USER GUIDE

MAN0146 rev 9

CXpro^{HD} Applications Library

Style conventions used in this document:

UI Text: Text that represents elements of the UI such as button names, menu options etc. is presented with a grey background and border, in Tahoma font which is traditionally used in Windows UIs. For example:

`Ok`

Standard Terms (Jargon): Text that is not English Language but instead refers to industry standard concepts such as Strategy, BACnet, or Analog Input is represents in slightly condensed font. For example:

BACnet

Code: Text that represents File paths, Code snippets or text file configuration settings is presented in fixed-width font, with a grey background and border. For example:

```
$config_file = c:\CYLON\settings\config.txt
```

Parameter values: Text that represents values to be entered into UI fields or displayed in dialogs is represented in fixed-width font with a shaded background. For example

`10°C`

Product Names: Text that represents a product name is represented in bold colored text. For example

INTEGRA™

Company Brand names: Brands that are not product names are represented by bold slightly compressed text:

ABB Active Energy

PC Keyboard keys: Text representing an instruction to press a particular key on the keyboard is enclosed in square brackets and in bold font. For example:

[Ctrl]+[1]

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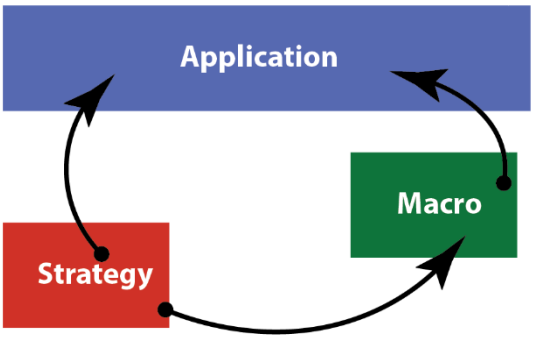
1 Introduction

WHAT IS THE CXPRO^{HD} APPLICATIONS LIBRARY?

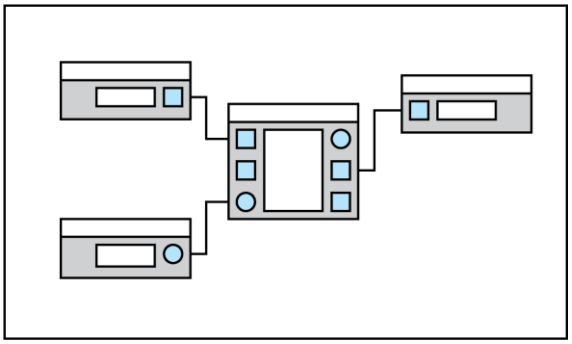
Cylon provides a library of pre-written Sample Applications and Pre-Engineerined Strategiesthat can be used to build a Site with the minimum effort. This CXpro^{HD} Application Library consists of pre-made strategies representing standard real-world use cases. Each Library Application can be used as it is, by copying its content into a controller or controllers on your site. The documentation in this index can then be copied verbatim to create user documentation for the site.

Note: Each of the Library Applications has certain points that are exposed on the BACnet system. In some Library Applications, there are additional points that are available to be exposed manually if required for specific implementations.

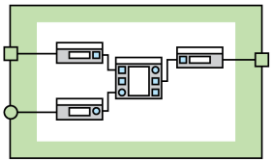
STRATEGY VS MACRO VS APPLICATION



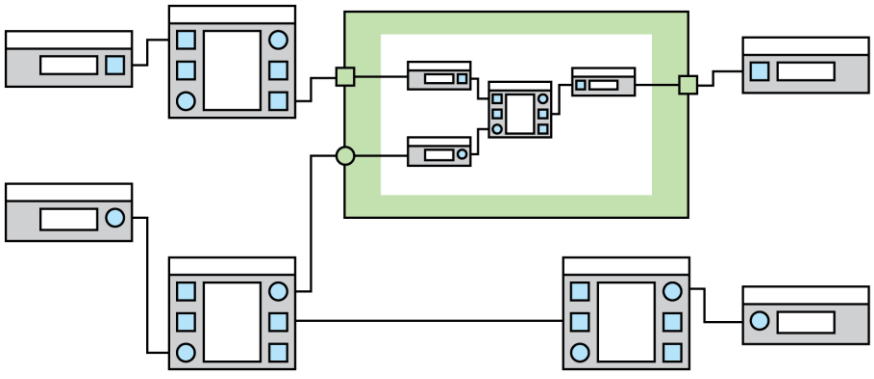
The CXpro^HD allows any custom strategy to be created by connecting modules.



However, to save time it is possible to group elements of a strategy into a Macro so that their combined functionality can be easily reused:



When strategy modules – and, if appropriate, macros- are combined, they provide the functionality required for a real-world Application such as AHU control, or Twin Pump with weekly changeover.



HOW TO USE CXpro^{HD} LIBRARY APPLICATIONS

The Applications Library can be found in the CXpro^{HD} Site Tree, where there is a pre-installed site containing a controller for each Library Application.

Each Library Application is a pre-configured strategy, based around one or more Macros whose internal settings can be adjusted for specific installations. The strategies can be copied as required to controllers on the user's site and adjusted if required for the specific needs of that site. This document also contains boilerplate text specific to each Library Application that can be copied into user documentation.

There is a section in this document for each Library Application, and each section is in two parts:

1. The first part gives a summary of the Application, lists any Macros used and shows the preset values of the each Macro's internal settings.
2. The second part is a generic description of the Application that can be copied into customer-facing documentation.

If one of the Library Applications described in this appendix provides functionality that matches or is close to the required functionality for a controller on your Site:

1. Find the corresponding Controller on the preinstalled Sample Applications Site in the CXpro^{HD}.
2. Copy the Strategy from the Controller into the Controller you are configuring on your own Site.
3. Adjust the Library Application if required, by changing the options in any Macros listed in the corresponding subsection of this appendix.
4. Copy the text of the subsection (excluding the first page) into the site description document for your own Site, if required.

2 Sample Applications

001 - WET SYSTEMS

1.1.1.1 SINGLE PUMP WEEKLY CHANGEOVER WITH DPS MONITORING

Summary

This Sample Application will control a single pump, using a DPS (Differential Pressure Switch) to monitor the flow. If no flow is detected an alarm will be raised at the Supervisor but the pump will remain enabled. When the pump has run for 5,000 hours a Maintenance alarm will be raised at the supervisor.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User has access only to the enable override.

Number of Strategy blocks used	**70**

This Sample Application uses the following macros:

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	1	No - Run
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following page.

Single pump weekly changeover with DPS monitoring

System overview

The pump system consists of the following plant:

- Single pump with DOL (Direct On Line) starter.
- DPS (Differential Pressure Switch) across the pump.

The pump will be enabled on demand.

System control

The system will be enabled when any plant requiring CT (Constant Temperature) water calls for it.

The system will be disabled when no plant requires CT water.

When the system is enabled any faults will be reset and the pump will be enabled.

When the system is disabled the pump control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.1.2 SINGLE PUMP WEEKLY CHANGEOVER WITH TRIP MONITORING

Summary

This Sample Application will control a single pump. The system will monitor the Trip of the pump starter and if a Trip is detected, an alarm will be raised at the Supervisor and the pump will be disabled. The pump will remain disabled until the alarm is reset by the operator at the Supervisor or the Enable signal goes off. When the pump has run for 5,000 hours a Maintenance alarm will be raised at the Supervisor.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

Number of Strategy blocks used	**70**

This Sample Application uses the following macros:

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	2	Trip
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following page.

Single Pump Weekly Changeover with Trip Monitoring

System overview

The pump system consists of the following plant:

- Single pump with DOL (Direct On Line) starter with trip contact.

The pump will be enabled on demand.

System control

The system will be enabled when any plant requiring CT (Constant Temperature) water calls for it.

The system will be disabled when no plant requires CT water.

When the system is enabled any faults will be reset and the pump will be enabled.

When the system is disabled the pump control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pump reset

The pump can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.1.3 SINGLE PUMP WEEKLY CHANGEOVER WITH PRESSURE CONTROL

Summary

This Sample Application will control a single pump with a pressure control. If the pressure deviates from the setpoint by 10% while the system is running, then an alarm will be raised at the supervisor and the pump will remain disabled.

When the pump has run for 5,000 hours a Maintenance alarm will be raised at the Supervisor.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

Number of Strategy blocks used	**71**

This Sample Application uses the following macros:

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	4	Pressure Mismatch
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Max Pressure Error	100	Pa
	0.01	psi
Start Delay	10	Seconds
Maintenance Limit	5000	Hours
Run On Time	600	Seconds

A System Description for any system based on this Sample Application is given on the following page.

Fixed Speed Weekly changeover with Pressure Control

System overview

The pump system consists of the following plant:

- Single pump with DOL (Direct On Line) starter.
- Pressure sensor across the flow and return.

The pump will be enabled on demand.

System control

The system will be enabled when any plant requiring CT (Constant Temperature) water calls for it.

The system will be disabled when no plant requires CT water.

When the system is enabled any faults will be reset and the pump will be enabled.

When the system is disabled the pump control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pressure control

When the pressure control is enabled it will ramp up the speed of the pump to achieve the required system pressure. The rate of change of the output will be limited to 3.3 % per second for the initial 30 seconds of start-up. The pressure control will then modulate the speed of the pump to maintain the required system pressure.

If the pressure sensor deviates from the required pressure setpoint by ±100pa for 10 seconds, then the pump will be deemed as failed and a pressure field alarm will be raised at the supervisor.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.1.4 TWIN PUMP WEEKLY CHANGEOVER WITH DPS MONITORING

Summary

This Sample Application will control a twin pump set with a DPS to monitor the flow. It is suitable for either common DPS (Differential Pressure Switch) monitoring the two pumps or a DPS across each pump. If a common DPS is used, it must be connected to both DP1 and DP2 of the Macro.

If no flow is detected, an alarm will be raised at the supervisor and then the standby pump will be started. If no flow is detected when the standby pump is enabled, a system failed alarm will be raised at the supervisor and the standby pump will remain enabled.

When a pump has run for 5,000 hours a Maintenance alarm will be raised at the supervisor.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

The designation of “lead” pump and “standby” pump will be changed at 2:00am on Sunday.

Number of Strategy blocks used	**162**

This Sample Application uses the following macros:

Macro: TWIN PLANT CONTROL

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	1	No – Standby Run
Fault Monitor Delay	20	Seconds
Fault Delay	5	Seconds
Start Delay	10	Seconds
Runtime Limit	5000	Hours
Run on time	600	Seconds
Lead Pump Changeover	0	Time of Day
TimeOfDay (Day) (Hour)	Sun 2	Only Sunday checked Hours
Hours Run Changeover	0	Hours
Min Off Delay	120	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

Twin Pump Weekly Changeover with DPS Monitoring

System overview

The pump system consists of the following plant:

- Two pumps with DOL (Direct On Line) starters.
- Two DPS (Differential Pressure Switches) one across each pump.

The pumps will be enabled on demand.

The pumps will operate in a duty-standby sequence with the lead pump changing each week.

System control

The system will be enabled when any plant requiring CT (Constant Temperature) water calls for it.

The system will be disabled when no plant requires CT water.

When the system is enabled any faults will be reset and the pump will be enabled.

When the system is disabled the pump control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pump rotation

The lead pump will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor:

1. To fix the lead pump disabling the automatic rotation.
2. To fix the running pump and disable the other pump.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.1.5 TWIN PUMP WEEKLY CHANGEOVER WITH TRIP MONITORING

Summary

This Sample Application will control a twin pump set monitoring the pump trips.

If a trip is detected on the lead an alarm will be raised at the Supervisor, the lead pump with be stopped and the standby pump will be started.

If a trip is detected when the standby pump is enabled, a system failed alarm will be raised at the supervisor and the standby pump will be disabled. When a pump has run for 5,000 hours a Maintenance alarm will be raised at the supervisor.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

The designation of “lead” pump and “standby” pump will be changed at 2:00am on Sunday.

Number of Strategy blocks used	**162**

This Sample Application uses the following macros:

Macro: TWIN PLANT CONTROL

Option	Value	Comment
Fault Select	2	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	No – Standby Run
Fault Monitor Delay	20	Seconds
Fault Delay	5	Seconds
Start Delay	10	Seconds
Runtime Limit	5000	Hours
Run on time	600	Seconds
Lead Pump Changeover	0	Time of Day
TimeOfDay (Day) (Hour)	Sun 2	Only Sunday checked Hours
Hours Run Changeover	0	Hours

A System Description for any system based on this Sample Application is given on the following pages.

Twin Pump Weekly Changeover with Trip Monitoring

System overview

The pump system consists of the following plant:

- Two pumps with DOL (Direct On Line) starters with trip contacts.
- The pumps will be enabled on demand.

The pumps will operate in a duty-standby sequence with the lead pump changing each week.

System control

The system will be enabled when any plant requiring CT (Constant Temperature) water calls for it.

The system will be disabled when no plant requires CT water.

When the system is enabled any faults will be reset and the pump will be enabled.

When the system is disabled the pump control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pump rotation

The lead pump will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead pump disabling the automatic rotation.
2. To fix the running pump and disable the other pump.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.1.6 TWIN PUMP WEEKLY CHANGEOVER WITH PRESSURE CONTROL

Summary

This Sample Application will control a twin pump set with a static pressure sensor to monitor the flow.

If a pressure mismatch is detected on the lead, an alarm will be raised at the Supervisor, the lead pump will be stopped and the standby pump will be started.

If a pressure mismatch is detected when the standby pump is enabled, a system failed alarm will be raised at the supervisor and the standby pump will be disabled.

When a pump has run for 5,000 hours a Maintenance alarm will be raised at the supervisor.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

The designation of “lead” pump and “standby” pump will be changed at 2:00am on Sunday.

Number of Strategy blocks used	**163**

This Sample Application uses the following macros:

Macro: TWIN PLANT CONTROL

Option	Value	Comment
Fault Select	4	Pressure
DPS Fault Monitor	0	Run Only
Stop on Fault	0	No – Standby Run
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Max Pressure Error	100	Pa
	0.01	psi
Start Delay	10	Seconds
Runtime Limit	5000	Hours
Run on time	600	Seconds
Lead Pump Changeover	0	Time of Day
TimeOfDay (Day) (Hour)	Sun 2	Only Sunday checked Hours
Hours Run Changeover	0	Hours

A System Description for any system based on this Sample Application is given on the following pages.

Twin pump weekly changeover with pressure control

System overview

The system consists of the following plant:

- Two pumps with inverters.
- One pressure sensor common to both pumps.

The pump system will be enabled on demand.

The pumps will operate in a duty-standby sequence with the lead pump changing each week.

The running pump's speed will be varied to maintain the required system pressure.

System control

The system will be enabled when any plant requiring CT (Constant Temperature) water calls for it.

The system will be disabled when no plant requires CT water.

When the system is enabled any faults will be reset and the pump will be enabled.

When the system is disabled the pump control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pressure control

When the pressure control is enabled it will ramp up the speed of the pump to achieve the required system pressure.

The rate of change of the output will be limited to 3.3 % per second for the initial 30 seconds of start-up. The pressure control will then modulate the speed of the pump to maintain the required system pressure.

If the pressure sensor deviates from the required pressure setpoint by ±100 Pa (±0.01 psi) for 10 seconds, then the pump will be deemed as failed and a pressure field alarm will be raised at the supervisor.

Pump rotation

The lead pump will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To rotate the lead pump. The lead pump will still be changed automatically.
2. To fix the lead pump disabling the automatic rotation.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.2.1 VT SINGLE PUMP WEEKLY CHANGEOVER WITH DPS MONITORING

Summary

This Sample Application will control a single pump with a DPS (Differential Pressure Switch) to monitor the flow and the flow temperature (VT = Variable Temperature).

If no flow is detected, an alarm will be raised at the supervisor but the pump will remain enabled. When the pump has run for 5,000 hours a maintenance alarm will be raised at the supervisor.

The flow temperature setpoint will be reset based on the outside air temperature.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

Number of Strategy blocks used	**104**

This Sample Application uses the following macros:

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	1	No - Run
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

VT Single pump weekly changeover with DPS monitoring

System overview

The pump system consists of the following plant:

- Single pump with DOL (Direct On Line) starter.
- DPS (Differential Pressure Switch) across the pump.

The pump will be enabled on demand.

- VT (Variable Temperature) Valve control.
- VT flow sensor.

System control

The system will be enabled when any plant requiring VT water calls for it.

The system will be disabled when no plant requires VT water.

When the system is enabled, any faults will be reset and both the pump and the VT control will be enabled.

When the system is disabled the VT control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

VT Control

When enabled, this will modulate the heating valve to achieve the calculated setpoint. The setpoint will be calculated based on the outside air temperature. When the outside air temperature is 2 °C (36 °F) or below, the calculated flow temperature will be 80 °C (176 °F) and when the outside air temperature is 20 °C (68 °F) or above, the calculated flow temperature will be 20 °C (68 °F).

If the flow temperature deviates from the calculated setpoint by ±2 °C (±4 °F) for 2 minutes, then an out of limits alarm will be raised at the supervisor.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.2.2 VT SINGLE PUMP WEEKLY CHANGEOVER WITH TRIP MONITORING

Summary

This Sample Application will control a single pump and the flow temperature (VT = Variable Temperature).

The system will monitor the Trip of the pump starter. If a Trip is detected, an alarm will be raised at the supervisor and the pump will be disabled. The pump will remain disabled until the alarm is reset by the operator at the Supervisor or the Enable signal goes off.

When the pump has run for 5,000 hours a Maintenance alarm will be raised at the Supervisor. The flow temperature setpoint will be reset based on the outside air temperature.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

Number of Strategy blocks used	**104**

This Sample Application uses the following macros:

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	2	Trip
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

VT Single pump weekly changeover with trip monitoring

System overview

The pump system consists of the following plant:

- Single pump with DOL (Direct On Line) starter with trip contact.

The pump will be enabled on demand.

- VT (Variable Temperature) Valve control.
- VT flow sensor.

System control

The system will be enabled when any plant requiring VT (Variable Temperature) water calls for it.

The system will be disabled when no plant requires VT water.

When the system is enabled, any faults will be reset and both the pump and the VT control will be enabled.

When the system is disabled the VT control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 5 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

VT Control

When enabled, this will modulate the heating valve to achieve the calculated setpoint. The setpoint will be calculated based on the outside air temperature. When the outside air temperature is 2 °C (36 °F) or below, the calculated flow temperature will be 80 °C (176 °F) and when the outside air temperature is 20 °C (68 °F) or above, the calculated flow temperature will be 20 °C (68 °F). If the flow temperature deviates from the calculated setpoint by ±2 °C (±4 °F) for 2 minutes, then an out of limits alarm will be raised at the supervisor.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.2.3 VT SINGLE PUMP WEEKLY CHANGEOVER WITH PRESSURE CONTROL

Summary

This Sample Application will control a single pump with pressure control and the flow temperature (VT = Variable Temperature).

If the pressure deviates from the setpoint by 10% while the system is running, then an alarm will be raised at the supervisor and the pump will remain disabled. When the pump has run for 5,000 hours a maintenance alarm will be raised at the supervisor.

The flow temperature setpoint will be reset based on the outside air temperature.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

Number of Strategy blocks used	**105**

This Sample Application uses the following macros:

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	4	Pressure Mismatch
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Max Pressure Error	100 0.01	Pa psi
Start Delay	10	Seconds
Maintenance Limit	5000	Hours
Run On Time	600	Seconds
Fault Select	4	Pressure Mismatch

A System Description for any system based on this Sample Application is given on the following pages.

VT Single pump weekly changeover with pressure control

System overview

The pump system consists of the following plant:

- Single pump with DOL (Direct On Line) starter.
- Pressure sensor across the flow and return.

The pump will be enabled on demand.

- VT (Variable Temperature) Valve control.
- VT flow sensor.

System control

The system will be enabled when any plant requiring VT (Variable Temperature) water calls for it.

The system will be disabled when no plant requires VT water.

When the system is enabled, any faults will be reset and both the pump and the VT control will be enabled.

When the system is disabled the VT control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 5 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pressure control

When the pressure control is enabled it will ramp up the speed of the pump to achieve the required system pressure.

The rate of change of the output will be limited to 3.3 % per second for the initial 30 seconds of start-up. The pressure control will then modulate the speed of the pump to maintain the required system pressure.

If the pressure sensor deviates from the required pressure Setpoint by ±100 Pa (±0.01 psi) for 10 seconds, then the pump will be deemed as failed and a pressure field alarm will be raised at the supervisor.

VT Control

When enabled, this will modulate the heating valve to achieve the calculated setpoint. The setpoint will be calculated based on the outside air temperature. When the outside air temperature is 2 °C (36 °F) or below, the calculated flow temperature will be 80 °C (176 °F) and when the outside air temperature is 20 °C (68 °F) or above, the calculated flow temperature will be 20 °C (68 °F). If the flow temperature deviates from the calculated setpoint by ±2 °C (±4 °F) for 2 minutes, then an out of limits alarm will be raised at the supervisor.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.2.4 VT TWIN PUMP WEEKLY CHANGEOVER WITH DPS MONITORING

Summary

This Sample Application will control a twin pump set with a DPS (Differential Pressure Switch) to monitor the flow and the flow temperature (VT = Variable Temperature).

It is suitable for either common DPS (Differential Pressure Switch) monitoring the two pumps or a DPS across each pump. If a common DPS is used, it must be connected to DP1 and DP2 of the Macro.

If no flow is detected an alarm will be raised at the Supervisor then the standby pump will be started, and if no flow is detected when the standby pump is enabled a system failed alarm will be raised at the supervisor and the standby pump will remain enabled.

When a pump has run for 5,000 hours a maintenance alarm will be raised at the supervisor. The flow temperature setpoint will be reset based on the outside air temperature.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

The designation of “lead” pump and “standby” pump will be changed at 2:00am on Sunday.

