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Microtech 4® Controller

Operating Manual
D-EOMOC00611-20EN

Intelligent Chiller Manager (Option 184)

Table of contents

1 WHAT IS iCM©

1.1 Before starting

Microtech© 4 provides a set of control functions that can be used to optimize and sequence chiller, heat pump and multipurpose Units.
These Unit functionalities can be distinguished with the followings:

- Master/Slave
- iCM© (intelligent Chiller Manager)

Master/Slave control is available as a standard and it can be activated at any time.
iCM© is instead a set of new control functionalities and it must be bought as an option of the Unit being specified in the material request of a chiller, a heat pump and a multipurpose Unit. iCM© can be activated at Factory level or through a license key.
The differences between iCM© and Master/Slave is that iCM© offers advanced optimization features and a comprehensive plant control and management, whereas Master/Slave is limited by offering a very basic chiller sequencing and staging without any energy efficiency optimization logics.
iCM© is available on Daikin Applied Europe Microtech©4 controllers.
In the following sections the differences between the two products will be further explained.

1.2 Sequencing functions

iCM© can control up to 8 Units compared with Master/Slave that can control at maximum 4 Units. Moreover, iCM© can manage most of the Unit control features and options, such as heat-recovery, demand limit and energy monitoring at system level whereas Master/Slave cannot.
The stage up and down of the Units with a logic based on capacities, adjustable individually for every Unit, is also available with iCM©. The main purpose of this logic is to let Units perform in their optimal operating areas that can be different from Unit to Unit.
Additional flexibility is given to iCM© by controlling a mix of VFD and non VFD Units further optimizing the overall plant efficiency.
Individual priorities for every Unit can be set, by default all Units have the same value. Both, iCM© and Master/Slave, will define the sequence to equalize starts and running hours of the Units composing the plant. Priorities are used for grouping or prioritizing more efficient Units with respect to plant conditions and the running Units performing at that point in time. In addition to this, iCM© can also set automatically the Unit priorities to handle special options like Heat Recovery or Freecooling.
Another important difference between iCM© and Master/Slave is that sequencing functions can use an additional configurable sensor to be installed on the supply headers or in the buffer tanks. Alternatively, the sensor-less mode can be always supported. In this case, the average entering water temperature of the running Units will be used. In case of plants with multipurpose Units, the control will require to use the additional leaving temperature sensors, properly installed, one for the chilled water loop and one for the heat water loop.

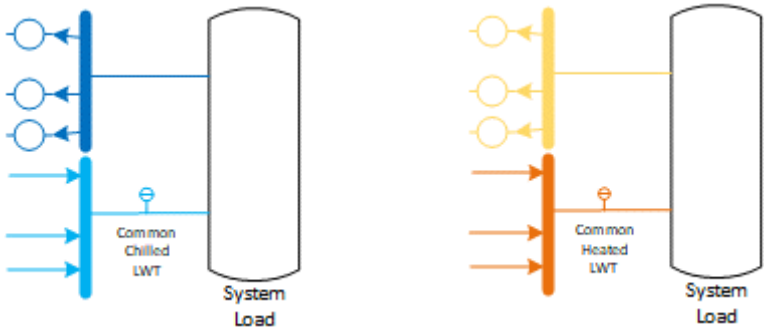


Figure 1:Common sensors positioning

To check for the sensors' configuration, please refer to Section **3.2 Common water temperature sensors.** More details on the staging strategies will be explain in Section **5**Errore. L'origine riferimento non è stata trovata. **FUNCTIONAL DESCRIPTION**.

1.3 Possible configurations

Different configurations can be managed with iCM. All of these must have at maximum 8 Units. The plant configurations are:

- all chillers (mix of air-cooled and water cooled is not allowed)

- all heat pumps (mix of air-cooled and water cooled is not allowed)
- all multipurpose
- mix of air cooled screw chillers and multipurpose (three circuits Units are currently not managed)
- mix of air cooled chillers and heat pumps (operating all in the same running mode, in two pipes plant)
- air cooled chillers with optional Heat Recovery (not all chillers must have heat recovery)
- air cooled chillers with optional Free-cooling (not all chillers must have free-cooling)
- mix of Screw and Scroll Compressor Air cooled Unit
- mix of VFD or step compressor Air cooled Unit

Please, note that Master/Slave can manage only plants with up to 4 Units and composed by:

- all chillers
- all heat pumps
- all multipurpose
- all the Units must have the same capacity control (all scroll or all screw compressors).

Microtech© 4 detects the type of Units connected in the network and it will eventually disable the sequencing functions if a not allowed mix of Units will be connected.

	In case of doubts about what Master/Slave can and cannot do, please refer to the following sections or contact your Sales Support reference.

1.4 Limitations

As mentioned in the previous Section 1.3, there are limitations in using Master/Slave and iCM in some plant layout.
Nevertheless, limitations of Master/Slave can be overcome by using iCM© control. If any of those limitations are found during system commissioning, it is given the possibility to activate a trial of the iCM© for a limited period of time. When the trial expires and the permanent license has not been activated, iCM© will be automatically disabled by the controller. To clarify this specific aspect, please refer to Section 2.

The following Table 1 resumes the possible configurations and limitations of the two control functions.

Option	Master/Slave	iCM©
Up to 8 Units	×	✓
All Chillers	✓	✓
All Heat Pumps	✓	✓
All Multipurpose	✓	✓
Mix of Water-cooled Units + Air-cooled Units	×	×
Mix of Water-cooled Units + Multipurpose Units	×	×
All Screw Units	✓	✓
All Scroll Units	✓	✓
All Centrifugal Units	✓	✓
Mix of Screw + Scroll Units	×	✓
Mix of Centrifugal + Screw/Scroll Units	×	×
Mix of Screw Units with slide compressor + VFD compressor	✓	✓
Mix of Chillers + Heat Pumps (only in two pipes system)	×	✓
Mix of Multipurpose + Air-cooled Screw Chillers (max 2 circuits)	×	✓
Mix of Chillers + Heat Pumps + Multipurpose	×	×
Chillers with Heat Recovery	×	✓
Mix of Chillers with HR + Multipurpose	×	×
Chillers with Free-cooling	×	✓

Table 1: Comparison between iCM and Master/Slave

Even if iCM© can manage Units with different operating mode (Chiller/Heat Pump), it can be applied only in plant room with 2-pipes system. In these plants, there are only one supply and return headers that provide chilled water or hot water according to Daikin Units operating mode. In fact, neither iCM nor Daikin Units can manage the changeover of the diverting valve needed for the connection to a 4-pipes system.
Only in case of combination of multipurpose with air-cooled chiller Units, iCM© is able to manage a 4-pipes system, where multipurpose is connected to heated water circuit, while multipurpose and chiller are connected to chilled water circuit.

	In case of doubts about what Master/Slave or iCM© can and cannot do, please refer to the following sections or contact your Sales Support reference.

1.5 Daikin on Site

iCM© is integrated within Daikin on Site (DoS). When a Unit is connected to DoS and it is elected as the Master of the plant, all the status info, settings and web graphics of the plant are displayed. Specific sections will support an easy commissioning of the system and trending to monitor capacities and temperatures, starts and stops can help the remote Operator to fine tune and optimize the plant control.

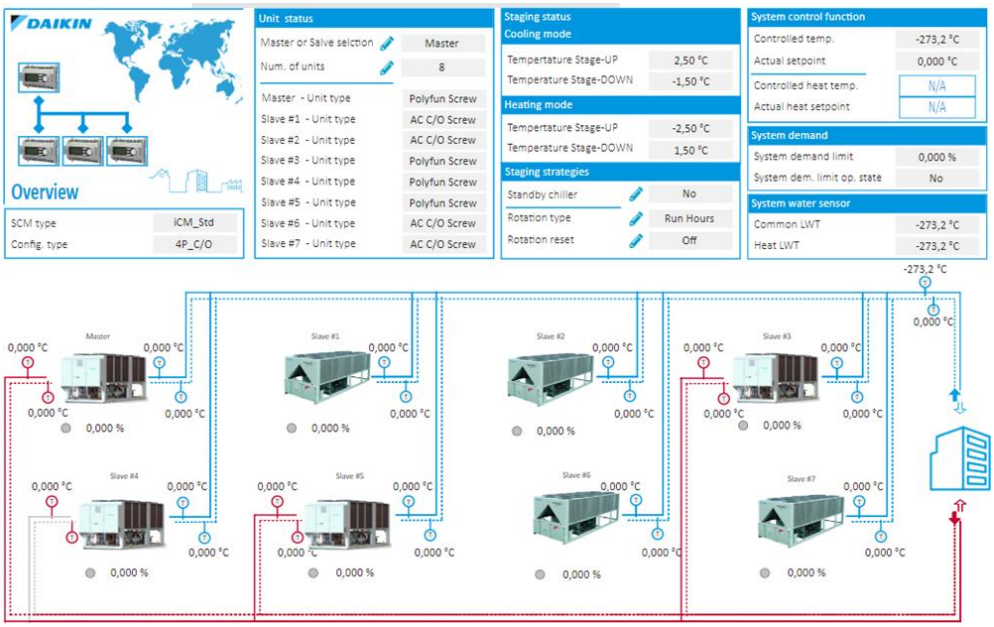


Figure 2 iCM plant visualization on Daikin on Site

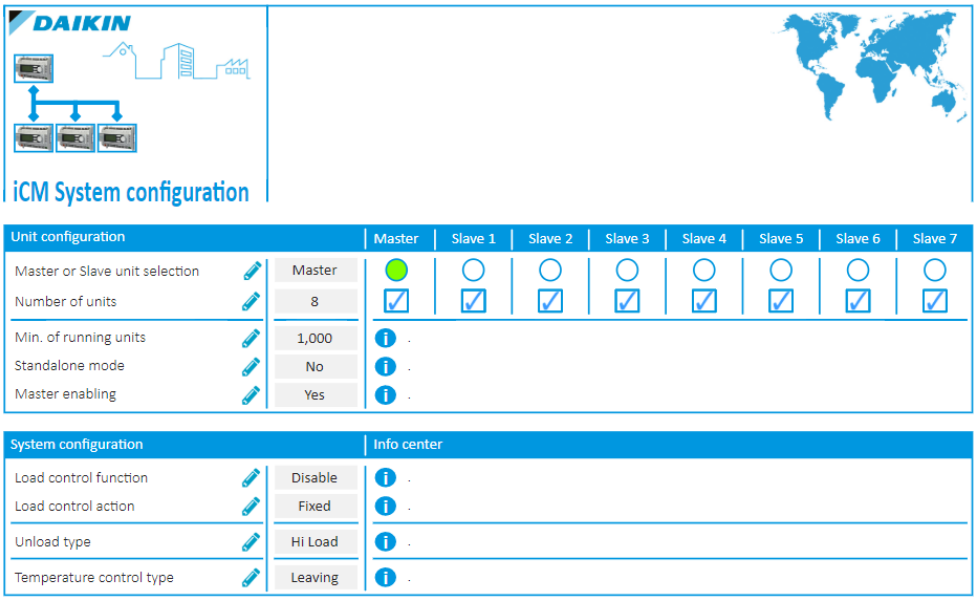


Figure 3 iCM System configuration page on Daikin on Site

2 LICENSING

2.1 When license is needed

When the plant configuration requires iCM© (please refer to Table 1 for more details), then a License key is needed.
In case iCM© is added to the Units' order, the control function is automatically activated from the Factory by allowing a Plug&Play control solution during the commissioning phase.
If iCM© is requested in a later stage, the License can be ordered from the Factory. Simple information like the order number of Units and the corresponding serial numbers of the Unit controllers are needed to for the License activation. The License key is a unique code specifying the special options associated to that Unit and applicable to that Unit only. In case of multiple Units in the same plant an individual License key must be set on every Unit to let iCM© being unlocked.

ⓘ	iCM© is a Unit option and must be purchased as any other option. Don't forget to add it to your order for Factory activation.

2.2 Temporary License

A temporary License can be used if iCM© has not been ordered and the system layout requires its functionalities. To activate the time-limited License for iCM© please, let's proceed through menu *Commissioning – Software Options* page and the *Temporary Passwords* menu:

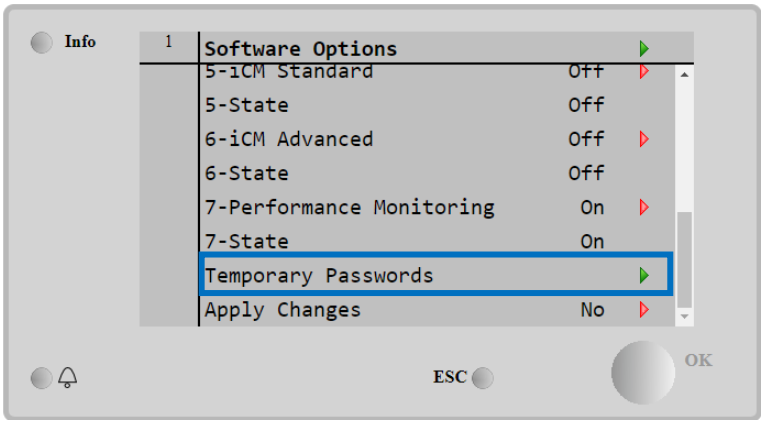


Figure 4: Temporary Activation

Then, by entering the page, three temporary passwords are displayed:

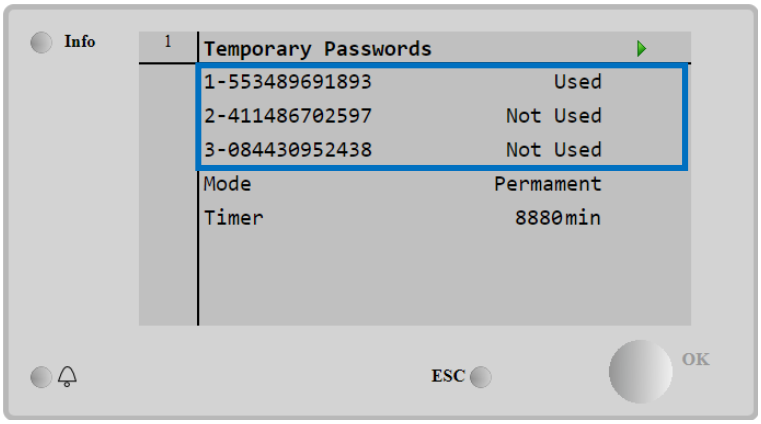


Figure 5: Temporary password activation

In the same page the usage of the activation code is also visible and a Timer indicating the remaining time before expiration can be checked.
When timer expires, iCM© will be disabled. All the settings will be retained, and a re-activation will restart the normal sequencing as per previous configuration.

ⓘ	If the iCM© get disabled because the temporary licenses expire, Daikin Applied Europe cannot be considered responsible for any consequence or claims from the customer.

2.3 Permanent License

To enter a permanent License and activation key of the iCM©, go into the *Commissioning – Software Options* page:

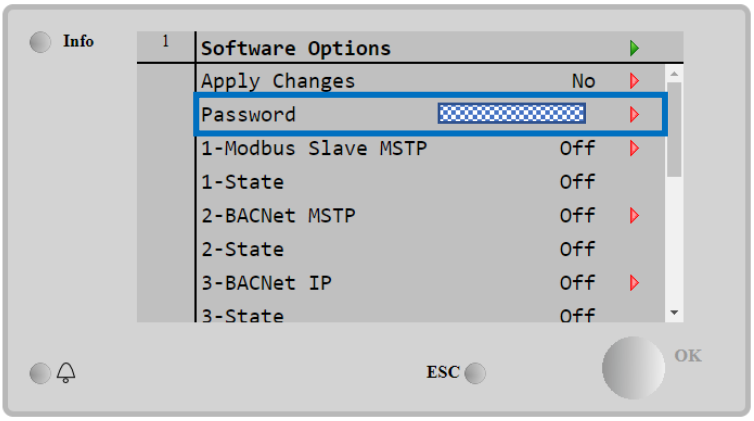


Figure 6:Software Options page

Click on the red arrow next to the item Password and enter the numeric License key.

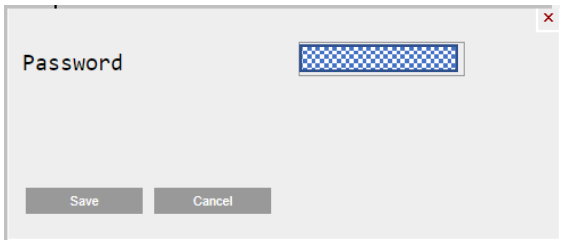


Figure 7: Enter the license code

With the License key correctly installed, let's proceed and activate all the options including the iCM© by changing the corresponding value to *On*, then apply all the changes.

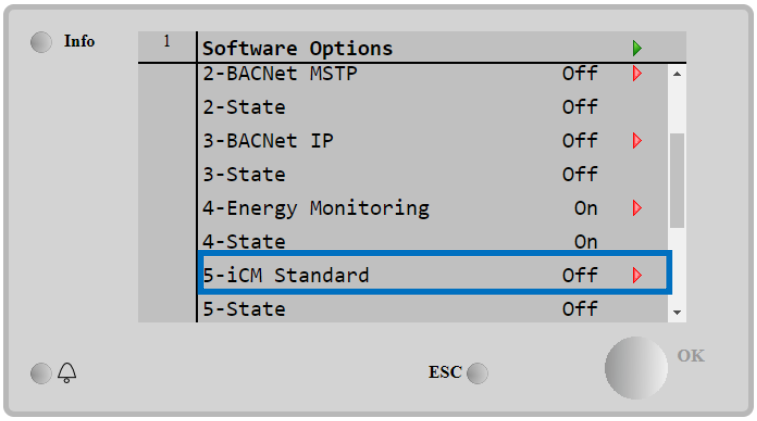


Figure 8: Activate the iCM Standard

After the controller reboot, go back again to the *Software Options* page and check if the activation states (5-State) are *On* to confirm the correct activation of the iCM© function.

3 FIELD WIRINGS

3.1 Daikin Communication Network connection

The following diagram shows how to connect the Daikin Units each other and establish the Daikin communication Network. Starting from first Daikin Unit, connect in parallel the PB terminals [CE+ / CE-] of every controller. Refer to the Unit wiring diagram for the enumeration of the terminals.
A shielded twisted pair cable must be used to make the connection.

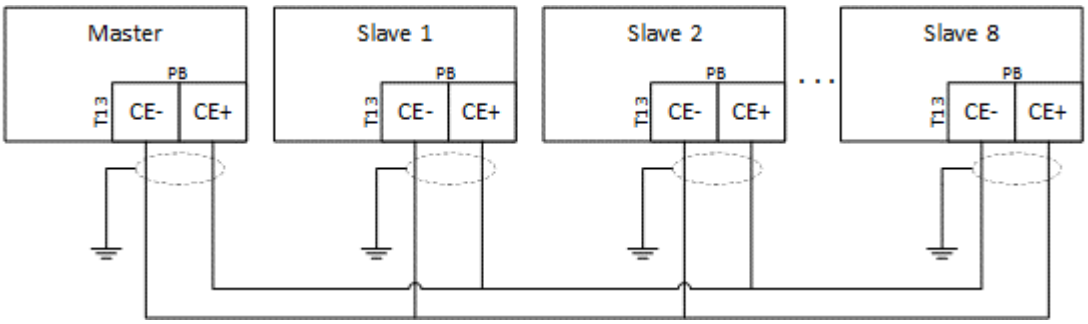


Figure 9: Connecting the network

It is important to respect the below limitation to avoid instability in the communication network:

- Bus cable length between 2 Units Max. 700 m
- Total bus cable length Max. 1,000 m

3.2 Common water temperature sensors

iCM© master controller can be equipped with common water temperature sensors depending on the specific configuration or set of Units. These sensors must be installed in a proper position to measure the supply water temperatures of the system.

Option	1 sensor	2 sensors
All Chillers	✓	×
All Heat Pumps	✓	×
All Multipurose	×	✓*
Mix of Chillers + Multipurpose	×	✓*
Mix of Chillers + Heat Pumps	✓	×
Water cooled cooling only	✓	×
Water cooled cooling/heating	✓	✓
Water cooled heating only	✓	✓

Table 2 Common Leaving water temperature in plant room

Configurations with the "*" symbol always requires 2 sensors. This means that any time a multipurpose is present in the system, 2 temperature sensors are always needed.
Please refer to the specific Unit wiring diagrams for a correct installation of the sensors to the controller terminals.
Type of sensors that can be used are the standard Daikin NTC10K (with a beta of 3977) or generic PT1000 sensors.

4 HMI DESCRIPTION

4.1 Introduction

The following sections will go into the configuration and navigation of both iCM and Master/Slave. All the menus and submenus will be described in terms of purpose and contents. All the pages will be described in terms of parameters and settings. The two classes can be easily identified referring to the below table.

Description	Default	Range and function	AL	MS
This is a parameter	7.6°C	-15.0°C…30.0°C This is a parameter	4	Y
This is a setting	2	iCM: 2…8 M/S: 2…4	2	N
This is a link to a subpage	u		4	Y

Table 3: Example of parameter and setting representation

The description of any setting or parameter will also include the required Access Level (AL). Access level is defined by the password entered to access the different menus of the Microtech© 4. Please refer to the Unit's Operating Manual for more details.
The column MS will show if a setting or parameter is available
Access levels are the following:

AL	Profile	Access rights
6	Basic user	Limited access to settings and parameters
4	Maintenance	extended access to settings and parameters
2	Service	full access to configuration, settings and parameters

Table 4:Access levels

Some of the settings for the lower profile users can be limited to read only but can be changeable with a higher access level.

4.2 Preliminary configuration

Before being able to configure all the function of the iCM© or Master/Slave, it is needed to activate this additional control on the Units. To do this, it is needed to enter the *Commission Unit – Configuration* menu:

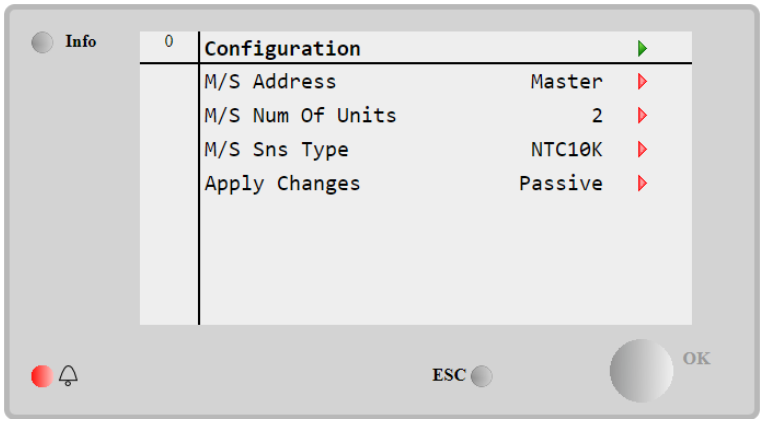


Figure 10: Basic system configuration

Description	Default	Range and function	AL	MS
M/S Address	None	iCM: Master, Slave1,…, Slave8 M/S: Master, Slave1,…, Slave4	4	Y
Defines the ID of each Unit inside the network.				
M/S Num Of Units	2	iCM: 2…8 M/S: 2…4	4	Y
Relevant on the Master Unit only to define the number of Units. This value is also used to set communication alarms on disconnected Units.				
M/S Sns Type	NTC10K	NTC10K, PT1000	4	Y
Defines the type of sensor connected to the Master Unit to monitor the supply water temperature to the System. In case of Return water temperature control this setting will not affect the regulation. In case of Supply water temperature control the sensor must be connected or an alarm will be generated				

Table 5:Basic configuration

⚠	The above settings if not properly adjusted may generate alarms on the Master controller. In this case check the settings on this page and on the corresponding page of each Slave controller. Refer to the Troubleshooting section for further details.

After a reboot of the controller the needed additional menus will be shown on the Master controller.

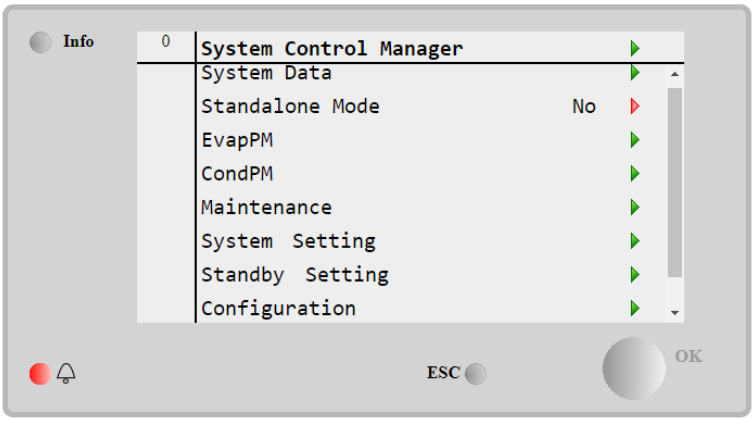


Figure 11: Extended configuration menu

A detailed description of all the sub-pages is in the following sections.

4.3 Main Menu

The Main Menu contains the links to all the configuration and visualization pages. The following table will list all the sections and the related contents.

Section	Content	AL
System Data	Operational data of the System	6
Evap PM	Evaporator Pump Manager menu contains data and setpoint exchanged between Master Controller and Pump Manager controller	
Cond PM	Condenser Pump Manager menu contains data and setpoint exchanged between Master Controller and Pump Manager controller	
Maintenance	Information about running hours and number of starts for each Unit. It also allows to disable the sequencing functions or disable the heat recovery management.	
System Settings	Allows to define the relevant settings for the temperature control of the plant.	6
Standby Settings	Allows to define the Standby chiller management.	4
Configuration	Options configuration, allows to review the type of system, define the main control strategies and activate additional controls	6

Table 6: Main Menu

ⓘ	EvapPM and CondPM menu will display only if Evaporator or Condenser Pump Manager are enabled in the Configuration menu

From the Main Menu is possible to access one setting, described in the following table.

Description	Default	Range and function	AL	MS
Standalone Mode	No	No, Yes	4	Y
Unit set in Standalone mode will work independently from iCM sequencing even if connected on Daikin Chiller network. Those Unit can be managed by Unit controller itself.				

Table 7: Additional settings in the Main Menu

ⓘ	If Master Unit is set “Standalone”, all the Units (Master and Slaves) will work independently from iCM sequencing.

