REV	00
Date	05-2026
Supersedes	-

Installation & Operating Manual
D-EIMOC03705-26_00EN

MUSE AC

MUSE AC Option Versioning

Revision	Software Version	Changelog
0 – 05/2026	MUSEAC_1.00	Introduction of MUSE AC Option

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1 WHAT IS MUSE AC©

1.1 Before starting

Each unit controller provides a set of embedded control functions that can be used to manage more than one Daikin Modular unit in a plantroom.
Daikin unit will be connected to each other through the Modbus RS485 communication.
MUSE control can be activated at any time on Daikin Microtech IV controller, and requires the purchase of “Option 180”, need to use Modbus RTU MSTP communication.
The activation can be performed by Factory or during the commissioning of the units on site by a Daikin technician.
In MUSE subsystem, one unit will be elected as “MUSE” (**M**odular **U**nit **SE**quencer), and the others will be elected as “Modular Unit Slave”. MUSE unit is the single point of management of Daikin units, whereas the Slave units will follow the MUSE management, which provides a comprehensive set of control functions for managing the array of modular units connected to it, resumed in the following paragraph.

1.2 Available Control functions

In this section are resumed all the control function provided by MUSE AC:

- **Modular Unit Sequencing**: allows to equalize the operation hours of the units through rotation of units.
- **Modular Unit Staging:** allows to provide a stable common leaving water, minimizing the number of running modular units and consequently reducing the power consumption.
- **Modular Unit Capacity control:** allows to manage the capacity generation of each modular unit, to increase or decrease the overall MUSE subsystem capacity according to building load demand. Thus, this function provides energy efficiency optimization.
- **Modular Unit Changeover:** allows to set the operating mode of the array of modular units and, consequently, on all the units that belongs to that array.
- **Modular Unit Defrost:** allows to manage the defrost process of the modular unit heat-pumps assuring that available heating capacity will be higher than cooling capacity generated during defrost
- **Modular Unit Variable primary flow management:** (available only for units with VPF option installed) allows to manage the speed of primary pumps to afford the building flow demand and assuring minimum flow to running units exchanger.

1.3 Possible configurations

MUSE AC can manage up to four 4 Air-Cooled Scroll Modular R290 Units together as a single air-cooled unit.
The modular unit array can be configured in two different layouts

- **Series**
- **Parallel**

MUSE can also be combined with iCM (Option 184), allowing the unit designated as MUSE for a specific subsystem of modular units to act as an iCM Master. In this scenario, a unit can assume one of the following roles:

- **MUSE**: modular unit elected as manager (Master) of an array of up to 4 modular units.
- **MU Slave** (**M**odular **U**nit **Slave**): Operates as a slave within an array of modular units.
- **MUSE + iCM Master**: Functions as MUSE within its subsystem while acting as a master in an iCM-managed network.
- **MUSE + iCM Slave**: Functions as MUSE within its subsystem while acting as a slave in an iCM-managed network.

For others details on the MUSE + iCM configuration refer to the dedicated section 2.5.

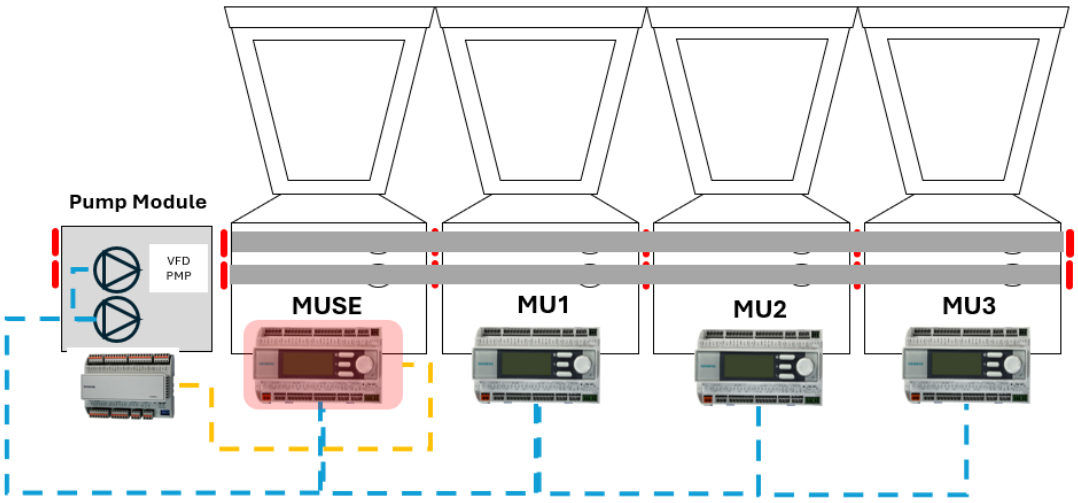

Figure 1: MUSE array of modular units

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

1.4 Limitations

MUSE AC can ONLY manage Air-Cooled Modular R290 Units and the changeover of them to satisfy the primary system demand.
Modular Unit staging is based on Leaving water temperature: the installation of a temperature sensor on supply header is mandatory.

ⓘ	In case of doubts about what MUSE AC can and cannot do, please refer to the following sections or contact your Sales Support referent in Daikin Applied Europe S.p.A.

1.5 Integration in a Building Management System

MUSE controller works as single point of integration with the BMS that will be able to gather all that information through protocol communication:

- BACnet over IP
- BACnet MSTP
- Modbus over RS485

Moreover, BMS will be able even to set the most important setpoints related to Daikin Unit Manager.

Please refer to document “BAS Integration – MUSE Modbus protocol” where all the datapoints are listed.

ⓘ	Not all the variables regarding the single unit are accessible through Master controller. In case all the information about single unit is request, even Slave controller must be integrated by BMS

1.6 Daikin on Site

MUSE AC© is integrated within Daikin on Site (DoS). When a Unit is connected to DoS and it is elected as the MUSE (Master) of the array of modular units, all the status info, settings configuration of the Modular array are displayed. Specific sections will support an easy commissioning of the subsystem and trending to monitor capacities and temperatures, starts and stops can help the remote Operator to fine tune and optimize the Modular array.

2 FIELD WIRINGS

2.1 MUSE Communication Network connection.

The following diagram shows how to connect Modular AC Scroll unit controllers to each other through Modbus RS485 communication.

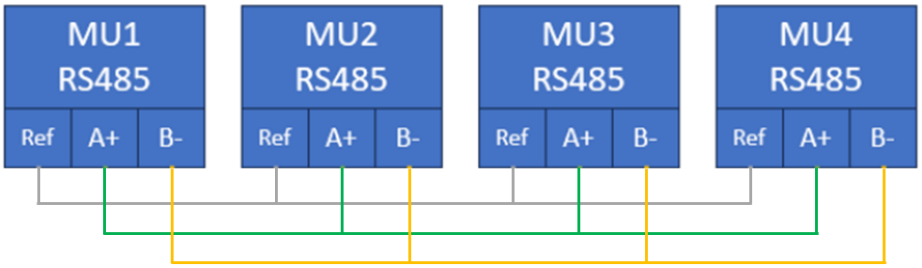

Figure 2 - MUSE Communication Network

Do not connect additional devices to this network.

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

- Twisted and Shielded 3-wire cable
- Bus cable length between 2 Units Max. 700 m
- Total bus cable length Max. 1,000 m

2.2 Common water temperature sensors

MUSE controller must be equipped with a mandatory common leaving water temperature.
Type of sensors that can be used are:

- ATEX NTC10K
- Generic PT1000 sensors.

Please refer to the specific Unit wiring diagrams for a correct hardwired connection of the sensors to the “MUSE” controller terminals.
These sensors must be installed in a proper position to measure the Supply water temperatures of the system.
The temperature sensor must be installed upstream an eventual bypass pipe or tank or common header that decouple primary circuit from secondary circuit.
Below picture shows the recommended position on supply header:

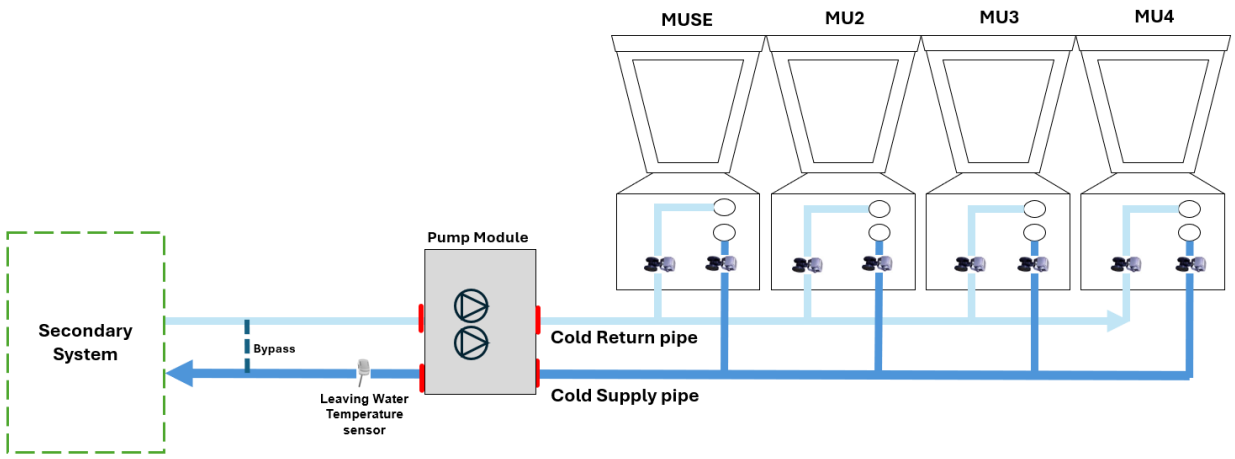

Figure 3 - Common Leaving Water Temperature Position

2.3 MUSE Parallel Configuration

In a parallel configuration, all modular units are connected to common supply and return headers. This means that the inlet of each unit is connected to the main supply line, while the outlet is connected to the main return line.
In this way each unit receives the same supply conditions, allowing for balanced operation and improved redundancy.
Each unit is equipped with shut-off valves on both the supply and return connections. These valves allow individual units to avoid water flow when the unit is shut off, or to be isolated for maintenance without interrupting the operation of the remaining units in the array.
Figure below shown an example of MUSE Parallel Configuration.

