MICRO CONTROL SYSTEMS

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MAGNUM RTU MANUAL

Revision 3.4.3- 2023-07-20

View Changes made since last Version Release, see page 2

For Latest changes:
Firmware Ver. RTU 17.72B2 and higher
MCS-CONFIG Ver. 18.03.01 and higher
MCS-CONNECT - Ver. 18.36 and higher

MCS Total Solution for all your Control Needs

RoHS Compliant

Energy Efficient and RoHS Compliant

MCS RTU Manual additions / changes since last Revision 3.3.1

1. **Chapter 32 - added RTU Unit and Compressor State Chart - pages 144-146**
2. **Chapter 35 - Setpoints - Changes descriptions to setpoints 251-255**
3. **Chapter 4 - Cooling Information - Compressor**
    a. 4.8 UNLOAD DELAY- RECIP/VFD COMPRESSORS- MCS-CONFIG Ver. 18.01Y - page 27
    b. 4.9. EMERGENCY STOP RELAY - CIRCUIT BASE - MCS-CONFIG Ver. 18.01Y - page 27
4. Outdoor Air Damper Proof before starting Fan - with MAGNUM RTU firmware update - 17.72B2
5. Added setpoint 132 with description
6. Added new options for Dehumid “Stasge On and Off by Control Sensor”
7. Chapter 31 - Capacity Control Logic Using PID
8. Chapter 25 - Condenser Control Logic using PIP
9. Change chart on network chapter

The MCS Commitment is to provide practical solutions for the industries needs and to be both a leader and partner in the effective use of microprocessor controls.

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Chapter - 1. MAGNUM Software

Magnum RTUM software joins the Magnum family of software:

HVAC MAG	-	Chillers with Screws, Reciprocating & Scroll Compressors
CENT MAG	-	Chillers with Centrifugal Compressors
LWC MAG	-	Controls multiple Chillers, Pumps, Modulating Valves
REFR MAG	-	Control Refrigeration Systems
RTU MAG	-	Control for Roof Top Units
CPM MAG	-	Chiller Plant Manager controlled via RS485 communications
MICROMAG	-	Controls RTU's & Chillers

All Magnum software is supported by a common MCS-CONNECT (version 18.00 or greater) and MCS-CONFIG (version 18.00 or greater) set of software.

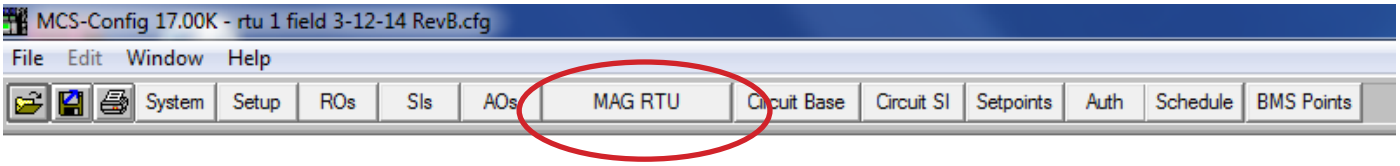
1.1. RTU Purpose

The purpose of the RTU software is to provide flexible control to roof top units that provide heating, cooling and/or dehumidification to a building. In addition the necessary ventilation control of fans and dampers to insure proper air quality and building pressure is provided.

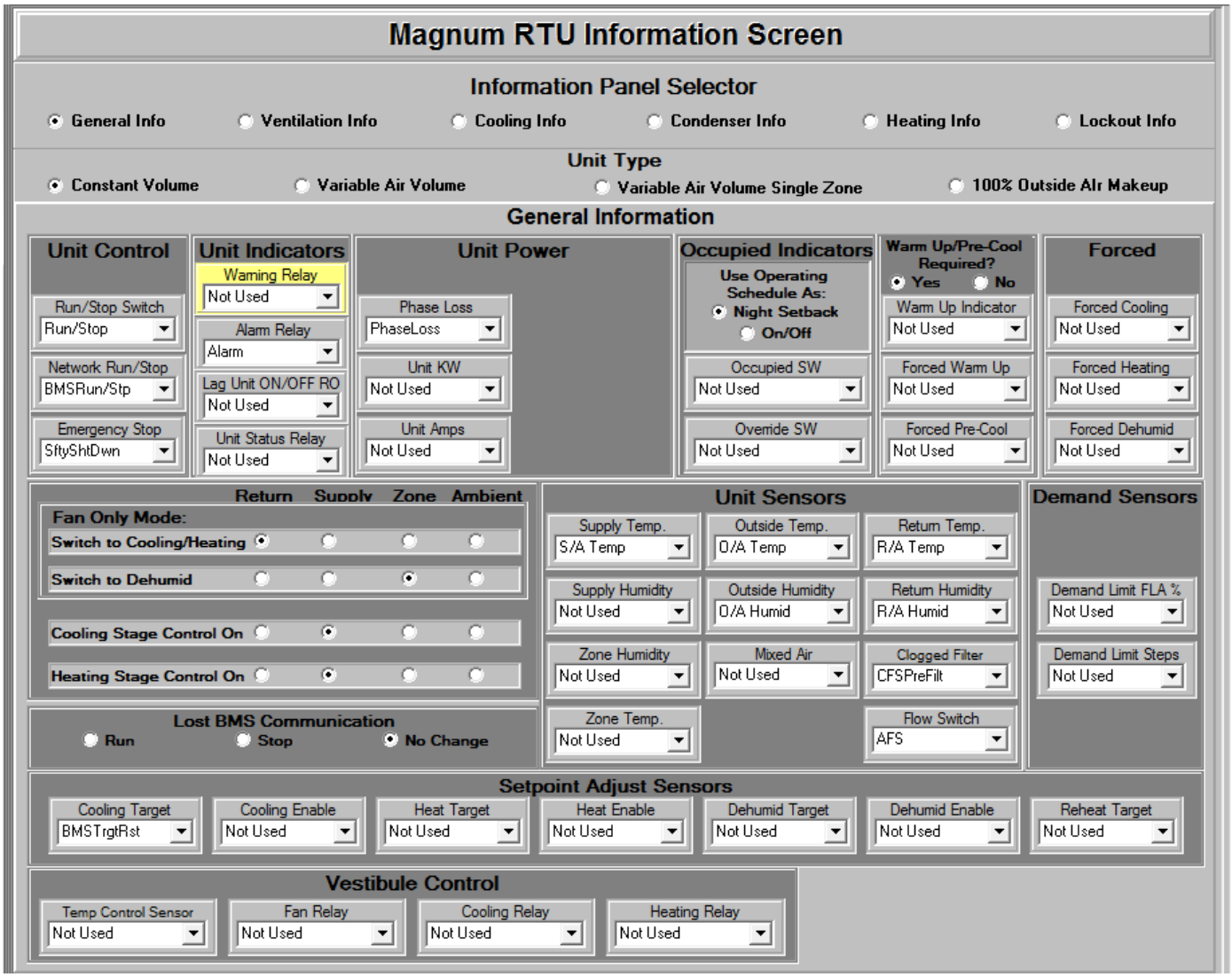
This software has been build using the HVAC control logic as its base. Therefore, all options and capabilities that address the cooling function have been incorporated in the RTU software. The Magnum RTU Manual is to be used as reference on these subjects.

1.2. Building a RTU Configuration File

MCS-CONFIG (version 17.00 or greater) is required to edit a RTU configuration file. The difference between this type and the HVAC is in the button that enables the RTU data to be selected.



By selecting the MAG RTU button the following screens can be accessed:



The above screen provides the base options and pointers for the RTU software.

Chapter - 2. Authorization Function

2.1. Authorization Function

The authorization code is a special four-character code that enables access to the Magnum controller.

The code may consist of any valid alpha/numeric characters if the system is being accessed through MCS-Connect, however, the code must be numeric with values between 1 and 8 if it is to be entered through the Keypad/Display. Each Magnum can have up to 10 different authorization codes, with four levels of authorization which provide differing levels of functionality. The authorization code and the associated level cannot be viewed or changed through the Keypad/Display or MCS-Connect, but only when the configuration file is opened in MCS-Config. The authorization codes should be protected and remain confidential, or unauthorized personnel may gain access to the system and perhaps cause irreparable damage.

From the Keypad/Display the following changes can be made based upon the authorization level:

FUNCTION	VIEW	USER	SERVICE	SUPERVISOR	FACTORY	ADMIN
Sensor offsets	NO	NO	YES	YES	YES	YES
Sensor diagnostics	NO	NO	YES	YES	YES	YES
Clear alarm history	NO	NO	NO	NO	NO	YES
Clear point information	NO	NO	NO	NO	NO	YES
Date and time set	NO	YES	YES	YES	YES	YES
Day of week set	NO	YES	YES	YES	YES	YES
Change No Flow Lockout or shut down	NO	NO	NO	NO	YES	YES
Change rotate Yes or No	NO	NO	NO	NO	YES	YES
Change Manual/Auto settings	NO	NO	NO	YES	YES	YES
Change setpoint values	NO	*	*	*	YES	YES
Change operating schedules	NO	YES	YES	YES	YES	YES
Change holiday dates	NO	YES	YES	YES	YES	YES
Lockout Reset	NO	**	**	**	YES	YES
*** Change RS485 network settings	NO	NO	YES	YES	YES	YES
Change Ethernet network settings	NO	NO	YES	YES	YES	YES
Adjust Keypad/Display contrast	YES	YES	YES	YES	YES	YES
Transmit Software	NO	NO	YES	YES	YES	YES
Transmit/Receive Configuration	NO	NO	YES	YES	YES	YES

* Setpoints may have individual authorization levels; you must have the proper authorization to view or edit them.

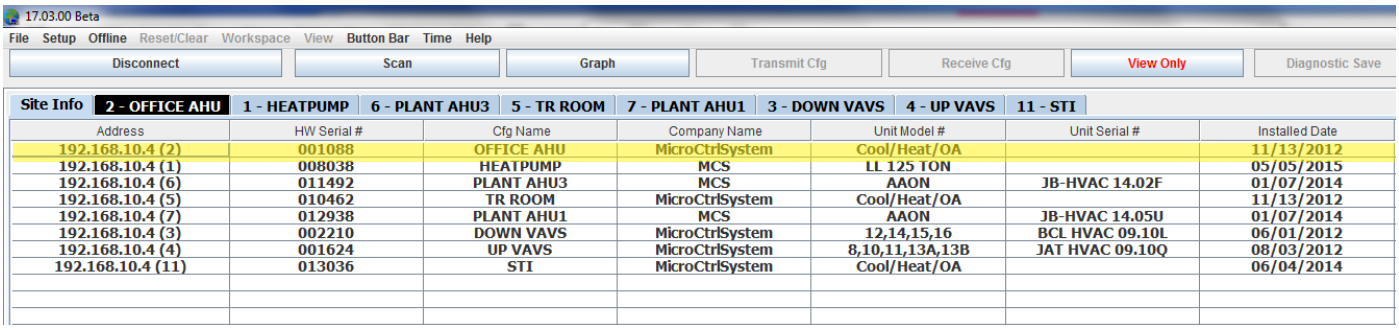
**See the Setup screen of the configuration for authorization level(s) that are allowed unlimited resets per day. Authorization levels below 'Auth Level Bypass' are allowed only a limited number of resets. Authorization levels at and above 'Auth Level Bypass' are allowed unlimited lockout resets.

***Firmware Version 17.62M, 'Change RS485 network settings - **SERVICE** or greater.'

To get authorized through the Keypad/Display do the following:

1. Press 'Menu'
2. Using ↑ ↓, →, or ← keys, move cursor to 'Passwords'

To get authorized through MCS-Connect do the following:



Address	HW Serial #	Cfg Name	Company Name	Unit Model #	Unit Serial #	Installed Date
192.168.10.4 (2)	001088	OFFICE AHU	MicroCtrlSystem	Cool/Heat/OA		11/13/2012
192.168.10.4 (1)	008038	HEATPUMP	MCS	LL 125 TON		05/05/2015
192.168.10.4 (6)	011492	PLANT AHU3	MCS	AAON	JB-HVAC 14.02F	01/07/2014
192.168.10.4 (5)	010462	TR ROOM	MicroCtrlSystem	Cool/Heat/OA		11/13/2012
192.168.10.4 (7)	012938	PLANT AHU1	MCS	AAON	JB-HVAC 14.05U	01/07/2014
192.168.10.4 (3)	002210	DOWN VAVS	MicroCtrlSystem	12,14,15,16	BCL HVAC 09.10L	06/01/2012
192.168.10.4 (4)	001624	UP VAVS	MicroCtrlSystem	8,10,11,13A,13B	JAT HVAC 09.10Q	08/03/2012
192.168.10.4 (11)	013036	STI	MicroCtrlSystem	Cool/Heat/OA		06/04/2014

1. Click View Only on desired Magnum in the Site Information screen.
2. Click button.
3. Enter the 4 digit code into the pop-up box and click ok (or press the enter key).
4. Depending on the authorization level, the button will change to one of the following displays, indicating if the code was accepted or not.

View Only | User | Service | Factory | Supervisor

Chapter - 3. General Info Button

The sections for Unit Control, Unit Indicators, Unit Power, Unit Sensors, and Demand Sensors will provide pointers for the various cells. These are standard drop down windows that allow the selection of the sensor inputs or relay outputs.

3.1. The Occupied Indicators section:

Provides information as to the status of the building; occupied or unoccupied.

Occupied can be indicated by a schedule being true or by the Occupied SW being on. This can be a digital type or input from a BMS.

If unoccupied all setpoints are adjusted with their night setback values, refer to the section on setpoints. The unoccupied can be over ridden with the Override SW. This will enable the system to operate as occupied for a given period of time, setpoint #118.

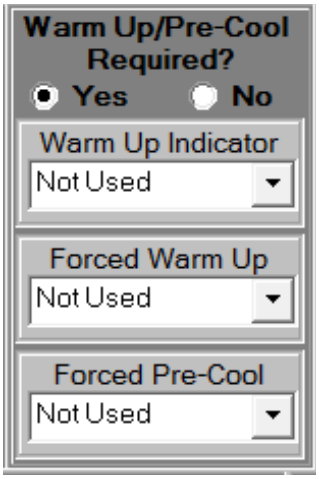
Occupied indicators section under general info in the MAG RTU screen.

-Use Operating Schedule As: Select ON/OFF

-Occupied SW: Set up an occupied SI as digital and select it here

-Override SW: Set up an override SI as digital and select it here

3.2. The Warm Up option can be specified:



A warm up can be initiated by either a schedule to indicate occupied or unoccupied and prior to moving to occupied mode the system will provide heat to the building to enable a warm up period or by a sensor input selected by the Forced Warm Up cell. This option has not been specified or implemented.

-Warm Up Required: Yes

-Warm Up Indicator: Set up an RO and call it InWarmUp and select it here

-Forced Warm Up: Not used

Setpoint #190 Set up (if inactive warm up will be skipped)

-Value: Maximum time in warm up

-Select Value: Minutes

-Type of Setpoint: Target

-High Zone: Cooling target

-Low Zone: Return target

-Night Setback: Heating target

3.3. Warm Up Sequence of Operations:

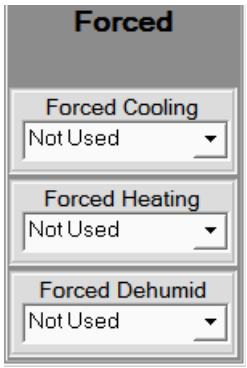
Only one warm up can occur per calendar day. When the unit enters occupied mode for the first time that day the RO “InWarmUp” will turn on letting us know the system is in warm up and the building mode will say warm up. Control will be on whatever is selected in the MAG RTU screen under the general info section. When the unit enters warm up it will go into heating if the return air temp is below the value that is in the Low Zone cell of setpoint #190. Setpoint #163 will then be

reset to the value that is in the Night Setback cell for setpoint #190. When the return air temp reaches the value that is in the Low Zone cell for setpoint #190 plus the value that is in the High Zone cell for setpoint #163 the unit will exit warm up and go into occupied mode and run as needed or if the maximum time in warm up has been met.

In warm up the unit will go into cooling if the return air temp is above the value that is in the High Zone cell

for setpoint #190. Setpoint #1 will not be reset. When the return air temp reaches the value that is in the High Zone cell for setpoint #190 minus the value of setpoint #3 the unit will exit warm up and go into occupied mode and run as needed or if the maximum time in warm up has been met.

3.4. Forced (on sensors)



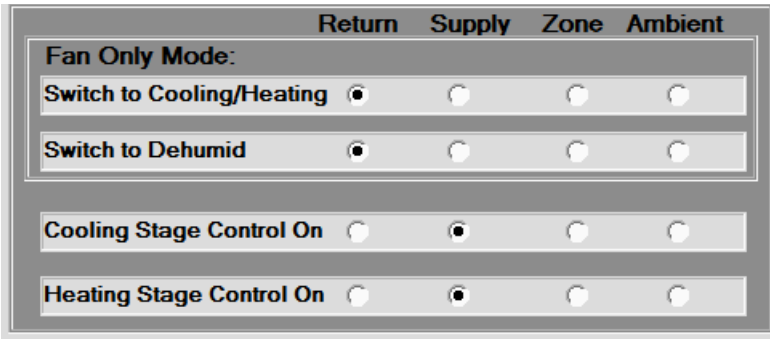
The purpose of these sensors if used is to force the unit into cooling or heating mode. The type of sensor can be digital, user logic or provided by a BMS; when it is on the appropriate mode will be entered. This removes the control from the ventilation mode control sensor to determine when the cooling or heating mode will be entered.

The Forced Dehumidification sensor has not been implemented at this time.

3.5. The Control ON section:

This indicates the sensor that will be used as controlling sensors in the various modes.

The sensor indicated for the Ventilation Mode control will determine which mode is enabled.

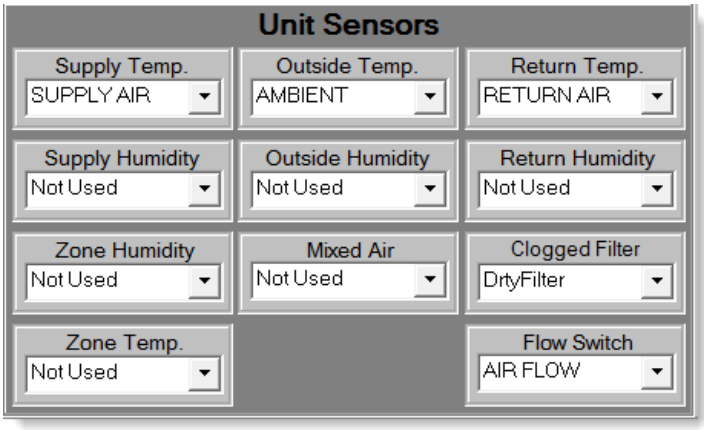


In the example when the zone temperature is above setpoint #218 or if the Forced Cooling is used and it is on, Cooling Mode will be enabled. The RTU state will be changed to COOLING, and the Supply Temperature will be used to control the cooling steps. Once the system is in the Cooling Mode it will remain in this mode until the temperature drops below the value of setpoint #218 minus its Low Zone offset.

In the example when the zone temperature is below setpoint #219 or if the Forced Heating is used and it is on. Heating Mode will be enabled. The RTU state will be changed to HEATING, and the Zone Temperature will be used to control the heating steps. Once the system is in the Heating Mode it will remain in this mode until the temperature rises above the value of setpoint #219 plus its High Zone offset.

If neither cooling nor heating is required the RTU will be Ventilation Only. From this mode the system can enter a dehumidification mode if the humidity is greater than setpoint #220 or if the Forced Dehumidifying is used and it is on. If the system is moving from the cooling mode to the ventilation only mode and dehumidification is required, the system will not turn off any cooling stages that have been turned on.

3.6. Unit Sensors

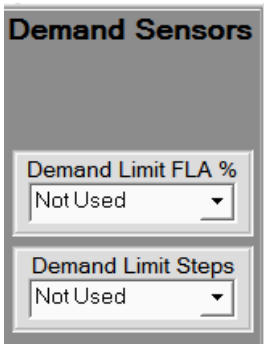


The set of sensors for Supply, Ambient, Return and Zone sensors are used in the control logic as indicated in the Control Mode On section as shown above.

Flow Switch if used, this digital input must indicate that there is flow or the unit will be turned off due to no flow.

3.7. Demand Limit FLA %

A sensor input can be used to limit how far the compressor can load based on FLA%. Commonly used with infinite capacity screw compressors and Centrifugal compressors..



3.8. Demand Limit Steps

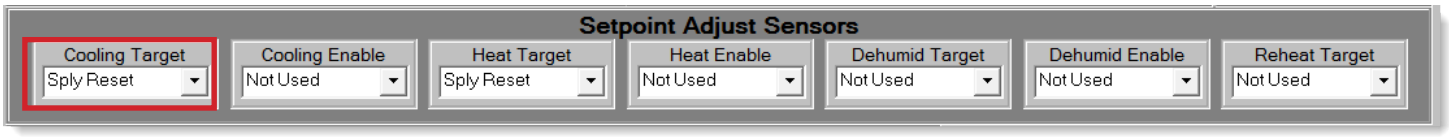
A sensor input can be used to limit the amount of steps of capacity the unit can load to. Typically used with On/Off scrolls or reciprocating compressors with unloaders.

3.9. Loss BMS Communication

On a loss of communication to the BMS for more than 10 minutes, the controller will default to RUN, STOP or NO CHANGE (if running continue to run or off leave off).

3.10. Setpoint Adjust Sensors

Gives the ability to override a setpoint. This can be used to increase or decrease a temperature range without the necessity of adjusting a thermostat or can be an adjustment initiated from a BMS control.



Example:
In the screen above the Cooling Target has a 'Sply Reset' sensor which has been hardwired to the unit. The sensor has been setup as 'TRGRST' and will reset the target value set up in setpoint #1 'CoolSply Trgt'.

SI Setting 1-9

Setpoint #21 TARGET RESET

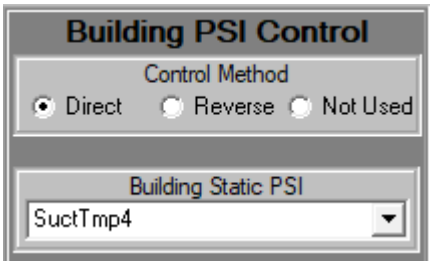
Chapter - 4. Information Panel - Ventilation Info

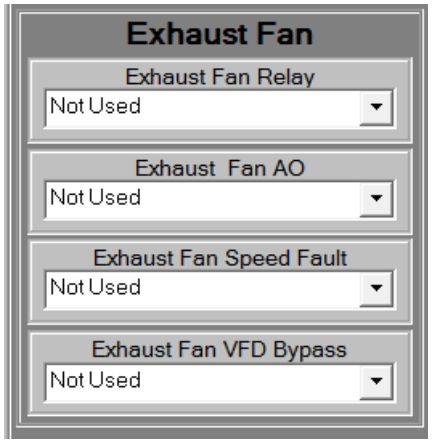
This section provides the Ventilation options that are using: Sensors inputs, Relay outputs and Analog outputs to control Exhaust Fan Damper, Outside Air Damper.

4.1. BUILDING PSI CONTROL:

4.1.1 DIRECT CONTROL METHOD

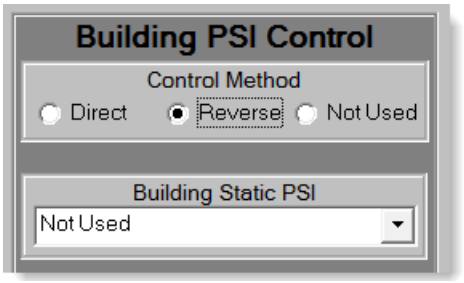
The following screens will appear. If the building pressure is high, setpoint #197, the speed of the exhaust fan will be increased.





4.1.2 REVERSE CONTROL METHOD

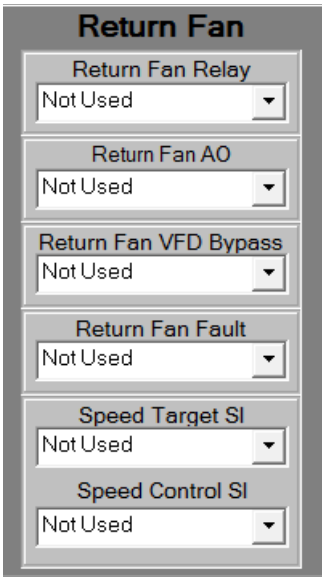
If the building pressure is low, setpoint #197, the outside air damper will be opened and the speed of the supply fan will be increased. The Exhaust Fan and Exhaust Fan Damper sections will not be displayed.



4.1.3 'NOT USED' CONTROL METHOD

The Exhaust Fan and Exhaust Fan Damper sections will not be displayed.

4.2. RETURN FAN CONTROL



4.2.1 BASED ON O/A AIR DAMPER:

The speed of the return fan will be based upon the outside air damper opening. If the outside air damper is at 75% then the return fan will be at 25%. The exhaust fan will also affect the speed as it will be reduced proportionately based upon the exhaust fan speed.

4.2.2 BASED ON CFM:

This method will be active if both the Supply & Return Fan CFM indexes are setup. This method uses a target that is developed by subtracting the value in setpoint #195 from the Supply Fan CFM value. Setpoint #195 can be modified by a BMS thus providing a floating target. The high & low zone cell values of this setpoint are used to develop the target zone. The Return Fan's VFD will be modulated to keep the Return Fan's CFM within the target zone. Setpoint #196 contains the adjustment values to modulate the Return FAN's VFD.

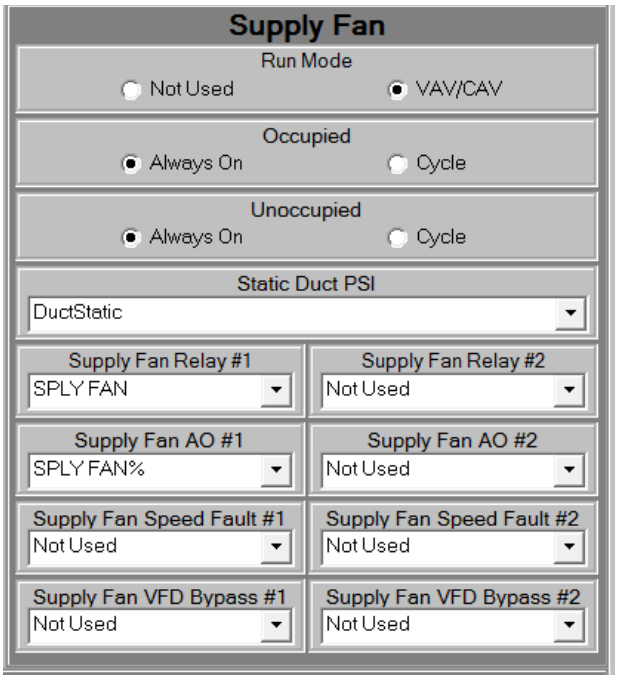
4.3. SUPPLY FAN CONTROL

The supply fan control options are:

- **Not Used: No supply fan control exists.**
- **Single Zone:** Not defined or implemented at this time.
- **Always On:** When the system is occupied the supply fan will always be on.
- **Cycle:** The supply fan will be turned on only if the system is not in Ventilation Only mode.

The supply has a pre and post delay time, setpoint #108. Also the system will not enable any cooling or heating stages to be turned on until the supply fan has been on for a period of time, setpoint #108.

These delays insure that there is air movement and any latent hot or cold air has begun to circulate.



4.4. OUTDOOR AIR DAMPER CONTROL

The Outdoor Air Damper performs various functions:

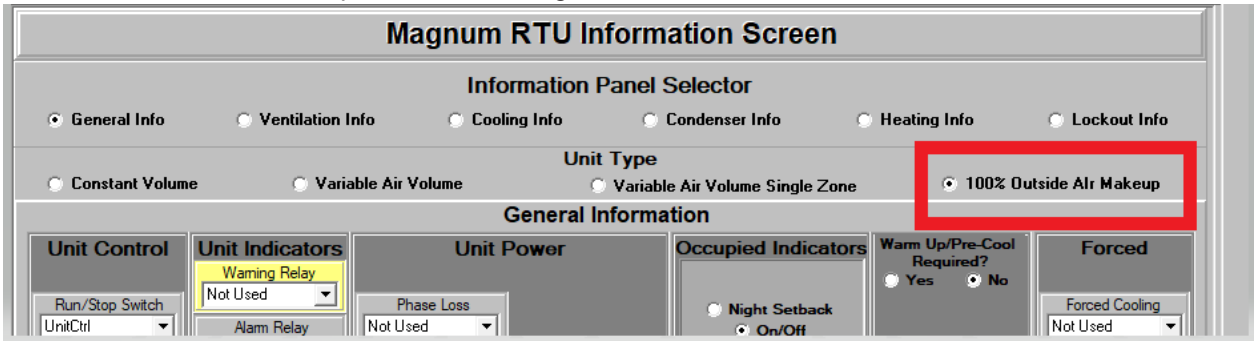
- **CONTROL FOR 100% OUTSIDE AIR UNITS**
- **NON-OUTSIDE AIR UNIT USING:**
  1. **Economizer** - Free Cooling
  2. **C02** - Indoor Air Quality
  3. **Building CFM**

1. Provides free cooling while functioning as an economizer. Refer to setpoint #119 through #126 for settings. As an economizer the damper will be modulated to provide free cooling prior to any mechanical cooling steps being activated. This control is the same as documented in Magnum Version 8 Manual; refer to section “Outside Air Economizer/Fluid Cooler with Analog Output Control.
2. Provides a minimum amount of outside air under normal operating conditions, refer to setpoint #121.
3. Ensure in-door air quality based upon the CO2 level; refer to setpoint #131, by maintaining a minimum opening if high CO2 exists.
4. Provide air flow based upon set point #127 by maintain a minimum opening to keep the flow with in it control zone.
5. Close economizer based on Low Ambient (Setpoint #192).
6. Note items 2, 3, & 4 provide a minimal opening for the damper.

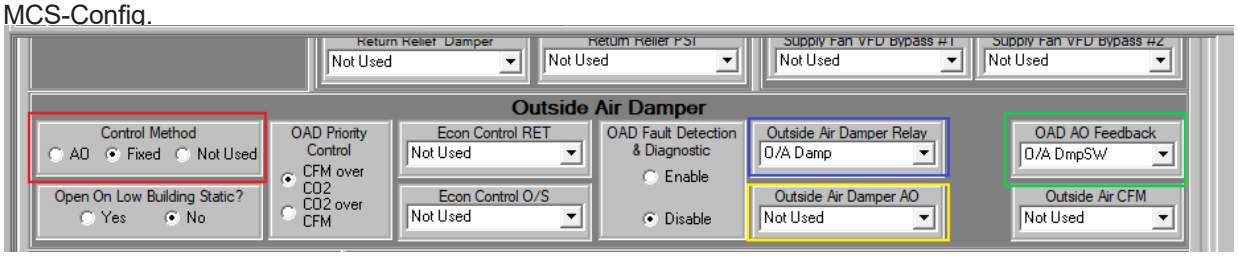
4.4.1 OUTDOOR AIR DAMPER CONTROL FOR 100% OUTSIDE AIR UNITS

Warning – This feature is supported in MCS-Magnum firmware version 17.72B2 and above.

This feature is enable by selection 100% Outside Air Makeup option(Red Box) in MCS-Config’s Mag RTU screen. See below screen clip from MCS-Config:



1. There are two options for OA Damper output. The output type is selected by the control method(Red Box), AO (Analog output) or Fixed (Relay Output). If AO type is selected, then Outside Air Damper AO(Yellow Box) points to the analog output for the OA Damper actuator. If Fixed type is selected, then the Outside Air Damper Relay(Blue Box) points the relay output to open the OA Damper. See below screen clip from MCS-Config.



2. The are two options for the OA Damper position indication/proof. The type of Feedback is determined by the sensor input type that is pointed to in the OAD AO Feedback (Green Box). See **above** screen clip from MCS-Config.

a. If the OAD AO Feedback sensor input display type is a Digital (see red box in screen clip below), then when the dry contacts on the damper feedback switch are closed the damper is fully open. Then the dry contact are open the damper is not fully open.

Sensor Input Information Screen

Point Number	Name (1 to 10 char)	Display Type	Offset	Manual Value or NC/NO (select to change)	Display Text (select to change)	Temp./ GPM / CFM / Pwr Factor SI	Humd./PSI/ Temp. Diff./ Enthal. Diff.
M-9	MtrFault	DIGITAL	Not Used	Closed=OFF	OK/TRIP	Not Used	Not Used
M10	O/A DmpSW	DIGITAL	Not Used	Open=OFF	NO/YES	Not Used	Not Used
M11	O/A Tmp	MCSTT00	0	85	Not Used	Not Used	Not Used
M12	O/A Humid	HUMD 0S	0	60	Not Used	Not Used	Not Used
M13	AirFlow	DIGITAL	Not Used	Open=OFF	NO/YES	Not Used	Not Used
M14	PhaseLoss	DIGITAL	Not Used	Closed=OFF	OK/TRIP	Not Used	Not Used
M15	Run/Stop	DIGITAL	Not Used	Open=OFF	STOP/RUN	Not Used	Not Used
M16	EmgStop	DIGITAL	Not Used	Closed=OFF	NO/YES	Not Used	Not Used

b. If the OAD AO Feedback sensor input display type is a Percent (See blue box in screen clip below), then when the sensor input reading is greater than the setpoint #132 value the OAD Damper is considered to be fully open. When the sensor input reading is less than or equal to setpoint #132 value the OAD Damper is not fully open.

Sensor Input Information Screen

Point Number	Name (1 to 10 char)	Display Type	Offset	Manual Value or NC/NO (select to change)	Display Text (select to change)	Temp./ GPM / CFM / Pwr Factor SI	Humd./PSI/ Temp. Diff./ Enthal. Diff.
M-9	MtrFault	DIGITAL	Not Used	Closed=OFF	OK/TRIP	Not Used	Not Used
M10	O/ADamper%	PERCENT	0	0	Not Used	Not Used	Not Used
M11	O/A Tmp	MCSTT00	0	85	Not Used	Not Used	Not Used
M12	O/A Humid	HUMD 0S	0	60	Not Used	Not Used	Not Used
M13	AirFlow	DIGITAL	Not Used	Open=OFF	NO/YES	Not Used	Not Used
M14	PhaseLoss	DIGITAL	Not Used	Closed=OFF	OK/TRIP	Not Used	Not Used
M15	Run/Stop	DIGITAL	Not Used	Open=OFF	STOP/RUN	Not Used	Not Used
M16	EmgStop	DIGITAL	Not Used	Closed=OFF	NO/YES	Not Used	Not Used
1-1	SPARE1-1	SPARE	0	0	Not Used	Not Used	Not Used

3. Setpoint #132 “OAD Fault” is used for determining when the OA Damper is fully open and once open detecting is the damper faults closed.

Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety
130	ReheatAdjust	1	1	8	1	10	15	0	0	Non-Active	HUMD or %	View Only	Delay		
131	Hi CO2 Open	1365	500	2000	1	20	20	0	0	Non-Active	METER/LEA	View Only	Target		
132	OAD FAULT	95	75	100	1	5	60	2	10	Active	HUMD or %	View Only	Lockout		90
133	NoHeatHiAmb	65	50	90	0	0	0	0	0	Non-Active	TEMP	View Only	Target		

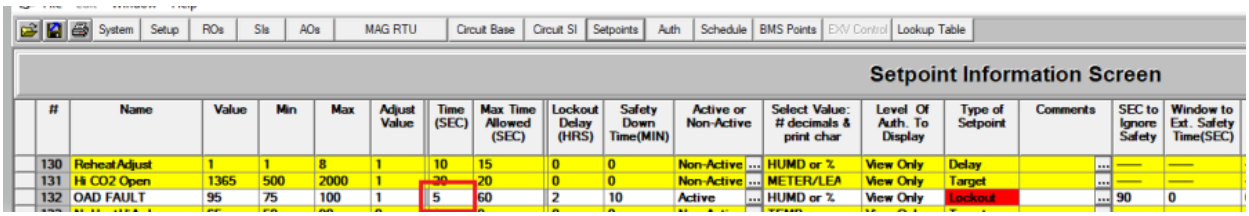
4. When the run command for the unit is applied to MCS-Magnum controller, the OA Damper will be open, if setup for a Fixed type the OA Damper relay is tuned on, if setup for AO type the analog output is set to the value in setpoint #122 Economizer Max VLV %.

5. The MCS-Magnum will than wait for X seconds for the OA Damper feedback to indicated the OA Damper is open. Where X is the calculated value of setpoint #132 **Time field plus the Sec to ignore Safety** fields (red box in screen clip below). If time delay expires before the OA Damper feedback indicates the OA Damper is open, the unit is locked out, an “OAD Fault” alarm is generated and the Alarm Relay(if setup) is turned on. And the unit is not allowed to run again until a manual Lockout Reset is performed by a service technician. If the OA Damper feedback indicated the damper is open before the time expires, the unit is allow to continue to run and the Supply Fan will be allow to start.

Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety
130	ReheatAdjust	1	1	8	1	10	15	0	0	Non-Active	HUMD or %	View Only	Delay		
131	Hi CO2 Open	1365	500	2000	1	20	20	0	0	Non-Active	METER/LEA	View Only	Target		
132	OAD FAULT	95	75	100	1	5	60	2	10	Active	HUMD or %	View Only	Lockout		90
133	NoHeatHiAmb	65	50	90	0	0	0	0	0	Non-Active	TEMP	View Only	Target		

6. Once OA Damper is open and the Supply Fan is running, the MCS-Magnum will monitor the OA Damper Feedback sensor and if it indicates the damper is not fully open for Y seconds, the unit is locked out, an “OAD Fault” alarm is generated and the Alarm Relay(if setup) is turned on. And the unit is not allowed to run again until a manual Lockout Reset is performed by a service technician. Where Y is the value of setpoint #132 **Time field.** (red box in screen clip below).



#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)
130	Reheat Adjust	1	1	8	1	10	15	0	0	Non-Active	HUMD or %	View Only	Delay		—	—
131	Hi CO2 Open	1365	500	2000	1	20	20	0	0	Non-Active	METER/LEA	View Only	Target		—	—
132	OAD FAULT	95	75	100	1	5	60	2	10	Active	HUMD or %	View Only	Lockout		90	0

4.4.2 NON-OUTSIDE AIR UNIT USING:

4.4.2.1. ECONOMIZER - provides free cooling

As an economizer the damper will be modulated to provide free cooling prior to any mechanical cooling steps being activated. Refer to setpoint #119 through #126 for settings.

119	EcoOffsetON	TARGET	If active the temperature differential to allow the outside air damper logic to run as an economizer will be the value of this set point. If inactive then the differential will be 2.0 degrees. The outside control temperature differential must be greater than the return control temperature to enable the economizer to be active. 1. If STP119 is setup as a target type and the setback value is not equal to zero then Differential is set equal to the value of STP119. setback, else Differential value is set equal to a hardcoded 1.0 2. Economizer ON -> if R/A temp is greater than O/A + STP119 value 3. Economizer OFF -> if R/A temp is less than (O/A temp + STP119. value – differential) Example: If return is 80 and ambient is 78 we will enable the economizer based on the value of setpoint 119 being 2.
120	Eco Stg Dely	SETPOINT	Once the economizer valve has been opened to its maximum and all fans associated only with it have been turned on, the economizer function will wait this time in seconds before the first condenser fan is turned on or VFD is set to its minimum position. The minimum setting of the VFD is the value of Setpoint #54 “CND MIN SPD”.
121	Economizer MIN VLV%	TARGET	Minimum Outside air damper (Economizer) Analog Output valve percentage. This will be the value used when first starting the econ-omizer function as well as the lowest level before turning off. This setpoint must be active to indicate that the Economizer AO option is active. This percent of opening must be maintained to version require-ments; only exception is in a smoke or fire situation then the opening goes to 0% If the system is in HEATING mode with Direct Fire Heating the Night Setback value will be added to the value of this setpoint to force the damper to be open. For example if the value is 10.0 and the Night Set back is 43.5 then the minimum damper opening when in Heating mode with direct fire heater will be 53.5%.
122	Economizer MAX VLV%	SETPOINT	Maximum Economizer Analog Output valve percentage.
123	Economizer MAX ADJ	SETPOINT	Maximum adjustment to the Economizer Analog Output valve percent-age with each calculation. Formula:[absolute value of(Target – current) * Multiplier setpoint #126] / Divisor setpoint #126
124	Economizer VFD Adjustment Delay	SETPOINT	Delay between Economizer Analog Output valve adjustments.

125	NOT USED		
126	Economizer MULT/ DIV	DELAY	Setpoint is used to scale adjustments to the Economizer Analog Output valve percentage. The difference between the control sensor and its target will be multiplied by this value and then divided by the value in the MAX VFD Adjustment cell.

1. Provides a minimum amount of outside air under normal operating conditions:
2. Refer to setpoint #121.
3. Ensure in-door air quality based upon the CO2 level; refer to setpoint #131, by maintaining a minimum opening if high CO2 exists.
4. Provide air flow based upon set point #127 by maintain a minimum opening to keep the flow with in it control zone.
5. Close economizer based on Low Ambient (Setpoint #192).

Note items 2, 3, & 4 provide a minimal opening for the damper.

4.4.2.1.1. Economizer ON/OFF

1. If STP119 is setup as a target type and the setback value is not equal to zero then Differential is set equal to the value of STP119.setback, else Differential value is set equal to a hardcoded 1.0
2. Economizer ON -> if R/A temp greater than O/A + STP119.value
3. Economizer OFF -> if R/A temp less than (O/A temp + STP119.value – differential)

If return is 80 and ambient is 78 we will enable the economizer based on the value of setpoint 119 being 2

When turning off say we have a 1 in the setback. 2-1=1 so we will disable the economizer when we are one degree apart.

4.4.3 C02 - INDOOR AIR QUALITY

Controlling indoor air quality using Outside Air Damper and or Supply Fan

131	CO2 opening	DELAY	If active and the CO2 level goes above the value of this setpoint than set the Outside Air Damper to the value in the (Min VFD Opening) Field. Note: If Setpoint #207 “CO2 High Min Damper opening” is active the value of this setpoint will be the minimum opening. (This is used when BMS wants to write/change the minimum opening.) Optional: modulating Outside Air Damper on High CO2 levels. The setpoint value will be the target along with the High Zone and Low Zone. The (Time (SEC)) Field is the delay between adjustments. Setpoint #207 “CO2 Modulating Multiplier/Divisor” value will be the multiplier and the MAX VFD ADJ will the divisor for the scaling of adjustment.

207	CO2 High Min Damper opening	SETPOINT	Set point usage if not 100% Outside Air unit. If the CO2 level is high, greater than value of setpoint #131 “CO2 Opening” the minimum opening of the outside air damper will be the value of this setpoint.

	CO2 Modulating Multiplier/Divisor	DELAY	Set point usage if modulating the Outside Air Damper on High CO2 Levels. The value will be the multiplier and the MAX VFD ADJ will be the divisor for the scaling of adjustment.

231	CO2 adjustments	DELAY	Set point only used when the supply fan is controlled on CO2. Value: Minimum adjustment to the value of set point #225. Safety time: Delay between adjustments to the value of set point #225. MAX ADJ: Maximum adjustment to the value of set point #225.
232	Supply Fan Cooling Limits	TARGET	Used when the supply fan is controlled on CO2. Provides the minimum and maximum settings for value of set point #225 when the unit is the cooling mode. Value: Minimum value setting of #225. High Zone: Maximum value setting of #225.
233	Supply Fan Heating Limits	TARGET	Used when the supply fan is controlled on CO2. The minimum and maximum settings for value of set point #225 when the unit is the heating mode. Value: Minimum value setting of #225. High Zone: Maximum value setting of #225.

4.4.4 Building Static Control

HIGH STATIC PRESSURE

When the supply fan is on, the duct static pressure will be tested for a high condition. If the duct static pressure is greater than the value of setpoint #149 for the safety time of this setpoint a HIGH STATIC pressure alarm message will be generated and the unit will be placed in a lockout condition. The system will attempt to restart if this setpoint is setup for auto restart.

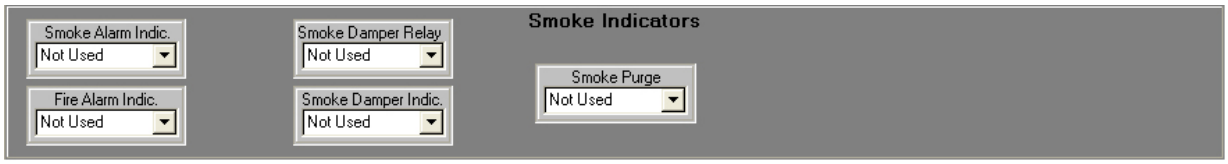
149	High Static PSI	Lockout	If the supply duct static pressure is greater than the value of this setpoint for the time in the safety time a high pressure alarm will be generated and the system will be locked out.

LOW STATIC PRESSURE

When the supply fan is on, the duct static pressure will be tested for a low condition. If the duct static pressure is less than the value of setpoint #146 for the safety time of this setpoint a low static pressure alarm message will be generated and the unit will be placed in a lockout condition. The system will attempt to restart if this setpoint is setup for auto restart.

146	Low Static PSI	Lockout	If the duct static pressure is less than the value of this setpoint for the time in the safety time a low pressure alarm will be generated and the system will be locked out.

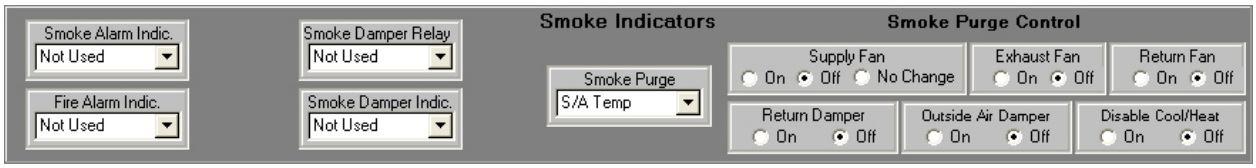
4.5. Smoke & Fire Alarm Indicators and Smoke Purge:



If either the smoke or fire alarm indicators, these are digital inputs are on the following action is taken:

1. Supply fan is off & at 0%.
1. Exhaust fan is off & at 0%,
1. Outside air damper is closed,
1. The RTU state is set to either “OFF SMOKE ALARM” or “OFF FIRE ALARM”,
1. The RTU & Cool states are set to either “OFF SMOKE ALARM” or “OFF FIRE ALARM”,
1. All cooling and heating stages are off.

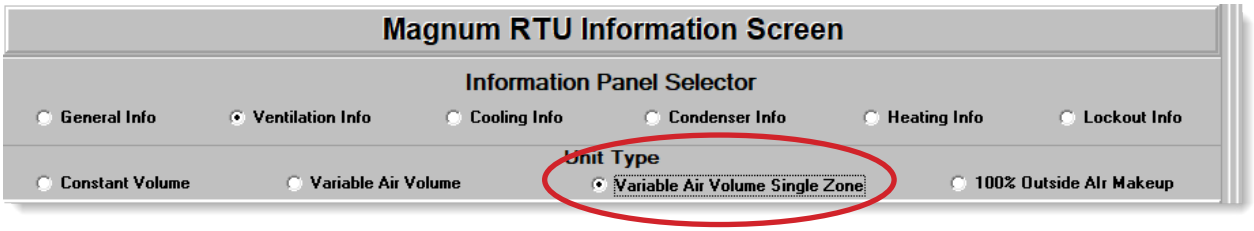
This indicates that a smoke or fire condition exists.



If the Smoke Purge is indicated, this is a digital input and it is on the following action is taken.

1. If the Cool/Heat state is not either “OFF SMOKE ALARM” or “OFF FIRE ALARM”, the Cool/Heat state will be change to “OFF SMOKE ALARM”. All cooling stages will be turned off and then the RTU state will be set to “SMOKE PURGE”, if off there is no change to mode and supply fan will be controlled on static pressure.
1. Supply fan is on & at 100%, off & at 0%, or no change & supply fan is controlled by static pressure based upon selection in the Smoke Purge Control

4.6. SINGLE ZONE VAV SUPPORT



Purpose is to control the supply fan VFD% based upon the Fan Only Mode controlling sensor (which should be the zone (space) temperature for single zone VAV applications

The Single Zone VAV will modulate the supply fan VFD to maintain the zone (space) cooling enable or heating enable set point while the unit’s cooling/heating source is modulating to maintain the appropriate supply air set point.

1. Under Unit Type select the Variable Air Volume Single Zone option.
2. Set point #225 must be a SETPOINT type.

USE THE FOLLOWING SET POINTS:

131	CO2 opening	SETPOINT	Provides the maximum CO2 value. Value Maximum CO2 value.

207	CO2 High Min Damper opening	DELAY	Fine tune the amount of adjustment, control sensor value minus value of set point #219. The value will be the multiplier and the MAXVFD ADJ will be the divisor for the scaling of adjustment.
218	Enable cooling mode	TARGET	This set point will be used when the unit is not in heating mode. Temperature zone is created using the value and the high zone value for + -.
219	Enable heating mode	TARGET	This setpoint value will be used when the unit is in heating mode. Temperature zone is created using the value and the high and low zones.
225	Supply Fan Speed	SETPOINT	This setpoint value will be modified to the Supply Fan VFD%. The Supply Fan VFD analog output will be set to this set point value. The value shown is the calculated/adjusted supply fan speed. Value is the output in Vent Mode.
231	CO2 adjustments	TARGET	Provides the minimum and mazimum Supply Fan VFD% adjustments, delay between adjustments. Value: Minimum adjustment to Supply Fan VFD% allowed. Safety Time: Delay between adjustments to the Supply Fan VFD%. High Zone: Maximum adjustment to Supply Fan VFD% allowed.
232	Supply Fan Cooling Limits	TARGET	The values of this setpoint are used when the unit is cooling or fan only modes. Value: Minimum Supply FanVFD% setting when the unit is cooling or fan only modes & CO2 is not high. High Zone: Maximum Supply FanVFD% setting when the unit is cooling or fan only modes. Low Zone: Minimum Supply FanVFD% setting when CO2 is high regardless of mode.
233	Supply Fan Heating Limits	TARGET	The values of this setpoint are used when the unit is in heating mode. Used when the supply fan is controlled on CO2. The minimum and maximum settings for value of set point #225 when the unit is the heating mode. Value: Minimum value setting of #225. High Zone: Maximum value setting of #225.

1. Controlling temperature sensor is the sensor selected as the zone temp under the fan only mode in the general info screen.

Processing Steps:

1. Delay between Supply Fan VFD% adjustments is based on safety time of set point #231.
1. Calculate Supply Fan VFD% adjustment:
   Adjustment = control temperature - the value of the enable set point (if in heating then #219 else #218}. This value is fine-tuned with values of set point #207 and limited by values of set point #231.
1. If not in heating mode: Set point #218 will be used to create the control zone and set point #232 will be used

when modulating the supply fan VFD.

If the control temperature is above the control zone then the temperature is too warm increase the fan speed by the adjustment value.

If the control temperature is above the control target and below top of the control zone then the temperature is acceptable, no change to the fan speed is required.

If the control temperature is below the control zone then the temperature is too cold decrease the fan speed by the adjustment value.

The minimum & maximum Supply Fan VFD% will be blocked with set point #232.

1. If in heating mode: Set point #219 will be used to create the control zone and set point #233 will be used when modulating the supply fan VFD.

   If the control temperature is above the control zone then the temperature is too cold decrease the fan speed by the adjustment value.

   If the control temperature is below the control target and above the bottom of the control zone then the temperature is acceptable, no change to the fan speed is required.

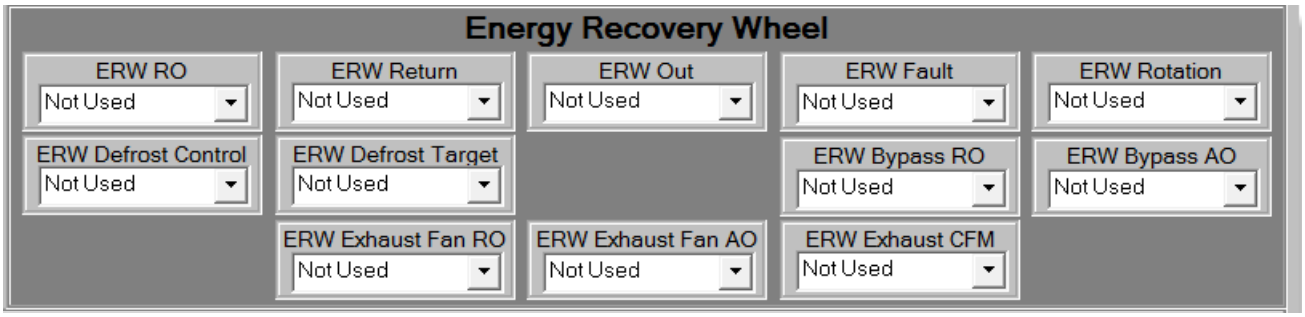
   If the control temperature is below the control zone then the temperature is too warm increase the fan speed by the adjustment value.

   The minimum & maximum fan speed will be blocked with set point #233.

   When in Vent Mode, set the speed to the value in setpoint #225.

2. If high CO2 then the minimum fan speed will be value in Low Zone cell of #232.

4.7. ENERGY RECOVERY WHEEL (ERW) WHEEL



Energy Recovery Wheel status is display both on the MCS Magnum display and by MCS Connect.

4.7.1 The Energy Recovery Wheel (ERW) setup requires:

1. ER Wheel RO cell points to the relay that will control the ER wheel. When the ER wheel is called to be on, rotating, this relay will be turned on. The Min Run-Time (SEC) cell in the Relay Output Information Screen for this relay contains the time between defrost cycles if required.
1. ER Wheel Return air cell points to the sensor input of the return control sensor.
1. ER Wheel Outside air cell points to the sensor input of the outside control sensor.
1. ER Wheel Rotation, if used this is a digital input that when on indicates that there is no wheel rotation.
1. ER Wheel Fault, if used this is a digital input that when on indicates that a fault has occurred with the heat wheel. If a fault occurs an alarm message will be generated. There will be no interruption to the unit processing.
1. ER Wheel Exhaust Fan RO, if used this relay will be turned on when the ER wheel is active.
1. ER Wheel Exhaust Fan AO, if used this analog output will be set to 100% when the ER wheel is active else it will be set to 0% opening.

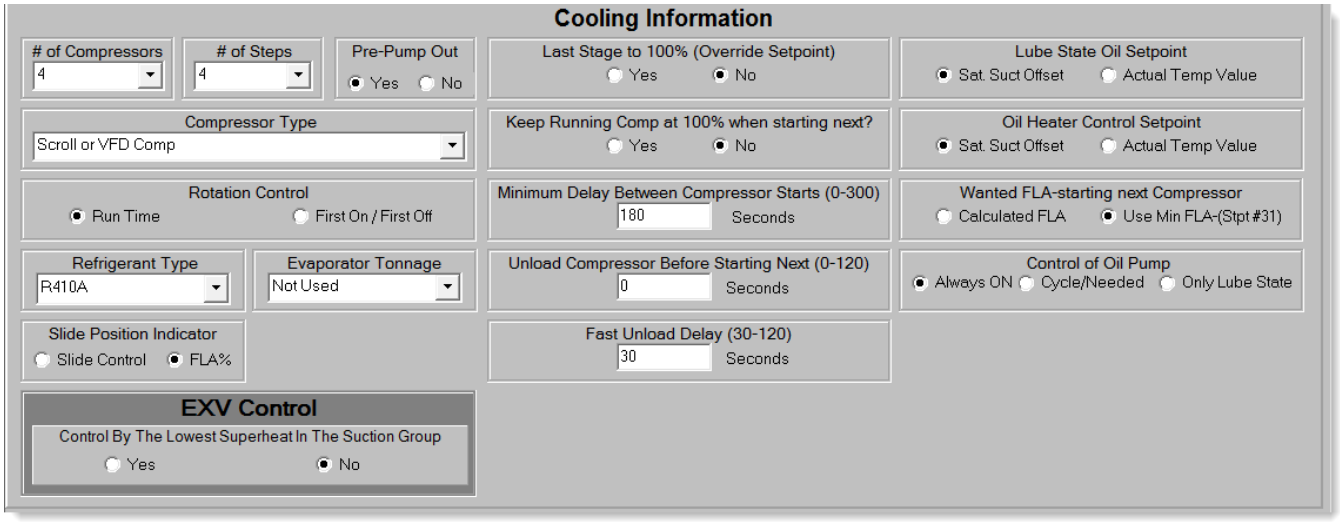
Setpoint #228, H-WHEEL Defrost, the value of this setpoint controls when a defrost cycle is enabled. If the wheel is on and the ambient temperature is less than this value then a defrost cycle is initialized.

4.7.2 Energy Recovery Wheel (ERW) control logic:

1. The ER wheel cannot be enabled if the Unit State is EVAP FAN ONLY or the Cooling State is ECONOMIZ-ER ONLY.
2. If in Cooling or Dehumid Mode and the ER Wheel Return sensor temperature is less than the ER Wheel Out sensor temperature the ER Wheel relay will be turned on.
3. If in Heating Mode and the ER Wheel Return sensor temperature is greater than the ER Wheel Out sensor temperature the ER Wheel relay will be turned on.
4. Defrost cycle; if the heat wheel relay has been on for a time greater than the value in the Min Run Time(SEC) cell and the ambient temperature is less than the value of setpoint #228 a defrost cycle will be initiated. The ER wheel relay will be turned off and the ER wheel state will be set to DEFST and the state timer reset. The defrost cycle will be terminated when the state timer is greater than the safety time of setpoint #228. At this point the ER wheel state will be changed to ON, the ER wheel relay will be turned on, and the state timer reset.
5. An information message will be generated if the ER wheel relay is on and either ER Wheel Rotation 1 or Heat Wheel Rotation 2 digital inputs are on.

Chapter - 5. Cooling Information

5.1. Selecting Cooling Info Button



The compressor type is selected from a drop down list in the Cooling Information panel on the Magnum RTU screen.

- Reciprocating Compressor with Oil
- Reciprocating Compressor without Oil
- Screw Compressor with Oil
- Scroll Compressor
- Hanbell-Load NO (load solenoid wired to normal open) Screw Compressor
- Hanbell-Load NC (load solenoid wired to normal close) Screw Compressor
- Hanbell- 3 Solenoid (50-100%) (not variable but 3 fixed step screw) Screw Compressor
- Hanbell- Step (fixed step) Screw Compressor
- Hitachi Screw Compressor
- Bitzer Screw Compressor
- Hartford Screw Compressor
- Carlyle Screw Compressor
- Centrifugal Compressor
- Mitsubishi Screw Compressor
- TurboCor Compressor
- Trane Screw Compressor
- McQuay Frame 4
- Fu Sheng Compressor
- Trane Trio
- Trane Quad

5.2. Energy Efficient Compressor Staging

In a multi-screw system, it may be more efficient to run the screws at less than 100% capacity until all compressors have been turned on.

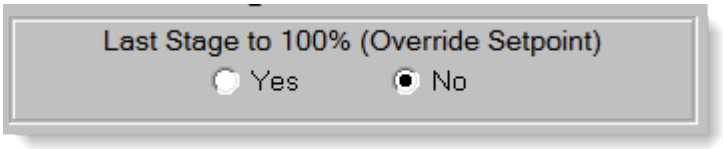
The following setpoints are used to control the screw compressor staging:

- Setpoint #30 “MAX SLIDE %” contains the maximum slide percentage, based upon amp draw before the system will bring on the next compressor.
- Setpoint #31 “MIN SLIDE %” contains the minimum slide percentage, based upon amp draw, before the system will reduce the number of compressors wanted on.

  For example if “MAX SLIDE %” is 80% and the “MIN SLIDE %“ is 40%, the two-screw compressor system would be ramped up as follows:

  The Lead compressor will be started at 40% and increased up to 80%. If more capacity is needed the next compressor will be started at 40% and the first compressor decreased to 40%. The two compressors will then have their slide positions changed together. Since there are only two compressors, they will be ramped together up to 100% if required. If both compressors are at 40% and less capacity is needed, one compressor will be turned off and the other increased to 80%.

  If running compressors at 100% is not desired, then the “Last Stage to 100% (Override Setpoint)” cell in the Cooling Information panel of the Magnum RTU screen should be set to ‘No’. Then the maximum capacity allowed will be the value in setpoint #30. If ‘Yes’, then all compressors will load to the value in setpoint #30 until all compressors are on, then they will load to 100% together.



5.3. Expanded Compressor Rotation to Check for Maximum Run Time

In the Cooling Information panel of the Magnum RTU screen in MCS-Config, there is now a check box to select how compressors are to be rotated, based either on Run Time or First On/First Off.

Screw, centrifugal, and compressors with external oil pumps all use this state. This state is used to ensure proper oil flow prior to compressor startup. Options that affect this state are setup in Cooling Information button under the Magnum RTU screen and in the Setpoints screen:

In this state the following Relay Outputs, if present, are set as follows:

1. Compressor relay(s) are OFF.
2. Oil pump is ON.
3. If suction group running is either 1 or 2 the hot gas solenoid is OFF.
4. Fast unloader is ON.
5. First 120 seconds or until the unload switch is ON the unloader is ON else it is OFF.
6. Loader is OFF.
7. VI increase and decrease are OFF.
8. Start unloader is OFF.
9. Low discharge superheat relay is OFF.
10. All liquid line solenoids are OFF.
11. Oil equalization relay is ON.
12. All unloaders are OFF if they are load type else they are ON.
13. All turbo ice relays are off.
14. Oil heater is controlled to maintain oil temperature.

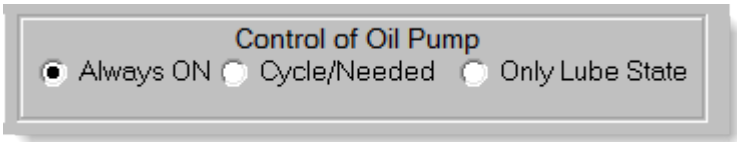
All of the following conditions must be met within the time allowed in setpoint #41 “LUBE DELAY”. If the compressor type is centrifugal an additional 10 seconds will be allowed for these conditions to be met.

1. Oil differential must be equal to or greater than the value in setpoint #40 “LUBE OIL PSI”. If this setpoint is not active this test is bypassed.
2. Oil temperature must be equal to or greater than the calculated oil temperature target. If setpoint #39 “LUBE OIL TEMP” is not active this test is bypassed. If the compressor type is centrifugal and the option to use the saturated temperature is indicated, then the value of the saturated temperature will be added to setpoint #39 “LUBE OIL TEMP”, else the value of setpoint #39 will be used by itself as the calculated oil temperature target.
3. The compressor must be unloaded. If there is an unloaded indicator it must be on. If it is a centrifugal compressor, it is forced to stay in this state for minimum of 15 seconds. If the compressor has no unloaded indicator it must stay in this state for a minimum of 10 seconds less than setpoint #41 “LUBE DELAY”.

If all of these conditions are met within the allotted time, the compressor will move to another state.

5.4. Oil Pump Control Option

The Magnum supports 3 different types of oil pump control. This option is selected in in the ‘Control of Oil Pump’ box in the ‘Cooling Information’ panel under the Magnum RTU screen.



- OIL PUMP ALWAYS ON – The oil pump will start before the compressor to build up oil pressure and will always be on when the associated compressor is on. If the oil pressure drops below setpoint #74 “OIL PUMP OFF”, then shut down the associated compressor and generate a LOW DIFFERENTIAL alarm. The oil pump will continue running after the compressor is turned off regardless of the reason, for the time specified in setpoint #62 “PUMP DOWN DELAY”.
- OIL PUMP CYCLES AS NEEDED – After the compressor has been running for 2 minutes and when the differential pressure (discharge pressure minus suction pressure) is greater than

  setpoint #74 “OIL PUMP OFF”, then the oil pump will be turned off. If the differential pressure drops 10 PSI below the value of setpoint #74, then the oil pump will be turned on again.
- OIL PUMP LUBE ONLY – After the compressor has been running for 2 minutes and when the differential pressure (discharge pressure minus the suction pressure) is greater than setpoint #74 “OIL PUMP OFF”, then the oil pump will be turned off. If the differential pressure has not reached setpoint #74 after 5 minutes, then shut down the associated compressor and generate a LOW DIFFERENTIAL alarm. If the differential pressure has been reached and the oil pump turned off, then if the differential pressure drops 5 psi below the value of setpoint #74, shut down the associated compressor and generate a LOW DIFFERENTIAL alarm.

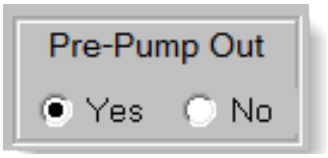
If a fixed step compressor with an external oil pump the state will either be UNLOADED or LOADED, depending if there are multiple compressor steps.

If a variable step compressor, then the percentage wanted on will be checked. If it is less than setpoint #31 “MIN SLIDE %”, or option “Use Min FLA” has been selected, the percentage wanted will be set to the value in setpoint #31 “MIN SLIDE %” and the state will be set to HOLDING.

Any associated EXV will be adjusted to allow for additional capacity.

If the compressor does not meet all of the conditions it will be LOCKED OUT and an error message will be generated indicating the reason for the failure: pressure, temperature or time.

5.4.1 PRE-PUMP OUT

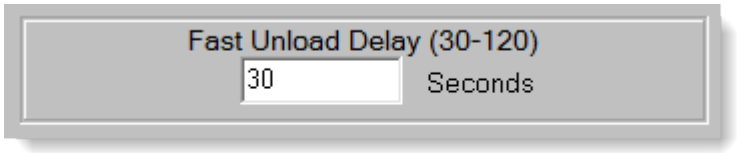


This state is only entered if the defrost type is any condition other than NONE. Hot gas will be used to perform the defrosting. This is selected in Cooling Information button under the Magnum RTU screen. When a defrost cycle begins this state is entered and an alarm message is generated. The liquid line solenoid will be closed and the compressor will remain in this state and continue running until the suction pressure is less

than setpoint #61"PMP DWN OFF" or the time in this state is greater than setpoint #62 "PMP DWN DELY". The compressor will then move to the DEFROSTING state.

5.5. FAST UNLOADING

For screw compressors only, this state is entered when the compressor is turned on. All load solenoids will be turned off and all unload solenoids will be turned on to ensure the screw is fully unloaded. If an oil pump is included in the system it will be turned on during this state. The time in this state is set in the "Fast Unload Delay" cell under the Cooling Information button in the Magnum RTU screen.



5.6. MCS-Magnum Oil Recovery Logic - Tandem Variable Speed & Fix Speed scroll compressor

MCS-Magnum Firmware: RTU 17.34X or greater is required

MCS-Connect version: 18.20.XX Beta or greater is required

MCS-Config version: 18.01X or greater is required

NOTE: Cannot have oil recovery logic and title 24 logic and subcooler exv logic together.

5.6.1 Purpose:

The purpose of the oil recovery logic is to return oil to the variable speed scroll compressor on a tandem refrigeration circuit where there is one variable speed compressor and one fix speed compressor. This logic only works for above compressor setup. No other compressor arrangement is supported, ie. screw compressors, reciprocating compressors, or more than 2 scroll compressors (trios, quads), etc.

If the variable speed compressor runs at low speed for a long period of time it possible the oil in the compressor sump will become too low. Too low of oil condition is indicated by the oil level switch in the variable speed compressor's oil sump. When the variable speed compressor is running and the oil level switch indicates a low condition the MCS-Magnum will enter into the oil recovery logic to collect the oil back into the variable speed oil sump and avoid tripping the compressor on low oil level.

5.6.2 Requirements:

1. Tandem Scroll Compressors, one variable speed and the other fix speed.
1. Variable speed compressor must have an oil sump level switch.
1. MCS-Magnum Config must be setup as follows:
    a. Setpoints #251 to #255 must be setup

Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint
250	SETPOINT-250	0	0	0	0	0	0	0	0	Non-Active	Spare	View Only	Setpoint
251	OilRecSpeed	100	50	100	1	5	15	0	0	Active	HUMD or %	View Only	Delay
252	OilRecMaxBal	30	10	240	1	0	0	2	10	Active	SECONDS	View Only	Alarm
253	ToManyOilBal	1	1	20	1	0	0	2	10	Active	MINUTES	View Only	Alarm
254	OilRecMaxBst	2	1	20	1	0	0	2	10	Active	MINUTES	View Only	Alarm
255	ToManyOilBst	45	1	120	1	0	0	2	10	Active	MINUTES	View Only	Lockout

b. Variable Speed Compressor must be configured with Oil Level Switch sensor input.

MAGNUM Circuit SI Screen

Circuit # (reset button)	Suction Pressure	Discharge Pressure	Suction Temperature	Discharge Temperature	Oil Pressure	Oil Temp	Motor Temp	Oil Flow Switch	Liquid Temp
1	Suct Psi A	Disc Psi A	Suct Tmp A	Disc Tmp A	Disc Psi A	Not Used	Mtr Flt 1A	Not Used	Not Used
2	Suct Psi B	Disc Psi B	Suct Tmp B	Disc Tmp B	Disc Psi B	Not Used	Mtr Flt 3B	Not Used	Not Used
3	Suct Psi A	Disc Psi A	Suct Tmp A	Disc Tmp A	Disc Psi A	Not Used	Mtr Flt 2A	Not Used	Not Used
4	Suct Psi B	Disc Psi B	Suct Tmp B	Disc Tmp B	Disc Psi B	Not Used	Mtr Flt 4B	Not Used	Not Used
5	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
6	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
7	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
8	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
9	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
10	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

Circuit # (reset button)	Oil Seal Temp	Pre Oil Filter	Oil Float	Leaving Temp	Refrigerant Temp	Refrig. Leak Sensor	Vane Position	Evap Suct Temp	Evap Suct PSI
1	Not Used	Not Used	Oil Lvl 1A	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
2	Not Used	Not Used	Oil Lvl 3B	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

5.6.3 Primary/Secondary Tandem Scroll Option:

If Setpoint #251 TYPE field is setup as “DELAY”, then the Fix Speed compressor is only allowed to run if the variable speed compressor can run. If the speed compressor is locked out or disabled, the fix speed compressor will be force in the “VFD TANDEM OFF” state and not allowed to run. It is recommended to enable this option.

If setpoint #251 TYPE field is not a “DELAY” type, then the fixed speed compressor can run without the variable speed compressor.

5.6.3.1. Oil Recovery Logic:

The oil recovery logic has two modes, Balance and Boost.

5.6.3.2. Balance Mode:

In Balance mode the variable speed compressor speed is set to the value in setpoint #251 “OilRecSpeed” and the fix speed compressor stay off or is forced off. In this mode the variable speed compressor speed is increased to pull oil from the fixed speed compressor oil sump. The variable speed compressor state is set to "OIL REC SPD UP". If the fixed compressor was running, it state is set to "OIL REC OFF". If the fixed speed compressor is not running, it will stay in its current state.

The balance mode is entered when the oil level sensor input has tripped for X seconds. X is defined by the time field in setpoint #251. This indicate the level in the oil sump is low and we need to recovery the oil.

Whn entering the Balance mode, a check is performed to see if time since the last oil recovery action has been too short, indication an issue with the oil or system. If the time of Y (setpoint #255 value) since the boost mode occurred has not passed the compressors are locked out and the alarm “ToManyOilBst” (Too Many Oil Boost actions) is generated. If the time of X min (setpoint #253 value) since the last oil recovery balance mode occurred, the Balance mode is skip and logic goes right to the boost mode. If setpoint #253 is an alarm type, an alarm “ToManyOilBal” (Too Many Oil Balance Actions) is generated.

5.6.3.3. The balance mode is stopped when:

a. The oil level sensor input reads OK indicating oil has been recovery to the sump and level is good or,

b. Time delay specified in setpoint #252 “OilRecMaxBal” value field has been exceeded. If this condition occurs, the oil recovery logic goes to boost mode, or

c. Run/Stop or flow, etc. wants the unit off, or

d. Compressor safety trip occurs.

5.6.3.4. Boost Mode:

In Boost mode the variable speed compressor speed is set to the value in setpoint #251 “OilRecSpeed” and the fix speed compressor is forced on. In this mode both compressors are run to pull the oil back from the refrigeration circuit. Both compressor’s states are set to "OIL REC BOOST ".

The Boost mode is entered when the balance mode did not clear the low oil condition (balance mode max time delay excess before oil level sensor indicator good oil sump level).

The Boost Mode is stopped when:

a. The oil level sensor input reads OK indicating oil has been recovery to the sump and level is good or,

b. Time delay specified in setpoint #254 “OilRecMaxBst” value field has been exceeded. If this condition occurs, both compressors are locked out and an “OilRecMaxBst” alarm is generated, or

c. Run/Stop or flow, etc. wants the unit off, or

d. Compressor safety trip occurs.

5.7. Setpoint #139 Low Oil Level Safety

With oil recovery logic active this setpoint will now be ignored IF a compressor with a VFD has an Oil level. The oil recovery logic will take over and control the compressor and lock it out if necessary.

If a compressor that is fixed speed (On/Off) with an oil level then setpoint #139 will be used to control the low oil level safety and ignore the oil recovery logic.

If all compressors in the config file are VFD compressors with oil levels and none of the fixed compressors have oil levels than please make setpoint #139 inactive as it serves no purpose.

5.7.1 Setpoint Descriptions Only

#251 – OilRecSpeed – HUMD or % - If setup as “Delay type” Fixed compressor cannot run without the vfd tandem. If not setup as a delay type the fixed compressor will be able to run without the vfd compressor being available.

Value – Speed in % to move the compressor to during an oil balance/boost

Time – Amount of time to wait in seconds after oil level is tripped before entering balance/boost

#252 – OilRecMaxBal – SECONDS - Alarm Type

Value – Max time allowed in seconds to stay in balance mode before moving onto Boost mode

#253 – ToManyOilBal – MINUTES – Alarm Type

Value – If an oil balance occurs twice within this time frame an alarm will be posted and the balance mode will be skipped and will be sent straight to a boost mode.

#254 – OilRecMaxBst – MINUTES – Alarm Type

Value – Max time allowed in minutes to stay in the boost mode before locking out that circuit on an alarm.

#255 – ToManyOilBst – MINUTES – Alarm Type

Value – If an oil boost occurs twice within this time frame an alarm will be posted and the circuit will be locked out.

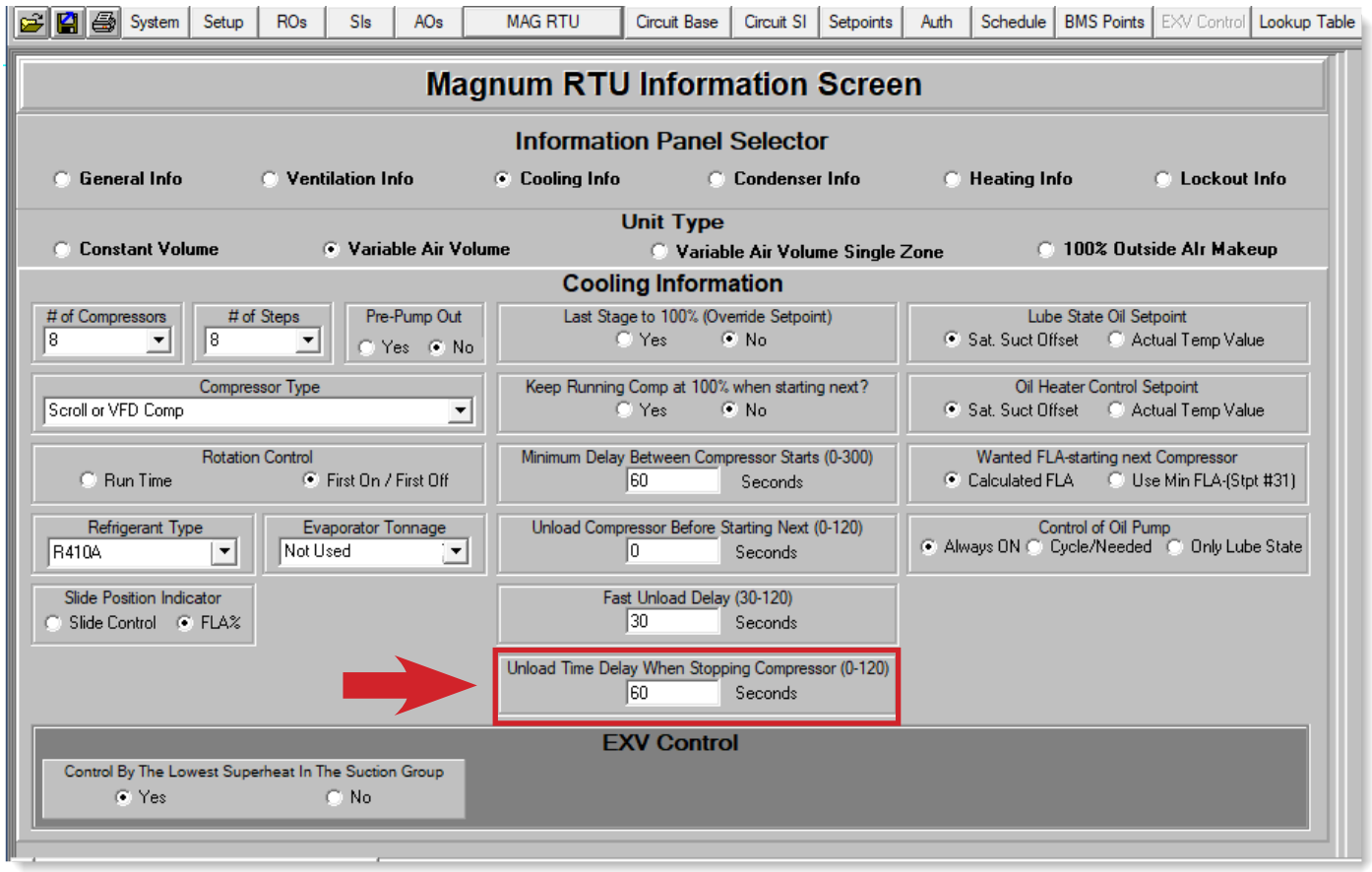
5.8. UNLOAD DELAY- RECIP/VFD COMPRESSORS

Config Version: 18.01Y or later

On the MAGNUM HVAC/RTU compressor screen, a new cell was added for setting the unload delay before pumpdown. If there's a value greater than "0" in this cell, the logic will enter the "Unload&PumpDown" state when calling for the compressor to shut down. In this state, it will wait the amount of time in that cell, before closing the LLS & or Closing the EXV to perform the normal pumpdown operation.

