Revision 2023-02-14

MICRO CONTROL SYSTEMS

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Magnum Loop Controller

LWC - V17 Manual Rev. 2.3

	State	Time	Delay	Wanted /Actual	Change
UNIT STATUS	UNIT IN LOST I/O	00:00:06			
1 SUPPLY FAN	LOOP STOPPED	00:01:07			
FAN(s) STATUS	ALL FANS OFF	00:01:07	30	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:07	30	0 / 0	0.0
2 COOLING	LOOP STOPPED	00:01:07			
FAN(s) STATUS	ALL FANS OFF	00:01:07	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:07	180	0 / 0	0.0
3 HEATING	LOOP STOPPED	00:01:07			
FAN(s) STATUS	ALL FANS OFF	00:01:07	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:07	180	0 / 0	0.0
4 CoolRtrnDmpr	LOOP STOPPED	00:01:07			
FAN(s) STATUS	FAN ANTI-CYCLE	-345141:-...	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:07	180	0 / 0	0.0
5 HeatRtrnDmpr	LOOP STOPPED	00:01:07			
FAN(s) STATUS	FAN FAILURE	-4659:-42:-4	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:07	180	0 / 0	0.0
6 ECONOMIZER	LOOP STOPPED	00:01:07			
FAN(s) STATUS	ALL FANS OFF	00:01:07	180	0 / 0	No AO

MCS Total Solution for all your Control Needs

RoHS Compliant

Energy Efficient and RoHS Compliant

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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Table of Contents

Chapter - 1. Introduction to LWC MAGNUM Software

This software family is designed to control loop systems. It has been built to be generic and handle many configurations of loop controllers. The type of loop, water with pumps or air with fans, is selected. The states have been modified to reflect the type of system.

The user is provided with the exact status of what the system is doing by displaying meaningful control state names. This together with history status of all the inputs and outputs plus alarm information, provided in simple English, provides excellent user/machine interface.

1.1. To create an LWC MAGNUM configuration file:

Use an existing LWC V8, V9 or V11 configuration file and under the File selection, select 'Convert V8,V9, V11 cfg to V14 cfg'. When the file is saved it will be in the magnum format V14 with the proper number of sensors, relays, analog outputs and set points.

Using an existing LWC V14 configuration file and under the File selection, select 'Convert V14 to V17. When the file is saved it will be in the magnum format V17 with the proper number of sensors, relays, analog outputs and set points.

1.2. LWC MAGNUM V17 Software:

- Has 8 loops.
- Allows for a relay output to be specified as enabling a loop to run. This eliminates the need to wire a relay output back to a sensor input to setup the run/stop indicator when one loop is controlling (enabling) another loop to run.
- Advantage of the additional set points in the Magnum. The following items are now contained in set points making them field adjustable.
  Set point 11, indicates if lock out if lost I/O occurs (used for testing).
  Set point 12, maximum cooling and heating target adjustment.
  Set point 13, maximum heating target adjustment based upon ambient temperature.
  Set point 43, 68, 93, 118, 143, 168, 193 & 218 by loop heating target adjustment per 1 degree of ambient temperature below set point 2.
- Advantage of the additional relays and sensor on the Magnum board. The Magnum board has 10 relay outputs, 4 analog outputs and 16 sensor inputs. This single board will support most of the loop applications with out adding addition boards.
- Magnum LCD display reflects the status of the LWC software. This information will be displayed in a form similar to the status of the MCS-CONNECT program.

1.3. Common support items of the LWC MAGNUM V17 Software Family:

Loops up to 8,
Pumps per Loop up to 12,
One Variable Speed for Pumps per Loop
Stages of Heating per Loop up to 16,
One Variable Speed for Heating Stage per Loop
Stages of Cooling per Loop up to 16,
One Variable Speed for Cooling Stage per Loop
Relay Outputs up to 80,
Analog Outputs up to 28,
Sensor Inputs up to 112,
Set points up to 255,
Alarms up to 100.

1.4. About MCS-MAGNUM Hardware Support for LWC MAGNUM Software

The following MCS boards can be connected via the MCS-I/O network:

- MCS-Magnum (10 RO - 16 SI - 4 AO LWC Magnum software),
- MCS-I/O (8 RO - 8 SI - 1 AO with IO 7.00-C with a GAL 5.0 chip),
- MCS-RO8 (8 RO),
- MCS-SI8 (8 SI),
- MCS-SI16. (16 SI).

New +12 volts boards can be used in place of the above boards:

- MCS-MAGNUM-12 (10 RO - 16 SI - 4 AO LWC Magnum software),
- MCS-IO Base and MCS-IO EXT expansion boards, MCS-IO-EXT mounts on top of MCS-IO-BASE, total of: 32 Sensor Inputs, 8 Analog Outputs and 20 Relay Outputs.
- MCS-SI-BASE and MCS-SI-EXT expansion boards, MCS-SI-EXT mounts on top of MCS-SI-BASE, total of: 32 Sensor Inputs, 8 Analog Outputs.
- MCS-RO-BASE and MCS-RO-EXT expansion boards, MCS-RO-EXT mounts on top of MCS-RO-BASE, total of: 20 Relay Outputs.

This provides flexibility in configuring the individual systems to obtain the desired number of points in the most economical way.

About this Manual

The purpose of this manual is to document MCS's LWC Magnum software.

This manual documents how the LWC MAGNUM 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 MCS-MAGNUM and hopefully introduce other ways that you may benefit from the existing control strategies. Quick Reference sheets provided in the appendixes.

This manual was created using Adobe Indesign and is available as a PDF. A printed copy may be ordered, please refer to our Price Book. Or a copy of this manual may be down loaded from our web site: www.mcscontrols.com.

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

1.5. About the MCS-Magnum

The MCS-Magnum is a rugged microprocessor based controller that is designed for the hostile environment of the HVAC/R industry. It is designed to provide primary control, no mechanical controls; interface with building management systems; communicate both locally and remotely. The MCS-MAGNUM provides flexibility with set points and control options that can be selected prior to commissioning a system or when the unit is live and functioning. Displays, alarms and other interfaces are accomplished in a clear and simple language that informs the user as to the status of the controller.

The MCS-MAGNUM is designed to safeguard the system that is being controlled, eliminate the need for manual intervention and to provide a simple but meaningful man-machine-interface.

1.6. About PC Support Software for MCS

MCS-CONFIG (V17.00 or later) program provides the configuration file: points list, set points, options, etc., for all versions of software. This program is user friendly with English questions and drop down menus. It is written in the Microsoft Visual Basic programming language.

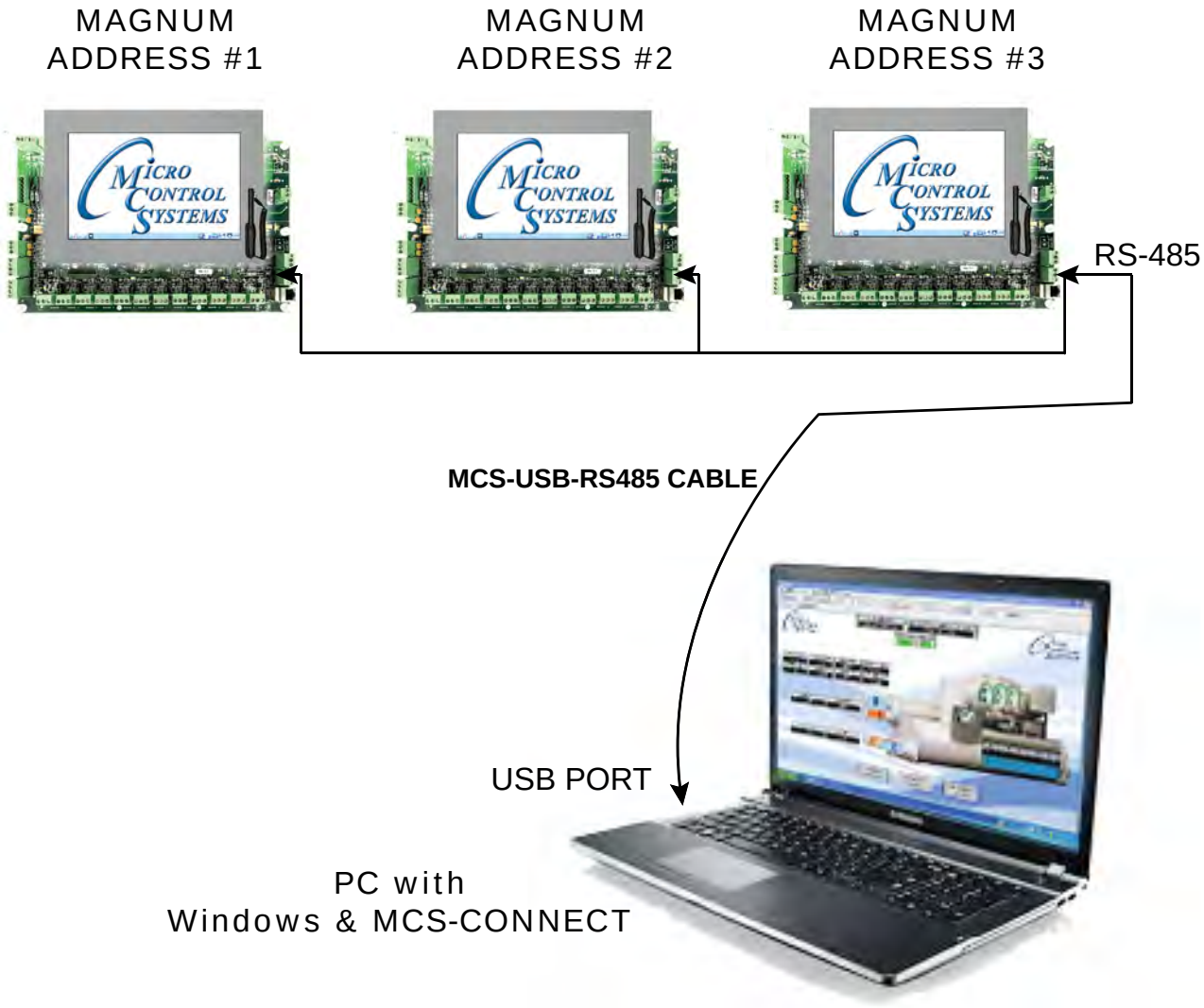
MCS-CONNECT (V17.00 or later) program provides both local and remote communications to the MCS-MAGNUM independent of the type of software. Through this program the status of the controller can be viewed and with proper authorization changes can be made to the system. Configuration files can be transmitted to or received from an MCS-MAGNUM unit. The MCS-MAGNUM automatically performs history logging; this program will graph selected items. This program is written in the Microsoft Visual C++ programming language. A general manual created under Adobe Indesign and saved as a PDF, for Windows 7 is available on our web site; www.mcscontrols.com.

Chapter - 2. MCS Communications

2.1. MCS485 Network with Local Communication

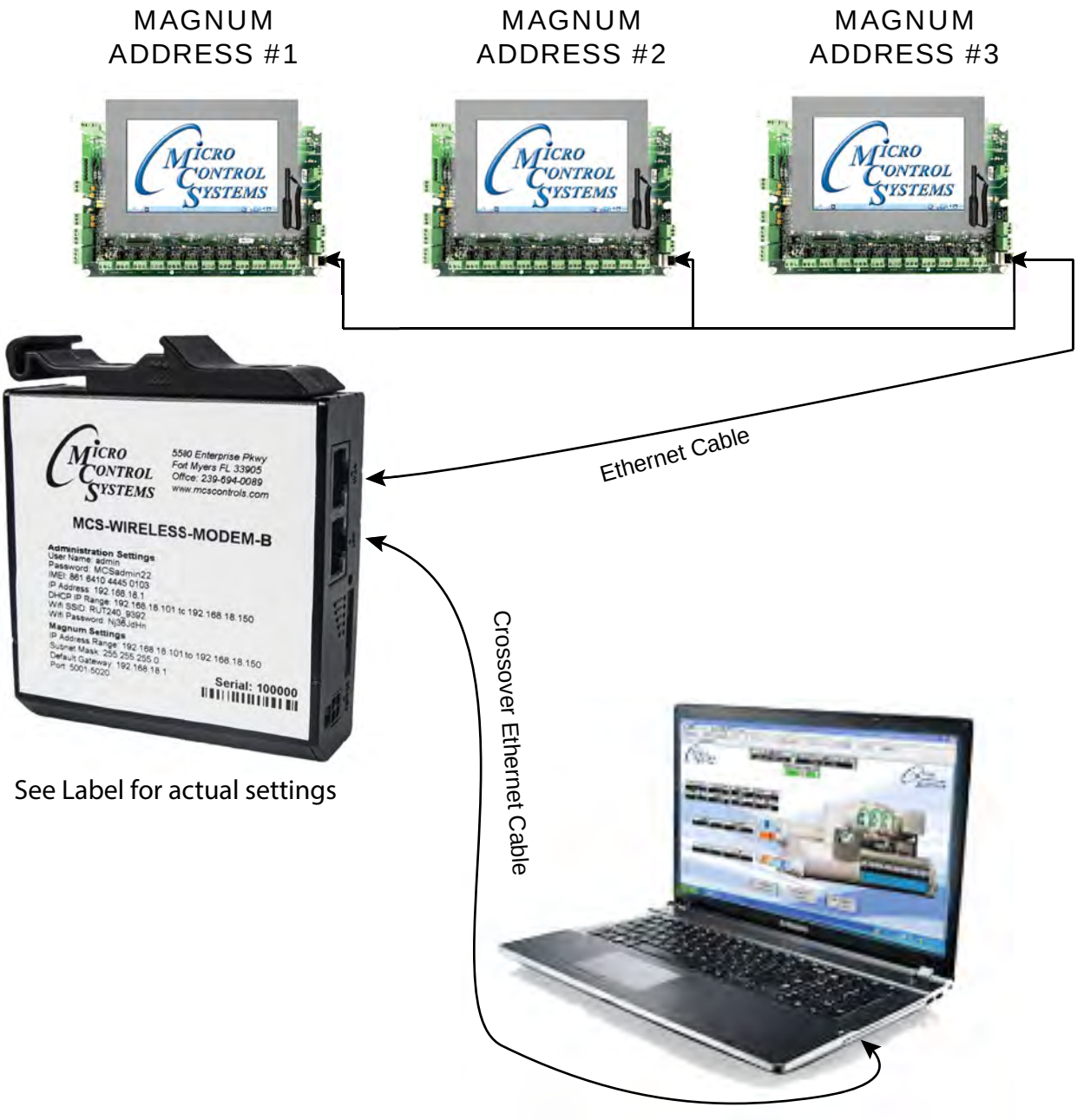
The MCS 485 Network can support up to 50 MCS-MAGNUM and its associated I/O's. Access to this network can be local or remote via a 14.4K Baud modem. There will be no degradation in the performance of the network. The PC connected to the network must be running Windows 3.1 or higher with MCS-CONNECT providing the actual interface program.

Each MCS-MAGNUM in the network must be assigned a unique address when the configuration file is build using the MCS-CONFIG program. This address will be the key in establishing communications with the appropriate MCS-MAGNUM system. This address with the proper authorization can be changed from the display / keypad of a unit.



2.2. Remote using Ethernet

When connecting directly through the 10 MBPS Ethernet port on the Magnum from a PC it is necessary to use a crossover Ethernet cable to the MCS-WIRELESS MODEM.



See Label for actual settings

MCS-WIRELESS MODEM is shipped from the factory with the IP address configured for you.
Instructions on how to setup your PC to communicate with the MCS-WIRELESS MODEM will be included.

Chapter - 3. The Magnum Keypad Display Quick Reference

Magnum Keypad Display

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

Chapter - 4. PC Support Software

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 RS-485 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.

4.1. Requirements for PC Software

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

Minimum System Required to Run Program

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

Chapter - 5. MCS LWC MAGNUM Sequence of Operation

5.1. General Information

The LWC MAGNUM unit control has been designed to provide easy to understand user interface via the on board key-pad and display or via the MCS-CONNECT program running on a Window based PC. The status; control state of the unit, of the pumps and stages of cooling or heating; is displayed. The control states are defined in this manual.

Set points can be changed in a live unit with the proper authorization. This provides the user with flexibility to change parameters during the commissioning or during the running of a live unit. The set points are defined in this manual.

The system will support up to 8 loops and control each loop independently.

Each loop will have:

- Pumps or fans can be selected and the loop states name will be changed to match the selection,
- Run/stop switch,
- Network run/stop indicator,
- Relay output run/stop indicator,
- Run override (occupancy) indicator,
- Individual schedule options can be selected,
- Up to eight pumps with one variable speed with its control sensor,
- Up to sixteen stages of cooling with one variable speed,
- Up to sixteen stages of heating with one variable speed,
- Up to sixteen stages of ice making are available,
- Either cooling or ice making can be selected plus the heating stages,
- The controlling sensor for the stages of heating and cooling-ice making can different sensors or the same,
- Each pump will have its own sensor to indicate a pump failure.

5.2. System Overview

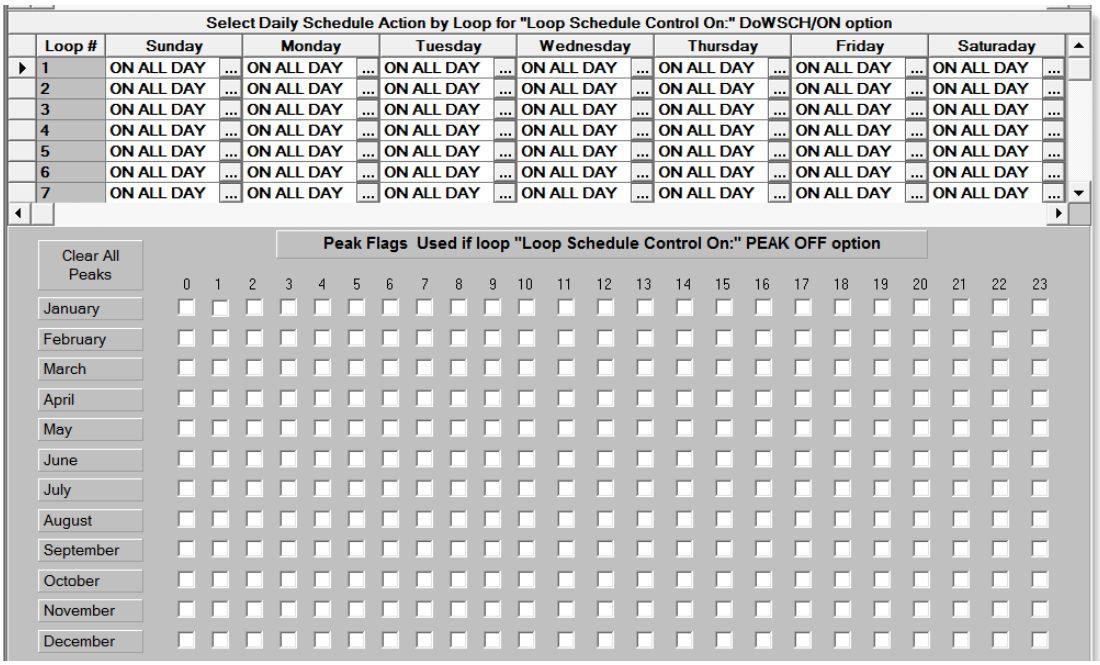
Unless there is a problem with the MCS-MAGNUM I/O network or the unit's emergency stop indicator is on, the unit will be in the UNIT-NORMAL RUN, in this state each loop will be controlled independently. If the unit state is not normal, no control of the individual loops will be executed.

The individual loops will be controlled based upon the various options that have been selected.

5.3. Schedule Options

The loop control logic has been designed to provide maximum flexibility in the scheduling of each individual loop. The following options are available:

1. **DOW SCH/ON** (Day of the Week), this option will first check the day of week schedule for the loop as specified in the MCS-CONFIG program. If this option is set to:
   - ON ALL DAY, the schedule will be true for that day;
   - OFF ALL DAY, the schedule will be false for that day;
   - DoW SCH/ON, the associate set points for this loop (set points 15, 37, 59, 81 or 103 for beginning of the first schedule and set points 16, 38, 60, 82 or 104 for the duration of the first schedule and set points 17, 39, 61, 83 or 105 for beginning of the second schedule and set points 18, 40, 62, 84 or 105 for the duration of the second schedule) will be tested to determine if the schedule is true or not. Note a schedule can extend into the next day.



2. **PEAK/OFF**, this option will look only at the Peak Hour Flags that have been set in the MCS-CONFIG program. If the time is one of the peak hours the schedule will be false and the Loop State will be LOOP STOP PEAK. If the current time is within ten minutes of the first peak hour, the schedule will be false and the Loop State will be LOOP PRE PEAK. If the current time is with in the first ten minutes following the last peak hour, the schedule will be false and the Loop State will be LOOP POST PEAK.

3. **ALWAYS ON**, this option will always set the schedule to true.

NOTE: The schedules cannot be changed from the MCS-MAGNUM keypad by selecting OPERATING SCHEDs option within the PROGRAM OPTION key or from the MCS-CONNECT program by clicking on the SCHED button. The DOW SCH/ON option's set points can be changed, other type of schedule options require a change to the MCS-CONFIG file.

5.4. Loop Pump Control Options

There are two methods of controlling the pumps on a loop:

1. **R/S ONLY**, This option allows all available pumps to be turned on, one per delay cycle, when the RUN/STOP switch is ON.
2. **R/S & TMP**, This option allows all available pumps to be turned on, one per delay cycle, when the RUN/STOP switch is ON and the temperature of the control sensor is greater than the cool target for that loop. The pumps will be turned off based upon the temperature control zone.

5.5. Ambient Control Options

There are four options (options 1, 2 & 3 require an ambient temperature sensor):

1. **LOW/LOOP OFF**, when this option is selected and the ambient temperature drops below the value in set point #2, all pumps and stages that are on will be turned off and the loop state will be LOOP STOP AMB. The purpose of this option is to stop the flow thus preventing freezing. The ambient temperature must then rise above this set point plus 5.0 degrees before the system will leave this state.
2. **LOW/RUN PUMPS**, when this option is selected and the ambient temperature drops below the value in set point #2 and the pumps are not on, all pumps will be turned on and the loop state will be LOOP AMB/PUMPS. The purpose of this option is to ensure flow thus preventing freezing. The ambient temperature must then rise above this set point plus 5.0 degrees before the system will leave this state.
3. **LOW/LOOP ON**, when this option is selected and the ambient temperature is greater than the value in set point #2, all pumps and stages that are on will be turned off and the loop state will be LOOP STOP AMB. When the ambient temperature is less than the value in set point #2 the loop will enter a normal run mode. The loop will remain in this state until the ambient temperature rises above this set point plus 5.0 degrees before the system will return to LOOP STOP AMB. The purpose of this option is to enable a loop to run when the ambient temperature is low, for example to option free cooling.
4. **NONE**, when this option is selected no action is taken based upon ambient temperature.

If either LOW/LOOP OFF or LOW/RUN PUMPS states occur and set point #2 is an ALARM type the alarm relay if one exists will be turned on and the loop state will be set accord ling. Executing a lock out reset can turn off this relay.

5.6. Ice Making Options

A loop can either provide cooling stages or ice making stages, not both. There are thee options if the loop is to make ice. If one of these options is selected, the loop can make ice once a normal scheduled on cycle. If an override switch is indicated and is active (ON) then the loop will be enabled to make ice during the override period. Once the loop begins to make ice, all ice making steps will be turned on, one per delay cycle.

1. **ICE/TEMP**, this option indicates that the loop is to make ice and is to be controlled only on temperature. This will be the sensor that is indicated as the control sensor for the pumps and cooling stages. When the control temperature is above the value in set point #4 plus the cooling target for that loop (set point #17, 39, 61, 83 or 105), the stage state will be changed to MAKING ICE, a message indicating this action will be generated and the first ice making stage will be turned on. All stages will be turned on one per delay cycle. The stage will remain in this state until the control temperature is less than set point #17 minus #19 (for loop 1, each loop has its own temperature target), at this point all steps of ice making will be turned off. When viewing the system with MCS-CONNECT, the status line of the stage for that loop will indicate MAKING ICE/TEMP.

2. CE/LEVEL, this option indicates that the loop is to make ice and is to be controlled only on level of the ice. This will be the sensor that is indicated as the ice level indicator. When the ice level sensor is less than the value in set point #6, the stage state will be changed to MAKING ICE, a message indicating this action will be generated and the first ice making stage will be turned on. All stages will be turned on one per delay cycle. The stage will remain in this state until ice level is greater than set point #5, at this point all steps of ice making will be turned off. When viewing the system with MCS-CONNECT, the status line of the stage for that loop will indicate MAKING ICE/LEVEL.
3. ICE/BOTH, this option indicates that the loop is to make ice and is to be controlled both on temperature and on the level of the ice. Both the temperature and ice level conditions must be meet before ice making will begin. If either the temperature or ice level indicates that the ice making should stop, all steps of ice making will be turned off. When viewing the system with MCS-CONNECT, the status line of the stage for that loop will indicate MAKING ICE/TP&LV.

5.7. Loop Control

There can be three run/stop indicators per loop. If specified each of these indicators must indicate the run mode. If any one is specified and indicates stop, the system will not run and its state will be LOOP STOP SW.

The run/stop indicators are:

1. A sensor input type digital that is selected in the Loop Run/Stop cell for that loop. When the sensor is on it will indicate run.
2. A sensor input type 485 RUN, this indicates that the value will be received via the RS485 communications from an external source. This is selected in the Network Run/Stop cell for that loop.
3. A relay output can be indicated, this is selected in the RO Run Enable cell for that loop. This gives one loop the capability to enable another loop to run. This is a new feature in the Magnum software, which eliminates the need to hard wire a relay output back to a sensor input to enable a loop to run.

The loop's RUN/STOP switch must indicate RUN before the system will attempt to start the loop. When the switch is set to STOP the Loop State will be LOOP STOP SW. If all run/stop indicators are in the RUN position or not specified, the loop's schedule will be checked. If the schedule is false, the Loop State will be LOOP STOP SCH, LOOP STOP PEAK, LOOP PRE PEAK or LOOP POST PEAK, depending on the schedule option selected for that loop. If the schedule is true, the Loop State will be LOOP NORMAL and system will begin to control the pumps, heating and cooling/ice making stages on the loop.

