CONTROL PANEL OPERATING MANUAL

AIR COOLED SCROLL CHILLER & HEAT PUMP

MICROTECH III CONTROLLER

Software Version 3.01.A

D-EOMHP00607-14EN

CE

Table of Content

Introduction

This manual provides setup, operating, troubleshooting and maintenance information for the Daikin Air Cooled Chillers with 1, 2 and 3 circuits using Microtech III Controller.

Hazard Identification Information

⚠ DANGER
Dangers indicate a hazardous situation which will result in death or serious injury if not avoided.

⚠ WARNING
Warnings indicate potentially hazardous situations, which can result in property damage, severe personal injury, or death if not avoided.

⚠ CAUTION
Cautions indicate potentially hazardous situations, which can result in personal injury or equipment damage if not avoided.

Software Version: This manual covers units with Software Version XXXXXXX The unit's software version number can be viewed by selecting the "About Chiller" menu item accessible without password. Then, pressing the MENU key will return to the Menu screen.

Minimum BSP Version: 9.22

⚠ WARNING
Electric shock hazard: can cause personal injury or equipment damage. This equipment must be properly grounded. Connections to, and service of, the MicroTech III control panel must be performed only by personnel who are knowledgeable in the operation of this equipment .

⚠ CAUTION
Static sensitive components. A static discharge while handling electronic circuit boards can cause damage to the components. Discharge any static electrical charge by touching the bare metal inside the control panel before performing any service work. Never unplug any cables, circuit board terminal blocks, or power plugs while power is applied to the panel.

NOTICE

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, can cause interference to radio communications. Operation of this equipment in a residential area can cause harmful interference, in which case the user will be required to correct the interference at the user's own expense. Daikin disclaims any liability resulting from any interference or for the correction thereof.**Operating Limits:**

- Maximum standby ambient temperature, 57 °C
- Minimum operating ambient temperature (standard), 2 °C
- Minimum operating ambient temperature (with optional low-ambient control), -20 °C
- Leaving chilled water temperature, 4 °C to 15 °C
- Leaving chilled fluid temperatures (with anti-freeze), 3 °C to -8 °C. Unloading is not permitted with fluid leaving temperatures below -1 °C.
- Operating Delta-T range, 4 °C to 8 °C
- Maximum operating inlet fluid temperature, 24 °C
- Maximum non-operating inlet fluid temperature, 38 °C

1.1 Controller Features

Readout is given of the following temperature and pressure readings:

Entering and leaving chilled water temperature

Saturated evaporator refrigerant temperature and pressure

Saturated condenser refrigerant temperature and pressure

Outside air temperature

Suction line, and discharge line temperatures – calculated superheat for discharge and suction lines

Automatic control of primary and standby chilled water pumps. The control will start one of the pumps (based on lowest run-hours) when the unit is enabled to run (not necessarily running on a call for cooling) and when the water temperature reaches a point of freeze possibility.

Two levels of security protection against unauthorized changing of set-points and other control parameters.

Warning and fault diagnostics to inform operators of warning and fault conditions in plain language. All events and alarms are time and date-stamped for identification of when the fault condition occurred. In addition, the operating conditions that existed just prior to an alarm shutdown can be recalled to aid in isolating the cause of the problem.

Twenty-five previous alarms and related operating conditions are available.

Remote input signals for chilled water reset, demand limiting, and unit enable.

Test mode allows the service technician to manually control the controllers' outputs and can be useful for system checkout.

Building Automation System (BAS) communication capability via LonTalk®, Modbus®, or BACnet® standard protocols for all BAS manufacturers.

Pressure transducers for direct reading of system pressures. Preemptive control of low evaporator pressure conditions and high discharge temperature and pressure to take corrective action prior to a fault trip.

2 System Outline

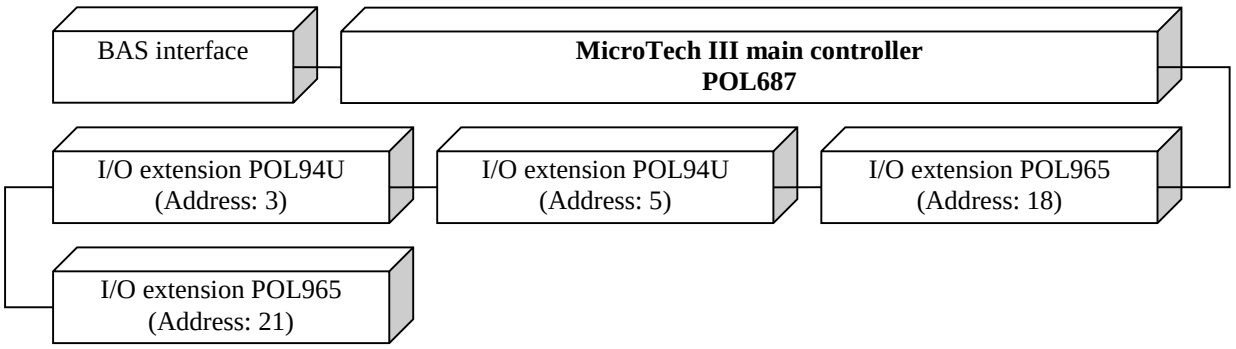
2.1 Communication components

Unit will use several communication components and that will depend on how many compressors are in the unit. The components to be used are defined by the following table. Also the diagram shown below indicates how those modules are connected.

Components	Address	Number of Compressors				
		2	3	4	5	6
BAS interface (Lon, BacNet, Modbus)	-	X	X	X	X	X
POL687 (MTIII Main controller)	-	X	X	X	X	X
POL965 (HP I/O extension module)	18	X	X	X	X	X
POL94U (EXV 1 I/O extension module)	3	X	X	X	X	X
POL94U (EXV 2 I/O extension module)	5	N/R	N/R	X	X	X
POL965 (OPZ 2 I/O extension module)	21	opz	opz	opz	opz	opz

Note: "x" means a unit will use that component.

Here is the sample diagram of component connection for 2 circuits unit, "W" configuration.



2.2 Unit I/O Mapping

The following table represents the physical connection from the controller hardware to the component physically in the machine.

Address	CONTROLLER			EWYQ-F- Heat Pump	
	Model	Section	I/O Type	I/O type	Value
	POL687	T2	Do1	Do	Cir 1 Comp 1
	POL687	T3	Do2	Do	Cir 1 Comp2
	POL687		Do3	Do	Cir 2 Comp 1
	POL687		Do4	Do	Cir 2 Comp 2
	POL687	T4	Do5	Do	Cir 1 Fan 1
	POL687		Do6	Do	Cir 1 Fan 2
	POL687		Do7	Do	Cir 1 Fan 3
	POL687		Do8	Do	Cir 2 Fan 1
	POL687	T5	Do9	Do	Cir 2 Fan 2
	POL687		Do10	Do	Cir 2 Fan 3
	POL687	T6	Di5	Di	Unit Switch
	POL687		Di6	Di	Double sp
	POL687	T7	AI1	Ai	Evap EWT
	POL687		AI2	Ai	Evap LWT
	POL687		AI3	Ai	Outside Ambient Temperature
	POL687	T8	X1	Ai	Cir 1 Suction Press
	POL687		X2	Ai	Cir 1 Discharge Press

	POL687		X3	Ai	Cir 1 Suction Temp
	POL687		X4	Di	Cir 1 Comp 1 Protection
	POL687	T9	X5	Ai	Cir 2 Suction Press
	POL687		X6	Ai	Cir 2 Discharge Press
	POL687		X7	Ai	Cir 2 Suction Temp
	POL687		X8	Do	Unit Alarm
	POL687	T10	Di1	Di	Cir 1 Comp 2 Protection
	POL687		Di2	Di	Evap Flow Switch
	POL687	T10	Di3	Di	Cir 1 switch
	POL687		Di4	Di	Cir 2 switch
	POL687	T12	Modbus		
	POL687	T13	KNX		
3	POL94U	T1	Do1	Do	Cir 1 Comp 3
	POL94U	T2	Di1	Di	Cir 1 Mechanical Hi Pressure Switch
	POL94U	T3	X1	Di	Cir 1 Comp 3 Protection
	POL94U		X2	Do	Cir 1 Fan 4
	POL94U		X3	Di	Cir 2 Comp 1 Protection
	POL94U	T4	M1+		
	POL94U		M1-		
	POL94U		M2+		
	POL94U		M2-		
5	POL94U	T1	Do1	Do	Cir 2 Comp 3
	POL94U	T2	Di1	Di	Cir 2 Mechanical Hi Pressure Switch
	POL94U	T3	X1	Di	Cir 2 Comp 2 Protection
	POL94U		X2	Do	Cir 2 Fan 4
	POL94U		X3	Di	Cir 2 Comp 3 Protection
	POL94U	T4	M1+		
	POL94U		M1-		
	POL94U		M2+		
	POL94U		M2-		
18	POL965	T1	Do1	Do	Cir 1 Liquid Line Solenoid Valve
	POL965		Do2	Do	Cir 2 Liquid Line Solenoid Valve
	POL965		Do3	Do	BUSY (Heat Recovery Pump)
	POL965		Do4		Not Used
	POL965	T2	Do5	Do	Evap Pump 1
	POL965		Do6	Do	Evap Pump 2
	POL965	T3	Di1	Di	Double Set-point
	POL965	T4	X1	Di	External Alarm
	POL965		X2	Ai	PVM
	POL965		X3	Ai	Demand Limit
	POL965		X4	Di	Not Used
	POL965	T5	X5	Ao	Cir 1 Fan Vfd
	POL965		X6	Ao	Cir2 Fan Vfd
	POL965		X7	Ai	LWT Reset
	POL965		X8	Di	Not Used
21	POL965	T1	Do1	Do	Water Drain Heater (North EU kit)
	POL965		Do2	Do	Cir 1 4 Way Valve
	POL965		Do3	Do	Not Used
	POL965		Do4	Do	Cir 1 4 Way Valve
	POL965	T2	Do5	Do	Circ1 Gas Purge Valve
	POL965		Do6	Do	Circ2 Gas Purge Valve
	POL965	T3	Di1	Di	Heat Pump Switch
	POL965	T4	X1		Not Used
	POL965		X2		Not Used
	POL965		X3	Ai	Cir 1 Discharge Temperature
	POL965		X4	Ai	Cir 2 Discharge Temperature
	POL965	T5	X5		Not Used
	POL965		X6		Not Used
	POL965		X7		Not Used
	POL965		X8		Not Used

2.3 Unit Mode

The unit EWYQ-F- has a different operating mode as follows:

- **COOL**, the unit works only as a chiller and the minimum set point set is 4,0 °C (39,2°F);
- **COOL w/GLYCOL**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), with glycol;
- **COOL/ICE w/GLYCOL**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), with glycol;
- **ICE**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), wh

3 Unit Functions

- it glycol;

3.1 HEAT, the Unit Mode

The unit EWYQ-F- has a different operating mode as follows:

- **COOL**, the unit works only as a chiller and the minimum set point set is 4,0 °C (39,2°F);
- **COOL w/GLYCOL**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), with glycol;
- **COOL/ICE w/GLYCOL**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), with glycol;
- **ICE**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F),
- **HEAT** the unit works only as a heat pump, the maximum set point set is 50°C (122°F), and works as a chiller in the same way of **COOL** mode;

3.2 HEAT / COOL w/GLYCOL the Unit Mode

The unit EWYQ-F- has a different operating mode as follows:

- **COOL**, the unit works only as a chiller and the minimum set point set is 4,0 °C (39,2°F);
- **COOL w/GLYCOL**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), with glycol;
- **COOL/ICE w/GLYCOL**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), with glycol;
- **ICE**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F),
- **HEAT** the unit works only as a heat pump, the maximum set point set is 50°C (122°F), and works as a chiller in the same way of **COOL w/GLYCOL** mode;

3.3 HEAT / ICE w/GLYCOL the Unit Mode

The unit EWYQ-F- has a different operating mode as follows:

- **COOL**, the unit works only as a chiller and the minimum set point set is 4,0 °C (39,2°F);
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- **COOL/ICE w/GLYCOL**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), with glycol;
- **ICE**, the unit works only as a chiller and the minimum set point set is -15,0 °C (5°F), wh
- as a heat pump, the maximum set point set is 50°C (122°F), and work as a chiller in the same way of **ICE w/GLYCOL** mode;
- **TEST**, the unit is not enabled to start automatically.

If is select the HEAT mode, for switch from heat pump to chiller is necessary to use the manual switch in the electric box, when the unit switch is set on OFF position.

3.4 Calculations

The calculations in this section are used in unit level control logic or in control logic across all circuits.

3.4.1 Evaporator Delta T

The Evaporator water delta t is calculated as the absolute value of entering water temperature minus leaving water temperature.

3.4.2 LWT Slope

LWT slope is calculated such that the slope represents the estimated change in LWT over a time frame of one minute.

3.4.3 Pull-down Rate

The slope value calculated above will be a negative value as the water temperature is dropping in Cool Mode or in Heat Mode.

In **COOL** Mode, pull-down rate is calculated by inverting the slope value and limiting to a minimum value of 0°C/min;

In **HEAT** Mode, pull-up rate is calculated using the slope value and limiting to a minimum value of 0°C/min;

3.4.4 LWT Error

LWT error is calculated as:

LWT – LWT target

3.4.5 Unit Capacity

Unit capacity will be based on the estimated circuit capacities.

The unit capacity is the number of compressors running (on circuits that are not pumping down) divided by the number of compressors on the unit *100.

3.4.6 Control Band

The Control Band defines the band in which unit capacity will not be increased or decreased.

The Control Band in **COOL** mode is calculated as follows:

Two compressor units: Control Band = Nominal Evap Delta T Set Point * 0.50
Three compressor units: Control Band = Nominal Evap Delta T Set Point * 0.50
Four compressor units: Control Band = Nominal Evap Delta T Set Point * 0.30
Six compressor units: Control Band = Nominal Evap Delta T Set Point * 0.20

The Control Band in **HEAT** mode is calculated as follows:

Two compressor units: Control Band = Nominal Cond Delta T Set Point * 0.50
Three compressor r units: Control Band = Nominal Cond Delta T Set Point * 0.50
Four compressor units: Control Band = Nominal Cond Delta T Set Point * 0.30
Six compressor units: Control Band = Nominal Cond Delta T Set Point * 0.20

3.4.7 Staging Temperatures

In **COOL** mode:
If the unit is configured for use without glycol:

When the LWT target is more than half the Control Band above 3.9°C (39.0°F)

Stage Up Temperature = LWT target + (Control Band/2)
Stage Down Temperature = LWT target – (Control Band/2)

If the LWT target is less than half the Control Band above 3.9°C (39.0°F)

Stage Down Temperature = LWT target – (LWT target - 3.9°C)
Stage Up temperature = LWT target + Control Band – (LWT target – 3.9°C)

If the unit is configured for use with glycol, the compressor staging temperatures are calculated as shown below:

Stage Up Temperature = LWT target + (Control Band/2)

For all cases the temperature start up or shut down is calculated as show below:

Start Up temperature = Stage Up temperature + Start Up delta T.
Shut Down temperature = Stage Down temperature – Shut Down delta T.

In **HEAT** mode:

Stage Up Temperature = LWT target - (Control Band/2)
Stage Down Temperature = LWT target + (Control Band/2)

For all cases the temperature start up or shut down is calculated as show below:

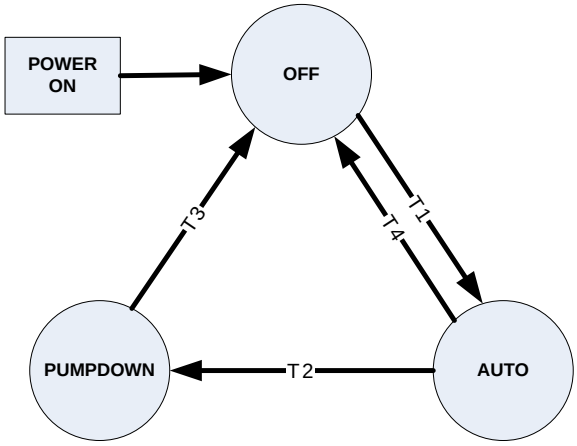
Start Up temperature = Stage Up temperature - Start Up delta T.
Shut Down temperature = Stage Down temperature + Shut Down delta T.

