MICRO CONTROL SYSTEMS

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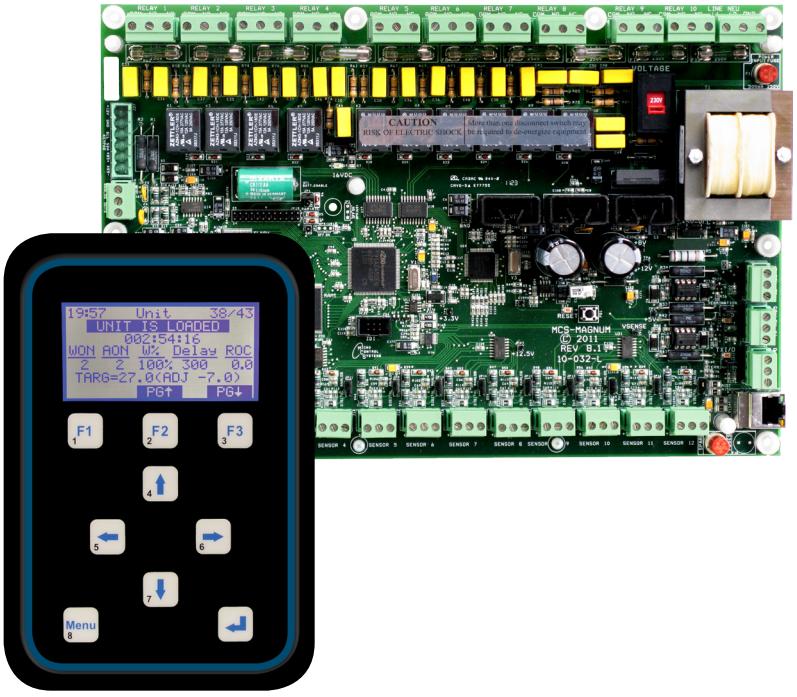
Magnum REFR V9 Manual

Rev. 1.0

Magnum V9 Software



MCS Total Solution for all your Control Needs

Energy Efficient and RoHS Compliant

Revision/Disclaimer Page

Date	Author	Description of Changes
08-10-07	RCT	Manual based upon V8 documention
03-30-15	DEW	New Cover and revsion page

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

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1. Table of Contents

2. Revision Page

Date	Author	Description of Changes
08-10-07	RCT	Manual based upon V8 documentation

3. Introduction to Magnum V9 Software

Magnum V9 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.

3.1. Magnum V9 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 80
- Setpoints 230
- Alarms 100

3.2. Magnum Hardware Supported by Magnum V8 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-I/O (8 RO - 8 SI - 1 AO with I/O 7.00-C with a GAL 5.0 chip)
- MCS-RO8 (8 RO)
- MCS-SI16 (16 SI)
- 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.

3.3. About this Manual

The purpose of this manual is to document MCS's V9 Refrigeration software for the Magnum. This software requires a configuration version #108 (PSR MAG) or #118 (REFR MAG) types 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 V9 Refrigeration 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.

3.4. 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.

3.5. 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.

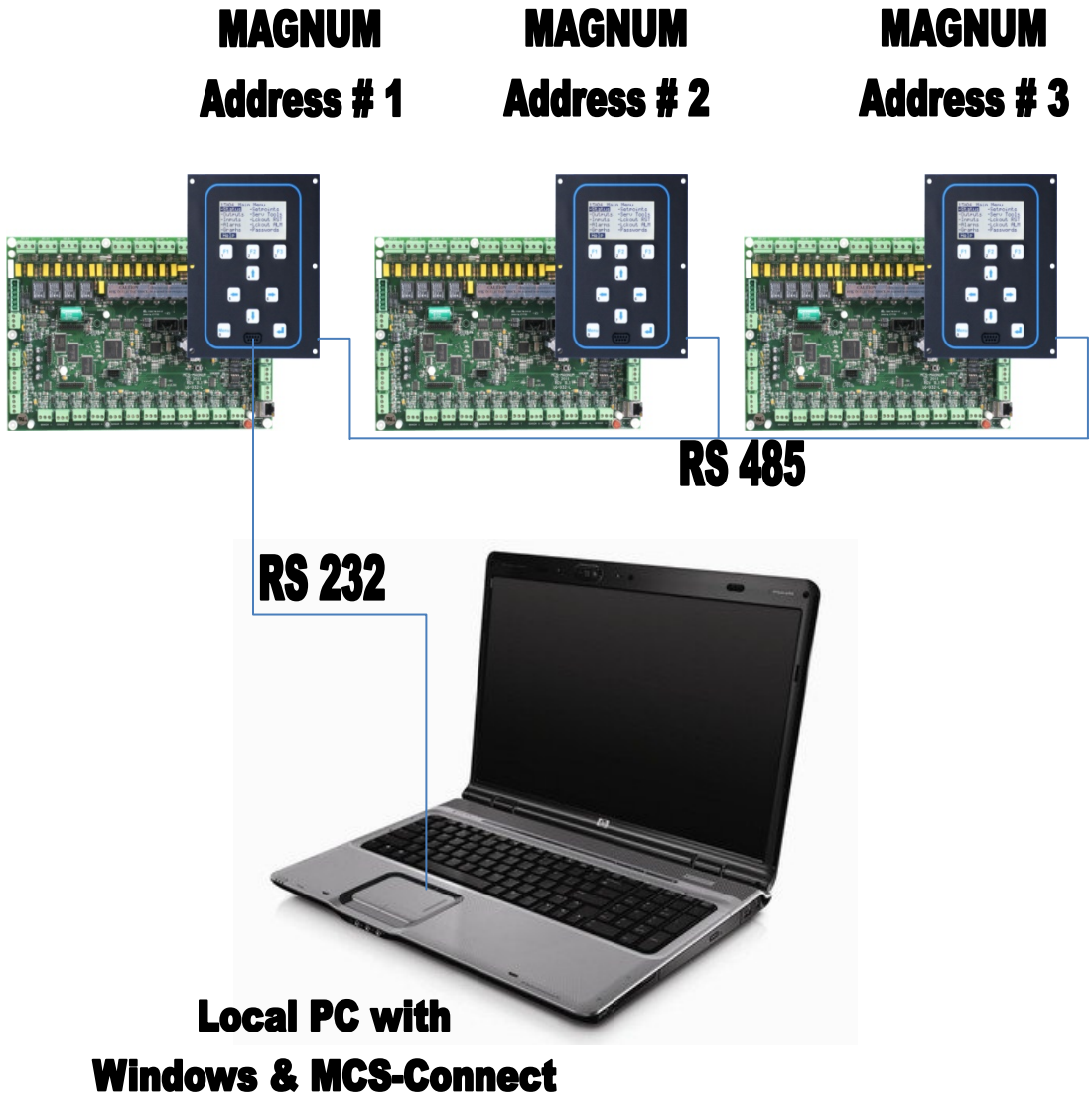
Notes:

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

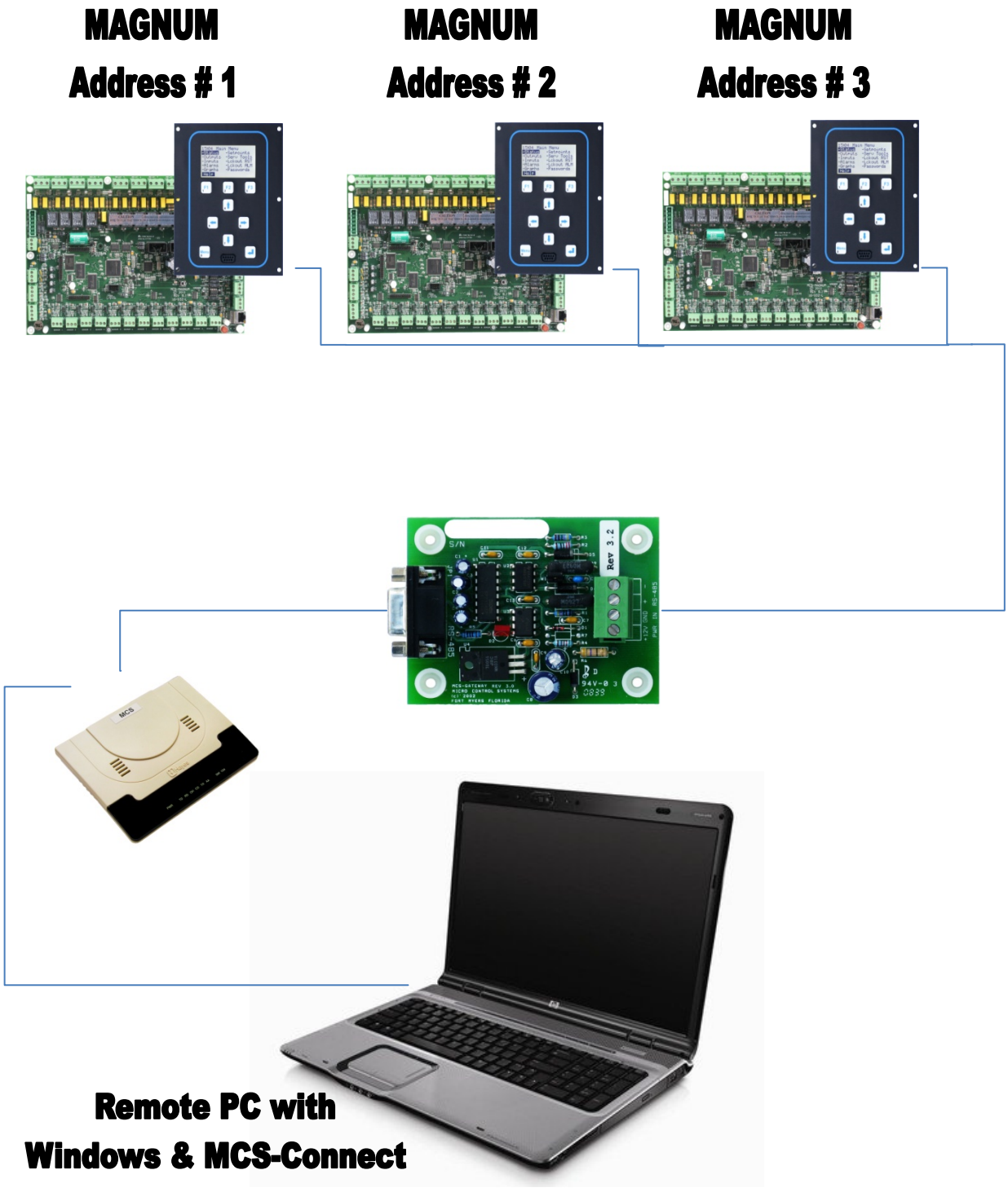
3.6. MCS Ethernet Port

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

3.7. RS485 Network with Local RS232 Communications



3.8. RS485 Network with Remote Modem Communications



3.9. 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.

3.10. Requirements for PC Software

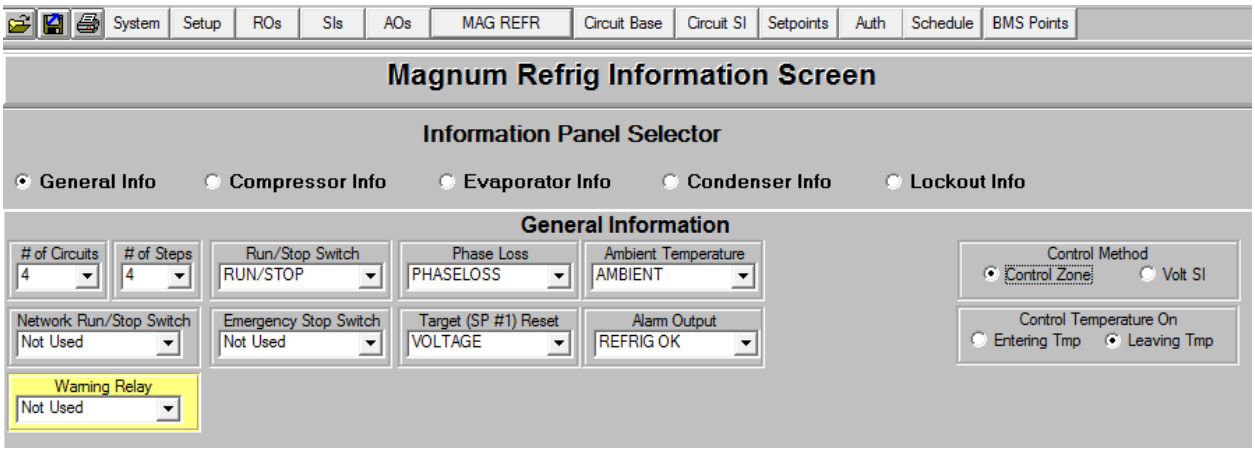
To install and run the program we suggest the following system requirements:

Minimum System Required to Run Program

- Windows 2000 or higher
- Pentium processor
- 20 Gigabyte Available Hard Disk space
- Super VGA Display capable of displaying 256 colors
- 512 Megabytes RAM

4. Magnum Control Zone Control Method Option

This option is selected in the MCS configuration program:



This control strategy is based upon developing a control zone and then to step the compressor(s) through their stages to maintain the control sensor reading within this zone. To accomplish this the system will constantly monitor the control value, its rate of change and position in relationship to the control zone.

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

This option is active in all software and is specified in the MCS-Config program.

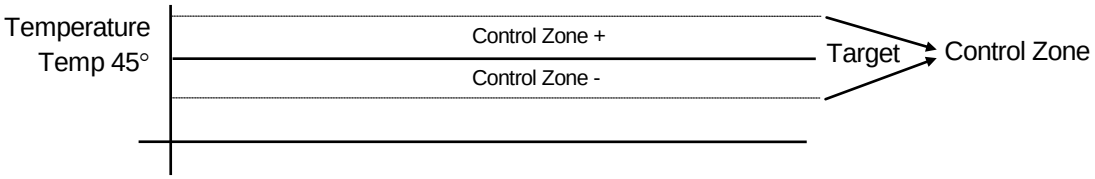
4.1. Common Definitions

4.1.1. Target

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

4.1.2. Control Zone

The control zone is developed by adding the set points for the control target (set point 1) and the dead band + (set point 2) to obtain the upper limit. The lower limit is obtained by subtracting the dead band - (set point 3) set point from the control target (set point 1).



Once the control zone has been established, the system will attempt to keep the control sensor reading with in this range.

4.1.3. Controlling Sensor

This is the sensor that has been specified in the MCS-Config program as providing the control value reading. It will normally be either the entering or leaving temperature or the suction pressure. The set points must be adjusted to agree with the controlling value.

4.1.4. The Rate of Change of the Control Input

The rate of change is how fast the control value is changing over a period of time. If the control value is increasing the rate will be positive, if decreasing the rate will be a negative value. How fast the input is changing, its direction and where the current input reading is in relationship to the control zone will determine what action the system will take.

4.1.5. Step Delay

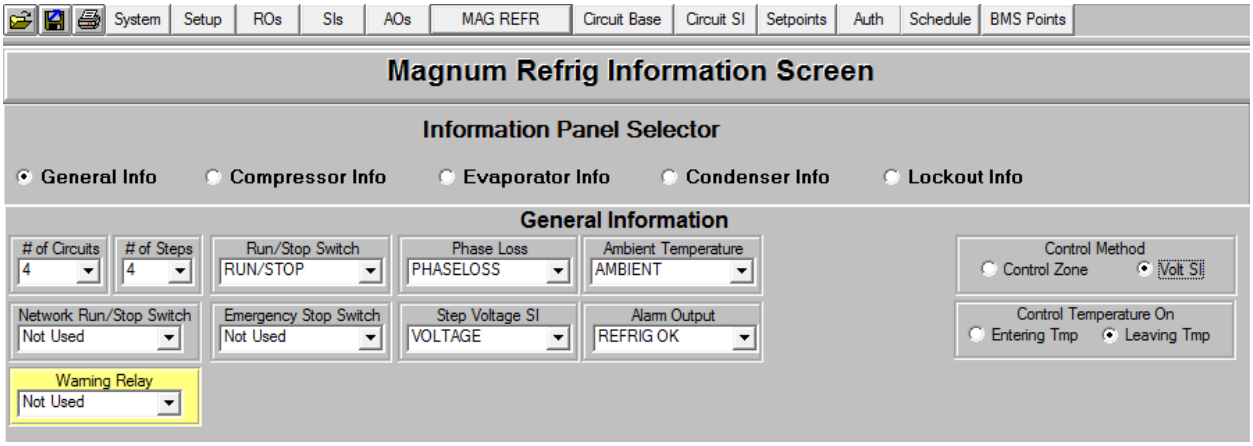
The system will not attempt to take action until the Step Delay reaches zero. Set point 26 contains the initial value. The speed that it is decrement by is based upon the rate of change of control input value and the sensitivity that has been specified.

4.1.6. Sensitivity

The sensitivity value is contained in set point 25. The purpose of the sensitivity value is to limit or dampen how fast the system reacts to changes indicated by the control sensor. The lower the number, the faster the system will react to changes of the control sensor.

5. Magnum Voltage SI Control Method

This option is selected in the MCS Configuration program.



This control strategy is based upon developing a series of cut in (turn on) and cut out (turn off) values for each capacity stage (step) in the system. When a cut in value has been reached or exceeded and the delay time between stages (steps) has been satisfied, the micro will turn on the next stage (step). Conversely, when a cut out value has been reached and the delay time between stages (steps) has been satisfied, the micro will turn off the last stage (step) that was turned on.

5.1. Number of steps supported:

REFR software supports 24 stages of capacity, set points 205 through 229 are used with this option.

5.2. Common Definitions

5.2.1. Targets, Stage Cut In Values

The control targets, stage cut in values, for up to 24 steps of capacity are specified in set points 206 through 229.

5.2.2. Stage Cut Out Values

The stage cut out values for each step of capacity is calculated by subtracting set point 205 from the individual step cut in value.

5.2.3. Step Delay

The step delay is contained in set point 26. This is the minimum time between changes in capacity.

5.2.4. Controlling Sensor

This is the sensor that has been specified in the MCS-Config program as providing the control value. It must be a voltage sensor type. The voltage value is provided by an external system.

6. Standard Variable Step Control Method

This option is specified in the MCS-Config program and is only supported in the REFR software versions.

The system will attempt to keep the control value with in the control zone that has been developed by calculating the required system capacity. The system capacity will be based upon the number of circuits (compressors) that are wanted on. When the first or an addition compressor is turned on, the system capacity will be set to the minimum value as specified in set point #31, MIN SLIDE %. The system will adjust the required capacity between the minimum and the maximum value an as specified in set point #30, MAX SLIDE %. All compressors that are on will be adjusted together to meet the system capacity.

When the maximum capacity value 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 minimum value and the sequence will began again. Once all available compressors are on, their maximum will be 100% regardless of the value in set point #30, MAX SLIDE %.

When the minimum capacity value has been reached, a compressor will be turned off. The number of compressors wanted on will be decreased by one and the system capacity will be set to the maximum value and the sequence will began again.

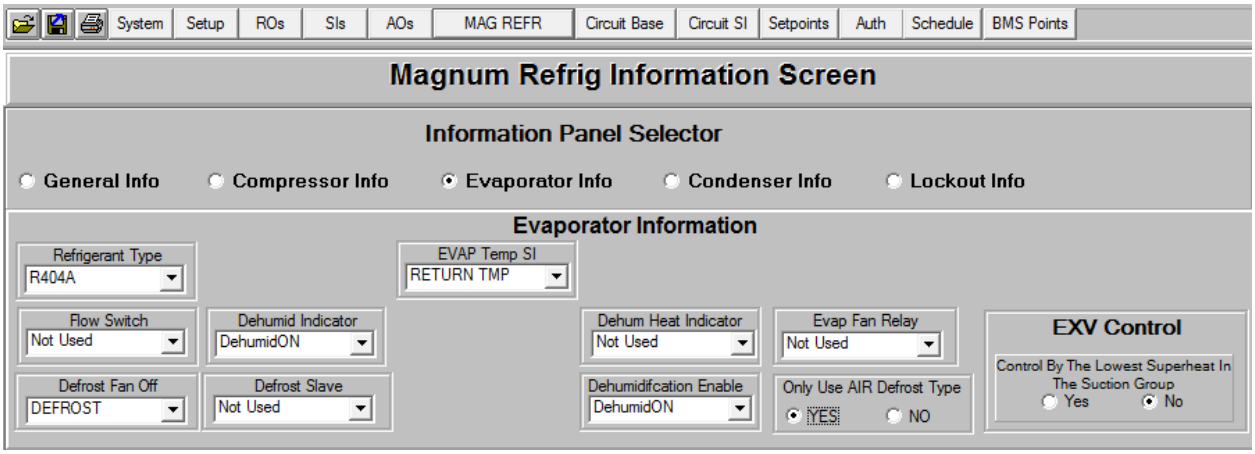
The compressor slide control is based upon the amps drawn of that compressor. For example if set point #31, MIN SLIDE %, is set to 30%, that is 30% of the full load amp for that compressor. An acceptable zone for the amp draw is developed based upon the desired capacity and set points #35 and #36. If the amp drawn is greater than the indicated capacity needed then the compressor is unloaded. Conversely if it is less, then it is loaded.

The compressors that are on are either loaded, their load solenoids are pulsed; unloaded, their unload solenoids are pulsed or are in a hold state, no action is required. The state of each circuit (compressor) reflects this action.

7. REFR Defrost: Rotating Coil Air Defrost

7.1. Rotating Coil Air Defrost Selection:

The Rotating Coil Air Defrost option selection is made in the Evaporator Information section under the MAG REFR button. Selecting YES in the cell labeled “Only Use AIR Defrost Type” activates this option. No other type of defrost will be used with this option. This option will use a time off method of defrosting the individual evaporators with a special hot gas defrost if the evaporator pressure indicates that ice is building on the individual evaporator coils.



Defrost function:
The system will support a normal defrost cycle based upon time and a hot gas defrost as a back up. The goal is to defrost the evaporators based solely on time. This is accomplished by rotating the evaporators. A system with 4 evaporators will be setup with a maximum of 3 on at a time. Initially evaporators 1, 2 & 3 will be turned on, evaporator 1 is the lead when it is time to rotate evaporator 1 will be turned off and 4 will be turned on the lead evaporator will be changed to 2. If the compressor is turned off at this point when the compressor is restarted evaporator 2 will be the lead.

Note the other types of defrost selection cell is not visible. It will become visible if the option NO was selected.

7.2. Rotating Coil Air Defrost: Number of Evaporator Selection:

CIRCUITS						
	Circuit #	# Evap/LLS	Modulating HGB (AO)	Number of Comps	Number of ULS per Compressor	Max Evap/LLS On
▶	1	4	Not Used	1	0	3
	2	4	Not Used	1	0	3
	3	4	Not Used	1	0	3
	4	0	Not Used	0	0	0
	5	0	Not Used	0	0	0
	6	0	Not Used	0	0	0
	7	0	Not Used	0	0	0
	8	0	Not Used	0	0	0

In the CIRCUITS screen under the MAG REFR button the number of evaporators, cell “# Evap/LLS”, and the maximum number that can be on at one time, cell “Max Evap/LLS On” per circuit is specified. There must be one RO per evaporator. A maximum of six evaporator per circuit is supported.

In the above example each circuit has 4 evaporators and only 3 can be on at the same time.

