucoat condensing coils** - Fins are protected by a special acrylic paint with a high resistance to corrosion.

**Evaporator Flow switch** - Supplied separately to be wired and installed on the evaporator water piping (by the customer).

**Suction line shut off valves** - Installed on the suction port of the compressor to facilitate maintenance operation. High pressure gauges.

**Kit container.**

**Rubber type antivibration mounts** - Supplied separately, these are positioned under the base of the unit during installation. Ideal to reduce the vibrations when the unit is floor mounted.

**Spring type antivibration mounts** - Supplied separately, these are positioned under the base of the unit during installation. Ideal for dampening vibrations for installation on roofs and metallic structures.

**Hydronic Kit (single water pump) (available only on chiller with 2 compressors)** - Hydronic kit consists of: single direct driven centrifugal pump, water filling system with pressure gauge, safety valve, drain valve. The motor pump is protected by a circuit breaker installed in control panel. The kit is assembled and wired to the control panel. The pipe and pump are protected from freezing with an additional electrical heater.

**Hydronic Kit (twin water pumps) (available only on chiller with 2 compressors)** - Hydronic kit consists of: twin direct driven centrifugal pumps, water filling system with pressure gauge, safety valve, drain valve. The motor pump is protected by a circuit breaker installed in control panel. The kit is assembled and wired to the control panel. The pipe and pumps are protected from freezing with an additional electrical heater.

**Witness test** - Every unit is always tested at the test bench prior to the shipment. On request, a second test can be carried out, at customer's presence, in accordance with the procedures indicated on the test form. (Not available for units with glycol mixtures).

**Acoustic test** - On request, a test can be carried out, at customer's presence (Not available for units with glycol mixtures).

**Evaporator right water connections (available only on 2 compressor sizes).**

**Evaporator flanged connections.**

**Refrigerant recovery tank** - This option allows to stock refrigerant charge of 1 circuit for maintenance operation. Liquid receiver includes in/out shut-off valve and relieve valve.

**Compressors circuit breakers.**

**Ground fault protection** - To shut down the entire unit if a ground fault condition is detected.

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## 1.5 Technical Specifications: EWAD~C-SS

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-SS					
				650	740	830	910	970	
Capacity (1)	Cooling		kW	647	744	832	912	967	
Capacity control	Type			Stepless					
	Minimum capacity			%	12.5	12.5	12.5	12.5	12.5
Unit power input (1)	Cooling		kW	221	262	299	318	351	
EER (1)				2.93	2.84	2.78	2.87	2.76	
ESEER				3.95	3.87	3.89	3.84	3.8	
IPLV				4.30	4.17	4.16	4.23	4.14	
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	
		Width	mm	2285	2285	2285	2285	2285	
		Length	mm	6185	6185	6185	6185	6185	
Weight	Unit		kg	5630	5740	5760	6280	6560	
	Operating Weight		kg	5910	5990	6010	6530	6810	
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume			l	266	266	251	251	251
	Nominal water flow rate	Cooling	l/s	30.9	35.56	39.74	43.6	46.21	
	Nominal Water pressure drop	Cooling	kPa	73	59	52	61	68	
Insulation material				Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter			mm	800				
	Nominal air flow			l/s	53444	53444	53444	64133	64133
	Model	Quantity	No.	10	10	10	12	12	
		Speed	rpm	920	920	920	920	920	
Motor input		W	1.75	1.75	1.75	1.75	1.75		
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge			l	38	38	38	44	50
	Quantity			No.	2	2	2	2	2
Sound level	Sound Power	Cooling	dB(A)	99.5	100.0	100.0	100.9	101.1	
	Sound Pressure (2)	Cooling	dB(A)	79.0	79.5	79.5	80.4	80.6	
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge			kg	128	128	128	146	144
	N. of circuits			No.	2	2	2	2	2
Piping connections	Evaporator water inlet/outlet		mm	168.3	168.3	168.3	168.3	168.3	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
Water freeze protection controller									

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Model				EWAD-C-SS					
				C11	C12	C14	C15	C16	C17
Capacity (1)	Cooling		kW	1064	1152	1419	1538	1622	1714
Capacity control	Type			Stepless					
	Minimum capacity		%	12.5	12.5	7	7	7	7
Unit power input (1)	Cooling		kW	378	402	500	551	580	618
EER (1)				2.82	2.86	2.84	2.79	2.8	2.77
ESEER				3.88	3.84	3.88	3.9	3.87	3.78
IPLV				4.17	4.19	4.19	4.22	4.18	4.13
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	2540
		Width	mm	2285	2285	2285	2285	2285	2285
		Length	mm	7085	7985	10185	10185	11085	11085
Weight	Unit		kg	7010	7280	10310	10320	10710	10770
	Operating Weight		kg	7250	7520	10730	10730	11110	11230
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume		l	243	243	421	408	408	474
	Nominal water flow rate	Cooling	l/s	50.85	55.04	67.78	73.5	77.51	81.89
	Nominal Water pressure drop	Cooling	kPa	63	72	47	59	65	73
Insulation material				Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter		mm	800					
	Nominal air flow		l/s	74822	85510	106888	106888	117577	117577
	Model	Quantity	No.	14	16	20	20	22	22
		Speed	rpm	920	920	920	920	920	920
Motor input		W	1.75	1.75	1.75	1.75	1.75	1.75	
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge		l	50	50	75	75	75	75
	Quantity		No.	2	2	3	3	3	3
Sound level	Sound Power	Cooling	dB(A)	101.5	101.7	102.9	103.0	103.2	103.3
	Sound Pressure (2)	Cooling	dB(A)	80.6	80.6	81.0	81.1	81.1	81.2
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge		kg	162	178	260	260	261	261
	N. of circuits		No.	2	2	3	3	3	3
Piping connections	Evaporator water inlet/outlet		mm	168.3	168.3	219.1	219.1	219.1	219.1
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
	Water freeze protection controller								

**Notes**

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(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

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## 1.6 Technical Specifications: EWAD~C-SL

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-SL					
				650	740	830	910	970	
Capacity (1)	Cooling		kW	647	744	832	912	967	
Capacity control	Type			Stepless					
	Minimum capacity		%	12.5	12.5	12.5	12.5	12.5	
Unit power input (1)	Cooling		kW	221	262	299	318	351	
EER (1)				2.93	2.84	2.78	2.87	2.76	
ESEER				3.95	3.87	3.89	3.84	3.8	
IPLV				4.30	4.17	4.16	4.23	4.14	
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	
		Width	mm	2285	2285	2285	2285	2285	
		Length	mm	6185	6185	6185	6185	6185	
Weight	Unit		kg	5920	6030	6050	6570	6850	
	Operating Weight		kg	6200	6280	6300	6820	7100	
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume		l	266	266	251	251	251	
	Nominal water flow rate	Cooling	l/s	30.9	35.56	39.74	43.6	46.21	
	Nominal Water pressure drop	Cooling	kPa	73	59	52	61	68	
Insulation material				Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter		mm	800					
	Nominal air flow			l/s	53444	53444	53444	64133	64133
	Model	Quantity	No.	10	10	10	12	12	
		Speed	rpm	920	920	920	920	920	
Motor input		W	1.75	1.75	1.75	1.75	1.75		
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge		l	38	38	38	44	50	
	Quantity		No.	2	2	2	2	2	
Sound level	Sound Power	Cooling	dB(A)	96.0	96.1	96.1	97.5	97.1	
	Sound Pressure (2)	Cooling	dB(A)	75.5	75.6	75.6	76.5	76.6	
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge		kg	128	128	128	146	144	
	N. of circuits		No.	2	2	2	2	2	
Piping connections	Evaporator water inlet/outlet		mm	168.3	168.3	168.3	168.3	168.3	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
Water freeze protection controller									

Model			EWAD~C-SL						
			C11	C12	C14	C15	C16	C17	
Capacity (1)	Cooling	kW	1064	1152	1419	1538	1622	1714	
Capacity control	Type		Stepless						
	Minimum capacity	%	12.5	12.5	7	7	7	7	
Unit power input (1)	Cooling	kW	378	402	500	551	580	618	
EER (1)			2.82	2.86	2.84	2.79	2.8	2.77	
ESEER			3.88	3.84	3.88	3.9	3.87	3.78	
IPLV			4.17	4.19	4.19	4.22	4.18	4.13	
Casing	Colour		Ivory White						
	Material		Galvanized and painted steel sheet						
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	2540
		Width	mm	2285	2285	2285	2285	2285	2285
		Length	mm	7085	7985	10185	10185	11085	11085
Weight	Unit	kg	7300	7570	10750	10770	11150	11210	
	Operating Weight	kg	7540	7810	11170	11170	11550	11700	
Water heat exchanger	Type		Single Pass Shell&Tube						
	Water volume	l	243	243	421	408	408	474	
	Nominal water flow rate	Cooling	l/s	50.85	55.04	67.78	73.5	77.51	81.89
	Nominal Water pressure drop	Cooling	kPa	63	72	47	59	65	73
	Insulation material		Closed cell						
Air heat exchanger	Type		High efficiency fin and tube type with integral subcooler						
Fan	Type		Direct propeller type						
	Drive		DOL						
	Diameter	mm	800						
	Nominal air flow	l/s	74822	85510	106888	106888	117577	117577	
	Model	Quantity	No.	14	16	20	20	22	22
		Speed	rpm	920	920	920	920	920	920
		Motor input	W	1.75	1.75	1.75	1.75	1.75	1.75
Compressor	Type		Semi-hermetic single screw compressor						
	Oil charge	l	50	50	75	75	75	75	
	Quantity	No.	2	2	3	3	3	3	
Sound level	Sound Power	Cooling	dB(A)	97.6	98.1	99.1	99.1	99.5	99.5
	Sound Pressure (2)	Cooling	dB(A)	76.8	76.9	77.2	77.2	77.3	77.4
Refrigerant circuit	Refrigerant type		R-134a						
	Refrigerant charge	kg	162	178	260	260	261	261	
	N. of circuits	No.	2	2	3	3	3	3	
Piping connections	Evaporator water inlet/outlet	mm	168.3	168.3	219.1	219.1	219.1	219.1	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
	Water freeze protection controller								

**1****Notes**

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(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

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## 1.7 Technical Specifications: EWAD~C-SR

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-SR				
				620	720	790	880	920
Capacity (1)	Cooling		kW	619	715	789	876	922
Capacity control	Type			Stepless				
	Minimum capacity		%	12.5	12.5	12.5	12.5	12.5
Unit power input (1)	Cooling		kW	223	272	315	331	369
EER (1)				2.77	2.62	2.51	2.65	2.5
ESEER				4.08	3.96	3.98	3.99	4
IPLV				4.37	4.23	4.19	4.29	4.21
Casing	Colour			Ivory White				
	Material			Galvanized and painted steel sheet				
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540
		Width	mm	2285	2285	2285	2285	2285
		Length	mm	6185	6185	6185	6185	6185
Weight	Unit		kg	5920	6030	6050	6570	6850
	Operating Weight		kg	6200	6280	6300	6820	7100
Water heat exchanger	Type			Single Pass Shell&Tube				
	Water volume		l	266	266	251	251	251
	Nominal water flow rate	Cooling	l/s	29.57	34.15	37.71	41.83	44.05
	Nominal Water pressure drop	Cooling	kPa	67	55	47	57	62
Insulation material				Closed cell				
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler				
Fan	Type			Direct propeller type				
	Drive			DOL				
	Diameter		mm	800				
	Nominal air flow		l/s	41006	41006	41006	49207	49207
	Model	Quantity	No.	10	10	10	12	12
		Speed	rpm	715	715	715	715	715
Motor input		W	0.78	0.78	0.78	0.78	0.78	
Compressor	Type			Semi-hermetic single screw compressor				
	Oil charge		l	38	38	38	44	50
	Quantity		No.	2	2	2	2	2
Sound level	Sound Power	Cooling	dB(A)	91.5	92.0	92.0	92.5	93.0
	Sound Pressure (2)	Cooling	dB(A)	71.0	71.5	71.5	72	72.5
Refrigerant circuit	Refrigerant type			R-134a				
	Refrigerant charge		kg	128	128	128	146	144
	N. of circuits		No.	2	2	2	2	2
Piping connections	Evaporator water inlet/outlet		mm	168.3	168.3	168.3	168.3	168.3
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
	Phase monitor							
	Emergency stop button							
Water freeze protection controller								

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Model				EWAD~C-SR					
				C10	C11	C13	C14	C15	C16
Capacity (1)	Cooling		kW	1020	1112	1367	1471	1556	1623
Capacity control	Type			Stepless					
	Minimum capacity		%	12.5	12.5	7	7	7	7
Unit power input (1)	Cooling		kW	395	417	517	576	603	647
EER (1)				2.59	2.67	2.64	2.55	2.58	2.51
ESEER				3.96	3.96	3.9	3.87	3.9	3.83
IPLV				4.20	4.29	4.24	4.22	4.24	4.18
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	2540
		Width	mm	2285	2285	2285	2285	2285	2285
		Length	mm	7085	7985	10185	10185	11085	11085
Weight	Unit		kg	7300	7570	10750	10770	11150	11210
	Operating Weight		kg	7540	7810	11170	11170	11550	11700
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume		l	243	243	421	408	408	474
	Nominal water flow rate	Cooling	l/s	48.75	53.11	65.32	70.28	74.32	77.57
	Nominal Water pressure drop	Cooling	kPa	58	68	44	54	60	66
Insulation material				Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter		mm	800					
	Nominal air flow		l/s	57408	65610	82012	82012	90213	90213
	Model	Quantity	No.	14	16	20	20	22	22
		Speed	rpm	715	715	715	715	715	715
		Motor input	W	0.78	0.78	0.78	0.78	0.78	0.78
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge		l	50	50	75	75	75	75
	Quantity		No.	2	2	3	3	3	3
Sound level	Sound Power	Cooling	dB(A)	93.5	93.8	94.8	94.9	95.1	95.2
	Sound Pressure (2)	Cooling	dB(A)	72.6	72.7	72.9	73.0	73	73.1
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge		kg	162	178	260	260	261	261
	N. of circuits		No.	2	2	3	3	3	3
Piping connections	Evaporator water inlet/outlet		mm	168.3	168.3	219.1	219.1	219.1	219.1
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
	Water freeze protection controller								



**Notes**

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(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

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## 1.8 Technical Specifications: EWAD~C-XS

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-XS			
				760	830	890	990
Capacity (1)	Cooling		kW	756	830	889	1001
Capacity control	Type			Stepless			
	Minimum capacity		%	12.5	12.5	12.5	12.5
Unit power input (1)	Cooling		kW	233	253	278	307
EER (1)				3.25	3.28	3.2	3.26
ESEER				4.02	4.11	4.02	4.11
IPLV				4.48	4.48	4.44	4.48
Casing	Colour			Ivory White			
	Material			Galvanized and painted steel sheet			
Dimensions	Unit	Height	mm	2540	2540	2540	2540
		Width	mm	2285	2285	2285	2285
		Length	mm	6185	7085	7085	7985
Weight	Unit		kg	5990	6340	6360	7190
	Operating Weight		kg	6240	6580	6600	7600
Water heat exchanger	Type			Single Pass Shell&Tube			
	Water volume		l	251	243	243	403
	Nominal water flow rate	Cooling	l/s	36.1	39.67	42.49	47.82
	Nominal Water pressure drop	Cooling	kPa	80	56	64	61
Insulation material				Closed cell			
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler			
Fan	Type			Direct propeller type			
	Drive			DOL			
	Diameter		mm	800			
	Nominal air flow		l/s	64133	74822	74822	85510
	Model	Quantity	No.	12	14	14	16
		Speed	rpm	920	920	920	920
Motor input		W	1.75	1.75	1.75	1.75	
Compressor	Type			Semi-hermetic single screw compressor			
	Oil charge		l	38	38	38	44
	Quantity		No.	2	2	2	2
Sound level	Sound Power	Cooling	dB(A)	100.2	100.5	100.5	101.4
	Sound Pressure (2)	Cooling	dB(A)	79.7	79.7	79.7	80.2
Refrigerant circuit	Refrigerant type			R-134a			
	Refrigerant charge		kg	146	162	162	182
	N. of circuits		No.	2	2	2	2
Piping connections	Evaporator water inlet/outlet		mm	168.3	168.3	168.3	219.1
Safety devices	High discharge pressure (pressure switch)						
	High discharge pressure (pressure transducer)						
	Low suction pressure (pressure transducer)						
	Compressor motor protection						
	High discharge temperature						
	Low oil pressure						
	Low pressure ratio						
	High oil filter pressure drop						
	Phase monitor						
	Emergency stop button						
	Water freeze protection controller						

Model				EWAD~C-XS					
				C10	C11	C12	C13	C14	
Capacity (1)	Cooling		kW	1074	1196	1280	1349	1409	
Capacity control	Type			Stepless					
	Minimum capacity		%	12.5	12.5	12.5	12.5	7	
Unit power input (1)	Cooling		kW	338	364	400	411	437	
EER (1)				3.18	3.29	3.2	3.29	3.23	
ESEER				4.05	4.14	4.02	4.28	4.23	
IPLV				4.44	4.51	4.47	4.59	4.56	
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	
		Width	mm	2285	2285	2285	2285	2285	
		Length	mm	7985	9785	9785	9785	11985	
Weight	Unit		kg	7470	8220	8240	8900	10560	
	Operating Weight		kg	7870	8610	8630	9890	11040	
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume		l	403	386	386	979	491	
	Nominal water flow rate	Cooling	l/s	51.32	57.13	61.18	64.45	67.34	
	Nominal Water pressure drop	Cooling	kPa	69	45	51	71	77	
Insulation material				Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter		mm	800					
	Nominal air flow			l/s	85510	106888	106888	106888	128266
	Model	Quantity		No.	16	20	20	20	24
		Speed		rpm	920	920	920	920	920
Motor input		W	1.75	1.75	1.75	1.75	1.75		
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge		l	50	50	50	50	63	
	Quantity		No.	2	2	2	2	3	
Sound level	Sound Power	Cooling	dB(A)	101.9	102.4	102.5	102.5	102.9	
	Sound Pressure (2)	Cooling	dB(A)	80.7	80.3	80.4	80.4	80.5	
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge		kg	182	214	214	225	291	
	N. of circuits		No.	2	2	2	2	3	
Piping connections	Evaporator water inlet/outlet		mm	219.1	219.1	219.1	273	219.1	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
	Water freeze protection controller								

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Model				EWAD~C-XS					
				C15	C16	C17	C18	C19	
Capacity (1)	Cooling		kW	1526	1596	1685	1768	1858	
Capacity control	Type			Stepless					
	Minimum capacity		%	7	7	7	7	7	
Unit power input (1)	Cooling		kW	474	504	533	561	590	
EER (1)				3.22	3.17	3.16	3.15	3.15	
ESEER				4.19	4.17	4.16	4.13	4.13	
IPLV				4.54	4.52	4.52	4.47	4.47	
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	
		Width	mm	2285	2285	2285	2285	2285	
		Length	mm	11985	11985	12885	13785	14685	
Weight	Unit		kg	11310	11570	11900	12260	12600	
	Operating Weight		kg	12170	11570	11900	12260	12600	
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume		l	850	850	850	871	850	
	Nominal water flow rate	Cooling	l/s	72.9	76.24	80.48	84.47	88.79	
	Nominal Water pressure drop	Cooling	kPa	57	62	68	64	37	
	Insulation material			Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter		mm	800					
	Nominal air flow			l/s	128266	128266	138954	149643	160332
	Model	Quantity	No.	24	24	26	28	30	
		Speed	rpm	920	920	920	920	920	
		Motor input	W	1.75	1.75	1.75	1.75	1.75	
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge		l	69	75	75	75	75	
	Quantity		No.	3	2	2	2	2	
Sound level	Sound Power	Cooling	dB(A)	103.1	103.2	103.5	103.7	103.9	
	Sound Pressure (2)	Cooling	dB(A)	80.7	80.9	80.8	81	81	
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge		kg	297	297	312	328	343	
	N. of circuits		No.	3	3	3	3	3	
Piping connections	Evaporator water inlet/outlet		mm	273	273	273	273	273	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
	Water freeze protection controller								

**Notes**

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(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

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## 1.9 Technical Specifications: EWAD~C-XL

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-XL			
				760	830	890	990
Capacity (1)	Cooling		kW	756	830	889	1001
Capacity control	Type			Stepless			
	Minimum capacity		%	12.5	12.5	12.5	12.5
Unit power input (1)	Cooling		kW	233	253	278	307
EER (1)				3.25	3.28	3.2	3.26
ESEER				4.02	4.11	4.02	4.11
IPLV				4.48	4.48	4.44	4.48
Casing	Colour			Ivory White			
	Material			Galvanized and painted steel sheet			
Dimensions	Unit	Height	mm	2540	2540	2540	2540
		Width	mm	2285	2285	2285	2285
		Length	mm	6185	7085	7085	7985
Weight	Unit		kg	6280	6630	6650	7480
	Operating Weight		kg	6520	6870	6890	7880
Water heat exchanger	Type			Single Pass Shell&Tube			
	Water volume		l	251	243	243	403
	Nominal water flow rate	Cooling	l/s	36.1	39.67	42.49	47.82
	Nominal Water pressure drop	Cooling	kPa	80	56	64	61
Insulation material				Closed cell			
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler			
Fan	Type			Direct propeller type			
	Drive			DOL			
	Diameter		mm	800			
	Nominal air flow		l/s	64133	74822	74822	85510
	Model	Quantity	No.	12	14	14	16
		Speed	rpm	920	920	920	920
Motor input		W	1.75	1.75	1.75	1.75	
Compressor	Type			Semi-hermetic single screw compressor			
	Oil charge		l	38	38	38	44
	Quantity		No.	2	2	2	2
Sound level	Sound Power	Cooling	dB(A)	96.8	97.4	97.4	98
	Sound Pressure (2)	Cooling	dB(A)	76.3	76.5	76.5	76.9
Refrigerant circuit	Refrigerant type			R-134a			
	Refrigerant charge		kg	146	162	162	182
	N. of circuits		No.	2	2	2	2
Piping connections	Evaporator water inlet/outlet		mm	168.3	168.3	168.3	219.1
Safety devices	High discharge pressure (pressure switch)						
	High discharge pressure (pressure transducer)						
	Low suction pressure (pressure transducer)						
	Compressor motor protection						
	High discharge temperature						
	Low oil pressure						
	Low pressure ratio						
	High oil filter pressure drop						
	Phase monitor						
	Emergency stop button						
	Water freeze protection controller						

Model				EWAD~C-XL					
				C10	C11	C12	C13	C14	
Capacity (1)	Cooling		kW	1074	1196	1280	1349	1409	
Capacity control	Type			Stepless					
	Minimum capacity		%	12.5	12.5	12.5	12.5	7	
Unit power input (1)	Cooling		kW	338	364	400	411	437	
EER (1)				3.18	3.29	3.2	3.29	3.23	
ESEER				4.05	4.14	4.02	4.28	4.23	
IPLV				4.44	4.51	4.47	4.59	4.56	
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	
		Width	mm	2285	2285	2285	2285	2285	
		Length	mm	7985	9785	9785	9785	11985	
Weight	Unit		kg	7760	8510	8530	9190	11000	
	Operating Weight		kg	8160	8900	8920	10180	11490	
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume		l	403	386	386	979	491	
	Nominal water flow rate	Cooling	l/s	51.32	57.13	61.18	64.45	67.34	
	Nominal Water pressure drop	Cooling	kPa	69	45	51	71	77	
Insulation material				Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter		mm	800					
	Nominal air flow			l/s	85510	106888	106888	106888	128266
	Model	Quantity	No.	16	20	20	20	24	
		Speed	rpm	920	920	920	920	920	
Motor input		W	1.75	1.75	1.75	1.75	1.75		
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge		l	50	50	50	50	63	
	Quantity		No.	2	2	2	2	3	
Sound level	Sound Power	Cooling	dB(A)	98.2	98.8	98.9	98.9	99.6	
	Sound Pressure (2)	Cooling	dB(A)	77.1	76.7	76.8	76.8	77.1	
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge		kg	182	214	214	225	291	
	N. of circuits		No.	2	2	2	2	3	
Piping connections	Evaporator water inlet/outlet		mm	219.1	219.1	219.1	273	219.1	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
Water freeze protection controller									

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Model				EWAD~C-XL					
				C15	C16	C17	C18	C19	
Capacity (1)	Cooling		kW	1526	1596	1685	1768	1858	
Capacity control	Type			Stepless					
	Minimum capacity		%	7	7	7	7	7	
Unit power input (1)	Cooling		kW	474	504	533	561	590	
EER (1)				3.22	3.17	3.16	3.15	3.15	
ESEER				4.19	4.17	4.16	4.13	4.13	
IPLV				4.54	4.52	4.52	4.47	4.47	
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	
		Width	mm	2285	2285	2285	2285	2285	
		Length	mm	11985	11985	12885	13785	14685	
Weight	Unit		kg	11760	12010	12350	12700	13040	
	Operating Weight		kg	12610	12870	13200	13580	13910	
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume		l	850	850	850	871	850	
	Nominal water flow rate	Cooling	l/s	72.9	76.24	80.48	84.47	88.79	
	Nominal Water pressure drop	Cooling	kPa	57	62	68	64	37	
	Insulation material			Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter		mm	800					
	Nominal air flow			l/s	128266	128266	138954	149643	160332
	Model	Quantity	No.	24	24	26	28	30	
		Speed	rpm	920	920	920	920	920	
		Motor input	W	1.75	1.75	1.75	1.75	1.75	
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge		l	69	75	75	75	75	
	Quantity		No.	3	2	2	2	2	
Sound level	Sound Power	Cooling	dB(A)	99.6	99.6	100	100.2	100.4	
	Sound Pressure (2)	Cooling	dB(A)	77.2	77.3	77.4	77.5	77.5	
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge		kg	297	297	312	328	343	
	N. of circuits		No.	3	3	3	3	3	
Piping connections	Evaporator water inlet/outlet		mm	273	273	273	273	273	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
	Water freeze protection controller								



**Notes**

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(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

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## 1.10 Technical Specifications: EWAD~C-XR

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-XR			
				740	810	870	970
Capacity (1)	Cooling		kW	736	811	866	974
Capacity control	Type			Stepless			
	Minimum capacity		%	12.5	12.5	12.5	12.5
Unit power input (1)	Cooling		kW	235	254	281	309
EER (1)				3.14	3.2	3.08	3.15
ESEER				4.29	4.36	4.23	4.34
IPLV				4.55	4.62	4.51	4.63
Casing	Colour			Ivory White			
	Material			Galvanized and painted steel sheet			
Dimensions	Unit	Height	mm	2540	2540	2540	2540
		Width	mm	2285	2285	2285	2285
		Length	mm	6185	7085	7085	7985
Weight	Unit		kg	6280	6630	6650	7480
	Operating Weight		kg	6520	6870	6890	7880
Water heat exchanger	Type			Single Pass Shell&Tube			
	Water volume		l	251	243	243	403
	Nominal water flow rate	Cooling	l/s	35.17	38.74	41.36	46.54
	Nominal Water pressure drop	Cooling	kPa	76	54	61	58
Insulation material				Closed cell			
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler			
Fan	Type			Direct propeller type			
	Drive			DOL			
	Diameter		mm	800			
	Nominal air flow		l/s	49207	57408	57408	65610
	Model	Quantity	No.	12	14	14	16
		Speed	rpm	715			
Motor input		W	0.78				
Compressor	Type			Semi-hermetic single screw compressor			
	Oil charge		l	38	38	38	44
	Quantity		No.	2	2	2	2
Sound level	Sound Power	Cooling	dB(A)	92	92.3	92.3	93.5
	Sound Pressure (2)	Cooling	dB(A)	71.5	71.5	71.5	72.3
Refrigerant circuit	Refrigerant type			R-134a			
	Refrigerant charge		kg	146	162	162	182
	N. of circuits		No.	2	2	2	2
Piping connections	Evaporator water inlet/outlet		mm	168.3	168.3	168.3	219.1
Safety devices	High discharge pressure (pressure switch)						
	High discharge pressure (pressure transducer)						
	Low suction pressure (pressure transducer)						
	Compressor motor protection						
	High discharge temperature						
	Low oil pressure						
	Low pressure ratio						
	High oil filter pressure drop						
	Phase monitor						
	Emergency stop button						
	Water freeze protection controller						

Model				EWAD~C-XR				
				C10	C11	C12	C13	C14
Capacity (1)	Cooling		kW	1041	1168	1247	1302	1378
Capacity control	Type			Stepless				
	Minimum capacity		%	12.5	12.5	12.5	12.5	7
Unit power input (1)	Cooling		kW	343	365	404	415	438
EER (1)				3.03	3.2	3.08	3.14	3.15
ESEER				4.24	4.38	4.25	4.33	4.34
IPLV				4.54	4.65	4.54	4.58	4.72
Casing	Colour			Ivory White				
	Material			Galvanized and painted steel sheet				
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540
		Width	mm	2285	2285	2285	2285	2285
		Length	mm	7985	9785	9785	9785	11985
Weight	Unit		kg	7760	8510	8530	9190	11000
	Operating Weight		kg	8160	8900	8920	10180	11490
Water heat exchanger	Type			Single Pass Shell&Tube				
	Water volume		l	403	386	386	979	491
	Nominal water flow rate	Cooling	l/s	49.76	55.78	59.56	62.21	65.85
	Nominal Water pressure drop	Cooling	kPa	65	43	49	67	74
Insulation material				Closed cell				
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler				
Fan	Type			Direct propeller type				
	Drive			DOL				
	Diameter		mm	800				
	Nominal air flow		l/s	65610	82012	82012	82012	98414
	Model	Quantity	No.	16	20	20	20	24
		Speed	rpm	715				
	Motor input	W	0.78					
Compressor	Type			Semi-hermetic single screw compressor				
	Oil charge		l	50	50	50	50	63
	Quantity		No.	2	2	2	2	3
Sound level	Sound Power	Cooling	dB(A)	93.7	94.3	94.5	94.4	95.1
	Sound Pressure (2)	Cooling	dB(A)	72.5	72.2	72.3	72.3	72.6
Refrigerant circuit	Refrigerant type			R-134a				
	Refrigerant charge		kg	182	214	214	225	291
	N. of circuits		No.	2	2	2	3	3
Piping connections	Evaporator water inlet/outlet		mm	219.1	219.1	219.1	273	219.1
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
	Phase monitor							
	Emergency stop button							
Water freeze protection controller								

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Model				EWAD~C-XR					
				C15	C16	C17	C18	C19	
Capacity (1)	Cooling		kW	1486	1550	1639	1722	1813	
Capacity control	Type			Stepless					
	Minimum capacity		%	7	7	7	7	7	
Unit power input (1)	Cooling		kW	479	513	541	567	595	
EER (1)				3.1	3.03	3.03	3.04	3.04	
ESEER				4.26	4.26	4.2	4.21	4.2	
IPLV				4.65	4.60	4.59	4.59	4.57	
Casing	Colour			Ivory White					
	Material			Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2540	2540	2540	2540	2540	
		Width	mm	2285	2285	2285	2285	2285	
		Length	mm	11985	11985	12885	13785	14685	
Weight	Unit		kg	11760	12010	12350	12700	13040	
	Operating Weight		kg	12610	12870	13200	13580	13910	
Water heat exchanger	Type			Single Pass Shell&Tube					
	Water volume		l	850	850	850	871	850	
	Nominal water flow rate	Cooling	l/s	70.98	74.07	78.32	82.3	86.61	
	Nominal Water pressure drop	Cooling	kPa	54	59	65	61	35	
	Insulation material			Closed cell					
Air heat exchanger	Type			High efficiency fin and tube type with integral subcooler					
Fan	Type			Direct propeller type					
	Drive			DOL					
	Diameter		mm	800					
	Nominal air flow			l/s	98414	98414	106616	114817	123018
	Model	Quantity	No.	24	24	26	28	30	
		Speed	rpm	715					
		Motor input	W	0.78					
Compressor	Type			Semi-hermetic single screw compressor					
	Oil charge		l	69	75	75	75	75	
	Quantity		No.	3	2	2	2	2	
Sound level	Sound Power	Cooling	dB(A)	95.2	95.3	95.6	95.7	95.9	
	Sound Pressure (2)	Cooling	dB(A)	72.8	72.9	72.9	73	73	
Refrigerant circuit	Refrigerant type			R-134a					
	Refrigerant charge		kg	297	297	312	328	343	
	N. of circuits		No.	3	3	3	3	3	
Piping connections	Evaporator water inlet/outlet		mm	273	273	273	273	273	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
	Emergency stop button								
	Water freeze protection controller								

**Notes**

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(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

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## 1.11 Technical Specifications: EWAD~C-PS

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-PS						
				820	890	980	C11	C12	C13	C14
Capacity (1)	Cooling	kW	821	890	975	1074	1158	1279	1390	
Capacity control	Type	Stepless								
	Minimum capacity	%	12.5							
Unit power input (1)	Cooling	kW	225	249	274	301	330	363	396	
EER (1)			3.64	3.58	3.56	3.56	3.51	3.52	3.51	
ESEER			4.44	4.5	4.41	4.53	4.39	4.44	4.31	
IPLV			4.78	4.67	4.71	4.69	4.73	4.65	4.73	
Casing	Colour	Ivory White								
	Material	Galvanized and painted steel sheet								
Dimensions	Unit	Height	mm	2540						
		Width	mm	2285						
		Length	mm	8885	8885	8885	9785	9785	11085	11985
Weight	Unit	kg	7530	7530	7660	8290	8550	9390	9730	
	Operating Weight	kg	8130	8130	8700	9330	9590	10380	10720	
Water heat exchanger	Type	Single Pass Shell&Tube								
	Water volume	l	599	599	1043	1027	1027	995	979	
	Nominal water flow rate	Cooling	l/s	39.22	42.53	46.6	51.3	55.31	61.12	66.41
	Nominal Water pressure drop	Cooling	kPa	57	65	30	61	69	60	73
	Insulation material	Closed cell								
Air heat exchanger	Type	High efficiency fin and tube type with integral subcooler								
Fan	Type	Direct propeller type								
	Drive	DOL								
	Diameter	mm	800							
	Nominal air flow	l/s	96199	96199	96199	106888	106888	117577	128266	
	Model	Quantity	No.	18	18	18	20	20	22	24
		Speed	rpm	920						
Motor input		W	1.75							
Compressor	Type	Semi-hermetic single screw compressor								
	Oil charge	l	38	38	38	44	50	50	50	
	Quantity	No.	2							
Sound level	Sound Power	Cooling	dB(A)	101	101.0	101.0	101.8	102.3	102.6	102.9
	Sound Pressure (2)	Cooling	dB(A)	79.5	79.5	79.5	80	80.5	80.4	80.5
Refrigerant circuit	Refrigerant type	R-134a								
	Refrigerant charge	kg	204	202	204	220	220	252	254	
	N. of circuits	No.	2							
Piping connections	Evaporator water inlet/outlet	mm	219.1	219.1	273	273	273	273	273	

Model		EWAD~C-PS						
		820	890	980	C11	C12	C13	C14
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
	Phase monitor							
	Emergency stop button							
	Water freeze protection controller							

**Notes**

(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

## 1.12 Technical Specifications: EWAD~C-PL

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-PL						
				820	890	980	C11	C12	C13	C14
Capacity (1)	Cooling	kW	821	890	975	1074	1158	1279	1390	
Capacity control	Type	Stepless								
	Minimum capacity	%	12.5							
Unit power input (1)	Cooling	kW	225	249	274	301	330	363	396	
EER (1)			3.64	3.58	3.56	3.56	3.51	3.52	3.51	
ESEER			4.44	4.5	4.41	4.53	4.39	4.44	4.31	
IPLV			4.78	4.67	4.71	4.69	4.73	4.65	4.73	
Casing	Colour	Ivory White								
	Material	Galvanized and painted steel sheet								
Dimensions	Unit	Height	mm	2540						
		Width	mm	2285						
		Length	mm	8885	8885	8885	9785	9785	11085	11985
Weight	Unit	kg	7820	7820	7950	8580	8840	10380	10020	
	Operating Weight	kg	8420	8420	8990	9620	9880	10670	11010	
Water heat exchanger	Type	Single Pass Shell&Tube								
	Water volume	l	599	599	1043	1027	1027	995	979	
	Nominal water flow rate	Cooling	l/s	39.22	42.53	46.6	51.3	55.31	61.12	66.41
	Nominal Water pressure drop	Cooling	kPa	57	65	30	61	69	60	73
	Insulation material	Closed cell								
Air heat exchanger	Type	High efficiency fin and tube type with integral subcooler								
Fan	Type	Direct propeller type								
	Drive	DOL								
	Diameter	mm	800							
	Nominal air flow	l/s	96199	96199	96199	106888	106888	117577	128266	
	Model	Quantity	No.	18	18	18	20	20	22	24
		Speed	rpm	920						
Motor input		W	1.75							
Compressor	Type	Semi-hermetic single screw compressor								
	Oil charge	l	38	38	38	44	50	50	50	
	Quantity	No.	2							
Sound level	Sound Power	Cooling	dB(A)	98.4	98.4	98.4	98.8	99.9	99.3	99.6
	Sound Pressure (2)	Cooling	dB(A)	76.9	76.9	76.9	77	77.1	77.1	77.2
Refrigerant circuit	Refrigerant type	R-134a								
	Refrigerant charge	kg	204	202	204	220	220	252	254	
	N. of circuits	No.	2							
Piping connections	Evaporator water inlet/outlet	mm	219.1	219.1	273	273	273	273	273	



Model		EWAD~C-PL						
		820	890	980	C11	C12	C13	C14
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
	Phase monitor							
	Emergency stop button							
	Water freeze protection controller							

**Notes**

(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

## 1.13 Technical Specifications: EWAD~C-PR

### Technical specifications

The table below contains the technical specifications.

Model				EWAD~C-PR						
				810	880	960	C10	C11	C13	C14
Capacity (1)	Cooling	kW	809	875	956	1053	1132	1251	1359	
Capacity control	Type	Stepless								
	Minimum capacity	%	12.5							
Unit power input (1)	Cooling	kW	219	244	272	299	330	364	396	
EER (1)			3.7	3.58	3.51	3.52	3.43	3.44	3.43	
ESEER			4.63	4.59	4.54	4.59	4.5	4.53	4.51	
IPLV			5.04	4.89	4.89	4.86	4.82	4.81	4.82	
Casing	Colour	Ivory White								
	Material	Galvanized and painted steel sheet								
Dimensions	Unit	Height	mm	2540						
		Width	mm	2285						
		Length	mm	8885	8885	8885	9785	9785	11085	11985
Weight	Unit	kg	7820	7820	7950	8580	8840	10380	10020	
	Operating Weight	kg	8420	8420	8990	9620	9880	10670	11010	
Water heat exchanger	Type	Single Pass Shell&Tube								
	Water volume	l	599	599	1043	1027	1027	995	979	
	Nominal water flow rate	Cooling	l/s	38.65	41.81	45.69	50.3	54.11	59.76	64.95
	Nominal Water pressure drop	Cooling	kPa	56	63	29	59	66	58	70
	Insulation material	Closed cell								
Air heat exchanger	Type	High efficiency fin and tube type with integral subcooler								
Fan	Type	Direct propeller type								
	Drive	DOL								
	Diameter	mm	800							
	Nominal air flow	l/s	73811	73811	73811	82012	82012	90213	98414	
	Model	Quantity	No.	18	18	18	20	20	22	24
		Speed	rpm	715						
Motor input		W	0.78							
Compressor	Type	Semi-hermetic single screw compressor								
	Oil charge	l	38	38	38	44	50	50	50	
	Quantity	No.	2							
Sound level	Sound Power	Cooling	dB(A)	92.7	92.7	92.7	93.4	93.8	94.1	94.4
	Sound Pressure (2)	Cooling	dB(A)	71.2	71.2	71.2	71.7	72.0	72.0	72.0
Refrigerant circuit	Refrigerant type	R-134a								
	Refrigerant charge	kg	204	202	204	220	220	252	254	
	N. of circuits	No.	2							
Piping connections	Evaporator water inlet/outlet	mm	219.1	219.1	273	273	273	273	273	

Model		EWAD~C-PR						
		810	880	960	C10	C11	C13	C14
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
	Phase monitor							
	Emergency stop button							
	Water freeze protection controller							

**Notes**

(1) Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.

(2) The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.

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1.14 Electrical Specifications: EWAD~C-SS

Electrical specifications

The table below contains the electrical specifications.

Model			EWAD~C-SS					
			650	740	830	910	970	
Power Supply	Phase		3					
	Frequency		Hz		50			
	Voltage		V		400			
	Voltage Tolerance	Minimum	%		-10%			
		Maximum	%		+10%			
Unit	Maximum starting current		A	628.4	665.2	665.2	904.2	949.8
	Nominal running current cooling		A	365	432	492	523	574
	Maximum running current		A	486	532	578	643	700
	Maximum current for wires sizing		A	535	585	636	707	770
Fans	Nominal running current in cooling		A	40	40	40	48	48
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%		-10%			
		Maximum	%		+10%			
	Maximum running current		A	223+223	223+269	269+269	269+326	326+326
	Starting Method		Wye - Delta type (Y -Δ)					

Model			EWAD~C-SS						
			C11	C12	C14	C15	C16	C17	
Power Supply	Phase		3						
	Frequency		Hz		50				
	Voltage		V		400				
	Voltage Tolerance	Minimum	%		-10%				
		Maximum	%		+10%				
Unit	Maximum starting current		A	1009	1017	1242.6	1293.8	1353	1353
	Nominal running current cooling		A	624	668	823	908	959	1023
	Maximum running current		A	772	844	1058	1122	1194	1258
	Maximum current for wires sizing		A	849	928	1164	1234	1313	1384
Fans	Nominal running current in cooling		A	56	64	80	80	88	88
Compressor	Phase		No.	3					
	Voltage		V	400					
	Voltage Tolerance	Minimum	%		-10%				
		Maximum	%		+10%				
	Maximum running current		A	326+390	390+390	326+326 +326	390+326 +326	390+390 +326	390+390 +390
	Starting Method		Wye - Delta type (Y -Δ)						

### 1.15 Electrical Specifications: EWAD~C-SL

**Electrical specifications**

The table below contains the electrical specifications

Model			EWAD~C-SL					
			650	740	830	910	970	
Power Supply	Phase		3					
	Frequency		Hz	50				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%	-10%				
		Maximum	%	+10%				
Unit	Maximum starting current		A	628.4	665.2	665.2	904.2	949.8
	Nominal running current cooling		A	365	432	492	523	574
	Maximum running current		A	486	532	578	643	700
	Maximum current for wires sizing		A	535	585	636	707	770
Fans	Nominal running current in cooling		A	40	40	40	48	48
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%	-10%				
		Maximum	%	+10%				
	Maximum running current		A	223+223	223+269	269+269	269+326	326+326
	Starting Method		Wye - Delta type (Y -Δ)					

Model			EWAD~C-SL						
			C11	C12	C14	C15	C16	C17	
Power Supply	Phase		3						
	Frequency		Hz	50					
	Voltage		V	400					
	Voltage Tolerance	Minimum	%	-10%					
		Maximum	%	+10%					
Unit	Maximum starting current		A	1009	1017	1242.6	1293.8	1353	1353
	Nominal running current cooling		A	624	668	823	908	959	1023
	Maximum running current		A	772	844	1058	1122	1194	1258
	Maximum current for wires sizing		A	849	928	1164	1234	1313	1384
Fans	Nominal running current in cooling		A	56	64	80	80	88	88
Compressor	Phase		No.	3					
	Voltage		V	400					
	Voltage Tolerance	Minimum	%	-10%					
		Maximum	%	+10%					
	Maximum running current		A	326+390	390+390	326+326 +326	390+326 +326	390+390 +326	390+390 +390
	Starting Method		Wye - Delta type (Y -Δ)						

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1.16 Electrical Specifications: EWAD~C-SR

Electrical specifications

The table below contains the electrical specifications

Model			EWAD~C-SR					
			620	720	790	880	920	
Power Supply	Phase		3					
	Frequency		Hz		50			
	Voltage		V		400			
	Voltage Tolerance	Minimum	%		-10%			
		Maximum	%		+10%			
Unit	Maximum starting current		A	614.4	651.2	651.2	887.4	933
	Nominal running current cooling		A	370	449	518	546	606
	Maximum running current		A	472	518	564	626	683
	Maximum current for wires sizing		A	519	570	620	689	752
Fans	Nominal running current in cooling		A	26	26	26	31	31
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%		-10%			
		Maximum	%		+10%			
	Maximum running current		A	223+223	223+269	269+269	269+326	326+326
	Starting Method		Wye - Delta type (Y -Δ)					

Model			EWAD~C-SR						
			C10	C11	C13	C14	C15	C16	
Power Supply	Phase		3						
	Frequency		Hz		50				
	Voltage		V		400				
	Voltage Tolerance	Minimum	%		-10%				
		Maximum	%		+10%				
Unit	Maximum starting current		A	989.4	994.6	1214.6	1265.8	1322.2	1322.2
	Nominal running current cooling		A	653	694	853	951	1001	1074
	Maximum running current		A	752	822	1030	1094	1163	1227
	Maximum current for wires sizing		A	828	904	1133	1203	1280	1350
Fans	Nominal running current in cooling		A	36	42	52	52	57	57
Compressor	Phase		No.	3					
	Voltage		V	400					
	Voltage Tolerance	Minimum	%		-10%				
		Maximum	%		+10%				
	Maximum running current		A	326+390	390+390	326+326 +326	390+326 +326	390+390 +326	390+390 +390
	Starting Method		Wye - Delta type (Y -Δ)						

### 1.17 Electrical Specifications: EWAD~C-XS

**Electrical specifications**

The table below contains the electrical specifications

Model			EWAD~C-XS				
			760	830	890	990	
Power Supply	Phase		3				
	Frequency		Hz		50		
	Voltage		V		400		
	Voltage Tolerance	Minimum	%		-10%		
		Maximum	%		+10%		
Unit	Maximum starting current		A	636.4	681.2	681.2	920.2
	Nominal running current cooling		A	386	423	463	511
	Maximum running current		A	494	548	594	659
	Maximum current for wires sizing		A	543	603	653	725
Fans	Nominal running current in cooling		A	48	56	56	64
Compressor	Phase		No.	3			
	Voltage		V	400			
	Voltage Tolerance	Minimum	%		-10%		
		Maximum	%		+10%		
	Maximum running current		A	223+223	223+269	269+269	269+326
	Starting Method		Wye - Delta type (Y -Δ)				

Model			EWAD~C-XS					
			C10	C11	C12	C13	C14	
Power Supply	Phase		3					
	Frequency		Hz		50			
	Voltage		V		400			
	Voltage Tolerance	Minimum	%		-10%			
		Maximum	%		+10%			
Unit	Maximum starting current		A	965.8	1033	1033	1033	1167.4
	Nominal running current cooling		A	559	608	668	686	729
	Maximum running current		A	716	796	860	860	960
	Maximum current for wires sizing		A	788	876	946	946	1056
Fans	Nominal running current in cooling		A	64	80	80	80	96
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%		-10%			
		Maximum	%		+10%			
	Maximum running current		A	326+326	326+390	390+390	326+326 +326	390+326 +326
	Starting Method		Wye - Delta type (Y -Δ)					

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Model				EWAD~C-XS				
				C15	C16	C17	C18	C19
Power Supply	Phase		3					
	Frequency		50					
	Voltage		400					
	Voltage Tolerance	Minimum	%	-10%				
		Maximum	%	+10%				
Unit	Maximum starting current		A	1213	1258.6	1317.8	1377	1385
	Nominal running current cooling		A	787	834	885	934	985
	Maximum running current		A	1017	1074	1146	1218	1290
	Maximum current for wires sizing		A	1119	1181	1261	1340	1419
Fans	Nominal running current in cooling		A	96	96	104	112	120
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%	-10%				
		Maximum	%	+10%				
	Maximum running current		A	390+390 +326	390+390 +390	326+326 +390	390+390 +326	390+390 +390
	Starting Method			Wye - Delta type (Y -Δ)				



### 1.18 Electrical Specifications: EWAD~C-XL

**Electrical specifications**

The table below contains the electrical specifications

Model			EWAD~C-XL				
			760	830	890	990	
Power Supply	Phase		3				
	Frequency		50				
	Voltage		400				
	Voltage Tolerance	Minimum	-10%				
		Maximum	+10%				
Unit	Maximum starting current		A	636.4	681.2	681.2	920.2
	Nominal running current cooling		A	386	423	463	511
	Maximum running current		A	494	548	594	659
	Maximum current for wires sizing		A	543	603	653	725
Fans	Nominal running current in cooling		A	48	56	56	64
Compressor	Phase		No.	3			
	Voltage		V	400			
	Voltage Tolerance	Minimum	-10%				
		Maximum	+10%				
	Maximum running current		A	223+223	223+269	269+269	269+326
	Starting Method		Wye - Delta type (Y -Δ)				

Model			EWAD~C-XL					
			C10	C11	C12	C13	C14	
Power Supply	Phase		3					
	Frequency		50					
	Voltage		400					
	Voltage Tolerance	Minimum	-10%					
		Maximum	+10%					
Unit	Maximum starting current		A	965.8	1033	1033	1033	1167.4
	Nominal running current cooling		A	559	608	668	686	729
	Maximum running current		A	716	796	860	860	960
	Maximum current for wires sizing		A	788	876	946	946	1056
Fans	Nominal running current in cooling		A	64	80	80	80	96
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	-10%					
		Maximum	+10%					
	Maximum running current		A	326+326	326+390	390+390	390+390	269+269 +326
	Starting Method		Wye - Delta type (Y -Δ)					

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Model				EWAD~C-XL				
				C15	C16	C17	C18	C19
Power Supply	Phase		3					
	Frequency		50					
	Voltage		400					
	Voltage Tolerance	Minimum	%	-10%				
		Maximum	%	+10%				
Unit	Maximum starting current		A	1213	1258.6	1317.8	1377	1385
	Nominal running current cooling		A	787	834	885	934	985
	Maximum running current		A	1017	1074	1146	1218	1290
	Maximum current for wires sizing		A	1119	1181	1261	1340	1419
Fans	Nominal running current in cooling		A	96	96	104	112	120
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%	-10%				
		Maximum	%	+10%				
	Maximum running current		A	326+326 +269	326+326 +326	326+326 +390	390+390 +326	390+390 +390
	Starting Method			Wye - Delta type (Y -Δ)				

### 1.19 Electrical Specifications: EWAD~C-XR

**Electrical specifications**

The table below contains the electrical specifications.

Model			EWAD~C-XR				
			740	810	870	970	
Power Supply	Phase		3				
	Frequency		Hz		50		
	Voltage		V		400		
	Voltage Tolerance	Minimum	%		-10%		
		Maximum	%		+10%		
Unit	Maximum starting current		A	619.6	661.6	661.6	897.8
	Nominal running current cooling		A	391	425	470	517
	Maximum running current		A	477	528	574	637
	Maximum current for wires sizing		A	525	581	632	700
Fans	Nominal running current in cooling		A	31	36	36	42
Compressor	Phase		No.	3			
	Voltage		V	400			
	Voltage Tolerance	Minimum	%		-10%		
		Maximum	%		+10%		
	Maximum running current		A	223+223	223+269	269+269	269+326
	Starting Method		Wye - Delta type (Y -Δ)				

Model			EWAD~C-XR					
			C10	C11	C12	C13	C14	
Power Supply	Phase		3					
	Frequency		Hz		50			
	Voltage		V		400			
	Voltage Tolerance	Minimum	%		-10%			
		Maximum	%		+10%			
Unit	Maximum starting current		A	943.4	1005	1005	1005	1133.8
	Nominal running current cooling		A	570	613	679	697	734
	Maximum running current		A	694	768	832	832	926
	Maximum current for wires sizing		A	763	845	915	915	1019
Fans	Nominal running current in cooling		A	42	52	52	52	62
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%		-10%			
		Maximum	%		+10%			
	Maximum running current		A	326+326	326+390	390+390	390+390	269+269 +326
	Starting Method		Wye - Delta type (Y -Δ)					

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Model				EWAD~C-XR				
				C15	C16	C17	C18	C19
Power Supply	Phase			3				
	Frequency		Hz	50				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%	-10%				
		Maximum	%	+10%				
Unit	Maximum starting current		A	1179.4	1225	1281.4	1337.8	1343
	Nominal running current cooling		A	799	851	901	950	1001
	Maximum running current		A	983	1040	1110	1179	1248
	Maximum current for wires sizing		A	1082	1144	1221	1297	1373
Fans	Nominal running current in cooling		A	62	62	68	73	78
Compressor	Phase		No.	3				
	Voltage		V	400				
	Voltage Tolerance	Minimum	%	-10%				
		Maximum	%	+10%				
	Maximum running current		A	326+326 +269	326+326 +326	326+326 +390	390+390 +326	390+390 +390
	Starting Method			Wye - Delta type (Y -Δ)				

## 1.20 Electrical Specifications: EWAD~C-PS

### Electrical specifications

The table below contains the electrical specifications

Model			EWAD~C-PS							
			820	890	980	C11	C12	C13	C14	
Power Supply	Phase		3							
	Frequency		Hz	50						
	Voltage		V	400						
	Voltage Tolerance	Minimum	%	-10%						
		Maximum	%	+10%						
Unit	Maximum starting current		A	660.4	697.2	697.2	936.2	981.8	1041	1049
	Nominal running current cooling		A	384	420	461	506	551	609	665
	Maximum running current		A	518	564	610	675	732	804	876
	Maximum current for wires sizing		A	570	620	671	743	805	884	964
Fans	Nominal running current in cooling		A	72	72	72	80	80	88	96
Compressor	Phase		No.	3						
	Voltage		V	400						
	Voltage Tolerance	Minimum	%	-10%						
		Maximum	%	+10%						
	Maximum running current		A	223 +223	223 +269	269 +269	269 +326	326 +326	390 +326	390 +390
Starting Method			Wye - Delta type (Y -Δ)							

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1.21 Electrical Specifications: EWAD~C-PL

Electrical specifications

The table below contains the electrical specifications

Model			EWAD~C-PL							
			820	890	980	C11	C12	C13	C14	
Power Supply	Phase		3							
	Frequency		Hz	50						
	Voltage		V	400						
	Voltage Tolerance	Minimum	%	-10%						
		Maximum	%	+10%						
Unit	Maximum starting current		A	660.4	697.2	697.2	936.2	981.8	1041	1049
	Nominal running current cooling		A	384	420	461	506	551	609	665
	Maximum running current		A	518	564	610	675	732	804	876
	Maximum current for wires sizing		A	570	620	671	743	805	884	964
Fans	Nominal running current in cooling		A	72	72	72	80	80	88	96
Compressor	Phase		No.	3						
	Voltage		V	400						
	Voltage Tolerance	Minimum	%	-10%						
		Maximum	%	+10%						
	Maximum running current		A	223 +223	223 +269	269 +269	269 +326	326 +326	390 +326	390 +390
Starting Method			Wye - Delta type (Y -Δ)							

## 1.22 Electrical Specifications: EWAD~C-PR

### Electrical specifications

The table below contains the electrical specifications

Model			EWAD~C-PR							
			820	890	980	C11	C12	C13	C14	
Power Supply	Phase		3							
	Frequency		Hz	50						
	Voltage		V	400						
	Voltage Tolerance	Minimum	%	-10%						
		Maximum	%	+10%						
Unit	Maximum starting current		A	635.2	672	672	908.2	953.8	1010.2	1015.4
	Nominal running current cooling		A	376	416	461	505	554	614	671
	Maximum running current		A	493	539	585	647	704	773	842
	Maximum current for wires sizing		A	542	593	643	712	774	851	927
Fans	Nominal running current in cooling		A	47	47	47	52	52	57	62
Compressor	Phase		No.	3						
	Voltage		V	400						
	Voltage Tolerance	Minimum	%	-10%						
		Maximum	%	+10%						
	Maximum running current		A	223 +223	223 +269	269 +269	269 +326	326 +326	390 +326	390 +390
Starting Method		Wye - Delta type (Y -Δ)								

## 1.23 Cooling Capacity Tables

EWAD~C-SS /  
EWAD~C-SL

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		42		44		46	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
650	4	653	182	624	196	592	211	554	227	538	233	521	240	502	247
	5	673	185	643	199	610	214	572	230	555	237	538	244	519	251
	6	693	188	662	202	628	218	590	234	573	241	555	248	536	255
	7	713	191	681	205	647	221	608	238	591	245	573	252	553	259
	8	733	194	701	209	666	224	626	241	609	248	590	256	570	263
	9	753	197	721	212	685	228	644	245	626	252	607	260	588	268
	10	774	200	741	215	704	231	662	249	644	256	625	264	605	272
	11	794	203	761	218	723	235	681	253	662	260	643	268	622	276
	12	815	206	781	222	743	238	700	257	681	264	660	272	639	280
	13	836	209	801	225	762	242	719	261	699	268	679	276	657	284
	14	857	212	821	228	782	246	737	264	718	272	697	280	663	284
15	879	216	842	232	801	249	756	268	736	276	715	285	664	281	
740	4	732	212	713	231	689	251	657	273	642	283	625	293	597	299
	5	752	215	732	234	707	254	675	277	659	287	642	297	605	299
	6	772	218	751	237	726	258	692	281	676	291	659	302	615	300
	7	792	222	771	241	744	262	710	285	693	295	673	305	624	301
	8	812	225	790	245	763	266	728	289	711	300	682	305	633	301
	9	833	228	810	248	782	270	746	294	729	304	692	306	642	302
	10	854	232	830	252	801	274	764	298	746	309	702	307	645	299
	11	875	235	851	256	821	278	782	303	762	312	712	308	647	297
	12	896	239	871	260	840	282	801	307	770	312	721	308	650	295
	13	918	243	892	264	860	286	819	312	781	313	730	309	653	292
	14	939	246	913	268	880	291	838	316	791	314	735	307	653	288
15	961	250	934	272	900	295	852	319	801	315	736	304	654	285	
830	4	825	241	801	262	770	285	729	310	710	321	688	333	621	323
	5	847	245	822	267	790	290	749	315	729	326	706	338	625	321
	6	869	249	844	271	811	295	768	321	748	332	707	335	623	316
	7	892	253	865	275	832	299	788	326	767	337	711	333	630	316
	8	914	258	887	280	852	304	807	331	786	342	710	329	631	312
	9	937	262	909	284	873	309	827	336	800	345	712	326	631	308
	10	960	266	931	289	894	314	847	342	800	342	720	326	637	306
	11	984	270	953	294	915	319	866	347	803	340	721	322	641	304
	12	1,007	275	976	298	936	324	886	352	806	338	721	318	639	298
	13	1,031	279	998	303	957	329	890	351	808	335	727	317	643	295
	14	1,055	284	1,021	308	979	335	894	349	809	331	726	312	646	292
15	1,079	289	1,044	313	1,000	340	896	346	815	330	730	310	648	289	



Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		42		44		46	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
910	4	899	257	875	279	845	304	806	331	787	342	766	355	723	358
	5	923	261	898	284	867	308	827	336	808	348	786	360	735	359
	6	947	265	921	288	890	313	849	341	829	353	807	365	747	360
	7	971	268	945	292	912	318	870	346	850	358	817	366	759	361
	8	996	273	969	297	935	322	892	351	871	363	830	367	770	362
	9	1,021	277	993	301	958	327	914	356	892	369	839	367	773	359
	10	1,046	281	1,017	306	981	332	936	361	914	374	851	368	778	357
	11	1,071	285	1,042	310	1,005	337	958	367	924	374	866	370	776	352
	12	1,097	289	1,066	315	1,028	342	980	372	937	375	877	370	780	349
	13	1,123	294	1,091	320	1,052	347	1,002	378	949	377	882	368	786	347
	14	1,149	298	1,117	324	1,076	352	1,022	382	961	377	887	366	789	344
15	1,175	303	1,142	329	1,100	358	1,035	383	973	378	891	364	790	340	
970	4	957	283	931	308	898	335	853	365	832	379	808	392	743	388
	5	983	287	955	312	921	340	875	371	853	384	829	398	748	386
	6	1,008	291	980	317	944	345	897	377	874	390	850	404	751	383
	7	1,033	296	1,004	322	967	351	919	382	896	396	850	400	754	380
	8	1,059	301	1,029	327	991	356	941	388	918	402	855	399	757	376
	9	1,085	305	1,054	332	1,014	361	963	394	939	408	853	394	758	371
	10	1,111	310	1,079	337	1,038	367	986	400	961	414	856	390	764	369
	11	1,138	315	1,105	342	1,062	373	1,008	406	961	410	865	390	764	363
	12	1,164	320	1,130	348	1,087	378	1,031	412	965	407	866	385	769	361
	13	1,191	325	1,156	353	1,111	384	1,054	418	968	405	867	380	774	358
	14	1,218	330	1,182	359	1,136	390	1,071	422	971	401	873	378	778	354
15	1,246	335	1,208	364	1,160	396	1,076	420	972	397	879	376	781	350	
C11	4	1,049	305	1,021	332	986	362	941	394	918	408	894	423	842	426
	5	1,077	310	1,048	337	1,012	367	965	400	942	414	917	429	853	426
	6	1,105	314	1,075	342	1,038	373	990	406	966	420	938	434	867	427
	7	1,133	319	1,103	347	1,064	378	1,014	412	990	427	950	435	879	428
	8	1,162	324	1,130	353	1,091	384	1,039	418	1,015	433	964	436	892	429
	9	1,191	329	1,158	358	1,117	389	1,065	424	1,039	439	978	438	896	425
	10	1,220	334	1,187	363	1,144	395	1,090	430	1,061	444	992	439	899	422
	11	1,250	339	1,215	369	1,172	401	1,116	437	1,073	444	1,005	439	900	417
	12	1,279	344	1,244	374	1,199	407	1,141	443	1,088	446	1,018	440	904	413
	13	1,310	349	1,273	380	1,226	413	1,167	450	1,102	447	1,025	438	911	411
	14	1,340	355	1,302	386	1,254	419	1,187	453	1,116	448	1,026	433	914	407
15	1,371	360	1,331	392	1,282	426	1,202	455	1130	448	1032	430	915	402	
C12	4	1,131	326	1,102	355	1,067	386	1,022	420	1,000	435	975	451	947	468
	5	1,160	330	1,131	360	1,095	391	1,048	426	1,026	442	1,000	458	972	474
	6	1,190	335	1,161	365	1,124	397	1,075	432	1,052	448	1,026	464	997	481
	7	1,221	340	1,190	370	1,152	402	1,102	438	1,078	454	1,052	470	1,022	488
	8	1,252	344	1,220	375	1,181	408	1,130	445	1,105	460	1,078	477	1,023	483
	9	1,283	349	1,250	380	1,210	414	1,157	451	1,132	467	1,104	484	1,029	481
	10	1,314	354	1,281	386	1,239	420	1,185	457	1,159	473	1,131	490	1,033	478
	11	1,346	359	1,311	391	1,268	426	1,213	464	1,186	480	1,157	497	1,037	474
	12	1,378	365	1,343	397	1,298	432	1,241	470	1,214	487	1,170	498	1,040	470
	13	1,410	370	1,374	403	1,328	438	1,270	477	1,242	494	1,176	496	1,041	465
	14	1,443	375	1,405	408	1,358	444	1,298	484	1,270	500	1,180	493	1,050	463
15	1,476	381	1,437	414	1,389	451	1,327	490	1,298	507	1,184	489	1,050	457	

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Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		42		44		46	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C14	4	1,391	404	1,355	440	1,311	479	1,253	522	1,225	540	1,194	560	1,155	578
	5	1,429	410	1,392	447	1,347	486	1,287	529	1,258	548	1,226	568	1,177	582
	6	1,468	416	1,429	453	1,382	493	1,321	537	1,291	556	1,258	576	1,201	586
	7	1,506	422	1,467	460	1,419	500	1,355	545	1,325	564	1,291	584	1,222	589
	8	1,546	429	1,505	467	1,455	507	1,390	552	1,359	572	1,319	590	1,246	593
	9	1,585	435	1,544	473	1,492	515	1,425	560	1,393	580	1,345	595	1,269	597
	10	1,626	441	1,583	480	1,529	522	1,461	569	1,428	588	1,367	598	1,290	599
	11	1,666	448	1,622	488	1,567	530	1,496	577	1,462	597	1,392	602	1,296	595
	12	1,708	455	1,662	495	1,605	538	1,532	585	1,492	603	1,417	606	1,297	589
	13	1,749	461	1,702	502	1,643	546	1,568	594	1,519	608	1,445	611	1,300	584
	14	1,791	468	1,743	509	1,682	554	1,605	602	1,542	611	1,469	615	1,305	579
15	1,834	475	1,783	517	1,721	562	1,642	611	1,568	615	1,474	610	1,309	573	
C15	4	1,517	445	1,475	484	1,423	527	1,354	574	1,321	594	1,284	616	1,205	619
	5	1,558	452	1,515	492	1,461	535	1,390	583	1,356	603	1,318	625	1,221	620
	6	1,600	459	1,556	499	1,499	543	1,426	591	1,391	612	1,353	634	1,237	620
	7	1,642	466	1,596	507	1,538	551	1,463	600	1,427	622	1,371	636	1,252	619
	8	1,685	473	1,637	515	1,577	560	1,500	610	1,463	631	1,382	634	1,266	618
	9	1,728	481	1,679	523	1,617	568	1,537	619	1,499	641	1,399	634	1,271	612
	10	1,772	488	1,721	531	1,657	577	1,574	628	1,536	650	1,414	634	1,277	607
	11	1,816	496	1,763	539	1,697	586	1,612	638	1,548	648	1,429	633	1,282	602
	12	1,860	504	1,806	548	1,738	595	1,650	648	1,565	649	1,443	631	1,290	597
	13	1,905	512	1,849	556	1,778	604	1,689	657	1,581	649	1,453	628	1,296	592
	14	1,951	520	1,893	565	1,820	614	1,718	663	1,597	648	1,460	623	1,298	585
15	1,997	528	1,936	574	1,861	623	1,732	662	1,612	647	1,468	620	1,305	580	
C16	4	1,598	468	1,554	509	1,501	554	1,431	604	1,397	625	1,359	648	1,275	650
	5	1,641	475	1,596	517	1,541	562	1,469	613	1,434	635	1,395	658	1,292	650
	6	1,685	482	1,639	525	1,581	571	1,507	622	1,471	644	1,432	667	1,308	650
	7	1,729	489	1,682	533	1,622	580	1,546	631	1,509	654	1,451	668	1,324	648
	8	1,774	497	1,725	541	1,664	588	1,585	641	1,547	663	1,463	666	1,339	646
	9	1,819	504	1,769	549	1,705	597	1,624	650	1,585	673	1,481	666	1,353	643
	10	1,865	512	1,813	557	1,747	606	1,664	660	1,624	683	1,498	665	1,373	644
	11	1,911	520	1,857	566	1,790	615	1,704	670	1,637	680	1,513	664	1,385	640
	12	1,958	528	1,902	574	1,833	625	1,744	680	1,655	681	1,529	661	1,404	639
	13	2,005	536	1,948	583	1,876	634	1,784	690	1,673	680	1,542	658	1,423	638
	14	2,053	544	1,993	592	1,919	644	1,818	696	1,690	679	1,564	659	1,440	637
15	2,101	553	2,039	601	1,963	653	1,830	694	1,706	677	1,584	659	1,444	631	
C17	4	1,676	499	1,631	543	1,574	591	1,499	645	1,462	668	1,422	693	1,329	694
	5	1,720	506	1,674	551	1,615	600	1,537	654	1,500	678	1,459	703	1,347	694
	6	1,765	514	1,717	559	1,656	609	1,576	664	1,538	688	1,490	710	1,363	694
	7	1,810	521	1,760	568	1,714	618	1,615	674	1,576	698	1,509	712	1,379	693
	8	1,855	529	1,804	576	1,739	627	1,655	684	1,615	708	1,522	710	1,385	688
	9	1,901	537	1,849	585	1,781	637	1,694	694	1,653	719	1,540	711	1,397	685
	10	1,948	546	1,893	594	1,824	646	1,735	704	1,686	726	1,557	710	1,396	676
	11	1,995	554	1,938	603	1,867	656	1,775	715	1,706	728	1,573	709	1,405	671
	12	2,042	562	1,984	612	1,910	666	1,816	726	1,718	725	1,585	706	1,405	661
	13	2,090	571	2,030	621	1,954	676	1,856	736	1,736	725	1,593	701	1,414	657
	14	2,138	580	2,076	631	1,997	686	1,884	741	1,753	725	1,595	693	1,419	650
15	2,187	589	2,123	641	2,041	697	1,903	742	1,777	727	1,603	689	1,427	644	

Notes

Cc (cooling capacity) – Pi (unit power input) – ELWT (evaporator leaving water temperature –  $\Delta t$  5°C).  
Data are referred to 0,0176 m<sup>2</sup>C/kW evaporator fouling factor.

EWAD~C-SR

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		42		44		46	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
620	4	632	182	602	197	567	212	543	221	527	228	500	238	472	249
	5	651	186	619	200	584	216	560	225	543	232	516	243	487	254
	6	670	189	637	204	602	219	577	230	560	236	532	247	502	258
	7	689	192	656	207	619	223	594	234	577	241	548	251	508	258
	8	709	196	674	211	636	227	611	238	593	245	564	256	510	256
	9	727	199	693	215	654	231	628	242	610	249	581	261	511	254
	10	747	203	712	219	672	235	645	246	626	254	597	265	515	252
	11	766	206	730	222	690	240	662	250	643	258	613	270	515	249
	12	785	210	749	226	708	244	680	255	660	262	629	274	518	246
	13	805	213	767	230	725	248	697	259	677	267	646	279	520	244
	14	825	217	786	234	743	252	715	264	695	272	662	284	526	243
15	845	221	805	238	761	257	732	268	712	276	671	285	528	239	
720	4	716	217	693	237	664	259	642	273	625	283	597	299	495	271
	5	735	221	711	241	681	263	658	278	641	288	605	299	496	268
	6	754	225	730	245	698	268	674	283	655	292	615	300	499	266
	7	773	229	748	250	715	272	691	287	665	293	625	300	502	263
	8	793	233	766	254	732	277	707	292	673	294	635	300	506	261
	9	812	237	785	258	749	282	724	297	682	295	644	300	507	258
	10	832	241	803	263	767	287	734	299	692	296	655	301	511	255
	11	852	245	822	267	784	292	744	300	701	296	660	298	511	251
	12	871	250	841	272	802	297	752	300	712	298	665	295	516	250
	13	892	254	860	277	820	302	762	301	716	297	667	289	518	246
	14	912	259	879	282	835	305	773	303	715	293	671	286	523	245
15	932	263	898	287	846	307	782	304	719	291	675	281	523	241	
790	4	803	251	773	274	733	298	705	314	683	325	629	329	487	280
	5	824	256	793	279	752	304	723	320	688	324	634	326	491	277
	6	845	261	812	284	771	309	740	326	688	321	635	319	490	272
	7	866	266	832	289	789	315	758	332	692	319	643	317	494	269
	8	887	270	852	295	808	321	763	331	695	317	646	312	496	265
	9	908	276	872	300	827	327	767	329	697	314	649	306	499	262
	10	929	281	892	306	845	333	765	325	699	311	656	303	506	262
	11	950	286	912	311	864	339	768	322	705	310	657	296	508	258
	12	972	291	932	317	873	340	770	319	705	305	663	293	508	253
	13	994	297	952	323	876	338	776	318	710	303	668	289	515	253
	14	1,015	302	972	329	879	336	776	314	709	298	673	285	515	248
15	1,037	308	992	335	881	333	782	313	713	296	677	281	521	247	

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Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		42		44		46	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
880	4	879	264	850	288	813	314	786	332	765	344	723	358	597	324
	5	902	269	872	293	834	320	806	337	784	349	736	359	598	320
	6	925	273	894	298	855	325	826	343	795	350	748	360	602	317
	7	948	278	916	303	876	331	846	349	807	352	760	360	605	314
	8	971	283	938	309	896	337	866	355	818	354	772	359	607	310
	9	995	288	961	314	917	342	881	358	830	355	783	359	611	307
	10	1,018	293	983	319	938	348	891	358	841	356	792	358	612	302
	11	1,042	298	1,006	325	959	354	902	360	852	356	795	352	619	301
	12	1,066	303	1,028	330	980	360	914	361	857	354	801	348	621	297
	13	1,090	309	1,051	336	1,002	366	925	362	862	352	805	343	623	293
	14	1,115	314	1,074	342	1,015	368	936	362	866	350	812	340	628	291
15	1,139	320	1,097	348	1,027	370	950	365	866	346	816	335	629	286	
920	4	934	293	902	320	859	350	828	369	804	383	751	396	585	336
	5	958	299	924	326	880	356	848	376	823	390	758	392	585	330
	6	982	304	947	332	901	362	868	382	824	386	763	388	589	327
	7	1,006	309	969	338	922	369	888	389	829	384	768	383	593	324
	8	1,030	315	992	344	943	375	908	396	833	382	773	377	597	320
	9	1,054	321	1,015	350	964	382	918	397	837	379	776	370	600	316
	10	1,078	326	1,038	356	986	388	918	392	839	376	784	367	602	311
	11	1,103	332	1,061	362	1,007	395	922	390	841	372	786	359	611	311
	12	1,128	338	1,084	369	1,028	402	925	387	842	367	793	355	612	306
	13	1,152	344	1,107	375	1,050	409	927	383	848	365	800	351	612	300
	14	1,177	350	1,130	382	1,055	407	928	379	854	363	806	346	620	299
15	1,202	357	1,153	389	1,059	405	935	378	852	356	811	341	619	293	
C10	4	1,026	315	992	343	949	375	917	396	892	411	842	427	689	382
	5	1,052	320	1,018	349	973	382	939	403	912	416	856	428	693	379
	6	1,079	326	1,043	355	996	388	962	409	923	417	870	428	697	375
	7	1,106	331	1,069	361	1,02	395	985	416	937	419	884	428	701	371
	8	1,133	337	1,094	368	1,044	401	1,008	423	951	421	897	428	706	368
	9	1,160	343	1,120	374	1,069	408	1,023	425	964	422	909	427	708	362
	10	1,188	349	1,146	380	1,093	415	1,034	426	976	423	917	423	712	358
	11	1,216	355	1,172	387	1,117	422	1,048	428	989	423	921	416	715	354
	12	1,243	361	1,199	394	1,142	429	1,061	429	995	422	927	411	722	352
	13	1,271	367	1,225	401	1,163	435	1,074	430	997	417	936	408	724	347
	14	1,300	374	1,252	407	1,178	437	1,091	433	1,002	415	941	402	730	344
15	1,328	381	1,278	415	1,193	439	1,100	431	1,007	411	945	395	730	338	
C11	4	1,109	333	1,076	363	1,033	397	1,001	419	977	435	935	460	792	431
	5	1,137	338	1,103	369	1,059	403	1,026	426	1,001	442	959	467	795	427
	6	1,166	344	1,131	375	1,085	410	1,051	433	1,026	449	982	474	803	425
	7	1,195	350	1,159	382	1,112	417	1,077	440	1,050	456	1,005	482	805	419
	8	1,225	355	1,187	388	1,138	423	1,102	447	1,075	463	1,029	489	812	417
	9	1,254	361	1,215	394	1,165	430	1,128	454	1,100	471	1,042	490	811	409
	10	1,284	367	1,244	401	1,192	437	1,153	461	1,125	478	1,049	485	817	406
	11	1,314	373	1,272	407	1,219	445	1,179	469	1,137	479	1,055	480	822	402
	12	1,345	380	1,301	414	1,246	452	1,205	476	1,143	477	1,060	473	826	397
	13	1,375	386	1,330	421	1,273	459	1,231	484	1,148	474	1,065	466	829	392
	14	1,406	392	1,360	428	1,300	467	1,258	492	1,151	471	1,075	462	832	387
15	1,437	399	1,389	435	1,328	474	1,263	489	1,154	467	1,077	453	843	387	

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		42		44		46	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C13	4	1,363	413	1,322	451	1,268	492	1,227	519	1,197	539	1,144	569	989	543
	5	1,400	420	1,357	458	1,300	500	1,259	528	1,227	547	1,172	577	994	538
	6	1,437	427	1,392	466	1,334	509	1,291	537	1,258	556	1,196	582	1,000	534
	7	1,474	434	1,427	474	1,367	517	1,323	546	1,287	564	1,217	584	1,006	529
	8	1,511	442	1,463	482	1,401	526	1,355	555	1,309	568	1,240	588	1,010	524
	9	1,549	449	1,499	490	1,435	535	1,388	564	1,333	573	1,263	591	1,013	517
	10	1,587	457	1,536	498	1,469	544	1,421	573	1,355	577	1,289	596	1,021	513
	11	1,626	465	1,572	507	1,503	553	1,443	577	1,378	581	1,311	599	1,028	509
	12	1,665	473	1,609	516	1,538	562	1,468	582	1,404	587	1,321	595	1,028	500
	13	1,704	481	1,646	524	1,573	572	1,493	587	1,427	591	1,328	586	1,033	495
	14	1,743	489	1,683	533	1,608	581	1,518	592	1,433	587	1,335	579	1,041	491
15	1,783	498	1,721	542	1,637	588	1,542	596	1,440	584	1,343	571	1,044	484	
C14	4	1,482	459	1,431	501	1,366	547	1,318	577	1,281	598	1,211	626	977	551
	5	1,521	467	1,469	510	1,401	556	1,351	587	1,313	608	1,226	623	985	547
	6	1,561	476	1,506	519	1,436	566	1,384	597	1,331	610	1,244	622	992	542
	7	1,600	484	1,544	528	1,471	576	1,418	607	1,345	610	1,260	619	997	535
	8	1,641	493	1,582	537	1,506	586	1,452	618	1,358	610	1,276	616	1005	531
	9	1,681	502	1,620	547	1,542	596	1,475	622	1,373	610	1,291	612	1,008	524
	10	1,722	511	1,658	557	1,578	607	1,489	622	1,388	609	1,305	609	1,014	518
	11	1,763	520	1,697	567	1,614	618	1,502	622	1,404	610	1,313	601	1,018	511
	12	1,804	530	1,736	577	1,650	628	1,518	622	1,418	608	1,324	594	1,022	504
	13	1,846	539	1,775	587	1,686	640	1,532	621	1,417	600	1,330	585	1,033	502
	14	1,888	549	1,814	598	1,701	639	1,549	621	1,426	597	1,339	577	1,034	494
15	1,930	559	1,853	609	1,714	638	1,566	622	1,429	590	1,346	568	1,043	490	
C15	4	1,562	481	1,511	525	1,444	573	1,395	605	1,358	627	1,286	657	1,071	590
	5	1,604	489	1,550	534	1,481	583	1,430	615	1,392	638	1,300	651	1,088	590
	6	1,645	498	1,589	543	1,518	593	1,466	626	1,411	639	1,319	649	1,102	588
	7	1,687	507	1,629	553	1,556	603	1,502	636	1,423	637	1,336	646	1,101	578
	8	1,729	515	1,670	562	1,593	614	1,537	647	1,440	638	1,353	642	1,114	577
	9	1,772	525	1,710	572	1,631	624	1,562	651	1,457	637	1,369	637	1,120	571
	10	1,815	534	1,751	582	1,669	635	1,574	649	1,472	636	1,391	636	1,124	564
	11	1,858	543	1,792	592	1,707	646	1,592	649	1,487	634	1,405	630	1,127	556
	12	1,902	553	1,833	603	1,745	657	1,609	649	1,508	636	1,425	628	1,129	548
	13	1,946	563	1,874	613	1,784	668	1,625	648	1,521	632	1,445	626	1,138	544
	14	1,990	573	1,916	624	1,803	669	1,639	645	1,541	633	1,464	624	1,141	536
15	2,034	583	1,957	635	1,815	666	1,661	647	1,552	628	1,483	622	1,152	534	
C16	4	1,638	515	1,583	563	1,511	615	1,458	649	1,418	674	1,336	702	1,070	613
	5	1,680	524	1,623	572	1,548	626	1,494	660	1,452	685	1,351	697	1,077	607
	6	1,722	533	1,663	582	1,586	636	1,529	672	1,466	684	1,369	696	1,084	601
	7	1,764	543	1,703	592	1,623	647	1,565	683	1,484	686	1,387	693	1,093	596
	8	1,807	552	1,744	603	1,661	658	1,601	695	1,496	684	1,404	690	1,097	588
	9	1,851	562	1,784	613	1,699	670	1,621	697	1,512	684	1,423	689	1,103	581
	10	1,894	572	1,826	624	1,738	681	1,639	698	1,528	684	1,427	676	1,109	574
	11	1,938	582	1,867	635	1,776	693	1,657	699	1,546	684	1,439	669	1,117	569
	12	1,982	592	1,908	646	1,815	705	1,674	700	1,547	676	1,443	655	1,120	560
	13	2,026	603	1,950	657	1,853	717	1,690	699	1,549	668	1,456	649	1,127	554
	14	2,071	613	1,992	669	1,866	715	1,705	698	1,558	664	1,465	639	1,137	550
15	2,115	624	2,033	680	1,884	716	1,709	691	1,566	658	1,472	629	1,136	540	



Notes

Cc (cooling capacity) – Pi (unit power input) – ELWT (evaporator leaving water temperature –  $\Delta t$  5°C).  
Data are referred to 0,0176 m<sup>2</sup>/kW evaporator fouling factor.

**EWAD~C-XS /  
EWAD~C-XL**

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		48		50	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
760	4	734	189	715	206	694	223	667	242	624	267	606	276	587	285
	5	755	192	736	209	714	226	687	245	643	270	625	280	605	289
	6	777	194	757	212	735	230	707	249	662	274	643	284	623	293
	7	799	197	779	215	756	233	727	252	681	278	662	287	641	297
	8	820	200	800	218	777	236	747	256	700	282	681	291	660	301
	9	842	203	822	221	798	239	768	259	719	286	700	295	678	305
	10	864	206	843	224	819	243	788	263	739	290	719	300	692	308
	11	886	208	865	227	840	246	809	267	759	294	738	304	697	306
	12	908	211	887	230	861	249	829	270	778	298	758	308	700	305
	13	931	214	908	233	883	253	850	274	798	302	777	312	697	301
	14	953	217	931	236	904	256	871	278	818	306	797	316	705	300
15	976	220	953	240	925	260	891	281	838	310	806	317	706	297	
830	4	805	206	784	224	762	243	734	264	690	291	671	301	651	311
	5	829	209	808	227	784	247	756	267	710	295	691	305	671	315
	6	853	212	831	231	807	250	778	271	731	299	712	309	691	319
	7	877	214	855	234	830	253	800	274	752	303	732	313	711	323
	8	900	217	879	237	854	257	823	278	773	307	753	317	731	328
	9	923	220	902	240	877	260	845	282	795	311	774	321	751	332
	10	947	223	925	243	900	264	868	286	816	315	795	325	764	333
	11	971	226	948	246	923	267	891	290	838	319	817	330	777	334
	12	995	229	972	249	946	271	913	293	861	323	839	334	789	335
	13	1,018	232	996	253	969	274	935	297	883	328	861	339	800	336
	14	1,041	234	1,019	256	992	278	958	301	905	332	880	342	812	336
15	1,064	237	1,041	259	1,015	281	981	305	926	336	893	343	823	336	
890	4	864	226	842	246	817	267	786	289	736	320	715	331	692	342
	5	889	229	866	250	841	271	809	293	757	324	736	335	712	347
	6	915	233	891	253	865	274	832	297	779	329	757	340	733	352
	7	941	236	917	257	889	278	855	302	801	333	779	345	754	357
	8	964	239	942	260	914	282	879	306	823	338	800	349	775	361
	9	986	242	965	264	939	286	903	310	845	342	822	354	797	366
	10	1,009	245	987	267	962	290	927	315	868	347	844	359	796	362
	11	1,033	248	1,010	270	984	294	951	319	891	352	866	364	801	361
	12	1,056	251	1,033	274	1,006	297	972	323	914	357	889	369	804	358
	13	1,080	254	1,056	277	1,029	301	994	327	938	362	912	374	807	355
	14	1,103	257	1,080	280	1,051	305	1,015	331	959	366	923	374	808	352
15	1,127	261	1,103	284	1,074	308	1,038	335	980	371	927	372	809	348	

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		48		50	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
990	4	972	249	946	271	917	294	881	319	824	351	801	363	775	376
	5	1,001	253	974	275	944	298	908	323	849	356	825	368	799	381
	6	1,031	257	1,003	279	972	303	935	328	874	361	850	374	823	386
	7	1,060	260	1,032	283	1,001	307	962	333	900	366	874	379	847	392
	8	1,090	264	1,062	288	1,030	312	989	337	925	372	900	384	859	392
	9	1,121	268	1,092	292	1,059	316	1,017	342	952	377	925	389	874	393
	10	1,151	272	1,122	296	1,088	321	1,046	347	978	382	951	395	885	393
	11	1,182	276	1,152	300	1,117	325	1,074	352	1,005	388	977	400	899	394
	12	1,214	280	1,183	304	1,147	330	1,102	357	1,032	393	993	402	916	396
	13	1,245	284	1,214	309	1,177	335	1,131	362	1,060	399	1,009	403	929	396
	14	1,276	288	1,244	313	1,207	339	1,160	367	1,087	404	1,024	404	932	392
15	1,308	292	1,275	318	1,237	344	1,189	373	1,115	410	1,039	405	938	390	
C10	4	1,045	274	1,017	298	985	323	945	350	879	387	853	400	824	414
	5	1,076	278	1,048	302	1,014	328	973	355	905	392	878	406	848	420
	6	1,108	282	1,078	307	1,044	333	1,001	361	932	398	904	411	873	426
	7	1,139	286	1,109	311	1,074	338	1,029	366	959	404	930	417	899	432
	8	1,170	290	1,141	316	1,104	343	1,058	371	986	410	956	423	906	430
	9	1,202	295	1,171	321	1,135	348	1,088	377	1,013	415	983	429	905	425
	10	1,234	299	1,202	325	1,165	353	1,117	383	1,041	421	1,010	436	909	423
	11	1,266	303	1,234	330	1,195	358	1,147	388	1,069	428	1,038	442	913	419
	12	1,297	308	1,265	335	1,226	363	1,176	394	1,097	434	1,051	442	916	416
	13	1,330	312	1,296	340	1,256	368	1,205	399	1,126	440	1,056	440	925	414
	14	1,362	317	1,328	344	1,287	374	1,235	405	1,153	446	1,060	438	926	409
15	1,396	321	1,360	349	1,318	379	1,264	411	1,182	453	1,064	434	925	404	
C11	4	1,160	295	1,130	322	1,097	349	1,057	378	991	417	964	431	934	446
	5	1,194	299	1,163	326	1,130	354	1,088	384	1,021	423	994	437	963	452
	6	1,228	303	1,197	331	1,163	359	1,120	389	1,051	429	1,023	443	992	458
	7	1,263	307	1,231	335	1,196	364	1,152	394	1,082	435	1,053	449	1,021	464
	8	1,298	312	1,266	340	1,229	369	1,184	400	1,113	440	1,083	455	1,051	471
	9	1,333	316	1,300	344	1,263	374	1,217	405	1,144	446	1,114	461	1,077	475
	10	1,368	320	1,335	349	1,297	379	1,250	410	1,175	452	1,145	467	1,091	475
	11	1,404	324	1,370	354	1,331	384	1,283	416	1,207	458	1,176	474	1,109	477
	12	1,441	329	1,406	359	1,366	389	1,316	422	1,238	465	1,207	480	1,126	478
	13	1,478	333	1,442	363	1,401	394	1,350	427	1,271	471	1,238	486	1,143	478
	14	1,515	338	1,478	368	1,436	400	1,384	433	1,303	477	1,262	489	1,159	479
15	1,552	342	1,515	373	1,472	405	1,418	439	1,335	483	1,276	489	1,180	481	
C12	4	1,245	324	1,214	353	1,177	383	1,132	416	1,058	459	1,028	475	994	492
	5	1,281	329	1,248	358	1,212	389	1,165	422	1,090	466	1,059	482	1,024	498
	6	1,317	333	1,284	363	1,246	394	1,198	428	1,121	472	1,089	488	1,054	505
	7	1,353	338	1,319	368	1,280	400	1,232	434	1,152	479	1,120	495	1,085	512
	8	1,389	343	1,355	374	1,316	405	1,265	440	1,185	485	1,152	502	1,115	519
	9	1,426	347	1,391	379	1,351	411	1,299	446	1,217	492	1,183	509	1,139	523
	10	1,463	352	1,427	384	1,386	417	1,333	452	1,249	499	1,215	516	1,138	518
	11	1,501	357	1,464	389	1,421	422	1,368	458	1,282	505	1,247	523	1,144	515
	12	1,539	362	1,501	395	1,457	428	1,402	464	1,315	512	1,279	530	1,148	511
	13	1,577	367	1,539	400	1,493	434	1,437	471	1,348	519	1,312	537	1,152	507
	14	1,616	372	1,577	406	1,530	440	1,471	477	1,381	526	1,327	537	1,154	502
15	1,655	378	1,615	411	1,567	446	1,507	484	1,414	533	1,324	531	1,165	500	

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Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		48		50	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C13	4	1,311	333	1,275	362	1,233	392	1,182	425	1,100	468	1,066	483	999	487
	5	1,352	338	1,314	368	1,271	398	1,218	431	1,133	475	1,099	490	1,007	482
	6	1,393	343	1,354	373	1,310	404	1,255	438	1,168	482	1,133	498	1,013	476
	7	1,434	348	1,395	379	1,349	411	1,292	444	1,202	489	1,166	505	1,018	470
	8	1,476	354	1,435	385	1,389	417	1,330	451	1,237	496	1,183	506	1,022	462
	9	1,518	359	1,477	391	1,428	423	1,368	458	1,273	504	1,190	501	1,034	459
	10	1,562	365	1,519	397	1,469	430	1,406	465	1,309	511	1,196	495	1,035	451
	11	1,606	371	1,561	403	1,509	437	1,445	472	1,346	519	1,201	489	1,046	447
	12	1,650	377	1,605	410	1,551	443	1,484	479	1,363	519	1,204	481	1,055	442
	13	1,694	383	1,648	416	1,593	450	1,524	487	1,369	514	1,217	478	1,052	432
	14	1,739	389	1,692	423	1,636	457	1,564	494	1,374	508	1,217	469	1,059	426
15	1,784	395	1,735	429	1,677	465	1,605	502	1,388	505	1,228	465	1,065	420	
C14	4	1,369	355	1,335	387	1,299	420	1,253	456	1,179	504	1,148	521	1,113	540
	5	1,407	360	1,373	392	1,335	426	1,289	462	1,213	510	1,182	528	1,146	546
	6	1,445	364	1,410	397	1,372	431	1,325	468	1,247	517	1,215	535	1,180	554
	7	1,484	369	1,449	403	1,409	437	1,361	474	1,282	524	1,249	542	1,213	561
	8	1,523	374	1,487	408	1,447	443	1,397	480	1,316	530	1,284	549	1,247	568
	9	1,562	379	1,526	413	1,485	448	1,434	486	1,351	537	1,318	556	1,275	572
	10	1,602	384	1,565	418	1,523	454	1,470	492	1,387	544	1,352	563	1,297	575
	11	1,643	389	1,605	424	1,561	460	1,508	499	1,422	551	1,387	570	1,322	578
	12	1,684	394	1,645	429	1,601	466	1,545	505	1,458	558	1,423	577	1,346	581
	13	1,726	399	1,686	435	1,640	472	1,583	512	1,494	565	1,458	584	1,371	584
	14	1,768	404	1,727	440	1,680	478	1,622	518	1,530	572	1,484	587	1,394	586
15	1,810	409	1,769	446	1,720	484	1,660	525	1,567	579	1,509	591	1,415	587	
C15	4	1,484	385	1,446	419	1,403	455	1,349	493	1,262	544	1,226	563	1,186	583
	5	1,526	390	1,488	425	1,443	461	1,388	500	1,299	552	1,262	571	1,221	591
	6	1,569	395	1,530	431	1,485	468	1,428	507	1,336	559	1,299	579	1,257	599
	7	1,612	401	1,572	437	1,526	474	1,468	514	1,374	567	1,336	587	1,293	607
	8	1,655	406	1,614	443	1,567	481	1,508	521	1,412	575	1,373	595	1,312	606
	9	1,699	412	1,657	449	1,609	487	1,548	528	1,450	583	1,411	603	1,324	601
	10	1,744	418	1,701	455	1,651	494	1,588	535	1,489	591	1,449	611	1,340	598
	11	1,789	424	1,745	462	1,694	501	1,629	543	1,528	599	1,487	619	1,363	598
	12	1,834	430	1,789	468	1,737	508	1,671	550	1,567	607	1,512	622	1,378	594
	13	1,880	436	1,834	474	1,780	515	1,712	558	1,606	615	1,530	620	1,393	590
	14	1,926	442	1,879	481	1,824	522	1,754	566	1,646	624	1,548	617	1,407	586
15	1,973	448	1,925	488	1,867	529	1,796	573	1,686	632	1,571	617	1,410	576	
C16	4	1,555	409	1,515	445	1,469	483	1,410	524	1,316	579	1,278	600	1,235	621
	5	1,599	415	1,558	452	1,511	490	1,451	532	1,354	587	1,314	608	1,271	629
	6	1,642	420	1,601	458	1,553	497	1,491	539	1,392	596	1,352	616	1,307	638
	7	1,686	426	1,644	464	1,596	504	1,533	547	1,431	604	1,390	625	1,344	647
	8	1,731	432	1,688	471	1,638	511	1,574	555	1,470	612	1,428	633	1,345	640
	9	1,776	438	1,732	477	1,680	518	1,615	562	1,510	621	1,466	642	1,353	637
	10	1,821	444	1,776	484	1,723	525	1,656	570	1,550	630	1,505	651	1,360	633
	11	1,868	451	1,822	491	1,767	533	1,698	578	1,589	638	1,545	660	1,365	628
	12	1,915	457	1,867	498	1,811	540	1,740	586	1,629	647	1,564	661	1,369	622
	13	1,962	463	1,913	505	1,855	548	1,782	594	1,668	656	1,572	658	1,371	615
	14	2,010	470	1,960	512	1,900	555	1,825	602	1,708	665	1,578	654	1,383	613
15	2,058	477	2,007	519	1,945	563	1,868	611	1,749	674	1,583	648	1,382	604	



Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		48		50	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C17	4	1,641	432	1,599	471	1,552	511	1,493	555	1,397	614	1,357	635	1,313	658
	5	1,686	438	1,644	478	1,596	518	1,535	563	1,436	622	1,396	644	1,351	667
	6	1,732	444	1,689	484	1,640	526	1,577	570	1,476	631	1,435	653	1,389	676
	7	1,778	450	1,734	491	1,685	533	1,620	578	1,517	639	1,474	661	1,428	685
	8	1,824	456	1,780	497	1,729	540	1,664	586	1,557	648	1,514	670	1,442	684
	9	1,872	463	1,826	504	1,773	547	1,707	594	1,599	657	1,554	679	1,462	685
	10	1,919	469	1,873	511	1,819	555	1,750	602	1,640	665	1,595	688	1,474	682
	11	1,968	475	1,920	518	1,864	562	1,793	610	1,682	674	1,636	698	1,481	678
	12	2,017	482	1,968	525	1,910	570	1,838	618	1,723	683	1,664	701	1,486	673
	13	2,067	489	2,017	532	1,957	578	1,882	627	1,765	692	1,684	703	1,489	666
	14	2,117	495	2,065	540	2,004	586	1,927	635	1,807	702	1,704	703	1,499	662
15	2,168	502	2,115	547	2,052	594	1,973	644	1,850	711	1,718	701	1,499	654	
C18	4	1,720	455	1,677	496	1,629	538	1,567	584	1,468	646	1,427	669	1,380	693
	5	1,768	461	1,724	503	1,675	546	1,612	592	1,509	655	1,468	678	1,421	702
	6	1,817	467	1,772	510	1,721	553	1,657	600	1,552	664	1,509	687	1,462	711
	7	1,866	474	1,820	516	1,768	561	1,702	608	1,594	673	1,551	696	1,502	721
	8	1,916	480	1,869	523	1,815	568	1,747	617	1,638	682	1,593	705	1,534	726
	9	1,967	487	1,919	531	1,863	576	1,793	625	1,681	691	1,636	715	1,566	732
	10	2,018	494	1,969	538	1,912	584	1,839	634	1,725	700	1,679	724	1,591	734
	11	2,070	500	2,020	545	1,961	592	1,886	642	1,769	709	1,722	734	1,592	728
	12	2,123	507	2,071	553	2,010	600	1,934	651	1,814	719	1,762	742	1,599	723
	13	2,176	514	2,123	560	2,061	608	1,982	660	1,859	728	1,796	748	1,604	717
	14	2,230	522	2,176	568	2,111	617	2,030	669	1,904	738	1,829	753	1,608	710
15	2,285	529	2,229	576	2,162	625	2,079	678	1,950	748	1,854	755	1,614	704	
C19	4	1,807	479	1,763	522	1,713	567	1,651	615	1,549	681	1,507	705	1,458	730
	5	1,857	485	1,812	529	1,761	574	1,697	623	1,592	690	1,550	714	1,502	740
	6	1,908	492	1,862	536	1,809	582	1,743	632	1,636	699	1,592	724	1,544	749
	7	1,960	498	1,912	543	1,858	590	1,790	640	1,681	708	1,636	733	1,586	759
	8	2,012	505	1,963	550	1,908	598	1,838	649	1,726	717	1,680	742	1,629	769
	9	2,065	512	2,015	558	1,958	606	1,886	657	1,771	727	1,724	752	1,673	779
	10	2,119	519	2,068	565	2,009	614	1,935	666	1,817	736	1,769	762	1,706	784
	11	2,173	526	2,121	573	2,061	622	1,984	675	1,863	746	1,815	772	1,705	776
	12	2,228	533	2,175	581	2,112	630	2,034	684	1,910	756	1,861	782	1,713	772
	13	2,284	540	2,229	588	2,165	639	2,084	693	1,958	766	1,907	792	1,720	766
	14	2,340	547	2,284	596	2,218	647	2,135	702	2,006	776	1,954	802	1,725	759
15	2,397	555	2,340	605	2,272	656	2,187	712	2,054	786	1,989	807	1,728	752	

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Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)														
		25		30		35		40		46		48		50		
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	
740	4	722	189	701	206	677	224	646	243	595	270	551	269	474	253	
	5	742	192	722	209	697	227	664	247	613	274	555	268	475	250	
	6	763	195	742	212	716	231	683	251	630	278	558	266	475	246	
	7	785	198	763	216	736	235	702	255	643	281	560	264	480	245	
	8	806	201	784	219	756	239	721	259	643	278	562	261	484	243	
	9	827	205	804	223	776	242	740	263	646	276	563	258	483	239	
	10	848	208	825	227	796	246	759	268	649	274	568	257	486	236	
	11	870	211	846	230	816	250	779	272	651	272	568	253	489	234	
	12	891	215	867	234	837	254	798	276	652	269	572	252	491	231	
	13	913	218	888	238	857	258	817	281	652	266	576	250	492	228	
	14	934	222	909	241	877	262	837	285	657	265	573	245	500	228	
	15	956	225	930	245	897	266	856	289	656	261	576	243	500	225	
	810	4	792	204	771	223	746	242	713	263	661	292	622	295	558	286
		5	815	207	793	226	767	246	734	268	681	297	633	296	564	285
		6	839	211	816	230	789	250	754	272	700	301	641	295	563	281
7		862	214	839	233	811	254	775	276	709	301	654	297	567	279	
8		886	217	862	237	833	258	796	280	721	303	664	298	567	275	
9		908	221	885	241	856	262	818	285	732	304	664	294	570	272	
10		931	224	907	244	878	266	839	289	743	305	669	293	574	270	
11		954	227	930	248	900	270	861	294	754	305	670	289	576	267	
12		978	231	953	252	922	274	883	298	765	305	673	287	579	264	
13		1,001	234	975	256	944	278	905	303	773	305	675	284	585	263	
14		1,024	238	999	260	966	282	926	307	774	302	680	282	585	259	
15		1,046	241	1,020	263	989	287	947	312	778	300	682	279	586	256	
870		4	849	226	826	246	798	268	761	292	701	324	641	320	546	297
		5	874	230	849	250	820	272	782	297	721	329	645	318	552	296
		6	898	234	873	254	842	277	803	301	741	334	643	314	553	292
	7	924	237	898	259	866	281	825	306	741	331	650	313	558	290	
	8	948	241	922	263	889	286	847	311	746	330	652	310	556	284	
	9	970	245	946	267	913	291	869	316	749	328	653	306	560	282	
	10	993	248	968	271	937	295	892	321	752	325	659	304	563	279	
	11	1,015	252	990	275	959	300	915	326	754	322	658	299	566	275	
	12	1,038	256	1,012	279	980	304	938	332	754	318	662	297	568	272	
	13	1,061	259	1,034	283	1,001	308	958	336	761	317	666	294	576	272	
	14	1,084	263	1,056	287	1,022	313	979	341	760	313	670	292	577	268	
	15	1,107	267	1,079	291	1,044	317	999	346	766	311	673	289	577	263	
	970	4	955	248	927	271	895	294	853	320	786	355	721	350	632	333
		5	983	253	955	275	921	299	877	325	798	356	734	351	637	330
		6	1,012	257	982	280	947	304	903	331	812	357	746	351	641	328
7		1,041	261	1,011	285	974	309	928	336	825	359	749	348	641	323	
8		1,070	266	1,039	290	1,001	315	954	342	838	360	752	346	644	320	
9		1,099	270	1,068	294	1,029	320	980	347	851	361	753	342	646	316	
10		1,129	275	1,096	299	1,057	325	1,006	353	864	361	758	339	650	313	
11		1,159	279	1,125	304	1,084	331	1,032	359	867	358	761	336	658	311	
12		1,189	284	1,155	309	1,112	336	1,059	365	872	356	764	333	657	306	
13		1,219	289	1,184	315	1,140	342	1,086	371	873	352	769	330	660	303	
14		1,249	294	1,213	320	1,169	347	1,112	377	877	349	770	326	666	301	
15		1,280	299	1,243	325	1,197	353	1,136	381	880	346	774	323	667	296	

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		48		50	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C10	4	1,026	275	995	300	958	326	910	355	833	394	726	372	617	344
	5	1,056	280	1,024	305	986	332	936	361	834	390	729	369	623	342
	6	1,086	285	1,053	310	1,013	338	962	367	840	389	732	365	629	339
	7	1,117	290	1,083	316	1,041	343	988	373	844	386	733	361	627	332
	8	1,147	295	1,113	321	1,070	349	1,015	380	848	384	740	359	631	329
	9	1,177	300	1,143	327	1,099	355	1,042	386	851	380	740	353	635	325
	10	1,208	305	1,172	332	1,128	361	1,069	392	852	376	746	351	637	321
	11	1,239	310	1,202	338	1,156	367	1,096	399	853	371	751	348	648	321
	12	1,270	316	1,232	344	1,184	373	1,124	406	860	369	756	344	649	316
	13	1,300	321	1,262	349	1,213	380	1,151	412	859	363	759	341	650	311
	14	1,332	326	1,292	355	1,241	386	1,178	419	864	361	762	337	659	310
15	1,363	332	1,321	361	1,270	392	1,198	423	869	358	764	333	658	305	
C11	4	1,141	293	1,110	320	1,073	348	1,026	378	949	420	888	421	798	410
	5	1,174	297	1,142	325	1,104	353	1,055	384	977	426	904	423	799	405
	6	1,208	302	1,175	330	1,136	359	1,085	390	1,002	431	920	424	805	403
	7	1,241	307	1,208	335	1,168	365	1,116	397	1,016	432	935	425	811	400
	8	1,276	312	1,241	340	1,199	370	1,147	403	1,032	433	946	424	812	394
	9	1,310	317	1,275	346	1,232	376	1,177	409	1,049	435	954	422	815	390
	10	1,344	322	1,308	351	1,264	382	1,208	415	1,065	436	952	417	822	387
	11	1,379	327	1,342	357	1,297	388	1,239	422	1,080	437	958	414	824	383
	12	1,414	332	1,376	362	1,329	394	1,271	429	1,095	437	957	408	829	379
	13	1,450	338	1,410	368	1,362	400	1,302	435	1,103	435	965	406	828	373
	14	1,486	343	1,445	374	1,396	407	1,334	442	1,104	430	968	401	837	371
15	1,522	348	1,480	380	1,429	413	1,365	449	1,109	427	969	396	840	367	
C12	4	1,224	325	1,190	354	1,148	385	1,095	420	1,008	466	921	454	798	415
	5	1,259	330	1,224	360	1,181	392	1,125	426	1,036	473	927	448	801	407
	6	1,294	335	1,258	366	1,214	398	1,156	433	1,059	477	932	442	810	402
	7	1,329	341	1,292	372	1,247	404	1,188	440	1,066	474	936	435	810	393
	8	1,364	346	1,327	378	1,280	411	1,220	447	1,065	465	939	427	817	388
	9	1,400	352	1,361	384	1,313	418	1,251	454	1,071	459	949	423	824	382
	10	1,436	358	1,396	390	1,347	424	1,283	462	1,083	456	958	419	830	376
	11	1,472	363	1,431	396	1,380	431	1,315	469	1,086	449	958	409	835	370
	12	1,508	369	1,466	402	1,414	438	1,347	476	1,088	440	965	404	839	364
	13	1,545	375	1,502	409	1,447	445	1,379	484	1,098	436	972	398	852	362
	14	1,583	381	1,537	415	1,482	452	1,411	491	1,107	432	978	392	854	355
15	1,620	388	1,574	422	1,516	459	1,444	499	1,105	422	982	386	856	348	
C13	4	1,281	333	1,242	363	1,194	394	1,134	428	1,043	475	927	448	798	406
	5	1,319	339	1,279	369	1,230	401	1,168	436	1,058	476	933	442	807	402
	6	1,358	345	1,317	376	1,266	408	1,201	443	1,066	472	937	435	816	397
	7	1,398	352	1,355	383	1,302	415	1,236	451	1,073	466	940	427	815	387
	8	1,438	358	1,394	390	1,339	423	1,270	459	1,078	460	950	423	822	382
	9	1,479	365	1,433	396	1,376	430	1,305	467	1,083	453	951	414	828	376
	10	1,521	371	1,472	404	1,414	438	1,340	475	1,086	446	960	409	833	370
	11	1,563	378	1,513	411	1,451	446	1,375	483	1,097	442	967	404	837	363
	12	1,604	385	1,553	418	1,490	453	1,411	491	1,097	433	974	399	851	362
	13	1,646	392	1,593	426	1,528	462	1,447	500	1,107	429	980	393	853	355
	14	1,688	399	1,634	433	1,567	470	1,484	508	1,115	424	986	387	854	348
15	1,731	406	1,675	441	1,606	478	1,510	513	1,123	418	990	380	867	346	

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Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		48		50	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C14	4	1,348	352	1,313	385	1,272	419	1,218	456	1,131	507	1,064	511	955	497
	5	1,385	357	1,350	390	1,307	425	1,252	463	1,163	515	1,087	514	959	492
	6	1,423	363	1,386	396	1,343	432	1,287	470	1,185	517	1,109	517	961	487
	7	1,461	368	1,423	402	1,378	438	1,321	477	1,208	521	1,126	518	966	482
	8	1,499	374	1,460	408	1,414	445	1,355	484	1,232	525	1,131	515	975	480
	9	1,537	379	1,498	414	1,450	451	1,390	491	1,252	527	1,133	510	975	473
	10	1,576	385	1,536	421	1,487	458	1,425	499	1,278	531	1,139	506	980	468
	11	1,615	391	1,574	427	1,523	465	1,460	506	1,300	534	1,140	500	987	464
	12	1,655	397	1,612	433	1,561	472	1,495	513	1,311	532	1,151	498	993	460
	13	1,695	403	1,652	440	1,598	479	1,530	521	1,318	529	1,153	493	990	452
	14	1,736	409	1,691	446	1,636	486	1,566	529	1,314	522	1,155	487	998	449
15	1,777	416	1,731	453	1,674	493	1,602	536	1,319	518	1,162	483	1001	443	
C15	4	1,459	385	1,418	420	1,368	457	1,304	497	1,202	552	1,083	535	944	507
	5	1,500	391	1,458	426	1,407	464	1,341	505	1,220	553	1,097	535	946	501
	6	1,541	397	1,499	433	1,446	472	1,378	513	1,231	551	1,110	533	953	497
	7	1,583	404	1,539	440	1,486	479	1,416	521	1,246	552	1,114	528	960	492
	8	1,625	410	1,580	447	1,525	487	1,453	530	1,261	551	1,121	525	965	487
	9	1,668	417	1,621	455	1,564	495	1,491	538	1,275	550	1,122	518	972	483
	10	1,711	424	1,663	462	1,604	502	1,529	547	1,288	549	1,130	514	975	477
	11	1,754	431	1,705	469	1,644	510	1,567	555	1,294	544	1,136	510	980	471
	12	1,798	438	1,747	477	1,685	519	1,605	564	1,300	540	1,144	506	984	466
	13	1,842	445	1,790	485	1,725	527	1,644	573	1,308	537	1,148	501	982	458
	14	1,886	452	1,832	492	1,766	535	1,683	582	1,307	529	1,151	494	993	456
15	1,931	460	1,876	500	1,807	544	1,721	591	1,316	526	1,155	489	993	448	
C16	4	1,527	411	1,483	448	1,430	488	1,360	532	1,249	591	1,088	558	933	520
	5	1,570	418	1,525	456	1,469	496	1,398	540	1,259	589	1,093	553	933	512
	6	1,612	425	1,567	463	1,510	504	1,435	549	1,258	583	1,096	547	941	508
	7	1,655	432	1,609	471	1,550	513	1,474	558	1,265	579	1,098	541	949	504
	8	1,698	439	1,650	478	1,591	521	1,512	567	1,271	575	1,110	538	956	499
	9	1,741	446	1,692	486	1,631	529	1,551	576	1,275	570	1,109	530	962	493
	10	1,785	453	1,734	494	1,671	538	1,590	585	1,277	563	1,118	526	966	487
	11	1,830	461	1,777	502	1,711	546	1,628	595	1,278	556	1,125	521	970	481
	12	1,875	468	1,820	510	1,752	555	1,667	604	1,288	553	1,132	517	972	474
	13	1,920	476	1,864	518	1,794	564	1,705	613	1,298	550	1,138	511	972	466
	14	1,966	484	1,908	527	1,835	573	1,744	623	1,295	541	1,143	505	986	465
15	2,012	492	1,952	535	1,877	582	1,784	633	1,302	536	1,146	499	985	457	
C17	4	1,612	434	1,568	473	1,514	515	1,443	562	1,329	625	1,182	602	1,013	561
	5	1,657	441	1,611	481	1,555	524	1,482	571	1,349	627	1,185	596	1,014	553
	6	1,701	448	1,655	489	1,597	532	1,522	580	1,362	626	1,190	590	1,020	547
	7	1,746	455	1,699	496	1,639	541	1,562	589	1,374	625	1,193	584	1,029	543
	8	1,791	462	1,742	504	1,682	549	1,602	598	1,377	619	1,202	580	1,037	538
	9	1,837	469	1,786	512	1,724	558	1,643	607	1,382	614	1,206	573	1,044	532
	10	1,883	477	1,831	520	1,766	566	1,683	617	1,386	609	1,212	567	1,045	524
	11	1,930	485	1,876	528	1,809	575	1,724	626	1,388	602	1,221	563	1,049	517
	12	1,977	492	1,921	537	1,852	584	1,764	636	1,396	597	1,229	558	1,057	513
	13	2,025	500	1,967	545	1,896	593	1,805	646	1,407	594	1,231	551	1,059	505
	14	2,073	509	2,013	554	1,940	603	1,847	656	1,404	585	1,237	545	1,068	501
15	2,121	517	2,060	563	1,984	612	1,888	666	1,413	580	1,241	538	1,067	493	

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		48		50	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C18	4	1,692	455	1,646	497	1,590	541	1,517	590	1,399	656	1,278	647	1,085	600
	5	1,738	463	1,692	505	1,634	550	1,558	599	1,433	664	1,279	641	1,097	597
	6	1,786	470	1,737	513	1,678	559	1,600	609	1,460	669	1,285	636	1,098	588
	7	1,833	477	1,784	521	1,722	567	1,643	618	1,483	672	1,290	630	1,108	584
	8	1,882	485	1,831	529	1,767	576	1,686	628	1,485	666	1,293	623	1,109	575
	9	1,931	493	1,878	538	1,812	585	1,728	638	1,492	662	1,298	616	1,117	569
	10	1,980	501	1,926	546	1,858	594	1,771	647	1,497	657	1,310	613	1,123	563
	11	2,031	509	1,974	555	1,904	604	1,815	657	1,501	650	1,308	603	1,128	557
	12	2,081	517	2,023	564	1,951	613	1,859	668	1,507	645	1,317	598	1,132	550
	13	2,133	525	2,072	573	1,998	623	1,903	678	1,507	636	1,325	593	1,139	544
	14	2,185	534	2,122	582	2,045	633	1,948	688	1,519	633	1,332	587	1,152	541
15	2,237	543	2,172	591	2,093	643	1,993	699	1,520	625	1,338	581	1,157	534	
C19	4	1,778	478	1,731	522	1,674	569	1,600	620	1,479	690	1,372	691	1,165	641
	5	1,827	485	1,779	530	1,720	578	1,644	630	1,521	701	1,371	683	1,178	638
	6	1,877	493	1,827	538	1,766	586	1,687	639	1,561	711	1,379	679	1,180	629
	7	1,927	501	1,876	547	1,813	595	1,731	649	1,592	717	1,385	673	1,191	625
	8	1,977	509	1,925	555	1,860	605	1,776	659	1,592	710	1,389	666	1,189	614
	9	2,029	517	1,974	564	1,907	614	1,821	669	1,600	707	1,391	658	1,198	608
	10	2,081	525	2,025	573	1,955	623	1,866	679	1,607	702	1,404	655	1,205	602
	11	2,133	533	2,075	581	2,004	633	1,912	690	1,612	696	1,403	645	1,211	595
	12	2,186	542	2,127	591	2,053	643	1,958	700	1,615	689	1,414	640	1,216	588
	13	2,240	550	2,178	600	2,102	653	2,005	711	1,617	681	1,423	635	1,220	580
	14	2,294	559	2,231	609	2,152	663	2,052	722	1,630	677	1,431	629	1,238	579
15	2,349	568	2,284	619	2,202	673	2,099	733	1,628	667	1,438	623	1,239	570	

**Notes**

Cc (cooling capacity) – Pi (unit power input) – ELWT (evaporator leaving water temperature –  $\Delta t$  5°C).  
 Data are referred to 0,0176 m<sup>2</sup>C/kW evaporator fouling factor.

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**EWAD~C-PS /  
EWAD~C-PL**

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		49		52	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
820	4	792	183	770	201	749	217	725	235	688	257	665	269	637	283
	5	817	186	794	203	772	220	748	238	710	260	686	273	659	286
	6	842	188	819	205	796	223	771	240	733	264	709	276	680	289
	7	868	190	844	208	821	225	795	243	756	267	731	279	702	293
	8	894	192	870	210	846	228	820	246	779	270	754	283	724	297
	9	920	195	896	213	871	231	844	249	803	273	777	286	747	300
	10	947	197	922	216	897	234	869	253	827	277	800	290	770	304
	11	975	199	949	218	924	237	895	256	851	280	824	293	793	307
	12	1,002	202	977	221	951	240	921	259	876	284	848	297	816	311
	13	1,030	204	1,004	224	978	243	947	262	901	287	873	300	840	315
	14	1,058	207	1,032	227	1,005	246	974	266	927	291	898	304	864	319
	15	1,086	209	1,060	229	1,032	249	1,000	269	953	294	923	308	889	322
890	4	860	202	836	221	813	240	786	259	744	284	718	298	686	313
	5	886	205	862	224	838	243	811	262	768	288	740	302	709	317
	6	913	207	888	227	864	246	836	265	792	291	764	305	732	321
	7	940	210	915	230	890	249	861	269	816	295	788	309	755	325
	8	968	213	942	232	917	252	887	272	841	299	812	313	768	326
	9	996	215	970	235	944	255	913	276	866	302	836	317	782	327
	10	1024	218	998	238	971	259	940	279	891	306	861	321	795	327
	11	1053	221	1026	241	999	262	966	283	917	310	886	325	808	328
	12	1082	224	1055	245	1027	265	994	287	943	314	911	329	821	328
	13	1111	227	1084	248	1055	269	1021	290	969	318	937	333	833	328
	14	1141	230	1113	251	1083	272	1049	294	996	322	963	338	841	327
	15	1171	232	1143	254	1112	276	1077	298	1023	326	989	342	843	325
980	4	942	223	916	243	889	263	858	285	810	312	779	328	743	344
	5	971	226	945	246	917	267	886	288	836	317	804	332	767	349
	6	1,002	229	974	250	946	271	913	292	862	321	829	337	792	353
	7	1,032	232	1,004	253	975	274	941	296	888	325	855	341	810	356
	8	1,064	235	1,035	257	1,005	278	970	300	915	329	881	346	816	354
	9	1,095	239	1,066	260	1,036	282	999	304	943	334	908	350	813	351
	10	1,128	242	1,098	264	1,066	286	1,029	309	971	338	935	355	816	348
	11	1,161	245	1,130	268	1,098	290	1,059	313	999	343	963	359	818	345
	12	1,195	249	1,163	271	1,130	294	1,090	317	1,028	348	990	364	827	345
	13	1,229	253	1,197	275	1,162	298	1,121	322	1,057	353	1,019	369	827	341
	14	1,264	256	1,231	279	1,195	302	1,152	326	1,087	357	1,048	374	826	337
	15	1,299	260	1,266	283	1,228	307	1,184	331	1,117	362	1,060	375	833	335
C11	4	1,037	245	1,008	267	979	289	945	313	892	343	859	360	820	379
	5	1,070	248	1,040	271	1,010	293	975	317	921	348	886	365	836	379
	6	1,103	251	1,073	274	1,042	297	1,006	321	949	353	914	370	851	380
	7	1,136	254	1,105	278	1,074	301	1,036	325	978	357	942	375	867	380
	8	1,170	258	1,139	282	1,106	305	1,068	330	1,008	362	971	380	882	379
	9	1,205	262	1,173	285	1,139	309	1,100	334	1,038	367	1,000	385	897	379
	10	1,241	265	1,208	289	1,173	314	1,132	339	1,069	372	1,030	390	912	378
	11	1,277	269	1,243	293	1,207	318	1,165	343	1,100	377	1,060	395	923	376
	12	1,314	273	1,279	298	1,242	322	1,198	348	1,131	382	1,086	399	929	372
	13	1,351	276	1,316	302	1,278	327	1,233	353	1,164	387	1,103	399	930	366
	14	1,388	280	1,352	306	1,314	332	1,267	358	1,196	392	1,120	399	935	362
	15	1,426	284	1,389	310	1,350	336	1,302	363	1,229	398	1,137	398	939	357

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		49		52	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C12	4	1,120	267	1,089	292	1,057	316	1,019	342	958	376	919	395	874	415
	5	1,154	271	1,123	296	1,090	321	1,050	347	988	381	949	400	882	412
	6	1,189	275	1,158	300	1,124	325	1,083	352	1,019	386	978	405	888	409
	7	1,225	279	1,192	304	1,158	330	1,116	356	1,050	392	1,008	411	894	404
	8	1,261	283	1,228	308	1,192	334	1,149	361	1,081	397	1,039	417	898	399
	9	1,298	286	1,264	313	1,227	339	1,183	366	1,113	402	1,070	422	901	393
	10	1,335	291	1,301	317	1,262	344	1,217	372	1,145	408	1,101	428	912	390
	11	1,374	295	1,338	321	1,299	348	1,251	377	1,178	414	1,133	434	913	384
	12	1,411	299	1,376	326	1,335	353	1,286	382	1,211	419	1,156	437	922	380
	13	1,449	303	1,413	331	1,372	358	1,322	387	1,244	425	1,162	433	920	372
	14	1,488	307	1,451	335	1,409	363	1,358	393	1,278	431	1,166	428	927	368
15	1,528	312	1,489	340	1,446	368	1,394	398	1,313	437	1,179	426	934	363	
C13	4	1,237	295	1,203	321	1,167	348	1,124	377	1,057	414	1,014	435	964	457
	5	1,275	299	1,241	326	1,204	353	1,160	382	1,090	420	1,046	441	973	455
	6	1,315	303	1,279	331	1,241	358	1,196	387	1,124	426	1,079	447	976	452
	7	1,354	307	1,318	335	1,279	363	1,232	393	1,158	432	1,112	453	976	448
	8	1,395	312	1,358	340	1,318	368	1,269	398	1,194	437	1,146	459	980	445
	9	1,436	316	1,398	345	1,357	374	1,307	404	1,229	444	1,181	465	983	441
	10	1,478	321	1,439	350	1,397	379	1,345	410	1,265	450	1,216	472	990	438
	11	1,521	325	1,481	355	1,437	384	1,384	415	1,302	456	1,251	478	990	433
	12	1,564	330	1,523	360	1,478	390	1,423	421	1,338	462	1,273	480	993	429
	13	1,607	335	1,565	365	1,519	395	1,463	427	1,376	469	1,278	478	1,001	427
	14	1,651	340	1,608	370	1,561	401	1,503	433	1,414	475	1,282	475	1,003	422
15	1,695	345	1,652	375	1,603	407	1,544	440	1,452	482	1,285	471	1,009	419	
C14	4	1,344	321	1,307	350	1,268	379	1,222	410	1,149	451	1,103	474	1,049	498
	5	1,386	325	1,348	355	1,308	385	1,261	416	1,185	457	1,138	480	1,058	496
	6	1,428	330	1,390	360	1,349	390	1,300	422	1,222	464	1,174	487	1,065	494
	7	1,470	334	1,432	365	1,390	396	1,339	428	1,260	470	1,210	493	1,062	488
	8	1,514	339	1,474	370	1,431	401	1,380	434	1,298	477	1,247	500	1,067	485
	9	1,558	344	1,517	375	1,473	407	1,420	440	1,336	483	1,284	507	1,070	481
	10	1,603	349	1,561	380	1,516	412	1,461	446	1,375	490	1,322	514	1,082	479
	11	1,649	354	1,606	386	1,559	418	1,502	452	1,414	496	1,360	521	1,082	474
	12	1,694	359	1,652	391	1,603	424	1,544	458	1,454	503	1,388	524	1,081	468
	13	1,740	364	1,697	397	1,648	430	1,587	465	1,494	510	1,394	522	1,090	465
	14	1,787	369	1,742	402	1,692	436	1,630	471	1,535	517	1,399	519	1,097	462
15	1,834	374	1,788	408	1,736	442	1,674	478	1,576	524	1,402	515	1,104	458	

Notes

Cc (cooling capacity) – Pi (unit power input) – ELWT (evaporator leaving water temperature – Δt 5°C).  
 Data are referred to 0,0176 m<sup>2</sup>/kW evaporator fouling factor.

