SENSORI® CONTROL MANUAL - CHILLER PLATFORM

VERSION 2.0

01/2025

OXFORD ENERGY SOLUTIONS

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CHILLER PLATFORM SYSTEM OVERVIEW

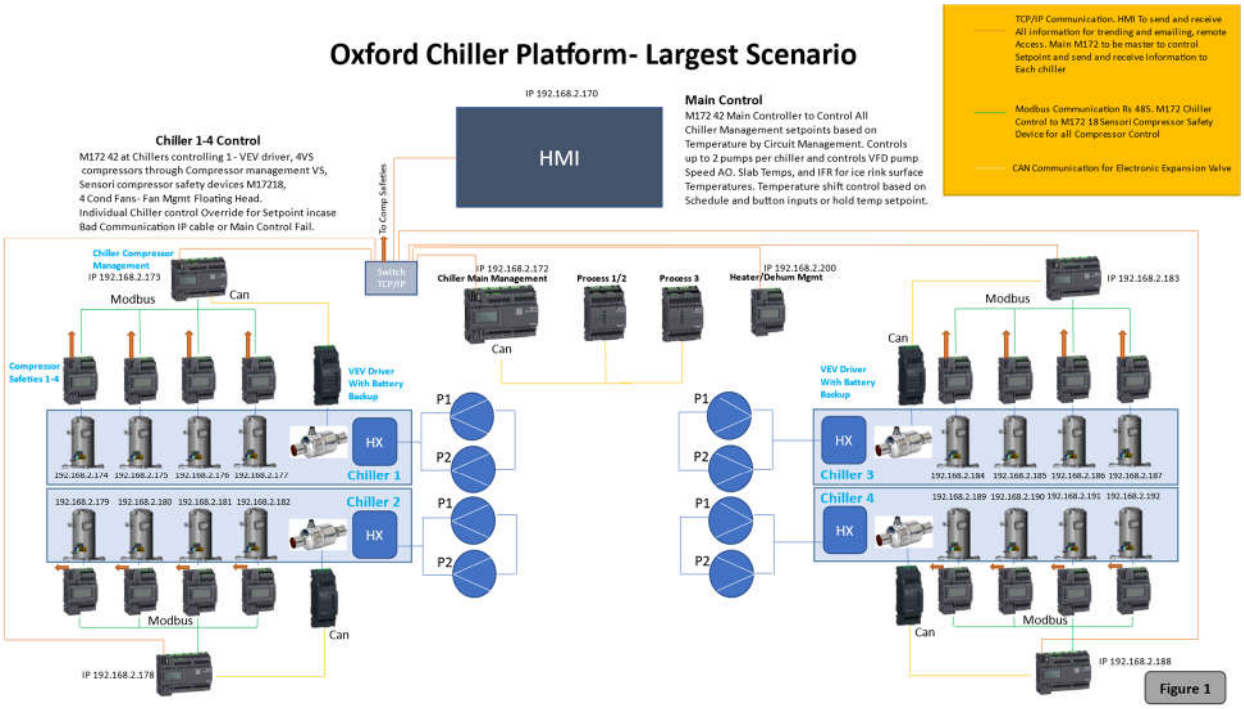


Figure 1 and 2(Above) shows the largest scenario for Oxford OLPP Chiller Platform. This platform consists of controlling multiple process lines for different cooling loads. The Main Management enables chiller control based on a PID algorithm over TCP/IP on a 0-100% scale. The main HMI is added to display all information from process to chiller including emailing high-level alarms on all

devices, trending every point of information, remote connectivity, and pushing data to a cloud-based software for further user friendly monitoring.

This Chiller Platform is broken down into the following groups.

1. **Main Chiller Sensori Management** (Consists of up to 2 Expansion modules for Process Control)
2. **Chiller Compressor Management**
3. **Compressor Safety**
4. **Integration with HMI, GateManager, and Cloud Based Aviva Insight**

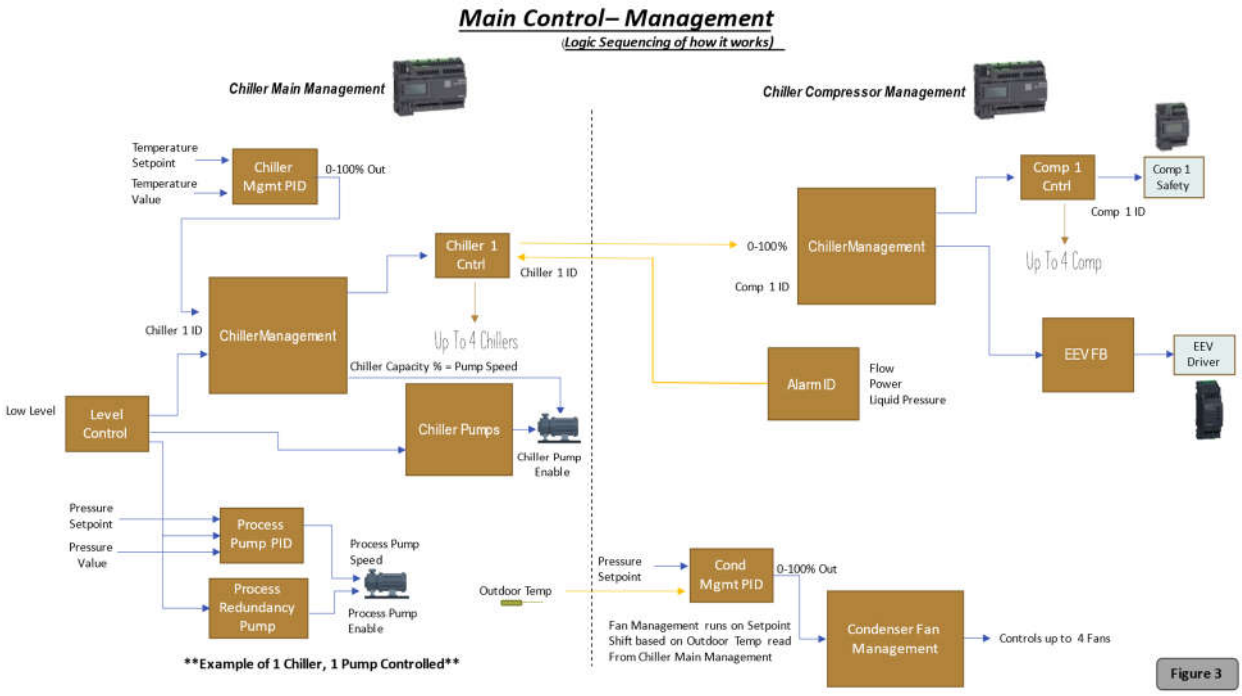


Figure 3 (above) illustrates the construction of each Sensori and how it operates internally. See more details further for operation and control. See ***Chiller Compressor Management***

1. MAIN CHILLER SENSORI MANAGEMENT (SENSORI 42IO)

The Main Chiller Management Controller 42 Inputs/Outputs not only controls system managing of Chillers based on one temperature, but has the capability of controlling slab temperature, infrared temperature monitoring or control, either on a set Hold temperature or multiple schedule setpoints. The Main Chiller Sensori Management has full Process Pump Control (up to three process lines with two pumps each). Up to four chillers can be controlled and two chiller pumps per chiller based on chiller capacity output. All communication is done through TCP/IP for this device to communicate with each chiller. The chiller sends out a capacity value on a 0-100% scale to each chiller based on required load from temperature, on a settable PID algorithm for all applications. If an alarm from a chiller is received, the Chiller Management will send a request for the next available chiller to come on.

CHILLER MANAGEMENT

Chiller Sequence Control

Chiller Sequence control helps to ensure equal usage of the chillers and optimize power consumption. Chillers are controlled based on the following sequences:

Sequence as per Chiller Mode	Description
Chiller 1 Primary	•Sets Chiller 1 to always be primary chiller regardless of operating hours. Advantage: Used when chiller 1 is the only variable speed chiller to be used. This feature can be enabled with any of the below sequences.
FIFO = First In First Out	•The chiller with the least operating hours is switched on first. •The first chiller which is switched on is also the first to be switched off. Advantage: operation time is limited.
Runtime	•The chiller with the least operating hours is the first chiller to be switched on. •The chiller with the most operating hours is the first chiller to be switched off. •Advantage: balanced operation hours.
LIFO = Last In First Out + Runtime	•The parameter pointer usiLifoSeq determines this sequence. •The first chiller to be switched on is the first one in the sequence. •The first chiller to be switched off is the last one that has been switched on. •Advantage: priority of chiller usage can be set. NOTE: If several chillers have the same priority, the chiller with the least operating hours is the first compressor to be switched on.

NOTE:

- It is recommended to keep the system at **LIFO** mode as this mode is fully tested based on optimum performance.
- If a chiller is not available (off timer or cycle timer are active, or the chiller is in alarm state), another chiller starts based on the sequence defined by Chiller Mode above.
- If a chiller cannot be stopped (on-timer is active), another chiller is stopped based on the sequence defined by Chiller Mode.

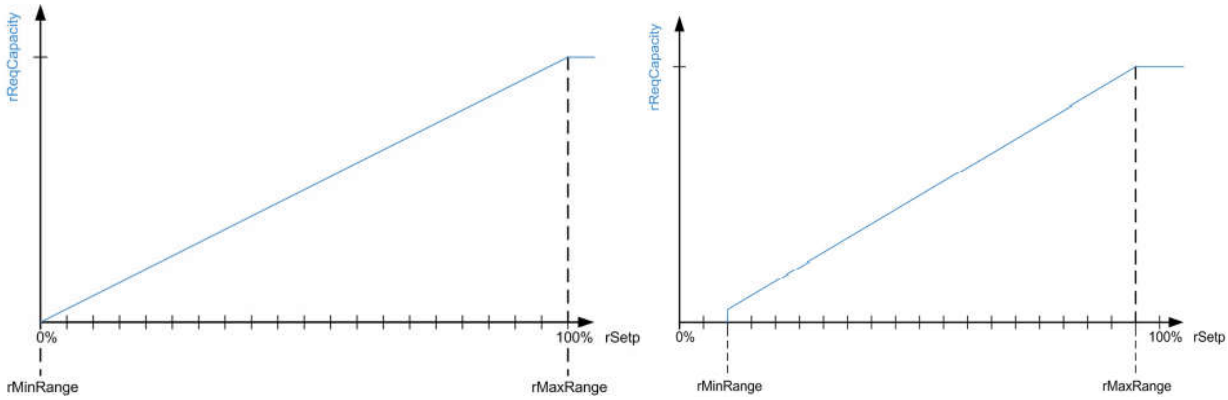
Chiller Breakdown Management

The compressor, which is detected as non-operating, is switched off. The next available compressor in the start sequence is switched on. The non-operating compressor cannot be started until the compressor is returned to an operational state.

Regulation with rMinRange and rMaxRange

To increase the stability of the system when the input of the Chiller Management (setpoint 0-100% called by the PID control) is close to 0% or 100%, the regulation range for the chiller is adapted to the range rMinRange to rMaxRange. xCtrlMode is set to FALSE (uiDelayOn and uiDelayOff are active. See parameter list).

The graphics show an example for rMinRange, rMaxRange (1 Chiller):



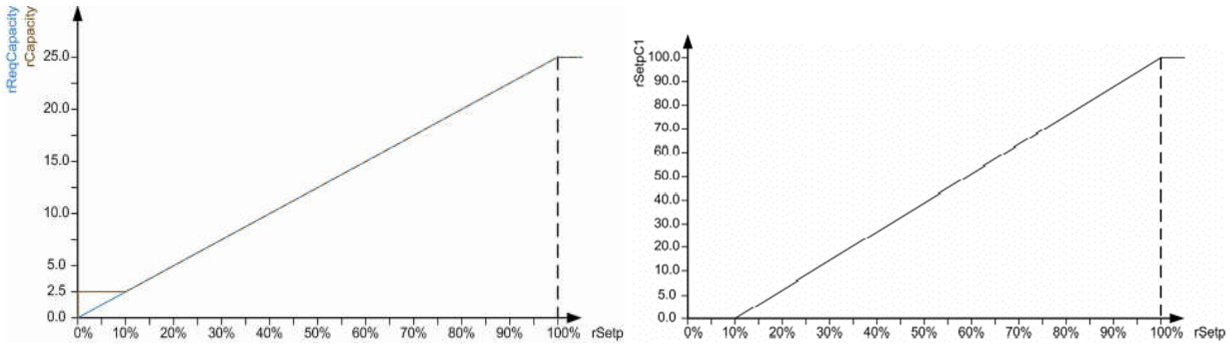
The following examples A and B are with a control mode (FIFO, LIFO, Runtime). In both examples, uiDelayOn and uiDelayOff are set to 0.

EXAMPLE A ***Parameter***	***Scale/Unit***
Number Chillers	1
Max Percentage	100%
Min Percentage	10%
Nom Percentage	100%
Min Range	0%
Max Range	100%
Chiller Capacity	25
Control Mode	0

Parameter	***Value/Unit***
CapMax	25.0 (For One Chiller Internally Calculated)
CapMin	2.5 (For One Chiller Internally Calculated)
rReqCapacity	0.0....25.0
rCapacity	2.5....25.0

Result: Maximum and minimum capacity (CapMax, CapMin) of Chiller, required capacity rReqCapacity (output)

Example rMinPerc, rMaxPerc, rNomPerc (1 Chiller):



EXAMPLE B ***Parameter***	***Scale/Unit***
Number Chillers	4
Max Percentage	100%
Min Percentage	60%
Nom Percentage	100%
Min Range	0%
Max Range	100%
Chiller Capacity	25
Control Mode	0

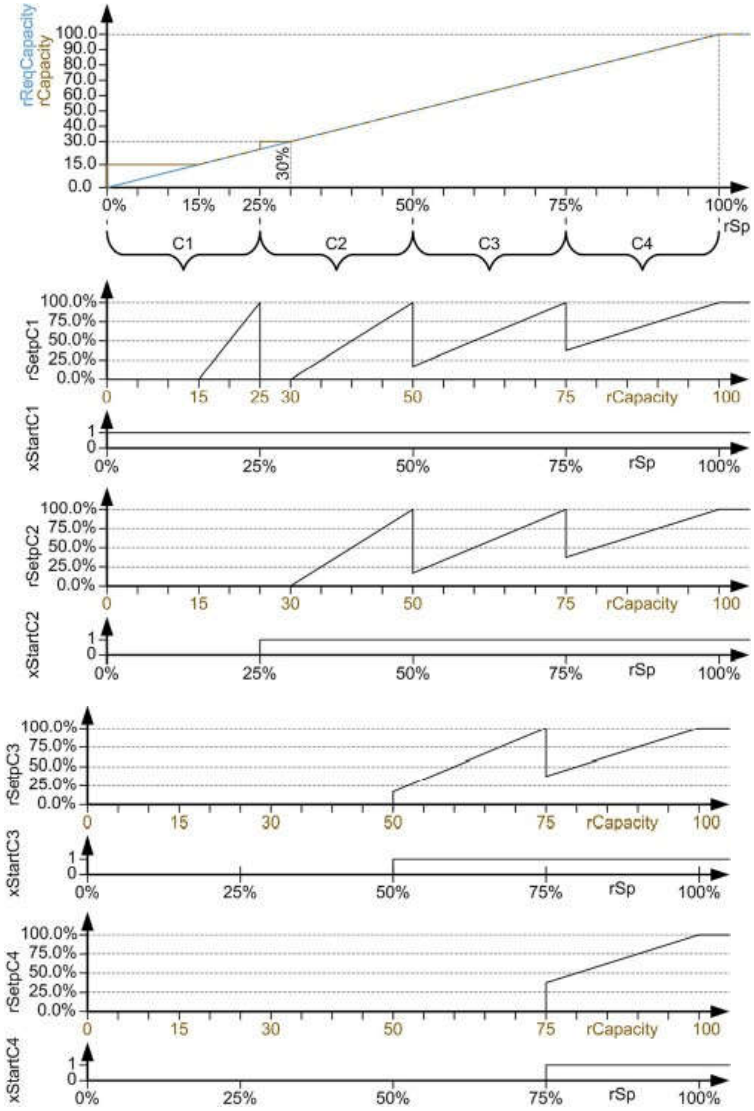
Result: Maximum and minimum capacity (CapMax, CapMin) of a Chiller, required capacity rReqCapacity (output).

Parameter	***Value/Unit***
CapMax	25.0 (For One Chiller Internally Calculated)
CapMin	15.0 (For One Chiller Internally Calculated)
rReqCapacity	0.0….25.0
rCapacity	15.0….25.0

The outputs rSetpC1 and rSetpC2 are not started at rCapacity = 0 and rCapacity = 25. rMinPerc is set to 60.0 % and CapMin = 15.

If...	Then...
If rSp is greater than rMinRange,	The output xStartC1 is set to TRUE. **Result**: A value of 15.0 is set at the output rCapacity, but the calculated required capacity rReqCapacity is less than the set rCapacity. In this case, the calculation of the output rSetpC1 starts by rReqCapacity > rCapacity.
If rReqCapacity > CapMax	The system requires two chillers **Result:** o rReqCapacity is for example 25.1 (> CapMaxVs) and the outputs xStartC1 and xStartC2 are set to TRUE. o rCapacity is 30; also rCapacity > rReqCapacity and no further capacity is needed. o Both outputs rSetpC1 and rSetpC2 are 0. In this case, the calculation of the outputs rSetpC1 and rSetpC2 start by rReqCapacity > rCapacity (here 30).
If rReqCapacity > 2 x CapMax	The system requires three chillers **Result:** o rReqCapacity is for example 50.1 (> 2 x CapMaxVs) and the outputs xStartC1 and xStartC2 are set to TRUE. o rCapacity is 45, also rCapacity < rReqCapacity. o The required outputs rSetpC1 and rSetpC2 and rSetpC3 are set to 17.0%.

Example rMinPerc, rMaxPerc, rNomPerc (4 Chillers):



Regulation With Hysteresis (rHys, rMinRange, rMaxRange)

The regulation with hysteresis is more adaptive than the regulation with delay because the time before starting or stopping a compressor depends on the variation speed of the value PID rSp

If...	Then...
If the setpoint of the PIDAdvanced rAnalog varies fast, for example when the machine is started or when the load reduces significantly,	The time to start or stop a Chiller is reduced which improves the response time of the system.
If the setpoint of the PIDAdvanced rAnalog varies slowly, for example when the load is constant,	The time to start or stop a Chiller is longer which increases the stability of the system.

The value of **rHys** has more priority than **rMinRange** and **rMaxRange**.

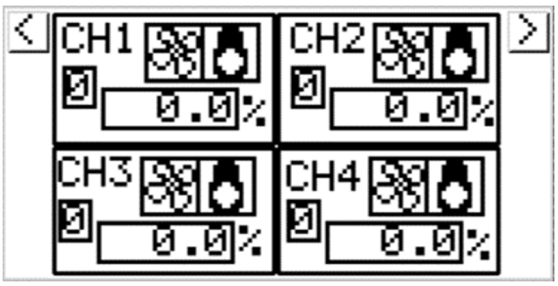
SENSORI MAIN CHILLER MANAGEMENT DEVICE

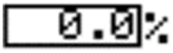
STATUS

Home Page Screen Consists of three status options. Status “1” displays information regarding individual chiller control, setpoint status and control temp, chiller pump Information, tank level (*if present*), and chiller management. Status “2” displays enable status of system, control temps, and other display temperatures. Status “3” displays all process pump information (up to 3) if its present in system.

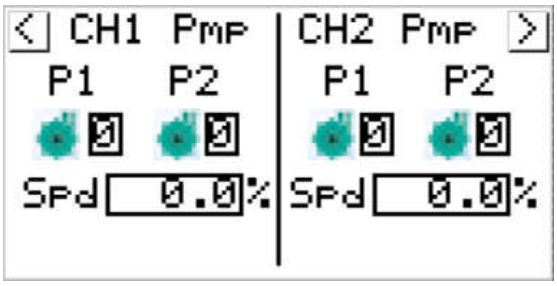
Status 1 - Chiller Display Screen

PAGE 1

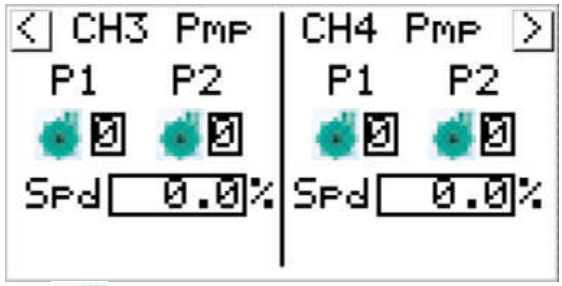


The above image  indicates a chiller command was sent over TCP/IP to the Chiller Compressor Management Device as well as the percentage  of that chiller being called. When the Main Chiller Management function block initially sends its command to the Chiller Control function block  , a value on “1” will be displayed here. This is the first initial call for the start of a chiller sequence. (*See Figure 3 for detail picture of function block*).

PAGE 2



PAGE 3



These images display **Chiller Pump Status 1-4**.  indicates an enable was sent to run the pump, and  value of "1" indicates a pump proof back (Digital Input is closed).
Spd shows the pump speed percentage, which is a percentage called on by the chiller. This is a linear curve based on chiller percentage and can only be scaled at the variable frequency drive of the pump.

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The above image displays **Control Temperature** (Which is also displayed in "Status 2"), and the active setpoint that the chiller management is being controlled. This setpoint can vary depending on if a schedule is active or if a push button is pressed (Digital Input is closed momentary) for a "setpoint setback". The **Setbk Dly Cnt** (setback delay count) is only active if this feature is enabled.

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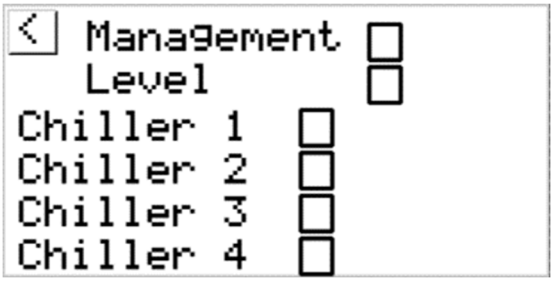
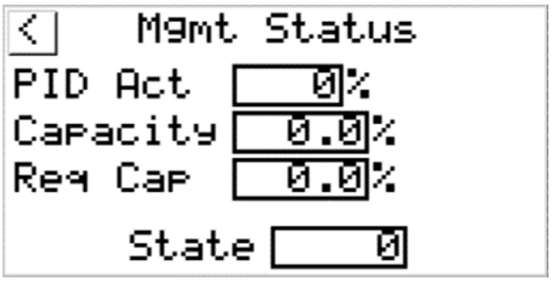


1. Main Status Management
2. Level Control Status
3. Chiller 1-4 Control Status

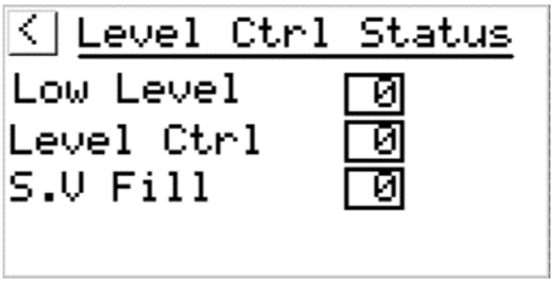
1. Main Management Status



PID Act- This is the PID value output (or input to the Chiller Management setpoint) from the PID function block being controlled based on control temperature. A slow PID with small change is best to optimize system performance and avoid unnecessary chiller/compressor cycling.
Capacity- Value that is being called by the main Chiller Management function based on management parameters set (see examples A and B previously in manual for control explanation).
Req Cap – Required capacity that is being called by, however delays and hysteresis will affect the capacity output for what is required.
State- indicates a number to represent the following status.

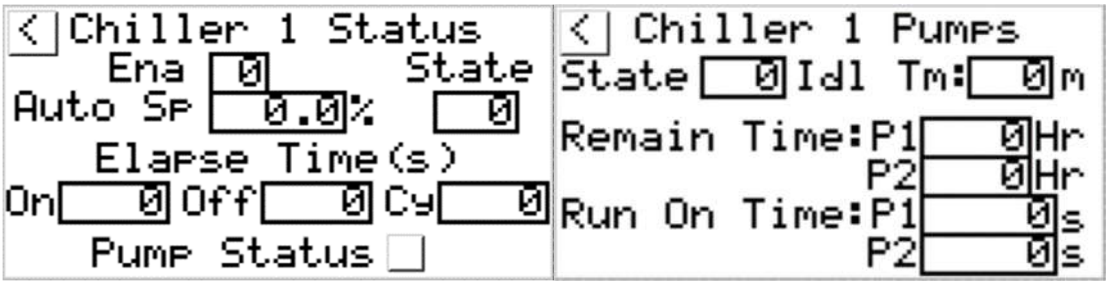
Current state:
1: Idle
20: Run
21: Holding last compressor on (pump down)
90: Alert
99: Alarm

2. Level Control Status



Simple level control screen if system is using a tank of fluid for level detect for pump and chiller safety.
Low Level- Indication of “1” shows that the digital input for low level is closed and in the ok/run state.
Level Ctrl- Indication of “1” tells system that the tank level is where it needs to be and no need to add more fluid. When this value is “0”, the “**S.V Fill**” will display “1” controlling a fluid fill solenoid valve from a digital output.

3. Chiller 1-4 Status/Pump Status



Chiller Status sent by the Main Management Control.
Chiller **Ena** (Enable) indicates that the "number of chillers" (in the main management setpoints) have been defined, and communication is enabled for that chiller. This is NOT an indication of the physical demand for cooling of the chiller running.
Auto Sp – Setpoint output from the chiller management function block being sent to the chiller control block to run at what percent. This value will be scaled based on high and low values set in the chiller management settings (See graphs above for behavior).
State - 1: Idle

10: Starting

20: Run

40: Stopping

99: Alarm

Elapse On Time - Remaining time before the minimum on time elapsed
Elapse Off Time - Remaining time before the minimum off time elapsed
Elapse Cycle Time - Remaining time before the minimum cycle time elapsed

Pump Status
State - 1: Idle

20: Normal

21: Timer normal

40: Locked rotor protection (PMode)

41: Start PMode

42: Timer PMode

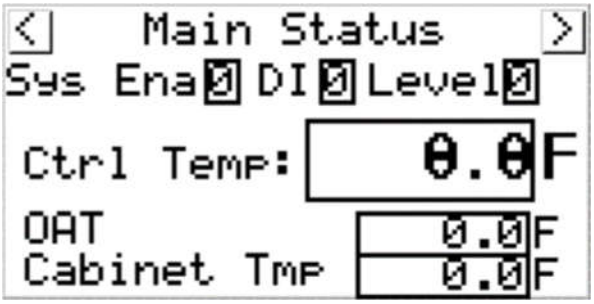
43: End PMode

99: Alarm

Idle Time - Remaining idle time before pump starts for the mode run time set.
Remain Time – Remaining time before pump shuts off. Only applicable when hours are set on both pump 1 and 2.
Run On Time – Amount of time pump is running after It has been disabled or switched off.

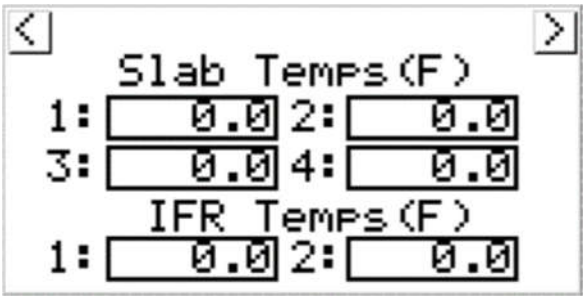
Status 2 - Temperature Display Screen

PAGE 1



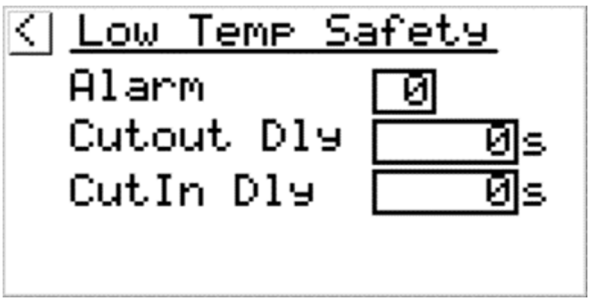
Sys Ena – indicates system is enabled. This can be switched on and off in "Setpoints."
DI – Digital Input Enable. This **MUST** be enabled for the system to run by either a jumper wire to the input (see wiring schematic) or a remote signal from third party device.
Level – When level control is enabled for chiller system to prevent cavitating pumps. Level at "0" indicates no level in a tank or pressure switch system. The system will be off and alarming. "1" indicates level is ok to run.
*****NOTE: All Three of the above values must be on(1) for system to be ok to run.*****
Ctrl Temp- Control Temp to modulate and control chillers. Usually installed in the supply or return line of chiller pump.
OAT – Outdoor Air Temperature. This is used for various control of chiller system and very important for how the chiller runs efficiently. Used for shifting the head pressure setpoint, EXV superheat setpoint shifts, max valve opening, and compressor low pressure cold weather operation.
Cabinet Tmp- Cabinet temperature used for controlling a cabinet fan to turn on when temperature is above 75F.

