APPLICATION NOTE

APP116

MCS FAST SSH

Maintains Suction Superheat

and

Anticipates Changing Conditions

This document supports HVAC-17.25P and RTU-17.25P releases

Any questions regarding this release, contact: support@mcscontrols.com

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Revision History

Date	Author	Description
6-30-16	JGW	SETUP APP
7-11-16	JGW	UPDATED MULTIPLE EXV / CIRCUIT & SET POINT 10 FUNCTION ADDED
7-12-16	JGW	UPDATED
7-14-16	DEW	EDITS FROM BRIAN
8-06-16	JGW	UPDATED BASED ON VERSION RTU 17.23Ia
8-09-16	JGW	CORRECTED SP 14 BOUND
8-09-16	JGW	ADDED SECTION ON STEPS TO CONVERT
8-10-16	DEW	ADDED INTO MAIN DOC ABOVE ADDITION
8-14-16	JGW	Increase EXV START TIME to 90 seconds
9-06-16	JGW	Edits made add another Fast Superheat
1-11-17	JGW	Added SP 11 for Future development, fixed Superheat SP names and values in Config
1-17/18/20/23-17	DEW	Edits from JGW
1-24-17	DEW	Edits from JGW
1-27-17	DEW	Edits from JGW
2-2-17	DEW	Edits from JGW SP Time Field
2-22-17	DEW	Edits from JJN
04-21/24-17	DEW	Edits from JGW
05-01-2017	DEW	add note ‘DO NOT DO ANY FILTERING ON CONTROLLING SENSOR’
05-17-17	DEW	add edits from JGW
06-12-17	DEW	Edits from JGW, add Under development
06-23-17	DEW	Add Low Suction Open control

Design Criteria

- ✔ **Holds Superheat to a Target**
- ✔ **Teaches itself Valve Starting Position**
- ✔ **Reduces Config Setup** to only **10 Standard Set Points**
- ✔ **Fine Tuning** with only **3 Adjustable Set Points**
- ✔ **Eliminate Low Superheat Safeties**
- ✔ **Eliminate Low PSI Safeties**

General Description

There currently are five (5) Electronic Expansion Valve Algorithm's available for the MCS Magnum controller and Three (4) additional under development, as follows:

Suct Sph - The standard suction super heat Algorithm. This uses control zones and has great flexibility to specify functions within each zone.

Evap Lvl - This Algorithm is used for Flooded Evaporators. It allows the user to define the level based on the current capacity of the chiller.

Disc Sph - This Algorithm is used on Flooded Evaporators when a Level sensor is not available.

Cond Lvl - This Algorithm is used for Condenser control.

FAST SSH - This is a fast suction Superheat algorithm designed to react to systems changes. This Is used with most Direct Expansion systems. (Chiller Barrels, Plate heat exchangers, Remote evaporators, Roof top units, etc.

New

Fast DSH	DISCHARGE SSH CONTROL- Field Testing
Fast EVPLVL	EVAPORATOR LEVEL CONTROL- Field Testing
FAST SUBCOOL	ECONOMIZER SSH CONTROL - Field Testing
Fast CNDLVL	CONDENSER LEVEL CONTROL - Under Development

