MICRO CONTROL SYSTEMS

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Magnum Version 8 Manual

Rev. 3.2

HVAC and CENT V8 Software

MCS Total Solution for all your Control Needs

RoHS Compliant

Energy Efficient and RoHS Compliant

The MCS Commitment: Our commitment is to provide practical solutions for the industry's needs and to be both a leader and partner in the effective use of microprocessor controls.

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(Website contains product descriptions, manuals, software releases, troubleshooting aids, etc.)

Revision Page

Date	Author	Description of Changes
11-03-09	RCT	Magnum Manual Rev 1.25 was used as the base for this manual Renamed file to Magnum Version 8 Manual Rev 1.0 to avoid confusion with existing manuals Expanded all items regarding Magnum V8 software
04-09-10	RCT	Rev 1.1 Added pump rotation changes Added process-pump rotation changes Checked and updated all Setpoints including the use of the 'Time (sec)' field Added new Setpoint fields Replaced MCS Connect screens with new versions Corrected items from DB E-mail dated 4/5/10 Reviewed and added compressor types to RO sequence Added low temperature safety and unload section Added high suction superheat for flooded chiller Added section on EXV control and maximum operating pressure control to the EXV logic
05-03-10	RCT	Rev 1.2 Updated the BMS points section for information on all 20 compressors Updated OIL PUMP LUBE state Added section on compressor setup Added section on slide calculation Added section on FLA calculation Added BWW's comments Added Centrifugal Setpoints Added Centrifugal write up and external purge option Added SI16-AO4 and RO10 drawings
05-10-10	RCT	Rev 1.3 Added section on V8 enhancements Corrected BMS entries for circuits 9-20
09-02-10	RCT	Rev 1.4 Expanded section on V8 enhancements Updated Setpoints Updated new functions through 8.013-J Added release version to new functions Updated and expanded the User Defined section
09-13-10	BWW	Rev 1.5 Corrected page 10 statement about MCS-SI16-AO4 board "SI16-AO4; 16 Sensor Inputs, 1 through 12 are universal and 13 through 16 can be either digital or virtual inputs pulse 4 Analog Outputs per board with a maximum of 4 boards." This is not correct; all 16 inputs are universal
10-27-10	WLK	Rev 1.6 Updated EXV logic and Setpoints
05-09-11	WLK	Rev 2.2 General editing/restructuring of manual Updated Setpoints

09-21-11	WLK	Rev 2.3 Added sections about Condenser Liquid Level Control (CLLC), Boiler Control, Defrost Control, and Second Set of Evaporator Pumps/Fans. Added TurboCor alarm section.
09-26-11	WLK	Rev 2.4 Updated section 13.2 Magnum Setpoints
	WLK	Rev 2.5 Added Transmit Software and Transmit/Receive Configuration to Authorization Function page.
12-09-11	BWW	Rev 2.5 Corrected section 7.60 MDP EXV Logic Updated section 13.2 Magnum Setpoints
06-24-12	MAS	Rev 2.6 Updated section 13.2 Magnum Setpoints Added section 7.7.6.4. Excess Purge Logic Updated Hardware
11-26-12	MAS	REV 2.7 Updated section 13.2 Magnum Setpoints Updated Micro Control System's Address
01-07-13	MAS	REV 2.8 Updated section 13.2 Magnum Setpoints Updated section 7.39.1. Economizer Set up Updated Authorization Function
02-13-13	MAS	REV 2.9 Updated section 13.2 Magnum Setpoints Updated Section 7.73. "Condenser Control Logic"
04-04-13	MAS	REV 3.0 Updated section 7.73.3.9. Modulating Condenser Updated section 13.2 Magnum Setpoints Updated 7.4.1. Screw Compressor with Slide Piston Updated 7.75. HVAC Defrost Cycle
10-18-13	MAS	REV 3.1 Updated section 13.2 Magnum Setpoints Added 7.10 Custom Rotation
02-26-15	DEW	Change Front Cover
07-6/8-15	DEW	Move to Indesign

1. Table of Contents

2. Introduction to Magnum V14 Software

Magnum V14 software has been designed to control many different types of compressors of both fixed and variable capacity, as well as many additional features. Supported control options include multiple liquid line solenoids, electronic expansion valves (EXVs), liquid injection, economizers, hot gas bypass, variable frequency drives for compressors (VFDs), digital scrolls, and many more.

Applications vary from control of a single compressor to complex multiple compressor systems. In all applications, however, safety and operating efficiency is of primary importance. The controller interface is made to be informative and meaningful, with built-in logic to prevent unsafe conditions from occurring. This helps reduce or even completely eliminate nuisance alarms.

There are two types of Magnum software described in this manual:

HVAC V14 - This software supports all types of compressors except centrifugals. It supports the configuration type 106 Chiller V14 CFG, as well as 109 Loop Control CFG. If this software is loaded into a Magnum with a different type of configuration file, an invalid configuration type message will be generated.

CENT V14 - This software supports only centrifugal compressors, and requires a configuration type 119 CENT MAG CFG. If this software is loaded into a Magnum with a different type of configuration file, an invalid configuration type message will be generated.

These software types are very similar and most topics will apply to both. However, if a topic applies only to one type it will be labeled as either 'only HVAC' or 'only CENT'.

2.1. Magnum V14 Software Control Point Capacity

- Circuits (compressors) up to 20
- Steps per Compressor up to 4
- Relay Outputs up to 80
- Analog Outputs up to 20
- Sensor Inputs up to 112
- Setpoints 255
- Alarms 100

2.2. Magnum Hardware Supported by Magnum V14 Software

The following MCS boards can be connected together through the MCS-I/O communications terminal block:

- MCS-Magnum (10 RO's, 12 SI's, 4 Digital SI's, and 4 AO's)
- MCS-RO10 (10 RO)
- MCS-SI16-AO4 (16 SI and 4 AO)

The versatility of the Magnum offers the user much flexibility in configuring the controls in an economical way. The limitation is not the number of boards but the total number of points.

2.3. About this Manual

The purpose of this manual is to document MCS's V.14 software for the Magnum. This software requires a configuration type 11 in MCS-Config. Any other type of configuration file will result in an invalid Config message and the unit will not function.

This manual documents how the Magnum V.14 software functions. Since this is a large manual, it is structured in logical sections for ease of reference. The Table of Contents will guide you through the sections but you are urged to read the entire manual. This will provide an understanding of the capabilities of the Magnum Control System and hopefully introduce other ways that you may benefit from the existing control strategies. Quick Reference sheets and MCS Specification sheets are provided in the appendixes.

This manual was created using Microsoft Office, Word 2000. A printed copy may be ordered, please refer to our Price Book. A PDF copy of this manual may be downloaded from our web site at www.mcscontrols.com free of charge.

An approved OEM of MCS may make copies and / or change any section of this manual to develop custom documentation for a site where a Magnum controller is installed. In this way, MCS supports the documentation requirements of individual customer sites.

2.4. About the Magnum

The Magnum is a rugged microprocessor controller designed for the harsh environment of the HVAC/R industry. It is designed to provide primary control without needing mechanical controls. It will interface locally with a null modem serial cable, remotely through an Ethernet connection, and also through building management systems. The Magnum offers a great deal of flexibility with adjustable Setpoints and control options that can be set prior to activating a system or even when the unit is operational. The Magnum is designed to safeguard the system being controlled, minimize the need for manual intervention, and to provide a simple but meaningful user interface.

2.5. MCS 485 Network

The MCS 485 Network can support up to 20 Magnum's and their associated I/O boards. Access to this network can be local through a RS232 or Ethernet connection, or remotely through a 14.4K Baud modem. When using the dialup connection through a modem there is no degradation in the performance of the network.

Each Magnum in the network must be assigned a unique address in the configuration file. This address will be the key in establishing communications with the appropriate Magnum system. It can be viewed or changed from the LCD / keypad of the unit with Factory authorization.

Notes:

- RS 232 transmissions should not exceed 50' in length.
- RS 485 transmissions should not exceed 1 mile without a repeater.

2.6. MCS Ethernet Port

When connecting directly through the 100 MBPS Ethernet port on the Magnum from a PC it is necessary to use a crossover Ethernet cable.

3. PC Support Software for Magnum

MCS-Config provides the configuration file (.cfg), which includes the input/output points list, Setpoints, circuit information, etc., for all versions of software. This program is designed to assist and make the task of building the configuration file as simple as possible. A manual created in a PDF format is available on our web site: www.MCScontrols.com, or available in other formats upon request.

MCS-Connect provides both local and remote communications to the Magnum independent of software type. Local communications can be either through an RS485 or Ethernet connection. This program displays the status of the controller, and changes can be made to the system with proper authorization. Configuration files can be transmitted to or received from a Magnum unit. The Magnum automatically performs history logging and this program allows the data to be presented in a useful graph form. A manual created in a PDF format is available on our web site: www.MCScontrols.com, or available in other formats upon request.

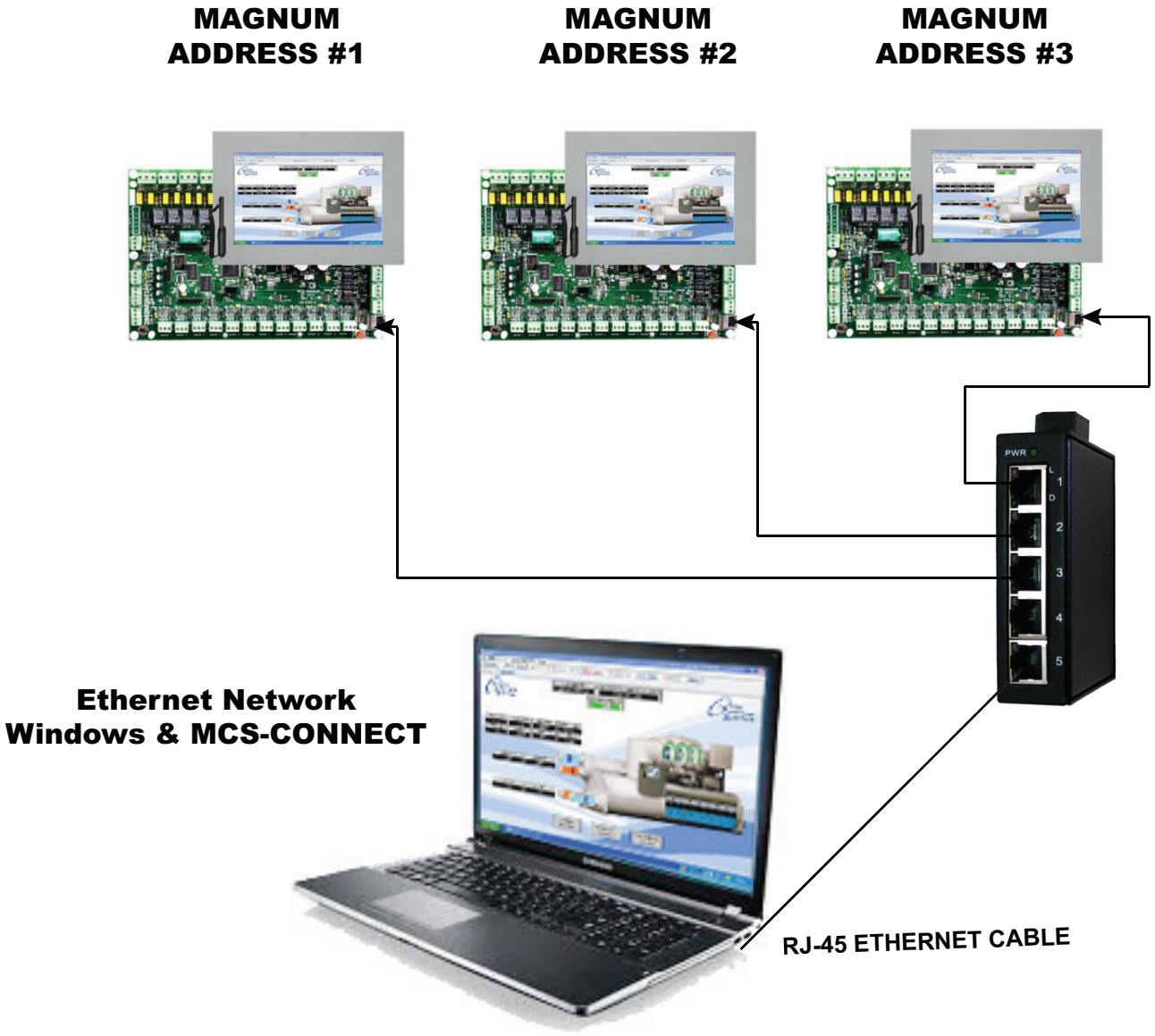
3.1. Requirements for PC Software

To install and run the program we suggest the following system requirements:

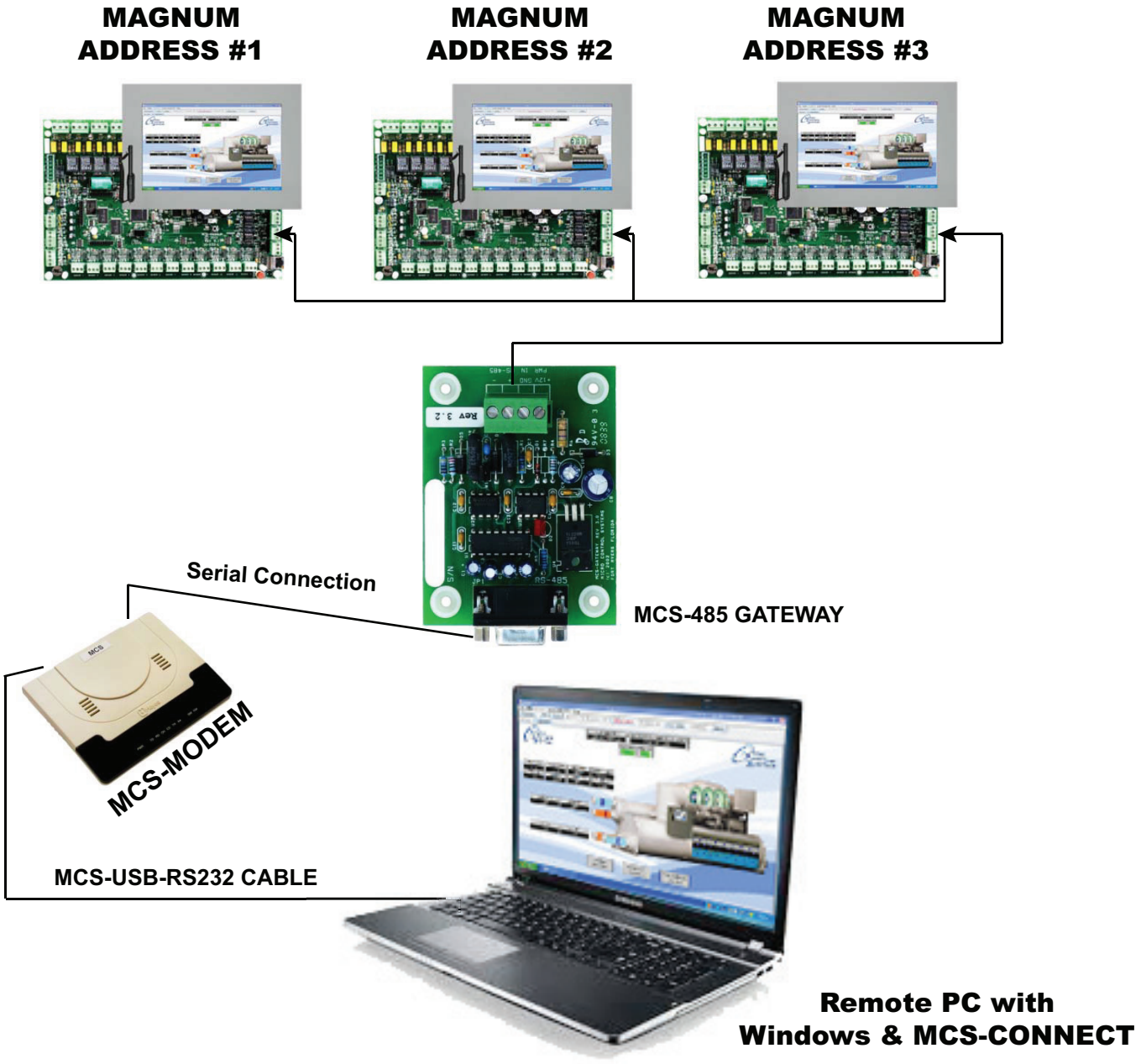
Minimum System Required to Run Program

- PC with a Pentium-class processor
- Windows 7 or later operating system or
- Linux operating system
- Minimum 1GB of RAM
- Minimum 4GB Drive
- 14.4k baud modem or higher for remote
- Communications
- 1280 x 800 pixel or higher display

4. Network Connection - Ethernet



5. Network Connection - Remote



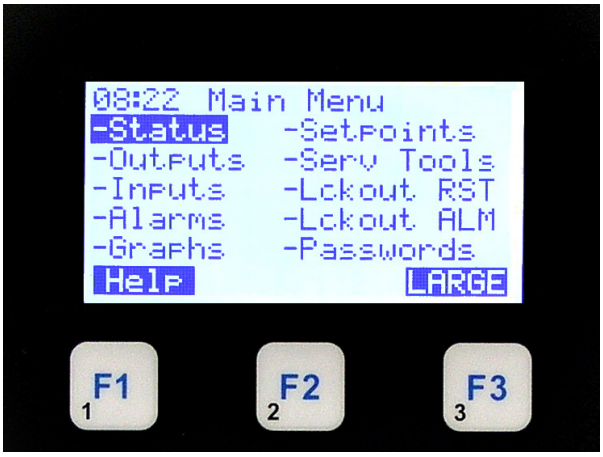
6. Magnum Displays

The following is an examination of all the information screens that can be accessed through both the Magnum keypad and MCS-Connect program.

6.1. Magnum keypad and display

6.1.1 Menu Screen

The main menu is accessed by pressing the “Menu” key.



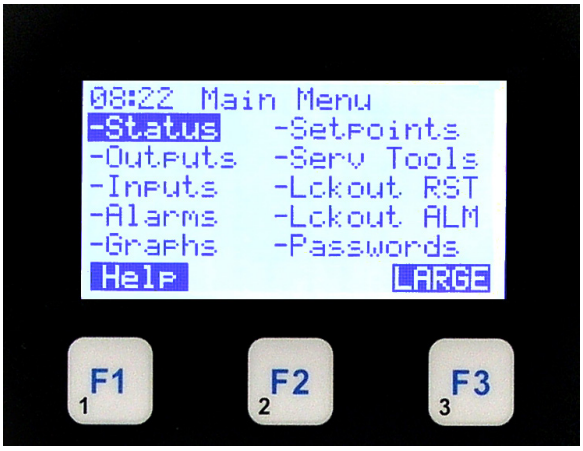
Select ‘F1’ (Help)

Pressing the Menu Key

Results in displaying the 10 available Menu items.
The highlight is on the Status display.
To select any item use the ▲ ▼ ◄ ► arrow keys to position the highlight and press ↵.
To understand the options select F1 for help.
For a LARGE display of the current chillers performance press F3.

6.1.2 Introduction to Status Screens

The current status of the unit and compressors is displayed by selecting the “Status” option from the “Menu” screen. This following screen will be displayed. By pressing the PG ⬆ or PG ⬇ function keys you will get additional information on each compressor.



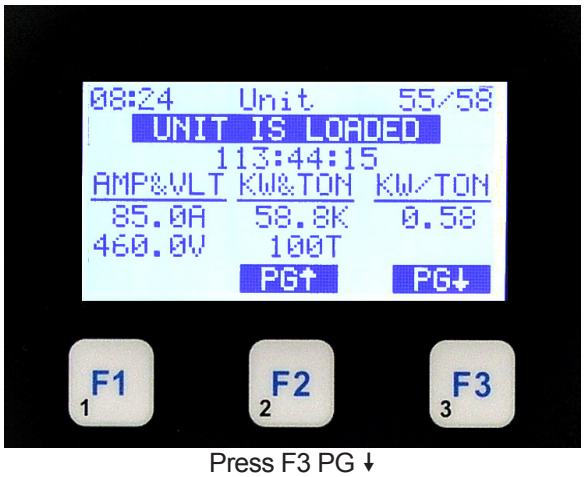
Press ↵

Pressing the Menu Key

Results in displaying the 10 available Menu items.
The highlight is on the Status display.
To select any item use the ▲ ▼ ◄ ► arrow keys to position the highlight and press ↵.
To understand the options select F1 for help.
To display the current Status Screens press the Enter Key.

6.1.3 Unit Tonnage and KW Information

If tonnage/KW information is available the following screen is added to the status screens:



Press F3 PG ↓

Unit Status KW/TON

- On the top line right chiller out & chiller in is displayed rounded to a whole number.
- The second line shows Unit status.
- The third line shows time in that mode.
- The next two lines show the following:

  -Current amps -Current voltage
  -Current KW -Current tons
  -Current KW/Ton

- This information is only available if the sensors are provided.

The above screen is based upon flow of 230 GPM and power factor (PF) of 1. All other values in the calculation are displayed on the screen.

6.1.4 Purge Status Screen (only if Purge cycles are active)

ACTUAL DISPLAY

```
09:55      PRG 1      45/54
           A-PRG OFF
    000:00:42        MODE COOL
SUC-LT     FLOAT     24TMR
 20F       NORMAL    27mi

                PG↑        PG↓
```

DESCRIPTION

```
HH:MM            Purge Circuit          LEV/ENT TMP
                 CURRENT PURGE STATE
   TIME IN CURRENT STATE                UNIT MODE
SUC-LT                  FLOAT                  24 TMR
Temperature of      Safety Float      Purge Run Time
suction line          Status        in last 24 hours
                    PAGE UP              PAGE DOWN
```

6.1.5 Compressor status

Press F3 PG↓

Compressor 1 PSI & Temp

- On the top line right chiller out & chiller in is displayed rounded to a whole number.
- The second line shows Circuit status.
- The third line shows time in that mode.
- The next two lines show the following:

  -Suct psi -Suct temp
  -Disc psi -Disc temp
  -Oil psi differential -Oil temp
  -Motor % -Motor temp

6.1.6 COMPRESSOR1 STATUS (Superheats)

Press F3 PG↓

Compressor 1 Superheats

- On the top line right chiller out & chiller in is displayed rounded to a whole number.
- The second line shows Circuit status.
- The third line shows time in that mode.
- The next line shows the following:

  -Sat Suct Tmp -Suct Superheat
  -Sat Cond Tmp -Disc Superheat

- The function keys F1 & F2 allow paging up or down.

6.1.7 Compressor status (only CENT)

ACTUAL DISPLAY

```
09:55      CMP #1      45/54
          CMP OFF/READY
             000:00:42
AROC  LROC     CNT     LIFT
0.0A  0.0P      0c      45F
0.0A  0.0P      0c     0.8F
              PG↑       PG↓
```

DESCRIPTION

```
HH:MM              COMPRESSOR          LEV/ENT TMP
                CURRENT CONTROL STATE
                TIME IN CURRENT STATE
AROC               LROC          CNT         LIFT
Current Comp.   Current Amp     Lift     Current Lift
Amp R.O.C.      Lift R.O.C.    Count
Last Comp.      Last            Lift
Amp R.O.C.      Lift R.O.C.    Count     Lift Ratio
                       PAGE UP                PAGE DOWN
```

6.1.8 EXV status

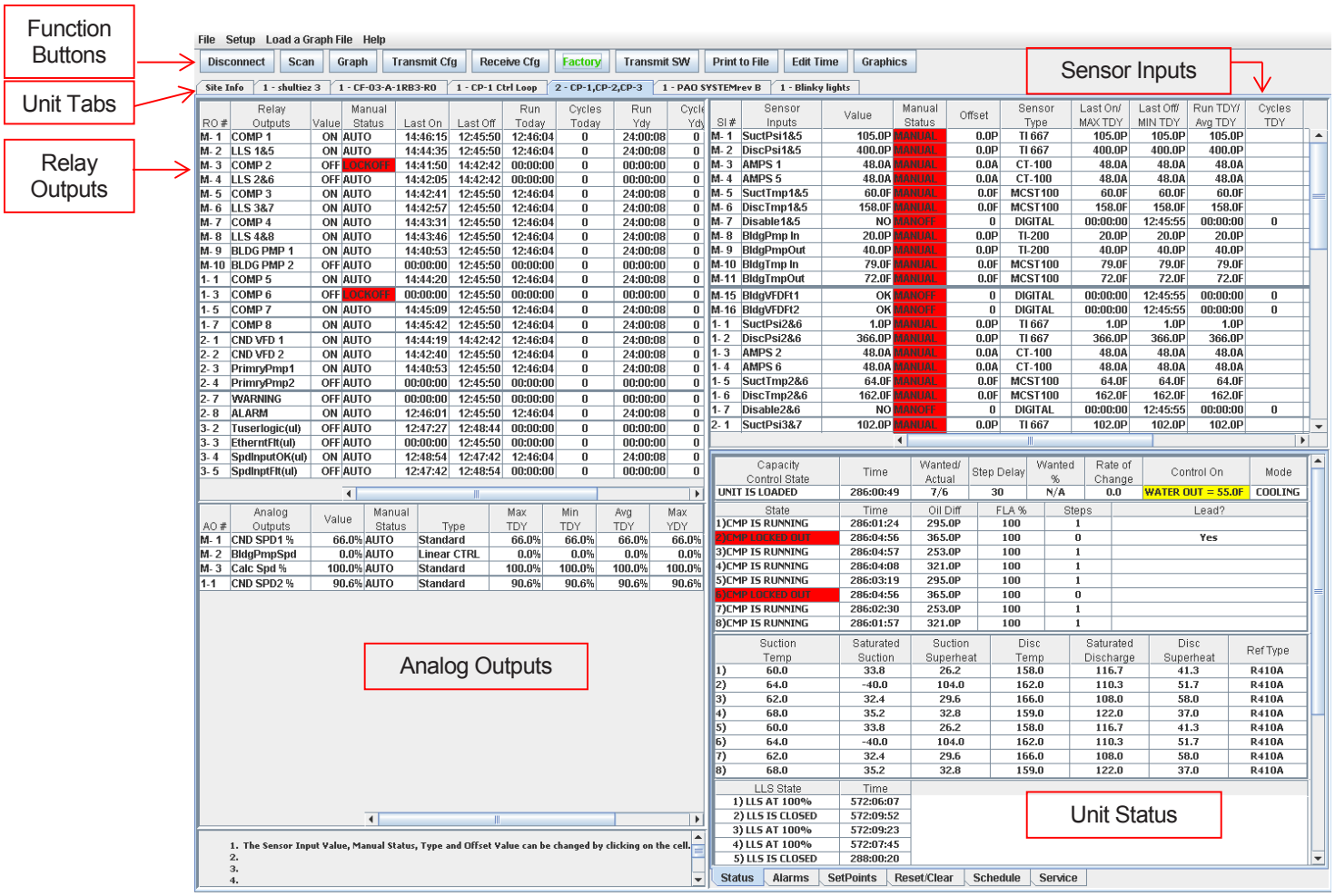
ACTUAL DISPLAY

```
09:55      EXV #1      45/54
          IS HOLDING
             000:36:42
VLV%   DELAY    SPHT     ROC
 27      60     12.2     0.0
              PG↑       PG↓
```

DESCRIPTION

```
HH:MM          ELECTRONIC EXP VLV          LEV/ENT TMP
                CURRENT CONTROL STATE
                TIME IN CURRENT STATE
VLV OPEN%   TIME DELAY     SUCT SHEAT     ROC
Percent     Delay To       Temperature    Rate Of
            Next Change                   Change
                       PAGE UP                PAGE DOWN
```

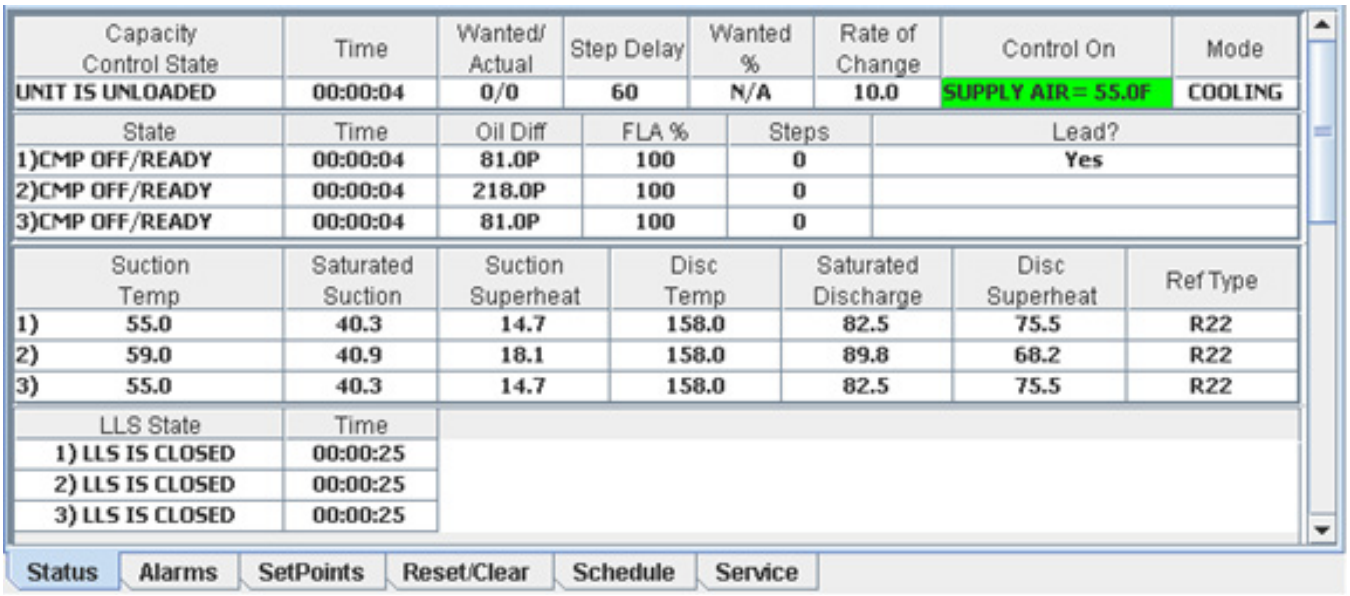
7. HVAC STATUS Display (MCS-Connect)



The screenshot above shows the following features:

- The top row of buttons provides function selection within MCS-Connect.
- The authorization level button is located in this row; it will automatically update to display the current authorization level. The example above is at a factory level authorization.
- Just below the top row of buttons, there is a row of tabs. The first is the Site Information screen which will show you details of all the Magnum controllers available to establish a connection, the remaining tabs allow you to access to each one respectively.
- There are four quadrants of information displayed for each Magnum controller, namely: Relay Outputs, Analog Outputs, Sensor Inputs, and Unit Status (with six sub-menus of Status, Alarms, Setpoints, Reset/Clear, Schedule, and Service). Note: these screens may not always be displayed in the same position; MCS-Connect will automatically adjust the screen arrangement for optimum display information.

The status of the Capacity Control States, Compressor Control States and EXV Control States can be viewed from MCS-Connect by clicking the “Status” screen in the Unit Status quadrant. The following screen will be displayed:



Capacity Control State	Time	Wanted/ Actual	Step Delay	Wanted %	Rate of Change	Control On	Mode
UNIT IS UNLOADED	00:00:04	0/0	60	N/A	10.0	SUPPLY AIR = 55.0F	COOLING

State	Time	Oil Diff	FLA %	Steps	Lead?
1)CMP OFF/READY	00:00:04	81.0P	100	0	Yes
2)CMP OFF/READY	00:00:04	218.0P	100	0	
3)CMP OFF/READY	00:00:04	81.0P	100	0	

	Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat	Ref Type
1)	55.0	40.3	14.7	158.0	82.5	75.5	R22
2)	59.0	40.9	18.1	158.0	89.8	68.2	R22
3)	55.0	40.3	14.7	158.0	82.5	75.5	R22

LLS State	Time
1) LLS IS CLOSED	00:00:25
2) LLS IS CLOSED	00:00:25
3) LLS IS CLOSED	00:00:25

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

System (unit) information is shown in the top section:

- **Capacity Control State** - State of chiller
- **Time** - Time spent in current state. If the state is UNIT IN POWER UP time will count down to zero.
- **Wanted / Actual** - Number of capacity steps Wanted On versus Actual On.
- **Step Delay** – Value that is counted down. The sensitivity and difference between the control sensor and control zone will determine the speed of the countdown. When this value reaches zero, the controller will determine if a change in the system capacity is required.
- **Wanted %** - Wanted slide percentage.
- **Rate Of Change** – Rate of Change of control sensor.
- **Control On** - The control sensor value. The name and the reading will be displayed, with color to indicate its relationship to the target Setpoint.
- Mode - The mode can be either COOLING or HEATING.

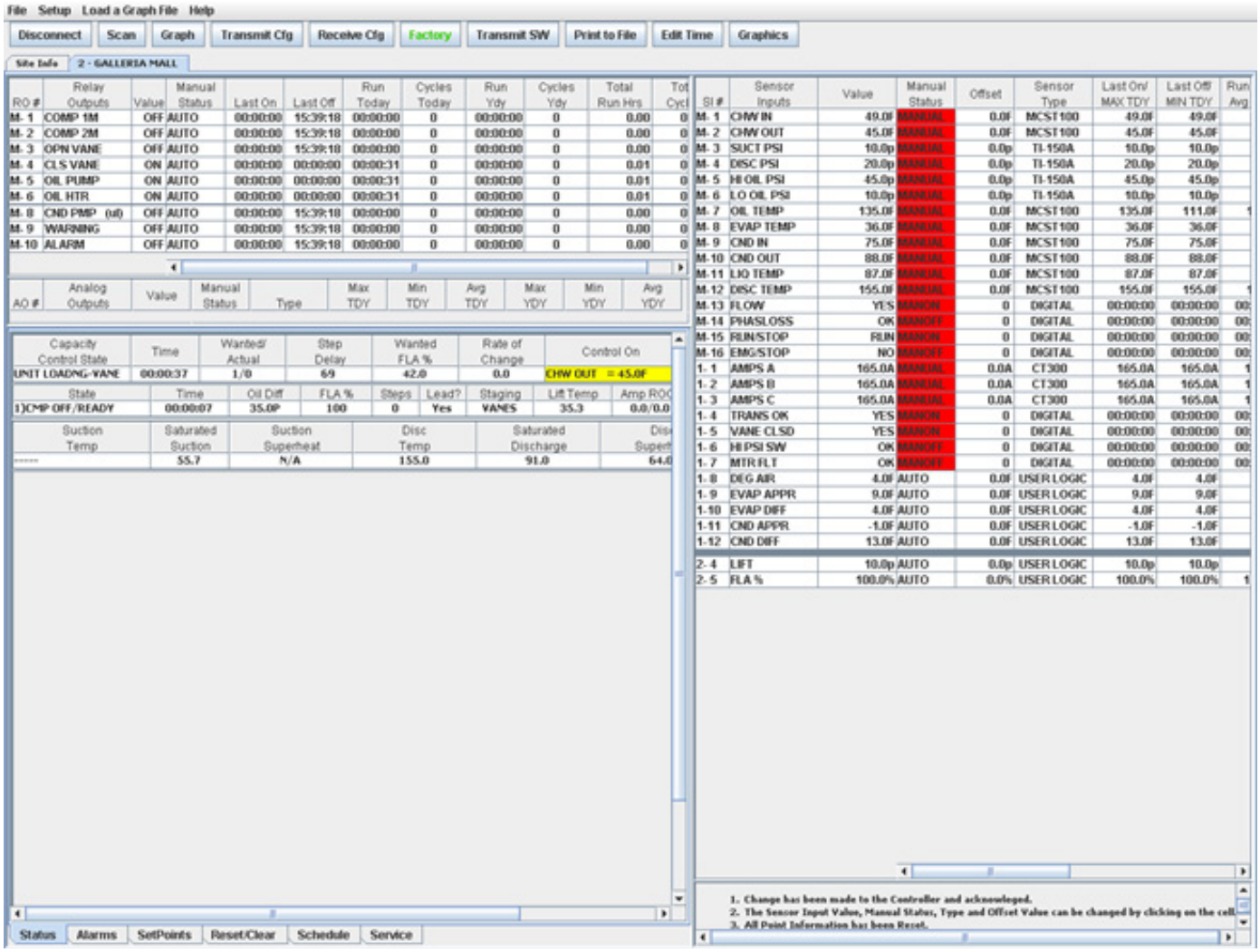
Compressor information (all active compressors will be displayed):

- **State** - Compressor number and state. The default Compressor number can be changed in MCS-Config with a 3 character entry in the “Comp Name/ID” column of the Circuit Base screen.
- **Time** - Time spent in current state. If the state is CMP ANTICYCLE time will count down to zero.
- **Oil Diff** - Oil differential pressure. It is calculated as follows:
  - Semi hermetic screws.....Oil PSI - Suction PSI
  - OR .....Discharge PSI - Suction PSI
  - Open drive horizontal and Carlyle screw compressor ..Oil PSI - Discharge PSI
  - Reciprocating compressors .....Oil PSI - Suction PSI
  - All Others .....Oil PSI - Discharge PSI
- **FLA %** - Full Load Amps based on the compressor’s respective Setpoint. For screw compressors this calculation is based current operating conditions.
- **Steps** - Indicates number of steps associated with this compressor that are turned on.
- **Lead?** - YES will be displayed for the lead compressor.

Compressor Superheat information:

- **Suction Temp** - Compressor number and Suction Temperature, if available.
- **Saturated Suction** - Calculated Suction Saturated Temperature (R22, R134a, R407c, and R410a are supported).
- **Suction Superheat** - Calculated Suction Superheat, only available if both the Suction Temperature and the Suction Pressure are used. Suction Superheat = Suction Temperature - Suction Saturated Temperature.
- **Disc Temp** - Discharge Temperature, if available.
- **Saturated Discharge** - Calculated Discharge Saturated Temperature (R22, R134a, R407c, and R410a are supported).
- **Disc Superheat** - Discharge Superheat is available only if both the Discharge Temperature and the Discharge Pressure are used. Discharge Superheat = Discharge Temperature - Discharge Saturated Temperature.
- **Ref Type** – Refrigerant type used.

7.1. CENT Status Display (MCS-Connect)



The Control Status for centrifugal compressor portion of the Status screen is shown below.

Capacity Control State	Time	Wanted/ Actual	Step Delay	Wanted FLA %	Rate of Change	Control On	Mode	CTRL LIFT
UNIT LOADNG-VANE	00:04:48	1/1	36	69.0	0.0	CHW OUT = 45.0F	COOLING	35.3

State	Time	Oil Diff	FLA %	Steps	Lead?	Staging	Lift Temp	Amp ROCs	Lift ROCs	Amp/Lift Surges
1)CMP CLOSE VANE	00:05:17	35.0P	100	1	Yes	VANES	35.3	0.0/0.0	0.0/0.0	0.0/0.0

Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat	Ref Type
-----	55.7	N/A	155.0	91.0	64.0	R11

Centrifugal (unit) information is shown in the top section:

- **Capacity Control State** - State of chiller
- **Time** - Time spent in current state. If the state is UNIT IN POWER UP time will count down to zero.
- **Wanted / Actual** - Number of capacity steps Wanted On versus Actual On.
- **Step Delay** – Value that is counted down. The sensitivity and difference between the control sensor and control zone will determine the speed of the countdown. When this value reaches zero, the controller will determine if a change in the system capacity is required.
- **Wanted FLA %** - Wanted Full Load Amp percentage.
- **Rate Of Change** – Rate of Change of control sensor.
- **Control On** - The control sensor value. The name and the reading will be displayed, with color to indicate its relationship to the target Setpoint.

- **Mode** - The mode can be either COOLING or HEATING.
- CTRL LIFT – Control Lift = Saturated Discharge Temperature - Saturated Suction Temperature (OR) Turbine Input PSI (converted to temperature).

Compressor information (all active compressors will be displayed):

- State - Compressor number and state. The default Compressor number can be changed in MCS-Config with a 3 character entry in the “Comp Name/ID” column of the Circuit Base screen.
- Time - Time spent in current state. If the state is CMP ANTICYCLE time will count down to zero.
- Oil Diff - Oil differential pressure. It is calculated as follows:
- Centrifugal compressors: Oil Pressure – Pre-oil Filter Pressure
- FLA % - Full Load Amps based on the compressor’s respective Setpoint.
- Steps - Indicates number of steps associated with this compressor that are turned on.
- Lead? - YES will be displayed for the lead compressor.
- Staging – This field will display “VANES” for centrifugal compressors
- Lift Temp – If an Inlet Pressure sensor is specified in the configuration, then this value will equal Saturated Discharge Temperature – Inlet PSI (converted to temperature). If no Inlet Pressure sensor is present, this value will equal Saturated Discharge Temperature - Saturated Suction Temperature.
- Lift ROC’s – Current lift Rate Of Change/ Last lift Rate Of Change
- Amp/Lift Surges – This field is a counter for the number of amp and lift surges respectively.

Compressor Superheat information:

- Suction Temp - Compressor number and Suction Temperature, if available.
- Saturated Suction - Calculated Suction Saturated Temperature (R22, R134a, R407c, and R410a are supported).
- Suction Superheat - Calculated Suction Superheat, only available if both the Suction Temperature and the Suction Pressure are used. Suction Superheat = Suction Temperature - Suction Saturated Temperature.
- Disc Temp - Discharge Temperature, if available.
- Saturated Discharge - Calculated Discharge Saturated Temperature (R22, R134a, R407c, and R410a are supported).
- Disc Superheat - Discharge Superheat is available only if both the Discharge Temperature and the Discharge Pressure are used. Discharge Superheat = Discharge Temperature - Discharge Saturated Temperature.
- Ref Type – Refrigerant type used.

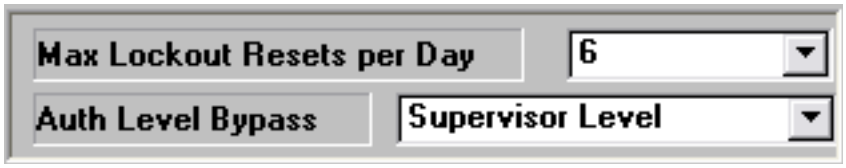
8. Authorization Function

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.

Based upon the authorization level the following changes can be made through the Keypad/Display:

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

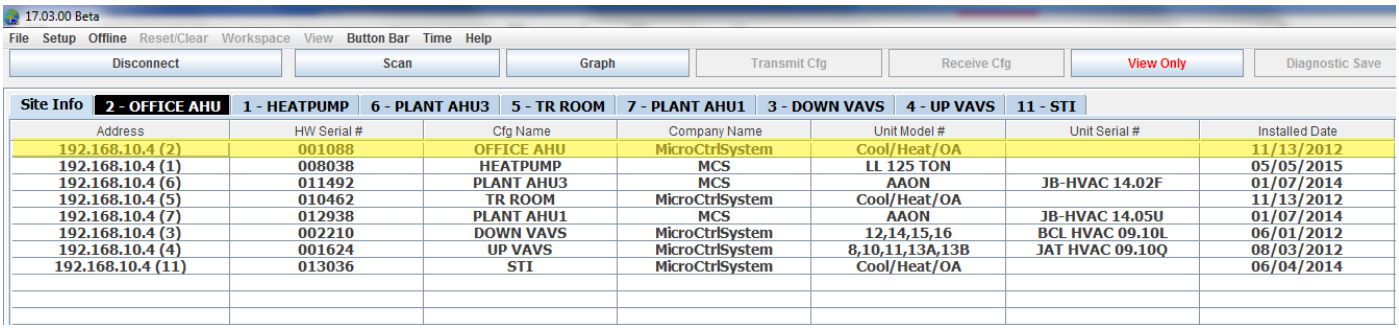
* Setpoints may have individual authorization levels; you must have the proper authorization to view or edit them.
**See the Setup screen of the configuration for authorization level(s) that are allowed unlimited resets per day. Authorization levels below 'Auth Level Bypass' are allowed only a limited number of resets. Authorization levels at and above 'Auth Level Bypass' are allowed unlimited lockout resets.



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

1. Press 'Menu'
2. Using ↑ ↓, →, or ← keys, move cursor to 'Passwords'
3. Press ↵ key.
4. Enter 4 digit password and press ↵
5. The authorization will be displayed.
6. Press 'Menu' to make next selection.

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 on desired Magnum in the Site Information screen.
2. Click View Only 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.

9. Magnum Control States

The Magnum controller is a state computer, that is, decisions are made based upon Setpoints, timers and Sensor Inputs, the controller moves from one state to another. The controller will change states to ensure the proper functioning of the chiller package.

As we review the various states, we must remember that a chiller package consists of a number of different parts or functions: the compressors and their related items such as unloaders hot gas bypasses, etc.; evaporator; and condensing functions.

Both the Capacity Control States and Compressor Control States are displayed in the Status screens on the Keypad Display. To view the state of the chiller, select the Status option from the menu on the Keypad. You can then view the entire status by using the page up / down function keys. The information can also be accessed through MCS-Connect under status screen by clicking on the CONTROL STATUS button.
4.1. Unit 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.

9.1. 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.

9.2. 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.

9.3. 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.

9.4. 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.

9.5. 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 chiller package. This state will end when more or less capacity is required.

9.6. UNIT UNLOADING (6) Only HVAC software

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.

9.7. UNIT UNLDNG-VANE (6) Only CENT software

This state is entered when less capacity is required and the vanes are not completely closed. The close vane relay will be modulated. The compressor speed will not be reduced in this state. Control temperature can be below the control zone, or in the zone but the temperature is dropping too fast.

9.8. UNIT IS LOADING (7) Only HVAC software

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.

9.9. UNIT IS LOADNG-VANE (7) Only CENT software

This state is entered when more capacity is required (control temperature above control zone) and the vanes are not 100% open. The open vane relay will be modulated. The compressor speed will not be changed in this state.

9.10. 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 V8 screen. When this sensor is trips, 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.

9.11. RUN/STOP SW OFF (9)

This state is entered when the run stop switch is off, in the stop position. When the chiller 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.

9.12. SCHEDULED OFF (10)

This state is entered when the schedule is calling for the package to be off. When the chiller 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.

9.13. OFF- NO FLOW (11)

This state is entered when the evaporator flow switch is off. When the chiller 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 chiller will lockout on no flow.

9.14. 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 chiller 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.

9.15. UNIT IS UNLOADED (15)

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

9.16. UNIT IS LOADED (16)

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

9.17. OFF TMP-ICE MADE (17)

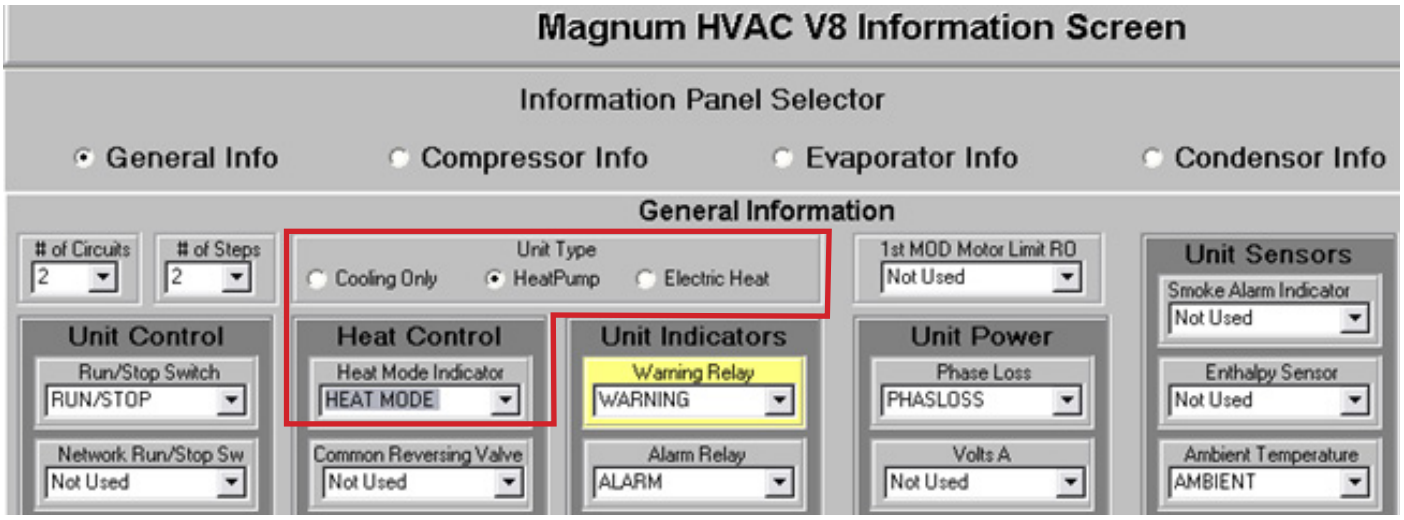
This state is entered when target temperature has been satisfied.

9.18. ECONOMIZER ONLY (18)

This state is entered when mechanical cooling is off and the economizer has been specified in the MCS-Configuration setup and it is being used for cooling. Refer to section 7.39 about Economizers.