PAGE 2



Slab Temps – Slab temps used for either display information, or used for control temperature based on average, min, max, etc.
IFR Temps – Infra Red temperature. A 4-20mA temperature is used for similar reasons as slab temperatures.

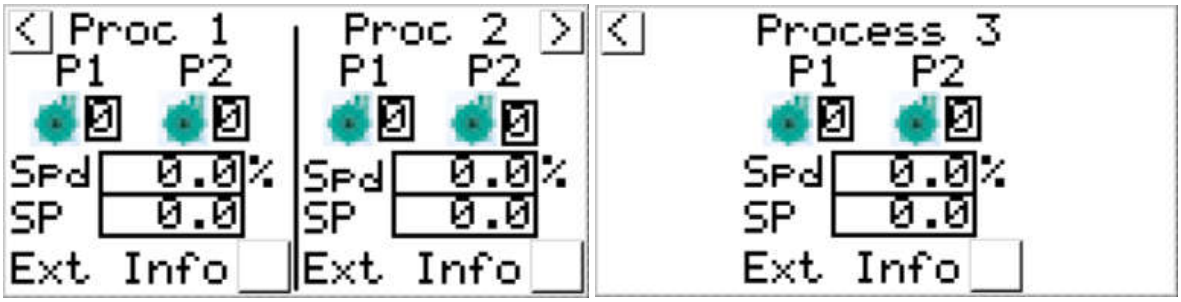
PAGE 3



Low Temperature Safety screen to indicate the temperature has fallen below the setpoint (or Low temperature setpoint set). ***This is NOT a critical alarm***, simply an extra safety to shut off the system after the **Cutout Dly** expires. This alarm type is common if many process/product loads shut off at the same time, or the PID control is not responsive enough to shut down the system. After the cut in value has been reached, the **Cut in Dly** will start to time before the alarm resets.

Status 3 - Process Display Screen

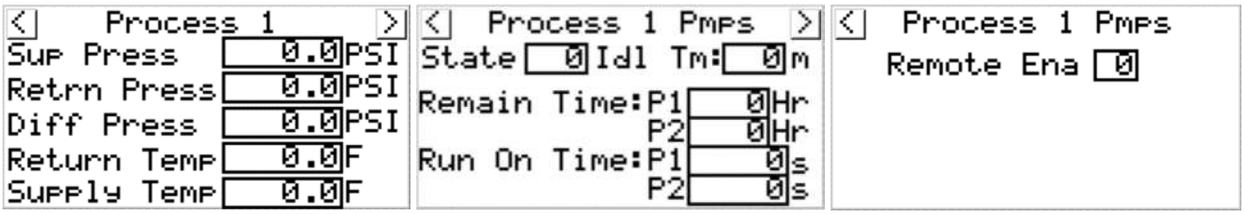
PAGE 1



These images display Process (*if enabled*) 1-3. Each process line can have up to 2 pumps, either flip-flop on desired running hours, both running all time, or set to 1 pump only.

Indicates an enable was sent to run the pump, and value of "1" indicates a pump proof back (digital input is closed). **Spd** shows the pump speed percentage called by the PID control based on **SP** (setpoint).

Ext Info (Extended Information), each consists of the following information.



Supply Pressure, **Return Pressure**, **Differential Pressure**, **Return Temperature**, **Supply Temperature.**

State

1: Idle

20: Normal

21: Timer normal

40: Locked rotor protection (PMode)

41: Start PMode

42: Timer PMode

43: End PMode

99: Alarm

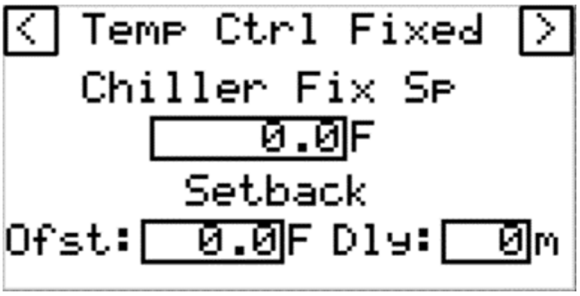
Idle Time – Pump will start for the duration of the locked rotor protection.
Remain Time running of pump 1 and 2 in hours.
Run On Time for pump 1 and 2 in seconds. Duration of running after being switched off.
Remote Enable- Must be on for process line to be enabled. If no remote third party enable, then a jumper MUST be present for digital input.

SETPOINTS

System Enable – to physically turn on entire system on or off. This valve is not a status variable. The value of "1" indicates that the system is set for enable, "0" is system off.

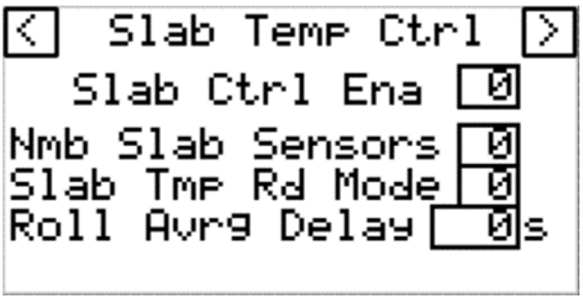
Temp Control Setpoints

PAGE 1



Chiller Fix SP- Main setpoint to be controlled by chillers based on the control temperature.
Setback – When Setback digital input is true (this is usually a push button type momentary switch (*see wiring schematic*), the **Chiller Fix Sp** will be offset based on the **Ofst** value for the time **Dly** also set in minutes. This offset value can be a positive or negative value. This feature is mostly used on ice pads, when the ice is about to be flooded with water and needs quicker freezing time.

PAGE 2



Slab Ctrl Ena – If this value is set to "1", **Chiller Fix SP** will now be based on the slab temperature sensors only, and NOT using the Control Temperature analog input. Select **Nmb Slab Sensors** that will be used (up to 4) for controlling the chiller setpoint.
Example: If 4 slab temperatures are enabled (Sensor Enable Setpoints page AI03, AI04, AI05, AI06), and only 3 of them will be controlling the chiller setpoint, then the first 3 analog inputs in order (3, 4, 5) will be used and the fourth (6) will only be used as a readout.

Select the **Slab Temperature Read Mode** desired for showing the temperature that will be used as the new control temperature.
0 = Actual Average Value (No Roll Average)
1 = Average (Roll)
2 = Max (Roll)
3 = Min (Roll)
Roll Average Delay used for smoothing out quick temperature variations. Set delay for a smooth "Roll" into temperature change.

PAGE 3

IFR Temp Ctr" – Infrared Temperature Sensor Control. This is a 4-20ma temperature sensor used for ice surface temperature; however, it can be manipulated as any 4-20ma temperature sensor. Max number of sensors is 2. Used in the same way as the slab temperature control listed on previous page as a new control temperature for controlling chillers. See Slab Temperature on the previous page for more details.

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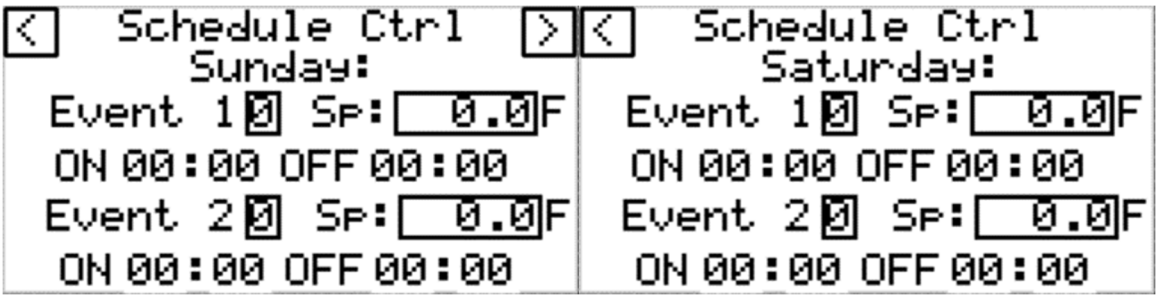


Schedule

A schedule for chiller setpoint can be used for every day of the week, Sunday to Saturday, and have up to two events per day.

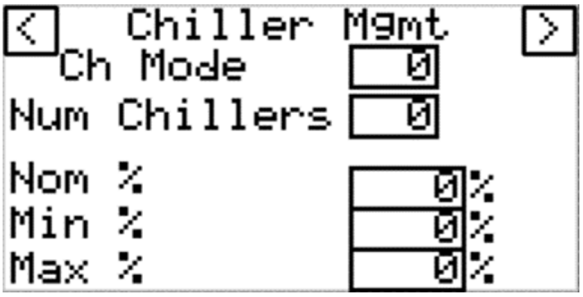
To enable the event for that day of the week, a value of "1" must be set.

Note: Be sure that the RTC (Real Time Clock) is set on the PLC before enabling any events.

Choose desired **Sp** setpoint for that event, this will start on the **ON** time and will automatically switch back to the original **Chiller Fix Sp** when the **OFF** time is present.

Chiller Management Setpoints

PAGE 1



Ch Mode – Chiller control sequence mode. **Default Value: 2**

- **o**0: FIFO
- **o**1: Runtime
- **o**2: LIFO

Num Chillers - Number of chillers being controlled.

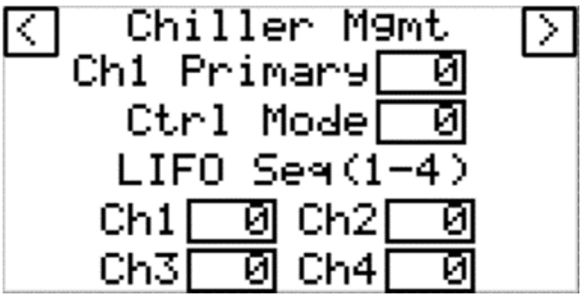
NOTE: ***PLC must be power cycled after selecting the number of chillers, for the system to take effect!***

Nom % - Nominal percentage of the chillers **Default Value: 100%**

Min % - Minimum percentage of the chillers being used **Default Value: 0%**

Max % - Maximum percentage of the chillers being used **Default Value: 100%**

NOTE: *Minimum and maximum percentage also set in "Chiller Control". Analog scaling will differ when changed!*



Ch1 Primary – when enabled, value set to "1", chiller 1 will always be the first and last to run. An internal timer resets the operating hours for chiller 1 to force it to be the first and last. Used when multiple chillers are present and only chiller 1 has a VFD present on a compressor.

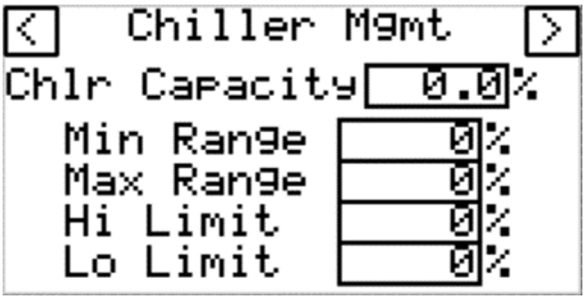
Ctrl Mode - Control mode (switch on/off the chillers). **Default Value: 0**

- 0: Delay
- 1: Hysteresis

LIFO Seq - Chiller start sequence (priority in sequencing mode LIFO).

NOTE: *All chillers have equal priority unless "Ch1 Primary" is set.*

PAGE 3



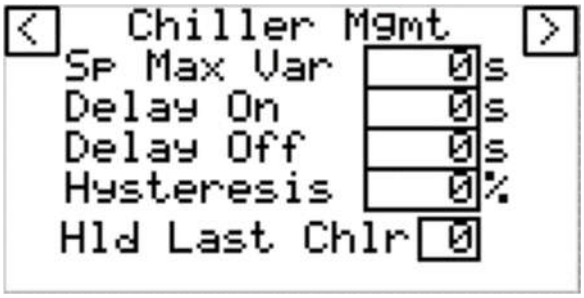
Chlr Capacity- should always be set to 100 percent unless scaling is needed for a readout. Changing this number will affect when chillers are enabled and disabled in the curve.

Min Range - Low limit of the range. *Refer to System Overview* (**Regulation with rMinRange and rMaxRange**) **Default Value: 3**

Max Range-High limit of the range. *Refer to System Overview* (**Regulation with rMinRange and rMaxRange**) **Default Value: 100**

Hi Limit – High limit of the "PID" Output (This is the Setpoint of the Compressor Management 0-100%) **Default Value: 100**
Lo Limit – Low limit of the "PID" Output (This is the Setpoint of the Compressor Management 0-100%) **Default Value: 0**

PAGE 4

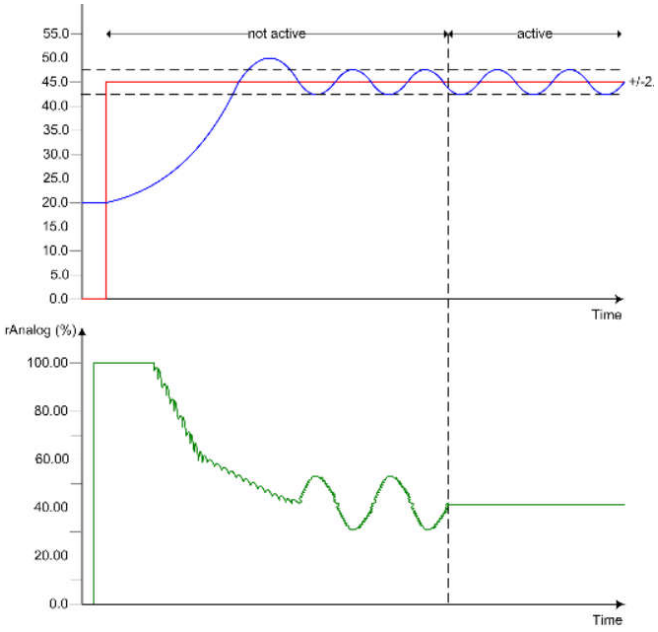


Sp Max Var - Maximum setpoint variation time to increase/decrease the setpoint of 10%. 0 leaves the setpoint unchanged. It is possible to limit the slope of setpoint signal coming from PID to prevent too quick variation and consequently too fast switching on or off the chillers (for example during first power on). The input "Sp Max Var" indicates the time necessary to increase or decrease the setpoint of 10% value. **Default Value: 5**
Delay On - Delay to increment the number of requested chillers ("Ctrl Mode" Set to 0). **Default Value: 15**
Delay Off - Delay to decrement the number of requested chillers ("Ctrl Mode" Set to 0). **Default Value: 1**
Hysteresis - Hysteresis to increment and decrement the number of requested chillers ("Ctrl Mode" Set to 1). **Default Value: 10**
Hld Last Chlr – Hold Last Chiller On, even if shut off is requested. **NOT recommended using**, as this could cause the control temperature to go too low. Be sure to enable "Low Temperature Safety", if this value is set to "1"!! **Default Value: 0**

PAGE 5

Hi Limit- High Limit percentage of the PID. This is the maximum value The Chiller Management will see. Be sure to set this value high enough that all chillers will be called for in the Management group to be enabled if need be. *Refer to System Overview for further information*. **Default Value: 100**
Lo Limit - Low limit that the PID will "ramp" down too. If a value greater than 0 is set, be sure the proper minimum range and low limit values are set up in the management group. **Default Value: 0**

Deadband- Used to smooth out control behaviour. Value is set in degrees Fahrenheit. Example: Value set at 2F deadband meaning that the PID output percentage (Compressor Management Setpoint), will not change when temperature is within 2F above and below PID Setpoint. See graph below. **Default Value: 0**



Proportional Gain rKp

Example:

rKp > 0	Direct mode, for example, control for heating.
rKp = 0	The outputs rAnalog and iAnalog are set to 0.
rKp < 0	Reverse mode, for example, control for cooling (inverse control).

Integral Time uiTi

Example:

uiTi = 1	Fast integration time, causes a fast influence on the outputs rAnalog and iAnalog.
uiTi = 10	10 times slower than the fast integration time (a) and causes a slower influence on the outputs rAnalog and iAnalog.
uiTi = 0	uiTi is deactivated.

Derivate Time uiTd

Example:

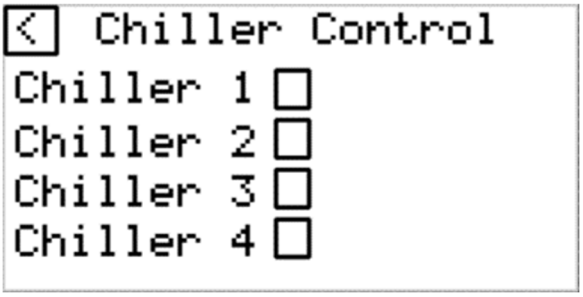
uiTd = 1	The smallest damping, causes a high influence to the outputs rAnalog and iAnalog.
uiTd = 10	1/10 of the smallest damping, causes a lower influence on the outputs rAnalog and iAnalog.
uiTd = 0	uiTd is deactivated.

NOTE: In systems with dead time, uiTd should be set to 0. The value of uiTd must be greater than the cycle time. If it is less than the cycle time, then the uiTd value is overwritten with the value of the cycle time.

P I D- Proportional, Integral, Derivative. <u>It is not recommended changing these values unless discussed with a qualified and trained technician</u>. The default values have been fully tested on multiple applications and damage can occur to chillers/compressors due to rapid cycling if set incorrectly! **Default Value: P= -5, I=500, D=0**

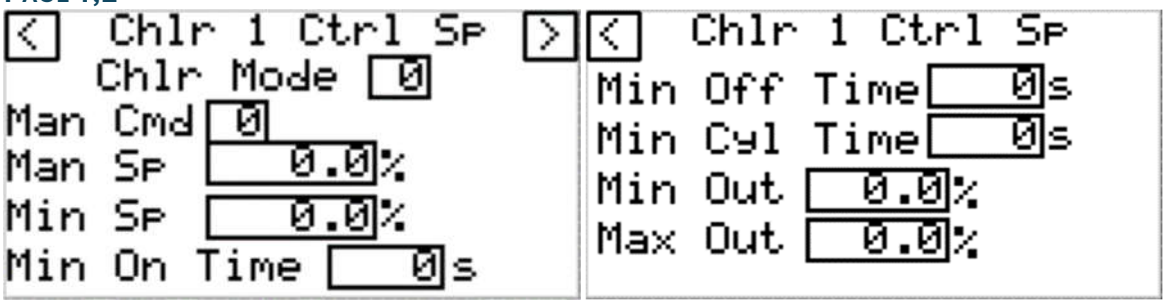
NOTE: ***For Proportional to work in cooling mode, the P must be a negative integer.*** *The PID is a separate "Block" from the Chiller Management and runs as an individual PID for a 0-100% setpoint to the Chiller Management "Block", based on control temperature.*

Chiller Control Setpoints



Chiller Control setpoints for up to four chillers.

PAGE 1,2



Chlr Mode - Compressor Mode control of the chiller: **Default Value: 1**

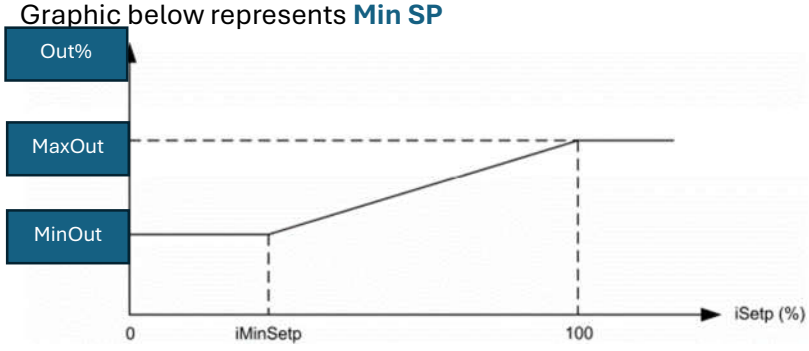
- **o**1: automatic - Runs the chiller based on setpoints and commands from the Chiller Management. Timers and alarms are enabled
- **o**2: manual – The chiller is controlled with Manual Setpoint and Manual Command. Timers and alarms are enabled
- **o**3: maintenance - The Chiller is controlled with Manual Setpoint and Manual Command. Timers are disabled and alarms are enabled

Man Cmd and **Man Sp** – Manually command the chiller (Set to 1) to the manual setpoint set in percentage. System must be enabled for this to work.

Min SP - Minimum set-point that corresponds to the **Min Out**. **Default Value: 0**

NOTE: Comp Min SP must be lower than 100.0%.

Graphic below represents **Min SP**



Min On Time - Minimum time the chiller will stay enabled.

Min Off Time - Minimum time the chiller is stopped.

Min Cyl Time - Minimum time between 2 consecutive starts of the chiller.

Min Out - Minimum Output percentage of the compressor that corresponds to the minimum set-point. **NOTE: Min Out must be lower than Max Out.**

Max Out – Maximum Output percentage of the compressor.

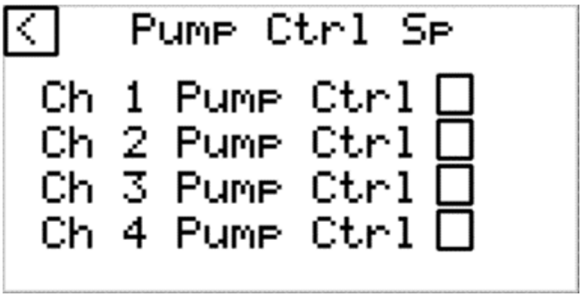
Pump Control Setpoints

The Pump Function balances the operating hours of two pumps and takes into account the status of each pump: operating time, detected error, maintenance mode.

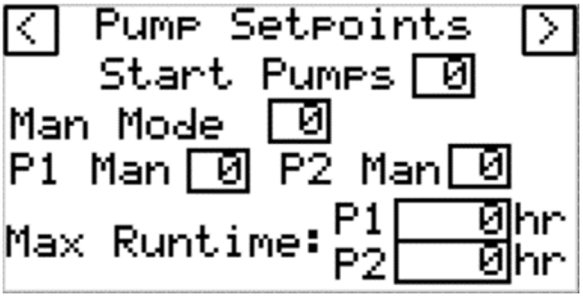
If one of the pumps is not available, the second pump will run continuously.

When the pumps are not used for a long time, to help avoid damage (corrosion, blocking, etc.) the pumps are switched on one after the other during a user-defined time.

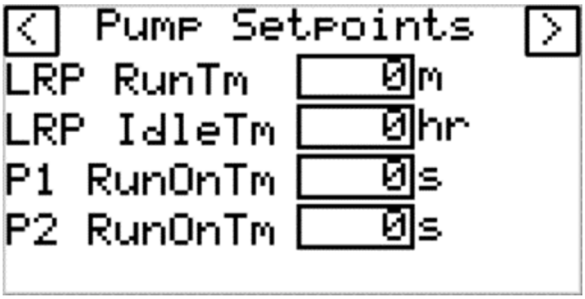
All time settings can be configured.



Chiller Pump Control Setpoints for each chiller pump. Up to 2 pumps per chiller.



Start Pumps – start stop for pump control. Set to 1 to enable pump function. Can be disabled if chiller pump is controlled from a remote system or device.
Man Mode – manual mode to enable and disable pumps on and off. **P1 Man** and **P2 Man** must be selected to turn individual pump on and off.
Max Runtime – Set the maximum runtime of each pump (0-1000Hrs). After the expired hours, the pumps will switch. If only P1 pump is used, set P2 to 0 and P1 to 24Hrs to never shut off.

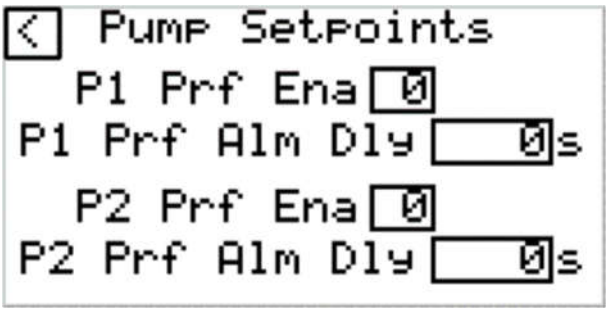


When the pumps (**P1** and **P2**) are not used for a long time, the pumps are switched on to avoid damage (corrosion, blocking, etc.). The duration when the pumps are switched off and the duration of the Protection mode (Pmode) are set by the user.

If **LRP Idletm** or **LRP RunTm** are set to zero, the locked rotor protection is not started and **LRP IdleTm** is set to zero.

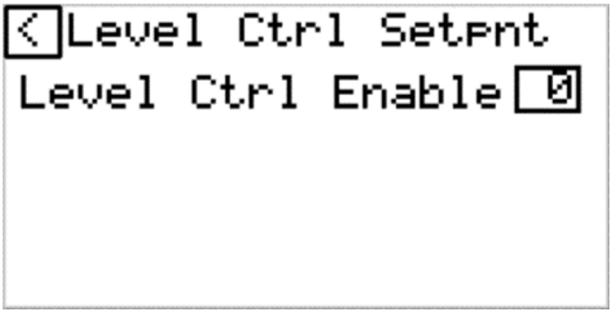
If the locked rotor protection is running (P1 or P2 are switched on), remaining idle time is set to **LRP IdleTm**.

RunOnTm is set to avoid flow switched tripping or lags in system, when switching between 2 pumps. Run on time will expire and pump will be switched off when disabled and called by the other pump to run.



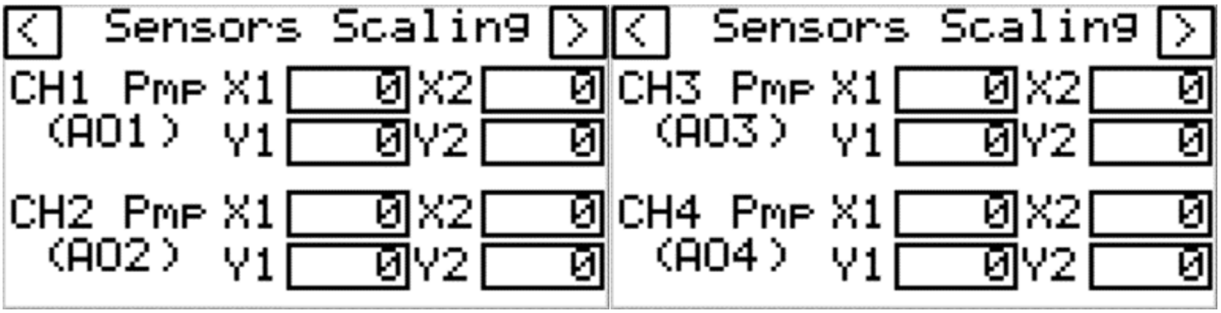
P1/P2 Prf Ena- Set to 1 to enable pump proof input. Alarm will be triggered if no “proof” input is active when the pump is calling after **P1/P2 Prf Alm Dly** (pump proof alarm delay) expires.

Level Control Setpoints



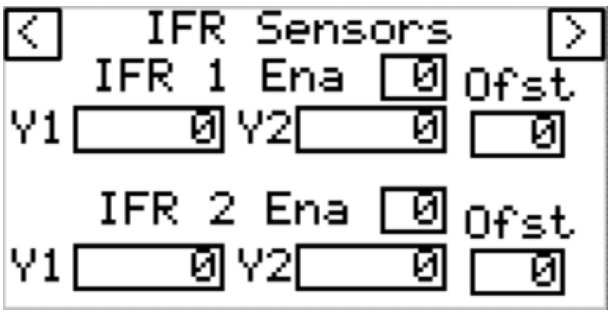
Level Control Enable to activate a solenoid fill valve based on level control digital input. Input is in series with main system enable and will shut down chiller system if this feature is enabled and digital input is not true.
See wiring schematic for digital input designation.

Sensor Configuration

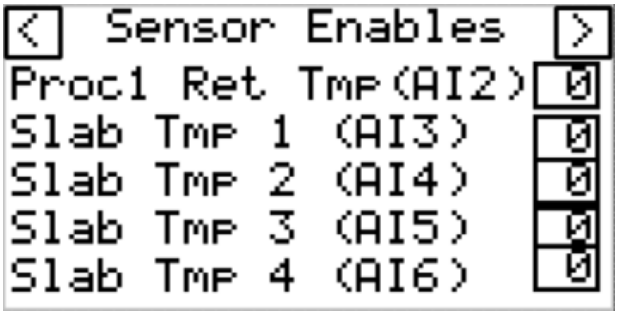


Scale

Scaling for Analog Output 1 - 4 for chiller pumps. 0-10vdc output only! Set “X” as Pressure scaling in REAL value. Set “Y” as voltage scaling in integer format (ex. 1000 = 10vdc).