4.4 System Data

This section will describe the parameters accessible in the Data page. It will also describe the links to other sub-sections.

Description	Default	Range and function	AL	MS
Sys State	Stop	Stop, Run	6	
This is the general System status. Stop will mean that Logic is not doing any sequencing. This may be due to the Enable switch on the Master controller. Run means that all the sequencing functions are running.				
Sys HeatRec State	Stop	Stop, Run	6	

This is the general System status. Stop will mean that Logic is not doing any sequencing. This may be due to the Enable switch on the Master controller. Run means that all the sequencing functions are running.				
System Mode	Cool	Cool, Ice, Heat, Multi	6	
This the actual System operating mode. It's defined by operating mode of the Master Unit unless a Multipurpose Unit is controlled. In that case the System Mode will be fixed to Multi.				
System Temperatures				
Sys Evap LWT	-.-°C		6	
This is the actual value of the system supply chilled water temperature. Its value may not be relevant in case of return water temperature control				
Sys Cond LWT	-.-°C		6	
This is the actual value of the system supply heated water temperature. Its value may not be relevant in case of return water temperature control in heating mode. It is available only for water cooled and multipurpose Units.				
Sys Evap EWT	-.-°C		6	
This is the average entering water temperatures of all the running Units. In normal condition is equivalent to the return water temperature from the System and can be used to control the staging if the additional water temperature sensor is not needed.				
Sys Cond EWT	-.-°C		6	
This is the average condenser entering water temperatures of all the running Units. In normal condition is equivalent to the return water temperature from the System and can be used to control the staging if the additional water temperature sensor is not needed. It is available only for water cooled and multipurpose Units.				
Sys Heat Rec EWT	-.-°C		6	
This is the average of the heat recovery entering water temperatures of the Units equipped with this option. This data is available only on the iCM.				
System Load				
Cooling Load	0%	0…100%	6	
This is the average of the individual running Unit capacities on the total number of Units running in Cool or Ice mode.				
Heating Load	0%	0…100%	6	
This is the average of the individual running Unit capacities on the total number of Units running in Heat mode.				
System Sequencing				
Next On	-	iCM: Master, Slave1,…, Slave7 M/S: Master, Slave1,…, Slave3	6	
This is the elected next on Unit. To understand how it is selected please refer to section @@@				
Next Off	-	iCM: Master, Slave1,…, Slave7 M/S: Master, Slave1,…, Slave3	6	
This is the elected next off Unit. To understand how it is selected please refer to section @@@				
Standby	-	iCM: Master, Slave1,…, Slave7 M/S: Master, Slave1,…, Slave3	6	
This is the elected standby Unit. To understand how it is selected please refer to section @@@. A link from this data will show a page with additional information related to date and time for the standby Unit change.				
System Staging				
Sys Ctrld Tmp	-.-°C		6	
This is the actual value of the controlled temperature. It may change as a function of the Unit type and Unit mode. For an air cooled chiller or reversible heat pump this will be always measured on the same water loop, while for a water cooled Unit it may change if operating in Cool mode or Heat mode.				
Sys Ctrld Heat	-.-°C		6	
This is the actual value of the controlled Heat temperature. This value is available only in case of multipurpose Units.				
StageUp Left	0s		6	
This is the time left before the next stage up of the Next On Unit.				
StageDn Left	0s		6	
This is the time left before the next stage down of the Next Off Unit.				

Table 8: System Data parameters

4.4.1 Units: States

This section will list the current status of each individual Unit connected in the Units network.

Item	Standalone	State	M/S
Mst	No	Off	Y
S_1	No	Off	Y
S_2	No	Off	Y
S_3	No	Off	Y
S_4	No	Off	N
S_5	No	Off	N
S_6	No	Off	N
S_7	No	Off	N
Possible values	No, Yes	Off, Run, Alarm, ComErr, N/Avail	

Table 9: Unit States overview

A standalone Unit must be considered not available for the sequencing and thermostatic control. This might be due to a communication error or to a setting on the related Unit controller. In case of communication error, also the Unit state (see column “State”) will display “ComErr”.
The different states have the following meaning:

- *Off:* the Unit is currently Off
- *Run:* the Unit is currently running
- *Alarm*: the Unit has an active alarm
- *ComErr*: the Unit is not communicating with the Master controller and requires actions to re-establish a proper communication. When a Unit is in communication error, it will run autonomously and in local mode. Please refer to the **Troubleshooting section** for further details.

4.4.2 Units: ActMode

This section will list the current operating mode of each individual Unit connected in Daikin Communication Network (column ActMode). If a multipurpose is connected in the network, also the individual operating modes of the circuits will be displayed (the rightmost of the two remaining columns is for circuit 2).

Item	ActMode	C1	C2	M/S
Mst	Cool	Off	Off	Y
S_1	Cool	Off	Off	Y
S_2	Cool	Off	Off	Y
S_3	Cool	Off	Off	Y
S_4	Cool	Off	Off	N
S_5	Cool	Off	Off	N
S_6	Cool	Off	Off	N
S_7	Cool	Off	Off	N
Possible values	Cool, Ice, Heat, Multi	Off, Water, Cool, Heat, N/Avail	Off, Water, Cool, Heat, N/Avail	

Table 10:Units and circuits actual operating modes

ActMode will represent the actual operating mode of each Unit. The different Unit operating modes are as follow:

- *Cool*: actual mode is cooling
- *Ice*: actual mode is ice (this operating mode has an impact on the capacity control)
- *Heat*: actual mode is heat
- *Multi*: actual mode for multipurpose Units

The two other columns are managed only if a multipurpose is connected in the network.

	Master/Slave cannot handle mixed systems including a multipurpose. In case of Master/Slave all the Units must be multipurpose.

If a multipurpose is present in the system or if all the Units are multipurpose the two additional columns will indicate the individual circuit modes. Description of the possible circuit operating modes are the followings:

- *Off*: Circuit is currently off
- *Water*: Circuit is currently running in water to water mode
- *Cool*: Circuit is currently running in cool mode
- *Heat*: Circuit is currently running in heat mode
- *N/A*: only for C2: Unit has only one circuit

4.4.3 Units: Load

This section will list the current Unit capacities and circuit capacities.

Item	Load	C1	C2	M/S
Mst	0%	0%	0%	Y
S_1	0%	0%	0%	Y
S_2	0%	0%	0%	Y
S_3	0%	0%	0%	Y
S_4	0%	0%	0%	N
S_5	0%	0%	0%	N
S_6	0%	0%	0%	N
S_7	0%	0%	0%	N
Possible values	0…100%	0…100%	0…100%	

Table 11: Units and circuits actual capacities

The column Load refers to the Unit capacity and the two columns to individual circuit capacities.

4.4.4 Evap Water Temps

This section will list the evaporator water temperatures (entering and leaving) of each Unit.

Item	ELWT	EEWT	M/S
Mst	-.-°C	-.-°C	Y
S_1	-.-°C	-.-°C	Y
S_2	-.-°C	-.-°C	Y
S_3	-.-°C	-.-°C	Y
S_4	-.-°C	-.-°C	N
S_5	-.-°C	-.-°C	N
S_6	-.-°C	-.-°C	N
S_7	-.-°C	-.-°C	N
Possible values	-40°C…+70°C	-40°C…+70°C	

Table 12: Individual evaporator water temperatures (leaving and entering)

4.4.5 Cond Water Temps

This section will list the condenser water temperatures (entering and leaving) of the Unit. These temperatures are displayed only in case of water cooled or multipurpose Units.

Item	CLWT	CEWT	M/S
Mst	-.-°C	-.-°C	Y
S_1	-.-°C	-.-°C	Y
S_2	-.-°C	-.-°C	Y
S_3	-.-°C	-.-°C	Y
S_4	-.-°C	-.-°C	N
S_5	-.-°C	-.-°C	N
S_6	-.-°C	-.-°C	N
S_7	-.-°C	-.-°C	N
Possible values	-40°C…+70°C	-40°C…+70°C	

Table 13: Individual condenser water temperatures (leaving and entering)

4.4.6 Units: Heat Recovery

This section will list the heat recovery entering water temperatures of the Units equipped with this option. These temperatures are displayed only if at least iCM Master Unit is equipped with the heat recovery option.

Item	Cnfgd	Avail	State	M/S
Mst	No	No	Stop	N
S_1	No	No	Stop	N
S_2	No	No	Stop	N
S_3	No	No	Stop	N
S_4	No	No	Stop	N
S_5	No	No	Stop	N
S_6	No	No	Stop	N
S_7	No	No	Stop	N
Possible values	No, Yes	No, Yes	Stop, Run	

Table 14: Individual heat recovery statuses

Master/Slave cannot manage systems which include chillers equipped with Heat Recovery option. This functionality is only managed by the iCM.

4.5 Evap / Cond PM (Evaporator or Condenser Pump Manager Menu)

This menu contains all the values communicated by the Pump Manager to iCM. Moreover, it contains the setpoint for Pump Speed control and Header Bypass Valve opening that iCM can set on the Pump Manager controller through Daikin Communication Network.

Description	Default	Range and function	AL	MS
Status	Off:Auto	Off:Auto, On:Auto, Off:Local, Off:SensAlarm, On:SensAlarm, Off:CommErr, On:CommErr, Configuration,		N

		Off:ConfigAlarm		
This value indicated the Status of Pump Manager to iCM				
State	Off	Off, On		N
This value indicates the operating state of Pump Manager				
Alarm Active	None	None*Alarm		N
This value indicates that an alarm occurred on Pump Manager.				
Clear Alarm	Off	Off, On		N
This setting allows to send a reset of the active alarms on Pump Manager from iCM.				
Nr Pump Running	0	0…10		N
	▶	Access menu showing actual status of each pump		
This value indicates the number of running pump				
Pump Speed	0%	0%...100%		N
This value indicates the speed percentage of the pump				
Speed Control	Constant	Constant, DTemp, DifPres, AbsPres		N
This indicates controlled sensor used by Pump Manager for Pump Speed Control				
The following sensor measurement and related setpoints display according to Speed Control value and they are exclusive.				
_Delta Temp	-.-°Dc			N
This value indicates the controlled sensor measurement on Pump Manager				
_Actual Setpoint	-.-°Dc			N
This value indicates the actual setpoint on Pump Manager for pump speed control				
_Setpt iCM	5.0°Dc	0.5°Dc…20.0°Dc		N
This setting allows to send setpoint for speed control to Pump Manager from Local HMI on iCM				
_Setpt Ntwk	5.0°Dc	0.5°Dc…20.0°Dc		N
This value indicates the setpoint for speed control to Pump Manager sent by BMS when iCM is in Control Source = Network				
Alternatively. (Speed Control Value = Differential Pressure)				
_Diff Press	-.-kPa			N
This value indicates the controlled sensor measurement on Pump Manager				
_Actual Setpoint	50.0 kPa			N
This value indicates the actual setpoint on Pump Manager for pump speed control				
_Setpt iCM	50.0 kPa	0.0kPa…300.0kPa		N
This setting allows to send setpoint for speed control to Pump Manager from Local HMI on iCM				
_Setpt Ntwk	50.0 kPa	0.0kPa…300.0kPa		N
This value indicates the setpoint for speed control to Pump Manager sent by BMS when iCM is in Control Source = Network				
Alternatively. (Speed Control Value = Absolute Pressure)				
_Abs Press	-.-kPa			N
This value indicates the controlled sensor measurement on Pump Manager				
_Actual Setpoint	-.-kPa			N
This value indicates the actual setpoint on Pump Manager for pump speed control				
_Setpt iCM	50.0 kPa	0.0kPa…300.0kPa		N
This setting allows to send setpoint for speed control to Pump Manager from Local HMI on iCM				
_Setpt Ntwk	50.0 kPa	0.0kPa…300.0kPa		N
This value indicates the setpoint for speed control to Pump Manager sent by BMS when iCM is in Control Source = Network				
BypValve Opening	0%	0%...100%		N
This value indicates the opening percentage of header bypass valve				
BypValve Control	None	None, MinDP, Flow, Ewt		N
This value indicates controlled sensor used by Pum Manager for control of Header bypass valve				
The following sensor measurement and related setpoints display according to Header Bypass Valve Control value and they are exclusive.				
_MinDPonUnits	None	None, Active		N
This value indicates that Minimum pressure drop has been reached by one of the Units and force opening of the header bypass Valve				
Alternatively. (Bypass Valve Control = Flow)				
_Flow	-.- l/s			N
This value indicates the controlled sensor measurement on Pump Manager				
_Actual Setpoint	-.- l/s			N
This value indicates the actual setpoint on Pump Manager for Header bypass valve control				
_Setpt iCM	4.5 l/s	0.0l/s…200.0l/s		N
This setting allows to send setpoint for speed control to Pump Manager from Local HMI on iCM				
_Setpt Ntwk	4.5 l/s	0.0l/s…200.0l/s		N

This value indicates the setpoint for speed control to Pump Manager sent by BMS when iCM is in Control Source = Network				
Alternatively. (Bypass Valve Control = EvapEwt)				
_EvapEwt	-.-°C			N
This value indicates the controlled sensor measurement on Pump Manager				
_Actual Setpoint	-.-°C			N
This value indicates the actual setpoint on Pump Manager for Header bypass valve control				
_Setpt iCM	7.0°C	4.0°C…30.0°C		N
This setting allows to send setpoint for header bypass valve control to Pump Manager from Local HMI on iCM				
_Setpt Ntwk	7.0°C	4.0°C…30.0°C		N
This value indicates the setpoint for Header bypass valve control to Pump Manager sent by BMS when iCM is in Control Source = Network				
Alternatively. (Bypass Valve Control = CondEwt)				
_CondEwt	-.-°C			N
This value indicates the controlled sensor measurement on Pump Manager				
_Actual Setpoint	-.-°C			N
This value indicates the actual setpoint on Pump Manager for pump speed control				
_Setpt iCM	25.0°C	15.0°C…40.0°C		N
This setting allows to send setpoint for header bypass valve control to Pump Manager from Local HMI on iCM				
_Setpt Ntwk	25.0°C	15.0°C…40.0°C		N
This value indicates the setpoint for Header bypass valve control to Pump Manager sent by BMS when iCM is in Control Source = Network				
_Active Power	-.- kW			N
This value indicates the Active Electrical Power consumption				

Table 15 Evaporator or Condenser Pump Manager Menu

ⓘ	Pump Speed Controlled sensor and related setpoint will display only if Speed Control is different from "Constant"

ⓘ	Header by-pass Valve controlled sensor and setpoint will display only if BypValve Control is different from "None"

ⓘ	Active Power value will display only if Energy Mtr is configured on Pump Manager

⚠	iCM can set the values of control functions of the Pump Manager. The values chosen depend on "Control Source" setting of Master Unit controller. - If "Control Source" is *Local*: _Setpt iCM: Local setpoint on HMI of Master controller will be communicated to Pump Manager - If "Control Source" is *Network* _Setpt Ntwk: Writeable setpoint by BMS through Modbus or BACnet communication with Master Unit controller, that will be communicated by iCM to the Pump Manager

4.6 Maintenance

This section will describe the parameters accessible in the Maintenance page. It will also describe the links to other sub-sections. This section contains two settings and two sub-menus. The settings are the following:

Mst Enable	Yes	No, Yes	4	Y
It is used to stop the Master Unit and take it out from sequencing, but iCM function keeps on working and managing the other slave Units. This setting shall be used to stop the Master for maintenance or other purpose.				
Mst HeatRec Enable	No	No, Yes	4	N
It is used to stop heat recovery function on Master Unit and take it out from sequencing, but iCM function keeps on working and managing the other slaves Units. This setting shall be used to stop the Master for maintenance or other purpose.				
Units Starts	▶		4	N
Sub-page with the individual Units and circuits starts				
Units Run Hours	▶		4	N
Sub-page with the individual Units and circuits run hours				
Evap LWT Sensor	-.-°C			Y
This value represents the actual reading of the common sensor on the evaporator loop.				
Evap LWT Offset	0.0°C	-5.0°C…5.0°C		Y
This setting represents the offset applied to the evaporator common sensor reading .				
Cond LWT Sensor	-.-°C			Y

This value represents the actual reading of the common sensor on the condenser loop. This sensor reading will be visible only in case of water cooled Units and multipurpose.				
Cond LWT Offset	0.0°C	-5.0°C…5.0°C		Y
This setting represents the offset applied to the condenser common sensor reading.				

Table 16: Maintenance page

ⓘ	iCM staging and sequencing is enabled through Unit switch and other enable settings on Master Unit controller. To stop the Master without stopping iCM functions, "Mst Enable" must be used

ⓘ	iCM staging and sequencing of heat recovery function is enabled through Unit switch and other enable settings on Master Unit controller. To stop the HR function on Master without stopping iCM functions, "Mst HeatRec Enable" must be used

The sub-menus will be explained in the following sub-sections.

4.6.1 Units Starts

This section will list the number of starts of each Unit and each circuit.

Item	Starts	C1	C2	MS
Mst	0	0	0	Y
S_1	0	0	0	Y
S_2	0	0	0	Y
S_3	0	0	0	Y
S_4	0	0	0	N
S_5	0	0	0	N
S_6	0	0	0	N
S_7	0	0	0	N
Possible values	0…4294967295	0…4294967295	0…4294967295	

Table 17: Individual number of starts for Units and circuits

The column Starts refers to the number of starts of each Unit and the two remaining columns refers to individual circuit starts.

4.6.2 Units Run Hours

This section will list the count of the running hours of each Unit and each circuit.

Unit Run Hours	0	0…4294967295	Set the Unit run hours	2
Item	**RunHours**	**C1**	**C2**	**MS**
Mst	0	0	0	Y
S_1	0	0	0	Y
S_2	0	0	0	Y
S_3	0	0	0	Y
S_4	0	0	0	N
S_5	0	0	0	N
S_6	0	0	0	N
S_7	0	0	0	N
Possible values	0…4294967295	0…4294967295	0…4294967295	

Table 18: Individual running hours for Units and circuits

The first column refers to the number of running hours of each Unit and the two others refer to individual circuit running hours.

4.7 System Settings

This section will describe the parameters accessible in the System Settings menu.

Description	Default	Range and function	AL	MS
Priority	▶			N
This is a sub-page where it's possible to set individual Unit priorities.				
Max Run Units	1	iCM: 1…8 M/S: 1…4		N
This setting allows to define the maximum number of Units that can be started by the M/S or iCM.				
Min Run Units	0	iCM: 0…1 M/S: 0…1		N

This setting allows to define the minimum number of Units that will always run in the system.				
Staging thersholds	▶			N
This is a sub-page where it's possible to set individual staging thresholds.				
Stage for Temperature				
StageUp DT Cool	2.5°C	0.0°C…5.0°C		N
This setting defines what is the delta temperature with setpoint to force a Unit stage up in Cool mode.				
StageDn DT Cool	1.5°C	0.0°C…5.0°C		N
This setting defines what is the delta temperature with setpoint to force a Unit stage up in Cool mode.				
StageUp DT Heat	2.7°C	0.0°C…5.0°C		N
This setting defines what is the delta temperature with setpoint to force a Unit stage up in Heat mode.				
StageDn DT Heat	1.5°C	0.0°C…5.0°C		N
This setting defines what is the delta temperature with setpoint to force a Unit stage up in Heat mode.				
Stage Up Time	600s	60s…3600s		N
This value indicates what is the actual stage up time to start the Next On Unit. This is a calculated value.				
Max Stage Up Time	600s	60s…3600s		N
This setting defines what is the maximum delay between to Unit starts.				
Min Stage Up Time	300s	60s…3600s		N
This setting defines what is the minimum delay between to Unit starts.				
Max StageUp Error	5.0°C	0.0°C…10.0°C		N
This setting defines what is the error which corresponds to the minimum delay in a linear interpolation. The maximum delay is calculated at 0.0°C of error.				
Stage Dn Time	600s	60s…3600s		N
This value indicates what is the actual stage up time to start the Next Off Unit. This is a calculated value.				
Max Stage Dn Time	600s	60s…3600s		N
This setting defines what is the maximum delay between Unit stops.				
Min Stage Dn Time	300s	60s…3600s		N
This setting defines what is the minimum delay between Unit stops.				
Max StageDn Error	5.0°C	0.0°C…10.0°C		N
This setting defines what is the error which corresponds to the minimum delay in a linear interpolation. The maximum delay is calculated at 0.0°C of error.				
Load Control Settings				
Dead Band	0.2°C	0.1°C…1.5°C		N
This setting defines what is the temperature range around the actual setpoint in which the system manager will not do any capacity change to the system.				
Delta Load	15%	0%...100%		N
This setting defines what is the capacity change that is commanded to each Unit if a capacity change (increase or decrease) is required.				
Load Time	30 sec	5sec...600sec		N
This setting defines what is the delay between capacity changes.				
Min Cool Tmp	4.0°C	-30.0°C…30.0°C		N
This setting defines what is the minimum acceptable cool setpoint for the Units in general.				
Max Heat Tmp	50.0°C	20.0°C…70.0°C		N
This setting defines what is the maximum acceptable heat setpoint for the Units in general.				
Heat Recovery Settings				
Ht Rec StageTimer	15min			N
This setting defines the stage delay between any heat recovery activation commanded by the iCM.				
Ht Rec Max Run	0	iCM: 1…8 M/S: Not Available		N
This setting specified the maximum number of heat recovery Units that can be activated. After staging up these Units, iCM will stop activating other heat recovery Units. Only a Unit shutdown can force the heat recovery to be disabled on that Unit.				

Table 19:System settings

4.7.1 Priority

This sub-page will allow to set the individual Units priorities for stage sequencing.

Description	Default	Range and function	AL	MS
Cooling Mode				
Master	1	1…4		N
Slave1	1	1…4		N
Slave2	1	1…4		N
Slave3	1	1…4		N
Slave4	1	1…4		N
Slave5	1	1…4		N
Slave6	1	1…4		N
Slave7	1	1…4		N

These settings are used to define the individual Unit priority when operating in cooling mode. If properly set, they will allow Units grouping.				
Heating Mode				
Master	1	1…4		N
Slave1	1	1…4		N
Slave2	1	1…4		N
Slave3	1	1…4		N
Slave4	1	1…4		N
Slave5	1	1…4		N
Slave6	1	1…4		N
Slave7	1	1…4		N
These settings are used to define the individual Unit priority when operating in heating mode. If properly set, they will allow Units grouping.				

Table 20: Priority settings for cooling and heating modes

ⓘ	In case the system includes multipurpose Units, those will always have the maximum priority and will be started first.

4.7.2 Staging thresholds

This sub-page will allow to set the individual staging thresholds for each individual Unit.

Description	Default	Range and function	AL	MS
Cooling Mode				
Stage Up Thresholds				
Master	100%	0%...100%		N
Slave1	100%	0%...100%		N
Slave2	100%	0%...100%		N
Slave3	100%	0%...100%		N
Slave4	100%	0%...100%		N
Slave5	100%	0%...100%		N
Slave6	100%	0%...100%		N
Slave7	100%	0%...100%		N
Stage Down Thresholds				
Master	30%	0%...100%		N
Slave1	30%	0%...100%		N
Slave2	30%	0%...100%		N
Slave3	30%	0%...100%		N
Slave4	30%	0%...100%		N
Slave5	30%	0%...100%		N
Slave6	30%	0%...100%		N
Slave7	30%	0%...100%		N
These settings are used to set the individual stage up and down thresholds on each Unit in cool mode. These thresholds are used for staging up and down the Units and, if properly set, can let the iCM achieve an improved system efficiency.				
Heating Mode				
Stage Up Thresholds				
Master	100%	0%...100%		N
Slave1	100%	0%...100%		N
Slave2	100%	0%...100%		N
Slave3	100%	0%...100%		N
Slave4	100%	0%...100%		N
Slave5	100%	0%...100%		N
Slave6	100%	0%...100%		N
Slave7	100%	0%...100%		N
Stage Down Thresholds				
Master	30%	0%...100%		N
Slave1	30%	0%...100%		N
Slave2	30%	0%...100%		N
Slave3	30%	0%...100%		N
Slave4	30%	0%...100%		N
Slave5	30%	0%...100%		N
Slave6	30%	0%...100%		N
Slave7	30%	0%...100%		N

Table 21: Stage up and stage down capacity thresholds for cooling and heating modes

ⓘ	In case of systems with multipurpose Units, the staging thresholds will not be managed as the iCM will control the individual circuits activation and operating modes.

4.8 Standby Chiller

This section will describe the settings needed to configure the standby function.

Description	Default	Range and function	AL	MS
Standby Chiller	No	No,Yes		Y
This setting is used to activate the Standby chiller management.				
Cycling Type	RunHour	RunHours,Sequence		Y
This setting is used to define how to select the standby Unit • Run Hours: the Unit with the higher number of run hours will be selected. • Sequence: the Unit with the next numeral id is selected. If the Unit in standby is the Slave 3 the next standby Unit will be Slave 4 and so on.				
Interval Time	7Day	1…365 days		Y
This setting is used to define after what number of days the standby Unit is rotated.				
Switch Time	00:00:00	00:00:00…23:59:59		Y
This setting is used to define at what time of the day the standby Unit is rotated. This might be useful to command the rotation of the standby Unit when the system is off.				
Tmp Comp	No	No, Yes		Y
This setting is used to activate the standby Unit for temperature compensation. If the active setpoint cannot be reached for multiple reasons different from a Unit alarm, the standby Unit can become operational and compensate the lack of capacity.				
Tmp Comp Time	120min	0min…600min		Y
This setting is used to define the how long the system manager should wait before activating the standby Unit to compensate the lack of capacity.				
Standby Reset	No	No, Yes		Y
This setting is used to reset the Standby Unit calculation. The elected Standby Unit will be re-defined if the reset is activated.				

Table 22: Standby chiller configuration

⚠	If the switch time is improperly set, the Standby Unit changeover may have an impact on the water temperature stability. Please, check with the plant Manager if there are specific limitations on the changeover time (i.e. process applications).

4.9 Configuration

This section will describe the parameters accessible in the Configuration page.