5.9. EMERGENCY STOP RELAY - CIRCUIT BASE

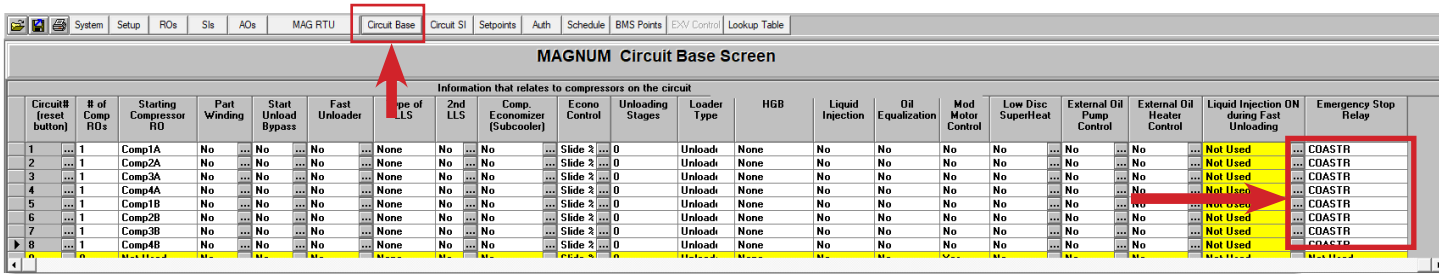
Config Version: 18.01Y or later



New logic for "Coast" relay on Bitzer VFD compressors has been added to the Circuit Base on HVAC/RTU firmware.

This allows the ability to point to a relay, that will be activated whenever that circuit is in alarm, OR the unit is in safety shutdown due to Phaseloss, Emg/Stop, etc.

Point to the relay as shown below in the Emergency Stop Relay box. (This relay is not a part of the compressor sequence and can be located on any wired point.)



Chapter - 6. Dehumidification Section (Condenser Info):

The dehumidification function will only be active if neither cooling nor heating is required and the sensor specified for 'Dehumid Mode" is above the value in setpoint #220.

Effective with version 18.03.01 release, a new option was added for controlling Dehumidification with MCS-RTU firmware, **'Stage compressors On and Off by controlling sensor'.**

220	Enable dehumidification mode	TARGET	If the 'Forced Dehumidifying' sensor is not used this set point will enable dehumidification mode when the control humidity is above this value and the dehumidify option is primary or the unit is in VENT ONLY mode. Once in the Dehumidify Mode the humidity must drop below this value minus the Low Zone offset. Value: Enable dehumidification value. High Zone: Not used Low Zone: Differential humidity to exit the Dehumidify Mode. Night Setback: Will adjust the dehumidify enable value if system is in the unoccupied mode.

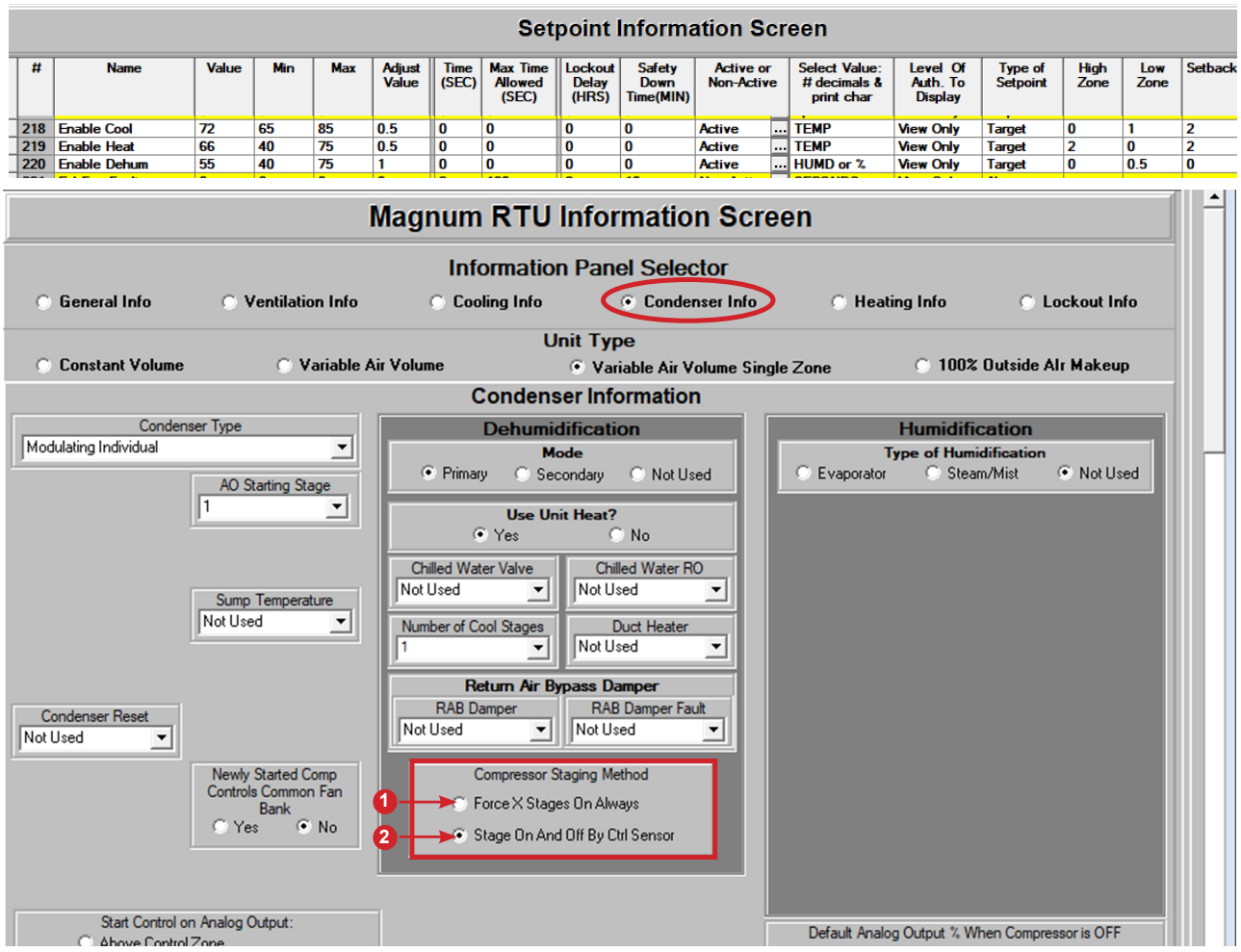
6.1. 'Force X on (old way)' Specify compressor staging method.

Uses Sensor for "Forced Dehumidifying"

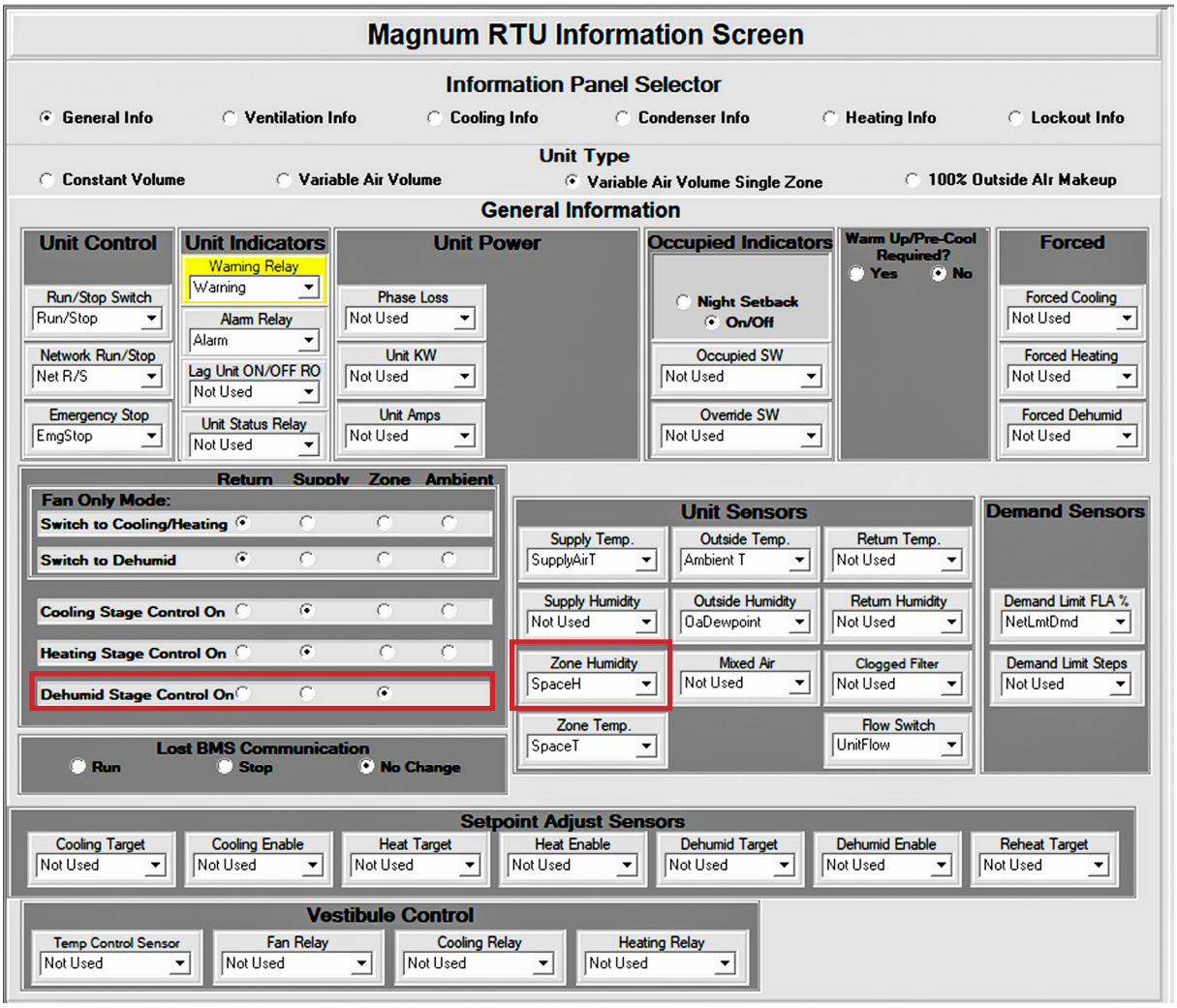
6.2. 'Stage On and Off by Control Sensor'

Specify which sensor to stage the compressor on/off when in dehumid mode.

6.2.1 Setpoints for Dehumid 'Stage On and Off by Control Sensor'



Dehumidification Section (Condenser Info) continued

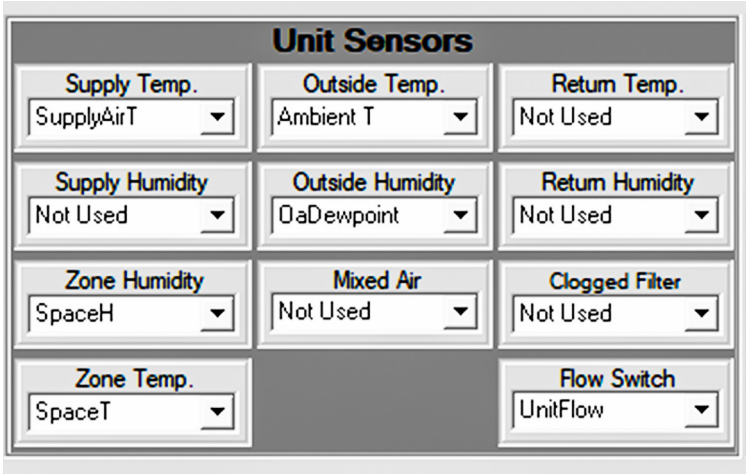


If neither cooling nor heating is required the RTU will be Ventilation Only. From this mode the system can enter a dehumidification mode if the humidity is greater than setpoint #220 or if the Forced Dehumidifying is used and it is on. If the system is moving from the cooling mode to the ventilation only mode and dehumidification is required, the system will not turn off any cooling stages that have been turned on.

6.3. Unit Sensors

The set of sensors for Supply, Ambient, Return and Zone sensors are used in the control logic as indicated in the Control 'Mode On' section as shown above.

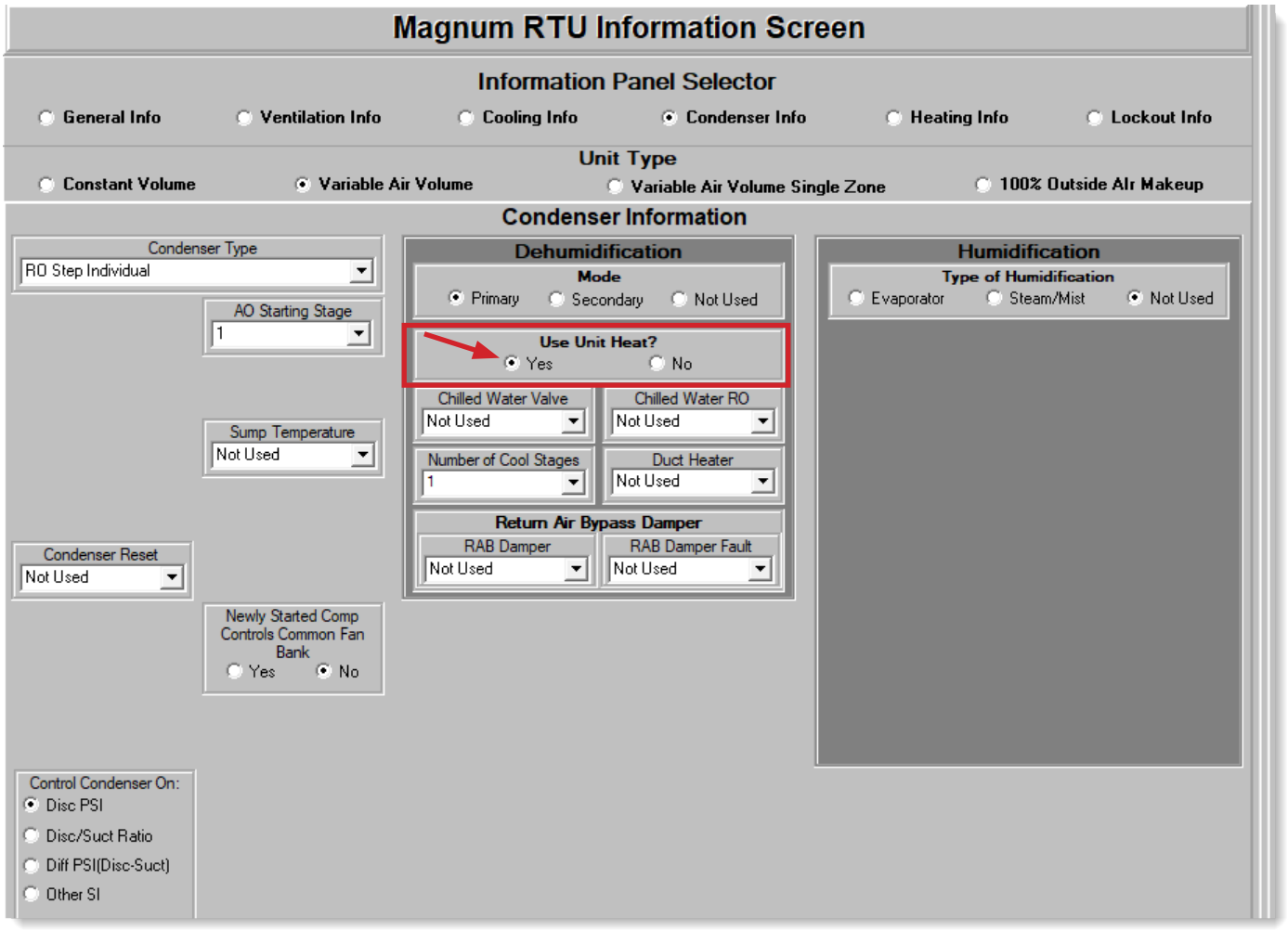
Flow Switch if used, this digital input must indicate that there is flow or the unit will be turned off due to no flow.



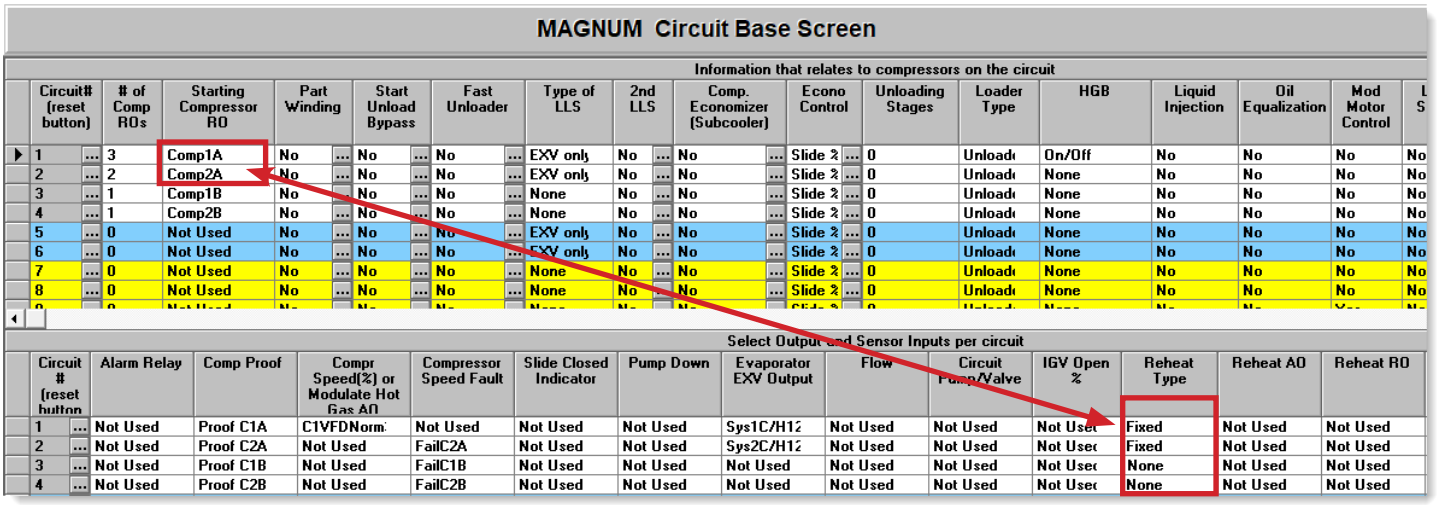
Chapter - 7. Electric Heat For Reheat In Dehumidification

Config Firmware Version 17.62S and above

Two fields need to be set in the config. Only compressors that are allowed to run are those setup with Reheat type. Decide which compressors run in Reheat Mode with electric heat.

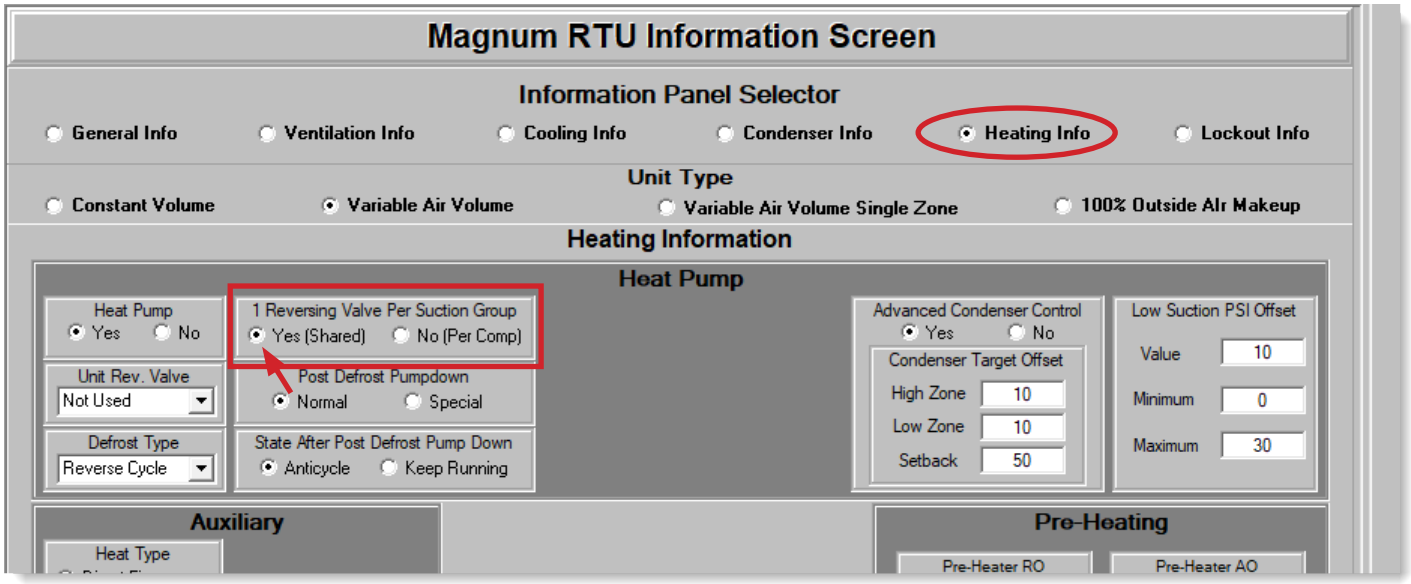


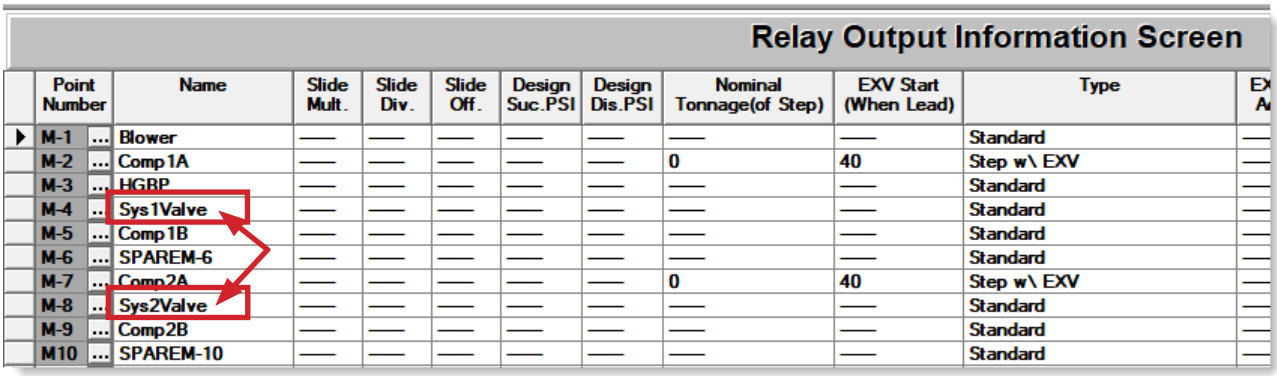
In below example cmp 1A and cmp2A has reheat type set as **"Fixed"** so these are the only compressors allowed to run in dehumidification mode. If you want all compressors to run then set all reheat types to fixed.



7.1. Heat pump Units

You can now have one reverse valve relay output per suction group. Before the only two options were, reverse valve relay for the whole unit or reverse valve relay for each compressor circuit. Now the third option allows reverse valve per suction group, ire tandem compressor share reverse valve relay.





Point Number	Name	Slide Mult.	Slide Div.	Slide Off.	Design Suc.PSI	Design Dis.PSI	Nominal Tonnage(of Step)	EXV Start (When Lead)	Type	EX A
M-1	Blower	——	——	——	——	——	——	——	Standard	——
M-2	Comp1A	——	——	——	——	——	0	40	Step w\ EXV	——
M-3	HGBP	——	——	——	——	——	——	——	Standard	——
M-4	Sys1Valve	——	——	——	——	——	——	——	Standard	——
M-5	Comp1B	——	——	——	——	——	——	——	Standard	——
M-6	SPAREM-6	——	——	——	——	——	——	——	Standard	——
M-7	Comp2A	——	——	——	——	——	0	40	Step w\ EXV	——
M-8	Sys2Valve	——	——	——	——	——	——	——	Standard	——
M-9	Comp2B	——	——	——	——	——	——	——	Standard	——
M10	SPAREM-10	——	——	——	——	——	——	——	Standard	——

3. For Heat pump units – Setpoint #159 controls what type of Post Defrost Pump down logic is performed. If setpoint #159 “TYPE” field is not equal to “TARGET” type a special post def pump down logic is performed.

Special Post Def pump down works as follows:

a. Compressor relays are turned off for X time (X is the value of setpoint #62 “Pmp Dwn Dely”.

b. Reverse Valve relay is on for the first 10 seconds, then it turned off.

c. After the pump down time delay:

* Compressor relays comes back on.

*If VFD cmp speed goes to 30% (or setpoint #158 low zone – if #158 is a “Target” type)

*After 10 seconds compressor speed goes to 50% (or setpoint #158 setback value).

*After 25 seconds compressor state goes back to normal – recip comp goes back to state prior to defrost, system go to holding.

Normal Post Pump down works as follows:

Liquid line solenoid relays are closed, EXV off and compressor pumps down, Once pump down suction pressure value is reached, or max time delay, the compressor:

a. if setpoint #162 (new feature just added) is a “Target” type the compressor goes to anti-cycle.

b. else compressor goes back to run state.

4. For Tandem or Trio compressor (multi compressor on same suction group) forced all compressors running into defrost state, once one compressor wants to defrost. And if compressor in suction group is off, do not allow it to start. Wait for the defrost to finish before stating any more compressor on the suction group.
5. If compressor was in defrost state and run/stop was placed in the stop mode, the defrost would have to finished before the compressor would stop. Now the defrost is stopped and the compressor will go off quickly.

158	DEF TRIG TMP	SETPOINT	If a defrost option has been specified and either coil #1 or coil #2 temperature is less than or equal to this setpoint a defrost cycle will be started if sufficient time has elapsed since the last defrost.
159	DEF TRIG CYC	SETPOINT	Target - If the setpoint type = " TARGET" type, then normal post defrost pump down occurs, else if = "TARGET" type then special post def pump down is perform. The comp is turned off for time setup in the setpoint #62 "Pmp Dwn Dlay" value field and Cmp VFD spd is set to 30% for 10 second, then 50% for 15 seconds, then cmp is set back to normal operation.
162	DEF TERM DEL	SETPOINT	The length of time in minutes of the defrost cycle. Target - If the setpoint type = 'Target' type, the comp goes to anticycle

Chapter - 8. Humidification Section (Condenser Info):

The humidification function is selected in the Condenser Info window. Its purpose is to add humidity to an area. Types of humidification are Not Used, Evaporator or Steam/Mist. .

Setpoints:

If humidification function is active then set points #35, #36, #134. #135 #189 are used.

35	Humidity Target	TARGET	Required if Humidity option is specified as other than 'Not Used'. Value: Humidity target. Safety time: Not used High zone: added to value to create the top of zone. Lo zone: subtracted from value to create the bottom of zone. Night setback: if the control value is greater than the value plus the night setback, the humidity control will be off.
36	Humidity Adjustment	DELAY	Required if Humidity option is specified as other than 'Not Used'. Value: Maximum adjustment to humidifier valve. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening.
134	Humidity Damper Target	TARGET	Required if Humidity option is specified as other than 'Not Used' and a damper has been specified. Value: Humidity Damper target. Safety time: Not used High zone: added to value to create the top of zone. Lo zone: subtracted from value to create the bottom of zone. Night setback: Not used.

135	Humidity Damper Adjustment	DELAY	Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
189	Humidification Fault	ALARM	Used for alarm message when the humidification sensor fault has been on for a time greater than the value in the safety time cell. This alarm will not generate a lockout or turn off any of the humidification points.

.

8.1. Type of Humidification

Specify the type of humidification:

Evaporator can be active in any mode.

Steam/Mist, can only be active in either Vent Only or Heating mode.

Not Used, no humidification is available.

8.2. Control with Cooling

These options are only available with Evaporator type of humidification is selected. They have not been implemented at this time. If Evaporator type is selected then humidification can be active with all stages of cooling.

8.3. Humidification Control

Specify control information:

Enable RO, this relay will be turned on if humidification is active.

MOD Valve AO, if VFD is to be modulated, select analog output.

Humidification Fault SI, fault indicator must be a digital input.

Control Humidification SI, sensor that will determine if humidification is needed.

8.4. Damper Control

If a damper is associated with the humidification function specify control information:

Damper RO, damper relay is not used.

Number of Damper RO's, not implemented.

Damper AO, if VFD is to be modulated, select analog output.

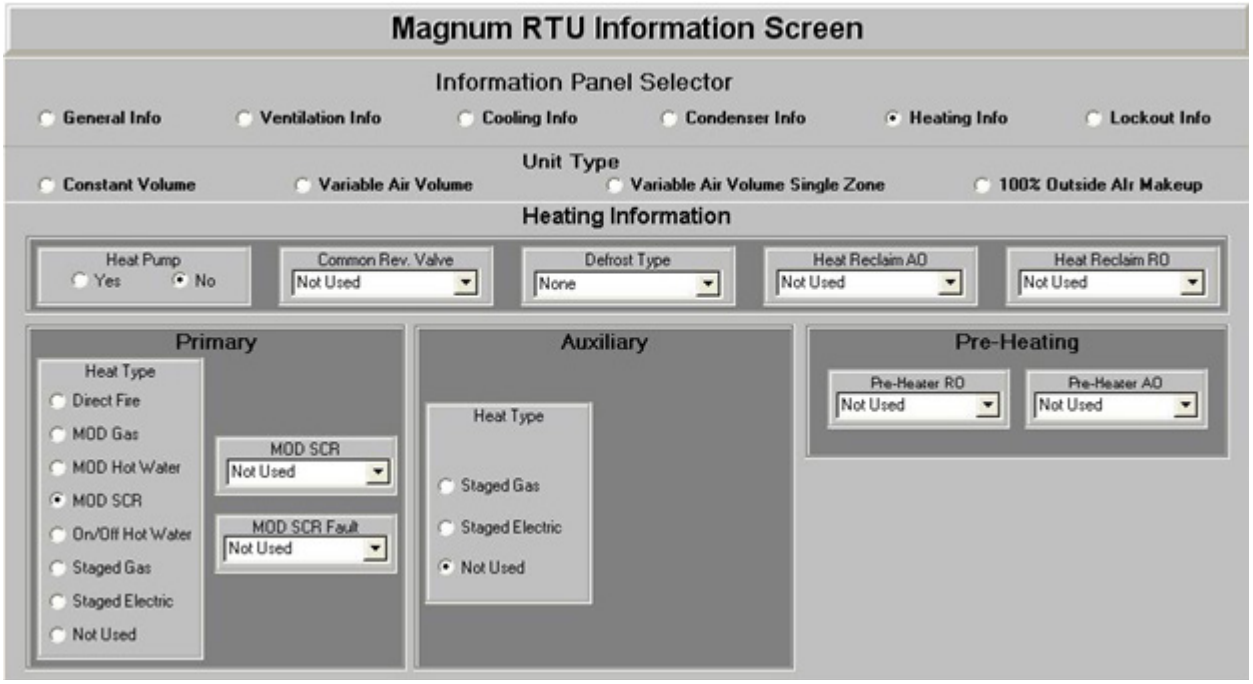
Damper Control SI, sensor that will determine Damper AO modulation.

8.5. Control Sequence

If the is not in a lockout state, the humidification options will be checked.

Relays will be turned on and analog outputs will be modulated based upon the associated set points.

Chapter - 9. Select Heating Info (Not Heat Pump)



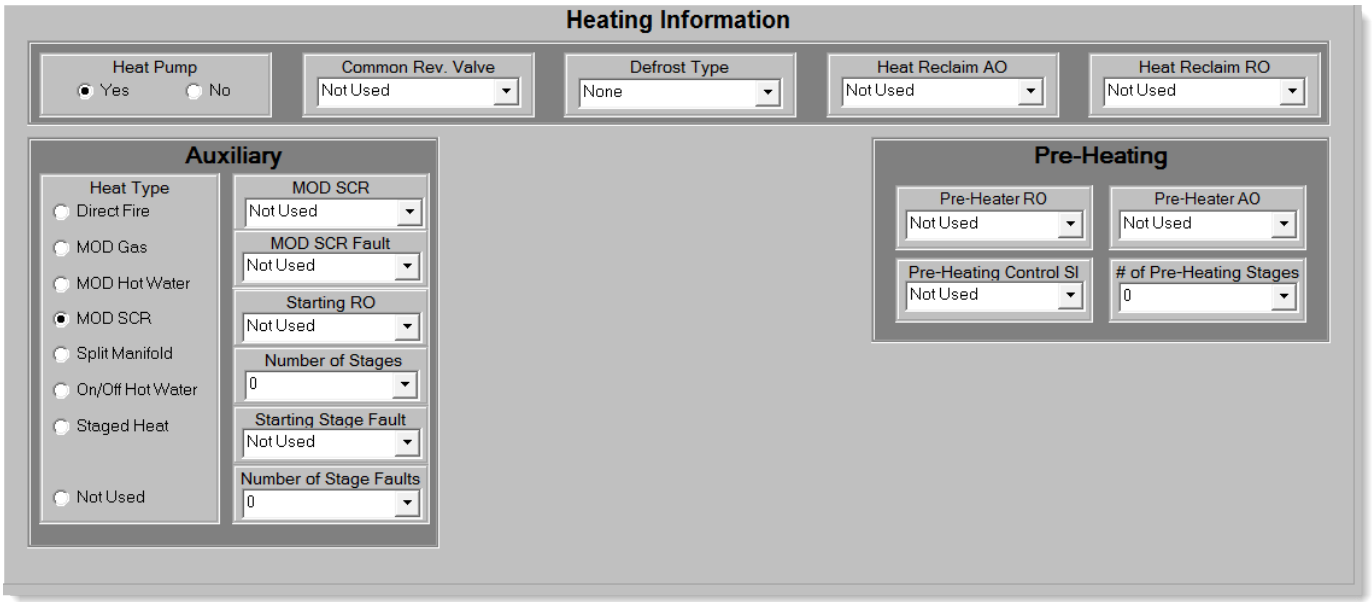
The RTU unit heating consists of primary and auxiliary heat. Not all types of heating are supported in the auxiliary heat stage. Select the type for the primary, the options in auxiliary will be adjusted and only show the allowable options.

Before auxiliary heating is allowed; primary must be at its maximum.

Above example uses MOD SCR (variable electric heat) for primary and auxiliary has 12 stages of fixed electric heat. Before any stages of fixed heat can be turned on the SCR must be at 100%. Once auxiliary heat begins and the heat requirement decreases all fixed electric heat must be must be turned off (auxiliary is off) before the SCR will be varied. If the fixed stages of electric must be on for minimum time this value is set up in the ROs information screen.

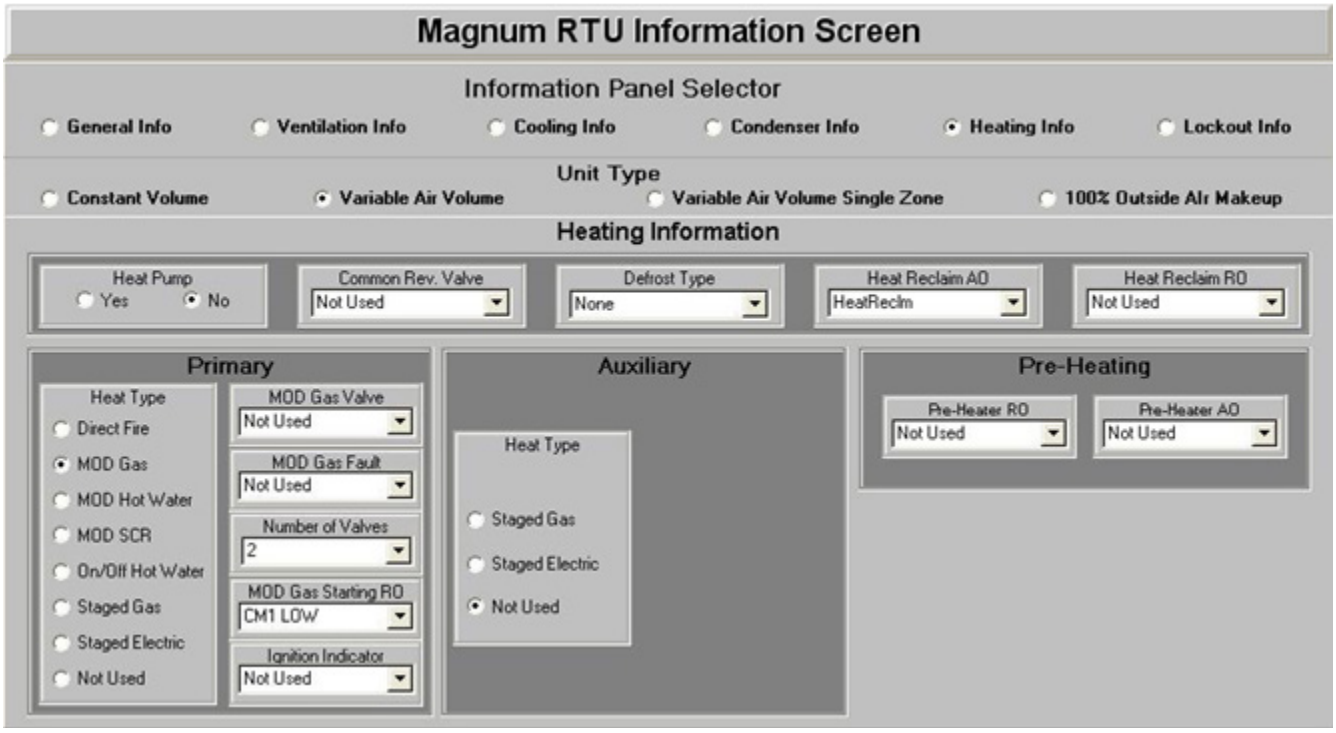
Chapter - 10. Select Heating Info (Heat Pump)

If the unit is a heat pump, Heat Pump option set to Yes; when heating is required the heat pump will be placed in heating mode and act as the first stage of heating. This will remain as the first stage as long as the ambient temperature is above setpoint #133. If additional heating is required the system will use the auxiliary heat.



The emergency heating can only be used if the heat pump is no longer active due to low ambient temperature or a failure.

Chapter - 11. Select Heating Info (Mod Gas)



The above Heat Type selection is for MOD Gas. This requires:

Two analog outputs that match the number of mod gas valves indicated.

	2-1	Mod Gas 1	Standard	NO
	2-2	Mod Gas 2	Standard	NO

Five stages, two associated with the gas valves these are 2 stage fans and 3 associated with the number of staged gas steps. The following relay outputs are required:

	2-1	...	CM1 W3 low	—	—	—	—	—	—	—	Standard
	2-2	...	CM1 W2 hi	—	—	—	—	—	—	—	Standard
	2-3	...	CM 2W3 low	—	—	—	—	—	—	—	Standard
	2-4	...	CM 2W2 hi	—	—	—	—	—	—	—	Standard
	2-5	...	CM 3	—	—	—	—	—	—	—	Standard
	2-6	...	CM 4	—	—	—	—	—	—	—	Standard
	2-7	...	CM 5	—	—	—	—	—	—	—	Standard

The raise in TEMP required to prove ignition is now based upon the lowest TEMP recorded during the ignition sequence.

#	Name	Type	Description
184	Mod Gas Adjustment (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	Adjustments for mod gas valve and minimum and maximum valve openings. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
185	Mod Gas multiplier & divisor & time that the gas stage must be off (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	-The value is the multiplier. -The time cell is the minimum time that the gas stage must be in the TIME OFF state. This is similar to an anti-cycle timer. -Min Opening is not used. -Max Opening is not used -Max Adj is the divisor used to fine tune the adjustments
186	Mod Gas ignition (This setpoint is also used with Direct Fire type of heating)	LOCKOUT	Only used if the Ignition Indicator sensor is not used. -The Value is the increase in heat that is needed to prove that ignition has been successful. If the control temperature decreases while waiting for ignition, the heat increase will be based on this value. -The time field contains the time to wait for ignition, if time expires then mark this stage off line and generate an error message (only one error message will be generated between lockout reset). -The time to ignore safety cell contains the time that the step will remain in the warm up state.
187	Mod Gas Fan switch to high speed (not used with Direct Fire type of heating)	SETPOINT	Determines when the system will switch from low fan speed to high fan speed. When the mod gas opening is greater than value of this setpoint plus the value in setpoint #184 the high speed fan will be turned on. With MOD GAS heating types when warm up has been satisfied, use high zone of set point #187 as the valve opening if is greater than 0 else use the minimum valve opening in set point #184.

(With all types of MOD GAS & SCR heating types can handle up to 30 fixed stages.)

(With MOD GAS heating types when warm up has been satisfied, use High zone to Setpoint #187 “Mod Gas Fan switch to high speed (not used with Direct Fire type of heating)” as the value opening if is greater than 0, else use the minimum valve opening is Setpoint #184 “Mod Gas Adjustment”.)

Chapter - 12. Mod Gas Capacity Heating States

1. **NOT USED**, indicates that there is no heating steps.
2. **OFF HIGH AMB**, the heating has been disabled due to high ambient. Refer to setpoint #133.
3. **DISABLED**, all heating stages have been disabled.
4. **OFF**, all heating stages are off.
5. **LOADING,** additional heating is required. The system is increasing capacity.
6. **UNLOADING**, less heating is required. The system is decreasing capacity.
7. **HOLDING**, heating is within the heating zone.
8. **HOLD FOR IGN**, this state is only for MOD GAS type of heating. An additional step of heating has been turned on and waiting for a rise in control heating temperature. Refer to setpoints #186.
9. **HOLD MG START**, this state is only for MOD GAS type of heating. A modulating valve step has been started with a valid ignition; now wait for warm up period. Refer to setpoint #186.
10. **LOADED**, all heating stages have been turned on.
11. **UNLOADED**, all heating stages have been turned off.
12. **OFF NO FLOW**, all heating stages have been turned off due to no flow.

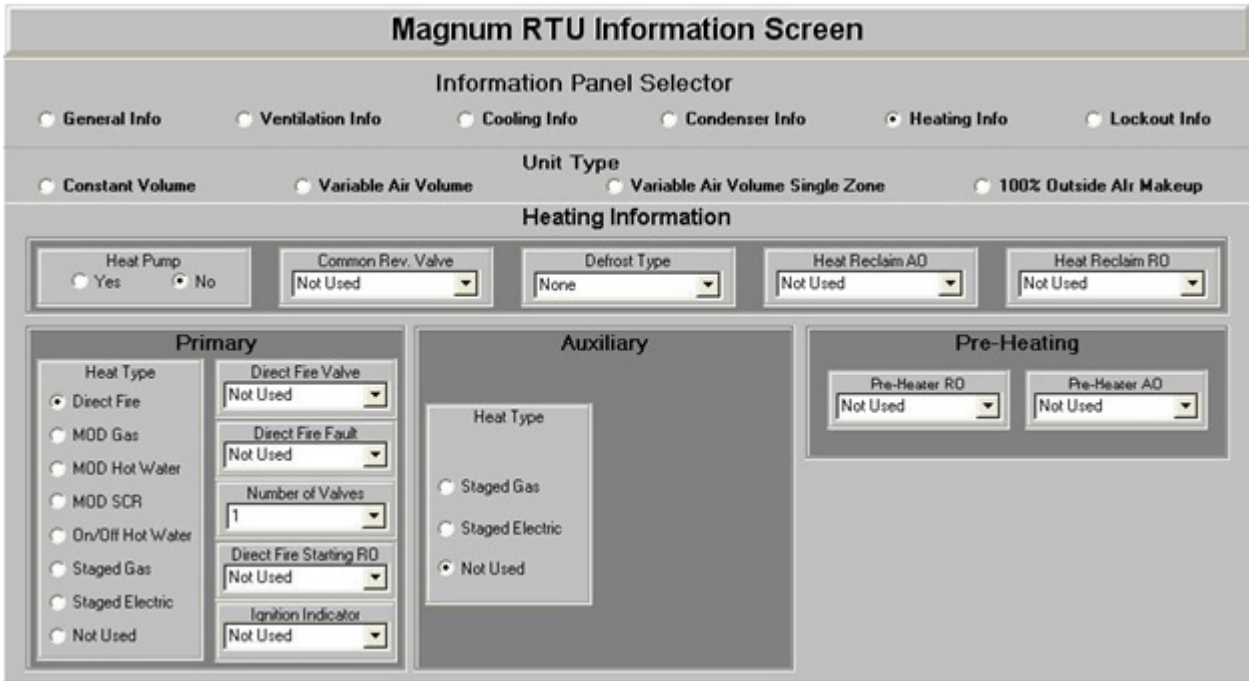
Chapter - 13. Mod Gas Stage Heating States

1. **NOT USED**: step is not used.
2. **MOD OFF READY**: MOD GAS valve step is ready to be activated.
3. **MOD OFF TIME**: MOD GAS valve step is off due to time from when the step was turned off.

#	Name	Type	Description
185	Mod Gas multiplier & diviMod Gas multiplier & divisor & time that the gas stage must be off (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	-The value is the multiplier. -The time cell is the minimum time that the gas stage must be in the TIME OFF state. This is similar to an anti-cycle timer. -Min Opening is not used. -Max Opening is not used -Max Adj is the divisor used to fine tune the adjustments.

4. **MOD ON**; MOD GAS valve step is on. The associated analog output will be modulated.
5. **MOD HOLD IGN**: MOD GAS valve step has been initiated but prove of a valid ignition has not yet occurred. Refer to setpoint #186.
6. **MOD HLD WARMUP**: MOD GAS valve step has a valid ignition and is now in the warm up state. Refer to setpoint #186.
7. **STEP OFF READY**: MOD GAS fixed step is ready to be activated.
8. **STEP OFF TIME**: MOD GAS fixed step is off due to time from when the step was turned off. Refer to setpoint #186.
9. **STEP ON**: MOD GAS fixed step is on.
10. **STEP HOLD IGN**: MOD GAS fixed step has been initiated but proof of a valid ignition has not yet occurred. Refer to setpoint #186.
11. **SAFETY NO IGN**: MOD GAS valve or fixed step was initiated but time expired prior to proof of a valid ignition. Refer to setpoint #186.
12. **LOCKOUT NO IGN**: MOD GAS valve or fixed step this state is not used at this time.
13. **OFF**: Not a MOD GAS step, it is off.
14. **LOADING**: Not a MOD GAS step, it is loading.
15. **UNLOADING**: Not a MOD GAS step, it is unloading.
16. **LOADED**: Not a MOD GAS step, it is fully loaded.
17. **HOLDING**: Not a MOD GAS step, it is holding.
18. **UNLOADED**: Not a MOD GAS step, it is fully unloaded.

Chapter - 14. Select Heating Type (Direct Fire)



This type of heating is similar to the MOD Gas type. Both cause an ignition to occur and wait for verification by an increase in the control temperature.

The above selection of Direct Fire requires one valve, Analog Output, and one Relay Output. If the Ignition Indicator is specified it must point to a digital input which will be on to indicate proof of ignition. If it is not used then the rise in temperature will be used as proof of ignition.

The raise in TEMP required to prove ignition is now based upon the lowest TEMP recorded during the ignition sequence.

#	Name	Type	Description
184	Mod Gas Adjustment (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	Adjustments for mod gas valve and minimum and maximum valve openings. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time

185	Mod Gas multiplier & divisor & time that the gas stage must be off (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	-The value is the multiplier. -The time cell is the minimum time that the gas stage must be in the TIME OFF state. This is similar to an anti-cycle timer. -Min Opening is not used. -Max Opening is not used -Max Adj is the divisor used to fine tune the adjustments.
186	Mod Gas ignition (This setpoint is also used with Direct Fire type of heating)	LOCKOUT	Only used if the Ignition Indicator sensor is not used. -The Value is the increase in heat that is needed to prove that ignition has been successful. If the control temperature decreases while waiting for ignition, the heat increase will be based on this value. -The time field contains the time to wait for ignition, if time expires then mark this stage off line and generate an error message (only one error message will be generated between lockout reset). -The time to ignore safety cell contains the time that the step will remain in the warm up state.

Chapter - 15. Direct Fire Capacity States

1 **NOT USED**, indicates that there is no heating steps.
2. **OFF HIGH AMB**, the heating has been disabled due to high ambient. Refer to setpoint #133.
3. **DISABLED**, all heating stages have been disabled.
4. **OFF**, all heating stages are off.
5. **LOADING**, additional heating is required. The system is increasing capacity.
6. **UNLOADING**, less heating is required. The system is decreasing capacity.
7. **HOLDING**, heating is within the heating zone.
8. **HOLD FOR IGN**, this state is only for MOD GAS type of heating. An additional step of heating has been turned on and waiting for a rise in control heating temperature. Refer to setpoints #186.
9. **LOADED**, all heating stages have been turned on.
10. **UNLOADED**, all heating stages have been turned off.
11. **OFF NO FLOW**, all heating stages have been turned off due to no flow.

Chapter - 16. Direct Fire Stage Heating States

1. **NOT USED**: step is not used.
2. **MOD OFF READY**: MOD GAS valve step is ready to be activated.
3. **MOD OFF TIME**: MOD GAS valve step is off due to time from when the step was turned off. Refer to set-point #186.
4. **MOD ON**; Direct Fire GAS valve step is on. The associated analog output will be modulated.
5. **MOD HOLD IGN**: Direct Fire GAS valve step has been initiated but prove of a valid ignition has not yet occurred. Refer to setpoint #186.
6. **STEP OFF READY**: Direct Fire GAS fixed step is ready to be activated.
7. **STEP OFF TIME**: Direct Fire GAS fixed step is off due to time from when the step was turned off. Refer to setpoint #186.
8. **STEP ON**: Direct Fire GAS fixed step is on.
9. **STEP HOLD IGN**: Direct Fire GAS fixed step has been initiated but prove of a valid ignition has not yet occurred. Refer to setpoint #186.
10. **SAFETY NO IGN**: Direct Fire GAS valve or fixed step was initiated but time expired prior to proof of a valid ignition. Refer to setpoint #186.
11. **LOCKOUT NO IGN**: Direct Fire GAS valve or fixed step this state is not used at this time.
12. **OFF**: Not a Direct Fire GAS step, it is off.

Heating status is display both on the MCS Magnum display and by MCS Connect.

Chapter - 17. Pre Heater:

The pre heater can be used to pre heat the incoming air based upon Setpoint #129. Either or both a relay or analog output can be specified. If analog output then Setpoint #130 will be used for adjustments.

17.1. PRE HEATING:

The purpose of the pre heating function is to pre heat the incoming air if needed.

The function is setup in the Pre Heating section under the Heating Information window, accessed by the Heating Info button.

Pre-Heater RO: Select the first pre-heater relay. Multiple steps are supported but they must be consecutive relays.

Number of Steps: Number from 0 to 12. If 0, then the pre-heating function is not active.

Pre-Heater AO: Select the analog output that is to be modulated. This may be 'Not Used'.

Control Sensor: Select the control sensor input that will be used to determine amount of heating that is required. This is usually outside temperature.

17.1.1 MCS Configuration Setup

The function is setup in the Pre Heating section under the Heating Information window, accessed by the Heating Info button.

Pre-Heater RO: Select the first pre-heater relay. Multiple steps are supported but they must be consecutive relays.

Number of Steps: Number from 0 to 12. If 0, then the pre-heating function is not active.

Pre-Heater AO: Select the analog output that is to be modulated. This may be 'Not Used'.

Control Sensor: Select the control sensor input that will be used to determine amount of heating that is required. This is usually outside temperature.

17.1.2 Setpoints

The following Setpoints must be setup for the pre-heating function.

Setpoint #44, PRE-HEAT MUL/DIV (type = Target): Purpose is to enable fine tuning the adjustment to both the delay timer and the AO opening.

- Value: multiply adjustment for the AO opening
- Safety time is not used
- High Zone cell is the multiply adjustment for the time delay between making adjustments
- Low Zone cell is the divisor adjustment for the time delay between making adjustments
- Night Setback cell is the divisor adjustment for the AO opening

Setpoint #170, PRE-HEAT TARGET (type = Target): Purpose is to develop the control zone for heating the incoming air.

- Value: target of the pre-heat function
- Safety time is not used
- High Zone cell is added the value to produce the high zone
- Low Zone cell is subtracted from the value to produce the low zone
- Night Setback cell is not used

Setpoint #179, PRE-HEAT ADJUSTMENT (type = Delay): Purpose is provide adjustment limits and minimum and maximum AO settings.

- Value: minimum adjustment that can be made
- Safety time is the delay between adjustments.
- MIN VFD Opening: this is the minimum AO setting
- MAX VFD Opening: this is the maximum AO setting
- MAX VFD Adjustment: this is the maximum adjustment that can be made

17.2. Control Zone

The control is developed based upon Setpoint #170. The AO will be modulated and pre-heating relays will be turned on or off to maintain the control temperature within this zone. When within this zone the delay counter will not be decremented.

17.3. Delay Timer

The delay timer is initially set to the safety time of Setpoint #179. The delay timer is decremented based upon the difference between the control temperature and its target (Setpoint #170) this value is then adjusted by the values in Setpoint #44. The maximum decrement is 10 that can be made each second.

17.4. AO Setting Adjustment

The AO adjustment is based upon the difference between the control temperature and its target (Setpoint #170) this value is then adjusted by the values in Setpoint #44. This value is then checked for its minimum and maximum adjustments based on Setpoint #179.

Adjustments to the AO setting will be made when the delay timer reaches zero. The delay counter will then be set to safety time of Setpoint #179.

The actual AO setting will be limited by its minimum and maximum values in Setpoint #179.

17.5. Pre-Heat Sequence of Operations

- If the unit is not in a normal run state, the pre heat will be off.

- Once the control temperature is below the control zone the pre heat sequence will begin. The first relay will be turned on and the AO setting will be at its minimum value. The AO setting will be increased to its maximum value (Setpoint #179); at this point the next step of heating will be turned on if available and the AO setting will be set to its minimum value. The AO setting will be increased until it reaches the maximum value. Once all heating steps are on then the AO setting will remain at its maximum value.

- When the control temperature is within the control zone there will be no adjustments.

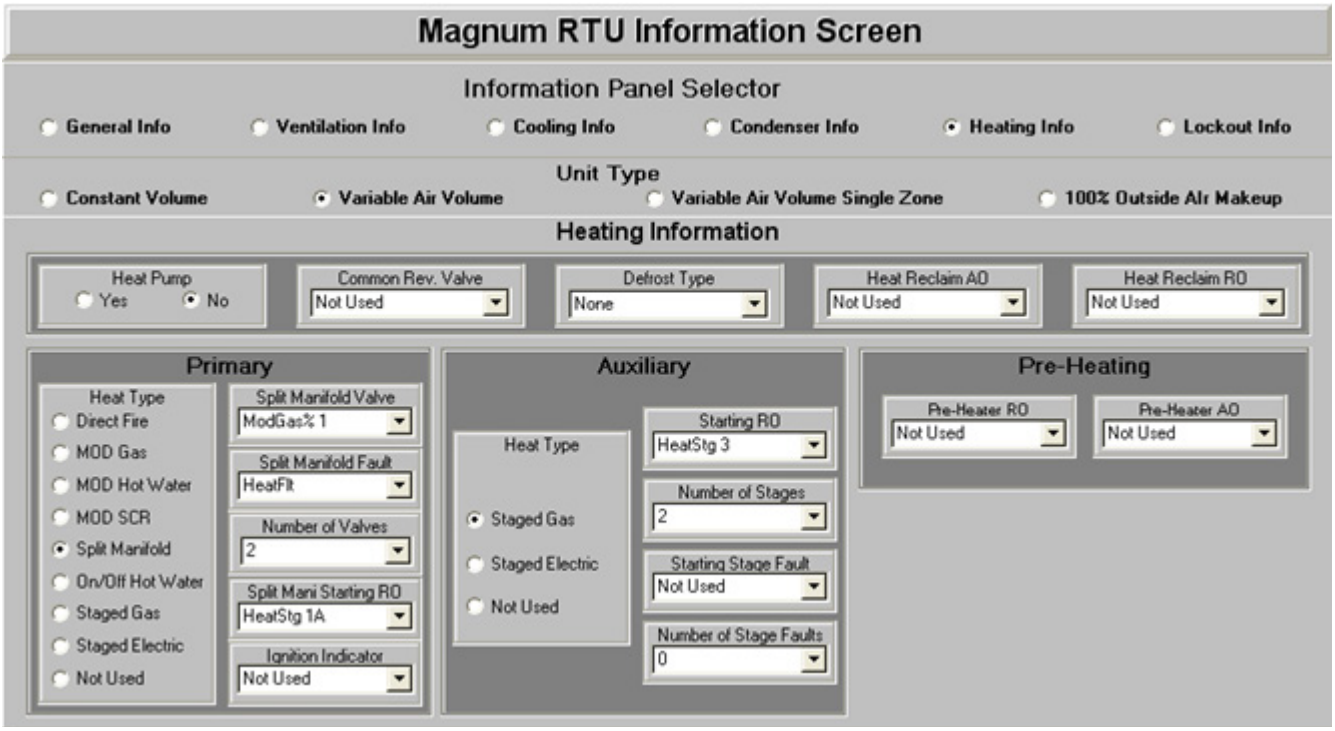
- When the control temperature is above the control zone the AO setting will be decreased to its minimum value (Setpoint #179); at this point a heating step will be turned off if available and the AO setting will be set to its maximum value. The AO setting will be decreased until it reaches the minimum value. Once all heating steps are off the AO setting will be zero. The pre heat will remain off until the control temperature is below the control zone.

17.6. Pre-Heat OFF

When the pre heat is off, all steps will be off and the AO setting will be zero. Note, this function will not be enabled if the system is in either the cooling or dehumidification mode.

Chapter - 18. Split Manifold Heating

This is similar to modulating gas except there will be 4 RO's tied to each gas valve. The first 2 RO's are the 2 stages for the gas valve. The sequence for this type of heating will be:



Heat Stage 1A

Heat Stage 1B

CombMtr1Lo

CombMtr1Hi

In the Magnum RTU screen under the heating info screen select Split Manifold as your primary heat. It needs to be setup as follows.

-In the "Split Manifold Valve" cell select the first gas valve.

-In the "Split Manifold Fault" cell select the SI if there is one for the heater fault.

-In the "Number of Valves" cell select the number of modulating gas valves you have.

-In the "Split Mini Starting RO" cell you will select the first RO in the sequence.

-In the "ignition Indicator" cell select the SI if there is one.

#	Name	Type	Description
184	Mod Gas Adjustment (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	Adjustments for mod gas valve and minimum and maximum valve openings. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time
185	Mod Gas multiplier & divisor & time that the gas stage must be off (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	-The value is the multiplier. -The time cell is the minimum time that the gas stage must be in the TIME OFF state. This is similar to an anti-cycle timer. -Min Opening is not used. -Max Opening is not used -Max Adj is the divisor used to fine tune the adjustments.
186	Mod Gas ignition (This setpoint is also used with Direct Fire type of heating)	LOCKOUT	Only used if the Ignition Indicator sensor is not used. -The Value is the increase in heat that is needed to prove that ignition has been successful. If the control temperature decreases while waiting for ignition, the heat increase will be based on this value. -The time field contains the time to wait for ignition, if time expires then mark this stage off line and generate an error message (only one error message will be generated between lockout reset). -The time to ignore safety cell contains the time that the step will remain in the warm up state.
187	Mod Gas Fan switch to high speed (not used with Direct Fire type of heating)	SETPOINT	Determines when the system will switch from low fan speed to high fan speed. When the mod gas opening is greater than value of this setpoint plus the value in setpoint #184 the high speed fan will be turned on. With MOD GAS heating types when warm up has been satisfied, use high zone of set point #187 as the valve opening if is greater than 0 else use the minimum valve opening in set point #184.

RO “Heat Stage 1A” will turn on and the gas valve will be set to 100% for ignition. Once ignition is proven the gas valve will go through a warmup period. After the warmup period the gas valve then gets set to a certain value (see set points). The gas valve will then modulate as usual. Once the gas valve reaches the value in the MAX VFD Opening cell of Set Point #184 the RO “Heat Stage 1B” will then turn on and the gas valve will go through its ignition and warmup sequence again. If there is a 2nd stage of Split Manifold Heating then the sequence will continue to stage 2.

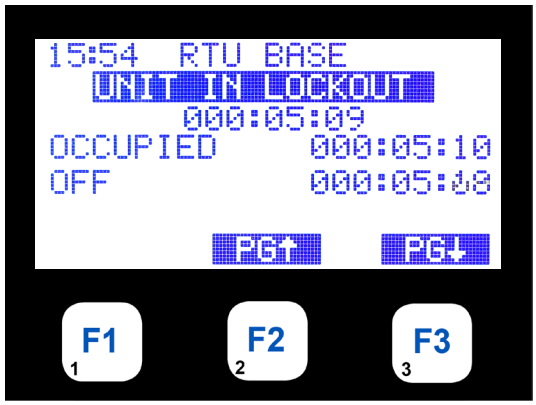
Chapter - 19. Magnum Keypad And Display

All Magnum LCD displays are identical to the displays documented in the Magnum Version 17 Manual with the exception when the Status is selected from the Main Menu screen.

When the status is selected a series of RTU screens can be scrolled through which provide the RTU status. When the Cooling status display is reached, this is the same as the Unit status screen for HVAC units. This is followed by the individual compressor information screens. These screens can be scrolled by using the F2 (Page up) and F3 (Page down) buttons.

All screens consist of up to 6 lines of data. Line 1 will always contain the time (hours: minutes) and the screen heading.

19.1. RTU Base Screen



DESCRIPTION

Line 1: Hour: Minute RTU
Line 2: RTU STATE
Line 3: Time in current state
Line 4: STATUS of the building time (Hour:Minute:Second)
Line 5: MODE & time (Hour:Minute:Second)

RTU STATE can be:

1. PowerUpDelay
2. MCS IO FAILED
3. UNIT IN LOCKOUT
4. OFF SMOKE ALARM
5. OFF RUN/STOP
6. EVAP FAN ONLY
7. COOLING STATE
8. HEATING STATE
9. DEHUMID STATE
10. SWITCHING STATE

RTU STATUS can be:

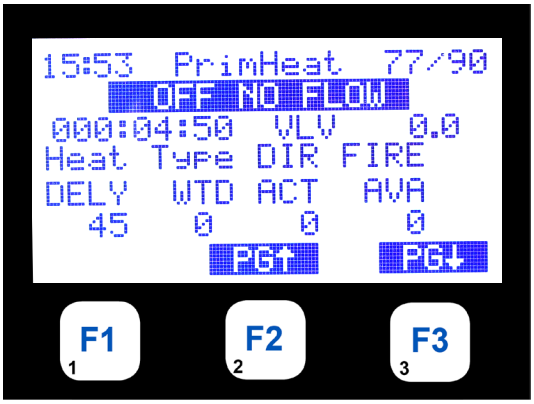
1. OCCUPIED
2. UNOCCUPIED
3. OVER RIDE

RTU MODE can be:

1. COOLING MODE
2. HEATING MODE
3. DEHUMIDITY
4. OFF

19.2. RTU PRIMARY Heating

(Only displayed if primary heating is used)



DESCRIPTION

Line 1: Hour: Minute Heat SI sensor value of heating control/heating Trg
Line 2: Heating STATE
Line 3: Primary Heat STATE & D: (delay counter in seconds)
Line 4: Type of heating for this stage

If type of heating is variable

Line 5: WTD % ACT % ROC
Line 6: Analog wanted %, actual % and the rate of change of the control heating temperature

If type of heating is fixed step

Line 5: WTD ACT AVAIL ROC
Line 6: Number of steps wanted on, actual steps turned on, available steps and the rate of change of the control heating temperature

Heating STATE can be:

1. HEAT NOT USED
2. HEAT OFF hiAMB
3. HEAT DISABLED
4. HEAT IS OFF
5. HEAT LOADING
6. HEAT UNLOADING
7. HEAT HOLDING
8. HEAT LOADED
9. HEAT UNLOADED

Heating stage STATE can be:

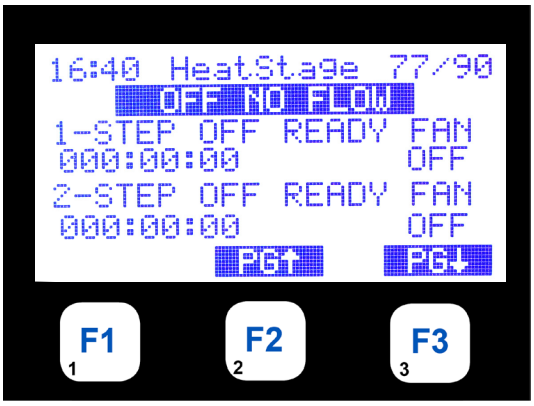
1. NOT USED
2. OFF
3. LOADING
4. UNLOADING
5. LOADED
6. HOLDING
7. UNLOADED

Type of Heating can be:

1. STAGE GAS
2. STAGE ELEC
3. HOT WATER (on or off)
4. MOD GAS
5. MOD WATER
6. MOD SCR
7. NOT USED

19.3. RTU AUXILIARY Heating

(Only displayed if auxiliary heating is used)

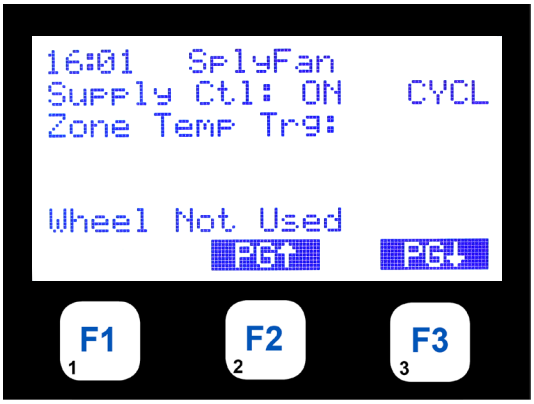


DESCRIPTION

Line 1: Hour: Minute Heat SI sensor value of heating control/heating Trg
Line 2: Heating STATE
Line 3: Auxiliary Heat STATE & D: (delay counter in seconds)
Line 4: Type of heating for this stage
If type of heating is variable
Line 5: WTD % ACT % ROC
Line 6: Analog wanted %, actual % , rate of change of the control heating Trg
If type of heating is fixed step
Line 5: WTD ACT AVAIL ROC
Line 6: Number of steps wanted on, actual steps turned on, available steps and the rate of change of the control heating temperature

19.4. RTU Ventilation Info

(Screen provides information on the supply fan control and on the heat wheel)



DESCRIPTION

Line 1: Hour: Minute SplyFan
Line 2: Supply Ctl: control type
Line 3: Supply Fan is ON or OFF
Line 4: VFD % T-PSI A-PSI DLY (display if VFD else 'No Supply Fan VFD')
Line 5: Supply fan wanted %, target psi for supply fan control, actual psi for supply fan control, delay in seconds between making adjustments to the supply fan VFD (line will be blank if no VFD)
Line 6: Wheel STATUS

Control type can be:

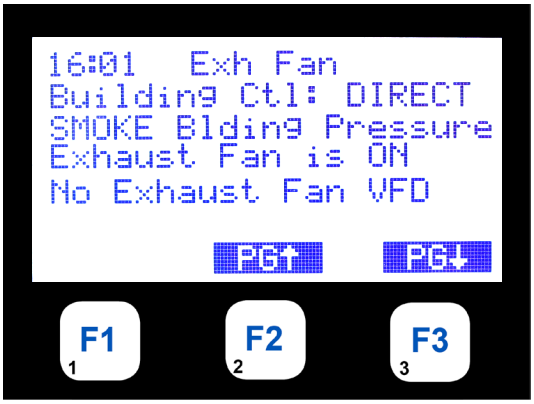
1. Always On
2. Cycle On
3. 1Zone VAV (not implemented at this time)
4. Not Used

(Heat) Wheel STATUS can be:

1. OFF
2. ON
3. DEFRST
4. NONE

19.5. RTU Ventilation Info

(Screen provides information on the exhaust fan/building control)



DESCRIPTION

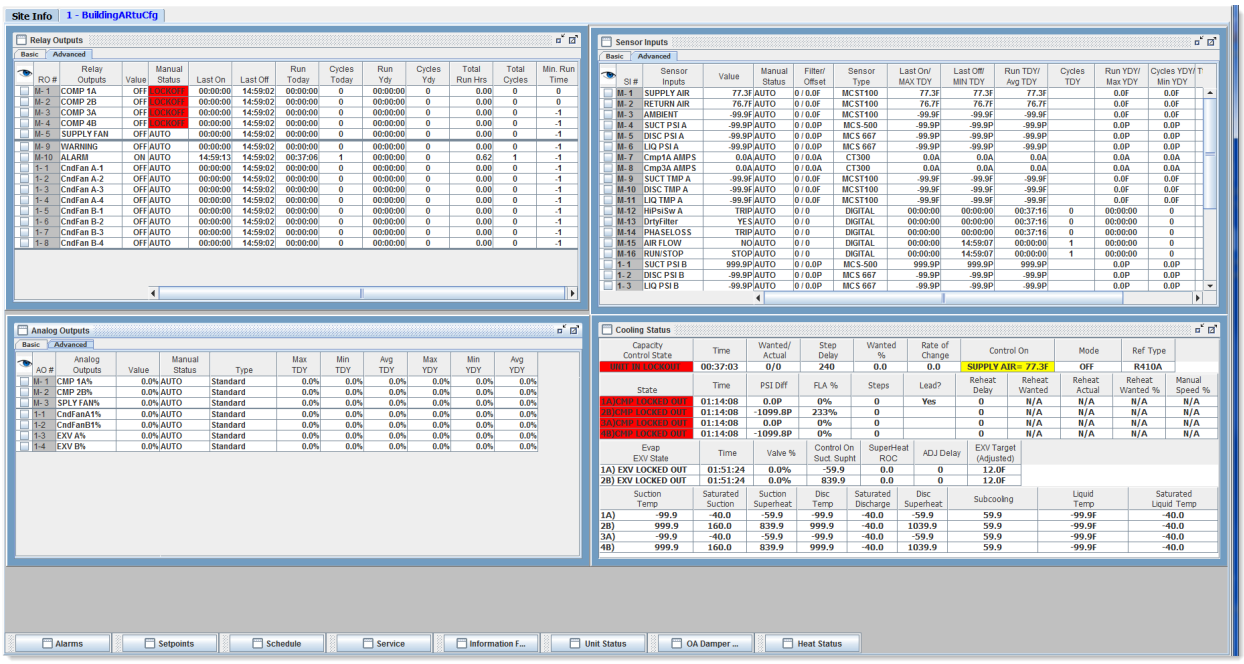
Line 1: Hour: Minute VentInf
Line 2: Building Ctl: control type
Line 3: STATUS Blding Pressure
Line 4: Exhaust Fan is ON or OFF
Line 5: VFD % T-PSI A-PSI DLY
Line 6: Exhaust fan wanted %, target psi for exhaust fan control, actual psi for exhaust fan control, delay in seconds between making adjustments to the exhaust fan VFD

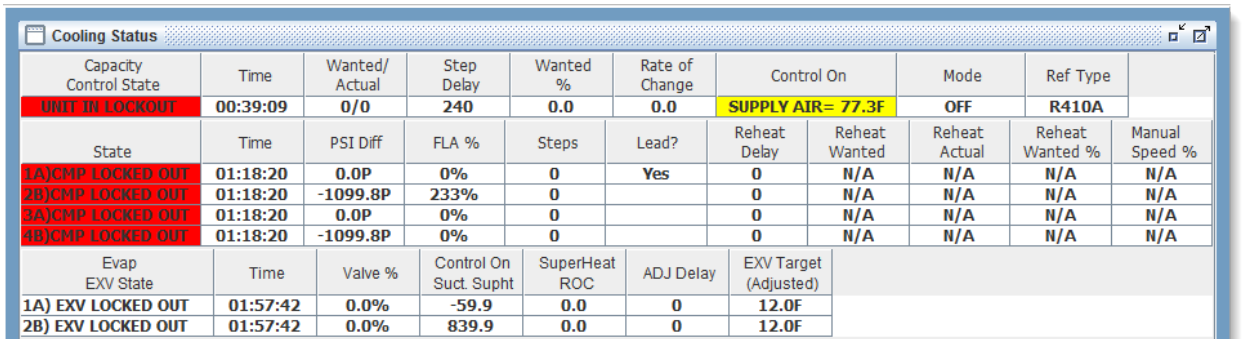
Control type can be:

1. DIRECT, if pressure is above control zone increase speed of the exhaust fan VFD; if below then decrease speed.
2. REVERSE, if pressure is above control zone decrease speed of the exhaust fan VFD; if below then increase speed.

Chapter - 20. Mcs Connect Displays

MCS Connect will display the RTU status. The following is a full screen of an RTU unit that is in the dehumidification mode. Note the only difference between the HVAC unit screens is in the status section where additional buttons are available.





20.1. UNIT Tab:

In the first section: the RTU state, time in that state, building mode (occupied or unoccupied), time in that mode, the unit mode (heating, cooling, dehumidify) and time in unit mode.

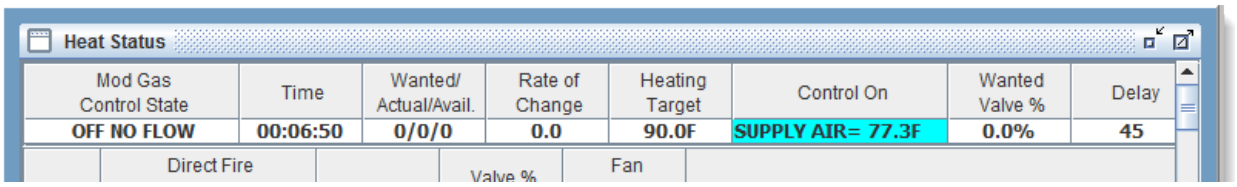
In the second section: the evaporator (supply) fan control, the percentage opening, the delay

between adjustments, the target value and the sensor input control value.

In the third section the status of the heat wheel. This unit does not have a heat wheel.

The fourth section provides information on the exhaust fan status.

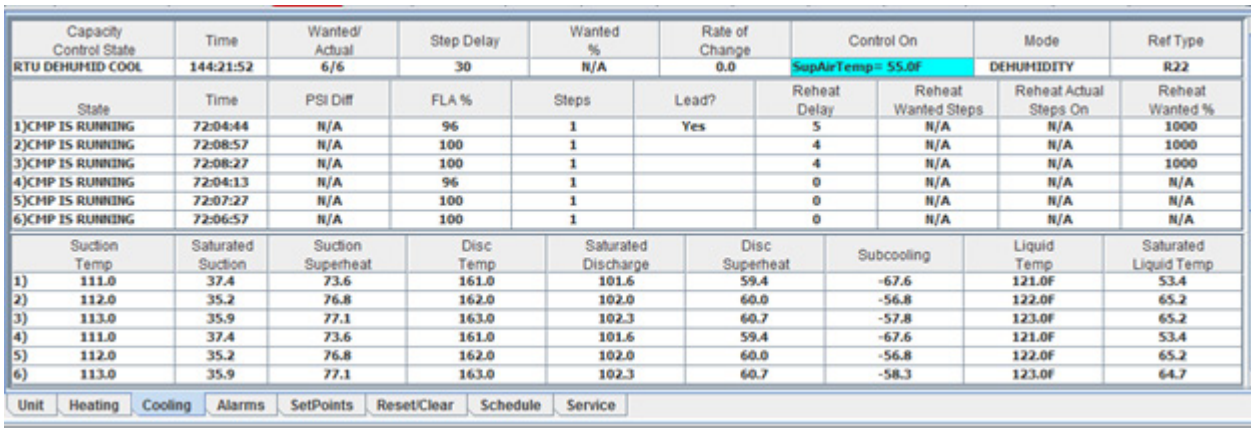
20.2. HEATING Tab:



The Heating button provides the RTU heating status.

In this example the heating is off. The primary heating type Direct Fire.

20.3. Cooling Tab:



The Cooling tab provides the same information as the unit status for an HVAC unit.

Chapter - 21. RTU Operation Steps

21.1. At Power Up

If the unit is not in a LOCKOUT condition, the system will determine if the supply fan can be started. If yes the fan will be started and no other functions can be initialized until flow has been established and the minimum supply startup time (setpoint #108) has passed.

21.2. DETERMINE BUILDING MODE

The MCS-MAGNUM will determine the building mode as Occupied, Unoccupied, Override, or Morning Warm Up. The MCS-MAGNUM can be configured to use its schedule or a sensor input to indicate occupied/unoccupied mode. The optional Morning Warm Up functions occurs once a day the first time the building mode is switched from Unoccupied to Occupied. The optional Override mode is active when the building mode is Unoccupied and someone presses the override button on the zone temperature sensor or a digital sensor input. The current building mode is indicated on the MCS-MAGNUM LCD display or in MCS-Connect's Unit Status.

Occupied

If the building mode is Occupied the following logic applies:

- Night setback values are not applied to cooling, heating, and reheat target setpoints.
- The Outsider Air Damper is controlled by:
- Minimum position setpoint value
- Economizer when in cooling mode (optional)
- Building CO2 level (optional)
- Outside Air CFM Target (optional)
- The supply and return fans are started and their speed (optional) is control to maintain duct static.

Unoccupied

If the building mode is Unoccupied the following logic applies:

- Night setback values will be applied to cooling, heating, and reheat target setpoints.
- The Outside Air Damper is closed.
- The supply and return fans are stopped and only turned on when there is a need for cooling, heating or dehumidification.