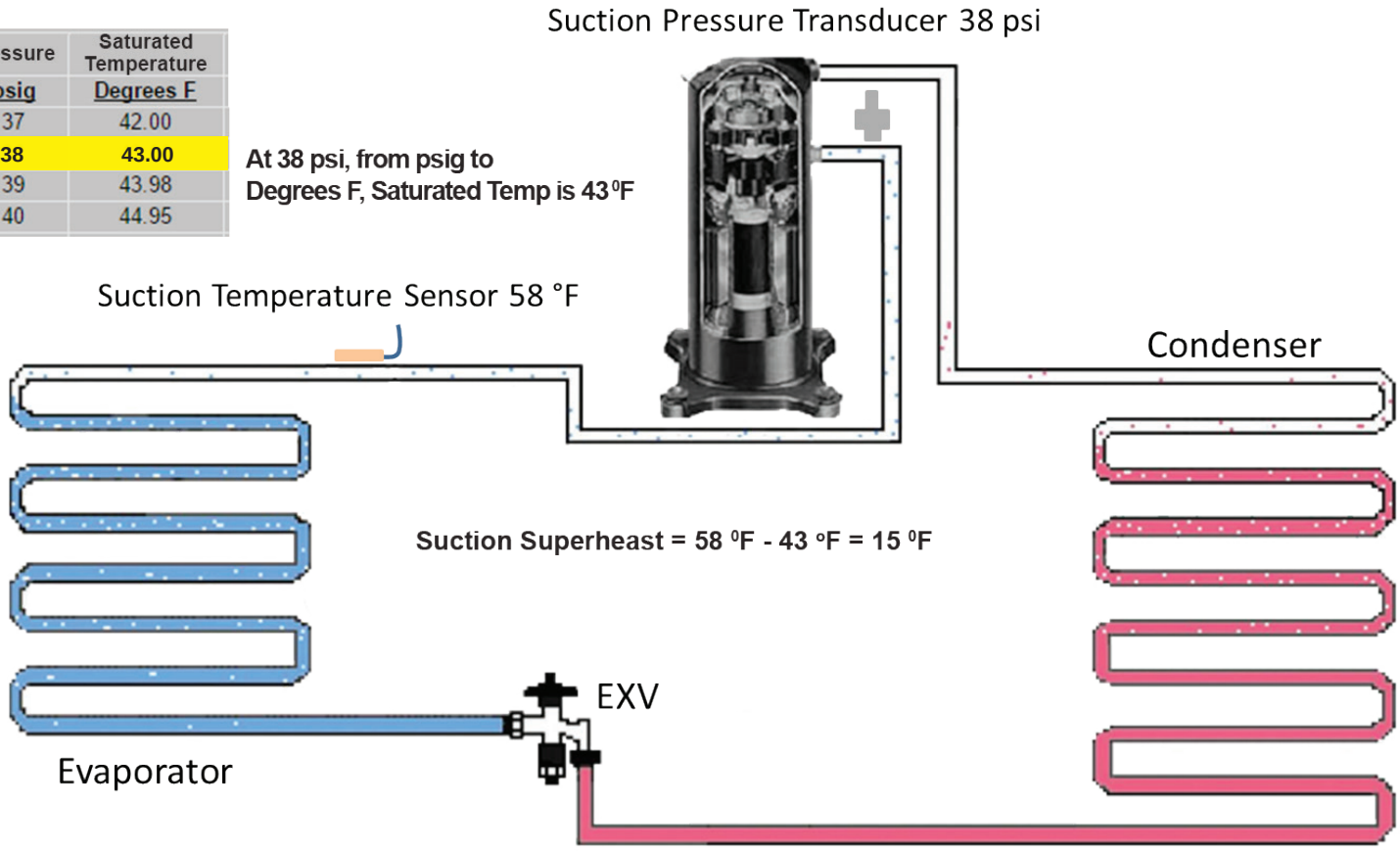
Requirements to convert to FAST SSH

1. Requires MCS-Config software Version 18.00V or greater.
2. Requires MCS-Connect Version 18.10.09 or greater.
3. Requires Magnum HVAC or RTU firmware Version 17.25P hex or greater.
4. Requires cfg file to be Version 17.

Description of Suction Superheat (134A)

Pressure	Saturated Temperature
psig	Degrees F
37	42.00
38	43.00
39	43.98
40	44.95

At 38 psi, from psig to Degrees F, Saturated Temp is 43 ^{0}F



Notes:

1. As the Suction Superheat increases the evaporator absorbs less heat and the System Efficiency decreases.
2. If the Suction Superheat gets too low you have the risk of liquid getting back to the compressor and causing damage.
3. With all refrigerants, the closer you can maintain the Superheat to the target the more stable the Suction psi becomes. (With R134A this is extremely important since their is very little room before you get into a low Suction psi condition.

This is the design function for FAST SSH

The Set Points for FAST SSH are divided into Four (4) Categories as follows:

Four (4) Groups of FAST SSH Set Points

- ✔ **Control** - This consist of **2 set points** that should be **standard** developed for each model
- ✔ **Adjustment** - This consist of **3 set points** used for Fine Tuning
- ✔ **Safety** - This consist of **3 set points** that should be **standard** based on model
- ✔ **Timing** - This consist of **3 set points** that should be **standard** based on Superheat Type

‘DO NOT DO ANY FILTERING ON CONTROLLING SENSOR’

Config Control Set Points (2)

SP#	NAME	DESCRIPTION	SP VALUE FIELD	SP TIME FIELD
9	FAST SH TRGT	TARGET	SUPERHEAT TARGET Usually 10 to 12 F	# SECONDS SH ROC Set to 1 second
10	FAST SH ZONE	DESIGN CTL RANGE	± SH DEGREES FAST ZN Usually 2.0 F	ADJ. MPLY FAST ZONE Usually 1

Config Adjustment Set Points (3)

SP#	NAME	DESCRIPTION	SP VALUE FIELD	SP TIME FIELD
12	SH ADJUST	DISTANCE TO TARG	ADJ BASED ON SH USUALLY 0.1	NOT USED
13	ROC ADJUST	CURRENT ROC	ADJ BASED ON ROC USUALLY 0.1 to 1.0	NOT USED
14	LIMIT ADJUST	MAX ADJUSTMENT	LIMIT IN FAST ZONE USUALLY 0.4	LIMIT Above 3 (Fast Zone) USUALLY 15

Config Safety Set Points (3)

SP#	NAME	DESCRIPTION	SP VALUE FIELD	SP TIME FIELD
15	EXV MIN %	MIN VLV %	MIN VLV % COMP ON USUALLY 5% / HI HGB	NOT USED
16	EXV MAX %	MAX VLV %	MAX VLV % COMP ON USUALLY 100%	NOT USED
17	LO SUPERHT	LOW SH SAFETY	SH<VALUE TM SPECIFIED USUALLY 2 F	TM BLW BEFORE SAFETY USUALLY 45 SEC

