CONTROL PANEL OPERATING MANUAL

AIR COOLED INVERTER WATER CHILLER & HEAT PUMP

MICROTECH III CONTROLLER

D-EOMHP00706-14EN

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Revision History

Rev #	Description	Date issued	Approved Checked Author
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Scope of Applicable Model(s)

BU's / Type: Air Cooled Multi Scroll Heat Pump / Cooling Chiller
Refrigerant: R410A

Voltage	Model Name
400V/50Hz	EWAQ GZ/EWYQ GZ

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1 Safety considerations

1.1 General

Installation, start-up and servicing of equipment can be hazardous if certain factors particular to the installation are not considered: operating pressures, presence of electrical components and voltages and the installation site (elevated plinths and built-up up structures). Only properly qualified installation engineers and highly qualified installers and technicians, fully trained for the product, are authorized to install and start-up the equipment safely.
During all servicing operations, all instructions and recommendations, which appear in the installation and service instructions for the product, as well as on tags and labels fixed to the equipment and components and accompanying parts supplied separately, must be read, understood and followed.
Apply all standard safety codes and practices. Wear safety glasses and gloves.
Use the proper tools to move heavy objects. Move units carefully and set them down gently.

1.2 Avoid electrocution

Only personnel qualified in accordance with IEC (International Electrotechnical Commission) recommendations may be permitted access to electrical components. It is particularly recommended that all sources of electricity to the unit be shut off before any work is begun. Shut off main power supply at the main circuit breaker or isolator.

IMPORTANT: This equipment uses and emits electromagnetic signals. Tests have shown that the equipment conforms to all applicable codes with respect to electromagnetic compatibility.

RISK OF ELECTROCUTION: Even when the main circuit breaker or isolator is switched off, certain circuits may still be energized, since they may be connected to a separate power source.

RISK OF BURNS: Electrical currents cause components to get hot either temporarily or permanently. Handle power cable, electrical cables and conduits, terminal box covers and motor frames with great care.

ATTENTION: In accordance with the operating conditions the fans can be cleaned periodically. A fan can start at any time, even if the unit has been shut down.

1.3 Safety Devices

Each unit is equipped with safety devices of three different kinds:

1.3.1 General safety devices

Safeties of this level of severity will shut down all the circuits and stop the entire unit. When a general safety device is happen, a manual intervention on the unit will be required in order to re-establish the normal operability of the machine. There are exceptions to this general rule in case of alarms linked to temporary abnormal conditions.

- Emergency Stop

A push button is placed on a door of the unit electrical panel. The button is highlighted by a red color in yellow background. A manual pressure of the emergency stop button stops all loads from rotating, thus preventing any accident which may occur. An alarm is also generated by the Unit Controller. Releasing the emergency stop button enables the unit, which may be restarted only after the alarm has been cleared on the controller.

⚠ **The emergency stop causes all motors to stop, but does not switch off power to the unit. Do not service or operate on the unit without having switched off the main switch.**

1.3.2 Circuit safety devices

Safety of this level of severity will shut down the circuit they protect. The remaining circuits will keep running.

1.3.3 Component safety devices

Safety of this level of severity will shut down a component against abnormal running condition that could create permanent damages to it. An overview of the protecting devices is listed below:

- Overcurrent/Overload Protections

Overcurrent/overload devices protect electrical motors used on compressors, fans and pumps in case of overload or short circuit. In case of inverter-driven motors, overload and overcurrent protection is integrated in the electronic drives. A further protection from short circuit is accomplished by fuses or circuit breakers installed upstream each load or group of loads.

- Overtemperature Protections

Fan electrical motors are also protected from overheating by thermistors immersed into motor windings. Should the winding temperature exceed a fixed threshold, the thermistors will trip and cause the motor to stop.

⚠ **Do not operate on a faulty fan before the main switch has been shut off. Overtemperature protection is auto-reset, therefore a fan may restart automatically if temperature conditions allow it.**

- Phase reversal, under/over voltage, ground fault protections

When one of those alarms occurs the unit is immediately stopped or even inhibited to start. The alarms clear automatically once the problem is fixed. This auto clear logic allows the unit to automatically recover in case of temporary conditions where the supply voltage reaches the upper or lower limit set on the protection device. In the other two cases a manual intervention on the unit will be required in order to solve the problem. In case of a phase reversal alarm two phases requires to be inverted.
In the event of a power supply outage, the unit will restart automatically without the need for an external command. However, any faults active when the supply is interrupted are saved and may in certain cases prevent a circuit or unit from restarting.

⚠ **Direct intervention on the power supply can cause electrocution, burns or even death. This action must be performed only by trained persons.**

- Flowswitch

The unit must be protected by a flow switch. The flow switch will stop the unit when the water flow becomes lower than the minimum allowed flow. When the water flow is restored the flow protection is reset automatically. Exception is when the flow switch opens with at least one compressor running, in this case the alarm shall be cleared manually.

- Freezing protection

Antifreeze protection prevents the water to freeze in the evaporator. It is automatically activated when the water temperature (entering or leaving) at the evaporator drops below the antifreeze limit. In freeze condition if the unit is in standby the evaporator pump will be activated to prevent freezing of the evaporator. If the freeze condition will activate when the unit is running all units will shut down in alarm while the pump will keep running. Alarm will automatically clear when the freeze condition will clear.

- Low pressure protection

If the circuit operates with a suction pressure lower than an adjustable limit for a certain time the circuit safety logic will shut down the circuit and generate an alarm. The alarm requires a manual action on the Unit Controller to be reset. Reset will take effect only if the suction pressure is no longer lower that the safety limit.

- High Pressure Protection

If the discharge pressure becomes too high and exceeds a limit which is linked with the operational envelop of the compressor the circuit safety logic will try to prevent the alarm or, if the corrective actions have no effect, it will shut down the circuit before the Mechanical High Pressure switch will open. This alarm required a manual action on the Unit Controller to be reset.

- Mechanical High Pressure Switch

Each circuit is equipped with at least one high pressure switch which tries to prevent the relief safety valve to open. When the discharge pressure becomes too high the Mechanical High Pressure switch will open and immediately stop the compressor cutting the power supply to the auxiliary relay. The alarm can be cleared as soon as the discharge pressure becomes normal again. The alarm must be reset on the switch itself and on the Unit Controller. The triggering pressure value cannot be changed.

- Relief Safety Valve

If the pressure becomes too high in the refrigerant circuit, the relief valve will open to limit the maximum pressure. If this happens switch off immediately the machine and contact your local service organization.

- Inverter fault

Each compressor can be equipped with its own inverter (integrated or external). The inverter can automatically monitor its status and inform the Unit Controller in case of faults or pre-alarm conditions. If this happen the Unit Controller will limit the compressor operation or eventually switch off the circuit in alarm. A manual action on the controller will be needed in order to clear the alarm.

2 General description

2.1 General

Microtech® III is a system for controlling single or dual-circuit ATS air-cooled liquid chillers. Microtech® III controls compressor start-up needed to maintain the desired heat exchanger leaving water temperature. In cooling mode it controls the operation of the fans to maintain the correct condensing pressure in each circuit.
Safety devices are constantly monitored by Microtech® III to ensure their safe operation. Microtech® III also gives access to a Test routine covering all inputs and outputs. All Microtech® III controls can work in accordance with three independent modes:

- Local mode: the machine is controlled by commands from the user interface.
- Remote mode: the machine is controlled by remote contacts (volt-free contacts).

Network mode: the machine is controlled by commands from a BAS system. In this case, a data communication cable is used to connect the unit to the BAS.
When the Microtech® III system operates autonomously (Local or Remote mode) it retains all of its own control capabilities but does not offer any of the features of the Network mode.

2.2 Abbreviations used

In this manual, the refrigeration circuits are called circuit #1 and circuit #2.
The following abbreviations are used frequently:

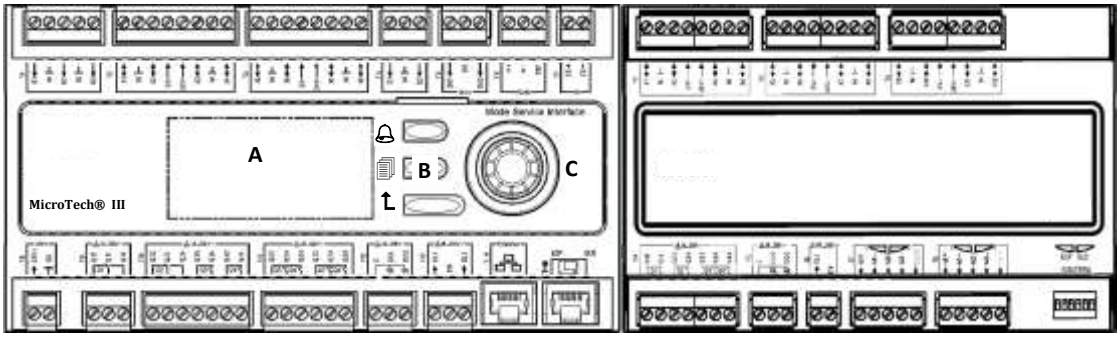
Abbreviations	Description
Ckt	Circuit
Temp	Temperature
Pr	Pressure
Comp	Compressor
Cond	Condenser
Evap	Evaporator
EXV	Electronic expansion valve
TXV	Thermostatic expansion valve
SV	Solenoid valve

ECON	Economizer
AHX	Air cooled heat exchanger
WHX	Water cooled heat exchanger
4WV	Four way valve
HPS	High pressure switch
LPS	Low pressure switch
INV	Inverter
PVM	Phase voltage monitor
EWT	Entering water temperature
LWT	Leaving water temperature
OAT	Outside ambient temperature
Disch	Discharge
Suct	Suction
Tc	Saturated condenser temperature
Te	Saturated evaporator temperature
Tr	Deicer temperature
SC	Sub cooling
SSH	Suction superheat
DSH	Discharge superheat
DPT	Discharge port temperature
BAS	Building automatic system
HMI	Human Machine Interface
ACS	One of the communication method

3 Control system

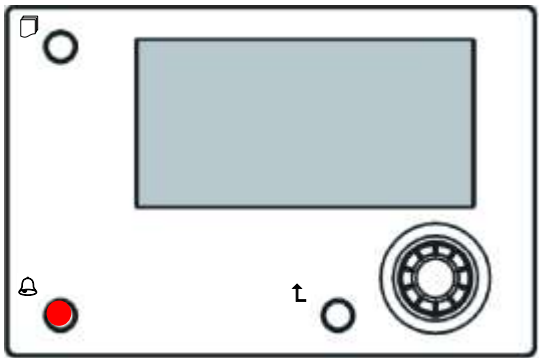
3.1 Overview

The control system consists of a unit controller (UC) equipped with a set of extension modules that implement additional features. I/O extension modules communicate via an internal peripheral bus with the UC. ACS I/F board, which controls compressor variable frequency drives, communicate via a Modbus with UC. The Microtech III continuously manages the information received from the various pressure and temperature probes installed on the compressors and communicated to the unit. The UC incorporates a program that controls the unit.
The standard HMI consists of an inbuilt display (A) with 3 buttons (B) and a push'n'roll control (C) to navigate interface screens and modify settings. It is integrated in the UC board and gives access to a full array of control parameters.
All boards are supplied from a common 24 Vac supply. Extension boards can be directly powered by the Unit Controller.

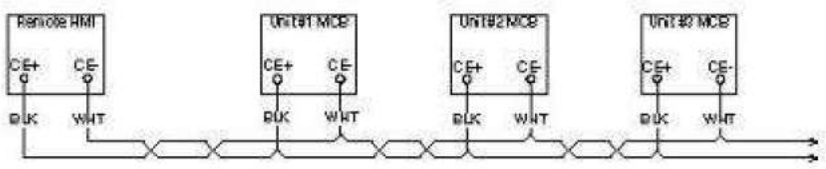


CAUTION: Maintain the correct polarity when connecting the power supply to the boards, otherwise the peripheral bus communication will not operate and the boards may be damaged.

As an option an external Remote HMI could be connected on the UC. The Remote HMI offers the same features than the inbuilt plus the alarm indication done with a light emitting diode located below the bell button.



The Remote HMI can be extended up to 700m using the process bus connection available on the UC. With a daisy-chain connection as below, a single HMI can be connected to up to 8 units. Refer to the specific HMI manual for details.



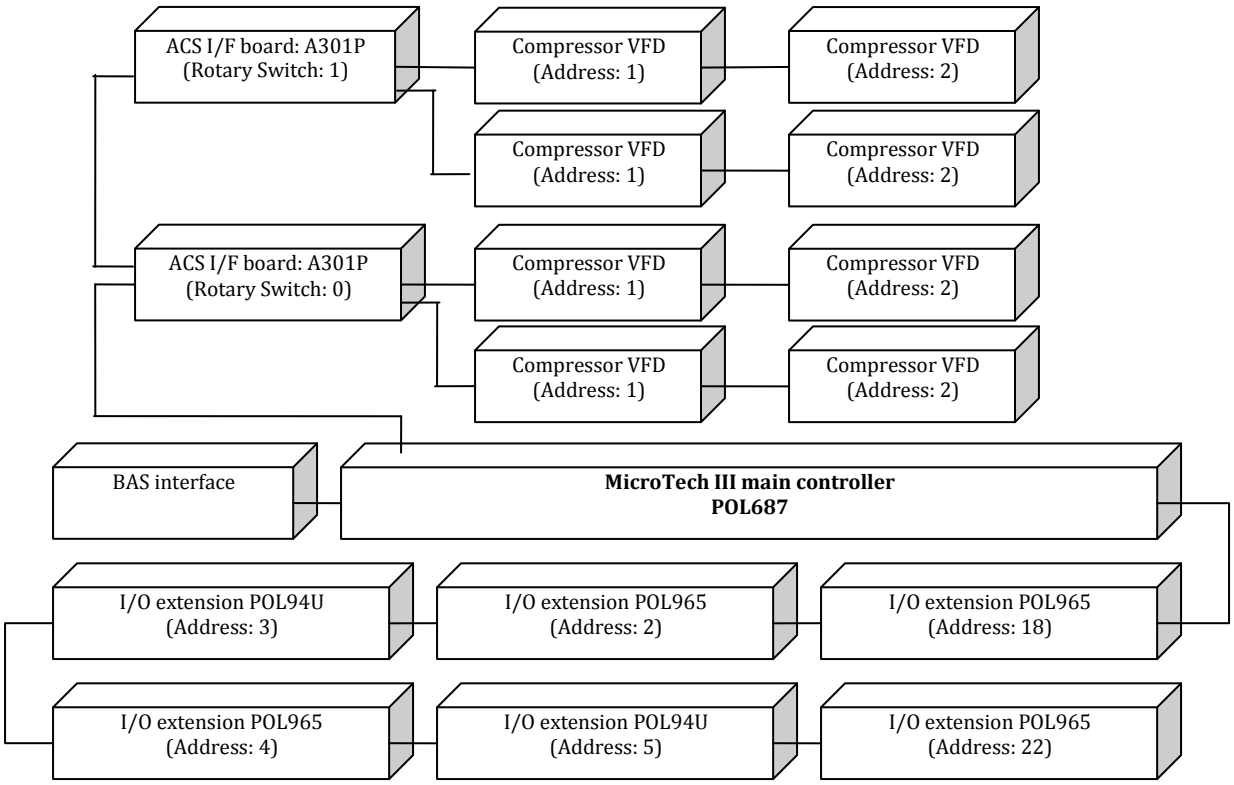
3.2 Communication components

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 as the following table. Also the diagram shown as below indicates how those modules are connected.