9.19. SWITCHING MODES (19)

This state is entered when the unit is switching between cooling mode and heating mode. Only heat pump units or units with electric heat and a Sensor Input selects either the cooling or heating mode will enter this state. Select this information under the MAG V8 screen.



9.20. VaneOpen-SpdHold (19) Only with CENT Software

This state is entered when the control temperature is above the control zone or in the zone but the control temperature is rising too fast but waiting for an indication that the compressor vanes are fully opened and it is before the compressor speed can be increased. The control temperature is above the control zone.

9.21. 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. See section 6.1.10.

9.22. UNIT OFF UNLDING (21)

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

9.23. 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.

9.24. 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.

9.25. UNIT UNLDNG-VFD (24) Only with CENT Software

This state is entered when it is necessary to unload a centrifugal compressor with a VFD and the vanes are fully open. The VFD will be modulated down to minimum speed before the vane positioning is changed.

9.26. UNIT LOADNG-VFD (25) Only with CENT Software

This state is entered when it is necessary to load a centrifugal compressor with a VFD and the vanes are fully open. The vane positioning will remain the same as the VFD is modulated up to maximum speed.

10. Compressor Control States (number)

All User Logic points can now access the Compressor Control State. The value accessed is the number listed in parenthesis in the following headings.

The action of the compressor control states may result in an increase or decrease in capacity. The Unit Control States may affect or change the Compressor Control States or supersede them altogether.

10.1. LOST IO LOCKED (0)

This state is entered when the Capacity Control State is NO RUN- I/O LOST. Resetting the lockout will move the compressor to the CMP OFF/READY state.

10.2. CMP LOCKED OUT (1)

This state is entered when the Capacity Control State is in UNIT IN LOCKOUT or a safety trip has occurred for this compressor (Examples of safety Setpoints include #77 “LOW SUCTION” and #81 “HI DISC PSI”). Lockouts can be reset without authorization from the keypad or MCS-Connect program, however if the condition causing the lockout has not been corrected, the compressor will again be forced into the LOCKOUT State.

10.3. SWITCHED OFF (2)

This state is entered when the compressor is off due to the pump down switch being on or the compressor flow switch being off. In this state the compressor and all related points, including the liquid line solenoid are off. The compressor will not leave this state unless the pump down switch is turned off. If the pump down switch is turned off, the compressor state will be changed to the CMP OFF/READY state.

10.4. UNLD and PMPDWN (3)

This state is entered when the pump down switch has been turned on or if this compressor is no longer Wanted On. The compressor remains on while the liquid line solenoid is closed. This state is active until the suction pressure reaches Setpoint #61 “PMP DWN OFF” or the time has exceeded Setpoint #62 “PMP DWN DELY”. The compressor will then move to the CMP ANTICYCE state.

10.5. CMP ANTICYCE (4)

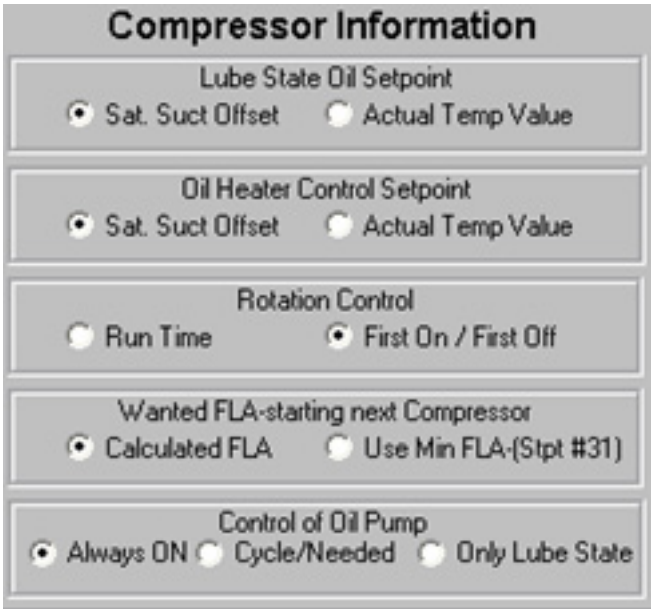
This state is entered when the UNLD and PMPDWN state has been completed. The compressor will stay in this state with all compressor points off for the period of time contained in Setpoint #59 “ACYC OFF-> ON” or Setpoint #63 “ACYC ON -> ON”, whichever is longer. The compressor will then move to the OFF state. NOTE: “ACYC ON -> ON” can be used to set the maximum number of compressor starts per hour.

10.6. CMP OFF/READY (5)

This state is entered when no capacity is required from this compressor, or the last state was CMP ANTICYCE, LOST I/O LOCKED, or SWITCHED OFF. In this state the compressor is ready to provide capacity if needed. The compressor will remain in this state for a minimum of 60 seconds.

10.7. OIL PMP LUBING (6)

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 Compressor Information button under the MAG V8 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.

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.

10.8. NOT USED (7)

10.9. CMP UNLOADED (8)

For variable step compressors, this state occurs when the slide is fully unloaded (indicated by unloaded input or after the unloader is pulsed for 30 seconds with no change). For fixed step compressors, this state occurs when the compressor is on and fully unloaded. In this state the compressor is supplying its minimum cooling capacity.

10.10. CMP UNLD STEP1 (9) Only HVAC Software

This state only applies for fixed step capacity compressors with a Hot Gas Bypass solenoid. In this state the Hot Gas Bypass solenoid is off and all unloaders in the compressor are on.

10.11. CMP DECR SPEED (9) Only CENT Software

In this state the compressor speed will be decreased.

10.12. CMP UNLD STEP2 (10) Only HVAC Software

This state only applies for fixed step compressors with two unloaders. This state occurs when the Hot Gas Bypass solenoid, if present, is off, the first unloader solenoid is off, and the second unloader solenoid is on.

10.13. CMP INCR SPEED (10) Only CENT Software

In this state the compressor speed will be increased.

10.14. CMP IS HOLDING (11)

This state only applies for variable step compressors. In this state, the required refrigeration capacity of system is being met; no movement of the slide valve is required.

10.15. CMP IS LOADING (12) Only HVAC Software

For variable step compressors, this state occurs when the load solenoid is being pulsed to increase the capacity of the compressor. The duration of the pulse is specified in the Setpoint #37 “LOAD PULSE” and the frequency of the pulse is determined by Setpoint #56 “PULSE DELAY”. The Setpoint “PULSE DELAY” should be a value of between 3 and 5 seconds to allow the amp sensor to reflect the change.

10.16. CMP OPEN VANES (12) Only CENT Software

In this state the vanes are being opened because more capacity is required.

10.17. CMP IS UNLDING (13) Only HVAC Software

For variable step compressors, this state is when the unload solenoid is being pulsed to reduce the capacity of the compressor. The duration of the pulse is specified in Setpoint #38 “UNLOAD PULSE” and the frequency of the pulse is determined by Setpoint #56 “PULSE DELAY”. The Setpoint “PULSE DELAY” should be a value of between 3 and 5 seconds to allow the refrigerant to enter the chamber slowly enough to not cause oil foaming.

10.18. CMP CLOSE VANES (13) Only CENT Software

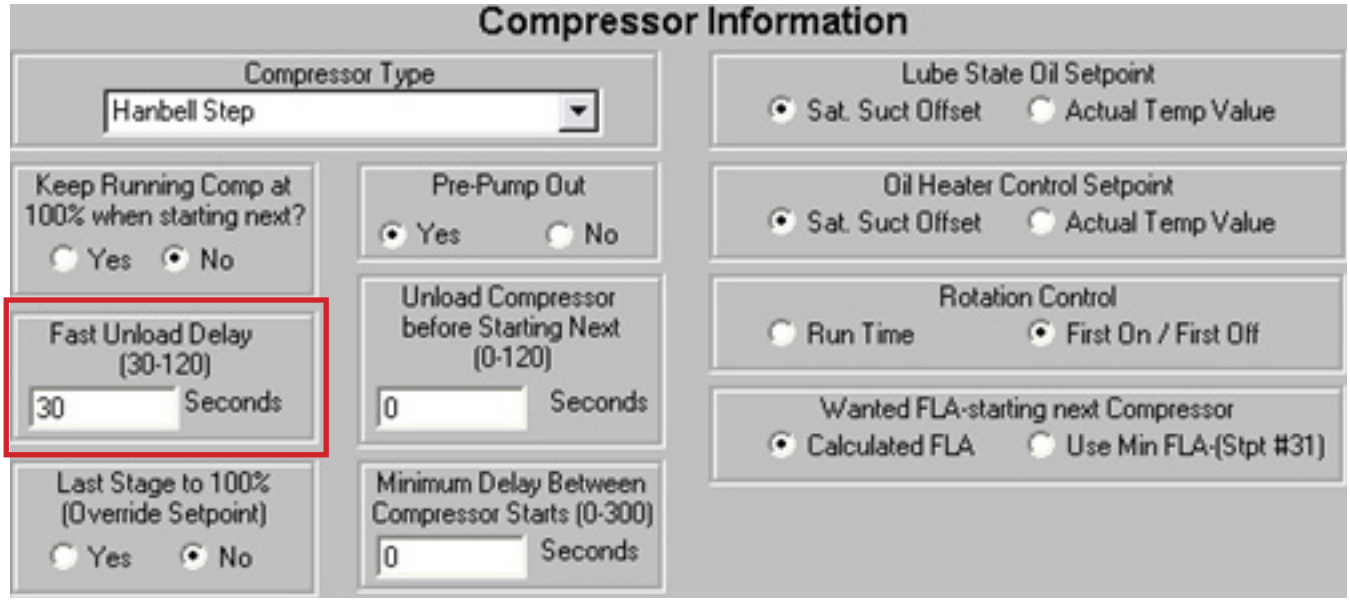
In this state the vanes are being closed because less capacity is required.

10.19. CMP IS RUNNING (14)

For fixed capacity compressors only, this state occurs when the compressor is fully loaded. In this state, the compressor is providing the maximum amount of cooling capacity.

10.20. FAST UNLOADING (15)

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 Compressor Information button in the MAG V8 screen.



10.21. LO SUCT UNLOAD (16)

Refer to Setpoints #77 “LOW SUCTION”; #78 “LO SUCT UNLD”; and #79 “LO SUCT RELD”.
For variable step compressors only. The capacity is being unloaded due to low suction pressure. The compressor will stay in this state until the suction pressure is above Setpoint #79 “LO SUCT RELD”. The system will then move to the LO SUCT HOLD state.

10.22. LO SUCT HOLD (17)

Refer to Setpoints #77 “LOW SUCTION”; #78 “LO SUCT UNLD”; and #79 “LO SUCT RELD”.
Fixed step compressors - This state is entered when a fully loaded compressor that has more than one step is unloading due to low suction pressure. One step of capacity is turned off. The compressor will remain in this state for a minimum of five minutes before returning to the LOADED state if the low suction condition has been corrected.
Variable Step Compressors - Capacity is being held due to low suction pressure. Once the suction pressure returns to a normal operating level the compressor will return to its normal running state.

10.23. HI DISC UNLOAD (18)

Refer to Setpoints #81 ”HI DISC PSI”; #82 “HI DISC UNLD”; #83 “HI DISC RELD”; #87 “HI DISC TMP”; #88 “HI DISC UNLD”; #89 “HI DISC RELD”, and #84 “LO DISC SHEAT”.
For variable step compressors only. The capacity is being unloaded due to a high discharge pressure, high discharge temperature, or low discharge superheat. The compressor will stay in this state until the pressure or temperature has dropped below the corresponding Setpoint. The system will then move to the HI DISC HOLD state.

10.24. HI DISC HOLD (19)

Refer to Setpoints #81 ”HI DISC PSI”; #82 “HI DISC UNLD”; #83 “HI DISC RELD”; #87 “HI DISC TMP”; #88 “HI DISC UNLD”; and #89 “HI DISC RELD”.

Fixed Step Compressors - This state is entered when a fully loaded compressor that has more than one step is unloading due to high discharge pressure or temperature. One step of capacity will be turned off. The compressor will remain in this state for a minimum of five minutes before returning to the LOADED state if the high discharge condition has been corrected.

Variable Step Compressors - Capacity is being held due to high discharge temperature or pressure. Once the discharge returns to normal operating levels the compressor will return to its normal running state.

10.25. SAFETY TRIPPED (20)

This state is entered when a safety trip occurs but a lockout is not generated. An alarm is generated but the system will automatically restart after the delay specified in the corresponding Setpoint. If a second trip occurs within the time specified in the Setpoint, the compressor will be placed in the CMP LOCKED OUT state.

10.26. LO TMP UNLOAD (21)

The following two conditions can cause this state to be entered and the system to begin unloading:
1) The leaving liquid temperature is within 1.5°F of the Setpoint #111 “FREEZE “
2) The refrigerant temperature is less than Setpoint #155 “LO REF TMP” if this Setpoint is active.

10.27. LO TMP HOLD (22)

Reload from the “LO TMP UNLOAD” occurs when the leaving liquid temperature is 3.0° F above Setpoint #111 “FREEZE “and the refrigerant temperature sensor, if present, is greater than Setpoint #155 “LO REF TMP” plus twice the value of Setpoint #156 “LO REF TMP”. Until this temperature is reached the system will remain in the LO TMP HOLD State.

10.28. HI AMP HOLD (23)

Fixed step compressors - This state occurs when a fully loaded compressor experiences an abnormally high amp draw. Refer to Setpoints #171-190 for FLA per compressor (compressors 1-20 respectively) and #75 “HI AMPS %”. In this state, one step of capacity will be turned off. The compressor will remain in this state for a minimum of five minutes before returning to the LOADED state if the high amp draw condition has been corrected.

Variable Step Compressors - This state occurs after HI AMP UNLDING. It will remain in this state for the time specified in Setpoint #101 “SAFETY HOLD DELAY”. If the amp draw is less than the FLA Setpoint for this compressor, it will return to the normal operating state and the compressor will be able to load if necessary. In this state the compressor will not load but it can be unloaded if needed.

10.29. HI DIS TMP HLD (24)

Refer to Setpoints #87 “HI DISC TMP”; #88 “HI DISC UNLD”; and #89 “HI DISC RELD”.
This state is entered when a fully loaded compressor that has more than one step encounters a high discharge temperature. One step of capacity will be turned off. The compressor will then remain in this state for a minimum of five minutes before returning to the LOADED state if the high discharge temperature has returned to normal.

10.30. CMP IS AT 40% (25) Only HVAC Software

For Mitsubishi Screw compressors only. This compressor does not provide variable capacity but has two solenoids used to regulate the compressor capacity. This state occurs when the compressor is providing 40% capacity. In this state, the Relay Output to activate the 40% valve is turned on.

10.31. SURGE SPD/VANE (25) Only CENT Software

This state is entered when the number of surges has exceeded Setpoint #212 “SurgingCount”. The Magnum will take preventive action to attempt to avoid a safety trip due to excess surges. The compressor speed will increase and the vanes closed.

10.32. CMP IS AT 70% (26) Only HVAC Software

For Mitsubishi Screw compressors only. This compressor does not provide variable capacity but has two solenoids used to regulate the compressor capacity. This state occurs when the compressor is providing 70% capacity. In this state, the Relay Output to activate the 70% valve is turned on.

10.33. HI WATER HOLD (27)

When the compressor is running and Setpoint #86 “HI RETURN TEMP” is active, the Magnum will check for high water temperature. If the control temperature is greater than Setpoint #86 for the time specified the Magnum will place the compressor in this state. The system will be unable to load when in this state.

10.34. EXTRA 70% STEP (28) Only HVAC Software

For Mitsubishi Screw compressors only. This compressor does not provide variable capacity but has two solenoids used to regulate the compressor capacity. This will move an extra step for this type of screw compressor.

10.35. OFF-LO OIL TMP (29)

In this state the compressor is disabled. The oil temperature will be checked only if the compressor type is a centrifugal or screw.
Centrifugal compressors - If the temperature is greater than the Saturated Suction Temperature plus Setpoint #39 “LUBE OIL TEMP” this state will be entered.
Screw compressors – If the temperature is greater than the value in Setpoint #39 “LUBE OIL TEMP” this state will be entered.

10.36. HI AMP UNLDING (30)

For variable step compressors this state is entered when the amp draw is greater than the respective FLA Setpoint plus half the value in Setpoint #75, “HI AMPS”. This action is to prevent a high amps safety trip from occurring. Once the amp draw has been reduced the system state will change to HI AMP HOLD.

10.37. DEF PREPMP OUT (31) Only HVAC Software

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 Compressor Information button under the MAG V8 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.

10.38. DEFROSTING (32) Only HVAC Software

Refer to DEF PREPMP OUT state. In this state the hot gas solenoid is opened. The compressor will remain in this state until both coil temperatures are greater than Setpoint #161 “DEF TERM TMP” or the time in this state is greater than the value in Setpoint #162 “DEF TERM DEL”. The compressor will then move to the DEF PUMP DOWN state.

10.39. DEF PUMP DOWN (33) Only HVAC Software

Refer to DEFROSTING state. In this state the hot gas solenoid is closed. The compressor will remain in this state 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 CMP IS HOLDING state.

10.40. HI TEMP UNLOAD (34) Only with HVAC Software

This state is only used when in Heating Mode. The system will unload if Setpoint #152 “HP OVERHEAT” is active and the leaving temperature is greater than the value in Setpoint #152 minus 15°F (8°C). The compressor will then move to the HI TEMP HOLD state when the temperature drops below the value in Setpoint #152 minus 30°F (16°C).

10.41. HI TEMP HOLD (35) Only with HVAC Software

Refer to HI TEMP UNLOAD state. When the temperature drops below Setpoint #152 minus 45°F (24°C) the compressor will return to a normal state.

10.42. SCROLL STEP 1 (36) Only with HVAC Software

Only used with special patterns for Trane Trio and Quad compressors. These compressors provide special staging as follows:

If Trane Trio then COMP C is on and COMP A and B are off.
If Trane Quad then COMP A is on and COMP B, C, and D are off.

10.43. SCROLL STEP 2 (37) Only with HVAC Software

Only used with special patterns for Trane Trio and Quad compressors. These compressors provide special staging as follows:

If Trane Trio then COMP A and B are on and COMP C is off.
If Trane Quad then COMP C and D are on and COMP A and B are off.

10.44. SCROLL STEP 3 (38) Only with HVAC Software

Only used with special patterns for Trane Trio and Quad compressors. These compressors provide special staging as follows:

If Trane Trio then COMP A, B, and C are on.
If Trane Quad then COMP B, C, and D are on and COMP A is off.

10.45. SCROLL STEP 4 (39) Only with HVAC Software

Only used with special patterns for Trane Quad compressors. These compressors provide special staging as follows:

If Trane Quad then COMP A, B, C, and D are on.

11. Standard Control Options

The following options are specified in MCS-Config when building the configuration. These options are used to customize the system to meet the individual control requirements.

11.1. General Options

- Control method can be based upon the control zone or a voltage input indicating the number of stages to be on.
- The control temperature sensor can be either the returning or leaving sensor.
- Electronic expansion valves make dynamic adjustments based on capacity changes.
- Chilled water reset from the Building Management System (BMS).
- Condenser control maintaining sufficient discharge superheat for good oil separation.
- Evaporator pump control.
- Anti-cycle timers (OFF to ON and ON to ON).
- Maximum of 20 circuits per Magnum, with selectable compressor rotation.
- Warning RO (turned on for low suction unload, high discharge unload, etc.).
- Alarm RO (turned on whenever an alarm is generated).
- Optional auto rotation for compressors.
- Low and/or high ambient temperature shut down.

11.2. Magnum Control Zone Logic

The control strategy is designed to modulate the compressor(s) capacity to maintain the control sensor reading within the specified control zone. To accomplish this, the Magnum will constantly monitor the control value, its rate of change, and position in relationship to the control zone and make adjustments accordingly.

The strategies for a fixed step system, reciprocating compressor, reciprocating compressor with an inverter, variable (slide) step system, or a screw compressor are all slightly different. The variable step system allows for infinite variations of capacity while the fixed step system does not.

11.3. Common Definitions

11.3.1 Target

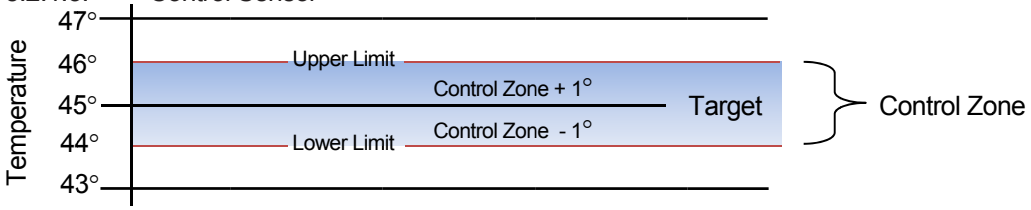
The control target is specified in Setpoint #1. This will be the base of developing the control zone.

11.3.2 Control Zone

The control zone is developed by utilizing two more Setpoints to calculate the upper and lower limits. Setpoint #2 is added to the target to determine the deadband to the upper limit, and Setpoint #3 is subtracted from the target to determine the deadband to the lower limit.

Example: Setpoint #1 Target = 45
Setpoint #2 Upper Deadband = 1
Setpoint #3 Lower Deadband = 1

5.2.1.3. Control Sensor



This sensor has been specified in MCS-Config as providing the control value reading. It will normally be the entering temperature, leaving temperature, or suction pressure. The Setpoints must be adjusted according to the type of control measurement selected.

11.3.3 Control Input Rate of Change

The Rate of Change is how rapidly the control value changes over a set period of time. If the control value is increasing, the rate will be positive; if it is decreasing, the rate will be a negative value. How quickly the input is changing, its direction, and its distance from the control zone will all be used to determine how the Magnum will respond.

11.3.4 Step Delay and Sensitivity

The Magnum will not attempt to take action until the Step Delay counts down to zero. Setpoint #26 contains the initial value. The speed that the counter will decrement by is based on the control input rate of change and the sensitivity that has been specified in Setpoint #25. The purpose of the sensitivity value is to limit how quickly the Magnum reacts to changes indicated by the control sensor. The lower the value of this Setpoint, the faster the Magnum will react to changes of the control sensor.

11.4. Voltage Step Control Logic

An alternate control strategy is based on a variable voltage input to the Magnum board. The different stages of capacity will Cut In or Out depending on the voltage input. This option is selected in the MAG V8 screen under the Evaporator Info tab.

Setpoints #2-18 contain the Cut-In and Cut-Out voltage thresholds. The status screen has been changed to show the actual voltage on the top line and to indicate voltage control on the bottom line. The step delay between adjustments is based on Setpoint #26 “STEP DELAY”.
Note: Liquid Injection and EXV logic are both disabled when this option is used.

11.5. Variable Capacity Control Method

11.5.1 Screw Compressor with slide piston

This option is specified in MCS-Config by selecting the compressor type in the Compressor Information Panel under the MAG V8 screen.

As stated in the previous section, the control strategy is designed to modulate the system capacity to maintain the control sensor reading within the specified control zone. The system capacity will be based upon the number of compressors that are Wanted On. When the first, or an additional compressor, is turned on the system capacity will be set to the calculated value. For the first compressor this will be the value of Setpoint #31 “MIN FLA %”. When additional compressors are brought on, their capacity is calculated to provide the same percentage of capacity prior to the change. The Magnum will adjust the required capacity between the calculated and the maximum value an as specified in Setpoint #30 “MAX FLA %”. All compressors that are on will be adjusted together to meet the system capacity.

When the maximum capacity value of the currently operating compressors has been reached, an additional compressor, if available, will be Wanted On. The number of compressors Wanted On will be increased by one and the system capacity will be set to the calculated value to maintain the same capacity as before the change and the sequence will begin again. Once all available compressors are on, their maximum will be 100% regardless of the value in Setpoint #30 “MAX FLA %”.

When the minimum calculated value has been reached, a compressor will be turned off. This will occur when the reduced number of compressors can achieve the same capacity at 90%. The number of compressors Wanted On will be decreased by one and the system capacity will be set to 90% and the sequence will begin again.

The compressor slide control is based upon the amps drawn by that compressor. For example, if Setpoint #31 “MIN FLA %” is set to 30%, that means 30% of the calculated full load amperage for that compressor.
Screw compressors with slide pistons that are turned on can either be loading (load solenoids are pulsed), unloading (unload solenoids are pulsed), or in a hold state (no action is taken). The state of each compressor reflects this action.

11.5.2 Compressor with a Variable Frequency Drive (VFD)

This option is specified in MCS-Config by selecting the Analog Output for the VFD in the "Compr Speed or Modulate Hot Gas AO" cell in the Circuit Base screen.

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
1 ...	Not Used	Not Used	COMP1 SPD	Not Used	Not Used	DISABLE 1	Not Used	Not Used	Not Used

The Magnum will control the compressor speed in the same matter as the compressor slide. The same Setpoints will be used. This allows a fixed staged compressor's capacity to be varied. See section 13 for Setpoints associated with variable capacity control logic.

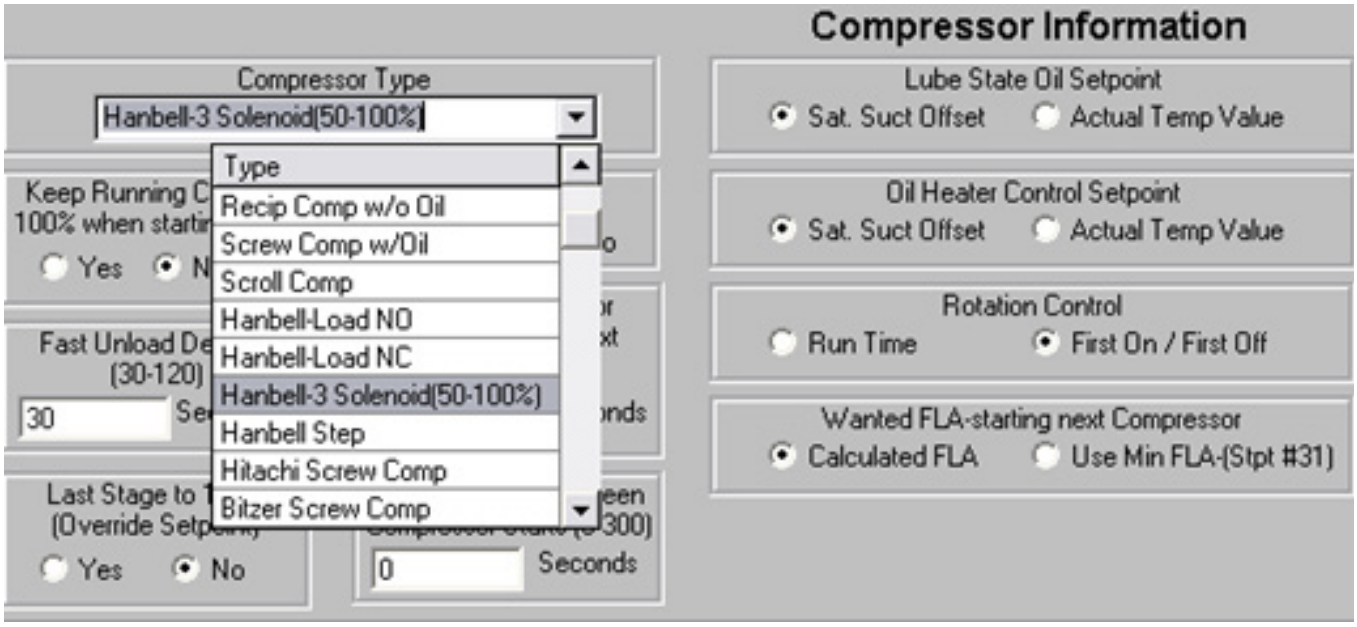
11.5.3 Example of a system with 3 variable Step Compressors

(Example below assumes compressor 1 is the current lead compressor.)

STAGE 1
Compressor 1's startup procedure has begun. Once on, the capacity will be adjusted from the minimum to the maximum. All other compressors will be off. The steps Wanted On / Actual On will be 1 / 1.

STAGE 2
Compressor 2's startup procedure has begun. Once on, the system capacity will be changed to the calculated % and compressor 1 will be unloaded until it matches the calculated system capacity. Both compressors will be varied from the calculated to the maximum. All other compressors will be off. The steps Wanted On / Actual On will be 2 / 2. If the system capacity has been reduced to 45%, or the calculated % (whichever is larger) and less capacity is needed, a compressor will be turned off and the system capacity will be set to the 90% or the maximum and the system will return to Stage 1.

STAGE 3
Compressor 3's startup procedure has begun. Once on, the system capacity will be changed to the calculated % and compressors 1 and 2 will be unloaded until they equal the required capacity. All compressors will be varied from the calculated to 100%. The steps Wanted On / Actual On will be 3 / 3. If the system capacity has been reduced to 60%, and less capacity is needed, a compressor will be turned off and the system capacity will be set 90% and the system will return to Stage 2.



11.6. Compressor Types

The compressor type is selected from a drop down list in the Compressor Information panel on the MAG V8 screen.

- Reciprocating Compressor with Oil
- Reciprocating Compressor without Oil
- 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
- Trane Quad
- Screw Compressor with Oil
- Scroll 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

The type of compressor will determine how the compressor is controlled and its particular Relay Output sequence.

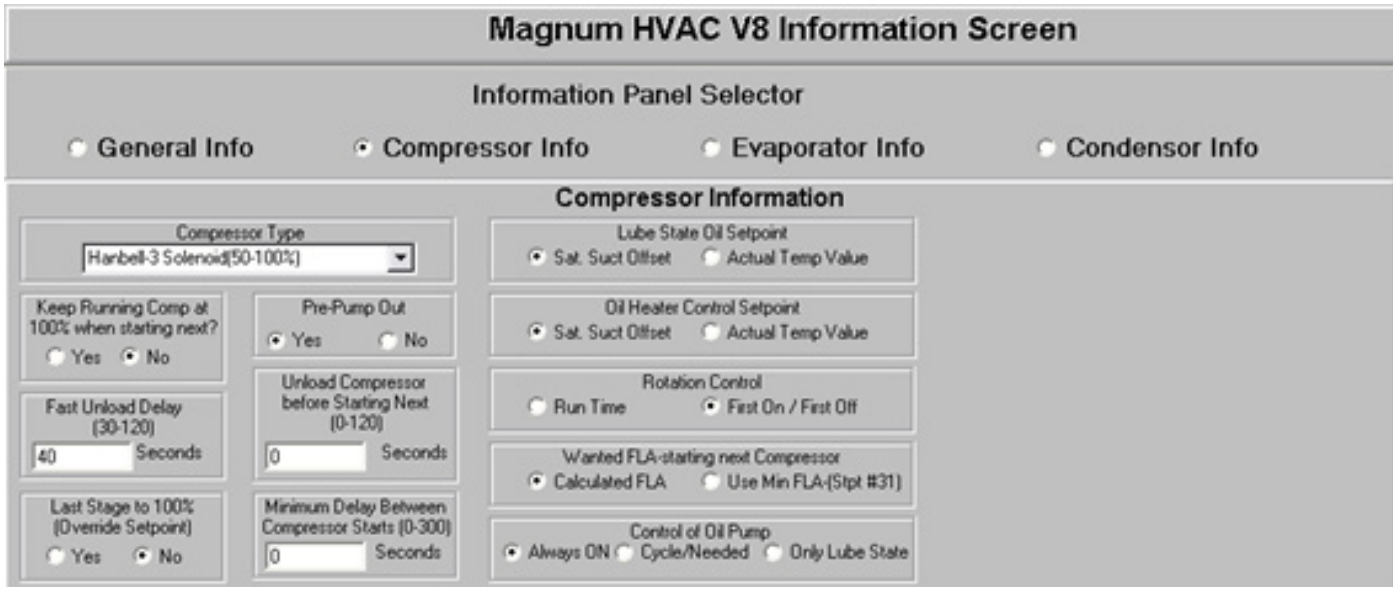
11.7. Compressor Setup and Options

All setup information and option selection is completed in MCS-Config.

11.7.1 General Information

- A maximum of four steps per compressor is supported (compressor plus three additional steps of either compressors, unloaders, or hot gas bypass points). Note: Compressor safeties relate to a circuit. If multiple compressors are on a single circuit and a safety trips, all compressors on that circuit will be turned off (If hot gas bypass, refer to Hot Gas Bypass section 7.15).
- If the compressor has an across-the-line start, only one RO point will be allocated for the compressor. If the compressor has a part winding start, two RO points will be used. The first RO will be turned on and the second RO will turn on after Setpoint #73 has been fulfilled.
- Pump down will take place when the compressor is started and when turning off. Note: When the compressor is started the liquid line solenoid is not opened until the suction pressure drops below Setpoint #61 “PMP DWN OFF” or Setpoint #62 “PMP DWN DELY” is exceeded. A liquid line solenoid is required for the pump down to function correctly.
- Up to 3 liquid line solenoids and up to 2 EXV valves are supported for each circuit.

11.7.2 Compressor Information setup



In this screen under the MAG V8 screen, compressor type is selected from a drop down list. Additional information about the compressor and how it will be controlled is also provided in this section. Review all cells and input the proper information.

The type of compressor will determine how the compressor is controlled and its particular Relay Output sequence.

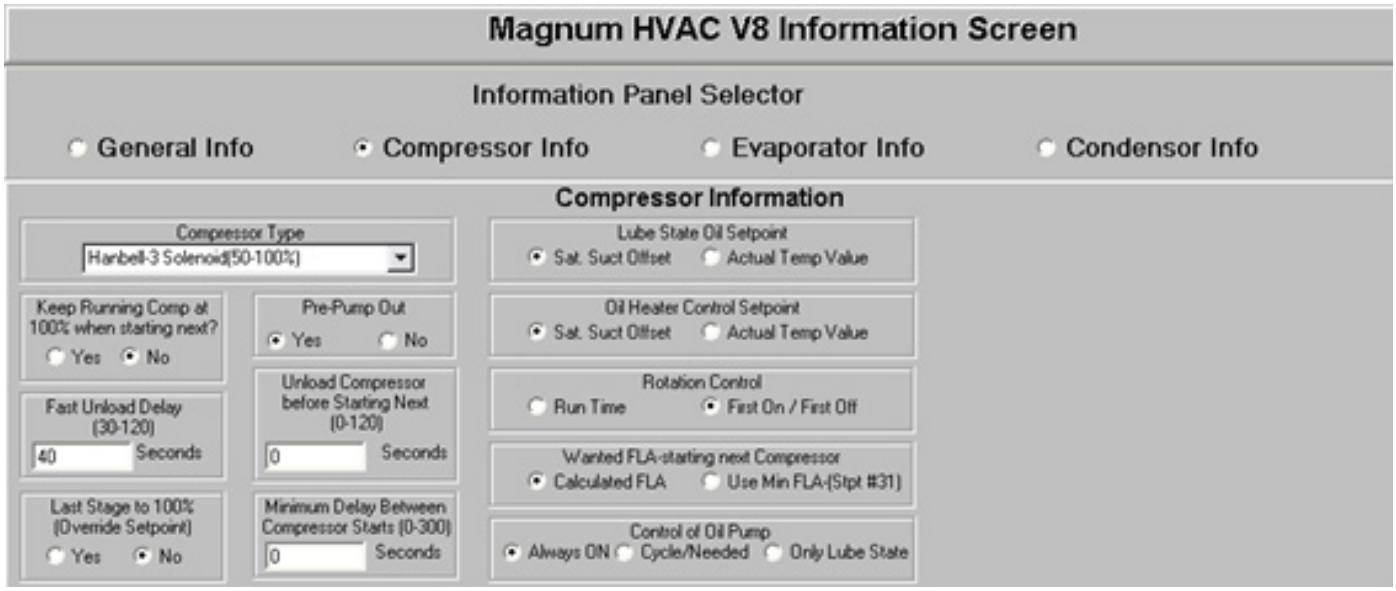
11.8. Compressor Setup and Options

All setup information and option selection is completed in MCS-Config.

11.8.1 General Information

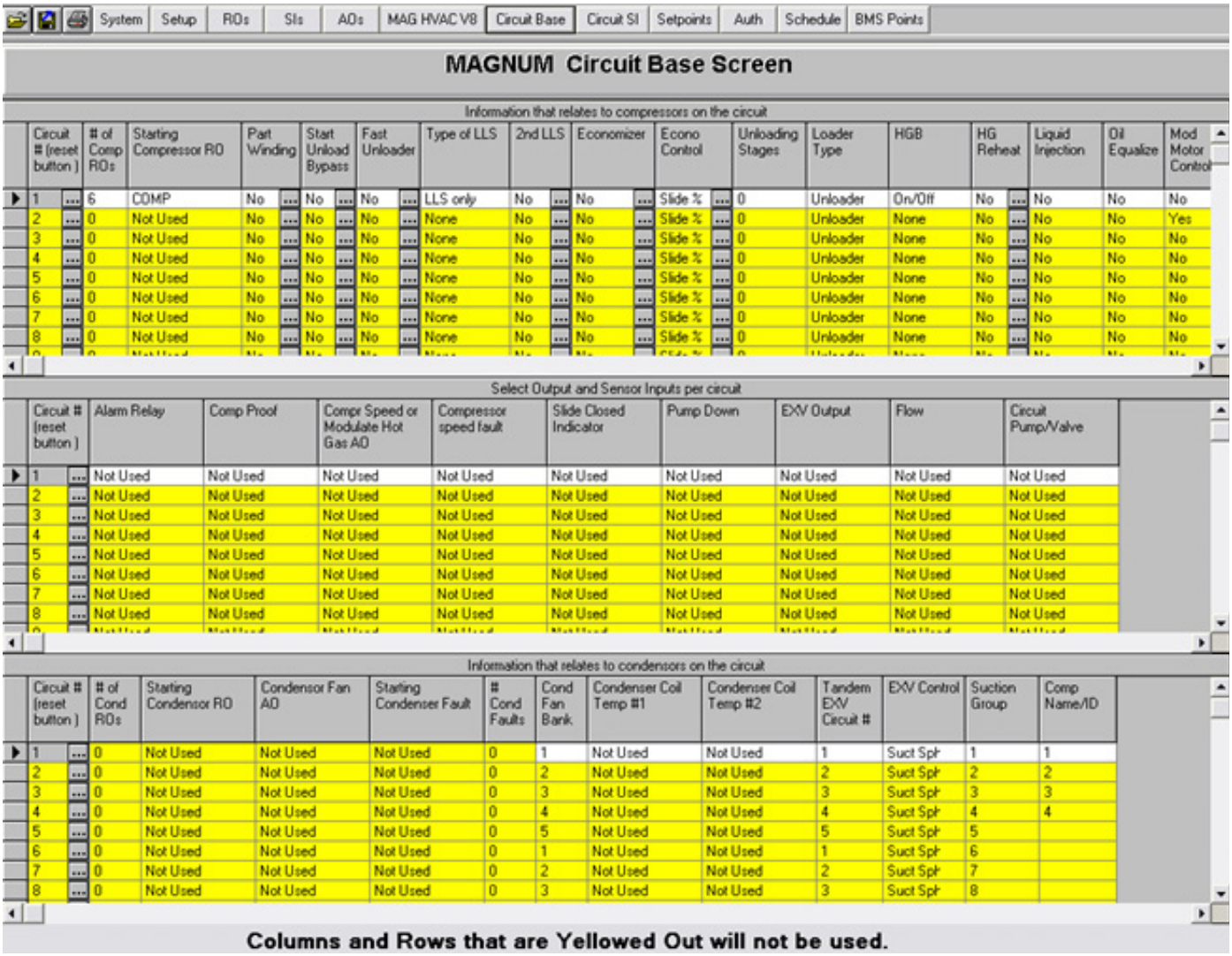
- A maximum of four steps per compressor is supported (compressor plus three additional steps of either compressors, unloaders, or hot gas bypass points). Note: Compressor safeties relate to a circuit. If multiple compressors are on a single circuit and a safety trips, all compressors on that circuit will be turned off (If hot gas bypass, refer to Hot Gas Bypass section 7.15).
- If the compressor has an across-the-line start, only one RO point will be allocated for the compressor. If the compressor has a part winding start, two RO points will be used. The first RO will be turned on and the second RO will turn on after Setpoint #73 has been fulfilled.
- Pump down will take place when the compressor is started and when turning off. Note: When the compressor is started the liquid line solenoid is not opened until the suction pressure drops below Setpoint #61 “PMP DWN OFF” or Setpoint #62 “PMP DWN DELY” is exceeded. A liquid line solenoid is required for the pump down to function correctly.
- Up to 3 liquid line solenoids and up to 2 EXV valves are supported for each circuit.

11.8.2 Compressor Information setup



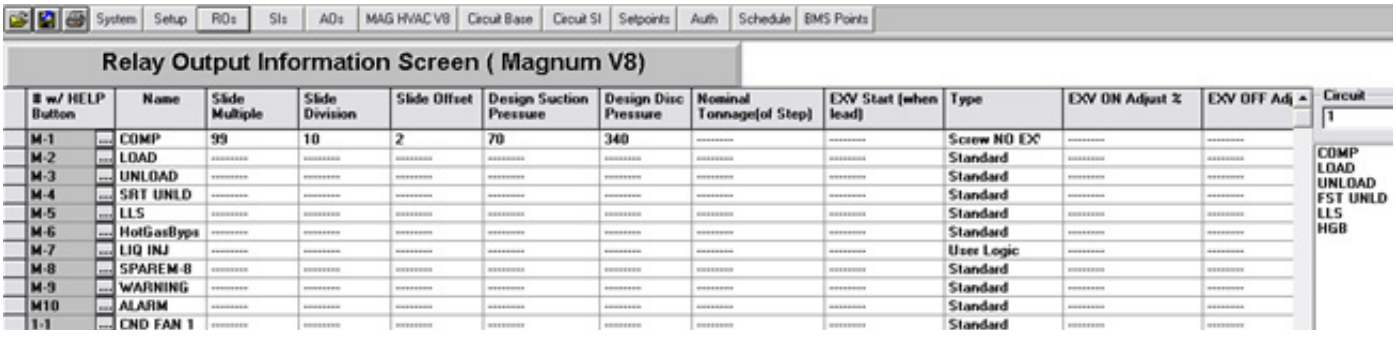
In this screen under the MAG V8 screen, compressor type is selected from a drop down list. Additional information about the compressor and how it will be controlled is also provided in this section. Review all cells and input the proper information.

11.8.3 Circuit Base setup



Compressor information is provided per circuit in this section under the Circuit Base screen. Review all cells and input the proper information about the compressor.

11.8.4 Relay Output Information Screen setup



This screen relates to the above example. The compressor is a variable capacity compressor; therefore, the slide information must be provided, this is used in calculating the amp draw of the compressor. Note the 'Type' column, for COMP, the first compressor point, Screw NO EXV was selected from the drop down menu.

This screen is an example of a variable capacity, screw, and compressor with EXV valves. Note the Type column selection. The EXV data must be provided.

Relay Output Information Screen (Magnum V8)

# w/ HELP Button	Name	Slide Multiple	Slide Division	Slide Offset	Design Suction Pressure	Design Disc Pressure	Nominal Tonnage(of Step)	EXV Start (when lead)	Type	EXV ON Adjust %	EXV OFF Ac
M-1	COMP 1	70	10	20	37	257	0	15	Screw w\ EXV	-------	-------
M-2	LOAD 1	-------	-------	-------	-------	-------	-------	-------	Standard	-------	-------
M-3	UNLOAD 1	-------	-------	-------	-------	-------	-------	-------	Standard	-------	-------
M-4	LLS 1	-------	-------	-------	-------	-------	-------	-------	Standard	-------	-------

This information can be viewed and changed, with proper authorization, from MCS Connect. By double clicking on the name field the following will be displayed.

11.9. Centrifugal Compressor Control

There are many differences, in both concept and function, between centrifugal compressors and other types. For certain applications, centrifugal compressors have distinct advantages such as high energy efficiency, high volume of airflow, and low maintenance due to the small number of moving parts. When combined with a Variable

Frequency Drive (VFD) it becomes simple and efficient to vary the speed of the compressor and operate at part load.

To provide control for this unique type of compressor MCS has developed a new type software specific to centrifugal units: CENT V8. Much of the control logic is similar to that found in HVAC V8. A target value and control zone are calculated, and then compressor capacity is modulated to keep the control sensor within that zone. Input sensors are monitored constantly and preventative action is taken to protect the unit from any potentially unsafe or damaging conditions. Different from other types of units though, both compressor speed and vane position must be taken into consideration since both affect cooling capacity.

11.9.1 Centrifugal Related Terminology

The following terms relate to the control of centrifugal compressors and how CENT V8 processes them.

11.9.1.1. Lift Pressure:

Lift pressure equals condenser pressure minus evaporator pressure. The lower the lift pressure is, the more efficiently the system operates.

11.9.1.2. Surge and Surge Protection:

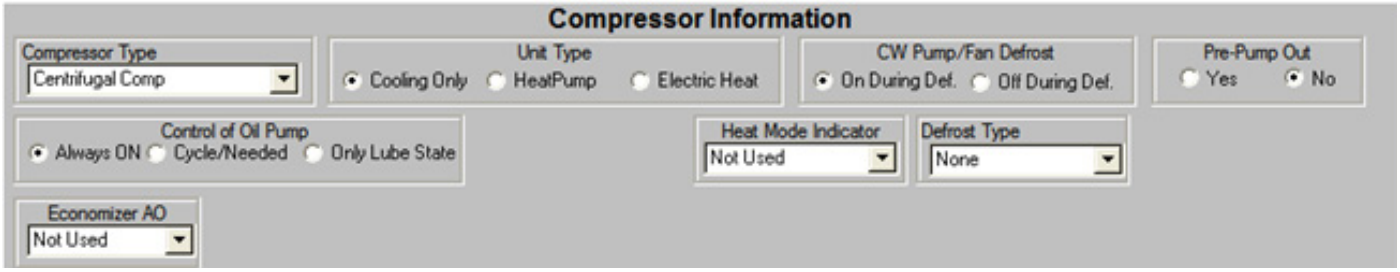
Surge is an unstable condition that occurs at low mass flows. Surges decrease compressor performance and efficiency, and could even cause permanent equipment damage.
CENT V8 defines a single surge as a large decrease in compressor amps followed by a large increase in the amps or a large decrease in lift pressure followed by large increase in lift pressure. The CENT V8 software will keep the last 60 seconds of samples for both amps and lift pressure. It will calculate the last ten 1 second Rate of Changes for both amps and lift pressure. If within these 10 Rate Of Changes there is a value less than (Setpoint #220 "AmpSurgeROC" x –1) or (Setpoint #221 "LiftSurgeROC" x –1) followed by a value greater than Setpoint #220 or #221, a compressor surge has occurred.

The software will then count the number of compressor surges that occur. If the number of surges is more than the value in Setpoint #219 "ExcessSurges" within 5 minutes (value of Setpoint #219 'Time (sec)' field) the system will shut down and generate an "ExcessSurges" alarm. This safety condition will automatically restart the compressor after the time in the Safety Down Time of the Setpoint #219. If a second "ExcessSurges" occurs within the time of the Lockout Delay Field, the compressor will be placed in "Cmp Locked Out" state and a manual reset is required to enable the compressor to restart again.

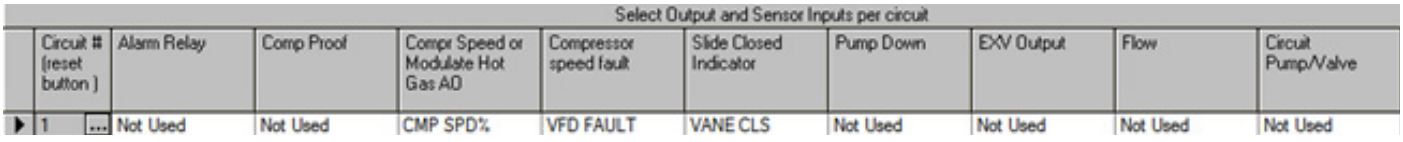
11.9.2 Centrifugal Base Compressor Setup MCS-Config

Similar to the HVAC V8 software the header buttons for this type of configuration file are as follows:

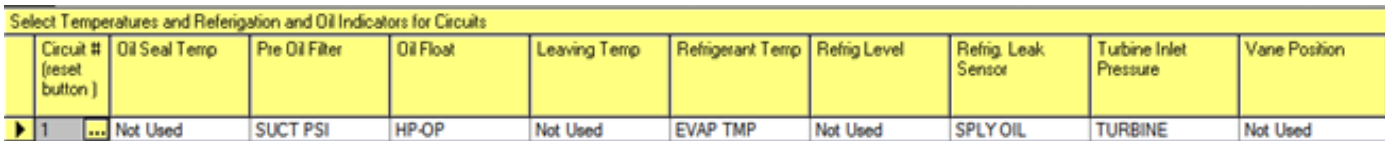
In the MAG CENT V8 screen the same information is required as for HVAC V8 setup. The compressor type must be centrifugal.



The VFD for compressor speed control, VFD fault, and Vane Closed Indicator are specified in the Circuit Base screen if they are used.



In the Circuit SI screen the sensors for the Turbine Inlet Pressure and Vane Position are specified if they are used.



For compressors with a VFD, a Vane Position sensor is required and is used for opening and closing the vanes.