Description	Default	Range and function	AL	MS
SCM Type	Mst/Slv	Mst/Slv, iCM Std, iCM Adv*		Y
This value indicates which type of system control is active on your Unit.				
Config Type	Undef	Undef, Only C/O, Only H/P, C/O_H/P, Only 4P, 4P_C/O		
This value indicates the type of system is being controlled. It includes the following: • Undef: Undefined mix of Units • Only C/O: system composed with cooling only Units • Only H/P: system composed with reversible (water side or refrigerant side) heat pumps only • C/O_H/P*: system composed with a mix of cooling only and heat pumps (all reversible refrigerant side or all reversible water side) • Only 4P: system composed with only multipurpose Units • 4P_C/O*: system composed with a mix of multipurpose and air-cooled cooling only Units *iCM only.				
Config Alarm	None	None, ModeErr, ComprErr, CooledErr, UnitNotDef, iCMtypeErr		
This value indicates if configuration alarm of iCM has occurred (please refer to Troubleshooting)				
Control Tmp	Leaving	Leaving, Entering		
This value indicates what temperature is used to stage up and down the Units: • Leaving: in this case the additional common water temperature sensor(s) is required • Entering: in this case the controlled temperature will be the average of the entering water temperature to the Units				
Load Control	Enable	Disable, Enable		
This setting specifies if the Unit capacity control shall be done by the iCM (Enable) or if a staging only control is needed (Disable).				

_Load Ctrl Mode	Fixed	Fixed, Regime		
This setting specifies the type of load control: • Fixed: iCM will control the load/unload of the Unit since start-up of the system • Regime: iCM will control the load/unload of the Units until the system temperature is inside Stage for Load/Unload temperature range.				
_Unload Type	Hi Load	Hi Load, Lo Load, Next Off		
This setting specifies the type of unload control: • Hi Load: the Unit with the higher capacity will be unloaded first • Lo Load: the Unit with the lower capacity will be unloaded first • Next Off: the elected Next Off Unit will be downloaded first				
HeatRec Configured	No	No, Yes		N
This value is automatically set based on the configuration of the Units in the system. If at least one Unit is equipped with Heat Recovery option, then this value become automatically Yes.				
Evap PM Enable	No	No, Yes		Y
This setting is used to activate communication and display values of the Evaporator Pump Manager				
Evap PM config	▶			Y
This menu contains the configuration settings communicated by Evap. Pump Manager to iCM				
Cond PM Enable	No	No, Yes		Y
This setting is used to activate communication and display values of the Condenser Pump Manager				
COnd PM config	▶			Y
This menu contains the configuration settings communicated by Cond Pump Manager to iCM				
Apply changes	No	No, Yes		Y
This setting forces a reboot of the Unit controller to configure the HMI layout and parameters accordingly with the system configuration.				

Table 23: System configuration

4.9.1 Pump Manager Configuration (PM Config)

This menu reports the configuration values of Pump manager communicated to iCM.

Description	Default	Range and function	AL	MS
Type	Config	Config*Evap*Cond		Y
This value indicates what kind of Pump Manager is connected to iCM				
Version	##.##			Y
Application version of Pump Manager				
Pump Number	0	0…10		Y
Number of pumps configured and managed by Pump Manager				
Speed Ctrl Type	Constant	Constant, DeltaTemp, DiffPress, AbsPress,		Y
This value indicates which kind of sensor is used by Pump Manager to control speed of the pumps				
BypValve Ctrl Type	None	None, MinDiffPress, Flow, Ewt		Y
This parameter specifies which kind of sensor is used by Pump Manager to control opening of Headers Bypass Valve				
Energy Mtr	No	No, Yes		Y
This value indicates if Energy Meter is enabled on Pump Manager				

Table 24 Evaporator or Condenser Pump Manager Configuration menu

ⓘ	This menu is available only if “Evap or Cond PM” is enabled and after reboot of controller

5 FUNCTIONAL DESCRIPTION

This section will try to explain how the Master/Slave and iCM operate. All the control strategies will be explained in detail to allow a proper understanding of all the settings and logics linked with settings.

⚠	Before proceeding, please, read carefully **Paragraph 4.2** for the basic system configuration.

5.1 Unit management

Embedded system control options provide certain functions to manage efficiently the Units and simultaneously to satisfy plant-room load demand.
The main features are:

1. Unit Sequencing
2. Unit Staging based on temperature
3. Unit Staging based on capacity range
4. Unit Capacity Control
5. Circuits Staging Control

The above functions are exclusive according to Unit type, in fact, in case of multipurpose Unit, the Staging function based on temperature and based on Circuit Control are available; whilst in system without multipurpose Units, Unit sequencing, staging based on temperature and capacity range, and Unit capacity control are applicable.

5.2 Unit Sequencing

This function decides which Unit must start or stop by selecting the Next-On Unit and the Next-Off Unit according to parameters and settings for each Unit.
Operator can fix the sequence of the Units by assigning individual priority. Unit with the highest priority will be the first to start and last to stop, at the contrary, Unit with the lowest priority will be the last to start and first to stop.
In case of Unit with same priority, running hours and number of starts are taken into consideration. For this reason:

A. NEXT ON Unit will be the one with highest priority, less running hours, lower number of starts;
B. NEXT OFF Unit will be the one with lowest priority, more running hours, higher number of starts;

Among Units with same priority, iCM control tries to balance the running hours of the Units increasing the overall system life cycle.

5.3 Unit Staging

This function decides when a Unit should start or stop in order to achieve and keep the system water setpoint.
Staging management is activated when the Master Unit is enabled from local switch, remote switch or by an external BMS. If the Master Unit is not enabled the whole system will not start. It is possible somehow to exclude the Master from the sequencing and keep the other functionalities still active. (Refer to **paragraph 4.6** for further details).
Staging Management requires to start or stop the Units to keep controlled temperature close to the system water temperature target. This target is set on the Master controller as the ordinary Unit water temperature target and communicated to the slave Units.
Staging function can be driven by Leaving or Entering water temperatures. This setting can be changed in the Configuration page (see **paragraph 4.9**).
Control based on the Leaving water temperature requires the installation of an additional sensor on the main supply header, or in the buffer decoupling tank, to measure the actual delivery temperature.
In case of water-cooled heat pump Units, the management of the heating mode is required, so that the sensors must be two: one on the evaporator header and the second on the condenser header.
In case of multipurpose Units two sensors are always needed and they must be installed on cold supply header and hot supply header. Refer to **paragraph 3.2** for the installation of these sensors.
Control on the Entering water temperature uses the temperatures measured by the individual Units. It makes the average of the running Units' temperature and it uses itas the main reference of the system. This kind of control is available only in system without multipurpose Units.
For both the above-mentioned controlled temperatures, the staging logic is always the same. For this reason, it will be explained referring to a target without specifying if it is related to entering or leaving water temperature.
Because iCM can manage chillers, heat pumps and multipurpose Units, the Operator can configure a range of temperatures (Cool and Heat Stage Delta temperature) around the Cool/Heat system water setpoints defining zones where the control functions of iCM are active.

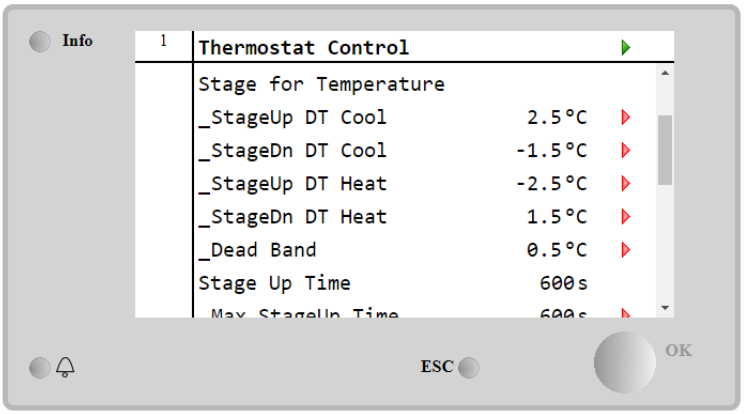


Figure 12 Staging Control Setting

5.4 Staging in system with NO multipurpose Units

In system with chillers or heat pump Units or a mix of them, staging function tries to achieve system water setpoint allowing the Unit to perform in a capacity range that enhances its efficiency point and consequently the overall system efficiency. Staging capacity thresholds will be used to configure this optimal capacity range of the Unit.

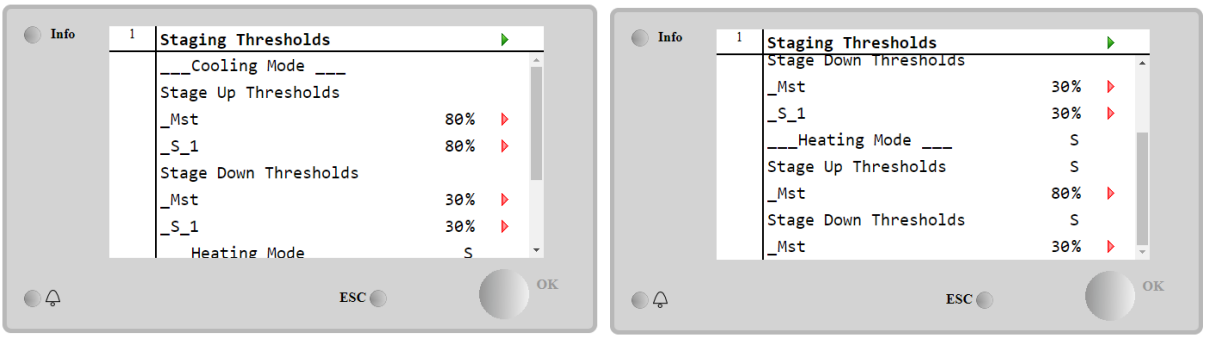


Figure 13 Staging for Capacity Settings

By setting the Stage Delta Temperatures and Dead Zone, it is possible to divide the range of controlled temperature around the setpoint in five different zones. In these areas, iCM decides to perform the staging according to different criteria. The following diagram will explain the function of the stage thresholds.

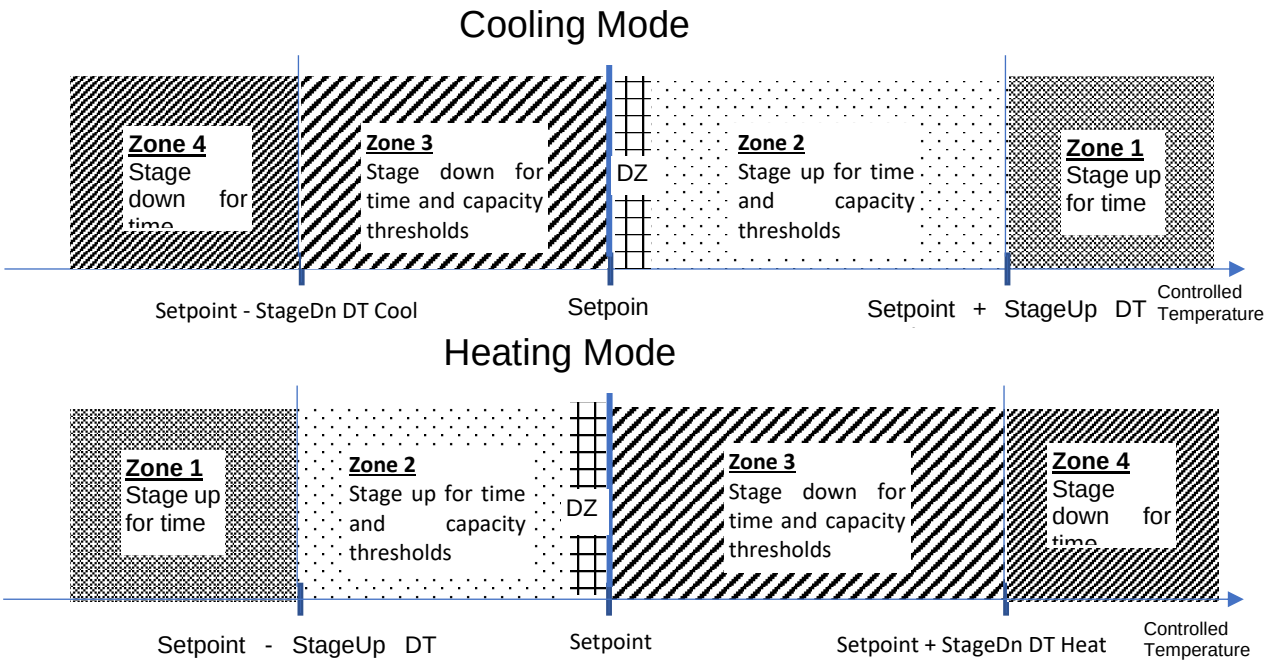


Figure 14: Staging bands for Cool and Heat modes

In the above Figure 14 Cooling Mode and Heating Mode are only mirrored so the explanation will cover only the Cooling Mode.
In Table 25 and Table 26 are explained the conditions in every area that bring iCM to staging actions.

Area	Condition	Action
Zone 1	1) *Controlled temperature* > Setpoint + StageUp DT Cool 2) Stage Up Delay is expired	Start Next On Unit
Zone 2	1) DZ < *Controlled temperature* < Setpoint + StageUp DT Cool 2) All running Units' capacity ≥ Stage Up Threshold 3) Stage Up Delay is expired	Start Next On Unit
DZ	Dead Zone, no staging action or capacity correction in this area.	No Staging
Zone 3	1) Setpoint - StageUp DT Cool < *Controlled temperature* < Setpoint 2) All running Units' capacity ≤ Stage Dn Threshold 3) Stage Down Delay is expired	Stop Next Off Unit
Zone 4	1) *Controlled temperature* < Setpoint - StageDn DT Cool 2) Stage Down Delay is expired	Stop Next Off Unit

Table 25: Staging rules in Cooling mode

Area	Condition	Action
Zone 1	1) *Controlled temperature* < Setpoint - StageUp DT Heat 2) Stage Up Delay is expired	Start Next On Unit
Zone 2	1) Setpoint - StageUp DT Heat < *Controlled temperature* < DZ 2) All running Units' capacity ≥ Stage Up Threshold 3) Stage Up Delay is expired	Start Next On Unit
DZ	Dead Zone, no staging action nor capacity correction in this area.	No Staging
Zone 3	1) Setpoint < *Controlled temperature* > Setpoint + StageDn DT Heat 2) All running Units' capacity ≤ Stage Dn Threshold 3) Stage Down Delay is expired	Stop Next Off Unit
Zone 4	1) *Controlled temperature* > Setpoint + StageDn DT Heat 2) Stage Down Delay is expired	Stop Next Off Unit

Table 26: Staging rules in Heating mode

The result is that, in system with chillers or heat pumps , Zones 1 and 4 represents back up zones where Units are started or stopped to avoid a far deviation from setpoint. Nevertheless, in Zone 2 and 3, staging on capacity is active to assure a smoother control of system water temperature.
Staging up or down will also respect the corresponding delays. Staging delays are calculated and proportional to the difference between stage up or down delta temperatures.

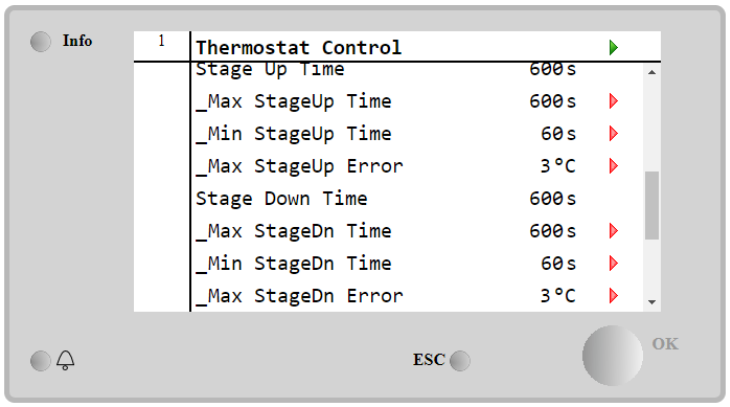


Figure 15: Stage delays settings

In the below Figure 16 the stage delays calculations are shown. Delays for Cooling and Heating modes are calculated for two different configurations in order to explain the flexibility when setting these values to adapt the iCM logics to the system dynamics.

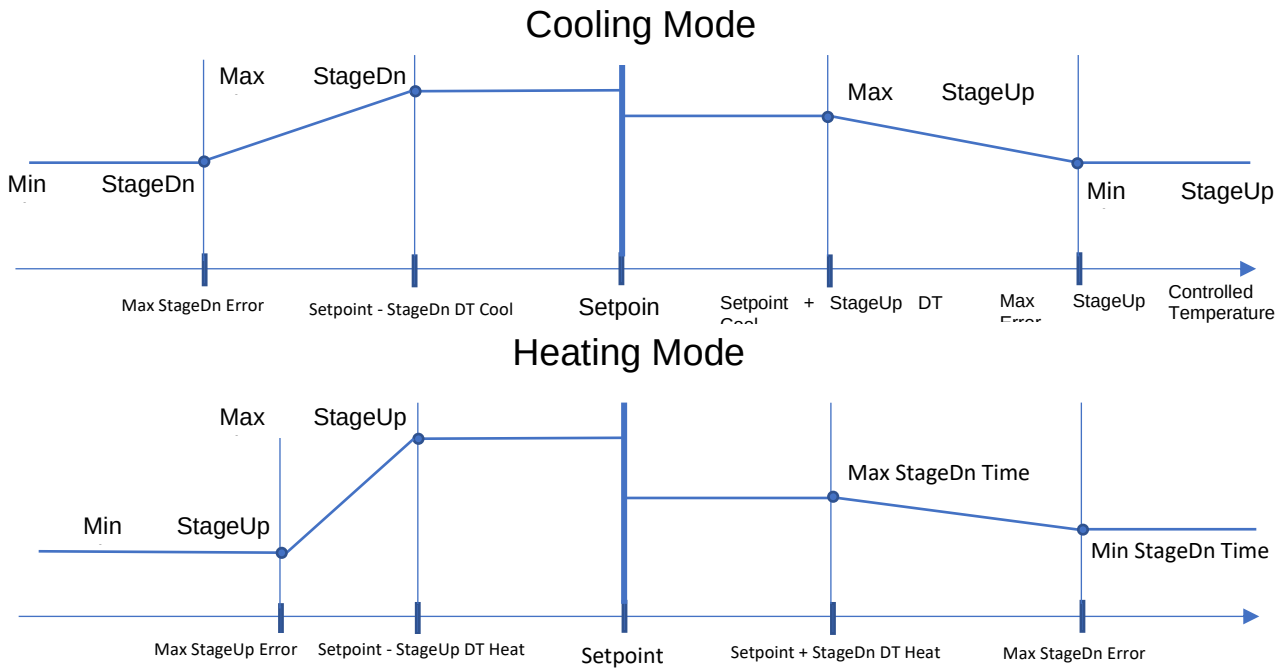
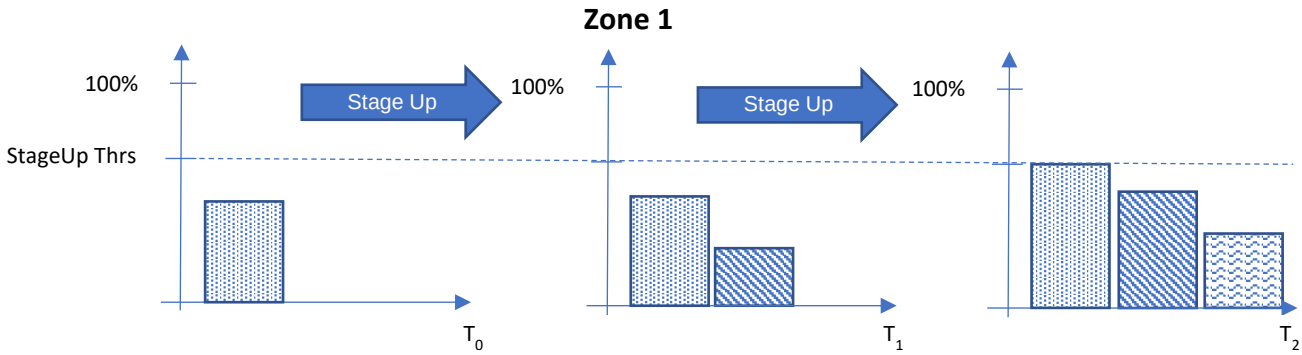


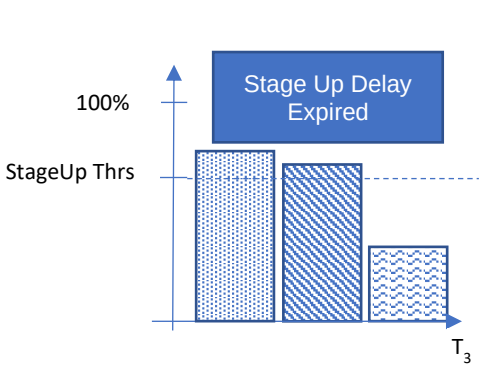
Figure 16: Staging delays calculations

5.4.1 Staging for capacity range

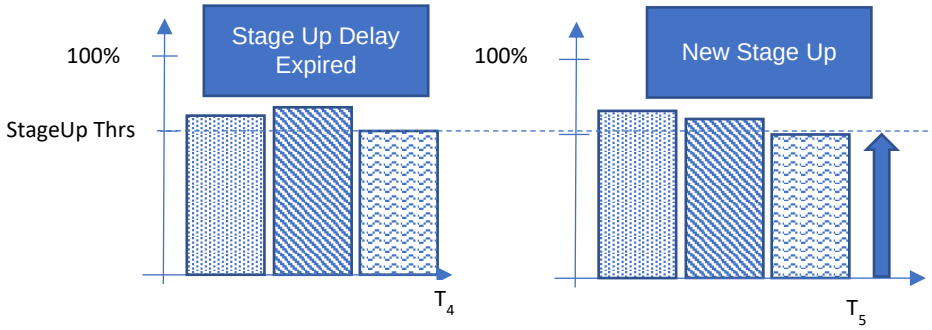
This function checks if the Units are working in the configured capacity range and it affects staging logic in case the controlled system water temperature is in Zone 2 or 3. If this temperature is outside the Stage Delta temperature range, Staging on capacity is not considered.
It is important to understand that staging on capacity is used by iCM to start or stop a Unit and it does not limit the capacity of the Unit. In fact, running Unit manages their own capacity to reach the setpoint and consequently the capacity can exceed the stage up threshold or go down stage down threshold until iCM decides to start Next On Unit or stop Next Off Unit.



In Zone 1, after each stage up delay, even if running unit did not achieve the stage up threshold, a Start of the Next on unit occurs



In Zone 2, even if stage up delay is expired, Start of the Next On unit does NOT occurs, because the third unit has not reached stage up threshold



In Zone 2, when all the units have reached Stage up threshold and stage up time is expired, Start of the Next on unit occurs

Figure 17: Load Management over time

When the Controlled Temperature enters the Dead Zone, no actions are performed as the setpoint is considered fully satisfied.

5.4.2 Unit Capacity Control

This function allows iCM to control directly the Unit capacity by forcing command to load or unload.
When this function is enabled and active, StageUp and StageDown thresholds define the limits on which the Unit is required to load or unload. In fact, in Zone 2, if all the running Units achieve the stage up thresholds, iCM will keep them at that capacity, then it starts an additional Unit (Stage for Capacity) and it will load up the new Unit (Capacity Control). In the same way, in Zone 3, if a running Unit has reached the Stage down threshold, iCM stops the Unit by sending the unload command then it starts to unload another running Unit.
Moreover, thresholds can be set for the two different modes (Cooling and Heating) in systems where the heat pump Units management are required.
Unit Capacity control uses different strategies to choose the Unit to load or unload.
In case of need to load up a Unit, iCM will force always the Unit with lowest capacity among the running Units. In case of Unit unload, the Operator can select three different methods: Hi Load, Lo Load and Next Off.

5.4.3 Load Strategy: “Min Load”

In case the system water temperature is in zone 2, iCM will force the loading of the Unit with the lowest capacity time by time.
Once the loading Unit has exceeded a configurable delta load or it has reached the StageUp threshold, iCM will start to load up another running Unit with the lowest capacity. Delta load by Delta load, iCM will force each Unit to reach its stage up threshold. When all the available Units are running and they have reached their individual StageUp Thresholds, in case the system requires more capacity, then the Units are loaded up to 100%.
StageUp Thresholds can be anyway set to 100% in order to try to reduce the number of running Units.
For ease of representation, the figure below shows the case of a system starting three Units, when the controlled temperature is in zone 2.