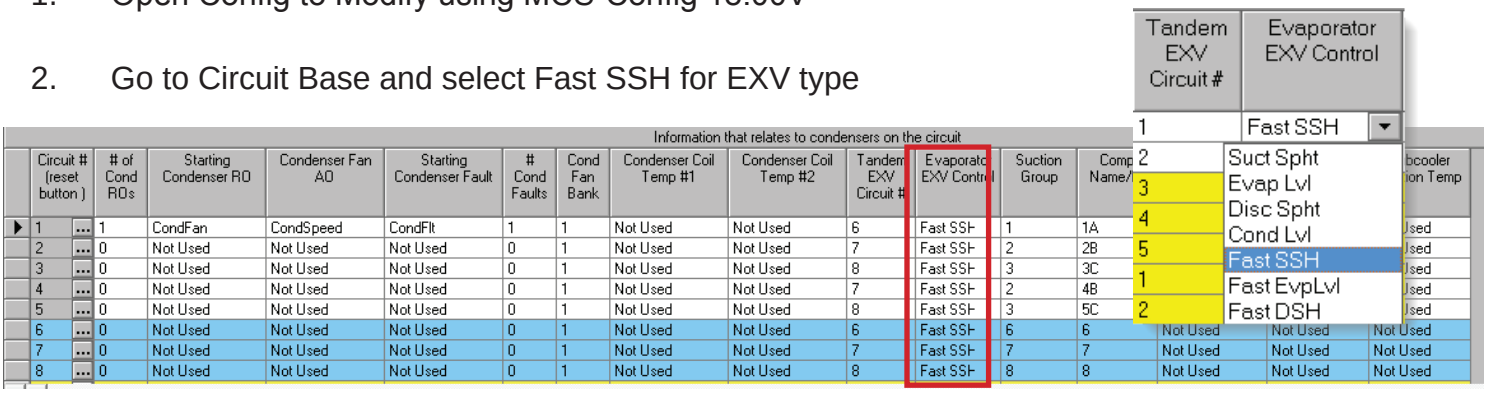
Config Timing Set Points (2)

SP#	NAME	DESCRIPTION	SP VALUE FIELD	SP TIME FIELD
19	EXV DELAY	CALC TME FAST ZN	FAST ZONE CALC TIME USUALLY 1 SEC	NOT USED
20	EXV START TM	MAX TME STARTUP	< 90 SECS-FIXED START >= 90 SECS-CALC START	NOT USED

Steps to Modify a Config to FAST SSH

1. Open Config to Modify using MCS-Config 18.00V

2. Go to Circuit Base and select Fast SSH for EXV type



3. Go to Set Points (The FAST SSH values are set to MCS Standards)
   a). SP 11 MUST BE Non-Active
   b). Set all items in value field to your company standards
   c). Set all values in Time(sec) to your company standards
   d). Set all values in Lockout Delay(HRS) to your company standards
   e). Set all values in Safety Down Time (MIN) to your company standards
   f). SP 18 must be Non-Active

4. SP 65. 66. 67, 69, 70, 71 & 72 are Non-Active

5. Next bring up Relay Output
   a). EXV Load & Unload adjust must not be setup here
   b). Nominal tonnage must not be setup here

6. Bring up Setup Screen and increase SI by 3 for User Logic Statements (If required)

7. Bring up SI screen to create User Logic Statements
   a). Create User Logic for Target +
   b). Create User Logic for Target –
   c). Create User Logic for Comp SH (You need to create one for each comp

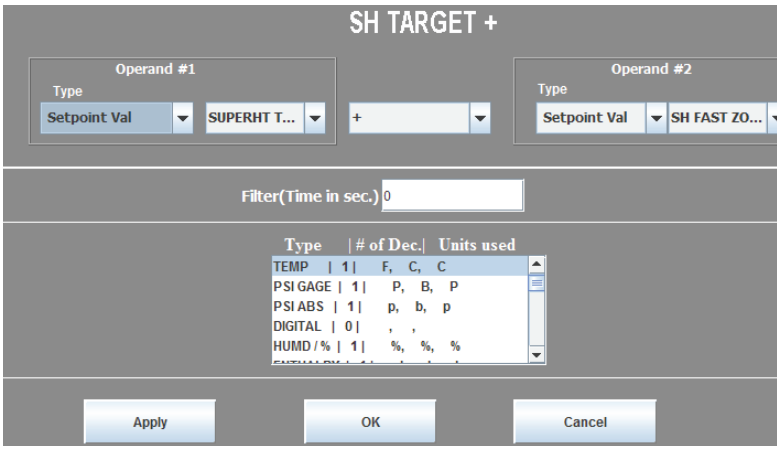
8. Change Revision Number in System tab to save with new Revision #

9. Test

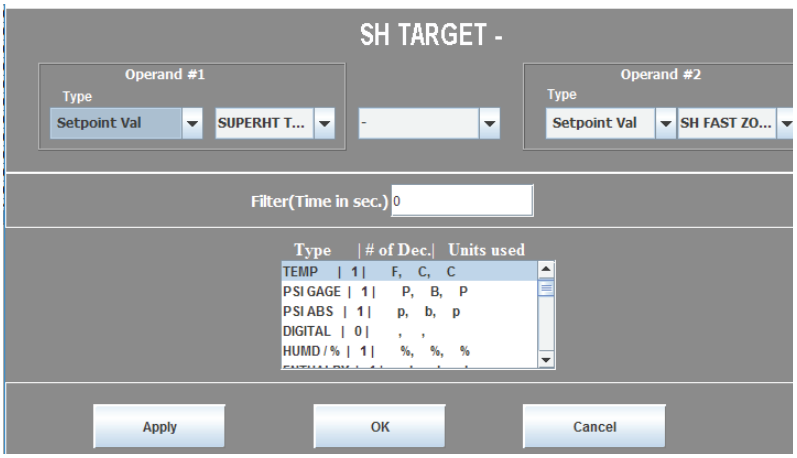
User Logic Setting in SI Grid

Setting up user logic SI will allow you to view in a live graph, with MCS-Connect. This way you can see results of any adjustments you make.

