Hoffman|Controls

Installation & Operating Instructions

861-ASQ Series

Condenser Fan Sequencer

Description

Low ambient control may be accomplished by reducing the quantity of ambient air through an air-cooled condenser. The 861-ASQ Sequencer provides incremental sequencing of multiple condenser fans. Maintaining sufficient pressure differential for proper expansion valve operation is critical when low ambients are encountered.

Uncontrolled condensing temperature, in low ambients, results in low evaporator temperature (freezing) and allows uncontrolled superheat at the expansion device. Uncontrolled vapor cycle performance causes liquid "slugging" and/or oil migration, resulting in compressor damage or failure.

Sequencing condenser fans may be utilized in single or multiple compressor (circuit) applications. Options available are as follows:

Sensing Circuits	Use Method	861-ASQ	816-10DH
Single	Liquid	Stand Alone	Optional
Up to 6	Liquid	With 851-MS	Optional

Condenser fan motors may be sequenced over a temperature range (50°F to 80°F) as represented by a 2–17.5V DC control ramp within the Sequencer. Although the Sequencer is capable of sensing liquid line or ambient temperature, **liquid line sensing is the recommended sensing method**. By sensing liquid sub-cooling performance, low ambient control is accomplished regardless of condenser and evaporator loading, or the compressor capacity on unloading.

Sequencer stages activate in succession requiring the previous stage to operate first. When two 861-ASQ Series boards are operated in series, the "NEXT OUT" terminal of the first board must be connected to the "PREV IN" terminal of the second board if proper, sequential operation is to be maintained. Use of two Sequencers in series will require recalibration of the boards.

Control differential (hysteresis) for each stage is fixed at 6°F, 1.7V DC or 3.4 mA DC, depending on the Sequencer input utilized.

If the possible maximum of 6 Sequencer stages are concurrently called to be on, they will sequence on symmetrically over an 8 second interval (factory set). Any fewer than 6 stages will react in a fractional portion of the total time interval, i.e., 3 stages sequence on in 4 seconds. Additionally, either 12 or 16 second intervals are optionally available.

All sequencers are factory calibrated for liquid line sensing.

General Applications

The condensing temperature of an air-cooled condenser is directly related to the degree of sub-cooling that occurs for a specific quantity of airflow and ambient air temperature.

Sequencing condenser fans to accomplish low ambient control, by controlling the liquid sub-cooling depends upon:

1. The low ambient design requirement, and
2. The quantity of fans available for sequencing.

Lower design temperatures will require an increased number of fans to be sequenced to adequately provide low ambient control. Reducing condenser flow to approximately 1/6th of full flow will generally provide condenser operation to 15°F (±) ambient. Sequencing up to six fans will effectively increase the minimum low ambient operating temperature. Control below 15°F (±) ambient temperatures will require more than six steps and/or require modulating motor speed control for one or more condenser fan motors. See Table 1 for Minimum Ambient Temperatures.

Sequencing condenser fans should reduce airflow over the entire face area of the condenser surface. Varying airflow by sequencing fans in a segregated or partitioned air-cooled condenser is not recommended.

Proper system refrigerant charge is critically important to the performance of low ambient condenser control. Verifying that refrigerant circuit(s) provide the recommended manufacturer's sub-cooling at maximum design ambient is critical. An over-charged or under-charged refrigerant circuit will adversely affect liquid line sensing and low ambient control operation.

Depending on the required minimum operating ambient, a compressor "lockout" should be incorporated in the control system. Compressor capacity should be limited in low ambients to provide only that needed to accomplish the evaporator loading for the specific low ambient temperature. High and low pressure safety limits should always be included in each compressor's refrigerant control circuit.

Once all fans have sequenced off, final condensing temperature (pressure) will vary depending on the quantity of ambient air being naturally circulated through the condenser.

Stand Alone Applications

Stand alone applications use one or more Sequencers, each utilizing their respective sensor (liquid) for controlling a single refrigerant circuit.

When two Sequencers are required to control multiple fans, mount one Sensor for use with both Sequencers hooked in series. Recalibration of both Sequencers will be required to energize fans over the anticipated liquid temperature range rather than the original factory calibrated range.

System Applications

System applications are described as one or more Sequencers that are utilized in combination in a control system with 816-10DH Series Controllers.

When the Sequencer(s) are used as part of a low ambient (15°F minimum) control system, the "SENSOR" terminals can be used.

The "2–10V DC" terminals can be used to accept an output signal from the 851-MS Series Multiple Sensor Selector or some other external DC volt source, over the range of 50° to 80°F.

The "4–20 mA" terminals will accept an external DC mA signal that reflects the 50° to 80°F liquid line temperature.