When the system is disabled the VT control will be disabled and the pump will continue to run for 10 minutes to dissipate any residual heat left in the system.

Number of Strategy blocks used	**197**

This Sample Application uses the following macros:

Macro: TWIN PLANT CONTROL

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	1	No – Standby Run
Fault Monitor Delay	20	Seconds
Fault Delay	5	Seconds
Start Delay	10	Seconds
Runtime Limit	5000	Hours
Run on time	600	Seconds
Lead Pump Changeover	0	Time of Day
TimeOfDay (Day) (Hour)	Sun 2	Only Sunday checked Hours
Hours Run Changeover	0	Hours

A System Description for any system based on this Sample Application is given on the following pages.

VT Twin pump weekly changeover with DPS monitoring

System overview

The pump system consists of the following plant:

- Two pumps with DOL (Direct On Line) starters.
- Two DPS (Differential Pressure Switch) one across each pump.

The pumps will be enabled on demand.

The pumps will operate in a duty-standby sequence with the lead pump changing each week.

System control

The system will be enabled when any plant requiring VT (Variable Temperature) water calls for it.

The system will be disabled when no plant requires VT water.

When the system is enabled, any faults will be reset and both the pump and the VT control will be enabled.

When the system is disabled the VT control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 5 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

VT Control

When enabled, this will modulate the heating valve to achieve the calculated setpoint. The setpoint will be calculated based on the outside air temperature. When the outside air temperature is 2 °C (36 °F) or below, the calculated flow temperature will be 80 °C (176 °F) and when the outside air temperature is 20 °C (68 °F) or above, the calculated flow temperature will be 20 °C (68 °F).

If the flow temperature deviates from the calculated setpoint by ±2 °C (±4 °F) for 2 minutes, then an out of limits alarm will be raised at the supervisor.

Pump rotation

The lead pump will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor:

1. To fix the lead pump disabling the automatic rotation.
2. To fix the running pump and disable the other pump.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.2.5 VT TWIN PUMP WEEKLY CHANGEOVER WITH TRIP MONITORING

Summary

This Sample Application will control a twin pump set monitoring the pump trips and the flow temperature (VT = Variable Temperature).

If a trip is detected on the lead an alarm will be raised at the supervisor then the lead pump with be stopped and the standby pump will be started. If a trip is detected when the standby pump is enabled, a system failed alarm will be raised at the supervisor and the standby pump will be disabled.

When a pump has run for 5,000 hours a maintenance alarm will be raised at the supervisor. The flow temperature setpoint will be reset based on the outside air temperature.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

The designation of “lead” pump and “standby” pump will be changed at 2:00am on Sunday.

When the system is disabled the VT control will be disabled and the pump will continue to run for 10 minutes to dissipate any residual heat left in the system.

Number of Strategy blocks used	**197**

This Sample Application uses the following macros:

Macro: TWIN PLANT CONTROL

Option	Value	Comment
Fault Select	2	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	No – Standby Run
Fault Monitor Delay	20	Seconds
Fault Delay	5	Seconds
Start Delay	10	Seconds
Runtime Limit	5000	Hours
Run on time	600	Seconds
Lead Pump Changeover	0	Time of Day
TimeOfDay (Day) (Hour)	Sun 2	Only Sunday checked Hours
Hours Run Changeover	0	Hours

A System Description for any system based on this Sample Application is given on the following pages.

VT Twin pump Weekly Changeover with Trip Monitoring

System overview

The pump system consists of the following plant:

- Two pumps with DOL (Direct On Line) starters and trip contacts.
- One pressure transducer across the flow and return.

The pumps will be enabled on demand.

The pumps will operate in a duty-standby sequence with the lead pump changing each week.

System control

The system will be enabled when any plant requiring VT (Variable Temperature) water calls for it.

The system will be disabled when no plant requires VT water.

When the system is enabled, any faults will be reset and both the pump and the VT control will be enabled.

When the system is disabled the VT control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 5 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

VT Control

When enabled, this will modulate the heating valve to achieve the calculated setpoint. The setpoint will be calculated based on the outside air temperature. When the outside air temperature is 2 °C (36 °F) or below, the calculated flow temperature will be 80 °C (176 °F) and when the outside air temperature is 20 °C (68 °F) or above, the calculated flow temperature will be 20 °C (68 °F).

If the flow temperature deviates from the calculated setpoint by ±2 °C (±4 °F) for 2 minutes, then an out of limits alarm will be raised at the supervisor.

Pump rotation

The lead pump will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead pump disabling the automatic rotation.
2. To fix the running pump and disable the other pump.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.2.6 VT TWIN PUMP WEEKLY CHANGEOVER WITH PRESSURE CONTROL

Summary

This Sample Application will control a twin pump set with a static pressure sensor to monitor the flow and the flow temperature (VT = Variable Temperature).

If a pressure mismatch is detected on the lead, an alarm will be raised at the supervisor, the lead pump will be stopped and the standby pump will be started.

If a pressure mismatch is detected when the standby pump is enabled a system failed alarm will be raised at the supervisor and the standby pump will be disabled.

When a pump has run for 5,000 hours a Maintenance alarm will be raised at the supervisor.

The flow temperature setpoint will be reset based on the outside air temperature.

An override is available with 2 modes: enable and system override.

- The enable override will override the system enable and leave all safely actions enabled.
- The system override will override the system enable and ignore all safety interlocks.

It is recommended that the End User only has access to the enable override.

The designation of “lead” pump and “standby” pump will be changed at 2:00am on Sunday.

When the system is disabled the VT control will be disabled and the pump will continue to run for 10 minutes to dissipate any residual heat left in the system.

Number of Strategy blocks used	**198**

This Sample Application uses the following macros:

Macro: TWIN PLANT CONTROL

Option	Value	Comment
Fault Select	4	Pressure
DPS Fault Monitor	0	Run Only
Stop on Fault	0	No – Standby Run
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Max Pressure Error	100 0.01	Pa psi
Start Delay	10	Seconds
Runtime Limit	5000	Hours
Run on time	600	Seconds
Lead Pump Changeover	0	Time of Day
TimeOfDay (Day) (Hour)	Sun 2	Only Sunday checked Hours

A System Description for any system based on this Sample Application is given on the following pages.

VT Twin pump Weekly Changeover with Pressure Control

System overview

The system consists of the following plant:

- Two pumps with inverters.
- One pressure sensor common to both pumps.

The pump system will be enabled on demand.

The pumps will operate in a duty-standby sequence with the lead pump changing each week.

The running pump's speed will be varied to maintain the required system pressure.

System control

The system will be enabled when any plant requiring VT (Variable Temperature) water calls for it.

The system will be disabled when no plant requires VT water.

When the system is enabled, any faults will be reset and both the pump and the VT control will be enabled.

When the system is disabled the VT control will be disabled.

Pump System Control

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 5 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised, indicating that the pump is in fault.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pressure control

When the pressure control is enabled it will ramp up the speed of the pump to achieve the required system pressure.

The rate of change of the output will be limited to 3.3 % per second for the initial 30 seconds of start-up. The pressure control will then modulate the speed of the pump to maintain the required system pressure.

If the pressure sensor deviates from the required pressure setpoint by ±100 Pa (±0.01 psi) for 10 seconds, then the pump will be deemed as failed and a pressure field alarm will be raised at the supervisor.

VT Control

When enabled, this will modulate the heating valve to achieve the calculated setpoint. The setpoint will be calculated based on the outside air temperature. When the outside air temperature is 2 °C (36 °F) or below, the calculated flow temperature will be 80 °C (176 °F) and when the outside air temperature is 20 °C (68 °F) or above, the calculated flow temperature will be 20 °C (68 °F).

If the flow temperature deviates from the calculated setpoint by ±2 °C (±4 °F) for 2 minutes, then an out of limits alarm will be raised at the supervisor.

Pump rotation

The lead pump will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To rotate the lead pump. The lead pump will still be changed automatically.
2. To fix the lead pump disabling the automatic rotation.

System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.3.1 FOUR-BOILER ON/OFF SEQUENCE CONTROL

Summary

This Sample Application will control 4 boilers with on-off control.

The lead boiler will be changed at 2:00am on Sunday. On failure of a boiler it will be taken out of the sequence until reset.

Number of Strategy blocks used	**452**

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	Comment
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	8	
PI Loop Integral	600	seconds
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	0	%
Stage 1 Off	5	%
Stage On	10	%
Stage Off	90	%

Macro: SEQUENCE MODULE

Option	Value	Comment
Hi-Lo	0	Lo

A System Description for any system based on this Sample Application is given on the following page.

Four-Boiler On/Off Sequence Control

System overview.

The boiler system consists of the following plant:

- 4 Boilers with integral shunt pumps and lockout indication.
- 1 Return temperature sensor.

The boilers will operate on demand with the lead boiler changing each week.

System Control

The system will be enabled when any plant requiring hot water calls for it. The system will be disabled when no plant requires hot water.

When the system is enabled the boiler control will be enabled.

When the system is disabled the boiler control will be disabled.

Boiler Control

When the system is enabled the system will determine how many boilers are required to meet the system demand and will adjust the enabled boilers as required.

If a boiler fails, then a Boiler Lockout alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the boiler control will remain static until the return temperature either rises 2 °C (4 °F) above or falls 2 °C (4 °F) below the required temperature.

Boiler rotation

The lead boiler will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead boiler disabling the automatic rotation.
2. To fix the number of boilers in the sequence.

System reset

Each boiler has a reset for a lockout alarm. When active this alarm must be reset before the boiler can be made available to the boiler sequencer.

Hours run

The system will log the hours run for each boiler. When a boiler has a logged run time of 5,000 Hours (user adjustable) a maintenance alarm will be raised. After the boiler has been serviced, the alarm can be reset via the supervisor.

1.1.3.2 FOUR-BOILER MODULATING SEQUENCE CONTROL

Summary

This Sample Application will control 4 boilers with modulating control.

The lead boiler will be changed at 2:00am on Sunday. On failure of a boiler it will be taken out of the sequence until reset.

Number of Strategy blocks used	452

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	Comment
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	8	
PI Loop Integral	600	seconds
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	0	%
Stage 1 Off	5	%
Stage On	10	%
Stage Off	90	%

Macro: SEQUENCE MODULE

Option	Value	Comment
Hi-Lo	0	Lo

A System Description for any system based on this Sample Application is given on the following page.

Four-Boiler Modulating Sequence Control

System overview.

The boiler system consists of the following plant:

- 4 Modulating Boilers with integral shunt pumps and lockout indication.
- 1 Return temperature sensor.

The boilers will operate on demand with the lead boiler changing each week.

System Control

The system will be enabled when any plant requiring hot water calls for it. The system will be disabled when no plant requires hot water.

When the system is enabled the boiler control will be enabled.

When the system is disabled the boiler control will be disabled.

Boiler Control

When the system is enabled the system will determine how many boilers are required to meet the system demand and will adjust the enabled boilers and modulation as required.

When another boiler is sequenced `on`, the total required demand will be sequenced between all the enabled boilers, with the lead boilers being set to 100% demand. Therefore, if the total demand is 120% and two boilers are `on`, the lead boiler demand will be set to 100% and the demand for the lag boilers will be set to 20%.

If a boiler fails, then a Boiler Lockout alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the boiler control will remain static until the return temperature either rises 2 °C (4 °F) above or falls 2 °C (4 °F) below the required temperature.

Boiler rotation

The lead boiler will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead boiler disabling the automatic rotation.
2. To fix the number of boilers in the sequence.
3. To fix the demand output of the last boiler in the sequence.

System reset

Each boiler has a reset for a lockout alarm. When active this alarm must be reset before the boiler can be made available to the boiler sequencer.

Hours run

The system will log the hours run for each boiler. When a boiler has a logged run time of 15,000 Hours (user adjustable) a maintenance alarm will be raised. After the boiler has been serviced, the alarm can be reset via the supervisor.

1.1.3.3 TWO-BOILER HIGH/LOW FIRE

Summary

This Sample Application will control 2 boilers with Hi/Lo fire control.

The lead boiler will be changed at 2:00am on Sunday. On failure of a boiler it will be taken out of the sequence until reset.

Number of Strategy blocks used	**310**

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	Comment
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	8	
PI Loop Integral	600	seconds
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	0	%
Stage 1 Off	5	%
Stage On	10	%
Stage Off	90	%

Macro: SEQUENCE MODULE

Option	Value	Comment
Hi-Lo	1	Lo

A System Description for any system based on this Sample Application is given on the following page.

Two-Boiler High/Low Fire

System overview

The boiler system consists of the following plant:

- 2 Hi/Lo fire boilers with integral shunt pumps and lockout indication.
- 1 Return temperature sensor.

The boilers will operate on demand with the lead boiler changing each week.

System Control

The system will be enabled when any plant requiring hot water calls for it. The system will be disabled when no plant requires hot water.

When the system is enabled the boiler control will be enabled.

When the system is disabled the boiler control will be disabled.

Boiler Control

When the system is enabled the system will determine how many boilers are required to meet the system demand and will adjust the enabled boilers as required.

If a boiler fails, then a Boiler Lockout alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the boiler control will remain static until the return temperature either rises 2 °C (4 °F) above or falls 2 °C (4 °F) below the required temperature.

Boiler rotation

The lead boiler will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead boiler disabling the automatic rotation.
2. To fix the number of boilers in the sequence.

System reset

Each boiler has a reset for a lockout alarm. When active this alarm must be reset before the boiler can be made available to the boiler sequencer.

Hours run

The system will log the hours run for each boiler. When a boiler has a logged run time of 5,000 Hours (user adjustable) a Maintenance alarm will be raised. After the boiler has been serviced, the alarm can be reset via the supervisor.

1.1.3.4 FOUR-BOILER ON/OFF SEQUENCE CONTROL WITH EXTERNAL SHUNT PUMP

Summary

This Sample Application will control 4 boilers with on-off control and the associated pumps.

The lead boiler will be changed at 2:00am on Sunday. On failure of a boiler or associated pump it will be taken out of the sequence until reset.

Number of Strategy blocks used	**708**

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	Comment
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint $\overline{SP}$	78 (172	°C °F)
Deadband $\overline{DB}$	2 (4	°C °F)
PI Loop Gain	8	
PI Loop Integral	600	seconds
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	0	%
Stage 1 Off	5	%
Stage On	10	%
Stage Off	90	%

Macro: SEQUENCE MODULE

Option	Value	Comment
Hi-Lo	0	Lo

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

Four-Boiler On/Off Sequence Control with External Shunt Pump

System overview

The boiler system consists of the following plant:

- 4 Modulating Boilers lockout indication.
- 4 Shunt pumps
- 1 Return temperature sensor.

The boilers will operate on demand with the lead boiler changing each week.

System Control

The system will be enabled when any plant requiring hot water calls for it. The system will be disabled when no plant requires hot water.

When the system is enabled the pump control will be enabled and when the DPS (Differential Pressure Switch) across the pump has proved flow for 30 seconds the boiler control will be enabled.

When the system is disabled the boiler control will be disabled and the pump will continue to run for 10 minutes to dissipate any residual heat left in the system and then the pump will be stopped.

Boiler Control

When the system is enabled the system will determine how many boilers are required to meet the system demand and will adjust the enabled boilers as required.

If a boiler fails, then a Boiler Lockout alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the boiler control will remain static until the return temperature either rises 2 °C (4 °F) above or falls 2 °C (4 °F) below the required temperature.

Boiler rotation

The lead boiler will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead boiler disabling the automatic rotation.
2. To fix the number of boilers in the sequence.

Boiler System reset

Each boiler has a reset for a lockout alarm. When active this alarm must be reset before the boiler can be made available to the boiler sequencer.

Boiler Hours run

The system will log the hours run for each boiler. When a boiler has a logged run time of 5,000 Hours (user adjustable) a Maintenance alarm will be raised. After the boiler has been serviced, the alarm can be reset via the supervisor.

Pump System control

The system will be enabled when any plant requiring CT (Constant Temperature) water calls for it. The system will be disabled when no plant requires CT water.

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised indicating that the pump is in fault. The pump will be disabled.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pump System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Pump Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Pump Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.3.5 FOUR-BOILER MODULATING SEQUENCE CONTROL WITH EXTERNAL SHUNT PUMP

Summary

This Sample Application will control 4 boilers with modulating control including the associated pumps.

The lead boiler will be changed at 2:00am on Sunday. On failure of a boiler or associated pump it will be taken out of the sequence until reset.

Number of Strategy blocks used	708

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	Comment
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	8	
PI Loop Integral	600	seconds
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	0	%
Stage 1 Off	5	%
Stage On	10	%
Stage Off	90	%

Macro: SEQUENCE MODULE

Option	Value	Comment
Hi-Lo	0	Lo

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

Four-Boiler Modulating Sequence Control with External Shunt Pump

System overview

The boiler system consists of the following plant:

- 4 Modulating Boilers lockout indication.
- 4 Shunt pumps
- 1 Return temperature sensor.

The boilers will operate on demand with the lead boiler changing each week.

System Control

The system will be enabled when any plant requiring hot water calls for it. The system will be disabled when no plant requires hot water.

When the system is enabled the pump control will be enabled and when the DPS (Differential Pressure Switch) across the pump has proved flow for 30 seconds the boiler control will be enabled.

When the system is disabled the boiler control will be disabled and the pump will continue to run for 10 minutes to dissipate any residual heat left in the system and then the pump will be stopped.

Boiler Control

When the system is enabled the system will determine how many boilers are required to meet the system demand and will adjust the enabled boilers and modulation as required.

If a boiler fails, then a Boiler Lockout alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the boiler control will remain static until the return temperature either rises 2 °C (4 °F) above or falls 2 °C (4 °F) below the required temperature.

Boiler rotation

The lead boiler will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead boiler disabling the automatic rotation.
2. To fix the number of boilers in the sequence.

Boiler System reset

Each boiler has a reset for a lockout alarm. When active this alarm must be reset before the boiler can be made available to the boiler sequencer.

Boiler Hours run

The system will log the hours run for each boiler. When a boiler has a logged run time of 5,000 Hours (user adjustable) a Maintenance alarm will be raised. After the boiler has been serviced, the alarm can be reset via the supervisor.

Pump System control

The system will be enabled when any plant requiring hot water calls for it. The system will be disabled when no plant requires hot water.

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised indicating that the pump is in fault. The pump will be disabled.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pump System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Pump Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Pump Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.3.6 FOUR-BOILER HI/LO SEQUENCE CONTROL WITH EXTERNAL SHUNT PUMP

Summary

This Sample Application will control 2 boilers with Hi-Lo control and the associated pumps.

The lead boiler will be changed at 2:00am on Sunday. On failure of a boiler or associated pump it will be taken out of the sequence until reset.

Number of Strategy blocks used	**356**

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	Comment
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	8	
PI Loop Integral	600	seconds
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	0	%
Stage 1 Off	5	%
Stage On	10	%
Stage Off	90	%

Macro: SEQUENCE MODULE

Option	Value	Comment
Hi-Lo	1	Hi

Macro: SINGLE PLANT CONTROL

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

Four-Boiler Hi/Lo Sequence Control with External Shunt Pump

System overview

The boiler system consists of the following plant:

- 2 Hi-Lo Fire Boilers lockout indication.
- 2 Shunt pumps
- 1 Return temperature sensor.

The boilers will operate on demand with the lead boiler changing each week.

System Control

The system will be enabled when any plant requiring hot water calls for it. The system will be disabled when no plant requires hot water.

When the system is enabled the pump control will be enabled and when the DPS (Differential Pressure Switch) across the pump has proved flow the boiler control will be enabled.

When the system is disabled the boiler control will be disabled and the pump will continue to run for 10 minutes to dissipate any residual heat left in the system and then the pump will be stopped.

Boiler Control

When the system is enabled the system will determine how many boilers are required to meet the system demand and will adjust the enabled boilers and modulation as required.

If a boiler fails, then a Boiler Lockout alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the boiler control will remain static until the return temperature either rises 2 °C (4 °F) above or falls 2 °C (4 °F) below the required temperature.

Boiler rotation

The lead boiler will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead boiler disabling the automatic rotation.
2. To fix the number of boilers in the sequence.

Boiler System reset

Each boiler has a reset for a lockout alarm. When active this alarm must be reset before the boiler can be made available to the boiler sequencer.

Boiler Hours run

The system will log the hours run for each boiler. When a boiler has a logged run time of 5,000 Hours (user adjustable) a Maintenance alarm will be raised. After the boiler has been serviced, the alarm can be reset via the supervisor.

Pump System control

The system will be enabled when any plant requiring CT (Constant Temperature) water calls for it. The system will be disabled when no plant requires CT water.

When the system is enabled any faults will be reset and the pump will be started.

When the system is enabled any faults will be reset and the pump will be started. After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed as in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised indicating that the pump is in fault. The pump will be disabled.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pump System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Pump Hours run

The system will log the 'hours run' for the pump. When the pump has a logged run time of 5,000 hours (user adjustable) a Maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Pump Override

The system can be overridden `Off` or `On` via the supervisor. If overridden `Off` the system will ignore all demands to run. If overridden `On` the system will run, but any safety interlocks will remain active.

Fire

If a Fire alarm is detected, the pump will be stopped. When the Fire alarm has cleared the pump will then restart as per the system run, if required.

1.1.3.7 FOUR-BOILER MODULATING PARALLEL CONTROL

Summary

This Sample Application will control 4 boilers with modulating control in parallel.

The lead boiler will be changed at 2:00am on Sunday. On failure of a boiler it will be taken out of the sequence until reset.

Number of Strategy blocks used	452

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	Comment
Type Select	2	Parallel 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	8	
PI Loop Integral	600	seconds
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	30	%
Stage 1 Off	10	%
Stage On	90	%
Stage Off	20	%

Macro: SEQUENCE MODULE

Option	Value	Comment
Hi-Lo	0	Lo

A System Description for any system based on this Sample Application is given on the following page.