7.3. Rotating Coil Air Defrost: Sequence of operations:

(1) Normal compressor and 3 evaporator solenoids are on.
(2) An air defrost cycle has been initiated. This is based only on time. There has been no ice build up as the evaporator pressure is above the hot gas trigger set point. The lead evaporator is turned off for defrosting and the next available evaporator is turned on. The system will cycle through the evaporators for defrosting as long as there is no ice build up.
(3) Normal compressor and 3 evaporator solenoids are on with the lead moved to evaporator 2.
(4) A hot gas defrost cycle has been initiated. There has been an ice build up indicated by the drop in the evaporator pressure. If there is an available compressor, this compressor will be turned off and the available compressor started. If there is not an available compressor then all compressors will enter a hot gas defrost cycle. All evaporator solenoids are turned off and will remain off through out the hot gas defrost cycle. The hot gas bleed solenoid has been turned on. It will remain on based up set point #148.
(5) Time to turn off hot gas bleed solenoid and turn on the hot gas main solenoid. This will be the situation until the hot gas time has exceeded the time in set point #132.
(6) The hot defrost is complete. The compressor must now be pumped down. Only the compressor is on. The pump down will be terminated based upon time or pressure.
(7) Following the pump down the compressor will be allowed to drip down, all the water drip off of the coils. This time is passed upon set point #132. During this time the compressor will not be ready to be turned on as its state is CMP OFF/D-DOWN. The compressor will then be placed in the CMP OFF/READY state. When the compressor is started evaporator 1 will be the lead.

7.3.1. Defrost is initiated

The normal defrost will be initiated based only upon time.
When the time since the last defrost is equal to the value in set point #145 a defrost cycle will be started.

7.3.2. System has not reached cooling target

The control voltage requesting more than one compressor state to be on indicates this condition.

The lead evaporator’s solenoid will be turned off and the next available evaporator’s solenoid will be turned on. With each defrost cycle the evaporators will be rotated.

7.3.3. System has reached cooling target

The control voltage requesting only one compressor state to be on indicates this condition.

When a defrost cycle is required and if there is an available compressor it will be turned on and the current compressor will be cycled off for defrost. The circuit state will be changed to CMP OFF/DefAIR. When the compressor has been off for the time specified in set point #147, the circuit state will be changed to CMP OFF/READY.

For a compressor to be considered available it must be ready to run and have been off for a minimum time, which will be a set point. If no compressors are available then the individual evaporators will be defrosted.

7.4. Rotating Coil Air: Hot Gas Defrost:

The system will monitor the evaporator pressure to ensure that ice is not building on the coils.

If the evaporator pressure drops below the trigger set point #119 and remands there for the time in set point #137 a hot gas defrost will be started. A message “AIR HOT GAS #x “, the x indicates the compressor, will be generated.

7.4.1. Hot Gas Defrost Sequence of operations system has not reached cooling target:

All evaporator solenoids will be closed, and the hot gas bleed solenoid will be opened. The hot gas bleed solenoid will remain open for the time specified in set point #136.

Once this time has passed the hot gas bleed solenoid will be closed and the hot gas main solenoid will be opened. This solenoid will remain open during the hot gas defrost cycle. The length of the hot gas defrost cycle is specified in set point #146, D-HG TIME.

Once this time has passed the hot gas main solenoid will be closed and the state will be changed to DEF_PUMP DOWN, the compressor is on and the hot gas is being pumped out. The compressor will remain in this state until the suction pressure is less than set point #62 or the time is greater than set point #63.

The state will be changed to DEF-AIR D-DOWN the compressor will be turned off. The length of the drip down is specified in set point #132, DEF DRIP DWN. This will enable all of the water to drip off of the coils.

Once this time has passed the circuit will be returned to normal and the lead evaporator will be 1 and the number of evaporators that are allowed on will be turned on.

7.4.2. System has reached cooling target

The control voltage requesting only one compressor state to be on indicates this condition.

When a defrost cycle is required and if there is an available compressor it will be turned on and the current compressor will be cycled off for defrost. The circuit state will be changed to CMP OFF/DefAIR. When the compressor has been off for the time specified in set point #118, the circuit state will be changed to CMP OFF/READY.

7.4.3. System has reached cooling target and all compressors need a hot gas defrost

A message “AIR HOT GAS #99 “, the 99 indicates that all compressors will run a hot gas cycle.

All compressors will be defrosted at the same time, refer to the hot gas sequence above.

8. REFR Defrost: Other Defrost Types

8.1. Defrost cycle initialization:

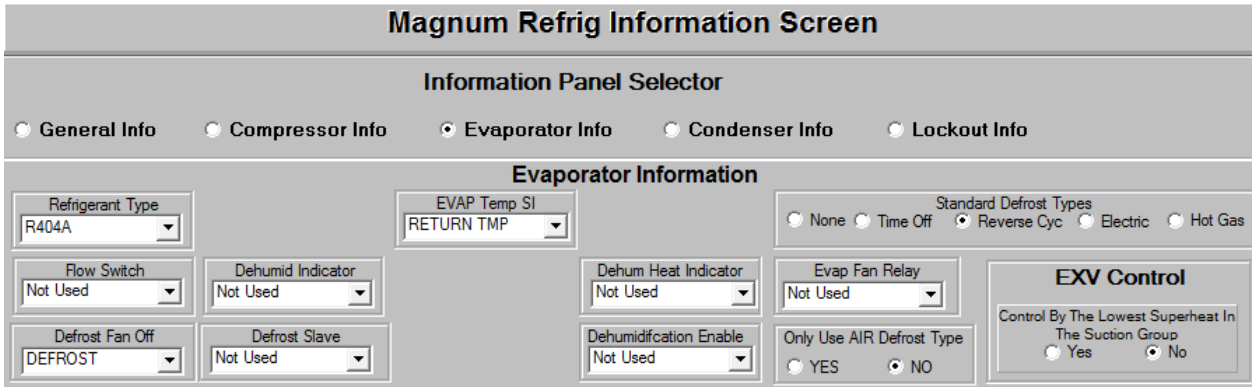
An defrost cycle can be initiated in the following three ways:

1. By the approach set point temperature and time being satisfied,
2. If the compressor accumulated run time exceeding the value in set point #118, or
3. By the Manual Defrost Switch being on. Manual Defrost Switch if it exists must be setup in the Circuits SI grid under the MAG REFR button.

Select Temperature, Referigation and Oil Indicators for Circuits

Circuit # (reset button)	Oil Seal Temp	Oil Float	Leaving Temp	Refrigerant Temp	Refrig Level	Manual Defrost Switch	Evap Suct Temp	Evap Suct PSI
1	Not Used	Not Used	Not Used	Not Used	Not Used	ManDefrost	COIL TMP 1	EVAP PSI 1
2	Not Used	Not Used	Not Used	Not Used	Not Used	ManDefrost	COIL TMP 2	EVAP PSI 2

The system evaporator temperature must be set up in MCS-Config under the MAG REFR button in the Evaporator Information section, cell EVAP Temp SI:



8.1.1. Approach type setup

If the system is in dehumidification mode, then the approach set up will be based upon the **dehumidify** values.

Approach Temperature = set point #127
Defrost Duration = set point #128

If there are two evaporators and set point # 115 is active and value is zero (indicates rotation of the evaporators) then set point #127 will contain the percentage of time allocated to the defrosting of the second evaporator.

If not in dehumidification mode, the defrost approach temperature and defrost duration is established by comparing the system evaporator temperature to set points #118, #121 and #124.

If the system evaporator temperature is greater than #121, DEF MED TEMP, then the approach set up will be based upon the **high** temperature values.

Approach Temperature = set point #119
Defrost Duration = set point #120

If the system evaporator temperature is greater than #124, DEF LOW TEMP but less than #121, DEF MED TEMP, then the approach set up will be based upon the **medium** temperature values.

Approach Temperature = set point #122
Defrost Duration = set point #123

If the system evaporator temperature is less than #124, DEF LOW TEMP, then the approach set up will be based upon the **low** temperature values.

Approach Temperature = set point #125
Defrost Duration = set point #126

The approach values will remain constant for the time specified in set point #131 then they will be reestablished.

These values are displayed in both the MCS-Connect program and on the Magnum screen under status.

MCS-Connect program under the Status tab:

Capacity Control State	Time	Wanted/ Actual	Step Delay	Def. Approach /Def. Time	Rate of Change	Control On	Wanted %
UNIT IS LOADING	00:00:09	2/2	6	20.0F / 00:03:00	0.0	VOLTAGE	100.0

Defrost setup for approach is displayed in column “Def. Approach/Def. Time’.

Magnum under the Status option under the Main Menu, scroll to any of the circuit screens:

```
09:55      CMP #(x)    +5.0v
        CMP OFF/READY
          000:00:42
SST      SSH      SCT      DSH
 38    16.9       97     79.2
APP/TME 20.0/00:03:00
                PG↑          PG↓
```

```
HH:MM                  CIRCUIT                CTL VOLTAGE
                  CURRENT CONTROL STATE
                  TIME IN CURRENT STATE
SAT.SUCT.      SUCT SHEAT      SAT.COND.      DISC HEAT
  TEMP           TEMP            TEMP           TEMP
UNIT'S defrost approach (repeated for each circuit)
                       PAGE UP                PAGE DN
```

NOTE: The approach set point and time (duration) will be displayed for each circuit.

8.1.2. Approach type based circuit evaporator temperature

The actual circuit approach temperature is the calculated as follows:

If an evaporator suction pressure sensor has been specified in the Circuit SI grid

			Select Temperature, Referigation and Oil Indicators for Circuits							
	Circuit # (reset button)		Oil Seal Temp	Oil Float	Leaving Temp	Refrigerant Temp	Refrig Level	Manual Defrost Switch	Evap Suct Temp	Evap Suct PSI
▶	1	...	Not Used	Not Used	Not Used	Not Used	Not Used	ManDefrost	COIL TMP 1	EVAP PSI 1
	2	...	Not Used	Not Used	Not Used	Not Used	Not Used	ManDefrost	COIL TMP 2	EVAP PSI 2

The evaporator suction temperature will be the evaporator suction pressure converted to temperature.

If the evaporator suction pressure sensor has not been specified then the evaporator suction temperature will be the circuit suction pressure plus the value of set point #203, SAT EVAP DIFF which is then converted to temperature..

This value is displayed for each circuit in MCS-Connect under the Status Tab in the column “Evap. Approach/Time”.

State	Time	Oil Diff	Sat. Evap./Lead	Evap. Approach /Time	Evap. Superheat	FLA %	Forced Defrost Delay(118)
1) CMP OFF/READY	00:00:56	75.0P	23.6 / 1	22.4F / 00:00:10	31.4	99	00:08:00
2) CMP OFF/READY	00:00:56	70.0P	27.8 / 1	18.2F / 00:00:10	22.2	99	00:08:00
3)<-- CMP IS AT 100%	00:04:44	70.0P	27.8 / 1	18.2F / 00:00:10	22.2	99	00:06:17

For circuit 1) the 22.4F is the calculated circuit evaporator temperature and time of 00:00:10 is the time that this temperature must be greater than the Defrost Approach temperature. This time is based upon the value of set point #110, DEF ON DELAY. When the compressor is running and the temperature is greater than the

defrost approach temperature this counter will be decremented. If the temperature is less then it will be reset to the value in set point #110.

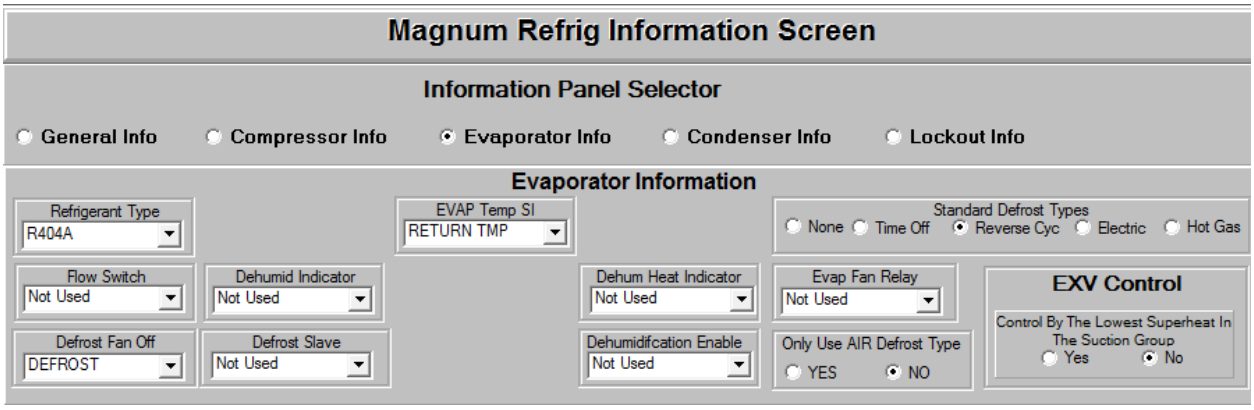
This value is display locally on the Magnum LCD under "Approach".

```
09:55   DEFROST #(X) +5.0V
  FroceDef(118) 01:58:23
EVAP     Approach      Delay
 41.1     50.0          3:00
EVSat    EVSht      E Lead
18.1     87.4           1
                PG↑          PG↓
```

```
HH:MM      DEFROST INFORMATION      CTL VOLTAGE
Time when next forced defrost is scheduled, will decrement
Evap pressure  Approach pressure  Delay for approach
 PSI                PSI        Counter decrementing
Evap Sat.     Evap SHEAT      Evap Lead
  TEMP          TEMP              #
                        PAGE UP                PAGE DN
```

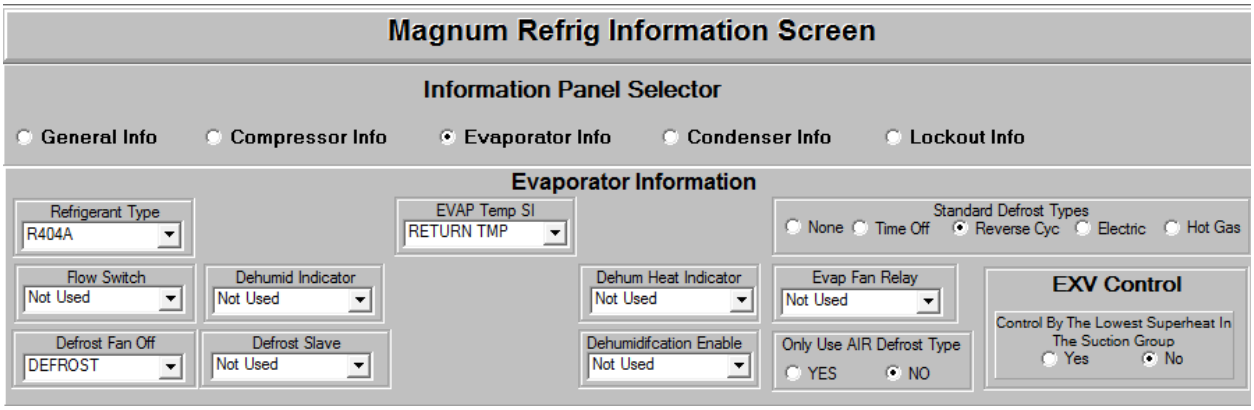
8.2. Defrost Ready Indicator

MAG REFR software will turn on a relay output when the system is getting ready to enter a defrost cycle. This must be setup in the cell "Defrost Slave" Indicator in the Evaporator Information section under the MAG REFR button. If not in defrost this relay output will be off.



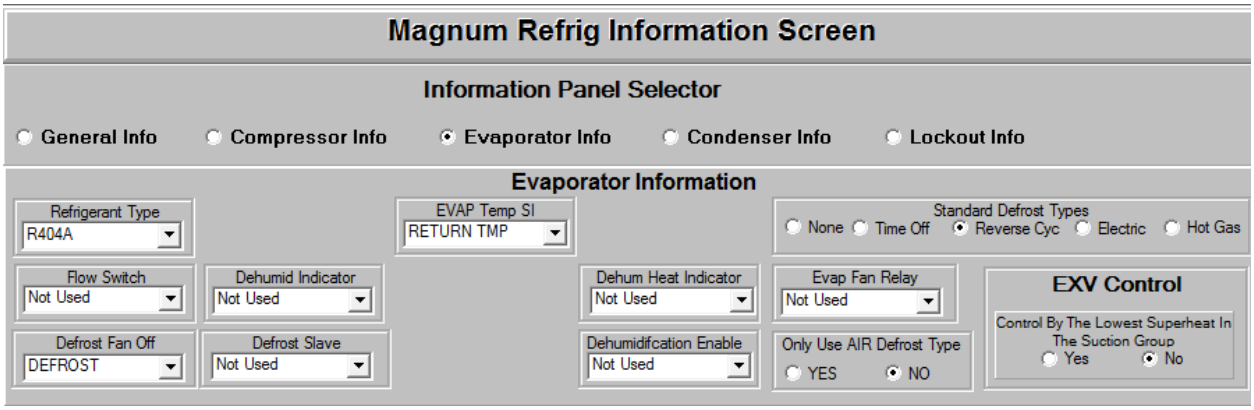
8.3. Defrost Indicator

MAG REFR software will turn on a relay output when the system is in a defrost cycle. This must be setup in the cell "Defrost Fan Off" in the Evaporator Information section under the MAG REFR button. If not in defrost this relay output will be off.



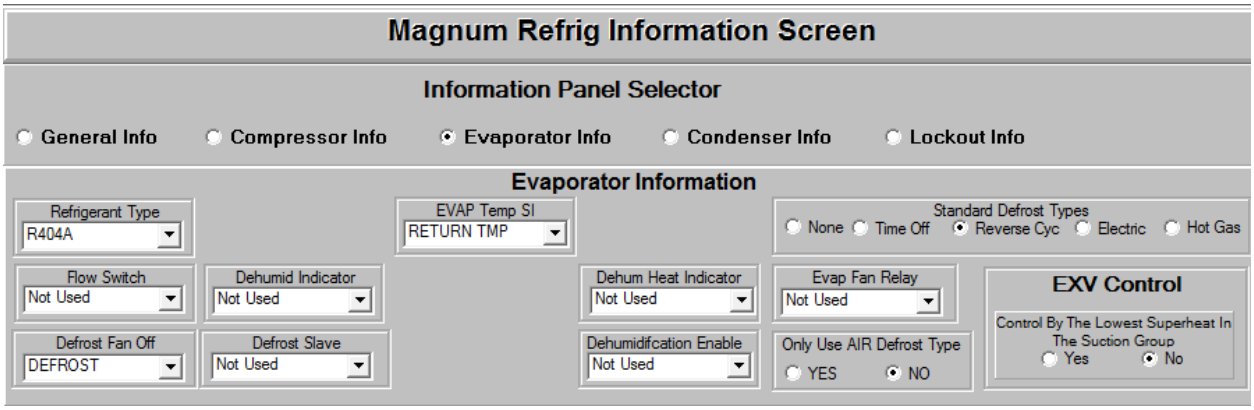
8.4. Defrost Indicator setup

These indicators must be setup in the Evaporator Information Section under the MAG REFR in the MCS-Config program.



8.5. Defrost Types supported:

Defrost Types are selected in the Evaporator Information Section under the MAG REFR in the MCS-Config program. The different types can only be selected if Only Use Air Defrost Type is NO.



8.5.1. None

No defrost is performed. The defrost approach will indicate NO DEF. One liquid line solenoid is require no other defrost relay output points are required.

8.5.2. Hot Gas Conventional (set point #117 active)

This type of defrost requires the circuit to consist of two separate evaporators with a liquid line and a hot gas solenoid for each. A defrost cycle will defrost both evaporators at the same time. When a compressor requires a defrost cycle, that compressor will defrost and all other compressors will be checked if their accumulated run time is greater than the value in set point #130 they will also enter a defrost cycle. If not, the compressor will be turned off until all defrost cycles have been completed. The circuit states will indicate which evaporator is in a defrost mode.

Following table shows the status of the circuit RO's when in various defrost states. The compressor states are not shown. When a defrost cycle begins, the circuit states will move from left to right as indicated below until both evaporators have been defrosted and then the circuit will return to a normal state.

Relay Outputs / Circuit State	DEF-PUMP DOWN	DEFROST COILS
COMPRESSOR	ON	ON
LLS1	OFF	OFF
LLS2	OFF	ON
HG MAIN	OFF	OFF (time in SP #135) then ON
HG DEF1	OFF	ON
HG DEF2	OFF	OFF
HG BLEED	OFF	ON (time in SP #135) then ON if #108 > 0 else OFF

The DEF-PUMP DOWN state can be terminated for the following reasons:

- Time in state exceeds the value of set point #141.
- Suction pressure is equal to or less than value of set point #142.

The DEFROST COILS state can be terminated for the following reasons:

- Time in state exceeds the time indicated by set point #120 if high temperature, or set point #123 if medium temperature, or set point #126 if low temperature or set point #128 if in dehumidify mode.
- Evaporator temperature is equal to or greater than value of set point #143.
- Discharge pressure is equal to or less than value of set point #144.

8.5.3. Hot Gas Defrost on the Fly (set point #117 inactive)

This type of defrost requires the circuit to consist of two separate evaporators with a liquid line and a hot gas solenoid for each. When a defrost cycle is required, the circuit will defrost one evaporator at a time. The circuit states will indicate which evaporator is in a defrost mode.

Following table shows the status of the circuit RO's when in various defrost states. The compressor states are not shown. When a defrost cycle begins, the circuit states will move from left to right as indicated below until both evaporators have been defrosted and then the circuit will return to a normal state.

Relay Outputs	DEFROST EVAP #1	DRIP DOWN 1	DEFROST EVAP #2	DRIP DOWN 2	NORMAL
COMP	ON	ON	ON	ON	ON
LLS1	OFF	OFF	ON	ON	ON
LLS2	ON	ON	OFF	OFF	ON
HG MAIN	OFF (time in SP 108) then ON	OFF	OFF (time in SP 108) then ON	OFF	OFF
HG DEF1	ON	OFF	OFF	OFF	OFF
HG DEF2	OFF	OFF	ON	OFF	OFF
BY PASS	ON (time in SP 108) then ON if 108 > 0 else OFF	OFF	ON (time in SP 108) then ON if 108 > 0 else OFF	OFF	OFF

8.5.4. Electric

This type of defrost requires the circuit to consist of one evaporators with one liquid line and electric heat relay per circuit. When a defrost cycle is required, the system will turn off the compressor. The circuit states will indicate which evaporator is in a defrost mode. The electric heat relay will be turned on when the state is in DEFROST COILS.

Following table shows the status of the circuit RO's when in various defrost states.

Relay Outputs	DEF-PUMP DOWN (1)	DEFROST COILS (2)	DRIP DOWN 1 (3)	NORMAL
COMP	ON	OFF	ON	ON
LLS1	OFF	OFF	ON	ON
ECLECTRIC	OFF	ON	OFF	OFF

(2) Circuit will remain in this state, DEF-PUMP DOWN, until either the suction pressure is less than value in set point #142 or the time is greater than set point #141. The state will then be set to DEFROST COILS.

(3) Circuit will remain in this state, DEFROST COILS, until either the evaporator temperature is greater than temperature of the approach or the time is greater than the time in the approach. The state will then be DRIP DOWN 1.

(4) Circuit will remain in this state, DRIP DOWN 1, for the time is specified in set point #132. The state will then be OFF and the circuit will return to normal.

8.5.5. Time Off

This type of defrost functions exactly like electric defrost except there is no electric defrost relay to be The Time OFF defrost type functions exactly like electric defrost except there is no electric defrost relay to be turned on.

8.5.6. Reverse Cycle

The Reverse Cycle defrost type is specified for a heat pump type of compressor.

WITH NO DEHUMIDIFICATION

RO's per compressor: Compressor, Liquid Line Solenoid, and Reversing Valve.

The Reversing Valve will be OFF in normal cooling mode and ON in defrost (heating) mode.

The defrost trigger is contained in set point #119, DEF TRIGGER.
The defrost time is contained in set point #120, DEF TIME.