For compressors without a VFD, a Vane Position sensor is optional. If unspecified then the amp sensor is used for opening and closing the vanes. In the above example the Vane Position sensor is not specified; therefore, the vane control will be based upon amp draw.

11.9.3 Typical Relay Output Setup

Typical setup of a centrifugal compressor:

Relay Output Information Screen (Magnum V11)

# w/ HELP Button	Name	Slide Multiple	Slide Division	Slide Offset	Design Suction Pressure	Design Disc Pressure	Nominal Tonnage(of Step)	EXV Start (when lead)	EXV off Adj % Diff	Type
M-1	COMP	4	20	-10	0	0	——	——	——	Screw NO EXV
M-2	OPN VANE	——	——	——	——	——	——	——	——	Standard
M-3	CLS VANE	——	——	——	——	——	——	——	——	Standard
M-4	OIL PUMP	——	——	——	——	——	——	——	——	Standard
M-5	OIL HTR	——	——	——	——	——	——	——	——	Standard
M-6	SPAREM-6	——	——	——	——	——	——	——	——	Standard
M-7	MTR COOL	——	——	——	——	——	——	——	——	User Logic

Circuit 1

COMP
LOAD
UNLOAD
OIL PMP
OIL HTR

11.9.4 Compressor Speed Control

Compressor speed is controlled by the associated Analog Output. The speed will only be changed after the vanes are either completely opened (speed will be increased) or closed (speed will be decreased).

11.9.5 Compressor Vane Control

If more capacity is needed the vanes will be opened by pulsing the Open Vane Relay Output (refer to UNIT LOADNG-VANE state). If less capacity is needed the vanes will be closed by pulsing the Close Vane Relay Output (refer to UNIT UNLDNG-VANE state). Vane positioning is based upon the Vane Position sensor if specified. If no Vane Position sensor is used, then the compressor amps are used to determine vane positioning.

11.9.6 Trane Purifier Purge System Interface

Since many centrifugal compressors operate in a vacuum, there is an opportunity for contaminates to get into the system from small leaks or minor servicing errors. These contaminates are classified as non-condensable requiring a method of disposal, known as purging. Setpoint #163 “Purge Target” must be active for the system to check for purge cycles.

(Refer to section 13 Setpoints #163, #164, and #165)

11.9.6.1. Purge Interface Setup

Under the Circuit Base screen, scroll down to the “Purge Relays and Sensors” section and enter the requested information.

Purge Relays and Sensors

Circuit # (reset button)	Purge Enable RO	Purge Solenoid RO	Purge Exhaust Pump RO	Purge Mode Switch SI	Purge Safety Switch SI	Purge Suction Temp SI
1 ...	PURGE	P-SEL	P-PUMP	MODE SW	SAFETY SW	PrgSucTEMP

Purge Enable RO – This relay will be turned ON when a purge cycle is active, else it will be off.

Purge Solenoid RO – This relay will be turned ON once the Purge Exhaust Pump has been on for 1 second.

Purge Exhaust Pump RO - This relay will be turned ON when a purge cycle is active, else it will be off.

Purge Mode Switch SI – This input’s type must be MODE SEL SW. This is an external three-way switch that can be set to:

OFF - in this setting the purge system will not function, the purge state will be SWITCHED OFF.

MANON - in this setting the purge state will be either M-PRG OFF if the system is not purging or M-PRG RUNNING if a purge cycle is active.

AUTO - in this setting the purge state will be either A-PRG OFF if the system is not purging or A-PRG RUNNING if a purge cycle is active.

Purge Safety Switch SI - If this switch is on for longer than the value in Setpoint #164 “P-FaultTimer” all purge Relay Outputs will be locked off and an error message will be generated. This will have no effect on the status of the unit.

Purge Suction Temp SI – This sensor provides the suction line temperature of the auxiliary unit. When a purge cycle is active this temperature is monitored. If it remains above the value in Setpoint #163 “PurgeTarget” the compressor will not exhaust any non-condensables from the purge drum. However, if the temperature drops below this value then the exhaust pump and solenoids must be on to capture the non-condensables.

11.9.6.2. Conditions to Run Purge Cycle

Mode selection switch in AUTO position: The compressor must be running and the suction line temperature of the auxiliary unit must be less than the value in Setpoint #163 “Purge Target”.

Mode selection switch in MANUAL position: The suction line temperature of the auxiliary unit must be less than the value in Setpoint #163 “Purge Target”.

Mode selection switch in OFF position: purge cycles will not run.

11.9.6.3. Purge States

SWITCHED OFF – The mode selection switch is in the OFF position.

FLOAT FAULT - The purge safety switch has been on longer than the value in Setpoint #164 “Purge Fault”. All purge Relay Outputs will be LOCKED OFF. When this switch returns to the normal off position, the purge Relay Outputs will be changed to AUTO and the purge state will be either M-PRG OFF or A-PRG OFF.

M-PRG OFF – The mode selection switch is in the MANUAL position. All purge Relay Outputs are OFF. If the suction line temperature of the auxiliary unit drops below the value in Setpoint #163 “PurgeTarget” the state will be changed to M-PRG-RUNNING. Note, in this state the status of the compressor is not checked.

M-PRG RUNNING – The purge relay enable and the purge pump are turned on. The purge solenoid will be turned on 1 second after the pump has started. If the suction line temperature of the auxiliary unit rises above the value in Setpoint #163 “PurgeTarget” the purge solenoid will be turned off. 1 second later the purge relay enable and the purge pump will be turned off and the state will be changed to M-PRG OFF,

A-PRG OFF - The mode selection switch is in the AUTO position. All purge Relay Outputs are OFF. If the compressor is running and the suction line temperature of the auxiliary unit drops below the value in Setpoint #163 “PurgeTarget” the state will be changed to A-PRG-RUNNING. Note, in this state the status of the compressor is checked.

A-PRG RUNNING - The purge relay enable and the purge pump will be turned on. The purge solenoid will be turned on 1 second after the pump has started. If the compressor goes off or the suction line temperature of the auxiliary unit rises above the value in Setpoint #163 “PurgeTarget” the purge solenoid will be turned off. 1 second later the purge relay enable and the purge pump will be turned off and the state will be changed to A-PRG OFF.

11.9.6.4. Excess Purge Logic

Setpoint #165 “Excess Purge” typical Value = 20 Minutes

MIN = 1
MAX = 120
ADJ = 10
Time = 0

The MCS-MAGNUM accumulates the amount of minutes a purge enable relay has been on for the last 24hrs (This is a rolling 24hrs window). If (purge enable accumulated on minutes) is greater than the value of Setpoint #165 an “Excess Purge” alarm is generated and the Warning relay is turned on. The (purge enable accumulated on minutes) counter is set to zero when a lockout reset has been performed by the user. The Warning light is also turned off.

11.10. Special Pattern for Scroll Compressors

Special patterns have been developed for Trane Scroll 3-D compressors. HVAC 7.00 software and newer is required for this function. These patterns are for either a 3 or 4 scroll unit. They are specified by selecting either the Trane Trio or Trane Quad package in the Compressor Type selection under the MAG V8 screen. The sequencing will provide proper oil control for the Trane compressors.

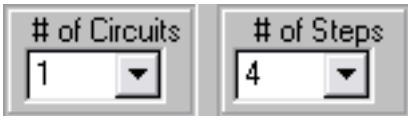
The compressors set will be treated as one compressor. There will be one common suction pressure, suction temperature, discharge pressure, and discharge temperature sensor for the package. Each compressor will have an individual amperage sensor. These must be consecutive inputs.

Chiller states have been allocated for these patterns: “SCROLL STEP 1” through “SCROLL STEP 4”.

11.10.1 The following is a sample of the four-compressor setup:

Select compressor type:

# of Compressors and # of steps:



Set up compressor:

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	3rd LLS	3rd LLS Control	Unloading Stages	Loader Type	HGB	HG Reheat	Liquid Injection	Oil Equalize	Mod Motor Control	Low Disc SuperHeat
1	5	COMP A	No	No	No	EXV&LLS	No	No	Last Step	3	Loader	None	No	No	No	No	No

Set up Relay Outputs:

Relay Output Information Screen (Magnum)

# w/ HELP Button	Name	Slide Multiple	Slide Division	Slide Offset	Design Suction PSI	Design Disc PSI	Nominal Tonnage(of Step)	EXV Start (when lead)	EXV off Adj % Diff	Type
M-1	CND FAN									Standard
M-2	SYS PUMP									Standard
M-3	COMP A						15	12		Step w\ EXV
M-4	EEVENABL									Standard
M-5	COMP B						15	12		Step w\ EXV
M-6	COMP C						15	12		Step w\ EXV
M-7	COMP D						15	12		Step w\ EXV
M-8	SpareM-8									Standard
M-9	SpareM-9									Standard
M10	ALARM									Standard

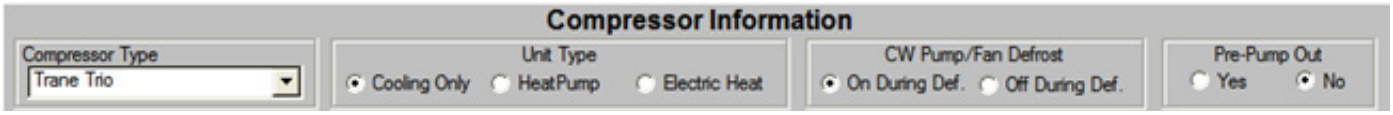
11.10.2 Pattern of the four-compressor setup:

Staging sequence

Staging sequence				
	COMP A	COMP B	COMP C	COMP D
Stage 1	ON	OFF	OFF	OFF
Stage 2	OFF	OFF	ON	ON
Stage 3	OFF	ON	ON	ON
Stage 4	ON	ON	ON	ON

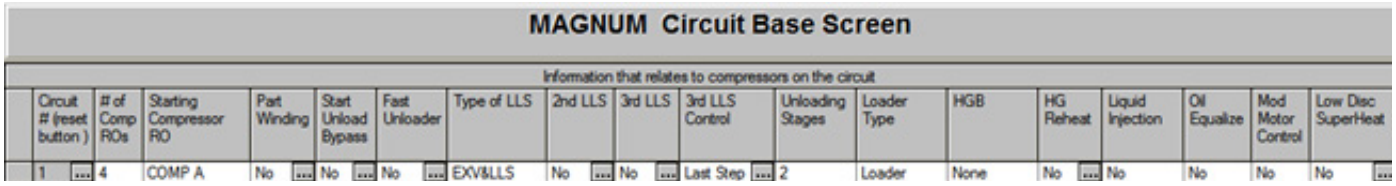
11.10.3 The three-compressor type will be setup in as follows:

Select the compressor:

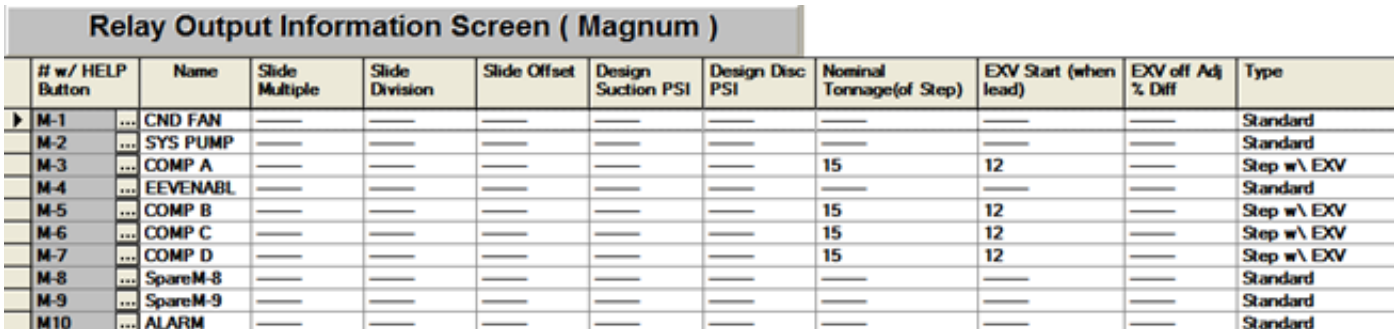


# of Compressors and # of steps:

Set up compressor:



Set up Relay Outputs:



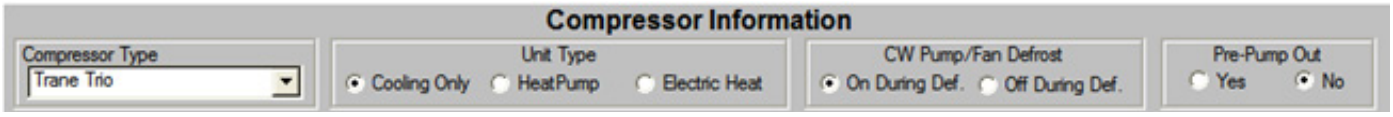
11.10.4 Pattern of the four-compressor setup:

Staging sequence

Staging sequence				
	COMP A	COMP B	COMP C	COMP D
Stage 1	ON	OFF	OFF	OFF
Stage 2	OFF	OFF	ON	ON
Stage 3	OFF	ON	ON	ON
Stage 4	ON	ON	ON	ON

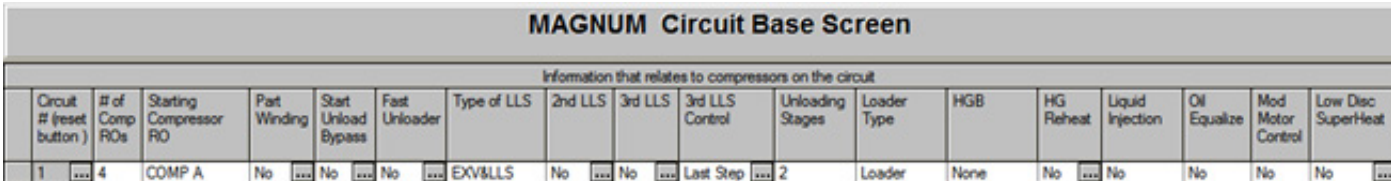
11.10.5 The three-compressor type will be setup in as follows:

Select the compressor:

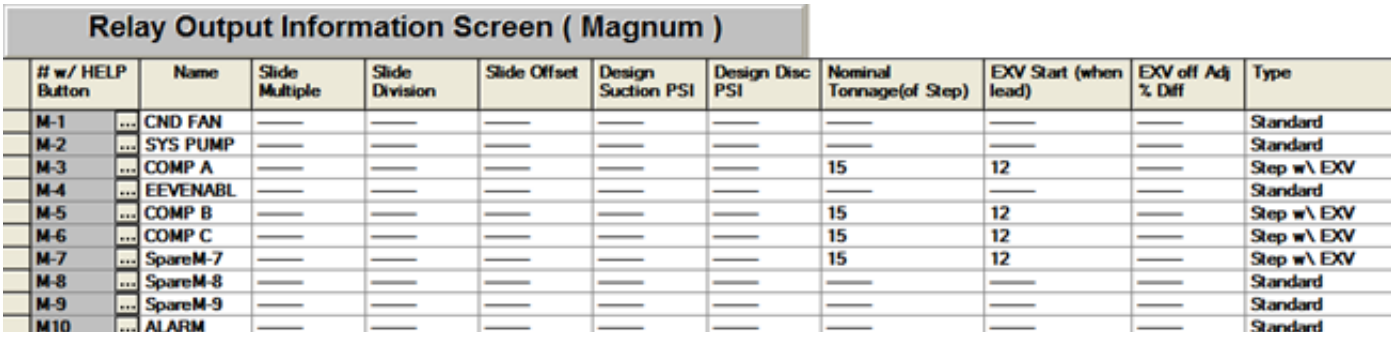


# of Compressors and # of steps:

Set up compressor:



Set up Relay Outputs:



11.10.6 Pattern of the three-compressor setup:

Staging sequence			
	COMP A	COMP B	COMP C
Stage 1	OFF	OFF	ON
Stage 2	ON	ON	OFF
Stage 3	ON	ON	ON
Stage 4	ON	ON	ON

11.10.7 Safeties are the same for both compressor types

The standard unloading and holding logic has been incorporated with their compressor state names. When a step is unloaded it will go to the previous step pattern. For example if the compressor is in SCROLL STEP 3 and unloading is required the Relay Output for SCROLL STEP 2 will be used. The state name will reflect why the compressor has unloaded.

The unloading and holding can result from high discharge and low suction pressure and high discharge temperature.

Low and high amp drawn will be check for all compressors that are on. The standard amp safety checks will be made and if one occurs the compressor will be off on a safety or a lock out if the same safety reoccurs.

Note, the standard Setpoints are used for all safety checks, unloading, and holding functions.

11.11. Compressor Auto Rotation

The auto rotation option is selected by setting the value in Setpoint #103 “LEAD COMP” to zero. If this value is nonzero, it will contain the number of the lead compressor and auto rotation will be disabled. Note this Setpoint can be manually changed to force a different compressor as the lead compressor or to enable auto rotation.

When this option is enabled, the Magnum will rotate the compressors based upon the value in Setpoint # 104 “CMP ROTATION”

If Setpoint # 104 is zero, rotation will occur with every complete capacity cycle and the next compressor will be selected as the lead compressor.

If Setpoint # 104 is nonzero, the value is the number of days between rotations. At midnight the Magnum will check if it is time to rotate compressors. If yes, the Magnum will check the run hours on each compressor and select the one with the least amount of run hours to be the lead compressor.

If Setpoint # 104 is set up as an ALARM Setpoint type, a compressor rotation message will be generated each time a compressor is rotated.

11.12. Custom Rotation

The requirement is to enable rotation only in the first barrel and do not turn ON any compressors associated with the second barrel until all compressors are ON in the first barrel. When decreasing refrigerant capacity, if any compressors in the second barrel are ON, they must first be turned OFF before turning OFF any compressors in the first barrel. Only first ON and first OFF lead rotation strategy can be used.

To activate this option Setpoint #103 “LEAD COMP” must be set up as follows:

Value:	0 (indicates auto rotation, must be 0)
Time (SEC):	0 (indicates first on first off, must be 0)
Select Value:	DIGITAL/SW
Type of Setpoint:	Target (must be Target type)
High Zone:	1 (this is the starting compressor following a reset; usually 1)
Low Zone:	1 (number to rotate, will default to 1)
Night Setback:	8 (number of compressors in the first barrel)

If the Value, Time, and Type cells are not set as indicated, normal rotation using Setpoints #103 “LEAD COMP” and #104 “COMP ROTATION” will be used.

The following examples have 16 compressors, dual barrels with 8 compressors in each. Barrel 1 has compressors 1 through 8 and 9 through 16 are in barrel 2. The wanted/actual ON will function as usual only the rotation and the sequence of turning on the compressors have been changed.

Example 1: Compressor 1 is the lead capacity calls for 4 circuits to be ON (wanted 4/ actual 4), then reduced to 0/0.

Compressors 1, 2, and 3, then 4 will be turned ON. As capacity is reduced, Compressor 1 will be turned OFF and the lead will be rotated to Compressor 2. Then Compressors 2, 3, and 4 will be turned OFF with the lead ending with Compressor 5.

Example 2: Compressor 5 is now the lead and capacity calls for 6 compressors to be ON (6/6) then reduce to 0/0.
Compressors 5, 6, 7, and 8, then 1 and 2 will be turned ON (6/6). As capacity is reduced, Compressors 5, 6, 7, and 8, then 1 and 2 will be turned OFF (0/0) and Compressor 3 will be the lead. Note, compressors in barrel 2 were not turned ON.

Example 3: Compressor 3 is now the lead and capacity calls for 12 compressors to be ON (12/12) then reduce to 0/0.

Compressors 3, 4, 5, 6, 7, and 8, then 1 and 2 will be turned ON (8/8). At this point all compressors in barrel 1 are ON, as more capacity is needed Compressors 9 through 16 will be used. Compressors 9, 10, 11, and 12 will be turned ON to reach 12/12. As capacity is reduced, Compressors 9 then 10, 11, and 12 will be turned OFF (8/8) at this point. Now, all compressors in barrel 2 are OFF and all compressors in barrel 1 can now be turned OFF if less capacity is needed. Compressor 3 followed by 4, 5, 6, 7, 8, and 1 then 2 will be turned OFF (0/0). At this point Compressor 3 is the lead compressor.

11.13. Compressor Anti-Cycle Logic

When a compressor is to be turned off, the Magnum software will make a calculation to determine the amount of time that the compressor will remain in an anti-cycle state. This calculation is based upon how long the compressor has been on and Setpoints #59 “ACYC OFF->ON” and #63 “ACYC ON->ON”.
If the value of Setpoint #63 minus the amount of time that the compressor has been on is greater than the value in Setpoint #59, the compressor will remain in the anti-cycle state for the period of time specified in Setpoint #63. Else the anti-cycle timer will be set to the value in Setpoint #59.

For example:
#59 (ANTI-CYC OFF) = 300 seconds
#63 (ANTI-CYC ON) = 600 seconds

If the compressor had been running for 3 minutes (180 seconds)
600 – 180 = 420 this is greater than Setpoint #59; therefore, the anti-cycle timer will be set to 600 seconds, the value of Setpoint #63.

If the compressor had been running for 12 minutes (720 seconds)
600 – 720 = -120 this is less than Setpoint #59; therefore, the anti-cycle timer will be set to 300 seconds, the value of Setpoint #59.

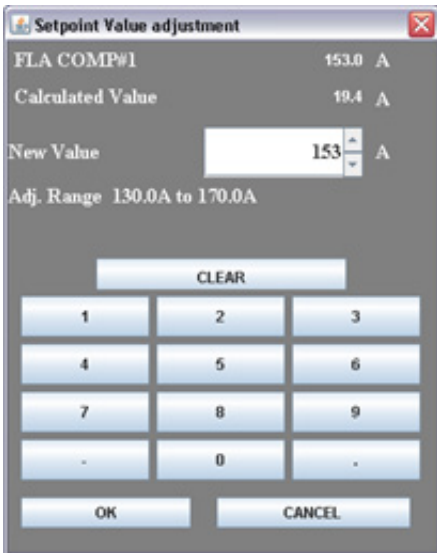
If the controller loses power, the length of time that the system was down will be taken into consideration when determining whether the compressor should be in an anti-cycle state and for how long.

11.14. Part Wind and Star Delta Starters

Both Part Winding and Star Delta starter types are supported by the Magnum software. This option is specified in the ‘Part Winding’ cell of the Circuit Base screen in MCS-Config and will require two successive Relay Output points. When this option is selected, make Setpoint #73 “STARTER DLAY” active. This Setpoint contains the delay in seconds or transition percentage before the second Relay Output is turned on. This delay is normally 1 second for part winding or 5 seconds for a star delta starter. If using the transition percentage option, after initial startup amp spike, the amps must fall below this percentage of the FLA for the second step to be turned on.

11.15. Full Load Amp (FLA) calculation and slide positioning

For variable capacity compressors the Magnum will calculate a FLA for each compressor and it will be stored in the FLA Setpoints (#171 to #190) for compressors 1 through 20 with every pass of the algorithm. The calculated FLA value will be displayed when viewing the respective compressor Setpoint through the Keypad/Display or MCS-Connect. The calculation is based upon the slide multiplier, divisor and offset values and then adjusted for the difference between the actual and design pressures for suction and discharge. This calculation is then used to determine the slide position by taking the actual amp draw divided the calculated FLA value. The load and unload solenoids will be used to match the compressor slide position with the wanted FLA.
If a FLA Setpoint is changed from MCS Connect both the original and calculated values are displayed in the following screen:



11.16. Chiller Barrel Heater

If a Chiller Barrel Heater is specified, it will be controlled based upon ambient temperature and Setpoint #134 “BARREL HEATER“.

11.17. Hot Gas Bypass

Control of the Hot Gas Bypass function will depend on which Setpoints are made active/inactive. Refer to section 13 Setpoints #4-#7.

- Setpoints #4-#7 INACTIVE - If Setpoints #4-#7 are all inactive, then the HGB is enabled when the machine is unloaded to within 25% of the minimum slide percentage. The HGB is disabled when the machine rises above 30% of the minimum slide percentage. (These are just default values that can be overridden in the “Time(sec)” fields of Setpoints #4 and #5. The “Time(sec)” field of Setpoint #4 contains the minimum slide percentage offset to enable the HGB; the “Time(sec)” field of Setpoint #5 contains the minimum slide percentage offset to disable the HGB. For example, if Setpoint #4 “Time(sec)” field has a value of 10 and Setpoint #5’s is15, then the HGB will enable when the compressors FLA% is within 10% of Setpoint #31 “MIN FLA%” and will disable when FLA% goes above 15%.)

- Only Setpoints #4-#5 ACTIVE - The HGB is on when the machine is unloaded and the leaving liquid goes below the Cut In (Setpoint #4 “HGS TEMP ON”). HGB is turned off when the leaving liquid temperature goes above the Cut Out (Setpoint #5 “HGS TEMP OFF”) or the machine leaves the unloaded state.

- Only Setpoints #6-#7 ACTIVE- The HGB is on when the machine is unloaded and the suction pressure goes below the Cut In (Setpoint #6 “HGS PSI ON”). HGB is turned off when the suction pressure goes above the Cut Out (Setpoint #7 “HGS PSI OFF”) or the machine leaves the unloaded state.

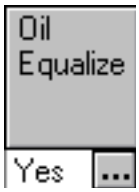
- Setpoints #4-#7 ACTIVE - If both groups of Setpoints are active, then the HGB is on when the machine is unloaded and either the leaving liquid temperature or the suction pressure goes below the respective Cut In limit. The HGB goes off when the machine leaves the unloaded state or both the leaving liquid temperature and the suction pressure goes above the respective Cut Out limits.

11.18. Chilled Water Reset

Chilled Water Reset (CWR) is a 0 to 5 volts dc Sensor Input (Display Type is TRGTRST) to the MCS microprocessor. The CWR follows the following rules using Setpoint #21 “MAX TRG RESET”:

1. If the input is 2.5 volts dc the CWR is zero.
2. At 0 vdc the CWR is a negative value equal to the Setpoint value.
3. At 5 vdc the CWR is a positive value equal to the value in the Setpoint.
4. For values in between 0 – 2.5 and 2.5 – 5.0 the CWR is a plus or minus value which is proportional to the Sensor Input voltage.

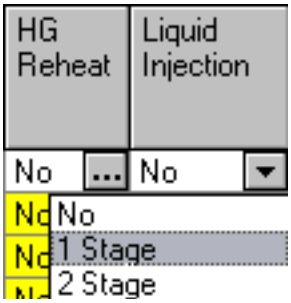
11.19. Oil Equalization Option



Oil equalization occurs with common suction/discharge systems. This feature allows for oil to equalize between compressors by opening a solenoid valve. The oil equalization occurs at compressor startup. Refer to section 12 for Relay Output order and options. If this feature is specified in the Circuit Base screen, the micro will energize the Oil Equalization solenoid valve for 1 minute at compressor startup.

11.20. Liquid Injection Option

This option is specified in the Circuit Base screen:



In the Liquid Injection column there is a dropdown menu for each compressor, giving options of No Liquid Injection, 1 Stage, or 2 Stage. If 2 Stage option is selected, the second stage relay must follow the list of available options, it may not necessarily follow the first stage relay. Refer to section 12 for Relay Output order and options.

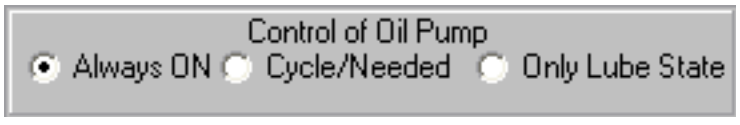
The first stage will be turned on if either the discharge temperature is greater than Setpoint #8 or suction pressure is less than Setpoint #80 plus 5 psi (.5 Bar). If 2 Stage, the second relay will be turned on if the discharge temperature is greater than Setpoint #8 plus 5.0° F (2.5° C) and the first relay has been on for a time greater that the 'Time (sec)' field of this Setpoint. If the Slide Multiplier cell of the Relay Output for the first stage of liquid injection is non-zero, then this relay will be turned on during the fast unload logic.

11.21. Oil Cooler Option

The oil cooler option can be enabled for compressors with oil. This feature requires an oil seal temperature sensor, a Relay Output to energize the oil cooler, and Setpoint #145 "OIL COOLER ON" to be active. If the oil seal temperature is above Setpoint #145 for longer than the time specified, the oil cooler is energized until the temperature is 5° F below the Setpoint value. Refer to section 12 for Relay Output order and options.

11.22. 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 'Compressor Information' panel under the MAG V8 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.

11.23. Oil Differential Calculation

For chillers with external oil pumps: Oil Differential = Oil Pressure - Discharge Pressure
For all others: Oil Differential = Oil Pressure - Suction Pressure
If an oil pressure sensor is not available, then discharge pressure can be used in place of it. This is set up in the Circuit SI screen of MCS-Config by selecting the discharge pressure sensor in the oil pressure sensor's column.

11.24. On/Off Switches

The following digital inputs can affect the entire package or individual circuits:

- Flow switch – If OFF the system has no flow. The system will Lockout (if Setpoint #105 is active), or shut down (if Setpoint #105 is inactive).
- Pump down – If ON and the compressor is off, the compressor will not be allowed to start. If the compressor is on, the system moves to the Pump Down state to begin turning off the compressor(s) in normal steps.
- Run/Stop – If OFF the system will not run. If the system is running, the system turns all compressors off in normal steps (If a RUN/STOP and a Network RUN/STOP are both available they operate in series).
- Network Run/Stop – If OFF the system will not run. This input is provided by another system on the network. It functions in the same matter as the Run/Stop switch.
- Emergency Stop – If ON the system will be shut down immediately and will remain disabled until the switch is OFF.

11.25. Low Suction Unloading and Holding

This option is activated when Setpoint #78 "LO SUCT UNLD" is active. When suction pressure is below the calculated value of Setpoint #77 "LOW SUCTION" plus Setpoint #78 "LO SUCT UNLD" for the time specified in the 'Time (sec)' field, the Magnum will turn on the WARNING Relay Output if specified in MCS-Config and take the following action:

- For fixed step compressors: The Magnum will turn off one step of capacity of the compressor(s) with low suction until all steps except one are unloaded. The circuit state will be LO SUCT HOLD. The compressor will remain in this state until the capacity control indicates that another step is to be unloaded or if the suction pressure has returned to normal after the time in Setpoint #101 "SAFETY HOLD DELAY" has passed.
- For variable step compressors: The Magnum will begin unloading the compressor(s) with low suction until the suction pressure rises above the calculated value. During this time the circuit state is LO SUCT UNLOAD. Once this pressure has been reached, the circuit state will be LO SUCT HOLD. The compressor will remain in this state until the capacity control indicates that another step is to be unloaded or if the suction pressure has returned to normal after the time in Setpoint #101 "SAFETY HOLD DELAY" has passed.

Normal suction pressure is defined as any value greater than Setpoint #77 "LOW SUCTION" plus Setpoint #79 "LO SUCT RELD". Refer to Setpoints #78 and #79 for additional information.

11.26. High Discharge Pressure Unloading and Holding

This option is activated when the Setpoint #82 "HI DISC UNLD" is active. When the discharge pressure is above the calculated value of Setpoint #81 "HI DISC PSI" minus Setpoint #82 "HI DISC UNLD" for the time specified in the 'Time (sec)' field, the Magnum will turn on the WARNING Relay Output if specified in MCS-Config and take the following action:

- For fixed step compressors: The Magnum will turn off one step of capacity of the compressor(s) with high discharge until all steps except one are unloaded. The circuit state will be HI DISC HOLD. The compressor will remain in this state until the capacity control indicates that another step is to be unloaded or if the discharge pressure has returned to normal after the time in Setpoint #101 "SAFETY HOLD DELAY" has passed.
- For variable step compressors: The Magnum will begin unloading the compressor(s) with high discharge until the discharge pressure drops below the calculated value. During this time the circuit state is HI DISC UNLOAD. Once this pressure has been reached, the circuit state will be HI DISC HOLD. The compressor will remain in

this state until the capacity control indicates that another step is to be unloaded or if the discharge pressure has returned to normal after the time in Setpoint #101 “SAFETY HOLD DELAY” has passed.

Normal discharge pressure is defined as any value less than the calculated value of Setpoint #81 “HI DISC PSI” minus Setpoint #83 “HI DISC RELD” and greater than Setpoint #85 “LO DISC PSI”. Refer to Setpoints #82 and #83 for additional information.

11.27. High Discharge Temperature Unloading and Holding

This option is activated when the Setpoint #88 “DISC TMP UNLD” is active. When the discharge temperature is above the calculated value of Setpoint #87 “HI DISC TMP” minus Setpoint #88 “DISC TMP UNLD” for the time specified in the ‘Time (sec)’ field, the Magnum will turn on the WARNING Relay Output if specified in MCS-Config and take the following action:

- For fixed step compressors: The Magnum will turn off one step of capacity of the compressor(s) with high discharge temperature until all steps except one are unloaded. The circuit state will be HI DISC HOLD. The compressor will remain in this state until the capacity control indicates that another step is to be unloaded or if the discharge temperature has returned to normal after the time in Setpoint #101 “SAFETY HOLD DELAY” has passed.
- For variable step compressors: The Magnum will begin unloading the compressor(s) with high discharge temperature until the temperature drops below the calculated value. During this time the circuit state is HI DISC UNLOAD. Once this temperature has been reached, the circuit state will be HI DISC HOLD. The compressor will remain in that state until the capacity control indicates that less capacity is needed or if the discharge temperature has returned to normal after the time in Setpoint #101 “SAFETY HOLD DELAY” has passed.

Normal pressure is defined as any value less than the calculated value of Setpoint #87 “HI DISC TMP” minus Setpoint #89 “HI DISC RELD”. Refer to Setpoints #88 and #89 for additional information.

11.28. High Ampere Unloading and Holding

This option is activated when the Setpoint #75 “HI AMPS %” is active. Note: This option can only be active for fixed step compressors. When the amp draw is within one-half of the calculated HI AMP safety value, the Magnum will turn on the WARNING Relay Output if specified in MCS-Config and take the following action:

- For fixed step compressors: the Magnum will turn off one step of capacity associated with that compressor until that compressor is in an UNLOADED state that is all steps except one are unloaded. The circuit state will be HI AMP HOLD. The compressor will remain in that state until the capacity control indicates that another step is to be unloaded or if the amp draw has returned to normal after the time in Setpoint #101 “SAFETY HOLD DELAY” has passed.

11.29. Low Water Temperature Unloading and Holding

When the leaving liquid temperature is within 1.5° F (.8° C) of the freeze safety, the Magnum will turn on the WARNING Relay Output if specified in MCS-Config and take the following action:

- For fixed step compressors: The Magnum will turn off one step of capacity of the compressor(s) with low water temperature until all steps except one are unloaded. The circuit state will be LO TMP HOLD. The compressor will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the leaving liquid temperature has turned to normal.
- For variable step compressors: The Magnum will begin unloading the compressor(s) with low water temperature until the leaving liquid temperature rises above the calculated value. During this time the circuit state is LO TMP UNLOAD. Once the leaving liquid temperature rises above the calculated temperature the circuit state will change to LO TMP HOLD. The compressor will remain in that state until the capacity control indicates that less capacity is needed or if after 5 minutes the leaving liquid temperature has turned to normal.

Normal leaving liquid temperature is defined as any value more than 3.0F (1.6C) above the freeze safety trip value.

11.30. 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 Compressor Information panel of the MAG V8 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.

11.31. Chilled Water Pump Control

The current Magnum software will support a chilled water pump plus a backup with rotation logic. These must be set up in MCS-Config. Setpoint #105 and Setpoint #106 are used with this control logic.

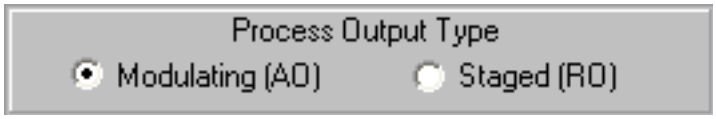
- If Setpoint #105 “PUMP FAILURE” is active, flow is lost for the period of time contained in the ‘Time (sec)’ field, and only one pump is present, then the system will move to a LOCKED OUT state. If the system has two pumps and flow is lost, then the backup pump will start and the lead pump will be locked out. A Lockout Reset will be required to restart the system or to reactive a locked out pump.
- If Setpoint #105 is inactive and the flow is lost, the system will move to the OFF- NO EVAP FLOW state. When flow is returned the system will automatically restart, no reset is required.

Setpoint #106 “LEAD PUMP” indicates whether the rotation option is active or which pump is the lead pump.

- If Setpoint #106 is zero, then rotation of the pumps will occur whenever the lead pump is turned off. If no rotation has occurred during the current day, a forced rotation at midnight will occur. This forces at least one rotation per day.
- If Setpoint #106 is non-zero, then rotation of the pumps is inactive and the value will specify the lead pump. This Setpoint can be changed in a live unit and the appropriate action will be taken.

11.32. Process Pump (Heat Exchanger) Control

The Magnum software can support either variable or fixed stages of heat exchangers with up to two process pumps with rotation and control based upon pressure or temperature. This option is specified in the Evaporator Information panel in the MAG V8 screen.



The pump information must be set up in the Evaporator Information Panel under the MAG V8 screen. The following information is required for each pump if used:
Pump Relay Output
Pump VFD Analog Output (if used)

VFD fault (if used)
Pressure Sensor Input (if used)
Pressure sensor output (if used)
Process temperature (if temperature control)

The following Setpoints are required:
#146 “PROC TARGET”
#147 “PROC ZONE”
#148 “PROC DELAY”
#149 “PROC MAX ROC”
#150 “Proc MinSpd%”
#197 “LEAD ProcPmp”
#198 “PROC PUMP FLT”
See Section 13 for Setpoint descriptions.

The process pump is on whenever the chilled water pump is on.

11.33. Control Power Relay (No Stop)

This feature provides the capability to interrupt the power supply to the system when a particular compressor continues to draw a specified amperage level when it is called to be OFF. A Relay Output, referred to as the control relay, must be wired so that no power reaches the compressors when it is switched OFF. The Relay Output must be selected in the ‘Control Relay’ cell of the General Information panel of MCS-Config and Setpoint #112 “NO STOP” must be active. The Magnum will continually monitor the amp draw of compressors that are called to be OFF. If the amp draw is greater than the FLA for that compressor multiplied by the percentage in Setpoint #112 “NO STOP” for the time specified in the ’Time (sec)’ field, then the control relay will turn OFF, a NO STOP alarm will be generated, and the system will be Locked Out.

11.34. Low and High Ambient Shutdown

The Magnum software supports both low and high ambient temperature shut downs. This option requires an ambient temperature sensor and one or both of Setpoints #24 “LOW AMB OFF” and #26 “HIGH AMB OFF”. The AMBIENT OFF state is entered when the ambient temperature falls below the Setpoint #24 or above Setpoint #26. The system will remain in this state until the ambient temperature rises 5.0F (2.5C) above Setpoint #24 value or drops 5.0F (2.5C) below Setpoint #25. When the chiller is in this state, the individual compressor states are changed to the CMP IS OFF state through the normal staging function.

11.35. Imperial, Metric, and Combined Unit sensor readings

The Magnum software supports Imperial, Metric, and Combined unit sensor readings. This setting is specified in the Setup screen of MCS-Config. All sensor values and all software-coded offsets are automatically converted to the option selected and displayed with the appropriate character. The following table contains the display character:

SENSOR READING	ENGLISH CHARACTER	METRIC CHARACTER	MIXED CHARACTER
Temperature	F	C	C
Pressure – Gage Reading	P	B	P
Pressure – Absolute Reading	p	b	p
Humidity	%	%	%
Digital or Switch			
Amp or CT	A	A	A
Voltage	V	V	V
Refrigeration Level	%	%	%

If the unit type is changed, MCS-Config will give you an option to automatically change the values of all items in the Setpoints to match the new type and will automatically adjust the display characters.

11.36. Warning and Alarm Relay Outputs

The Warning Relay Output will be turned on whenever the Magnum generates a warning message. These messages are:

- LOW REFR TEMP UNLOAD
- LOW SUCT PSI UNLOAD
- HIGH DISC TEMP UNLOAD
- LOW SUCT RELOAD
- LOW DISC RELOAD
- CICRUIT IS IN A SAFETY STATE

The system will continue to run since no safeties have tripped. The Warning Relay Output will also be turned on whenever a compressor is placed in a safety state.
The Alarm Relay Output will be turned on whenever the Magnum generates an alarm message. This indicates that a safety trip or Lockout has occurred.

11.37. Vi Port Control Logic (Open Drive Screw only)

The internal volume (Vi) of the open drive screw can be dynamically adjusted to achieve maximum efficiency modulating the Vi control solenoids. The duration of each solenoid pulse is contained in Setpoint #114 “Vi PULSE”.

The ratio of discharge pressure divided by suction pressure is calculated. This ratio is blocked between 50 and 22. The value of Setpoint #115 ”Vi DEADBAND” is added to and subtracted from this ratio to develop a control zone. The control zone will be recalculated based upon the time in Setpoint #116 ”Vi DELAY”. Refer to Setpoints #117, #118 and #119. The system will pulse the solenoids to keep the Vi reading within the calculated control zone.

11.38. Operating Schedules

Two operating schedules per each day of the week and 8 holidays are supported by the Magnum software. Each schedule contains a start and end time. If the time and day of the Magnum clock is within these limits then the schedule is true and the system will be allowed to run. If not, the system will be off due to schedule.

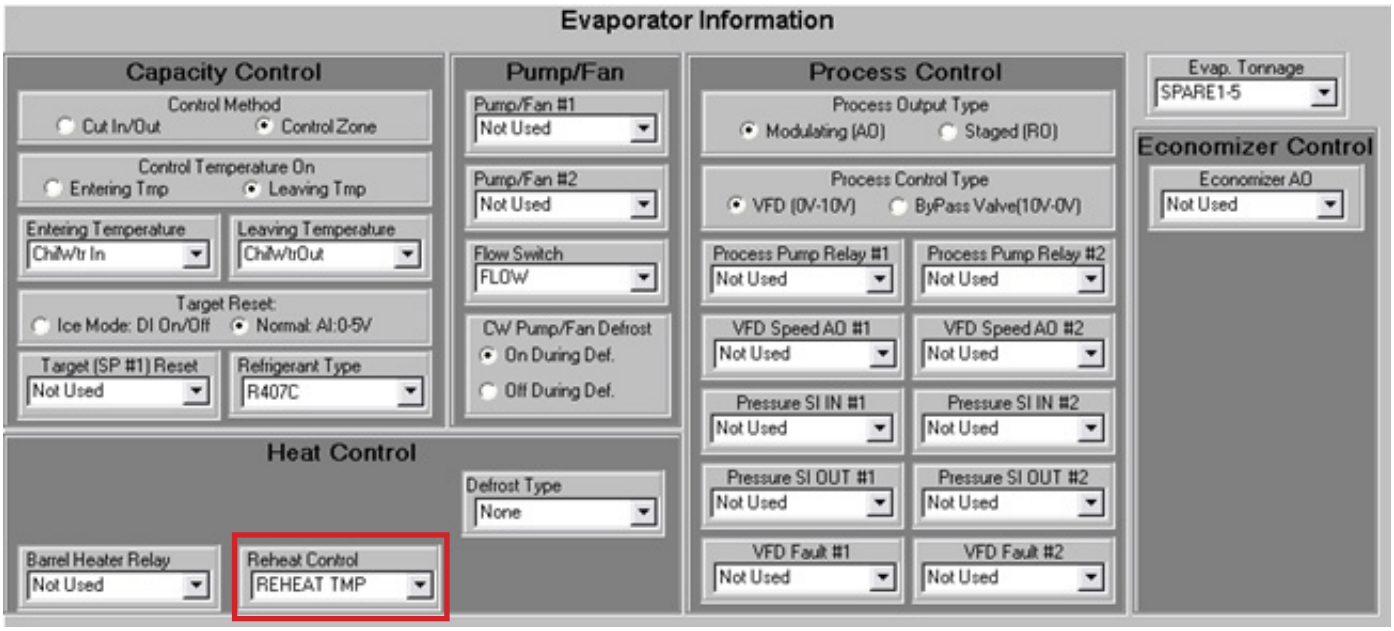
11.39. Mod-Motor Limit Control for Flooded Chiller

This option was added for Dunham-Bush flooded chillers. The Mod-Motor is a self-contained device that modulates a flooded chiller barrel level control valve based on a level sensor. The Magnum controls two Relay Outputs that change the limits on the movement of the Mod-Motor (The Relay Outputs change resistance to an input on the Mod-Motor). These Relay Outputs must be placed consecutively and specified in the General Information panel under the MAG V8 screen of MCS-Config.

- When one or less compressors are on, the first Mod-Motor Relay Output is turned on and the second Mod-Motor Relay Output is off.
- When 2 or more compressors are on, the first Mod-Motor Relay Output is turned off.
- The second Mod-Motor Relay Output will be turned on if the suction pressure is greater than 85.0 psi (5.8 bar) and the discharge suction pressure differential is less than 30.0 psi (2.0 bar), and the second Mod-Motor Relay Output will stay on as long as the suction pressure is greater than 80.0 psi (5.8 bar) and the discharge suction pressure differential is less than 35.0 psi (2.4 bar). If neither of the above is true, then the second Mod-Motor Relay Output will be turned off.

11.40. Hot Gas Reheat (Humidity) Control

The Hot Gas Reheat Control option is activated by selecting Yes in the ‘HGReheat’ cell in the Circuit Base Screen.
The hot gas control sensor is specified in the Evaporator Information panel of the MAG V8 screen. Select the input sensor that will be used to control the hot gas reheat function in the ‘Reheat Control’ cell.



When this option is selected the Reheat Relay Outputs must be setup as follows:

Relay Output Information Screen (Magnum V8)

	# w/ HELP Button	Name	Slide Multiple	Slide Division	Slide Offset	Design Sucti Pressure
▶	1-1 ...	COMP	--------	--------	--------	--------
	1-2 ...	LOAD	--------	--------	--------	--------
	1-3 ...	UNLOAD	--------	--------	--------	--------
	1-4 ...	LLS	--------	--------	--------	--------
	1-5 ...	LIQ INJ	--------	--------	--------	--------
	1-6 ...	REHEAT	--------	--------	--------	--------
	1-7 ...	R-Hvalve	--------	--------	--------	--------
	1-8 ...	R-Hbleed	--------	--------	--------	--------

These Hot Gas Reheat relays are required and they must be placed in the proper sequence to work correctly.

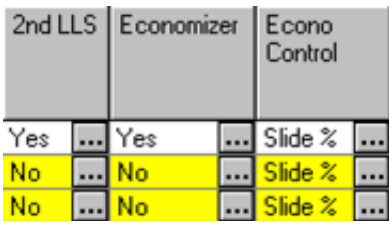
The following Setpoints must be active: #129 “RH CUTIN”, #130 “RH CUTOUT ADJ”, #131 “RH START DLY”, #132 “RH BLEED DLY”, #133 “RH STAGE DLY”.(see Section 13 for full Setpoint descriptions).

Hot Gas Reheat sequence of operations:

(The names in the above example will be used to indicate the status of the relays: 1-6 REHEAT, 1-7 R-Hvalve, and 1-8 R-Hbleed)

Condition	1-6 REHEAT	1-7 R-Hvalve	1-8 R-Hbleed
The reheat state is OFF. The compressor is running and the RH TEMP is greater than Setpoint #129 plus #130.	ON	OFF	OFF
The reheat state is STARTING. The compressor is running and the RH TEMP is less than Setpoint #129. It will remain in this state until the time is greater than Setpoint #131, and then will move to the ON state.	ON	ON	ON
The reheat state is ON. The reheat will remain in this state until the reheat temperature is greater than Setpoint #129 plus #130. When the temperature is greater the state will be changed to BLEED.	OFF	ON	ON
The reheat state is BLEED. It will remain in this state until the time is greater than Setpoint #132, it will then move to the OFF state.	ON	OFF	ON

11.41. Extra Liquid Line Solenoid Control



Second and third Liquid Line Solenoids (economizers) are supported and can be used for extra control. To specify, select the Circuit Base Screen:

The third solenoid (economizer) can be controlled either on the slide wanted percentage or as the last step on for that compressor (Refer to section 13 Setpoints #98 and #99). Liquid line solenoids 2 and 3 will be turned on and off as indicated in their Setpoints.

11.42. Outside Air Economizer/Fluid Cooler with Analog Output Control

The purpose of an economizer/fluid cooler is to take advantage of any available free cooling so as to avoid the need of mechanical cooling. Several options can be specified in MCS-Config to accomplish this.

11.42.1 Economizer Set up

The analog valve that will be modulated is selected in the 'Economizer AO' cell in the Evaporator Information panel. In this example the name is 3 WAY VLV.

If the economizer/fluid cooler has separate fans (not associated with condensers) then answer yes in the 'Separate Economizer Fans?' cell. If Yes, then four additional cells will appear: 'Starting Economizer Fan' (select the first fan Relay Output), '# of Econ Fans' (specify the number of fan points), 'Starting Economizer Fault' (select the first fan fault, this is a Sensor Input), and '# of Econ Faults' (specify the number of faults)

In the above example there are two fans and two faults associated with the economizer/fluid cooler. If there is more than one fan they must be consecutive Relay Outputs. The same is true of the condenser faults.