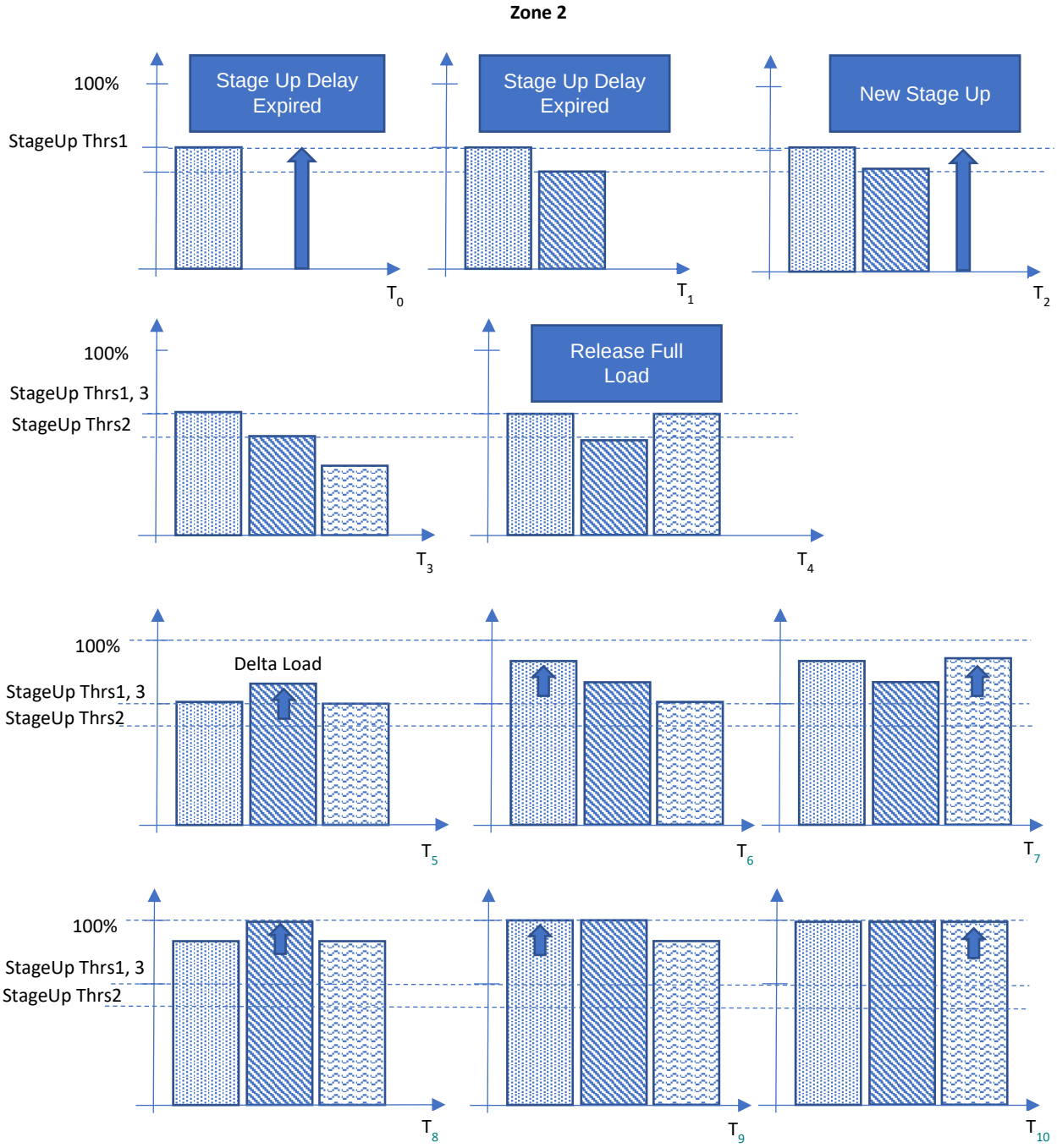


Figure 18 Unit Capacity Control – Strategy Load: Unit with Minimum Load

5.4.4 Unload Strategy: “Hi Load” Unit

Selecting Hi Load, the running Unit with the highest capacity is chosen to be unloaded. Once another running Unit becomes the one with the highest capacity in the system, this Unit will be then loaded down. Unloading Unit by Unit, the system capacity is reduced till all the Units have reached their StageDown thresholds; only then iCM decides to stop the Units per time by following the Next Off sequence. In case all the Units are running at same capacity, the unload sequence will start from the first one (Master) and proceed in numerical order till the last.
This strategy enhances a distributed capacity reduction and consequently the load sharing among the running Units.
In the following picture the sequence will be explained with a sequence of simple charts.

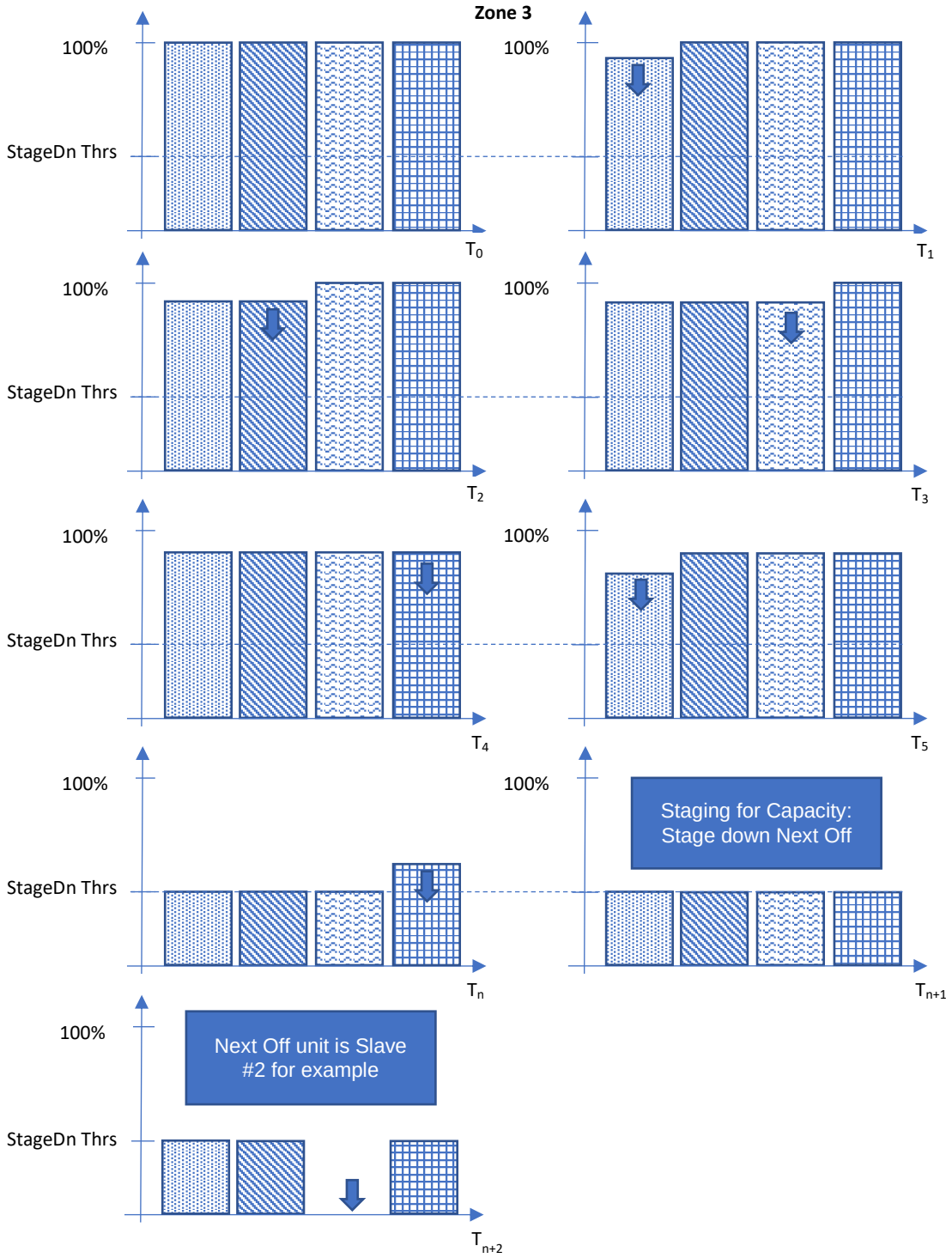


Figure 19: Unit Capacity control - Unload Strategy: Unit with High Load

In the previous example, the assumption is that any unload action does not cause any increase in the controlled temperature and drive the system to Unit shutdowns. The evolution described in Figure 19 is purely for explanation purpose.

In case of unload, the iCM offers the capability to set individual Stage Down Thresholds for each operating mode to let the Units to perform at their best efficiency point. In this case, all the running Units will have to reach their own thresholds before the Next off Unit is staged down on Zone 3. If properly set, these thresholds will allow the System to run at the best possible efficiency.
The following picture shows the behaviour of the iCM in case the controlled temperature falls below the Stage down DT for a sudden decrease of the system load. Even if stage down threshold has not been achieved, iCM forces a stop of the Next Off Unit when the stage down delay expires. Consequently, Stage for Capacity range and Unit capacity unload control are by-passed in order to avoid a larger deviation from the setpoint.
In the following example it is considered extreme load variations of the system and the consequent iCM reactions.

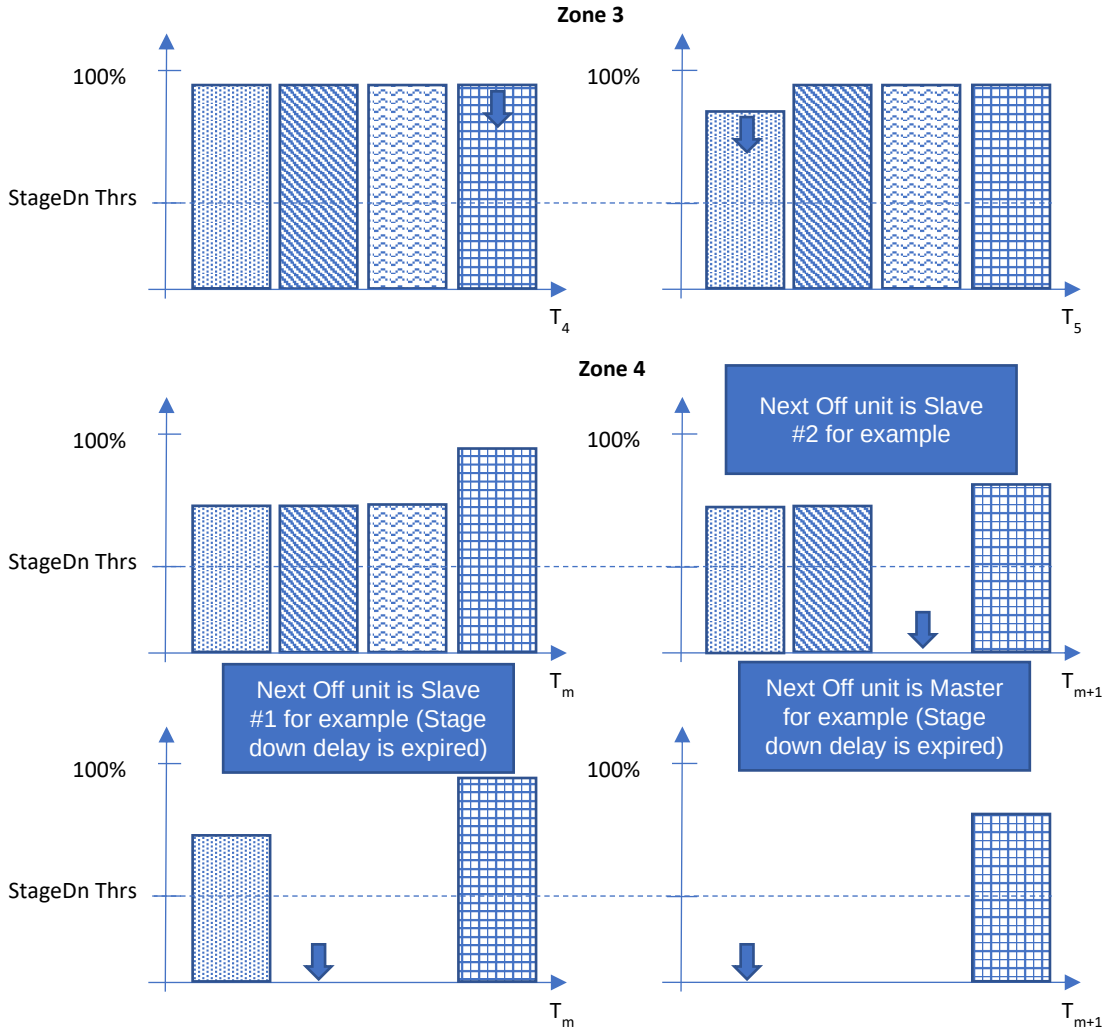


Figure 20: Unit Capacity control - in Zone 4 (all strategies)

When last Unit is running at or below the stage down threshold, it will be kept enabled by iCM to allow recirculation of the water and to measure the system leaving water temperature and load variations. It could be possible that if the setpoint is satisfied Unit could stop the compressor, but iCM will keep the Unit enabled.

5.4.5 Unload Strategy: “Lo Load” Unit

Selecting “Lo Load”, iCM unloads the Unit with lowest capacity among the running Units until the StageDown Threshold is reached. While a Unit is unloaded, the other Units are kept running at the last reached capacity. Once all the running Units have been unloaded and the controlled temperature keeps on being in zone 3, iCM begins to turn off the Units by following the Next Off sequence.
This strategy enhances the modulation of the overall system capacity by using one Unit per time while satisfying the baseline load with the other Units running.
For example, if all the capacities are at the same value, iCM will start to unload the first Unit (Master) and only when it has reached the StageDown Threshold, it will proceed to unload the next Unit in numerical order.
In the following picture shows capacity management during the unload of the system (zone 3):

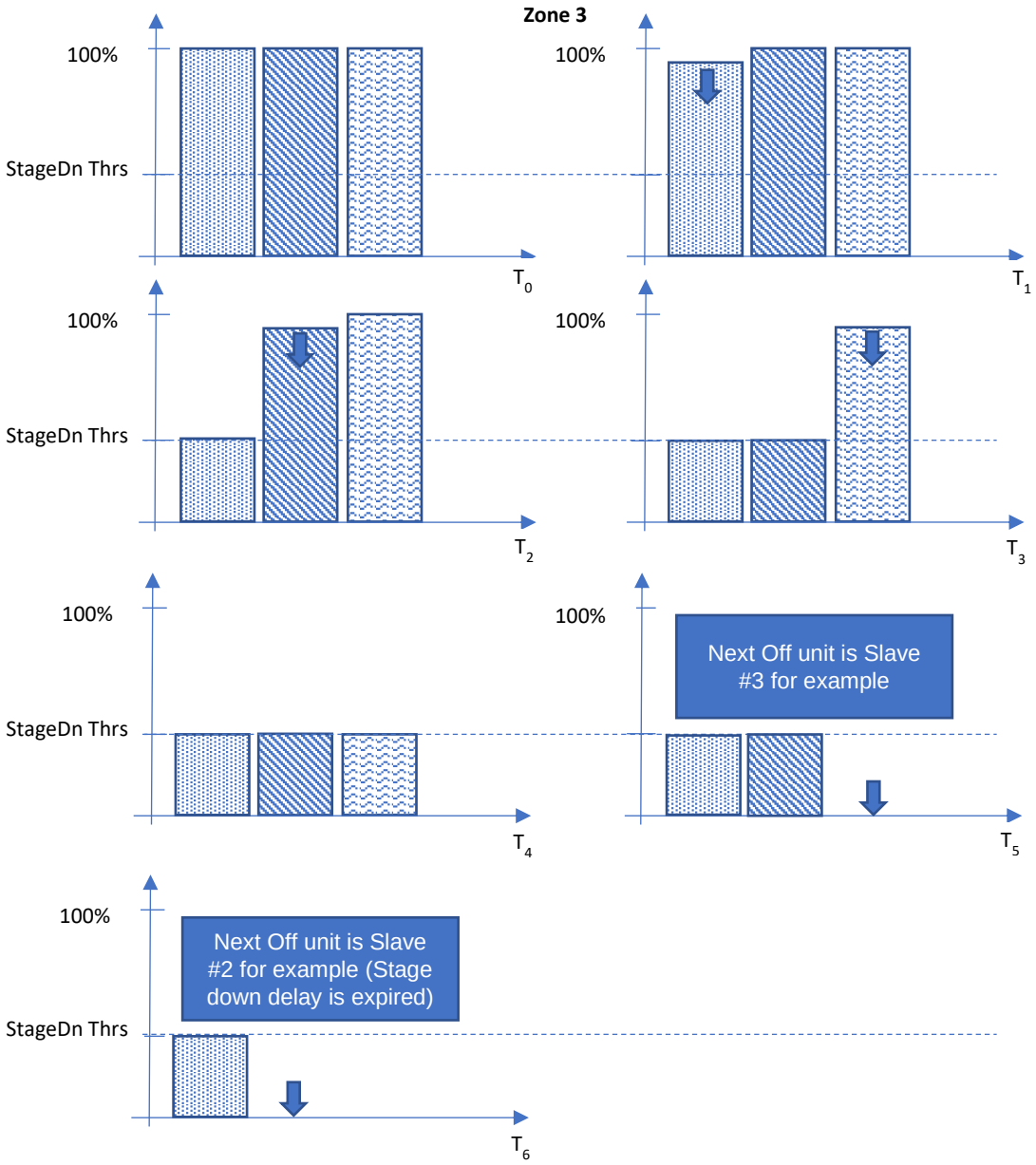


Figure 21: Unit Capacity control - Unload Strategy: Unit with Low Load

5.4.6 Unload Strategy: “Next Off” Unit

Selecting “Next Off” strategy, iCM will start to unload the Unit by Unit until each one has reached the StageDown thresholds and consequently, iCM will stop it. Then the logic performs equally with the other Units running while trying to maintain the water setpoint.
This strategy can be used to avoid load sharing and to allow to run as few Units as possible.

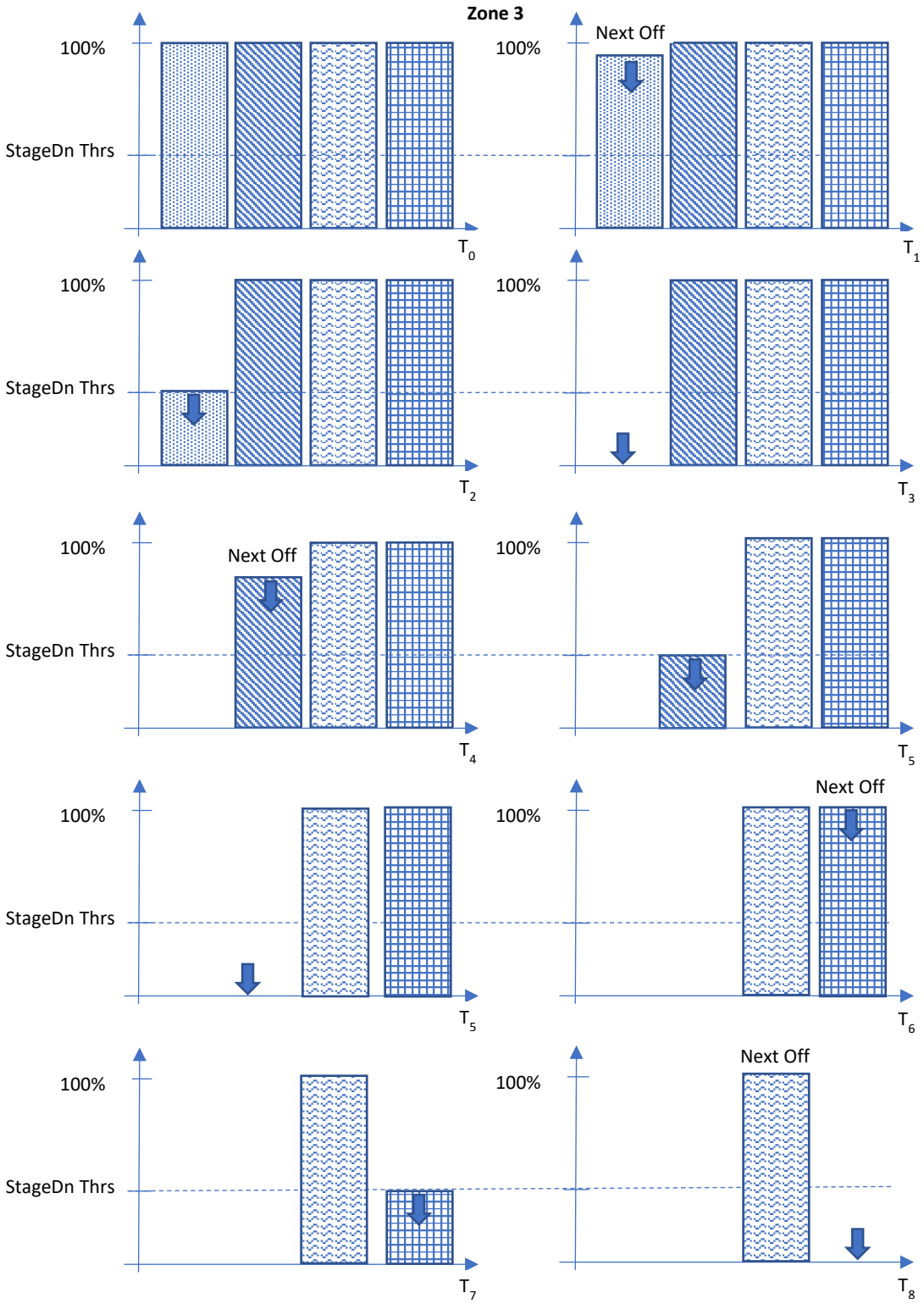


Figure 22: Unit Load control – Unload Strategy: Next Off Unit

5.4.7 Disabling the Load Control

Load control is enabled in system controlled through Entering water temperature.
Nevertheless, Load control can be disabled in system controlled through Leaving water temperature. In this case, iCM will not control the individual Unit capacities but will take care only of the staging up or down depending on the capacity range. Capacity increase or decrease are, in this case, managed directly by each Unit looking to the individual water temperatures. For this reason, when the controlled temperature is related to the Entering water, the Unit capacity with a load control strategy is mandatory and it is strictly required to reach higher performance and energy savings.

5.5 Staging in system with multipurpose

A multipurpose Unit manages the start/stop of the circuit and the changeover mode (cooling, heating or Water), in order to satisfy simultaneously the cold and hot water demand. In cooling mode, circuit is providing only cooling water, in heating mode only hot, whereas in water mode is providing cool and heat water at the same time.
In the same way, iCM manages all the available circuits of all connected Units, trying to minimize the number of running Units through Circuit Control function. Then the thermostatic control of each Unit will then manage to reach and maintain the active targets.
For this reason, when the iCM shall control a system with multipurpose Units or with a mix of chillers and multipurpose Units, staging on capacity range and control of Unit capacity is not available.
By setting the Stage Delta Temperatures, it is possible to divide the range of cold and hot water temperature around the two setpoints in three zones. In these areas, iCM takes the decision for staging or changing mode of the Unit circuits.
The following diagram will explain Zones where Circuit Control is active.

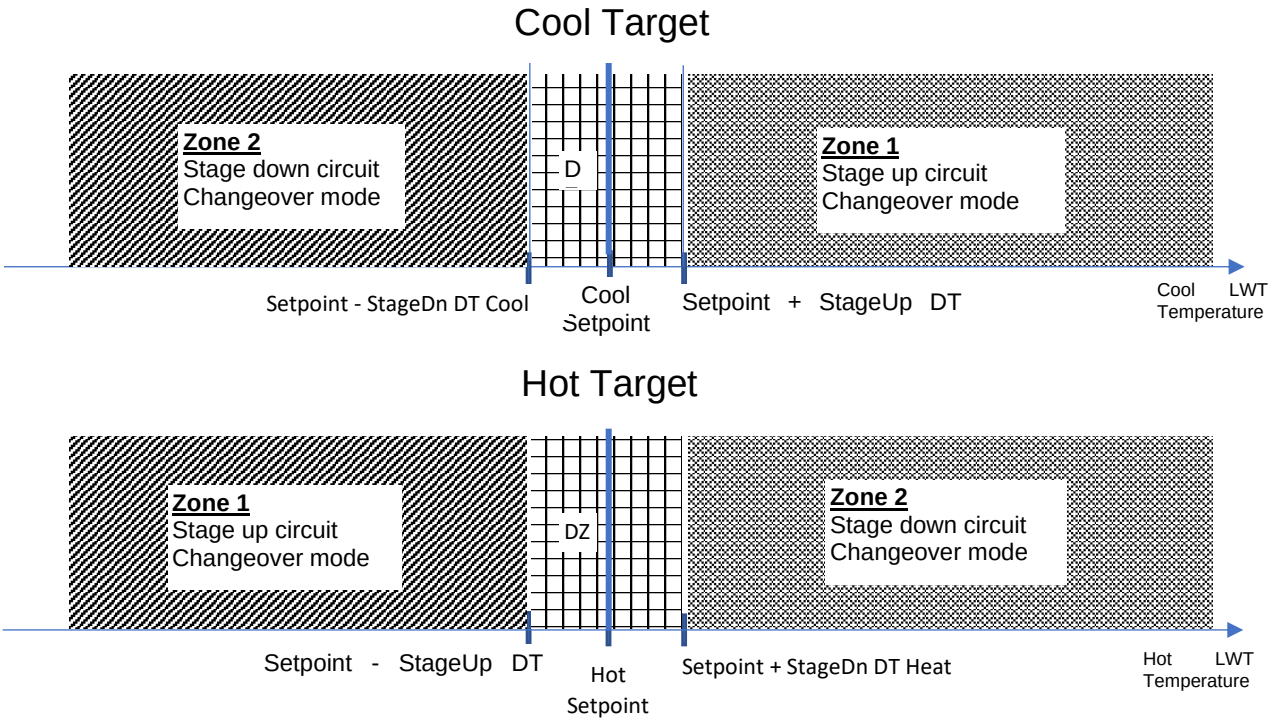


Figure 23: Staging bands for Cool and Heat modes

Indeed, to avoid unnecessary mode changeovers or start and stop of the circuit, iCM provide stabilizing timer depending on the deviation from the two setpoints.

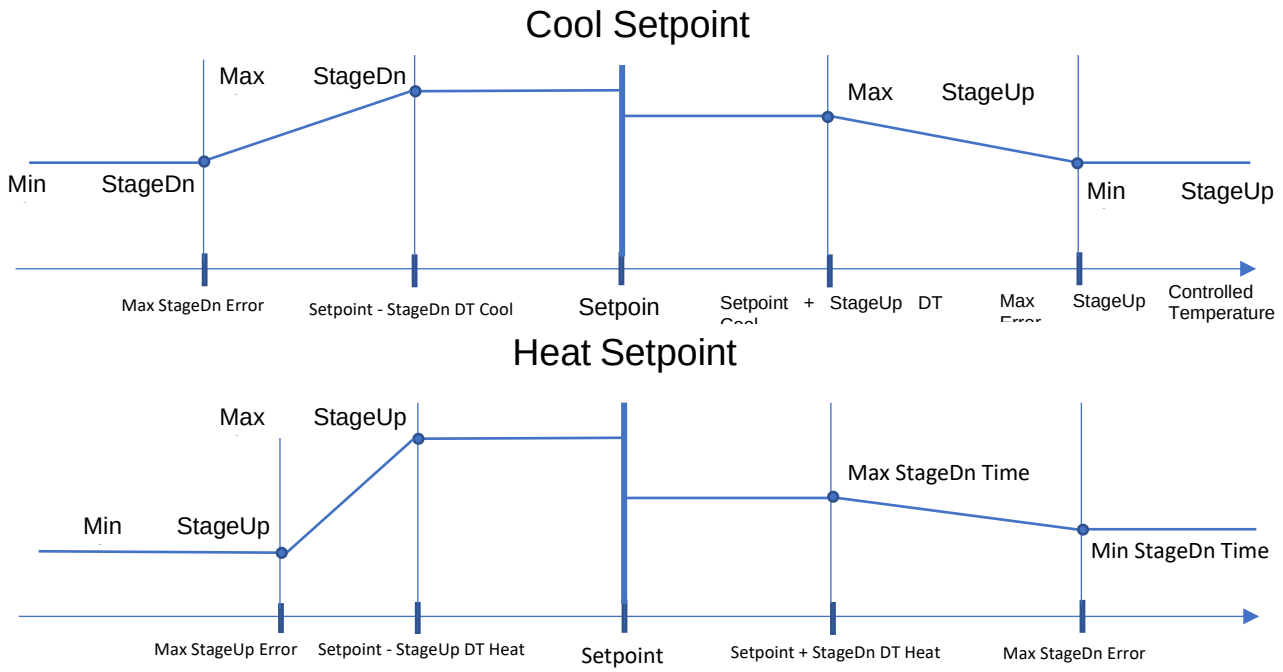


Figure 24: Stage delays calculation chart

Time is variable and can assume a linear value between a configurable Maximum Time and Minimum time. The furthest is the controlled temperature from Stage Delta temperature, the shorter will be the delay to wait for Circuit Control action (Start/Stop/Mode Changeover).