3.5 Unit States

The unit will always be in one of three states, these states are the same whether the unit works as a Chiller or a Heat Pump:

Off – Unit is not enabled to run (the compressors are not enable to start)
Auto – Unit is enabled to run (the compressors are enable to start if it is necessary)
Pump down – Unit is doing a normal shutdown

Transitions between these states are shown in the following diagram, these transitions are the only causes of a change of state:



T1 - Off to Auto

All of the following are required to switch from OFF state:
Unit Switch is set on Loc or Rem position, if it is in Rem position the remote ON/OFF is set to ON
No Unit Alarm
At least one circuit is enabled to start
If Unit Mode is set Ice, then the Ice Delay is not active
No change of configuration settings

T2 - Auto to Pump-down

Any of the following are required to switch from AUTO to PUMP DOWN state:
Unit Switch is set on Loc and the unit is disabled by HMI
LWT target is reached in any unit mode
Unit Pump down Alarm active
Unit Switch moved from Loc or Rem to OFF

T3 – Pump-down to Off

Any of the following are required to switch from PUMP-DOWN to OFF state:
Unit rapid stop alarm active
All circuits have completed pump-down

T4 - Auto to Off

Any of the following are required to switch from AUTO to OFF state:
Unit rapid stop alarm active
No circuit enabled and no compressors running

3.6 Unit Status

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

Status	**Conditions**
Auto	Unit run
Motor Protector Start Delay	Unit still waiting for the recycling timer
Off: Ice Mode Timer	Unit is forced to stop for ice timer
Off :OAT Lockout	Unit doesn't start because the external temperature is too low
Off: All Cir Disabled	All circuit switches are in Off position
Off: Unit Alarm	Unit is off and cannot start due to active alarm.
Off: Keypad Disable	Unit is disabled from keypad
Off: Remote Switch	Unit is disabled from remote switch

Off: BAS Disable	Unit is disabled from network supervisor
Off: Unit Switch	Unit is disabled from local switch
Off:Test Mode	Unit is in test mode
Auto:Wait for load	Unit is able to run, but no compressor running for thermoregulation
Auto:Evap Recirc	Unit is able to run, but the evaporator recycling timer is active
Auto:Wait for flow	Unit is able to run, but is waiting for the flow switch to close
Pump-down	Unit is making the pump-down
Auto:Max Pull limited	Unit runs but the pull-down rate of the LWT is too high
Auto:Unit Cap Limit	Unit runs and the capacity limit is reach
Off:Config Changed, Reboot	Some parameters are changed that require a system reboot
Defrosting	Unit in defrost

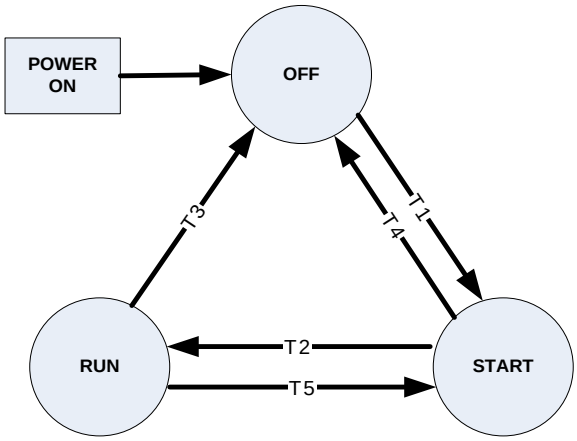
3.7 Power Up Start Delay

After powering up the unit, the motor protectors may not work properly for up to 150 seconds. Therefore, after the control is powered up, no compressor can start for 150 seconds. In addition, the motor protect inputs are ignored during this time so as to avoid tripping a false alarm.

3.8 Evaporator Pump Control

Whether the unit works as a chiller or a heat-pump, the evaporator pump control has three modes. .:
Off - No pump on.
Start – Pump is on, water loop is being recirculated.
Run – Pump is on, water loop has been recirculated and circuits can start if needed.

Transitions between these states are shown in the following diagram.



T1 – Off to Start
Requires any of the following

Unit state is Auto
LWT is less than the Evap Freeze set point – 0.6°C (1.1°F) and LWT sensor fault isn't active
Freeze Temp less than the Evap Freeze set point – 0.6°C (1.1°F) and Freeze Temp sensor fault isn't active

T2 – Start to Run
Requires the following

The flow switch is closed for time longer than evaporator recirculate time set point

T3 – Run to Off
Requires all of the following

Unit state is Off
LWT is higher than the Evap Freeze set point or LWT sensor fault is active

T4 – Start to Off
Requires all of the following

Unit state is Off
LWT is higher than the Evap Freeze set point or LWT sensor fault is active

3.9 Evaporator Pump configuration

The unit can manage one or two water pumps, the following set point are used to manage the working mode:

#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

3.9.1 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 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 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.

3.9.2 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.

3.10 LWT Target

The LWT Target varies based on settings and inputs.

The base LWT Target is selected as follows:

	COOL LWT target 1	COOL LWT target 2	ICE LWT target	HEAT LWT target 1	HEAT LWT target 2
COOL	**X**	**X**			
COOL w/GLYCOL	**X**	**X**			
COOL/ICE w/GLYCOOL	**X**	**X**	**X**		
ICE	**X**	**X**	**X**		
HEAT	**X**	**X**		**X**	**X**
HEAT/COOL w/GLYCOOL	**X**	**X**		**X**	**X**
HEAT/ICE w/GLYCOL	**X**	**X**	**X**	**X**	**X**

3.10.1 Leaving Water Temperature (LWT) Reset

The base LWT target may be reset if the unit is in Cool mode and LWT reset is enabled via the set point.

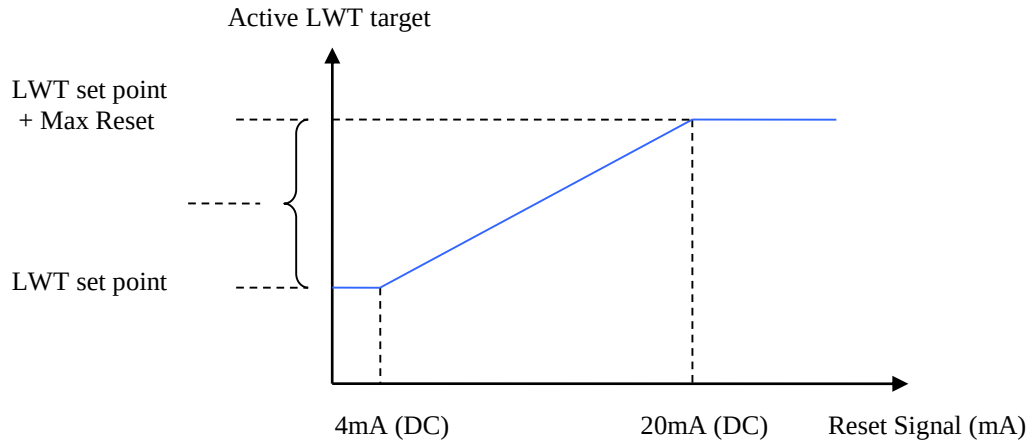
The reset amount is adjusted based on the 4 to 20 mA reset input. Reset is 0° if the reset signal is less than or equal to 4 mA. Reset is 5.56°C (10.0°F) if the reset signal equals or exceeds 20 mA. The amount of reset will vary linearly between these extremes if the reset signal is between 4 mA and 20 mA.
When the reset amount increases, the Active LWT Target is changed at a rate of 0.1°C every 10 seconds. When the active reset decreases, the Active LWT Target is changed all at once.
After the reset is applied, the LWT target can never exceed a value of 15.56°C (60°F).

3.10.2 Leaving Water Temperature (LWT) Override

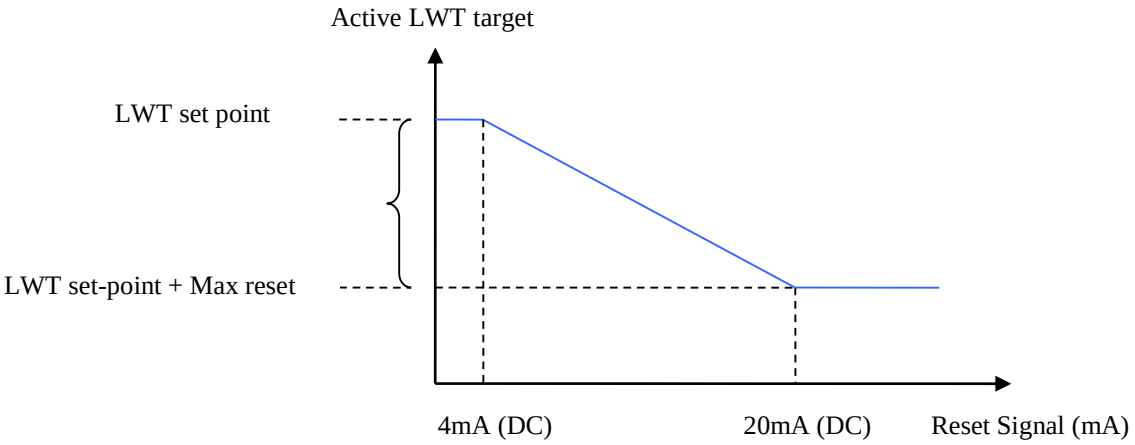
The base LWT target may be automatically overridden if the unit is in Heat mode and outside ambient temperature (OAT) decreases to less than -2°C, as follows:
This automatic control ensures that compressors work inside the normal and secure working envelope and prevents motor breakage.

3.10.3 4-20mA Reset

The Active Leaving Water variable is adjusted by the 4 to 20mA reset analog input.
--- For cooling ---

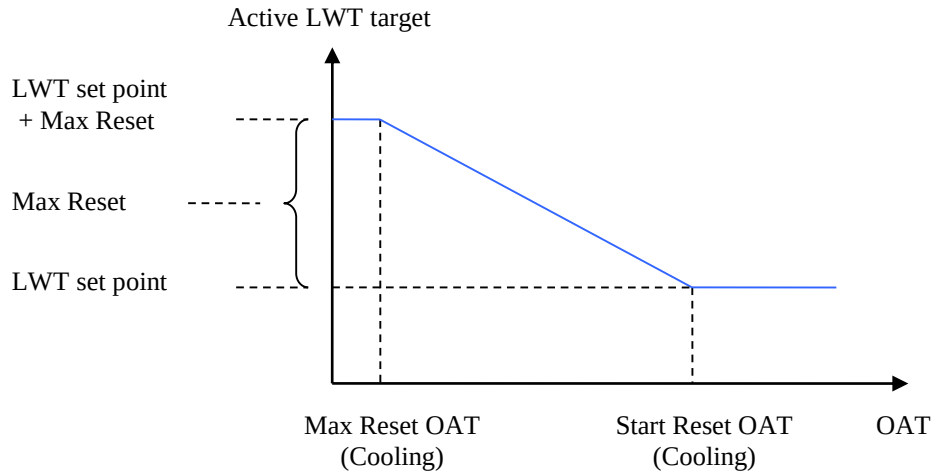


--- For heating ---

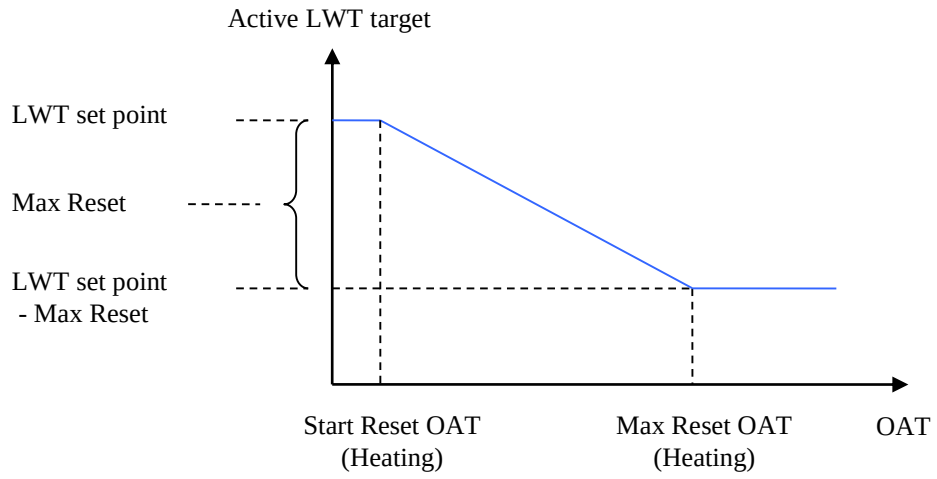


3.10.4 OAT Reset

The Active Leaving Water variable is adjusted by the OAT.
--- For cooling ---



--- For heating ---



Name	Class	Unit	Default	Min.	Max.
Max Reset OAT (Cooling)	Unit	°C	15.0	10.0	30.0
Start Reset OAT (Cooling)	Unit	°C	23.0	10.0	30.0
Max Reset OAT (Heating)	Unit	°C	23.0	10.0	30.0
Start Reset OAT (Heating)	Unit	°C	15.0	10.0	30.0

3.11 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.

3.11.1 Compressor Staging in Cool Mode

The first compressor on the unit is started when evaporator LWT is higher than the Startup Temperature and the Evaporator recycling time has expired.

Additional compressors can be started when Evaporator LWT is higher than the Stage Up Temperature and the Stage Up Delay is not active.
When multiple compressors are running, one will shut down if the evaporator LWT is lower than the Stage Down Temperature and the Stage Down Delay is not active.
All running compressors shut down when the evaporator LWT is lower than the Shut Down Temperature.

3.11.2 Compressor Staging in Heat Mode

The first compressor on the unit is started when evaporator LWT is lower than the Startup Temperature.
Additional compressors can be started when Evaporator LWT is lower than the Stage Up Temperature and the Stage Up Delay is not active.
When multiple compressors are running, one will shut down if the evaporator LWT is lower than the Stage Down Temperature and the Stage Down Delay is not active.
All running compressors shut down when the evaporator LWT is higher than the Shut Down Temperature.

3.11.3 Compressors Staging Delay

Both in Cool or Heat mode, the sequencing has the following delay times

3.11.3.1 Stage Up Delay

A minimum amount of time, defined by the Stage Up Delay set point, passes between increases in the capacity stage. This delay will only apply when at least one compressor is running. If the first compressor starts and quickly shuts off for some reason, another compressor may start without this minimum time passing.

3.11.3.2 Stage Down Delay

A minimum amount of time, defined by the Stage Down Delay set point, passes between decreases in the capacity stage. This delay doesn't apply when the LWT drops below the Shut Down Temperature (unit is immediately shut down).

Name	Unit/Circuit	Default	Scale		
			min	max	delta
Stage Up Delay	Unit	60 s	60 s	300 s	1
Stage Down Delay	Unit	60 s	60 s	300 s	1

3.11.3.3 Compressor Staging in Ice Mode

The first compressor on the unit is started when evaporator LWT is higher than the Startup Temperature.
Additional compressors are started as quickly as possible with respect to the Stage Up Delay.
The unit shut down when evaporator LWT is less than the LWT target.

3.11.3.4 Stage Up Delay

A fixed stage up delay of one minute between compressor starts is used in this mode.

3.11.3.5 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.
If possible circuits will be balanced during staging. If a circuit is unavailable for any reason, the other circuit shall be allowed to stage all compressors on. When staging down, one compressor on each circuit shall be left on until each circuit has only one compressor running.

3.11.3.6 Next To Start

If both circuits have an equal number of compressors running or a circuit has no compressors available to start:

- the available compressor with the least starts will be next to start
- if starts are equal, the one with the least run hours will be next to start
- if run hours are equal, the lowest numbered one will be next to start

If the circuits have an unequal number of compressors running, the next compressor to start will be on the circuit with the least compressors running if it has at least one compressor available to start. Within that circuit:

- the available compressor with the least starts will be next to start
- if starts are equal, the one with the least run hours will be next to start
- if run hours are equal, the lowest numbered one will be next to start

3.11.3.7 Next To Stop

If both circuits have an equal number of compressors running:

- the running compressor with the most run hours will be next to stop
- if run hours are equal, the one with the most starts will be next to stop
- if starts are equal, the lowest numbered one will be next to stop

If the circuits have an unequal number of compressors running, the next compressor to stop will be on the circuit with the most compressors running. Within that circuit:

- the running compressor with the most run hours will be next to stop
- if run hours are equal, the one with the most starts will be next to stop
- if starts are equal, the lowest numbered one will be next to stop

Unit Capacity Overrides

In cooling or heating mode only, the total unit capacity can be limited. Multiple limits may be active at any time, and the lowest limit is always used in the unit capacity control.

3.11.4 Demand Limit

The maximum unit capacity can be limited by a 4 to 20 mA signal on the Demand Limit analog input. This function is only enabled if the Demand Limit Option set point is set to ENABLE. The maximum unit capacity stage is determined as shown in the following tables:

Two compressors:

Demand Limit Signal (%)	Demand Limit (mA)	Stage Limit
Demand Limit ≥ 50%	Demand Limit ≥ 12 mA	1
Demand Limit < 50%	Demand Limit < 12 mA	None

Three compressors:

Demand Limit Signal (%)	Demand Limit (mA)	Stage Limit
Demand Limit ≥ 66.6%	Demand Limit ≥ 14.6 mA	1
66.6% > Demand Limit ≥ 33.3%	14.6 mA > Demand Limit ≥ 9.3 mA	2
Demand Limit < 33.3%	Demand Limit < 9.3 mA	None

Four compressors:

Demand Limit Signal (%)	Demand Limit (mA)	Stage Limit
Demand Limit ≥ 75%	Limit ≥ 16 mA	1
75% > Demand Limit ≥ 50%	16 mA > Limit ≥ 12 mA	2
50% > Demand Limit ≥ 25%	12 mA > Limit ≥ 8 mA	3
Demand Limit < 25%	Demand Limit < 8 mA	None

Six compressors:

Demand Limit Signal (%)	Demand Limit (mA)	Stage Limit
Demand Limit ≥ 83.3%	Demand Limit ≥ 17.3 mA	1
83.3% > Demand Limit ≥ 66.7%	17.3 mA > Demand Limit ≥ 14.7 mA	2
66.7% > Demand Limit ≥ 50%	14.7 mA > Demand Limit ≥ 12mA	3
50% > Demand Limit ≥ 33.3%	12 mA > Demand Limit ≥ 9.3 mA	4
33.3% > Demand Limit ≥ 16.7%	9.3 mA > Demand Limit ≥ 6.7 mA	5
Demand Limit <16.7%	Demand Limit <6.7 mA	None

3.11.5 Network Limit

The maximum unit capacity can be limited by a network signal. This function is only enabled if the control source is set to network and the Network Limit Option set point is set to ENABLE The maximum unit capacity stage is based on the network limit value received from the BAS, and is determined as shown in the following tables:

Two compressors:

Network Limit	Stage Limit
Network Limit ≥ 100%	None
Network Limit < 50%	1

Three compressors:

Network Limit	Stage Limit
Network Limit ≥ 100%	None
66.6% > Network Limit ≥ 33.3%	2
Network Limit < 33.3%	1

Four compressors:

Network Limit	Stage Limit
Network Limit ≥ 100%	**None**
100% > Network Limit ≥ 75%	**3**
75% > Network Limit ≥ 50%	**2**
Network Limit < 50%	**1**

Six compressors:

Network Limit	Stage Limit
Network Limit ≥ 100%	**None**
100% > Network Limit ≥ 83.3%	**5**
83.3% > Network Limit ≥ 66.7%	**4**
66.7% > Network Limit ≥ 50%	**3**
50% > Network Limit ≥ 33.3%	**2**
Network Limit < 33.3%	**1**

3.11.6 Maximum LWT Pull down/up Rate

The maximum rate at which the leaving water temperature can drop shall be limited by the Maximum Pull-down Rate set point, only when the unit mode is Cool; instead in Heat mode, the maximum rate at which the leaving water temperature can raise shall be limited by the Maximum Pull-up Rate.
If the rate exceeds this set point, no more compressors shall be started until the pull-down or pull-up rate is less than the set point both in Cool or Heat mode.
Running compressors will not be stopped as a result of exceeding the maximum pull down or pull-up rate.