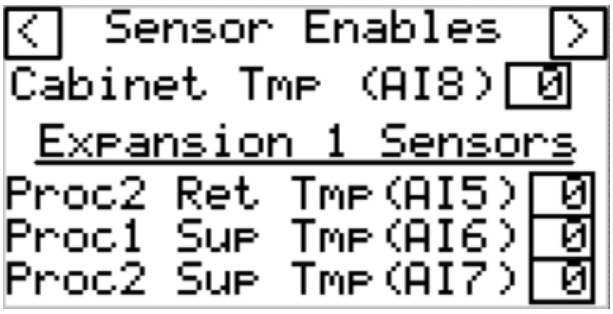


IFR Sensors (Infra-Red Ice Surface Temp) is a 4-20ma input. Set **Y** scale in temperature (Fahrenheit). This input could be used as any 4-20 ma input as a “Read only” value if necessary, however does have the ability to be used as chiller control temperature to enable chillers on/off (see *Temperature Control Setpoints*). Set **Ena** to 1 to enable this Analog Input.



Proc1 Ret Tmp (Process 1 Return Temp) Enable to be set to 1 if process is enabled. If process piping/pumps are present, this can be used as a “Read Only” value to display the return temp of a process line. This temperature could be manipulated as any temperature since it is read only, however it will display on the process pumps page on the main HMI Scada program.

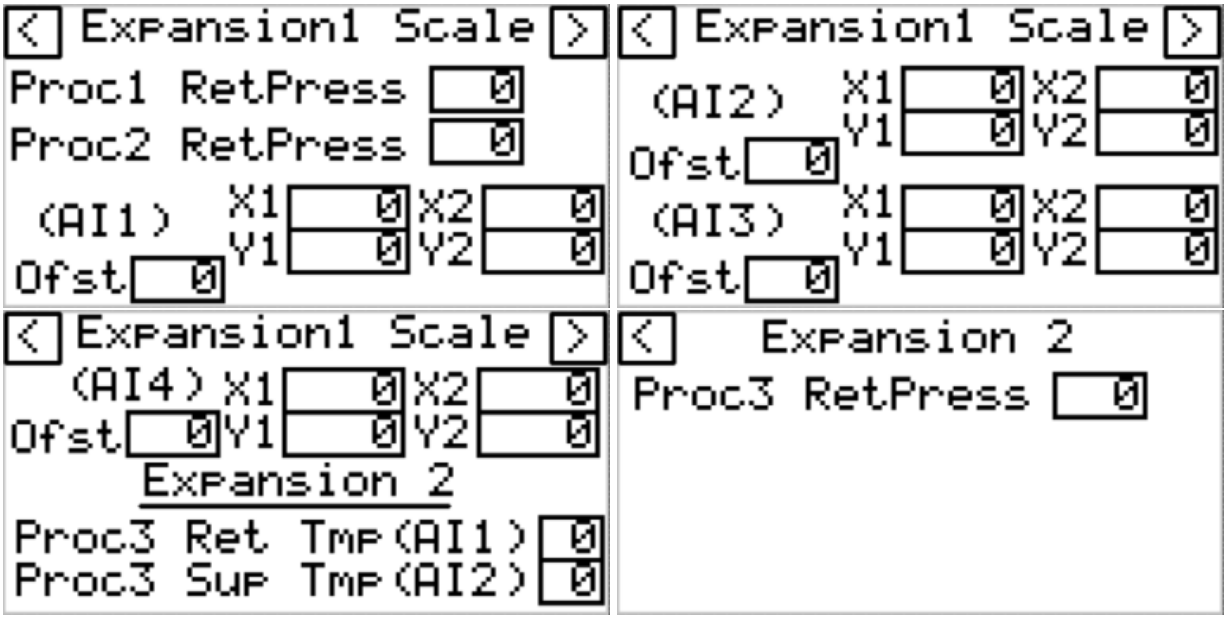
Slab Temps 1-4 Enable to be set to 1 if temperatures are present for reading ice surface temperature. Up to four slab temperatures can be used. This value can be displayed by “Read Only”, however does have the ability to be used as chiller control temperature to enable chillers on/off (see *Temperature Control Setpoints*).



Cabinet Tmp Enable will enable Cabinet Fan to be controlled based on temperature to cool electrical cabinet. This value can also be enabled for a "Read Only" value if no fan is connected or needed.

Expansion 1 Sensors

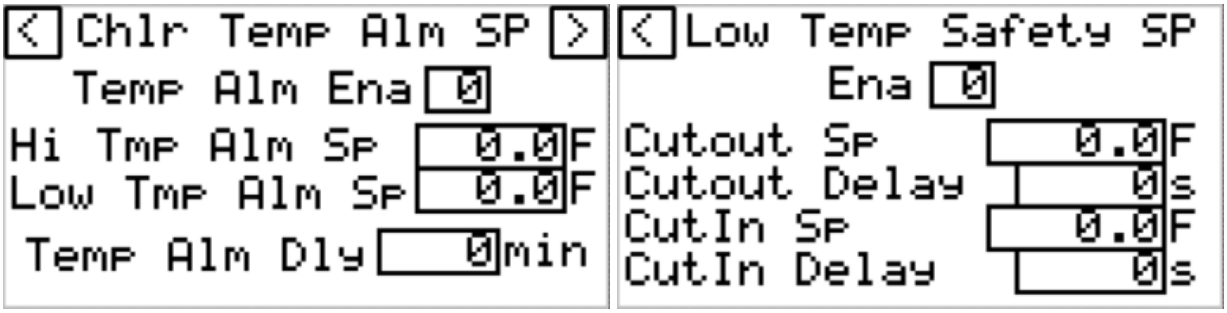
Proc 2 Ret Tmp, **Proc 1 Sup Tmp**, **Proc 2 Sup Tmp**, **Proc1 RetPress** (next pic below), and **Proc2 RetPress** (see pic below). These process temp/press can only be enabled if an expansion module is present.



Expansion 1 Scale - Scaling for analog pressure value, set "**X**" as pressure scaling in REAL value, 0-100% of the 4-20mA signal. Set "**Y**" as pressure scaling in integer format (ex. 0-100 psi). Set **Ofst** (offset) to pressure if needed in +/- format.

Expansion 2- same as expansion 1 settings, this expansion module is present if process 3 is used.

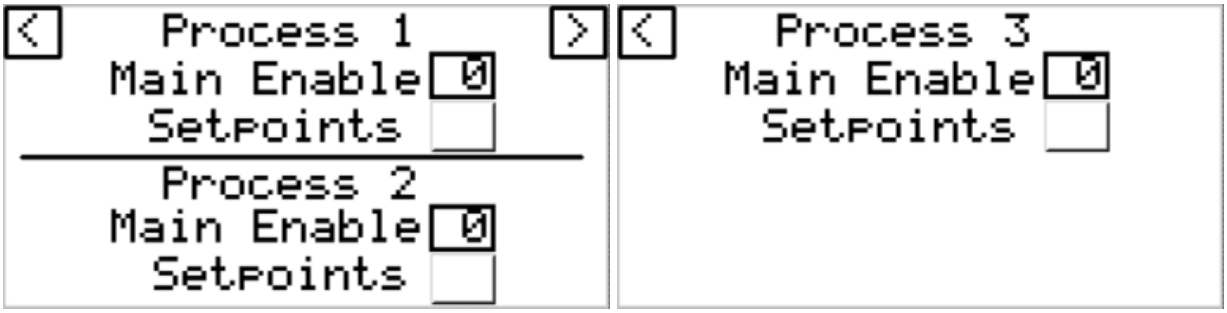
Alarm Setpoints



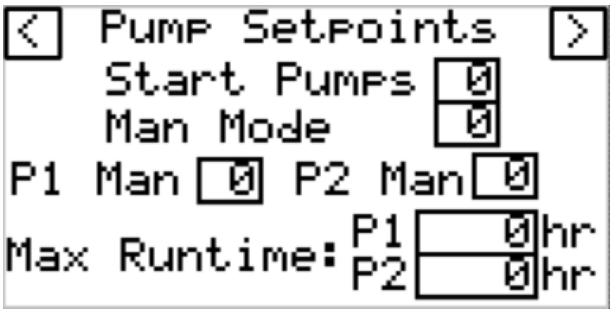
Chiller Temperature Alarm Setpoints- Enable **High and Low Temperature Setpoints** selecting **Temp Alm Ena** to "1". Set **Hi/Low Tmp Alm Sp** at limit to trigger alarm after **Temp Alm Dly** time in minutes. Alarm is only a notification and does not affect the operation of the chiller.

Low Temperature Safety Setpoints – This feature is to ensure the chiller will not run based on **Cutout Sp**. The chiller platform performs operation by PID method. Set this value in case the PID reaction time/change is too slow to shut off the chiller.
When this cutout value is reached, an orange light will blink and indicate a low temp safety. This will not email/notify that an alarm occurred when connected through Scada, rather, just a cutout setpoint for the lowest temperature value that is allowed to be reached.
It is best to set the **CutIn Sp** below the temperature setpoint to allow the PID control to be within range to start from 0%. Set the **Cutin delay** and **Cutout delay** as desired for reaction time. Every system is different, and temperature will react differently based on load size/ heat transfer.

Process Setpoints

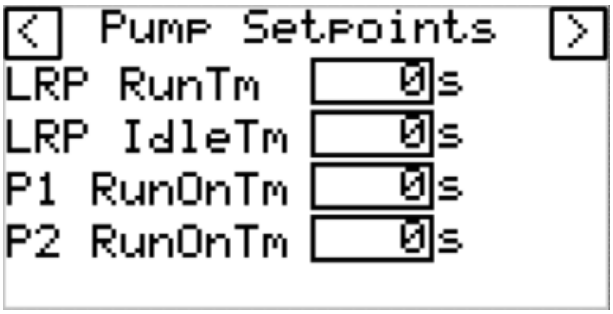


Enabling Process 1 or 2 will automatically enable a communication for Can Expansion module 1, and all process inputs will need to be enabled necessary for read values in **Sensor Setpoints**.
Process 3 main enable set to "1" will enable a communication for Can Expansion module 2. Dip Switches will need to be set for addressing and end of line on the Expansion modules.
See wiring schematics for dip switch settings.
Anytime the Process Main Enable is changed, both the PLC and Expansion must be power cycled.



Start Pumps – start stop for pump control. Set to 1 to enable pump function. Can be disabled if process pump is controlled from a remote system or device for the "Process remote enable" input (see wiring diagram).

Man Mode – manual mode to enable and disable pumps on and off. **P1 Man** and **P2 Man** must be selected to turn individual pump on and off.
Max Runtime – Set the maximum runtime of each pump (0-1000Hrs). After the expired hours, the pumps will switch. If only P1 pump is used, set P2 to 0 and P1 to 24Hrs to never shut off.

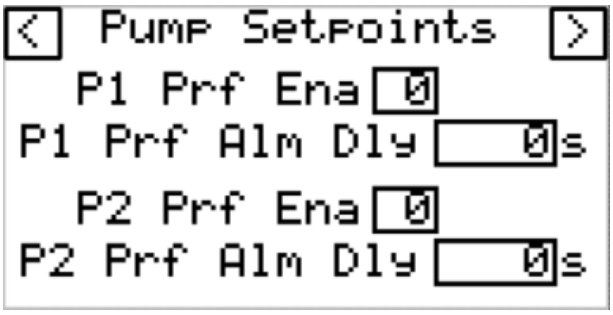


When the pumps (P1 and P2) are not used for a long time, the pumps are switched on to avoid damage (corrosion, blocking, etc.). The duration when the pumps are switched off and the duration of the Protection mode (Pmode) are set by the user.

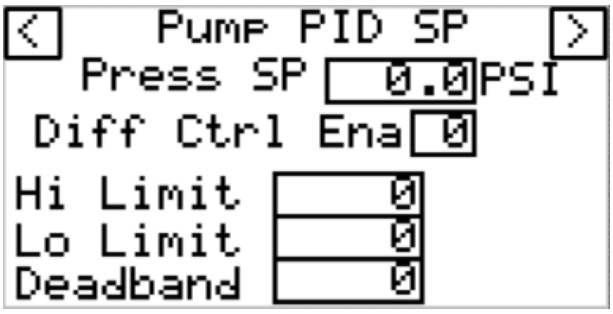
If **LRP Idletm** or **LRP RunTm** are set to zero, the locked rotor protection is not started and **LRP IdleTm** is set to zero.

If the locked rotor protection is running (P1 or P2 are switched on), the remaining idle time is set to **LRP IdleTm**.

RunOnTm is set to avoid flow switched tripping or lags in system, when switching between 2 pumps. Run on time will expire and pump will be switched off when disabled and called by the other pump to run.

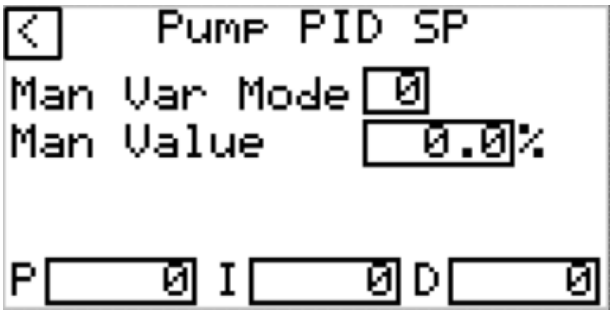


P1/P2 Prf Ena- Set to 1 to enable pump proof input. Alarm will be triggered if no "proof" input is active when the pump is calling after **P1/P2 Prf Alm Dly** (pump proof alarm delay) expires.



Set **Press SP** (Pressure Setpoint) desired to maintain process pump pressure in psi. If **Diff Ctrl Ena** is set to 1, than pressure setpoint will be the differential pressure between the supply pressure and return pressure of the process line. Both pressures MUST be present for this to work.
Otherwise, If no differential control is enabled, the process pump will maintain process supply pressure by default. Process supply pressure must always be present. This is imperative to run process pump speed based on a 0-10vdc analog output signal.

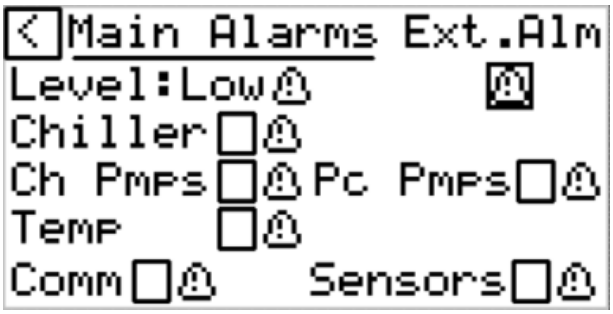
Hi Limit- High Limit percentage of the PID. This is the maximum value the process pump output will see. **Default Value: 100**
Lo Limit - Low limit that the PID will "ramp" down too. **Default Value: 0**
Deadband- Used to smooth out control behaviour. Value is set in psi. Example: Value set at 2psi deadband meaning that the PID output percentage will not change when pressure is within 2psi above and below PID setpoint. **Default Value: 0**



Man Var Mode- Manual Variable Mode set to 1 to enable manual mode to run process pump at a set **Man Value** (manual Value) in percentage.
P I D- Proportional, Integral, Derivative. Set PID for proper pump speed reaction based on load.

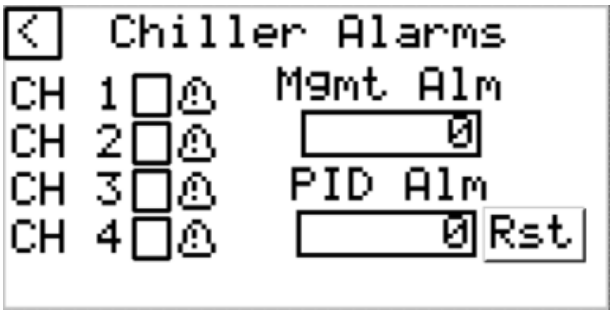
ALARMS

An alarm bell is an indication that an alarm is present. The Sensori controller will be blinking a red LED light indicating an alarm. Simply follow the alarm bell on the display until an indication of "1" is shown next to the present alarm to see what is alarming.



Ext.Alm (External Alarm) is an alarm input that, when active (Voltage is present on the Digital input), will signal that an alarm is present externally and Sensori Control yellow LED will flash. This input is primarily used to tie an external system alarm into the system if no email capability or signals are present on that controller, when connected through Sensori HMI Scada software.
Low Level alarm icon will appear when level control is enabled in "Level Setpoints" and no input is active on low level digital input.

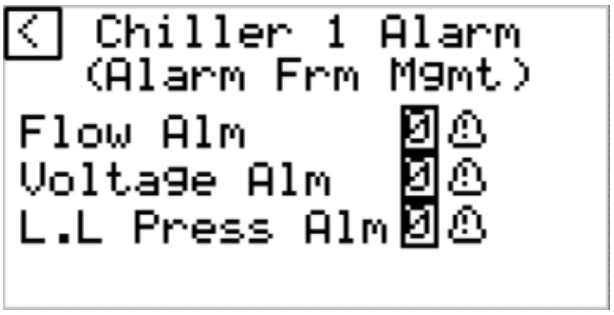
Chiller Alarms



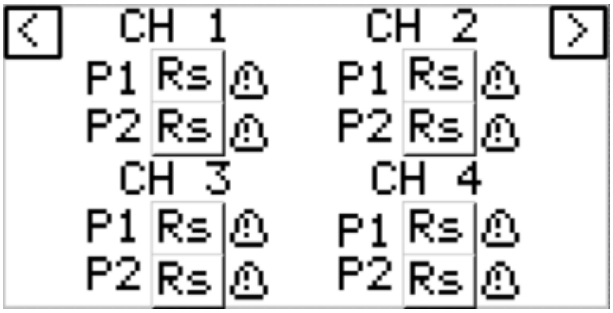
If a number > 0 appears on **Mgmt Alm**, it is indicating a setting on the chiller management is either outside of its range or indicates all chillers are in alarm state. This Management Alm ID is directly from the chiller management function block output.

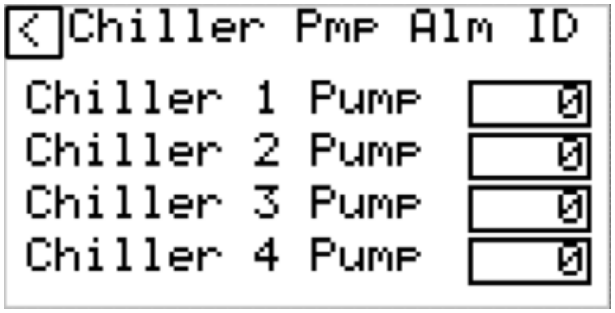
If a number >0 appears on **PID Alm**, it is indicating that a reset must be present. This is usually from a setting that has been changed and caused the PID to go into an alarm state. Press Enter on **Rst** button to restart PID.

CH 1-4 Alarms. See below. Chiller alarms are active from Chiller Compressor Management only. Alarm must be dealt with from the Chiller Management Sensori Control. The alarm indicated is an indication of alarm and will shut down that chiller when active (**Flow Switch alarm**, **Voltage monitor Alarm**, **Liquid Line Pressure Sensor Fail Alarm**).



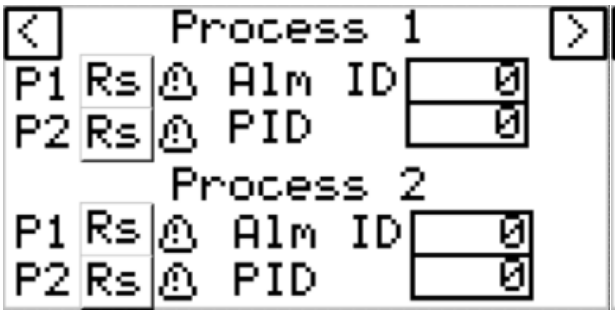
Chiller Pump Alarms

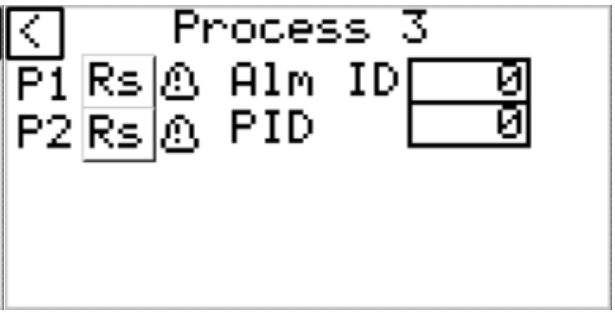




Each chiller can consist of 2 pumps. If a pump is in alarm state, the other pump will automatically come on until the pump alarm is reset and dealt with. Press **Rs** to reset the Pump “proof” alarm. When the alarm is active a chiller pump alarm ID indicates that the chiller pump is in alarm state.

Process Pump Alarms

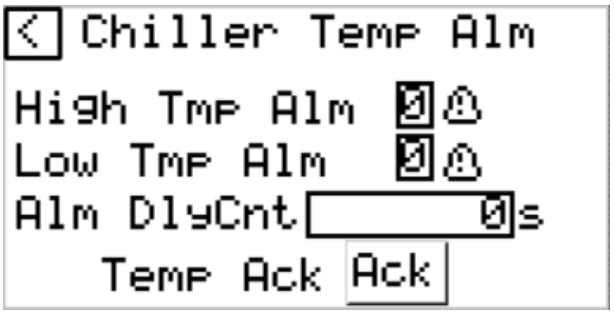




Each process line (Up to 3 process) can consist of 2 pumps. If a pump is in alarm state, the other pump will automatically come on until the pump alarm is reset and dealt with. Press **Rs** to reset the pump "proof" alarm. When the alarm is active, a process pump alarm ID will indicate that the process pump is in alarm state.

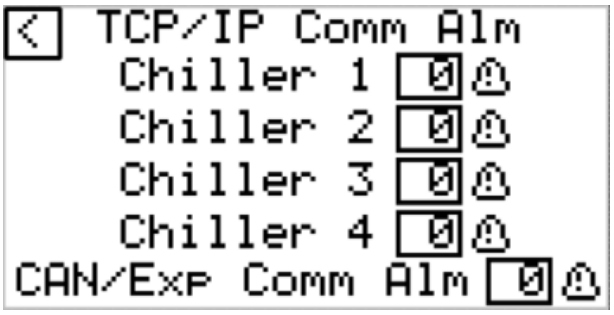
If a number > 0 appears on **PID Alm**, it is indicating that a reset must be present. This is usually from a setting that has been changed and caused the PID to go into an alarm state. Press enter on **Rst** button to restart PID.

Chiller Temperature Alarm



Chiller Temperature alarm will indicate a "1" along with the alarm bell if the control temperature exceeds the limit set in Chiller Temperature Alarm Setpoints. **Alm DlyCnt** will indicate the full delay counted in seconds when an alarm is reached based on the delay set in setpoints. Press temperature acknowledge button **Ack** to restart the temperature alarm.

Communication Alarms

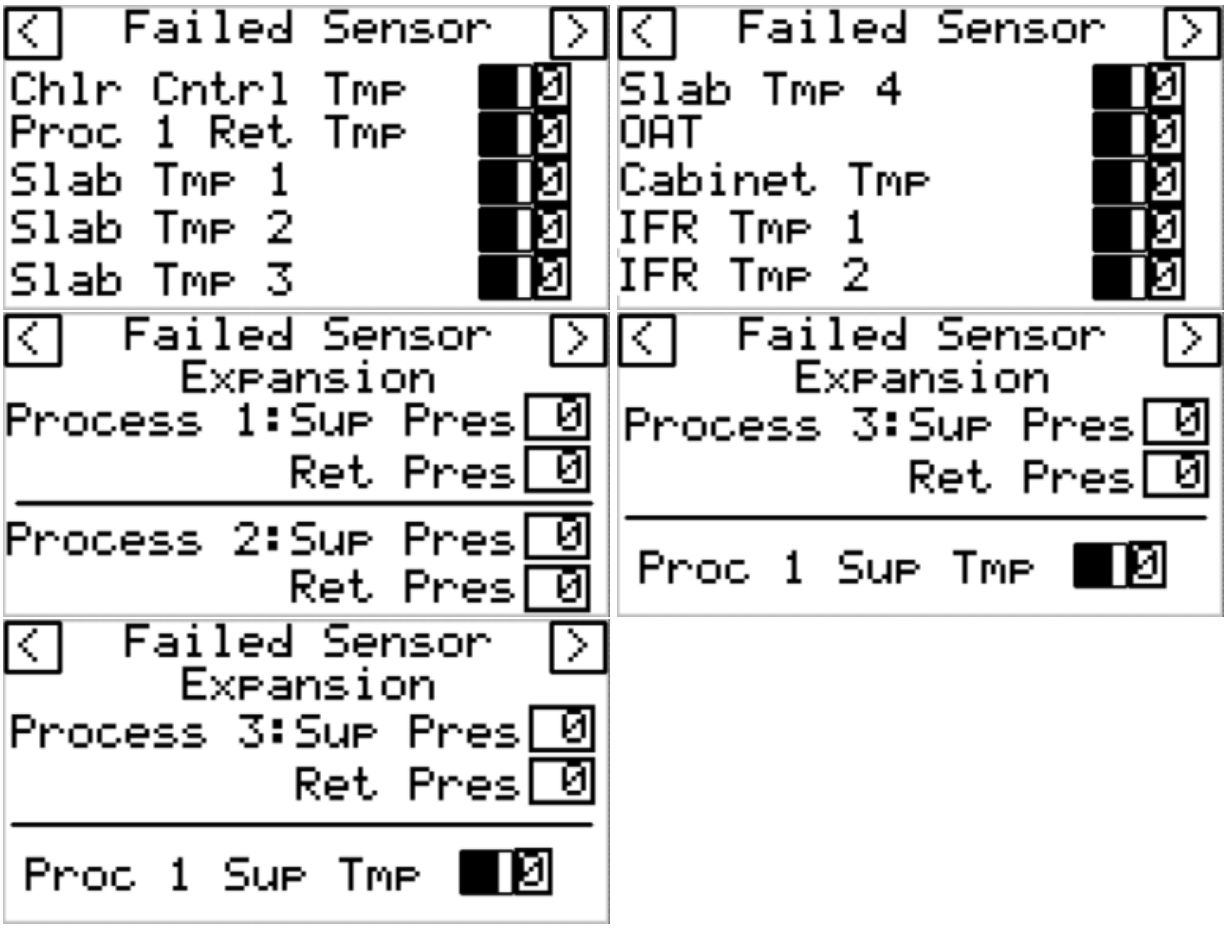


The Sensori Main Chiller Management PLC communicates with the Sensori Chiller Compressor Management PLC over TCP/IP (ethernet cable). Without communication, the chiller will not run as it has its run command and capacity percentage being sent over TCP/IP. If an alarm is active on a chiller, you must verify cable connection or proper static IP address for each chiller.

If a **CAN/Exp Communication alarm** is present, please verify the process expansion 1 and 2. Process 1 and 2 main enables (***see setpoints page***) control the communication being sent to CAN expansion 1. Process 3 main enable controls the communication being sent to CAN expansion 2. Verify wiring for the Expansions with proper end of line dip switch termination and start of line 120-ohm resistor being present, with proper use of ground/shield wire.

NOTE: *A power cycle MUST be present to both the plc and expansion module after the "Main Enable" setpoint has been changed, as well, if any dip switches have been changed on the expansion modules.*

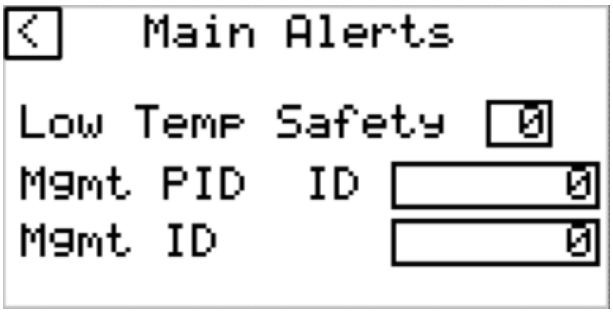
Sensor Alarms



Indication of "1" to show failed temperature/pressure alarms.

Alerts

An active alert will be indicated by a blinking amber LED light on the Sensori PLC, followed by an alarm bell beside the “Alert”



If a “1” is active next to **Low Temp Safety**, the chiller has reached its low temperature setpoint safety set and has shut down all chillers active. Usually this occurs when the PID set does not respond quick enough to shut down all chilling. This alert will not be emailed when connected to Sensori HMI Scada software and is simply an alert also used as a shut off for temperature for safety.

If **Mgmt PID ID** or **Mgmt ID** has a value greater than 0, this will indicate when there is a chiller alarm (coming from Chiller Compressor Management), or a PID setting has been inputted incorrectly.

2. CHILLER CONTROL MANAGEMENT

Sensori Chiller Control Management is the controller for the chiller to command up to 4 compressors (on/off, or variable speed), electronic expansion valve control, and fan control. Each compressor will be enabled to run through Sensori Compressor Safety devices with all its own setpoints and fine tuning, protecting each compressor individually over Modbus TCP to further protect compressor from failure and malfunction. Ambient shifting on valve and condenser applications allows the chiller to run at a peak efficiency performance and maintain proper operating conditions for all applications.