When the loop state is in any of the stopped states, the loop's override indicator will be tested. If on the loop state will be LOOP OVER RIDE and control of all functions of that loop will be executed. If the loop has been selected to make ice, one cycle of ice making will be allowed.

The ambient temperature and ambient control option will be checked regardless of the loop state. Appropriate action will be taken based upon the ambient temperature option selected.

The loop control functions consist of pump or fan control and controlling the steps of heating and cooling/ice making. The various options will determine how these elements are controlled.

Before any steps of heating or cooling/ice making can be turned on, the pumps must be on for the time contained in set point #10. This is to ensure proper flow through the loop.

5.8. Common Pump or Fan Setup

There are two methods of controlling and indicating if a pump/fan fault exists.

If the Common Flow Option cell for that loop is set to YES then only one fault, one flow indicator and one set of pressure sensor will be checked for all the pumps on that loop.

If the Common Flow Option cell for that loop is set to NO then there must be one fault, one flow indicator and one set of pressure sensor each pump that is on that loop.

5.9. Pump or Fan Control

There can be a maximum of eight pumps or fans per loop.

If a pump or fan fault sensor is provided it can be a digital input and if on or an analog input and if its value is less than its corresponding set point 41, 66, 91, 116,141 or 166, that individual pump or fan will be locked off and its state changed to FAULT. This action will NOT change the pump or fan state of the loop but it will reduce he number of pumps or fans on by one.

Two methods of controlling the pumps or fans in a loop are available.

If R/S ONLY was selected in the MCS-CONFIG program for this loop, then when the loop is running a pump or fan will be turned on. If there are multiple pumps or fans, additional pumps or fans will be turned on until the maximum pumps or fans allowed on, is reached.

If R/S &TMP CTL was selected in the MCS-CONFIG program for this loop, then when the loop is running a pump or fan will be turned on only if a pump or fan needed to support the heating or cooling/ice making stages.

Pumps or fans will not be turned off until all stages of heating and cooling/ice making are off and the stage state timer is greater than the value in set point #10, PmpOnOffDely.

If variable speed control has been specified, when the first pump or fan is turned on the system will vary the speed of the associated Analog Output based upon the target zone that has been established and the step points that control the minimum, maximum and speed adjustment.

5.10. Heating Temperature Target Adjustment

The heating target for a loop can be adjusted based upon the ambient temperature. For each degree that the ambient temperature is below set point #2 the heat target for each individual loop will be increased by the value of set point #43, 68, 93, 118, 143, 168, 193, or 218 (HEAT ADJ/AMB) for that loop. The HEAT ADJ/AMB must be active for that loop for this adjustment to be made. The maximum amount of adjustment will be set by set point #13 MAX HEAT ADJ.

5.11. LWC MAGNUM Temperature Control Zone Control for Heating and Cooling

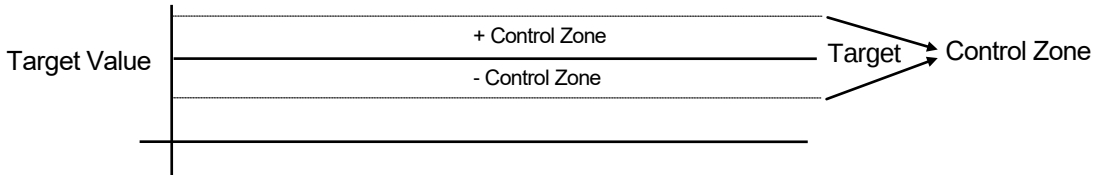
This control strategy is based upon developing a control zone and then to step the steps of heating or cooling or vary the speed of a pump or fan to maintain the control sensor reading within this zone. A unique control zone will be developed for a variable speed or fan, cooling or heating for each loop. To accomplish this the system will constantly monitor the control value, its rate of change and position in relationship to the control zone.

5.11.1 Target

The control target for each loop is specified for cooling, set point 28, 53, 78, 103, 128, 153, 178, or 203; and for heating, set points 29, 54, 79, 104, 129, 154,179, or 204.

5.11.2 Control Zone

Adding and subtracting the value in set point 30, 55, 80, 105,130 or 155, to both cooling and heating targets, develop the control zone.



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

5.11.3 Controlling Sensor

This is the sensor that has been specified in the MCS-CONFIG program as providing the control value reading. Each loop can have a unique control sensor. If the loop has pump or fan variable speed a unique sensor will be specified to control the speed of the pump or fan.

5.11.4 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.

5.11.5 Step Delay

The system will not attempt to take action until the Step Delay reaches zero. Set point 31, 56, 81, 106, 131 or 156 contains the initial value for the staging of heating or cooling. All step delays are decrement each second.

5.12. Heating Cooling Stage Control

The heating and cooling stages have the same temperature control sensor. Cooling or heating stages will be changed based upon this control temperature and it relationship to the control zone and its rate of change.

5.13. Variable Speed Control

If variable speed has been indicated for either or both the cooling/ice making or heating stages, the system will vary the speed of the associated Analog Output based upon the target zone that has been established and the step points that control the minimum, maximum and speed adjustment. An addition stage will not be added unless the maximum value has been reached, set point #34, 59, 84, 109, 134, 159, 184, or 209 when an additional stage is added, the Analog Output value will be set to its minimum speed, set point #33, 58, 83, 109, 133, 158, 183, or 208.

5.14. Unit is in Cooling

The loop is in a run mode and the loop water or air temperature indicates that cooling is required. The action of the system is display in the Staging Status section of the Control Status.

5.14.1 Temperature is above the Control Zone

If the temperature is dropping, rate of change, is greater than the value in set point #32, 57, 82, 107, 132, 157, 182, or 209; StageROC LP x. The system will hold, COOL-HOLDING, the temperature is moving toward the target at a sufficient speed.

If not, then the system will add one stage of cooling, COOL LOADING.

5.14.2 Temperature is above the Target but with in the Control Zone

If the temperature is with in 2.0 degrees of the target, the system will hold, COOL-TMP HOLDG.

If not and the temperature is not dropping, then the system will add stages of cooling, COOL LOADING. Else the system will hold, COOL-ROC HOLDG.

5.14.3 Temperature is below the Target but with in the Control Zone

If the temperature rate of change is ½ of the maximum positive, set point #32, 57, 82, 107, 132, 157, 182, or 209; StageROC LP x, the system will reduce the number of stages of cooling by one, COOL-ROC UNLDG.

Else the system will hold, COOL HOLDING.

5.14.4 Temperature is below the Control Zone

If the temperature is increasing, rate of change, is greater than the value in set point #32, 57, 82, 107, 132, 157, 182, or 209; StageROC LP x. The system will hold, COOL-ROC HOLDG, the temperature is moving toward the target at a sufficient speed.

If not, then the system will reduce stages of cooling, COOL-ROC UNLDG.

5.15. Rotation of Cooling Stages

The individual loop cooling target set point will indicate if the cooling stages are to be rotated. If the time in safety is not zero the chiller stages will be rotated. Rotation is based upon first on first off. When the lead stage is turned off the next available stage will be set to the lead.

For example if 4 stages and the lead is stage 1, stage 1 will be turned on then stage 2. If less cooling is needed stage 1 will be turned off and stage 2 will become the lead. If more cooling is required stage 3 will be turned on followed by stage 4 then stage1. If less cooling is needed stage 2 will be turned off and stage 3 will become the lead stage.

5.16. Cooling Stages Fault Indicators

Cooling stage faults have been added. For multiple stages these must be consecutive digital inputs. When the fault is on the associated stage will be marked as off and it will be skipped in the staging sequence.

Loop Information							
Ice Making Option:		# of Cooling Stages	1st Cool Stage RO	Cool Variable Speed AO	1st Cool Stage Fault	Ice Level Indicator	Tank Fill Indicator
NONE	...	0	Not Used	Not Used	Not Used	Not Used	Not Used
NONE	...	0	Not Used	Not Used	Not Used	Not Used	Not Used
NONE	...	0	Not Used	Not Used	Not Used	Not Used	Not Used
NONE	...	0	Not Used	Not Used	Not Used	Not Used	Not Used
NONE	...	1	SPARE6-2	BYPS VALVE	Not Used	Not Used	Not Used

5.17. Unit is in Heating

The loop is in a run mode and the loop water or air temperature must be heated. The action of the system is display in the Staging Status section of the Control Status.

5.17.1 Temperature is above the Control Zone

If the temperature is dropping, rate of change is greater than the value in set point #32, 57, 82, 107, 132, 157, 182, or 207; StageROC LP x. The system will hold, HEAT-ROC HOLDG, the temperature is moving toward the target at a sufficient speed.

If not, then the system will reduce the number stages of heating, HEAT-UNLOADING.

5.17.2 Temperature is above the Target but with in the Control Zone

If the temperature is dropping, rate of change is greater than the value in set point #32, 57, 82, 107, 132, 157, 182, or 207; StageROC LP x. The system will reduce the number of stages of heating by one, HEAT-ROC UNLDG, the temperature is moving away from the target.

If not, the system will hold, HEAT HOLDING.

5.17.3 Temperature is below the Target but with in the Control Zone

If the temperature is with in 2.0 degrees of the target, the system will hold, HEAT-TMP HOLDG.

Else, if the temperature rate of change has not increased, the system will turn on a stage of heating, HEAT LOADING. The temperature is not moving toward the target.

Else the system will hold, HEAT-ROC HOLDG.

5.17.4 Temperature is below the Control Zone

If the temperature is increasing, rate of change, is greater than the value in set point #32, 57, 82, 107, 132, 157, 182, or 207; StageROC LP x. The system will hold, HEAT-ROC HOLDG, the temperature is moving toward the target at a sufficient speed.

If not, then the system will add stages of heating, HEAT-LOADING.

5.18. Unit is Making Ice

The loop is in a run mode and the loop indicates that ice is to be made. The action of the system is display in the Staging Status section of the Control Status. One step will be turned on per delay cycle until all available steps are on.

When the unit begins making ice based upon the control criteria, the state will indicate making ice and an alarm “MAKING ICE #n” will be generated. The n will indicate the loop number. When the system stops making ice and an alarm “STOP MAKING #n” will be generated and the state will be ALL STAGES OFF.

Chapter - 6. LWC MAGNUM Control States

We should consider the MCS-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 package.

As we review the various states, we must remember that a Loop Control package consists of a number of different parts or functions: the basic unit and the individual loops with pumps or fans and stages of cooling/ice making and heating. To control these functions the states will be divided into four sections:

- Unit Control States
- Loop Control States
- Pump or Fan Control States
- Stage Control States (either heating or cooling/ice making)

All control information is displayed on the 2x16 LCD. Press the SERVICE DIAGNOSTICS key until the option is the CONTROL STATUS, then press the ENTER key. The INCREASE and DECREASE keys can be used to scroll through the various state screens. Or it can be accessed via the MCS-CONNECT program under status screen by clicking on the CONTROL STATUS button.

6.1. Control Status Display (from the MCS-MAGNUM keypad)

The following is an example of a unit with a four-loop configuration file. The first loop will control the pumps and allow the other loops to run if cooling, loop 2, heating, loop 3, or reheating, loop 4, are needed.

Pressing the Menu Button and then selecting Status will display the following:

By pressing the PG ↑ you will go back to the previous display OR PG ↓ you will get information on the next circuit.

6.1.1 The CURRENT STATE OF THE UNIT.

ACTUAL DISPLAY	DESCRIPTION
09:55 Unit with 4 Loops UNIT-NORMAL RUN 025:42:33	HH:MM Unit with number of loops CURRENT UNIT STATE TIME IN CURRENT STATE

6.1.2 The Loop 1 Status base screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#1 CONTROL LOOP NORMAL 000:00:30 FANS LOADING 000:00:30 DELY 7 W/A/Avail 3/ 3/ 3 PG ↑ PG ↓	HH:MM Identifies loop # & its name CURRENT LOOP STATE TIME IN CURRENT STATE CURRENT PUMP/FAN STATE TIME IN CURRENT STATE Delay counter Wanted On/Actual On/Available PUMP/FAN stages PAGE UP PAGE DN

6.1.3 The Loop 1 pump/fan status screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#1 CONTROL Individual Fan Status 1<-ON 2 ON 3 ON	HH:MM Identifies loop # & its name Identifies fan status Display all pumps/fans that are on this loop and there status. Lead is indicated by <-

6.1.4 The Loop 1 stage status screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#1 CONTROL LOOP NORMAL 000:00:30 CL/HT COOL-LOADING 000:00:30 DELY 17 W/A/Avail 1/ 1/ 1 PG ↑ PG ↓	HH:MM Identifies loop # & its name CURRENT LOOP STATE TIME IN CURRENT STATE “CL/HT” loop has both cool & heating stages CURRENT STAGE STATE TIME IN CURRENT STAGE STATE Delay counter Wanted On/Actual On/Available cooling/heating stages

6.1.5 The Loop 2 Status base screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#2 CoolLoop LOOP NORMAL 000:00:30 MAX FANS ON 000:00:30 DELY 7 W/A/Avail 0/ 0/ 0 PG ↑ PG ↓	HH:MM Identifies loop # & its name CURRENT LOOP STATE TIME IN CURRENT STATE CURRENT PUMP/FAN STATE TIME IN CURRENT STATE Delay counter Wanted On/Actual On/Available PUMP/FAN stages (This loop has no pumps or fans)

6.1.6 The Loop 2 pump/fan status screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#2 CoolLoop Individual Fan Status No fans on loop	HH:MM Identifies loop # & its name Identifies fan status Display all pumps/fans that are on this loop and there status. Lead is indicated by <- (These loop has no fans) PAGE UP PAGE DN

6.1.7 The Loop 2 stage status screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#2 CoolLoop LOOP NORMAL 000:00:30 COOL COOL-LOADING 000:00:30 DELY 17 W/A/Avail 1/ 1/ 1 SPD=100% PG ↑ PG ↓	HH:MM Identifies loop # & its name CURRENT LOOP STATE TIME IN CURRENT STATE "Cool" loop has only cooling stages CURRENT STAGE STATE TIME IN CURRENT STAGE STATE Delay counter Wanted On/Actual On/Available cooling stages

6.1.8 The Loop 3 Status base screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#3 HeatLoop LOOP STOP SW 000:00:30 MAX FANS ON 000:00:30 DELY 7 W/A/Avail 0/ 0/ 0 PG ↑ PG ↓	HH:MM Identifies loop # & its name CURRENT LOOP STATE TIME IN CURRENT STATE CURRENT PUMP/FAN STATE TIME IN CURRENT STATE Delay counter Wanted On/Actual On/Available PUMP/FAN stages (This loop has no pumps or fans)

6.1.9 The Loop 3 pump/fan status screen.

ACTUAL DISPLAY	*DESCRIPTION*
09:56 LOOP#3 HeatLoop Individual Fan Status No fans on loop PG ↑ PG ↓	HH:MM Identifies loop # & its name Identifies fan status Display all pumps/fans that are on this loop and there status. Lead is indicated by <- (This loop has no pumps or fans)

6.1.10 The Loop 3 stage status screen.

ACTUAL DISPLAY	*DESCRIPTION*
09:56 LOOP#3 CONTROL LOOP STOP SW 000:00:30 Heat ALL STAGES OFF 000:00:30 DELY 17 W/A/Avail 0/ 0/ 1 PG ↑ PG ↓	HH:MM Identifies loop # & its name CURRENT LOOP STATE TIME IN CURRENT STATE "Heat" loop has only heating stages CURRENT STAGE STATE TIME IN CURRENT STAGE STATE Delay counter Wanted On/Actual On/Available heating stages

6.1.11 The Loop 4 Status base screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#4 ReHtLoop LOOP NORMAL 000:00:30 MAX FANS ON 000:00:30 DELY 7 W/A/Avail 0/ 0/ 0 PG ↑ PG ↓	HH:MM Identifies loop # & its name CURRENT LOOP STATE TIME IN CURRENT STATE CURRENT PUMP/FAN STATE TIME IN CURRENT STATE Delay counter Wanted On/Actual On/Available PUMP/FAN stages (This loop has no pumps or fans)

6.1.12 The Loop 4 pump/fan status screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#4 ReHtLoop Individual Fan Status No fans on loop PG ↑ PG ↓	HH:MM Identifies loop # & its name Identifies fan status Display all pumps/fans that are on this loop and there status. Lead is indicated by <- (This loop has no pumps or fans)

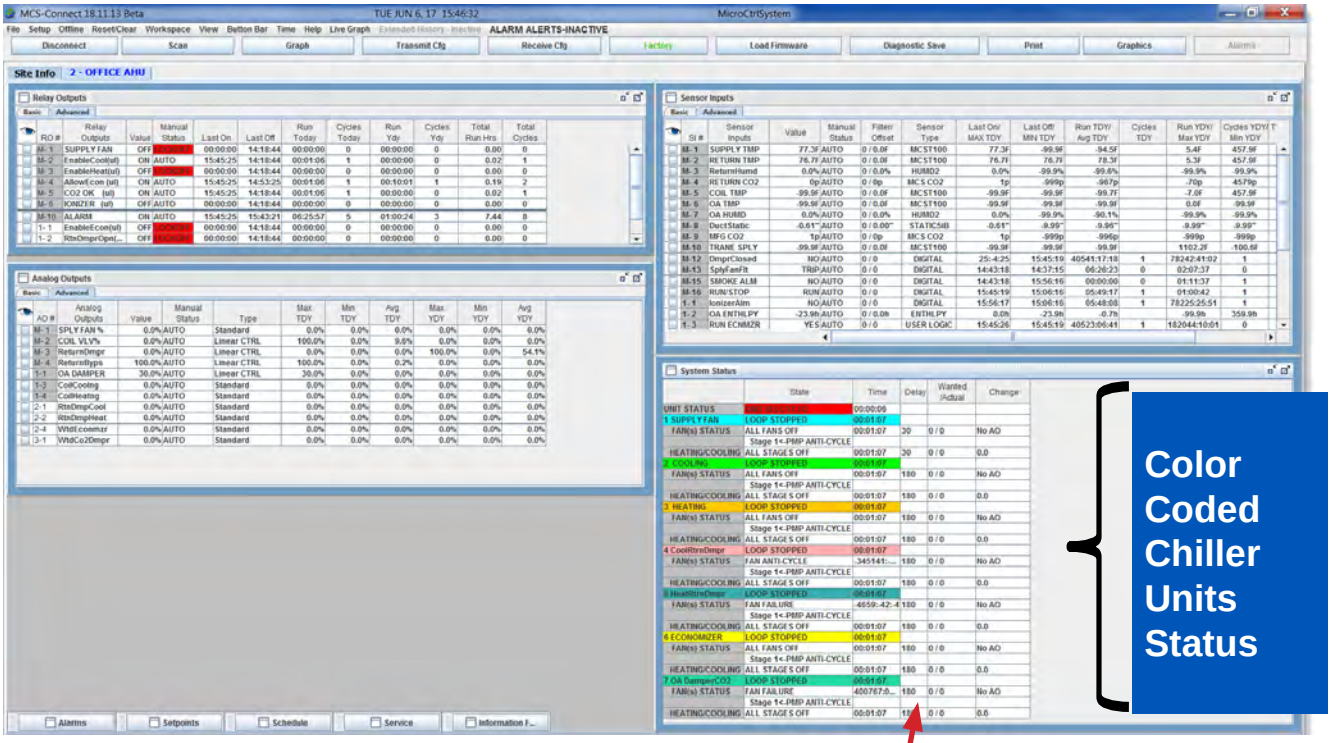
6.1.13 The Loop 4 stage status screen.

ACTUAL DISPLAY	DESCRIPTION
09:56 LOOP#4 ReHtLoop LOOP NORMAL 000:00:30 Heat ALL STAGES OFF 000:00:30 DELY 17 W/A/Avail 0/ 0/ 1 PG ↑ PG ↓	HH:MM Identifies loop # & its name CURRENT LOOP STATE TIME IN CURRENT STATE “Heat” loop has only heating stages CURRENT STAGE STATE TIME IN CURRENT STAGE STATE Delay counter Wanted On/Actual On/Available heating stages

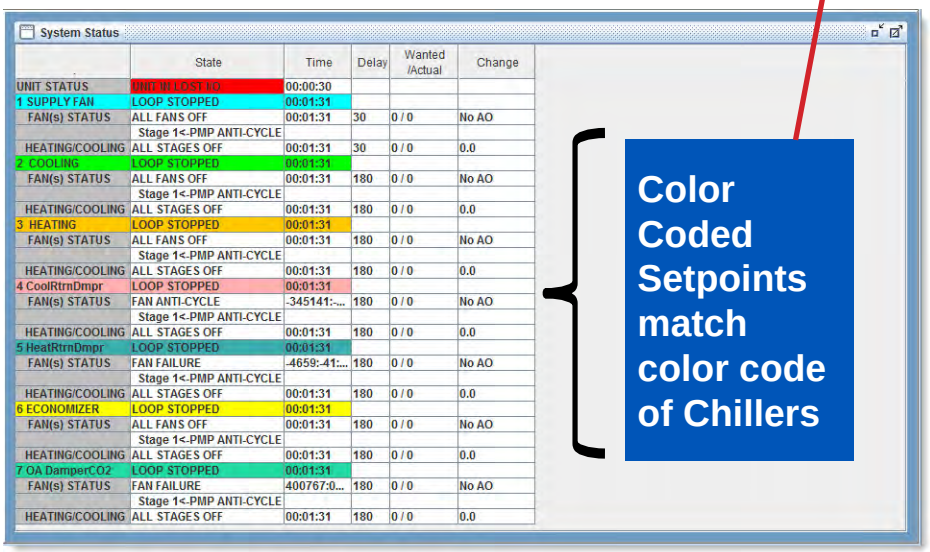
Page DN will return to first screen
Page UP will return to previous screen

6.2. Control Status Display (from the MCS-CONNECT program)

The status of the unit can be viewed from the MCS-CONNECT program by accessing the CONTROL STATUS key under status screen. The following will be displayed:



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



	State	Time	Delay	Wanted /Actual	Change
UNIT STATUS	UNIT W/LOST I/O	00:00:30			
1 SUPPLY FAN	LOOP STOPPED	00:01:31			
FAN(s) STATUS	ALL FANS OFF	00:01:31	30	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:31	30	0 / 0	0.0
2 COOLING	LOOP STOPPED	00:01:31			
FAN(s) STATUS	ALL FANS OFF	00:01:31	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:31	180	0 / 0	0.0
3 HEATING	LOOP STOPPED	00:01:31			
FAN(s) STATUS	ALL FANS OFF	00:01:31	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:31	180	0 / 0	0.0
4 CoolRtrnDmpr	LOOP STOPPED	00:01:31			
FAN(s) STATUS	FAN ANTI-CYCLE	-345141:-...	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:31	180	0 / 0	0.0
5 HeatRtrnDmpr	LOOP STOPPED	00:01:31			
FAN(s) STATUS	FAN FAILURE	-4659:-41:...	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:31	180	0 / 0	0.0
6 ECONOMIZER	LOOP STOPPED	00:01:31			
FAN(s) STATUS	ALL FANS OFF	00:01:31	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:31	180	0 / 0	0.0
7 OA DamperCO2	LOOP STOPPED	00:01:31			
FAN(s) STATUS	FAN FAILURE	400767:0...	180	0 / 0	No AO
	Stage 1<-PMP ANTI-CYCLE				
HEATING/COOLING	ALL STAGES OFF	00:01:31	180	0 / 0	0.0

The number of the loop and its name will be displayed in the row that is high lighted. The loop state and the time in that state will also be displayed on that row. The following rows will contain the status of the pumps/fans that are on that loop with the lead pump being indicated with <- symbol. If the pump/fan is to be modulated, the cell in CHANGE column will contain AO followed by the delay timer value. The status of the heating or cooling that has been setup for the loop will follow the pump information.

This information will be repeated for each active loop.

Information displayed in the status grid contains one line for the unit plus three lines for each loop. Only the number of loops that is specified for this system will be display. A number on the loop status line identifies each loop.

UNIT STATUS line:

- **UNIT STATE** – State of unit
- **TIME** – time in that state, if the state is UNIT IN POWER UP time will decrement to zero

Line one of a loop (only active loops will be displayed):

- **LOOP NUMBER** with the loop name & “LOOP STATUS” - This identities the beginning of a loop
- **STATE** – loop state.
- **TIME** – time in that state.
- **INDIVIDUAL PUMP or FAN STATE** – There can be a maximum of four pumps or fans per loop.

The pump or fan number and its state are shown. This state cannot be accessed by the

- MCS-MAGNUM keypad.

Line two of a loop (only active loops will be displayed) will begin the pump status:

- **“PUMP or FAN STATUS”** - This identities that this line contains information on the staging of the pumps or fans on this loop. It is NOT the status of the individual pumps or fans on this loop.
- **STATE** – pump or fan staging state.
- **TIME** – time in that state.
- **DELAY** – Delay between decisions on pump or fan staging. This counter that will be set to the set point value contained in PumpStepDely, #5 and counted down to zero.
- **WANTED** – Number of pumps or fans that the system wants on. If a pump or fan is in the ANTI-CYCLE state, the system will wait until it moves to the OFF state; however if the pump or fan is in the FAILED state, the system will attempt to move to the next pump or fan if available.
- **ACTUAL** – Number of pumps or fans that the system has turned on.
- **CHANGE** – If there is AO (variable speed) pump or fan associated with this loop, this cell will contain AO and its delay counter. This is the delay between decisions on adjusting the pump or fan speed. This counter that will be set to the set point value contained in PumpVSDelay, #6 and counted down to zero. If there is no AO, this cell will contain “No AO”.

Line three through the number of pumps on the loop (only active loops will be displayed) will contain the pump status:

- **“PUMP #x”** – the number of the pump (1 through 4) will be indicated followed by its status: ON, OFF, FAILED etc. Only the number of pumps specified for that loop will be displayed.
- Next line of a loop (only active loops will be displayed):
- **“HEATING or COOLING STATUS/ice making”** - This identities that this line contains information on the stages of heating or cooling/ice making steps.
- **STATE** –stage state of the heating or cooling/ice making.
- **TIME** – time in that state.
- **DELAY** – Delay between decisions on staging. This counter that will be set to the set point value contained in StageDelyLPx, #56 – 60 (each loop has its own set point) and counted down to zero.
- **WANTED** – Number of stages that the system wants on. Before a stage can be wanted on, a pumpor fan must be on for the time specified in set point PmpOnOffDely, #10.
- **ACTUAL** – Number of stages that the system has turned on.
- **CHANGE** – This is the rate of change for the control sensor for this loop.