3.11.7 High Ambient Limit

On units configured with single point power connections, the maximum load amps could be exceeded at high ambient temperatures. If all compressors are running on circuit 1 or all but one compressor on circuit 1, power connection is single point, and the OAT is greater than 46.6°C (115.9°F), circuit 2 is limited to running all but one compressor. This limit will allow the unit to operate at higher temperatures than 46.6°C (115.9°F).

3.11.8 Fan Control in "V" configuration

The fan control of EWYQ-F- unit depends from the configuration of the unit, if the unit is configured as a "V" type, the fan control is managed directly from the unit, if the unit is configured as a "W", each circuit will control its own fans.
The fan control is used in COOL, COOL w/Glycol or ICE mode to maintain the best condensation pressure and in HEAT mode for maintain the best evaporation pressure, all modes of control are based on the saturated temperature of the gas.

3.11.8.1 Fan Staging

Fans can be staged as needed as long as at least one compressor is running. Since proper staging up has to be assured for the circuit with the greater saturated condensing temperature in COOL mode or the lower saturated evaporating temperature in HEAT mode; if both circuits are on, they are given the same reference saturated condensing/evaporating temperature, that is calculated as the higher/lower of each circuit saturated condensing/evaporating temperature:

Ref_Sat_Con T = MAX (T_Sat_Cond_T_Cir#1, T_Sat_Cond_T_Cir#1)

Ref_Sat_Evap T = MIN (T_Sat_Evap_T_Cir#1, T_Sat_Evap_T_Cir#1)

Fan staging accommodates anywhere from 4 to 6 common fans, using up to 4 outputs for control. The total number of fan on is adjusted with changes of 1 or 2 fan at time, as shown in the following table:

4 FANS					
Fan Stage	**Outputs Energized for each Stage**	**Out 1**	**Out 2**	**Out 3**	**Out 4**
1	1	●	○	○○	○○
2	1,2	●	●	○○	○○
3	1,3	●	○	●●	○○
4	1,2,3	●	●	●●	
5 FANS					
Fan Stage	**Outputs Energized for each Stage**	**Out 1**	**Out 2**	**Out 3**	**Out 4**
1	1	●	○	○○	○○
2	1,2	●	●	○○	○○
3	1,3	●	○	●●	○○
4	1,2,3	●	●	●●	○○
5	1,2,3,4	●	●	●●	●
6 FANS					
Fan Stage	**Outputs Energized for each Stage**	**Out 1**	**Out 2**	**Out 3**	**Out 4**
1	1	●	○	○○	○○
2	1,2	●	●	○○	○○
3	1,3	●	○	●●	○○
4	1,2,3	●	●	●●	○○
5	1,3,4	●	○	●●	●●
6	1,2,3,4	●	●	●●	●●

3.11.8.2 Condenser Target

The condenser target is automatically selected from the set points (see set points tables, "Condenser Target x%"), basing on the actual unit capacity percentage (compressors running / total number of compressors on the unit). Each stage of capacity on a circuit uses a different condensing target set point.
A minimum condenser target, calculated on the base of evaporator LWT, has anyway to be enforced.
The Condenser Target, thus, will be the maximum between selected set point and the calculated one.
For "V" double circuit units, further target adjustment is needed to allow for significant differences between circuit saturated condensing temperatures. This can happen when unit load is unbalanced between circuits (25%, 75%, or 50% with one circuit at full load and the other off).
In this condition, to prevent a further compressor stage up from being inhibited, the Condenser Target(*) is overriden as follows:

New Condenser Target = Condenser Target + [30°C - MIN (Tcond#1, Tcond#2)]

Name	Unit/Circuit	Default	Scale		
			min	max	delta
Condenser Max Target	Circuit	38°C	25°C	55°C	1
Condenser Min Target	Circuit	30°C	25°C	55°C	1

3.12 Evaporator Target

The evaporator target is fixed at 2°C (35.6°F). This fixed value is based on mechanical and thermodynamic characteristics of R410a.

3.12.1 Unbalanced load management

If unit load is 50% and one circuit is moving from off to starting, the application forces the unit load redistribution by mean of a staging down. The standard unit capacity control logic provides the "next off" compressor to stop on the full load circuit and, consequently, the unit load will be rebalanced. In this conditions, there are no issues for further compressor starts,.

3.12.2 Staging Up

In COOL mode, the first fan will not start until the evaporator pressure drop or condenser pressure rise requirement for the No Pressure Change After Start alarm is satisfied. Once that requirement is met, if there is no fan VFD then the first

fan turns on when the saturated condenser temperature exceeds the condenser target. If there is a fan VFD, then the first fan turns on when the saturated condenser temperature exceeds the condenser target less 5.56°C (10°F).
After this, the four stage up dead-bands shall be used. Stages one through four use their respective dead-bands. Stages five through six use the Stage Up Dead-band 4.
When the saturated condenser temperature is above the target + the active dead-band, a stage up error is accumulated.

Stage Up Error Step = Saturated Condenser Temperature – (Target + Stage Up dead-band)

The Stage Up Error Step is added to Stage Up Accumulator once every 5 seconds, but only if the Saturated Condenser Refrigerant Temperature is not falling. When Stage Up Error Accumulator is greater than 11°C (19.8°F) 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.
In HEAT Mode, before the first compressor starts, all the fans are turned on to prepare the coil; that in this cycle work as a condenser..

3.12.3 Staging Down

Four stage down dead-bands shall be used. Stages one through four use their respective dead-bands. Stages five and six all use Stage Down Dead-band 4.

When the saturated condenser refrigerant temperature is below the target – the active dead-band, a stage down error is accumulated:

Stage Down Error Step = (Target - Stage Down dead-band) - Saturated Condenser Temperature

The Stage Down Error Step is added to Stage Down Accumulator once every 5 seconds. When the Stage Down Error Accumulator is greater than 2.8°C (5°F) another stage of condenser fans is removed.

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.

3.12.4 VFD

Condenser pressure trim control is accomplished using optional VDF on the first outputs (Speedtrol) or on all outputs (fan speed modulation) for fan control.
This VFD control varies the first fan or all fans speed to drive the saturated condenser temperature to a target value.
The target value is normally the same as the saturated condenser temperature target.
The speed is controlled between the minimum and maximum speed set points.

Name	Unit/Circuit	Default	Scale		
			min	max	delta
VFD Max Speed	Circuit	100%	60%	110%	1
VFD Min Speed	Circuit	25%	25%	60%	1

3.12.5 VFD State

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

3.12.6 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 dead-band to the VFD target. The higher target causes the VFD logic to decrease fan speed. Then, every 2 seconds, 0.1°C (0.18°F) is subtracted from the VFD target until it is equal to the saturated condenser temperature target set point.

4 Circuit Functions

4.1 Calculations

4.1.1 Refrigerant Saturated Temperature

Refrigerant saturated temperature shall be calculated from the pressure sensor readings for each circuit. A function will provide the converted value of temperature to match NIST values as generated by the REFPROP program:
within 0.1°C for pressure input ranging from 0 kPa to 2070 kPa
within 0.2°C for pressure input ranging from -80 kPa to 0 kPa

4.1.2 Evaporator Approach

The evaporator approach shall be calculated for each circuit. The equation is as follows:

In **COOL** mode : Evaporator Approach = LWT – Evaporator Saturated Temperature
In **HEAT** mode : Evaporator Approach = OAT – Evaporator Saturated Temperature

4.1.3 Condenser Approach

The condenser approach shall be calculated for each circuit. The equation is as follows:

In **COOL** mode : Condenser Approach = Condenser Saturated Temperature – OAT
In **HEAT** mode : Condenser Approach = Condenser Saturated Temperature - LWT

4.1.4 Suction Superheat

Suction superheat shall be calculated for each circuit using the following equation:

Suction superheat (SSH) = Suction Temperature – Evaporator Saturated Temperature

4.1.5 Pump-down Pressure

The pressure to which a circuit will pump-down is based on the Low Evaporator Pressure Unload set point in COOL mode, instead in HEAT mode is based on actual evaporating pressure, this because in HEAT mode the evaporating pressure is just low.
The equation is as follows:

In **COOL** mode : Pump-down pressure = Low Evap Pressure Unload set point – 103kPa
In **HEAT** mode : Pump-down pressure = MIN (200 kPa, (pressure before PD – 20 kPa), 650 kPa)

4.2 Circuit Control Logic

4.2.1 Circuit Enabling

A circuit is enabled to start if the following conditions are true:

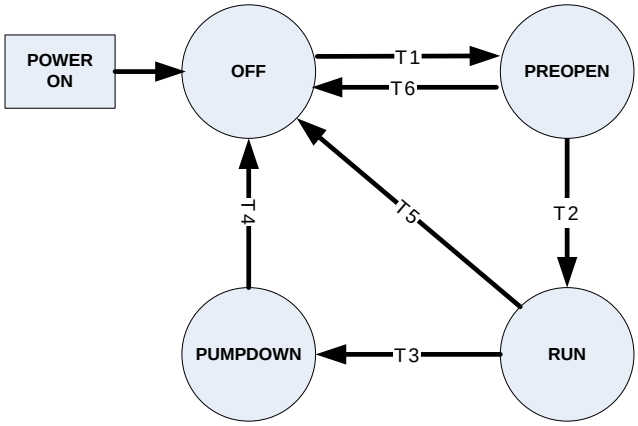
- Circuit switch is closed
- No circuit alarms are active
- Circuit Mode set point is set to Enable
- At least one compressor is enabled to start (according to enable set points)

4.2.2 Circuit States

The circuit will always be in one of four states:

- **OFF**, circuit is not running
- **PRE-OPEN**, circuit is preparing to start
- **RUN**, circuit is running
- **PUMP-DOWN**, circuit is doing a normal shutdown

Transitions between these states are shown in the following diagram:



T1 – Off to Pre-open

No compressors are running and any compressor on circuit is commanded to start (see unit capacity control in unit)

T2 – Pre-open to Run

5 seconds from PRE-OPEN phase has passed

T3 – Run to Pump-down

Any of the following are required:
Last compressor on circuit is commanded to stop
Unit State is PUMP-DOWN
Circuit switch is open
Circuit mode is disable
Circuit PUMP-DOWN alarm is active

T4 – Pump-down to Off

Any of the following are required:
Evaporator Pressure < Pump-down Pressure Value[1]

[1] In Chiller mode the value is equal to Low Press Unload – 103.0 kPa

Unit State is OFF
Circuit Rapid Stop alarm is active

T5 – Run to Off

Any of the following are required:
Unit State is OFF
Circuit Rapid Stop alarm is active
A low ambient start attempt failed

T6 – Pre-open to Off

Any of the following are required:
Unit State is OFF
Unit State is PUMP-DOWN
Circuit switch is open
Circuit mode is disable
Circuit Rapid Stop alarm is active
Circuit Pump-down alarm is active

4.3 Circuit Status

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

Status	Conditions
Off: Ready	Circuit is ready to start when needed.
Off: Cycle Timers	Circuit is off and cannot start due to active cycle timer on all compressors.
Off: All Compressors Disabled	Circuit is off and cannot start due to all compressors being disabled.
Off: Keypad Disable	Circuit is off and cannot start due to circuit enable set point.
Off: Circuit Switch	Circuit is off and circuit switch is off.
Off: Alarm	Circuit is off and cannot start due to active circuit alarm.
Off: Test Mode	Circuit is in test mode.
Pre-open	Circuit is in pre-open state.
Run: Pump-down	Circuit is in pump-down state.
Run: Normal	Circuit is in run state and running normally.
Run: Evap Pressure Low	Circuit is running and cannot load due to low evaporator pressure.
Run: Cond Pressure High	Circuit is running and cannot load due to high condenser pressure.
Run: High Ambient Limit	Circuit is running and cannot add more compressors due to the high ambient limit on unit capacity. Applies only to circuit 2.
Run: Defrosting	Defrost running is running

Pump-down Procedure

The pump-down is performed as follows:

- If multiple compressors are running, shut off the appropriate compressors based on sequencing logic and leave only one running;
- Turn off liquid line output (if valve present);
- Keep running until evaporator pressure reaches the pump-down pressure, then stop compressor;
- If evaporator pressure does not reach pump-down pressure within two minutes, stop compressor and generate a pump-down failed warning;

4.4 Compressor Control

Compressors run only when the circuit is in a run or pump-down state. They will not run when the circuit is in any other state.

In Heat Mode the value is equal to Evap Press @ Pump down start -20 kPa (limit from 200 kPa and 650 kPa)

4.4.1 Compressor Availability

A compressor is considered available to start if all the following are true:

- The corresponding circuit is enabled
- The corresponding circuit is not in pump-down
- No cycle timers are active for the compressor
- No limit events are active for the corresponding circuit
- The compressor is enabled via the enable set points
- The compressor is not already running

4.4.2 Starting a Compressor

A compressor starts if it receives a start command from the unit capacity control logic or if defrost routine are calling the start up.

4.4.3 Stopping a Compressor

A compressor is turned off if any of the following occur:

Unit capacity control logic commands it off
An unload alarm occurs and the sequencing requires this compressor to be next off
Circuit state is pump-down and sequencing requires this compressor to be next off
Defrost routine has called a stop

4.4.4 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 determined by the Start-Start Timer and Start-Stop Timer set points.

Name	Unit/Circuit	Default	Scale		
			min	max	delta
Start to Start Time	Circuit	6 min	6	15	1
Stop to Start Time	Circuit	2 min	1	10	1

These cycle timers aren't enforced through cycling of power to the chiller. This means that if power is cycled, the cycle timers isn't active.
These timers may be cleared via a setting on the HMI.
When the defrost routine is active the timers are set by the defrost phase logic.

4.5 Fan Control in "W" configuration

Condenser Fan Control is managed at this level when the unit is configured a "W" or "V" single circuit type . What follows covers this type of units. Condenser Fan Control of "V" double circuit configuration, is described in "Unit Functions" chapter, before in this document.

4.5.1 Fan Staging

Fans have to be staged as needed any time compressors are running on the circuit. All running fans turn off when the circuit goes to the off state.
Fan staging shall accommodate anywhere from 3 to 6 fans on a circuit using up to 4 outputs for control. The total number of fan on is adjusted with changes of 1 or 2 fan at time, as shown in the following table:

3 FANS					
Fan Stage	Outputs Energized for each Stage	Out 1	Out 2	Out 3	Out 4
1	1	●	○	○○	
2	1,2	●	●	○○	
3	1,3	●	○	●●	
4 FANS					

Fan Stage	Outputs Energized for each Stage	Out 1	Out 2	Out 3	Out 4
1	1	●	○	○○	○○
2	1,2	●	●	○○	○○
3	1,3	●	○	●●	○○
4	1,2,3	●	●	●●	
5 FANS					
Fan Stage	**Outputs Energized for each Stage**	**Out 1**	**Out 2**	**Out 3**	**Out 4**
1	1	●	○	○○	○○
2	1,2	●	●	○○	○○
3	1,3	●	○	●●	○○
4	1,2,3	●	●	●●	○○
5	1,2,3,4	●	●	●●	●
6 FANS					
Fan Stage	**Outputs Energized for each Stage**	**Out 1**	**Out 2**	**Out 3**	**Out 4**
1	1	●	○	○○	○○
2	1,2	●	●	○○	○○
3	1,3	●	○	●●	○○
4	1,2,3	●	●	●●	○○
5	1,3,4	●	○	●●	●●
6	1,2,3,4	●	●	●●	●●
7FANS					
Fan Stage	**Outputs Energized for each Stage**	**Out 1**	**Out 2**	**Out 3**	**Out 4**
1	1	●	○	○○	○○
2	1,2	●	●	○○	○○
3	1,3	●	○	●●	○○
4	1,2,3	●	●	●●	○○
5	1,3,4	●	○	●●	●●
6	1,2,3,4	●	●	●●	●●
7	1,2,3,4	●	●	●●	●●●

4.5.2 Fan Control Target

In COOL mode the condensing temperature target is automatically calculated using the follow:

Condensing Temperature Target = (0,5 * Condenser Saturated Temperature) – 30.0

This value is limited between a Min Condensing temperature target and a Max Condensing target, set by interface.
In HEAT mode the evaporating temperature target is fixed set to 2°C.