SYSTEM OVERVIEW

Compressor Management

Compressor Management Enables
Compressor Management is enabled through a master on/off switch (Digital Input). VEV Suction pressure (AI11), VEV Suction Temperature (AI10), Flow Switch, Voltage Monitor, and Communication TCP/IP Alarms, will disable compressor management if any of these alarms are active. **The VEV must be in "Ready" state**. When the valve driver initializes on a power up, the battery backup will need to be charged, and a 3-minute wait time will occur until "Ready" and ready for compressor management.

Compressor Sequence Control
Compressor Sequence Control helps to ensure equal usage of the compressors and optimize power consumption.
Compressors are controlled based on the following sequences:

Sequence as per `usiCompMode`	Description
FIFO = First In First Out	o The compressor with the least operating hours is switched on first. o The first compressor which is switched on is also the first to be switched off. o Advantage: operation time is limited.
Runtime	o The compressor with the least operating hours is the first compressor to be switched on. o The compressor with the most operating hours is the first compressor to be switched off. o Advantage: balanced operation hours.
LIFO = Last In First Out + Runtime	o The parameter pointer `usiLifoSeq` determines this sequence. o The first compressor to be switched on is the first one in the sequence. o The first compressor to be switched off is the last one that has been switched on. o Advantage: priority of compressor usage can be set. **NOTE:** If several compressors have the same priority, the compressor with the least operating hours is the first compressor to be switched on.

NOTE:

- It is recommended to keep the system at LIFO mode as this mode is fully tested based on optimum performance.
- If a variable speed drive is available, the variable speed drive is switched on before the on/off compressors switch on, and the variable speed drive is stopped last.
- If a compressor is not available (off timer or cycle timer are active, or the compressor is in alarm state), another compressor is started based on the sequence defined by Comp Mode above.
- If a compressor cannot be stopped (on-timer is active), another compressor is stopped based on the sequence defined by Comp Mode.

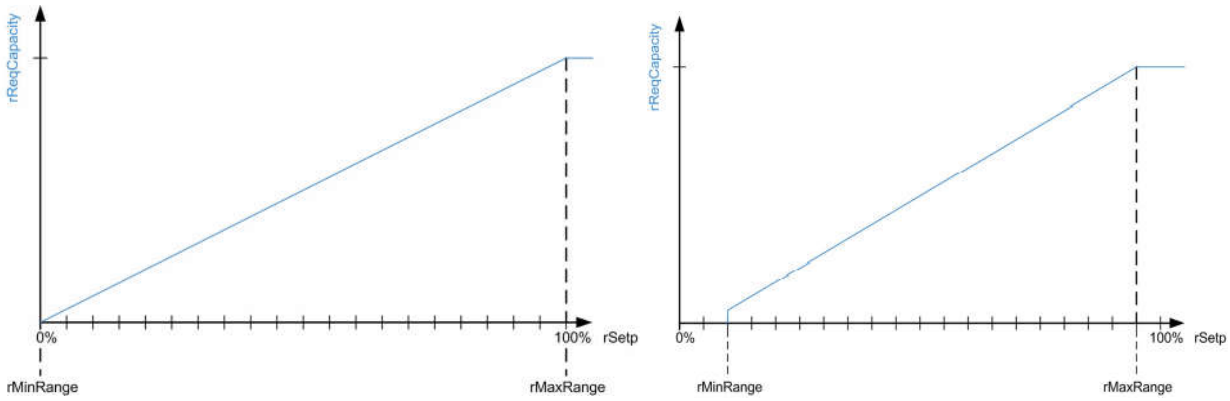
Compressor Breakdown Management

The compressor, which is detected as non-operating, is switched off. The next available compressor in the start sequence is switched on. The non-operating compressor cannot be started until the compressor is returned to an operational state.

Regulation with rMinRange and rMaxRange

To increase the stability of the system when the input of the Compressor Management (setpoint 0-100% called by the PID control) is close to 0% or 100%, the regulation range for the compressor is adapted to the range rMinRange to rMaxRange. xCtrlMode is set to FALSE (uiDelayOn and uiDelayOff is active. *See parameter list*).

The graphics show an example for rMinRange, rMaxRange (1VS):

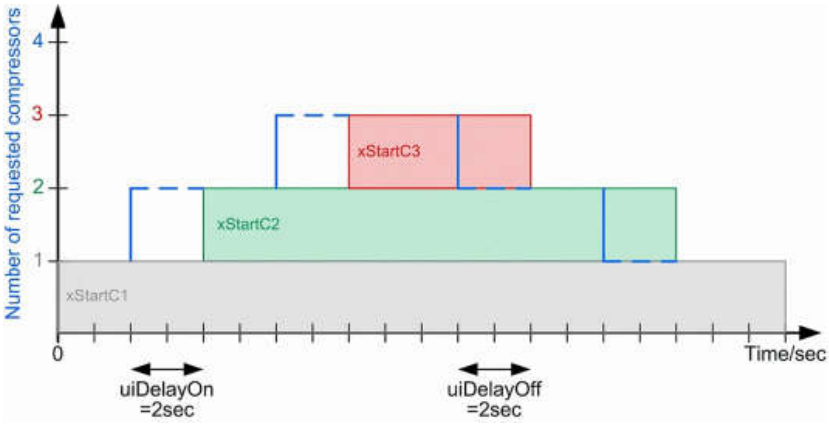


Regulation With Delay

The input **xCntrlMode** is set to FALSE. To increase the stability of the system, the input **uiDelayOn** can be set to delay the increment, or **uiDelayOff** to decrement the number of requested compressors.

NOTE: *When the first variable speed compressor must be switched on, the delay is not active. When the first On/Off compressor has to be switched on, the delay is active.*

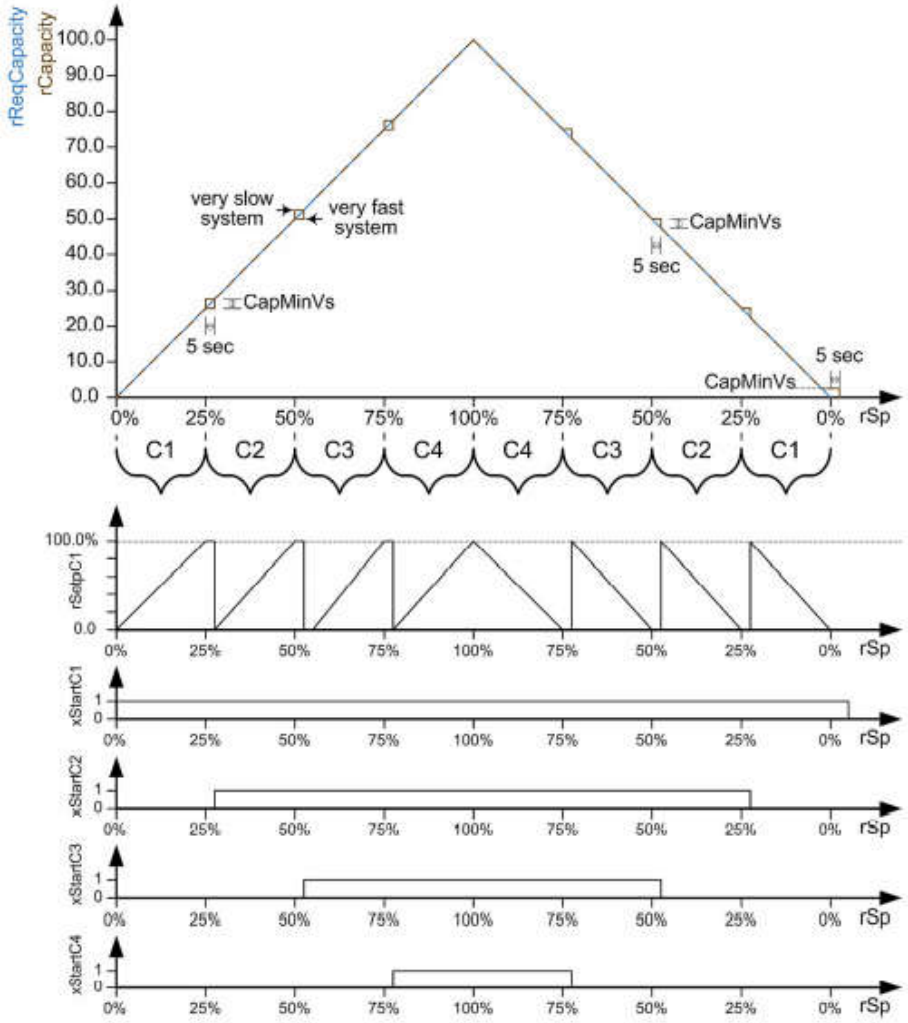
Example uiDelay overview:



The following example applies for one variable speed compressor and three on/off compressors with control mode (**FIFO**, **Runtime**, **LIFO**+ **Runtime**). The following values were set to show the diagram:

Parameter	Value/Unit
rMaxRange	100.0%
rMinRange	0.01%(∿ 0.0%)
usiNbVs	1
usiNbOnOff	3
rMaxFreq	50.0 Hz
rMinFreq	5.0 Hz
CapMaxVs	25.0 (for 1 variable speed compressor, internally calculated)
CapMinVs	2.5 (for 1 variable speed compressor, internally calculated)
rReqCapacity	0.0...100.0
rCapacity	2.5...100.0
uiDelayOn	5 s
uiDelayOff	5 s
rNomFreq	50 Hz
xCtrlMode	FALSE
uiCapVs	25
uiCapOnOff	25

The graphic shows an example for **rMinRange**, **rMaxRange** (1Vs+ 3 on/off)



REGULATION WITH MINIMUM FREQUENCY, MAXIMUM FREQUENCY, AND NOMINAL FREQUENCY

If...	Then...
If a variable speed compressor is available and ready,	A variable speed compressor is started first and a variable speed compressor is stopped last.
If more than one variable speed compressor is set by usiNbVs,	The variable speed compressors run until the maximum frequency (`rMaxFreq`) is reached before a new compressor is started. This is also valid if several variable speed drives are used.
If `xStartC1` is set to TRUE and `rSetpC1` is equal to 100.0%,	The variable speed compressor C1 is running at the maximum frequency `rMaxFreq`.
If more than one variable speed compressor is required,	The analog outputs `rSetpC*` has the same calculated values (analog for the value `iSetpC*`).

The following examples A and B are with a control mode (FIFO, LIFO, Runtime). In both examples, uiDelayOn and uiDelayOff are set to 0.

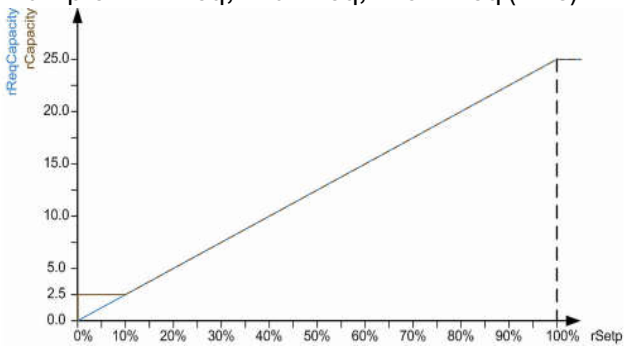
Example A

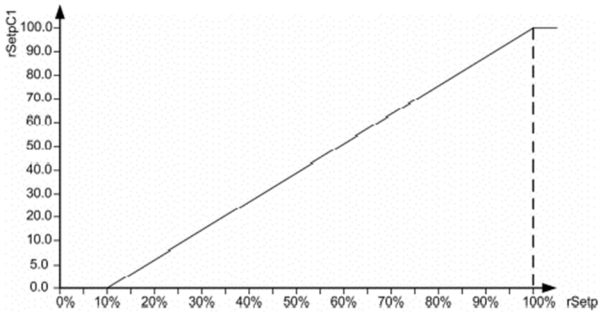
Parameter	Value / Unit
usiNbVs	1
usiNbOnOff	0
rMaxFreq	50 Hz
rMinFreq	5 Hz
rMinRange	0.01% (~ 0.0%)
rMaxRange	100%
rNomFreq	50 Hz
xCtrlMode	FALSE
uiCapVs	25
uiCapOnOff	25

Result: Maximum and minimum capacity (**CapMaxVs**, **CapMinVs**) of a variable speed drive, required capacity **rReqCapacity** (output)

Parameter	Value / Unit
CapMaxVs	25.0 (for 1 variable speed compressor, internally calculated)
CapMinVs	2.5 (for 1 variable speed compressor, internally calculated)
rReqCapacity	0.0...25.0
rCapacity	2.5...25.0

Example rMinFreq, rMaxFreq, rNomFreq (1 Vs):





Example B

Parameter	Scale / Unit
usiNbVs	4
usiNbOnOff	0
rMaxFreq	50 Hz
rMinFreq	30 Hz
rMinRange	0.01% (~ 0.0%)
rMaxRange	100%
rNomFreq	50 Hz
xCtrlMode	FALSE
uiCapVs	25
uiCapOnOff	25

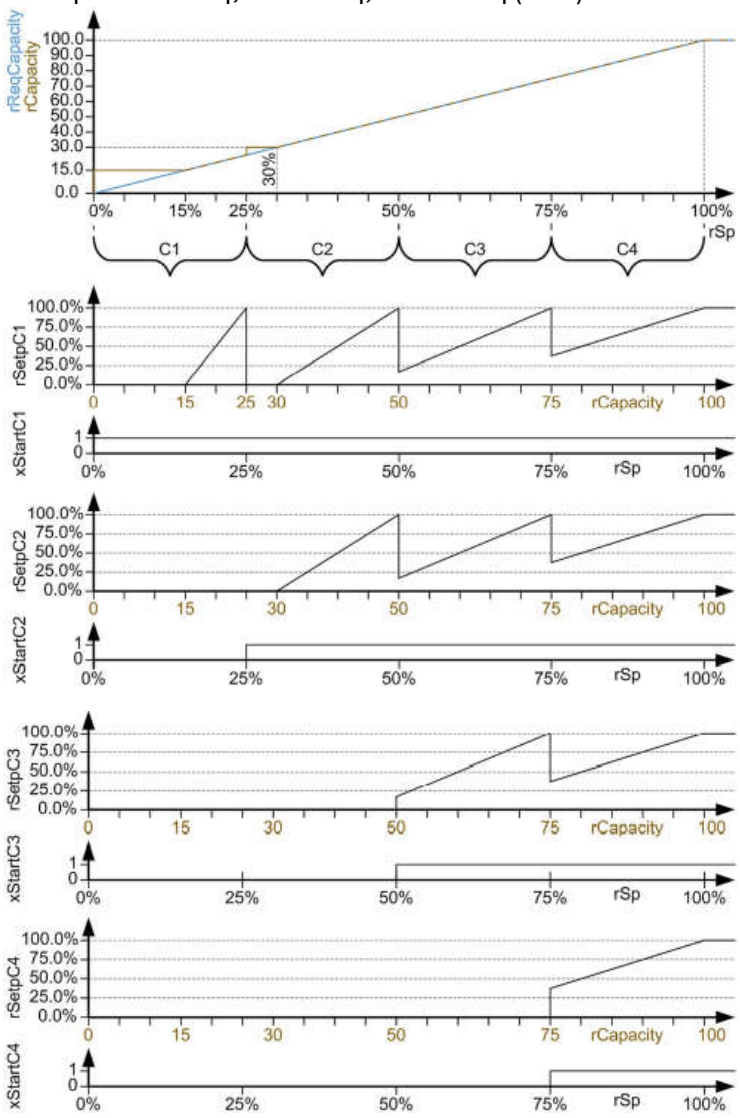
Result: Maximum and minimum capacity (CapMaxVs, CapMinVs) of a variable speed drive, required capacity rReqCapacity (output).

Parameter	Scale / Unit
CapMaxVs	25.0 (for 1 variable speed compressor, internally calculated)
CapMinVs	15 (for 1 variable speed compressor, internally calculated)
rReqCapacity	0.0...100.0
rCapacity	15...100.0

The outputs **rSetpC1** and **rSetpC2** are not started at **rCapacity** = 0 and rCapacity = 25. **rMinFreq** is set to 30.0 Hz and CapMinVs = 15.

If...	Then...
If rSp is greater than rMinRange,	The output xStartC1 is set to TRUE. **Result**: A value of 15.0 is set at the output rCapacity, but the calculated required capacity rReqCapacity is less than the set rCapacity. In this case, the calculation of the output rSetpC1 starts by rReqCapacity > rCapacity.
If rReqCapacity > CapMaxVs,	The system requires two variable speed drives. **Result:** o rReqCapacity is for example 25.1 (> CapMaxVs) and the outputs xStartC1 and xStartC2 are set to TRUE. o rCapacity is 30; also rCapacity > rReqCapacity and no further capacity is needed. o Both outputs rSetpC1 and rSetpC2 are 0. In this case, the calculation of the outputs rSetpC1 and rSetpC2 start by rReqCapacity > rCapacity (here 30).
If rReqCapacity > 2 x CapMaxVs,	The system requires three variable speed drives. **Result:** o rReqCapacity is for example 50.1 (> 2 x CapMaxVs) and the outputs xStartC1 and xStartC2 are set to TRUE. o rCapacity is 45, also rCapacity < rReqCapacity. o The required outputs rSetpC1 and rSetpC2 and rSetpC3 are set to 17.0%.

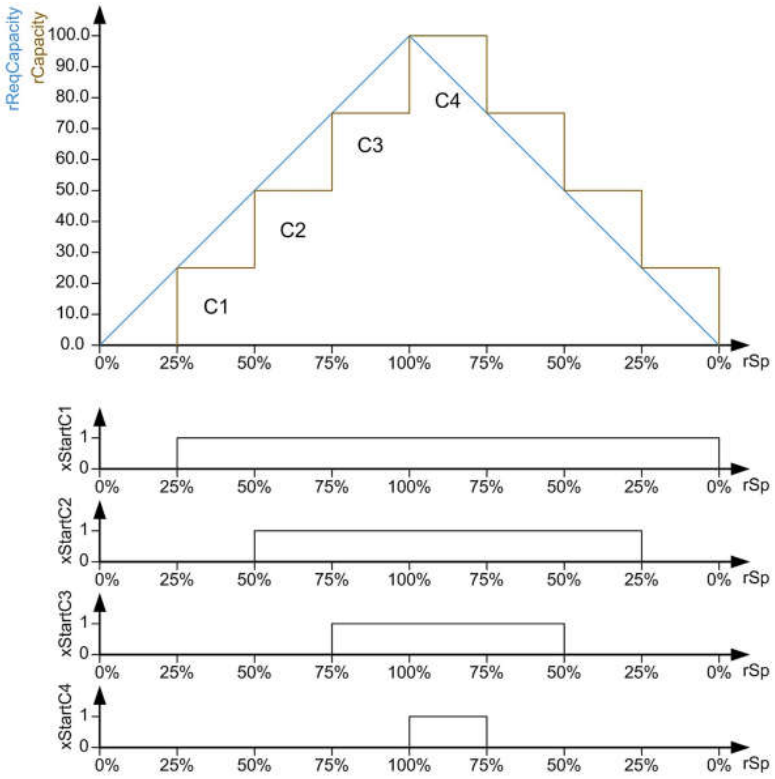
Example rMinFreq, rMaxFreq, rNomFreq (4 Vs):



Regulation with 4 On/Off Compressors

This regulation is possible but not as precise as variable speed compressors. The following example is with control mode (FIFO, LIFO, Runtime). The following values were set to show the diagram:

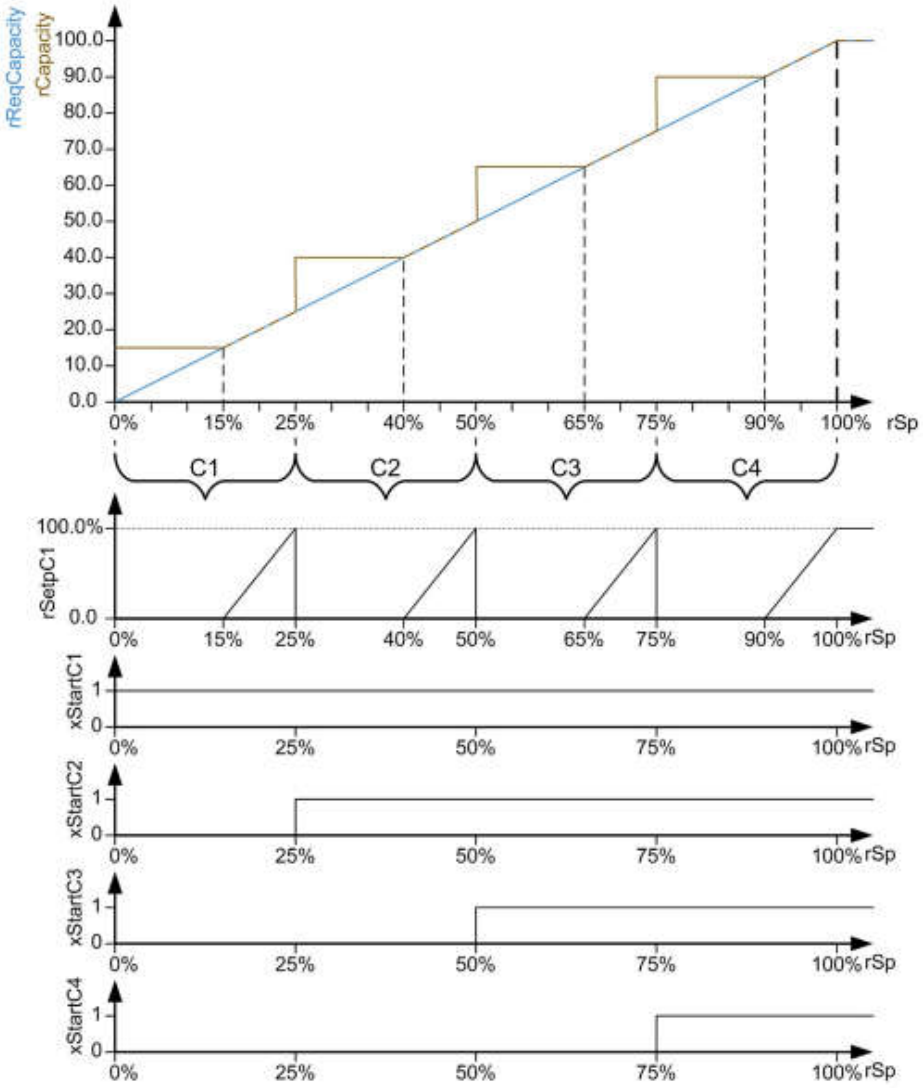
Parameter	Scale / Unit
rMaxRange	100
rMinRange	0.01% (~ 0.0%)
uiDelayOn	0
uiDelayOff	0
xCtrlMode	FALSE



Regulation with One Variable Speed Compressor and 3 On/Off Compressors

The following example is with a control mode (FIFO, LIFO, Runtime). The following values were set to show a hypothetical diagram:

Parameter	Value / Unit
rMaxRange	100%
rMinRange	0.01% (~ 0.0%)
usiNbVs	1
usiNbOnOff	3
rMaxFreq	50 Hz
rMinFreq	30 Hz
CapMaxVs	25.0 (for 1 variable speed compressor, internally calculated)
CapMinVs	15.0 (for 1 variable speed compressor, internally calculated)
rReqCapacity	0.0...100.0
rCapacity	15.0...100.0
uiDelayOn	0
uiDelayOff	0
xCtrlMode	FALSE
rNomFreq	50 Hz
uiCapVs	25
uiCapOnOff	25



Regulation With Hysteresis (rHys, rMinRange, rMaxRange)

The regulation with hysteresis is more adaptive than the regulation with delay because the time before starting or stopping a compressor depends on the variation speed of the value PID rSp

If...	Then...
If the setpoint of the `PIDAdvanced rAnalog` varies fast, for example when the machine is started or when the load reduces significantly,	The time to start or stop a compressor is reduced which improves the response time of the system.
If the setpoint of the `PIDAdvanced rAnalog` varies slowly, for example when the load is constant,	The time to start or stop a compressor is longer which increases the stability of the system.

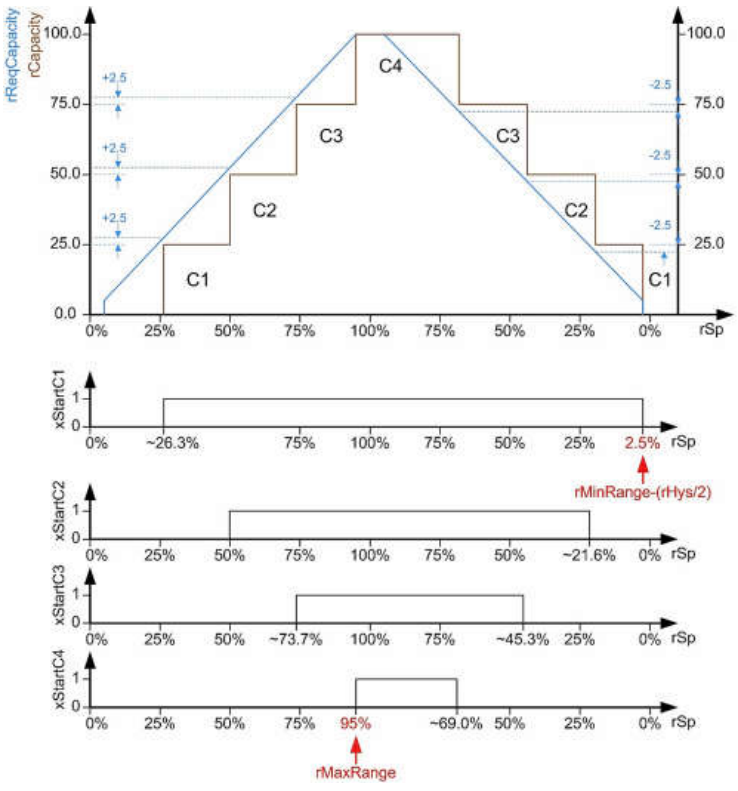
The value of rHys has more priority than rMinRange and rMaxRange.

If...	Then...
$\left(\frac{rHys}{2.0}\right) \leq rMinRange$	The last compressor stops by the value of $rMinRange - \left(\frac{rHys}{2.0}\right)$
	The last compressor will stop by the setpoint=0.0 (rSp).
$\left(\frac{rHys}{2.0}\right) > rMinRange$	

Example A:

Parameter	Value / Unit
rMaxRange	95%
rMinRange	5%
usiNbVs	0
usiNbOnOff	4
xCtrlMode	TRUE
rHys	5.0%

Example regulation with hysteresis (4 On/Off):



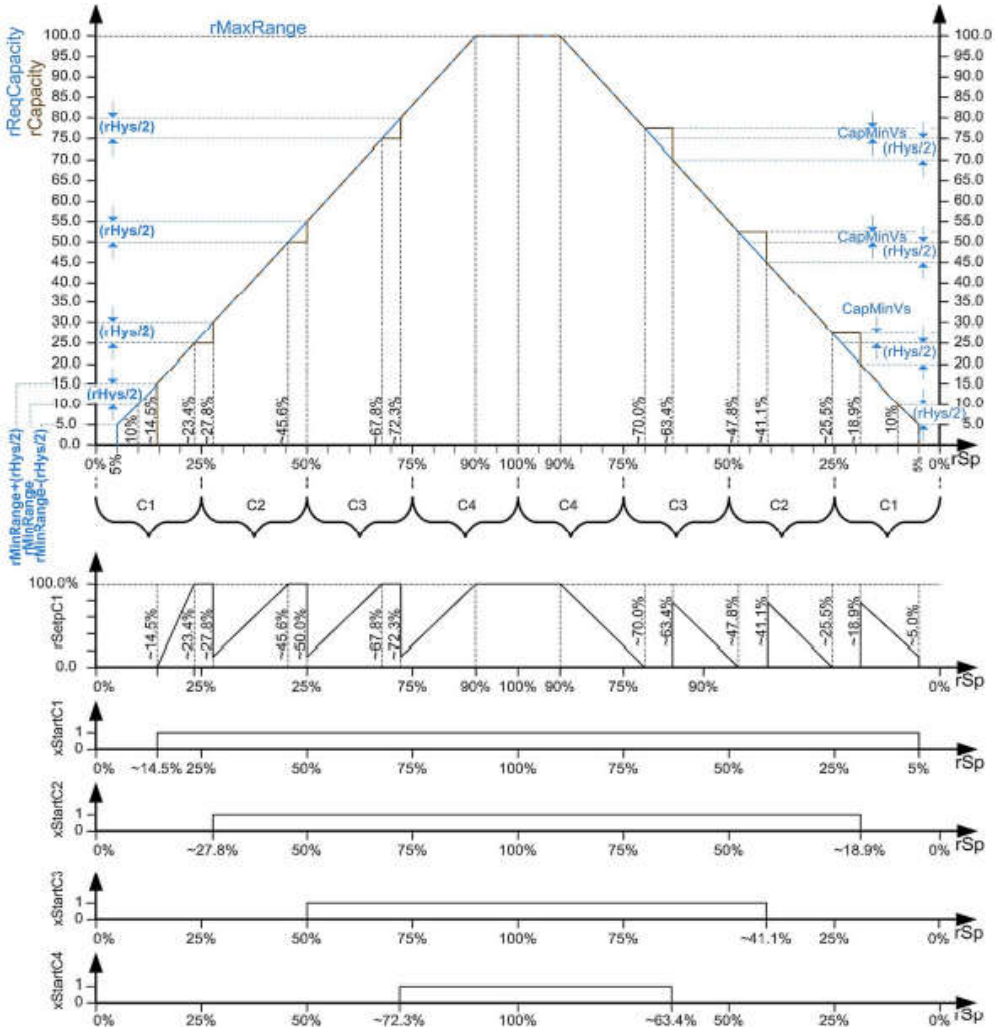
Example B:

Parameter	Value / Unit
rMaxRange	90%
rMinRange	10%
usiNbVs	1
usiNbOnOff	3
xCtrlMode	TRUE
rHys	10.0%
rMaxFreq	50 Hz
rMinFreq	5 Hz
rNomFreq	50 Hz
uiCapVs	25 (user unit)
uiCapOnOff	25 (user unit)

Result: Maximum and minimum capacity (CapMaxVs, CapMinVs) of a variable speed drive, required capacity rReqCapacity (output).

