



SOFTWARE RELEASE NOTES

MCS-MAGNUM

Version 8.05U

06/02/2011

Updates from previous versions:

New Features:

1. CENT ONLY:
 - a. Added Condenser Liquid Level Control:

Condenser Liquid Level Control (CLLC)

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

There can be two types of control of the CLLC valve.

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

The following items in the MCS Config are required

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

- 1) No Condenser Liquid Level Control selected.

The screenshot shows a dialog box titled "Subcooler Valve Control". Inside, there is a section labeled "Type of Subcooler Valve in Use" with three radio button options: "None" (which is selected), "RO Type", and "AO Type".

- 2) RO Type selected.

The screenshot shows the same "Subcooler Valve Control" dialog box. In this view, the "RO Type" radio button is selected. Below the radio buttons, there are two additional fields: "Condensor Level" with a dropdown menu showing "CLLC level", and "Valve Position" with a dropdown menu showing "CLLCroPost".

Any questions regarding this release, contact:

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

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

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

Relay Output Information Screen (Magnum V8)									
	Number	Name	Type	Comments	Pulse Count (in Seconds)	Pulse Delay (in Seconds)			
	M-1	COMP M	Standard						
	M-2	COMP SD	Standard						
	M-3	OPEN VANE	Standard						
	M-4	CLOSE VANI	Standard						
	M-5	OIL PUMP	Standard						
	M-6	OIL HEATER	Standard						
	M-7	HOT GAS	Standard						
	M-8	CLLCroON	Pulse Relay		5	2			
	M-9	CLLCroOFF	Pulse Relay		5	2			

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

3) AO Type selected.

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

Valve Actuator: select from a drop down list of analog outputs. This will be the analog output that controls the CLLC valve.

The following sensor inputs are required by the CLLC

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

Sensor Input Information Screen V8														
#	Name (1 to 10 char)	Display Type	Offset	Manual Value or NC/NO (select to change)	Display Text (select to change)	Temp. / GPM / CFM / Pwr Factor SI	Humd. SI / Temp. Diff. / Enthal. Diff.	Auto Manual (select to change)	Circuit Index	Multiplier	Divisor	Off Set	Select Display Type	
1-12	CLLC level	REF LEVEL	0	50	Not Used	Not Used	Not Used	Auto	...	Not Used	Not Used	Not Used	Not Used	Not Used
1-13	CLLCroPost	REF LEVEL	0	0	Not Used	Not Used	Not Used	Auto	...	Not Used	Not Used	Not Used	Not Used	Not Used

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The following setpoints are required by the CLLC

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

CLLC States

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

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

CLLC Valve States

The CLLC valve states indicate the status of the CLLC valve. They can be view either from the Magnums status screen, screen will follow the compressor information or from the MCS Connect status screen. The **(XX)** will contain either **(AO)** or **(RO)** indicating the type of valve control that has been selected.

VALVE OPENING (XX): The unit is in an unstable state and valve is being opened.

VALVE CLOSING (XX): The unit is in an unstable state and valve is being closed.

VALVE HOLDING (XX): The unit is in an unstable state and valve not being changed.

ZONE 1 VLV HOLDG (XX): The unit is stable and the condenser liquid level is in ZONE 1 which requires no valve positioning.

ZONE 2 VLV HOLDG (XX): The unit is stable and the condenser liquid level is in ZONE 2 and the valve position is not being changed as the condenser liquid level rate of change is decreasing at an acceptable rate.

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ZONE 2 VLV OPENG (XX): The unit is stable and the condenser liquid level is in ZONE 2 above the target opening and the liquid level rate of change is not decreasing at an acceptable rate; therefore, the valve must be opened.

ZONE 2 VLV CLOSG (XX): The unit is stable and the condenser liquid level is in ZONE 2 below the target opening and the liquid level rate of change is not increasing at an acceptable rate; therefore, the valve must be closed.

ZONE 3 VLV HOLDG (XX): The unit is stable and the condenser liquid level is in ZONE 3 and the valve position is not being changed as the condenser liquid level rate of change is decreasing at an acceptable rate.