4.5.2.1 Staging Up in COOL mode

The first fan will not start until the evaporator pressure drop or condenser pressure rise requirement for the No Pressure Change After Start alarm is satisfied. Once that requirement is met, if there is no fan VFD then the first fan turns on when the saturated condenser temperature exceeds the condenser target. If there is a fan VFD, then the first fan turns on when the saturated condenser temperature exceeds the condenser target less 5.56°C (10°F).

After this, the four stage up dead-bands shall be used. Stages one through four use their respective dead-bands. Stages five through six all use the Stage Up Dead-band 4.

When the saturated condenser temperature is above the target + the active dead-band, a stage up error is accumulated.

Stage Up Error Step = Saturated Condenser Temperature – (Target + 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 11°C (19.8°F) 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.

4.5.2.2 Staging Down in COOL mode

Four stage down dead-bands shall be used. Stages one through four use their respective dead-bands. Stages five and six all use Stage Down Dead-band 4.

When the saturated condenser refrigerant temperature is below the target minus the active dead-band, a stage down error is accumulated.

Stage Down Error Step = (Target - Stage Down dead-band) - Saturated Condenser Temperature

The Stage Down Error Step is added to Stage Down Accumulator once every 5 seconds. When the Stage Down Error Accumulator is greater than 2.8°C (5°F) another stage of condenser fans is removed.

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.**

4.5.2.3 Staging Up in HEAT mode

When the circuit is in Pre-open phase all the fan stages are turned on to prepare the coil for the evaporating phase of the cycle.
When the refrigerant saturated evaporating temperature is below the target minus the active dead-band, a stage up error is accumulated.

Stage Up Error Step = Saturated Evaporating Temperature - Target

The Stage Down Error Step is added to Stage Down Accumulator once every 5 seconds. When the Stage Down Error Accumulator is greater than 11°C (51.8°F) another stage of condenser fans is added.

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.

4.5.2.4 Staging Down in HEAT mode

Four stage down dead-bands shall be used. Stages one through four use their respective dead-bands. Stages five and six all use Stage Down Dead-band 4.

When the saturated evaporating refrigerant temperature is below the target minus the active dead-band, a stage down error is accumulated.

Stage Down Error Step = Saturated Evaporating Temperature + Target

The Stage Down Error Step is added to Stage Down Accumulator once every 5 seconds. When the Stage Down Error Accumulator is greater than 2.8°C (5°F) another stage of condenser fans is removed.

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.

4.5.2.5 VFD

Coil pressure trim control is accomplished using optional VDF on the first outputs (Speedtrol) or on all outputs (fan speed modulation) for fan control.
This VFD control varies the first fan or all fans speed to drive the saturated condenser/evaporating temperature to a target value. The target value is normally the same as the fan control target.
The speed is controlled between the minimum and maximum speed set points.

4.5.2.6 VFD State

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

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

4.5.2.7 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 dead-band to the VFD target. The higher target causes the VFD logic to decrease fan speed. Then, every 2 seconds, 0.1°C (0.18°F) is subtracted from the VFD target until it is equal to the saturated condenser temperature target set point.

4.6 EXV Control

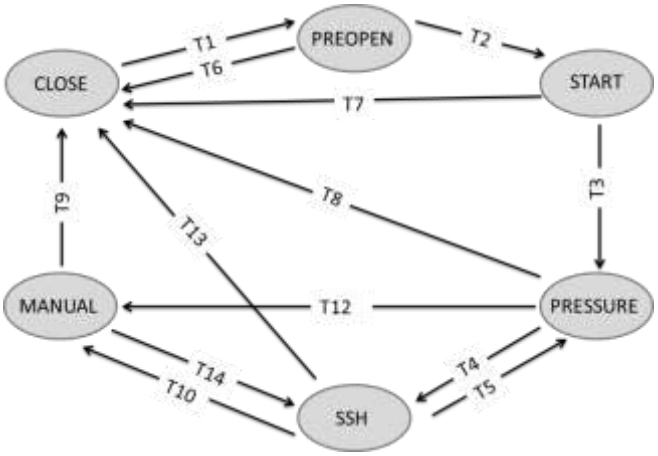
The EWYQ-F- is equipped with an Electronic Expansion Valve with pre-set parameters as follow:

- Max Steps: 3530
- Max acceleration: 150 steps/sec
- Hold current: 0 mA
- Phase current: 100 mA

Also the electronic expansion valve work is managed as shown in the state- logic figure below, the states are:

- **CLOSED**, in this state the valve is totally closed, no regulation is active;

- **PRE-OPEN**, in this state the valve is positioned in a fixed position, to prepare the circuit compressors for start- up;
- **START**, in this state the valve is locked in a fixed position, greater than the PRE-OPEN phase, to prevent liquid returning to the compressors;
- **PRESSURE**, in this state the valve controls the evaporating pressure, with PID regulation, , this phase has 3 different types of control:
    - **Starting pressure control**: always, after the START phase, the expansion valve controls the pressure to maximize thermal exchange at the unit start;
    - **Max evaporating pressure control**: when the evaporating pressure rises above the Max Operating Evaporating Pressure;
    - **Defrost pressure control**: in defrost routine.
-
- **SSH**, in this state the valve controls the Suction Super Heat, with PID regulation; calculated as Suction Temperature – Saturated Evaporation Temperature;
- **MANUAL**, in this state the valve controls a pressure set-point, inserted via the HMI, with PID regulation



T1 – Close to Pre-open

Circuit State is PRE-OPEN;

T2 – Pre-open to Start

Is passed from EXV PRE-OPEN phase a time equal at the Pre-open time set point;

T3 – Start to Pressure

Is passed from EXV START phase a time equal at the Start time set point;

T4 – Pressure to SSH

SSH is lower than set point for at least 30 seconds, when the control is in PRESSURE phase;

T5 – SSH to Pressure

If the Starting pressure control is passed,
OR the evaporating pressure is greater than max evaporating pressure for at least 60 seconds,

OR the Defrost state is greater or equal than 2;

T6 – Pre-open to Close
Circuit state is OFF or PUMP-DOWN and Exv state is PRE-OPEN

T7 – Start to Close
Circuit state is OFF or PUMP-DOWN and Exv state is START

T8 – Pressure to Close
Circuit state is OFF or PUMP-DOWN and Exv state is PRESSURE

T9 – Manual to Close
Circuit state is OFF or PUMP-DOWN and Exv state is MANUAL

T10 – SSH to Manual
Manual set-point is switched on TRUE from HMI;

T12 – Pressure to Manual
Manual set-point is switched on TRUE from HMI;

T13 – SSH to Close
Circuit state is OFF or PUMP-DOWN and Exv state is MANUAL

T14 –Manual to SSH
Manual set-point is switched on FALSE from HMI;

4.6.1 EXV Position Range

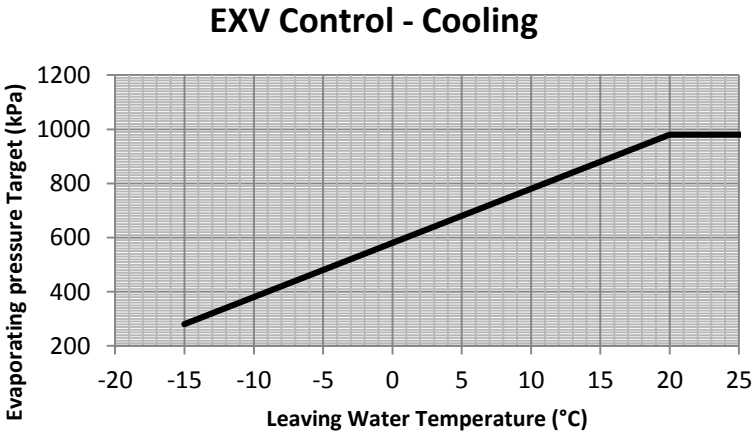
The EXV range varies between 12% and 95% for each pair of compressors running and the total number of fans on the unit.

When staging down a compressor the maximum position is reduced by 10% for one minute to prevent liquid refrigerant from getting to compressors. After this initial one minute delay, the valve's maximum is allowed to return to its normal value at a rate of 0.1% every six seconds. This offset to the maximum position should not occur if the stage down is due to a low pressure unload.

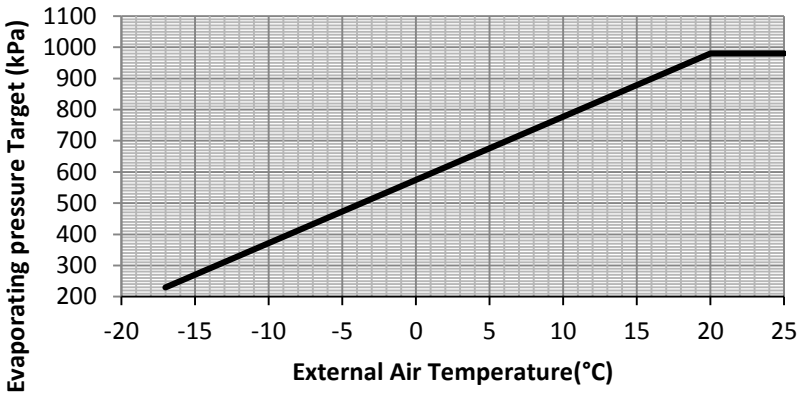
In addition, the expansion valve maximum position may be increased if after two minutes both the suction superheat is greater than 7.2°C (13°F) and the expansion valve has been within 5% of its current maximum position. The maximum increases at a rate of 0.1% every six seconds up to a total of an additional 5%. This offset to the maximum position is reset when the EXV is no longer in the Superheat Control state, or a compressor on the circuit stages.

4.6.2 Starting Pressure Control

One of the Pressure Control modes is during the unit start-up, in this situation the control of the electronic expansion valve is used to maximize the heat- exchange with water (COOL cycle) or external air temperature (HEAT cycle) the target value, is as follows:



Based on the value of Leaving Water Temperature, the set point of the starting pressure control is calculated, the operating ranges is between the follow values:
LWT @ Max operating evaporating pressure (980 kPa) = 20°C (68°F)
LWT @ Min operating evaporating pressure (280 kPa) = -15°C (5°F)



Based on the value of External Air, the set point of the starting pressure control is calculated, the operating ranges is between the follow values:

OAT@ Max operating evaporating pressure (980 kPa) = 20°C (68°F)
OAT @ Min operating evaporating pressure (280 kPa) = -17°C (5°F)

This particular Pressure control runs every time that the unit starting up.
The Exv control exits from this sub routine if the SSH is lower than the set point for a time longer than 5 seconds or the sub-routine has been active for more than 5 minutes.
After this phase the control always passes to SSH control.

4.6.3 Max Pressure Control

This Pressure control starts when the evaporating pressure rises to the Max evaporation pressure for a time longer than 60 seconds.
After this time elapses, the valve control switches to PID control dedicated to the regulate the pressure to the Max evaporating pressure set point (default to 980 kPa).
The Exv control exits from this sub routine when the SSH is lower than the set point for a time longer than 5 second.
After this phase the control passes always to SSH control.

4.6.4 Manual Pressure Control

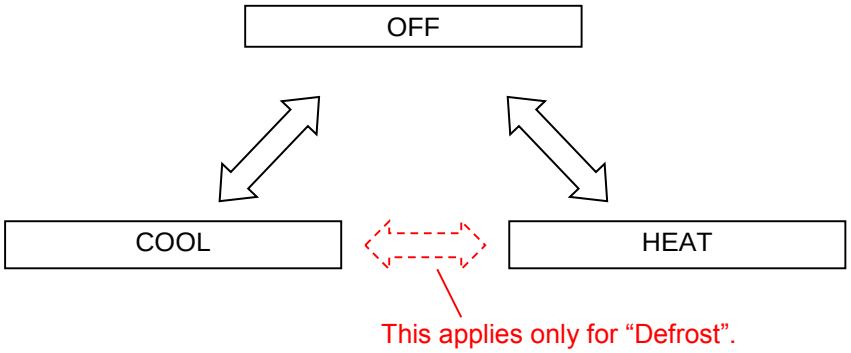
This routine was designed to manage the pressure set point of the Exv control manually. When the routine is enabled, starting position of the valve remains at the last position it held in automatic control, in this way the valve doesn't move resulting in a 'bumpless' change.
When the Exv control is in manual pressure state, the logic will switch automatically Max Pressure control, if the operating pressure exceeds the maximum operating pressure

4.7 Four Way Valve Control

The four way valve is the component of the heat pump that inverts the thermodynamics cycle and hence the mode, from chiller to heat pump and back.
The logic inside of the controller manages this change of cycle, preventing accidental switch of the valve, and ensures that the valve is in the correct position according to the cycle selected from the HMI.

4.7.1 Four Way Valve Status

The state of the four way valve is according the following chart:



The operating modes is selected from the manual switch in the control panel.

To activate a changeover of the valve, all the compressors must be off; only in defrost phase is the valve able to switch a compressor running.

If the switch is used to change mode during normal running, the HP switch will trip. The unit will make a normal pump down and then shut off the compressor. After all compressors are off a 10 second timer starts, after which, the valve is switched.

The compressors start up follows the normal recirculation timer.

The valve switching is also limited by the differential pressure limits of the four way valve. i.e. the differential pressure must be between 300 kPa and 3100 kPa.

The valve is controlled by a digital output with the following logic.

4way valve	Cooling cycle	Heating cycle
	OFF	ON

4way valve State	Conditions
OFF	Hold last operation output.
COOL	Hold cooling output
HEAT	Hold heating output

4.8 Gas Purge Valve

This valve is used to bleed gas from the liquid receiver and ensure correct filling. This routine is active only when the machine is in **HEAT** mode.

This valve is open when:

- Exv Control is in Pre-open phase, in **HEAT** mode;
- Circuit control is in Pump Down phase, in **HEAT** mode;
- For 5 minutes after the circuit start up, in **HEAT** mode;
- For 5 minute after the start of phase 7 of defrost routine, after that the four way valve returns to the **HEAT** position;

The valve is closed when:

- Circuit state is OFF;
- Operation mode is different from **HEAT;**
- In defrost routine when the four way valve is in **COOL** position;

4.9 Capacity Overrides – Limits of Operation

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

4.9.1 Low Evaporator Pressure

If the Low Evaporator Pressure Hold or Low Evaporator Pressure Unload alarms are triggered, the circuit capacity may be limited or reduced. See the Circuit Events section for details on triggering, reset, and actions taken.

4.9.2 High Condenser Pressure

If the High Condenser Pressure Unload alarm is triggered, the circuit capacity may be limited or reduced. See the Circuit Events section for details on triggering, reset, and actions taken.

4.9.3 Low Ambient Starts

A low OAT start is initiated if the condenser refrigerant saturated temperature is less than 29.5°C (85.1° F) when the first compressor starts. Once the compressor starts the circuit is in a low OAT start state for a time equal to the Low OAT Start Time set point. During Low OAT Starts, the freeze start logic for the low evaporator pressure alarm as well as the low evaporator pressure hold and unload alarms are disabled. The absolute limit for low evaporator pressure is enforced and the low evaporator pressure trip is triggered if the evaporator pressure drops below that limit.

When the Low OAT Start Timer has expired, if the evaporator pressure is greater than or equal to the Low Evaporator Pressure Unload set point, the start is considered successful and normal alarm and event logic is reinstated. If the evaporator pressure is less than the Low Evaporator Pressure Unload set point when the Low OAT Start Timer expires, the start is unsuccessful and the compressor will shut down.

Multiple Low Ambient Start attempts are allowed. On the third failed Low Ambient Start attempt the Restart Alarm is triggered and the circuit will not attempt to restart until the Restart alarm has been cleared.

The restart counter is 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.

This routine is enabled only in **COOL** mode.

4.10 High Pressure Test

This routine is used only to test high pressure switch at the end line of the production.
This test shuts off all fans, and increases the threshold high pressure unload . When the high pressure switch trips , the routine id deactivate and the unit returns with the initial setting.

In every case after 5 minutes the routine is automatically disabled.

4.11 Defrost Control Logic

Defrosting is required when the unit is in HEAT mode, and the ambient temperature falls to a level at which the dew point is below 0°C. In this condition, ice can form on the coil and needs to be periodically removed to prevent low evaporating pressures.

The defrost routine detects the condition of ice accumulation on the coil and reverses the cycle. Thus, with the coil now working as a condenser, the heat of rejection melts the ice.

When this routine take the control, because have been detects the condition for the defrost, its manage the compressors, the fan , the expansion valve, the four way valve and the solenoid valve (if present) of the circuit interested.

All the operations are made with the use of the low pressure and high pressure transducer, external air temperature, St temperature sensors.
By use of the high and low pressure transducers and temperature sensors, the defrost control mode manages the compressor, fans, four-way valve and liquid line solenoid valve (if present) to achieve the reverse cycle and defrost.

The reverse-cycle defrost is automatic when the ambient temperature is below 8°C; above this temperature, but only up to 10°C, if a defrost is required, this must be initiated manually from a set-point in the HMI circuits section. Above 10°C, the reverse-cycle mode cannot be used, and defrost can only be achieved by switching off the unit and allowing the ice to melt in the high ambient temperature.