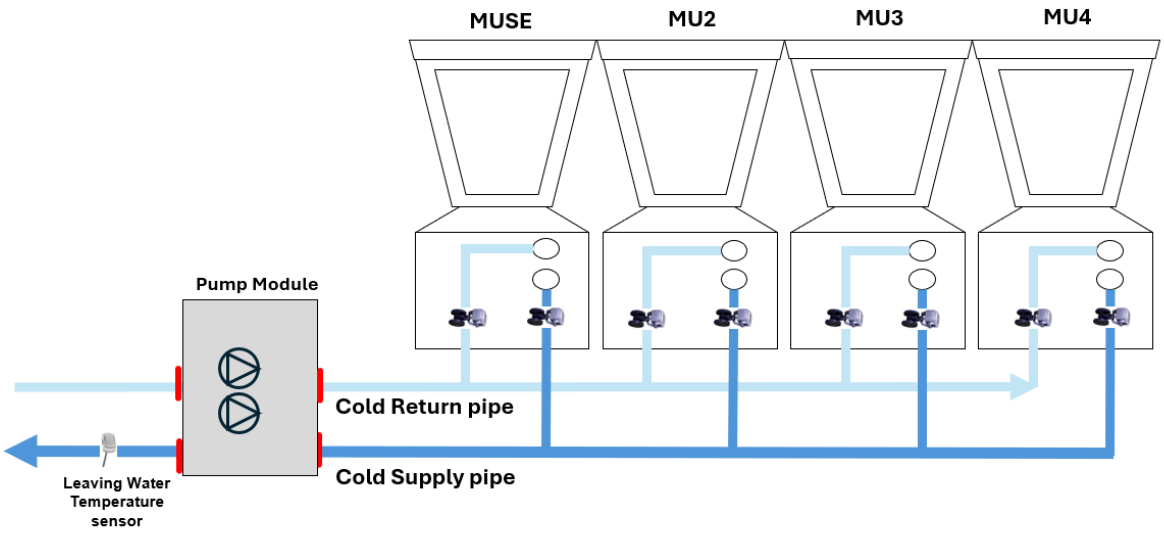

Figure 4 - MUSE Parallel Configuration

2.4 MUSE Series Configuration

In a series configuration, the modular units are connected sequentially so that the outlet of one unit is directly connected to the inlet of the next. The first unit in the sequence receives the fluid from the return pipe, and the last unit discharges it to the supply line. This arrangement ensures that the fluid flows through each unit in succession.
Unlike the parallel configuration, shut-off valves are not included in this setup, meaning that isolating a single unit is not possible without interrupting the entire flow path.
Figure below shown an example of MUSE Series Configuration.

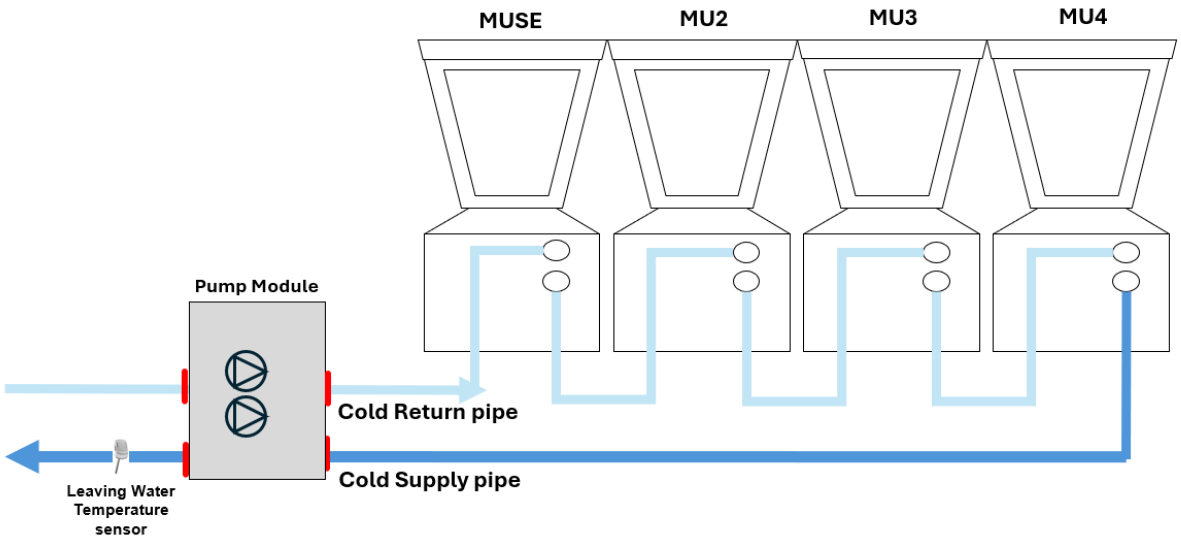

Figure 5 - MUSE Series Configuration

2.5 MUSE + iCM Configuration

MUSE can be combined with iCM (enabled through Option 184), allowing MUSE to allowing it to operate either as an iCM Master or an iCM Slave depending on the system configuration.
When iCM is active:

- Each subsystem is managed by its own MUSE, which controls the operation of the associated array of modular units.
- The unit designated as MUSE + iCM Master can manage multiple arrays of modular units, as well as individual units (which may be modular or non-modular), in accordance with the iCM control logic and its operational constraints.

In this configuration:

- The MUSE + iCM Master unit continues to manage its own array of modular units as a standard MUSE.
- From the perspective of the MUSE + iCM Master, other arrays are treated as individual units, each represented by the MUSE of its respective subsystem.
- The MUSE units in the other subsystems also function as iCM Slaves, ensuring proper communication and coordination under the iCM Master logic.

For detailed information on iCM-based control logic and architecture, please refer to the iCM manual as it works as a classical iCM system.
The following figure illustrates an example of a combined MUSE + iCM configuration, in which two arrays of modular units are present, each managed by its own MUSE. One array includes the unit acting as iCM Master, while the other includes the unit acting as iCM Slave. Additionally, a non-modular AC unit is integrated into the system as another iCM Slave.

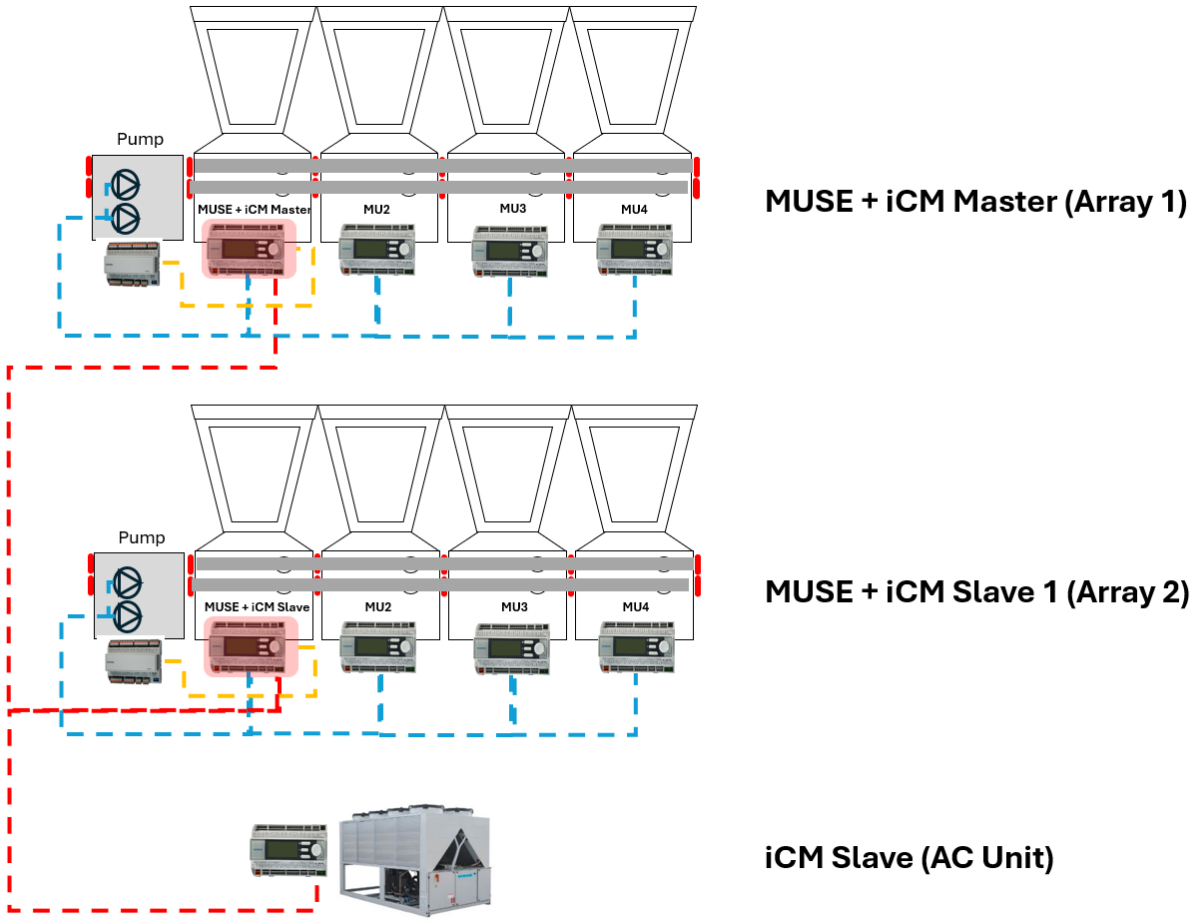

Figure 6 - MUSE + iCM Configuration

2.6 Modular Variable primary flow with pump module: equipment installation

Variable primary flow speed control can be managed only by:

- Single Modular unit
- MUSE controller of an array of MU in Parallel configuration

MUSE cannot manage VPF when the array of MU is in Series configuration.

When Daikin unit controller is equipped with “VPF Option”, the modular unit is provided with a Differential pressure sensor installed across Evaporator.
Moreover, an additional differential pressure sensor must be purchased as accessory and connected to a single unit or to the MUSE of an array of modular units. This sensor must be installed on the most disadvantaged device in the building water distribution circuit of the building, and it will be used to control the speed of pump module.