Components	Address	Number of compressors						
		3	4	5	6	8	10	12
BAS interface (Lon, BacNet, Modbus)	-	x	x	x	x	x	x	x
POL687 (MTIII Main controller)	-	x	x	x	x	x	x	x
POL965 (I/O extension module)	18	x	x	x	x	x	x	x
POL965 (I/O extension module)	2	x	x	x	x	x	x	x
POL94U (I/O extension module)	3	x	x	x	x	x	x	x
POL965 (I/O extension module)	4	N/R	N/R	N/R	N/R	x	x	x
POL94U (I/O extension module)	5	N/R	N/R	N/R	N/R	x	x	x
POL965 (I/O extension module)	23	N/R	N/R	N/R	N/R	x	x	x
POL925 (I/O extension module)	21	Opt	Opt	Opt	Opt	Opt	Opt	Opt
POL965 (I/O extension module)	22	Opt	Opt	Opt	Opt	Opt	Opt	Opt
ACS I/F board: A301P	Modbus comm. Rotary Switch: 0	x	x	x	x	x	x	x
ACS I/F board: A302P	Modbus comm. Rotary Switch: 1	N/R	N/R	N/R	N/R	x	x	x
Compressor VFD	ACS comm. Address: 1	x	x	x	x	x	x	x
Compressor VFD	ACS comm. Address: 2	x	x	x	x	x	x	x

Note: “x” means a unit will use that component.

Here is the sample diagram of components connection for 8 compressors unit.



3.3 Light emitting diodes on boards

All boards continuously check and indicate the proper operation of their electronic circuits. A light emitting diode (LED) lights on the UC and two additional lights on each extension board when it is operating properly.

3.3.1 UC BSP LED

Mode	LED
BSP initialization. This indicates the startup and preparation of all files. After this mode the final run mode (bellow) is active. Available since VVS10.	Green flashing with 50ms on and 1000ms off
BSP upgrade mode in progress	Per second flashing between red and green.
Application not loaded	Yellow flashing with 50ms on and 1000ms off
Application loaded but not running or BSP Upgrade mode active	Yellow
Application running	Green
BSP error (software error)	Red flashing with 2Hz
Hardware error	Red
Fail safe mode (in case that the BSP upgrade was interrupted)	Yellow with Red flashing every second for 500ms
(since VVS10) BSP startup phase. The controller needs time for starting.	Green flashing with 50ms on and 1000ms off

3.3.2 Extension modules BSP LED

Mode	LED
BSP upgrade mode	Per second flashing between red and green.
BSP running	Green
BSP error (software error)	Red flashing with 2Hz
Hardware error	Red

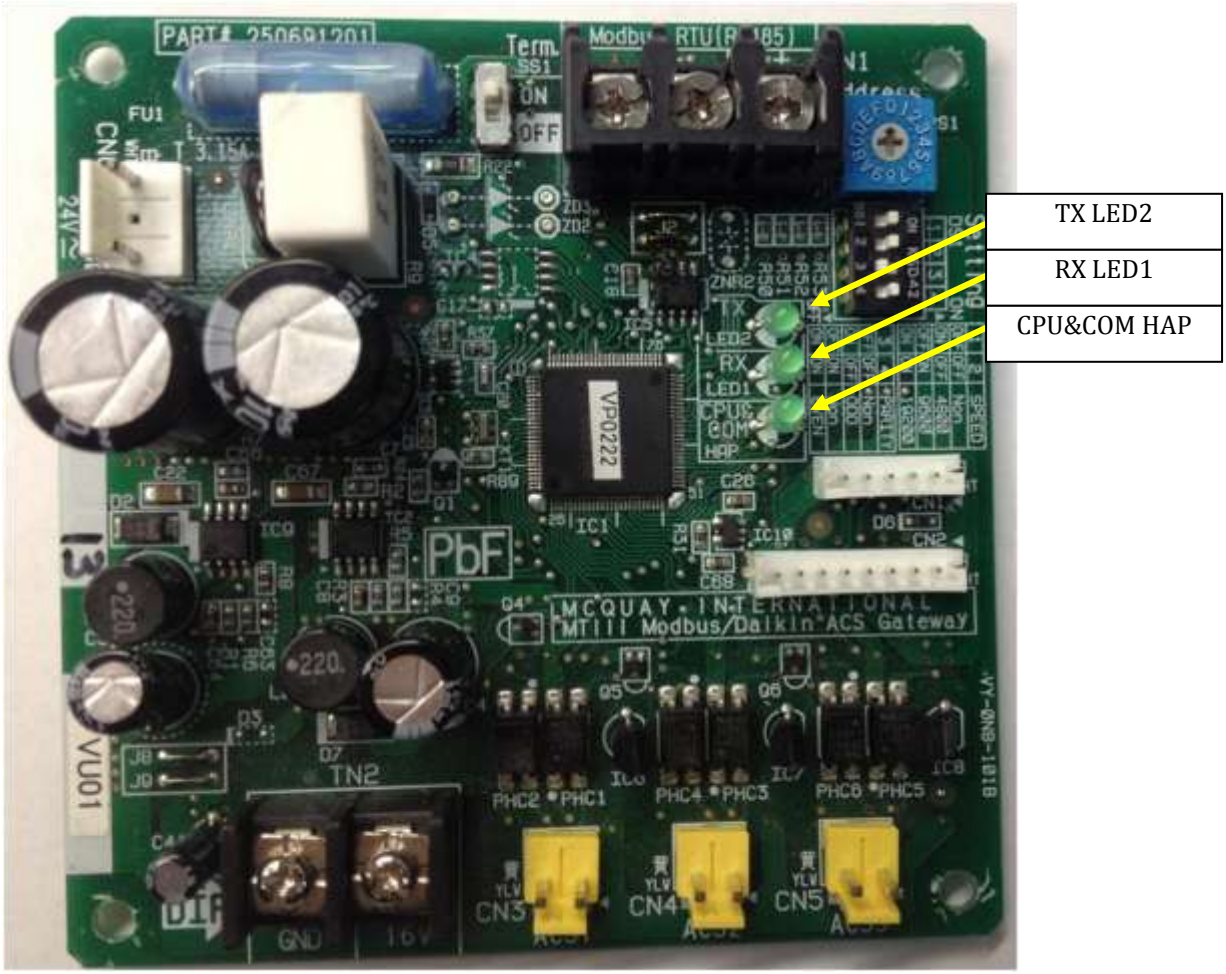
3.3.3 BUS LED

This LED indicates the status of the communication with the controller.

Mode	LED
Communication running but parameter from the application wrong or missing, or the calibration from the factory not correct	Yellow
Communication running, IO working	Green
Communication down	Red

3.3.4 ACS I/F Board LEDs

There are three LEDs in ASC I/F board.



TX LED2

Mode	LED
Sending Modbus data successfully	Flashing
Not sending Modbus data	No lights

RX LED1

Mode	LED
Receiving Modbus data successfully	Flashing
Not receiving Modbus data	No lights

CPU&COM HAP

Mode	LED
Main chip is working. ACS communication has not started yet.	Flashing with 200ms cycle
Main chip is working. ACS communication is running.	Flashing with 400ms cycle
Main chip is not working.	No lights

3.3.5 Compressor VFD LED

Mode	LED
Main chip is working correctly.	Flashing
Main chip is not working. Power is coming to chip.	Lights (not flashing)
Main chip is not working.	No lights

3.4 Available sensors

3.4.1 Pressure transducers

Two types of electronic sensors are used to measure suction, discharge and oil pressure on each circuit. The range of each sensor is clearly indicated on the sensor casing. Discharge and oil pressures are monitored using a sensor of the same range.

Description	Number of sensors	Type	Calibration
Cond Pr	1 per Ckt	500mV ~ 4500mV	Offset by set point
			Offset by set point
Evap Pr	1 per Ckt	500mV ~ 4500mV	Offset by set point
			Offset by set point

3.4.2 Temperature Sensors

The evaporator water sensors are installed in the entering and leaving side. An outdoor temperature sensor is mounted inside the chiller. Additionally each circuit installs a suction and discharge temperature sensors to monitor and control the superheated refrigerant temperatures.
On refrigerant-cooled inverters additional sensors immersed into the cooling plate measure the temperature of the drives.

Description	Number of sensors	Type	Calibration
EWT	1 per Unit	NTC10K	Offset by set point
LWT	1 per Unit	NTC10K	Offset by set point
OAT	1 per Unit	NTC10K	Offset by set point
Deicer Temp	1 per Ckt	NTC10K	Offset by set point
Evap Gas Temp	1 per Ckt	NTC10K	Offset by set point
Suct Temp	1 per Ckt	NTC10K	Offset by set point
Disch Temp	1 per Comp	-	Offset by set point
Comp casing Temp	1 per Comp	-	Offset by set point
INV FIN Temp	1 per Comp	-	No calibration

3.4.3 Thermistors

Thermistors trip to a high value in case the motor temperature reaches a hazardous temperature.

3.4.4 Other sensors

Description	Number of sensors	Type	Calibration
INV Output current	1 per Comp	-	No calibration

3.5 Available Controls

3.5.1 Evaporator pumps

The controller can regulate one or two evaporator pumps and takes care of automatic change-over between pumps. It's also possible to prioritize the pumps and temporarily disable one of the twos. The controller is also able to control the pump speeds if the pumps are equipped with inverters.

3.5.2 Compressors

The controller can regulate maximum twelve compressors installed on one or two independent refrigerant circuit (maximum six compressors per circuit). All the safeties of each compressor will be managed by the controller. Embedded inverter safeties are handled by the inverter onboard electronic and only notified to the UC.

3.5.3 Expansion Valve

The controller can regulate an electronic expansion valve per each refrigerant circuit. Microtech® III embedded logic will always guarantee the best operation for the refrigerant circuit.

3.6 Customer Terminal Block Connections

3.6.1 General description

The contacts below are available at the user's terminal block referred as MC24 or MC230 in the wiring diagram. The following table summarizes the connections at the user's terminal block.

Description	Terminals	Notes
Flow Switch (mandatory)	708-724 (MC24)	24 Vdc digital input
Double setpoint	703-728 (MC24)	24 Vdc digital input
Current limit enable	884-885 (MC24)	24 Vdc digital input
External Fault	883-884 (MC24)	24 Vdc digital input
Rapid Restart Enable (optional)	-	24 Vdc digital input
Back-up chiller (optional)	-	24 Vdc digital input
LOC/BMS selection (optional)	-	24 Vdc digital input
On-Off Remote	-	230 Vac digital input
General Alarm	525-526 (MC230)	NO digital output (24…230 Vac ext supply)
Compressor #1 status	-	NO digital output (24…230 Vac ext supply)
Compressor #2 status	-	NO digital output (24…230 Vac ext supply)
Alarm Circuit #1 (optional)	-	NO digital output (24…230 Vac ext supply)
Alarm Circuit #2 (optional)	-	NO digital output (24…230 Vac ext supply)
Evaporator Pump #1 start	527-528 (MC230)	NO digital output (24 Vdc internal supply)
Evaporator Pump #2 start	530-531 (MC230)	NO digital output (24 Vdc internal supply)
Demand Limit	888-889 (MC24)	4-20 mA analog input
Current Limit (optional)	889-890 (MC24)	4-20 mA analog input
Setpoint Override	886-887 (MC24)	4-20 mA analog input

3.6.1.1 Flow Switch

Although the flow switch is offered as an optional, it is mandatory to install one and connect it to the digital input terminals in order to enable chiller operation only when a minimum flow is sensed.

⚠ Operating the unit by-passing the flow switch input or without an appropriate flow switch may damage the evaporator due to freezing. Operation of the flow switch must be checked prior to start up the unit.

3.6.1.2 Double setpoint

This contact can be used to switch between two different LWT setpoints and depending on the application between different modes of operation.

3.6.1.3 Current limit (optional)

This optional feature enables a capacity control of the unit in order to limit the input current. The current limit feature is included in the Energy Meter option. The limiting signal will be compared with a limiting value set on the HMI. By default the current limit setpoint is selected through the HMI; an external 4-20 mA signal can be enabled to allow a remotely changeable setpoint.

3.6.1.4 External Fault

This contact is available to report to the UC a fault or a warning from an external device. It could be an alarm coming from an external pump to inform the UC of the fault. This input can be configured as a fault (unit stop) or a warning (displayed on the HMI).
Ice operation must be selected in case of ice storage application. In this case the UC will run the chiller in on/off mode switching all chillers off as soon as the setpoint is reached. In this case the unit will run to full capacity and then will switch off applying an ice delay different chiller starts.

3.6.1.5 Rapid Restart (optional)

Purpose of the rapid restart feature is to let the unit restart in the shortest possible time after a power failure, and then recover in the shortest possible time (maintaining the reliability level of the normal operations) the capacity it had before the power failure. The rapid restart is enabled by the enable switch.

3.6.1.6 Remote On-Off

This unit can be started through a remote enable contact. The Q0 switch must be selected to “Remote”.

3.6.1.7 General Alarm

In case of a unit alarm, this output is closed thus indicating a fault condition to an externally connected BMS.

3.6.1.8 Compressor Status

The digital output is closed when the related circuit is in run state.

3.6.1.9 Alarm Circuit (optional)

This option is included with the “Rapid Restart” option. The related digital contact is closed in case of alarm on a circuit.

3.6.1.10 Evaporator Pump Start

A 24 Vdc digital output (with internal supply) is enabled when a pump (#1 or #2) is required to start. The output can be used to start an external pump (either at fixed or variable speed). The output requires an external input or a relay with less than 20 mA excitation current.

3.6.1.11 Demand limit

This optional function can be used to limit the unit capacity percentage to a changeable limit value. This limitation cannot be directly linked to a corresponding limitation of the unit current (50% demand limit can differ from 50% of the unit FLA).

The demand limit signal can be changed continuously between 4 and 20 mA. The Microtech III will convert this signal into a unit capacity limitation changing between minimum capacity and full capacity with a linear relationship. A signal between 0 and 4mA will correspond to a full unit capacity. In this way if nothing is connected to this input no limitation will be applied. The maximum limitation will never force a unit shutdown.

3.6.1.12 **Setpoint override**

This input allows applying an offset on the Active Setpoint to adjust the operating point of the ELWT. This input can be used to maximize the comfort.

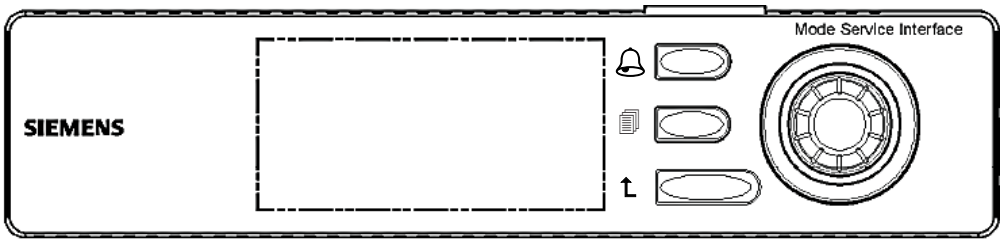
4 Working with this unit

4.1 Human Machine Interface

The unit is equipped with Microtech® III located directly on the control service panel. The controller has a friendly Human Machine Interface (HMI) which allows to adjust all operational settings within their own safety ranges and to monitor all the running parameters. Each section of this chapter will explain all the tasks that can be performed on the UC HMI.
The HMI structure is based on access level that means that each password will disclose all the settings and parameters allowed to that password level. Basic information about the status including the active alarm list, active setpoint and controlled water temperature can be accessed without the need to enter the password.
The user UC handles two levels of passwords:

USER	5321
MAINTENANCE	2526

The following information will cover all data and settings accessible with the maintenance password. User password will disclose a subset of the settings explained in the chapter **Errore. L'origine riferimento non è stata trovata.**.