Override

If the building mode is Override the following logic applies:

- The unit run the same logic as Occupied mode
- The unit stays in the mode for time period specified by a setpoint, then the building mode is switched back to Unoccupied.

21.2.1 Determine Unit mode

The setting of the unit mode will enable the cooling, heating or dehumidification functions to be executed. The setting of the control mode will be based on the control sensor for the Ventilation Mode.

The following modes can be indicated:

OFF

The Unit Mode will be OFF if the unit has experience a safety condition resulting in a LOCKOUT or the unit RUN/STOP indicates STOP (do not allow the system to run).

21.2.1.1. Cooling Mode

When the control sensor input for the Ventilation Mode is above the value of setpoint #218, “Enable Cooling”, the unit mode will be set to COOLING MODE. The MCS-MAGNUM can be configured to stage the cooling based on one of the following sensor inputs:

- Space / Zone Temperature
- Supply Air Temperature
- Return Air Temperature
- Ambient Temperature

The staging of the cooling is the same as the MCS-MAGNUM HVAC software. The unit will stay in this mode until the Ventilation Mode control sensor input drops below the value of setpoint #218 minus its low zone value. The unit will enter a SWITCHING state when the system is leaving the cooling mode. If the humidity is high at this point and the system is entering the VENT ONLY mode any compressors that are on will remain on in anticipation of entering the DEMUNIDITY mode; else all steps will be staged off.

21.2.1.2. Heating Mode

When the control sensor input for the Ventilation Mode is below the value of setpoint #219, “Enable Heating”, the mode will be set to HEATING. The MCS-MAGNUM can be configured to stage the heating based on one of the following sensor inputs:

- Space / Zone Temperature
- Supply Air Temperature
- Return Air Temperature
- Ambient Temperature

For non-heat pump systems the first stage of heating will be activated. Once the heating pump is fully loaded, the fixed stages of heating will be used as needed. Once a heating stage is turned on a minimum on time can be specified in the ROs information screen if needed, default is 0 time. If stage 1 is a variable type of heating the associated analog output will be modulated to maintain the heating setpoint value. If additional heating is required and stage 1 is at its maximum then stage 2 if available will be enabled. If less heating is required the system will unload all heating steps in stage 2 prior to unloading stage 1.

For a heat pump system the first stage of heating will be the heat pump with the reversing valve on if the ambient conditions are met. (The ambient temperature must be above the setpoint “LOW AMB OFF” Setpoint 22). The second stage of heating can be used if additional heating is required. The emergency heating, if specified, can only be used if the heat pump is not functioning as the first stage of heating.

The unit will stay in the heating mode until the Ventilation Mode control sensor input rises above the value of setpoint #219 plus its high zone value. The unit will enter a SWITCHING state when the system is leaving the heating mode if any heating stages are on.

21.2.1.3. Vent Mode

When the control sensor for the Ventilation Mode is below the value of setpoint #218 minus its low zone value and above the value of setpoint #219 plus its high zone the VENT ONLY mode will be entered. This indicates that neither heating nor cooling is required. When in this mode and the Dehumid Mode sensor is greater than setpoint #220, this setpoint must be active, the DEHUMIDITY mode will be entered.

21.2.1.4. Dehumidify Mode

The dehumidification mode will use the cooling stages to cool the air and the Hot Gas to heat the air if necessary to remove the humidity and supply neutral temperature air to the space. The cooling state will be set to RTU DEHUMID-COOL and the number of cooling stages wanted on will be staged on up to the number indicated in Dehumidification Section of the Condenser Information window. Note a compressor must be associated with a suction group that has reheat capabilities; refer to the Circuit Base screen, to be turned on and it’s suction pressure greater than Setpoint #106 “DEH SUCT TARG” value plus Setpoint #106 “DEH SUC TARG” night setback value.

If the compressor is digital or has Variable Frequency Driver it capacity is modulated to maintain its suction

pressure in the control zone defined by Setpoint #106 value plus the setpoint #106 “DEH SUC TARG” high zone value and minus Setpoint #106 “DEH SUC TARG” low zone value.

If the control sensor temperature (typically supply temperature) is less than the value of Setpoint #129 “Reheat Target” the reheat function of all compressors that are on will be used to maintain the control sensor within the control zone define by Setpoint #129” Reheat Target” value plus Setpoint #129 “Reheat Target” high zone and min minus Setpoint #129 “Reheat Target” low zone.

For systems with Tandem compressors a second compressor will be turned off / on based on its suction pressure. This control is setup as a user logic using relay outputs & a digital input per circuit. Control has been setup to turn on compressors if the suction psi is greater than 87 and off is less than 80 psi. (Using R410A refrigeration.) The system will stay in this mode until the humidity decreases below the value of Setpoint #220 “Enable dehumidification mode” minus its low zone or heating or cooling is required.

21.2.1.5. Reheat Flush

Version RTU _ VI7.23 & up

Setpoint #213 - Night setback cell will be the value that the compressor AO is incriminated by when in reheat flush.

Setpoint #11- Safety time cell, this value will act as a multiplier to the value of this setpoint... this will increase the "load" jump when we're ramping up the compressor AO for a reheat flush. Before, it'd only jump the valve the Value ... which could be too little when jumping the compressor 10% every 3 seconds. With the multiplier, a value of ".2" for normal load adjusts, and a "5" in the Time field .. will jump the valve 1% every time the AO is jumped, this will keep the valve consistent with the amount we're jumping the compressor by. Obviously, it'll need to be fine-tuned in the field. This is for STANDARD superheat control only, FAST superheat needs no multiplier (it responds quick enough normally).

21.2.1.6. Forced Reheat Flush

Set point #213, ReHeat Flush is used to allow this option. The set point #213 setup as a TARGET types:

- **Value**= length of flush.
- **Time** (SEC) NOT USED.
- **High Zone**= time in seconds that the reheat must be on when in cooling mode.
- **Low Zone**= time in seconds that the reheat must be on when in dehumidification mode.
- If safety time is greater than 0; the forced flush will occur when a compressor is started and it will have no effect on the normal flush either in cooling or dehumidification mode.

For a reheat flush to occur Set point #213 must be active, its value greater than 0 and there must be a reheat AO. This software also corrects the issue of a reheat flush not being executed when in cooling mode.

Note, the reheat functions do not change the compressor state, when in reheat flush the AO will be set to 100.0%

21.2.1.7. Flush for Fast Superheat Logic

You need to have setpoint #213 "Night Setback" cell populated. The value of this cell is the AO adjustment to the compressor when we enter a flush cycle.

You also need to have setpoint #56 set up as a "Target" type. The "High Zone" cell needs to have a value >0. This value divides the value of setpoint #56, and the result is the delay between adjustments to the compressor AO. IE: If you have a 20% for the night setback in setpoint #213, a 10 for the value of Setpoint #56 and a 2 in the High Zone of Setpoint #56 .. then the logic will increase the compressor AO by 20% every 5 seconds.

For VFD compressors, recommend value for Setpoint #56 at "3", and the High Zone at "1".

This will be 3 second delays between compressor adjustments. For Setpoint #213's Night Setback field, I'd use "10". This will increase the compressor AO by 10% every 3 seconds when we enter a flush cycle.

Chapter - 22. RTU/Cooling Control States (Number)

Note: All User Logic points can now access the Unit Control State. The value accessed is the number Listed in parenthesis in the following headings.

22.1. UNIT IN POWER UP (0)

This state is entered when the Magnum is powered up or the system has been reset. The system will remain in this state for the time specified in setpoint #23 “POWER DELAY” or for 60 seconds if not active. In this state all Relay Outputs are turned off. This time delay is to insure the microprocessor has stable power before starting the algorithm.

22.2. POWER LOSS DELAY (1)

This state is entered when a loss of power occurs. When power is restored the unit will automatically start.

22.3. NO RUN-I/O LOST (2)

This state will be entered whenever the Magnum loses communications with any of the I/O boards that are connected through the MCS I/O network. When this state is entered the Magnum will generate an MCS I/O offline alarm, which identifies which I/O is offline and a lost I/O shutdown alarm which locks out the unit. Once locked out, if there are ten consecutive successful I/O reads the Magnum will reset and attempt to run. When this occurs a “LOST I/O RESTART” will be generated. Or, the lockout-reset key can be pressed to reset the Magnum, after the lost I/O has been corrected. This will generate a “LOCKOUT RESET.” In this state all RO’s except ALARM and OIL HEATER are turned OFF.

22.4. UNIT IN LOCKOUT (3)

This state is entered whenever a critical situation is encountered that could cause harm to the chiller package. Items such as freeze protect and emergency stop will force the system into this state. Lockouts can be reset without authorization from the keypad or MCS-Connect program; however if the lockout condition has not been corrected, the system will again be forced into the LOCKOUT state. In this state, all RO’s except ALARM and OIL HEATER (for screws with an oil pump) are turned OFF and placed in the “LOCKOUT” state. Note: If the Lockout Reset is pressed more than the programmed allowable number of times in one day the unit cannot be reset during the current day except through MCS-Connect and requires Factory authorization. This number is selected from a drop down menu under the Setup Information button, with a range of 2 to12.

22.5. UNIT IS OFF (4)

This state is entered when the system has finished a STARTUP, DISABLE, LOCKOUT, or NO RUN- I/O LOST state. The chiller is now ready to move into an active state to meet the capacity required.

22.6. UNIT IS HOLDING (5)

This state is entered when one of three conditions exists:

1) The control sensor reading is being maintained with in the control zone.

2) Control sensor reading is above the control zone but the Rate of Change is less than the value in the (MAX ROC-, #27) setpoint. This indicates that the temperature is decreasing

Toward the target at an acceptable speed. Therefore, no additional cooling is needed at this time.

3) The temperature is below the control zone but the Rate of Change is greater than the (MAX ROC+, #28) setpoint. This indicates that the temperature is increasing toward the target. Therefore, no reduction in cooling is needed at this time.

This state indicates that there is no need to adjust the capacity of the RTU package. This state will end when more or less capacity is required.

22.7. UNIT UNLOADING (6)

This state is entered when less capacity is required. Every second an adjustment is made to the step delay. When the delay reaches zero, the counter “steps wanted” on is decreased by 1.

22.8. UNIT IS LOADING (7)

This state is entered when more capacity is required. Every second an adjustment is made to the step delay. When the delay reaches zero, the counter “steps wanted on” is increased by 1.

22.9. OFF-SMOKE ALARM (8)

This state is entered when a smoke alarm has been detected. In the MCS-Configuration file the Smoke Alarm Indicator must be selected in the General Information panel under the MAG RTU screen. When this sensor is tripped, an error message “OFF-SMOKE ALARM” is generated and the unit state is changed. In this state all RO’s except ALARM and OIL HEATER are turned OFF.

22.10. RUN/STOP SW OFF (9)

This state is entered when the run stop switch is off, in the stop position. When the RTU is in this state, the individual compressor states if active are moved to the CMP IS OFF state through the normal states. One capacity STEP will be moved per second.

22.11. SCHEDULED OFF (10)

This state is entered when the schedule is calling for the package to be off. When the RTU is in this state, the individual compressor states if active are moved to the CMP IS OFF state through the normal states. One capacity STEP will be moved per second.

22.12. OFF-NO FLOW (11)

This state is entered when the evaporator flow switch is off. When the RTU is in this state, the individual compressor states if active are moved to the CMP IS OFF state through the normal states. One capacity STEP will be moved per second. If the NO FLOW setpoint is active and set to Lockout the unit will lockout on no flow.

22.13. OFF-NO COND FLOW (12)

This state is entered when the system is calling for a stage of condensing but it is not on.

22.14. AMBIENT OFF (13)

This state is entered when the ambient temperature falls below setpoint #24 “LOW AMB OFF” or is above setpoint #26 “HIGH AMB OFF”. The system will remain in this state until the ambient temperature if low rises 5.0°F (2.5°C) above the “LOW AMB OFF” setpoint value or if high drops 5.0°F (2.5°C) below the “HIGH AMB OFF” setpoint value. When the unit is in this state, the individual compressor states if active are moved to the CMP IS OFF state through the normal staging function. One capacity STEP will be moved per second.

22.15. PROCRESS HEAT OFF (14)

This state is entered when the process heat has reached temperature and is no longer required.

22.16. UNIT IS UNLOADED (15)

This state is entered when all of the systems available capacity steps are off. The package is providing no cooling or heating capacity, as none is required. The system is ready to react to space needs.

22.17. UNIT IS LOADED (16)

This state is entered when all of the system’s available capacity steps are on and the unit is providing the maximum amount of conditioning capacity.

22.18. RTU DEHUMID COOL (17)

This state is entered when dehumidification is required. This state can only be entered when the RTU mode is in VENT ONLY mode and the control dehumidification sensor is greater than the value of setpoint #220, ENABLE DEHUMID. The unit will remain in this state until the control dehumidification sensor drops below the value of setpoint #220 minus the low zone value of this setpoint or heating or cooling is required.

22.19. CONOMIZER ONLY (18)

This state is entered when mechanical cooling is off and the economizer (outside air damper) has been specified in the MCS-Configuration setup and it is being used for cooling.

22.20. SWITCHING MODES (19)

This state is entered when the unit is switching modes from either cooling mode or heating mode to Venation only and the unit has a number of cooling or heating steps on. The unit will stay in this state until all steps are off.

22.21. UNIT SMOKE UNLDG (20)

This state is entered when the system is unloading because a smoke alarm sensor has tripped. When this sensor is on, an error message “OFF-SMOKE ALARM” is generated and the unit state is changed.

22.22. UNIT OFF UNLDING (21)

This state is entered when the unit has been disabled. It will force a quick unload of the system.

22.23. UNIT DMD UNLDING (22)

This state is only entered when the demand limiting input has been selected. The demand limit sensor must be selected in the General Information panel under the MAG V8 screen and its type must be “485 Dmd Step”.

This input will indicate the maximum number of steps that the unit can run. If this value is less than the number of steps that are currently on, the unit will unload to meet this value.

22.24. UNIT HEAT UNLDING (23)

This state will be entered and will begin unloading the system if it is in heating mode and the control temperature is greater than the control temperature setpoint plus setpoint #164 “HP CTL ZONE +” and the system is not already fully unloaded.

22.25. UNLDING RUN CMPS (24)

State is only used with TurboCor type of compressors.

22.26. OPENING BY VLV (25)

State is only used with TurboCor type of compressors.

22.27. CMP RAMPING UP (26)

State is only used with TurboCor type of compressors.

22.28. CLOSING BYP VLV (27)

State is only used with TurboCor type of compressors.

22.29. FACTORY STARTUP (28)

A factory startup has been specified. The system cannot be commissioned until the proper authorization has been entered and the factory startup preformed.

22.30. MAXIMUM RUN TIME (29)

The maximum run time option has been specified. All functions will remain off unit the proper authorization has been entered.

22.31. RTU RUN NORMAL (30)

The RTU is in a normal operating condition; no safeties, smoke alarm etc. have occurred.

22.32. OFF-FIRE ALARM (31)

This is similar to the OFF-SMOKE ALARM state but the fire indicator sensor is on. The system will be shut down until the indicator is off and the system returns to normal.

22.33. UNIT HEAT HLDG (32)

The unit is in the heat mode and the control temperature is with its zone.

Chapter - 23. MAGNUM Alarms And Safeties

There are three types of alarms that are generated by the Magnum control logic:

- Information only alarms,
- Magnum system alarms and
- Magnum setpoint safety alarms.

All alarms have the same format. The alarm is identified and is date/time stamped. Alarms can be viewed from the Magnum keypad by selecting the 'Alarms' from the main menu, or through MCS-Connect.

23.1. System Generated Alarms

The following alarms are generated to provide information; all except the "LOST A/D CONVTR" will not cause a change in the operation of the unit.

- **POWER FAILED** – Generated when power to the Magnum was lost.
- **POWER RETURNED** – Generated when power to the Magnum returned.
- **HW DATE INVALID** – The date contained/read from the hardware real time clock chip is not valid. Check battery voltage, it should be > 2.0 vdc.
- **HW TIME INVALID** – The time contained/read from the hardware real time clock chip is not valid. Check battery voltage, it should be > 2.0 vdc.
- **SW DATE INVALID** – The date contained/read from the software clock is not valid.
- **SW TIME INVALID** –The time contained/read from the software clock is not valid.
- **RAM INTEGRITY** – the data contained in the battery-backed up RAM memory may be corrupted. This does not stop the Magnum from running. It means the historical data may be incorrect

  (run times, cycles, min/max values, and trend/graph data).
- **WATCHDOG RESET** – The Magnum has reset itself because of improper operator of the

  Magnum board. Please consult the manufacturer if this alarm has occurred.
- **LOST A/D CONVTR** – The Magnum microprocessor has lost communications to the Analog to Digital converter chip (chip that converts sensor voltages to a digital number). Check for a shorted sensor that may cause. This will cause a unit lockout.
- **LOST DISPLAY** – Generated when communication to the Keypad/Display is lost.
- **CF INIT ERROR** – The Compact Flash card that was installed cannot be initialized and therefore cannot be used. Replace the Compact Flash card with one that works.
- **BATTERY FAILED** – Generated when Magnum is not getting power from the Battery.

23.2. User Initiated Alarms

The following alarms indicate that an individual took action: (Most require proper authorization)

- **LOCKOUT RESET** – Generated when a user resets the unit or a compressor from a locked condition.
- **COMPUTER RESET** – Generated when the manual reset button on the Magnum is pressed.
- **ALARMS CLEARED** – Generated when a user clears the alarm history.
- **STPT CHANGED** – Generated when a user makes a change to a setpoint; the number of the setpoint will also be displayed with the alarm.
- **RO TO (Selected Condition)** – Generated when a user manually changes the condition of a Relay Output (either AUTO, MANON, or MANOFF).

- **AO TO (Selected Condition)** – Generated when a user changes the condition of an Analog Output (either AUTO or MANUAL. If MANUAL, then a dialog box will appear to input the number value).
- **SI TO (Selected Condition)** – Generated when a user changes the condition of a Sensor Input (If a digital input, then either AUTO, MANON, or MANOFF. If an analog input, then either AUTO or MANUAL. If MANUAL, then a dialog box will appear to input the number value).
- **POINT INFO CLEAR** – Generated when a user clears all point information (run times, cycles, min/max values, etc.).
- **CLOCK SET** – Generated when a user makes a change to the Magnum real time clock.
- **CFG DOWNLOADED** – Generated when a user uploads a new configuration file into the Magnum.
- **ETHERNET CHANGE** – Generated when a user makes a change to the Ethernet settings through the Keypad/Display.
- **RS485 CHANGED** – Generated when a user makes changes to the RS485 address through the Keypad/Display.
- **CF CARD INSERTED** – Generated when a user inserts a Compact Flash memory card into the Magnum.
- **CF CARD REMOVED** – Generated when a user removes a Compact Flash memory card from the Magnum.

23.3. Automatic Alarms

The following alarms indicate an action that the MCS-MAGNUM made automatically:

- **ROTATED LEAD** – Generated when the MCS-MAGNUM automatically rotates the Lead Compressor.
- **DAYLIGHT SAVINGS** – Generated when the MCS-MAGNUM automatically changes the clock to adjust for Daylight Savings Time.

23.4. Configuration Alarms

These alarms indicate a problem with the configuration file in the unit. The unit is not operational and a new configuration must be transmitted to the MCS-MAGNUM using MCS-Connect.

- **INVALID CONFIG** – Checksums are incorrect.
- **INVALID CFG VER** – The version number of the configuration is invalid.
- **INVALID CFG TYPE** – The configuration type does not match the software type.

23.5. MCS I/O Network Alarms

These alarms indicate problems with the MCS local network:

- **LOST SI COMM #_ / LOST RO COMM #_** - Generated when communications to a Sensor Input or Relay Output board is lost. The number of the board will be displayed with the alarm. The system can be accessed but will be in a NO RUN- I/O LOST state.
- **MCS-STAT OFFLINE** – The Magnum has lost communications to the MCS-STAT.
- **LOST IO SHUTDOWN** – Generated when Magnum is running and there are no communications to one or more of the I/O boards. The MCS-MAGNUM can be accessed but the unit will be in a NO RUN- I/O LOST state.
- **LOST I/O RESTART** – Generated when the Magnum does an automatic reset once I/O communications are restored.

23.6. CONTROLLING Sensor INPUT Alarms

These alarms indicate a problem with a sensor; it is either shorted or open. The alarm will generate using the following format: “ALARM xxx” where xxx is the sensor input name. The following sensors related to the entire system are tested:

- **Leaving temperature**: If failed, and this sensor is used for control then Lock Out the system, else alarm only.
- **Returning temperature:** If failed, and this sensor is used for control then Lock Out the system, else alarm only.
- **Space temperature:** If failed, and this sensor is used for control then Lock Out the system, else alarm only.
- **Ambient temperature:** If failed, and this sensor is used for control then Lock Out the system, else alarm only.

The following compressor sensors are tested. If they fail, then that compressor only is locked out:

- Suction pressure and temperature
- Discharge pressure and temperature
- Oil pressure and temperature
- Motor temperature (if an analog input)

23.7. Emergency Stop Alarm

- **EMERGENCY STOP** – Generated when the emergency stop sensor input has been turned on. The system can be accessed but the unit is in a Lock Out state and will not run.

23.8. Setpoint Safety Alarms

The Magnum algorithm incorporates a number of safety checks, based on setpoints, preventing unsafe conditions that could potentially cause damage to the system. When a safety trip occurs the compressor will be placed in the SAFETY TRIPPED state. The compressor will remain in this state for the time in the 'Safety Down Time (min)' cell and then move to the CMP ANTICYCLE or CMP IS OFF state where the compressor will be allowed to run again if required. If the same safety trip occurs again within the time in the 'Lockout Delay Hrs' cell since the first trip, the circuit will be set to CMP LOCKED OUT state, which requires a manual reset to restart the compressor. If the lockout delay time is set to zero, the Magnum will generate a lockout condition the first time that the safety occurs.

23.9. Sensor Inputs Used With Magnum Setpoint Safeties:

- Suction Pressure(Analog or Digital)
- Discharge Pressure (Analog or Digital)
- Oil Pressure (Analog or Digital)
- Oil Differential Pressure (Calculated value)
- Oil Temperature (Analog or Digital)
- Discharge Temperature (Analog or Digital)
- Motor Temperature (Analog or Digital)
- Motor Amps (Analog or Digital)
- Motor Fault (Analog or Digital)
- Liquid Temperature (Analog Only)
- Compress Proof (Digital Only)
- Flow Switch (Digital Only)

23.10. Setpoint Safeties

For a safety trip to occur, both the Sensor Input and the associated setpoint must be active. If a safety trips, the alarm name will consist of the setpoint name plus additional identification such as point number, compressor number, or 30 second history leading up to the trip if applicable.

Note: Most safeties are checked only if the compressor is running, however if the safety is always checked it will be noted.

The following is a list of safeties that are incorporated in the standard chiller algorithm control. These safeties are checked every second. For a system with multiple circuits, each one is tested individually. If a safety trip occurs, only that respective compressor will be affected, the others will continue to function normally.

23.11. Freeze Protection (SAFETY IS ALWAYS CHECKED)

If the leaving temperature drops below the setpoint value then the entire system will Lock Out and a FREEZE alarm will be generated. There is also an option to have one freeze protect for each individual circuit. Refer to section Setpoint #111.

23.12. No Flow Protection

If a flow switch is used, then the entire system will be Locked Out if setpoint #105 is active. If the setpoint is inactive, the Magnum will determine if there is a second pump, if so it will be started. Else, the system will shut down and automatically restart when the flow switch is on, indicating flow has returned. There is also an option to have a flow switch for each individual circuit. Refer to section setpoint #105.

23.13. Phase Loss Protection

Phase loss, as indicated by the phase loss monitor, will result in the entire system being Locked Off and a phase loss alarm will be generated. If setpoint #166 is inactive the Magnum will wait for 2 seconds before the Lock Out occurs. The alarm will be PHASE LOSS and no restart will be attempted. If setpoint #166 is active, the name of the setpoint will be in the message. Refer to section setpoint #166.

23.14. Low Differential Oil Pressure

This safety is designed to meet the compressor manufacturer requirements on oil pressure.

For the first 5 seconds following a compressor start (60 seconds if Hitachi screw compressor) this safety is NOT checked. For the next 30 seconds, if the oil differential pressure drops below ½ of the value of the setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field of that setpoint, then the circuit will be Locked Out and a LOW OIL alarm generated. After this time period, if the oil differential pressure drops below the value of the setpoint and it remains there for the time specified in the 'Time (sec)' field, then the compressor will be Locked Out and a low oil alarm generated. This safety is checked for when the compressor is on and not in a Pump Down state. Refer to section setpoint #91.

23.15. Low Suction Pressure

If the suction pressure drops below the value of the setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field, the compressor will be locked out and a LOW SUCTION alarm generated. This safety is bypassed when the compressor is in a Pump Down state. This safety can also be used as a freeze protection based upon the suction pressure. When this safety trip occurs, all compressors in the same suction group will react in the same manner. Refer to section setpoint #77.

23.16. Unsafe Suction Pressure

This safety is similar to the low suction pressure safety, except it is often set up with a lower value and a shorter safety time. If the suction pressure drops below the value of the setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field of that setpoint, then the circuit will be Locked Out and a UNSAFE SUCTION alarm generated. This safety will always cause a Lock Out on the first trip, requiring a manual reset. This safety is bypassed when the compressor is in a Pump Down state. When this safety trip occurs, all compressors in the same suction group will react the same. Refer to section setpoint #80.

23.17. High Discharge Pressure (SAFETY IS ALWAYS CHECKED)

If the discharge pressure rises above the value of the setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field of that setpoint, then the circuit will be locked out and a HIGH DISCHARGE alarm generated. Refer to section setpoint #81.

23.18. Low Discharge Pressure

If the discharge pressure drops below the value of the setpoint for the time specified in the 'Time (sec)' field, the compressor will be Locked Out and a LOW DISCHARGE alarm generated. Refer to section setpoint #85.

23.19. High Discharge Temperature (SAFETY IS ALWAYS CHECKED)

If the discharge temperature analog input rises above the value of the setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field, the compressor will be Locked Out and a HIGH TEMPERATURE alarm generated. Refer to section setpoint #87.

23.20. High Motor Temperature or Motor Fault (SAFETY IS ALWAYS CHECKED)

If the high motor temperature input rises above the value of the setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field, the circuit will be Locked Out and a HIGH MOTOR TEMPERATURE or MOTOR FAULT alarm generated. Refer to section setpoint #95.

23.21. High Oil Temperature

If the oil temperature rises above the value of the setpoint or the digital input turns ON for the time specified in the Time (sec)' field, the compressor will be locked out and a HIGH OIL TEMPERATURE alarm generated. Refer to section setpoint #94.

23.22. High Motor Amperage

If the amperage analog input rises above the value of the compressor's respective FLA setpoint #171 – 190 times the value of setpoint #75 or the digital input turns ON for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a HIGH MOTOR AMP alarm generated. Refer to section setpoint #75.

23.23. Low Motor Amperage

If the amperage analog input drops below the value of the compressor's respective FLA setpoint #171 – 190 times the value of setpoint #76 or the digital input turns ON for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a LOW MOTOR AMP alarm will be generated. Refer to section setpoint #76.

23.24. No Compressor Proof

If a compressor is called to be on and the compressor proof digital input is OFF, a NO COMP PROOF alarm will be generated. Refer to section setpoint #96.

23.25. High Oil Seal Temperature (Screw Compressors only)

If the oil seal temperature analog input rises above the value of the setpoint for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a HIGH OIL SEAL alarm generated. This safety is by-passed when the compressor is in a Pump Down state. Refer to section setpoint #93.

23.26. Dirty Oil Filter (Fixed Step Compressors only)

If the difference between the discharge pressures minus the oil pressure is above the value of the setpoint for the time specified in the Time (sec)' field, a DIRTY OIL FILTER alarm will generate. Refer to section setpoint #97.

23.27. Low Discharge Superheat

If the discharge superheat is below the value in setpoint for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a LOW DISCHARGE SUPERHEAT alarm will be generated. Refer to section setpoint #84.

23.28. Low Discharge Superheat

If the discharge superheat is below the value in setpoint for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a LOW DISCHARGE SUPERHEAT alarm will be generated. Refer to section setpoint #84.

Chapter - 24. RTU Safeties & Faults

24.1. High Static Pressure

When the supply fan is on, the duct static pressure will be tested for a high condition. If the duct static pressure is greater than the value of setpoint #149 for the safety time of this setpoint a HIGH STATIC pressure alarm message will be generated and the unit will be placed in a lockout condition. The system will attempt to restart if this setpoint is setup for auto restart.

24.2. Low Static Pressure

When the supply fan is on, the duct static pressure will be tested for a low condition. If the duct static pressure is less than the value of setpoint #146 for the safety time of this setpoint a low static pressure alarm message will be generated and the unit will be placed in a lockout condition. The system will attempt to restart if this setpoint is setup for auto restart.

24.3. Supply Fan VFD Fault

If the 'Supply Fan Speed Fault' in the Ventilation Info section, is used and this sensor is on for a time greater than the safety time of setpoint #150, indicates that a fault condition exists with the supply fan's VFD. An alarm message with the name in setpoint #150 will be generated for information purposes only there will be no change to the operation of the unit.

24.4. Exhaust Fan VFD Fault

If the 'Exhaust Fan Speed Fault' in the Ventilation Info section, is used and this sensor is on for a time greater than the safety time of setpoint #221, indicates that a fault condition exists with the exhaust fan's VFD. An alarm message with the name in setpoint #221 will be generated for information purposes only there will be no change to the operation of the unit.

24.5. Return Fan Fault

If the 'Return Fan Fault' in the Ventilation Info section, is used and this sensor is on for a time greater than the safety time of setpoint #102, indicates that a fault condition exists with the return fan. An alarm message with the name in setpoint #102 will be generated for information purposes only there will be no change to the operation of the unit.

24.6. MOD Gas Alarm

If the MOD GAS option has been specified and the 'MOD Gas Fault' in the Heating Info section, is used and this sensor is on for a time greater than the safety time of setpoint #148, indicates that a fault condition exists with the mod gas heating unit. An alarm message with the name in setpoint #148 will be generated for information purposes only there will be no change to the operation of the unit.

24.7. No Ignition Alarm

If either heating option MOD Gas or Direct Fire is selected a proof of ignition is required. This can be indicated either with a digital input, 'Ignition Indicator' if specified or if not specified by the system seeing an increase in the control temperature, refer to setpoint #186. If proof of ignition has not occurred within the time specified in setpoint #186 the associated heating relay with be locked off and an NO IGNITION alarm will be generated.

24.8. SCR Heating Alarm

If the MOD SCR option has been specified and the 'MOD SCR Fault' in the Heating Info section, is used and this sensor is on for a time greater than the safety time of setpoint #147, this indicates that a fault condition exists with the mod SCR heating unit. An alarm message with the name in setpoint #147 will be generated for information purposes only there will be no change to the operation of the unit.

24.9. Clogged Filter Alarm

If the 'Clogged Filter' in the Ventilation Info section, is used and this sensor is on for a time greater than the safety time of setpoint #227, indicates that a clogged filter condition exists. An alarm

message with the name in setpoint #227 will be generated for information purposes only there will be no change to the operation of the unit.

24.10. Energy Wheel Alarm (No Rotation)

If a heat wheel has been specified and the 'Heat Wheel Rotation' in the Heating Info section, is used and this sensor is off indicating no rotation of the wheel after the heat wheel has been called to be on for a time greater than the bypass safety time of setpoint #188, this indicates that the heat wheel is not rotating. An alarm message will be generated for information purposes only there will be no change to the operation of the unit.

24.11. Energy Wheel Alarm (Fault)

If a heat wheel has been specified and the 'Heat Wheel Fault' in the Heating Info section, is used and this sensor is on indicating that a fault has occurred with the heat wheel after the heat wheel has been called to be on for a time greater than the bypass safety time of setpoint #188, this indicates that a heat wheel fault exists. An alarm message with the name in setpoint #188 will be generated for information purposes only there will be no change to the operation of the unit.

24.12. Smoke Alarm

If the 'Smoke Alarm Indic' in the General Info section, is used and this sensor is on a smoke

condition exists. An 'OFF-SMOKE ALARM' alarm message will be generated for information. Both the RTU Unit state and the Cooling State are set to 'OFF SMOKE ALARM'; the supply and exhaust fan will be off, outside air dampers will be closed and all cooling and heating stages will be off.

24.13. Fire Alarm

If the 'Fire Alarm Indic' in the General Info section, is used and this sensor is on a fire condition

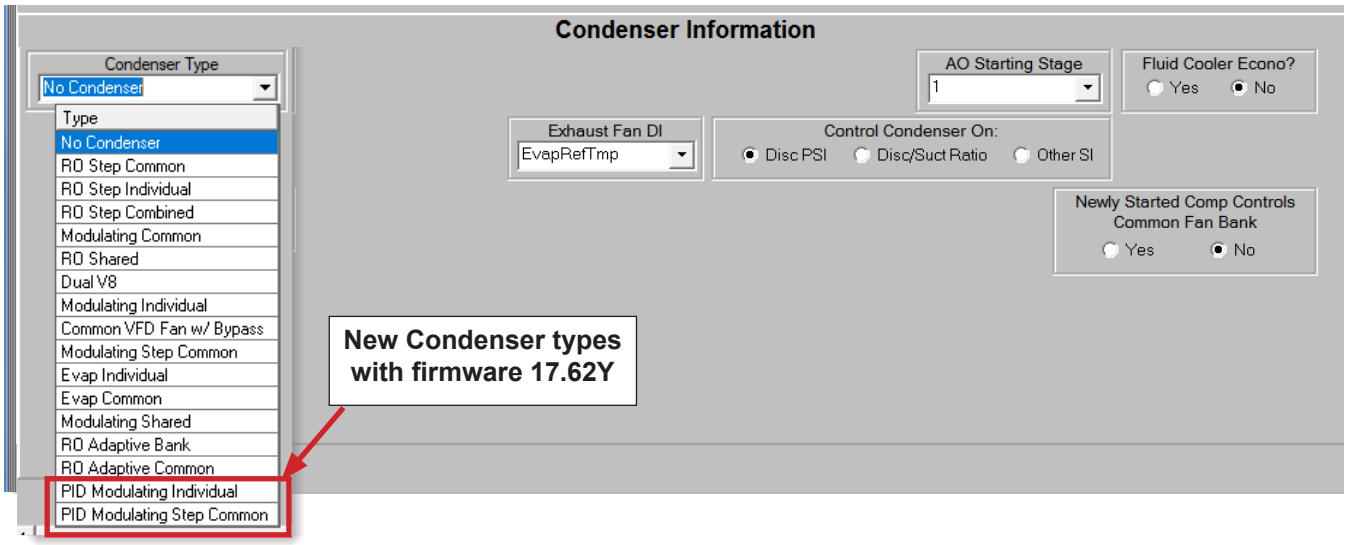
exists. An 'OFF-FIRE ALARM' alarm message will be generated for information. Both the RTU Unit state and the Cooling State are set to 'OFF FIRE ALARM'; the supply and exhaust fan will be off, outside air dampers will be closed and all cooling and heating stages will be off.

24.14. Smoke Purge Alarm

If the 'Smoke Purge' in the General Info section, is used and this sensor is on and the smoke alarm is off then the system will enter a smoke purge condition. A 'SMOKE PURGE' alarm message will be generated for information. Both the RTU Unit state and the Cooling State will 'SMOKE PURGE' the system will remain in this state until the purge indicator goes off.

Chapter - 25. Condenser Types Supported by the Magnum

Many condenser types are supported by the Magnum controller including individual condensers per circuit, shared condensers between multiple circuits, and common condensers for all circuits. The type of condenser plus the number of Relay Outputs needed are specified in MCS-Config.



The Magnum supports the following Condenser Types:

- No Condenser

  No condenser specified.

- RO Step Common

  The highest discharge pressure from any compressor on the system will be the controlling pressure.

- RO Step Individual

  Each compressor will have one or more condenser Relay Outputs associated with it. The discharge pressure on that compressor will be the control pressure for its own condenser.

- RO Step Combined

  The highest discharge pressure from either of the compressors on the shared circuits will be the controlling pressure (circuits 1 and 2 are shared, circuits 3 and 4 are shared, circuits 5 and 6 are shared, and circuits 7 and 8 are shared).

- Modulating Common

  The highest discharge pressure from any compressor on the system will be the controlling pressure. The Analog Output is modulated based on the Rate of Change of the controlling discharge pressure. It can also be controlled on a selected sensor input.

- Modulating Step Common

  This type of condenser has a common fan bank for the system. The control will be on the systems highest discharge pressure. The Relay Outputs are also supported along with an Analog Output.

- Modulating Individual

  Each compressor will have its own condenser Analog Outputs associated with it. The Analog Output for each circuit is modulated based on its own discharge pressure Rate of Change. It can also be controlled on a selected sensor input. You may also select Relay Outputs to be turned ON/OFF while modulating the Analog Output.

- RO Shared

  This type of condenser will take the highest discharge pressure of circuits 1 and 2, then 2 and 3, then 3 and 4, etc. to use as the control discharge pressure. This condenser type does not have the option to bypass the startup compressor.

- Dual V8

  This special type of condenser is a common control air condenser with two stages of fans plus a VFD Fan. Control of the fan speed will be different depending on whether one or two stages are on. All compressors are in the same fan bank with the highest discharge pressure being the control.

- Common VFD Fan with Bypass

  Three consecutive Relay Outputs, an Analog Output, and a VFD fault indicator are required to control this type of condenser. RO's needed:

  1) VFD LOAD–This relay will be ON indicating the fan can be used.

  2) VFD BYPS–This relay will be OFF unless a VFD fault has occurred.

  3) VFD ENAB–This relay will be ON unless a VFD fault has occurred.

  During normal operation, VFD LOAD will be on, VFD BYPS will be off, and VFD ENAB will be on. The fan will be modulated as required by the condenser or economizer logic. If a fault occurs, all relays will be turned off and the VFD will be set to 0. The Magnum will wait for the time specified in Setpoint #90 "COND FAULT" before the fan will be run without VFD control if it is needed by the condenser logic (economizer logic will not function in this condition). Once this time has passed and the condenser logic calls for the fan, then VFD BYPS will be turned on thereby turning the fan on, however it will NOT be modulated.

  The Magnum can also support a variable speed fan for all three of the air type of condensers. Each compressor can support a variable speed fan. The variable speed must be on the first Relay Output associated with that compressor.

  Note 1: The discharge temperature must be at least 117° F and the discharge superheat needs to be at least 20° F to guarantee good oil separation.

  Note 2: Condenser staging is critical if the Magnum is to function in different climates. The best option for air-cooled chillers is to have each fan on its own contactor and a frequency drive on fan 1. This configuration allows the most optimum control in all weather.

- Modulating Step Common

  Similar to the Modulating Common type with the addition of relay outputs. The highest discharge pressure from any compressor on the system will be the controlling pressure. The Analog Output is modulated based on the Rate of Change of the controlling discharge pressure. It can also be controlled on a selected sensor input. When the analog output reaches it maximum value and more cooling is required the next relay will be turned on and the analog output value will be set to its minimum value.

- Evap Individual

  Evaporative condensers are used to improve the condensers efficiency by spraying water over the condensing coil from above while air is blown up through the coil from below. Each compressor will have its own condenser Analog Outputs associated with it. The Analog Output for each circuit is modulated based on its own discharge pressure Rate of Change. It can also be controlled on a selected sensor input. You may also select Relay Outputs to be turned ON/OFF while modulating the Analog Output.

- Evap Common

  Evaporative condensers are used to improve the condensers efficiency by spraying water over the condensing coil from above while air is blown up through the coil from below .Similar to the Modulating Common type with the addition of relay outputs. The highest discharge pressure from any compressor on the system will be the controlling pressure. The Analog Output is modulated based on the Rate of Change of the controlling discharge pressure. It can also be controlled on a selected sensor input. When the

analog output reaches it maximum value and more cooling is required the next relay will be turned on and the analog output value will be set to its minimum value.

- RO Adaptive Bank– Air cooled Condenser Fan Control

  Used to control the condenser fan relay outputs for a single compressor, multiple compressors on the same refrigerant circuit, or a bank of condenser fans for multiple refrigerant circuits. If single compressor the condenser fans are stage on/off based on the compressor discharge pressure. If multiple compressor or refrigerant circuit, then the high discharge of the running compressors is used to stage condenser fans.

- RO Adaptive Common – Air Cooled Condenser Fan Control

  Used to control the condenser fan relay outputs for all the refrigerant circuits on the unit. This control logic finds the high discharge pressure on the running compressors and uses it to stage on/off the condenser fan relays.

- PID MOD Individual

  Required software:
  Config version 18.01V or later
  Connect version 18.31 or later
  Firmware 17.62Y (all firmware except LWC MAG and CPM MAG)

  Each compressor will have its own condenser Analog Outputs associated with it.
  PID control will turn an analog output into a stand alone PID controlled output. This output will have a controlling sensor that modulates the AO to a maintain target. This logic will run all the time.

- PID Step Common

  Required software:
  Config version 18.01V or later
  Connect version 18.31 or later
  Firmware 17.62Y (all firmware except LWC MAG and CPM MAG)

  This type of condenser has a common fan bank for the system. The control will be on the systems highest discharge pressure.

  PID control will turn an analog output into a stand alone PID controlled output. This output will have a controlling sensor that modulates the AO to a maintain target. This logic will run all the time.

25.1. Condenser Introduction

25.1.1 RO Step Condenser Cut In – Out Logic

The Cut In and Cut Out Logic Setpoints are as follows:

Setpoint #45 “CND STG1 ON” - Condenser stage 1 Cut In (ON).
Setpoint #46 “CND STG1 OFF” - Condenser stage 1 Cut Out (OFF).
Setpoint #47 “CND DIFF ON“ - Cut In differential for additional condenser stages for (ON).
Setpoint #48 “CND DIFF OFF” - Cut Out differential for additional condenser stages (OFF).
Setpoint #49 “CND MIN RUN” - Minimum run time for a condenser stage

Condenser Relay Outputs will be turned on based upon the value in Setpoint #45 “CND STG1 ON”. When discharge pressure reaches this value, the first condenser Relay Output is turned on. If additional condenser outputs are present, they will be turned on when the pressure exceeds the cut in value plus the value contained in Setpoint #47 “CND DIFF ON“. When discharge pressure falls, the condenser outputs will be turned off based upon the Setpoint #46 “CND STG1 OFF” plus the value contained in Setpoint #48 “CND DIFF OFF”. The first step will be turned off when discharge pressure falls below Setpoint #46 “CND STG1 OFF”.

Example: COND FAN 1 ON at 200 psi (Discharge)

Setpoint #45 “CND STG1 ON” = 200 psi	COND FAN 1 OFF at 170 psi
Setpoint #46 “CND STG1 OFF”= 170 psi	
Setpoint #47 “CND DIFF ON” = 20 psi	COND FAN 2 ON at 220 psi (200 + 20)

Setpoint #48 “CND DIFF OFF” = 5 psi
COND FAN 2 OFF at 175 psi (175 + 5)
COND FAN 3 ON at 240 psi (220 + 20)
COND FAN 3 OFF at 180 psi (175 + 5)

25.1.2 RO Step Condenser with Variable Speed Fan

The Setpoints for variable speed fan control are as follows:

Setpoint #54 “CND MIN SPD” - Minimum variable speed allowed.

Setpoint #55 “CND MAX SPD“ - Maximum variable speed allowed.

The purpose of the variable speed fan is to reduce the cycling of the fans by adjusting the speed of the variable fan point. This control works in conjunction with the Cut In and Cut Out logic of each compressor. When a fan is turned on, the speed of the variable point for that compressor is set to maximum allowed percentage. As the discharge pressure falls, the fan speed is adjusted proportionally. When the minimum is reached the fan will turn off.

25.1.3 Condenser Control

The Condenser Control logic is run with every pass of the algorithm.

25.1.3.1. Common Terms

Information that relates to condensors on the circuit

	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV Control	Suction Group	Comp Name/ID
	0	1	Not Used	Not Used	1	Suct Spht	1	1
	0	2	Not Used	Not Used	2	Suct Spht	2	2
	0	3	Not Used	Not Used	3	Suct Spht	3	3

Condenser Fan Bank:

Indicates which circuits share common condenser fans or are individually controlled.

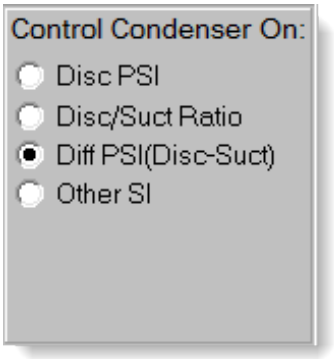
Suction Group:

Indicates which circuits share a common suction line.

Fluid Cooler Econo?option:

Specifies if the Fluid Cooler Economizer (if used) can use the condenser fans or VFD.

25.1.3.2. Control Discharge Pressure Calculation



If control is based on discharge pressure, all types of condensers will operate in the following sequence. For compressors within the same fan bank or suction group, the compressor with the highest discharge pressure will be held as the control pressure, regardless if the compressors are running or not.

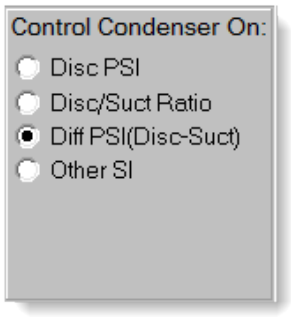
The newly started compressor will have the controlling discharge pressure even if it is not the highest value in order for it to build pressure (startup mode is defined as the compressor has been on for less than 5 minutes and its discharge pressure is less than the value of Setpoint #45 “CND STG1 ON” minus the value of Setpoint #47 “CND DIFF ON”). However, this logic will be overruled if another compressor sharing the same condenser approaches the high discharge safety (if discharge pressure rises above calculated value of Setpoint #81 “HI DISC PSI” minus #83 “HI DISC RELOAD”)

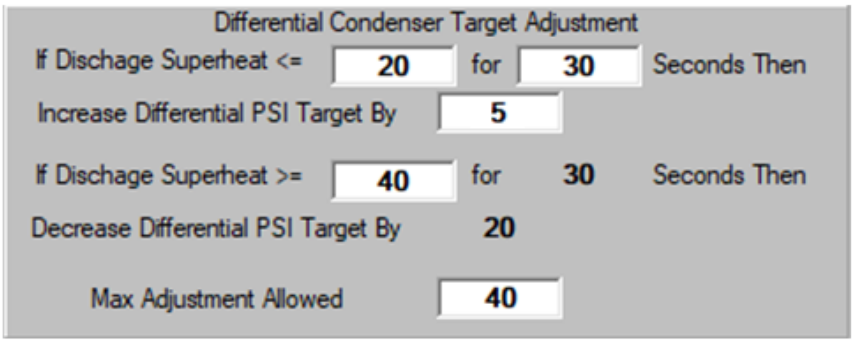
If control is based on Other SI, the value of that sensor is always used as the control discharge pressure.

Control Condenser On:

- **Disc PSI–**The Magnum will check for the compressor with the highest discharge and use that as the controlling pressure.
- **Disc/Suct Ratio** - Control logic will be the same as Disc PSI control except the ratio of the discharge pressure to the suction pressure will be used as the control. Note changes to related set points will be required.
- **Diff PSI(Disc-Suct) -**

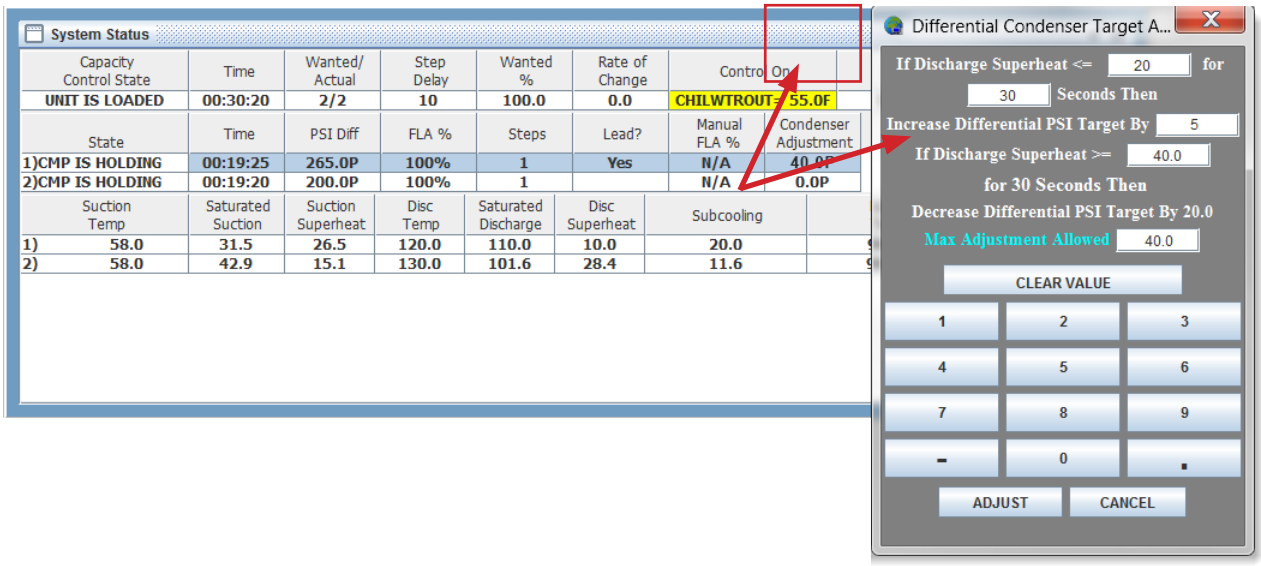
HVAC FIRMWARE VERSION 17.34 and up





MCS-CONFIG VERSION 18.01G and up
MCS-CONNECT VERSION 18.20.06 and up
NEW LOGIC ADDED WITH THESE UPDATES

This logic will utilize the calculated differential pressure (Discharge Pressure/Suction Pressure) to control the condenser.

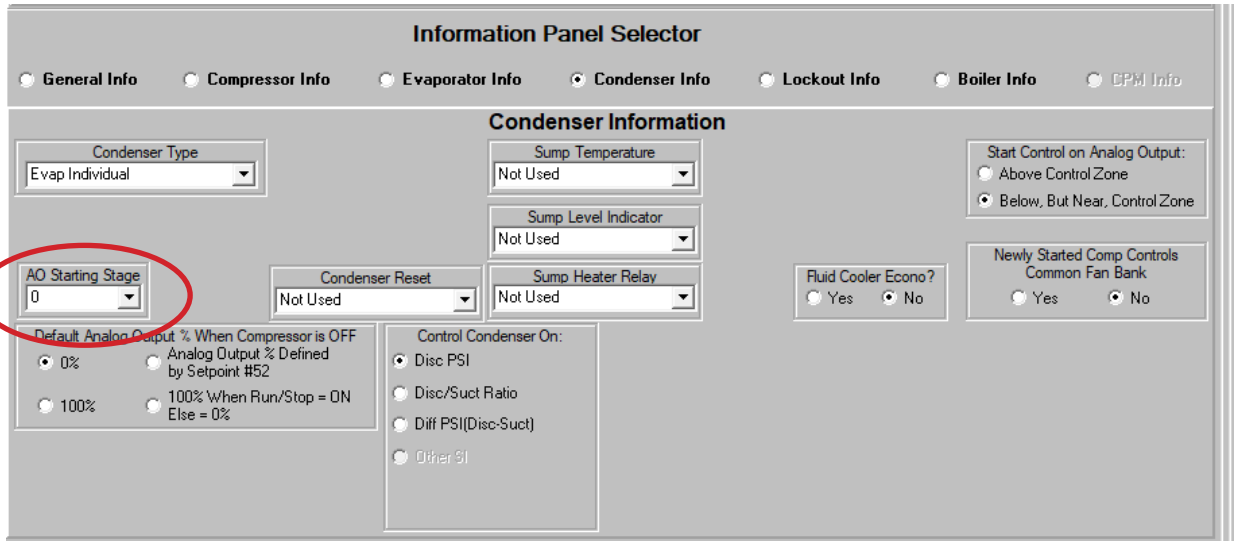


All condenser setpoints will remain the same for both modulating and step control.

When Diff PSI is selected the below information will become editable in the config program.

Here you will be able to customize adjustments to the differential target based on discharge superheat being low or high.

In this config example if discharge superheat falls below 20 degrees for 30 seconds then the differential target will be increased by 5 psi. If 30 more seconds goes by and the discharge superheat has not increased above 20 degrees then we will do another increase of 5 psi to the target. The adjustments will continue all the way up to a maximum of 40 psi defined by our “Max Adjustment Allowed” box. Once discharge superheat is between the high and low settings the adjustment will hold where it’s currently at.

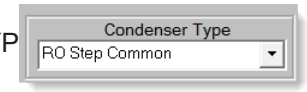


The logic works the same exact way when the discharge superheat rises above 40 degrees only we will decrease the differential every 30 seconds by 5 psi all the way back down to a 0 psi adjustment. The adjustments cannot go to a negative value.

MCS-CONNECT SCREEN ADJUSTMENT - Diff PSI(Disc-Suct

- **Other SI** - Control logic will be the same as Disc PSI control except the value of the sensor that is specified will be used as the control. Note changes to related set points will be required. When this option is selected a “Other Control Sensor” window will enable the sensor to be selected.

To use ‘Other SI’, the condenser type must be a ‘COMMON TYP



The Magnum will not check for the compressor with the highest discharge pressure but will always use the value of the sensor that is selected as the control.

25.1.3.3. Condenser Reset

If Diff PSI(Disc-Suct) is selected as your 'control condenser on' in the MCS Config program you’ll have a “Condenser Adjustment” box in your system status window through MCS Connect. Here you will see the adjustments made to your condenser target based on the discharge superheat. If you’re at least “Factory” authorized you can double click the value in the condenser adjustment box, it will open a window as you see in the example which will allow you to make changes to how the adjustments are made.

If sensor is specified its value will be added to the condenser control set points #45, #46 and #50.

25.1.3.4. Condenser Low Ambient

When a compressor is started its discharge pressure will be used as the controlling pressure for five minutes,

enabling that compressor to build head pressure. However, if Setpoint #204 COND LOW AMB is active and there is an ambient temperature sensor reading less than this Setpoint, then this compressor's discharge pressure will remain in control for an additional time as specified in the "Time (sec)" field.

25.1.3.5. Condenser Related Setpoints

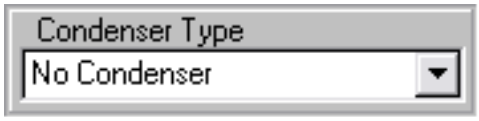
The following are Condenser related Setpoints:

45	CND STG1 ON (RO Type)	When the discharge pressure is above this value, turn on the first stage of the condenser fans. 'Time (sec)' field: (Applies to compressors with shared condensers) If non-zero, then the compressor in startup state will not be in sole control of the condenser fans, it will control off of highest discharge pressure. If zero, then compressor in startup will have sole condenser control for 5 minutes. This option is selected in in the 'Newly started Comp Controls Common Fan Bank' box in the 'Condenser Information' panel under the MAGNUM screen.
46	CND STG1 OFF (RO Type)	If stage 1 of condenser capacity is on and the discharge pressure drops below this value, then turn this stage off.
50	CND TRGT (Modulating Type)	Target logic will try to maintain by modulating the AO. SP must be set up as target type. Hi/Low zones are used for setting control zone. If target type in HP mode, setback is added to target.

25.2. CONDENSER TYPES

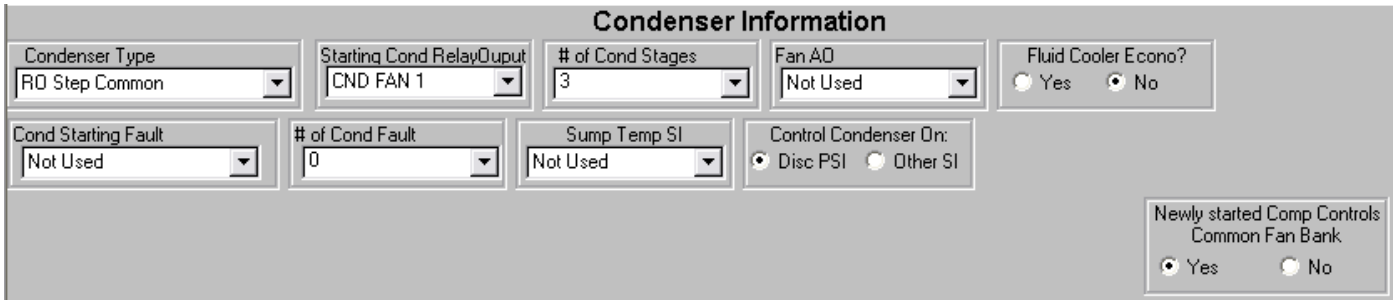
25.2.1 No Condenser

This option indicates there is no condenser associated with this unit.



25.2.2 RO Step Common

The RO Step Common of condenser has one bank of fans. Make sure that all compressors in the Circuit Base point to the same common fan bank. The above example does not have a Fan Analog Output and there are three stages of fans starting with CND FAN 1 relay. All stages must be consecutive Relay Outputs.



For example:

Setpoint #	Name	Value
45	CND STG1 ON	200.0P
46	CND STG2 OFF	170.0P
47	CND DIFF ON	15.0P
48	CND DIFF OFF	5.0P

Discharge control pressure is 200.0 P, CND FAN 1, first condenser stage will be turned on.

If control pressure is equal to or greater than 215.0 P then the second stage will be turned on. (200.0 + (15.0 * 1))

If control pressure is equal to or greater than 230.0 P then the third stage will be turned on. (200.0 + (15.0 * 2))

Discharge control pressure is above 230.0 P; all three condenser stages are on.

When the control pressure drops below 180.0P the third condenser stage will be turned off. (170.0 + (5.0 * 2))

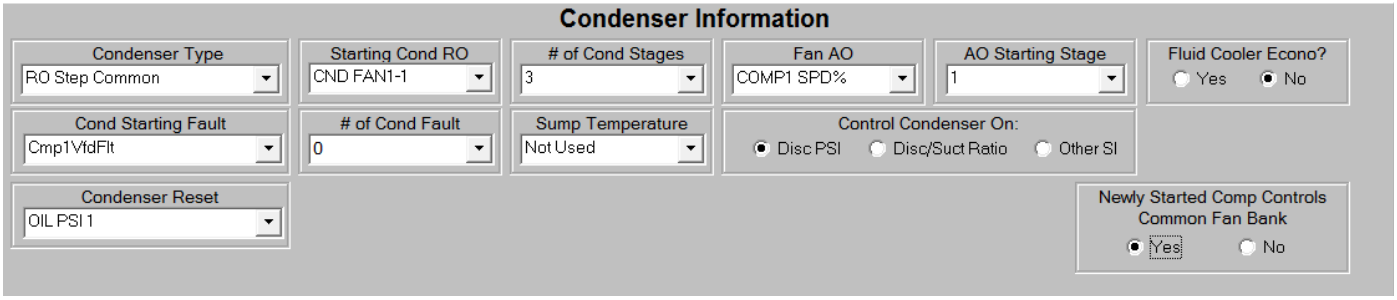
When the control pressure drops below 175.0P the second condenser stage will be turned off. (170.0 + (5.0 * 1))

When the control pressure drops below 170.0P the first condenser stage will be turned off. (170.0)

Condenser Faults

This example has no condenser faults. If used, and any one of the digital inputs are ON for the time specified in Setpoint #90 if active, then the unit will be locked out and an alarm message will be generated.

25.2.2.1. RO Step Common with a Fan AO and Condenser Faults



The above example is the same as the previous example with the addition of a Fan AO and two condenser faults.

Fan AO Control (same for all types of air condenser control)

Two more Setpoints than the previous example are needed to control the speed of the fan:

Setpoint #	Name	Value
54	CND MIN SPD	20.0%
55	CND MAX SPD	100.0%

CND FAN 1 will be turned on when the control pressure is equal to or greater than 200.0, same as in previous example. At this point the Fan AO speed will be set to its maximum value, Setpoint #55. If the pressure changes between 170.0 and 214.9 the fan speed will also be modulated proportionally between its maximum and minimum settings. If the pressure is at 185.0 the fan speed will be set to 61.2%. If the pressure is at 190.0 the fan speed will increase to 75.0%. This will provide precision control in maintaining optimum discharge pressure.

If the pressure increases to 215.0 the condenser's second stage will be turned on and the fan speed will also be at 100.0%. If the pressure changes between 175.0 and 229.9 the fan speed will also be modulated proportionally between its maximum and minimum settings.

If the pressure increases to 230.0 the condenser's third stage will be turned on and the fan speed will also be at 100.0%. If the pressure changes between 180.0 and 229.9 the fan speed will also be modulated proportionally between its maximum and minimum settings. If the pressure is at 230.0 and above the fan speed will be at 100.0%.

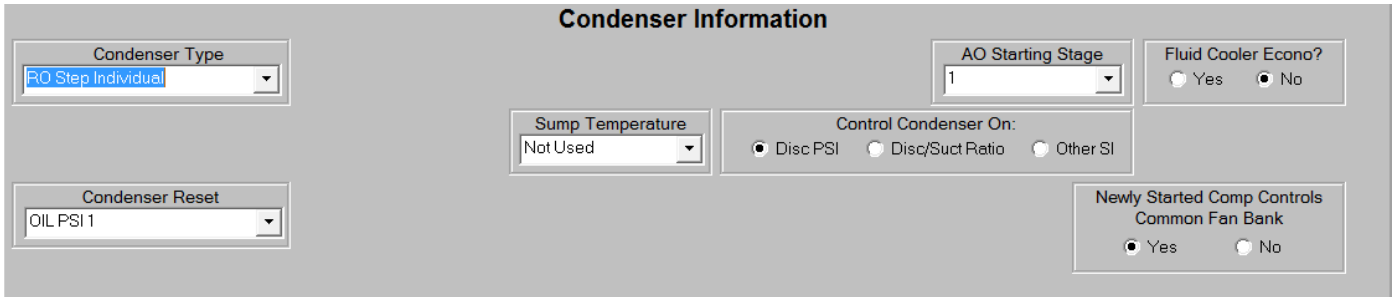
As the pressure decreases toward the Cut Out point the fan speed will decrease toward its minimum setting. Once a stage is turned off, the fan speed will be set to 100.0% and again it will be modulated based upon the pressure.

Condenser Faults

This example has two condenser faults. They must be consecutive digital input types starting with FAN FLT

1. If either of these digital inputs are ON for the time specified in Setpoint #90 if active, then the unit will be locked out and an alarm message will be generated.

25.2.3 RO Step Individual



The RO Step Individual has a bank of fans for each compressor. The number and location of the fan are specified under the Circuit Base screen.

Information that relates to condensors on the circuit

Circuit # (reset button)	# of Cond ROs	Starting Condensor RO	Condensor Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV Control	Suction Group	Comp Name/ID
1 ...	3	CND FAN 1	Not Used	Not Used	0	1	Not Used	Not Used	1	Suct Spr	1	1
2 ...	3	CND FAN 2	Not Used	Not Used	0	2	Not Used	Not Used	2	Suct Spr	2	2

# of Cond ROs –Total number of Relay Outputs of each compressor, in this example there are 3. The number of fans in each compressor does not have to be the same.

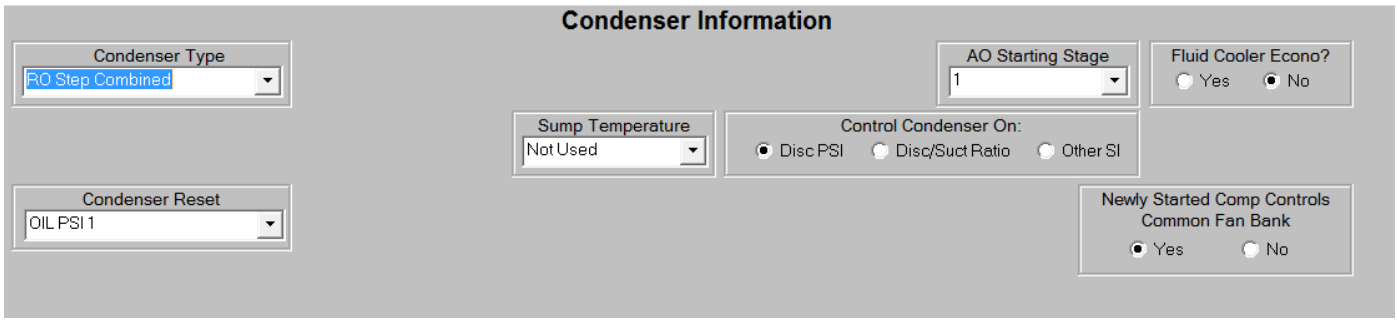
Starting Condenser RO – The starting condenser Relay Output. All the Relay Outputs specified for each circuit must follow consecutively to this point. In this example CND FAN 1 is the starting Relay Output for circuit 1 and the other 2 fans follow consecutively in the RO screen.

Condenser Fan AO–If a condenser fan AO was specified in this cell it would function as described in the example in section 7.74.3.6 RO Step Common with a Fan AO and Condenser Faults. There is no condenser fan AO in this example.

Starting Condenser Fault–If there were condenser faults specified in this cell they would function as described in the example in section 7.74.3.6 RO Step Common with a Fan AO and Condenser Faults. There are no condenser faults in this example.

 # Cond Faults – Total number of Condenser Faults.

Cond Fan Bank – In this type of condenser all compressors should have a different fan bank.



Each compressor fan bank is controlled individually. The discharge pressure for each compressor is used to control condenser logic.

25.2.4 RO Step Combined

The RO Step Combined has a bank of fans that are shared by two consecutive circuits. The number and location of the fans are specified in the Circuit Base screen. This is similar to the RO Step Individual set up except only every other compressor has a condenser fans associated with it.

Information that relates to condensors on the circuit													
	Circuit # (reset button)	# of Cond ROs	Starting Condensor RO	Condensor Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV Control	Suction Group	Comp Name/ID
	1 ...	3	FAN 1&3 #1	Not Used	Not Used	0	1	Not Used	Not Used	1	Suct Spr	1	1
	2 ...	0	Not Used	Not Used	Not Used	0	1	Not Used	Not Used	2	Suct Spr	2	2
	3 ...	3	FAN 2&4 #1	Not Used	Not Used	0	3	Not Used	Not Used	3	Suct Spr	3	3
	4 ...	0	Not Used	Not Used	Not Used	0	3	Not Used	Not Used	4	Suct Spr	4	4

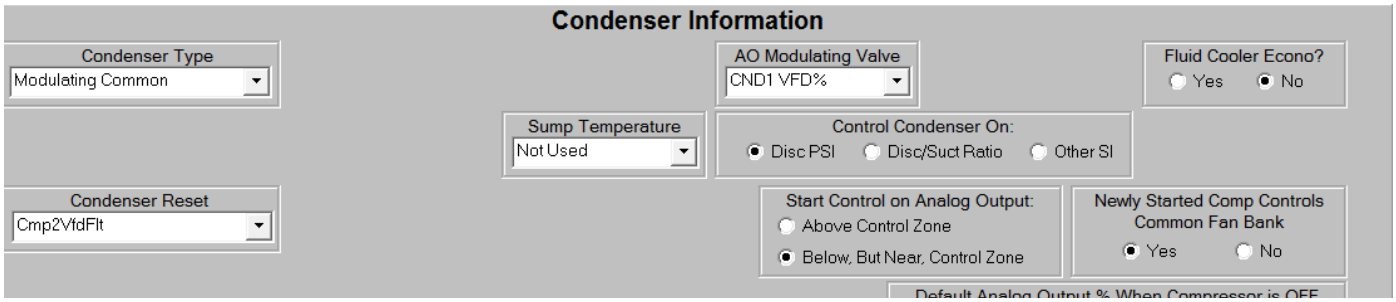
Circuit 1 and 2 will share the same fan bank specified in the ‘Cond Fan Bank’ cell. Circuit 3 and 4 will also share the same fan bank specified. The highest discharge pressure between the two compressors on each respective circuit will be used as the control pressure for their fan bank.

Condenser Faults

If any of these digital inputs are ON for the time specified in Setpoint #90 if active, then both compressors sharing that condenser will we will be locked out and an alarm message will be generated. This example has no condenser faults.

25.2.5 Modulating

25.2.5.1. Modulating Common



This type of condenser uses water for condenser cooling. The AO Modulating Valve will modulate the cold water valve based upon the system’s highest discharge pressure.

48	CND ADJ DELAY (Modulating Type)	If active this is the time in seconds between condenser adjustments to the AO. If inactive, then 30 seconds will be used as the delay. If type is DELAY: (required for condenser relay delays). -MIN VFD Opening cell contains the time delay between turning on a relay and moving the AO to its minimum position (Setpoint #52). -MAX VFD Opening cell contains the time delay between turning off a relay and moving the AO to 100%.
49	CND START % (Modulating Type)	If active, then the value is the starting % for the AO when the RO that is tied to it turns on. The value in the “Time (SEC)” cell is the AO starting stage. If no Relays are used when CMP starts set value.
50	CND TARG (Modulating Type)	Target logic will try to maintain by modulating the AO. SP must be set up as target type. Hi/Low zones are used for setting control zone. If target type in HP mode, setback is added to target.
51	CND ADJ DIV (Modulating Type)	Controls scaling of the amount the AO is adjusted (usually 1). The larger the number the smaller the AO adjustment as the adjustment will be divided by this value.

52	CND MIN % (Modulating Type)	Minimum AO % allowed. If compressor is off, then check the “Time (SEC)” field: If 0, then the AO % will be set to the value of this Setpoint. If 2 and the run/stop is set to run, then set the AO % to 100%, else set the AO % to 0%. This option is selected in the “Default Valve Opening % when Comp. is OFF” box in the condenser information section in the MAG HVAC screen.
53	CND ROC- (Modulating Type)	Maximum negative rate of change allowed. If the rate of change is less than this Set-point, then stop modulating the AO. The absolute value of this Setpoint also serves as the maximum positive rate of change allowed. If the rate of change is greater than the absolute value of this Setpoint, then stop modulating the AO.
54	CND ADJ MULT (Modulating Type)	Controls scaling of the amount the AO is adjusted. The larger the number the larger the AO adjustment as the adjustment will be multiplied by this value.
55	CND MIN ADJ (Modulating Type)	The value in this Setpoint is the minimum % the AO will be modulated when a change is made.

Note 1: The purpose of Setpoint #193 ‘CND HI/LO ZONE’ and the delays in the MAX AND MIN VFD Opening cells for Setpoint #48 ‘CND ADJ DELAY’ are to prevent repeated cycling of additional stages.

Note 2: The purpose of Setpoint #194 ‘CND 2nd ZONE’ is to prevent the discharge pressure from over shooting the target (Setpoint #50 ‘CND TARG’). The way the logic works is if the discharge pressure is in the 2nd Zone and the pressure is falling less than twice the CND ROC- (Setpoint #53 ‘CND ROC-‘) then a negative adjustment will be made to the AO. If the discharge pressure is raising more than twice the rate of change (Setpoint #53) then a positive adjustment will be made to the AO.

Note 3: The value in the “AO Starting Stage” cell under the MAG HVAC screen in the condenser info section is the stage that has to be turned on to begin modulating the AO.

The following applies to both the modulating common and individual water condenser types:
The ‘Default Valve Opening % when Comp. is OFF’ cell can be used to set the valve (1) to be completely closed (0%), (2) the value of Setpoint #52 (Valve % defined by Setpoint #52), or (3) completely open (100% if the Run/Stop indicator = ON else = 0%).

The delay timer will be decremented by a standard value of 1 every second, however if the control discharge pressure is more than 15.0 psi (1.5 bar) away from the target Setpoint #50, then the delay will be decremented by 2; if more than20.0 psi (2.0 bar) away from the target then the delay will be decremented by 4.

When the delay counts down to zero, an adjustment will be made based on the equation:
(Control discharge pressure – Setpoint #50) × Setpoint #54 ÷ Setpoint #51 = Adjustment Value.

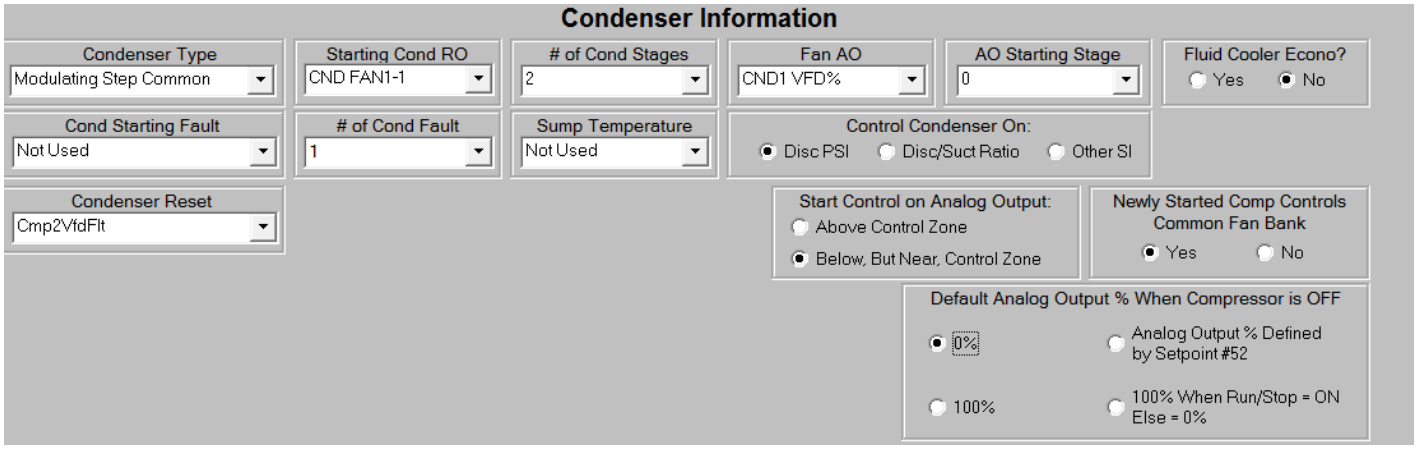
When the control discharge pressure is greater than Setpoint #50 plus the value in the high zone:
If the control discharge pressure rate of change is dropping too fast (more than twice the value of Setpoint #53), then close the valve by the calculated adjustment. If the control discharge pressure rate of change is dropping too slowly (more than the value of Setpoint #53), then open the valve by the calculated adjustment. Else make no adjustment.

When the control discharge pressure is less than Setpoint #50 minus the value in the low zone:
If the control discharge pressure rate of change is increasing too fast (more than twice the value of Setpoint #53), then close the valve by the calculated adjustment. If the control discharge pressure rate of change is increasing too slowly (more than the value of Setpoint #53), then open the valve by the calculated adjustment. Else make no adjustment.

When the control discharge pressure is within the zone: If the control discharge pressure rate of change is increasing more than the value of Setpoint #53, then close the valve by 1 percent. If the control discharge pressure change is decreasing more than the value of Setpoint #53, then open the valve by 1 percent.

Modulating Condenser Type: If heat pump and the mode is HEAT (not in defrost) all condenser relays will be turned on and the VFD set to 100% when compressor is turned on. If the control pressure is above the control zone, the condenser will unload; if below the control zone the condenser will load else there will be no change.

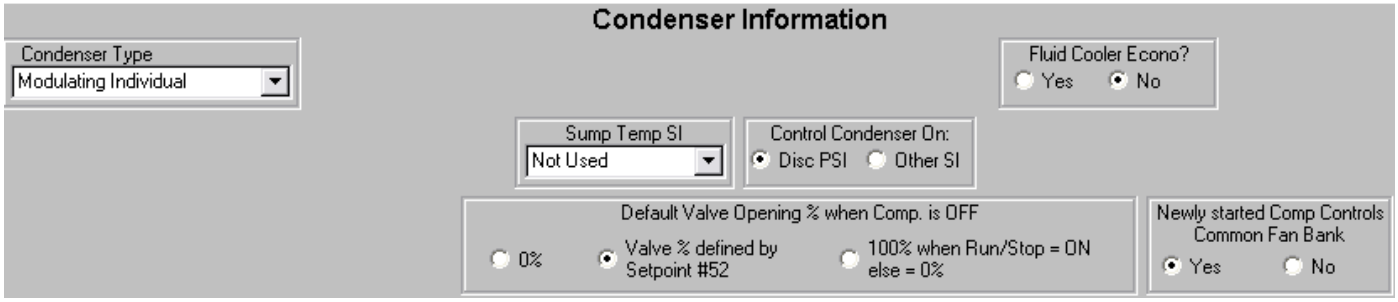
25.2.6 Modulating Step Common



When a RO is being used with an AO the AO will key off the RO turning on. The RO will turn on when the discharge pressure enters the bottom of the CND HI/LO ZONE (Setpoint #193). At that time the AO will move to its starting % (Setpoint #49). The AO will stay at its starting % until the discharge pressure gets outside the top of the CND HI/LO ZONE (Setpoint #193). At that point the AO will modulate based on Setpoints #51, #53-55. Now if there are 2 RO's tied to the AO and the "AO Starting Stage" is 1 then once the AO gets to 100% the 2nd RO will be turned on after a delay (value in the "MIN VFD Opening" cell for Setpoint #48) and the AO will be set back to its minimum % (Setpoint #52) and then modulate as described above. Now if the pressure begins to fall and goes below the CND HI/LO ZONE (Setpoint #193) the AO will modulate. Once the AO gets to its minimum % (Setpoint #52) the 2nd RO will be turned off after a delay (value in the "MAX VFD Opening" cell for Setpoint #48) and the AO will be set back to 100% and continue to modulate as needed.