The condenser fans can also be used to assist in the free cooling function when the system is not using mechanical cooling. To set this up in the condenser information grid, select "Fluid Cooler Econo" equals "Yes", else "No" if condenser fans are not used. All types of condensers can be used. The above example has individual fans per compressor. Whenever a compressor is running the control of its condenser fans will be based solely on the discharge pressure of that compressor, while the condenser fans of compressors that are not running will be controlled by the economizer function. If the type of condenser is common; if any compressor is on all of the fans will be controlled by the highest discharge pressure and not by the economizer function.

The following Setpoints must be set up: #107 "EcoDelayMech", #115 "EcoVFDfanDely", #119 "EcoOffsetON", #120 "Eco Stg Dely", #121 "Eco MIN VLV%", #122 "Eco MAX VLV%", #123 "Eco MAX ADJ", #124 "EcoVlvAdjDly", #125 "Eco StageDly", #126 "Eco MULTI", and #127 "Eco DIVIDE"
(Refer to section 13 for Setpoint descriptions)

11.42.2 Sequence of Operation

The Economizer logic will be enabled whenever the ambient temperature meets the requirement as stated in Setpoint #119 "EcoOffsetON" (Ambient Temperature < Target Temperature - Setpoint #119). For example if the target is 45.0F and Setpoint #119 is 10.0F, then the ambient temperature must be less than 35.0F to enable the economizer function to begin.

If mechanical cooling has not been enabled (no steps are Wanted On or Actual On), when the economizer starts the Unit State will be ECONOMIZER ONLY. In this state mechanical cooling will not be started until the economizer

function has reached its maximum capacity (Economizer valve is at maximum opening, all available fans are turned on, and the control temperature is still not in the target zone).

When the economizer logic starts, the Magnum will modulate the Analog Output to the economizer valve to maintain the control sensor reading within the target zone. The valve will be modulated between Setpoint #121"Eco MIN VLV%" and Setpoint #122 "Eco MAX VLV%" and will wait the time contained in Setpoint #124 "EcoVlvAdjDly" before making each adjustment to the valve opening.

- If control temperature is above the control target, Setpoints #1, and the control temperature rate of change is greater than the value of Setpoint #27 "MAX ROC-":

This indicates that the control temperature is too high and it is not approaching the target fast enough, therefore the valve opening must be increased if possible. The adjustment value will be the difference between the target (Setpoint #1) and the control sensor temperature multiplied by Setpoint #126 "Eco MULTI" and divided by Setpoint #127 "Eco DIVIDE". If the absolute adjustment is greater than the value of Setpoint #123 "Eco MAX ADJ", then it will be limited to this value. The economizer valve opening will be increase by this value.

- If control temperature is below the economizer control zone (Setpoint #1 - Setpoint #3) and the control temperature rate of change is less than the value of Setpoint #28 "MAX ROC+":

  This indicates that the control temperature is too low and it is not approaching the target fast enough, therefore the valve opening must be decreased if possible. The adjustment value will be the difference between the target (Setpoint #1) and the control sensor temperature multiplied by Setpoint #126 "Eco MULTI" and divided by Setpoint #127 "Eco DIVIDE". If the absolute adjustment is greater than the value of Setpoint #123 "Eco MAX ADJ", then it will be limited to this value. The economizer valve opening will be decrease by this value.

- If control temperature is above the bottom of control zone (Setpoint #1 - Setpoint #3) but less than the control target (Setpoint #1) no change to the economizer valve opening will be made.

Once the valve has reached its maximum opening (Setpoint #122), the Magnum will wait the time specified in Setpoint #125 "Eco StageDly" before checking if there are any fans associated with the economizer function. If there are the Magnum will stage the fans to maintain the control temperature with in the target zone. If a fan VFD is present, then this will be modulated in the same manner. The delay between VFD adjustments will be the value in Setpoint #115 "EcoVFDfanDely" if active, else Setpoint #124 will be used. Once all fans associated with the economizer function are on, the Magnum will check if any condenser fans can also be used. If yes, then these fans will then be staged to maintain the control temperature.

Once all the fans and/or VFD have been turned on and the control temperature is still greater than the control zone for the time specified in Setpoint #107 "EcoDelayMech" if active (else the time in Setpoint #125 "Eco StageDly" will be used) then mechanical cooling will be enabled.

- If the ambient temperature rises above the offset in Setpoint #119 during economizer cooling mode, then the economizer function will be terminated, its valve opening will be set to zero, and mechanical cooling will be enabled.

- If the control temperature is less than the target temperature (Setpoint #1) minus the 3 times value of Setpoint #3, then the economizer function will be terminated, its valve opening will be set to zero, and all fans will be turned off.

- If during mechanical cooling mode the ambient temperature drops below the offset in Setpoint #119, then the economizer function will begin. Note: the Unit State will not change, the economizer valve will be modulated as described above, fans directly associated with the economizer will be used, and no fans associated with the condensers will used.

- The control rate of change is always checked before an adjustment to the valve is made. The purpose is to not change the valve opening if the temperature is moving toward the target at an acceptable rate.

11.42.3 Outside Air Supply Economizer

If the purpose of the economizer is to provide outside air, then there will be no fans associated with the economizer and no condenser fans will be used. In this setup the economizer valve opening will never be less than the value of Setpoint #121 ”Eco MIN VLV%”. This is required to supply the minimum of outside air.

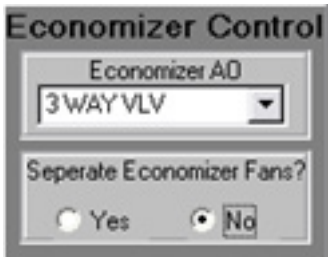
11.42.4 Mechanical Cooling Enabled

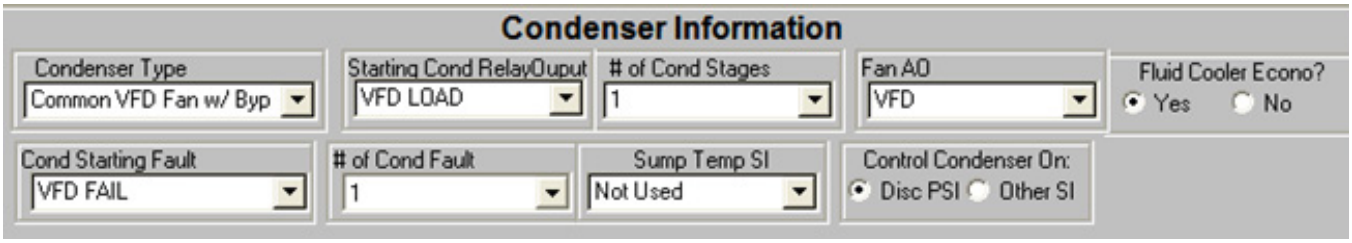
Once mechanical cooling has been enabled, the economizer will control only the individual compressor condenser fans of compressors that have not been started. The discharge pressure will control all others.

The percentage of the economizer valve opening will not be decreased. It will remain at its maximum setting until all stages of mechanical cooling are off.

11.42.5 Example: Fluid Cooler with VFD condenser fan

The economizer AO has been selected and there are no separate economizer fans.





The condenser type is common with VFD control and the Fluid Cooler Economizer option has been enabled. The VFD of the condenser fan will be controlled by the economizer function unless any compressor is running. If a compressor is running the VFD control will be based upon the highest discharge pressure.

Assume the following setup:

Setpoint #	Name	Value
1	SPPLY TRGT	44.0F
2	CTRL ZONE+	2.0F
3	CTRL ZONE-	1.0F
27	MAX ROC-	-.6F
28	MAX ROC+	.6F
54	CND MIN OPEN	20.0%
55	CND MAX OPEN	100.0%
107	ECON-MECHdly	240s
115	EconVFDdelay	45s
119	EcoOffsetON	10.0F
120	EconDelyFans	60s
121	EcoVlvMinVlv	0.0%
122	EcoVlvMaxVlv	100.0%
123	EcoVlvMaxAdj	5.0%
124	EcoVlvDelay	30s
125	EcoVlvMaxDly	120s
126	EcoVlv Mul	3
127	EcoVlv Div	2

Analog output	Name
AO M-1	3 WAY VLV
AO M-2	VFD

Conditions when the run/stop was set to RUN

Ambient temperature 30.0F
Control temperature 48.5F

The ambient temperature is less than 44.0 (Setpoint #1) – 10.0 (Setpoint #119) and no mechanical cooling steps are on; therefore, the Unit state will be ECONOMIZER ONLY and the economizer function will be enabled.

The AO M-1 "3 WAY VLV" will be opened to its minimum valve of 0% (Setpoint #121) and it will be modulated based upon the control temperature and the target (Setpoint #1). The first adjustment will be 48.5 – 44.0 = 4.5. This value will be adjusted by multiplier of 3 (Setpoint #126) and divided by 2 (Setpoint #127) to give an adjusted value of 6.7. This value is blocked; maximum allowed adjustment, by Setpoint #123 to allow an adjustment of 5.0%. The economizer valve opening will be increased by this amount if the temperature control rate of change is greater than the value of Setpoint #27.

The economizer function will wait 30 seconds (Setpoint #124) before determining the next adjustment. If the control temperature is now 47.3F; the following adjustment will be calculated.
47.3 – 44.0 = 3.3 x 3 / 2 = 4.9. Since this is less than 5.0 the valve will be open an additional 4.9% if the temperature control rate of change is greater than the value of Setpoint #27.

Each adjustment will be made after a delay of 30 seconds. If the control temperature is below the control target (Setpoint #1) and above the bottom the control zone (43.0F to 44.0F) there will be no change to valve opening.

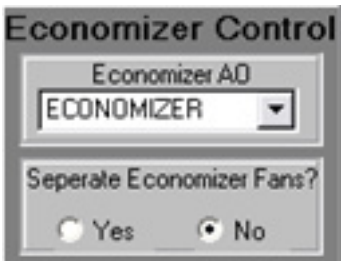
If the control temperature drops below the control zone the valve opening will be reduced. For example if the control temperature is 42.6F then the following calculation will be made:
42.6 – 44.0 = 1.4 x 3 / 2 = 2.1. Since this is less than 5.0 the valve opening will be reduced an additional 2.1%.

When the valve reaches its maximum opening of 100.0% (Setpoint #122) the economizer function will use other fans if they are available. In this example there are no fans that are associated only with economizer but the VFD fan can now be used. At time delay of 120 seconds (Setpoint #125) be for the VFD will be modulated. Following this initial delay the VFD will be opened to its minimum opening, Setpoint #54 of 20%.

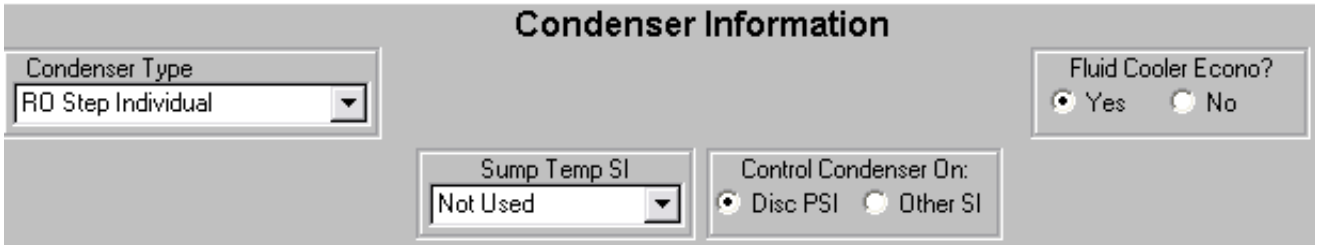
At this point the unit state is ECONOMIZER ONLY, economizer valve is at 100% and VFD will be modulated between its minimum (Setpoint #54) and it maximum (Setpoint #55). The delay between these adjustments will be 45 seconds (Setpoint #115).

Once the VFD opening is equal to its maximum (Setpoint #55) there will be a delay of 240 seconds (Setpoint #107). At this time the unit state will be changed and mechanical cooling will be enabled.

11.42.6 Example: Fluid Cooler with condenser compressor fans



The economizer AO has been selected and there are no separate economizer fans.



The condenser type is RO Step Individual and the Fluid Cooler Economizer option has been enabled. The individual compressor condenser fans will be controlled by the economizer function unless a compressor is running. If a compressor is running, then the condenser fans associated with that compressor will be controlled based upon the discharge pressure of the compressor that is running.

Assume the following setup:

Setpoint #	Name	Value
1	SPPY TRGT	44.0F
2	CTRL ZONE+	2.0F
3	CTRL ZONE-	1.0F
27	MAX ROC-	-.6F
28	MAX ROC+	.6F
107	ECON-MECHdly	240s
115	EconVFDdelay	45s
119	EcoOffsetON	10.0F
120	EconDelyFans	60s
121	EcoVlvMinVlv	10.0%
122	EcoVlvMaxVlv	100.0%
123	EcoVlvMaxAdj	10.0%
124	EcoVlvDelay	30s
125	EcoVlvMaxDly	120s
126	EcoVlv Mul	2
127	EcoVlv Div	1

Analog output	Name
AO M-1	ECONOMIZER

Conditions when the run/stop was set to RUN

Ambient temperature 30.0F
Control temperature 49.7

The ambient temperature is less than 44.0 (Setpoint #1) – 10.0 (Setpoint #119) and no mechanical cooling steps are on, therefore the Unit state will be ECONOMIZER ONLY and the economizer function will be enabled.

The AO M-1 “ECONOMIZER” will be opened to its minimum valve of 10% (Setpoint #121) and it will be modulated based upon the control temperature and the target (Setpoint #1). The first adjustment will be 49.7 – 44.0 = 5.7. This value will be adjusted by multiplier of 2 (Setpoint #126) and divided by 1 (Setpoint #127) to give an adjusted value of 11.4. This value is blocked by the maximum allowed adjustment (Setpoint #123) to 10.0%. The economizer valve opening will be increased by this amount if the temperature control rate of change is greater than the value of Setpoint #27. With Setpoint #126 equal to 2 and #127 equal to 1, the valve will be adjusted by 2% for every degree difference from the target.

The economizer function will wait 30 seconds (Setpoint #124) before calculating the next adjustment. If the control temperature is now 47.3F the following adjustment will be made.
47.3 – 44.0 = 3.3 x 2 / 1 = 6.6. Since this is less than 10.0 the valve will be open an additional 6.6% if the temperature control rate of change is greater than the value of Setpoint #27.

Each adjustment will be made after a delay of 30 seconds. If the control temperature is below the control target (Setpoint #1) and above the bottom the control zone (43.0F to 44.0F) there will be no change to valve opening.

If the control temperature drops below the control zone the valve opening will be reduced. For example if the control temperature is 42.6F then the following calculation will be made:

42.6 – 44.0 = 1.4 x 2 / 1 = 2.8. Since this is less than 10.0 the valve opening will be reduced an additional 2.8%.

When the valve reaches its maximum opening of 100.0% (Setpoint #122) the economizer function will use other fans if they are available. In this example there are no fans that are associated only with economizer but the condenser fans can now be used. After the time delay of 120 seconds (Setpoint #125) the first condenser fan will be turned on (the first fan of the first compressor unless unavailable).

At this point the unit state is ECONOMIZER ONLY, the economizer valve is at 100%, and the compressor fans will be used to aid in the economizer cooling. The delay between starting the condenser fans will be 30 seconds (Setpoint #124). If all condenser fans are available and not manually turned off, the pattern of starting fans will be the first fan on compressor 1, after the delay then the first fan of compressor 2, after the delay then the second fan on compressor 1. This will continue until all available condenser fans have been turned on.

Once all of the condenser fans have been turned on there will be a delay of 240 seconds (Setpoint #107). At this time the Unit State will be changed and mechanical cooling will be enabled. When a compressor is running, its associated condenser fans will be controlled by the discharge pressure of the running compressors.

11.43. High Suction Superheat Safety

To add a high suction superheat safety, make Setpoint #203 “HiSuctSheat” active. If the suction superheat is greater than the value of this Setpoint for the ‘Time(sec)’ field, an alarm will be generated and the compressor will be shut down with a safety or Lockout state.

11.44. Low Temperature Safety and Unload (Low Saturated Suction Temperature)

The Magnum is set up to check for low refrigerant temperature safety and unload functions. To enable this test make Setpoint #155 “LO REF TMP” active and point to the sensor in the ‘Refrigeration Temp’ column of the Compressor SI grid in MCS-Config.

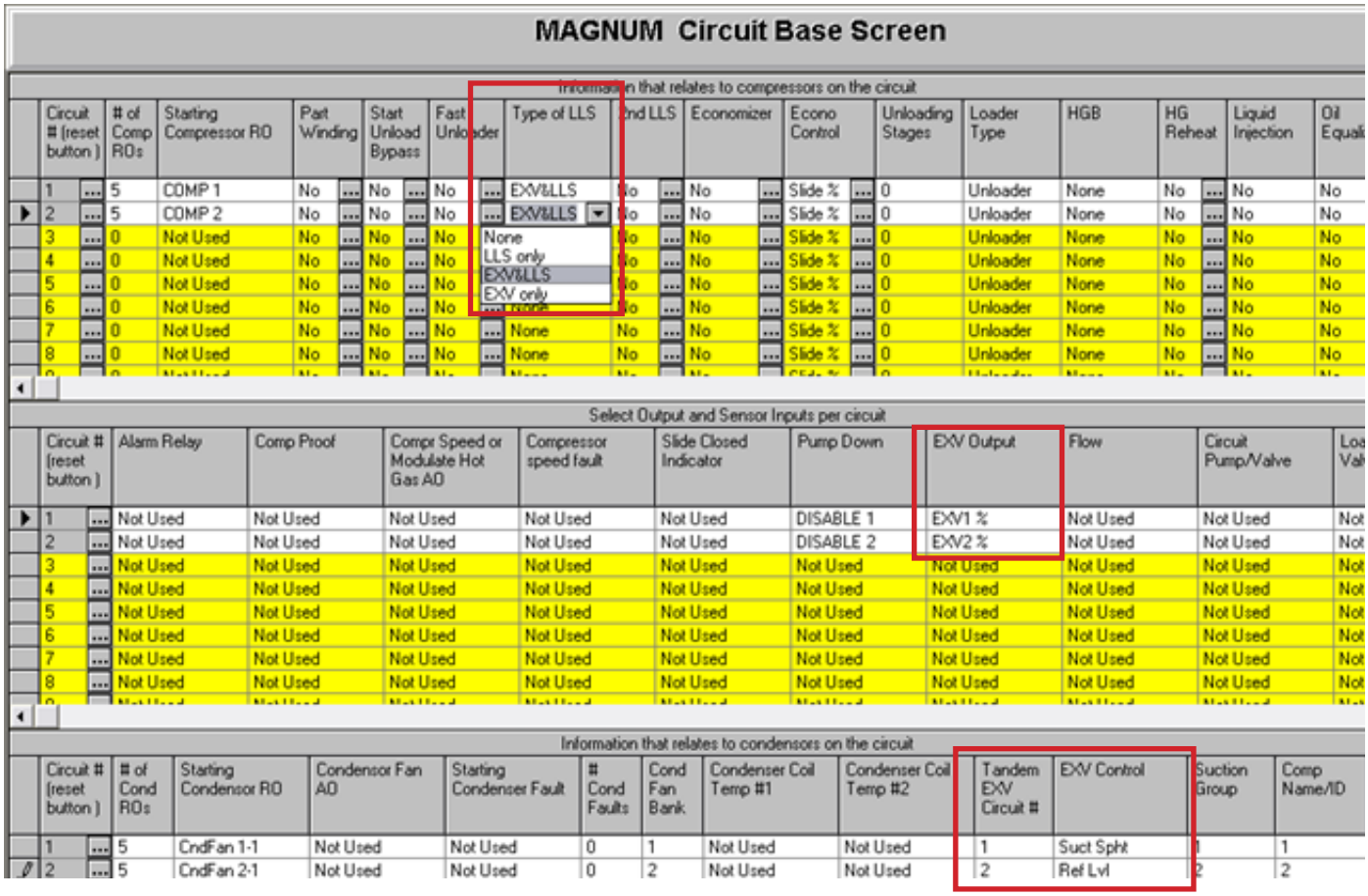
This safety will be checked only when the compressor is running. If the sensor value is less than Setpoint #155 for the ‘Time(sec)’ field, then an alarm message will be generated and the associated compressor will either be placed in a safety or Lockout state.

The Magnum will also determine if a low temperature condition occurs and to stop loading or unload if necessary. If the sensor value is less than the value of Setpoint #155 plus Setpoint #156 “LO REF UNLD”, then the compressor state will be LO TMP UNLOAD. Refer to state (21) in section 6.2.26.

By using the User Logic type sensor, we can test any value for a low condition. For example point the refrigerant temperature index to a User Logic sensor that picks up the saturated suction temperature for that compressor. Make Setpoint #155 active with the low temperature value that will trigger the safety and unload action and you have a low saturated suction temperature condition.

11.45. Electronic Expansion Valve Control Logic (EXV)

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



By clicking on the 'EXV Control' cell under the Circuit Base screen, the option will cycle between Suction Superheat, Discharge Superheat, and Refrigerant Level control.

MCS-MAGNUM V8 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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DATE:	07-23-12 Page 1 of 3
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REVISION :	G
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MCS-MAGNUM V8 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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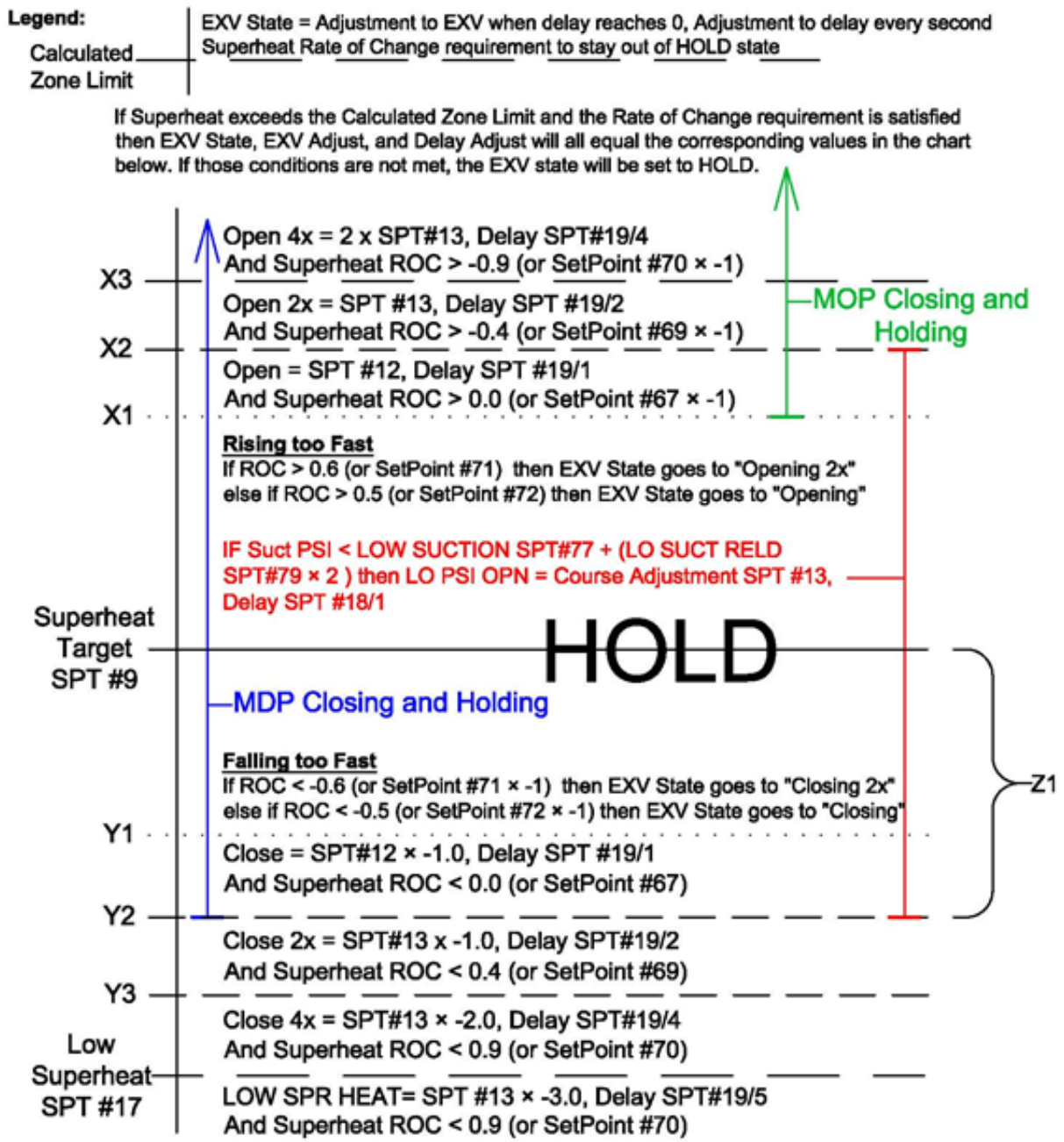


X1 = Stpt #9 + Stpt #10
X2 = X1 + Stpt #10
or if Setpoint #65 is active
then X2 = X1 + Stpt #65
X3 = X2 + Stpt #10
or if Setpoint #66 is active
then X3 = X2 + Stpt #66

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.

MICRO CONTROL SYSTEMS Inc.	
DATE:	07-23-12 Page 3 of 3
DRAWN BY:	M. Schreiber
REVISION :	G
DWG NAME:	MCS-MAGNUM EXV SUCTION-DISCHARGE SUPERHEAT LOGIC - REV G.DWG

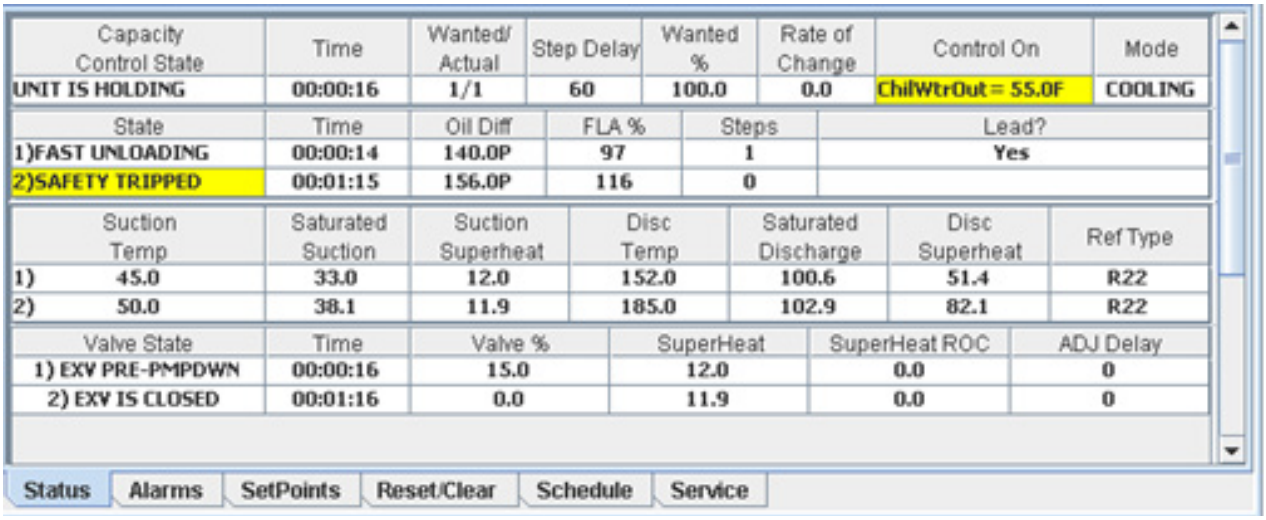
11.45.1 EXV Related Setpoints.

(Refer to section 13 Setpoints 9-20, 65-72, 109-110, 199-201, 205, 215, 217, and 230)

These Setpoints were added to provide fine-tuning to the testing of the movement of the superheat temperature. Refer to EXV control logic chart in a previous section.

11.45.2 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.

11.45.3 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.

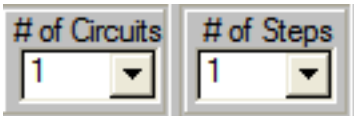
In the EXV IS MOP HOLD state the EXV valve’s opening cannot be increased but it can be closed. The EXV will remain in this state until the suction pressure drops below the MOP control zone. At that time the EXV control state will change to EXV IS HOLDING and normal EXV control will resume.
(Refer to section 13 Setpoints #199, #200, and #201)

11.45.4 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.

11.45.5 Example: One Compressor with One Step and Tandem EXV’s

In the General Information panel of the MAG V8 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

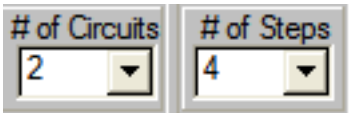
In the Compressor SI screen the active compressors information is to be completed as normal, while only the Suction Pressure and Suction Temperature must be entered for the tandem EXV. The different suction temperature provides separate control for the tandem EXV.

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

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

In the General Information panel of the MAG V8 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
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.

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

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

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

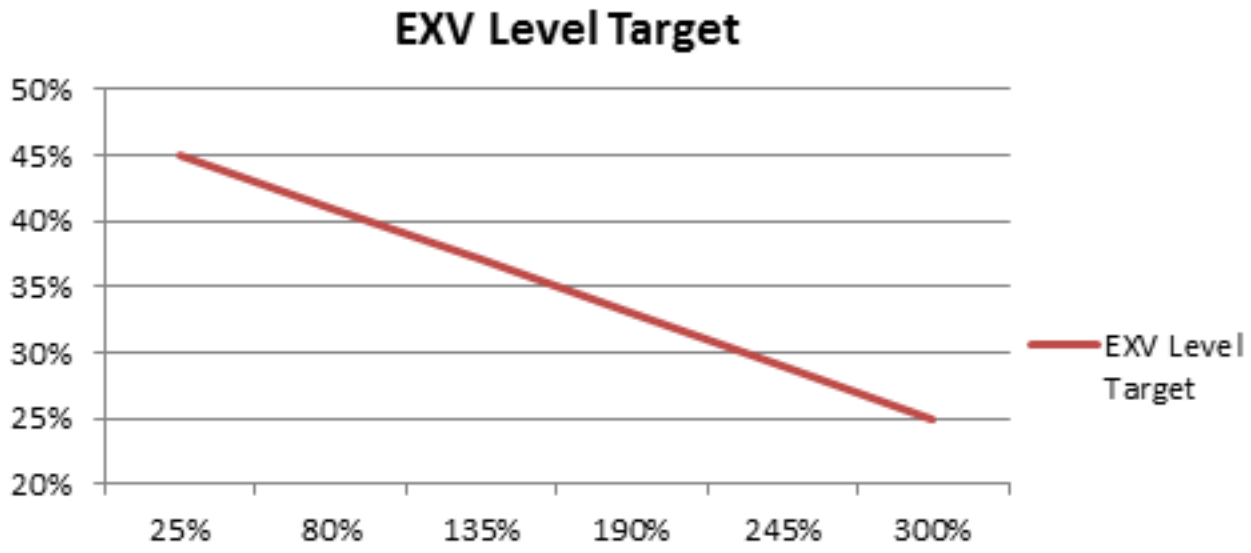
11.45.6 Refrigerant Level Control

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

11.45.6.1. 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.



11.45.7 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 (Magnum V8)

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.

11.46. New Setpoint Functions (08.00-A)

The following features have been added to provide additional flexibility in starting and fine-tuning a system.

Three new fields have been added to each Setpoint:
Sec. to Ignore Safety: Time delay that the safety will be ignored upon compressor startup.

Window to Extend Safety Time: The amount of time after compressor startup (or "Sec to Ignore Safety" if used) in which the "Safety Time Extension" field is added to the "Time (sec)" field.

Safety Time Extension: The amount of time added to the "Time (sec)" field during the "Window to Extend Safety Time".

Four new Setpoints have been added to provide flexibility:
Setpoint #191, TEMP DIFF
Setpoint #192, FRZ TEMP DIFF
Setpoint #193, TE PSI DIFF
Setpoint #194, PSI DIFF

Eight new EXV related Setpoint have been added to provide flexibility:
Setpoint #65, EXV ZONE1
Setpoint #66, EXV ZONE2
Setpoint #67, EXV ROC ZONE
Setpoint #68, EXV ROC ZONE1
Setpoint #69, EXV ROC ZONE2
Setpoint #70, EXV ROC ZONE3
Setpoint #71, EXV TOO FAST
Setpoint #72, EXV CHANGING

Refer to their definitions in the Setpoints section for a complete description.

11.47. Voltage Sensor (08.00-R)

Up to three sensors that measure voltage input can be specified. If used, a safety condition based upon Setpoint #195 LOW VOLTAGE and Setpoint #196 HI VOLTAGE will be checked. If a safety trip occurs the unit will be placed in a safety hold state.

11.48. Motor Amps (08.00-R)

Up to three sensors that measure amperage input can be specified per circuit. If used a safety condition based upon Setpoints #75 HI AMPS and #76 LO AMPS, plus the associated Full Load Amps (FLA) for that circuit will be checked. If a safety trip occurs, that circuit will be placed in a safety hold state.

11.49. Custom display description of circuit (08.00-R)

Instead of displaying the circuit number in the status screens of both the Magnum and MCS Connect, up to 3 characters can be supplied using MCS-Config to replace the circuit number. For example, if 1-A is entered for circuit 1, then 1-A will be displayed in place of 1. This provides the user additional flexibility in describing a particular circuit.

11.50. User Logic RO Delay Before Off (08.00-R)

A timer delay before turning off a relay has been added, providing the ability to keep a relay on for a period of time after the condition to turn it off is met.

11.51. Additional Information Messages (08.00-U)

The messages generated when manually changing the status of a Relay Output or Sensor Input have been expanded. The messages now indicate which relay or sensor was changed and if the change was from AUTO to MANUAL or MANUAL to AUTO.

11.52. Pump Rotation (08.01-C)

Pump rotation functionality has been added. This is specified with Setpoint #106 LEAD PUMP. If the Setpoint is active and its value is zero, then rotation will occur with each on/off cycle of the pump.

11.53. Process Pump Addition and Rotation (08.01-C)

The number of process pumps has been expanded to two and rotation functionality has been added. This is specified with Setpoint #197 LEAD ProcPmp. If the Setpoint is active and its value is zero, then rotation will occur with each on/off cycle of the process pump.

11.54. MOP Control Option to EXV Logic (08.01-G)

Maximum Operating Pressure (MOP) has been added to the EXV control logic. If Setpoint #199 MOP TARG PSI is active then MOP logic will be activated. Refer to section 7.43 on Electronic Expansion Valve Control Logic.

11.55. Delta Temperature Evaporator (08.01-G)

If Setpoint #202 DELTA TEMP EVP is active and the delta temperature across the evaporator is greater than the value of this Setpoint the unit will not increase wanted capacity.

11.56. Condenser Low Ambient (08.01-O)

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.

11.57. New Pressure Sensor Supported (08.01-V)

Two pressure transducers developed by Huba Control designed refrigeration industry. These are the HB-350 and the HB-700.

11.58. Centrifugal Vane Control (08.01-C)

Vane control now can be based on either a vane position or compressor amp draw Sensor Input.

11.59. External Centrifugal Purge Control (08.01-P)

Support for the Trane Purifier Purge operation has been added. If Setpoint #163 Purge Target is active, it will activate this feature.

11.60. MCS Touch Screens Interface (08.00-U)

The interface with the various touch screens has been expanded.

11.61. Sensor Averaging (08.00-R)

Sensor inputs can now be averaged over a period of time, up to a maximum time of 30 seconds. This will enable sensor smoothing if it is needed. Note: At power up, the initial value of the Sensor Input will be counted as the sensor history for the number of seconds that has been selected as the averaging time (for example, if the averaging time was selected at 5 seconds, the initial Sensor Input reading at startup will be counted as having already run at that value for 5 seconds previously).

11.62. Virtual Points Separated From Real Points (08.00-A)

Virtual points are Sensor Inputs, Relay Outputs, or Analog Outputs that are not connected to an outside device, while a real point is connected with wiring from the input/output to an outside device (sensor, motor, etc.). By placing the virtual points after the real points they will not take up points on an actual hardware board. In the Setup section of MCS-Config the total number of points are specified and the number of Input/Output boards must now be specified. Only the number of I/O boards indicated will be accessed.

11.63. MDP to EXV Control Logic (8.01-X)

Minimal (oil) Differential Psi (MDP) requires the following Setpoint #205 be active (Refer to section 13 Setpoint #205).

The EXV logic will forced the state to “EXV MDP CLOSE” when the all of the following conditions are true:
1. Setpoint #205 “MDP MIN OIL DIFF” is active,
2. The compressor oil differential pressure is less than Setpoint #205 value field,
3. The compressor has been running for less than X mins or X is equal to zero (where X is the value contained in Setpoint #205 “SEC to IGNORE SAFETY” field),
4. The compressor suction pressure is greater than or equal to (Setpoint #77 “LOW SUCTION” value plus Setpoint #79 “LO SUCT RELD” value).

In this state the EXV will be closed by the adjustment value in Setpoint #205 “Lockout Delay” field. If this value is positive the valve is closed, if this value is negative the valve will be opened.

The EXV logic will exit the “EXV MDP CLOSE” state and go to “EXV HOLDING” state when the any of the follow conditions are true:
1. The compressor oil differential pressure is greater than (Setpoint #205 value field plus Setpoint #205 Time field),
2. The compressor has been running for more than X mins and X is not equal to zero (where X is the value contained in Setpoint #205 “SEC to IGNORE SAFETY” field),
3. The compressor suction pressure is less than or equal to (Setpoint #77 “LOW SUCTION” value plus Setpoint #78 “LO SUCT ULLD” value).

11.64. Low Discharge Superheat Adjustment to EXV Logic (8.01-X)

Setpoint #110 LOW REFRIGERANT LEVEL TARGET must be active.

If discharge superheat is less than Setpoint #84 LO DISC SUPERHEAT for 1/3 of its safety time and both discharge

temperature and pressure sensors are active, then add the value of Setpoint #110 LOW REFRIGERANT LEVEL TARGET to Setpoint #9 EXV TARGET. This function takes precedence over the regular control zone logic.

11.65. Normal Condenser Discharge Control Bypass (8.02-A)

Depending on what option was selected in MCS-Config, normal condenser control can either be based upon the compressor with the highest discharge pressure or on the pressure of the most recently started compressor. If control based on newly started compressor was selected then Setpoint #206 may be used to bypass this logic because of a high ambient temperature.
(Refer to section 13 Setpoint #206)

11.66. Test for Voltage Out of Balance (8.02-A)

This test requires Setpoint #207 to be active. (Refer to section 13 Setpoint #207)
Only voltage sensors that are specified in the MAG V8 screen of MCS-Config will be included in the calculation.

11.67. Expanded Testing of Low and High Off (8.02-E)

This test requires Setpoints #208 LOW SI OFF and #209 HI SI OFF to be active. (Refer to section 13 Setpoints #208 and #209)

11.68. Expanded Compressor Rotation to Check for Maximum Run Time (8.02-E)

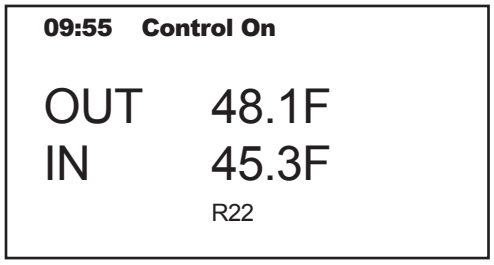
In the Compressor Information panel of the MAG V8 screen in MCS-Config, there is now a check box to select how compressors are to be rotated, based either on Run Time or First On/First Off.

11.69. New Option to test for Low Superheat on Suction or Discharge PSI (8.02-E)

In the Circuit Base screen under the EXV Control column select “Disc Sph” to test discharge pressure or “Suct Sph” to test the suction pressure to determine low superheat.

11.70. New Large Character Screen Displaying Control Information (8.03-B)

A new information screen has been added with large character size for ease of reading. This screen is accessed



HH:MM Heading

First line is sensor that is the controlling sensor; either entering or leaving

Second line is contains the other value

The last line is the refrigerant type

from the Main Menu of the Magnum Keypad by pressing the F3 key.

ACTUAL DISPLAY *DESCRIPTION*

If the “Scrolling Information” option has been selected from MCS-Config, this page will be included in the screen rotation.

11.71. Circuit Amp Value added to Circuit Status Screen (8.03-B)

The amp value is now included in the first page of each compressor information screen. Use the right arrow button to access it.

11.72. Low Discharge Superheat Test to Economizer (8.03-F)

Requires Setpoint #210 ECO LL3 D-SHT (Refer to section 13 Setpoint #210)

11.73. Tonnage and KW Information (8.03-F)

11.73.1 KW Sensors

Sensor Input Information Screen V8

#	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. SI / Temp. Diff. / Enthal. Diff.	Auto Manual (select to change)
1-8	UNIT KW	KW	0	0	Not Used	PWR FACTOR	Not Used	Auto ...
1-9	PWR FACTOR	User Logic	0	0	Not Used	Not Used	Not Used	Auto ...
1-10	UNIT VOLTS	0-600 VAC	0	0	Not Used	Not Used	Not Used	Auto ...
1-11	UNIT AMPS	CT-500	0	0	Not Used	Not Used	Not Used	Auto ...

Unit KW – virtual sensor that calculates the unit Kilowatt usage. The Power Factor (PF) sensor must be selected in the 'Temp. / GPM / CFM / Pwr Factor SI' cell.
Kw = Amps * Volts * Power Factor * Internal Constant of .00173
Power Factor – Virtual sensor tied to a Setpoint where a manual value of the unit's power factor may be defined. If not specified, a hardcoded value of .85 will be used.
Unit Volts – Voltage being supplied to the unit. This sensor can be an actual voltage sensor or virtual point that reads a static value from a Setpoint.
Unit Amps – Sensor reading the amperage of the entire unit. If no total unit amp sensor is specified, the software will automatically sum all the individual compressor amp sensors to approximate the unit amps.

11.73.2 Tonnage Sensors

For Air Cooling Systems

Sensor Input Information Screen V8

#	Name (1 to 10 char)	Display Type	Temp./ GPM / CFM / Pwr Factor SI	Humd. SI / Temp. Diff. / Enthal. Diff.	Auto Manual (select to change)	Multiplier	Divisor	Select Display Type
1-12	UNIT TONS	TONS	UNIT CFM	ENTH DIFF	Auto ...	45	10	
1-13	UNIT CFM	User Defined	Not Used	Not Used	Auto ...	100	1025	FPM
1-14	ENTH DIFF	User Logic	Not Used	Not Used	Auto ...	Not Used	Not Used	TEMP
1-15	RETURN TMP	MCST100	Not Used	Not Used	Auto ...	Not Used	Not Used	Not Used
1-16	RETURN HUM	HUMD	Not Used	Not Used	Auto ...	Not Used	Not Used	Not Used
2-1	RETURN ENT	ENTHALPY	RETURN TMP	RETURN HUM	Auto ...	Not Used	Not Used	Not Used
2-2	SUPPLY TMP	MCST100	Not Used	Not Used	Auto ...	Not Used	Not Used	Not Used
2-3	SUPPLY HUM	HUMD	Not Used	Not Used	Auto ...	Not Used	Not Used	Not Used
2-4	SUPPLY ENT	ENTHALPY	SUPPLY TMP	SUPPLY HUM	Auto ...	Not Used	Not Used	Not Used

For Air Cooling Systems

Sensor Input Information Screen V8

#	Name (1 to 10 char)	Display Type	Temp./ GPM / CFM / Pwr Factor SI	Humd. SI / Temp. Diff. / Enthal. Diff.	Auto Manual (select to change)	Multiplier	Divisor	Select Display Type
1-12	UNIT TONS	TONS	UNIT GPM	TEMP DIFF	Auto ...	1	24	
1-13	UNIT GPM	User Defined	Not Used	Not Used	Auto ...	100	1025	FPM
1-14	TEMP DIFF	User Logic	Not Used	Not Used	Auto ...	Not Used	Not Used	TEMP
1-15	WATER IN	MCST100	Not Used	Not Used	Auto ...	Not Used	Not Used	Not Used
1-16	WATER OUT	MCST100	Not Used	Not Used	Auto ...	Not Used	Not Used	Not Used

Unit Tons – a virtual sensor that calculates the unit tonnage. The Unit Flow (GPM or CFM) sensor must be selected in the 'Temp. / GPM / CFM / Pwr Factor SI' cell, and the Enthalpy Differential or Temperature Differential sensor (air and water cooling systems respectively) must be selected in the 'Humd. SI / Temp. Diff. / Enthal. Diff.' cell. Also the correct values must be placed in the 'Multiplier' and 'Divisor' cells depending on the type of system; 45 and 10 respectively for air, 1 and 24 respectively for water (refer to pictures above).

*Tonnage (air) = Flow (CFM) * Enthalpy Differential * 4.5*
*Tonnage (water) = Flow (GPM) * Temperature Differential / 24*

Unit Flow (GPM or CFM) – Gallons per minute (for water) or cubic feet per minute (for air). This can be an actual flow sensor or virtual point that reads a static value from a Setpoint. NOTE: It is essential for a correct calculation that this sensor must be configured so as to have no decimal places.

Water In and Out Temperatures – (Water only) Temperature sensors for Water In and Out.

Temperature Differential – (Water only) User logic that subtracts Water Out Temperature from Water In Temperature. **Temp Diff** = Water In – Water Out

Supply and Return Humidity – (Air only) Humidity sensors for Return and Supply air.

Supply and Return Temperatures – (Air only) Temperature sensors for Return and Supply air.

Return Enthalpy – (Air only) Virtual sensor that calculates enthalpy for Return air. The Return Temperature sensor must be selected in the 'Temp. / GPM / CFM / Pwr Factor SI' cell and the Return Humidity sensor must be selected in the 'Humd. SI / Temp. Diff. / Enthal. Diff.' cell.

Supply Enthalpy – (Air only) Virtual sensor that calculates enthalpy for Supply air. The Supply Temperature sensor must be selected in the 'Temp. / GPM / CFM / Pwr Factor SI' cell and the Supply Humidity sensor must be selected in the 'Humd. SI / Temp. Diff. / Enthal. Diff.' cell.

Enthalpy Differential – (Air only) User logic that subtracts Supply Enthalpy from Return Enthalpy.

Enth Diff = Return Ent – Supply Ent

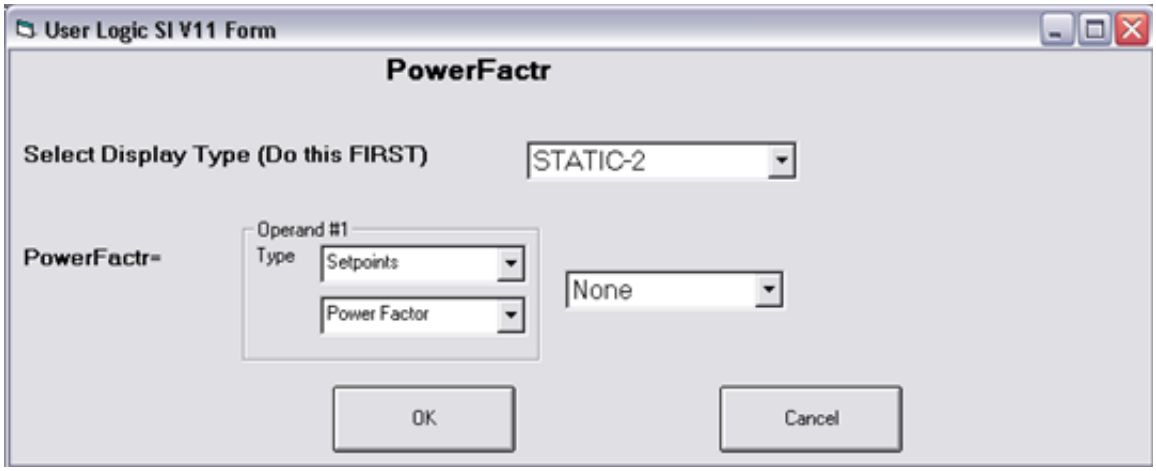
11.73.3 Configuring KW and Tonnage

To set up User Logic for Power Factor (or GPM, CFM, or Unit Volts if desired), first go to the Setpoints screen and scroll down to the very bottom. Starting at Setpoint #230 and working your way up, activate the number of Setpoints you will need. Give each point a descriptive name that will help you identify its function, such as the example below. Then input the value you would like that sensor to read, as well as a range that value may vary in and the interval at which you would like to adjust the value. Pay special note to the type of Setpoint selected (as in the example below) in the "Select Value: # decimals & print char" cell so that the values will read and calculate correctly.