The HMI is composed of three soft keys and a push'n'roll command. The function of the three buttons is described below:

🔔	Alarm status (from any page it links with the page with alarm list, alarm log and alarm snapshot if available)
🗐	Back to Main Page
↰	Back to the previous level (it can be the Main Page)

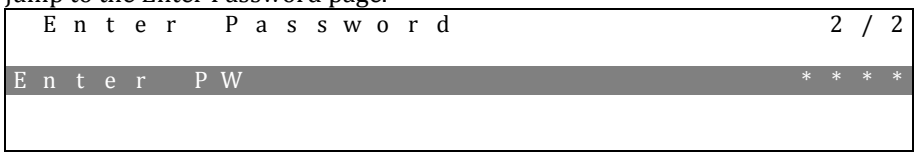
The push'n'roll command is used to scroll between the different menu pages, settings and data available on the HMI for the active password level. An example of the HMI screens is shown in the following picture.

```
  Main Menu                    1 / 11
Enter Password                    ▶
Unit Status =
  Off: Unit SW
Active Setpt =              7.0 °C
```

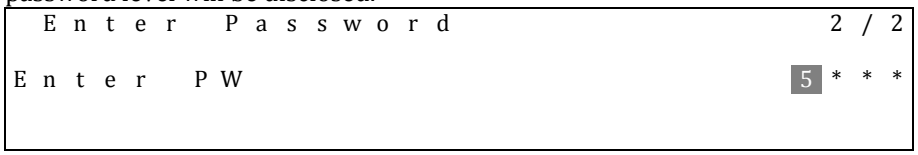
A bell ringing in the top right corner will indicate an active alarm. If the bell doesn't move it means that the alarm has been acknowledged but not cleared because the alarm condition hasn't been removed.

```
  Main Menu                    1 / 🔔
Enter Password                    ▶
Unit Status =
```

The active item is highlighted in contrast, in this example the item highlighted in Main Menu is a link to another page. By pressing the push'n'roll, the HMI will jump to a different page. In this case the HMI will jump to the Enter Password page.



In the Enter Password screen, the line with the password field will be highlighted to indicate that the field on the right can be changed. This represents a setpoint for the controller. Pressing the push'n'roll the individual field will be highlighted to allow an easy introduction of the numeric password. By changing all fields, the 4 digits password will be entered and, if correct, the additional settings available with that password level will be disclosed.



4.2 Menu navigation

The first column is the top level of the menu hierarchy. As the user makes selections in a column, they move to the right. When no more menus exist in a path, selecting an option takes the user to the selected screen. Some options are only visible when they can be selected as a result of unit configuration and user password.

Menu Level 1		Menu Level 2		Menu Level 3		Menu Level 4
ENTER PASSWORD						
Unit overview information						
QUCIK MENU						
VIEW / SET UNIT	--->	STATUS				
		SETUP	--->	CALIBRATE SENSORS		
				CHILLER NETWORK CTRL		
		DATA				
VIEW / SET CIRCUIT	--->	CKT #n	--->	STATUS		
				SETUP	--->	CALIBRATE SENSORS
				DATA		
				COMP #n		
				MANUAL CONTROL		
COMMISSION UNIT	--->	CONFIGURATION				
		CTRLR IP SETUP				
		LON SETUP				
		BACNET IP SETUP				
		BACNET MSTP SETUP				
		MODBUS SETUP				
		AWM SETUP				
		MENU PASSWORD				
TIME UNTIL RESTART						
ALARMS	--->	ACTIVE ALARM				
		ALARM LOG				
		EVENT LOG				
		ALARM LIMITS				
SCHEDULED MAINTENANCE						
TEST I/O	--->	UNIT I/O TEST				
		CKT #1 I/O TEST				
		CKT #2 I/O TEST				
ABOUT THIS CHILLER						
DATA / TIME						

4.3 Basic settings

Before starting up the unit, some basic settings need to be done. These set points can be accessed via the following path.

Menu Level 1		Menu Level 2
ENTER PASSWORD		
Unit overview information		
QUCIK MENU		
VIEW / SET UNIT		
VIEW / SET CIRCUIT		
COMMISSION UNIT	--->	CONFIGURATION
		CTRLR IP SETUP
		LON SETUP
		BACNET IP SETUP
		BACNET MSTP SETUP
		MODBUS SETUP
		AWM SETUP
		MENU PASSWORD
TIME UNTIL RESTART		
ALARMS		
SCHEDULED MAINTENANCE		
ABOUT THIS CHILLER		
DATA / TIME		

4.3.1 Chiller configuration setting

Generally this setting has been done in the factory. However, chiller configuration settings must be set via HMI keypad when the new software is installed. Unless setting all configurations the chiller will not be able to start.

Contents	Default	Selectable values	Note
Voltage	400	200~220, 220~230, 380, 400, 460	
Frequency	50	50, 60	
Unit type	Cool only	Cool only, Heat pump	
Efficiency type	Hi Eff	Std Eff, Hi Eff	
Number of Ckt	1	1,2	
Number of comps	3	3, 4, 5, 6	Need to be set for each circuits
Number of fans	3	3, 4, 5	Need to be set for each circuits
Fan VFD	Disable	Enable, Disable	
Liquid line SV	Disable	Enable, Disable	
HPS setting	Normal	Normal, Higher limit	“Higher limit” will be used only

			for US chillers.
Comm. Module1	Automatically detected.	BACNET IP, BACNET MSTP, LON, MODBUS, AWM	
Comm. Module2			
Comm. Module3			

⚠ *Modification to any of these value will require to be acknowledged to the controller by setting "Apply Changes = Yes". This will cause a controller reboot!*

4.3.2 Controller IP setup

The Microtech ® III controller has an embedded web server showing a replica of the onboard HMI screens. To access this additional web HMI can be required to adjust the IP settings to match the settings of the local network. This can be done in this page. Please contact your IT department for further information on how to set the following setpoints. The controller also supports DHCP, in this case the name of the controller must be used.

CTRLR IP SETUP		read	write
	Apply Changes	R	W
	DHCP	R	W
	Actual IP Address	R	-
	Actual Mask	R	-
	Actual Gateway	R	-
	Given IP Address	R	W
	Given Mask	R	W
	Given Gateway	R	W

⚠ *Modification to any of these value will require to be acknowledged to the controller by setting "Apply Changes = Yes". This will cause a controller reboot!*

4.3.3 Setup for BMS

The following set points have to be set based on customer requirements for enabling the unit working with BMS.

4.3.3.1 LON setup

LON SETUP		read	write
	Apply Changes	R	W
	Module Status	R	-
	Neuron ID	R	-
	Max Send Time	R	W
	Min Send Time	R	W
	Receive Heartbeat	R	W
	LON BSP	R	-

	LON App Version	R	-

⚠ *Modification to any of these value will require to be acknowledged to the controller by setting "Apply Changes = Yes". This will cause a controller reboot!*

4.3.3.2 BACNET setup

BACNET IP SETUP		read	write
	Apply Changes	R	W
	Module Status	R	-
	Name	R	W
	Dev Instance	R	W
	UDP Port	R	W
	DHCP	R	W
	Actual IP Address	R	-
	Actual Mask	R	-
	Actual Gateway	R	-
	Given IP Address	R	W
	Given Mask	R	W
	Given Gateway	R	W
	Unit Support	R	W
	NC Dev 1	R	W
	NC Dev 2	R	W
	BACnet BSP	R	-

BACNET MSTP SETUP		read	write
	Apply Changes	R	W
	Module Status	R	-
	Name	R	W
	Dev Instance	R	W
	MSTP Address	R	W
	Baud Rate	R	W
	Max Master	R	W
	Max Info Frm	R	W
	Unit Support	R	W
	NC Dev 1	R	W
	NC Dev 2	R	W
	BACnet BSP	R	-

⚠ *Modification to any of these value will require to be acknowledged to the controller by setting "Apply Changes = Yes". This will cause a controller reboot!*

4.3.3.3 MODBUS setup

MODBUS SETUP		read	write
	Apply Changes	R	W
	Module Status	R	-
	Address	R	W
	Parity	R	W
	Two Stop Bits	R	W
	Baud Rate	R	W
	Response Delay	R	W
	Comm LED Time Out	R	W
	Modbus BSP	R	-

⚠ *Modification to any of these value will require to be acknowledged to the controller by setting "Apply Changes = Yes". This will cause a controller reboot!*

4.3.4 Date/Time

This page will allow adjusting the time and dating in the UC. This time and date will be used in the alarm log and to enable and disable the Quiet Mode. Additionally it's also possible to set the starting and ending date for the DayLight Saving time (DLS) if used.

DATA / TIME		read	write
	Actual Time	R	W
	Actual Date	R	W
	UTC Difference	R	W
	DLS Enable	R	W
	DLS Start Month	R	W
	DLS Start Week	R	W
	DLS End Month	R	W
	DLS End Week	R	W

- *On board real time clock settings are maintained thanks to a battery mounted on the controller. Make sure that the battery is replaced regularly each 2 years.*

4.3.5 Scheduled Maintenance

This may contain the contact number of the Service organization taking care of this unit and the next maintenance visit schedule.

SCHEDULED MAINTENANCE		read	write
	Next maintenance mm/yy	R	W
	Service support ref.	R	W

4.4 Operation settings

To make the unit working on purpose, the following items need to be set correctly. In particular, first two items have to be set for all chillers. Other items are for optional controls. The following sections describe how to deal with each parameter.

Items to be set for chiller control	Reference section #
Unit enabling control	5 Unit availability
Activate set point	6.1 LWT target setting
Pump selection	6.2 Pump control
Ice mode control	10.1 Ice mode
Noise reduction control	10.2 Noise reduction control
Unit current limit control	10.3 Unit current limit control
Flexible current limit control	10.4 Flexible current limit control
4-20mA Demand limit control	10.5 4-20mA Demand limit control
Unit capacity Network limit control	10.6 Network limit control
Soft load control	10.7 Soft load control
Unit capacity Network limit control	10.6 Network limit control
Water valve control	10.10 Water valve control
Rapid restore control	10.11 Rapid restore
Chiller network control	10.12 Chiller network control

All the set points required for above items can be accessed via the "VIEW/SET UNIT" – "SETUP".

Menu Level 1		Menu Level 2
ENTER PASSWORD		
Unit overview information		
QUCIK MENU		
VIEW / SET UNIT	--->	STATUS
		SETUP
		DATA
VIEW / SET CIRCUIT		
COMMISSION UNIT		
TIME UNTIL RESTART		
ALARMS		
SCHEDULED MAINTENANCE		
ABOUT THIS CHILLER		
DATA / TIME		

Following list describes each set point under "SETUP". "W*" under "write" column in the list means the maintenance password is required to change values.

SETUP	read	write	Description, reference section
Unit enable	R	W	See section 5. Unit availability
Ctrl source	R	W	See section 5. Unit availability
Available mode	R	W*	See section 5. Unit availability

Max # ckts running	R	W*	Define allowable maximum number of circuits as needed.
Sequence # C1	R	W*	See section 6.3.1 Circuit Staging Sequence
Sequence # C2	R	W*	See section 6.3.1 Circuit Staging Sequence
Chiller status after power failure	R	W*	Define chiller status after power faliure. If set "Disable", then chiller stays off after power failure.
Pump ctrl	R	W*	See section 6.2 Pump selection
Pump var flow	R	W*	Set if the water pump diriven by variable frequency device.
Pump recirc tm	R	W*	Set the time for water circulation in the system.
Cool LWT 1	R	W	See section 6.1 LWT target setting
Cool LWT 2	R	W	See section 6.1 LWT target setting
Heat LWT 1	R	W	See section 6.1 LWT target setting
Heat LWT 2	R	W	See section 6.1 LWT target setting
Ice LWT	R	W	See section 6.1 LWT target setting
Start up DT	R	W*	See section 6.3.2 Unit capacity control.
Stage up DT	R	W*	See section 6.3.2 Unit capacity control.
Stage dn DT	R	W*	See section 6.3.2 Unit capacity control. Not recommend to change. May cause frequently stop/start.
Shut dn DT	R	W*	See section 6.3.2 Unit capacity control. Not recommend to change. May cause frequently stop/start.
Nominal water DT	R	W*	Not necessary to change with variable water flow.
EWT Max pulldown rate	R	W*	See section 6.3.2 Unit capacity control. Not necessary to change except when problem happen.
Stage up tm	R	W*	Cycle timer between Circuit#1 and #2. Not necessary to change except when problem happen.
Ice dly tm	R	W*	Optional control. See section 8.1 Ice mode
Light load stage dn	R	W*	Define the capacity for the circuit to stop when load is too light. Not necessary to change except when problem happen.
High load stage up	R	W*	Define the capacity for the circuit to start when load is too light. Not necessary to change except when problem happen.
LWT reset type	R	W	See section 6.1 LWT target setting
Max reset	R	W	See section 6.1 LWT target setting
Start reset DT	R	W	See section 6.1 LWT target setting
Max reset OAT in cool	R	W	See section 6.1 LWT target setting
Start reset OAT in cool	R	W	See section 6.1 LWT target setting
Max reset OAT in heat	R	W	See section 6.1 LWT target setting
Start reset OAT in heat	R	W	See section 6.1 LWT target setting
Soft load	R	W	Optional control. See section 8.7 Soft load control
Soft load begin cap lim	R	W	Optional control. See section 8.7 Soft load control
Soft load ramp	R	W	Optional control. See section 8.7 Soft load control
Current limit	R	W	Optional control. See section 8.3 Current limit control
Current limit type	R	W	Optional control. See section 8.3 Current limit control
Current limit setting	R	W	Optional control. See section 8.3 Current limit control
Current @20mA	R	W	Optional control. See section 8.3 Current limit control
Flex current limit	R	W	Optional control. See section 8.4 Flexible current limit control

Demand limit	R	W	Optional control. See section 8.5 Demand limit control
Noise reduction	R	W	Optional control. See section 8.2 Noise reduction mode
Noise reduction start tm	R	W	Optional control. See section 8.2 Noise reduction mode
Noise reduction end tm	R	W	Optional control. See section 8.2 Noise reduction mode
Noise reduction Cond tar offset	R	W*	Optional control. See section 8.2 Noise reduction mode
Noise reduction Evap tar offset	R	W*	Optional control. See section 8.2 Noise reduction mode
Rapid restore	R	W	Optional control. See section 8.11 Rapid Restore
RR max power failure tm	R	W	Optional control. See section 8.11 Rapid Restore
Water valve ctrl	R	W	Optional control. See section 8.10 Water valve control

4.5 Before operation

⚠ *Make sure that the circuit breaker on the power supply panel of the unit is switched off.*

4.5.1 Checks before initial start-up

After the installation of the unit, check follows before switching on the circuit breaker.

Items	Contents
Field wiring	Confirm that the field wiring between the local supply panel and the unit has been hooked up according to the installation manual, wiring diagrams and European and national regulations.
Fuses or protection devices	Confirm that the size and type of the fuses or protection devices are specified in the installation manual.
Earth wiring	Confirm that the earth wiring is done properly and that the earth terminals are tightened.
Internal wiring	Confirm the loose connections or damaged electrical components in the control box visually.
Fixation	Confirm that the unit is properly anchored. If not, it can be the causes of noise and vibration.
Damaged equipment	Confirm that there is no damaged part on the unit.
Refrigerant leak	Confirm that there is no leak from all connections. If the leak is found, contact your local dealer.
Oil leak	Confirm that there is no leak from compressor. If the leak is found, contact your local dealer.
Stop valves	Fully open all stop valves on liquid line, discharge and suction (if provided).
Air inlet / outlet to control box and fin&tube coils.	Confirm that there is no obstruction to disturb air flow to the control box and fin&tube coils.
Power supply voltage	Confirm the power supply voltage on the local supply panel. Voltage should correspond to the identification label on the unit.
Water pipe connection	Confirm that water can be provided to the unit properly.

4.5.2 Water supply

Confirm that the quality and volume of water described in the installation manual is provided to the unit. And also, air should be purged from system completely. Finally make sure that water can circulate system properly.

4.5.3 Power supply connection and crankcase heating

In order to avoid compressor damage, it is necessary to turn the crankcase heater on for at least 6 hours prior to start compressor after a long period of standstill.