Parameter	Scale / Unit
CapMaxVs	25.0 (for 1 variable speed compressor, internally calculated)
CapMinVs	2.5 (for 1 variable speed compressor, internally calculated)
rReqCapacity	5.0…100.0 $\left(5.0 = rMinRange - \left(\frac{rHys}{2}\right)\right)$
rCapacity	15…100.0 $\left(5.0 = rMinRange - \left(\frac{rHys}{2}\right)\right)$

Example regulation with hysteresis (1 VS, 3 On/Off):



Compressor Control

The ***Compressor Control*** provides the following purposes:

- The compressor can be operated in automatic, manual or in maintenance mode.
- The integrated timers help to prevent the compressor from frequent switching.
- The Compressor Control function block suppresses resonance frequencies to reduce noise and increase compressor lifetime
- 3 different operating modes: automatic, manual, maintenance
- Quick stop of the compressor
- Start/stop procedure enabled by the Compressor Management
- Timers: uiMinOnTime, uiMinOffTime, uiMinCycleTime
- Counts compressor operating hours for Compressor Management to decide compressor Starts
- Display remaining time: minimum on timer, minimum off timer, and cycle timer
- Gathers all alarm information by compressor to notify Compressor Management group

Condenser Fan Management

Condenser Fan Management works with a PID block (similar to the compressors) to control up to 6 fan stages based on a 0-100% setpoint. The primary fan is recommended using a VFD for optimum system performance and steady head pressure. This enables the system for more stability and less compressor cycling, tighter EXV bandwidth, and overall system performance.

The following methods for fan management are provided:
- Fan Stages Sequence Control
- Fan Stages Status Management
- Fan Stages Operation Hours Control
- Fan Frequency Calculation
- Fan Stages Increment / Decrement Timer

FAN STAGES ARE CONTROLLED BASED ON THE FOLLOWING SEQUENCES:

Sequence	Description
FIFO = First In First Out	o The fan with the least operating hours is switched on first. o The first fan which is switched on is also the first to be switched off. o Advantage: operation time is limited.
Runtime	o The fan with the least operating hours is the first fan to be switched on. o The fan with the greatest operating hours is the first fan to be switched off. o Advantage: balanced operation hours.
LIFO = Last In First Out	o The parameter `usiPriorityStage1...usiPriorityStage4` determines this sequence. o The first fan stage to be switched on is the first one in the sequence. o The first fan stage to be switched off is the last one that has been switched on. o Advantage: priority of fan stage usage can be set. o If fan stages have the same priority, the starting sequence is based on the operating hours.

NOTE: *LIFO is recommended for most applications with chiller control. Also, If the number of fans per stage are not equal, LIFO mode is only available*.

Fan Status Management

If an input alarm is set to TRUE, a fan stage has at least a non-operating fan, the function block assumes that only 1 fan per stage is not operating. The function block re-calculates the capacity and adapts the frequency setpoint and the number of running fans to compensate for the fan loss.

Fan Frequency Calculation

The fan frequency calculation is controlled by 2 modes specified in the **xMode** parameter.
- Manual Mode: xMode = TRUE
- Automatic Mode: xMode = FALSE

The following table provides an overview of the different modes:

Mode	Description
Manual	The fan speed signal is set to the frequency `uiManualFreq` and the fan stages are controlled with the inputs `xManualStage1`, `xManualStage2`, `xManualStage3` and `xManualStage4`. **NOTE:** Take care that the frequency `uiManualFreq` is set within the specified ranges of the drive and that the input signals `xManualStage1`, `xManualStage2`, `xManualStage3` and `xManualStage4` are set to TRUE only if the fan stages are present.
Auto	o The fan frequency and the number of operating fan stages are automatically calculated. o When all fans are in operation, `FanControlSignal` is set as fan speed signal after limiting between `FanFreqMin` and `FanFreqMax` values. o If `xLowNoiseOper` = TRUE, the maximum frequency `uiFanFreqMax` is reduced by a value specified in the parameter `uiLowNoiseMaxFreq`.

Fan Increment / Decrement Timer

The FanMgmt function block controls the fan increment sequence by the delay time set in the input parameters:

- **uiFanDelayIncr**
- **uiFanDelayDecr**

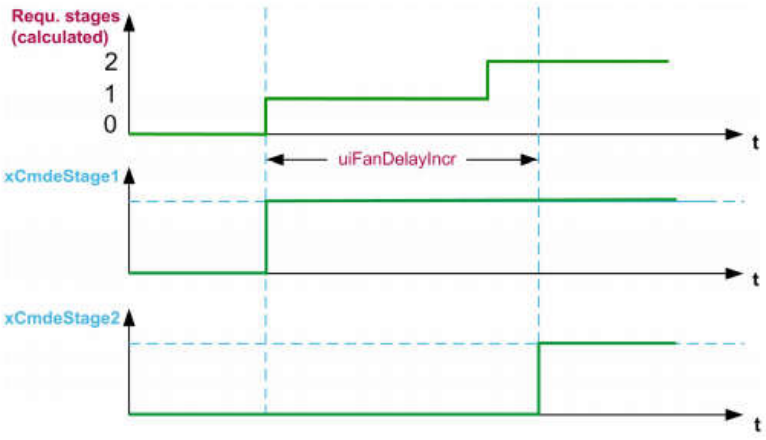
The FanMgmt function block differs between the increment and the decrement sequence:

Sequence	Description
Increment Sequence	When the number of fans is incremented, if the timer `uiDelayFanIncr` is active, the operating fan stages run at the frequency `uiFanFreqMax`.
Decrement Sequence	When the number of fans is decremented, if the timer `uiDelayFanDecr` is active, the operating fan stages run at the frequency `uiFanFreqMin`.

Fan Stage Minimum OFF Time

The function block controls the minimum off time of the fan stages. When a fan stage is switched off, the timer **uiMinOffTime** is started. The fan stages are not available until the timer uiMinOffTime has elapsed. If all the fan stages are not available, the function block starts anyway with fan stages according to the priority defined by the fan mode **usiFanMode**.

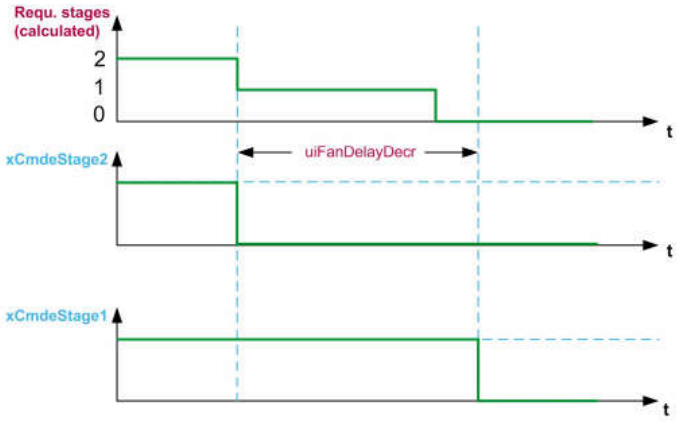
Fan Increment Sequence The timing diagram below describes the incrementing sequence of the Fan Management



If...	Then...
the number of required fans is set from 0 to 1	o xCmdeStage1 is switched on FanDelayCmd o The next fan stage can be switched on only after the uiFanDelayIncr timer is complete
the number of required fans is set from 1 to 2	xCmdeStage2 is switched on after the time delay uiFanDelayIncr is complete.

Fan Decrement Sequence

This timing diagram presents the decrement sequence of the FanMgmt function block:



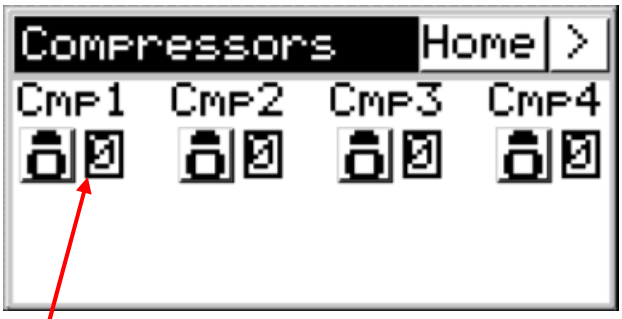
If...	Then...
the number of required fans is set from 2 to 1	o xCmdeStage2 is switched Off after the uiFanDelayIncr is complete. o The next fan can be switched Off only after the uiFanDelayIncr timer is complete
the number of required fans is set from 1 to 0	xCmdeStage1 is switched Off after the uiFanDelayIncr is complete.

Sensori Management Device

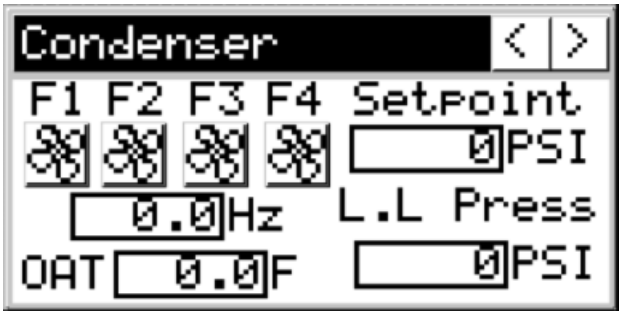
STATUS

Home Page Screen Consists of two status options. **Status 1** displays information regarding all compressor status and Fan Management information. **Status 2** displays information regarding temperatures and pressures, electronic VEV.

Status 1

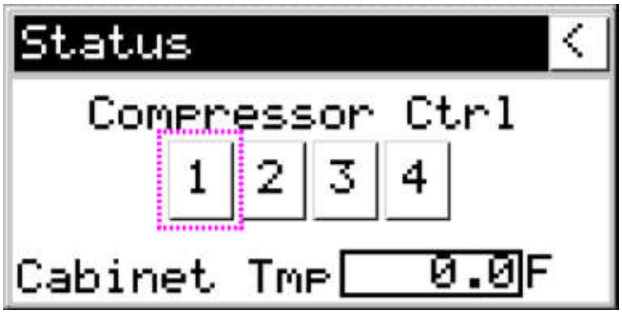


Compressor(Cmp) display symbol represents an active compressor called by the "Compressor Control". This is only said to run by the management group. When this symbol is visible, the signal to run that compressor through serial communication is sent to the Sensori Safety Device of that compressor. The value beside it displays the proof back. **Value 1 = proof active**.
NOTE: *If no symbol is visible, remember to check the elapse times and delays. See compressor control below.*

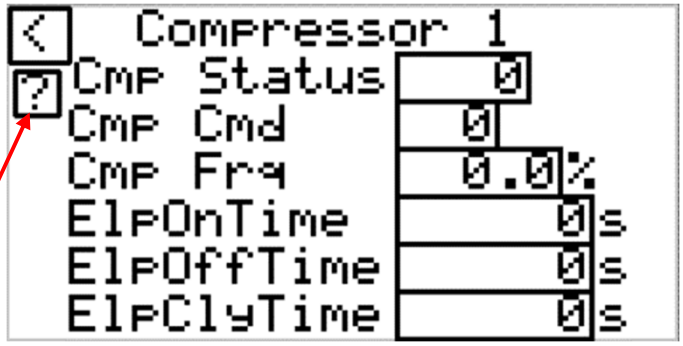


F1-4 Display symbol represents an active fan when called by the "Condenser Management". Fan 1 will always be active (variable speed) before any other fan is active. This is explained above in the Condenser Management section. Below Fan 1 indicates the frequency (**Hz**) that is called for by the

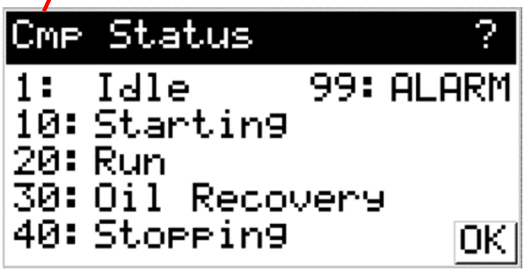
group. When the “max frequency” is shown and the setpoint is still below the active **Liquid Line Pressure**, a second fan will be enabled when called by the PID control, based on the priority fan. The setpoint is the active setpoint of the PID control controlling the Condenser Management group of fans based on liquid pressure shown. Depending on the ambient conditions (**OAT**), this setpoint will change in a linear matter. See Condenser Setpoints below for further information.



Cabinet Temperature (If enabled in Sensor Setpoints) to control a cabinet fan on and off. **Compressor Control 1-4** displays the status of each compressor being called on by the compressor management.

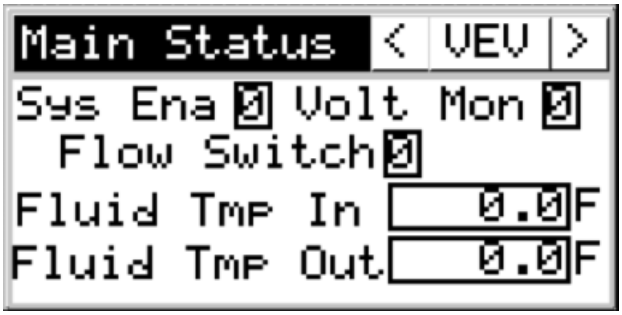


Cmp Cmd (Compressor Command) displays the value (1 being active) that is being sent to the Sensori Compressor Safety Device, along with the **frequency** that is called to run. This is over serial communication.

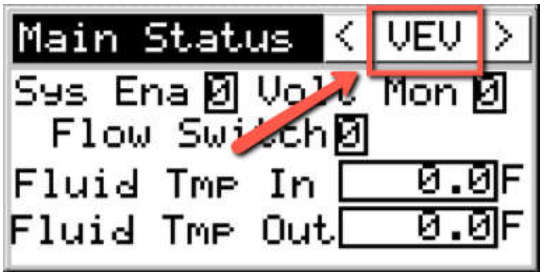


NOTE: ***Oil Recovery is NOT used on Sensori Chiller****! The system has been designed and tested that oil recovery is not an issue*.
When **99** is displayed as Cmp Status, the compressor is being told by the external “Sensori Safety Device” that there is an alarm. See the external device to find out what is alarming. This will also trigger the compressor management alarm/alert to let the group know that the compressor is not available.

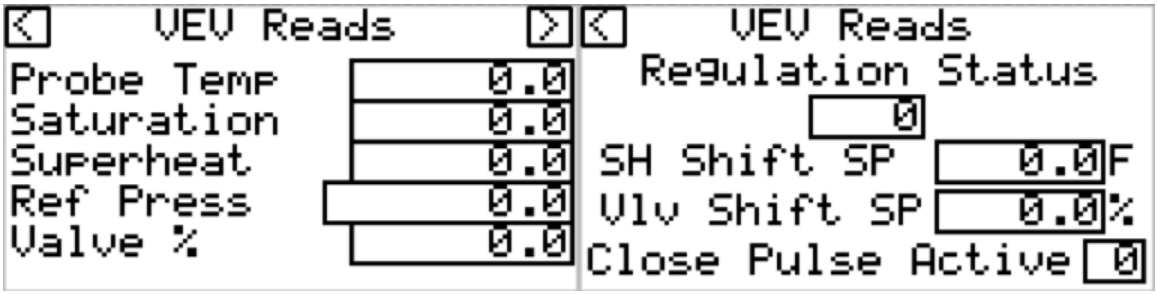
Status 2



Sys Ena (System Enable)- This is associated with physical digital input 1 (*see wiring schematic*). When this input is not seen, the value displayed will read "0", and the entire system will be off.
Volt Mon (Voltage Monitor)- When this function (*see "Setpoints" below*) is enabled, the value will read 1, if the physical digital input (see wiring schematic) is true. If the function is not used, the value will remain 1, even when the input is not seen.
Flow Switch – Must present a value of 1 or a flow switch alarm will be present and enable to the Compressor management and Sensori Main Management (*see separate manual*), will be disabled and no compressors will be commanded to run.
Fluid Temp in and Out- Read values only. This is to strictly see the temperature of water/glycol/brine difference (TD) between in and out of the chiller heat exchanger for troubleshooting.



VEV (Electronic Expansion Valve) Status Page



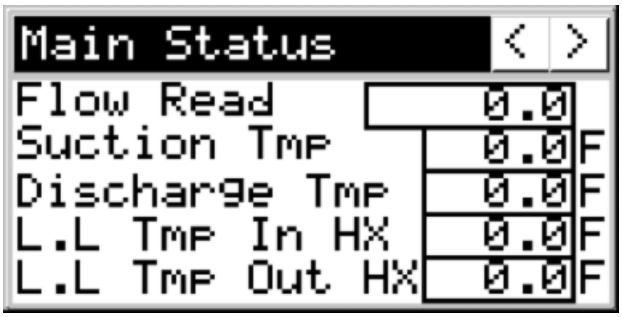
Electronic valve status reads- **Probe temperature of the Suction line**, **Suction Saturation Temperature**, **Suction Superheat**, **Suction Pressure**, **Electronic valve** operating percentage.

Regulation Status values:
0=OFF
1=SH
2= MOP
3=CONTINUOUS MODULATION
4=EXTERNAL LIMITATION
5=START
6=STOP
7=DEFROST
8=MANUAL
9=ALARM

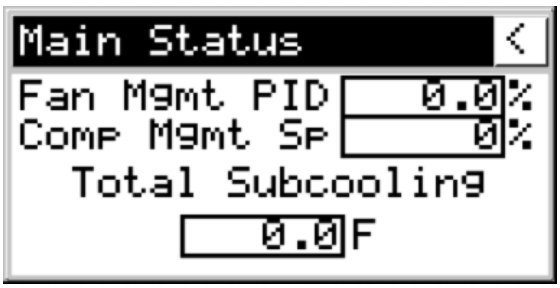
SH Shift SP (Superheat Shift Setpoint active)- setpoint of superheat based on outdoor air temperature. *See Setpoints for more information*.

Vlv Shift SP (Max Valve Open Shift Setpoint)- Active setpoint of max valve open based on outdoor air temperature. *See Setpoints for more information*.

Close Pulse Active- indicates for a quick pulse closure of the valve to ensure proper step position and no steps have been lost in valve. Only active when feature becomes enabled.



Flow Read- 4-20mA input for reading flow rate. **Read value only**.
Suction Temperature – reads 0 if not enabled. **Read value only**. Used for reading main suction pressure on a multiple compressor system.
Discharge Temperature - reads 0 if not enabled. **Read value only**. Used for reading main discharge pressure on a multiple compressor system.
L.L Tmp in HX (Liquid Line Temperature on Liquid Subcooler/Heat Exchanger Accumulator on the inlet) - reads 0 if not enabled. **Read value only**.
L.L Tmp Out HX (Liquid Line Temperature on Liquid Subcooler/Heat Exchanger Accumulator on the inlet) - reads 0 if not enabled. **Read value only**.

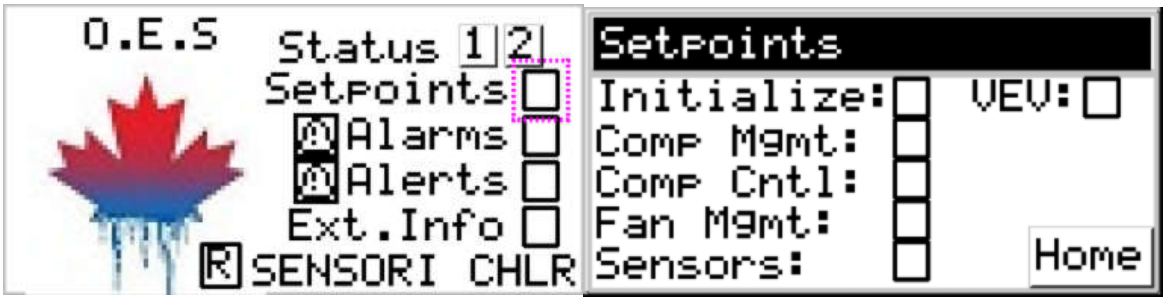


Fan Mgmt PID (Condenser Fan Management PID)- output of management PID for controlling fan outputs on and off

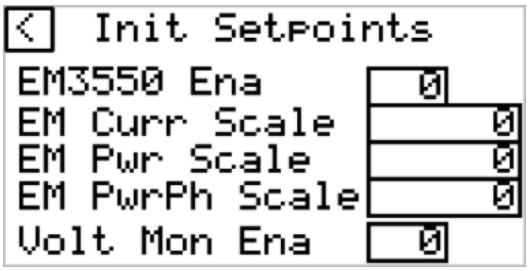
Comp Mgmt Sp (Compressor Management Setpoint) – input of the compressor management called on by the Main Chiller Management (*see manual "Sensori Chiller Main Management for more details*)

Total Subcooling – Liquid line temperature out must be enabled for this to be used. Display of Subcooling using Saturated Liquid Temperature (Converted from pressure) and Liquid line temperature out of HX.

SETPOINTS



Initialize



EM3550 Ena – Schneider EM3550 Energy Meter Enable. **Set to 1 when using Oxford LPP System**. This will enable Modbus communication. The address of the Energy Meter **MUST be set to address 17** and be the last device (see wiring schematic).

Set the Energy Meter to the following communication settings…

- Address 17
- Baud Rate 38400 b/s
- Even Parity
- 8 Data Bits
- 1 Stop Bit

No data will be able to be read on the display screen of the Main Management PLC. This is strictly for Oxford Chiller Main HMI/IPC for reading and trending energy data.

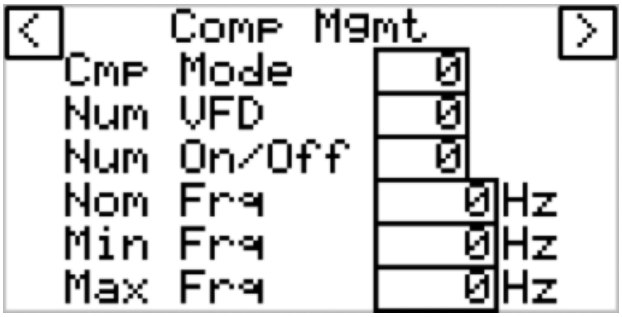
EM Curr Scale – Energy Meter Current Scaling used only for scaling decimal point for Oxford Chiller IPC/HMI through EcoStruxure Machine Scada Expert used for displaying and trending data.

EM Pwr Scale - Energy Meter Power Scaling used only for scaling decimal points on all Real, Reactive and Apparent Power Displays for Oxford Chiller IPC/HMI through EcoStruxure Machine Scada Expert used for displaying and trending data.

EM PwrPh Scale - Energy Meter Power Scaling used only for scaling decimal points for all power phase A, B, and C on Oxford Chiller IPC/HMI through EcoStruxure Machine Scada Expert used for displaying and trending data.

Volt Mon Ena – System Voltage Monitor Enable. When set to 1, Voltage Monitor physical digital input (*see wiring schematic*) must be True, or alarm will be triggered. When set to 0, the voltage input will be bypassed internally and display a true status variable.

Compressor Management



Cmp Mode - Compressor control sequence mode. **Default value: 2**

- **o**0: FIFO
- **o**1: Runtime
- **o**2: LIFO

NOTE: ***It is recommended using "LIFO" Compressor Mode with Oxford Chiller systems.*** *This mode has been tested fully for optimum energy analysis and maximum operating conditions.*

Num VFD - Number of variable speed compressors.
Num on/off + Num VFD ≤ 4

Num On/Off - Number of on/off compressors.
Num on/off + Num VFD ≤ 4

Total combined not to exceed 4 compressors

NOTE: **PLC must be power cycled after selecting number of compressors vfd and on/off, for system to take effect!**

Nom Frq - Nominal Frequency Speed of the compressors (Hz) **Default value: 60**
Min Frq - Minimum speed of the variable speed compressors (Hz) **Default value: 30**
Max Frq - Maximum Speed of the variable speed compressors (Hz) **Default value: 60**

NOTE: *Minimum and maximum frequencies also set in "Compressor Control". Analog scaling will differ when changed!*

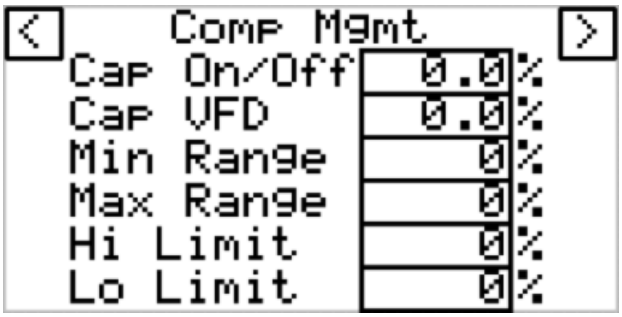
Ctrl Mode - Control mode (switch on/off of the compressors). **Default value: 0**

0: Delay

1: Hysteresis

LIFO Seq - Compressor start sequence (priority in sequencing mode LIFO).