Four-Boiler Modulating Parallel Control

System overview.

The boiler system consists of the following plant:

- 4 Modulating Boilers with integral shunt pumps and lockout indication.
- 1 Return temperature sensor.

The boilers will operate on demand with the lead boiler changing each week.

System Control

The system will be enabled when any plant requiring hot water calls for it. The system will be disabled when no plant requires hot water.

When the system is enabled the boiler control will be enabled.

When the system is disabled the boiler control will be disabled.

Boiler Control

When the system is enabled the system will determine how many boilers are required to meet the system demand and will adjust the enabled boilers and modulation as required.

When another boiler is sequenced `on`, the total required demand will be shared equally between all the enabled boilers. Therefore, if the total demand is 120% and two boilers are on, each boiler will have its demand set to 60%.

If a boiler fails, then a Boiler Lockout alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the boiler control will remain static until the return temperature either rises 2 °C (4 °F) above or falls 2 °C (4 °F) below the required temperature.

Boiler rotation

The lead boiler will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead boiler disabling the automatic rotation.
2. To fix the number of boilers in the sequence.
3. To fix the demand output of the last boiler in the sequence.

System reset

Each boiler has a reset for a lockout alarm. When active this alarm must be reset before the boiler can be made available to the boiler sequencer.

Hours run

The system will log the hours run for each boiler. When a boiler has a logged run time of 5,000 Hours (user adjustable) a Maintenance alarm will be raised. After the boiler has been serviced, the alarm can be reset via the supervisor.

1.1.4.1 HWS WITH ON-OFF CONTROL

Summary

This Sample Application will control an HWS (Hot Water System) calorifer with On-Off valve control.

It will generate alarms on temperature out of limits and high limit.

Number of Strategy blocks used	**44**

This Sample Application uses the following macros:

Macro: HWS CONTROL

Option	Value	Comment
Setpoint SP	60 (140	°C °F)
Deadband DB	2 (4	°C °F)

Macro: SENSOR ALARM AND LOG

(no settings required)

A System Description for any system based on this Sample Application is given on the following page.

HWS with On-Off control

System overview

The HWS (Hot Water System) consists of the following plant:

- HWS calorifer.
- HWS Valve On-Off.

The system will be enabled by a time schedule.

System control

The system will be enabled via a user adjustable schedule initially set to 7:00 – 18:00 for Monday to Friday.

When enabled, the system will enable the temperature control.

When disabled the system will disable the temperature control.

Temperature control.

The temperature control will enable-disable the valve to achieve a temperature of 60 °C (140 °F) in the calorifer. If the high limit stat is activated, then the system will close the valve.

If the temperature deviates from this temperature for 5 minutes, then an alarm will be raised at the supervisor indicating that the HWS system has failed.

High Limit.

The calorifer is protected by a hard wired thermostat that will close an isolating valve. This thermostat will require a manual reset. When active, it will raise an alarm at the supervisor.

1.1.4.2 HWS CONTROL WITH CIRCULATION PUMP

Summary

This Sample Application will control an HWS (Hot Water System) calorifer with On-Off valve control valve and circulation pump.

It will generate alarms on temperature out of limits and high limit.

Number of Strategy blocks used	**116**

This Sample Application uses the following macros:

Macro: HWS CONTROL

Option	Value	Comment
Setpoint SP	60 (140	°C °F)
Deadband DB	2 (4	°C °F)

Macro: SENSOR ALARM AND LOG

(no settings required)

Macro: SINGLE PLANT CONTROL

Option	Value	
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	1	No -Run
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

HWS control with circulation pump

System overview

The HWS (Hot Water System) consists of the following plant:

- HWS calorifer.
- HWS Valve On-Off.
- Circulation pump with DOL (Direct On Line) starter.
- DPS (Differential Pressure Sensor) across the pump.

The system will be enabled by a time schedule.

System control

The system will be enabled via a user adjustable schedule initially set to 7:00 – 18:00 for Monday to Friday.

When enabled, the system will enable the temperature control.

When disabled the system will disable the temperature control and after 5 minutes disable the pump control.

Temperature control.

The temperature control will modulate the valve to achieve a temperature of 60 °C (140 °F) in the calorifer. If the high limit stat is activated, then the system will close the valve.

If the temperature deviates from this temperature for 5 minutes, then an alarm will be raised at the supervisor indicating that the HWS system has failed.

High Limit.

The calorifer is protected by a hard-wired thermostat that will close an isolating valve. This thermostat will require a manual reset. When active it will raise an alarm at the supervisor.

Pump control.

When the pump control is enabled any faults will be reset and the pump will be started. After the pump has run for 20 seconds the system will monitor the differential pressure across the pump, and if no flow is detected for a period of 10 seconds the pump will be deemed as in fault.

This fault will be latched until reset by either the operator or a system restart. A general alarm will then be raised indicating that the pump is in fault.

The pump will still remain enabled until the system is disabled.

When the system is disabled the pump will continue to run for 5 minutes to dissipate any residual heat left in the system and then the pump will be stopped.

Pump reset.

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a frost level 1 or 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the hours run for the pump. When the pump has a logged run time of 5,000 Hours (User adjustable) a maintenance alarm will be raised. After the pump has been serviced the alarm can be reset via the supervisor.

Override

The system can be overridden off or on via the supervisor. If overridden `off` the system will ignore any demands to run. If overridden `on` the system will run but any safety interlocks will remain active.

Fire

If a fire alarm is detected the pump will be stopped. When the fire alarm has cleared the pump will then restart as per the system run if required.

1.1.4.3 HWS CONTROL WITH CIRCULATION AND DE-STRATIFICATION PUMP

Summary

This Sample Application will control an HWS (Hot Water System) calorifer with an analogue valve and circulation pump.

It will generate alarms on temperature out of limits and high limit.

Number of Strategy blocks used	**182**

This Sample Application uses the following macros:

Macro: HWS CONTROL

Option	Value	Comment
Setpoint SP	60 (140	°C °F)
Deadband DB	2 (4	°C °F)
Legionella SP	80	Seconds
Legionella Run time	60	Minutes

Macro: SENSOR ALARM AND LOG

(no settings required)

Macro: SINGLE PLANT CONTROL (Circulation and Destrat Pumps)

Option	Value	
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	1	No -Run
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

HWS control with circulation and de-stratification pump

System overview

The HWS (Hot Water System) consists of the following plant:

- HWS calorifer.
- HWS Valve 0-10V.
- Circulation pump with DOL (Direct On Line) starter.
- DPS (Differential Pressure Switch) across the Circulation pump.
- De-stratification pump with DOL starter.
- DPS across the De-stratification pump.

The system will be enabled by a time schedule.

System control

The system will be enabled via a user adjustable schedule initially set to 7:00 – 18:00 for Monday to Friday.

When enabled, the system will enable the temperature control.

When disabled the system will disable the temperature control and after 5 minutes disable the pump control.

Temperature control

The temperature control will modulate the valve to achieve a temperature of 60 °C (140 °F) in the calorifer. If the high limit stat is activated, then the system will close the valve.

If the temperature deviates from this temperature for 5 minutes, then an alarm will be raised at the supervisor indicating that the HWS system has failed.

High Limit

The calorifer is protected by a hard wired thermostat that will close an isolating valve. This thermostat will require a manual reset. When active it will raise an alarm at the supervisor.

De-stratification Pump control

When the de-stratification pump control is enabled it will monitor the high and low temperature sensors in the calorifer and if the difference is greater than 5 °C (9 °F) for 60 seconds it will enable the pump until the difference is less than 5 °C (9 °F) for 60 seconds.

After the pump has been enabled and run for 20 seconds, the system will monitor the differential pressure across the pump, and if no flow is detected for a period of 10 seconds the pump will be deemed as in fault.

This fault will be latched until reset by either the operator or a system restart. A general alarm will be then raised indicating that the pump is in fault.

The pump will still remain enabled until the system is disabled.

De-stratification Pump reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

De-stratification Hours run

The system will log the hours run for the pump. When the pump has a logged run time of 5,000 Hours (User adjustable) a maintenance alarm will be raised. After the pump has been serviced the alarm can be rest via the supervisor.

De-stratification Fire

If a fire alarm is detected the pump will be stopped. When the fire alarm has cleared the pump will then restart as per the system run if required.

Circulation Pump control

When the circulation pump control is enabled any faults will be reset and the pump will be started. After the pump has run for 20 seconds the system will monitor the differential pressure across the pump, and if no flow is detected for a period of 10 seconds the pump will be deemed as in fault.

This fault will be latched until reset by either the operator or a system restart. A general alarm will be then raised indicating that the pump is in fault.

The pump will still remain enabled until the system is disabled.

When the system is disabled the pump will continue to run for 5 minutes to dissipate any residual heat left in the system and then the pump will be stopped.

Circulation Pump reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Circulation Pump frost protection

If the pump is not enabled and either a frost level 1 or 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Circulation Hours run

The system will log the hours run for the pump. When the pump has a logged run time of 5,000 hours (User adjustable) a maintenance alarm will be raised. After the pump has been serviced the alarm can be rest via the supervisor.

Circulation Override

The system can be overridden off or on via the supervisor. If overridden `off` the system will ignore any demands to run. If overridden `on` the system will run but any safety interlocks will remain active.

Circulation Fire

If a fire alarm is detected the pump will be stopped. When the fire alarm has cleared the pump will then restart as per the system run if required.

1.1.4.4 HWS CONTROL WITH CIRCULATION PUMP AND LEGIONELLA PREVENTION

Summary

This Sample Application will control an HWS (Hot Water System) calorifer with an analogue valve and circulation pump.

It will generate alarms on temperature out of limits and high limit.

Number of Strategy blocks used	**119**

This Sample Application uses the following macros:

Macro: HWS CONTROL

Option	Value	Comment
Setpoint SP	60 (140	°C °F)
Deadband DB	2 (4	°C °F)
Legionella SP	80	Seconds
Legionella Run time	60	Minutes

Macro: SENSOR ALARM AND LOG

(no settings required)

Macro: SINGLE PLANT CONTROL

Option	Value	
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	1	No -Run
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

HWS control with circulation pump and Legionella prevention

System overview

The HWS (Hot Water System) consists of the following plant:

- HWS calorifer.
- HWS Valve On-Off.
- Circulation pump with DOL (Direct On Line) starter.
- DPS (Differential Pressure Switch) across the pump.

The system will be enabled by a time schedule.

System control

The system will be enabled via a user adjustable schedule initially set to 7:00 – 18:00 for Monday to Friday.

When enabled, the system will enable the temperature control.

When disabled the system will disable the temperature control and after 5 minutes disable the pump control.

Temperature control.

The temperature control will enable-disable the valve to achieve a temperature of 60 °C (140 °F) in the calorifer. If the high limit stat is activated, then the system will close the valve.

If the temperature deviates from this temperature for 5 minutes, then an alarm will be raised at the supervisor indicating that the HWS system has failed.

Legionella control.

The legionella temperature control will be activated at midnight every Saturday and run until the calorifer temperature has been at 80 °C (176 °F) for 1 hour.

If this is not achieved before the next start time a Legionella fail alarm will be raised at the supervisor and normal temperature control will be resumed.

If the high limit stat is activated, then the system will close the valve.

If the temperature deviates from this temperature for 5 minutes, then an alarm will be raised at the supervisor indicating that the HWS system has failed.

High Limit.

The calorifer is protected by a hard wired thermostat that will close an isolating valve. This thermostat will require a manual reset. When active it will raise an alarm at the supervisor.

Pump control.

When the pump control is enabled any faults will be reset and the pump will be started. After the pump has run for 20 seconds the system will monitor the differential pressure across the pump, and if no flow is detected for a period of 10 seconds the pump will be deemed as in fault.

This fault will be latched until reset by either the operator or a system restart. A general alarm will be then raised indicating that the pump is in fault.

The pump will still remain enabled until the system is disabled.

When the system is disabled the pump will continue to run for 5 minutes to dissipate any residual heat left in the system and then the pump will be stopped.

Pump reset.

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a frost level 1 or 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Hours run

The system will log the hours run for the pump. When the pump has a logged run time of 5,000 hours (User adjustable) a maintenance alarm will be raised. After the pump has been serviced the alarm can be rest via the supervisor.

Override

The system can be overridden off or on via the supervisor. If overridden `off` the system will ignore any demands to run. If overridden `on` the system will run but any safety interlocks will remain active.

Fire

If a fire alarm is detected the pump will be stopped. When the fire alarm has cleared the pump will then restart as per the system run if required.

1.1.5.1 TWO-CHILLER ON/OFF SEQUENCE CONTROL

Summary

This Sample Application will control 2 chillers with on-off control.

The lead chiller will be changed at 2:00am on Sunday.

On failure of a chiller it will be taken out of the sequence until reset.

Number of Strategy blocks used	**303**

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	12 (22	°C °F)
PI Loop Integral	600	seconds
PI Offset	10	%
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	30	%
Stage 1 Off	10	%
Stage On	90	%
Stage Off	10	%

Macro: SEQUENCE MODULE

Option	Value	
HiLo Select	0	Low

A System Description for any system based on this Sample Application is given on the following page.

Two Chiller On/Off Sequence Control

System overview

The chiller system consists of the following plant:

- 2 Chillers with integral shunt pumps and fault indication.
- 1 Return Temperature sensor.

The chiller will operate on demand with lead chiller changing each week.

System Control

The system will be enabled when any plant requiring chilled water calls for it. The system will be disabled when no plant requires chilled water.

When the system is enabled the chiller control will be enabled.

When the system is disabled the chiller control will be disabled.

Chiller Control

When the system is enabled the system determines how many chillers are required to meet the system demand and adjusts the enabled chillers as required.

If a chiller fails, then a chiller failed alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved the chiller control will remain static until the return temperature either rises beyond 1 °C (2 °F) above or falls beyond 1 °C (2 °F) below the required temperature.

Chiller rotation

The lead chiller will be automatically rotated at 2:00am on Sunday morning.

The operator will also have the following options via the supervisor:

- To fix the lead chiller, disabling the automatic rotation.
- To fix the number of chillers in the sequence.

System reset

Each chiller has a reset for a failed alarm. When active, this alarm must be reset before the chiller can be made available to the chiller sequencer.

Hours run

The system will log the hours run for each chiller. When a chiller has a logged run time of 5,000 Hours (User adjustable) a maintenance alarm will be raised. After the chiller has been serviced the alarm can be rest via the supervisor.

1.1.5.2 TWO-CHILLER MODULATING SEQUENCE CONTROL

Summary

This Sample Application will control 2 chillers with modulating control.

The lead chiller will be changed at 2:00am on Sunday.

On failure of a chiller it will be taken out of the sequence until reset.

Number of Strategy blocks used	303

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	12 (22	°C °F)
PI Loop Integral	600	seconds
PI Offset	10	%
Min On Time	0	seconds
Min Off Time	0	seconds
Min On Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	30	%
Stage 1 Off	10	%
Stage On	90	%
Stage Off	10	%

Macro: SEQUENCE MODULE

Option	Value	
HiLo Select	0	Low

A System Description for any system based on this Sample Application is given on the following page.

Two Chiller Modulating Sequence Control

System overview

The chiller system consists of the following plant:

- 2 Modulating Chillers with integral shunt pumps and fault indication.
- 1 Return temperature sensor.

The chiller will operate on demand with lead chiller changing each week.

System Control

The system will be enabled when any plant requiring chilled water calls for it. The system will be disabled when no plant requires chilled water.

When the system is enabled the chiller control will be enabled.

When the system is disabled the chiller control will be disabled.

Chiller Control

When the system is enabled the system will determine how many chillers are required to meet the system demand and will adjust the enabled boilers and modulation as required.

When another chiller is sequenced on, the total required demand will be shared equally between all the enabled chillers. Therefore, if the total demand is 120% and two chillers are on, each chiller will have its demand set to 60%.

If a chiller fails, then a chiller failed alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the chiller control will remain static until the return temperature either rises 1 °C (2 °F) above or falls 1 °C (2 °F) below the required temperature.

Chiller rotation

The lead chiller will be automatically rotated at 2:00am on Sunday morning.

The operator will also have the following options via the supervisor:

- To fix the lead chiller disabling the automatic rotation.
- To fix the number of chillers in the sequence.
- To fix the demand output of the last chiller in the sequence.

System reset

Each chiller has a reset for a fault alarm. When active, this alarm must be reset before the chiller can be made available to the chiller sequencer.

Hours run

The system will log the hours run for each chiller. When a chiller has a logged run time of 5,000 Hours (User adjustable) a maintenance alarm will be raised. After the chiller has been serviced the alarm can be rest via the supervisor.

1.1.5.3 TWO-CHILLER ON/OFF SEQUENCE CONTROL WITH SHUNT PUMP

Summary

This Sample Application will control 2 chillers with on-off control and the associated shunt pumps.

The lead chiller will be changed at 2:00am on Sunday.

On failure of a chiller it will be taken out of the sequence until reset.

Number of Strategy blocks used	438

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	12 (22	°C °F)
PI Loop Integral	600	seconds
PI Offset	10	%
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	30	%
Stage 1 Off	10	%
Stage On	90	%
Stage Off	10	%

Macro: SEQUENCE MODULE

Option	Value	
HiLo Select	0	Low

Macro: SINGLE PLANT CONTROL

Option	Value	
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

Two Chiller On/Off Sequence Control with Shunt Pump

System overview

The chiller system consists of the following plant:

- 2 Chillers with fault indication.
- 2 Shunt pumps.
- 1 Return temperature sensor.

The chiller will operate on demand with lead chiller changing each week.

System Control

The system will be enabled when any plant requiring chilled water calls for it. The system will be disabled when no plant requires chilled water.

When the system is enabled the pump control will be enabled and when the DPS (differential Pressure) across the pump has proved flow the Chiller control will be enabled.

When the system is disabled the Chiller control will be disabled and the pump will continue to run for 10 minutes to dissipate any residual heat left in the system and then the pump will be stopped.

Chiller Control

When the system is enabled the system determines how many chillers are required to meet the system demand and adjusts the enabled chillers as required.

If a chiller fails, then a chiller failed alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved the chiller control will remain static until the return temperature either rises beyond 1 °C (2 °F) above or falls beyond 1 °C (2 °F) below the required temperature.

Chiller rotation

The lead chiller will be automatically rotated at 2:00am on Sunday morning.

The operator will also have the following options via the supervisor:

- To fix the lead chiller disabling the automatic rotation.
- To fix the number of chillers in the sequence.

Chiller System reset

Each chiller has a reset for a failed alarm. When active, this alarm must be reset before the chiller can be made available to the chiller sequencer.

Chiller Hours run

The system will log the hours run for each chiller. When a chiller has a logged run time of 5,000 Hours (User adjustable) a maintenance alarm will be raised. After the chiller has been serviced the alarm can be rest via the supervisor.

Pump system control

The system will be enabled when any plant requiring chilled water calls for it. The system will be disabled when no plant requires chilled water.

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised indicating that the pump is in fault. The pump will be disabled.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pump System reset

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Pump Hours run

The system will log the hours run for the pump. When the pump has a logged run time of 5,000 Hours (user adjustable) a maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Pump Override

The system can be overridden `off` or `on` via the supervisor. If overridden `off` the system will ignore all demands to run. If overridden `on` the system will run but any safety interlocks will remain active.

Fire

If a fire alarm is detected the Chiller and pump and Chiller control will be stopped. When the fire alarm has cleared the Chiller and pump will then restart as per the system control if required.

1.1.5.4 TWO-CHILLER MODULATING CONTROL WITH SHUNT PUMP

Summary

This Sample Application will control 4 Chillers with on-off control and the associated shunt pumps.

The lead Chiller will be changed at 2:00am on Sunday.

On failure of a Chiller it will be taken out of the sequence until reset.

Number of Strategy blocks used	438

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	12 (22	°C °F)
PI Loop Integral	600	seconds
PI Offset	10	%
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	30	%
Stage 1 Off	10	%
Stage On	90	%
Stage Off	10	%

Macro: SEQUENCE MODULE

Option	Value	
HiLo Select	0	Low

Macro: SINGLE PLANT CONTROL

Option	Value	
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	600	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

Two-Chiller Modulating Control with Shunt Pump

System overview

The chiller system consists of the following plant:

- 2 Chillers with fault indication.
- 2 Shunt pumps.
- 1 Return temperature sensor.

The chiller will operate on demand with lead chiller changing each week.

System Control

The system will be enabled when any plant requiring chilled water calls for it. The system will be disabled when no plant requires chilled water.

When the system is enabled the pump control will be enabled and when the DPS (Differential Pressure Switch) across the pump has proved flow the Chiller control will be enabled.

When the system is disabled the Chiller control will be disabled and the pump will continue to run for 10 minutes to dissipate any residual heat left in the system and then the pump will be stopped.

Chiller Control

When the system is enabled the system will determine how many chillers are required to meet the system demand and will adjust the enabled boilers and modulation as required.

When another chiller is sequenced on, the total required demand will be shared equally between all the enabled chillers. Therefore, if the total demand is 120% and two chillers are on, each chiller will have its demand set to 60%.

If a chiller fails, then a chiller failed alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the chiller control will remain static until the return temperature either rises 1 °C (2 °F) above or falls 1 °C (2 °F) below the required temperature.

Chiller rotation

The lead chiller will be automatically rotated at 2:00am on Sunday morning.

The operator will also have the following options via the supervisor:

- To fix the lead chiller disabling the automatic rotation.
- To fix the number of chillers in the sequence.

Chiller System reset

Each chiller has a reset for a failed alarm. When active, this alarm must be reset before the chiller can be made available to the chiller sequencer.

Chiller Hours run

The system will log the hours run for each chiller. When a chiller has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the chiller has been serviced the alarm can be rest via the supervisor.

Pump system control

The system will be enabled when any plant requiring chilled water calls for it. The system will be disabled when no plant requires chilled water.