4.5.4 General recommendations

1. Close all service accesses of the unit after installation and setting are done.
2. The access on the control box or all electrical relates may only be worked by the licenced electrician for maintenance purpose.
3. Install an optional digital remote controller if accessibility of the digital controller is frequently occurred.
4. In order to prevent an evaporator and water pipng from freezing when unit is off, make sure all the water is drained out completely from system. Or make sure appropreate anti-freeze devices (i.e. heater) are installed and they work properly. Don't turn the electrical power off to the unit if the anti-freeze devices are hooked up to the unit.

4.6 Maintenance

In order to ensure optimal availability of the unit, proper maintenance is required at regular intervals. It is once a year for air conditioning application and once every 4 months for other applications recommended.

⚠ *Make sure that all the electrical power to the unit must be turned off for the maintenance not require electrical power. Only the licensed electrician is allowed for checking the wiring and power supply to the unit.*

⚠ *Never clean the unit with water under pressure.*

⚠ *Don't step on the top of chiller.*

Items	Contents
Field wiring and power supply	Confirm the power supply voltage on the local supply panel. Voltage should correspond to the identification label on the unit. Confirm the loose connections or damaged electrical components visually.
Internal wiring	Confirm the loose connections or damaged electrical components in the control box visually.
Earth wiring	Confirm the loose connections or damaged electrical components visually.
Refrigerant leak	Confirm that there is no leak from all connections. If the leak is found, contact your local dealer.
Oil leak	Confirm that there is no leak from compressor. If the leak is found, contact your local dealer.
Damaged equipment	Confirm that there is no damaged part on the unit.
Air inlet / outlet to control box and fin&tube coils.	Confirm that there is no obstruction to disturb air flow to the control box and fin&tube coils.
Compressor	Confirm there is no abnormal noise and vibration.
Fan motor	Confirm there is no abnormal noise and vibration.
Water supply	Confirm if the water connection is still well fixed. Confirm that the quality and volume of water described in the installation manual is provided.
Water filters	Clean the water filter to evaporator. Confirm the meshing doesn't have any damage affects to filtering performance.
Water pressure	Confirm the pressure drop is still in acceptable range.

5 Unit availability

5.1 Unit enabling

Enabling and disabling the run command is accomplished using set points and inputs to the chiller. The unit switch, remote switch input, and unit enable set point all are required to be "on" or "enable" for the unit to be enabled when the control source is set to local. The same is true if the control source is set to network, with the additional requirement that the BAS enable set point must be enabled. The table below shows how to set the switches and set points for enabling unit run command.

Unit switch	Control source set point	Remote switch	Unit enable set point	BAS enable set point	Unit enable
OFF	x	x	x	x	Disable
x	x	OFF	x	x	Disable
x	x	x	Disable	x	Disable
ON	Local	ON	Enable	x	Enable
x	Network	x	x	Disable	Disable
ON	Network	ON	Enable	Enable	Enable

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

5.2 Unit mode selection

Unit mode can be set according to the following table. If the mode change is occurred during operation the chiller will stop at once, then restart in required mode. Test mode can be enabled only if the unit is off.

5.2.1 Heat pump chillers

Unit type set point	Available modes set point	Control source set point	Heat/Cool switch	Mode input	BAS req.	Unit mode
Heat pump	Cool / Heat	Local	Cool	x	x	Cool
			Heat	x	x	Heat
		Network	x	x	Cool	Cool
					Heat	Heat
	Cool / Heat / Ice with Glycol	Local	Cool	OFF	x	Cool with Glycol
				ON	x	Ice with Glycol
			Heat	x	x	Heat with Glycol
		Network	x	x	Cool	Cool with Glycol
					Ice	Ice with Glycol
					Heat	Heat with Glycol
x	Test	x	x	x	x	Test

Note1: "x" indicates those settings can be ignored.
Note2: Heat / Cool switch needs 3seconds to make sure Heat or Cool state when it's changed.

5.2.2 Cooling chillers

Unit type set point	Available modes set point	Control source set point	Heat/Cool switch	Mode input	BAS req.	Unit mode
Cooling	Cool	x	x	x	x	Cool
	Cool with Glycol	x	x	x	x	Cool with Glycol
	Cool / Ice	Local	x	OFF	x	Cool with Glycol

	with Glycol			ON	x	Ice with Glycol
		Network	x	x	Cool	Cool with Glycol
					Ice	Ice with Glycol
	Ice with Glycol	x	x	x	x	Ice with Glycol
x	Test	x	x	x	x	Test

Note: “x” indicates those settings can be ignored.

5.3 Unit Status

The displayed unit status should be determined by the conditions in the following table.

Enum	Unit status	Conditions
0	AUTO	Unit in normal operation
1	AUTO Wait For Load	Unit state = Auto, with no circuits running and LWT error is less than startup delta T.
2	AUTO Evap Recirc	Unit state = Auto, Evaporator pump started
3	AUTO Wait For Flow	Unit state = Auto, waiting for evaporator flow switch to close
4	AUTO Pumpdown	All running circuits in Pumpdown state
5	AUTO Max Pulldown	Unit State = Auto, pulldown rate has met or exceeded the limit
6	AUTO Unit Cap Limit	Unit State = Auto, unit capacity has met or exceeded the limit
7	AUTO Current Limit	Unit State = Auto, unit current has met or exceeded the limit
8	AUTO Noise Reduction	Noise reduction is active
9	OFF Unit Alarm	Unit Alarm is active
10	OFF Ice mode timer	In Ice mode, and ice cycle timer is active
11	OFF All Cir Disable	All circuits are unavailable
12	OFF Keypad Disable	Unit Enable set point = Disable
13	OFF BAS Disable	Control Source = Network, and BAS Enable = false
14	OFF Remote Switch	Remote switch is open
15	OFF Unit Switch	Unit switch is disable
16	OFF Cfg Chg, Need Rst	Configuration has been changed and controller needs to be reset
17	OFF Test Mode	In Test mode

6 Unit functions

6.1 LWT target setting

The follows define the how to set or reset the LWT target by Local or Network control.

6.1.1 LWT target

--- For Heat pump Unit ---

If Unit type set point is set to "Heat pump" the Base LWT target shall be set according to the table below.

Available Modes Set Point	Control Source Set Point	Heat/Cool switch	Mode Input	BAS req	Base LWT Target
Cool / Heat	Local	Cool	OFF	x	Cool LWT 1
			ON	x	Cool LWT 2
		Heat	OFF	x	Heat LWT 1
			ON	x	Heat LWT 2
	Network	x	x	Cool	BAS Cool set point
				Heat	BAS Heat set point
Cool / Heat / Ice w/Glycol	Local	Cool	OFF	x	Cool LWT 1
			ON	x	Ice LWT
		Heat	OFF	x	Heat LWT 1
			ON	x	Heat LWT 2
	Network	x	x	Cool	BAS Cool set point
				Ice	BAS Ice set point
				Heat	BAS Heat set point

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

--- For Cooling Unit ---

If Unit type set point is set to "Cooling" the Base LWT target shall be set according to the table below.

Available Modes Set Point	Control Source Set Point	Mode Input	BAS req	Base LWT Target
Cool	Local	OFF	x	Cool LWT 1
		ON	x	Cool LWT 2
	Network	x	x	BAS Cool set point
Cool w/Glycol	Local	OFF	x	Cool LWT 1
		ON	x	Cool LWT 2
	Network	x	x	BAS Cool set point
Cool / Ice w/Glycol	Local	OFF	x	Cool LWT 1
		ON	x	Ice LWT
	Network	x	Cool	BAS Cool set point
			Ice	BAS Ice set point
Ice w/Glycol	Local	x	x	Ice LWT
	Network	x	x	BAS Ice set point

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

6.1.2 LWT target resetting

The base LWT target may be reset and it is configured for a reset. The type of reset to be used is determined by the LWT Reset Type set point. After resets are applied, the LWT target can never exceed a value of 20°C in cooling and never fall short of a value of 25°C in heating mode. Target will be reset every 10seconds with each 0.1°C.

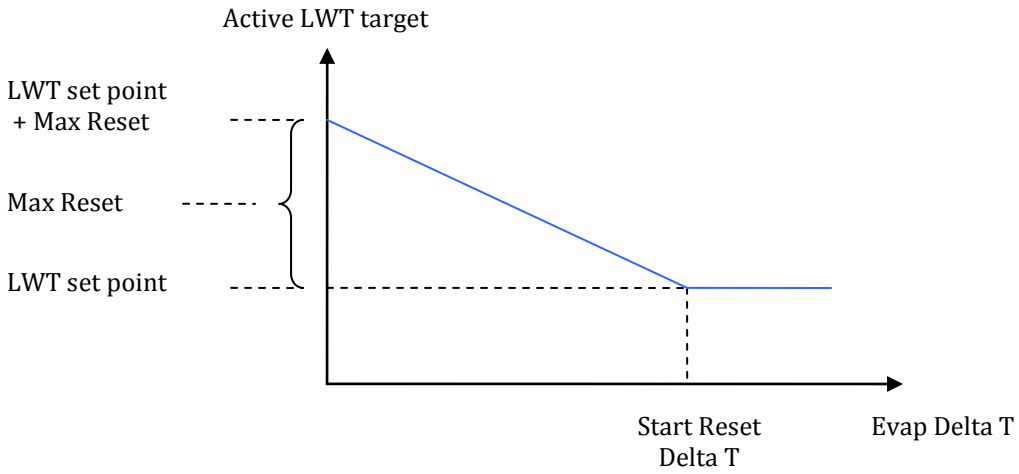
6.1.2.1 No reset

The Active Leaving Water variable is set equal to the current LWT set point.

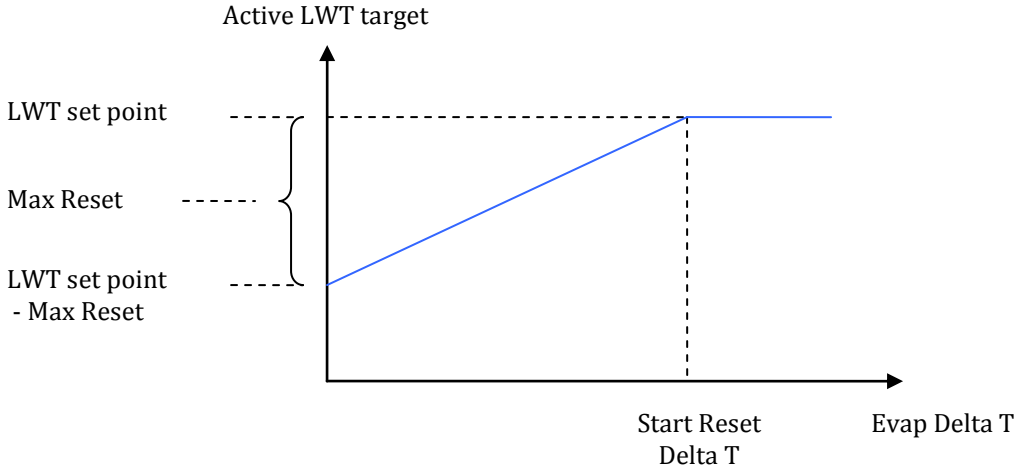
6.1.2.2 Return reset

The Active Leaving Water variable is adjusted by the return water temperature.

--- For cooling ---

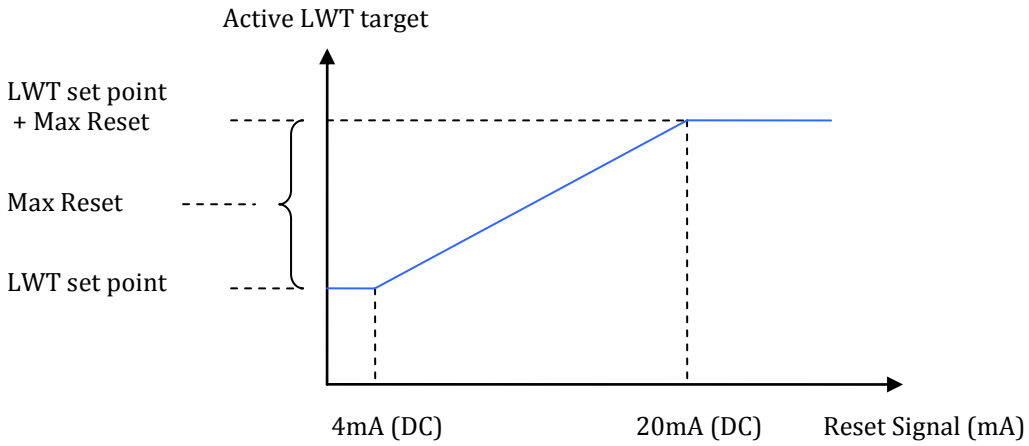


--- For heating ---

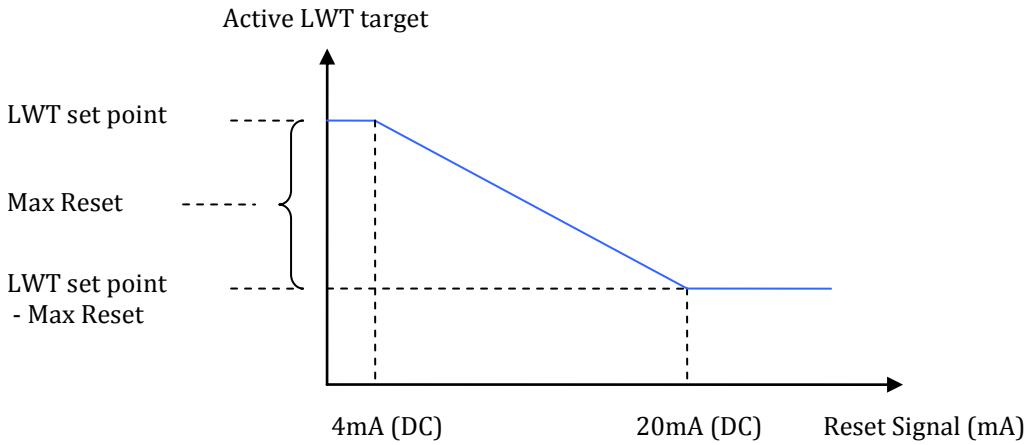


6.1.2.3 4-20mA Reset

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

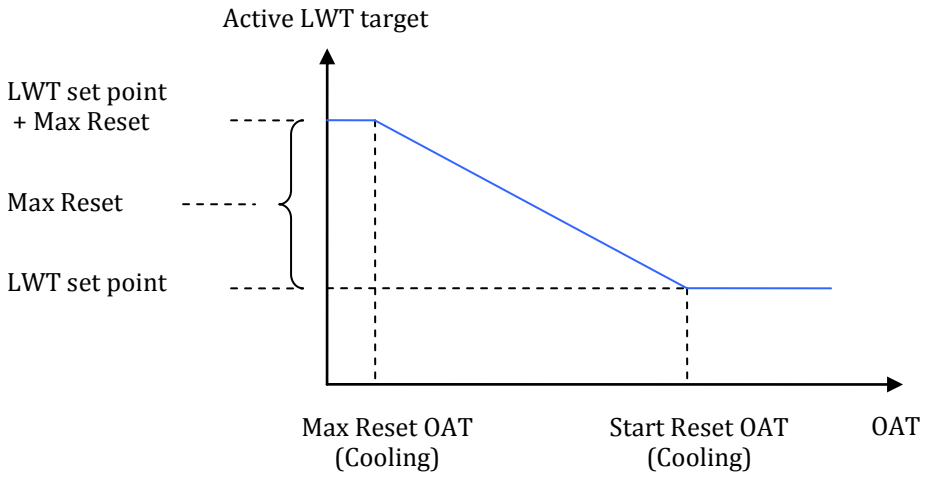


--- For heating ---

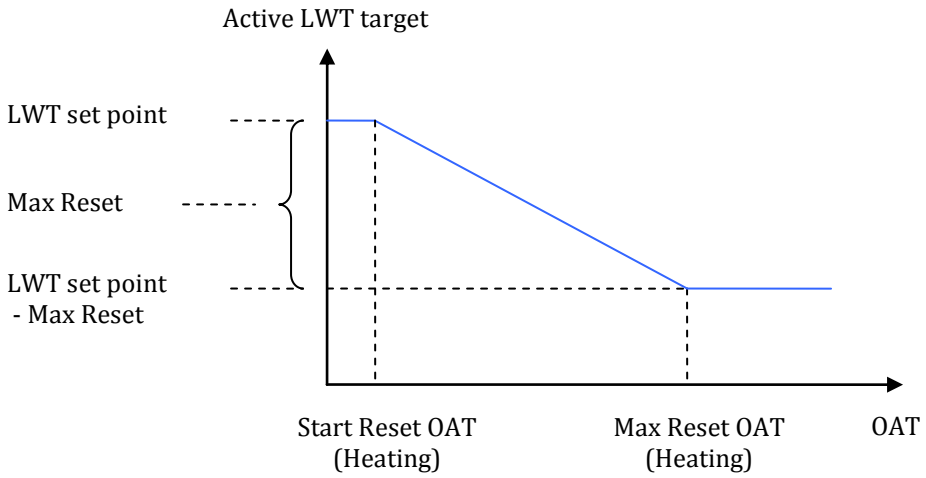


6.1.2.4 OAT Reset

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


Active LWT target
LWT set point
+ Max Reset
Max Reset
LWT set point
Max Reset OAT
(Cooling)
Start Reset OAT
(Cooling)
OAT

--- For heating ---


Active LWT target
LWT set point
Max Reset
LWT set point
- Max Reset
Start Reset OAT
(Heating)
Max Reset OAT
(Heating)
OAT

6.2 Pump selection

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

HMI setting	Description
#1 Only	Pump 1 will always be used
#2 Only	Pump 2 will always be used
#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
Auto	The primary pump is the one with the least run hours, the other is used as a backup

The Primary / Standby selection will be designated with the least hours.