Chapter - 7. LWC MAGNUM Control State Definitions

7.1. Unit Control States (number)

UNIT IN I/O LOST (1)

This state will be entered whenever the MCS-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 alarm, which identifies which I/O is off-line, and a lost IO shutdown alarm. The lockout-reset key must be depressed to reset the system, after the lost I/O has been corrected. In this state, all RO's except ALARM RO are turned OFF.

UNIT IN LOCKOUT (2)

This state is entered whenever emergency stop switch is on. 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 turned OFF & placed in the 'LOCKOUT' state.

UNIT IN POWER UP (3)

This state is entered when the MCS-MAGNUM is powered up or the system has been reset. The system will remain in this state for 60 seconds; this is no longer a set point. 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.

UNIT NORMAL RUN (4)

This state is entered when the emergency stop switch is off, in the stop position, communications to all I/O boards has been established and the system is not in power up. When the chiller is in this state, the individual loops will be checked to determine if they should be running.

7.2. Loop Control State (number)

These states indicate the status of the individual loops.

LOOP STOPPED (1)

LOOP STOP SW (2)

This state is entered when the run/stop switch, if used, is in the stop (off) position. The loop will not leave this state unless the run/stop switch is turned on (run), the loop override switch is on or the ambient temperature test is active and the temperature is above the set point AMB OFF TEMP, #2.

LOOP STOP SCH (3)

This state is entered when the run/stop switch, if used, is in the run (on) position and the schedule option for the loop is DoW SCH/ON and both of the two schedules for this loop are false. The loop state will remain in this state unless one of the two schedules for this loop becomes true, the loop override switch is on or the ambient temperature test is active and the temperature is above the set point AMB OFF TEMP, #2.

LOOP STOP PEAK (4)

This state is entered when the run/stop switch, if used, is in the run (on) position and the schedule option for the loop is PEAK/OFF and hour is a peak hour. The loop state will remain in this state until the hour is no longer a peak off hour, the loop override switch is on or the ambient temperature test is active and the temperature is above the set point AMB OFF TEMP, #2. All pumps and steps of staging are off in this state.

LOOP POST PEAK (5)

This state is entered when the run/stop switch, if used, is in the run (on) position and the schedule option for the loop is PEAK/OFF and time is within the first ten minutes of the first non peak hour. The loop state will remain in this state until the minutes exceed this value, the loop override switch is on or the ambient temperature test is active and the temperature is above the set point AMB OFF TEMP, #2. All pumps and steps of staging are off in this state.

LOOP PRE PEAK (6)

This state is entered when the run/stop switch, if used, is in the run (on) position and the schedule option for the loop is PEAK/OFF and next hour is a peak hour and the current minute is within ten minutes of the top of the hour.

The loop state will remain in this state until the next hour is reached, the loop override switch is on or the ambient temperature test is active and the temperature is above the set point AMB OFF TEMP, #2. All pumps and steps of staging are off in this state.

LOOP STOP AMB (7)

This state is entered when the loop is in a stopped state due to:

1) the ambient temperature option of turn off all pumps/fans and cooling/heating stages if the temperature is below the set point AMB OFF TEMP, #2. The purpose of this state is to prevent freezing. The loop will remain in this state until the ambient temperature raises 5 degrees above the set point AMB OFF TEMP, #2. Or

2) The ambient temperature option of turn on all pumps/fans and cooling/heating stages if the temperature is above the set point AMB OFF TEMP, #2. Once the loop is out of this state, it will remain in a normal run until the ambient temperature raises 5 degrees above the set point AMB OFF TEMP, #2, then it will return to the LOOP STOP AMB state.

LOOP NORMAL (8)

This state is entered when the run/stop switch, if used, is in the run (on) position and schedule for this loop is true. The loop state will remain in this state unless a schedule for this loop become false or the run/stop switch, if used, is in the stop (off) position. In this state, the system determines what pumps or fans and stages of cooling/ice making or heating or ice making should be on.

LOOP OVERRIDE (9)

This state is entered when the loop is stopped state and the loop override switch is turned on. The loop state will remain in this state until the override switch is off plus the time specified set point #1. This state is the same as the LOOP NORMAL state.

LOOP AMB/PUMPS (10)

This state is entered when the loop is in a stopped state due to and the ambient temperature option of turn on the loop pumps if when the temperature is below the set point AMB OFF TEMP, #2. In this state only the loop pumps or fans will be turned on. The purpose of this state is to circulate the liquid to prevent freezing. The loop will remain in this state until the ambient temperature raises 5 degrees above the set point AMB OFF TEMP, #2.

LOOP SI FAULT (11)

If the ambient temperature sensor is specified it is reading must be greater than –99.9 and less than 999.9, if not this state will be entered. The loop control sensor that is specified its reading must be greater than –99.9 and less than 999.9, if not this state will be entered. Note, if either of these sensors are a USER DEFINED type this test is not made. When state is entered when the loop is in a stopped state and a error message generated specifying the sensor that failed.

7.3. Pump or Fan Control States (number)

These states indicate the status of the pumps or fans that are on a loop. These are not the state of the individual pumps or fans. If the option of loop with water and pumps is selected then the states will indicate pumps else fans will be indicated.

PMP FAILURE or FAN FAILURE (1)

PMP ANTI-CYCLE or FANS ANTI-CYCLE (2)

ALL PUMPS OFF or ALL FANS OFF (3)

All pumps or fans on the loop are off.

PMPS UNLOADING or FANS UNLOADING (4)

The loop needs another pump or fan off. The wanted on count is less than the actually on count. The system will turn off a pump or a fan and reduce the number of actually on by one. The pumps or fans will not be turned off until after all stages of heating and cooling/ice making have been turned off and the stage state timer is greater than set point PumpOnOffepDely, #10. This is to insure that proper flow is maintained.

MAX PUMPS ON or MAX FANS ON (5)

All available pumps or fans are on.

PUMPS LOADING or FANS LOADING (6)

The loop needs another pump or fan on. The wanted on count is greater than the actually on count.

7.4. Individual Pump or Fan Control States (only viewed from MCS-CONNECT)

These states can only be viewed from MCS-Connect. They indicate the status of the individual pumps or fans that are on a loop. There can be a maximum of four pumps or fans per loop.

FAILED (1)

This pump or fan has failed, its corresponding fault sensor has indicated a fault and the relay output for this pump or fan has been LOCKED OFF. Manual intervention is required by executing a lockout reset either form the MCS-MAGNUM keypad or MCS-CONNECT.

ANTI-CY (2)

This pump or fan has been turned off and it will remain in this state for the time specified in set point 4, PUMP ANTICYC. The relay output for this pump or fan has been turned OFF. It cannot be turned on until it has been move to the OFF state.

OFF (3)

This pump or fan has been turned off and has been move from PUMP ANTICYC to the OFF state. It can now be turned on if the loop needs this pump or fan. The relay output for this pump or fan is OFF.

ON (4 or 5)

This pump or fan has been turned on. The relay output for this pump or fan is ON and it is running normally.

WantdON (6)

The system has determined that a pump is wanted on but it can not be turned at this time. May be waiting for a time delay to count down or there are no pumps available.

7.5. Stage Control State (number)

These states indicate the status of the stages of heating or cooling or ice making that are on the loop.

ALL STAGES OFF (1)

All of the stages of heat heating or cooling/ice making are on the loop are off. The loop does not need any stages to be on.

These states are active when the loop is in a cooling mode.

COOL- HOLDING (2)

The control temperature is above the cooling target but within the zone and the temperature is falling at a rate of change greater than one half the set points StageROC LPx, #32, 57, 82, 107, 132, 157,182, or 207. No change to the number of stages of cooling is required.

COOL-ROC HOLDG (3)

The control temperature is above the cooling target zone but the temperature is falling at a rate of change greater than set point StageROC LPx, #32, 57, 82, 107, 132, 157,182, or 207. No change to the number of stages of cooling is required.

COOL-TMP HOLDG (4)

The control temperature is within the cooling target zone. No change to the number of stages of cooling is required.

COOL-UNLOAD (5)

The control temperature is below the cooling target zone and the temperature is falling at a rate of change greater

than set point StageROC LPx, ##32, 57, 82, 107, 132, 157,182, or 207. The number of stages of cooling wanted will be reduced by one.

COOL-ROC UNLDG (6)

The control temperature is below the cooling target but within the control zone and the temperature is falling at a rate of change greater than set point StageROC LPx, #32, 57, 82, 107, 132, 157,182, or 207. The number of stages of cooling wanted will be reduced by one.

COOL-LOADING (7)

The control temperature is above the cooling target zone and the temperature is not falling at a rate of change greater than set point StageROC LPx, ##22, 44, 64, 86, 108, 133, or 158; or the control temperature is above the cooling target but within the control zone and the temperature is not moving toward the cooling target. The number of stages of cooling wanted will be increased by one.

These states are active when the loop is in a heating mode.

HEAT- HOLDING (8)

The control temperature is below the heating target but within the zone and the temperature is relativity stable. No change to the number of stages of heating is required.

HEAT -ROC HOLDG (9)

The control temperature is below the heating target but within in the heating zone and the temperature is increasing or the control temperature is below the heating target zone and the temperature is increasing at a rate of change greater than set point StageROC LPx, ##32, 57, 82, 107, 132, 157, 182, or 207; or the control temperature is above the heating target but within in the heating zone and the temperature is decreasing. No change to the number of stages of heating is required.

HEAT -TMP HOLDG (10)

The control temperature is below the heating target but within the zone and the temperature is not decreasing and the control temperature is within two degrees of the heating target. No change to the number of stages of heating is required.

HEAT –UNLOADING (11)

The control temperature is above the heating target zone and the temperature is not falling. The number of stages of heating wanted will be reduced by one.

HEAT -ROC UNLDG (12)

The control temperature is above the heating target but within the control zone and the temperature is increasing at a rate of change greater than one half of the set point StageROC LPx, #32, 57, 82, 107, 132, 157, 182, or 207. The number of stages of heating wanted will be reduced by one.

HEAT –LOADING (13)

The control temperature is below the heating target zone and the temperature is not increasing at a rate of change greater than set point StageROC LPx#32, 57, 82, 107, 132, 157, 182, or 207; or the control temperature is below the heating target but within the control zone and the temperature is not within 2 degrees of the heating target and the control temperature is not increasing. The number of stages of heating wanted will be increased by one.

MAKING ICE (14)

The ice making option has been selected for this loop and the ice making stage(s) are on. Refer to this option for more details. The system will allow only one ice making sequence per scheduled on. When an ice making sequence begins and ends, a message indicating this action will be generated.

Chapter - 8. AUTHORIZATION FUNCTION

The authorization code is a special four-character code that enables access in to the MCS-MAGNUM system. The code must be numeric with values between 1 and 8 if it is to be entered from the Keypad/Display. If the system is being accessed via MCS-CONNECT program, the code may consist of any valid alpha/numeric characters. Each system can have up to 15 different authorization codes. This provides the capability of issuing different codes to different people if desired. There are four levels of authorization, which provide different capabilities with in the system. The authorization code and the associated level cannot be displayed or viewed in an MCS-MAGNUM system. These are established when building the configuration file in the MCS-CONFIG program. The authorization codes must be protected and remain confidential, if they are compromised unauthorized personnel can gain access to the system.

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

FUNCTION	VIEW	SERVICE	SUPERVISORY	FACTORY
SENSOR OFFSETS	NO	YES	YES	YES
SENSOR DIAGNOSTICS	NO	YES	YES	YES
CLEAR ALARM HISTORY	NO	NO	NO	YES
CLEAR POINT INFORMATION	NO	NO	NO	YES
DATE & TIME SET	YES	YES	YES	YES
DAY OF WEEK SET	YES	YES	YES	YES
CHANGE NO FLOW LOCKOUT OR SHUT DOWN	NO	NO	NO	YES
CHANGE ROTATE YES OR NO	NO	NO	NO	YES
CHANGE MANUAL/AUTO SETTINGS	NO	NO	YES	YES
CHANGE SETPOINT VALUES*	NO	YES	YES	YES
CHANGE OPERATING SCHEDULES	NO	YES	YES	YES
CHANGE HOLIDAY DATES	NO	YES	YES	YES
LOCK OUT RESET	YES	YES	YES	YES

*Note - before a set point can be changed the set point must be able to be viewed.

Chapter - 9. MCS-MAGNUM Alarms and Safeties

9.1. Introduction

There are three types of alarms that are generated by the MCS-MAGNUM control logic:

- Information only alarms,
- MCS-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 MCS-MAGNUM by pressing the ALARM STATUS (4) key or from the MCS-CONNECT program.

9.2. Information only alarms

9.2.1 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

9.2.2 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

9.2.3 Alarms generated by the control algorithm

The following alarms indicate that the control algorithm took action:

- ROTATED LEAD
- DAYLIGHT SAVINGS

9.3. MCS-MAGNUM system alarms

9.3.1 **Alarms are generated by the MCS-MAGNUM control algorithm:**

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

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

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)

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

9.4. Set point safety alarms

9.4.1 Introduction

The LWC MAGNUM algorithm incorporates a number of safety checks to ensure that the various components that make up the control package are not damaged. These types of safeties are based upon set points. When a safety trips for the first time, the pump or fan will be set to “SAFETY TRIPPED” state. The pump or fan will remain in “SAFETY TRIPPED” state for ten minutes and then move to the “PMP OFF” state where the pump or fan will be allowed to run if required. If the same safety trip occurs again within two hours of the first trip, the compressor will be set to “FAILED state, which

requires a manual reset to restart the pump or fan. In this matter the LWC 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.

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:

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.

9.4.2 High or Low Amp

When a pumps or fans are on and an ampere sensor has been specified for that loop, the ampere for that loop will be check every second. Each pump or fan on the loop will have an associated amp sensor input.

If the amp reading is less than the value in set point # 27, 52, 77, 102, 127, 152, 177, 202 for loops 1 through 8 minus the value in set point #7, LOW AMPS, for longer than the time specified in set point #7, an alarm indicating LOW AMPS # will be generated and that individual pump or fan on the loop will be placed in a safety state.

If the amp reading is greater than the value in set point # 27, 52, 77, 102, 127, 152, 177, 202 for loops 1 through 8 plus the value in set point #8, HIGH AMPS, for longer than the time specified in set point #8, an alarm indicating HIGH AMPS # will be generated and that individual pump or fan on the loop will be placed in a safety state.

The RO number of the pump will be display in # of the alarm message. For example if the pump is at M-7 a 7 will be displayed if the pump is at 1-2 then a 12 will be displayed.

If a pump or fan is turned off, and there is another available pump or fan, that pump or fan will be started.

9.4.3 Lost of Flow

When a pumps or fans are on, the flow for that loop will be check every second. Each pump or fan on the loop will have an associated fault indicator input unless the common flow option is no. This input can be either a digital indicating a fault if it is on or an analog indicating the pressure. If multiple pumps or fans on a circuit, each pump or fan will be checked.

If the flow indicator is a digital input, if it is on for longer than the time specified in set point # 41, 65, 90, 115, 140, 165, 190, 215 for loops 1 through 8, No Flow #, an alarm will be generated and that individual pump or fan on the loop will be placed in a safety state.

If the flow indicator is an analog input, if it is value is less than the value in set point # # 41, 65, 90, 115, 140, 165, 190, 215 for loops 1 through 8, No Flow #, for longer than the time specified, an alarm will be generated and that individual pump or fan on the loop will be placed in a safety state.

The RO number of the pump will be display in # of the alarm message. For example if the pump is at M-7 a 7 will be displayed if the pump is at 1-2 then a 12 will be displayed.

9.4.4 Tank Low Level

If a loop contains a tank low-level sensor, then if this sensor indicates a low level, it is on for longer than the time specified in set point # # 42, 66, 91, 116, 141, 166, 191, 216 for loops 1 through 8, TankLow LPx; the system will generate low-level alarm for that loop. This is an informational message only. The status of the loop will not be changed.

9.4.5 Tank High Temperature

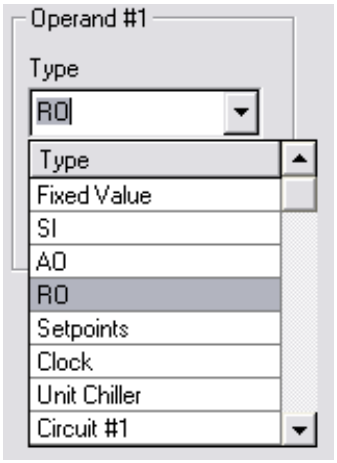
If set point #40, 65, 90, 115, 140, 165, 190, 215 for loops 1 through 8, HiTankTmpLPx, is active and the tank temperature is greater than this value for longer than the time; the system will generate high tank temperature alarm for that loop. This is an informational message only. The status of the loop will not be changed.

Chapter - 10. User Logic

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

10.1. Operands

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



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

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

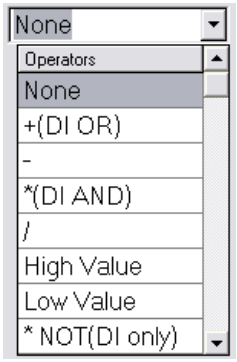
- A Relay Output's value is 0 if it is off and a 1 if it is on.
- A Digital Input's value is 0 if it is off and a 1 if it is on.
- An Analog Input and Analog Output value are the actual values as displayed, includes the decimal place.

- The unit, compressor, or loop state is a numeric value that will relate to the state names in this manual.

This value is show as the number in parenthesis following the state name.

10.2. Operators

The action cell is located between the operand cells.

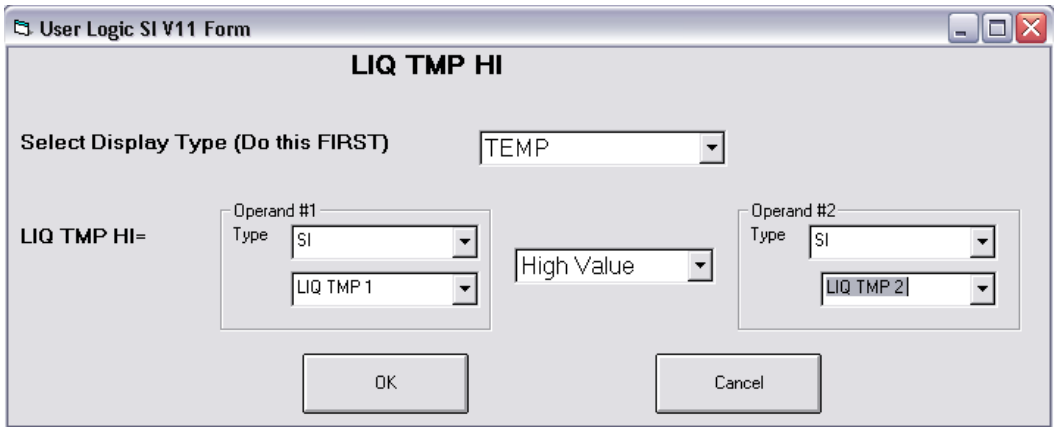


The following actions can be selected from a drop down list this will determine the value of the sensor:

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

10.3. User Sensor Input

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

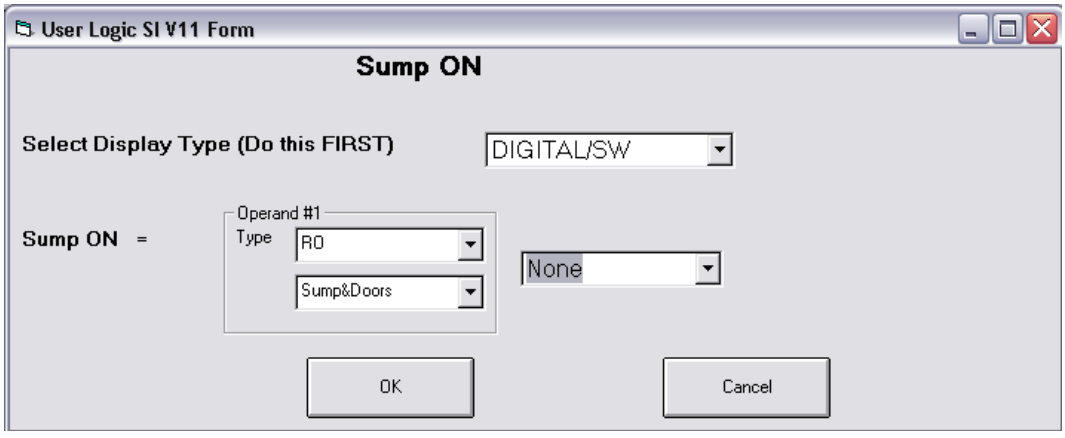


First select the display type and then complete the selections. Note operand #1 and #2 are defined in the Operands section above and the Action Cell is defined in the drop down menu between.

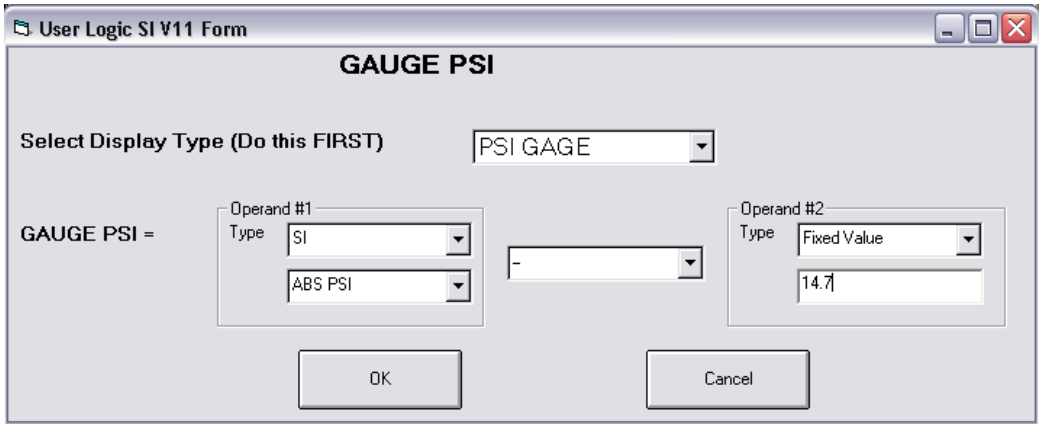
The window below is from MCS-CONFIG is configuring a User Logic type of sensor. It is a digit type of sensor (ON or OFF) and it is only looking an Operand 1. If the RO Sump and Doors is ON then the value of this sensor will be ON.

10.3.1 Examples of User Logic Sensor Inputs

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

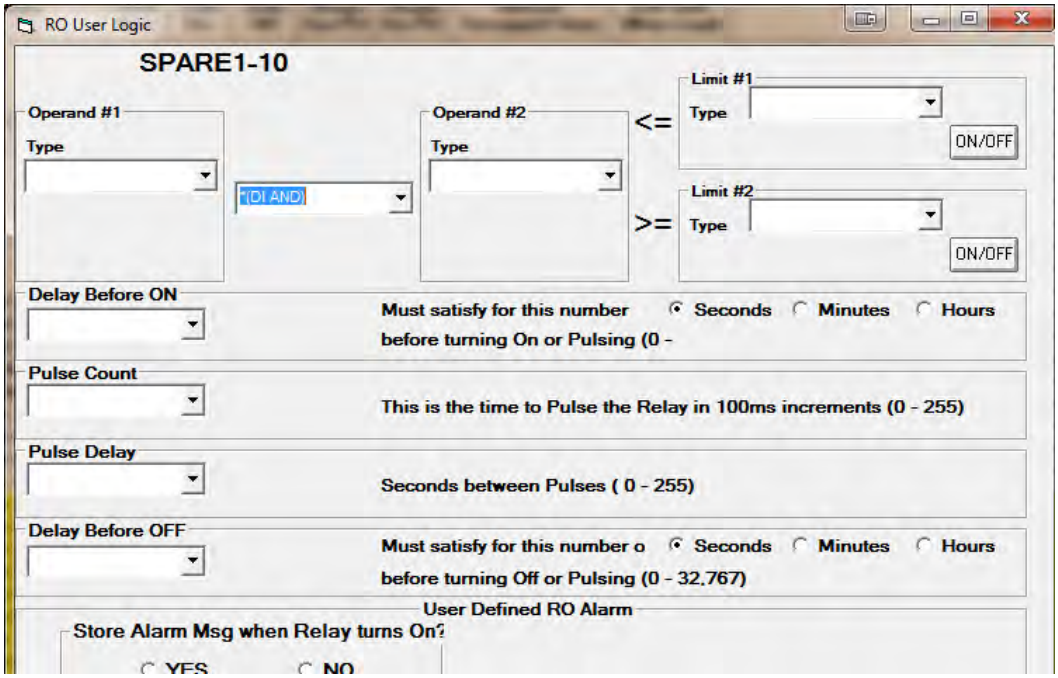


The window below is from MCS-CONFIG building a User Logic type of sensor. It is a pressure type of sensor (display a value with 1 decimal place). The value of this sensor will be result of Operand 1 minus Operand 2.



10.4. User Relay Output

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



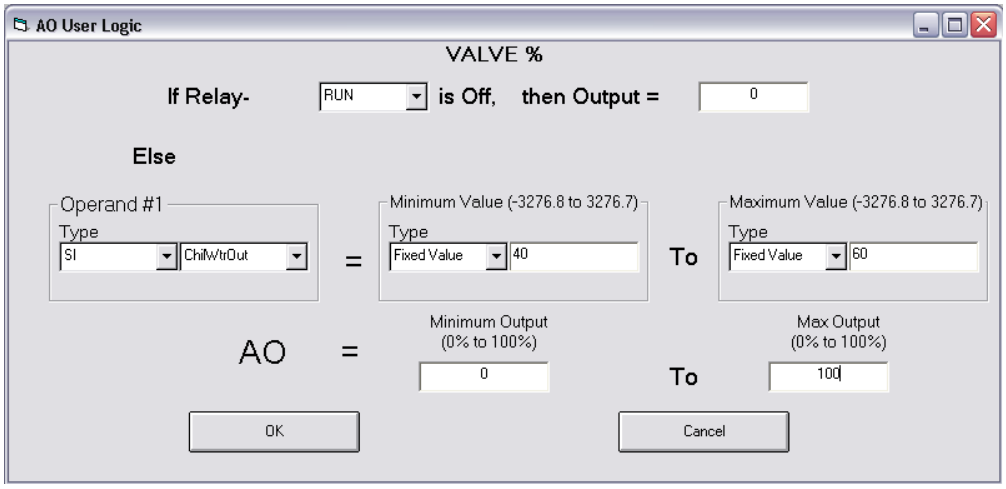
In the above example the “Store Alarm Msg“ option has been enabled. When this relay goes from an OFF to an ON state an alarm message will be generated with the name of this relay.