NOTE: **Variable speed drives have the highest priority.**



Cap On/Off - Capacity of the on/off compressors. This capacity is of each compressor. It is recommended to size all on/off compressors the same capacity for optimum performance and for the Management to enable compressors based on true capacity. This value is a number set from 0 – 100%. **Default value: 32**

Cap VFD – Capacity of the variable speed compressors at 60 Hz. See "Cap On/Off". **Default value: 18**

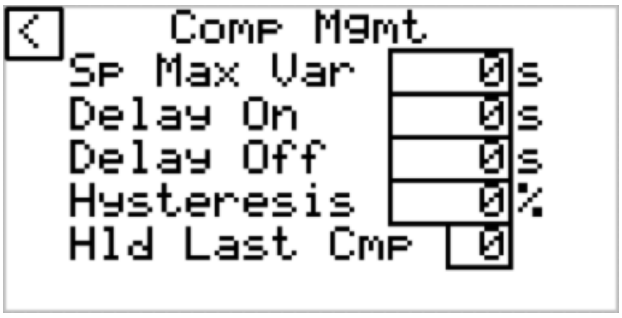
NOTE: *Notice the default values for the total number of compressors and capacities. Two on/off compressors at 32% each (64% of the system capacity) and two VFD compressors at 18% each (36% of the system capacity). This totals the full 100% system capacity.*

Min Range - Low limit of the range. Refer to System Overview (**Regulation with rMinRange and rMaxRange**) **Default Value: 3**

Max Range-High limit of the range. Refer to System Overview (**Regulation with rMinRange and rMaxRange**) **Default Value: 100**

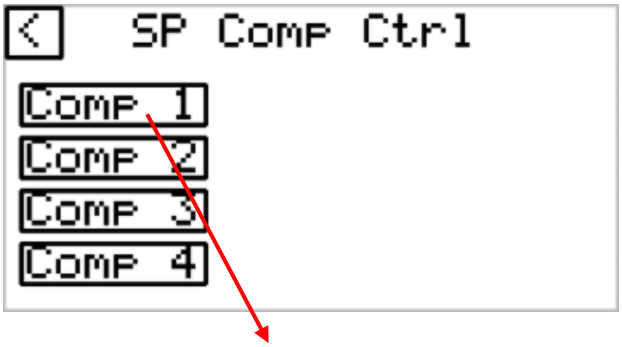
Hi Limit – High limit of the "PID" output (This is the setpoint of the Compressor Management 0-100%) **Default Value: 100**

Lo Limit – Low limit of the "PID" output (This is the setpoint of the Compressor Management 0-100%) **Default Value: 0**

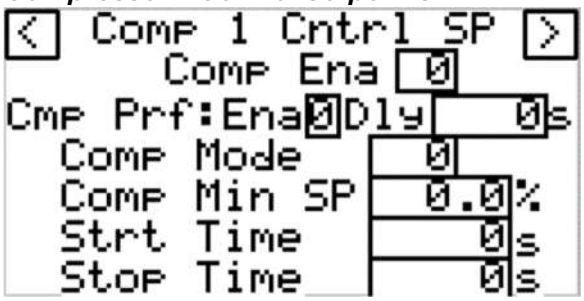


Sp Max Var - Maximum Setpoint Variation Time to increase/decrease the setpoint of 10%. 0 leaves the setpoint unchanged. It is possible to limit the slope of setpoint signal coming from PID to prevent too quick variation and consequently switching on or off the compressors too fast (for example during first power on). The input "Sp Max Var" indicates the time necessary to increase or decrease the setpoint of 10% value. **Default Value: 5**
Delay On - Delay to increment the number of requested compressors ("Ctrl Mode" Set to 0). **Default Value: 15**
Delay Off - Delay to Decrement the number of requested compressors ("Ctrl Mode" Set to 0). **Default Value: 1**
Hysteresis - Hysteresis to increase and decrease the number of requested compressors ("Ctrl Mode" Set to 1). **Default Value: 10**
Hld Last Cmp – Hold Last Compressor On, even if shut off is requested. Used for pump down procedure. Not recommended using Oxford LPP systems, as this will generate an alarm on the Sensori Compressor Safety Device. **Default Value**

Compressor Control Setpoints



Compressor 1 Control Setpoints- 1

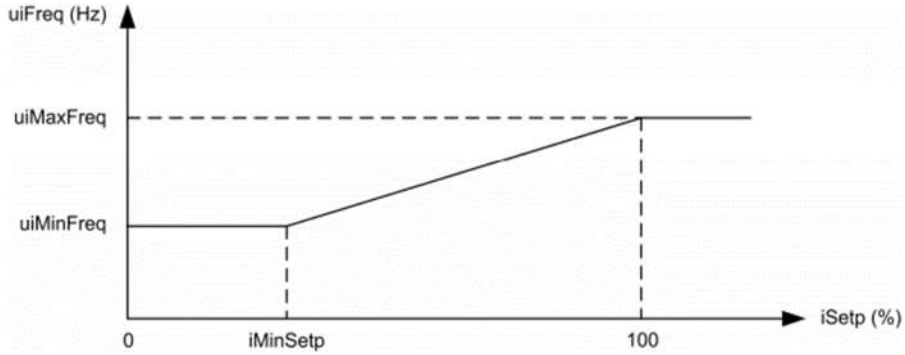


Cmp Prf Ena - Enables compressor proof alarm. When proof alarm occurs, a manual reset is required at the PLC device or HMI. Set to 0 if no proof alarm is being used, and 1 if present (*See wiring schematic for proper Digital Input configuration*). **Default Value: 0**
Cmp Prf Dly - Time delay set before compressor proof alarm will occur. **Default Value: 120s**
Comp Mode - Compressor Mode control of the compressor: **Default Value: 1**

- **o**1: automatic - Runs the compressor based on setpoints and command from the Compressor Management. Timers and alarms are enabled
- **o**2: manual – The compressor is controlled with Manual Setpoint and Manual Command. Timers and alarms are enabled
- **o**3: maintenance - The compressor is controlled with Manual Setpoint and Manual Command. Timers are disabled and alarms are enabled

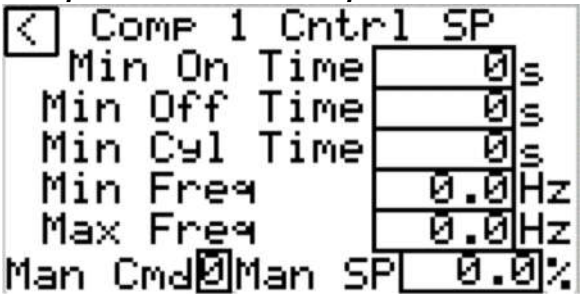
Comp Min SP - Minimum set-point that corresponds to the "Min Frequency". **Default Value: 0**
NOTE: ***Comp Min SP must be lower than 100.0%.***

Graphic below represents **Comp Min SP**



Strt Time - When The compressor receives a command from the management to run, the compressor will go to "Max Freq" for x "Strt Time" set. Set this value to 0 if comp speed is based on setpoint when initial command is set. **Default Value: 0**
Stop Time - When the compressor has no command from the management, the compressor will go to "Max Freq" for x "Stop Time" set. Set this value to 0 if compressor speed is based on setpoint when command is stopped, therefore, no command equals no compressor. **Default Value: 0**

Compressor 1 Control Setpoints- 2

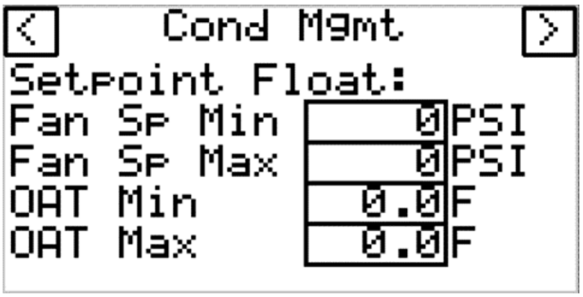


Min On Time - Minimum time the compressor will stay running. **Default Value: 25 (value is different on all compressors)**
Min Off Time - Minimum time the compressor is stopped. **Default Value: 30 (value is different on all compressors)**

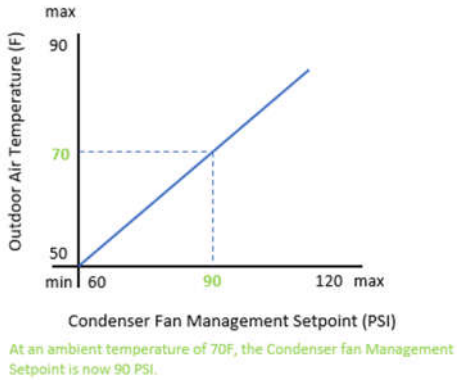
Min Cyl Time - Minimum time between 2 consecutive starts of the compressor. **Default Value: 30 (value is different on all compressors)**
Min Freq - Minimum frequency of the compressor that corresponds to the minimum set-point. **Default Value: 30**
NOTE: Min Freq must be lower than Max Freq.
Max Freq – Maximum frequency of the compressor. **Default Value: 60**
Man Cmd and **Man Sp** – Manually command the compressor (Set to 1) to the manual setpoint set in percentage.

Condenser Management Setpoints

Condenser Management is only enabled when a MT Compressor is calling to run. The first fan will be active when the PID starts to react at start up. After the Condenser Fan Management has been enabled and the PID is at 0, the primary fan will not shut off (physical Digital Output) and run minimum speed set on the VFD/Fan Management minimum frequency. A Voltage Monitor (physical Digital Input) or System Enable (physical Digital Input) will also disable the function.



Condenser Fan Management Setpoint Float
Condenser Fan **Setpoint Float** is always enabled and is used to float the setpoint of the Condenser Management based on ambient temperature in a linear way. When ambient falls below the **OAT Min** value, the Condenser Fan Management setpoint will be the **Fan Sp Min**. When ambient is above the **OAT Max** value, the Condenser Fan Management setpoint will be the **Fan Sp Max**.



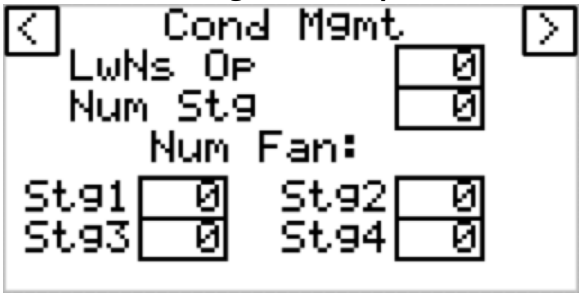
At an ambient temperature of 70F, the Condenser fan Management Setpoint is now 90 PSI.

Fan Sp Min - Minimum condenser fan setpoint to float. **Default Value: 60**
Fan Sp Max - Maximum value the condenser fan setpoint will reach to float. **Default Value: 120**
OAT Min - Minimum outdoor ambient temperature. **Default Value: 50**
OAT Max - Maximum outdoor ambient temperature. **Default Value: 90**

Condenser Management Setpoints-1

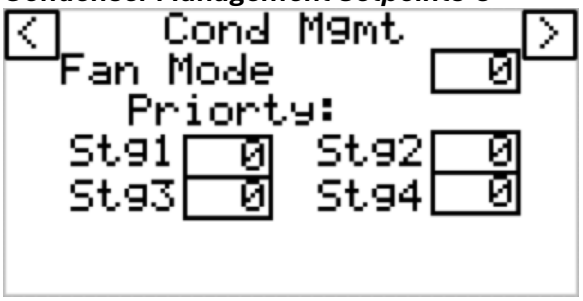
Hi Limit- High limit percentage of the PID. This is the maximum value Condenser Management will see. Be sure to set this value high enough that all fans will be called for in the management group. *Refer to System Overview for further information*. **Default Value: 100**
Lo Limit - Low limit that the PID will "ramp" down too. If a value greater than 0 is set, be sure the proper minimum range and low limit values are set up in the management group. **Default Value: 0**
Deadband- Used to smooth out control behavior. Value is set in PSI. Example: Value set at 2PSI deadband meaning that the PID output percentage (Condenser Management Setpoint), will not change when pressure is withing 2 PSI above and below PID Setpoint. **Default Value: 2**
P I D- Proportional, Integral, Derivative. It is not recommended that we change these values on Oxford LPP system unless discussed with a qualified and trained technician. The default values have been fully tested on multiple applications and damage can occur to fans due to rapid cycling if set incorrectly! **Default Value: P= -1, I=300, D=0**
NOTE: ***For Proportional to work in cooling mode, the P must be a negative integer*!**

Condenser Management Setpoints-2



LwNs Op – Low Noise Operation.
If xLwNs Op = 1, the maximum frequency "Freq Max" is reduced by a value specified in the parameter "Lw Noise Max Freq". **Default Value: 0**
Num Stg – select the number of fan stages that will be used. Select stages 1-4.
Num Fan Stg 1-4 – Number of fans per stage. For simplicity, keep 1 fan per stage active.
See System Overview for further information. **Default Value: 1 for each stage (min 1, max 12)**

Condenser Management Setpoints-3

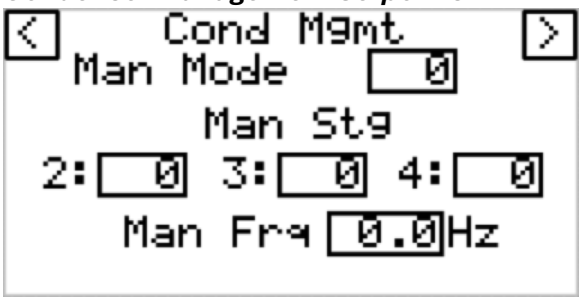


Fan Mode - Fan On/Off sequence mode. *See System Overview for more information*.
Default Value: 2

0 FIFO
1 Runtime
2 LIFO

Priority Stg 1-4 – Choose priority of fan stage. Only available in LIFO mode. *See System Overview for more information*.
Default Value Stg 1: 1
Default Value Stg 2: 10
Default Value Stg 3: 40
Default Value Stg 4: 50 (min 0, max 255)

Condenser Management Setpoints-4



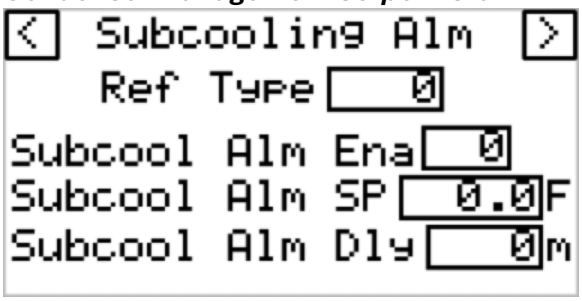
Man Mode - Manual mode if value is set to 1. Set to 0 for Automatic mode. **Default Value: 0**
Man Stg 1-4 - Select 1 where fan stage is necessary for manual mode. **Default Value: All 0**
Man Frq - Select the manual frequency that is necessary to run VFD speed. **Default Value: 0**

Condenser Management Setpoints-5

See System Overview for further information on all Parameters.
Lw Ns Mx Frq – Low Noise Max Frequency setting. Only Used when "Lw Ns Op" is enabled. **Default Value: 5**

Fan Dly Incr – Delay to increment the number of fan stages. **Default Value: 10**
Fan Dly Decr – Delay to decrement the number of fan stages. **Default Value: 10**
Min Off Time – Minimum off time of the stages. **Default Value: 10**
Hysteresis – Hysteresis of the fan stages. **Default Value: 100**
Fq Mn – Minimum frequency. **Default Value: 5**
Fq Mx – Maximum frequency. **Default Value: 60**

Condenser Management Setpoints-6



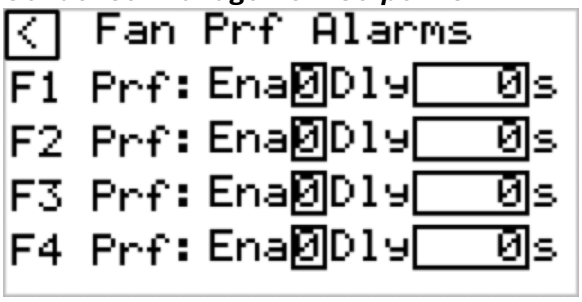
Subcooling Alarm
Subcooling alarms' main purpose is to detect a low refrigerant situation. When "Subcool Alm Ena" AND Liquid line Temp Out of HX accumulator (AI9) is set to 1, the function looks first for a running medium temp compressor. When any compressor is requested on, the "Subcool Alm Dly" starts to count if the total subcooling is below "Subcool Alm SP". The system uses the Main Liquid Line Temperature out of the HX Accumulator and the Main Liquid line pressure to calculate total subcooling.

Ref Type – Select refrigerant type to be used for subcooling alarm.

0 = R22	13 = R448A
1 = R134a	14 = R427A
2 = R404A	15 = R450(N13)
3 = R407C	16 = R513A
4 = R410A	17 = R449A
5 = R407A	18 = R1234yf
6 = R407F	19 = R454B
7 = R290	20 = R454C
8 = R507A	21 = R455A
9 = R717	22 = R434A
10 = R723	23 = R442A
11 = R1234ze	24 = R32
12 = R744	255 = R515B

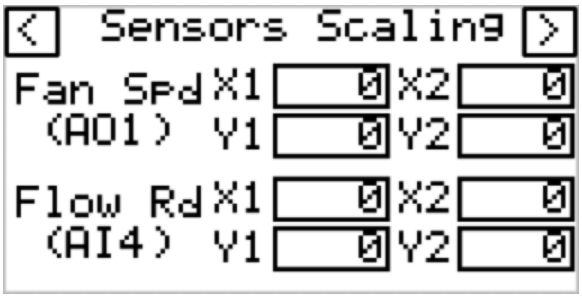
Subcool Alm Ena – Set to 1 if using subcooling alarm, 0 is disabled. **Default Value: 0**
Subcool Alm SP – Subcooling setpoint at which the system will alarm if below this value for Subcool Alm Dly time. **Default Value: 4 (Min 0, Max 20)**
Subcool Alm Dly – Alarm delay set before system alarm is triggered. Set in minutes. **Default Value: 60 (Min 5, Max 120)**

Condenser Management Setpoints-7

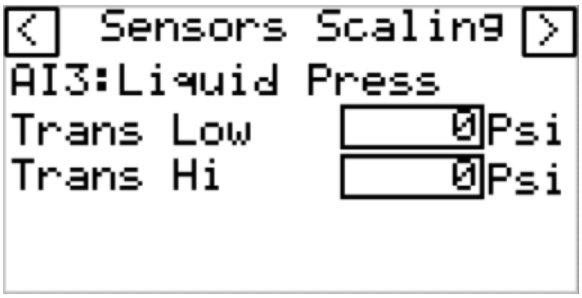


Select all desired **Fan Proof** alarm enables with a value of 1.
Dly – Delay in seconds before the system alarms when no proof is present, and a command is sent.

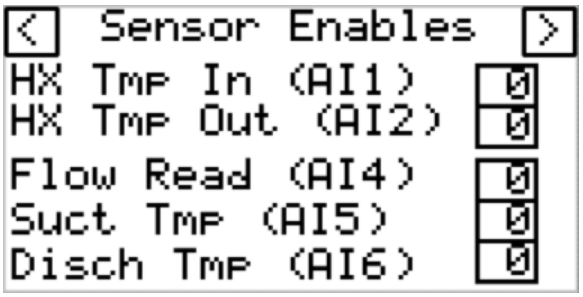
Sensor Setpoints



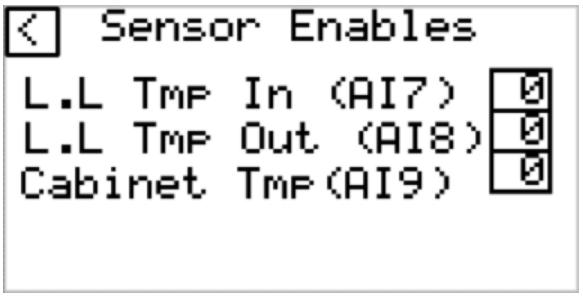
***AO SCALING*: Fan Speed** for condenser primary fan scaling is set here. This is the scaling of the physical analog output value as an INTEGER type. For example. The default x values are set at 0 (X1) – 1000(X2) and y values are set at 0(Y1) – 600(Y2). This wide range value gives more system accuracy for controlling fan speed.
Flow Read input scale for reading 4-20ma flow rate input. Set X1 and X2 in full scale for accuracy 0-100. Y1 and Y2 scale of flow meter being read (lpm, gpm, etc).



Liquid Line Pressure input scale in PSI. 4-20ma input only.



Sensor Enables
Enable sensors with a value of "1". All these sensors are Read Only. **Heat Exchanger Temperature in and out** (secondary side), **Flow meter read** value, refrigerant **suction temperature**, refrigerant **discharge temperature**.



Liquid Line Temperature In/out values can be used on liquid heat exchangers such as Hx Accumulators to show subcooling gain. When using "subcooling alarm", L.L Tmp Out must be enabled.
Cabinet Temperature for controlling an electrical cabinet fan on temperature.

VEV Setpoints: Refer to "*Sensori Control with VEV Driver" Manual for all Electronic valve setpoints*.

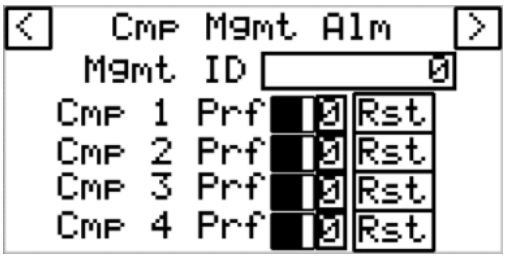
ALARMS

Flashing red LED Light on the represents an alarm is active. Yellow/amber light represents an alert is active. When the alarm symbol is present, this indicates where the alarm/alert is situated.

Voltage Monitor Alarm will exist If voltage monitor is being used/ enabled and digital input is not present. *See wiring schematic for input designation and wiring*.

Flow alarm will exist if flow switch is not made/true, and digital input is not present. See wiring schematic for input designation and wiring.
VEV Suction pressure (AI11), VEV Suction Temperature (AI10), Flow, Voltage Monitor, and communication TCP/IP alarms, will disable compressor management if any of these alarms are active.

Compressor Alarms



Mgmt Id - The output Mgmt Alarm ID represents a value from 0 to 15, whereby each bit represents an alarm. The bits and their description are described in the following table:

Alarm Bit	Alarm Cause	Effect
0	The parameter `rSp` is not set within the specified range.	The compressors are not operating.
1	The parameter `usiCompMode` is not set within the specified range.	
2	The parameters `usiLifoSeqC1`, `usiLifoSeqC2`, `usiLifoSeqC3`, `usiLifoSeqC4` are not set within the specified range.	

3	The parameters `usiNbOnOff` and `usiNbVs` are not set within the specified range or
	`(usiNbOnOff + usiNbVs) > 4 or`
	`usiNbOnOff + usiNbVs) = 0.`	

4	`usiNbOnOff > 0 or usiNbVs>0 and` `rNomFreq <= 0.0 or rNomFreq > 500.0.`	

5	`usiNbVs > 0 and`
	`rMinFreq <= 0.0 or rMinFreq > 500.0 or`
	`rMaxFreq <= 0.0 or rMaxFreq > 500.0 or`
	`rMaxFreq < rMinFreq.`	

6	`usiNbOnOff >0 and`
	`uiCapOnOff <= 0 or`
	`uiCapOnOff>1000`	

7	`usiNbVs > 0 and`
	`uiCapVs <= 0 or`
	`uiCapVs > 1000`	

8	`rMinRange > 99.90 or rMinRange <= 0.0 or`
	`rMaxRange > 100.0 or rMaxRange <= 0.0 or`
	`rMinRange > rMaxRange`	

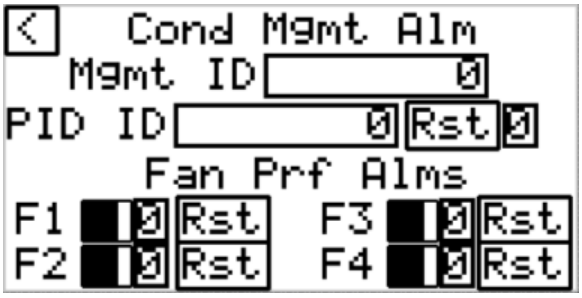
9	The parameters `uiDelayOn` and `uiDelayOff` are not set within the specified range.	
10	The parameter `rHys` is not set within the specified range.	
11	All the compressors are in alarm state.	
12	System Clock Alarm, the value of the controller clock is not valid, for example 0:0:0:0:0:0. The internal calculation requires a valid value.	
13...15	Reserved	–

Comp 1-4 Prf alarms: Value of 1 indicating an alarm is present. The compressor proof input is not active/true before the compressor proof delay has expired. “Rst” = manual reset. **This must be manually reset for the management to command the compressor on again**.

Compressor 1-4 Sensori Safety Alarms: An indication of 1 shows that one of the following compressor safety devices are in alarm state. The alarm must be seen/reset from the Sensori Compressor Safety. The following alarms could be present.

-Communication to the compressor safety from the management
-Oil level alarm
-Compressor high and low superheat
-Compressor discharge temperature high alarm
-An analog input alarm is active on the compressor safety
-Compressor off due to high pressure or low-pressure safety
-Compressor proof alarm is active

Condenser Fan Alarms

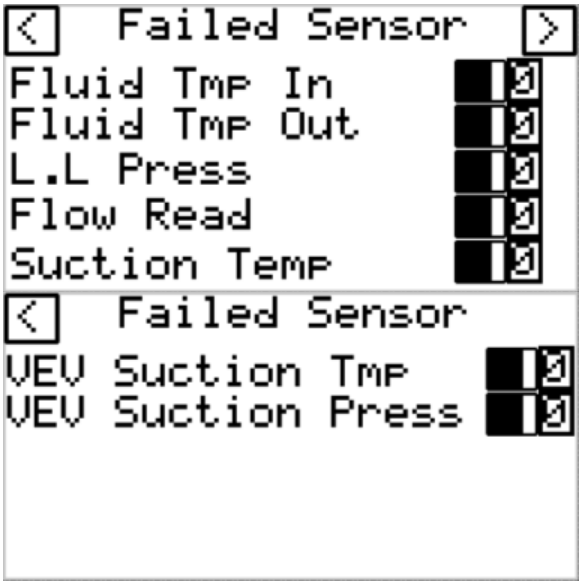


Mgmt ID - The Alarm ID output represents a value between 0 and 7, whereby each bit represents a detected alarm. The bits and their description are described in the following table:

Alarm Bit	Alarm Description	Result
0	The value of the parameter `usiNbStage` is not set within the specified range.	Function block is disabled.
1	The minimum frequency is greater than the maximum frequency (`uiFanFreqMin > uiFanFreqMax`)	Function block is disabled.
2	The value of the parameters `usiNbFanStage1...usiNbFanStage4` are not set within the specified range.	Function block is disabled.
3	The value of the parameter `usiFanMode` is not set within the specified range.	Function block is disabled.
4	The value of the parameter `uiHysteresis` is not set within the specified range.	Function block is disabled.
5	The value of the parameter `uiFanFreqMin` is not set within the specified range.	Function block is disabled.
6	The value of the parameter `uiFanFreqMax` is not set within the specified range.	Function block is disabled.
7	The number of fans per stage `usiNbFanStage`, is different and the fan mode `usiFanMode` is not equal to 2 (LIFO mode).	Function block is disabled.

PID ID - Fault in PID setting out of range. **Rst** reset must be pressed to restart Management PID for fans.
Condenser fan 1-4 Prf alarms: Value of 1 indicating an alarm is present. The fan proof input is not active/true before the condenser fan proof delay has expired. **Rst** = manual reset. This must be manually reset for the management to command the condenser fan on again.

Sensor Alarms



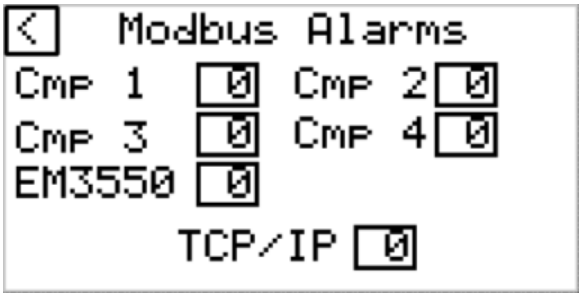
Failed sensors indicate a value of “1”.

****NOTE:** **VEV Suction Temperature and Pressure alarms will disable Compressor Management when failed.** No other sensors will disable this group when failed. Liquid temp out will impact the

subcooling alarm if enabled. Liquid Line pressure sensor fail will not disable any group, as fans can be overrode on in a state of fail/emergency. All other sensors are strictly a read value, more importantly used with Oxford LPP system and HMI for trending information.

VEV Alarms – *Refer to "**Sensori EEV Control Manual**" or "**Schneider Modicon M172 Electronic Expansion Valve**" for all VEV alarm descriptions*.

Communication Alarms

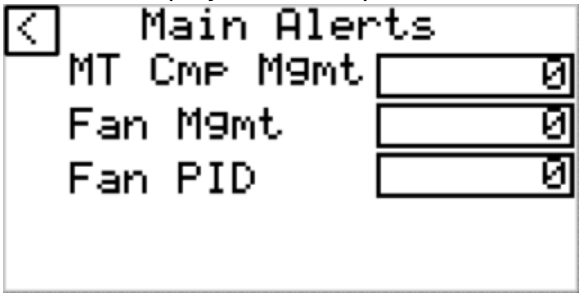


Communication Alarm is indicated with a value of "1". This is over Modbus serial (*see wiring schematics*). When communication is lost to a device, the system is scanning and looking for a present value. This will slow the systems read and writes down if a device is configured and not present. If the Chiller Control Management does not see any present value from a Modbus device within 30 seconds an alarm will trigger.

TCP/IP alarm will be present over communication to the Chiller Main Sensori Management device if no ethernet is detected or bad cable. Chiller Control Management is said to be enabled by this Sensori device as well as at what percentage called upon the PID. Outdoor temperature is also sent from the Chiller Main Management over this communication through ethernet.

