CEC Macro Library

User Manual

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CEC Macro Library (MAN0029US rev 4)

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Contents

SECTION 1 : INTRODUCTION

What are Engineering Tool Macros?

A macro is a combination of modules used in the **Engineering Tool** that can be saved and subsequently inserted into another strategy when required.

If there are parts of a strategy that you use frequently, or if you have a special strategy which involves a lot of repetition, then it is quicker to use a macro than to continuously rewrite one piece of strategy.

What is the CEC Macro Library?

This **Macro Library** consists of macros representing standard strategy applications. Each represents a piece of strategy that controls a particular piece of equipment, or causes specific behaviour within a set of equipment.

Accessing the Macro library

The Macro Library is installed as part of the main CEC install.

The macros can be easily accessed by selecting the button representing the macro required from the Macro bar at the bottom of the **Engineering Tool** screen and then clicking over the part of the canvas where the macro is to be placed. To view the function components of the macro click inside it with the right hand mouse button.

Information about each macro is also available within the **Engineering Tool**. To access this double-click the button of the desired macro on the bar at the bottom of the screen. This will open a text file with explanations and an example for the macro.

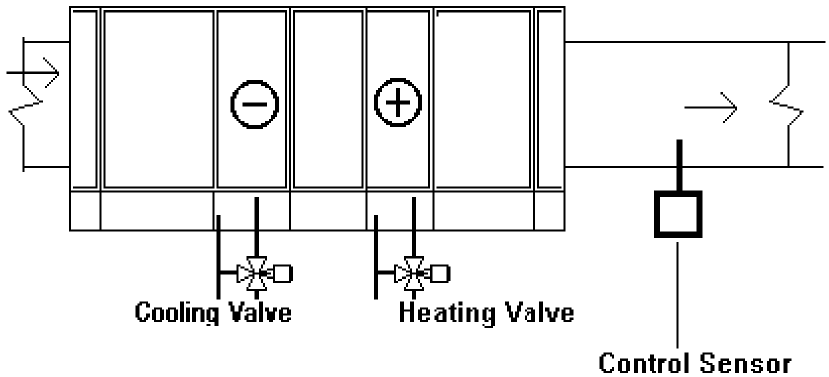
Real constants, Digital constants and Integers can be changed inside the macro, as can function block variables, such as integration time in a PID loop. However, point numbers should not be changed or adjusted as the macro always takes the next available point and block numbers automatically.

SECTION 2 : AIR SYSTEMS

A01 Heating and cooling demand with deadband

Application

Heating and cooling load calculation for air handling unit.



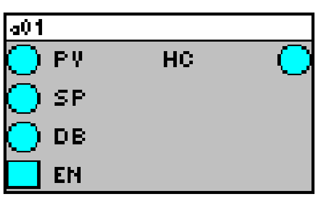
Function of module

This macro calculates the combined heating and cooling load based on the process variable. The combined heating and cooling load is determined by subtracting the cooling load from the heating load. The output range is -100 to +100. The heating load is found by comparing the process variable with the heating setpoint using a PID loop. The cooling load is found by comparing the process variable with the cooling setpoint using a PID loop. The cooling setpoint is calculated by adding the deadband to the heating setpoint. The enable point must be set "on" for the macro to function, otherwise, the output will be 0. This macro may be used with *A04 Heating valve, cooling valve and damper control from demand*

Number of Blocks

9

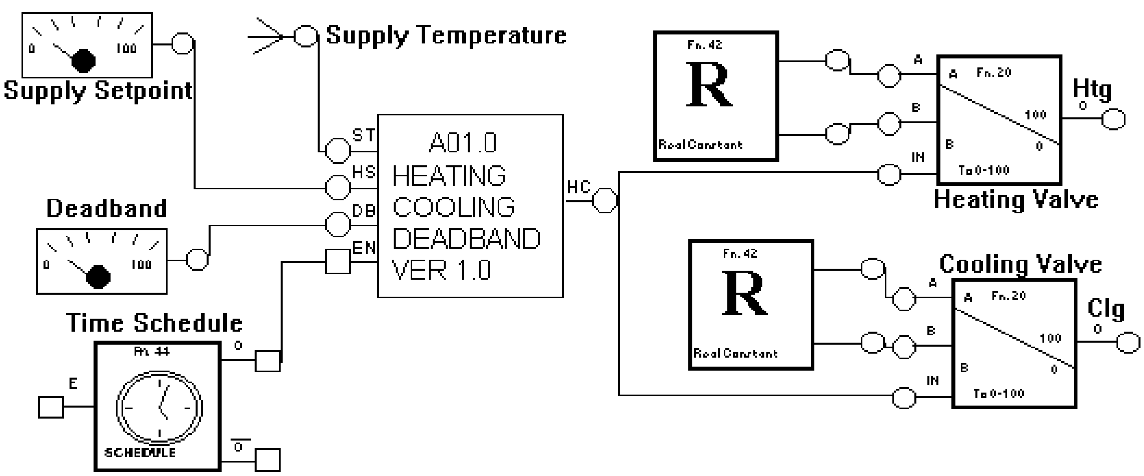
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Process Variable (PV)	Input point that is monitored.	0 C
	Heating Setpoint (SP)	The heating setpoint for the process variable.	0 C
	Deadband (DB)	0 C above heating setpoint when there is no cooling.	0 C
Digital Inputs	Enable (EN)	Input must be on (1) for macro to calculate combined load.	
Analog Outputs	Combined Heating and Cooling load (HC)	Calculated combined heating and cooling load. Output range: -100 full cooling 0 no heating or cooling +100 full heating	
Parameters	Heating Integral Time	Integration time applied to heating.	0 seconds
	Heating Derivative Time	Derivative time applied to heating.	0 seconds
	Cooling Gain	Proportional Gain applied to cooling.	8
	Cooling Integral Time	Integration time applied to cooling.	0 seconds
	Cooling Derivative Time	Derivative time applied to cooling.	0 seconds
	Heating Gain	Proportional gain applied to heating.	8

Example



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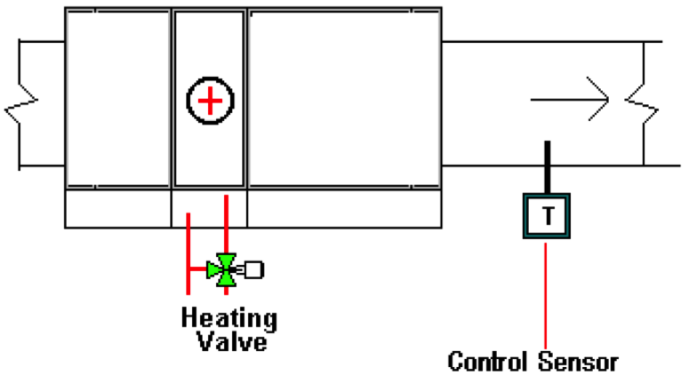
A02 Heating demand

Application

AHU with single stage heating.



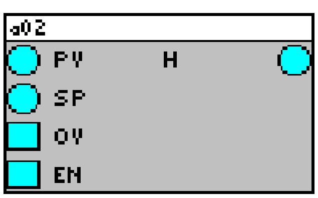
Function of module

This macro calculates the heating load based on the process variable. The output range is 0 to +100. The heating load is found by comparing the process variable with the heating setpoint using a PID loop. The heating PID gain is set at 8. The heating PID is enabled through the enable input. When the override input is on (1) the output is set at the override value of 100%. The override replaces the PID loop output with the override value. The PID does not have to be enabled for this point to work. The override may be used for heating boost or frost protection.

Number of Blocks:

3

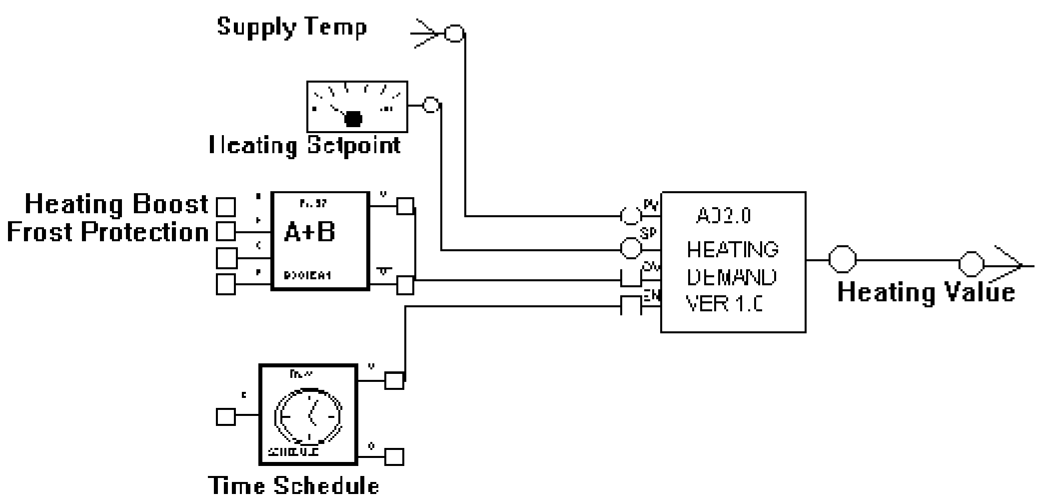
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Process Variable (PV)	Input point that is monitored.	0 C
	Heating Setpoint (SP)	The setpoint for the process variable.	0 C
Digital Inputs	Override (OV)	When override is on (1) the heating load output is 100% otherwise heating load takes the PID output.	Off (0)
	Enable (EN)	Input must be on (1) for macro to calculate heating load.	Off (0)
Analog Outputs	Heating Valve (HV)	Output value varies between 0% (closed) to 100% (open).	0%
Parameters	Heating Gain	Proportional gain applied to the heating valve.	8
	Heating Integral Time	Integration time applied to the heating valve.	0 seconds
	Heating Derivative Time	Derivative time applied to the heating valve.	0 seconds
	Cooling Gain	Proportional gain applied to the cooling valve.	8
	Cooling Integral Time	Integration time applied to the cooling valve.	0 seconds
	Cooling Derivative Time	Derivative time applied to the cooling valve.	0 seconds

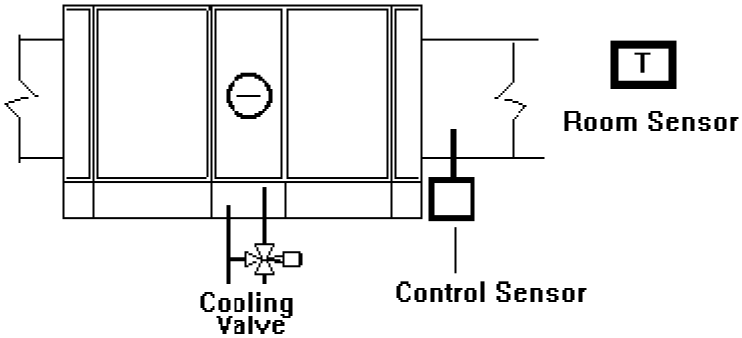
Example



A03 Cooling Demand

Application

AHU single stage cooling.



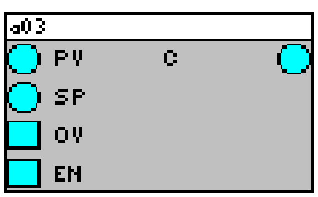
Function of module

This module provides PID control of a cooling valve based on the process variable. When the enable input point is off the cooling valve is closed. When the enable input is on and the override input is off the cooling valve is modulated to maintain the supply temperature setpoint. When the override input is on the cooling valve goes to the override position which defaults to open.

Number of Blocks:

3

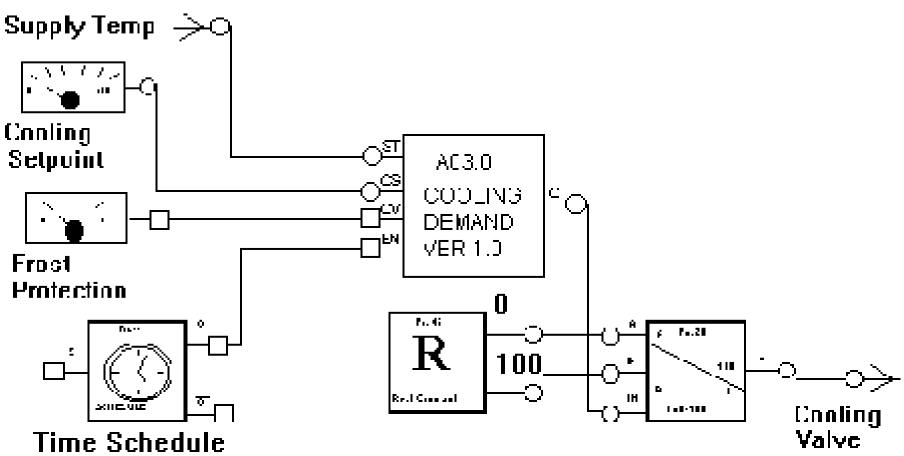
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Process Variable (PV)	Input point that is monitored.	0 C
	Cooling Setpoint (SP)	The setpoint for the process variable.	0 C
Digital Inputs	Override (OV)	If input is on (1) cooling valve is open (100%).	Off (0)
	Enable (EN)	This input must be on (1) for the module to work.	Off (0)
Analog Outputs	Cooling Valve (CV)	Output value varies from 0% (closed) to 100% (open).	0%
Parameters	Cooling Proportional Gain	Proportional gain applied to the cooling valve.	8
	Cooling Integral Time	Integration time applied to the cooling valve.	0 seconds
	Cooling Derivative Time	Derivative time applied to the cooling valve.	0 seconds

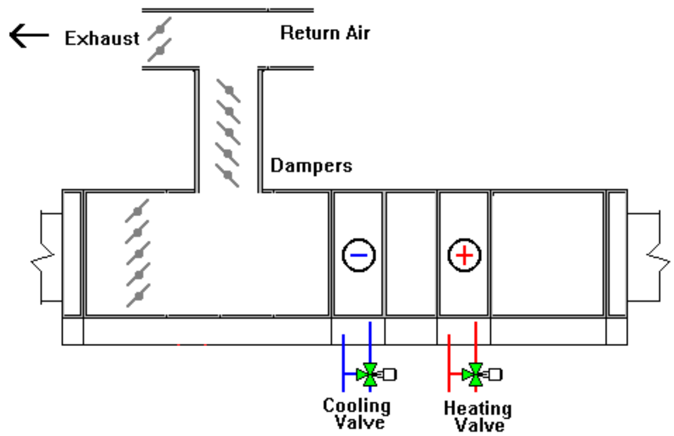
Example



A04 Heating valve, cooling valve and damper control from demand

Application

Dampers, heating and cooling valves for air handling unit.



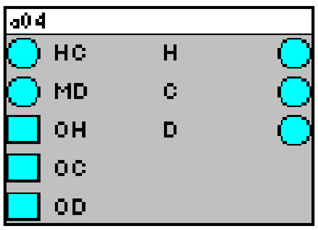
Function of module

This macro takes the heating-cooling load output from, for example, macro *A01 Heating and cooling demand with deadband*, and stages the heating valve, damper and cooling valve. The valid input range is from -100 to +100. All outputs are linear. The heating valve operating range is set from +30 (0% open) to +100 (100% open). The damper operating range is set from +30 (0% open) to -30 (100% open). The cooling valve operating range is set from -30 (0% open) to -100 (100% open). These values may be changed in the macro if desired. The heating valve is set to 100% when the heating override is enabled. The damper is set to 0% when the damper override is enabled. The cooling valve is set to 100% when the cooling override is enabled. The damper has a minimum position set through the minimum position input. When the minimum position is set to a value greater than 0% the input from the heating cooling load macro is rescaled to the range between this value and 100%. If the input is 0% and the minimum position is 15% the output to the dampers is 57.5% which is 50% of the 15-100 range.