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

10.5. User Analog Output

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

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



Chapter - 11. Using Lookup Tables

The purpose of Lookup tables is to provide additional capability for entering reference data for reading of sensors. Tables are handy, in that, you do not need to create separate configuration files for each change in the performance curve on a non linear sensor. The Magnum will look at the lookup table to get the right information for that sensor.

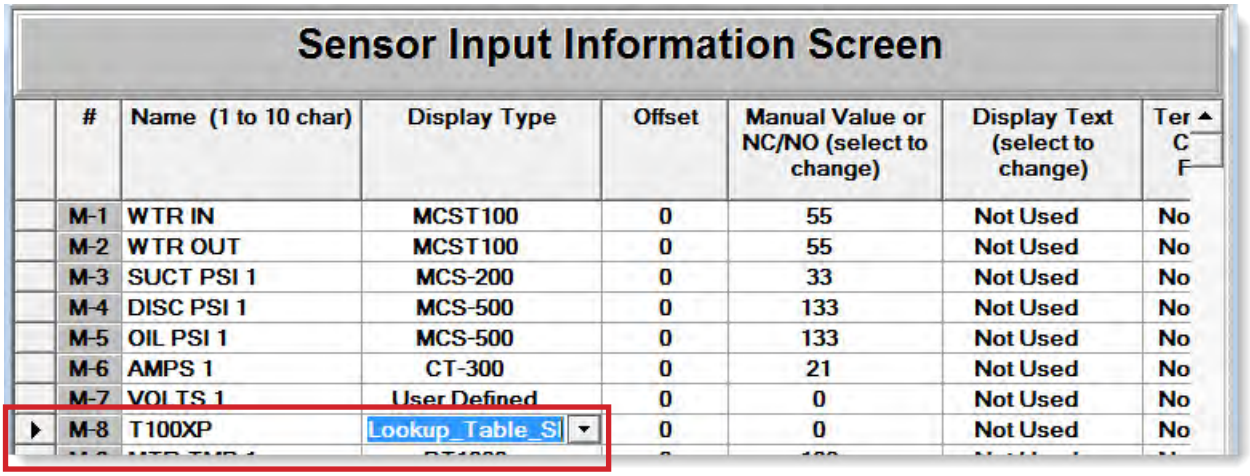
11.1. Lookup tables used with MCS-MAGNUM controls

In the sample below, we are using a Temperature sensor. The magnitude of the current is converted to a linear (0-5vdc) output signal which can be read as a standard analog input signal. The signal is used by MCS micro controllers for controlling some of the following:

1. For slide valve positioning on screw machines
2. For high amp motor overload protection
3. For verification of device on / off
4. For reading any temperature, voltage, or current sensors that has typical voltage input which ranges from 0 to 5 Vdc.
5. For reading non linear sensors that use a 4-20mA signal.

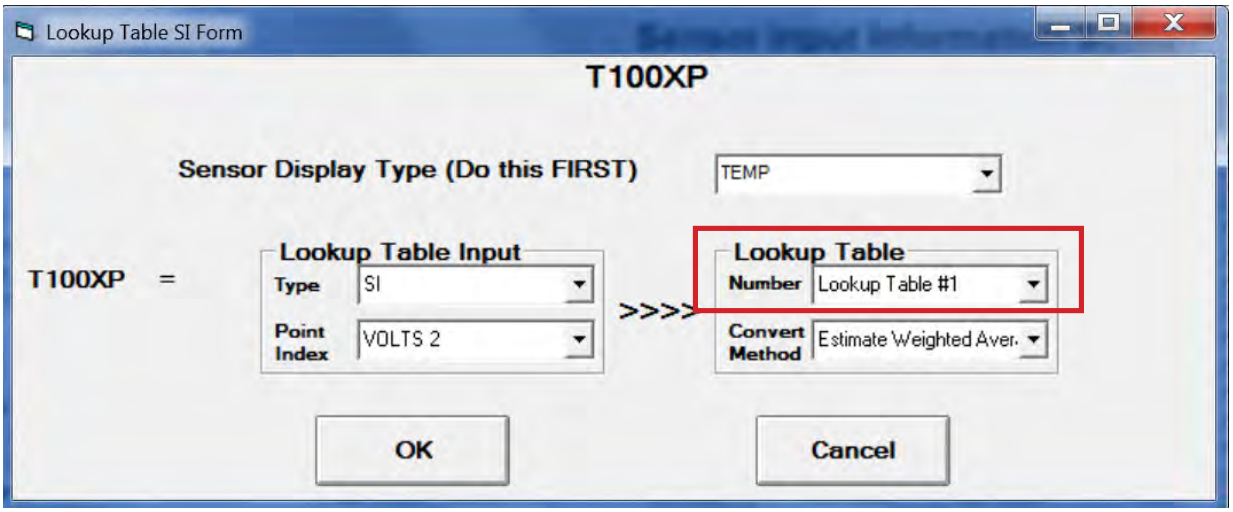
11.1.1 Setting up a Lookup table using MCS-CONFIG

1. Setup new temperature sensor in MCS-Config as shown in Screen 1.



Screen 1

2. Using the pull down icon, specified the Lookup table that you will be using for this sensor as shown in screen 2.

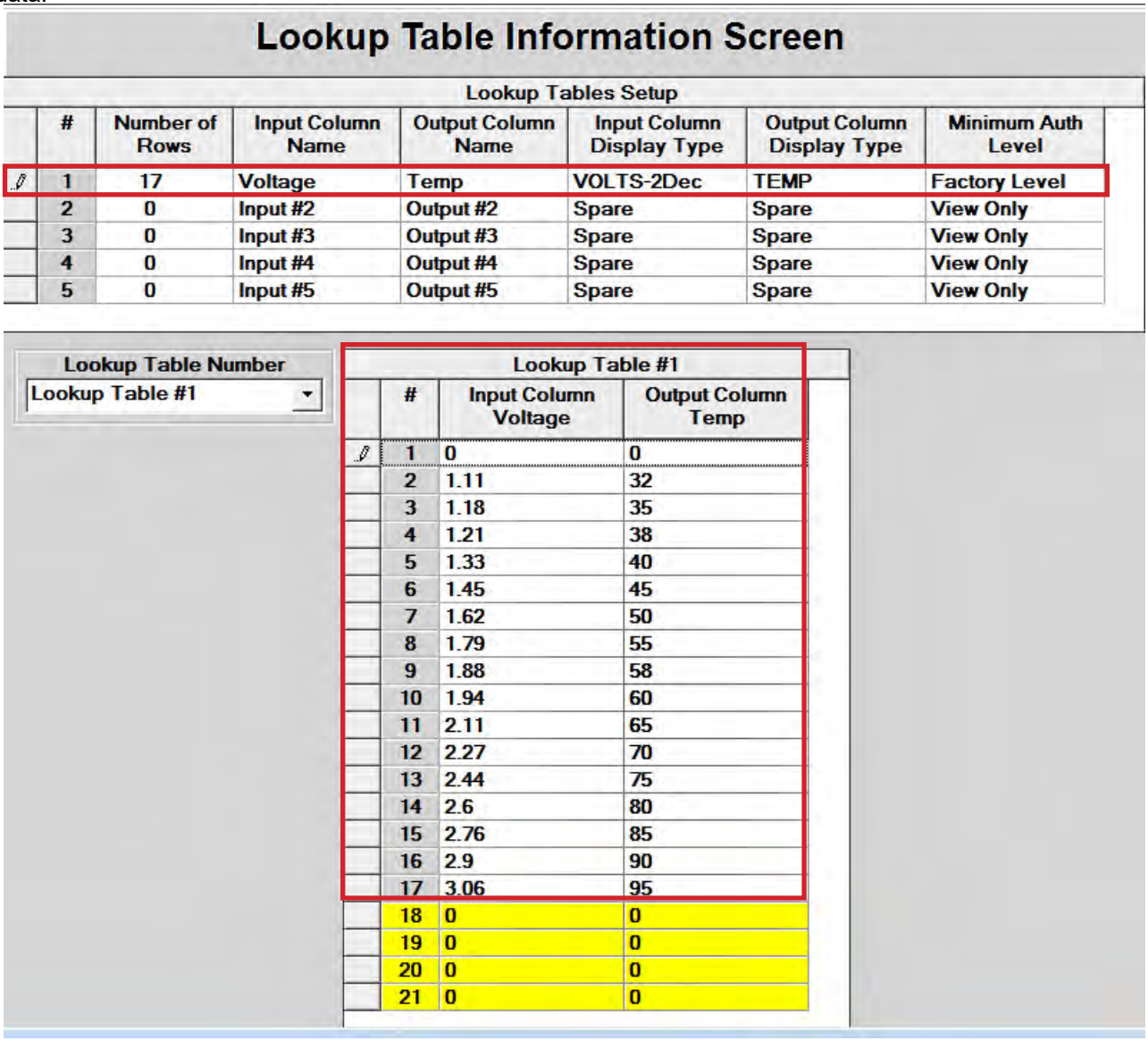


Screen 2

11.1.2 Setting up Lookup table #1 - see screen 3 below:

The sensor we have setup in this example is a temperature sensor. We are entering data into the lookup table using data from the manufacture of the sensor. In the sample table, we have used 17 rows for the data to give us a clear view of the temperature and voltage range of this sensor.

1. In column one, we have entered the number of rows we will use.
2. The second column we have entered Voltage as the Input
3. In the third column we have entered Temp as the output.
4. The fourth column we have shown Volts2 which will allow the example to have two decimal places for the voltage data.



Lookup Table Information Screen

Lookup Tables Setup

#	Number of Rows	Input Column Name	Output Column Name	Input Column Display Type	Output Column Display Type	Minimum Auth Level
1	17	Voltage	Temp	VOLTS-2Dec	TEMP	Factory Level
2	0	Input #2	Output #2	Spare	Spare	View Only
3	0	Input #3	Output #3	Spare	Spare	View Only
4	0	Input #4	Output #4	Spare	Spare	View Only
5	0	Input #5	Output #5	Spare	Spare	View Only

Lookup Table Number: Lookup Table #1

Lookup Table #1

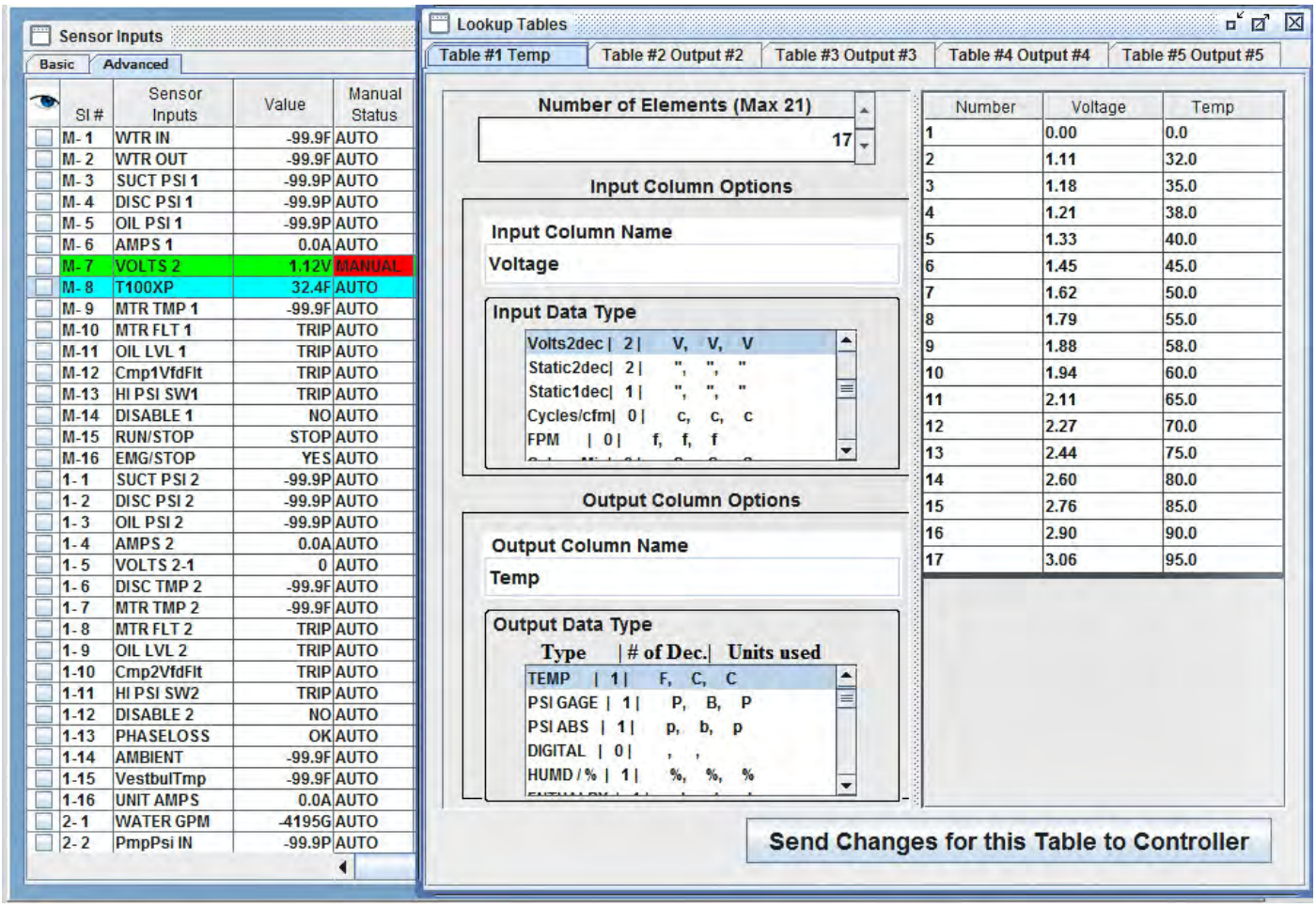
#	Input Column Voltage	Output Column Temp
1	0	0
2	1.11	32
3	1.18	35
4	1.21	38
5	1.33	40
6	1.45	45
7	1.62	50
8	1.79	55
9	1.88	58
10	1.94	60
11	2.11	65
12	2.27	70
13	2.44	75
14	2.6	80
15	2.76	85
16	2.9	90
17	3.06	95
18	0	0
19	0	0
20	0	0
21	0	0

Screen 3

5. The last column shows the authorization level needed to make changes in MCS-Connect.

11.1.3 Viewing the Lookup Table in MCS-Connect

In MCS-Connect we can view the sensor example as shown in Screen 4 and view the same information that we setup in MCS-Config. Changes can be made if you are authorized to view or make changes. We setup the authorization as 'FACTORY' in MCS-Config for this sensor example.



SI #	Sensor Inputs	Value	Manual Status
M-1	WTR IN	-99.9F	AUTO
M-2	WTR OUT	-99.9F	AUTO
M-3	SUCT PSI 1	-99.9P	AUTO
M-4	DISC PSI 1	-99.9P	AUTO
M-5	OIL PSI 1	-99.9P	AUTO
M-6	AMPS 1	0.0A	AUTO
M-7	VOLTS 2	1.12V	MANUAL
M-8	T100XP	32.4F	AUTO
M-9	MTR TMP 1	-99.9F	AUTO
M-10	MTR FLT 1	TRIP	AUTO
M-11	OIL LVL 1	TRIP	AUTO
M-12	Cmp1VfdFlt	TRIP	AUTO
M-13	HI PSI SW1	TRIP	AUTO
M-14	DISABLE 1	NO	AUTO
M-15	RUN/STOP	STOP	AUTO
M-16	EMG/STOP	YES	AUTO
1-1	SUCT PSI 2	-99.9P	AUTO
1-2	DISC PSI 2	-99.9P	AUTO
1-3	OIL PSI 2	-99.9P	AUTO
1-4	AMPS 2	0.0A	AUTO
1-5	VOLTS 2-1	0	AUTO
1-6	DISC TMP 2	-99.9F	AUTO
1-7	MTR TMP 2	-99.9F	AUTO
1-8	MTR FLT 2	TRIP	AUTO
1-9	OIL LVL 2	TRIP	AUTO
1-10	Cmp2VfdFlt	TRIP	AUTO
1-11	HI PSI SW2	TRIP	AUTO
1-12	DISABLE 2	NO	AUTO
1-13	PHASELOSS	OK	AUTO
1-14	AMBIENT	-99.9F	AUTO
1-15	VestbulTmp	-99.9F	AUTO
1-16	UNIT AMPS	0.0A	AUTO
2-1	WATER GPM	-4195G	AUTO
2-2	PmpPsi IN	-99.9P	AUTO

Number	Voltage	Temp
1	0.00	0.0
2	1.11	32.0
3	1.18	35.0
4	1.21	38.0
5	1.33	40.0
6	1.45	45.0
7	1.62	50.0
8	1.79	55.0
9	1.88	58.0
10	1.94	60.0
11	2.11	65.0
12	2.27	70.0
13	2.44	75.0
14	2.60	80.0
15	2.76	85.0
16	2.90	90.0
17	3.06	95.0

11.1.3.1. Using as Control Temperature Sensor

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

Chapter - 12. MCS Control States Quick Reference – LWC

Control States tell the user the system's status; this information is critical.

	UNIT CONTROL STATES
STATE	**DESCRIPTION**
UNIT IN POWER UP	System Reset or Power Returned.
UNIT IN LOCKOUT	Emergency Stop SI is ON (STOP) Unit will not run.
UNIT IN I/O LOST	Lost communications with an I/O board of some type.
UNIT IN NORMAL RUN	Unit is normal-loops will run.
	LOOP CONTROL STATES
STATE	**DESCRIPTION**
LOOP STOP SW	Loop is stopped, RUN/STOP indicator being off (STOP).
LOOP STOP SCH	Loop is stopped, schedule being false, RUN/STOP indicator is on (RUN).
LOOP STOP PEAK	Loop is stopped. RUN/STOP is on / peak off and peak hour.
LOOP POST PEAK	Loop is stopped / peak off and in hour after peak hour.
LOOP PRE PEAK	Loop is stopped / peak off, next hour is a peak hour.
LOOP NORMAL	Loop is running normal. RUN/STOP is on the schedule is true,
LOOP OVERRIDE	Loop was stopped but OVERRIDE is on, running.
LOOP LOW AMB	Loop was stopped ambient temp is too low, run pumps only.
LOOP STOP AMB	Loop was running ambient temp is too low -stop the loop.
	PUMP/FAN CONTROL STATES
STATE	DESCRIPTION
ALL PUMPS OFF or ALL FANS OFF	All pumps/fans in the loop are off.
PUMPS LOADING OR FANS LOADING	Pumps/fans wanted is greater than pumps on, trying to turn on another pump.
MAX PUMPS ON or MAX FANS ON	All pumps/fans in the loop that are allowed on are on.
PMPS UNLOADING or FANS UNLOADING	Pumps/fans wanted less than pumps/fans on, trying to turn off a pump/fan.

	INDIVIDUAL PUMP/FAN STATES
STATE	**DESCRIPTION**
FAILED	Pump or fan has failed. Its relay output is locked off.
ANTI-CY	Pump or fan turned off, must wait until it can be turned back on.
OFF	Pump or fan turned off; ready to be turned on when the loop needs it.
ON	Pump or fan is on.
	HEATING/COOLING STATES
STATE	DESCRIPTION
ALL STAGES OFF	No stages of heating or cooling are on.
COOL- HOLDING	In cooling mode and with in the control target zone. No change.
COOL- ROC HOLDG	In cooling mode and control temperature ROC is moving toward target zone.
COOL- TMP HOLDG	In cooling mode and control temperature is with in target zone. No change.
COOL- TMP HOLDG	In cooling mode and control temperature is with in target zone. No change.
COOL- UNLOAD	In cooling mode and the control temperature is too low. Turn off one stage
COOL- ROC UNLDG	In cooling mode and control temp is with in target zone but it is moving away too fast. Add one stage.
COOL-LOADING	In cooling mode. Control temp is too high or not moving toward target.
COOL-LOADING	In cooling mode. Control temp is too high or not moving toward target.
HEAT- HOLDING	In heating mode and with in the control target zone. No change.
HEAT- ROC HOLDG	In heating mode and control temperature ROC is moving toward target zone.
HEAT- TMP HOLDG	In heating mode and control temperature is with in target zone. No change.
HEAT- UNLOAD	In heating mode and the control temperature is too high. Turn off one stage
HEAT- ROC UNLDG	In heating mode and control temp is with in target zone but it is moving away too fast. Add one stage.
HEAT-LOADING	In heating mode and control temperature is too low or not moving toward target. Add one stage.
MAKING ICE	The loop is making ice.

Chapter - 13. OEM Factory Checkout Procedure

13.1. Visual Check

- 120 VAC power wiring
- Jumper settings
- Sensor input
- Address
- MCS communication termination
- EEPROM write protection
- Sensor Wiring
- MCS-IO Communication Wiring
- LCD Connector (dot to mark on the board)
- Keypad Connector (dot to mark on the board)
- Chips
- Master software and chip
- I/O software
- RO Wiring

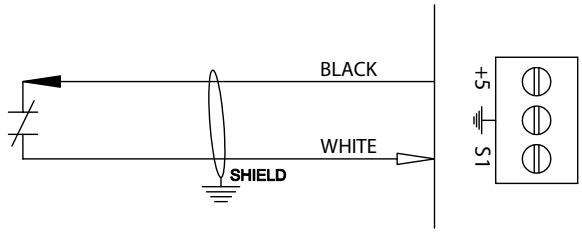
Ensure that the EMG stop is on (closed position) or run/stop input off so that the unit will not run after power applied to micro.

13.2. MCS's Power On (Compressor Power off)

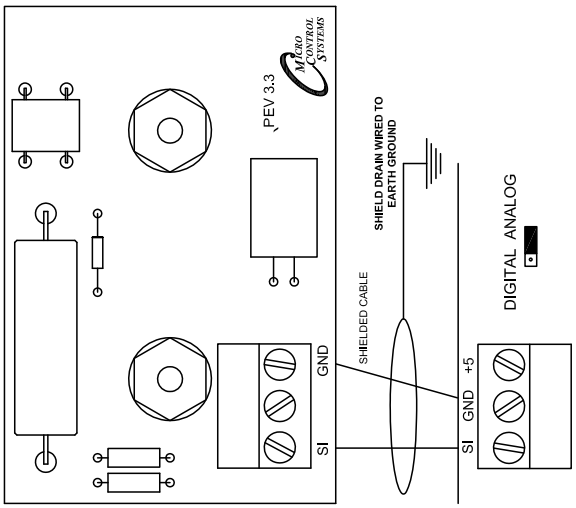
- MCS System on
- LCD on and valid display - "MCS Initialization" then default screen
- Communications light blinking if I/O units
- Get AUTHORIZED
- Check board version number: SERVICE DIAGNOSTICS/UNIT INFORMATION/HARDWARE VERSION/ENTER (if change is required)
- Check sensor readings
- Manually bump (on then off) each point (take care your in control)

Chapter - 14. The MCS Sensors Quick Reference Sheet

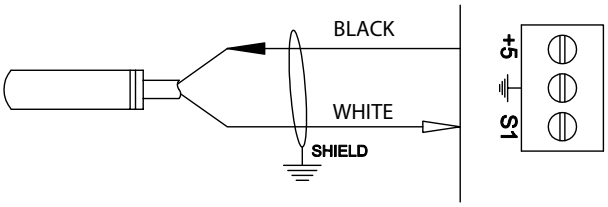
DRY CONTACT (DIGITAL INPUT)



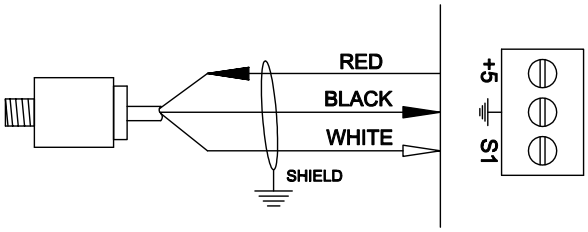
AMPERAGE SENSOR (MCS-CTXXX)



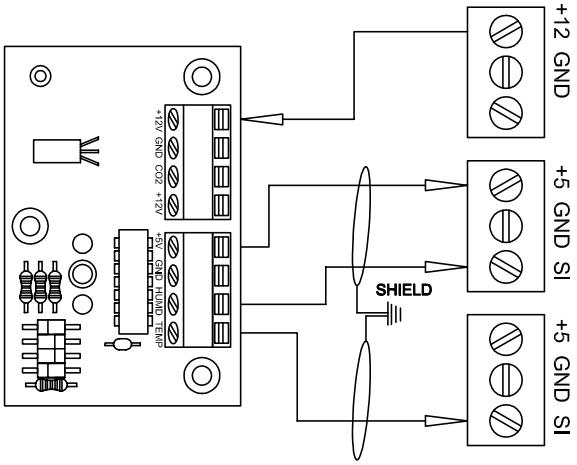
TEMPERATURE SENSOR (MCS-T100)



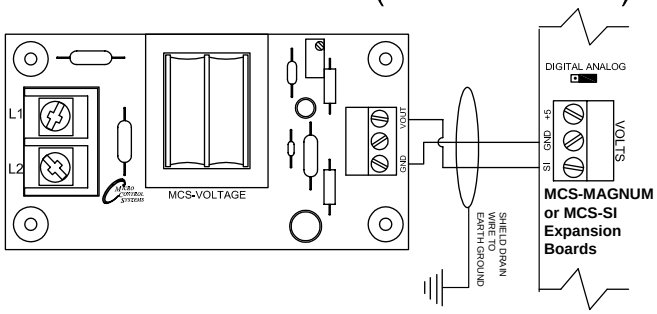
PRESSURE SENSURE (MCS-XXX)



HUMIDITY SENSOR (MCS-HUMD-II)



VOLTAGE SENSOR (MCS-VOLTAGE)



NOTES:

1. Sensors MUST use shielded cable and shield must not be broken.
Shield Drain wired to earth ground

2. All sensor inputs are 0 to 5vdc.

3. Amp input sensors are field wired and must be shielded cable. They generate their own voltage and do not require 5vdc from the MCS unit.