5.5.1 Circuit Staging Control

The staging logic determines the system cooling demand, heating demand or simultaneous demand for both comparing the deviation from the two leaving water temperature setpoints.
In case of request of cooling only, the stage up action force the start-up of one circuit in cooling mode or a changeover from water to cooling.
In case of heating demand only, the stage up action will force the start-up of the circuit in heating mode or a changeover of a water circuit to heating mode.
In case of simultaneous demand, Stage function will start a new circuit in water mode.
To minimize the number of running Units, Circuit control function tents to start both circuits of a multipurpose Unit rather than start one circuit of an additional Unit. Moreover, Circuit control function gives priority to mode changeover of the running circuits, rather than starting an additional circuit of a stopped Unit.
In the following figures, some examples explain Circuit control logic. For ease of representation, it will be considered the management of two multipurpose Units will consider and the orange and blue areas around the two setpoints as dead zones for heating and cooling.

5.5.1.1 System with multipurpose and balanced cooling and heating demands

In the next example a case of balanced load will be shown. All the available circuits will operate in Heat Recovery mode. It is possible to see in temperature trends that there is always a request of both cooling and heating from the system. Consequently, the logic will keep activating circuits in Heat Recovery mode until both targets are reached.

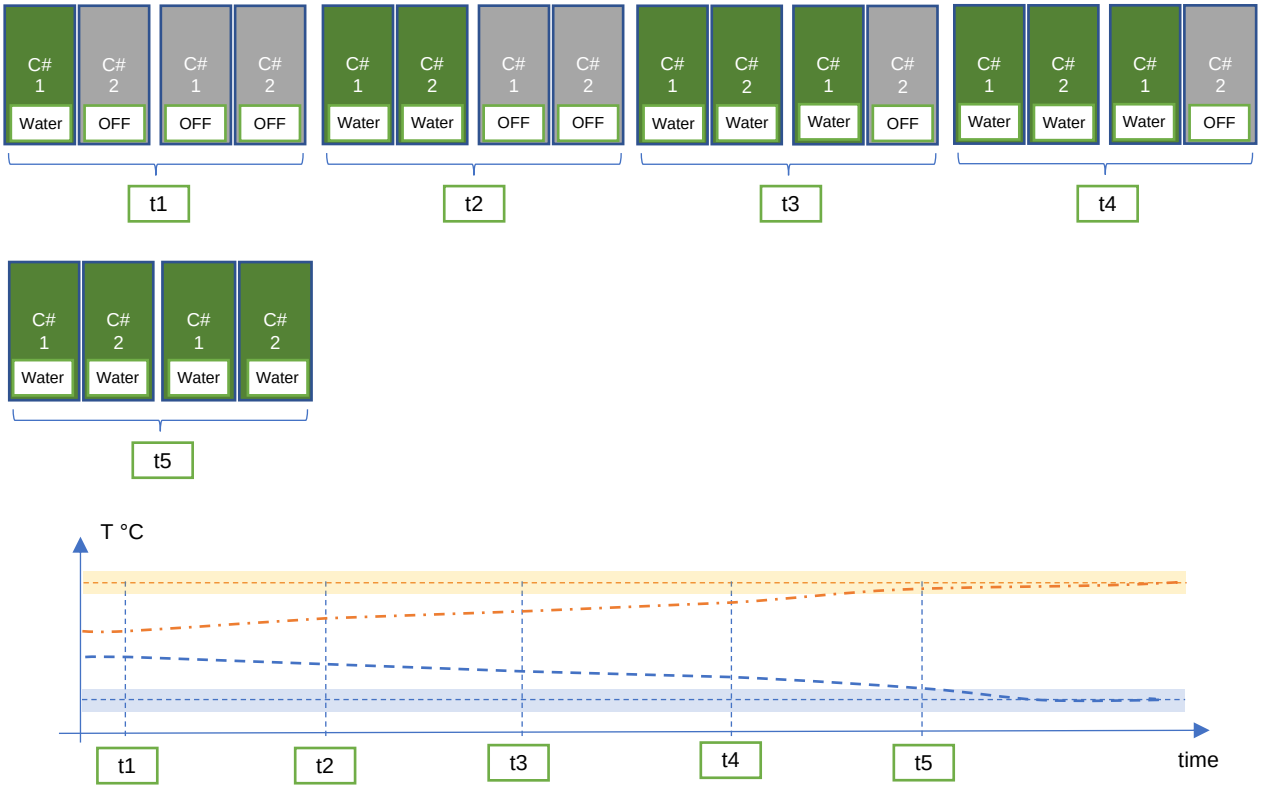


Figure 25: System with Balanced Cool and Heat Demand.

5.5.1.2 System with multipurpose and an excess of cooling demand

Below figure shows how the circuits are managed in case the cooling load exceeds the heating load.
Up to t2 the cooling and heating loads are in the stage up area, so the logic keeps starting the circuits in Water mode.
At t3, heating demand is satisfied whereas, cooling demand is not; so, a new circuit in Cool mode is started.
Then in t4 the Heating load is satisfied and a changeover to Cool mode is commanded.
In t5 finally also the Cooling load is satisfied and the circuit still operating in Cool is switched off.

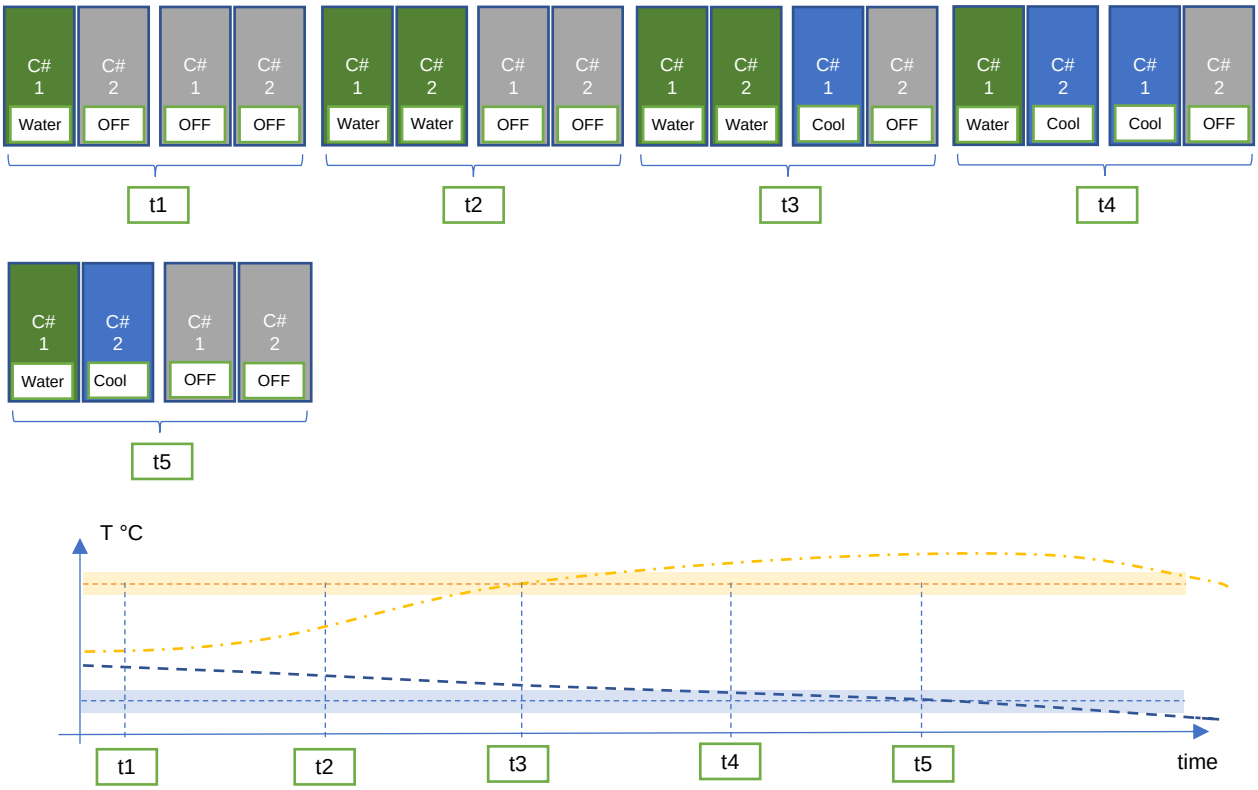


Figure 26: System with prevalence of cooling demand

5.5.1.3 System with Multipurpose and an excess of heating demand

In the next example a case with heating load higher than the cooling load will be shown.
At the first daily start-up (t1), the first circuit of the first Unit will be started most probably in Heat Recovery mode. This will help to make the water flow in cooling and heating circuits and to let logic identify which is the higher load between Cooling circuit and Heating circuit
At t2 the Cooling load is satisfied, and no other stage up is performed; whereas the Heating load is still in the stage up zone and the second circuit of the Units will be started in Heat mode.
At t3 System in generating more Cooling load than necessary. In this case, instead of staging up a new circuit, the logic will force a mode-changeover of the Unit circuit from Heat Recovery mode (water) to Heat.
At t4 and t5, because heating load is not satisfied, the logic will start a new Unit and each circuit directly in Heat mode.

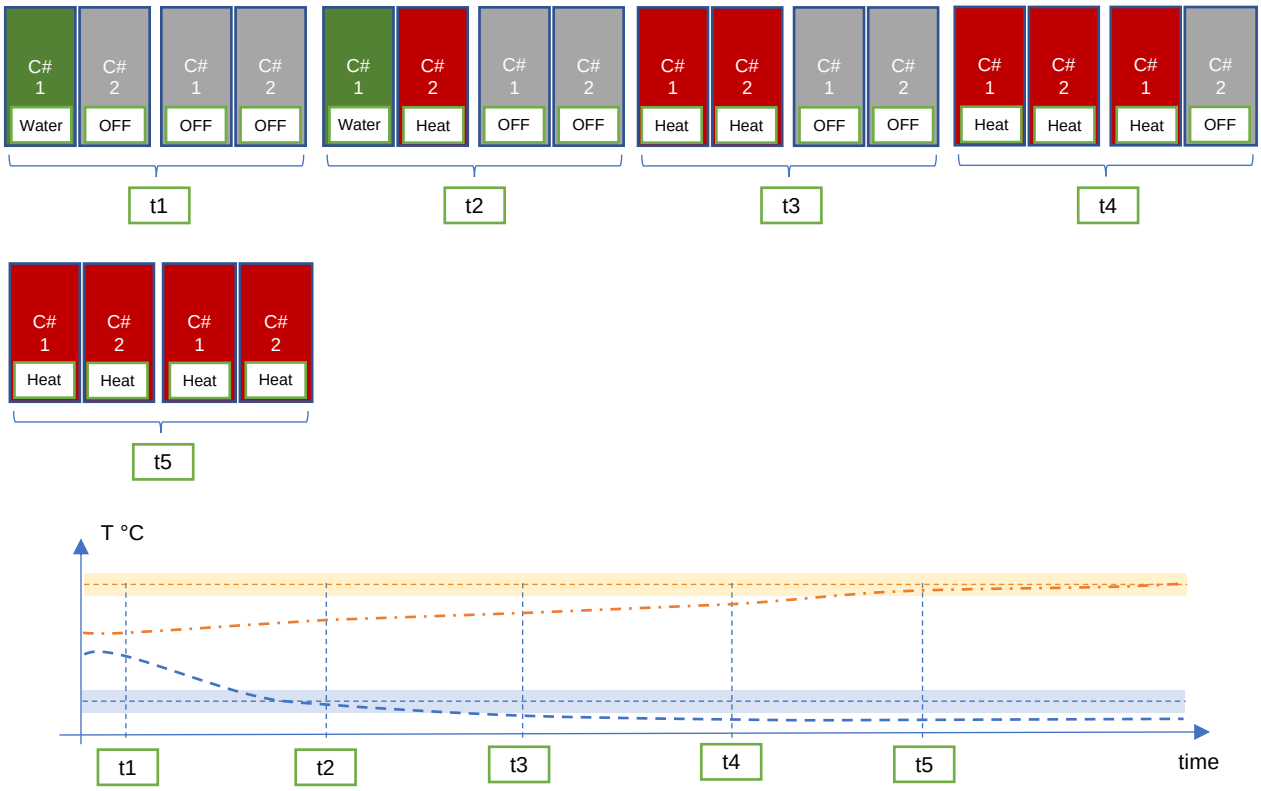


Figure 27: System with prevalence of heating load

5.5.1.4 System with Multipurpose and chiller Units

A mixed system is composed of multipurpose and chiller Units.
Chillers are used to cope with the load unbalance between cooling and heating which is common during summer or in case of process applications. In this case, the iCM logic starts and stops circuits as explained before with the obvious limitation that chillers cannot change their operating modes, that means, circuits will only be started in cooling or stopped.
So, in mixed system, multipurpose Units will be always the first to start and chiller will help to afford the additional the Cooling load if needed. iCM logic takes care of adjusting the priority to manage the staging up and down of the Units.

⚠	Master Unit must be a multipurpose Unit. Different configurations may lead to improper operations of the iCM.

In the examples below, the Unit on the left is a multipurpose while the other is a cooling only.

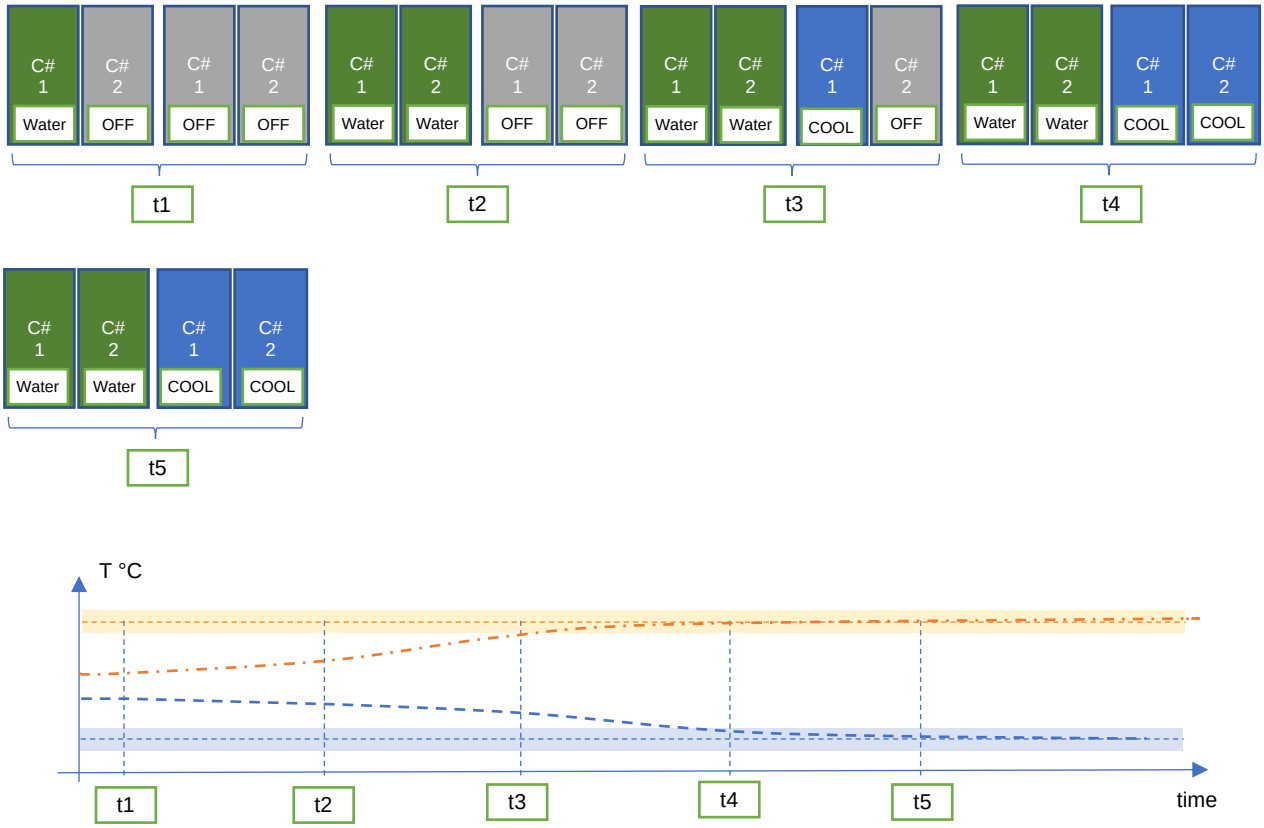


Figure 28: Mixed system with cooling load higher than heating load

5.6 Heat Recovery Control (iCM Option only)

For Unit with iCM option, Heat Recovery option will be managed by iCM Master at system level. For Unit with Master/Slave only, heat recovery is in any case available on the local Unit management.

⚠	Master Unit must have the Heat Recovery Option installed and enabled. Different configurations may lead to improper operations of the iCM.

Heat Recovery enable switch or network enable command on iCM Master controller activate the Heat Recovery management at system level. When Heat recovery is enabled, iCM give automatically higher priority to the Units equipped with Heat Recovery to satisfy the heat demand and consequently those Unit will be the first to start and last to stop in the sequence. Moreover, iCM automatically set 100% Capacity threshold to let this Units reach full load before starting a new Unit. When heat recovery is disabled on iCM Master controller, priorities and capacity thresholds will get back to original values. This functioning is performed to make the Units work at full load, because the capacity generated by the heat recovery is of the cooling capacity of the running Unit.
In the management of heat recovery, iCM at first check the Unit with Heat recovery “Available” (enabled by heat recovery switch on each slave Unit), then iCM activate the heat recovery on a running Unit or start a stopped Unit with heat recovery to satisfy the heat demand. Any new activation will be delayed letting the Unit adjust its local operations to the new mode and to let the system react at the increased heating capacity.
It worth noting that cooling demand has always priority over the heat demand. For this reason, if the cooling demand is not satisfied, iCM can stage up Units without activating the heat recovery.

5.6.1 System with all Units equipped with Heat Recovery option

In system where all the Units are equipped with heat recovery, iCM management could be as follows:
At t1 two Unit are running to keep cooling water temperature setpoint.
At t2 the Heat Recovery is activated on the Master Unit and iCM starts heat recovery on the first Unit.
At t3 (after a delay time from t2), heating demand is not still fulfilled and iCM activates Heat recovery on the second Unit.
At t4 and t5 the Heat Recovery target is satisfied, and no actions are performed.

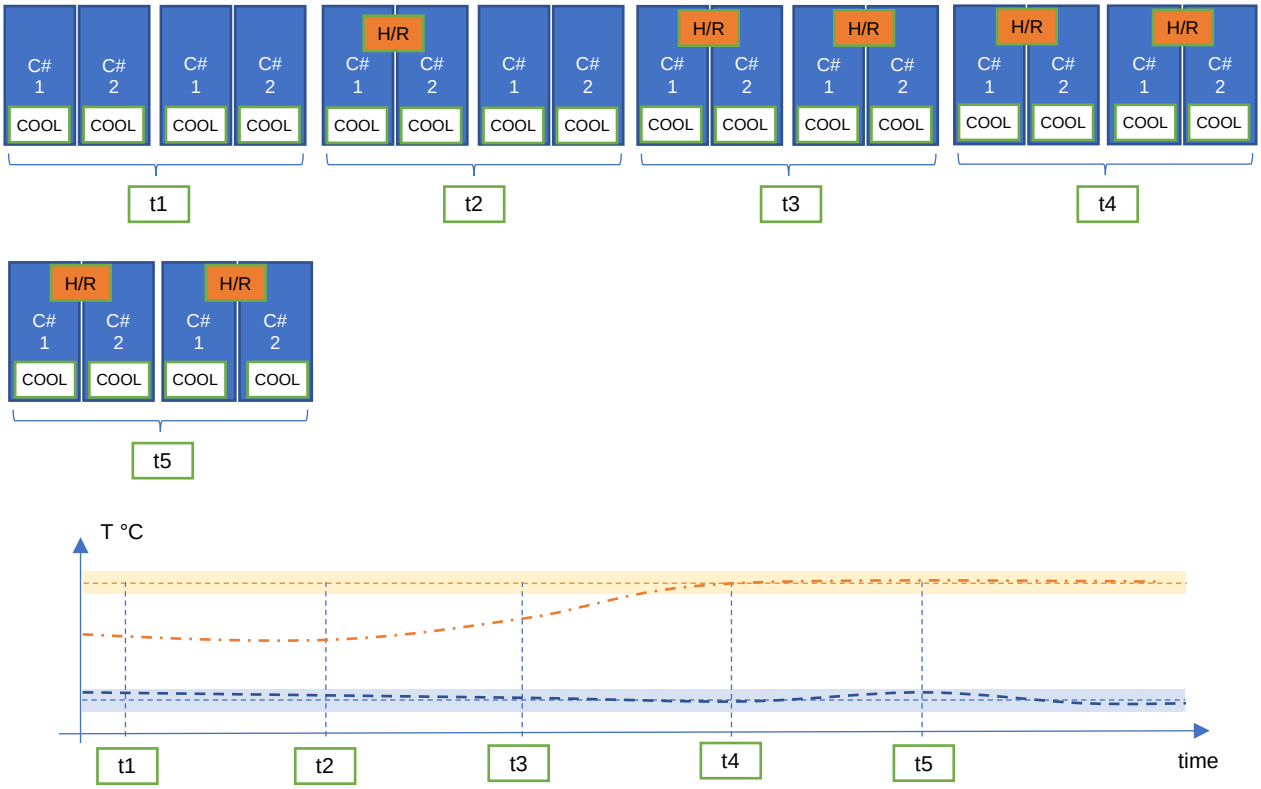


Figure 29: Heat Recovery staging

5.6.2 System with some Units equipped with heat recovery option

iCM can also manage plant-room where only some Units are equipped with heat recovery option.
In this system, if Unit without heat recovery are running to satisfy cooling demand, at the moment of heat recovery activation, iCM forces a stage up of a stopped Unit with Heat Recovery. This may create a temporary instability in the cooling water temperature, but it will allow to satisfy both the requests. Then, if cooling capacity should exceed the cooling

demand a stage down of a Non-Heat Recovery Unit is forced after an adjustable delay. This stage down is performed to avoid that the Unit with Heat Recovery may work at part load.
In the next example, only iCM Master Unit is equipped with Heat Recovery option. Heat recovery is activated when the system cooling setpoint is satisfied by the other Unit without Heat Recovery.

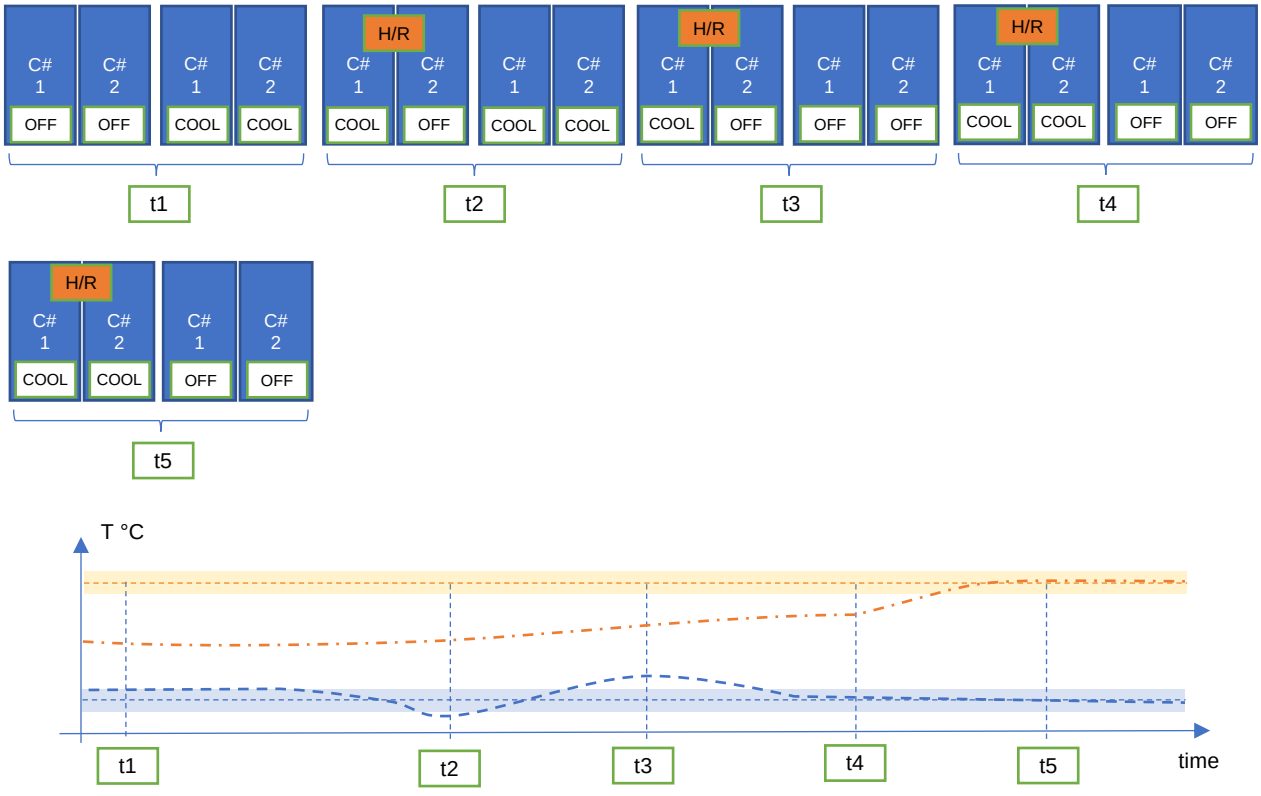


Figure 30: Heat Recovery staging control with setpoint satisfied

At t2 when the Heat Recovery is activated, the Unit with Heat Recovery (Master in this case) is staged up.
At t3 the drop in temperature forces a stage down to avoid undershoot of the controlled temperature but also to let the Unit with Heat Recovery to load up to full load.
From t4, the second Unit is kept stopped until Cooling Capacity of Heat Recovery Unit will reach full load.