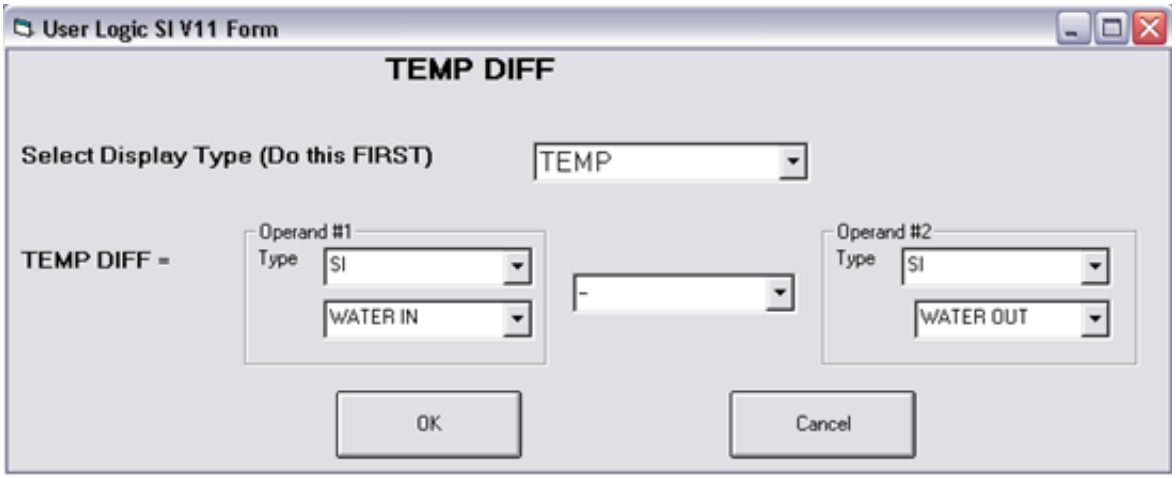
Setpoint Information Screen V8

#	Name	Value	Min	Max	Adjust Value	Time (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 extend Safety Time (Sec)	Safety Time Extension (Sec)
230	Power Factor	0.85	0	1	0.01	0		0	Active	STATIC-2 dec	View Only	Setpoint		0	0	0

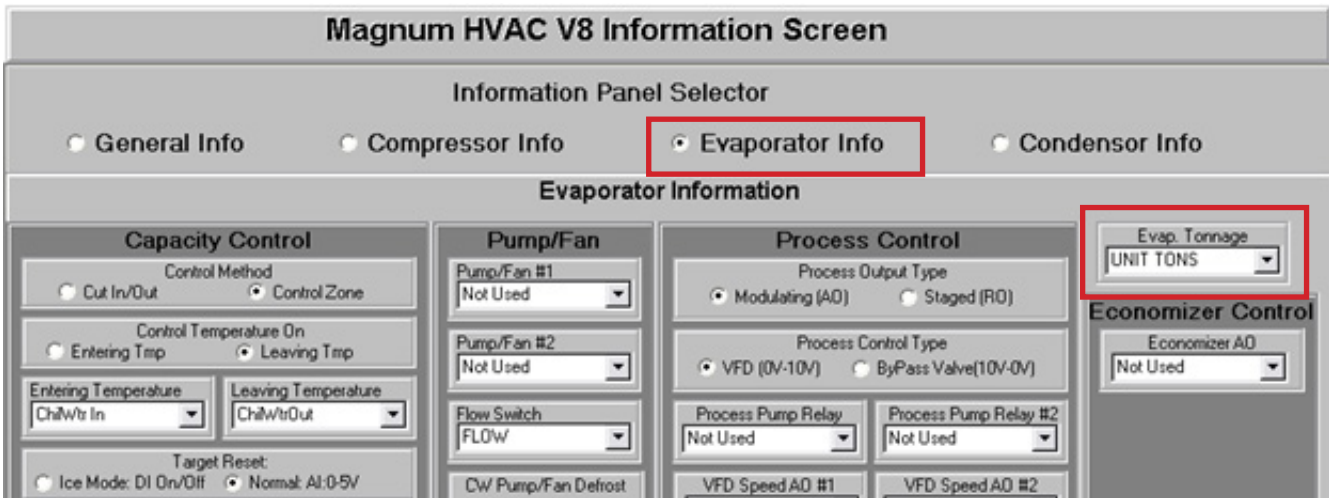
Once your Setpoints have been defined, go back to the SI screen. Find the respective sensor you wish to tie to a Setpoint and select User Logic in the "Display Type" column. The "User Logic SI V11 Form" screen will pop up. First select the same Display Type as you did in the "Select Value: # decimals & print char" cell for the respective Setpoint. Next, select "Setpoints" in the first dropdown menu of the Operand #1 box, and select the respective Setpoint in the second dropdown menu. Finally, select "None" in the middle dropdown menu (Operators). An example User Logic displaying the value of a Setpoint is shown below:



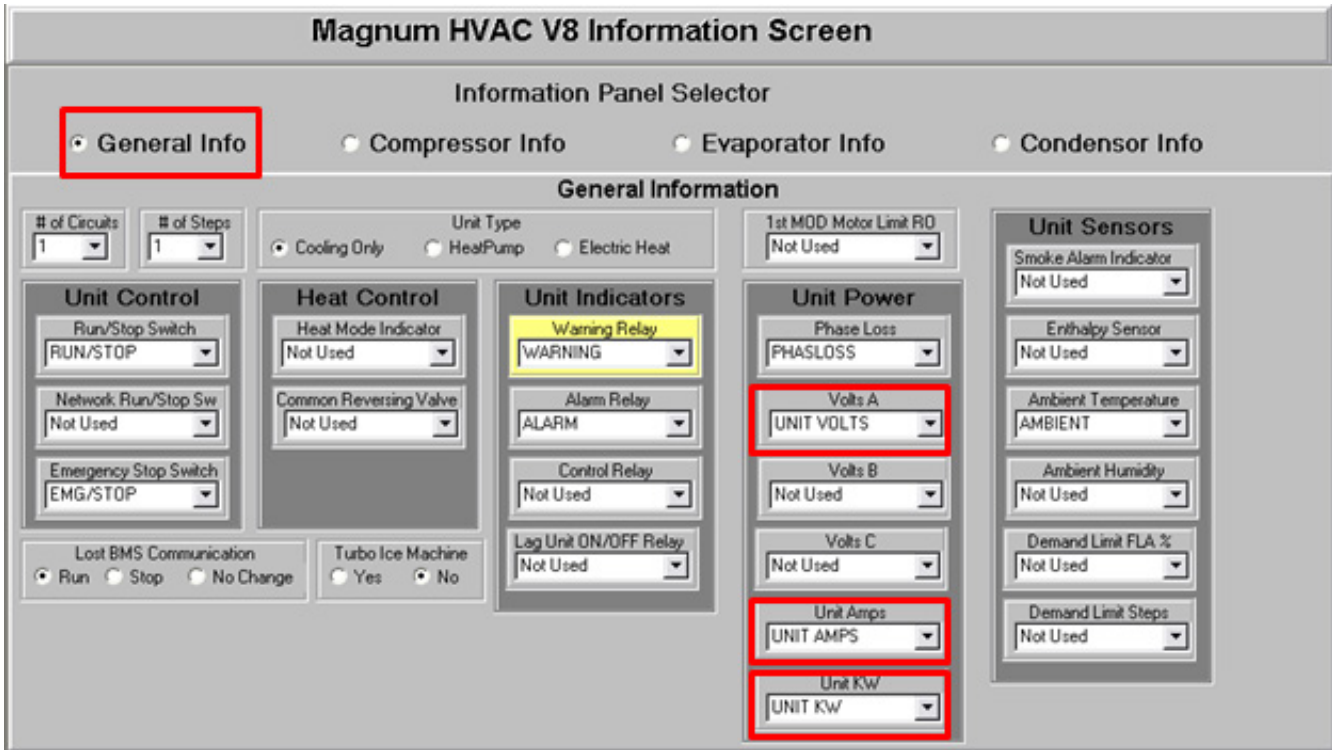
To set up the User logic for differential calculations, such as for Temperature Differential, first select User Logic as the Display Type for that particular sensor. Again the “User Logic SI V11 Form” screen will pop up. This time you will select the corresponding display type, as well as SI type for Operands #1 and #2. Then select Water In Temperature for Operand #1 and Water Out Temperature for Operand #2 and subtraction from the middle drop down menu (See picture below).



The Unit Tons value is selected in the “Evap. Tonnage” cell in the Evaporator Information panel under the MAG V8 screen.



The Unit Volts sensor is selected in the “Volts A” cell in the General Information panel. The Unit Amps sensor is selected in the “Unit Amps” cell (If not used then the “Amps A” cell from each circuit in the Circuit SI screen will be totaled together to calculate the amps value). The Unit KW sensor is selected in the “Unit KW” cell.



The following screen has been added to the status screens in the keypad display to show Tonnage/KW information (if available):

ACTUAL DISPLAY			*DESCRIPTION*		
09:55	Unit 60/65		HH:MM	CHILLER UNIT	LEV/ENT
	UNIT IS UNLOADED			CURRENT CONTROL STATE	
	025:42;33			TIME IN CURRENT STATE	
AMP&VLT	KW&TO	KW/TON	AMP and VOLT	KW and TON	KW/TON
110.0A	73.8K	0.15	AMPS	KW	KW/TON with
388.0V	479T		VOLTAGE	TONS	2 decimals
	PG↑	PG↓		PAGE UP	PAGE DN

11.74. Oil Flow Safety (8.03-J)

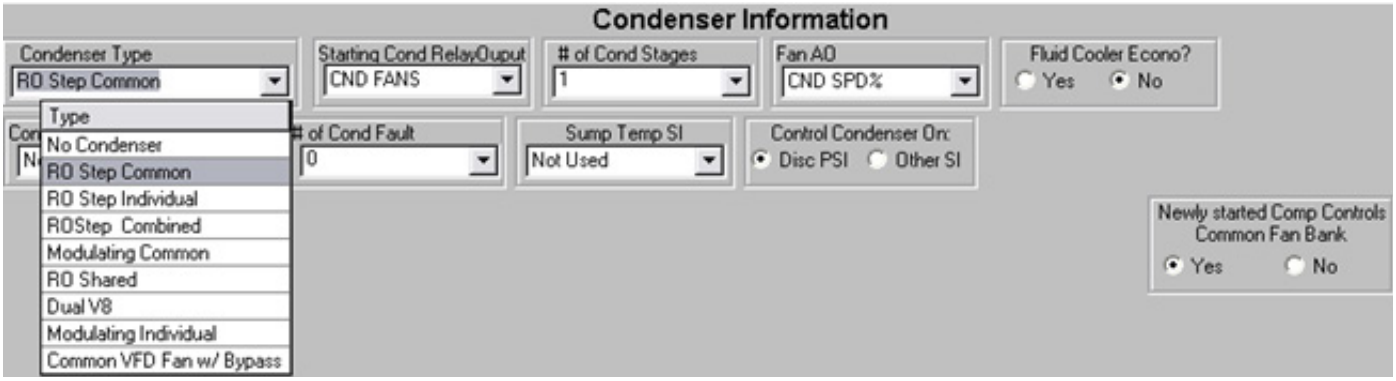
Requires Setpoint #211 if HVAC configuration type, Setpoint #214 if CENT (Refer to section 13 Setpoints #211 and #214).

11.75. RTC Access to User Logic (8.03-J)

The real time clock (RTC) can now be accessed in the User Logic.

11.76. Condenser Control Logic

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 options:

- 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.

11.76.1 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:
Setpoint #45 “CND STG1 ON” = 200 psi
Setpoint #46 “CND STG1 OFF” = 170 psi
Setpoint #47 “CND DIFF ON” = 20 psi
Setpoint #48 “CND DIFF OFF” = 5 psi

COND FAN 1 ON at 200 psi (Discharge)
COND FAN 1 OFF at 170 psi

COND FAN 2 ON at 220 psi (200 + 20)
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)

11.76.2 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.

11.76.3 Condenser Control

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

11.76.3.1. 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.

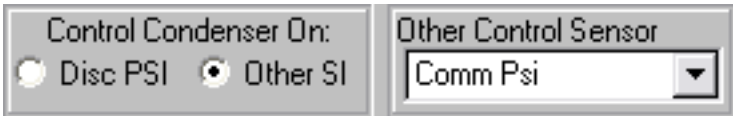
Suction Group:
Indicates which circuits share a common suction line.

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

Control Condenser On:

(Disc PSI) - The Magnum will check for the compressor with the highest discharge and use that as the controlling pressure.

(Other SI) - 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.



11.76.3.2. 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.

11.76.3.3. 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 MAG V8 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.
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.

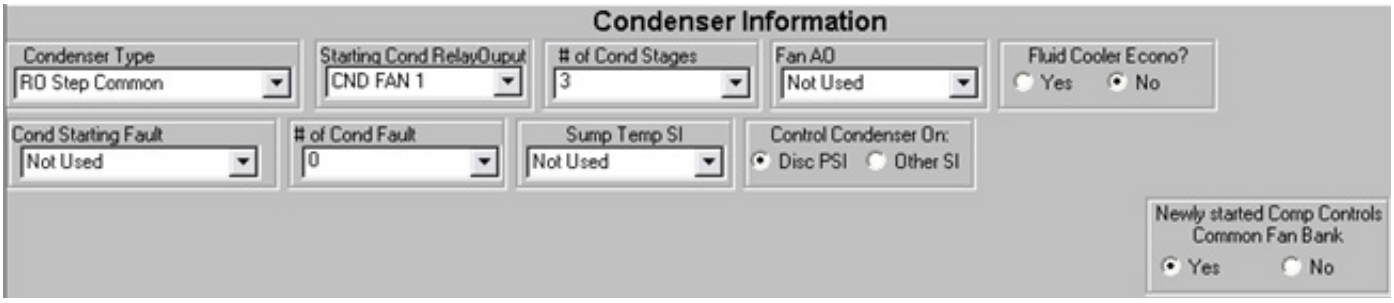
48	CND DIFF OFF (RO Type)	Differential pressure added to Setpoint #46 to set the threshold at which each additional stage of condenser capacity will turn off.
	CND ADJ DELAY (Modulating Type)	If active this is the time in seconds between condenser adjustments to the AO. If inactive, then 30 seconds will 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%.
	DUAL PSI DELTA (Dual V8)	Minimum difference in pressure before the second stage of condenser capacity can be started.
49	CND MIN RUN (RO Type)	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)	Time delay once the pressure difference in Setpoint #48 has been reached before the second condenser stage can be started.
	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 TRGT (Modulating Type)	Target the logic will try to maintain by modulating the AO.
	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 (hardcoded 15°F if inactive), then the sump pump relay will be allowed on again.
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.
	CND VFD MIN	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)	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 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)	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.
57	LO AMB PROC	When this Setpoint is active and there is a process pump, the process pump will be turned on when the ambient temperature is less than the value of this Setpoint. The process pump will be turned off again when the ambient temperature is 5.0° Fahrenheit greater than the value of this Setpoint.
90	COND FAULT	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 Lockout, and a condenser fault occurs, then all of the compressors associated with this fault will be locked off. For Common VFD Fan Condensers with Bypass: Time in seconds before the bypass can be used when a fault has occurred.
193	CND HI/LO ZONE	The value in this Setpoint is the high and low zone for your target of Setpoint #50 “CND TRGT“. If inactive then a default zone of 5 psi will be used, if metric .3 Bar.
194	CND 2ND ZONE	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.
197	COND LOW AMB (Only CENT)	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.
204	COND LOW AMB (Only HVAC)	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.
206	COND HI AMB	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.

11.76.3.4. No Condenser

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

11.76.3.5. RO Step Commo



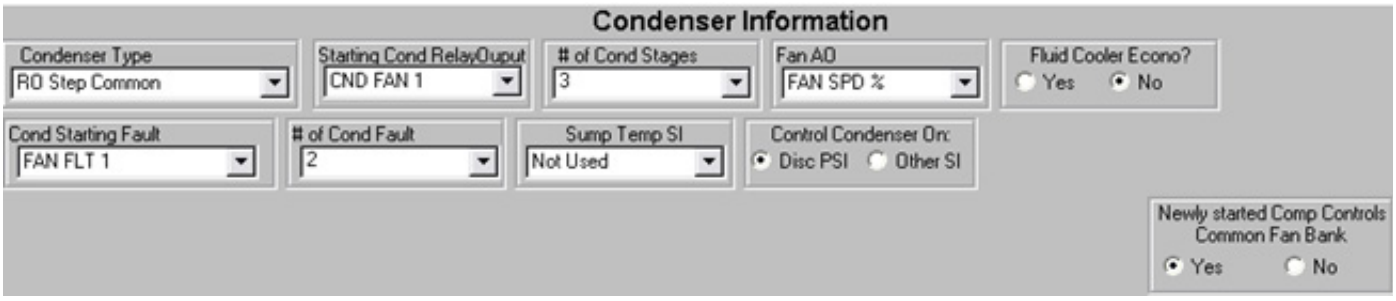
The RO Step Common of condenser has one bank of fans. Make sure that all compressors in the Circuit Base point to the same common fan bank. The above example does not have a Fan Analog Output and there are three stages of fans starting with CND FAN 1 relay. All stages must be consecutive Relay Outputs.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

11.76.3.6. 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.

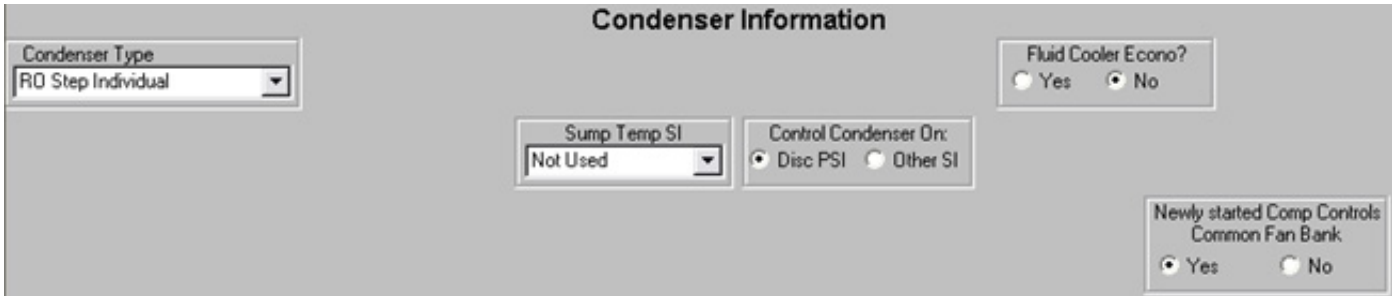
If the pressure increases to 215.0 the condenser's second stage will be turned on and the fan speed will also be at 100.0%. If the pressure changes between 175.0 and 229.9 the fan speed will also be modulated proportionally between its maximum and minimum settings.

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.

11.76.3.7. 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 Spl	1	1
	2 ...	3	CND FAN 2	Not Used	Not Used	0	2	Not Used	Not Used	2	Suct Spl	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.

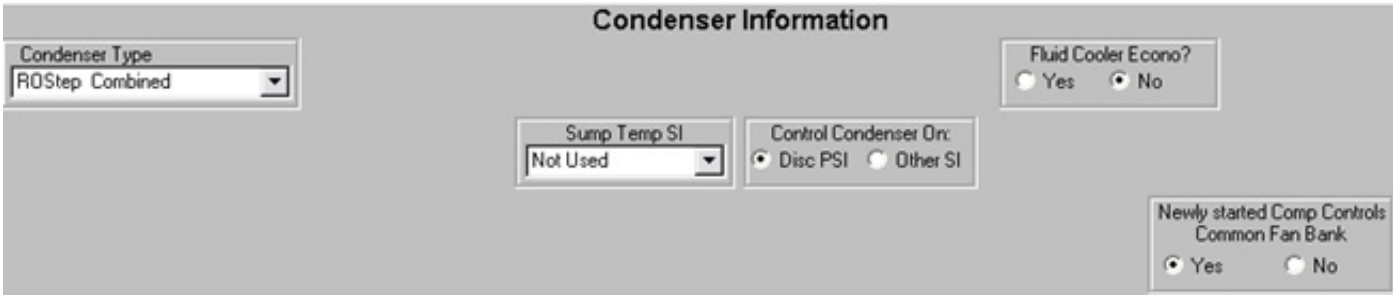
Starting Condenser Fault - If there were condenser faults specified in this cell they would function as described in the example in section 7.74.3.6 RO Step Common with a Fan AO and Condenser Faults. There are no condenser faults in this example.

 # 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.

11.76.3.8. 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

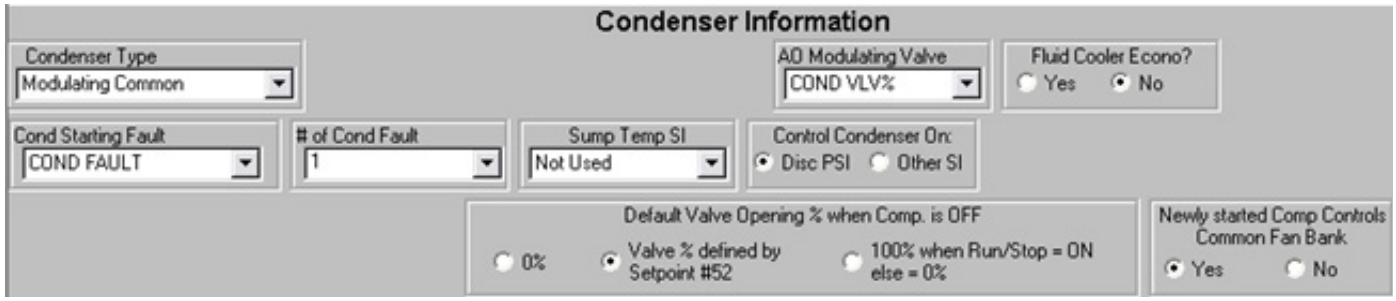
Circuit # (reset button)	# of Cond ROs	Starting Condensor RO	Condensor Fan AO	Starting Condenser Fault	# Cond Faults	Cond Fan Bank	Condenser Coil Temp #1	Condenser Coil Temp #2	Tandem EXV Circuit #	EXV Control	Suction Group	Comp Name/ID
1 ...	3	FAN 1&3 #1	Not Used	Not Used	0	1	Not Used	Not Used	1	Suct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

11.76.3.9. Modulating

11.76.3.9.1. 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 the logic will try to maintain by modulating the AO.
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 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 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.
90	COND FAULT	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 Lockout, and a condenser fault occurs, then all of the compressors associated with this fault will be locked off. For Common VFD Fan Condensers with Bypass: Time in seconds before the bypass can be used when a fault has occurred.
193	CND HI/LO ZONE	The value in this Setpoint is the high and low zone for your target of Setpoint #50 "CND TRGT". If inactive then a default zone of 5 psi will be used, if metric .3 Bar.
194	CND 2ND ZONE	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.

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.

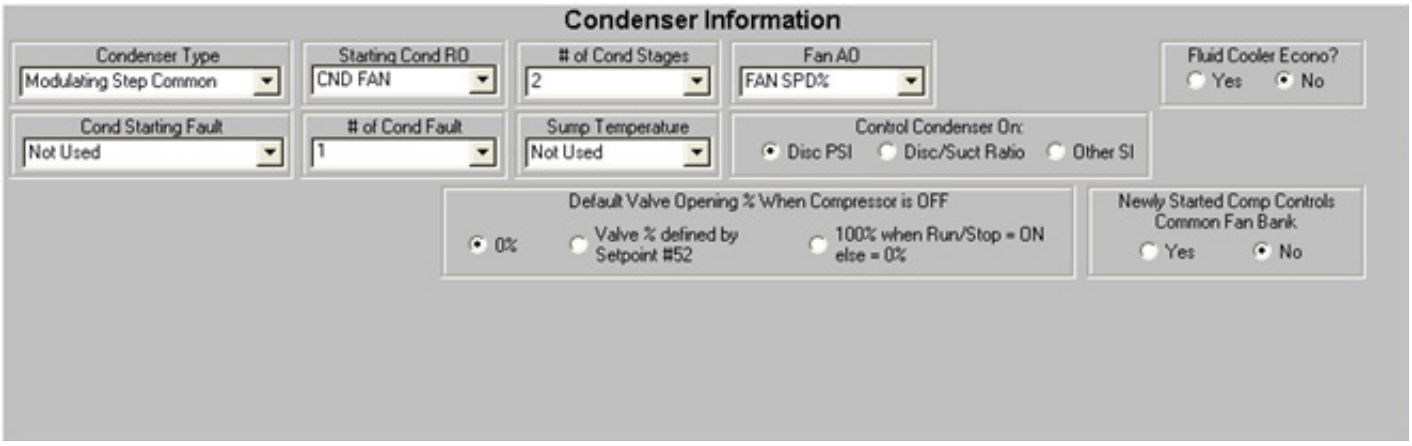
When the control discharge pressure is greater than Setpoint #50 plus 5.0 psi (.5 bar) : If the control discharge pressure rate of change is dropping too fast (more than twice the value of Setpoint #53), then close the valve by the calculated adjustment. If the control discharge pressure rate of change 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 5.0 psi (.5 bar): If the control discharge pressure rate of change is increasing too fast (more than twice the value of Setpoint #53) and the control discharge pressure is greater than Setpoint #50 minus 20.0 psi (1.3 bar), 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.

11.76.3.9.2. Modulating Step Common

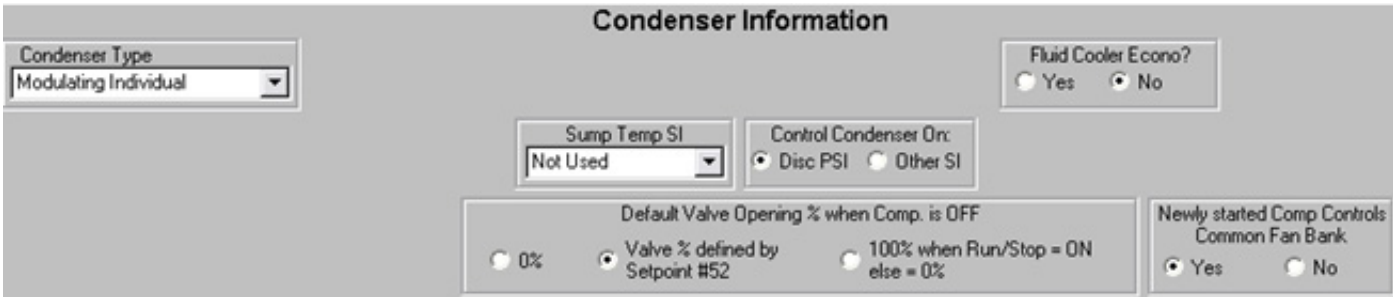


When a RO is being used with an AO the AO will key off the RO turning on. The RO will turn on when the discharge pressure enters the bottom of the CND HI/LO ZONE (Setpoint #193). At that time the AO will move to its starting % (Setpoint #49). The AO will stay at its starting % until the discharge pressure 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).

11.76.3.9.3. 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.

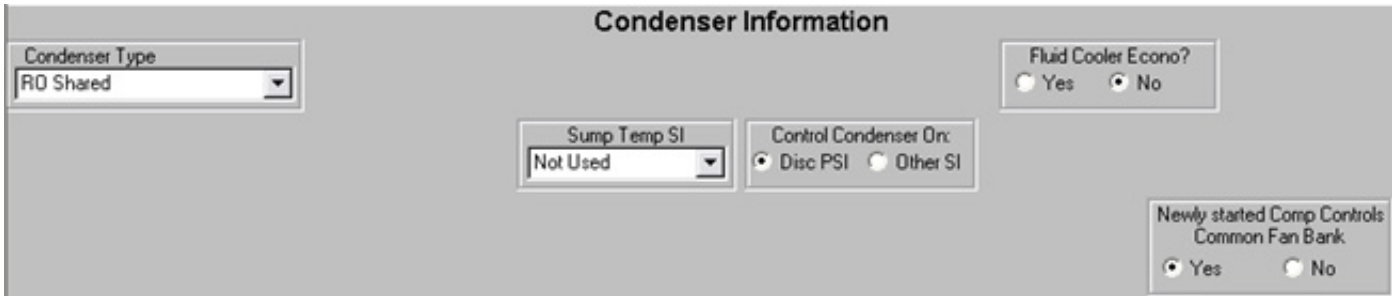
The individual condensers must be set up in the Circuit Base screen.

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 ...	1	CND FAN 1	CND VLV 1%	Not Used	0	1	Not Used	Not Used	1	Suct Spr	1	1
2 ...	1	CND FAN 2	CND VLV 2%	Not Used	0	2	Not Used	Not Used	2	Suct Spr	2	2

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

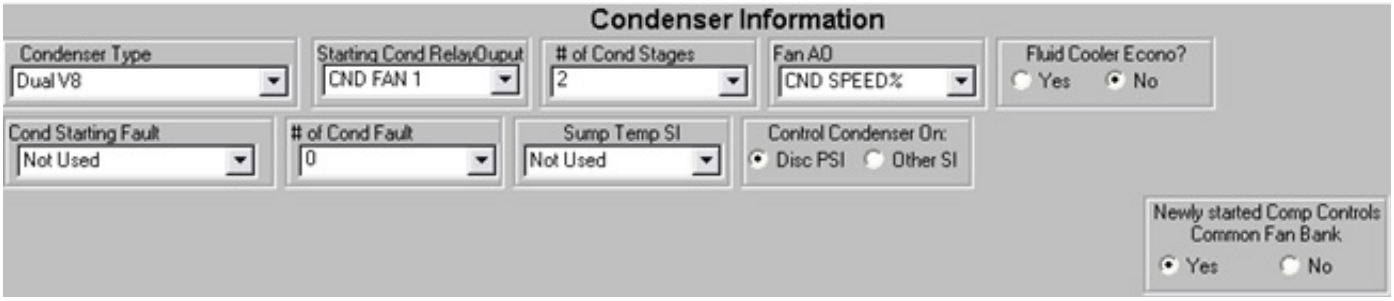
11.76.3.9.4. RO Shared



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.

11.76.3.9.5. 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.

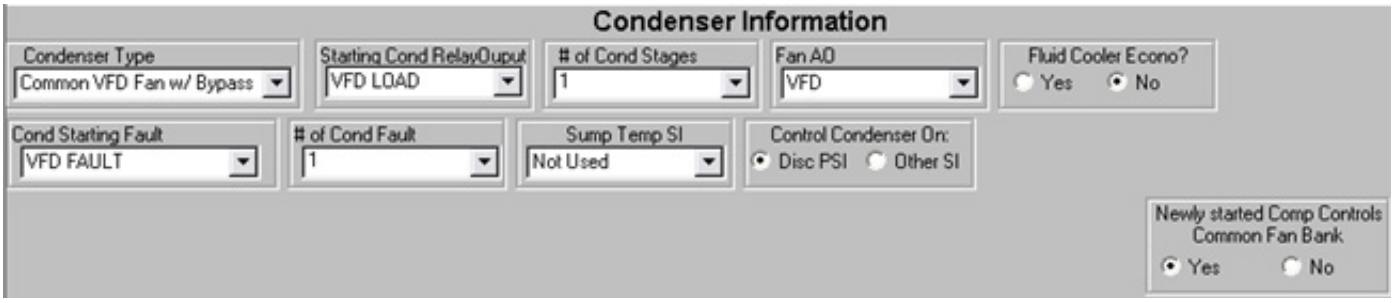
If the control discharge pressure is less than Setpoint #45, then both condenser stages are off and the fan speed is zero.

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.

11.76.3.9.6. 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:

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 in the 'Newly started Comp Controls Common Fan Bank' box in the 'Condenser Information' panel under the MAG V8 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.
54	CND MIN SPD (RO Type)	Minimum speed percentage for variable speed condenser control.
55	CND MAX SPD (RO Type)	Maximum speed percentage for variable speed condenser control.
90	COND FAULT	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 Lockout, and a condenser fault occurs, then all of the compressors associated with this fault will be locked off. For Common VFD Fan Condensers with Bypass: Time in seconds before the bypass can be used when a fault has occurred.

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.

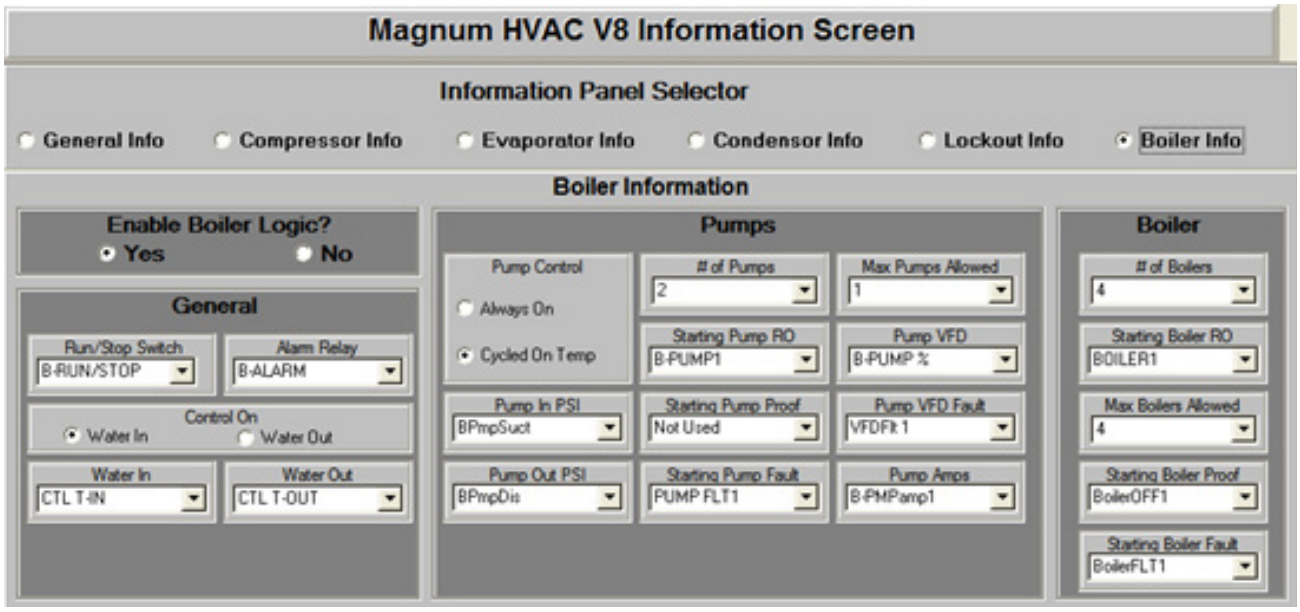
If the fault resets itself, and is no longer on, the state of VFD LOAD will be set to AUTO, the VFD BYPASS relay will be turned off and VFD will be enabled to control the fan speed if it is needed.

11.77. Boiler/Pump Control

Boiler/Pump control logic has been added to the standard HVAC software. This will provide similar but limited pump control that is provided in Loop Water Control (LWC) software. This will enable boilers and their associated pumps to be controlled without the need to add an additional MCS Magnum with LWC software to control these functions.

11.77.1 MCS-Config Requirements

The following panel has been added to the Magnum HVAC V8 Information screen as the setup for the Boiler/Pump information.



11.77.1.1. Enable Boiler Logic?

If No is selected the additional Boiler Information will not appear. The Boiler logic is inactive.
If Yes is selected the additional Boiler Information will appear and the Boiler logic is active.

11.77.1.2. General

Select the Run/Stop Switch and the Alarm Relay from dropdown lists (if applicable).
Select either Water In or Water Out for the control of the boilers.
Select the Water In and Water Out sensors from dropdown lists (if applicable).

11.77.1.3. Pumps

Select the Pump Control method:

Always On - If the unit is on then a pump will be on.
Cycled On Temp - Pumps will be cycled on and off based temperature of the water.

# of Pumps: Indicates the number of pumps that will be controlled (Maximum of 12).

Max Pumps Allowed: Indicates the maximum number of pumps that can be turned on concurrently.

Starting Pump RO: Select the starting pump Relay Output from a dropdown list. There must be one Relay Output for each pump.

Pump VFD: Select the pumps variable speed Analog Output from a dropdown list (if applicable).

Pump In PSI: Select the sensor from a dropdown list that will display the pressure coming into the pumps.

Pump Out PSI: Select the sensor from a dropdown list that will display the pressure leaving the pumps. If this is provided the system will calculate a pressure differential by subtracting Pump In PSI from the value of this sensor. The target Setpoint #160 must reflect the target as a differential.

Starting Pump Proof: Select the sensor from a dropdown list that will indicate the status of a pump that has been turned on. If used, there must be one input per pump. If the pump is on and the associated digital input is OFF a boiler fault has occurred.
Pump VFD Fault: Select the sensor from a dropdown list that will indicate when a pump VFD has occurred. If no sensor is selected this safety will not be checked.

Starting Pump Fault: Select the sensor from a drop down list that will indicate the status of a pump that has been turned on. If used, there must be one input per pump. If the associated pump is on and this digital input is ON a fault has occurred.

Pump Amps: Select the sensor from a drop down list that will indicate the amp draw of the associated pump. If selected, there must be one sensor per pump. If no sensor is selected, the amp safety will not be checked.

11.77.1.4. Boiler

# of Boilers: Indicates the number of boilers that will be controlled (Maximum of 12).

Starting Boiler RO: Select the starting boiler relay output from a drop down list. There must be one Relay Output for each boiler.

Max Boilers Allowed: Indicate the maximum number of boilers that can be turned on concurrently.

Starting Boiler Proof: Select the sensor from a dropdown list that will indicate the status of a boiler that has been turned on. If used, there must be one input per boiler. If the associated boiler is on and this digital input is OFF a boiler fault has occurred.

Starting Boiler Fault: Select the sensor from a dropdown list that will indicate the status of a boiler that has been turned on. If used, there must be one input per boiler. If the associated boiler is on and this digital input is ON a fault has occurred.

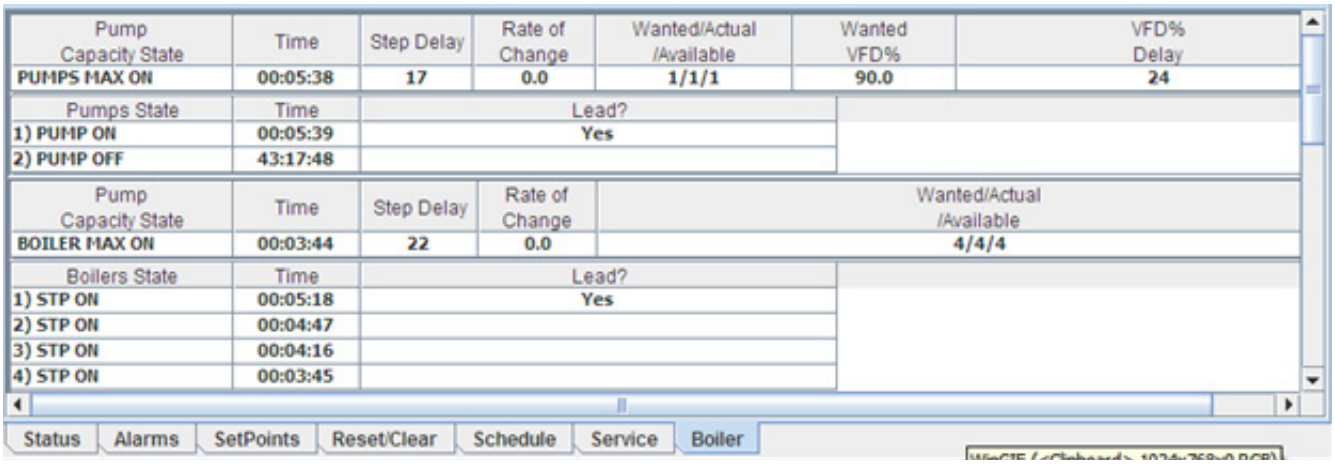
11.77.2 The following set points are required by the Boiler Logic

#	Name	Typical Value	Description
157	B-PUMP DELAY	30	The time delay expressed as seconds between making decisions as to pump settings.
158	B-STAGE DELY	60	The time delay expressed as seconds between making decisions as to boiler stage settings.

#	Name	Typical Value	Description
159	B-VFD DELAY	30 500 1000	The time delay expressed as seconds between making decisions as to pump VFD setting. 'Sec. to Ignore Safety' field: contains the minimum valve setting. For example if this cell contains 500, the valve will initially be set to 50.0% and it will never be less than this value. 'Window to extend Safety Time(sec)' field: contains the maximum valve setting. This will normally be 1000 for 100.0%.
160	B-VFD TARGET	60.0 120 30 25 30	The target flow that is to be maintained. This can be a differential if both input and output pressures sensors are specified or the actual flow of the input if only sensor specified. 'Time(sec)' field: contains the delay in seconds before another pump can be turned on once the valve gets to 100.0% 'Sec. to Ignore Safety' field: contains high dead band for the control zone. This is added to the value of this set point. In this example the high dead band will be 63.0. 'Window to extend Safety Time(sec)' field: contains low dead band for the control zone. This is subtracted from the value of this set point. In this example the low dead band will be 57.5. 'Safety Time Extension' field: contains the maximum valve adjustment that can be made at one time. In this example the maximum adjustment to the valve will be 3.0%..
161	B-PUMP FLT	0 30	The 'Value' is not used as this set point is set up to check the status of a digital input indicated in the Starting Pump Fault cell. 'Time(sec)' field: contains the delay before the system will place a pump in a failed state.
162	NO USED		
163	B-HEAT TRGT	180.0	The heating target that is to be maintained.
164	B-HEAT ZONE+	3.0	The high dead band for the heating control zone. This value is added to the value of set point #163.
165	B-HEAT ZONE-	3.0	The low dead band for the heating control zone. This value is subtracted form the value of set point #163.
189	B-FLA PUMP	30.0	The expended amp draw of the pump. If active this value is used to calculate the high and the low ampere safeties limits. Refer to set points 75 and 76.
190	B-FLA BOILER	120.0	The 'Value' is not used as this set point is set up to check the status of a digital input indicated in the Starting Boiler Fault cell. 'Time(sec)' field: contains the delay before the system will place a boiler stage in a failed state.

11.77.3 Status of Boiler Logic displayed by MCS Connect

The Boiler status is displayed by clicking on the Boiler tab:



Pump Capacity State	Time	Step Delay	Rate of Change	Wanted/Actual /Available	Wanted VFD%	VFD% Delay
PUMPS MAX ON	00:05:38	17	0.0	1/1/1	90.0	24

Pumps State	Time	Lead?
1) PUMP ON	00:05:39	Yes
2) PUMP OFF	43:17:48	

Pump Capacity State	Time	Step Delay	Rate of Change	Wanted/Actual /Available
BOILER MAX ON	00:03:44	22	0.0	4/4/4

Boilers State	Time	Lead?
1) STP ON	00:05:18	Yes
2) STP ON	00:04:47	
3) STP ON	00:04:16	
4) STP ON	00:03:45	

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

Pump General Status:

- Pump Capacity State: Pump state.
- Time: Time in current pump state.
- Step Delay: Seconds remaining before next pump adjustment is checked.
- Rate of Change: Rate of change of the controlling sensor. In above example the control on water in has been selected, sensor CTLT-IN.
- Wanted/Actual/Available: Pumps wanted on = 1, actual =1, available =1. In above example there are 2 pumps but only 1 can be on at a time. The second pump is back up.
- Wanted VFD%: Position of pump VFD if applicable.
- VFD% Delay: Seconds remaining before next pump VFD adjustment is checked.

Pump Individual Status:

- Pumps State: State of individual pumps.
- Time: Time in current individual pump state.
- Lead?: Indicates the lead pump.

Boiler Stage General Status:

- Pump Capacity State: Boiler state.
- Time: Time in current boiler state.
- Step Delay: Seconds remaining before next boiler stage adjustment is checked.
- Rate of Change: Rate of change of the controlling sensor. In above example the control on water in has been selected, sensor CTLT-IN.
- Wanted/Actual/Available: Pumps wanted on = 4, actual =4, available =4. In above example there are 4 boiler stages and all are on.

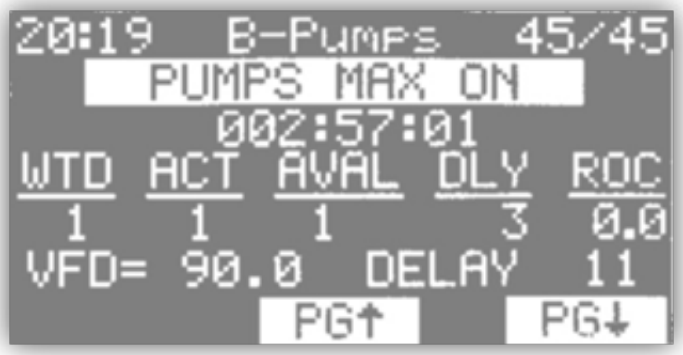
Boiler Individual Status:

- Boiler State: State of individual boiler stages.
- Time: Time in current individual boiler stages state.
- Lead?: Indicates the lead boiler stage.

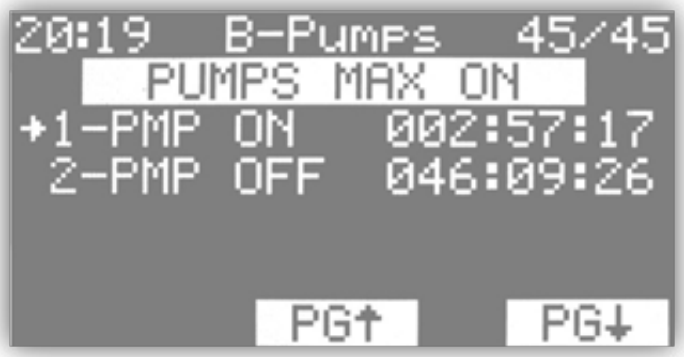
11.77.4 Status of Boiler Logic displayed by the Magnum

The Boiler status is displayed by selecting the Status form the main menu. The Boiler/Pump information is the same as above but it requires the following 4 screens:

Screen 1



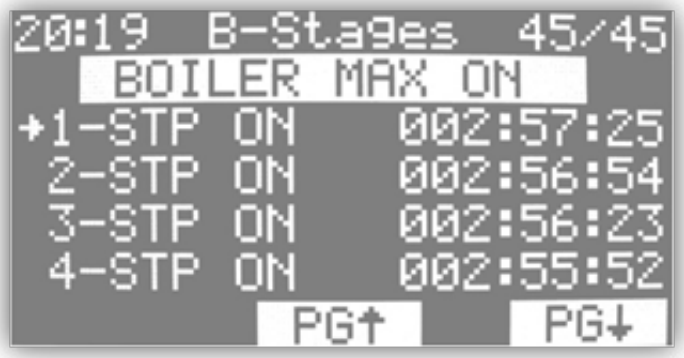
Screen 2



If there are more than 4 pumps addition screens will be displayed showing up to the maximum of 12 pumps. The status of 4 pumps will be displayed per screen.

Screen 3

Screen 4



If there are more than 4 boiler stages addition screens will be displayed showing up to the maximum of 12 boiler stages. The status of 4 boiler stages will be displayed per screen.

11.77.5 Pump States

The general pump states are as follows:

- PUMPS STOPPED: The Run/Stop Switch is in the STOP (OFF) position.
- PUMPS ALL OFF: The Run/Stop Switch is in the RUN (ON) position but no pumps are required at this time. Control temperature is high and no heating is required.
- PUMPS HOLDING: The Run/Stop Switch is in the RUN (ON) position at least one pump is on, no additional pumps are needed. Pump flow is being maintained.
- PUMPS UNLOADING: The Run/Stop Switch is in the RUN (ON) position and a pump will be turned off.
- PUMPS LOADING: The Run/Stop Switch is in the RUN (ON) position additional pumps are needed.
- PUMPS MAX ON: The Run/Stop Switch is in the RUN (ON) position and the maximum number of pumps that are available are on.

The individual pump states are as follows:

- PMP OFF: The pump is off and it is ready to be turned on if needed.
- PMP ON: The pump is on.
- PMP FLT: The pump is off due to the digital input, Starting Pump Fault, associated with this pump being on for a time longer than the safety time in set point #161.
- PMP LOamp: The pump is off due to low amp draw.
- PMP HIamp: The pump is off due to high amp draw.

11.77.6 Boiler States

The general boiler states are as follows:

- BOILER STOPPED: The Run/Stop Switch is in the STOP (OFF) position.
- BOILER HOLDING: The Run/Stop Switch is in the RUN (ON) position at least one boiler stage is on, no additional boiler stage are needed. Control temperature is being maintained.
- BOILER UNLOADING: The Run/Stop Switch is in the RUN (ON) position and a boiler stage will be turned off as the control temperature is too high.
- BOILER LOADING: The Run/Stop Switch is in the RUN (ON) position additional boiler stages are needed as the control temperature is too low.
- BOILER MAX ON: The Run/Stop Switch is in the RUN (ON) position and the maximum number of boiler stages that are available are on.

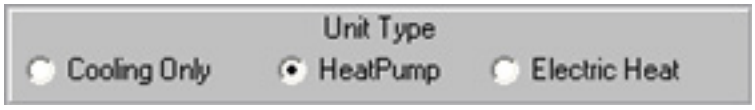
The individual boiler states are as follows:

- STP OFF: The boiler stage is off and it is ready to be turned on if needed.
- STP ON: The boiler stage is on.
- STP FLT: The boiler stage is off due to the digital input, Starting Boiler Fault, associated with this boiler stage being on for a time longer than the safety time in set point #190.