If the evaporator temperature is greater than set point #118, DEF HI TEMP, there is no need to defrost. This will be indicated by the defrost trigger be set to NO DEFROST. A defrost cycle cannot be initiated.

The calculated defrost trigger valve is develop based upon the evaporator suction pressure. This is converted to temperature and subtracted from the evaporator temperature. This value can be seen on the Magnum screen under defrost for each compressor or on the MCS Connect Status screen for each compressor.

The following conditions must be true to enable a defrost cycle:

1. The calculated defrost trigger must be greater than value of set point #119 for the time in set point #120. If at any point the value is less than the in set point #119, the counter will reset.

2. The compressor must be on for a time greater than set point #138.

3. The compressor must have accumulated run since last defrost that is greater than set point #130.

The defrost cycle will be terminated for the standard reasons:
RUN/STOP or Network R/S being off (STOP) or the operating schedules being false or the disable (pump down) indicator being on.

The following table shows the RO status and the circuit states during defrost cycles.

RO's	NORMAL (COOLING)	DEFROST PUMP DOWN	DEFROST COILS	DRIP DOWN	ANTI-CYCLE	OFF/READY
COMP	ON	ON	ON	ON/OFF	OFF	OFF
LLS	ON	OFF	OFF	OFF	OFF	OFF
REV VAL	OFF	ON	ON	ON/OFF	OFF	OFF
Notes	1	2	3	4	5	

Notes:

1. Able to begin a defrost cycle.

2. Pump down will be terminated by suction psi less than set point #142 or time exceeds set point #143.

3. Defrost will be terminated if evap suction temp is above set point #143 or on time set point #120.

4. During the drip down the compress and the reversing valve will be turned of once they have been pumped down. Same criteria as pump down state. Drip down will be terminated based on time, set point #132.

5. Anti-cycle termination is based upon set point #59 or #60.

WITH DEHUMIDIFICATION

RO's per compressor: Compressor, Liquid Line Solenoid, Second Liquid Line Solenoid and Reversing Valve.

The Reversing Valve will be OFF in normal cooling mode and ON in defrost (heating) mode.

The defrost trigger is contained in set point #127, DEF TRIGGER.
The defrost time is contained in set point #128 DEF TIME.

If the evaporator temperature is greater than set point #118, DEF HI TEMP, there is no need to defrost. This will be indicated by the defrost trigger be set to NO DEFROST. A defrost cycle cannot be initiated.

The calculated defrost trigger valve is develop based upon the evaporator suction pressure. This is converted to temperature and subtracted from the evaporator temperature. This value can be seen on the Magnum screen under defrost for each compressor or on the MCS Connect Status screen for each compressor.

The following conditions must be true to enable a defrost cycle:

1. The calculated defrost trigger must be greater than value of set point #119 for the time in set point #127. If at any point the value is less than the in set point #119, the counter will reset.

2. The compressor must be on for a time greater than set point #138.

3. The compressor must have accumulated run since last defrost that is greater than set point #130.

The defrost cycle will be terminated for the standard reasons:
RUN/STOP or Network R/S being off (STOP) or the operating schedules being false or the disable (pump down) indicator being on.

The following table shows the RO status and the circuit states during defrost cycles.

RO's	NORMAL (COOLING)	DEFROST PUMP DOWN	DEFROST COILS	DRIP DOWN	ANTI-CYCLE	OFF/READY
COMP	ON	ON	ON	ON/OFF	OFF	OFF
LLS 1	ON	OFF	OFF	OFF	OFF	OFF

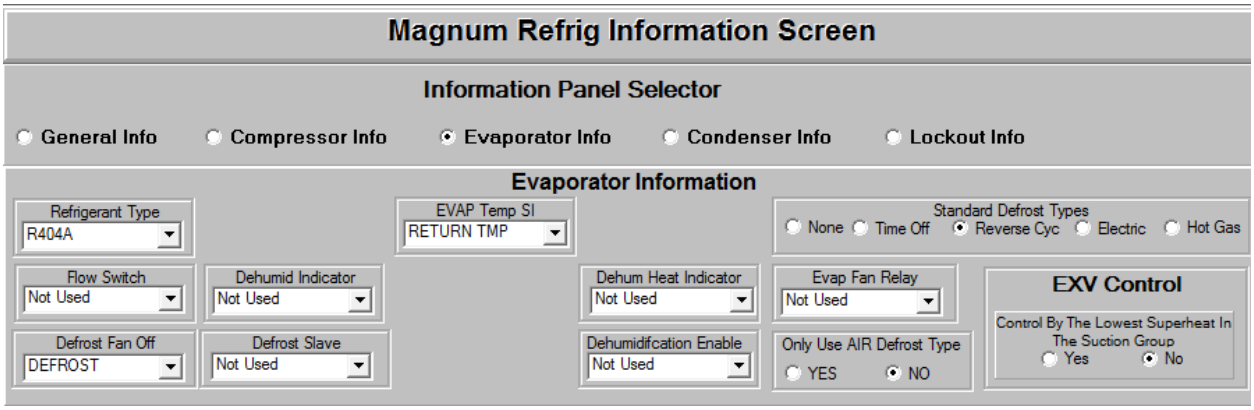
LLS 2	ON	OFF	OFF	OFF	OFF	OFF
REV VAL	OFF	ON	ON	ON/OFF	OFF	OFF
Notes	1	2	3	4	5	

Notes:

1. Able to begin a defrost cycle.
2. Pump down will be terminated by suction psi less than set point #142 or time exceeds set point #143.
3. Defrost will be terminated if evap suction temp is above set point #143 or on time set point #128.
4. During the drip down the compress and the reversing valve will be turned off once they have been pumped down. Same criteria as pump down state. Drip down will be terminated based on time, set point #132.
5. Anti-cycle termination is based upon set point #59 or #60.

8.6. Dehumidify Function:

This function is setup by selecting a sensor input in the cell Dehumidification Enable in the Evaporator Information section under the MAG REFR button.



MAG REFR software will turn on a relay output when the system is in the dehumidification mode. This must be setup in the cell “Dehumidify Indicator” in the Evaporator Information section under the MAG REFR button. If not in dehumidification mode this relay output will be off.

When the Dehumidification Enable sensor is on, the approach temperature and time will be changed to the values in set point #127, DEF DEH APPR for temperature, and set point #128, DEF DEH TIME for time. When is indicator is on, the system will provide only half of its cooling capacity.

8.7. Dehumidify Function with Defrost (no rotation):

Following table shows the status of the circuit RO’s during a defrost cycle (Note, this is with out rotation).

Relay Outputs	NORMAL	DH Mode	DEFROST EVAP#1	DRIP DOWN#1	DEFROST EVAP#2	DRIP DOWN#2
COMP	ON	ON	ON	ON	ON	ON
LLS1	ON	ON	OFF	OFF	ON	ON
LLS2	ON	OFF	ON	ON	OFF	OFF
HG MAIN	OFF	OFF	OFF/ON	OFF	OFF/ON	OFF
HG DEF1	OFF	OFF	ON	OFF	ON	OFF
HG DEF2	OFF	OFF	OFF	OFF	OFF	OFF

HG BLEED	OFF	OFF	ON	OFF	ON	OFF
NOTES;	1	2	3	4	3	4, 5

NOTES:

1. Status when the Dehumidification Enable sensor is OFF.
2. Status when the Dehumidification Enable sensor is ON.
3. Status when all conditions to begin a defrost cycle have been met, this is the first state. When this state is entered the HG MAIN will be off for the time contained in set point #108 then it will be turned on. This state will only be terminated due to the defrost time.
4. This state will only be terminated when the time exceeds set point #105, DEF DRIP DWN.
5. The circuit will return to the DH Mode status.

8.8. Dehumidify Function with Rotation:

If the system is in the dehumidification mode and **set point #115 is active and equal to 0**, then rotation when in defrost will be enabled.

Following table shows the status of the circuit RO's during a defrost cycle (Note, this is with rotation).

Relay Outputs	NORMAL	DH Mode	DEFROST EVAP#1	DRIP DOWN#1	DEFROST EVAP#2	DRIP DOWN#2
COMP	ON	ON	ON	ON	ON	ON
LLS1	ON	ON	OFF	OFF	ON	ON
LLS2	ON	OFF	ON	ON	OFF	OFF
HG MAIN	OFF	OFF	OFF	OFF	OFF	OFF
HG DEF1	OFF	OFF	OFF	OFF	OFF	OFF
HG DEF2	OFF	OFF	OFF	OFF	OFF	OFF
HG BLEED	OFF	OFF	OFF	OFF	OFF	OFF

The defrost states are the same as with out defrost but none of the hot gas solenoids are ever turned on.

8.9. Dehumidify Heating Function

This function is setup by selecting a sensor input in the cell Dehum Heat Indicator in the Evaporator Information section under the MAG REFR button. If this sensor is on and the system is in a DH Mode, additional heat is required by the system.

Following table shows the status of the circuit RO's when in various dehumidification modes.

Relay Outputs	DHH Mode (heat indicator is on)	DH Mode (heat indicator is off)	NORMAL
COMP	ON	ON	ON
LLS1	ON	ON	ON
LLS2	OFF	OFF	ON
HG MAIN	OFF (time in SP108) then ON	OFF	OFF
HG DEF1	OFF	OFF	OFF
HG DEF2	ON	OFF	OFF

HG PASS	ON (time in SP 108) then ON if 109 > 0 else OFF	OFF	OFF

8.10. Common Definitions

8.10.1. How a Defrost Cycle can be initiated (only if air normal defrost)

A defrost cycle can be initiated by the evaporator pressure dropping be low set point #119, this indicates that ice is building up and a hot gas defrost cycle is required. Or the time since the last evaporator's defrost has been passed. Or by the Manual Defrost Switch is on. Manual Defrost Switch if it exists must be setup in the Circuits grid under the MAG REFR button.

8.10.2. How a Defrost Cycle can be initiated (only if not air normal defrost)

A defrost cycle can be initiated by the approach set point temperature and time being satisfied or by the Manual Defrost Switch being on. Manual Defrost Switch if it exists must be setup in the Circuits grid under the MAG REFR button.

8.10.3. Approach Set point Temperature & Time (only if not air normal defrost)

The evaporator temperature (must be setup as the Entering Temperature in the Evaporator Information section under the MAG REFR button in the MCS-Config program) determines which approach values will be used. The approach values can be changed once the time in set point #131, DEF TMP LOCK, has been met.

If this temperature is greater than set point #118, DEF HI TEMP, then no defrost is required. Approach will indicate NO DEF.

If the temperature is less than set point #118 but greater than set point #121, DEF MED TEMP; the approach set point temperature will be set point #119, DEF HI APPR and the time will be set point #120, DEF HI TIME.

If the temperature is less than set point #121 greater than set point #122, DEF LOW TEMP; the approach set point temperature will be set point #122, DEF MED APPR and the time will be set point #123, DEF MED TIME.

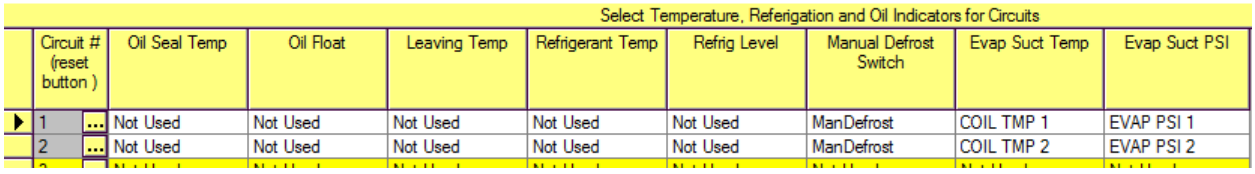
If the temperature is less than set point #124, DEF LOW TEMP; the approach set point temperature will be set point #125, DEF LOW APPR and the time will be set point #126, DEF LOW TIME.

If the dehumidify enable input is on; the approach set point temperature will be set point #127, DEF DEH APPR and the time will be set point #128, DEF DEH TIME. The dehumidify enable input is it exists must be specified in the Evaporator Information section under MAG REFR button in the MCS-Confg program.

8.10.4. Approach Actual Temperature & Time (only if not air normal defrost)

The actual circuit approach temperature is the calculated as follows:

If an evaporator suction pressure sensor has been specified in the Circuit SI grid

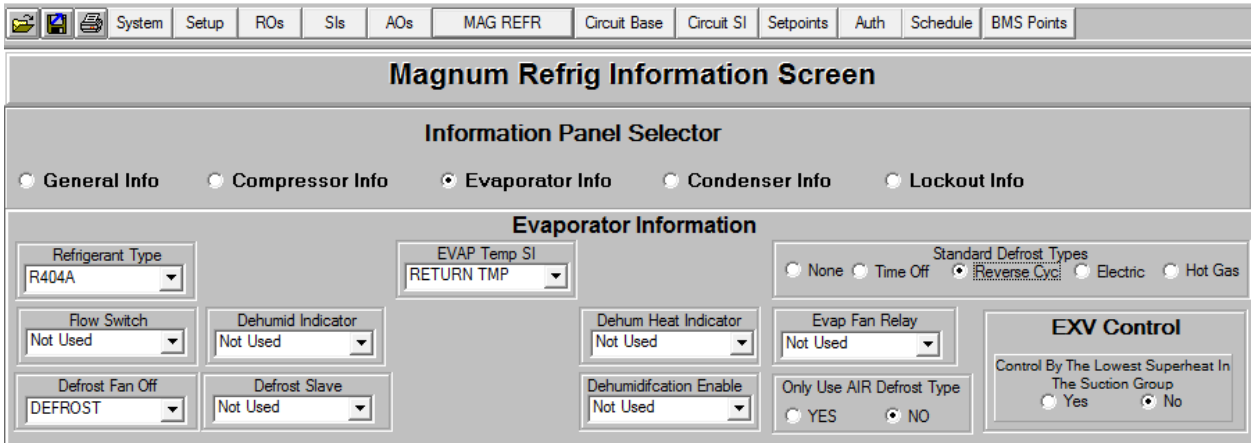


The evaporator suction temperature will be the evaporator suction pressure converted to temperature.

If the evaporator suction pressure sensor has not been specified then the evaporator suction temperature will be the circuit suction pressure plus the value of set point #203, SAT EVAP DIFF which is then converted to temperature..

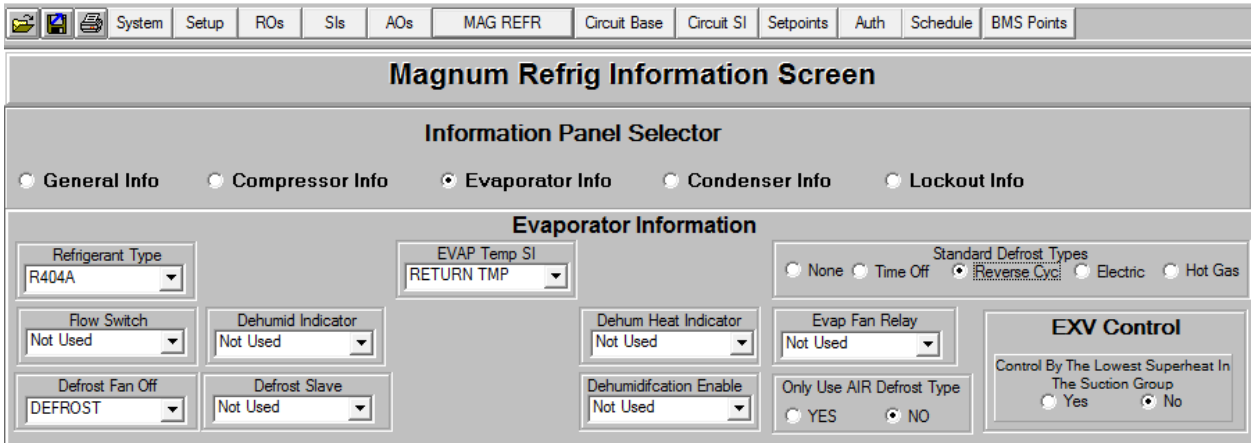
This value is displayed for each circuit in MCS-Connect under the Status Tab in the column “Evap. Approach/Time”.

8.10.5. Defrost Fan Relay



MAG REFR software will turn on a relay output when the system is getting ready to enter a defrost cycle. This must be setup in the cell Defrost Ready Indicator in the Evaporator Information section under the MAG REFR button. If not in defrost this relay output will be off.

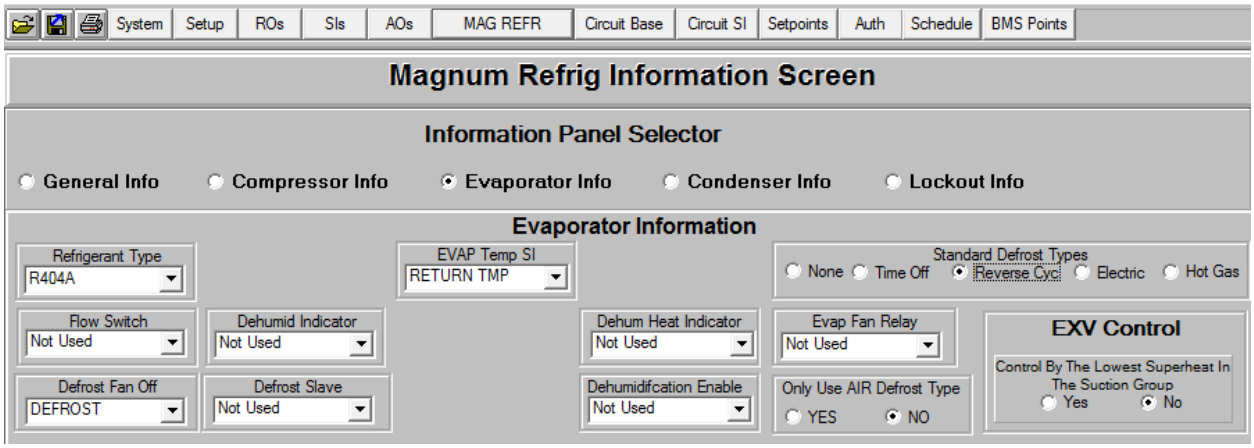
8.10.6. Defrost Slave



MAG REFR software will turn on a relay output when the system is in a defrost cycle. This must be setup in the cell Defrost Indicator in the Evaporator Information section under the MAG REFR button. If not in defrost this relay output will be off.

8.11. Dehumidify Function: (only if air normal defrost)

This function is setup by selecting a sensor input in the cell Dehumidification Enable in the Evaporator Information section under the MAG REFR button. If this sensor is on, the number of evaporators that can be turned on will be limited by set point #116.



8.12. Dehumidify Function: (only if not air normal defrost)

This function is setup by selecting a sensor input in the cell Dehumidification Enable in the Evaporator Information section under the MAG REFR button. If this sensor is on, the approach temperature and time will be changed to the values in set point #127, DEF DEH APPR for temperature, and set point #127, DEF DEH TIME for time. When is indicator is on, the system will provide only half of its cooling capacity.

Following table shows the status of the circuit RO's when in various dehumidification modes.

Relay Outputs	DH Mode	NORMAL
COMP	ON	ON
LLS1	ON	ON
LLS2	OFF	ON
HG MAIN	OFF	OFF
HG DEF1	OFF	OFF
HG DEF2	OFF	OFF
HG PASS	OFF	OFF

8.13. Dehumidify Heating Function (only if not air normal defrost)

This function is setup by selecting a sensor input in the cell Dehum Heat Indicator in the Evaporator Information section under the MAG REFR button. If this sensor is on and the system is in a DH Mode, additional heat is required by the system.

Following table shows the status of the circuit RO's when in various dehumidification modes.

Relay Outputs	DHH Mode (heat indicator is on)	DH Mode (heat indicator is off)	NORMAL
COMP	ON	ON	ON
LLS1	ON	ON	ON
LLS2	OFF	OFF	ON
HG MAIN	OFF (time in SP#135) then ON	OFF	OFF

HG DEF1	OFF	OFF	OFF
HG DEF2	ON	OFF	OFF
HG PASS	ON (time in SP #135) then ON if 136 > 0 else OFF	OFF	OFF

9. Magnum Control States

We should consider the Magnum controller as a state computer, that is, decisions are made based upon set points, 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. To control these functions the states will be divided into three sections:

- **Capacity Control States**
- **Circuit Control States**
- **Condenser Control States**

This information can be viewed form the Magnum's display, see section Magnum Displays or from MCS-Connect, see section MCS-Connect Status.

10. Magnum Displays

10.1. Menu Key

Pressing the 'Menu' key provides the following: The display shows options available.

ACTUAL DISPLAY

```
09:56 Main Menu
-Status        -Setpoints
-Outputs       -Serv Tools
-Inputs        -Lckout RST
-Alarms        -Lckout ALM
-Graphs        -Passwords
Help
```

DESCRIPTION

```
HH:MM      Screen Title
-Control Status Display     -Active set pts Display
-Relay/Analog Display       -Service Tools Display
-Sensor Input Display       -Lockout Reset Display
-Alarm Display              -Lockout Alarm Display
-Graphing Display           -Password Display
Help
```

10.2. Status Display – Chiller (Default at Power Up)

The CURRENT STATE OF THE PACKAGE.

The display shows the current capacity of the package and how long we have been at this level. By pressing the **PG↑** OR **PG↓** you will get additional information on each circuit.

ACTUAL DISPLAY

```
09:55      Unit      +5.0v
     UNIT IS UNLOADED
          025:42;33
WTD  ACT  FLA%  DLY   ROC
 0    0    40%  180   0.0
   CTL ON VOLTAGE   +5.0V
             PG↑       PG↓
```

DESCRIPTION

```
HH:MM              CHILLER UNIT        CTL VOLTAGE
                CURRENT CONTROL STATE
                TIME IN CURRENT STATE
WANTED     ACTUAL     WANTED%    DELAY      SLOPE
#STEPS     #STEPS     ACTUAL%   NEXT CHG   DIRECTION
          INDICATES CONTROL ON VOLTAGE OR TEMP
                    PAGE UP                PAGE DN
```

10.3. Status Display – Circuit (x)

The CURRENT STATE OF A CIRCUIT.

The display shows the current capacity of circuit (x) and how long we have been at this level. By pressing the **PG↑** you will go back to the Chiller state display OR **PG↓** you will get additional information on this circuit.