When the system is enabled any faults will be reset and the pump will be started.

After the pump has run for 20 seconds the system will monitor the differential pressure across the pump and if no flow is detected for a period of 10 seconds the pump will be deemed to be in fault.

This fault will be latched until reset by either the operator or a system restart.

A general alarm will then be raised indicating that the pump is in fault. The pump will be disabled.

When the system is disabled the pump will continue to run for 10 minutes to dissipate any residual heat left in the system, and then the pump will be stopped.

Pump System reset.

The system can be reset via the supervisor. This will clear all latched faults. If the system is enabled and is in fault, the system will be restarted as described in System Control.

Pump frost protection

If the pump is not enabled and either a Frost Level 1 or a Frost Level 2 is initiated, then the pump control will be enabled. This will remain enabled until all frost states are cleared.

Pump Hours run

The system will log the hours run for the pump. When the pump has a logged run time of 5,000 Hours (user adjustable) a maintenance alarm will be raised. After the pump has been serviced, the alarm can be reset via the supervisor.

Pump Override

The system can be overridden `off` or `on` via the supervisor. If overridden `off` the system will ignore all demands to run. If overridden `on` the system will run but any safety interlocks will remain active.

Fire

If a fire alarm is detected the Chiller and pump and Chiller control will be stopped. When the fire alarm has cleared the Chiller and pump will then restart as per the system control if required.

1.1.6.1 FOUR STAGE DX COOL ONLY SEQUENCE CONTROL

Summary

This Sample Application will control 4 stage DX (Direct Expansion) cooling control. The lead DX will be changed at 2:00am on Sunday. On failure of a DX stage it will be taken out of the sequence until reset.

Number of Strategy blocks used	**458**

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	12 (22	°C °F)
PI Loop Integral	600	seconds
PI Offset	30	%
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	0	%
Stage 1 Off	5	%
Stage On	10	%
Stage Off	90	%

Macro: SEQUENCE MODULE

Option	Value	
HiLo Select	0	Low

A System Description for any system based on this Sample Application is given on the following page.

Four Stage DX Cool Only Sequence Control

System overview

The DX (Direct Expansion) system consists of the following plant:

- 4 Stage DX unit.
- 1 Return temperature sensor.

The DX will operate on demand with lead DX unit changing each week.

System Control

The system will be enabled when the plant requires chilled air. The system will be disabled when the plant no longer requires chilled air.

When the system is enabled the DX control will be enabled.

When the system is disabled the DX control will be disabled.

DX Control.

When the system is enabled, the system determines how many DX units are required to meet the system demand and adjusts the enabled DXs as required.

The sequencer will only enable or disable one DX unit at any given time.

Once a DX unit is enabled or disabled the sequencer will not enable or disable another unit for at least 2 minutes.

If a DX unit fails, then a DX unit failed alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the DX control will remain static until the return temperature either rises beyond 2 °C (4 °F) above or falls beyond 2 °C (4 °F) below the required temperature.

DX rotation

The lead DX unit will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead DX unit disabling the automatic rotation.
2. To fix the number of DX units in the sequence.

System reset

Each DX unit has a reset for a failed alarm. When active, this alarm must be reset before the DX unit can be made available to the sequencer.

Hours run

The system will log the hours run for each DX unit. When a DX unit has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the DX unit has been serviced the alarm can be reset via the supervisor.

1.1.6.2 FOUR STAGE DX COOL HEAT SEQUENCE CONTROL

Summary

This Sample Application will control 4 stage DX (Direct Expansion) cooling and heating control. The lead DX will be changed at 2:00am on Sunday. On failure of a DX stage it will be taken out of the sequence until reset.

Number of Strategy blocks used	**464**

This Sample Application uses the following macros:

Macro: SEQUENCE CONTROL

Option	Value	
Type Select	0	Cascade 1
HoursRunTime	0	Time
Time Of Day (Day) Time Of Day (Hour)	Sun 2	Only Sunday checked Hours
Setpoint SP	78 (172	°C °F)
Deadband DB	2 (4	°C °F)
PI Loop Gain	12 (22	°C °F)
PI Loop Integral	600	seconds
PI Offset	30	%
Min On Time	0	seconds
Min Off Time	0	seconds
Next Stage On Time	60	seconds
Next Stage Off Time	60	seconds
Stage 1 On	0	%
Stage 1 Off	5	%
Stage On	10	%
Stage Off	90	%

Macro: SEQUENCE MODULE

Option	Value	
HiLo Select	0	Low

A System Description for any system based on this Sample Application is given on the following page.

Four Stage DX Cool Heat Sequence Control

System overview

The DX (Direct Expansion) system consists of the following plant:

- 4 Stage DX unit.
- 1 Return temperature sensor.

The DX will operate on demand with lead DX unit changing each week.

System Control

The system will be enabled when the plant requires either chilled or heated air. The system will be disabled when the plant no longer requires chilled or heated air.

When the system is enabled the DX control will be enabled.

When the system is disabled the DX control will be disabled.

DX Control.

When the system is enabled, the system determines how many DX units are required to meet the system demand and adjusts the enabled DX as required.

The sequencer will only enable or disable one DX unit at any given time.

Once a DX unit is enabled or disabled the sequencer will not enable or disable another unit for at least 2 minutes.

The sequence control will determine if chilled or heated air is required, and will switch the DX units to the relevant mode. When a change of mode is required, the sequencer will wait until no DX units are enabled before sending a mode change to the DX units.

If a DX unit fails, then a DX unit failed alarm will be raised at the supervisor and it will be taken out of the sequence until the alarm has been reset by the supervisor.

When the required return temperature is achieved, the DX control will remain static until the return temperature either rises beyond 2 °C (4 °F) above or falls beyond 2 °C (4 °F) below the required temperature.

DX rotation

The lead DX unit will be automatically rotated at 2:00am on Sunday morning. The operator will also have the following options via the supervisor.

1. To fix the lead DX unit disabling the automatic rotation.
2. To fix the number of DX units in the sequence.

System reset

Each DX unit has a reset for a failed alarm. When active, this alarm must be reset before the DX unit can be made available to the sequencer.

Hours run

The system will log the hours run for each DX unit. When a DX unit has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the DX unit has been serviced the alarm can be reset via the supervisor.

002 - AIR HANDLING UNIT

2.1.1.1 AHU WITH HEATING, COOLING AND FULL FRESH AIR

Summary

This Sample Application will control an AHU with full fresh air dampers, heating and cooling valves.

On failure of either the supply or extract fans the AHU with be disabled until reset.

Number of Strategy blocks used	209

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	10	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Heating, Cooling and Full Fresh Air

System overview

This Sample Application will control AHU system with the following plant:

- Single speed supply fan with DPS (Differential Pressure Switch).
- Single speed extract fan with DPS.
- Heating Valve.
- Cooling Valve.
- Dampers full fresh air.
- Damper End Switch.
- Frost Stat.
- Space temperature sensor.

System Start up

When the AHU is enabled via the schedule, the temperature control will be enabled.

Ten seconds after the temperature control is enabled the dampers will open.

Five seconds after the dampers are fully opened the supply fan control will be enabled.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

System Control

When enabled, the system will maintain a space temperature between $\overline{SP} \pm (\overline{DB} / 2)$ within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply and extract fans, closing the damper and stopping the temperature control.

System Shut Down

When the schedule has ended, the extract and supply fans will be disabled.

Ten seconds after the fans have been disabled the dampers will be closed.

Thirty seconds after the dampers have been closed the temperature control will be disabled.

Supply Fan Control

When the supply fan control is enabled the supply fan will be enabled.

After the supply fan has been enabled for 20 seconds the system will monitor the DPS and if the DPS status is “no flow” for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan will be enabled.

After the extract fan has been enabled for 20 seconds, the system will monitor the DPS, and if the DPS status is “no flow” for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor.

Temperature Control

The required space temperature is set via the space temperature setpoint (SP) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating and cooling valves will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F). The heating valve will be modulated to maintain the space temperature to SP – (DB /2). The cooling valve will be modulated to maintain the space temperature to SP + (DB /2). When the temperature is between these limits both the heating and cooling valves will be closed.

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the heating valve will be opened to 100%. This will remain enabled until all frost states are cleared or the AHU is enabled.

Heating coil frost protection

The heating coil has a frost stat fitted across it, set to activate at 2 °C (36 °F). The stat will auto reset when the temperature rises to 5 °C (41 °F). If this stat is activated an alarm will be raised via the supervisor, the fans will be stopped, the heating valve opened to 100% and the cooling valve closed.

Hours run

The system will log the hours run for both the supply and extract fans. When a fan has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the fan has been serviced the alarm can be reset via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

2.1.1.2 AHU WITH HEATING, COOLING AND DAMPERS

Summary

This Sample Application will control an AHU with modulating air dampers, heating and cooling valves. On failure of either the supply or extract fans the AHU with be disabled until reset.

Number of Strategy blocks used	**234**

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	10	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Heating, Cooling and Dampers.

System overview

This Sample Application will control AHU system with the following plant:

- Single speed supply fan with DPS (Differential Pressure Switch).
- Single speed extract fan with DPS.
- Heating Valve.
- Cooling Valve.
- Dampers modulating.
- Frost Stat.
- Space temperature sensor.
- Outside air temperature sensor.
- Return air temperature sensor.

System Start up

When the AHU is enabled via the schedule, the supply fan control will be enabled.

When the supply fan is proved running the temperature control will be enabled with the dampers remaining in the fully recirculation position for 2 minutes.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

Ten seconds after the temperature control is enabled the dampers will open.

System Control

When enabled, the system will maintain a space temperature of 21 °C (69.8 °F) within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply and extract fans, fully closing the damper and stopping the temperature control.

System Shut Down

When the schedule has ended, the extract and supply fans will be disabled.

Ten seconds after the fans have been disabled the temperature control will be disabled fully closing the dampers.

Supply Fan Control

When the supply fan control is enabled the supply fan will be enabled.

After the supply fan has been enabled for 20 seconds the system will monitor the DPS and if the DPS status is “no flow” for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan will be enabled.

After the extract fan has been enabled for 20 seconds the system will monitor the DPS, and if the DPS status is “no flow” for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor.

Temperature Control

The required space temperature is set via the space temperature setpoint ($\overline{SP}$) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating valve dampers and cooling valve will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F). The heating valve will be modulated to maintain the space temperature to SP – (DB /2). The cooling valve will be modulated to maintain the space temperature to SP + (DB /2). The dampers will be modulated to maintain SP. When the temperature is between these limits both the heating and cooling valves will be closed.

Damper Control.

The dampers will be modulated between their minimum position of 10% (user adjustable) and fully open position.

The direction of the dampers be determined on the return temperature and the outside air temperature.

If the outside air temperature is less that the return temperature, then the dampers will modulate `open` when cooling is required.

If the outside air temperature is greater that the return temperature, then the dampers will modulate `close` when cooling is required.

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the heating valve will be opened to 100%. This will remain enabled until all frost states are cleared or the AHU is enabled.

Heating coil frost protection

The heating coil has a frost stat fitted across it, set to activate at 2 °C (36 °F). The stat will auto reset when the temperature rises to 5 °C (41 °F). If this stat is activated, an alarm will be raised via the supervisor, the fans will be stopped, the heating valve opened to 100% and cooling valves closed.

Hours run

The system will log the hours run for both the supply and extract fans. When a fan has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the fan has been serviced the alarm can be reset via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

2.1.1.3 AHU WITH HEATING, COOLING AND THERMAL WHEEL

Summary

This Sample Application will control an AHU with full fresh air dampers, Thermal wheel, heating and cooling valves. On failure of either the supply or extract fans the AHU with be disabled until reset.

Number of Strategy blocks used	239

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	0	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Heating, Cooling and Thermal Wheel

System overview

This Sample Application will control AHU system with the following plant:

- Single speed supply fan with DPS (Differential Pressure Switch).
- Single speed extract fan with DPS.
- Heating Valve.
- Cooling Valve.
- Dampers full fresh air.
- Thermal Wheel.
- Frost Stat.
- Space temperature sensor.

System Start up

When the AHU is enabled via the schedule, the supply fan control will be enabled.

When the supply fan is proved running, the temperature control will be enabled with the dampers remaining in the fully recirculation position for 2 minutes.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

Ten seconds after the temperature control is enabled the dampers will open.

System Control

When enabled, the system will maintain a space temperature of 21 °C (69.8 °F) within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply and extract fans, closing the damper and stopping the temperature control.

System Shut Down

When the schedule has ended, the extract and supply fans will be disabled.

Ten seconds after the fans have been disabled the dampers will be closed.

Thirty seconds after the dampers have been closed the temperature control will be disabled.

Supply Fan Control

When the supply fan control is enabled the supply fan will be enabled.

After the supply fan has been enabled for 20 seconds the system will monitor the DPS and if the DPS status is “no flow” for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan will be enabled.

After the extract fan has been enabled for 20 seconds the system will monitor the DPS, and if the DPS status is “no flow” for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor.

Temperature Control

The required space temperature is set via the space temperature setpoint ($\overline{SP}$) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating valve, thermal wheel and cooling valve will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F). The heating valve will be modulated to maintain the space temperature to SP – (DB /2). The cooling valve will be modulated to maintain the space temperature to SP + (DB /2). The thermal wheel will be modulated to maintain SP. When the temperature is between these limits both the heating and cooling valves will be closed.

Thermal Wheel Control.

The thermal wheel speed will be modulated between its minimum and maximum speed to achieve the required space temperature.

If the outside air temperature is less than the return temperature, then the thermal wheel will speed will be increased when heating is required.

If the outside air temperature is greater that the return temperature, then the thermal wheel will speed will be increased when cooling is required.

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the heating valve will be opened to 100%. This will remain enabled until all frost states are cleared or the AHU is enabled.

Heating coil frost protection

The heating coil has a frost stat fitted across it, set to activate at 2 °C (36 °F). The stat will auto reset when the temperature rises to 5 °C (41 °F). If this stat is activated, an alarm will be raised via the supervisor, the fans will be stopped, the heating valve opened to 100% and the cooling valve closed.

Hours run

The system will log the hours run for both the supply and extract fans. When a fan has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the fan has been serviced the alarm can be reset via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

2.1.1.4 AHU WITH HEATING, COOLING, FULL FRESH AIR AND HUMIDITY

Summary

This Sample Application will control an AHU with Humidity control, modulating air dampers, heating and cooling valves. On failure of either the supply or extract fans the AHU with be disabled until reset.

Number of Strategy blocks used	**241**

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	10	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Heating, Cooling, Full Fresh Air and Humidity

System overview

This Sample Application will control AHU system with the following plant:

- Single speed supply fan with DPS (Differential Pressure Switch).
- Single speed extract fan with DPS.
- Heating Valve.
- Cooling Valve.
- Dampers full fresh air.
- Frost Stat.
- Humidifier with 0 – 10 V control.
- Space temperature sensor.

System Start up

When the AHU is enabled via the schedule, the temperature control will be enabled.

Ten seconds after the temperature control is enabled the dampers will open.

Five seconds after the dampers are fully opened the supply fan control will be enabled.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

Ten seconds after the extract fan is proved running, the humidity control will be enabled.

System Control

When enabled, the system will maintain a space temperature between SP ±(DB / 2) within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply and extract fans, closing the damper and stopping the temperature control.

System Shut Down

When the schedule has ended, the humidity control, extract and supply fans will be disabled.

Ten seconds after the fans have been disabled the dampers will be closed.

Thirty seconds after the dampers have been closed the temperature control will be disabled.

Supply Fan Control

When the supply fan control is enabled the supply fan will be enabled.

After the supply fan has been enabled for 20 seconds the system will monitor the DPS and if the DPS status is “no flow” for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan will be enabled.

After the extract fan has been enabled for 20 seconds the system will monitor the DPS, and if the DPS status is “no flow” for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor.

Temperature Control

The required space temperature is set via the space temperature setpoint ($\overline{SP}$) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating and cooling valves will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F). The heating valve will be modulated to maintain the space temperature to SP – (DB /2). The cooling valve will be modulated to maintain the space temperature to SP + (DB /2). When the temperature is between these limits both the heating and cooling valves will be closed.

Humidity Control

When enabled the humidity control will modulate the humidifier to maintain a supply relative humidity of 50%.

When disabled the humidity control will remain at 0%.

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the heating valve will be opened to 100%. This will remain enabled until all frost states are cleared or the AHU is enabled.

Heating coil frost protection

The heating coil has a frost stat fitted across it, set to activate at 2 °C (36 °F). The stat will auto reset when the temperature rises to 5 °C (41 °F). If this stat is activated, an alarm will be raised via the supervisor, the fans will be stopped, the heating valve opened to 100% and the cooling valve closed.

Hours run

The system will log the hours run for both the supply and extract fans. When a fan has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the fan has been serviced the alarm can be reset via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

2.1.1.5 AHU WITH FROST, HEATING, COOLING AND FULL FRESH AIR

Summary

This Sample Application will control an AHU with a frost heater battery, full fresh air dampers, heating and cooling valves. On failure of either the supply or extract fans the AHU with be disabled until reset.

Number of Strategy blocks used	**224**

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	10	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Frost, Heating, Cooling and Full Fresh Air

System overview

This Sample Application will control AHU system with the following plant:

- Single speed supply fan with DPS (Differential Pressure Switch).
- Single speed extract fan with DPS.
- Frost Off Coil Temperature sensor.
- Frost Valve.
- Heating Valve.
- Cooling Valve.
- Dampers full fresh air.
- Frost Stat.
- Space temperature sensor.

System Start up

When the AHU is enabled via the schedule, the temperature and frost control will be enabled.

Ten seconds after the temperature control is enabled the dampers will open.

Five seconds after the dampers are fully opened the supply fan control will be enabled.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

System Control

When enabled, the system will maintain a space temperature between $\overline{SP} \pm (\overline{DB} / 2)$ within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply and extract fans and stopping the temperature control.

System Shut Down

When the schedule has ended, the extract and supply fans will be disabled.

Ten seconds after the fans have been disabled the dampers will be closed.

Thirty seconds after the dampers have been closed the frost and temperature control will be disabled.

Supply Fan Control

When the supply fan control is enabled the supply fan will be enabled.

After the supply fan has been enabled for 10 seconds the system will monitor the DPS and if the DPS status is “no flow” for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan will be enabled.

After the extract fan has been enabled for 10 seconds the system will monitor the DPS, and if the DPS status is “no flow” for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor.

Temperature Control

The required space temperature is set via the space temperature setpoint (SP) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating and cooling valves will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F). The heating valve will be modulated to maintain the space temperature to SP – (DB /2). The cooling valve will be modulated to maintain the space temperature to SP + (DB /2). When the temperature is between these limits both the heating and cooling valves will be closed.

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the heating valve will be opened to 100%. This will remain enabled until all frost states are cleared or the AHU is enabled.

Heating coil frost protection

The heating coil has a frost stat fitted across it, set to activate at 2 °C (36 °F). The stat will auto reset when the temperature rises to 5 °C (41 °F). If this stat is activated, an alarm will be raised via the supervisor, the fans will be stopped, the heating valve opened to 100% and the cooling valve closed.

Hours run

The system will log the hours run for both the supply and extract fans. When a fan has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the fan has been serviced the alarm can be reset via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

2.1.1.6 AHU WITH FROST, HEATING, COOLING AND DAMPERS

Summary

This Sample Application will control an AHU with a frost heater battery, modulating air dampers, heating and cooling valves. On failure of either the supply or extract fans the AHU with be disabled until reset.

Number of Strategy blocks used	**249**

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	10	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Frost, Heating, Cooling and Dampers

System overview

This Sample Application will control AHU system with the following plant:

- Single speed supply fan with DPS (Differential Pressure Switch).
- Single speed extract fan with DPS.
- Frost Off Coil Temperature sensor.
- Frost Valve.
- Heating Valve.
- Cooling Valve.
- Dampers modulating.
- Frost Stat.
- Space temperature sensor.
- Outside air temperature sensor.
- Return air temperature sensor.

System Start up

When the AHU is enabled via the schedule, the supply fan control will be enabled.

When the supply fan is proved running the temperature control will be enabled with the dampers remaining in the fully recirculation position for 2 minutes.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

Ten seconds after the temperature control is enabled the dampers will open.

System Control

When enabled, the system will maintain a space temperature between SP ±(DB / 2) within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply and extract fans, fully closing the damper and stopping the temperature control

System Shut Down

When the schedule has ended, the extract and supply fans will be disabled.

Ten seconds after the fans have been disabled the temperature control will be disabled fully closing the dampers.

Supply Fan Control

When the supply fan control is enabled the supply fan will be enabled.

After the supply fan has been enabled for 20 seconds the system will monitor the DPS and if the DPS status is “no flow” for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan will be enabled.

After the extract fan has been enabled for 20 seconds the system will monitor the DPS, and if the DPS status is “no flow” for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor.

Temperature Control

The required space temperature is set via the space temperature setpoint ($\overline{SP}$) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating valve dampers and cooling valve will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F). The heating valve will be modulated to maintain the space temperature to SP – (DB /2). The cooling valve will be modulated to maintain the space temperature to SP + (DB /2). The dampers will be modulated to maintain SP. When the temperature is between these limits both the heating and cooling valves will be closed.

Damper Control.

The dampers will be modulated between their minimum position of 10% (user adjustable) and fully open position.

The direction of the dampers be determined on the return temperature and the outside air temperature.

If the outside air temperature is less that the return temperature, then the dampers will modulate `open` when cooling is required.

If the outside air temperature is greater that the return temperature, then the dampers will modulate `close` when cooling is required.

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the heating and frost valves will be opened to 100%. This will remain enabled until all frost states are cleared or the AHU is enabled.

Frost Coil Control.

When the frost coil control is active the frost valve will be modulated to maintain an off coil temperature of 10 °C (50 °F). When the frost coil is inactive the frost valve will be closed.