In case of modular unit array connected to the pump module, an absolute pressure sensor is installed on the return piping, positioned upstream of the unit designated as MUSE. Through the sensor measurement, Pump Speed Control sets a limit pump speed to prevent overpressure across the evaporator of running modular units.
When the VPF (Variable Primary Flow) option is enabled and applied to an array of modular units in parallel, each unit is equipped with:

- Two shut-off valves (on leaving and entering water pipe of evaporator).
- A differential pressure sensor, which measures the pressure difference between the unit’s inlet and outlet

The equipment installation and connection to modular units is shown in the following picture:

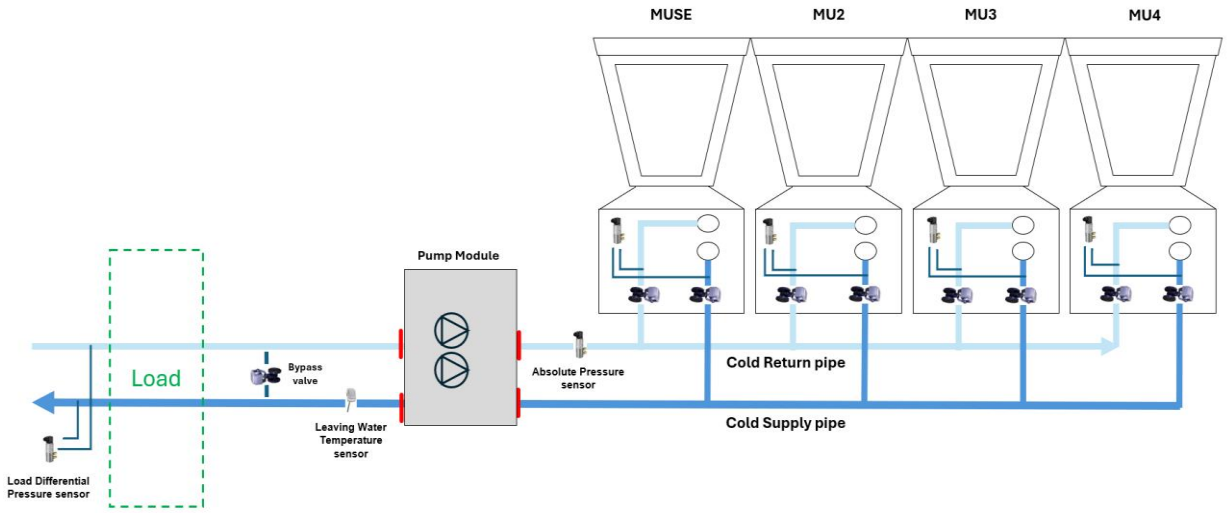

Figure 7 - Variable Flow based on DP in primary system with pumps module in a parallel configuration

MUSE is able to manage the pump module with the following signals:

- “Pump Request”: Digital Output (Normally Open contact) to command the start of variable speed driver (VFD) of the pumps.

Pump Request Contact need an External Power Supply at 24 or 230 Vac (not provided by unit controller)

- Pump Speed Signal”: 0…10Vdc Output Signal to command the speed of VFD of the pumps.

On MUSE controller, by-pass valve actuator and Differential pressure sensor on the building must be connected to the following controller terminals:

- “Load Differential pressure”: 0…10Vdc Input Signal to gather the measurement of the sensor (unit controller provides 24Vdc for power supply)
- “By-pass Valve Request”: Digital Output (Normally Close and Normally Open) of internal relay to command the closing/opening of the valve actuator.

By-pass Valve Request needs an External Power Supply at 24 or 230 Vac (not provided by unit controller)

Please refer to the specific Unit wiring diagrams for a correct hardwired connection of the equipment to the controller terminals.

3 HMI DESCRIPTION

3.1 Introduction

The following sections will go into the configuration and navigation of MUSE AC. 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
This is a parameter	7.6°C	-15.0°C, …,30.0°C This is a parameter	4
This is a setting	2	0, …,4	2
This is a link to a subpage	u		4

Table 1: 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.
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 2: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.

3.2 Preliminary configuration

Before being able to configure all the function of MUSE AC, it is needed to activate this additional control on the Units. To do this, it is needed to enter the *Commission Unit → Configuration → MUSE Configuration* menu:

Description	Default	Range and function	AL
MU Addr	None	None, MU1+MUSE, MU2, MU3, MU4	6
Defines the ID of each MU inside the network.			
Num of Units	0	0, ...,4	6
This parameter defines the number of units that the MUSE Unit is expected to manage.			
Layout	None	None, Parallel, Series	6
This setting specifies whether the modular unit operates with a parallel piping configuration or a series piping configuration			
CmnLWTSnsType	None	None, ATEX	6
Defines the type of sensor connected to the MUSE Unit to monitor the supply water temperature to the subsystem. The sensor must be connected, or an alarm will be generated NOTE: this parameter has no effect on others MU			

Table 3 - Basic MUSE Configuration

If the MU Addr parameter is set to MU1+MUSE, the system automatically sets the CmnLWTSnsType parameter to ATEX.

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

After a reboot of the controller the needed additional menus will be shown on the MUSE controller and MU controller.
A detailed description of all the sub-pages is in the following sections.

3.3 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
MUSE Data	Operational data of the MUSE subsystem	
MUs Data	Operational data of each MU	
Settings	Allows to define the relevant settings for the control of the plant.	4
Configuration	Allows to review the type of system, define the main control strategies and set configuration parameters	2
Maintenance	Allows to define all the limit values of delays, set unit in standalone mode and offsets about MUSE parameter	4

Table 4: Main Menu

From the Main Menu, if the selected MU is MUSE, is also possible to visualize an overview of the actual status of MUSE subsystem, described in the following table.

Description	Default	Range and function	AL
Status	Off	Off, Start, WaitLoad, Run, Run-MinAlm, Off-MinAlm, Off-ShutAlm, Discon	
This is the general MUSE subsystem status: - *Off* means MUSE is not active - *Start* means MUSE is enabled, but no modular units are currently running. - *WaitLoad* means that there is no Load and the actual number of running units is limited to 1. - *Run* means that MUSE is enabled and operating under load conditions to meet the system demand - *Run-MinAlm* means MUSE is running, but one or more alarms may be active, such as LWT sensor fault, communication issues with MUs, or alarms reported by the MUs themselves - *Off-MinAlm* means MUSE is not running, but one or more alarms may be active, such as LWT sensor fault, communication issues with MUs, or alarms reported by the MUs themselves - *Off-ShutAlm* means a shutdown alarm has occurred, which indicates that all units in the subsystem are unavailable. - *Discon* means MUSE unit has been configured to operate in standalone mode			
Nr Run MUs	0	0…4	
Indicates the number of Modular Units (MUs) currently running within the system			
Ctrl Temp	-.-°C		
Displays the current measured value of the Common Evaporator Leaving Water Temperature (LWT).			
Act Setp	-.-°C		
Displays the current value of the configured temperature setpoint			
Load	- %	0…100%	
Indicates the current overall load of the MUSE subsystem			
Act Mode	Cool	Cool, Ice, Heat	
Indicates the current operating mode of the MUSE subsystem			
MUSE Ver	MUSE_-.--.-		
Information about the currently installed version of MUSE AC			

Table 5: Subsystem overview in the Main Menu

3.4 MUSE Data

This section will describe the parameters accessible in the MUSE Data page.

Description	Default	Range and function	AL
Cmn Evap LWT	0°C	-30, …,130°C	
This is the actual value of the controlled leaving water temperature measured on the evaporator loop			
Avrg EEWT	0°C	-100, …,100°C	
This is the average of the Entering Water Temperatures (EWT) measured across all Modular Units (MUs) within the selected array. Used exclusively in parallel configuration			
Nr Run Units	0	0, …,4	
Indicates the number of Modular Units (MUs) currently running within the system			
Next On	0	0, …,4	
This is the elected next on Unit. To understand how it is selected please refer to the specific section.			
Stg Up Time	0s	0, …, 3600s	
This is the time left before the next stage up of the Next On Unit.			
Next Off	0	0, …,4	
This is the elected next off Unit. To understand how it is selected please refer to the specific section.			
Stg Dwn Time	0s	0, …,3600s	
This is the time left before the next stage down of the Next Off Unit.			
Dmd Lim	100%	0, … ,100%	
This is the value of Capacity limit set on MUSE controller that will be used to limit the Subsystem Capacity			
Therm Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual system Thermal Power			
Elect Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual system Electrical Power			
Evap Bypass Dmd	off	Off, On	
Indicates whether any Modular Unit (MU) within the MUSE subsystem is currently requesting the bypass valve to open			

Table 6: MUSE Data parameters

3.5 MUs Data

The *MUs Data* menu provides direct access to the configuration and visualization pages for each Modular Unit (MU) within the subsystem. It also displays the operational status of every individual MU. This section will also describe the links to other sub-section.

Description	Default	Range and function	AL
MU#1	Off	Off, Run, NotAvail, Alm, Stdaln, ComErr, N/Cfgd	
Displays the actual status of Modular Unit 1. This also serves as a link to the dedicated subsection containing detailed information and parameters related to the same MU.			
MU#2	Off	Off, Run, NotAvail, Alm, Stdaln, ComErr, N/Cfgd	
Displays the actual status of Modular Unit 2. This also serves as a link to the dedicated subsection containing detailed information and parameters related to the same MU.			
MU#3	Off	Off, Run, NotAvail, Alm, Stdaln, ComErr, N/Cfgd	
Displays the actual status of Modular Unit 3. This also serves as a link to the dedicated subsection containing detailed information and parameters related to the same MU.			
MU#4	Off	Off, Run, NotAvail, Alm, Stdaln, ComErr, N/Cfgd	
Displays the actual status of Modular Unit 4. This also serves as a link to the dedicated subsection containing detailed information and parameters related to the same MU.			

Table 7: MUs Menu

The MU Status can assume the following values:

- *Off:* the Modular Unit is currently Off
- *Run:* the Modular Unit is currently running
- *N/Av*: the Unit is “Not Available” and stopped by MUSE, i.e out of sequencing and staging control, for one of the following conditions:
  - “Unit Switch” on unit electrical panel are turned OFF.
  - Unit has “available capacity” less than 5%, i.e. a shut-down alarm prevents unit from starting.
  - Unit is set with “Operation Mode” (Cool/Heat), different from Master Operation Mode. (This is applicable only in case subsystem composed by Heat-pump units or in mixed system in parallel configuration with Heat-pump and Chiller units).