Number of Blocks:

13

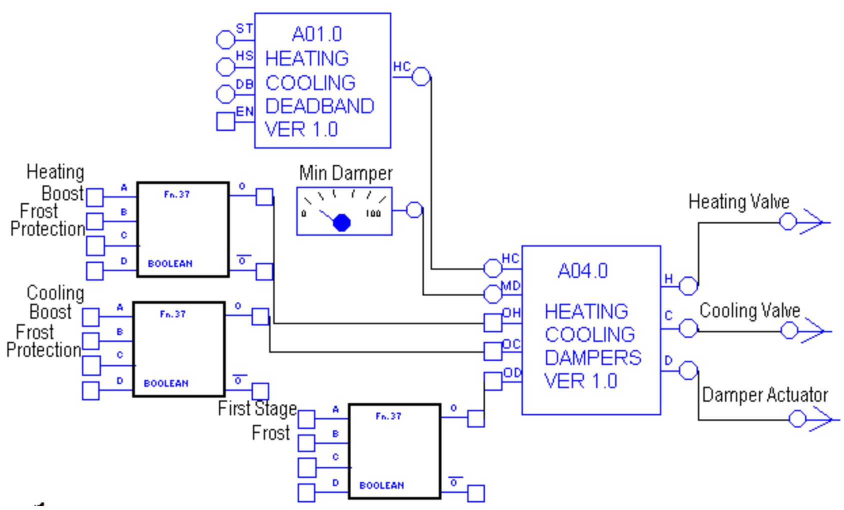
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Heating Cooling load (HC)	Calculated heating cooling load. Range is -100 to +100.	0
	Minimum Damper Position (MD)	Minimum output to the damper.	0
Digital Inputs	Heating Override (OH)	When this value is set to on (1) heating valve is set at override position.	Off (0)
	Cooling Override (OC)	When this value is set to on (1) heating valve is set at 100%.	Off (0)
	Damper Override (OD)	When this value is set to on (1) damper is set at 0%.	Off (0)
Analog Outputs	Heating Valve (HV)	Heating valve output. Range is 0% (closed) to 100% (open).	0%
	Cooling Valve (HV)	Cooling valve output. Range is 0% (closed) to 100% (open).	0%
	Damper (DA)	Damper output. Range is 0% (closed) to 100% (open).	0%
Parameters	Heating Override Position	When heating override (OH) is on (1) 100% Heating Value (HV) is set to this position.	100%
	Cooling Override Position	When Cooling Override (OC) is on (1) Cooling Value (CV) is set to this position.	100%
	Damper Override Position	When Damper Override (OD) is on (1) damper (DA) is set to this position.	0%

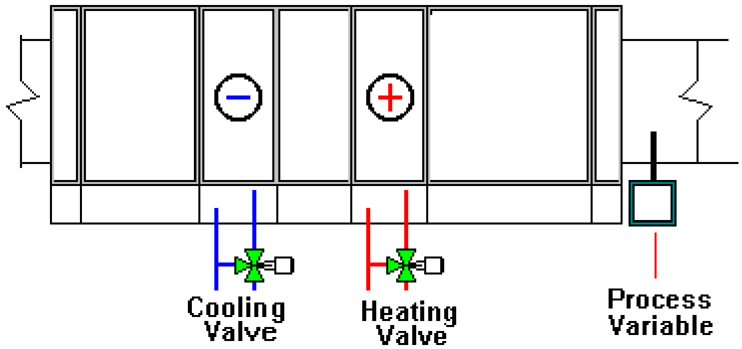
Example



A05 Heating and cooling valve control from demand

Application

Heating and cooling valves for air handling unit.



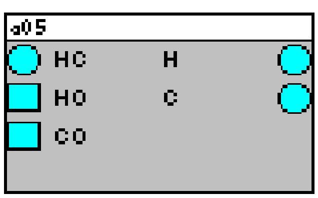
Function of module

This macro takes the heating-cooling load output from macro A01.0, for example, and stages the heating and cooling valves. The valid input range is from -100 to +100. All outputs are linear. The heating valve operating range is set from +1 (0% open) to +100 (100% open). The cooling valve operating range is set from 0 (0% open) to -100 (100% open). These values may be changed in the macro if desired. The heating valve is set to 100% when the heating override is enabled. The cooling valve is set to 100% when the cooling override is enabled, (these override values can be amended in the macro).

Number of Blocks

8

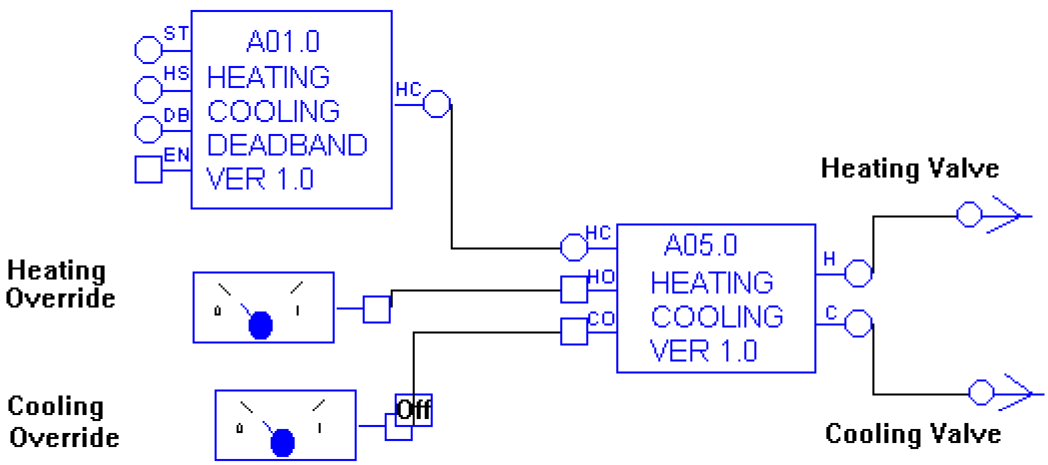
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Heating Cooling load (HC)	Calculated heating cooling load. Range is -100 to +100.	
Digital Inputs	Heating Override (HO)	When this value is set to on (1) heating valve is set to override position.	
	Cooling Override (CO)	When this value is set to on (1) cooling valve is set to override position.	
Analog Outputs	Heating Valve (HV)	Heating valve output. Range is 0% (closed) to 100% (open).	
	Cooling Valve (HV)	Cooling valve output. Range is 0% (closed) to 100% (open).	
Parameters	Heating Override Position	When Heating Override (OH) is on (1) Heating Valve (HV) is set to this position.	100%
	Cooling Override Position	When Cooling Override (OC) is on (1) Cooling Valve (CV) is set to this position.	100%

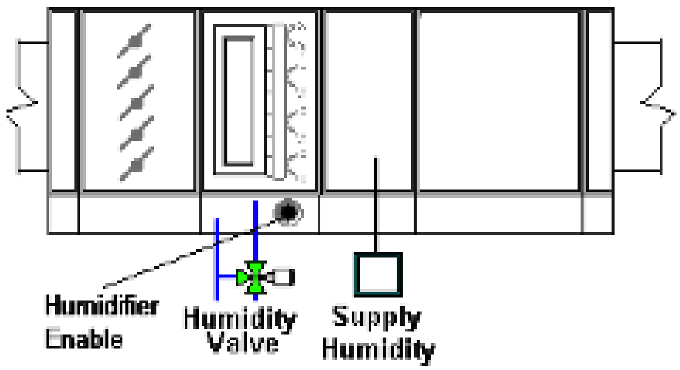
Example



A06 Humidity control from one control sensor

Application

Humidifier control.



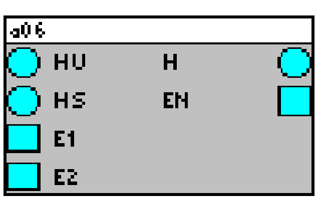
Function of module

This macro determines the humidifier load based on the control sensor humidity. The output range is 0 to +100. The humidity load is found by comparing the supply humidity with the humidity setpoint using a PID loop. The humidifier PID gain is set at 8. The integration time is set at 600 seconds. The humidifier is enabled when the supply humidity is less than the humidity setpoint and both E1 and E2 inputs are on (1). E1 and E2 may be tied to a time schedule and the supply fan status respectively. The macro provides a humidifier demand and humidifier enable.

Number of Blocks

8

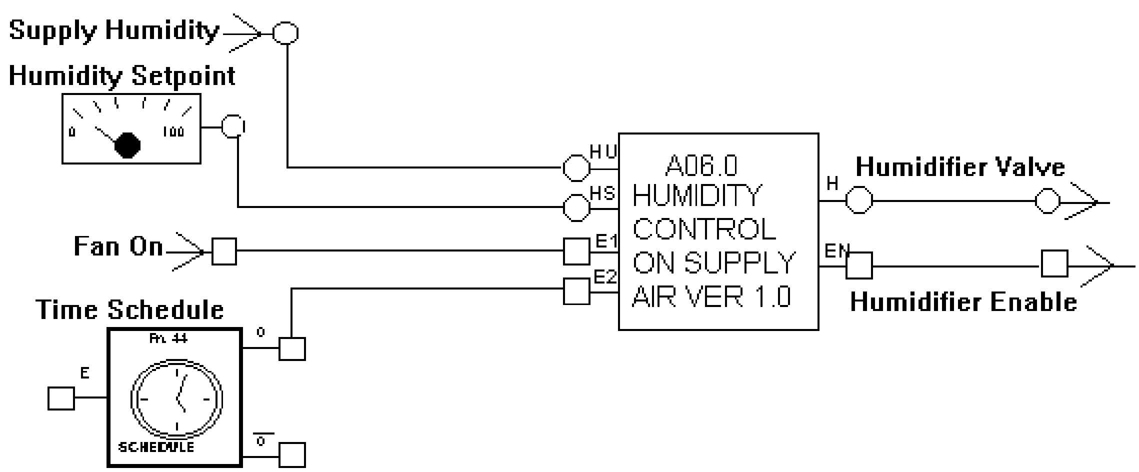
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Supply Air Humidity (HU)	Humidity of the supply air.	% RH
	Supply Air Humidity Setpoint (HS)	Humidity setpoint of the supply air.	% RH
Digital Inputs	Enable 1 (E1)	Both E1 and E2 must be on (1) to enable humidifier and PID.	Off (0)
	Enable 2 (E2)	Both E1 and E2 must be on (1) to enable humidifier and PID.	Off (0)
Analog Outputs	Humidifier Valve (H)	Humidifier valve output. Range is 0% (closed) to 100% (open).	0%
Digital Outputs	Humidifier Enable (EN) – (optional)	Output is on (1) when E1 and E2 are on and supply humidity is less than humidity setpoint.	
Parameters	Humidifier Gain	Gain of humidity PID.	8
	Humidifier Integration	Integration time of humidity PID.	600 seconds
	Humidifier Derivative	Derivative time of humidity PID.	0 seconds
	Humidifier on Timer Delay	Humidifier enable on delay.	0 seconds

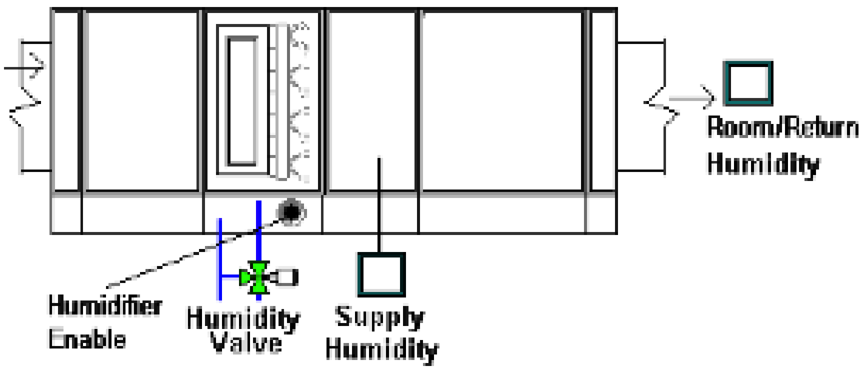
Example



A07 Humidity control on return or room air with supply air limits

Application

Humidifier control.



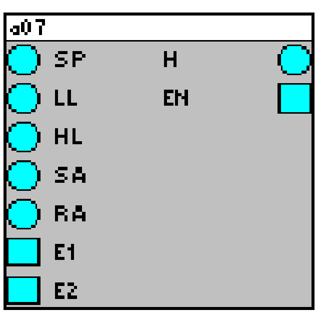
Function of module

This macro finds the humidifier load based on the return humidity. The output range is 0 to +100. The supply humidity setpoint is calculated by comparing the return humidity with the room humidity setpoint using a PID loop. Upper and lower limits are applied to the calculated supply humidity setpoint. The resulting setpoint is then used to find the humidifier load. Both gains are set at 8. The integration times are set at 600 seconds. The humidifier is enabled when the supply humidity is less than the humidity setpoint and both E1 and E2 inputs are on (1). E1 and E2 may be tied to a time schedule and the supply fan status respectively.