Frost coil frost protection

The heating coil has a frost stat fitted across it, set to activate at 2 °C (36 °F). The stat will auto reset when the temperature rises to 5 °C (41 °F). If this stat is activated, an alarm will be raised via the supervisor, the fans will be stopped, the frost valve opened to 100% and the heating and cooling valves closed.

Hours run

The system will log the hours run for both the supply and extract fans. When a fan has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the fan has been serviced the alarm can be reset via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

2.1.1.7 AHU WITH FROST, HEATING, COOLING AND THERMAL WHEEL

Summary

This Sample Application will control an AHU with a frost heater battery, full fresh air dampers, Thermal wheel, heating and cooling valves. On failure of either the supply or extract fans the AHU with be disabled until reset.

Number of Strategy blocks used	**253**

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	0	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Frost, Heating, Cooling and Thermal Wheel

System overview

This Sample Application will control AHU system with the following plant:

- Single speed supply fan with DPS (Differential Pressure Switch).
- Single speed extract fan with DPS.
- Frost Off Coil Temperature sensor.
- Frost Valve.
- Heating Valve.
- Cooling Valve.
- Dampers full fresh air.
- Thermal Wheel.
- Frost Stat.
- Space temperature sensor.

System Start up

When the AHU is enabled via the schedule, the supply fan control will be enabled.

When the supply fan is proved running the temperature control will be enabled with the dampers remaining in the fully recirculation position for 2 minutes.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

Ten seconds after the temperature control is enabled the dampers will open.

System Control

When enabled, the system will maintain a space temperature of 21 °C (69.8 °F) within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply, extract and fans, closing the damper and stopping the temperature control.

System Shut Down

When the schedule has ended, the extract and supply fans will be disabled.

Ten seconds after the fans have been disabled the dampers will be closed.

Thirty seconds after the dampers have been closed the frost and temperature control will be disabled.

Supply Fan Control

When the supply fan control is enabled the supply fan will be enabled.

After the supply fan has been enabled for 20 seconds the system will monitor the DPS and if the DPS status is “no flow” for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan will be enabled.

After the extract fan has been enabled for 20 seconds the system will monitor the DPS, and if the DPS status is “no flow” for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor.

Temperature Control

The required space temperature is set via the space temperature setpoint ($\overline{SP}$) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating valve, thermal wheel and cooling valve will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F). The heating valve will be modulated to maintain the space temperature to SP – (DB /2). The cooling valve will be modulated to maintain the space temperature to SP + (DB /2). The thermal wheel will be modulated to maintain SP. When the temperature is between these limits both the heating and cooling valves will be closed.

Thermal Wheel Control.

The thermal wheel speed will be modulated between its minimum and maximum speed to achieve the required space temperature.

If the outside air temperature is less than the return temperature, then the thermal wheel will speed will be increased when heating is required.

If the outside air temperature is greater that the return temperature, then the thermal wheel will speed will be increased when cooling is required.

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the frost and heating valves will be opened to 100%. These will remain enabled until all frost states are cleared or the AHU is enabled.

Frost Coil Control.

When the frost coil control is active the frost valve will be modulated to maintain an off coil temperature of 10 °C (50 °F). When the frost coil is inactive the frost valve will be closed.

Frost coil frost protection

The frost coil has a frost stat fitted across it set to activate at 2 °C (36 °F). The stat will auto reset when the temperature rises to 5 °C (41 °F). If this stat is activated, an alarm will be raised via the supervisor, the fans will be stopped, the frost valve opened to 100% and the heating and cooling valves closed.

Hours run

The system will log the hours run for both the supply and extract fans. When a fan has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the fan has been serviced the alarm can be reset via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

2.1.1.8 AHU WITH FROST, HEATING, COOLING, FULL FRESH AIR AND HUMIDITY

Summary

This Sample Application will control an AHU with a frost heater battery, humidity control, modulating air dampers, heating and cooling valves. On failure of either the supply or extract fans the AHU will be disabled until reset.

Number of Strategy blocks used	**254**

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	10	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Frost, Heating, Cooling, Full Fresh Air and Humidity

System overview

This Sample Application will control AHU system with the following plant:

- Single speed supply fan with DPS (Differential Pressure Switch).
- Single speed extract fan with DPS.
- Frost Off Coil Temperature sensor.
- Frost Valve.
- Heating Valve.
- Cooling Valve.
- Dampers full fresh air.
- Frost Stat.
- Humidifier with 0 – 10 V control.
- Space temperature sensor.

System Start up

When the AHU is enabled via the schedule, the frost and temperature control will be enabled.

Ten seconds after the temperature control is enabled the dampers will open.

Five seconds after the dampers are fully opened the supply fan control will be enabled.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

Ten seconds after the extract fan is proved running, the humidity control will be enabled.

System Control

When enabled, the system will maintain a space temperature between $\mathrm{SP} \pm \frac{\mathrm{DB}}{2}$ within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply, extract and temperature control.

Ten seconds after the extract fan is proved running, the humidity control will be enabled.

System Shut Down

When the schedule has ended, the humidity control, extract and supply fans will be disabled.

Ten seconds after the fans have been disabled the dampers will be closed.

Thirty seconds after the dampers have been closed the frost and temperature control will be disabled.

Supply Fan Control

When the supply fan control is enabled the supply fan will be enabled.

After the supply fan has been enabled for 20 seconds the system will monitor the DPS and if the DPS status is “no flow” for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan will be enabled.

After the extract fan has been enabled for 20 seconds the system will monitor the DPS, and if the DPS status is “no flow” for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor

Temperature Control

The required space temperature is set via the space temperature setpoint ($\overline{SP}$) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating and cooling valves will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F). The heating valve will be modulated to maintain the space temperature to SP – (DB /2). The cooling valve will be modulated to maintain the space temperature to SP + (DB /2). When the temperature is between these limits both the heating and cooling valves will be closed.

Humidity Control

When enabled the humidity control will modulate the humidifier to maintain a supply relative humidity of 50%.

When disabled the humidity control will remain at 0%

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the frost and heating valves will be opened to 100%. These will remain enabled until all frost states are cleared or the AHU is enabled.

Frost Coil Control.

When the frost coil control is active the frost valve will be modulated to maintain an off coil temperature of 10 °C (50 °F). When the frost coil is inactive the frost valve will be closed.

Frost coil frost protection

The frost coil has a frost stat fitted across it set to activate at 2 °C (36 °F). The stat will auto reset when the temperature rises to 5 °C (41 °F). If this stat is activated, an alarm will be raised via the supervisor, the fans will be stopped, the frost valve opened to 100% and the heating and cooling valves closed.

Hours run

The system will log the hours run for both the supply and extract fans. When a fan has a logged run time of 5,000 hours (user adjustable) a maintenance alarm will be raised. After the fan has been serviced the alarm can be reset via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

2.1.1.9 AHU WITH FROST, HEATING, COOLING AND DAMPERS

Summary

This Sample Application will control an AHU with a modulating air dampers, and heating and cooling valves. On failure of either the supply or extract fans the AHU will be disabled until reset.

Number of Strategy blocks used	**234**

This Sample Application uses the following macros:

Macro: HEATING COOLING AND FREE ENERGY CONTROL WITH PID

Option	Value	
Htg Gain	8 (14	°C °F)
Free Gain	12 (22	°C °F)
Clg Gain	8 (14	°C °F)
Htg Integral	300	Seconds
Free Integral	300	Seconds
Clg Integral	300	Seconds
Damper Min Pos	10	%
Htg Frost Stat Pos	100	%
Free Frost Stat Pos	0	%
Clg Frost Stat Pos	0	%
Htg Frost 1_2 Pos	100	%
Free Frost 1_2 Pos	0	%
Clg Frost 1_2 Pos	0	%
Htg Warm Up Pos	100	%
Free Warm Up Pos	0	%
Clg Warm Up Pos	0	%

Macro: SINGLE PLANT CONTROL (Supply and Extract Fans)

Option	Value	Comment
Fault Select	1	DPS
DPS Fault Monitor	0	Run Only
Stop on Fault	0	Yes
Fault Monitor Delay	20	Seconds
Fault Delay	10	Seconds
Maintenance Limit	5000	Hours
Run on time	5	Seconds

A System Description for any system based on this Sample Application is given on the following pages.

AHU with Frost, Heating, Cooling, Full Fresh Air and Humidity

System overview

This Sample Application will control AHU system with the following plant:

Single speed supply fan.
Single speed extract fan.
Pressure sensor mounted in supply fan duct.
Pressure sensor mounted in extract fan duct.
Heating Valve.
Cooling Valve.
Dampers modulating.
Frost Stat.
Space temperature sensor.
Outside air temperature sensor.
Return air temperature sensor.

System Start up

When the AHU is enabled via the schedule, the temperature control will be enabled.

Ten seconds after the temperature control is enabled the supply fan control will be enabled.

Five seconds after the supply fan is proved running the extract fan control will be enabled.

System Control

When enabled, the system will maintain a space temperature of 21 °C (69.8 °F) within the space.

If the extract fan or supply fan indicates a fault the system will be disabled, stopping the supply, extract and temperature control.

System Shut Down

When the schedule has ended, the humidity control, extract and supply fans will be disabled.

Thirty seconds after the fans have been disabled the frost and temperature control will be disabled.

Supply Fan Control

When the supply fan control is enabled the supply fan and pressure control will be enabled.

The pressure control will modulate the supply fan to maintain the required supply pressure setpoint.

After the supply fan has been enabled for 20 seconds the system will monitor the supply fan pressure and if the pressure is outside the supply fan pressure setpoint ±100 Pa (0.01 psi) for 10 seconds the supply fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the supply fan has failed. This will require a system reset from the supervisor.

Extract Fan Control

When the extract fan control is enabled the extract fan and pressure control will be enabled.

The pressure control will modulate the extract fan to maintain the required extract pressure setpoint.

After the extract fan has been enabled for 20 seconds the system will monitor the extract fan pressure and if the pressure is outside the extract fan pressure setpoint ±100 Pa (0.01 psi) for 10 seconds the extract fan will be deemed as failed and will be disabled.

The system will raise an alarm at the supervisor indicating that the extract fan has failed. This will require a system reset from the supervisor

Temperature Control

The required space temperature is set via the space temperature setpoint ($\overline{SP}$) from the supervisor. This can be adjusted between 18 °C (64 °F) and 23 °C (73 °F).

When the AHU is enabled, the heating, dampers and cooling valves will be modulated in sequence to maintain the required space temperature.

The temperature control has a deadband (DB) of 2 °C (4 °F), if the space temperature is within the SP – (DB /2) and SP + (DB /2), the PID loop output will be held holding the cooling and heating valves at their current positions.

Damper Control

The dampers remain fully closed for 2 minutes after being enabled. The dampers will be modulated between their minimum position and fully open position. The direction of the dampers be determined on the return temperature and the outside air temperature. If the outside air temperature is less that the return temperature, then the dampers will modulate open when cooling is required. If the outside air temperature is greater that the return temperature, then the dampers will modulate close when cooling is required.

Frost level 1 and 2 protection

If the AHU is not enabled, and either a frost level 1 or 2 is initiated, then the frost and heating valves will be opened to 100%. These will remain enabled until all frost states are cleared or the AHU is enabled.

Frost level 1 and 2 protection

If the AHU is not enabled and either a frost level 1 or 2 is initiated, then the heating valve will be opened to 100%. This will remain enabled until all frost states are cleared or the AHU is enabled.

Heating coil frost protection.

The heating coil has a frost thermostat fitted across it set to activate at 2 °C (36 °F).

The thermostat will auto-reset when the temperature rises to 5 °C (41 °F).

If this thermostat is activated, an alarm will be raised via the supervisor, the fans will be stopped, the heating valve opened to 100% and the cooling valve closed.

Hours run

The system will log the hours run for both the supply and extract fans.

When a fan as a logged run time of 5,000 Hours (user adjustable), a maintenance alarm will be raised.

After the fan has been serviced the alarm can be rest via the supervisor.

Fire

If a fire alarm is detected the AHU fans are hard-wired to stop. The control software will also disable the fans to stop any false alarms.

AHU reset

The AHU fans can be reset via a common reset on the supervisor.

3 Pre-engineered Strategies

003 - FCU : FAN COIL UNIT

CBT-4T4-2U1R 10080100/10090100 V1_1 FCU WITH MODULATING VALVES, DAMPER, FAN (IMPERIAL/METRIC)

Summary

This Sample Application will control an FCU with fresh air dampers, heating and cooling valves. Optional fan status, window contacts, and CO_2 monitoring.

Number of Strategy blocks used **222**

This Sample Application uses the following macros:

MACRO: Setpoint Control

Option	Value	
occSPDeadband	2 (2	°C °F)
unoccSPDeadband	12 (12	°C °F)
standbyOffsetSP	4 (4	°C °F)

MACRO: Heartbeat

Option	Value	
BacNET Heartbeat	True	
BacNET HeartbeatTimer	10	Minutes
BacNET EnableHeartbeat	False	

MACRO: Dual PID

Option	Value	
PIDTuneGain	2	
PIDTuneInt	10	

MACRO: AO Scaler

Option	Value	
Damper LowAOValue	2	Volts
Damper HiAOValue	10	Volts
Fan LowAOValue	2	Volts
Fan HiAOValue	10	Volts
HWValve LowAOValue	2	Volts
HWValve HiAOValue	10	Volts
CHWValve LowAOValue	2	Volts
CHWValve HiAOValue	10	Volts

MACRO: Thermostat

Option	Value	
TwoPipe Offset	1 (1	°C °F)

FCU with Modulating Valves, Damper, Fan

System Overview

This Sample Application will control an FCU system with the following I/O:

	IO POINTS	DESCRIPTION
1AI	UI1	Space Temp/XOver Temp
1 AI/DI	UI2	5k Offset/OccSensor
1 AI	UI3	Supply Air Temp
1 AI	UI4	CO2 Monitoring
1 DI	DI10	Fan Status
1 DI	DI11	Window Contact
1 AO	AO13	Heating Valve/2Pipe Valve
1 AO	AO14	Cooling Valve
1 AO	AO09	Damper
1 AO	AO12	Supply Fan Signal
1 DO	DO15	Supply Fan Start/Stop

Note: For humidity monitoring, or to use the XOver Temp feature for 2-pipe control, a CBT-Stat is required.

Note: If using a 2-pipe Valve, wire it to Heating Valve output.

Enabling Control Features

inputConfig (AV1) will enable the following:

0 = Space Sensor on UI1, Ohm Offset on UI2
1 = Enable XOver Temp on UI1
2 = Enable Occ Sensor on UI2

unitConfig (AV42) will enable the following:

0 = Master unit, our pipe system, fan status disabled, two pipe summer/winter switch, slider disabled

1 = Slave
2 = Two pipe system
4 = Two Pipe using XOver Temp
8 = Enable window contact
16 = Enable demand ventilation sequence
32 = Enable supply air reset
64 = Enable fan status
128 = Enable 5k slider
256 = Enable internal schedule

To enable more than one feature, add numbers together. For example, to enable both window contact and supply air reset, add 8 + 32 = 40.

System Start up

The unit can be enabled through the occCmd (AV63) point, or the internal schedule.

Occupied Mode

To enable occupied mode, change the occCmd (AV63) to 2. The supply fan will be enabled, the damper will open to minimum position, and the valves will modulate.

Unoccupied Mode

To enable unoccupied mode, change the occCmd (AV63) to 0. The supply fan will will be disabled. The damper and valves will close.

Warmup Mode

To enable warmup mode, change occCmd (AV63) to 1. The supply fan will be enabled, and the hot water valve will open 100%. The damper will remain closed.

Fire Shutdown Mode

To enable fire shutdown mode, change occCmd (AV63) to 3. The supply fan will be disabled. The damper and valves will close.

System Control

Temperature

The zoneSP (AV3) is the main adjustment for the zone setpoint (default 72 °F/22 °C).

If the slider span is enabled thru the unit configuration, sliderSpanSP (AV36) is used to offset the zone setpoint up or down using UI2. If it is set for 4 degrees, the range the slider will work is 2 degrees above, and 2 degrees below.

The activeCoolSP (AV49) and activeHeatSP (AV50) are calculated using an offset

- For occupied mode, the occSPDeadband (AV4) is 2 °, this will take the zoneSP (AV3) and add +1 to calculate the cooling setpoint and add -1 to calculate the heating setpoint. If the zone setpoint is 22 °C (72 °F), the active cooling setpoint will be 23 °C (73 °F), and the active heating setpoint will be 21 °C (71 °F).
- For unoccupied mode, the unoccSPDeadband (AV21) is 12 °. This will take the zoneSP (AV3) and add +6 to calculate the cooling setpoint and add -6 to calculate the heating setpoint. If the zone setpoint is 22 °C (72 °F), the active cooling setpoint will be 28 °C (78 °F), and the active heating setpoint will be 16 °C (66 °F).
- For standby mode, the standbyOffsetSP (AV28) is 4 °. This will take the zoneSP (AV3) and add the occSPDeadband and +2 to calculate the cooling setpoint and add -2 to calculate the heating setpoint. If the zone setpoint is 72 °F/22°C and the occSPDeadband is 2 °, the active cooling setpoint will be 74°F/24°C, and the active heating setpoint will be 70 °F/20°C.

Shedding will offset the occupied temperature setpoints to the standby temperature setpoints based on a 0 …100% range. This is adjusted at NET_ShedPercent (AV40). If set to 0%, shedding will be disabled, any number above 0% will enable shed mode. For example, at 50%, if the occupied setpoints are 23 °C (73 °F) cooling and 21 °C (71 °F) heating, and the standby setpointsare 25 °C (75 °F) cooling and 19 °C (69 °F) heating, the active heating and cooling setpoints will be halfway between occupied and standby setpoints. This would be 24 °C (74 °F) cooling and 20 °C (70 °F) heating. If a CBT-STAT is used, shed mode will lockaout user adjustment.

Supply air reset will tem per the supply air to maintain it above the supplyAirSP (AV80) of 12 °C (55 °F). If the supply air temperature falls below 12 °C (55 °F), the demand for cooling will be ramped down, allowing the supply temperature to rise above setpoint.

Test Mode

To trigger Test Mode, toggle the testModeEnable (BV29) to TRUE.

The supply fan will be enabled and ramp to 100%.
Hot water valve will be 100% open for 60 seconds.
Hot water valve will be closed for 60 sectonds.
Chilled water valve will be 100% open for 60 seconds.
Chiller water valve will be closed for 60 seconds.
The fan will be disabled or will operate in current occupied state.

BACnet Heartbeat

An optional BACnet heartbeat is available. A digital point needs to be sent down from a global controller every 10 minutes. If this point is not triggered within the timeframe, the unit will default to occupied mode.

To enable, set BACnetEnableHeartbeat (BV149) to TRUE.
The global point to write to is BACnet Heartbeat (BV145)
The time parameter adjustment is BACnet Hearbeat Timer (AV224)

Fan Control

When the fan is enabled, the analog signal to the fan control will ramp based on heating or cooling demand. The digital point will be enabled.

FanMinSpeed (AV156) sets the minimum fan speed (20%). FanMaxSpeed (AV157) sets the maximum fan speed (100%)

If fan needs to be constant volume, set both min and max fan speeds to the same percentage.

Damper Control and Demand Ventilation

During occupied mode, the damper will open to minimum position (20%), set at DamperMinPosition (AV85).

If demand ventilation is enabled, on a rise in carbon dioxide above setpoint CO2_SP (AV82) of 800 ppm, the damper will modulate open. On a fall in carbon dioxide below setpoint, the damper will modulate closed.

Occupancy Sensors and Overrides

If a space sensor is used on UI1, and it has the ability to short out (close) the input on a button press, the unit will go into an occupied override for 1 hour if in unoccupied mode.

If UI2 is set for an occupancy sensor and the input is closed, the unit will be in occupied mode if scheduled for occupied mode. If scheduled for occupied mode, and the sensor is open for more than 60 seconds, the unit will go into standby mode.

If a CBT-STAT is used, pressing the right button twice during unoccupied mode will trigger the occupied override for 1 hour.

occOvrTime (AV92) will set the time parameter for occupied override.

Output Ranges

The analog output voltage ranges can be adjusted through BACnet. Default output ranges for damper, fan, hot and chilled water valves are 2V to 10V.

DamperLowAOValue (AV99)
DamperHiAOValue (AV100)
InvertAO09 (BV92) will invert the voltage signal for AO09
FanLowAOValue (AV107)
FanHiAOValue (AV108)
InvertAO12 (BV94) will invert the voltage signal for AO12
HWValveLowAOValue (AV115)
HWValveHiAOValue (AV116)
InvertAO13 (BV95) will invert the voltage signal for AO13
CHWValveLowAOValue (AV99)
CHWValveHiAOValue (AV100)
InvertAO14 (BV96) will invert the voltage signal for AO14

Two-Pipe Control

If 2-pipe control is selected, there are two options to change from summer to winter control:

- Summer=1, Winter=0 (BV98) – If set to TRUE, valve will modulate only during summer (assuming chilled water supply). If set to FALSE, valve will modulate only during winter (assuming hot water supply). Used if a global point is sent down from a global controller.
- TwoPipeChangeOverSP (AV190) – Set to 20 °C (68 °F). If the XOver temperature read at UI1 is above setpoint, the unit will be in winter mode. If the XOver temperature read at UI1 is below setpoint, the unit will be in summer mode. Used if standalone control is needed.

Unoccupied Setback/Setup

During unoccupied mode, if the space temprature rises above the unoccupied cooling setpoint, the fan will be enabled, and the valves allowed to modulate.

During unoocuiped mode, if the space temperature falls below the unocciuped heating setpoint, the fan will be enabled, and the valves allowed to modulate.

Master/Slave

The FCU can act with other FCU in a master/slave scenario. The FCU set as master will send out the active cooling and heating setpoints and the zone temperature to all slave units.