ACTUAL DISPLAY

```
09:56     CMP #(x)   +5.0v
       CMP OFF/READY
          000:00;30
SUCT   DISC    OPD   MOTOR
 66P   190P    134P    0%
 55F   177F    ----    OK
             PG↑       PG↓
```

DESCRIPTION

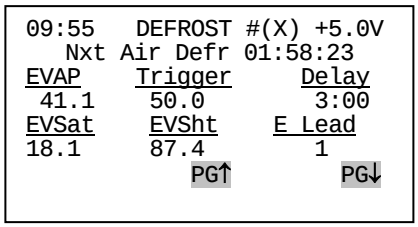
```
HH:MM                CIRCUIT           CTL VOLTAGE
                CURRENT CONTROL STATE
                TIME IN CURRENT STATE
  SUCTION     DISCHARGE    OIL DIFFERENTIAL    MOTOR
 PRESSURE      PRESSURE       PRESSURE         AMP %
TEMPERATURE  TEMPERATURE       ----           STATUS
                    PAGE UP                 PAGE DN
```

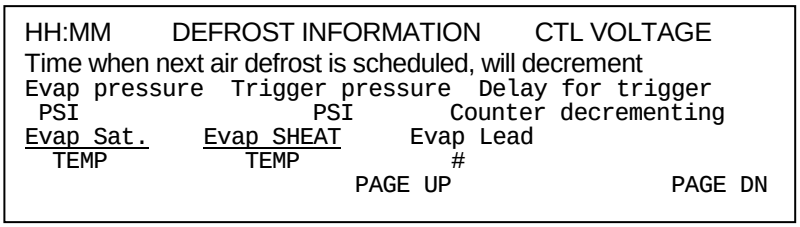
```
09:55     CMP #(x)   +5.0v
       CMP OFF/READY
          000:00:42
SST    SSH    SCT    DSH
 38   16.9     97    79.2

             PG↑       PG↓
```

```
HH:MM                CIRCUIT           CTL VOLTAGE
                CURRENT CONTROL STATE
                TIME IN CURRENT STATE
SAT.SUCT.    SUCT SHEAT     SAT.COND.     DISC HEAT
  TEMP         TEMP           TEMP          TEMP

                    PAGE UP                 PAGE DN
```



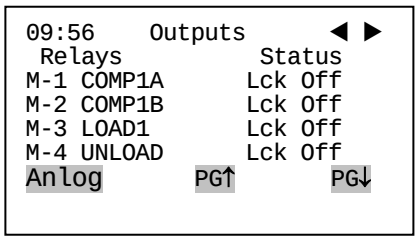


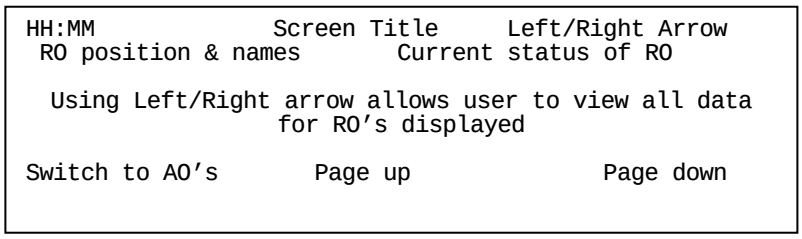
By pressing the **PG↑** you will go back to the previous display OR **PG↓** you will get information on the next circuit. After all circuit information is displayed pressing the **PG↓** will return the user to the chiller display.

10.4. Outputs

Selecting the 'Outputs' option provides the following:

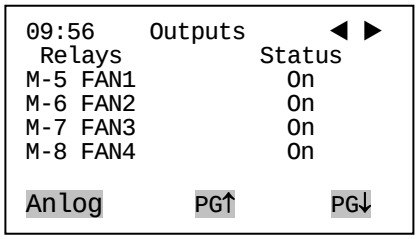
ACTUAL DISPLAY *DESCRIPTION*

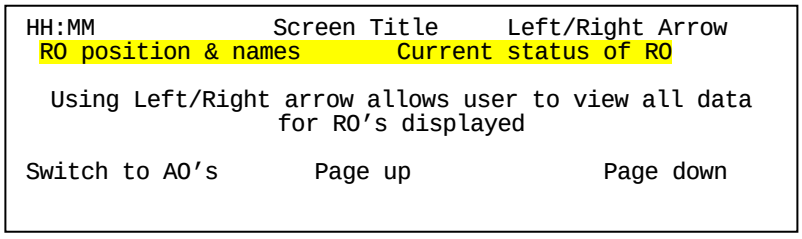




Selecting the Page Down option provides the following:

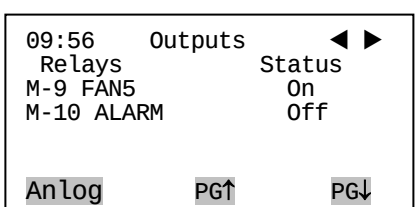
ACTUAL DISPLAY *DESCRIPTION*

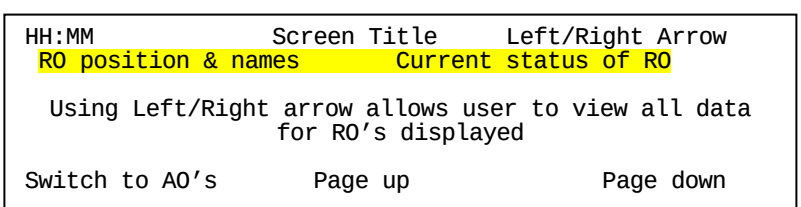




Selecting the Page Down option provides the following:

ACTUAL DISPLAY *DESCRIPTION*





10.5. Inputs

Selecting the 'Inputs' option provides the following:

ACTUAL DISPLAY

```
09:56    Inputs       ◀ ▶
 Sensor           Value
M-1 SUCT1         66.0P
M-2 DISC1        121.3P
M-3 AMPS1          0.0A
M-4 SUCTTMP1      52.3F
            PG↑         PG↓
```

DESCRIPTION

```
HH:MM             Screen Title     Left/Right Arrow
 SI position & names       Current status of SI

 Using Left/Right arrow allows user to view all data
                  for SI's displayed

                     Page up              Page down
```

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56    Inputs       ◀ ▶
 Sensor           Value
M-1 SUCT1        44.0P Man
M-2 DISC1       222.0P Man
M-3 AMPS1        98.0A Man
M-4 SUCTTMP1     33.0F Man

Anlog       PG↑       PG↓
```

DESCRIPTION

```
HH:MM             Screen Title     Left/Right Arrow
 SI position & names       Current status of SI

  Using Left/Right arrow allows user to view all data
                  for SI's displayed

Switch to AO's       Page up              Page down
```

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56    Inputs       ◀ ▶
 Sensor           Value
M-5 DISCTMP1    177.0F Man
M-6 MOTFLT1         NO Man
M-7 PUMPDWN1        NO Man
M-8 COMPOIL1    200.0P Man

Anlog       PG↑       PG↓
```

DESCRIPTION

```
HH:MM             Screen Title     Left/Right Arrow
 SI position & names       Current status of SI

  Using Left/Right arrow allows user to view all data
                  for SI's displayed

Switch to AO's       Page up              Page down
```

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56    Inputs       ◀ ▶
 Sensor           Value
M-9 ENT LIQ      35.0F Man
M-10LEV LIQ      25.0F Man
M-11AMBIENT      88.0F Man
M-12FLOW            ON Man

Anlog       PG↑       PG↓
```

DESCRIPTION

```
HH:MM             Screen Title     Left/Right Arrow
 SI position & names       Current status of SI

  Using Left/Right arrow allows user to view all data
                  for SI's displayed

Switch to AO's       Page up              Page down
```

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56    Inputs          ◀ ▶
 Sensor              Value
M-13RUN/STOP        RUN Man
M-14PHASLOSS         NO Man


Anlog          PG↑          PG↓
```

DESCRIPTION

```
HH:MM              Screen Title      Left/Right Arrow
 SI position & names        Current status of SI

  Using Left/Right arrow allows user to view all data
                    for SI's displayed

Switch to AO's        Page up               Page down
```

10.6. Alarms

Selecting the 'Alarms' option provides the following:

ACTUAL DISPLAY

```
09:56    Alarms
 1 LOST RO COMM       #2
      JUL 04   12:09:16
 2 LOST RO COMM       #1
      JUL 04   12:09:16

             PG↑          PG↓
```

DESCRIPTION

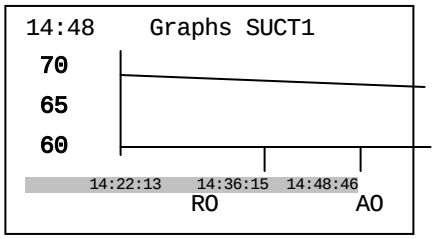
```
HH:MM               Screen Title
1st Alarm #          Alarm Title          Unit Number
             Alarm Date & Time of 1st alarm
2nd Alarm #          Alarm Title          Unit Number
             Alarm Date & Time of 2nd alarm

                       Page up               Page down
```

10.7. Graphs

Selecting the 'Alarms' option provides the following:

ACTUAL DISPLAY



DESCRIPTION

```
HH:MM         Screen Title  Sensor Name

 The graph has the last 25 samples with an appropriate
   scale to allow it to fit on the display. Using the
    up/down arrows will plot sensors before or after.
                Switched to RO's   Switches to AO's
```

10.8. Set points

Selecting the 'Set points' option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints          ◀ ▶
   Name                Value
 1 LEV TARGET           27.0P
 2 CTRL ZONE+            0.5P
 3 CTRL ZONE-            0.0P
 9 SUPERHT TARG         12.5F
             PG↑          PG↓
```

DESCRIPTION

```
HH:MM         Screen Title          Left/Right Arrow

The Level Target is the targeted value.  The Control Zone + creates the top
of the control zone. The Control Zone –creates the bottom of the control
zone.  The Superheat Target is the target value the system will maintain.
Use left/right arrows to see time and type.
                              Page up               Page down
```

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints          ◀ ▶
   Name                Value
 10 SPRHT ZONE+-         2.5F
 11 EXV LOAD ADJ         0.5%
 12 EXV FINE ADJ         0.1%
 13 EXV COURSE           0.5%
            PG↑           PG↓
```

DESCRIPTION

HH:MM Screen Title Left/Right Arrow

This set point defines the width of each control zone. EXV load adjustments are made in response to a load or unload slide adjustment. EXV fine adjustments are made when in the 1st zone above or below the control zone. The EXV course adjustment is made when in the 2nd zone above or below the control zone. Use left/right arrows to see time and type.

Page up Page down

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints          ◀ ▶
   Name                Value
 14 EXV LOAD DIV           3
 15 EXV MIN %           10.0%
 16 EXV MAX %           50.0%
 17 LO SUPERHEAT         2.0F
            PG↑           PG↓
```

DESCRIPTION

HH:MM Screen Title Left/Right Arrow

EXV Load Division: Max slide% – min slide% / Max vlv% - min vlv%) +1. Minimum valve position allowed when modulating the expansion valve. Maximum position allowed when modulating the expansion valve. Low Superheat value before alarm is generated. Use left/right arrows to see time and type.

Page up Page down

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints          ◀ ▶
   Name                Value
 18 LOSUCTPSIDLY          30s
 19 EXV DELAY             60s
 20 EXV STRT TME           5s
 23 POWERUP DLAY          30s
            PG↑           PG↓
```

DESCRIPTION

HH:MM Screen Title Left/Right Arrow

Delay in seconds when in Low Suction PSI Opening. Delay in seconds between valve adjustments. Time in seconds to hold the valve at the start % set point when the compressor starts. Delay in seconds to power up. Use left/right arrows to see time and type.

Page up Page down

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints          ◀ ▶
   Name                Value
 25 STEP SENSIT            1
 26 STEP DELAY           300s
 27 MAX ROC-            -0.6P
 28 MAX ROC+             0.6p
            PG↑           PG↓
```

DESCRIPTION

HH:MM Screen Title Left/Right Arrow

This value is used to adjust the speed of responding to changes in the control algorithm. Time delay before increasing or decreasing the number of refrigeration steps. Maximum negative Rate Of Change allowed before stopping the unit from loading. Maximum positive Rate Of Change allowed before stopping the unit from unloading. Use left/right arrows to see time and type.

Page up Page down

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints        ◄ ►
   Name                Value
 29 ROC INTERVAL         30s
 30 MAX SLIDE %       100.0%
 31 MIN SLIDE %        55.0%
 32 MAX ADJUST %        5.0%
            PG↑          PG↓
```

DESCRIPTION

HH:MM Screen Title Left/Right Arrow
Number of seconds between the samples used for calculating the actual Rate Of Change. Maximum slide or speed allowed. Minimum slide or speed allowed. Maximum percentage adjustment change that can be made. Use left/right arrows to see time and type.

Page up Page down

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints        ◄ ►
   Name                Value
 33 MIN ADJUST %        2.0%
 34 SLIDE SENSIT           1
 35 AMP DB HI           5.0A
 36 AMP DB LO           3.0A
            PG↑          PG↓
```

DESCRIPTION

HH:MM Screen Title Left/Right Arrow
Minimum percentage change that can be made. Allows control of the adjustment made to slide wanted percentage. Upper dead band limit to stop pulsing the slide valve. Lower dead band limit to stop pulsing the slide valve. Use left/right arrows to see time and type.

Page up Page down

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints        ◄ ►
   Name                Value
 37 LOAD PULSE             3
 38 UNLOAD PULSE           2
 45 CND STG1 ON        200.0P
 46 CND STG1 OFF       170.0P
            PG↑          PG↓
```

DESCRIPTION

HH:MM Screen Title Left/Right Arrow
Length of time to turn on the slide valve load solenoid. Length of time to turn on the slide valve unloader solenoid. When the discharge pressure is above this value; turns on the first stage of the condenser fans. When the discharge pressure drops below this value turns off the first stage of condenser fans. Use left/right arrows to see time and type.

Page up Page down

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

```
09:56 Setpoints        ◄ ►
   Name                Value
 47 CND DIFF ON         5.0P
 48 CND DIFF OFF        2.0P
 49 CND MIN RUN           1m
 56 PULSE DELAY           4s
            PG↑          PG↓
```

DESCRIPTION

HH:MM Screen Title Left/Right Arrow
Differential PSI to turn on the remaining stages of condenser fans. Differential PSI to turn off the remaining stages of condenser fans. Condenser fan will remain on for at least the amount of minutes specified. The number of seconds between load or unload pulses. Use left/right arrows to see time and type.

Page up Page down

ACTUAL DISPLAY

```
09:56 Setpoints        ◄ ►
   Name                Value
 59 ACYC OFF->ON          60s
 61 PMP DWN OFF        30.0P
 62 PMP DWN DLAY          20s
 63 ACYC ON->ON          120s
            PG↑          PG↓
```

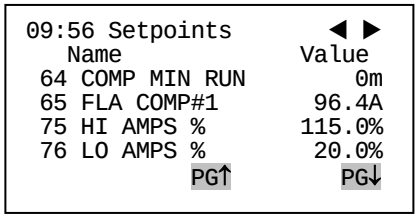
DESCRIPTION

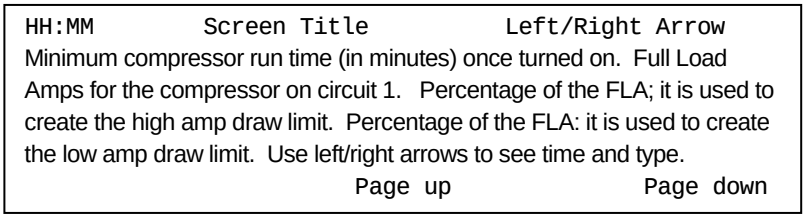
HH:MM Screen Title Left/Right Arrow
Anti cycle time delay (in seconds) based on when the compressor was turned off. Suction pressure value for turning off the compressor when in the PUMP DOWN state. Maximum time delay (in seconds) that a compressor can remain in the PUMP DOWN state. Anti cycle time delay (in seconds) based on when the compressor was turned on. Use left/right arrows to see time and type. Page up Page down

Selecting the Page Down option provides the following:

ACTUAL DISPLAY

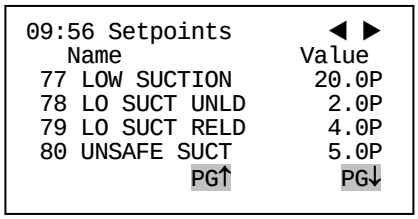
DESCRIPTION

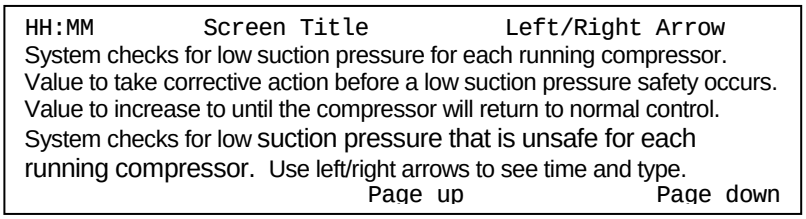




Selecting the Page Down option provides the following:

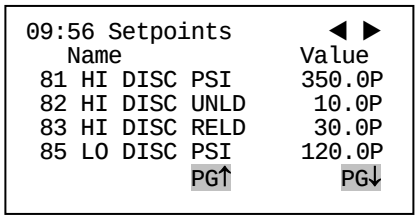
ACTUAL DISPLAY *DESCRIPTION*

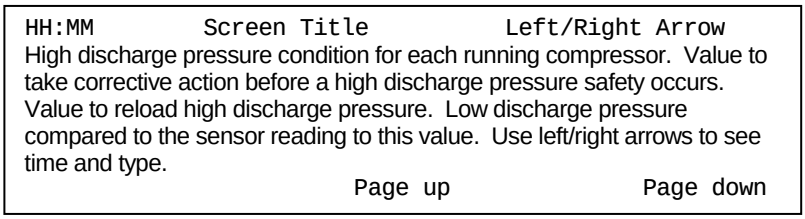




Selecting the Page Down option provides the following:

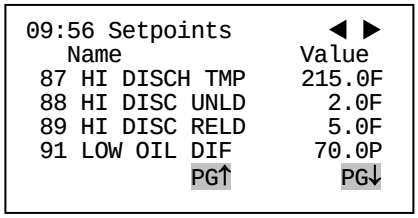
ACTUAL DISPLAY *DESCRIPTION*

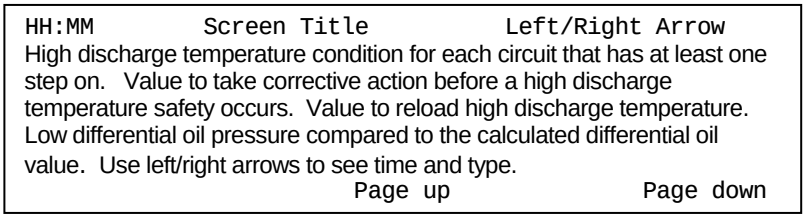




Selecting the Page Down option provides the following:

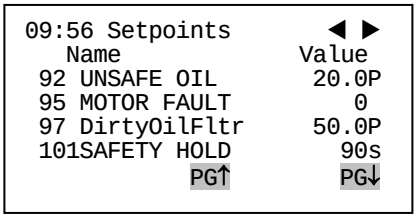
ACTUAL DISPLAY *DESCRIPTION*

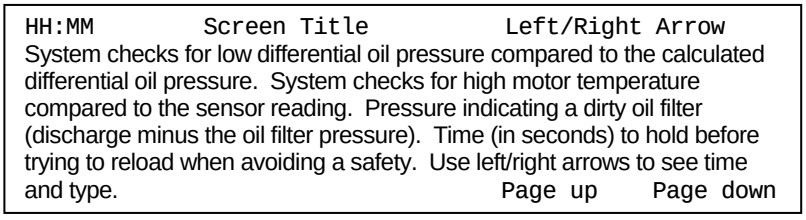




Selecting the Page Down option provides the following:

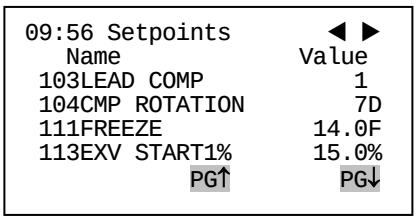
ACTUAL DISPLAY *DESCRIPTION*





Selecting the Page Down option provides the following:

ACTUAL DISPLAY *DESCRIPTION*



HH:MM	Screen Title	Left/Right Arrow

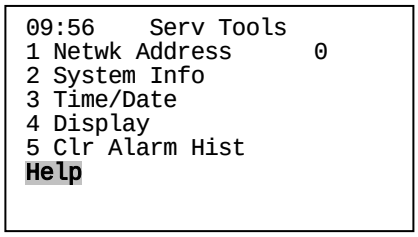
Identifies the lead compressor. Specifies the number of days between rotations. Temperature indicated for freeze protection. Starting % which the valve will be opened to after the pump down state. Use left/right arrows to see time and type.

Page up Page down

10.9. Service Tools

Selecting the 'Service Tools' option provides the following:

ACTUAL DISPLAY	*DESCRIPTION*

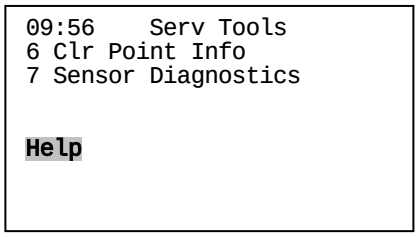


HH:MM	Screen Title

Highlight choice and press enter to access Sub Menu. 1.View network address press enter. 2.View system info (config name, company name, model name) press enter. 3.To change the time or date press enter and use the up/down arrows to adjust. 4.View display settings (contrast, background, backlight) press enter. 5.To clear the alarm history press enter and save.

Pressing the down arrow provides the following:

ACTUAL DISPLAY	*DESCRIPTION*

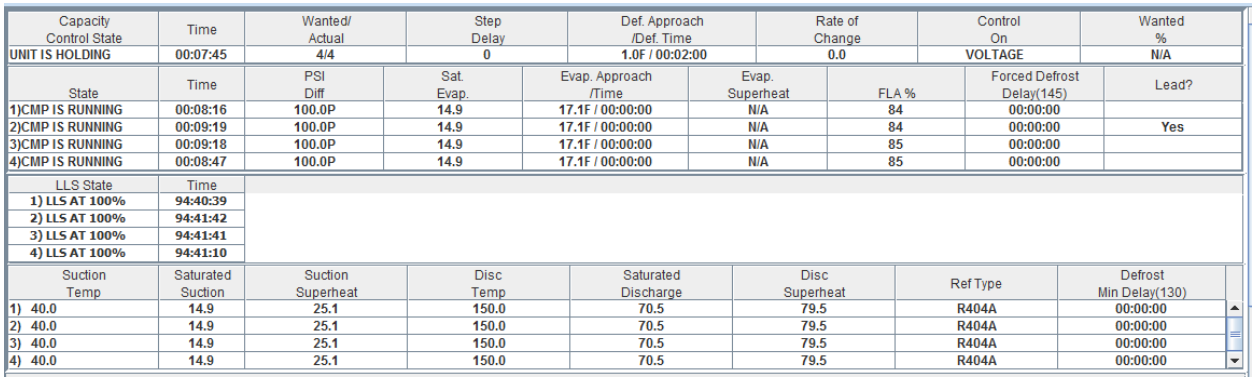


HH:MM	Screen Title

Highlight choice and press enter to access Sub Menu. 6.To clear the point information press enter and save. 7. View sensor values and voltages. Page Up/Down for more sensors. Press the Back button to return to the Service Tools Main Menu.

11. Control Status Display (from the MCS-Connect program)

The status of both the CAPACITY CONTROL STATES and CIRCUIT CONTROL STATES can be viewed from the MCS-Connect program by accessing the CONTROL STATUS key under status screen. The following will be displayed:



Capacity Control State	Time	Wanted/ Actual	Step Delay	Def. Approach /Def. Time	Rate of Change	Control On	Wanted %
UNIT IS HOLDING	00:07:45	4/4	0	1.0F / 00:02:00	0.0	VOLTAGE	N/A

State	Time	PSI Diff	Sat. Evap.	Evap. Approach /Time	Evap. Superheat	FLA %	Forced Defrost Delay(145)	Lead?
1)CMP IS RUNNING	00:08:16	100.0P	14.9	17.1F / 00:00:00	N/A	84	00:00:00	
2)CMP IS RUNNING	00:09:19	100.0P	14.9	17.1F / 00:00:00	N/A	84	00:00:00	Yes
3)CMP IS RUNNING	00:09:18	100.0P	14.9	17.1F / 00:00:00	N/A	85	00:00:00	
4)CMP IS RUNNING	00:08:47	100.0P	14.9	17.1F / 00:00:00	N/A	85	00:00:00	

LLS State	Time
1) LLS AT 100%	94:40:39
2) LLS AT 100%	94:41:42
3) LLS AT 100%	94:41:41
4) LLS AT 100%	94:41:10

Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat	Ref Type	Defrost Min Delay(130)
1) 40.0	14.9	25.1	150.0	70.5	79.5	R404A	00:00:00
2) 40.0	14.9	25.1	150.0	70.5	79.5	R404A	00:00:00
3) 40.0	14.9	25.1	150.0	70.5	79.5	R404A	00:00:00
4) 40.0	14.9	25.1	150.0	70.5	79.5	R404A	00:00:00

Use your arrow keys to access all information (Active circuits will be displayed)

Information displayed:

Chiller information:

- **CAPACITY CONTROL STATE** - State of chiller
- **TIME** - time in that state, if the state is UNIT IN POWER UP time will decrement to zero
- **STEPS WANTED** - Number of steps wanted on
- **/ACTUAL** - actual steps turned on
- **STEP DELAY** – value that is counted down. The sensitivity and where the control temperature is in relationship to the control zone will determine the speed of the count down. When the value decrements to zero, the system will determine if a change in the system's capacity is required.
- **Def. Approach/Def Time –** defrost trigger is the value in of the associated approach set point, if evaporator pressure is below this value the timer will begin to decrement. When it reaches 0, a hot gas defrost will be required.
- **RATE OF CHNG** – Rate of Change of control temperature, the speed at which the control temperature is changing.
- **Control On**– this will indicated either VOLTAGE or TEMPERATURE.
- **Wanted %** – if a screw compressor the value will be the slide wanted.