- *Alarm*: the Modular Unit has an active alarm
- *Stda*ln: Modular Unit in Standalone mode must be considered not available for the sequencing and thermostatic control managed by MUSE. User can set the Modular Unit in Standalone mode through setting in menu: *Maintenance→Disconnect*.
- ComErr: the Modular Unit is not communicating with the MUSE controller and requires corrective actions to re-establish proper communication. The resulting action depends on the selected layout. In Series configuration, Communication Error leads to Rapid Stop of the whole array. In Parallel configuration, a Communication Error affecting a Slave MU excludes only the affected Slave from sequencing and staging while the remaining available units continue to operate; if communication with the MUSE unit is lost, Slave MUs enter Rapid Stop when the MUSE Communication Alarm is detected.
- *N/Cfgd*: This status occurs when the MUNumOfUnit parameter configured in the MUSE subsystem is lower than the index assigned to a specific Modular Unit (MU).
  For example, if MUNumOfUnit is set to 3, MU number 4 will display the status N\Cfgd (Not Configured)

3.5.1 MU#1 Menu

This menu provides all data and information related to the actual status and operational parameters of MU1.

Description	Default	Range and function	AL
Status	Off	Off, Run, NotAvail, Alm, Stdaln, ComErr, N/Cfgd	
Displays the actual status of MU1. To understand the meaning of the different status parameter values, refer to section 3.5			
Op Sta	Stop	Stop, Run	
This is the current operational status of MU1			
Act Mode	Cool	Cool, Ice, Heat	
Indicates the current operating mode of the MU1			
Load	- %	0 … 100%	
Indicates the current load of the MU1			
ELWT	-.-°C	-50…100°C	
Displays the measured Evaporator Leaving Water Temperature for MU1			
EEWT	-.-°C	-50°C…100°C	
Displays the measured Evaporator Entering Water for MU1			
Evap State	Off	Off, Start, Run	
Indicates the current operational state of MU1's evaporator			
Run Hours	0	0…4294967295	
Displays the total number of hours MU1 has been running.			
Nr Starts	0	0…4294967295	
Displays the total number of starts performed by MU1.			
Defr Op Sta	Off	Off, On	
This indicates whether the MU1 is currently performing operations related to the defrost function			
Therm Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual MU1 Thermal Power			
Elect Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual MU1 Electrical Power			

Table 8: MU#1 Menu

3.5.2 MU#2 Menu

This menu provides all data and information related to the actual status and operational parameters of MU2.

Description	Default	Range and function	AL
Status	Off	Off, Run, NotAvail, Alm, Stdaln, ComErr, N/Cfgd	
Displays the actual status of MU2. To understand the meaning of the different status parameter values, refer to section 3.5			
Op Sta	Stop	Stop, Run	
This is the current operational status of MU2			
Act Mode	Cool	Cool, Ice, Heat	
Indicates the current operating mode of the MU2			
Load	- %	0 … 100%	
Indicates the current load of the MU2			
ELWT	-.-°C	-50…100°C	
Displays the measured Evaporator Leaving Water Temperature for MU2			
EEWT	-.-°C	-50°C…100°C	
Displays the measured Evaporator Entering Water for MU2			
Evap State	Off	Off, Start, Run	

Indicates the current operational state of MU2's evaporator			
Run Hours	0	0…4294967295	
Displays the total number of hours MU2 has been running.			
Nr Starts	0	0…4294967295	
Displays the total number of starts performed by MU2.			
Defr Op Sta	Off	Off, On	
This indicates whether the MU2 is currently performing operations related to the defrost function			
Therm Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual MU2 Thermal Power			
Elect Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual MU2 Electrical Power			

Table 9 - MU#2 Menu

3.5.3 MU#3 Menu

This menu provides all data and information related to the actual status and operational parameters of MU3.

Description	Default	Range and function	AL
Status	Off	Off, Run, NotAvail, Alm, Stdaln, ComErr, N/Cfgd	
Displays the actual status of MU3. To understand the meaning of the different status parameter values, refer to section 3.5			
Op Sta	Stop	Stop, Run	
This is the current operational status of MU3			
Act Mode	Cool	Cool, Ice, Heat	
Indicates the current operating mode of the MU3			
Load	- %	0 … 100%	
Indicates the current load of the MU3			
ELWT	-.-°C	-50…100°C	
Displays the measured Evaporator Leaving Water Temperature for MU3			
EEWT	-.-°C	-50°C…100°C	
Displays the measured Evaporator Entering Water for MU3			
Evap State	Off	Off, Start, Run	
Indicates the current operational state of MU3's evaporator			
Run Hours	0	0…4294967295	
Displays the total number of hours MU3 has been running.			
Nr Starts	0	0…4294967295	
Displays the total number of starts performed by MU3			
Defr Op Sta	Off	Off, On	
This indicates whether the MU3 is currently performing operations related to the defrost function			
Therm Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual MU3 Thermal Power			
Elect Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual MU3 Electrical Power			

Table 10 - MU#3 Menu

3.5.4 MU#4 Menu

This menu provides all data and information related to the actual status and operational parameters of MU4.

Description	Default	Range and function	AL
Status	Off	Off, Run, NotAvail, Alm, Stdaln, ComErr, N/Cfgd	
Displays the actual status of MU4. To understand the meaning of the different status parameter values, refer to section 3.5			
Op Sta	Stop	Stop, Run	
This is the current operational status of MU4			
Act Mode	Cool	Cool, Ice, Heat	
Indicates the current operating mode of the MU4			
Load	- %	0 … 100%	
Indicates the current load of the MU4			
ELWT	-.-°C	-50…100°C	
Displays the measured Evaporator Leaving Water Temperature for MU4			
EEWT	-.-°C	-50°C…100°C	
Displays the measured Evaporator Entering Water for MU4			
Evap State	Off	Off, Start, Run	
Indicates the current operational state of MU4's evaporator			
Run Hours	0	0…4294967295	
Displays the total number of hours MU4 has been running.			
Nr Starts	0	0…4294967295	
Displays the total number of starts performed by MU4.			
Defr Op Sta	Off	Off, On	
This indicates whether the MU4 is currently performing operations related to the defrost function			
Therm Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual MU4 Thermal Power			
Elect Pwr	-.- kW	0.0, …,100000000.0 kW	
This shows the actual MU4 Electrical Power			

Table 11 - MU#4 Menu

3.6 Settings

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

Description	Default	Range and function	AL
Min Run Units	1	1, …,4	
This setting allows to define the minimum number of Units that will always run in the system			
Max Run Units	2	1, …,4	
This setting allows to define the maximum number of Units that can be started			
Prio 1st	1	1, …,4	
This setting is used to define the individual priority assigned to MU1			
Prio 2nd	1	1, …,4	
This setting is used to define the individual priority assigned to MU2			
Prio 3rd	1	1, …,4	
This setting is used to define the individual priority assigned to MU3			
Prio 4th	1	1, …,4	
This setting is used to define the individual priority assigned to MU4			
StartUpDT	2.7°C	0.0°C, …,5.0°C	
This setting defines what is the delta temperature with setpoint to force a Modular Unit stage up.			
ShutDwnDT	1.5°C	0.0°C, …,5.0°C	
This setting defines what is the delta temperature with setpoint to force a Modular Unit stage down.			
DeadBand	0.2°C	0.1°C, …,MIN(StartUpDT,ShutDwnDT)°C	
This setting defines what is the temperature range around the actual setpoint in which the subsystem manager will not do staging actions or capacity control.			
ThresCapHigh	80%	30%, …,100%	
This setting is used to set the individual stage up threshold on each Modular Unit. It is used for staging up the Modular Units and, if properly set, can let the MUSE achieve an improved system efficiency.			
ThresCapLow	40%	0%, …,100%	
This setting is used to set the individual stage down threshold on each Modular Unit. It is used for staging down the Modular Units and, if properly set, can let the MUSE achieve an improved system efficiency.			
StageUpTime	300s	15s…1800s	
This value indicates what is the actual stage up time to start the Next On Unit. This is a calculated value.			
StageDnTime	180s	15s…1800s	
This value indicates what is the actual stage down time to shut down the Next Off Unit. This is a calculated value.			
LoadCtrlEn	No	No, Yes	
This setting specifies if the Unit capacity control shall be done by MUSE (Enable) or if a staging only control is needed (Disable).			
LoadCtrlType	Fixed	Fixed, Regime	
This setting specifies the type of load control: • Fixed: MUSE will control the load/unload of the Modular Unit since start-up of the system • Regime: MUSE will control the load/unload of the Modular Units until the system temperature is inside Stage for Load/Unload temperature range.			
UnloadType	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			
Delta Load	15%	10%...100%	
This setting defines the capacity step that the modular unit needs to perform during load or unload of compressors, after MUSE swaps to another unit to load or unload.			
LoadInhibTime	30 sec	0sec...600sec	
This setting defines the wait time after each unit load before MUSE swaps to another modular unit.			
DefrostMngtEn	No	No, Yes	
This value show if Defrost management of MUSE is enabled			
Defr Inhibit Time	5min	0…10min	
This setting defines the time that should expire since modular unit defrost demand before MUSE allow the defrost on Modular Unit			
NrDefrNotAlwd	1	0, …,4	
This value indicates the number of modular units in the MUSE subsystem that are not allowed to Defrost.			

Table 12: Settings page

3.7 Configuration

This section describes the parameters accessible in Configuration menu that help the operator to set the unit in the MUSE subsystem control environment.

Description	Default	Range and function	AL
MU Addr	None	None MU1+MUSE MU2 MU3 MU4	
This parameter sets the role of the modular unit in the MUSE subsystem - MU1+MUSE is the modular unit where subsystem control logic operates, and it manages all the modular units in the subsystem - MU is the modular unit that send its own information to MUSE and receive command and setpoints from MUSE Control Logic			
Num of Units	0	0, ...,4	
This parameter defines the number of units that the MUSE Unit is expected to manage.			
Layout	None	None, Parallel, Series	
This setting specifies whether the modular unit operates with a parallel piping configuration or a series piping configuration			
CmnLWTSnsType	ATEX	None, ATEX	
Defines the type of sensor connected to the MUSE Unit to monitor the supply water temperature to the subsystem. The sensor must be connected, or an alarm will be generated NOTE: this parameter has no effect on others MU			

Table 13 - Configuration page

3.8 Maintenance

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

Disconnect	No	No, Yes	
This allows to disconnect the Modular Units from control of MUSE (MU is set to operate in standalone mode)			
Enable 1st	Enable	Disable, Enable	
This setting allows you to enable or disable the first Modular Unit (MU1), which corresponds to the MUSE unit. When disabled, the unit is marked as *Not Available,* but MUSE logic keeps on working and managing the other MUs. This setting shall be used to stop the MUSE unit for maintenance or other purpose.			
CommAlmDly	5s	0, …,300s	
This setting allows the configuration of the delay time for triggering the communication alarm			
AlmSelfRelTi	5s	0, …,300s	
This setting allows to configure the time interval for alarm self-release			
CmnEvapLwtOffs	0°C	-5, …,5°C	
This setting represents the offset applied to the evaporator common sensor reading .			