4. Digital input sensors are field wired and must be shielded cable. The 5vdc is taken out from the sensor terminal and wired through the switch. The jumper must then be set to digital.

5. Pressure and Temperature sensors are available with 20', 40', & 60' of cable.

6. Make sure the sensor jumper is in the correct position (Analog for analog SI, Digital for digital SI.)

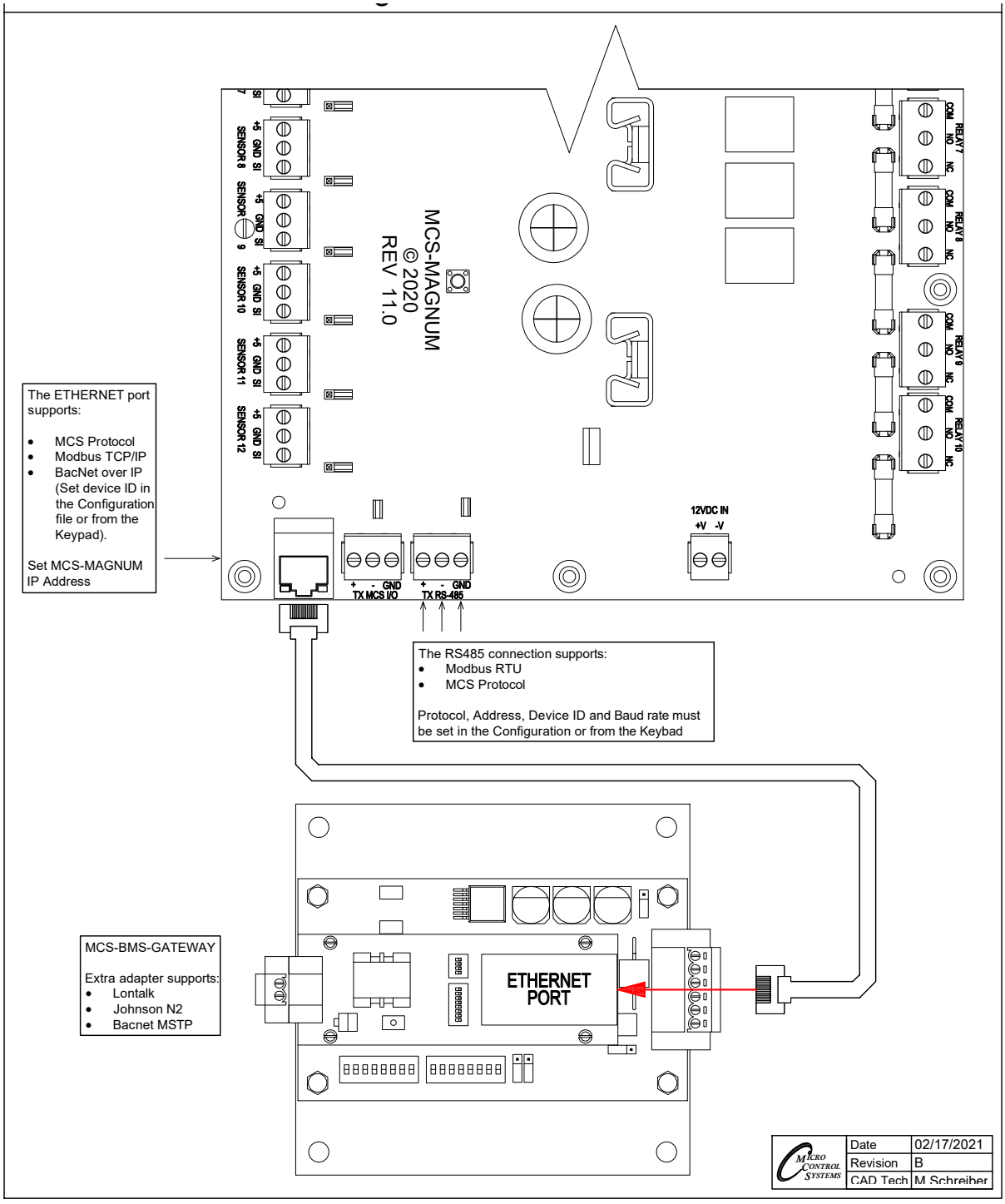
Chapter - 15. BMS Communication Protocols

The MCS-Magnum supports as standard: Modbus RTU protocol.

Using the MCS-BMS-GATEWAY, the MCS-Magnum can also support Johnson N2, LonTalk and Bacnet MSTP, BACnet IP and Modbus TCP/IP.

Supported baud rates for Modbus RTU and Johnson N2 are 4800bps, 9600bps, 19200bps, 38400bps, and 57600bps.

15.1. MCS-Magnum to BMS Connections



Chapter - 16. MCS-CONFIG-RS485 & ETHERNET COMMUNICATION

16.1. Setting up Communication in MCS-CONFIG - RS485 or ETHERNET

The examples below show how MCS-CONFIG is setup to communicate to the BMS System.

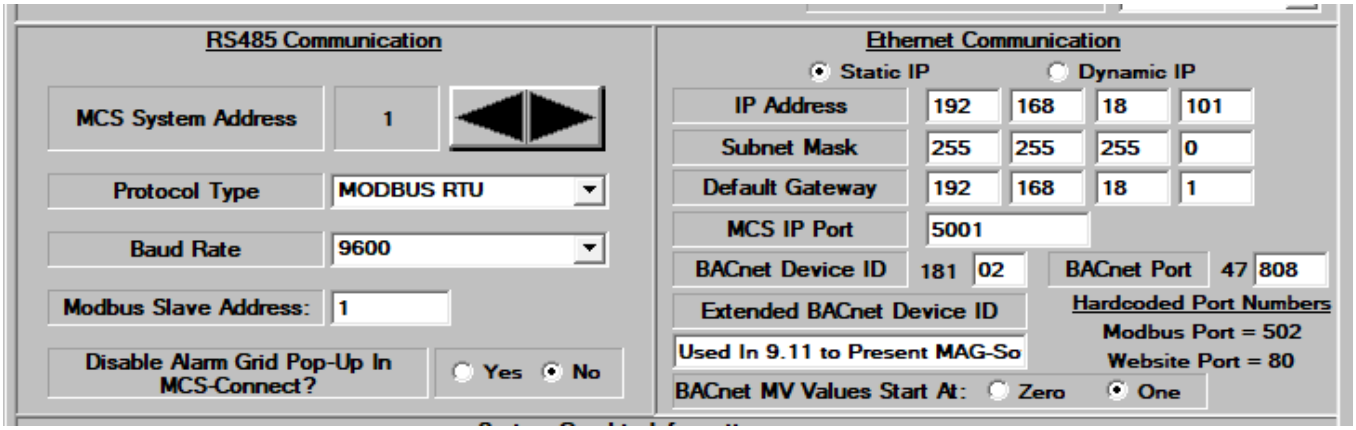
The MCS-MAGNUM RS485 uses the following protocols for communicating to a BMS system:

- **MODBUS RTU**

The following settings need to be made in your config file:

1. MCS System Address: (this number changes depending on the number of Modbus Slaves)
2. Protocol Type: MODBUS RTU (MCS, CPM)
3. Baud Rate: 9600
4. Modbus Slave Address (this number changes depending on the number of Modbus Slaves)

The MCS-Magnum Modbus RTU protocol setting allow you to specify the Modbus Slave address plus the following Baud rates are supported: 4800, 9600, 19200, 38400, 57600.



16.2. Setting ETHERNET to Communicate to a BMS System

- **STATIC IP or DYNAMIC IP**

The following settings need to be made in you MCS-CONFIG file (if using Static IP)

1. IP Address (must be the same address as the MCS Controller)
2. Subnet Address (must be the same address as the MCS Controller)
3. Default Gateway (must be the same address as the MCS Controller)
4. MCS IP Port (setup by MCS or OEM)
5. BACnet Device ID (MCS vendor ID (181), id number used for communicating to BACnet IP

16.3. Understanding the BMS setup in MCS-CONFIG for Points

The number of data bit is 8, stop bit is 1 and parity is none (these parameter are not adjustable).

The sensors inputs are 16 bit signed values. (Read input Registers, Function code = 4)

- The Analog sensor inputs values typically have 1 assumed decimal place, meaning a value of 12.3 will be transmitted as value 123. The # of decimal point depending on the sensor type define in the MCS-MAGNUM CONFIG. Most sensor types are 1 decimal place.

  But take care there are a few 2 decimal and a few zero decimal place types.

  The BMS point list has a column which indicates how many assumed decimal are contained in the value.

  - The digital sensor inputs values will be 0 or 1, 0 = off and 1 = on.

  The analog outputs are 16 bit signed values. (Read Input Registers, Function code = 4)

  - The analog output have 1 assumed decimal place, meaning a value of 12.3 will be transmitted as value 123.

  The relay outputs are 16 bit packed values. (Read Coil Status , Function code = 1)

  - Each bit within the 16 bits can contains a relay output. A bit value of 0 = relay off, 1 = relay on.

  The number of packed bit depends on the requesting Modbus message.

  If only one coil is asked for, then only bit 0 will contains a relay status value and bit 1 thru 7 are do not care.

  If two relays are asked for, then bit 0 and bit 1 will contains values and bit 2 thru 7 are do not care.

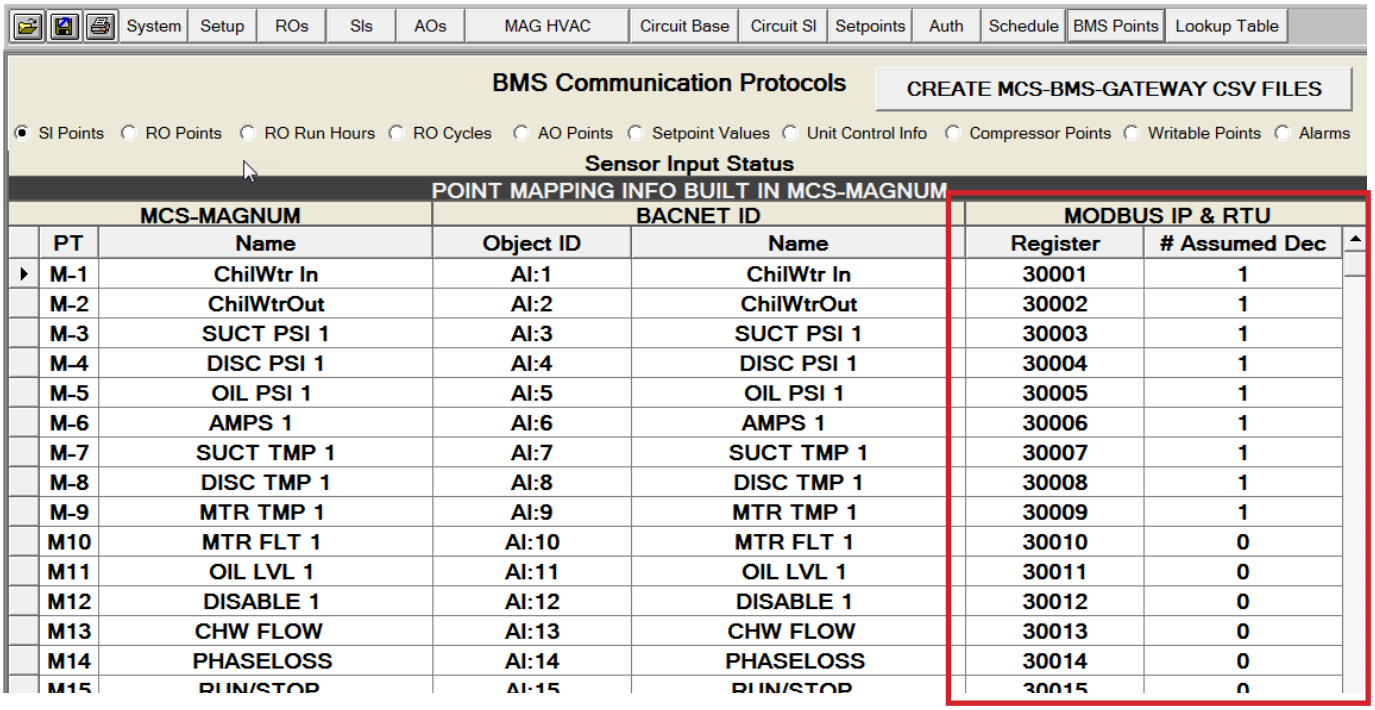
  The setpoints are 16 bit signed values. (Read Holding Registers, Function code = 3)

  - The setpoints values typically have 1 assumed decimal place, meaning a value of 12.3 will be transmitted as value 123.

  The # of decimal point depending on the setpoint type defined in the MCS-MAGNUM CONFIG.

16.4. **Viewing and printing a list of the Modbus IP/RTU Registers):**

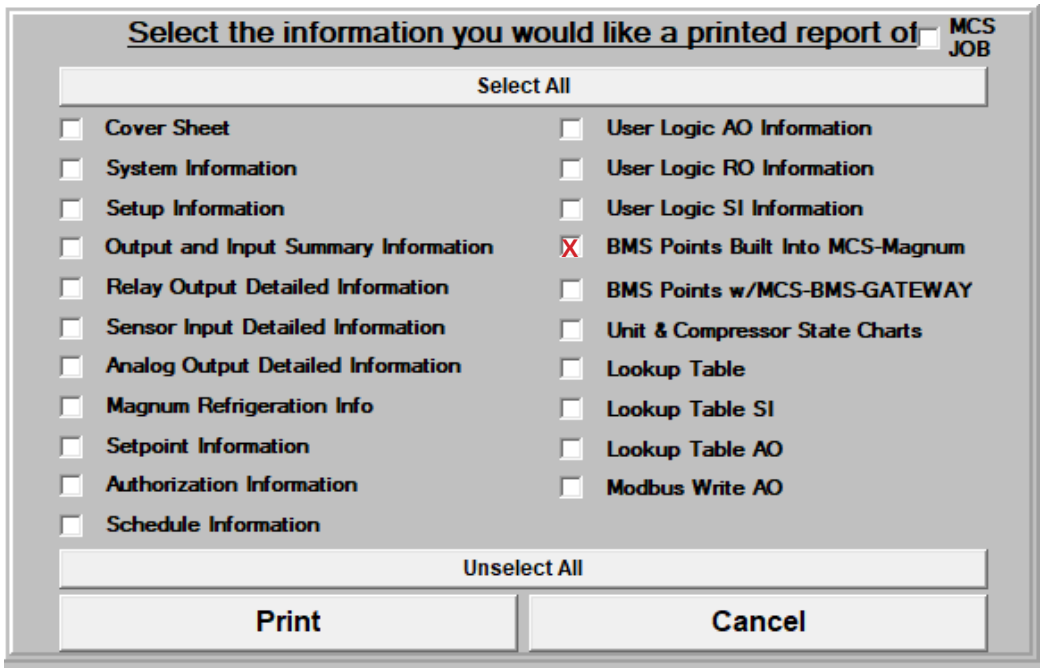
Below shows a part of the MCS-CONFIG BMS points screen.



MCS-MAGNUM		BACNET ID		MODBUS IP & RTU	
PT	Name	Object ID	Name	Register	# Assumed Dec
M-1	ChilWtr In	AI:1	ChilWtr In	30001	1
M-2	ChilWtrOut	AI:2	ChilWtrOut	30002	1
M-3	SUCT PSI 1	AI:3	SUCT PSI 1	30003	1
M-4	DISC PSI 1	AI:4	DISC PSI 1	30004	1
M-5	OIL PSI 1	AI:5	OIL PSI 1	30005	1
M-6	AMPS 1	AI:6	AMPS 1	30006	1
M-7	SUCT TMP 1	AI:7	SUCT TMP 1	30007	1
M-8	DISC TMP 1	AI:8	DISC TMP 1	30008	1
M-9	MTR TMP 1	AI:9	MTR TMP 1	30009	1
M10	MTR FLT 1	AI:10	MTR FLT 1	30010	0
M11	OIL LVL 1	AI:11	OIL LVL 1	30011	0
M12	DISABLE 1	AI:12	DISABLE 1	30012	0
M13	CHW FLOW	AI:13	CHW FLOW	30013	0
M14	PHASELOSS	AI:14	PHASELOSS	30014	0
M15	RUN/STOP	AI:15	RUN/STOP	30015	0

16.5. Print Report from the MCS-CONFIG BMS COMMUNICATION SCREEN

1. Click on 'FILE' or the printer 'ICON' on the top of the screen.



2. Choose the report you need, in this case we want to see the BMS Points Built Into MCS-MAGNUM.

Example showing
BMS Points from MCS-MAGNUM
The report will require a number of pages depending on your config and the number of points

C:\DESKTOP\EXAMPLES\CFG\EXAMPLES\TRAINING CLASS-V17\V17 INSTRUCTOR TRAINING CLASS_Rev_A.cfg
CONFIG DATE = 9/29/17 at 11:55 AM PRINT DATE = 1/25/23 08:55 AM

BMS Points SI Grid Information

POINT MAPPING INFO BUILT IN MCS-MAGNUM

MCS-MAGNUM		BACNET ID		MODBUS IP & RTU	
PT #	Name	Object ID	Name	Register	# Assumed Dec
M-1	ChilWtr In	AI:1	ChilWtr In	30001	1
M-2	ChilWtrOut	AI:2	ChilWtrOut	30002	1
M-3	SUCT PSI 1	AI:3	SUCT PSI 1	30003	1
M-4	DISC PSI 1	AI:4	DISC PSI 1	30004	1
M-5	OIL PSI 1	AI:5	OIL PSI 1	30005	1
M-6	AMPS 1	AI:6	AMPS 1	30006	1
M-7	SUCT TMP 1	AI:7	SUCT TMP 1	30007	1
M-8	DISC TMP 1	AI:8	DISC TMP 1	30008	1
M-9	MTR TMP 1	AI:9	MTR TMP 1	30009	1
M10	MTR FLT 1	AI:10	MTR FLT 1	30010	0
M11	OIL LVL 1	AI:11	OIL LVL 1	30011	0
M12	DISABLE 1	AI:12	DISABLE 1	30012	0
		AI:13	CHW FLOW	30013	0
		AI:14	PHASELOSS	30014	0
		AI:15	RUN/STOP	30015	0
		AI:16	EMG/STOP	30016	0
		AI:17	SUCT PSI 2	30017	1
		AI:18	DISC PSI 2	30018	1
		AI:19	OIL PSI 2	30019	1
		AI:20	AMPS 2	30020	1
		AI:21	SUCT TMP 2	30021	1
		AI:22	DISC TMP 2	30022	1
		AI:23	MTR TMP 2	30023	1
		AI:24	MTR FLT 2	30024	0
1-9	OIL LVL 2	AI:25	OIL LVL 2	30025	0
1-10	DISABLE 2	AI:26	DISABLE 2	30026	0
1-11	LIQ PSI 1	AI:27	LIQ PSI 1	30027	1
1-12	LIQ TMP 1	AI:28	LIQ TMP 1	30028	1
1-13	LIQ PSI 2	AI:29	LIQ PSI 2	30029	1
1-14	LIQ TMP 2	AI:30	LIQ TMP 2	30030	1
1-15	PmpPsi In	AI:31	PmpPsi In	30031	1
1-16	PmpPsiOut	AI:32	PmpPsiOut	30032	1
2-1	SUBCOOL 1	AI:33	SUBCOOL 1	30033	1
2-2	SUBCOOL 2	AI:34	SUBCOOL 2	30034	1
2-3	KW/TON	AI:35	KW/TON	30035	1
2-4	UNIT KW	AI:36	UNIT KW	30036	1
2-5	UNIT TONS	AI:37	UNIT TONS	30037	0
2-6	CHW DIFF	AI:38	CHW DIFF	30038	1
2-7	UNIT GPM	AI:39	UNIT GPM	30039	0
2-8	PowerFactr	AI:40	PowerFactr	30040	2
2-9	UNIT VOLTS	AI:41	UNIT VOLTS	30041	1

BMS Points RO Grid Information

POINT MAPPING INFO BUILT IN MCS-MAGNUM

MCS-MAGNUM		BACNET ID		MODBUS IP & RTU	
PT #	Name	Object ID	Name	Register	# Assumed Dec
M-1	COMP 1	BO:1	COMP 1	00001	0
M-2	LOAD 1	BO:2	LOAD 1	00002	0
M-3	UNLOAD 1	BO:3	UNLOAD 1	00003	0
M-4	STRT UNLD1	BO:4	STRT UNLD1	00004	0
M-5	LLS 1	BO:5	LLS 1	00005	0
M-6	CHMBR INJ1	BO:6	CHMBR INJ1	00006	0
M-7	MOTOR INJ1	BO:7	MOTOR INJ1	00007	0
M-8	CND FAN1-1	BO:8	CND FAN1-1	00008	0
M-9	WARNING	BO:9	WARNING	00009	0
M10	ALARM	BO:10	ALARM	00010	0

Chapter - 17. SETUP PROTOCOLS IN MCS-CONNECT

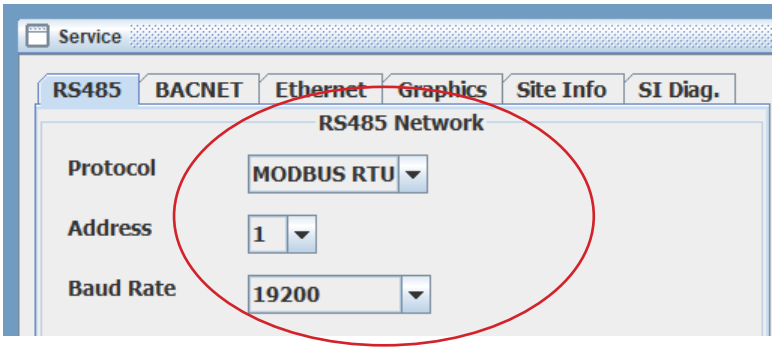
17.1. MCS-MAGNUM BMS PROTOCOL (Modbus TCP/IP)

Modbus TCP/IP is simply the Modbus RTU protocol with a TCP interface that runs on Ethernet.

The **MCS-MAGNUM-12** includes the integration of Modbus RTU communication protocol, which is based on the master-slave architecture for data transfer over RS485 to a BMS system.

Changes can be made to the settings (if authorized) using the Keypad or can be made using MCS-CONNECT SERVICE WINDOW.

MCS-CONNECT SERVICE WINDOW RS485 SETUP



17.1.1 Communication to MCS-MAGNUM over Ethernet (MODBUS RTU)

For communication over Ethernet the MCS-MAGNUM uses a five-digit number for DEVICE ID. The first three digits are based on MCS's BACnet Vendor ID 181, and the last two are set by the BACnet/MS/TP address.

181	XX
↓	↓
BACnet Vendor181	BACnet IP Address

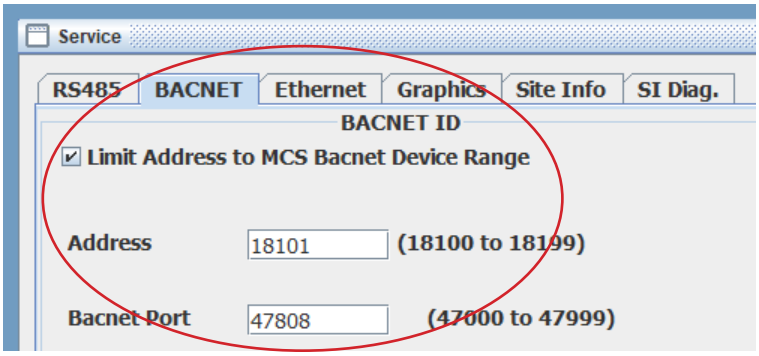
In case the end user would like to set up an BACnet Device ID other than 181-XX, there is an CUSTOM (extended) BACnet setting that can only be set in MCS Config.

The following changes can be made using the Keypad or can be made using **MCS-CONNECT SERVICE WINDOW.**

The **BACnet IP** address can be verified and changed (if authorized) from the Keypad/LCD. The following steps will display the BACnet IP Network address, and the TCP/IP port:

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Use ⬆ arrow to **BACnet Setting** then press Enter.
- Select address then press Enter. Change the address so it matches the last two digits of the device ID then press Enter.
- Use ⬇ arrow to tab to the TCP/IP address.
- Select address then press Enter. Change the address and port to match your device.

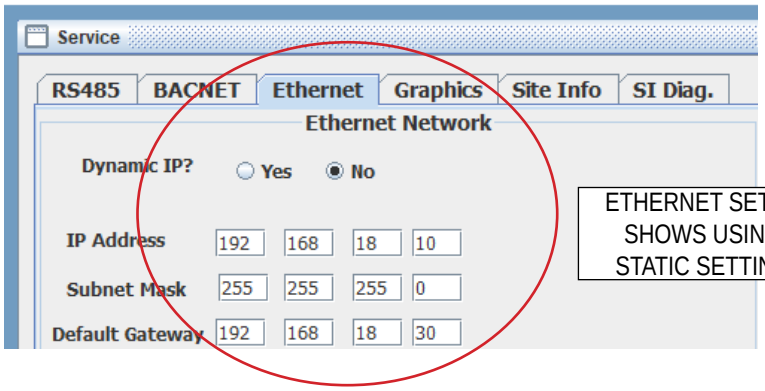
MCS-CONNECT SERVICE WINDOW BACNET SETUP



17.1.2 ETHERNET OVER (MODBUS RTU) PROTOCOL

The following steps will display the **ETHERNET NETWORK** settings:

MCS-CONNECT SERVICE WINDOW ETHERNET SETUP



ETHERNET SETUP SHOWS USING STATIC SETTING

If you are going to manually assign the IP Address, Subnet Mask, and Default Gateway.

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Select Ethernet Network then press Enter.
- Set “DYNAMIC IP” to NO.
- Set the “IP Address”.
- Set the “Subnet Mask”.
- Set “Default Gateway”.
- Reset Magnum for change to take effect.