Circuit information (all active circuits will be displayed):

- **# -** circuit number.
- **STATE** -compressor state.
- **TIME** - time in that state, if the state is CMP ANTICYCLE time will decrement to zero.
- **PSI DIFF** - Oil differential pressure. Oil differential pressure is calculated as follows:
  Hitachi, Hartford, & Hanbell screw compressor:
  Discharge minus Suction Pressure;
  Carlyle screw compressor:
  Discharge minus Oil Pressure;
  NOT a screw and Not a Bitzer screw compressor:
  Oil minus Suction Pressure
  All Others
  Oil minus Discharge Pressure.
- **Sat Evap** – this is the saturation evaporation temperaturer.
- **Evap Trigger / Time** – this is the evaporation pressure / time will decrement when the evaporation pressure is less than the trigger pressure value.
- **EvapSuperheat** – Calculated evaporation SUPERHEAT.

- **FLA %** – reflexes the amp draw of the compressor.
- **Forced Delay (145) Defrost** – this is the time remaining until the next defrost is forced to begin.
- **LEAD** - Yes indicates the lead compressor.

LLS State (status of the liquid line & tandem liquid line if they exist)

- **LLS State-** Status of the LLS.
- **Time-** Time in the state indicated.

Circuit SUPERHEAT information (all active circuits will be displayed):

- **Suction Temp** – Circuit number and current valve of the Suction Temperature, if available.
- **Saturated Suction**– Calculated Suction Saturated Temperature, if available. The Suction Pressure is converted into temperature based upon the type of refrigerant (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. The calculation is Suction Temperature minus the Suction Saturated Temperature.
- **Disc Temp** – Discharge Temperature, if available.
- **Saturated Discharge**– Calculated Discharge Saturated Temperature, if available. The Discharge Pressure is converted into temperature based upon the type of refrigerant (R22, R134a, R407c, And R410a are supported).
- **Disc Superheat** – Calculated Discharge SUPERHEAT, only available if both the Discharge Temperature and the Discharge Pressure are used. The calculation is Discharge Temperature minus the Discharge Saturated Temperature.
- **Refr Type is** –Indicates the type of refrigerant in the system.
- **Defrost Min Delay (130)** –when the circuit is not in defrost this timer will be decremented. It is the minimum time between defrost cycles based upon set point #130.

12. Capacity 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.

Capacity Control States are active for all five releases of software.

12.1. 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 30 seconds. In this state all points (RO's) are turned off. This is a time delay to insure the micro has stable power before turning any points on.

12.2. POWER LOSS DELAY (1)

This state is entered when the Magnum has been powered off for greater than 2 hours. In this state all points (RO's) are turned off. The system will remain in this state for the time specified in set point #23, PWR OFF DLAY.

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

This state will be entered whenever the Magnum loses communications with any of the I/O boards that are connected via the MCS I/O network. When this state is entered the system will generate an MCS I/O off line alarm, which identifies which I/O is off-line and a lost I/O shutdown alarm which locks out the unit. The lockout-reset key must be depressed or reset from MCS-Connect to reset the system, after the lost I/O has been corrected. In this state, all RO's except ALARM RO are turned OFF.

12.4. UNIT IN LOCKOUT (3)

This state is entered whenever a critical situation is encountered that could cause harm to the chiller package. Items such as freeze protect, no flow 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 RO and the oil heater RO for screws with an oil pump are turned OFF & placed in the 'LOCKOUT' state.

12.5. UNIT IS OFF (4)

This state is entered when the system has moved from a STARTUP, DISABLE, LOCKOUT or LOST I/O state. The chiller is now ready to move into an active state to meet the capacity required.

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

12.6. UNIT IS HOLDING (5)

This state is entered when one of three conditions exists:

1) The control sensor reading is being maintained with in the control zone.
2) Control sensor reading is above the control zone but the Rate of Change is less than the value in the (MAX ROC-, #27) set point. 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) set point. 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 add or subtract the cooling capacity of the chiller package. This state will change as capacity requirement changes.

12.7. UNIT UNLOADING (6)

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

12.8. UNIT IS LOADING (7)

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

12.9. NOT USED (8)

12.10. 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 circuit states if active are moved to the CMP IS OFF state through the normal states. One capacity STEP will be moved per second.

12.11. 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 circuit states if active are moved to the CMP IS OFF state through the normal states. One capacity STEP will be moved per second.

12.12. OFF- NO FLOW(s) (11)

This state is entered when the evaporator flow switch is off. When the chiller is in this state, the individual circuit states if active are moved to the CMP IS OFF state through the normal states. One capacity STEP will be moved per second.

12.13. NOT USED (12)

12.14. NOT USED (13)

12.15. NOT USED (14)

12.16. UNIT IS UNLOADED (15)

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

12.17. UNIT IS LOADED (16)

This state is entered when all of the systems available capacity steps are on. The package is providing the maximum amount of cooling capacity.

12.18. NOT USED (17)

12.19. NOT USED (18)

12.20. NOT USED (19)

12.21. DEF-STARTING CMP (20) (only used if not Air Normal Defrost)

This state is entered when a capacity steps has indicated a need for defrosting. The system will remain in this state until the defrosting circuits discharge pressure is less than the value in set point #141, DEF Min PSI or the time in this state is greater than the value in set point #142.

12.22. DEFROSTING COILS (21) (only used if not Air Normal Defrost)

This state is entered when the defrosting circuits discharge pressure is less than the value in set point #139, DEF Min PSI. The system will remain in this state until the defrosting function has been completed.

13. Circuit 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.

Refer to the section in MCS Control States and Relay Output Sequence Quick Reference for the particular software for an overview of which states are active in the various software releases.

The action of the circuit control states actually result in more, less or no change in the amount of cooling capacity. The CAPACITY CONTROL STATES dictate how the individual circuits move within their states.

Following the state name will be an indicator in which software release the state is active:

13.1. LOST IO LOCKED (0)

This state is entered when the Capacity Control State is LOST IO. Lockout reset key will move the circuit to the OFF state. Lockouts can be reset without authorization from the keypad or MCS-Connect program; however if the lockout condition has not been corrected, the circuit will again be forced into the LOCKOUT State.

13.2. CMP LOCKED OUT (1)

This state is entered when the Capacity Control State is LOCK OUT or a safety set point for this circuit has indicated that a critical situation has been encountered. Set points such as (LOW SUCTION #69) or (HI DISCH PSI #73) are examples of safety set points. Lockouts can be reset without authorization from the keypad or MCS-Connect program; however if the lockout condition has not been corrected, the circuit will again be forced into the LOCKOUT State.

13.3. SWITCHED OFF (2)

This state is entered after the circuit has been pumped down due to the pump down switch being on or if the circuit flow switch is off. In this state the compressor, and all related points, plus the liquid line are off. The circuit will not leave this state unless the pump down switch is turned off. If the pump down switch is turned off, the circuit-state will be changed to the OFF State.

13.4. UNLD & PMPDWN (3)

This state is entered whenever the pump down switch has been turned on or if this circuit is no longer wanted on. The compressor is on and the liquid line solenoid is closed. This state is active until the suction pressure reaches the value in the set point 62, PMP DWN OFF or the time has exceeded the value in the set point 63, PMP DWN DELY. The circuit will then move to the ANTICYC State.

13.5. 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 #60 “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.

13.6. 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.

13.7. NOT USED (6)

13.8. NOT USED (7)

13.9. CMP UNLOADED (8)

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

13.10. CMP UNLD STEP1 (9)

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.

13.11. CMP UNLD STEP2 (10)

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.

13.12. 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.

13.13. CMP IS LOADING (12)

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 #35 “LOAD PULSE” and the frequency of the pulse is determined by setpoint #165 “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.

13.14. CMP IS UNLDING (13)

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 #36 “UNLOAD PULSE” and the frequency of the pulse is determined by setpoint #165 “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.

13.15. 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.

13.16. 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 REFR MAG screen.

13.17. LO SUCT UNLOAD (16)

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 REFR MAG screen.

13.18. LO SUCT HOLD (17)

Refer to setpoints #69 “LOW SUCTION”; #70 “LO SUCT UNLD”; and #71 “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.

13.19. HI DISC UNLOAD (18)

Refer to setpoints #73 ”HI DISC PSI”; #74 “HI DISC UNLD”; #75 “HI DISC RELD”; #79 “HI DISC TMP”; #80 “HI DISC UNLD”; #89 “HI DISC RELD”, and #81 “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.

13.20. HI DISC HOLD (19)

Refer to setpoints #73 ”HI DISC PSI”; #74 “HI DISC UNLD”; #75 “HI DISC RELD”; #87 “HI DISC TMP”; #80 “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.

13.21. SAFETY TRIPPED (20)

This state is entered when a safety trips but a lockout is not to be generated. An alarm is generated but the system will restart after the delay specified in the corresponding set point. If a second trip occurs within the time specified in the set point, the circuit will be placed in the CMP LOCK EDOUT State.

13.22. NOT USED (21)

13.23. HI AMP UNLDING (22)

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 #191, “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.

13.24. HI AMP HOLD (23)

Not used with infinite step compressors. This state is entered when a fully loaded circuit, that has more than one step, has encountered a dangerously high AMP draw. Refer to set points numbers 171 through

190 for FLA per circuit and 191 HI AMPS %. In this state, one step of cooling capacity will be turned off. The circuit will remain in this state for a minimum of five minutes before returning to the LOADED State if the dangerous condition has been corrected

13.25. HI DIS TMP HLD (24)

Refer to setpoints #79 “HI DISC TMP”; #80 “HI DISC UNLD”; and #81 “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.

13.26. NOT USED (25)

13.27. NOT USED (26)

13.28. HI WATER HOLD (27)

When the compressor is running and setpoint #78 “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.

13.29. DEFROST EVAP1 (28) (not Rotating Coil Air Defrost Only)

The circuit’s first evaporator is being defrosted. Refer to the section on circuit defrost and to the sequence of operations for the various software versions.

13.30. DRIP DOWN #1 (29) (not Rotating Coil Air Defrost Only)

The circuit’s first evaporator has completed its defrost cycle and moisture is allowed to drip off the coils before cooling begins. Refer to the section on circuit defrost and to the sequence of operations for the various software versions.

13.31. DEFROSTR EVAP2 (30) (not Rotating Coil Air Defrost Only)

The circuit’s second evaporator is being defrosted. Refer to the section on circuit defrost and to the sequence of operations for the various software versions.

13.32. DRIP DOWN #2 (31) (not Rotating Coil Air Defrost Only)

The circuit’s second evaporator has completed its defrost cycle and moisture is allowed to drip off the coils before cooling begins. Refer to the section on circuit defrost and to the sequence of operations for the various software versions.

13.33. DEF-START CMP (32) (not Rotating Coil Air Defrost Only)

Once one of the circuits is ready for defrost: The circuit that is ready to begin a defrost cycle it will then be placed in the DEF-PUMP DOWN state. If the circuit is not ready for a defrost cycle it will be turned off.

13.34. DEF-PUMP DOWN (33)

This state is only used when the defrost type is either Electric or Time Off. In this state the compressor will be on and the liquid line solenoid will be closed. The circuit will remain in this state until the suction pressure is less than the value in set point #62 PMP DWN OFF or the time in set point #63, PMP DWN DELY has been exceeded. The circuit will then be placed in the DEFROST COIL state.

In this state the compressor will be on and the liquid line solenoid will be closed. The circuit will remain in this state until the suction pressure is less than the value in set point #142 DEF PDWN PSI or the time in set point #141, DEF PDWN TIM has been exceeded. The circuit will then be placed in the DEFROST COIL state.

13.35. DEFROST COILS (34) (not Rotating Coil Air Defrost Only)

This state is only used when the defrost type is either Electric or Time Off. In this state the compressor will be off and the liquid line solenoid will be closed. If the defrost type is Electric, the electric defrost relay output will be turned on. The circuit will remain in this state until evaporator temperature is greater than the value in set point indicated by the approach temperature or the time has been exceeded. The circuit will then be placed in the DRIP DOWN #1 state.

In this state the compressor will be off and the liquid line solenoid will be closed. The circuit will remain in this state until evaporator temperature is greater than the value in set point indicated by the approach temperature or the time has been exceeded or the discharge pressure is less than the value in set point #144, DEF TERMIN P. If this is not the last circuit running, the circuit will be turned off. If it is the last circuit running, the circuit will remain on and the system will return to normal operations.

13.36. DEF-AIR NORMAL (35)(only used if Air Normal Defrost)

This state is entered when the defrosting circuit has turned off an evaporator for air defrosting. The system will remain in this state until the defrosting function has been completed.

13.37. DEF-AIR HOTGAS (36) (only used if Air Normal Defrost)

This state is entered when the evaporator pressure has dropped below the trigger indicating that ice has built up on the coils and there is a need for hot gas defrosts. The system will remain in this state until the defrosting function has been completed.

13.38. CMP OFF/D-DOWN (37) (only used if Air Normal Defrost)

This state is entered after the hot gas defrost cycle has been completed include the pump down period. The system will remain in this state for time specified in set point #132, this will complete the defrosting cycle. The state will then be changed to CMP OFF/READY.

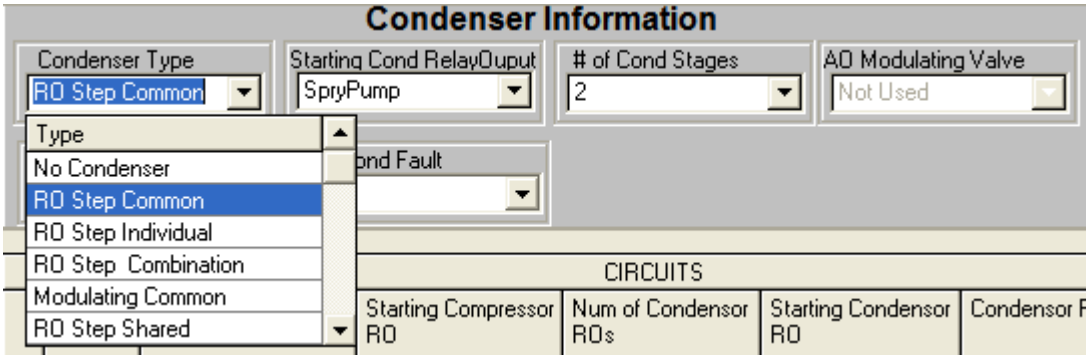
13.39. CMP OFF/DefAIR (38) (only used if Air Normal Defrost)

Only one compressor is on to maintain target temperature. If a defrost is needed either hot gas or air normal, the compressor that is on will be turned off and its state will be CMP OFF/DefAIR for the length of time of the defrost cycle. The next available compressor will be turned on.

14. Condenser Control Logic

14.1. Condenser Type Selection

The type of condenser is selected from a drop down menu by clicking on the Condenser Type cell in the Condenser Information Section of under the MAG REFR button.



14.2. Condenser Introduction

Controls of common condenser, individual condensers per circuit or condensers that are shared between circuits are supported. The type of condenser plus the number of condenser points (RO's) are specified when building the configuration file. The condensers set points are adjusted by the value of set point #140, DEF COND ADJ when a circuit is in defrost. The system supports the following options:

1. **No Condenser** - No condenser specified.
2. **RO Step Common** - If RO Step Common condenser is specified, the highest discharge pressure from any one of the circuits on the system will be the controlling pressure.
3. **RO Step Individual** - If RO Step Individual condenser is specified, each circuit will have one or more condenser points that are associated with that circuit. The discharge pressure on that circuit will be the controlling pressure.
4. **RO Step Combined** - If RO Step Combined condenser is specified, then the highest discharge pressure from any one of the compressors on the shared circuits will be the controlling pressure (circuits 1&2 are shared; circuits 3&4 are shared, circuits 5&6 are shared, and circuits 7&8 are shared).
5. **Modulating Common**- If Modulating Common condenser is specified, the highest discharge pressure from any one of the circuits on the system will be the controlling pressure. A change to the modulating analog output position is calculated every 30 seconds based on the Rate of Change of the controlling discharge pressure.
6. **RO Step Shared-** If RO Step Shared condenser is specified, then the highest discharge pressure from any one of the compressors on the shared circuits will be the controlling pressure are shared.

The system will also support a variable speed fan for all three of the air type of condensers. Each circuit can support a variable speed fan. The variable speed must be on the first condenser point associated with that circuit.

14.3. RO Step Condenser Cut In – Out Logic

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

Setpoint #40 "CND STG1 ON" - Condenser stage 1 Cut In (ON).
Setpoint #41 "CND STG1 OFF" - Condenser stage 1 Cut Out (OFF).
Setpoint #42 "CND DIFF ON" - Cut In differential for additional condenser stages for (ON).

Setpoint #43 “CND DIFF OFF” - Cut Out differential for additional condenser stages (OFF).
Setpoint #44 “CND MIN RUN” - Minimum run time for a condenser stage

Condenser Relay Outputs will be turned on based upon the value in setpoint #40 “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 #42 “CND DIFF ON“. When discharge pressure falls, the condenser outputs will be turned off based upon the setpoint #41 “CND STG1 OFF” plus the value contained in setpoint #43 “CND DIFF OFF”. The first step will be turned off when discharge pressure falls below setpoint #41 “CND STG1 OFF”.

Example:
Setpoint #40 “CND STG1 ON” = 200 psi
Setpoint #41 “CND STG1 OFF” = 170 psi
Setpoint #42 “CND DIFF ON” = 20 psi
Setpoint #43 “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)

14.4. RO Step Condenser with Variable Speed Fan

The setpoints for variable speed fan control are as follows:
Setpoint #50 “CND MIN SPD” - Minimum variable speed allowed.
Setpoint #51 “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.

14.5. Modulating Condenser

The example is of a system with a water condenser. The water valve will be modulated.
The water condenser set points are as follows:
Set point 46 CND VLV TARG - Discharge target pressure
Set point 47 CND VLV DIV - Condenser valve adjustment sensitivity
Set point 48 CND VLV MIN - Condenser valve minimum opening
Set point 49 CND VLV ROC- - Condenser max negative Rate of Change

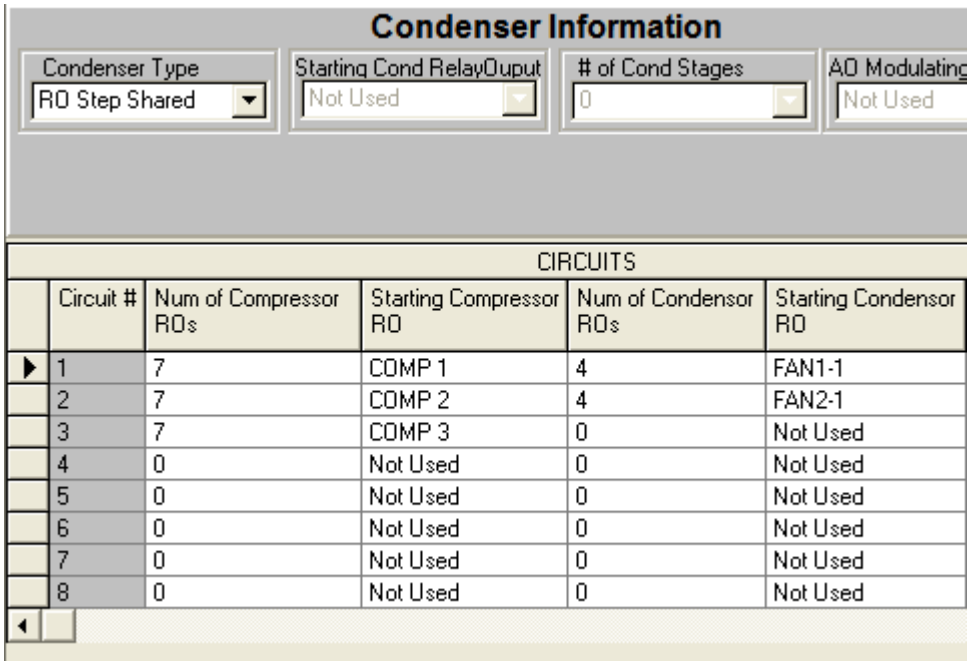
Condenser water valve will be adjusted based upon the Rate of Change of the discharge pressure. The logic is setup to modulate a water valve using the analog output (0 to 10vdc), to maintain the discharge pressure (logic selects the highest discharge pressure from the running circuits).

Example	CND VLV TARG	=	190.0P
	CND VLV DIV	=	1
	CND VLV MIN	=	25%
	CND VLV ROC-	=	-5.0P

14.6. RO Step Shared Example

The RO Step Shared option uses the same control logic as the RO Step Condenser Cut In – Out logic. The controlling suction pressure is based upon the highest of the shared compressors.

This example has two banks of fans and three compressors. COMP 1 and COMP 2 share bank 1 fans. COMP 2 and COMP 3 share bank 2 fans. The compressor with the highest discharge pressure will control the number of fans that are turned on.



Condenser Information

Condenser Type	Starting Cond RelayOuput	# of Cond Stages	AO Modulating
RO Step Shared	Not Used	0	Not Used

CIRCUITS

Circuit #	Num of Compressor ROs	Starting Compressor RO	Num of Condensor ROs	Starting Condensor RO
1	7	COMP 1	4	FAN1-1
2	7	COMP 2	4	FAN2-1
3	7	COMP 3	0	Not Used
4	0	Not Used	0	Not Used
5	0	Not Used	0	Not Used
6	0	Not Used	0	Not Used
7	0	Not Used	0	Not Used
8	0	Not Used	0	Not Used

15. Set point Definitions

15.1. Set point elements that can be viewed:

1) Number - the number is from 1 to 170, maximum number of set points that are supported. Only active set points will be displayed.
2) Name - the set point's name consists of up to 12 alphanumeric characters. The name is displayed following the number on the first line of the LCD display. The name of the set point can be changed to make it meaningful to the given application. **HOWEVER** the function of the set point will remain the same.
3) Value - this is the value or target of a set point. This value is displayed on the second line of the LCD display. With the proper authorization this value can be changed within limits that have been established by the MCS-Config program.
4) Time - this is the time that the set point must be true before it will trip. E.g. a high discharge safety must have its value exceeded for this length of time before it will trip. This time is always in seconds and it is not displayed on the LCD and can only be seen via the MCS-Connect program, it can be changed in both the MCS-Connect and the MCS-Config program.
5) Type - the type indicates the action that will be taken.

A list of set points and all their elements can be obtained from the MCS-Config program.