If the "AO Starting Stage" is 2 then when the discharge pressure enters the bottom of the CND HI/LO ZONE (Setpoint #193) the 1st RO (stage 1) will be turned on. The 2nd RO will turn on once the discharge pressure gets outside the Heating Info CND HI/LO ZONE (Setpoint #193) and the delay has been met (value in the "MIN VFD Opening cell" for Setpoint #48) at that time AO will be set to its starting % (Setpoint #49). If the discharge falls below the CND HI/LO ZONE (Setpoint #193) the AO will begin to modulate. Once the AO reaches its minimum % (Setpoint #52) it will turn off the associated RO after a delay (value in the "MAX VFD Opening" cell for Setpoint #48). The 1st RO will remain on until the discharge pressure falls below the CND HI/LO ZONE (Setpoint #193) and the delay has been met (value in the "MAX VFD Opening" cell for Setpoint #48).

25.2.6.1. Modulating Individual

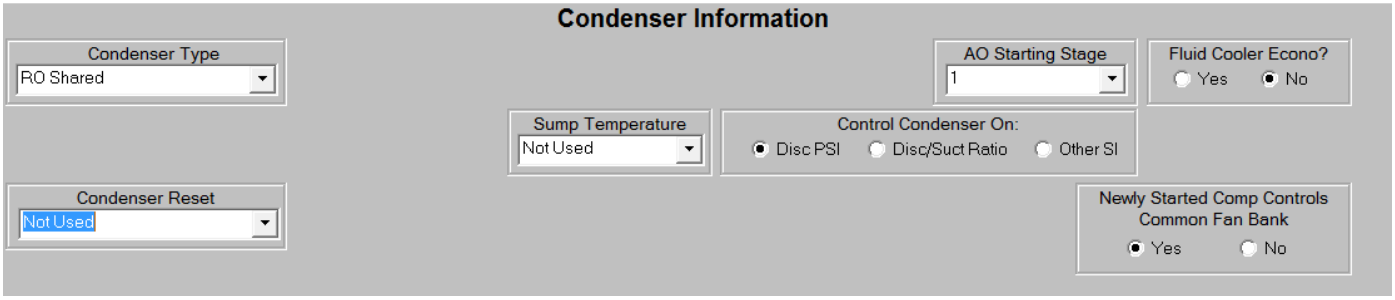


This type of condenser uses water to provide cooling to the compressors. The AO Modulating Valve will modulate the cold water based upon this discharge pressure for each circuit. You may also select Relay Outputs to be turned ON/OFF while modulating the Analog Output.

The individual condensers must be set up in the Circuit Base screen.

The control will be similar to the Modulating Common type, except that the discharge pressure for each circuit will control its own condenser.

25.2.7 RO Shared



The RO Shared condenser has banks of fans that are shared between two consecutive circuits. The number and location of the fans are specified under the Circuit Base screen. This is similar to the RO Step Individual set up. Circuits 1 and 2 will share the fan bank that is specified in the circuit 1 grid in the Circuit Base screen. The highest discharge pressure of these two compressors will be used to control this bank of fans. Circuits 2 and 3 will share the fan bank that is specified in the circuit 2 grid in the Circuit Base screen. The highest discharge pressure of these two compressors will be used to control this bank of fans. In a unit with three circuits, circuit three will not have a fan bank associated with it. It shares circuit 2's fan bank.

25.2.8 Dual V8

This is a special type of condenser. It is a common circuit control type with two stages of fans and VFD. The control of the fan speed will be different depending on whether one or two stages are on. All circuits are checked to calculate the control discharge pressure, and should be in the same fan bank.

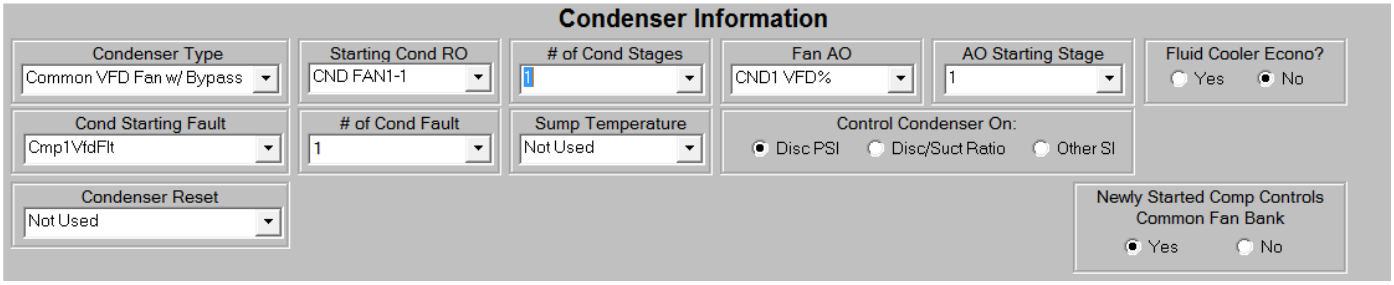
If the control discharge pressure is less than Setpoint #45, then both condenser stages are off and the fan speed is zero.

If the control discharge pressure is greater than Setpoint #45 and less than Setpoint #46 stage 1 will be on. The fan speed will be equal the value of (Setpoint #55 minus Setpoint #54) divided by (Setpoint #46 minus Setpoint #45) and then multiplied by (control discharge pressure minus Setpoint #46) plus Setpoint #54.

If the control discharge pressure increases while in stage 1 above the value of Setpoint #46 plus Setpoint #48 for the time contain in Setpoint #49 stage 2 will be entered. Both relays will be on and the fan speed will be equal the value of (Setpoint #55 minus Setpoint #54) divided by Setpoint #46 and then multiplied by (control discharge pressure minus Setpoint #46) plus Setpoint #54.

If the speed of the condenser fan is less than Setpoint #54 it will be set to that value or if the speed of the condenser fan is greater than Setpoint #55 it will be set to that value.

25.2.9 Common VFD Fan w/Bypass



The Common VFD Fan with a Bypass type of condenser has one fan. All circuits will use this fan; make sure that all circuits in the Circuit Base point to the same common fan bank. The above setup shows that there is one condenser stage. However this type requires the following three consecutive Relay Outputs to be set up. For example:

1-5	...	VFD LOAD
1-6	...	VFD BYPASS
1-7	...	VFD ENABLE

This type of condenser requires one condenser fault. If the fault occurs then the VFD will be bypassed and the fan will run at 100% if needed.

45	CND STG1 ON (RO Type)	When the discharge pressure is above this value, turn on the first stage of the condenser fans. 'Time (sec)' field: (Applies to compressors with shared condensers) If non-zero, then the compressor in startup state will not be in sole control of the condenser fans, it will control off of highest discharge pressure. If zero, then compressor in startup will have sole condenser control for 5 minutes. This option is selected in the 'Newly started Comp Controls Common Fan Bank' box in the 'Condenser Information' panel under the MAGNUM screen.
	PID MOD Individual PID Step Common	Uses PID condenser control KP (Proportional). Setup as setpoint.
46	CND STG1 OFF (RO Type)	If stage 1 of condenser capacity is on and the discharge pressure drops below this value, then turn this stage off.
	PID MOD Individual PID Step Common	If active, uses Multiplier for Ki adjustments, (Integral Delay). Setup as setpoint
54	CND MIN SPD (RO Type)	Minimum speed percentage for variable speed condenser control.
	CND ADJ MULT (Modulating Type)	Controls scaling of the amount the AO is adjusted. The larger the number the larger the AO adjustment as the adjustment will be multiplied by this value.
55	CND MAX SPD (RO Type)	Maximum speed percentage for variable speed condenser control.
	CND MIN ADJ (Modulating Type)	The value in this Setpoint is the minimum % the AO will be modulated when a change is made.

Fan control when there is no fault:

The highest discharge pressure of all the compressors is the control value.

The first relay, VFD LOAD, is on and the second relay, VFD BYPASS, is off.

When the control discharge pressure is greater than the value of Setpoint #45, then the third relay (VFD ENABLE) will be turned on and the VFD will be set to the value of Setpoint #55. If the control discharge pressure decreases the VFD will be modulated between Setpoints #54 and #55 based upon the control discharge pressure.

Assume Setpoint values:

45	CND STG1 ON	250 psi
46	CND STG1 OFF	170 psi
54	CND MIN SPD	20%
55	CND MAX SPD	100%
90	COND FAULT	30s

When the discharge control pressure is greater than 250 psi the relay VFD ENABLE will be on and the VFD on the fan will be set to 100%. If the discharge control pressure drops to 210, then the fan speed will be set to 60%. The discharge control pressure is half of its Cut In and Cut Out range (250 – 170 = 80 / 2 = 40= 170 = 210) therefore, the VFD will be positioned to half of its range (100 –20 = 80 / 2 = 40 + 20 = 60). The VFD will continue to be modulated in this matter until the discharge control pressure drops below 170. Then the VFD will be at 0% and relay VFD ENABLE will remain on. If the pressure goes above 170 the VFD will be modulated. For example if the discharge control pressure goes to 190.0 the VFD will be set to 50%.

Fan control when a fault occurs:

If a fault occurs, an alarm message will be generated, relay VFD LOAD will Lock off, relay VFD ENABLE will be off, the VFD speed will be set to 0% and the bypass, VFD BYPASS, will be enabled if needed after waiting for 30 seconds, Setpoint #90. Once the fan bypass is enabled and the discharge control pressure goes above 250 psi the bypass will be turned on enabling the fan to run at 100% and it will remain on regardless of the discharge control pressure.

If the fault resets itself, and is no longer on, the state of VFD LOAD will be set to AUTO, the VFD BYPASS relay will be turned off and VFD will be enabled to control the fan speed if it is needed.

54	CND MIN SPD	20%
55	CND MAX SPD	100%
90	COND FAULT	30s

When the discharge control pressure is greater than 250 psi the relay VFD ENABLE will be on and the VFD on the fan will be set to 100%. If the discharge control pressure drops to 210, then the fan speed will be set to 60%. The discharge control pressure is half of its Cut In and Cut Out range (250 – 170 = 80 / 2 = 40= 170 = 210) therefore, the VFD will be positioned to half of its range (100 –20 = 80 / 2 = 40 + 20 = 60). The VFD will continue to be modulated in this matter until the discharge control pressure drops below 170. Then the VFD will be at 0% and relay VFD ENABLE will remain on. If the pressure goes above 170 the VFD will be modulated. For example if the discharge control pressure goes to 190.0 the VFD will be set to 50%.

Fan control when a fault occurs:

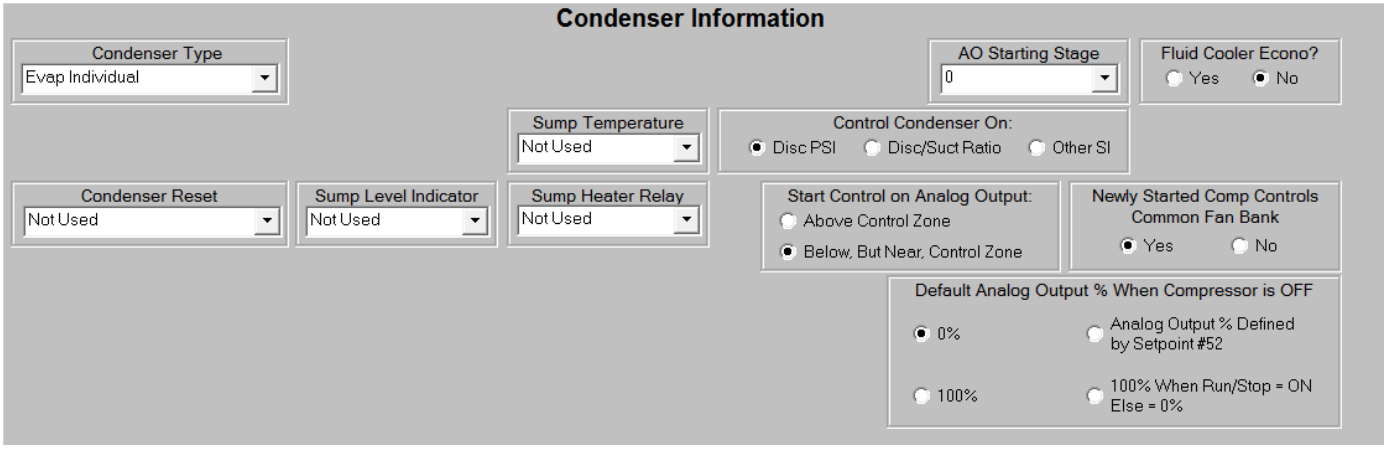
If a fault occurs, an alarm message will be generated, relay VFD LOAD will Lock off, relay VFD ENABLE will be off, the VFD speed will be set to 0% and the bypass, VFD BYPASS, will be enabled if needed after waiting for 30 seconds, Setpoint #90. Once the fan bypass is enabled and the discharge control pressure goes above 250 psi the bypass will be turned on enabling the fan to run at 100% and it will remain on regardless of the discharge control pressure.

If the fault resets itself, and is no longer on, the state of VFD LOAD will be set to AUTO, the VFD BYPASS relay will be turned off and VFD will be enabled to control the fan speed if it is needed.

25.2.10 Evaporative types of Condenser Control

Evaporative condensers are used to improve the condensers efficiency by spraying water over the condensing coil from above while air is blown up through the coil from below.

Two types are support:



- Evap Individual Step, has the same control logic as Modulating Individual.

- Evap Common, has the same control logic as Modulating Common.

In addition to the standard control logic, the evaporative spraying water requires addition input.

Sump Temperature, this sensor will provide the temperature of the sump, area where the spray water is held.

Sump Level Indicator, if set point #249 and a digital input is specified, if it is continually on for the time greater than the value of the safety time of set point #249 a Sump Low Level alarm will be generated and this condenser will locked off. If the digital goes to an off state and the condenser is locked off, its state will be changed to auto and the condenser will be available.

Sump Heater Relay, if this relay and sump temperature sensor is specified and set point #250 is active, this relay will be turned on and off based upon the values of set point #250.

25.2.11 RO Adaptive Bank– Air cooled Condenser Fan Control

Used to control the condenser fan relay outputs for a single compressor, multiple compressors on the same refrigerant circuit, or a bank of condenser fans for multiple refrigerant circuits. If single compressor the condenser fans are stage on/off based on the compressor discharge pressure. If multiple compressor or refrigerant circuit, then the high discharge of the running compressors is used to stage condenser fans.

Relay Output Information Screen

Number	Name	Slide Mult.	Slide Div.	Slide Off.	Design Suc.PSI	Design Dis.PSI	Nominal Tonnage(of Step)	EXV Start (When Lead)	Type	EXV L Adjus
1-3 ...	CND FAN 1	——	——	——	——	——	——	——	Standard	——
1-4 ...	CND FAN 2	——	——	——	——	——	——	——	Standard	——

Circuit: 1

Singe Compressor

Information that relates to condensers on the circuit

Circuit # (reset button)	# of Cond ROs	Starting Condenser RO	Condenser Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	Evaporator EXV Control	Suction Group	Comp Name/ID
1 ...	2	CND FAN 1	Not Used	Not Used	0	1	Not Used	Not Used	1	Suct Spht	1	1

Tandem Compressors

Information that relates to condensers on the circuit

Circuit # (reset button)	# of Cond ROs	Starting Condenser RO	Condenser Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	Evaporator EXV Control	Suction Group	Comp Name/ID
1 ...	2	CND FAN 1	Not Used	Not Used	0	1	Not Used	Not Used	1	Suct Spht	1	1
2 ...	0		Not Used	Not Used	0	1	Not Used	Not Used	2	Suct Spht	1	2

Tandem Compressors- 2 Circuits

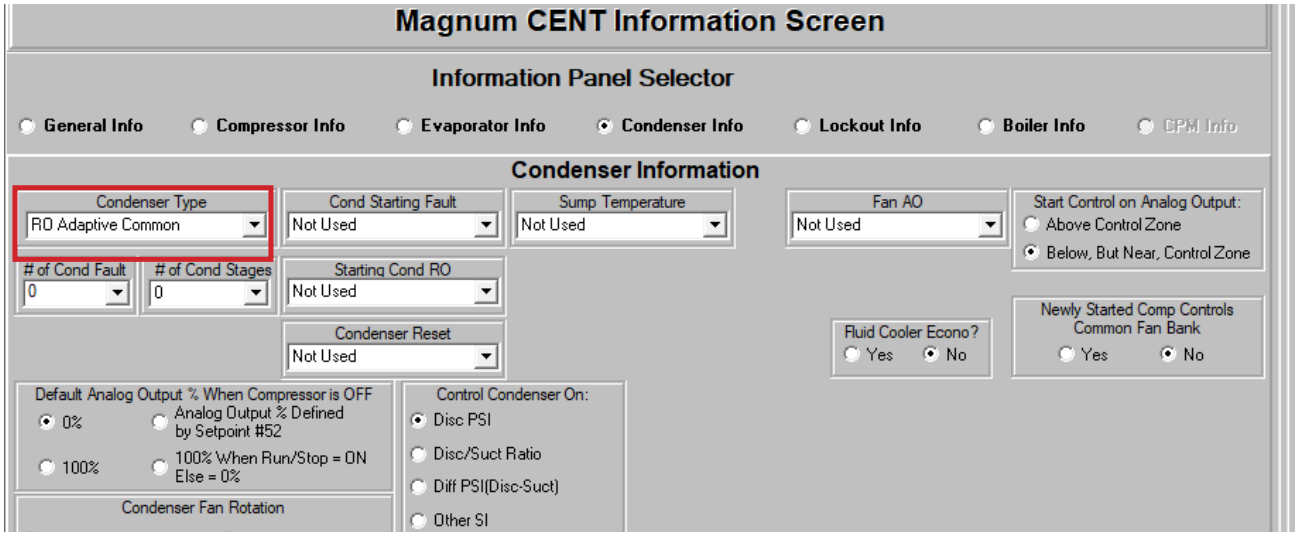
Circuit 1 and 2 will share the same fan bank specified in the 'Cond Fan Bank' cell. Circuit 3 and 4 will also share the same fan bank specified. The highest discharge pressure between the two compressors on each respective circuit will be used as the control pressure for their fan bank.

Information that relates to condensors on the circuit

	Circuit # (reset button)	# of Cond ROs	Starting Condensor RO	Condensor Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV Control	Suction Group	Comp Name/ID
	1 ...	3	FAN 1&3 #1	Not Used	Not Used	0	1	Not Used	Not Used	1	Suct Spt	1	1
	2 ...	0	Not Used	Not Used	Not Used	0	1	Not Used	Not Used	2	Suct Spt	2	2
	3 ...	3	FAN 2&4 #1	Not Used	Not Used	0	3	Not Used	Not Used	3	Suct Spt	3	3
	4 ...	0	Not Used	Not Used	Not Used	0	3	Not Used	Not Used	4	Suct Spt	4	4

25.2.12 RO Adaptive Common – Air Cooled Condenser Fan Control

Used to control the condenser fan relay outputs for all the refrigerant circuits on the unit. This control logic finds the high discharge pressure on the running compressors and uses it to stage on/off the condenser fan relays.



25.2.12.1. Adaptive Condenser Control Setpoints

Setpoint #45 "CND STG1 ON" – contains the value for turning on 1st condenser fan relay.

Setpoint #46 "CND STG2 OFF" – contains the value for turning off the 2nd condenser fan relay.

Setpoint #47 "CND DIFF ON" – contains the differential value for turning on the 2nd condenser fan., plus all the remaining condenser fan stages. This value is added to previous stage on value to calculate when to turn on the next condenser fan.

Setpoint #48 "CND DIFF OFF" – contains the differential value for turn off the 3rd condenser fan relay, plus all the remaining condenser fan stages. This value is added to the previous stage off value to calculate when to turn off the next condenser fan.

Setpoint #49 "CND STG1 OFF" – contains the value for turning off 1st condenser fan relay.

Setpoint #50 "CND TARG PSI" – contains the maximum adjusted value for turning on the last condenser stage.

A compressor must be operating for the condenser fans to operate. The definition of an operating compressor is a, compressor amps >= Low Amp limit or no amp sensor and compressor is in a running control state. The condenser relays (i.e. fans) will turn on based upon the value in setpoint STAGE 1 ON. When the discharge pressure exceeds this value, the first condenser relay is turned on. If additional condenser relays exist, they will be turned on when the pressure exceeds the previous cut in value (Stage 1 ON for the first stage) plus the value contained in STAGE DIFF ON setpoint.

Condenser relays (i.e. fans) will be turned off based upon the value in the setpoint STAGE 2 OFF (Stage 2 turn OFF point). As the discharge pressure is reduced, the condenser relay will be turned off based upon the STAGE 2 OFF setpoint, plus the value in STAGE OFF DIFF setpoint for each stage number above stage 2. Stage 1 of condenser staging will be turned off based upon the value in the setpoint (Stage 1 OFF).

Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint
45	CND STG1 ON	200	190	220	0.5	0	1	0	0	Active ...	PSI GAGE	View Only	Setpoint
46	CNC STG2 OFF	170	170	220	0.5	0	0	0	0	Active ...	PSI GAGE	View Only	Setpoint
47	CND DIFF ON	20	10	50	1	0	0	0	0	Active ...	PSI GAGE	View Only	Setpoint
48	CND DIFF OFF	10	5	50	1	0	0	0	0	Non-Active ...	PSI GAGE	View Only	Setpoint
49	CND STG1OFF	175	170	195	0.5	0	0	0	0	Active ...	PSI GAGE	View Only	Setpoint
50	CND TARG PSI	225	220	240	0.5	0	0	0	0	Active ...	PSI GAGE	View Only	Setpoint

25.2.12.2. Adaptive Control Logic

The Adaptive Condenser logic is a self-learning fan control. The adaptive self-learning logic offers reduced fan cycling and improved efficiency. The Adaptive Condenser Control Logic automatically adjusts the fan cut-in offset based upon the following criteria:

1. If the last stage fan turned on (including stage 1) is cycled off in 10 minutes or less, then an Adaptive Offset value will be incriminated by 5 PSI. This increases the stage 1 turn on value ("CND STG1 ON" plus Adaptive Offset) which in turn increases all the remaining fan on values. The Adaptive Offset will continue to increase, until fan cycling ceases or the adjusted turn on value for the last fan stage is greater than setpoint #50 "LastStgMax".
2. The Adaptive Offset value will be decreased by 5 PSI if the last fan to be turned on has not cycled off within 1 hour. The Adaptive Offset will continue to decrease by 5 PSI every 10 minutes unless fan cycling begins again.

The Adaptive Control Logic will only affect the condenser fan turn on logic, it will not affect the fan turn off logic.

25.2.12.3. Adaptive Rotation Logic

The adaptive condenser logic can be setup to rotate the condenser fans based on first on/first off or the lead condenser fan can be forced to any one of the condenser fans. Setpoint #46 is used to setup/control the type of rotation.

If setpoint #46 is not setup as "TIME" type of setpoint no rotation is done and lead condenser fan is forced to the first condenser fan relay output.

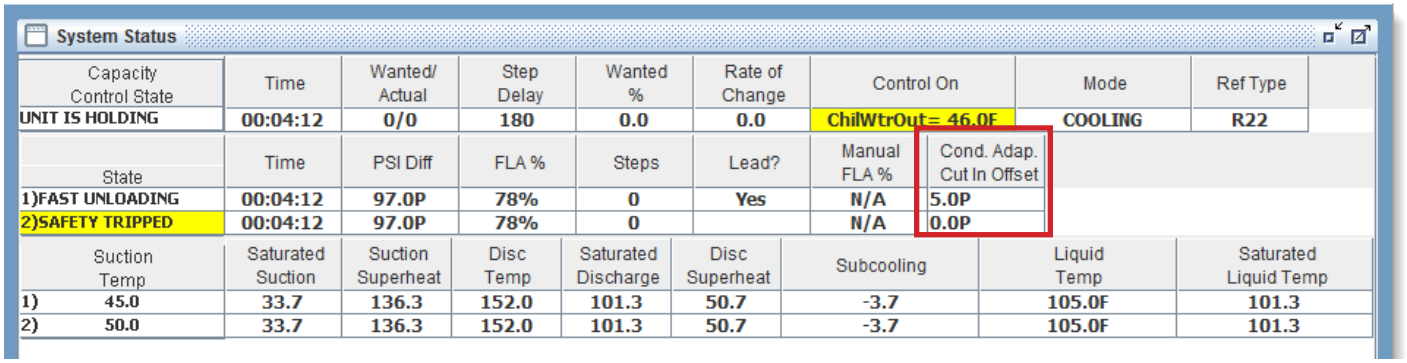
If setpoint #46 is setup as a "TIME" type

- And the value of the "Time" column is Zero, then first on/first off rotation is performed. The rotation occurs when a fan is required to cycle off by the pressure cut out value.
- And the value of the "Time" column is greater than zero and less than the max condenser stages, the lead condenser fan is set to the value in the "Time" field. For example, if the time column contains a 2, then the lead condenser fan is the second condenser fan in the relay output sequence.
- And if the value if the "Time" column is greater than the max condenser stages, the lead condenser fan is force to first condenser fan in the relay output sequence.

25.2.12.4. Viewing on MCS-CONNECT and MCS-MAGNUM LCD KEYPAD

25.2.12.4.1. MCS-Connect Display

New columns in the compressor section are being added to the control status window where the adaptive offset values will be display.



System Status

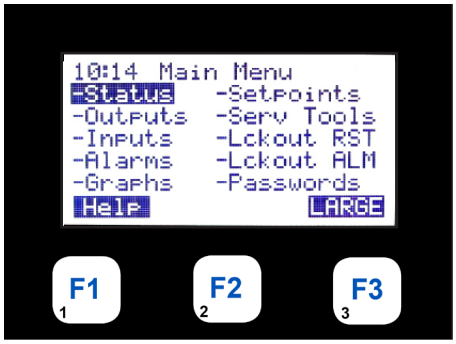
Capacity Control State	Time	Wanted/ Actual	Step Delay	Wanted %	Rate of Change	Control On	Mode	Ref Type
UNIT IS HOLDING	00:04:12	0/0	180	0.0	0.0	ChilWtrOut= 46.0F	COOLING	R22

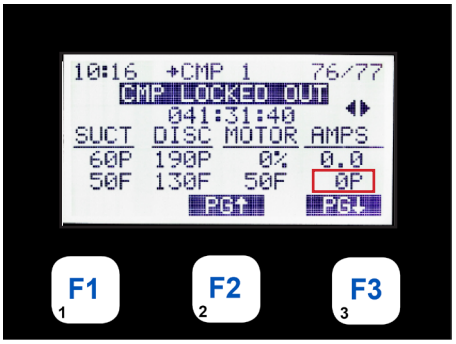
State	Time	PSI Diff	FLA %	Steps	Lead?	Manual FLA %	Cond. Adap. Cut In Offset
1)FAST UNLOADING	00:04:12	97.0P	78%	0	Yes	N/A	5.0P
2)SAFETY TRIPPED	00:04:12	97.0P	78%	0		N/A	0.0P

Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat	Subcooling	Liquid Temp	Saturated Liquid Temp
1) 45.0	33.7	136.3	152.0	101.3	50.7	-3.7	105.0F	101.3
2) 50.0	33.7	136.3	152.0	101.3	50.7	-3.7	105.0F	101.3

25.2.12.4.2. MCS-MAGNUM LCD KEYPAD

The adaptive Offset value can be viewed on the MCS-Magnum LCD/Keypad by selecting the “Status” option from the Menu screen. Once in the “Status” screens page down to the compressor 1st screen showing Compressor state, state timer, Suct, Disch, OPD, and Motor values. Then press the right arrow button one time to scroll over to view the AMPS. On the second line below the AMPS heading (not the first line below the heading which displays the comp amps) the Adaptive Offset value is displayed.





Chapter - 26. Condenser Logic using PID Control

Required to have the software below or later version

- Config version 18.01T or higher
- Connect version 18.31.15 or higher
- Firmware HVAC 17.62R2 or higher

PID control will turn an analog output into a stand alone PID controlled output. This output will have a controlling sensor that modulates the AO to a maintain target. This logic will run all the time. Setpoint Definitions

26.1. Setpoint Definitions used for Condenser PID Control Logic

SP#	SETPOINT NAME	DESCRIPTION
45	COND Kp	Kp is proportional change to discharge psi. = Control feedback change from last calculation * Setpoint Value.
46	COND Ki	Ki is the integral change to discharge psi taken at seconds interval specified in time field. = Condenser psi difference from Target * Setpoint Value.
47	COND Kd	Kd is derivate changed. The time field specifies the ROC time interval. = Last condenser psi – Current condenser psi * Setpoint Value.
49	COND START%	Specifies the condenser starting speed.
50	COND FAN TARG	Specifies the condenser discharge psi target. The target should provide a discharge temperature min of 140 F for good oil separation. (For 134a recommended min setpoint is 130) (For R410a recommended min setpoint is 325)
52	COND FAN MIN	Condenser fan minimum speed % allowed to run
55	COND MAX ADJ	Condenser fan maximum ± adjustment.

26.1.1 Recommended Setpoint Range (134A)

SP#	NAME	VALUE	MIN	MAX	ADJ VALUE	TIME (SEC)	MAX TIME ALW	SELECT # DEC	HI ZONE	LOW ZONE	SET BACK
45	COND Kp	.05	.O1	.10	0.01	0	0	DEC-02NOCH	-----	-----	-----
46	COND Ki	.05	.01	.10	0.01	60	900	DEC-02NOCH	-----	-----	-----
47	COND Kd	.05	.01	.10	0.01	5	20	DEC-02NOCH	-----	-----	-----
49	COND START%	59%	16	80	1	1	100	HUMD or %	-----	-----	-----
50	COND FAN TARG	132P	125	175	1	1	1	PSI GAGE	4	4	-----
52	COND FAN MIN	18%	18	50	0.5	1	1	HUMD or %	-----	-----	-----
55	COND MAX ADJ	10%	1	20	1	0	0	HUMD or %	-----	-----	-----

26.1.2 HVAC/RTU PID CONTROL DESCRIPTION

- Kp is calculated every second.
- Kd is calculated every sec based on the ROC over time specified in ‘TIME’ field.
- Ki adjustment is only allowed based on time delay specified in ‘TIME’ field.
- The Condenser pressure target is maintained within the ‘VALUE’ + ‘HI ZONE’ or – ‘LOW ZONE”.
- Kp, Kd & Ki are added together and a change is made if result is >1.

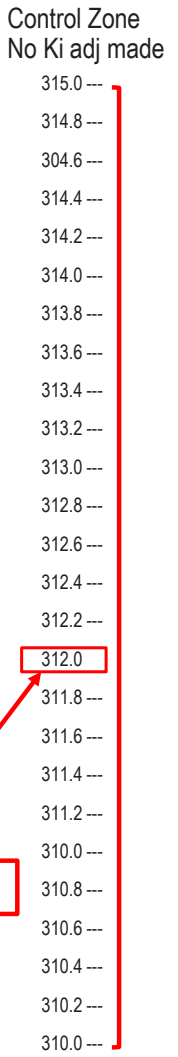
26.1.3 Example: SETPOINT INTERACTIONS & DEFINATIONS

SETPOINT #	SETPOINT NAME	ADJUST VALUE	TIME FIELD	PRINT CHAR	SETPOINT TYPE	HI ZONE	LOW ZONE	SETBACK
45	COND Kp	0.07	0	DEC 2	SETPOINT	-	-	-
46	COND Ki	0.05	120	DEC 2	SETPOINT	-	-	-
47	COND Kd	0.03	5	DEC 2	SETPOINT	0	0	0
49	COND START%	25	1	HUM%	SETPOINT	-	-	-
50	COND FAN TARG	322	1	PSI G	TARGET	3	2	-
52	COND FAN MIN	15.5	1	HUM%	SETPOINT	-	-	-

ROC TIME INTERVAL

Ki ADJ DLY

CTL ZN HIGH= 315.0
CTL ZN LOW = 310.0



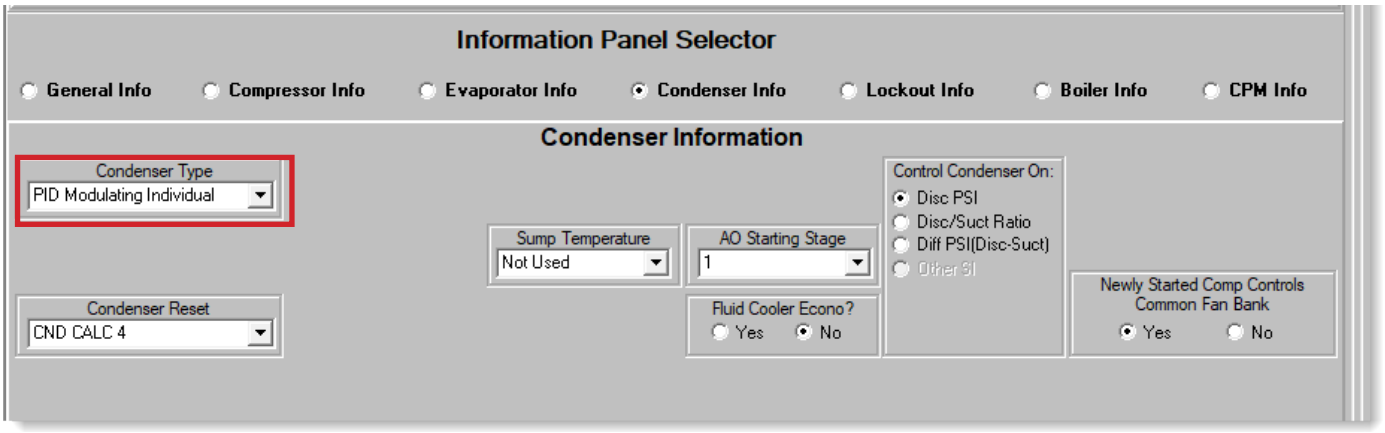
Target 312 +3 -2

SET POINTS ABOVE USED RTU SOFTWARE

4 ton scroll, 3 phase, frequency drive, 65 to 100%
Condenser Fan ECM motor 15.5 to 100%
Set Point 50 value should result in discharge temp >140^{0}F (Oil Separation)

26.1.4 PID Modulating Individual

- Each compressor will have ***its own condenser Analog Outputs associated with it.***
- The Analog Output for each ***circuit is modulated*** based on its own ***discharge pressure Rate of Change.***
- It can also be ***controlled on a selected sensor input***.
- You may also select **Relay Outputs** to be ***turned ON/OFF while modulating the Analog Output***.
- ***PID control*** will turn an analog output into a ***stand alone PID controlled output***.
- This output will have a controlling sensor that modulates the AO to a maintain target**.**
- This logic will run all the time.

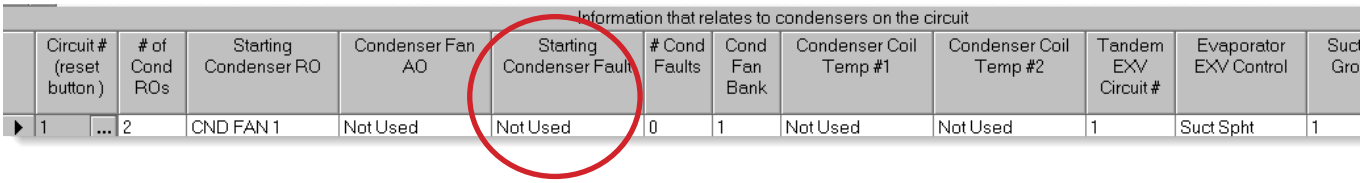


Setpoints used for PID Mod Individual and PID Step Common

45	CND STG1 ON (RO Type)	When the discharge pressure is above this value, turn on the first stage of the condenser fans. 'Time (sec)' field: (Applies to compressors with shared condensers) If non-zero, then the compressor in start-up state will not be in sole control of the condenser fans, it will control off of highest discharge pressure. If zero, then compressor in start-up will have sole condenser control for 5 minutes. This option is selected in the 'Newly started Comp Controls Common Fan Bank' box in the 'Condenser Information' panel under the MAGNUM screen.
	PID MOD Individual PID Step Common	If active, the value is the multipiler for the Proportional(Kp) adjustment, Setup as Setpoint Type
46	CND STG1 OFF (RO Type)	If stage 1 of condenser capacity is on and the discharge pressure drops below this value, then turn this stage off.
	PID MOD Individual PID Step Common	If active, uses Multiplier for Ki adjustments (Integral Time Delay). Setup as Time Field
47	CND DIFF ON (RO Type)	Differential pressure added to Setpoint #45 to set the threshold at which each additional stage of condenser capacity will turn on.
	PID MOD Individual PID Step Common	If active, use Multiplier for Kd adjustments, Setup as Time Field- Time (sec) field is ROC window

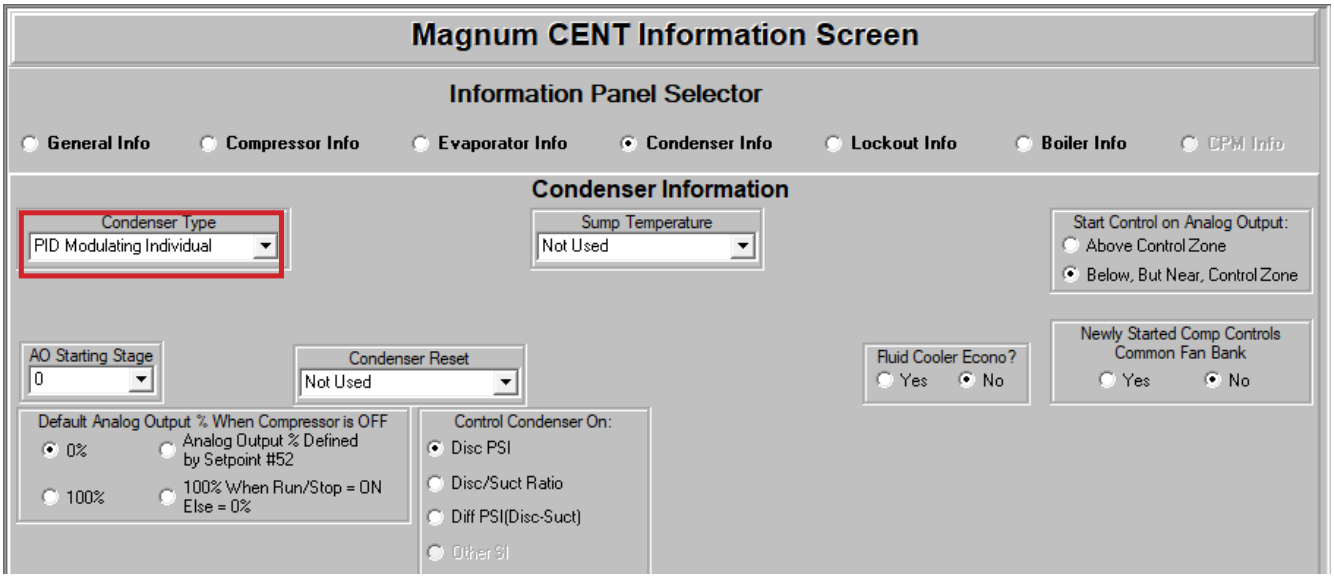
50	CND TRGT (Modulating Type)	Target logic will try to maintain modulating the AO. SP must be set up as target type and use the Hi/Low zones for the target control zone. **If target type in Heat Pump mode, setback is added to target.**
	LO AMB SUMP OFF (RO Type)	If active and ambient temperature is less than the value of this Setpoint, then the sump pump relay will be locked off if it is the starting condenser Relay Output. When the ambient temperature rises above the value of this Setpoint plus two times the value in Setpoint #192 “FRZ TEMP DIFF” if active (hard coded 15°F if inactive), then the sump pump relay will be allowed on again.
52	CND MIN % (Modulating Type)	Minimum AO % allowed. If compressor is off, then check the “Time (SEC)” field: If 0, then the AO % will be set to the value of this Setpoint. If 2 and the run/stop is set to run, then set the AO % to 100%, else set the AO % to 0%. This option is selected in the “Default Valve Opening % when Comp. is OFF” box in the condenser information section in the MAG HVAC screen.
55	CND MAX SPD (RO Type)	Maximum speed percentage for variable speed condenser control.
	CND MIN ADJ (Modulating Type)	The value in this Setpoint is the minimum % the AO will be modulated when a change is made.

Circuit Base settings



26.1.5 PID Step Common

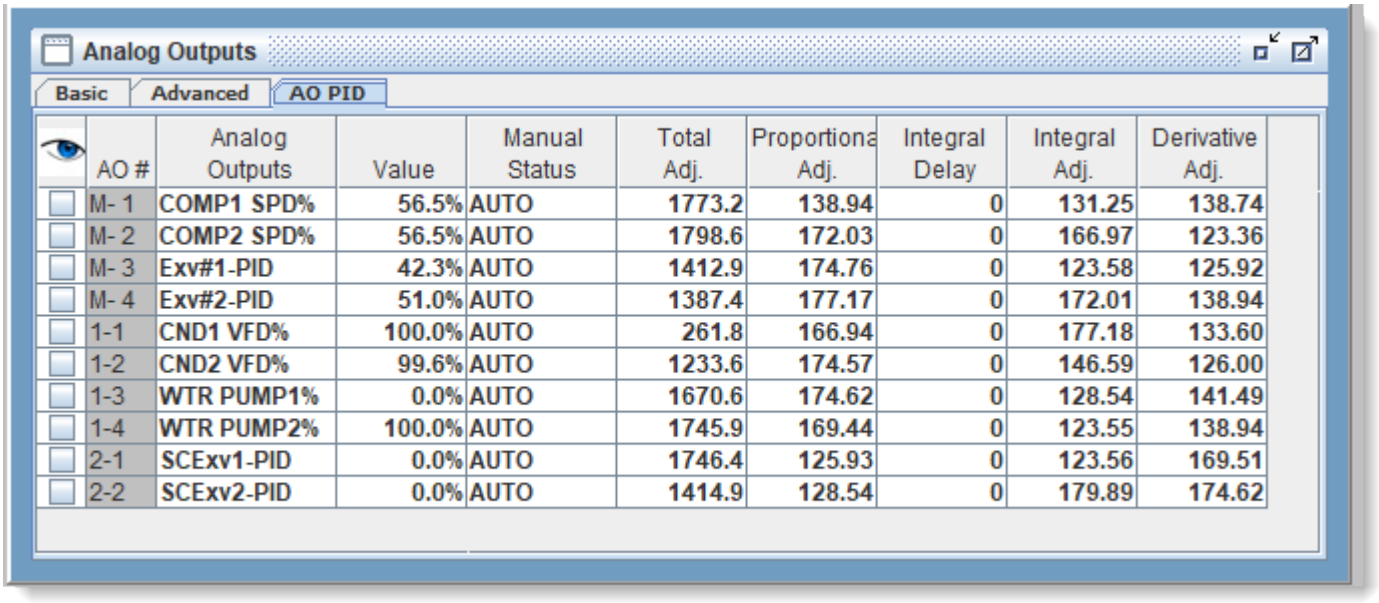
- This type of condenser has a ***common fan bank for the system.***
- The control will be on the systems ***highest discharge pressure.***
- The Relay Outputs are also supported along with an Analog Output.
- ***PID control*** will turn an analog output into a ***stand alone PID controlled output.***
- This output will have a controlling sensor that ***modulates the AO to a maintain target.***
- This logic will run all the time.



26.2. PID CONTROL

- **Control Target** - SI, AO, or Setpoint used as the target the AO will try to maintain.
- **AO** - Min to Max value the AO can modulate between.
- **Proportional(Kp)**
  Multiplier for Kp adjustments.
- **Integral(Ki)**
  Multiplier and delay between Ki Adjustments.
- **Derivative(Kd)**
  Multiplier and time in seconds interval to calculate Kd.
- **Adjustment Limits**
  Min and Max adjustments allowed to the AO per adjustment, both negative and positive.

Under the Analog Outputs window in the MCS Connect software. You'll find an AO PID tab that will show all of the PID CONTROL AOs and all of the calculated adjustments being made to those Analog Outputs. Here you will be able to see all three adjustments being made to the PID. This will assist you in any fine tuning required for the given analog output.



AO #	Analog Outputs	Value	Manual Status	Total Adj.	Proportiona Adj.	Integral Delay	Integral Adj.	Derivative Adj.
M- 1	COMP1 SPD%	56.5%	AUTO	1773.2	138.94	0	131.25	138.74
M- 2	COMP2 SPD%	56.5%	AUTO	1798.6	172.03	0	166.97	123.36
M- 3	Exv#1-PID	42.3%	AUTO	1412.9	174.76	0	123.58	125.92
M- 4	Exv#2-PID	51.0%	AUTO	1387.4	177.17	0	172.01	138.94
1-1	CND1 VFD%	100.0%	AUTO	261.8	166.94	0	177.18	133.60
1-2	CND2 VFD%	99.6%	AUTO	1233.6	174.57	0	146.59	126.00
1-3	WTR PUMP1%	0.0%	AUTO	1670.6	174.62	0	128.54	141.49
1-4	WTR PUMP2%	100.0%	AUTO	1745.9	169.44	0	123.55	138.94
2-1	SCExv1-PID	0.0%	AUTO	1746.4	125.93	0	123.56	169.51
2-2	SCExv2-PID	0.0%	AUTO	1414.9	128.54	0	179.89	174.62

Chapter - 27. Electronic Expansion Valve Control

27.1. Electronic Expansion Valve Control Logic (EXV)

The function of the thermostatic expansion valve is to hold a constant evaporator superheat.

The EXV is set up in MCS-Config as follows:

Relay Output Information Screen

Number	Name	Slide Mult.	Slide Div.	Slide Off.	Design Suc.PSI	Design Dis.PSI	Nominal Tonnage(of Step)	EXV Start (When Lead)	Type	EXV Load Adjust %	EXV Unld Adjust %
M-1 ...	COMP 1	——	——	——	——	——	0	28.5	Step w\ EXV		

For relay outputs for Type of Step w\ EXV:

'EXV Start (when Lead)' cell contains the EXV start percentage if this relay is the lead compressor.

'EXV Load Adjust %' cell contains the percentage of adjustment to the EXV when a step is added.

'EXV Unld Adjust %' cell contains the percentage of adjustment to the EXV when a step is deleted.

MAGNUM Circuit Base Screen

Information that relates to compressors on the circuit

Circuit # (reset button)	# of Comp ROs	Starting Compressor RO	Part Winding	Start Unload Bypass	Fast Unloader	Type of LLS	2nd LLS	Economizer	Econo Control	Unloading Stages	Loader Type	HGB	HG Reheat	Liquid Injection	Oil Equali
1	5	COMP 1	No	No	No	EXV&LLS	No	No	Slide %	0	Unloader	None	No	No	No
2	5	COMP 2	No	No	No	EXV&LLS	No	No	Slide %	0	Unloader	None	No	No	No
3	0	Not Used	No	No	No	None / LLS only / EXV&LLS / EXV only	No	No	Slide %	0	Unloader	None	No	No	No
4	0	Not Used	No	No	No		No	No	Slide %	0	Unloader	None	No	No	No
5	0	Not Used	No	No	No		No	No	Slide %	0	Unloader	None	No	No	No
6	0	Not Used	No	No	No		No	No	Slide %	0	Unloader	None	No	No	No
7	0	Not Used	No	No	No	None	No	No	Slide %	0	Unloader	None	No	No	No
8	0	Not Used	No	No	No	None	No	No	Slide %	0	Unloader	None	No	No	No

Select Output and Sensor Inputs per circuit

Circuit # (reset button)	Alarm Relay	Comp Proof	Compr Speed or Modulate Hot Gas AO	Compressor speed fault	Slide Closed Indicator	Pump Down	EXV Output	Flow	Circuit Pump/Valve	Loa Valv
1	Not Used	Not Used	Not Used	Not Used	Not Used	DISABLE 1	EXV1 %	Not Used	Not Used	Not
2	Not Used	Not Used	Not Used	Not Used	Not Used	DISABLE 2	EXV2 %	Not Used	Not Used	Not
3	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not
4	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not
5	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not
6	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not
7	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not
8	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not

Information that relates to condensors on the circuit

Circuit # (reset button)	# of Cond ROs	Starting Condensor RO	Condensor Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV Control	Suction Group	Comp Name/ID
1	5	CndFan 1-1	Not Used	Not Used	0	1	Not Used	Not Used	1	Suct Spht		1
2	5	CndFan 2-1	Not Used	Not Used	0	2	Not Used	Not Used	2	Ref Lvl	2	2

MCS-MAGNUM EXV SUCTION/DISCHARGE SUPERHEAT LOGIC

MCS-MAGNUM EXV Setpoints

#9 SUPERHT TARG = Target temperature setting for Superheat ('Time (sec)' is the seconds between samples used for calculating the Superheat Rate of Change).

#10 SPRHT ZONE+- = This value is added to and subtracted from setpoint #9 to calculate the upper and lower zones of the superheat control zone.

#11 EXV LOAD ADJ = The opening adjustment that will be made to the EXV when the compressor load solenoid is pulsed, or the closing adjustment when the compressor unload solenoid is pulsed.

#12 EXV FINE ADJ = Small Adjustment for the Valve (See Chart).

#13 EXV COURSE = Large Adjustment for the Valve (See Chart).

#14 EXV LOAD DIV = As the compressor amp draw % changes, this divides the EXV % change. It is calculated as follows: (Last FLA % - Current FLA %)/Setpoint #14

#15 EXV MIN% = Minimum Valve % allowed.

#16 EXV MAX% = Maximum Valve % allowed.

#17 LO SUPERHEAT = Temperature setting for Low Superheat.

#18 LOSUCTPSIDLY = Delay (sec) when in Lo Suct PSI Opening

#19 EXV DELAY = Maximum Delay (sec) between valve adjustments.

#20 EXV STRT TME = Delay (sec) to remain in EXV IN STARTUP when the compressor first starts.

#65 EXV ZONE1 DB = When set up as a setpoint or target type, the value field is added to and subtracted from setpoint #9 "Superheat Target" ± setpoint #10 "Superheat zone" to develop the upper and lower limits for "EXV is Opening" and "EXV is Closing" zones in zone 1. When set up as a target, the night setback field is used as an offset that is added to setpoint #9 (Superheat Target) to calculate the bottom value for the limit of where Low PSI opening is allow to operate.

#66 EXV ZONE2 DB = The offset added to and subtracted from setpoint #9 "Superheat Target" ± (setpoint #10 "Superheat zone" × 2 OR setpoint #65 "EXV ZONE1 DB" if active) to develop the upper and lower limit for "EXV Opening 2x" and "EXV Closing 2x" zones in zone 2.

#67 EXV ROC ZN1 = The superheat's Rate Of Change (ROC) holding limit for the "EXV Opening" and "EXV Closing" zone. This setpoint value is entered as a positive number and for "EXV is Opening" zone multiplied by -1. Time in seconds = Minimum time to hold when ouside the zone and the ROC is moving in the right direction. The EXV will be forced into a hold state for this minimum time.

#69 EXV ROC ZN2 = The superheat's Rate Of Change (ROC) holding limit for the "EXV Opening 2x" and "EXV Closing 2x" zone. The setpoint value is entered as a positive number and for "EXV Opening 2x" zone multiplied by -1. Time in seconds = Minimum time to hold when ouside the zone and the ROC is moving in the right direction. The EXV will be forced into a hold state for this minimum time.

#70 EXV ROC ZN3 = The superheat's Rate Of Change (ROC) holding limit for the "EXV Opening 4x" and "EXV Closing 4x" zone. The setpoint value is entered as a positive number and for "EXV Opening 4x" zone multiplied by -1. Time in seconds = Minimum time to hold when ouside the zone and the ROC is moving in the right direction. The EXV will be forced into a hold state for this minimum time.

#71 EXV ROC HD2x = The superheat ROC Opening 2x/Closing 2x limit for the "EXV is HOLDING" zone. The setpoint value is entered as a positive number and for "EXV Opening 2x" tested multiplied by -1. Time in seconds = Minimum time to hold when ouside the zone and the ROC is moving in the right direction. The EXV will be forced into a hold state for this minimum time.

#72 EXV ROC HD1x = The superheat ROC Opening/Closing limit for the "EXV is HOLDING" zone. The setpoint value is entered as a positive number and for "EXV Opening" zone multiplied by -1.

#77 LOW SUCTION = Low suction PSI safety (See chart for calculation).

#78 LO SUCT UNLD = Time value is used to delay the comp from going into safety unloading state to allow EXV time to open.

#79 LO SUCT RELD = Low suction reloading (See chart for calculation).

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DRAWN BY:	M. Schreiber
REVISION :	G
DWG NAME:	MCS-MAGNUM EXV SUCTION-DISCHARGE SUPERHEAT LOGIC - REV G.DWG

MCS-MAGNUM EXV SUCTION/DISCHARGE SUPERHEAT LOGIC

MCS-MAGNUM EXV Setpoints

#199 MOP TARG PSI = The Maximum Operation Suction pressure (MOP). If the suction pressure is greater than this value plus setpoint #200, then the EXV is forced to close. The EXV state is set to "EXV IS MOP CLS".

#200 MOP PSI ZONE = If the suction pressure is greater than setpoint #199 minus this value, then the EXV is force into "EXV IS MOP HLD" and the EXV will not be allowed to open.

#201 MOP ADJ % TME = This setpoint's value is used as the amount to adjust the EXV closed when in "EXV IS MOP CLS". This setpoint's "Time in sec" column is used as the delay between EXV adjustments when in the "EXV IS MOP CLS" state.

#205 EXV MDP = The Minimum Oil Differential pressure limit. When oil differential is below this value the EXV state will go to "EXV is MDP CLS". The setpoint's 'Time (sec)' column is an offset pressure value to allow the EXV back to normal control (Value is entered with one assumed decimal place. Ex: value of 50 = 5.0 psi offset). The 'Sec. To Ignore Safety' column is the time in minutes for the MDP logic to run after the compressor starts; if zero then MDP logic will run all the time. The 'Lockout Delay Hrs.' column is the adjust amount the EXV will be closed each time the delay reaches zero (Value is entered with one assumed decimal place. Ex: value of 20 = 2.0%).

EXV STARTING % is stored in RO Grid in Compressor row.

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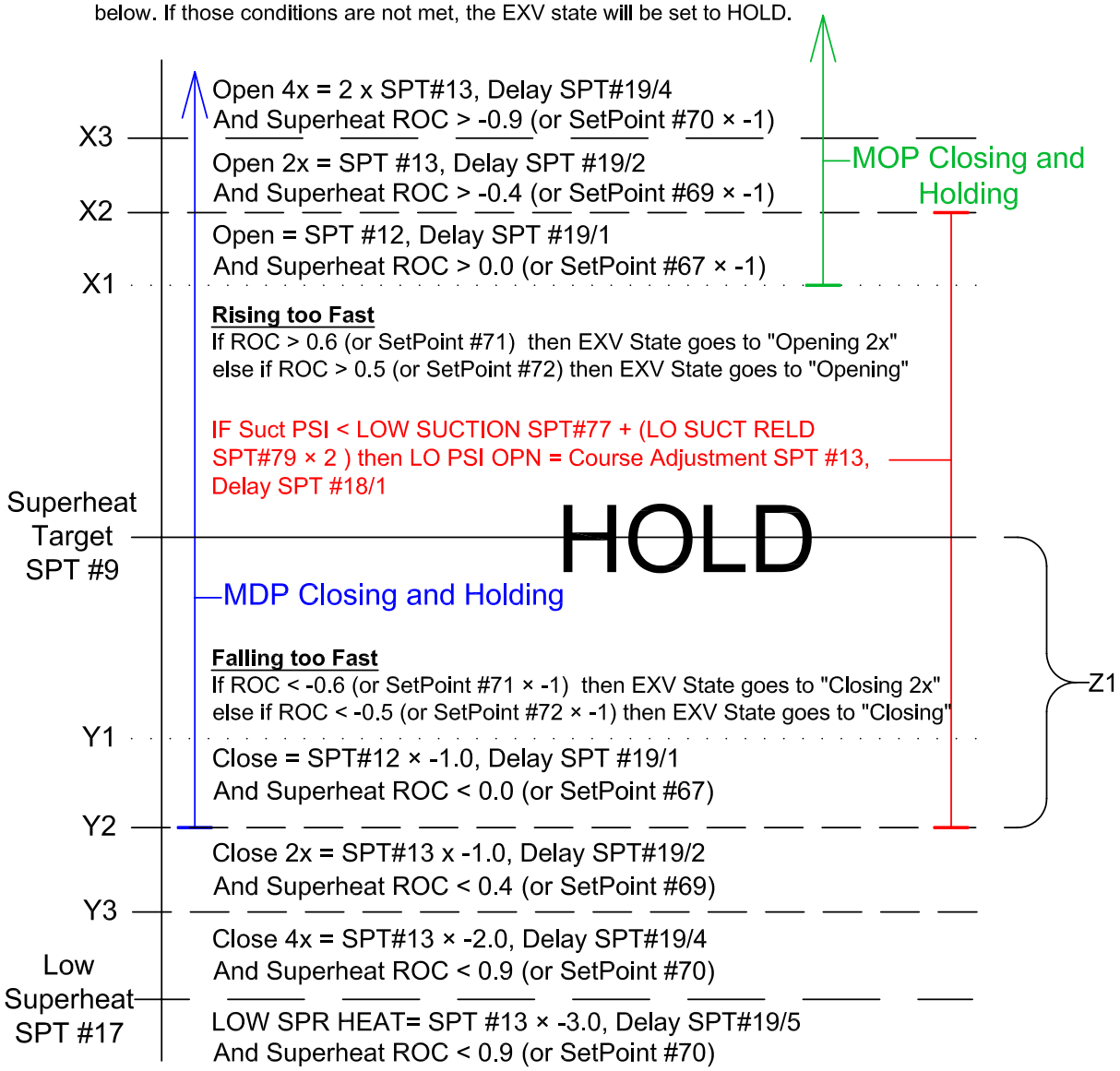
Legend:

Calculated Zone Limit

EXV State = Adjustment to EXV when delay reaches 0, Adjustment to delay every second
Superheat Rate of Change requirement to stay out of HOLD state

If Superheat exceeds the Calculated Zone Limit and the Rate of Change requirement is satisfied then EXV State, EXV Adjust, and Delay Adjust will all equal the corresponding values in the chart below. If those conditions are not met, the EXV state will be set to HOLD.



X1 = Stpt #9 + Stpt #10
X2 = X1 + Stpt #10
or if Setpoint #65 is active
then X2 = X1 + Stpt #65
X3 = X2 + Stpt #10
or if Setpoint #66 is active
then X3 = X2 + Stpt #66

Y1 = Stpt #9 - Stpt #10
Y2 = Y1 - Stpt #10
or if Setpoint #65 is active
then Y2 = Y1 - Stpt #65
Y3 = Y2 - Stpt #10
or if Setpoint #66 is active
then Y3 = Y2 - Stpt #66

Z1 = If setpoint #65 is not defined as a "TARGET" type then Y2 is the bottom limit where "LO PSI OPN" logic is allowed to work.
If setpoint #65 is defined as a "TARGET" type then setpoint #65 night setback field is added to setpoint #9 valve to calculate the bottom limit where "LO PSI OPN" logic is allowed to work.

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DATE:	07-23-12 Page 3 of 3
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REVISION :	G
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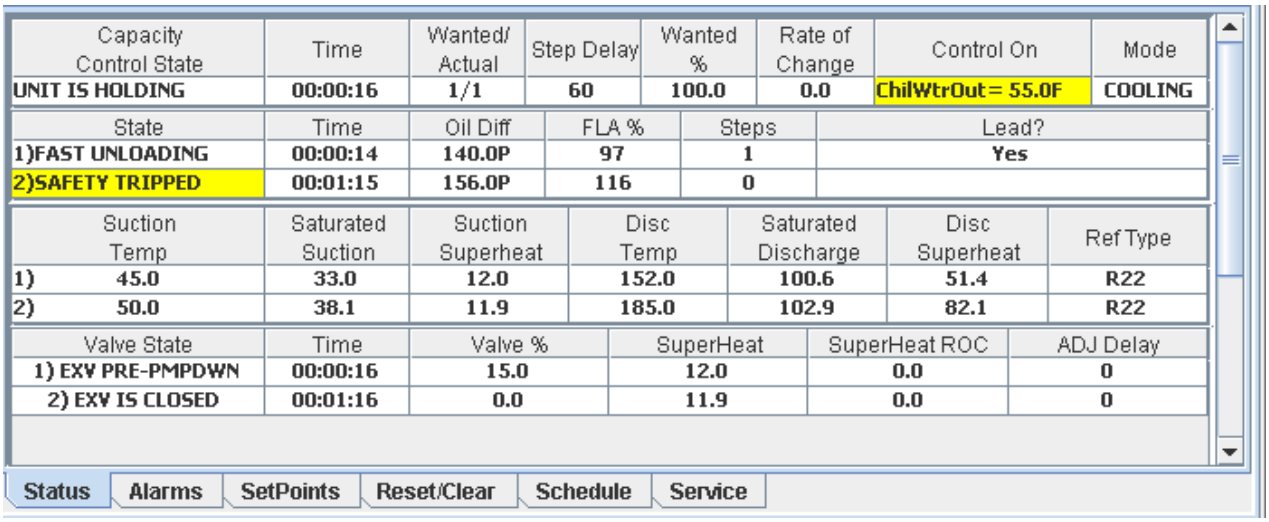
27.1.1 EXV Control States

The EXV Control States show the status of the compressor's expansion valve. If the compressor has an EXV it will be displayed under the Status entry.



Capacity Control State	Time	Wanted/ Actual	Step Delay	Wanted %	Rate of Change	Control On	Mode
UNIT IS HOLDING	00:00:16	1/1	60	100.0	0.0	ChilWtrOut = 55.0F	COOLING

State	Time	Oil Diff	FLA %	Steps	Lead?
1)FAST UNLOADING	00:00:14	140.0P	97	1	Yes
2)SAFETY TRIPPED	00:01:15	156.0P	116	0	

	Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat	Ref Type
1)	45.0	33.0	12.0	152.0	100.6	51.4	R22
2)	50.0	38.1	11.9	185.0	102.9	82.1	R22

Valve State	Time	Valve %	SuperHeat	SuperHeat ROC	ADJ Delay
1) EXV PRE-PMPDWN	00:00:16	15.0	12.0	0.0	0
2) EXV IS CLOSED	00:01:16	0.0	11.9	0.0	0

Status | Alarms | SetPoints | Reset/Clear | Schedule | Service

To view the EXV status through the Keypad LCD, select Status from the Main Menu and then page to the EXV screen.

EXV States:

LOCKED OUT	The compressor is in a Lockout state.
IS CLOSED	The associated compressor is OFF and the valve is closed
PRE-PMPDWN	The valve has been in a closed state and the system is now requiring the valve action.
IN STARTUP	At startup the valve will remain in this state for the time in Setpoint #20. At that time the state will be changed to holding, at this point the valve control logic will position the valve.
AT 100%	This state will be entered when the valve opening reaches 100%.
IS HOLDING	Refer to EXV Logic Chart, superheat is in control zone and ROC is acceptable.
IS OPENING	Refer to EXV Logic Chart, superheat is in control zone but rising too fast, ROC less than 1.0.
IS CLOSING	Refer to EXV Logic Chart, superheat is in the control zone and the rate of change is acceptable, ROC greater than –0.5.
LOW SPRHT	Refer to EXV Logic Chart, force a course valve adjustment.
OPENING 4x	Refer to EXV Logic Chart, superheat is above control zone.
OPENING 2x	Refer to EXV Logic Chart, superheat is in control zone but rising too fast, the ROC is greater than 1.0.
LO PSI OPN	Refer to EXV Logic Chart, state indicates that a low suction pressure condition exists. The suction pressure is less than Setpoint #77 "LOW SUCTION" plus twice the value of Setpoint #79 "LOW SUCT RELOAD" and the superheat is greater than Setpoint #9 "SUPERHT TRGT" plus twice the value of Setpoint #10 "SPRHT ZONE+-".
CLOSING 2x	Refer to EXV Logic Chart, superheat is in the control zone and the rate of change is acceptable, the ROC is less than -0.5 and greater than -1.0.
CLOSING 4x	Refer to EXV Logic Chart, superheat is in control zone but falling too fast, ROC less than -1.0.
HI LVL CLS	This state indicates that a high refrigerant level. This state is entered if Setpoint #109 "HiRefLevel" is active and the superheat is greater than the value of this Setpoint.
IS MOP CLS	Refer to EXV Logic Chart. Maximum operating pressure option is active and it is forcing the EXV to close. In this state the EXV valve's opening will be reduced.
IS MOP HLD	Refer to EXV Logic Chart. Maximum operating pressure option is active and it is forcing the EXV to hold.

27.1.2 EXV Maximum Operating Pressure

Setpoint #199 "MOP TARG PSI" must be active if the suction pressure is to be checked for maximum operating pressure.

If the suction pressure is above the MOP control zone, then the EXV state will be changed to EXV IS MOP CLS. The EXV valve opening will be closed by the value in Setpoint #201 with each adjustment. The 'Time(sec)' field of Setpoint #201 will be the delay between making adjustments to the EXV valves. The EXV will remain in this state until the suction pressure drops below the top of the MOP control zone. At this point the state will be changed to EXV IS MOP HOLD.

In the EXV IS MOP HOLD state the EXV valve's opening cannot be increased but it can be closed. The EXV will remain in this state until the suction pressure drops below the MOP control zone. At that time the EXV control state will change to EXV IS HOLDING and normal EXV control will resume.

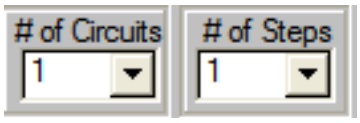
(Refer to section 13 Setpoints #199, #200, and #201)

27.1.3 Tandem EXV Setup

The Magnum supports tandem EXV control. However a separate compressor must be set up to support this function. Therefore, the maximum compressors that can be supported with tandem EXV are ten. The tandem EXV compressors must follow the active compressors in the system.

27.1.4 Example: One Compressor with One Step and Tandem EXV's

In the General Information panel of the MAGNUM screen enter the number of compressors and steps:



In the Circuit Base screen the base compressor information will be entered. The active compressors information is to be completed as normal and the tandem EXV information will be provided as needed. Note the Type of LLS cell must be 'EXV&LLS' for the active compressor and 'EXV only' for the tandem compressor.

	Information that relates to compressors on the circuit													
	Circuit # (reset button)	# of Comp ROs	Starting Compressor RO	Part Winding	Start Unload Bypass	Fast Unloader	Type of LLS	2nd LLS	3rd LLS	3rd LLS Control	Unloading Stages	Loader Type	HGB	HG Reheat
▶	1	2	COMP	No	No	No	EXV&LLS	No	No	Slide %	0	Unloader	None	No
	2	0	Not Used	No	No	No	EXV only	No	No	Slide %	0	Unloader	None	No

In the next section the EXV Output cell must be set up for both the EXV's

	Select Output and Sensor Inputs per circuit							
	Circuit # (reset button)	Alarm Relay	Comp Proof	Compr Speed or Modulate Hot Gas AO	Compressor speed fault	Slide Closed Indicator	Pump Down	EXV Output
▶	1	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	EXV A
	2	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	EXV B

In the next section the active compressor is associated with its tandem EXV in the 'Tandem EXV Circuit #' cell. Circuit #1 ties to circuit #2, this is the tandem EXV. The Suction Group cells are 1 and 2 respectively.

	Information that relates to condensors on the circuit											
	Circuit # (reset button)	# of Cond ROs	Starting Condensor RO	Condensor Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV Control	Suction Group
▶	1	0	Not Used	Not Used	Not Used	0	1	Not Used	Not Used	2	Superht	1
	2	0	Not Used	Not Used	Not Used	0	1	Not Used	Not Used	2	Superht	2

In the Compressor SI screen the active compressors information is to be completed as normal, while only the Suction Pressure and Suction Temperature must be entered for the tandem EXV. The different suction temperature provides separate control for the tandem EXV.

27.1.4.1. Example: Two Compressors with Four Steps and Tandem EXV's

In the General Information panel of the MAGNUM screen enter the number of compressors and steps:

# of Circuits	# of Steps
2	4

	Information that relates to compressors on the circuit											
	Circuit # (reset button)	# of Comp ROs	Starting Compressor RO	Part Winding	Start Unload Bypass	Fast Unloader	Type of LLS	2nd LLS	3rd LLS	3rd LLS Control	Unloading Stages	Loader Type
▶	1	3	COMP 1	No	No	No	EXV&LLS	No	No	Slide %	1	Unloader
	2	3	COMP 2	No	No	No	EXV&LLS	No	No	Slide %	1	Unloader
	3	0	Not Used	No	No	No	EXV only	No	No	Slide %	0	Unloader
	4	0	Not Used	No	No	No	EXV only	No	No	Slide %	0	Unloader

In the next section the EXV Output cell must be set up for all the EXV's

	Select Output and Sensor Inputs per circuit							
	Circuit # (reset button)	Alarm Relay	Comp Proof	Compr Speed or Modulate Hot Gas AO	Compressor speed fault	Slide Closed Indicator	Pump Down	EXV Output
▶	1	Not Used	Not Used	Not Used	Not Used	Not Used	DISABLE1	EXV1A%
	2	Not Used	Not Used	Not Used	Not Used	Not Used	DISABLE2	EXV2A%
	3	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	EXV1B%
	4	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	EXV2B%

In the next section the active compressor is associated with its tandem EXV in the 'Tandem EXV Circuit #' cell. Circuit #1 ties to circuit #3, and circuit #2 ties to circuit #4 (circuits #3 and #4 are the Tandem EXV's). The Suction Group cells are 1, 2, 3, and 4 respectively.

In the Compressor SI screen the active compressors information is to be completed as normal, while only the Suction Pressure and Suction Temperature must be entered for the tandem EXV's. The different suction temperature provides separate control for the tandem EXV's.

	Information that relates to condensors on the circuit											
	Circuit # (reset button)	# of Cond ROs	Starting Condensor RO	Condensor Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV Control	Suction Group
▶	1	2	FAN 1-1	Not Used	Not Used	0	1	Not Used	Not Used	3	Superht	1
	2	2	FAN 2-1	Not Used	Not Used	0	2	Not Used	Not Used	4	Superht	2
	3	0	Not Used	Not Used	Not Used	0	3	Not Used	Not Used	3	Superht	3
	4	0	Not Used	Not Used	Not Used	0	4	Not Used	Not Used	4	Superht	4

	Select Suction, Discharge, Oil and Motor Sensors for Circuits								
	Circuit # (reset button)	Suction Pressure	Discharge Pressure	Suction Temperature	Discharge Temperature	Oil Pressure	Oil Temp	Motor Amps	Motor Temp
▶	1	SUCT PSI	DISC PSI	EVP TmpA	DISC TMP	OIL PSI	Not Used	AMPS	MTR FLT
	2	SUCT PSI	Not Used	EVP TmpB	Not Used	Not Used	Not Used	Not Used	Not Used

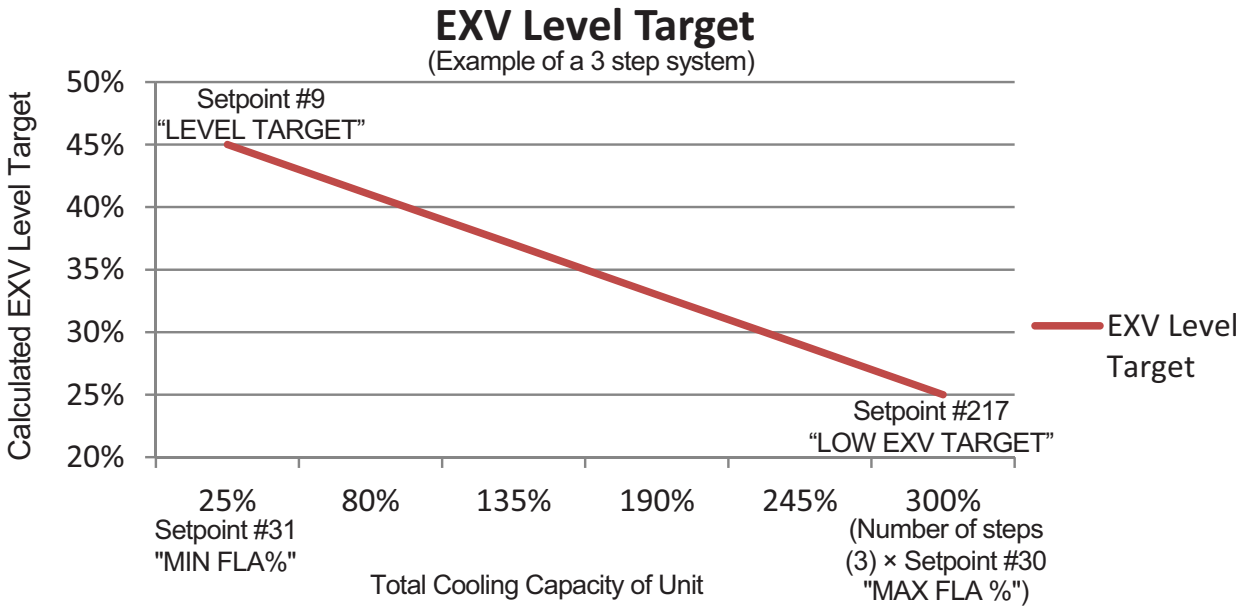
27.1.5 'Evaporator or Condenser Refrigerant Level Control

There is an alternate method to control the EXV based on Ref Level.

27.1.5.1. Minimum Refrigerant Level target (HVAC ONLY)

If active and the EXV is controlled by Refrigerant Level, then a new variable level target logic will be activated. As the unit capacity increases, the refrigerant level target will change according to a linear calculation between Setpoint #9 "LEVEL TARGET" (the maximum target level) and Setpoint #217 "LOW EXV TARGET" (the minimum target level). This relationship is explained in the following graph:

In the Compressor SI screen the active compressors information is to be completed as normal, while only the Suction Pressure and Suction Temperature must be entered for the tandem EXV's. The different suction temperature provides separate control for the tandem EXV's.



27.1.5.2. Evaporator Level Control

This option will control the EXV based upon the Refig Level sensor which is selected in Circuit SI screen, column Refrig Level. Control will be as indicated in the MCS-MAGNUM EXV SUCTION/ DISCHARGE SUPERHEAT LOGIC sections except the EXV states will be the opposite of the SUCTION/DISCHARGE control. When the refrigerant level is above the associated control point the EXV valve will be closed and when it is below the associated control point the EXV valve will be opened.

27.1.5.3. Condenser Level Control

This option will control the EXV based upon the Refig Level sensor which is selected in Circuit SI screen column Refrig Level. This sensor will indicate the refrigerant level in the condenser. Control is the opposite of the Refrigerant Level Control. When the condenser level is above the associated control point the EXV valve will be opened and when it below the associated control point the EXV valve will be closed.

27.1.6 EXV control methods for Step Loading Compressors

Percentage per Step: (Requires Magnum Software HVAC 8.03L and MCS-Config 8.00W or higher)

To control the EXV based on a percentage per step for fixed step compressors, insert the relative load and unload adjustment percentages in the respective fields in the Relay Output screen. The load and unload adjustments will increase or decrease respectively based on a percentage of the current EXV position (not a fixed value)

Here is an example of a Hanbell Screw compressor configured to load by fixed steps:

Relay Output Information Screen

	Number	Name	EXV Start (When Lead)	Type	EXV Load Adjust %	EXV Unld Adjust %	Comments
	M-1 ...	COMP 1	25	Step w\ EXV	50	60	...
	M-2 ...	LLS 1	------	Standard	------	------	...
	M-3 ...	HotGasByps	0	Step w\ EXV	50	60	...
	M-4 ...	UNLOAD 50%	0	Step w\ EXV	30	40	...
	M-5 ...	UNLOAD 75%	0	Step w\ EXV	20	30	...

These columns are used for the compressor when there are multiple compressors on a single suction circuit, however, values must be in these fields for this logic to be in effect.

The logic will work as follows: When the compressor starts the EXV will go to the value in the ‘EXV Start (when lead)’ column, in this example it is 25%. The EXV will then modulate normally according to the controlling superheat or refrigerant level, until the unit is ready to load another step of capacity. Assume the EXV has stayed at 35% when the second step of capacity is ready to engage (turning off the Hot Gas Bypass). The EXV adjustment will be 50% (the amount in the ‘EXV Load Adjust’ column of the current EXV position

‘EXV Load Adjust’ column (50%) × current EXV position (35%) = EXV adjustment (17.5%)

50% × 35% = 17.5%

Current EXV position (35%) + EXV adjustment (17.5%) = New EXV position (42.5%)

35% +17.5% = 42.5%

Therefore the final EXV valve position would be 42.5%

This same calculation will be repeated every time a new stage of capacity is turned on. Conversely, when the unit is unloading, the EXV adjustment will be subtracted from the current EXV position for every step that turns off. Assume the EXV is at 40% and the compressor is at 100% and is ready to unload a step (turning on Unload 75% solenoid).

‘EXV Unld Adjust’ column (30%)× current EXV position (40%)= EXV adjustment (12%)

30% × 40% = 12%

Current EXV position (40%)–EXV adjustment (12%) = New EXV position (28%)

40%–12% = 28%

Therefore the final EXV valve position would be 28%

The values given in the example are only start points. You will need to adjust the values for your system. The idea is to jump the EXV position so that the superheat would still be above the target slightly, and then the EXV control logic would then adjust the value to achieve the target superheat. We do not want to open the EXV valve too much when loading or close the valve too much when unloading so we do not cause low superheat or liquid flooding to the compressor.

Chapter - 28. EXV Control SSH, SSH2

MCS has released two new superheat control systems in addition to its existing EXV Superheat Control Systems.