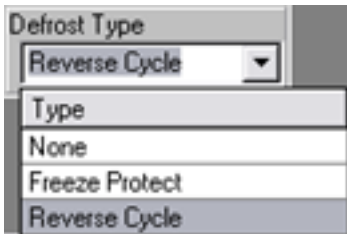
11.78. HVAC Defrost Cycle

All types of compressors that are heat pumps will now support with the defrost function. The following must be set up in MCS-Config to activate a defrost cycle:

- In the General Information panel under the MAG V8 screen, the Unit Type must be set to heat pump.



- In the Evaporator Information panel the Type of Defrost must not be 'NONE'.\



- Either or both Condenser Coil Temperature #1 or #2 must be set up in the Circuit Base screen.

- If the reversing valve is common, it is specified in the General Information panel under the MAG V8 screen. If individual reversing valves, they must be in the compressor relay sequence, following the 3rd liquid line solenoid of each circuit.

- Heat pump-defrost Setpoints #158 - #162 must be set up. Note: The value in these Setpoints will be used regardless if they are active or not. (See section 13 for Setpoint description)

The following conditions must be met to initialize a defrost cycle:

- The heat pump must be in a heating mode with the reversing valve on for a minimum time specified in Setpoint #160 "DEF REV DEL".
- Either of the condenser coil temperatures must be less than Setpoint #158 "DEF TRIG TMP" for the time specified in Setpoint #159 "DEF TRIG DEL".

The first step in the defrost cycle is to change the circuit states that satisfy all conditions to initiate a defrost cycle to "DEF PREPMP OUT". In this state the reversing valve remains on but the following relays are turned off:

- Loader
- Fast Unloader
- 2nd LLS, Oil Equalization
- Hot Gas Bypass
- Liquid Injection
- LLS (only if a fixed step compressor)

This state is terminated when the suction pressure is less than Setpoint # 61 "PMP DWN OFF", or when the state time is greater than Setpoint #62 "PMP DWN DELY". The circuit state is changed to "DEFROST".

In the "DEFROST" state the LLS will be turned on and the reversing valve will be turned off. This will reverse the flow

of hot gas and perform the defrost function. The condenser fans will also be affected during this time and the amp's slide adjustment will be set to 70.0% if a variable step compressor.

The DEFROST state will be terminated when both condenser coil temperatures, are greater than Setpoint #161 "DEF TERM TMP" or the state time is greater than Setpoint #162 "DEF TERM DEL". The circuit state will be changed to "DEF PUMP DOWN".

The action and termination in the "DEF PUMP DOWN" state is the same as "DEF PREPMP OUT". When this state is terminated a variable step compressor will have its state changed to "HOLD". A fixed step compressor's state will return to its state prior to the defrost cycle and the LLS will be turned on.

11.79. Control for Second set of Evaporator Pumps/Fans

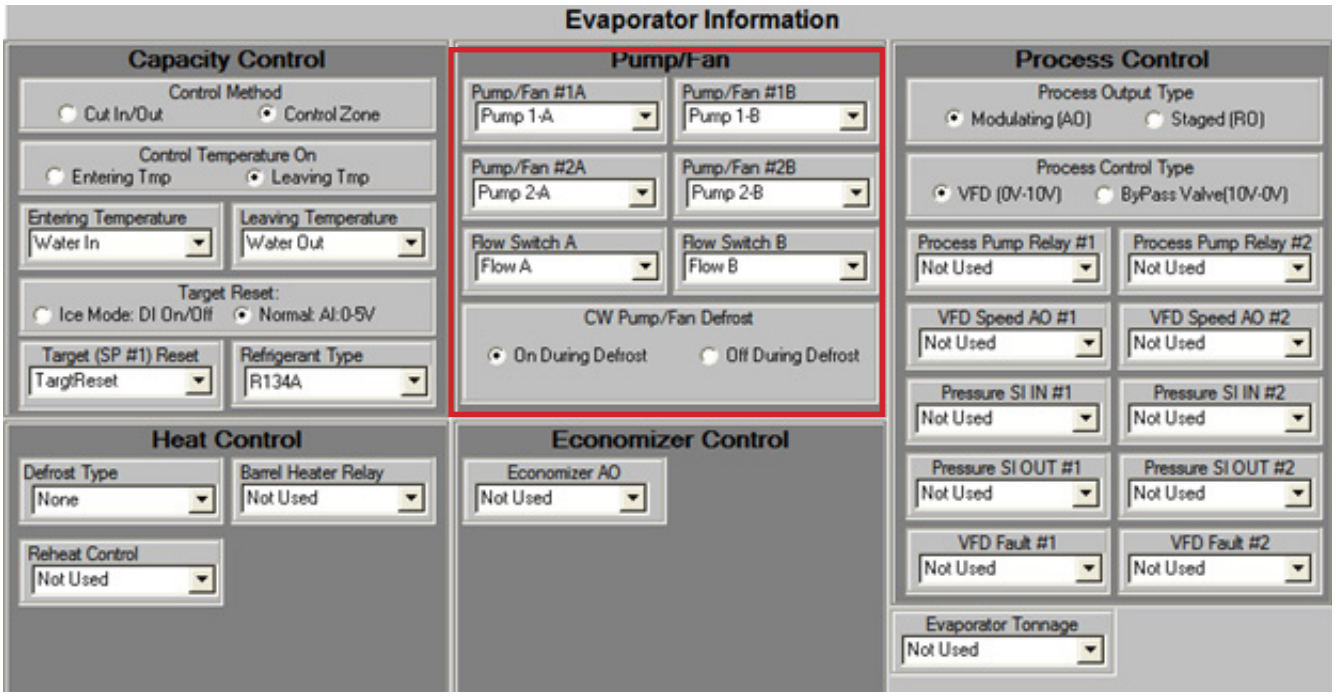
A second set (bank) of Pumps/Fans have been added to the HVAC software. The purpose is to support systems with two sets of pumps which provide flow to different circuits.

When the system is in a run condition, both lead pumps of each bank will be turned on to provide flow. If either of the lead pumps fails, the running pump will be locked off and the backup pump for that respective bank will be started. The circuits associated with the failed pump will be moved to a no flow state (disabled) as soon as flow is lost. If flow is restored the circuit will be enabled again. If both pumps on a bank fail, then the circuit will be in a safety off state.

The 2 pump banks function independently, however, they both use common Setpoints to determine pump rotation, pump lead, and safety times.

11.79.1 MCS-Config Setup

Evaporator Info panel under the MAG HVAC V8 Screen:



The Pump/Fan section now consists of entries for bank A and bank B.

Select Output and Sensor Inputs per circuit panel under the Circuit Base button:

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
▶	1 ...	Not Used	Not Used	Not Used	Not Used	Not Used	Disable 1	EXV1 %	Flow A	Not Used
	2 ...	Not Used	Not Used	Not Used	Not Used	Not Used	Disable 2	EXV2 %	Flow B	Not Used
	3 ...	Not Used	Not Used	Not Used	Not Used	Not Used	Disable 3	EXV3 %	Flow A	Not Used
	4 ...	Not Used	Not Used	Not Used	Not Used	Not Used	Disable 4	EXV4 %	Flow B	Not Used

In the Flow column, select the flow indicators for the individual pump bank control.

In the above example:
Pump bank A has 2 pumps, Pump 1-A and Pump 2-A, and the flow indicator is Flow A. If Flow A indicates that there is no flow, then circuits 1 and 3 will be disabled.

Pump bank B has 2 pumps, Pump 1-B and Pump 2-B, and the flow indicator is Flow B. If Flow B indicates that there is no flow, then circuits 2 and 4 will be disabled.

However if Flow A indicates that there is flow then circuits 1 and 3 will be in a ready to run state and Flow B indicates that there is flow then circuits 2 and 4 will be in a ready to run state. The circuit states are based upon the flow indicators associated with that circuit.

If Flow A indicates no flow, then circuits 1 and 3 will immediately be placed in a disabled state due to no flow, the lead pump will be Locked Out after the time delay as stated in the 'Value' field in Setpoint #105 "PUMP FAILURE". When the lead pump is Locked Out the backup pump will be started. If flow is returned, then circuits 1 and 3 will be allowed to run. If flow is not returned and the backup pump is Locked Out, then circuits 1 and 3 will be placed in a Safety Off state. The same is true with Flow B and circuits 2 and 4.

The unit and all individual circuits will be placed in a Lockout state if all pumps have failed.

11.80. Condenser Liquid Level Control (CLLC) only with CENT

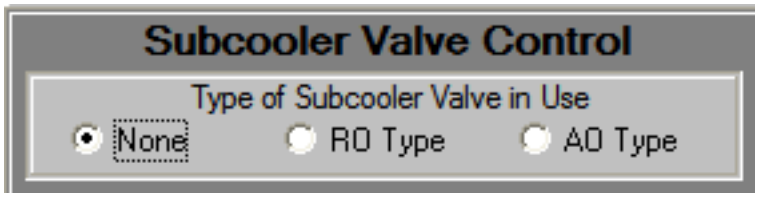
CLLC has been developed to control the condenser liquid level with centrifugal compressors. When activated via MCS Config options the system will control the level by determining the status of the chilled water and then position the opening of the CLLC control valve to either maintain liquid level or to create a liquid seal so the chiller can generate lift and drop the water temperature to its set point.

There can be two types of control of the CLLC valve.
1) AO TYPE, the valve uses an analog output that will be varied to open or close the valve; or
2) RO TYPE, the valve uses 2 relays one for opening and one for closing the valve. These relays will be pulsed to provide the desired opening of the valve. This option requires an input that indicates the actual valve opening.

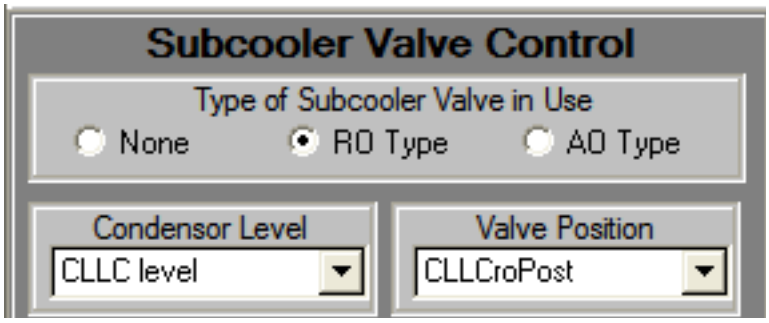
11.80.1 The following items in the MCS Config are required

Base set up for the CLLC. The following section has been added to the Evaporator Info panel under the MAG CENT V8 button:

1) No Condenser Liquid Level Control selected.



2) RO Type selected.



Condenser Level: select from a drop down list of sensor inputs. This sensor will provide the level of the condenser liquid level.

Valve Position: select from a drop down list of sensor inputs. This sensor will provide the position of the CLLC valve.

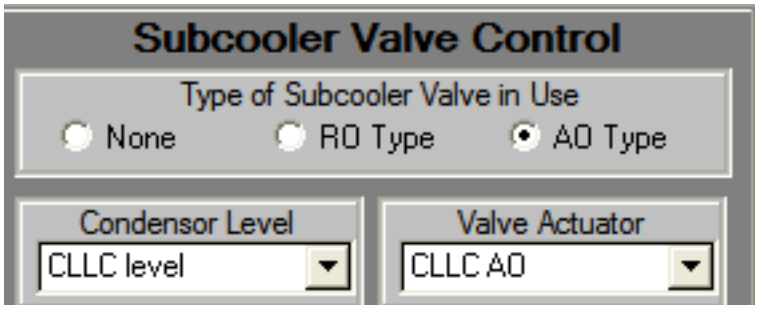
In the Relay Output Information screen 2 relays must be added at the end of the compressor relay output sequence:

Relay Output Information Screen (Magnum V8)

Number	Name	Type	Comments	Pulse Count (in Seconds)	Pulse Delay (in Seconds)
M-1	COMP M	Standard		———	———
M-2	COMP SD	Standard		———	———
M-3	OPEN VANE	Standard		———	———
M-4	CLOSE VANI	Standard		———	———
M-5	OIL PUMP	Standard		———	———
M-6	OIL HEATER	Standard		———	———
M-7	HOT GAS	Standard		———	———
M-8	CLLCroON	Pulse Relay		5	2
M-9	CLLCroOFF	Pulse Relay		5	2

The relays must be set up as Pulse Relay type and the Pulse on Time (in tenth of second) and the Delay Between Pulse (in seconds) columns must be setup. Suggest the initial values are Pulse on Time of 5 (.5 seconds) and Delay Between Pulse of 2 (2 seconds).

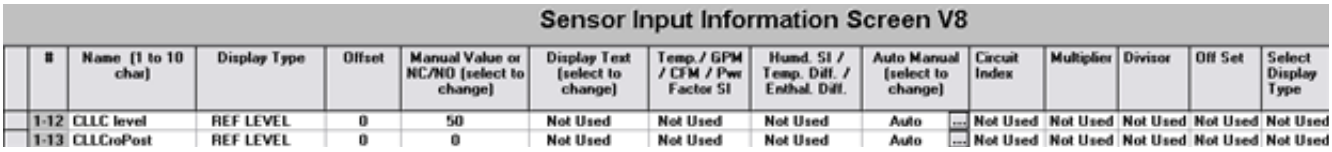
3) AO Type selected.



Condenser Level: select from a drop down list of sensor inputs. This will provide the level of the condenser liquid level.
Valve Actuator: select from a drop down list of analog outputs. This will be the analog output that controls the CLLC valve.

11.80.2 The following sensor inputs are required by the CLLC

1) A CLLC Level sensor – This sensor will indicate the level percentage of Condenser Liquid Level.
2) CLLC Relay Output Position sensor – This sensor is required of the valve type is RO. This sensor will indicate valve position. It may be necessary to develop an appropriate calculation for this sensor to read correctly using the User Defined sensor type.



Sensor Input Information Screen V8

#	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. SI / Temp. Diff. / Enthal. Diff.	Auto Manual (select to change)	Circuit Index	Multiplier	Divisor	Off Set	Select Display Type
1-12	CLLC level	REF LEVEL	0	50	Not Used	Not Used	Not Used	Auto ...	Not Used	Not Used	Not Used	Not Used	Not Used
1-13	CLLCroPost	REF LEVEL	0	0	Not Used	Not Used	Not Used	Auto ...	Not Used	Not Used	Not Used	Not Used	Not Used

11.80.3 The following Setpoints are required by the CLLC

#	Name	Typical Value	Description
216	CLLC LEVEL TRG	60.0 5	The 'Value' is the target that is to be maintained of the condenser liquid level. The 'Time(sec)' contains the dead band of the target. For example if the value is 60.0 (target) and the 'Time(sec)' field is 5 (dead band) the control zone for the condenser liquid level is between 55.0 and 65.0.
217	CLLC VALVE TRG	50.0 30 10 50	The 'Value' is the target or minimum opening of the CLLC control valve. The 'Time(sec)' contains the normal delay between making valve adjustments. This time is expressed in seconds. The 'Sec. to Ignore Safety' contains the delay between making valve adjustments when the CLLC is in a startup mode or the chilled water is not with in its control zone, this is an unstable condition. The 'Window to extend Safety Time(sec)' contains the maximum valve adjustment value. This value has an assumed decimal place; that is a value of 50 will allow a maximum adjustment of 5.0. The actual adjustment will be calculated based upon the valve setting and its desired position. This set point is only used if the AO TYPE of CLLC valve has been selected.
218	CLLC MAX ROC	2.5	The 'Value' contains the rate of change that will determine if the condenser liquid level rate of change is moving fast enough

11.80.4 CLLC States

The CLLC states indicate the status of the CLLC unit. They can be viewed either from the Magnum's status screen, screen will follow the compressor information or from the MCS Connect status screen.

- CLLC OFF: in this state there are no compressors on. The CLLC valve will be move to 100% open.
- CLLC UNSTABLE: in this state a compressor is running but it either in startup mode or the chilled water temperature is not within an acceptable range. The CLLC valve is not being controlled to provide the target level of the condenser liquid but to provide a liquid seal to enable the compressor to generate lift. This state will be entered whenever the chilled water temperature is not within an acceptable range. Refer to section on CLLC Determining Stable or Unstable Condition.
- CLLC STABLE: in this state a compressor is running but and the chilled water temperature is within an acceptable range. The CLLC valve will be modulated to maintain the condenser liquid level within the target control zone as defined by set point #216. Refer to section on CLLC Determining Stable or Unstable Condition.

11.80.5 CLLC Valve States

The CLLC valve states indicate the status of the CLLC valve. They can be view either from the Magnums status screen, screen will follow the compressor information or from the MCS Connect status screen. The (XX) will contain

either **(AO)** or **(RO)** indicating the type of valve control that has been selected.

VALVE OPENING (XX): The unit is in an unstable state and valve is being opened.
VALVE CLOSING (XX): The unit is in an unstable state and valve is being closed.
VALVE HOLDING (XX): The unit is in an unstable state and valve not being changed.
ZONE 1 VLV HOLDG (XX): The unit is stable and the condenser liquid level is in ZONE 1 which requires no valve positioning.
ZONE 2 VLV HOLDG (XX): The unit is stable and the condenser liquid level is in ZONE 2 and the valve position is not being changed as the condenser liquid level rate of change is decreasing at an acceptable rate.
ZONE 2 VLV OPENG (XX): The unit is stable and the condenser liquid level is in ZONE 2 above the target opening and the liquid level rate of change is not decreasing at an acceptable rate; therefore, the valve must be opened.
ZONE 2 VLV CLOSG (XX): The unit is stable and the condenser liquid level is in ZONE 2 below the target opening and the liquid level rate of change is not increasing at an acceptable rate; therefore, the valve must be closed.
ZONE 3 VLV HOLDG (XX): The unit is stable and the condenser liquid level is in ZONE 3 and the valve position is not being changed as the condenser liquid level rate of change is decreasing at an acceptable rate.
ZONE 3 VLV OPENG (XX): The unit is stable and the condenser liquid level is in ZONE 3 above the target opening and the liquid level rate of change is not decreasing at an acceptable rate; therefore, the valve must be opened.
ZONE 3 VLV CLOSG (XX): The unit is stable and the condenser liquid level is in ZONE 3 below the target opening and the liquid level rate of change is not increasing at an acceptable rate; therefore, the valve must be closed.
ZONE 4 VLV HOLDG (XX): The unit is stable and the condenser liquid level is in ZONE 4 and the valve position is not being changed as the condenser liquid level rate of change is decreasing at an acceptable rate.
ZONE 4 VLV OPENG (XX): The unit is stable and the condenser liquid level is in ZONE 4 above the target opening and the liquid level rate of change is not decreasing at an acceptable rate; therefore, the valve must be opened.
ZONE 4 VLV CLOSG (XX): The unit is stable and the condenser liquid level is in ZONE 4 below the target opening and the liquid level rate of change is not increasing at an acceptable rate; therefore, the valve must be closed.
VLV FULLY OPENED (XX): The valve position is fully opened, 100%.
bThe valve position is fully closed, 0%.

11.80.6 CLLC Status viewed from MCS Connect

CLLC State	CLLC Time	Level	Rate of Change	Valve State	Valve %		Valve Delay
CLLC OFF	07:16:28	50.0%	0.0	VALVE OPENING (AO)	100.0%		20

Capacity Control State	Time	Wanted/ Actual	Step Delay	Wanted FLA %	Rate of Change	Control On	Mode
RUN/STOP SW OFF	01:13:52	0/0	60	0.0	0.0	ChilWtrOut= 45.0F	COOLING

State	Time	Oil Diff	FLA %	Steps	Lead?	Staging	Lift Temp	Amp ROCs	Lift ROCs
1)SWITCHED OFF	01:13:53	76.0P	0	0	Yes	VANES	59.0	0/0	0.0/0.0

Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat
1) 55.0	38.1	16.9	154.0	97.1	56.9

The CLLC status is display as the first line of the Status screen.
1) The CLLC State.
2) The CLLC Time, this is the time in the display CLLC State.
3) Level, this is the level of the condenser liquid level.
4) Rate of Change, this is the change of the liquid level.
5) Valve State.
6) Valve %, if AO this is the actual value of the analog output; if RO then this is the value reported by the sensor input of the valve position feedback pot.
7) Delay is the delay between valve adjustments.

11.80.7 CLLC Status viewed from MCS Magnum

In this state the purpose of the CLLC is to position the valve to create a sub-cooler level to get the efficiency out of the chiller and not to control the valve within a couple percent of the actual set point. As long as the condenser liquid level is stable and in the control range then the valve is being controlled properly. To accomplish this control of the CLLC valve is based upon the level of the condenser liquid level.

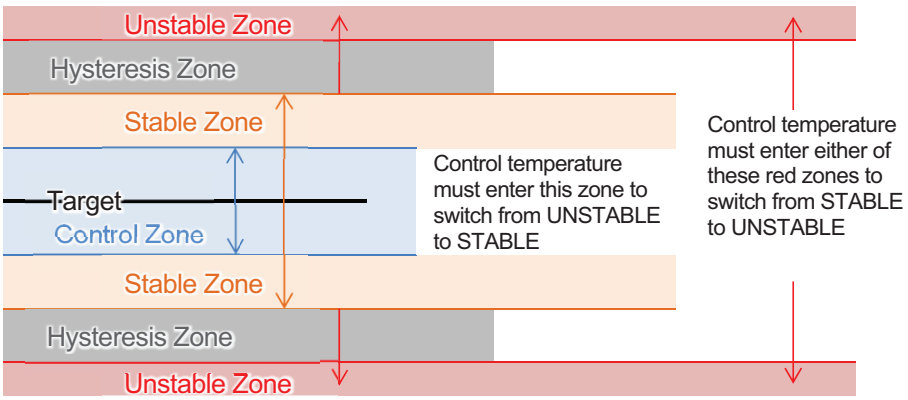
The value of set point #216 contains the target and the 'Time(sec)' field provides a plus and minus dead band. For example if the value is 60.0 and the 'Time(sec)' field is 3 then the control zone will be between 57.0 and 63.0. An additional control range is developed by adding/subtracting the 'Time(sec)' field to the original zone.

11.80.8 CLLC Determining Stable/Unstable Condition

Once a compressor is turned on the CLLC will determine if the system is in a stable, chilled water temperature is within an acceptable range, or unstable condition.

Setpoints 1 (chilled water target), 2 (plus dead band) & 3 (negative dead band) are used in this determination.

Setpoint #2×3	46.5°F
Setpoint #2×2	46.0°F
Setpoint #2	45.5°F
Setpoint #1	45.0°F
Setpoint #3	44.5°F
Setpoint #3×2	44.0°F
Setpoint #3×3	43.5°F



Example Setpoint Values:

#	Name	Value	Time(sec)
1	Control Target	44.0	
2	Control Zone +	.5	0
3	Control Zone -	.5	0

The zone boundaries can be increased by using the 'Time(sec)' field as a multiplier (Setpoint #2 for positive and Setpoint #3 for negative boundaries). If this value is a 0 or 1 then the multiplier will be an assumed 1. In the example above, if the 'Time(sec)' field was set to 2, then the differential between zones would be 1.0°F instead of 0.5°F; if set to 3, then the zone differential would be 1.5°F, etc.

Once the chilled water temperature is within the stable zone the CLLC will control the CLLC valve to maintain the condenser liquid level. Once the system is considered stable it will remain in this condition unless the chilled water temperature raises or drops into the unstable zones.

11.80.9 CLLC Control Logic

The CLLC can be in one of the following three states:

1) CLLC OFF in this state the compressor is off. The CLLC will drive the valve to 100.0% and then hold. There is no control in this state.

2) CLLC UNSTABLE in this state the compressor is on but the chilled water is not with in an acceptable temperature range. Refer to section on CLLC Determining Stable or Unstable Condition.

In this state the purpose of the CLLC is to position the valve to create a liquid seal so that the chiller can generate lift and pull the water temperature within the acceptable range.

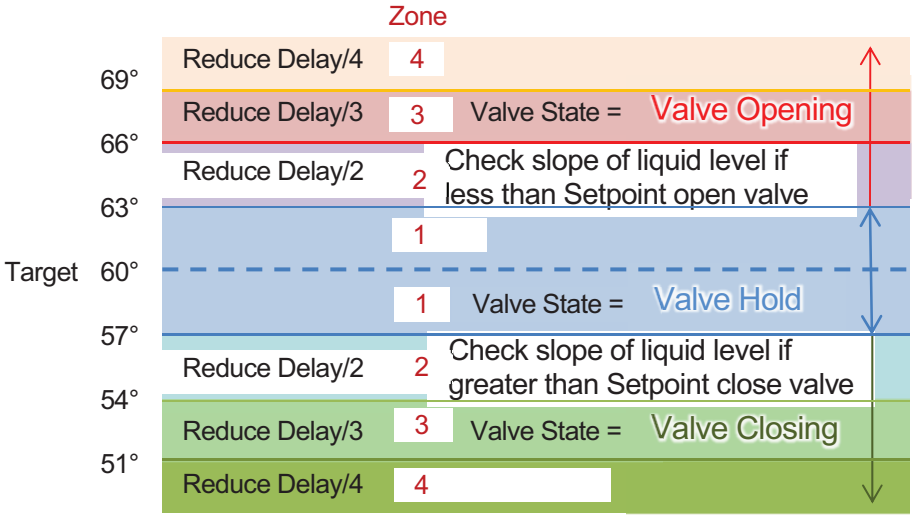
If the liquid level is above the value in set point #216, the CLLC valve setting will remain at its present position. The valve state will be VALVE HOLD.

If the liquid level is less than the value in set point #216, the CLLC valve setting will be closed until its opening is equal to the value of set point #217, once this is reached the valve state will be VALVE HOLD. The CLLC will not leave this state until the chilled water temperature returns to acceptable level or the compressor is turned off.

3) CLLC STABLE in this state the compressor is on and the chilled water is with in an acceptable temperature range. Refer to section on CLLC Determining Stable or Unstable Condition.

In this state the purpose of the CLLC is to position the valve to create a sub-cooler level to get the efficiency out of the chiller and not to control the valve within a couple percent of the actual set point. As long as the condenser liquid level is stable and in the control range then the valve is being controlled properly. To accomplish this control of the CLLC valve is based upon the level of the condenser liquid level.

The value of set point #216 contains the target and the 'Time(sec)' field provides a plus and minus dead band. For example if the value is 60.0 and the 'Time(sec)' field is 3 then the control zone will be between 57.0 and 63.0. An additional control range is developed by adding/subtracting the 'Time(sec)' field to the original zone.



11.80.10 Condenser liquid level positioning:

- If the condenser liquid level is in ZONE 1, no change to the valve position will be made.
- If the condenser liquid level is above the target and in ZONES 2, 3, or 4, the rate of change of the condenser liquid level will be checked. If the rate of change is less than the negative value of set point #216, this indicates that the condenser liquid level is decreasing a rate fast enough make no change to the valve positioning. The valve state will indicate that the valve is holding.

- If the condenser liquid level is above the target and in ZONES 2, 3, or 4, the rate of change of the condenser liquid level will be checked. If the rate of change is greater than the negative value of set point #216, this indicates that the condenser liquid level is NOT decreasing a rate fast enough; therefore, the valve position must be increased, opened. The valve state will indicate that the valve is opening.
- If the condenser liquid level is below the target and in ZONES 2, 3, or 4, the rate of change of the condenser liquid level will be checked. If the rate of change is greater than the value of set point #216, this indicates that the condenser liquid level is increasing a rate fast enough make no change to the valve positioning. The valve state will indicate that the valve is holding.
- If the condenser liquid level is below the target and in ZONES 2, 3, or 4, the rate of change of the condenser liquid level will be checked. If the rate of change is not greater than the value of set point #216, this indicates that the condenser liquid level is NOT increasing a rate fast enough; therefore, the valve position must be decreased, closed. The valve state will indicate that the valve is closing.

11.80.11 Condenser Liquid Level Adjustment

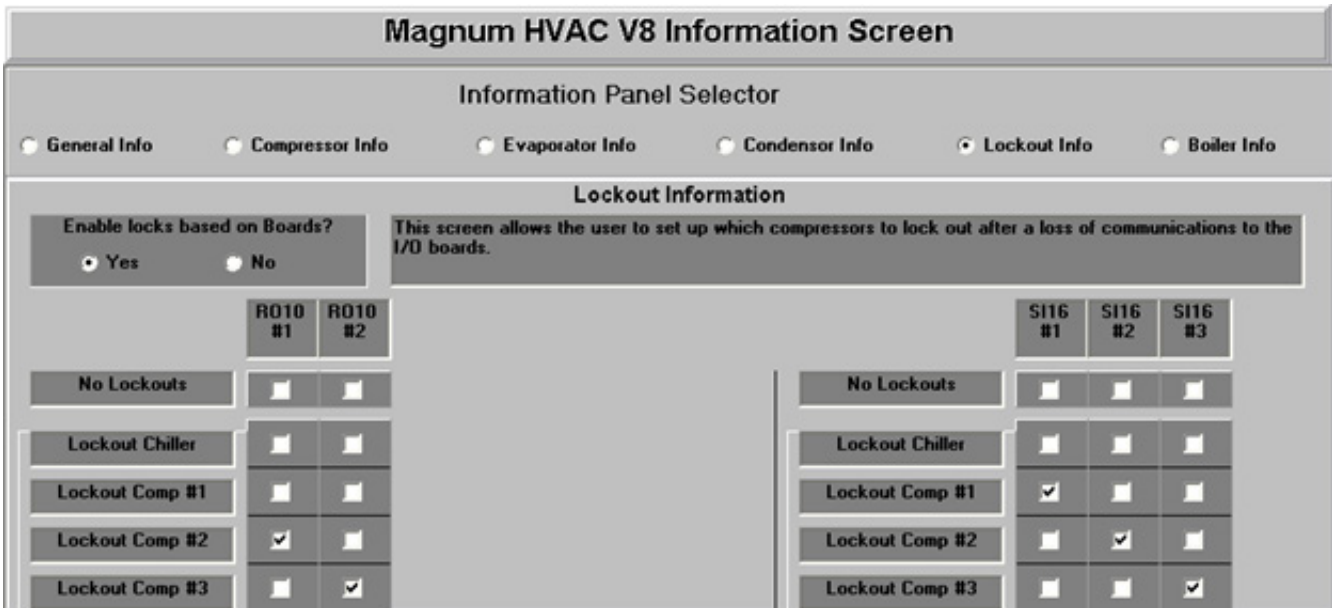
- If the valve type is a Relay Output, the pulse time and pulse delay will be the same for all zones.
- If the valve type is an Analog Output, the amount of valve adjustment will be the difference from the Condenser Liquid Level Target (Setpoint #216). The adjustment will be limited to the setting of the 'Window to Extend Safety Time' of Setpoint #216. This is true for all zones.

11.80.12 Condenser Liquid Level Time Delay

The delay between determining if an adjustment to the valve is required varies based upon the zone. Zone 1 is the 'Time(sec)' of Setpoint #217. Zone 2 is this time divided by 2, Zone 3 is divided by 3, and Zone 4 is divided by 4. Thus the farther from the Condenser Liquid Level Target the quicker the system checks for valve positioning.

11.81. Lockout per Compressor

In software 8.05-C and newer, the feature to lockout only certain affected compressors when communications to an I/O board is lost was added. The screen to setup this feature is found in MCS-Config under the MAG V8 screen under the Lockout Info panel.



Each I/O board in the system will have its own column (Relay Output boards on the left, Sensor Input boards on the right). Each circuit (compressor) will have its own row, as well as the entire chiller and no lockout options.

To setup this feature, first select Yes to the prompt 'Enable locks based on Boards?' Then simply select which circuit(s) you want locked out when I/O communications are lost for each particular board. If 'No Lockouts' is selected, then the unit will continue to run normally when communication with that board is lost. If 'Lockout Chiller' is selected, then the entire unit will lockout when communication with that board is lost. If 'Lockout Comp #X' is selected then all the

circuit(s) that match will lockout when communication with that board is lost.

When communication is reestablished the circuit state is automatically reset from “LOST IO LOCKED” to “CMP ANTICYCLE” or “COMP OFF/READY”.

11.82. Factory Authorized Startup and Run Hour Lockout

Two new features have been added to HVAC Magnum software (requires HVAC 806-B or greater)

- Factory Authorized Startup- this prevents the Magnum from running until Factory Authorization is given.
- Run Hour Lockout- At midnight if any compressor has reached a set number of run hours, the unit will be disabled until an authorized service call is performed.

These functions can only be activated or reset from the Magnum keypad, not from MCS-Connect.

11.82.1 MCS-Config Setup: (requires MCS-Config 8.10D or greater)

11.82.1.1. Factory Authorized Startup

In the Setup screen select the option Factory Startup Required.

In the authorization screen, setup a Factory Startup level code.

	#	Code	Level
	1	4444	Factory Startup

11.82.1.2. Run Hour Lockout

In the Setup screen select the option Run Hour Lockout Required. If enabled, then enter the number compressor run hours that must pass before the run hour lockout is triggered.

In the authorization screen, setup a Run Hour Lockout level code.

	#	Code	Level
	2	5555	Run Hour Lockout

11.82.2 MCS Connect (requires MCS-Connect 8.10-V)

Two new chiller states have been added to MCS-Connect:

- #28 “Factory Startup”
- #29 “Maximum Run Time”

11.82.2.1. Magnum HVAC software only

Function 1: (Factory authorized startup is required)
When the password for Factory Startup is entered using the MCS-Magnum Keypad/LCD the user is allowed to activate the function to lockout the Magnum until Factory Startup authorization is given. When activated the chiller state will be FACTORY STARTUP, the Magnum will not allow the unit to run, and the only screen that will be enabled is Passwords. If the Magnum is reset the chiller state will be FACTORY STARTUP not UNIT IN POWER UP. Once the system state is FACTORY STARTUP the system can be accessed from MCS-Connect but the system will not accept changes to Relay Output states.

When the password for Factory Startup activation is entered and the function is active, the user is allowed to deactivate it. When deactivated the chiller state will be changed to UNIT IN POWER UP and normal operations will be allowed.
To activate the Factory Startup function from the Magnum keypad, open the Password menu option and enter the Factory Startup password. The following pop-up will appear asking if you would like to activate this feature.

When active, the following heading will appear on all Status screens, showing that the unit is locked out until Factory Startup authorization is entered.

Here is what the status screen looks like through MCS-Connect:

Capacity Control State	Time	Wanted/ Actual	Step Delay	Wanted %	Rate of Change	Control On	Mode
FACTORY STARTUP	00:00:09	0/0	240	N/A	0.0	ChilWtrOut= 90.0F	COOLING

State	Time	PSI Diff	FLA %	Steps	Lead?
1)CMP LOCKED OUT	00:00:00	100.0P	86	0	Yes

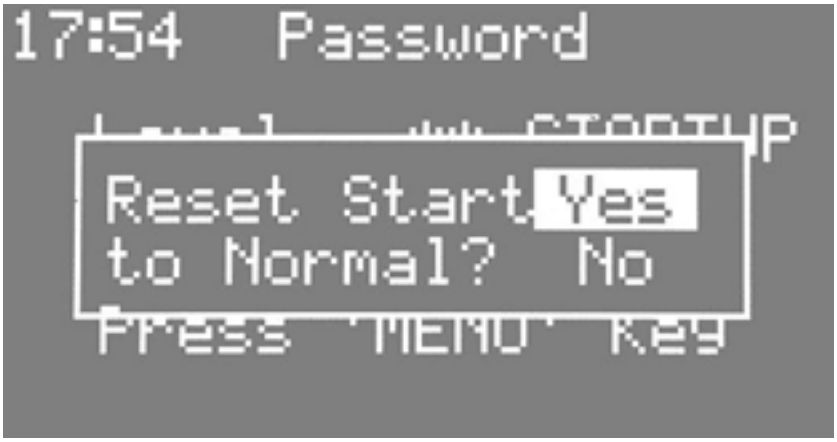
	Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat	Ref Type
1)	50.0	-99.9	149.9	180.0	97.8	82.2	R22

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

To deactivate the Factory Startup function, navigate back to the password screen and the following screen will appear. Select Yes to deactivate.

Enter the correct password to deactivate the Factory Startup function.

Select Yes to confirm you want to deactivate this function.

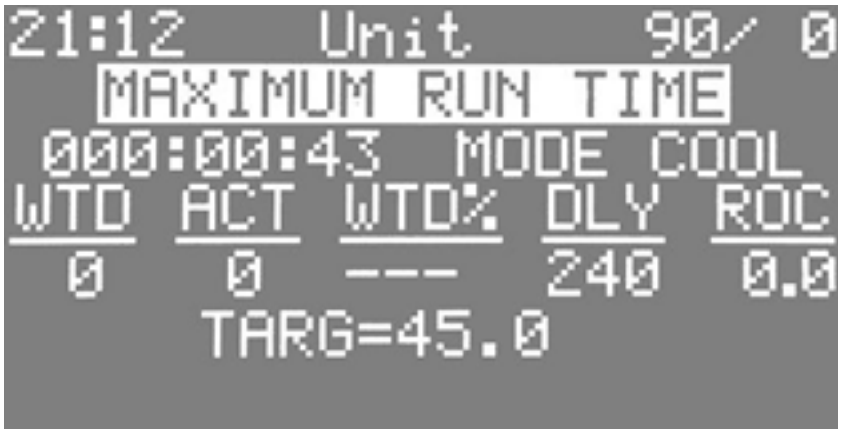


Function 2: (Compressor lockout based on run time hours)
If this option has been enabled, at midnight if any compressor exceeds the number of run hours specified, the system will disable all compressors (circuits) and change the unit state to MAXIMUM RUN TIME. This test will only be made a midnight when new day logic is being executed. In this state the Magnum will not enable normal operations and the only screen that will be available is the Passwords. If the Magnum is reset the chiller state will be MAXIMUM RUN TIME not UNIT IN POWER UP. Once the system state is MAXIMUM RUN TIME the system can be accessed from MCS-Connect but the system will not accept changes to the Relay Output states.

When the password for Maximum Run Time is entered the user can reset the maximum number of compressor run hours. If reset is selected and chiller state is MAXIMUM RUN TIME the state will be changed to UNIT IS OFF. The maximum run hours counters for all compressors will be reset and normal processing will be allowed. If reset is selected and the chiller state is not MAXIMUM RUN TIME the state will not be changed but the maximum run hours counter will be reset.

To activate the Maximum Run Time function from the Magnum keypad, open the Password menu option and enter the Maximum Run Time password. The following pop-up will appear asking if you would like to activate this feature.

When active, the following heading will appear on all Status screens, showing that the unit is locked out until Maximum Run Time authorization is entered.



Here is what the status screen looks like through MCS-Connect:

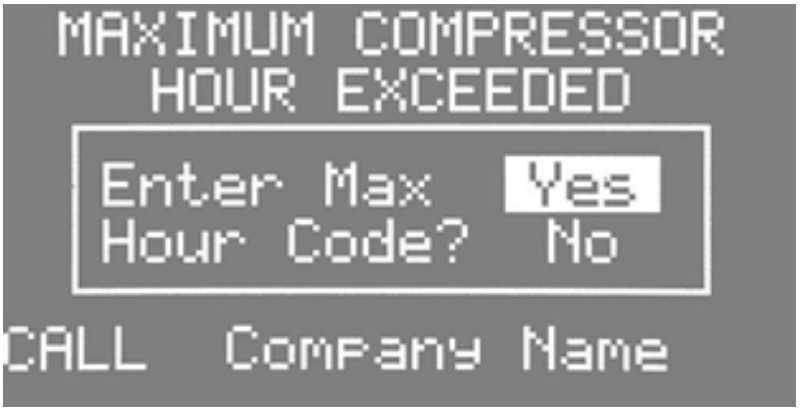
Capacity Control State	Time	Wanted/ Actual	Step Delay	Wanted %	Rate of Change	Control On	Mode
MAXIMUM RUN TIME	00:00:18	0/0	240	N/A	0.0	ChilWtrOut = 90.0F	COOLING

State	Time	PSI Diff	FLA %	Steps	Lead?
1)CMP OFF/READY	00:00:18	100.0P	0	0	Yes

	Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat	Ref Type
1)	50.0	-99.9	149.9	180.0	97.8	82.2	R22

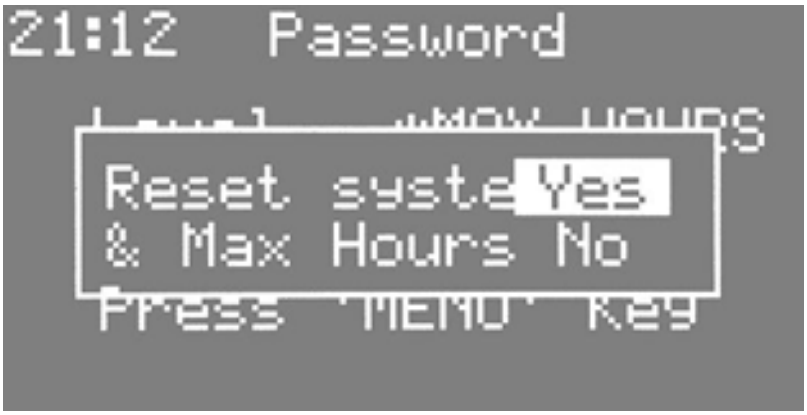
Status | Alarms | SetPoints | Reset/Clear | Schedule | Service

To deactivate the Maximum Run Time function, navigate back to the password screen and the following screen will appear. Select Yes to deactivate.



Enter the correct password to deactivate the Maximum Run Time function.

Select Yes to confirm you want to deactivate this function.

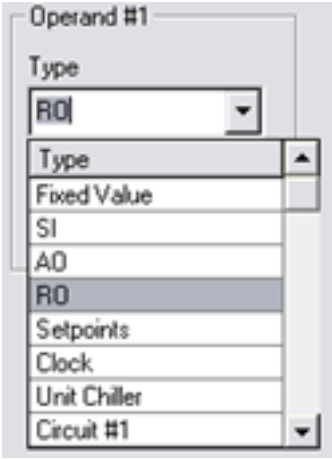


11.83. User Logic

Magnum provides the user the ability to customize control logic and calculated values. This is done in MCS-Config by defining a Sensor Input, Relay Output, or Analog Output as a User Logic type. This type of point can be adjusted through MCS-Connect by double clicking on the name of a User Logic point (This requires factory authorization) MCS-Connect identifies a user-defined Relay Output by following the name with (UL), a Sensor Input's Sensor Type cell has User Logic as the type and Analog Output's Type cell has Linear CTRL.

11.83.1 Operands

Operands are the building blocks of the Magnum User Logic. An operand consists of two parts: the top cell provides a drop down list to select the types and then a drop down list to select the item within that type:



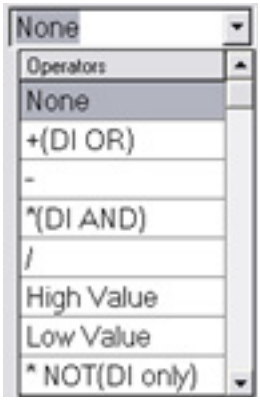
TYPE	ITEM
Fixed Value	Enter a fixed value with decimal place if required.
SI	Select Sensor Input
AO	Select Analog Output
RO	Select Relay Output
Setpoints	Select Setpoint, number is also display for ease of selection. All Setpoints are shown, both active and inactive.
CLOCK	Select system clock. The following can be selected: Hours, Minutes, Seconds, Day of Month, Day of Week (1 = Sunday - 7 = Saturday), Year (2 digits), and Month (1-12). These are current values from the Magnum.
Unit Chiller	The following can be selected: FLA %, Steps wanted, Steps ON, Steps available, steps allowed on, % Load, STATE, Lead Compressor, Mode (cooling or heating), and Ice Mode Done (if ice mode option selected).
Compressor #1 - Compressor #20	The following can be selected for any compressor: Compressor State, Suction Pressure, Discharge Pressure, Oil Pressure Differential, Motor Amps, Suction Temperature, Discharge Temperature, Oil Temperature, Motor Temperature, EXV Value Position, Oil Pressure, Refrigerant Temperature, Flow Indicator, Compressor Proof, Compressor Speed, Oil Float, Refrigerant Level, Condenser Temperature #1, Condenser Temperature #2, Fla %, Saturated Suction Temperature, Suction Superheat, Saturated Discharge Temperature, and Discharge Superheat. Note all of the above may not exist for an individual configuration.

The value that is passed to the User Logic depends on the item selected. For example:

- A Relay Output's value is 0 if it is off and a 1 if it is on.
- A Digital Input's value is 0 if it is off and a 1 if it is on.
- An Analog Input and Analog Output value are the actual values as displayed, includes the decimal place.
- The unit, compressor, or loop state is a numeric value that will relate to the state names in this manual. This value is show as the number in parenthesis following the state name.

11.83.2 Operators

The action cell is located between the operand cells.

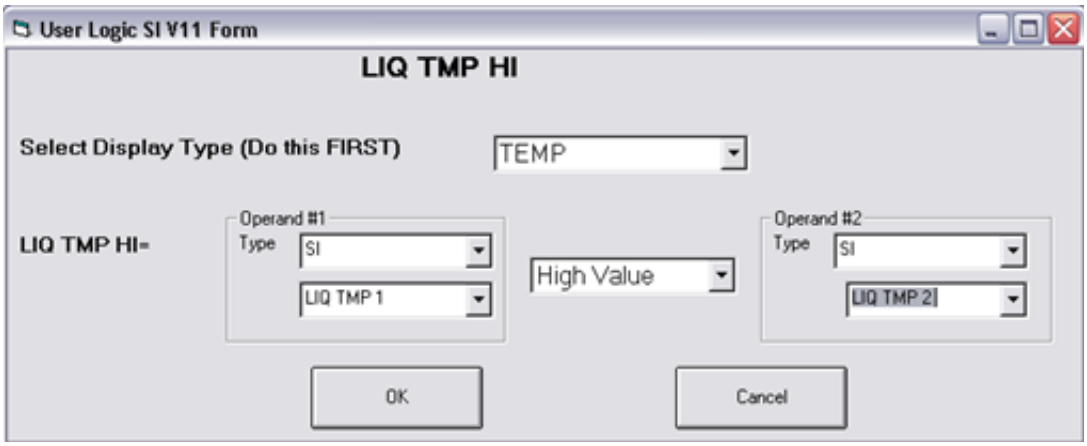


The following actions can be selected from a drop down list this will determine the value of the sensor:

Display as:	Action
None	Second operand is not required.
+(DI OR)	Add the value of the two operands if they are analog values; if digital then they will be OR together. If digital and either operand is on the result will be 1 (ON).
-	Operand 1 minus Operand 2.
*(DI AND)	Operand 1 times Operand 2 if they are analog values; if digital then they will be AND together. If digital and both operands are on the result will be 1 (ON) else the result will be 0 (OFF).
/	Operand 1 divided by Operand 2
High Value	Result will be the highest value between Operand 1 and Operand 2
Low Value	Result will be the lowest value between Operand 1 and Operand 2
* NOT (DI only)	Operand 1 times the opposite value of Operand 2, which must be a digital. If Operand 2 is on value will be 1; therefore its opposite will be 0.
/ NOT (DI only)	Operand 1 divided by the opposite value of Operand 2, which must be a digital. If Operand 2 is on value will be 1; therefore its opposite will be 0.
>=	Sensor value will be on (true) if Operand 1 is greater than or equal to Operand 2.
<=	Sensor value will be on (true) if Operand 1 is less than or equal to Operand 2.
> NOT (DI only)	Sensor value will be on (true) if Operand 1 is greater than the opposite of Operand 2.
< NOT (DI only)	Sensor value will be on (true) if Operand 1 is less than the opposite of Operand 2.
==	Sensor value will be on (true) if Operand 1 is equal to Operand 2.
NOT = (DI only)	Sensor value will be on (true) if the opposite of Operand 1 is equal to Operand 2.

11.83.3 User Sensor Input

Selecting the “User Logic” display in the Sensor Information screen of MCS-Connect sets up this type of sensor. This type of sensor can be either an analog or digital sensor. This is a virtual input; the User Logic sensor value is a calculated value instead of a hardwired external sensor.

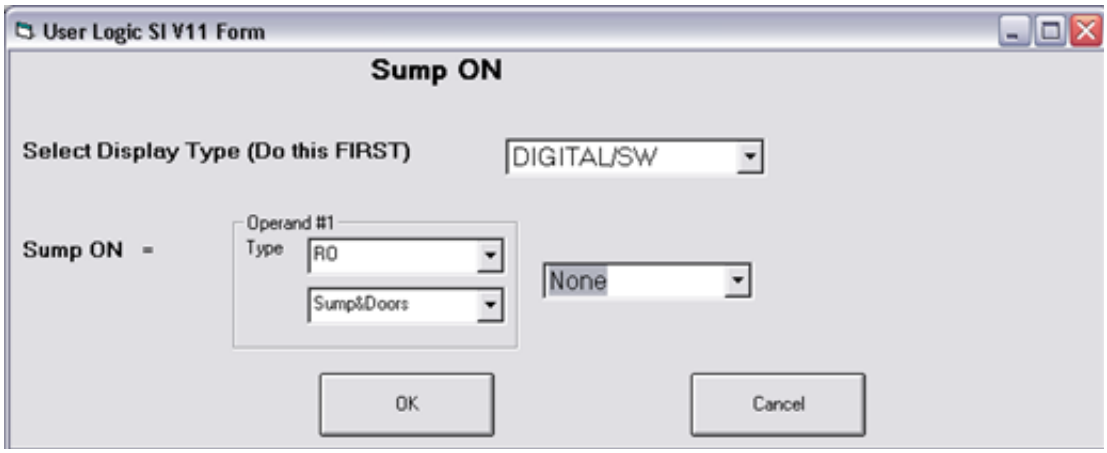


First select the display type and then complete the selections. Note operand #1 and #2 are defined in the Operands section above and the Action Cell is defined in the drop down menu between.