15.2. Set point Types:

There are three different types of set points. The type determines the action that the system will take.

15.2.1. SETPOINT

This type of set point's value contains a target or provides information for some type of action. The time element in this type is not used.

15.2.2. LOCKOUT

This type of set point's value contains a safety level and the time that the safety must be violated before the safety will trip. Once a safety has tripped the system will take the appropriate action, shutting down the entire package or an individual circuit (compressor) depending on the purpose of the safety. The system will then wait the safety down time contained in that set point before trying to return the system to normal. If successful, the system will continue to operate. If a second trip occurs on the same set point with in the lock out delay time that is contained in that set point 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 will require manual intervention to reset the system. With each safety trip, the system will generate an alarm; refer to Alarms and Safeties section of this manual.

The safety down time and the lock out delay time are unique for each set point. They cannot be viewed in a live unit. They are set in the MCS-Config program.

15.2.3. ALARM

This type is similar to the LOCKOUT set point except it will never cause a lock out. The system will continue to try to return to normal operation after waiting the safety down time. An ALARM set point type will never require manual intervention to reset the system.

16. Set points for MAG REFR V9 Software

#	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 system. 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.
3	CTL ZONE -	Subtracted from the CTL TARGET to create the lower limit of the control zone.
4 ** **not used at this time**	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: If this field is not zero, it is added to setpoint #31 to determine when the hot gas solenoid is to be turned on. If zero, then the value of 2.5 is added.
5 ** **not used at this time**	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: If this field is not zero, it is added to setpoint #31 to determine when the hot gas solenoid is to be turned off. If zero, then the value of 3.0 is added.
6 ** **not used at this time**	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.
7 ** **not used at this time**	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.
8 ** **not used at this time**	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). ‘Time (sec)’ field: If the first liquid injection solenoid has been on for a time greater than this value, then turn on the second liquid injection solenoid.
9	SPRHT TARGET or LEVEL TARGET	If EXV control is based upon superheat, this is the Superheat target that the system will control from. If EXV control is based upon refrigerant level, this is the refrigerant level target that the system will control from. ‘Time (sec)’ field: Seconds between samples used for calculating the Superheat Rate of Change.
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.
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.
12	EXV FINE ADJ	The adjustment is made when in the 1st zone above or below the control zone.

#	Name	Description
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.
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
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.
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.
17	LO SUPERHEAT	If the calculated superheat remains below this value for the time specified, the system will generate a LOW SUPERHEAT alarm. This is the superheat calculated at the compressor.
18	LOWSUCPSI DLY	Delay in seconds when in 'Low Suction PSI Opening' between adjustments to the EXV valve.
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 ** **not used at this time**	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 with both the Magnum Control Zone and Voltage Step 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' section under the MAG V8 tab.
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)

#	Name	Description
30	MAX FLA % or MAX VFD %	Indicates the maximum amp draw or speed allowed. Usually set to 100%, else compressors will load to the value of this setpoint until all steps are on, 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' section under the MAG V8 tab.
31	MIN FLA % or MIN VFD %	Value: Indicates the minimum amp draw 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' section under the MAG V8 tab.
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' section under the MAG V8 tab.
33	MIN ADJUST %	Indicates the minimum percentage change that can be made to the slide valve or the VFD.
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).
35	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 twice the value of setpoint #36 "AMP DB LO".
36	UNLOAD PULSE	Length of time to engage the slide valve unload solenoid in tenths of a second (usually between 1 and 9).
37	LUBE OIL TMP	Safety. If oil seal temperature sensor and this set point is active then when the compressor is running the oil temperature will be checked for a low condition based on the values in this set point.
38 ****	LUBE OIL PSI **not used at this time**	The oil must reach this pressure before the circuit will move out of the LUBE state.
39	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.
40	CND STG1 ON *(Air cooled)*	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' section under the MAG V8 tab.
41	CND STG1 OFF *(Air cooled)*	If stage 1 of condenser capacity is on and the discharge pressure drops below this value, then turn this stage off.
42	CND DIFF ON *(Air cooled)*	Differential pressure added to setpoint #45 to set the threshold at which each additional stage of condenser capacity will turn on.
43	CND DIFF OFF *(Air cooled)*	Differential pressure added to setpoint #46 to set the threshold at which each additional stage of condenser capacity will turn off.

#	Name	Description
	CND DELAY *(Water cooled)*	If active, this is the time in seconds between adjustments to the water valve. If inactive, then 30 seconds will be used as the delay.
	DUAL PSI DELTA *(Dual V8)*	Minimum difference in pressure before the second stage of condenser capacity can be started.
44 **	CND MIN RUN *(Air cooled)*	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 VLV START *(Water cooled)* **not used at this time**	If the valve opening is less than setpoint 52 and this setpoint is active, then make the valve opening equal to this setpoint. This enables the minimum opening to be set at a larger percentage.
45 **	LO AMB COND OFF **not used at this time**	
46	CND VLV TARG *(Water cooled)*	Target discharge pressure which the condenser valve will try to maintain by modulating open or closed.
47	CND VLV DIV *(Water cooled)*	Controls scaling of the amount the valve is adjusted (Usually 1). The larger the number the smaller the valve 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.
48	CND VLV MIN *(Water cooled)*	Minimum valve opening percentage allowed. If the compressor is off, then check the 'Time (sec)' field: If 0, then set the VFD to the value of this setpoint. If 2 and the run/stop is set to run, then set the VFD to 100%, else set the VFD to 0%. This option is selected in in the 'Default Valve Opening % when Comp. is OFF' box in the 'Condenser Information' section under the MAG V8 tab.
49	CND VLV ROC- *(Water cooled)*	Maximum negative discharge pressure rate of change allowed. If the rate of change is less than this setpoint, then stop opening the valve. 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 closing the valve.
50	CND MIN SPD *(Air cooled)*	Minimum speed percentage for variable speed condenser control.
	CND VLV MULT *(Water cooled)*	Allows scaling of the amount the valve is adjusted. The larger the number the larger the valve adjustment will be multiplied by this value.
51	CND MAX SPD *(Air cooled)*	Maximum speed percentage for variable speed condenser control.
52	COND LOW AMB	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.
54	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.
55	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.
56	COND PHASE FLT1	If this set point is active and a digital input has been selected for the Condenser Phase Failure 1 when the compressor is on this digital input will be checked. If the digital input is on for the Time specified for this set point, the circuit will enter a safety state and an alarm will be generated indicating which circuit has the failure.

#	Name	Description
57	COND PHASE FLT2	If this set point is active and a digital input has been selected for the Condenser Phase Failure 2 when the compressor is on this digital input will be checked. If the digital input is on for the Time specified for this set point, the circuit will enter a safety state and an alarm will be generated indicating which circuit has the failure.
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 14.27, Compressor Anti-Cycle Logic (OFF to ON).
60	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 14.27, Compressor Anti-Cycle Logic (ON to ON).
61 ****	PMP CUT IN **not used at this time**	
62	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. 'Time (sec)' field: If non-zero, then the system will bypass the pre-pump down state. This option is selected in the 'Pre-Pump Out' box in the 'Compressor Information' section under the MAG V8 tab.
63	PMP DWN DELY	Maximum time delay (in seconds) that a compressor can remain in the PUMP DOWN or PRE-PUMP down states.
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	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.
66 ****	OIL PUMP OFF **not used at this time**	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.
67	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.
68	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.
69	LOW SUCTION	If active, the system 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.

#	Name	Description
70	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 infinite 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 #90 “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.
71	LOW SUCT RELD	Refer to setpoint #78 description.
72	UNSAFE SUCT	If active, the system 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. 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.
73	HI DISCH PSI	If active, the system 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.
74	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 #73 “HI DISCH PSI” minus the value of this setpoint, then one step of capacity will be turned off. For infinite step compressors: If a compressor has a discharge pressure more than the value of setpoint #73 “HI DISCH 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 #90 “SAFETY HOLD DELAY”. At that time, if the discharge pressure has decreased below than the value of setpoint #73 “HI DISCH PSI” minus the value of setpoint #83 “HI DISC RELD” the compressor will return to normal control.
75	HI DISC RELD	Refer to setpoint #82 description.
76	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.
77	LO DISC PSI	If active, the system 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.
78 ****	HI RETURN TEMP **Not used at this time**	Only active in Mistubishi compressors. If active the system 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.
79	HI DISCH TMP	If active, the system 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.

#	Name	Description
80	DIS TMP UNLD	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 #79 "HI DISCH TMP" minus the value of this setpoint, then one step of capacity will be turned off. For infinite step compressors: If a compressor has a discharge temperature more than the value of setpoint #79 "HI DISCH 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 #90 "SAFETY HOLD DELAY". At that time, if the discharge temperature has decreased below than the value of setpoint #79 "HI DISCH TMP" minus the value of setpoint #81 "DIS TMP RELD" the compressor will return to normal control.
81	DIS TMP RELD	Refer to setpoint #80 description.
82	LOW OIL DIF	If active, the system 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.
83	UNSAFE OIL	If active, the system 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.
84 ** **Not used at this time**	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.
85	HI OIL TEMP	If active, the system 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.
86	MOTOR FAULT	If active, the system 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.
87	NO CMP PROOF	If active, when the compressor is called to be on by the controller, the system 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
88	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.
89 ** **not used at this time**	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.
90	SAFETY HOLD DELAY **(only used with variable type of compressors)**	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

#	Name	Description
91 ** **not used at this time**	PUMP FREEZE PROTECTION	
92	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.
93	COMP ROTATION	Specifies the number of days between rotations (setpoint #92 must be set to zero to enable auto rotation). If zero, then rotation will occur with every cycle.
94 ** **not used at this time**	LLS#2 ON	This setpoint is used to control a second liquid line solenoid. When the capacity wanted is greater than this value (can either be number of steps for Fixed Step compressors, or percentage of full load amps for Infinite Step compressors) for the number of seconds in the 'Time (sec)' field, the second liquid line solenoid will open. When the compressor capacity below this value for the number of seconds in Delay Between Trips Field 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. Delay Between Trips Field: The delay in seconds before turning this solenoid off. If zero, then an offset of 20 seconds will be used.
95 ** **not used at this time**	LLS#3 ON	This setpoint is used to control a third liquid line solenoid. When the capacity wanted is greater than this value (can either be number of steps for Fixed Step compressors, or percentage of full load amps for Infinite Step compressors) for the number of seconds in the 'Time (sec)' field, the third liquid line solenoid will open. When the compressor capacity below this value for the number of seconds in Delay Between Trips Field 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. Delay Between Trips Field: The delay in seconds before turning this solenoid off. If zero, then an offset of 20 seconds will be used.
96	FREEZE	If active, the system 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.
97	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 #171-#190. 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.
98 ** **not used at this time**	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).
99 ** **not used at this time**	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.
100	OIL FLOAT	If active, the system 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.
101	Lost Leg Alm	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.
102 ** **not used at this time**	LOW SI COMPRESSOR OFF	Compressors with a low SI Off sensor will be disabled when the sensor is below this setpoint.
103 ** **not used at this time**	HI SI COMPRESSOR OFF	Compressors with a high SI Off sensor will be disabled when the sensor is above this setpoint.

#	Name	Description
104 **	UNLOADED % **not used at this time**	Used if a slide open percentage sensor is present. When this sensor is reading less than the value of this setpoint, then the slide is considered closed.
105 **	OIL HEATER ON **not used at this time**	The oil heater will be turned on if the oil temperature is less than the value of this setpoint. It will be turned off if the oil temperature is greater than the value of this setpoint plus 5.0° Fahrenheit. 'Time (sec)' field: If zero, then the calculated oil temp will be the saturated suction temperature plus the value of the setpoint. Else it will be the value of this setpoint.
106 **	OIL COOLER ON **not used at this time**	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.
107 **	UNLOADED OFF **not used at this time**	If active, the system is fully unloaded, and the control temperature is greater than this value, then the capacity state will be set to holding.
108 **	HP OVERHEAT **not used at this time**	This setpoint is only used when the heat pump option has been selected in the 'Unit Type' box in the 'General Information' section under the MAG V8 tab. 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.
109 **	SftyUnld Del **not used at this time**	The time delay in seconds between compressor capacity adjustments when safety unloading.
110 **	VFD Sfty Adj **not used at this time**	The VFD percentage adjustment to be made after every amount of time in setpoint #153 "SftyUnld Del" when safety unloading.
111	LO REF TMP	If active, the system 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.
112	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 #111 "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 #111 "LO REF TMP" plus twice the value of this setpoint. The compressor state change to LO TMP HOLD.
113	CRANK CASE HEAT	
114	DHH WAIT	The system will wait the number of seconds contained in this set point if the compressor is in dehumidification heat mode and the compressor is ready to be defrosted before the defrost cycle begins.
115	ROTATE EVAP	If active, then the Relay Outputs must have a second liquid line solenoid and 2 hot gas solenoids. Not used with Reverse Cycle type of defrost. If active and the value is 0 then when the system is in the dehumidification mode the evaporators will be rotated during the defrost cycle. Refer to dehumidification defrost with rotation.
116	MAX IN DEHUM	This is the maximum number of evaporator solenoids that can be on when the system is in the dehumidify mode.
117	DefConvType	Indicates the types of defrost. If active and value is a 1 then conventional defrost will be used (PSR V9). Else Defrost on the Fly (PSR V8) type of defrost will be used.
118	DEF HI TEMP	Set points #118, #119 & #120 work as a group. If the entering temperature is less than set point #118 but greater than set point #121, the values in #118, #119 & #120 will be used to determine if a defrost cycle is required.
119	DEF HI APPR	The calculated defrost approach temperature must be greater than the value of this set point for the system to enter a high defrost cycle.
120	DEF HI TIME	This set point contains the time expressed in minutes that a compressor will remain in a high defrost cycle. Expressed as minutes.

#	Name	Description
121	DEF MED TEMP	Set points #121, #122 & #123 work as a group. If the entering temperature is less than set point #121 but greater than set point #123, the values in #121, #122 & #123 will be used to determine if a defrost cycle is required.
122	DEF MED APPR	The calculated defrost approach temperature must be greater than the value of this set point for the system to enter a medium defrost cycle.
123	DEF MED TIME	This set point contains the time expressed in minutes that a compressor will remain in a medium defrost cycle. Expressed as minutes.
124	DEF LO TEMP	Set points #124, #125 & #126 work as a group. If the entering temperature is less than set point #121, the values in #124, #125 & #126 will be used to determine if a defrost cycle is required..
125	DEF LO APPR	The calculated defrost approach temperature must be greater than the value of this set point for the system to enter a low defrost cycle.
126	DEF LO TIME	This set point contains the time expressed in minutes that a compressor will remain in a low defrost cycle. Expressed as minutes.
127	DEF DEH APPR	If the dehumidification enable indicator is on, the calculated defrost approach temperature must greater than the value of this set point for the system to enter a defrost cycle.
128	DEF DEH TIME	This set point contains the time expressed in minutes that a compressor will remain in a dehumidification enable defrost cycle. Expressed as minutes.
129	DEF DEH 2ND	This set point contains the percent of the time that a compressor will remain in a dehumidification enable defrost cycle for the second evaporator if set point 115, ROTATE EVAP, is active and equal to 0.
130	DefMinAccTime	This is the minimum accumulated run that a compressor must be on before a defrost cycle can be initiated. Expressed as minutes.
131	Def AppLOCK	This set point contains the time expressed in minutes that the system will wait between defrost cycles.
132	DEFDRIP DWN	This set point contains the time expressed in minutes that the system will remain in a drip down state for each evaporator defrost.
133	DEF MAX EVAP	This set point contains the maximum number of circuits that can be in defrost at any one time.
134 ******	SAT EVAP ADJ **not used at this time**	This set point contains the temperature adjustment that is made to suction temperature (converted from suction PSI) when calculating the evaporator approach value.
135	HTGDTD MAIN	When the circuit is in a defrost cycle and the time has not exceeded the value of this set point, the hot gas main is turned off and the hot gas bypass is turned on. When the time exceeds this value, the hot gas main is turned on; refer to set point #136 to determine the status of the hot gas bypass.
136	HGDBP&BLEED	When the circuit is in a defrost cycle and the time has exceeded the value in set point #135, HTGDTD MAIN; if this set point contains a zero the hot gas bypass will be turned off, else it will be turned on.
137	ApprONdly	This is the time expressed in seconds that the evaporator temperature must be greater than the defrost trigger temperature before a defrost cycle will be checked to determine if a defrost cycle is required.
138	DEF CMP RTIM	This is the minimum time that a compressor must be on before a defrost cycle can be initiated. Expressed as minutes. Note, time in set point #130, accumulated run must be meet and the compressor must be on for the time specified in this set point before a defrost cycle is initiated.
139	DEF Min PSI	When a compressor is in a defrost start state the defrost cycle will not begin until the discharge pressure is less or equal to the value in this set point.
140	DEF COND ADJ	When a compress is in defrost, the value of this set point is added to the condenser set points.
141	DEF PDWN TIM	This is the maximum time that a compressor will remain in the defrost pump down state. Expressed in seconds.
142	DEF PDWN PSI	A compressor will remain in the defrost pump down state until the suction pressure decreases by the value of this set point. Also refer to set point #143
143	DEF TERMIN T	When a compressor is in a defrost mode and the evaporator suction temperature rises above the value in this set point, the defrost cycle will be terminated.

#	Name	Description
144	DEF TERMIN P	When a compressor is in a defrost mode and the discharge pressure drops below the value in this set point, the defrost cycle will be terminated.
145	DEF TIME DLY	This is the time delay between defrost cycles expressed as minutes. Note this was a fixed time
146	DEF AIR HGAS	Set point is used to indicate when the defrost air option is used and a hot gas defrost as backup is required. If this set point is active a message will be generated indicating which circuit required the hot gas defrost.
147	DEF AIR TIME	Value expressed in minutes is the maximum time that a circuit will be in air defrosts cycle.
148	DEF AIR BLEED	Time expressed in minutes that the bleed solenoid will be on when a normal air defrost cycle begins. During this time the hot gas main solenoid will be off. Once this time as pasted the bleed solenoid will be turned off and hot gas main solenoid will be turned on.
149	DEF AIR ALARM	If this set point is active, a defrost alarm messages will be generated.
150	EVAP FAN WAIT **Used only with Air Defrost type**	After defrost time to keep the system off.
151	LIQUID LINE CTL	Only used with a variable type of compressor to control the liquid injection solenoid.
152	ADJUST APPROACH	If this set point is active and the number of steps on is greater than the minimum, then all approach defrost set points will be adjusted by this set point. This set point is expressed as a percentage The amount of adjustment is calculated by taking the number of steps that are on greater than the minimum number and dividing this by the number of available steps. This is then multiplied by the value of this set point and it is subtracted from the approach set points. The actual value of the set point will be changed.
153	HOT GAS ON	If there is a modulating hot gas valve, this valve will be modulated when the control voltage or temperature is below this value.
154 **	PUMP DELAY **not used at this time**	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.
155	HI SI OFF	If active, and a High SI OFF sensor is specified (sensor can be an analog or digital input, and is specified in the Circuit SI screen for each compressor). If the High SI Off sensor reading ON (Digital) or the temperature 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 the value of this setpoint minus the value in the 'Time (sec)' field.
156	LOW SI OFF	If active, and a LOW SI OFF sensor is specified (sensor can be an analog or digital input, and is specified in the Circuit SI screen for each compressor). If the LOW SI Off sensor reading ON (Digital) or temperature drops 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 off. If an analog input, the circuit will be enabled once the sensor is rises above the value of this setpoint plus the value in the 'Time (sec)' field.
157 **	COND COMP HIGH **not used at this time**	If active, this set point contains the pressure difference that will be used to determine if a compressor has reached a critical condition when another compressor is in a start up. If inactive, a value of 50.0 PSI will be used. A critical condition is determined by subtracting this value from set point #70, HI DISCH PSI. If the discharge pressure is greater then this pressure will be used to control the fans.
158	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.
159	PWR OFF TIME	If the system is off for a time greater than 2 hours then the system state will be 'POWER LOSS DELAY' for the time contained in this setpoint , the time is expressed in hours.

#	Name	Description
160	LO SHT DXcoil	If the calculated superheat remains below this value for the time specified, the system will generate a LOW SHT DX alarm. This is the superheat calculated at the dx coil.
161	HI SHT DXcoil	If the calculated superheat remains above this value for the time specified, the system will generate a HIGH SHT DX alarm. This is the superheat calculated at the dx coil.
162	LHI SUPERHEAT	If the calculated superheat remains above this value for the time specified, the system will generate a HIGH SUPERHEAT alarm. This is the superheat calculated at the compressor.
163	HiRefLevel	This setpoint has two functions. If active, the system 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 ‘Refirg Level’ column in the Circuit SI screen
164	LoRefLvlTarg	If setpoint #76 “LO DiscSPRHT” is active and it has reached one third of its safety time, then setpoint #9 “REF LVL TARG” will be set to the value of this setpoint,
165	PULSE DELAY	Used with infinite 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’ section under the MAG V8 tab.If non-zero, and when the compressor’s amp draw is more than twice the value of setpoint #192 “AMP DB LO” away from the wanted FLA, then set the delay between pulses to zero.
166	REVERSE CYCLE COMP OFF TIME WHEN DEFROST START	Add logic for Reverse Cycle defrost to have adjustable time delay for turning off the compressors when first entering into the defrosting coil state. If this setpoint is active its value is used as the delay, otherwise 5 seconds is still used. This change was made to help the reversing valve to switch back after defrost was completed. The scroll compressors do not need this extra time but reciprocating compressors do need it.
167 **	PUMP FAILURE (NO FLOW) **not used at this time**	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.
168	UNLOAD DELAY	This is the time delay before the system will begin to unload a circuit due to a pending safety condition. This includes: high discharge PSI, high discharge temperature, low or high amps, or low suction PSI.
169	LO SUCT SHEAT	This set point contains the value that indicates a low suction SUPERHEAT condition. If the calculated suction SUPERHEAT is less than this value, the low suction SUPERHEAT timer will be set to 120 seconds. This will keep the low suction SUPERHEAT RO on for that period of time. (This can be used as a warning only or the user may wire through the low suction superheat relay to solve the problem.) . **Note,** during the first 5 minutes that compressor has been running, the safety time is increased to 3 times the safety time of this set point.
170	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
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.
189	FLA COMP#19	Full Load Amps for compressor #19. Refer to setpoint #171.
190	FLA COMP#20	Full Load Amps for compressor #20. Refer to setpoint #171.
191	AMP DB HI	Used only with screw 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.
192	AMP DB LO	Used only with screw 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.
193	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.
194	MOP PSI ZONE (Only HVAC)	Added to and subtracted from setpoint #199 to develop the upper and lower limits of the MOP control zone.
195	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.
196	MDP MIN OIL DIFF	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 unless the suction pressure is less than setpoint #69 "LOW SUCTION" plus twice the value of setpoint #71 "LOW SUCT RELD". The MDP logic will be exited and go to EXV HOLDING when the suction pressure is less than the setpoint #69 "LOW SUCTION" plus the value of setpoint #71 "LOW SUCT RELD". The 'Sec to Ignore Safety' cell contains the time that the MDP will be active after a compressor is started. The ''Time (sec)' field' cell contains the offset to exit the MDP control. The 'Safety Down Time' contains the percentage to close the EXV valve.
197 **	DELTA TEMP EVP **not used at this time**	If active, the system 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.
198	HiSuctSheat	If active, the system 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.