If you are going to let your network assign the IP Address, Subnet Mask, and Default Gateway:

- Press the Menu key, select Serv Tools, and then press the Enter key.
- Select Ethernet Network then press Enter.
- Set “DYNAMIC IP” to YES.
- Connect the MCS-Magnum to the network and power up the board.

17.2. MCS-BMS-GATEWAY PROTOCOLS (over Ethernet - Modbus RTU)

- BACnet MS/IP
- Johnson N2
- Modbus RTU / Modbus TCP/IP
- Modbus RTU / BACnet IP
- LonTalk

The MCS-BMS-GATEWAY is a microprocessor based communication device that provides translation from Modbus RTU to BACnet IP, Modbus RTU to Modbus TCP/IP, BACnet MS/TP, Johnson Control N2 or LonTalk.

Information that can be transmitted includes the status of control points, alarm information, digital inputs, analog inputs or setpoints.

Network protocols are formatting rules that specify how data is sent and received between devices. Protocols are necessary for devices to interact with each other.

17.2.1 Protocols MCS controllers support:

✓ = Built in Support

MCS Network Protocol Support

PROTOCOL from MCS Controller >	Magnum	MicroMag
Modbus RTU	✓	✓
PROTOCOLS from MCS-BMS-GATEWAY >		
BACnet MSTP	MCS-BMS-Gateway	MCS-Ethernet-RS485
Johnson N2	MCS-BMS-Gateway	MCS-Ethernet-RS485
Modbus RTU to Modbus TCP/IP	MCS-BMS-Gateway	MCS-Ethernet-RS485
Modbus RTU to BACNet IP	MCS-BMS-Gateway	MCS-Ethernet-RS485
LonTalk	MCS-BMS-Gateway	MCS-Ethernet-RS485

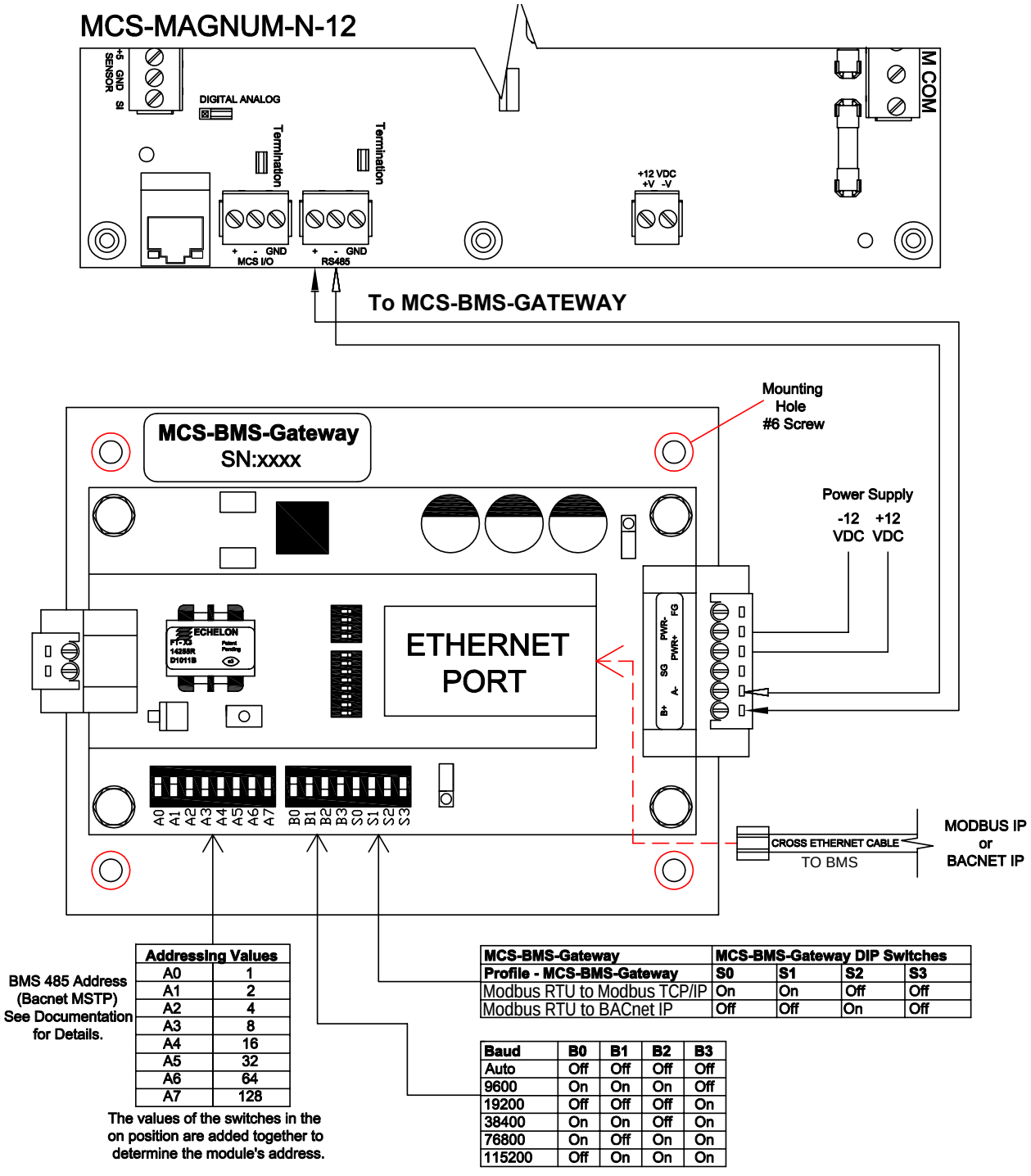
Chapter - 18. WIRING MCS-BMS GATEWAY

18.1. WIRING MCS-MAGNUM for MCS-BMS-GATEWAY over RS485

The MCS-MAGNUM-12 includes the integration of Modbus RTU communication protocol, which is based on the master-slave architecture for data transfer over RS485 to a BMS system.

A MCS-BMS-GATEWAY is available to provide protocols for: Bacnet IP or Modbus IP.

Information that can be transmitted includes the status of the unit, status of the inputs and outputs, alarm information, and setpoints.



Addressing Values	
A0	1
A1	2
A2	4
A3	8
A4	16
A5	32
A6	64
A7	128

BMS 485 Address (Bacnet MSTP) See Documentation for Details.

The values of the switches in the on position are added together to determine the module's address.

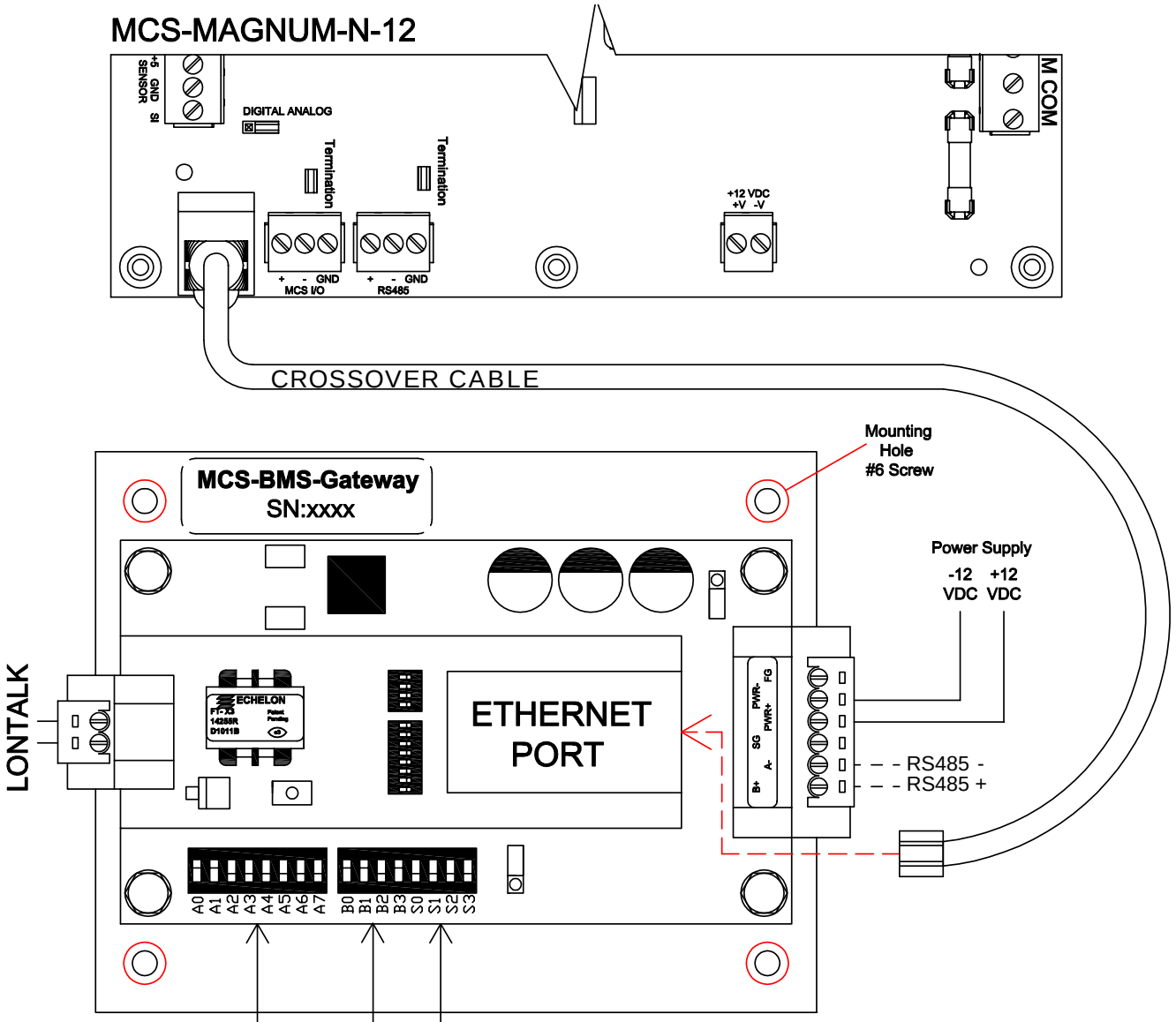
MCS-BMS-Gateway	MCS-BMS-Gateway DIP Switches			
Profile - MCS-BMS-Gateway	S0	S1	S2	S3
Modbus RTU to Modbus TCP/IP	On	On	Off	Off
Modbus RTU to BACnet IP	Off	Off	On	Off

Baud	B0	B1	B2	B3
Auto	Off	Off	Off	Off
9600	On	On	On	Off
19200	Off	Off	Off	On
38400	On	On	Off	On
76800	On	Off	On	On
115200	Off	On	On	On

18.2. WIRING MCS-MAGNUM for MCS-BMS-GATEWAY over Ethernet

The MCS-MAGNUM-12 uses BACnet IP communication protocol over the ethernet.

A MCS-BMS-GATEWAY is available to provide protocols for: Bacnet MSTP, Lontalk, or Johnson N2 communication interface. Information that can be transmitted includes the status of the unit, status of the inputs and outputs, alarm information, and setpoints.



BMS 485 Address (Bacnet MSTP) See Documentation for Details.

Addressing Values	
A0	1
A1	2
A2	4
A3	8
A4	16
A5	32
A6	64
A7	128

The values of the switches in the on position are added together to determine the module's address.

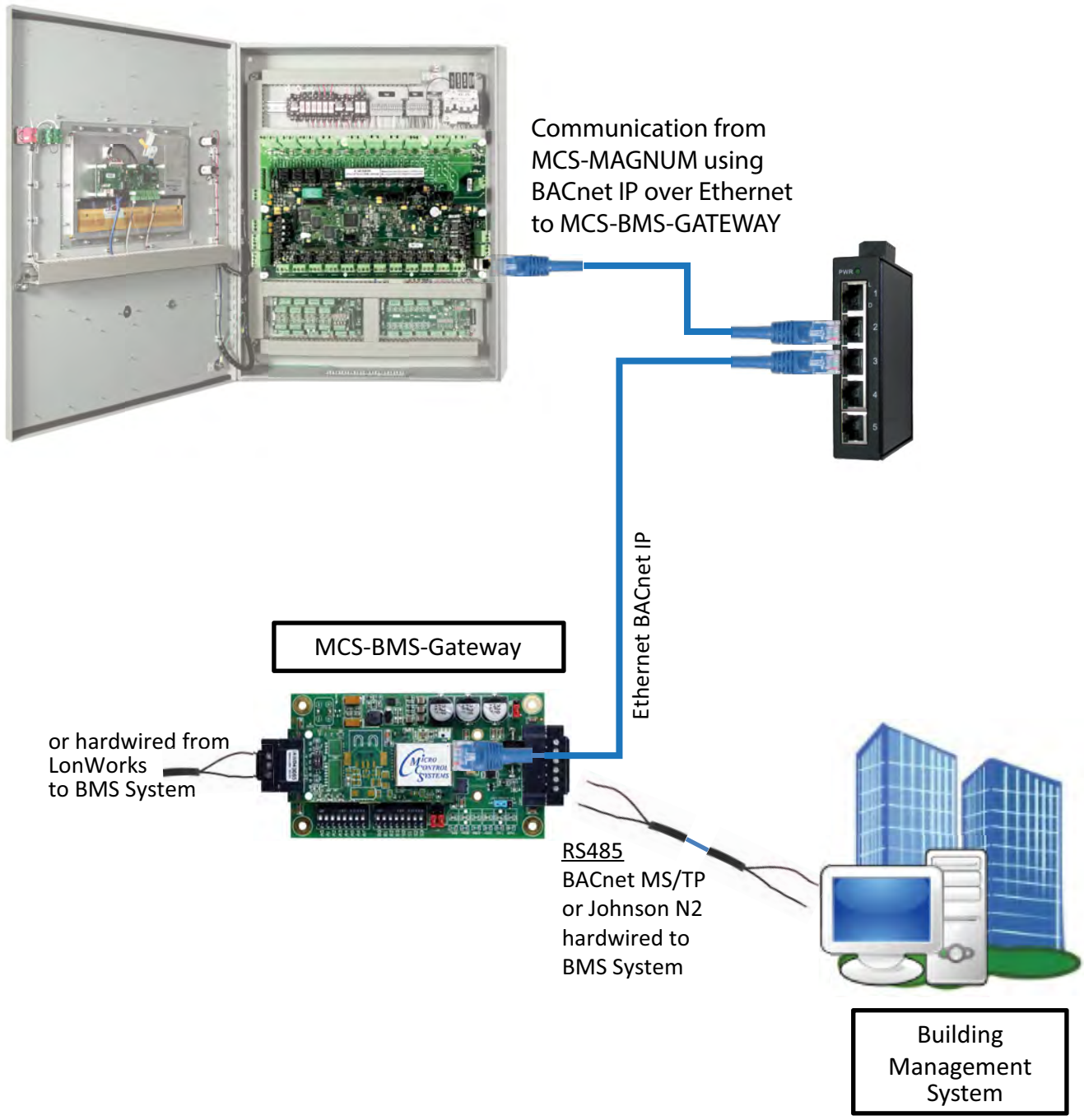
MCS-BMS-Gateway	MCS-BMS-Gateway DIP Switches			
Profile - MCS-BMS-Gateway	S0	S1	S2	S3
LonWorks	Off	Off	Off	Off
Bacnet MS/TP	On	Off	Off	Off
Johnson N2	Off	On	Off	Off

Baud	B0	B1	B2	B3
Auto	Off	Off	Off	Off
9600	On	On	On	Off
19200	Off	Off	Off	On
38400	On	On	Off	On
76800	On	Off	On	On
115200	Off	On	On	On

18.3. EXAMPLE NETWORK

18.3.1 Standalone MCS-Magnum (using Modbus RTU Protocol)

- MCS INDUSTRIAL CONTROL PANEL with a MCS-MAGNUM controller using an Ethernet cable to communicate to the MCS-BMS-GATEWAY over BACnet IP.
- MCS-BMS-GATEWAY hardwired to BMS Management System using:
  1. BACnet MS/TP protocol or
  2. Johnston N2 protocol or
  3. LonTalk protocol using the LonWorks port



Chapter - 19.APPENDIX - INPUT / OUTPUT POINTS / STATES

19.1. Sensor Input Points

All sensor inputs are read-only.

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 2 - 1	AI:25	Refer to Config	*30025	*AI: 25
Sensor 2 - 2	AI:26	Refer to Config	*30026	*AI: 26
Sensor 2 - 3	AI:27	Refer to Config	*30027	*AI: 27
Sensor 2 - 4	AI:28	Refer to Config	*30028	*AI: 28
Sensor 2 - 5	AI:29	Refer to Config	*30029	*AI: 29
Sensor 2 - 6	AI:30	Refer to Config	*30030	*AI: 30
Sensor 2 - 7	AI:31	Refer to Config	*30031	*AI: 31
Sensor 2 - 8	AI:32	Refer to Config	*30032	*AI: 32
Sensor 3 - 1	AI:33	Refer to Config	*30033	*AI: 33

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
Sensor 3 - 2	AI:34	Refer to Config	*30034	*AI: 34
Sensor 3 - 3	AI:35	Refer to Config	*30035	*AI: 35
Sensor 3 - 4	AI:36	Refer to Config	*30036	*AI: 36

Sensor 3 - 5	AI:37	Refer to Config	*30037	*AI: 37
Sensor 3 - 6	AI:38	Refer to Config	*30038	*AI: 38
Sensor 3 - 7	AI:39	Refer to Config	*30039	*AI: 39
Sensor 3 - 8	AI:40	Refer to Config	*30040	*AI: 40
Sensor 4 - 1	AI:41	Refer to Config	*30041	*AI: 41
Sensor 4 - 2	AI:42	Refer to Config	*30042	*AI: 42
Sensor 4 - 3	AI:43	Refer to Config	*30043	*AI: 43
Sensor 4 - 4	AI:44	Refer to Config	*30044	*AI: 44
Sensor 4 - 5	AI:45	Refer to Config	*30045	*AI: 45
Sensor 4 - 6	AI:46	Refer to Config	*30046	*AI: 46
Sensor 4 - 7	AI:47	Refer to Config	*30047	*AI: 47
Sensor 4 - 8	AI:48	Refer to Config	*30048	*AI: 48

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

19.2. Relay Output Points

Relay output points are read-only.

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 2 - 1	BO:19	Refer to Config	00019	BO: 19
Relay 2 - 2	BO:20	Refer to Config	00020	BO: 20
Relay 2 - 3	BO:21	Refer to Config	00021	BO: 21
Relay 2 - 4	BO:22	Refer to Config	00022	BO: 22

Magnum	BACnet ID	BACnet Name	Modbus	N2
Relay 2 - 5	BO:23	Refer to Config	00023	BO: 23
Relay 2 - 6	BO:24	Refer to Config	00024	BO: 24

Relay 2 - 7	BO:25	Refer to Config	00025	BO: 25
Relay 2 - 8	BO:26	Refer to Config	00026	BO: 26
Relay 3 - 1	BO:27	Refer to Config	00027	BO: 27
Relay 3 - 2	BO:28	Refer to Config	00028	BO: 28
Relay 3 - 3	BO:29	Refer to Config	00029	BO: 29
Relay 3 - 4	BO:30	Refer to Config	00030	BO: 30
Relay 3 - 5	BO:31	Refer to Config	00031	BO: 31
Relay 3 - 6	BO:32	Refer to Config	00032	BO: 32
Relay 3 - 7	BO:33	Refer to Config	00033	BO: 33
Relay 3 - 8	BO:34	Refer to Config	00034	BO: 34
Relay 4 - 1	BO:35	Refer to Config	00035	BO: 35
Relay 4 - 2	BO:36	Refer to Config	00036	BO: 36
Relay 4 - 3	BO:37	Refer to Config	00037	BO: 37
Relay 4 - 4	BO:38	Refer to Config	00038	BO: 38
Relay 4 - 5	BO:39	Refer to Config	00039	BO: 39
Relay 4 - 6	BO:40	Refer to Config	00040	BO: 40
Relay 4 - 7	BO:41	Refer to Config	00041	BO: 41
Relay 4 - 8	BO:42	Refer to Config	00042	BO: 42
Relay 5 - 1	BO:43	Refer to Config	00043	BO: 43
Relay 5 - 2	BO:44	Refer to Config	00044	BO: 44
Relay 5 - 3	BO:45	Refer to Config	00045	BO: 45
Relay 5 - 4	BO:46	Refer to Config	00046	BO: 46
Relay 5 - 5	BO:47	Refer to Config	00047	BO: 47
Relay 5 - 6	BO:48	Refer to Config	00048	BO: 48

19.3. Analog Output Points

Analog Output points are read-only. 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 2-1	AO:7	Refer to Config	*30207	*AO: 7
Analog Out 2-2	AO:8	Refer to Config	*30208	*AO: 8
Analog Out 3-1	AO:9	Refer to Config	*30209	*AO: 9
Analog Out 3-2	AO:10	Refer to Config	*30210	*AO: 10
Analog Out 4-1	AO:11	Refer to Config	*30211	*AO: 11
Analog Out 4-2	AO:12	Refer to Config	*30212	*AO: 12

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

19.4. Set Points

Set points are read-only.
Notable BACnet properties available

Magnum	BACnet ID	BACnet Name	Modbus	N2
Set point #1	AV:0	STP# 1-<Set point name>	40301	ADF:1
Set point #2	AV:1	STP# 2-<Set point name>	40302	ADF:2
Set point #3	AV:2	STP# 3-<Set point name>	40303	ADF:3
Set point #4	AV:71	STP# 4-<Set point name>	40304	ADF:72
Set point #5	AV:72	STP# 5-<Set point name>	40305	ADF:73
Set point #6	AV:73	STP# 6-<Set point name>	40306	ADF:74
Set point #7	AV:74	STP# 7-<Set point name>	40307	ADF:75
Set point #8	AV:75	STP# 8-<Set point name>	40308	ADF:76
Set point #9	AV:76	STP# 9-<Set point name>	40309	ADF:77
Set point #10	AV:77	STP# 10-<Set point name>	40310	ADF:78
Set point #11	AV:78	STP# 11-<Set point name>	40311	ADF:79
Set point #12	AV:79	STP# 12-<Set point name>	40312	ADF:80
Set point #13	AV:80	STP# 13-<Set point name>	40313	ADF:81
Set point #14	AV:81	STP# 14-<Set point name>	40314	ADF:82
Set point #15	AV:82	STP# 15-<Set point name>	40315	ADF:83
Set point #16	AV:83	STP# 16-<Set point name>	40316	ADF:84
Set point #17	AV:84	STP# 17-<Set point name>	40317	ADF:85
Set point #18	AV:85	STP# 18-<Set point name>	40318	ADF:86
Set point #19	AV:86	STP# 19-<Set point name>	40319	ADF:87
Set point #20	AV:87	STP# 20-<Set point name>	40320	ADF:88
Set point #21	AV:88	STP# 21-<Set point name>	40321	ADF:89
Set point #22	AV:89	STP# 22-<Set point name>	40322	ADF:90
Set point #23	AV:90	STP# 23-<Set point name>	40323	ADF:91
Set point #24	AV:91	STP# 24-<Set point name>	40324	ADF:92
Set point #25	AV:92	STP# 25-<Set point name>	40325	ADF:93
Set point #26	AV:93	STP# 26-<Set point name>	40326	ADF:94
Set point #27	AV:94	STP# 27-<Set point name>	40327	ADF:95
Set point #28	AV:95	STP# 28-<Set point name>	40328	ADF:96
Set point #29	AV:96	STP# 29-<Set point name>	40329	ADF:97
Set point #30	AV:97	STP# 30-<Set point name>	40330	ADF:98
Set point #31	AV:98	STP# 31-<Set point name>	40331	ADF:99
Set point #32	AV:99	STP# 32-<Set point name>	40332	ADF:100
Set point #33	AV:100	STP# 33-<Set point name>	40333	ADF:101
Set point #34	AV:101	STP# 34-<Set point name>	40334	ADF:102
Set point #35	AV:102	STP# 35-<Set point name>	40335	ADF:103
Set point #36	AV:103	STP# 36-<Set point name>	40336	ADF:104
Set point #37	AV:104	STP# 37-<Set point name>	40337	ADF:105
Set point #38	AV:105	STP# 38-<Set point name>	40338	ADF:106
Set point #39	AV:106	STP# 39-<Set point name>	40339	ADF:107
Set point #40	AV:107	STP# 40-<Set point name>	40340	ADF:108
Set point #41	AV:108	STP# 41-<Set point name>	40341	ADF:109

Magnum	BACnet ID	BACnet Name	Modbus	N2
Set point #42	AV:109	STP# 42-<Set point name>	40342	ADF:110
Set point #43	AV:110	STP# 43-<Set point name>	40343	ADF:111
Set point #44	AV:111	STP# 44-<Set point name>	40344	ADF:112
Set point #45	AV:112	STP# 45-<Set point name>	40345	ADF:113
Set point #46	AV:113	STP# 46-<Set point name>	40346	ADF:114
Set point #47	AV:114	STP# 47-<Set point name>	40347	ADF:115
Set point #48	AV:115	STP# 48-<Set point name>	40348	ADF:116
Set point #49	AV:116	STP# 49-<Set point name>	40349	ADF:117
Set point #50	AV:117	STP# 50-<Set point name>	40350	ADF:118
Set point #51	AV:118	STP# 51-<Set point name>	40351	ADF:119
Set point #52	AV:119	STP# 52-<Set point name>	40352	ADF:120
Set point #53	AV:120	STP# 53-<Set point name>	40353	ADF:121
Set point #54	AV:121	STP# 54-<Set point name>	40354	ADF:122
Set point #55	AV:122	STP# 55-<Set point name>	40355	ADF:123
Set point #56	AV:123	STP# 56-<Set point name>	40356	ADF:124
Set point #57	AV:124	STP# 57-<Set point name>	40357	ADF:125
Set point #58	AV:125	STP# 58-<Set point name>	40358	ADF:126
Set point #59	AV:126	STP# 59-<Set point name>	40359	ADF:127
Set point #60	AV:127	STP# 60-<Set point name>	40360	ADF:128
Set point #61	AV:128	STP# 61-<Set point name>	40361	ADF:129
Set point #62	AV:129	STP# 62-<Set point name>	40362	ADF:130
Set point #63	AV:130	STP# 63-<Set point name>	40363	ADF:131
Set point #64	AV:131	STP# 64-<Set point name>	40364	ADF:132
Set point #65	AV:132	STP# 65-<Set point name>	40365	ADF:133
Set point #66	AV:133	STP# 66-<Set point name>	40366	ADF:134
Set point #67	AV:134	STP# 67-<Set point name>	40367	ADF:135
Set point #68	AV:135	STP# 68-<Set point name>	40368	ADF:136
Set point #69	AV:136	STP# 69-<Set point name>	40369	ADF:137
Set point #70	AV:137	STP# 70-<Set point name>	40370	ADF:138
Set point #71	AV:138	STP# 71-<Set point name>	40371	ADF:139
Set point #72	AV:139	STP# 72-<Set point name>	40372	ADF:140
Set point #73	AV:140	STP# 73-<Set point name>	40373	ADF:141
Set point #74	AV:141	STP# 74-<Set point name>	40374	ADF:142
Set point #75	AV:142	STP# 75-<Set point name>	40375	ADF:143
Set point #76	AV:143	STP# 76-<Set point name>	40376	ADF:144
Set point #77	AV:144	STP# 77-<Set point name>	40377	ADF:145
Set point #78	AV:145	STP# 78-<Set point name>	40378	ADF:146
Set point #79	AV:146	STP# 79-<Set point name>	40379	ADF:147
Set point #80	AV:147	STP# 80-<Set point name>	40380	ADF:148
Set point #81	AV:148	STP# 81-<Set point name>	40381	ADF:149
Set point #82	AV:149	STP# 82-<Set point name>	40382	ADF:150
Set point #83	AV:150	STP# 83-<Set point name>	40383	ADF:151
Set point #84	AV:151	STP# 84-<Set point name>	40384	ADF:152
Set point #85	AV:152	STP# 85-<Set point name>	40385	ADF:153