28.1. Fast Suction Superheat (Fast SSH)

Released with firmware 17.26-B.hex with the following objectives:

- Reduce the number of set points required. (SP 65 through 72 were eliminated)
- Provide only one control zone.
- Anytime the superheat moves outside this zone to recovery within two minutes or less.
- Provide Fast Suction Superheat control for Subcooler's with standard set points.
  (SP 65 through 72 were used. (SP 253 through 255 were eliminated)

Provide option to dynamically calculate the EXV starting position

28.2. Fast Suction Superheat 2 (Fast SSH2)

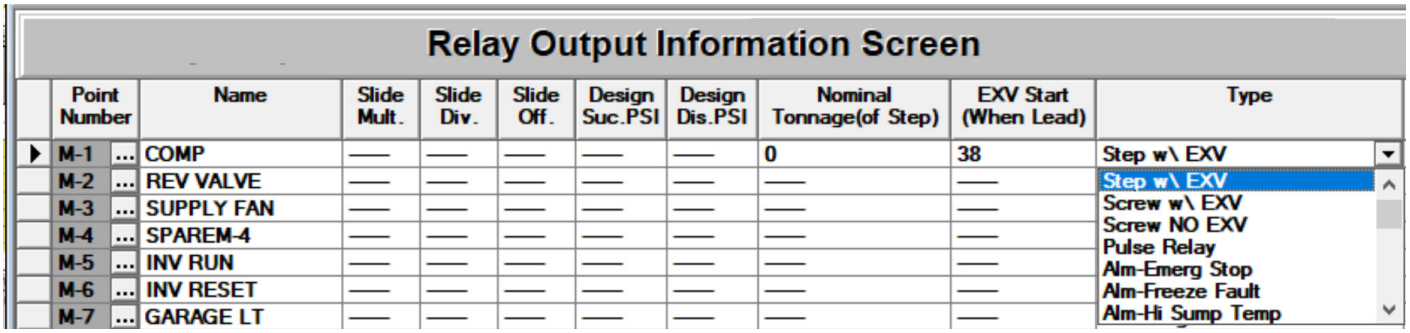
Released with firmware 17.37D1.hex with the following objectives:

- Provide MCS Default set points for all EXV controls types.
- Improve on self learning EXV Valve starting position.
- Provide color coded identification for Fast SSH, Fast SSH2 & Subcooler options in MCS-Config.
- Add an extended SH ROC to allow finer decisions and reduce valve movement.
- Add explicit states for Fast SSH and Fast SSH2.

28.3. Selecting Fast SSH or Fast SSH2 in MCS-Config

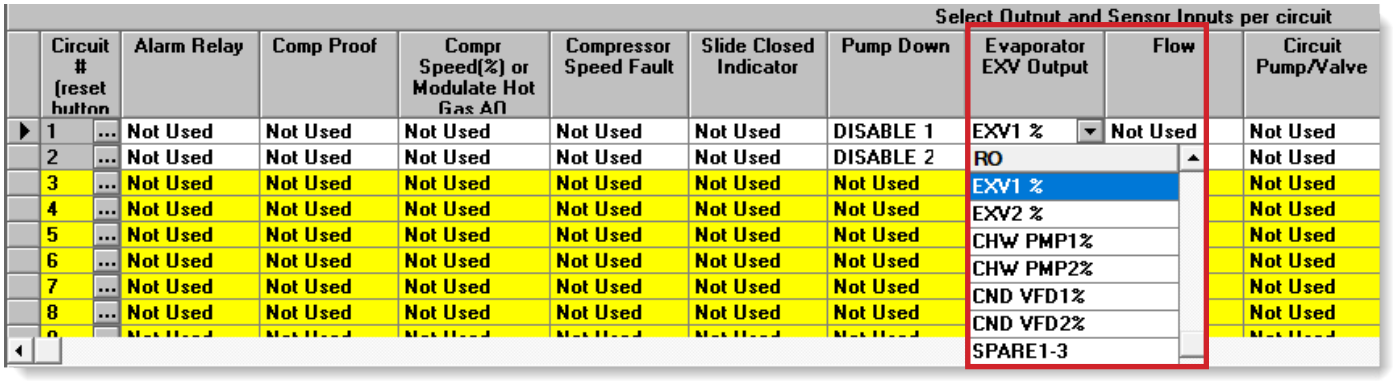
In Fast SSH & Fast SSH2 only Set Points 9 through 20 are used to control the EXV valve. If you select Fast SSH or Fast SSH2 as your superheat EXV control and you have a subcooler (an economizer injecting refrigerant into the compression chamber) you will get Fast SSH control on the EXV for the subcooler. The Fast SSH set points for the subcooler are 65 through 72.

Select Type of Control in Relay Output Information Screen. In the RO screen, from the drop down window in 'Type' you select either 'Step w \ EXV' or 'Screw w \ EXV'

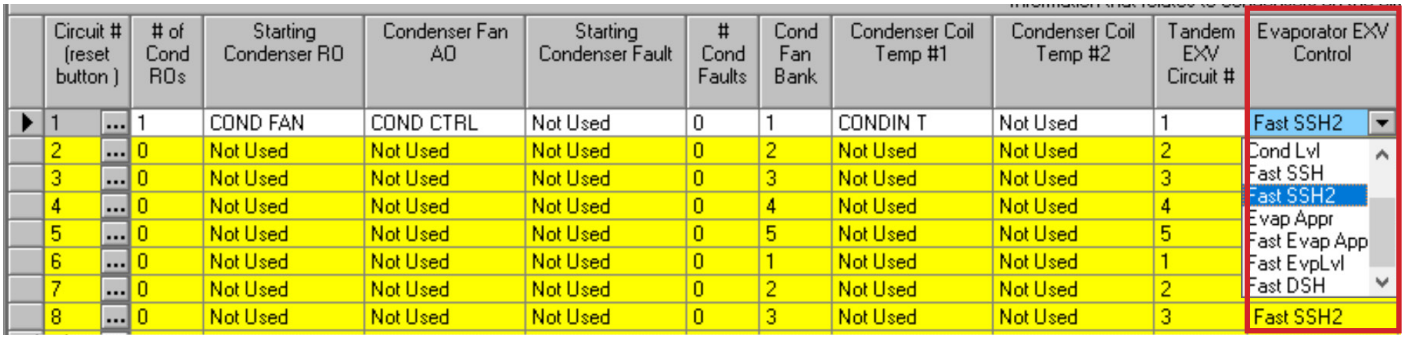


28.4. Circuit Base

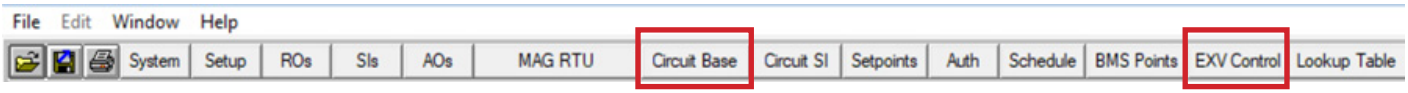
In the Circuit Base screen you need to select the Analog Output for the EXV.



Next in the Circuit Base screen you need to select 'Fast SSH' or 'Fast SSH2' from the Evaporator EXV Control section drop down menu.



With the release of Fast SSH2 MCS has released a new MCS-Config to support the new functions. The new MCS-Config provides a new tab, 'EXV Control', where you define your system. This then allows MCS-Config to provide MCS Default Set Point Values for you. The figure below shows the Current 'Circuit Base' tab and the new 'EXV Control' tab.



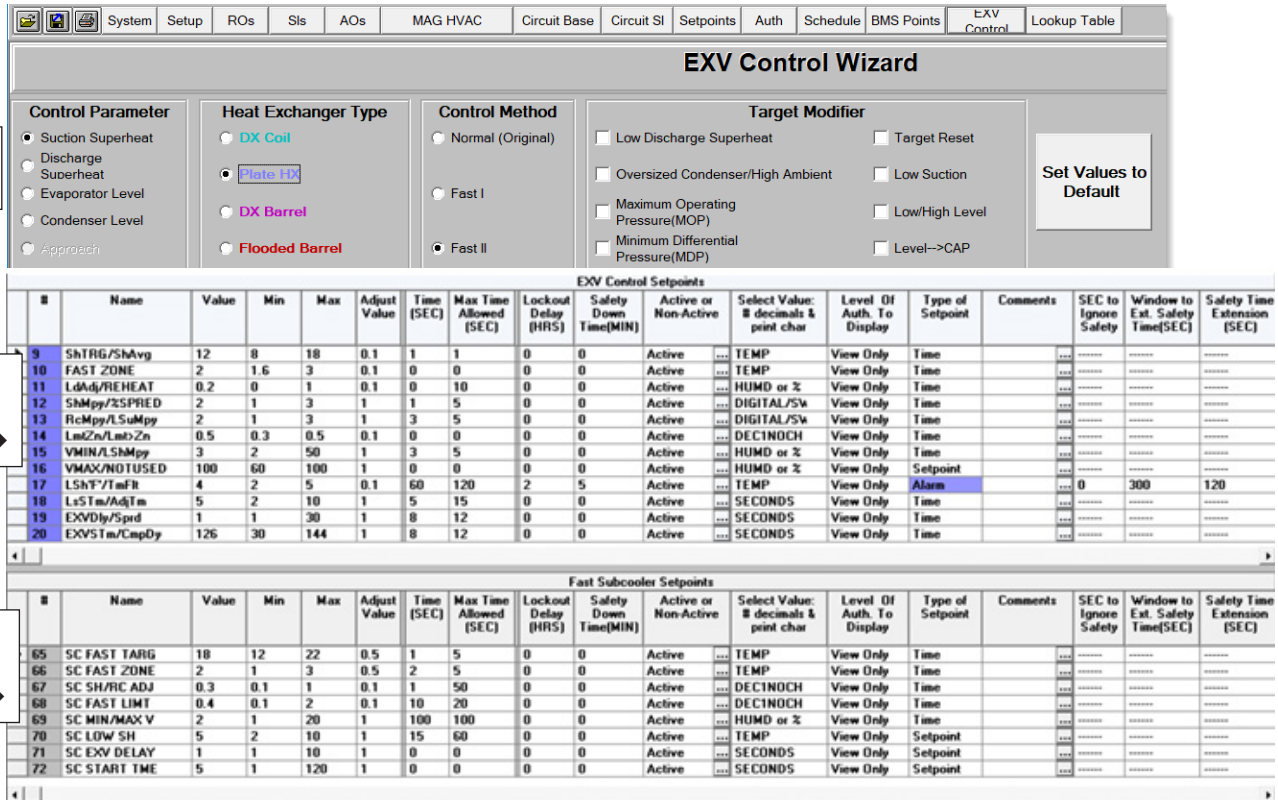
If you enter data in the EXV portion of the Circuit Base tab or in the EXV Control tab it is carried through to the other tab.

28.4.1 Selecting the 'EXV Control' tab you are prompted with the following:

Selection Option ➔

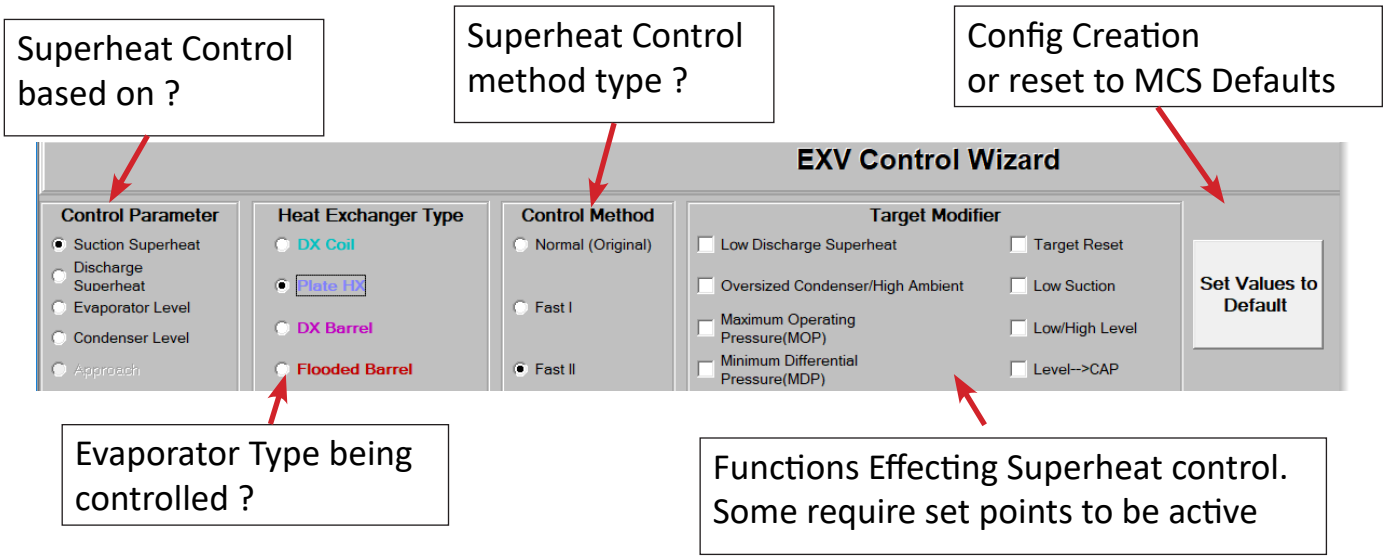
Compressor EXV Results ➔

Subcooler EXV Results ➔



Based on your selections will dictate the set points for compressor control. The subcooler set points are only displayed if a subcooler id present.

28.4.2 Selection Options



IMPORTANT

NOTE: Once you have clicked on the boxes for your setup, be sure to click on **'Set Values to Default'**. This will set the values to the default for **'Control Parameter, Heat Exchanger Type and the Control Method. Make note that clicking in the 'Target Modifier' require that some set points must be active.**

28.4.3 Compressor EXV Results

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
9	FAST SH TRGT	12	8	20	0.1	3	7	0	0	Active	TEMP	View Only	Time		—	—	—
10	FAST CTL ZN	1.6	1	3	0.1	0	0	0	0	Active	TEMP	View Only	Time		—	—	—
11	EXV LD/UNLD%	0.3	0	0.5	0.1	0	0	0	0	Active	HUMD or %	View Only	Time		—	—	—
12	SH MPY/%SPRD	2	1	3	1	0	0	0	0	Active	DIGITAL/SW	View Only	Time		—	—	—
13	ROC MPY/LSUC	2	1	3	1	3	5	0	0	Active	DIGITAL/SW	View Only	Time		—	—	—
14	LIMIT ADJUST	1	0.1	1.5	0.1	0	0	0	0	Active	DEC1NOCH	View Only	Time		—	—	—
15	V MIN LS MPY	3	2	25	1	2	5	0	0	Active	HUMD or %	View Only	Time		—	—	—
16	V MAX	100	50	100	1	0	1	0	0	Active	HUMD or %	View Only	Setpoint		—	—	—
17	LO SUPERHEAT	3.5	2	5	0.1	60	120	2	10	Active	TEMP	View Only	Alarm		0	300	120
18	LOW PSI DELY	5	1	30	1	30	60	0	0	Active	SECONDS	View Only	Time		—	—	—
19	EXV DELAY	1	1	30	1	0	0	0	0	Active	SECONDS	View Only	Time		—	—	—
20	EXV STRT TME	126	1	270	9	10	10	0	0	Active	SECONDS	View Only	Time		—	—	—

- Control on ‘Suction Superheat’
- Evaporator Type ‘Plate HX’
- Control Method ‘Fast SSH2’
- MCS Default ‘Selected’
- Degrees F or C are automatic

28.4.4 Subcooler EXV Results

- If you have selected Fast SSH or Fast SSH2 and have a subcooler this will use set points 65 through 72. If you setup ‘Subcooler EXV & Subcooler Suction PSI’ MCS-Config will automatically complete set points 65 through 72 with MCS standard defaults.
- If this is an existing config and you are converting to Fast SSH or Fast SSH2 set points 253 through 255 will be spared out. (HVAC only)

Fast Subcooler Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
65	SC FAST TARG	18	12	22	0.5	1	5	0	0	Active	TEMP	View Only	Time		—	—	—
66	SC FAST ZONE	2	1	3	0.5	2	5	0	0	Active	TEMP	View Only	Time		—	—	—
67	SC SH/RC ADJ	0.3	0.1	1	0.1	1	50	0	0	Active	DEC1NOCH	View Only	Time		—	—	—
68	SC FAST LIMT	0.4	0.1	2	0.1	10	20	0	0	Active	DEC1NOCH	View Only	Time		—	—	—
69	SC MIN/MAX V	2	1	20	1	100	100	0	0	Active	HUMD or %	View Only	Time		—	—	—
70	SC LOW SH	5	2	10	1	15	60	0	0	Active	TEMP	View Only	Setpoint		—	—	—
71	SC EXV DELAY	1	1	10	1	0	0	0	0	Active	SECONDS	View Only	Setpoint		—	—	—
72	SC START TME	5	1	120	1	0	0	0	0	Active	SECONDS	View Only	Setpoint		—	—	—

- Set Points if Fast SSH or Fast SSH2 selected & you have a Sub Cooler
- Set Points 65 thru 72 are set up
- Degrees F or C are automatic

With this release of MCS-Config MCS has developed Default Set Points for all EXV Types

28.4.5 MCS EXV Factory Default Set Point

28.4.5.1. Fast SSH2, Suction Superheat, Plate HX

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
9	TARG/S STOP	12	8	20	0.1	2	7	0	0	Active	TEMP	Factory Lı	Time		------	------	------
10	FAST CTL ZN	2	1.6	3	0.1	0	0	0	0	Active	TEMP	Factory Lı	Time		------	------	------
11	EXV LD/UNLD%	0	0	0.5	0.1	0	10	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
12	SH MPL/%SPRD	1	1	3	1	5	10	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
13	ROC MPY/LSUC	1	1	3	1	4	15	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
14	LIMIT ADJUST	0.5	0.1	1.5	0.1	0	0	0	0	Active	DEC1NOCH	Factory Lı	Time		------	------	------
15	VMIN/LSH MPY	3	2	25	1	2	15	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
16	VMAX	100	50	100	1	0	0	0	0	Active	HUMD or %	Factory Lı	Setpoint		------	------	------
17	LO SUPERHEAT	3	2	5	0.1	60	300	2	10	Active	TEMP	Factory Lı	Alarm		0	300	120
18	LSUC/LSH DLY	1	1	10	1	1	10	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
19	E DLY/S CALC	1	1	30	1	0	10	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
20	E STRT/C DLY	126	1	270	1	8	15	0	0	Active	SECONDS	Factory Lı	Time		------	------	------

28.4.5.2. Fast SSH2, Suction Superheat, DX Coil

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
9	TARG/S STOP	10	8	18	0.1	4	7	0	0	Active	TEMP	Factory Lı	Time		------	------	------
10	FAST CTL ZN	2	1.6	3	0.1	0	0	0	0	Active	TEMP	Factory Lı	Time		------	------	------
11	EXV LD/UNLD%	0.2	0	3	0.1	0	0	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
12	SH MPL/%SPRD	1	1	3	1	0	5	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
13	ROC MPY/LSUC	2	1	3	1	3	5	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
14	LIMIT ADJUST	0.5	0.3	0.5	0.1	0	0	0	0	Active	DEC1NOCH	Factory Lı	Time		------	------	------
15	VMIN/LSH MPY	3	2	50	1	3	5	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
16	VMAX	100	60	100	1	0	0	0	0	Active	HUMD or %	Factory Lı	Setpoint		------	------	------
17	LO SUPERHEAT	4	2	4	0.1	60	120	2	5	Active	TEMP	Factory Lı	Alarm		0	300	120
18	LSUC/LSH DLY	5	2	15	1	5	15	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
19	E DLY/S CALC	20	1	60	1	8	12	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
20	E STRT/C DLY	126	30	180	1	8	12	0	0	Active	SECONDS	Factory Lı	Time		------	------	------

28.4.5.3. Fast SSH, Suction Superheat, DX Barrel

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
9	TARG/S STOP	12	8	20	0.1	2	5	0	0	Active	TEMP	Factory Lı	Time		------	------	------
10	FAST CTL ZN	2	1.6	3	0.1	1	1	0	0	Active	TEMP	Factory Lı	Time		------	------	------
11	EXV LD/UNLD%	0	0	0.5	0.1	0	10	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
12	SH MPL/%SPRD	1	1	3	1	5	10	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
13	ROC MPY/LSUC	1	1	3	1	4	15	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
14	LIMIT ADJUST	0.2	0.1	0.4	0.1	3	6	0	0	Active	DEC1NOCH	Factory Lı	Time		------	------	------
15	VMIN/LSH MPY	3	2	25	1	2	15	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
16	VMAX	100	50	100	1	0	0	0	0	Active	HUMD or %	Factory Lı	Setpoint		------	------	------
17	LO SUPERHEAT	3	1	5	0.1	120	300	2	10	Active	TEMP	Factory Lı	Alarm		0	300	120
18	LSUC/LSH DLY	1	1	10	1	1	10	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
19	E DLY/S CALC	1	1	30	1	10	10	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
20	E STRT/C DLY	126	1	270	1	8	15	0	0	Active	SECONDS	Factory Lı	Time		------	------	------

(Samples of Fast SSH & Fast SSH2 most often used)

28.4.5.4. Fast SSH2, Discharge Superheat, DX Barrel

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
9	DShTRG/ShAvg	30	22	40	0.1	1	1	0	0	Active	TEMP	Factory Lı	Time		------	------	------
10	FAST ZONE	2	1.6	3	0.1	0	0	0	0	Active	TEMP	Factory Lı	Time		------	------	------
11	LdAdj/REHEAT	0.2	0	3	0.1	0	10	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
12	ShMpy/%SPRED	2	1	3	1	0	5	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
13	RcMpy/LSuMpy	2	1	3	1	3	5	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
14	LmtZn/Lmt>Zn	0.5	0.3	0.5	0.1	0	0	0	0	Active	DEC1NOCH	Factory Lı	Time		------	------	------
15	VMIN/LShMpy	3	2	50	1	3	5	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
16	VMAX/NOTUSED	100	60	100	1	0	0	0	0	Active	HUMD or %	Factory Lı	Setpoint		------	------	------
17	LSh'F'/TmFlt	4	2	4	0.1	60	120	2	5	Active	TEMP	Factory Lı	Alarm		0	300	120
18	LsSTm/AdjTm	5	2	15	1	5	15	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
19	EXVDly/Sprd	1	1	60	1	8	12	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
20	EXVSTm/CmpDy	126	30	135	1	8	12	0	0	Active	SECONDS	Factory Lı	Time		------	------	------

28.4.5.5. Fast SSH, Suction Superheat, DX Barrel

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
9	TARG/S STOP	12	8	20	0.1	2	5	0	0	Active	TEMP	Factory Lı	Time		------	------	------
10	FAST CTL ZN	2	1.6	3	0.1	1	1	0	0	Active	TEMP	Factory Lı	Time		------	------	------
11	EXV LD/UNLD%	0	0	0.5	0.1	0	10	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
12	SH MPL/%SPRD	1	1	3	1	5	10	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
13	ROC MPY/LSUC	1	1	3	1	4	15	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
14	LIMIT ADJUST	0.2	0.1	0.4	0.1	3	6	0	0	Active	DEC1NOCH	Factory Lı	Time		------	------	------
15	VMIN/LSH MPY	3	2	25	1	2	15	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
16	VMAX	100	50	100	1	0	0	0	0	Active	HUMD or %	Factory Lı	Setpoint		------	------	------
17	LO SUPERHEAT	3	1	5	0.1	120	300	2	10	Active	TEMP	Factory Lı	Alarm		0	300	120
18	LSUC/LSH DLY	1	1	10	1	1	10	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
19	E DLY/S CALC	1	1	30	1	10	10	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
20	E STRT/C DLY	126	1	270	1	8	15	0	0	Active	SECONDS	Factory Lı	Time		------	------	------

28.4.5.6. Suct Spht, Suction Superheat, DX Barrel

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
9	TARG/S STOP	12	8	20	0.1	2	5	0	0	Active	TEMP	Factory Lı	Time		------	------	------
10	FAST CTL ZN	2	1.6	3	0.1	1	1	0	0	Active	TEMP	Factory Lı	Time		------	------	------
11	EXV LD/UNLD%	0	0	0.5	0.1	0	10	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
12	SH MPL/%SPRD	1	1	3	1	5	10	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
13	ROC MPY/LSUC	1	1	3	1	4	15	0	0	Active	DIGITAL/SW	Factory Lı	Time		------	------	------
14	LIMIT ADJUST	0.2	0.1	0.4	0.1	3	6	0	0	Active	DEC1NOCH	Factory Lı	Time		------	------	------
15	VMIN/LSH MPY	3	2	25	1	2	15	0	0	Active	HUMD or %	Factory Lı	Time		------	------	------
16	VMAX	100	50	100	1	0	0	0	0	Active	HUMD or %	Factory Lı	Setpoint		------	------	------
17	LO SUPERHEAT	3	1	5	0.1	120	300	2	10	Active	TEMP	Factory Lı	Alarm		0	300	120
18	LSUC/LSH DLY	1	1	10	1	1	10	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
19	E DLY/S CALC	1	1	30	1	10	10	0	0	Active	SECONDS	Factory Lı	Time		------	------	------
20	E STRT/C DLY	126	1	270	1	8	15	0	0	Active	SECONDS	Factory Lı	Time		------	------	------

28.5. Set Point Descriptions (Fast SSH & Fast SSH2)

Fast SSH set points **Available in MCS release 17.26-B and later**

Fast SSH2 set points **Available in MCS release 17.41 and later**

SP #	Name	Description
9	EXV Target	(Value Field) – This is the superheat target the system will make adjustments to the Electronic Expansion Valve to maintain. (Time Field) – In Fast SSH when in low suction psi this is the number of seconds the suction psi must be increasing before the systems stops adjusting the valve. (Time Field) - In Fast SSH2 it is the number of seconds to calculate the extended slope. When in low suction, adjustments are stopped when the suction pressure slope is positive for 1 second.
10	EXV Fast Zone	((Value Field) – The system makes adjustments to the EXV Valve percentage to maintain the superheat within this range. (Time Field) – The Time Field is not used.
11	EXV Adjustment made when a modulating compressor's capacity changes	(Value Field) – The opening adjustment that is made to the EXV current valve % when the circuit changes to the loading state or the closing adjustment that is made when the circuit changes to the unloading state. When in the MOP hold state, only closing adjustments are allowed. (Time Field) – When > zero it is used to increase the hold time.
12	Super Heat adjust multiplier	(Value Field) – This value is used to multiply times the calculated value of superheat target – current superheat target value. (The difference from where we want to be verses where we are) (Time Field) – The maximum different between two EXV's on the same circuit allowed once out of startup and under control.

13	Rate of Change adjust multiplier	(Value Field) - This value is used to multiply times the calculated value of current superheat – the superheat value one second ago. (The slope of the current superheat) Time Field) – If set point type = 'Time' and Time Field is ≥ 2 and ≤ 100 this is the adjustment multiplier for when the system is in Low Suction. It takes the base valve adjustment of 0.5% and multiplies it with this value. Adjustments stop when the suction psi starts too increase. (See set point 9 time field for additional information.) If the conditions are not met then a value of 0.5 is used. (Delay between adjustments is specified in the value field of SP 17.)
14	Limit of Adjustment	(Value Field) – In FSH this value limits the adjustment while the superheat is < then the Fast Zone times two. In FSH2 this value is the maximum limit of the adjustment. (Time Field) - In FSH this value is the limit of adjustment when the superheat > then two times the Fast Zone. Remember in the value field of this set point you are typically using a value of 0.2 to 0.5. In the time field a value of 7 is equivalent to 0.7. (Time Field) - In FSH2 this field is not used.
15	Minimum EXV Valve %	(Value Field) – The minimum position of the valve. Usually 3%. Will need to be larger if hot gas is on system. (Time Field) - The adjustment multiplier for when the system is in Low Superheat.
16	Maximum EXV Valve %	(Value Field) – The maximum position of the valve allowed. Usually 100%. Sometimes used if valve is oversized. (Time Field) – Not Used
17	Low Superheat	(Value Field) – If the superheat falls below this value and stays below for longer than the number of seconds specified in the Time Field, of this set point, the system will enter a safety, generate an alarm and shut off this compressor then restart if required. If this specifies a lockout then it will follow the lockout rules. In FSH and FSH2 the system will take corrective action to correct this potential problem. (Time Field) – Timer for this set point as described.
18	Low Psi Delay	(Value Field) – The value specifies the number of seconds between valve adjustments, (for Low Suction) trying to correct this situation. Adjustments will continue until the slope of the suction pressure starts to increase. (Time Field) – This value specifies the number of seconds delay between adjustments, (for Low Superheat) trying to correct this situation. Adjustments continue until the superheat is above the Value Field.
19	EXV Delay	(Value field) – The value in this field id decremented by the difference between the absolute value of the current superheat – superheat target. When the result reaches zero the FSH & FSH2 make the current calculated adjustment to the current valve percentage. (Time Field) – The value in the time field determines when control will begin when two EXV's are on the same circuit. This value times the value field in the fast zone plus the current target defines when control is taken, at startup. If this value is 10 and the value in the fast zone is 2 and the target is 12 the result would be (10 * 2 + 12) = 32%. When both valves are ≤ this % control is taken and then kept within the value specified in the time field of set point 12.
20	EXV Startup Time	(Value Field) – EXV starting time in seconds. The following decisions are made on taking control: a). If the current superheat is > target + 5.0 º & State timer > Startup time / 2 Take control. b). If the current superheat is < target – Fast zone & State timer > Startup time / 2 Take Control. c). If the Suct psi is < Low Suct SP + Low unload & State timer > Startup time / 2 Take Control. d). If the EXV startup time ≥ 90 & a) or b) is true adjust the valve start percentage

28.5.1 Set Point Adjustments

Fast SSH & Fast SSH2 Common adjustments

When using FSH or FSH2 you should not experience a low suction or low superheat alarm unless you are low on refrigerant or have a mechanical problem. (If you bring on too much condenser that causes the head psi to drop too quickly it will also pull the suction psi with it.) Set the multiplier of SP 13 'Time Field' to a value high enough to recover from a low suction.

28.5.2 Low Suction Multiplier-SP 13

'Time Field' is a multiplier for the change being made to adjust for a Low Suction condition. The MCS Default is 2. If a low suction occurs and the system does not recover in time, an a low suction alarm occurs increase SP 13 Time Field by 1.

If a low suction occurs and the system over corrects, (that is the EXV valve opens more than is required) then reduce SP 13 Time Field by 1.

If an alarm occurs you can increase the multiplier and or decrease the time delay between adjustments. (Set Point 18 Value Field)

28.5.2.1. Low Superheat Adjustment-SP 15

'Time Field' is a multiplier for the change being made to adjust for a Low Superheat condition. The MCS Default is 2.

If a low superheat occurs and the system over corrects, (the EXV valve closes more than is required) then reduce SP 15 Time Field by 1.

If an alarm occurs you can increase the multiplier and or decrease the time delay between adjustments. (Set Point 18 Time Field)

28.5.2.2. EXV Startup Time-SP 20

'Value Field' specifies the maximum time the valve will remain in the EXV Startup State. If the value is less than 90 seconds the Magnum will remain in this state for the entire time specified unless it reaches one of the startup exit conditions covered in SP 20. It is not recommended to make this value less than 25 seconds.

If the value is ≥ 90 the Magnum will calculate a new valve opening percentage, if required. When setting a value of 90, or greater it is recommended it be in increments of 9 for Fast SSH. For Fast SSH the Magnum starts evaluating it's position after 44% of its startup time has passed. In Fast SSH2 it starts evaluation after 50% of its startup time has passed.

28.5.2.3. EXV Compressor Start Delay-SP 20

'Time Field' specifies the number of seconds to delay starting the compressor to allow the valve to partially open. MCS recommends 8 to 10 seconds and not more than 15 seconds. Remember this is part of the EXV startup time.

28.5.2.4. EXV Target & EXV Fast Zone-SP 9

'Value Field' specifies the superheat target we want to achieve and SP 10 'Value Field' specifies the Control Zone we are maintaining. The table shows the MCS recommendations for both English and Metric.

Units	English			Metric		
Range	Low	Standard	High	Low	Standard	High
Superheat	10.0	12.0	14.0	5.6	6.7	7.8
Fast Zone	1.6	2.0	3.0	0.9	1.1	1.7

28.6. Fast SSH States

Listed below shows the format of the states used.

EXV-AA-BB-CCCC

AA	DESC.		BB	DESC		CCCC	DESC.
HD	HOLDING		>T	GREATER TARG		RcSm	RATE OF CHANGE SMALL
OP	OPENING		<T	LESS TARG		RcLg	RATE OF CHANGE LARGE
CL	CLOSING		Sh	SUPERHEAT		ShHi	SUPERHEAT HIGH
						ShSm	SUPERHEAT SMALL
						Rc=0	RATE OF CHANGE EQUALS ZERO
						InDb	IN DEAD BAND
						InZn	IN ZONE

28.6.1 FAST SSH2 State Format

Listed below shows the format of the states used.

EXV-AA-BB-CCCC

AA	DESC.
HD	HOLDING
OP	OPENING
CL	CLOSING

BB	DESC
>T	GREATER TARG
<T	LESS TARG
Es	EXTENDED SLOPE
Sh	SUPERHEAT

CCCC	DESC.
EsLo	EXTENDED SLOPE LOW
EsHi	EXTENDED SLOPE HIGH
0 OR 1	EXTENDED SLOPE IS 0 OR 1
= T	SUPERHEAT EQUALS TARGET
ShHi	SUPERHEAT HIGH
ShLo	SUPERHEAT LOW
St=5	STATE TIMER EQUALS 5
RcSm	RATE OF CHANGE SMALL
RcLg	RATE OF CHANGE LARGE
Rc=0	RATE OF CHANGE EQUALS ZERO
InDb	IN DEAD BAND
InZn	IN ZONE

Chapter - 29. General Introduction to EXV PID

29.1. MCS PID REQUIREMENTS

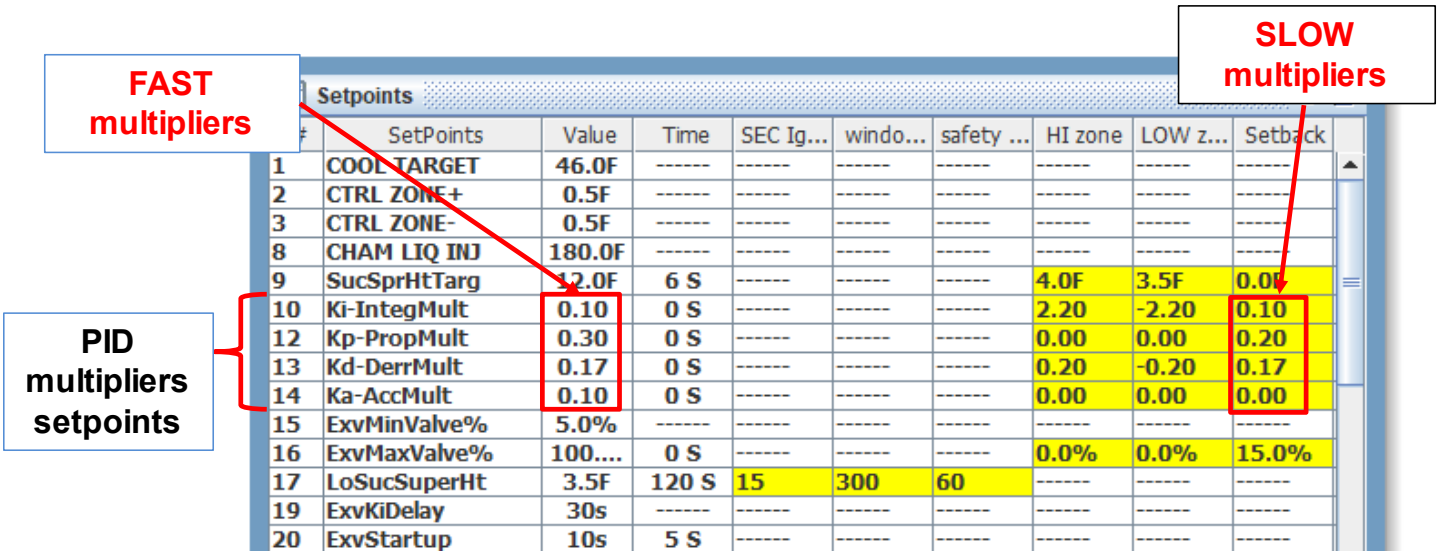
- FIRMWARE 17.60E4 or greater
- MCS-CONNECT 18.26.11 or greater
- MCS-CONFIG 18.01N or greater

- An EXV PID controller uses information about: PRESENT, PAST and errors to adjust the Expansion Valve.
- EXV PID automatically applies accurate and responsive correction to a control function.

P	**PROPORTIONAL (Kp)**	**Change in Superheat**	**=**	**Current Superheat minus last Superheat from 1 second ago (Rate of Change)**
I	**INTEGRAL (Ki)**	**Offset in Superheat**	**=**	**Current Superheat minus Target Superheat (setpoint #9 value field)**
D	**DERIVATIVE (Kd)**	**Velocity of Superheat**	**=**	**Current Superheat minus the Superheat from x seconds ago (setpoint #9 time seconds value)**
A	**ACCELERATION (Ka)**	**Change in Velocity**	**=**	**Current Kd minus the Kd from x seconds ago (setpoint #9 time seconds value)**

29.2. Calculations for the adjustment to EXV valve

MCS EXV PID algorithm uses two different sets of K multipliers to calculate adjustments to EXV on how far the superheat is from the superheat target, (setpoint #9 value field).



#	SetPoints	Value	Time	SEC Ig...	windo...	safety ...	HI zone	LOW z...	Setback
1	COOL TARGET	46.0F	------	------	------	------	------	------	------
2	CTRL ZONE+	0.5F	------	------	------	------	------	------	------
3	CTRL ZONE-	0.5F	------	------	------	------	------	------	------
8	CHAM LIQ INJ	180.0F	------	------	------	------	------	------	------
9	SucSprHtTarg	12.0F	6 S	------	------	------	4.0F	3.5F	0.0F
10	Ki-IntegMult	0.10	0 S	------	------	------	2.20	-2.20	0.10
12	Kp-PropMult	0.30	0 S	------	------	------	0.00	0.00	0.20
13	Kd-DerrMult	0.17	0 S	------	------	------	0.20	-0.20	0.17
14	Ka-AccMult	0.10	0 S	------	------	------	0.00	0.00	0.00
15	ExvMinValve%	5.0%	------	------	------	------	------	------	------
16	ExvMaxValve%	100....	0 S	------	------	------	0.0%	0.0%	15.0%
17	LoSucSuperHt	3.5F	120 S	15	300	60	------	------	------
19	ExvKiDelay	30s	------	------	------	------	------	------	------
20	ExvStartup	10s	5 S	------	------	------	------	------	------

29.3. EXV PID Firmware

Uses information about: PRESENT, PAST and errors to adjust the Expansion Valve.

- Provides extremely fast reaction to changes in superheat caused in part by the following:
  - High ambient chiller running in low ambient conditions.
  - Condenser fans turning on or off creating large changes in discharge and suction pressure .
  - Subcooling going temporarily negative and not having a solid column of liquid for short periods.
  - Large subcooler / economizers coming on and off.

EXV PID Logic supports:

- Suction Superheat, Discharge Superheat, Evaporator Level and Condenser Level Control.

29.4. MCS PID REQUIREMENTS

- FIRMWARE 17.60E4 or greater
- MCS-CONNECT 18.26.11 or greater
- MCS-CONFIG 18.01N or greater

29.5. Selecting PID in MCS-CONFIG

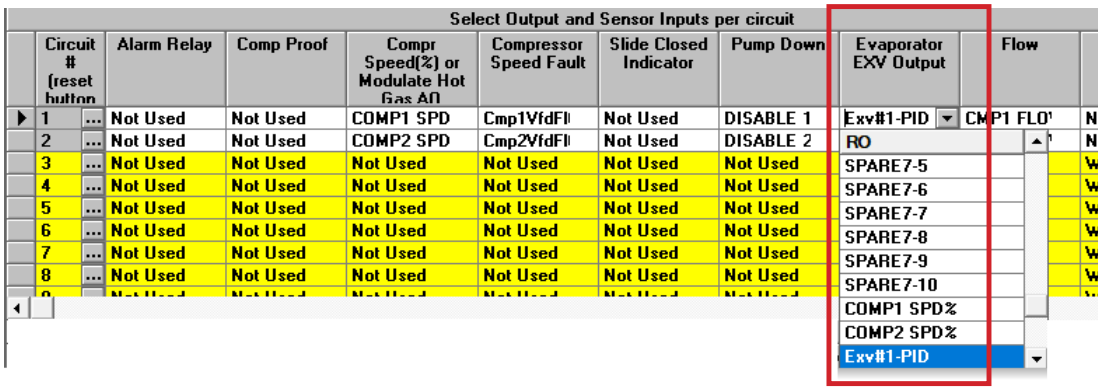
In PID only setpoints 9 through 20 are used to control the EXV valve. If you select PID as your superheat EXV control and you have a subcooler (an economizer injecting refrigerant into the compression chamber) you will get PIP control on the EXV for the subcooler. The PID set points for the subcooler are 65 through 72. Select Type of Control in Relay Output Information Screen. In the RO screen, from the drop down window in 'Type' you select either 'Step w \ EXV' or 'Screw w \ EXV'.

Relay Output Information Screen

Point Number	Name	Slide Mult.	Slide Div.	Slide Off.	Design Suc.PSI	Design Dis.PSI	Nominal Tonnage(of Step)	EXV Start (When Lead)	Type
4-1 ...	COMP 1	——	——	——	——	——	0	35	Step w\ EXV
4-2 ...	CHAM INJ 1	——	——	——	——	——	——	——	Standard
4-3 ...	ECONO 1	——	——	——	——	——	0	20	Step w\ EXV
4-4 ...	REV VLV 1	——	——	——	——	——	——	——	Standard

29.6. Circuit Base

In the Circuit Base screen you need to select the Analog Output for the EXV.



IMPORTANT

Next in the Circuit Base screen you need to select 'PIP SSH' from the Evaporator EXV Control section drop down menu.

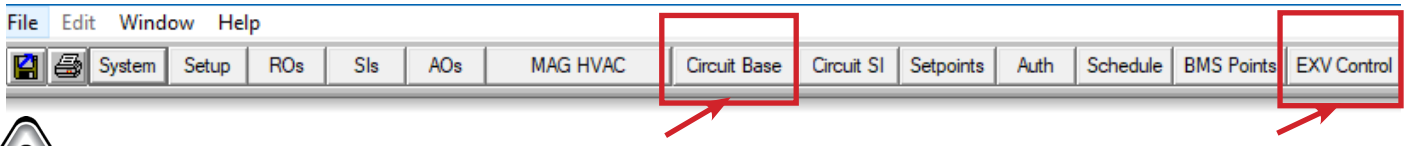
NOTE: ***TANDEM 6 EXV PER CIRCUIT NOT SUPPORTED IN RTU AND CENTRIFUGAL FIRMWARE***

Information that relates to Condensers and Evaporators on the circuit

Starting ondenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV #3 Circuit#	EXV #4 Circuit#	EXV #5 Circuit#	EXV #6 Circuit#	Evaporator EXV Control
Used	0	1	Not Used	Not Used	1	1	1	1	1	PID Cond Lvl
Used	0	2	Not Used	Not Used	2	2	2	2	2	PID Cond Lvl

The MAGNUM supports up to 6 tandem EXVs per circuit.
NOT AVAILABLE with RTU and Centrifugal firmware

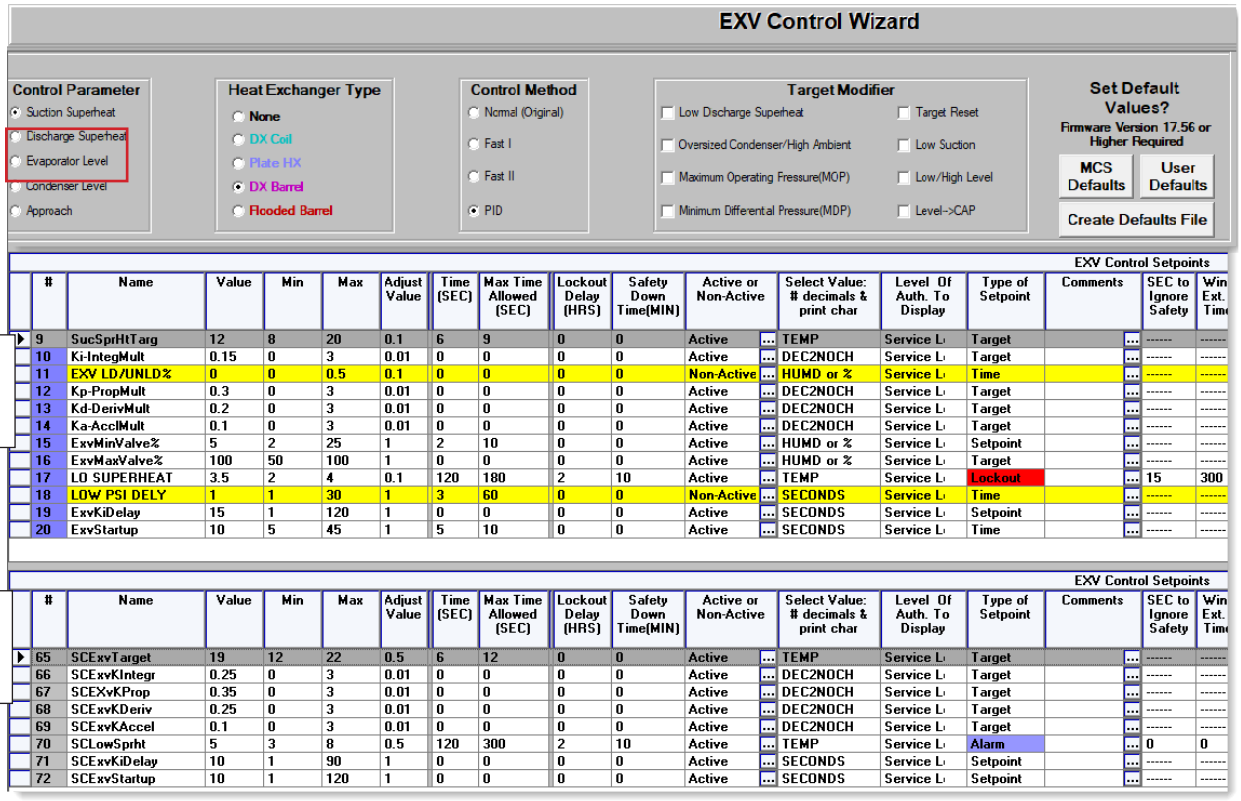
With the release of Fast SSH2 AND PID MCS has released a new MCS-Config to support the new functions. The new MCS-Config provides a new tab, 'EXV Control', where you define your system. This then allows MCS-Config to provide MCS Default Set Point Values for you. The figure below shows the Current 'Circuit Base' tab and the new 'EXV Control' tab.



If you enter data in the EXV portion of the Circuit Base tab or in the EXV Control tab it is carried through to the other tab.

29.7. Selecting the 'EXV Control' tab you are prompted with the following:

Selection Option ➔ (Evaporator and condenser Level not available with Fast I or Fast II Control Method)



#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Win Ext. Time
9	SucSprHtTarg	12	8	20	0.1	6	9	0	0	Active	TEMP	Service L	Target		------	------
10	Ki-IntegMult	0.15	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------
11	EXV LD/UNLD%	0	0	0.5	0.1	0	0	0	0	Non-Active	HUMD or %	Service L	Time		------	------
12	Kp-PropMult	0.3	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------
13	Kd-DerivMult	0.2	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------
14	Ka-AcclMult	0.1	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------
15	ExvMinValve%	5	2	25	1	2	10	0	0	Active	HUMD or %	Service L	Setpoint		------	------
16	ExvMaxValve%	100	50	100	1	0	0	0	0	Active	HUMD or %	Service L	Target		------	------
17	LO SUPERHEAT	3.5	2	4	0.1	120	180	2	10	Active	TEMP	Service L	Lockout		15	300
18	LOW PSI DELY	1	1	30	1	3	60	0	0	Non-Active	SECONDS	Service L	Time		------	------
19	ExvKiDelay	15	1	120	1	0	0	0	0	Active	SECONDS	Service L	Setpoint		------	------
20	ExvStartup	10	5	45	1	5	10	0	0	Active	SECONDS	Service L	Time		------	------

Compressor EXV Results ➔

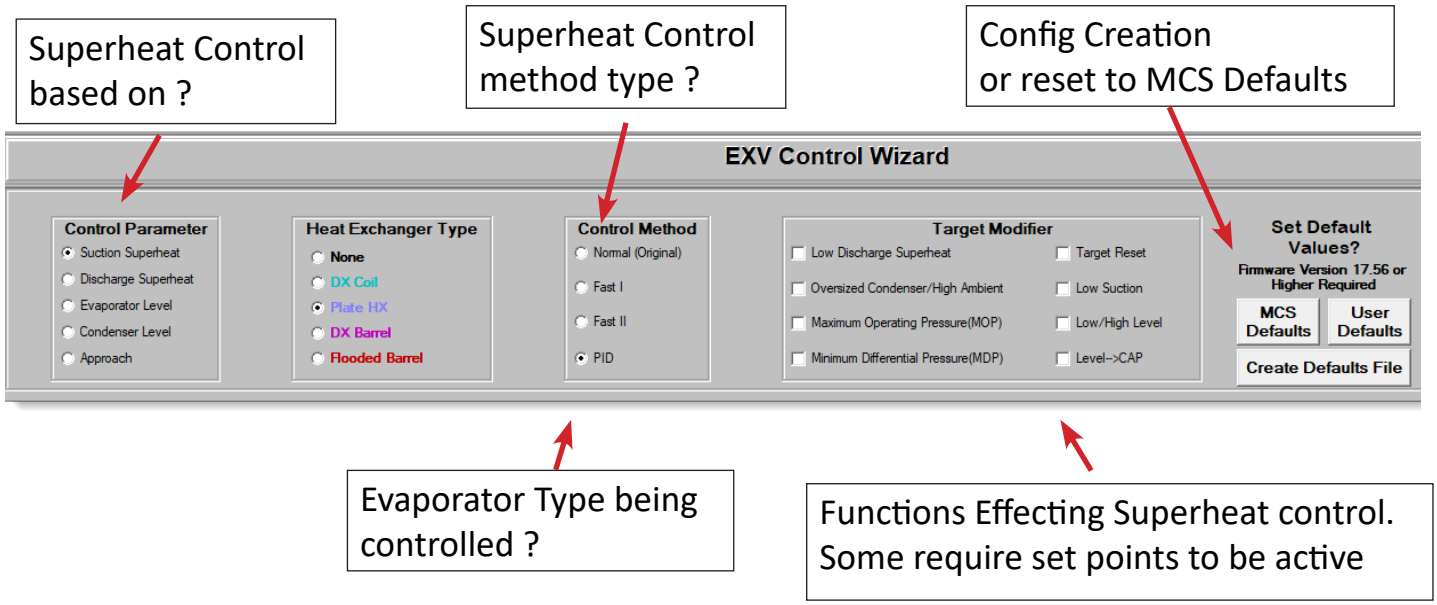
Subcooler EXV Results ➔

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Win Ext. Time
65	SCExvTarget	19	12	22	0.5	6	12	0	0	Active	TEMP	Service L	Target		------	------
66	SCExvKIntegr	0.25	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------
67	SCExvKProp	0.35	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------
68	SCExvKDeriv	0.25	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------
69	SCExvKAccel	0.1	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------
70	SCLowSprht	5	3	8	0.5	120	300	2	10	Active	TEMP	Service L	Alarm		0	0
71	SCExvKiDelay	10	1	90	1	0	0	0	0	Active	SECONDS	Service L	Setpoint		------	------
72	SCExvStartup	10	1	120	1	0	0	0	0	Active	SECONDS	Service L	Setpoint		------	------

Based on your selections will dictate the set points for compressor control. The subcooler set points are only displayed if a subcooler id is present.

29.8. Selection Options



IMPORTANT

NOTE: Once you have clicked on the boxes for your setup, be sure to click on **'Set Values to Default'**. This will set the values to the default for **'Control Parameter, Heat Exchanger Type and the Control Method. Make note that clicking in the 'Target Modifier' require that some set points must be active.**

29.9. Compressor EXV Results

EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
9	SucSprHtTarg	12	8	20	0.1	6	9	0	0	Active	TEMP	Service L	Target		------	------	------
10	Ki-IntegMult	0.15	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------	------
11	EXV LD/UNLD%	0	0	0.5	0.1	0	0	0	0	Non-Active	HUMD or %	Service L	Time		------	------	------
12	Kp-PropMult	0.3	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------	------
13	Kd-DerivMult	0.2	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------	------
14	Ka-AcclMult	0.1	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L	Target		------	------	------
15	ExvMinValve%	5	2	25	1	2	10	0	0	Active	HUMD or %	Service L	Setpoint		------	------	------
16	ExvMaxValve%	100	50	100	1	0	0	0	0	Active	HUMD or %	Service L	Target		------	------	------
17	LO SUPERHEAT	3.5	2	4	0.1	120	180	2	10	Active	TEMP	Service L	Lockout		15	300	60
18	LOW PSI DELY	1	1	30	1	3	60	0	0	Non-Active	SECONDS	Service L	Time		------	------	------
19	ExvKiDelay	15	1	120	1	0	0	0	0	Active	SECONDS	Service L	Setpoint		------	------	------
20	ExvStartup	10	5	45	1	5	10	0	0	Active	SECONDS	Service L	Time		------	------	------

- Control on 'Suction Superheat'
- Evaporator Type 'Plate HX'
- Control Method 'PID'
- MCS Default 'Selected'
- Degrees F or C are automatic

29.10. Set Point Descriptions (PID)

Set points **Available in MCS release 17.26-B and later**

SP #	Name	Description
9	SPRHT TARGET or LEVEL TARGET	If EXV control is based upon superheat, this is the Superheat target that the Magnum will control from. If EXV control is based upon refrigerant level, this is the refrigerant level target that the Magnum will control from. 'Low Zone' if nonzero then develop control super heat based upon the lowest superheat of any compressor that is on with in this suction group else use the superheat of this compressor. 'Time (sec)' field: Seconds between samples used for calculating the Superheat Rate of Change.
	STAGE 7 CUT IN (Cut In/Out Control)	Stage 7 cut in, Setpoint value contains the voltage when this stage is turned on.
10	SPRHT ZONE +-	The value in this setpoint is added and subtracted to setpoint #9 to determine the upper and lower limits of the control zone respectively. Refer to section on EXV control. 'Time (sec)' field: If non-zero, skip ROC adjustment logic in the control zone.
	Ki-IntegMult	**EXV PID Integral** - Offset in Superheat= Current Superheat minus Target Superheat (setpoint #9 value field) Value is the Fast Multiplier for Kp adjustments, setback is the slow multiplier.
	STAGE 8 CUT IN (Cut In/Out Control)	Stage 8 cut in, Setpoint value contains the voltage when this stage is turned on.
12	EXV FINE ADJ	The adjustment is made when in the 1st zone above or below the control zone. Refer to section on EXV control.
	Kp-PropMult	**EXV PID Proportional** - Change in Superheat = Current Superheat minus last Superheat from 1 second ago (Rate of Change). Value is the Fast Multiplier for Kp adjustments, setback is the slow multiplier.
13	EXV COURSE	If a course adjustment to the EXV when in the 2nd zone above or below the control zone. If the type is TIME and the time (SEC) field is greater than 1 and less than 7 then multiple the value field by the time field else multiple by 2 for adjustment amount. If a course adjustment to the EXV when in the 3rd zone above or below the control zone. Multiple value by the by 2 for adjustment amount. If a course adjustment to the EXV when above or below the 3nd zone the control zone. The value is the adjustment amount. Refer to section on EXV control. If a course adjustment to the EXV when in the 3rd zone above or below the control zone. Multiple value by the by 2 for adjustment amount. If a course adjustment to the EXV when above or below the 3rd zone the control zone. The value is the adjustment amount. Refer to section on EXV control.
	Kd-DerrMult	**EXV PID Derivative** - Velocity of Superheat = Current Superheat minus the Superheat from x seconds ago (setpoint #9 time seconds value). Value is the Fast Multiplier for Kp adjustments, setback is the slow multiplier.
14	EXV LOAD DIV	The EXV slide adjustment can be fined tuned by dividing by the value of this set point. Note the value of this set point is used regardless if the its is active or not. Refer to section on EXV control.
	Ka-AccMult	**EXV PID Acceleration** - Change in Velocity = Current Kd minus the Kd from x seconds ago (setpoint #9 time seconds value). Value is the Fast Multiplier for Kp adjustments, setback is the slow multiplier.
	STAGE 12 CUT IN (Cut In/Out Control)	Stage 12 cut in, Setpoint value contains the voltage when this stage is turned on.

15	ExvMinValve%	This is the minimum valve position allowed when modulating the expansion valve. This value should be set so when hot gas is applied the valve opening is adequate. Note the value of this set point is used regardless if it is active or not. Refer to section on EXV control. Note the value of this set point is used regardless if it is active or not. Refer to section on EXV control. Note the value of this set point is used regardless if it is active or not. Refer to section on EXV control.
	STAGE 13 CUT IN (Cut In/Out Control)	Stage 13 cut in, Setpoint value contains the voltage when this stage is turned on.
16	ExvMaxValve%	This is the maximum position allowed when modulating the expansion valve to maintain the superheat target. This value should be the valve % opening at full capacity plus a 10 to 15 % margin. Note the value of this set point is used regardless if the its is active or not. Refer to section on EXV control.
	STAGE 14 CUT IN (Cut In/Out Control)	Stage 14 cut in, Setpoint value contains the voltage when this stage is turned on.
17	LoSucSuperHt	If super heat is less or equal to this value and the control slope is less that the roc for zone 3 make a slide adjustment of 3 times the value of set point #13. If the calculated superheat remains below this value for the time specified in the Time (SEC) cell, the Magnum will generate a LOW SUPERHEAT alarm. Refer to section on EXV control.
	STAGE 15 CUT IN (Cut In/Out Control)	Stage 15 cut in, Setpoint value contains the voltage when this stage is turned on.
19	EXV DELAY	Delay in seconds between valve adjustments. Should not be less than 48. (When adjusting at 4x this will allow 12 seconds for the controller to process the results of the last action before making the next adjustment). Refer to section on EXV control.
	ExvKiDelay	
20	ExvStartup	This is the time in seconds to hold the valve at the start % setpoint when the compressor starts. Since the superheat calculation is not valid when the compressor is not running the EXV logic sets the valve to a given position for a set time to allow the system to develop a valid superheat. 'Time (sec)' field: If zero, then there is no delay when a compressor is ready to start. If non-zero, this is the time delay in which the EXV valve is allowed to open before the compressor starts. Refer to section on EXV control.

29.11. PID Example Setpoint Defaults

Default **Celsius** values for Suction Superheat with DX Chiller Barrel.

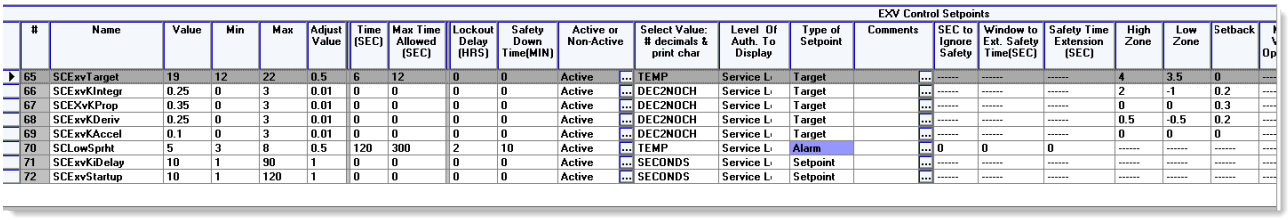
#	SETPOINT	VALUE	TIME	SEC Ignore	WINDOW EXT	SAFETY EXT	HI ZONE	LOW ZONE	SETBACK	TYPE
9	**SucSprHtTarg**	**6.5C**	**6 S**	**-**	**-**	**-**	**3.0C**	**2.7C**	**0.0C**	**TARGET**
10	**Ki-IntegMult**	**0.20**	**0 S**	**-**	**-**	**-**	**2.20**	**-2.20**	**0.10**	**TARGET**
12	**Kp-PropMult**	**0.45**	**0 S**	**-**	**-**	**-**	**0.00**	**0.00**	**0.20**	**TARGET**
13	**Kd-DerrMult**	**0.15**	**0 S**	**-**	**-**	**-**	**0.20**	**-0.20**	**0.17**	**TARGET**
14	**Ka-AccMult**	**.10**	**0 S**	**-**	**-**	**-**	**0.00**	**0.00**	**0.00**	**TARGET**
15	**ExvMinValve%**	**5.0%**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**SETPOINT**
16	**ExvMaxValve%**	**100**	**0 S**	**-**	**-**	**-**	**0.0%**	**0.0%**	**15.0%**	**TARGET**
17	**LO SUPERHEAT**	**1.6F**	**120 S**	**15**	**300**	**60**	**-**	**-**	**-**	**LOCKOUT**
19	**ExvKiDelay**	**15s**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**SETPOINT**
20	**ExvStartup**	**10s**	**5 S**	**-**	**-**	**-**	**-**	**-**	**-**	**TIME**

Below setpoints are the default **Fahrenheit** values for Suction Superheat with DX Chiller Barrel.

#	SETPOINT	VALUE	TIME	SEC Ignore	WINDOW EXT	SAFETY EXT	HI ZONE	LOW ZONE	SET-BACK	TYPE
9	SucSprHtTarg	12.0F	6 S	-	-	-	4.0F	3.5F	0.0F	TARGET
10	Ki-IntegMult	0.15	0 S	-	-	-	2.20	-2.20	0.10	TARGET
12	Kp-PropMult	0.30	0 S	-	-	-	0.00	0.00	0.20	TARGET
13	Kd-DerrMult	0.20	0 S	-	-	-	0.20	-0.20	0.17	TARGET
14	Ka-AccMult	0.10	0 S	-	-	-	0.00	0.00	0.00	TARGET
15	ExvMinValve%	5.0%	-	-	-	-	-	-	-	SETPOINT
16	ExvMaxValve%	100	0 S	-	-	-	0.0%	0.0%	15.0%	TARGET
17	LO SUPERHEAT	3.5F	120 S	15	300	60	-	-	-	LOCKOUT
19	ExvKiDelay	15s	-	-	-	-	-	-	-	SETPOINT
20	ExvStartup	10s	5 S	-	-	-	-	-	-	TIME

29.11.1 Subcooler EXV Results

- If you have selected PID and have a subcooler this will use set points 65 through 72. If you set-up 'Subcooler EXV & Subcooler Suction PSI' MCS-Config will automatically complete set points 65 through 72 with MCS standard defaults.
- If this is an existing config and you are converting to PID set points 253 through 255 will be spared out. (HVAC only)



EXV Control Setpoints

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Setback
65	SCExvTarget	19	12	22	0.5	6	12	0	0	Active	TEMP	Service L.	Target		------	------	------	4	3.5	0
66	SCExvKIntegr	0.25	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L.	Target		------	------	------	2	-1	0.2
67	SCExvKProp	0.35	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L.	Target		------	------	------	0	0	0.3
68	SCExvKDeriv	0.25	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L.	Target		------	------	------	0.5	-0.5	0.2
69	SCExvKAccel	0.1	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service L.	Target		------	------	------	0	0	0
70	SCLowSpHt	5	3	8	0.5	120	300	2	10	Active	TEMP	Service L.	Alarm		0	0	0	------	------	------
71	SCExvKiDelay	10	1	90	1	0	0	0	0	Active	SECONDS	Service L.	Setpoint		------	------	------	------	------	------
72	SCExvStartup	10	1	120	1	0	0	0	0	Active	SECONDS	Service L.	Setpoint		------	------	------	------	------	------

- Set Points if PID is selected & you have a Sub Cooler
- Set Points 65 thru 72 are set up
- Degrees F or C are automatic

65	EXV ZONE1	Temperature differential used to build the EXV Zone 1 both plus and minus.
	SCExvTarget	SC SUPERHEAT TARGET - SC SUPERHEAT AVERAGE THIS # SECONDS - Setup as Target
66	EXV ZONE2	Temperature differential that is used to build the EXV Zone 2 both plus and minus. Temperatures above this zone are considered in zone 3.
	SCExvKIntegr	SC SUPERHEAT CONTROL ZONE - SC MPLY Ki) FOR VALVE ADJ WHEN IN FAST ZONE- Setup as Target
67		The EXV control logic will compare the value of this Setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within the EXV control zone. 'Safety Down Time (MIN)' field: The minimum time delay between EXV adjustments when in the EXV control zone.
	SCExvKProp	SC SUPERHEAT MULTIPLIER (Kp) -SC RATE OF CHG MULTIPLIER - Setup as Target

68	EXV ROC ZONE1	The EXV control logic will compare the value of this Setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within zone 1. 'Safety Down Time (MIN)' field: This is the minimum time delay between EXV adjustments when in the EXV control zone 1. If this Setpoint is inactive then the ROC for this zone is 0 and the delay is 15 seconds.
	SCExvKDeriv	SC ADJUST LIMIT IN FAST ZONE (Kd) Velocity of Superheat - SC OUTSIDE FAST ZONE ADJ LIMIT
69	EXV ROC ZONE2	The EXV control logic will compare the value of this Setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within zone 2. 'Safety Down Time (MIN)' field: This is the minimum time delay between EXV adjustments when in the EXV control zone 2. If this Setpoint is inactive then the ROC for this zone is 0 and the delay is 15 seconds.
	SCExvKAccel	Setup as Target
70	EXV ROC ZONE3	The EXV control logic will compare the value of this Setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within zone 3. 'Safety Down Time (MIN)' field: This is the minimum time delay between EXV adjustments when in the EXV control zone 3. If this Setpoint is inactive then the ROC for this zone is 0 and the delay is 15 seconds.
	SCLowSprht	SC LOW SUPERHEAT SAFETY - SC LOW SH TIME TO SAFETY - Setup as Alarm
71	EXV TOO FAST	When the superheat is with the control zone, the EXV control logic will compare the value of this Setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within the zone and rising too fast. 'Safety Down Time (MIN)' field: This is the minimum time delay between EXV adjustments if the rate of change is too fast when in EXV control zones 1 or 2. If this Setpoint is inactive then the ROC for this zone is 0 and the delay is 15 seconds.
	SCExvKiDelay	SC SECONDS DELAY BETWEEN ADJUSTMENTS (Ki) - Setup as Setpoint
72	EXV CHANGING	When the superheat is with the control zone, the EXV control logic will compare the value of this Setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within the zone and rising.

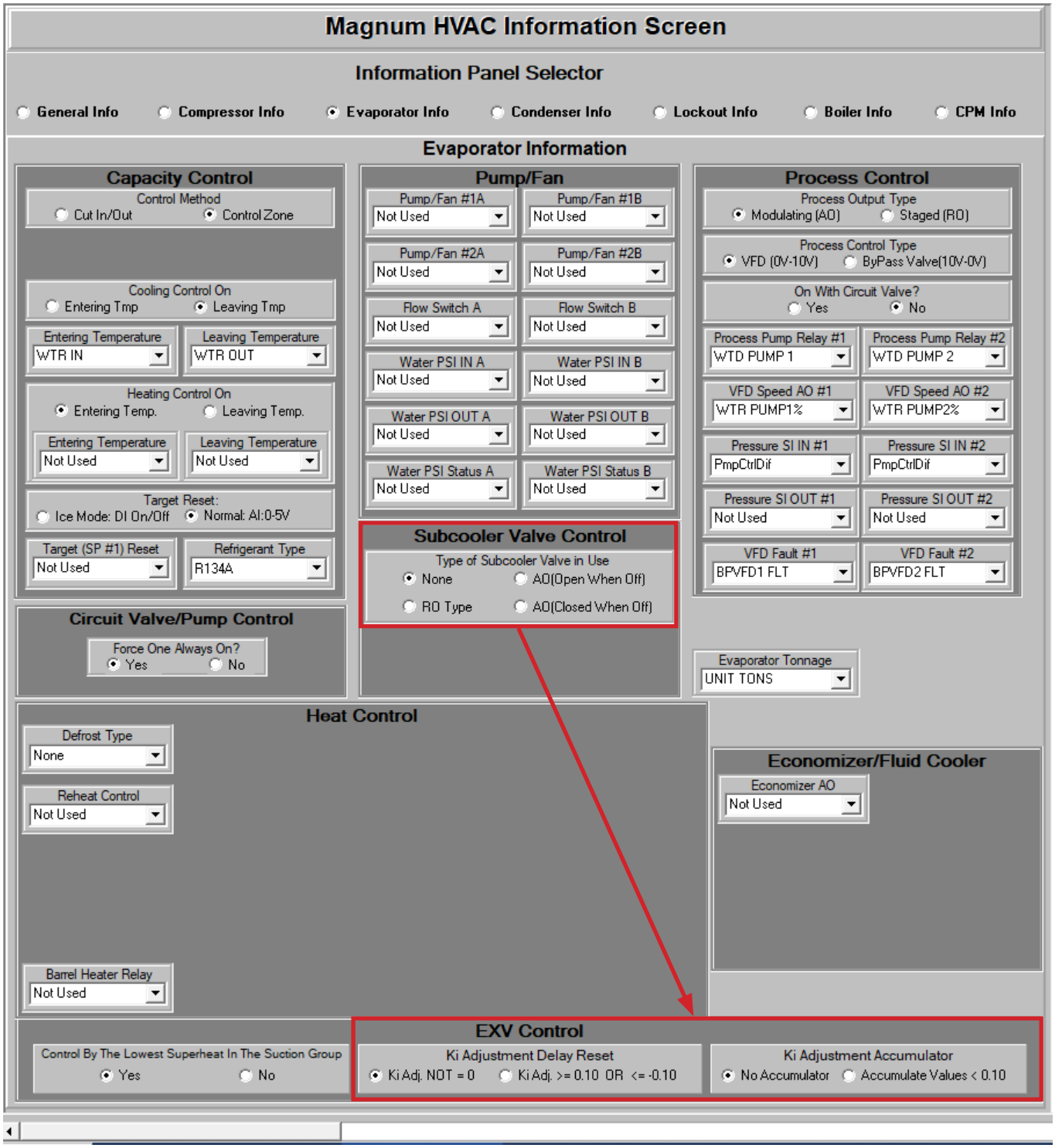
29.12. EXV PID Ki Delay Timer and Ki Accumulator

Magnum firmware 17.63 and greater adds support for two new EXV PID Ki adjustment options.

#1 **Reset the Ki Delay Timer** – only reset the Ki delay when a 0.1 or greater or -0.1 or less adjustment occurs, vs resetting it when Ki is not equal to zero. This is the reset time when the Ki adjustment is enough to actual move the EXV 0.1% or more.

#2 **Ki Accumulator** – this keeps the second decimal point in the Ki adjustment and accumulator until an actual adjustment is made, adjust is greater 0.1 or less than -0.1.

Both of these change are designed to help Ki adjustments when very close to the target.



29.13. Logic to Determine which K Multipliers to Use

- Calculations are done every second

29.13.1.1. Switching to Fast K multipliers is based on:

a. Distance from target

1. If current superheat is greater than (setpoint #9 value field plus setpoint #9 high zone field x 2)

Setpoint	Value		Hi Zone		Total
#9 SucSprHtTarg	12.0F	+	4.0F x 2	=	20

EXV PID algorithm will use the fast multipliers (Setpoint Value Field)

2. If current superheat value is less than (setpoint #9 value field minus setpoint #9 high zone field)

Setpoint	Current Superheat Value		HI Zone		Total
#9 SucSprHtTarg	12.0F	-	4.0F	=	8

EXV PID algorithm will use the fast multipliers (Setpoint Value Field)

#	SetPoints	Value	Time	SEC Ig...	windo...	safety ...	HI zone	LOW z...	Setback
9	SucSprHtTarg	12.0F	6 S	------	------	------	4.0F	3.5F	0.0F
10	Ki-IntegMult	0.10	0 S	------	------	------	2.20	-2.20	0.10
12	Kp-PropMult	0.30	0 S	------	------	------	0.00	0.00	0.20
13	Kd-DerrMult	0.17	0 S	------	------	------	0.20	-0.20	0.17
14	Ka-AccMult	0.10	0 S	------	------	------	0.00	0.00	0.00

FAST multipliers

29.13.1.2. Switching to Slow K multipliers is based on:

b. Distance from target

1. If current superheat is less than (setpoint #9 value field plus setpoint #9 low zone field) but above the fast multiplier switch of 8 (12 - 4)

Setpoint	Value		LOW Zone		Total
#9 SucSprHtTarg	12.0F	+	3.5F	=	15.5F

EXV PID algorithm will use the slow multipliers (Setback Value Field)

2. If current superheat is more than (setpoint #9 value field minus setpoint #9 low zone field) and below the fast multiplier switch of 20 (12 + 4 x 2)

Setpoint	Value		LOW Zone		Total
#9 SucSprHtTarg	12.0F	-	3.5F	=	8.5

EXV PID algorithm will use the slow multipliers (Setback Value Field)

#	SetPoints	Value	Time	SEC Ig...	windo...	safety ...	HI zone	LOW z...	Setback
9	SucSprHtTarg	12.0F	6 S	------	------	------	4.0F	3.5F	0.0F
10	Ki-IntegMult	0.10	0 S	------	------	------	2.20	-2.20	0.10
12	Kp-PropMult	0.30	0 S	------	------	------	0.00	0.00	0.20
13	Kd-DerrMult	0.17	0 S	------	------	------	0.20	-0.20	0.17
14	Ka-AccMult	0.10	0 S	------	------	------	0.00	0.00	0.00

SLOW multipliers

29.13.1 Rate of Change_- Moving too Fast

1. If current superheat ROC is greater than setpoint #13 (Kd) high zone and current superheat is above target

Current Superheat ROC	Setpoint #13 High Zone	Current Superheat
0.7	.20	16F

EXV PID algorithm will use the fast multipliers (Setpoint Value Field)

2. If current superheat ROC is greater than setpoint #13 (Kd) low zone and current superheat is below target

Current Superheat ROC	Setpoint #13 Low Zone	Current Superheat value
-0.3	-0.20	8

EXV PID algorithm will use the fast multipliers (Setpoint Value Field)

#	SetPoints	Value	Time	SEC Ig...	windo...	safety ...	HI zone	LOW z...	Setback
9	SucSprHtTarg	12.0F	6 S	------	------	------	4.0F	3.5F	0.0F
10	Ki-IntegMult	0.10	0 S	------	------	------	2.20	-2.20	0.10
12	Kp-PropMult	0.30	0 S	------	------	------	0.00	0.00	0.20
13	Kd-DerrMult	0.17	0 S	------	------	------	0.20	-0.20	0.17
14	Ka-AccMult	0.10	0 S	------	------	------	0.00	0.00	0.00

FAST multipliers

29.13.2 Rate of Change - Moving Slow Enough

If current superheat ROC is less than setpoint #13 (Kd) high zone and current superheat is above target

Current Superheat ROC	Setpoint #13 High Zone	Current Superheat
0.1	0.20	15F

EXV PID algorithm will use slow multipliers (Setback Field)

If current superheat ROC is less than setpoint #13 (Kd) low zone and current superheat is below target

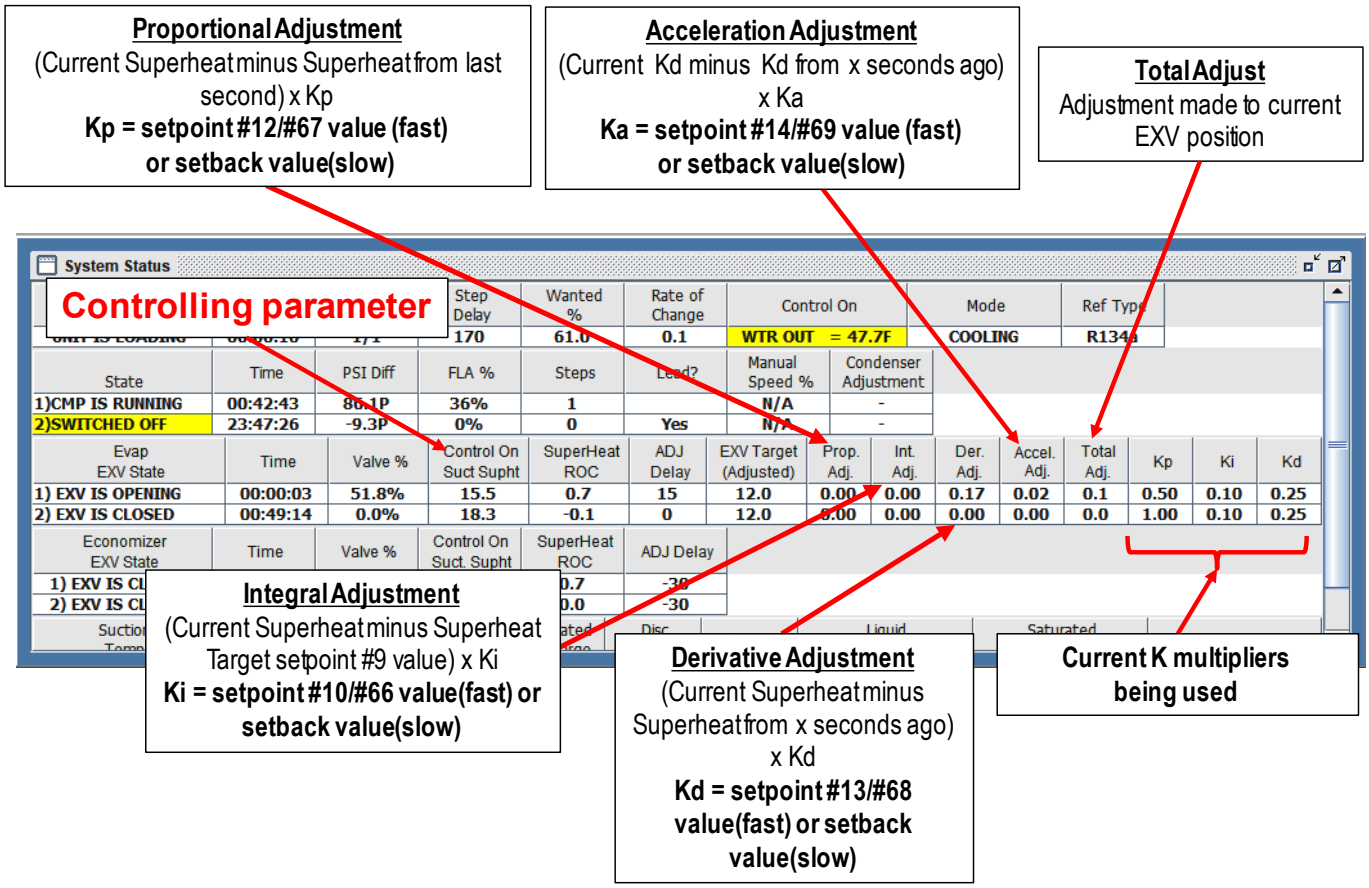
Current Superheat ROC	Setpoint #13 Low Zone	Current Superheat
-0.1	-0.20	10

EXV PID algorithm will use slow multipliers (Setback Field)

#	SetPoints	Value	Time	SEC Ig...	windo...	safety ...	HI zone	LOW z...	Setback
9	SucSprHtTarg	12.0F	6 S	------	------	------	4.0F	3.5F	0.0F
10	Ki-IntegMult	0.10	0 S	------	------	------	2.20	-2.20	0.10
12	Kp-PropMult	0.30	0 S	------	------	------	0.00	0.00	0.20
13	Kd-DerrMult	0.17	0 S	------	------	------	0.20	-0.20	0.17
14	Ka-AccMult	0.10	0 S	------	------	------	0.00	0.00	0.00

SLOW multipliers

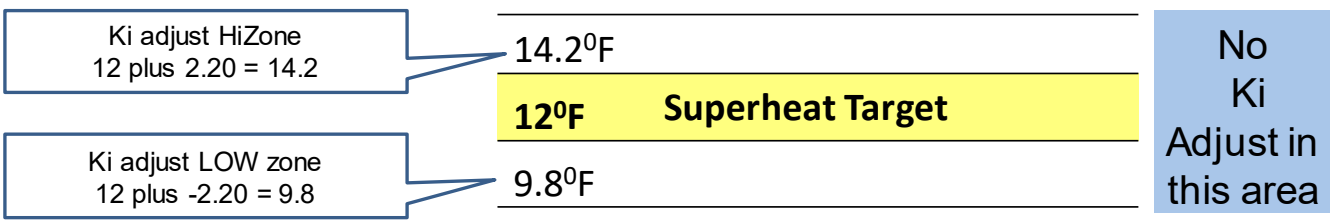
29.14. MCS-Connect Evaporator EXV PID Status



29.15. Allowing an Adjustments to the EXV Valve

(When Ki & Kd are in opposite, we are going in the right direction)

1. When the Proportional adjust, Integral adjust, Derivative adjust and Acceleration all add up to be ≥ to .1 or -.1, the adjustment is made based on that number.
2. The Proportional adjust, Derivative adjust and Acceleration all run every second.
3. The Integral adjust uses setpoint #19 (ExvKiDelay) as a delay before posting a value as long as;
    a. If the current Integral adjust (Ki) is > 0 and the current superheat > the current target plus setpoint #10 high zone field.
    b. If the current Integral adjust (Ki) is < 0 and the current superheat < the current target plus setpoint #10 low zone.