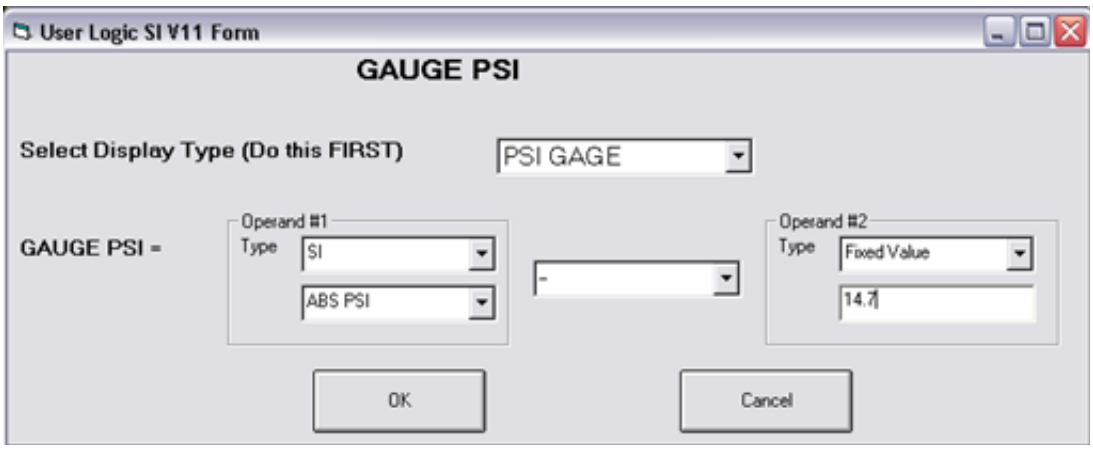
The window below is from MCS-Config is configuring a User Logic type of sensor. It is a digit type of sensor (ON or OFF) and it is only looking an Operand 1. If the RO Sump and Doors is ON then the value of this sensor will be ON.

11.83.3.1. Examples of User Logic Sensor Inputs

The window below is from MCS-Config is configuring a User Logic type of sensor. If the Sump and Doors Relay Output is ON, then this sensor will read ON.

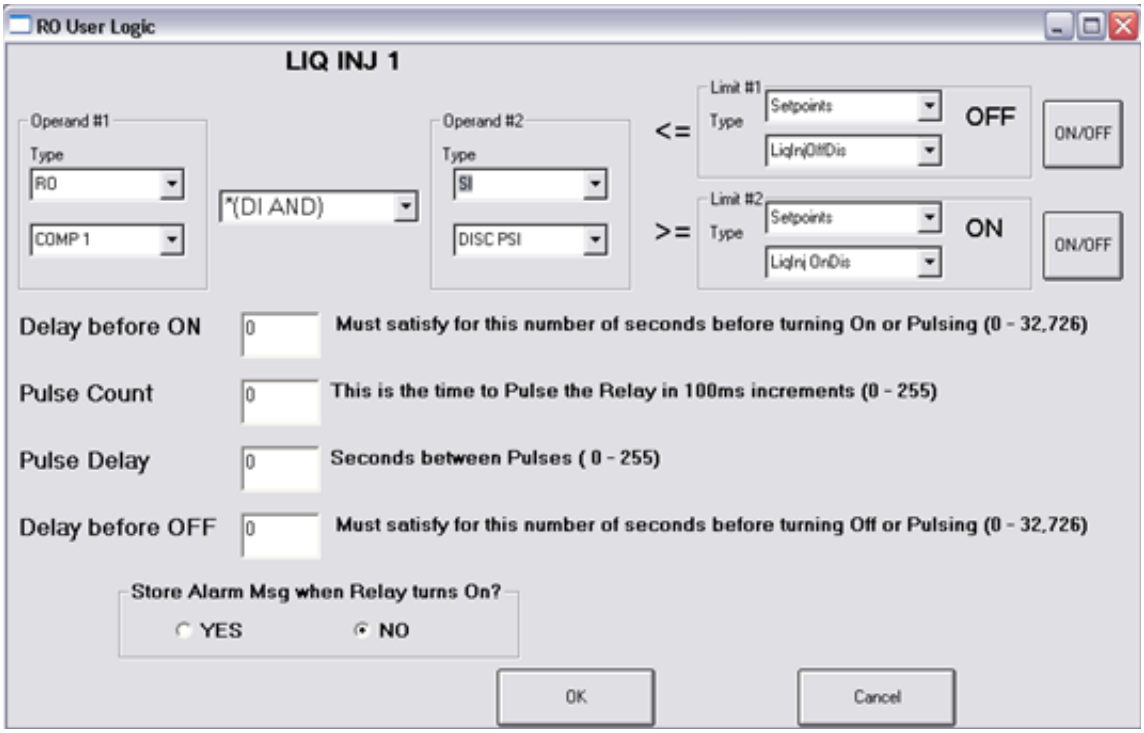


The window below is from MCS-Config building a User Logic type of sensor. It is a pressure type of sensor (display a value with 1 decimal place). The value of this sensor will be result of Operand 1 minus Operand 2.



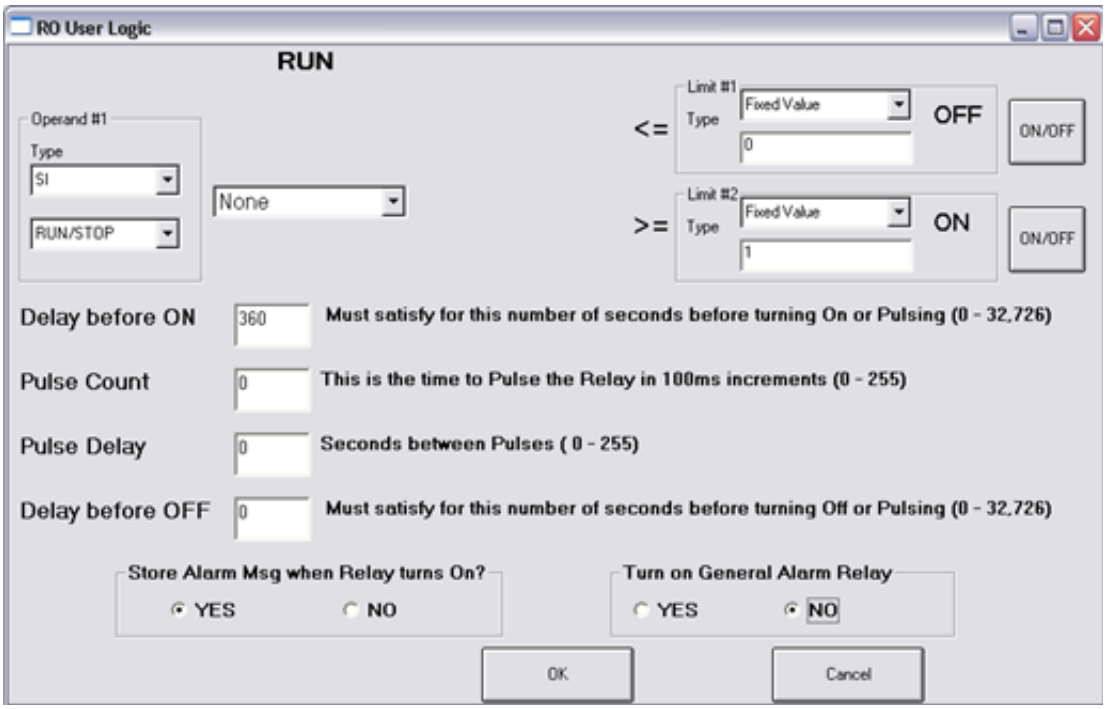
11.83.4 User Relay Output

User Relay Outputs allow customized control of relays based on operand values. The User Relay Output can calculate a value derived from two operands and combine the calculated value with a greater than and less than conditions to turn a relay ON/OFF. The User relay is capable of delaying the relay ON condition before turning the relay ON. Note this relay can be a virtual relay with nothing wired to it or an actual relay that controls an outbound device.

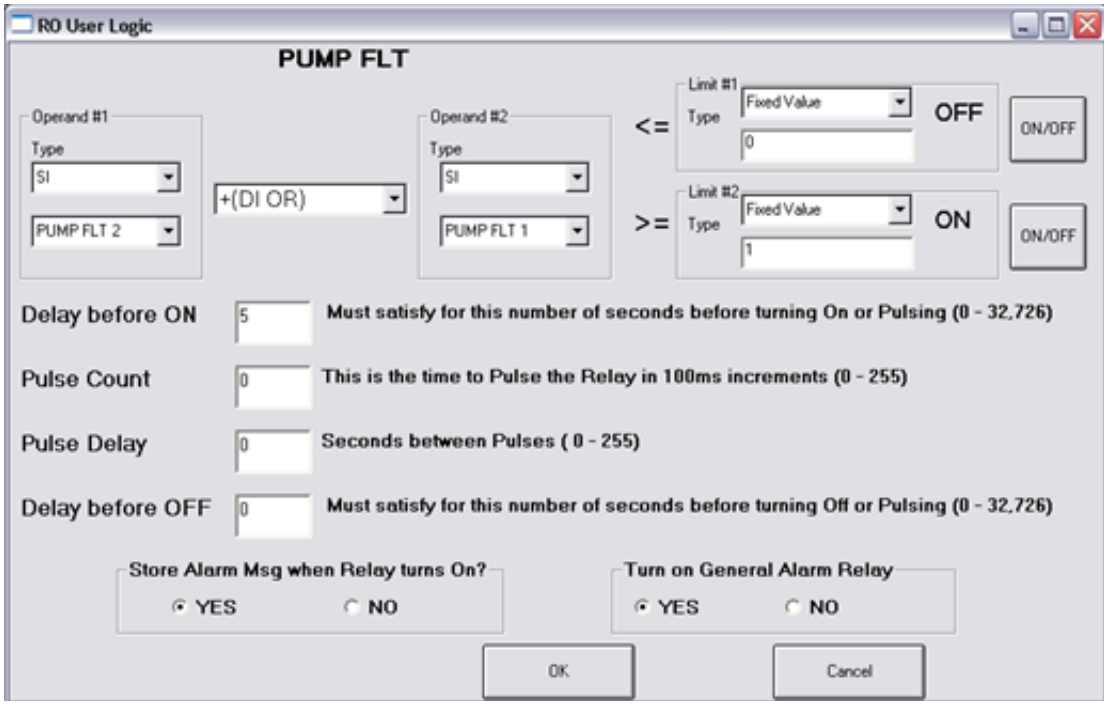


11.83.4.1. Examples of User Logic Relay Outputs

In the above example the “Store Alarm Msg“ option has been enabled. When this relay goes from an OFF to an ON state an alarm message will be generated with the name of this relay.



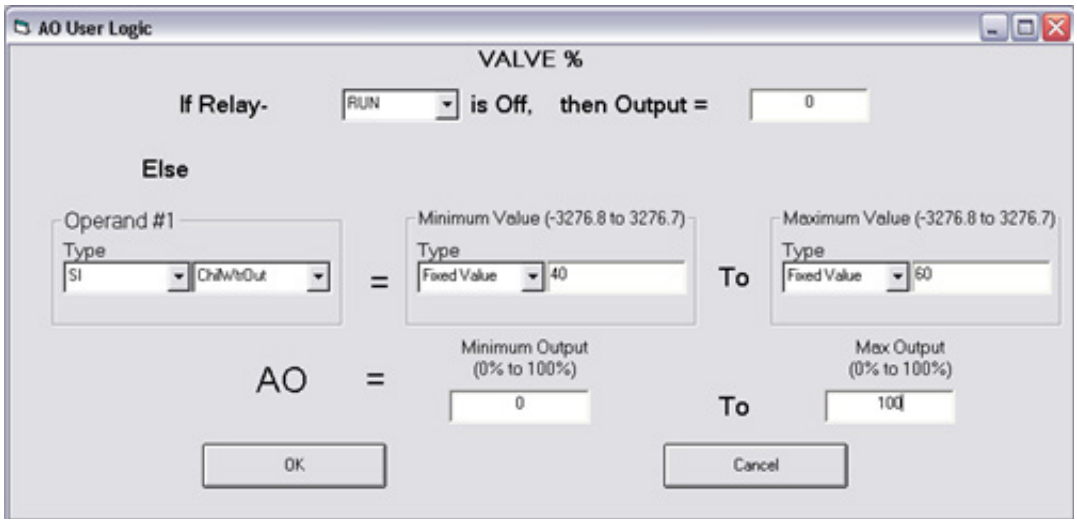
In the above example the “Store Alarm Msg“ option has been enabled. When this relay goes from an OFF to an ON state an alarm message will be generated with the name of this relay.



In this example, if either of the operands become true, then this relay will turn ON, an alarm message will be generated, and the General alarm relay will also turn ON.

11.83.5 User Analog Output

Linear control for Analog Output allows the user to control an analog value based on feedback from a Sensor Input or other operant control input value. The output can be set to control only when a relay is ON and fixed at a given output when the relay is OFF. Linear Control will monitor the Control Input and adjust the Analog Output based the minimum/ maximum output values. Linear Control settings are adjustable through MCS-Connect with Factory level authorization.



In the above example if relay 'RUN' is OFF, the value of this Analog Output will be zero. If ON, the value will be calculated based on the Sensor Input 'ChilWtrOut'. If 'ChilWtrOut's value is 40 (or less) then the Analog Output will be set to 0%; If 60 (or above) then the Analog Output will be 100%. The output value will vary based on a linear calculation between these two points.

12. 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
- Chiller 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.

12.1. Information Only Alarms

12.1.1 System Generated Alarms

The following alarms are generated to provide information; they will not cause a change in the control algorithm such as a lock out condition or a Relay Output being forced off.

- 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
- 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.

12.1.2 User Initiated Alarms

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

- LOCKOUT RESET – Generated when a user resets a compressor other unit 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.

12.1.3 Automatic Alarms

The following alarms indicate an action that the Magnum made automatically:

- ROTATED LEAD – Generated when the Magnum automatically rotates the Lead Compressor.
- DAYLIGHT SAVINGS – Generated when the Magnum automatically changes the real time clock to adjust for Daylight Savings Time.

12.2. Magnum System Alarms

12.2.1 Configuration Alarms

These alarms indicate a problem with the configuration file in the system. The system is not operational and a new configuration must be transmitted to the unit through 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.

12.2.2 MCS Local 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 system can be accessed but 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.

12.2.3 Key Sensors Alarms

These alarms indicate a problem with a key sensor, it is either shorted or open. The alarm will contain ALARM followed by the 10-character name of the sensor. The following sensors related to the entire system are tested:

- Leaving temperature: If failed, then Lock Out the system.
- Returning temperature: If failed, then alarm only no Lock Out.
- Ambient temperature: If failed, then alarm only no Lock Out.

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)

12.2.4 Emergency Stop Alarm

- EMERGENCY STOP – Generated when the emergency stop switch has been turned on. The system can be accessed but is in a Lock Out state.

12.3. 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 trips the circuit will be in a SAFETY TRIPPED state. The circuit 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.

12.3.1 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)

12.3.2 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.

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 11 Setpoint #111.

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 11 Setpoint #105.

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 11 Setpoint #166.

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 11 Setpoint #91.

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 11 Setpoint #77.

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 11 Setpoint #80.

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 11 Setpoint #81.

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 11 Setpoint #85.

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 11 Setpoint #87.

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 11 Setpoint #95.

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 11 Setpoint #94.

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 11 Setpoint #75.

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 11 Setpoint #76.

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 11 Setpoint #96.

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 bypassed when the compressor is in a Pump Down state. Refer to section 11 Setpoint #93.

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 11 Setpoint #97.

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 11 Setpoint #84.

12.4. TurboCor Compressor Alarms

Inverter Temperature Fault (Hex code =0x0001)

The measured Inverter Temperature has exceeded either the Alarm or Fault limit, probably due to insufficient inverter cooling.

Discharge Temperature Fault (Hex code =0x0002)

The measured Discharge Temperature has exceeded either the Alarm or Fault limit, probably due to insufficient charge (not enough gas).

Suction Pressure Fault (Hex code =0x0004)

The measured Suction Pressure has exceeded either the Alarm or Fault limit, probably due to insufficient charge or insufficient system load.

Discharge Pressure Fault (Hex code =0x0008)

The measured Discharge Pressure has exceeded either the Alarm or Fault limit, probably due to a faulty condenser. *Instantaneous lock out at fault level.

3 Phase Over Current Fault (Hex code =0x0010)

The estimated Mains Supply voltage has exceeded either the Alarm or Fault limit, probably due to excessive system load on mains supply (usually the compressor is pumping liquid). *Instantaneous lock out at fault level.

Cavity Temperature Fault (Hex code =0x0020)

The measured Cavity Temperature has exceeded either the Alarm or Fault limit, probably due to insufficient motor cooling (shaft cavity).

Leaving Fluid Temperature Fault (Hex code =0x0040)

The measured Air / Water Temperature has exceeded either the Alarm or Fault limit, probably due to insufficient air / water flow.

Pressure Ratio Fault (Hex code =0x0080)

The measured Compression Ratio of Discharge and Suction has exceeded either the Alarm or Fault limit, probably due to faulty condenser or insufficient load on the evaporator.

Generic Bearing/Motor/Compressor Fault (Hex code =0x0100)

If the Motor Fault Word, 40106, or the Bearing Fault Word, 40098, is different from 0, then the Generic Compressor Fault is triggered.

Sensor Fault (Hex code =0x0200)

If the following measured degrees Celsius are surpassed, a Sensor Fault is triggered. The pressure values are in kPa:
40105 Inverter Temperature>100 or < 0
40037 Cavity Temperature>100 or < -20
40034 Suction Temperature>100 or < -30
40036 Discharge Temperature>110 or < -30
40046 Leaving Water Temperature>100 or < -20
40031 Suction Pressure>1200 or < -30
40033 Discharge Pressure>3500 or < -30

SCR Temperature Fault (Hex code =0x0400)

The measured SCR Temperature has exceeded either the Alarm or Fault limit. Probably due to insufficient SCR plate cooling.

Lock Out Fault (Hex code =0x0800)

If any (or a combination of) the Faults listed below occurs more than 3 times (reg. 40262) within 30 minutes (reg. 40263), a “Lock Out Fault” occurs:

- Inverter Temperature trip
- SCR Temperature trip
- Motor Current High trip
- Inverter Error Signal Active trip
- Rotor May Be Locked trip
- Motor Back emf trip

***Instantaneous lock outs:**

- Discharge Pressure
- 3 Phase Over-Current

Winding Temperature Fault (Hex code =0x1000)
The measured motor winding temperature has exceeded 155ºC.

Superheat Fault (Hex code =0x2000)

The Fault limit is based on the suction pressure and temperature values. There is no time delay on this fault or alarm. The difference between the fault limit and alarm limit is the dead band for the control.

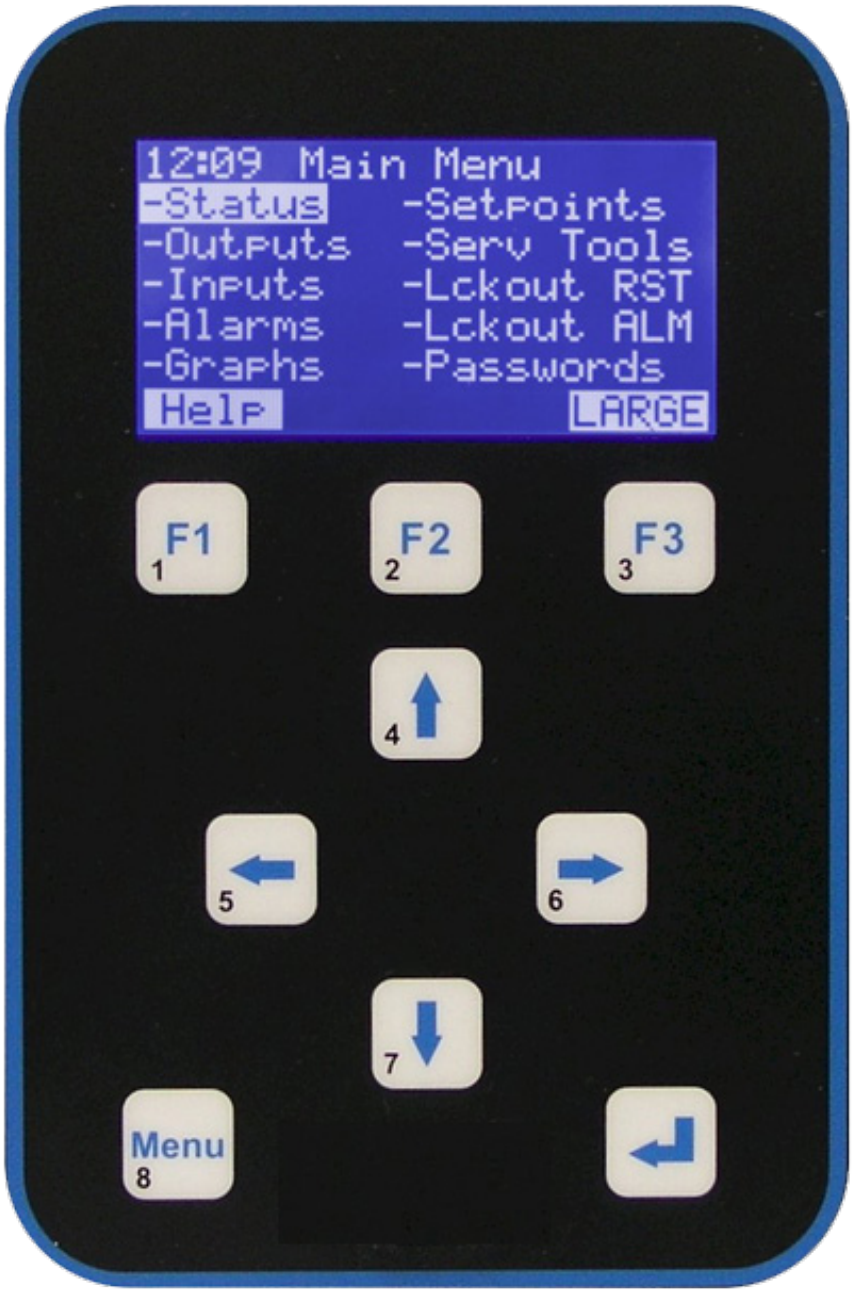
Reserved (Hex code =0x4000)

Reserved (Hex code =0x8000)

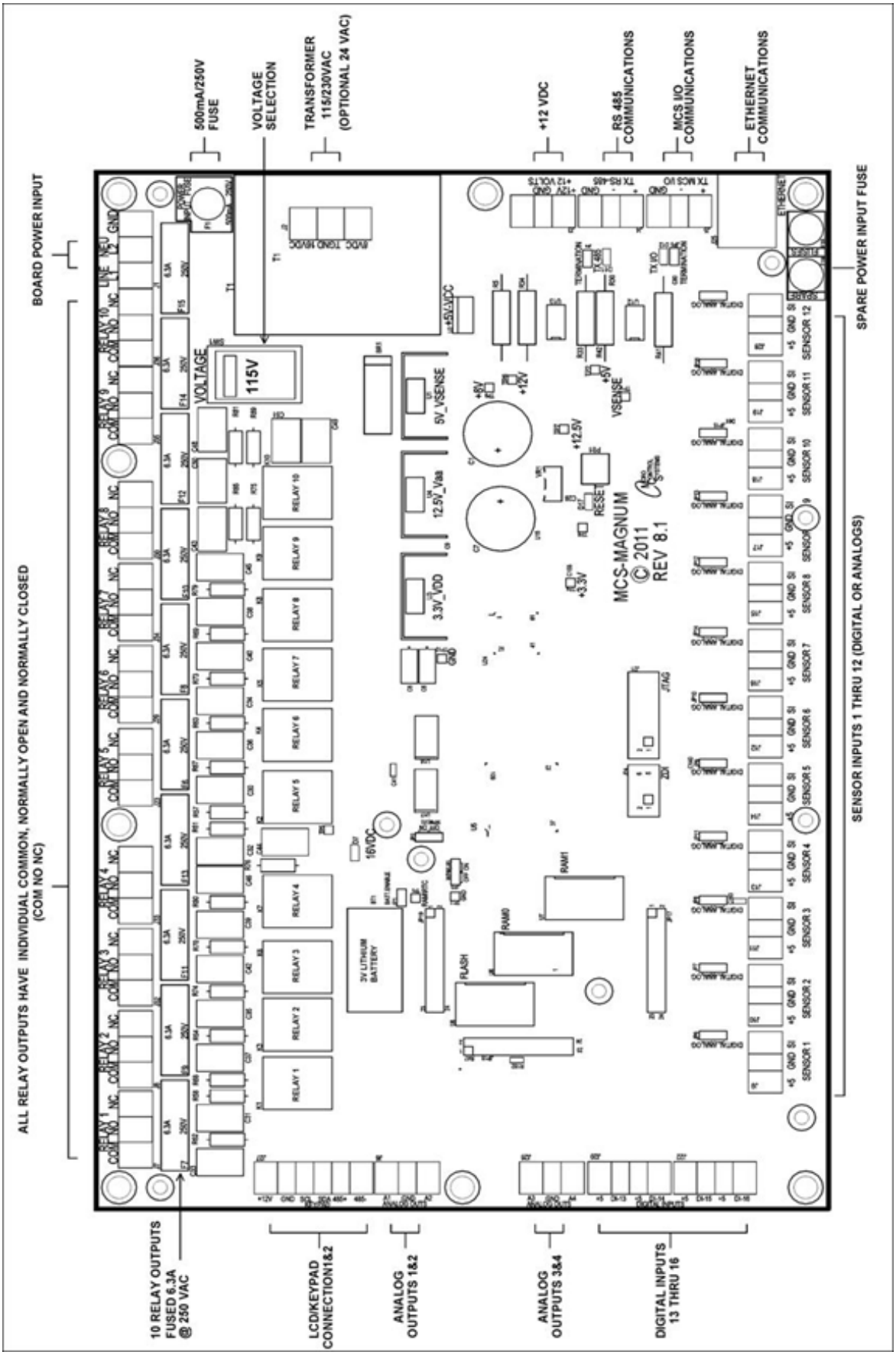
13. Hardware Quick References

13.1. Magnum Keypad Display

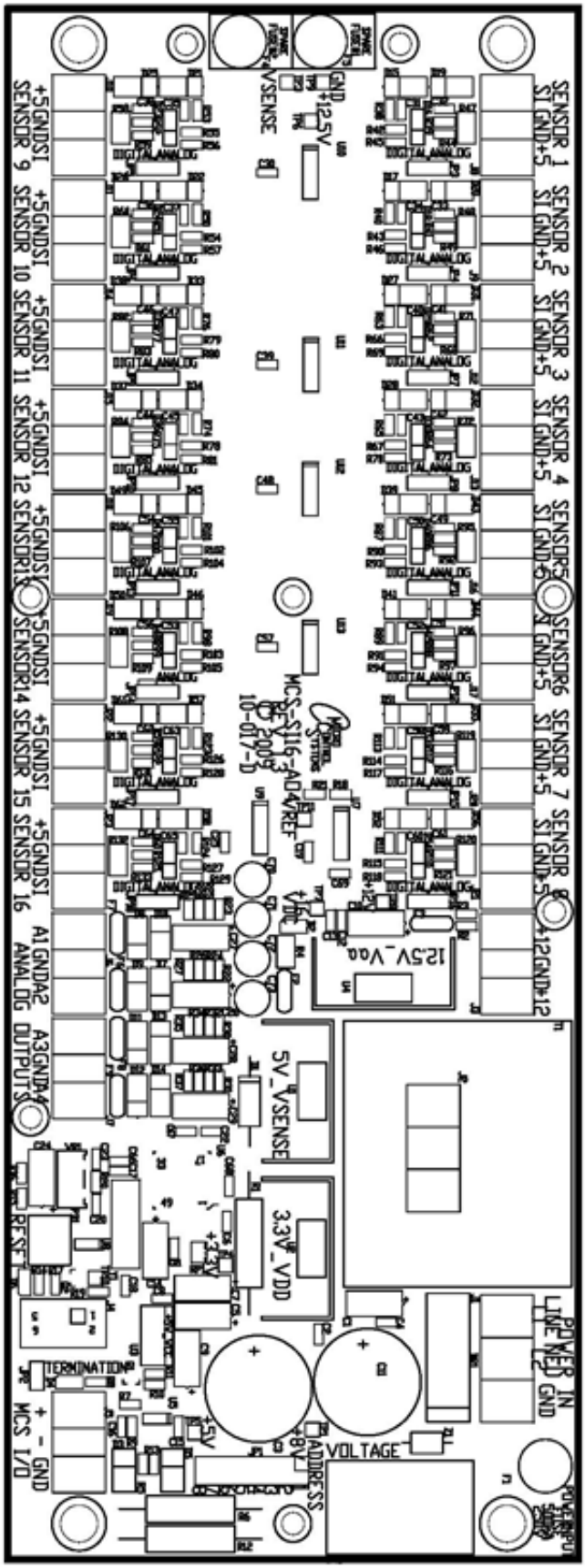
- No authorization is required to view information.
- Pressing the 'MENU' key will display the information below.
- Using the ←,↑, →, and ↓ buttons will change the selection to the item you want.
- Press the ↵ (Enter) key to select the highlighted item.
- The bottom line of the display defines the functions of F1 –F3.
- To enter the authorization code, refer to the small numbers on the bottom left corner of the keys (1 - 8).
- To use MCS-Connect you must use a null modem cable.



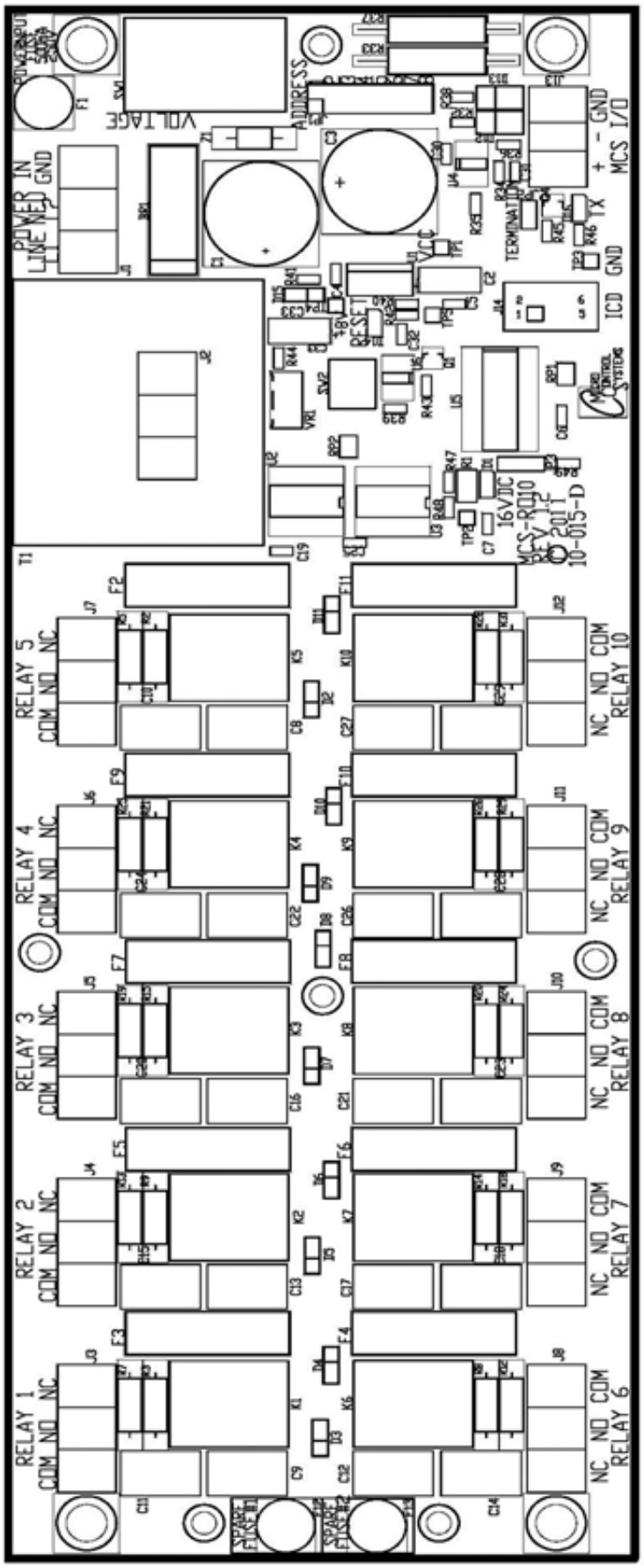
13.2. MCS-Magnum Revision 8.1



13.3. MCS-SI16-AO4



13.4. MCS-RO10


POWER IN
LINE NEU GND
VOLTAGE
ADDRESS
MCS I/O
+ - GND
TX
ICD
GND
RESET
16VDC
MCS-RO10
REV 1.F
2011
10-015-D
RELAY 5
COM NO NC
NC NO COM
RELAY 10
RELAY 4
COM NO NC
NC NO COM
RELAY 9
RELAY 3
COM NO NC
NC NO COM
RELAY 8
RELAY 2
COM NO NC
NC NO COM
RELAY 7
RELAY 1
COM NO NC
NC NO COM
RELAY 6

14. Troubleshooting Quick Reference

(A more detailed troubleshooting guide is available on our website: *www.MCScontrols.com*)

PROBLEM	POTENTIAL SOLUTION
No Sensor + 5 vdc or sensor +5 vdc output is less than 4.90 vdc.	Indicates a possible shorted input sensor Remove all sensor terminal blocks. Wait about 30 to 60 seconds. If + 5 vdc returns, replace one sensor wire at a time until the + 5 vdc is lost again. This will be the shorted sensor.
A Sensor Input reads -99.9	This indicates an open Sensor Input signal or 5 VDC problem. Check sensor wiring for missing wire or poor connection. Check for faulty sensor. Check + 5 vdc on Sensor Input to ground. If less than 5 VDC is on the sensor 5 VDC terminal block, the problem is with probably a shorted sensor. (A poly fuse protects the board) Remove all Sensor Input terminals. Wait about 1 minute or until 5 VDC restored at Sensor Input. Connect terminals 1 at time until short reappears and fix bad sensor.
A Sensor Input reads +999.9	This indicates a shorted Sensor Input signal. Check sensor wiring for +5VDC shorted to signal etc. Check for faulty sensor.
A pressure sensor is reading more than 1 psi off (The temperature and humidity sensors do not require calibration.)	This indicates the transducer Sensor Input needs to be calibrated through the offset capability in the software. (Transducers by design need to be calibrated based on construction and altitude.) You must use the MCS-Connect with a valid Authorization code to change sensor offsets See MCS-Connect Interactive section for instructions. (Change SI Status, Manual Value and / or offset.)
Invalid reading on one Sensor Input.	This indicates an input problem with 1 sensor. Verify jumper settings correct for that SI.
Lost I/O	Indicates communications problem. Verify RS485 LED blinking. Verify termination jumper J6 only on at Magnum and last I/O. Verify Magnum and I/O address's set correctly. Verify wiring from Magnum to each I/O correct. Check fuses/120 VAC on I/O units
MCS-Connect cannot make changes	This indicates you are not at a proper authorization level. Follow steps below for proper authorization From either the SITE INFO or STATUS screen in MCS-Connect, click the 'View Only' button at the top of the screen, or click on the 'Passwords' menu option on the lower right of your Keypad/LCD display. Follow prompts and enter a valid 4-digit authorization number. The authorization level is displayed at the top of the display and is reflected by the color of the Authorization button. Red = View Only Light Blue = User level Purple = Service level Dark Blue = Supervisor level Green = Factory level

PROBLEM	POTENTIAL SOLUTION
Invalid authorization	This indicates an invalid authorization number. Follow steps below for proper authorization Press Service Diagnostics key until the authorization option appears Press the Enter key From the “Display Status” press keys corresponding to your authorization number. Press Enter
SI from AMPS board 10 A low.	This indicates a problem with this SI only. Jumper setting on this SI in wrong position. Incorrect sensor type used.
INVALID CONFIG VER	Indicates layout of CFG wrong. CFG layout for different version than software
INVALID CONFIG TYPE	Indicates CFG incompatible with software.
INVALID CONFIG CHECKSUM	Indicates Checksum invalid Reload a valid CFG
Sensor input believed invalid (Under Sensor Diagnostic Sub Menu)	Verify Berg jumpers using Quick Reference Sheets Check board version number Check wiring of sensor
Communications to MCS-485-GATEWAY from MCS-Connect not working.	Verify red LED on the gate way is blinking. This indicates that MCS-Connect is talking to the gateway. Verify that the two wire shielded cable is properly wired from the RS-485 connector to the gateway. Verify red LED (Located just to the left of the RS-485 connector on the Magnum board is blinking. This indicates that the Magnum is responding to the gateway. If both of these LED are blinking, check the address of the Magnum and any other Magnums that are on the network. Each must have a unique address. This address can be changed from the Magnum. Proper authorization is required. Enter the UNIT INFORMATION screen by pressing the SERVICE DIAGNOSTIC key and scrolling to this item. Press the enter key and scroll to the NETWORK ADDRESS screen. Change address if needed. Verify + 12 vdc to MCS-485-GATEWAY
INVALID CONFIG	Indicates Checksum invalid Either set to factory defaults on reset settings.

15. BMS Communication Protocols

Magnum supports BACnet IP, Modbus RTU, Modbus TCP/IP, and Johnson N2. Supported baud rates for Modbus RTU and Johnson N2 are 4800bps, 9600bps, 19200bps, 38400bps, and 57600bps.

15.1. Sensor Input Points

Sensor numbering is based upon SI16-AO4 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)

15.2. Relay Output Points

Relay Output points are read-only. Sensor numbering is based upon RO-10 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

Analog Output PointsAnalog Output points are read-only. Sensor numbering is based upon SI16-AO4 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)

15.3. Setpoints

Setpoints are read-only. Notable BACnet properties available: Units

Magnum	BAC-net 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)

15.4. Chiller/Compressor States

State values are read-only. Notable BACnet properties available: Number of States, State-Text (Contains character text of current state)

Magnum	BAC-net 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
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

15.5. Other 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 #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 #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 #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
Compressor #4 Oil Pres Diff	AV:66	C4_Oil Pres Diff	*30378	*ADF:67
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 #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

Magnum	BACnet ID	BACnet Name	Modbus	N2
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 #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 #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 #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 #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 #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
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

Magnum	BACnet ID	BACnet Name	Modbus	N2
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 #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 #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	*3062	*ADF: 531
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 #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 #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 #19 FLA%	AV: 510	C19_FLA%	*30582	*ADF: 511
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

Magnum	BACnet ID	BACnet Name	Modbus	N2
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 #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

*- Indicates value multiplied by 10 to include one decimal place. (I.e. BMS value of 500 indicates actual value 50.0)

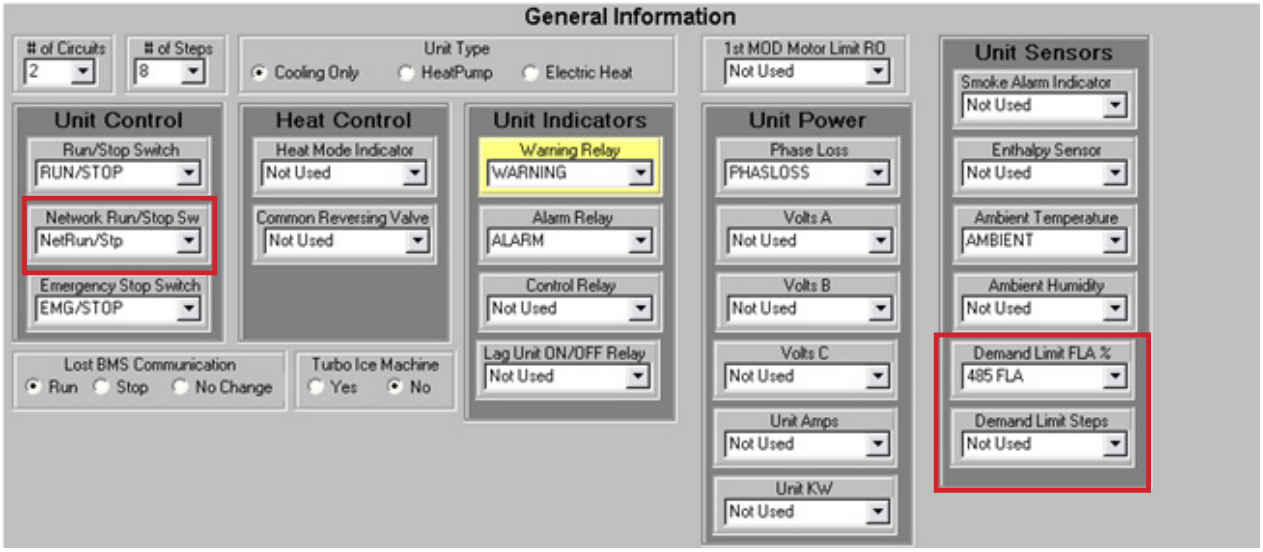
15.6. Network inputs to MCS-Magnum

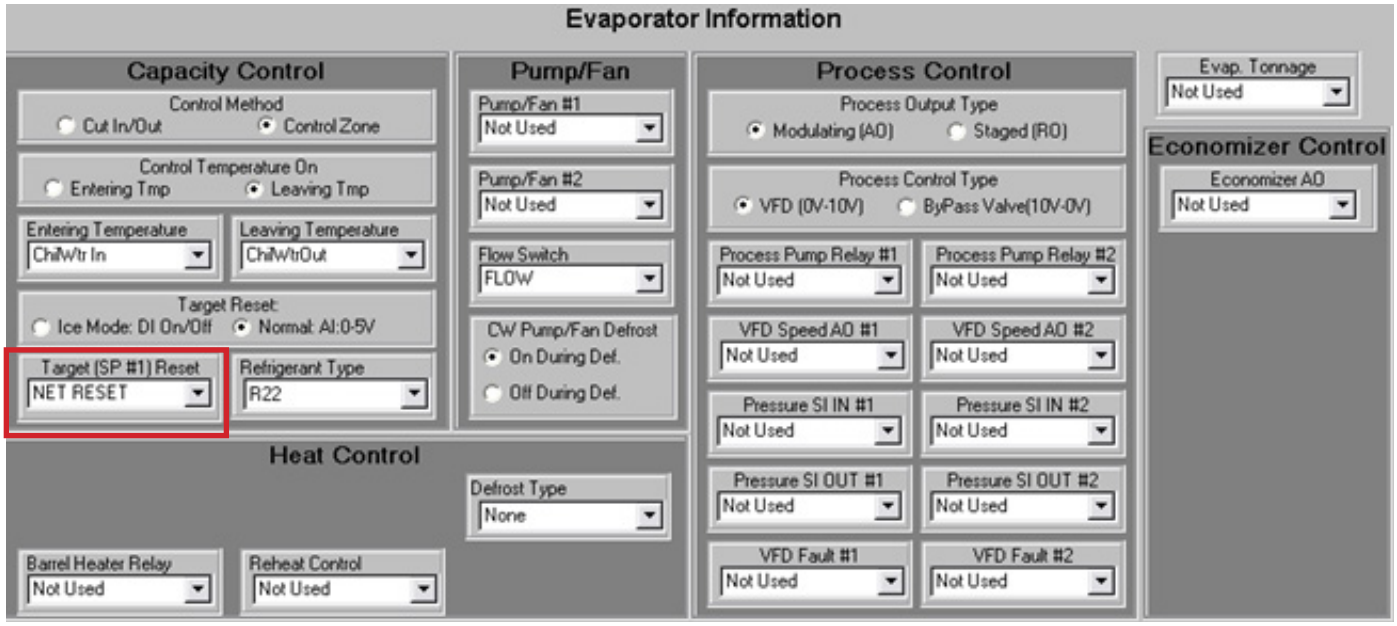
The MCS-Magnum can receive changes from the network to enable or disable the Network Run/Stop, Network Target Reset (adjustments to the Cooling Target, Setpoint #1, based on Setpoint #21), Network Demand FLA, and Network Demand Steps.

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

The MCS-Magnum must be setup to accept these inputs. The configuration file in the MCS-Magnum must contain a Network Run/Stop, and /or Network Target Reset, and/or Network Demand FLA, and/or Network Demand Steps sensors. 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	NET R/S	485 RUN	0	0	Not Used	Not Used	Not Used	Auto
1-2	NETTRS	485 CW RSET	0	0	Not Used	Not Used	Not Used	Auto
1-3	485FLA	485 Dmd FLA%	0	0	Not Used	Not Used	Not Used	Auto
1-4	485Steps	485 Dmd Step	0	0	Not Used	Not Used	Not Used	Auto

15.7. MCS Capacity Control State Chart

The values exposed in the capacity state relate to the descriptions in this table.

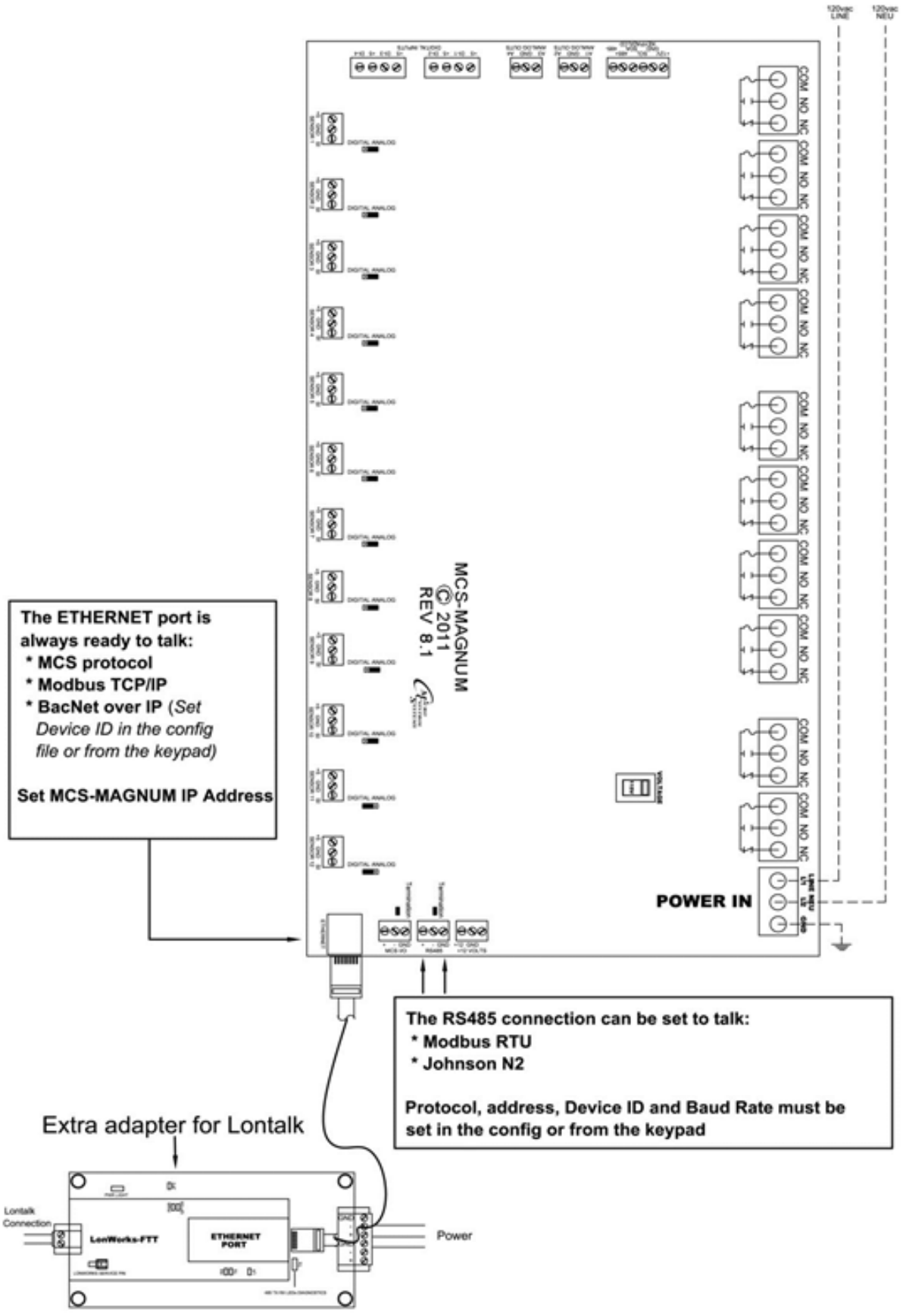
State Number	Description
0	“UNIT IN POWER UP”
1	RESERVED
2	“NO RUN- I/O LOST”
3	“UNIT IN LOCKOUT “
4	“UNIT IS OFF “
5	“UNIT IS HOLDING “
6	“UNIT UNLOADING “
7	“UNIT IS LOADING “
8	“NO RUN - SAFETY “
9	**“RUN/STOP SW OFF “**
10	“SCHEDULED OFF “
11	“OFF-NO FLOW(s)”
12	RESERVED
13	“AMBIENT OFF “
14	“PROCESS HEAT OFF”
15	“UNIT IS UNLOADED”
16	“UNIT IS LOADED “
17	**“OFF TMP-ICE MADE “**
18	“ECONOMIZER ONLY “
19	“SWITCHING MODES “
20	“UNIT SMOKE UNLDG”
21	“UNIT OFF UNLDING”
22	“UNIT DMD UNLDING”
23	“UNIT HEAT UNLDNG”

15.8. MCS Compressor Control State Chart

The values expressed in the compressor state relate to the descriptions in this table.