Number of Blocks

10

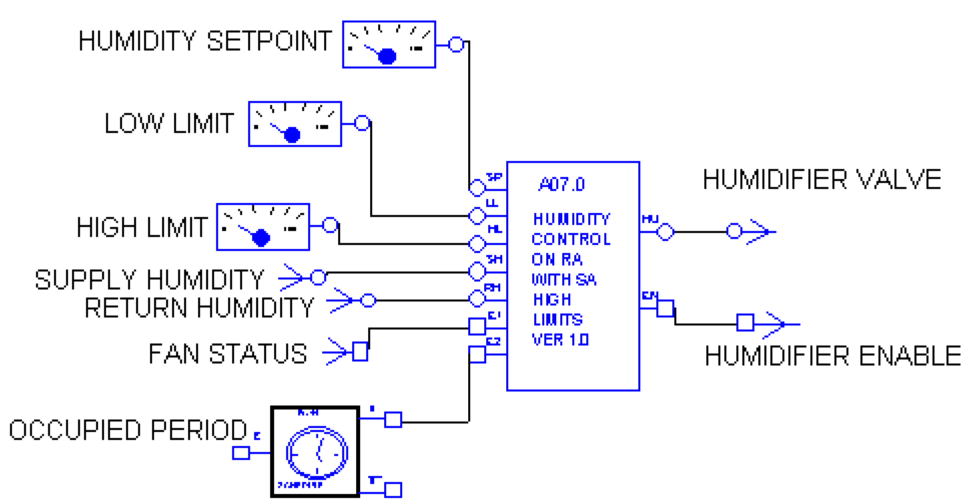
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Return Air Humidity Setpoint (HS)	Humidity setpoint of the return air.	
	Supply Air Humidity Low Limit (LL)	Lowest setpoint for supply air humidity.	
	Supply Air Humidity High Limit (HL)	Highest setpoint for supply air humidity.	
	Supply Air Humidity (SH)	Humidity of the supply air.	
	Return Air Humidity (RH)	Humidity of the return air.	
Digital Inputs	Enable 1 (E1)	Both E1 and E2 must be on (1) to enable humidifier and PID. Should be tied to time schedule.	
	Enable 2 (E2)	Both E1 and E2 must be on (1) to enable humidifier and PID. Should be tied to time schedule.	
Analog Outputs	Humidifier Valve (H)	Humidifier valve output. Range is 0% (closed) to 100% (open).	
Digital Outputs	Humidifier Enable (EN)	Output is on (1) when E1 and E2 are on and supply humidity is less than humidity setpoint.	
Parameters	Return Humidity Gain	Gain of return humidity PID.	8
	Return Humidity Integration	Integration time of return humidity PID.	600 seconds
	Return Humidity Derivative	Derivative time of return humidity PID.	0 seconds
	Humidifier Gain	Gain of humidity PID.	8
	Humidifier Integration	Integration time of humidity PID.	600 seconds
	Humidifier Derivative	Derivative time of humidity PID.	0 seconds
Parameters	Timer	Enable Humidifier On delay – 0 seconds Off delay – 0 seconds	

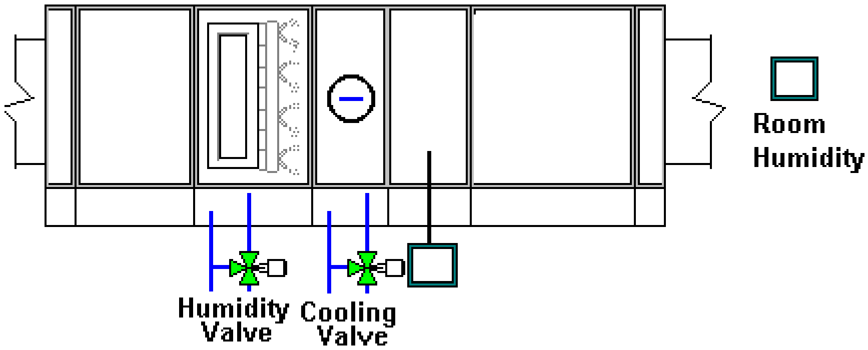
Example



A08 Humidity and dehumidification control on return or room air with supply air limits

Application

Humidifier and dehumidifier control.



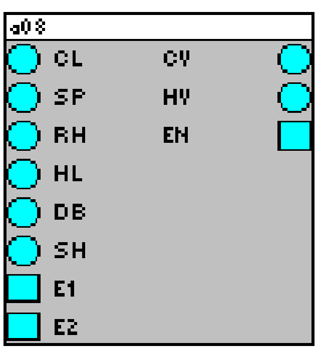
Function of module

The supply humidity setpoint is calculated by comparing the return or room humidity with the humidity setpoint. The calculated supply humidifier setpoint has an upper limit. This high limit setpoint is used to control humidity output. The deadband is added to humidification setpoint to determine the dehumidification setpoint. The dehumidification demand is used as minimum output to cooling valve. The cooling load input should be calculated based on temperature. The macro *A03 Cooling Demand* may be used to find this value. All of the gains are set at 8. Integration times are 600 seconds. Humidification is enabled when the supply humidity is less than the humidity setpoint and both E1 and E2 are on.

Number of Blocks

19

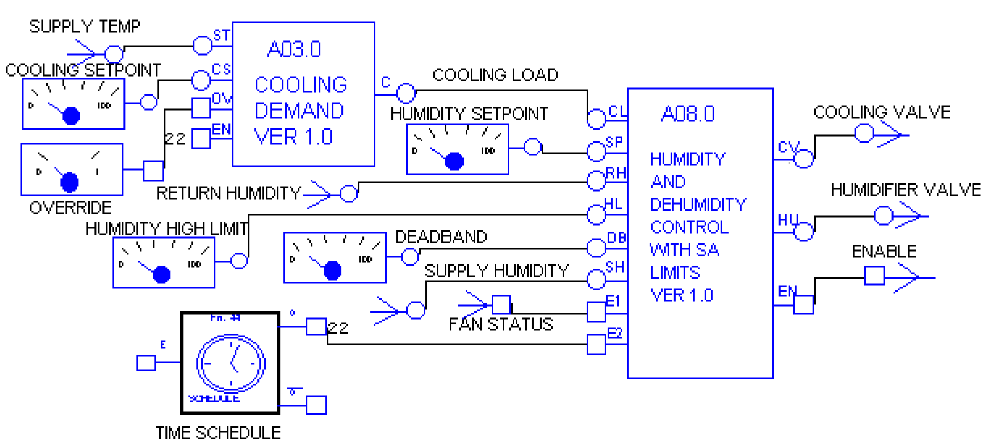
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Cooling Load (CL)	Cooling requirement based on temperature.	%
	Return Air Humidity Setpoint (HS)	Humidity setpoint of the return air.	
	Supply Air Humidity High Limit (HL)	Highest setpoint for supply air humidity.	
	Humidity Deadband (DB)	Added to return air humidity setpoint to get dehumidification setpoint.	
	Supply Air Humidity (SH)	Humidity of the supply air.	
	Return Air Humidity (RH)	Humidity of the return air.	
Digital Inputs	Enable 1 (E1)	Both E1 and E2 must be on (1) to enable humidifier and PID. Should be tied to time schedule.	
	Enable 2 (E2)	Both E1 and E2 must be on (1) to enable humidifier and PID. Should be tied to time schedule.	
Analog Outputs	Cooling Valve (CV)	Output to cooling valve (0-100).	
	Humidifier Valve (HV)	Humidifier valve output. Range is 0% (closed) to 100% (open).	
Digital Outputs	Humidifier Enable (EN)	Output is on (1) when E1 and E2 are on and supply humidity is less than humidity setpoint.	
Parameters	Return Humidity Gain	Gain of return humidity PID.	8
	Return Humidity Integration	Integration time of return humidity PID.	600 seconds
	Return Humidity Derivative	Derivative time of return humidity PID.	0 seconds
	Dehumidification Gain	Gain of Dehumidification PID.	8
	Dehumidification Integration	Integration time of Dehumidification PID.	600 seconds
	Dehumidification Derivative	Derivative time of Dehumidification PID.	0 seconds
	Humidifier Gain	Gain of humidity PID.	8
	Humidifier Integration	Integration time of humidity PID.	600 seconds
	Humidifier Derivative	Derivative time of humidity PID.	0 seconds

Example

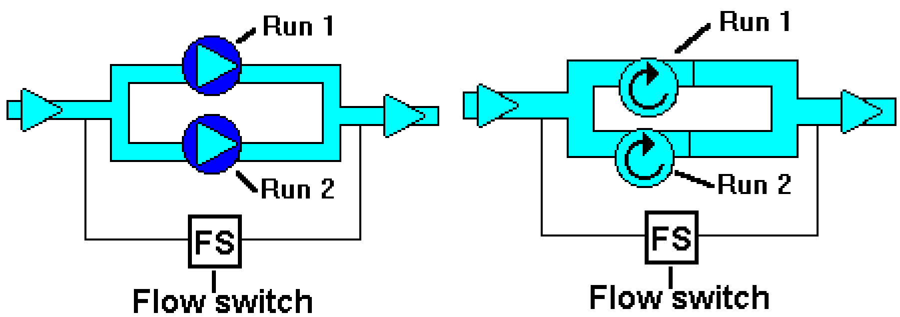


SECTION 3 : GENERAL

G01 Duty standby with changeover from pressure or flow switch

Application

Pump or fan duty cycling.



Function of module

This module provides duty sharing between two outputs. Typical outputs include fans and pumps. The duty output changes when the changeover input changes state. When the value is 0 the duty output is R1 and when value is 1 duty output is R2. The two outputs share a common status point. In the event of duty output failing as detected by the status, then the standby output is selected. An alarm is generated indicating duty output failure. In the event of standby output failure as indicated by the status, an additional alarm is generated. The alarms are generated after 30 second time delay. The module operation is activated by an enable point. When both outputs fail they are turned off after the time delays have elapsed. To change this, the Boolean blocks for each output need to be set as follows:

Output 1: `acD+aBCD` Output 2: `acD+aBcD` (Both off)

Output 1: `cD+aBCD` Output 2: `aCD+BcD` (Both on)

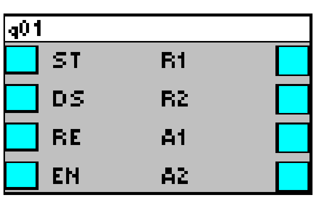
Output 1: `acD+BCD` Output 2: `aCD+BcD` (Duty off and standby on)

Note: The alarms are cleared by either the reset input or the enable point being set first low, then high.

Number of Blocks

9

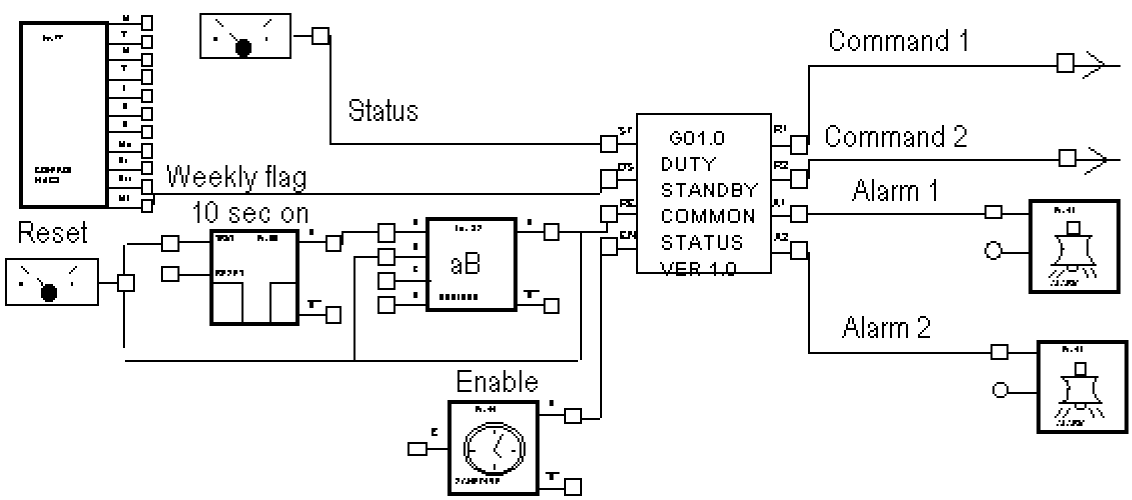
Symbol



Variables

Variable type	Variable name	Description	Default values
Digital Inputs	Flow Status (ST)	Provides status on both Run 1 and Run 2.	
	Duty Select (DS)	Off (0): Run 1 is duty output and Run 2 is standby output. On (1): Run 2 is duty output and Run 1 is standby output.	
	Reset (RE)	When Reset is on (1) both outputs alarm 1 and alarm 2 are set to off (0).	
	Enable (EN)	This input must be set to on (1) for the module to function.	
Digital Outputs	Run 1	When Run 1 is desired output, this value is on (1). Else value is off (0).	
	Run 2	When Run 2 is desired output, this value is on (1). Else value is off (0).	
	Alarm 1	On (1) when Run 1 is on (1) and Flow Switch is off (0). Else value is off (0).	
	Alarm 2	On (1) when Run 2 is on (1) and Flow Switch is off (0). Else value is off (0).	
Parameters	Alarm Delay 1	Time that Run 1 is on (1) and Flow Switch is off (0) before Alarm 1 is set to on (1).	30 seconds
	Alarm Delay 2	Time that Run 2 is on (1) and Flow Switch is off (0) before Alarm 2 is set to on (1).	30 seconds

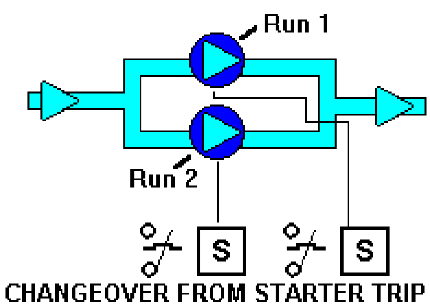
Example

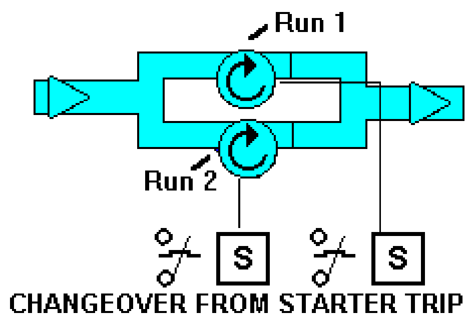


G02 Duty standby with changeover from starter trip

Application

Pump or fan duty cycling.





Function of module

This module provides duty sharing between two outputs. Typical outputs include fans and pumps. The duty output changes when the changeover input changes state. When the value is 0 the duty output is R1 and when value is 1 duty output is R2. In the event of duty output failing as detected by starter trip, then the standby output is selected. An alarm is generated indicating duty output failure. In the event of standby output failure as indicated by the status, an additional alarm is generated. The alarms are generated after 2 second time delay. The module operation is activated by an enable point. When both outputs fail they are turned off after the time delays have elapsed. To change this the Boolean blocks for each output need to set as follows:

Output 1: `acD+aBCD` Output 2: `acD+aBcD` (Both off)

Output 1: `cD+aBCD` Output 2: `aCD+BcD` (Both on)

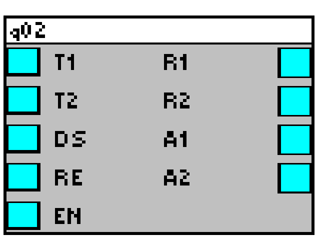
Output 1: `acD+BCD` Output 2: `aCD+BcD` (Duty off and standby on)

Note: The alarm is reset by either the reset bit or the enable flag being set off.