Setpoints

#	SetPoints	Value	Time	SEC Ig...	windo...	safety ...	HI zone	LOW z...	Setback	MIN VFD	MAX VFD	MAX V...	Type
9	SucSprHtTarg	12.0F	6 S	------	------	------	4.0F	3.5F	0.0F	------	------	------	TARGET
10	Ki-IntegMult	0.10	0 S	------	------	------	2.20	-2.20	0.10	------	------	------	TARGET

Chapter - 30. EXV Level Control using PID

- The following versions of Firmware are needed to setup EXV Level Control:
- MCS-CONFIG – 17.17.00U or later
- MCS-CONNECT – 17.003.11 or later
- MCS-MAGNUM Firmware - 17.16C or later

30.1. Setting up EXV Level Control

- Setup Analog Outputs to control electronic expansion valves.

Analog Output Information Screen

Point Number	Name	Control Type	Invert	Comments	Modbus Display Type	Feedback Sensor
M-1	EEV-1	Standard	NO		Spare	Not Used
M-2	EEV-2	Standard	NO		Spare	Not Used

- Setup INPUTS to read evaporator or condenser level.

Sensor Input Information Screen

Point Number	Name (1 to 10 char)	Display Type	Offset	Manual Value or NC/NO (select to change)	Display Text (select to change)	Temp./ GPM / CFM / Pwr Factor SI	Humd./PSI/ Temp. Diff./ Enthal. Diff.	Auto/Manual (Click here for all)	Circuit Index
1-12	REFLVL1	User Defined	0	0	Not Used	Not Used	Not Used	Auto	Not Used
1-13	REFLVL2	User Defined	0	0	Not Used	Not Used	Not Used	Auto	Not Used

30.1.1 Setting up EXV Level Control – User Defined

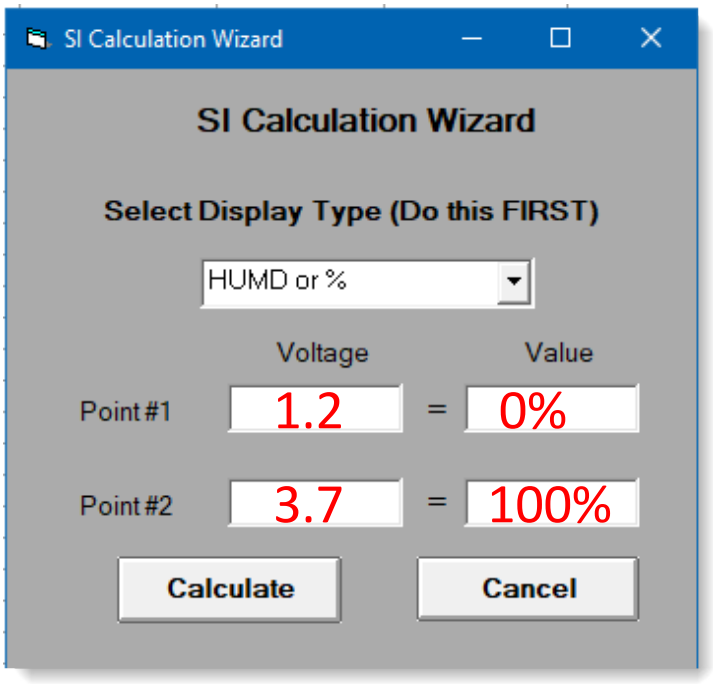
- Selecting 'User Defined' type

Sensor Input Information Screen

Point Number	Name (1 to 10 char)	Display Type	Offset	Manual Value or NC/NO (select to change)	Display Text (select to change)	Temp./ GPM / CFM / Pwr Factor SI	Humd./PSI/ Temp. Diff./ Enthal. Diff.	Auto/Manual (Click here for all)	Circuit Index
1-12	REFLVL1	User Defined	0	0	Not Used	Not Used	Not Used	Auto	Not Used
1-13	REFLVL2	User Defined	0	0	Not Used	Not Used	Not Used	Auto	Not Used
1-14	BARLTMP1	User Logic	0	0	Not Used	Not Used	Not Used	Auto	Not Used
1-15	BARLTMP2	VirtualVane%	0	0	Not Used	Not Used	Not Used	Auto	Not Used
1-16	SPARE	VOLT5DC	0	0	Not Used	Not Used	Not Used	Auto	Not Used
2-1	SPARE2-1	0-600 VAC	0	0	Not Used	Not Used	Not Used	Auto	Not Used
		600VAC4							

Under the Display Type, select User Defined

- Screen below will open:



1. Setting up the Level Sensor
2. Wire the Level Sensor to the designated input.
3. If available, have the Level Sensor loose and manually move the float or submerge in a bucket of liquid to 100% (standpipe full of refrigerant).
4. Record the voltage input, this would be point #2 on the SI Calculation Wizard
   (Ex. Voltage = 3.7 Value = 100%)
5. Move the float to 0% (no refrigerant in the standpipe=empty)
6. Record the voltage input. This would be point #1 on the SI calculation wizard
   (Ex. Voltage = 1.2 Value = 0%)

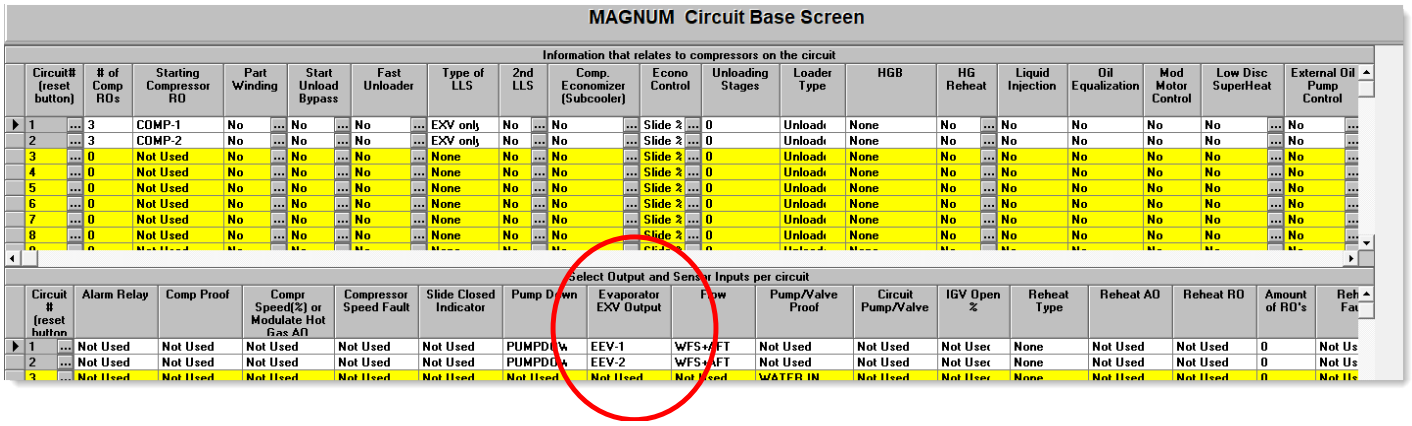
NOTE: If Level Sensor is a 4-20ma output, where at 4ma = 0% level and at 20ma = 100% level, you would put the designated input jumper on digital and the SI calculation wizard would be Setup as:

Point #1 .882 vdc = 0%
Point #2 4.41 vdc = 100%

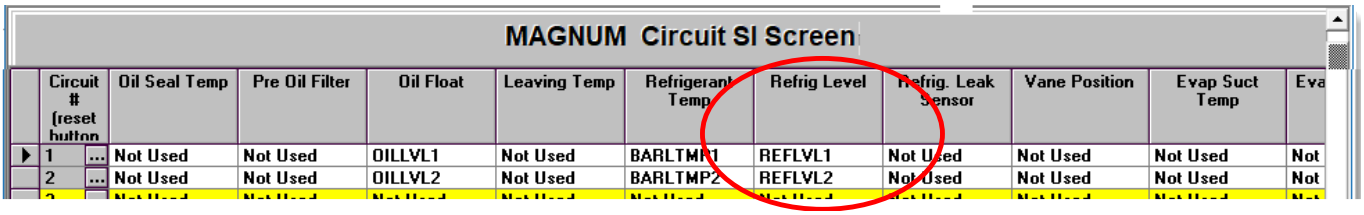
See APP066- 4-20mA Sensor Connection to MCS-Magnum

30.1.2 Circuit Base Setup

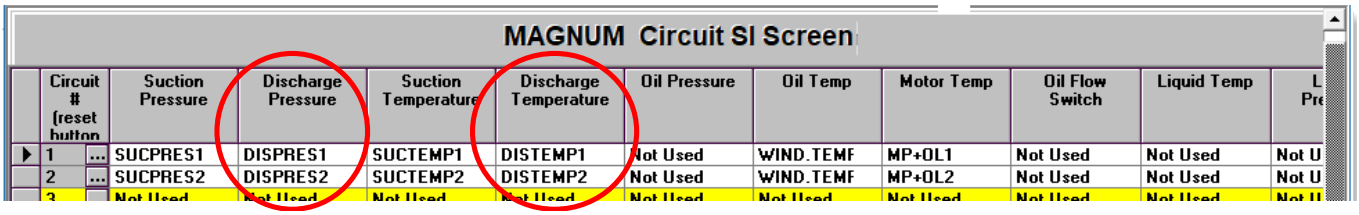
- Point to the EXV outputs in the Circuit Base screen.



- Point to the Refrigerant Level inputs in the Circuit SI screen.

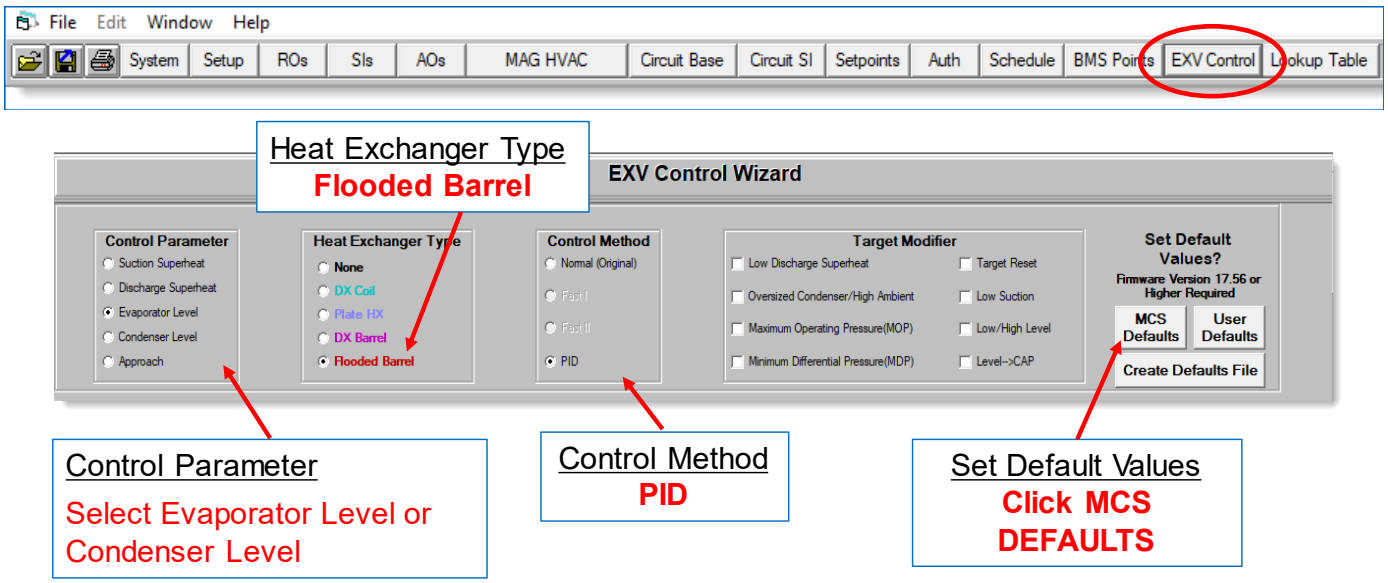


- Make sure the Discharge Pressure and Discharge Temperature are pointing to correct sensors for the calculation of discharge superheat.



30.1.3 Setup using EXV CONTROL WIZARD

- Select the EXV Control button and set up for level control with the desired EXV control method.



- The following setpoints will be setup:

Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Setback
9	EvpLevelTarg	40	25	70	1	6	9	0	0	Active	HUMD or %	Service Li	Target		—	—	—	0.1	1	0
10	Ki-IntegMult	0.13	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service Li	Target		—	—	—	1	-1	0.1
11	EXV LD/UNLD%	0	0	0.5	0.1	0	0	0	0	Non-Active	HUMD or %	Service Li	Time		—	—	—	—	—	—
12	Kp-PropMult	0.15	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service Li	Target		—	—	—	0	0	0.2
13	Kd-DerivMult	0.03	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service Li	Target		—	—	—	0.6	-0.6	0.05
14	Ka-AcclMult	0.05	0	3	0.01	0	0	0	0	Active	DEC2NOCH	Service Li	Target		—	—	—	0	0	0
15	ExvMinValve%	5	2	25	1	2	10	0	0	Active	HUMD or %	Service Li	Setpoint		—	—	—	—	—	—
16	ExvMaxValve%	100	50	100	1	0	0	0	0	Active	HUMD or %	Service Li	Target		—	—	—	0	0	10
17	LO Suc sprht	1	-20	4	0.1	120	900	2	10	Non-Active	TEMP	Service Li	Lockout		15	300	60	—	—	—
18	LOW PSI DELY	1	1	30	1	3	60	0	0	Non-Active	SECONDS	Service Li	Time		—	—	—	—	—	—
19	ExvKiDelay	90	1	120	1	0	0	0	0	Active	SECONDS	Service Li	Setpoint		—	—	—	—	—	—
20	ExvStartup	30	5	45	1	5	10	0	0	Active	SECONDS	Service Li	Time		—	—	—	—	—	—

- NOTE: If more than one circuit is available and you want to control two independent circuit target levels, make setpoint#9 'Non-Active' in the setpoint screen.
- Make the used FLA setpoints#171-190 a 'target' type and set the level target up in the setback field.

Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Setback
171	FLA COMP#1	292	200	300	1	1	1	0	0	Active	AMPS/CT	Factory Li	Target		—	—	—	0	0	42
172	FLA COMP#2	292	200	300	1	1	1	0	0	Active	AMPS/CT	Factory Li	Target		—	—	—	0	0	34

30.1.4 Low Discharge Superheat EXV Target Adjust Logic

- Requires Firmware Version: MCS-MAGNUM Firmware - 17.61-D or later

Below are three enables for the low discharge EXV target adjustment:

IMPORTANT

7. **Comp has been running for 5 minutes, or**
8. **Discharge temperature is greater than 130F (or 54.5C), or**
9. **EXV control is setup for PID Evap, PID Cond, Old Evap Level or Old Cond Level control.**

- Make setpoint #110 (LoDisSHExvAd) active if you want to dynamically change the EXV target based on Low Discharge Superheat.

Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Setback
109	HiRefLevel	95	50	100	1	120	120	2	10	Active	HUMD or %	Factory Li	Lockout		600	300	60	—	—	—
110	LoDisSHExvAd	0.5	0.1	5	0.1	90	300	0	0	Active	HUMD or %	Factory Li	Target		—	—	—	45	10	30
111	FREEZE	38	36	40	1	3	10	0	0	Active	TEMP	Factory Li	Lockout		0	0	0	—	—	—

30.1.4.1. The Low Discharge Superheat logic:

- If Setpoint #110 (#164 for REFR) is setup as a "TARGET" type setpoint the following logic occurs (New Logic):

1. If discharge superheat <= setpoint #110 (#164) low zone value and the low discharge superheat adjusted amount is less than the max adjust limit setpoint #110 setback value and the Time (SEC) value has elapsed, then:
    a. If Evap Level control, setpoint #110 (#164) value field is subtracted from the EXV Target and this value becomes the new EXV target. The value in the Time (SEC) field will count down again and

another adjustment will be made until the max adjust is reached (setpoint #110 setback value) or the discharge superheat goes above setpoint #110 (#164) low zone value.

b. For Cond Level control method, setpoint #110 (#164) value field is added to the EXV Target and this value becomes the new EXV Target. The value in the Time (SEC) field will count down again and another adjustment will be made until the max adjust is reached (setpoint #110 setback value) or the discharge superheat goes above setpoint #110 (#164) low zone value.

- Else if discharge superheat >= setpoint #110 (#164) high zone value and the low discharge superheat adjusted amount is greater than 0 and the Time (SEC) value has elapsed, then:

a. If Evap Level control, setpoint #110 (#164) value field is added to the EXV Target and this value becomes the new EXV Target. The value in the Time (SEC) field will count down again and another adjustment will be made until the min adjust is reached (0) or the discharge superheat goes below setpoint #110 (#164) high zone value.

NOTE: The EXV Target adjusted value will not go <u>above</u> the original setpoint Target value.

b. For Cond Level control method, setpoint #110 (#164) value field is subtracted from the EXV Target and this value becomes the new EXV Target. The value in the Time SEC) field will count down again and another adjustment will be made until the min adjust is reached (0) or the discharge superheat goes below setpoint #110 (#164) high zone value.

NOTE: The EXV Target adjusted value will not go <u>below</u> the original setpoint Target value.

- Else If Setpoint #110 (#164) is not a “TARGET” type setpoint the following logic occurs (Old Logic):

2. If discharge superheat is < Low discharge superheat safety setpoint #84 value, then:

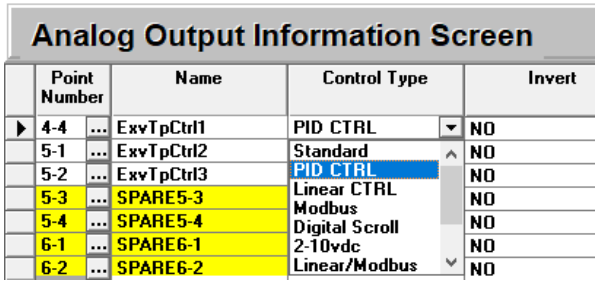
a. If Evap Level or Cond Level and not level target by compressor circuit, then set EXV target to setpoint #110 value.

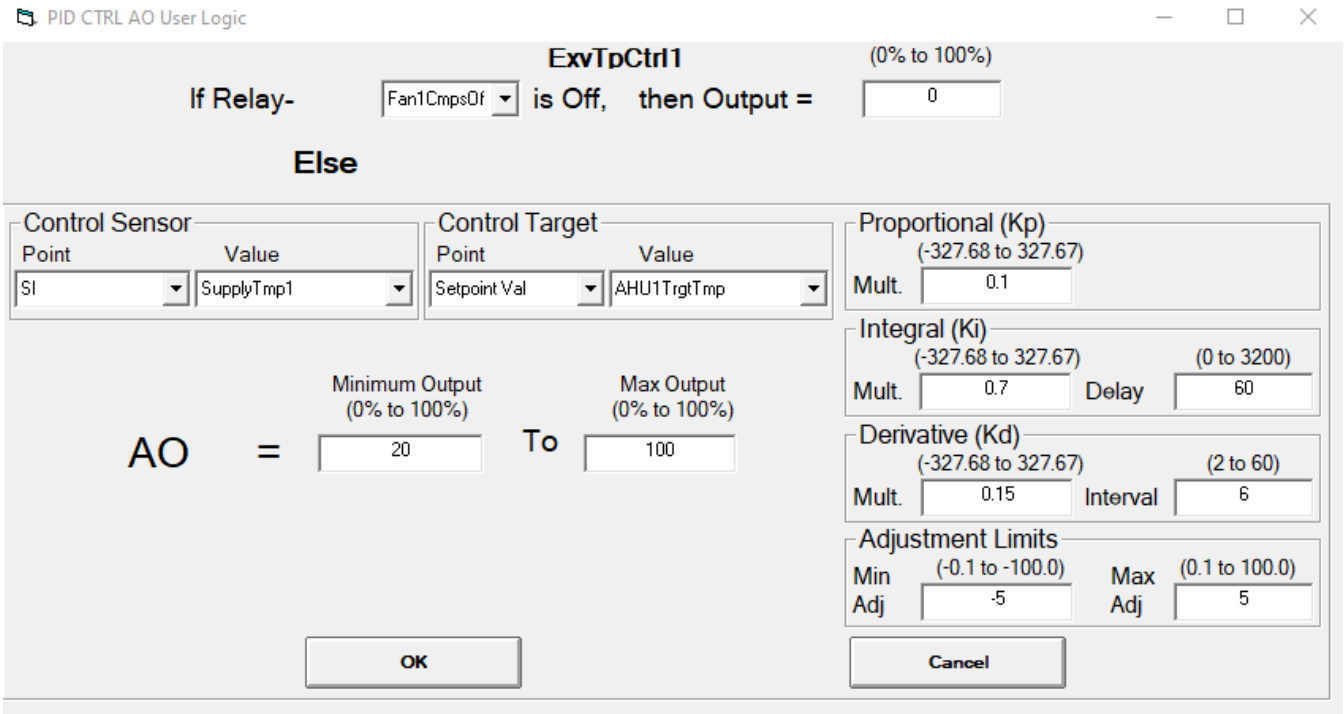
b. Else If Evap Level or Cond Level and EXV target is by compressor circuit, then subtract setpoint #110 value from the current EXV target.

Chapter - 31. Analog Output Control using PID

Required to have the software below or later version
Config version 18.01T
Connect version 18.31.15
Firmware HVAC 17.62R2

PID control will turn an analog output into a stand alone PID controlled output. This output will have a controlling sensor that modulates the AO to a maintain target. This logic will run all the time.





NOTE

If AO is modulating the wrong direction, simply make all three multipliers negative values to reverse the direction the AO modulates and vice versa.

If Relay-

If a relay is used and is OFF then associated AO will be set to the defined value and not modulate. If 'not used' the logic is ignored.

Control Sensor

AO or SI point to be used as the controlling sensor for the AO.

Control Target

SI, AO, or Setpoint used as the target the AO will try to maintain.

AO

Min to Max value the AO can modulate between.

Proportional(Kp)

Multiplier for Kp adjustments.

Integral(Ki)

Multiplier and delay between Ki Adjustments

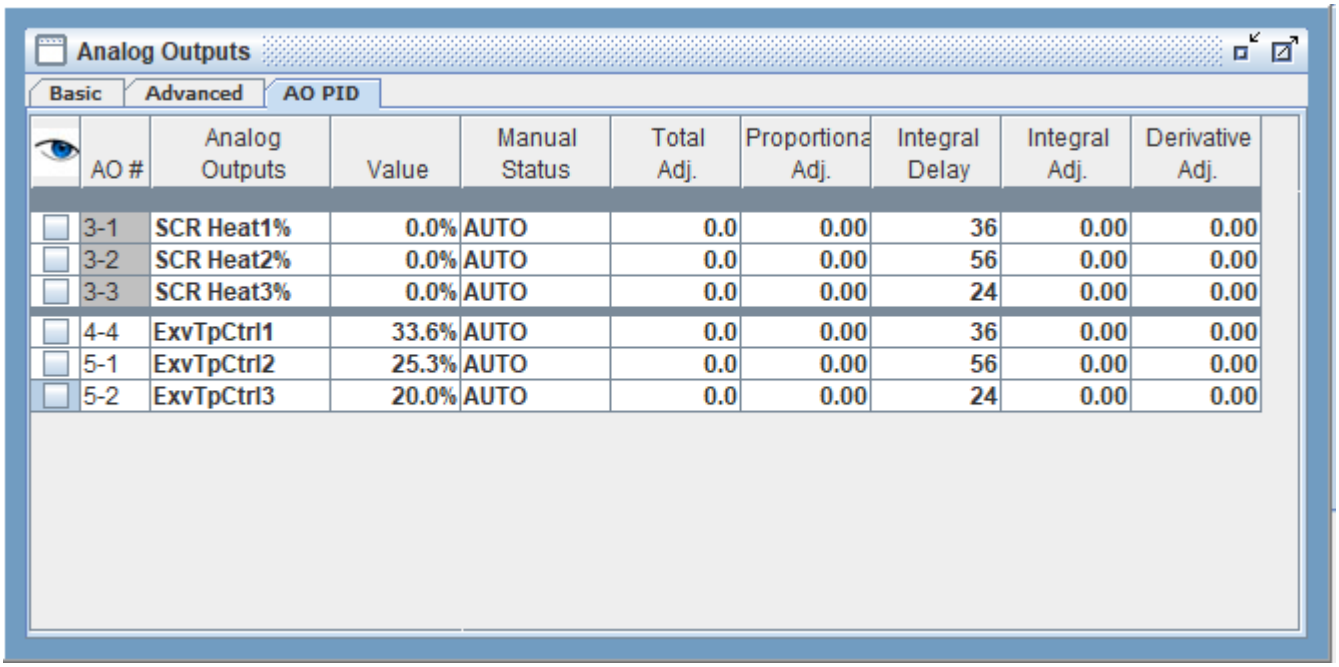
Derivative(Kd)

Multiplier and time in seconds interval to calculate Kd.

Adjustment Limits

Min and Max adjustments allowed to the AO per adjustment, both negative and positive.

Under the Analog Outputs window in the MCS Connect software. You'll find an AO PID tab that will show all of the PID CONTROL AOs and all of the calculated adjustments being made to those Analog Outputs. Here you will be able to see all three adjustments being made to the PID. This will assist you in any fine tuning required for the given analog output.



AO #	Analog Outputs	Value	Manual Status	Total Adj.	Proportiona Adj.	Integral Delay	Integral Adj.	Derivative Adj.
3-1	SCR Heat1%	0.0%	AUTO	0.0	0.00	36	0.00	0.00
3-2	SCR Heat2%	0.0%	AUTO	0.0	0.00	56	0.00	0.00
3-3	SCR Heat3%	0.0%	AUTO	0.0	0.00	24	0.00	0.00
4-4	ExvTpCtrl1	33.6%	AUTO	0.0	0.00	36	0.00	0.00
5-1	ExvTpCtrl2	25.3%	AUTO	0.0	0.00	56	0.00	0.00
5-2	ExvTpCtrl3	20.0%	AUTO	0.0	0.00	24	0.00	0.00

Chapter - 32. Capacity Control Logic Using PID

Requirment to use this new Capacity Control PID Logic:
Config version 18.02I
Connect version 18.39.15
Firmware HVAC 17.90A

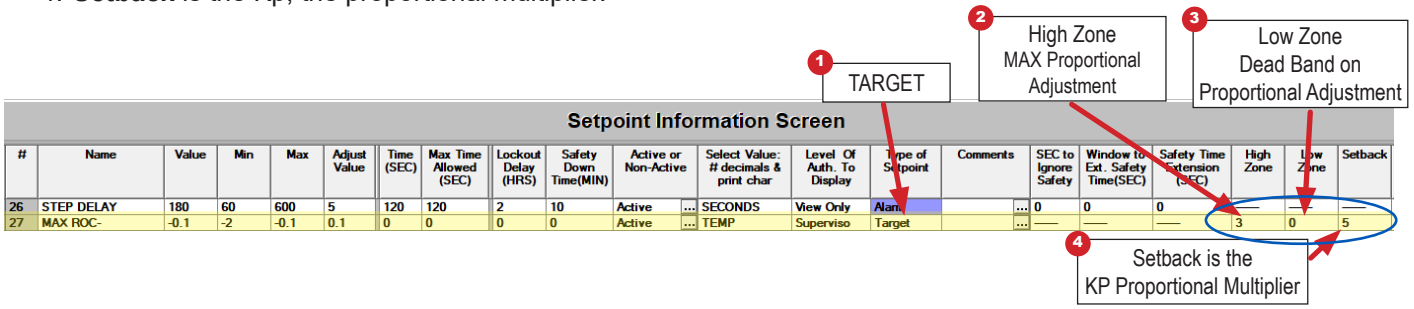
The MCS-Magnum firmware always had Capacity Control Logic Integral Control, ***"I" in PID***.

This new MCS-Magnum firmware adds ***Proportional ("P") and Derivative ("D")*** to capacity control logic to the adjust ***"Wanted %"***.

The Proportional and Derivative adjustments are optional and enabled in the MCS-Magnum configuration file. Both the Proportional and Derivative adjustments to capacity control are made every second and adjust only the "Wanted %".

To enable Proportional capacity control logic, setup as follows:

1. Make Setpoint #27 "MAX ROC-" a **TARGET** type of setpoint.
2. **High Zone** field is the max proportional adjustment allowed each second to the "Wanted %"
3. **Low Zone** field is dead band on proportional adjustment. If proportional change(absolute difference from last control valve to current control valve) is less than or equal to the value in the low zone, the proportional adjustment to the wanted % is skipped, ie no proportional adjustment is made because the porportional change is small.
4. **Setback** is the Kp, the proportional multiplier.



Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Setback
26	STEP DELAY	180	60	600	5	120	120	2	10	Active	SECONDS	View Only	Alarm		0	0	0	—	—	—
27	MAX ROC-	-0.1	-2	-0.1	0.1	0	0	0	0	Active	TEMP	Superviso	Target		—	—	—	3	0	5

Once the proportion logic is enable, the capacity control logic will calculated a proportional adjustment to make to the "Wanted %". The calculated adjustment is as follows:

Proportional adjustment = [(current controlling sensor value – controlling sensor value from 1 second ago) * Setpoint #27 Setback value] + Accumulated Proportional adjustment remainder;

Accumulated proportional adjustment remainder = Proportional adjustment modulus 10 (This accumulates the hundredths value, 2nd decimal point, values x.x0)

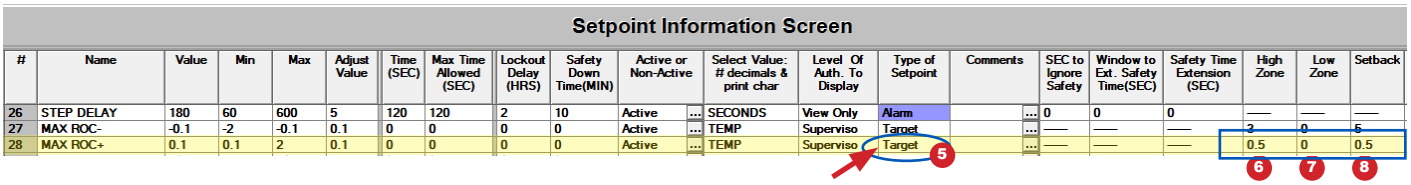
Proportional adjustment = Proportional adjustment / 10 (This gets rid of the hundreths value, 2nd decimal place, "Wanted %" resolution is only 1 decimal place)

To enable Derivative capacity control logic, setup as follows:

5. Make Setpoint #28 "MAX ROC+" a TARGET type of setpoint.

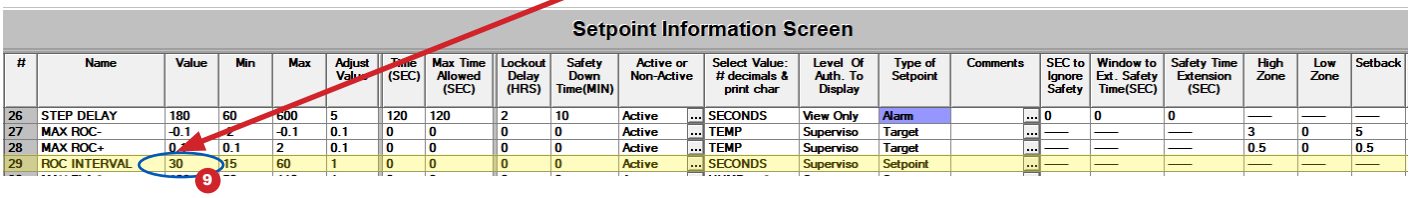
Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Setback
26	STEP DELAY	180	60	600	5	120	120	2	10	Active	SECONDS	View Only	Alarm		0	0	0	—	—	—
27	MAX ROC-	-0.1	-2	-0.1	0.1	0	0	0	0	Active	TEMP	Superviso	Target		—	—	—	3	0	5
28	MAX ROC+	0.1	0.1	2	0.1	0	0	0	0	Active	TEMP	Superviso	Target		—	—	—	0.5	0	0.5



6. **High Zone** field is the max Derivative adjustment allowed each second to the "Wanted %"
7. **Low Zone** field is dead band on Derivative adjustment. If absolute valve of Derivative(ROC) is less than or equal to the value in the low zone, the Derivative adjustment to the wanted % is skipped, ie no Derivative adjustment is made.
8. **Setback** is the Kd, the Derivative multiplier.

9. Change setpoint #29 value to maximum of 30.



Setpoint Information Screen

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Setback
26	STEP DELAY	180	60	600	5	120	120	2	10	Active	SECONDS	View Only	Alarm		0	0	0	——	——	——
27	MAX ROC-	-0.1	-2	-0.1	0.1	0	0	0	0	Active	TEMP	Superviso	Target		——	——	——	3	0	5
28	MAX ROC+	0.2	0.1	2	0.1	0	0	0	0	Active	TEMP	Superviso	Target		——	——	——	0.5	0	0.5
29	ROC INTERVAL	30	15	60	1	0	0	0	0	Active	SECONDS	Superviso	Setpoint		——	——	——	——	——	——

9

Once the Derivative logic is enable, the capacity control logic will calculated a Derivative adjustment to make to the “Wanted %”. The calculated adjustment is as follows:

Derivative adjustment = (capacity control’s ROC value * Setpoint #28 Setback value) + Accumulated Derivative adjustment remainder;

Accumulated Derivative adjustment remainder = Derivative adjustment modulus 10 (This accumulates the 2nd decimal point values x.x0)

Derivative adjustment = Proportional adjustment / 10 (This gets rid of the 2nd decimal place, “Wanted %” resolution is only 1 decimal place)

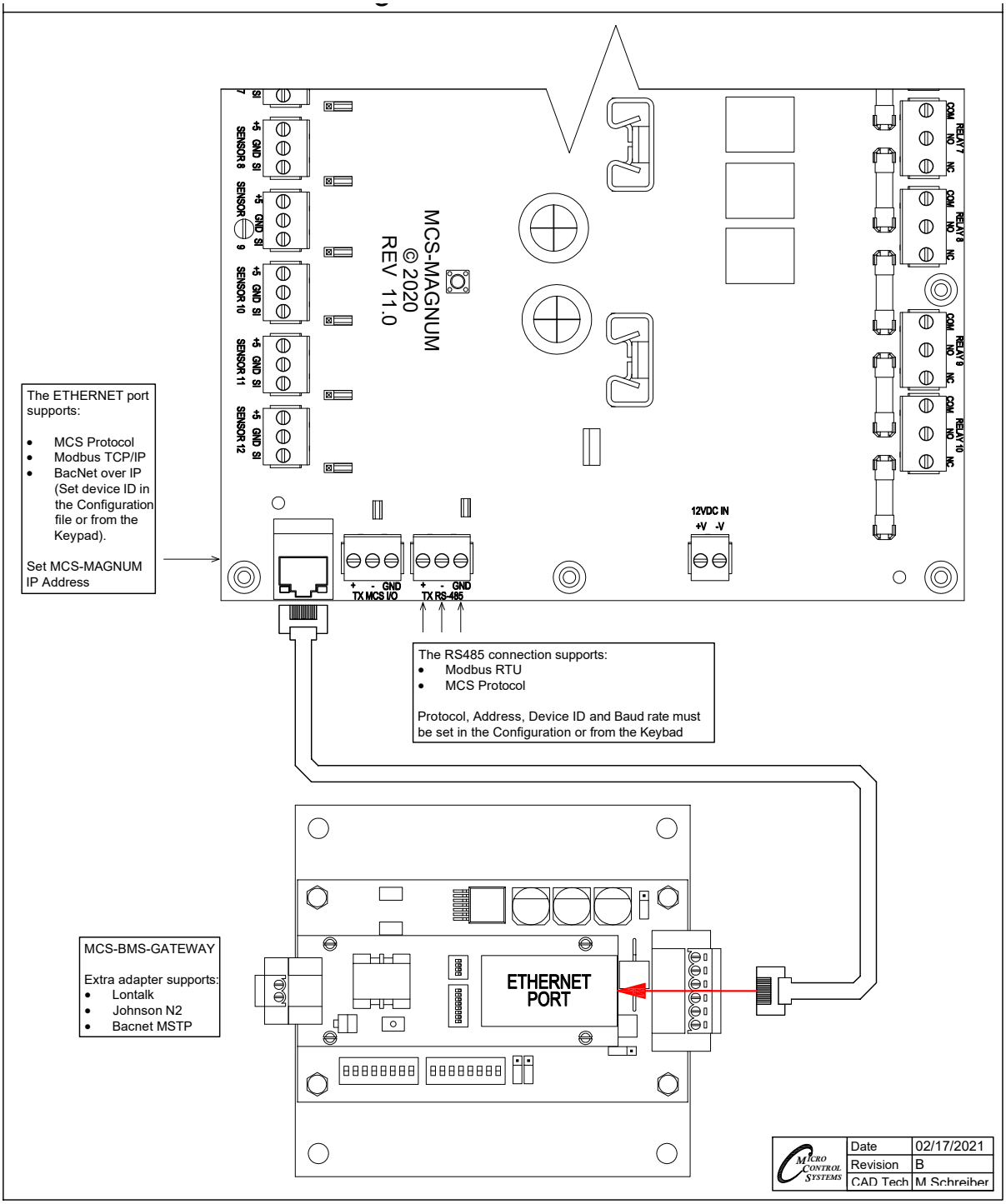
Chapter - 33. BMS Communication Protocols

The MCS-Magnum supports as standard: Modbus RTU protocol.

Using the MCS-BMS-GATEWAY, the MCS-Magnum can also support Johnson N2, LonTalk and Bacnet MSTP, BACnet IP and Modbus TCP/IP.

Supported baud rates for Modbus RTU and Johnson N2 are 4800bps, 9600bps, 19200bps, 38400bps, and 57600bps.

33.1. MCS-Magnum to BMS Connections



33.2. Sensor Input Points

Sensor numbering is based upon the MCS-MAGNUM or MCS-SI-BASE / EXT hardware type board Notable BACnet properties available: Units

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
Sensor M-1	AI: 1	Refer to Config	*30001	*AI: 1
Sensor M-2	AI: 2	Refer to Config	*30002	*AI: 2
Sensor M-3	AI: 3	Refer to Config	*30003	*AI: 3
Sensor M-4	AI: 4	Refer to Config	*30004	*AI: 4
Sensor M-5	AI: 5	Refer to Config	*30005	*AI: 5
Sensor M-6	AI: 6	Refer to Config	*30006	*AI: 6
Sensor M-7	AI: 7	Refer to Config	*30007	*AI: 7
Sensor M-8	AI: 8	Refer to Config	*30008	*AI: 8
Sensor M-9	AI: 9	Refer to Config	*30009	*AI: 9
Sensor M-10	AI:10	Refer to Config	*30010	*AI: 10
Sensor M-11	AI:11	Refer to Config	*30011	*AI: 11
Sensor M-12	AI:12	Refer to Config	*30012	*AI: 12
Sensor M-13	AI:13	Refer to Config	*30013	*AI: 13
Sensor M-14	AI:14	Refer to Config	*30014	*AI: 14
Sensor M-15	AI:15	Refer to Config	*30015	*AI: 15
Sensor M-16	AI:16	Refer to Config	*30016	*AI: 16
Sensor 1-1	AI:17	Refer to Config	*30017	*AI: 17
Sensor 1-2	AI:18	Refer to Config	*30018	*AI: 18
Sensor 1-3	AI:19	Refer to Config	*30019	*AI: 19
Sensor 1-4	AI:20	Refer to Config	*30020	*AI: 20
Sensor 1-5	AI:21	Refer to Config	*30021	*AI: 21
Sensor 1-6	AI:22	Refer to Config	*30022	*AI: 22
Sensor 1-7	AI:23	Refer to Config	*30023	*AI: 23
Sensor 1-8	AI:24	Refer to Config	*30024	*AI: 24
Sensor 1-9	AI:25	Refer to Config	*30025	*AI: 25
Sensor 1-10	AI:26	Refer to Config	*30026	*AI: 26
Sensor 1-11	AI:27	Refer to Config	*30027	*AI: 27
Sensor 1-12	AI:28	Refer to Config	*30028	*AI: 28
Sensor 1-13	AI:29	Refer to Config	*30029	*AI: 29
Sensor 1-14	AI:30	Refer to Config	*30030	*AI: 30
Sensor 1-15	AI:31	Refer to Config	*30031	*AI: 31
Sensor 1-16	AI:32	Refer to Config	*30032	*AI: 32
Sensor 2-1	AI:33	Refer to Config	*30033	*AI: 33
Sensor 2-2	AI:34	Refer to Config	*30034	*AI: 34
Sensor 2-3	AI:35	Refer to Config	*30035	*AI: 35
Sensor 2-4	AI:36	Refer to Config	*30036	*AI: 36
Sensor 2-5	AI:37	Refer to Config	*30037	*AI: 37
Sensor 2-6	AI:38	Refer to Config	*30038	*AI: 38
Sensor 2-7	AI:39	Refer to Config	*30039	*AI: 39
Sensor 2-8	AI:40	Refer to Config	*30040	*AI: 40

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
Sensor 2-9	AI:41	Refer to Config	*30041	*AI: 41
Sensor 2-10	AI:42	Refer to Config	*30042	*AI: 42
Sensor 2-11	AI:43	Refer to Config	*30043	*AI: 43
Sensor 2-12	AI:44	Refer to Config	*30044	*AI: 44
Sensor 2-13	AI:45	Refer to Config	*30045	*AI: 45
Sensor 2-14	AI:46	Refer to Config	*30046	*AI: 46
Sensor 2-15	AI:47	Refer to Config	*30047	*AI: 47
Sensor 2-16	AI:48	Refer to Config	*30048	*AI: 48
Sensor 3-1	AI:49	Refer to Config	*30049	*AI:49
Sensor 3-2	AI:50	Refer to Config	*30050	*AI: 50
Sensor 3-3	AI:51	Refer to Config	*30051	*AI: 51
Sensor 3-4	AI:52	Refer to Config	*30052	*AI: 52
Sensor 3-5	AI:53	Refer to Config	*30053	*AI: 53
Sensor 3-6	AI:54	Refer to Config	*30054	*AI: 54
Sensor 3-7	AI:55	Refer to Config	*30055	*AI: 55
Sensor 3-8	AI:56	Refer to Config	*30056	*AI: 56
Sensor 3-9	AI:57	Refer to Config	*30057	*AI: 57
Sensor 3-10	AI:58	Refer to Config	*30058	*AI: 58
Sensor 3-11	AI:59	Refer to Config	*30059	*AI: 59
Sensor 3-12	AI:60	Refer to Config	*30060	*AI: 60
Sensor 3-13	AI:61	Refer to Config	*30061	*AI: 61
Sensor 3-14	AI:62	Refer to Config	*30062	*AI: 62
Sensor 3-15	AI:63	Refer to Config	*30063	*AI: 63
Sensor 3-16	AI:64	Refer to Config	*30064	*AI: 64
Sensor 4-1	AI:65	Refer to Config	*30065	*AI: 65
Sensor 4-2	AI:66	Refer to Config	*30066	*AI: 66
Sensor 4-3	AI:67	Refer to Config	*30067	*AI: 67
Sensor 4-4	AI:68	Refer to Config	*30068	*AI: 68
Sensor 4-5	AI:69	Refer to Config	*30069	*AI: 69
Sensor 4-6	AI:70	Refer to Config	*30070	*AI: 70
Sensor 4-7	AI:71	Refer to Config	*30071	*AI: 71
Sensor 4-8	AI:72	Refer to Config	*30072	*AI: 72
Sensor 4-9	AI:73	Refer to Config	*30073	*AI: 73
Sensor 4-10	AI:74	Refer to Config	*30074	*AI: 74
Sensor 4-11	AI:75	Refer to Config	*30075	*AI: 75
Sensor 4-12	AI:76	Refer to Config	*30076	*AI: 76
Sensor 4-13	AI:77	Refer to Config	*30077	*AI: 77
Sensor 4-14	AI:78	Refer to Config	*30078	*AI: 78
Sensor 4-15	AI:79	Refer to Config	*30079	*AI: 79
Sensor 4-16	AI:80	Refer to Config	*30080	*AI: 80

*- Indicates value multiplied by 10 to include one decimal place. (I.e. BMS value of 500 indicates actual value 50.0)

33.3. Relay Output Points

Relay Output points are read-only. Sensor numbering is based upon MCS-RO-BASE / EXT hardware type board

Magnum	BACnet ID	BACnet Name	Modbus	N2
Relay M–1	BO: 1	Refer to Config	00001	BO: 1
Relay M–2	BO: 2	Refer to Config	00002	BO: 2
Relay M–3	BO: 3	Refer to Config	00003	BO: 3
Relay M–4	BO: 4	Refer to Config	00004	BO: 4
Relay M–5	BO: 5	Refer to Config	00005	BO: 5
Relay M–6	BO: 6	Refer to Config	00006	BO: 6
Relay M–7	BO: 7	Refer to Config	00007	BO: 7
Relay M–8	BO: 8	Refer to Config	00008	BO: 8
Relay M–9	BO: 9	Refer to Config	00009	BO: 9
Relay M-10	BO:10	Refer to Config	00010	BO: 10
Relay 1–1	BO:11	Refer to Config	00011	BO: 11
Relay 1–2	BO:12	Refer to Config	00012	BO: 12
Relay 1–3	BO:13	Refer to Config	00013	BO: 13
Relay 1–4	BO:14	Refer to Config	00014	BO: 14
Relay 1–5	BO:15	Refer to Config	00015	BO: 15
Relay 1–6	BO:16	Refer to Config	00016	BO: 16
Relay 1–7	BO:17	Refer to Config	00017	BO: 17
Relay 1–8	BO:18	Refer to Config	00018	BO: 18
Relay 1–9	BO:19	Refer to Config	00019	BO: 19
Relay 1- 10	BO:20	Refer to Config	00020	BO: 20
Relay 2–1	BO:21	Refer to Config	00021	BO: 21
Relay 2–2	BO:22	Refer to Config	00022	BO: 22
Relay 2–3	BO:23	Refer to Config	00023	BO: 23
Relay 2–4	BO:24	Refer to Config	00024	BO: 24
Relay 2–5	BO:25	Refer to Config	00025	BO: 25
Relay 2–6	BO:26	Refer to Config	00026	BO: 26
Relay 2–7	BO:27	Refer to Config	00027	BO: 27
Relay 2–8	BO:28	Refer to Config	00028	BO: 28
Relay 2–9	BO:29	Refer to Config	00029	BO: 29
Relay 2 -10	BO:30	Refer to Config	00030	BO: 30
Relay 3–1	BO:31	Refer to Config	00031	BO: 31
Relay 3–2	BO:32	Refer to Config	00032	BO: 32
Relay 3–3	BO:33	Refer to Config	00033	BO: 33
Relay 3–4	BO:34	Refer to Config	00034	BO: 34
Relay 3–5	BO:35	Refer to Config	00035	BO: 35
Relay 3- 6	BO:36	Refer to Config	00036	BO: 36
Relay 3–7	BO:37	Refer to Config	00037	BO: 37
Relay 3–8	BO:38	Refer to Config	00038	BO: 38
Relay 3–9	BO:39	Refer to Config	00039	BO: 39
Relay 3–10	BO:40	Refer to Config	00040	BO: 40

Magnum	BACnet ID	BACnet Name	Modbus	N2
Relay 4–1	BO:41	Refer to Config	00041	BO: 41
Relay 4–2	BO:42	Refer to Config	00042	BO: 42
Relay 4–3	BO:43	Refer to Config	00043	BO: 43
Relay 4–4	BO:44	Refer to Config	00044	BO: 44
Relay 4–5	BO:45	Refer to Config	00045	BO: 45
Relay 4–6	BO:46	Refer to Config	00046	BO: 46
Relay 4–7	BO:47	Refer to Config	00047	BO: 47
Relay 4–8	BO:48	Refer to Config	00048	BO: 48
Relay 4–9	BO:49	Refer to Config	00049	BO: 49
Relay 4 -10	BO:50	Refer to Config	00050	BO: 50
Relay 5–1	BO:51	Refer to Config	00051	BO: 51
Relay 5–2	BO:52	Refer to Config	00052	BO: 52
Relay 5–3	BO:53	Refer to Config	00053	BO: 53
Relay 5–4	BO:54	Refer to Config	00054	BO: 54
Relay 5–5	BO:55	Refer to Config	00055	BO: 55
Relay 5–6	BO:56	Refer to Config	00056	BO: 56
Relay 5–7	BO:57	Refer to Config	00057	BO: 57
Relay 5–8	BO:58	Refer to Config	00058	BO: 58
Relay 5–9	BO:59	Refer to Config	00059	BO: 59
Relay 5 -10	BO:60	Refer to Config	00060	BO: 60
Relay 6–1	BO:61	Refer to Config	00061	BO: 61
Relay 6–2	BO:62	Refer to Config	00062	BO: 62
Relay 6–3	BO:63	Refer to Config	00063	BO: 63
Relay 6–4	BO:64	Refer to Config	00064	BO: 64
Relay 6–5	BO:65	Refer to Config	00065	BO: 65
Relay 6- 6	BO:66	Refer to Config	00066	BO: 66
Relay 6–7	BO:67	Refer to Config	00067	BO: 67
Relay 6–8	BO:68	Refer to Config	00068	BO: 68
Relay 6–9	BO:69	Refer to Config	00069	BO: 69
Relay 6–10	BO:70	Refer to Config	00760	BO: 70
Relay 7–1	BO:71	Refer to Config	00071	BO: 71
Relay 7–2	BO:72	Refer to Config	00072	BO: 72
Relay 7–3	BO:73	Refer to Config	00073	BO: 73
Relay 7–4	BO:74	Refer to Config	00074	BO: 74
Relay 7–5	BO:75	Refer to Config	00075	BO: 75
Relay 7–6	BO:76	Refer to Config	00076	BO: 76
Relay 7–7	BO:77	Refer to Config	00077	BO: 77
Relay 7–8	BO:78	Refer to Config	00078	BO: 78
Relay 7–9	BO:79	Refer to Config	00079	BO: 79
Relay 7–10	BO:80	Refer to Config	00070	BO: 80

*- Indicates value multiplied by 10 to include one decimal place. (I.e. BMS value of 500 indicates actual value 50.0)

Analog Output PointsAnalog Output points are read-only. Sensor numbering is based upon MCS-SI-BASE / EXT hardware type board. Notable BACnet properties available: Units

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
Analog Out M-1	AO:1	Refer to Config	*30201	*AO: 1
Analog Out M-2	AO:2	Refer to Config	*30202	*AO: 2
Analog Out M-3	AO:3	Refer to Config	*30203	*AO: 3
Analog Out M-4	AO:4	Refer to Config	*30204	*AO: 4
Analog Out 1-1	AO:5	Refer to Config	*30205	*AO: 5
Analog Out 1-2	AO:6	Refer to Config	*30206	*AO: 6
Analog Out 1-3	AO:7	Refer to Config	*30207	*AO: 7
Analog Out 1-4	AO:7	Refer to Config	*30208	*AO: 8
Analog Out 2-1	AO:8	Refer to Config	*30209	*AO: 9
Analog Out 2-2	AO:10	Refer to Config	*30210	*AO: 10
Analog Out 2-3	AO:11	Refer to Config	*30211	*AO: 11
Analog Out 2-4	AO:12	Refer to Config	*30212	*AO: 12
Analog Out 3-1	AO:13	Refer to Config	*30213	*AO: 13
Analog Out 3-2	AO:14	Refer to Config	*30214	*AO: 14
Analog Out 3-3	AO:15	Refer to Config	*30215	*AO: 15
Analog Out 3-4	AO:16	Refer to Config	*30216	*AO: 16
Analog Out 4-1	AO:17	Refer to Config	*30217	*AO: 17
Analog Out 4-2	AO:18	Refer to Config	*30218	*AO: 18
Analog Out 4-3	AO:19	Refer to Config	*30219	*AO: 19
Analog Out 4-4	AO:20	Refer to Config	*30220	*AO: 20

*- Indicates value multiplied by 10 to include one decimal place. (I.e. BMS value of 500 indicates actual value 50.0)

33.4. Setpoints

Setpoints are read-only. Notable BACnet properties available: Units

Magnum	BACnet ID	BACnet Name	Modbus	N2
Setpoint #1	AV:0	STP# 1-<Setpoint name>	40301	ADF:1
Setpoint #21	AV:88	STP# 21-<Setpoint name>	40321	ADF:89
Setpoint #163	AV:230	STP# 163-<Setpoint name>	40463	ADF:231

*- Indicates value multiplied by 10 to include one decimal place. (I.e. BMS value of 500 indicates actual value 50.0)

33.5. Chiller/Compressor States

State values are read-only. Notable BACnet properties available: Number of States, State-Text (Contains character text of current state)

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
Chiller Unit State	MV:0	CHILLER STATE	30306	BYT:1
Compressor #1 State	MV:1	COMPRESSOR #1 STATE	30307	BYT:2
Compressor #2 State	MV:2	COMPRESSOR #2 STATE	30308	BYT:3
Compressor #3 State	MV:3	COMPRESSOR #3 STATE	30309	BYT:4
Compressor #4 State	MV:4	COMPRESSOR #4 STATE	30310	BYT:5
Compressor #5 State	MV:5	COMPRESSOR #5 STATE	30311	BYT:6
Compressor #6 State	MV:6	COMPRESSOR #6 STATE	30312	BYT:7

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
Compressor #7 State	MV:7	COMPRESSOR #7 STATE	30313	BYT:8
Compressor #8 State	MV:8	COMPRESSOR #8 STATE	30314	BYT:9
Compressor #9 State	MV:130	COMPRESSOR #9 STATE	30560	BYT:131
Compressor #10 State	MV:131	COMPRESSOR #10 STATE	30561	BYT:132
Compressor #11 State	MV:132	COMPRESSOR #11 STATE	30562	BYT:133
Compressor #12 State	MV:133	COMPRESSOR #12 STATE	30563	BYT:134
Compressor #13 State	MV:134	COMPRESSOR #13 STATE	30564	BYT:135
Compressor #14 State	MV:135	COMPRESSOR #14 STATE	30565	BYT:136
Compressor #15 State	MV:136	COMPRESSOR #15 STATE	30566	BYT:137
Compressor #16 State	MV:137	COMPRESSOR #16 STATE	30567	BYT:138
Compressor #17 State	MV:138	COMPRESSOR #17 STATE	30568	BYT:139
Compressor #18 State	MV:139	COMPRESSOR #18 STATE	30569	BYT:140
Compressor #19 State	MV:140	COMPRESSOR #19 STATE	30570	BYT:141
Compressor #20 State	MV:141	COMPRESSOR #20 STATE	30571	BYT:142

33.6. Chiller/Compressor Points

These points are read-only.

Magnum	BACnet ID	BACnet Name	Modbus	N2
Wanted FLA%	AV:3	Wanted FLA%	30318	ADF:4
Steps Wanted	AV:4	Steps Wanted On	30315	ADF:5
Steps On	AV:5	Steps On	30316	ADF:6
Step Delay	AV:6	Step Delay	30317	ADF:7
Compressor #1 FLA%	AV:7	C1_FLA%	*30319	*ADF:8
Compressor #1 Sat Suction	AV:10	C1_Sat Suct	*30327	*ADF:11
Compressor #1 Sat Disch	AV:11	C1_ Sat Disch	*30329	*ADF:12
Compressor #1 Disch SH	AV:12	C1_Disch SH	*30330	*ADF:13
Compressor #1 Suct SH	AV:13	C1_Suct SH	*30328	*ADF:14
Compressor #1 Oil Pres Diff	AV:63	C1_Oil Pres Diff	*30375	*ADF:64
Compressor #1 Comp State Timer		C1_Comp State Timer	*32602	
Compressor #2 FLA%	AV:14	C2_FLA%	*30320	*ADF:15
Compressor #2 Sat Suction	AV:17	C2_Sat Suct	*30331	*ADF:18
Compressor #2 Sat Disch	AV:18	C2_ Sat Disch	*30333	*ADF:19
Compressor #2 Disch SH	AV:19	C2_Disch SH	*30334	*ADF:20
Compressor #2 Suct SH	AV:20	C2_Suct SH	*30332	*ADF:21
Compressor #2 Oil Pres Diff	AV:64	C2_Oil Pres Diff	*30376	*ADF:65
Compressor #2 Comp State Timer		C2_Comp State Timer	*32603	
Compressor #3 FLA%	AV:21	C3_FLA%	*30321	*ADF:22
Compressor #3 Sat Suction	AV:24	C3_Sat Suct	*30335	*ADF:25
Compressor #3 Sat Disch	AV:25	C3_ Sat Disch	*30337	*ADF:26
Compressor #3 Disch SH	AV:26	C3_Disch SH	*30338	*ADF:27
Compressor #3 Suct SH	AV:27	C3_Suct SH	*30336	*ADF:28
Compressor #3 Oil Pres Diff	AV:65	C3_Oil Pres Diff	*30377	*ADF:66
Compressor #3 Comp State Timer		C3_Comp State Timer	*32604	
Compressor #4 FLA%	AV:28	C4_FLA%	*30322	*ADF:29
Compressor #4 Sat Suction	AV:31	C4_Sat Suct	*30339	*ADF:32
Compressor #4 Sat Disch	AV:32	C4_ Sat Disch	*30341	*ADF:33
Compressor #4 Disch SH	AV:33	C4_Disch SH	*30342	*ADF:34
Compressor #4 Suct SH	AV:34	C4_Suct SH	*30340	*ADF:35

Magnum	BACnet ID	BACnet Name	Modbus	N2
Compressor #4 Oil Pres Diff	AV:66	C4_Oil Pres Diff	*30378	*ADF:67
Compressor #4 Comp State Timer		C4_Comp State Timer	*32605	
Compressor #5 FLA%	AV:35	C5_FLA%	*30323	*ADF:36
Compressor #5 Sat Suction	AV:38	C5_Sat Suct	*30343	*ADF:39
Compressor #5 Sat Disch	AV:39	C5_ Sat Disch	*30345	*ADF:40
Compressor #5 Disch SH	AV:40	C5_Disch SH	*30346	*ADF:41
Compressor #5 Suct SH	AV:41	C5_Suct SH	*30344	*ADF:42
Compressor #5 Oil Pres Diff	AV:67	C5_Oil Pres Diff	*30379	*ADF:68
Compressor #5 Comp State Timer		C5_Comp State Timer	*32606	
Compressor #6 FLA%	AV:42	C6_FLA%	*30324	*ADF:43
Compressor #6 Sat Suction	AV:45	C6_Sat Suct	*30347	*ADF:46
Compressor #6 Sat Disch	AV:46	C6_ Sat Disch	*30349	*ADF:47
Compressor #6 Disch SH	AV:47	C6_Disch SH	*30350	*ADF:48
Compressor #6 Suct SH	AV:48	C6_Suct SH	*30348	*ADF:49
Compressor #6 Oil Pres Diff	AV:68	C6_Oil Pres Diff	*30380	*ADF:69
Compressor #6 Comp State Timer		C6_Comp State Timer	*32607	
Compressor #7 FLA%	AV:49	C7_FLA%	*30325	*ADF:50
Compressor #7 Sat Suction	AV:52	C7_Sat Suct	*30351	*ADF:53
Compressor #7 Sat Disch	AV:53	C7_ Sat Disch	*30353	*ADF:54
Compressor #7 Disch SH	AV:54	C7_Disch SH	*30354	*ADF:55
Compressor #7 Suct SH	AV:55	C7_Suct SH	*30352	*ADF:56
Compressor #7 Oil Pres Diff	AV:69	C7_Oil Pres Diff	*30381	*ADF:70
Compressor #7 Comp State Timer		C7_Comp State Timer	*32608	
Compressor #8 FLA%	AV:56	C8_FLA%	*30326	*ADF:57
Compressor #8 Sat Suction	AV:59	C8_Sat Suct	*30352	*ADF:53
Compressor #8 Sat Suction	AV:59	C8_Sat Suct	*30355	*ADF:60
Compressor #8 Sat Disch	AV:60	C8_ Sat Disch	*30357	*ADF:61
Compressor #8 Disch SH	AV:61	C8_Disch SH	*30358	*ADF:62
Compressor #8 Suct SH	AV:62	C8_Suct SH	*30356	*ADF:63
Compressor #8 Oil Pres Diff	AV:70	C8_Oil Pres Diff	*30382	*ADF:71
Compressor #8 Comp State Timer		C8_Comp State Timer	*32609	
Compressor #9 FLA%	AV:440	C9_FLA%	*30572	*ADF:441
Compressor #9 Sat Suction	AV: 443	C9_Sat Suct	*30584	*ADF: 442
Compressor #9 Sat Disch	AV: 444	C9_ Sat Disch	*30586	*ADF: 443
Compressor #9 Disch SH	AV: 445	C9_Disch SH	*30587	*ADF: 444
Compressor #9 Suct SH	AV: 446	C9_Suct SH	*30585	*ADF: 445
Compressor #9 Oil Pres Diff	AV:524	C9_Oil Pres Diff	*30656	*ADF:525
Compressor #9 Comp State Timer		C9_Comp State Timer	*32610	
Compressor #10 FLA%	AV:447	C10_FLA%	*30573	*ADF:448
Compressor #10 Sat Suction	AV: 450	C10_Sat Suct	*30588	*ADF: 451
Compressor #10 Sat Disch	AV: 451	C10_ Sat Disch	*30590	*ADF: 452
Compressor #10 Disch SH	AV: 452	C10_Disch SH	*30591	*ADF: 453
Compressor #10 Suct SH	AV: 453	C10_Suct SH	*30589	*ADF: 454
Compressor #10 Oil Pres Diff	AV:525	C10_Oil Pres Diff	*30657	*ADF:526
Compressor #10 Comp State Timer		C10_Comp State Timer	*32611	
Compressor #11 FLA%	AV:454	C11_FLA%	*30574	*ADF:455
Compressor #11 Sat Suction	AV: 457	C11_Sat Suct	*30592	*ADF: 458
Compressor #11 Sat Disch	AV: 458	C11_ Sat Disch	*30594	*ADF: 459
Compressor #11 Disch SH	AV: 459	C11_Disch SH	*30595	*ADF: 460
Compressor #11 Suct SH	AV: 460	C11_Suct SH	*30593	*ADF: 461
Compressor #11 Oil Pres Diff	AV: 526	C11_Oil Pres Diff	*30658	*ADF: 527

Magnum	BACnet ID	BACnet Name	Modbus	N2
Compressor #11 Comp State Timer		C11_Comp State Timer	*32612	
Compressor #12 FLA%	AV: 461	C12_FLA%	*30575	*ADF: 462
Compressor #12 Sat Suction	AV: 464	C12_Sat Suct	*30596	*ADF: 465
Compressor #12 Sat Disch	AV: 465	C12_ Sat Disch	*30598	*ADF: 466
Compressor #12 Disch SH	AV: 466	C12_Disch SH	*30599	*ADF: 467
Compressor #12 Suct SH	AV: 467	C12_Suct SH	*30597	*ADF 468
Compressor #12 Oil Pres Diff	AV:527	C12_Oil Pres Diff	*30659	*ADF:528
Compressor #12 Comp State Timer		C12_Comp State Timer	*32613	
Compressor #13 FLA%	AV:468	C13_FLA%	*30576	*ADF:469
Compressor #13 Sat Suction	AV: 471	C13_Sat Suct	*30600	*ADF: 470
Compressor #13 Sat Disch	AV: 472	C13_ Sat Disch	*30602	*ADF: 473
Compressor #13 Disch SH	AV: 473	C13_Disch SH	*30603	*ADF: 474
Compressor #13 Suct SH	AV: 474	C13_Suct SH	*30600	*ADF: 475
Compressor #13 Oil Pres Diff	AV: 528	C13_Oil Pres Diff	*30661	*ADF: 529
Compressor #13 Comp State Timer		C13_Comp State Timer	*32614	
Compressor #14 FLA%	AV: 475	C14_FLA%	*30577	*ADF: 476
Compressor #14 Sat Suction	AV: 478	C14_Sat Suct	*30604	*ADF: 479
Compressor #14 Sat Disch	AV: 479	C14_ Sat Disch	*30606	*ADF: 480
Compressor #14 Disch SH	AV: 480	C14_Disch SH	*30607	*ADF: 481
Compressor #14 Suct SH	AV: 481	C14_Suct SH	*30605	*ADF: 482
Compressor #14 Oil Pres Diff	AV: 529	C14_Oil Pres Diff	*30661	*ADF: 530
Compressor #14 Comp State Timer		C14_Comp State Timer	*32615	
Compressor #15 FLA%	AV: 482	C15_FLA%	*30578	*ADF: 483
Compressor #15 Sat Suction	AV: 485	C15_Sat Suct	*30608	*ADF: 486
Compressor #15 Sat Disch	AV: 486	C15_ Sat Disch	*30610	*ADF: 487
Compressor #15 Disch SH	AV: 487	C15_Disch SH	*30611	*ADF: 488
Compressor #15 Suct SH	AV: 488	C15_Suct SH	*30609	*ADF: 489
Compressor #15 Oil Pres Diff	AV: 530	C15_Oil Pres Diff	*30662	*ADF: 531
Compressor #15 Comp State Timer		C15_Comp State Timer	*32616	
Compressor #16 FLA%	AV: 489	C16_FLA%	*30579	*ADF: 490
Compressor #16 Sat Suction	AV: 492	C16_Sat Suct	*30612	*ADF: 493
Compressor #16 Sat Disch	AV: 493	C16_ Sat Disch	*30614	*ADF: 494
Compressor #16 Disch SH	AV: 494	C16_Disch SH	*30615	*ADF: 495
Compressor #16 Suct SH	AV: 495	C16_Suct SH	*30613	*ADF: 496
Compressor #16 Oil Pres Diff	AV: 531	C16_Oil Pres Diff	*30663	*ADF: 532
Compressor #16 Comp State Timer		C16_Comp State Timer	*32617	
Compressor #17 FLA%	AV: 496	C17_FLA%	*30580	*ADF: 497
Compressor #17 Sat Suction	AV: 499	C17_Sat Suct	*30616	*ADF: 500
Compressor #17 Sat Disch	AV: 500	C17_ Sat Disch	*30618	*ADF: 501
Compressor #17 Disch SH	AV: 501	C17_Disch SH	*30619	*ADF: 502
Compressor #17 Suct SH	AV: 502	C17_Suct SH	*30617	*ADF: 503
Compressor #17 Oil Pres Diff	AV: 532	C17_Oil Pres Diff	*30664	*ADF: 533
Compressor #17 Comp State Timer		C17_Comp State Timer	*32618	
Compressor #18 FLA%	AV: 503	C18_FLA%	*30581	*ADF: 504
Compressor #18 Sat Suction	AV: 506	C18_Sat Suct	*30620	*ADF: 507
Compressor #18 Sat Disch	AV: 507	C18_ Sat Disch	*30622	*ADF: 508
Compressor #18 Disch SH	AV: 508	C18_Disch SH	*30623	*ADF: 509
Compressor #18 Suct SH	AV: 509	C18_Suct SH	*30621	*ADF: 510
Compressor #18 Oil Pres Diff	AV: 533	C18_Oil Pres Diff	*30665	*ADF: 534
Compressor #18 Comp State Timer		C18_Comp State Timer	*32619	
Compressor #19 FLA%	AV: 510	C19_FLA%	*30582	*ADF: 511

Magnum	BACnet ID	BACnet Name	Modbus	N2
Compressor #19 Sat Suction	AV: 513	C19_Sat Suct	*30624	*ADF: 514
Compressor #19 Sat Disch	AV: 514	C19_ Sat Disch	*30626	*ADF: 515
Compressor #19 Disch SH	AV: 515	C19_Disch SH	*30627	*ADF: 516
Compressor #19 Suct SH	AV: 516	C19_Suct SH	*30625	*ADF: 517
Compressor #19 Oil Pres Diff	AV: 534	C19_Oil Pres Diff	*30666	*ADF: 535
Compressor #19 Comp State Timer		C19_Comp State Timer	*32620	
Compressor #20 FLA%	AV: 517	C20_FLA%	*30583	*ADF: 518
Compressor #20 Sat Suction	AV: 520	C20_Sat Suct	*30628	*ADF: 521
Compressor #20 Sat Disch	AV: 521	C20_ Sat Disch	*30630	*ADF: 522
Compressor #20 Disch SH	AV: 522	C20_Disch SH	*30631	*ADF: 523
Compressor #20 Suct SH	AV: 523	C20_Suct SH	*30629	*ADF: 524
Compressor #20 Oil Pres Diff	AV: 535	C20_Oil Pres Diff	*30667	*ADF: 536
Compressor #20 Comp State Timer		C21_Comp State Timer	*32621	

*- Indicates value multiplied by 10 to include one decimal place. (I.e. BMS value of 500 indicates actual value 50.0)

33.7. Unit Alarms

	Modbus Info		Bacnet Object Identifier		V17 Frimware		
Unit Alarms	Function Type	Register	Bacnet Object Type	Address	Relay output	Modbus	Bacnet
EMERGENCY_STOP	04:input Register	31011	AV: Ananlog Value	1296	HVAC//RTU	HVAC//RTU	HVAC//RTU
FREEZE_PROTECTION	04:input Register	31012	AV: Ananlog Value	1297	HVAC//RTU	HVAC//RTU	HVAC//RTU
HIGH_SUMP_TEMP	04:input Register	31013	AV: Ananlog Value	1298	HVAC//RTU	HVAC//RTU	HVAC//RTU
PHASE_LOSS	04:input Register	31014	AV: Ananlog Value	1299	HVAC//RTU	HVAC//RTU	HVAC//RTU
HIGH_DELTA_TEMP	04:input Register	31015	AV: Ananlog Value	1300	HVAC/	HVAC/	HVAC/
VOLTAGE	04:input Register	31016	AV: Ananlog Value	1301	HVAC//RTU	HVAC//RTU	HVAC//RTU
SMOKE_ALARM	04:input Register	31017	AV: Ananlog Value	1302	No Support	No Support	No Support
FIRE_ALARM	04:input Register	31018	AV: Ananlog Value	1303	HVAC//RTU	HVAC//RTU	HVAC//RTU
COMMON_CONDENSER	04:input Register	31019	AV: Ananlog Value	1304	HVAC//RTU	HVAC//RTU	HVAC//RTU
CIRCUIT_CONDENSER	04:input Register	31020	AV: Ananlog Value	1305	HVAC//RTU	HVAC//RTU	HVAC//RTU
Fuild Cooler Fan Fault	04:input Register	31021	AV: Ananlog Value	1306	HVAC//RTU	HVAC//RTU	HVAC//RTU
PUMP_FAILURE	04:input Register	31022	AV: Ananlog Value	1307	HVAC//RTU	HVAC//RTU	HVAC//RTU
PROCESS_PUMP_FAILURE	04:input Register	31023	AV: Ananlog Value	1308	HVAC//RTU	HVAC//RTU	HVAC//RTU
PROCESS_PUMP_LOW_FLOW	04:input Register	31024	AV: Ananlog Value	1309	HVAC	HVAC	HVAC
BOILER_PUMP_FAULT	04:input Register	31025	AV: Ananlog Value	1310	HVAC	HVAC	HVAC
BOILER_PUMP_HIGH_AMPS	04:input Register	31026	AV: Ananlog Value	1311	HVAC	HVAC	HVAC
BOILER_PUMP_LOW_AMPS	04:input Register	31027	AV: Ananlog Value	1312	HVAC	HVAC	HVAC
BOILER_STAGE_FAULT	04:input Register	31028	AV: Ananlog Value	1313	HVAC	HVAC	HVAC
HIGH_WATER_TEMP	04:input Register	31029	AV: Ananlog Value	1314	HVAC//RTU	HVAC//RTU	HVAC//RTU
OVERHEAT_PROTECTION	04:input Register	31030	AV: Ananlog Value	1315	HVAC	HVAC	HVAC
RTU_SUPPLY_DUCT	04:input Register	31031	AV: Ananlog Value	1316	RTU	RTU	RTU
RTU_EXHAUST_FAN_FAULT	04:input Register	31032	AV: Ananlog Value	1317	RTU	RTU	RTU
RTU_MOD_GAS_HEATER_FAULT	04:input Register	31033	AV: Ananlog Value	1318	RTU	RTU	RTU
RTU_SCR_HEATER_FAULT	04:input Register	31034	AV: Ananlog Value	1319	RTU	RTU	RTU
RTU_CLOGGED_FILTER	04:input Register	31035	AV: Ananlog Value	1320	RTU	RTU	RTU
RTU_HIGH_STATIC_PRESSURE	04:input Register	31036	AV: Ananlog Value	1321	RTU	RTU	RTU
RTU_LOW_STATIC_PRESSURE	04:input Register	31037	AV: Ananlog Value	1322	RTU	RTU	RTU
BOILER_PUMP_FLOW_FAULT	04:input Register	31038	AV: Ananlog Value	1323	HVAC	HVAC	HVAC
Leaving Water Temp. Sensor Fault	04:input Register	31039	AV: Ananlog Value	1324	HVAC//RTU	HVAC//RTU	HVAC//RTU
Reutrn Water Temp. Sensor Fault	04:input Register	31040	AV: Ananlog Value	1325	HVAC//RTU	HVAC//RTU	HVAC//RTU
Evap Water Pressure In #1 Sensor Fault	04:input Register	31041	AV: Ananlog Value	1326	HVAC//RTU	HVAC//RTU	HVAC//RTU
Evap Water Pressure Out #1 Sensor Fault	04:input Register	31042	AV: Ananlog Value	1327	HVAC//RTU	HVAC//RTU	HVAC//RTU
Evap Water Pressure In #2 Sensor Fault	04:input Register	31043	AV: Ananlog Value	1328	HVAC//RTU	HVAC//RTU	HVAC//RTU
Evap Water Pressure Out #2 Sensor Fault	04:input Register	31044	AV: Ananlog Value	1329	HVAC//RTU	HVAC//RTU	HVAC//RTU
RTU Zone Temp. Sensor Fault	04:input Register	31045	AV: Ananlog Value	1330	HVAC//RTU	HVAC//RTU	HVAC//RTU
RTU Ambient Temp. Sensor Fault	04:input Register	31046	AV: Ananlog Value	1331	HVAC//RTU	HVAC//RTU	HVAC//RTU