Table 14: Maintenance page

ⓘ	In a series configuration, the *LoadCtrlEn* parameter is always set to *Yes*. Additionally, the *UnloadType* parameter within the Load Control function is fixed to the value *HiLoad*.

4 SYSTEM COMMISSIONING

This section will try to explain how MUSE 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 examples, can help to extend the same operations to any plant covered by the MUSE.

4.1 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.

4.2 How to configure MUSE

Configuration settings are divided in three different menus:

1) Main Menu Commission Unit → Configuration → OptionSW
2) Main Menu Commission Unit → Configuration → MUSE Configuration
3) Main Menu →MUSE System → Settings

4.2.1 Unit Configuration → OptionSW Menu

In Menu OptionSW is possible to insert the license key to enable "Modbus Slave MSTP" option (Opt.180).

4.2.2 Unit Configuration → MUSE Configuration Menu

In this menu operator can set the address of the unit in the MUSE subsystem. Unit can be elected as MUSE+MU1 or MUi, with i=2…4.
Also, in this menu, can be selected the following parameters:

- The number of units managed by the MUSE logic
- The Plant layout: identify if MUSE is going to manage modular unit in a Parallel configuration or Series configuration array.
- The type of sensor used for the common leaving water temperature (CmnLWT) of the array

If the MU Addr parameter is set to MU1+MUSE, the CmnLWTSnsType parameter is automatically set to ATEX.
Once all desired values are configured, set the Apply Changes parameter to Yes. This will restart the controller and apply the new settings.

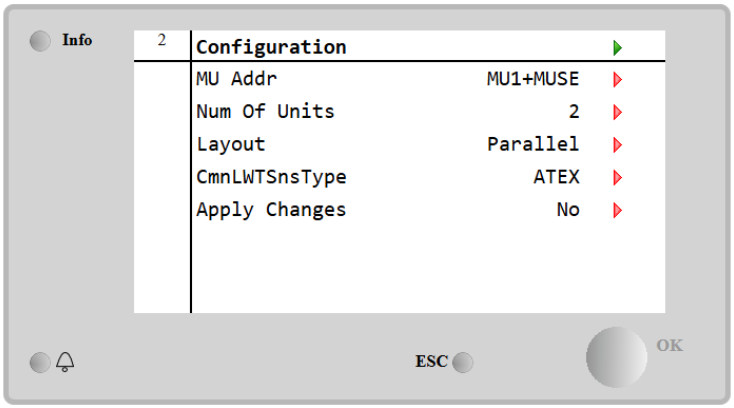

Figure 8 – MUSE Configuration menu

If communication errors between MUSE unit (Master) and MU Slaves occur, network between controllers is not properly installed. Before keeping on configuring system, all communication issues MUST be solved.

4.2.3 MUSE System →Settings menu

In the menu “MUSE System→Settings”, parameter to configure MUSE logic are available. Available options include enabling features such as Load Control or Defrost Management, setting the minimum and maximum number of active units within the logic, and adjusting parameters for staging and sequencing operations.

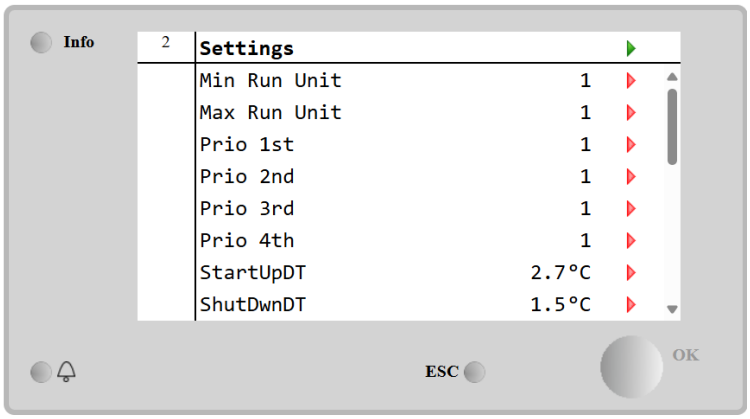

Figure 9 - MUSE Settings menu

4.2.4 Configuring Unit Load Control function

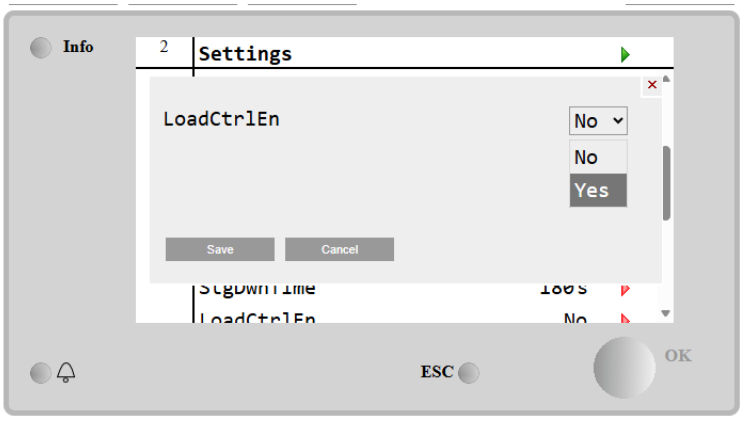

Figure 10 - Load Control No/Yes

ⓘ	If the series configuration is selected for the MUSE array, Load Control is enabled by default

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

4.2.4.1 *Configuring the Load Control Mode*

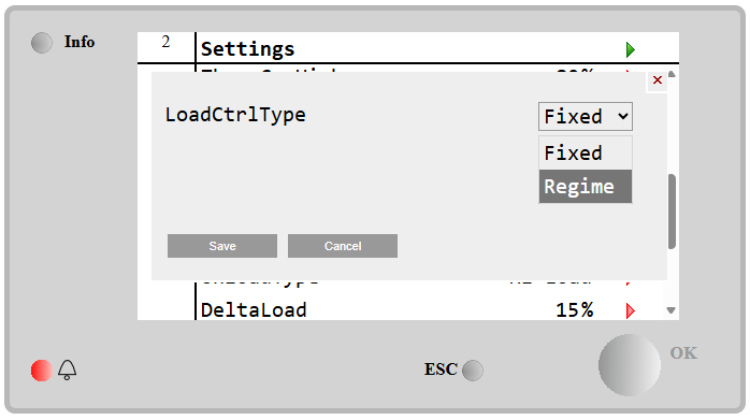

Figure 11 - Load control mode selection

This setting will define when the Load Control will be used. Fixed will give the MUSE the continuous load control of the Modular 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, while in Zone 1 MUSE will only control the staging of the Modular Units. This second option is preferable when the Modular Unit should get to the setpoint quickly and eventually starting more Modular Units than in an optimal situation.

4.2.4.2 *Configuring the Unloading Strategy*

Configuration requires to select the unloading strategy.

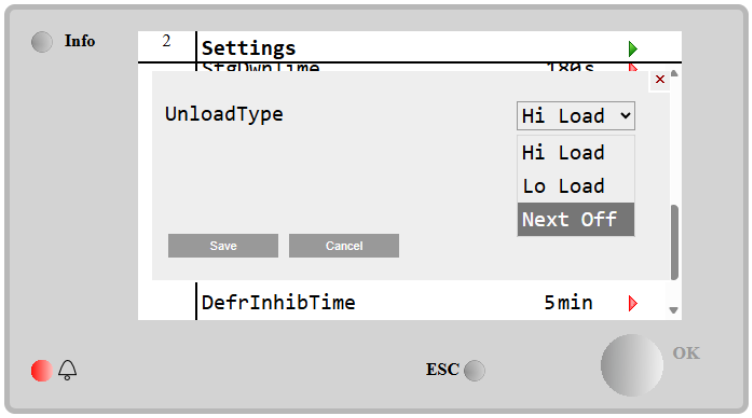

Figure 12 - Unload Type selection

Unload can follow three different strategies that may lead to different distribution of the capacities as seen from the above picture.

With **Hi Load**, MUSE will force the unload of the running MUs 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 MUs 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 Modular Unit with lower capacity per time, down to its stage down threshold. In this case, decrease of system load will be compensated by one Modular Unit at time and left running MUs will keep the achieved capacity. When all the MUs will be unloaded to their stage down thresholds, then one MU 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 Modular Unity capacity reaches the stage down threshold the Modular Unit is switched off. The decrease of system load is compensated by one Unit at time till total shutdown. 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.

ⓘ	If the series configuration is selected for the MUSE array, the only available unload strategy is *Hi Load*.

4.2.5 Configuring Subsystem Mode Management

This setting allows operator to enable the System changeover (management of operating mode of the MU units by MUSE unit).
The Mode Changeover Management feature must be enabled in the iCM settings menu only when the MUSE controller is configured as MUSE + iCM Master. For detailed instructions on how to configure this functionality in this specific setup, please refer to the iCM Manual.
If the iCM option (*Opt.184*) is not enabled, MUSE automatically manages mode changeover by default. In this case, no additional configuration is required to ensure this functionality.
When MUSE assigns an operating mode that a MU in the array cannot support, that MU is marked as Unavailable. Consequently, it is excluded from sequencing and staging operations for as long as the array remains in the selected operating mode.

4.2.6 Configuring Subsystem Defrost Management

This setting displays in Settings menu and allows operator to enable the MUSE Subsystem Defrost Management.