ZONE 3 VLV OPENG (XX): The unit is stable and the condenser liquid level is in ZONE 3 above the target opening and the liquid level rate of change is not decreasing at an acceptable rate; therefore, the valve must be opened.

ZONE 3 VLV CLOSG (XX): The unit is stable and the condenser liquid level is in ZONE 3 below the target opening and the liquid level rate of change is not increasing at an acceptable rate; therefore, the valve must be closed.

ZONE 4 VLV HOLDG (XX): The unit is stable and the condenser liquid level is in ZONE 4 and the valve position is not being changed as the condenser liquid level rate of change is decreasing at an acceptable rate.

ZONE 4 VLV OPENG (XX): The unit is stable and the condenser liquid level is in ZONE 4 above the target opening and the liquid level rate of change is not decreasing at an acceptable rate; therefore, the valve must be opened.

ZONE 4 VLV CLOSG (XX): The unit is stable and the condenser liquid level is in ZONE 4 below the target opening and the liquid level rate of change is not increasing at an acceptable rate; therefore, the valve must be closed.

VLV FULLY OPENED (XX): The valve position is fully opened, 100%.

VLV FULLY CLOSED (XX): The valve position is fully closed, 0%.

CLLC Status viewed from MCS Connect

CLLC State	CLLC Time	Level	Rate of Change	Valve State	Valve %	Valve Delay			
CLLC OFF	07:16:28	50.0%	0.0	VALVE OPENING (AO)	100.0%	20			
Capacity Control State	Time	Wanted/ Actual	Step Delay	Wanted FLA %	Rate of Change	Control On	Mode		
RUN/STOP SW OFF	01:13:52	0/0	60	0.0	0.0	ChlWtrOut= 45.0F	COOLING		
State	Time	Oil Diff	FLA %	Steps	Lead?	Staging	Lift Temp	Amp ROCs	Lift ROCs
1)SWITCHED OFF	01:13:53	76.0P	0	0	Yes	VANES	59.0	0/0	0.0/0.0
Suction Temp	Saturated Suction	Suction Superheat	Disc Temp	Saturated Discharge	Disc Superheat				
1) 55.0	38.1	16.9	154.0	97.1	56.9				

The CLLC status is display as the first line of the Status screen.

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

CLLC Status viewed from MCS Magnum

07:19	CLLC	45/45
OFF	003:44:27	
VLV FULLY OPENED (RO)		
	TARG	ACT
LEVEL	60.0	50.0
VALVE	50.0	100.0
	PG↑	PG↓

CLLC Determining Stable/Unstable Condition

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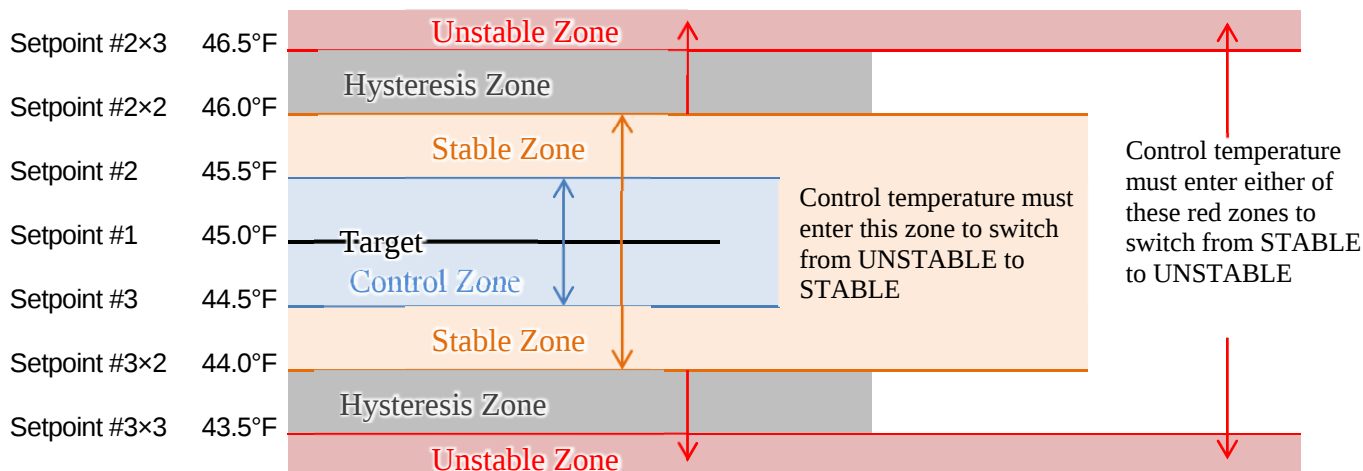
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Once a compressor is turned on the CLLC will determine if the system is in a stable, chilled water temperature is within an acceptable range, or unstable condition.

