APPLICATION NOTE

APP-058

Revision History

Date	Author	Revision	Description
02/24/10	John Walterick		Created Application Note
05/31/11	Weston Klebs		Updated Application Note
11/18/15	Justin Mulligan		Revised Application Note

MCS-MAGNUM Interface To Copeland Digital Scroll

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1. General Concept

This description is intended to aid in the setup of a Copeland Digital Scroll Compressor with a Copeland Digital Compressor Controller in conjunction with a MCS-Controller. The MCS micro controller is used to control compressor capacity with a PID loop. This loop can be used to control demand % based on a variety of different sensor readings.

2. Challenges

The Copeland Controller is used in many systems without a main CPU controller. It has logic built into the module for controlling the compressor on its own. Because of this, careful consideration to time delays and wiring must be taken when incorporating the controller into an MCS-Controls package. Below is a list of items that should be considered when setting up the config for MCS Controller.

2.1 The Copeland Controller has a build in time delay of between 90 and 120 seconds. This is initialized when:

A. On a power fail/return the time delay will start when 24VAC is supplied to the module
B. If the demand signal drops below .5 Vdc at any time.
C. It the demand signal rises above 1.44Vdc without the module sensing compressor current draw.
D. After each compressor shut down event. (N/A for Refrigeration-Scroll and Discuss Copeland Controllers).

2.2 The Copeland Controller modulates or cycles the unloader solenoid in an on/off pattern according to the capacity demand signal from the MCS-Controller.

A. Suction pressure is read by a transducer wired through the Copeland Controller then to an input on the MCS Controller. The Copeland Controller filters the signal to compensate for the 15 or 20 second load pattern.
B. If the MCS-Controller is monitoring discharge pressure, a filter will need to be applied to the sensor input in the config. Filter should be set to 15 or 20 seconds depending on the unloading pattern. It can be checked/changed by double clicking on the SI in Connect. This will ensure proper Condenser fan operation if the reading is being used to control head pressure.

2.3 Copeland Controller will not load the compressor above 50% capacity if a discharge thermistor is not installed or if a resistor is not in place to simulate the thermistor is installed.

A. If a MCS T-100 is to be used to monitor disc temperature, install the resistor to bypass high disc temp safety on Copeland Controller.

3. MCS-Config Setup

3.1 One Analog Output will be set up per compressor. It is not recommended to set up multiple Copeland Controllers on one capacity demand AO. Set the AO display type to Digital Scroll in the Analog Output Information Screen.

This changes the output from 0-10Vdc to 1.4-5Vdc. The Analog Output is used by the capacity control logic and is modulated between set point #31 “MIN CAPACITY” and set point #30 “MAX CAPACITY”. Set point #31 “MIN CAPACITY” must not be set lower than 30% to ensure proper operation.

Num #	Name	Control Type	Invert	Comments	Modbus Display Type
M-1	CMP LOAD%	Digital Scroll	NO		SPARE
M-2	SPAREM-2	Standard	NO		SPARE
M-3	SPAREM-3	Standard	NO		SPARE
M-4	SPAREM-4	Standard	NO		SPARE
1-1	SPARE1-1	Standard	NO		SPARE
1-2	SPARE1-2	Standard	NO		SPARE
1-3	SPARE1-3	Standard	NO		SPARE

3.2 The Analog Output M-1 “CMP LOAD%” is selected in the ‘Compr Speed or Modulate Hot Gas AO’ column of the Circuit Base screen. This is the output that the MCS-Controller will modulate based on control temperature sensor (typically Chilled Water Out).

MAGNUM Circuit Base Screen

Select Output and Sensor Inputs per circuit

Compr Speed or Modulate Hot Gas AO	Compressor speed fault	Slide Closed Indicator	Pump Down	EXV Output
CMP LOAD%	Not Used	Not Used	DISABLE 1	Not Used