If several master/slave pairs are on the system, the BACnet Broadcast Rx and TX modules need to be edited in CXpro[HD].

Change the Broadcast name property to something unique for that master/slave pair. The Broadcast name needs to be identical in the Tx and Rx module of that pair.

Hours Run

Fan runtime is monitored through the fan status. If fan status is not enabled, the fan runtime is always on during occupied mode. To reset runtime, toggle fanRuntimeReset (BV107) to TRUE.

Alarms

If the zone temperature is out of range (20° … 240°) a zoneTempFault alarm will be raised. The PID loops will be disabled and the damper closed. The fan will be allowed to run.

If the supply air temperature is out of range (20° … 240°) a supplyTempFault alarm will be raised.

If the zone temperature is out of setpoint range, either above the cooling or below the heating setpoints, for more than 10 minutes, a zoneTempAlarmOOR alarm will be raised.

Points Summary

POINT	SETPOINT	OBJECTNAME	DESCRIPTION	IMPERIAL		METRIC	
				DEFAULT VALUE	UNIT	DEFAULT VALUE	UNIT
AV49	no	*activeCoolSP*	Current active cooling setpoint. Calcuated point.	73	°F	22	°C
AV50	no	*activeHeatSP*	Current active heating setpoint. Calculated point.	71	°F	21.5	°C
BV149	yes	*BACnetEnableHeartbeat*	Enable BACnet heartbeat	FALSE	-	FALSE	-
BV145	yes	*BACnetHeartbeat*	Digital point global controller sends heartbeat to	FALSE	-	FALSE	-
AV224	yes	*BACnetHeartbeatTimer*	Timer for heartbeat	10	min	10	min
AV46	no	*CBTStat_CoolingSP*	CBT-Stat Cooling setpoint.	73	°F	22	°C
AV45	no	*CBTStat_HeatingSP*	CBT-Stat Heating setpoint.	71	°F	21.5	°C
AV44	no	*CBTStat_Humidity*	CBT-Stat Humidity reading	-	%rh	-	%rh
AV43	no	*CBTStat_Temp*	CBT-Stat Temperature reading	-	°F	-	°C
BV75	yes	*CBTStatAdj = 1/Disable* *CBTStatAdj = 0*	Enable users to use keypad to adjust temperature setpoints on CBT-Stat.	TRUE	-	TRUE	-
AV144	no	*CHWPosition*	Postion of chilled water valve from 0-100%	0	%	0	%
AO14	no	*CHWValve*	Output of chilled water valve	-	-	-	-
AV125	yes	*CHWValve HiAOValue*	High value of analog output voltage	10	V	10	V
AV124	yes	*CHWValveLowAOValue*	Low value of analog output voltage	2	V	2	V
AI4	no	*CO2*	Carbon dioxide reading. 0-10V input.	-	ppm	-	ppm
AV82	yes	*CO2_SP*	Carbon dioxide setpoint for demand ventilation	800	ppm	800	ppm
BV39	no	*commAlarm*	If BACnet heartbeat is enabled, and there is a loss of communication, this alarm will be enabled.	-	-	-	-
AO09	no	*Damper*	Output of Damper	-	-	-	-
AV100	yes	*Damper HiAOValue*	High value of analog output voltage	10	V	10	V
AV99	yes	*Damper LowAOValue*	Low value of analog output voltage	2	V	2	V
AV85	yes	*DamperMinPosition*	Damper minimum position setpoint	20	%	20	%
AV90	no	*DamperPosition*	Position of Damper	0	%	0	%
AV108	yes	*Fan HiAOValue*	High value of analog output voltage	10	V	10	V
AV107	yes	*Fan LowAOValue*	Low value of analog output voltage	2	V	2	V
DO12	no	*FanCmd*	Output of fan signal	-	-	-	-
AV160	no	*FanDemand*	Analog fan command from 0-100%	0	%	0	%
AV157	yes	*fanMaxSpeed*	Maximum fan speed setpoint	100	%	100	%
AV156	yes	*fanMinSpeed*	Minimum fan speed setpoint	20	%	20	%
AV68	no	*fanRuntime*	Fan runtime	-	Hours	-	Hours
BV107	yes	*fanRuntime Reset*	Reset fan runtime	FALSE	-	FALSE	-
DO15	no	*FanSS*	Output of digital signal for fan	-	-	-	-
DI10	no	*FanStatus*	Fan status input if used. Closed = fan running.	FALSE	-	FALSE	-
BV24	yes	*fireShutdown*	remote fire shutdown setpoint	FALSE	-	FALSE	-
AV145	no	*HWPosition*	Postion of hot water/ 2-pipe valve from 0-100%	0	%	0	%

POINT	SETPOINT	OBJECTNAME	DESCRIPTION	IMPERIAL		METRIC	
				DEFAULT VALUE	UNIT	DEFAULT VALUE	UNIT
AO13	no	*HWValve*	Output of hot water/2-pipe valve	-	-	-	-
AV116	yes	*HWValve HiAOValue*	High value of analog output voltage	10	V	10	V
AV115	yes	*HWValve LowAOValue*	Low value of analog output voltage	2	V	2	V
AV1	yes	*inputConfig*	Sets the UI input monitoring for UI1 and UI2	0	-	0	-
BV25	no	*internalScheduleCmd*	Status of internal Schedule occupancy command	FALSE	-	FALSE	-
BV92	yes	*InvertAO09*	Invert the 0 … 10 volt signal of this output	FALSE	-	FALSE	-
BV94	yes	*InvertAO12*	Invert the 0 … 10 volt signal of this output	FALSE	-	FALSE	-
BV95	yes	*InvertAO13*	Invert the 0 … 10 volt signal of this output	FALSE	-	FALSE	-
BV96	yes	*InvertAO14*	Invert the 0 … 10 volt signal of this output	FALSE	-	FALSE	-
AV40	yes	*NET_ShedPercent*	0 … 100% signal to reset from occupied setpoints to standby setpoints during shed mode	0	%	0	%
AV63	yes	*occCmd*	Occupancy command. 0=Unoccupied 1=Warmup 2=Occupied 3=RemoteFireShutdown	-	-	-	-
BV13	no	*occMode*	Status of occupancy. Occupied = On, Unoccupied = Off	-	-	-	-
AV92	yes	*occOvrTime*	Sets the time for occupied override during unoccupied mode.	60	min	60	min
AV4	yes	*occSPDeadband*	Offset for calculation of occupied setpoints	2	°F	2	°C
AV161	no	*OperatingStatus*	Operating status of unit: 0=Unoccupied 1=Occupied 3=Shed 4=Warmup 8=Shutdown 17=Standby 32=UnoccCallHeat 64=UnoccCallCool 129=WindowShutdown	-	-	-	-
BV43	no	*shedMode*	Status of shed mode	-	-	-	-
AV36	yes	*sliderSpanSP*	Set the 5k potentiometer range for space temperature	2	°F	2	°C
BV58	yes	*StandbyCmd_Ovr*	Optional setpoint to set unit into stanby mode. Standby = On	FALSE	-	FALSE	-
BV59	no	*standbyMode*	Status of standby mode. Standby = On	-	-	-	-
AV28	yes	*standbyOffsetSP*	Offset for calculation of standby setpoints	4	°F	4	°C
AV2	no	*StrategyVersion*	Version number. Used with CXPro for commissioning feature	10090100	-	10090100	-
BV98	yes	*Summer=1 Winter=0*	2-pipe digital changeover between winter and summer	FALSE	-	FALSE	-
AV80	yes	*supplyAirSP*	Supply temperature setpoint for supply air reset	55	°F	12	°C
AI3	no	*SupplyAirTemp*	Supply air temp reading	-	°F	-	°C
BV46	no	*supplyTempFault*	Supply air temp alarm	-	-	-	-
BV38	no	*testMode_CoolOff*	When in test mode, valve is at 0%	-	-	-	-
BV37	no	*testMode_CoolOn*	When in test mode, valve is at 100%	-	-	-	-
BV35	no	*testMode_fanEnable*	When in test mode, fan is at 100%	-	-	-	-
BV36	no	*testMode_HeatOff*	When in test mode, valve is at 0%	-	-	-	-

POINT	SETPOINT	OBJECTNAME	DESCRIPTION	IMPERIAL		METRIC	
				DEFAULT VALUE	UNIT	DEFAULT VALUE	UNIT
BV34	no	*testMode_HeatOn*	When in test mode, valve is at 100%	-	-	-	-
BV29	yes	*testModeEnable*	Enable test mode	FALSE	-	FALSE	-
BV81	no	*totalDemand*	PID output of unit: Cool % = +100 Heat % = -100	0	%	0	%
AV150	yes	*TwoPipeChangeOverSP*	2-pipe analog changeover between summer and winter based on pipe temperature read at UI1	68	°F	20	°C
AV42	yes	*unitConfig*	Unit setup configuration point	-	-	-	-
AV162	no	*UnitMode*	Mode of unit: 1=VentMode 2=CoolMode 4=HeatMode	-	-	-	-
BV85	no	*UnoccCallCool*	When unit is in unoccupied mode and temperature is above or below setpoint, and unit is called to run in cooling mode	-	-	-	-
BV70	no	*UnoccCallHeat*	When unit is in unoccupied mode and temperature is above or below setpoint, and unit is called to run inheating mmode	-	-	-	-
AV21	yes	*unoccSPDeadband*	Offset for calculation of unoccupied setpoints	12	°F	12	°C
BV21	no	*warmupMode*	Status of warmup mode. Warmup = On	-	-	-	-
DI11	no	*WindowContact*	Status of window contact. Closed = Window open	-	-	-	-
AV3	yes	*zoneSP*	Zone temperature setpoint	72	°F	22	°C
AV61	no	*zoneTemp*	Zone temperature	-	°F	-	°C
BV47	no	*zoneTempAlarmOOR*	Zone temperature out of range of setpoint alarm	-	-	-	-
BV44	no	*zoneTempFault*	Zone temperautre fault alarm	-	-	-	-

CBT-4T4-2U1R 10080101/10090101 (IMPERIAL/METRIC) V1_0

This Sample Application is a demo strategy provided for use on the CBT-4T4-2U1R.

See the *CBT-4T4-2U1R 10080100/10090100 v1_1 FCU with Modulating Valves, Damper, Fan (Imperial/Metric)* documentation for details.

004 - VAV: VARIABLE AIR VOLUME UNIT

CBV-2U4-3T-N 10020801/10030801 VAV NO ACTUATOR (IMPERIAL/METRIC) V2_2

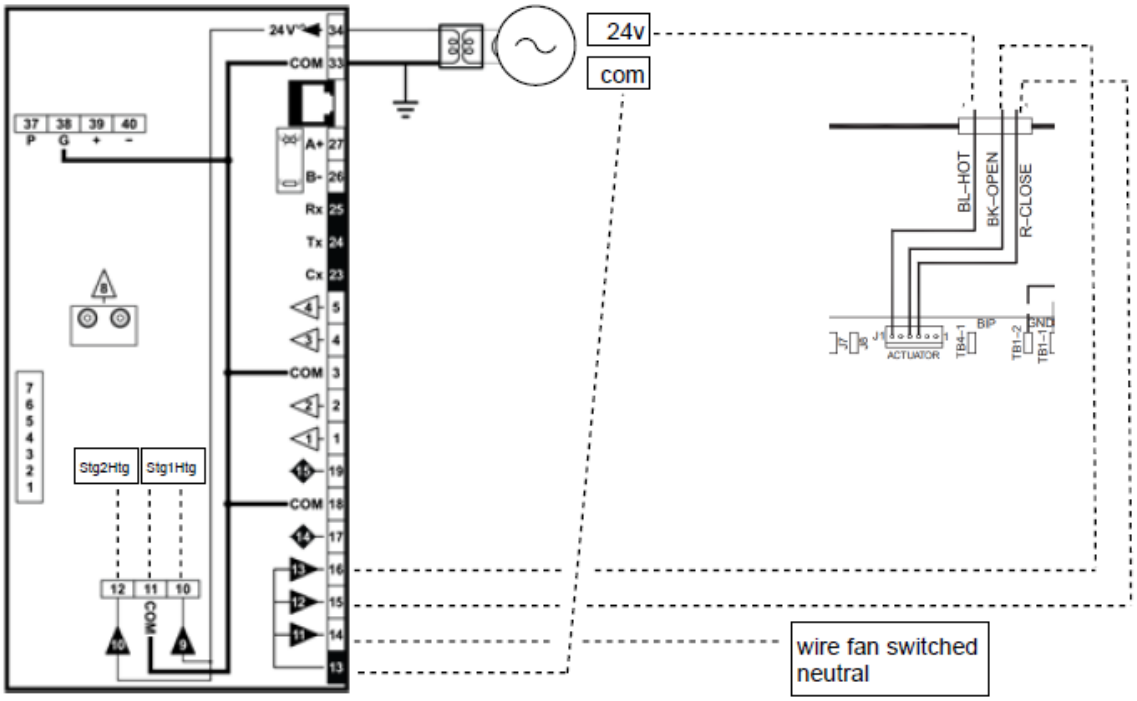
This Sample Application is a pre-installed strategy available for CBV controllers. For details on the sequence of operations and points list, see manual *MAN0139US* for the CBV-2U4-3T and CBV-2U4-2T-N.

CBV-2U4-3T-N 10020802/10030802 VAV NO ACTUATOR (IMPERIAL/METRIC) V1_0

This Sample Application is a pre-installed strategy available for CBV controllers. For details on the sequence of operations and points list, see manual *MAN0139US* for the CBV-2U4-3T and CBV-2U4-2T-N.

CBV-2U4-3T-N 20020800 VAV NO ACTUATOR (IMPERIAL ONLY) TRANE VAV

This Sample Application is available for use with Trane units that require a switched neutral. For details on the sequence of operations and points list, see manual *MAN0139US* for the CBV-2U4-2T-N.



CBV-2U4-3T 10020901/10030901 VAV INTEGRAL ACTUATOR (IMPERIAL/METRIC) V2_4

This Sample Application is a pre-installed strategy available for CBV controllers. For details on the sequence of operations and points list, see manual *MAN0139US* for the CBV-2U4-3T and CBV-2U4-2T-N.

CBV-2U4-3T 10020902/10030902 VAV INTEGRAL ACTUATOR (IMPERIAL/METRIC) V1_2

This Sample Application is a pre-installed strategy available for CBV controllers. For details on the sequence of operations and points list, see manual *MAN0139US* for the CBV-2U4-3T and CBV-2U4-2T-N.

005 - RTU: ROOFTOP UNIT

CBT-3T6-5R 10040100 ROOFTOP (IMPERIAL)

This Sample Application is a pre-installed strategy available for CBT14 and CBT-3T6-5R controllers. For details on the sequence of operations and points list, see manual *MAN0130US CBT-3T6-5R RoofTopUnit*.

CBT-3T6-5R 10050100 ROOFTOP (METRIC)

This Sample Application is a pre-installed strategy available for CBT14 and CBT-3T6-5R controllers. For details on the sequence of operations and points list, see manual *MAN0130US CBT-3T6-5R RoofTopUnit*.

CBT-3T6-5R 10040101 V1_0 ROOFTOP (IMPERIAL)

This Sample Application is a pre-installed strategy available for CBT14 and CBT-3T6-5R controllers. For details on the sequence of operations and points list, see manual *MAN0130US CBT-3T6-5R RoofTopUnit*.

CBT-3T6-5R 10050101 V1_0 ROOFTOP (METRIC)

This Sample Application is a pre-installed strategy available for CBT14 and CBT-3T6-5R controllers. For details on the sequence of operations and points list, see manual *MAN0130US CBT-3T6-5R RoofTopUnit*.

006 - HP: HEAT PUMP UNIT

CBT-3T6-5R 10060100 HEAT PUMP (IMPERIAL)

This Sample Application is a pre-installed strategy available for CBT14 and CBT-3T6-5R controllers. For details on the sequence of operations and points list, see manual *MAN0128US CBT-3T6-5R HeatPump*.

CBT-3T6-5R 10070100 HEAT PUMP (METRIC)

This Sample Application is a pre-installed strategy available for CBT14 and CBT-3T6-5R controllers. For details on the sequence of operations and points list, see manual *MAN0128US CBT-3T6-5R HeatPump*.

CBT-3T6-5R 10060101 V1_0 HEAT PUMP (IMPERIAL)

This Sample Application is a pre-installed strategy available for CBT14 and CBT-3T6-5R controllers. For details on the sequence of operations and points list, see manual *MAN0128US CBT-3T6-5R HeatPump*.

CBT-3T6-5R 10070101 V1_0 HEAT PUMP (METRIC)

This Sample Application is a pre-installed strategy available for CBT14 and CBT-3T6-5R controllers. For details on the sequence of operations and points list, see manual *MAN0128US CBT-3T6-5R HeatPump*.

007 - FBVI-2U4-4T 10021300/10031300 (IMPERIAL/METRIC) V1_0

This Sample Application is a pre-installed strategy available for FBVI-2U4-4T controllers. For details on the sequence of operations and points list, see manual *MAN0148_FBVi User Guide*.

008 - FUSION SENSOR: EXAMPLES OF FUSIONAIR SMART SENSOR CONFIGURATIONS

The following examples illustrate different ways in which standard control sequences can be made compatible with FusionAir, and FusionAir-specific features can be implemented in the Strategy of any supported Controller.

8.1.1.1 SINGLE SETPOINT CONTROL

For basic temperature control applications, a single setpoint can be used to control a room with both heating and cooling capability. In CXpro[HD] sample control Strategy 8.1.1.1,

- The heating and cooling setpoints are calculated by an offset, with the single setpoint used as the midpoint.
- The Fusion Sensor will display the calculated heating setpoint when in heating mode and show the calculated cooling setpoint when in cooling or vent mode.
- If the user overrides the setpoint at the sensor, the calculated setpoints will be incremented or decremented and the adjusted setpoint will be used for calculating heating and cooling capacity. The overridden setpoint will reset to the calculated setpoints after the Setpoint Override Duration time has expired.

8.1.1.2 DUAL SETPOINT CONTROL

CXpro[HD] sample control Strategy 8.1.1.2 shows dual setpoints being used to control a room with both heating and cooling capability. This is a useful application for heating / cooling control where occupancy isn't required.

- The heating and cooling setpoints are set separately. A macro prevents the heating setpoint going above the cooling setpoint, or the cooling setpoint going below the heating setpoint.
- The FusionAir Smart Sensor will display the calculated heating setpoint when in heating mode, and show the calculated cooling setpoint when in cooling or vent mode.
- If the user overrides the setpoint at the sensor, the heating and cooling setpoints will be incremented or decremented and the adjusted setpoint will be used for calculating heating and cooling capacity.
  The overridden setpoint will reset to the heating and cooling setpoints after the Setpoint Override Duration time has expired.

8.1.1.3 FOUR SETPOINT CONTROL

In ABB VAV Strategies it is common to use 4 setpoints:

1. occupied cooling
2. occupied heating
3. unoccupied cooling
4. unoccupied heating

CXpro[HD] sample control Strategy 8.1.1.3 shows and example of how this could be implemented:

- Occupancy is used to determine if the occupied heating and setpoints or if the unoccupied heating and cooling setpoints are used.
  A macro prevents the heating setpoint going above the cooling setpoint, or the cooling setpoint going below the heating setpoint.
- The Fusion Sensor will display the occupied heating setpoint when in heating mode and show the occupied cooling setpoint when in cooling or vent mode.
- If the user overrides the setpoint at the sensor, the occupied heating and cooling setpoints will be incremented or decremented and the adjusted setpoint will be used for calculating heating and cooling capacity.
  The overridden setpoint will reset to the occupied heating and cooling setpoints after the Setpoint Override Duration time has expired.

When the FusionAir Smart Sensor is touched, the room is set to `occupied`.

8.1.1.4 HUMIDIFY-DEHUMIDIFY

The FusionAir Smart Sensor can detect the humidity level which can be used in humidification and dehumidification applications.

In CXpro^{HD} sample control Strategy 8.1.1.4:

- When the humidity level rises above the Dehumidify Setpoint + Offset, a digital point will enable the room to dehumidify.
- When the humidity level falls below the Dehumidify Setpoint - Offset, the digital point will be disabled.
- When the humidity level falls below the Humidify Setpoint - Offset, a digital point will enable the room to humidify.
- When the humidity level rises above the Humidify Setpoint + Offset, or if the high duct humidity alarm is triggered, the humidify digital point will be disabled.

8.1.1.5 ACCENT LIGHTS

The FusionAir Smart Sensor's LED lighting provides a full range of RGB colors for all sorts of applications, such as architectural accent lighting or to display unsafe conditions for the occupants of the room.

In CXpro^{HD} sample control Strategy 8.1.1.5, which aims to control CO_2 levels in the environment, the accent lights are triggered by the measured level of CO_2 displaying different colors for 3 levels:

- If the CO_2 level is higher than the CO_2 Setpoint + CO_2 Offset, the accent lights will turn red. The supply fan will ramp up based on the amount of offset.
- If the CO_2 level is lower than the CO_2 Setpoint – CO_2 Offset, the accent lights will turn green. The supply fan will ramp down based on the amount of offset.
- If the CO_2 level is within the CO_2 Offset range, the accent lights will turn blue. The supply fan will ramp based on current CO_2 level.
- On an increase in the difference between temperature from temperature setpoint, the supply fan speed will increase.
- On a decrease in the difference between temperature from temperature setpoint, the supply fan will decrease.