The Controller is factory calibrated for liquid line sensing for sequencing up to four (4) fans (861-4ASQ) or six (6) fans (861-6ASQ); see Table 1. Two (2) 861-ASQ Series Sequencers in series may be controlled from one (1) 851-MS Multiple Sensor Selector.

When 816-10DH Series (variable speed) controls are used in a system, the 861-ASQ Series Sequencers provide incremental step control of a selected group of condenser fan motors. The 816-10DH Series Controller modulates speed of one or more motors. The 851-MS Control is required for multiple circuit applications.

"Aux Out" Output

The "Aux Out" is a feature of the 861-ASQ Controller that provides an output that varies from 2 to 10 volts DC.

This output can be generated from the liquid line sensor, the 2–10V DC input signal, or the 4–20mA input signal.

The "Aux Out" output can serve at least two functions:

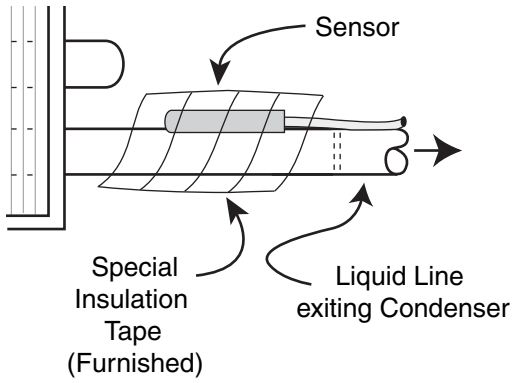
1. Drive a series of not more than twenty (20) 816-10DH(DC) Fan Speed Controllers.
2. Be a means of extending the 2–17 volt ramp to another 861-ASQ Controller, adding another six (6) stages of control maximum.

Installation Procedure

- **Preinstallation** — Install tab to the "OPR" terminals, connect 24V AC and observe.
- **Installation** — Select the Controls or Controllers required for the application. See Table 1 to determine the specific control required.

Sensor Terminals	861-ASQ Function
"Open"	Stages will not energize
"Shorted"	All stages will energize

Mount the 861-ASQ Series Controller and 851-MS or 816-10DH Series controls in a typical weather protected control panel. See Figure 4 Controls dimensions.



Sensor Cross Section Diagram

Table 1

Factory Standard Calibration — 861-4ASQ								
Fan To Be Controlled	Use Step Number	Energize Stages @ Liquid °F/VDC Ramp					Min. Low Ambient	Comp Liq. °F
		Stage 1	Stage 2	Stage 3	Stage 4		°F	Lockout
1*	4*				78 / 15.6		*	*
2	3			72.5 / 14.2	78 / 15.6		52° ±	66°
3	2		67 / 12.8	72.5 / 14.2	78 / 15.6		40° ±	60°
4	1	61.5 / 11.7	67 / 12.8	72.5 / 14.2	78 / 15.6		28° ±	54°

Factory Standard Calibration — 861-6ASQ									
Fan To Be Controlled	Use Step Number	Energize Stages @ Liquid °F/VDC Ramp						Min. Low Ambient	Comp Liq. °F
		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6		
1*	6*						78 / 15.6	*	*
2	5					72.5 / 14.2	78 / 15.6	52° ±	66°
3	4				67 12.8	72.5 / 14.2	78 / 15.6	40° ±	60°
4	3			61.5 / 11.7	67 12.8	72.5 / 14.2	78 / 15.6	28° ±	54°
5	2		56 / 10.3	61.5 / 11.7	67 12.8	72.5 / 14.2	78 / 15.6	21° ±	50°
6	1	50.5 / 9.4	56 / 10.3	61.5 / 11.7	67 12.8	72.5 / 14.2	78 / 15.6	14° ±	47°

* On/Off control of one fan is not recommended for ambient control.

1. **Liquid Line Mounting** — Mount Sensor on top of the liquid line where the line exits the condenser coil.
   a. Fasten Sensor firmly, using tape provided. Make sure the metal tab "heat sink" on the Sensor makes firm contact with the liquid line tubing.
2. **Single Circuit Refrigerant Systems** — Attach Sequencer Sensor to terminals marked "SENSOR" "IN1" and "IN2" on the Controller. When applicable, attach Sensor to terminals on 816-10DH Series Motor Speed Controller (see Figure 5.)
3. **Multi Circuit Refrigerant Systems** — Connect Sensor cables to S1, S2, S3, etc. on 851-MS Control and wire 2–10V DC Out on 851-MS to 2–10V DC In on the 861-ASQ Sequencer (see Figure 5.)
4. **When additional cable is required** —
   a. Always use 22 AWG (minimum) stranded twisted pair cable, properly insulated for outdoor applications.
   b. Sensor cables, 2–10V DC, 4–20 mA, Aux Output, and PREV IN, NEXT OUT leads should not run in proximity, or attached to conduit carrying line voltage power.