6.3 General unit control

6.3.1 Circuit Staging Sequence

This section defines which circuit is the next one to start or stop. In general, circuits with fewer starts will normally start first, and circuits with more run hours will normally stop first. Circuit staging sequence can also be determined by an operator defined sequence via set points. The next circuit to start or stop must meet the following requirements.

Priority	Next Start	Next Stop
1st	Lowest sequence number	Lowest sequence number
2nd	Least starts	Least starts
3rd	Least run hours	Most run hours
4th	Lowest numbered circuit	Lowest numbered circuit

6.3.2 Unit capacity control

6.3.2.1 Summary of unit capacity control

- Unit capacity shall be controlled by LWT error and EWT pulldown rate.
- If there is limitation (i.e. network limit, current limit, event limit,) that limitation should be priority.
- The target variation is plus or minus 4% of nominal evaporator delta T
- Just one circuit can load or unload per load or unload command.
- Capacities of each circuit shall be balanced when possible.

6.3.2.2 LWT error

"LWT error" will be calculated to determine the circuit start up, shut down, stage up or stage down and the compressors loading or unloading. The equation of LWT error varies based on Unit mode.

[For cooling]

LWT error = Evaporator LWT – LWT active set point

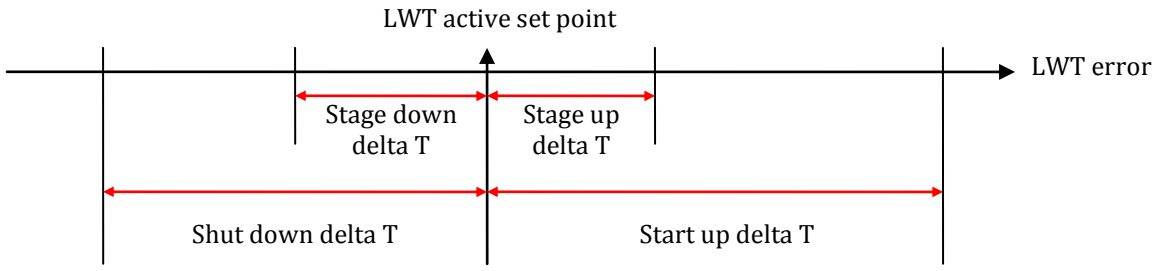
[For heating]

LWT error = LWT active set point – Evaporator LWT

LWT active set point will be determined by LWT set point on HMI and LWT resetting.

6.3.2.3 Start up, Stage up, Stage down, Shut down delta T

The purpose of this logic is to avoid excessive circuit start and stop when the cooling or heating capacity required is very low. Start up delta T and the Shut down delta T shall use the diagrammed below.



The first circuit on the unit should be started when;

LWT error > Start up delta T

An additional circuit should be started when;

LWT error > Stage up delta T

When multiple circuits are running, one should shut down if;

LWT error < Stage down delta T

All running circuits should shut down when;

LWT error < Shut down delta T

6.3.3 Circuit Status

The displayed unit status should be determined by the conditions in the following table.

Enum	Circuit status	Conditions
0	OFF Ready	Circuit ready to start when needed
1	OFF Cycle timer	Circuit is Off, and cannot start due to active cycle timers
2	OFF BAS Disable	BAS Circuit Mode set point is not set to Auto when the control source is remote
3	OFF Keypad Disable	Circuit Mode set point = Disable
4	OFF Circuit Switch	Circuit switch is open
5	OFF Alarm	Circuit alarm is active
6	OFF Test Mode	In Test mode
7	RUN Preopen	In preopen state
8	RUN Pumpdown	In Pumpdown state
9	RUN Starting	In Auto and running normally
10	RUN Normal	In Auto and running normally
11	RUN Defrost	In Reverse cycle Defrost
12	RUN Off cycle Defrost	In Off cycle Defrost
13	RUN Disch Port Temp High	Unload or inhibit load due to high disch port temp
14	RUN Evap Press Low	Unload or inhibit load due to low evaporator pressure
15	RUN Cond Press High	Unload or inhibit load due to high condenser pressure
16	RUN Press Ratio High	Unload or inhibit load due to high press ratio.
17	RUN Comp Vfd Amps High	Unload or inhibit load due to high compressor vfd amperes

6.3.4 Defrost control

In heating mode, a unit makes frost on air heat exchanger at a certain condition. This frost may cause low pressure alarm, less heating capacity, leak due to damage to cupper tube or something negative. So far, when the amount of frost reaches unallowable level the chiller must do “Defrost”.
In this section three kinds of Defrost control are defined, which are “Off cycle defrost”, “Reverse cycle defrost” and “Manual defrost”. If the circuit is in defrost control all components, which are compressors, fans, EXV, 4way valve and solenoid valves, shall be controlled by defrost control.

7 Alarm

7.1 Unit alarm

7.1.1 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 unit state. Just depends on pump state
Water pump freeze protection	Fault	-	Auto	This alarm can be active only when unit state is OFF.
Water pump hot water protection	Fault	-	Auto	This alarm can be active only when unit state is OFF.
Water temp inverted	Fault	Normal	Manual	
Low OAT lock out	Fault / Warning	Normal	Auto	Unit AUTO…Fault Unit OFF…Warning
High 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 unit state.
EWT sensor fault	Fault	Normal	Manual	This alarm can be active regardless unit state.
OAT sensor fault	Fault	Normal	Manual	
Emergency stop	Fault	Rapid	Manual	This alarm can be active regardless unit state.
External alarm	Fault	Rapid	Manual	This alarm can be active regardless unit state.
Bad demand limit input	Warning	-	Auto	
Bad LWT reset point	Warning	-	Auto	
Bad unit current reading	Warning	-	Auto	
Bad flexible current limit input	Warning	-	Auto	
Chiller network communication failure	Warning	-	Auto	This alarm can be active regardless unit state.

7.1.2 Unit fault alarms

7.1.2.1 Phase Volts loss / GFP fault

[Purpose]
Checking inverted phase, lack of phase and imbalance 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.

7.1.2.2 Water freeze shut down

[Purpose]
Reduce the risk of damage to chiller due to freeze.

[Trigger]
EWT or LWT is less than 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.

7.1.2.3 Water flow loss

[Purpose]
Reduce the risk of damage to chiller due to freeze or unstable condition.

[Trigger 1]
Flow switch is open for 15seconds

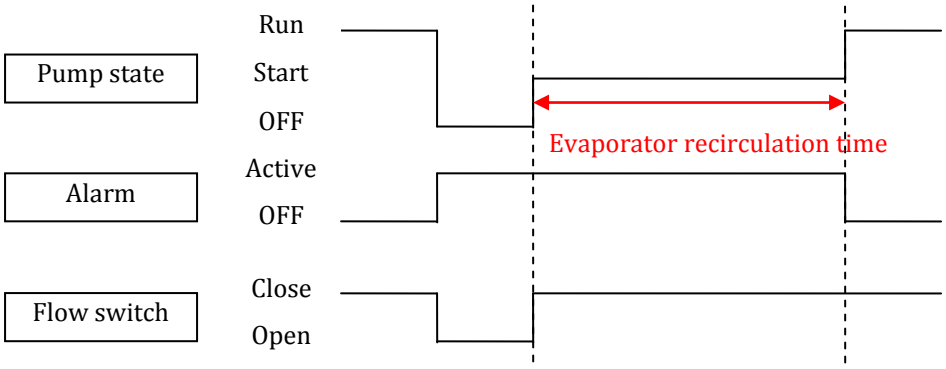
[Trigger 2]
Pump is running, but flow switch is open for 3minutes

[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.

7.1.2.4 Pump freeze protection

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

[Trigger]

EWT or LWT is less than Water freeze set point – 0.6°C when unit is off.

[Action]
Start pump

[Reset]
Auto clear when trigger conditions no longer exist. As well pump should be turned off.

7.1.2.5 Pump hot water protection

[Purpose]
Keep system in safety. If water temperature goes up to over set point pump should be stopped regardless chiller operation.

[Trigger]

EWT of LWT is more than 65°C when pump is running.

[Action]
Stop pump

[Reset]
Auto clear when trigger conditions no longer exist. As well pump can be turned on if needed.

7.1.2.6 Water temp inverted

[Purpose]
Detect wiring mistake. Keep LWT control in right operation.

[Trigger]

Water temperature is inverted compared to expectation.

[Action]
Normal shutdown (pumpdown) of all running circuits

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

7.1.2.7 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]
Avoid a unit operates outside of operational envelope.

[Alarm type]
Trigger1 --- Fault
Trigger2 --- Warning

[Trigger 1]
OAT is less than low OAT lockout set point value for 20 minutes when unit is running.

[Trigger 2]
OAT is less than low OAT lockout set point value for 5seconds when unit is off. However, this alarm shouldn't be triggered if OAT is out of range.

[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 becomes more than Low OAT lockout set point +2.5°C

7.1.2.8 High OAT lock out

This alarm has two actions to be taken, which vary based on triggers. This alarm can be active only when chiller operates in heating mode.

[Purpose]
Avoid a unit operates outside of operational envelope.

[Alarm type]
Trigger1 --- Fault
Trigger2 --- Warning

[Trigger 1]

OAT is more than high OAT lockout set point value for 20 minutes only when unit is running in heating mode.

[Trigger 2]

OAT is more than high OAT lockout set point value for 5seconds only when unit is off in heating mode.

[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 < High OAT lock out set point - 2.5°C.

7.1.2.9 LWT sensor fault

[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.

7.1.2.10 EWT sensor fault

[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.

7.1.2.11 OAT sensor fault

[Range]
Minimum = -40°C, Maximum = 70°C

[Trigger]

Out of range for 1second

[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.

7.1.2.12 Emergency stop

[Trigger]
Emergency stop switch is active

[Action]
Rapid shutdown of all running circuits

[Reset]
This alarm can be cleared manually via the keypad or via BAS command if emergency stop switch is not active.

7.1.2.13 External alarm

[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.

7.1.3 Unit warning alarms

7.1.3.1 Bad demand limit input

[Trigger]

Demand limit input out of range (range: 4-20mA) for 1second when 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.

7.1.3.2 Bad LWT reset point

[Trigger]
LWT reset input out of range (range: 4-20mA) for 1second when LWT reset setting = 4-20mA

[Action]
Ignore LWT reset.

[Reset]
Auto clear when LWT reset setting is not 4-20mA or LWT reset input back in range for 5 seconds.

7.1.3.3 Bad unit current reading

[Trigger]

Current input out of range (range: 4-20mA) for 1second when 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.

7.1.3.4 Bad flexible current limit input

[Trigger]
Flexible current limit input is out of range (range: 4-20mA) for 1second when Current limit enable digital input is closed and Flexible current limit' set point is set to 'Enable'

[Action]
Ignore flexible current limit input. Current limit control will be still active with current limit set point.

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

7.1.3.5 Chiller network communication failure

[Trigger]
Process bus communication is failure for 30 seconds when Chiller network set point is set to enable.

[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 a 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.

7.2 Circuit alarm

7.2.1 Circuit alarm descriptions

Description	Type	Shut down	Reset	Note
High discharge port temperature	Fault	Rapid	Manual	
Mechanical High Pressure Switch	Fault	Rapid	Manual	Triggered regardless compressor state
High Cond Pr shut down	Fault	Rapid	Manual	
Low Evap Pr shut down	Fault	Rapid	Manual	
Low Evap Gas Temperature	Fault	Rapid	Manual	
High Pr ratio shut down	Fault	Rapid	Manual	
Multi times Low Pr diff. 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	
Deicer temp sensor fault	Fault / Warning	Normal	Manual	Heating…Fault Cooling…Warning
Suct temp sensor fault	Fault	Rapid	Manual	
Evap gas temp sensor fault	Warning	-	Auto	
ACS MB communication failure	Fault	Rapid	Auto	
Modbus communication failure	Fault	Rapid	Auto	
External I/O communication failure	Fault	Rapid	Auto	
No pressure at start	Warning	-	Manual	
High condenser pressure at start	Warning	-	Auto	

7.2.2 Detailed Circuit alarms

7.2.2.1 High discharge port temperature

[Purpose]
Avoid damage to compressor (oil deterioration, high fluctuation of metal, motor).

[Triggers, Actions and Resets]
The Circuit takes rapid shutdown when the discharge port temperature becomes higher than the limit. The Circuit takes unload or inhibit load sequence before it goes over the limit. Shutdown requires reset manually. Unload and inhibit load is reset automatically when conditions are recovered.

7.2.2.2 Mechanical High Pressure Switch

[Purpose]
To avoid the circuit operates at over design pressure.

[Trigger]
HPS digital input is open

[Action]
Rapid shut down of circuit

[Reset]

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

7.2.2.3 High Condenser Pressure Shutdown

[Purpose]
To avoid the circuit triggers HPS fault alarm.

[Triggers, Actions and Resets]
The Circuit takes rapid shutdown when the condenser pressure becomes higher than the limit. The Circuit takes unload or inhibit load sequence before it goes over the limit. Shutdown requires reset manually. Unload and inhibit load is reset automatically when conditions are recovered.

7.2.2.4 Low Evaporator Pressure Shutdown

[Purpose]
To protect compressor in case of that refrigerant charge is less or refrigerant tube is closed due to some problems. This alarm could work in heating mode. In case of cooling mode “Low evaporator gas temperature alarm” may be triggered before this alarm.

[Alarm type]
Fault

[Triggers, Actions and Resets]

The Circuit takes rapid shutdown when the evaporator pressure becomes lower than the limit. The Circuit takes unload or inhibit load sequence before it goes under the limit. Shutdown requires reset manually. Unload and inhibit load is reset automatically when conditions are recovered.

7.2.2.5 Low Evap Gas Temperature freeze Shutdown

[Trigger]
Evaporator Gas temperature is less than limit when Circuit is running in cooling cycle

[Alarm type]
Fault

[Action]
Rapid shut down of running circuit

[Reset]
This alarm can be cleared manually via the keypad or via BAS command if the trigger condition no longer exists.

7.2.2.6 High Pressure Ratio Shutdown

[Purpose]
Protect scroll parts of compressor.

[Alarm type]
Fault

[Triggers, Actions and Resets]
The Circuit takes rapid shutdown when the pressure ratio becomes more than the limit. The Circuit takes unload or inhibit load sequence before it goes over the limit. Shutdown requires reset manually. Unload and inhibit load is reset automatically when conditions are recovered.