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EWAD~C-PR

Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)														
		25		30		35		40		46		49		52		
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	
810	4	782	176	760	193	738	210	712	228	671	251	645	264	615	278	
	5	806	178	784	195	761	213	735	231	693	255	666	268	635	282	
	6	830	181	808	198	785	216	758	234	714	258	687	271	656	286	
	7	856	183	833	201	809	219	781	238	737	262	709	275	676	290	
	8	881	186	858	204	833	222	804	241	759	266	730	279	697	293	
	9	907	189	883	207	858	225	828	244	781	269	753	283	719	297	
	10	934	192	909	210	883	229	852	248	804	273	775	287	741	302	
	11	961	194	935	213	909	232	877	251	827	277	797	291	762	306	
	12	987	197	962	216	935	235	902	255	851	281	820	295	773	306	
	13	1,015	200	989	219	961	239	927	259	875	285	843	299	771	300	
	14	1,042	203	1,016	223	987	242	953	263	899	289	866	303	780	299	
	15	1,070	206	1,043	226	1,014	246	978	266	924	293	890	307	782	295	
	880	4	847	196	824	215	800	234	770	254	723	281	693	295	623	298
		5	873	199	850	218	825	237	794	258	745	285	715	299	635	299
		6	900	202	876	221	850	241	818	261	768	289	737	304	646	299
7		926	205	902	225	875	244	843	265	791	293	759	308	652	297	
8		953	208	928	228	901	248	867	269	815	297	779	311	651	294	
9		981	212	955	232	927	252	893	273	839	301	789	311	656	292	
10		1,009	215	982	235	953	256	918	277	863	306	802	312	660	290	
11		1,037	218	1,010	239	980	259	944	281	887	310	815	313	659	286	
12		1,065	221	1,038	242	1,007	263	970	286	912	315	827	314	661	283	
13		1,094	225	1,066	246	1,035	267	996	290	937	319	839	314	666	281	
14		1,123	228	1,094	250	1,062	271	1,023	294	962	324	855	316	667	278	
15		1,152	232	1,123	253	1,090	275	1,049	298	980	326	856	313	670	275	
960		4	927	219	902	239	873	260	839	282	783	312	749	328	632	317
		5	956	222	930	243	901	264	864	286	807	316	772	333	635	314
		6	986	226	958	247	928	268	891	291	832	321	796	338	637	311
	7	1,016	230	988	251	956	272	918	295	857	326	820	343	638	307	
	8	1,046	233	1,017	255	985	277	945	300	882	331	825	341	644	306	
	9	1,077	237	1,047	259	1,014	281	972	305	908	336	830	340	643	301	
	10	1,109	241	1,078	263	1,043	286	1,000	309	934	341	833	338	648	299	
	11	1,141	245	1,109	267	1,073	290	1,029	314	961	346	836	335	653	296	
	12	1,173	249	1,141	272	1,104	295	1,058	319	988	352	837	332	657	294	
	13	1,207	254	1,173	276	1,134	300	1,087	325	1,015	357	838	328	660	291	
	14	1,240	258	1,206	281	1,166	305	1,117	330	1,035	360	846	327	662	287	
	15	1,275	263	1,239	286	1,197	310	1,147	335	1,039	358	844	322	664	284	
	C10	4	1,021	240	993	262	962	285	924	310	863	342	825	360	711	342
		5	1,053	244	1,024	266	992	290	952	314	890	347	847	364	715	338
		6	1,085	248	1,055	271	1,022	294	981	319	917	353	860	363	718	333
7		1,118	252	1,087	275	1,053	299	1,010	324	944	358	875	364	723	329	
8		1,151	256	1,120	279	1,084	304	1,040	329	972	363	890	363	728	324	
9		1,185	260	1,153	284	1,116	308	1,070	334	1,000	369	905	363	735	321	
10		1,220	264	1,186	288	1,148	313	1,101	340	1,029	374	923	364	738	315	
11		1,255	268	1,220	293	1,181	318	1,132	345	1,058	380	937	363	744	311	
12		1,290	273	1,255	298	1,214	323	1,164	350	1,075	381	941	359	745	305	
13		1,327	278	1,290	303	1,248	329	1,196	356	1,091	381	942	353	750	301	
14		1,363	282	1,326	308	1,282	334	1,228	362	1,108	381	951	350	753	296	
15		1,399	287	1,361	313	1,316	339	1,261	367	1,124	381	955	345	761	293	



Size	ELWT (°C)	Condenser Inlet Air Temperature (°C)													
		25		30		35		40		46		49		52	
		Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)	Cc (kW)	Pi (kW)
C11	4	1,101	265	1,071	290	1,036	315	992	342	922	378	878	398	704	353
	5	1,135	269	1,104	294	1,067	320	1,022	347	950	384	899	401	706	346
	6	1,169	274	1,137	299	1,100	325	1,053	353	979	390	906	398	714	343
	7	1,204	278	1,171	304	1,132	330	1,084	358	1,008	396	904	390	714	335
	8	1,239	283	1,205	309	1,165	336	1,116	364	1,037	402	909	385	721	331
	9	1,275	288	1,240	314	1,199	341	1,147	370	1,067	408	920	384	727	326
	10	1,311	292	1,275	319	1,232	346	1,179	376	1,097	414	923	377	732	321
	11	1,348	297	1,311	324	1,267	352	1,212	382	1,127	421	925	370	736	316
	12	1,385	302	1,347	330	1,301	358	1,244	388	1,133	418	934	367	740	311
	13	1,422	307	1,383	335	1,336	364	1,278	394	1,138	413	933	359	742	305
	14	1,460	312	1,419	340	1,372	370	1,311	400	1,142	408	940	355	754	304
15	1,498	318	1,456	346	1,407	376	1,345	407	1,144	401	947	351	755	298	
C13	4	1,216	292	1,182	319	1,143	347	1,094	377	1,017	416	969	438	758	398
	5	1,254	297	1,219	324	1,178	352	1,128	383	1,048	423	988	440	764	395
	6	1,292	302	1,256	330	1,214	358	1,162	389	1,080	429	991	438	768	391
	7	1,331	307	1,294	335	1,251	364	1,197	395	1,112	436	993	434	771	386
	8	1,371	312	1,332	341	1,288	370	1,232	401	1,144	443	997	431	773	381
	9	1,411	317	1,371	346	1,325	376	1,267	408	1,177	450	1,000	427	779	378
	10	1,451	323	1,410	352	1,362	382	1,303	414	1,211	457	1,002	423	783	374
	11	1,493	328	1,450	358	1,401	388	1,339	421	1,241	462	1,007	420	787	370
	12	1,534	334	1,491	364	1,439	395	1,376	428	1,247	460	1,012	416	790	365
	13	1,576	339	1,532	370	1,479	401	1,413	435	1,246	456	1,015	412	792	360
	14	1,618	345	1,573	376	1,518	408	1,451	442	1,249	452	1,022	409	799	358
15	1,661	351	1,614	382	1,558	415	1,489	449	1,251	448	1,024	404	804	354	
C14	4	1,322	318	1,285	347	1,243	378	1,190	410	1,106	453	1,054	477	826	434
	5	1,363	323	1,325	353	1,281	384	1,226	417	1,140	460	1,079	481	836	432
	6	1,404	329	1,365	359	1,320	390	1,263	423	1,174	468	1,078	477	836	426
	7	1,446	334	1,406	365	1,359	396	1,301	430	1,209	475	1,084	474	844	423
	8	1,488	339	1,447	371	1,399	403	1,339	437	1,244	482	1,089	471	842	416
	9	1,531	345	1,488	377	1,439	409	1,377	444	1,280	490	1,093	467	848	412
	10	1,574	351	1,531	383	1,480	416	1,416	451	1,317	497	1,095	463	853	408
	11	1,619	357	1,574	389	1,521	423	1,455	458	1,353	505	1,096	457	857	403
	12	1,663	363	1,617	396	1,562	429	1,494	466	1,360	503	1,106	455	860	398
	13	1,708	369	1,661	402	1,604	436	1,534	473	1,355	496	1,104	449	862	393
	14	1,753	375	1,705	409	1,647	444	1,574	481	1,358	492	1,113	446	876	392
15	1,798	381	1,749	415	1,689	451	1,615	488	1,361	488	1,120	442	876	386	

**Notes**

Cc (cooling capacity) – Pi (unit power input) – ELWT (evaporator leaving water temperature – Δt 5°C).  
 Data are referred to 0,0176 m<sup>2</sup>°C/kW evaporator fouling factor.

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1.24 Capacity Correction Factor EWAD~C-

Evaporator fouling factors

Fouling factors m <sup>2</sup> °C / kW	Cooling capacity correction factor	Power input correction factor	EER correction factor
0.0176	1.000	1.000	1.000
0.0440	0.978	0.986	0.992
0.0880	0.957	0.974	0.983
0.1320	0.938	0.962	0.975

Altitude correction factors

Elevation above sea level (m)	0	300	600	900	1200	1500	1800
Barometric pressure (mbar)	1013	977	942	908	875	843	812
Cooling capacity correction factor	1.000	0.993	0.986	0.979	0.973	0.967	0.960
Power input correction factor	1.000	1.005	1.009	1.015	1.021	1.026	1.031

Minimum glycol percentage for low water temperature

Evaporator Leaving Water Temperature (°C)	2	0	-2	-4	-6	-8
Ethylene glycol (%)	10	20	20	20	30	30
Propylene glycol (%)	10	20	20	30	30	30

**Note:** Minimum glycol percentage to be used with evaporator leaving water temperature below 4°C to prevent freezing of water circuit.

Minimum glycol percentage for low air temperature

Air Ambient Temperature (°C) (2)	-3	-8	-15	-23	-35
Ethylene glycol (%) (1)	10%	20%	30%	40%	50%
Air Ambient Temperature (°C) (2)	-3	-7	-12	-20	-32
Propylene glycol (%) (1)	10%	20%	30%	40%	50%

**Note (1):** Minimum glycol percentage to prevent freezing of water circuit at indicated air ambient temperature.

**Note (2):** Air ambient temperature do exceed the operating limits of the unit. as protection of water circuit may be needed in winter season at non-working conditions.

Correction factors for low evaporator leaving water temperature

Evaporator Leaving Water Temperature (°C)	2	0	-2	-4	-6	-8
Cooling Capacity	0.842	0.785	0.725	0.670	0.613	0.562
Compressor Power Input	0.950	0.940	0.920	0.890	0.870	0.840

**Note:** Correction factors have to be applied at working conditions: evaporator leaving water temperature 7°C.

**Correction factors for water and glycol mixture**

Ethylene Glycol (%)		10%	20%	30%	40%	50%
Ethylene Glycol	Cooling Capacity	0.991	0.982	0.972	0.961	0.946
	Compressor Power Input	0.996	0.992	0.986	0.976	0.966
	Flow Rate ( $\Delta t$ )	1.013	1.040	1.074	1.121	1.178
	Evaporator Pressure Drop	1.070	1.129	1.181	1.263	1.308
Propylene Glycol	Cooling Capacity	0.985	0.964	0.932	0.889	0.846
	Compressor Power Input	0.993	0.983	0.969	0.948	0.929
	Flow Rate ( $\Delta t$ )	1.017	1.032	1.056	1.092	1.139
	Evaporator Pressure Drop	1.120	1.272	1.496	1.792	2.128

**How to use the Correction factors proposed in the previous tables?**

- Mixture Water and Glycol - Evaporator leaving water temperature > 4°C
  - Depending on the type and percentage (%) of glycol filled in the circuit (see table "Minimum glycol percentage for low air temperature" on page 1–72 and table "Correction factors for water and glycol mixture" on page 1–73).
  - Multiply the Cooling Capacity, the Compressor Power Input by the Correction factor of table "Correction factors for water and glycol mixture" on page 1–73.
  - Starting from this new value of Cooling Capacity, calculate the Flow Rate (l/s) and the Evaporator Pressure Drop (kPa).
  - Now multiply the new Flow Rate and the new Evaporator Pressure Drop by the Correction Factors of table "Correction factors for water and glycol mixture" on page 1–73.

Example	
Unit Size:	EWAD650C-SS
Mixture:	Water
Working Condition:	ELWT 12/7°C – Condenser inlet air temperature 35°C
Cooling capacity:	647 kW
Power Input:	221 kW
Flow Rate ( $\Delta t$ 5°C):	30.90 l/s
Evaporator pressure drop:	79 kPa
Mixture:	Water + Ethylene Glycol 30% (for a winter air temperature up to -15°C)
Working Condition:	ELWT 12/7°C – Condenser inlet air temperature 35°C
Cooling capacity:	647 x 0.972 = 629 kW
Power Input:	221 x 0.986 = 218 kW
Flow Rate ( $\Delta t$ 5°C):	30.05 (referred to 629 kW) x 1.074 = 32.27 l/s
Evaporator pressure drop:	85 (referred to 32.27 l/s) x 1.181 = 100 kPa

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- Mixture Water and Glycol - Evaporator leaving water temperature < 4°C
  - Depending on the type and percentage (%) of glycol filled in the circuit (see table "Minimum glycol percentage for low water temperature" on page 1–72 and table "Minimum glycol percentage for low air temperature" on page 1–72 and table "Correction factors for water and glycol mixture" on page 1–73).
  - Depending from the evaporator leaving water temperature (see table "Correction factors for low evaporator leaving water temperature" on page 1–72).
  - Multiply the Cooling Capacity, the Compressor Power Input by the Correction factor of table "Correction factors for low evaporator leaving water temperature" on page 1–72 and table "Correction factors for water and glycol mixture" on page 1–73.
  - Starting from this new value of Cooling Capacity, calculate the Flow Rate (l/s) and the Evaporator Pressure Drop (kPa).
  - Now multiply the new Flow Rate and the new Evaporator Pressure Drop by the Correction Factors of table "Correction factors for water and glycol mixture" on page 1–73.

<b>Example</b>	
<b>Unit Size:</b>	<b>EWAD650C-SS</b>
Mixture:	Water
Working Condition:	ELWT 12/7°C – Condenser inlet air temperature 30°C
Cooling capacity:	681 kW
Power Input:	205 kW
Flow Rate (Δt 5°C):	32.54 l/s
Evaporator pressure drop:	87 kPa
Mixture:	Water + Glycol 30% (for a low evaporator leaving temperature of -1/-6°C)
Working Condition:	ELWT -1/-6°C – Condenser inlet air temperature 30°C
Cooling capacity:	$681 \times 0.613 \times 0.972 = 406 \text{ kW}$
Power Input:	$205 \times 0.870 \times 0.986 = 176 \text{ kW}$
Flow Rate (Δt 5°C):	$19.40 \text{ l/s (referred to 406 kW)} \times 1.074 = 20.83 \text{ l/s}$
Evaporator pressure drop:	$39 \text{ kPa (referred to 20.83 l/s)} \times 1.181 = 46 \text{ kPa}$

### 1.25 Available Fan Static Pressure Correction Factors

Type	EWAD~C-SS / EWAD~C-SL			EWAD~C-XS / EWAD~C-XL			EWAD~C-PR LN		EWAD~C-PS / EWAD~C-PL		
	0	10	20	30	40	50	60	70	80	90	100
External Static Pressure (Pa)	0	10	20	30	40	50	60	70	80	90	100
Cooling Capacity (kW) Correction factor	1.000	0.998	0.996	0.995	0.993	0.992	0.991	0.989	0.986	0.985	0.982
Compr. Power Input (kW) Correction factor	1.000	1.004	1.009	1.012	1.018	1.021	1.024	1.027	1.034	1.039	1.045
Reduction of Max CIAT (°C)	1.000	-0.3	-0.5	-0.7	-1.0	-1.1	-1.3	-1.6	-1.8	2.1	-2.4

CIAT: Condenser Inlet Air Temperature

Type	EWAD~C-SR			EWAD~C-XR			EWAD~C-PR	
	0	10	20	30	40	50	60	70
External Static Pressure (Pa)	0	10	20	30	40	50	60	70
Cooling Capacity (kW) Correction factor	1.000	0.996	0.991	0.985	0.978	0.97	0.954	0.927
Compr. Power Input (kW) Correction factor	1.000	1.005	1.012	1.02	1.028	1.039	1.058	1.092
Reduction of Max CIAT (°C)	1.000	-0.3	-0.7	-1.1	-1.6	-2.2	-3.3	-5.1

CIAT: Condenser Inlet Air Temperature

**How to use the Correction factors proposed in the previous tables?**

Example	
Unit Size:	EWAD650C-SS
External Static Pressure:	0 Pa
Working Condition:	ELWT 12/7°C – Condenser inlet air temperature 35°C
Cooling capacity:	647 kW
Power Input:	221 kW
Maximum CIAT:	46°C (see graphic operating limit)
External Static Pressure:	40 Pa
Working Condition:	ELWT 12/7°C – Condenser inlet air temperature 35°C
Cooling capacity:	647 x 0.993 = 642 kW
Power Input:	221 x 1.018 = 225 kW
Maximum CIAT:	46°C - 1.0 = 45°C

1.26 Water Charge, Flow and Quality

Items <sup>(1)(5)</sup>			Cooling Water			Cooled Water	
			Circulating System		Once Flow		
			Circulating water	Supply water <sup>(4)</sup>	Flowing water	Circulating water [Below 20°C]	Supply water <sup>(4)</sup>
Items to be controlled	pH	at 25°C	6.5~8.2	6.0~8.0	6.0~8.0	6.0~8.0	6.0~8.0
	Electrical conductivity	[mS/m] at 25°C	Below 80	Below 30	Below 40	Below 40	Below 30
		[µS/cm] at 25°C	(Below 800)	(Below 300)	(Below 400)	(Below 400)	(Below 300)
	Chloride ion	[mgCl <sub>2</sub> -/l]	Below 200	Below 50	Below 50	Below 50	Below 50
	Sulfate ion	[mgSO <sub>2</sub> -4/l]	Below 200	Below 50	Below 50	Below 50	Below 50
	M-alkalinity (pH4.8)	[mgCaCO <sub>3</sub> /l]	Below 100	Below 50	Below 50	Below 50	Below 50
	Total hardness	[mgCaCO <sub>3</sub> /l]	Below 200	Below 70	Below 70	Below 70	Below 70
Calcium hardness	[mgCaCO <sub>3</sub> /l]	Below 150	Below 50	Below 50	Below 50	Below 50	
Items to be referred to	Silica ion	[mgSiO <sub>2</sub> /l]	Below 50	Below 30	Below 30	Below 30	Below 30
	Iron	[mgFe/l]	Below 1.0	Below 0.3	Below 1.0	Below 1.0	Below 0.3
	Copper	[mgCu/l]	Below 0.3	Below 0.1	Below 1.0	Below 1.0	Below 1.0
	Sulfite ion	[mgS <sub>2</sub> -/l]	Not detectable	Not detectable	Not detectable	Not detectable	Not detectable
	Ammonium ion	[mgNH <sub>4</sub> /l]	Below 1.0	Below 1.0	Below 1.0	Below 1.0	Below 1.0
	Remaining chloride	[mgCL/l]	Below 0.3	Below 0.3	Below 0.3	Below 0.3	Below 0.3
	Free carbide	[mgCO <sub>2</sub> /l]	Below 4.0	Below 4.0	Below 4.0	Below 4.0	Below 4.0
	Stability index		6.0~7.0				

Items <sup>(1)(5)</sup>			Heated water <sup>(2)</sup>				Tendency if out of criteria
			Low temperature		High temperature		
			Circulating water [20°C~60°C]	Supply water <sup>(4)</sup>	Circulating water [20°C~60°C]	Supply water <sup>(4)</sup>	
Items to be controlled	pH	at 25°C	7.0~8.0	7.0~8.0	7.0~8.0	7.0~8.0	Corrosion + Scale
	Electrical conductivity	[mS/m] at 25°C	Below 30	Below 30	Below 30	Below 30	Corrosion + Scale
		[µS/cm] at 25°C	(Below 300)	(Below 300)	(Below 300)	(Below 300)	Corrosion + Scale
	Chloride ion	[mgCl <sub>2</sub> -/l]	Below 50	Below 50	Below 30	Below 30	Corrosion
	Sulfate ion	[mgSO <sub>2</sub> -4/l]	Below 50	Below 50	Below 30	Below 30	Corrosion
	M-alkalinity (pH4.8)	[mgCaCO <sub>3</sub> /l]	Below 50	Below 50	Below 50	Below 50	Scale
	Total hardness	[mgCaCO <sub>3</sub> /l]	Below 70	Below 70	Below 70	Below 70	Scale
Calcium hardness	[mgCaCO <sub>3</sub> /l]	Below 50	Below 50	Below 50	Below 50	Scale	
Items to be referred to	Silica ion	[mgSiO <sub>2</sub> /l]	Below 30	Below 30	Below 30	Below 30	Scale
	Iron	[mgFe/l]	Below 1.0	Below 0.3	Below 1.0	Below 0.3	Corrosion + Scale
	Copper	[mgCu/l]	Below 1.0	Below 0.1	Below 1.0	Below 0.1	Corrosion
	Sulfite ion	[mgS <sub>2</sub> -/l]	Not detectable	Not detectable	Not detectable	Not detectable	Corrosion
	Ammonium ion	[mgNH <sub>4</sub> /l]	Below 0.3	Below 0.1	Below 0.1	Below 0.1	Corrosion
	Remaining chloride	[mgCL/l]	Below 0.25	Below 0.3	Below 0.1	Below 0.3	Corrosion
	Free carbide	[mgCO <sub>2</sub> /l]	Below 0.4	Below 4.0	Below 0.4	Below 4.0	Corrosion
Stability index						Corrosion + Scale	

**Notes**

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(1) Names, definitions and units are according to JIS K 0101. Units and figures between brackets are old units published as reference only.

(2) In case of using heated water (more than 40°C), corrosion is generally noticeable. Especially when the iron materials is in direct contact with water without any protection shields, it is desirable to give the valid measure for corrosion. E.g. chemical measure.

(4) Supply water is considered drink water, industrial water and ground water except for genuine water, neutral water and soft water.

(5) The above mentioned items are representable items in corrosion and scale cases.

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## 1.27 Water Content in Cooling Circuits

The cooled water distribution circuits should have minimum water content to avoid excessive compressors start and stop. In fact, each time the compressor starts up, an excessive quantity of oil goes from the compressor sump and simultaneously there is a rise in the temperature of the compressor motor's stator due to the inrush current during the start-up.

To prevent damage to the compressors, we have envisaged the application of a device to limit frequent stops and restarts.

During the span of one hour there will be no more than 6 starts of the compressor. The plant side should therefore ensure that the overall water content allows a more constant functioning of the unit and consequently greater environmental comfort.

The minimum water content per unit should be calculated using this simplified formula:

- For 2 compressors unit:

$$M \text{ (litres)} = ( 0.1595 \times \Delta T(^{\circ}\text{C}) + 3.0825 ) \times P(\text{kW})$$

- For 2 compressors unit:

$$M \text{ (litres)} = ( 0.1595 \times \Delta T(^{\circ}\text{C}) + 3.0825 ) \times P(\text{kW})$$

where:

- M Minimum water content per unit expressed in litres
- P Cooling Capacity of the unit expressed in kW
- $\Delta T$  Evaporator entering / leaving water temperature difference expressed in  $^{\circ}\text{C}$

This formula is valid for standard microprocessor parameters.

For more accurate determination of quantity of water, it is advisable to contact the designer of the plant.



## 1.28 Heat Recovery Ratings

### Water Pump Kit - Combination Matrix

Version	Size	Single Pump			Double Pump			
		SPK1	SPK2	SPK3	DPK1	DPK2	DPK3	DPK4
EWAD~C-SS EWAD~C-SL EWAD~C-SR	650	X	X		X	X		X
	740	X	X		X	X		X
	830	X	X		X	X		X
	910	X	X		X	X		X
	970	X	X	X	X	X	X	X
	C11	X	X	X	X	X	X	X
	C12	X	X	X	X	X	X	X
EWAD~C-XS EWAD~C-XL EWAD~C-XR	760	X	X		X	X		X
	830	X	X		X	X		X
	890	X	X		X	X		X
	990	X	X	X	X	X	X	X
	C10	X	X	X	X	X	X	X
	C11	X	X	X		X	X	X
	C12	X	X	X		X	X	X
EWAD~C-PS EWAD~C-PL EWAD~C-PR	820	X	X		X	X		X
	890	X	X		X	X		X
	980	X	X	X	X	X	X	X
	C11	X	X	X	X	X	X	X
	C12	X	X	X		X	X	X
	C13	X	X	X		X	X	X
	C14		X	X		X	X	X

### Water Pump Kit - Technical Information

		Pump Motor Power (kW)	Pump Motor Current (A)	Power Supply (V-ph-Hz)	PN	Motor Protection	Insulation (Class)	Working Temp. (°C)
Single Pump	SPK1	11.0	20.0	400V-3ph-50hz	16	IP55	class F	-20 +140
	SPK2	15.0	26.5	400V-3ph-50hz	16	IP55	class F	-20 +140
	SPK3	18.5	32.5	400V-3ph-50hz	16	IP55	class F	-20 +140
Double Pump	DPK1	11.0	20.0	400V-3ph-50hz	16	IP55	class F	-20 +140
	DPK2	15.0	26.5	400V-3ph-50hz	16	IP55	class F	-20 +140
	DPK3	18.5	32.5	400V-3ph-50hz	16	IP55	class F	-20 +140
	DPK4	22.0	39.0	400V-3ph-50hz	16	IP55	class F	-20 +140

**Notes:** When using mixture of water and glycol please contact the factory as above specification can change.

## 1.29 Evaporator Pressure Drops

### EWAD~C-SS EWAD~C-SL

	650	740	830	910	970	C11	C12	C14	C15	C16	C17
Cooling Capacity (kW)	647	744	832	912	967	1064	1152	1419	1538	1622	1714
Water Flow (l/s)	30.90	35.56	39.74	43.60	46.21	50.85	55.04	67.78	73.5	77.51	81.89
Pressure Drops (kPa)	73	59	52	61	68	63	72	47	59	65	73

Water flow and pressure drop referred to nominal condition: evaporator water in/out: 12/7°C – condenser air inlet: 35°C.

### EWAD~C-SR

	650	740	830	910	970	C11	C12	C14	C15	C16	C17
Cooling Capacity (kW)	619	715	789	876	922	1020	1112	1367	1471	1556	1623
Water Flow (l/s)	29.57	34.15	37.71	41.83	44.05	48.75	53.11	65.32	70.28	74.32	77.57
Pressure Drops (kPa)	67	55	47	57	62	58	68	44	54	60	66

Water flow and pressure drop referred to nominal condition: evaporator water in/out: 12/7°C – condenser air inlet: 35°C.

### EWAD~C-XS EWAD~C-XL

	760	830	890	990	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19
Cooling Capacity (kW)	756	830	889	1001	1074	1196	1280	1349	1409	1526	1596	1685	1768	1858
Water Flow (l/s)	36.10	39.67	42.49	47.82	51.32	57.13	61.18	64.45	67.34	72.90	76.24	80.48	84.47	88.79
Pressure Drops (kPa)	80	56	64	61	69	45	51	71	77	57	62	68	64	37

Water flow and pressure drop referred to nominal condition: evaporator water in/out: 12/7°C – condenser air inlet: 35°C.

### EWAD~C-XR

	760	830	890	990	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19
Cooling Capacity (kW)	736	811	866	974	1041	1168	1247	1302	1378	1486	1550	1639	1722	1813
Water Flow (l/s)	35.17	38.74	41.36	46.54	49.76	55.78	59.56	62.21	65.85	70.98	74.07	78.32	82.3	86.61
Pressure Drops (kPa)	76	54	61	58	65	43	49	67	74	54	59	65	61	35

Water flow and pressure drop referred to nominal condition: evaporator water in/out: 12/7°C – condenser air inlet: 35°C.

**EWAD~C-PS  
EWAD~C-PL**

	<b>820</b>	<b>890</b>	<b>980</b>	<b>C11</b>	<b>C12</b>	<b>C13</b>	<b>C14</b>
Cooling Capacity (kW)	821	890	975	1074	1158	1279	1390
Water Flow (l/s)	39.22	42.53	46.6	51.30	55.31	61.12	66.41
Pressure Drops (kPa)	57	65	30	61	69	60	73

Water flow and pressure drop referred to nominal condition: evaporator water in/out: 12/7°C – condenser air inlet: 35°C.

**EWAD~C-PR**

	<b>820</b>	<b>890</b>	<b>980</b>	<b>C11</b>	<b>C12</b>	<b>C13</b>	<b>C14</b>
Cooling Capacity (kW)	809	875	956	1053	1132	1251	1359
Water Flow (l/s)	38.65	41.81	45.69	50.30	54.11	59.76	64.95
Pressure Drops (kPa)	56	63	29	59	66	58	70

Water flow and pressure drop referred to nominal condition: evaporator water in/out: 12/7°C – condenser air inlet: 35°C.

**To determinate the pressure drop for different versions or at different working conditions. Please refer to the following formula:**

$$PD_2 \text{ (kPa)} = PD_1 \text{ (kPa)} \times \left( \frac{Q_2 \text{ (l/s)}}{Q_1 \text{ (l/s)}} \right)^{1.8}$$

Where:

- PD<sub>2</sub> Pressure drop to be determinate (kPa)
- PD<sub>1</sub> Pressure drop at nominal condition (kPa)
- Q<sub>2</sub> Water flow at new working condition (l/s)
- Q<sub>1</sub> Water flow at nominal condition (l/s)

**How to use the formula: Example**

- The unit EWAD650C-SS has been selected for working at the following conditions:
  - Evaporator water in/out: 11/6°C
  - Condenser air inlet: 46°C
- The cooling capacity at these working conditions is: 536 kW
- The water flow at these working conditions is: 25.61 l/s
  
- The unit EWAD650C-SS at nominal working conditions has the following data:
  - Evaporator water in/out: 12/7°C
  - Condenser air inlet: 35°C
- The cooling capacity at these working conditions is: 647 kW
- The water flow at these working conditions is: 30.90 l/s
- The pressure drop at these working conditions is: 73 kPa

**1**

The pressure drop at the selected working condition will be:

$$PD_2 \text{ (kPa)} = 73 \text{ (kPa)} \times \left( \frac{25.61 \text{ (l/s)}}{30.90 \text{ (l/s)}} \right)^{1.8}$$

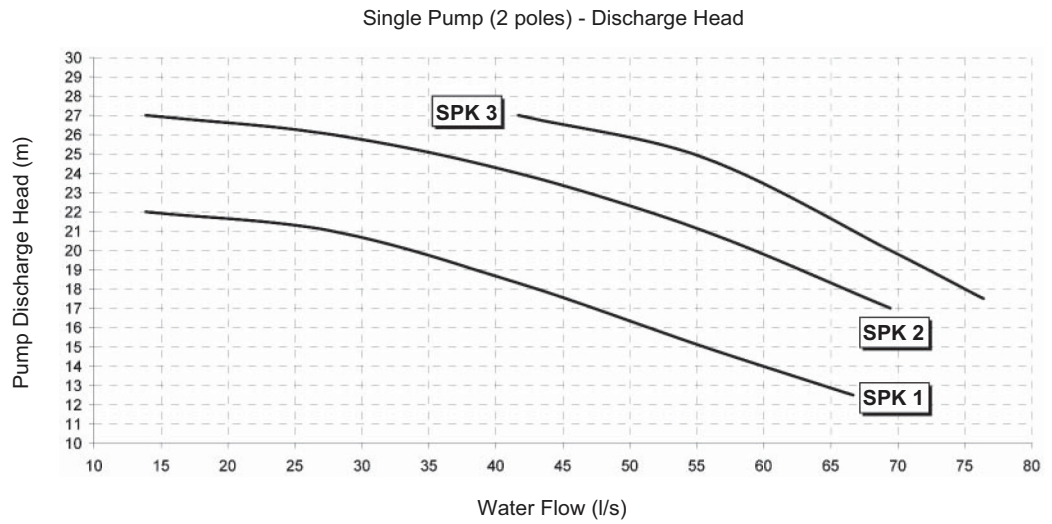
$$PD_2 \text{ (kPa)} = 52 \text{ (kPa)}$$

**Notes:**

If the calculated evaporator water pressure drop is below 10 kPa or above 100 kPa please contact the factory for dedicated evaporator.

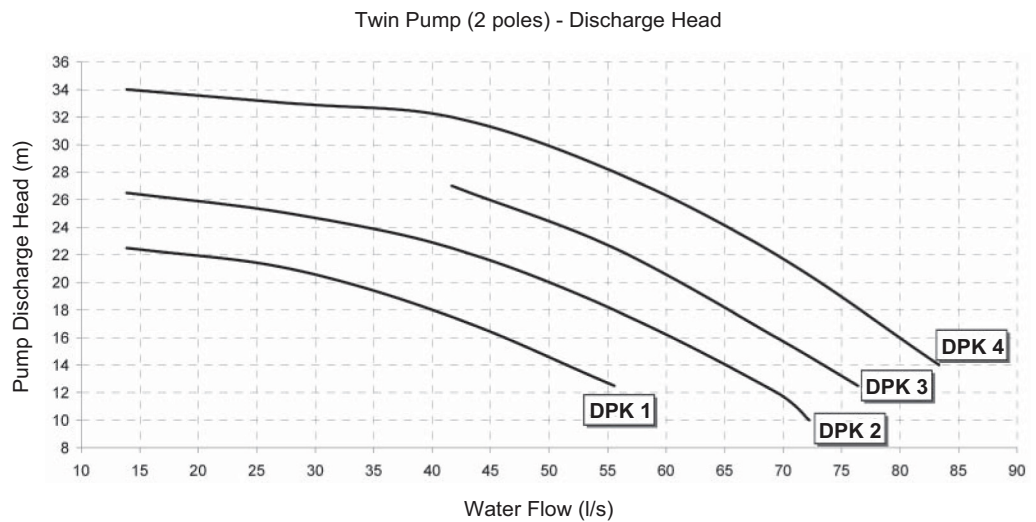
### 1.30 Condensor Pressure Drops

#### Water Pump Kit - Discharge Head



**Notes:**

- The above curves are referred to the discharge head of the pump only.
- When selecting the pump you have to consider the installation and evaporator pressure drops.
- When using mixture of water and glycol please contact the factory as above specification can change.



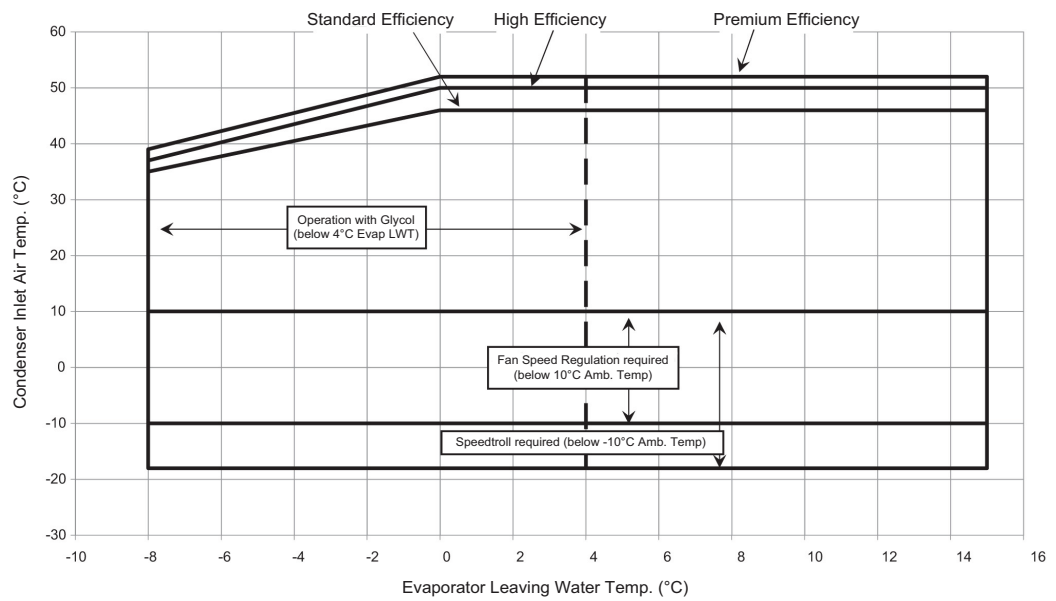
**Notes:**

- The above curves are referred to the discharge head of the pump only.
- When selecting the pump you have to consider the installation and evaporator pressure drops.
- When using mixture of water and glycol please contact the factory as above specification can change.

1

1.31 Operation Range

EWAD~C-



Evaporator minimum and maximum water  $\Delta t$

Max evaporator water $\Delta t$	°C	8
Min evaporator water $\Delta t$	°C	4

## 1.32 Mechanical Installation

### Shipping

The stability of the machine during shipping must be ensured. If the machine is shipped with a wooden cross-plank on its base, the cross-plank must be removed only after the final destination has been reached.

### Responsibility

The manufacturer declines all responsibility, present and future, for any damage to persons, animals or property caused by negligence of operators failing to follow the installation and maintenance instructions in this manual. All safety equipment must be regularly and periodically checked in accordance with this manual and with local laws and regulations regarding safety and environmental protection.

### Safety

All activities concerning the machine, be they: movement, installation, start-up or maintenance, must in any case comply with all current laws on safety and only be carried out by authorised, qualified personnel.

Thus stated, the following are some warnings, although the list is not intended as exhaustive:

- The machine must be firmly secured to the ground.
- The machine can only be lifted and moved by correctly using the lifting points on the machine base, marked in yellow. These are the only points that can support the entire weight of the unit, and only if used according to the lifting diagram described in this manual.
- The machine can only be used safely once it has been firmly secured to the ground or to an equivalent structure.
- Do not access the electrical components if the machine is not in safe conditions.
- Do not access the electrical components without having opened the machine's general switch to disconnect the power supply.
- An insulating platform must be used.
- Do not access the electrical components if water and/or moisture are present.
- All operations on the refrigerant circuit and on pressurised components must be carried out by qualified personnel only.
- Replacement of a compressor or addition of lubricating oil must be carried out by qualified personnel only.
- Sharp edges and the surfaces of the condensing section, can cause injury. Avoid direct contact.
- Disconnect the machine's electrical supply by opening the general switch, before working on the cooling fans and/or compressors. Failure to comply with this rule may cause serious personal injury.
- Avoid introducing solid bodies into the water pipes while the machine is connected to the system.
- A mechanical filter must be installed on the water pipe connected to the heat exchanger inlet. The filter must have a maximum mesh size of 500 µm.
- The machine is supplied with safety valves installed on both the high and low pressure sides of the refrigerant gas circuit.

In case of sudden stop of the unit, follow the instructions on the Control Panel Operating Manual which is part of the on-board documentation delivered to the end user with this manual. It is recommended to perform installation and maintenance with other people. In case of accidental injury or unease, it is necessary to:

- Keep calm.
- Press the alarm button if present in the installation site.
- Move the injured person in a warm place far from the unit and in rest position.
- Contact immediately emergency rescue personnel of the building or if the Health Emergency Service.
- Wait without leaving the injured person alone until the rescue operators come.
- Give all necessary information to the rescue operators.

**Warning:**

- Before carrying out any operation on the machine, please read this instruction and operating manual carefully. Installation and maintenance must be carried out by qualified personnel familiar with the provisions of law and local regulations, and who has been properly trained or has experience with this type of equipment.
- Avoid installing the machine in a place that could be dangerous during maintenance operations, such as (but not only) platforms without parapets or railings, or areas not complying with the clearance requirements.

**Moving and lifting**

The machine must be moved and lifted by using cables, spacing bars and scales of appropriate dimensions to the machine weight. This is stated on its identification plate. The table of weights included in the manual should be considered as indicative only. Installation of certain accessories can increase machine weight. Always refer to the dimensional diagrams supplied for any technical information.

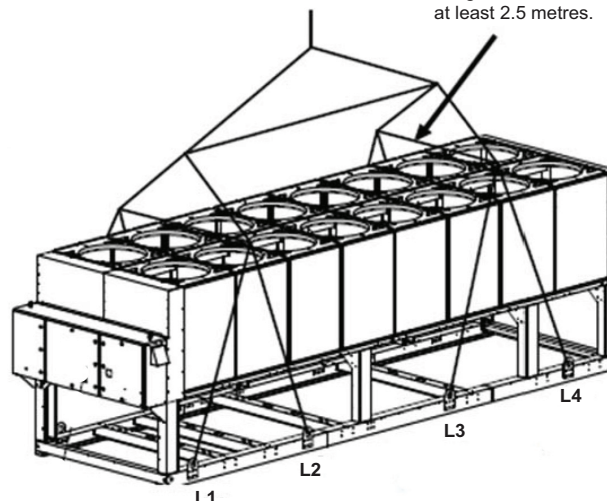
Block machine sliding on lorries to prevent damage to the panels and base frame. Avoid bumping, jolting and impacts during unloading and/or moving the machine. Do not push or pull the machine from any part other than the base frame. These falls could cause serious damages for which the manufacturer will not be held liable.

All units of the series are supplied with lifting points marked in yellow. Only use these points to lift the unit, as shown in the figure.

**Lifting the unit**

**N.B.:**  
The lifting method specified below is valid for all EWAD-C-models

Use spacing bars to prevent damage to the condensation bank. Position these above the fan grills at a distance of at least 2.5 metres.



Only use the designated lifting points marked on the unit.



**Warning:**

- Both the lifting ropes and the spacing bar and/or scales must be sized to support the machine weight safely. Please check the unit's weight on the machine's nameplate. The weights shown in the 'Technical data' tables in the 'General information' chapter refer to standard units, without any added accessories. The specific machine may have accessories that increase its overall weight (pumps, copper banks/copper, etc.).
- The machine must be lifted with the utmost attention and care. Avoid jolting when lifting and lift the machine very slowly, keeping it perfectly level.
- If the machine is fitted with soundproof cabins for the compressors, remove the side panels at the lifting points to avoid damage and deformation.

**Positioning and assembly**

All units are designed for installation outdoors on terraces or the ground, as long as the area is free from obstacles that could limit air flow to the condensation banks. The machine must be installed on a robust and perfectly level foundation. Should the machine be installed on balconies and/or roofs, it may be necessary to use weight distribution beams. For installation on the ground, there must be a robust cement base that is at least 250 mm longer and wider than the machine. Furthermore, this base must be strong enough to support the weight of the machine as stated in the technical specifications. Should the machine be installed in places that are easily accessible to people and animals, it is advisable to install protection gratings for the banks and compressors, and guarantee access to the machine only when in a safe condition. To ensure the best possible performance on the installation site, the following precautions and instructions must be followed:

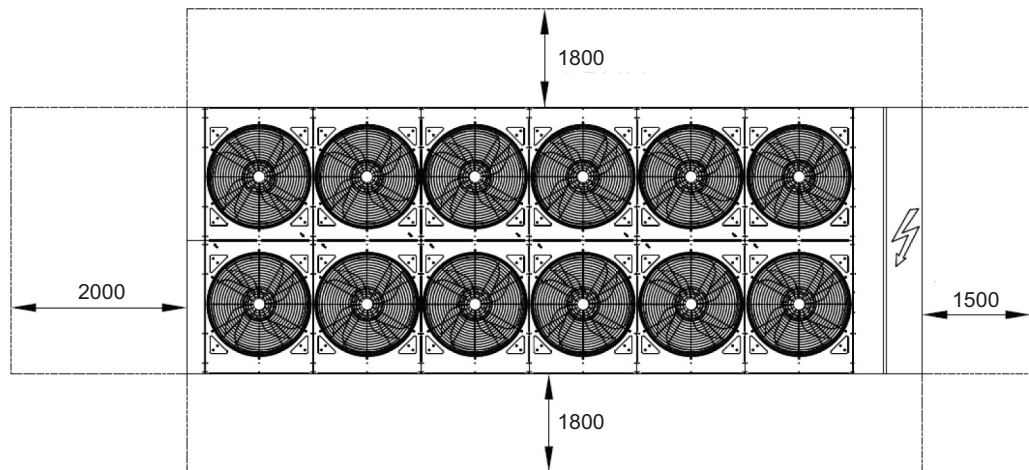
- Avoid recirculation of air flow out from the fans towards bank suction.
- Ensure there are no obstacles obstructing air flow to the banks, guaranteeing correct suction and expulsion.
- Guarantee a strong, solid foundation to reduce noise and vibration as much as possible.
- Do not install in particularly dusty environments as this will dirty the condensation banks.
- The water in the system must be particularly clean and all traces of oil or rust must be removed. A mechanical water filter must be installed on the machine's inlet piping.

**Clearance**

Correct machine operation depends on compliance with the minimum clearance requirement for installation, which guarantee correct ventilation of the condensation banks. Reduced installation space could reduce normal air flow, significantly reducing machine performance and increasing the electricity consumed. In determining the correct machine position, consider the following factors:

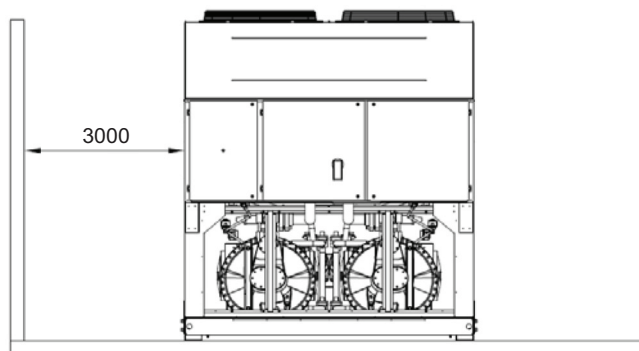
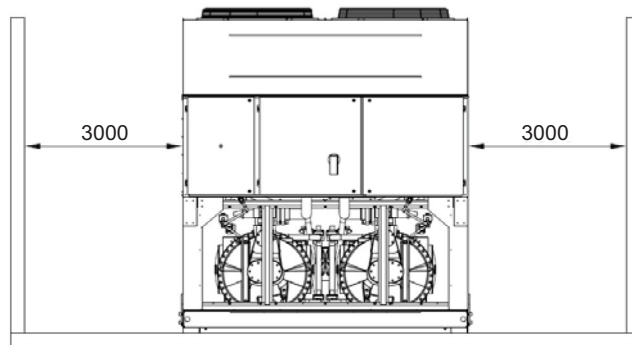
- Avoid any recirculation of hot air between fans and condensers.
- Avoid under-supplying the air flow to the condensation banks.

Both these conditions can cause the condensation pressure to increase, determining a reduction in energy efficiency and refrigeration capacity (despite the fact that the unit's condenser geometry allows it to partly compensate for poor air distribution, and software is particularly able to calculate machine operating conditions and optimise load in abnormal operating conditions). Machine installation not only guarantees its correct operation, but also allows for all post-installation and maintenance work to be carried out correctly. The figure below shows the minimum clearance requirements. If the machine is positioned in a place surrounded by walls or obstacles of the same height as the machine, it must be at least 2500 mm away from these. Should the obstacles be higher, the machine must be at least 3,000 mm away from these. If the machine is installed without complying with these recommended minimum distances from walls and/or vertical obstacles, hot air may re-circulate and/or the air condenser may be under-supplied and this can lead to a loss of efficiency.

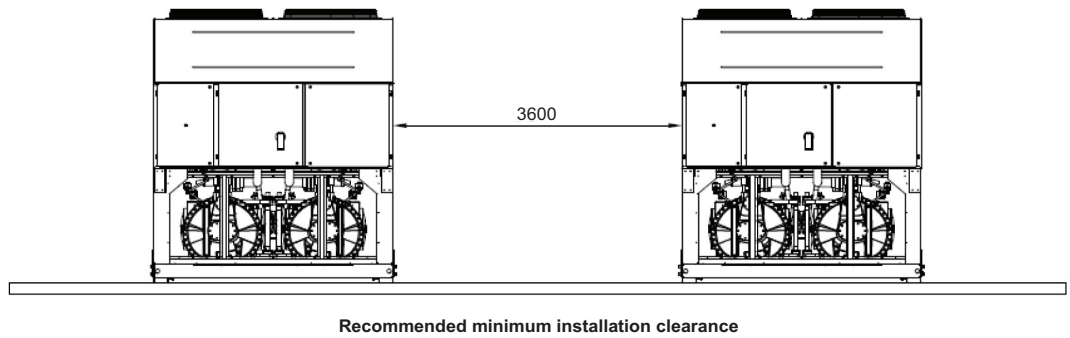


Clearance requirements for machine maintenance

When two or more machines are positioned side by side, a space of at least 3,600 mm is recommended between the condensation banks. For further solutions, please consult authorised technicians. In any case, the microprocessor will allow the machine to adapt to the new condition, producing maximum capacity available even at side distances of less than the recommended clearance space.



Minimum installation clearance of the individual machine



**Attention:** The minimum installation clearance spaces described previously are indicative only and not a fundamental requirement. Each installation must be carefully evaluated according to the specific environmental parameters. For example: should you fail to consider dominant wind at the point of installation, this can affect overall machine function, even where the recommended minimum installation clearance spaces are left.

**Sound protection**

When sound levels require special control, great care must be exercised to isolate the machine from its base by appropriately applying anti-vibration elements (supplied as an accessory). Flexible joints must be installed on the water connections as well.

**Water piping**

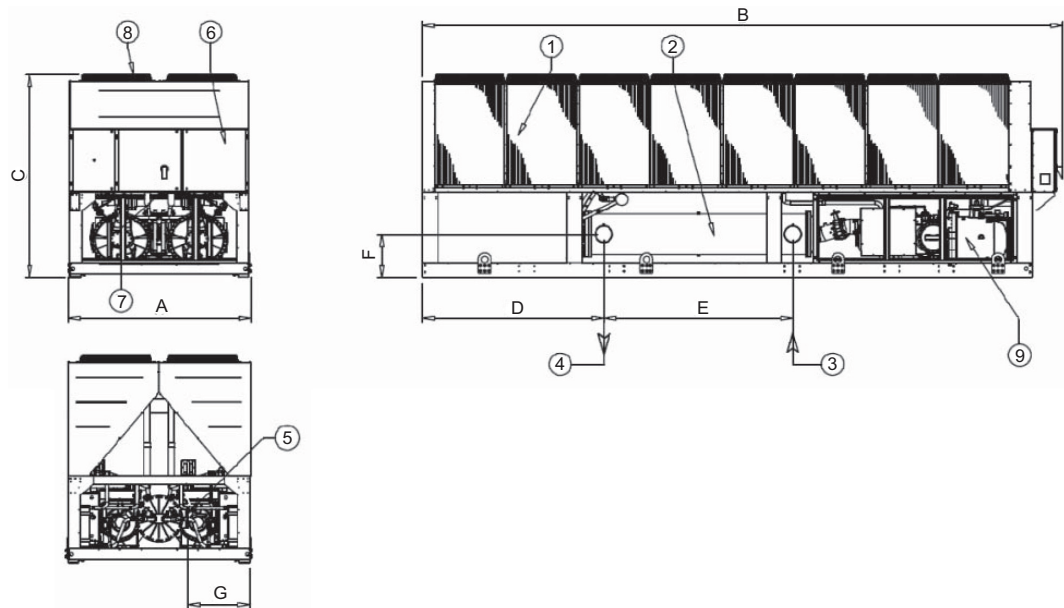
**Attention:** Adjust the anti-vibration mountings beneath the machine before connecting the water circuit.

Piping must be designed with the lowest number of elbows and the lowest number of vertical changes of direction. In this way, installation costs are reduced considerably and system performance is improved. The water system should have:

1. Anti-vibration mountings in order to reduce transmission of vibrations to the underlying structure.
2. Isolating valves to isolate the machine from the water system during service.
3. Manual or automatic air venting device at the system's highest point. Drain device at the system's lowest point.
4. Neither the evaporator nor the heat recovery device must be positioned at the system's highest point.
5. A suitable device that can maintain the water system under pressure (expansion tank, etc.) and offset temperature changes.
6. Water temperature and pressure indicators on the machine to assist the operator during service and maintenance.
7. A filter or device which can remove foreign particles from the water before it enters the pump (in order to prevent cavitation, please consult the pump manufacturer for the recommended filter type). The use of a filter prolongs the life of the pump and helps keep the water system in better condition.
8. Another filter must be installed on the machine inlet water pipe, near the evaporator and heat recovery (if installed). The filter prevents solid particles from entering the heat exchanger, as they could damage it or reduce its heat exchanging capacity.
9. The shell and tube heat exchanger is fitted with a thermostatic electrical resistance that guarantees protection against water freezing down to external temperatures of -25°C. All other water piping outside the machine must be protected against freezing. To guarantee correct resistance function, the machine must be powered even when not in use.
10. The heat recovery device must be emptied of water during the winter season, unless an appropriate percentage antifreeze mix is added to the water circuit.
11. If the machine is installed to replace another, the entire water system must be emptied and cleaned before the new unit is installed. Regular tests and proper chemical treatment of water are recommended before starting up the new machine.