33.8. Compressor Alarms

	V17 Frimware Supporting Alarm Indicators		
Compressor Alarms	**Relay output**	**Modbus**	**Bacnet**
LOW_SUCTION	HVAC/RTU	HVAC/RTU	HVAC/RTU
UNSAFE_SUCTION	HVAC/RTU	HVAC/RTU	HVAC/RTU
HIGH_DISCHARGE_PSI	HVAC/RTU	HVAC/RTU	HVAC/RTU
HIGH_DISCHARGE_TEMP	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_OIL_PSI	HVAC/RTU	HVAC/RTU	HVAC/RTU
UNSAFE_OIL_PSI	HVAC/RTU	HVAC/RTU	HVAC/RTU
HIGH_OIL_TEMP	HVAC/RTU	HVAC/RTU	HVAC/RTU
DIRTY_OIL_FILTER	HVAC/RTU	HVAC/RTU	HVAC/RTU
HIGH_OIL_SEAL_TEMP	HVAC/RTU	HVAC/RTU	HVAC/RTU
NO_CRANK_CASE_HEATER_PROOF	Not Supported	Not Supported	Not Supported
HIGH_AMPS	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_AMPS	HVAC/RTU	HVAC/RTU	HVAC/RTU
HIGH_MOTOR_TEMP	HVAC/RTU	HVAC/RTU	HVAC/RTU
NO_COMPRESSOR_PROOF	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_OIL_SUPERHEAT (Not Supported -no code)	Not Supported	Not Supported	Not Supported
PUMP_DOWN	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_DISCHARGE_PSI	HVAC/RTU	HVAC/RTU	HVAC/RTU
LUBE_OIL_TEMP	HVAC/RTU	HVAC/RTU	HVAC/RTU
LUBE_OIL_PSI	HVAC/RTU	HVAC/RTU	HVAC/RTU
LUBE_OIL_TIME	HVAC/RTU	HVAC/RTU	HVAC/RTU
REFRIGERATION_LEAK	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_REFRIGERATION_TEMP	HVAC/RTU	HVAC/RTU	HVAC/RTU
TOO_MANY_PURGES	HVAC/RTU	HVAC/RTU	HVAC/RTU
EXCESS_PURGING_TIME	HVAC/RTU	HVAC/RTU	HVAC/RTU
PURGE_FLOAT_ERROR	Not Supported	Not Supported	Not Supported
LOW_DIFFERENTIAL_PSI_RATIO	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_SUPERHEAT	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_DISCHARGE_SUPERHEAT	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOST_LEG_PART_WINDING	HVAC/RTU	HVAC/RTU	HVAC/RTU
HIGH_PARTS_PER_MILLION_LEAK	Not Supported	Not Supported	Not Supported
HIGH_REFRIGERATION_LEVEL	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_OIL_LEVEL	HVAC/RTU	HVAC/RTU	HVAC/RTU
NO_FLOW	Not Supported	Not Supported	Not Supported
OIL_FLOW	HVAC/RTU	HVAC/RTU	HVAC/RTU
COMPRESSOR_SPEED_FAULT	HVAC/RTU	HVAC/RTU	HVAC/RTU
LOW_TANDEM_SUPERHEAT	Not Supported	Not Supported	Not Supported
HIGH_TANDEM_SUPERHEAT	Not Supported	Not Supported	Not Supported
EXCESS_SURGES	HVAC/RTU	HVAC/RTU	HVAC/RTU

	V17 Frimware Supporting Alarm Indicators		
Compressor Alarms	**Relay output**	**Modbus**	**Bacnet**
HIGH_SUPERHEAT	HVAC/RTU	HVAC/RTU	HVAC/RTU
Suction Temperature Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Discharge Temperature Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Suction Pressure Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Discharge Pressure Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Oil Pressure Sensor Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Oil Temperature Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Motor Temperature Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Evap Refrigerant Temperature Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Evap Refrigerant Level Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Oil Seal Temperature Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Pre-Oil Filter Presssure Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU
Circuit Leaving Water Sensor Fault	HVAC/RTU	HVAC/RTU	HVAC/RTU

		Modbus Register																			
Alarms	Modbus Function Type	Comp. #1	Comp. #2	Comp. #3	Comp. #4	Comp. #5	Comp. #6	Comp. #7	Comp. #8	Comp. #9	Comp. #10	Comp. #11	Comp. #12	Comp. #13	Comp. #14	Comp. #15	Comp. #16	Comp. #17	Comp. #18	Comp. #19	Comp. #20
LOW_SUCTION	04:input Register	31201	31252	31303	31354	31405	31456	31507	31558	31609	31660	31711	31762	31813	31864	31915	31966	32017	32068	32119	32170
UNSAFE_SUCTION	04:input Register	31202	31253	31304	31355	31406	31457	31508	31559	31610	31661	31712	31763	31814	31865	31916	31967	32018	32069	32120	32171
HIGH_DISCHARGE_PSI	04:input Register	31203	31254	31305	31356	31407	31458	31509	31560	31611	31662	31713	31764	31815	31866	31917	31968	32019	32070	32121	32172
HIGH_DISCHARGE_TEMP	04:input Register	31204	31255	31306	31357	31408	31459	31510	31561	31612	31663	31714	31765	31816	31867	31918	31969	32020	32071	32122	32173
LOW_OIL_PSI	04:input Register	31205	31256	31307	31358	31409	31460	31511	31562	31613	31664	31715	31766	31817	31868	31919	31970	32021	32072	32123	32174
UNSAFE_OIL_PSI	04:input Register	31206	31257	31308	31359	31410	31461	31512	31563	31614	31665	31716	31767	31818	31869	31920	31971	32022	32073	32124	32175
HIGH_OIL_TEMP	04:input Register	31207	31258	31309	31360	31411	31462	31513	31564	31615	31666	31717	31768	31819	31870	31921	31972	32023	32074	32125	32176
DIRTY_OIL_FILTER	04:input Register	31208	31259	31310	31361	31412	31463	31514	31565	31616	31667	31718	31769	31820	31871	31922	31973	32024	32075	32126	32177
HIGH_OIL_SEAL_TEMP	04:input Register	31209	31260	31311	31362	31413	31464	31515	31566	31617	31668	31719	31770	31821	31872	31923	31974	32025	32076	32127	32178
NO_CRANK_CASE_HEATER_PROOF	04:input Register	31210	31261	31312	31363	31414	31465	31516	31567	31618	31669	31720	31771	31822	31873	31924	31975	32026	32077	32128	32179
HIGH_AMPS	04:input Register	31211	31262	31313	31364	31415	31466	31517	31568	31619	31670	31721	31772	31823	31874	31925	31976	32027	32078	32129	32180
LOW_AMPS	04:input Register	31212	31263	31314	31365	31416	31467	31518	31569	31620	31671	31722	31773	31824	31875	31926	31977	32028	32079	32130	32181
HIGH_MOTOR_TEMP	04:input Register	31213	31264	31315	31366	31417	31468	31519	31570	31621	31672	31723	31774	31825	31876	31927	31978	32029	32080	32131	32182
NO_COMPRESSOR_PROOF	04:input Register	31214	31265	31316	31367	31418	31469	31520	31571	31622	31673	31724	31775	31826	31877	31928	31979	32030	32081	32132	32183
LOW_OIL_SUPERHEAT	04:input Register	31215	31266	31317	31368	31419	31470	31521	31572	31623	31674	31725	31776	31827	31878	31929	31980	32031	32082	32133	32184
PUMP_DOWN	04:input Register	31216	31267	31318	31369	31420	31471	31522	31573	31624	31675	31726	31777	31828	31879	31930	31981	32032	32083	32134	32185
LOW_DISCHARGE_PSI	04:input Register	31217	31268	31319	31370	31421	31472	31523	31574	31625	31676	31727	31778	31829	31880	31931	31982	32033	32084	32135	32186
LUBE_OIL_TEMP	04:input Register	31218	31269	31320	31371	31422	31473	31524	31575	31626	31677	31728	31779	31830	31881	31932	31983	32034	32085	32136	32187
LUBE_OIL_PSI	04:input Register	31219	31270	31321	31372	31423	31474	31525	31576	31627	31678	31729	31780	31831	31882	31933	31984	32035	32086	32137	32188
LUBE_OIL_TIME	04:input Register	31220	31271	31322	31373	31424	31475	31526	31577	31628	31679	31730	31781	31832	31883	31934	31985	32036	32087	32138	32189
REFRIGERATION_LEAK	04:input Register	31221	31272	31323	31374	31425	31476	31527	31578	31629	31680	31731	31782	31833	31884	31935	31986	32037	32088	32139	32190
LOW_REFRIGERATION_TEMP	04:input Register	31222	31273	31324	31375	31426	31477	31528	31579	31630	31681	31732	31783	31834	31885	31936	31987	32038	32089	32140	32191
TOO_MANY_PURGES	04:input Register	31223	31274	31325	31376	31427	31478	31529	31580	31631	31682	31733	31784	31835	31886	31937	31988	32039	32090	32141	32192
EXCESS_PURGING_TIME	04:input Register	31224	31275	31326	31377	31428	31479	31530	31581	31632	31683	31734	31785	31836	31887	31938	31989	32040	32091	32142	32193
PURGE_FLOAT_ERROR	04:input Register	31225	31276	31327	31378	31429	31480	31531	31582	31633	31684	31735	31786	31837	31888	31939	31990	32041	32092	32143	32194
LOW_DIFFERENTIAL_PSI_RATIO	04:input Register	31226	31277	31328	31379	31430	31481	31532	31583	31634	31685	31736	31787	31838	31889	31940	31991	32042	32093	32144	32195
LOW_SUPERHEAT	04:input Register	31227	31278	31329	31380	31431	31482	31533	31584	31635	31686	31737	31788	31839	31890	31941	31992	32043	32094	32145	32196
LOW_DISCHARGE_SUPERHEAT	04:input Register	31228	31279	31330	31381	31432	31483	31534	31585	31636	31687	31738	31789	31840	31891	31942	31993	32044	32095	32146	32197
LOST_LEG_PART_WINDING	04:input Register	31229	31280	31331	31382	31433	31484	31535	31586	31637	31688	31739	31790	31841	31892	31943	31994	32045	32096	32147	32198
HIGH_PARTS_PER_MILLION_LEAK	04:input Register	31230	31281	31332	31383	31434	31485	31536	31587	31638	31689	31740	31791	31842	31893	31944	31995	32046	32097	32148	32199
HIGH_REFRIGERATION_LEVEL	04:input Register	31231	31282	31333	31384	31435	31486	31537	31588	31639	31690	31741	31792	31843	31894	31945	31996	32047	32098	32149	32200
LOW_OIL_LEVEL	04:input Register	31232	31283	31334	31385	31436	31487	31538	31589	31640	31691	31742	31793	31844	31895	31946	31997	32048	32099	32150	32201
NO_FLOW	04:input Register	31233	31284	31335	31386	31437	31488	31539	31590	31641	31692	31743	31794	31845	31896	31947	31998	32049	32100	32151	32202
OIL_FLOW	04:input Register	31234	31285	31336	31387	31438	31489	31540	31591	31642	31693	31744	31795	31846	31897	31948	31999	32050	32101	32152	32203

		Modbus Register																			
Alarms	Modbus Function Type	Comp. #1	Comp. #2	Comp. #3	Comp. #4	Comp. #5	Comp. #6	Comp. #7	Comp. #8	Comp. #9	Comp. #10	Comp. #11	Comp. #12	Comp. #13	Comp. #14	Comp. #15	Comp. #16	Comp. #17	Comp. #18	Comp. #19	Comp. #20
COMPRESSOR_SPEED_FAULT	04:input Register	31235	31286	31337	31388	31439	31490	31541	31592	31643	31694	31745	31796	31847	31898	31949	32000	32051	32102	32153	32204
LOW_TANDEM_SUPERHEAT	04:input Register	31236	31287	31338	31389	31440	31491	31542	31593	31644	31695	31746	31797	31848	31899	31950	32001	32052	32103	32154	32205
HIGH_TANDEM_SUPERHEAT	04:input Register	31237	31288	31339	31390	31441	31492	31543	31594	31645	31696	31747	31798	31849	31900	31951	32002	32053	32104	32155	32206
EXCESS_SURGES	04:input Register	31238	31289	31340	31391	31442	31493	31544	31595	31646	31697	31748	31799	31850	31901	31952	32003	32054	32105	32156	32207
HIGH_SUPERHEAT	04:input Register	31239	31290	31341	31392	31443	31494	31545	31596	31647	31698	31749	31800	31851	31902	31953	32004	32055	32106	32157	32208
Suction Temperature Sensor Fault	04:input Register	31240	31291	31342	31393	31444	31495	31546	31597	31648	31699	31750	31801	31852	31903	31954	32005	32056	32107	32158	32209
Discharge Temperature Sensor Fault	04:input Register	31241	31292	31343	31394	31445	31496	31547	31598	31649	31700	31751	31802	31853	31904	31955	32006	32057	32108	32159	32210
Suction Pressure Sensor Fault	04:input Register	31242	31293	31344	31395	31446	31497	31548	31599	31650	31701	31752	31803	31854	31905	31956	32007	32058	32109	32160	32211
Discharge Pressure Sensor Fault	04:input Register	31243	31294	31345	31396	31447	31498	31549	31600	31651	31702	31753	31804	31855	31906	31957	32008	32059	32110	32161	32212
Oil Pressure Sensor Sensor Fault	04:input Register	31244	31295	31346	31397	31448	31499	31550	31601	31652	31703	31754	31805	31856	31907	31958	32009	32060	32111	32162	32213
Oil Temperature Sensor Fault	04:input Register	31245	31296	31347	31398	31449	31500	31551	31602	31653	31704	31755	31806	31857	31908	31959	32010	32061	32112	32163	32214
Motor Temperature Sensor Fault	04:input Register	31246	31297	31348	31399	31450	31501	31552	31603	31654	31705	31756	31807	31858	31909	31960	32011	32062	32113	32164	32215
Evap Refrigerant Temp. Sensor Fault	04:input Register	31247	31298	31349	31400	31451	31502	31553	31604	31655	31706	31757	31808	31859	31910	31961	32012	32063	32114	32165	32216
Evap Refrigerant Level Sensor Fault	04:input Register	31248	31299	31350	31401	31452	31503	31554	31605	31656	31707	31758	31809	31860	31911	31962	32013	32064	32115	32166	32217
Oil Seal Temperature Sensor Fault	04:input Register	31249	31300	31351	31402	31453	31504	31555	31606	31657	31708	31759	31810	31861	31912	31963	32014	32065	32116	32167	32218
Pre-Oil Filter Presssure Sensor Fault	04:input Register	31250	31301	31352	31403	31454	31505	31556	31607	31658	31709	31760	31811	31862	31913	31964	32015	32066	32117	32168	32219
Circuit Leaving Water Sensor Fault	04:input Register	31251	31302	31353	31404	31455	31506	31557	31608	31659	31710	31761	31812	31863	31914	31965	32016	32067	32118	32169	32220

		Bacnet Object Identifier																				
Alarms	Bacnet Object Type	Comp. #1	Comp. #2	Comp. #3	Comp. #4	Comp. #5	Comp. #6	Comp. #7	Comp. #8	Comp. #9	Comp. #10	Comp. #11	Comp. #12	Comp. #13	Comp. #14	Comp. #15	Comp. #16	Comp. #17	Comp. #18	Comp. #19	Comp. #20
LOW_SUCTION	Analog Value	1396	1447	1498	1549	1600	1651	1702	1753	1804	1855	1906	1957	2008	2059	2110	2161	2212	2263	2314	2365
UNSAFE_SUCTION	Analog Value	1397	1448	1499	1550	1601	1652	1703	1754	1805	1856	1907	1958	2009	2060	2111	2162	2213	2264	2315	2366
HIGH_DISCHARGE_PSI	Analog Value	1398	1449	1500	1551	1602	1653	1704	1755	1806	1857	1908	1959	2010	2061	2112	2163	2214	2265	2316	2367
HIGH_DISCHARGE_TEMP	Analog Value	1399	1450	1501	1552	1603	1654	1705	1756	1807	1858	1909	1960	2011	2062	2113	2164	2215	2266	2317	2368
LOW_OIL_PSI	Analog Value	1400	1451	1502	1553	1604	1655	1706	1757	1808	1859	1910	1961	2012	2063	2114	2165	2216	2267	2318	2369
UNSAFE_OIL_PSI	Analog Value	1401	1452	1503	1554	1605	1656	1707	1758	1809	1860	1911	1962	2013	2064	2115	2166	2217	2268	2319	2370
HIGH_OIL_TEMP	Analog Value	1402	1453	1504	1555	1606	1657	1708	1759	1810	1861	1912	1963	2014	2065	2116	2167	2218	2269	2320	2371
DIRTY_OIL_FILTER	Analog Value	1403	1454	1505	1556	1607	1658	1709	1760	1811	1862	1913	1964	2015	2066	2117	2168	2219	2270	2321	2372
HIGH_OIL_SEAL_TEMP	Analog Value	1404	1455	1506	1557	1608	1659	1710	1761	1812	1863	1914	1965	2016	2067	2118	2169	2220	2271	2322	2373
NO_CRANK_CASE_HEATER_PROOF	Analog Value	1405	1456	1507	1558	1609	1660	1711	1762	1813	1864	1915	1966	2017	2068	2119	2170	2221	2272	2323	2374
HIGH_AMPS	Analog Value	1406	1457	1508	1559	1610	1661	1712	1763	1814	1865	1916	1967	2018	2069	2120	2171	2222	2273	2324	2375
LOW_AMPS	Analog Value	1407	1458	1509	1560	1611	1662	1713	1764	1815	1866	1917	1968	2019	2070	2121	2172	2223	2274	2325	2376
HIGH_MOTOR_TEMP	Analog Value	1408	1459	1510	1561	1612	1663	1714	1765	1816	1867	1918	1969	2020	2071	2122	2173	2224	2275	2326	2377
NO_COMPRESSOR_PROOF	Analog Value	1409	1460	1511	1562	1613	1664	1715	1766	1817	1868	1919	1970	2021	2072	2123	2174	2225	2276	2327	2378
LOW_OIL_SUPERHEAT	Analog Value	1410	1461	1512	1563	1614	1665	1716	1767	1818	1869	1920	1971	2022	2073	2124	2175	2226	2277	2328	2379
PUMP_DOWN	Analog Value	1411	1462	1513	1564	1615	1666	1717	1768	1819	1870	1921	1972	2023	2074	2125	2176	2227	2278	2329	2380
LOW_DISCHARGE_PSI	Analog Value	1412	1463	1514	1565	1616	1667	1718	1769	1820	1871	1922	1973	2024	2075	2126	2177	2228	2279	2330	2381
LUBE_OIL_TEMP	Analog Value	1413	1464	1515	1566	1617	1668	1719	1770	1821	1872	1923	1974	2025	2076	2127	2178	2229	2280	2331	2382
LUBE_OIL_PSI	Analog Value	1414	1465	1516	1567	1618	1669	1720	1771	1822	1873	1924	1975	2026	2077	2128	2179	2230	2281	2332	2383
LUBE_OIL_TIME	Analog Value	1415	1466	1517	1568	1619	1670	1721	1772	1823	1874	1925	1976	2027	2078	2129	2180	2231	2282	2333	2384
REFRIGERATION_LEAK	Analog Value	1416	1467	1518	1569	1620	1671	1722	1773	1824	1875	1926	1977	2028	2079	2130	2181	2232	2283	2334	2385
LOW_REFRIGERATION_TEMP	Analog Value	1417	1468	1519	1570	1621	1672	1723	1774	1825	1876	1927	1978	2029	2080	2131	2182	2233	2284	2335	2386
TOO_MANY_PURGES	Analog Value	1418	1469	1520	1571	1622	1673	1724	1775	1826	1877	1928	1979	2030	2081	2132	2183	2234	2285	2336	2387
EXCESS_PURGING_TIME	Analog Value	1419	1470	1521	1572	1623	1674	1725	1776	1827	1878	1929	1980	2031	2082	2133	2184	2235	2286	2337	2388
PURGE_FLOAT_ERROR	Analog Value	1420	1471	1522	1573	1624	1675	1726	1777	1828	1879	1930	1981	2032	2083	2134	2185	2236	2287	2338	2389
LOW_DIFFERENTIAL_PSI_RATIO	Analog Value	1421	1472	1523	1574	1625	1676	1727	1778	1829	1880	1931	1982	2033	2084	2135	2186	2237	2288	2339	2390
LOW_SUPERHEAT	Analog Value	1422	1473	1524	1575	1626	1677	1728	1779	1830	1881	1932	1983	2034	2085	2136	2187	2238	2289	2340	2391
LOW_DISCHARGE_SUPERHEAT	Analog Value	1423	1474	1525	1576	1627	1678	1729	1780	1831	1882	1933	1984	2035	2086	2137	2188	2239	2290	2341	2392
LOST_LEG_PART_WINDING	Analog Value	1424	1475	1526	1577	1628	1679	1730	1781	1832	1883	1934	1985	2036	2087	2138	2189	2240	2291	2342	2393
HIGH_PARTS_PER_MILLION_LEAK	Analog Value	1425	1476	1527	1578	1629	1680	1731	1782	1833	1884	1935	1986	2037	2088	2139	2190	2241	2292	2343	2394
HIGH_REFRIGERATION_LEVEL	Analog Value	1426	1477	1528	1579	1630	1681	1732	1783	1834	1885	1936	1987	2038	2089	2140	2191	2242	2293	2344	2395
LOW_OIL_LEVEL	Analog Value	1427	1478	1529	1580	1631	1682	1733	1784	1835	1886	1937	1988	2039	2090	2141	2192	2243	2294	2345	2396
NO_FLOW	Analog Value	1428	1479	1530	1581	1632	1683	1734	1785	1836	1887	1938	1989	2040	2091	2142	2193	2244	2295	2346	2397
OIL_FLOW	Analog Value	1429	1480	1531	1582	1633	1684	1735	1786	1837	1888	1939	1990	2041	2092	2143	2194	2245	2296	2347	2398

		Bacnet Object Identifier																			
Alarms	Bacnet Object Type	Comp. #1	Comp. #2	Comp. #3	Comp. #4	Comp. #5	Comp. #6	Comp. #7	Comp. #8	Comp. #9	Comp. #10	Comp. #11	Comp. #12	Comp. #13	Comp. #14	Comp. #15	Comp. #16	Comp. #17	Comp. #18	Comp. #19	Comp. #20
COMPRESSOR_SPEED_FAULT	Analog Value	1430	1481	1532	1583	1634	1685	1736	1787	1838	1889	1940	1991	2042	2093	2144	2195	2246	2297	2348	2399
LOW_TANDEM_SUPERHEAT	Analog Value	1431	1482	1533	1584	1635	1686	1737	1788	1839	1890	1941	1992	2043	2094	2145	2196	2247	2298	2349	2400
HIGH_TANDEM_SUPERHEAT	Analog Value	1432	1483	1534	1585	1636	1687	1738	1789	1840	1891	1942	1993	2044	2095	2146	2197	2248	2299	2350	2401
EXCESS_SURGES	Analog Value	1433	1484	1535	1586	1637	1688	1739	1790	1841	1892	1943	1994	2045	2096	2147	2198	2249	2300	2351	2402
HIGH_SUPERHEAT	Analog Value	1434	1485	1536	1587	1638	1689	1740	1791	1842	1893	1944	1995	2046	2097	2148	2199	2250	2301	2352	2403
Suction Temperature Sensor Fault	Analog Value	1435	1486	1537	1588	1639	1690	1741	1792	1843	1894	1945	1996	2047	2098	2149	2200	2251	2302	2353	2404
Discharge Temperature Sensor Fault	Analog Value	1436	1487	1538	1589	1640	1691	1742	1793	1844	1895	1946	1997	2048	2099	2150	2201	2252	2303	2354	2405
Suction Pressure Sensor Fault	Analog Value	1437	1488	1539	1590	1641	1692	1743	1794	1845	1896	1947	1998	2049	2100	2151	2202	2253	2304	2355	2406
Discharge Pressure Sensor Fault	Analog Value	1438	1489	1540	1591	1642	1693	1744	1795	1846	1897	1948	1999	2050	2101	2152	2203	2254	2305	2356	2407
Oil Pressure Sensor Sensor Fault	Analog Value	1439	1490	1541	1592	1643	1694	1745	1796	1847	1898	1949	2000	2051	2102	2153	2204	2255	2306	2357	2408
Oil Temperature Sensor Fault	Analog Value	1440	1491	1542	1593	1644	1695	1746	1797	1848	1899	1950	2001	2052	2103	2154	2205	2256	2307	2358	2409
Motor Temperature Sensor Fault	Analog Value	1441	1492	1543	1594	1645	1696	1747	1798	1849	1900	1951	2002	2053	2104	2155	2206	2257	2308	2359	2410
Evap Refrigerant Temp. Sensor Fault	Analog Value	1442	1493	1544	1595	1646	1697	1748	1799	1850	1901	1952	2003	2054	2105	2156	2207	2258	2309	2360	2411
Evap Refrigerant Level Sensor Fault	Analog Value	1443	1494	1545	1596	1647	1698	1749	1800	1851	1902	1953	2004	2055	2106	2157	2208	2259	2310	2361	2412
Oil Seal Temperature Sensor Fault	Analog Value	1444	1495	1546	1597	1648	1699	1750	1801	1852	1903	1954	2005	2056	2107	2158	2209	2260	2311	2362	2413
Pre-Oil Filter Presssure Sensor Fault	Analog Value	1445	1496	1547	1598	1649	1700	1751	1802	1853	1904	1955	2006	2057	2108	2159	2210	2261	2312	2363	2414
Circuit Leaving Water Sensor Fault	Analog Value	1446	1497	1548	1599	1650	1701	1752	1803	1854	1905	1956	2007	2058	2109	2160	2211	2262	2313	2364	2415

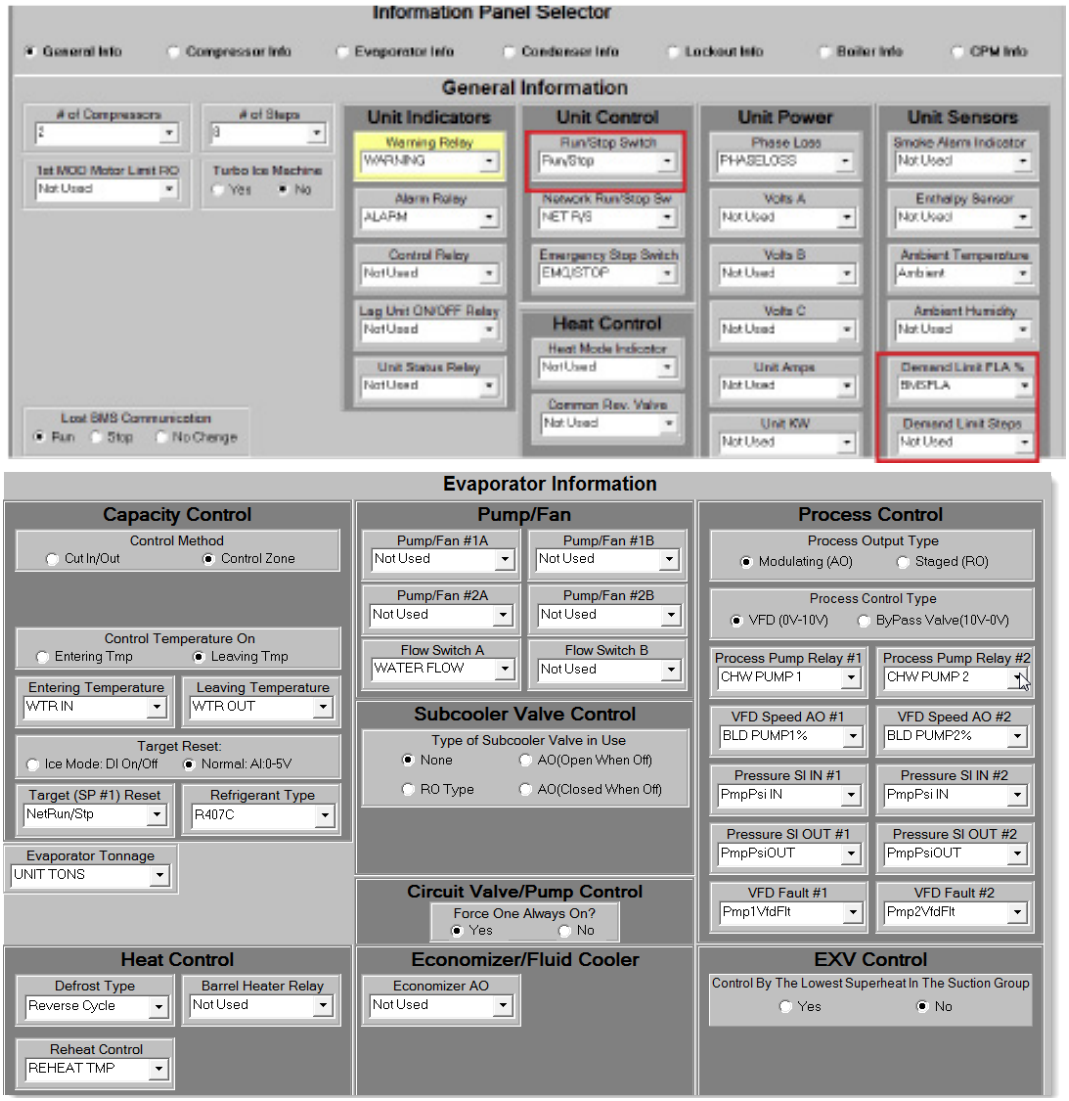
33.9. Network inputs to MCS-Magnum

The MCS-Magnum can receive changes from the network to enable or disable the Network Run/Stop, Network Target Reset (adjustments to the Cooling Target, Setpoint #1, based on Setpoint #21), Network Demand FLA, and Network Demand Steps.

The MCS-Magnum must be setup to accept these inputs. The configuration file must contain a Network Run/Stop, Network Target, Network Demand FLA, and Network Demand Steps sensors.

Magnum	BACnet ID	BACnet Name	Modbus	N2
Network Run/Stop	AV:246	Net_R/S	40201	BO:247
Network Target/Reset	AV:247	Net_Tar/Res	40202	AO:248
Network Demand/FLA	AV:248	Net_Demad_FLA	40204	AO:249
Network Demand/Steps	AV:249	Net_Demad_Steps	40205	AO:250

Note the following Information panel has a Network Run/Stop, and /or Network Target Reset sensors inputs indicated. This is an example of how MCS-Config must be setup in the General Information and Evaporator Information panels.



The sensors must be set up as follows (This is only an example)

1-1	BMS R/S	BMS RUN	Not Used	Open=OFF	OFF/ON	Not Used	Not Used	Auto
1-2	BMS TRS	BMS CW RSET	0	0	Not Used	Not Used	Not Used	Auto
1-3	BMSFLA	BMS Dmd FLA%	0	0	Not Used	Not Used	Not Used	Auto
1-4	BMSSteps	BMS Dmd Step	0	0	Not Used	Not Used	Not Used	Auto

33.10. MCS-BMS-GATEWAY PROTOCOLS (over Ethernet - Modbus RTU)

The following Protocols are available with the Magnum. Changes can be made to the settings using the Keypad or can be made using MCS-CONNECT SERVICE WINDOW.

- BACnet MS/IP (using MCS-BMS-GATEWAY)
- Johnson N2 (using MCS-BMS-GATEWAY)
- Modbus RTU to Modbus TCP/IP (using MCS-BMS-GATEWAY)
- Modbus RTU / BACnet IP (using MCS-BMS-GATEWAY)
- LonTalk (using MCS-BMS-GATEWAY)

The BACNET DEVICE ID is a five-digit number. The first three digits are based on MCS's Bacnet Vendor ID 181, and the last two are set by the Bacnet/MSTP address.

181	XX
↓	↓
Bacnet MCS181	Bacnet IP Address

In case the end user would like to set up an ID other than 181-XX, there is an extended BACnet setting that can only be set in MCS Config.

The following changes can be made using the Keypad or can be made using MCS-CONNECT SERVICE WINDOW.

The **BACnet IP** address can be verified and changed (with the proper authorization code) from the Keypad/LCD.

The following steps will display the Bacnet IP Network address, and the the TCP/IP port:

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Use ⬆ arrow to **BACnet Setting** then press Enter.
- Select address then press Enter. Change the address so it matches the last two digits of the device ID then press Enter.
- Use ⬇ arrow to tab to the TCP/IP address.
- Select address then press Enter. Change the address and port to match your device.

33.10.1 ETHERNET NETWORK PROTOCOL

The following steps will display the **ETHERNET NETWORK** settings:

If you are going to manually assign the IP Address, Subnet Mask, and Default Gateway.

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Select Ethernet Network then press Enter.
- Set "DYNAMIC IP" to NO.
- Set the "IP Address".
- Set the "Subnet Mask".
- Set "Default Gateway".
- Reset Magnum for change to take effect.

If you are going to let your network assign the IP Address, Subnet Mask, and Default Gateway:

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Select Ethernet Network then press Enter.
- Set "DYNAMIC IP" to YES.
- Connect the MCS-Magnum to the network and power up the board.

33.10.2 MODBUS RTU PROTOCOL

The Modbus RTU address can be verified and changed (with the proper authorization code) from the keypad/LCD or can be made using MCS-CONNECT SERVICE WINDOW.

The following steps will display the Modbus RTU Network address, and the Baud Rate:

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Select RS485 Network then press Enter.
- Select Protocol then press Enter. Change the protocol to Modbus RTU.
- Select address then press Enter. Change the address then press Enter.
- Select Baud then press Enter. Set the baud rate then press Enter.
- Connect the communication wires to the TX RS485 three-position terminal located above the Ethernet connector.
- Reset Magnum for change to take effect.
- Select Ethernet Network then press Enter.
- Set “DYNAMIC IP” to NO.
- Set the “IP Address”.
- Set the “Subnet Mask”.
- Set “Default Gateway”.
- Reset Magnum for change to take effect.

If you are going to let your network assign the IP Address, Subnet Mask, and Default Gateway:

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Select Ethernet Network then press Enter.
- Set “DYNAMIC IP” to YES.
- Connect the MCS-Magnum to the network and power up the board.

33.11. PROTOCOLS USING MCS-BMS-GATEWAY

The MCS-BMS-GATEWAY is a microprocessor based communication device that provides translation from BACnet IP to LonTalk, BACnet MSTP, or Johnson Control N2.

Information that can be transmitted includes the status of control points, alarm information, digital inputs, analog inputs or setpoints.

For more information on the MCS-BMS-GATEWAY please go to www.MCScontrols.com.

33.11.1 MODBUS TCP/IP PROTOCOL

This protocol is always active.

Make sure the MCS-Magnum network settings are set correctly.

If you are going to manually assign the IP Address, Subnet Mask, and Default Gateway.
Press the Menu key, select Serv Tools, and then press the Enter key.

- Select Ethernet Network then press Enter.
- Set “DYNAMIC IP” to NO.
- Set the “IP Address”.
- Set the “Subnet Mask”.
- Set “Default Gateway”.
- Reset Magnum for change to take effect.

If you are going to let your network assign the IP Address, Subnet Mask, and Default Gateway:

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Select Ethernet Network then press Enter.
- Set “DYNAMIC IP” to YES.
- Connect the MCS-Magnum to the network and power up the board.

33.12. PROTOCOLS USING MCS-BMS-GATEWAY

The MCS-BMS-GATEWAY is a microprocessor based communication device that provides translation from BACnet IP to LonTalk, BACnet MSTP, or Johnson Control N2.

Information that can be transmitted includes the status of control points, alarm information, digital inputs, analog inputs or setpoints.

For more information on the MCS-BMS-GATEWAY please go to www.MCScontrols.com.

Chapter - 34. Network Protocols

Network protocols are formatting rules that specify how data is sent and received between devices. Protocols are necessary for devices to interact with each other.

34.1. Protocols MCS controllers support:

- BACnet MS/IP
- Johnson N2
- Modbus RTU / Modbus TCP/IP
- Modbus RTU / BACnet IP
- LonTalk

The MCS-BMS-GATEWAY is a microprocessor based communication device that provides translation from Modbus RTU to BACnet IP, Modbus RTU to Modbus TCP/IP, BACnet MS/TP, Johnson Control N2 or LonTalk.

Information that can be transmitted includes the status of control points, alarm information, digital inputs, analog inputs or setpoints.

Network protocols are formatting rules that specify how data is sent and received between devices. Protocols are necessary for devices to interact with each other.

34.1.1 Protocols MCS controllers support:

✓ = Built in Support

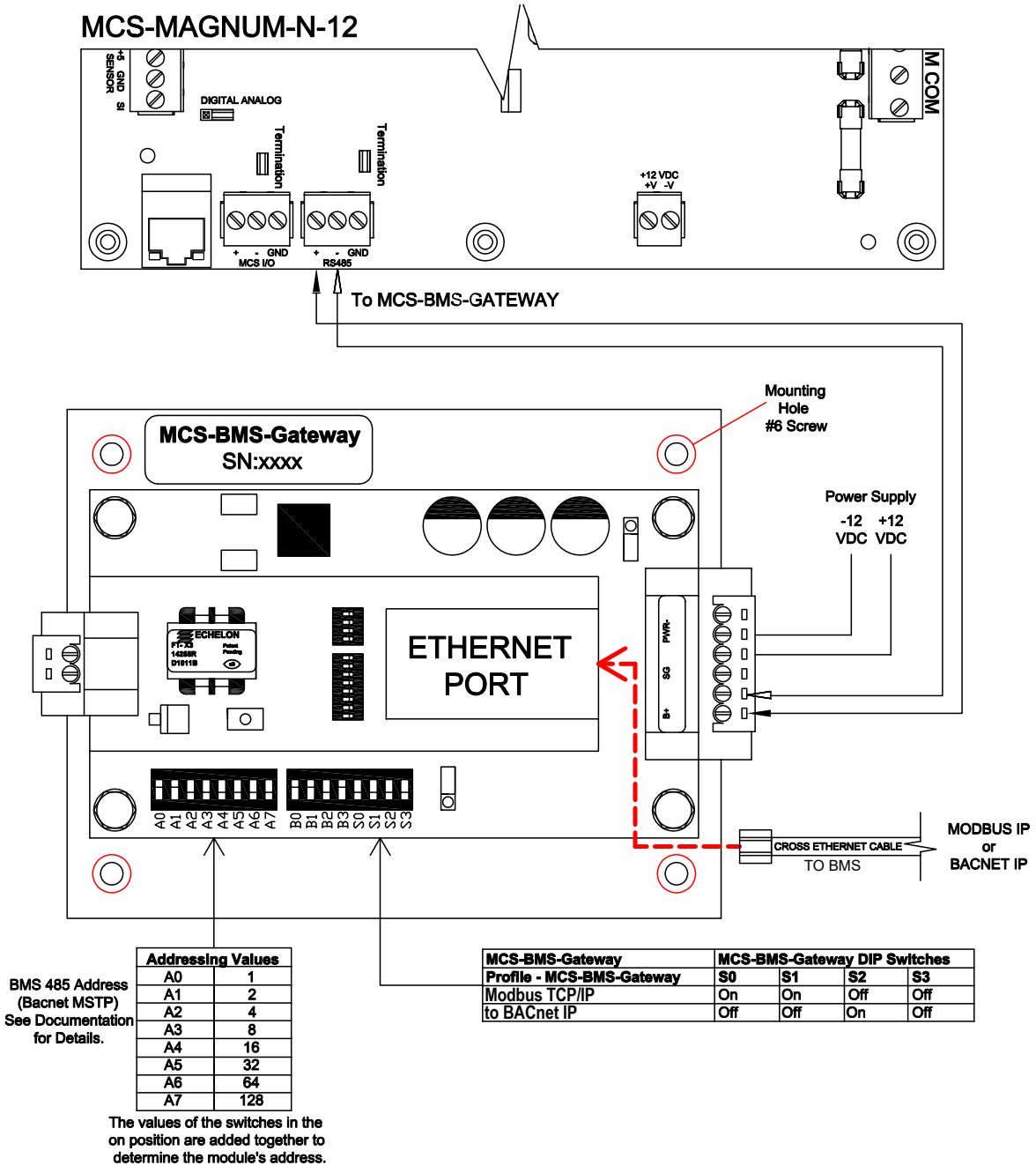
MCS Network Protocol Support		
	MAGNUM	**MicroMag**
BACnet IP	MCS-BMS-Gateway	MCS-Bacnet-Router2
Modbus IP	MCS-BMS-Gateway	MCS-BMS-Gateway
MCS IP	✓	MCS-Ethernet-RS485
Modbus RTU	✓	✓
MCS 485	✓	✓
BACnet MS/TP	MCS-BMS-Gateway	✓
Johnson N2	MCS-BMS-Gateway	MCS-BMS-Gateway
LonTalk	MCS-BMS-Gateway	MCS-BMS-Gateway

Chapter - 35. WIRING MCS-BMS GATEWAY

WIRING BACnet IP OR MODBUS IP TO BMS OVER ETHERNET

In this configuration the MCS-BMS-GATEWAY provides Ethernet RJ45 Cat5 connection to the BMS using BACnet IP or Modbus IP.

The MCS-BMS-GATEWAY in this configuration connects to the MCS-MAGNUM RS485 port, using MODBUS RTU protocol with baud rate of 9600, Modbus slave 1.



BMS 485 Address (Bacnet MSTP) See Documentation for Details.

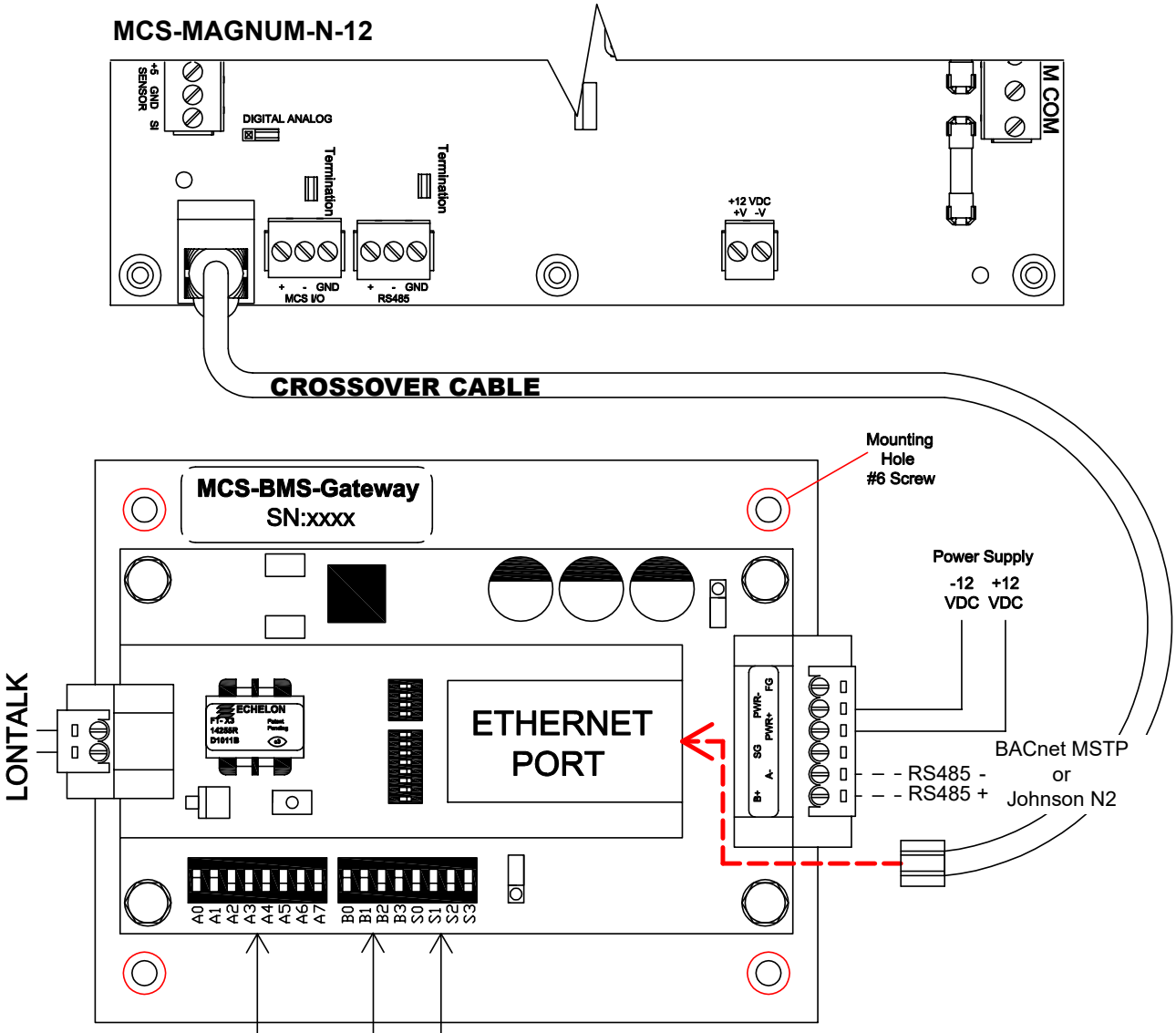
Addressing Values	
A0	1
A1	2
A2	4
A3	8
A4	16
A5	32
A6	64
A7	128

The values of the switches in the on position are added together to determine the module's address.

MCS-BMS-Gateway	MCS-BMS-Gateway DIP Switches			
Profile - MCS-BMS-Gateway	S0	S1	S2	S3
Modbus TCP/IP	On	On	Off	Off
to BACnet IP	Off	Off	On	Off

Wiring BACnet MSTP, Johnson N2, or LonTalk to BMS

In this configuration the MCS-BMS-GATEWAY provides a RS485 port for BACnet MSTP or Johnson N2 and uses the port for LonTalk as shown in the drawing below.
The MCS-BMS-GATEWAY in this configuration connects to the MCS-MAGNUM using a Ethernet RJ45 Cat5 connection talking BACnet IP.



BMS 485 Address (Bacnet MSTP) See Documentation for Details.

Addressing Values	
A0	1
A1	2
A2	4
A3	8
A4	16
A5	32
A6	64
A7	128

The values of the switches in the on position are added together to determine the module's address.

MCS-BMS-Gateway	MCS-BMS-Gateway DIP Switches			
Profile - MCS-BMS-Gateway	S0	S1	S2	S3
LonWorks	Off	Off	Off	Off
Bacnet MSTP	On	Off	Off	Off
Johnson N2	Off	On	Off	Off

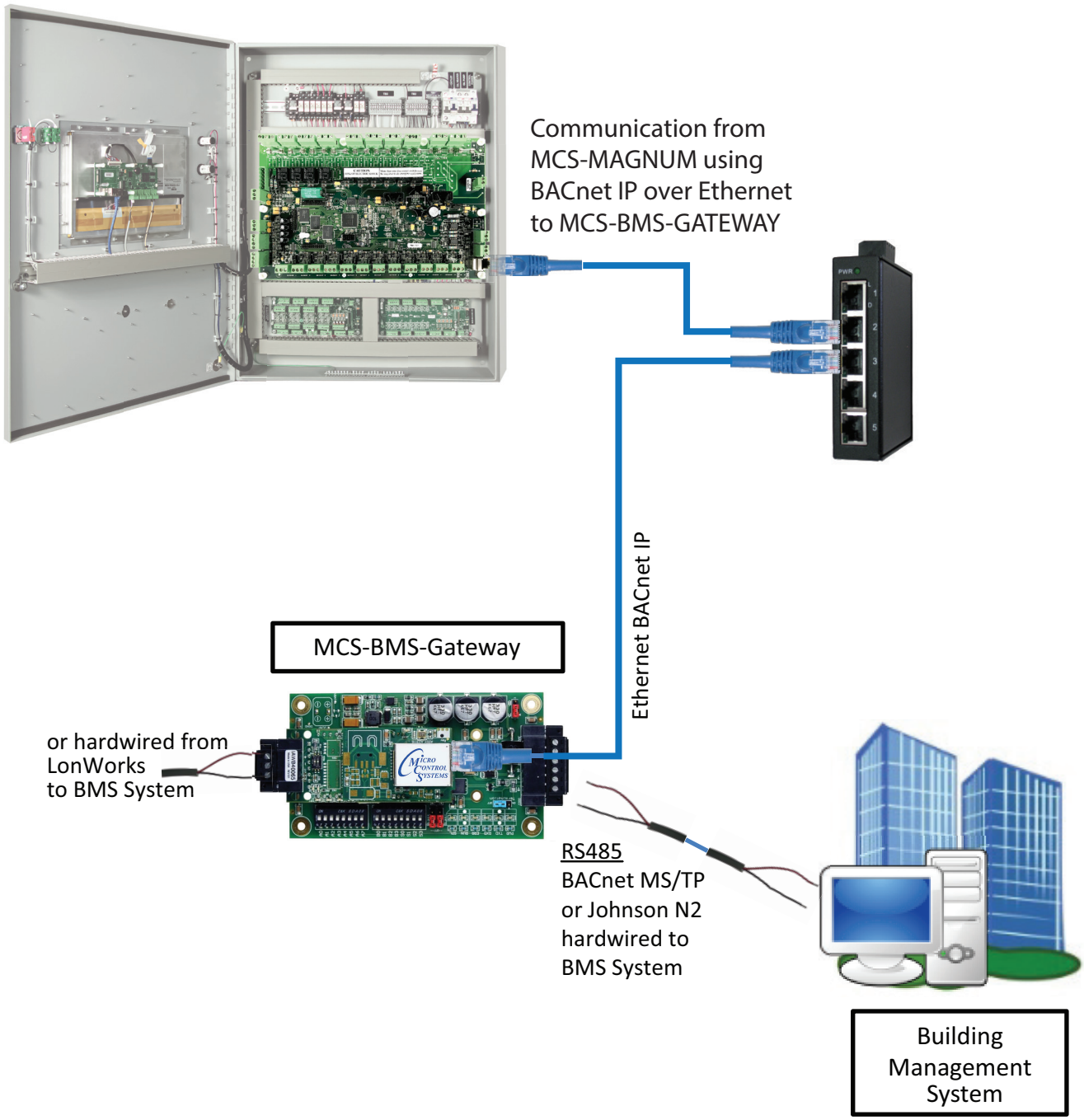
Baud	B0	B1	B2	B3
Auto	Off	Off	Off	Off
9600	On	On	On	Off
19200	Off	Off	Off	On
38400	On	On	Off	On
76800	On	Off	On	On
115200	Off	On	On	On

MCS-BMS-GATEWAY Wiring Diagram S:Products/MCS-BMS-GATEWAY/Drawings 7-19-2023-dew

35.1. EXAMPLE NETWORK

35.1.1 Standalone MCS-Magnum (using Modbus RTU Protocol)

- MCS INDUSTRIAL CONTROL PANEL with a MCS-MAGNUM controller using an Ethernet cable to communicate to the MCS-BMS-GATEWAY over BACnet IP.
- MCS-BMS-GATEWAY hardwired to BMS Management System using:
  1. BACnet MS/TP protocol or
  2. Johnston N2 protocol or
  3. LonTalk protocol using the LonWorks port



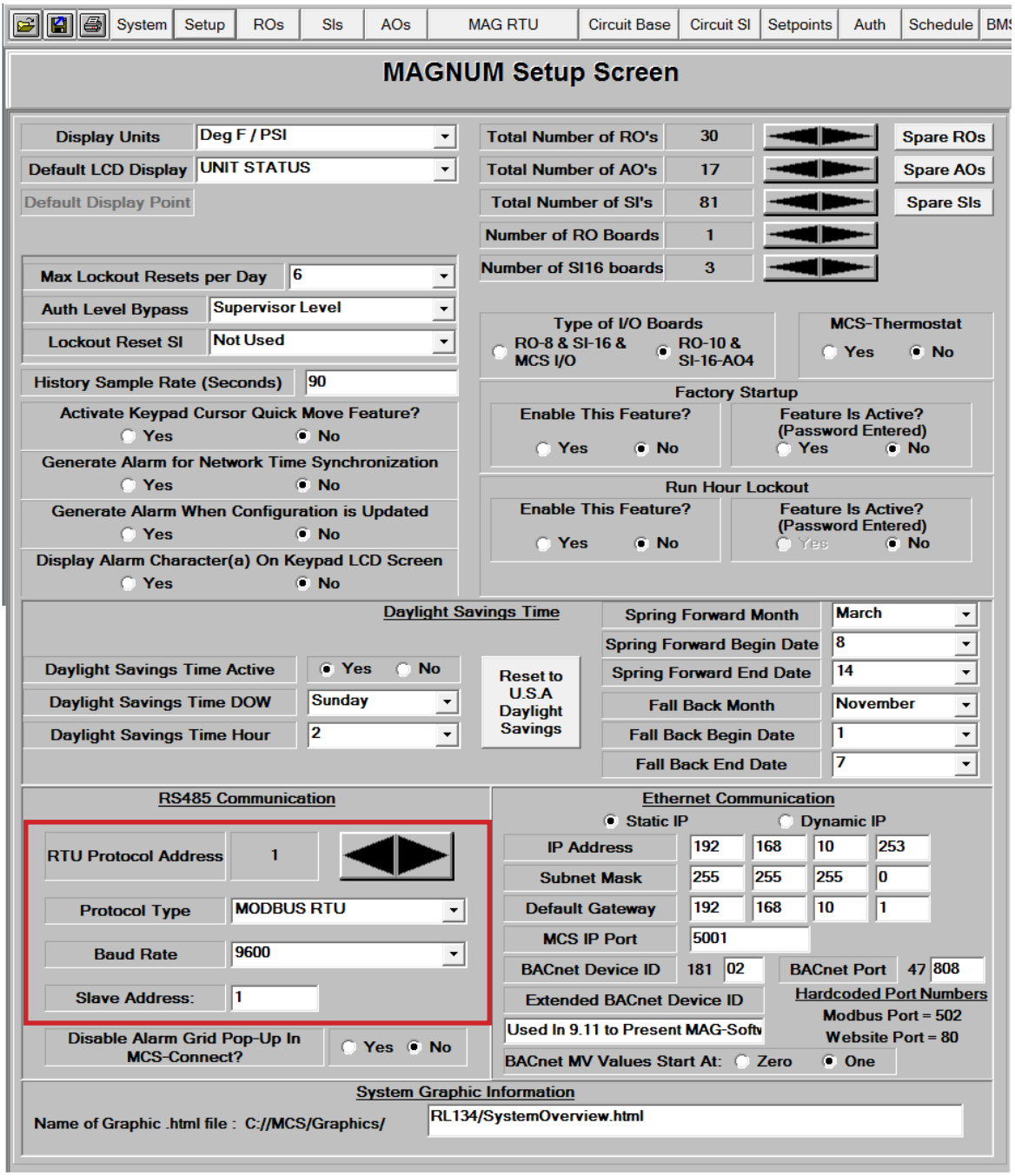
Chapter - 36. MODBUS RTU

Modbus RTU is supported directly by the Magnum using the RS485 port.

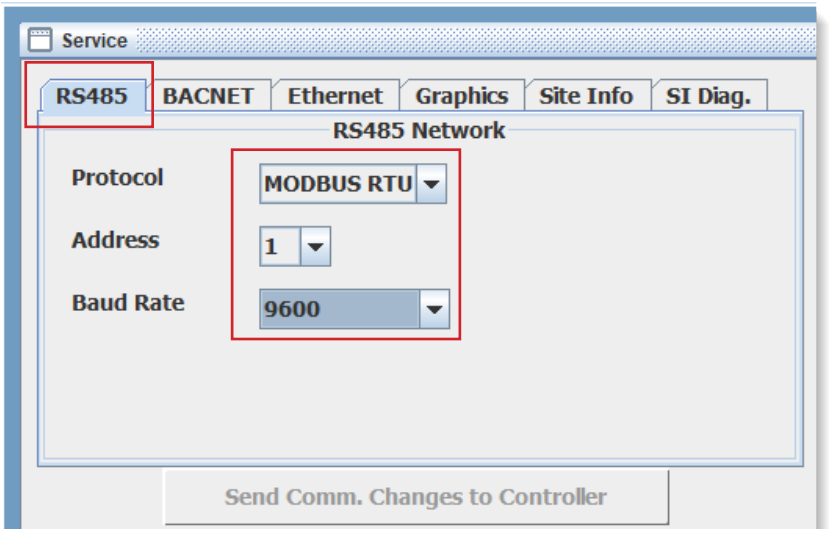
Please note this is the same port you plug into the RS232, so if using Modbus RTU you cannot plug you laptop into RS232 port on the older keypad.

Please note the RS485 follows industry standard, two wire twisted pair in shielded cable.

36.1. Setup the Modbus from MCS-Config's Magnum Setup Screen(see below):

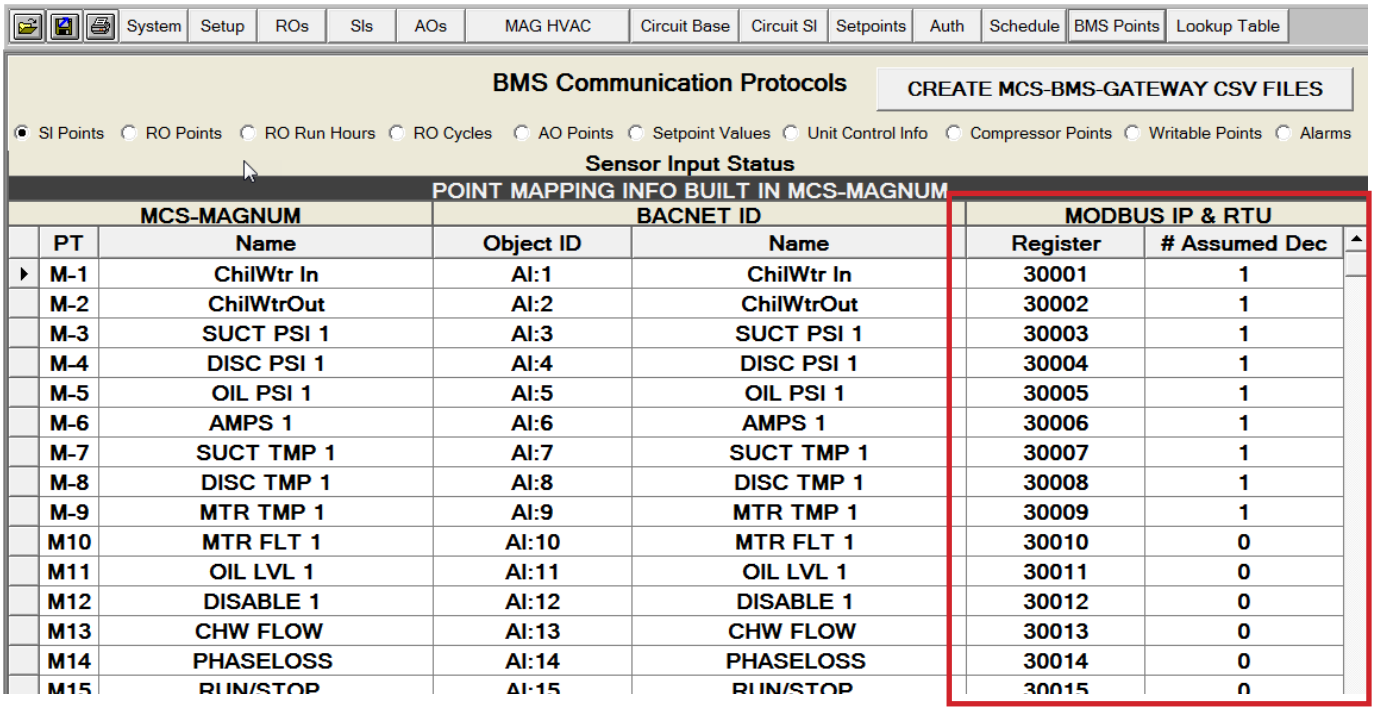


36.2. From MCS-CONNECT's Service Window RS485 tab (see below):



36.3. From Magnum LCD/Keypad(see below):

36.4. In MCS-CONFIG you can see & print a list of the Modbus Registers (see below):



MCS-MAGNUM		BACNET ID		MODBUS IP & RTU	
PT	Name	Object ID	Name	Register	# Assumed Dec
M-1	ChilWtr In	AI:1	ChilWtr In	30001	1
M-2	ChilWtrOut	AI:2	ChilWtrOut	30002	1
M-3	SUCT PSI 1	AI:3	SUCT PSI 1	30003	1
M-4	DISC PSI 1	AI:4	DISC PSI 1	30004	1
M-5	OIL PSI 1	AI:5	OIL PSI 1	30005	1
M-6	AMPS 1	AI:6	AMPS 1	30006	1
M-7	SUCT TMP 1	AI:7	SUCT TMP 1	30007	1
M-8	DISC TMP 1	AI:8	DISC TMP 1	30008	1
M-9	MTR TMP 1	AI:9	MTR TMP 1	30009	1
M10	MTR FLT 1	AI:10	MTR FLT 1	30010	0
M11	OIL LVL 1	AI:11	OIL LVL 1	30011	0
M12	DISABLE 1	AI:12	DISABLE 1	30012	0
M13	CHW FLOW	AI:13	CHW FLOW	30013	0
M14	PHASELOSS	AI:14	PHASELOSS	30014	0
M15	RUN/STOP	AI:15	RUN/STOP	30015	0

The Magnum Modbus RTU setting allow you to specify the Modbus Slave address, Modbus Baud rate (4800, 9600, 19200, 38400, 57600 are supported).

The number data bit is 8, stop bit is 1 and parity is none (these parameter are not adjustable).

The sensors inputs are 16 bit signed values. (Read input Registers, Function code = 4)

- The analog sensor inputs values typically have 1 assumed decimal place, meaning a value of 12.3 will be transmitted as value 123. The # of decimal point depending on the sensor type define in the Magnum CONFIG. Most sensor types are 1 decimal place.

But take care there are a few 2 decimal and a few zero decimal place types.

The BMS point list has a column which indicates how many assumed decimal are contained in the value.

- The digital sensor inputs values will be 0 or 1, 0 = off and 1 = on.

The analog outputs are 16 bit signed values. (Read Input Registers, Function code = 4)

- The analog output have 1 assumed decimal place, meaning a value of 12.3 will be transmitted as value 123.

The relay outputs are 16 bit packed values. (Read Coil Status , Function code = 1)

- Each bit within the 16 bits can contains a relay output. A bit value of 0 = relay off, 1 = relay on.

The number of packed bit depends on the requesting Modbus message.

If only one coil is asked for, then only bit 0 will contains a relay status value and bit 1 thru 7 are do not care.

If two relays are asked for, then bit 0 and bit 1 will contains values and bit 2 thru 7 are do not care.

The setpoints are 16 bit signed values. (Read Holding Registers, Function code = 3)

- The setpoints values typically have 1 assumed decimal place, meaning a value of 12.3 will be transmitted as value 123.

The # of decimal point depending on the setpoint type defined in the Magnum CONFIG.

36.5. Modbus Fault Sensors

If using a MCS-MODBUS I/O to connect a slave to the MCS-MAGNUM for reading register alarms, you need to setup the 'Sensor Input Information' **'CIRCUIT INDEX'** column to point to the circuit number the Modbus fault sensor belongs to.

The MCS-Magnum supports several special Modbus fault sensor types for reading multiple alarms from one Modbus register. The following are Modbus Fault sensor types:

1. DBCENT1
2. DBCENT2
3. DBCENT3
4. DanFltHi
5. DanFltLo
6. DanFlt2Hi
7. DanFlt2Lo
8. DWarHi
9. DWarLo
10. DWar2Hi
11. DWar2Lo
12. BitFltHi
13. BitFltLo
14. RKNG F1
15. RKNG F2
16. RKNG F3
17. RKNG F4
18. TurboCorFault

Chapter - 37. RTU Unit and Compressor State Chart

BMS Points Unit State Chart		
State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	UNIT IN POWER UP
1	2	POWER LOSS DELAY
2	3	NO RUN- I/O LOST
3	4	UNIT IN LOCKOUT
4	5	UNIT IS OFF
5	6	UNIT IS HOLDING
6	7	UNIT UNLOADING
7	8	UNIT IS LOADING
8	9	OFF-SMOKE ALARM
9	10	RUN/STOP SW OFF
10	11	SCHEDULED OFF
11	12	OFF-NO FLOW(s)
12	13	OFF-WTR PSI FLOW
13	14	AMBIENT OFF
14	15	PROCESS HEAT OFF
15	16	UNIT IS UNLOADED
16	17	UNIT IS LOADED
17	18	RTU DEHUMID COOL
18	19	ECONOMIZER ONLY
19	20	SWITCHING MODES
20	21	UNIT SMOKE UNLDG
21	22	UNIT OFF UNLDING
22	23	UNIT DMD UNLDING
23	24	UNIT HEAT UNLDNG
24	25	UNLDING RUN CMPS
25	26	OPENING BYP VLV
26	27	CMP RAMPING UP
27	28	CLOSING BYP VLV
28	29	FACTORY STARTUP
29	30	MAXIMUM RUN TIME
30	31	NOT USED
31	32	OFF-FIRE ALARM
32	33	UNIT HEAT HOLDG
33	34	CMP SPD OPTIMIZE
34	35	UNUSED STATE
35	36	RS-STARTING COMP
36	37	RS-LOADING
37	38	RS-HOLDING
38	39	UNIT OFF CTRL SI

BMS Points Unit Mode Chart		
State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	COOLING MODE
1	2	ICE MAKING MODE
2	3	HEATING MODE
3	4	DEHUMID MODE
4	5	VENT ONLY
5	6	DEHUMID MODE
6	7	OFF
7	8	SWITCHING MODES
8	9	COOLING WHEAT

BMS Points RTU Building Mode Chart		
State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	OCCUPIED
1	2	UNOCCUPIED
2	3	OVER RIDE
3	4	WARM UP

BMS Points RTU Building Control States Chart		
State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	HIGH
1	2	NORMAL
2	3	LOW
3	4	SMOKE
4	5	OFF

BMS Points RTU State Chart		
State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	PowerUpDelay
1	2	MCS IO FAILED
2	3	UNIT IN LOCKOUT
3	4	OFF SMOKE ALARM
4	5	OFF NO AIR FLOW
5	6	OFF RUN/STOP
6	7	EVAP FAN ONLY
7	8	COOLING STATE
8	9	HEATING STATE
9	10	DEHUMID STATE
10	11	SWITCHING STATE
11	12	OFF FIRE ALARM
12	13	SMOKE PURGE
13	14	WARM UP
14	15	SCHEDULED OFF

BMS Points RTU Heat State Chart		
State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	NOT USED
1	2	OFF HIGH AMB
2	3	DISABLED
3	4	OFF
4	5	LOADING
5	6	UNLOADING
6	7	HOLDING
7	8	HOLD FOR IGN
8	9	HOLD MG START
9	10	LOADED
10	11	UNLOADED
11	12	OFF NO FLOW
12	13	LOADG RECLAIM
13	14	HOLD RECLAIM
14	15	UNLODG RECLAIM
15	16	LOADED RECLAIM

BMS Points RTU Heat Stage States		
State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	NOT USED
1	2	MOD OFF READY
2	3	MOD ANTI-CYCLE
3	4	MOD ON
4	5	MOD HOLD IGN
5	6	MOD HLD WARMUP
6	7	STEP OFF READY
7	8	STEP OFF TIME
8	9	STEP ON
9	10	STEP HOLD IGN
10	11	SAFETY NO IGN
11	12	LOCKOUT NO IGN
12	13	OFF
13	14	LOADING
14	15	UNLOADING
15	16	LOADED

BMS Points RTU Energy Recovery Wheel		
State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	OFF
1	2	ON
2	3	DEFROST
3	4	NONE
4	5	CLEAN

RTU Compressor State Chart

State #	State #	
MCS & Modbus	BACnet	State Text/Name
0	1	LOST IO LOCKED
1	2	CMP LOCKED OUT
2	3	SWITCHED OFF
3	4	UNLD & PMPDWN
4	5	CMP ANTICYCLE
5	6	CMP OFF/READY
6	7	OIL PMP LUBING
7	8	CMP IN STARTUP
8	9	CMP UNLOADED
9	10	CMP UNLD STEP1
10	11	CMP UNLD STEP2
11	12	CMP IS HOLDING
12	13	CMP IS LOADING
13	14	CMP IS UNLDING
14	15	CMP IS RUNNING
15	16	FAST UNLOADING
16	17	LO SUCT UNLOAD
17	18	LO SUCT HOLD
18	19	HI DISC UNLOAD
19	20	HI DISC HOLD
20	21	SAFETY TRIPPED
21	22	LO TEMP UNLOAD
22	23	LO TEMP HOLD
23	24	HI AMP HOLD
24	25	HI DIS TMP HLD
25	26	CMP IS AT 40%
26	27	CMP IS AT 70%
27	28	HI WATER HOLD
28	29	EXTRA 70% STEP
29	30	OFF-LO OIL TMP
30	31	HI AMP UNLDING
31	32	DEF PREPMP OUT
32	33	DEFROSTING
33	34	DEF PUMP DOWN
34	35	HI TEMP UNLOAD
35	36	HI TEMP HOLD
36	37	SCROLL STEP 1
37	38	SCROLL STEP 2
38	39	SCROLL STEP 3
39	40	SCROLL STEP 4
40	41	ON OIL RECOVRY
41	42	WAIT P-RATIO
42	43	CMP GROUP OFF
43	44	CLOSING VANES
44	45	TimingVaneOpn
45	46	TimingVaneCls
46	47	SURGE HOLD
47	48	OIL REC SPD UP
48	49	OIL REC OFF
49	50	OIL REC BOOST
50	51	VFD TANDEM OFF

Chapter - 38. Setpoints Used By RTU Software

New setpoint types and additional fields have been activated to expand the individual setpoint capabilities. The fields that are displayed for the type of setpoint can also be changed via MCS Connect or from the Magnum keypad with the proper authorization.

38.1. SETPOINT Types

1. **SETPOINT** (standard setpoint value)

Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Night Setback	MIN VFD Opening	MAX VFD Opening	MAX VFD Adjustment	BMS Writeable (Click Here to Disable All)
Setpoint	...	—	—	—	—	—	—	—	—	—	☐

allows the setpoint value to be viewed and changed.

2. **ALARM or LOCKOUT** (produce either an alarm of lockout condition)

Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Night Setback	MIN VFD Opening	MAX VFD Opening	MAX VFD Adjustment	BMS Writeable (Click Here to Disable All)
Lockout	...	60	0	0	—	—	—	—	—	—	☐

Allows the value, safety time, Sec. to Ignore Safety, Window to Ext and Safety Ext fields to be viewed and changed.

3. **TIME** (time field can now be viewed)

Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Night Setback	MIN VFD Opening	MAX VFD Opening	MAX VFD Adjustment	BMS Writeable (Click Here to Disable All)
Time	...	—	—	—	—	—	—	—	—	—	☐

Allows the value and time to be viewed and changed.

4. **TARGET** (create a target with a control zone)

Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Night Setback	MIN VFD Opening	MAX VFD Opening	MAX VFD Adjustment	BMS Writeable (Click Here to Disable All)
Target	...	—	—	—	0.01	0.01	0	—	—	—	☐

Allows the value (target), time, Hi Zone (added to value for high zone), Low Zone (subtracted from the value for the low zone) and Night Setback (change to the value if night set back occurs). These fields will contain the same number of decimals as value fields.

5. **ADJUST** (maximum adjustment & minimum and maximum opening %)

Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)	High Zone	Low Zone	Night Setback	MIN VFD Opening	MAX VFD Opening	MAX VFD Adjustment	BMS Writeable (Click Here to Disable All)
Adjust	...	—	—	—	—	—	—	10	100	5	☐

Allows the value (adjustment), time, MIN VFD Opening, MAX VFD Opening, and MAX VFD Adjustment. These fields will contain the same number of decimals as value fields

Chapter - 39. RTU Setpoints

IMPORTANT: REVIEW SETPOINT USAGE, TYPE PLUS THE ADDITIONAL FIELDS!

#	Name	Type	Description
1	CTL TARGET	TARGET	Control target. This value is used as the base to develop the Control Zone when the unit is in a cooling mode. Refer to setpoints #2 and #3. The control target is used with the control zone and rate of change of the controlling sensor to determine required action for the Magnum. The controlling sensor is usually one of the following: Leaving Temperature – Most common used as a target, fitting for most applications. Return Temperature – Used in sites with large air masses, ice rinks, common areas, etc. Suction Pressure – Used in continuously running process systems. If unoccupied state is used, when the system is in unoccupied mode the value in the Night Setback cell is added to the control target. Low Zone – Offset to target that will prevent the unit from exiting Economizer mode. Controlling air temp must fall below the target minus the value in the low zone cell.
2	CTL ZONE +	SETPOINT	Added to the CTL TARGET to create the upper limit of the control zone.
3	CTL ZONE -	SETPOINT	Subtracted from the CTL TARGET to create the lower limit of the control zone.
4	HGS TEMP ON	SETPOINT (TIME)	This setpoint is used with compressors with a hot gas bypass solenoid to provide temperature control for turning on the solenoid. When this setpoint is active and the control temperature is less than the CTL TARGET plus the value in this setpoint and there is at least one compressor running in this suction group or the FLA % is within the slide percentage offset (refer to Time cell of this set point) of setpoint #31 “MIN SLIDE%”, the hot gas bypass solenoid for the compressor will be turned on. **‘Time (sec)’** field: Contains the minimum slide percentage offset to enable the HGB. If non-zero, this value is added to setpoint #31 “MIN FLA%” to determine the range in which to enable the HGB. If zero, then the default value of 20 is added. **For example**, if this value is 10, then the HGB will enable when the compressors FLA% is within 10% of setpoint #31 “MIN FLA%”. See setpoint #31 on how to setup as a target type to get the hardcoded 20% out of the way.
5	HGS TEMP OFF	SETPOINT (TIME)	This setpoint is used with compressors with a hot gas bypass solenoid to provide temperature control for turning off the solenoid. When this setpoint is active and the control temperature is greater than the CTL TARGET plus the value in this setpoint and there is at least one compressor running in this suction group or the FLA % is not within the slide percentage offset (refer to Time cell of this set point) of setpoint #31 “MIN SLIDE%”, the hot gas bypass solenoid for the compressor will be turned off. **‘Time (sec)’** field: Contains the minimum slide percentage offset to disable the HGB. If non-zero, this value is added to setpoint #31 “MIN FLA%” to determine the range in which to disable the HGB. If zero, then the default value of 30 is added. For example, if this value is 15, then the HGB will disable when the compressors FLA% is 15% or more above setpoint #31 “MIN FLA%”. See setpoint #31 on how to setup as a target type to get the hardcoded 20% out of the way.

6	HGS PSI ON	SETPOINT	This setpoint is used with compressors with a hot gas bypass solenoid to provide pressure control for turning on the solenoid. When this setpoint is active and the suction pressure is less than the value of this setpoint and the FLA % **is within offset** of setpoint #31 “MIN SLIDE%”, the hot gas bypass solenoid for the compressor will be turned on. (refer to setpoint #4)
7	HGS PSI OFF	SETPOINT	This setpoint is used with compressors with a hot gas bypass solenoid to provide pressure control for turning off the solenoid. When this setpoint is active and the suction pressure is greater than the value of this setpoint or the FLA % **is not within** 25% of the setpoint #31 “MIN SLIDE%”, the hot gas bypass solenoid for the compressor will be turned off. (refer to setpoint #5)
8	L.INJECT.ON	TARGET	This setpoint can be used for both liquid injection solenoids. (These must be specified in the Liquid Injection column of the Circuit Base screen.) If active and type is TARGET: The adjustment multiplier is the value in the High Zone cell. The adjustment divisor is the value in the Low Zone cell. Else: The adjustment multiplier is fixed at 3. The adjustment divisor is fixed at 2. Value: Liquid injection is turned on when the discharge temperature is greater than or equal to this setpoint, and is turned off when the discharge temperature is less than this setpoint minus 10.0°F (5.5°C). If the controlling SUPER HEAT is 3x its target, LIQ INJ is turned ON and remains ON until the controlling SUPER HEAT falls below 2x its target. u(If you change the setpoint to a target type, the High Zone cell if not zero will be the ON multiplier and the Low Zone sell if no zero will be the OFF multiplier.) ‘Time (sec)’ field: If the first liquid injection solenoid has been on for a time greater than this value, then turn on the second liquid injection solenoid.
9	SPRHT TARGET or LEVEL TARGET	SETPOINT (TIME)	If EXV control is based upon superheat, this is the Superheat target that the Magnum will control from. If EXV control is based upon refrigerant level, this is the refrigerant level target that the Magnum will control from. ‘Time (sec)’ field: Seconds between samples used for calculating the Superheat Rate of Change.
10	SPRHT ZONE +-	SETPOINT (TIME)	The value in this setpoint is added and subtracted to setpoint #9 to determine the upper and lower limits of the control zone respectively. ‘Time (sec)’ field: If non-zero, skip ROC adjustment logic in the control zone.
11	EXV LOAD ADJ	SETPOINT	The opening adjustment that will be made to the EXV percentage when the circuit changes to the Loading state or the closing adjustment that will be made when the circuit changes to the Unloading state. Note: In MOP hold state, only closing adjustments are allowed. Safety time cell, this value will act as a multiplier to the value of this setpoint… this will increase the “load” jump when we’re ramping up the compressor AO for a reheat flush. If not used, it will only jump the valve the Value… which could be too little when jumping the compressor 10% every 3 seconds. With the multiplier, a value of “.2” for normal load adjusts, and a “5” in the Time field.. will jump the valve 1% every time the AO is jumped, this will keep the valve consistent with the amount we’re jumping the compressor by. Obviously, it’ll need to be fine-tuned in the field. This is for STANDARD superheat control only, FAST superheat needs no multiplier (it responds quick enough normally)
12	EXV FINE ADJ	SETPOINT	The adjustment is made when in the 1st zone above or below the control zone.