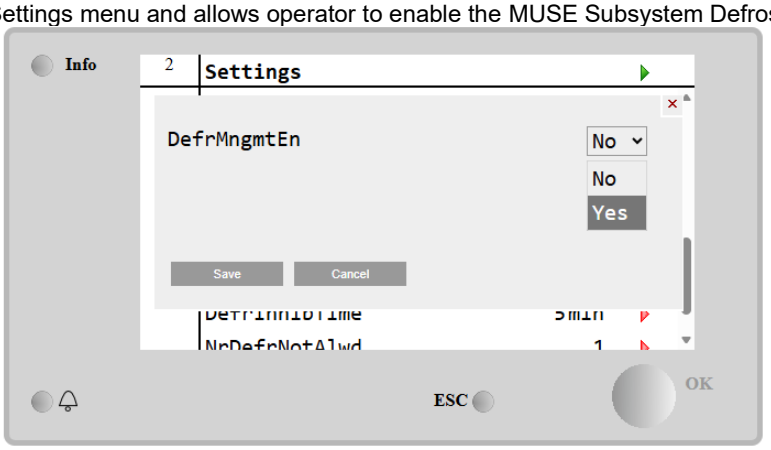

Figure 13 - Defrost Management selection

4.3 How to setup MUSE System Settings

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

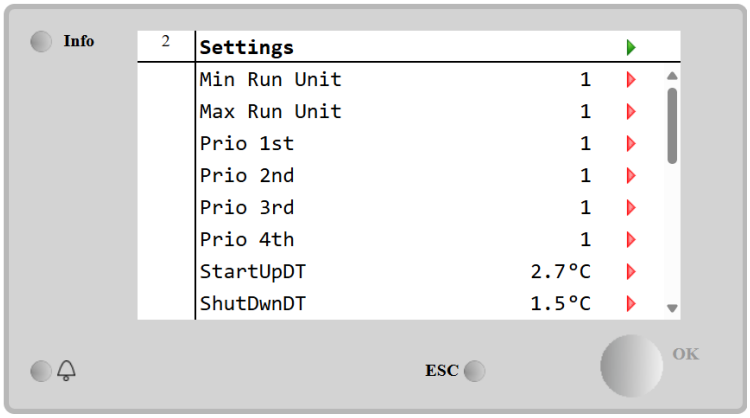

Figure 14 - MUSE System settings page

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

4.3.1 Min and Max Run Units

Following the order of these settings, Min and Max Run Units are used to define the minimum and maximum number of Modular Units that can run.
With Min Run Units is possible to define a number of Modular 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 MUSE will always keep this number of Modular Units enabled.
Operator cannot set which units will be kept enabled, but they depend on sequencing function (at the start up the Next On Units; at system low demand the running Next Off Units).
The Max Run Units defines the maximum number of Modular Units that can run at the same time. With this setting is possible to define a number of Modular Units as backup of the others whose are started in case of alarm. For example, in a system of 4 Modular Units this setting can be set to 3. These 3 Modular Units will be started following the sequence function among the available 3 modular units. If one MU fails, the logic will start the 4th Modular Unit to integrate the capacity request.

4.3.2 Priority

MUSE allows to set individual chiller priorities. When doing this it has to be considered that MUSE accepts grouping of Modular Units. MUs 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 MUs are sequenced to balance run hours and starts.
Changing the priorities will have an impact on the balancing of the run hours.

4.3.3 Staging Settings

Staging Settings affect the staging functions in different ways:

- Staging Thresholds determine the behaviour of Staging for Capacity Range
- Staging Differential temperatures force staging on temperature when the deviation from setpoints is too far
- Staging delay: are used by MUSE logic to stabilize the behaviour of staging function to changes in the system demand.

The following picture shows how the settings of Staging Thresholds, Staging Delta temperature, Staging Delays affects Unit Staging function and Unit Load Control function:

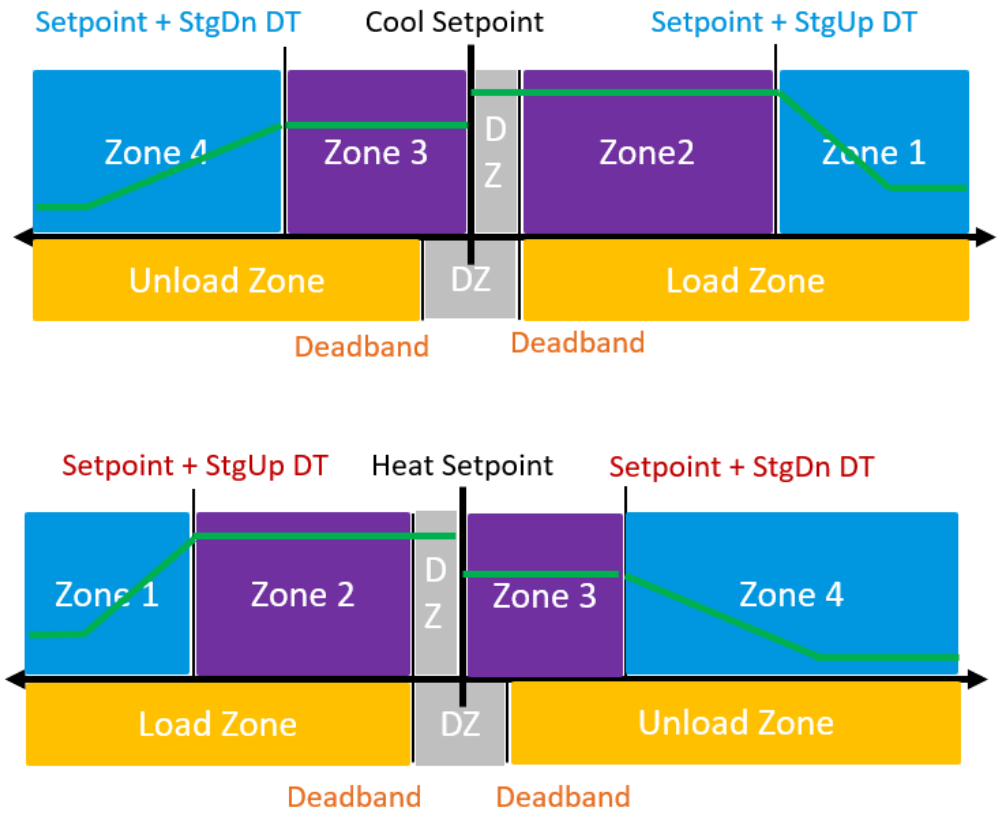

Figure 15 - Staging Setting effects in two pipe plant room

In zone 2 and 3, Staging on Capacity Range is active; in zone 1 and 4 Staging on temperature takes over the staging on Capacity Range. Outside the Dead zone around the setpoint, Unit Capacity control is working.

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

4.3.4 Staging Capacity Thresholds

The staging Up and Down Thresholds define the management of the start and stop strategy of the Modular Units and, if Unit Load control function is enabled, the management of load up and load down range of the MUs.

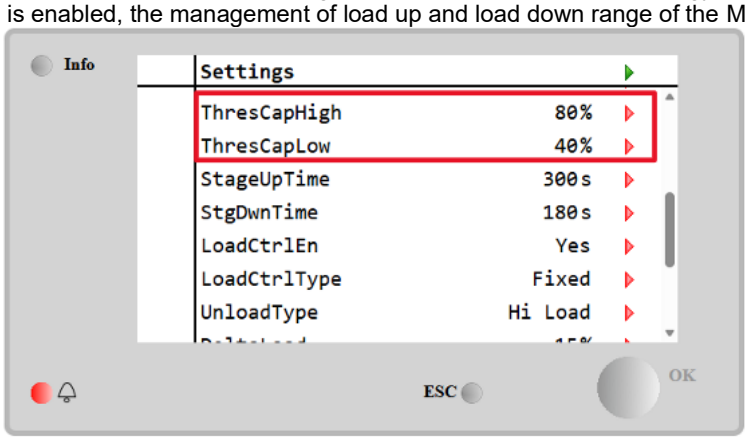

Figure 16 - Staging thresholds

Selection of optimal Staging thresholds depends on several factors: number and size of Modular Unit, type of compressor, etc.
In general, Stage Up and Stage down thresholds are set in order to make the Modular Unit work inside a capacity range in which the specific MU has the higher efficiency. The thresholds are the same for both cooling and heating.
Moreover, it is worth noting that the lower is staging up threshold (ThresCapHigh parameter) , the higher will be the number of started MUs, leading to a partial load sharing, whereas the higher is the staging up threshold, the lower will be the number of started MUs, leading to a full load step staging.

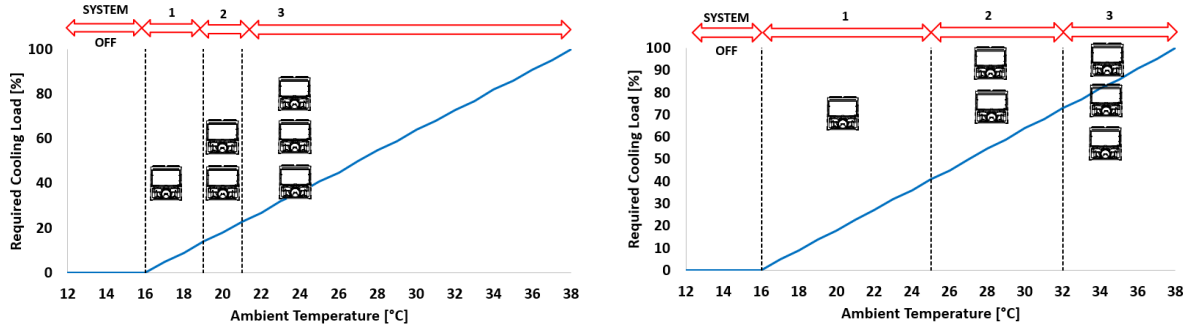

Figure 17 Load Sharing VS Minimum running Units

It's important to consider that the overall system efficiency is not only achieved letting the MUs work in their best efficiency range, but it depends on other systems that have electrical consumption and own efficiency that shall be considered.
Concerning the stage down capacity thresholds (ThresCapLow parameter) , this determines when a running MU must be stopped: the higher is the value, the smaller is the number of running MU, whereas the lower is the value, the larger will be the number of running MUs at partial load.
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 MU and it can force MUSE to load up the remaining running MUs to compensate the requested system load and even to start again another stopped MU. That can cause a fluctuation of leaving water temperature and unnecessary start and stop of the MUs.
For example, in case of process application, to decide how to set the stage down thresholds, note down the minimum capacity percentage of each MU and use this value to configure the thresholds. This will permit the MUSE to unload the MUs 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.
In heating mode, it can be convenient to have more Units at part load because this may mean less defrosts over time.
Moreover, the Stage up and down threshold has an impact on the Load Control. In fact, MUSE progressively loads each running MU up to stage up threshold. So, a too low Stage up threshold will force the system to start all the MUs and reach the stage up threshold before releasing the loading up to maximum system capacity.
In case of decrease of system load, MUSE will load down the MUs down to stage down capacity before stopping a running MU (if unload type is high load or Low load) or MUSE will load down the Next Off Unit to stage down capacity before stopping the MU 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 MUs.