ALERTS

All values display an ID to depict the alert active



MT Cmp Mgmt Alert – In the event of an alert, the still available compressors are running, and the output Alert ID gives some indications about the alert. The Alert ID output represents a value from 0 to 15, whereby each bit represents an alert. The bits and their description are described in the following table:

Alert Bit	Alert Cause	Effect
0	Operating hours of compressor 1 > 16,700,100.	At 16,700,100 operating hours, the value is frozen and the AFB cannot calculate with the real operating hours of compressor 1.
1	Operating hours of compressor 2 > 16,700,100.	At 16,700,100 operating hours, the value is frozen and the AFB cannot calculate with the real operating hours of compressor 2.
2	Operating hours of compressor 3 > 16,700,100.	At 16,700,100 operating hours, the value is frozen and the AFB cannot calculate with the real operating hours of compressor 3.
3	Operating hours of compressor 4 > 16,700,100.	At 16,700,100 operating hours, the value is frozen and the AFB cannot calculate with the real operating hours of compressor 4.
4	Compressor 1 is in alarm state or not in auto mode	Compressor 1 is switched off and another available compressor is started.
5	Compressor 2 is in alarm state or not in auto mode	Compressor 2 is switched off and another available compressor is started.
6	Compressor 3 is in alarm state or not in auto mode	Compressor 3 is switched off and another available compressor is started.
7	Compressor 4 is in alarm state or not in auto mode	Compressor 4 is switched off and another available compressor is started.
8	`usiCompMode`: This controlled parameter has been modified, which requires a machine restart. The new configuration parameter is effective only after restart of the function block.	Present modifications are not active. The function block uses the previously set values.
9	`xCtrlMode`: These controlled parameters have been modified, which requires a machine restart. The new configuration parameter is effective only after restart of the function block.	
10	`usiNbOnOff` or `usiNbVs`: These controlled parameters have been modified, which requires a machine restart. The new configuration parameter is effective only after restart of the function block.	
11...15	Reserved	–

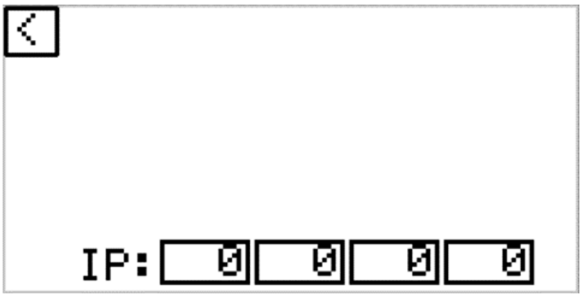
PID Alerts – All PID alerts are similar. The output uiAlertID represents a value from **0** to **15** whereby each bit represents a detected alert. The table contains the bits and their description:

Alert Bit	Alert Cause	Effect
0	Invalid value of the input `rManualValue`	`rAnalog` and `iAnalog` outputs are set to `rHighLimit` or `rLowLimit`
1	`rLowlimit` is equal to `rHighLimit`	`rAnalog` and `iAnalog` outputs are set to `rLowLimit`
2	Autotuning is active, the input `xAutoTune` is set to TRUE.	`rAnalog` and `iAnalog` outputs are set to `rAutoTuneValue`
3	`rKp` is set to 0.0	`rAnalog` and `iAnalog` outputs are set to 0.
4-15	Reserved	–

Fan Mgmt Alert - The uiAlertID output represents a value between **0** and **65535**, whereby each bit represents an alert. The bits and their description are described in the following table:

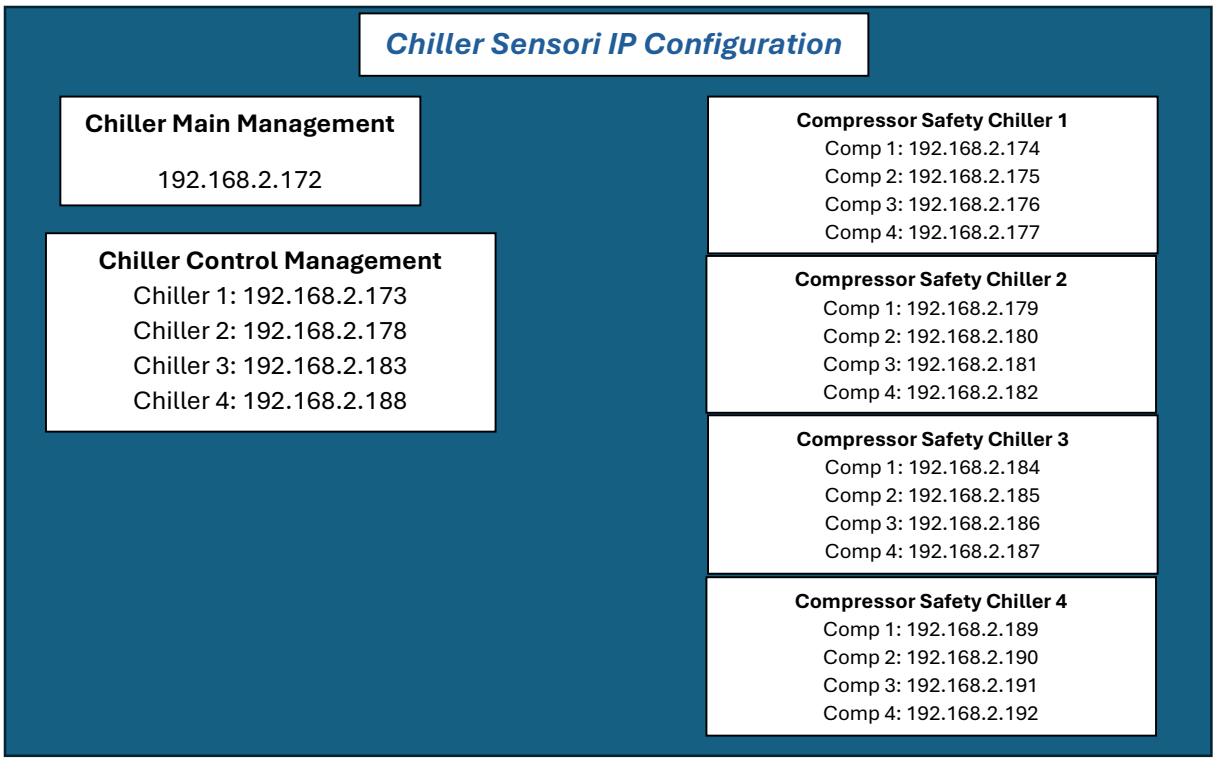
Alert Bit	Alert Description	Result
0	A controlled parameter has been modified. The new configuration parameter is effective only after a restart of the function block. List of the latched parameters: o usiFanMode o uiFanFreqMax o uiFanFreqMin o uiHysteresis o usiNbStage o usiNbFanStage1 o usiNbFanStage2 o usiNbFanStage3 o usiNbFanStage4 o usiPriorityStage1 o usiPriorityStage2 o usiPriorityStage3 o usiPriorityStage4	Present modifications are not active. Function block uses the previously set values.
1	The value of the input uiFanCntrlSignal is not set within the specified range.	The value is limited.
2	The value of the parameter uiLowNoiseMaxFreq is not set within the specified range.	The value is limited.
3	The value of the parameter uiFanDelayIncr is not set within the specified range.	Function is in operation with limited performance.
4	The value of the parameter uiFanDelayDecr is not set within the specified range.	Function is in operation with limited performance.
5	xStage1Alarm input is active	An fan of the stage1 is in alarm state, the fan loss is compensated.
6	xStage2Alarm input is active	An fan of the stage2 is in alarm state, the fan loss is compensated.
7	xStage3Alarm input is active	An fan of the stage3 is in alarm state, the fan loss is compensated.
8	xStage4Alarm input is active	An fan of the stage4 is in alarm state, the fan loss is compensated.

EXT INFO



Set **IP Address**. Proper IP addressing must be set, to connect to Sensori Chiller Main Management over TCP/IP as well as communicate with main IPC HMI. See the next page for all IP addressing for all devices.

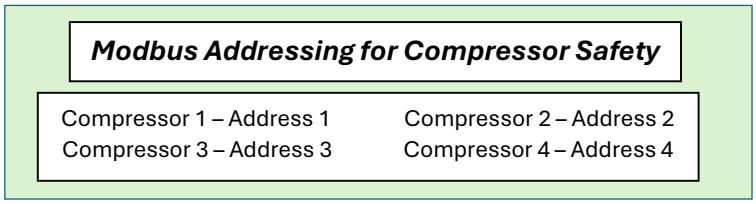
***For a full overview of Chiller Platform and IP configuration also refer to "Chiller Platform – Sensori Chiller Main Management" overview.**



Parameter USB Backup and Restore: Insert USB and select "**To**" to backup all Eeprom parameters/Setpoints in Sensori PLC.
It is recommended to leave a copy on site with PLC in case of future problems. To restore Setpoints into a new PLC, simply insert USB with backup file and select "**Frm**" Usb to input USB Eeprom files.

Modbus Addressing

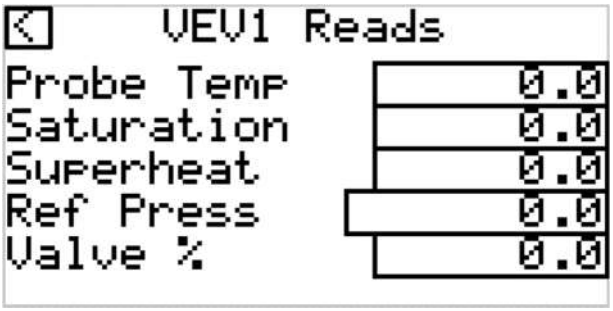
The table below shows the modbus serial addressing for the compressors to connect to the Sensori Compressor safety devices. **These address values are fixed and cannot be changed**!
When enabling the compressor in "compressor control setpoints", the Sensori Chiller Control Management will look for the address in the initialization, once the system is power cycled.
Valve Driver communication is done over CANBUS communication.
See Sensori wiring schematics for proper wiring and grounding.



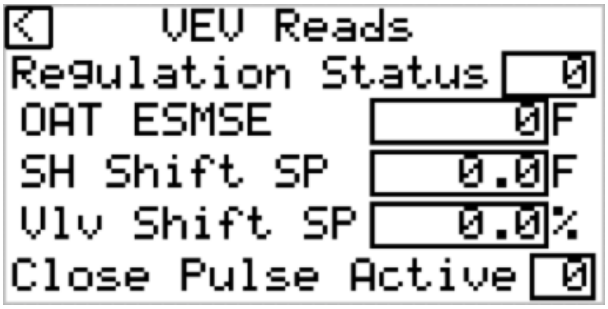
All Device Baud Rate = 38400 and Parity = Even.
See Compressor Safety Manual for Further Information on Compressor Safety

3. SENSORI CONTROL WITH VEV DRIVER

STATUS



Probe temp = Temperature probe located on suction line at outlet of evaporator as installed by contractor
Saturation = The SST of the selected refrigerant based on its current pressure
Superheat = The calculated superheat in real time
Ref Press = The pressure of the suction line where the suction line transducer was installed by contractor
Valve % = EXV valve operating % in real time.



Indicates the current **Regulation Status**:

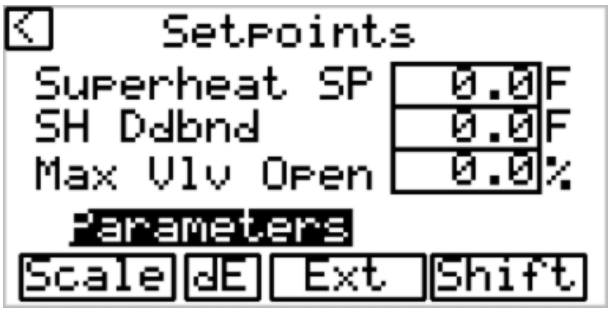
- 0= OFF
- 1=SH
- 2= MOP
- 3=CONTINUOUS MODULATION
- 4=EXTERNAL LIMITATION
- 5=START
- 6=STOP
- 7=DEFROST
- 8=MANUAL
- 9=ALARM

OAT ESMSE (Only Available on Sensori Case Management 18IO) – Outdoor Air temperature sent over TCP/IP through Sensori OLPP HMI Scada System. This Outdoor Temperature is generated from "Sensori Main Management" and sent to all Sensori Case Management controllers through Scada when enabled.
SH Shift SP – Superheat Setpoint Shift based on Outdoor Temperature used in a linear scale, for setting superheat setpoint to improve Case efficiency and minimize compressor superheat. As Outdoor temperature increases, superheat setpoint will decrease. See Setpoints for more details.
Vlv Shift SP – Electronic Valve Max open Shift Setpoint. Max open setpoint of valve when "Vlv Shift" is enabled. This is used to prevent Electronic Valve from opening to far during cooling and causing flooding due to "Lazy" coils and possible slow reaction time of valve. Max valve should always be set on cases as a safety, in case of sensor fails, to prevent cases from flooding. See setpoints for more details.
Close Pulse Active – Valve Closing pulse active will indicate "1" when valve goes to close to ensure no step loss after valve has been running for x time set in setpoints only when this feature is enabled. See Setpoints for more details.

SETPOINTS

See Schneider's Manual (Modicon M172 Electronic Expansion Valve Driver) for more information and selection of setpoints.
https://download.schneider-electric.com/files?p_enDocType=User+guide&p_File_Name=M172-EEV-Driver-User-Guide-EN-EIO0000004034-02.pdf&p_Doc_Ref=EIO0000004034
Or Scan **QR Code** Below

*Certain Parameters must require a power cycle/**Modification Reset** to the device for change to take effect and save. **Refer to Schneider's Manual to see list of parameters that need to be reset.**

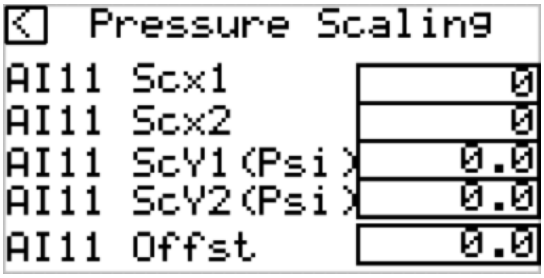


Set ***Superheat Setpoint*** for Electronic valve to modulate at.
Note: *when Superheat Setpoint Shift is enabled, the actual superheat setpoint the valve will be listening to will change based on ambient and shift conditions. Please be aware of external parameters that will affect valve modulation, such as continuous modulation, superheat and valve shift, and dynamical setpoints.*

Superheat Regulation Deadband/DeadZone. The dead zone is applied to the P and D component of the PID output, not to the integral one, to obtain better results in the SH control.

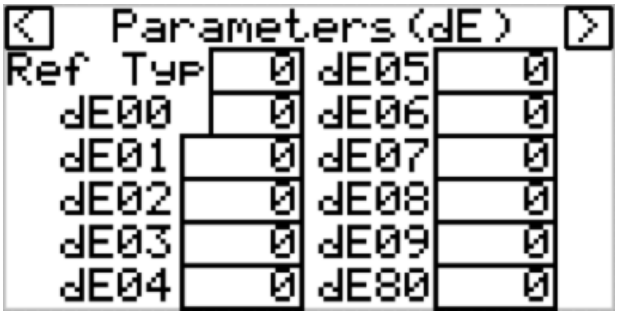
Once a system has been running for some time, it is always best to set **Max Valve Open** to the desired modulation max range. Setting this to an appropriate max scale will not allow the valve to open to far and cause flooding, due to large valve capacity ranges, PID response times, and evaporator coil design. This also acts as a safety feature if a failed sensor has occurred, giving false superheat readings. Warmer ambient conditions will affect this value, due to less subcooling/liquid quality performance, and may need to be adjusted accordingly.

Scale



The default x values are set at 0 (X1) – 1000(X2) and y values are set at psi range of suction pressure transducer. This wide range of values gives more system accuracy for fine tuning the suction pressure transducer, as well as using an ***Offset*** if needed.
AI SCALING*:* Scaling is only for a 4-20mA sensor!

Parameters dE and Advanced



Refrigerant Type

Refrigerant	RefTyp Selection
R22	0
R134a	1
R404A	2
R407C	3
R410A	4
R407A	5
R407F	6
R290	7
R507A	8
R717	9
R723	10
R1234ze	11
R744	12
R448A	13
R427A	14
R450 (N13)	15
R513A	16
R449A	17
R1234yf	18
R454B	19
R454C	20
R455A	21
R434A	22
R442A	23
R32	24
R452B	25
R452A	26
R515b	255

Customizable Bipolar Valve Configuration Parameters - Valve parameters if *dE00 = 0*

Valve Type Settings (Alco / Danfoss Colibri ETS)

Alco EX4-8 and Danfoss Colibri Expansion Valve ETS12C – ETS100C has been fully tested with the Sensori platform. *See Modicon M172 Driver Manual for other valve types and settings*. Other valve types have not been tested by Oxford Sensori Platform.

dE00=0: The valve parameters **dE01…n40** are customizable. Refer to *Customizable Bipolar Valve Configuration Parameters, page 69 of Modicon M172 Driver Manual*.

dE00≠0 (unused dE00 values are reserved): The Preconfigure Values will be used. See Table Listed below (*next page*).

For all other valve types not listed in table below, refer to Preconfigured Bipolar Valve Configuration Parameters (see *Modicon M172 Electronic Expansion Valve Driver, Preconfigured Valves Parameters Guide*).

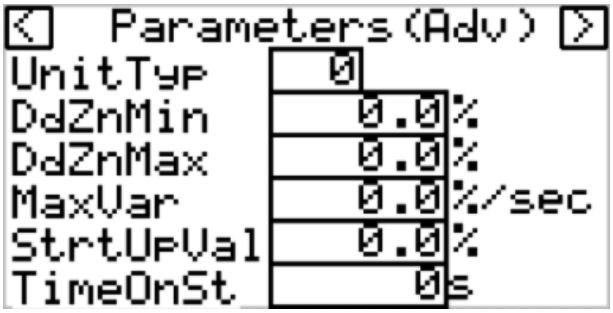
NOTE: Valves may need additional settings depending on wire length, power supply, or erratic valve response time PID to avoid step loss and proper closure. For Additional settings see "*VEV Post Control*" setpoints, valve current settings (dE03, dE04 can only be adjusted when dE00=0), current *Boost Mode* (*n27-n29*), and Max Variation Out.

LABEL	Parker-Sporlan				Emerson-ALCO			Danfoss			
	SER	SERI	SERI	SEHI	EX			ETS			
	AA, B, C, D	F, G, J, K	L	175, 400	4, 5, 6	7 '	8	12.5, 25, 50	100	250, 400	12C, 24C, 50C, 100C
dE00	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
dE01	200				500	210	500	300			240
dE02	2500			6386	750	1600	2600	2625	3530	3810	600
dE03	0				100			263	353	160	6
dE04	90	150		120	500	750	800	100			800
dE05	100			75	13	8	6	52			10
dE06	0				100	250	500	100			0
dE07	0										2
dE08	100										
dE09	0		50	0							
dE80	0		10	0							
n10	25			0							
n11	100			0							
n12...n15	0										
n16	1										
n17	0										
n18	0			1							
n19	3072										
n20	256										
n21	50										

LABEL	ADDRESS Valve 1	ADDRESS Valve 2	DATA TYPE	R/W	CPL	RESET	DESCRIPTION	RANGE	DEFAULT	U.M.
dE01	15801	16001	UINT	R/W	-	-	Maximum speed. Defines the maximum valve motor speed to allow step precision and integrity.	0...999	200	Steps/s
dE02	15802	16002	UINT	R/W	-	-	Full opening. Defines the maximum number of valve steps. The total travel refers to the FULL STEP mode (*dE07*=0). The valve opening is complete when this value is reached.	0...9990	2500	Steps
dE03	15803	16003	UINT	R/W	-	-	Extra movement in full closure. Defines the number of extra valve steps beyond the limit switch to allow a correct total closure. A total closure command implies the valve positioned to zero and a further number of steps *dE03*.	0...999	0	Steps
dE04	15804	16004	INT	R/W	-1	-	Winding maximum current. Defines the maximum current per phase utilized by the valve (maximum torque). Negative current value: the maximum current is set to the value with no sign (absolute) *dE04* with an extra 50% with the valve movement command (starting or end point) within 5% of total opening, to a value equal to the absolute value of *dE04* for the other movements.	-560 ... 850	90	mA
dE05	15805	16005	UINT	R	-	-	Reserved	0...999	100	Ohm
dE06	15806	16006	UINT	R/W	-	-	Winding holding current. Defines the phase circulating current in the valve stop condition (minimum torque).	0...850	0	mA
dE07	15807	16007	UINT	R/W	-	-	Type of stepper motor control. Defines the driving modes: • 0: FULL STEP • 1: HALF STEP • 2: MICRO STEP For more details, refer to the technical documentation of the electronic valve.	0...2	0	Num
dE08	15808	16008	UINT	R/W	-	-	Duty cycle. In the case of valve superheat, reduce the enabling duty cycle to allow it to cool down.	0...100	100	%
dE09	15809	16009	UINT	R/W	-	-	Acceleration/deceleration Defines the acceleration/deceleration in motor start/stop. The time between one step and the next is reduced by *dE09* at each step until *dE01* is reached. If *dE09* = 0 acceleration is not applied.	0...999	0	ms/10
dE80	15810	16010	UINT	R/W	-	-	Minimum motor speed for acceleration/ deceleration To be modified only if `dE09` >0	0...999	0	Steps/s
n10	15811	16011	UINT	R/W	-	-	Pause time.	0...999	25	ms
n11	15812	16012	UINT	R/W	-	-	Extra movement in full closure every `n15` hours working.	0...9990	100	Steps
n12	15813	16013	UINT	R/W	-	-	Change direction counter limit.	0...9990	0	Num

LABEL	ADDRESS Valve 1	ADDRESS Valve 2	DATA TYPE	R/W	CPL	RESET	DESCRIPTION	RANGE	DEFAULT	U.M.
n13	15814	16014	UINT	R/W	-	-	Extra movement in full opening. Related to bit 7 of Diagnostic Parameters, page 64.	0…9990	0	Steps
n14	15815	16015	UINT	R/W	-	-	Duty cycle period of activation/deactivation.	0…9990	0	s/10
n15	15816	16016	UINT	R/W	-	-	Period of periodical synchronization. • 0 = Function is disabled	0…9990	0	Hours
n16	15817	16017	UINT	R	-	-	Unipolar/Bipolar valve selection. • 1 = Bipolar • 2 = Unipolar	1…2	1	Num
n17	15818	16018	UINT	R/W	-	-	Maximum speed in emergency closing. If set at 0, referred value is dE01	0…999	0	Steps/s
n18	15819	16019	UINT	R	-	-	Reserved	0…1	0	Num
n19	15820	16020	UINT	R/W	-	-	Reserved	0…4095	3072	Num
n20	15821	16021	UINT	R/W	-	-	Reserved	0…2047	256	Num
n21	15822	16022	UINT	R/W	-	-	Reserved	0…512	50	Num
n22	15823	16023	UINT	R/W	-	-	Reserved	0…512	288	Num
n23	15824	16024	UINT	R/W	-	-	Reserved	0…2047	1296	Num
n24	15825	16025	UINT	R/W	-	-	Reserved	0…4095	2562	Num
n25	15826	16026	UINT	R/W	-	-	Reserved	0…4095	240	Num
n26	15827	16027	UINT	R/W	-	-	Periodical override mode: • 0=after n15 period with *Open_at_wr* = 0 • 1=after n15 period)	0…1	0	Flag
n27	15828	16028	UINT	R/W	-	-	Winding maximum current during boosting phase.	0…850	0	mA
n28	15829	16029	UINT	R/W	-	-	Boosting windows.	0…1000	0	‰
n29	15830	16030	UINT	R/W	-	-	Boosting mode: • 0=no • 1=open • 2=close • 3=both	0…3	0	Num
n30	15831	16031	UINT	R/W	-	-	Emergency Opening percentage.	0…1000	0	‰
n31	15832	16032	UINT	R/W	-	-	Behaviour on power fail: • 0 = no action, an alarm is generated Refer to bit 9 of Diagnostic Parameters, page 64 • 1 = close	0…1	1	Num
n32	15833	16033	UINT	R/W	-	-	Reserved	0…4	0	Num
n33	15834	16034	UINT	R/W	-	-	Reserved	0…4	0	Num
n34	15835	16035	UINT	R/W	-	-	Reserved	0…4	0	Num
n35	15836	16036	UINT	R/W	-	-	Reserved	0…4	0	Num
n36	15837	-	UINT	R/W	-	-	Number of Battery Backup modules. **NOTE:** Parameter value for valve 2 is not used. **NOTE:** This parameter is overwritten by *i_usi_batterynr*. This is a parameter of the driver, not of the valve. Input of the FB settings is preponderant respect to parameter value.	0…2	0	Num
n37	15838	16038	UINT	R/W	-	-	Valve energization time at startup.	0… 65535	25	ms

LABEL	ADDRESS Valve 1	ADDRESS Valve 2	DATA TYPE	R/W	CPL	RESET	DESCRIPTION	RANGE	DEFAULT	U.M.
n38	15839	16039	UINT	R/W	-	-	Valve energization time at stop.	0... 65535	25	ms
n39	15840	16040	UINT	R/W	-	-	Reserved	0... 65535	0	Num
n40	15841	16041	UINT	R/W	-	-	Reserved	0... 65535	0	Num

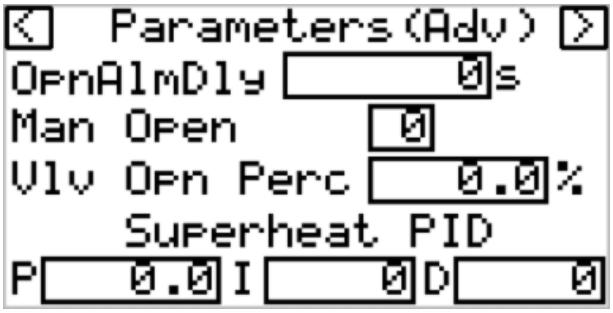


Unit Type - Type of unit to be controlled. If Unit Type = 0, parameters ***Superheat PID***, ***Enable SH Evo***, ***Superheat Deadband/DeadZone***, ***MOP PID***, ***Enable Dyn SP, Dyn Sp MxOf***, ***SP Inc Step***, ***SP Inc Time***, are used as input for regulation.
If uUnit type is different from 0 (Default 5), those parameters are automatically set (the used values are available on output) to cope with different type of unit or machine that can be found in HVAC or refrigeration:

E2_usiUnitType	Description of Unit
1	Ducted refrigeration unit and evaporation pressure quickly variable (for example step control)
2	Ducted refrigeration unit and evaporation pressure controlled (for example INVERTER control)
3	Refrigeration unit with on-board compressor
4	Refrigeration unit with on-board compressor and regenerative heat exchanger
5 Defaul	HVAC unit with plate heat exchanger (slow reaction)
6	HVAC unit with shell and tube heat exchanger (medium reaction)
7	HVAC unit with finned coil heat exchanger (moderately fast reaction)
8	HVAC unit with variable cooling capacity (fast reaction)
9	Perturbed HVAC unit (very fast reaction)

Dead Zone Min Value – Dead Zone minimum opening value (0% default)
Dead Zone Max Value – Dead Zone max opening value (100% default)
Max Variation Output –To limit quick variations of open value that can create oscillations in superheat and mechanics issues, it is possible to set a maximum variation of opening degree (%) per second. This value should be arranged depending on the mechanics of the electronic valve, for example it can be set less than maximum admitted speed for the EEV. If Max Variation Out = 0, The valve output is not limited in speed.

Start up Value / Time on Start – Active for initial valve command at startup. If **Start Up Value** setpoint differs from zero, the regulator fixes the opening value to **Start Up Value** for **Time On Start** seconds. After this time is elapsed the regulation starts from this opening value, as for the super heat, as for the MOP (if enabled). If **Start up Value** is equal to zero, the regulator fixes the opening value to the opening value recorded before the stop and stored in EEPROM into the address **Last Value**. After the **Time On Start** time is elapsed, the regulation starts.



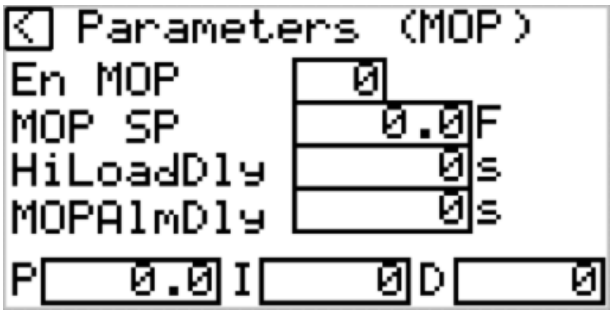
Open Alarm Delay - if **Manual Open** = FALSE and the valve stays open at maximum value for a time longer than **Open Alarm Delay** an alarm will occur. The alarm resets automatically if the output changes to a smaller value.

Manual Valve Open – Set to value of "1" to enable manual valve opening. Set **Valve Open Percent** to required open position when in manual mode.

Superheat P – Proportional band

I – Integral time constant(s)

D – Derivitive time constant(s)



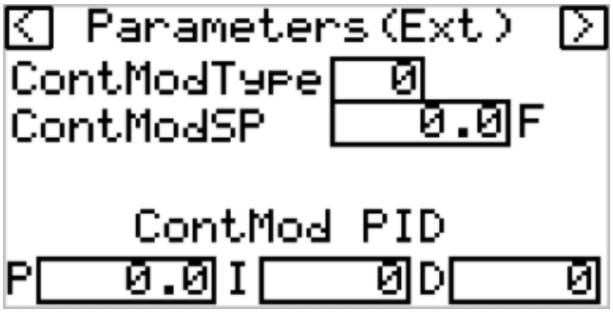
MOP (Maximum Operating Pressure):

Set the **MOP Setpoint**, the maximum saturated vapor temperature. This is the set point of the **MOP PID**. When approaching this value, the MOP regulation starts to close the valve to come back to a safety operating mode. In this case, superheat control is abandoned but closing action is kept at minimum to start again to regulate when this load situation disappears.

High Load Delay – When The valve is initially started, for a time (**High Load Delay**), MOP alarm is not monitored, and MOP control is not performed. Also, dynamic setpoint calculation is frozen if being used.

MOP Alarm Delay - If **MOP Setpoint** is passed for a longer time than **MOP Alarm Delay,** the function block puts the output to zero and the MOP alarm is triggered. This alarm is not monitored for a time (**High Load Delay**) after the initial start.