#	Name	Description
199 **	**not used at this time**	
200 **	**not used at this time**	
201 **	**not used at this time**	
202	NO OIL FLOW	If active and there is an Oil Flow sensor specified in the 'Oil Flow Switch' cell of the Circuit SI screen, then the system 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.
203	SAT EVAP ADJ	This set point contains the temperature adjustment that is made to suction temperature (converted from suction PSI) when calculating the evaporator approach value.
204	SPARE	Not used at this time.
205	STAGE CUT OUT	Off set used in calculating the cut out value. Subtracted from the stage cut in set points #206 through #229
206	STAGE 1 CUT IN	STAGE 1 cut in, set point value contains the value when this stage is turned on.
207	STAGE 2 CUT IN	STAGE 2 cut in, set point value contains the value when this stage is turned on.
208	STAGE 3 CUT IN	STAGE 3 cut in, set point value contains the value when this stage is turned on.
209	STAGE 4 CUT IN	STAGE 4 cut in, set point value contains the value when this stage is turned on.
210	STAGE 5 CUT IN	STAGE 5 cut in, set point value contains the value when this stage is turned on.
211	STAGE 6 CUT IN	STAGE 6 cut in, set point value contains the value when this stage is turned on.
212	STAGE 7 CUT IN	STAGE 7 cut in, set point value contains the value when this stage is turned on.
213	STAGE 8 CUT IN	STAGE 8 cut in, set point value contains the value when this stage is turned on.
214	STAGE 9 CUT IN	STAGE 9 cut in, set point value contains the value when this stage is turned on.
215	STAGE 10 CUT IN	STAGE 10 cut in, set point value contains the value when this stage is turned on.
216	STAGE 11 CUT IN	STAGE 11 cut in, set point value contains the value when this stage is turned on.
217	STAGE 12 CUT IN	STAGE 12 cut in, set point value contains the value when this stage is turned on.
218	STAGE 13 CUT IN	STAGE 13 cut in, set point value contains the value when this stage is turned on.
219	STAGE 14 CUT IN	STAGE 14 cut in, set point value contains the value when this stage is turned on.
220	STAGE 15 CUT IN	STAGE 15 cut in, set point value contains the value when this stage is turned on.
221	STAGE 16 CUT IN	STAGE 16 cut in, set point value contains the value when this stage is turned on.
222	STAGE 17 CUT IN	STAGE 17 cut in, set point value contains the value when this stage is turned on.
223	STAGE 18 CUT IN	STAGE 18 cut in, set point value contains the value when this stage is turned on.
224	STAGE 19 CUT IN	STAGE 19 cut in, set point value contains the value when this stage is turned on.
225	STAGE 20 CUT IN	STAGE 20 cut in, set point value contains the value when this stage is turned on.
226	STAGE 21 CUT IN	STAGE 21 cut in, set point value contains the value when this stage is turned on.
227	STAGE 22 CUT IN	STAGE 22 cut in, set point value contains the value when this stage is turned on.
228	STAGE 23 CUT IN	STAGE 23 cut in, set point value contains the value when this stage is turned on.
229	STAGE 24 CUT IN	STAGE 24 cut in, set point value contains the value when this stage is turned on.
230	Not Available	This set point cannot be used it MUST be INACIVE!

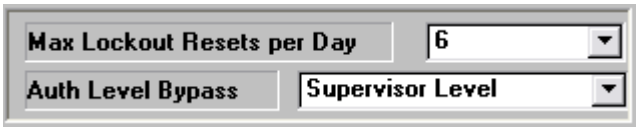
17. Authorization Function

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	YES
Clear point information	NO	NO	NO	NO	YES
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:

1. Highlight desired Magnum in the Site Information screen.
2. Click 

button.
3. Enter the 4 digit code into the pop-up box and click ok (or press the enter key).
4. Depending on the authorization level, the button will change to one of the following displays, indicating if the code was accepted or not.

18. Standard Control Options

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

18.1. General Options

- Control method can be based upon the control zone strategy or upon a voltage input that indicates the number of stages to be on.
- The control temperature can specify either the return or leaving sensor.
- Specify if the anti recycle timer should start when the compressor is turned on or turned off. (All circuits)
- Number of circuits, maximum of eight.
- Number of evaporators, maximum of six per compressor.
- Alarm RO, this point will be turned on when ever an alarm is generated.
- Specify auto rotation for circuits.

18.2. Compressor Options

- Type of compressors:
  - Reciprocating with oil,
  - Reciprocating with out oil,
  - Screw with oil,
  - Scroll,
  - Hitachi Screw,
  - Bitzer Screw
  - Hartford Screw
  - Hall 85/95 Ton Screw
  - Carlyle Screw
  - Hanbell Screw

- Four compressor steps per circuit can be supported. Compressor plus three additional steps of either compressors or unloaders and hot gas bypass points. Note, compressor safeties relate to a circuit. If multiple compressors are on a circuit and a safety trips all compressor on that circuit will be turned off. If hot gas bypass refer to Hot Gas Bypass Option.

- Specify that part winding, two RO points will be used with fixed step compressors, the first RO will be turned on with the second RO being turn on the number of seconds later that is specified in set point #62. (By circuit) If not part winding, only allocate one RO point for the compressor.

- Type of pump down, when the compressor is off, continuous will cause the compressor to be turned on if the suction pressure rises above the set point value. Else, the compressor will be pumped down only when the compressor is being turned off. Note, when the compressor is started the liquid line solenoid is not opened until the suction pressure reaches the value that is contained in the pump down set point. A liquid line solenoid is required. (All circuits)

- The liquid line solenoids may be eliminated. This is indicated in the circuit section in MCS-Config program.

18.3. Condenser Options

- Number of condensing stages.
- Type of condenser:
  - None,
  - RO Step Common (all compressors monitored for discharge pressure),

- RO Step Individual per circuit (compressor on circuit monitored for discharge pressure),
- RO Step Combined, circuits 1 & 2 and circuits 3 & 4 will share a condenser (compressor on related circuits monitored for discharge pressure),
- All of the RO Step type condenser can have a variable speed fan per circuit,
- Modulating Common. This is usually used to control a water condenser with a value that will be modulated depending on the rate of change of the discharge pressure
- RO Step Shared, selected circuits will share a condenser (compressor on related circuits monitored for discharge pressure),

18.4. Hot Gas Bypass

Used as the first stage of capacity. The software will support up to 4 stages of capacity; compressor, two unloaders and hot gas stage. There is no specialized control for the hot gas. That is the hot gas by-pass is turned on or off based upon the capacity needs of the system. It must be assigned following the last unloader if any exist. In MCS-Config, count the hot gas by-pass as an unloader.

18.5. Modulating Hot Gas Bypass (not implemented)

(not implemented at this time)

The hot gas bypass valve will be modulated when a low suction condition exists.

The hot gas bypass valve will be modulated based upon voltage input. When the voltage input is less than set point value.

18.6. Chilled Water Reset (only if temperature control)

This option is only available if the control on zone (temperature) has been selected.

Chilled Water Reset (CWR) is a 0 to 5 volts dc sensor input; Display Type is TRGTRST, to the Magnum microprocessor. The CWR follows the following rules using set point #21, MAX TRG RESET:

1. If the input is 2.5 volts dc the CWR is zero.
2. At 0 volts dc the CWR is a negative value equal to the set point value.
3. At 5.00 volts dc the CWR is a positive value equal to the value in the set point.
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.

18.7. Oil Equalization Option

Oil equalization occurs with common suction/common discharge systems. This feature allows for a solenoid valve to open, allowing oil to equalize between compressors.

If this feature is installed the micro will energize the Oil Equalization solenoid valve for 1 minute at the time a compressor is turned on.

18.8. Oil Differential Calculation

For all other software the calculation is OIL PRESSURE minus SUCTION PRESSURE. This provides the flexibility of using oil pressure if available or if not, discharge pressure can be used in place of the oil pressure. This is set up in the circuit information section of MCS-Config by pointing the oil pressure sensor to the discharge pressure sensor.

18.9. On/Off Switches

- The following digital input switches can be associated with the system, their action will affect the chiller package or an individual circuit, then action will only affect that circuit:

- Flow switch, if off the system has lost flow. The system wills either lock out, if NO FLOW set point is active, or shut down, if NO FLOW set point is inactive.

- Pump down switch, if on and the compressor is off, will not start the compressor. If the compressor is on, the system moves to the pump down state to begin the process of turning off the compressor(s) in normal steps.

- Run/Stop, if off the system will not run. This is usually wired to a RUN/STOP switch that is manually positioned. If the system is running, the system moves all circuits (compressor) to off in normal steps.

- Network Run/Stop, if off the system will not run. This input is provided by another system that resides on the network. It functions in the same matter as the Run/Stop switch.

- Emergency Stop switch, if on, the system will be shut down immediately and will remain disabled until the switch is off.

18.10. Low Suction Unloading & Holding

Set point #168, UNLOAD DELAY, will delay the unloading.

This option is activated when the set point #70, LO SUCT UNLD, is active. The purpose of this option is to take corrective action prior to a safety being tripped. When the suction pressure is below the value calculated by adding the value of this set point to the value of the LOW SUCTION set point for the time specified, the system will turn on the WARNING relay output if specified in the MCS-Config and take the following action:

- For a fixed step compressor, the system will turn off one step of capacity associated with that compressor until that circuit is in an UNLOADED state, which all steps except one are unloaded. The circuit (compressor) state will be LO SUCT HOLD. The circuit will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the suction pressure has turned to normal.

- For an infinite step compressor, the system will begin unloading that compressor until the suction pressure rises above the calculated value. During this time the circuit (compressor) state is LO SUCT UNLOAD. Once this pressure has been reached, the circuit (compressor) state will be LO SUCT HOLD. The circuit will remain in that state until the capacity control indicates that less capacity is needed or if after 5 minutes the suction pressure has turned to normal.

Normal pressure is the value calculated by adding the value of the LO SUCT RELD set point #71 to the value of the LOW SUCTION set point #69.

18.11. High Discharge Pressure Unloading & Holding

Set point #168, UNLOAD DELAY, will delay the unloading.

This option is activated when the set point #74, HI DISC UNLD, is active. The purpose of this option is to take corrective action prior to a safety being tripped. When the discharge pressure is above the value calculated by subtracting the value of this set point from the value of the HI DISCH PSI set point for the time specified, the system will turn on the WARNING relay output if specified in the MCS-Config and take the following action:

- For a fixed step compressor, the system will turn off one step of capacity associated with that compressor until that circuit is in an UNLOADED state, that is all steps except one are unloaded. The circuit (compressor) state will be HI DISC HOLD. The circuit will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the discharge pressure has turned to normal.

- For an infinite step compressor, the system will begin unloading that compressor until the discharge pressure drops below the calculated value. During this time the circuit (compressor) state is HI DISC UNLOAD. Once this pressure has been reached, the circuit (compressor) state will be HI DISC HOLD. The circuit will remain in that state until the capacity control indicates that less capacity is needed or if after 5 minutes the discharge pressure has turned to normal.

Normal pressure is the value calculated by subtracting the value of the HI DISC RELD set point #75 from the value of the HI DISC PSI set point #73.

18.12. High Discharge Temperature Unloading & Holding

Set point #168, UNLOAD DELAY, will delay the unloading.

This option is activated when the set point #80, HI DISC UNLD, is active. The purpose of this option is to take corrective action prior to a safety being tripped. When the discharge temperature is above the value calculated by subtracting the value of this set point from the value of the HI DISCH TMP set point for the time specified, the system will turn on the WARNING relay output if specified in the MCS-Config and take the following action:

- For a fixed step compressor, the system will turn off one step of capacity associated with that compressor until that circuit is in an UNLOADED state, that is all steps except one are unloaded. The circuit (compressor) state will be HI DISC HOLD. The circuit will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the discharge temperature has turned to normal.

- For an infinite step compressor, the system will begin unloading that compressor until the discharge temperature drops below the calculated value. During this time the circuit (compressor) state is HI DISC UNLOAD. Once this temperature has been reached, the circuit (compressor) state will be HI DISC HOLD. The circuit will remain in that state until the capacity control indicates that less capacity is needed or if after 5 minutes the discharge temperature has turned to normal.

Normal pressure is the value calculated by subtracting the value of the DIS TMPRELD set point #81 from the value of the HI DISC TMP set point #79.

18.13. High Ampere Unloading & Holding

Set point #168, UNLOAD DELAY, will delay the unloading.

This option is activated when the set point #191, HI AMPS %, is active. The purpose of this option is to take corrective action prior to a safety being tripped. When the amp draw is within one-half of the calculated HI AMP safety value, the system will turn on the WARNING relay output if specified in the MCS-Config and take the following action:

- For a fixed step compressor, the system will turn off one step of capacity associated with that compressor until that circuit is in an UNLOADED state, that all steps except one are unloaded. The circuit (compressor) state will be HI AMP HOLD. The circuit will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the amp draw has turned to normal.

18.14. Evaporator Fan

This must be setup in the Evaporator Information section under the MAG REFR button. If present, this relay will be turned on when every the capacity state is normal (allow to run) and off if it is not.

18.15. Control Power Relay –No Stop

This option provides the capability of interrupting the power supply to the compressors in the system. A relay output, referred to as the control relay, must be wired so that when it is off no power reaches the compressors. This is a safety measure that will insure that the compressors are off then the system calls for them to be off. The relay output must be indicated in the MCS-Config program and set point #97, NO STOP, must be active. The system will continually monitor the amp draw of compressors that the system has in an off state. The system will calculate the minimum amp draw by multiplying the FLA for that compressor times the percentage value in the NO STOP set point. If the amp draw is greater than this value for the time specified; the system will turn the control relay off, generate a NO STOP alarm and place the system in a lockout state. This provides an additional level of protection.

18.16. Part Wind or Star Delta Starter

Either a part winding or star delta type of compressor starter is supported. This option is specified in the MCS-Config program and will require two successive relay output points. When this option is specified, set point #65, PARTW DELAY, must contain the delay in seconds 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. With this option, when a compressor is to be turned on, the first relay output is turned on and the system will wait the time specified in set point #65 before the second relay output is turned on.

18.17. English or Metric sensor readings

The system supports English, Metric, or a combination sensor readings, this is specified in the MCS-Config program. All sensor values and all software-coded offsets are automatically converted into the option selected and displayed with the appropriate character. The following table contains the display character:

SENSOR READING	ENGLISH CHARACTER	METRIC CHARACTER	METRIC 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	%	%	%

NOTE: Set point values are **NOT** automatically adjusted. Their values must be set up in MCS-Config to reflect either English or Metric values. Their display character will be automatically adjusted.

18.18. Compressor Auto Rotation

The auto rotation option is selected by setting the value in set point #46, LEAD COMP to zero. If this value is not zero, it will contain the number of the lead circuit (compressor) and auto rotation is disabled. Note this set point can be manually changed to force a different compressor as the lead compressor or to enable auto rotation.

When this option is enabled, the system will rotate the compressors based upon the value in set point # 93, CMP ROTATION.

If the value set point # 93 is zero, rotation will occur with every complete capacity cycle and the next compressor will be selected as the lead compressor.

Else, the value is the number of days between rotations. At midnight the system will check if it is time to rotate compressors. If yes, the system 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 set point # 93 is set up as an ALARM type of set point, a compressor rotation message will be generated each time a compressor is rotated.

18.19. 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 #60 “ACYC ON->ON”.
If the value of setpoint #60 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 #60. Else the anti-cycle timer will be set to the value in setpoint #59.

For example:
#59 (ANTI-CYC OFF) = 300 seconds
#60 (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.

18.20. Warning & Alarm Relay Outputs

Warning Relay Output will be turned on whenever the system generates a warning type of 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 and no safeties have been tripped.

Warning Relay Output will also be turned on whenever a circuit is placed in a safety state.

Alarm Relay Output will be turned on whenever the system generates an alarm type of message. This indicates that a safety or lockout condition has occurred.

18.21. Operating Schedules

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

18.22. Modification to adjust approach values

New set point #152 is required. To activate the adjustment to all approach set points (119. 122, 125 & 127) this set point must be active. Its value is the maximum adjustment that will be made to the approach set points.

The adjustment will be made proportional to the positioning of the wanted on of the slide. If the slide is mi-point between its minimal and maximum, then the adjustment will be one half of the value in set point #89.

The following table is the result of testing this change:
Set point #152 = 10.0. Range is 60 (100.0 – 40.0)

	Adjusted Values	Adjusted Values	Adjusted Values	Adjusted Values	Adjusted Values	Adjusted Values
Voltage		0.3	.7	1.9	2.1	5.0
% Wanted		40	50	83	89	100
% Of range		0	16	71	81	100
Set PT #119	19.0	19.0	17.7	11.8	10.9	9.0
Set PT #122	20.0	20.0	18.2	12.8	11.9	10.0
Set PT #125	14.0	14.0	12.2	6.8	5.9	4.0
Set PT #127	19.0	19.0	17.2	11.8	10.9	9.0

19. Magnum Alarms and Safeties

19.1. Introduction

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

- Information only alarms,
- Magnum system alarms and
- Chiller set point safety alarms.

All of the alarms have the same format. The alarm is identified and it is date time stamped. Alarms can be viewed from the Magnum by pressing the ALARM STATUS (4) key or from the MCS-Connect program.

19.2. Information only alarms

19.2.1. 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
- POWER RETURNED
- COMPUTER RESET
- LCD FAILURE
- HW DATE INVALID
- HW TIME INVALID
- SW DATE INVALID
- SW TIME INVALID
- RAM INTEGRITY
- WATCHDOG RESET

19.2.2. Alarms as a result of individual action

The following alarms indicate that an individual took action:

- ALARMS CLEARED
- STPT CHANGED
- RO MANUAL
- AO MANUAL
- SI MANUAL
- POINT INFO CLEAR
- CLOCK SET
- CFG DOWNLOADED

19.2.3. Alarms generated by the control algorithm

The following alarms indicate that the control algorithm took action:

- ROTATED LEAD
- DAYLIGHT SAVINGS

19.3. Magnum system alarms

19.3.1. Alarms are generated by the Magnum control algorithm:

19.3.1.1.Configuration problem alarms

These alarms indicate a problem with the configuration file that has been loaded into the system. The system is not operational, a configuration must be transmitted to the unit form MCS-Connect or the config chip must be replaced with a valid one.

- INVALID CONFIG. (Check if sums are incorrect)
- INVALID CFG VER (version number of the configurator is invalid)
- INVALID CFG TYPE (the type does not agree with software, chiller software with a home unit configuration)

19.3.1.2.MCS local network problem alarms

These alarms indicate problems with the MCS local network, the system can be accessed but the system is in a lock out state, LOST I/O.

- MCS-I/O 1 LOST
- MCS-I/O 2 LOST
- MCS-I/O 3 LOST
- LOST IO SHUTDOWN

19.3.1.3.Key sensors problem alarms

This alarm indicate a problem with a key sensor, it is either shorted or open. The alarm will contain ALARM followed by the 8-character name of the sensor.

The following sensors related to the entire system are tested:

- Leaving liquid, if failed: lock out the chiller system
- Returning liquid, if failed: alarm only no lock out
- Ambient temperature, if failed: alarm only no lock out

The following circuit sensors are tested. If they fail that circuit only is locked out.

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

19.3.1.4.EMERGENCY STOP alarm

This alarm indicates that the emergency stop switch has been turned on. The system can be accessed but the entire system is in a lock out state.

- EMERGENCY STOP

19.4. Set point safety alarms

19.4.1. Introduction

The Magnum chiller algorithm incorporates a number of safety checks to ensure that the various components that make up the chiller package are not damaged. These types of safeties are based upon

set points. When a safety trips for the first time, the compressor will be set to “SAFETY TRIPPED” state. The compressor will remain in “SAFETY TRIPPED” state for ten minutes and then move to the “CMP IS OFF” state where the compressor will be allowed to run if required. If the same safety occurs again within two hours of the first trip, the compressor will be set to “CMP LOCKED OUT” state, which requires a manual reset to restart the compressor. In this matter the Magnum attempts to take corrective action to protect the compressors but avoid nuisance trips.

The time in the safety state and the time between safeties are specified in the individual set points. This enables the times to be unique for each lock out set point.

19.4.2. Sensor inputs used in conjunction with Magnum set point safeties:

Suction Pressure

Read the suction pressure. (Optional digital input)

Discharge Pressure

Read the discharge pressure. (Optional digital input)

Oil Pressure

Read the oil pressure (optional digital input)

Oil Differential Pressure

Calculated valve of the oil pressure as follows:

- Fixed step compressors, oil psi minus suction psi
- Screws with oil pump, Oil psi minus discharge psi
- Screws without oil pump, discharge psi minus suction psi

Oil Temperature

Indicates that a high oil temperature condition. This can be either a temperature sensor or a digital input.

Discharge Temperature

Indicates that a high discharge temperature condition. This can be either a temperature sensor or a digital input.

Motor Temperature

Indicates that a high motor temperature condition. This can be either a temperature sensor or a digital input.

Motor Amps

Sensor input that measures AMP draw of the compressor. (Optional digital input)

Motor Fault

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 setpoint #86.

Liquid Temperature

Temperature sensor that can be used to detect a freeze condition

Compress Proof

A digital input that when on indicates that a compressor is running.

Flow Switch

A digital input that indicates that flow through the chiller barrel exists. There can be one switch per chiller or one for each circuit.

19.4.3. Set point safeties

For a safety to be interrogated, both the associated sensor input and the lockout set point must be active. If a safety trips, the alarm name will consist of the set point name plus additional identification such as point number or circuit number if applicable.

The system exercises “smart” safety testing in the following manner:

If a safety applies to a circuit and it is an active lockout type of a set point, the first time this safety trips an alarm will be generated and the circuit will be shut down and placed in a safety state. The system will attempt to reactivate this circuit after waiting the length of time specified in this set point, safety down time. If successful the system will continue to run. If the same safety trips the time specified in the lockout delay time, the circuit will be locked off and a manual intervention is required. If the lockout delay time is set to zero, the system will generate a lockout condition the first time that the safety occurs.

The time in the safety state and the time between safeties are specified in the individual set points. This enables the times to be unique for each lock out set point.

MOST SAFETIES ARE CHECKED ONLY IF THE COMPRESSOR IS RUNNING, IF THE SAFETY IS ALWAYS CHECKED IT WILL BE SO NOTED.

The following are a list of safeties that are incorporated in the standard chiller algorithm control. These safeties are checked every second. Note, for a multiple circuit system, each circuit is tested individually. If a safety condition exists, action will be taken with that circuit only, other circuits will continue to function.

Freeze Protection (SAFETY IS ALWAYS CHECKED)

If the leaving liquid temperature drops below the set point value the system, and all circuits, will enter a lockout state and a freeze notification alarm will be generated. You have the option of one freeze protect for the package or individual freeze protections by circuit. This is selected in the MCS-Config program.

No Flow Protection

If the flow switch is for the chiller system, then the entire system will be shut down with the LOCK OUT state if set point 167, PUMP FAILURE, is an active lockout type of set point. If the set point is inactive, the system will determine if there is a second pump, if so it will be started. Else, the system will be shut down and automatically restarted when the flow switch is on, indicating that there is flow. If the flow switch is for the individual circuit, then that circuit will be locked out.

Phase Loss Protection

Phase loss, as indicated by the phase loss monitor, will result in the system and all circuits being locked off and a phase loss notification alarm will be generated. Refer to set point is #158.

Emergency Stop

Emergency stop, as indicated by the emergency stop switch, will result in the system and all circuits being locked off and an emergency stop notification alarm will be generated. No set point is required.

Low Differential Oil Pressure

This safety is designed to meet the compressor manufacturer requirements on oil pressure. For the first 5 (60 seconds if setup as Hitachi screw compressors) seconds following a compressor start this safety is NOT checked. For the next 30 seconds, if the oil differential pressure drops below ½ of the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor 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 set point and it remains there for the time specified in the safety time, the compressor will be locked out (as described in section ‘Chiller set point safety alarms.’) and a low oil alarm generated. This enables the set point value and the safety time to be much tighter. This safety is interrogated when the compressor is on and not in a pump down state.