7.2.2.7 Low pressure differential shutdown / protection

[Purpose]
• Avoid oil supply issue
• Avoid damaging scroll parts of compressor due to high over compression.

[Alarm type]
Fault

[Triggers, Actions and Resets]

The Circuit takes rapid shutdown when the pressure ratio or pressure differential become lower than the limit. The Circuit adjusts EXV position before it goes under the limit. Multiple Shutdowns within certain time requires reset manually. Shutdown, Unload and inhibit load is reset automatically when conditions are recovered.

7.2.2.8 Inverter over current shutdown

[Purpose]
Avoid compressor over current alarm

[Alarm type]
Compressor fault

[Triggers, Actions and Resets]
The Compressor takes rapid shutdown when the motor current becomes more than the limit. The Circuit takes unload or inhibit load sequence before it goes over the limit. Shutdown requires reset manually. Unload and inhibit load is reset automatically when conditions are recovered.

7.2.2.9 No pressure change after start

[Trigger]
The change of both Evaporator pressure and Condenser pressure is less than expected.

[Action]
Rapid shutdown of circuit

[Reset]
This alarm can be cleared manually via the keypad or via BAS command any time.

7.2.2.10 Condenser pressure sensor fault

[Trigger]
Out of range for 1second

[Action]
Rapid shutdown of circuit

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

7.2.2.11 Evaporator pressure sensor fault

[Trigger]
Out of range for 1second

[Action]
Rapid shutdown of circuit

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

7.2.2.12 Deicer temperature sensor fault

[Trigger 1]
Out of range for 1seconds when Circuit is running in cooling cycle

[Trigger 2]
Out of range for 1seconds when Circuit is running in heating cycle

[Action]
If active via trigger 1:
None (Warning only)
If active via trigger 2:
Rapid shutdown of circuit

[Reset]
If active via trigger 1:
Auto clear if the sensor is back in range for 5seconds.
If active via trigger 2:
This alarm can be cleared manually via the keypad or via BAS command if the sensor is back in range for 5seconds.

7.2.2.13 Suction temperature sensor fault

[Trigger]
Out of range for 1second

[Action]
Rapid shutdown of circuit

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

7.2.2.14 Evaporator gas temperature sensor fault

[Trigger]
Out of range for 1second

[Action]
None (Warning only)

[Reset]
Auto clear if the sensor is back in range for 5seconds.

7.2.2.15 No pressure at start

[Purpose]
To avoid the circuit runs with less refrigerant or closed manual valves.

[Alarm type]
Warning

[Trigger]
The values of either Condenser pressure or Evaporator pressure is less than expected when circuit is ready to start.

[Action]
Not allow to start

[Reset]
This alarm can be cleared manually via the keypad or via BAS command if trigger conditions no longer exist.

7.2.2.16 High condenser pressure at start

[Alarm type]
Warning

[Trigger]
Condenser pressure is more than limit when circuit is ready to start.

[Action]
None

[Reset]
Auto clear if condenser pressure is less than limit.

7.3 Compressor alarm

Unless otherwise specified compressor alarm shouldn't be triggered during compressor state is OFF.

7.3.1 Compressor alarm descriptions

Description	Type	Shut down	Reset	Note
Multi times High discharge gas temperature	Fault	Rapid	Manual	
High comp. body temperature	Fault	Rapid	Manual	
Inverter over current shutdown	Fault	Rapid	Manual	
Imbalance inverter current	Fault	Rapid	Manual	
Inverter alarm	Fault	Rapid	Manual	
Discharge temperature sensor fault	Fault	Rapid	Manual	
Compressor body temperature sensor fault	Fault	Rapid	Manual	

7.3.2 Detailed compressor alarm

7.3.2.1 High discharge gas temperature

[Purpose]
For compressor protection

[Trigger]
Discharge gas temperature is higher than the limit.

[Action]
Compressor should take Rapid shutdown as an event. However, if it repeats 3 times on the same compressor within a week it becomes an alarm.

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

7.3.2.2 High compressor body temperature

[Purpose]
For compressor protection

[Trigger]
Compressor body temperature is higher than the limit.

[Action]
Rapid shutdown of compressor

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

7.3.2.3 Inverter over current shut down

See Inverter over current shutdown / unload / inhibit load in circuit alarm.

7.3.2.4 Imbalance inverter current

[Trigger]
One of the motor current is extremely higher than other motor currents

Note: “INV current” use INV secondary current.

[Action]
Rapid shutdown of compressor

[Reset]
This alarm can be cleared manually via the keypad or via BAS command when compressor is off.

7.3.2.5 Inverter alarm

[Inverter alarm list]

Fault code	Description	Note
E5	Compressor motor lock	
L0	Inverter system error	
L4	Inverter fin temperature high	
L5	Inverter compressor motor grounding or short circuit	
L8	Inverter over current	
L9	Start up error	
P1	Power supply imbalance	
P4	Inverter fin temperature sensor fault	
PJ	Model setup problem	
U1	Reverse phase, open phase	
U2	Power supply insufficient	

[Action]
Rapid shutdown of compressor

[Reset]
This alarm can be cleared manually via the keypad or via BAS command if INV no longer requires stop.

7.3.2.6 Discharge temperature sensor fault

[Trigger]
Out of range for 1second

[Action]
Rapid shutdown of compressor

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

7.3.2.7 Compressor body temperature sensor fault

[Trigger]
Out of range for 1second

[Action]

Rapid shutdown of compressor

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

7.3.3 Compressor shutdown for oil distribution

If the compressor alarm is occurred, some of the other running compressors in the circuit should be shutdown due to oil management. Here is the list for showing which one should be shutdown when compressor alarm is occurred.

Compressor # on alarm	Number of compressor per ckt			
	3	4	5	6
#1 alarm	Ckt shutdown	Ckt shutdown	Ckt shutdown	Ckt shutdown
#2 alarm	Off #2 only	Off #2 only	Off #2 only	Off #2 only
#3 alarm	Off #2 and #3	Off #2 and #3	Off #2 and #3	Off #2 and #3
#4 alarm	-	Ckt shutdown	Ckt shutdown	Off #2, #3 and #4
#5 alarm	-	-	Ckt shutdown	Ckt shutdown
#6 alarm	-	-	-	Ckt shutdown

8 Optional function

8.1 Ice mode

8.1.1 Unit setting

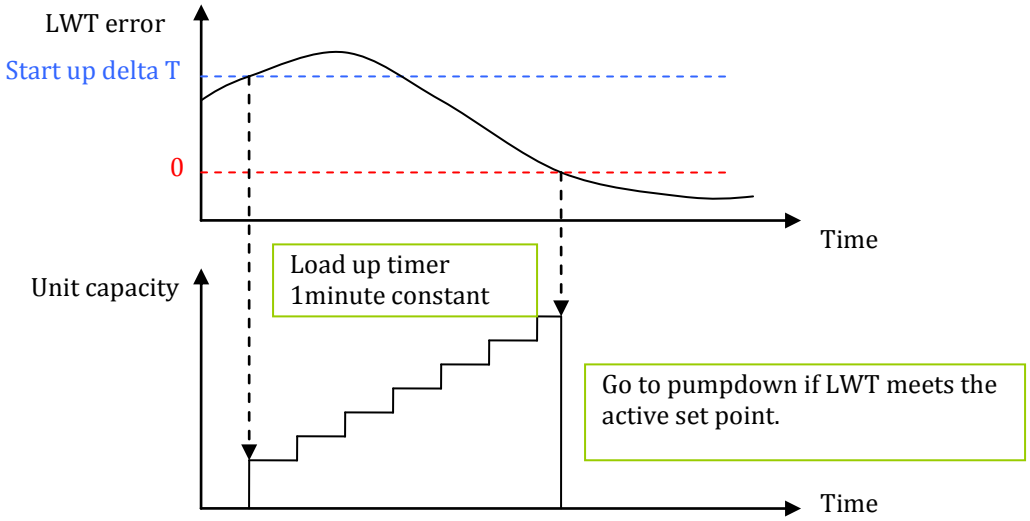
Unit mode should be set to Ice mode. If mode change is occurred during operation the chiller should stop at once, then restart in required mode.

8.1.2 Ice mode operation

Unit can start as an Ice mode only when unit mode is Ice mode, there is enough load and all the delay timer is cleared. Follows are special operations for Ice mode. Other controls are same as standard.

8.1.2.1 Capacity control

Ice mode load up timer is 1minute constant. Until LWT error become negative unit should be running.



8.1.2.2 Ice mode delay timer

An adjustable start to start ice delay timer will limit the frequency with which the chiller may start in Ice mode. The timer starts when the first compressor starts while the unit is in ice mode. While this timer is active, the chiller cannot restart in Ice mode. The time delay is user adjustable. The ice delay timer may be manually cleared to force a restart in ice mode. A set point specifically for clearing the ice mode delay is available. In addition, cycling the power to the controller should clear the ice delay timer.

8.1.2.3 Mask

EWT pulldown rate capacity control will be ignored in Ice mode.

8.2 Noise reduction mode

8.2.1 Unit setting

Noise Reduction always requires the Noise Reduction set point to be set to ‘enable’. If it is set to ‘disable’, it will not be active for any reason.

8.2.2 Noise reduction operation

Assuming this functionality is enabled, there are two ways it can become active. One is that Unit controller clock time is in between the Noise reduction start time and end time. Another is that Control Source set point is set to network, and the BAS command is "enable". If Noise Reduction becomes active during normal operation the unit should shut down and restart in Noise Reduction mode.

8.2.3 LWT reset

When Noise Reduction is active, the Maximum Reset is applied to the cool LWT set point. However, if any reset type is selected, that reset will continue to be used rather than the Maximum Reset.

8.2.4 Fan control target

8.2.4.1 In cooling cycle

Saturated condenser target for each circuit will be offset by the Noise Reduction Condenser Target Offset.

Sat cond. target with noise reduction = Sat cond. target + Offset

8.2.4.2 In heating cycle

Saturated evaporator target for each circuit will be offset by the Noise Reduction Evaporator Target Offset.

Sat evap. target with noise reduction = Sat evap. target – Offset

8.3 Unit current limit control

8.3.1 Unit setting

Unit current Limit control should be enabled only when Current limit enable digital input is closed and Current limit set point is enabled. If this control is enabled 'Current limit type', 'Current at 20mA' and 'Current limit' set points needs to be arranged for each unit.

Current limit type	Current at 20mA	Current limit	Description
INV	N/R	Need to set some value	Unit current will be limited by inverter primary current and fans estimated current. It doesn't require an additional current measuring device, such as CT.
CT (4-20mA)	Need to set some value	Need to set some value	Unit current will be limited by an analog input from CT.

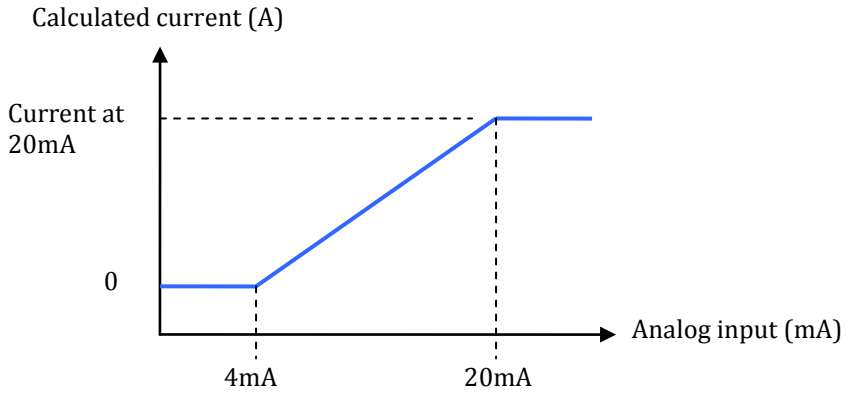
This control can be enabled during normal operation without shutdown.

8.3.2 Current limit control

8.3.2.1 Unit current calculation

• If 'Current limit type' is set to INV:
See section 4 "Calculations"

• If 'Current limit type' is set to CT (4-20mA):
Unit current will be calculated based on the 4-20mA input that received a signal from an external device and 'Current at 20mA' set point.



8.3.2.2 Capacity control with current limit

The current limit should use a dead band centered on the actual limit value, such that unit capacity increase is not allowed when current is within this dead band. If unit current is above the dead band, capacity should be decreased until it is back within the dead band. The current limit dead band should be 5% of the current limit.

8.3.3 Unit current control during defrost

Circuit capacity control during defrost should not be limited by this function. In other words if the unit has dual circuits this function shall be accomplished by the circuit which is not doing defrost.

8.4 Flexible current limit control

This control is an option. It requires an additional extension module (POL965 address 21) for using analog input.

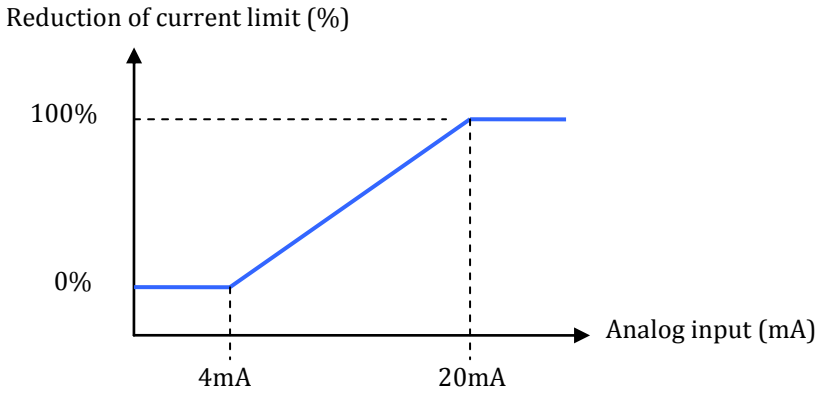
8.4.1 Unit setting

Flexible current limit control should be enabled only when Current limit enable digital input is closed and Flexible current limit set point is set to enable. This control can be enabled during normal operation without shutdown.

8.4.2 Current limit adjustment

By using an analog input current limit can be adjustable. Actual current limit will be decided by the following equation.

Actual current limit = Current limit set point x Reduction of current limit



However the dead band of current limit capacity control will not be reduced even if the current limit is reduced. Anytime it is 5% of Current limit set point on HMI.

8.5 4-20mA Demand limit control

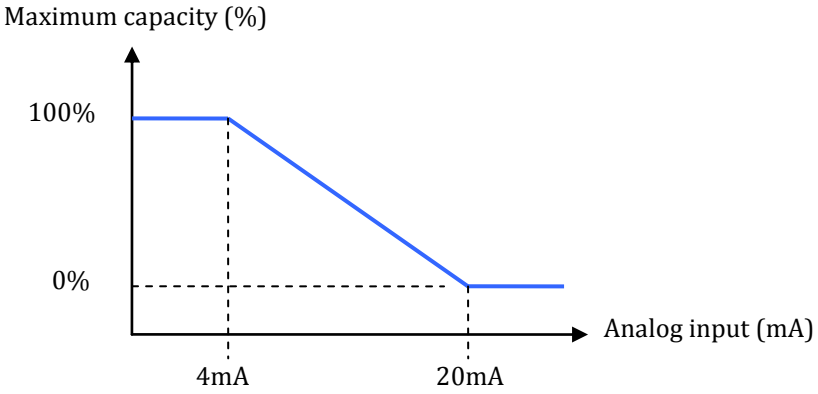
8.5.1 Unit setting

Demand Limit control should be enable only when the 'Demand limit' set point is set to ON. This control can be enabled during normal operation without shutdown.

8.5.2 Demand limit control

8.5.2.1 Capacity limit calculation

The maximum unit capacity can be limited by 4 to 20mA signal on the demand limit analog input on the HMI. As signal varies from 0% up to 100%, the maximum unit capacity changes from 0% to 100%.