5.7 Standby Unit control

iCM and Master/Slave both include the management of one Standby Unit. There are parameters that allows to configure this function in a very flexible way and respond to any system requirement. The Standby Unit is started in case another Unit fails.

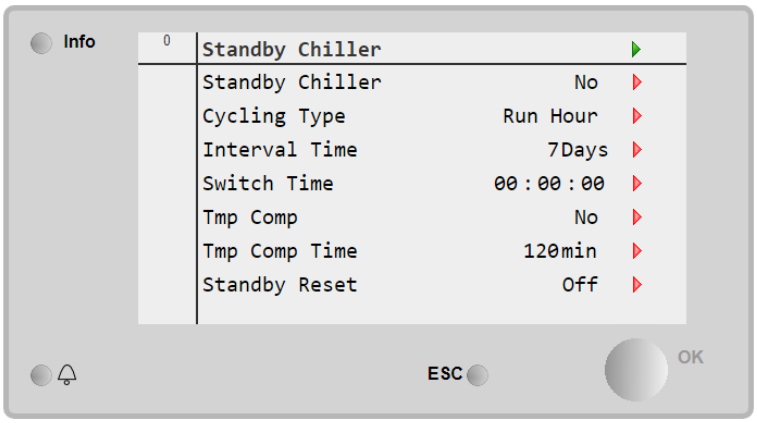


Figure 31: Standby chiller configuration

First, if needed, the function shall be activated, to do this the first setting shall be changed. There are several options

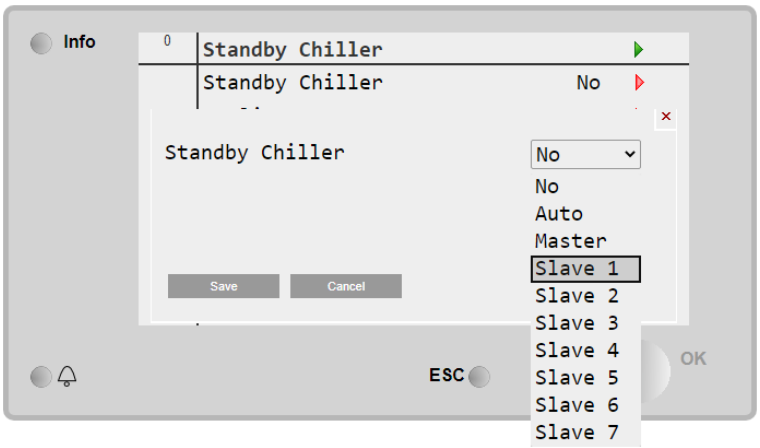


Figure 32: Selection of the Standby chiller mode

The configuration allows to select one specific Unit to become the Standby Unit. This can be useful in case one of the Units in the system is older than the others or has a lower efficiency for example. This setting allows also to define an Auto selection of the Standby Unit with an automatic rotation of the Standby Unit based on two strategies to determine the which Unit to hold.

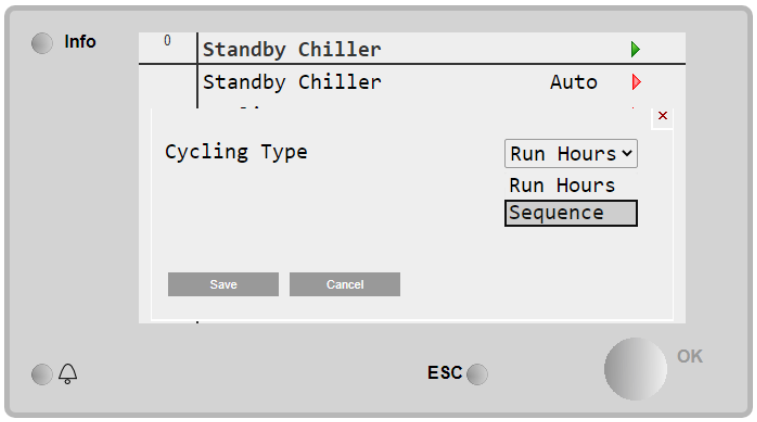


Figure 33: Rotation strategy configuration

The more convenient could be to hold the Unit with the higher number of running hours by selecting Run Hours. This strategy can be an additional method to keep the running hours balanced.
The other strategy will follow the ordinal number to define the new Standby Unit so, for example, if the actual Standby Unit is the Slave 1 the next will be the Slave 2.

It is possible to select the changeover period of the Standby Unit in number of days and the time of the day in which the changeover will be performed. Selecting properly this time the changeover can be executed when the system is off so not affecting the system stability.
The Standby function can also start the Standby Unit for temperature compensation which is, by default, not active.

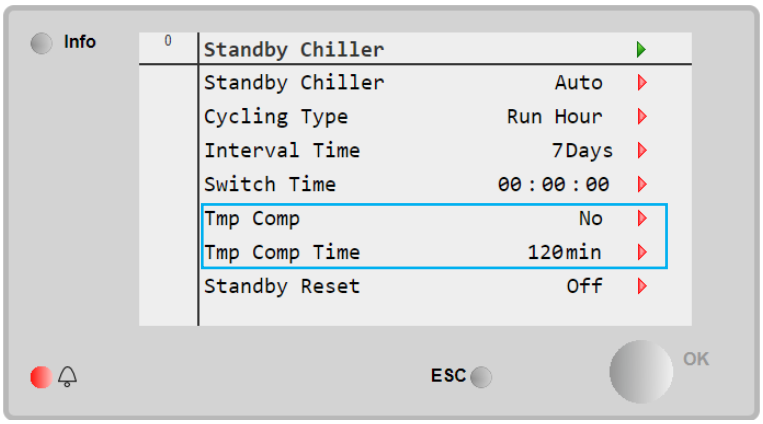


Figure 34: Temperature compensation with Standby Unit

Once activated by selecting Tmp Comp equal to Yes, the compensation function will start the Standby Unit if the system setpoint is not reached after 120 minutes by default. This delay can be increased or reduced to fit the application. In case of process application this delay can be reduced as 2 hours can be a too long time. This setting should be evaluated on the basis of the system requirements.
It's also possible to reset the Standby Unit function. This mainly refers to Unit selection and the interval time for the changeover.

5.8 Rapid Restart

Rapid Restart feature is basically a Unit feature that must be bought together with the Units. iCM cannot manage Rapid Restart if not available on each Unit.
In case of Rapid Restart, the logic will store the status of the running chillers prior to the power failure. At power restore the iCM will take care to re-enable immediately all the Units that were previously running. To do this, a UPS should be installed on the Unit controllers (Master and Slaves) so the Master controller will not lose the status references and should not wait to re-establish the communication with the slaves.
Once re-enabled by the iCM, chillers will perform by their own the Rapid Restart to restore the cooling load to the system.

5.9 Energy Monitoring (iCM only)

iCM can read all the energy data from each Unit equipped with the energy monitoring software option. The feature should be activated on all the Units; otherwise if information from some of the Units are missing, the cumulative data will be meaningless. Differently, if all the Units are equipped with energy monitoring, the iCM will display power inputs and cooling power from any of the Units, the cumulative values and the estimated system efficiency.

5.10 Demand Limit

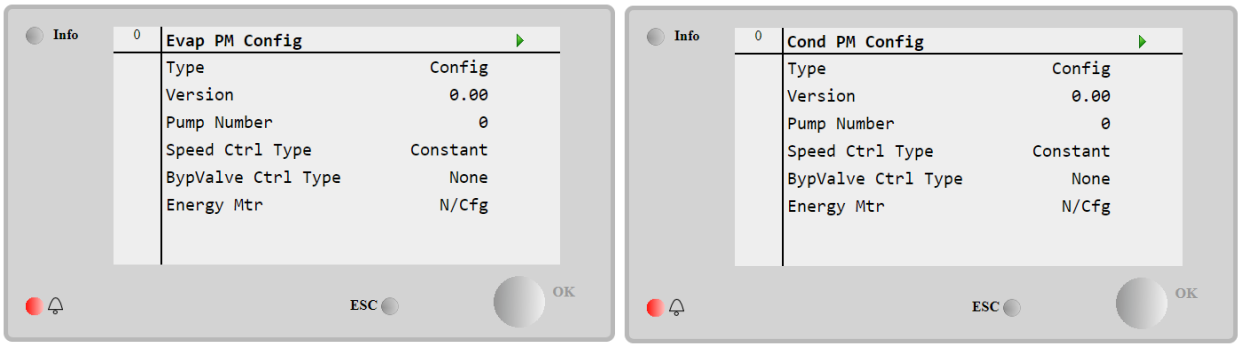
When demand limit is enabled on iCM Master controller, this function will be proposed at system level.
iCM manages the system demand limit in two different ways according to the interaction with other system control functions.

1) System Demand limit with Unit Capacity control:
   Demand limit function is combined with Unit capacity control, the demand limit set on iCM Master is considered the demand limit of the whole system. When the Unit capacity control is enabled, iCM manages the load up or load down of each Unit. Then, when the whole capacity of the running Units reaches the demand limit, iCM stops to load up the Units and it inhibits the staging, even if system temperature setpoint is not satisfied. Moreover, if the whole capacity should exceed the Limit, iCM forces the unload of a running Unit.
2) System Demand limit without Unit Capacity control:
   When Unit Capacity control is disabled, each Unit can manage its own capacity and iCM takes care of Unit stage up when the setpoint is not satisfied. In this situation, if demand limit is set on iCM Master, that value will be communicate and set on all the Units. Consequently, all the Units on the Daikin Network will be limited at the same demand limit setpoint. In this situation, until the system temperature setpoint is satisfied, iCM will stage up the Units that could reach at maximum the demand limit.

5.11 Manifolded Pump Management

In chiller plant-room with manifolded pump installation on evaporator or condenser side, one or two external electrical panel "iPM – Intelligent Pump Manager" able to manage the pump system can be provided as accessory of the iCM Option.

In fact, Unit controller, where iCM Option is set as Master, is able to communicate with Pump Manager/s in the same way as Slave Unit controller.
iCM can retrieve from iPM the configuration and actual data of the pump system; moreover, iCM is able to set the setpoints for the control functions of Pump manager like pump speed control or bypass valve control.
The menu “Evap PM Config” or “Cond PM config” contains the configuration values communicated to iCM describing pumps, sensors and devices managed by iPM.



Moreover, according to configuration communicated by iPM, iCM make available specific setpoints to the user to manage the iPM and control functions of the pumps and header bypass valve.

5.12 Daikin on Site

iCM and Master/Slave have a dedicated visualization on Daikin on Site. It offers dashboards and web pictures to simplify the system setup, system view and system control from remote. All the Units will be visible and will show their individual water temperatures, capacities and status.

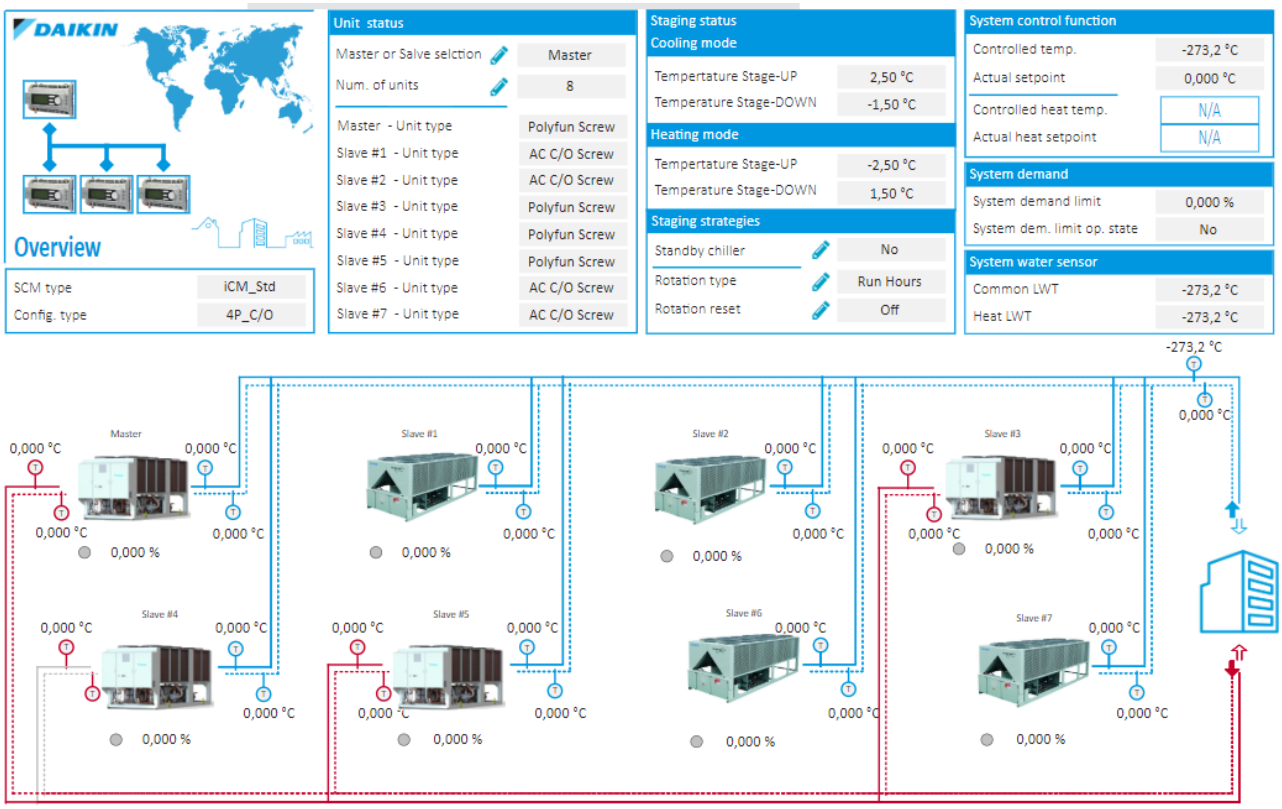


Figure 35: iCM overview web graphic

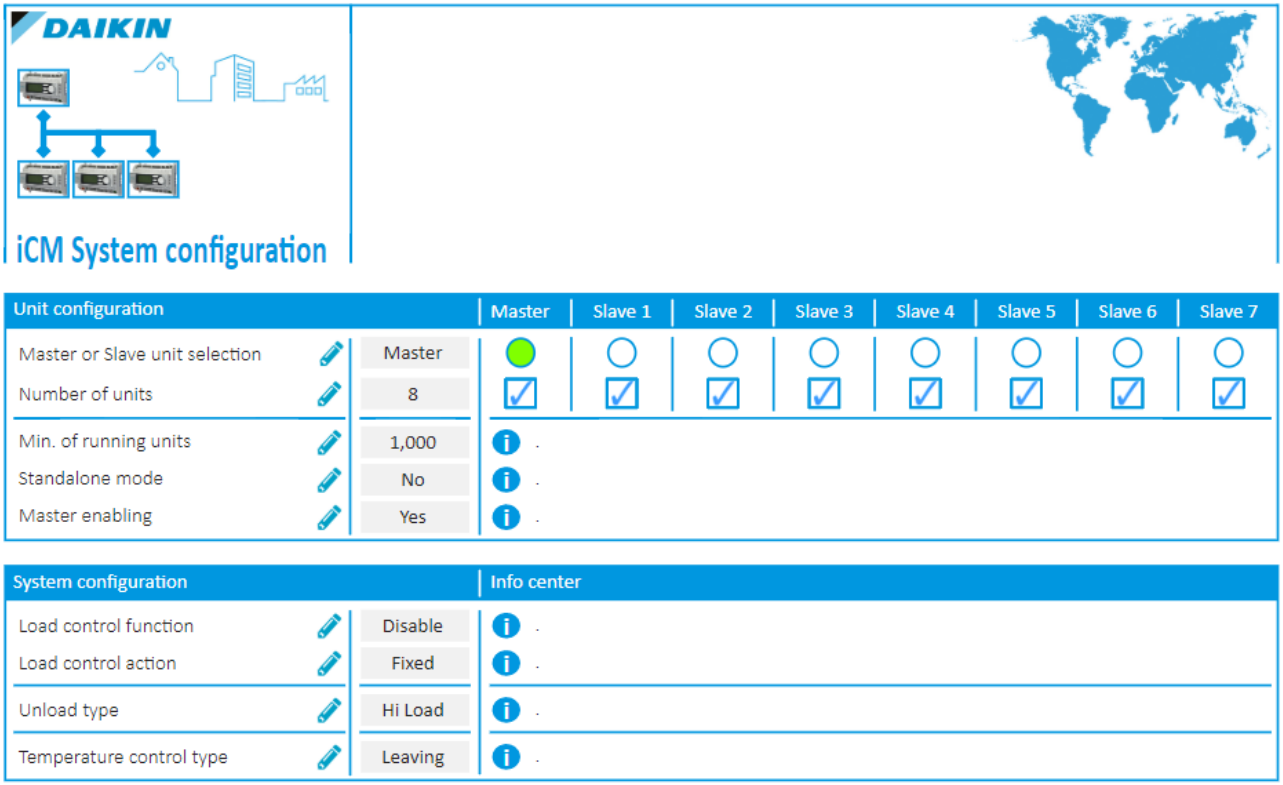


Figure 36: System configuration web graphic

5.13 Time scheduler

iCM and Master/Slave can use the integrated time scheduler to:

- Switch on and off the system,
- Switch from primary to secondary setpoint.

The second feature can be very useful to save energy. It's possible to define the secondary setpoint to maintain the water temperature to a value that allows the system reach quickly the primary setpoint. In the following schematic an example will be given.

With Master/Slave and iCM it's not needed to set the Scheduler on any controller in the system but only on the Master controller which will command all the others.

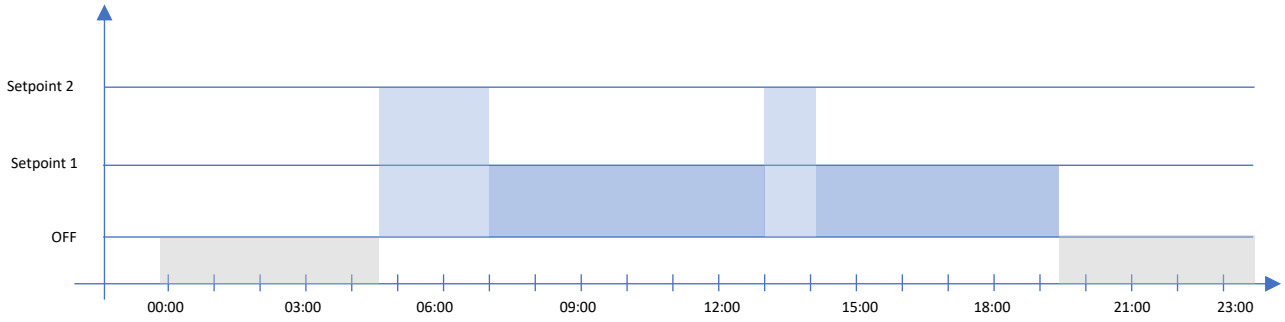


Figure 37: Example of a daily schedule

In this example the system is off from 19:30 to 4:30 and then it's started with the secondary target which could be for example 10°C. Then at 7:00 the target is changed to the primary setpoint which can be for example 7.0°C automatically. The setpoint is again changed to 10°C at 13:00 for one hour which could be the lunch break in the office building. At 14:00 the setpoint is again changed to the primary till 19:30 when the system will automatically turn off.

The time scheduler should be set on the Master controller. This can be done either from the Unit controller or from Daikin on Site which offers a better and easier view of the weekly schedule.

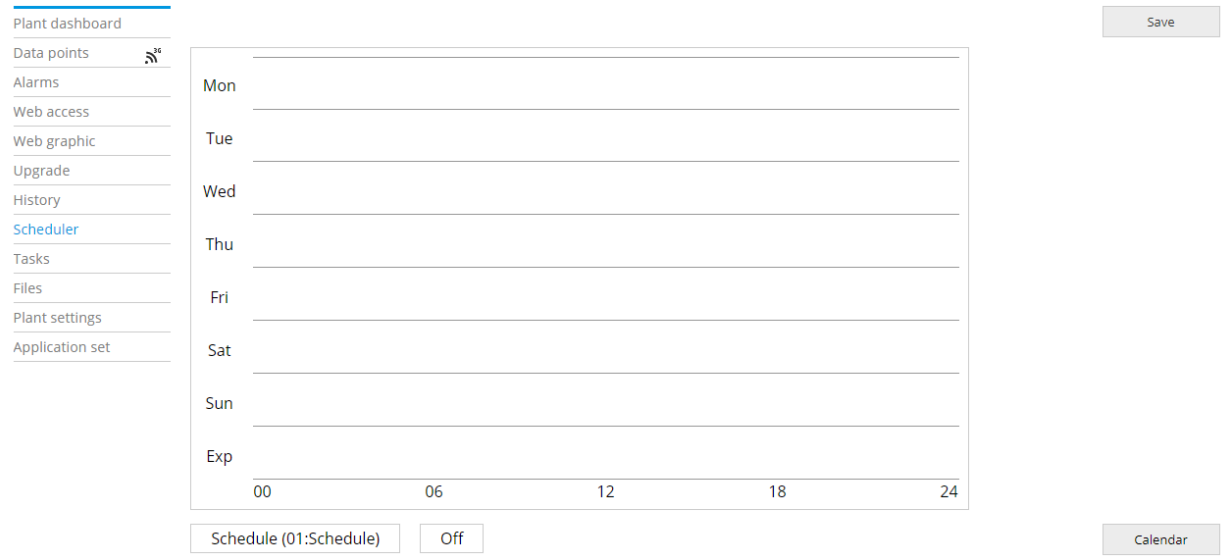


Figure 38: Weekly schedule on Daikin on Site

On the Master controller the Scheduler page will appear as follows:

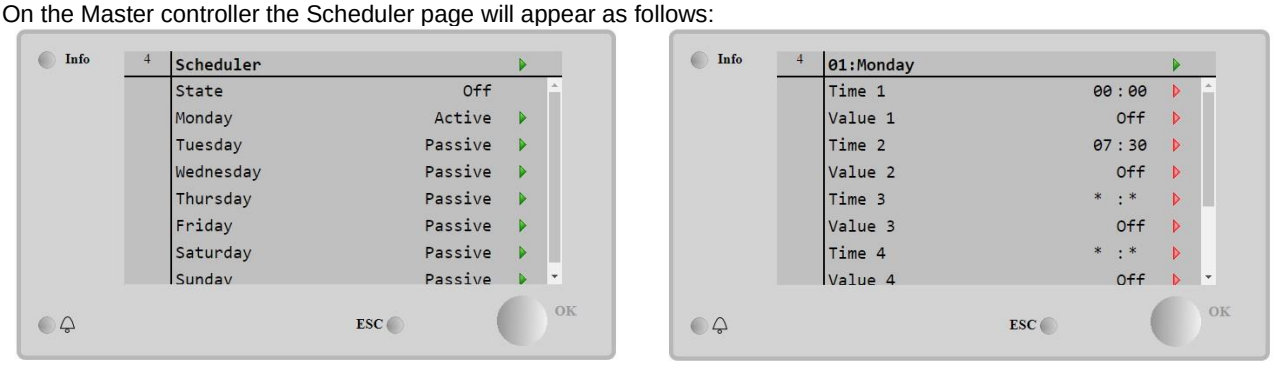


Figure 39: Weekly scheduler on the Master controller

This page is part of the View/Set Unit page as this is a feature of all the Units.
The Scheduler feature also offers the possibility to define on a calendar, intervals where the system will be off. This feature is only accessible from Daikin on Site.

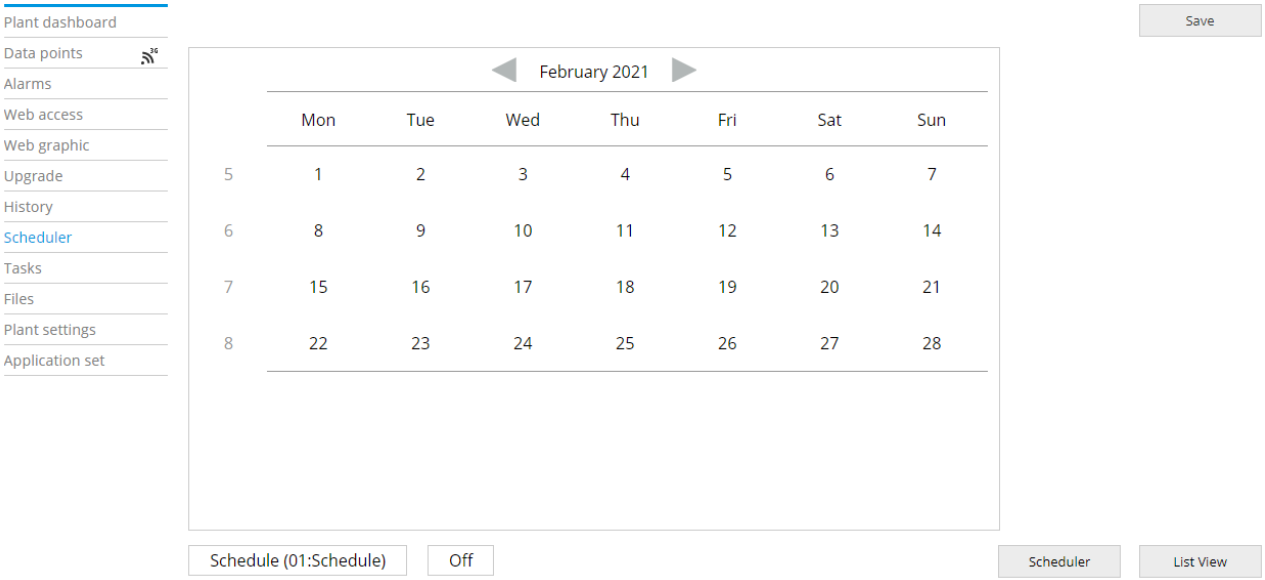


Figure 40: Calendar setup on Daikin on Site

This feature cannot be set using the controller HMI because a calendar cannot be displayed.