4.3.5 Staging Temperature Differentials

The staging temperature thresholds and deadband are used to define the regulation zones for MUSE when Staging on Capacity Range and/or Unit Load Control (If enabled) and Staging for temperature are active.

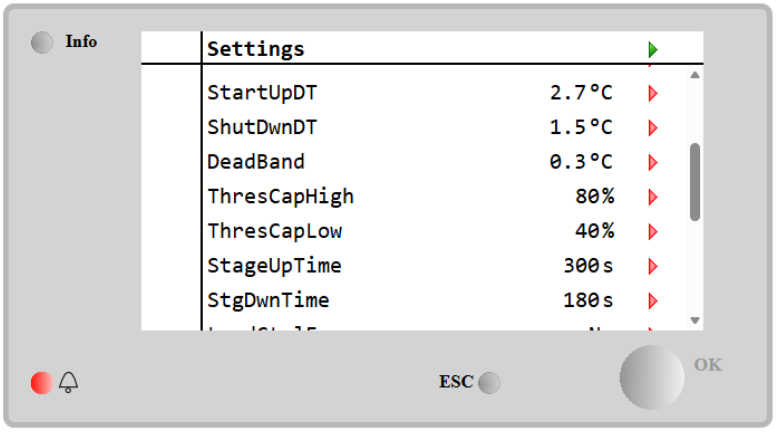

Figure 18 - Staging temperature thresholds configuration

If controlled temperature is higher than setpoint + StartUpDT, MUSE starts an additional MU without considering actual capacity of running MUs, whereas if the controlled temperature is lower than setpoint - SthutDwnDT, MUSE stops a running MU without considering actual capacity of the running MUs. 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 to start/stop the unit efficiently. In fact, a too low Stage Up DT can lead to unnecessary start-up of MU and a too low Stage Down DT can lead to unnecessary shut down of a MU.
Regarding the deadband, this parameter affects Unit Capacity Control logic, if enabled. When controlled temperature is inside range between setpoint and setpoint + deadband, MUSE will stop to load or unload the MU. 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 MUSE to follow controlled temperature fluctuations, which might be needed in process application when operator can set 0,3...0,5°C.

4.3.6 Staging Delays

The stage up and down of a MU are defined also following delays. The delays are introduced to limit the simultaneous starts of different MUs in the subsystem and to let the MUs load up or down to influence the water temperature.
These timers are fixed for both Stage Up and Stage Down zones and remain the same regardless of the MUSE operating mode (Cooling or Heating).
The delays are started at each start up or shut down of a MU.

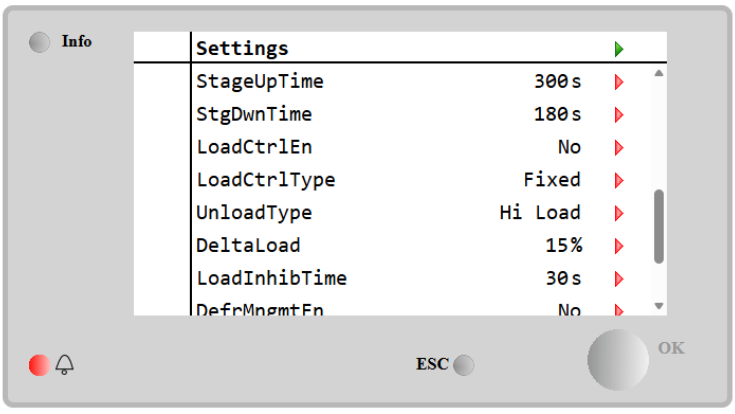

Figure 19 - Stage delays configuration

4.3.7 Unit Capacity Control

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

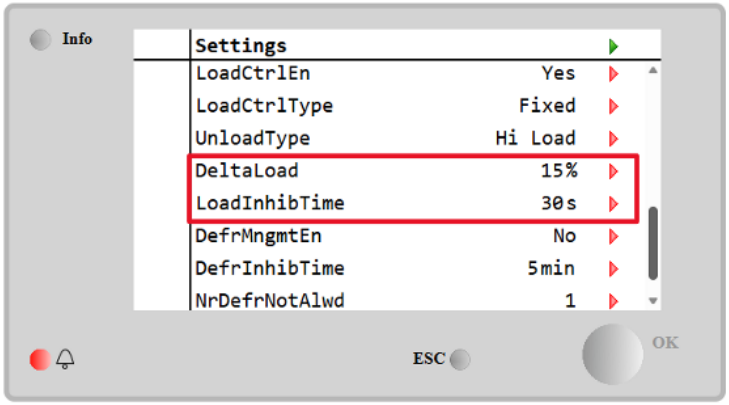

Figure 20 - Unit Capacity Control Settings

When load control is enabled and active, MUSE controls the load up and load down of the MUs one by one. The Delta Load represents the percentage of capacity that loading/unloading MU must generate from its actual capacity before MUSE switches to load/unload the next MU. In case of Load up (controlled temperature is higher than setpoint + deadband), after each capacity step of the loading Unit, MUSE will wait for LoadInhibTime to expire and then it commands the load up of the next MU. During Load down (controlled temperature is below setpoint - deadband), after each unload step, MUSE will wait for LoadInhibTime to expire before commanding to unload the next MU. Inside the deadband, MU will keep the reached capacity.
The Load/Unload inhibition timer is the same for both Load Up and Load Down operations.
These timers should provide to MUSE the time to evaluate the impact of each delta capacity increase or decrease on controlled temperature and, at the same time, prevent MUSE from delaying the load Up or shortening the load down with consequently system capacity fluctuation. In fact, a too short Load timer can cause an increase of Modular 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 Modular Unit.
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.

5 MUSE SUBSYSTEM OPERATING

This chapter explains how to interact with controllers where MUSE is configured.
Firstly, it must be highlighted that MUSE logic is embedded in the unit controller. When a unit is elected as “MUSE” in an array of modular units, main setpoints on MUSE unit controller will be used as “System Setpoints” of that array. On the other hand, the “MU” units are under MUSE control and receive operating setpoints and commands from the MUSE controller. If a “MU” unit is set in “Standalone” mode through HMI setting, it operates independently using its own setpoints.

5.1 Subsystem Enable setpoint

The enabling conditions on MUSE unit controller, generally checked to enable a unit, must be satisfied to enable MUSE logic and consequently the system sequencing and staging. Those conditions are the following:

1. “Unit Enable” = ON on unit controller HMI
2. “Unit Switch” turned ON on the unit cabinet
3. “Netwrk En Sp” on unit controller HMI (only if “Control Source” = Network, i.e. MUSE is commanded by third party BMS though protocol communication with object “Chiller Enable Setpoint – Network”)

If all the above conditions are true on MUSE Unit controller, in menu

- “MUSE System → Status” = “Run”

and MUSE sequencing and staging logic will be performed.

If one of the above conditions is false on MUSE Unit, MUSE sequencing and staging logic is stopped and all the units will be stopped by MUSE controller.

5.1.1 MUSE Disable

If user would like to stop the MUSE unit and take it out of sequence, keeping MUSE logic running, he should operate on the setpoint in menu

- “MUSE System → Maintenance → Enable 1st ” = Disable

In this way, state of MUSE unit will become “Not Available” and will be stopped. At the same time MUSE logics keeps on sequencing the other available units.

5.1.2 MU Disable

If user would like to stop a MU unit and take it out of sequence, he should set one of the enabling conditions to false.
When MU unit is disabled, MUSE logic will consider it as “Not available” and consequently, out of sequencing logic. MUSE logic will send stop command to that MU, and it will show in menu

- “MUSE System → MUs Data → MU#i → Status” = N/Av (not available)

where “i” represents the address number assigned to the unit within the array

5.2 Subsystem water temperature setpoints

To set temperature setpoints, used by MUSE for sequencing and staging logic, user should operate on Cool or Hot setpoint on MUSE Unit controller.
It must be highlighted that MUSE can sequence the units according to Subsystem (MUSE array) Leaving water temperature.

5.2.1 Subsystem Cool Setpoint

User must change the setpoint of the MUSE unit controller HMI:

- “Cool LWT 1”

Typically, this is located under *Main Menu → Setpoint → Cool LWT 1*. However, the exact path may vary depending on the HMI layout of the modular unit in use.
When operating in cooling mode, the Cool setpoint on MUSE becomes the 'Subsystem Active Setpoint'.

5.2.2 Subsystem Heat Setpoint

If the MUSE is a Heat-pump, user should operate on the setpoint of the MUSE controller HM:

- “Heat LWT 1”

Typically, this is located under *Main Menu → Setpoint → Heat LWT 1*. However, the exact path may vary depending on the HMI layout of the modular unit in use.
When operating in heating mode, the Heat setpoint on MUSE becomes the 'Subsystem Active Setpoint'.

5.2.3 Subsystem Setpoints by Network communication

It worth noting that if MUSE controller is connected to a third party BMS and “Control Source = Network” on MUSE controller HMI, BMS can write the temperature setpoints on MUSE; those setpoints will become the “Active setpoints” on MUSE unit controller and consequently for MUSE logic.
BMS should operate on

- Cool Setpoint – Network
- Heat Setpoint – Network

on MUSE Unit protocol communication (Please refer to specific Unit Protocol Communication Mapping).
Those setpoints can be used to set Subsystem Temperature Setpoints in MUSE logic.

The above setpoints set by BMS on MUSE unit controller can be checked on HMI:

- View/Set Unit → Network Control → Cool LWT
- View/Set Unit → Network Control → Heat LWT

5.2.4 Subsystem Active Setpoint

Once Temperature setpoints and Operation Mode (Cool/Heat) are set on MUSE controller, “Active setpoint” of MUSE will become “Subsystem Active Setpoint”.
MUSE unit controller sends the “Subsystem Active Setpoint” to all the MUs. This setpoint overwrites the “Local” setpoints of the MUs and it can be visualized in each unit in main page

- “Main Menu → Setpoints”.