8.5.2.2 Capacity control with demand limit

Unit capacity limits can be used to limit total unit capacity in cool, cool with glycol, heat or heat with glycol mode. The unit capacity shall be adjusted as needed to meet capacity limit, except that the last running compressor cannot be turned off to meet a limit lower than the minimum unit capacity.

8.5.2.3 Multiple capacity limits

Multiple limits may be active at any time, and the lowest limit is always used in the unit capacity control. Soft load, demand limit, and network limit should use a dead band around the actual limit value, such that unit capacity increase is not allowed within this dead band. If unit capacity is above the dead band, capacity should be decreased until it is back into the dead band range.
Now the range of dead band shall be varied based on number of circuits.

Number of circuit	Dead band for capacity limit control		
	Demand limit	Network limit	Soft load
1	7%	7%	7%
2	5%	5%	5%

8.5.3 Demand limit control during defrost

This function shall be ignored during defrost operation.

8.6 Network limit control

8.6.1 Unit setting

Network Limit control should be enable only when the Unit control source set point is set to network. This control can be enabled during normal operation without shutdown.

8.6.2 Network limit control

The maximum unit capacity can be limited by the signal received through the BAS interface on the unit controller. As signal varies from 0% up to 100%, the maximum unit capacity changes from 0% to 100%. Capacity control is same as demand limit control.

8.6.3 Network limit control during defrost

This function shall be ignored during defrost operation.

8.7 Soft load control

8.7.1 Unit setting

Soft Loading is a configurable function used to ramp up the unit capacity over a given time. The set points that control this function are:
1) Soft Load – (ON/OFF)
2) Begin Capacity Limit – (Unit %)
3) Soft Load Ramp – (seconds)
This control can be enabled during normal operation. But this will be active at next start.

8.7.2 Soft load control

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

8.7.3 Soft load control with 56rps start

If the 56rps start is required the begin capacity limit will be ignored. In that case Soft load unit limit increases linearly from 56rps to 100% over the amount of Soft load ramp time. Concerning "56rps start", see compressor control section.

8.7.4 Soft load control during defrost

This function shall be ignored during defrost operation.

8.8 Fan VFD control

8.8.1 Unit setting

Fan VFD should be enabled only when the Fan VFD configuration is set to enable.

8.8.2 Fan control with VFD

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

8.9 Liquid line solenoid valve

8.9.1 Unit setting

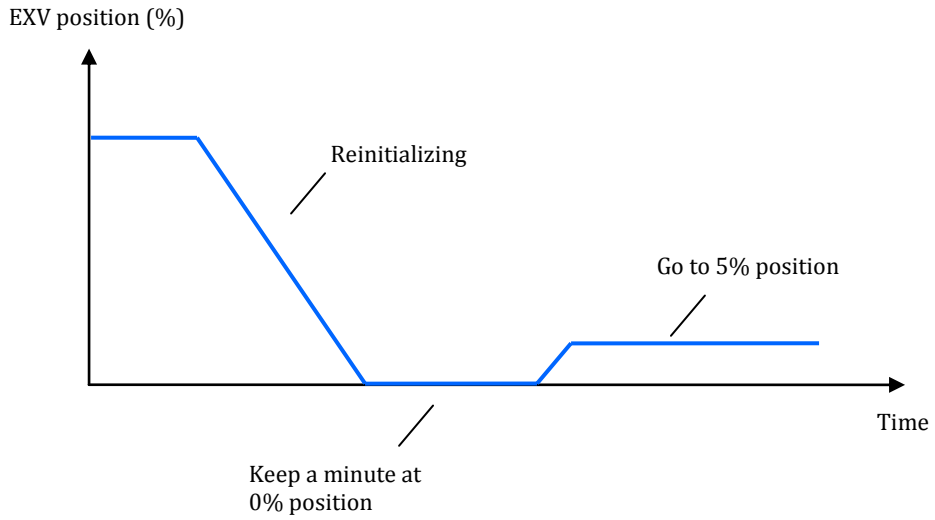
If the unit has a liquid line solenoid valve unit configuration must be set to enable.

8.9.2 Liquid line solenoid valve control

Liquid line solenoid valve should be close when circuit state is off. Otherwise it should be open.

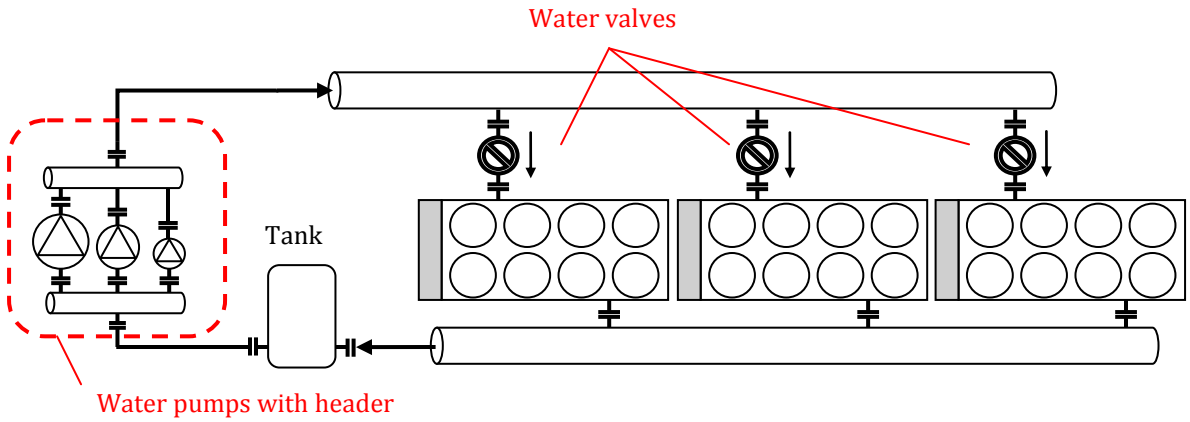
8.9.3 EXV control with LLSV

If the unit is configured for use with liquid line solenoid valves EXV closed position will be different from normal EXV control.
The EXV position should be 0% when the EXV initially enters the closed state, while it is reinitializing to the zero position. After EXV position command has been 0% for a minute, EXV should go to 5% position. (To prevent excessive pressure between EXV and liquid line solenoid valve).



8.10 Water valve control

Here is a sample diagram of water valve installation. If each chiller has a water valve and if it can be controlled by chiller it will help for building management.



This function will require;
1) Digital Output to be addressed at Do2 in POL965 ad21 for controlling water valve open or close.
2) Digital Input to be addressed at X5 in POL965 ad21 for recognizing water valve full open or not.

8.10.1 Unit setting

Water valve control should be enabled only when the Water valve control set point is set to enable.

8.10.2 Water valve control

8.10.2.1 Close operation

Water valve state should be CLOSE when the conditions are sure for the pump off. Once the state becomes CLOSE water valve goes to closed position. However if open command is activated in closing sequence the valve should stop closing, and then start to open.

8.10.2.2 Opening operation

Water valve state should be OPENING when the pump is ready to start. When the state becomes OPENING water valve starts to open.

8.10.2.3 OPEN operation

Water valve state should be OPEN when the valve digital feedback is set to open for 2 seconds.

8.11 Rapid Restore

For Data Center customer it's very important to recover cooling capacity quickly after power failure. The target of this logic is that the chiller restarts within 30seconds after short power failure (Note) and recovers cooling capacity as quickly as possible. This function requires POL925 extension module to be enabled. Rapid Restore can be enabled only if Rapid Restore set point is set to enable, Digital input at POL925 (Di1) is closed and Liquid line solenoid valve set point is set to be enabled.

Note: The time of "Short power failure" can be defined by unit set point "RR max power failure tm". If the power failure continues more than that, then the unit takes normal start sequence.

8.12 Chiller network control

This function can manage max four units as one unit by using wired connection in between main controllers. But the water pipes of chillers should be connected as in parallel. If it's in series this function does not work correctly.

8.12.1 Unit setting

Chiller network control can be enabled only when the Chiller network control set point is set to enable, all units are set to same operation mode and one unit should be defined as "Master"

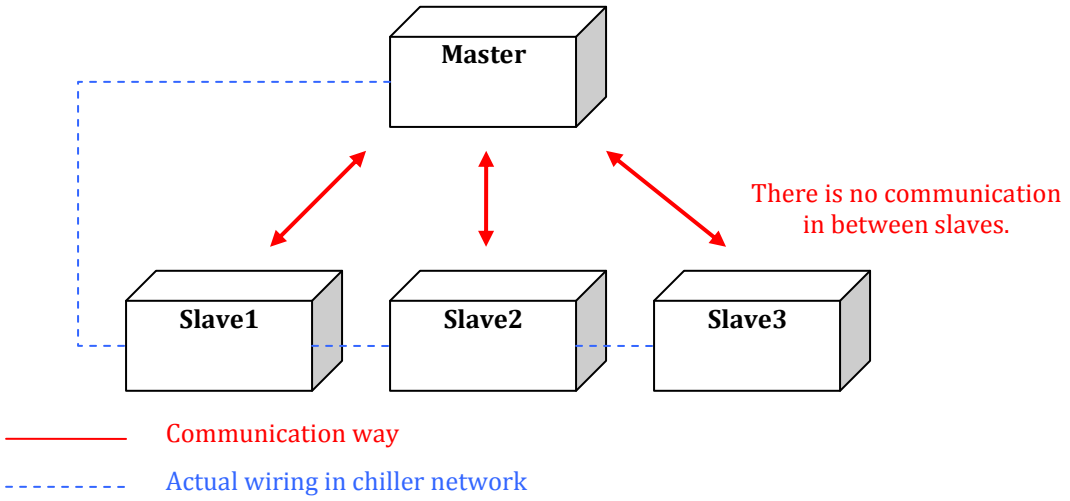
8.12.2 Master / Slave communication

8.12.2.1 Communication setting

Units in chiller network should be defined as "Master" or "Slave" via keypad set points for communicating in between units. But only one unit can be a Master. In other words, if there is already a Master unit the other unit can only set as Slave.

8.12.2.2 Communication type

Units in chiller network can communicate with Master or Slave by using shield cable connected in between POL687 Process bus terminal of each unit. This communication type is KNX TP1. Only master unit shall be able to communicate with each slave. A slave cannot communicate with other slaves.



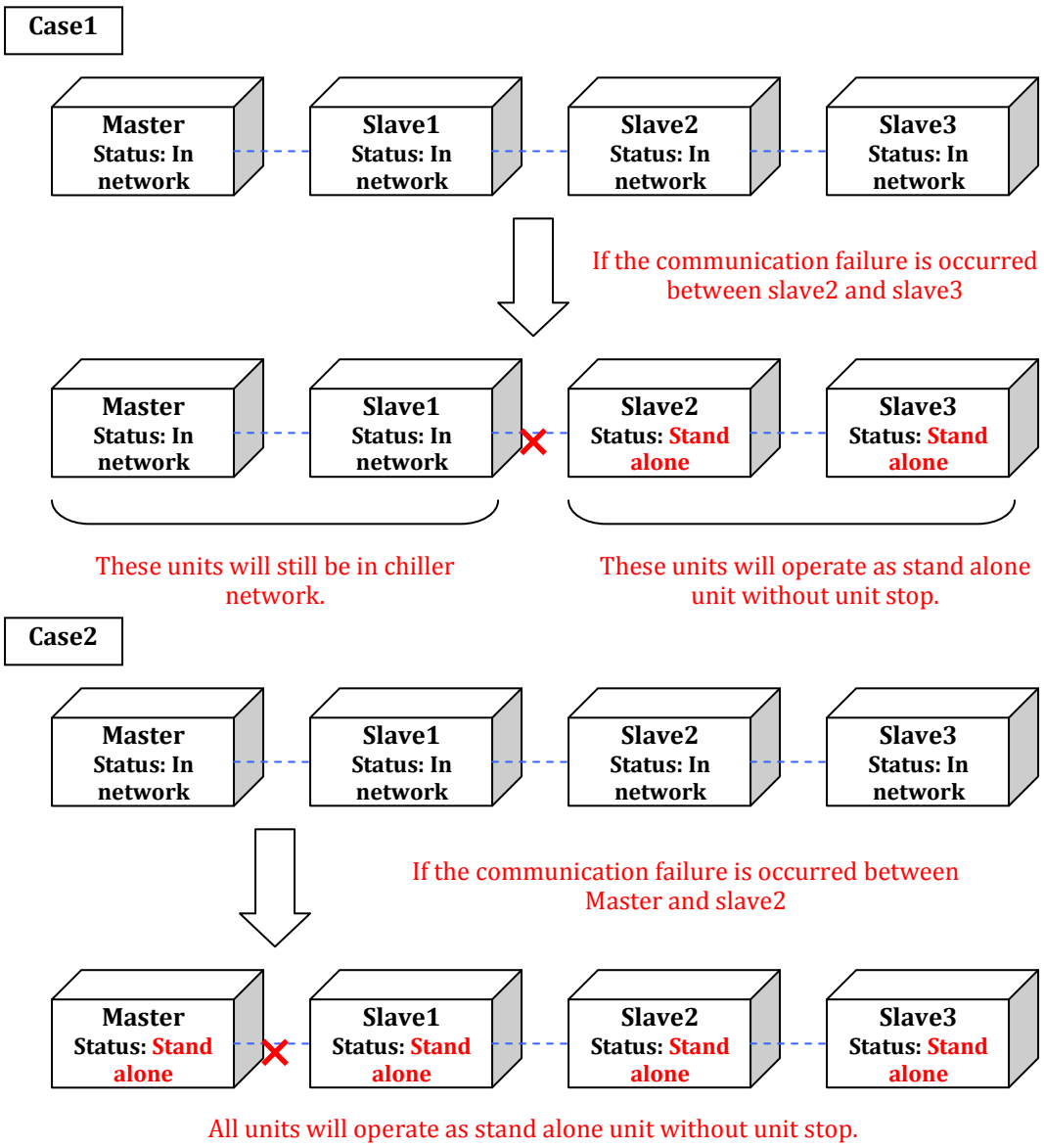
8.12.2.3 Communication failure

8.12.2.3.1 Alarm

If communication failure is occurred the unit makes warning alarm to notice that to customer. Detail of this alarm is defined at Alarm section.

8.12.2.3.2 Operation with communication failure

If there is no master and slave in chiller network due to communication failure the unit operates as a standalone unit. At that time it is not necessary to stop the unit disconnected from chiller network. Communication failure does not require unit stop any time.



8.12.2.3.3 Operation after restoring communication

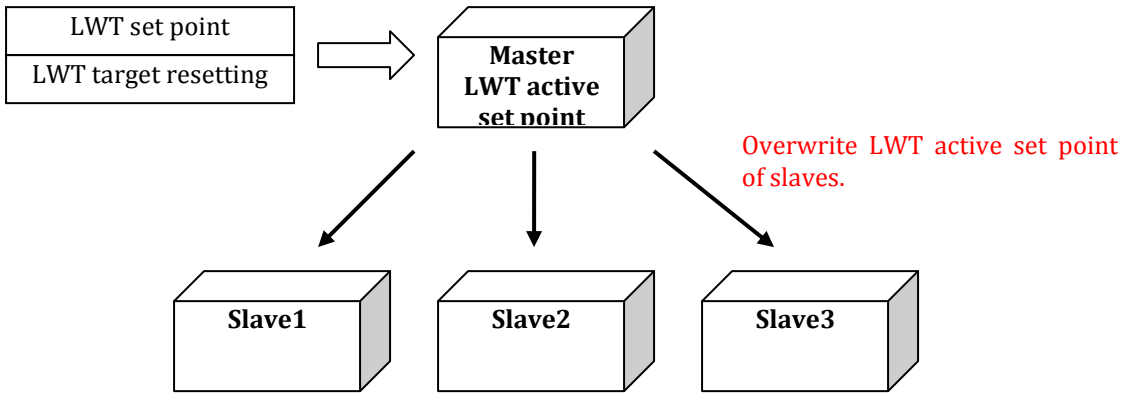
Once the unit restores communication it will start operation as the unit in chiller network. However if the unit restoring communication is in pumpdown or defrost operation it should continue that, and then the unit should be back to chiller network after completing that.