4.11.1 Defrost Condition Detect

Automatic defrost is initiated on the basis of the following algorithm:-

$$St < (0{,}7 * OAT) - DP \text{ and } St < 0°C$$

Where DP is Defrost Parameter, default set to 10.

The defrost routine cannot start if:

- Defrost timer is expired (time between the end of one defrost and start of another defrost);
- Any other circuits have defrost active (only one circuit at a time can start defrost routine);

In the second case, the circuit that requests the defrost start will wait until the other circuit defrost finishes.

4.11.2 Reverse Cycle Defrost

This type of Defrost routine is only available when the external air temperature is under 8°C, and regular ice build-up is likely.

In this mode, the unit is forced to work in COOL mode, reversing the working status.The defrost routine is composed of 8 different phases. The switch of four way valve is made with one compressor active, and when it is in the COOL MODE, the Low Evaporation pressure alarm is inhibited,

To ensure that this routine starts, it is necessary that this follow conditions are true:

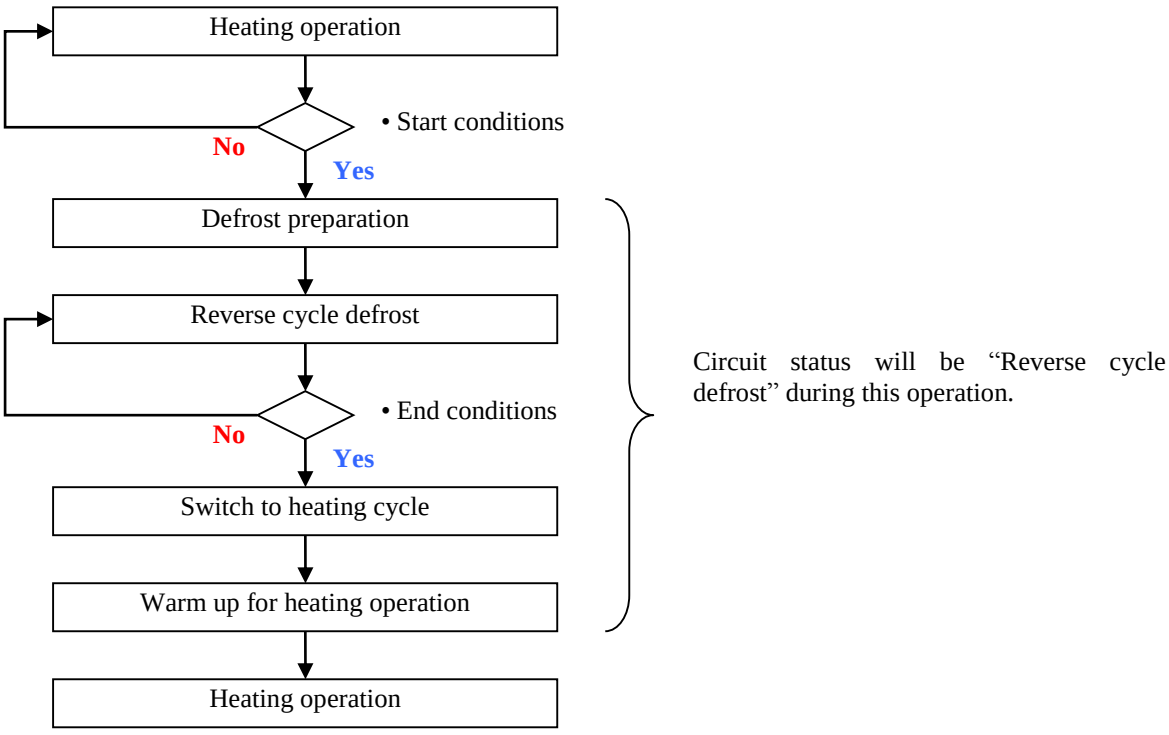
- Defrost Cycle Timer [2] (default 30 min) expired;
- No other circuit with defrost active;
- Unit cycle is **HEAT**;
- St < (0,7 * OAT) – DP, DP is defrost parameter default set to 10;
- St < 0°C;
- OAT < 8°C

All of these conditions must be true for 30 seconds.

The defrost will terminate if at least one of the following conditions are true:

- Condensing pressure > 2960 kPa;
- LWT < 6°C;
- 10 minutes are passed from the start of phase 3 of Defrost routine;

When one of these conditions are true, the unit is returned to the Heat cycle and the defrost routine ends.



[2] *Defrost Cycle Timer* is a timer that start when the defrost routine finish and is not stopped during a circuit stop.

4.11.2.1 Phase 1: Defrost Preparation

In this phase the controller prepares the circuit for cycle inversion. Each component is managed by the Defrost control logic:

This phase requires that one compressor is active for at least 10 seconds.

4.11.2.2 Phase 2: Cycle Inversion

In this phase the four-way valve is temporarily reversed and the chiller operates in cooling mode: the heat from the condensing discharge gas melts the ice on the outside of the coil.

The passage to next phase is enabled if the follows conditions are true:

Differential Pressure (DP) > 400kPa for 5 seconds
OR
At least 60 seconds have elapsed from the start of phase 2

4.11.2.3 Phase 3: Defrosting

In this phase, the defrost process starts.

The passage to next phase is enabled if the follows conditions are true:

20 seconds have passed from the start of phase 3

If the EWT is under 14°C the defrost control logic bypasses phase 4 and go directly to phase 5.

4.11.2.4 Phase 4: Accelerate Defrost

In this phase the Defrost control logic runs all of the compressors for increase the condensation pressure and temperature to accelerate the defrosting process.

The passage to the next phase is enabled if the follows conditions are true:

300 seconds have passed from the start of phase 4
OR
Condensing Pressure > 2620 kPa (45°C) for at least 5 seconds

4.11.2.5 Phase 5: Ice Cleaning

In this phase the compressor power is reduced, in order to operate with a constant discharge pressure while the residual ice is removed.

The passage to the next phase is enabled if the follows conditions are true:

Condensing Pressure > 2960 kPa
OR
LWT < 6°C
OR
10 minute have passed from the start of phase 3

4.11.2.6 Phase 6: Preparation to restore Heating Mode

In this phase the Defrost control logic prepares the circuit to return to Heating mode.

The passage to the next phase is enabled if the follows conditions are true:

Number of compressors active is 1 for at least 10 seconds

4.11.2.7 Phase 7: Cycle Inversion, Return in Heating

In this phase the four-way valve is inverted and the circuit returns to Heating mode.

The passage to the next phase is enabled if the follows conditions are true:

Differential Pressure (DP) > 400 kPa for at least 25 seconds
OR
60 seconds have passed from phase 7 start

There is a time delay to ensure that liquid refrigerant is not returned to the compressor.

4.11.2.8 Phase 8: Heating Mode

With this phase the thermodynamic circuit returns to Heating mode and control returns to the heat set-point.

The circuit returns to normal Heating Mode, and the defrost routine finishes, if the follow conditions are true:

SSH < 6°C for at least 10 seconds
OR
120 seconds have passed from the start of phase 8
OR
Discharge temperature > 125°C

The meaning of the pressure control after the switch of the inversion valve is to prevent liquid return to the compressors.

4.11.3 Manual Defrost

The logic of manual defrost follows all of the phases of the defrost logic: the object of this feature is to allow the defrost to be initiated when even though the automatic criteria are not fulfilled This enables a test of the machine in critical conditions.

The manual defrost is started by a manual switch in the HMI, and the defrost begins if the following conditions are true:

The circuit is in Run state and work in Heating mode
AND
Manual Defrost switch in HMI is turn in ON
AND
Suction Temperature < 0°C
AND
No other circuit in Defrost

Following activation of the Manual Defrost switch, it returns to OFF position after a couple of seconds

<table>
<tr><th>Alarm / Event</th><th>Water temp inverted</th><th>Lo Pr difference shutdown, Event</th><th>Lo Evap Pr shutdown</th><th>Lo Evap Pr unload</th><th>Lo Evap Pr Inhibit load</th></tr>
<tr><td>Stage1</td><td rowspan="3">Ignored</td><td rowspan="3">Ignored</td><td>Normal</td><td rowspan="2">Ignored</td><td rowspan="3">Ignored</td></tr>
<tr><td>Stage2,3,4,5,6,7</td><td>Temporary Trigger shall be 0kPa for 10seconds</td></tr>
<tr><td>Stage8</td><td>Normal</td></tr>
</table>

4.12 Set Point Tables

Set points are stored in permanent memory. Read and write access to these set points is determined by a separate HMI password.
Set points are initially set to the values in the Default column, and can be adjusted to any value in the Range column.

Unit Level Set Points:

Description	Default	Range	
Mode/Enabling			
Unit Enable	Enable	Disable, Enable	
Network Unit Enable	Disable	Disable, Enable	
Control source	Local	Local, Network	
Available Modes	Cool	Cool Cool w/Glycol Cool/Ice w/Glycol Ice	Heat Heat/Cool w/Glycol Heat/Ice w/Glycol Test
Network Mode Command	Cool	Cool, Ice	
Staging and Capacity Control			
Cool LWT 1	7°C (44.6°F)	See section 2.1	
Cool LWT 2	7°C (44.6°F)	See section 2.1	
Ice LWT	4.0°C (39.2°F)	-15.0 to 4.0 °C (5 to 39.2 °F)	
Heat LWT 1	45°C (113°F)	See section 2.1	
Heat LWT 2	45°C (113°F)	See section 2.1	
Network Cool Set Point	7°C (44.6°F)	See section 2.1	
Network Ice Set Point	4.0°C (39.2°F)	-15.0 to 4.0 °C (5 to 39.2 °F)	
Startup Delta T	2.7°C (4.86°F)	0.6 to 8.3 °C (1.08 to 14.94 °F)	
Shut Down Delta T	1.7°C (3.06°F)	0.3 to 1.7 °C (0.54 to 3.06 °F)	
Max Pulldown	1.7°C (3.06°F/min)	0.1 to 2.7 °C/min (0.18 to 4.86 °F/min)	
Nominal Evap Delta T	5.6 °C (10.08°F)		
Unit Condenser			
Condenser Target 100%	38.0°C (100.4°F)	25 to 55 °C (77 to 131 °F)	
Condenser Target 67%	33.0°C (91.4°F)	25 to 55 °C (77 to 131 °F)	
Condenser Target 50%	30.0°C (86°F)	25 to 55 °C (77 to 131 °F)	
Condenser Target 33%	30.0°C (86°F)	25 to 55 °C (77 to 131 °F)	
Configuration			
Number of Circuits	2	1,2	
Number of Comps/Circuit	3	2,3	
Number of tot Fans	5+5	4,5,6,3+3,4+4,5+5,6+6,7+7	
Power Config	Single Point	Single Point, Multi Point	
Comm Module 1	None	IP, LON, MSTP, Modbus	
Comm Module 2	None	IP, LON, MSTP, Modbus	
Comm Module 3	None	IP, LON, MSTP, Modbus	
Options			
Fan VFD	Disable	Disable, Enable	
LLS Valve	Disable	Disable, Enable	
Double Stpt	Disable	Disable, Enable	
LWT Reset	Disable	Disable, Enable	
Demand Lim	Disable	Disable, Enable	
Ext Alarm	Disable	Disable, Enable	
Power Meter	Disable	Disable, Enable	
Retrofit	Disable	Disable, Enable	
Evap Pump Control	#1 Only	#1 Only, #2 Only, Auto, #1 Primary, #2 Primary	
Timers			
Evap Recirc Timer	30 sec	15 to 300 seconds	
Stage Up Delay	240 sec	120 to 480 sec	
Stage Down Delay	30 sec	20 to 60 sec	
Stage Delay Clear	No	No, Yes	
Start-start timer	15 min	10-60 minutes	
Stop-start timer	5 min	3-20 minutes	
Clear Cycle Timers	No	No, yes	
Ice Time Delay	12	1-23 hours	
Clear Ice Timer	No	No, Yes	

Sensor Offsets		
Evap LWT sensor offset	0.0°C (0°F)	-5.0 to 5.0 °C (-9.0 to 9.0 °F)
Evap EWT sensor offset	0.0°C (0°F)	-5.0 to 5.0 °C (-9.0 to 9.0 °F)
OAT sensor offset	0.0°C (0°F)	-5.0 to 5.0 °C (-9.0 to 9.0 °F)
Alarm Settings		
Low Evap Pressure Unload	685.0 kPa (99.35 psi)	See section 5.1.1
Low Evap Pressure Hold	698.0 kPa (101.23 psi)	See section 5.1.1
High Condenser Pressure	4000 kPa (580.15 psi)	3310 to 4300 kPa (480 to 623 psi)
High Condenser Pressure Unload	3950 kPa (572.89 psi)	3241 to 4200 kPa (470 to 609 psi)
Evaporator Flow Proof	5 sec	5 to 15 sec
Recirculate Timeout	3 min	1 to 10 min
Evaporator Water Freeze	2.0°C (35.6°F)	See section 5.1.1
Low OAT Start Time	165 sec	150 to 240 sec
Low Ambient Lockout	-18.0°C (-0.4°F)	See section 5.1.1
External Alarm Configuration	Event	Event, Alarm
Clear Alarms	Off	Off, On
Network Clear Alarms	Off	Off, On

The following set points exist individually for each circuit:

Description	Default	Range
Mode/Enabling		
Circuit mode	Enable	Disable, Enable, Test
Compressor 1 Enable	Enable	Enable, Disable
Compressor 2 Enable	Enable	Enable, Disable
Compressor 3 Enable	Enable	Enable, Disable
Network Compressor 1 Enable	Enable	Enable, Disable
Network Compressor 2 Enable	Enable	Enable, Disable
Network Compressor 3 Enable	Enable	Enable, Disable
EXV control	Auto	Auto, Manual
EXV manual pressure	See Section 3.7.4	
Suction SH Target Cool	5.0°C (41°F)	4.44 to 6.67 °C (8 to 12 °F)
Suction SH Target Heat	5.0°C (41°F)	4.44 to 6.67 °C (8 to 12 °F)
Max Evap Pressure	1076 kPa(156.1 psi)	979 to 1172 kPa (142 to 170 psi)
Circuit Condenser		
Condenser Target 100%	38.0°C (100.4°F)	25 to 55 °C (77 to 131 °F)
Condenser Target 67%	33.0°C (91.4°F)	25 to 55 °C (77 to 131 °F)
Condenser Target 50%	30.0°C (86°F)	25 to 55 °C (77 to 131 °F)
Condenser Target 33%	30.0°C (86°F)	25 to 55 °C (77 to 131 °F)
VFD Max Speed	100%	60 to 110%
VFD Min Speed	25%	25 to 60%
Fan Stage Up Dead-band 1	8.33°C (15°F)	0 to 15 °C (0 to 27 °F)
Fan Stage Up Dead-band 2	5.56°C (10°F)	0 to 15 °C (0 to 27 °F)
Fan Stage Up Dead-band 3	5.56°C (10°F)	0 to 15 °C (0 to 27 °F)
Fan Stage Up Dead-band 4	5.56°C (10°F)	0 to 15 °C (0 to 27 °F)
Fan Stage Down Dead-band 1	11.11°C (20°F)	0 to 15 °C (0 to 27 °F)
Fan Stage Down Dead-band 2	11.11°C (20°F)	0 to 15 °C (0 to 27 °F)
Fan Stage Down Dead-band 3	8.33 °C (15 °F)	0 to 15 °C (0 to 27 °F)
Fan Stage Down Dead-band 4	5.56 °C (10 °F)	0 to 15 °C (0 to 27 °F)
Sensor Offsets		
Evap pressure offset	0 kPa (0 psi)	-100 to 100 kPa (-14.5 to 14.5 psi)
Cond pressure offset	0 kPa (0 psi)	-100 to 100 kPa (-14.5 to 14.5 psi)
Suction temp offset	0°C (0°F)	-5.0 to 5.0 °C (-9.0 to 9.0 °F)

Note – Condenser Target 67% and Condenser Target 33% will be available only when number of Comps is 3 (1 circuit) or 6 (2 circuits). Condenser Target 50% will be available only when Number of Compressors is 2 (1 circuit) or 4 (2 circuits).