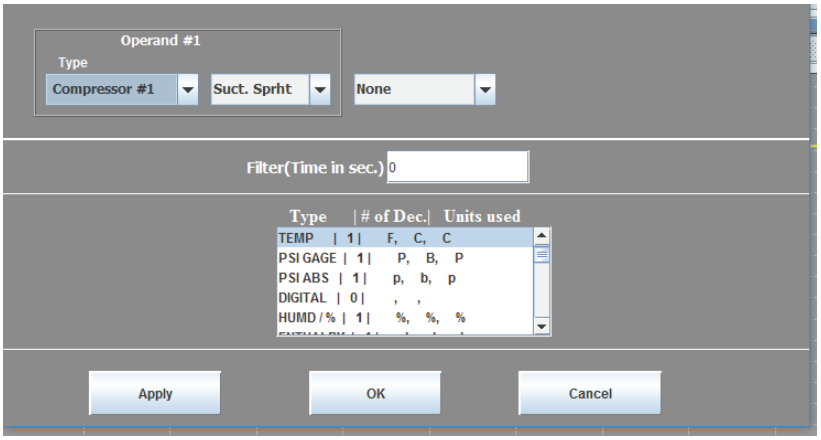
SH TARGETS +



SH TARGET -



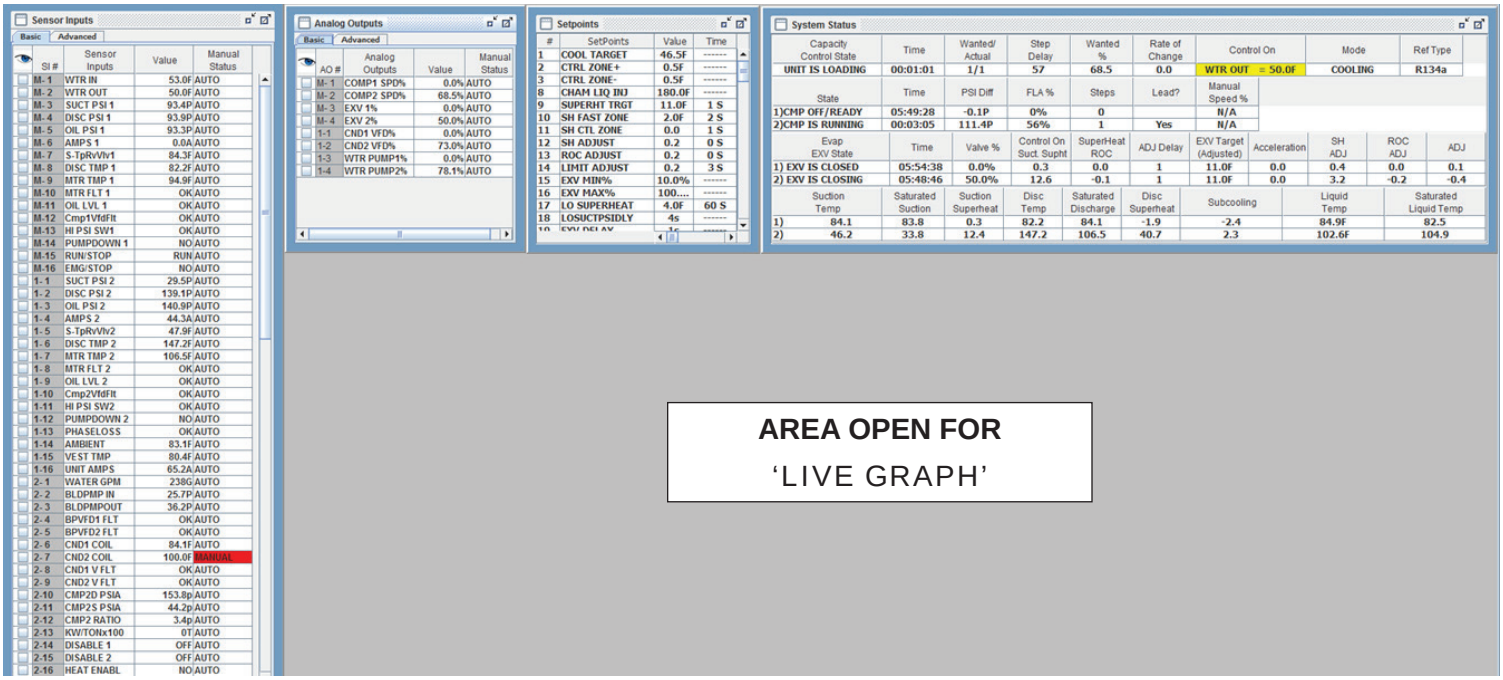
COMPRESSOR SUPER HEAT



You need to setup a User Logic SI for each compressor

MCS-Connect for Live Graph Setup

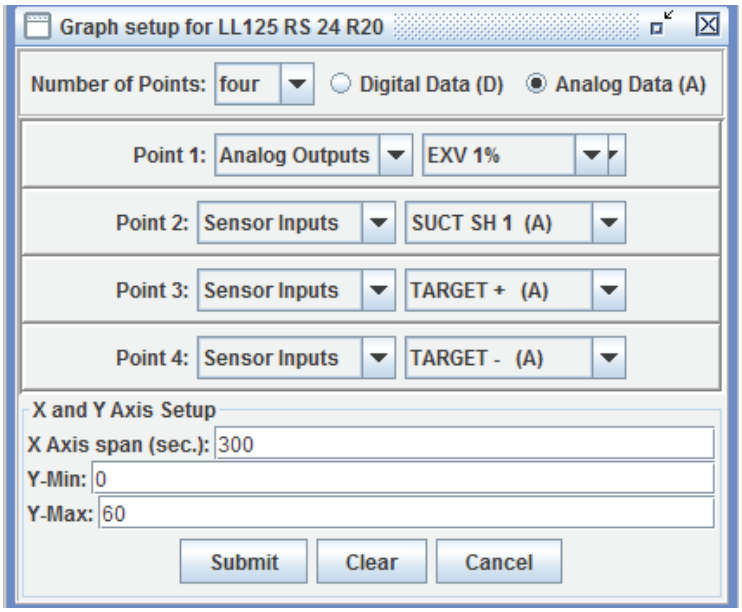
Setting up MCS-Connect for EXV Large Graph



- Using windows functions move MCS-Connect blocks to desired position
- Using Workspace tab save window just created