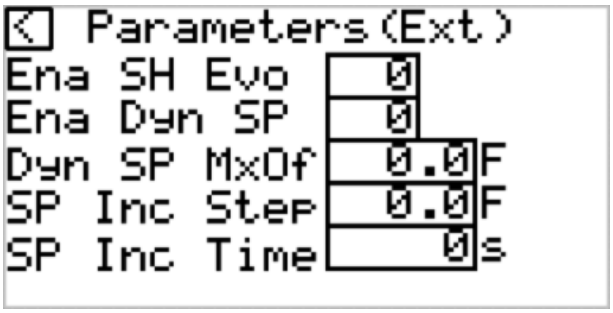
Extended Parameters



Continuous Modulation: *Used to control case Temperature for Sensori M172-18IO Case Management*

Continuous Modulation Type enables the continuous modulation regulation and permits us to set a **cool** PID regulation. Cool regulation means that the output increases as the process variable is below the setpoint. Set to 0 = disabled, 1= cool

The **Continuous Modulation Setpoint**. When approaching this value, the continuous modulation regulation starts to close the valve in order to maintain the setpoint while abandoning the superheat control. In that case, superheat control is abandoned but closing action is kept at minimum in order to start again to regulate superheat when this setpoint is far. This permits us to use the EEV to control the air temperature, while keeping superheat as low as possible and preventing at the same time to go beyond the MOP.



If **SH Evolution Enable** is set to "1", the superheat control is performed with an advanced algorithm, instead of the standard PID. *See Schneider's Manual (Modicon M172 Electronic Expansion Valve Driver*) for more information.

Dynamic Setpoint:

If **Dynamic SP Enable** = 0, the super heat set point is given directly to the super heat PID. If **Dynamic SP Enable** = 1 then dynamic set point calculation is enabled and the super heat set point is calculated with the following routine.

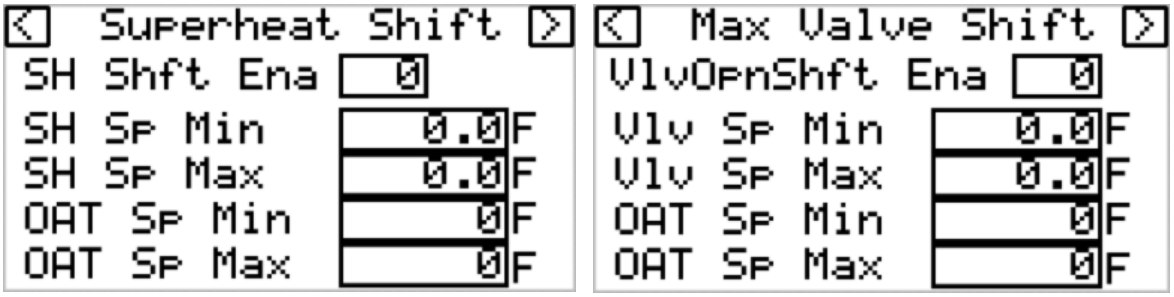
For a time, **High Load Delay**, after the initial valve start command: Superheat Setpoint Calculation = **Superheat SP** + **Dyn Setpoint Max Offset** (Dyn SP MxOf). After that, there is a dynamic set point calculation if superheat regulator is acting (Regulation Status = Superheat) with a timing of **Setpoint Increment Time** (SP Inc Time) Step time in the dynamical set point calculation):

If Superheat value > ***Superheat Setpoint***, Superheat calculation = Superheat Regulation Setpoint – **Setpoint Increment Step** (SP Inc Step).

If Superheat value < ***Superheat Setpoint***, Superheat calculation = Superheat Regulation Setpoint + ***Setpoint Increment Step*** (SP Inc Step).

Lastly, the calculated set point is forced to stay above ***Superheat Setpoint*** and under ***Superheat Setpoint*** + ***Dyn Setpoint Max Offset***.

Shift Setpoints



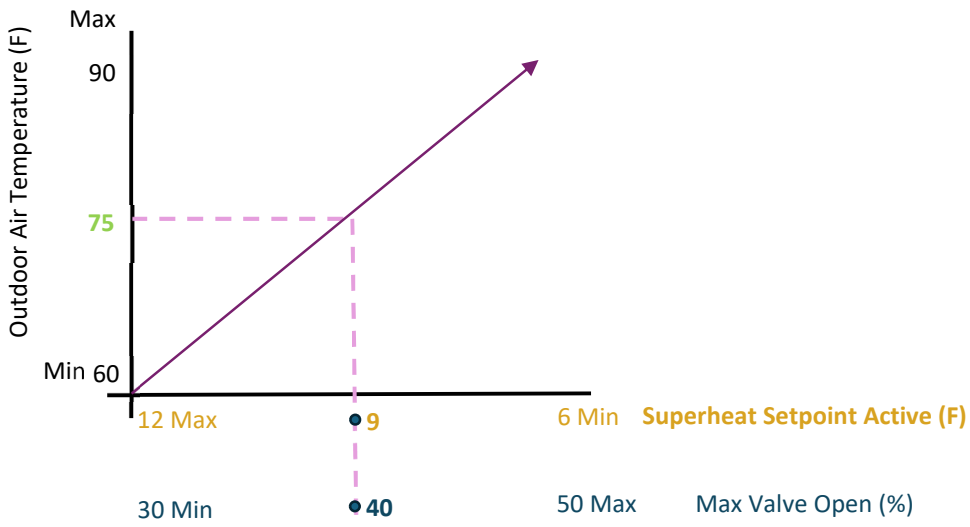
Superheat Shift:

Superheat Setpoint Shift based on Outdoor Temperature used in a linear scale, for setting superheat setpoint to improve case efficiency and minimize compressor superheat. As outdoor temperature increases, superheat setpoint will decrease.

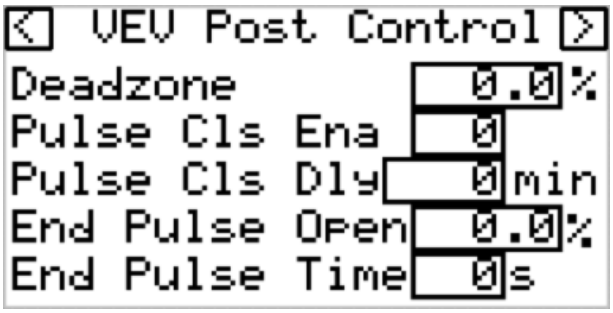
Set **Superheat Shift Enable** = 1 to enable this feature. Outdoor temperature MUST be enabled for this to work. Set the **Superheat Minimum and Maximum Setpoint** for superheat to float in a linear scale within the **Outdoor Air Temperature Min and Max Setpoint**.

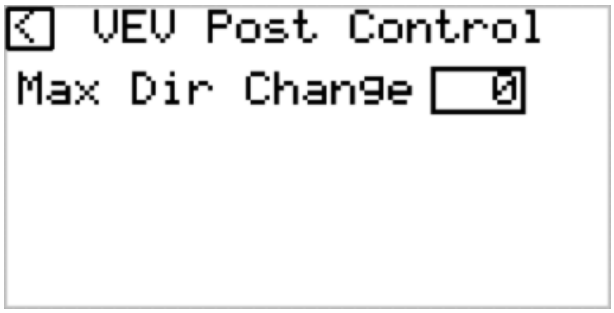
Max Valve Shift:

Electronic Valve Max open Shift Setpoint. Max open setpoint of valve in a linear scale, for setting a max valve open based on Outdoor ambient when **Valve Open Shift Enable** = 1. This is used to prevent the Electronic Valve from opening to far during cooling and causing flooding due to "Lazy" coils and possible slow reaction time of valve. Max valve should always be set on cases as a safety, in case of sensor fails, to prevent cases from flooding. Set the **Valve Setpoint Min and Max** for floating max valve scale withing **Outdoor Air Temperature Min and Max Setpoint**.



On This Graph, Superheat Shift Active setpoint would be 9-degree F and Max Valve Open Shift Setpoint would be at 40%, at a 75-degree F ambient day.





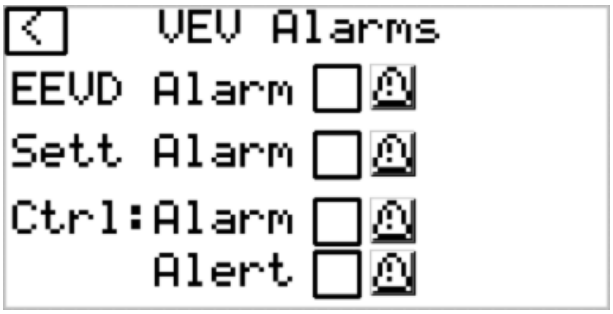
Deadzone is the output Dead Zone filter before a change is made to the valve percentage. For example, if the valve Dead Zone is set to 1, no output change will be sent to the valve while modulating 20.1,20.2,20.3... until 21, then will be sent.
Note: This is NOT to be mixed up with Superheat Dead Zone for PID control and is only available on Post Valve Control.

When **Pulse Close Enable** = 1, the valve will do an emergency quick close to ensure no valve step loss and proper closure after **Pulse Close Delay** has expired. Set **End Pulse Open** to a percentage that the valve will open to after the valve does a full closure, to ensure the operating system will recover and not pump down, for **End Pulse Time** seconds. It is only necessary to enable Pulse Close when the valve continues to run for long periods of time and does not lose the start command, such as a chiller for a curling rink on initial ice temperature pull down.

Max Direction Change > 0 and **Dead Zone** > 1% enables an algorithm which try to balance the number of change directions in valve steps. When set to 0, this function will be disabled. A direction counter tells how unbalanced the change of direction are (example. 5 means the valve made 5 opening steps more than closing. If negative, the closing action are more than the opening).

ALARMS


Indication that an alarm is present. Follow the image to find which alarm is present.



Refer to ***Modicon M172 Electronic Valve Driver Manual*** for more information on alarms and diagnostics

EEVD Alarms:

Diagnostic Parameter		Alarm	TM172EVEV••			Valve Driver Action	Rearm Condition
Bit	Description		1U	1B	2B		
0	Chip does not respond	Detected error on bipolar driver chip: chip does not respond.	No	Yes		Valve stops in current position	Automatic
1	Thermal shutdown	Detected error on bipolar driver chip: chip in fault protection	No	Yes		Moves the valve to the emergency position *n30*. Then any activity on the valve is stopped.	
2	Predriver detected error(*)						
3	Undervoltage Lockout(*)						
4	Reserved						
5	Overcurrent	Valve coil in short-circuit	Yes			Valve stops in current position	Manual: Alarm cause must be solved and a new "Activate and synchronize" command must be sent. Automatic rearm is managed by the AFB **EEVDAlarmMgmt**.
6	Reserved						
7	Max number of valve direction changing (only if *n12* > 0)	Max number of valve direction changing achieved	Yes			Moves the valve to the emergency position *n30*. Then any activity on the valve is stopped.	Automatic
8	Quantity of TM172EVEVBAT connected <> parameter *n36* value or TM172EVEVBAT exceeds charging time timeout	TM172EVEVBAT inoperable	Yes			Non-blocking alarm	Automatic
9	Power supply outage If TM172EVEVBAT connected and charged with enough energy	Power supply not detected	Yes			Movement towards the emergency position *n30* is executed only if *n31*=1 otherwise no action is done. If *n17*=0, the value of the "maximum speed in emergency closing" is equal to dE01. If *n17* >0 the movement towards the emergency position *n30* is done using *n17* speed.	Automatic
10	TM172EVEVBAT degraded due to: • the charge is too fast	TM172EVEVBAT degraded (*)	Yes			Non-blocking alarm	Automatic

Diagnostic Parameter		Alarm	TM172EVEV••			Valve Driver Action	Rearm Condition
Bit	Description		1U	1B	2B		
	• or if the last time that there has been an emergency movement followed by power fail, this has not been completed. The value has persisted in EEPROM so an emergency movement must be repeated successfully to cancel it.						
11	Configuration error *n16* value not compatible with TM172EVEV•• model. or: • Unipolar: *n32*, *n33*, *n34*, and *n35* value combination not allowed • Bipolar: *dE04*<0 and at least one of *n27*, *n28*, *n29* not 0	Configuration error	Yes			Valve stops in current position	Manual: Alarm cause must be solved and a new "Activate and synchronize" command must be sent. Automatic rearm is managed by the AFB `EEVDSettingsU` or `EEVDSettingsB` after sending new parameter values.
12	Disconnection on W1+ or W1-	Valve disconnected Detected only when valve is in synchronization phase. *See Note Below for synchronization*	Yes			Driver moves the EEV in any case. By default, the AFB **EEVDCntrl** considers this alarm as a stopping condition and try to move the valve to the "Alarm" position, where the EEV rest until the alarm disappear.	Manual: The alarm is detected and/or reset only in synchronization phase. If detected, it is maintained active until the next synchronization, as the disconnection is checked again and alarm is confirmed or reset. Automatic rearm is managed by the AFB `EEVDAlarmMgmt` that by default is set to periodically drive a synchronization phase to check again the alarm when present.
13	Disconnection on W2+ or W2-						
14	CAN not working, communication with master lost (not readable via CAN)	Loss of communication on CAN expansion bus Detected only after first connection with CAN master controller	Yes			Moves the valve to the emergency position *n30*. Then any activity on the valve is stopped.	Automatic
15	Reserved						
(*) Contact your local support.							

Note: *Valve will do an extra Synchronization on the falling edge of the start command, and valve is at 0%. When this sync is done, the valve driver will look for alarms and valve "Not Ready" will appear. A valve disconnection error will ONLY appear when this sync is being done, and the valve is unplugged. Be sure to allow for proper valve closure after some time to ensure proper step count and valve ok.*

*** Make sure to disconnect power to device when valve is being changed or wired! If an error occurs. A power reset is required to clear this alarm. ***

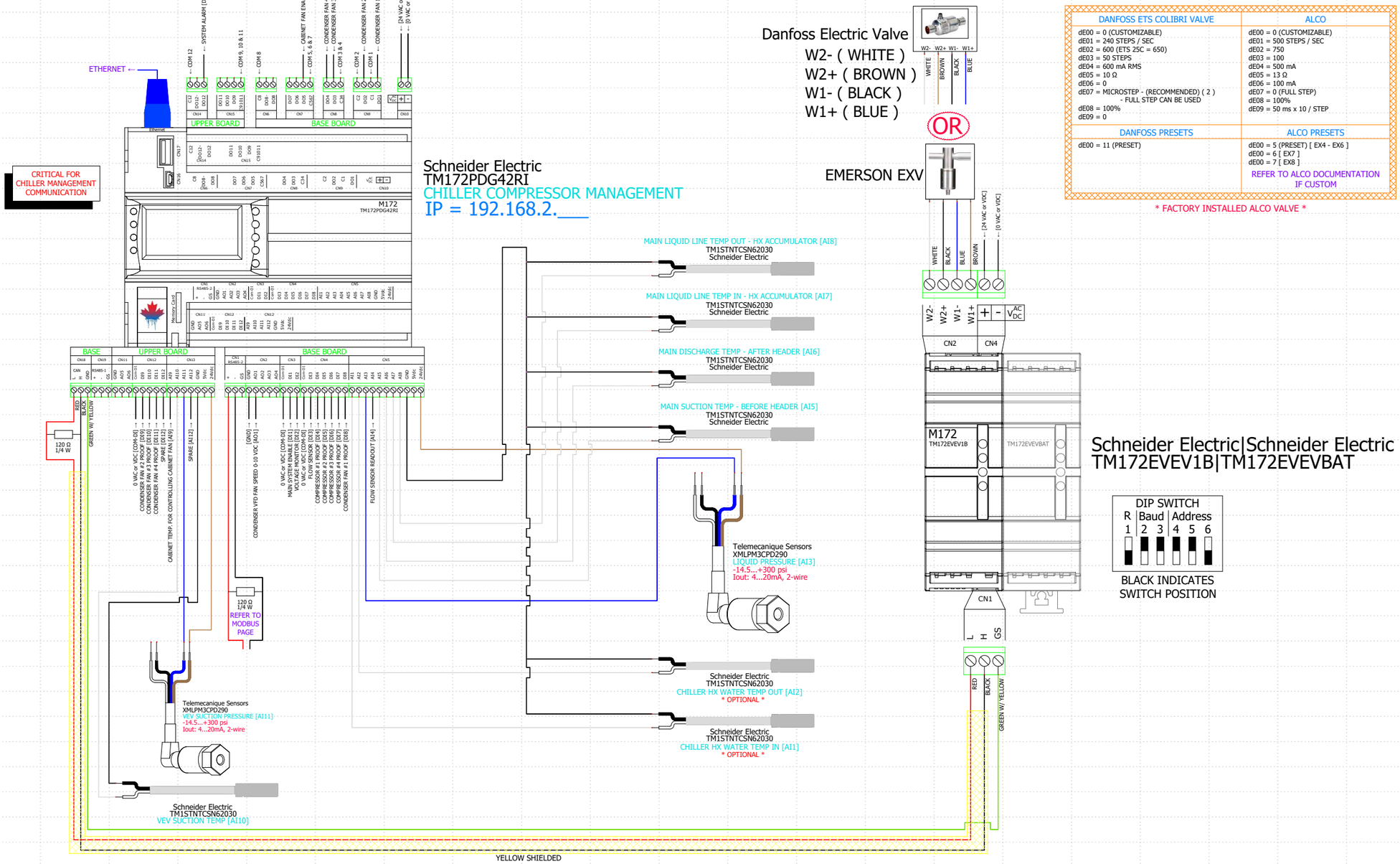
Settings Alarms:

Alarm bit	Alarm Cause	Effect
0	Communication interruption	Parameters list not sent
1	Parameters not set	Some parameters are not correctly set
2	File not found	Parameters list not loaded nor sent
3	Invalid file format: header not found	
4	Invalid file format: invalid values	
5	Invalid file format: EEV not found	
6	Invalid task	Parameters list not sent
7	Pointers to EEPROM not initialized (only if E2_ uidE00=0)	Parameters list not sent (only if E2_ uidE00=0), EEPROM parameter not updated
8...10	Reserved	–
11	Writing in EEPROM not possible (only if E2_ uidE00=0)	EEPROM parameter not updated
12	Parameters externally modified	Event to be externally managed
13...15	Reserved	–

Control Alarms/Alerts:

Bit	Alarm condition	Effect
0	Super heat PID parameter (Pb, Ti, Td) out of range	block disabled: `uiOut` goes to zero
1	MOP PID parameter (Pb, Ti, Td) out of range	
2	Continuous modulation PID parameter (Pb, Ti, Td) out of range	
3	Super heat dead band	
4	`E2_iSuperHeatSetp`, `E2_iMopSetp` or `iContModSetp` out of range	
5	`E2_uiPbAlarmValue` or `E2_uiExtAlarmValue` or `uiComAlarmValue` out of range	
6	`E2_uiTimeOnStart` or `E2_uiTimeOnStop` out of range	
7	`E2_uiValueOnDefrost` or `E2_uiValueOnStart` or `E2_uiValueOnStop` or `E2_uiExtLimitValue` or `E2_uiManualValue` out of range	
8	Dynamical set point parameters out of range	
9	Maximum open value or maximum output variation or dead zone values out of range	
10	`E2_usiUnitType` or `E2_usiContModType` out of range	
11	Saturated temperature probe out of range	
12	MOP alarm	
13	External alarm	block disabled: `uiOut` goes to fixed value
14	Communication alarm	block disabled: `uiOut` goes to zero
15	Error detected on EEPROM writing or incorrect task	block disabled: `uiOut` goes to fixed value

Bit	Alert condition	Effect
0	Super heat probe out of range	`iOut` goes to `uiPbAlarmValue`
1	Continuous modulation probe out of range	`iOut` goes to `uiPbAlarmValue`
2	Open alert	Alert the user of the open situation
3	`E2_uiTimeOnStop` changed runtime	The block runs with the old value
4	`E2_uiTimeOnStart` changed runtime	The block runs with the old value
5	`E2_uiMopAlarmDelay` changed runtime	The block runs with the old value
6	`E2_uiOpenAlarmDelay` changed runtime	The block runs with the old value
7	`E2_uiHighLoadDelay` changed runtime	The block runs with the old value
8	`E2_usiUnitType` changed runtime	Only alert (parameters are changed so)
9...15	Reserved	-



SOLIDWORKS Electrical

Oxford Energy Solutions Inc.
505082 Old Stage Road
Woodstock, ON, N4S 7V8, Canada
226-242-5674

CHILLER CONTROL COMPRESSOR MANAGEMENT

CONTRACT:

LOCATION: OES SENSORI DRAWINGS

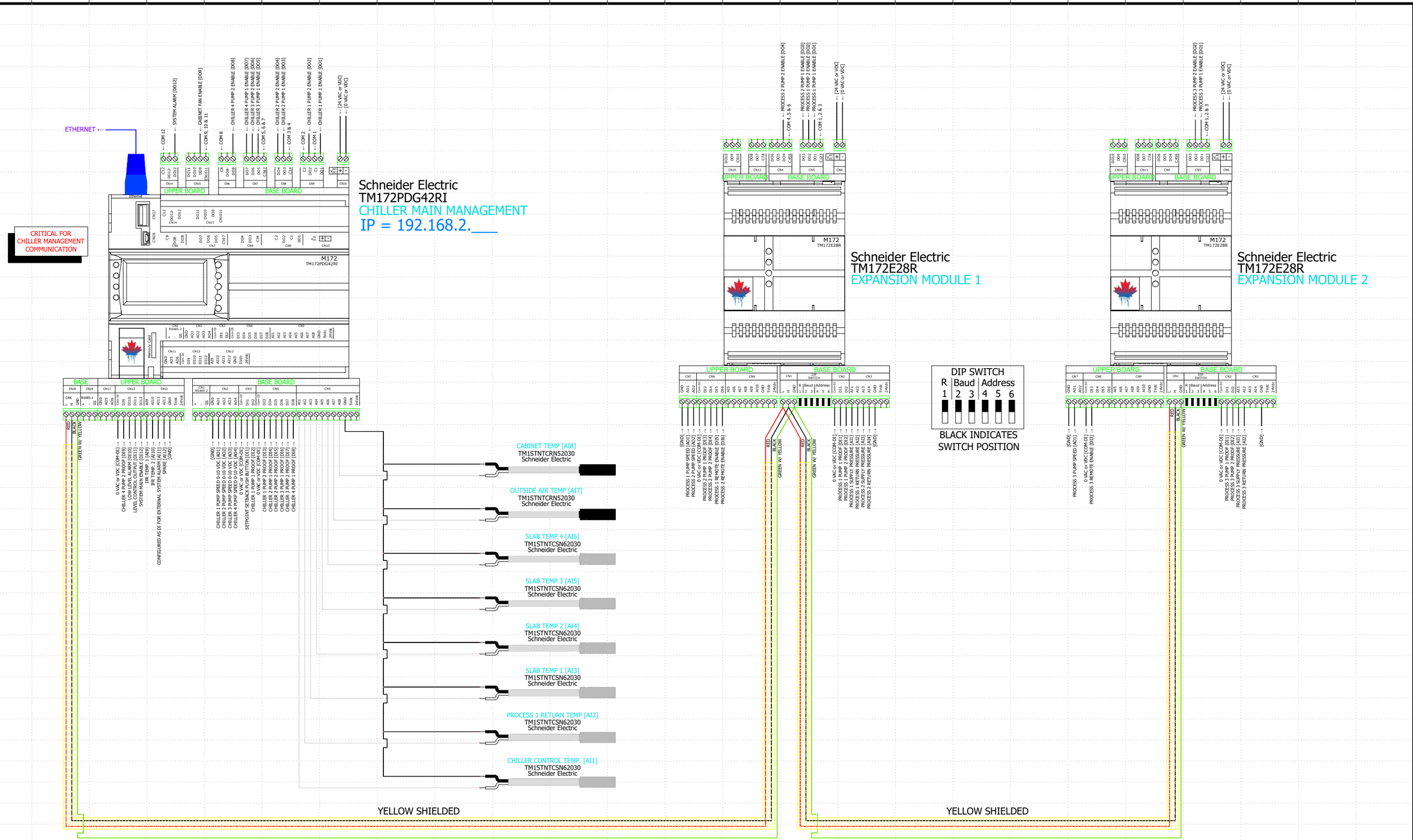
REV.	DATE	NAME	CHANGES
0	2025-06-05	Michael D	INITIAL RELEASE

Drawn By: Michael D

Date: 2025-04-16

REVISION 0

SCHEME 08



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226-242-5674

MAIN CHILLER CONTROL

CONTRACT:

LOCATION: OES SENSORI DRAWINGS

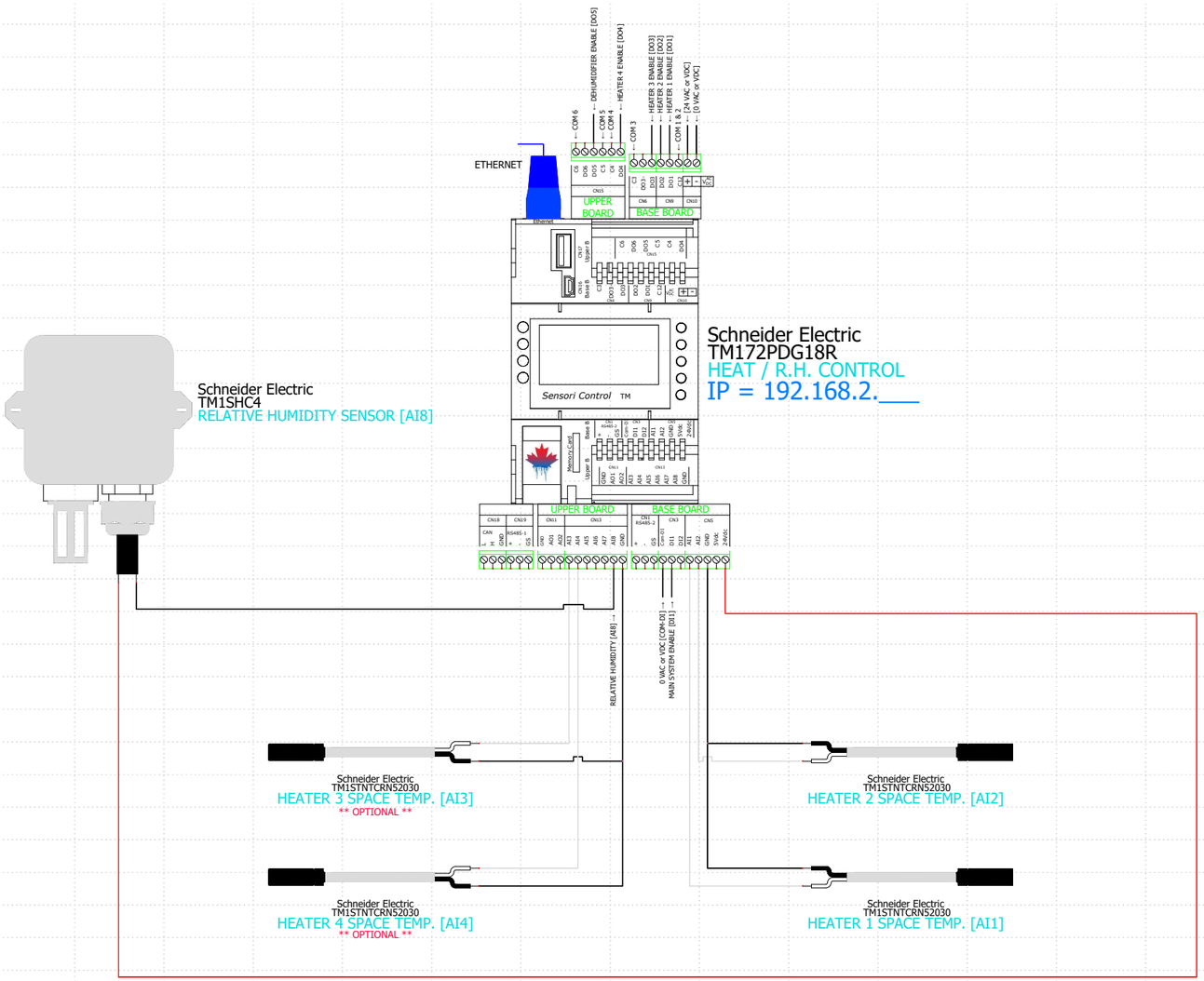
REV.	DATE	NAME	CHANGES
0	2025-06-05	Michael D	INITIAL RELEASE

Drawn By: Michael D

Date: 2025-04-16

REVISION 0

SCHEME 07



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HEAT / RELATIVE HUMIDITY CONTROL

CONTRACT:

LOCATION: OES SENSORI DRAWINGS

REV.	DATE	NAME	CHANGES
0	2025-06-05	Michael D	INITIAL RELEASE

Drawn By: Michael D
Date: 2025-04-16

REVISION 0
SCHEME 09