Number of Blocks

8

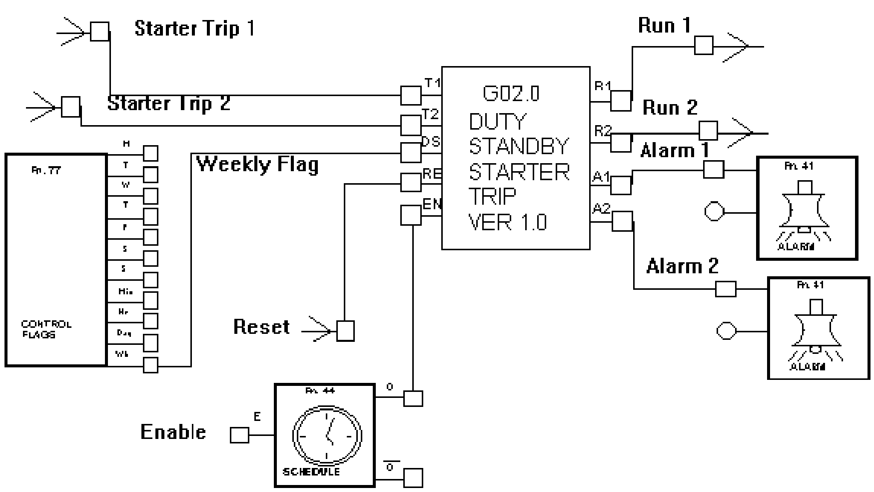
Symbol



Variables

Variable type	Variable name	Description	Default values
Digital Inputs	Starter Trip (T1)	Provides starter trip status on Run 1.	
	Starter Trip (T2)	Provides starter trip status on Run 2.	
	Duty Select (DS)	Off (0): Run 1 is duty output and Run 2 is standby output. On (1): Run 2 is duty output and Run 1 is standby output.	
	Reset (RE)	When Reset is on (1) both outputs alarm 1 and alarm 2 are set to off (0).	
	Enable (EN)	This input must be set to on (1) for the module to function.	
Digital Outputs	Run 1	When Run 1 is desired output, this value is on (1). Else value is off (0).	
	Run 2	When Run 2 is desired output, this value is on (1). Else value is off (0).	
	Alarm 1	On (1) when Run 1 is on (1) and Starter Trip 1 is on (1). Else value is off (0).	
	Alarm 2	On (1) when Run 2 is on (1) and Starter Trip 2 is on(1). Else value is off (0).	
Parameters	Alarm Delay 1	Time that Run 1 is on (1) and starter trip 1 is on (1) before Alarm 1 is set to on (1).	2 seconds
	Alarm Delay 2	Time that Run 2 is on (1) and starter trip 2 is on (1) before Alarm 2 is set to on (1).	2 seconds

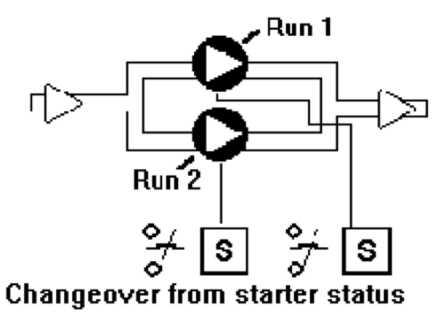
Example

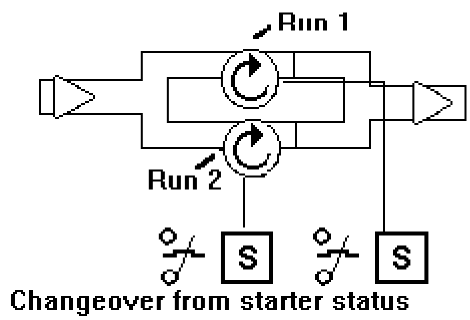


G03 Duty standby with changeover from starter status mis-match or flow switches

Application

Pump or fan duty cycling.





Function of module

This module provides duty sharing between two outputs. Typical outputs include fans and pumps. The duty output changes when the changeover input changes state. When the value is 0 the duty output is R1 and when value is 1 duty output is R2. In the event of duty output failing as detected by starter status mis-match, or flow switch, then the standby output is selected. An alarm is generated indicating duty output failure. In the event of standby output failure, an additional alarm is generated. The alarms are generated after 30 second time delay. The module operation is activated by an enable point. When both outputs fail they are turned off after the time delays have elapsed. To change this the Boolean blocks for each output need to set as follows:

Output 1: `acD+aBCD` Output 2: `acD+aBcD` (Both off)

Output 1: `cD+aBCD` Output 2: `aCD+BcD` (Both on)

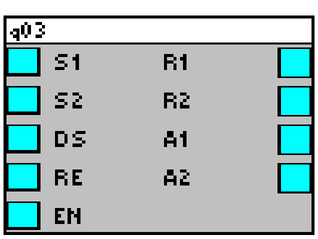
Output 1: `acD+BCD` Output 2: `aCD+BcD` (Duty off and standby on)

Note: The alarm is reset via the reset bit or when the plant enable is set off.

Number of Blocks

8

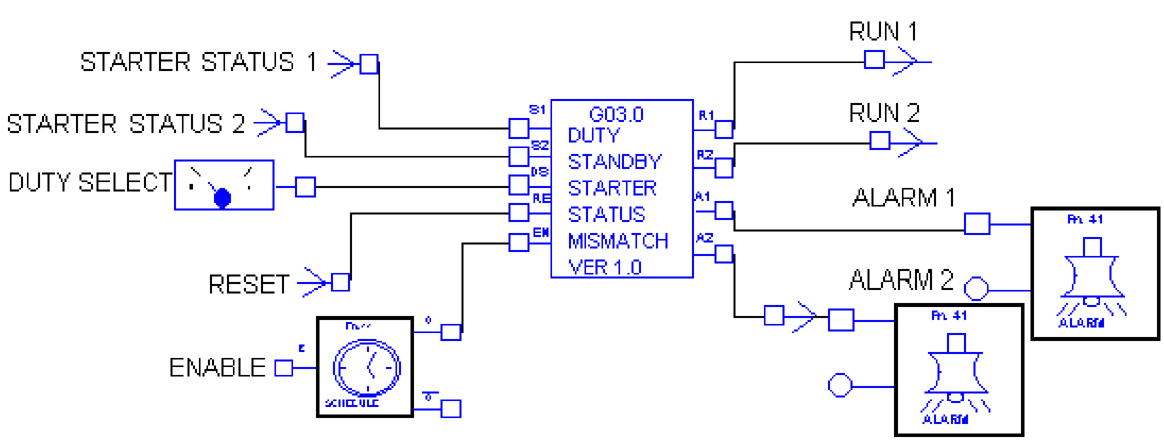
Symbol



Variables

Variable type	Variable name	Description	Default values
Digital Inputs	Starter Status (S1)	Provides status on Run 1.	
	Starter Status (S2)	Provides status on Run 2.	
	Duty Select (DS)	Off (0): Run 1 is duty output and Run 2 is standby output. On (1): Run 2 is duty output and Run 1 is standby output.	
	Reset (RE)	When Reset is on (1) both outputs alarm 1 and alarm 2 are set to off (0).	
	Enable (EN)	This input must be set to on (1) for the module to function.	
Digital Outputs	Run 1	When Run 1 is desired output, this value is on (1). Else value is off (0).	
	Run 2	When Run 2 is desired output, this value is on (1). Else value is off (0).	
	Alarm 1	On (1) when Run 1 is on (1) and Starter Status is off (0). Else value is off (0).	
	Alarm 2	On (1) when Run 2 is on (1) and Starter Status is off (0). Else value is off (0).	
Parameters	Alarm Delay 1	Time that Run 1 is on (1) and starter status 1 is off (1) before Alarm 1 is set to on (1).	30 seconds
	Alarm Delay 2	Time that Run 2 is on (1) and starter status 2 is off (1) before Alarm 2 is set to on (1).	30 seconds

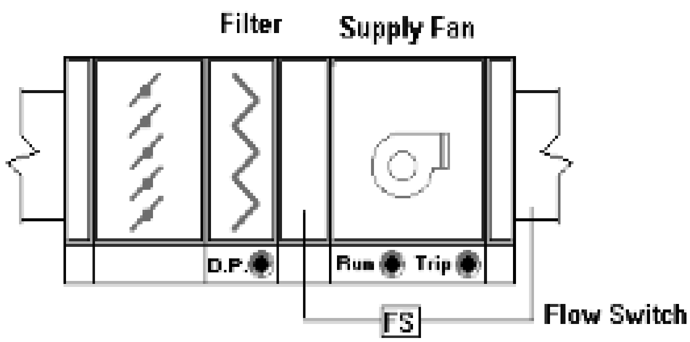
Example



G04 Status alarm with time delay

Application

Flow alarm on supply fan.



Function of module

This macro provides for a status alarm. The macro has two inputs: enable and status. If enable is on and status is off for the on delay time period an alarm is generated and the alarm output is on. The alarm stays on for the minimum on time period. The priority and alarm number both have to be set in the alarm module.

Number of Blocks

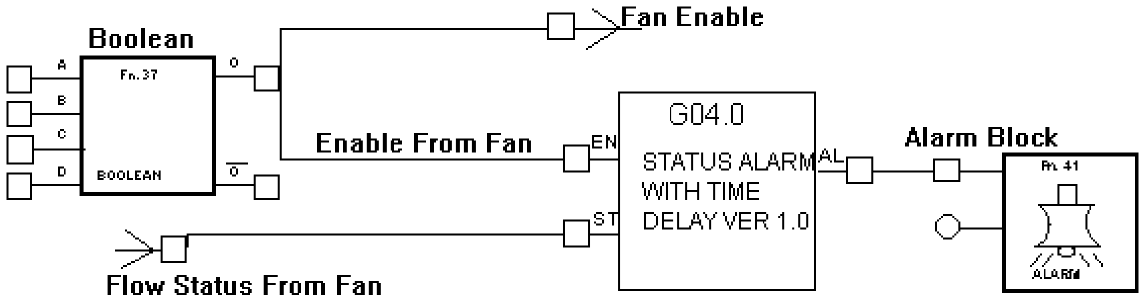
3

Symbol

Variables

Variable type	Variable name	Description	Default values
Digital Inputs	Enable (EN)	Shows state of the enable point.	
	Status (ST)	Provides status on Enable. for alarm state for healthy state	
Digital Outputs	Alarm (AL)	On (1) if Enable is on (1) and Status off (0) for on delay.	
Parameters	On Delay	Time that Enable is on (1) and Status is off (1) before Alarm is set to on (1).	30 seconds
	Off Delay	Time that alarm state has returned to normal before Alarm is set to off (0).	0 seconds
	Minimum Off Time	Minimum Time that Alarm is on (1).	20 seconds

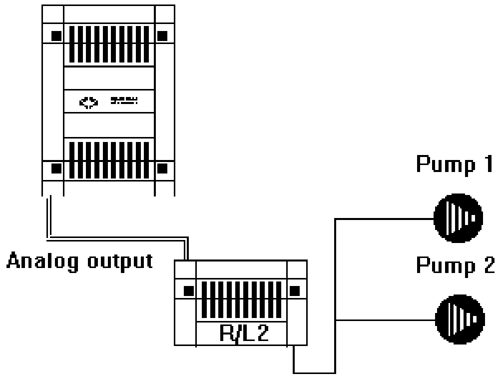
Example


Boolean
A
B
C
D
Fn.37
BOOLEAN
O
Fan Enable
Enable From Fan
EN
ST
G04.0
STATUS ALARM
WITH TIME
DELAY VER 1.0
AL
Alarm Block
Fn. 41
ALARM
Flow Status From Fan

G05 Binary driver

Application

Control of two digital output points through one analog point.



Function of module

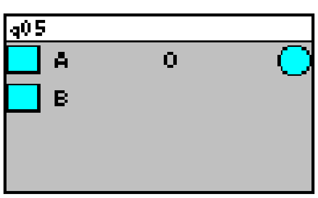
This macro allows control of two digital outputs through one output on a UC16, UC12 or UC8. The macro is used with the raise lower module R/L 4. The input on the R/L 4 is set to binary mode through the jumper switch. The raise lower module takes the macro output and selects the correct digital output configuration. The following is the macro output:

1. A=0, B=0, O=0%
2. A=1, B=0, O=40%
3. A=0, B=1, O=100%
4. A=1, B=1, O=70%.

Number of Blocks

7

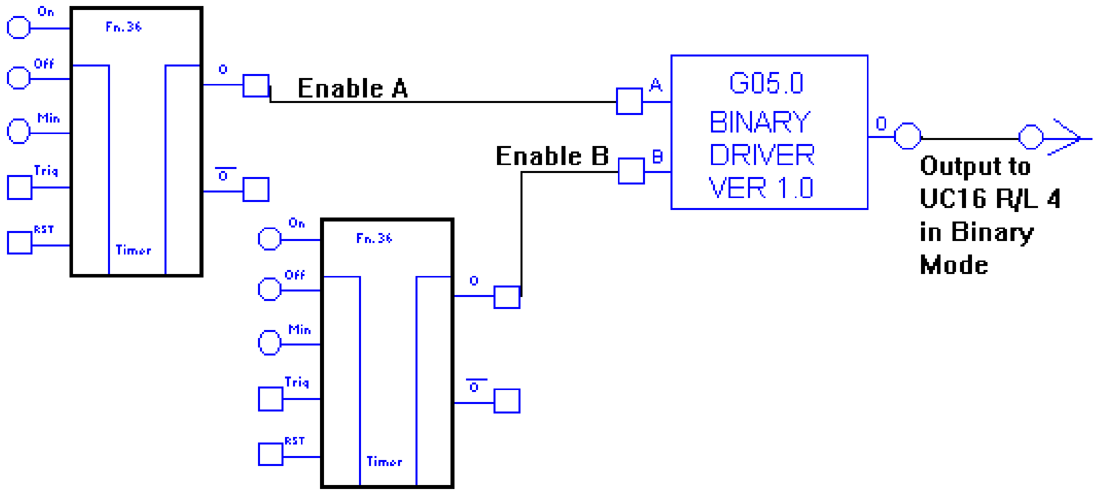
Symbol



Variables

Variable type	Variable name	Description	Default values
Digital Inputs	Input A (A)	Shows state of input point A.	
	Input B (B)	Shows state of input point B.	
Analog Outputs	Output to Raise Lower in binary mode (O)	A=0, B=0, O=0% A=1, B=0, O= 40% A=0, B=1, O=100% A=1, B=1, O=70%	0%

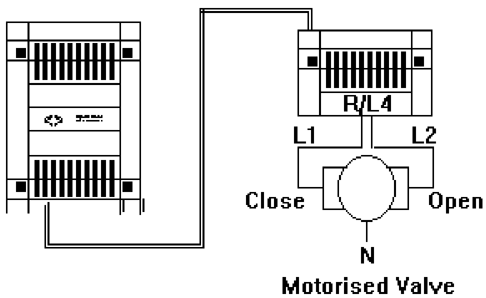
Example


On
Off
Min
Trig
RST
Fn.36
Timer
O
Ō
Enable A
Enable B
A
B
G05.0
BINARY
DRIVER
VER 1.0
O
Output to
UC16 R/L 4
in Binary
Mode
On
Off
Min
Trig
RST
Fn.36
Timer
O
Ō

G06 Raise Lower

Application

Control of raise lower valve through one analog point.



Function of module

This macro allows control of a raise lower valve through one output on a uc16, uc12 or uc8. The macro is used with the raise lower module R/L 4. The input on the R/L 4 is set to raise lower mode through the jumper switch. The raise lower module takes the macro output and selects the correct digital output configuration. The following is the macro output:

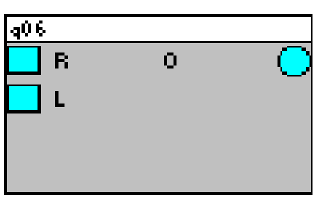
1. R=0, L=0, O=40%
2. R=1, L=0, O=70%
3. R=0, L=1, O=0%
4. A=1, B=1, O=70%.

If both raise and lower are on then raise takes precedence.