4.13 Auto Adjusted Ranges

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

Cool LWT 1, Cool LWT 2, and Network Cool Set Point	
Available Mode Selection	Range
Without Glycol	4.0 to 15.0 °C (39.2 to 59.0 °F)
With Glycol	-15.0 to 15.0 °C (5 to 59.0 °F)

Evaporator Water Freeze	
Available Mode Selection	Range
Without Glycol	2.0 to 5.6 °C (35.6 to 42 °F)
With Glycol	-17.0(*) to 5.6 °C (1.4 to 42 °F)

Low Evaporator Pressure Hold and Unload	
Available Mode Selection	Range
Without Glycol	669 to 793 kPa (97 to 115 psi)
With Glycol	300 to 793 kPa (43.5 to 115 psi)

Low Ambient Lockout	
Fan VFD	Range
= no for all circuits	-18.0 to 15.6 °C (-0.4 to 60 °F)
= yes on any circuit	-23.3 to 15.6 °C (-9.9 to 60 °F)

(*) Proper amount of antifreeze must be applied

4.14 Special Set Point Operations

The following set points are not changeable unless the unit switch is off:

Number of Circuits
Number of Compressors
Number of Fans
Fan VFD enable : enable the management of the ventilation with the VFD
LLS Valve enable : enable the management of the Liquid Line Solenoid valve
Double Stpt enable : enable the activation of double set point by a digital input
LWT Reset enable : enable the reset of the LWT set-point by a 4-20 mA external signal
Demand Lim enable : enable the Demand Limit routine
Ext Alarm enable : enable the signal of alarm as digital output of the controller
Power Meter enable : enable the communication (Modbus) with an energy meter

Retrofit enable : enable the possibilities of retrofit of the application for a hold EWYQ-F- C unit

The Circuit Mode set points are not changeable unless the corresponding circuit switch is off.
The Compressor Enable set points are not changeable unless the corresponding compressor is not running.
The following settings are automatically set back to Off after being On for 1 second:

Clear Alarms
Network Clear Alarms
Clear Cycle Timers
Clear Ice Timer
Stage Delay Clear
HP Test
Test Mode Set Points

All outputs are manually controllable via test mode; set points only when test mode is enabled.
For Unit level outputs, test mode is enabled only when the unit mode is Test. For Circuit outputs test mode is enabled when either unit mode is Test, or the circuit mode is Test.
The compressor outputs are a special case, and they are allowed to remain on for 3 seconds before being automatically set back to ‘off’.
When the unit mode is no longer in Test, all unit test mode set points are be changed back to their ‘off’ values. When test mode is no longer enabled for a circuit, all the circuit test mode set points for that circuit are changed back to their ‘off’ values.

5 Alarm

Unless otherwise specified unit alarms should not be triggered during unit state is OFF.

5.1 Unit alarm descriptions

Description	Type	Shut down	Reset	Note

Phase Volts loss / GFP fault	Fault	Rapid	Auto	
Water temperature freeze shut down	Fault	Rapid	Manual	
Water flow loss	Fault	Rapid	Manual	This alarm can be active regardless of unit state. Just depends on pump state
Water temp inverted	Fault	Normal	Manual	
OAT lock out	Fault / Warning	Normal	Auto	Unit AUTO…Fault Unit OFF…Warning
LWT sensor fault	Fault	Rapid	Manual	This alarm can be active regardless of unit state.
EWT sensor fault	Fault	Normal	Manual	This alarm can be active regardless of unit state
OAT sensor fault	Fault	Normal	Manual	
External alarm	Fault	Rapid	Manual	This alarm can be active regardless of unit state
Bad demand limit input	Warning	-	Auto	
Bad LWT reset point	Warning	-	Auto	
External event	Event	-	N/R	
Unit optional control fault	Fault	-	Auto	
Exv Modul 1 fault	Fault	-	Auto	
Exv Modul 2 fault	Fault		Auto	
Pump 1 fault	Fault		Auto	
Pump 2 fault	Fault		Auto	
Unit configuration Error	Fault		Auto	
Chiller network communication failure	Warning	-	Auto	This alarm can be active regardless of unit state
Power loss while running	Event	-	N/R	

5.2 Unit fault alarms

5.2.1 Phase Volts loss / GFP fault

[Purpose]

Checking inverted phase, lack of phase and unbalanced voltage.

[Trigger]

• PVM / GFP input is “low”

[Action]

Rapid shutdown of all running circuits

[Reset]

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

5.2.2 Water freeze shut down

[Purpose]

Reduce the risk of damage to chiller due to freeze.

[Trigger]

EWT < 2.8°C for 5second
OR
LWT < 2.8°C for 5second

[Action]

Rapid shutdown of all running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if trigger conditions no longer exists.

Name	Class	Unit	Default	Min.	Max.
Water freeze	Unit	°C	2.8	2.8	6.0
			2.8	-18.0	6.0

5.2.3 Water flow loss

This alarm can be active regardless of unit state. Just depends on pump state.

[Purpose]

Reduce the risk of damage to chiller due to freezing or unstable condition.

[Trigger 1]

Pump state is RUN

AND
Flow switch is open
AND
15 seconds delay

[Trigger 2]

Pump state is Start
AND
3 minutes has passed

[Action]

Rapid shutdown of all running circuits

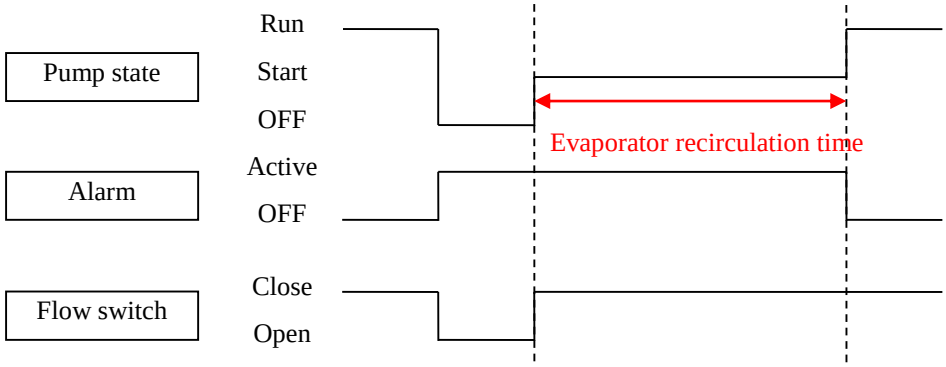
[Reset]

This alarm can be cleared at any time manually via the keypad or via the BAS clear alarm command.

If active via trigger 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 water pump 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 2:

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

Name	Class	Unit	Default	Min.	Max.
Water flow proof	Unit	Sec.	15	5	15
Recirculated timeout	Unit	Min.	3	1	10

5.2.4 Pump freeze protection

[Purpose]

Avoid water freezing. If water temperature goes down to below set point pump should be started regardless chiller operation.

[Trigger]

LWT < Water freeze set point
AND
LWT sensor fault is not active
AND
Unit state is OFF
3 seconds delay

[Action]

Start pump

[Reset]

Auto clear when trigger conditions no longer exist. Or pump is turned off.

5.2.5 Water temp inverted

[Purpose]

Detect wiring mistake. Keep LWT control in right operation.

[Trigger]

• EWT < LWT – 1°C in cooling mode
OR
• LWT < EWT – 1°C in heating mode
AND
• At least one circuit state is RUN
• 60seconds delay

[Action]

Normal shutdown (pump-down) of all running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if trigger conditions no longer exists.

[Mask]

This alarm shall be ignored during the following operations.

- Defrost operation
- 4way valve switching operation (until 4way valve goes fixed position)

5.2.6 Low OAT lock out

This alarm has two actions to be taken, which vary based on triggers. Also the set points are varied based on Fan VFD configuration and circuit operation mode.

[Purpose]

Avoids unit operation outside of operational envelope.

[Alarm type]

Trigger1 --- Fault
Trigger2 --- Warning

[Trigger 1]

OAT < Low OAT lock out set point
AND
At least one circuit running
AND
20minutes delay

[Trigger 2]

To avoid the error of using a faulty sensor, if OAT is out of range this alarm shouldn't be triggered.

OAT < Low OAT lock out set point
AND
No circuit is running
AND
Unit state is AUTO
AND
OAT sensor fault is not active
AND
5seconds delay

[Action]

If active via trigger 1:
Normal shutdown of all running circuits as fault
If active via trigger 2:
Not allow to start (Warning)

[Reset]

Auto clear when OAT > Low OAT lock out set point +2.5°C

Name	Class	Unit	Default	Min.	Max.	Note
Low OAT lock out	Unit	°C	2.0	2.0	15.0	Set point (Cooling w/o Fan VFD)
			2.0	-20.0	15.0	Set point (Cooling with Fan VFD)
			-17.0	-17.0	0.0	Set point (Heating)

5.2.7 LWT sensor fault

This alarm can be active regardless of the unit state.

[Range]

Minimum = -40°C, Maximum = 100°C

[Trigger]

Out of range for 1second

[Action]

Rapid shutdown of all running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if the sensor is back in range for 5seconds.

5.2.8 EWT sensor fault

This alarm can be active regardless of the unit state.

[Range]

Minimum = -40°C, Maximum = 100°C

[Trigger]

Out of range for 1second

[Action]

Rapid shutdown of all running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if the sensor is back in range for 5seconds.

5.2.9 OAT sensor fault

[Range]

Minimum = -40°C, Maximum = 70°C

[Trigger]

Out of range for 1second
AND
Unit state is AUTO

[Action]

Normal shutdown of all running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if the sensor is back in range.

5.2.10 External alarm

This alarm can be active regardless unit state.
[Trigger]

External alarm input is open for 5seconds

[Action]

Rapid shutdown of all running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if trigger conditions no longer exists.

5.3 Unit warning alarms

5.3.1 Bad demand limit input

[Trigger]

Demand limit input out of range (range: 4-20mA) for 1second
AND
Demand limit is enabled

[Action]

Ignore demand limit.

[Reset]

Auto clear when demand limit disabled or demand limit input back in range for 5 seconds.

5.3.2 Bad LWT reset point

[Trigger]

LWT reset input out of range (range: 4-20mA) for 1second
AND
LWT reset setting = 4-20mA

[Action]

Ignore LWT reset.

[Reset]

Auto clear when LWT reset setting is within 4-20mA or LWT reset input back in range for 5 seconds.

5.3.3 Bad unit current reading

[Trigger]

Current input out of range (range: 4-20mA) for 1second
AND
Current limit enable digital input is closed
AND
Current limit type is set to CT (4-20mA)

[Action]

Ignore current limit.

[Reset]

Auto clear if trigger conditions no longer exists for 5 seconds.

5.3.4 Chiller network communication failure

[Trigger]

Chiller network set point is set to enable
AND
Process bus communication has failed

AND
30 seconds delay

[Action]

It varies based on Master / Slave setting.

For Master unit

If the unit still has communication with at least one slave it should run as in network. Otherwise it should run as stand-alone.

For Slave unit

If the unit still has communication with the master it should run as in network. Otherwise it should run as stand-alone.

[Reset]

Auto clear if trigger conditions no longer exists for 5 seconds.

5.4 Unit events

5.4.1 Power loss while running

[Trigger]

Control system is rebooted after losing power while compressor was running

[Action]

None

[Reset]

N/R

5.5 Circuit alarm

Unless otherwise specified circuit alarm shouldn't be triggered when circuit state is OFF.

5.5.1 Circuit alarm descriptions

Description	Type	Shut down	Reset	Note
Mechanical High Pressure Switch	Fault	Rapid	Manual	
High Cond Pr shut down	Fault	Rapid	Manual	
High Cond Pr hold	Event	-	Auto	
Low Evap Pr shut down	Fault	Rapid	Manual	
No pressure change after start	Fault	Rapid	Manual	
Cond Pr sensor fault	Fault	Rapid	Manual	
Evap Pr sensor fault	Fault	Rapid	Manual	
Suct temp sensor fault	Fault	Rapid	Manual	
Cx Motor Prot	Fault	Rapid	Auto / Manual	After 3 time in 6 hour
High Discharge Temp Alarm	Fault	Rapid	Auto / Manual	
Pump down fail	Event	-	Auto	
Low Evap Pr unload	Event	-	Auto	
Low Evap Pr hold	Event	-	Auto	

Detailed Circuit alarms

5.5.1.1.1 Mechanical High Pressure Switch

[Purpose]

To avoid operating the circuit at over design pressure.

[Trigger]

MHP digital input is open

MHP set point is equal to 90% of the security valve (90% of 4500 kPa = 4100 kPa).

[Action]

Rapid shut down of circuit

[Reset]

This alarm can be cleared manually via the keypad if MHP digital input is closed.

5.5.1.1.2 High Condenser Pressure Shutdown / Unload

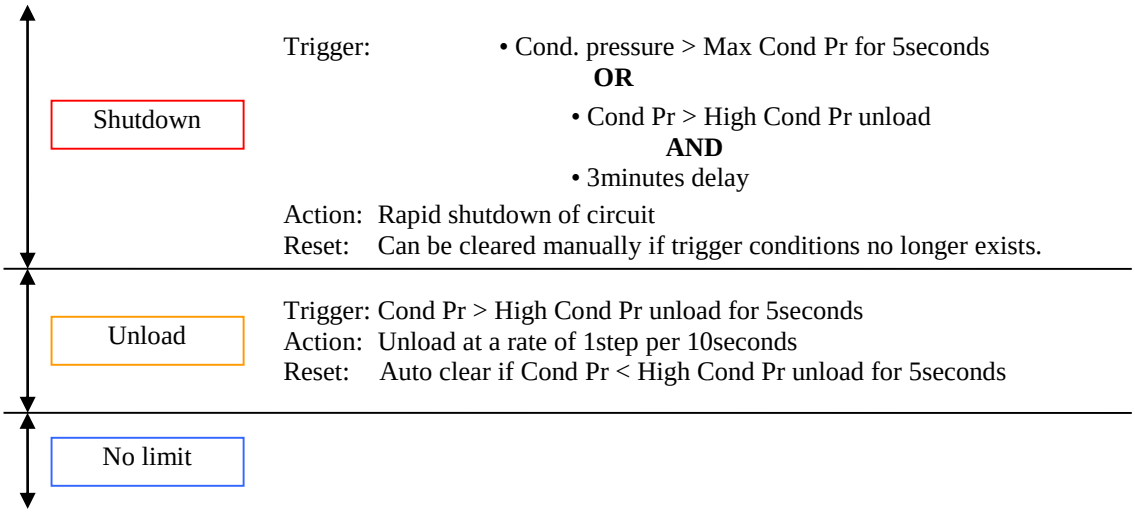
[Purpose]

To avoid triggering the circuit HPS fault alarm.

[Alarm type]

Shutdown --- Fault
Unload, Inhibit load --- Event

[Triggers, Actions and Resets]



[Calculations]

The limit are reported in the follow table

Name	Class	Unit	Default	Min.	Max.
Hi Cond Press Stop	Unit	kPa	4000	3900	4300
Hi Cond Pres Unload	Unit	kPa	3900	3800	HiPressStop set-point - 20

5.5.1.1.3 Low Evap Pressure Shutdown / Unload / Inhibit load

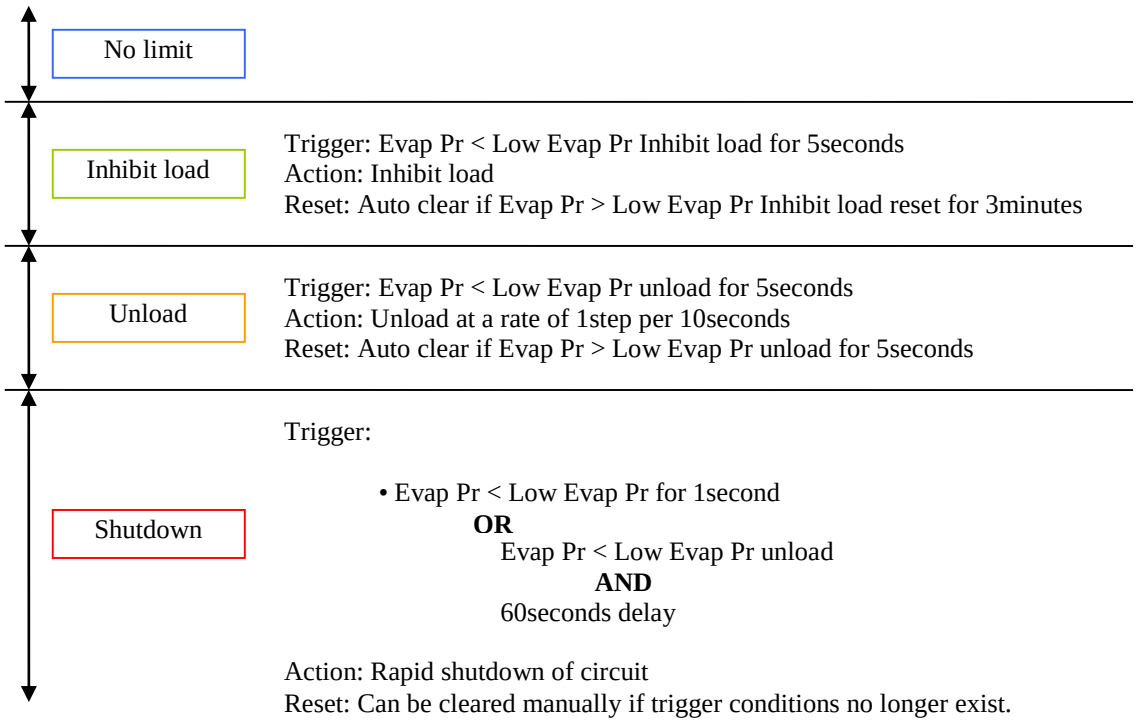
[Purpose]

To protect compressor in the event of refrigerant loss or low evaporator performance. This alarm operates in both heating and in cooling mode, although the heat exchangers are transposed.

[Alarm type]

Shutdown --- Fault
Unload, Inhibit load --- Event

[Triggers, Actions and Resets]



[Calculations]

The limit are reported in the follow table

Name	Class	Unit	Default	Min.	Max.
Low Evap Pres Hold Cooling	Unit	kPa	670	630	793
Low Evap Pres Hold Heating	Unit	kPa	325	300	400
Low Pres Unload Cooling	Unit	kPa	650	600	793
Low Pres Unload Heating	Unit	kPa	260	240	320
Low Pres Alarm	Unit	kPa	200	200	630

[Mask]

These logics shall be ignored or changed during the following operation.

