Retrofitting a Qualmark HALT/HASS Chamber

Figure 1, Synergy Controller Installation

Introduction

This Synergy Controller application note describes a QualMark HALT/HASS environmental test chamber retrofit (See figure 1).

Installation, Equipment required, Controller Setup and Calibration are covered.

Synergy Controller is Tidal Engineering's ® Environmental Chamber retrofit package that drops in many Environmental Test Chambers and provides state-of-the-art usability and operating efficiency.

Synergy Controller includes:

--> Color touch screen
--> Ethernet, RS-232 and GPIB communications
--> Built in Data logger and Data Acquisition, Up to 64 T-type thermocouples
--> Built in Web Server for remote control
--> Compatible with LinkTenn32 software
--> Built in Floppy drive for data logging and program transfer.
--> Built in USB port compatible with USB Disk drives for data logging and program transfer.

Installation

Install the Synergy Controller in the Enclosure.

The following wiring instructions refer to the Wiring Diagrams in Figures 6,7 and 8.

Synergy Controller Control Inputs

1. Wire up the RTD1 Temperature sensor to the Olympic Board connector P2.
   P2-Pin 2 White
   P2-Pin 3 White
   P2-Pin 4 Red

2. Wire the Vibration Signal conditioner to the A4 signal Synergy Retransmit Conditioner.

3. Wire the A4 output to the Olympic Board connector P2 (Item K).
   P2-Pin 1 White (signal 0-5 VDC, 0 - 100% RH)
   P2-Pin 7 Black Ground

4. Jump the Temp Guard input to the Olympic Board connector P1 (Item L).
   P1-Pin 1 to P1-Pin 11

Synergy Controller Triac/SSR outputs

1. Wire A5 Triac Outputs 1 thru 9 to the Qualmark SSR's.1 thru 9.

Synergy Controller Analog Output

1. Wire the two DAC outputs to the A2 and A3 signal conditioners.

2. Wire the signal conditioners to the I/P valves. A2 to the Bauman valve. A3 to the Pneumatic valve.

Synergy Controller Power Inputs

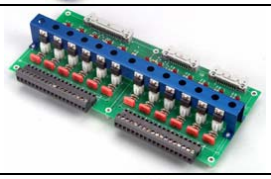
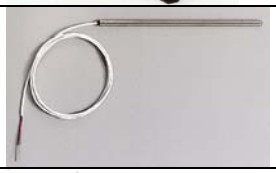
1. Wire PK1 to the 115 VAC input power.

2. Wire A6 Power Supply to the 115 VAC input source.

3. Wire the A6 output to the Vibration Signal Conditioner.

The following parts are required for this installation; see Table 1, Parts List

Table 1 Parts List

Reference Designator	Part Number	Quantity	Image	Description
A1	TE1530	1		Synergy Controller
A2,A3,A4	TE1803	3		Synergy Retransmit Conditioner. Isolated Output Ranges include 0-5V, 0-10V, 0-20mA, 4-20mA
A5	TE1151-12	1		Triac Board, 12 Channel
A6	TE1811	1		Power Supply, +5, +/- !2 V
A7	TE1299-16	1		UUT Module, 16 Channel Thermocouple Data Acquisition Unit
RTD1	TE1594	1		RTD, 100 Ohm Pt
TC1	TE1675	As Required		T-Type, 20 AWG, Fiberglass insulated Thermocouple wire
Enclosure	TE1879	1		Enclosure: 12” X 12”