### 1.33 Dimensional Drawing

Dimensions  
EWAD~C-  
(2 circuits)

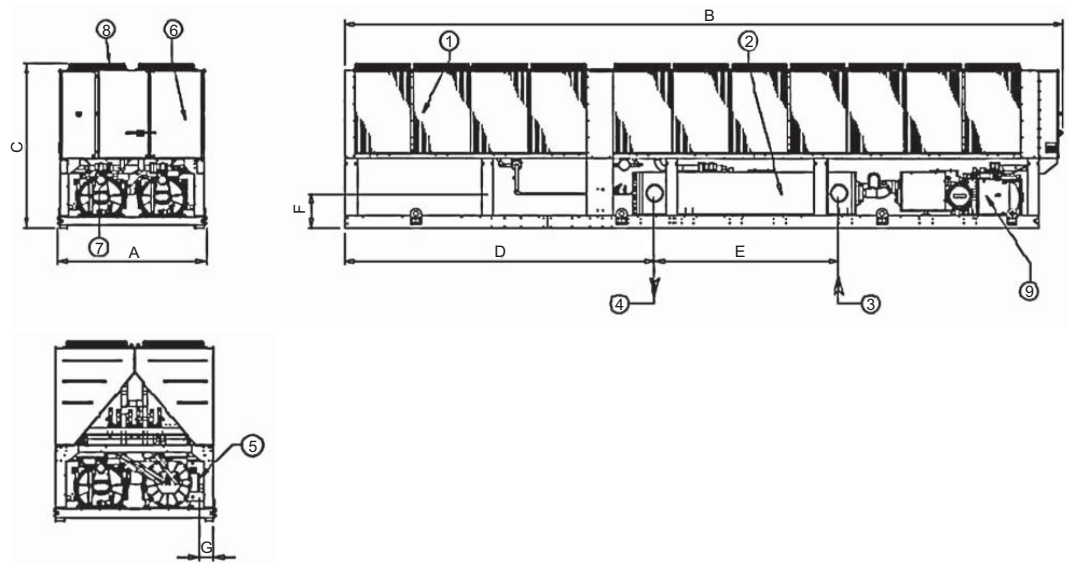


EWAD-C~		Dimensions							
Size	Size	A	B	C	D	E	F	G	Fans
650 ÷ 830 SS/SL	620 ÷ 720 SR	2285	6185	2540	450	2412	435	810	Nr 10
910 ÷ 970 SS/SL	880 ÷ 920 SR	2285	6185	2540	450	2412	435	810	Nr 12
C11 SS/SL	C10 SR	2285	7085	2540	1350	2412	435	810	Nr 14
C12 SS/SL	C11 SR	2285	7985	2540	2250	2412	435	810	Nr 16
760 XS/XL	740 XR	2285	6185	2540	470	2412	435	810	Nr 12
830 ÷ 800 XS/XL	810 ÷ 870 XR	2285	7085	2540	1370	2412	435	810	Nr 14
990 ÷ C10 XS/XL	970 ÷ C10 XR	2285	7985	2540	2270	2360	540	760	Nr 16
C11 ÷ C13 XS/XL	C11 ÷ C13 XR	2285	9785	2540	4070	2360	540	760	Nr 20
820 ÷ 890 PS/PL	810 ÷ 880 PR	2285	8885	2540	2020	3510	540	760	Nr 18
980 PS/PL	960 PR	2285	8885	2540	2020	3440	540	685	Nr 18
C11 ÷ C12 PS/PL	C10 ÷ C11 PR	2285	9785	2540	2920	3440	540	685	Nr 20
C13 PS/PL	C13 PR	2285	11085	2540	4205	3440	540	685	Nr 22
C14 PS/PL	C14 PR	2285	11985	2540	5105	3440	540	685	Nr 24

**Notes**

1. Condenser Coil
2. Water heat exchanger (evaporator)
3. Evaporator water inlet
4. Evaporator water outlet
5. Victaulic connection
6. Operating and control panel
7. Slot for power and control connection
8. Fan
9. Compressor

**Dimensions  
EWAD~C-  
(3 circuits)**



EWAD-C~		Dimensions							
Size	Size	A	B	C	D	E	F	G	Fans
C14 ÷ C15 SS/SL	C13 ÷ C14 SR	2285	10185	2540	4440	2360	540	285	Nr 20
C16 ÷ C17 SS/SL	C15 ÷ C16 SR	2285	11085	2540	5340	2360	540	285	Nr 22
C14 XS/XL	C14 XR	2285	11985	2540	5680	2910	540	285	Nr 24
C15 ÷ C16 XS/XL	C15 ÷ C16 XR	2285	11985	2540	5680	2840	540	210	Nr 24
C17 XS/XL	C17 XR	2285	12885	2540	6580	2840	540	210	Nr 26
C18 XS/XL	C18 XR	2285	13785	2540	7480	2840	540	210	Nr 28
C19 XS/XL	C19 XR	2285	14685	2540	8380	2840	540	210	Nr 30

**Notes**

1. Condenser Coil
2. Water heat exchanger (evaporator)
3. Evaporator water inlet
4. Evaporator water outlet
5. Victaulic connection
6. Operating and control panel
7. Slot for power and control connection
8. Fan
9. Compressor

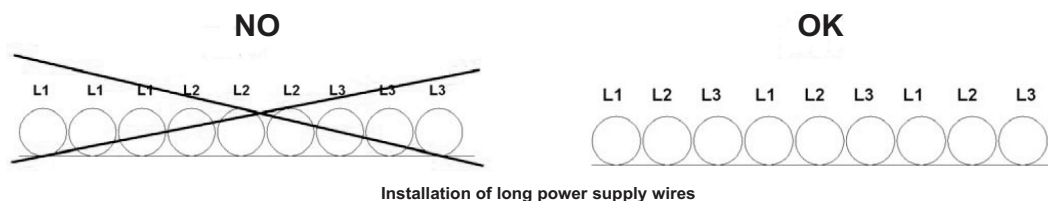
## 1.34 Electrical Installation

### General specifications

#### Caution:

- All electrical connections to the machine must be carried out in compliance with laws and regulations in force. All installation, operating and maintenance activities must be carried out by qualified personnel. Please refer to the specific wiring diagram for the machine that you have purchased and which was sent with the unit. Should the wiring diagram not appear on the machine or should it have been lost, please contact your dealer who will provide for a copy to be forwarded.
- Use copper conductors only. Failure to use copper conductors could cause overheating or corrosion at the connection points and damage the unit. To avoid interference, all control wires must be installed separately from the power wires. Use separate electrical conduits for this purpose.
- Before servicing the machine in any way, open the general disconnecting switch on the machine's main power supply. When the machine is off but the disconnect switch is in the closed position, unused circuits are live as well. Never open the terminal board box of the compressors before having opened the unit's general disconnecting switch.
- Series units are fitted with high power non-linear electrical components (VPD compressor supply). These cause superior harmonics and can cause significant leakage towards ground (about 2 A). The protection for the power supply system must be designed in accordance with the above-mentioned values.
- The short circuit current that can be withstood by the electrical board in accordance with EN 60439-1, is 25 kA. Please therefore check the short-circuit current at the machine power supply line connection terminals to ensure that it is less than or equal to the machine panel hold current.
- In installations with power supply lines longer than 50 metres, inductive coupling between phases and between phase and earth generates significant phenomena, namely:
  - Unbalancing of phase currents
  - Excessive voltage drop

In order to limit these phenomena, it is good practise to lay out the phase wires symmetrically, as described in the figure.



### Electrical components

All power and interface electrical connections are specified in the wiring diagram that is shipped with the machine. The installer must supply the following components:

- Power supply wires (dedicated conduit).
- Interconnection and interface wires (dedicated conduit).
- Thermal-magnetic circuit breaker of suitable size (please see electrical data).

### Electrical wiring

#### Power circuit:

Connect the electrical power supply cables to the terminals of the general circuit breaker on the machine's terminal board. The access panel must have a hole of appropriate diameter for the cable used and its cable gland. A flexible conduit can also be used, containing the three power phases plus earth. In any case, absolute protection against water penetrating through the connection point must be ensured.

**Control circuit:**

Every machine of the series is supplied with an auxiliary 400/115 V control circuit transformer. No additional cable for the control system power supply is thus required. Only if the optional separate accumulation tank is requested, the electrical antifreeze resistance must have a separate power supply.

**Electrical heaters**

The machine has an antifreeze electrical heater installed directly on the evaporator. Each circuit also has an electrical heater installed in the compressor, whose purpose is to keep the oil warm thus preventing the presence of liquid refrigerant mixed with the oil in the compressor. Clearly, the operation of electrical heaters is guaranteed only if there is a constant power supply. If it is not possible to keep the machine powered when inactive during winter, apply at least two of the procedures described in the 'Mechanical installation' section under the 'antifreeze protection of evaporator and exchangers', and power the machine at least 24 hours prior to compressor start-up in order to allow the oil to warm up.

**Pump electrical supply**

On request, the machine can be fitted with a fully-wired pump kit controlled by the machine microprocessor. In this case, no further checks are required. Should the system use pumps outside the machine (not supplied with the unit), fit the supply line for each pump with a thermal-magnetic circuit breaker and a command contact.

**Water pump control**

Connect the control contactor coil power supply to terminals 27 and 28 (pump #1) and 48 and 49 (pump 2) located on terminal board M5, and install the contactor on a power supply with the same voltage as the pump contactor coil. The terminals are connected to a clean microprocessor contact. The microprocessor contact has the following commutation capacity:

- Maximum voltage: 250 V AC
- Maximum current: 2 A Resistive - 2 A Inductive
- Reference standard: EN 60730-1

The wiring described above allows the microprocessor to manage the water pump automatically. It is good practice to install a clean status contact pump's thermal-magnetic circuit breaker and to connect it in series with the flow switch.

**Alarm relays - Electrical wiring**

The unit has a clean-contact digital output that changes state whenever an alarm occurs in one of the refrigerant circuits. Connect this signal to an external visual or sound alarm, or to the BMS, in order to monitor its operation. See the machine's wiring diagram for wiring.

**Unit on/off remote control - Electrical wiring**

The machine has a digital input that allows remote control. A start-up timer, a circuit breaker or a BMS can be connected to this input. Once the contact has been closed, the microprocessor launches the start-up sequence by first turning on the water pump and then the compressors. When the contact is opened, the microprocessor launches the machine shutdown sequence. The contact must be clean.

**Double setpoint - Electrical wiring**

The double setpoint function uses a switch to allow for to change over the unit setpoint between two predefined values in the unit controller. An example of an application is ice production during the night and standard operation during the day. Connect a circuit breaker or timer between terminals 20 and 21 and terminal board M5. The contact must be clean.

**External water setpoint reset - Electrical wiring (optional)**

The machine's local setpoint can be modified by means of an external analogue 4-20 mA signal. Once this function has been enabled, the microprocessor allows for the modification of the setpoint from the set local value up to a differential of 3°C max. 4 [mA] corresponds to a 0 [°C] reset, 20 [mA] corresponds to the setpoint plus maximum differential. The signal cable must be directly connected to terminals 35 and 36 of the M5 terminal board. The signal cable must be of the shielded type and must not be laid in the vicinity of the power cables, so as not to induce interference with the electronic controller.

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Unit limitation - Electrical wiring (optional)

The machine's microprocessor allows for the limitation of capacity by means of two separate criteria:

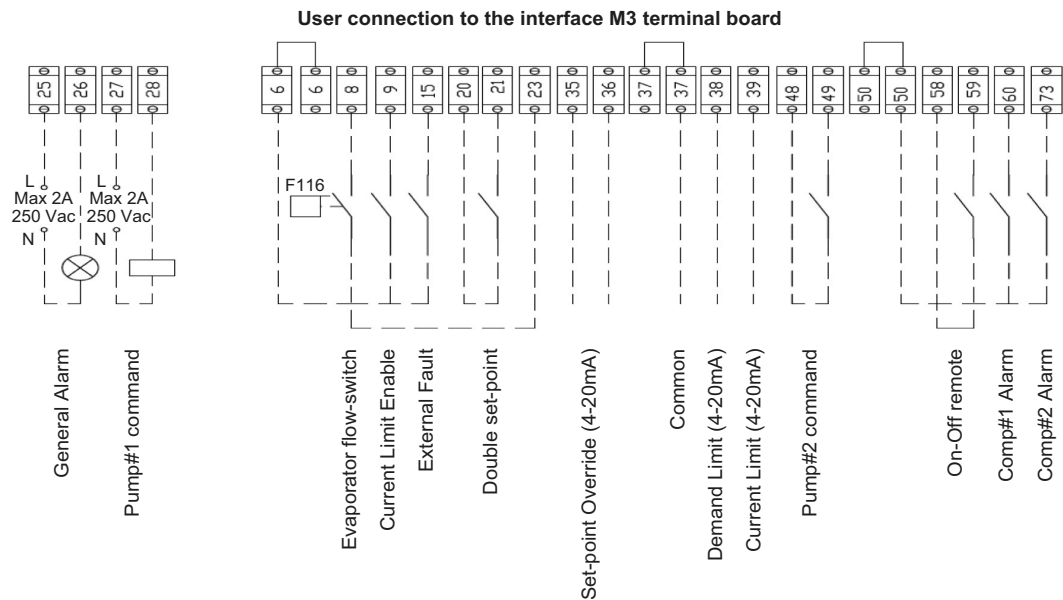
■ Load limitation

The load can be varied directly by means of 4-20 external signal or directly from a BMS. The signal cable must be directly connected to terminals 37 and 38 of the M5 terminal board. The signal cable must be of the shielded type and must not be laid in the vicinity of the power cables, so as not to induce interference with the electronic controller.

■ Current limitation (optional)

This option, if installed, allows for the control of machine load according to current absorbed. Connect a switch, timer, clean BMS to terminals 37-39 on the terminal board M5. Once the digital input is closed, the microprocessor will limit the current absorbed by the machine according to the command set point set. The enabling of this control needs enabling by means of a clean contact, using terminals 6-9 on terminal board M5.

**Caution:** The two options cannot be enabled simultaneously. Setting one function excludes the other.



General alarm	
Pump1 command	
Evaporator flowswitch	
Current limit enable	
External fault	
Double setpoint	
Setpoint override (4-20 mA)	
Common	
Demand limit (4-20 mA)	
Current limit (4-20 mA)	
Pump2 command	
On-off remote	
Comp1 alarm	
Comp2 alarm	



## 1.35 Operation

### Operator's responsibilities

It is important that the operator is appropriately trained and becomes familiar with the system before operating the machine. In addition to reading this manual, the operator must study the microprocessor operating manual and the wiring diagram in order to understand the start-up sequence, operation, shut-down sequence and operation of all safety devices. During the machine's initial start-up phase, an authorised technician is available to answer any questions and to give instructions as to the correct operating procedures. The operator is advised to keep a record of operating data for every installed machine. Another record should also be kept of all the periodical maintenance and servicing activities. If the operator notes abnormal or unusual operating conditions, he is advised to consult the authorised technical service.

### Description of the machine

This machine, of the air-condensation type, is made up of the following main components:

- **Compressor:** The single-screw compressor of the FR3B or FR4A series is of the semi-hermetic type and utilises gas from the evaporator to cool the motor and allow optimal operation under any expected load conditions. The oil-injection lubrication system does not require an oil pump as oil flow is ensured by the pressure difference between delivery and suction. In addition to ensuring lubrication of ball bearings, oil injection dynamically seals the screw, thus enabling the compression process.
- **Water exchanger:** Direct expansion, shell and tube type for all models.
- **Air exchanger:** Finned type with pipes, internally micro-finned, directly expanded onto the high-efficiency strip fin.
- **Fan:** Axial, high-efficiency type. Allows for quiet system operation even during adjustment.
- **Expansion valve:** As standard, the machine is fitted with an electronic expansion valve controlled by an electronic control device that optimises its operation.

### Description of the refrigeration cycle

The low-temperature refrigerant gas from the evaporator is drawn by the compressor through the electric motor, cooling it. It is later compressed, and during this phase the refrigerant mixes with the oil from the separator.

The high-pressure oil-refrigerant mix is drawn into the oil separator, that separates it. The oil accumulated on the bottom of the separator is forced by the pressure difference back into the compressor, while the oil-free refrigerant is sent to the condenser.

The refrigerant liquid is evenly distributed inside the condenser throughout all bank circuits. As it passes through it cools and starts to condense.

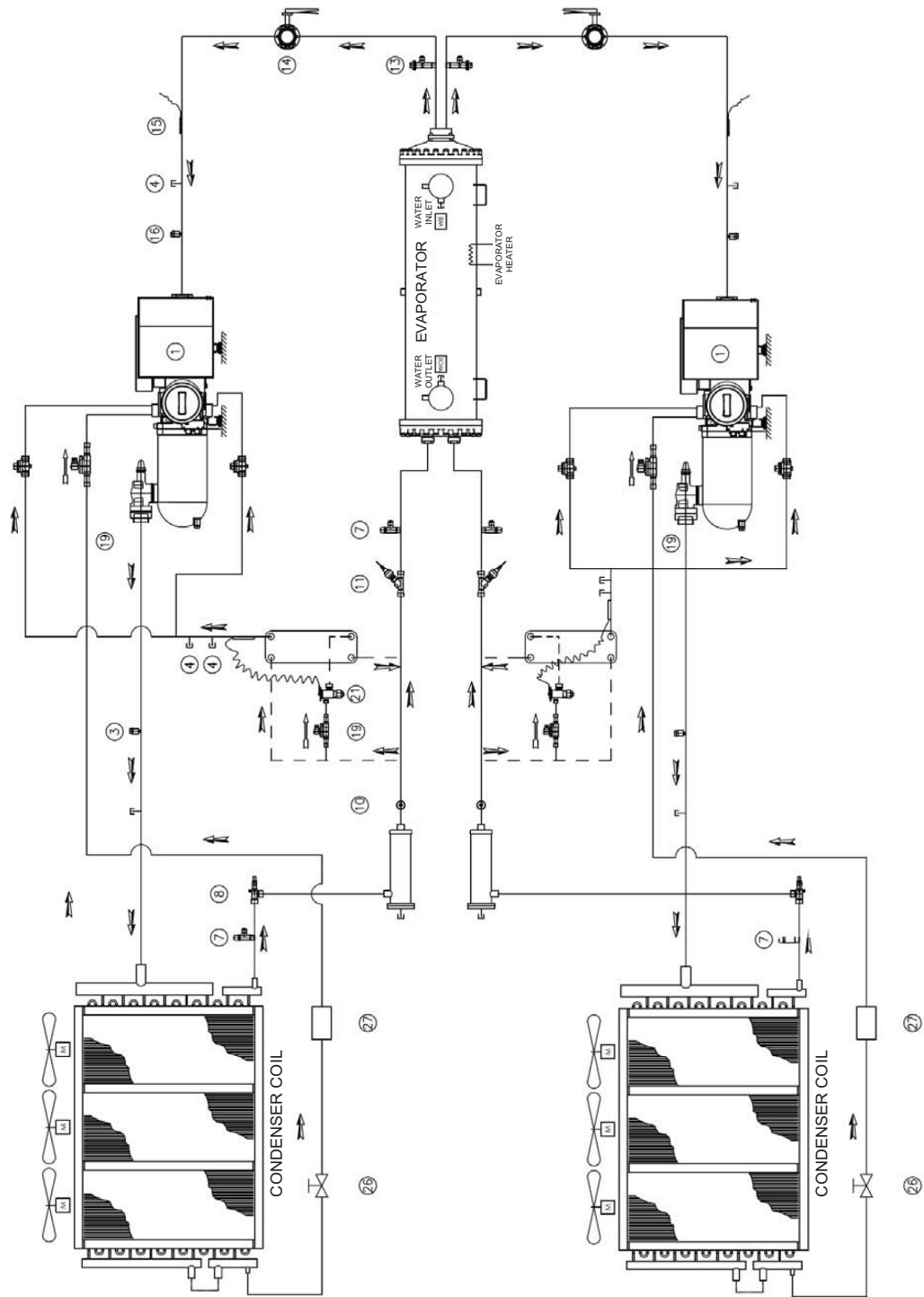
The condensed fluid at saturation temperature passes through the subcooling section where it loses even more heat, increasing cycle efficiency. The heat taken from the fluid during cooling, condensation and subcooling is exchanged with that of the cooling air, which is discharged at higher temperatures.

The subcooled fluid flows through the high-efficiency filter dryer and then reaches the lamination element through which a fall in pressure starts the evaporation process.

The result at this point is a low-pressure and low-temperature liquid-gas mixture entering the evaporator.

When the refrigerant liquid-vapour is uniformly distributed in the direct expansion evaporator tubes, heat is exchanged with the cooling water, thus reducing the temperature until complete evaporation, followed by superheating.

Once it has reached the superheated-vapour state, the refrigerant leaves the evaporator and is once again taken into the compressor to repeat the cycle.



Legend

No	Name
1	Compressor
2	2-way discharge valve
3	High-pressure transducer
4	Schrader valve
5	High-pressure safety valve
6	Fans

7	Condensation bank
8	Load valve
9	2-way angle valve
10	Filter dryer
11	Sight glass
12	Solenoid valve
13	Thermostatic expansion valve
14	Non-return valve
15	Electronic expansion valve
16	Water outlet temp. transducer
17	Evaporator
18	Water inlet temp. transducer
19	Low-pressure safety valve
20	Suction valve (optional)
21	Suction gas temp. transducer
22	Suction gas press. transducer
23	High-pressure pressure switch
24	Oil/delivery press. transd.
25	Delivery gas temp. transducer
26	Liquid injection valve
27	Liquid injection mesh filter

**Note:** Water inlet and outlet are indicative. Please refer to the machine dimensional diagrams for exact water connection of the partial recovery exchangers.

### Description of the refrigeration cycle with partial heat recovery

The low-temperature refrigerant gas from the evaporator is drawn by the compressor through the electric motor, cooling it. It is subsequently compressed and during this process, the refrigerant mixes with the oil from the oil separator.

The high-pressure oil-refrigerant mix is drawn into the high-efficiency oil separator, that separates it. The oil depositing on the bottom of the separator through pressure difference is sent back to the compressor while the refrigerant that has been separate from the oil is sent to the partial recovery exchanger, where it dissipates the heat from post-overheating cooling, warming the water which travels through the exchanger. On leaving the exchanger, the refrigerant fluid enters the condensation bank where, by forced ventilation, it is condensed.

The condensed fluid at saturation temperature passes through the subcooling section where it loses even more heat, increasing cycle efficiency.

The subcooled fluid then passes through the high-efficiency filter dryer. It subsequently passes through the lamination element, which, by means of a pressure drop, starts the evaporation process.

The result at this point is a low-pressure and low-temperature liquid-gas mixture entering the evaporator.

When the refrigerant liquid-vapour is uniformly distributed in the direct expansion evaporator tubes, heat is exchanged with the cooling water, thus reducing the temperature, changing state until complete evaporation, followed by superheating.

Once it has reached the superheated-vapour state, the refrigerant leaves the evaporator and is once again taken into the compressor to repeat the cycle.

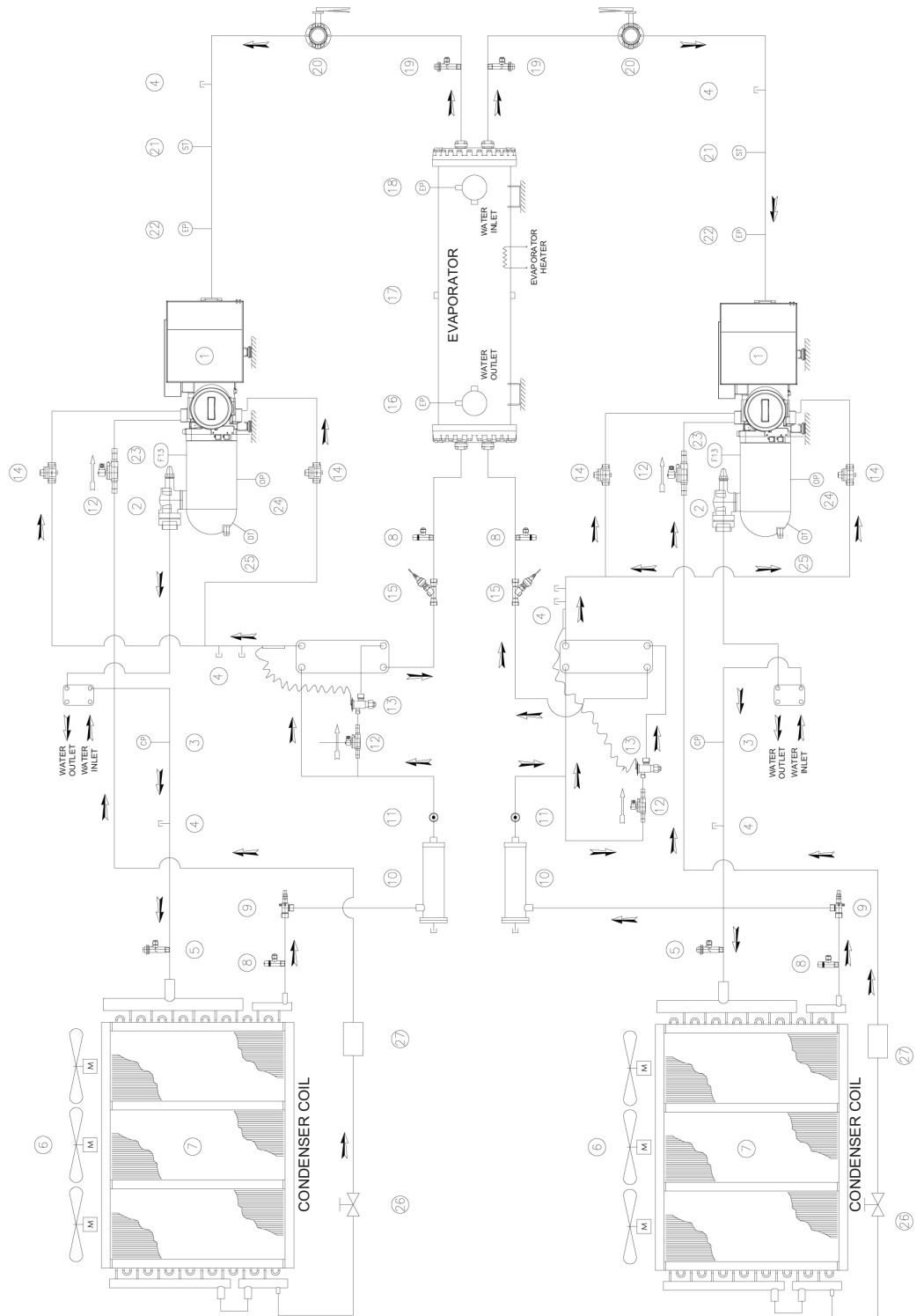
## 1

**Controlling the partial recovery circuit and installation recommendations**

The partial heat recovery system is not managed and/or controlled by the machine. The installer should follow the suggestions below for best system performance and reliability:

1. Install a mechanical filter on the heat exchanger inlet pipe.
2. Install shut-off valves to isolate the heat exchanger from the water system during periods of inactivity or system maintenance.
3. Install a drain valve that allows the heat exchanger to be emptied in the event that air temperature is expected to fall below 0°C during periods of machine inactivity.
4. Install flexible anti-vibration joints on the heat recovery water inlet and outlet piping, so that transmission of vibrations, and therefore noise, to the water system is kept as low as possible.
5. Do not load exchanger joints with the weight of the heat recovery piping. The water joints of the exchangers are not designed to support the weight.
6. Should heat recovery water temperature be lower than ambient temperature, it is advised to switch off the heat recovery water pump 3 minutes after having switched off the last compressor.

**Important:** Partial heat recovery, which exploits the post-overheating cooling of the delivery gas, is designed as a source to integrate an external heating source. Recovery availability is only guaranteed with the refrigerating circuit operating upon request of the refrigerated water circuit. Specifically, it is not suitable for operation with exchanger water inlet temperatures of below 40°C for periods in excess of normal system operation (approx. 30 minutes). Prolonged operation in these conditions can lead to malfunctions of the refrigerating circuit and the intervention of the protective devices. The installer must ensure that the recovery circuit water reaches the minimum value admitted as quickly as possible. This is also why the lack of water flow must be ensured in the exchanger when the refrigerating circuit is not running.



Legend

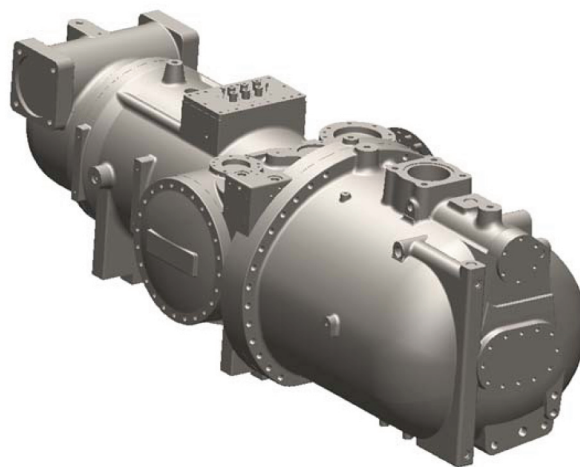
No	Name
1	Compressor
2	2-way discharge valve
3	High-pressure transducer
4	Schrader valve
5	High-pressure safety valve

6	Fans
7	Condensation bank
8	Load valve
9	2-way angle valve
10	Filter dryer
11	Sight glass
12	Solenoid valve
13	Thermostatic expansion valve
14	Non-return valve
15	Electronic expansion valve
16	Water outlet temp. transducer
17	Evaporator
18	Water inlet temp. transducer
19	Low-pressure safety valve
20	Suction valve (optional)
21	Suction gas temp. transducer
22	Suction gas press. transducer
23	High-pressure pressure switch
24	Oil/delivery press. transd.
25	Delivery gas temp. transducer
26	Liquid injection valve
27	Liquid injection mesh filter

**Note:** Water inlet and outlet are indicative. Please refer to the machine dimensional diagrams for exact water connection of the partial recovery exchangers.

## Compressor

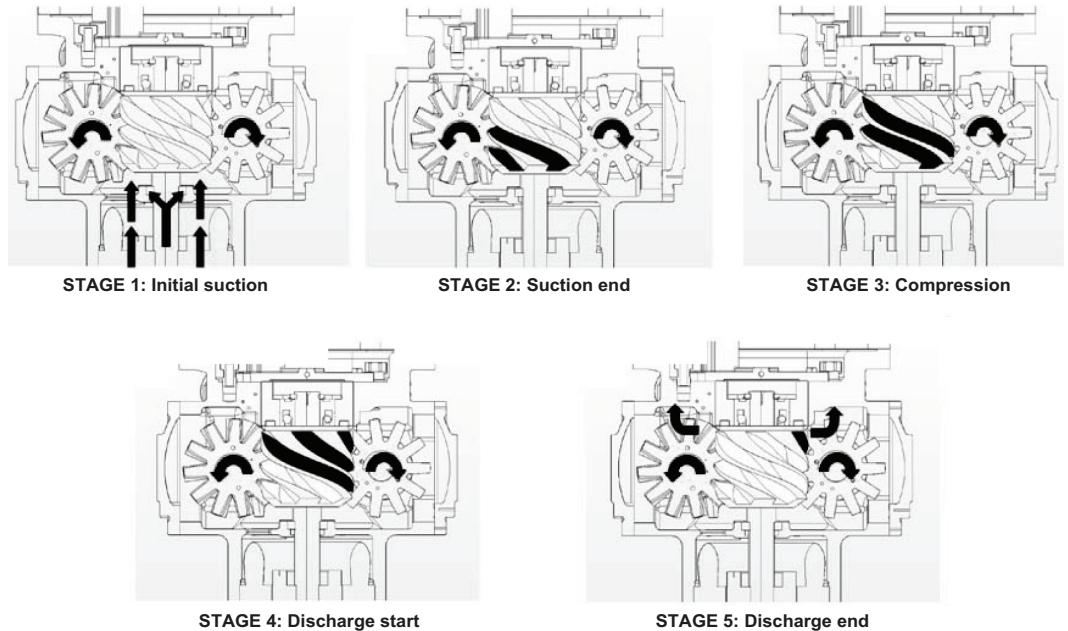
The single-screw compressor is of the semi-hermetic type with an asynchronous three-phase, two-pole motor directly splined on the main shaft. The suction gas from the evaporator cools the electric motor before entering the suction ports. There are temperature sensors inside the electric motor which are completely covered by the coil winding and constantly monitor motor temperature. Should the coil winding temperature become very high (120°C), a special external device connected to the sensors and to the electronic controller will deactivate the corresponding compressor. There are only three moving rotating parts and there are no other parts in the compressor with an eccentric and/or alternating movement. The basic components are therefore only the main rotor and the two satellites that carry out the compression process, meshing perfectly together. The F3B and F4A compressors are fitted with two satellites arranged horizontally to the screw. Compression sealing is obtained thanks to a suitably-shaped special composite material that is interposed between the main screw and the satellite. The main shaft on which the main rotor is splined is supported by ball bearings. The system made up in this way is both statically and dynamically balanced before assembly.



F4AL compressor

**Compression process**

With the single-screw compressor, the suction, compression and discharge process takes place in a continuous manner thanks to the two satellites. In this process, the suction gas penetrates into the profile between the rotor, teeth of the upper satellite and the compressor body. The volume is gradually reduced by compression of the refrigerant. The compressed gas under high pressure is thus discharged into the built-in oil separator. In the oil separator, the gas/oil mixture separates and the oil is collected in a cavity in the lower part of the compressor, where it is injected into the compressor mechanisms in order to guarantee compression sealing and lubrication of the ball bearings.



■ **STAGE 1-2 SUCTION**

During screw rotation, the main rotor flutes communicate with the suction chamber, where they begin suction without compressing the gas mixture. As it rotates, the main rotor increases the effective length of the free flute, thereby increasing the volume open to the suction. This fills the flute up to its closing towards the suction chamber by means of the satellite teeth, which gears onto the screw. Once the gas is closed into the flute and the suction chamber is separated, the suction stage is complete.

■ **STAGE 3 COMPRESSION**

As the main rotor turns, the volume of gas trapped within the screw flute is reduced by the satellite teeth that gear onto the screw, thereby reducing the volume available to the gas mixture. This entails compression mixture to its maximum value.

■ **STAGE 4-5 DISCHARGE**

As the satellite tooth approaches the end of the flute, the pressure of the trapped vapour reaches a maximum value occurring near the triangular aperture of the discharge port. Compression immediately ceases and the gas is delivered into the discharge manifold. The satellite tooth continues to push the vapour until the flute volume reaches a minimum value.

This compression process is repeated for each screw flute at each turn.

**Refrigeration capacity control**

The compressors are set up as standard with an infinite control of their capacity. Two shutters reduce suction capacity, delaying flute closing and decreasing its effective length. These shutters are used to allow the compressor to operate at minimum and maximum loads. The shutters are controlled by the pressure of the oil from the separator or drained towards compressor suction. A spring helps create the force necessary to move the shutter. The compressors for the EWAD-C- series use two shutters for both load and discharge, controlled by the oil-gas flow through the circuits and directly controlled by the controller through the solenoid valves that are normally closed (NC). The first shutter allows you to change both the load and discharge continuously. The second, on the other hand, has the on/off operation. Both individually guarantee a 50% change in load/discharge.

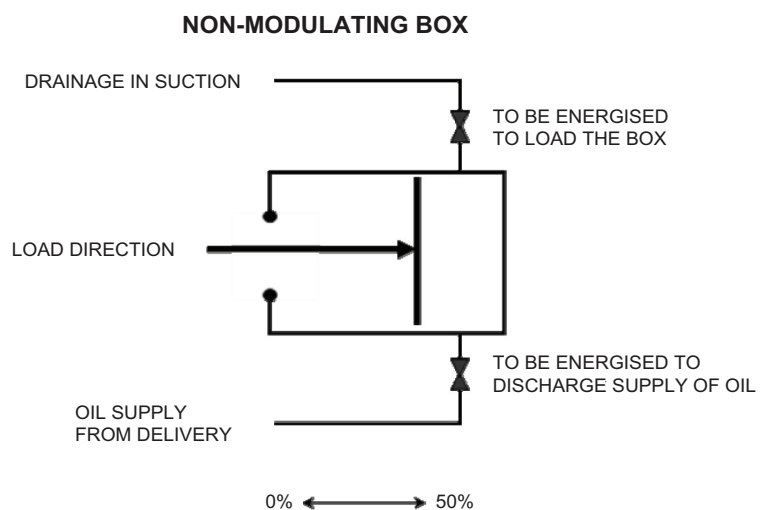
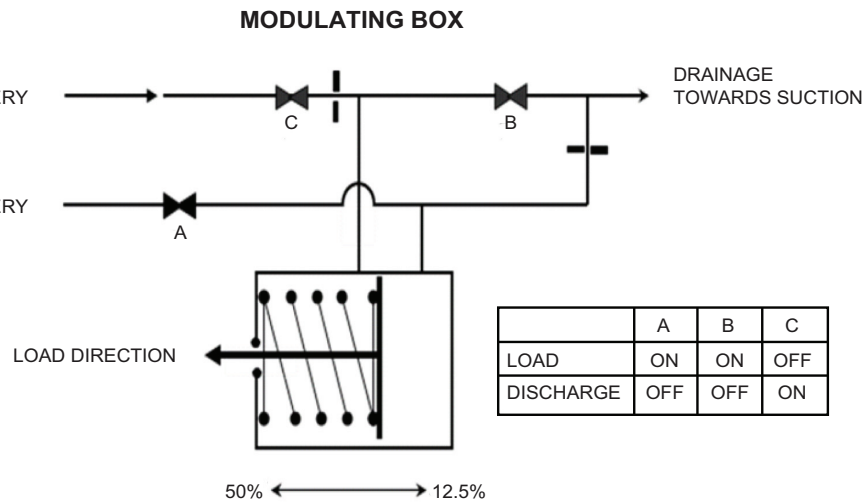
1

**Modulating box**

The operating diagram of the modulating box is shown in the following figure. The system is controlled by three solenoids, A, B, C, which are normally closed if not powered, and by a spring assembled directly onto the slide. During loading, solenoid C is closed because it is not excited, whilst the remaining A and B are energised. With this configuration, the gas from the supply pressure runs through to the chamber on the right of the slide where the pressure wins over the spring resistance, whilst the pipe, passing by the open solenoid B, allows the oil to drain towards suction. In the drain phase, on the other hand, solenoids A and B are de-excited and therefore closed, whilst solenoid C is opened. In this way, the oil flow, to the delivery pressure, runs towards the chamber to the left of the slide, moving it towards the left helped by the spring action. At the same time, the gasses contained on the right-hand side of the slide discharge in suction, through the free vent pipes.

**Non-modulating on/off box**

The non-modulating slide operating diagram is shown in the following figure. The slide is only controlled by means of the opening and closing of two solenoids that always operate by opposition. During the load stage, the solenoid bringing the slide chamber into communication with the suction is opened, thereby helping pressurised oil drain towards the suction, moving the slide to the load position up to maximum extension. On the contrary, if closed at the same time as the second slide opens, it allows the pressurised oil flowing from the delivery to move the slide to the discharge position until maximum extension.





## 1.36 Wiring Diagrams - EWAD-CJYNN

### Overview

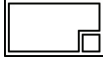

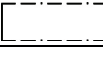



This chapter contains the following topics:

Topic	See page
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1.36.2–Power Compressor 3	1–106
1.36.3–Kit Pumps	1–107
1.36.4–Circuit Fan Power Supply 1	1–108
1.36.5–Circuit Fan Power Supply 1	1–109
1.36.6–Circuit Fan Power Supply 2	1–110
1.36.7–Circuit Fan Power Supply 2	1–111
1.36.8–Circuit Fan Power Supply 3	1–112
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1.36.10–Unit Control Circuit Power Supply	1–114
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1.36.31–Terminals M5 - MQ	1–135
1.36.32–Legend	1–136
1.36.33–Field Wiring Connection	1–141

## 1

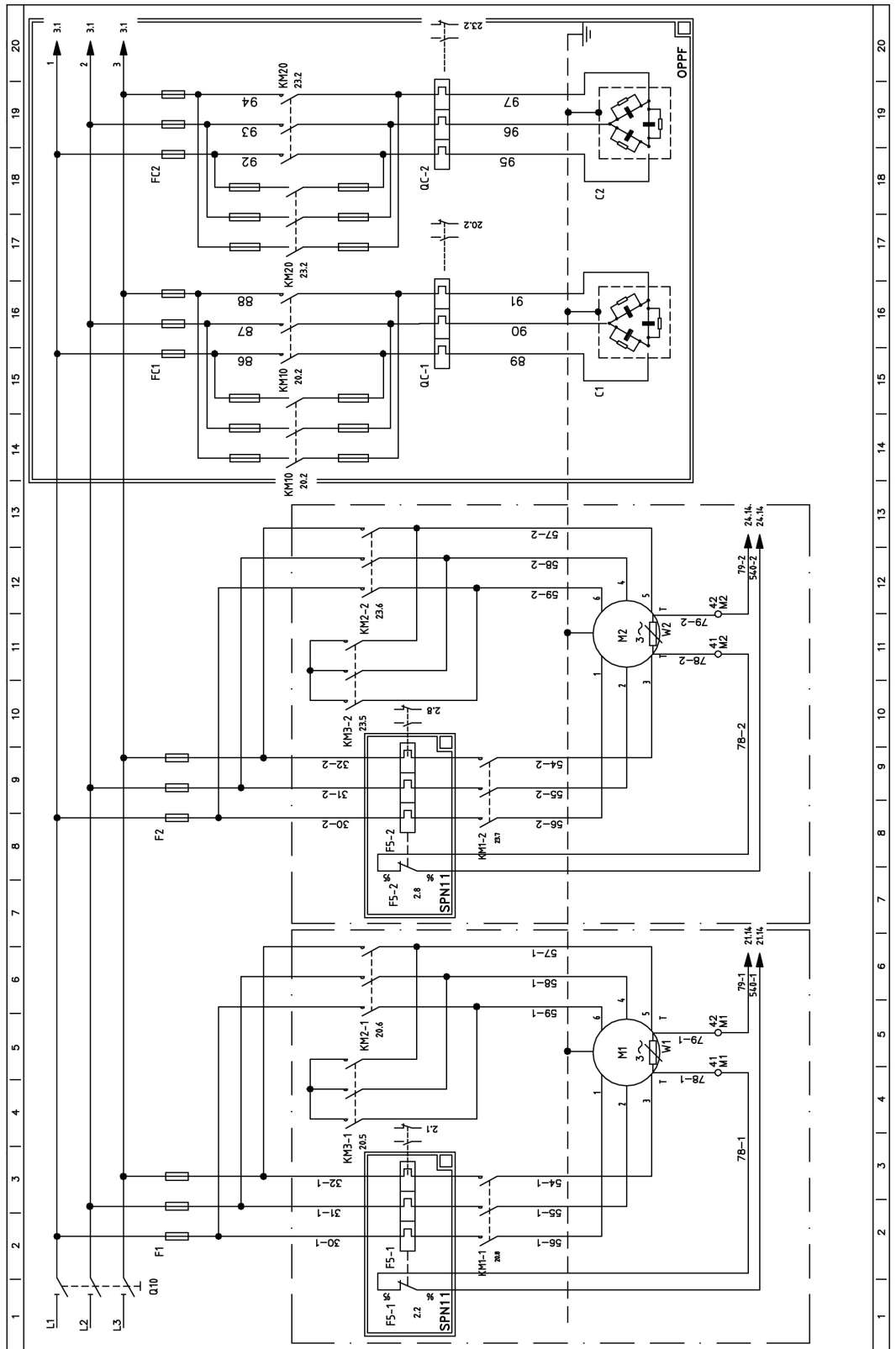
## Symbols

The following symbols are used on the wiring diagrams:

	Optional equipments
	Equipment installed
	Electrical equipment installed on compressor terminals box
	Field wiring connections
	Remove this wire or MJ if the option is requested
	Manual reset