Building a Live Graph using MCS-Connect

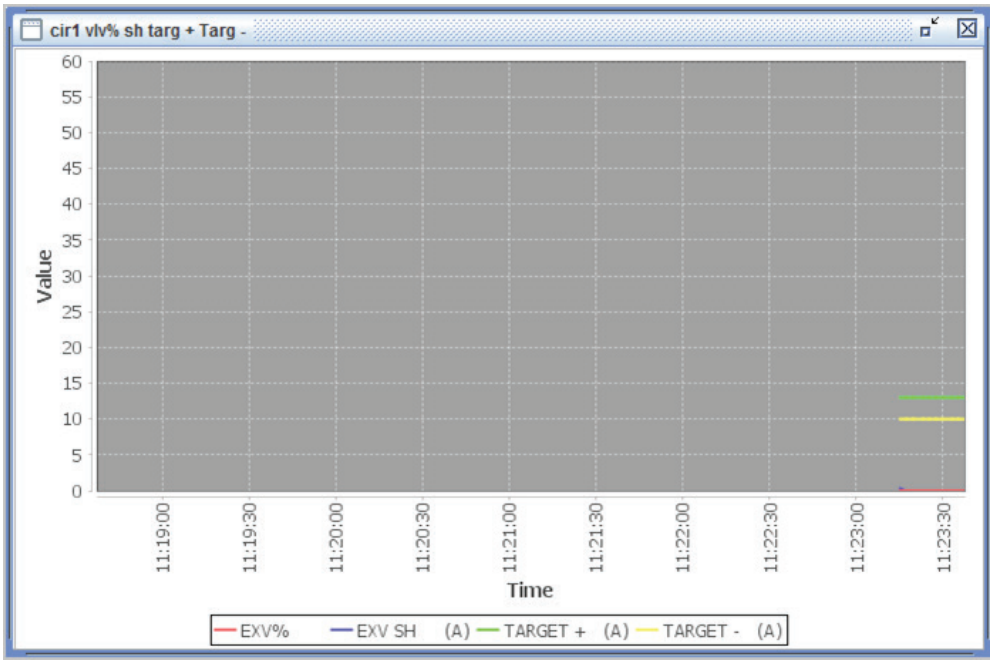
1. Select Live Graph tab at top
2. Select add a graph
3. When prompted select Number of points, select 4
4. Change point 1 to Analog Outputs and select EXV 1 %
5. Point 2 Sensor Input select Suct SH 1
6. Point 3 Sensor input select Target +
7. Point 4 Sensor Input select Target -
8. Set X Axis span to 300 seconds
9. Set Y Axis max to max valve % expected
10. Now Submit