Number of Blocks

3

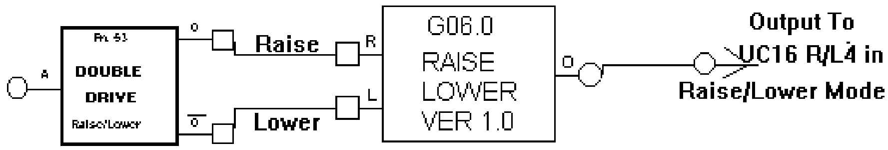
Symbol



Variables

Variable type	Variable name	Description	Default values
Digital Inputs	Raise (R)	Shows state of input point Raise.	
	Lower (L)	Shows state of input point Lower.	
Analog Outputs	Output to Raise Lower in binary mode (O)	R=0, L=0, O=40% R=1, L=0, O= 70% R=0, L=1, O=0% R=1, L=1, O=70%	0%

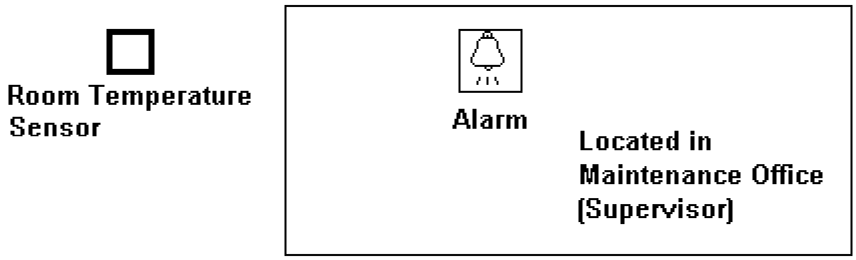
Example


A
DOUBLE
DRIVE
Raise/Lower
O
Raise
Lower
R
L
G06.0
RAISE
LOWER
VER 1.0
O
Output To
UC16 R/L4 in
Raise/Lower Mode

G07 Sensor out of range alarm

Application

Room temperature alarm.



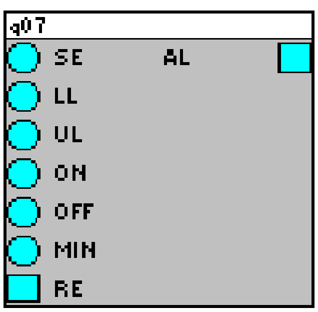
Function of module

This module provides an alarm indicating that the sensor is out of range with time delays and minimum on time. The sensor alarm limits are set through the lower and upper inputs. When the sensor input goes out of this range an alarm is generated after the associated time delays. The sensor has an on delay, off delay, minimum on time and alarm timer reset. The alarm priority and alarm number must be set before the alarm will function properly. Each alarm should have a unique alarm number in the controller.

Number of Blocks

4

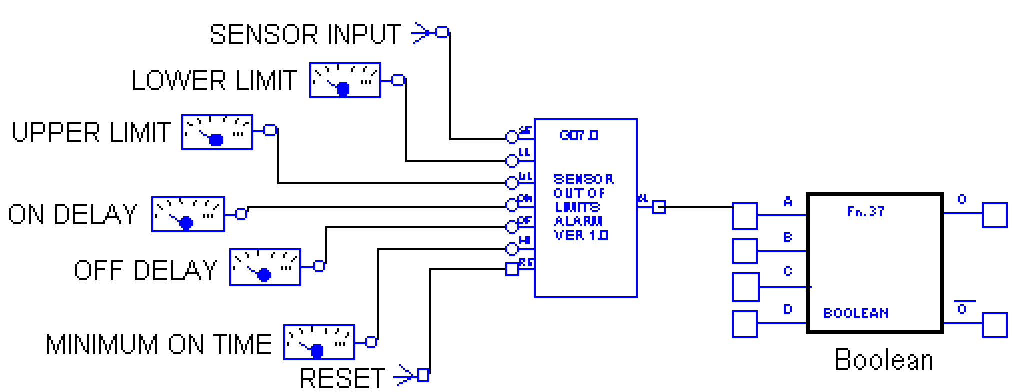
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Sensor Input (SE)	Analog value from sensor.	
	Lower Limit (LL)	When sensor input is less than this value alarm output is set after time delays.	
	Upper Limit (UL)	When sensor input is greater than this value alarm output is set after time delays.	
	On Delay (ON)	Sensor input must be outside of range set by upper and lower limits for this time before alarm is generated.	
	Off Delay (OF)	Sensor input returns to range set by upper and lower limits for this time before alarm is condition is cleared.	
	Minimum On Time (MI)	Minimum time that alarm exists.	
Digital Input.	Reset (RE)	This input resets the alarm timer.	
Digital Outputs	Alarm (AL)	When module is in alarm condition., this value is set to on (1). Else value is off (0).	Off (0)

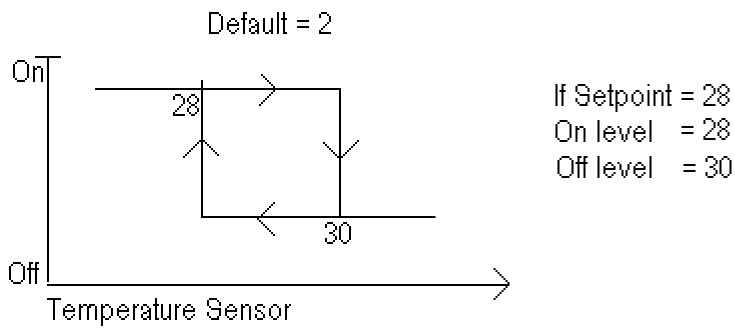
Example



G08 Hysteresis with plus deadband

Application

Heating enable based on room temperature.



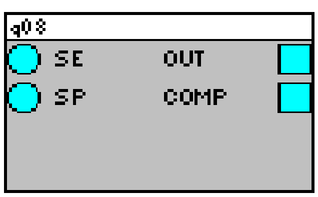
Function of module

This module provides a hysteresis loop with a plus deadband. When the sensor input falls below the setpoint the enable output is on. The enable output remains on until the sensor input rises by 2°C (default deadband value) above the setpoint. The enable then remains off until the sensor input falls below the setpoint value.

Number of Blocks

4

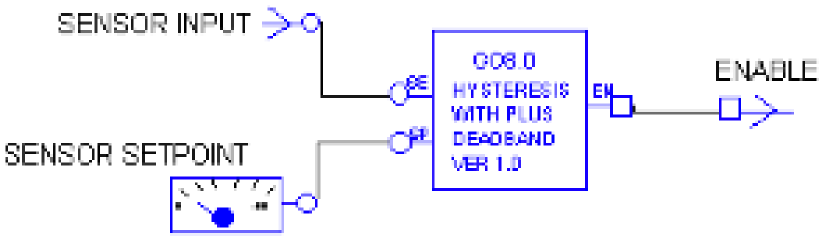
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Sensor Input (SE)	Analog value from sensor.	
	Sensor Setpoint (SP)	Setpoint for sensor.	
Digital Outputs	Enable (EN)	When sensor input is less than setpoint enable turns on. Remains on until sensor is greater than the setpoint plus deadband.	
Parameters	Plus Deadband	Sensor input must rise by this value above the setpoint before enable is set to off (this can be amended).	2°C

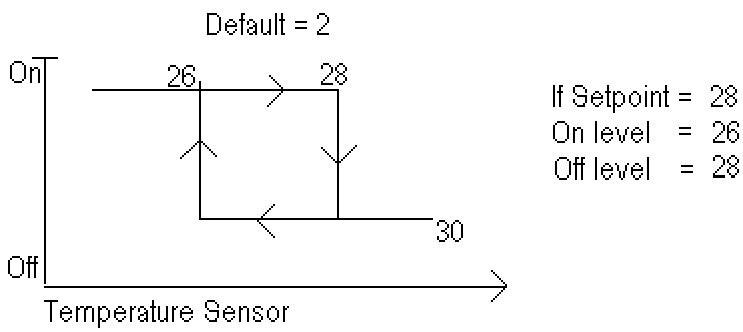
Example


SENSOR INPUT
GC8.0
HYSTERESIS
WITH PLUS
DEADBAND
VER 1.0
SE
EN
ENABLE
SENSOR SETPOINT

G09 Hysteresis with minus deadband

Application

Heating enable based on room temperature.



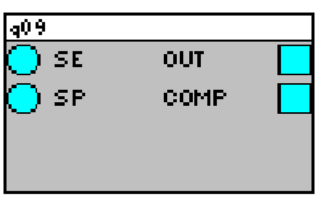
Function of module

This module provides a hysteresis loop with a minus deadband. When the sensor input falls below the setpoint by 2°C (default deadband) the enable output is on. The enable output remains on until the sensor input rises above the setpoint. The enable then remains off until the sensor input falls below the setpoint minus deadband value.

Number of Blocks

4

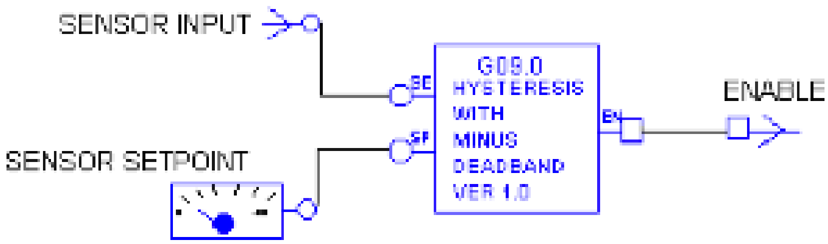
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Sensor Input (SE)	Analog value from sensor.	
	Sensor Setpoint (SP)	Setpoint for sensor.	
Digital Outputs	Enable (EN)	When sensor input is less than setpoint minus deadband enable turns on. Remains on until sensor is greater than the setpoint.	
Parameters	Minus Deadband	Sensor input must fall by this value below the setpoint before enable is set to on (this can be amended).	2°C

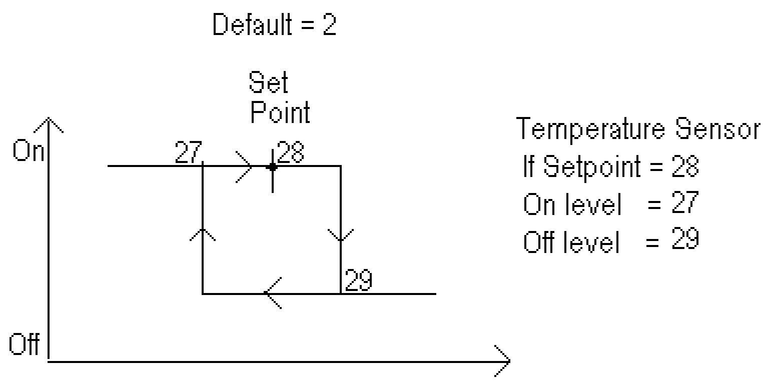
Example


SENSOR INPUT
SENSOR SETPOINT
SE
SP
G09.0
HYSTERESIS
WITH
MINUS
DEADBAND
VER 1.0
EN
ENABLE

G10 Hysteresis with plus and minus deadband

Application

Heating enable based on room temperature.



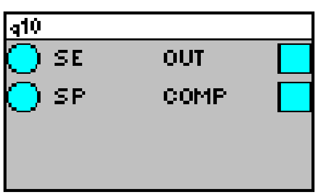
Function of module

This module provides a hysteresis loop with plus and minus deadbands. When the sensor input falls below the setpoint by 1°C (default minus deadband) the enable output is on. The enable output remains on until the sensor input rises by 1°C (default plus deadband) above the setpoint. The enable then remains off until the sensor input falls below the setpoint minus deadband value.

Number of Blocks

5

Symbol

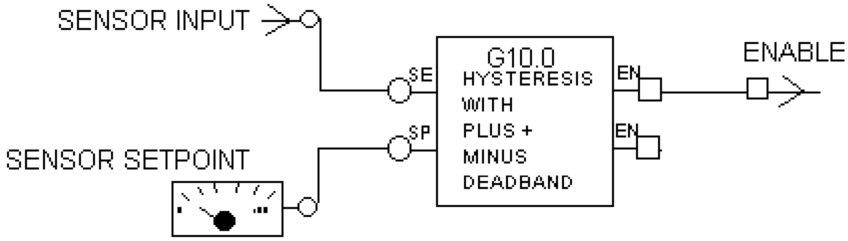


Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Sensor Input (SE)	Analog value from sensor.	
	Sensor Setpoint (SP)	Setpoint for sensor.	
Digital Outputs	Enable (EN)	When sensor input is less than setpoint minus deadband enable turns on. Remains on until sensor is greater than the setpoint.	
Parameters	Plus Deadband	Sensor input must rise by this value above the setpoint before enable is set to off.	1°C
	Minus Deadband	Sensor input must fall by this value below the setpoint before enable is set to on. This can be amended.	1°C

 © American Auto-Matrix

Example

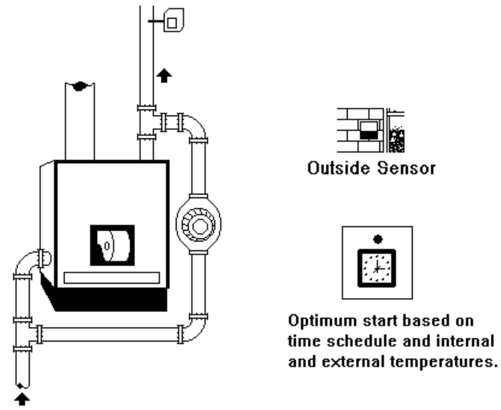


SENSOR INPUT
SE
G10.0
HYSTERESIS
WITH
PLUS +
MINUS
DEADBAND
EN
ENABLE
SP
EN
SENSOR SETPOINT

G11 Heating enable optimum start/stop

Application

Optimum start/stop of central plant equipment.



Function of module

This module provides the optimum start/stop based on internal and external temperatures and building characteristics. The optimizer has two stages of operation. The first occurs when the learning factor is 5 or below. This equation is based on the initial building constants and is:

```
P=A(X-Y)+B
```

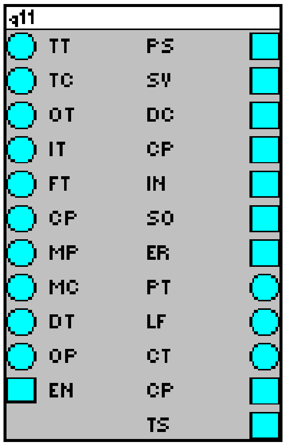
where P is preheat time, X is target temperature, Y is current internal temperature, and A and B are building constants.

The second stage uses a second order equation. Optimizer enable input defaults to on if the input is not attached to a point otherwise the optimizer only operates when the attached point is on. The module contains a time schedule block for each day. The time schedule set the building occupancy. All seven analog inputs must be connected for correct operation. The main output from this module is the optimum start or pump status point (PS). This point should be attached to the plant equipment that needs to be controlled. In addition to the other outputs which are explained in the variables section there is a time schedule (TS) point that connects to each time schedule block. This point is on during occupancy time.