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



Example Setpoint Values:

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

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

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

CLLC Control Logic

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

- 1) **CLLC OFF** in this state the compressor is off. The CLLC will drive the valve to 100.0% and then hold. There is no control in this state.
- 2) **CLLC UNSTABLE** in this state the compressor is on but the chilled water is not within an acceptable temperature range. Refer to section on CLLC Determining Stable or Unstable Condition. In this state the purpose of the CLLC is to position the valve to create a liquid seal so that the chiller can generate lift and pull the water temperature within the acceptable range. If the liquid level is above the value in set point #216, the CLLC valve setting will remain at its present position. The valve state will be VALVE HOLD. If the liquid level is less than the value in set point #216, the CLLC valve setting will be closed until its opening is equal to the value of set point #217, once this is reached the valve state will be VALVE HOLD. The CLLC will not leave this state until the chilled water temperature returns to acceptable level or the compressor is turned off.
- 3) **CLLC STABLE** in this state the compressor is on and the chilled water is within an acceptable temperature range. Refer to section on CLLC Determining Stable or Unstable Condition. In this state the purpose of the CLLC is to position the valve to create a sub-cooler level to get the efficiency out of

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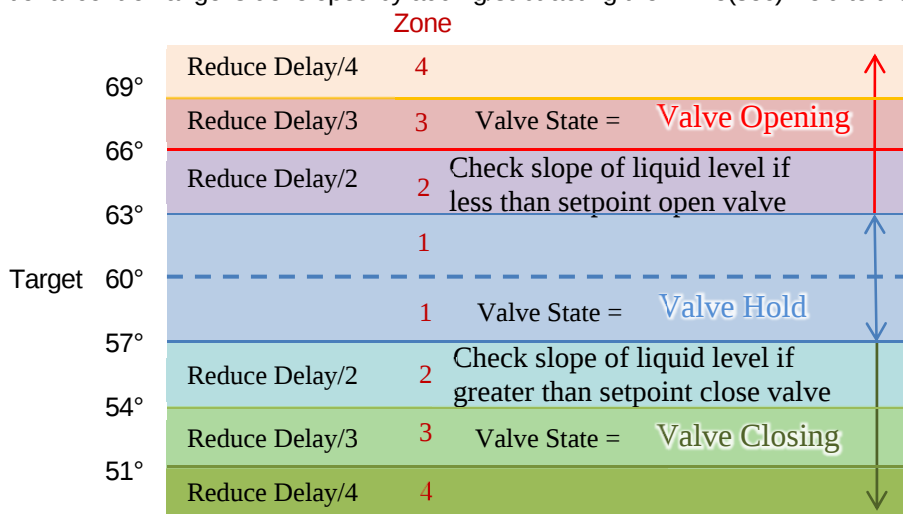
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the chiller and not to control the valve within a couple percent of the actual set point. As long as the condenser liquid level is stable and in the control range then the valve is being controlled properly. To accomplish this control of the CLLC valve is based upon the level of the condenser liquid level.