Low Suction Pressure

If the suction pressure drops below the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time, the compressor will be locked out and a low suction alarm generated. For the first 5 minutes after the compressor has started the safety time is extend by 2 minutes, this enables the set point safety time to be set much tighter for normal operation. This safety is bypassed when the compressor is in the “CMP PUMP DOWN” state. This safety can also be used as a freeze protection based upon the suction PSI.

Unsafe Suction Pressure

This safety is similar to the low suction pressure safety except this set point can be set up with a lower value and a very short safety time. If the suction pressure drops below the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a low suction alarm generated. This safety will always cause a lock out on the first trip requiring a manual reset to restart the compressor. For the first 5 minutes after the compressor has started the safety time is extend by twice the normal time delay, this enables the set point safety time to be set much tighter for normal operation. . This safety is bypassed when the compressor is in the “CMP PUMP DOWN” state.

Low Discharge Pressure

If the discharge pressure drops below the value of the set point and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a low discharge alarm generated.

High Discharge Pressure (SAFETY IS ALWAYS CHECKED)

If the discharge pressure raised above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a high discharge alarm generated.

High Discharge Temperature (SAFETY IS ALWAYS CHECKED)

If the discharge temperature analog input rises above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time, the compressor will be locked out and a high temperature alarm generated.

HI Motor Temp or Motor Fault (SAFETY IS ALWAYS CHECKED)

If the high motor temperature input rises above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time, the compressor will be locked out and a high motor temperature or motor fault alarm generated.

Hi Oil Temp

If the oil temperature rises above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a high oil temperature alarm generated.

Hi Motor Amp

If the ampere analog input rises above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a high motor amp alarm generated. This safety is bypassed for the first 3 seconds after a compressor has started.

Low Motor Amp

If the ampere analog input drops below the value of the set point and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a low motor amp alarm generated. This alarm can be used to indicate low refrigerant. This safety is bypassed for the first 3 seconds after a compressor has started.

No Compress Proof

If a compressor is called to be on and the compressor proof input is off (this is a digital input), a NO COMP PROOF alarm will be generated.

High Oil Seal Temperature (Screw Compressors only)

If the oil seal temperature analog input rises above the value of the set point and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a high oil seal alarm generated. This safety is bypassed for the first 4 minutes after a compressor has started and when the compressor is in the “CMP PUMP DOWN” state.

Dirty Oil Filter (Fixed Step Compressors only)

If the difference between the discharge pressure minus the oil pressure is above the value of the set point and it remains there for the time specified in the safety time of that set point a dirty oil filter alarm will generate. If the difference raises 20.0 above the set point then the compressor is locked out on the first trip requiring a manual reset to restart the compressor.

20. Sample of Relay Outputs & Inputs

The sequence of the relay outputs is critical and must be set up as show in the following examples. If any optional relays are not required, then the following relays move up in the sequence so that no relays are skipped or wasted. It is not necessary for the inputs to me in a fixed sequence.

20.1. Reciprocating Compressor with Rotating Coil Air Defrost

Relay Outp

#	Name
M-1	COMP 1
M-2	LLS-1A
M-3	LLS-1B
M-4	LLS-1C
M-5	LLS-1D
M-6	HG1MAIN
M-7	HG1BLEED
M-8	SPAREM-8

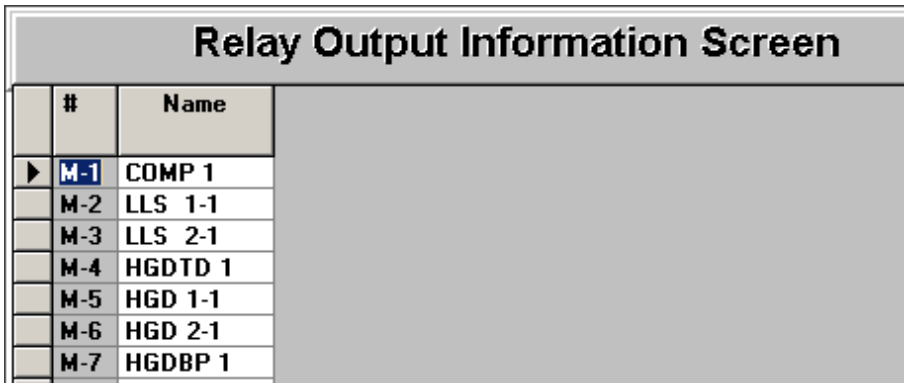
Sensor Input Information Screen

#	Name (1 to 8 char)	Display Type	Offset	Manual Value or NC/NO (select to change)	Display Text (select to change)	Setpoint Index	Temperature sensor
M-1	EVAP-1	TI-500	0	40	Not Used	Not Used	Not Used
M-2	SUCT-1	TI-500	0	55.5	Not Used	Not Used	Not Used
M-3	DISC-1	TI-500	0	180.8	Not Used	Not Used	Not Used
M-4	OPS-1	TI-500	0	190.9	Not Used	Not Used	Not Used
M-5	HI PSI-1	DIGITAL	Not Used	Open=OFF	OK, TRIP	Not Used	Not Used
M-6	SSM-1	DIGITAL	Not Used	Open=OFF	OK, TRIP	Not Used	Not Used
M-7	SUC TP-1	MCST100	0	81.1	Not Used	Not Used	Not Used
M-8	EVAP TP1	MCST100	0	99.1	Not Used	Not Used	Not Used
M-9	0-5 VDS	VOLT5DC	0	0	Not Used	Not Used	Not Used
M10	SUPPLY	MCST100	0	55.5	Not Used	Not Used	Not Used
M11	PDS-1	DIGITAL	Not Used	Closed=OFF	YES, NO	Not Used	Not Used
M12	PDS-2	DIGITAL	Not Used	Open=OFF	YES, NO	Not Used	Not Used
M13	PDS-3	DIGITAL	Not Used	Open=OFF	YES, NO	Not Used	Not Used
M14	CrCASE-1	DIGITAL	Not Used	Open=OFF	OK, TRIP	Not Used	Not Used
M15	CrCASE-2	DIGITAL	Not Used	Open=OFF	OK, TRIP	Not Used	Not Used
M16	CrCASE-3	DIGITAL	Not Used	Open=OFF	OK, TRIP	Not Used	Not Used

The above example shows the RO's and SI's for 1 compressor. The configuration actually has 3 compressors.

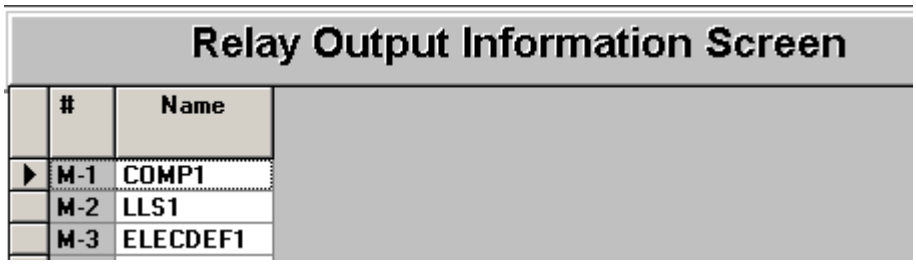
20.2. Reciprocating Compressor

The example below has one compressor without a split-winding starter with Rotating Coil Air Defrost option of NO . Hot Gas Defrost option was selected and set points 87 and 108 are both active.



20.3. Reciprocating Compressor

The example below has one compressor without a split-winding starter with Rotating Coil Air Defrost option of NO. Electric Defrost option was selected



20.4. Reciprocating Compressor

The example below has one compressor without a split-winding starter with Rotating Coil Air Defrost option of NO. Time Off Defrost option was selected

20.5. Screw Compressor

The example below has one screw compressor with modulating hot gas valve controlled on voltage with Rotating Coil Air Defrost option of NO. No defrost options were selected.

Relay Output Information Screen

#	Name
M-1	COMP
M-2	LOAD
M-3	UNLOAD
M-4	FASTUNL
M-5	LLS
M-6	HGBY

20.6. Screw Compressor

The example below is for a Hanbell screw compressor and set points 87 and 108 are both active.

Relay Output Information Screen (Magnum)

#	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	REF OK	--------	--------	--------	--------	--------	--------	--------	--------	Standard
M-2	COMP-1	95	10	21	53	300	--------	--------	--------	Screw NO EXV
M-3	LOAD-1	--------	--------	--------	--------	--------	--------	--------	--------	Standard
M-4	UNLOD-1	--------	--------	--------	--------	--------	--------	--------	--------	Standard
M-5	LLS1-1	--------	--------	--------	--------	--------	--------	--------	--------	Standard
M-6	LLS2-1	--------	--------	--------	--------	--------	--------	--------	--------	Standard
M-7	HGDMtd-1	--------	--------	--------	--------	--------	--------	--------	--------	Standard
M-8	HGD1-1	--------	--------	--------	--------	--------	--------	--------	--------	Standard
M-9	HGD2-1	--------	--------	--------	--------	--------	--------	--------	--------	Standard
M10	HGBP-1	--------	--------	--------	--------	--------	--------	--------	--------	Standard

21. General Sequence of a Defrost Cycle

The sequence of the relay outputs is critical and must be set up as show in the following examples. If any optional relays are not required, then the following relays move up in the sequence so that no relays are skipped or wasted.

21.1. With Rotating Coil Air Defrost option of YES

The example will have 4 evaporators with a maximum of 3 being allowed on at one time when in normal mode, when in dehumidify mode than only 2 can be on.

Following table is an attempt to show the status of the circuit RO's when in various states.

	NORMAL (1)	AIR DEFR (2)	NORMAL (3)	HOT GAS DEFR (4)	HOT GAS DEFR (5)	HOT GAS DEFR (6)	DRIP DOWN (7)
COMP	ON	ON	ON	ON	ON	ON	OFF
LLS 1-A	ON (lead)	OFF	OFF	OFF	OFF	OFF	OFF
LLS 1-B	ON	ON (lead)	ON (lead)	OFF	OFF	OFF	OFF
LLS 1-C	ON	ON	ON	OFF	OFF	OFF	OFF
LLS 1-D	OFF	ON	ON	OFF	OFF	OFF	OFF
HG1MAIN	OFF	OFF	OFF	OFF	ON	OFF	OFF
HG1BLEED	OFF	OFF	OFF	ON	OFF	OFF	OFF

(1) Normal compressor and 3 evaporator solenoids are on.
(2) An air defrost cycle has been initiated. This is based only on time. There has been no ice buildup as the evaporator pressure is above the hot gas trigger set point. The lead evaporator is turned off for defrosting and the next available evaporator is turned on. The system will cycle through the evaporators for defrosting as long as there is no ice buildup.
(3) Normal compressor and 3 evaporator solenoids are on with the lead moved to evaporator 2.
(4) A hot gas defrost cycle has been initiated. There has been an ice buildup indicated by the drop in the evaporator pressure. If there is an available compressor, this compressor will be turned off and the available compressor started. If there is not an available compressor then all compressors will enter a hot gas defrost cycle. All evaporator solenoids are turned off and will remain off throughout the hot gas defrost cycle. The hot gas bleed solenoid has been turned on. It will remain on based upon set point #148.
(5) Time to turn off hot gas bleed solenoid and turn on the hot gas main solenoid. This will be the situation until the hot gas time has exceeded the time in set point #147.
(6) The hot defrost is complete. The compressor must now be pumped down. Only the compressor is on. The pump down will be terminated based upon time or pressure.
(7) Following the pump down the compressor will be allowed to drip down, all the water drip off of the coils. This time is passed upon set point #132. During this time the compressor will not be ready to be turned on as its state is CMP OFF/D-DOWN. The compressor will then be placed in the CMP OFF/READY state. When the compressor is started evaporator 1 will be the lead.

21.2. With Defrost option of NO

The following is a general sequence of operations during defrost cycles with set points 87 and 108 are both active

	DEFROST EVAP #1	DRIP DOWN 1	DEFROST EVAP #2	DRIP DOWN 2	DH Mode (1)	DHH Mode (2)	NORMAL
COMP	ON	ON	ON	ON	ON	ON	ON
LLS1	OFF	OFF	ON	ON	ON	ON	ON
LLS2	ON	ON	OFF	OFF	OFF	OFF	ON
HG MAIN (HGDTD-M)	OFF (time in SP 108) then ON	OFF	OFF (time in SP 108) then ON	OFF	OFF	OFF(time in SP108) then ON	OFF
HG DEF1	ON	OFF	OFF	OFF	OFF	OFF	OFF
HG DEF2	OFF	OFF	ON	OFF	OFF	ON	OFF

HG-BY PASS (HGD-BP)	ON (time in SP 108) then ON if 109 > 0 else OFF	OFF	ON (time in SP 108) then ON if 109 > 0 else OFF	OFF	OFF	ON (time in SP 108) then ON if 109 > 0 else OFF	OFF

NOTE: DHH should not be short cycled.

(1) The (DH) mode dehumid enable input **must be on** and DHH mode **on** in order to dehumidify with heat. The approach value and time are changed to the values in set points #100 and 101. If Evap#1 needs defrost the defrost cycle will initiate and terminate as programmed for that approach temp. Evap #2 defrost, the time is reduced by the percentage in set point #102. The circuit state will not be changed. If DHH is still on the EVAP #2 will again be used as a re heat coil.

(2) Both the DH enable and the DHH enable input must be on and the circuit must be in a normal state. There is no time delay in turning on or off the HG DEF2. However, if a defrost is required, the HG DEF2 will be turned off and defrost circuit 1 can start its defrost cycle. The HG DEF1 defrost state will not be on for the time contained in set point #86 to allow some bleed line time to pump out.

Set point 108 contains the time expressed as seconds that the HGDTD MAIN will be off or in other words the HGD BP output is ON for approximate 30 seconds to prevent liquid surge when starting a defrost for evap 1 or 2. Both HGDTD-M and HGD BP are off when defrost cycle is timed out.

108 = 30, then HGDTD-M will wait for 30 seconds then ON. HGD BP will be ON for 30 seconds then OFF. Never set below 15 seconds minimum

Set point 86 contains the time expressed as seconds that the system will delay when the DHH mode is true and a defrost cycle is required. The HG DEF2 and HGDTD-M and HGD BP will be turned off and system will then wait for this time to pass before initiating a defrost state.

22. 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.

1.1. 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
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)

1.2. 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
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:

Magnum	BACnet ID	BACnet Name	Modbus	N2
				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

1.3. Analog Output Points

Analog 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)

1.4. Setpoints

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

Magnum	BACnet ID	BACnet Name	Modbus	N2
Setpoint #1	AV:0	STP# 1-<Setpoint name>	40301	ADF:1
Setpoint #21	AV:88	STP# 21-<Setpoint name>	40321	ADF:89
Setpoint #163	AV:230	STP# 163-<Setpoint name>	40463	ADF:231

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

1.5. Chiller/Compressor States

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

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
Chiller Unit State	MV:0	CHILLER STATE	30306	BYT:1
Compressor #1 State	MV:1	COMPRESSOR #1 STATE	30307	BYT:2
Compressor #2 State	MV:2	COMPRESSOR #2 STATE	30308	BYT:3
Compressor #3 State	MV:3	COMPRESSOR #3 STATE	30309	BYT:4
Compressor #4 State	MV:4	COMPRESSOR #4 STATE	30310	BYT:5
Compressor #5 State	MV:5	COMPRESSOR #5 STATE	30311	BYT:6
Compressor #6 State	MV:6	COMPRESSOR #6 STATE	30312	BYT:7
Compressor #7 State	MV:7	COMPRESSOR #7 STATE	30313	BYT:8

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
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

1.6. 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

Magnum	BACnet ID	BACnet Name	Modbus	N2
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
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
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

Magnum	BACnet ID	BACnet Name	Modbus	N2
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
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)

22.1. 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

22.2. 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"

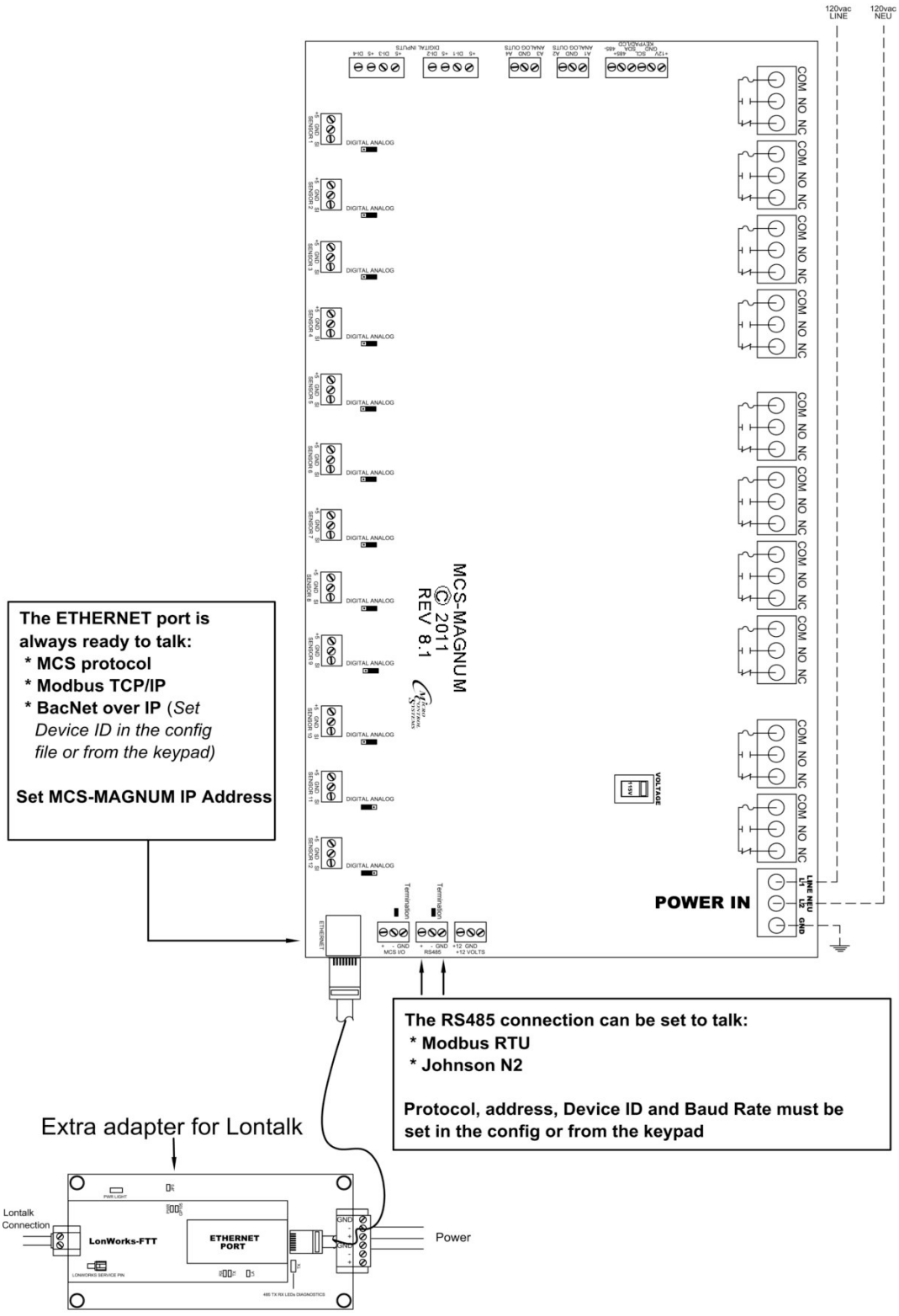
22.3. MCS Compressor Control State Chart

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 "

State Number	Description
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 "

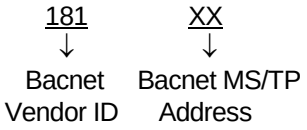
22.4. MCS-Magnum to BMS Connections



22.5. MCS-Magnum BMS protocols settings

22.5.1. 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.



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.

22.5.2. 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.

22.5.3. 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.

22.5.4. 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.

23. Hardware & Software support information

Refer to MCS web site at mcscontrols.com.

23.1. OEM Factory Checkout Procedure

Then select the “Support” button and then select “Installation, Testing & Unit Commissioning”.

23.2. Hardware Trouble Shooting

Then select the “Support” button and then select “Hardware Troubleshooting”.

23.3. The MCS Trouble Shooting Quick Reference Sheet

The following is a quick summary

PROBLEM	POTENTIAL SOLUTION
No Sensor + 5 vdc	• Indicates a possible shorted input sensor • Remove all sensor + 5 vdc wires. • 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 sensor for bad 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 min. or until 5 VDC restored at sensor input. - Connect terminals 1 at time until short reappears & 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 sensor for bad sensor.
A pressure sensor is reading more than 1 psi off (The temperature & humidity sensors do not require calibration.)	This indicates the transducer sensor input needs to be calibrated via the offset capability in the software. (Transducers by design need to be calibrated based on construction and altitude.) • You need to have a valid Auth code to change sensor offsets • You must use the Windows based software package ‘PConn’ • See PConn Interactive section for instructions. (‘Change SI Status, Manual Value and / or offset.)

PROBLEM	POTENTIAL SOLUTION
Invalid reading on one sensor input.	This indicates an input problem with 1 sensor. • Verify jumper settings correct for that SI.
'MCS CONTROLLER INITIALIZATION' on LCD display.	Indicates Micro in constant reset. • Check incoming power > 105 VAC or 22 VAC
Top row of LCD display all bars & 2nd row blank.	Indicates software chip problem possible. • Possible U11 software version incorrect or chip bad. • Possible U13 GAL chip incorrect or chip bad. • Possible bad connection or cable between LCD and MCS8
LCD blank.	Indicates bad connection. • Connector J2 on MCS not on or offset on connector. • Resistor adjustment VR1 out of adjustment.
Lost I/O	Indicates communications problem. • Verify RS485 LED blinking. • Verify termination jumper J6 only on at MCS-8 & last I/O. • Verify MCS-8 & I/O address's set correctly. • Verify wiring from MCS-8 to each I/O correct. • Check fuses/120 VAC on I/O units
Changes to MCS not being made from the unit's keypad.	This indicates inability to write to chip U10. • Verify 'EEP WRITE ENABLE' jumper W6 is on. • Not authorized
MCS-PConnect – cannot make changes	This indicates you are not at a proper authorization level. Follow steps below for proper authorization • From either the SYSTEM INFO or STATUS screen, under PConn, click on the 'AUTH' button on the lower right of your 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 via the color of the AUTH button. 1. RED = view only 2. YELLOW = service level 3. BLUE = Supervisor level 4. Green = Factory level
Invalid authorization	This indicates an invalid auth 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

PROBLEM	POTENTIAL SOLUTION
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 chip U11.
INVALID CONFIG TYPE	Indicates U10 CFG incompatible with U11 software. • Example U10 CFG for home while U11 for chiller.
INVALID CONFIG	Indicates Checksum invalid • Reload 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 the MCS-Connect program 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 he left of the RS-485 connector on the MCS-8 board is blinking. This indicates that the MCS-8 is responding to the gateway. • If both of these LED are blinking, check the address of the MCS-8 and any other MCS-8s that are on the network. Each must have a unique address. This address can be changed from the MCS-8. Proper authorization is required. Enter the UNIT INFORMATION screen by depressing the SERVICE DIAGNOSTIC key and scrolling to this item. Depress 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.

--- NOTE ---

ALL SENSOR INPUTS SHOULD BE SHIELDED CABLE WITH SHIELD TIED TO GROUND ON MCS-8 SENSOR INPUT GROUND TERMINAL