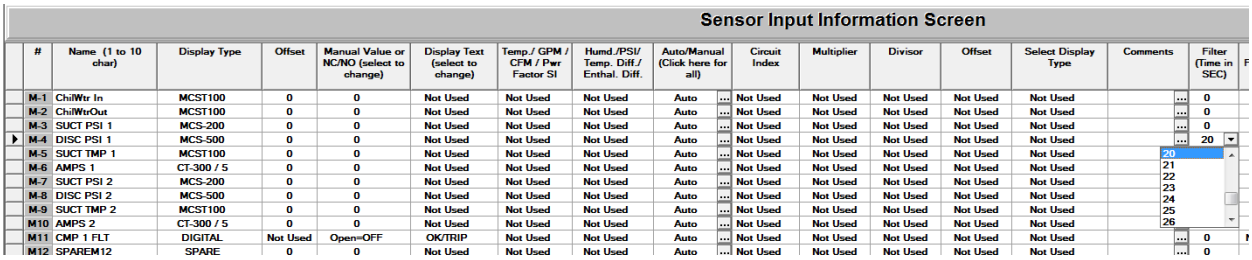
3.3 Compressor Fault Sensor Input is set up in the SIs screen. The input is selected as a digital type. The A1/A2 contacts on the Copeland Controller are normally open and close when a fault is detected. Below is how the set up looks in MCS-Config.

M-8	DISC PSI 2	MCS-500	0	0	Not Used
M-9	SUCT TMP 2	MCST100	0	0	Not Used
M10	AMPS 2	CT-300 / 5	0	0	Not Used
M11	CMP 1 FLT	DIGITAL	Not Used	Open=OFF	OK/TRIP
M12	SPAREM12	SPARE	0	0	Not Used
M13	CHW FLOW	DIGITAL	Not Used	Open=OFF	NO/YES

The digital Compressor Fault SI is selected Compressor Speed Fault Column of the Circuit Base screen.

Circuit # (reset button)	Alarm Relay	Comp Proof	Compr Speed(%) or Modulate Hot Gas AO	Compressor Speed Fault	Slide Closed Indicator
1	Not Used	Not Used	CMP LOAD%	CMP 1 FLT	Not Used
2	Not Used	Not Used	Not Used	Not Used	Not Used
3	Not Used	Not Used	Not Used	Not Used	Not Used
4	Not Used	Not Used	Not Used	Not Used	Not Used
5	Not Used	Not Used	Not Used	Not Used	Not Used

3.4 Discharge Pressure Sensor Input is set up in the SIs screen (optional). This input is wired to the MCS discharge pressure transducer. Apply a filter to the SI in order to smooth out the discharge pressure reading which has a tendency to fluctuate with the compressor load pattern. Select a 15 or 20 second filter depending on the load pattern of Copeland Controller used.



Sensor Input Information Screen

#	Name (1 to 10 char)	Display Type	Offset	Manual Value or NC/NO (select to change)	Display Text (select to change)	Temp./ GPM / CFM / Pwr Factor SI	Humd./PSI/ Temp. Diff./ Enthal. Diff.	Auto/Manual (Click here for all)	Circuit Index	Multiplier	Divisor	Offset	Select Display Type	Comments	Filter (Time in SEC)
M-1	ChilWtr In	MCST100	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		0
M-2	ChilWtrOut	MCST100	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		0
M-3	SUCT PSI 1	MCS-200	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		0
M-4	DISC PSI 1	MCS-500	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		20
M-5	SUCT TMP 1	MCST100	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		
M-6	AMPS 1	CT-300 / 5	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		
M-7	SUCT PSI 2	MCS-200	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		
M-8	DISC PSI 2	MCS-500	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		
M-9	SUCT TMP 2	MCST100	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		
M10	AMPS 2	CT-300 / 5	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		
M11	CMP 1 FLT	DIGITAL	Not Used	Open=OFF	OK/TRIP	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		0
M12	SPAREM12	SPARE	0	0	Not Used	Not Used	Not Used	Auto	Not Used	Not Used	Not Used	Not Used	Not Used		0