6 SYSTEM COMMISSIONING

This section will try to explain how the M/S or iCM shall be set to provide proper control of the system. The aim of this section is not to cover each possible system configuration which may require a lot of pages and may create some confusion. The purpose would be to provide a guideline that, starting from some example, can help to extend the same operations to any plant covered by the iCM.

6.1 Introduction

Before starting to read the following, it's strongly suggested to read the previous sections especially the HMI description and the functional description to get familiarity with some terminology and choices.

⚠	Before proceeding, please, read carefully paragraph 4.2 for the basic system configuration.

6.2 Before starting the Commissioning

It is fundamental to understand if the plant can be controlled by Master/Slave or if it requires the iCM. The decision can be driven by the following decision table:

Questions:
Are there more than 4 Units?
Is the system composed with a mix of chillers and multipurpose?
Is the system composed with a mix of VFD and non VFD Units?
Is the system composed with chillers and heat pumps?
Is the system composed with screw chillers and scroll chillers?
Is it needed to manage the Heat Recovery on air cooled chillers?
Is it needed to manage Freecooling?
Is the energy monitoring needed for the whole plant?
Does the customer expect energy saving?

If any of the above question is affirmative, then the iCM is needed. In this case a license will be needed to unlock the iCM functionalities. A license can be purchased from the factory for each Unit in the system and inserted in each Unit controller following the procedure in paragraph 2.
As a second pre-check it's suggested to verify if an indirect control of the Entering Water Temperature (sufficient for comfort applications) can be accepted or if a direct control of the Leaving Water Temperature is needed (process applications may need to monitor and control directly the supply temperature to the system). In this second case an additional NTC sensor is required and should be carried at Commissioning.
A connection with DoS is also preferable to monitor and tune the iCM during the first period of operations. It's suggested to connect the Master controller to DoS without activating the iCM control and monitor how the load changes over the week. To do this in the Maintenance menu change the `Mst Enable` setpoint from Yes to no. DoS activation is done using the standard procedure on the Master controller. From the data recorded during this period of monitoring it might be possible to define some of the parameters required to complete the iCM commissioning.

ⓘ	Default settings are suitable for a plug'n'play commissioning once the iCM configuration is done. System will run but some optimization may not be provided.

6.3 How to configure the iCM

Only fundamentals settings must be set on the iCM. These have been grouped and inserted in the Configuration page. This page will also give some indication about the type of active license and the mix of Units connected. In the below example the license is for the iCM Standard and the configuration type is made of multipurpose and cooling only chillers Units (4P and C/O).

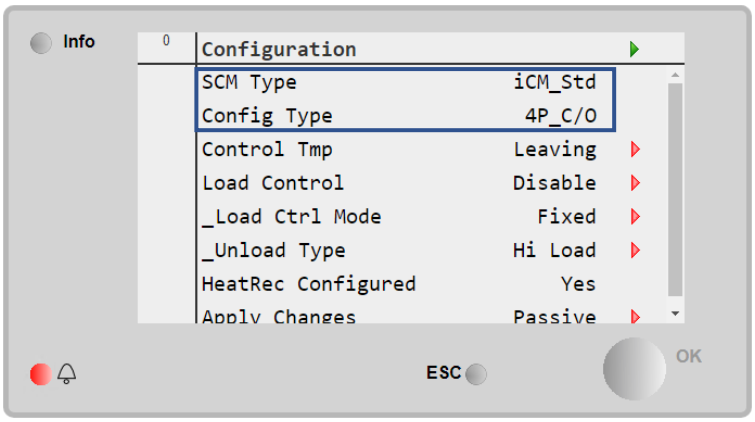


Figure 41: iCM license type and system configuration type indications

All the above settings are available also on Daikin on Site both as a dashboard and a web graphic with a more intuitive and helpful layout.

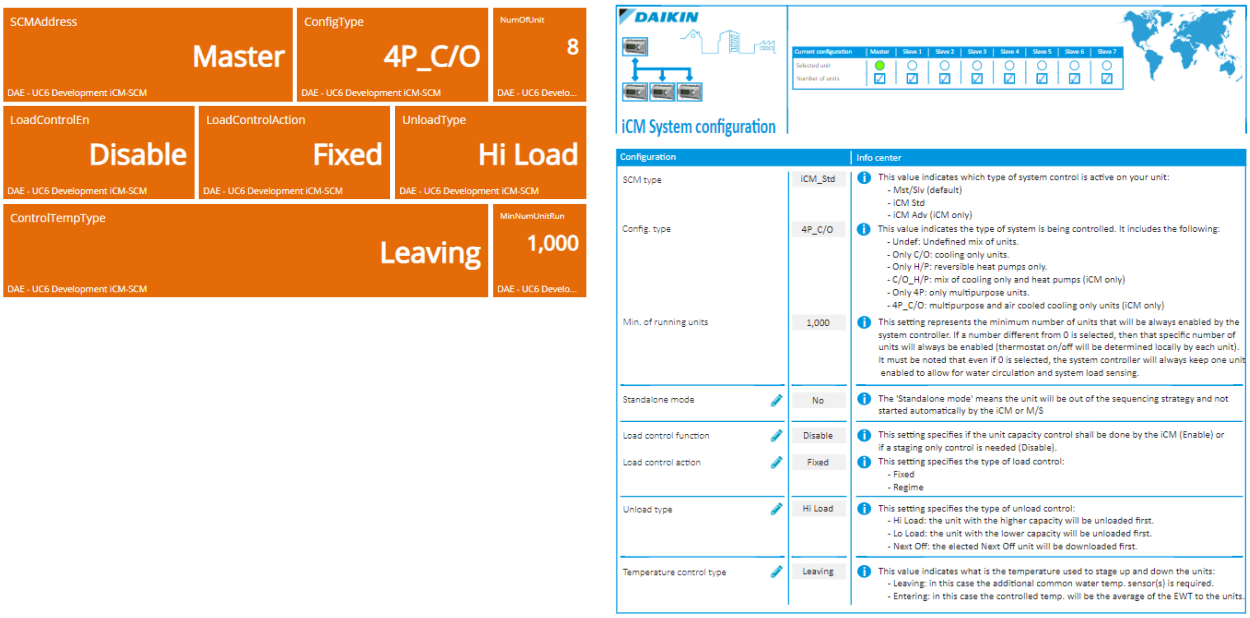


Figure 42: System Configuration from Daikin on Site

6.4 Configuration Check

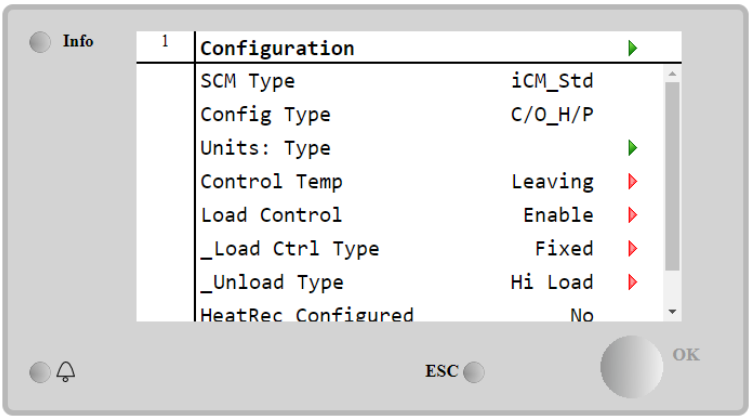


Figure 43 Configuration Status menu

At first start up, Master reports SCM Type (Master/Slave, iCM Standard, iCM Advanced) and detects the System Configuration (Undefined, Only Chiller, Only Heat pump, Chiller+HeatPump, Only Multipurpose, Chiller+Multipurpose) according to Unit Type (Menu: *"Units: Type"*) communicated by slaves.

Unit Type	Description
Undef	
AC C/O Screw	AirCooled Chiller Screw
AC H/P Screw	AirCooled Heat Pump Screw
Polyfun Screw	Multipurpose Screw
WC C/O Screw	WaterCooled Chiller Screw
WC H/P Screw	WaterCooled Heat Pump Screw
AC C/O Scroll	AirCooled Chiller Scroll
AC H/P Scroll	AirCooled Heat Pump Scroll
Polyfun Scroll	Multipurpose Scroll
WC C/O Scroll	WaterCooled Chiller Scroll
WC H/P Scroll	WaterCooled Heat Pump Scroll
WC C/O Centrif	WaterCooled Chiller Centrifugal
WC H/P Centrif	WaterCooled Heat Pump Centrifugal

Table 27 Unit Types

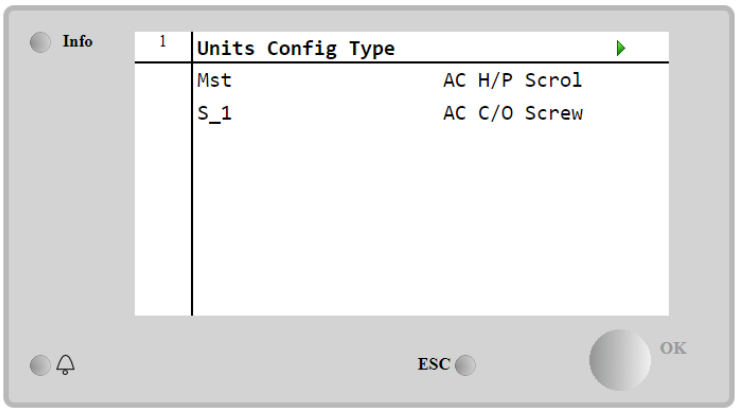


Figure 44 Unit types menu

⚠	if communication errors between Master and Slaves occur, network between controllers is not properly installed. Before keeping on configuring system, all communication issues MUST be solved.

⚠	if “Config Type” or “Units: Type” is Undef, "ConfigurationAlarm= UnitNotDef” is raised by Master. Reset of Master is needed before keeping on configuration.

6.4.1 Available Configurations and Configuration Alarm

As explained, Master detects the Unit Type of connected Units and SCM Type (Software Option enabled). If configuration is not allowed, Master raises an alarm.
In the following table Available configuration are described.

SCM Type	Units Type	Config Type	Configuration Alarm
Master: iCM_Std Slaves: Mst/Slv		Undef	ICM Type Error
Mst/Slv	Same Condensation (AC or WC) Mode (Chiller, Heat Pump, Polyfun) Compressor (Screw, Scroll)	OnlyC/O OnlyH/P Only4P	None
Mst/Slv	AC + WC or WC + Polyfun	-	CooledErr (Units differently cooled)
Mst/Slv	Chiller + Heat Pump	C/O_H/P	ModeErr (Units with different mode)
Mst/Slv	Multipurpose + Chiller	4P_C/O	ModeErr
Mst/Slv	Multipurpose + Heat Pump	Undef	ModeErr
Mst/Slv	Scroll + Screw or Scroll + Centrif	-	ComprErr (Units with different compressor)
iCM Std or iCM Adv	AC + WC or WC + Polyfun	-	CooledErr
iCM Std or iCM Adv	Chiller + Heat Pump	C/O_H/P	None
	Multipurpose + Chiller	4P_C/O	None

	Multipurpose + Heat Pump	Undef	ModeErr
	Scroll + Screw	-	None
	Scroll + Centrif	Undef	ComprErr

Table 28: Available configurations between Master/Slave and iCM

Some configurations that are not allowed with Mst/Slv , can be managed with iCM Software Option.

⚠	If Configuration Alarm is raised, Mst/Slv or iCM logic cannot be started.

6.5 Configuring the Controlled Temperatures

The first setting requires to select the controlled temperature between leaving and entering.

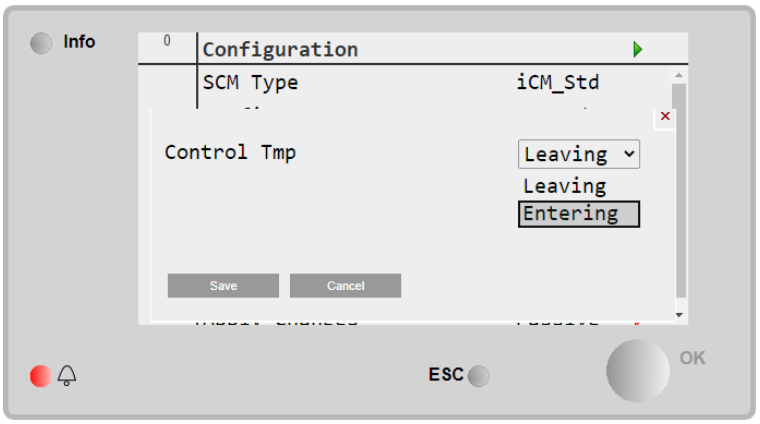


Figure 45: Selection of the controlled temperature

Selection of leaving water temperature will require to install the additional sensor on the supply header. On the other hand, selection of entering water temperature will not require any additional sensor as the iCM will calculate and use the average of the entering water temperature of all the running Units.
The decision between leaving and entering is mainly related to the application of the system. Leaving control tries to deliver exactly the temperature requested by the customer on supply header. On the other hand, with Entering control iCM will manage the load and unload of the running Units to achieve the entering water setpoint. In this case water temperature of supply header is not take in consideration and it can be higher or lower than default leaving water temperature setpoint of individual Unit. For this reason, selection of Entering water temperature control forces the enabling of Load Control (described in following paragraph).

6.6 Configuring the Load Control

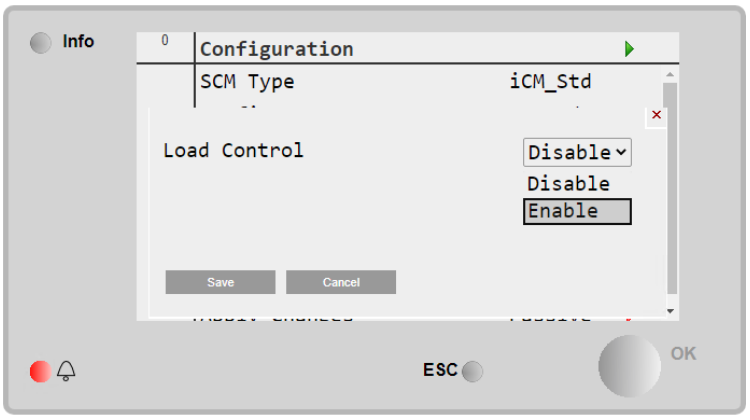


Figure 46: Load control Enable/Disable

ⓘ	If the iCM controls on the Entering Water Temperature the Load Control will be enabled by default.

ⓘ	In case of systems with multipurpose Units, iCM will control always on the Leaving Water Temperature and Load Control will be always disabled.

This setting will enable or disable the load control by the iCM. When the load control is enabled, iCM will force Units to load or unload basing on the water temperature error. Commands will be given to each Unit individually. This setting will try to share the system capacity on all the running Units when loading and unloading.
There is only one loading up strategy, and it is based on **Minimum Load**: iCM will force the load up of the running Unit with lower capacity time by time, up to stage up threshold. This strategy makes the Units load up one by one altogether, so that increase of system load will be shared homogeneously among the Units
On the other hand, there are three possible Loading down strategies each of those delivering different unloading profiles, described in the following paragraph.

6.6.1 Configuring the Load Control Mode

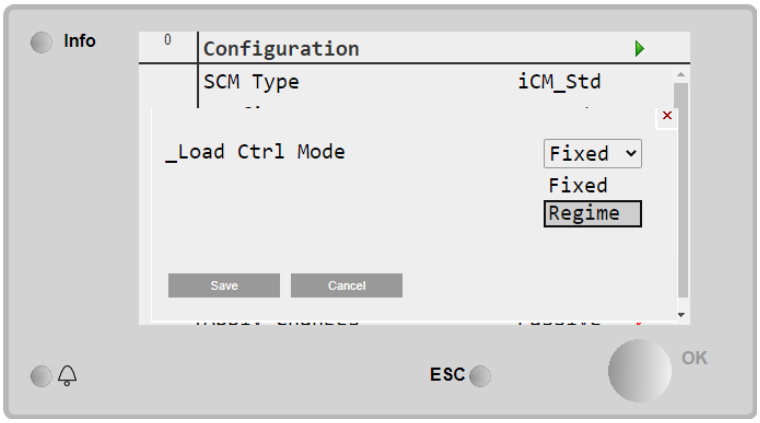


Figure 47: Load control mode selection

This setting will define when the Load Control will be used. Fixed will give the iCM the continuous load control of the Units. This might be good in case of comfort application and can help to get to the target sharing better the system load. When Regime is selected, the Load Control is activated only in Zone 2 (see par. 5.3) while in Zone 1 the iCM will only control the staging of the Units. This second option is preferable when the Unit should get to the setpoint quickly and eventually starting more Units than in an optimal situation.

6.6.2 Configuring the Unloading Strategy

Configuration requires to select the unloading strategy.

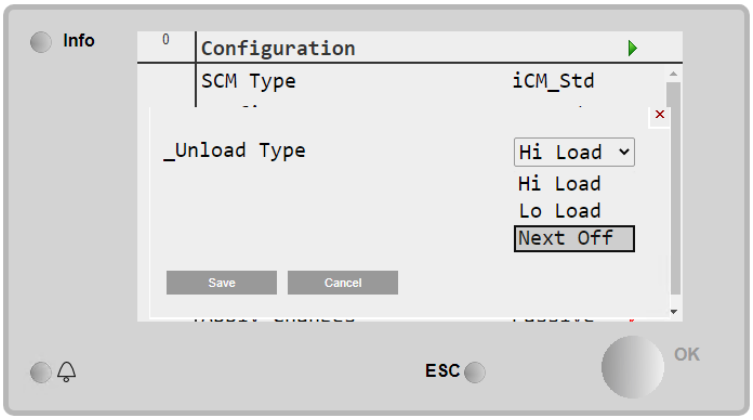


Figure 48: Unload Type selection

Unload can follow three different strategies that may lead to different distribution of the capacities as seen from the above picture.
With **Hi Load**, the iCM will force the unload of the running Units with higher load time by time. This strategy makes the Units unload one by one altogether, so that decrease of system load will be shared homogeneously among the Units during the unload. One application of this strategy could be the case of all non VFD Units with VFD pumps with variable.
The **Lo Load** strategy will force the unload of the Unit with lower capacity per time, down to its stage down threshold. In this case, decrease of system load will be compensated by one Unit at time and left running Unit will keep the achieved capacity. When all the Units will be unloaded to their stage down thresholds, then one Unit is disabled and switched off. This strategy fits well in applications with all VFD Units and VFD pumps with variable flow.
The **Next Off** strategy will unload the Next Off Unit and when the Unity capacity reaches the stage down threshold the Unit is switched off. The decrease of system load is compensated by one Unit at time till total shut-down. This strategy could be the right choice in case of fixed speed pumps (manifolded or dedicated) because it minimizes the number of running chillers so the number of running pumps.

6.7 Heat Recovery Configured

The last item in this page is the status of Heat Recovery. When the Master controller is equipped with Heat Recovery then this value will be Yes.

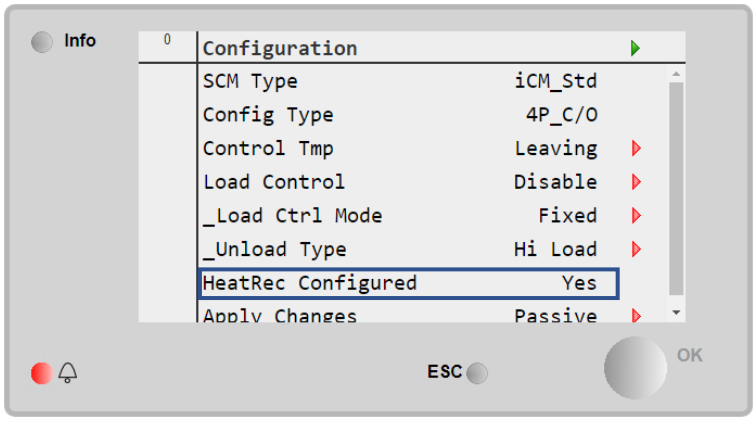


Figure 49: Activation status of Heat Recovery

To operate the heat recovery sequencing in the iCM the individual Heat Recovery enable switch shall be enabled. The status of the switch on the Master will activate the sequencing at system level of all the Units with Heat Recovery. The same will happen for the activation from BMS which could be given to Master only.

ⓘ	Heat Recovery Management by iCM can operate only with iCM Software option and if there are no Multipurpose Unit in the system.

6.8 How to setup the System Settings

The System Settings page includes all the settings that define how the iCM will control the water temperature of the system. Most of those settings are quite intuitive to be set, few others may require some care.

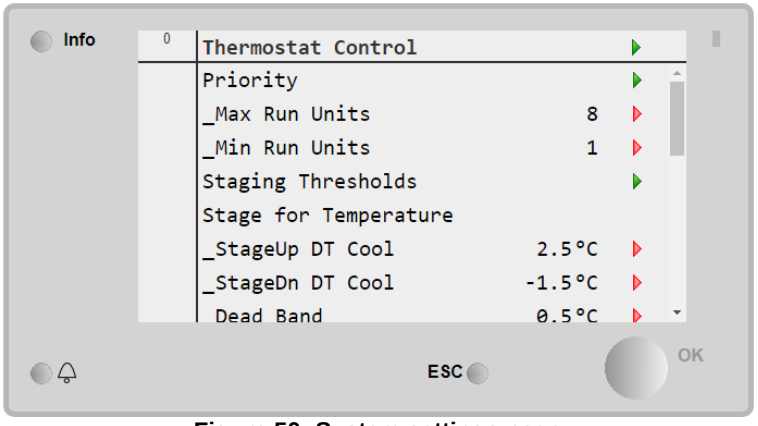


Figure 50: System settings page

Also, in this case the same settings can be done from Daikin on Site with two dedicated Dashboards for sequencing and staging.

ⓘ	Thresholds are chosen after a process of fine tuning: during iCM commissioning, service engineer needs to test the response of the iCM to system load request and consequently refine the values.

6.8.1 Priority

Following the order of these settings, priorities must be defined first. iCM allows to set individual chiller priorities. When doing this it has to be considered that iCM accepts grouping of Units. Units with the same priority are sequenced only looking to run hours and starts. By default, all the priorities are set to 1 so all the Units are sequenced to balance run hours and starts.
In case the iCM must control VFD and non VFD Units, it is possible to let the VFD Units start first and the non VFD Units follow. Or let one VFD Unit start, then the non VFD and as last another VFD Unit using three different priority assignments. In the table below an example with 4 Units will be shown for the two scenarios.

Unit Type	Default	Case 1	Case 2
EWAD-CZ	1	1	1

EWAD-CZ	1	1	3
EWAD-C	1	2	2
EWAD-C	1	2	2

Table 29: Setting the priorities

Changing the priorities will have an impact on the balancing of the run hours. Different priorities will be available for cool and heat mode.

ⓘ	Some specific configuration (mixed systems or heat recovery for example) may override the HMI settings.

6.8.2 Min and Max Run Units

Min and Max Run Units are used to define the minimum and maximum number of Units that can run.
With Min Run Units is possible to define a number of Units that will be always running. This can be useful in case of process application where part of the system load is fixed. In this case the iCM will always keep this number of Units on. Selected minimum Units left to run or first to start will not be fixed (not two specific Units) but chosen according to priority (if different priorities are set) or to run hours and starts.
The Max Run Units defines the maximum number of Units that can run at the same time. With this setting is possible to define a number of Units as backup of the others whose are started in case of alarm. For example, in a system of 6 Units this setting can be set to 5. These 5 Units will be started following the sequence selecting over all the 6. If one Unit fails, the logic will start the 6th Unit to integrate the capacity request.

Figure 51: Max number of Units running equal 5

6.8.3 Staging Capacity Thresholds

The staging Up and Down Thresholds define the management of the start and stop strategy of the Units and, if Load control is enabled, the management of load up and load down range of the Units.
Before proceeding it's very important that what explained in paragraph 5.4.1 has been fully understood.

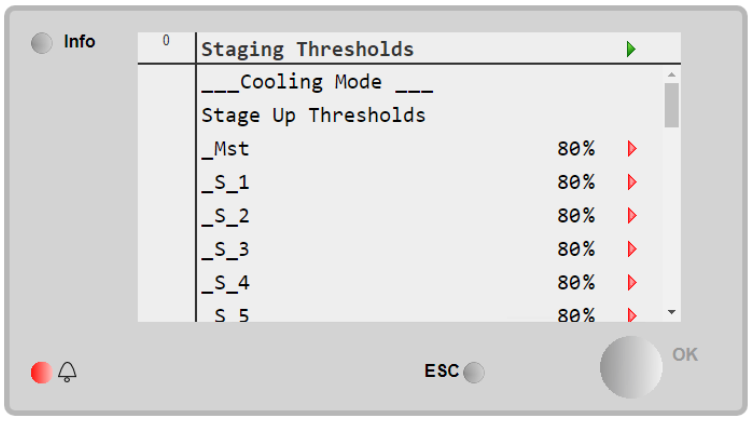


Figure 52: Staging thresholds

Selection of optimal Staging thresholds depends on several factors: number and size of Unit, type of compressor, etc.
In general, Stage Up and Stage down thresholds are set in order to make the Unit work inside a capacity range in which the specific Unit has the higher efficiency.
For example, in case of Units with Non-Inverter screw compressor Stage up should be set about 80%, whereas in case of Units with Inverter Screw compressor these thresholds should be set about 60%. Moreover, it is worth noting that the lower

is staging up threshold, the higher will be the number of started Units, leading to a partial load sharing, whereas the higher is the staging up threshold, the lower will be the number of started Units, leading to a full load step staging.