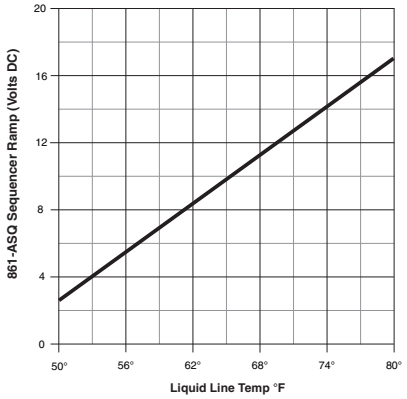
Sequencer Recalibration

Should the Sequencer require recalibration, refer to Figure-1 (Ramp Volts DC vs. Liquid Line Temperature °F). Use Figure 2 for 2–10V DC input and Figure 3 for 4–20 mA DC input. With compressor control circuit de-energized:

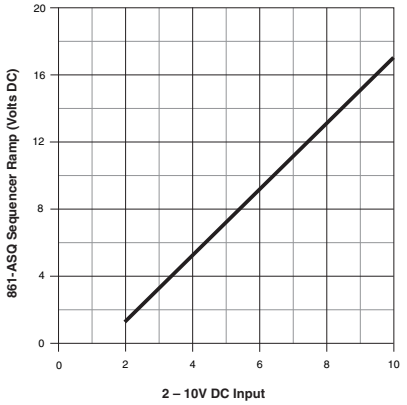
1. Remove common from relay(s) on Sequencer to de-energize condenser fan circuit.
2. Place jumper across "CAL" pins at JP1.
3. Turn all "Step Adjust" trim pots R31 through R36 fully CW.
4. Attach (+) Digital Voltmeter to TP1. Attach (–) side of Voltmeter to "AUX OUT" (–) terminal.
5. Apply 24V AC power.
6. Select from Figure 1, the desired temperature °F (liquid) to energize fans. Stage 1 should always be the lowest temperature. Stage 4 or 6 should always be the highest temperature value. Use Figure 2 for 2–10V DC input and Figure 3 for 4–20 mA DC input.
7. Set "CAL" pot R6 to V DC selected for energizing Stage 1.
8. Turn STG1 pot CCW until the associated relay just energizes.
9. Repeat Steps 7 and 8 for 2nd through 4th or 6th stages for DC voltages selected.
10. Remove jumper from "CAL" pins.
11. Re-install "common" to relays to reconnect condenser fan circuit interlock.
12. Re-install compressor control circuit; start A/C system.

Series Sequencer Calibration

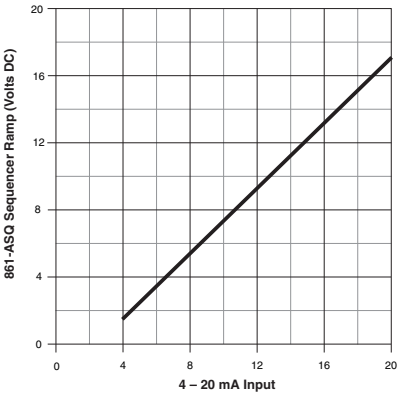
When using two Sequencers in series, ensure "NEXT OUT" of first board is connected to "PREV IN" of second board. Connect "AUX OUT" to 2–10 "VDC" and "LO", observing correct polarity. Calibrate boards as though they are one board with an increased number of stages, i.e., 861-6ASQ in series with an 861-4ASQ would be treated as a single 10-stage board. Calibrate using the above procedure allowing for additional stages. Only the first board is jumpered for "CAL" and levels set with CAL pot R6 on the first board while monitoring TP1 on same.



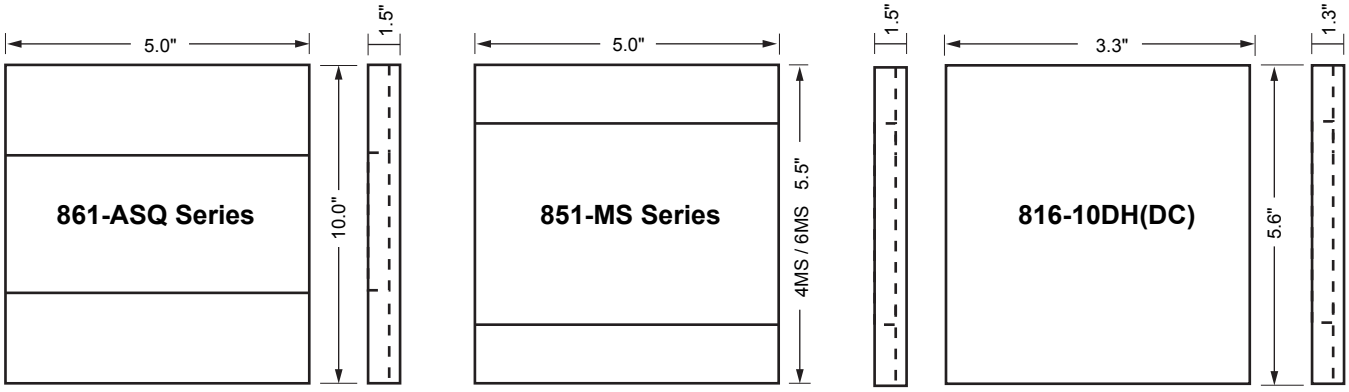
Ramp Volts DC vs. Liquid Line Temp. °F
Figure 1