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



Condenser liquid level positioning:

- If the condenser liquid level is in ZONE 1, no change to the valve position will be made.
- If the condenser liquid level is above the target and in ZONES 2, 3, or 4, the rate of change of the condenser liquid level will be checked. If the rate of change is less than the negative value of set point #216, this indicates that the condenser liquid level is decreasing a rate fast enough make no change to the valve positioning. The valve state will indicate that the valve is holding.
- If the condenser liquid level is above the target and in ZONES 2, 3, or 4, the rate of change of the condenser liquid level will be checked. If the rate of change is greater than the negative value of set point #216, this indicates that the condenser liquid level is NOT decreasing a rate fast enough; therefore, the valve position must be increased, opened. The valve state will indicate that the valve is opening.
- If the condenser liquid level is below the target and in ZONES 2, 3, or 4, the rate of change of the condenser liquid level will be checked. If the rate of change is greater than the value of set point #216, this indicates that the condenser liquid level is increasing a rate fast enough make no change to the valve positioning. The valve state will indicate that the valve is holding.
- If the condenser liquid level is below the target and in ZONES 2, 3, or 4, the rate of change of the condenser liquid level will be checked. If the rate of change is not greater than the value of set point #216, this indicates that the condenser liquid level is NOT increasing a rate fast enough; therefore, the valve position must be decreased, closed. The valve state will indicate that the valve is closing.

Condenser Liquid Level Adjustment

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

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Condenser Liquid Level Time Delay

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

Bug Fixes:

- b. Corrected the test for capacity control state going to "UNIT IS LOADED" to work correctly for units with a VFD. (When Wanted Percentage was 100% and Actual Percentage was 100% the non-VFD units would not go to "UNIT IS LOADED" state. The test for going to "UNIT IS LOADED" state was modified for VFD Centrifugal units and preventing non-VFD unit for getting there.)
- c. Changed warning relay output to not turn on when in the "HI AMP HOLD" state with VFD control. The warning relay output will turn on when in the "HI AMP HOLD" state in a non-VFD controlled unit. (This change was made because the centrifugal compressor can reach full load amps, before the vanes are fully open (VFD control) and this is a normal condition. In non-VFD control the software will stop loading the vanes based on high amps, but in VFD control we are loading the compressor based on vane position, not amps.)
- 2. HVAC ONLY:
 - a. Modified EXV Minimum Differential Pressure logic (setpoint #205 "MDP MIN OIL DIFF"): Now 'Lockout Delay Hrs' and 'Time(sec)' fields have been adjusted to have no decimal points. (For example, now 2 in the 'Lockout Delay Hrs' field equals a 2% adjustment or 5 'Time(sec)' field equals 5.0 psi.)
 - b. Modified EXV control not to adjust the target level due to Low Discharge Superheat unless setpoints #84 "LO DISC SHEAT" and #110 "LoRefLvITarg" are active.
 - c. Modified the new EXV Diff PSI adjustment logic not to open the valve unless superheat is greater than Target - Y2 zone or if refrigerant level is less than the X2 zone. The valve will not open if we are closing X2 or more.
 - d. Corrected initialization of Oil Differential Temperature that is used in various oil temperature calculations (See setpoint #114 'OIL TEMP DIFF'). It was not working properly in systems using Centigrade temperatures.
 - e. Modified Relay Output for a Heat Pump Reversing Valve control so reversing valve will only turn on if in heating mode and will turn off when in cooling mode (was incorrectly turning on during pumpdown).
- 3. All software:
 - a. Changed sensor type TI-150 to not subtract 14.7 psi from the manual value. If a TI-150 sensor was placed in manual with a value of 50.0psi, the sensor would go to a value of 35.3psi (50.0-14.7). This issue has been corrected so a manual value 50.0psi will remain as 50.0 for the sensor value.
 - b. Corrected Keypad display not being able to show more than one page of pumps/boilers in the status screens.
 - c. Changed the LARGE display screen to be used only for HVAC and CENT config files types, and not in Loop Water Control (LWC) configs.
 - d. Changed the Evaporator Suction Temperature to not display in MCS-Connect when no Suction Temperature exists.

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