13	EXV COURSE	SETPOINT	This adjustment is made when in the 2nd zone above or below the control zone and the adjustments are made in 1/2 the time. When above or below the 2nd control zone the adjustments are made in 1/4 the time.
14	EXV LOAD DIV	SETPOINT	As the Amp draw % changes this divides the EXV % change. It is calculated as follows: [(Max slide% – min slide%) / (Max vlv% - min vlv%)] +1
15	EXV MIN %	SETPOINT	This is the minimum valve position allowed when modulating the expansion valve. This value should be set so when hot gas is applied the valve opening is adequate.
16	EXV MAX %	SETPOINT	This is the maximum position allowed when modulating the expansion valve to maintain the superheat target. This value should be the valve % opening at full capacity plus a 10 to 15 % margin.
17	LO SUPERHEAT	SETPOINT	If the calculated superheat remains below this value for the time specified, the Magnum will generate a LOW SUPERHEAT alarm.
18	LOWSUCPSI DLY	SETPOINT	Delay in seconds when in 'Low Suction PSI Opening' between adjustments to the EXV valve.
19	EXV DELAY	SETPOINT	Delay in seconds between valve adjustments. Should not be less than 48. (When adjusting at 4x this will allow 12 seconds for the controller to process the results of the last action before making the next adjustment)
20	EXV STRT TIME	SETPOINT (TIME)	This is the time in seconds to hold the valve at the start % setpoint when the compressor starts. Since the superheat calculation is not valid when the compressor is not running the EXV logic sets the valve to a given position for a set time to allow the system to develop a valid superheat. 'Time (sec)' field: If zero, then there is no delay when a compressor is ready to start. If non-zero, this is the time delay in which the EXV valve is allowed to open before the compressor starts.
21	MAX TRG RESET	SETPOINT	This value is used to adjust setpoint #1 "CTL TARGET". The Sensor Input value will vary between 0 and 5 volts and the adjustment to the control target will be modulated from negative "MAX TRG RESET" to the positive "MAX TRG RESET" value.
22	LOW AMBIENT	SETPOINT	If the ambient temperature is below this value the system will be disabled the compressor(s) will be AMBIENT OFF. The unit will remain off until the ambient temperature rises above this setpoint value by 5.0F (2.5C).
23	POWERUP DELAY	SETPOINT	If this set point is active the value will be the time in seconds that the system will remain in the START UP state before moving to the next state. If inactive the startup delay will be 60 seconds. 'Time': When set to CPM control the time field now becomes the delay before defaulting to stand alone control on loss of communication from the CPM. This value can't be set below 30 seconds (hardcoded)
24	HI AMBIENT	SETPOINT	If active and the ambient temperature is above this value the system will be disabled the compressor(s) will be AMBIENT OFF. The unit will remain off until the ambient temperature drops below this setpoint value by 5.0F (2.5C).
25	STEP SENSTIY	SETPOINT	This value is used to adjust the rate of response to changes in the control algorithm. 1 is the fastest response, whereas higher numbers will mean a more gradual response.
26	STEP DELAY	SETPOINT (TIME)	Value: This is the time delay before making adjustments to the system capacity. Used only with the Magnum Control Zone control method. 'Time (sec)' field: If used, this will force a minimum time delay between any two compressor starts. This time delay is specified in the 'Minimum Delay Between Compressor Starts' box in the 'Cooling Info' panel under the MAG RTU screen.
27	MAX ROC -	SETPOINT	Maximum negative Rate of Change allowed before preventing the unit from loading. If the ROC is less than this value the capacity control state is set to HOLDING.

28	MAX ROC +	SETPOINT	Maximum positive Rate of Change allowed before preventing the unit from unloading. If the ROC is greater than this value the capacity control state is set to HOLDING.
29	ROC INTERV	SETPOINT	Seconds between samples used for calculating the Rate of Change. Used only with the Magnum Control Zone control method. (Maximum 60 seconds)
30	MAX FLA % or MAX VFD %	ALARM	Indicates the maximum amp draw or speed allowed. Usually set to 100%, else compressors will load to the value of this setpoint until all steps are on, and then the system will load to 100%. 'Time (sec)' field: If non-zero, then force individual compressors to stay at maximum capacity when another compressor starts. This option is selected in in the 'Keep Running Comp at 100% when starting next?' box in the 'Cooling Info' panel under the MAG RTU screen. 'SEC to Ignore Safety' field (Fully Loaded Screw Compressor logic): If non-zero, turn on the load solenoid every 5 min for 5 seconds when fully loaded. If zero, then do not turn on solenoid for 5 seconds every 5 minutes. 'SEC to Ignore Safety' field (Holding Screw Compressor logic): If non-zero, turn on the load solenoid every 5 min for 5 seconds when holding. If zero, then do not turn on solenoid for 5 seconds every 5 minutes.
31	MIN FLA % or MIN VFD %	SETPOINT (TIME)	Value: Indicates the minimum amp draw, slide %, digital scroll load%, or speed allowed (usually 40%). This is where the slide valve or VFD will be set when the compressor is turned on. This % is a function of actual amp draw relative to the FLA. 'Time (sec)' field: If used, this forces a time delay before unloading all running compressors before the next compressor is started. This time delay is specified in the 'Unload Compressor Before Starting Next' box in the 'Compressor Information' panel under the MAGNUM screen. Will Delay next compressor for this time after EVAP pump/valve is opened. Target: If this set point is setup as a target type the value in the night setback column will be added to the set point VALUE to allow safety unloading all the way down to this value. This replaces a hardcoded 20%. This is also utilized in conjunction with hotgas setpoints #4 and #5 on temperature.
32	MAX ADJUST %	SETPOINT (TIME)	Indicates the maximum percentage change that can be made to the slide valve or VFD. 'Time (sec)' field: A zero indicates that the calculated FLA will be used; else the value in setpoint #31 will be used when starting the next compressor. This value is specified in the 'Wanted FLA starting next Compressor' box in the 'Cooling Info' panel under the MAG RTU screen.
33	MIN ADJUST %	SETPOINT	Indicates the minimum percentage change that can be made to the slide valve or the VFD. For Fixed Step Compressors with adjustable speed AO's when returning to 100% after shutting down another compressor, this setpoint will be the percent of adjustment along with setpoint #56 "PULSE DELAY" which is the time frame between capacity adjustments.
34	SLIDE SENSITY	SETPOINT	This controls the sensitivity of the adjustment made to the Wanted Percentage (adjustments are relative to the difference between the current control sensor and target). The larger the value the larger the adjustment (usually 1).

35	Humidity Target	TARGET	Required if Humidity option is specified as other than 'Not Used'. Value: Humidity target. Safety time: Not used High zone: added to value to create the top of zone. Lo zone: subtracted from value to create the bottom of zone. Night setback: if the control value is greater than the value plus the night setback, the humidity control will be off.
36	Humidity Adjustment	DELAY	Required if Humidity option is specified as other than 'Not Used'. Value: Maximum adjustment to humidifier valve. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening.
37	LOAD PULSE	SETPOINT (TIME)	Length of time to engage the slide valve load solenoid in tenths of a second (usually between 1 and 9). 'Time (sec)' field: If non-zero, use this value as a multiplier to increase the load pulse when the compressor's amp draw is more than three times the value of setpoint #36 "AMP DB LO". 'SEC to Ignore Safety' field: If zero, then use delay between pulses. If non-zero, then no delay between pulses when the compressor's amp draw is more than twice the value of setpoint #36 "AMP DB LO" away from the wanted FLA.
38	UNLOAD PULSE	SETPOINT	Length of time to engage the slide valve unloads solenoid in tenths of a second (usually between 1 and 9).
39	LUBE OIL TMP	SETPOINT (TIME)	The oil must reach this temperature before the system will move out of the LUBE state. If the oil temperature is below this value before the compressor begins its startup sequence, the circuit will be placed in the OFF-LO OIL TMP state. 'Time (sec)' field: If in LUBE state, the compressor type is centrifugal, and this field is equal to 0 then the calculated oil temperature shut down is the saturated suction temperature plus the value of this setpoint, else it is simply the value of this setpoint. This option is selected in in the 'Lube State Oil Setpoint' box in the ''Cooling Info' panel under the MAG RTU screen.
40	LUBE OIL PSI	SETPOINT	The oil must reach this pressure differential between low and high oil pressure before the circuit will move out of the LUBE state.
41	LUBE DELAY	SETPOINT	This is the maximum time that a compressor can be in the LUBE state. When this time is exceeded, an alarm is generated and the compressor is locked out. Both the oil temperature and pressure must be satisfied before the LUBE state will be exited. Refer to the OIL PMP LUBING state.
42	HI WATER TMP	SETPOINT	If active, the control sensor's value will be compared to the value of this setpoint. If it exceeds this temperature for the time specified in the ''Time (sec)' field' a HI WATER TMP alarm will be generated. No lockouts will occur. This alarm will repeat if the control value drops .5° below this setpoint and then rises above it again.
43	CENT P-DWN FLA	SETPOINT	Only used with variable compressors. If active, this will be the thresh-old for ending the pump down state, number of amps. If the Setpoint is inactive then the FLA Setpoint for that compressor will be used.

44	PRE-HEAT MUL/DIV	TARGET	Value: Multiply adjustment for the AO opening. Safety time is NOT USED. High Zone cell is the multiply adjustment for the time delay between making adjustments. Low Zone cell is the divisor adjustment for the time delay between making adjustments. Night Setback cell is the divisor adjustment for the AO opening.
45	CND STG1 ON *(RO Type)*	SETPOINT	When the discharge pressure is above this value, turn on the first stage of the condenser fans. 'Time (sec)' field: (Applies to compressors with shared condensers) If non-zero, then the compressor in startup state will not be in sole control of the condenser fans, it will control off of highest discharge pressure. If zero, then compressor in startup will have sole condenser control for 5 minutes. This option is selected in the 'Newly started Comp Controls Common Fan Bank' box in the 'Condenser Information' panel under the MAGNUM screen. When in dehumidification mode, night setback cell of Setpoint #45 is used to add a offset value to the discharge pressure target for the condenser logic and this Setpoint needs to be a TARGET type.
	PID MOD Individual PID Step Common	SETPOINT	If active, multiplier uses PID condenser control KP (Proportional). Set-up as setpoint.
46	CND STG1 OFF *(RO Type)*	SETPOINT	If stage 1 of condenser capacity is on and the discharge pressure drops below this value, then turn this stage off.
	PID MOD Individual PID Step Common	SETPOINT	If active, uses Multiplier for Ki adjustments (Integral Time Delay). Setup as setpoint
47	CND DIFF ON *(RO Type)*	SETPOINT	Differential pressure added to setpoint #45 to set the threshold at which each additional stage of condenser capacity will turn on.
	PID MOD Individual PID Step Common	Target	If active, uses Multiplier for Kd adjustments, (ROC Time Delay). Setup as Target.
48	CND DIFF OFF *(RO Type)*	SETPOINT	Differential pressure added to setpoint #46 to set the threshold at which each additional stage of condenser capacity will turn off.
	CND ADJ DELAY *(Modulate)*	SETPOINT	If active this is the time in seconds between condenser adjustments to the AO. If inactive, then 30 seconds will be used as the delay. If type is DELAY: (required for condenser relay delays). -MIN VFD Opening cell contains the time delay between turning on a relay and moving the AO to its minimum position (setpoint #52). -MAX VFD Opening cell contains the time delay between turning off a relay and moving the AO to 100%.
	DUAL PSI DELTA *(Dual V8)*	SETPOINT	Minimum difference in pressure before the second stage of condenser capacity can be started.
49	CND MIN RUN *(RO Type)*	SETPOINT	Once a condenser stage has been turned on, it will remain on for at least the amount of minutes specified in this setpoint.
	DUAL TIME DELAY *(Dual V8)*	SETPOINT	Time delay once the pressure difference in setpoint #48 has been reached before the second condenser stage can be started.
	CND START % *(Modulating Type)*	SETPOINT	If active, then the value is the starting % for the AO when the RO that is tied to it turns on. The value in the "Time (SEC)" cell is the AO starting stage. If no Relays are used when CMP starts set value.
50	CND TRGT *(Modulating Type)*	SETPOINT	Target logic will try to maintain modulating the AO. **SP must be set up as target type** and use the Hi/Low zones for the target control zone. **If target type in Heat Pump mode, setback is added to target.**

	LO AMB SUMP OFF *(RO Type)*	SETPOINT	If active and ambient temperature is less than the value of this setpoint, then the sump pump relay will be locked off if it is the starting condenser Relay Output. When the ambient temperature rises above the value of this setpoint plus two times the value in setpoint #192 “FRZ TEMP DIFF” if active (hardcoded 15°F if inactive), then the sump pump relay will be allowed on again.
51	CND ADJ DIV *(Modulating Type)*	SETPOINT	Controls scaling of the amount the AO is adjusted (usually 1). The larger the number the smaller the AO adjustment as the adjustment will be divided by this value.
	CND VFD MIN	SETPOINT	If there is a VFD associated with the condenser, this is the starting minimum speed. ‘Time (sec)’ field: This field contains the condenser stage that must be on before the VFD is modulated.
52	CND MIN % *(Modulating Type)*	SETPOINT	Minimum AO % allowed. If compressor is off, then check the “Time (SEC)” field: If 0, then the AO % will be set to the value of this setpoint. If 2 and the run/stop is set to run, then set the AO % to 100%, else set the AO % to 0%. This option is selected in the “Default Valve Opening % when Comp. is OFF” box in the condenser information section in the MAG HVAC screen.
53	CND ROC- *(Modulating Type)*	SETPOINT	Maximum negative rate of change allowed. If the rate of change is less than this setpoint, then stop modulating the AO. The absolute value of this setpoint also serves as the maximum positive rate of change allowed. If the rate of change is greater than the absolute value of this setpoint, then stop modulating the AO.
54	CND MIN SPD *(RO Type)*	SETPOINT	Minimum speed percentage for variable speed condenser control.
	CND ADJ MULT *(Modulating Type)*	SETPOINT	Controls the scaling of the amount the AO is adjusted. The larger the number the larger the AO adjustment as the adjustment will be multiplied by this value.
55	CND MAX SPD *(RO Type)*	SETPOINT	Maximum speed percentage for variable speed condenser control.
	CND MIN ADJ *(Modulating Type)*	SETPOINT	The value in this setpoint is the minimum % the AO will be modulated when a change is made.
56	PULSE DELAY	SETPOINT (TIME) (TARGET)	Used with variable capacity screws. The number of seconds between load or unload pulses (Usually between 3 and 5. Allows load change to be checked before next pulse and eliminates oil foaming when unloading too fast). ‘Time (sec)’ field: If used, this is the fast unloading state time delay. This option is selected in in the ‘Fast Unload Delay’ box in the ‘Compressor Information’ panel under the MAG V8 screen. For Fixed Step Compressors with adjustable speed AO’s when returning to 100% after shutting down another compressor, this setpoint will be the time frame between capacity adjustments along with setpoint #33 “MIN ADJUST %” which is the percent of adjustment. Target: When using reheat flush with a VFD compressor this must be a **target type setpoint** and it will control the ramping of the compressors AO when entering a reheat flush cycle. The high zone will be the divider of the value. Example: If you have a 20% for the night setback in setpoint #213, a 10 for the value of setpoint #56 and a 2 in the high zone of setpoint #56. Then the logic will increase the compressor AO by 20% every 5 seconds.
57	NOT USED		
58	NOT USED		

59	ACYC OFF->ON	SETPOINT	This is the anti-cycle time delay (in seconds) from when the compressor was turned off. This value is used in a calculation to determine how long a compressor should be in the anti-cycle state. Refer to the Standard Control Options section, Compressor Anti-Cycle Logic (OFF to ON).
60	MITSI P-DWN CUTIN	SETPOINT	If the compressor is a Mitsubishi, is being unloaded, and the suction pressure is greater than this setpoint, then the compressor will be forced to pump down. NOTE: this value is used whether the setpoint is active or inactive.
61	PMP DWN OFF	SETPOINT	This is the suction pressure value for turning off the compressor when in the PUMP DOWN or for opening the liquid line solenoid during the PRE-PUMP down state.
62	PMP DWN DELY	SETPOINT	Maximum time delay (in seconds) that a compressor can remain in the PUMP DOWN or PRE-PUMP down states. The Time in sec field specifies the time the unit will remain in unloading before shutting off the LLS & EXV and pumping down.
63	ACYC ON->ON	SETPOINT	This is the anti-cycle time delay (in seconds) from when the compressor was turned on. This value is used in a calculation to determine how long a compressor should be in the anti-cycle state. Refer to the Standard Control Options section, Compressor Anti-Cycle Logic (ON to ON).
64	COMP MIN RUN	SETPOINT	This is the minimum run time (in minutes) for a compressor once it is turned on. This minimum run time can be overridden by a safety condition, however.
65	EXV ZONE1	SETPOINT	Temperature differential used to build the EXV Zone 1 both plus and minus.
66	EXV ZONE2	SETPOINT	Temperature differential that is used to build the EXV Zone 2 both plus and minus. Temperatures above this zone are considered in zone 3.
67	EXV ROC ZONE 1	SETPOINT	The EXV control logic will compare the value of this setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within the EXV control zone. ‘Safety Down Time (MIN)’ field: The minimum time delay between EXV adjustments when in the EXV control zone.
68	EXV ROC ZONE1	SETPOINT	The EXV control logic will compare the value of this setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within zone 1. ‘Safety Down Time (MIN)’ field: This is the minimum time delay between EXV adjustments when in the EXV control zone 1. If this setpoint is inactive then the ROC for this zone is 0 and the delay is 15 seconds.
69	EXV ROC ZONE2	SETPOINT	The EXV control logic will compare the value of this setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within zone 2. ‘Safety Down Time (MIN)’ field: This is the minimum time delay between EXV adjustments when in the EXV control zone 2. If this setpoint is inactive then the ROC for this zone is 0 and the delay is 15 seconds.
70	EXV ROC ZONE3	SETPOINT	The EXV control logic will compare the value of this setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within zone 3. ‘Safety Down Time (MIN)’ field: This is the minimum time delay between EXV adjustments when in the EXV control zone 3. If this setpoint is inactive then the ROC for this zone is 0 and the delay is 15 seconds.

71	EXV TOO FAST	SETPOINT	When the superheat is with the control zone, the EXV control logic will compare the value of this setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within the zone and rising too fast. 'Safety Down Time (MIN)' field: This is the minimum time delay between EXV adjustments if the rate of change is too fast when in EXV control zones 1 or 2. If this setpoint is inactive then the ROC for this zone is 0 and the delay is 15 seconds.
72	EXV CHANGING	SETPOINT	When the superheat is with the control zone, the EXV control logic will compare the value of this setpoint to the temperature rate of change to determine the valve adjustment when the temperature is within the zone and rising.
73	STARTER DLAY	SETPOINT	This Setpoint controls the start of a compressor's second relay. If the 'Select Value: # decimals & print char' cell is set to 'HUMD or %' then logic is: If First Compressor Relay has been on longer than 2 seconds and the FLA% goes below the value of this setpoint or is still above the value but reaches the time value in the safety time field than turn on the second relay. (If the low zone field is zero use the hardcoded 2 seconds belay at start. If greater than zero use that valve). Setpoint Information Screen, if the **'Select Value: # decimals & print char'** cell is set to 'Seconds' then the Setpoints value is a time delay between the first and second relay's start. Used for part wind (typical value of 1) and star delta (typical value of 5) starter.
74	OIL PUMP OFF	SETPOINT	If oil pump is always on (specified in MCS-Config), this setpoint is not used. Otherwise this setpoint contains the oil pressure value when the oil pump is to be turned off.
75	HI AMPS	SETPOINT	This setpoint is a percentage of the FLA; it is used to create the high amp draw limit. The value of this setpoint is multiplied by the respective compressor's full load amps setpoint (#171 through #190) to obtain its upper limit. If the compressor's amps exceed this value for the time specified in this setpoint, then a safety trip occurs.
76	LO AMPS	SETPOINT	This setpoint is a percentage of the FLA; it is used to create the low amp draw limit. The value of this setpoint is multiplied by the respective compressor's full load amps setpoint (#171 through #190) to obtain its lower limit. If the compressor's amps fall below this value for the time specified in this setpoint, then a safety trip occurs.
77	LOW SUCTION	SETPOINT	If active, the Magnum checks for low suction pressure for each running compressor. If suction pressure is less than this value for the specified period of time, a safety trip occurs. Refers to 'Suction Pressure' column in the Circuit SI screen.
78	LO SUCT UNLD	SETPOINT	The purpose of this setpoint is to take corrective action to prevent a low suction pressure safety trip. For fixed step compressors: If a compressor has more than one step, is fully loaded, and if the suction pressure is less than the value of setpoint #77 "LOW SUCTION" plus the value of this setpoint, then one step of capacity will be turned off. For variable step compressors: If a compressor has a suction pressure less than the value of setpoint #77 "LOW SUCTION" plus the value of this setpoint, then the compressor will be forced to unload. The circuit state will be changed to LO SUCT HOLD, and will remain in this state for a minimum of the time in setpoint #101 "SAFETY HOLD DELAY". At that time, if the suction pressure has increased greater than the value of setpoint #77 "LOW SUCTION" plus the value of setpoint #79 "LOW SUCT RELD" the compressor will return to normal control.
79	LOW SUCT RELD	SETPOINT	Refer to setpoint #78 descripition.

80	UNSAFE SUCT	SETPOINT	If active, the Magnum checks for unsafely low suction pressure for each running compressor. If suction pressure is less than this value for the specified period of time a lockout occurs (can configured as a regular safety with automatic reset if 'Setpoint Type' is Setpoint instead of Lockout). NOTE: The time period specified should be very short (2-5 seconds). If this setpoint trips, the compressor will be sent straight to the Lockout state. Refers to 'Suction Pressure' column in the Circuit SI screen.
81	HI DISC PSI	SETPOINT	If active, the Magnum checks for high discharge pressure for each running compressor. If the discharge pressure sensor reads greater than this setpoint for the specified period of time, a safety trip will occur. Refers to 'Discharge Pressure' column in the Circuit SI screen.
82	HI DISC UNLD	SETPOINT	The purpose of this setpoint is to take corrective action to prevent a high discharge pressure safety trip. For fixed step compressors: If a compressor has more than one step, is fully loaded, and if the discharge pressure is more than the value of setpoint #81 "HI DISC PSI" minus the value of this setpoint, then one step of capacity will be turned off. For variable step compressors: If a compressor has a discharge pressure more than the value of setpoint #81 "HI DISC PSI" minus the value of this setpoint, then the compressor will be forced to unload. The circuit state will be changed to HI DISC HOLD, and will remain in this state for a minimum of the time in setpoint #101 "SAFETY HOLD DELAY". At that time, if the discharge pressure has decreased below than the value of setpoint #81 "HI DISC PSI" minus the value of setpoint #83 "HI DISC RELD" the compressor will return to normal control.
83	HI DISC RELD	SETPOINT	Refer to setpoint #82 descripition.
84	LO DISC SHEAT	SETPOINT	If the calculated discharge superheat is less than this value for the specified period of time, a safety trip will occur. Also, there is an option in the Circuit Base screen to tie a Relay Output to this setpoint that will activate whenever a low discharge superheat condition occurs. A Low Discharge Superheat condition can also put the circuit into a 'HI DISC UNLOAD' state where the compressor will unload to try to raise the superheat. If economizer is being used, when the discharge superheat goes below the value for the safety time / 9 the economizer is turned off.
85	LO DISC PSI	SETPOINT	If active, the Magnum checks for low discharge pressure. If the discharge sensor reading is less than this value for the specified period of time, a safety trip occurs.
86	HI RETURN TEMP	SETPOINT	Only active in Mitsubishi compressors. If active the Magnum will check for high entering liquid temperature. If this temperature is greater than the value in this setpoint, the circuit state will be HI WATER HOLD.
87	HI DISC TMP	SETPOINT	If active, the Magnum checks for high discharge temperature for each compressor. If the discharge temperature sensor reading is greater than this setpoint for the specified period of time, a safety trip will occur. Refers to 'Discharge Temperature' column in the Circuit SI screen.

88	DIS TMP UNLD	SETPOINT	The purpose of this setpoint is to take corrective action to prevent a high discharge temperature safety trip. For fixed step compressors: If a compressor has more than one step, is fully loaded, and if the discharge temperature is more than the value of setpoint #87 “HI DISC TMP” minus the value of this setpoint, then one step of capacity will be turned off. For variable step compressors: If a compressor has a discharge temperature more than the value of setpoint #87 “HI DISC TMP” minus the value of this setpoint, then the compressor will be forced to unload. The circuit state will be changed to HI DISC HOLD, and will remain in this state for a minimum of the time in setpoint #101 “SAFETY HOLD DELAY”. At that time, if the discharge temperature has decreased below than the value of setpoint #87 “HI DISC TMP” minus the value of setpoint #89 “HDISC T RELD” the compressor will return to normal control.
89	DIS TMP RELD	SETPOINT	Refer to setpoint #88 description.
90	CND FAULT	SETPOINT	For condensers with Fault Indicators: If setpoint is active, a condenser fault occurs, and the setpoint type is Alarm, then an alarm message will be generated. If the type is Lock-out, and a condenser fault occurs, then all of the compressors associated with this fault will be locked off.
91	LOW OIL DIF	SETPOINT	If active, the Magnum checks for low differential oil pressure. If the calculated differential oil pressure is less than this value for the specified period of time, a safety trip occurs. Refers to ‘Oil Pressure’ column in the Circuit SI screen.
92	UNSAFE OIL	SETPOINT	If active, the Magnum checks for unsafe differential oil pressure. If the calculated differential oil pressure is less than this value for the specified period of time, a lockout occurs. NOTE: The time period specified should be very short (2-5 seconds). If this setpoint trips, the compressor will be sent straight to the Lockout state. Refers to ‘Oil Pressure’ column in the Circuit SI screen.
93	HI OIL SEAL	SETPOINT	Only used with screw or centrifugal compressors. If the oil seal or oil cooler temperature exceeds the value of this setpoint for the time specified, a safety trip occurs. Refers to ‘Oil Seal Temp’ column in Circuit SI screen.
94	HI OIL TEMP	SETPOINT	If active, the Magnum checks for high oil temperature. The sensor can be either an analog or digital input. If the oil temperature sensor reading is ON (Digital) or exceeding the temperature value of this setpoint (Analog) for the specified period of time, a safety trip occurs. Refers to ‘Oil Temp’ column in the Circuit SI screen.
95	MOTOR FAULT	SETPOINT	If active, the Magnum checks for high motor temperature. The sensor can be either an analog or digital input. If the motor temperature sensor reading is ON (Digital) or exceeding the temperature value of this setpoint (Analog) for the specified period of time, a safety trip occurs. Refers to ‘Motor Temp’ column in the Circuit SI screen.
96	NO CMP PROOF	SETPOINT	If active, when the compressor is called to be on by the controller, the Magnum will check for a digital input to indicate that the compressor is indeed running. If the controller calls for a compressor to turn on and no proof is given in the specified period of time, a safety trip occurs. Refers to ‘Comp Proof’ column in the Circuit Base screen
97	DIRTY FILTER	SETPOINT	Only used for screw compressors. If discharge pressure minus oil filter pressure is greater than this value for the time specified, a safety trip occurs.

98	LLS#2 ON	SETPOINT	This setpoint is used to control a second liquid line solenoid. When the actual circuit capacity is greater than this value (can either be number of steps for Fixed Step compressors, or percentage of full load amps for Variable Step compressors) for the number of seconds in the 'Time (sec)' field, the second liquid line solenoid will open. When the actual circuit capacity falls below this value minus the 'Lockout Delay Hrs.' Field, then the second liquid line will be turned off. 'Time (sec)' field: The delay in seconds before the solenoid will be turned on. If zero, then there will be no delay. 'Lockout Delay Hrs.' Field: Offset that will be subtracted from the value of this setpoint. When the actual circuit capacity falls below this offset, the solenoid will be turned off. If zero, then an offset of 20% will be used.
99	LLS#3 ON (ECONOMIZER)	SETPOINT	This setpoint is used to control a third liquid line solenoid. When the actual circuit capacity is greater than this value (can either be number of steps for Fixed Step compressors, or percentage of full load amps for Variable Step compressors) for the number of seconds in the 'Time (sec)' field, the third liquid line solenoid will open. When the actual circuit capacity falls below this value minus the 'Lockout Delay Hrs.' Field, then the third liquid line will be turned off. 'Time (sec)' field: The delay in seconds before the solenoid will be turned on. If zero, then there will be no delay. 'Lockout Delay Hrs.' Field: Offset that will be subtracted from the value of this setpoint. When the actual circuit capacity falls below this offset, the solenoid will be turned off. If zero, then an offset of 20% will be used. If the LO DISC SHEAT setpoint #84 is active and the discharge super-heat goes below the value in this setpoint for the safety time / 9, the economizer will be turned off.
100	HIGH SUMP TEMP	SETPOINT	If active, and sump temperature is above the value of this setpoint for the time specified, a HIGH SUMP TEMP alarm is generated and the unit is locked out.
101	SAFETY HOLD DE-LAY	SETPOINT	Time in seconds that the circuit will remain in a hold state after the condition that caused it has returned to normal. The circuit can be hold-ing for the following reasons: Low suction pressure Low refrigerant temperature High discharge pressure High discharge temperature High amperage
102	Return Fan Fault	LOCKOUT ALARM	If active and there is a return fan fault and it is on for the time specified in the safety time field the return fan fault message will be generated. If the type is LOCKOUT the unit will be locked out.
103	LEAD COMP	SETPOINT	Enables the user to specify the lead compressor. The value of this setpoint will indicate the lead compressor. If zero, then auto rotation is enabled. 'Time (sec)' field: If non-zero, the compressor with the least amount of run time will be made the lead upon rotation.
104	COMP ROTATION	SETPOINT	Specifies the number of days between rotations (setpoint #103 must be set to zero to enable auto rotation). If zero, then rotation will occur with every cycle.
105	AIR FLOW FAILURE	SETPOINT	If active and air flow is lost for the time specified in the safety time cell an alarm message will be generated and the unit will be locked off. Unit state will be 'OFF NO AIR FLOW' and the cooling state will be 'UNIT IN LOCKOUT'.

106	Dehumidification suction target Time(sec) Delay between modulating CMP VFD	TARGET	Used to add compressors when in dehumidification mode. One compressor per suction group is required to be turned on. If the suction pressure is greater than the value of this setpoint plus the high zone value and the compressor is fully loaded (VFD is at 100&) an additional compressor, if available, in this suction group will be turned on. A High SI OFF must be set up to turn off this additional compressor.
107	NOT USED		
108	Supply Fan delay	DELAY	If the Supply fan is cycled, the value contains the pre delay once the fan is wanted on before the fan can be turned on and the safety time contains the post delay. The MIN VFD Adjustment is the initial delay before the fan can be started after lockout.
109	High refrigeration Level	SETPOINT	This setpoint has two functions. If active, the Magnum checks for high refrigeration level. If the refrigeration level sensor is greater than this value for the specified period of time, a safety trip occurs. If active, system has EXV valve control based on refrigerant level, and the refrigerant level is greater than this value, then the EXV valve adjustment will be set to the value in setpoint #13 “EXV COURSE” * (–3). Refers to ‘Refrig Level’ column in the Circuit SI screen
110	Refrigeration Level EXV Adjustment (EXV Control: Refrigerant Level)	SETPOINT	If setpoint #84 “LO DISC SHEAT” is active and it has reached one third of its safety time, then setpoint #9 “REF LVL TRG” will be set to the value of this setpoint. The purpose is to decrease the EXV valve opening to avoid a low discharge superheat safety trip. This change will be updated in the setpoint status value.
	Discharge Super heat EXV Adjustment (EXV Control: Discharge or Suction Superheat)	SETPOINT	If setpoint #84 “LO DiscSPRHT” is active and it has reached one third of its safety time, then setpoint #9 “SUPERHT TRGT” will be increased by the value of this setpoint. The purpose is to decrease the EXV valve opening to avoid a low discharge superheat safety trip.
111	FREEZE	SETPOINT	If active, the Magnum will compare the leaving temperature to this setpoint. If it is less than this value for the specified period of time, a safety trip occurs.
112	NO STOP	SETPOINT	This setpoint is used to ensure that a compressor is actually off when the controller calls for it to be off. This setpoint contains a percentage of the FLA for setpoints #65-#72. If the compressor amperage is greater than this percentage of the FLA setpoint for the specified period of time, signaling that the compressor is still running, then the entire system is locked out and a NO STOP alarm is generated. If a Control Power relay is specified, then it will be turned off when this safety trips.
113	OIL INJ TEMP DIFF	SETPOINT	This is a temperature differential subtracted from setpoint #8 to control the oil injection relay. When discharge temperature is above this differential, then oil injection is turned on. If inactive then value will be 5.6° F (2.8° C).
114	OIL TEMP DIFF	SETPOINT	This is a temperature differential used in controlling the oil heater and second liquid line solenoid. If inactive then value will be set to 5° F.
115	Economizer VFD fan Delay	SETPOINT	If active, and the fluid cooler has a VFD condenser fan, this Setpoint will be the time in seconds between adjustments to the VFD. If inactive, then the value of Setpoint #124 “EcoVlvAdjDly “will be used for this delay timer.
116	Relief damper pressure target (Control Exhaust Fan Damper)	TARGET	Only used if relief damper control is selected. The high & low zone values are used to create the control zone.

117	Relief damper adjustment	DELAY	Only used if relief damper control is selected. Value: Not used. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
118	Override timer for changing unoccupied to occupy.	SETPOINT	The amount of time that the override state will be maintained once the override indicator is off. The time is adjusted based upon selection in the Select Value: column. If HOURS are selected and the value is 1, the time will be adjusted to 1 hour.
119	EcoOffsetON	TARGET	If active the temperature differential to allow the outside air damper logic to run as an economizer will be the value of this set point. If inactive then the differential will be 2.0 degrees. The outside control temperature differential must be greater than the return control temperature to enable the economizer to be active. 1. If STP119 is setup as a target type and the setback value is not equal to zero then Differential is set equal to the value of STP119. setback, else Differential value is set equal to a hardcoded 1.0 2. Economizer ON -> if R/A temp is greater than O/A + STP119 value 3. Economizer OFF -> if R/A temp is less than (O/A temp + STP119. value – differential) Example: If return is 80 and ambient is 78 we will enable the economizer based on the value of setpoint 119 being 2.
120	Eco Stg Dely	SETPOINT	Once the economizer valve has been opened to its maximum and all fans associated only with it have been turned on, the economizer function will wait this time in seconds before the first condenser fan is turned on or VFD is set to its minimum position. The minimum setting of the VFD is the value of Setpoint #54 “CND MIN SPD”.
121	Economizer MIN VLV%	TARGET	Minimum Outside air damper (Economizer) Analog Output valve percentage. This will be the value used when first starting the economizer function as well as the lowest level before turning off. This setpoint must be active to indicate that the Economizer AO option is active. This percent of opening must be maintained to version requirements; only exception is in a smoke or fire situation then the opening goes to 0% If the system is in HEATING mode with Direct Fire Heating the Night Setback value will be added to the value of this setpoint to force the damper to be open. For example if the value is 10.0 and the Night Set back is 43.5 then the minimum damper opening when in Heating mode with direct fire heater will be 53.5%.
122	Economizer MAX VLV%	SETPOINT	Maximum Economizer Analog Output valve percentage.
123	Economizer MAX ADJ	SETPOINT	Maximum adjustment to the Economizer Analog Output valve percentage with each calculation. Formula:[absolute value of(Target – current) * Multiplier setpoint #126] / Divisor setpoint #126
124	Economizer VFD Adjustment Delay	SETPOINT	Delay between Economizer Analog Output valve adjustments.
125	NOT USED		
126	Economizer MULT/ DIV	DELAY	Setpoint is used to scale adjustments to the Economizer Analog Output valve percentage. The difference between the control sensor and its target will be multiplied by this value and then divided by the value in the MAX VFD Adjustment cell.

127	Damper Air Flow	TARGET	If the unit has an Outdoor Air Flow sensor, then the O/A damper's minimum opening will be adjusted to maintain the air flow with in the control zone of this setpoint. The high & low zone values are used to create the control zone. The time is the delay between adjustments.
128	Lost Leg Alarm	SETPOINT	If active, a check for a lost leg (lost current flow) on a part winding starter is added. A current sensor will be placed on only one of the legs; it must be set up to be multiplied by 2 in MCS-Config (select CT-### x2 as the sensor in the SI screen). If current flow to the leg with the sensor is lost, a low amp alarm will be generated. If the sensor is reading more than the wanted FLA times the value of this setpoint for the specified period of time, then a high amp alarm is generated.
129	Reheat Target (If unit was R/A , byps modulate first to maintain temp then reheat.)	TARGET	Dehumidification reheat target and control zone. Used in the control of the circuit reheat when the system is in dehumidify mode. The high & low zone values are used to create the control zone. When Reheat is on the night setback, value will be used to allow a flush if less than the value.
130	Reheat Adjustment	DELAY	Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
131	CO2 opening	DELAY	If active and the CO2 level goes above the value of this setpoint than set the Outside Air Damper to the value in the (Min VFD Opening) Field. Note: If Setpoint #207 "CO2 High Min Damper opening" is active the value of this setpoint will be the minimum opening. (This is used when BMS wants to write/change the minimum opening.) Optional: modulating Outside Air Damper on High CO2 levels. The setpoint value will be the target along with the High Zone and Low Zone. The (Time (SEC)) Field is the delay between adjustments. Setpoint #207 "CO2 Modulating Multiplier/Divisor" value will be the multiplier and the MAX VFD ADJ will the divisor for the scaling of adjustment.
132	OAD PROOF	DELAY	Keep Supply fan OFF until oad_ao_position_feedback is ON or fully open
133	No heat high ambient	TARGET	If active: Disable heating if outside air temperature is above the value. Once disabled, outside air temperature must be less than the value minus the low zone. If inactive: The above test will not be made.
134	Humidity Damper Target	TARGET	Required if Humidity option is specified as other than 'Not Used' and a damper has been specified. Value: Humidity Damper target. Safety time: Not used High zone: added to value to create the top of zone. Lo zone: subtracted from value to create the bottom of zone. Night setback: Not used.
135	Humidity Damper Adjustment	DELAY	Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
136	Supply fan adjustment multiplier & divisor	DELAY	Value is the multiplier and the MAX VFD ADJ is the divisor used to fine tune the adjustments to the supply fan.

137	Exhaust fan adjustment multiplier & divisor	DELAY	Set point is used to adjust the control value of the building static minus building target. The value is the multiplier and the MAX ADJ value is the divisor which is used to fine tune the adjustments to the Exhaust Fan.
138	Exhaust Damper multiplier & divisor	DELAY	Set point is used to adjust the control value of the building static minus building target. The value is the multiplier and the MAX ADJ value is the divisor which is used to fine tune the adjustments to the Exhaust Damper.
139	OIL LEVEL	SETPOINT	If active and there is an oil float digital input. It must be ON for the period of time specified in the setpoint before this setpoint will trip.
140	Heat Reclaim Adjustment	DELAY	Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
141	Heat Reclaim multiplier & divisor	DELAY	Set point is used to adjust the control value heat target minus heating sensor The value is the multiplier and the MAX ADJ value is the divisor which is used to fine tune the adjustments to the Heat Reclaim.
142	SERVICE MODE	SETPOINT	If active and the value is non-zero, then a compressor being disabled by the pump down switch will be continue to run until its suction pressure is zero. The compressor will be turned on to perform the pump down the number of times indicated in this setpoint. This is in preparation for service to be performed on the compressor.
143	UNLOADED %	SETPOINT	Used if a slide percentage sensor is present. When this sensor is reading less than the value of this Setpoint, then the slide is considered unloaded. Also used for a centrifugal vane closed. If the vane% sensor is reading less than the value of this Setpoint, then the vane is considered closed. Optional: If Setpoint is set up as a target, the value of this Setpoint equals the % at which the slide is considered closed. If the Time(SEC) field is set > 0 then slide control will be used instead of AMPS. High & low zone are used to develop the control zone based upon the capacity wanted %. Make Setpoint #35 “AMP DB HI” and Setpoint #36 “AMP DB LO” non-active.
144	OIL HEATER ON	SETPOINT (TIME)	The oil heater will be turned on if the oil temperature is less than the value of this setpoint. It will be turned off if the oil temperature is greater than the value of this setpoint plus 5.0° Fahrenheit. ‘Time (sec)’ field: If zero, then the calculated oil temp will be the saturated suction temperature plus the value of the setpoint. Else it will be the value of this setpoint.
145	OIL COOLER ON	SETPOINT	The oil cooler will be turned on if the oil seal temperature is greater than the value of this setpoint. It will be turned off if the oil seal temperature is less than the value of this setpoint minus 5.0° Fahrenheit.
146	Low Static PSI	Lockout	If the duct static pressure is less than the value of this setpoint for the time in the safety time a low pressure alarm will be generated and the system will be locked out.
147	NOT USED		
148	Fault for the modulating GAS or modulating SCR heater types.	SETPOINT	Used for alarm message when associated fault occurs
149	High Static PSI	Lockout	If the supply duct static pressure is greater than the value of this setpoint for the time in the safety time a high pressure alarm will be generated and the system will be locked out.

150	Supply fan fault	Lockout Alarm	If the supply fan fault is on an alarm message indicating this will be generated. If this set point is a LOCKOUT type then the unit will be locked out when this fault occurs; else the system will continue to function.
151	UNLOADED OFF	SETPOINT (TIME)	If active, the system is fully unloaded, and the control temperature is greater than this value, then the capacity state will be set to holding. 'Time (sec)' field: If non-zero, then the value of this setpoint is used as a differential and not a set temperature. The value of this setpoint is subtracted from setpoint #1.
152	HP OVERHEAT	SETPOINT	This setpoint is only used when the heat pump option has been selected in the 'Heat Pump' option in the 'Heat Info' panel under the MAG RTU screen. It is used to protect against a heat pump with unloaders (or variable speed) from overheating. When this setpoint is active and the leaving temperature sensor is greater than this setpoint minus 3.0° Fahrenheit, then the compressor will enter HIGH TEMP UNLOAD state. The temperature must drop to less than this setpoint minus 4.5° Fahrenheit before the system will move to the holding state.
153	Safety Unload delay	SETPOINT	The time delay in seconds between compressor capacity adjustments when safety unloading.
154	VFD Adjustment when in safety unloading	SETPOINT	The VFD percentage adjustment to be made after every amount of time in setpoint #153 "SftyUnld Del" when safety unloading.
155	LO REF TMP	SETPOINT	If active, the Magnum checks for low refrigerant temperature. If the refrigerant temperature is less than the value of this setpoint for the specified period of time, a safety trip occurs.
156	LO REF UNLD	SETPOINT	The purpose of this setpoint is to take preventative action before a low refrigerant temperature safety trip. The compressor will unload when the refrigerant temperature is less than the value of the setpoint #155 "LO REF TMP" plus this setpoint. The compressor state will be changed to LO TMP UNLOAD. The compressor will remain in this state until the refrigerant temperature is above the value of setpoint #155 "LO REF TMP" plus twice the value of this setpoint. The compressor state change to LO TMP HOLD.
157	Heat pump Low Suction Adjustment	SETPOINT	This setpoint is only used when the heat pump option has been selected in the 'Heat Pump' option in the 'Heat Info' panel under the MAG RTU screen. If active and in heating mode, the low suction value setpoint #77 "LOW SUCTION" is reduced by the value of this setpoint.
158	DEF TRIG TMP	SETPOINT	If a defrost option has been specified and either coil #1 or coil #2 temperature is less than or equal to this setpoint a defrost cycle will be started if sufficient time has elapsed since the last defrost.
159	DEF TRIG CYC	SETPOINT	Target - If the setpoint type != " TARGET" type, then normal post defrost pump down occurs, else if = "TARGET" type then special post def pump down is perform. The comp is turned off for time setup in the setpoint #62 "Pmp Dwn Dlay" value field and Cmp VFD spd is set to 30% for 10 second, then 50% for 15 seconds, then cmp is set back to normal operation.
160	DEF REV DEL	SETPOINT	If a reversing valve is used, this is the delay in minutes the system must wait once the valve has been opened before the defrost cycle can continue.
161	DEF TERM TMP	SETPOINT	If both coil #1 and coil #2 temperature are greater than the value of this setpoint, then the defrost cycle can be terminated.
162	DEF TERM DEL	SETPOINT	The length of time in minutes of the defrost cycle. Target - If the setpoint type = 'Target' type, the comp goes to anticycle
163	Heating Target	TARGET	Target when in heating mode. High and Low values used to create the control zone. If unit is in unoccupied mode the Night Setback value will be subtracted from the value of this setpoint for control purposes.

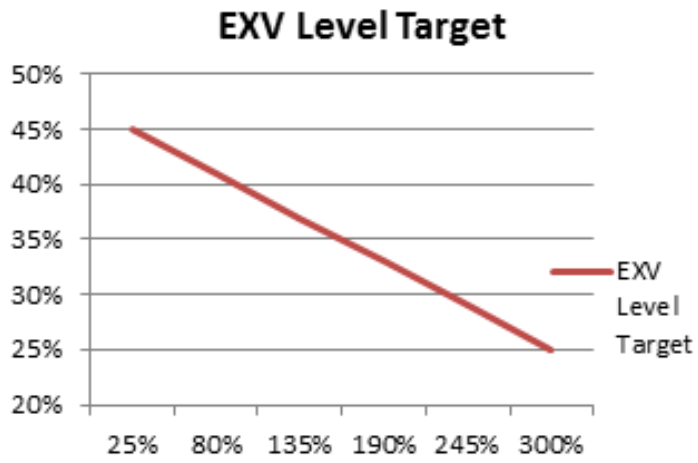
164	Heating Stage 1 Delay	TIME	Delay between heating adjustments for stage 1 of heating
165	Heating Stage 2 Delay	TIME	Delay between heating adjustments for stage 2 of heating
166	PHASE LOSS	SETPOINT	If active and the phase loss digital input is ON for the specified period of time, a safety trip occurs. The system will attempt to restart after waiting the number of minutes contained in the 'Safety Down Time' field of this setpoint.
167	PURGE FLT ERROR (Only used with Screw Compressor)	SETPOINT	If active and purge float error occurs, a purge float alarm is generated.
168	PURGE COUNT (Only used with Screw Compressor)	SETPOINT	If the total number of purges that occurred during the last three purge cycles exceed this value, then reset all counters and generate a Maximum Purges Exceeded alarm.
169	PURGE PSI ST (Only used with Screw Compressor)	SETPOINT	When the purge pressure sensor reading is equal or greater than this value, then a purge cycle will be initiated. The cycle will end when the purge pressure sensor reading is less than the value of this setpoint minus setpoint #193 "PSI DIFF", or 5 psi if inactive. If the time in a purge cycle exceeds this setpoint's value in seconds, then the cycle will be terminated and an Excessive Purge Time alarm will be generated.
170	PRE-HEAT TARGET	TARGET	Value: Target of the pre-heat function. Safety Time is NOT USED. High Zone cell is added the value to produce the high zone. Low Zone cell is subtracted from the value to produce the low zone. Night Setback cell is NOT USED.
171 - 178	FLA AMP for circuits 1 through 8. (RTU supports a maximum of 8 circuits.)	TARGET	Value: AMP drawn of circuit. Safety time: Not used High zone: This is added to the value to create the upper dead band limit of the FLA. If the amps are within the dead band, the slide valve will not be moved. Lo zone: This is subtract to the value to create the lower dead band limit of the FLA. If the amps are within the dead band, the slide valve will not be moved. Night setback: Not used. (The high & low zone values are NOT percentages but actual values.)
179	PRE-HEAT ADJUST-MENT	DELAY	Value: Minimum adjustment that can be made. Safety time is the delay between adjustments. MIN VFD Opening: This is the minimum AO setting. MAX VFD Opening: This is the maximum AO setting. MAX VFD Adjustment: This is the maximum adjustment that can be made.
180	Energy Wheel Offset Temp	SETPOINT	If active the value will be used as the offset to determine if the energy wheel can function. If inactive, then a fixed value of 2.0 will be used as the differential.
181	Return Relief Damper	TARGET	This set point is required if a return relief damper has been specified. Target for return static psi. High and Low values used to create the control zone. Value: Return Relief Damper target. Safety time: Delay between adjustments High zone: added to value to create the top of zone. Lo zone: subtracted from value to create the bottom of zone. Night setback: Not used.

182	Return Relief Damper Adjustment	DELAY	This set point is required if a return relief damper has been specified. It is used to adjust the relief damper's VFD. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
183	Return Relief Damper multiplier & divisor	DELAY	Value is the multiplier and the night set back value is the divisor used to fine tune the adjustments to the return relief damper's VFD.
184	Mod Gas Adjustment (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	Adjustments for mod gas valve and minimum and maximum valve openings. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
185	Mod Gas multiplier & divisor & time that the gas stage must be off (This setpoint is also used with Direct Fire type of heating and Modulating SCR.)	DELAY	-The value is the multiplier. -The time cell is the minimum time that the gas stage must be in the TIME OFF state. This is similar to an anti-cycle timer. -Min Opening is not used. -Max Opening is not used -Max Adj is the divisor used to fine tune the adjustments.
186	Mod Gas ignition (This setpoint is also used with Direct Fire type of heating)	LOCKOUT	Only used if the Ignition Indicator sensor is not used. -The Value is the increase in heat that is needed to prove that ignition has been successful. If the control temperature decreases while waiting for ignition, the heat increase will be based on this value. -The time field contains the time to wait for ignition, if time expires then mark this stage off line and generate an error message (only one error message will be generated between lockout reset). -The time to ignore safety cell contains the time that the step will remain in the warm up state.
187	Mod Gas Fan switch to high speed (not used with Direct Fire type of heating)	SETPOINT	Determines when the system will switch from low fan speed to high fan speed. When the mod gas opening is greater than value of this setpoint plus the value in setpoint #184 the high speed fan will be turned on. With MOD GAS heating types when warm up has been satisfied, use high zone of set point #187 as the valve opening if is greater than 0 else use the minimum valve opening in set point #184.
188	ENGY Wheel ALARM	ALARM	Used for alarm message when the ERW fault is on for a time greater than the value in the safety time cell
189	Humidification Fault	ALARM	Used for alarm message when the humidifications fault is on for a time greater than the value in the safety time cell.
190	Warm Up	TARGET (setup in minutes)	This setpoint must be active to execute warm up and provide set point information when in the warm up mode. Value: Maximum time for warm up must be greater than zero. Safety time: Not Used High Zone: R/A Target if cooling is required. Low Zone: R/A Target if heating is required. Night Setback: The heat S/A Target (Setpoint #163 "Heating Target") gets reset to this valve.

191	TEMP DIFF	SETPOINT	This temperature differential is used to replace the hardcoded temperature differential values of several values. It is used with the following: Discharge temperature Low oil seal temperature Low/high ambient cutoffs Compressor discharge superheat If inactive, then hardcoded value of 5° F is used Display Units specified as Deg F/PSI (English) else 2.8C (Metric).
192	FRZ O/A Damper Close	TARGET	If active the outside air damper opening will be checked. Value: if the leaving temperature is less than the value of this set point outside air damper minimum opening will be reduced by the night setback value. Safety Time: Time between adjustments. Night Setback: Reduce the opening by this amount.
193	PSI DIFF	SETPOINT	This temperature differential is used to replace the hardcoded temperature differential values of several values. It is used with the following: Discharge temperature Low oil seal temperature Low/high ambient cutoffs Compressor discharge superheat If inactive, then hardcoded value of 5° F is used Display Units specified as Deg F/PSI (English) else 2.8C (Metric).
194	CND 2ND ZONE	SETPOINT	The value in this setpoint is the 2nd high and low zone for your target of setpoint #50 “CND TRGT“. If inactive then a default zone of 20 psi will be used, if metric 1.4 Bar.
195	CFM Adjustment TARGET	TARGET	Set point is used when the supply fan is being controlled on CFM. Value: value is subtracted from the S/A CFM sensor value to give you the return CFM Target. Target is dynamic. High Zone: Added to the target to create the top of the control zone. Low Zone: Subtracted from the target to create the bottom of the control zone.
196	Return Fan Multiplier/ Divisor	TARGET	Value is the multiplier and the night set back value is the divisor used to fine tune the adjustments to the return relief fan’s VFD. Safety Time: Delay before the return fan can be turned off.
197	Building PSI Target	TARGET	Set point used to develop the control zone for the building pressure. Value: Target for building pressure and control zone. High Zone added to target to create the top of the control zone Low Zone: Subtracted from the target to create the bottom of the control zone.
198	Building PSI Adjust-ment	DELAY	Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
199	MOP TARG PSI	SETPOINT	If active, maximum operating pressure (MOP) control will be added to the EXV control logic. This value will be the MOP suction pressure target.
200	MOP PSI ZONE	SETPOINT	Added to and subtracted from setpoint #199 to develop the upper and lower limits of the MOP control zone.
201	MOP ADJ % TME	SETPOINT (TIME)	The adjustment value by which the EXV valve will close each time the MOP logic calls for it to maintain the suction pressure target. This adjustment will be made each time after the delay in the ‘Time (sec)’ field has expired. ‘Time (sec)’ field: The delay between MOP adjustments.

202	DELTA TEMP EVP	SETPOINT	If active, the Magnum will check the temperature differential before additional capacity is enabled. If the difference between entering and leaving temperature is greater than the value of this setpoint for the amount of time in the 'Time (sec)' field, then no additional capacity will be allowed.
203	High Suction Superheat	SETPOINT	If active, the Magnum will check for high suction superheat. If the suction superheat is greater than the value of this setpoint for the specified period of time, an alarm will be generated and a safety trip occurs.
204	COND LOW AMB	SETPOINT	Standard condenser logic dictates that a newly started compressor will use its own discharge pressure as the control for the first five minutes. If this setpoint is active and the ambient temperature sensor is reading less than the value of this setpoint, then this compressor's discharge pressure will remain in control for the additional time in seconds as specified in the 'Time (sec)' field.
205	MDP MIN OIL DIFF	SETPOINT (ALARM)	If active, MDP logic will be added to EXV control. If the oil differential pressure is less than the value of this setpoint following compressor start up during the time specified in the Sec to Ignore Safety field, then the MDP function is active and will close the EXV valve to restore the oil differential pressure. However, the EXV will not be allowed to go into the MDP logic if the suction pressure is less than setpoint #77 "LOW SUCTION" plus the value of setpoint #79 "LOW SUCT RELD". The MDP logic will be exited and go to EXV HOLDING when the suction pressure is less than the setpoint #77 "LOW SUCTION" plus the value of setpoint #78 "LOW SUCT UNLD". The ''Time (sec)" field contains the offset value added to setpoint #205 value field to calculate the oil differential pressure for exiting the MDP control. Magnum software version 8.05S1 and later multiple this value by 10 to add a decimal, so if you enter a value of 5 in this field the offset is 5.0psi. Prior to 8.05S1 software version you need to enter the value with 1 assumed decimal place, for example if you wanted an offset of 5.0psi you need to enter 50 in this field. The 'Lockout Delay" field contains the percentage to close the EXV valve when in the "MDP CLOSE" state. Magnum software version 8.05S1 and later multiple this value by 10 to add a decimal, so if you enter a value of 2 in this field the adjustment is 2.0%. Prior to 8.05S1 software version you need to enter the value with 1 assumed decimal place, for example if you wanted an adjustment of 2.0% you need to enter 20 in this field. The 'Sec to Ignore Safety' cell contains the time (**in minutes – not seconds**) that the MDP will be active after a compressor is started.
206	COND HI AMB	SETPOINT	If active, standard condenser control on compressor startup logic will be bypassed when there is a high ambient temperature. If the condenser type is common and the ambient temperature is above the value of this setpoint, then the compressor with the highest discharge pressure will have control of the condenser.
207	CO2 High Min Damper opening	SETPOINT	Set point usage if not 100% Outside Air unit. If the CO2 level is high, greater than value of setpoint #131 "CO2 Opening" the minimum opening of the outside air damper will be the value of this setpoint.
	CO2 Modulating Multiplier/Divisor	DELAY	Set point usage if modulating the Outside Air Damper on High CO2 Levels. The value will be the multiplier and the MAX VFD ADJ will be the divisor for the scaling of adjustment.

208	LOW SI OFF	SETPOINT (TIME)	If active, the Magnum checks for a Low SI Off sensor for each compressor. The sensor can be either an analog or digital input, and is specified in the Circuit SI screen. If the Low SI Off sensor reading is OFF (Digital) or falls below the value of this setpoint (Analog) for the specified period of time, the circuit will be disabled. If a digital input, the circuit will be enabled once the sensor is ON. If an analog input, the circuit will be enabled once the sensor is greater than this value plus the value in the 'Time (sec)' field. 'Time (sec)' field: Differential value of this setpoint which the analog input must be greater than to enable the compressor.
209	HI SI OFF	SETPOINT	If active, the Magnum checks for a High SI Off sensor for each compressor. The sensor can be either an analog or digital input, and is specified in the Circuit SI screen. If the High SI Off sensor reading is ON (Digital) or rises above the value of this setpoint (Analog) for the specified period of time, the circuit will be disabled. If a digital input, the circuit will be enabled once the sensor is OFF. If an analog input, the circuit will be enabled once the sensor is less than this value minus the value in the 'Time (sec)' field. 'Time (sec)' field: Differential value of this setpoint which the analog input must be less than to enable the compressor.
210	ECO LL3 D-SHT	SETPOINT	If active and the economizer liquid line solenoid is controlled on percentage (not last step), then a low discharge superheat test is added before checking whether the solenoid should be turned on or not. If discharge superheat is less than this value plus setpoint #84 "LO DISC SHEAT", then the solenoid will simply be turned off.
211	NO OIL FLOW	SETPOINT	If active and there is an Oil Flow sensor specified in the 'Oil Flow Switch' cell of the Circuit SI screen, then the Magnum will test for oil flow. If the No Oil Flow sensor reading is OFF (Digital) or falls below the value of this setpoint (Analog) for the specified period of time, then a safety trip occurs.
212	COMP SPD FLT	SETPOINT	If active and there is an Compressor Speed Fault sensor specified in the 'Compressor speed fault' cell of the Circuit Base screen, then the Magnum will test for Compressor Speed Fault whether the compressor is running or not. The fault sensor can be either an analog or digital input. If the fault sensor reading is ON (Digital) or falls below the value of this setpoint (Analog) for the specified period of time, then a safety trip occurs.
213	REHEAT TIMER	TARGET	Set point is used with the circuit reheat function to determine when a reheat flush is required. Value: Time to stay in reheat flush state, expressed in seconds. High Zone: If in cooling mode, the time to wait before flush. Low Zone: If in dehumidification mode, the time to wait before flush. Night setback cell will be the value that the compressor AO is incriminated by when in reheat flush (no longer the safety time) Time Field: This will set the AO value to the valve during a reheat flush. If value is set to 0, the AO value is set to 100% during flush.
214	TURBO BAL VLV DELAY (Only Turbocor)	SETPOINT	The delay between adjustments to the balancing valve is the 'Time(sec)' field, typical value is 20 seconds.
	TURBO STAGING VLV DELAY (Only Turbocor)	SETPOINT	The adjustment made to open the valve will be the value of setpoint #214, typical value is 10%.
215	TURBO RATIO (Only Turbocor)	SETPOINT	The discharge to suction pressure ratio must be less than the value in Setpoint #215 (typical value is 2.4) or balancing valve is at a 100% to end the balancing valve opening.

216	LIS MOTOR TEMP	SETPOINT (TIME)	If active, and motor temperature is greater than this value then Liquid injection solenoid (LIS) is ON. If it is less than this value minus the 'Time (sec)' field of this setpoint then the LIS is OFF. 'Time (sec)' field: Offset of motor temperature to turn LIS OFF.
217	LOW EXV TARGET	SETPOINT	The minimum Refrigerant Level target. If active and the EXV is controlled by Refrigerant Level, then a new variable level target logic will be activated. As the unit capacity increases, the refrigerant level target will change according to a linear calculation between setpoint #9 "LEVEL TARGET" (the maximum target level) and setpoint #217 "LOW EXV TARGET" (the minimum target level). This relationship is explained in the following graph: 
218	Enable cooling mode	TARGET	If the 'Forced Cooling' sensor is not used this set point will enable cooling when the control temperature is above this value. Once in the Cooling Mode the temperature must drop below this value minus the Low Zone offset. Value: Enable cooling temperature. High Zone: Not used Low Zone: Differential temperature to exit the Cooling Mode. Night Setback: Will adjust the cooling enable value if system is in the unoccupied mode.
219	Enable heating mode	TARGET	If the 'Forced Heating' sensor is not used this set point will enable heating when the control temperature is below this value. Once in the Heating Mode the temperature must raise above this value plus the High Zone offset. Value: Enable heating temperature. High Zone: Differential temperature to exit the Heating Mode. Low Zone: Not used Night Setback: Will adjust the heating enable value if system is in the unoccupied mode.
220	Enable dehumidification mode	TARGET	If the 'Forced Dehumidifying' sensor is not used this set point will enable dehumidification mode when the control humidity is above this value and the dehumidify option is primary or the unit is in VENT ONLY mode. Once in the Dehumidify Mode the humidity must drop below this value minus the Low Zone offset. Value: Enable dehumidification value. High Zone: Not used Low Zone: Differential humidity to exit the Dehumidify Mode. Night Setback: Will adjust the dehumidify enable value if system is in the unoccupied mode.

221	Exhaust fan fault	ALARM	Used for alarm message when the exhaust fan fault is on for a time greater than the value in the safety time cell
222	Heat Adjustment USED WITH MOD HOT WATER	DELAY	Set point is used to adjust the heating VFD. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
223	Heat Rate of Change USED WITH MOD HOT WATER	SETPOINT	Used with the heat control. When the control temperature is within the control zone and above the target and the heating control slope is greater than the value and the heating is not fully loaded then set the heating state to loading. If above target and the slope of the heating control is less than the value then set the heating state to unloading. If the compressor is not a fixed step then this value is divided by 2.
224	Heat VFD Multiplier/ Divisor USED WITH MOD HOT WATER	DELAY	Set point usage is used to fine tune the heat VFD adjustments. The value will be the multiplier and the MAX VFD ADJ will be the divisor for the scaling of adjustment.
225	Supply Fan Duct PSI	TARGET	Target for supply fan based upon duct pressure and control zone. -Value: is the duct psi target for the supply fan. -High Zone: Top of the control zone. -Low Zone: Bottom of the control zone.
226	Supply Fan Duct adjustments	DELAY	Adjustments for the supply fan based upon duct pressure and control zone. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
227	Clogged Filter	ALARM	If active the system will test for a clogged filter condition. The clogged filter sensor and the supply fan must be on for a time greater than indicated in the set point's safety time.
228	Energy Recovery Wheel (ERW) Defrost	TIME	If active this set point will enable a defrost cycle for the ERW. The outside temperature must be less than the value of this setpoint to enable the heat wheel to have a defrost cycle. The safety time contains the length of the defrost cycle. Note the heat wheel relay output contains minimum run time contains the run time between defrost cycles.
229	Energy Recovery Wheel (ERW) Clean Cycle	TIME	If this setpoint is active, the system will determine if ERW requires a clean cycle when it is off. Value: Accumulated supply fan run time between ERW cycles. If the ERW is off and the supply fan run time exceeds this value a CLEAN cycle will be initialized. Safety Time: Length of time of the CLEAN cycle. During this cycle the ERW will be rotated.

230	MAX DIFF PSI ROC	SETPOINT (ALARM)	Maximum Differential Pressure Rate of Change before forcing a change to the EXV position. 'Time (sec)' field: Seconds between samples used for calculating the Rate of Change. 'Safety Down Time(min)' field: Minimum delay between EXV adjustments. 'Sec. to Ignore Safety' field: Delay after compressor start before adjusting the EXV based on the Maximum Differential Pressure Rate of Change. 'Window to Extend Safety Time(sec)' field: Adjustment multiplier to the EXV. 'Safety Time Extension (sec)' field: Adjustment divisor to the EXV.
231	CO2 adjustments	DELAY	Set point only used when the supply fan is controlled on CO2. Value: Minimum adjustment to the value of set point #225. Safety time: Delay between adjustments.to the value of set point #225. MAX ADJ: Maximum adjustment to the value of set point #225.
232	Supply Fan Cooling Limits	TARGET	Used when the supply fan is controlled on CO2. Provides the minimum and maximum settings for value of set point #225 when the unit is the cooling mode. Value: Minimum value setting of #225. High Zone: Maximum value setting of #225.
233	Supply Fan Heating Limits	TARGET	Used when the supply fan is controlled on CO2. The minimum and maximum settings for value of set point #225 when the unit is the heating mode. Value: Minimum value setting of #225. High Zone: Maximum value setting of #225.
231	Single Zone Supply Fan VFD Adjustments	DELAY	Set point only used with single zone VAV and set point #225 being a SETPOINT type. Provides the minimum and maximum Supply Fan VFD% adjustments, delay between adjustments. Value: Minimum adjustment to Supply Fan VFD% allowed. Safety Time: Delay between adjustments to the Supply Fan VFD%. MAX ADJ: Maximum adjustment to Supply Fan VFD% allowed.
232	Supply Fan Cooling Adj	TARGET	Set point only used with single zone VAV and set point #225 being a SETPOINT type. Value: Minimum supply fan speed when in cooling mode. High Zone: Maximum supply fan speed when in cooling mode. Low Zone: Minimum supply fan speed if high CO2 readings.
233	Supply Fan Heating Adj	TARGET	Set point only used with single zone VAV and set point #225 being a SETPOINT type. Value: Minimum supply fan speed when in heating mode. High Zone: Maximum supply fan speed when in heating mode. Low Zone: Minimum supply fan speed if high CO2 readings.
234	HP Freeze Protect	LOCKOUT	This set point is to protect a heat pump when it is in a defrost cycle. The coil temperature must be less than this value for the time indicated in the safety time.

235	LO AMB SUMP OFF	TARGET	If type of condenser is evaporative condenser and the setpoint is active and target type. This is used with a sump pump and condenser fans. If the ambient drops below the valve then disable the sump pump. When the ambient goes above the HIGH ZONE allow the sump pump as the first stage. If the ambient goes below the HIGH ZONE minus the NIGHT SETBACK but above the set point value plus the NIGHT SETBACK then the sump pump becomes the second stage.
236	NOT USED		
237	Low Suction Unload Count	LOCKOUT	If this set point is active the number of low suction unloads will be tracked. If number exceeds the value of this set point within the time in cell 'Delay Between Trips' then the circuit will be lockoff.
238	ERW Bypass Damper Adjustment	DELAY	Adjustments for the ERW bypass damper. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
239	ERW Bypass Damper Multiplier/Divisor	DELAY	Set point is used to fine tune the ERW bypass damper adjustments. The value will be the multiplier and the MAX VFD ADJ will be the divisor for the scaling of adjustment.
240	Return Fan VFD Adjustment	DELAY	Adjustments for the return fan VFD. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum opening. MAX VFD Opening: Maximum opening. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
241	NOT USED		
242	ERW Exhaust Fan CO2	TARGET	Set point is used to control the ERW exhaust fan AO when there is a high CO2 present. Value: Acceptable CO2 target. High Zone: High zone for CO2, above this value must increase the speed of the ERW exhaust fan's speed. Low Zone: Low zone for CO2, below this value the speed can be decrease to its minimum value.
243	ERW Exhaust Fan Adjustment	DELAY	Adjustments for the ERW exhaust fan. Value: Minimum adjustment. Safety time: Delay between adjustments. MIN VFD Opening: Minimum speed. MAX VFD Opening: Maximum speed. MAX ADJ: Maximum adjustment to the opening percentage that can be made at one time.
244	ERW Exhaust Fan Multiplier/Divisor	DELAY	Set point is used to fine tune the ERW exhaust fan's adjustments. The value will be the multiplier and the MAX VFD ADJ will be the divisor for the scaling of adjustment.
245	Second Supply Fan Control	DELAY	Set point is required if there are two supply fans. Value: Minimum adjustment. Safety time: Delay between turning on the 2nd relay and setting the 2nd fan's AO value. MIN VFD Opening: AO speed setting when the 2nd fan starts. MAX VFD Opening: Maximum speed of the supply fans.

246	Vent Only Heat Target	TARGET	If set point is active and a TARGET type and set point #111 is active, option to allow heating if needed when in VENT ONLY mode. Value: Is not used, the value of #111 will be used as the heating target. High Zone: High zone for heating. Low Zone: Low zone for heating.
247	Vestibule Cooling Target	TARGET	Set point provides controls for vestibule cooling Value: Is the cooling target. High Zone: High zone for cooling. Low Zone: Low zone for cooling.
248	Vestibule Heating Target	TARGET	Set point provides controls for vestibule heating Value: Is the heating target. High Zone: High zone for heating. Low Zone: Low zone for heating.
249	Low Sump Level Timer	TIME	If set point is active and there is a sump level sensor provides the timer to generate the low sump level alarm. Value: Is not used. The safety time contains the time delay that the sump level sensor indicates a low sump level condition.
250	Sump Heating Target	TARGET	If set point is active and there is a sump temperature sensor and a sump heater relay output then the sump temperature will be checked. Value: Is the sump heating target. High Zone: High zone for heating. If temperature is above the high zone turn off the heating. Low Zone: Low zone for heating. If temperature is below the low zone turn on the heating.
251	FDD Control	TARGET	If the economizer Fault Detection and Diagnostics option has been select, this set point will provide basic control information. Value: Actual economizer opening. Safety Time: This is the feed-back delay. High Zone: High zone for economizer VFD opening. Low Zone: Low zone for economizer VFD opening.
	OilRecSpeed	DELAY	HUMD or % - If setup as “Delay type” Fixed compressor cannot run without the vfd tandem. If not setup as a delay type the fixed compressor will be able to run without the vfd compressor being available. Value – Speed in % to move the compressor to during an oil balance/ boost. Time – Amount of time to wait in seconds after oil level is tripped before entering balance/boost
252	FDD Temperature Control	TARGET	If the economizer Fault Detection and Diagnostics option has been select, this set point will provide temperature control information. Value: Actual economizer opening. Safety Time: Not used. High Zone: High zone for mixed air temperature test. Low Zone: Low zone for mixed air temperature test.
	OilRecMaxBal	ALARM	SECONDS - Alarm Type Value – Max time allowed in seconds to stay in balance mode before moving onto Boost mode.
253	OB Off Cycle	ALARM	MINUTES – Alarm Type Value – If an oil balance occurs twice within this time frame an alarm will be posted and the balance mode will be skipped and will be sent straight to a boost mode.
254	OilRecMaxBst	ALARM	MINUTES – Alarm Type Value – Max time allowed in minutes to stay in the boost mode before locking out that circuit on an alarm.
255	ToManyOilBst	ALARM	MINUTES – Alarm Type Value – If an oil boost occurs twice within this time frame an alarm will be posted and the circuit will be locked out

Revision/Disclaimer Page

Date	Author	Description of Changes
02-13-12	RCT	Updated
03-08-12	RCT	Update with smoke purge function & setpoints.
04-12-12	RCT	Update with low static pressure safety.
05-14-12	RCT	Update with Smoke Purge, Relief Damper & Mod Gas logic. Setpoints have been updated
07-09-12	RCT	Add RTU/Cooling states
07-24-12	RCT	RTU dehumidification update
07-27-12	RCT	Updated to match RTU 09.10-M software Setpoints Added Direct Fire heating option Expanded the Outdoor damper section Forced (on sensors)
09-14-12	RCT	General updated based upon Tony Fisher's suggestions.
11-21-12 (Rev 1.4)	RCT	Add new return fan control logic. Updated setpoints.
01-09-13	MAS	REV 1.5 Updated Photos Updated The Warm Up Sequence Updated Smoke Purge Updated Setpoints: Added Setpoints: 1 to 34, 37 to 101, 103 to 105, 109 to 115, 128, 142 to 145, 151 to 162, 166 to 170, 180, 191 to 196, 119 to 206, 208 to 217, 230 Setpoint #131 "CO2 Opening" Setpoint #207 "CO2 High Min Damper Opening" Setpoint #48 "CND ADJ DELAY" Setpoint #49 "CND START %" Setpoint #50 "CND TRGT PSI" Setpoint #51 "CND ADJ DIV" Setpoint #52 "CND MIN %" Setpoint #53 "CND ROC" Setpoint #54 "CND ADJ MULT" Setpoint #55 "CND MIN ADJ" Setpoint #90 "CND FAULT" Setpoint #193 "CND HI/LO ZONE" Setpoint #194 "CND 2ND ZONE'

Date	Author	Description of Changes
02-12-13	MAS	REV 1.6 Updated 12. RTU Safeties & Faults Added 11. MAGNUM Alarms & Safeties Updated 9.2 DETERMINE BUILDING MODES Updated 5.10.3. MOD GAS STAGE HEATING STATES: Changed Setpoint from #186“Mod Gas ignition” to #185 “Mod Gas multiplier & divisor & time that the gas stage must be off “. Updated 5.8. SELECTING HEATING INO (MOD GAS) Photo Removed 6. RTU MCS CONNECT DISPLAY INFORMATION Removed Setpoint #125 “Eco StageDly” Updated Setpoints: Setpoint #131 “CO2 opening” Setpoint #136 “Supply fan adjustment multiplier & divisor” Setpoint #137 “Relief fan adjustment multiplier & divisor” Setpoint #138 “Relief damper multiplier & divisor” Setpoint #141 “Heat Reclaim multiplier & divisor” Setpoint #207 “CO2 Modulating Multiplier/Divisor” Setpoint #224 “Heat VFD adjustment multiplier & divisor” Setpoint #45 “CND STG1 ON” Setpoint #46 “CND STG1 OFF” Setpoint #47 “CND DIFF ON” Setpoint #48 “CND DIFF OFF” Setpoint #48 “DUAL PSI DELTA” Setpoint #49 “CND MIN RUN” Setpoint #49 “DUAL TIME DELAY” Setpoint #50 “LO AMB SUMP OFF” Setpoint #51 “CND VFD MIN” Setpoint #54 “CND MIN SPD” Setpoint #55 “CND MAX SPD” Updated 5.3. SELECT COOLING INFO Updated 5.4. SELECT CONDENSER INFO Updated Revision Page
04-04-13	MAS	REV 1.7 Updated Setpoints: Setpoint #43 “CENT P-DWN FLA”, Setpoint #44 “CENT P-DWN TMR”, Setpoint #132 “Enable Economizer” changed to NOT USED Setpoint #119 “EcoOffsetON” Setpoint #120 “Eco Stg Dely” changed to RESERVED Setpoint #123 “Eco MAX ADJ” Added Setpoint #139 “OIL LEVEL” Setpoint #167-170 is Only used with Screw Compressor. Setpoint #184 “Mod Gas Adjustment” Setpoint #185 “Mod Gas multiplier & divisor & time that the gas stage must be off” Setpoint #187 “Mod Gas Fan switch to high speed” Setpoint #188 “Energy Recovery Wheel Fault” changed to “Energy Wheel Alarm” Setpoint #190 “Warm Up” Setpoint #192 “EconAdjLOSup” Setpoint #195 “CFM Adjustment TARGET” Setpoint #196 “Return Fan Multiplier/Divisor” Setpoint #213 “REHEAT TIMER” Setpoint #220 “Enable dehumidification mode” Setpoint #222 “Heat VFD adjustments” changed to RESERVED Setpoint #224 “Heat VFD adjustment multiplier & divisor” changed to RESERVED Updated 5.1.5. Unit Sensors Updated 5.9. Select Heating Info (MOD GAS) Updated 5.12. Select Heating Type (Direct Fire) Added Section 5.16. Split Manifold Heating Updated 12.10. “Energy Recovery Wheel Alarm (No Rotation)” changed to “Energy Wheel Alarm (No Rotation)” Updated 12.11. “Energy Recovery Wheel Alarm (Fault)” changed to “Energy Wheel Alarm (Fault)”

Date	Author	Description of Changes
10-18-13	MAS	REV 1.8 Updated All Setpoints Updated 7.3. Outdoor Air Damper Updated 7.6. Energy Recovery Wheel (ERW) wheel Updated 7.7. Energy Recovery Wheel (ERW) control logic Updated 13. Select Heating Info (MOD GAS) Update 25.3. Determine Unit Mode - Dehumidify mode Updated Photos
03-23-15	DEW	Changes pages 58 PHE-HEAT Sequence of Operations reversed
04-08-15	DEW	Change page 81 setpoint 108
05-14-15	DEW	Move to Indesign, edits, update setpoints
06-29-30-15	DEW	Change format in Indesign
08-24-15	DEW	Changes to format only
08-31-15	DEW	Changes to EXV Suction/Dischsarge pages
09-27-16	DEW	Add changes to setpoint 11 and 231
10-4,5-17	DEW	Fix setpoint 119 as per DC, clean up manual, add Keypad screen shots
11-01-17	DEW	Add setpoint 119 as target for Economizer
12-11-17	DEW	Add Target type to setpoint 56 as per Danny Chapman
05-16-18	DEW	Added Reheat Flushing info
05-24-18	DEW	Corrections from Danny C on Reheat Flush
07-23-18	DEW	Add Oil Recovery Logic Variable speed & Fixed Speed Scroll Compressor
07-23-18	DEW	Made change to setpoint 129 as per Brett
08-14-18	DEW	Updated section on EXV Superheat - Add BMS info to this manual
12-11-18	DEW	Add Superheat module to RTU manual
12-18-18	DEW	Updated Setpoint #1 as per Jeff
12-6-2019	DEW	Add section on Single Zone VAV support
04-17-2020	DEW	Changed description for Setpoint 159 as per BWW
05-05-2020	DEW	hot gas reheat for dehumidification
05-20-2020	DEW	REV 3.1 Updated Chapter Condenser Control Logic - added screen shot to Condenser Reset
06-17-2020	DEW	Modify the EXV section, added separate SSH, SSH2, PID section
08-05-2020	DEW	Modify the BMS section, add Unit States, etc.
08-11-2020	DEW	Changes made to setpoints 251-255
02-02-2021	DEW	Added UNLOAD RELAY AND COAST EMERGENCY STOP CIRCUIT BASE
12--2-2021	DEW	Added into for “load proof” for supply fan
12-2-2021	DEW	Worked on section 4 on Outdoor Air Damper
04-14-2022	DEW	Update photos, etc
04-27-2022	DEW	Update Chapter on Dehumid
081-12-2022	DEW	rev 3.4.1 - 10/21/2022 Condenser section PIP

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