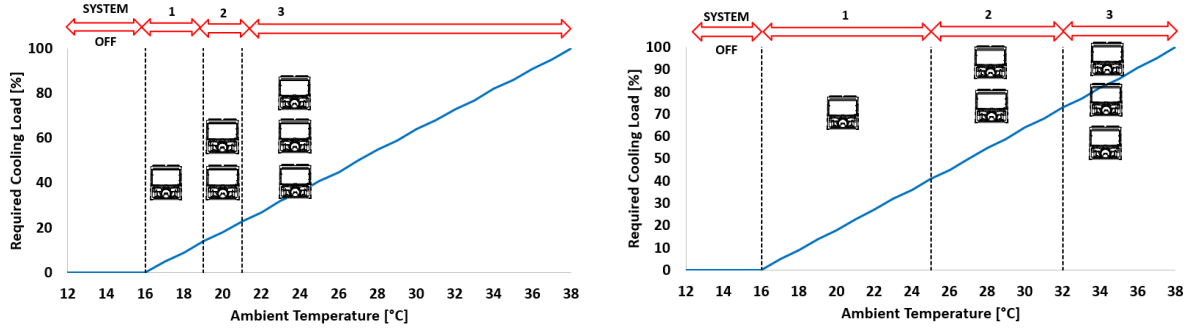


Figure 53 Load Sharing VS Minimum running Units

It's important to consider that the overall system efficiency is not only achieved letting the Units work in their best efficiency range, but it depends on other systems that have electrical consumption and own efficiency that shall be considered.
For example, in system with dedicated fixed speed pumps, starting an additional Unit leads to start one additional pump and consequently to an increase of power consumption. On the other hand, with a VFD pump, each start-up will correspond to a speed increase with a smaller increase in power consumption compared with fixed speed.
Concerning the stage down capacity thresholds, this determines when a running Unit must be stopped: the higher is the value, the lower is the number of running Unit, whereas the lower is the value, the higher will be the number of running Unit at partial load. For example, with Non-VFD screw Unit, Stage Down Threshold can be set about 40%, whereas with VFD screw Unit, the threshold can be set about 30% to enhance the load sharing.
Moreover, it is worth noting that this parameter has an impact on the setpoint stability. In fact, a too high value (for example above 50%) can lead to an anticipated shut-down of a running Unit and it can force iCM to load up the remaining running Units to compensate the requested system load and even to start again a stopped Unit. That can cause a fluctuation of leaving water temperature and unnecessary start and stop of the Units.
For example, in case of process application, to decide how to set the stage down thresholds, note down the minimum capacity percentage of each Unit and use this value to configure the thresholds. This will permit the iCM to unload the Units down to the minimum and have a smoother effect on the water stability. In case of process application, it might be also suggested to use the Next Off load control.
The thresholds are available for both cooling and heating.

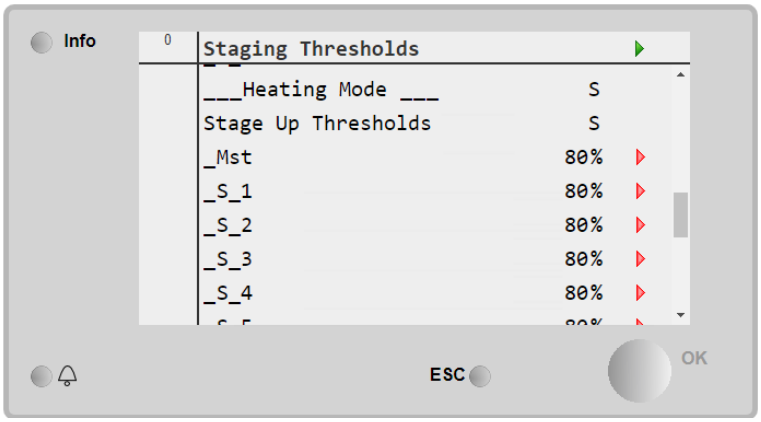


Figure 54: Staging thresholds for heat

In heating it can be convenient to have more Units at part load because this may mean less defrosts over time. So, it is better to set a lower capacity range.
Moreover, the Stage up and down threshold has an impact on the Load Control. In fact, iCM will load up each running Unit up to stage up threshold. So, a too low Stage up threshold will force the system to start all the Units and reach the stage up threshold before releasing the loading up to maximum system capacity.
In case of decrease of system load, iCM will load down the Units down to stage down capacity before stopping a running Unit (if unload type is high load or Low load) or iCM will load down the Next Off Unit to stage down capacity before stopping the Unit and start to load down the new next off. For this reason, a too high load down threshold can lead to unnecessary shut-down that cannot be afforded by remaining running Units.

6.8.4 Staging Temperature Thresholds

The staging temperature thresholds and deadband are used to define the regulation zones for the iCM where Staging on capacity threshold or Load Control (If enabled) are active.

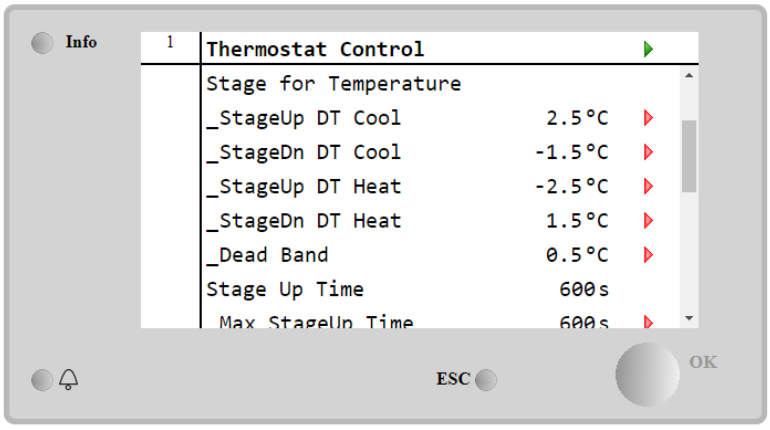


Figure 55: Staging temperature thresholds configuration

In fact, if controlled temperature is higher than setpoint + Stage Up DT, iCM will start an additional Unit without considering actual capacity of running Units, whereas if the controlled temperature is lower than setpoint + Stage Down DT, iCM will stop a running Unit without considering actual capacity of the running Units. This represents a back-up logic to compensate a sudden increase or decrease of system load, as faster as possible.
Those values must be set quite wide from setpoint to allow Staging on Capacity and Load control logics to control the temperature. In fact, a too low Stage Up DT can lead to unnecessary start-up of Unit and a too low Stage Down DT can lead to unnecessary shut down of a Unit.
Regarding the deadband, this parameter affects Load Control logic, if enabled. When controlled temperature is inside range between setpoint and setpoint + deadband, iCM will stop to load or unload the Unit. So, the higher is this value the higher is the deviation from setpoint that can be afforded. For example, in comfort application it can be set at 0,7...1,0°C. On the other hand, the lower is the parameter, the higher is the precision of iCM to follow controlled temperature fluctuations, which might be needed in process application when operator can set 0,3...0,5°C.
The Stage Up and Down delta temperatures are available in both cooling and heating if there is a heat pump in the system. In case of system with multipurpose Unit, where Staging on Capacity and Load control are disabled, staging is based only on temperature control and iCM will manage the individual circuits of all the Units to satisfy the cooling and heating request. So, stage up and stage down DT are used to evaluate the deviation from cooling and heating setpoint. Inside the range between Stage up and down thresholds iCM will keep the system as it is, whereas outside this temperature range, iCM will decide to start/stop/change mode of circuits. For this reason, those parameters can be lower and the range of regulation around the two setpoints can be narrower. Usually this range can be set about 2,0°C around the two setpoint and so stage up and down thresholds are set to 1,0°C and –1,0°C.

6.8.5 Staging Delays

The stage up and down of a Unit are defined also following delays. The delays are introduced to limit the simultaneous starts of different Units in the system and to let the Units load up or down to have an effect on the water temperature.
The delays depend on the distance from the Stage temperature Threshold, the farther is the controlled temperature from the target, the lower is the delay. The delays are started at each start up or shut down of a Unit.
The delay profiles for stage up and down are split to maximize the iCM configuration flexibility.

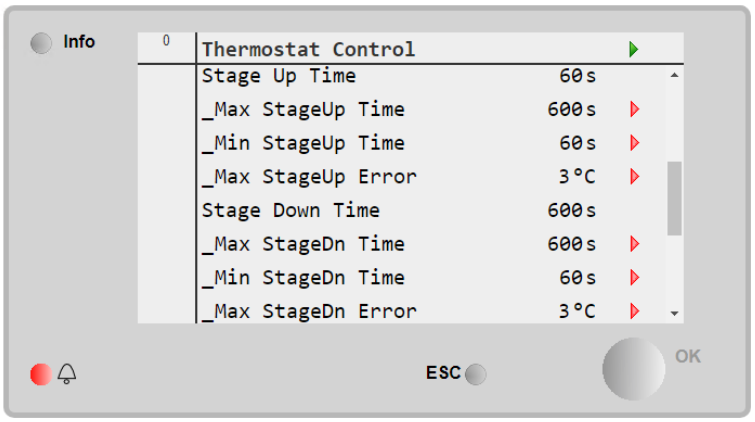


Figure 56: Stage delays configuration

Considering as example the default values, it results that if the controlled temperature is higher than 3°C (Max StageUp Error) from Stage Up temperature the delay is calculated at 60 seconds; in any temperature between stage up temp and 3°C, the delay is calculated using a linear interpolation so that at the StageUp Threshold the delay becomes 600 seconds. The same applies to stage down delay so that as the controlled temperature drops below stage down threshold in cooling or raise above stage down threshold in heating the stage delay can range between 600s and 60s accordingly.

So, the staging delays are affected by kind of Unit on system, kind of enabled iCM functions, kind of controlled temperature and temperature dynamic of the whole system.
For this reason, in system without multipurpose Units, Staging on Capacity and Load Control logics are enabled. When controlled temperature is inside stage delta temperature, iCM checks and manages the actual capacity of the Unit, so that a too long “Max Stage Up Time” could delay the start-up of an additional Unit, whereas a too short “Max Stage down Time” could cause shut-downs of Units too close in time. In the same way, when controlled temperature is outside stage delta temperature, where staging on temperature works as back up logic for sudden increase or decrease in load demand, a too long “Min Stage Up time” or a too high “Stage Error” could delay the start-up, whereas a too short “Min Stage down Time” can cause unnecessary shutdowns of Units.
Generally, Max Stage Up time is set at 5 minutes and Min Stage Up time at 2 minutes with a short Stage Up Error, about 1°C, because Stage Up DT is still quite high (default, 2,5°C). For the shut-down, Max Stage Down is set at 6 minutes, Min Stage Down time at 3 minutes and a short Stage down Error (about 0,5°C).
It is important to mention the case of Entering water temperature as controlled temperature. In this case, start/stop of Units can be evaluated after a certain delay due to dynamic of water in the system. For this reason, Stage Delays should be higher compared with the case of control with the leaving water temperature.
On the other hand, in system with Multipurpose Unit, iCM manages individual circuits of the Units according only to deviation from leaving water temperature setpoint (Cool and Heat), set with Stage Up and Down DTs. So, to appreciate the effect of circuit start/stop/mode change on controlled temperature is needed more time and consequently Staging delays and Stage Error must be longer. For this reason, Max Stage Time could be set at 10 minutes, Min Stage time at 1 minutes and Stage Error at 3°C.

6.8.6 Load Control setting

The last parameters to set are the ones related to Unit Capacity control.

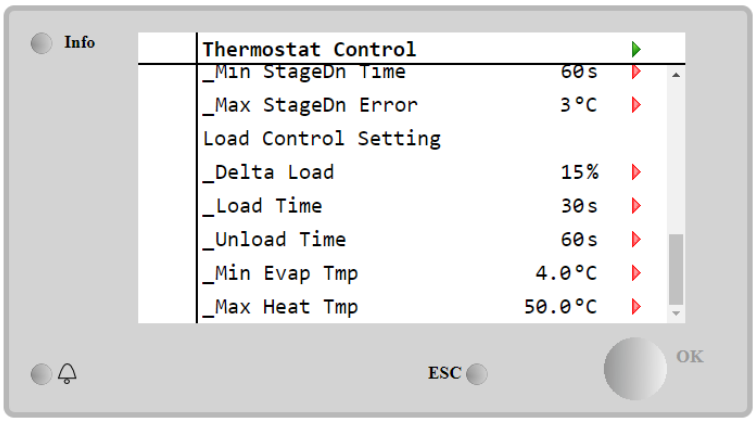


Figure 57: Load Control Settings

When load control is enabled and active iCM control the load up and load down of the Units one by one. The Delta Load represents the percentage of capacity that loading/unloading Unit must generate from its actual capacity before iCM switches to load/unload the next Unit. In case of Load up (controlled temperature is higher than setpoint + deadband), after each capacity step of the loading Unit, iCM will wait for Load time to expire and then it commands the load up of the next Unit. During Load down (controlled temperature is below setpoint), after each unload step, iCM will wait for Unload time to expire before commanding to unload the next Unit. Inside the deadband, Unit will keep the reached capacity.
Load/Unload timers should provide to iCM the time to evaluate the impact of each delta capacity increase or decrease on controlled temperature and, at the same time, prevent iCM from delaying the load Up or shorting the load down with consequently system capacity fluctuation. In fact, a too short Load timer can cause an increase of Units’ capacity too close in time; whereas a too long Load time can bring to an increase of temperature. Unload time can have the same effect with an excessive capacity generation or an unnecessary capacity decrease and possible shut down of the Unit.
Generally, Capacity unload of the Unit is faster than load up, so Load time can be set at 30sec and Unload time at 60sec.
It is worth noting that controlled temperature has an impact on the choice. In fact, if controlled temperature is the Entering water temperature, a capacity change of the Units has a delayed effect on the controlled temperature, so timers must be increased and fine-tuned according to plant-room inertia.
Regarding the temperature ranges, Min Cool Temp and Max Heat Temp must be set according to specific Unit parameters and system application. For example, in case of brine applications, the Min Cool Temp shall be reduced accordingly with the system setpoint. The same will happen with the Max Heat Temp and High temperature heat pumps.

6.8.7 Heat Recovery setting

iCM can control the staging of Heat Recovery of all the Units with this option installed.

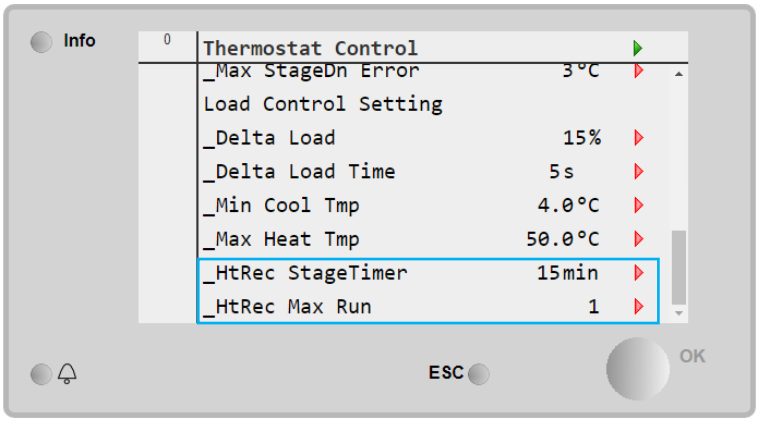


Figure 58: Heat Recovery settings

The settings allow to configure the maximum number of Units with Heat Recovery to be activated to reach the required temperature. If the total Heat Recovery available capacity exceeds the maximum required load, then this number can be set lower than the number of heat recovery Units. In case of doubts or to easily configure this function, it's suggested to set this value equal to the number of Units with heat recovery. What is important to remember is that the activation of heat recovery influences the Unit efficiency and capacity so in order to try to keep the overall efficiency high, when possible, the HtRec Max Run should be set at the minimum possible value.
That said, iCM will stage up the number of Units needed to reach the Heat Recovery target trying to not exceed the Heat Recovery system load and maximizing the system efficiency. As already set for ease of commissioning set this value equal to the number of Units with heat recovery.
The HtRec Stage Timer represents the delay between activations of heat recovery across the different Units.

6.9 Standby Unit configuration

The standby configuration has been already explained in par. 5.7. All the information related to the use of this function can be found there.
One remark is to always check when the changeover can be performed without affecting the system stability. In case of process application, it would be better to check whether this can be done or not.

7 TROUBLESHOOTING

This chapter will try to explain the alarms and events generated by the iCM and Master/Slave and guide to resolution.
In the following sections all the alarms will be described. Alarms will disable the iCM and Master/Slave or will reduce their ability to control the system properly.

7.1 iCM Master Alarms

7.1.1 Configuration Error

This alarm on **Master** controller can occur during configuration of System Control and it indicates that kinds of Unit (Unit Type) or kind of System Control Type (M/S or iCM Std) from Units on process network is not correct.
The reason of configuration alarm can be checked in menu: *System --> Configuration --> ConfigAlarm*.
Available configurations and possible configuration alarms are explained on Paragragh 1.3

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *iCMConfigAlm* System does not start even if enabled by Master Unit Switch	*ConfigAlarm = Undef* Connected slaves did not send the "Unit Type".	Check if Communication Error with slaves occurred. Reboot Master controller when all the communication errors with slaves are fixed.
	ConfigAlarm = iCMTypeError System Control Type (Software Option: Master/Slave or iCM Standard) is different among connected Units.	Check if iCM Standard (software option) is not unlocked on all the connected Units. Contact Factory for Unlock Key
	ConfigAlarm = CooledError WaterCooled + AirCooled Chiller or WaterCooled + Multipurpose Unit are connected to Master	Configuration NOT supported. Contact Factory
	ConfigAlarm = ModeError Multipurpose + HeatPump Units are connected to Master	Configuration NOT supported Contact Factory
	ConfigAlarm = ModeError Unit with Master/Slave option Chiller + HeatPump or Chiller + Multipurpose Unit are connected to Master	iCM standard option must be unlocked on all the Units Contact Factory for Unlock Key.
	ConfigAlarm = ComprError Scroll + Centrifugal compressor Units are connected to Master	Configuration NOT supported Contact Factory
	ConfigAlarm = ComprError Unit with Master/Slave Option Scroll + Screw compressor Units are connected to Master	iCM standard option must be unlocked on all the Units Contact Factory for Unlock Key.
Reset	.	Notes
Local HMI Network	☑ ☑	

7.1.2 System Lwt Sensor Fault

This alarm indicates that the sensor for the Cool/Heat water header on Evaporator side is not working properly. This alarm can occur if CommonLWT sensor is configured on all the Unit

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *Common EvapLWT* Forced Start of all Units, Load control disabled,	Sensor is broken.	Check for sensor integrity. according table and allowed kOhm (kΩ) range.
		Check correct sensors operation
	Sensor is shorted.	Check if sensor is shorted with a resistance measurement.

All Units in Local.	Sensor is not properly connected (open).	Check for absence of water or humidity on electrical contacts.
		Check for correct plug-in of the electrical connectors.
		Check for correct sensors wiring also according electrical scheme.
Reset		Notes
Local HMI Network	☑ ☑	

7.1.3 System Heat Lwt Sensor Fault

This alarm indicates that the sensor for the hot water header on condenser side is not working properly. This alarm can occur if CommonLWT sensor is configured only on WaterCooled and Multipurpose Units.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *Common HeatLWT* Forced Start of all Units, Load control disabled, All Units in Local.	Sensor is broken.	Check for sensor integrity. according table and allowed kOhm (kΩ) range.
		Check correct sensors operation
	Sensor is shorted	Check if sensor is shorted with a resistance measurement.
	Sensor is not properly connected (open).	Check for absence of water or humidity on electrical contacts.
		Check for correct plug-in of the electrical connectors.
		Check for correct sensors wiring also according electrical scheme.
Reset		Notes
Local HMI Network	☑ ☑	

7.1.4 Slave Communication Error

This alarm on the **Master** controller, indicates that the communication with one Slave is not working properly. There is the possibility that this alarm can be related to several Units in case of wrong wiring.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *Slave# CommErr.* *# identifies the Slave number* Unit Not available for sequencing and staging.	Process bus network is not properly cabled.	Check the continuity of the RS485 network with the Unit which is not communicating.
	Process bus communication is not running properly.	Check Units' addresses in the Process bus network. All the addresses must be different.
	EM noise over the process bus	Check the cabling. It's required to use shielded twisted pairs to connect the different Units with the shield properly connected to the system ground. See section related to field wiring for further details.
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when the communication is re-established.

7.1.5 Slave Missing

This alarm on the **Master** controller, indicates that some of the Slaves are not visible in the network. This can happen during the system configuration if the Master is configured first.

Symptom	Cause	Solution

Bell icon is moving on controller's display. String in the alarm list: *Slave# Missing* *# identifies the Slave number* Unit Not available for sequencing and staging.	Wrong configuration of the system.	Check the number of configured Units and the corresponding individual Units' configurations. All the Units must be configured with a different address and the number of Units configured on the Master matches the number of Units in the system.
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when the communication is re-established.

7.2 Slave Alarms

7.2.1 Master Communication Error

This alarm on the **Slave** controller, indicates that the communication with the Master is not working properly. There is the possibility that this alarm can be related to several Units in case of wrong wiring.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *CommError* Each Unit starts working in Local according to Unit logic, Enable setpoints and Temperature setpoints.	Process bus network is not properly cabled.	Check the continuity of the RS485 network with the Unit which is not communicating.
	Process bus communication is not running properly.	Check Units' addresses in the Process bus network. All the addresses must be different.
	EM noise over the process bus	Check the cabling. It's required to use shielded twisted pairs to connect the different Units with the shield properly connected to the system ground. See section related to field wiring for further details.
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when the communication is re-established.

7.2.2 Master Missing

This alarm on the **Slave** controller, indicates that the Master is not visible in the network. This can happen during the system configuration if the Slaves are configured first.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *Master Missing* Each Unit starts working in Local according to Unit logic, Enable Setpoints and Temperature setpoints	Wrong configuration of the system.	Configure the Master address and the number of Units on the Master.
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when the communication is re-established.

7.2.3 Master Disconnect

This alarm on the **Slave** controller, indicates Unit is not managed by Master anymore.

Symptom	Cause	Solution

Bell icon is moving on controller's display. String in the alarm list: *Master Disconnect* Each Unit starts working in Local according to Unit logic, Enable Setpoints and Temperature setpoints	1) Parameter "Disconnect" on Master Unit controller is set "Yes" 2) An Alarm of System controlled sensor has occurred.	1) Set "Disconnect" = "No" on Master. 2) Fix the alarm of LWT sensor on Master
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when the communication is re-established.

7.3 Pump Manager Alarms

7.3.1 Pump Manager Communication Error

This alarm can occur only on **iCM Master** if Evaporator pump Manager or Condenser pump manager has been configured but communication is not working properly.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *EvapPM CommErr.* Or *CondPM CommErr* Staging Up of the Units is inhibited.	Process bus network is not properly cabled.	Check the continuity of the RS485 network with the Unit which is not communicating.
	Process bus communication is not running properly.	Check Units' addresses in the Process bus network. All the addresses must be different.
	EM noise over the process bus	Check the cabling. It's required to use shielded twisted pairs to connect the different Units with the shield properly connected to the system ground. See section related to field wiring for further details.
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when the communication is re-established.

7.3.2 Pump Manager Missing

This alarm on the **iCM Master** controller indicates that Pump managers are not visible in the network. This can happen during the system configuration if the Master is configured first.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *EvapPM Missing* Or *CondPM Missing* System does not start even if enabled by Master Unit Switch	Wrong configuration of the system.	Check that iPM has been configured (on iPM controller). Check that same iPM has been configured on iCM.
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when the communication is re-established.

7.3.3 Pump Manager Configuration Error

This alarm on the **iCM Master** controller when Pump Manager is configured and in communication, but configuration of pump system as not been received. This can happen during the system configuration if the Master is configured first.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *EvapPM Config Error* Or *CondPM Config Error* System does not start even if enabled by Master Unit Switch	Configuration from Pump Manager has not been received through Daikin Network and applied on iCM.	Check that no communication error is active and that iPM have been send its own configuration parameters to iCM. Then reboot iCM controller
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when the communication is re-established, and controller is reboot.

7.3.4 Pump Manager Sensor Fault

This alarm on the **iCM Master** controller when Pump Manager communicates the alarm of connected sensor used for pump speed control.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *EvapPM Sensor Fault* Or *CondPM Sensor Fault* Staging Up of the Units is inhibited.	On iPM sensor is broken.	Check for sensor integrity. according table and allowed kOhm (kΩ) range.
		Check correct sensors operation
	On iPM sensor is shorted	Check if sensor is shorted with a resistance measurement.
	On iPM sensor is not properly connected (open).	Check for absence of water or humidity on electrical contacts.
		Check for correct plug-in of the electrical connectors.
		Check for correct sensors wiring also according electrical scheme.
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	The alarm clears automatically when sensor issue is fixed.

7.3.5 Pump Manager Available Pump Alarm

This alarm on the **iCM Master** controller when Pump Manager communicates a cumulative alarm of the pumps.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *EvapPM NotAvail Pumps* Or *CondPM NotAvail Pumps* Staging Up of the Units is inhibited.	On iPM number of alarmed pumps exceed the number of Daikin Units.	Check pumps connected to iPM controller and solve the cause of alarm.
Reset		Notes
Local HMI Network Auto	☑ ☑ ☑	This alarm clears automatically when pump issue is fixed.

7.4 Events

In this section all the events will be described. Events are situation where some functionality cannot be started or managed by the iCM for a wrong configuration of the system.

7.4.1 Heat Recovery Configuration Error

This alarm on the Master controller, indicates that the system configuration would require the use of the iCM function, but the Master/Slave is present.

Symptom	Cause	Solution
No alarm bell is shown on controller display The event will be shown in the event log. String in the event log: *HeatRec Config Error* Heat Recovery managed by iCM is inhibited.	Wrong configuration of the system to be managed by iCM.	Check if the selected Master controller has the heat recovery installed. If not, a different Master controller shall be chosen and this must have the heat recovery installed.

7.4.2 Energy Monitoring Configuration Error

This alarm on the Master controller, indicates that the system configuration would require the use of the iCM function, but the Master/Slave is present.

Symptom	Cause	Solution
No alarm bell is shown on controller display The event will be shown in the event log. String in the event log: *EnergyMon Config Error* Energy monitoring at system level is not available	Wrong configuration of the system to be managed by iCM.	Check if the selected Master controller has the heat recovery installed. If not, a different Master controller shall be chosen and this must have the heat recovery installed.

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