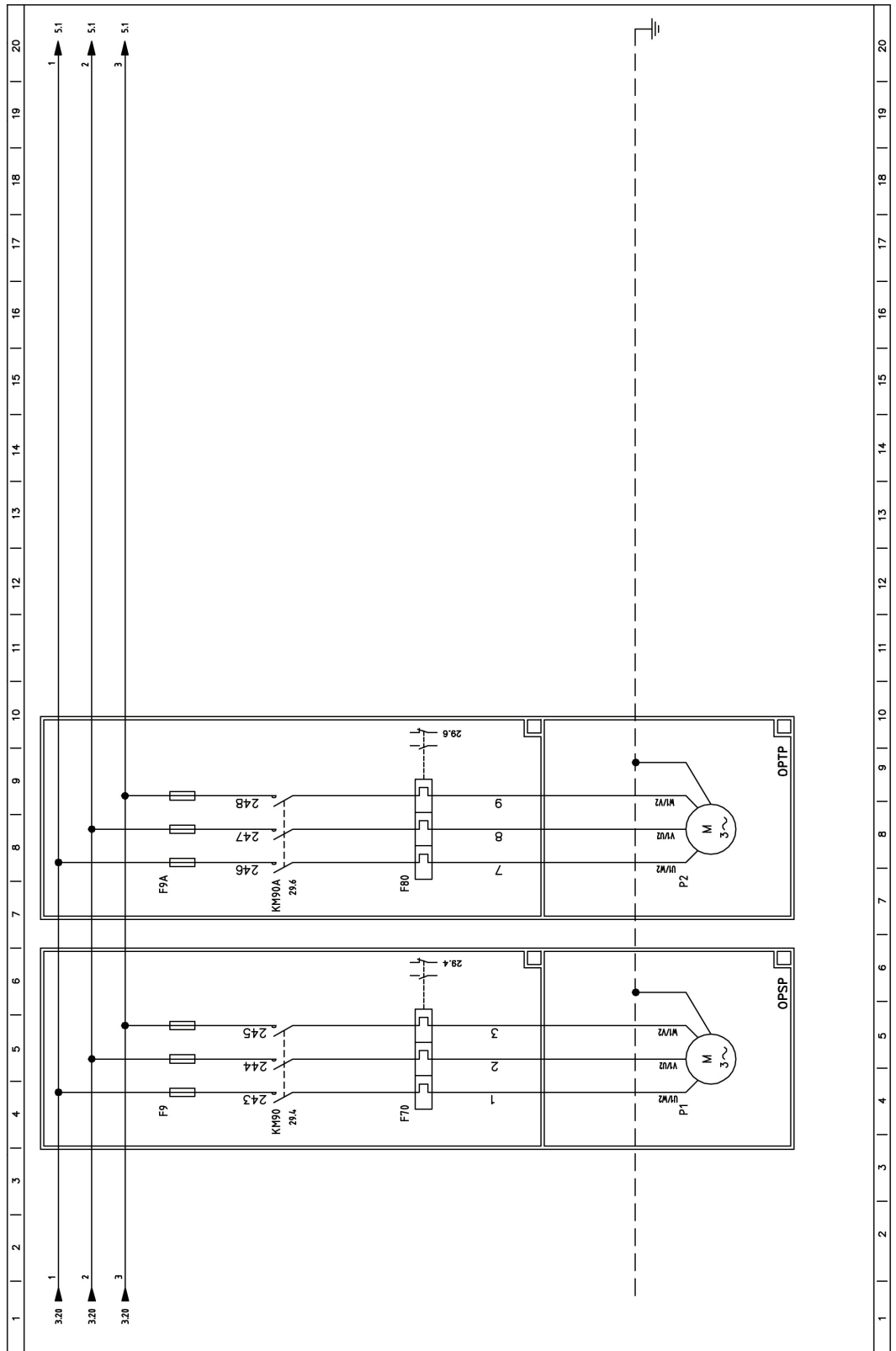
1.36.1 Power Compressor 1-2

1



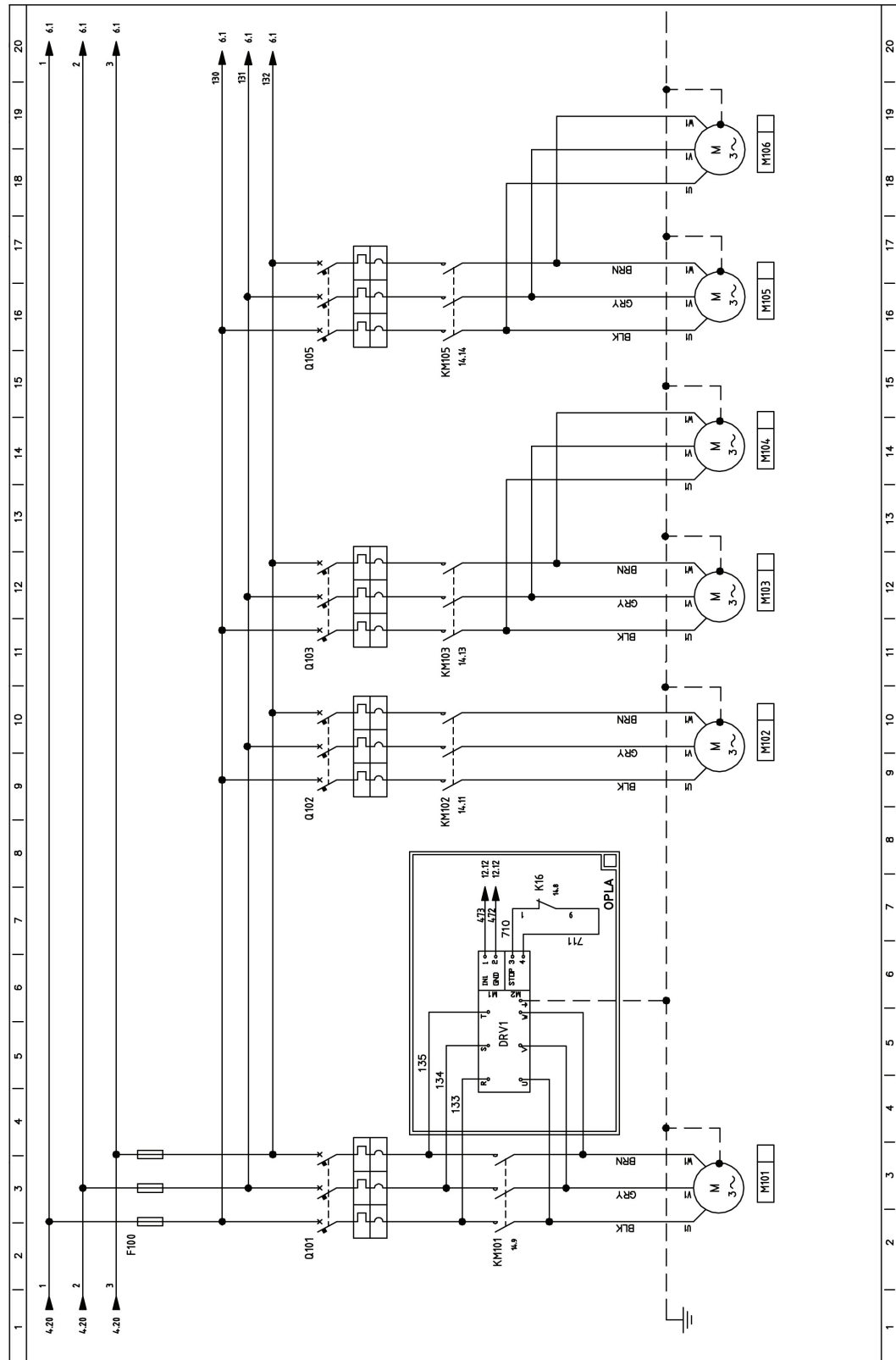


1.36.3 Kit Pumps

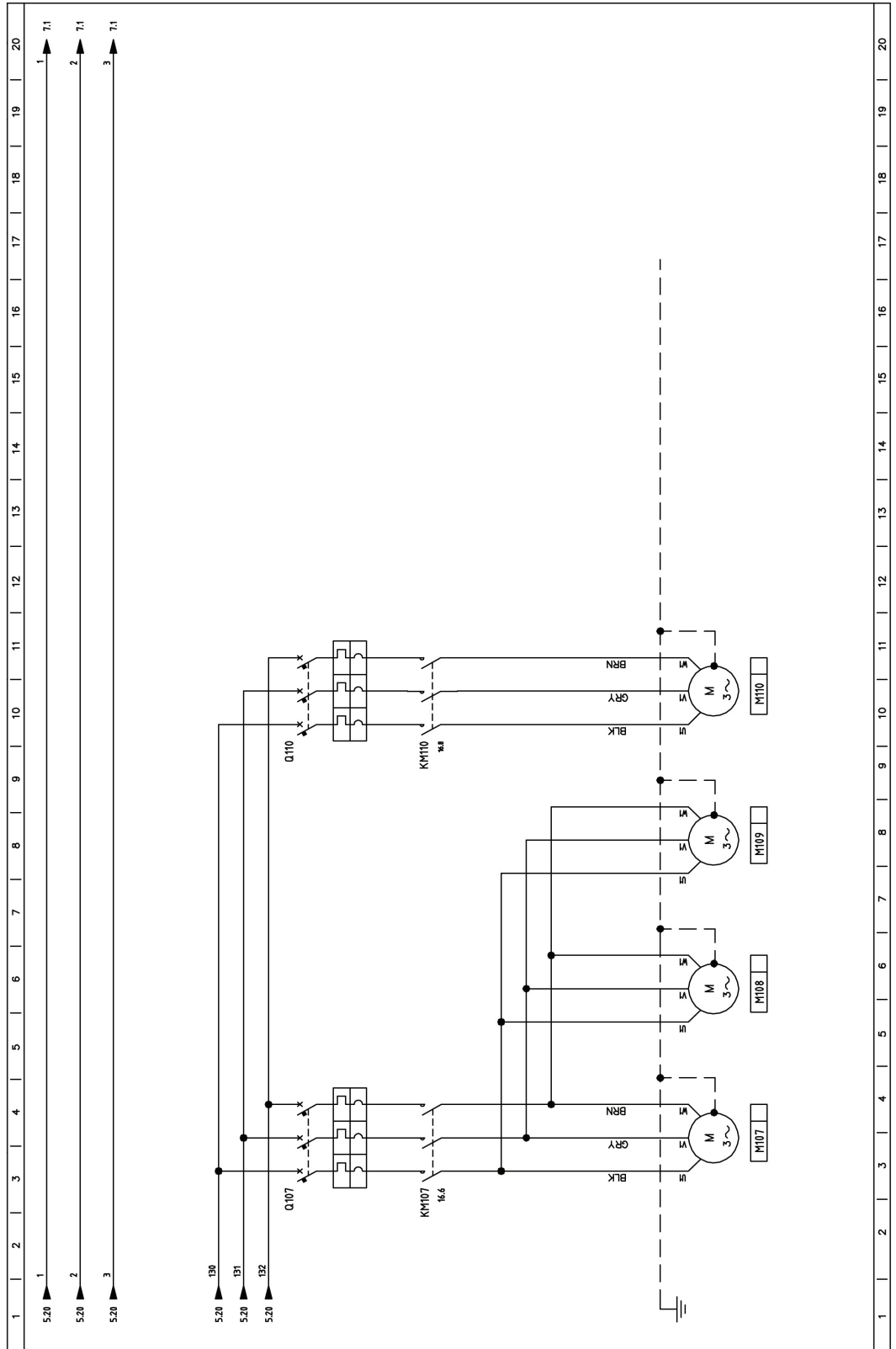


1.36.4 Circuit Fan Power Supply 1

1

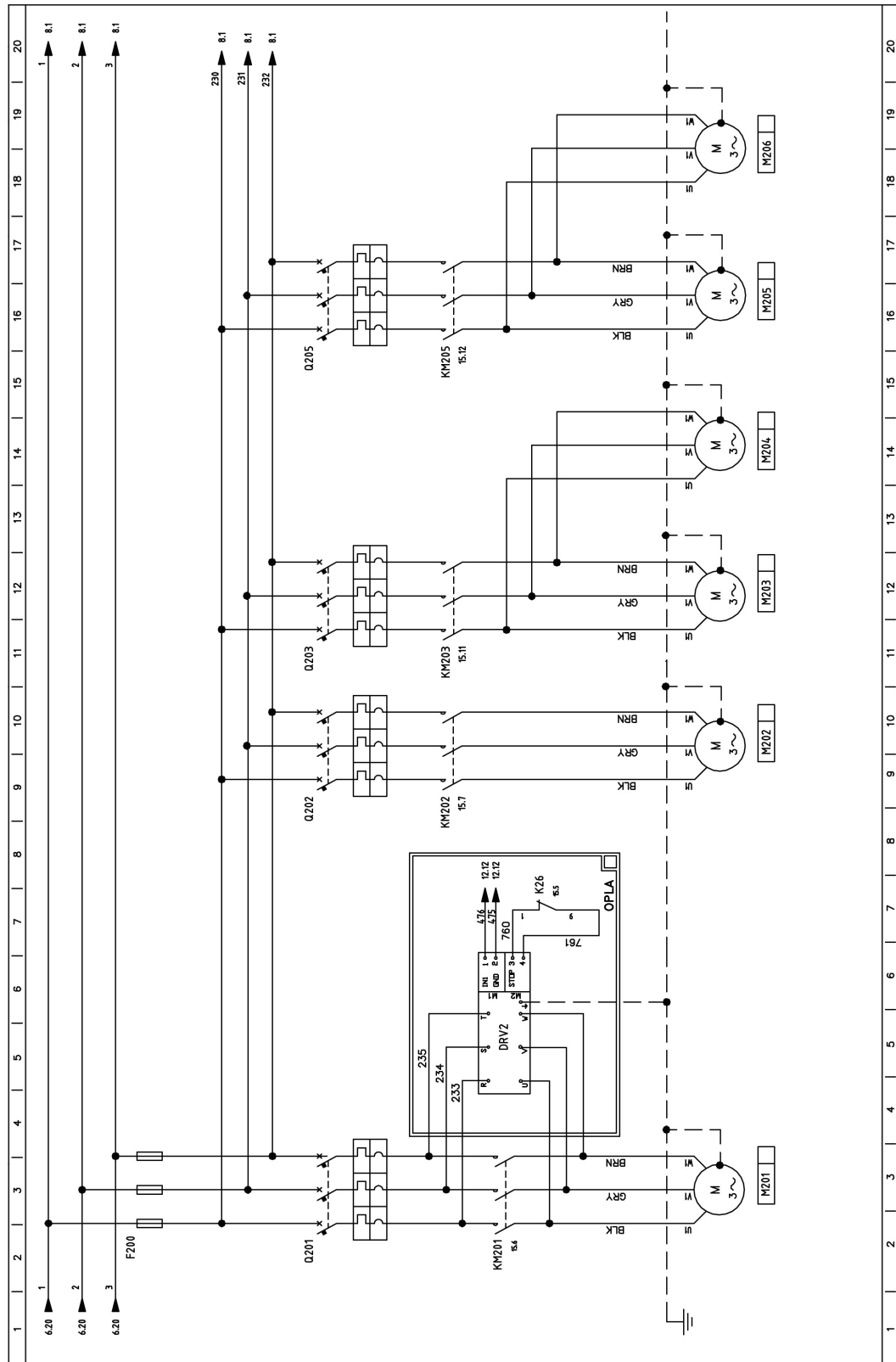


### 1.36.5 Circuit Fan Power Supply 1



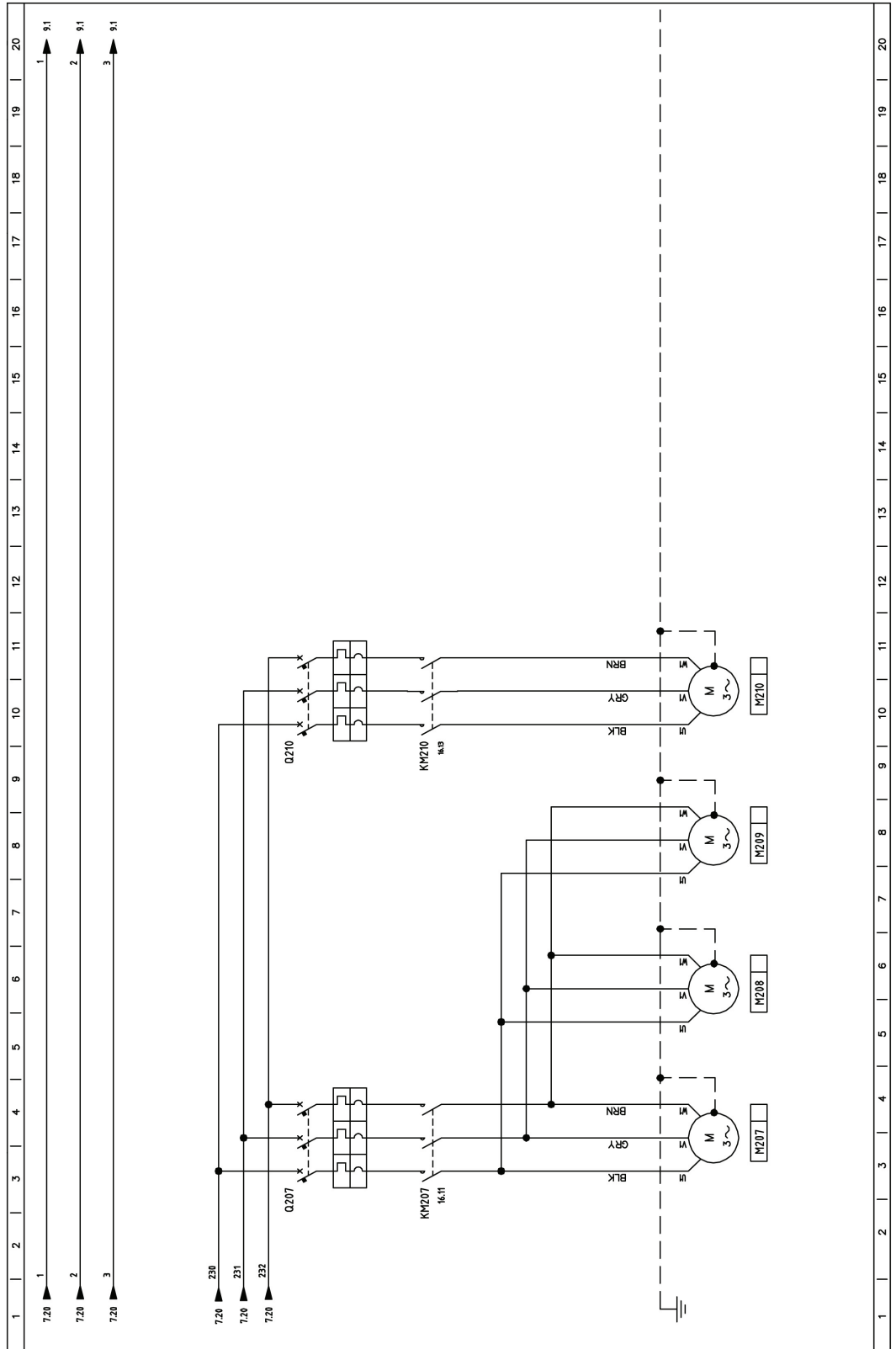
1.36.6 Circuit Fan Power Supply 2

1

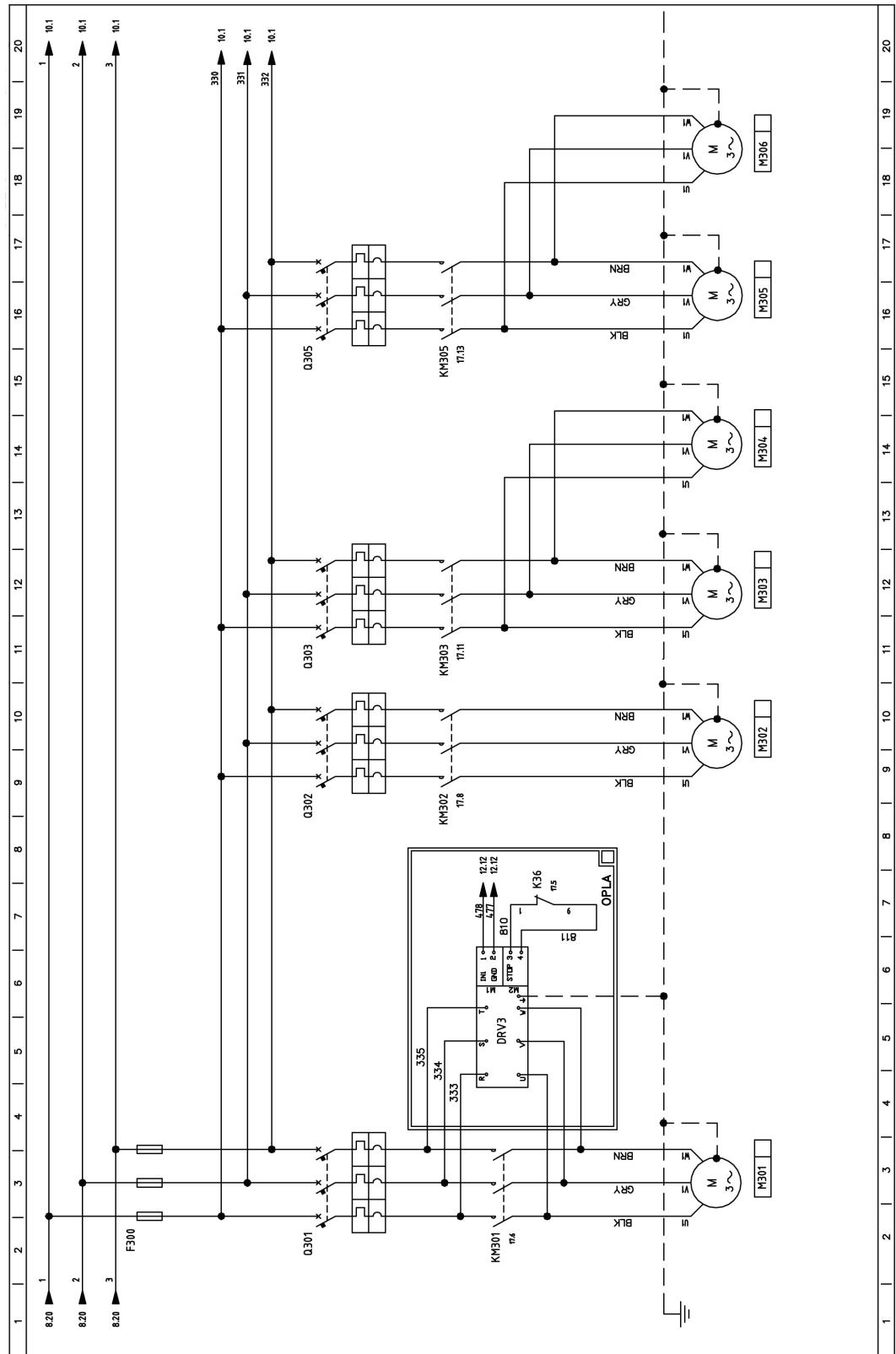




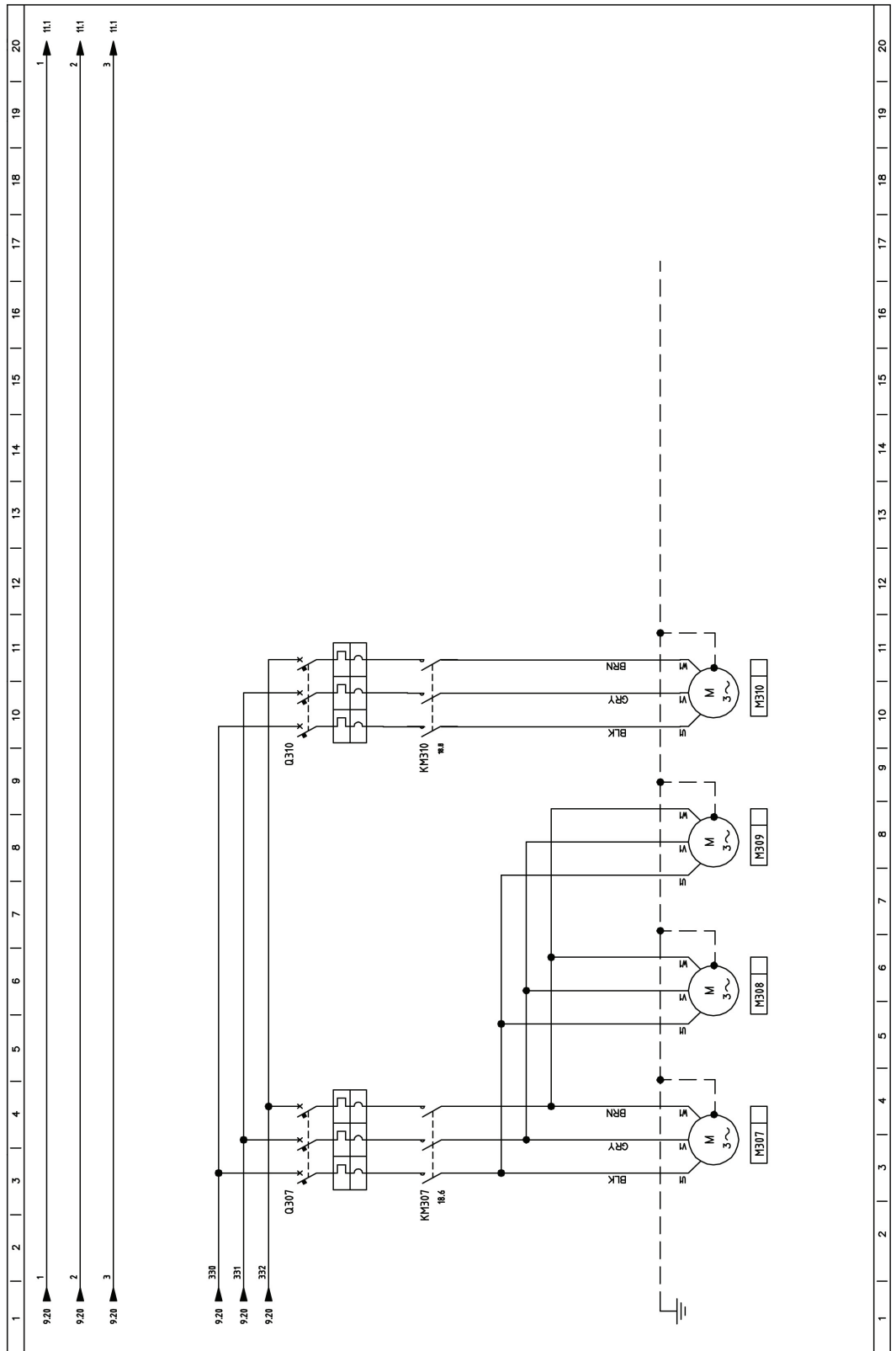
### 1.36.7 Circuit Fan Power Supply 2



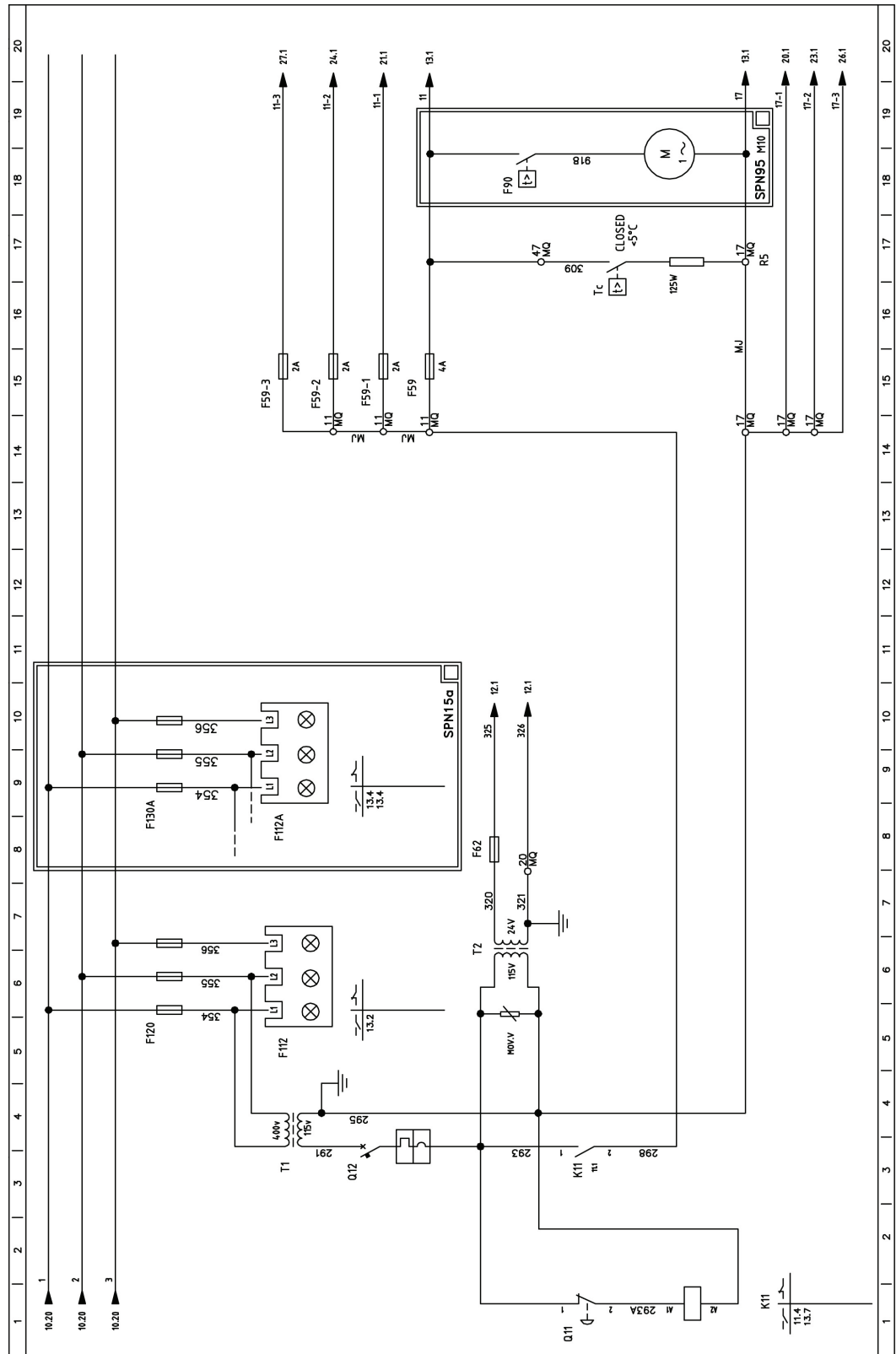
1.36.8 Circuit Fan Power Supply 3



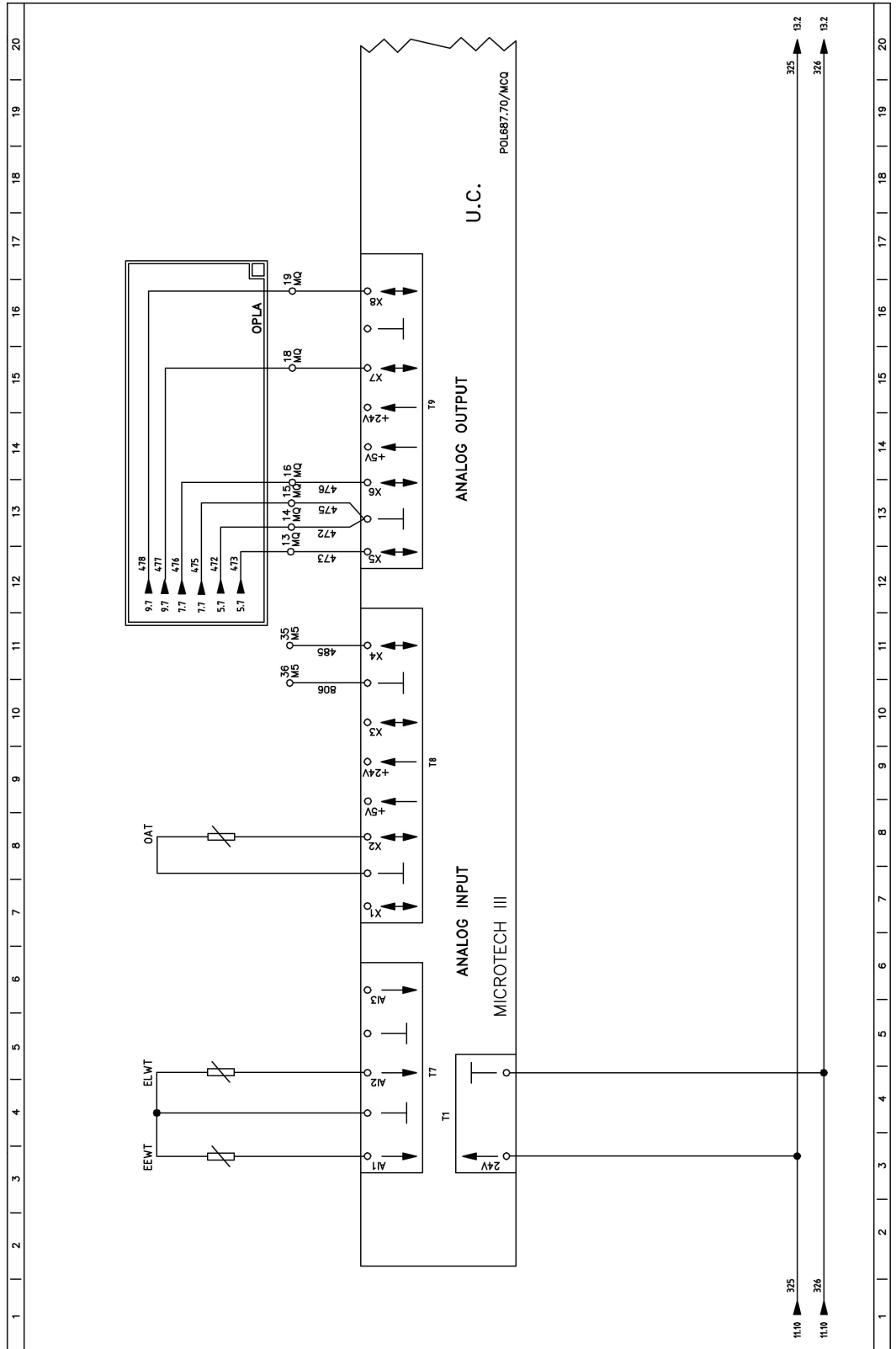
1.36.9 Circuit Fan Power Supply 3



1.36.10 Unit Control Circuit Power Supply



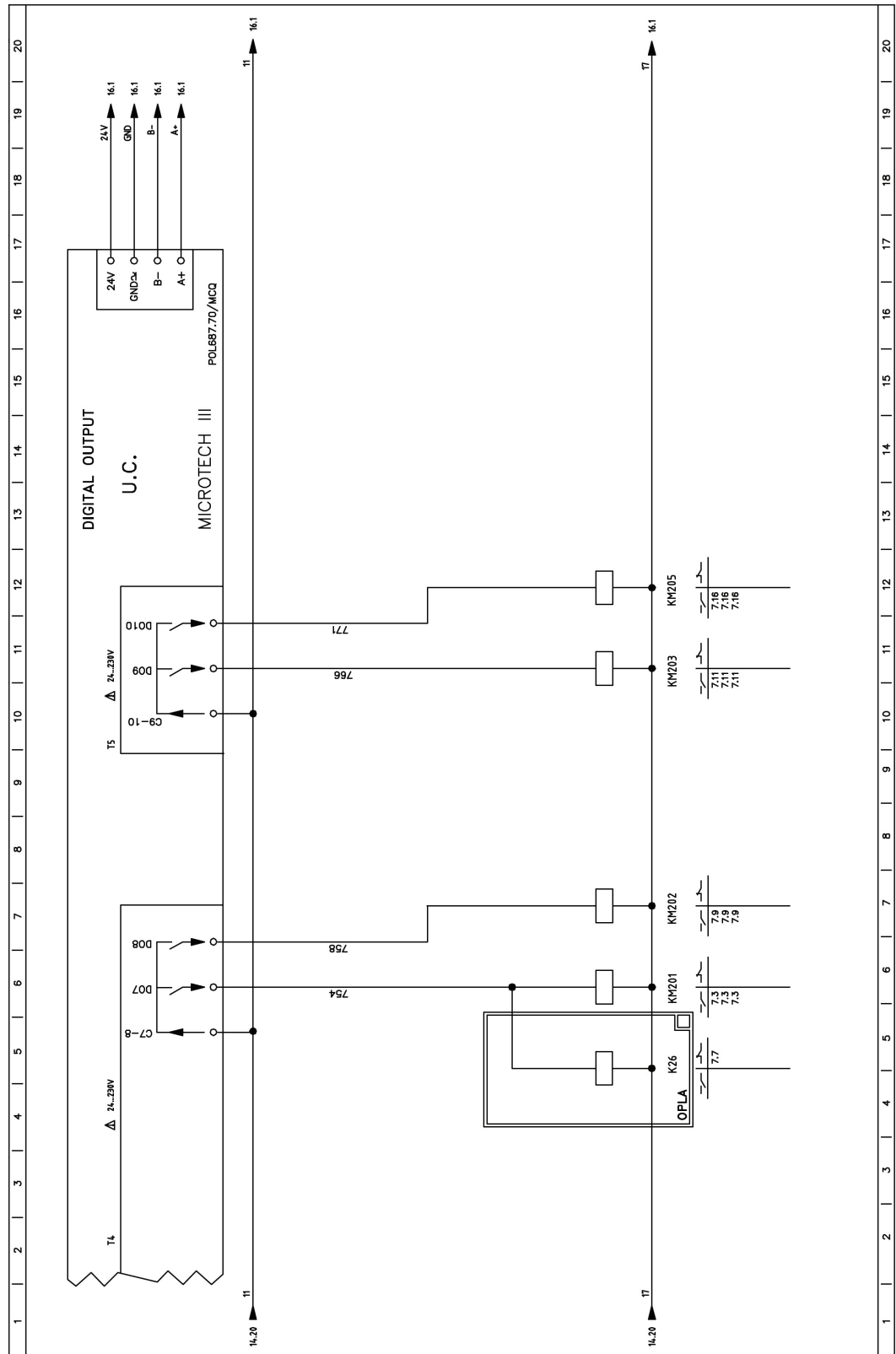
### 1.36.11 Analog Inputs-Output Board





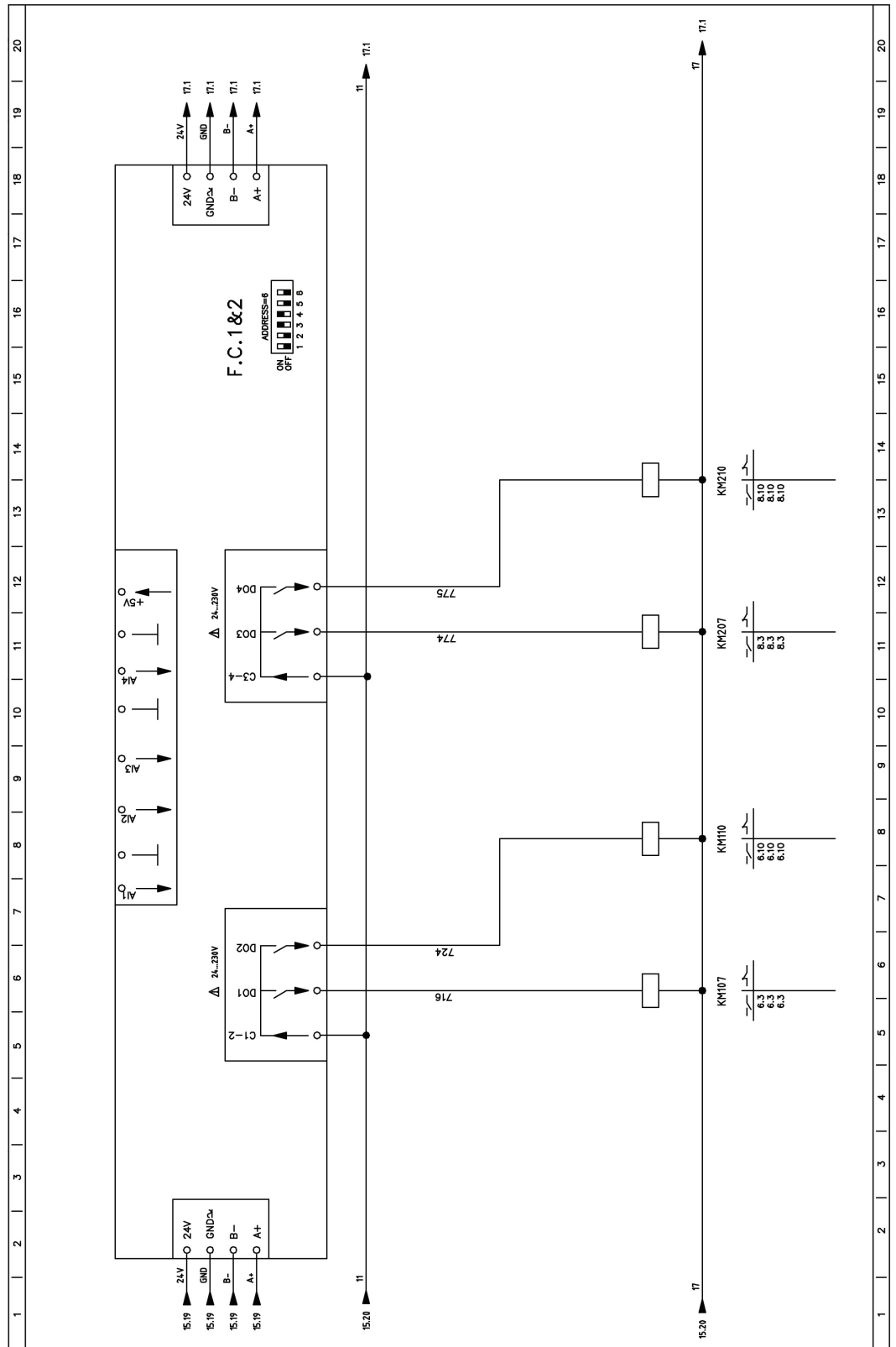


### 1.36.14 Digital Outputs Board

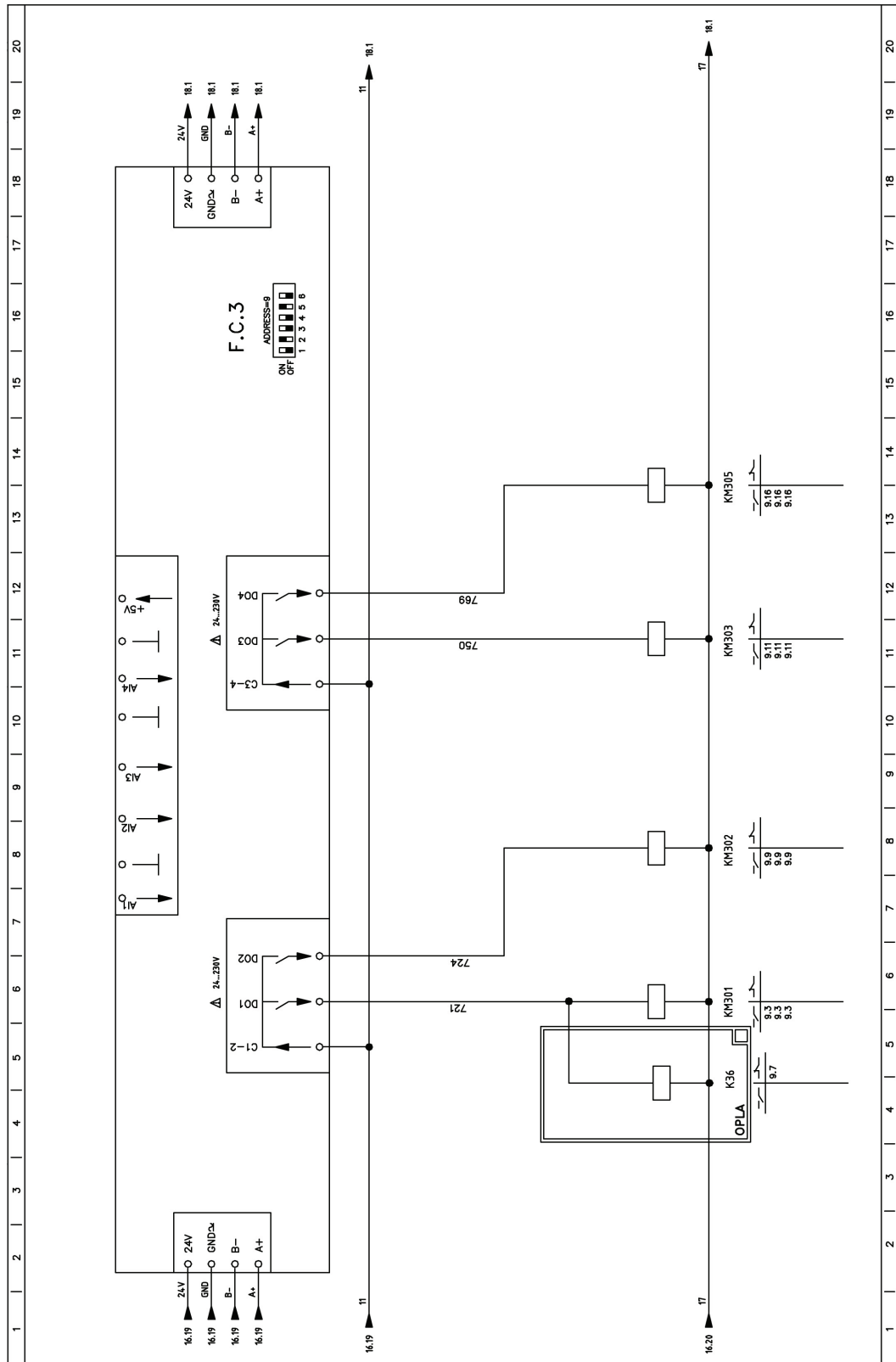




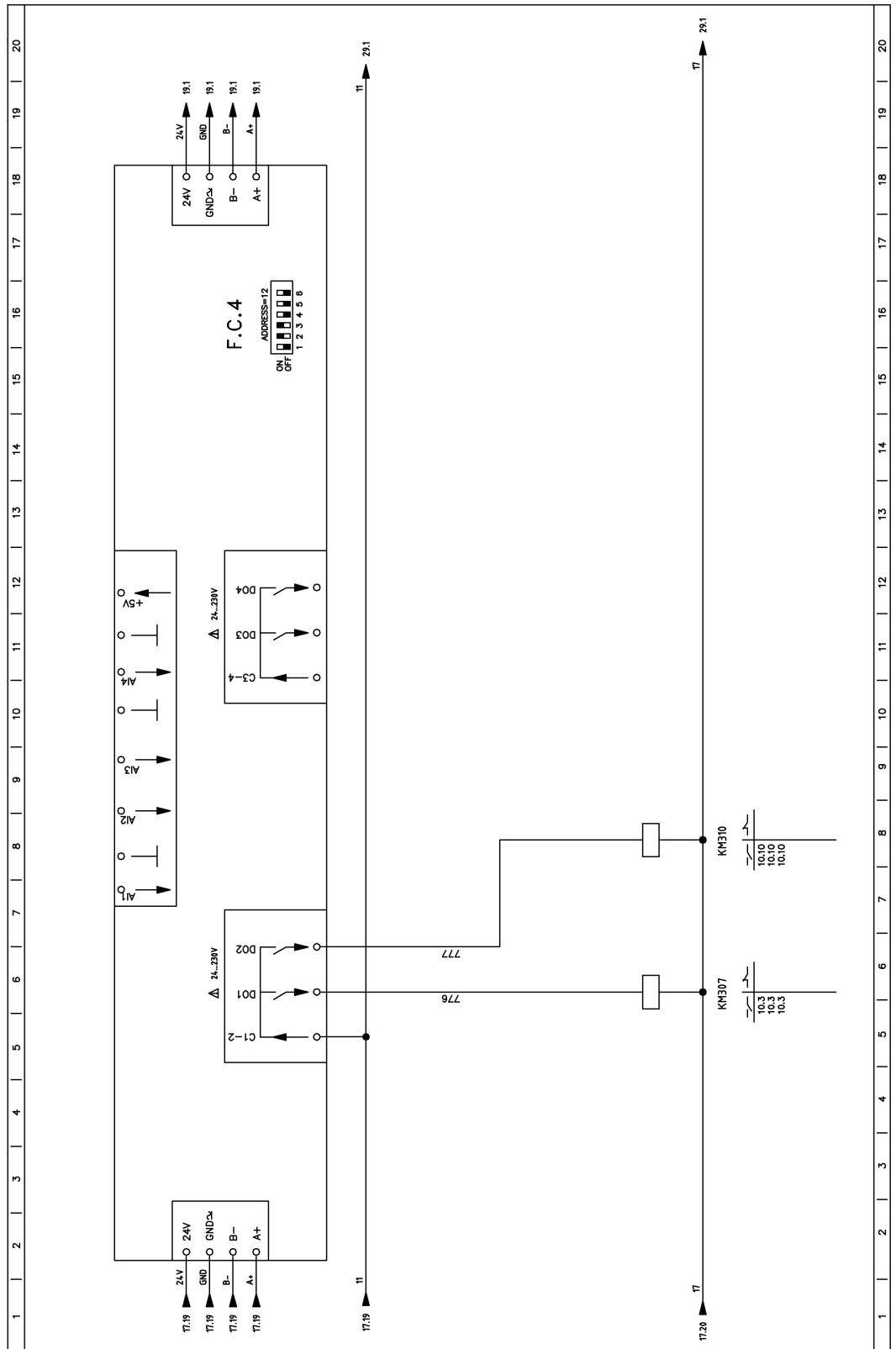
1.36.15 Extension Control Fans 1&2



1.36.16 Extension Control Fans 3

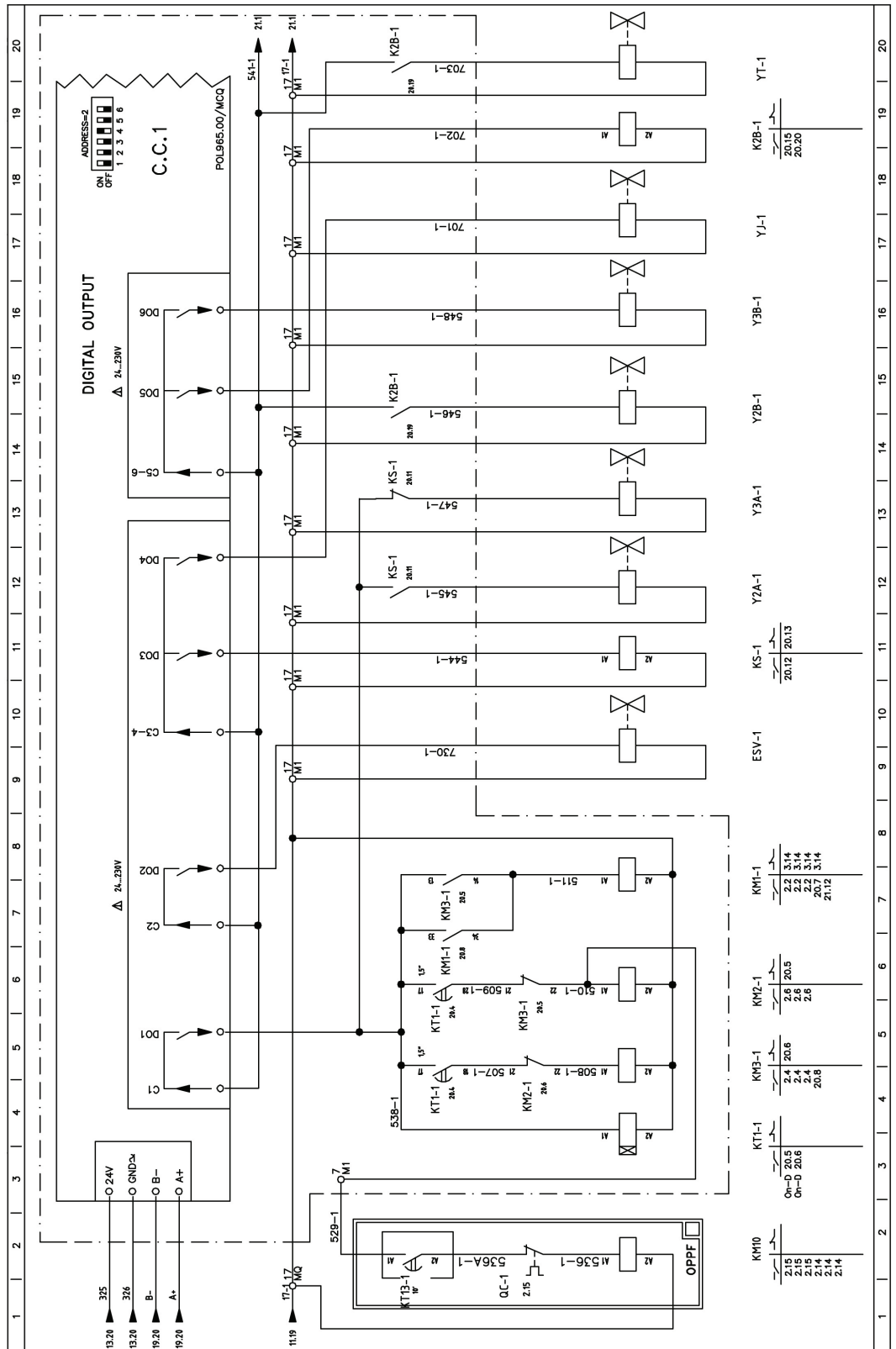


1.36.17 Extension Control Fans 4

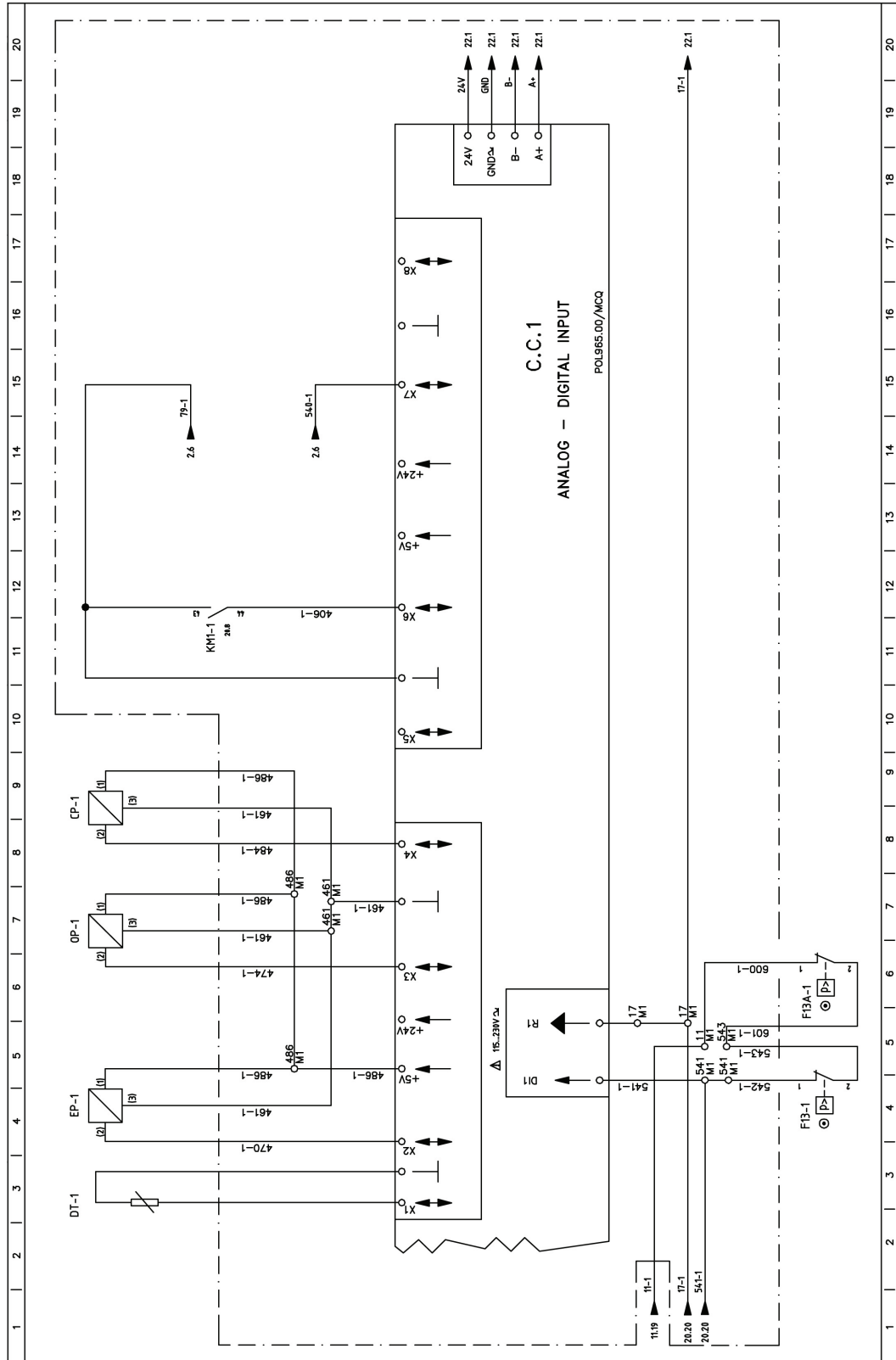




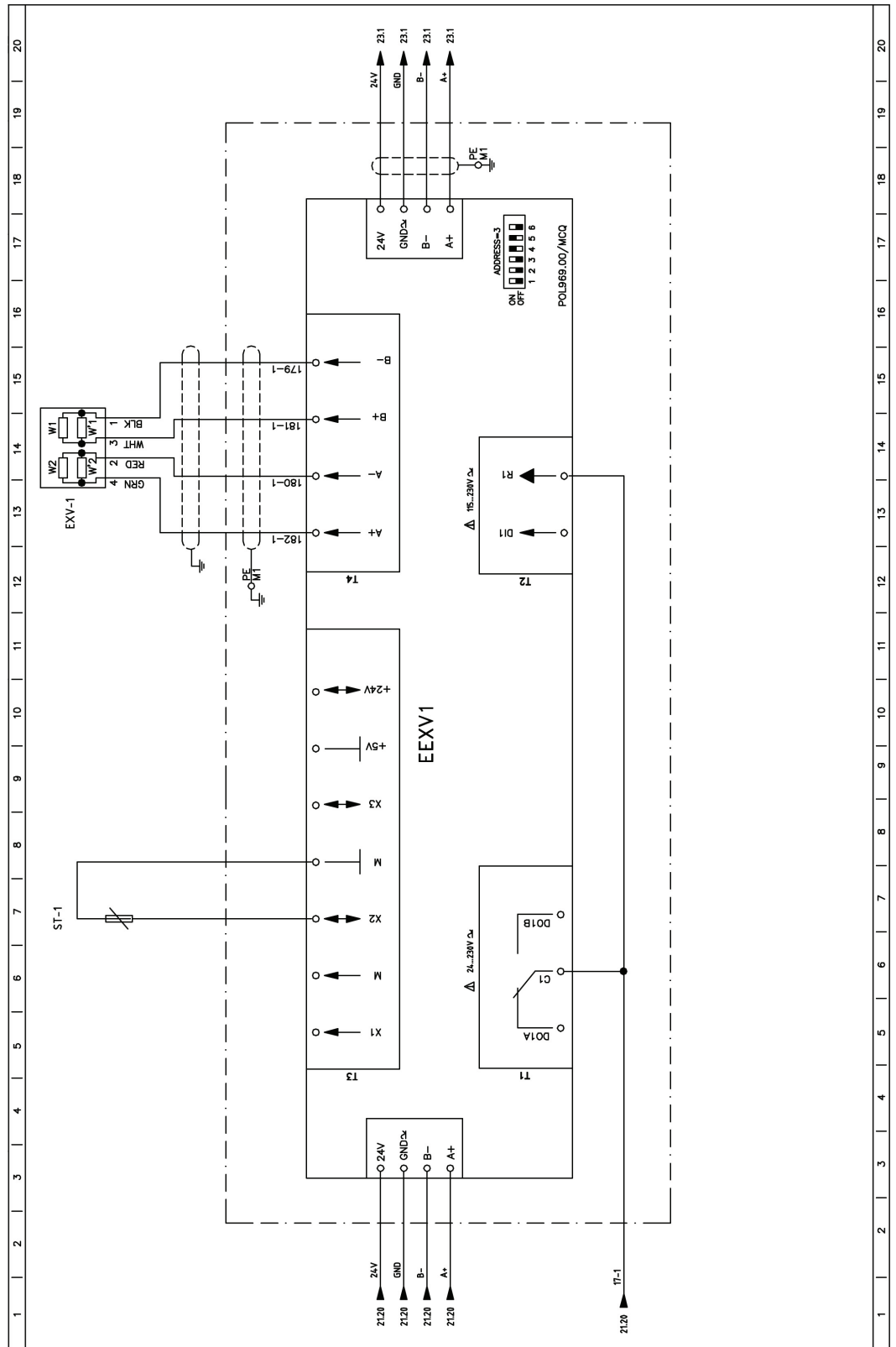
1.36.19 Expansion Control Compressor 1



### 1.36.20 Expansion Control Compressor 1



1.36.21 EEXV Compressor 1



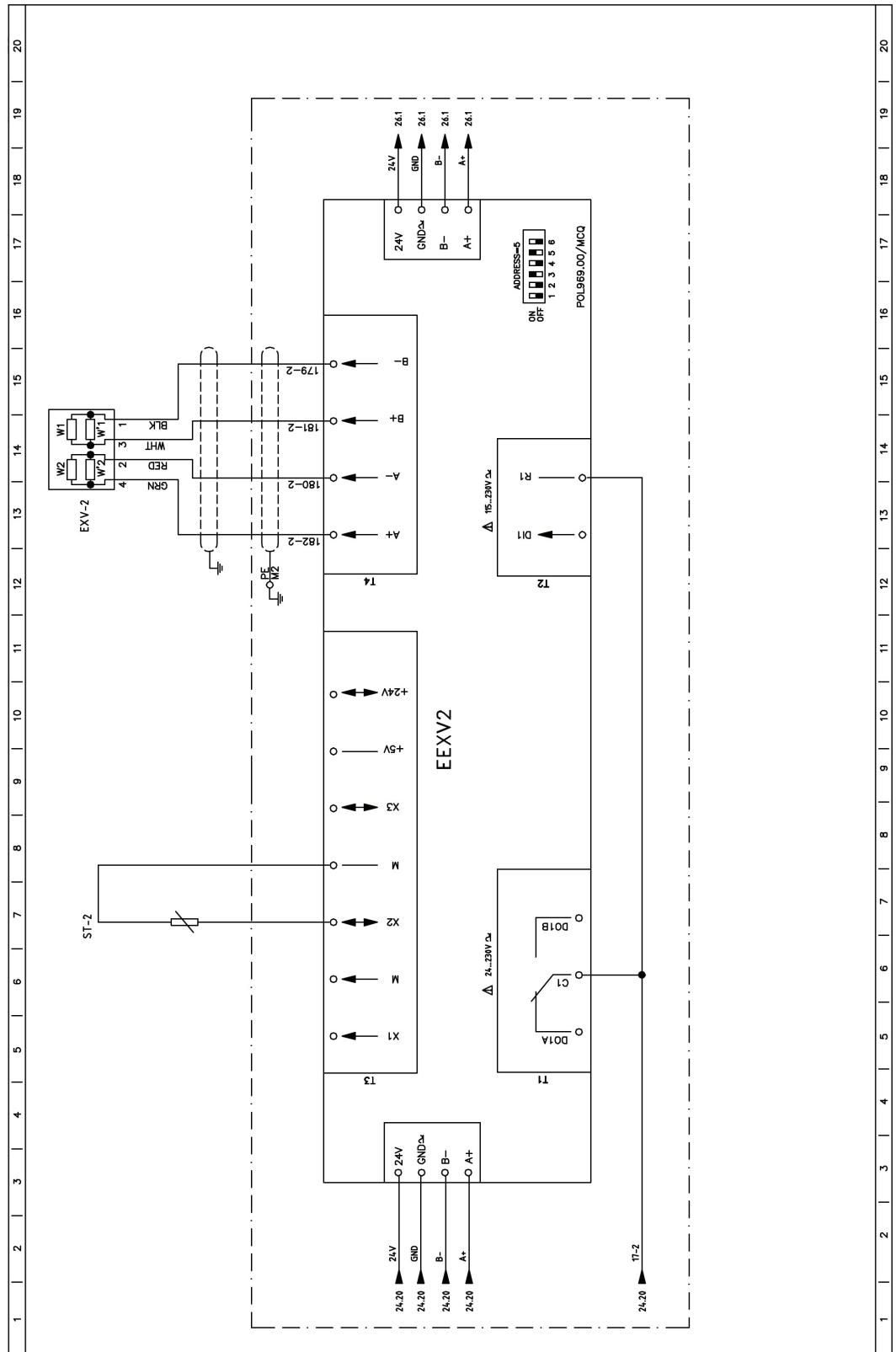




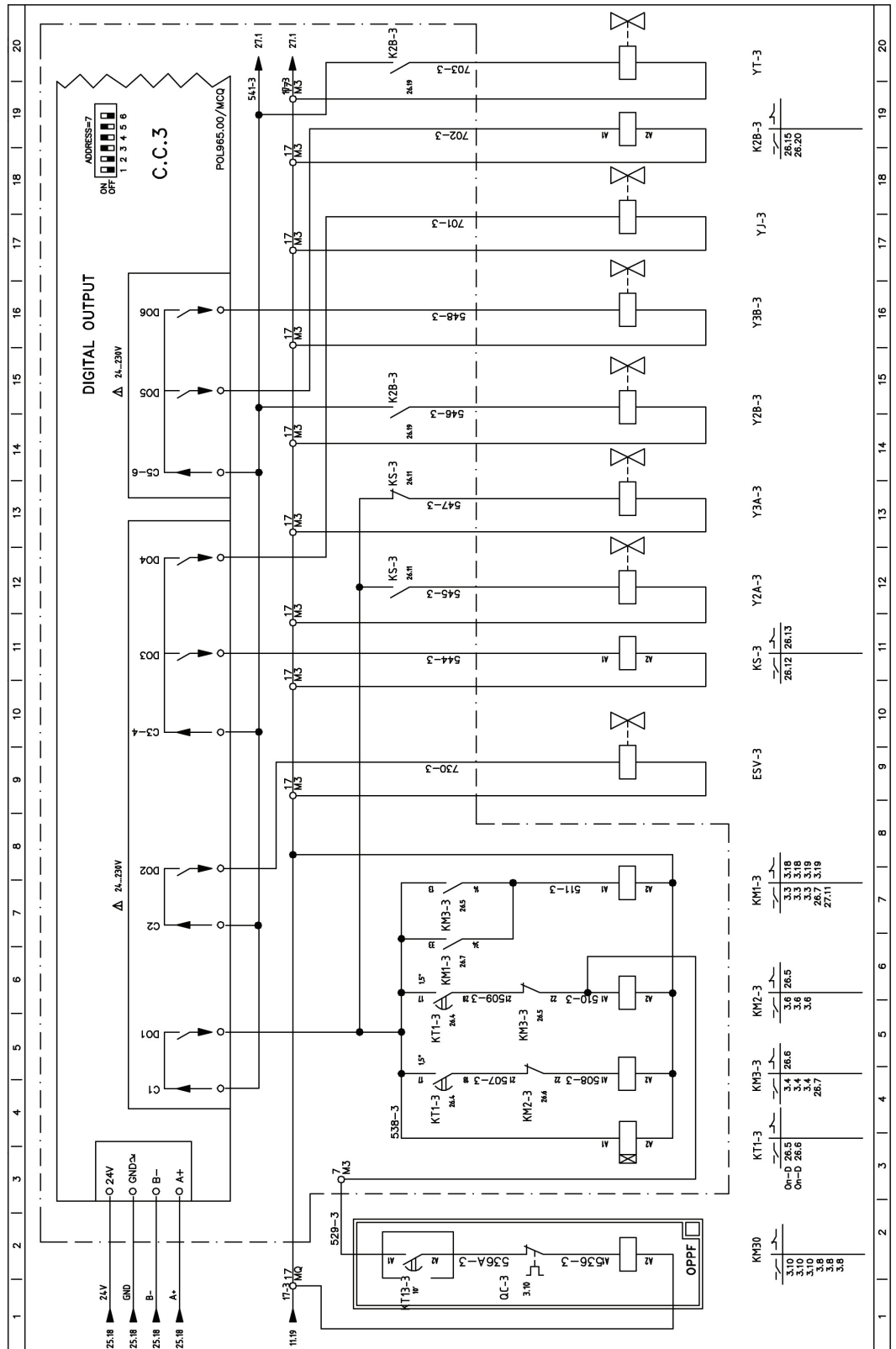


1.36.24 EEXV Compressor 2

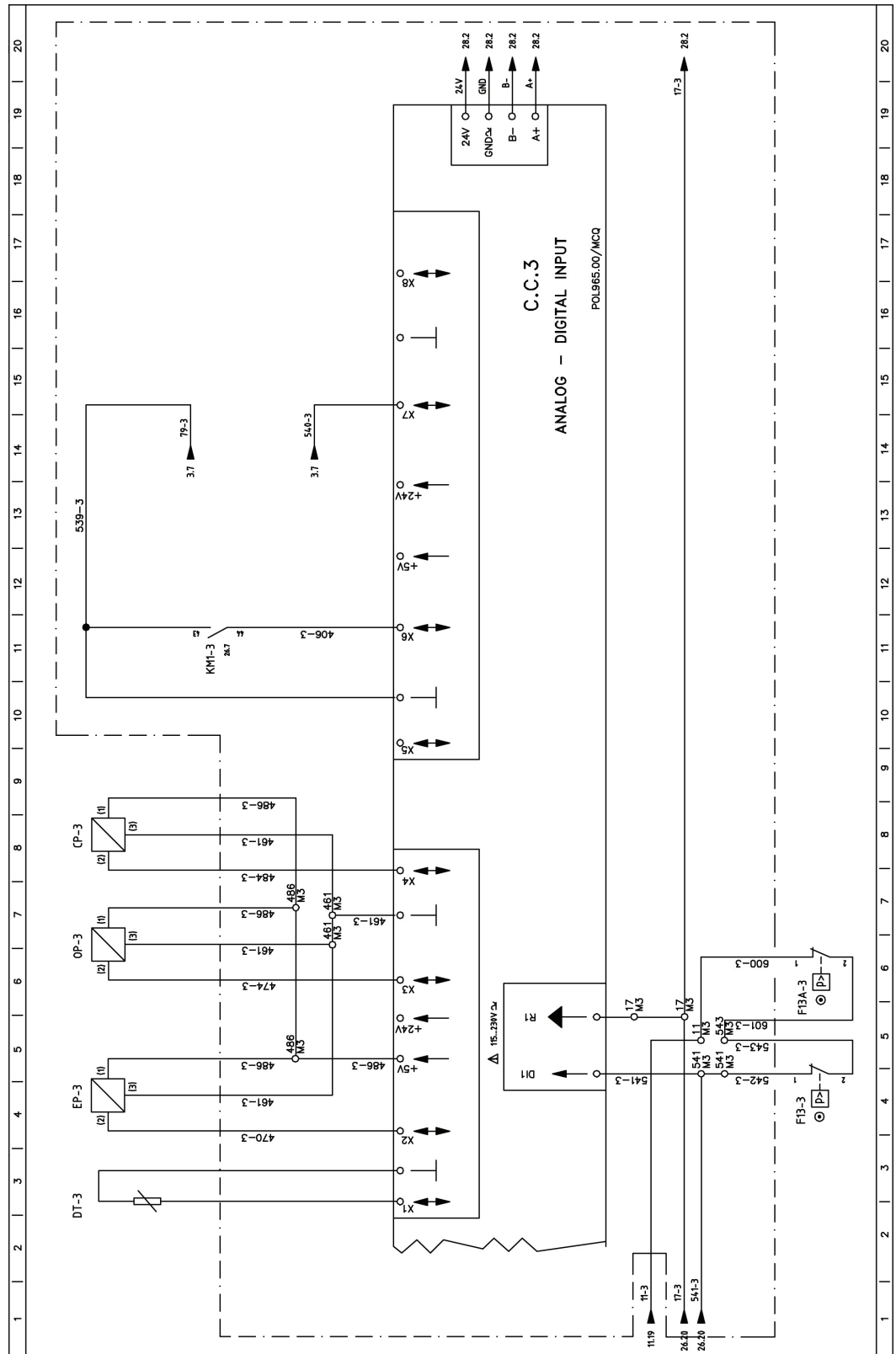
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1.36.25 Expansion Control Compressor 3



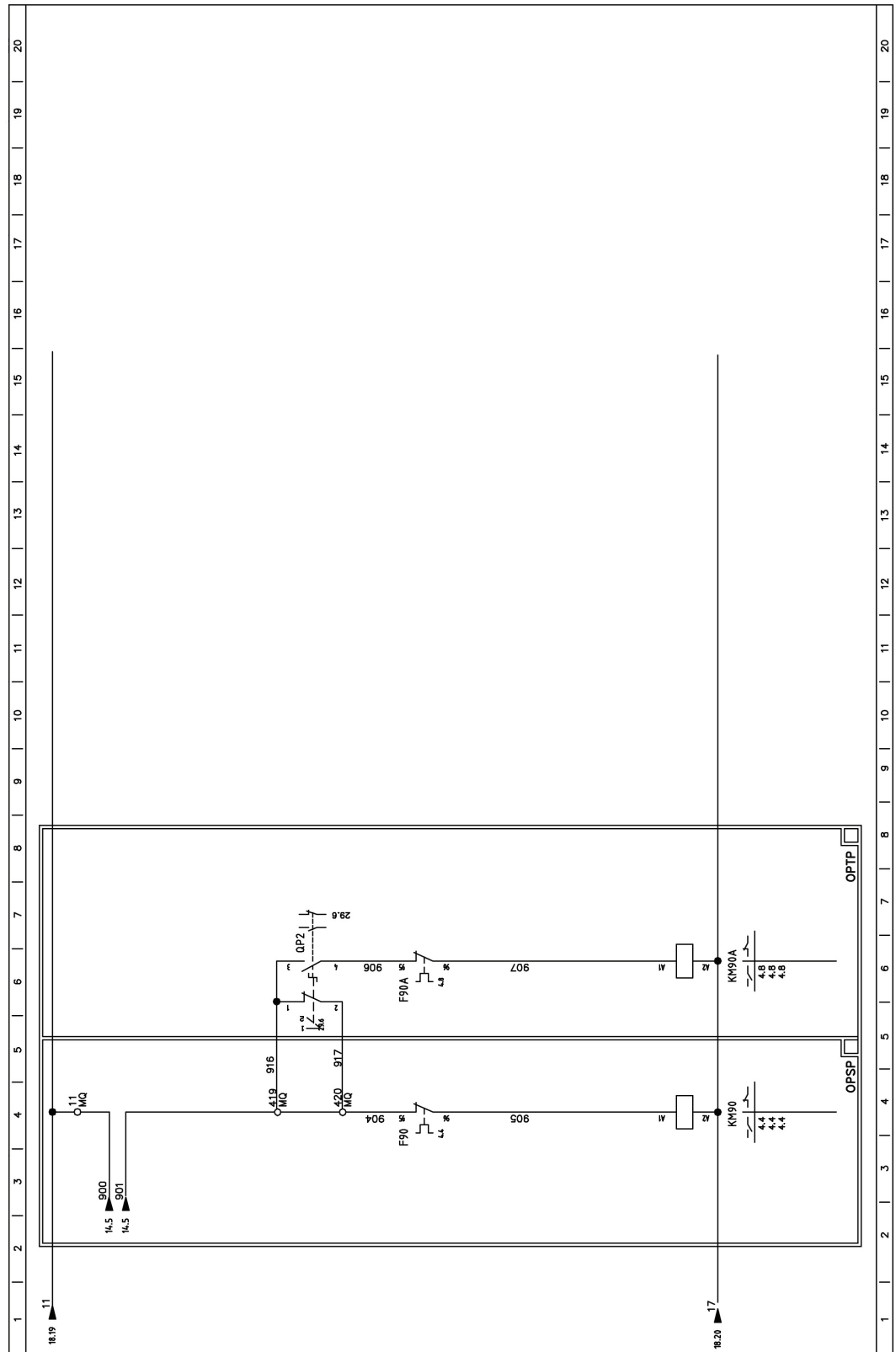
1.36.26 Expansion Control Compressor 3





1

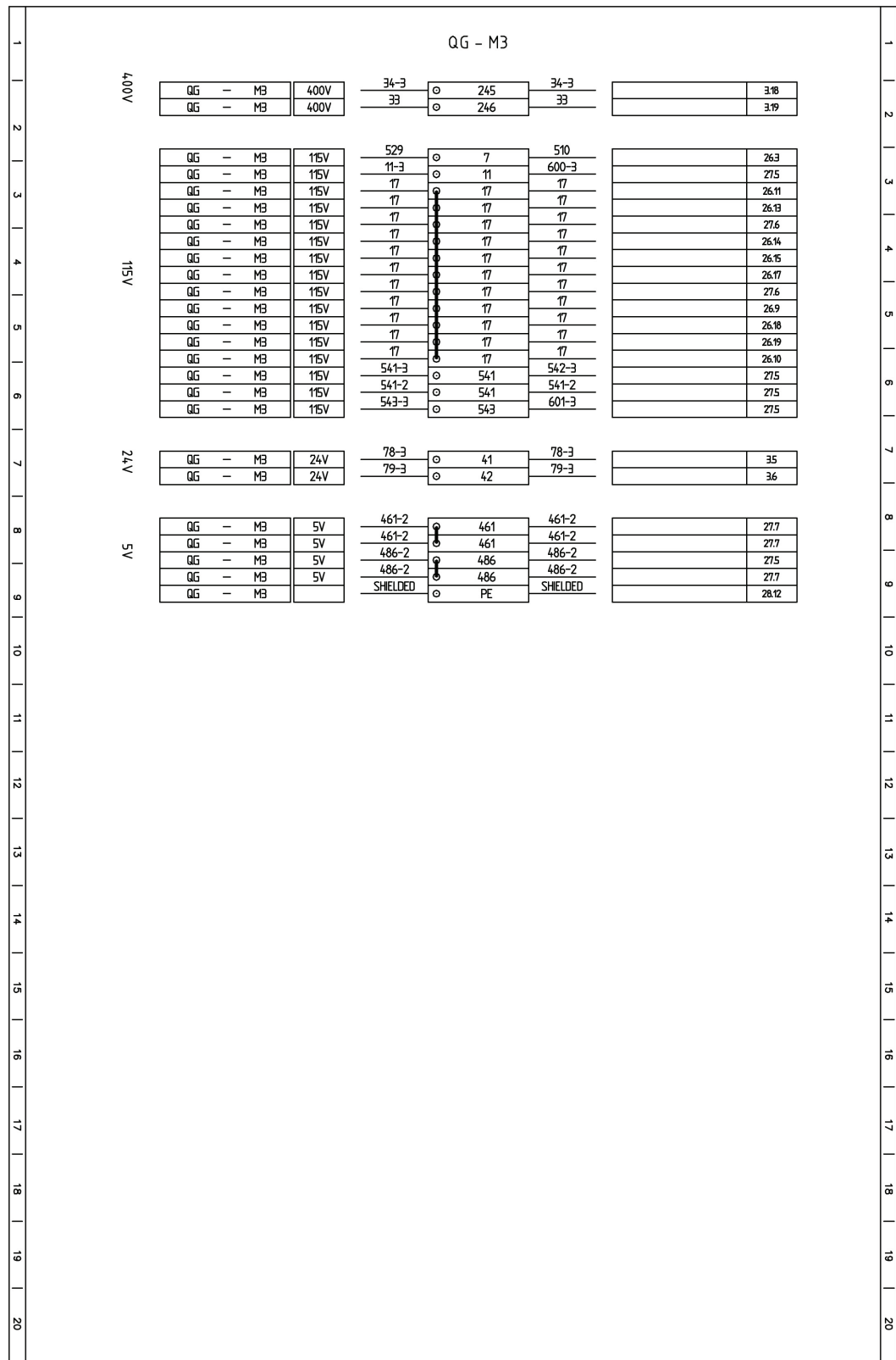
1.36.28 Pumps Control



1.36.29 Terminals M1 - M2

		QG - M1					
1							
2	400V	QG - M1	400V	34-1	45	34-1	314
		QG - M1	400V	33-1	46	33-1	314
3		QG - M1	115V	529	7	510	203
		QG - M1	115V	11	11	600-1	215
		QG - M1	115V	17	17	17	20.9
		QG - M1	115V	17	17	17	20.11
		QG - M1	115V	17	17	17	20.13
		QG - M1	115V	17	17	17	20.14
		QG - M1	115V	17	17	17	216
		QG - M1	115V	17	17	17	216
		QG - M1	115V	17	17	17	20.15
		QG - M1	115V	17	17	17	20.17
		QG - M1	115V	17	17	17	20.19
		QG - M1	115V	17	17	17	20.10
		QG - M1	115V	17	17	17	20.18
		QG - M1	115V	541-1	541	541-1	215
		QG - M1	115V	541-1	541	542-1	215
		QG - M1	115V	543-1	543	601-1	215
7	24V	QG - M1	24V	78-1	41	78-2	25
		QG - M1	24V	79-1	42	79-1	25
8		QG - M1	5V	461-1	461	461-1	217
		QG - M1	5V	461-1	461	461-1	217
		QG - M1	5V	486-1	486	486-1	217
		QG - M1	5V	486-1	486	486-1	215
		QG - M1		SHELDDED	PE	SHELDDED	22.12
		QG - M1		SHELDDED	PE	SHELDDED	22.18
11							
12							
13							
14							
15							
16							
17							
18	24V	QG - M2	24V	78-2	41	78-2	2.11
		QG - M2	24V	79-2	42	79-2	2.11
19		QG - M2	5V	461-2	461	461-2	24.7
		QG - M2	5V	461-2	461	461-2	24.7
		QG - M2	5V	486-2	486	486-2	24.7
		QG - M2	5V	486-2	486	486-2	24.5
		QG - M2		SHELDDED	PE	SHELDDED	25.12
20							