Magnum	BACnet ID	BACnet Name	Modbus	N2
Set point #86	AV:153	STP# 86-<Set point name>	40386	ADF:154
Set point #87	AV:154	STP# 87-<Set point name>	40387	ADF:155
Set point #88	AV:155	STP# 88-<Set point name>	40388	ADF:156
Set point #89	AV:156	STP# 89-<Set point name>	40389	ADF:157
Set point #90	AV:157	STP# 90-<Set point name>	40390	ADF:158
Set point #91	AV:158	STP# 91-<Set point name>	40391	ADF:159
Set point #92	AV:159	STP# 92-<Set point name>	40392	ADF:160
Set point #93	AV:160	STP# 93-<Set point name>	40393	ADF:161
Set point #94	AV:161	STP# 94-<Set point name>	40394	ADF:162
Set point #95	AV:162	STP# 95-<Set point name>	40395	ADF:163
Set point #96	AV:163	STP# 96-<Set point name>	40396	ADF:164
Set point #97	AV:164	STP# 97-<Set point name>	40397	ADF:165
Set point #98	AV:165	STP# 98-<Set point name>	40398	ADF:166
Set point #99	AV:166	STP# 99-<Set point name>	40399	ADF:167
Set point #100	AV:167	STP# 100-<Set point name>	40400	ADF:168
Set point #101	AV:168	STP# 101-<Set point name>	40401	ADF:169
Set point #102	AV:169	STP# 102-<Set point name>	40402	ADF:170
Set point #103	AV:170	STP# 103-<Set point name>	40403	ADF:171
Set point #104	AV:171	STP# 104-<Set point name>	40404	ADF:172
Set point #105	AV:172	STP# 105-<Set point name>	40405	ADF:173
Set point #106	AV:173	STP# 106-<Set point name>	40406	ADF:174
Set point #107	AV:174	STP# 107-<Set point name>	40407	ADF:175
Set point #108	AV:175	STP# 108-<Set point name>	40408	ADF:176
Set point #109	AV:176	STP# 109-<Set point name>	40409	ADF:177
Set point #110	AV:177	STP# 110-<Set point name>	40410	ADF:178
Set point #111	AV:178	STP# 111-<Set point name>	40411	ADF:179
Set point #112	AV:179	STP# 112-<Set point name>	40412	ADF:180
Set point #113	AV:180	STP# 113-<Set point name>	40413	ADF:181
Set point #114	AV:181	STP# 114-<Set point name>	40414	ADF:182
Set point #115	AV:182	STP# 115-<Set point name>	40415	ADF:183
Set point #116	AV:183	STP# 116-<Set point name>	40416	ADF:184
Set point #117	AV:184	STP# 117-<Set point name>	40417	ADF:185
Set point #118	AV:185	STP# 118-<Set point name>	40418	ADF:186
Set point #119	AV:186	STP# 119-<Set point name>	40419	ADF:187
Set point #120	AV:187	STP# 120-<Set point name>	40420	ADF:188
Set point #121	AV:188	STP# 121-<Set point name>	40421	ADF:189
Set point #122	AV:189	STP# 122-<Set point name>	40422	ADF:190
Set point #123	AV:190	STP# 123-<Set point name>	40423	ADF:191
Set point #124	AV:191	STP# 124-<Set point name>	40424	ADF:192
Set point #125	AV:192	STP# 125-<Set point name>	40425	ADF:193
Set point #126	AV:193	STP# 126-<Set point name>	40426	ADF:194
Set point #127	AV:194	STP# 127-<Set point name>	40427	ADF:195
Set point #128	AV:195	STP# 128-<Set point name>	40428	ADF:196
Set point #129	AV:196	STP# 129-<Set point name>	40429	ADF:197

Magnum	BACnet ID	BACnet Name	Modbus	N2
Set point #130	AV:197	STP# 130-<Set point name>	40430	ADF:198
Set point #131	AV:198	STP# 131-<Set point name>	40431	ADF:199
Set point #132	AV:199	STP# 132-<Set point name>	40432	ADF:200
Set point #133	AV:200	STP# 133-<Set point name>	40433	ADF:201
Set point #134	AV:201	STP# 134-<Set point name>	40434	ADF:202
Set point #135	AV:202	STP# 135-<Set point name>	40435	ADF:203
Set point #136	AV:203	STP# 136-<Set point name>	40436	ADF:204
Set point #137	AV:204	STP# 137-<Set point name>	40437	ADF:205
Set point #138	AV:205	STP# 138-<Set point name>	40438	ADF:206
Set point #139	AV:206	STP# 139-<Set point name>	40439	ADF:207
Set point #140	AV:207	STP# 140-<Set point name>	40440	ADF:208
Set point #141	AV:208	STP# 141-<Set point name>	40441	ADF:209
Set point #142	AV:209	STP# 142-<Set point name>	40442	ADF:210
Set point #143	AV:210	STP# 143-<Set point name>	40443	ADF:211
Set point #144	AV:211	STP# 144-<Set point name>	40444	ADF:212
Set point #145	AV:212	STP# 145-<Set point name>	40445	ADF:213
Set point #146	AV:213	STP# 146-<Set point name>	40446	ADF:214
Set point #147	AV:214	STP# 147-<Set point name>	40447	ADF:215
Set point #148	AV:215	STP# 148-<Set point name>	40448	ADF:216
Set point #149	AV:216	STP# 149-<Set point name>	40449	ADF:217
Set point #150	AV:217	STP# 150-<Set point name>	40450	ADF:218
Set point #151	AV:218	STP# 151-<Set point name>	40451	ADF:219
Set point #152	AV:219	STP# 152-<Set point name>	40452	ADF:220
Set point #153	AV:220	STP# 153-<Set point name>	40453	ADF:221
Set point #154	AV:221	STP# 154-<Set point name>	40454	ADF:222
Set point #155	AV:222	STP# 155-<Set point name>	40455	ADF:223
Set point #156	AV:223	STP# 156-<Set point name>	40456	ADF:224
Set point #157	AV:224	STP# 157-<Set point name>	40457	ADF:225
Set point #158	AV:225	STP# 158-<Set point name>	40458	ADF:226
Set point #159	AV:226	STP# 159-<Set point name>	40459	ADF:227
Set point #160	AV:227	STP# 160-<Set point name>	40460	ADF:228
Set point #161	AV:228	STP# 161-<Set point name>	40461	ADF:229
Set point #162	AV:229	STP# 162-<Set point name>	40462	ADF:230
Set point #163	AV:230	STP# 163-<Set point name>	40463	ADF:231
Set point #164	AV:231	STP# 164-<Set point name>	40464	ADF:232
Set point #165	AV:232	STP# 165-<Set point name>	40465	ADF:233
Set point #166	AV:233	STP# 166-<Set point name>	40466	ADF:234
Set point #167	AV:234	STP# 167-<Set point name>	40467	ADF:235
Set point #168	AV:235	STP# 168-<Set point name>	40468	ADF:236
Set point #169	AV:236	STP# 169-<Set point name>	40469	ADF:237
Set point #170	AV:237	STP# 170-<Set point name>	40470	ADF:238

*- Indicates value multiplied by 10 to include one decimal place. (ie. BMS value of 500 indicates actual value 50.0)
- Set points 4-170 were added to available points in MAGNUM software version 5.01G. For previous versions of MAGNUM software, only set points 1-3 are available.

19.5. LWC 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
LWC Unit State	MV:9	LWC UNIT STATE	30383	
Pumps L#1 State	MV:10	PUMPS L-#1 STATE	30384	
Pumps L#2 State	MV:11	PUMPS L-#2 STATE	30385	
Pumps L#3 State	MV:12	PUMPS L-#3 STATE	30386	
Pumps L#4 State	MV:13	PUMPS L-#4 STATE	30387	
Pumps L#5 State	MV:14	PUMPS L-#5 STATE	30388	
Pumps L#6 State	MV:15	PUMPS L-#6 STATE	30389	
Loop #1 Pump #1 State	MV:16	LOOP #1 PUMP #1 STATE	30420	
Loop #1 Pump #2 State	MV:17	LOOP #1 PUMP #2 STATE	30421	
Loop #1 Pump #3 State	MV:18	LOOP #1 PUMP #3 STATE	30422	
Loop #1 Pump #4 State	MV:19	LOOP #1 PUMP #4 STATE	30423	
Loop #1 Pump #5 State	MV:20	LOOP #1 PUMP #5 STATE	30424	
Loop #1 Pump #6 State	MV:21	LOOP #1 PUMP #6 STATE	30425	
Loop #1 Pump #7 State	MV:22	LOOP #1 PUMP #7 STATE	30426	
Loop #1 Pump #8 State	MV:23	LOOP #1 PUMP #8 STATE	30427	
Loop #1 Pump #9 State	MV:24	LOOP #1 PUMP #9 STATE	30428	
Loop #1 Pump #10 State	MV:25	LOOP #1 PUMP #10 STATE	30429	
Loop #1 Pump #11 State	MV:26	LOOP #1 PUMP #11 STATE	30430	
Loop #1 Pump #12 State	MV:27	LOOP #1 PUMP #12 STATE	30431	
Loop #2 Pump #1 State	MV:28	LOOP #2 PUMP #1 STATE	30432	
Loop #2 Pump #2 State	MV:29	LOOP #2 PUMP #2 STATE	30433	
Loop #2 Pump #3 State	MV:30	LOOP #2 PUMP #3 STATE	30434	
Loop #2 Pump #4 State	MV:31	LOOP #2 PUMP #4 STATE	30435	
Loop #2 Pump #5 State	MV:32	LOOP #2 PUMP #5 STATE	30436	
Loop #2 Pump #6 State	MV:33	LOOP #2 PUMP #6 STATE	30437	
Loop #2 Pump #7 State	MV:34	LOOP #2 PUMP #7 STATE	30438	
Loop #2 Pump #8 State	MV:35	LOOP #2 PUMP #8 STATE	30439	
Loop #2 Pump #9 State	MV:36	LOOP #2 PUMP #9 STATE	30440	
Loop #2 Pump #10 State	MV:37	LOOP #2 PUMP #10 STATE	30441	
Loop #2 Pump #11 State	MV:38	LOOP #2 PUMP #11 STATE	30442	
Loop #2 Pump #12 State	MV:39	LOOP #2 PUMP #12 STATE	30443	
Loop #3 Pump #1 State	MV:40	LOOP #3 PUMP #1 STATE	30444	
Loop #3 Pump #2 State	MV:41	LOOP #3 PUMP #2 STATE	30445	
Loop #3 Pump #3 State	MV:42	LOOP #3 PUMP #3 STATE	30446	

Loop #3 Pump #4 State	MV:43	LOOP #3 PUMP #4 STATE	30447	
Loop #3 Pump #5 State	MV:44	LOOP #3 PUMP #5 STATE	30448	
Loop #3 Pump #6 State	MV:45	LOOP #3 PUMP #6 STATE	30449	
Loop #3 Pump #7 State	MV:46	LOOP #3 PUMP #7 STATE	30450	
Magnum	**BACnet ID**	**BACnet Name**	**Modbus Register**	**N2**
Loop #3 Pump #8 State	MV:47	LOOP #3 PUMP #8 STATE	30451	
Loop #3 Pump #9 State	MV:48	LOOP #3 PUMP #9 STATE	30452	
Loop #3 Pump #10 State	MV:49	LOOP #3 PUMP #10 STATE	30453	
Loop #3 Pump #11 State	MV:50	LOOP #3 PUMP #11 STATE	30454	
Loop #3 Pump #12 State	MV:51	LOOP #3 PUMP #12 STATE	30455	
Loop #4 Pump #1 State	MV:52	LOOP #4 PUMP #1 STATE	30456	
Loop #4 Pump #2 State	MV:53	LOOP #4 PUMP #2 STATE	30457	
Loop #4 Pump #3 State	MV:54	LOOP #4 PUMP #3 STATE	30458	
Loop #4 Pump #4 State	MV:55	LOOP #4 PUMP #4 STATE	30459	
Loop #4 Pump #5 State	MV:56	LOOP #4 PUMP #5 STATE	30460	
Loop #4 Pump #6 State	MV:57	LOOP #4 PUMP #6 STATE	30461	
Loop #4 Pump #7 State	MV:58	LOOP #4 PUMP #7 STATE	30462	
Loop #4 Pump #8 State	MV:59	LOOP #4 PUMP #8 STATE	30463	
Loop #4 Pump #9 State	MV:60	LOOP #4 PUMP #9 STATE	30464	
Loop #4 Pump #10 State	MV:61	LOOP #4 PUMP #10 STATE	30465	
Loop #4 Pump #11 State	MV:62	LOOP #4 PUMP #11 STATE	30466	
Loop #4 Pump #12 State	MV:63	LOOP #4 PUMP #12 STATE	30467	
Loop #5 Pump #1 State	MV:64	LOOP #5 PUMP #1 STATE	30468	
Loop #5 Pump #2 State	MV:65	LOOP #5 PUMP #2 STATE	30469	
Loop #5 Pump #3 State	MV:66	LOOP #5 PUMP #3 STATE	30470	
Loop #5 Pump #4 State	MV:67	LOOP #5 PUMP #4 STATE	30471	
Loop #5 Pump #5 State	MV:68	LOOP #5 PUMP #5 STATE	30472	
Loop #5 Pump #6 State	MV:69	LOOP #5 PUMP #6 STATE	30473	
Loop #5 Pump #7 State	MV:70	LOOP #5 PUMP #7 STATE	30474	
Loop #5 Pump #8 State	MV:71	LOOP #5 PUMP #8 STATE	30475	
Loop #5 Pump #9 State	MV:72	LOOP #5 PUMP #9 STATE	30476	
Loop #5 Pump #10 State	MV:73	LOOP #5 PUMP #10 STATE	30477	
Loop #5 Pump #11 State	MV:74	LOOP #5 PUMP #11 STATE	30478	
Loop #5 Pump #12 State	MV:75	LOOP #5 PUMP #12 STATE	30479	
Loop #6 Pump #1 State	MV:76	LOOP #6 PUMP #1 STATE	30480	
Loop #6 Pump #2 State	MV:77	LOOP #6 PUMP #2 STATE	30481	

Loop #6 Pump #3 State	MV:78	LOOP #6 PUMP #3 STATE	30482	
Loop #6 Pump #4 State	MV:79	LOOP #6 PUMP #4 STATE	30483	
Loop #6 Pump #5 State	MV:80	LOOP #6 PUMP #5 STATE	30484	
Loop #6 Pump #6 State	MV:81	LOOP #6 PUMP #6 STATE	30485	
Loop #6 Pump #7 State	MV:82	LOOP #6 PUMP #7 STATE	30486	
Loop #6 Pump #8 State	MV:83	LOOP #6 PUMP #8 STATE	30487	
Loop #6 Pump #9 State	MV:84	LOOP #6 PUMP #9 STATE	30488	
Loop #6 Pump #10 State	MV:85	LOOP #6 PUMP #10 STATE	30489	
Loop #6 Pump #11 State	MV:86	LOOP #6 PUMP #11 STATE	30490	
Loop #6 Pump #12 State	MV:87	LOOP #6 PUMP #12 STATE	30491	
Loop #1 Stage State	MV:88	LOOP #1 STAGE STATE	30492	

Magnum	BACnet ID	BACnet Name	Modbus Register	N2
Loop #2 Stage State	MV:89	LOOP #2 STAGE STATE	30493	
Loop #3 Stage State	MV:90	LOOP #3 STAGE STATE	30494	
Loop #4 Stage State	MV:91	LOOP #4 STAGE STATE	30495	
Loop #5 Stage State	MV:92	LOOP #5 STAGE STATE	30496	
Loop #6 Stage State	MV:93	LOOP #6 STAGE STATE	30497	
Loop #1 State	MV:94	LOOP #1 STATE	30510	
Loop #2 State	MV:95	LOOP #2 STATE	30511	
Loop #3 State	MV:96	LOOP #3 STATE	30512	
Loop #4 State	MV:97	LOOP #4 STATE	30513	
Loop #5 State	MV:98	LOOP #5 STATE	30514	
Loop #6 State	MV:99	LOOP #6 STATE	30515	

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

19.6. Other Points

These points are read-only.

Magnum	BACnet ID	BACnet Name	Modbus	N2
L-1 Pumps Steps W/O	AV:250	L-1 PUMPS STEPS W/O	*30390	*ADF:251
L-1 Pumps Steps T/O	AV:251	L-1 PUMPS STEPS T/O	*30396	*ADF:252
L-1 Pumps Wanted%	AV:252	L-1 PUMPS WANTED%	*30402	*ADF:253
L-1 Lead Pump	AV:253	L-1 LEAD PUMP	*30408	*ADF:254
L-2 Pumps Steps W/O	AV:254	L-2 PUMPS STEPS W/O	*30391	*ADF:255
L-2 Pumps Steps T/O	AV:255	L-2 PUMPS STEPS T/O	*30397	*ADF:256
L-2 Pumps Wanted%	AV:256	L-2 PUMPS WANTED%	*30403	*ADF:257
L-2 Lead Pump	AV:257	L-2 LEAD PUMP	*30409	*ADF:258
L-3 Pumps Steps W/O	AV:258	L-3 PUMPS STEPS W/O	*30392	*ADF:259
L-3 Pumps Steps T/O	AV:259	L-3 PUMPS STEPS T/O	*30398	*ADF:260

L-3 Pumps Wanted%	AV:260	L-3 PUMPS WANTED%	*30404	*ADF:261
L-3 Lead Pump	AV:261	L-3 LEAD PUMP	*30410	*ADF:262
L-4 Pumps Steps W/O	AV:262	L-4 PUMPS STEPS W/O	*30393	*ADF:263
L-4 Pumps Steps T/O	AV:263	L-4 PUMPS STEPS T/O	*30399	*ADF:264
L-4 Pumps Wanted%	AV:264	L-4 PUMPS WANTED%	*30404	*ADF:265
L-4 Lead Pump	AV:265	L-4 LEAD PUMP	*30411	*ADF:266
L-5 Pumps Steps W/O	AV:266	L-5 PUMPS STEPS W/O	*30394	*ADF:267
L-5 Pumps Steps T/O	AV:267	L-5 PUMPS STEPS T/O	*30400	*ADF:268
L-5 Pumps Wanted%	AV:268	L-5 PUMPS WANTED%	*30406	*ADF:269
L-5 Lead Pump	AV:269	L-5 LEAD PUMP	*30412	*ADF:270
L-6 Pumps Steps W/O	AV:270	L-6 PUMPS STEPS W/O	*30395	*ADF:271
L-6 Pumps Steps T/O	AV:271	L-6 PUMPS STEPS T/O	*30401	*ADF:272
L-6 Pumps Wanted%	AV:272	L-6 PUMPS WANTED%	*30407	*ADF:273
L-6 Lead Pump	AV:273	L-6 LEAD PUMP	*30413	*ADF:274
L-1 Stage Steps W/O	AV:274	L-1 STAGE STEPS W/O	*30498	*ADF:275
Magnum	**BACnet ID**	**BACnet Name**	**Modbus Register**	**N2**
L-1 Stage Steps T/O	AV:275	L-1 STAGE STEPS T/O	*30504	*ADF:276
L-1 Water ROC	AV:276	L-1 WATER ROC	*30414	*ADF:277
L-2 Stage Steps W/O	AV:277	L-2 STAGE STEPS W/O	*30499	*ADF:278
L-2 Stage Steps T/O	AV:278	L-2 STAGE STEPS T/O	*30505	*ADF:279
L-2 Water ROC	AV:279	L-2 WATER ROC	*30415	*ADF:280
L-3 Stage Steps W/O	AV:280	L-3 STAGE STEPS W/O	*30500	*ADF:281
L-3 Stage Steps T/O	AV:281	L-3 STAGE STEPS T/O	*30506	*ADF:282
L-3 Water ROC	AV:282	L-3 WATER ROC	*30416	*ADF:283
L-4 Stage Steps W/O	AV:283	L-4 STAGE STEPS W/O	*30501	*ADF:284
L-4 Stage Steps T/O	AV:284	L-4 STAGE STEPS T/O	*30507	*ADF:285
L-4 Water ROC	AV:285	L-4 WATER ROC	*30417	*ADF:286
L-5 Stage Steps W/O	AV:286	L-5 STAGE STEPS W/O	*30502	*ADF:287
L-5 Stage Steps T/O	AV:287	L-5 STAGE STEPS T/O	*30508	*ADF:288
L-5 Water ROC	AV:288	L-5 WATER ROC	*30418	*ADF:289
L-6 Stage Steps W/O	AV:289	L-6 STAGE STEPS W/O	*30503	*ADF:290
L-6 Stage Steps T/O	AV:290	L-6 STAGE STEPS T/O	*30509	*ADF:291
L-6 Water ROC	AV:291	L-6 WATER ROC	*30419	*ADF:292

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

19.7. Network inputs to MCS-Magnum

The MCS-MAGNUM can receive changes from the network to enable or disenable the Network Run/Stop indicator, and adjustments to the cooling and heating targets for the individual loops of the MCS-MAGNUM with LWC configurator.

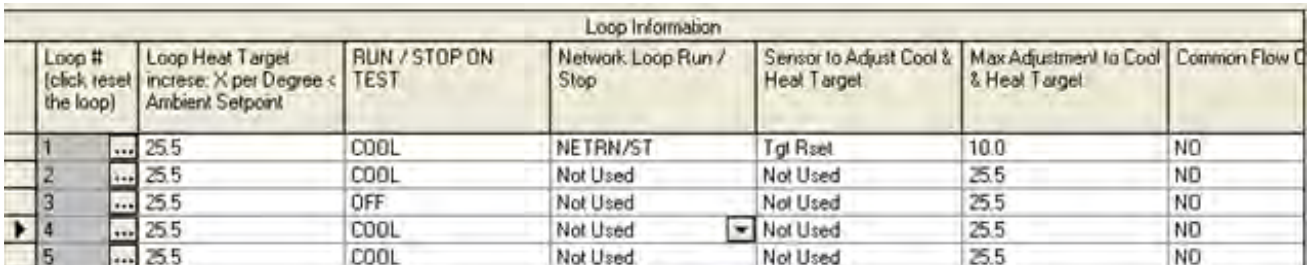
The MCS-Magnum must be setup to accept these inputs.

- A LWC configuration file must contain a Network Run/Stop, Network Target.

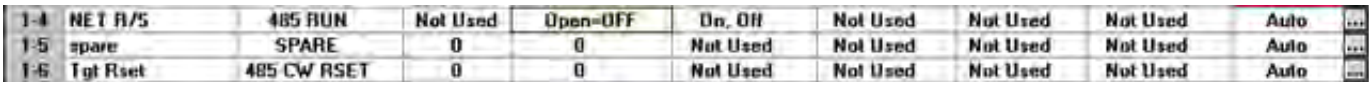
Note: If these sensors are not setup properly, changes will not be accepted by the MCS-Magnum.

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

For the Loop Run/Stop and the Target Reset must be set up as follows:



The sensor for the Network Run/Stop and/or the Target Reset must be setup as follows:



Sensor 1-4 is the network run/stop and its type is 485 RUN.
Sensor 1-6 is the adjustment value for cooling and heating targets in MCS-Magnum LWC and its type is 485 CW RSET.

If these are viewed in MCS-Connect program, their types must be '485 RUN' for the run/stop indicator and '485 CW RSET' for the target-reset sensor.

If these sensors are not setup properly, changes will not be accepted by the MCS-Magnum.