8.12.3 Capacity control

Unit capacity will be varied based on LWT error of each LWT as like usual capacity control. However circuit stage down and compressor stage down shall be forbidden unless more than two units are running.

8.12.3.1 LWT active set point

LWT active set point of master unit shall be taken as chiller network LWT active set point. LWT active set point of slaves shall be overwritten by master one.
This means LWT target resetting of master is also used as chiller network target resetting.



There is one note for calculating return reset. It requires averaged LWT of running units to calculate return reset.

8.12.3.2 Capacity limit

Capacity limit for each unit varies based on chiller network capacity limit set point.
If the set point is set to “Common” the capacity limit to master shall be applied to all units in chiller network. If it is set to “Each” capacity limit can be set to each unit. Where capacity limits are unit current limit, 4-20mA demand limit and BAS network limit.

8.12.3.3 Unit start up

This control is same as normal control. However this will be applied to first starter unit only. The other units in chiller network shall take stage up sequence.

8.12.3.4 Unit stage up

During chiller network control unit stage up and stage down are required for controlling multi units as one unit. The first starter unit will take normal start up sequence. After that the other units will take unit stage up sequence instead of startup sequence.

8.12.3.5 Unit stage down

Unit stage down will be taken as an alternative logic of circuit stage down or compressor stage down. So, if the unit is under chiller network control the circuit stage down and compressor stage down control will be forbidden.

8.12.3.6 Unit shut down

Unit shut down by switches and LWT error shall be same as normal control. Light load unit shut down shall be ignored unless more than two units are running under chiller network control.

8.12.3.7 Next one to start, next one to stop

The master unit will manage which one should be next to start or stop based on the following table.

Priority	Next one to start	Next one to stop
1st	Highest unit sequence number	Lowest unit sequence number
2nd	Highest nominal capacity unit	Lowest nominal capacity unit
3rd	Least starts	Least starts
4th	Least run hours	Most run hours
5th	Highest network communication address	Lowest network communication address

8.12.4 Defrost

If the unit is in chiller network the defrost control of those units shall be limited to maintain certain capacity.

8.12.5 Chiller network Status

The displayed chiller network status should be determined by the conditions in the following table.

Enum	Chiller network status	Conditions
0	In network	Chiller network set point is set to Enable and there is no communication failure of chiller network
1	Disconnected	Chiller network set point is set to Disable
2	Comm fail	Chiller network set point is set to Enable and there is communication failure of chiller network

9 Set Point Table

9.1 Chiller configuration set points

All set points can be accessed via key pad with certain password. Those set points require controller reset to activate new setting. Direction will be [Main menu] / [Commission Unit] / [Configuration].

Name	Default	Range	Note
Voltage	400	208~230, 380, 400, 460	
Frequency	50	50, 60	
Unit type	Cool only	Cool only, Heat pump	
Efficiency type	Hi Eff	Std Eff, Hi Eff	
Number of Ckt	1	1,2	
Ckt # Number of comps	3	3, 4, 5, 6	Need to be set for each circuits
Ckt # Number of fans	3	3, 4, 5	Need to be set for each circuits
Ckt # Liquid line SV	Disable	Enable, Disable	Need to be set for each circuits
HPS setting	Normal	Normal, Higher limit	"Higher limit" will be used only for US chillers.
Comm. Module1	Automatically detected	BACNET IP, BACNET MSTP, LON, MODBUS, AWM	
Comm. Module2			
Comm. Module3			

9.2 Unit set points

All set points can be accessed via key pad with certain password. Those set points do not require controller reset to activate new setting. Direction will be [Main menu] / [View/Set Unit] / [Setup].

Name	Class	Unit	Default	Min.	Max.	Note
Unit enable	Unit	-	Enable	Disable, Enable		
Ctrl source	Unit	-	Local	Local, Network		
Available mode	Unit	-	Cool / Heat	Cool/ Heat, Cool/Heat/Ice w/glycol, Test		For heat pump chiller
Available mode	Unit	-	Cool	Cool, Cool w/glycol, Cool/Ice w/ glycol, Ice w/glycol, Test		For cooling chiller
Max # ckts running	Unit	-	1	1	2	
Sequence # C1	Unit	-	1	1	2	
Sequence # C2	Unit	-	1	1	2	
Chiller status after power failure	Unit	-	Enable	Enable, Disable		
Pump ctrl	Unit	-	#1 only	#1 only, #2 only, Auto, #1 primary, #2 primary		
Pump variable flow	Unit	-	No	No, Yes		
Pump recur tm	Unit	Sec.	30	0	300	
Cool LWT 1	Unit	°C	7.0	4.0	20.0	

Cool LWT 2	Unit	°C	7.0	4.0	20.0	
Cool LWT 1	Unit	°C	7.0	-8.0	20.0	With glycol
Cool LWT 2	Unit	°C	7.0	-8.0	20.0	With glycol
Heat LWT 1	Unit	°C	45.0	25.0	50.0	
Heat LWT 2	Unit	°C	45.0	25.0	50.0	
Ice LWT	Unit	°C	-4.0	-8.0	4.0	
Start up delta T	Unit	°C	2.7	0.0	5.0	
Stage up delta T	Unit	°C	0.5	0.0	2.0	
Stage down delta T	Unit	°C	0.8	0.0	1.7	
Shut down delta T	Unit	°C	1.5	0.0	1.7	
Nominal water delta T	Unit	°C	5.0	4.0	8.0	
EWT max pulldown rate	Unit	°C/min	3.0	2.0	6.0	
Stage up tm	Unit	Min.	3	0	60	
Ice delay timer	Unit	Hrs	12	1	23	
Light load stage down	Unit	%	35	20	50	
High load stage up	Unit	%	80	50	100	
LWT reset type	Unit	-	None	None, 4-20mA, Return, OAT		
Max Reset	Unit	°C	5.0	0.0	10.0	
Start Reset Delta T	Unit	°C	5.0	0.0	10.0	
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	For heating operation
Start Reset OAT (Heating)	Unit	°C	15.0	10.0	30.0	For heating operation
Soft load control	Unit	-	Disable	Enable, Disable		
Begin capacity limit	Unit	%	40	20	100	
Soft load ramp	Unit	Min.	20	10	60	
Current limit	Unit	-	Disable	Enable, Disable		
Current limit type	Unit	-	INV	INV, CT (4-20mA)		
Current limit setting	Unit	A	400	0	500	
Current @20mA	Unit	A	400	0	500	
Flex current limit	Unit	-	Disable	Enable, Disable		
Demand limit	Unit	-	Disable	Enable, Disable		
Noise reduction	Unit	-	Disable	Enable, Disable		
Noise reduction start tm	Unit	-	21:00	18:00	23:59	
Noise reduction end tm	Unit	-	06:00	05:00	09:59	
Noise reduction Cond target offset	Unit	°C	5	0	10	For cooling operation
Noise reduction Evap target offset	Unit	°C	5	0	10	For heating operation
Rapid restore	Unit	-	Disable	Enable, Disable		
Rapid Restore max power failure tm	Unit	Sec.	15	15	180	
Water valve ctrl	Unit	-	Disable	Enable, Disable		
Chiller network control	Unit	-	Disable	Disable, Enable		Chiller network ctrl
Master / Slave	Unit	-	Slave	Master, Slave		Chiller network ctrl
Unit sequence number	Unit	-	1	1	4	Chiller network ctrl
Chiller network capacity limit setting	Unit	-	Common	Common, Each		Chiller network ctrl
Light load unit stage down	Unit	%	35%	20%	50%	Chiller network ctrl
Unit stage down timer	Unit	Min.	5	0	60	Chiller network ctrl
High load unit stage up	Unit	%	80%	50%	100%	Chiller network ctrl
Unit stage up timer	Unit	Min.	5	0	60	Chiller network ctrl

9.3 Circuit set points

All set points can be accessed via key pad with certain password. Those set points do not require controller reset to activate new setting. Direction will be [Main menu] / [View/Set Circuit] / [Setup].

Name	Class	Unit	Default	Min.	Max.	Note
Circuit enable	Circuit	-	Enable	Disable, Enable, Test		
Start – Start timer	Circuit	Min.	10	5	60	
Stop – Start timer	Circuit	Sec.	180	180	300	
Pumpdown time limit	Circuit	Sec.	60	10	120	
Service pumpdown	Circuit	-	Disable	Enable, Disable		
Service Pumpdown Pr	Circuit	kPa	250	100	400	
HPS test set point	Circuit	-	Disable	Enable, Disable		
Max fan sat cond temp target	Circuit	°C	20	20	40	
Min fan sat cond temp target	Circuit	°C	40	25	50	
Fan VFD max speed	Circuit	%	25	20	60	With fan VFD
Fan VFD min speed	Circuit	%	100	90	110	With fan VFD
Caftan up DB stg0	Circuit	°C	4.0	1.0	15.0	
C_Fan up DB stg1	Circuit	°C	6.0	1.0	15.0	
C_Fan up DB stg2	Circuit	°C	7.0	1.0	15.0	
C_Fan up DB stg3,4	Circuit	°C	8.0	1.0	15.0	
C_Fan down DB stg1	Circuit	°C	10.0	1.0	15.0	
C_Fan down DB stg2	Circuit	°C	10.0	1.0	15.0	
C_Fan down DB stg3	Circuit	°C	8.0	1.0	15.0	
C_Fan down DB stg4,5	Circuit	°C	7.0	1.0	15.0	
C_Fan up DB stg0 w/ VFD	Circuit	°C	2.5	1.0	15.0	
C_Fan up DB stg1 w/ VFD	Circuit	°C	4.5	1.0	15.0	With fan VFD
C_Fan up DB stg2 w/ VFD	Circuit	°C	5.5	1.0	15.0	With fan VFD
C_Fan up DB stg3, 4 w/ VFD	Circuit	°C	6.5	1.0	15.0	With fan VFD
C_Fan down DB stg1 w/ VFD	Circuit	°C	8.5	1.0	15.0	With fan VFD
C_Fan down DB stg2 w/ VFD	Circuit	°C	8.5	1.0	15.0	With fan VFD
C_Fan down DB stg3 w/ VFD	Circuit	°C	6.5	1.0	15.0	With fan VFD
C_Fan down DB stg4, 5 w/ VFD	Circuit	°C	5.5	1.0	15.0	With fan VFD
H_Fan up DB stg1	Circuit	°C	5.0	1.0	15.0	For heating operation
H_Fan up DB stg2	Circuit	°C	6.0	1.0	15.0	For heating operation
H_Fan up DB stg3,4	Circuit	°C	7.0	1.0	15.0	For heating operation
H_Fan down DB stg2	Circuit	°C	10.0	1.0	15.0	For heating operation
H_Fan down DB stg3	Circuit	°C	10.0	1.0	15.0	For heating operation
H_Fan down DB stg4,5	Circuit	°C	10.0	1.0	15.0	For heating operation
H_Fan up DB stg1 w/ VFD	Circuit	°C	3.5	1.0	15.0	For heating operation with fan VFD
H_Fan up DB stg2 w/ VFD	Circuit	°C	4.5	1.0	15.0	For heating operation with fan VFD
H_Fan up DB stg3, 4 w/ VFD	Circuit	°C	5.5	1.0	15.0	For heating operation with fan VFD
H_Fan down DB stg2 w/ VFD	Circuit	°C	8.5	1.0	15.0	For heating operation with fan VFD
H_Fan down DB stg3 w/ VFD	Circuit	°C	8.5	1.0	15.0	For heating operation with fan VFD
H_Fan down DB stg4, 5 w/ VFD	Circuit	°C	8.5	1.0	15.0	For heating operation with fan VFD

9.4 Alarm limit set points

All set points can be accessed via key pad with certain password. Those set points do not require controller reset to activate new setting. Direction will be [Main menu] / [Alarms] / [Alarm limits].

Name	Class	Unit	Default	Min.	Max.	Note
Water freeze	Unit	°C	2.8	2.8	6.0	
Water freeze w/ glycol	Unit	°C	2.8	-18.0	6.0	With glycol
Water flow proof	Unit	Sec.	15	5	15	
Recirc timeout	Unit	Min.	3	1	10	
Low OAT lockout	Unit	°C	2.0	2.0	15.0	
Low OAT lockout w/ VFD	Unit	°C	2.0	-20.0	15.0	With fan VFD
Low OAT lockout in heat	Unit	°C	-15.0	-15.0	0.0	For heating operation
High OAT lockout in heat	Unit	°C	25.0	10.0	25.0	For heating operation
Low evap gas temp	Circuit	°C	-3.5	-3.5	5.0	
Low evap gas temp w/ glycol	Circuit	°C	-3.5	-25.0	5.0	With glycol
External fault cfg	Unit	-	-	-	-	

9.5 Sensor calibration set points

All set points can be accessed via key pad with certain password. Those set points do not require controller reset to activate new setting. Direction will be [Main menu] / [View/Set Unit] / [Setup] / [Calibrate sensors] or [Main menu] / [View/Set Circuit] / [Setup] / [Calibrate sensors].

Name	Class	Unit	Default	Min.	Max.	Note
EWT offset	Unit	°C	0.0	-5.0	5.0	
LWT offset	Unit	°C	0.0	-5.0	5.0	With glycol
OAT offset	Unit	°C	0.0	-5.0	5.0	
Cond pr offset	Circuit	kPa	0	-100	100	
Evap pr offset	Circuit	kPa	0	-100	100	
Deicer temp offset	Circuit	°C	0.0	-5.0	5.0	With fan VFD
Evap gas temp offset	Circuit	°C	0.0	-5.0	5.0	For heating operation
Suct temp offset	Circuit	°C	0.0	-5.0	5.0	For heating operation
Disch temp offset	Comp	°C	0.0	-5.0	5.0	
Casing temp offset	Comp	°C	0.0	-5.0	5.0	With glycol

9.6 Test mode set points

All outputs except for compressor starter outputs should be manually controllable via test mode set points. For each output, there should be a set point that is visible and changeable 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”. When the unit mode is no longer Test, all unit test mode set points should be changed back to their ‘off’ values. The same should occur for circuit test mode set points. When test mode is no longer enabled for the circuit, all the circuit test mode set points for that circuit should be changed back to their ‘off’ values.

10 Calculations

10.1 Refrigerant Saturated temperature

Refrigerant saturated temperature (Tc and Te) shall be calculated from the pressure sensor readings for each circuit. A function will provide the converted value of temperature.

10.2 Suction Superheat

SSH shall be calculated for each circuit by the following equation.

SSH = Suct. Temp – Te

10.3 Discharge Superheat

DSH shall be calculated for each compressor by the following equation.

DSH = Disch. Temp – Tc

10.4 Evaporator Approach, Condenser Approach

Evaporator approach and condenser approach shall be calculated for each circuit.

10.4.1 At cooling mode

Condenser Approach = Tc – OAT
Evaporator Approach = (EWT – LWT) / Ln ((EWT – Te) / (LWT – Te))
Note: If EWT = LWT or LWT = Te, then Evaporator approach = 0

10.4.2 At heating mode

Condenser Approach = (LWT – EWT) / Ln ((Tc – EWT) / (Tc – LWT)
Evaporator Approach = OAT – Te
Note: If EWT = LWT or LWT = Tc, then Condenser approach = 0

10.5 Pressure Differential

Pressure differential shall be calculated for each circuit.
Pressure differential = Cond. Pr – Evap. Pr

10.6 Pressure ratio

Pressure ratio shall be calculated for each circuit.
Pressure ratio = (Cond. Pr +101.325) / (Evap. Pr + 101.325)

10.7 Unit and circuit capacity

Unit capacity, circuit capacity and compressor capacity will be defined by the following equation.

Unit capacity [%] = Average (Circuit capacities [%])
Circuit capacity [%] = Average (Compressor capacity [%])
Compressor capacity [%] = Current rps / Maximum rps

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