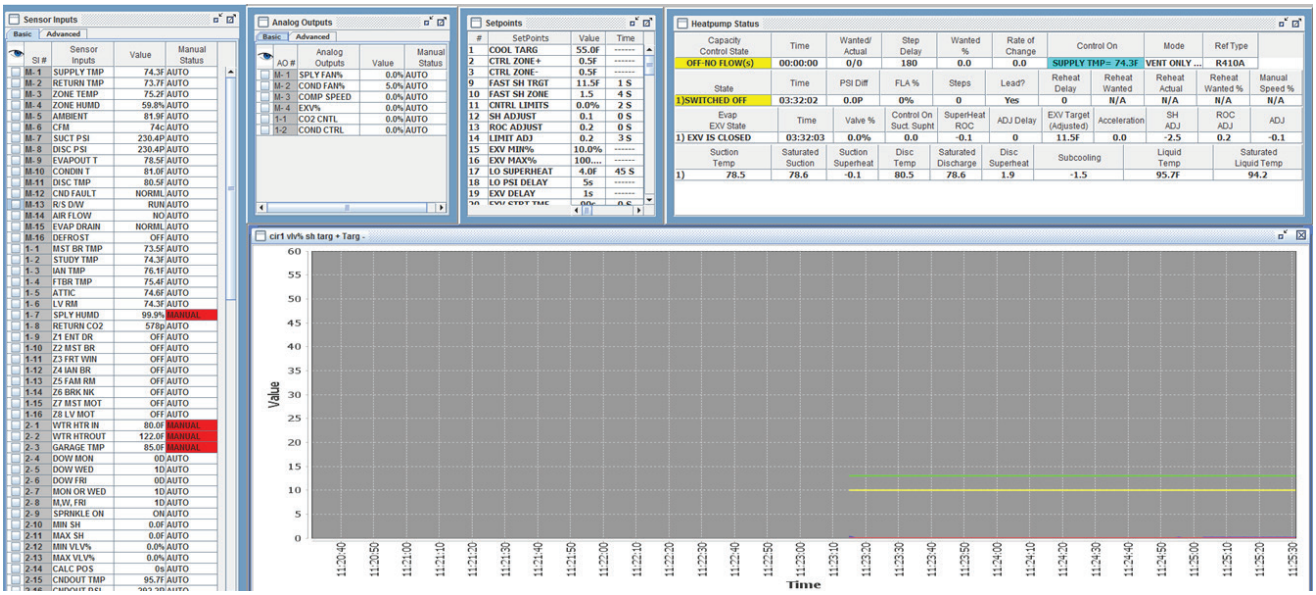
Positioning Graph in MCS-Connect

1. Using Windows function position graph in left open area setup.

2. Using Window functions expand graph to fit space.



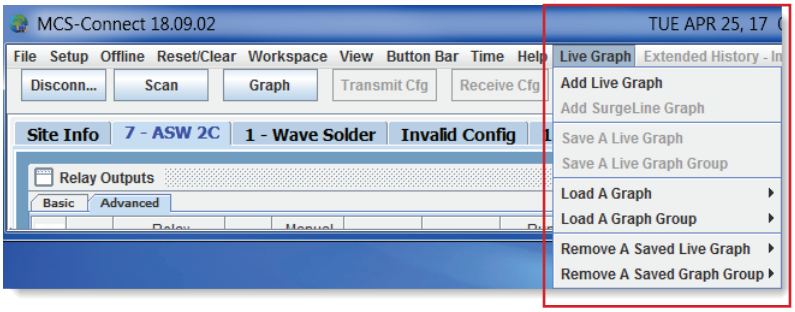
3. 'Live Graph' positioned in workspace window below.



Saving Live Graph

1. To save the New Live Graph click on the Live Graph tab .

2. Click on Save A Graph option and save



DEVELOPING STANDARDS FOR FAST SSH

✓ Fast Suction SH F / PSI Setup

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint
9	SUPERHT TRGT	11	5	20	0.5	1	1	0	0	Active ...	TEMP	Service Le	Time
10	SH FAST ZONE	2	0.5	4	0.1	1	10	0	0	Active ...	TEMP	Factory Le	Time
11	EXV LOAD ADJ	0	0	3	0.5	1	10	0	0	Non-Active ...	DEC1NOCH	Supervisor	Time
12	SH ADJUST	0.1	0.1	0.5	0.1	0	0	0	0	Active ...	DEC1NOCH	Supervisor	Setpoint
13	ROC ADJUST	0.1	0.1	15	0.1	0	0	0	0	Active ...	DEC1NOCH	Supervisor	Setpoint
14	LIMIT ADJUST	0.3	0.1	1	0.1	15	25	0	0	Active ...	DEC1NOCH	Supervisor	Time
15	EXV MIN%	5	2	50	1	0	0	0	0	Active ...	HUMD or %	Service Le	Setpoint
16	EXV MAX%	100	40	100	1	0	0	0	0	Active ...	HUMD or %	Service Le	Setpoint
17	LO SUPERHEAT	2	1	5	0.5	30	60	2	10	Active ...	TEMP	Service Le	Alarm
18	LO PSI DELAY	3	1	10	1	0	0	0	0	Non-Active ...	SECONDS	Supervisor	Time
19	EXV DELAY	1	1	1	1	0	0	0	0	Active ...	SECONDS	Service Le	Time
20	EXV STRT TME	90	90	90	1	0	0	0	0	Active ...	SECONDS	Service Le	Time

1. SP 9 FAST SH TRGT 11.0 DEGREES F
2. SP 10 FAST SH ZONE 2.0 DEGREES F
3. SP 14 LIMIT ADJUST 0.3 PERCENT & 1.5 PERCENT (ASSUMED DECIMAL 1.5)
4. SP 17 LO SUPERHEAT 2.0 DEGREES F
5. SP 20 EXV START TIME If < 90 SECONDS - START TIME FIXED
   If >= 90 SECONDS - START TIME CALCULATED