State Number	Description
0	“LOST IO LOCKED”
1	“CMP LOCKED OUT”
2	“SWITCHED OFF “
3	“CMP PUMP DOWN “
4	“CMP ANTICYCLE “
5	**“CMP OFF/READY “**
6	**“OIL PMP LUBING”**
7	“CMP IS RUNNING”
8	“CMP UNLOADED “
9	“UNLD1/HGBP OFF”
10	“PART LOADED “
11	“CMP IS HOLDING”
12	“CMP IS LOADING”
13	“CMP IS UNLDING”
14	“CMP IS AT 100%”
15	“FAST UNLOADING”
16	“LO SUCT UNLOAD”
17	“LO SUCT HOLD “
18	“HI DISC UNLOAD”
19	“HI DISC HOLD “
20	“SAFETY TRIPPED”
21	“LO TEMP UNLOAD”
22	“LO TEMP HOLD “
23	“HI AMP HOLD “
24	“HI DIS TMP HLD”
25	“CMP IS AT 40% “
26	“CMP IS AT 70% “
27	“HI WATER HOLD “
28	“EXTRA 70% STEP “
29	“OFF-LO OIL TMP “
30	“HI AMP UNLDING “
31	“DEF PREPMP OUT “
32	“DEFROSTING “
33	“DEF PUMP DOWN “
34	“HI TEMP UNLOAD “
35	“HI TEMP HOLD “
36	“SCROLL STEP1 “
37	“SCROLL STEP2 “
38	“SCROLL STEP3 “
39	“SCROLL STEP4 “

15.9. MCS-Magnum to BMS Connections



15.10. MCS-Magnum BMS protocols settings

15.10.1 Bacnet Over IP

The BACNET DEVICE ID is a five-digit number. The first three digits are based on our Bacnet vendor ID 181, and the last two are set by the Bacnet/MSTP address.

181	XX
↓	↓
Bacnet Vendor ID	Bacnet MS/TP Address

The Bacnet address can be verified and changed (with the proper authorization code) from the Keypad/LCD. The following steps will display the Bacnet MSTP 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 BACnet MSTP
- Select address then press Enter. Change the address so it matches the last two digits of the device ID then press Enter.
- Select Protocol then press Enter. Set the protocol back to MCS.

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 “DHCP Enabled” to NO.
- Set the “IP Address”.
- Set the “Subnet Mask”.
- Set “Default Gateway”.

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 “DHCP Enabled” to YES.
- Connect the MCS-Magnum to the network and power up the board.

15.10.2 Modbus RTU

The Modbus RTU address can be verified and changed (with the proper authorization code) from the keypad/LCD. 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.
- 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.

15.10.3 Modbus TCP/IP

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 “DHCP Enabled” to NO.
- Set the “IP Address”.
- Set the “Subnet Mask”.
- Set “Default Gateway”.

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 “DHCP Enabled” to YES.
- Connect the MCS-Magnum to the network and power up the board.

15.10.4 Johnson N2

The N2 address can be verified and changed (with the proper authorization code) from the keypad/LCD.

- 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 N2.
- 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.

16. Relay Output Sequences

The sequence of Relay Outputs must be correctly matched to the particular type of compressor being controlled. Relays are required unless marked as optional. If a relay is optional and it is not used then its position is skipped and the following relays will be moved up. Compressor type selection as displayed in MCS-Config is shown within brackets.

15.11. Reciprocating Compressors (Recip Comp w/Oil) and (Recip Comp w/o Oil)

Compressor relay
Part winding compressor relay (OPTIONAL)
Liquid line solenoid
Unloader 1 (OPTIONAL)
Unloader 2 (OPTIONAL)
Unloader 3 (OPTIONAL)
Oil pump (OPTIONAL, ONLY USED WITH **Recip Comp w/Oil)**
Oil heater (OPTIONAL, ONLY USED WITH **Recip Comp w/Oil)**
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.12. Screw Compressor with Oil (Screw Comp w/Oil)

Compressor relay
Part winding compressor relay (OPTIONAL)
Loader
Unloader
Oil pump
Oil heater
Liquid line solenoid (OPTIONAL)
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)

Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.13. Scroll Compressor (Scroll Comp)

Compressor relay
Part winding compressor relay (OPTIONAL)
Liquid line solenoid
Unloader 1 (OPTIONAL)
Unloader 2 (OPTIONAL)
Unloader 3 (OPTIONAL)
Oil pump
Oil heater
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.14. Hitachi Screw Compressor (Hitachi Screw Comp)

Compressor relay
Part winding compressor relay (OPTIONAL)
Loader
Unloader
Fast unloader
Oil pump (OPTIONAL)
Oil heater (OPTIONAL)
Liquid line solenoid (OPTIONAL)
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)

Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.15. Carlyle Screw (Carlyle Screw)

Compressor relay
Part winding compressor relay (OPTIONAL)
Liquid line solenoid
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.16. Hanbell Screw Compressor, McQuay Frame 4 Compressor, Bitzer Screw Compressor, Hartford Screw Compressor, and Fu Sheng Compressor (McQuay Frame 4), (Fu Sheng), (Hanbell-Load NO), (Bitzer Screw Comp), (Hartford Screw Comp), and (Hanbell-Load NC)

Compressor relay
Part winding compressor relay (OPTIONAL)
Loader
Unloader
Oil pump (OPTIONAL)
Oil heater (OPTIONAL)
Liquid line solenoid (OPTIONAL)
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)

Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.17. Hanbell- 3 Solenoid (Hanbell- 3 Solenoid [50-100%])

Compressor relay
Part winding compressor relay (OPTIONAL)
Loader
Unloader
Fast unloader
Oil pump (OPTIONAL)
Oil heater (OPTIONAL)
Liquid line solenoid (OPTIONAL)
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.18. Hanbell Fixed Step (Hanbell Step)

Compressor relay
Part winding compressor relay (OPTIONAL)
Unloader 1 (OPTIONAL)
Unloader 2 (OPTIONAL)
Unloader 3 (OPTIONAL)
Liquid line solenoid
Oil pump (OPTIONAL)
Oil heater (OPTIONAL)
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)

Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.19. Centrifugal (Centrifugal Comp)

Compressor relay
Part winding compressor relay (OPTIONAL)
Open Vane
Close Vane
Oil pump
Oil heater
Liquid line solenoid (OPTIONAL)
Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.20. Mitsubishi Screw (Mitsubishi Screw)

Compressor relay
Part winding compressor relay (OPTIONAL)
Fast unloader
40 % open
70 % open
Liquid line solenoid (OPTIONAL)
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.21. Trane Scroll with 3 Compressor Sets (Trane Trio)

Staging sequence			
	COMP A	**COMP B**	**COMP C**
Stage 1	OFF	OFF	ON
Stage 2	ON	ON	OFF
Stage 3	ON	ON	ON

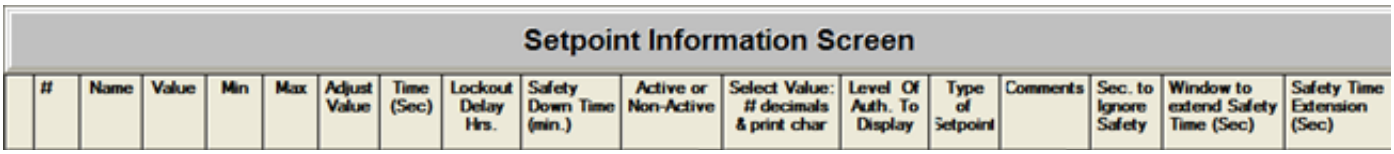
Compressor relay for COMP A
Part winding compressor relay (OPTIONAL)
Liquid line solenoid
Compressor relay for COMP B
Compressor relay for COMP C
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

15.22. Trane Scroll with 4 Compressor Sets (Trane Quad)

Staging sequence				
	COMP A	**COMP B**	**COMP C**	**COMP D**
Stage 1	ON	OFF	OFF	OFF
Stage 2	OFF	OFF	ON	ON
Stage 3	OFF	ON	ON	ON
Stage 4	ON	ON	ON	ON

Compressor relay for COMP A
Part winding compressor relay (OPTIONAL)
Liquid line solenoid
Compressor relay for COMP B
Compressor relay for COMP C
Compressor relay for COMP D
Hot gas bypass (OPTIONAL)
Common Hot gas bypass (OPTIONAL)
Liquid injection (OPTIONAL)
Fast unloader (OPTIONAL)
Second liquid line solenoid (OPTIONAL)
Oil equalization (OPTIONAL)
Oil seal cooler (OPTIONAL)
VI increase valve % (OPTIONAL)
VI decrease valve % (OPTIONAL)
Start unloader bypass (OPTIONAL)
Low disc superheat (OPTIONAL)
Hot gas reheat off (OPTIONAL) If hot gas reheat all 3 hot gas relays are required.
Hot gas reheat on (OPTIONAL)
Hot gas reheat bleed (OPTIONAL)
Third liquid line solenoid (OPTIONAL)
Reversing valve (heat pump) (OPTIONAL)
Liquid injection #2 (OPTIONAL)
Mod motor (OPTIONAL)

17. Magnum V8 Setpoints



Setpoint Information Screen																	
	#	Name	Value	Min	Max	Adjust Value	Time (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 extend Safety Time (Sec)	Safety Time Extension (Sec)

 # (Number) - From 1 to 230 (maximum number of Setpoints supported). Only active Setpoints will be displayed in MCS-Connect and on the keypad display.

Name - The Setpoint's name consists of up to 12 characters. The name is displayed following the number on the LCD display. The Setpoint name can be changed to make it more meaningful to the current application, however the function of the Setpoint will remain the same.

Value - The value or target of the Setpoint. With proper authorization this value can be changed, within limits that have been established in MCS-Config.

Min - The minimum value that can be set. This field is not displayed and cannot be changed in MCS-Connect or in the keypad display.

Max - The maximum value that can be set. This field is not displayed and cannot be changed in MCS-Connect or in the keypad display.

Adjust Value - The interval that the value field can be changed by. This field is not displayed and cannot be changed in MCS-Connect or in the keypad display.

'Time (sec)' – this field has two purposes: 1) In either a LOCKOUT or ALARM type; this is the length of time the Setpoint must be true before it will trip. This time is always in seconds and it is displayed on the keypad display and MCS-Connect if the Setpoint is either a LOCKOUT or ALARM type. This field can be changed in MCS-Connect and through the keypad. 2) In a non-safety type Setpoint this field can be used as an extra timer. This will be specified in the Setpoint definition if it is used.

Lockout Delay Hrs. – If a second safety occurs within this time, the unit or compressor will be locked out. This field is not displayed and cannot be changed through MCS-Connect or in the keypad display.

Safety Down Time (min.) – After the first safety occurs the Magnum will wait this number of minutes before the unit or associated compressor is allowed to run again.

Active or Non-Active – Only active Setpoints will be displayed in MCS-Connect or on the keypad display, but only if the needed authorization level has been achieved.

Select Value: # decimals and print char – This indicates the number of decimal places and the unit character that accompanies the value displayed. The number of decimal places is crucial when the Value, Minimum, and Maximum data is entered in MCS-Config.

Level of Auth. To Display – This column indicates what authorization level a user must have in order to view the Setpoint from MCS-Connect or the keypad display.

Comments – This column allows the user to add comments about the function of the Setpoint.
Sec. to ignore safety - If this value is not zero, at compressor startup this safety will be ignored for the time in this field.

Window to extend Safety 'Time (sec)' – If this value is not zero, at compressor startup the normal Safety Time will be increased by the value in Safety Time Extension field for the time specified in this field.
Safety Time Extension (Sec) – This is the value that will be added to the Safety Time during the Window to extend Safety Time period.

17.1. Setpoint Types

There are three different types of Setpoints. The Magnum software determines if a Setpoint contains a target value or is a safety. If it is a safety then its type determines what action the Magnum will take when the safety occurs (either locking out the unit or generating an alarm only).

17.1.1 SETPOINT

This type of Setpoint contains a target or provides information for some action. The time element in this type can be used for an additional counter if specified. This time is displayed and can be changed through MCS-Connect, MCS-Config or from the keypad display.

17.1.2 LOCKOUT

This type of Setpoint contains a safety value and the time that the safety must be violated before the safety will trip. Once a safety has tripped the Magnum will take the appropriate action, shutting down the entire package or an individual compressor depending on the purpose of the safety. The Magnum will then wait the Safety Down Time contained in that Setpoint before trying to return the normal. If successful, the system will continue to operate. If a second trip occurs on the same Setpoint with in the Lock Out Delay Time that is contained in that Setpoint the system will move to a LOCKOUT state. If the lockout delay time is set to zero the lockout will occur on the first trip. This requires manual intervention to reset the system. With each safety trip, the Magnum will generate an alarm; refer to section 6 Magnum Alarms and Safeties.

The Safety Down Time and the Lock Out Delay Time are unique for each Setpoint. They cannot be viewed or adjusted in a live unit; only through MCS-Config.

17.1.3 ALARM

This type of Setpoint has two uses:

1) When it is used as a safety, it will be similar to the LOCKOUT Setpoint except it will never cause a lock out. The system will continue to try returning to normal operation after waiting the safety down time. An ALARM Setpoint type will never require manual intervention to reset the system.

2) When the Setpoint is being used as a second timer it will be available to change in a live unit. If the type is not changed to ALARM then the time field cannot be viewed or changed from a live unit.

17.2. Setpoints for Magnum HVAC and CENT V8 Software

If a particular Setpoint is supported only in either HVAC or CENT software it will be indicated with (Only HVAC) or (Only CENT).

#	Name	Description
1	CTL TARGET	Control target. This value is used as the base to develop the Control Zone. 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.
2	CTL ZONE +	Added to the CTL TARGET to create the upper limit of the control zone.
2	STAGE CUT OUT (Cut In/Out Control)	Offset used in calculating the cut out value. Subtracted from the stage cut in Setpoints #3 through #18
3	CTL ZONE -	Subtracted from the CTL TARGET to create the lower limit of the control zone.
	(Only CENT)	If this Setpoint is a target type and the Low Zone cell is >0 and <=5, use this value as the offset to the target to allow an unload adjustment of 3 else use 1.
	STAGE 1 CUT IN (Cut In/Out Control)	Stage 1 cut in, Setpoint value contains the voltage when this stage is turned on.
4	HGS TEMP ON	This Setpoint is used with screw compressors with a hot gas bypass solenoid. When this Setpoint is active and the control temperature is less than the CTL TARGET plus the value in this Setpoint and the FLA % is within 25% 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 25 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%”.
	STAGE 2 CUT IN (Cut In/Out Control)	Stage 2 cut in, Setpoint value contains the voltage when this stage is turned on.

#	Name	Description
5	HGS TEMP OFF	This Setpoint is used with screw compressors with a hot gas bypass solenoid. When this Setpoint is active and the control temperature is greater than the CTL TARGET plus the value in this Setpoint or the FLA % is not within 25% 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 value at 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%”.
	STAGE 3 CUT IN (Cut In/Out Control)	Stage 3 cut in, Setpoint value contains the voltage when this stage is turned on.
6	HGS PSI ON	This Setpoint is used with screw compressors with a hot gas bypass solenoid. When this Setpoint is active and the suction pressure is less than the value of this Setpoint and the FLA % is within 25% of the Setpoint #31 “MIN SLIDE%”, the hot gas bypass solenoid for the compressor will be turned on.
	STAGE 4 CUT IN (Cut In/Out Control)	Stage 4 cut in, Setpoint value contains the voltage when this stage is turned on.
7	HGS PSI OFF	This Setpoint is used with screw compressors with a hot gas bypass 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.
	STAGE 5 CUT IN (Cut In/Out Control)	Stage 5 cut in, Setpoint value contains the voltage when this stage is turned on.
8	L.INJECT.ON	This Setpoint can be used for both liquid injection solenoids. 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.
	STAGE 6 CUT IN (Cut In/Out Control)	Stage 6 cut in, Setpoint value contains the voltage when this stage is turned on.

#	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. '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. 'Time (sec)' field: If non-zero, skip ROC adjustment logic in the control zone.
	STAGE 8 CUT IN (Cut In/Out Control)	Stage 8 cut in, Setpoint value contains the voltage when this stage is turned on.
11	EXV LOAD ADJ	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.
	STAGE 9 CUT IN (Cut In/Out Control)	STAGE 9 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.
	STAGE 10 CUT IN (Cut In/Out Control)	Stage 10 cut in, Setpoint value contains the voltage when this stage is turned on.
13	EXV COURSE	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.
	STAGE 11 CUT IN (Cut In/Out Control)	Stage 11 cut in, set point value contains the voltage when this stage is turned on.
14	EXV LOAD DIV	As the Amp draw % changes this divides the EXV % change. It is calculated as follows: [(Max slide% – min slide%) / (Max vlv% - min vlv%)] +1
	STAGE 12 CUT IN (Cut In/Out Control)	Stage 12 cut in, Setpoint value contains the voltage when this stage is turned on.
15	EXV MIN %	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.
	STAGE 13 CUT IN (Cut In/Out Control)	Stage 13 cut in, Setpoint value contains the voltage when this stage is turned on.

#	Name	Description
16	EXV MAX %	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.
	STAGE 14 CUT IN (Cut In/Out Control)	Stage 14 cut in, Setpoint value contains the voltage when this stage is turned on.
17	LO SUPERHEAT	If the calculated superheat remains below this value for the time specified, the Magnum will generate a LOW SUPERHEAT alarm.
	STAGE 15 CUT IN (Cut In/Out Control)	Stage 15 cut in, Setpoint value contains the voltage when this stage is turned on.
18	LOWSUCPSI DLY	Delay in seconds when in 'Low Suction PSI Opening' between adjustments to the EXV valve.
	STAGE 16 CUT IN (Cut In/Out Control)	Stage 16 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)
20	EXV STRT 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	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	If the ambient temperature is below this value the system will be disabled and the unit state 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	The time in seconds that the system will remain in the START UP state before moving to the next state.
24	HI AMBIENT	If the ambient temperature is above this value the system will be disabled and the unit state 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	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. Used only with the Magnum Control Zone control method.
26	STEP DELAY	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 'Compressor Information' panel under the MAG V8 screen.

#	Name	Description
27	MAX ROC -	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. Used only with the Magnum Control Zone control method.
28	MAX ROC +	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. Used only with the Magnum Control Zone control method.
29	ROC INTERV	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 SLIDE % or MAX CAPACITY% or MAX VFD %	Indicates the maximum amp draw, slide %, digital scroll load%, or speed allowed. Usually set to 100%, else compressors will load to the value of this Setpoint until all steps are on, 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 'Compressor Information' panel under the MAG V8 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 SLIDE % or MIN CAPACITY% or MIN VFD %	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 MAG V8 screen. Will Delay next compressor for this time after EVAP pump/valve is opened.
32	MAX ADJUST %	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 'Compressor Information' panel under the MAG V8 screen.
33	MIN ADJUST %	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	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).

#	Name	Description
35	AMP DB HI	Used only with screw and centrifugal compressors. This value is the upper dead band limit of the FLA. If the amps are within the dead band, the slide valve will not be moved. If controlled by Slide Position, instead of FLA, this Setpoint will not be used.
36	AMP DB LO	Used only with screw and centrifugal compressors. This value is the lower dead band limit of the FLA. If the amps are within the dead band, the slide valve will not be moved. If controlled by Slide Position, instead of FLA, this Setpoint will not be used.
37	LOAD PULSE	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	Length of time to engage the slide valve unload solenoid in tenths of a second (usually between 1 and 9). Optional: If compressor type is Hanbell 3 solenoid and Time (SEC) cell of Setpoint #38, is not zero DO NOT turn the unload solenoid ON (which is normal) when the compressor is in a fast unload state, pumpdown unloading state or for the first 15 minutes after the compressor is turned off.
39	LUBE OIL TMP	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 'Compressor Information' panel under the MAG V8 screen.
40	LUBE OIL PSI	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	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	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	Only used for centrifugal compressors. If active, this will be the threshold for ending the pump down state (can either be number of amps or vane percentage, depending on the compressor control method). If the Setpoint is inactive then the FLA Setpoint for that compressor will be used.
44	CENT P-DWN TMR	Only used for centrifugal compressors. This is the maximum time allowed in the pump down state. NOTE: This value is used whether the Setpoint is active or inactive.

#	Name	Description
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 MAG V8 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.
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.
48	CND DIFF OFF (RO Type)	Differential pressure added to Setpoint #46 to set the threshold at which each additional stage of condenser capacity will turn off.
	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%.
	DUAL PSI DELTA (Dual V8)	Minimum difference in pressure before the second stage of condenser capacity can be started.
49	CND MIN RUN (RO Type)	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)	Time delay once the pressure difference in Setpoint #48 has been reached before the second condenser stage can be started.
	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 TRGT (Modulating Type)	Target the logic will try to maintain by modulating the AO.
	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 (hardcoded 15°F if inactive), then the sump pump relay will be allowed on again.
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.
	CND VFD MIN	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.

#	Name	Description
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 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)	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.
56	PULSE DELAY	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.
57	LO AMB PROC	When this Setpoint is active and there is a process pump, the process pump will be turned on when the ambient temperature is less than the value of this Setpoint. The process pump will be turned off again when the ambient temperature is 5.0° Fahrenheit greater than the value of this Setpoint.
58	CFG TESTING	This must be setup as ‘Not Used’. If active the system will not lockout when an I/O communications signal is lost. This Setpoint should NOT be active in a live unit.
59	ACYC OFF->ON	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 5.11, Compressor Anti-Cycle Logic (OFF to ON).
60	MITSI P-DWN CUTIN	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	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.

#	Name	Description
62	PMP DWN DELY	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	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 5.11, Compressor Anti-Cycle Logic (ON to ON).
64	COMP MIN RUN	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	Temperature differential used to build the EXV Zone 1 both plus and minus.
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.
67	EXV ROC ZONE 1	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	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	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	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	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	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.

#	Name	Description
73	STARTER DLAY	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 the slide amp percentage is less than the value of this Setpoint and the first relay has been on for 2 seconds or it has been on longer than the value in the safety time of this Setpoint, then turn on the second relay. Else it is off. If the 'Select Value: # decimals & print char' cell is set to 'Seconds' then the Setpoint's value is a time delay between the first and second relay's starts. Used for part wind (typical value of 1) and star delta (typical value of 5) starter.
74	OIL PUMP OFF	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	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	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	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	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	Refer to Setpoint #78 description.
80	UNSAFE SUCT	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.

#	Name	Description
81	HI DISC PSI	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	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	Refer to Setpoint #82 description.
84	LO DISC SHEAT	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	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	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	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 (Not CENT?)	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	Refer to Setpoint #88 description.

#	Name	Description
90	COND FAULT	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 Lockout, and a condenser fault occurs, then all of the compressors associated with this fault will be locked off. For Common VFD Fan Condensers with Bypass: Time in seconds before the bypass can be used when a fault has occurred.
91	LOW OIL DIF	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	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	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	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	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	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	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	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.

#	Name	Description
99	LLS#3 ON (ECONOMIZER)	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 superheat goes below the value in this Setpoint for the safety time / 9, the economizer will be turned off.
100	HIGH SUMP TEMP	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 DELAY	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 holding for the following reasons: ■ Low suction pressure ■ Low refrigerant temperature ■ High discharge pressure ■ High discharge temperature ■ High amperage
102	PUMP FREEZE PROTECTION	If active, and the leaving temperature sensor is below the value of this Setpoint, a pump will be forced on to protect against freezing. The leaving temperature must rise above this Setpoint plus Setpoint #192 "FRZ TMP DIFF" to turn the pump off again.
103	LEAD COMP	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	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	PUMP FAILURE (NO FLOW)	If active, flow is lost, and only one pump is present, then the system will be locked out. If the system has two pumps and flow is lost, then the backup pump will start and the lead pump will be locked out. If the second pump is running and flow is lost again then the entire system will be locked out. A lock out reset will be required to restart the system or to reactivate a locked out pump. If inactive, and the flow is lost, the system will move to the OFF- NO EVAP FLOW state. When flow is returned the system will automatically restart. If looking at individual pumps for each circuit in the Circuit base. Make this Setpoint a "Lockout". If flow is not made within the value of this Setpoint the first time than, an alarm will be generated. The system counts through the value of this Setpoint a second time, if flow is made then the unit will run as normal. If flow is not made the second time, the pump and all associated compressors for that circuit will be locked out.

#	Name	Description
106	LEAD PUMP	Indicates which pump is the lead. If zero, then rotation of the pumps will occur whenever the lead pump is turned off. If no rotation has occurred during the current day, a forced rotation will occur at midnight, ensuring at least one rotation per day. If value is non-zero, then rotation of the pumps is inactive and the value will specify the lead pump. This Setpoint can be changed in a live unit and the appropriate action will be taken immediately.
107	EcoDelayMech	Seconds to delay after the economizer is fully loaded, valve opened to its maximum, and all associated fans are on before the mechanical cooling is enabled. If inactive, then the value of Setpoint #125 “Eco StageDly” will be used for this delay. ‘Time (sec)’ field: This value is used as a multiplier in the calculation that determines when it is too cold to use economizer cooling. If the control temperature drops below Setpoint #1”CTL TARGET” minus (‘Time (sec)’ field of this Setpoint multiplied by the value of Setpoint #3 “CTL ZONE -“) then shut off all economizer cooling. If the value in this ‘Time (sec)’ field is zero, a hardcoded 3 will be used instead.
108	PUMP DELAY	Time in seconds to keep the chilled water pump running after the last compressor has been turned off to ensure the chiller barrel does not freeze.
109	HiRefLevel	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	RefLvlExvAdj (EXV Control: Refrigerant Level)	If Setpoint #84 “LO DiscSPRHT” 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.
	DSprhtExvAdj (EXV Control: Discharge or Suction Superheat)	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	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	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	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	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.

#	Name	Description
115	EcoVFDfanDely	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	Defrost On Temp	Only used in Turbo Ice Machines. When control temperature falls below this value, then a defrost cycle begins. When the temperature rises .5° F above this value then the defrost cycle will be terminated.
117	Defrost On Delay	Only used in Turbo Ice Machines. Time in seconds of pre-defrost delay.
118	Defrost On Cycle	Only used in Turbo Ice Machines. Time in defrost cycle for each circuit.
119	EcoOffsetON	Temperature offset to determine when the economizer can be used. The ambient temperature must be less than Setpoint #1 “CTL TARGET “minus the value of this Setpoint for the economizer to begin.
120	Eco Stg Dely	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”.
120	H-PMP SW TIME	Time delay for switching between heating and cooling modes for heat pumps.
121	Eco MIN VLV%	Minimum 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.
122	Eco MAX VLV%	Maximum Economizer Analog Output valve percentage.
123	Eco MAX ADJ	Maximum adjustment to the Economizer Analog Output valve percentage with each calculation. Formula:[absolute value of(Target – current) * Multiplier Setpoint #126] / Divisor Setpoint #127
124	EcoVlvAdjDly	Delay between Economizer Analog Output valve adjustments.
125	Eco StageDly	Time delay between economizer reaching its maximum opening and turning on the associated condenser fans. If no condenser fans associated, then this Setpoint needs to be 0 and non-active.
126	Eco MULTI	Multiplier 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.
127	Eco DIVIDE	Divisor to scale adjustments to the Economizer Analog Output valve percentage. The difference between the control sensor and its target will be divided by this value.
128	Lost Leg Alarm (Only HVAC)	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.
	CmpMinSpeed% (Only CENT)	This is the minimum allowed compressor speed. This value will dynamically change based on an internal calculation, but will never be less than the original number.

#	Name	Description
129	RH CUTIN (Only HVAC)	Used with the 'Hot Gas Reheat' option. If the reheat sensor temperature is less than this value, then the hot gas reheat function will be activated.
	CmpMaxSpeed% (Only CENT)	This is the maximum allowed compressor speed.
130	RH CUTOUT ADJ (Only HVAC)	The reheat cutout temperature is calculated by adding this value to Setpoint #129 "RH CUTIN"
	CmpSpdUnld% (Only CENT)	The value in this Setpoint is the actual % decrease in this adjustment to the compressor AO, when adjusting to meet the calculated Wanted %. Cannot be greater than 1.
131	RH START DLY (Only HVAC)	Delay in seconds that the hot gas reheat function will remain in startup mode.
	CmpSpdLoad% (Only CENT)	The value in this Setpoint is the actual % increase in this adjustment to the compressor AO, when adjusting to meet the calculated Wanted %. Cannot be greater than 1.
132	RH BLEED DLY (Only HVAC)	Delay in seconds that the hot gas reheat function will keep the bleed solenoid on before exiting reheat mode.
	MinLiftTemp (Only CENT)	This is the minimum allowed lift temperature. Refer to Setpoint #128 "CmpMinSpeed%".
133	RH STAGE DLY (Only HVAC)	Delay in seconds until the hot gas reheat function starts when all criteria has been meet.
	MaxLiftTemp (Only CENT)	This is the maximum allowed lift temperature. Refer to Setpoint #128 "CmpMinSpeed%".
134	BARREL HEATER	If ambient falls below this temperature, then the barrel heater will turn on.
135	REFRIG LEAK	Used to detect a digital signal from a refrigerant leak detector.
136	VI PULSE	Used with an adjustable VI, volume ratio. This is the pulse time expressed in tenths of a second to adjust the VI.
137	VI DEADBAND	Used with an adjustable VI, volume ratio. If the VI reading is greater than the VI wanted ratio plus the value of this Setpoint, then the increase RO is off and the decrease RO is pulsed. If the VI reading is less than the VI wanted ratio minus the value of this Setpoint, then the increase RO is pulsed and the decrease RO is off.
138	VI DELAY	This is the time delay between VI wanted ratio calculations.
139	OIL FLOAT	If active, the Magnum checks for an oil float digital input. It must be ON for the period of time specified in the Setpoint before this Setpoint will trip.
140	NOT IN USED: 208	Compressors with a low SI Off sensor will be disabled when the sensor is below this Setpoint.
141	NOT IN USED: 209	Compressors with a high SI Off sensor will be disabled when the sensor is above this Setpoint.
142	SERVICE MODE	If 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.

#	Name	Description
143	UNLOADED %	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	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	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	PROC TARG	Process pump target. The control value can be either temperature or pressure.
147	PROC ZONE	Process pump control zone. This value is added to Setpoint #146 “PROC TARG” to calculate the high value and subtracted to calculate the low value of the control zone. The process pump’s VFD will be modulated to maintain inside this zone. The adjustment to the pump speed is calculated by subtracting the controlling SI from the value of Setpoint #146. This range has a minimum of 1% ADJ and a maximum of 15%.
148	PROC DELY	Process pump delay in seconds before next change. If calculated adjustment (Target minus controlling SI) is greater than the zone x2, or if the slope is greater than the ROC x2, decrement twice as fast.
149	PROC MAX ROC	Process pump rate of change limit. If the ROC exceeds this value, no change is required. The ROC window equals the value of Setpoint 148 to a maximum of 60 seconds.
150	PROC MIN SPD%	Minimum process pump speed if using the Modulating (AO) option. Number of Relay Outputs that will be staged if using the Staging (RO) option.
151	UNLOADED OFF	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	This Setpoint is only used when the heat pump option has been selected in the ‘Unit Type’ box in the ‘General Information’ panel under the MAG V8 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	SftyUnld Del	The time delay in seconds between compressor capacity adjustments when safety unloading.

#	Name	Description
154	VFD Sfty Adj	The VFD percentage adjustment to be made after every amount of time in Set-point #153 “SftyUnld Del” when safety unloading.
155	LO REF TMP	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	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	HP LoSuctAdj (Only HVAC)	This Setpoint is only used when the heat pump option has been selected in the ‘Unit Type’ box in the ‘General Information’ panel under the MAG V8 screen. When in heating mode, the low suction value Setpoint #77 “LOW SUCTION” is reduced by the value of this Setpoint.
	COV LIFT TEMP (Only CENT)	Minimum change to the saturated lift before calculating a new minimum speed.
	B-PUMP DELAY (Boiler/Pump Control)	The time delay expressed as seconds between making decisions as to pump settings.
158	DEF TRIG TMP (Only HVAC)	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.
	B-STAGE DELY (Boiler/Pump Control)	The time delay expressed as seconds between making decisions as to boiler stage settings.
159	DEF TRIG DEL (Only HVAC)	Time in minutes between defrost cycles.
	B-VFD DELAY (Boiler/Pump Control)	The time delay expressed as seconds between making decisions as to pump VFD setting. ‘Sec. to Ignore Safety’ field: contains the minimum valve setting. For example if this cell contains 500, the valve will initially be set to 50.0% and it will never be less than this value. ‘Window to extend Safety Time(sec)’ field: contains the maximum valve setting. This will normally be 1000 for 100.0%.

#	Name	Description
160	DEF REV DEL (Only HVAC)	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.
	B-VFD TARGET (Boiler/Pump Control)	The target flow that is to be maintained. This can be a differential if both input and output pressures sensors are specified or the actual flow of the input if only sensor specified. 'Time(sec)' field: contains the delay in seconds before another pump can be turned on once the valve gets to 100.0% 'Sec. to Ignore Safety' field: contains high dead band for the control zone. This is added to the value of this set point. In this example the high dead band will be 63.0. 'Window to extend Safety Time(sec)' field: contains low dead band for the control zone. This is subtracted from the value of this set point. In this example the low dead band will be 57.5. 'Safety Time Extension' field: contains the maximum valve adjustment that can be made at one time. In this example the maximum adjustment to the valve will be 3.0%..
161	DEF TERM TMP (Only HVAC)	If both coil #1 and coil #2 temperature are greater than the value of this Setpoint, then the defrost cycle can be terminated.
	B-PUMP FLT (Boiler/Pump Control)	The 'Value' is not used as this set point is set up to check the status of a digital input indicated in the Starting Pump Fault cell. 'Time(sec)' field: contains the delay before the system will place a pump in a failed state.
162	DEF TERM DEL (Only HVAC)	The length of time in minutes of the defrost cycle.
163	HP HEAT TARG (Only HVAC)	If active, then this value will become the target temperature during heating mode.
	Purge Target (Only CENT)	If active, it indicates that a Trane external purge system is incorporated. When the suction temperature is less than this value for the number of seconds in the 'Safety Down Time', then the purging sequence will begin.
	B-HEAT TRGT (Boiler/Pump Control)	The heating target that is to be maintained.
164	HP CTL ZONE + (Only HVAC)	Added to Setpoint #163 "HP HEAT TARG" to create the upper limit of the control zone during heating mode.
	Purge Fault (Only CENT)	If active and a purge safety switch is used, this Setpoint will contain the number of seconds the switch must be ON before a purge error alarm occurs.
	B-HEAT ZONE+ (Boiler/Pump Control)	The high dead band for the heating control zone. This value is added to the value of set point #163.
165	HP CTL ZONE – (Only HVAC)	Subtracted from Setpoint #163 "HP HEAT TARG" to create the lower limit of the control zone during heating mode.
	Purge ExTime (Only CENT)	If the time in purging mode for the last 24 hours is greater than the value of this Setpoint, an excessive purging alarm will be generated.
	B-HEAT ZONE- (Boiler/Pump Control)	The low dead band for the heating control zone. This value is subtracted form the value of set point #163.

#	Name	Description
166	PHASE LOSS	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 ER-ROR	If active and purge float error occurs, a purge float alarm is generated. This Fault requires a lockout reset to resume purge operation.
168	PURGE COUNT	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. For the first thirty minutes of compressor run time – this alarm is by passed.
169	PURGE PSI ST	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.
170	EXCESS PURGE	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. This fault requires a lockout reset to resume purge operation.
171	FLA COMP#1	Full Load Amps for compressor #1. This is the amps at design suction and discharge pressures referenced in the MCS-Config RO screen. This value is used to calculate the high and the low amperage safety limits. Refer to Setpoints #75 and #76. For screw compressors: The amp draw when the compressor is fully loaded. This value is used to calculate the Full Load Amps Percentage (FLA %), which is used to control loading and unloading the slide valve.
172	FLA COMP#2	Full Load Amps for compressor #2. Refer to Setpoint #171.
173	FLA COMP#3	Full Load Amps for compressor #3. Refer to Setpoint #171.
174	FLA COMP#4	Full Load Amps for compressor #4. Refer to Setpoint #171.
175	FLA COMP#5	Full Load Amps for compressor #5. Refer to Setpoint #171.
176	FLA COMP#6	Full Load Amps for compressor #6. Refer to Setpoint #171.
177	FLA COMP#7	Full Load Amps for compressor #7. Refer to Setpoint #171.
178	FLA COMP#8	Full Load Amps for compressor #8. Refer to Setpoint #171.
179	FLA COMP#9	Full Load Amps for compressor #9. Refer to Setpoint #171.
180	FLA COMP#10	Full Load Amps for compressor #10. Refer to Setpoint #171.
181	FLA COMP#11	Full Load Amps for compressor #11. Refer to Setpoint #171.
182	FLA COMP#12	Full Load Amps for compressor #12. Refer to Setpoint #171.
183	FLA COMP#13	Full Load Amps for compressor #13. Refer to Setpoint #171.
184	FLA COMP#14	Full Load Amps for compressor #14. Refer to Setpoint #171.
185	FLA COMP#15	Full Load Amps for compressor #15. Refer to Setpoint #171.
186	FLA COMP#16	Full Load Amps for compressor #16. Refer to Setpoint #171.
187	FLA COMP#17	Full Load Amps for compressor #17. Refer to Setpoint #171.
188	FLA COMP#18	Full Load Amps for compressor #18. Refer to Setpoint #171.

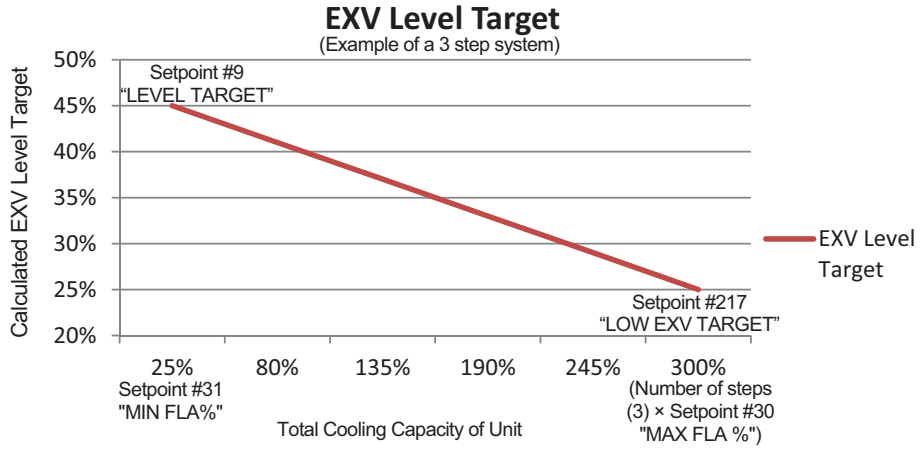
#	Name	Description
189	FLA COMP#19	Full Load Amps for compressor #19. Refer to Setpoint #171.
	B-FLA PUMP (Boiler/Pump Control)	The expended amp draw of the pump. If active this value is used to calculate the high and the low ampere safeties limits. Refer to set points 75 and 76.
190	FLA COMP#20	Full Load Amps for compressor #20. Refer to Setpoint #171.
	B-FLA BOILER (Boiler/Pump Control)	The 'Value' is not used as this set point is set up to check the status of a digital input indicated in the Starting Boiler Fault cell. 'Time(sec)' field: contains the delay before the system will place a boiler stage in a failed state.
191	TEMP DIFF	This temperature differential is used to replace the hardcoded temperature differential values of several other Setpoints. 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.
192	FRZ TEMP DIFF	This value is added to Setpoint #102 "PUMP FREEZE PROTECTION" to determine if the leaving temperature is above the freeze protection zone.
193	CND HI/LO ZONE	The value in this Setpoint is the high and low zone for your target of Setpoint #50 "CND TRGT". If inactive then a default zone of 5 psi will be used, if metric .3 Bar.
194	CND 2ND ZONE	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	LOW VOLTAGE	If the voltage of any one of the voltage sensors is less than the value of this Setpoint, then a Low Voltage alarm will be generated and the unit will be locked out. Voltage sensors are specified in the General Information panel under the MAG V8 screen.
196	HI VOLTAGE	If the voltage of any one of the voltage sensors is greater than the value of this Setpoint, then a Hi Voltage alarm will be generated and the unit will be locked out. Voltage sensors are specified in the General Information panel under the MAG V8 screen.
197	LEAD Procom (Only HVAC)	If zero, then rotation of the process pumps will occur whenever the lead process pump is turned off. If no rotation has occurred during the current day, a forced rotation at midnight will occur. If non-zero, then process pumps rotation is inactive and this value will specify the lead process pump.
	COND LOW AMB (Only CENT)	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.
198	PROC PUMP FLT. (Only HVAC)	If active, the Magnum checks for process pump failure. The process pump sensor reading is ON (Digital).
199	MOP TARG PSI (Only HVAC)	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 (Only HVAC)	Added to and subtracted from Setpoint #199 to develop the upper and lower limits of the MOP control zone.

#	Name	Description
201	MOP ADJ % TME (Only HVAC)	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.
	LOW SI OFF (Only CENT)	FEATURE NOT YET AVAILABLE 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.
202	DELTA TEMP EVP (Only HVAC)	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.
	HI SI OFF (Only CENT)	FEATURE NOT YET AVAILABLE 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.
203	HiSuctSheat (Only HVAC)	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 (Only HVAC)	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.
	SurgeHldDlay (Only CENT)	The time in minutes to remain in a surge increase hold state after the occurrence of a surge. The surge counter will be reset with each new surge. When the surge counter exceeds this value the compressor state will move to CMP IS HOLDING state.

#	Name	Description
205	MDP MIN OIL DIFF (Only HVAC)	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.
	SurgeLoadAdj (Only CENT)	The adjustment to increase compressor speed when surging is detected.
206	COND HI AMB	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	UNBAL VOLTS	If active, the average of the voltage sensors is calculated. Each individual voltage sensor is compared to this average and if the difference is greater than the value of this Setpoint, an alarm is generated and the unit is locked out.
208	LOW SI OFF (Only HVAC)	FEATURE NOT YET AVAILABLE 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.

#	Name	Description
209	HI SI OFF (Only HVAC) (HVAC 08.02E1 or Greater Formerly #140)	FEATURE NOT YET AVAILABLE 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.
	COMP SURGING (Only CENT) (HVAC 08.02E1 or Greater Formerly #141)	The number of surges allowed before a safety trip occurs. Surges can either come in the form of sudden amperage or lift changes. The amp draw rate of change difference for the compressor is recorded over a period of time, not to exceed 60 seconds. When change exceeds the value in Setpoint #210 "AMP SurgeROC", it is counted as a surge. This rate of change difference can be either a positive or negative value. The lift pressure rate of change is the difference between discharge and suction pressure for the compressor recorded over a period of time, not to exceed 60 seconds. When change exceeds the value in Setpoint #211 "LiftSurgeROC", it is counted as a surge. This rate of change difference can be either a positive or negative value.
210	ECO LL3 D-SHT (Only HVAC)	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.
	AMP SurgeROC (Only CENT)	Refer to Setpoint #209 "COMP SURGING".
211	NO OIL FLOW (Only HVAC)	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.
	LiftSurgeROC (Only CENT)	Refer to Setpoint #209 "COMP SURGING".
212	COMP SPD FLT (Only HVAC)	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.
	SurgingCount (Only CENT)	This Setpoint is used to take preventive action to avoid a safety trip from excess surges. If the number surges exceed this value within the time in seconds of Setpoint #213 "SurgingTime", then the compressor speed will increase and the vain will close and the compressor state will change to UNIT LOADING-VFD.
213	PROC LOW FLOW (Only HVAC)	If active and process pump differ. is less than this Setpoint, then a safety trip occurs.
	SurgingTime (Only CENT)	Refer to Setpoint #212 "SurgingCount".

#	Name	Description
214	NO OIL FLOW (Only CENT)	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.
215	COMP SPD FLT (Only CENT)	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. 'SEC to Ignore Safety' field: delay before adjusting the EXV on TurboCor compressors on a common suction group, allowing the system to stabilize before making an adjustment.
216	LIS MOTOR TEMP	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 set point then the LIS is OFF. 'Time (sec)' field: Offset of motor temperature to turn LIS OFF.
	CLLC LEVEL TRG (Only CENT)	The 'Value' is the target that is to be maintained of the condenser liquid level. The 'Time(sec)' contains the dead band of the target. For example if the value is 60.0 (target) and the 'Time(sec)' field is 5 (dead band) the control zone for the condenser liquid level is between 55.0 and 65.0.

#	Name	Description
217	CLLC VALVE TRG (Only CENT)	The 'Value' is the target or minimum opening of the CLLC control valve. The 'Time(sec)' contains the normal delay between making valve adjustments. This time is expressed in seconds. The 'Sec. to Ignore Safety' contains the delay between making valve adjustments when the CLLC is in a startup mode or the chilled water is not with in its control zone, this is an unstable condition. The 'Window to extend Safety Time(sec)' contains the maximum valve adjustment value. This value has an assumed decimal place; that is a value of 50 will allow a maximum adjustment of 5.0. The actual adjustment will be calculated based upon the valve setting and its desired position. This set point is only used if the AO TYPE of CLLC valve has been selected.
	LOW EXV TARGET (Only HVAC)	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	CLLC MAX ROC (Only CENT)	The 'Value' contains the rate of change that will determine if the condenser liquid level rate of change is moving fast enough.
	OIL REC VENT CYCLE #1	Time on for device #1vent cycle.
219	OIL REC VENT CYCLE #2	Time on for device #2 vent cycle.
220	OIL REC VENT CYCLE #3	Time on for device #3 vent cycle.
221	OIL REC VENT CYCLE #4	Time on for device #4 vent cycle.
222	OIL REC OIL POT CYCLE	Time on for oil pot cycle, common.
223	OIL REC OIL CHARGE CYCLE	Time on for oil charge cycle.
224	OIL REC REPEAT CYCLE	Time delay before repeating cycles.

#	Name	Description
225	CLLC LEVEL TARGET	Condenser Liquid Level Control level target. The safety time is dead band + and -.
226	CLLC VALVE TARGET	'Safety Time' is normal delay between valve adjustments. Time to bypass safety test is delay when in startup or unstable. Time to extend safety time is ADJ % if AO valve.
227	CLLC MAX ROC	Condenser Liquid Level Control max ROC both + & -.
228	Force On Oil Recovery	If active, this Setpoint force compressor ON for oil, if more than 1 compressor in a group is needed then the safety time is delay. The 'Value' is compressor current run time in minutes. The safety time is time between turning on multiple compressors. Time to bypass or extend safety time is not used. The max adj is time that a compressor is in ON OIL RECOVERY state. Extend safety test time is on time to force off ready compressor to on.
229	CHK VALVE FLT	If active, when the compressor is off, test the difference between discharge & suction psi. This safety is to determine if a check valve has failed; when triggered an error message with "CHK VALVE FLT" and the circuit that has the problem will be generated and the entire unit will be locked out. Value: The pressure difference. Time (SEC): The safety delay; SEC to Ignore Safety cell contains the time in seconds that the compressor must be off before the safety test is made.
230	MAX DIFF PSI ROC	If active, this Setpoint helps with Low Suction/Unsafe Suction trips in EXV Logic. Value field: Maximum Differential Pressure Rate of Change before forcing a change to the EXV position (Suggested value of 10 PSI). 'Time (sec)' field: Seconds between samples used for calculating the Rate of Change (Suggested value of 15 seconds). 'Safety Down Time(min)' field: Minimum delay between EXV adjustments (Suggested value of 10 seconds). 'Sec. to Ignore Safety' field: Delay after compressor start before adjusting the EXV based on the Maximum Differential Pressure Rate of Change (Suggested value of 300 seconds). 'Window to Extend Safety Time(sec)' field: Adjustment multiplier to the EXV (Suggested value of 1).'Safety Time Extension (sec)' field: Adjustment divisor to the EXV (Suggested value of 20).

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