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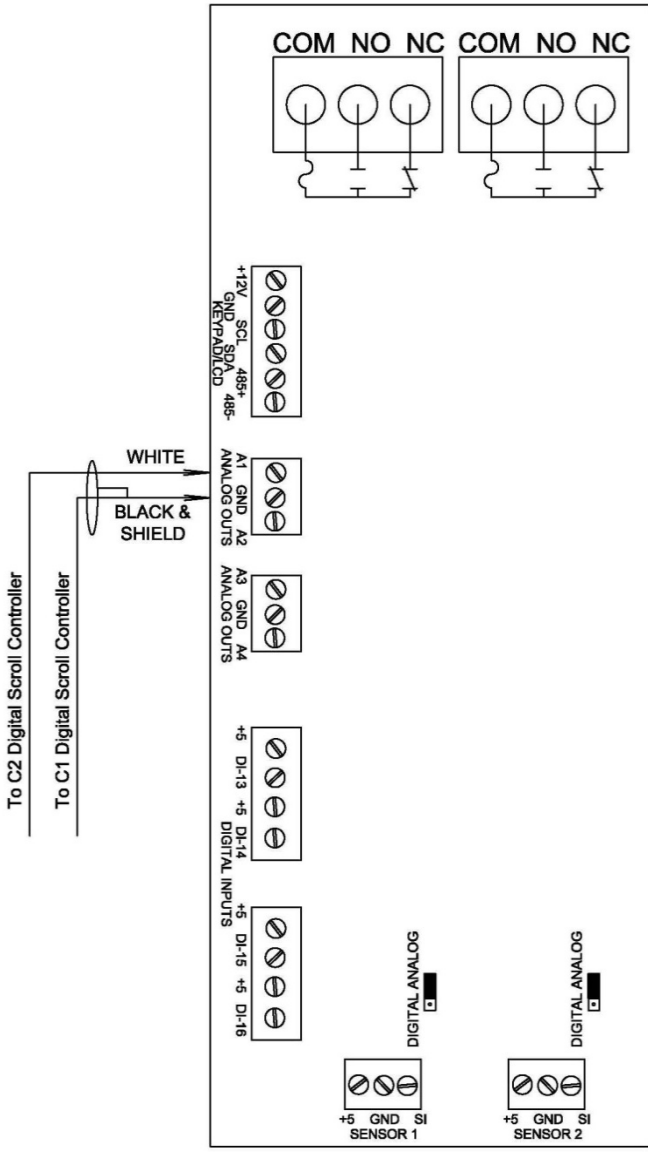
3.5 Set Points