Chiller operation	Shutdown	Unload	Inhibit load
Reverse cycle defrost stage 2,3,4,5,6 7	Ignored	Ignored	Ignored
Reverse cycle defrost stage 8		Normal	

5.5.1.1.4 No Pressure Change after Start

[Purpose]

This alarm prevents the compressor from running if there is insufficient pumping, indicating a compressor fault

[Alarm type]

Shutdown --- Fault

[Triggers, Actions and Resets]

Evap Press @ Compressor Start – Actual Evap Pres >= 7.0 kPa

OR

Actual Cond Pres – Cond Pres @ Start >= 35.0 kPa

AND

30 Sec from compressor start

[Action]

Rapid shutdown of the circuit

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if the sensor is back in range.

5.5.1.1.5 Condenser Pressure Sensor Fault

[Range]

Minimum = 0 kPa, Maximum = 5000 kPa

[Trigger]

Out of range for 1second

AND

Unit state is AUTO

[Action]

Normal shutdown of the running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if the sensor is back in range.

5.5.1.1.6 Evaporator Pressure Sensor Fault

[Range]

Minimum = 0 kPa, Maximum = 3000 kPa

[Trigger]

Out of range for 1second

AND

Unit state is AUTO

[Action]

Normal shutdown of the running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if the sensor is back in range.

5.5.1.1.7 Suction Temperature sensor fault

This alarm can be active regardless unit state.

[Range]

Minimum = -40°C, Maximum = 100°C

[Trigger]

Out of range for 1second

[Action]

Rapid shutdown of running circuits

[Reset]

This alarm can be cleared manually via the keypad or via BAS command if the sensor is back in range for 5seconds.

5.5.1.1.8 Cx Motor Protection Alarm

This alarm protects the electric motor of each of the compressors.

[Trigger]

Digital input for the compressors kriwan is active

OR

Digital input from thermal circuits breaker is active

[Action]

Rapid shutdown of running circuits

[Reset]

This alarm have an automatic reset for the first 3 time in 6 hour for each compressors, after 5 minutes are passed from the alarm back; after this the alarm can be cleared manually via the keypad or via BAS command.

5.5.1.1.9 High Discharge Temperature Alarm

This alarm is made for prevent a too high discharge temperature from compressor

[Trigger]

Discharge temperature > 135.0 °C

AND

5 seconds

[Action]

Rapid shutdown of running circuits

[Reset]

This the alarm can be cleared manually via the keypad or via BAS command and the discharge temperature are over 100.0°C.

5.5.1.1.10 Pump Down Fail

This alarm monitors that the pump-down operation has been completed in the correct time.

[Trigger]

2 minutes are passed from the start of the pump down operations.

Appendix A : Sensor specifications, calibrations

5.6 Temperature Sensors

Description	Number of sensors	Type	Range	Calibration	Note
EWT	1 per Unit	NTC10K	-40°C ~ 100°C	Offset by set point	Vendor: Thermotech
LWT	1 per Unit	NTC10K	-40°C ~ 100°C	Offset by set point	Vendor: Thermotech
OAT	1 per Unit	NTC10K	-40°C ~ 100°C	Offset by set point	Vendor: Thermotech
Suction Temp	1 per Ckt	NTC10K	-40°C ~ 100°C	Offset by set point	Vendor: Thermotech
Discharge Temp	1 per Ckt	NTC10K	-40°C ~ 150°C	Offset by set point	Vendor: Thermotech

5.7 Pressure transducers

Description	Number of sensors	Type	Range	Calibration	Note
Cond Pr	1 per Ckt	500mV ~ 4500mV	0kPa ~ 5000.0kPa	Offset by set point	Vendor: Danfoss Saginomiya
Evap Pr	1 per Ckt	500mV ~ 4500mV	0kPa ~ 3000.0kPa	Offset by set point	Vendor: Danfoss Saginomiya

6 Appendix B : Troubleshooting

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.

6.1 PVM/GFP FAULT (on display: PvmGfpAl)

Purpose:

- *to avoid incorrect direction of rotation of the compressor.*
- *to avoid unsafe working conditions from a short circuit*

Symptom: all circuits are stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Loss of one phase; 2. Incorrect sequence connection of L1,L2,L3; 3. Voltage level on the unit's panel is not in the allowed range (±10%); 4. There is a short-circuit on the unit	1. Check voltage level on each of the phases; 2. Check sequence of L1, L2, L3 connections according indication on chiller's electrical scheme; 3. Check that voltage level on each phase is within the allowed range that is indicated on the chiller label; Is important to check the voltage level on each phase not only with the chiller not running, but also with the chiller running from minimum capacity up to full load capacity. That is because voltage drops can occur at a certain unit cooling capacity level, or because of certain working condition (i.e. high values of OAT); In these cases the issue can be related to the sizing of power cables. 4. Check for correct electrical insulation condition of each unit's circuit with a Megger tester	Rapid stop of all circuits
RESET : Auto reset when input is closed for at least 5 seconds or if Power Configuration = Multi Point.		

6.2 EVAPORATOR FLOW LOSS (on display: EvapFlowLoss)

Purpose:

- *To avoid freezing risks of the water in chiller's evaporator;*
- *To prevent the chiller starting without proper water flow conditions into evaporator.*

Symptom: all circuits are stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
No water flow for 5 seconds continuously or too low water flow.	Check the water pump filter and the water circuit for obstructions.	Rapid stop of all circuits
RESET : After finding the cause, the flow-switch is reset automatically, but the controller still needs to be reset.		

6.3 EVAPORATOR WATER FREEZE PROTECT (on display: EvapWaterTmpLo)

Purpose:

- *To prevent freezing of the water in the evaporator with possible mechanical damage*

NOTE: the setting of the freeze protect temperature of the refrigerant is depending if the unit is a glycol application or not

Symptom: all circuits are stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Water flow too low; 2. Inlet temperature to the evaporator is too low; 3. Flow switch is not working or no water flow; 4. Refrigerant temperature too low (< -0.6°C);	1. Increase the water flow; 2. Increase the inlet water temperature; 3. Check the flow switch and the water pump; 4. Check the water flow and filter. Poor exchange condition into the evaporator.	Rapid stop of all circuits
RESET : This alarm can be cleared manually via the keypad, but only if the alarm conditions no longer exist.		

6.4 TEMPERATURE SENSOR FAULT

This paragraph is in reference to the follows topics:

- EVAPORATOR LWT SENSOR FAULT (on display: EvapLwtSenf)
- FREEZE TEMPERATURE SENSOR FAULT (on display: FreezeTempSenf)
- OUTDOOR AIR TEMPERATURE (OAT) SENSOR FAULT (on display: OatSenf)

Purpose:

- *To check proper operating conditions of the temperature sensors to allow proper and safe working condition of the chiller*

Symptom: all circuits are stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Sensor is broken; 2. Sensor is shorted; 3. Sensor is poorly connected (open)	1. Check for sensor integrity; Check correct sensor operation according to the table and allowed kOhm (kΩ) range in section 3.2 of this manual part. 2. Check if sensor is shorted with a resistance	Normal stop of all circuits

	measurement; 3. Check for absence of water or humidity on electrical contacts; Check for correct plug-in of the electrical connectors; Check for correct sensor wiring according to the electrical drawing.	
RESET : This alarm can be cleared manually via the keypad or BAS command, but only if the sensor is back in range.		

6.5 EXTERNAL ALARM or WARNING (on display: ExtAlarm)

Purpose:

- *To prevent damage to the chiller because of external events or external alarm*

Symptom: all circuits are stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
There is an external event that has caused the opening, for at least 5 seconds, of the port on the controller board.	Check causes of the external event or alarm; Check electrical wiring from unit controller to the external equipment in case any external events or alarms have occurred.	This fault will have a consequence according to the USER configuration of the external event as an ALARM or WARNING. In case of ALARM configuration the consequence is a rapid stop of all circuits.
RESET : Auto clear when once digital input for external alarm/event is closed again.		

Circuit fault overview

When any Circuit Fault Alarm is active, the alarm digital output is turned on.
If no Unit Fault Alarm is active, but any Circuit Fault Alarm is active, the alarm digital output is alternate five seconds on and five seconds off continuously.

All alarms appear in the active alarm list while active.
All alarms are added to the alarm log when triggered and when cleared.

	MESSAGE CIRCUIT FAULT MENU		MESSAGE AS SHOWN ON SCREEN
CIRCUIT FAULT LIST	1	Low Evaporator Pressure	**LowEvPr**
	2	High Condenser Pressure	**HighCondPr**
	3	Mechanical High Pressure Switch	**CoX.MhpAl**
	4	Motor Protection Fault	**CoX.MotorProt**
	5	Low OAT Restart Fault	**CoX.RestartFlt**
	6	No Pressure Change After Start	**NoPrChgAl**
	7	Evaporator Pressure Sensor Fault	**EvapPsenf**
	8	Condenser Pressure Sensor Fault	**CondPsenf**
	9	Suction Temperature Sensor Fault	**SuctTsenf**
	10	EXV Module 1 Comm Failure	**EvPumpFlt1**
	11	EXV Module 2 Comm Failure	**EvPumpFlt2**

6.5.1 LOW EVAPORATOR PRESSURE (on display: LowEvPr)

Purpose:

- *To avoid incorrect working conditions of the circuit, with poor efficiency.*
- *To avoid the risk of freezing the unit's evaporator*

NOTE: the setting of the freeze protect temperature of the refrigerant depends on whether the unit is a glycol application or not

Symptom: circuits is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Water flow into water heat exchanger is too low; 2. Shortage of refrigerant; 3. Unit is working out of its possible range or operative envelope; 4. Inlet temperature to water heat exchanger is too low; 5. Dirty evaporator; 6. Low pressure safety settings too high; 7. Flow-switch is not working or no water flow; 8. EEXV is not working correctly. i,e, not opening enough; 9. Low pressure sensor is not working properly;	1. Increase the water flow; 2. Check for the leaks and add refrigerant if necessary; 3. Check the operation condition of the chiller; 4. Increase the inlet water temperature; 5. Clean the evaporator and check for the good quality of the fluid that flows into heat exchanger; 6. Refer to the "settings parameter" of this manual to control the allowed range for "minimum outlet water temperature"; 7. Check the flow-switch and the correct operation of the water pump 8. Check for correct operation of the expansion valve (EXV) on the circuit; 9. Check for proper operation of the low pressure sensor; Refer to 3.1	Rapid stop of circuits
RESET : This alarm can be cleared manually via the keypad if the evaporator pressure is back in the allowed range.		

6.5.2 HIGH CONDENSER PRESSURE ALARM

This paragraph is in reference to the follows topics:

- HIGH CONDENSER PRESSURE (on display: HighCondPr)
- MECHANICAL HIGH PRESSURE (MHP) SWITCH (on display: CoX.MhpAl)

Purpose:

- *To avoid incorrect working conditions of the circuit: reducing efficiency.*
- *To protect the chiller from an over-pressure event that could damage unit components.*

Symptom: circuits is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*

1. One or more condenser fans do not operate properly; 2. Dirty or partially blocked condenser coil; 3. Inlet air temperature of the condenser is too high; 4. One or more condenser fans turning in wrong direction; 5. Excessive charge of refrigerant into the unit; 6. High pressure sensor could not operate properly	1. Check that the fans turn freely; Clean if necessary; Check that there are no obstacles to the free exit of the air. 2. Remove any obstacle and clean the condenser coil using soft brush and blower; 3. The air temperature measured at the inlet of the condenser may not exceed the limit indicated in the operative range (working envelope) of the chiller; Check the location where the unit is installed and check that there are no short-circuits of the hot-air blown from the fans of the same unit, or even from fans of next chillers; 4. Check for correct phase sequence (L1, L2, L3) in the electrical connection of the fans; 5. Check liquid sub-cooling and suction super-heat to control indirectly the correct charge of refrigerant. If necessary recover all the refrigerant to weigh the entire charge and control if the value is in line with kg indication on unit label. 6. Check for proper operation of the high pressure sensor; Refer to 3.1	Rapid stop of circuits
RESET : This alarm can be cleared manually via the controller keypad		

NOTE: in case of "Mechanical High Pressure Switch" fault, it is mandatory to mechanically reset the switch before resetting the alarm on unit controller.

To reset the switch, it is necessary push the colored button located on top of the high pressure switch.

6.5.3 MOTOR PROTECTION FAULT (on display: CoX.MotorProt)

Purpose:

- *To avoid damages to the electric motor of the compressor and also potential damage to mechanical parts of the compressor.*
  The fault is activated both by too much high discharge temperature of the compressor and by too much high temperature of the compressor's electrical motor that is not sufficiently cooled by low pressure refrigerant vapour.

Symptom: circuits is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Failure of one of the phases; 2. Voltage too low;	1. Check fuses on the supply electrical or measure the supply voltage;	Rapid stop of circuits

3. The unit is working out of the allowed operating range (working envelope); 4. Overload of the motor; 5. There is a short circuit on the motor; 6. The compressor is running in wrong direction; 7. The discharge gas temperature of the compressors is too high. 8. Temperature sensors could not operate properly; 9. Shortage of refrigerant into the unit	2. Measure the supply voltage not only with unit stopped but also with unit running. Voltage drops with current absorptions, therefore voltage drops when unit is running. 3. Make sure the unit operates within its allowed working envelope (too high ambient or too high water temperature); 4. Try to reset and restart. Make sure the compressor motor is not locked. 5. Check the wiring utilizing a Megger tester if necessary to evaluate the electrical insulation level; 6. Check wiring and correct sequence of phases (L1, L2, L3) according to the electrical drawing 7. Check for correct oil quantity and correct oil quality into compressors; High compressor discharge temperature could be related to potential mechanical issues into compressors. 8. Check for proper operation of the temperature sensors. Refer to 3.2; 9. Make sure there are no leaks of refrigerant and check if the unit's refrigerant charge is correct. If necessary, re-charge the unit with refrigerant after having repaired the leaks.	
RESET : This alarm can be cleared manually via the controller keypad if the motor protection input is closed.		

LOW OUTSIDE AMBIENT TEMPERATURE (OAT) RESTART FAULT
(on display: CoX.RestartFlt)

Purpose:

- *To avoid improper working conditions of the chiller, with too low condensing pressure.*

Symptom: circuits is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Outside ambient temperature is too low or is lower than value set into unit's controller; 2. Shortage of refrigerant; 3. Incorrect operation of high pressure sensor, or	1. Check for reason of water chilled production request even with low outside ambient temperature, therefore check about the proper application and utilization of the chiller;	Rapid stop of circuits

even low pressure sensor	2. Check unit's refrigerant charge; 3. Check for proper operation of high and low pressure sensor. Refer to 3.1; **NOTE**: however in any case try two-three times to reset this circuit's alarm and restart chiller again.	
RESET : This alarm can be cleared manually via the keypad or via BAS command.		

6.5.4 NO PRESSURE CHANGE AFTER START (on display: NoPrChgAl)

Purpose:

- *To avoid operation of the compressor, with an internal fault.*

Symptom: circuits is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Compressor's fuses blown; 2. Compressor's circuit breakers are open or compressor is not powered; 3. Compressor has motor electrical or internal mechanical troubles; 4. Compressor is turning in wrong direction; 5. Refrigerant circuit is empty of refrigerant;	1. Check fuses; 2. Check status of the circuit breakers; Check about proper operation of the starting electrical device of the compressor (soft starter etc…); 3. Check compressor's status or if motor is locked; 4. Check correct phases sequence (L1, L2, L3) according electrical scheme; 5. Check circuit pressure and presence of refrigerant; No. 6 removed –not relevant	Rapid stop of circuits
RESET : This alarm can be cleared manually via the keypad or via BAS command.		

6.5.5 EVAPORATOR PRESSURE SENSOR FAULT (on display: EvapPsenf)

This paragraph is in reference to the follows topics:

- EVAPORATOR PRESSURE SENSOR FAULT (on display: EvapPsenf)
- CONDENSER PRESSURE SENSOR FAULT (on display: CondPsenf)

Purpose:

- *To avoid improper working conditions of the chiller.*

Symptom: circuits is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Sensor is broken; 2. Sensor is short-circuit 3. Sensor is open-circuit	1. Check for sensor integrity; Check correct sensor operation according to mVolt (mV) range related to pressure values in kPa, as shown in section 3.1 of this manual	Rapid stop of circuits

	2. Check if sensor is shorted with a resistance measurement; 3. Check for correct installation of the sensor on refrigerant circuit pipe. Check for absence of water or humidity on sensor electrical contacts; Check for correct plug-in of the electrical connectors; Check for correct sensor wiring according to the electrical drawing	
RESET : This alarm can be cleared manually via the keypad or BAS command, but only if the sensor is back in range.		

6.5.6 SUCTION TEMPERATURE SENSOR FAULT (on display: SuctTsenf)

Purpose:

- *To avoid improper working conditions of the compressor, with insufficient cooling condition of the compressor's electrical motor.*

Symptom: circuits is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Sensor is broken; 2. Sensor is short-circuit 3. Sensor is open-circuit	1. Check for sensor integrity; Check correct sensors operation according to kOhm (kΩ) range related to temperature values, as shown in section 3.2 of this manual 2. Check if sensor is shorted with a resistance measurement; 3. Check for correct installation of the sensor on refrigerant circuit pipe. Check for absence of water or humidity on sensor electrical contacts; Check for correct plug-in of the electrical connectors; Check for correct sensor wiring according to the electrical drawing	Normal shutdown of circuits
RESET : This alarm can be cleared manually via the keypad or BAS command, but only if the sensor is back in range.		