Number of Blocks

16

Symbol

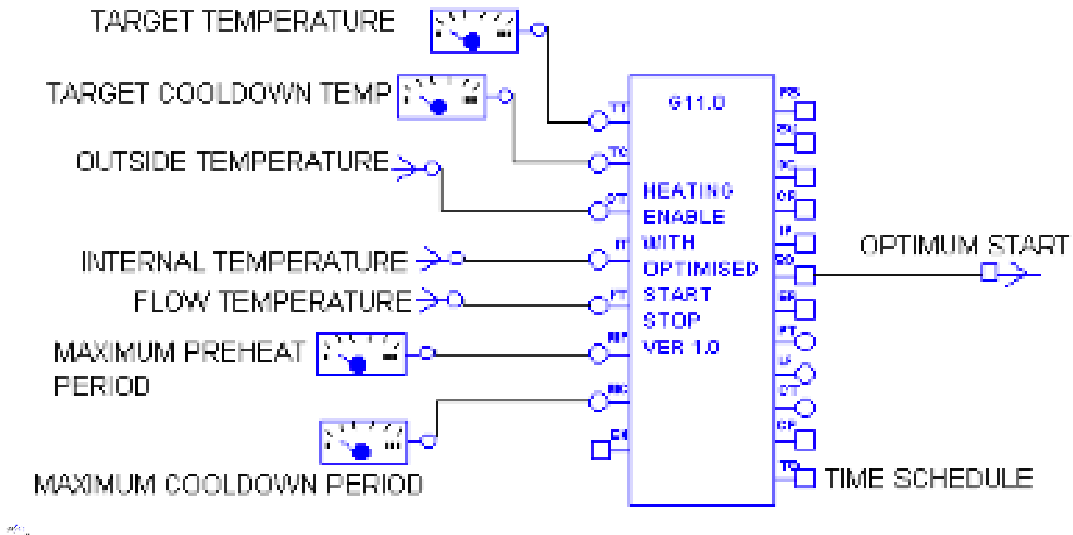


Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Target Temperature (TT)	Internal temp that should be reached at occupancy time.	
	Target Cooldown Temp (CT)	Minimum permissible internal temp when occupancy period ends.	
	Outside Temp (OT)	Measured value of the outside temperature.	
	Internal Temp (IT)	Measured value of the internal temperature.	
	Flow Temp (FT)	Measured value of the heating medium temperature.	
	Max Preheat Period (MP)	Maximum permissible preheat period. A typical value is 80 minutes.	
	Max Cooldown Period (MC)	Maximum permissible cooldown period. A typical value is 80 minutes.	
Digital Inputs	Optimizer Enable (EN)	Enables optimizer operation. defaults to on if point not connected otherwise point must be set on for operation.	
Analog Outputs	Predicted Preheat Time (PT)	Value predicted for preheat by module.	0 Minutes
	Learning Factor (LF)	Each time the optimizer is reaches target temp and initial plant conditions are valid this point is incremented. Max = 255.	0
	Predicted Cooldown Period (CT)	Value predicted for cooldown by module.	0 Minutes
Digital Outputs	Optimum Start (PS)	This point is SET after the optimum start/stop has been decided by the optimizer.	0ff (0)
	Status Value (SV)	This point is SET optimizer is within maximum preheat period.	0ff (0)
	Day Control (DC)	This point is SET optimizer reverts to day control. Day control occurs when internal temperature exceeds target temp, current time > (occupancy time+	0ff (0)

		overlap period) and internal temp < cooldown target temp during cooldown.	
	Condensation Protection (CP)	Point becomes set when condensation protection is in operation.	0ff (0)
	Preheat Period (PP)	Point becomes set when optimizer switches to preheat mode.	0ff (0)
	System Off (SO)	Point becomes set when heating system is turned off.	0ff (0)
	Error (ER)	Point becomes set when the optimizer macro is not set up correctly.	0ff (0)
	Time Clock (TS)	This is used to provide the Heating Optimizer with seven UC16 time schedules, which may be updated with a UCC4 time schedule. See page 136 of the UC16 Programming Manual.	
Parameters	Max. temp. for condensation protection	Module will remain in condensation protection mode until internal temp. rises above this value.	120C
	Min. temp. for condensation protection	If plant is off and internal temp. falls below this value condensation protection mode until start.	100C
	Min. Flow Temp. for adaptation	The optimizer will only learn today's heating characteristics if flow temp<this value at start of preheat, max. flow temp during preheat>max> flow temp for adaptation and condensation protection not in force.	250C
	Max. Flow Temp. for adaptation	See Min. flow temp for adaptation.	400C
	Max. Internal Temp. for preheat	Internal temp. corresponding to that requiring maximum preheat period.	120C
	Dead Time	Time between start of preheat and change in internal temperature. Typical value is 9.	0 Minutes
	Overlap Period	Maximum time that preheat allowed to continue if internal temp has not reached target at start of occupancy. Typical value is 30.	0 Minutes
	Initial Value A	This building constant is used for first 4 good starts.	50
	Initial Value B	This building constant is used for first 4 good starts.	50
	Time Clock (TS)	This is used to provide the Heating Optimizer with seven UC16 time schedules, which may be updated with a UCC4 time schedule. See page 136 of the UC16 Programming Manual.	

Example

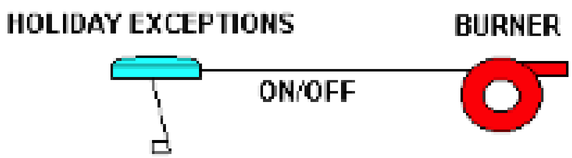


TARGET TEMPERATURE
TARGET COOLDOWN TEMP
OUTSIDE TEMPERATURE
INTERNAL TEMPERATURE
FLOW TEMPERATURE
MAXIMUM PREHEAT PERIOD
MAXIMUM COOLDOWN PERIOD
G11.0
HEATING ENABLE WITH OPTIMISED START STOP VER 1.0
OPTIMUM START
TIME SCHEDULE

G13 Holiday Schedule

Application

Holiday Schedules for UC16 time schedules.



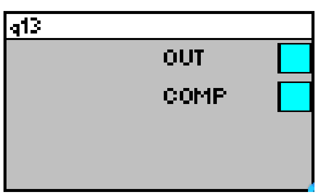
Function of module

This macro contains five holiday schedule blocks. If any of these are on then the output is also on. The macro may be used to make holiday programming easier. There are two outputs: the true output and the inverse of the true output

Number of Blocks

6

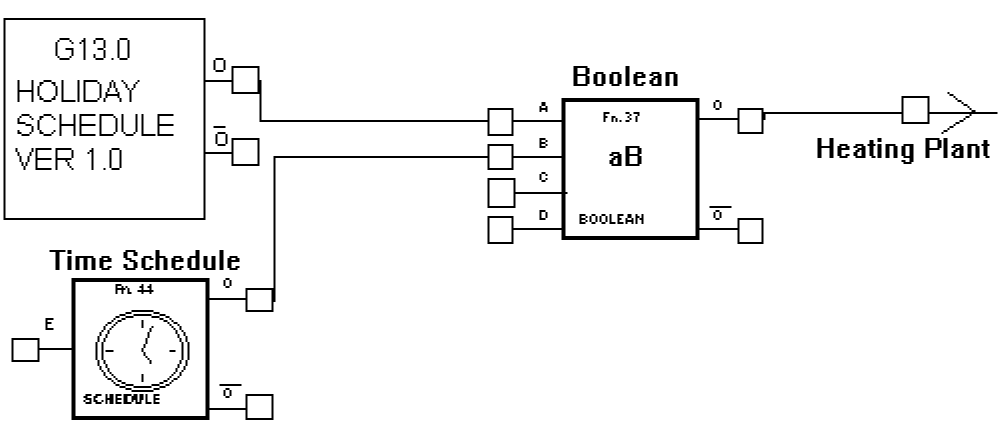
Symbol



Variables

Variable type	Variable name	Description	Default values
Digital Outputs	Holiday On (0)	On if any of the holiday outputs are on.	Off (0)
	Holiday Off (inv 0)	Off when all of the holiday outputs are off.	On (1)

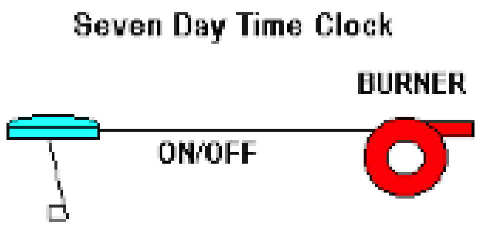
Example



G14 Seven day schedule

Application

Seven day time schedules.



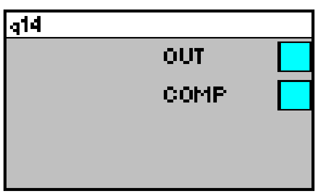
Function of module

This macro contains seven UC16 time schedule blocks. If any of these are on then the output is also on. The macro may be used to make time schedule programming easier. There are two outputs: the true output and the inverse of the true output. The default on times are Monday to Friday 08:00-17:00 and Saturday to Sunday 00:00-00:00.

Number of Blocks

8

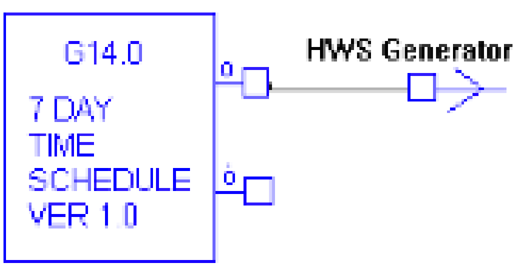
Symbol



Variables

Variable type	Variable name	Description	Default values
Digital Outputs	Time Schedule (0)	On if any of the seven day schedules are on.	
	Time Schedule Off (inv 0)	Off when all of the seven day outputs are off.	On (1)

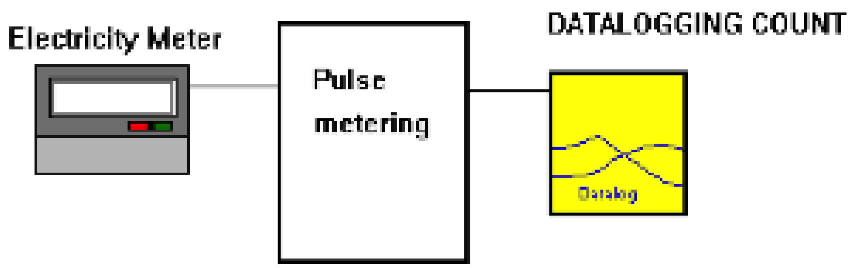
Example



G15 Pulse metering

Application

Monitoring and logging electricity usage on daily and hourly basis.



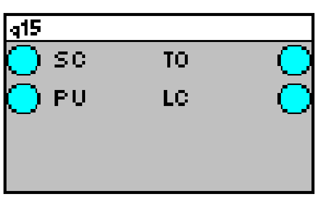
Function of module

This macro monitors and datalogs pulse meter values on both a daily and an hourly basis. The two macro inputs are; scalar and pulse input. The scalar is the multiplier used to convert the pulses into real units such as KWH. The hourly and daily totals update every five minutes. The outputs from this macro are the total number of pulses since servicing began and the last count value. This macro will typically be used for logging electricity or other pulse output meters.

Number of Blocks

11

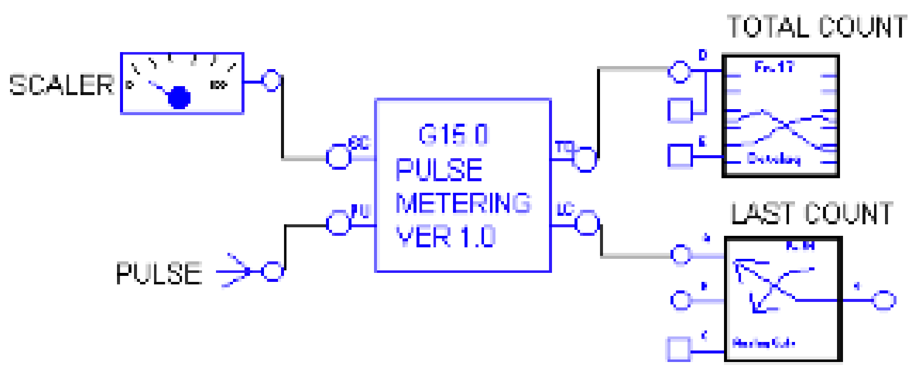
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Scalar (SC)	Converts pulse into real value.	
	Pulse (PU)	Pulse input from meter.	
Analog Outputs	Total Count (TO)	Total pulse count since macro started servicing.	
	Last Count (LC)	Pulse count for last period.	
Parameters	Pulse period	Time interval over which pulses are counted.	300 Seconds
	Pulse Scalar	Scalar applied to pulse by meter module. This value should not be changed.	1

Example

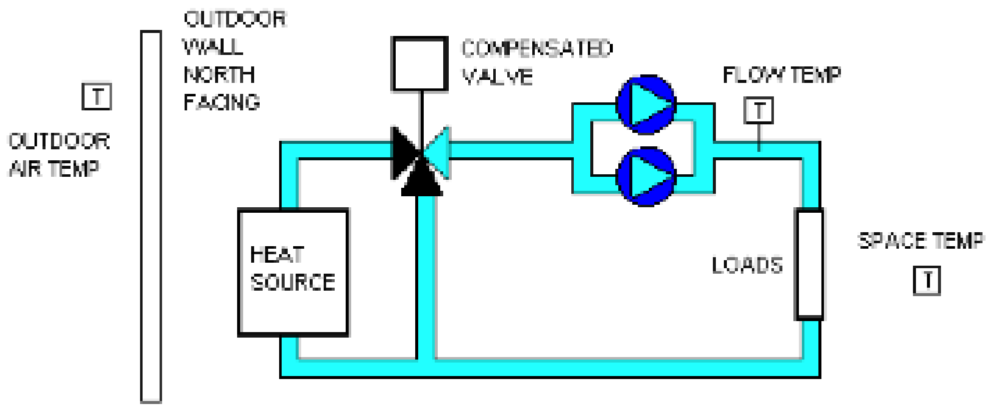


SECTION 4 : WET SYSTEMS

W01 Weather compensator with space influence

Application

Heating reset from outside air temperature with space influence.



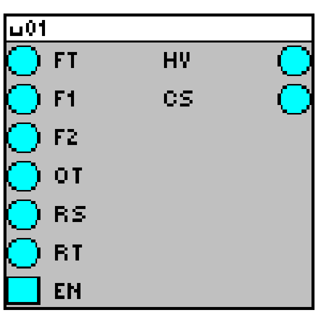
Function of module

This module provides PID control of compensated heating valve. The valve compensation is reset on outside air temperature. The flow temperature setpoint(F1) is the flow setpoint when the outdoor air temperature is 20°C. The flow temperature setpoint(F2) is the flow setpoint at 0°C. The space influence is found by multiplying the difference between the space temperature and the space setpoint by the space influence gain. The space influence is added to both flow setpoints. The compensation setpoint limits are set in the macro. The PID is enabled through the enable input point.