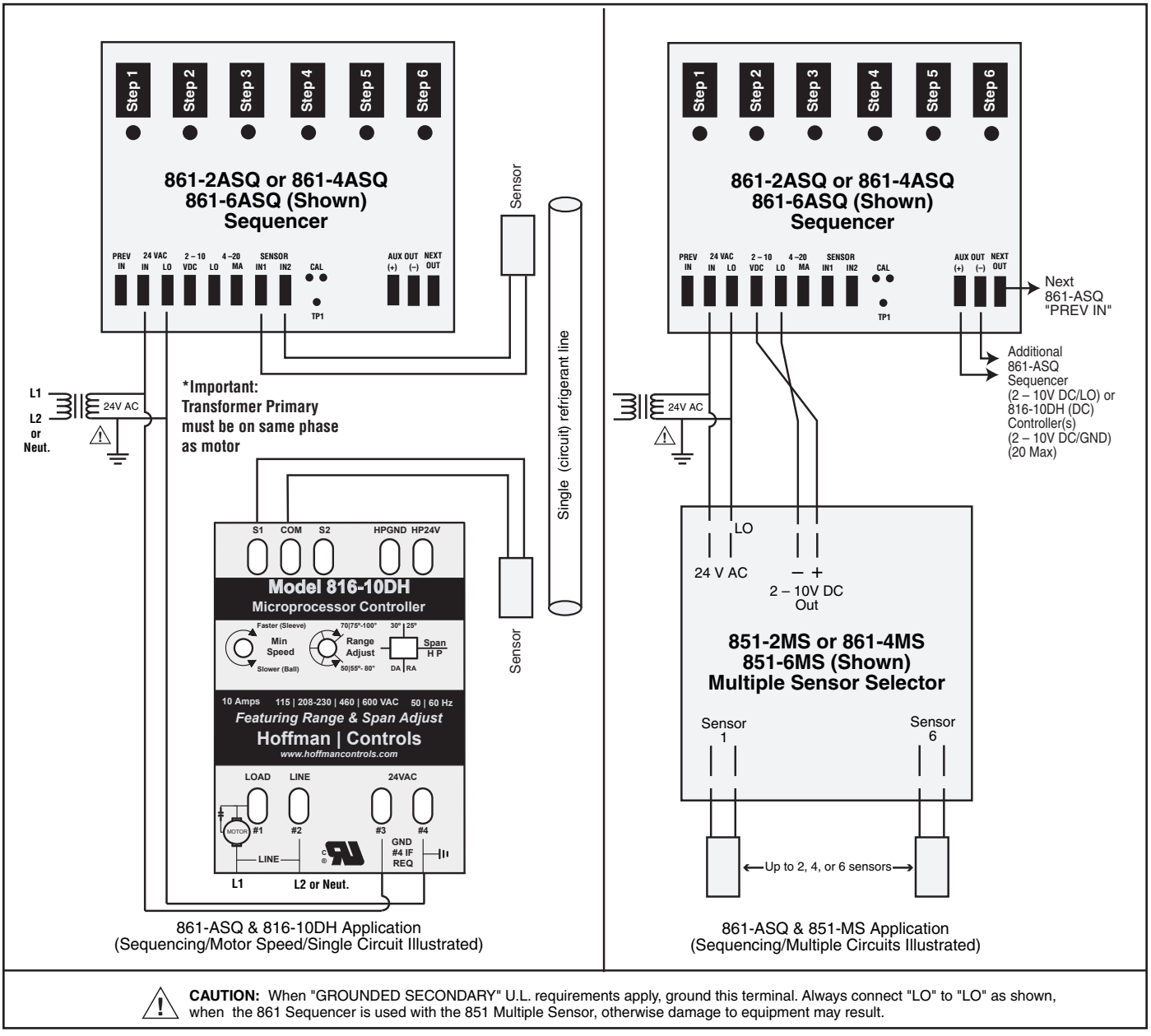
Ramp Volts DC vs. DC Volts Input
Figure 2



Ramp Volts DC vs. DC mA Input
Figure 3



800 Series Controls Dimensions Figure 4



861-ASQ Series System Wiring Figure 5

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