✓ Fast Suction SH C / BARS Setup

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint
9	SUPERHT TRGT	6	5	20	0.5	1	1	0	0	Active ...	TEMP	Service Le	Time
10	SH FAST ZONE	1.2	0.5	4	0.1	1	10	0	0	Active ...	TEMP	Factory Le	Time
11	EXV LOAD ADJ	0	0	3	0.5	1	10	0	0	Non-Active ...	DEC1NOCH	Supervisor	Time
12	SH ADJUST	0.1	0.1	0.5	0.1	0	0	0	0	Active ...	DEC1NOCH	Supervisor	Setpoint
13	ROC ADJUST	0.1	0.1	15	0.1	0	0	0	0	Active ...	DEC1NOCH	Supervisor	Setpoint
14	LIMIT ADJUST	0.3	0.1	1	0.1	15	25	0	0	Active ...	DEC1NOCH	Supervisor	Time
15	EXV MIN%	5	2	50	1	0	0	0	0	Active ...	HUMD or %	Service Le	Setpoint
16	EXV MAX%	100	40	100	1	0	0	0	0	Active ...	HUMD or %	Service Le	Setpoint
17	LO SUPERHEAT	1	1	5	0.5	30	60	2	10	Active ...	TEMP	Service Le	Alarm
18	LO PSI DELAY	3	1	10	1	0	0	0	0	Non-Active ...	SECONDS	Supervisor	Time
19	EXV DELAY	1	1	1	1	0	0	0	0	Active ...	SECONDS	Service Le	Time
20	EXV STRT TME	90	90	90	1	0	0	0	0	Active ...	SECONDS	Service Le	Time

1. SP 9 FAST SH TRGT 6.0 DEGREES C
2. SP 10 FAST SH ZONE 1.2 DEGREES C
3. SP 14 LIMIT ADJUST 0.2 PERCENT & 1.5 PERCENT (ASSUMED DECIMAL 1.5)
4. SP 17 LO SUPERHEAT 1.0 DEGREES C

✓ Fast LEVEL SH Setup

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint
9	SUPERHT TRGT	36	10	50	0.5	1	1	0	0	Active ...	TEMP	Service Le	Time
10	SH FAST ZONE	4	2	10	0.1	1	10	0	0	Active ...	TEMP	Factory Le	Time
11	EXV LOAD ADJ	0	0	3	0.5	1	10	0	0	Non-Active ...	DEC1NOCH	Superviso	Time
12	SH ADJUST	0.1	0.1	0.5	0.1	0	0	0	0	Active ...	DEC1NOCH	Superviso	Setpoint
13	ROC ADJUST	0.1	0.1	15	0.1	0	0	0	0	Active ...	DEC1NOCH	Superviso	Setpoint
14	LIMIT ADJUST	0.3	0.1	1	0.1	15	25	0	0	Active ...	DEC1NOCH	Superviso	Time
15	EXV MIN%	10	2	50	1	0	0	0	0	Active ...	HUMD or %	Service Le	Setpoint
16	EXV MAX%	100	40	100	1	0	0	0	0	Active ...	HUMD or %	Service Le	Setpoint
17	LO SUPERHEAT	3	1	5	0.5	30	60	2	10	Active ...	TEMP	Service Le	Alarm
18	LO PSI DELAY	3	1	10	1	0	0	0	0	Non-Active ...	SECONDS	Superviso	Time
19	EXV DELAY	60	1	120	1	0	0	0	0	Active ...	SECONDS	Service Le	Time
20	EXV STRT TME	210	210	300	1	0	0	0	0	Active ...	SECONDS	Service Le	Time

1. SP 9 FAST LVL TRGT 36 PERCENT
2. SP 10 FAST SH ZONE 4.0 PERCENT
3. SP 14 LIMIT ADJUST 0.2 PERCENT & 1.5 PERCENT (ASSUMED DECIMAL 1.5)
4. SP 17 LO SUPERHEAT 1.0 DEGREES C

Fast SH Low Suction Open

Low suction pressure logic kicks in when the compressor suction pressure drops below Setpoint #77 + Setpoint #79.

Example: Setpoint #77 = 15 PSI
Setpoint #79 = 1 PSI (15 PSI + 1 PSI = 16 PSI) when suction Superheat drops below 16 psi, enter low psi opening.

#	Name	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint
77	LOW SUCTION	15	30	0.1	90	120	2	10	Active ...	PSI GAGE	Factory Le	Lockout
78	LO SUCT UNLD	0.5	6	0.1	30	45	0	0	Active ...	PSI GAGE	Factory Le	Setpoint
79	LO SUCT RELD	1	8	0.1	0	0	0	0	Active ...	PSI GAGE	Factory Le	Setpoint

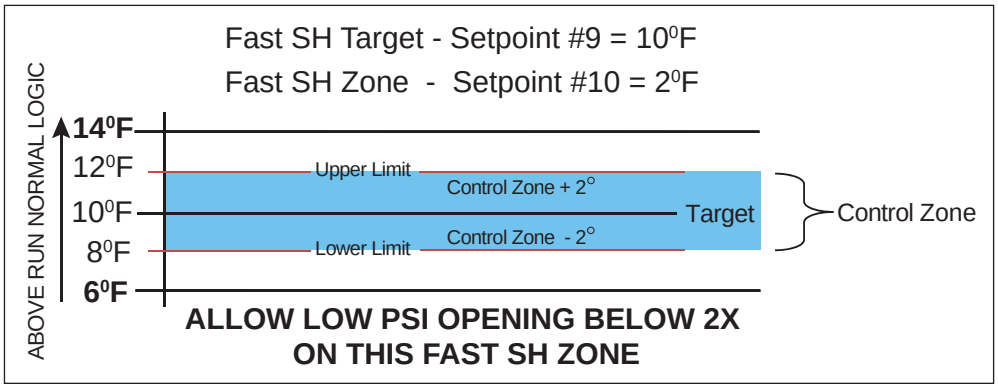
The adjustment made to the EXV in 'LOW SUCTION PSI' opening logic is controlled by two items:

1. **The delay between EXV adjustment is defined by setpoint #18 = 1 second**
2. **The amount to adjust the EXV opening is calculated as follow: 1.0% (hard coded) x setpoint #13 (3 seconds time field).**
3. **Calculation would be 1% x 3 seconds = 3% for opening of EXV.**

#	Name	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint
13	ROC ADJUST	0.1	0.5	0.1	3	10	0	0	Active ...	DEC1NOCH	Factory Le	Time
14	LIMIT ADJ	0.1	0.5	0.1	8	10	0	0	Active ...	DEC1NOCH	Factory Le	Time
15	EXV MIN%	2	50	0.5	0	0	0	0	Active ...	HUMD or %	Factory Le	Setpoint
16	EXV MAX%	40	100	1	0	0	0	0	Active ...	HUMD or %	Factory Le	Setpoint
17	LO SUPERHEAT	2	5	0.5	120	120	2	10	Active ...	TEMP	Factory Le	Alarm
18	LO PSI DELAY	1	5	1	0	0	0	0	Active ...	SECONDS	View Only	Setpoint

3 SEC.

1%



WHEN BELOW 16 PSI AS IN THIS EXAMPLE, RUN LOW PSI OPENING, IF SUPERHEAT RATE OF CHANGE GOES POSITIVE, GO BACK TO NORMAL CONTROL LOGIC

- **SP 77-** Defines when Low Suction safety occurs and based on the time field how long before the system will go into that safety.
- **SP 78-** Defines at what value above the Low Suction safety the system will take corrective action, if available. The Time field in this Set Point defines how long to wait before starting corrective action.
- **SP 79-** Defines at what value above the Low Suction SP the system is considered safe and can start to reload.

These Set Points, #77, #78 and #79 are not a function of FAST SSH

It is defined here since it could change the capacity of the compressor by going into low suction unloading if the FAST SH does not correct the low suction within the time frame specified.

✓ Fast Sub Cooler SH Setup

#	Name	Value	Min	Max	Adjust Value	Time (SEC)	Max Time Allowed (SEC)	Lockout Delay (HRS)	Safety Down Time(MIN)	Active or Non-Active	Select Value: # decimals & print char	Level Of Auth. To Display	Type of Setpoint
65	SC FSH TARG	18	12	22	0.5	1	5	0	0	Active	TEMP	View Only	Time
66	SC FSH ZONE	2	1	3	0.5	1	5	0	0	Active	TEMP	View Only	Time
67	SC SH/RC ADJ	0.1	0.1	0.5	0.1	1	50	0	0	Active	DEC1NOCH	View Only	Time
68	SC FSH LIMIT	0.4	0.1	2	0.1	10	10	0	0	Active	DEC1NOCH	View Only	Time
69	SC MIN/MAX V	2	1	20	1	100	100	0	0	Active	HUMD or %	View Only	Time
70	SC LOW SH	5	2	10	1	15	60	0	0	Active	TEMP	View Only	Setpoint
71	SC EXV DELY	1	1	10	1	0	0	0	0	Active	SECONDS	View Only	Setpoint
72	SC START TME	5	1	120	1	0	0	0	0	Active	SECONDS	View Only	Alarm

SETPOINT	NAME	VALUE FIELD	TIME FIELD	
1. SP 65	FAST SC TARGET	18.0 DEGREES F		
2. SP 66	FAST SC FAST ZN	2.0 DEGREES F		
3. SP 67	FAST SC SH ADJ & ROC	0.1 SH ADJ	0.1 ROC ADJ	(ASSUMED 1 DECIMAL)
4. SP 68	FAST SC SH LIMITS	0.4 MAX CLOSE ADJ	0.1 MAX LARGE ADJ	(ASSUMED 1 DECIMAL)
5. SP 69	FAST SC MIN/MAX V	2.0 MIN VLV %	100.O MAX VLV %	(ASSUMED 1 DECIMAL)
6. SP 70	FAST SC LOW SH	5.0 DEGREES F		
7. SP 71	FAST SC EXV DELY	1 SECOND		
8. SP 72	FAST SC START TIME	5 SECONDS		

Suggestion for Controlling FAST SSH

1. Suggest using MCS-CONNECT with **'LIVE GRAPH'** to make adjustments.

2. Make one (1) adjustment at a time and watch **'LIVE GRAPH'** for a minimum of five (5) minutes before making another adjustment.

3. If **'LIVE GRAPH'** shows movement back and forth, increase SP 13 by 0.1 and evaluate again using **'LIVE GRAPH'** for a minimum of five (5) minutes before making another adjustment.

4. If **'LIVE GRAPH'** shows SH always at bottom of FAST ZONE, increase SP 12 by 0.1 and evaluate again using **'LIVE GRAPH'** for a minimum of five (5) minutes before making another adjustment.

5. If recovery from compressor speed change or a 2nd compressor (tandem) comes on or off and recovery to FAST ZONE takes longer than two (2) minutes, increase SP 14 time field by 2.

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