5.3 Subsystem mode and System mode setpoint

To allow changeover of the operation mode in the sequencing and staging logic of MUSE, user should operate on setpoints on MUSE unit controller.
The following conditions trigger the mode-changeover from Cool mode to Heat Mode:

1. “Unit Available Mode = Cool/Heat” on controller HMI (showing that unit is a heat-pump and changeover is possible)
2. “Mode Switch” is turned on “Heat” on Unit cabinet
3. “Network Mode” = Heat” on controller HMI (only if “Control Source” = Network, i.e. MUSE unit is commanded by third party BMS through protocol communication with object “Unit Mode Setpoint – Network”).

If one of the previous conditions should become “Cool”, MUSE change Subsystem operation mode in “Cool”.
If one of the previous conditions should become “Heat”, MUSE change Subsystem operation mode in “Heat”
Subsystem Operation Mode can be checked in menu:

- “MUSE System → Act Mode”

ⓘ	If a modular unit should not be set with same operation mode of the modular unit elected as MUSE, MUSE logic will consider it “Not Available” and stop it.

For changeover management on all other modular units within the array, MUSE will set the Subsystem mode on all the connected MUs

ⓘ	Subsystem Mode Setpoint by MUSE takes over the previous conditions on the MUs (Mode Switch and Network mode setpoint are ignored by modular unit controller).

5.4 Subsystem controlled temperature

This variable represents the temperature at MUSE subsystem level that MUSE tries to affect with sequencing and staging of the units to achieve the system temperature setpoint. The variable is shown in menu:

- “MUSE System → Ctrl Temp”

5.5 Safety behaviour in case of Communication Error

If communication between MUSE and one or more MUs is lost, the unit behaviour depends on the selected layout. In Series configuration, a Communication Error affecting either the MUSE unit or any Slave MU leads the whole array to Rapid Stop. In Parallel configuration, loss of communication with the MUSE unit causes the Slave MUs to enter Rapid Stop when the MUSE Communication Alarm is detected. If the Communication Error affects only a Slave MU, the affected Slave is excluded from sequencing and staging, while the MUSE subsystem continues to operate with the remaining available units

5.6 Standalone Mode

In any moment, setting a modular unit in “Standalone” mode allows to operate the unit independently from MUSE control. User needs to set the related setpoint in menu:

- “Maintenance → Disconnect” = Yes

When a unit is set in “Standalone” mode, MUSE cannot manage the unit that is considered out of sequencing logic. Moreover, unit starts to work with local settings: Enable setpoint, Temperature setpoints, Operation Mode setpoint.
User can check the unit set “Standalone” on master unit controller in menu:

- “MUs Data → MU#*N* → Status”

where *N* represents the index associated to the MU which is set in “Standalone” mode.

5.6.1 Setting MU in Standalone

If a MU unit is set “Standalone”, it cannot become Next On or Next Off unit and user must operate locally.
Once a modular unit is set again under MUSE control (setting “Disconnect” = No), MUSE starts to operate the unit in the last found status. In other words, if the unit previously in “Standalone”, was running, MUSE lets the unit running and stops it only if Stage Down conditions are satisfied. Likewise, if the unit previously in “Standalone”, was stopped, MUSE leaves the unit stopped and available for sequencing and staging.

5.6.2 Setting MUSE in Standalone

If MUSE unit is set “Standalone”, all the units in the system start to work in “Standalone” mode and MUSE cannot manage them.
Only when MUSE is set back to “Not standalone”, MUSE start to manage the units, keeping them in the last operating status and start the sequencing and staging logic.

5.7 Subsystem Overview

On MUSE unit controller HMI, Main menu shows an overview of the status of the units through icons:

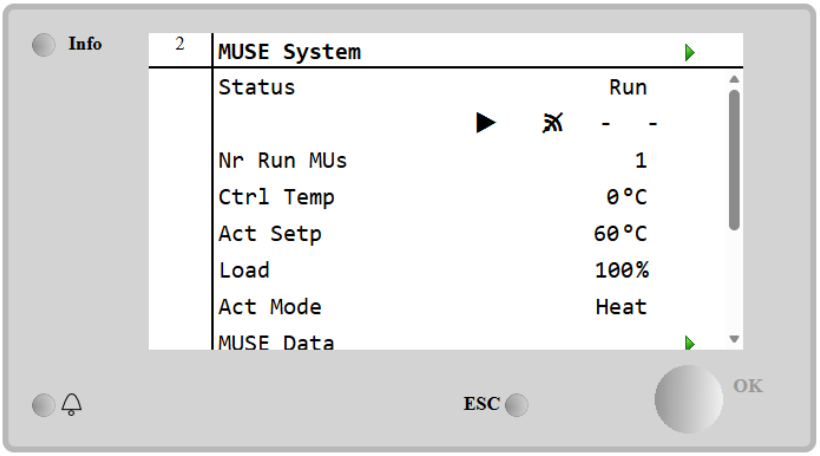

Figure 21 - Subsystem Overview on MUSE System page of MUSE unit HMI

The icons represent the different operating statuses of the units. Their meanings are described in the table below.

Icon	Status	Description
	*Off*	the Modular Unit is currently Off
	*Run*	the Modular Unit is currently running
	*Alarm*	the Modular Unit has an active alarm
	*ComErr*	the Modular Unit is not communicating with the MUSE controller. In Series configuration, this condition leads to Rapid Stop of the whole MUSE array. In Parallel configuration, if the communication error affects a Slave MU, only the affected Slave is excluded from sequencing and staging and the subsystem continues to operate with the remaining available units. If communication with the MUSE unit is lost, Slave MUs enter Rapid Stop when the MUSE Communication Alarm is detected.
	*StdaIn*	the modular unit functions independently from the MUSE control logic and other modular units in the array. In this configuration, the unit manages its own operating parameters and setpoints,
	*N/Av*	the Modular Unit is “Not Available” and stopped by MUSE, i.e out of sequencing and staging control, for one of the following conditions: • “Unit Switch” or all the “Circuit Switch” on unit electrical panel are turned OFF. • Modular Unit is set with “Operation Mode” (Cool/Heat), different from MUSE Operation Mode. (This is applicable only in case system composed by Heat-pump units or in mixed system with Heat-pump and Chiller units).
–	*N/Cfg*	Modular unit does not exist

Table 15 - MUSE modular unit status icons

At any moment, user can check all the information about subsystem management and unit statuses on MUSE unit HMI in menu:

- “Main Menu → MUSE System → MUSE Data”
- “Main Menu → MUSE System → MUs Data”

6 TROUBLESHOOTING

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

6.1 MUSE Alarms

6.1.1 Common Evaporator LWT Sensor Fault

This alarm indicates that the sensor for the Cool/Heat water header on Evaporator side is not working properly.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *MuseCmnEvapLwt SenfSen* Forced Start of all Units, Load control disabled, All Units in Local.	Sensor is broken.	Check for sensor integrity according to 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 to electrical scheme.
Reset		**Notes**
Local HMI Network	□ □	

6.1.2 MU Communication Error

This alarm on the MUSE controller indicates that communication with one Slave is not working properly. The resulting action depends on the selected layout: in Series configuration the whole MUSE array is brought to Rapid Stop; in Parallel configuration only the affected Slave MU is excluded while the subsystem continues to operate with the remaining available units. 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: MU# CommErrAlm. # identifies the MU number	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 Modular 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 Modular 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. If the event has caused a Rapid Stop, the array can be restarted only after the communication fault has been solved and the Rapid Stop or related alarm condition has been reset according to the applicable unit procedure.

6.1.3 MU Missing Alarm

This alarm on the **MUSE** 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: *MU# MissingAlm* *# identifies the MU number* Modular Unit Not available for sequencing and staging.	Wrong configuration of the system.	Check the number of configured Units and the corresponding individual Modular Units' configurations. All the Modular Units must be configured with a different address and the number of Modular Units configured on the MUSE matches the number of Modular Units in the system.
Reset		**Notes**
Local HMI Network Auto	□ □ □	The alarm clears automatically when the communication is re-established.

6.1.4 MUSE Shutoff Alarm

This alarm on the **MUSE** controller, indicates that all the MUs (MUSE included), or all their circuits, are in an unavailable state.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: *MuseShutAlm* All Modular units are turned off because they have active unit alarms or alarms on both circuits, which result in the shutdown of the respective unit.	Each MUs as is own AlarmState set to True. Possible alarm causes include sensor faults on the Leaving Water Temperature (LWT), refrigerant leaks, communication errors with compressors or fans, external alarms, fan damage, power loss at startup, and other related issues. Note: These alarms refer to individual units. For details on the root cause, please refer to the documentation of the specific unit.	Check MUs HIMI. To clear this MUSE-related alarm, it is necessary to resolve the root cause of the alarms on the individual modular units (MUs) by referring to their respective documentation
Reset		**Notes**
Local HMI Network Auto	□ □ □	The alarm clears automatically when almost one MU as its own AlarmState set to True.

6.2 MUs Alarms

6.2.1 MUSE Communication Error

This alarm on the MU controller indicates that communication with the MUSE is not working properly. The Slave MU enters Rapid Stop when the MUSE Communication Alarm is detected. This behaviour has priority over local autonomous operation. 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: MuseCommError Alm	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 Modular 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 Modular 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 communication with the MUSE controller is re-established. After Rapid Stop, restart only after the communication fault has been removed and the Rapid Stop or related alarm condition has been reset according to the applicable unit procedure.

6.2.2 Muse Missing Alarm

This alarm on the MU controller indicates that the MUSE is not visible in the network. This can happen during the system configuration if the MUs are configured first. During operation, loss of communication with the MUSE controller leads the Slave MU to Rapid Stop according to the safety logic described in section 4.2.

Symptom	Cause	Solution
Bell icon is moving on controller's display. String in the alarm list: MUSE Missing Alm	Wrong configuration of the system.	Configure the MUSE address and the number of Units on the MUSE controller.
Reset		**Notes**
Local HMI Network Auto	□ □ □	The alarm clears automatically when the communication is re-established.

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