1.36.30 Terminals M3







## 1.36.32 Legend

Item	Description
A.C.	Alarm Control
C1	Power Factor Correction
C2	Power Factor Correction
C3	Power Factor Correction
C.C.1	Control Compressor (Siemens)
C.C.2	Control Compressor (Siemens)
C.C.3	Control Compressor (Siemens)
CP-1	Condenser Pressure Transducer Cir. 1
CP-2	Condenser Pressure Transducer Cir. 2
CP-3	Condenser Pressure Transducer Cir. 2
DRV1	Speedtrol 1
DRV2	Speedtrol 1
DRV3	Speedtrol 1
DT-1	Discharge Temp. Sensor Cir. 1 (PT1000)
DT-2	Discharge Temp. Sensor Cir. 2 (PT1000)
DT-3	Discharge Temp. Sensor Cir. 2 (PT1000)
EEWT	Evaporator Entering Water Temperature
EEXV1	Expansion Compressor 1
EEXV2	Expansion Compressor 1
EEXV3	Expansion Compressor 1
ELWT	Evaporator Leaving Water Temperature
EP-1	Evaporator Pressure Transducer Cir. 1
EP-2	Evaporator Pressure Transducer Cir. 2
EP-3	Evaporator Pressure Transducer Cir. 2
ESV-1	Economizer Solenoid Valve Cir. 1
ESV-2	Economizer Solenoid Valve Cir. 1
ESV-3	Economizer Solenoid Valve Cir. 1
EXV-1	Electronic Expansion Valve
EXV-2	Electronic Expansion Valve
EXV-3	Electronic Expansion Valve
F0	Compressor Fuses
F1	Compressor Fuses
F2	Compressor Fuses
F3	Compressor Fuses
F9	Pump Fuses 1
F59	Auxiliary Circuit Fuse
F62	Protection Fuse
F70	Thermal Relay Pump 1
F80	Thermal Relay Pump 2
F90	Thermostat (Closed > 30°C)
F9A	Pump Fuses 2
F100	Fan Fuses
F112	Phase Volt Monitor
F116	Evaporator Flow Switch
F120	Auxiliary Protection Fuses
F200	Fan Fuses
F300	Fan Fuses
F5-1	Thermal Relay
F5-2	Thermal Relay
F5-3	Thermal Relay
F112A	Under/Overvoltage Control
F13-1	Mech. High Pressure Switch Cir. 1

Item	Description
F13-2	Mech. High Pressure Switch Cir. 1
F13-3	Mech. High Pressure Switch Cir. 3
F130A	Under/Overvoltage Control Fuse
F59-1	Auxiliary Circuit Fuse
F59-2	Auxiliary Circuit Fuse
F59-3	Auxiliary Circuit Fuse
F13A-1	Mech. High Pressure Switch Cir. 1
F13A-2	Mech. High Pressure Switch Cir. 1
F13A-3	Mech. High Pressure Switch Cir. 1
F.C.3	Standard Compressor
F.C.4	Standard Compressor
F.C.1&2	Standard Compressor
FC1	Power Factor Correction Fuses 1
FC2	Power Factor Correction Fuses 1
FC3	Power Factor Correction Fuses 3
K11	Contactors
K16	Fan Motor Contactor
K26	Fan Motor Contactor
K36	Fan Motor Contactor
K2B-1	Contactors
K2B-2	Auxiliary Relay
K2B-3	Auxiliary Relay
KM10	Power Factor Correction Contactors
KM20	Power Factor Correction Contactors
KM30	Power Factor Correction Contactors
KM90	Pump Contactor
KM90A	Pump Contactor
KM1-1	Contactors
KM1-2	Contactors
KM1-3	Contactors
KM101	Fan Motor Contactor
KM102	Fan Motor Contactor
KM103	Fan Motor Contactor
KM105	Fan Motor Contactor
KM107	Fan Motor Contactor
KM110	Fan Motor Contactor
KM2-1	Contactors
KM2-2	Contactors
KM2-3	Contactors
KM201	Fan Motor Contactor
KM202	Fan Motor Contactor
KM203	Fan Motor Contactor
KM205	Fan Motor Contactor
KM207	Fan Motor Contactor
KM210	Fan Motor Contactor
KM3-1	Contactors
KM3-2	Contactors
KM3-3	Contactors
KM301	Fan Motor Contactor
KM302	Fan Motor Contactor
KM303	Fan Motor Contactor
KM305	Fan Motor Contactor
KM307	Fan Motor Contactor
KM310	Fan Motor Contactor
KS-1	Contactors
KS-2	Auxiliary Relay
KS-3	Auxiliary Relay

1

Item	Description
KT1-1	Delay Relay
KT1-2	Delay Relay
KT1-3	Delay Relay
KT13-1	Time Delay Relay
KT13-2	Time Delay Relay
KT13-3	Time Delay Relay
M1	Compressor 1
M2	Compressor 2
M3	Compressor 1
M101	Fan Motor
M102	Fan Motor
M103	Fan Motor
M104	Fan Motor
M105	Fan Motor
M106	Fan Motor
M107	Fan Motor
M108	Fan Motor
M109	Fan Motor
M110	Fan Motor
M201	Fan Motor
M202	Fan Motor
M203	Fan Motor
M204	Fan Motor
M205	Fan Motor
M206	Fan Motor
M207	Fan Motor
M208	Fan Motor
M209	Fan Motor
M210	Fan Motor
M301	Fan Motor
M302	Fan Motor
M303	Fan Motor
M304	Fan Motor
M305	Fan Motor
M306	Fan Motor
M307	Fan Motor
M308	Fan Motor
M309	Fan Motor
M310	Fan Motor
MOV.V	Varistor
OAT	Outside Air Temperature
OP-1	Oil Pressure Transducer Cir. 1
OP-2	Oil Pressure Transducer Cir. 2
OP-3	Oil Pressure Transducer Cir. 2
OPLA	Low Ambient
OPLA	Low Ambient
OPLA	Low Ambient
OPLA	Low Ambient
OPLA	Low Ambient
OPLA	Low Ambient
OPLA	Low Ambient
OPPF	Power Factor Correction
OPSP	Single Pump
OPTP	Twin Pump or Dual Pump
P1	Pump 1
P2	Pump 2
Q0	Unit On - Off

Item	Description
Q1	Circuit Switch 1
Q2	Circuit Switch 2
Q10	Main Switch
Q11	Emergency Stop
Q12	Automatic Circuit Breaker
Q101	Fan Circuit Breaker
Q102	Fan Circuit Breaker
Q103	Fan Circuit Breaker
Q105	Fan Circuit Breaker
Q107	Fan Circuit Breaker
Q110	Fan Circuit Breaker
Q201	Fan Circuit Breaker
Q202	Fan Circuit Breaker
Q203	Fan Circuit Breaker
Q205	Fan Circuit Breaker
Q207	Fan Circuit Breaker
Q210	Fan Circuit Breaker
Q301	Fan Circuit Breaker
Q302	Fan Circuit Breaker
Q303	Fan Circuit Breaker
Q305	Fan Circuit Breaker
Q307	Fan Circuit Breaker
Q310	Fan Circuit Breaker
QC-1	Thermal Relay
QC-2	Thermal Relay
QC-3	Thermal Relay
QP2	Pumps Choice Switch
R1	Compressor Crankcase Heater Circ. 1
R2	Compressor Crankcase Heater Circ. 2
R3	Compressor Crankcase Heater Circ. 2
R5	Evaporator Heater
SPN11	Thermal Relay
SPN11	Thermal Relay
SPN11	Thermal Relay
SPN95	Forced Ventilation
SPN15a	Variable Phase Monitor
ST-1	Suction Temperature Sensor 1
ST-2	Suction Temperature Sensor 2
ST-3	Suction Temperature Sensor 2
T1	400/115 V Transformer
T2	230 V/24 V Transformer
Tc	Termostat
U.C.	Unit Control
W1	Compressor Thermistor Circ. 1
W2	Compressor Thermistor Circ. 2
W3	Compressor Thermistor Circ. 1
Y2A-1	Loader Sol. Valve Cir. 1
Y2A-2	Loader Sol. Valve Cir. 1
Y2A-3	Loader Sol. Valve Cir. 1
Y2B-1	Loader Sol. Valve Cir. 1
Y2B-2	Loader Sol. Valve Cir. 1
Y2B-3	Loader Sol. Valve Cir. 1
Y3A-1	Unloader Sol. Valve Cir. 1
Y3A-2	Unloader Sol. Valve Cir. 1
Y3A-3	Unloader Sol. Valve Cir. 1
Y3B-1	Unloader Sol. Valve Cir. 1
Y3B-2	Unloader Sol. Valve Cir. 1

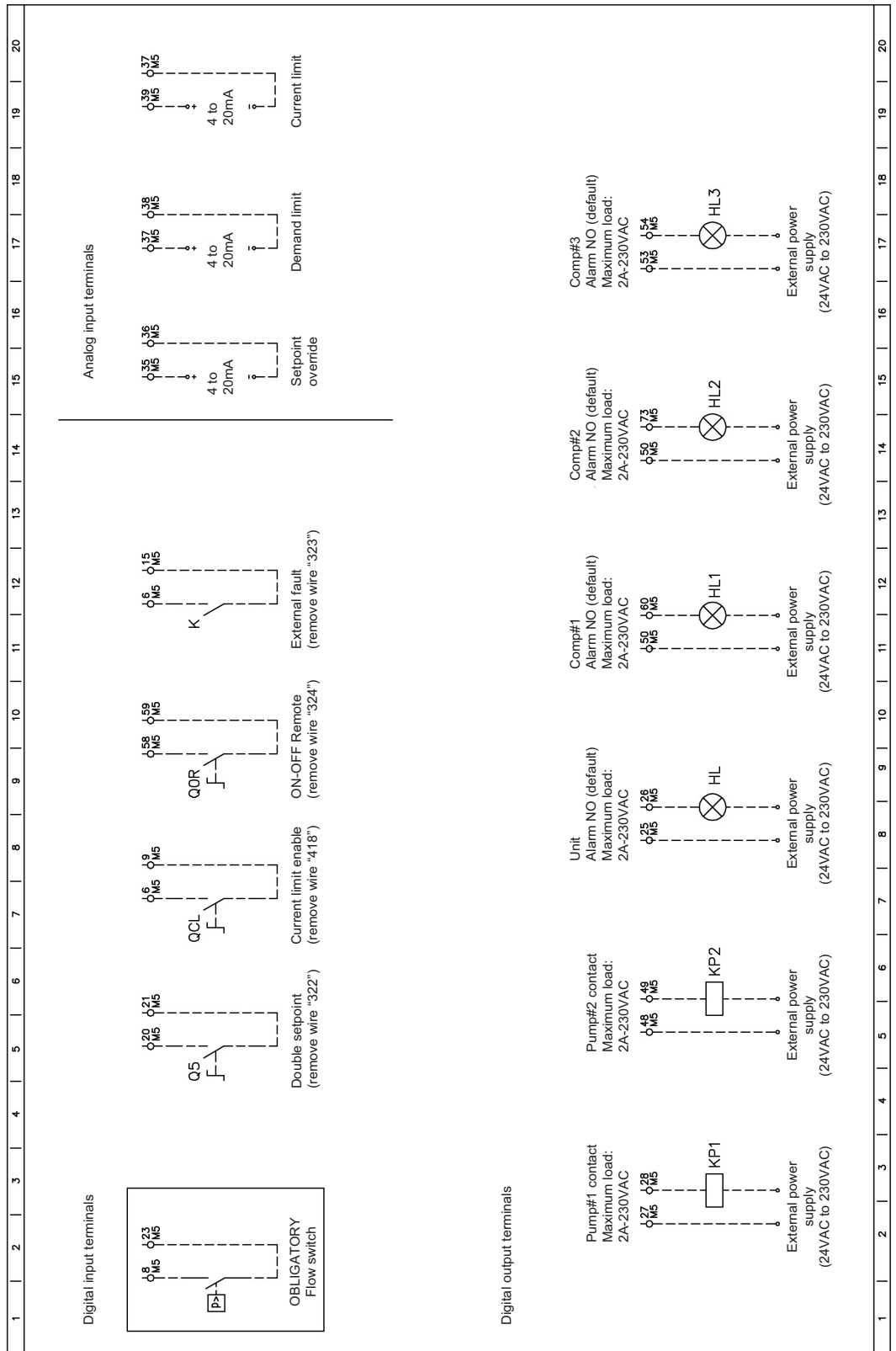
**1**

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<b>Item</b>	<b>Description</b>
Y3B-3	Unloader Sol. Valve Cir. 1
YJ-1	Oil By-Pass Solenoid Valve Circ. 1
YJ-2	Oil By-Pass Solenoid Valve Circ. 1
YJ-3	Oil By-Pass Solenoid Valve Circ. 1
YT-1	Oil By-Pass Solenoid Valve Circ. 1
YT-2	Oil By-Pass Solenoid Valve Circ. 1
YT-3	Turbo Solenoid Valve Circ. 3

---

1.36.33 Field Wiring Connection



**1**



# Part 2

## Functional Description

---

**Introduction**

This part gives more detailed information on the functions and controls of the unit. This information is used as background information for troubleshooting. An extensive overview of the functioning of the controller is also given in this part. Knowledge of the controller is essential to gather information prior to servicing and troubleshooting.

---

**What is in this part?**

This part contains the following chapters:

Chapter	See page
1–The Digital Controller	2–3
2–Functional Control	2–23

---

**2**

# 1 The Digital Controller

## 1.1 What Is in This Chapter?

---

### Introduction

This chapter gives more detailed information about the controller and the software. Understanding these functions is vital when diagnosing a malfunction, which is related to system architecture or software.

---

### Overview

This chapter contains the following topics:

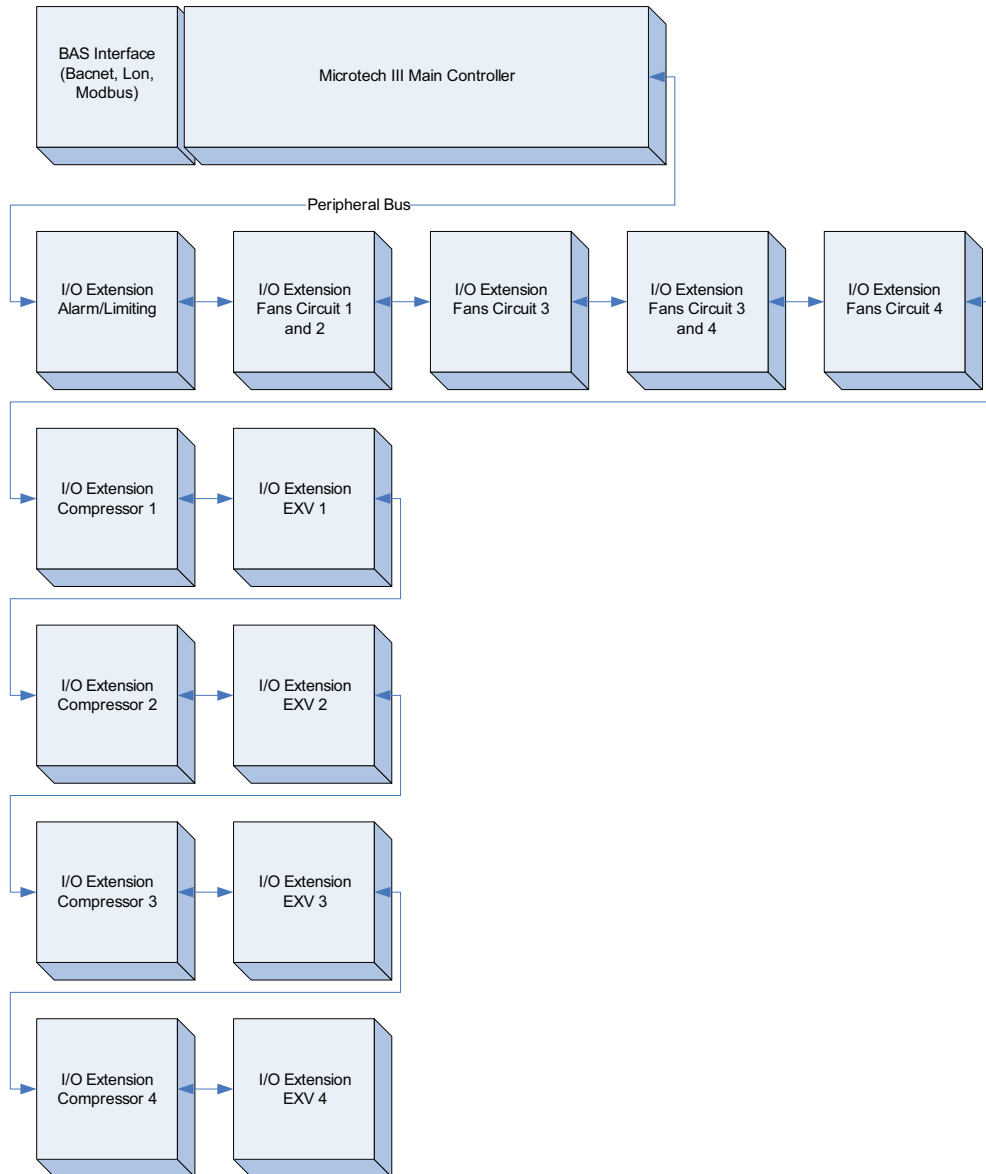
Topic	See page
1.2–System Architecture	2–4
1.3–Customer Interfaces	2–6
1.4–Display and Keypad	2–10

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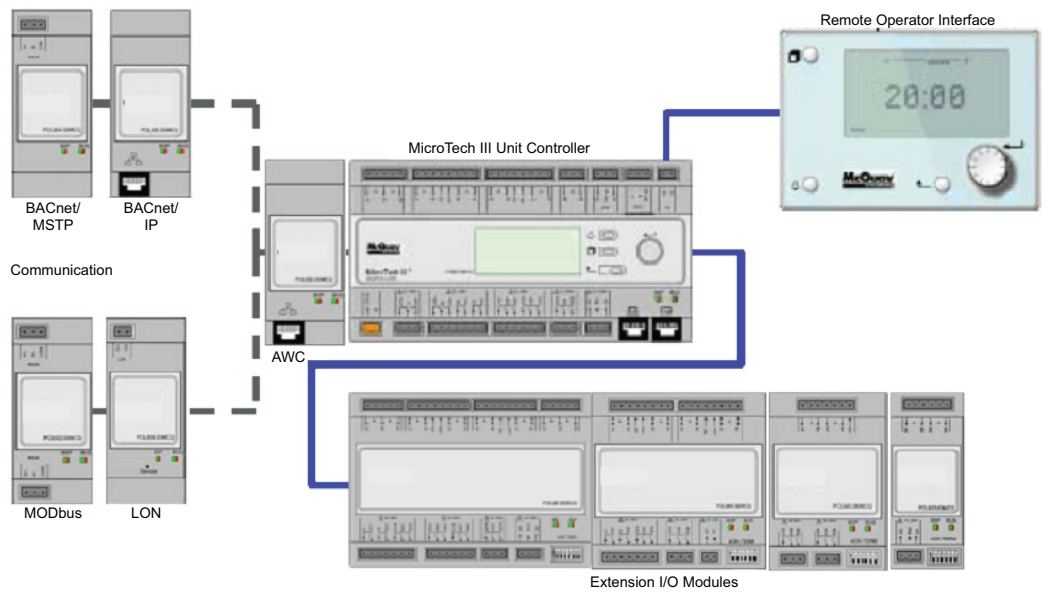
## 1.2 System Architecture

The overall controls architecture shall use the following:

- One Microtech III main controller
- I/O extensions as needed depending on the configuration of the unit
- BMS interface as selected
- All modules are connected with a BUS system throughout the unit



Configuration of chiller



2

## 1.3 Customer Interfaces

### Overview

This chapter contains the following topics:

Topic	See page
1.3.1–Control Panel	2–7
1.3.2–Addresses Used In System	2–8
1.3.3–Communication Modules	2–9

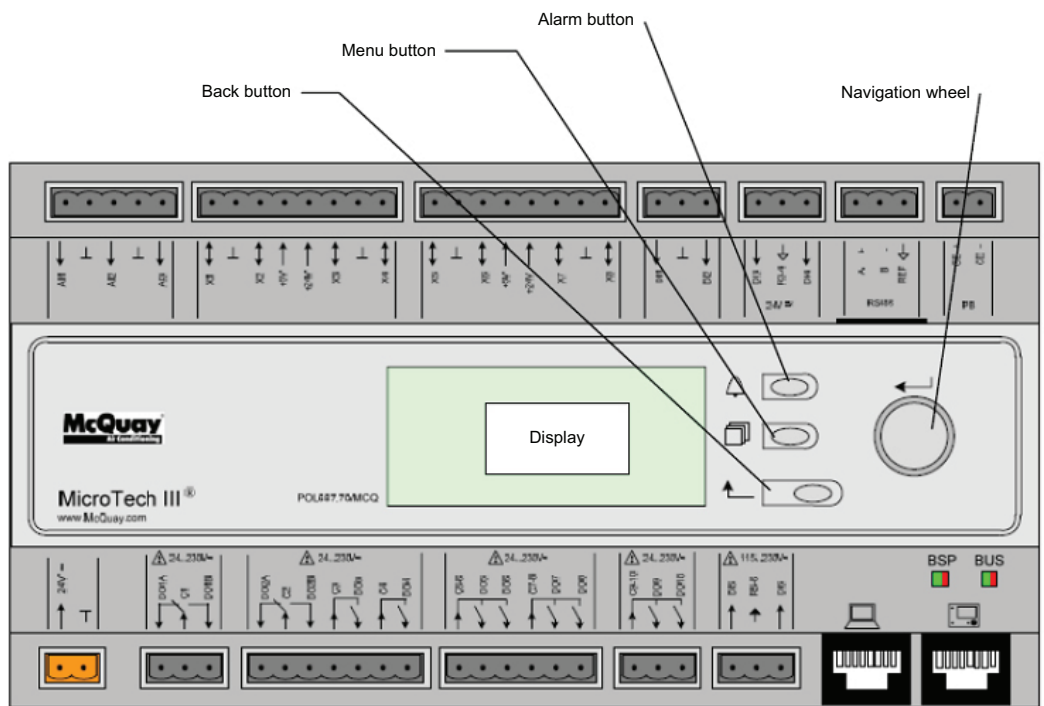
### 1.3.1 Control Panel

#### General description



2

#### Layout of controller



### 1.3.2 Addresses Used In System



Each module in the system has it's own address (mentioned in wiring diagram).

Special way to configure address:

- Do not use dipswitch 6
- Start configuring the address from dipswitch 5
- Advance from right to left

Example: address 6 means 3 and 4 ON, rest OFF.

#### Extension addressing

Peripheral bus is used to connect I/O extensions to the main controller.

Controller	Siemens Description of Expansion Boards	Address	Usage
Unit	PolyCool Controller 687.70 MCQ (UC)	n/a	Used on all configurations
Comp. #1	Ext-IO 965.00 (CC1)	2	Used on all configurations
EEXV #1	Ext-ECV (EEXV1)	3	
Comp. #2	Ext-IO 965.00 (CC2)	4	
EEXV #2	Ext-ECV (EEXV2)	5	
Fans #1&2	Ext-IO 945 (FC12)	6	Used when number of fans on circuit 1 is more than 6, number of fans on circuit 2 is more than 6, or unit has multipoint power
Comp. #3	Ext-IO 965.00 (CC3)	7	Used when configured for 3 or 4 circuits
EEXV #3	Ext-ECV (EEXV3)	8	
Fans #3	Ext-IO 945 (FC3)	9	
Comp. #4	Ext-IO 965.00 (CC4)	10	Used when configured for 4 circuits
EEXV #4	Ext-ECV (EEXV4)	11	
Fans #4	Ext-IO 945 (FC4)	12	
Fans #3&4	Ext-IO 945 (FC34)	13	Used when number of fans on circuit 3 or 4 is more than 6
Alarm/Limit	Ext-IO 965.00 (AC)	18	Used on all configurations



### 1.3.3 Communication Modules

Any of the following modules can be connected directly to the left side of the main controller to allow a BMS interface to function.

Module	Siemens Description of Expansion Boards	Usage
BacNet/IP	POL908.00/MCQ	Optional
Lon	POL906.00/MCQ	Optional
MODBUS	POL902.00/MCQ	Optional
BACnet/MSTP	POL904.00/MCQ	Optional

## 1.4 Display and Keypad

### Overview

This chapter contains the following topics:

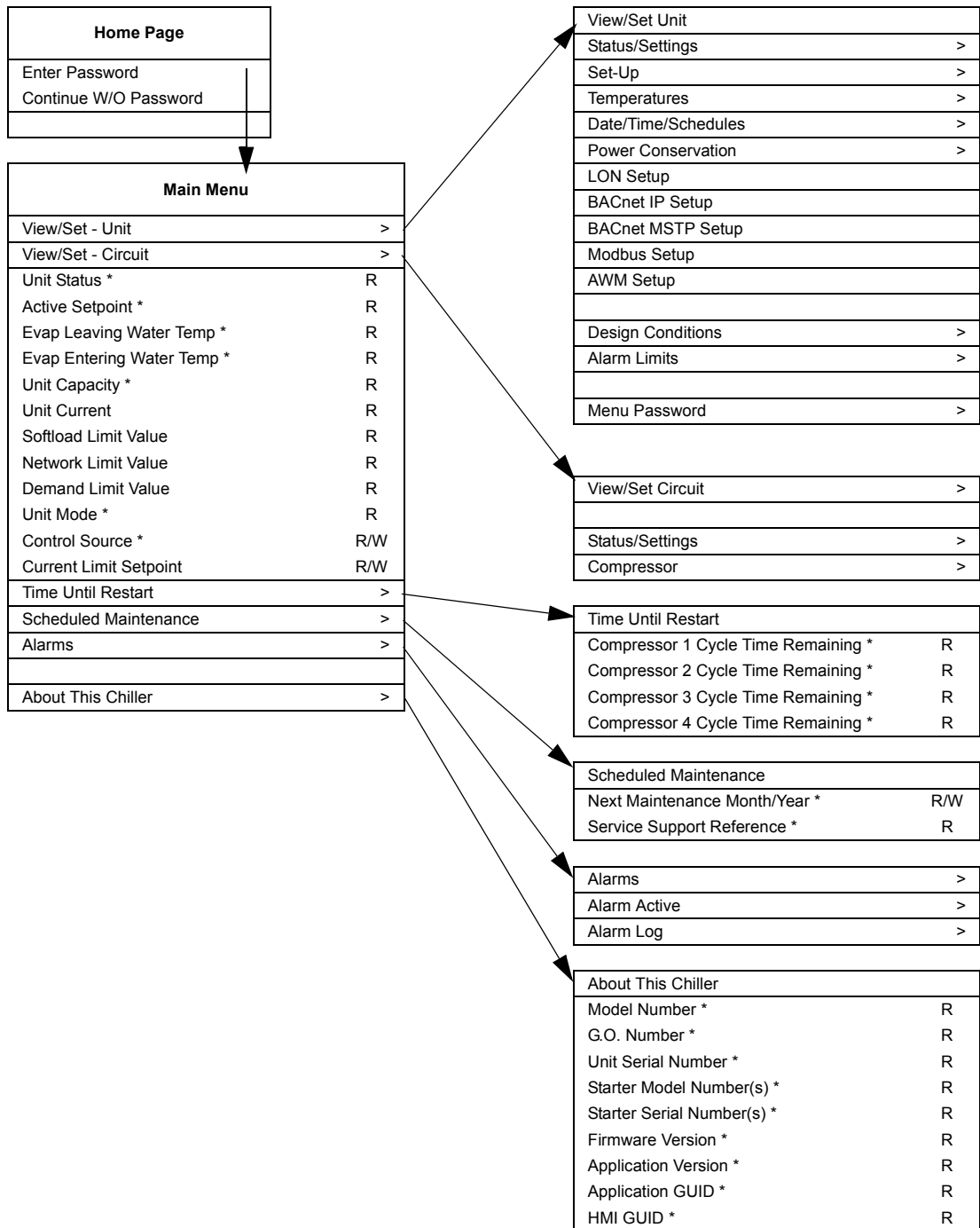
Topic	See page
1.4.1–General Description	2–11
1.4.2–Set Point	2–16

## 1.4.1 General Description

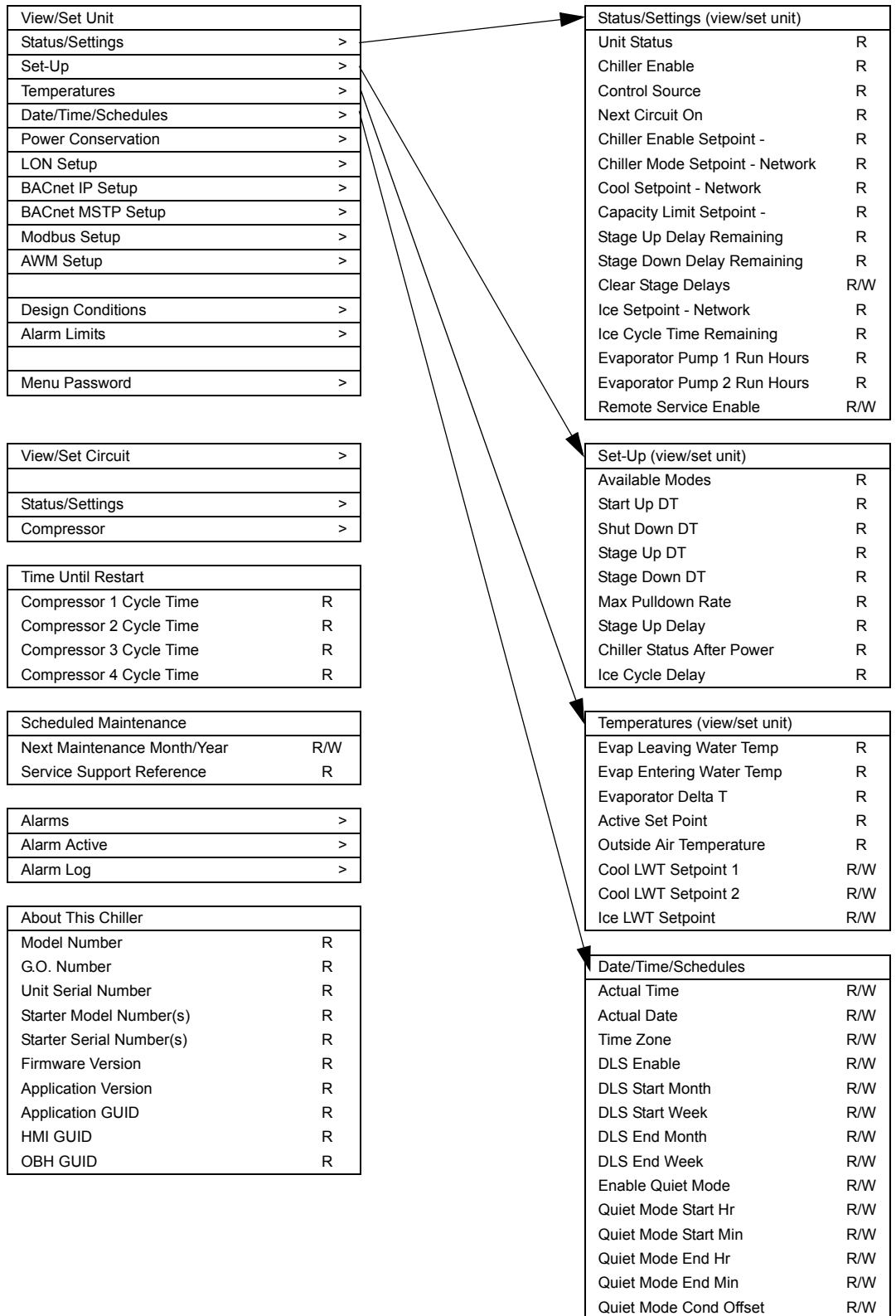
### Layout of screen

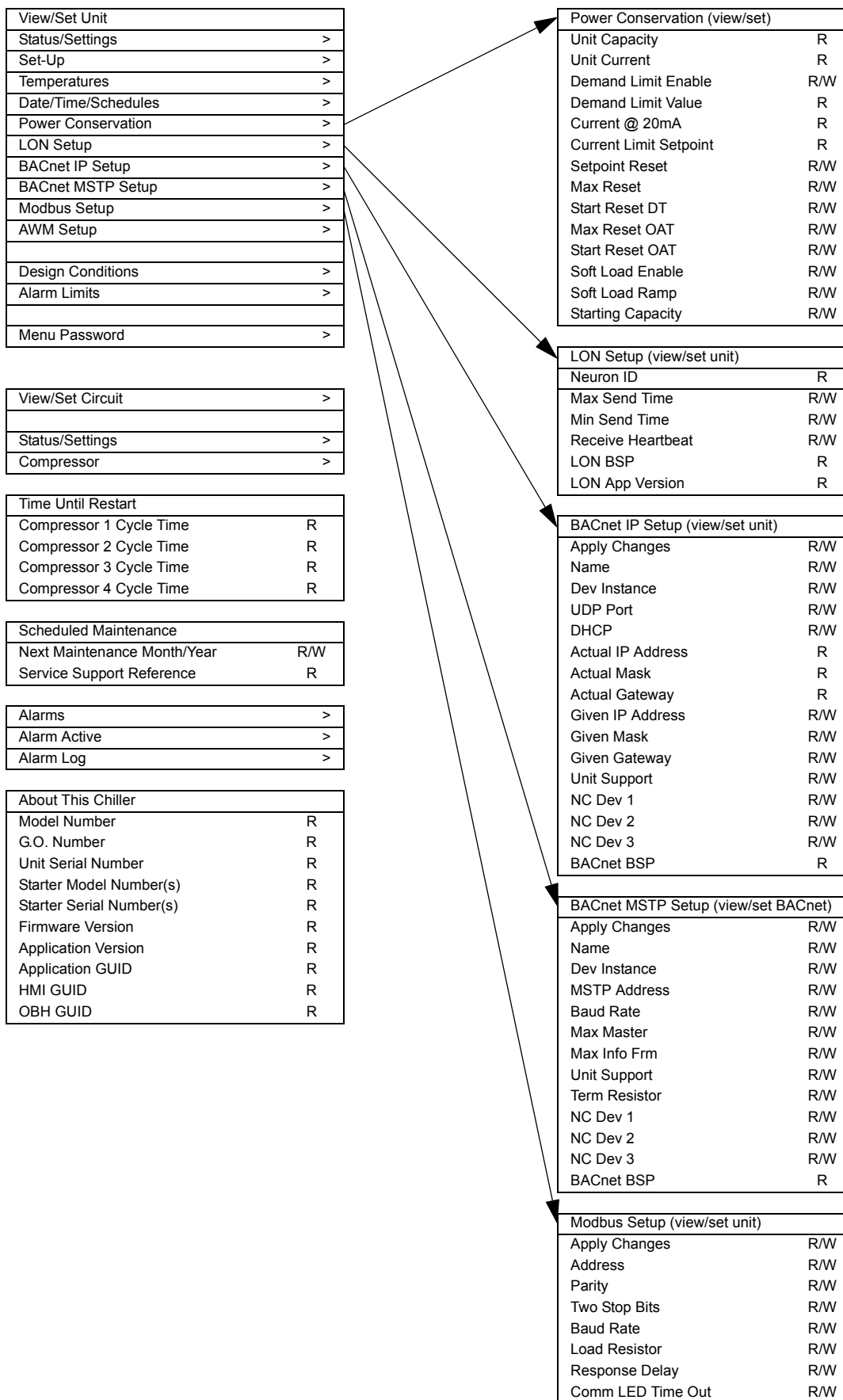
◆ b	View/Set Unit	3
	Status/Settings	>
	Set Up	>
	Temperature	>
	Date/Time/Schedule	>

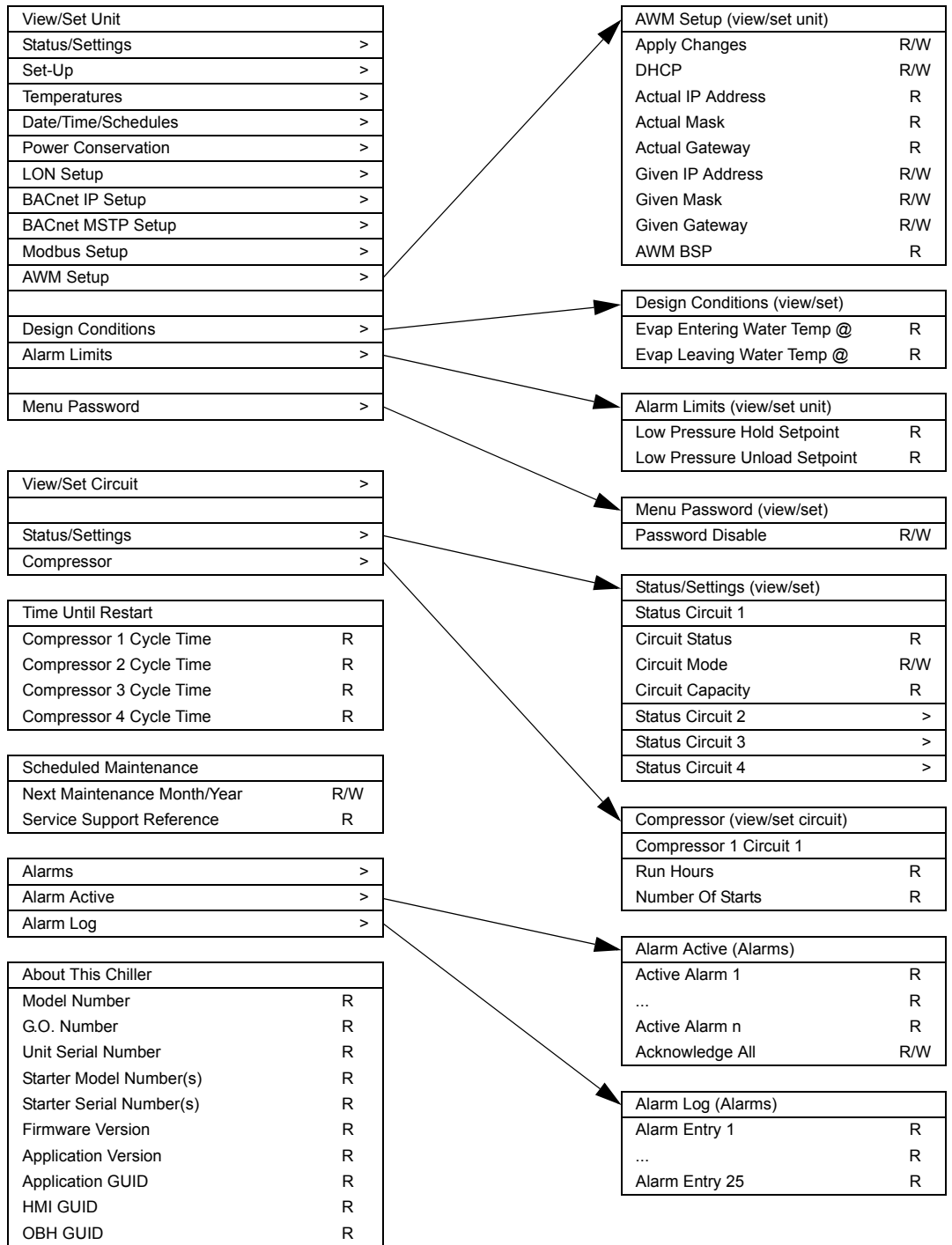
- Menu title
- A parameter (setpoint, value, ...)
- Link to further menu (arrow on right side)



**Note:** Parameters with an “\*” are available without entering a password.







## 1.4.2 Set Point

### Set point table

The following set points are remembered during power off, are factory set to the Default value, and can be adjusted to any value in the Range column.

**Warning:** These values are the default settings; however they might not be correct ones to provide a correct operation of the unit in any given situation. All parameters and settings should be checked during the commissioning by an authorized and skilled engineer.

Description	Default	Range
<i>Unit</i>	<b>SI</b>	
Manufacturing Location	Not Selected	Not Selected, Europe, USA
Unit Enable	OFF	OFF, ON
Unit Status after Power Failure	OFF	OFF, ON
Control source	Local	Local, Network
Available Modes	Cool	COOL COOL/w GLYCOL COOL/ICE w GLYCOL ICE TEST
Cool LWT 1	7°C	See auto adjusted settings
Cool LWT 2	7°C	See auto adjusted settings
Ice LWT	-4°C	-8 to 4°C
Startup Delta T	2.7°C	0 to 5°C
Shut Down Delta T	0.7°C	0 to 1.7°C
Stage Up Delta T (between compressors)	1°C	0 to 1.7°C
Stage Down Delta T (between compressors)	0.5°C	0 to 1.7°C
Max Pulldown	1.7°C/min	0.3 to 2.7°C/min
Evap Recirc Timer	30	0 to 300 seconds
Evap Control	#1 Only	#1 Only, #2 Only, Auto, #1 Primary, #2 Primary
LWT Reset Type	NONE	NONE, RETURN, 4-20mA, OAT
Max Reset	5°C	0 to 10°C
Start Reset Delta T	5°C	0 to 10°C
Start Reset OAT	23.8°C	10.0 – 29.4°C
Max Reset OAT	15.5°C	10.0 – 29.4°C
Soft Load	Off	Off, On
Begin Capacity Limit	40%	20-100%
Soft Load Ramp	20 min	1-60 minutes
Demand Limit	Off	Off, On



Current Limit	Off	Off, On
Current @ 20 mA	800 Amp	0 to 2000 Amp = 4 to 20 mA
Current limit Set Point	800 Amp	0 to 2000 Amp
# of Circuits	2	2-3-4
Ice Time Delay	12	1-23 hours
Clear Ice Timer	No	No, Yes
SSS Communication	No	No, Yes
PVM	Multi Point	Single Point, Multi Point, None (SSS)
Noise Reduction	Disabled	Disabled, Enabled
Noise Reduction Start Time	21:00	18:00 – 23:59
Noise Reduction End Time	6:00	5:00 – 9:59
Noise Reduction Condenser Offset	5°C	0.0 to 20.0°C
BMS Protocol	None	None, BACnet, LonWorks, Modbus
Ident number	1	
Baud Rate	19200	1200, 2400, 4800, 9600, 19200
Evap LWT sensor offset	0°C	-5.0 to 5.0°C
Evap EWT sensor offset	0°C	-5.0 to 5.0°C
OAT sensor offset	0°C	-5.0 to 5.0°C
<b>Compressors-Global</b>		
	<b>SI</b>	
Start-start timer	20 min	15-60 minutes
Stop-start timer	5 min	3-20 minutes
Pumpdown Pressure	100 KPA	70 to 280 KPA
Pumpdown Time Limit	120 sec	0 to 180 sec
Light Load Stg Dn Point	50%	20 to 50%
Load Stg Up Point	50%	50 to 100%
Stage Up Delay	5 min	0 to 60 min
Stage Down Delay	3 min	3 to 30 min
Stage Delay Clear	No	No, Yes
Max # Comps Running	4	1-4
Sequence # Cir 1	1	1-4
Sequence # Cir 2	1	1-4
Sequence # Cir 3	1	1-4
Sequence # Cir 4	1	1-4
Number of Pulses 10% to 50%	10	10 to 20
Slide Load Delay Minimum	30 seconds	10 to 60 seconds

Slide Load Delay Maximum	150 seconds	60 to 300 seconds
Slide Unload Delay Minimum	10 seconds	5 to 20 seconds
Slide Unload Delay Maximum	50 seconds	30 to 75 seconds
Liquid Injection Activation	85°C	75 to 90°C
Liquid Line Solenoid Valves	No	No, Yes
<b>Alarm Limits</b>		
	<b>SI</b>	
Low Evap Pressure-Unload	190 KPA	See auto adjusted settings
Low Evap Pressure-Hold	200 KPA	See auto adjusted settings
Oil Press Delay	30 sec	10-180 sec
Oil Press Differential	250 KPA	0 to 415 KPA
Low Oil Level Delay	120 sec	10 to 180 sec
High Discharge Temperat.	110°C	65 to 110°C
High Lift Pressure Delay	5 sec	0 to 30 sec
Low Pressure Ratio Delay	90 sec	30-300 sec
Start Time Limit	60 sec	20 to 180 sec
Evaporator Water Freeze	2.2°C	See auto adjusted settings
Evaporator Flow Proof	15 sec	5 to 15 sec
Recirculate Timeout	3 min	1 to 10 min
Low Ambient Lockout Enable	Disable	Disable, Enable
Low Ambient Lockout	12°C	See auto adjusted settings

The following set points exist individually for each circuit:

Description	Default	Range
	<b>SI</b>	
Circuit mode	Enable	Disable, enable, test
Compressor Size	To be Verified	
Capacity Control	Auto	Auto, Manual
Manual Capacity	See note 1 below table	0 to 100%
Clear Cycle Timers	No	No, yes
EXV control	Auto	Auto, manual
EXV position	See note 2 below table	0 to 100%
Oil Sump Check	Enable	Enable, Disable
Service Pumpdown	No	No, Yes
Evap pressure offset	0 KPA	-100 to 100 KPA

Cond pressure offset	0 KPA	-100 to 100 KPA
Oil pressure offset	0 KPA	-100 to 100 KPA
Suction temp offset	0°C	-5.0 to 5.0°C
Discharge temp offset	0°C	-5.0 to 5.0°C
<b>Fans</b>		
<i>Fans</i>	<b>SI</b>	
Fan VFD enable	On	Off, On
Number of fans	5	5 to 12
Saturated Condenser Temp Target Min	32°C	26.0 to 43.0°C
Saturated Condenser Temp Target Max	43°C	32.0 to 50°C
Fan Stage Up Deadband 0	2.5°C	1-10°C
Fan Stage Up Deadband 1	2.5°C	1-10°C
Fan Stage Up Deadband 2	4°C	1-10°C
Fan Stage Up Deadband 3	5°C	1-10°C
Fan Stage Up Deadband 4	4°C	1-10°C
Fan Stage Up Deadband 5	4°C	1-10°C
Fan Stage Down Deadband 2	4°C	1-13°C
Fan Stage Down Deadband 3	3.5°C	1-13°C
Fan Stage Down Deadband 4	3°C	1-13°C
Fan Stage Down Deadband 5	2.5°C	1-13°C
Fan Stage Down Deadband 6	2.5°C	1-13°C
VFD Max Speed	100%	90 to 110%
VFD Min Speed	25%	20 to 60%

**Note 1** - This value will follow the actual capacity while Capacity Control = Auto.

**Note 2** - This value will follow the actual EXV position while EXV Control = Auto.

**Auto adjusted ranges**

Some settings have different ranges of adjustment based on other settings.

**Cool LWT 1 and Cool LWT 2**

Available Mode Selection	Range SI
Without Glycol	4 to 15°C
With Glycol	-4 to 15°C

**Evaporator Water Freeze**

Available Mode Selection	Range SI
Without Glycol	2 to 6°C
With Glycol	-18 to 6°C

**Low Evaporator Pressure - Hold**

Available Mode Selection	Range SI
Without Glycol	195 to 310 KPA
With Glycol	0 to 310 KPA

**Low Evaporator Pressure - Unload**

Available Mode Selection	Range SI
Without Glycol	180 to 310 KPA
With Glycol	0 to 410 KPA

**Low Ambient Lockout**

Fan VFD	Range SI
= no for all circuits	2 to 15°C
= yes on any circuit	-23 to 15°C

**Dynamic default values**

The fan staging dead bands have different default values based on the vfd enable set point. When the vfd enable set point is changed, a set of default values for the fan staging dead bands is loaded as follows:

VFD is enabled		
Set Point	Default loaded	
		°C
Fan Stage Up Deadband 1		2.5
Fan Stage Up Deadband 2		4
Fan Stage Up Deadband 3		5
Fan Stage Up Deadband 4		4
Fan Stage Up Deadband 5		4
Fan Stage Down Deadband 2		4
Fan Stage Down Deadband 3		3.5
Fan Stage Down Deadband 4		3
Fan Stage Down Deadband 5		2.5
Fan Stage Down Deadband 6		2.5

VFD is disabled		
Set Point	Default loaded	
		°C
Fan Stage Up Deadband 0		4
Fan Stage Up Deadband 1		5
Fan Stage Up Deadband 2		5.5
Fan Stage Up Deadband 3		6
Fan Stage Up Deadband 4		6.5
Fan Stage Up Deadband 5		6.5
Fan Stage Down Deadband 2		10
Fan Stage Down Deadband 3		8
Fan Stage Down Deadband 4		5.5
Fan Stage Down Deadband 5		4
Fan Stage Down Deadband 6		4



**2**

## 2 Functional Control

### 2.1 What Is In This Chapter?

---

**Introduction**

This chapter will give more detailed information about the functions used to control the system. Understanding these functions is vital when diagnosing a malfunction, which is related to functional control.

---

**Overview**

This chapter contains the following topics:

Topic	See page
2.2–Unit Functions	2–24
2.3–Circuit Functions	2–40

---

## 2.2 Unit Functions

### Overview

This chapter contains the following topics:

Topic	See page
2.2.1–Unit Enable	2–25
2.2.2–Unit Mode Selection	2–26
2.2.3–Unit Control States	2–27
2.2.4–Unit Status	2–28
2.2.5–Ice Mode Start Delay	2–29
2.2.6–Evaporator Pump Control	2–30
2.2.7–Noise Reduction	2–31
2.2.8–LWT Target	2–32
2.2.9–Unit Capacity Control	2–35
2.2.10–Unit Capacity Overrides	2–38



**2.2.1 Unit Enable**

There are different ways to start and stop a unit. Enabling and disabling the chiller is accomplished using set points and inputs to the chiller. The unit switch, remote switch input, and Unit Enable Set Point all are required to be 'on' for the unit to be enabled when the control source is set to 'local'. The same is true if the control source is set to 'network', with the additional requirement that the BMS request must be 'on'.

Unit is enabled according to the following table.

**Note:** An "x" indicates that the value is ignored.

Unit Switch	Control Source Set Point	Remote Switch Input	Unit Enable Set Point	BMS Request	Unit Enable
Off	x	x	x	x	Off
x	x	x	Off	x	Off
x	x	Off	x	x	Off
On	Local	On	On	x	On
x	Network	x	x	Off	Off
On	Network	On	On	On	On

All these normal methods for disabling the chiller (no alarms) should cause a normal shutdown, discussed later on, of any running circuits.

When the controller is powered up, the Unit Enable Set Point should be initialized to 'off' if the Unit Status After Power Failure Set Point is set to 'off'.



**2.2.2 Unit Mode Selection**

2

The operating mode of the unit is determined by set points and inputs to the chiller. The Available Modes Set Point determines what modes of operation can be used. This set point also determines whether the unit is configured for glycol use. The Control Source Set Point determines where a command to change modes will come from. A digital input switches between cool mode and ice mode if they are available and the control source is set to 'local'. The BMS mode request switches between cool mode and ice mode if they are both available and the control source is set to 'network'.

The Available Modes Set Point should only be changeable when the unit switch is off. This is to avoid changing modes of operation inadvertently while the chiller is running.

Unit Mode is set according to the following table.

**Note:** An "x" indicates that the value is ignored.

Control Source Set Point	Mode Cool/Ice Input	BMS Cool/Ice Request	Available Modes Set Point	Unit Mode
x	x	x	Cool	Cool
x	x	x	Cool w/Glycol	Cool
Local	Off	x	Cool/Ice w/Glycol	Cool
Local	On	x	Cool/Ice w/Glycol	Ice
Network	x	Cool	Cool/Ice w/Glycol	Cool
Network	x	Ice	Cool/Ice w/Glycol	Ice
x	x	x	Ice w/Glycol	Ice

**Glycol Configuration**

If the Available Modes Set Point is set to an option 'w/Glycol', then glycol operation should be enabled for the unit. Glycol operation should only be disabled when the Available Modes Set Point is set to 'Cool'.

### 2.2.3 Unit Control States

---

The unit will always be in one of three states:

- Off – Unit is not enabled to run.
- Auto – Unit is enabled to run.
- Pumpdown – Unit is doing a normal shutdown.

The unit should be in the Off state if any of the following are true:

- A manual reset unit alarm is active.
- All circuits are unavailable to start (cannot start even after any cycle timers have expired).
- The unit mode is ice, all circuits are off, and the ice mode delay is active.

The unit should be in the Auto state if any of the following are true:

- Unit enabled based on settings and switches.
- If unit mode is ice, the ice timer has expired.
- No manual reset unit alarms are active.
- At least one circuit is enabled and available to start.
- Low OAT Lockout is not active.

The unit should be in Pumpdown until all running compressors finish pumping down if any of the following are true:

- Unit is disabled via settings and/or inputs.
  - Low OAT Lockout is triggered.
-

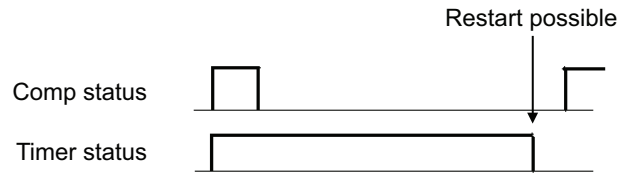
## 2.2.4 Unit Status

The displayed unit status is determined by the conditions in the following table:

Enum	Status	Conditions
0	Auto	Unit State = Auto
1	Off:Ice Mode Timer	Unit State = Off, Unit Mode = Ice, and Ice Delay = Active
2	Off:OAT Lockout	Unit State = Off and Low OAT Lockout is active
3	Off:All Cir Disabled	Unit State = Off and all compressors unavailable
4	Off:Emergency Stop	Unit State = Off and Emergency Stop Input is open
5	Off:Unit Alarm	Unit State = Off and Unit Alarm active
6	Off:Keypad Disable	Unit State = Off and Unit Enable Set Point = Disable
7	Off:Remote Switch	Unit State = Off and Remote Switch is open
8	Off:BMS Disable	Unit State = Off, Control Source = Network, and BMS Enable = false
9	Off:Unit Switch	Unit State = Off and Unit Switch = Disable
10	Off:Test Mode	Unit State = Off and Unit Mode = Test
11	Auto:Noise Reduction	Unit State = Auto and Noise Reduction is active
12	Auto:Wait for load	Unit State = Auto, no circuits running, and LWT is less than the active set point + startup delta
13	Auto:Evap Recirc	Unit State = Auto and Evaporator State = Start
14	Auto:Wait for flow	Unit State = Auto, Evaporator State = Start, and Flow Switch is open
15	Auto:Pumpdown	Unit State = Pumpdown
16	Auto:Max Pulldown	Unit State = Auto, max pulldown rate has been met or exceeded
17	Auto:Unit Cap Limit	Unit State = Auto, unit capacity limit has been met or exceeded
18	Auto:Current Limit	Unit State = Auto, unit current limit has been met or exceeded

2.2.5 Ice Mode Start Delay

An adjustable start to start ice delay timer will limit the frequency with which the chiller may start in Ice mode. The timer starts when the first compressor starts while the unit is in ice mode. While this timer is active, the chiller cannot restart in Ice mode. The time delay is user adjustable.



The ice delay timer may be manually cleared to force a restart in ice mode. A set point specifically for clearing the ice mode delay is available. In addition, cycling the power to the controller should clear the ice delay timer.

## 2.2.6 Evaporator Pump Control

---

For control of the evaporator pumps, three evaporator pump control states are possible:

- Off – No pump on.
- Start – Pump is on, water loop is being recirculated.
- Run – Pump is on, water loop has been recirculated.

The control state is Off when all of the following are true:

- Unit state is Off.
- LWT is less than the Evap Freeze set point or LWT sensor fault is active.
- EWT is less than the Evap Freeze set point or EWT sensor fault is active.

The control state is Start when any of the following are true:

- The unit state is auto.
- LWT is higher than the Evap Freeze set point plus 0.6°C and LWT sensor fault isn't active.
- EWT is higher than the Evap Freeze set point plus 0.6°C and EWT sensor fault isn't active.

The control state should be Run when the flow switch input has been closed for a time greater than the Evaporator Recirculate time.

### Pump selection

---

The pump output used will be determined by the Evap Pump Control set point. This setting allows the following configurations:

- #1 only – Pump 1 will always be used.
  - #2 only – Pump 2 will always be used.
  - Auto – The primary pump is the one with the least run hours, the other is used as a backup.
  - #1 Primary – Pump 1 is used normally, with pump 2 as a backup.
  - #2 Primary – Pump 2 is used normally, with pump 1 as a backup.
  