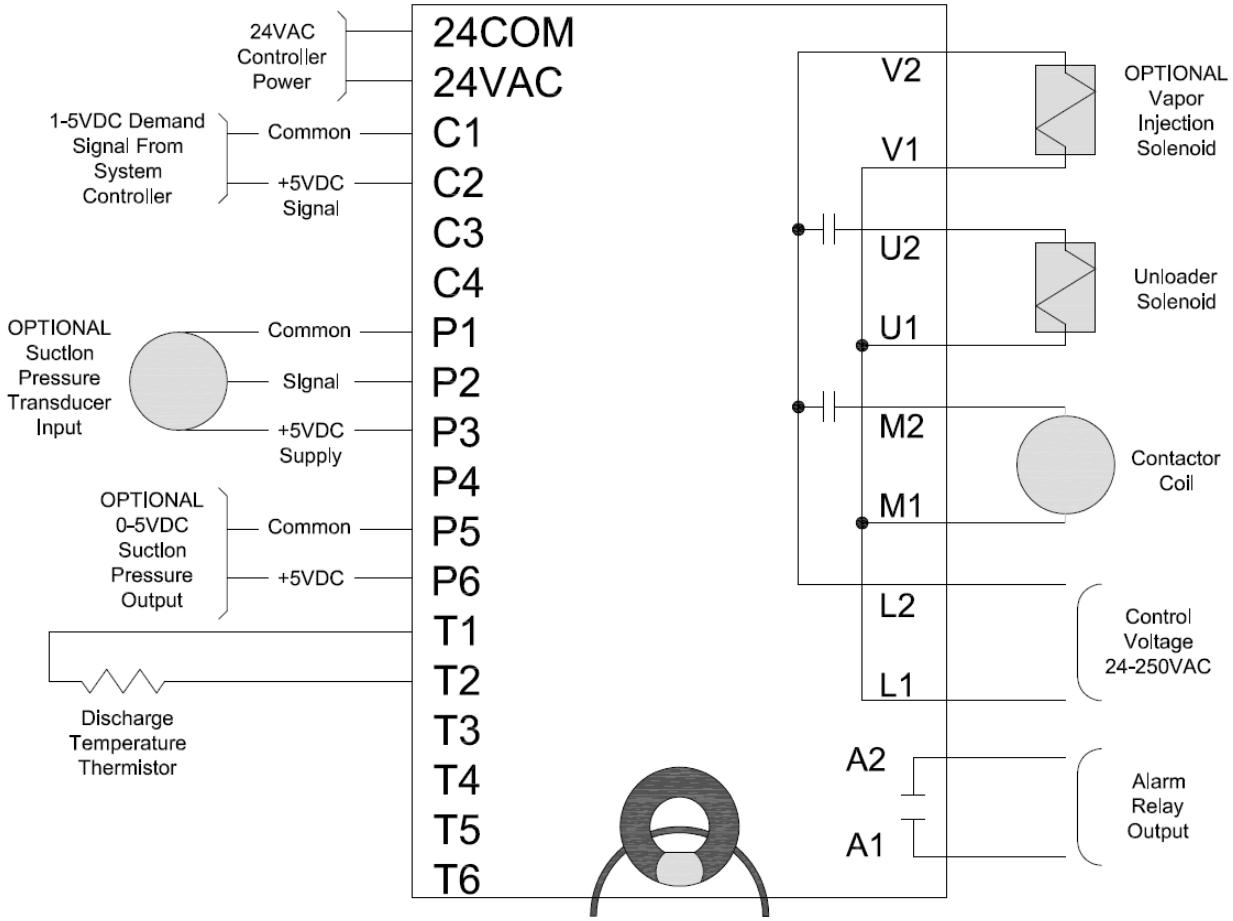
SP #	SP NAME	SP VALUE	COMMENTS
23	POWERUP DLAY	90 SECONDS MIN	At power up we need to get by digital scroll controller time delay
30	MAX CAPACITY	100% MAX	Maximum compressor capacity
31	MIN CAPACITY	30% MIN	Minimum compressor capacity. Set 30% and above to ensure voltage to compressor is above 1.4vdc
59	ACYC OFF-ON	120 SECONDS MIN	When compressor shuts off this 60 second delay plus 60 seconds in ready state
63	ACYC ON-ON	NO MIN	This is used to control # starts per hour
76	LoAmpNoStart	MIN = MAX = 5 SECONDS	By getting the time delays by the scroll controller delay we can test amps to verify running correctly
87	HI DISC TEMP	230° F	Using the magnum discharge temp control allows the system to stop loading, unload & reload as required
88	HI DISC UNLD	2° F	Unload if 228 f
89	HI DISC RELD	5° F	Reload if 225 f
212	CMP 1 FLT	0 (digital)	Set up as a Lockout Type. Time(SEC) column should be set to 2 seconds.

4. Magnum / Copeland Wiring

4.1. MCS-Magnum Controller



4.2. Copeland Digital Controller



5. Wiring Steps

5.1 Copeland Controller

A. Wire 24 VAC Line & Common to terminals L1 / L2.
B. Wire 24 VAC to VAC / COM on opposite sides of the board.
C. Wire M1 / M2 directly to compressor contactor. Do not wire through the Compressor RO on MCS –Controller.
D. Wire U1 / U2 to compressor unloader.
E. Wire AO from Magnum to C1 and C2.
F. Wire between 4K to 5K Resistor between T2 & T1. (If discharge temperature safety is on MCS Controller. Otherwise wire Copeland Discharge Thermistor to T2 & T1.)
G. Wire A1 and A2 to a Compressor Fault SI set up in the MCS-Config as a digital input. Wire to terminals +5 and SI on the input.

5.2 MCS-Magnum Controller

A. See drawing 4.1 above.

6. Conclusion

- By setting up the controllers as specified above, it allows the MCS-Controller to provide many unique safeties without interference from the Copeland Controller time delay.
- The Low Amp/No Start Safety checks for inadequate amp draw. Possible mechanical trip, missing phase, etc. keeping the compressor contactor coil from energizing.
- The MCS Hi Disc safety logic allows the MCS-Controller to unload to control its way past a High Discharge Temp Failure.
- The Anti-Cycle timer settings are long enough to ensure we pass the Copeland Controller anti short cycle delay with minimum wasted time.
- MCS Controller is used primarily to monitor compressor safeties. Alarms are displayed in written form rather than only having a flash code.
- For a full description of flash codes on the Copeland Controller please refer to Copeland Application Engineering Document AE-1328 R2. These will be helpful when diagnosing a Comp Fault alarm.