Number of Blocks

10

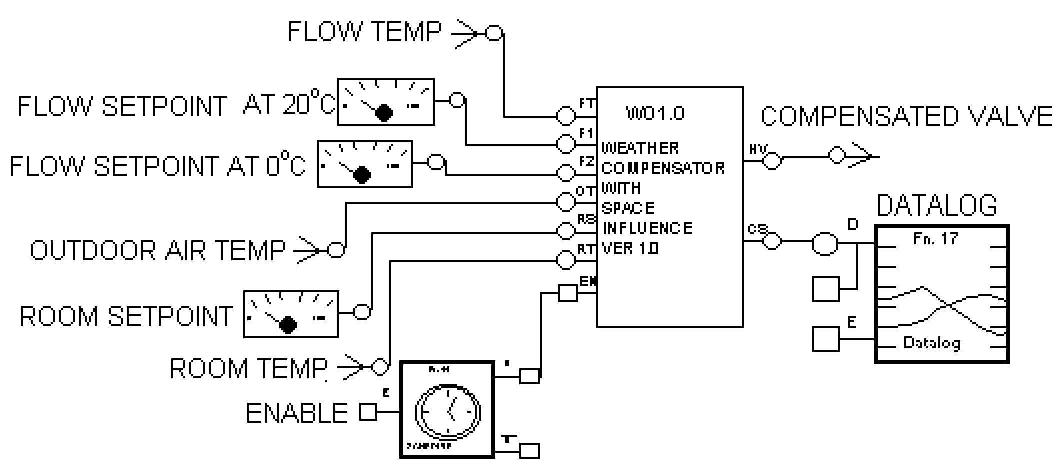
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Flow Temperature (FT)	The temperature of the water supplied to the space.	
	Flow Setpoint at 20°C (F1)	The setpoint of the heating medium at 20°C Outdoor Temperature.	
	Flow Setpoint at 0°C (F2)	The setpoint of the heating medium at 0°C Outdoor Temperature.	
	Outdoor Air Temperature (OT)	The temperature of the outdoor air.	
	Room Setpoint (SP)	The setpoint of the space air temperature.	
	Room Temperature (RT)	The air temperature of the space.	
Digital Inputs	Enable (En)	This input must be set to on (1) for the module to function.	
Analog Outputs	Compensated Valve (HV)	The output to the compensated valve. Valid range is between 0 and 100%.	
	Compensated Setpoint (CS)	The calculated compensated setpoint.	
Parameters	Minimum Compensated Setpoint	Minimum value for the compensated setpoint.	20°C
	Maximum Compensated Setpoint	Maximum value for the compensated setpoint.	82°C
	Room Influence Gain	Gain value for room influence.	5
	Integration Time	Integration time for PID loop.	600 seconds
	Derivative Time	Derivative time for PID loop.	0 seconds
	Gain	Gain value for PID loop.	8

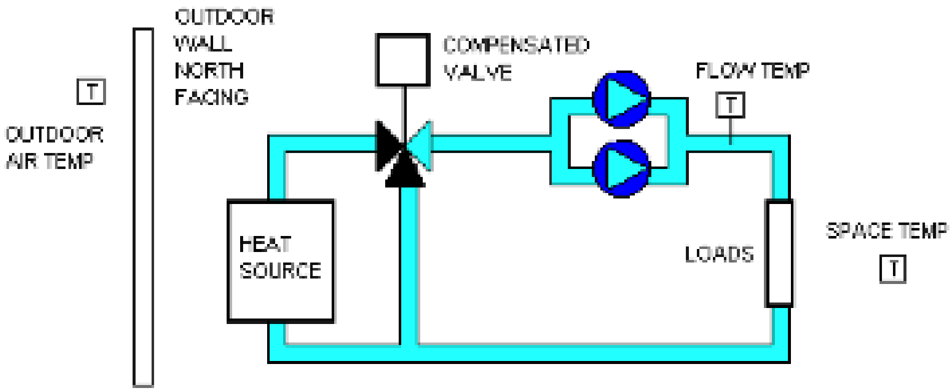
Example



W02 Weather compensator with space influence and night setback

Application

Heating reset from outside air temperature with space influence and night setback.



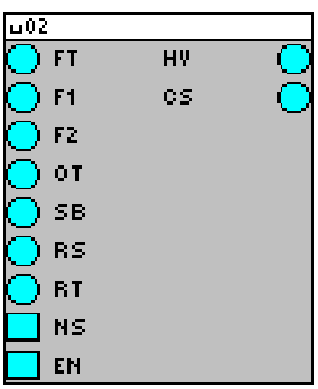
Function of module

This module provides PID control of compensated heating valve. The valve compensation is reset on outside air temperature. The flow temperature setpoint (F1) is the flow setpoint when the outdoor air temperature is 20°C. The flow temperature setpoint (F2) is the flow setpoint at 0°C. The space influence is found by multiplying the difference between the space temperature and the space setpoint by the space influence gain. The space influence is added to both flow setpoints. The compensation setpoint limits are set in the macro. The PID is enabled through the enable input point. When the night setback input is on the macro uses the setback setpoint instead of the room setpoint.

Number of Blocks

11

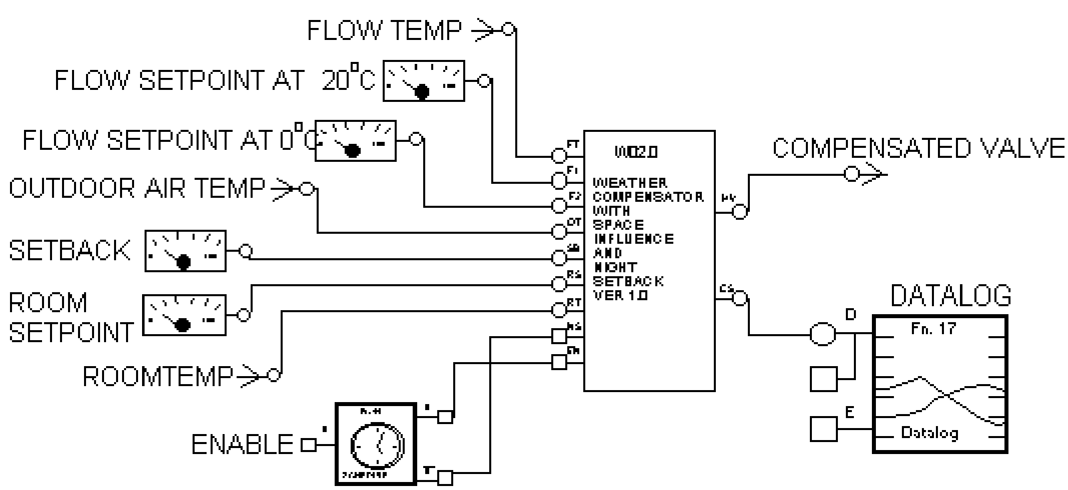
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Flow Temperature (FT)	The temperature of the water supplied to the space.	
	Flow Setpoint at 20°C (F1)	The setpoint of the heating medium at 20°C Outdoor Temperature.	
	Flow Setpoint at 0°C (F2)	The setpoint of the heating medium at 0°C Outdoor Temperature.	
	Outdoor Air Temperature (OT)	The temperature of the outdoor air.	
	Setback (SB)	The setpoint of the space air temperature when night setback is on.	
	Room Setpoint (SP)	The setpoint of the space air temperature when night setback is off.	
	Room Temperature (RT)	The air temperature of the space.	
Digital Inputs	Night Setback (NS)	When set to on macro uses setback input as the room setpoint else occupied setpoint is used.	
	Enable (En)	This input must be set to on (1) for the module to function.	
Analog Outputs	Compensated Valve (HV)	The output to the compensated valve. Valid range is between 0 and 100%.	
	Compensated Setpoint (CS)	The calculated compensated setpoint.	
Parameters	Minimum Compensated Setpoint	Minimum value for the compensated setpoint.	20°C
	Maximum Compensated Setpoint	Maximum value for the compensated setpoint.	82°C
	Room Influence Gain	Gain value for room influence.	5
	Integration Time	Integration time for PID loop.	600 seconds
	Derivative Time	Derivative time for PID loop.	0 seconds
	Gain	Gain value for PID loop.	8

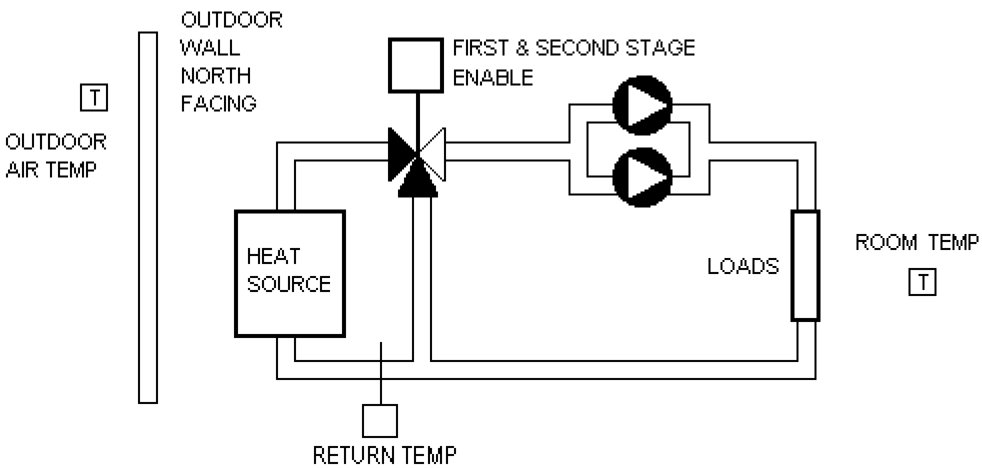
Example



W03 First, and second stage frost logic

Application

Frost protection of plant equipment and condensation protection.



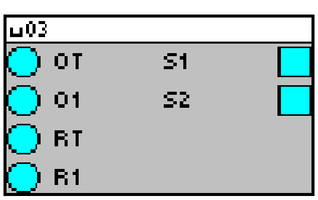
Function of module

This macro provides first, and second stage frost logic protection for heating circuits. When the outdoor air temperature is less than the setpoint stage 1 is enabled. The output remains enabled until the outdoor air temperature rises above the setpoint by 2°C. The second stage frost is only enabled when the first stage has been enabled and the boiler return temperature falls below 15°C. The second stage turns off when the boiler return temperature rises above 30°C.

Number of Blocks

5

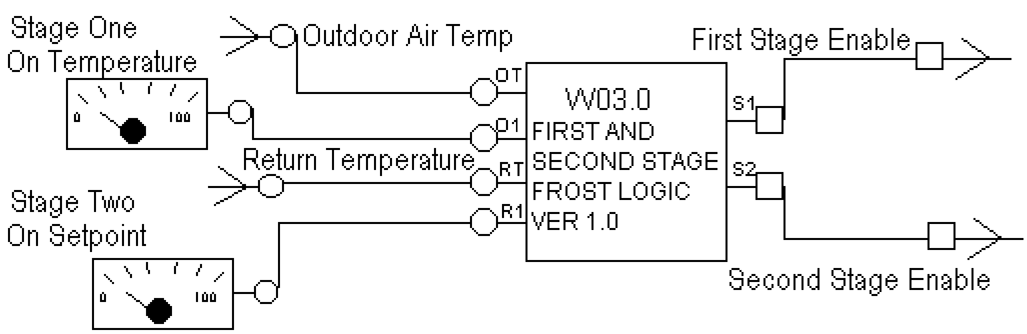
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Outdoor Air Temperature (OT)	The temperature of the outdoor air.	
	Stage One On Temperature (O1)	The point below which first stage enable will occur.	
	Boiler Return Temperature (RT)	The temperature of the water returning to the boiler.	
	Stage Two On Setpoint (R1)	The temperature at which the second stage enable will occur.	
Digital Outputs	First Stage Enable (S1)	When module selects First Stage Enable as desired output, this value is set to on. Otherwise value is off.	Off (0)
	Second Stage Enable (S2)	When module selects Second Stage Enable as desired output, this value is set to on. Otherwise value is off. First stage must be enabled before second stage will be enabled.	Off (0)
Parameters	Outdoor air deadband	The first stage output turns on when the outdoor air temperature is less than this value and module is enabled.	2°C
	Boiler Return deadband	The second stage output turns on when first stage is on and boiler return temperature is less than this value.	10°C

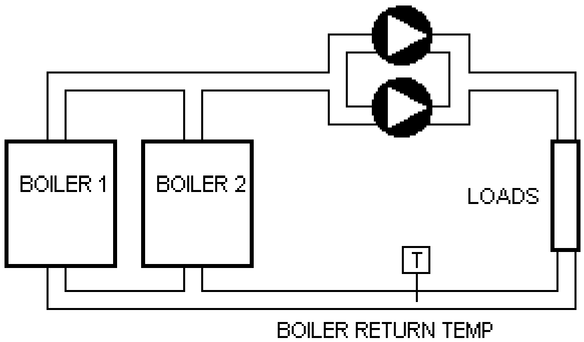
Example



W04 Two-Boiler sequence with weekly rotation

Application

Boiler sequencing and control.



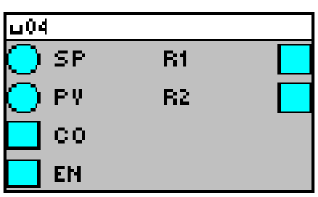
Function of module

This macro provides control of two boilers with duty sharing. The lead boiler is rotated every week. The macro finds the heating load based on the supply setpoint when the PID is enabled. If the heating load is greater than 25% then the lead boiler is selected. The setting for the lag boiler is 99%. The boilers have an on delay of 60 seconds.

Number of Blocks

27

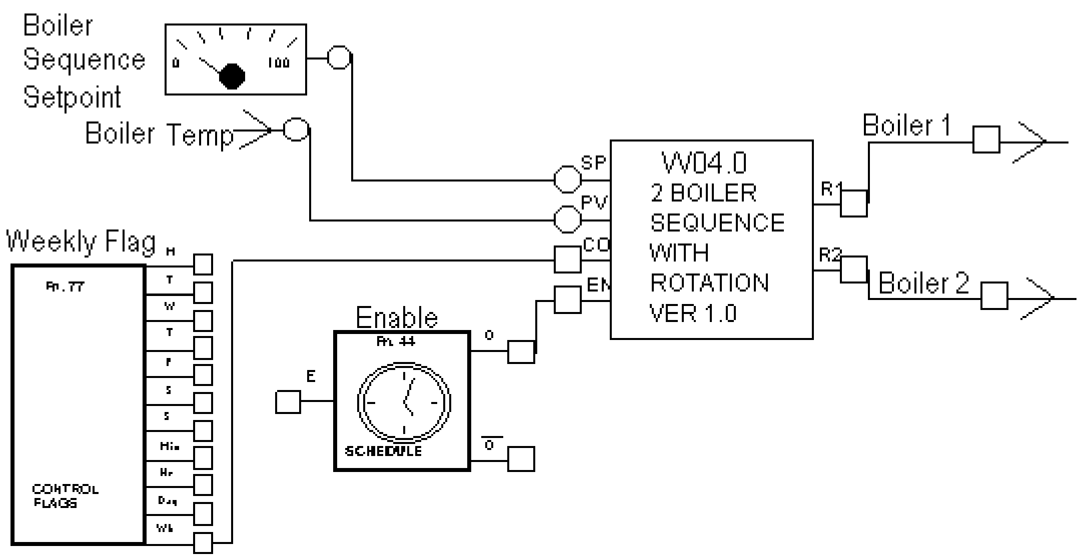
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Boiler Sequence Setpoint (SP)	Setpoint of the boilers.	
	Boiler Sequence Temperature (PV)	Temperature of the boiler.	
Digital Inputs	Changeover (CO)	Weekly flag allowing lead and lag boilers to be rotated.	0
	Enable (EN)	Should be joined to time schedule. Boilers and pumps are disabled when value is 0ff	Off (0)
Digital Outputs	Boiler 1 (B1)	Output is on (1) when boiler 1 is selected as desired output.	Off (0)
	Boiler 2 (B2)	Output is on (1) when boiler 2 is selected as desired output.	Off (0)
Parameters	Lead enable	heating load > value to enable lead boiler.	25
	Lag enable	heating load > value to enable lag boiler.	99
	Boiler 1 on delay	Time delay before boiler 1 is set on.	60 seconds
	Boiler 2 on delay	Time delay before boiler 2 is set on.	60 seconds

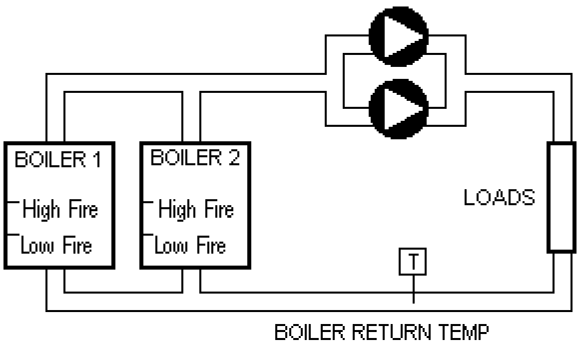
Example



W05 Two-Boiler sequence with high/low fire and weekly rotation

Application

Boiler sequencing and control.