6.5.7 EXV MODULE 1/2 COMM. FAILURE (on display: EvPumpFlt1)

Purpose:

- *To avoid improper working conditions of the compressor, with insufficient cooling of the compressor's electrical motor.*

Symptom: circuits is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Communication	1. Check for proper Peripheral	Rapid stop of circuit

with I/O extension module has failed;	Bus connection between main controller and I/O extension module. Refer to section 2.2 of this manual	
RESET : This alarm can be cleared manually via the keypad or BAS command when communication between main controller and the extension module is working for 5 seconds.		

6.6 Overview of Problem Alarm

This section provides useful information for diagnosing and correcting certain problems which may occur in the unit.

Before starting the troubleshooting procedure, carry out a thorough visual inspection of the unit and look for obvious defects such as loose connections or defective wiring.

When carrying out an inspection on the supply panel or on the switch box of the unit, always make sure that the circuit breaker of the unit is switched off.

Unit problem overview

	MESSAGE U N I T PROBLEM MENU		MESSAGE AS SHOWN ON SCREEN
UNIT PROBLEM LIST	1	Low Ambient Lockout	**LowOATemp**
	2	Evaporator Pump #1 Failure	**EvPumpFlt1**
	3	Evaporator Pump #2 Failure	**EvPumpFlt2**

6.6.1 LOW AMBIENT LOCKOUT (on display: LowOATemp)

Purpose:

- *To avoid improper working conditions of the chiller, with condensing pressure too low*

Symptom: unit is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Outside ambient temperature is lower than value set into unit's controller; 2. No proper operation of Outside Ambient Temperature sensor	1. Check the minimum outside ambient temperature value set into the unit's controller; Check if this value is in accordance with chiller application, therefore check about the proper application and utilization of the chiller; 2. Check for proper operation of OAT sensor according kOhm (kΩ) range related to temperature values; Refer also to corrective action indicated in section 3.2 of this manual	Normal shutdown of all circuits.
RESET : The lockout should clear when OAT rises to the lockout set point plus 2.8°C		

6.6.2 EVAPORATOR PUMP #1 FAILURE (on display: EvPumpFlt1)

Purpose:

- *To avoid improper working conditions of the chiller, with risk of incorrect flow into the evaporator.*

Symptom: unit could be ON and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Pump nr.1 does not work;	1. Check for problem in electrical wiring of the pump #1; Check that electrical breaker of pump #1 is ON; Check for problem in wiring connection between pump starter and unit controller; Check the water pump filter and the water circuit for obstructions	Backup pump is used.
RESET : This alarm can be cleared manually via the keypad or BAS command.		

6.6.3 EVAPORATOR PUMP #2 FAILURE (on display: EvPumpFlt2)

Purpose:

- *To avoid improper working conditions of the chiller, with risk of incorrect flow into the evaporator.*

Symptom: unit is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Pump nr.2 does not work;	1. Check for problem in electrical wiring of the pump #2; Check that electrical breaker of pump #2 is ON; Check for problem in wiring connection between pump starter and unit controller; Check the water pump filter and the water circuit for obstructions	Backup pump is used or stop of all circuits in case of pump #1 failure.
RESET : This alarm can be cleared manually via the keypad or BAS command.		

6.7 Overview of Warning Alarm

This section provides useful information for diagnosing and correcting certain warnings which may occur in the unit.

Before starting the troubleshooting procedure, carry out a thorough visual inspection of the unit and look for obvious defects such as loose connections or defective wiring.

When carrying out an inspection on the supply panel or on the switch box of the unit, always make sure that the

circuit breaker of the unit is switched off.

6.7.1 Unit warning overview

	MESSAGE UNIT WARNING MENU		MESSAGE AS SHOWN ON SCREEN
UNIT WARNING LIST	1	External Event	**ExternalEvent**
	2	Bad Demand Limit Input	**BadDemandLmInpW**
	3	Bad Leaving Water Temperature (LWT) Reset Input	**BadSPtOvrdInpW**
	4	Evaporator Entering Water Temperature (EWT) Sensor Fault	**EvapEwtSenf**

6.7.2 EXTERNAL EVENT (on display: ExternalEvent)

Purpose:

- *To avoid potential improper working conditions of the chiller.*

Symptom: unit is running and bell icon is moving on controller's display		
	CORRECTIVE ACTION	*CONSEQUENCE*
1. External Alarm/event input is open for at least 5 second. The "External Fault" has been configured as "Event"	1. Check for reasons of external event and if it can be a potential problem for a correct chiller operation.	None.
RESET : Auto clear when digital input is closed.		

6.7.3 BAD DEMAND LIMIT INPUT (on display: BadDemandLmInpW)

Purpose:

- *To avoid potential improper working conditions of the chiller.*

Symptom: unit is running and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Demand limit input out of range For this warning out of range is considered to be a signal less than 3mA or more than 21mA.	1. Check for values of input signal to the unit controller. It has to be in the allowed mV range; Check for electrical shielding of wirings; Check for right value of the unit's controller output in case input signal is into allowed range.	Cannot use demand limit function.
RESET : Auto clear when demand limit disabled or demand limit input back in range for 5 seconds.		

6.7.4 BAD LEAVING WATER TEMPERATURE (LWT) RESET INPUT

(on display:* BadSPtOvrdInpW*)

Purpose:

- *To avoid potential improper working conditions of the chiller.*

Symptom: unit is running and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. LWT reset input out of range; For this warning out of range is considered to be a signal less than 3mA or more than 21mA.	1. Check for values of input signal to the unit controller. It has to be in the allowed mV range; Check for electrical shielding of wirings; Check for right value of the unit's controller output in case input signal is into allowed range.	Cannot use LWT reset function.
RESET : Auto clear when LWT reset is disabled or LWT reset input back in range for 5 seconds.		

6.7.5 EVAPORATOR ENTERING WATER TEMPERATURE (EWT) SENSOR FAULT

(on display:* EvapEwtSenf*)

Purpose:

- *To avoid potential improper working conditions of the chiller.*

Symptom: unit is running and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Sensor is broken; 2. Sensor is short-circuit 3. Sensor is open-circuit	1. Check for sensor integrity; Check correct sensor output as shown in section 3.2 of this manual 2. Check if sensor is shorted with a resistance measurement; 3. Check for correct installation of the sensor on water circuit pipe. Check for absence of water or humidity on sensor electrical contacts; Check for correct plug-in of the electrical connectors; Check for correct sensor wiring also according electrical scheme;	Unit cannot control; Replace sensor or correct fault to restore correct operation.
RESET : Auto clear when the sensor is back in range.		

6.8 Circuit warning overview

CIRCUIT WARNING LIST	**MESSAGE CIRCUIT WARNING MENU**		**MESSAGE AS SHOWN ON SCREEN**
	1	Failed Pump-down	**PdFail**

6.8.1 FAILED PUMP-DOWN (on display: PdFail)

Purpose:

- *To inform of incorrect operation of the chiller and terminate the pemp-down to prevent damage*

Symptom: unit is stopped and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. EEXV is not closing completely, therefore there's "short-circuit" between high pressure side with low pressure side of the circuit; 2. Low pressure sensor is not working properly; 3. Setting on unit controller for low pressure value of pump-down is not correct; 4. Compressor on circuit is internally damaged with a mechanical problems for example on internal check-valve, or on internal spirals or vanes.	1. Check for proper operation and full closing position of EEXV; 2. Check for proper operation of low pressure sensor; Refer to section 3.1 of this manual; 3. Check settings on controller for pump-down procedure; 4. Check compressors on circuits.	Rapid stop circuit.
RESET : None		

6.8.2 Overview of Events

This section provides useful information for diagnosing and correcting certain events which may occur in the unit.

Situations may arise that require some action from the chiller or that should be logged for future reference, but aren't severe enough to track as alarms.
These events are stored in a log separate from alarms.
This log shows the time and date of the latest occurrence, the count of occurrences for the current day, and the count of occurrences for each of the previous 7 days.

NOTE: In case an event occurs on the chiller, specific actions or service procedures may be required. Such events can occur even in a normal operation of the chiller.

Before starting the troubleshooting procedure, carry out a thorough visual inspection of the unit and look for obvious defects such as loose connections or defective wiring.

When carrying out an inspection on the supply panel or on the switch box of the unit, always make sure that the circuit breaker of the unit is switched off.

6.8.3 Unit events overview

UNIT EVENT LIST	**MESSAGE UNIT EVENT MENU**	
	1	Unit Power Restore

6.8.4 UNIT POWER RESTORE

Purpose:

- *To inform concerning important operating event occurred to the chiller.*

Symptom: unit is running or is in 'stand-by' mode and bell icon is moving on controller's display		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
1. Unit has lost power	1. Check reasons of losing external power	None.

supply for a period of time; 2. Unit's controller has lost power supply because of a failure on 24V fuse	supply and if it can be a potential problem for correct chiller operation. 2. Check 24V fuse	
RESET : None.		

6.9 Circuit events overview

	MESSAGE CIRCUIT EVENT MENU	
CIRCUIT EVENT LIST	1	Low Evaporator Pressure - Hold
	2	Low Evaporator Pressure - Unload
	3	High Condenser Pressure - Unload

6.9.1 LOW EVAPORATOR PRESSURE - HOLD

Purpose: To prevent excessively low evaporator pressure on the chiller and provide indication of the event.

Symptom: unit is running and Low Evaporator Pressure event is listed on controller		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
This event is triggered if all of the following are true: circuit state = Run AND evaporator pressure <= Low Evaporator Pressure - Hold set point AND circuit is not currently in a low OAT start AND it has been at least 30 seconds since a compressor has started on the circuit.	Check for temperature approach of the refrigerant in the evaporator. Check for right flow of water in the evaporator; Check for correct operation of EXV Check for loss of refrigerant Check instrument calibration	Inhibit starting of additional compressors on the circuit.
RESET : While still running, the event will be reset if evaporator pressure > Low Evaporator Pressure Hold SP + 90 kPa . The event is also reset if the circuit is no longer in the run state.		

OW EVAPORATOR PRESSURE - UNLOAD

Purpose:

- *To prevent excessively low evaporator pressure on the chiller and provide indication of the event.*

Symptom: unit is running and Low Evaporator Pressure event is listed on controller		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
This event is triggered if all of the following are true: circuit state = Run AND more than one compressor is running on the circuit AND	Check for temperature approach of the refrigerant in the evaporator. Check for right flow of water in the evaporator; Check for correct	Stage off one compressor on the circuit every 10 seconds while evaporator pressure is less than the unload set point, except the last one.

evaporator pressure <= (Low Evaporator Pressure - Unload set point) for a time greater than half of the current freeze-stat time AND circuit is not currently in a low OAT start AND it has been at least 30 seconds since a compressor has started on the circuit. On units equipped with 6 compressors, electronic expansion valves, and 10 or more fans, when each compressors starts, there should be a 2 minute window during which the evaporator pressure must drop an additional 27 kPa to trigger the alarm. After this 2 minute window, the trigger point should return to normal.	operation of EXV Check for loss of refrigerant Check instrument calibration	
RESET : While still running, the event will be reset if evaporator pressure > Low Evaporator Pressure Hold SP + 90 kPa. The event is also reset if the circuit is no longer in the run state.		

6.9.2 HIGH CONDENSER PRESSURE HOLD

6.9.3 HIGH CONDENSER PRESSURE - UNLOAD

Purpose:

- *To prevent excessive condenser pressure on the chiller and provide indication of the event.*

Symptom: unit is running and HIGH CONDENSER PRESSURE is listed on controller		
CAUSES	*CORRECTIVE ACTION*	*CONSEQUENCE*
This event is triggered if all of the following are true: circuit state = Run AND more than one compressor is running on the circuit AND condenser pressure > (High Condenser Pressure – Unload set point)	Check for temperature approach of the refrigerant in the condenser. Check for right flow of air through the coil Check for proper operation of the condenser fans and proper cleaning condition of the coils Check for condenser air short-circuit on the coils	Stage off one compressor on the circuit every 10 seconds while condenser pressure is higher than the unload set point, except the last one. Inhibit staging more compressors on until the condition resets.
RESET : While still running, the event will be reset if condenser pressure <= (High Condenser Pressure Unload SP – 862 kPa). The event is also reset if the circuit is no longer in the run state		

7 Appendix C : Basic Control System Diagnostic

MicroTech III controller, extension modules and communication modules are equipped with two status LED (BSP and BUS) to indicate the operational status of the devices.

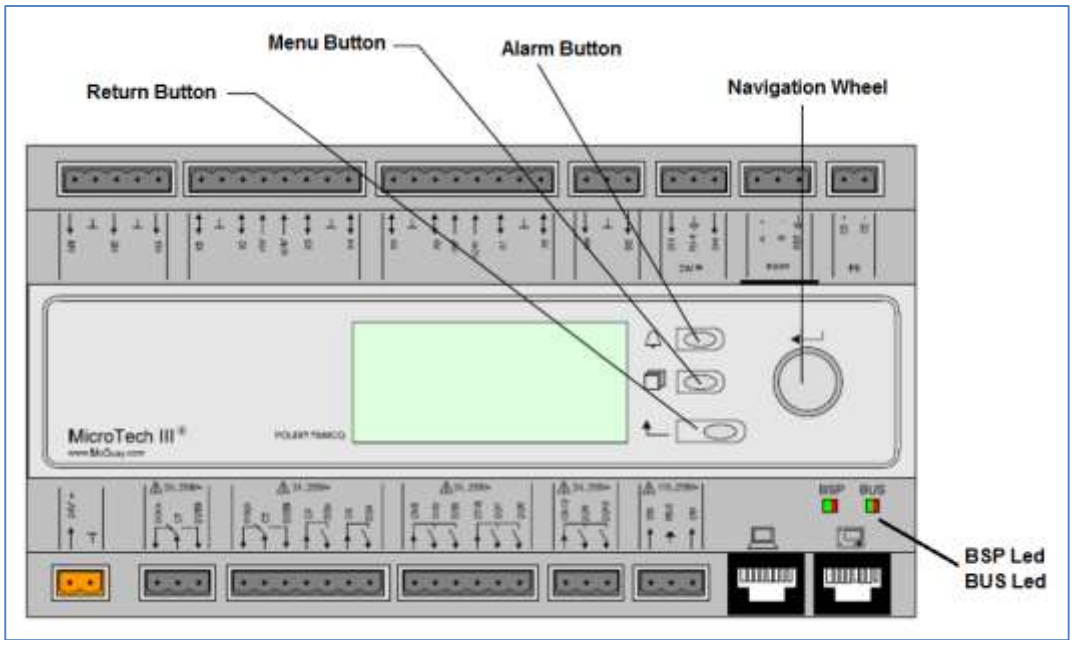


Figure of Controller "MicroTech III" with indications of main buttons and LEDs

7.1 Controller Module LED

The meaning of the two status LED for Controller module is indicated in below table.

BSP LED	***BUS LED***	***MODE***	***ACTIONS***
Solid Green	OFF	Application running	None
Solid Yellow	OFF	Application loaded but not running	Contact Service
Solid Red	OFF	Hardware Error	Contact Service
Flashing Yellow	OFF	Application not loaded	Contact Service
Flashing Red	OFF	BSP Error	Contact Service
Flashing Red/Green	OFF	Application/BSP update	Contact Service

7.2 Extension Module LED

The meaning of the two status LED for Extension module is indicated in below table.

BSP LED	***BUS LED***	***MODE***	***ACTIONS***
Solid Green		BSP running	None
Solid Red		Hardware Error	Contact Service
Flashing Red		BSP Error	Contact Service
	Solid Green	Communication running, I/O working	None
	Solid Yellow	Communication running, parameter missing	Contact Service
	Solid Red	Communication down	Contact Service

7.3 Communication Module LED

The meaning of the BSP status LED for Communication module is indicated in below table.

BSP LED	***MODE***	***ACTIONS***
Solid Green	BPS running, communication with controller	None
Solid Yellow	BSP running, no communication with controller	Contact Service
Solid Red	Hardware Error	Contact Service
Flashing Red	BSP Error	Contact Service
Flashing Red/Green	Application/BSP update	None

BUS LED status depends by particular protocol of communication.

Protocol	***BUS LED***	***MODE***
LON module	Solid Green	Ready for Communication. (All Parameter loaded, Neuron configured). Doesn't indicate a communication with other devices.
	Solid Yellow	Startup
	Solid Red	No Communication to Neuron (internal error, could be solved by downloading a new LON application)
	Flashing Yellow	Communication not possible to the Neuron. The Neuron must be configured and set online over the LON Tool.

Protocol	***BUS LED***	***MODE***
BACnet MSTP module	Solid Green	Ready for Communication. The BACnet Server is started. It doesn't indicate a active communication
	Solid Yellow	Startup
	Solid Red	BACnet Server down. Automatically a restart after 3 seconds are initiated.

Protocol	***BUS LED***	***MODE***
BACnet IP module	Solid Green	Ready for Communication. The BACnet Server is started. It doesn't indicate a active communication
	Solid Yellow	Startup. The LED stays yellow until the module receives an IP Address, therefore a link must be established.
	Solid Red	BACnet Server down. Automatic restart after 3 seconds is initiated.

Protocol	***BUS LED***	***MODE***
MODbus module	Solid Green	All Communication running
	Solid Yellow	Startup, or one configured channel not communicating to the Master.
	Solid Red	All configured Communications down. Means no communication to the Master. The timeout can be configured. In case that the timeout is zero the timeout is disabled.

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