8.1.1.6 LIGHTING SCENE CONTROL

CXpro[HD] sample control Strategy 8.1.1.6 simulates a conference room with different lighting scenes for meetings and presentations. The Strategy switches between the scenes when the physical button on the side of the FusionAir

Physical push-button

The Conference room has 3 areas:

1. Area 1 – Border of room with dimmable lights
2. Area 2 – Front of room with 2-stage ceiling light fixtures
3. Area 3 – Back of room with 2-stage ceiling light fixtures

The Strategy switches between 5 scenes:

	Scene 0 →	Scene 1 →	Scene 2 →	Scene 3 →	Scene 4
Area 1	0%	100%	50%	0%	50%
Area 2	both stages OFF	both stages ON	OFF	both stages ON	1 stage ON
Area 3	both stages OFF	both stages ON	1 stage ON	both stages ON	1 stage ON

Pressing the Physical side button will increase the scene selection by 1. Once **Scene 4** is reached, pressing it again will start again at **Scene 0**.

If `Occupied Cmd BV6` is set to false, the lights will reset to **Scene 0**. `Occupied Cmd BV6` must be set to true to enable lighting Scene selection.

8.1.1.7 LIGHT CONTROL SENSOR OVERRIDE

CXpro[HD] sample control Strategy 8.1.1.7 illustrates how dimmable lighting could be controlled through the FusionAir Smart Sensor using an external lux sensor.

As the amount of light in the room increases, the lighting will be reset to a lower level.

The lighting level can be overridden at the sensor for a set period of time.

8.1.1.8 SUNBLIND CONTROL

CXpro[HD] sample control Strategy 8.1.1.8 shows 3 types of sunblind control with the FusionAir Smart Sensor using an external lux sensor. The sensor can be used to manually override sunblind control sequences set up in the Strategy. In a similar manner to lighting in the previous sections, sunblind control can also be applied to conference rooms for meetings and presentations, or general ambient light control.

The type of control applied to the sunblinds is selected by setting `AV56 blindControl` to one of 3 values:

`0` = allow the user to override the sunblind position through the FusionAir Smart Sensor.

`1` = adjust the sunblind position based on a set light level in the room.

- As the light level increases, the sunblinds will close.
- As the light level decreases, the sunblinds will open.

`2` = the lower sunblinds will be at minimum position. The upper sunblinds will adjust to a set light level in the room.

- As the light level increases, the sunblinds will close.
- As the light level decreases, the sunblinds will open.

8.1.1.9 ECO LEAF

The ECO Leaf icon is intended to show operational efficiency. It can be used when site specifications require you to inform room occupants of the efficiency of the HVAC equipment.

CXpro[HD] sample control Strategy 8.1.1.9 shows how the ECO leaf can be made to depend on setpoint overrides and fan speed.

If the `temperature setpoint` is overridden or if the heating or cooling is `enabled`, the efficiency will be reduced by a calculated leaf amount:

- If the fan speed is below `20`%, the efficiency will not be affected.
- If the fan speed is between `21`% and `60`%, the efficiency will be reduced by `1 leaf`.
- If the fan speed is above `60`%, the efficiency will be reduced by `2 leaves`.

8.1.2.0 CO_2 AND VOC CONTROL

The Fusion Sensor will detect CO_2 and VOC levels, which can be used for monitoring safe air quality conditions in the room.

In CXpro[HD] sample control Strategy 8.1.2.0, if the CO_2 level rises above the setpoint, the signal will increase until the damper reaches maximum position. If the CO_2 level falls below the setpoint, the signal will decrease until the damper reaches minimum position.

The CO_2 signal is used along with an Economizer sequence based on mixed air temperature. If the outside air temperature is within the temperature range to economize the room, the damper will modulate to maintain mixed air temperature:

- If the mixed air temperature rises above setpoint, the damper will modulate open.
- If the mixed air temperature falls below setpoint, the damper will modulate closed.

8.1.2.1 3-STAGE FAN CONTROL

CXpro[HD] sample control Strategy 8.1.2.1 is an example of 3-Speed fan control that is often used in applications such as fancoils and unit vents in hotels and classrooms.

There are 3 states of fan operation, set `AV25 FanOperation` to one of the following:

`0` = At minimum the fan will be always running at the lowest speed.

`1` = The fan will only run based on the current heating and cooling demand. The higher the heating or cooling demand, the higher the fan speed. The lower the heating or cooling demand, the lower the fan speed.

`2` = The fan speed will be manually set by the user. If the Fan Operation is set to 2, set `AV12 ManualFanCmd` to one of the following:

- `0` = Fan is Off
- `1` = Fan is at low speed
- `2` = Fan is at medium speed
- `3` = Fan is at high speed
- `4` = Fan speed is overridden at the fusion sensor

8.1.2.2 ANALOG FAN CONTROL

CXpro[HD] sample control Strategy 8.1.2.2 illustrates how fan speed can be based on duct pressure, using an external duct pressure sensor. In this example,

- If the duct pressure rises above the setpoint, the signal will increase until the fan reaches maximum speed.
- If the duct pressure falls below the pressure setpoint, the signal will decrease until the fan reaches minimum speed.

8.1.2.3 DIGITAL DRY CONTACTS

The two digital inputs (dry contacts) on the sensor can be used to detect occupancy, light switch, room card, widow open/closed etc. CXpro[HD] sample control Strategy 8.1.2.3 uses the example of a room card and window contact.

- When the user scans a room card in the hotel room, both the lighting and HVAC are energized.
- If the window contact is open, indicating that the window has been opened, the HVAC is automatically de-energized.
- Once the window contact is closed, the HVAC will be re-enabled.

8.1.2.4 SIDE BUTTON

CXpro[HD] sample control Strategy 8.1.2.4 uses the side push button as an occupancy override.

- When the side button is pressed, a digital occupancy override will be set to `On`.
- The occupancy override will remain on until the number of minutes set in `AV1 OccupancyOverrideTime` have elapsed.

Once the time has elapsed, the digital occupancy override will be set to `Off`.

8.2.1.1 SAMPLE STRATEGY

CXpro[HD] sample control Strategy 8.2.1.1 combines several of the preceding samples to demonstrate a complete FusionAir-compatible Strategy.

Heating/cooling Setpoints

This sample Strategy uses the 4 setpoint model:

1. occupied cooling
2. occupied heating
3. unoccupied cooling
4. unoccupied heating

- Occupancy is used to determine if the occupied heating and setpoints or if the unoccupied heating and cooling setpoints are used.
  A macro prevents the heating setpoint going above the cooling setpoint, or the cooling setpoint going below the heating setpoint.
- The Fusion Sensor will display the occupied heating setpoint when in heating mode and show the occupied cooling setpoint when in cooling or vent mode.
- If the user overrides the setpoint at the sensor, the occupied heating and cooling setpoints will be incremented or decremented and the adjusted setpoint will be used for calculating heating and cooling capacity.
  The overridden setpoint will reset to the occupied heating and cooling setpoints after the Setpoint Override Duration time has expired.

The unoccupied setpoints are used when the room is unoccupied and are not adjustable from the FusionAir Smart Sensor.

When the FusionAir Smart Sensor is touched, the room is set to be occupied.

CO_2 Monitoring

This sample Strategy uses the color of the accent lights on the FusionAir Smart Sensor to indicate CO_2 levels.

In addition, the supply fan operation will be controlled to improve CO_2 levels when required.

- If the CO_2 level is higher than the `CO₂ Setpoint` + `CO₂ Offset`, the accent lights will turn `Red`. The supply fan will ramp up based on the amount of offset.
- If the CO_2 level is lower than the `CO₂ Setpoint` – `CO₂ Offset`, the accent lights will turn `Green`. The supply fan will ramp down based on the amount of offset.
- If the CO_2 level is within the CO_2 Offset range, the accent lights will turn `Blue`. The supply fan will ramp based on current CO_2 level.

Humidity Monitoring

In this sample Strategy, Humidity is controlled for both humidification and dehumidification situations.

- When the humidity level rises above the `Dehumidify Setpoint`, a digital point will enable the room to dehumidify. When the humidity level falls below the `Dehumidify Setpoint` - `Offset`, the digital point will be disabled.
- When the humidity level falls below the `Humidify Setpoint` - `Offset`, a digital point will enable the room to humidify. When the humidity level rises above the Humidify Setpoint - Offset, or if the high duct humidity alarm is triggered, the humidify digital point will be disabled.

Fan Command

In this sample Strategy, the fan is programmed to control humidity, CO_2 and room temperature.

- As the room humidity is offset from setpoint from `0`…`10%`, and the room is dehumidifying or humidifying, a signal from `0`…`100%` will be sent to the fan command.
- As the room CO_2 is offset from setpoint from `-200` to `300` ppm, a signal from `0`…`100%` will be sent to the fan command.
- As the room temperature is offset from setpoint from `1` to `5` degrees, and the room is in heating or cooling mode, a signal from `0`…`100` will be sent to the fan command.

ECO Leaf

In this sample Strategy, the ECO Leaf will provide indication of how efficient the HVAC equipment is operating.

If the `temperature setpoint` is overridden or if the heating or cooling is `enabled`, the efficiency will be reduced by a calculated leaf amount:

- If the fan speed is below `20`%, the efficiency will not be affected.
- If the fan speed is between `21`% and `60`%, the efficiency will be reduced by `1 leaf`.
- If the fan speed is above `60`%, the efficiency will be reduced by `2 leaves`.

Lighting Control

The lighting Control section of this sample Strategy, generates a `0`…`100%` lighting signal to control dimmable lighting, with the ability to override the setting from the sensor.

- When the room is occupied, the lighting level will be set based on the signal from an external Light Level sensor (`AV64 Lighting Level`).
- The user can override the lighting command for up to `120` minutes.
- When the room is unoccupied, the lighting level will go to `0%`.

sunblind Control

In this sample Strategy, the type of control to be applied to window sunblinds is selected by setting `AV56 blindControl` to one of the following 3 values:

`0` = allow the user to override the sunblind position through the FusionAir Smart Sensor.

`1` = adjust the sunblind position based on a set light level in the room.

- As the light level increases, the sunblinds will close.
- As the light level decreases, the sunblinds will open.

`2` = The lower sunblinds will be at minimum position. The upper blinds will adjust to a set light level in the room.

- As the light level increases, the sunblinds will close.
- As the light level decreases, the sunblinds will open.

009 - FBVI-2U4-4T 10021301/10031301 (IMPERIAL/METRIC) V1_0

This Sample Application is a pre-installed strategy available for FBVI-2U4-4T controllers. For details on the sequence of operations and points list, see manual *MAN0148_FBVi User Guide*.

010 - FBVI-2U4-4T 10021300/10031300(IMPERIAL/METRIC) V2_0

This Sample Application is a pre-installed strategy available for FBVI-2U4-4T controllers. For details on the sequence of operations and points list, see manual *MAN0148_FBVi User Guide*.

011 - FBVI-2U4-4T 10021301/10031301(IMPERIAL/METRIC) V2_0

This Sample Application is a pre-installed strategy available for FBVI-2U4-4T controllers. For details on the sequence of operations and points list, see manual *MAN0148_FBVi User Guide*.

012 - FBTI-7T7-1U1R 10121400/10101400 (IMPERIAL/METRIC) V1_0

This Sample Application is a demo strategy provided for use on the FBTi-7T7-1U1R. This strategy is for a 9-point fan coil operation with analog control outputs and an ECM Fan.

The configuration options for the FBTi Fan Coil unit strategy inputs and strategy options can be set with the CXpro^{HD} BACnet Commissioning tool. If this isn't available, the following will explain how to set up the unit only using BACnet points.

These codes are the same for all the different output setups available for the Fan Coil unit series. Any setpoints that are specific to each strategy will be covered under each strategy section.

Inputs

Standard input setups:

- **UI-1** Will always be used for supply air temperature.
- **UI-2** This input is set for fan status as the default. Other options are a digital safety input, or as a digital filter status.
- **UI-3** This input is used as a digital safety input as the default. Other options are a 10k pipe temperature, a digital input for summer/winter changeover, or as a digital fan status.

Outputs

Standard output setup for ANALOG OUTPUT CONTROL (Strategy ID 10121400)

- **AO-09** is configured for an analog fan command. (AO1 on 9-point controller)
- **DO-10** is configured for digital electric heat. (DO4 on 9-point controller)
- **AO-11** is configured for an analog heating or analog 2-pipe valve. (AO5 on 9-point controller)
- **AO-12** is configured for an analog cooling valve. (AO6 on 9-point controller)
- **AO-13** is configured for an analog damper. (AO7 on 9-point controller)
- **DO-14** is configured for a digital fan on/off command. (Relay on 9-point controller)

Standard output setup for DIGITAL/FLOATING OUTPUT CONTROL (Strategy ID 10131400)

- **AO-09** is configured for an analog fan command. (AO1 on 9-point controller)
- **DO-10** is configured for digital electric heat. (DO4 on 9-point controller)
- **DO-11** is configured for a digital heating or analog 2-pipe valve. (DO5 on 9-point controller)
- **DO-12** is configured for a digital cooling valve. (DO6 on 9-point controller)
- **DO-13** is configured for a digital damper. (DO7 on 9-point controller)
- **DO-14** is configured for a digital fan on/off command. (Relay on 9-point controller)

The FBTI with Fan Coil Unit Strategy may have several pre-loaded strategies to choose from that are designed to be configurable for a variety of Fan Coil Unit (FCU) sequences.

The setup can be selected by writing a value to configurable BACnet setpoints that are within the strategy. There are multiple ways to configure the FBTI for a specific sequence. Users can set these configuration values through CXpro^{HD}, NBPro, or a BACnet interface.

The preset configuration variables from the factory are:

- tempControlConfig = `0`
- unitConfig = `0`
- UI2Config = `0`
- UI3Config = `0`

Temp Control Configuration Code

The type of temperature control for the Fan Coil Unit strategy are selected using tempControlConfig.

There are multiple options which can be selected for each input. Adding these together will result in the final code for tempControlConfig.

Supply Air Temp Control : `0` is the default for supply temperature control. The supply air temperature setpoint will reset based on the zone temperature demand. Based on **ASHRAE** recommendations. The heating and cooling control will be based on the deviation from supply air temperature from supply air temperature setpoint.

Zone Temp Control : `1` is the default for zone temperature control. The cooling and heating demand will be based on the zone temperature deviation from heating and cooling setpoints. Does not use supply air temperature setpoint.

Heat Only : If `2` is added, the unit will only operate when there is a heating demand. Cooling will not be enabled.

Cool Only : If `4` is added, the unit will only operate when there is a cooling demand. Heating will not be enabled.

Digital Heat Enabled : If `8` is added, the digital heat will be used for heating. Digital heating will be based on zone temperature control only. If Digital heat has been configured, analog heating will be disabled.

Free Cooling : If `16` is added, the outside air damper will modulate based on cooling demand. An outdoor air temperature is required to be sent to the unit.

Unit Configuration Code

The different basic sequence options that are available to all fan coil unit configurations are selected using unitConfig.

There are multiple options which can be selected for each. Adding these together will result in the final code for unitConfig.

- **Not Set** – `0` is the default, no additional configuration. Basic operation.
- **Slave Mode –** If `1` is added, the unit will be set to Slave mode.
- **Master Mode** – If `2` is added, the unit will be set to Master mode.
- **Demand Control Ventilation** – If `4` is added, the outdoor air damper will modulate based on CO2 levels.
- **Occ Sensor –** If `8` is added, the occ sensor wired to the FusionAir Sensor digital input will be used to determine occupancy. Occupancy = closed, Standby = open.
- **Window Contact –** If `16` is added, the window contact wired to the FusionAir Sensor digital input will be used to determine window status. Window closed = closed, Window open = open.
- **Fan Cycling Off** – If `32` is added, when the unit is in ventilation mode, the fan will shut off. When heating or cooling, the fan will be enabled.
- **Fan Cycling Deadband** – If `64` is added, when the unit is in ventilation mode, the fan will run at deadband speed.
- **Remote 2-Pipe Changeover** – If `128` is added, if 2-pipe control is needed, but UI3 cannot be used, the strategy will use the remoteSummerWinterTemp analog setpoint.

UI2 Configuration Code

The different universal input options that are available on UI2 to all fan coil unit configurations are selected using UI2Config.

There are multiple options which can be selected for each. Adding these together will result in the final code for UI2Config.

- **Fan Status** : `0` is the default, no additional configuration. UI2 will be used as a digital status of the unit fan.
- **Safety** : If `1` is added, UI2 will be used as a digital status of a combination of smoke, freeze or water pan alarm.
- **Filter Status** : If `2` is added, UI2 will be used as a digital status of the unit filter.

UI3 Configuration Code

The different universal input options that are available on UI3 to all fan coil unit configurations are selected using UI3Config.

There are multiple options which can be selected for each. Adding these together will result in the final code for UI3Config.

- **Safety :** `0` is the default, no additional configuration. UI3 will be used as a digital status of a combination of smoke, freeze or water pan alarm.
- **2-Pipe temperature sensor** : If `1` is added, UI3 will be used as a 10k water temperature sensor to determine heating or cooling season.
- **2-Pipe digital changeover** : If `2` is added, UI3 will be used as a digital input to determine heating or cooling season.
- **Fan Status** : If `4` is added, UI3 will be used as a digital status of the unit fan.

Heat Digital Output Configuration

Strategy ID `10131400`

The different universal input options that are available on UI3 to all fan coil unit configurations are selected using HeatConfigDO

- `0` is the default, no additional configuration.
    - DO1 Electric Heat `On`/`Off`
    - DO2 Hot Water `On`/`Off`
- `1`
    - DO1 Electric Heat `On`/`Off`
    - DO2 2-Pipe `On`/`Off`
- `2`
    - DO1 Float Open Hot Water
    - DO2 Float Close Hot Water
- `4`
    - DO1 Float Open 2-Pipe
    - DO2 Float Close 2-Pipe

Cool Digital Output Configuration

Strategy ID `10131400`

The different universal input options that are available on UI3 to all fan coil unit configurations are selected using CoolDOConfig.

- `0` is the default, no additional configuration.
    - DO3 Chilled Water `On`/`Off`
    - DO4 Damper `On`/`Off`
- `1`
    - DO3 Float Open Chilled Water
    - DO4 Float Closed Chilled Water

Occupancy Sequence

Occupancy can be achieved in 4 different ways:

1. **Internal Schedule**: When intScheduleEnb is `ON`, the Fan Coil unit will be commanded to the occupied mode when the BACnet schedule returns a `True` value. Otherwise the Fan Coil unit will be in unoccupied mode.
2. **External schedule through an analog command**: When the point occCmd is set to `1`, the Fan Coil unit will be commanded to the occupied mode. If it is set to `0`, the Fan Coil will be in the unoccupied mode. If it is set to `2`, the fan coil will be in the standby mode.
3. **Occupancy Override**: If the unit is unoccupied, when the face of the FusionAir Sensor is touched, the unit will go into a temporary occupied mode. Temporary occupancy time will be defined by the configuration occOvrTime in minutes.

FusionAir Sensor

Some optional settings are available through setpoints:

- FusionStatStptEnb : Set to `FALSE` to disable users from changing the setpoint.
- Fusion_Offset : Set the allowable range for users to change the setpoints
- Fusion_Increment : Set the amount of temperature setpoint change for each press of the button.
- alt_CO2input : If a remote sensor is used for CO_2 sensing, then sending that sensor's reading to this analog setpoint will cause the remote sensor's reading to be displayed on the FusionAir Sensor.

Fan Sequence

The FCU strategy sequence can accommodate several different fan settings: The default setting during ventilation mode is to run continuously at the minimum speed set in minCoolSpeed. The fan can be set to cycle `off` during ventilation mode, or to run continuously at a separate ventilation speed, which is defined by the deadbandSpeed setpoint. These can be set at unitConfig.

In Occupied mode, or during an unoccupied call:

On a cooling signal, the supply air fan will be enabled, and the fan speed command will rise from minCoolSpeed to maxCoolSpeed.

On a heating signal, the supply air fan will be enabled, and the fan speed command will rise from minHeatSpeed to maxHeatSpeed.

In Unoccupied mode, the fan will be disabled.

Temperature Control

There are two options to control space temperature:

The default method is supply air temperature control. When the zone temperature calls for cooling or heating, the supply air temperature setpoint will reset between the maxSupplyAirStpt and minSupplyAirStpt setpoints. Then the heating and cooling control will be based on the deviation from supply air temperature as defined in the supply air temperature setpoint. (**ASHRAE** recommendation).

PI Tuning for Supply Air control:

To tune the reset between the supply air temperature setpoints, use PIDSupplyResetGain and PIDSupplyResetInt. To tune the heating and cooling demand based on the supply air temperature setpoint and actual supply air temperature, use supplyAirGain and supplyAirIntegration.

The unit can also control based on zone temperature. The cooling and heating demand will be based on the zone temperature deviation from heating and cooling setpoints. In this mode, the strategy does not use supply air temperature setpoint.

PI Tuning for Zone Air control:

To tune the zone temperature to the zone temperature setpoints, use PIDTuneGain and PIDTuneInt.

Note: If there is a supply air temperature fault, the unit will automatically change over to zone air temperature control.

Cooling Calculation

When the zone space temperature rises above the current cooling setpoint, the Fan Coil unit will switch into cooling mode. If the unit has been selected as a heating only unit, this will not apply.

In an OCCUPANCY state, on a rise in zone temperature above the occCoolStpt, the cooling demand will rise from `0%` to `100%`. On a fall in zone temperature below the occCoolStpt, the cooling demand will fall from `100%` to `0%`.

The occCoolStpt setpoint can be affected by shed or standby modes. The active cooling setpoint will be reflected by the activeCoolStpt analog value.

In an UNOCCUPANCY state, on a rise in zone temperature above the unoccCoolStpt, the cooling demand will rise from `0%` to `100%`. The unit will be in **Setup Mode**. On a fall in zone temperature below the unoccCoolStpt, the cooling demand will fall from `100%` to `0%`.

Heating Calculation

When the zone space temperature falls below the current heating setpoint, the Fan Coil unit will switch into heating mode. If the unit has been selected as a cooling only unit, this will not apply.