  - Primary/Standby Pump Staging  
The pump designated as primary will start first. If the evaporator state is start for a time greater than the recirculate timeout timer and there is no flow, then the primary pump will shut off and the standby pump will start. When the evaporator is in the run state, if flow is lost for more than half of the flow proof set point value, the primary pump will shut off and the standby pump will start. Once the standby pump is started, the flow loss alarm logic will apply if flow cannot be established in the evaporator start state, or if flow is lost in the evaporator run state.
  - Auto Control  
If auto pump control is selected, the primary/standby logic above is still used. When the evaporator is not in the run state, the run hours of the pumps will be compared. The pump with the least hours will be designated as the primary at this time.
-

## 2.2.7 Noise Reduction

---

Noise Reduction should be enabled only when the Noise Reduction set point is 'enable'. Noise Reduction is in effect when enabled via the set point, the unit mode is cool, and the unit controller clock time is between the Noise Reduction start time and end time.

When Noise Reduction is in effect, the Maximum Reset is applied to the cool LWT set point. However, if any reset type is selected, that reset will continue to be used rather than the maximum reset. Also, the saturated condenser target for each circuit will be offset by the Noise Reduction Condenser Target Offset.

---

2.2.8 LWT Target

The LWT Target varies based on settings and inputs.

The base LWT Target is selected as follows:

Control Source Set Point	Mode Input	BMS Request	Available Modes Set Point	Base LWT Target
Local	OFF	X	COOL	Cool Set Point 1
Local	ON	X	COOL	Cool Set Point 2
Network	X	X	COOL	BMS Cool Set Point
Local	OFF	X	COOL w/Glycol	Cool Set Point 1
Local	ON	X	COOL w/Glycol	Cool Set Point 2
Network	X	X	COOL w/Glycol	BMS Cool Set Point
Local	OFF	x	COOL/ICE w/Glycol	Cool Set Point 1
Local	ON	x	COOL/ICE w/Glycol	Ice Set Point
Network	x	COOL	COOL/ICE w/Glycol	BMS Cool Set Point
Network	x	ICE	COOL/ICE w/Glycol	BMS Ice Set Point
Local	x	x	ICE w/Glycol	Ice Set Point
Network	x	x	ICE w/Glycol	BMS Ice Set Point

Leaving water temperature (LWT) reset

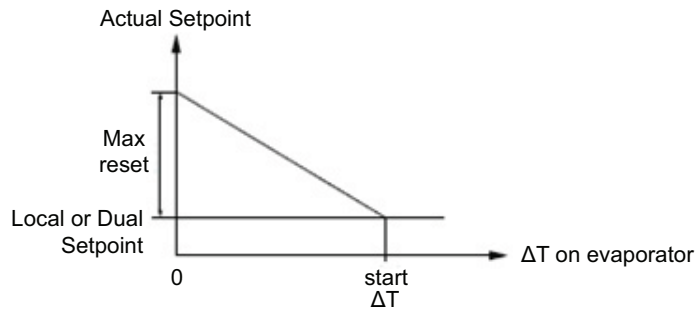
The base LWT target may be reset if the unit is in Cool mode and it is configured for a reset. The type of reset to be used is determined by the LWT Reset Type set point.

When the active reset increases, the Active LWT Target is changed at a rate of 0.1°F every 10 seconds. When the active reset decreases, the Active LWT Target is changed all at once.

After resets are applied, the LWT target can never exceed a value of 60°F.

- Reset Type – None  
The Active Leaving Water variable is set equal to the current LWT set point.
- Reset Type – Return  
**Introduction:** When return water is selected as the reset mode, the controller will adjust the leaving chilled water setpoint to maintain a constant return water temperature equal to the return water setpoint. The return water temperature is sampled every 5 minutes and a proportional correction is made to the leaving chilled water setpoint. The corrected leaving water setpoint is never set to a value greater than the return water setpoint and is never set to a value less than the actual leaving chilled water setpoint.  
**Function description**  
**Remark:** When the unit is designed for a ΔT of 5°C (at 100% capacity), then the start ΔT and Max Reset should also be set to 5°C.  
**Explanation:** The return water reset will adjust the leaving chilled water setpoint according to the evaporator ΔT. In this way the chiller can maintain a constant return water temperature.



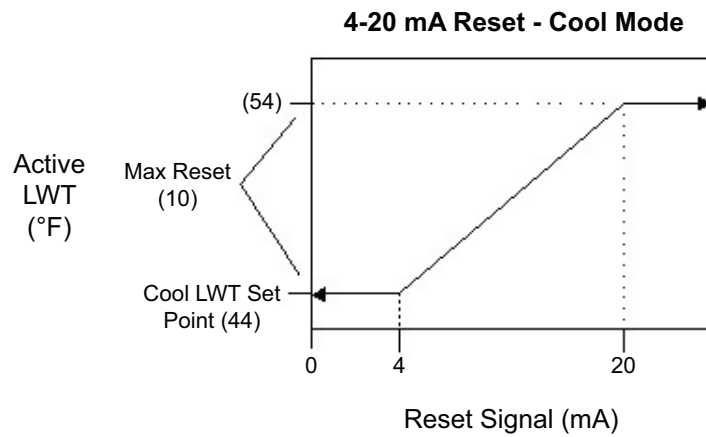


- **Reset Type – 4-20 mA**  
The Active Leaving Water variable is adjusted by the 4 to 20 mA reset analog input.

Parameters used:

1. Cool LWT set point.
2. Max Reset set point.
3. LWT Reset signal.

Reset is 0 if the reset signal is less than or equal to 4 mA. Reset is equal to the Max Reset Delta T set point if the reset signal equals or exceeds 20 mA. The amount of reset will vary linearly between these extremes if the reset signal is between 4 mA and 20 mA. An example of the operation of 4-20 reset in Cool mode is shown below.

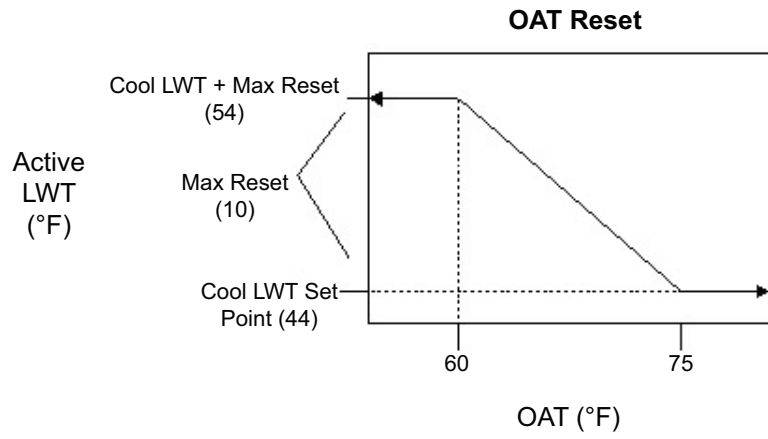


- **Reset Type – OAT**  
The Active Leaving Water variable is reset based on the outdoor ambient temperature. Parameters used:

  1. Cool LWT set point.
  2. Max Reset set point.
  3. OAT.

Reset is 0 if the outdoor ambient temperature is greater than Start Reset OAT set point. From Start Reset OAT set point down to Max Reset OAT the reset varies linearly from no reset to the max reset at Max Reset OAT set point. At ambient temperatures less than Max Reset OAT set point, reset is equal to the Max Reset set point.

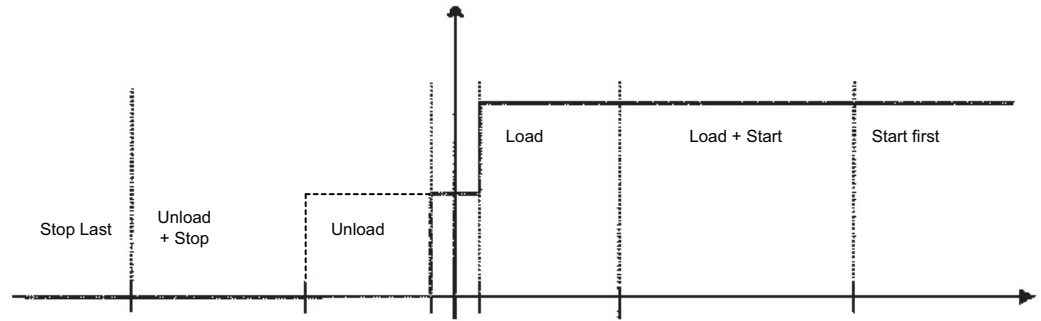
2



### 2.2.9 Unit Capacity Control

Unit capacity control will be performed as described in this section. All unit capacity limits described in following sections must be applied as described.

#### Compressor staging in cool mode



The first compressor on the unit should be started when evaporator LWT is higher than the target plus the Startup Delta T set point.

An additional compressor should be started when Evaporator LWT is higher than the target plus the Stage Up Delta T set point.

When multiple compressors are running, one should shut down if evaporator LWT is lower than the target minus the Stage down Delta T set point.

The last compressor running should shut down when the evaporator LWT is lower than the target minus the Shut Down Delta T set point.

- **Stage Up Delay**  
A minimum amount of time should pass between compressors starting, which is defined by the Stage Up Delay set point. This delay should only apply when at least one compressor is running. If the first compressor starts and quickly fails on an alarm, another compressor may start without this minimum time passing.

For units in Ice mode, a fixed stage up delay of one minute between compressor starts should be used in this mode. When at least one compressor is running, the other compressors should start as quickly as possible with respect to the stage up delay.

- **Required Load for Stage Up**  
An additional compressor should not be started until all running compressors are at a capacity higher than the Load Stage Up set point, or running in a limited state.
- **Light Load Stage Down**  
When multiple compressors are running, one should shut down if all running compressors are at a capacity lower than the Load Stage Down set point and the evaporator LWT is less than the target plus the Stage Up Delta T set point. A minimum amount of time should pass between compressors stopping as a result of this logic, which is defined by the Stage Down Delay set point.
- **Maximum Circuits Running**  
If the number of compressors running is equal to the Max Circuits Running set point, no additional compressors should be started.

When multiple compressors are running, one should shut down if the number of compressors running is more than the Max Circuits Running set point.

**Staging sequence**

This section defines which compressor is the next one to start or stop. In general, compressors with fewer starts will normally start first, and compressors with more run hours will normally stop first. Compressor staging sequence can also be determined by an operator defined sequence via set points.

**■ Next To Start**

The next compressor to start must meet the following requirements:

Lowest sequence number of those compressors available to start:

- If sequence numbers are equal, it must have the least starts.
- If starts are equal, it must have least run hours.
- If run hours are equal, it must be the lowest numbered compressor.

**■ Next To Stop**

The next compressor to shut down must meet the following requirements:

Lowest sequence number of the compressors that are running:

- If sequence numbers are equal, it must have the most run hours.
- If run hours are equal, it must be the lowest numbered compressor.

**Compressor capacity control in cool mode**

In Cool mode, evaporator LWT is controlled to within 0.2°C of the target under constant flow conditions by controlling capacity of the individual compressors.

Compressors are loaded with a fixed step scheme. The rate of capacity adjustment should be determined by the time between capacity changes. The farther away from the target, the faster compressors will be loaded or unloaded.

The logic should project ahead to avoid overshoot, such that the overshoot does not cause the unit to shut off due to evaporator LWT dropping below the target minus the Shutdown Delta T set point while there is still a load on the loop at least equal to the minimum unit capacity.

Capacity of the compressors should be controlled so that when possible their capacities are balanced.

Circuits that are running in manual capacity control or running with active capacity limiting events should not be considered in the capacity control logic.

The compressor capacities should be adjusted one at a time while maintaining a capacity imbalance that does not exceed 12.5%.

---

**Load/unload sequence**

This section defines which compressor is the next one to load or unload.

- Next To Load

The next compressor to load must meet the following requirements:

Lowest capacity of the running compressors that can load up:

- If capacities are equal, it must have the highest sequence number of the compressors that are running.
- If the sequence numbers are equal, it must have the least run hours.
- If run hours are equal, it must have the most starts.
- If starts are equal, it must be the highest numbered compressor.

- Next To Unload

The next compressor to unload must meet the following requirements:

Highest capacity of the running compressors:

- If capacities are equal, it must have the lowest sequence number of the compressors that are running.
- If sequence numbers are equal, it must have the most run hours.
- If run hours are equal, it must have the least starts.
- If starts are equal, it must be the lowest numbered compressor.

---

**Compressor capacity control in ice mode**

In Ice mode, running compressors shall be loaded up simultaneously at the maximum possible rate that allows for stable operation of the individual circuits.

---

## 2.2.10 Unit Capacity Overrides

Unit capacity limits can be used to limit total unit capacity in Cool mode only. Multiple limits may be active at any time, and the lowest limit is always used in the unit capacity control.

Soft load, demand limit, and network limit should use a deadband around the actual limit value, such that unit capacity increase is not allowed within this deadband. If unit capacity is above the deadband, capacity should be decreased until it is back within the deadband.

- For 2 circuit units, the deadband should be 7%.
- For 3 circuit units, the deadband should be 5%.
- For 4 circuit units, the deadband should be 4%.

### Soft load

Soft Loading is a configurable function used to ramp up the unit capacity over a given time. The set points that control this function are:

- Soft Load - (ON/OFF).
- Begin Capacity Limit - (Unit %).
- Soft Load Ramp - (seconds).

The Soft Load Unit Limit increases linearly from the Begin Capacity Limit set-point to 100% over the amount of time specified by the Soft Load Ramp set-point. If the option is turned off, the soft load limit is set to 100%.

### Demand limit

The maximum unit capacity can be limited by a 4 to 20 mA signal on the Demand Limit analog input at the unit controller. This function is only enabled if the Demand Limit set point is set to ON.

As the signal varies from 4 mA up to 20 mA, the maximum unit capacity changes by steps of 1% from 100% to 0%. The unit capacity shall be adjusted as needed to meet this limit, except that the last running compressor cannot be turned off to meet a limit lower than the minimum unit capacity.

### Network limit

The maximum unit capacity can be limited by a network signal. This function is only enabled if the unit control source is set to network. The signal will be received through the BMS interface on the unit controller.

As the signal varies from 0% up to 100%, the maximum unit capacity changes from 0% to 100%. The unit capacity shall be adjusted as needed to meet this limit, except that the last running compressor cannot be turned off to meet a limit lower than the minimum unit capacity.

### Current limit

Current Limit control is enabled only when the current limit enable input is closed.

Unit current will be calculated based on the 4-20 mA input that receives a signal from an external device. The current at 4 mA is assumed to be 0, and the current at 20 mA is defined by a set point. As the signal varies from 4 to 20 mA, the calculated unit current varies linearly from 0 amps to the amp value defined by the set point.

The current limit should use a deadband centered around the actual limit value, such that unit capacity increase is not allowed when current is within this deadband. If unit current is above the deadband, capacity should be decreased until it is back within the deadband. The current limit deadband should be 10% of the current limit.

### Maximum LWT pulldown rate

The maximum rate at which the leaving water temperature can drop shall be limited by the Maximum Rate set point, only when the LWT is less than 15°C.

If the pulldown rate is too fast, the unit capacity will be reduced until the rate is less than the Maximum Pulldown Rate set point.

---

**High water  
temperature  
capacity limit**

If the evaporator LWT exceeds 18°C, compressor load shall be limited to a maximum of 75%. Compressors shall unload to 75% or less if running at greater than 75% load when the LWT exceeds the limit. This feature is to keep the circuit running within the capacity of the condenser coil. A dead-band placed below the limit set-point will be used to increase function stability. If the actual capacity is in the band, unit loading will be inhibited.

---

## 2.3 Circuit Functions

### Overview

This chapter contains the following topics:

Topic	See page
2.3.1–Circuit Control Logic	2–41
2.3.2–Circuit Status	2–43
2.3.3–Compressor Control	2–44
2.3.4–Condenser Fan Control	2–46
2.3.5–EXV Control	2–48
2.3.6–Economizer Control	2–50
2.3.7–Liquid Injection	2–51



### 2.3.1 Circuit Control Logic

#### Circuit availability

A circuit should be available to start if the following conditions are true:

- Circuit switch is closed.
- No circuit alarms are active.
- Circuit Mode set point is set to Enable.
- BMS Circuit Mode set point is set to Auto.
- No cycle timers are active.
- Discharge Temperature is at least 5°C higher than Oil Saturated Temperature.

#### Starting

The circuit should start if all these conditions are true:

- Adequate pressure in the evaporator and condenser (see No Pressure At Start Alarm).
- Circuit Switch is closed.
- Circuit Mode set point is set to Enable.
- BMS Circuit Mode set point is set to Auto.
- No cycle timers are active.
- No alarms are active.
- Staging logic requires this circuit to start.
- Unit state is Auto.
- Evaporator pump state is Run.

- Circuit Startup Logic

Circuit startup is the time period following the starting of the compressor on a circuit. During the startup, the low evaporator pressure alarm logic should be ignored. When the compressor has been running at least 20 seconds and the evaporator pressure rises above the low evaporator pressure unload set point, the startup is complete.

If the pressure does not rise above the unload set point and the circuit has been running longer than the Startup Time set point, then the circuit should be turned off and an alarm triggered. If the evaporator pressure drops below the absolute low pressure limit then the circuit should be turned off and the same alarm triggered.

- Low OAT Restart Logic

Low OAT restart logic allows multiple start attempts in low ambient conditions. If the condenser saturated temperature is less than 60 F when the compressor starts, the startup is considered to be a 'low OAT start'. If a low OAT start is not successful the circuit shall shut down, but no alarm should be triggered for the first two attempts of the day. If a third low OAT start attempt fails, then the circuit should shut down and the Low OAT Restart Alarm should be triggered.

The restart counter should be reset when either a startup is successful, the Low OAT Restart alarm is triggered, or the unit time clock shows that a new day has started.

## Stopping

### ■ Normal Shutdown

A normal shutdown requires the circuit to pumpdown before the compressor is turned off. This is to be done by closing the EXV, and closing the liquid line solenoid (if present) while the compressor is running.

The circuit should do a normal shutdown (pumpdown) if any of the following are true:

- Staging logic requires this circuit to stop.
- Unit State is Pumpdown.
- A pumpdown alarm occurs on the circuit.
- Circuit switch is open.
- Circuit Mode set point is set to Disable.
- BMS Circuit Mode set point is set to Off.

The normal shutdown is complete when any of the following are true:

- Evaporator Pressure is less than the Pumpdown Pressure set point.
- Circuit has been pumping down for longer than the Pumpdown Time Limit set point.

### ■ Rapid Shutdown

A rapid shutdown requires the compressor to stop and the circuit to go to the Off state immediately.

The circuit should do a rapid shutdown if either of these conditions occur at any time:

- Unit State is Off.
- A rapid stop alarm occurs on the circuit.

### 2.3.2 Circuit Status

The displayed circuit status should be determined by the conditions in the following table:

Enum	Status	Conditions
0	Off:Ready	Circuit is ready to start when needed.
1	Off:Stage Up Delay	Circuit is off and cannot start due to stage up delay.
2	Off:Cycle Timer	Circuit is off and cannot start due to active cycle timer.
3	Off:Keypad Disable	Circuit is off and cannot start due to keypad disable.
4	Off:Circuit Switch	Circuit is off and circuit switch is off.
5	Off:Refr In Oil Sump	Circuit is off and Discharge Temperature – Oil Saturated Temperature at gas pressure $\leq 5^{\circ}\text{C}$
6	Off:Alarm	Circuit is off and cannot start due to active circuit alarm.
7	Off:Test Mode	Circuit is in test mode.
8	EXV Preopen	Circuit is in preopen state.
9	Run:Pumpdown	Circuit is in pumpdown state.
10	Run:Normal	Circuit is in run state and running normally.
11	Run:Disc SH Low	Circuit is running and cannot load due to low discharge superheat.
12	Run:Evap Press Low	Circuit is running and cannot load due to low evaporator pressure.
13	Run:Cond Press High	Circuit is running and cannot load due to high condenser pressure.

### 2.3.3 Compressor Control

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The compressor should run only when the circuit is in a run or pumpdown state. This means the compressor should not be running any time the circuit is off or preopening the EXV.

---

#### Cycle timers

A minimum time between starts of the compressor and a minimum time between shutdown and start of the compressor shall be enforced. The time values are set by global circuit set points.

These cycle timers shall be enforced even through cycling of power to the chiller.

---

#### Compressor run timer

When a compressor starts, a timer will start and run as long as the compressor runs. This timer is used in the alarm log.

---

#### Compressor capacity control

After starting, the compressor should be unloaded to the minimum physical capacity and no attempt to increase compressor capacity should be made until the differential between evaporator pressure and oil pressure meets a minimum value.

After the minimum differential pressure is met, compressor capacity shall be controlled to 25%.

- Auto Capacity Control

Changes to capacity shall be performed as needed to meet unit capacity requirements (see unit capacity control section).

Capacity shall not be increased above 25% until discharge superheat has been at least 22°F for a time of at least 30 seconds.

- Manual capacity control

The capacity of the compressor may be controlled manually. Manual capacity control is to be enabled via a set point with choices of auto or manual. Another set point should allow setting the compressor capacity from 25% to 100%.

Capacity control shall revert back to automatic control if either:

- The circuit shuts down for any reason.
- Capacity control has been set to manual for four hours.

- Slide Control Solenoids

The required capacity should be achieved by controlling one modulating slide and one non-modulating slide. The modulating slide can control 10% to 50% of the total compressor capacity, infinitely variable. The non-modulating slide can control either 0% or 50% of the total compressor capacity.

Either the load or the unload solenoid for the non-modulating slide should be on any time the compressor is running. For compressor capacity from 10% up to 50%, the non-modulating slide unload solenoid should be on to keep that slide in the unloaded position. For capacity from 60% to 100%, the non-modulating slide load solenoid should be on to keep that slide in the loaded position.

The modulating slide should be moved via pulsing of the load and unload solenoids to achieve the required capacity.

An additional solenoid should be controlled to assist in moving the modulating slide in certain conditions. This solenoid should be activated when the pressure ratio (condenser pressure divided by evaporator pressure) is less than or equal to 1.2 for at least 5 seconds. It should be deactivated when pressure ratio is more than 1.2.

**Capacity overrides -  
limits of operation**

---

The following conditions shall override automatic capacity control when the chiller is in COOL mode. These overrides keep the circuit from entering a condition in which it is not designed to run.

**■ Low Evaporator Pressure**

If the Low Evaporator Pressure Hold event is triggered, the compressor will not be allowed to increase in capacity.

If the Low Evaporator Pressure Unload event is triggered, the compressor will begin reducing capacity.

The compressor will not be allowed to increase in capacity until the Low Evaporator Pressure Hold event has cleared.

**■ High Condenser Pressure**

If the High Condenser Pressure Hold event is triggered, the compressor will not be allowed to increase capacity. High Cond Hold Value = Max Saturated Condenser Value - 2.78°C

If the High Condenser Pressure Unload event is triggered, the compressor will begin reducing capacity. High Cond Unload Value = Max Saturated Condenser Value - 1.67°C

The maximum saturated condenser temperature calculation is modelled after the compressor operational envelope.

If Sat Evap Temp < 0°C then Max Sat Cond Temp = 1.596 (Sat Evap Temp) + 68.3°C  
Otherwise, Max Sat Cond Temp = 68.3°C

The compressor will not be allowed to increase in capacity until the High Condenser Pressure Hold event has cleared.

---

### 2.3.4 Condenser Fan Control

**Saturated condenser temperature target**

The condenser fan control logic will attempt to control the saturated condenser temperature to a calculated target. A base condenser target is calculated based on evaporator saturated temperature. The equation is:

$$\text{Base saturated condenser target} = 5/6 (\text{saturated evaporator temperature}) + 3.5^{\circ}\text{C}.$$

This value is then limited to a maximum and minimum determined by the Condenser Target Maximum and Minimum set points. If these set points are both set to the same value, then the saturated condenser temperature target will be locked at that value.

**Fan staging**

The fan stage shall be adjusted in steps of 1 fan.

Fan staging shall accommodate anywhere from 5 to 12 fans according to the table below:

**Output Number**

1	2	3	4	5	6	# of fans	# of DO
*	*	**	*			5	4
*	*	**	**			6	
*	*	**	**	*		7	5
*	*	**	**	**		8	
*	*	**	**	***		9	
*	*	**	**	***	*	10	6
*	*	**	**	***	**	11	
*	*	**	**	***	***	12	

**Staging up**

Six stage up dead bands shall be used. Stages one through five should use their respective dead bands. Stages six through twelve should all use the sixth stage up dead band.

When the saturated condenser temperature is above the Target + the active deadband, a Stage Up error is accumulated.

$$\text{Stage up Error Step} = \text{Saturated Condenser Refrigerant temperature} - (\text{Target} + \text{Stage Up dead band})$$

The Stage Up Error Step is added to Stage Up Accumulator once every 5 seconds, only if the Saturated Condenser Refrigerant Temperature is not falling. When Stage Up Error Accumulator is greater than 20 another stage is added.

When a stage up occurs or the saturated condenser temperature falls back within the Stage Up dead band the Stage Up Accumulator is reset to zero.

**Staging down**

Five stage down dead bands shall be used. Stages two through five should use their respective dead bands. Stages six through twelve should all use the stage six dead band.

When the saturated condenser refrigerant temperature is below the Target - the active deadband, a Stage Down error is accumulated.

$$\text{Stage Down Error Step} = (\text{Target} - \text{Stage Down dead band}) - \text{Saturated Condenser Refrigerant temperature}.$$

The Stage Down Error Step is added to Stage Down Accumulator once every Stage Down Error Delay seconds. When the Stage Down Error Accumulator is greater than the Stage Down Error Set Point another stage of condenser fans is removed.

When one fan is running, a fixed point is used in place of a deadband. When the Saturated Condenser temperature drops below 20°C, stage down error is accumulated.

When a stage down occurs or the saturated temperature rises back within the Stage Down dead band the Stage Down Error Accumulator is reset to zero. The accumulator is held at zero after startup until either the outside ambient temperature is less than or equal to 24°C, or the saturated condenser temperature is greater than the condenser target less the active stage down deadband.

**2**

---

**VFD**

Condenser pressure trim control is accomplished using an optional VFD on the first fan. This VFD control should vary the fan speed to drive the saturated condenser temperature to a target value. The target value is normally the same as the saturated condenser temperature target.

- VFD State

The VFD speed signal should always be 0 when the fan stage is 0.

When the fan stage is greater than 0, the VFD speed signal should be enabled and control the speed as needed.

- Stage Up Compensation

In order to create a smoother transition when another fan is staged on, the VFD compensates by slowing down initially. This is accomplished by adding the new fan stage up deadband to the VFD target. The higher target causes the VFD logic to decrease fan speed. Then, every 5 seconds, 0.1°F is subtracted from the VFD target until it is equal to the saturated condenser temperature target set point. This will allow the VFD to slowly bring the saturated condenser temperature back down.

---

### 2.3.5 EXV Control

---

The EXV moves at a rate of 150 steps per second, with a total range of 3810 steps. Positioning should be determined as described in the following sections, with adjustments made in increments of 0.1% of the total range.

---

#### Preopen operation

The EXV control should include a preopen operation that is used only when the unit has liquid line solenoids. The unit will be configured for use with or without liquid line solenoids via a set point.

When a circuit start is required, the EXV should be opened before the compressor starts. The preopen position should be defined by a set point. The time allowed for this preopen operation should be at least enough time for the EXV to open to the preopen position based on the programmed movement rate of the EXV.

---

#### Startup operation

When the compressor starts if no liquid line solenoid valve is installed, the EXV will start to open to an initial position that allows a safe start up. The value of LWT will determine if it is possible to enter the normal operation. If it is higher than 20°C then a pressure control will start to keep the compressor into the operating range. It goes in normal operation as soon as the suction superheat drops below a value equal to the suction superheat setpoint.

---

#### Normal operation

Normal operation of the EXV can be used when the circuit has completed startup operation of the EXV and is not in a slide transition conditions.

During normal operation, the EXV should control suction superheat to a target that can vary from 4°C to 8.5°C.

The EXV should control the suction superheat within 0.8°C during stable operating conditions (stable water loop, static compressor capacity, and stable condensing temperature).

The target value should be adjusted as needed to maintain discharge superheat within a range from 15°C to 25°C. As the discharge superheat approaches 15°C, the suction superheat target should be adjusted up. As the discharge superheat approaches 25°C, the suction superheat target should be adjusted down. The control will apply a 0.5°C maximum reset every 5 minutes to the base target.

---

#### Maximum operating pressures

The EXV control must maintain the evaporator pressure in the range defined by the maximum operating pressure.

If the leaving water temperature is higher than 20°C at startup or if the pressure becomes higher than 3.5 bar during normal operations, then a pressostatic control will be started to keep the compressor into the envelope.

Maximum operating pressure should be 3.5 bar.

It switches back to normal operation as soon as the suction superheat drops below 4°C suction superheat setpoint.

---

#### Response to compressor capacity change

The logic will consider transition from 50% to 60% and from 60% to 50% as special conditions. When a transition is entered the valve opening will change to adapt to the new capacity, this new calculated position will be kept for 60 seconds. The valve opening will be increased during 50% to 60% transition and decreased in 60% to 50% transition. Purpose of this logic is to limit liquid flood back when changing from 50% to 60% if the capacity increases above 60% due to slides movement.



**Manual control**

The EXV position can be set manually. Manual control can only be selected when the EXV state is Pressure or Superheat control. At any other time, the EXV control set point is forced to auto.

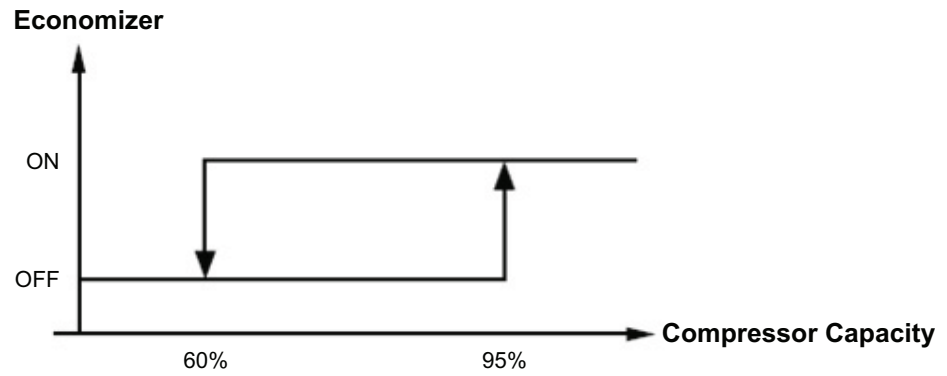
When EXV control is set to manual, the EXV position is equal to the manual EXV position setting. If set to manual when the circuit state transitions from run to another state, the control setting is automatically set back to auto. If EXV control is changed from manual back to auto while the circuit state remains run, the EXV state should go back to the normal operations if possible or to pressure control to limit maximum operating pressure.

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### 2.3.6 Economizer Control

The economizer shall be activated when the circuit is in a run state and the capacity exceeds 95%.

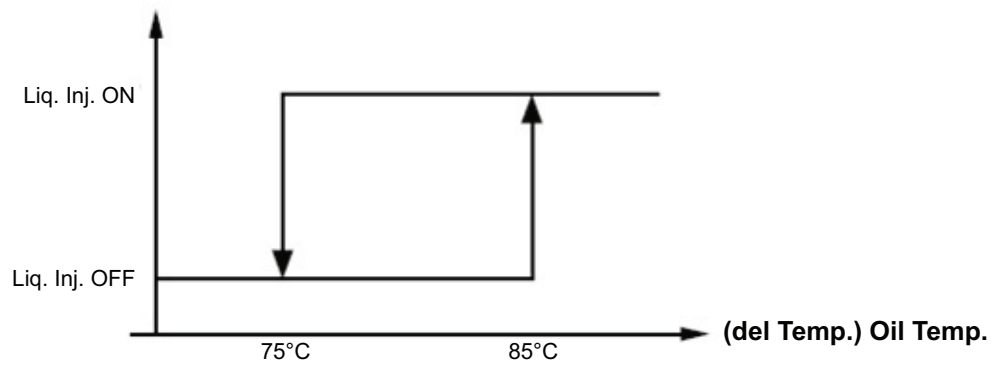
It shall turn back off when either the load drops below 60% or the circuit is no longer in a run state.



**2.3.7 Liquid Injection**

Liquid injection shall be activated when the circuit is in a run state and the discharge temperature rises above the Liquid Injection Activation set point.

Liquid injection should be turned off when the discharge temperature decreases below the activation set point by a differential of 10°C.



**2**

**2**

# Part 3

## Troubleshooting

---

**Introduction**

When a problem occurs, all possible faults have to be checked. This chapter gives a general idea of where to look for faults. Furthermore the general procedures for refrigeration circuit repair and for electrical circuit repair are explained.

---

**Remark**

Not all repair procedures are described. Some procedures are considered common practice.

---

**What is in this part?**

This part contains the following chapters:

Chapter	See page
1–Alarms and Events	3–3
2–Controller Inputs and Outputs	3–55
3–Procedure for Software Programming	3–67
4–Procedure to Protect Compressor in Case of Frozen Evaporator	3–71
5–Procedure to Clear the Refrigerant Circuit in Case of Frozen Evaporators	3–73
6–Troubleshooting Chart	3–75

---

**3**

# 1 Alarms and Events

## 1.1 What Is in This Chapter?

### Introduction

Situations may arise that require some action from the chiller or that should be logged for future reference. A condition that requires a shutdown and/or lockout is an alarm. Alarms may cause a normal stop or a rapid stop. Most alarms require manual reset, but some reset automatically when the alarm condition is corrected. Other conditions can trigger what is known as an event, which may or may not cause the chiller to respond with a specific action in response. All alarms and events are logged.

### Overview

This chapter contains the following topics:

Topic	See page
1.2–Unit Stop Alarms	3–4
1.3–Unit Events	3–14
1.4–Circuit Stop Alarms	3–18
1.5–Circuit Events	3–45
1.6–Alarm Logging	3–52
1.7–Event Logging	3–53

## 1.2 Unit Stop Alarms

---

The alarm output should be on constantly when any stop alarm occurs. It shall be turned off when all alarms have been cleared.

---

### Overview

This chapter contains the following topics:

Topic	See page
1.2.1–Phase Volts Loss/GFP Fault	3–5
1.2.2–Evaporator Flow Loss	3–6
1.2.3–Evaporator Water Freeze Protect	3–7
1.2.4–Evaporator Water Temperatures Inverted	3–8
1.2.5–Leaving Evaporator Water Temperature Sensor Fault	3–9
1.2.6–AC Comm Failure	3–10
1.2.7–Outdoor Air Temperature Sensor Fault	3–11
1.2.8–External Alarm	3–12
1.2.9–Emergency Stop Alarm	3–13

---



### 1.2.1 Phase Volts Loss/GFP Fault

---

**Alarm description (as shown on screen):** Unit PVM/GFP Fault.

**Trigger:** PVM set point is set to Single Point and PVM/GFP input is low.

**Action Taken:** Rapid stop all circuits.

**Reset:** Auto reset when PVM input is high or PVM set point does not equal single point for at least 5 seconds.

---

## 1.2.2 Evaporator Flow Loss

---

**Alarm description (as shown on screen):** Evap Water Flow Loss.

**Trigger:**

1. Evaporator Pump State = Run AND Evaporator Flow Digital Input = No Flow for time > Flow Proof Set Point AND at least one compressor running.
2. Evaporator Pump State = Start for time greater than Recirc Timeout Set Point and all pumps have been tried.

**Action Taken:** Rapid stop all circuits.

**Reset:**

This alarm can be cleared at any time manually via the keypad or via the BMS clear alarm signal.

If active via trigger condition 1:

When the alarm occurs due to this trigger, it can auto reset the first two times each day, with the third occurrence being manual reset.

For the auto reset occurrences, the alarm will reset automatically when the evaporator state is Run again. This means the alarm stays active while the unit waits for flow, then it goes through the recirculation process after flow is detected. Once the recirculation is complete, the evaporator goes to the Run state which will clear the alarm. After three occurrences, the count of occurrences is reset and the cycle starts over if the manual reset flow loss alarm is cleared.

If active via trigger condition 2:

If the flow loss alarm has occurred due to this trigger, it is always a manual reset alarm.

---

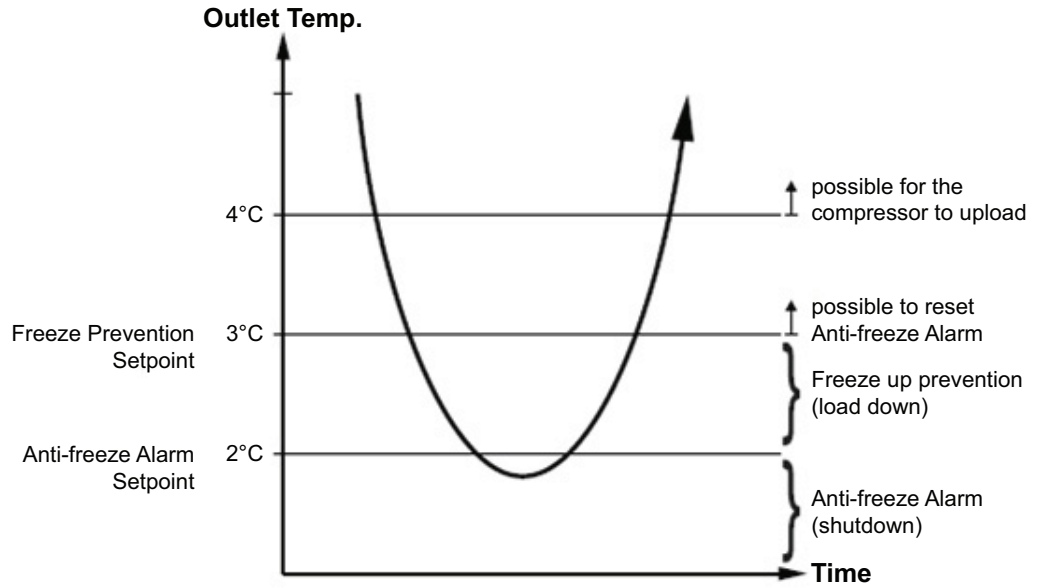
### 1.2.3 Evaporator Water Freeze Protect

**Alarm description (as shown on screen):** Evap Water Freeze.

**Trigger:** Evaporator LWT or EWT drops below evaporator freeze protect set point. If the sensor fault is active for either LWT or EWT, then that sensor value cannot trigger the alarm.

**Action Taken:** Rapid stop all circuits.

**Reset:** This alarm can be cleared manually via the keypad or via the BMS clear alarm signal, but only if the alarm trigger conditions no longer exist.



### 1.2.4 Evaporator Water Temperatures Inverted

---

**Alarm description (as shown on screen):** Evap Water Inverted.

**Trigger:** [Evap EWT < Evap LWT - 1 deg C AND at least one circuit is running AND EWT sensor fault not active AND LWT sensor fault not active] for 30 seconds.

**Action Taken:** Pumpdown stop on all circuits.

**Reset:** This alarm can be cleared manually via the keypad.

---

### 1.2.5 Leaving Evaporator Water Temperature Sensor Fault

---

**Alarm description (as shown on screen):** Evap LWT Sens Fault.

**Trigger:** Sensor shorted or open.

**Action Taken:** Rapid stop all circuits.

**Reset:** This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

---

### 1.2.6 AC Comm Failure

---

**Alarm description (as shown on screen):** AC Comm. Fail.

**Trigger:** Communication with the I/O extension module has failed.

**Action Taken:** Rapid stop of all running circuits.

**Reset:** This alarm can be cleared manually via the keypad when communication between main controller and the extension module is working for 5 seconds.

---

## 1.2.7 Outdoor Air Temperature Sensor Fault

---

**Alarm description (as shown on screen):** OAT Sensor Fault.

**Trigger:** Sensor shorted or open and Low Ambient Lockout is enabled.

**Action Taken:** Normal shutdown of all circuits.

**Reset:** This alarm can be cleared manually via the keypad if the sensor is back in range or Low Ambient Lockout is disabled.

---

### 1.2.8 External Alarm

---

**Alarm description (as shown on screen):** External Alarm.

**Trigger:** External Alarm/Event input is open for at least 5 seconds and external fault input is configured as an alarm.

**Action Taken:** Rapid stop of all circuits.

**Reset:** Auto clear when digital input is closed.

---



## 1.2.9 Emergency Stop Alarm

---

**Alarm description (as shown on screen):** Emergency Stop Switch.

**Trigger:** Emergency Stop input is open.

**Action Taken:** Rapid stop of all circuits.

**Reset:** This alarm can be cleared manually via the keypad, but only if the emergency switch is closed.

---

## 1.3 Unit Events

---

The following unit events are logged in the event log with a time stamp.

---

### Overview

This chapter contains the following topics:

Topic	See page
1.3.1–Entering Evaporator Water Temperature Sensor Fault	3–15
1.3.2–External Event	3–16
1.3.3–Low Ambient Lockout	3–17

---

### 1.3.1 Entering Evaporator Water Temperature Sensor Fault

---

**Event description (as shown on screen):** EWT Sensor Fail.

**Trigger:** Sensor shorted or open.

**Action Taken:** Return water reset cannot be used.

**Reset:** Auto reset when sensor is back in range.

---

### 1.3.2 External Event

---

**Alarm description (as shown on screen):** External Event.

**Trigger:** External Alarm/Event input is open for at least 5 seconds and external fault is configured as an event.

**Action Taken:** None.

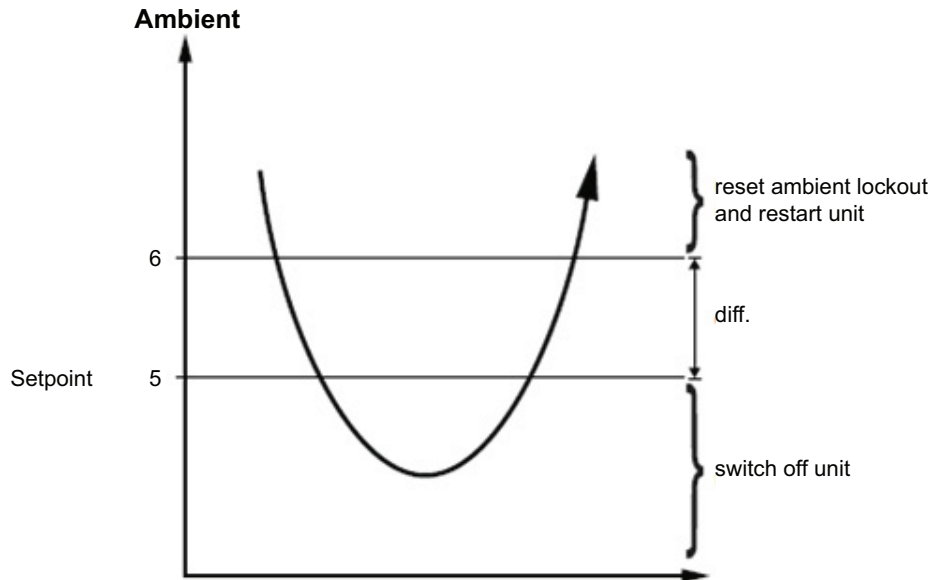
**Reset:** Auto clear when digital input is closed.

---

1.3.3 Low Ambient Lockout

**Alarm description (as shown on screen):** Low Ambient Lockout.

**Trigger:** The OAT drops below the low ambient lockout set point and low ambient lockout is enabled.



**Action Taken:** Normal shutdown of all running circuits.

**Reset:** The lockout should clear when OAT rises to the lockout set point plus 2.5°C, or when low ambient lockout is disabled.

## 1.4 Circuit Stop Alarms

All circuit stop alarms require shutdown of the circuit on which they occur. Rapid stop alarms do not do a pumpdown before shutting off. All other alarms will do a pumpdown.

When one or more circuit alarms are active and no unit alarms are active, the alarm output should be switched on and off on 5 second intervals.

Alarm descriptions apply to all circuits, the circuit number is represented by 'N' in the description.

### Overview

This chapter contains the following topics:

Topic	See page
1.4.1–Phase Volts Loss/GFP Fault	3–19
1.4.2–Low Evaporator Pressure	3–20
1.4.3–Low Pressure Start Fail	3–21
1.4.4–Mechanical Low Pressure Switch	3–22
1.4.5–High Condenser Pressure	3–23
1.4.6–Low Pressure Ratio	3–24
1.4.7–Mechanical High Pressure Switch	3–25
1.4.8–High Discharge Temperature	3–26
1.4.9–High Oil Pressure Difference	3–27
1.4.10–Compressor Starter Fault	3–28
1.4.11–High Motor Temperature	3–29
1.4.12–Low OAT Restart Fault	3–30
1.4.13–No Pressure Change After Start	3–31
1.4.14–No Pressure At Startup	3–32
1.4.15–CC Comm Failure N	3–33
1.4.16–FC Comm Failure Circuit 1/2	3–34
1.4.17–FC Comm Failure Circuit 3	3–35
1.4.18–FC Comm Failure Circuit 4	3–36
1.4.19–FC Comm Failure Circuit 3/4	3–37
1.4.20–EEXV Comm Failure N	3–38
1.4.21–Evaporator Pressure Sensor Fault	3–39
1.4.22–Condenser Pressure Sensor Fault	3–40
1.4.23–Oil Pressure Sensor Fault	3–41
1.4.24–Suction Temperature Sensor Fault	3–42
1.4.25–Discharge Temperature Sensor Fault	3–43
1.4.26–Motor Temperature Sensor Fault	3–44

### 1.4.1 Phase Volts Loss/GFP Fault

---

**Alarm description (as shown on screen):** PVM/GFP Fault N.

**Trigger:** PVM input is low and PVM set point = Multi Point.

**Action Taken:** Rapid stop circuits.

**Reset:** Auto reset when PVM input is high or PVM set point does not equal multi point for at least 5 seconds.

---

## 1.4.2 Low Evaporator Pressure

---

**Alarm description (as shown on screen):** Evap Press Low N.

**Trigger:** [Freezestat trip AND Circuit State = Run] OR Evaporator Press < 0.7 bar.

Freezestat logic allows the circuit to run for varying times at low pressures. The lower the pressure, the shorter the time the compressor can run. This time is calculated as follows:

- Freeze error = Low Evaporator Pressure Unload - Evaporator Pressure.
- Freeze time = 70 - 6.25 x freeze error, limited to a range of 20-70 seconds.

When the evaporator pressure goes below the Low Evaporator Pressure Unload set point, a timer starts. If this timer exceeds the freeze time, then a freezestat trip occurs. If the evaporator pressure rises to the unload set point or higher, and the freeze time has not been exceeded, the timer will reset.

The alarm cannot trigger if the evaporator pressure sensor fault is active.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually if the evaporator pressure is above 0.7bar.

---



### 1.4.3 Low Pressure Start Fail

---

**Alarm description (as shown on screen):** LowPressStartFail N.

**Trigger:** Circuit state is in the 'start'-status for time greater than Startup Time set point.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad.

---

#### 1.4.4 Mechanical Low Pressure Switch

---

**Alarm description (as shown on screen):** Mech Low Pressure Sw N.

**Trigger:** Mechanical Low Pressure switch input is low.

**Action Taken:** Rapid stop circuit.

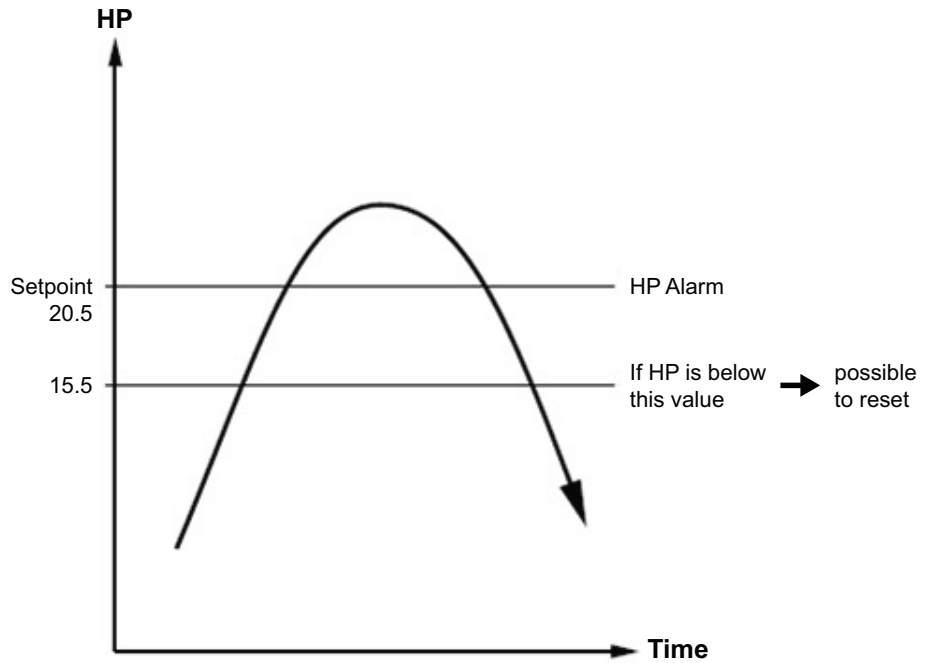
**Reset:** This alarm can be cleared manually via the Unit Controller keypad if the MLP switch input is high.

---

### 1.4.5 High Condenser Pressure

**Alarm description (as shown on screen):** Cond Pressure High N.

**Trigger:** Condenser Saturated Temperature is higher than the Max Saturated Condenser Value for time longer than High Cond Delay set point.



**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad.

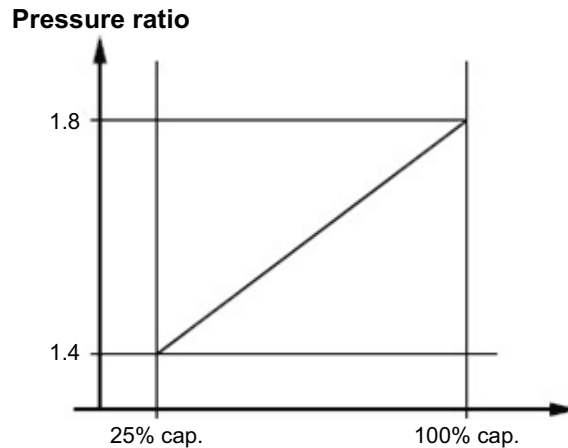
### 1.4.6 Low Pressure Ratio

---

**Alarm description (as shown on screen):** Low Pressure Ratio N.

**Trigger:** Pressure ratio is lower than calculated limit for a time longer than Low Pressure Ratio Delay set point after circuit startup has completed. The calculated limit will vary from 1.4 to 1.8 as the compressor's capacity varies from 25% to 100%.

$$\text{pressure ratio} = \frac{\text{discharge pressure (Abs)}}{\text{suction pressure (Abs)}}$$



**Action Taken:** Normal shutdown of circuit.

**Reset:** Alarm can be cleared manually via the Unit Controller keypad.

---

### 1.4.7 Mechanical High Pressure Switch

---

**Alarm description (as shown on screen):** Mech High Pressure Sw N.

**Trigger:** Mechanical High Pressure switch input is low AND Emergency Stop Alarm is not active. (Opening emergency stop switch kills power to MHP switches).

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad if the MHP switch input is high.

---

### 1.4.8 High Discharge Temperature

---

**Alarm description (as shown on screen):** Disc Temp High N.

**Trigger:** Discharge Temperature > High Discharge Temperature set point AND compressor is running. Alarm cannot trigger if discharge temperature sensor fault is active.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad.

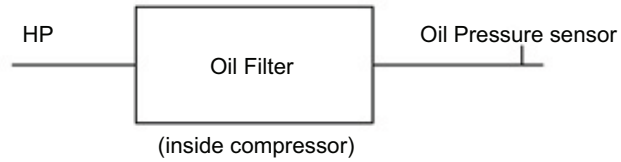
---

### 1.4.9 High Oil Pressure Difference

---

**Alarm description (as shown on screen):** Oil Pres Diff High N.

**Trigger:** When the Oil Pressure Differential measured over the oil filter is bigger than the High Oil Pressure Differential set point for a time greater than Oil Pressure Differential Delay, the unit will trip on high oil pressure difference.



$DP = (HP - \text{oil pressure})$

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad.

---

### 1.4.10 Compressor Starter Fault

---

**Alarm description (as shown on screen):** Starter Fault N.

**Trigger:**

- If PVM set point = None(SSS): any time starter fault input is open.
- If PVM set point = Single Point or Multi Point: compressor has been running for at least 14 seconds and starter fault input is open.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad.

---



### 1.4.11 High Motor Temperature

---

**Alarm description (as shown on screen):** Motor Temp High.

**Trigger:** In the windings of the compressor, a temperature sensitive resistor is installed. If the value for the resistor is 4500 ohms or higher, the unit will trip on high motor temperature alarm.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad after input value for motor temperature has been 200 ohms or less for at least 5 minutes.

---

### 1.4.12 Low OAT Restart Fault

---

**Alarm description (as shown on screen):** LowOATRestart Fail N.

**Trigger:** Circuit has failed three low OAT start attempts.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad.

---

### 1.4.13 No Pressure Change After Start

---

**Alarm description (as shown on screen):** NoPressChgAtStrt N.

**Trigger:** After start of compressor, at least a 1 psi drop in evaporator pressure OR 5 psi increase in condenser pressure has not occurred after 15 seconds.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad.

---

### 1.4.14 No Pressure At Startup

---

**Alarm description (as shown on screen):** No Press At Start N.

**Trigger:** [Evap Pressure < 5 psi OR Cond Pressure < 5 psi] AND Compressor start requested AND circuit does not have a fan VFD.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the Unit Controller keypad.

---

### 1.4.15 CC Comm Failure N

---

**Alarm description (as shown on screen):** CC Comm. Fail N.

**Trigger:** Communication with the I/O extension module has failed.

**Action Taken:** Rapid stop of affected circuit.

**Reset:** This alarm can be cleared manually via the keypad when communication between main controller and the extension module is working for 5 seconds.

---

### 1.4.16 FC Comm Failure Circuit 1/2

---

**Alarm description (as shown on screen):** FC Comm Fail Cir 1/2.

**Trigger:** [Circuit 1 or Circuit 2 have more than 6 fans OR PVM Config = Multi Point] and communication with the I/O extension module has failed.

**Action Taken:** Rapid stop of circuit 1 and 2.

**Reset:** This alarm can be cleared manually via the keypad when communication between main controller and the extension module is working for 5 seconds.

---

### 1.4.17 FC Comm Failure Circuit 3

---

**Alarm description (as shown on screen):** FC Comm Fail Cir 3.

**Trigger:** Number of Circuits set point is greater than 2 and communication with the I/O extension module has failed.

**Action Taken:** Rapid stop of circuit 3.

**Reset:** This alarm can be cleared manually via the keypad when communication between main controller and the extension module is working for 5 seconds.

---

### 1.4.18 FC Comm Failure Circuit 4

---

**Alarm description (as shown on screen):** FC Comm. Fail Cir 4.

**Trigger:** Number of Circuits set point is greater than 3 and communication with the I/O extension module has failed.

**Action Taken:** Rapid stop of circuit 4.

**Reset:** This alarm can be cleared manually via the keypad when communication between main controller and the extension module is working for 5 seconds.

---



### 1.4.19 FC Comm Failure Circuit 3/4

---

**Alarm description (as shown on screen):** FC Comm. Fail Cir 3/4.

**Trigger:** Circuit 3 or circuit 4 have more than 6 fans and communication with the I/O extension module has failed.

**Action Taken:** Rapid stop of circuit 3 and 4.

**Reset:** This alarm can be cleared manually via the keypad when communication between main controller and the extension module is working for 5 seconds.

---

### 1.4.20 EEXV Comm Failure N

---

**Alarm description (as shown on screen):** EEXV Comm. Fail N.

**Trigger:** Communication with the I/O extension module has failed. Alarm on Circuit #3 will be enabled if Number of Circuits set point > 2; alarm on Circuit #4 will be enabled if Number of Circuits set point > 3.

**Action Taken:** Rapid stop of affected circuit.

**Reset:** This alarm can be cleared manually via the keypad when communication between main controller and the extension module is working for 5 seconds.

---

### 1.4.21 Evaporator Pressure Sensor Fault

---

**Alarm description (as shown on screen):** EvapPressSensFault N.

**Trigger:** Sensor shorted or open.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

---

### 1.4.22 Condenser Pressure Sensor Fault

---

**Alarm description (as shown on screen):** CondPressSensFault N.

**Trigger:** Sensor shorted or open.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

---

### 1.4.23 Oil Pressure Sensor Fault

---

**Alarm description (as shown on screen):** OilPressSensFault N.

**Trigger:** Sensor shorted or open.

**Action Taken:** Normal shutdown of circuit.

**Reset:** This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

---

### 1.4.24 Suction Temperature Sensor Fault

---

**Alarm description (as shown on screen):** SuctTempSensFault N.

**Trigger:** Sensor shorted or open.

**Action Taken:** Normal shutdown of circuit.

**Reset:** This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

---

### 1.4.25 Discharge Temperature Sensor Fault

---

**Alarm description (as shown on screen):** DiscTempSensFault N.

**Trigger:** Sensor shorted or open.

**Action Taken:** Normal shutdown of circuit.

**Reset:** This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

---

### 1.4.26 Motor Temperature Sensor Fault

---

**Alarm description (as shown on screen):** MotorTempSensFault N.

**Trigger:** Sensor shorted or open.

**Action Taken:** Rapid stop circuit.

**Reset:** This alarm can be cleared manually via the keypad, but only if the sensor is back in range.

---



## 1.5 Circuit Events

---

The following events limit operation of the circuit in some way as described in the Action Taken column. The occurrence of a circuit event only affects the circuit on which it occurred. Circuit events are logged in the event log on the unit controller.

---

### Overview

This chapter contains the following topics:

Topic	See page
1.5.1–Low Evaporator Pressure - Hold	3–46
1.5.2–Low Evaporator Pressure - Unload	3–47
1.5.3–High Condenser Pressure - Hold	3–48
1.5.4–High Condenser Pressure - Unload	3–49
1.5.5–Failed Pumpdown	3–50
1.5.6–Power Loss While Running	3–51

---

### 1.5.1 Low Evaporator Pressure - Hold

---

**Event description (as shown on screen):** EvapPress Low Hold N.

**Trigger:** This event is not enabled until the circuit startup is complete and the unit mode is Cool. Then, while running, if evaporator pressure  $\leq$  Low Evaporator Pressure Hold set point the event is triggered. The event is not to be triggered for 90 seconds following the capacity change of the compressor from 50% to 60%.

**Action Taken:** Inhibit loading.

**Reset:** While still running, the event will be reset if evaporator pressure gets above the Low Evaporator Pressure Hold setpoint plus a difference. The event is also reset if the unit mode is switched to Ice, or the circuit is no longer in the run state.