Chapter - 20. Magnum Control State Chart

20.1. Magnum Unit Control State Chart

Capacity State Number	Description
1	"UNIT IN LOST I/O"
2	" UNIT IN LOCKOUT"
3	" UNIT IN POWER UP"
4	" UNIT–NORMAL RUN"

20.2. Magnum Loop Control State Chart

Capacity State Number	Description
1	"LOOP STOPPED"
2	" LOOP STOP SW "
3	" LOOP STOP SCH "
4	" LOOP STOP PEAK"
5	" LOOP POST PEAK"
6	" LOOP PRE PEAK"
7	" LOOP STOP AMB"
8	"LOOP NORMAL "
9	"LOOP OVER RIDE "
10	"LOOP AMB/PUMPS "
11	"LOOP SI FAULT "

20.3. Magnum PUMP Control State Chart

Capacity State Number	Description
1	"PMP FAILURE"
2	" PMP ANTI-CYCLE "
3	" ALL PUMPS OFF "
4	" PMPS UNLOADING"
5	" MAX PUMPS ON"
6	" PUMPS LOADING"

20.4. Magnum FAN Control State Chart

Capacity State Number	Description
1	"FAN FAILURE"
2	" FAN ANTI-CYCLE "
3	" ALL FAN SOFF "
4	" FAN UNLOADING"
5	" MAX FAN ZON"
6	" FAN s LOADING"

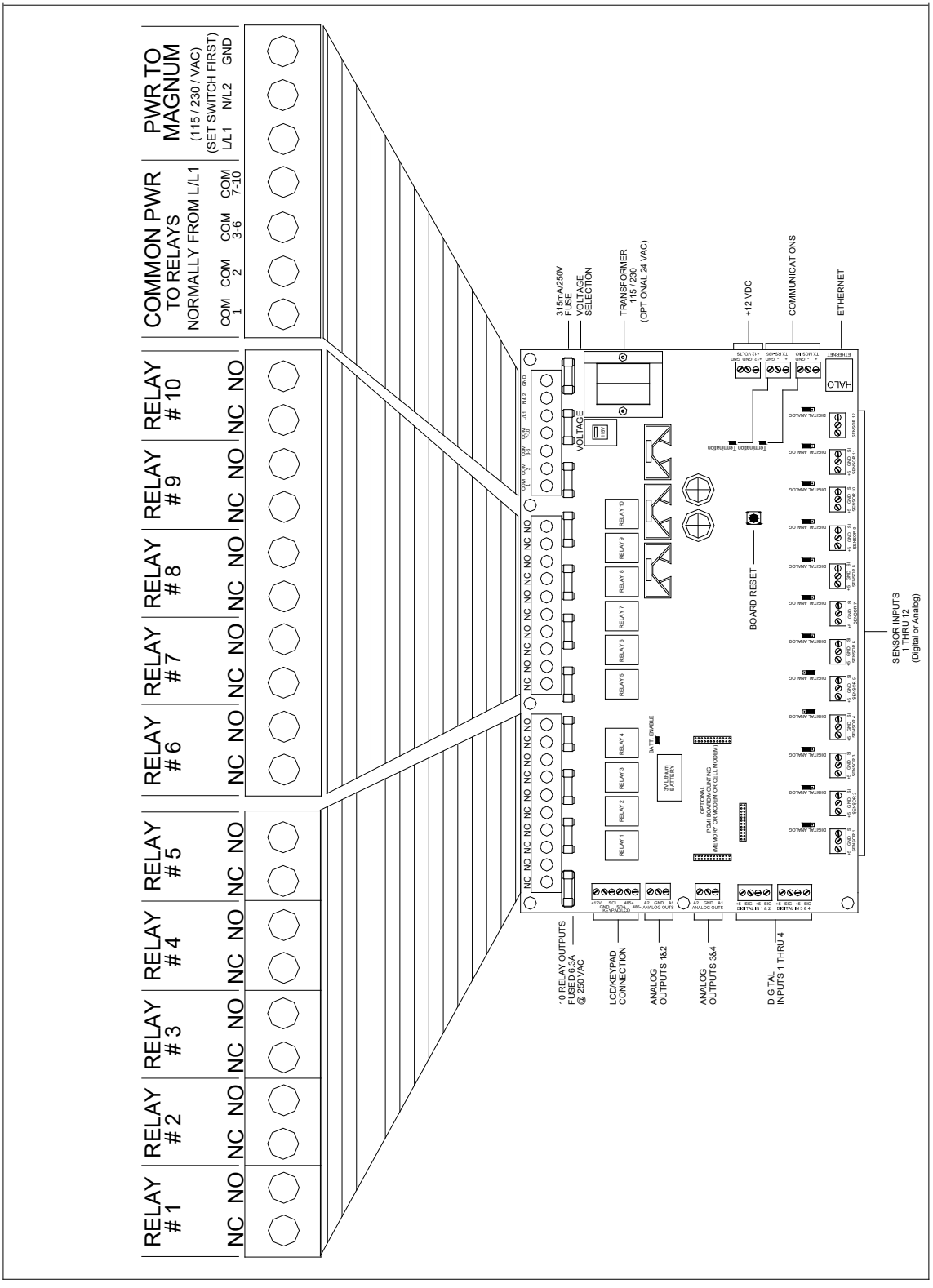
20.5. Magnum Stage Control State Chart

Capacity State Number	Description
1	" ALL STAGES OFF "
2	" COOL-HOLDING "
3	" COOL-ROC HOLDG "
4	" COOL-TMP HOLDG "
5	" COOL-UNLOADG "
6	" COOL-ROC UNLDG "
7	" COOL-LOADING "
8	" HEAT-HOLDING "
9	" HEAT-ROC HOLDG "
10	" HEAT-TMP HOLDG "
11	" HEAT-UNLOADING "
12	" HEAT-ROC UNLDG "
13	" HEAT-LOADING "
14	NOT USED AT THIS TIME
15	" MAKING ICE "

20.6. Magnum Individual Pump or Fan Control State Chart

Capacity State Number	Description
1	" FAILED "
2	" ANTI-CY "
3	" OFF "
4	" ON "
5	" ON "
6	" WantdON "

20.6.1 Relay Output Block Details



Chapter - 21. The MCS Trouble Shooting Quick Reference

(Complete trouble shooting write up is available on web site *www.mcscontrols.com*)

PROBLEM	POTENTIAL SOLUTION
No Sensor + 5 vdc or sensor +5 vdc less than 4.90 vdc.	• Indicates a possible shorted input sensor • Remove all sensor terminal blocks. • Wait about 30 to 60 seconds. If + 5 vdc returns, replace one sensor wire at a time until the + 5 vdc is lost again. This will be theshorted 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 'MCS-Connect' • See MCS-Connect' Interactive section for instructions. ('Change SI Status, Manual Value and / or offset.)
Invalid reading on one sensor input.	This indicates an input problem with 1 sensor. • Verify jumper settings correct for that SI.
'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 MAGNUM & last I/O. • Verify MAGNUM & I/O address's set correctly. • Verify wiring from MAGNUM 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-Connect– cannot make changes	This indicates you are not at a proper authorization level. Follow steps below for proper authorization

PROBLEM	POTENTIAL SOLUTION
	• From either the SYSTEM INFO or STATUS screen, under MCS-Connect, 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. 5. RED = view only 6. YELLOW = service level 7. BLUE = Supervisor level 8. 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
SI from AMPS board 10 A low.	This indicates a problem with this SI only. • Jumper setting on this SI in wrong position. • Incorrect sensor type used.
INVALID CONFIG VER	Indicates layout of CFG wrong. • CFG layout for different version than software
INVALID CONFIG TYPE	Indicates CFG incompatible with software. .
INVALID CONFIG CHECKSUM	Indicates Checksum invalid • Reload a valid CFG
Sensor input believed invalid (Under Sensor Diagnostic Sub Menu)	• Verify Berg jumpers using Quick Reference Sheets • Check board version number • Check wiring of sensor
Communications to MCS-485-GATEWAY from MCS-Connect not working.	• Verify red LED on the gate way is blinking. This indicates that 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 MAGNUM board is blinking. This indicates that the MAGNUM is responding to the gateway. • If both of these LED are blinking, check the address of the MAGNUM and any other MAGNUMs that are on the network. Each must have a unique address. This address can be changed from the MAGNUM. Proper authorization is required. Enter the UNIT INFORMATION screen by 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.

Chapter - 22. Set point Definitions

22.1. 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. ime - 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.

22.2. Set point Types:

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

22.2.1 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. Examples are the set points defined in sections 12.1 through 12.7.

22.2.2 LOCKOUT

This type of set points 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.

22.2.3 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.

22.3. Window/Safety extension

22.3.1 Time and seconds to ignore for setpoints

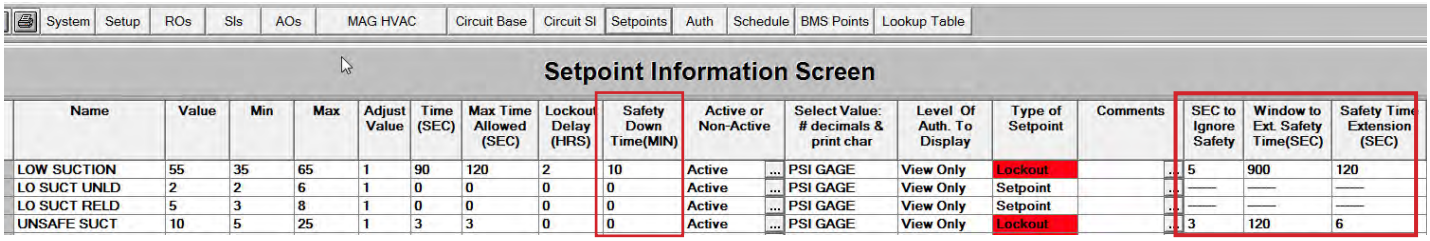
- Seconds to ignore – This is the time in seconds to ignore the associated safety at compressor start up.

The window to extend safety time and safety time extension fields work together.

- Window to extend safety – This value in seconds is the time window when the compressor starts that the **safety time extension** is added to the safety **time(sec)** value.

- Safety time extension – This value is the time that is added to the **time(sec)** value during the **window to extend safety time(sec)** time.

Example **– Unsafe suction setpoint has a 3 second safety trip. So if we add a 120 to our window to extend safety, we will then be telling the controller at startup we're going to extend that 3 second safety trip for 120 seconds. This is where the Safety time extension comes into play. If we put a 6 in this field we're telling the controller for the first 120 seconds at startup we're extending the safety trip time to 9 seconds (3 second trip plus the 6 second extension). Once the 120 seconds expires we will then revert back to a 3 second trip time for the duration of the compressors run time till the next startup.**



Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint	Comments	SEC to Ignore Safety	Window to Ext. Safety Time(SEC)	Safety Time Extension (SEC)
LOW SUCTION	55	35	65	1	90	120	2	10	Active	PSI GAGE	View Only	Lockout		5	900	120
LO SUCT UNLD	2	2	6	1	0	0	0	0	Active	PSI GAGE	View Only	Setpoint		——	——	——
LO SUCT RELD	5	3	8	1	0	0	0	0	Active	PSI GAGE	View Only	Setpoint		——	——	——
UNSAFE SUCT	10	5	25	1	3	3	0	0	Active	PSI GAGE	View Only	Lockout		3	120	6

Chapter - 23. Set points for LWC MAGNUM Algorithm

23.1. Control Set points #1-20 (apply to all loops)

1	OVERIDE TIME	This is the time expressed in minutes that the loop override will be in effect. If the over ride indicator is a momentary type switch, then the loop will be placed in an over ride state for this period of time. . If the over ride indicator is a switch that remains on, the loop will be placed in an over ride state as long as the indicator is on and once off, it will remain in that state for the time contained in this set point.
2	AMB OFF TEMP	If the loop points to an ambient temperature sensor; three options are available: LOW/LOOP OFF; if the loop is on and the ambient temperature drops below this value, all heating or cooling/ice making stages will be turned off and followed by the pumps or fans being turned off. This is to prevent the loop from freezing. Loop state will be LOOP OFF AMB. LOW/RUN PUMP; if the loop is off and the ambient temperature drops below this value, the pumps in the loop will be turned on. This is to prevent the loop from freezing. Loop state will be LOOP AMB/PUMPS. 3) NONE; no special action will be taken based upon ambient temperature.
3	PUMP ANTICYC	Delay, expressed in seconds, for each pump or fan when it is turned off before it can be restarted. The individual pump or fan state will be ANTI-CY. Once this time is pasted, the individual pump or fan state will be OFF and the pump or fan is ready to be started if needed.
4	ICETempHIGH	This set point must be active if any of the loops have the ICE MAKING option with control on Temperature. The cool control temperature sensor must be greater than the value of this set point plus the value of set point 18, 40, 62, 84 or 106, ChilCOOL TRG, before the loop will turn on any stages of ice making. Once on, the stages will remain on until the temperature drops below the ChilCOOL TRG minus the ChilCTL Zone set point values for that loop. Note only one ice making cycle per schedule on will be allowed.
5	ICELevelFULL	This set point must be active if any of the loops have the ICE MAKING option with control on Level. When the ice level sensor is greater than the value of this set point the loop will turn off all stages of ice making. Stages will remain off until the ice level sensor is less than the value of set point #6 ICELevelLOW. Note only one ice making cycle per schedule on will be allowed.
6	ICELevelLOW	This set point is the indicator that the ice level is low. See set point #5.
7	Lo AMP FAULT	This value is a percentage of the FLA amps. All loops will use this value to determine if a low amp condition is encountered.
8	Hi AMP FAULT	This value is a percentage of the FLA amps. All loops will use this value to determine if a high amp condition is encountered.
9	ROC INTERVAL	Time span, expressed in seconds, that is used in calculated the slope of the control temperature sensor. Usually set to 60 seconds.
10	PmpOnOffDely	Delay, expressed in seconds, that the pump or fan state timer must exceed once a pump or fan has been turned on before the first stage of heating or cooling/ice making can be turned on. When all stages of either heating or cooling/ice making have been turned off, the stage state timer must exceed this value before any pumps or fans can be turned off. The purpose of this delay is to ensure that there is flow before turning on stages of heating or cooling/ice making and also to ensure that there is flow after turning off stages of heating or cooling/ice making.
11	CFG TEST-I/O	If this set point is active and the value is equal to zero then the Lost I/O errors will not result in a lockout to the system. This is used for testing a configuration file with out the necessary expansion (I/O) boards.

12	MAX TARG ADJ	This set point contains the maximum adjustment that can be made to the loops cooling and heating targets. This will block the adjustment both plus and minus values.
13	MAX HEAT ADJ	This set point contains the maximum adjustment that can be made to the loops heating target based on ambient temperature. Refer to set points 43, 68, 93, 118, 143 & 168.
14	PHASE LOSS	This setpoint will be the delay in time prior to tripping the unit on a phase loss digital input.
15	Cool Fault	This setpoint will be the delay in time prior to tripping the associated loop on a cool stage fault digital input.
16	Heat Fault	This setpoint will be the delay in time prior to tripping the associated loop on a heat stage fault digital input.
17	Max Pump Reset	This setpoint will define the maximum target reset allowed both positive and negative to the pump targets. This reset will adjust setpoints 21, 46, 71, 96, 121, 146, 171, 196.
18-20	Spare	Not used at this time.

23.2. Control Set points #21- 170 (loop set points)

(These set points apply to the individual loops, there are 25 unique set points per loop, and these will be repeated for the other loops.

Since each loop can be named it is suggested that the set points names relate to the loop name.

For example, a loop with the name of BLDG LP1 may have the name of each set point start with BLD.

A sample of the configuration file for Edgewood School is below:

Loop Names

Loop 1 Name	BLDG PUMP	Loop 5 Name	
Loop 2 Name	CHIL1 PUMP	Loop 6 Name	
Loop 3 Name	CHIL2 PUMP	Loop 7 Name	
Loop 4 Name		Loop 8 Name	

21	BldgPmpVSTrg
22	BldgPmpVS+ -
23	BldgPmpVSDly
24	BldPmpVSMinS
25	BldPmpVSMaxS
26	BldPmpVSMaxA
27	BldgPMP AMPS
28	BldgCOOL TRG

23.3. Control set points #21- 45 for loop 1

These set points will be repeated for the other loops: (note the different coloring of the # column)

LOOP 2 Set points #46-70
LOOP 3 Set points #71-95
LOOP 4 Set points #96-120
LOOP 5 Set points #121-145
LOOP 6 Set points #146-170
LOOP 7 Set points #171-195
LOOP 8 Set points #196-220

Set points #221-255 are available to be used in user logic points.

Use the column headers to determine the loop.

23.4. Control set points #21- 26 (only required for pump or fan variable speed)

#1	#2	#3	#4	#5	#6	#7	#8	NAME	DESCRIPTION
21	46	71	96	121	146	171	196	PumpVS TRG1	Control target for variable speed pump or fan.
22	47	72	97	122	147	172	197	PumpVS Zone1	This value is added to and subtracted from the control target to create the control target zone.

23	48	73	98	123	148	173	198	PumpVSDelay1	Delay, expressed in seconds, between calculating the desired pump or fan speed. This value is only displayed in the MISC GRID of the STATUS screen on MCS-CONNECT.
24	49	74	99	124	149	174	199	PumpVS Min1	This is the minimum speed of the variable speed for the pump or fan. When a pump or fan is started, it speed is set to this value. Before a pump or fan is turned off, its speed must be reduced to this value.
25	50	75	100	125	150	175	200	PumpVS Max1	This is the maximum speed of the variable speed for the pump or fan.
26	51	76	101	126	151	176	201	PumpVS Adj1	This is the maximum adjustment, either increase or decrease, that can be made to the speed of the variable speed for the pump or fan.

23.5. Control Set point #27 (only required for pump with an amp sensor)

#1	#2	#3	#4	#5	#6	#7	#8	NAME	DESCRIPTION
27	52	77	102	127	152	177	202	PumpFLA Amps	The value of this set point contains the Full Load Amp drawn for all pumps or fans that are on the associated loop. All pumps or fans on a loop will use the same FLA set point. Set point #7, Lo AMP FAULT and set point #8, Hi AMP FAULT will be used to test for low and high amp draw when a pump or fan is on.

23.6. Control Set points #28-32 (control for heating-cooling stages)

#1	#2	#3	#4	#5	#6	#7	#8	NAME	DESCRIPTION
28	53	78	103	128	153	178	203	COOL TRG LP1	Control target for cooling temperature on this loop. If the Time in Safety is not zero, the chiller stages will be rotated. Rotation will be based on first on first off.
29	54	79	104	129	154	179	204	HEAT TRG LP1	Control target for heating temperature on this loop.
30	55	80	105	130	155	180	205	StageZoneLP1	This value is added to and subtracted from the cooling control target to create the control target zone for cooling. This value is also added to and subtracted from the heating control target to create the control target zone for heating.
31	56	81	106	131	156	181	206	StageDelyLP1	Delay, expressed in seconds, between interrogating the status of the pumps and the cooling and heating stages.

32	57	82	107	132	157	182	207	StageROC LP1	This is the maximum slope of the control temperature for both the cooling and heating stages. This slope is used to for both positive (temperature increasing) and negative (temperature decreasing) slopes. This is used to determine if the temperature is moving away from the target too rapidity, require reduction in number of stages, or is moving toward the target at a sufficient rate, hold the number of stages constant.

23.7. Control Set points #33- 35 (control for heating-cooling VFD)

#1	#2	#3	#4	#5	#6	#7	#8	NAME	DESCRIPTION
33	58	83	108	133	158	183	208	StageVS Min1	This is the minimum speed of the variable speed for both the cooling and heating variable speed. When a stage of either cooling or heating is started, the speed is set to this value. Only required if variable speed, Analog Output, has been specified for this loop.
34	59	84	109	134	159	184	209	StageVS Max1	This is the maximum speed of the variable speed for both the cooling and heating variable speed. The variable speed is increased to this value before the next stage of either cooling or heating can be started. Only required if variable speed, Analog Output, has been specified for this loop.
35	60	85	110	135	160	185	210	StageVS Adj1	This is the maximum adjustment, either increase or decrease, that can be made to the speed of the variable speed for either the cooling and heating stages. Only required if variable speed, Analog Output, has been specified for this loop.

23.8. Control Set points #36- 39 (schedules, two per loop, used with DoW SCH/ON option)

#1	#2	#3	#4	#5	#6	#7	#8	NAME	DESCRIPTION
36	61	86	111	136	161	186	211	Sch1 On LP1	Starting time for the first schedule for this loop. The schedule is expressed in military time. For example: start at 6:45AM would be entered as 0645: start a 2:00PM would be entered as 1400. This schedule will not be tested, always true, if this set point is inactive.

37	62	87	112	137	162	187	212	Sch1 Dur LP1	Duration of the first schedule for this loop is expressed in minutes. If a schedule is to be true for 5 hours, then 300 will be entered. Note the schedule can cross mid-night. For example if a schedule is true from 7:00AM until 5AM of the next day: Sch1 On LP1 is 0700 and Sch1 Dur LP1 is 1320. The duration is for 22 hours or 1320 minutes.
38	63	88	113	138	163	188	213	Sch2 On LP1	Starting time for the second schedule for this loop. The schedule is expressed in military time. For example: start at 10:05AM would be entered as 1005: start a 10:10PM would be entered as 2210. This schedule will not be tested, always true, if this set point is inactive.
39	64	89	114	139	164	189	214	Sch2 Dur LP1	Duration of the second schedule for this loop is expressed in minutes. If a schedule is to be true for 3 hours and 15 minutes, then 195 will be entered. Note the schedule can cross mid-night. For example if a schedule is true from 11:00PM until 6:15AM of the next day: Sch2 On LP1 is 2300 and Sch2 Dur LP1 is 435. The duration is for 7 hours and 15 minutes or 435 minutes.

23.9. Control Set points #40-42 (loop testing)

#1	#2	#3	#4	#5	#6	#7	#8	NAME	**DESCRIPTION**
40	65	90	115	140	165	190	215	HiTankTmpLP1	If the tank temperature exceeds this value for the time specified in this set point, the alarm relay output will be turned on and an error message indicating this condition will be generated. If this condition occurs there will be no change to the loop status or state. **This set point will only be tested if the loop contains a tank temperature sensor and this set point is active.**

41	66	91	116	141	166	191	216	No Flow LP1	If the pump or fan has a fault sensor, normally indicating flow, and it drops below this value, or if pump or fan fault sensor is a digital input and it is on, for the time contained in the safety time of this set point a pump or fan failure has occurred. The pump or fan will be locked off and the individual pump or fan state will indicate failed, the number of pumps or fans on will be reduced by one and if there are more available pumps or fans in the loop, one will be started. Note, the pump or fan state will not be changed. **This set point will only be tested if the loop contains pumps or fans with a flow sensor.**
42	67	92	117	142	167	192	217	TankLow LP1	If the tank level indicator is on, indicates a low level for a time that exceeds time specified in this set point safety time, the alarm relay output will be turned on and an error message indicating this condition will be generated. . If this condition occurs there will be no change to the loop status or state. **This set point will only be tested if the loop contains a tank level sensor.**
43	68	93	118	143	168	193	218	HEAT ADJ/AMB	This set point contains the value by which the loop's heating target will be increased for every degree that the ambient temperature is below set point #2, AMB OFF TEMP. This set point must be active and the loop contain an ambient temperature sensor.
44 45	69 70	94 95	119 120	144 145	169 170	194 195	219 220	SPARE	Not used at this time.

23.10. Control Set points #46-70 for loop 2

For definition of set point #46…. #70 refers to column header #2

23.11. Control Set points #71-95 for loop 3

For definition of set point #71…. #95 refers to column header #3

23.12. Control Set points #96-120 for loop 4

For definition of set point #96…. #120 refers to column header #4

23.13. Control Set points #121-145 for loop 5

For definition of set point #121…. #145 refers to column header #5

23.14. Control Set points #146-170 for loop 6

For definition of set point #146…. #170 refers to column header #6

23.15. Control Set points #171-195 for loop 7

For definition of set point #171…. #195 refers to column header #7

23.16. Control Set points #196-220 for loop 8

For definition of set point #196…. #220 refers to column header #8

Chapter - 24. The MCS Trouble Shooting Quick Reference Sheet

(Complete trouble shooting write up is available on web site www.mcscontrols.com)

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 'MCS-CONFIG' • See MCS-CONFIG Interactive section for instructions. ('Change SI Status, Manual Value and / or offset.)
Invalid reading on one sensor input.	This indicates an input problem with 1 sensor. • Verify jumper settings correct for that SI.
Lost I/O	Indicates communications problem. • Verify RS485 LED blinking. • Verify termination jumper J6 only on at MCS-MAGNUM & last I/O. • Verify MCS-MAGNUM & I/O address's set correctly. • Verify wiring from MCS-MAGNUM to each I/O correct. • Check fuses/120 VAC on I/O units
MCS-Connect – cannot make changes	This indicates you are not at a proper authorization level. Follow steps below for proper authorization • From either the SYSTEM INFO or STATUS screen, under MCS-CONFIG or MCS-Connect, 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.

Revision Page

Date	Author	Description of Changes
01-18-03	RCT	Initial manual, Following are the earliest releases required: LWC 09.00-B, MCS8 software; MCS-CONNECT V3.3-H; MCS-CONFIG V3.1-C. The above software supports the features described in this manual.
02-07-03	RCT	Updated set point and alarm information
02-21-03	RCT	Updated set points and new functions that are supported in software release LWC0900-D.
04-03-03	RCT	Changed from a loop water to a general loop controller
05-23-03	RCT	Requires software LWC 09.01-A Regrouped the set points, this is a major change. Added ice making options with a new state MAKING ICE.
06/23/03	SAK	Updated manual
06/29/03	RCT	Increased number of cooling and heating stages from 4 to 16. Requires software LWC 09.01-C
09/13/04	RCT	Add a new ambient control option, low ambient on. Software LWC 09.01-F
09/21/04	RCT	If a low ambient condition, turn on the alarm output. Software LWC 09.01-G
09/28/04	RCT	Expanded the set point tables to show set point numbers for all loops. Change logo and address.
02/07/05	RCT	Add adjustment to heat target set points.
03/25/07	RCT	Created Magnum documentation V1.0
02/19/08	RCT	Pump failure alarms point to pump RO #, added high & low amp alarm.
06/24/08	RCT	Added Magnum user defined and firmware load sections.
11/14/08	CAG	Changed Revision number from 1.2 to 1.3 Added new BMS mapping table for LWC. Added BMS connection drawings Replaced MCS-8 communication pictures with MCS-MAGNUM pictures Copied from MAG chiller manual: The Magnum Keypad Display Quick Reference, Magnum Hardware, MCS Sensor reference and Quick troubleshooting guide
01/14/09	RCT	Added the state table for internet communications
02-25-09	CAG	Changed Revision number from 1.4 to 1.5 Change Modbus Relay registers from 10000 to 00000
06-02-09	RCT	Added chiller stage rotation and faults. Requires HVAC 6.02-C software and MCS Config 6.01-S or later versions.
08-02-13	RCT	Updated to V14 software
07-08-15	DEW	Updated to Indesign Layout
06-05-8-17	DEW	Updated to V17 software
03-30-2020	DEW	Add changes to setpoint #17 as per Danny C., Moved setpoint to back of Manual
06-14-2021	DEW	Add setpoints 14-16
02-14-2023	DEW	Made changes from Chis - BMS section changed

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