In an OCCUPANCY state, on a fall in zone temperature below the occHeatStpt, the heating demand will rise from `0%` to `100%`. If heat is available, the stages of heat will be enabled. On a rise in zone temperature above the occHeatStpt, the heating demand will fall from `100%` to `0%`.

The occHeatStpt setpoint can be affected by shed or standby modes. The active heating setpoint will be reflected by the activeHeatStpt analog value.

In an UNOCCUPANCY state, on a fall in zone temperature below the unoccHeatStpt, the heating demand will rise from `0%` to `100%`. If heat is available, the stages of heat will be enabled, and the unit will be in **Setback Mode**. On a rise in zone temperature above the unoccHeatStpt, the heating demand will fall from `100%` to `0%`.

Note: If the user tries to set the cooling setpoint occCoolStpt lower than the heating setpoint occHeatStpt, the heating setpoint will be automatically lowered. If the user tries to set the heating setpoint occHeatStpt higher than the cooling setpoint occCoolStpt, the heating setpoint will not change.

Morning Warmup

If the HVACModeCmd analog setpoint has been set to `1` for Morning Warm-up, or the slave FCU has been sent a signal from the master FCU, the unit will change to **Occupied Mode** and maintain the occupied heating setpoint.

Once the room has met the occupied heating setpoint, the HVACModeCmd will reset to `0`, disabling Morning Warm-up for that unit.

Standby Mode

This mode will be enabled only when occupancy sensors are used or on network command. Whenever the scheduled occupancy is OCCUPIED, and the occupancy sensor detects no occupants, this will offset the occupied heating and cooling setpoints for energy conservation. Once an occupant has been detected in the zone, the occupied heating and cooling setpoints will return to normal operation. Standby Mode can also be set manually by toggling analog setpoint occCmd = `2`.

Occupancy sensors need to be wired to dry contact 1 on the FusionAir Sensor, and unitConfig set for occupancy sensors if not using the occCmd analog setpoint.

Standby setpoints are calculated as an offset from the occupied heating and cooling setpoints. standbyOffset is used to set the offset amount.

- For example, the standbyOffset is set to 3 deg, and the cooling setpoint is `72` °F (`22` °C). and the heating setpoint is 70(20C). When no occupancy is detected by the occupancy sensor, the activeCoolStpt will change by `+3` deg and change to `75` °F (`25` °C). The activeHeatStpt will change by `-3` deg and change to 67F(17C). Once there is occupancy detected, the cooling and heating setpoints will revert to their occupied setpoints.

Window Contact

If unitConfig has been set to monitor a window contact, and the window contact input detects that the widow is open, the fan coil unit will shut down. The supply fan will be disabled, the damper will close, and all cooling and heating outputs will be `closed` or `off`. If the window contact closes, the fan coil unit will be enabled to run.

Window contacts need to be wired to dry contact 2 on the FusionAir Sensor.

Fire Shutdown

If HVACModeCmd has been set to `16`, or a signal has been sent from the master fan coil unit to the slave fan coil unit, the fan coil will shut down. The supply fan will be disabled, the damper will close, and all cooling and heating outputs will be `closed` or `off`. If the fire signal has been `disabled`, the fan coil unit will be enabled to run.

Load Shedding

If a value other than `0` is entered into shedDemand the occupied setpoints will offset toward the standby offsets.

- Shed cooling setpoint = (Standby cooling setpoint - Occupied Cooling setpoint) * Shedding%/100
- Shed heating setpoint = (Standby heating setpoint - Occupied Heating setpoint) * Shedding%/100

Comm Fail/Heartbeat

The BACnet heartbeat is disabled by default. To enable the digital heartbeat, toggle enableHeartbeat to `true`.

The heartbeatPulse must toggle from `false` to `true`, or from `true` to `false` within the heartbeatTimer time (default is `10 minutes`). If heartbeatPulse fails to change state within the set time, a communication alarm will be set. A communication alarm will cause the unit to go into occupied mode.

Demand Ventilation

This sequence requires a damper to be part of the I/O configuration.

In Occupied Mode:

On a rise in space carbon dioxide above setpoint, set at CO2_Stpt (default is `800 ppm`), the damper will modulate `open`. On a fall in space carbon dioxide below setpoint, the damper will modulate to minimum position, damperMinPosition (default is `20%`).

In Unoccupied Mode

In Unoccupied Mode, the damper will be `closed`.

Free Cooling

This sequence requires a damper to be part of the I/O configuration. Add `16` to tempControlConfig to enable this sequence.

In Occupied Mode:

An outdoor air temperature is required to be set, at outdoorAirTemp. If the outdoor air temperature is within the minOATStpt and maxOATStpt, the outdoor air damper will modulate open based on the cooling demand.

If the outdoor air temperature is within range, the first stage of cooling will be the damper, the second stage of cooling will enable the cooling valve.

If the outdoor air temperature is out of range, the damper will not modulate. The cooling valve will be used for the cooling signal.

In Unoccupied Mode, the damper will be closed.

2-Pipe Control

2-pipe control can be achieved in 3 different ways:

- **2-Pipe temperature sensor** – If `1` is added to UI3Config, UI3 will be used as a 10k water temperature sensor to determine heating or cooling season.
- **2-Pipe digital changeover** – If `2` is added to UI3Config, UI3 will be used as a digital input to determine heating or cooling season.
- **Remote 2-Pipe Changeover** – If `128` is added to unitConfig, if 2-pipe control is needed, but cannot utilize UI3, the strategy will use the remoteSummerWinterTemp analog setpoint.

The 2-pipe valve should be wired to **AO-11** if the strategy is for an analog control, or xxxxx if the strategy is for digital control.

If the 2-pipe temperature sensor source is above changeOverStpt, the unit will be set to WinterMode. If the temperature sensor is below the changeOverStpt, the unit will be set to SummerMode.

Master/Slave Mode

In applications where more than one unit serves an area, one unit can serve as master and the others as slaves to maintain coordinated control.

Add `2` to unitConfig to set the unit as the master.

Add `1` to unitConfig to set the unit as a slave to the master.

The master unit will distribute the following to the slave units:

- Zone Temperature
- Active cooling setpoint
- Active heating setpoint
- Occupancy command
- HVAC command

Alarms/Monitoring

- **Fan Alarm** : If either UI2 or UI3 are set to use a fan status, on a loss of fan status for more than `30` seconds, a BACnet alarm called fanAlarm will be generated.
- **Fan Runtime** : Fan runtime is calculated in hours. Runtime can be reset by setting fanRuntimeReset to `true`.
- **Maintenance Alarm** : Maintenance runtime is calculated in hours. If the runtime exceeds the amount set at maintAlarmStpt, an alarm will be generated at maintAlarm. Runtime can be reset by setting maintAlmReset to `true`.
- **Zone Temperature Alarm** : If the FusionAir Sensor temperature is out of range, a zoneTempFailure BACnet alarm will be generated.
- **Supply Temperature Alarm** : If the supply air temperature is out of range, a supplyTempFault BACnet alarm will be generated.
- **Safety Alarm** : If UI2 or UI3 are set for a digital safety alarm, and the contact closes, a safetyAlarm BACnet alarm will be generated.
- **Low and High Zone Temperature Alarms** : If the FusionAir Sensor temperature is above the active cooling setpoint for more than `5` minutes, a highZoneTempAlarm will be generated. If the FusionAir Sensor temperature is below the active heating setpoint for more than `5` minutes, a lowZoneTempAlarm will be generated.

Analog Setpoints

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	DEFAULT	UNITS
1	Analog	occCmd	Network occupancy command: 0 = Unoccupied Mode 1 = Occupied Mode 2 = Standby Mode	1	no-units
2	Analog	HVACModeCmd	Network HVAC Mode command: 0 = Auto 1 = Morning Warm Up 4 = Heat Only 8 = Cool Only 16 = Fire 32 = Purge	0	no-units
22	Analog	minHeatSpeed	Minimum speed of fan during heating demand.	20	%
25	Analog	minCoolSpeed	Minimum speed of fan during cooling demand.	20	%
26	Analog	deadbandSpeed	Speed of fan during ventilation mode, set at unitConfig	10	%
27	Analog	maxHeatSpeed	Maximum speed of fan during heating demand.	50	%
28	Analog	maxCoolSpeed	Maximum speed of fan during cooling demand.	100	%
29	Analog	minSupplyAirStpt	Minimum temperature supply air will control to.	52/11	°F/°C
30	Analog	maxSupplyAirStpt	Maximum temperature supply air will control to.	90/32	°F/°C
35	Analog	CO2_Stpt	Carbon Dioxide setpoint.	800	ppm
36	Analog	alt_CO2input	Alternative carbon dioxide point that can be used by 3rd party CO2 sensors over the BACnet network. Will be shown on the Fusion Sensor.	0	ppm
45	Analog	tempControlConfig	Configuration of Temperature Control: 0 = Supply Air Temp Control 1 = Zone Temp Control 2 = Heat Only 4 = Cool Only 8 = Aux Digital Heat Enabled 16 = Free Cooling	0	no-units
53	Analog	MaxChange	Value for regulating ramp speed of fan	0.5	no-units
68	Analog	unitConfig	Configuration of unit control options: 0 = NotSet 1 = Slave 2 = Master 4 = DemandControlVentilation 8 =OccSensor 16 =WindowSensor 32 = Fan Cycling Off 64 = Fan Cycling Deadband 128 = Remote2-PipeChangeover	0	no-units
69	Analog	shedDemand	The amount of setpoint shedding from 0-100%, ranges from occupied setpoints to standby setpoints.	0	%
79	Analog	damperMinPosition	Minimum damper position during occupied mode.	20	%
80	Analog	damperMaxPosition	Maximum damper position during occupied mode.	100	%
81	Analog	HeatDOConfig	0 = DO1 Electric Heat On/Off DO2 On/Off HW 1 = DO1 Electric Heat On/Off DO2 On/Off 2 Pipe 2 = DO1 Float Open HW DO2 Float Close HW 4 = DO1 Float Open 2-Pipe DO2 Float Close 2-Pipe	0	no-units
82	Analog	CoolDOConfig	0 = DO3 On/Off CHW DO4 Damper 1 = DO3 Float Open CHW DO4 Float Close CHW	0	no-units
83	Analog	HWactuatorDegrees	Damper angle travel range for floating point control	90	deg
84	Analog	HWactuatorDriveTime	Damper actuator travel time for floating point control	95	sec
86	Analog	UI2Config	Configuration of UI2: 0=FanStatus 1=Safety 2=FilterStatus	0	no-units
87	Analog	UI3Config	Configuration of UI3: 0=Safety 1=10k 2-Pipe Temp 2=Digital changeover 2 -Pipe 4=FanStatus	0	no-units
100	Analog	outdoorAirTemp	Network provided outdoor air temperature	0	°F/°C
101	Analog	maxOATStpt	Maximum outdoor air temperature setpoint to allow free cooling.	60/ 15	°F/°C
102	Analog	minOATStpt	Minimum outdoor air temperature setpoint to allow free cooling.	50/10	°F/°C

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	DEFAULT	UNITS
104	Analog	changeOverStpt	Used with 2-pipe system. When pipe temperature rises above setpoint, system goes into winter mode. When pipe temperature falls below setpoint, system goes into summer mode.	68/20	°F/°C
108	Analog	remoteSummerWinterTemp	Used with 2-pipe system. Used as a network variable to set pip temperature if UI3 is not available.	0	°F/°C
110	Analog	FanLowAOValue	Low voltage range amount for output.	2	volts
111	Analog	FanHiAOValue	High voltage range amount for output.	10	volts
123	Analog	occCoolStpt	Occupied cooling setpoint.	72/22	°F/°C
124	Analog	occHeatStpt	Occupied heating setpoint.	70/20	°F/°C
125	Analog	unoccCoolStpt	Unoccupied cooling setpoint.	80/26	°F/°C
126	Analog	unoccHeatStpt	Unoccupied heating setpoint.	65/18	°F/°C
131	Analog	HWLowAOValue	Low voltage range amount for output.	2	volts
132	Analog	HWHiAOValue	High voltage range amount for output.	10	volts
146	Analog	standbyOffset	Offset between the standby heating and cooling setpoints.	3	°F/°C
154	Analog	CHWactuatorDegrees	Damper angle travel range for floating point control	90	deg
155	Analog	CHWactuatorDriveTime	Damper actuator travel time for floating point control	95	sec
155	Analog	CHWLowAOValue	Low voltage range amount for output.	2	volts
156	Analog	CHWHiAOValue	High voltage range amount for output.	10	volts
169	Analog	DamperLowAOValue	Low voltage range amount for output.	2	volts
170	Analog	DamperHiAOValue	High voltage range amount for output.	10	volts
180	Analog	occOvrTime	Amount of time unit will be in occupied override once the Fusion Sensor is touched.	160	min
193	Analog	maintAlarmStpt	Amount of time unit needs to run until a maintenance alarm is triggered.	2160	hours
195	Analog	supplyAirGain	PI Gain tuning value for supply air control of heating or cooling	10	no-units
196	Analog	supplyAirIntegration	PI Integration tuning value for supply air control of heating or cooling	80	no-units
200	Analog	Fusion_Offset	Allowable offset amount of user entered setpoint from Fusion Sensor.	3	°F/°C
201	Analog	PIDTuneGain	PI Gain tuning value for zone air control of heating or cooling	3	no-units
202	Analog	PIDTuneInt	PI Integration tuning value for zone air control of heating or cooling	60	no-units
203	Analog	PIDSupplyResetGain	PI Gain tuning value for supply air setpoint reset	30	no-units
204	Analog	PIDSupplyResetInt	PI Integration tuning value for supply air setpoint reset	60	no-units
218	Analog	Fusion_Increment	Amount of temperature increase or decrease of temperature setpoint when user presses up or down arrow on Fusion Sensor.	0.5	°F/°C
408	Analog	heartbeatTimer	If the heartbeat has not changed within this timeframe, trigger an alarm.	10	min

Analog Values

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	DEFAULT	UNITS
5	Analog	activeCoolStpt	Current active cooling setpoint that unit is controlling to.	varies	°F/°C
6	Analog	Fusion_Humidity	FusionAir sensor humidity reading	0-100	%RH
7	Analog	Fusion_CO2	FusionAir sensor carbon dioxide reading	0-2000	ppm
12	Analog	standbyCoolStpt	Standby cooling setpoint used for internal calculations	varies	°F/°C
13	Analog	standbyHeatStpt	Standby heating setpoint used for internal calculations	varies	°F/°C
14	Analog	shedCoolStpt	Shed cooling setpoint for internal calculations	varies	°F/°C
15	Analog	shedHeatStpt	Shed heating setpoint for internal calculations	varies	°F/°C
23	Analog	activeHeatStpt	Current active heating setpoint that unit is controlling to.	varies	°F/°C
41	Analog	supplyAirTempStpt	Calculated supply air temperature setpoint if unit is controlling off supply air temperature. This will equal zone supply air temperature if in ventilation mode, or unit is controlling to zone temperature only.	varies	°F/°C
46	Analog	coolDemand	The analog demand signal sent to the cooling outputs	0-100	%
47	Analog	heatDemand	The analog demand signal sent to the heating outputs	0-100	%
65	Analog	fanSpeedCmd	Current fan speed command from 0-100%	0-100	%
67	Analog	Fusion_Temp	FusionAir sensor zone temperature reading	varies	°F/°C
76	Analog	fanRuntime	Current fan runtime in hours.	varies	hours
83	Analog	damperCmd	Current damper command from 0-100% for analog control output	0-100	%
88	Analog	activeZoneTemp	Current active zone temperature the unit is controlling to.	varies	°F/°C
144	Analog	FloatHWPosition	Calculated damper position for floating valve	0-100	%
169	Analog	FloatCHWPosition	Calculated damper position for floating valve	0-100	%
189	Analog	occStatus	Current occupancy status. Enumerations are: 0=Unocc 1=Occ 3=Standby 4=SetbackMode 8=SetupMode	varies	no-units
190	Analog	unitStatus	Current unit status. Enumerations are: 1=CoolMode 2=VentMode 4=HeatMode	varies	no-units
191	Analog	HVACModeStatus	Current HVACMode status. Enumerations are: 0 = Auto 1 = Morning Warm Up 4 = Heat Only 8 = Cool Only 16 = Shed 32 = Fire 64 = Purge	varies	no-units
194	Analog	fanPosition	Current fan position from 0-100%. Rescaled from voltage output.	0-100	%
197	Analog	HWValvePosition	Current valve position from 0-100%. Rescaled from voltage output.	0-100	%
198	Analog	CHWValvePosition	Current valve position from 0-100%. Rescaled from voltage output.	0-100	%
199	Analog	DamperPosition	Current damper position from 0-100%. Rescaled from voltage output.	0-100	%
213	Analog	terminalLoad	Single PI signal to determine heating or cooling load. Cooling 0 to 100 Heating 0 to -100	0-100 -0-100	%
220	Analog	StrategyVer	Strategy versioning	varies	No-units

Digital Setpoints

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS 0/OFF	UNITS 1/ON
1	Digital	intScheduleEnb	Internal schedule, enable if unit is to use a stand-alone schedule.	disabled	enabled
97	Digital	HWReverse	Reverse floating point operation	disabled	enabled
98	Digital	reverseDO5	Reverse the output from low to high voltage -> high to low voltage (digital/floating control)	disabled	enabled
98	Digital	reverseAO5	Reverse the output from low to high voltage -> high to low voltage (analog control)	disabled	enabled
99	Digital	reverseDO6	Reverse the output from low to high voltage -> high to low voltage (digital/floating control)	disabled	enabled
99	Digital	reverseAO6	Reverse the output from low to high voltage -> high to low voltage (analog control)	disabled	enabled
100	Digital	reverseDO7	Reverse the output from low to high voltage -> high to low voltage (digital/floating control)	disabled	enabled
100	Digital	reverseAO7	Reverse the output from low to high voltage -> high to low voltage (analog control)	disabled	enabled
101	Digital	reverseAO1	Reverse the output from low to high voltage -> high to low voltage	disabled	enabled
102	Digital	reverseDO4	Reverse digital output control from closed = ON to open = ON	disabled	enabled
103	Digital	reverseRelay1	Reverse digital output control from closed = ON to open = ON	disabled	enabled
121	Digital	Fusion_OvrReset	Resets any overrides currently running on a Fusion Sensor.	disabled	enabled
124	Digital	FusionStatStptEnb	Enables the user to adjust the temperature setpoint on a Fusion Sensor.	disabled	enabled
142	Digital	maintAlmReset	Resets the maintenance runtime alarm.	disabled	enabled
144	Digital	fanRuntimeReset	Resets the fan runtime.	disabled	enabled
306	Digital	heartbeatPulse	Enable if using the Heartbeat feature. If there is a loss of comm, system will go into occupied mode.	disabled	enabled
307	Digital	enableHeartbeat	Enables the heartbeat macro.	disabled	enabled

Digital Values

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS 0/OFF	UNITS 1/ON
2	Digital	ScheduleOccCmd	Status of the internal schedule.	off	on
3	Digital	commAlarm	Communication alarm. Enabled when the heartbeat macro has been enabled.	off	on
6	Digital	Fusion_TempOK	Fusion Sensor temperature reading is valid	off	on
7	Digital	Fusion_HumidityOK	Fusion Sensor humidity reading is valid	off	on
8	Digital	Fusion_CO2OK	Fusion Sensor CO2 reading is valid	off	on
10	Digital	occMode	Shows occupancy mode status. On = Occupied. Off = unoccupied.	off	on
11	Digital	unoccCallForHeat	If the zone temperature falls below the unoccupied heating setpoint, the unit will be enabled to run.	off	on
12	Digital	unoccCallForCool	If the zone temperature rises above the unoccupied cooling setpoint, the unit will be enabled to run.	off	on
29	Digital	occSensor	Occupancy sensor status. Occupancy = Closed Standby = Open	off	on
30	Digital	windowSensor	Window sensor status. Window Closed = Closed Window Open = Open	off	on
32	Digital	shedMode	Shed Mode status.	off	on
37	Digital	supplyTempFault	Supply Temperature fault alarm.	off	on
38	Digital	maintAlarm	Maintenance Alarm.	off	on
42	Digital	highZoneTempAlarm	High zone temperature alarm.	off	on
43	Digital	lowZoneTempAlarm	Low zone temperature alarm.	off	on
45	Digital	zoneTempFailure	Zone temperature failure alarm.	off	on
60	Digital	fanStatus	If a digital fan status is wired to an input, closed = running.	off	on
62	Digital	filterStatus	If a digital filter status is wired to an input, closed = dirty.	off	on
65	Digital	standbyMode	Standby Mode status.	off	on
69	Digital	unitShutdown	If unit has been shutdown due to safety, fire or window contact, unitShutdown = ON.	off	on
79	Digital	freeCoolingActive	If free cooling is active, this will be ON.	off	on
81	Digital	damperCmd	Damper position command, digital control only	off	on
83	Digital	safetyAlarm	If a safety contact has closed at UI2 or UI3, this will show ON.	off	on
85	Digital	SummerMode	Summer mode status for 2-pipe system	off	on
86	Digital	WinterMode	Winter mode status for 2-pipe system	off	on
107	Digital	coolMode	Cooling mode status	off	on
108	Digital	heatMode	Heating mode status	off	on
110	Digital	ventMode	Ventilation mode status	off	on
123	Digital	OccOvr	If Fusion Sensor has been touched and is in occupied override, this will be ON	off	on
141	Digital	fanAlarm	If the unit is set up to monitor a fan status at UI2 or UI3 and there is no status when fan is commanded on, this will be ON.	off	on

013 - FBTI-7T7-1U1R 10131400/10111400 (IMPERIAL/METRIC) V1_0

This Sample Application is a demo strategy provided for use on the FBTi-7T7-1U1R. This strategy is for a 9-point fan coil operation with digital and floating control outputs and an ECM Fan.

See the *10121400/10101400 (Imperial/Metric) v1_0* documentation for details.