---

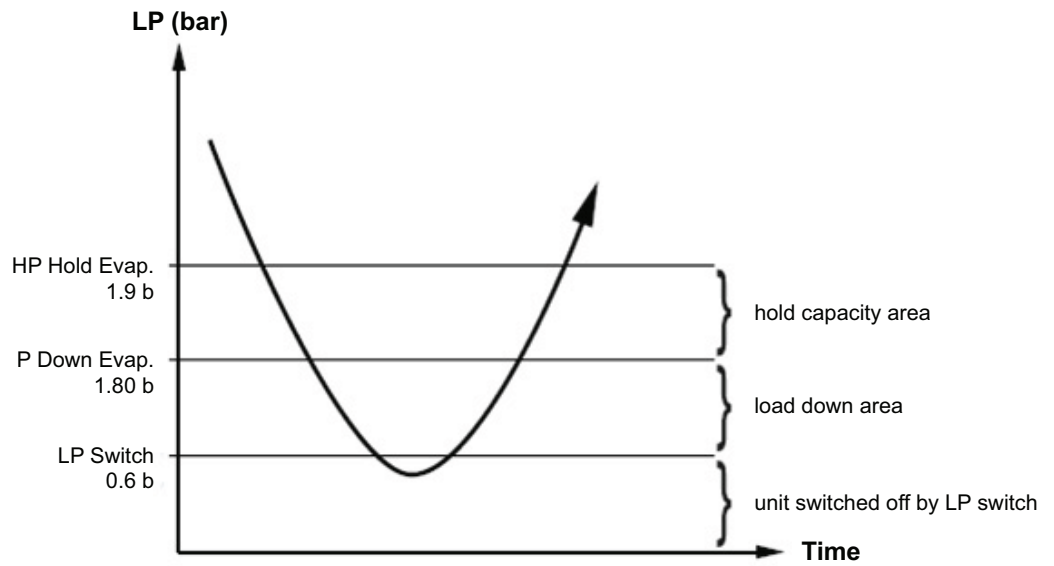
### 1.5.2 Low Evaporator Pressure - Unload

**Event description (as shown on screen):** EvapPressLowUnload N.

**Trigger:** This event is not enabled until the circuit startup is complete and the unit mode is Cool. Then, while running, if evaporator pressure  $\leq$  Low Evaporator Pressure Unload set point the event is triggered. The event is not to be triggered for 90 seconds following the capacity change of the compressor from 50% to 60%.

**Action Taken:** Unload the compressor by decreasing the capacity by one step every 5 seconds until the evaporator pressure rises above the Low Evaporator Pressure Unload set point.

**Reset:** While still running, the event will be reset if evaporator pressure gets above the Low Evaporator Pressure Hold setpoint plus a difference. The event is also reset if the unit mode is switched to Ice, or the circuit is no longer in the run state.



### 1.5.3 High Condenser Pressure - Hold

---

**Event description (as shown on screen):** CondPressHigh Hold N.

**Trigger:** While the compressor is running and unit mode is Cool, if saturated condenser temperature is higher or equal to the High Saturated Condenser Hold Value, the event is triggered.

**Action Taken:** Inhibit loading.

**Reset:** While still running, the event will be reset if saturated condenser temperature drops below the High Saturated Condenser Hold Value - 5°C. The event is also reset if the unit mode is switched to Ice, or the circuit is no longer in the run state.

---

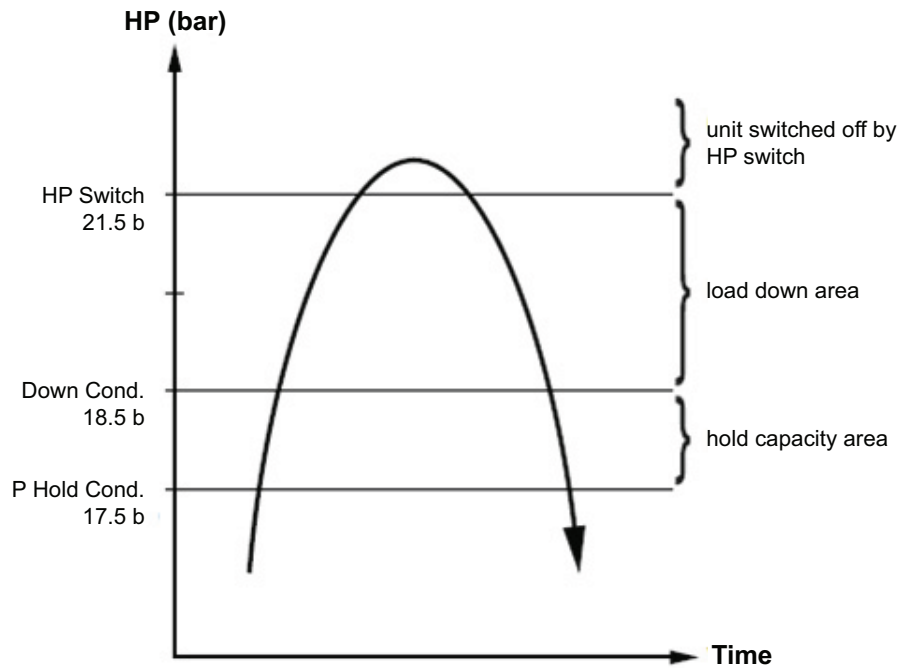
### 1.5.4 High Condenser Pressure - Unload

**Event description (as shown on screen):** CondPressHighUnloadN.

**Trigger:** While the compressor is running and unit mode is Cool, if saturated condenser temperature is higher or equal to High Saturated Condenser Unload Value, the event is triggered.

**Action Taken:** Unload the compressor by decreasing the capacity by one step every 5 seconds until the evaporator pressure rises above the High Condensing Pressure Unload set point.

**Reset:** While still running, the event will be reset if saturated condenser temperature drops below the High Saturated Condenser Unload Value - 5°C. The event is also reset if the unit mode is switched to Ice, or the circuit is no longer in the run state.



### 1.5.5 Failed Pumpdown

---

**Event description (as shown on screen):** Pumpdown Fail Cir N.

**Trigger:** If the circuit state is 'pumpdown' for a time longer than the pumpdown time setpoint, the alarm is triggered.

**Action Taken:** Shutdown circuit.

**Reset:** N/A.

---

### 1.5.6 Power Loss While Running

---

**Event description (as shown on screen):** Run Power Loss Cir N.

**Trigger:** Circuit controller is powered up after losing power while compressor was running.

**Action Taken:** N/A.

**Reset:** N/A.

---

## 1.6 Alarm Logging

---

When an alarm occurs, the alarm type, date, and time are stored in the active alarm buffer corresponding to that alarm (viewed on the Alarm Active screens) also in the alarm history buffer (viewed on the Alarm Log screens). The active alarm buffers hold a record of all current alarms. The active alarms can be cleared by pressing the Edit key when the end of the list has been reached by scrolling.

A separate alarm log stores the last 25 alarms to occur. When an alarm occurs, it is put into the first slot in the alarm log and all others are moved down one, dropping the last alarm. In the alarm log, the date and time the alarm occurred are stored, as well as a list of other parameters. These parameters include unit state, OAT, LWT, and EWT for all alarms. If the alarm is a circuit alarm, then the circuit state, refrigerant pressures and temperatures, EXV position, compressor load, number of fans on, and compressor run time are also stored.

---



## 1.7 Event Logging

---

An event log similar to the alarm log holds the last 25 events to occur. When an event occurs, it is put into the first slot in the event log and all other entries are moved down one, dropping the last event. Each entry in the event log includes an event description as well as the time and date of the occurrence. No additional parameters are logged for events.

The event log shall only be accessible with the Manager password.

---

**3**

## 2 Controller Inputs and Outputs

### 2.1 What is in This Chapter?

**Introduction**

This chapter gives information of the configuration of the input and output channels.

**Overview**

This chapter contains the following topics:

Topic	See page
2.2–Main Board Controller (POL687.70/MCQ)	3–56
2.3–Expansion I/O Compressor #1 to #4 (POL965.00/MCQ)	3–58
2.4–Expansion I/O EXV Circuit #1 to #4 (POL94U.00/MCQ)	3–60
2.5–Expansion I/O Fan Module Circuit #1 & #2 (POL945.00/MCQ)	3–61
2.6–Expansion I/O Fan Module Circuit #3 (POL945.00/MCQ)	3–62
2.7–Expansion I/O Fan Module Circuit #4 (POL945.00/MCQ)	3–63
2.8–Expansion I/O Fan Module Circuit #3 & #4 (POL945.00/MCQ)	3–64
2.9–Expansion I/O Unit Alarm & Limiting (POL965.00/MCQ)	3–65

## 2.2 Main Board Controller (POL687.70/MCQ)

### Analog inputs

#	Description	Signal Source	Expected Range
AI1	Evaporator Entering Water Temp	NTC Thermister (10K@25°C)	-50°C – 120°C
AI2	Evaporator Leaving Water Temp	NTC Thermister (10K@25°C)	-50°C – 120°C
AI3	Evaporator #1 Leaving Water Temp (*)	NTC Thermister (10K@25°C)	-50°C – 120°C
X1	Evaporator #2 Leaving Water Temp (*)	NTC Thermister (10K@25°C)	-50°C – 120°C
X2	Outside Ambient Temperature	NTC Thermister (10K@25°C)	-50°C – 120°C
X4	LWT Reset	4-20 mA Current	1 to 23 mA

### Analog outputs

#	Description	Output Signal	Range
X5	Fan VFD #1	0-10VDC	0 to 100% (1000 steps resolution)
X6	Fan VFD #2	0-10VDC	0 to 100% (1000 steps resolution)
X7	Fan VFD #3	0-10VDC	0 to 100% (1000 steps resolution)
X8	Fan VFD #4	0-10VDC	0 to 100% (1000 steps resolution)

### Digital inputs

#	Description	Signal Off	Signal On
DI1	Unit PVM	Fault	No Fault
DI2	Evaporator Flow Switch	No Flow	Flow
DI3	Double Set Point/ Mode Switch	Cool mode	Ice mode
DI4	Remote Switch	Remote off	Remote on
DI5	Unit Switch	Unit off	Unit on
DI6	Emergency Stop	Unit off/rapid stop	Unit on

Digital outputs

#	Description	Output OFF	Output ON
DO1	Evaporator Water Pump	Pump Off	Pump On
DO2	Unit Alarm	Alarm not Active	Alarm Active (Flashing= circuit alarm)
DO3	Circuit #1 Fan Step #1	Fan Off	Fan On
DO4	Circuit #1 Fan Step #2	Fan Off	Fan On
DO5	Circuit #1 Fan Step #3	Fan Off	Fan On
DO6	Circuit #1 Fan Step #4	Fan Off	Fan On
DO7	Circuit #2 Fan Step #1	Fan Off	Fan On
DO8	Circuit #2 Fan Step #2	Fan Off	Fan On
DO9	Circuit #2 Fan Step #3	Fan Off	Fan On
DO10	Circuit #2 Fan Step #4	Fan Off	Fan On

## 2.3 Expansion I/O Compressor #1 to #4 (POL965.00/MCQ)

### Analog inputs

#	Description	Signal Source	Expected Range
X1	Discharge Temperature	NTC Thermister (10K@25°C)	-50°C – 120°C
X2	Evaporator Pressure	Ratiometric (0,5-4,5 Vdc)	0 to 5 Vdc
X3	Oil Pressure	Ratiometric (0,5-4,5 Vdc)	0 to 5 Vdc
X4	Condenser Pressure	Ratiometric (0,5-4,5 Vdc)	0 to 5 Vdc
X7	Motor Protection	NTC Thermister (10K@25°C)	n/a

**Note:** X7 is configured the same regardless of Manufacturing Location. However, for U.S. chillers the signal source is a digital input so the control logic must account for this.

### Analog outputs

#	Description	Output Signal	Range
Not Needed			

### Digital inputs

#	Description	Signal Off	Signal On
X6	Starter Fault	Fault	No fault
DI1	High Pressure Switch	Fault	No fault

**Digital outputs**

Outputs DO3, DO4, and XO8 are configured based on Manufacturing Location.

■ Europe Configuration

#	Description	Output Off	Output On
DO1	Start Compressor	Compressor Off	Compressor On
DO2	Economizer	Solenoid Closed	Solenoid Open
DO3	Non-modulating Slide Load/Unload	Solenoid Closed	Solenoid Open
DO4	Liquid Injection	Solenoid Closed	Solenoid Open
DO5	Modulating Slide Load	Solenoid Closed	Solenoid Open
DO6	Modulating Slide Unload	Solenoid Closed	Solenoid Open
X5	Modulating Slide 'Turbo'	Solenoid Closed	Solenoid Open

■ U.S. Configuration

#	Description	Output Off	Output On
DO1	Start Compressor	Compressor Off	Compressor On
DO2	Economizer	Solenoid Closed	Solenoid Open
DO3	Non-modulating Slide Load	Solenoid Closed	Solenoid Open
DO4	Non-modulating Slide Unload	Solenoid Closed	Solenoid Open
DO5	Modulating Slide Load	Solenoid Closed	Solenoid Open
DO6	Modulating Slide Unload	Solenoid Closed	Solenoid Open
X5	Modulating Slide 'Turbo'	Solenoid Closed	Solenoid Open
X8	Liquid Injection	Solenoid Closed	Solenoid Open

## 2.4 Expansion I/O EXV Circuit #1 to #4 (POL94U.00/MCQ)

### Analog inputs

#	Description	Signal Source	Expected Range
X2	Suction Temperature	NTC Thermister 10K@25°C)	-50°C – 120°C

### Analog outputs

#	Description	Output Signal	Range
Not Needed			

### Digital inputs

#	Description	Signal Off	Signal On
DI1	Low Pressure switch	Fault	No fault

### Digital outputs

#	Description	Output Off	Output On
DO1	Liquid Line	Solenoid Closed	Solenoid Open

### Stepper motor output

#	Description
M1+	EXV Stepper Coil 1
M1-	
M2+	EXV Stepper Coil 2
M2-	



## 2.5 Expansion I/O Fan Module Circuit #1 & #2 (POL945.00/MCQ)

### Digital inputs

#	Description	Output Off	Output On
DI1	PVM/GFP Circuit #1	Fault	No fault
DI2	PVM/GFP Circuit #2	Fault	No fault

### Digital outputs

#	Description	Output Off	Output On
DO1	Circuit #1 Fan Step #5	Fan Off	Fan On
DO2	Circuit #1 Fan Step #6	Fan Off	Fan On
DO3	Circuit #2 Fan Step #5	Fan Off	Fan On
DO4	Circuit #2 Fan Step #6	Fan Off	Fan On

## 2.6 Expansion I/O Fan Module Circuit #3 (POL945.00/MCQ)

### Digital inputs

---

#	Description	Output Off	Output On
DI1	PVM/GFP Circuit #3	Fault	No fault

---

### Digital outputs

#	Description	Output Off	Output On
DO1	Circuit #3 Fan Step #1	Fan Off	Fan On
DO2	Circuit #3 Fan Step #2	Fan Off	Fan On
DO3	Circuit #3 Fan Step #3	Fan Off	Fan On
DO4	Circuit #3 Fan Step #4	Fan Off	Fan On

---

**2.7 Expansion I/O Fan Module Circuit #4 (POL945.00/MCQ)**

**Digital inputs**

---

#	Description	Output Off	Output On
DI1	PVM/GFP Circuit #4	Fault	No fault

---

**Digital outputs**

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#	Description	Output Off	Output On
DO1	Circuit #4 Fan Step #1	Fan Off	Fan On
DO2	Circuit #4 Fan Step #2	Fan Off	Fan On
DO3	Circuit #4 Fan Step #3	Fan Off	Fan On
DO4	Circuit #4 Fan Step #4	Fan Off	Fan On

---

## 2.8 Expansion I/O Fan Module Circuit #3 & #4 (POL945.00/MCQ)

### Digital outputs

---

#	Description	Output Off	Output On
DO1	Circuit #3 Fan Step #5	Fan Off	Fan On
DO2	Circuit #3 Fan Step #6	Fan Off	Fan On
DO3	Circuit #4 Fan Step #5	Fan Off	Fan On
DO4	Circuit #4 Fan Step #6	Fan Off	Fan On

---

## 2.9 Expansion I/O Unit Alarm & Limiting (POL965.00/MCQ)

### Analog inputs

#	Description	Signal Source	Range
X3	Demand Limit	4-20 mA	1 to 23 mA
X4	Unit Current	4-20 mA	1 to 23 mA

### Analog outputs

#	Description	Output Signal	Range
Not Needed			

### Digital inputs

#	Description	Signal Off	Signal On
X1	External Alarm/Event	External Device Failure	External Device OK
X2	Current Limit Enable	No Limiting	Limiting
X5	Circuit Switch #1	Circuit Off	Circuit On
X6	Circuit Switch #2	Circuit Off	Circuit On
X7	Circuit Switch #3	Circuit Off	Circuit On
X8	Circuit Switch #4	Circuit Off	Circuit On

### Digital outputs

#	Description	Output Off	Output On
DO1	Evaporator Water Pump #2	Pump Off	Pump On
DO2	Open		
DO3	Circuit #1 Alarm	No Alarm	Alarm
DO4	Circuit #2 Alarm	No Alarm	Alarm
DO5	Circuit #3 Alarm	No Alarm	Alarm
DO6	Circuit #4 Alarm	No Alarm	Alarm

**3**

## 3 Procedure for Software Programming

### 3.1 What is in This Chapter?

#### Overview

---

This chapter contains the following topics:

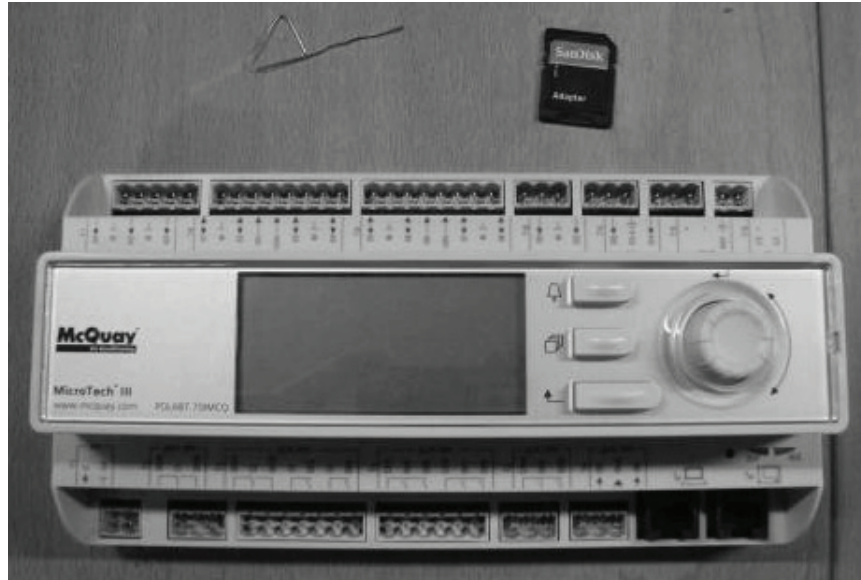
Topic	See page
3.2–Software Programming with SD Card	3–68

---

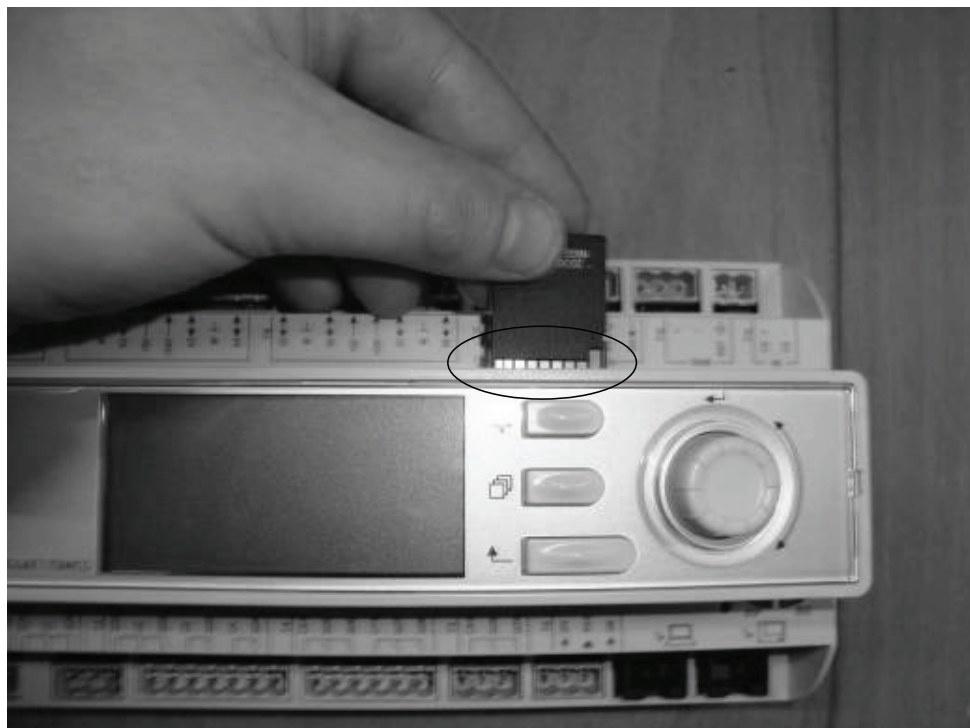
### 3.2 Software Programming with SD Card

Controllers are programmed with a SD card. You'll need following things:

- SD card with software (not new fast SD card).
- Pin.
- Controller.



Put the SD card in the controller in the correct position.

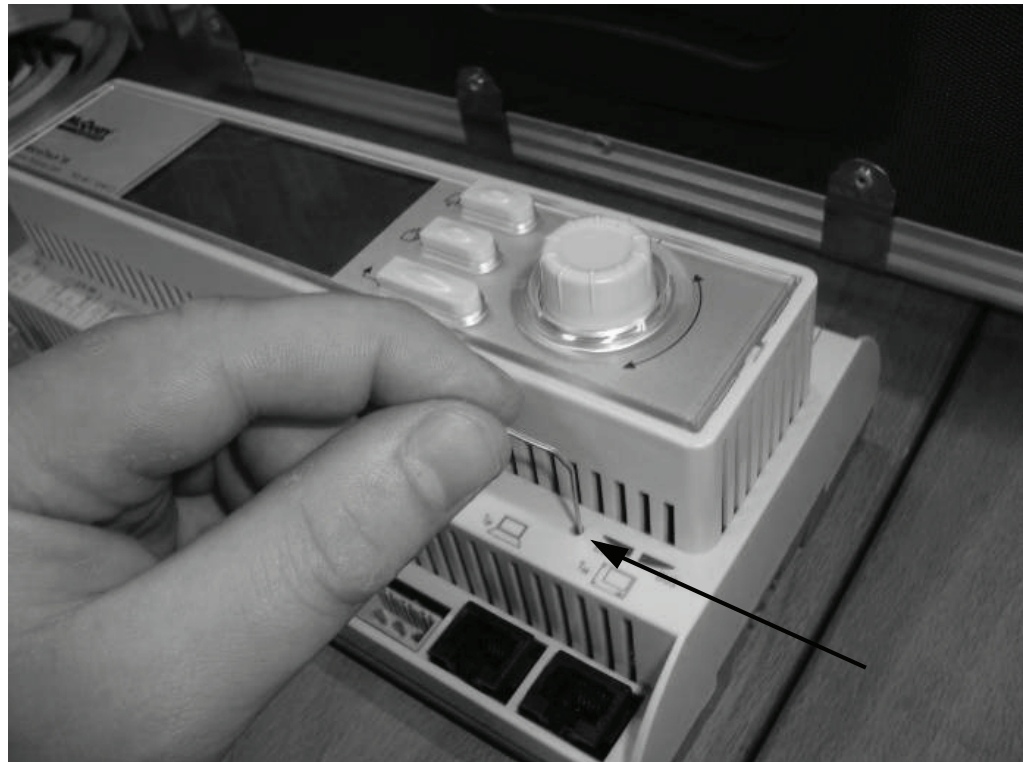






**3**

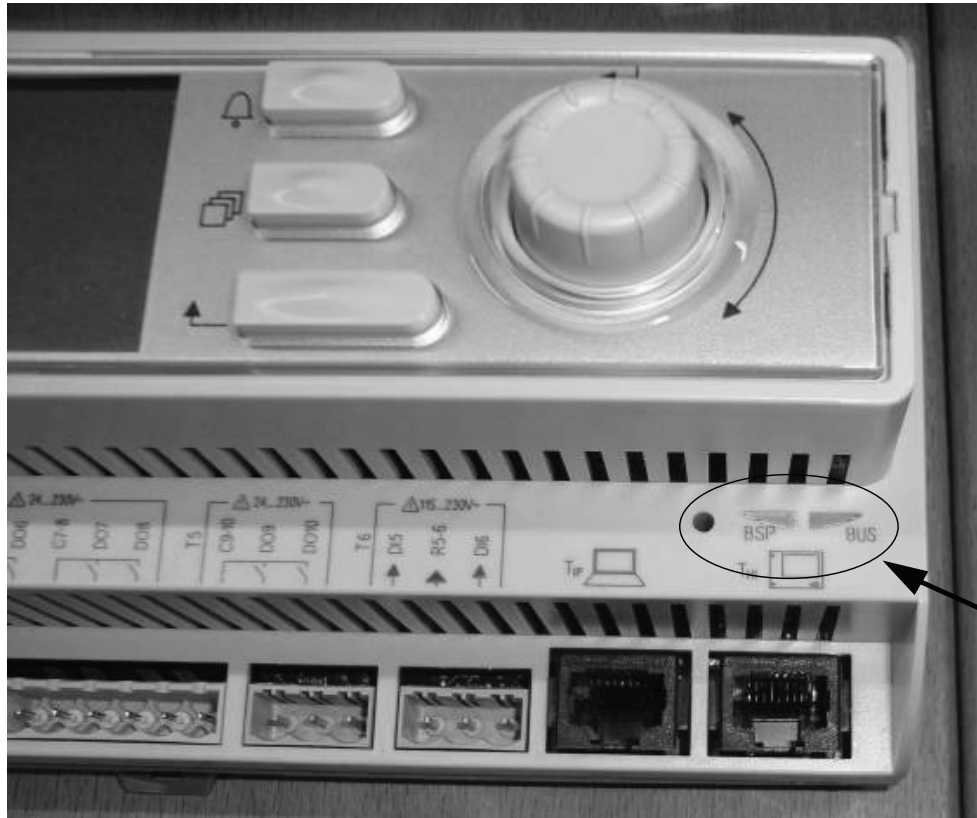
Put the pin in the small hole in the controller and push. Switch on power.



Remove pin when LED becomes orange. Then LED will start to blink red/green. Programming complete when LED is orange again.

1. Pin till orange.
2. Remove pin.
3. Blinking till orange.
4. Power off and remove SD card.

3



## 4 Procedure to Protect Compressor in Case of Frozen Evaporator

### 4.1 What is in This Chapter?

#### Overview

---

This chapter contains the following topics:

Topic	See page
4.2–Procedure to Protect Compressor in Case of Frozen Evaporator	3–72

---

## 4.2 Procedure to Protect Compressor in Case of Frozen Evaporator

If water is detected in the compressor after an evaporator damage, the following procedure should be executed within the first day.

Step	Action
1	Supply the compressor crank case heater.
2	Insulate the compressor from the rest of the refrigerant circuit. If there is no suction valve available on the compressor, use a plate to close the suction of the compressor.
3	Open the oilplugs to drain the oil and the water out of the compressor.
4	Blow-dry nitrogen through the compressor using the service ports on the HP and LP side of the compressor.
5	Close the drain plugs and vacuum the compressor for a few hours while the crank case heater is on.
6	If the vacuum oil becomes coloured (milky colour) replace the vacuum oil.
7	Repeat step 6 each time the vacuum oil becomes milky.
8	After 4 hours break the vacuum using step 3.
9	Repeat step 5 till step 7 until the oil of the vacuum pump becomes clear.
10	If the vacuum oil remains clear fill the compressor with the necessary compressor oil.
11	Charge the compressor with nitrogen.

# 5 Procedure to Clear the Refrigerant Circuit in Case of Frozen Evaporators

## 5.1 What Is in This Chapter?

### Overview

This chapter contains the following topics:

Topic	See page
5.2–Procedure to Clean the Refrigerant Circuit in Case of Frozen Evaporators	3–74

## 5.2 Procedure to Clean the Refrigerant Circuit in Case of Frozen Evaporators

If water is detected in the refrigerant circuit after an evaporator damage, the following procedure should be executed to clear the system.

Step	Action
1	Inspection and cleaning of compressor. Vacuum and heat-up the compressor to remove moisture. Fill with oil and N <sub>2</sub> .
2	Cleaning & drying refrigerant circuit. Cleaning components: <ul style="list-style-type: none"> <li>■ Expansion valve body.</li> <li>■ Liquid line solenoid valve.</li> <li>■ Suction and liquid line.</li> </ul> Replace components: <ul style="list-style-type: none"> <li>■ Sight glass</li> <li>■ Drier filter element by high density filter</li> <li>■ Compressor oil</li> </ul> Actions: <ul style="list-style-type: none"> <li>■ Drill a hole on the bottom of the condenser headers to remove water.</li> <li>■ Braze the drilled holes.</li> <li>■ Draw the rags through the suction and liquid line.</li> <li>■ Blow-<b>dry</b> N<sub>2</sub> through all the pipes.</li> <li>■ Drain compressor oil</li> <li>■ Vacuum the whole installation:                             <p style="margin-left: 20px;">Check on a regular basis the condition of the oil of the vacuum pump. If the vacuum oil becomes milky, it should be replaced by new vacuum oil. The crankcase heater must be activated. It is advisable to connect a second heater tape at the suction of the compressor.</p> </li> <li>■ Stop the vacuum and purge with dry nitrogen.</li> <li>■ Restart the vacuum of the installation; check after a couple of hours the condition of the vacuum oil. If OK the unit can be recharged.</li> <li>■ Charge the unit with R-134a.</li> <li>■ Start the unit &amp; re-commissioning.</li> <li>■ After 24 hours replace HD filter by new HD filter &amp; replace compressor oil.</li> <li>■ Check oil contamination with measuring kit.</li> <li>■ After 48 hours replace HD filter by normal filter drier + check sight glass and pressures.</li> </ul>
3	Find the cause of this evaporator breakdown and take the necessary actions to prevent recurrence in the future.

3

## 6 Troubleshooting Chart

### 6.1 What is in This Chapter?

#### Overview

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This chapter contains the following topics:

Topic	See page
6.2–Troubleshooting Chart	3–76

---

## 6.2 Troubleshooting Chart

3

Problem	Possible causes	Possible corrective steps
<p><b>Compressor will not run</b></p>	<p>1 Main power switch is open.</p>	<p>1 Close switch.</p>
	<p>2 Unit system switch is open.</p>	<p>2 Check the unit status on the control panel. Close switch.</p>
	<p>3 Circuit switch is in pump-down position.</p>	<p>3 Check the circuit status on the control panel. Close switch.</p>
	<p>4 Evaporator flow switch is not closed.</p>	<p>4 Check the unit status on the control panel. Close switch.</p>
	<p>5 Circuit breakers are open.</p>	<p>5 Close circuit breakers.</p>
	<p>6 Fuse is blown or circuit breakers are tripped.</p>	<p>6 Check the electrical circuits and motor windings for shorts or grounds. Investigate for possible overloading. Check for loose or corroded connections. Reset breakers or replace fuses after fault is corrected.</p>
	<p>7 Unit phase voltage monitor is not satisfied.</p>	<p>7 Check unit power wiring to unit for correct phasing. Check voltage.</p>
	<p>8 Compressor overload is tripped.</p>	<p>8 Overloads are manual reset. Reset overload at button on overload.</p>
	<p>9 Compressor contactor or contactor coil is defective.</p>	<p>9 Check wiring. Repair or replace contactor.</p>
	<p>10 System was shut down by safety devices.</p>	<p>10 Determine the type and cause of the shutdown and correct the problem before attempting to restart.</p>
	<p>11 There is no cooling required.</p>	<p>11 Check control settings. Wait until unit calls for cooling.</p>
	<p>12 There is motor electrical trouble.</p>	<p>12 See 6, 7, 8 above.</p>
	<p>13 There is loose wiring.</p>	<p>13 Check circuits for voltage at required points. Tighten all power wiring terminals.</p>



<p><b>Compressor overload relay tripped or circuit breaker trip or fuses blown</b></p>	<ol style="list-style-type: none"> <li>1 There is low voltage during high load condition.</li> <li>2 There is loose power wiring.</li> <li>3 There is a power line fault causing unbalanced voltage.</li> <li>4 There is defective or grounded wiring in the motor.</li> <li>5 There is high discharge pressure.</li> </ol>	<ol style="list-style-type: none"> <li>1 Check the supply voltage for excessive voltage drop.</li> <li>2 Check and tighten all connections.</li> <li>3 Check the supply voltage.</li> <li>4 Check the motor and replace if defective.</li> <li>5 See corrective steps for high discharge pressure.</li> </ol>
<p><b>Compressor noisy or vibrating</b></p>	<ol style="list-style-type: none"> <li>1 There is a compressor internal problem.</li> <li>2 The oil injection is not adequate.</li> </ol>	<ol style="list-style-type: none"> <li>1 Contact Daikin.</li> <li>2 Contact Daikin.</li> </ol>
<p><b>Compressor will not load or unload</b></p>	<ol style="list-style-type: none"> <li>1 The capacity control is defective.</li> <li>2 The unloader mechanism is defective.</li> <li>3 The control solenoids are defective.</li> </ol>	<ol style="list-style-type: none"> <li>1 See capacity control section.</li> <li>2 Replace.</li> <li>3 Replace.</li> </ol>
<p><b>High discharge pressure</b></p>	<ol style="list-style-type: none"> <li>1 Discharge shut-off valve is partially closed.</li> <li>2 Non condensable is in the system.</li> <li>3 Fans are not running.</li> <li>4 Fan control is out of adjustment.</li> <li>5 Heat recovery condensers are dirty.</li> <li>6 System is overcharged with refrigerant.</li> <li>7 The condenser coil is dusty.</li> <li>8 The air recirculates from the outlet into the unit coils.</li> <li>9 Air entering the unit is restricted.</li> </ol>	<ol style="list-style-type: none"> <li>1 Open the shut-off valve.</li> <li>2 Purge the non-condensable from the condenser coil after shutdown.</li> <li>3 Check the fan fuses and electrical circuits.</li> <li>4 Check if the unit set-up in the microprocessor matches the unit model number. Check the microprocessor condenser pressure sensor for proper operation.</li> <li>5 Clean the condenser tubes by mechanical or chemical tools.</li> <li>6 Check for excessive sub-cooling. Remove the excess charge.</li> <li>7 Clean the condenser coil.</li> <li>8 Remove the cause of recirculation.</li> <li>9 Remove any obstructions near the unit.</li> </ol>

3

<p><b>Low discharge pressure</b></p>	<ol style="list-style-type: none"> <li>1 There is wind effect at low ambient.</li> <li>2 The condenser fan control is not correct.</li> <li>3 There is low suction pressure.</li> <li>4 The compressor is operating unloaded.</li> </ol>	<ol style="list-style-type: none"> <li>1 Protect the unit against excessive wind into the vertical coils.</li> <li>2 Check if the unit set-up in the microprocessor matches the unit model number.</li> <li>3 See the corrective steps for low suction pressure.</li> <li>4 See the corrective steps for failure to load.</li> </ol>
<p><b>Low suction pressure</b></p>	<ol style="list-style-type: none"> <li>1 The refrigerant charge quantity is inadequate.</li> <li>2 The evaporator is dirty.</li> <li>3 The liquid line filter-drier is clogged.</li> <li>4 The expansion valve is malfunctioning.</li> <li>5 The water flow to the evaporator is insufficient.</li> <li>6 The water temperature leaving the evaporator is too low.</li> <li>7 There is an evaporator head ring gasket slippage.</li> </ol>	<ol style="list-style-type: none"> <li>1 Check the liquid line sight-glass. Check the unit for leaks.</li> <li>2 Clean chemically.</li> <li>3 Replace.</li> <li>4 Check the expansion valve superheat and valve opening positions. Replace only the valve that is not working.</li> <li>5 Check the water pressure drop across the evaporator and adjust the flow.</li> <li>6 Adjust the water temperature to a higher value.</li> <li>7 If the suction pressure <b>and</b> the superheat are both low, it may indicate an internal problem.</li> </ol>
<p><b>High suction pressure</b></p>	<ol style="list-style-type: none"> <li>1 There is excessive load - high water temperature.</li> <li>2 The compressor unloaders are open.</li> <li>3 The superheat is too low.</li> </ol>	<ol style="list-style-type: none"> <li>1 Reduce the load or add additional equipment.</li> <li>2 See corrective steps below for failure of compressor to load.</li> <li>3 Check the superheat on the microprocessor display. Check the suction line sensor installation and sensor.</li> </ol>

# Part 4

## Commissioning and Test Run

---

**Introduction**

Commissioning and test run are well known practices in service engineering. This part contains a systematic approach on test run checks and test values, which guarantees a high quality installation and operation of the units.

---

**What is in this part?**

This part contains the following chapters:

Chapter	See page
1–Pre-Test Run Checks	4–3
2–Running Data	4–9

---

**4**

# 1 Pre-Test Run Checks

## 1.1 What Is in This Chapter?

---

**Introduction**

This chapter contains checks you have to carry out before every test run.

---

**Overview**

This chapter contains the following topics:

Topic	See page
1.2–Pre-Start Commissioning Check List	4–4
1.3–General Checks	4–5
1.4–Water Piping Checks	4–6

---

## 1.2 Pre-Start Commissioning Check List

Unit type:	Serial n°:		
	YES	NO	N/A
<b>General</b>			
Minimum system load sufficient for testing at 100% for approx. 1h			
Operation and service space are according to installation manual			
Oil heaters energized at least 24h before startup			
<b>Hydraulic circuit</b>			
Check if there is refrigerant pressure before connecting water circuit (if no pressure, do not connect)			
Water system filled & vented			
Condenser water temperature sensors installed in pockets (field installation)			
Pump installed, rotation checked, strainers cleaned			
Controls (3-way valves, cooling towers, bypass valves, etc) operational			
Water volume checked and according to specs			
Water flow checked and according to specs			
Water quality checked and according to specs			
<b>Electrical</b>			
Flowswitch fully installed and wired			
Power supply connected (+ earth wiring)			
Pump contact wired in series with the flow switch			
Field wiring in accordance with the local regulation			
<b>Completed and checked by:</b>			
<b>Signature:</b>			
<p>If installation on site is not according to the specifications as stated in the installation manual or the pre-commissioning checklist, or the unit can not run within the operation limits stated in the databooks, the unit can not be commissioned. However, in the aforementioned case the standard commissioning fee will still be charged to the customer.</p>			
<p><b>Please E-mail this document to <a href="mailto:fqs.technicalservices@daikineurope.com">fqs.technicalservices@daikineurope.com</a></b></p>			

### 1.3 General Checks

**Checklist**

The table below contains the general checklist.

Step	Check whether...
1	There is external damage.
2	The unit is properly supported and/or has a proper foundation.
3	The unit is installed horizontally with a deviation of maximum 1°.
4	Anti-vibration pads are required.
5	Check for remaining metal dust or burrs. Metal dust or burrs from grinding or drilling in the metal parts during construction facilitates the rust process and shortens the lifetime of the unit.
6	The operator has received the operation manual.
7	The installer has received the installation manual.
8	The air volume over the coil is adequate; there is no blockage (from paper, plastic...) or air short circuit due to wrong positioning.







**4**

## 2 Running Data

### 2.1 What Is in This Chapter?

---

**Introduction**

This chapter contains the typical operating data.

---

**Overview**

This chapter contains the following topics:

Topic	See page
2.2–Typical Operating Data	4–10

---

## 2.2 Typical Operating Data

### Standard eff with ST/LN

Nominal Conditions: OAT 35°C – Ent/Leav. Water Temp. 12/7°C – 100%

Operating Value	Standard Noise	Low Noise
Condensing Temperature	52-53°C	54-56°C
Evaporating Temperature	2-3°C	2-3°C
Total Liquid Sub Cooling	4-6°C	4-6°C
Suction Superheat	4-6°C	4-6°C
Discharge Superheat	20-25°C	20-25°C

### High eff with ST/LN

Nominal Conditions: OAT 35°C – Ent/Leav. Water Temp. 12/7°C

Operating Value	Standard Noise	Low Noise
Condensing Temperature	50-52°C	53-55°C
Evaporating Temperature	2-4°C	2-4°C
Total Liquid Sub Cooling (Cond. Coil 4-6°C – Eco 15-18°C)	19-24°C	19-24°C
Suction Superheat	4-6°C	4-6°C
Economiser Superheat	5-8°C	5-8°C
Discharge Superheat	20-25°C	20-25°C

### Premium eff with ST/LN

Nominal Conditions: OAT 35°C – Ent/Leav. Water Temp. 12/7°C

Operating Value	Standard Noise	Low Noise
Condensing Temperature	48-50°C	50-52°C
Evaporating Temperature	4-5°C	4-5°C
Total Liquid Sub Cooling (Cond. Coil 4-6°C – Eco 15-18°C)	19-24°C	19-24°C
Suction Superheat	4-6°C	4-6°C
Economiser Superheat	5-8°C	5-8°C
Discharge Superheat	20-25°C	20-25°C



**4**

# Part 5

## Maintenance

---

**Introduction**

Preventive maintenance should be set up for operation at maximum capacity or to avoid damage. The following chapter explain how to or when to maintain the units.

It is also applicable on other types of Daikin chillers.

---

**What is in this part?**

This part contains the following chapter:

Chapter	See page
1–Maintenance	5–3

---

**5**



# 1 Maintenance

## 1.1 What Is in This Chapter

**Introduction**

As shown in the table below, we have grouped the maintenance in maintenance of the system and standard checks.

**Precautions**

Correct choices and decisions have to be made before any maintenance is done. Opening the refrigerant circuit may cause a loss of refrigerant or lead to system contamination.

- Avoid high gas concentrations.  
While the heavy concentration of the refrigerant gas will remain on the floor level, good ventilation is a must.
- Avoid all contact with open fires or hot surfaces.  
By high temperatures, the refrigerant gas R-134a may decompose into irritating and poisonous gas. Avoid skin and hand contact with the liquid refrigerant and protect your eyes against liquid splashes.

**Overview**

This chapter covers the following topics:

Topic	See page
1.2–System Maintenance	5–4
1.3–Standard Checks	5–10

## 1.2 System Maintenance

---

### Warning:

- All routine and non-routine maintenance activities on the machine must be carried out solely by qualified personnel who have been suitably trained and are familiar with the device, its operation and maintenance, and who are aware of the safety requirements and risks involved.
- It is absolutely forbidden to remove all the protections of the moving parts of the unit.

### Attention:

- The causes of repeated shut-downs deriving from triggering of safety devices must be investigated and corrected. Simply re-starting the alarms may seriously damage the equipment.
  - A correct refrigerant and oil change is essential for optimal operation of the machine and for environmental protection. Any oil and refrigerant recovery must conform to legislation in force.
- 

### General

#### ■ Important:

Besides the checks suggested hereto, in order to keep the unit at optimal performance levels and efficiency and prevent malfunction, it is recommended to schedule periodical inspections of the unit by qualified personnel. Specifically, the following is recommended:

- 4 inspections per year (every three months) for units running about 365 days per year.
- 2 inspections per year (1 at seasonal start-up and the second mid-season) for units running about 180 days per year.
- 1 inspection per year (at seasonal start-up) for units running about 90 days per year.

Regular checks and routine controls should be considered extremely important both during initial start-up and regularly during operation. These checks also include suction and condensation pressures, the sight glass on the liquid line and that the superheating and subcooling parameters, read through the microprocessor installed on the machine, fall within the range of operating parameters.

A recommended ordinary maintenance programme is given at the end of this chapter, whilst an operating data collection card is at the end of the manual. We recommend recording all machine operating parameters on a weekly basis. The collection of this data will also be very useful for technicians, should technical assistance be required.

---

### Compressor maintenance

#### ■ Important:

Although the single-screw compressor is of a semi-hermetic type and therefore does not need scheduled maintenance, for the purposes of keeping the compressor at optimal levels of performance and efficiency and to prevent malfunction, we recommend a visual check on the state of satellite wear every 10000 hours of operation, and a measurement of satellite-screw coupling tolerance. This inspection must be carried out by qualified, trained personnel.

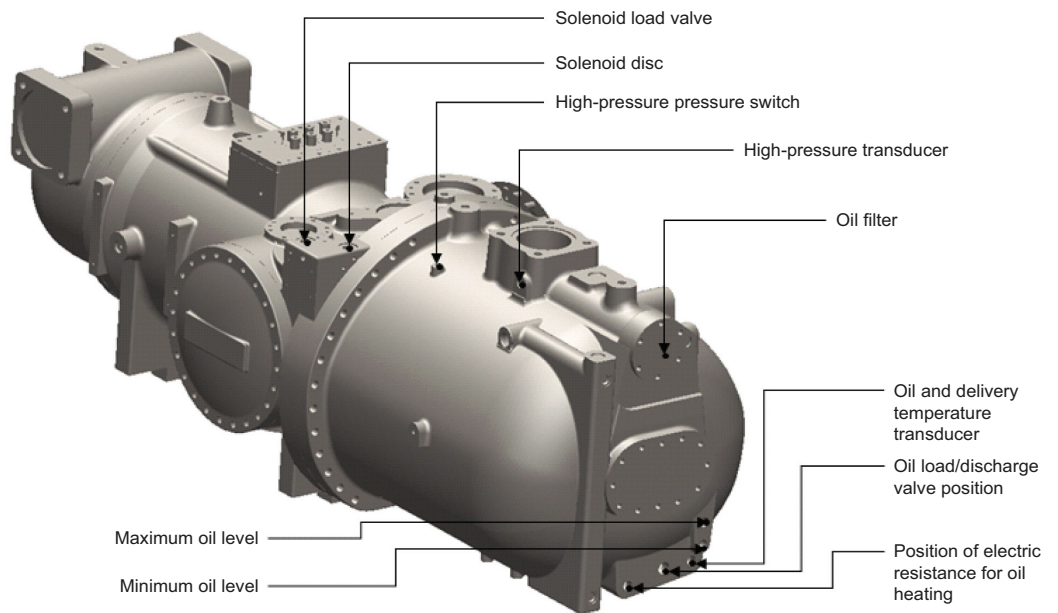
Vibration analysis is a good method for verifying the mechanical conditions of the compressor. Verification of vibration readings immediately after start-up and periodically on an annual basis is recommended. The compressor load must be similar to the previous measurement's load to ensure measurement reliability.

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### Lubrication

The units do not require a routine procedure for lubrication of components. The fan bearings are permanently lubricated and as such no additional lubrication is required.

Compressor oil is synthetic and highly hygroscopic. It is therefore advised to limit its exposure to the atmosphere during storage and filling. It is recommended that oil is exposed to the atmosphere for a period of no more than 15 minutes. The compressor oil filter is positioned above the oil separator (delivery side). Replacement is recommended when its pressure drop exceeds 2.0 bar. The pressure drop across the oil filter is the difference between the compressor discharge pressure and oil pressure. Both these pressures can be monitored through the microprocessor for both compressors.



Installation of F4AL compressor control devices

**Ordinary maintenance**

The following table shows the ordinary maintenance schedule:

List of activities	Weekly	Monthly (Note 1)	Yearly (Note 2)
<b>General:</b>			
Collection of operating data (Note 3)	X		
Visual inspection of machine for any damage and/or loosening		X	
Checking of thermal insulation integrity			X
Clean and paint where necessary			X
Water analysis (6)			X
<b>Electrical:</b>			
Checking of correct function of on-board machine instruments			X
Check contactor wear - Replace if necessary			X
Check fastening of all electrical terminals - Tighten if necessary			X
Clean the inside of the electrical control board			X
Visual inspection of components for any signs of overheating		X	
Check operation of compressor and electrical resistance		X	
Measure compressor motor insulation using the Megger			X
<b>Refrigeration circuit:</b>			
Check for any refrigerant leakage		X	

List of activities	Weekly	Monthly (Note 1)	Yearly (Note 2)
Check refrigerant flow using the liquid sight glass - Sight glass full	X		
Check filter dryer pressure drop		X	
Check oil filter pressure drop (Note 5)		X	
Analyse compressor vibrations			X
Analyse compressor oil acidity (7)			X
<b>Condenser section:</b>			
Clean the condensation banks (Note 4)			X
Check that the fans are properly fastened			X
Check the bank fins - Comb if necessary			X

**N.B.:**

1. Monthly activities include all weekly ones.
2. Yearly (or early season) activities include all weekly and monthly activities.
3. Machine operating values should be read on a daily basis thus keeping high observation standards.
4. Bank cleaning may be necessary more frequently in environments with a high percentage of particles in the air.
5. Replace the oil filter when the pressure drop reaches 2.0 bar.
6. Check for any dissolved metals.
7. TAN (Total Acid Number):
  - $\leq 0.10$ : No action.
  - Between 0.10 and 0.19: Replace anti-acid filters and check after 1,000 running hours. Continue to replace filters until the TAN is lower than 0.10.
  - $> 0.19$ : Change oil, replace oil filter and filter dryer. Check at regular intervals.

**Filter dryer replacement**

It is strongly recommended that the filter dryer cartridges be replaced in the event of a considerable pressure drop across the filter, or if bubbles are observed through the liquid sight glass while the subcooling value is within the accepted limits.

Replacement of the cartridges is advised when the pressure drop across the filter reaches 50 kPa with the compressor under full load.

The cartridges must also be replaced when the humidity indicator in the liquid sight glass changes colour and shows excessive humidity, or when the periodic oil test reveals the presence of acidity (TAN is too high).

### Filter dryer cartridge replacement procedure

**Attention:** Ensure proper water flow through the evaporator during the entire servicing period. Interrupting the water flow during this procedure would cause the evaporator to freeze, with consequent breakage of internal piping.

1. Shut down the relevant compressor turning the Q1 or Q2 switch to off.
2. Wait until the compressor has stopped and close the valve located on the liquid line.
3. Start up the relevant compressor turning the Q1 or Q2 switch to on.
4. Check the microprocessor display for the corresponding evaporation pressure.
5. When evaporation pressure reaches 100 kPa, turn switch Q1 or Q2 once again, to shut the compressor down.
6. Once the compressor has stopped, place a label on the start-up switch of the compressor being serviced, to avoid undesired start-ups.
7. Close the compressor suction valve (if any).
8. Using a recovery unit, remove surplus refrigerant from the liquid filter until atmospheric pressure is reached. The refrigerant must be stored in a suitable and clean container.

**Warning:** To protect the environment, do not release removed refrigerant into the atmosphere. Always use a recovery and storage device.

9. Balance internal pressure with external pressure by pressing the vacuum pump valve installed on the filter cover.
10. Remove the filter dryer cover.
11. Remove the filter elements.
12. Install the new filter elements in the filter.
13. Replace the cover gasket. Do not allow any mineral oil onto the filter gasket so as not to contaminate the circuit. Use only compatible oil for this purpose (POE).
14. Close the filter cover.
15. Connect the vacuum pump to the filter and pull vacuum to 230 Pa.
16. Close the vacuum pump valve.
17. Recharge the filter with the refrigerant recovered during emptying.
18. Open the liquid line valve.
19. Open the suction valve (if any).
20. Start up the compressor turning the Q1 or Q2 switch.

### Oil filter replacement

- **Important:** The lubrication system has been designed to keep most of the oil charge inside the compressor. During operation, however, a small amount of oil circulates freely in the system, conveyed by the refrigerant. The amount of replacement oil going into the compressor should therefore be equal to the quantity removed rather than the amount stated on the nameplate. This will avoid excess oil during the following start-up.

The quantity of oil removed from the compressor must be measured after having allowed the refrigerant present in the oil to evaporate for a suitable amount of time. To reduce the refrigerant content in the oil to a minimum, it is advised that the electrical resistances be kept on and that the oil be removed only when it has reached a temperature of 35÷45°C.

- **Attention:** The replacement of the oil filter requires careful attention with regard to the oil recovery. The oil must not be exposed to air for more than about 30 minutes. In case of doubts, check oil acidity or, if it is impossible to carry out the measurement, replace the charge of lubricant with fresh oil stored in sealed tanks or as specified by the supplier.

The compressor oil filter is positioned beneath the oil separator (delivery side). Replacement is recommended when its pressure drop exceeds 2.0 bar. The controller stops the compressor in an alarm status when the filter pressure drop reaches 2.5 bar. The pressure drop across the oil filter is the difference between the compressor delivery pressure minus oil pressure. Both these pressures can be monitored through the microprocessor for both compressors.

Compatible oils: Daphne PVE Hermetic oil FCV 68D

**Oil filter replacement procedure:**

1. Shut down both compressors by turning the Q1 and Q2 switches to the off position.
2. Turn the Q0 switch to off, wait for the circulation pump to turn off and open the general disconnecting switch Q10 to cut off the machine's electrical power supply.
3. Place a label on the handle of the general disconnecting switch in order to prevent accidental start-up.
4. Close the suction, discharge and liquid injection valves.
5. Connect the recovery unit to the compressor and recover the refrigerant in a suitable and clean container.
6. Evacuate the refrigerant until the internal pressure has turned negative (compared to atmospheric pressure). The amount of refrigerant dissolved in the oil is therefore reduced.
7. Drain the oil in the compressor by opening the drain valve located under the oil separator.
8. Remove the oil filter cover and the internal filter element.
9. Replace the cover o-ring and internal sleeve. Do not lubricate the o-ring with mineral oil in order not to contaminate the system.
10. Insert the new filter element.
11. Reposition the filter cover and tighten the screws. The screws must be tightened alternately and progressively, setting the torque wrench at 60 Nm.
12. Charge the oil from the upper cover on the oil separator. Considering the high hygroscopy of ester oil, it should be charged as quickly as possible. Do not expose ester oil to the atmosphere for more than 15 minutes.
13. Close the oil charging cover.
14. Connect the vacuum pump and evacuate the compressor up to a vacuum of 230 Pa.
15. On reaching the above vacuum level, close the vacuum pump valve.
16. Open the suction, discharge and liquid injection system valves.
17. Disconnect the vacuum pump from the compressor.
18. Remove the warning label from the general disconnecting switch.
19. Close the general disconnecting switch Q10 to supply power to the machine.
20. Start the machine by following the start-up procedure described above.

**Refrigerant charge**

- **Important:** The units have been designed to operate with R-134a refrigerant. DO NOT USE refrigerants other than R-134a.
- **Warning:** The addition or removal of refrigerant gas must be in accordance with current regulations and laws.
- **Attention:** When refrigerant gas is added to or removed from the system, ensure proper water flow through the evaporator for the entire charge/discharge time. Interrupting the water flow during this procedure would cause the evaporator to freeze, with consequent breakage of internal piping.  
Damage caused by freezing makes the warranty void.
- **Warning:** Removal of the refrigerant and replenishing operations must be performed by technicians who are qualified to use the appropriate materials for this unit. Unsuitable maintenance can result in uncontrolled losses in pressure and fluid. Do not disperse the refrigerant and lubricating oil in the environment. Always be equipped with a suitable recovery system.

The units ship with a full refrigerant charge, but in some cases it may be necessary to replenish the machine in the field.

- **Warning:** Always check the causes of a loss of refrigerant. Repair the system if necessary, then recharge it.

The machine can be replenished under any stable load condition (preferably between 70 and 100%) and under any ambient temperature condition (preferably above 20°C). The machine should be kept running for at least 5 minutes to allow the fan steps to stabilise and therefore condensation pressure. The units have approximately 15% of condensation banks devoted to subcooling of the refrigerant liquid. The subcooling value is equal to approx. 5-6°C (10-15°C for the economised machines). Once the subcooling section has been completely filled, additional refrigerant will not increase system efficiency. However, a small additional quantity of refrigerant (1÷2 kg) makes the system less sensitive.

- **N.B.:** As the load changes and the number of active fans changes, subcooling also changes and takes a few minutes to stabilise. In any case, it must never go below 3°C in any condition. Furthermore, the subcooling value may change slightly as the water temperature and suction superheating vary.

One of the two following scenarios can arise in a machine without refrigerant:

1. If the refrigerant level is slightly low, the flow of bubbles can be seen through the liquid sight glass. Replenish the circuit as described in the replenishment procedure.
2. If the gas level in the machine is moderately low, the corresponding circuit could have some low pressure stops. Replenish the corresponding circuit as described in the replenishment procedure.

**Refrigerant replenishment procedure**

1. If the machine has lost refrigerant, it is necessary to first establish the causes before carrying out any replenishment operation. the leak must be found and repaired. Oil stains are a good indicator, as they can appear in the vicinity of a leak. However, this is not necessarily always a good search criterion. Searching with soap and water can be a good method for medium to large leaks, while an electronic leak detector is required to find small leaks.
2. Add refrigerant to the system through the service valve on the evaporator inlet pipe.
3. The refrigerant can be added under any load condition between 25 and 100% of the circuit. Suction superheating must be between 4 and 6°C.
4. Add enough refrigerant to fill the liquid sight glass entirely so that no flow of bubbles can be seen any more. Add an extra 2 ÷ 3 kg of refrigerant as a reserve, to fill the subcooler if the compressor is operating at 50 - 100% load.
5. Check the subcooling value by reading the liquid pressure and the liquid temperature near the expansion valve. The subcooling valve must be between 4 and 8°C and 10 and 15°C for the machines with economiser. The subcooling value will be lower at 75 - 100% load and greater at 50% load.
6. With ambient temperature higher than 16°C, all fans must be on.
7. Overcharging the system will cause a rise in the compressor's discharge pressure, due to excessive filling of the condensation section tubes.

Pressure/Temperature table of the HFC-134a							
°C	Bar	°C	Bar	°C	Bar	°C	Bar
-14	0.71	12	3.43	38	8.63	64	17.47
-12	0.85	14	3.73	40	9.17	66	18.34
-10	1.01	16	4.04	42	9.72	68	19.24
-8	1.17	18	4.37	44	10.30	70	20.17
-6	1.34	20	4.72	46	10.90	72	21.13
-4	1.53	22	5.08	48	11.53	74	22.13
-2	1.72	24	5.46	50	12.18	76	23.16
0	1.93	26	5.85	52	13.85	78	24.23
2	2.15	28	6.27	54	13.56	80	25.33
4	2.38	30	6.70	56	14.28	82	26.48
6	2.62	32	7.15	58	15.04	84	27.66
8	2.88	34	7.63	60	15.82	86	28.88
10	3.15	36	8.12	62	16.63	88	30.14

## 1.3 Standard Checks

### Temperature and pressure sensors

The unit comes factory-equipped with all the sensors listed below. Periodically check that their measurements are correct by means of reference instruments (manometers, thermometers) and correct any wrong readings as necessary, using the microprocessor keypad. Well-calibrated sensors guarantee greater machine efficiency and a longer life.

**N.B.:** refer to the microprocessor use and maintenance manual for a complete description of the applications, settings and adjustments.

All sensors are preassembled and connected to the microprocessor. The descriptions of each sensor are listed below:

- **Outlet water temperature sensor** – This sensor is located on the evaporator outlet water connection and is used by the microprocessor to control the machine load depending on the system's thermal load. It also helps control the evaporator's antifreeze protection.
- **Inlet water temperature sensor** – This sensor is located on the evaporator inlet water connection and is used for monitoring the return water temperature.
- **External air temperature sensor** – Optional. This sensor allows for the monitoring of the external air temperature on the microprocessor display. It is also used to carry out the 'OAT setpoint override'.
- **Compressor discharge pressure compressor** – This is installed on every compressor and allows to monitor the discharge pressure and to control the fans. Should the condensation pressure increase, the microprocessor will control the compressor load in order to allow it to function even if split. It also contributes to the oil control logic.
- **Oil pressure transducer** – This is installed on every compressor and allows you to monitor the oil pressure. The microprocessor uses this sensor to inform the operator on the conditions of the oil filter and on how the lubrication system is functioning. By working together with the high and low pressure transducers, it protects the compressor from problems deriving from poor lubrication.
- **Low pressure compressor** – This is installed on every compressor and allows to monitor the compressor suction pressure along with the low pressure alarms. It also contributes to the oil control logic.
- **Suction sensor** – This is installed optionally (if the electronic expansion valve has been requested) on every compressor, and allows for the monitoring of suction temperature. The microprocessor uses the signal from this sensor to control the electronic expansion valve.
- **Compressor discharge temperature sensor** – This is installed on every compressor and allows to monitor the compressor discharge pressure along with the oil temperature. The microprocessor uses the signal from this sensor to control liquid injection and shut down the compressor should discharge temperature reach 110°C. It also protects the compressor from pumping liquid at start-up.



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