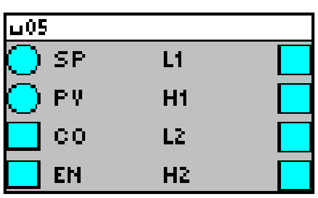
Function of module

This macro provides control of two boilers with duty sharing. The lead boiler is rotated every week. The macro finds the heating load based on the supply setpoint when the PID is enabled. The lead boiler is selected when the load is less than 50%. When the load reaches 25% of the 0-50% range i.e. 12.5% the low fire setting on the lead is enabled. When the load reaches 99% of the 0-50% range the high fire setting on the lead is enabled. The lag boiler is selected when the load is greater than 50%. When the load reaches 25% of the 50-100% range the low fire setting on the lag is enabled. When the load reaches 99% of the 50-100% range the high fire setting on the lag is enabled. The boilers have an on delay of 60 seconds.

Number of Blocks

34

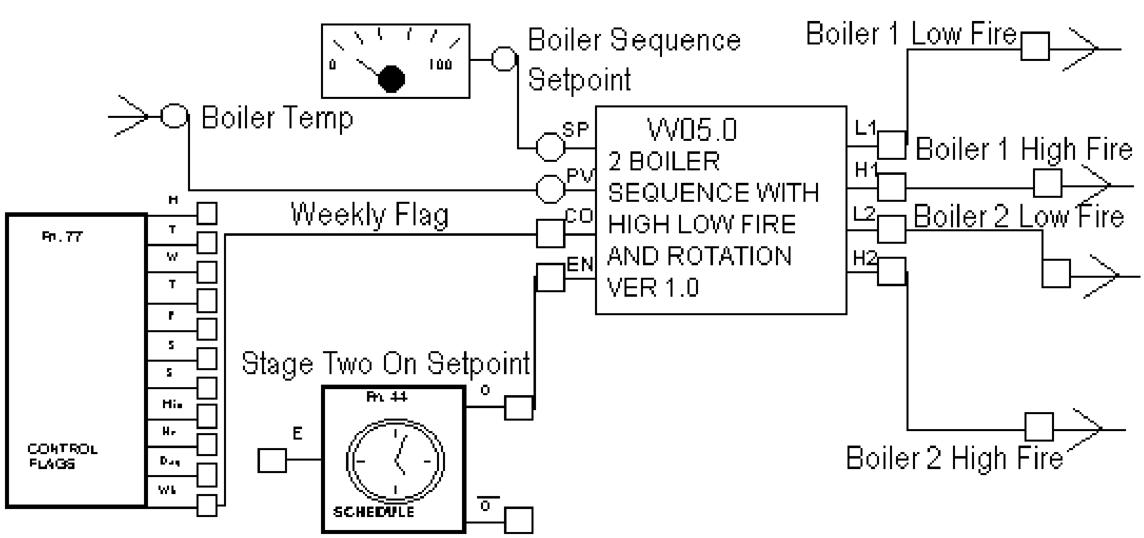
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Boiler Sequence Setpoint (SP)	Setpoint of the boilers.	
	Boiler Sequence Temperature (PV)	Temperature of the boilers.	
Digital Inputs	Changeover (CO)	Weekly flag allowing lead and lag boilers to be rotated.	0
	Enable (EN)	Should be joined to time schedule. Boilers and pumps are disabled when value is 0ff	Off (0).
Digital Outputs	Boiler 1 Low Fire (L1)	Output is on (1) when boiler 1 low fire is selected as desired output.	Off (0).
	Boiler 1 High Fire (H1)	Output is on (1) when boiler 1 high fire is selected as desired output.	Off (0).
	Boiler 2 Low Fire (L2)	Output is on (1) when boiler 2 low fire is selected as desired output.	Off (0).
	Boiler 2 High Fire (H2)	Output is on (1) when boiler 2 high fire is selected as desired output.	Off (0).
Parameters	Lead enable	heating load > value to enable lead boiler.	25
	Lag enable	heating load > value to enable lag boiler.	99
	Boiler 1 low fire on delay	Time delay before boiler 1 low fire is set on.	30 seconds
	Boiler 1 high fire on delay	Time delay before boiler 1 high fire is set on.	60 seconds
	Boiler 2 low fire on delay	Time delay before boiler 2 low fire is set on.	30 seconds
	Boiler 2 high fire on delay	Time delay before boiler 2 high fire is set on.	60 seconds

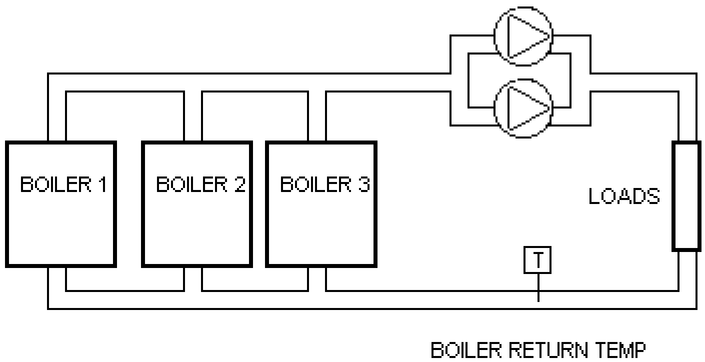
Example



W06 Three-Boiler sequence with weekly rotation

Application

Boiler sequencing and control.



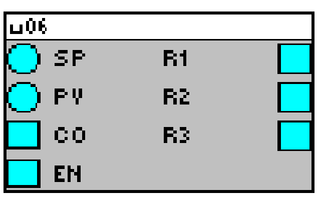
Function of module

This macro provides control of three boilers with duty sharing. The lead boiler is rotated every week. The macro finds the heating load based on the supply setpoint when the PID is enabled. If the heating load is greater than 33% then the lead boiler is selected. The setting for the lag boiler is 66%. The setting for the lag-lag boiler is 99%. The boiler sequence is 1-2-3, 2-3-1, 3-1-2. The boilers have an on delay of 60 seconds.

Number of Blocks

35

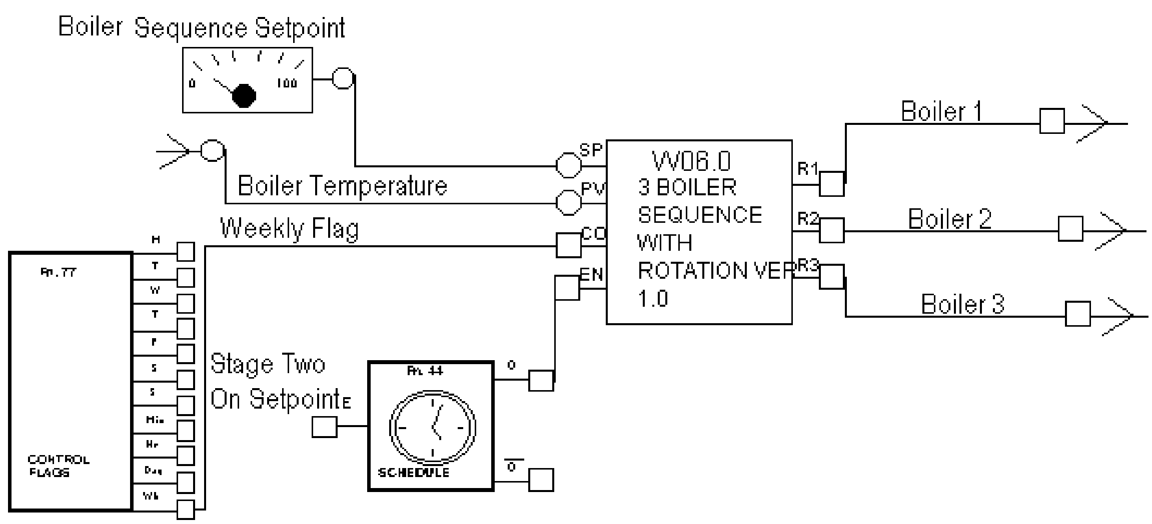
Symbol



Variables

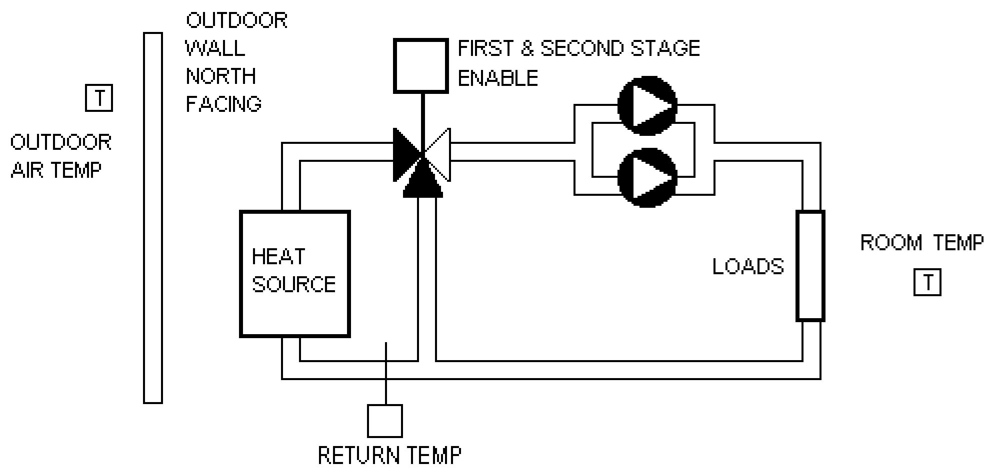
Variable type	Variable name	Description	Default values
Analog Inputs	Boiler Sequence Setpoint (SP)	Setpoint of the boilers.	
	Boiler Sequence Temperature (RT)	Temperature of the boilers.	
Digital Inputs	Changeover (CO)	Weekly flag allowing lead and lag boilers to be rotated.	0
	Enable (EN)	Should be joined to time schedule. Boilers and pumps are disabled when value is 0ff	Off (0)
Digital Outputs	Boiler 1 (B1)	Output is on (1) when boiler 1 is selected as desired output.	Off (0)
	Boiler 2 (B2)	Output is on (1) when boiler 2 is selected as desired output.	Off (0)
	Boiler 3 (B3)	Output is on (1) when boiler 3 is selected as desired output.	Off (0)
Parameters	Lead enable	heating load > value to enable lead boiler.	33
	Lag enable	heating load > value to enable lag boiler.	66
	Lag-Lag enable	heating load > value to enable lag-lag boiler.	99
	Boiler 1 on delay	Time delay before boiler 1 is set on.	60 seconds
	Boiler 2 on delay	Time delay before boiler 2 is set on.	60 seconds
	Boiler 3 on delay	Time delay before boiler 3 is set on.	60 seconds

Example



W07 First, second and third stage frost logic

Application



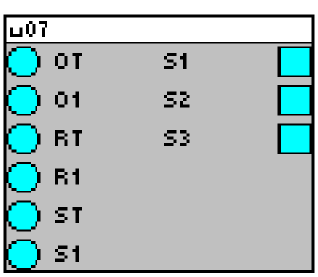
Function of module

This macro provides first, second and third stage frost logic protection for heating circuits. When the outdoor air temperature is less than the setpoint stage 1 is enabled. The output remains enabled until the outdoor air temperature rises 2°C above the setpoint. The second stage frost is only enabled when the first stage has been enabled and the boiler return temperature falls below 15°C. The second stage turns off when the boiler return temperature rises above 30°C. When any of the room temperatures falls below 10°C the third stage is enabled. The third stage operates independently from stages 1 and 2.

Number of Blocks

11

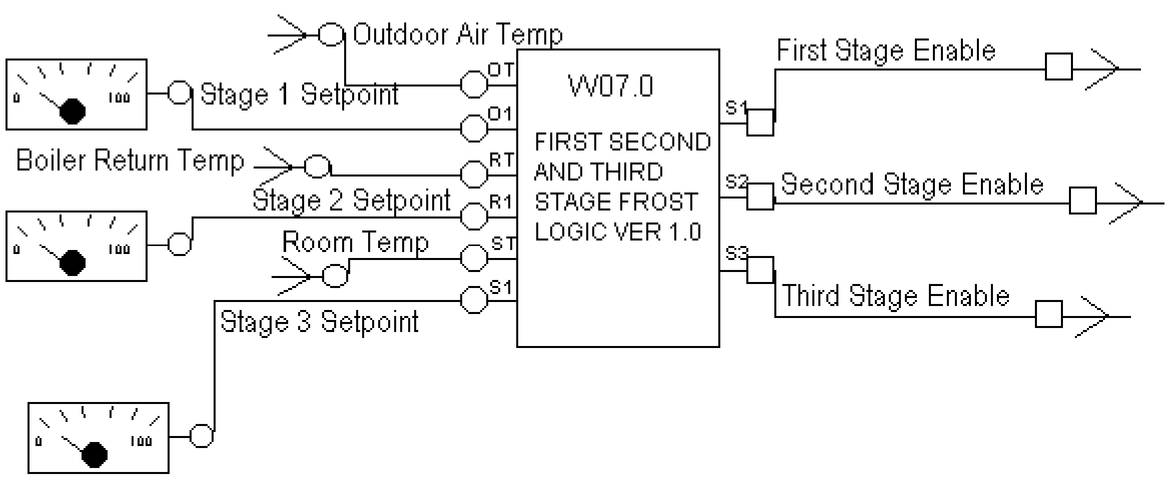
Symbol



Variables

Variable type	Variable name	Description	Default values
Analog Inputs	Outdoor Air Temperature (OT)	The temperature of the outdoor air.	
	Stage One Setpoint (O1)	Setpoint which, when passed, enables first stage.	
	Boiler Return Temperature (RT)	The temperature of the water returning to the boiler.	
	Stage Two On Setpoint (R1)	Setpoint which, when passed, enables second stage.	
	Room Temperature (ST)	The temperature of the room.	
	Stage Three On Setpoint (S1)	Setpoint which, when passed, enables third stage.	
Digital Outputs	First Stage Enable (S1)	When module selects First Stage Enable as desired output, this value is set to on. Otherwise value is off.	Off (0)
	Second Stage Enable (S2)	When module selects Second Stage Enable as desired output, this value is set to on. Otherwise value is off.	Off (0)
	Third Stage Enable (S3)	When module selects Third Stage Enable as desired output, this value is set to on. Otherwise value is off.	Off (0)
Parameters	Outdoor air temperature ON value	The first stage output turns on when the outdoor air temperature is less than this value and module is enabled.	2°C
	Boiler Return temperature ON value	The second stage output turns on when first stage is on and boiler return temperature is less than this value.	15°C
	Room temperature ON value	The third stage Output turns on when minimum room temperature is less than this value.	10°C

Example



AMERICAN AUTO-MATRIX
ONE TECHNOLOGY LANE
EXPORT, PA 15632
(877) AAM-HVAC [P]
(724) 327-6124 [F]

CYLON ENERGY INC.
8025 SOUTH WILLIAM STREET,
SUITE 107,
MANCHESTER, NH 03103
T + 603-782-8870

WWW.AAMATRIX.COM