Installation

Figure 2, Block Diagram

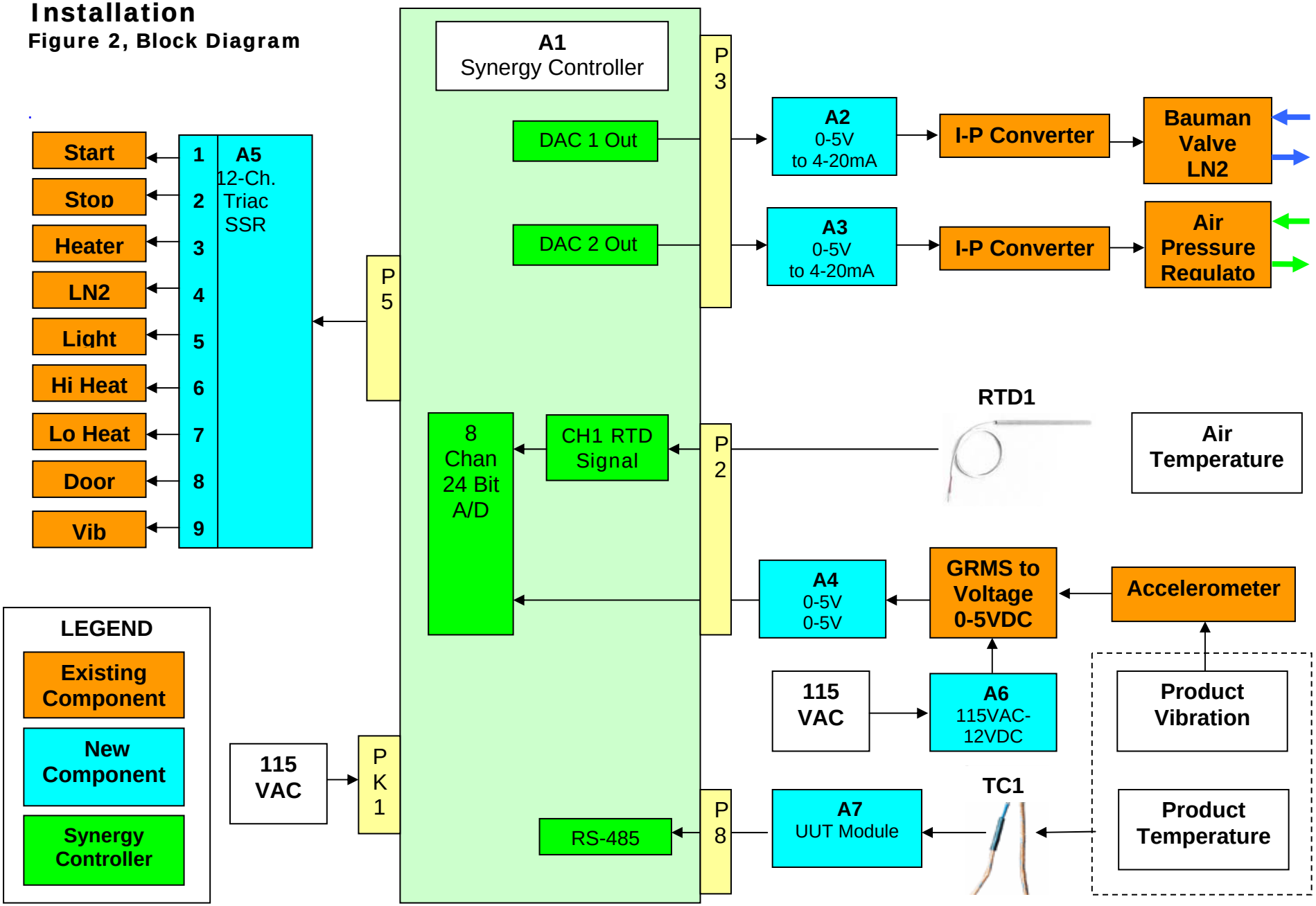


Table 2, TRIAC OUTPUT MAPPING

Output	Connector Pins	Function	Description
1	P1-1 to P1-3	Start	Operates for 10 seconds when starting, then turn off
2	P1-4 to P1-6	Stop	Operates when running
3	P1-7 to P1-9	Heater Contactor	Operates when running
4	P1-10 to P1-12	Redundant LN2 Solenoid	Operates when running
5	P1-13 to P1-15	Light	Event 1, Under user control
6	P1-16 to P1-18	High Heat	Boost Heat
7	P2-1 to P2-3	Low Heat	PID Heat
8	P2-4 to P2-6	Pneumatic Door	Operate when running
9	P2-7 to P2-9	Pneumatic Initiator	Operate when running
10	P2-10 to P2-12	Not Used	Not Used
11	P2-13 to P2-15	Not Used	Not Used
12	P2-16 to P2-18	Not Used	Not Used

Controller Setup

Chamber Configuration

Configuring the Synergy Controller for a Qualmark HALT/HASS chamber you involves the following steps; 1. Set the controller to a HALT setup, 2. configure the Analog Retransmits and 3. configure the Boost Heat turn on and turn off values.

Chamber Setup

1. Go to the Setup screen.
2. Click on the Chamber Setup Icon.
3. Click the Change button.
4. Click on HALT in the list.
5. Click Accept, then click OK when prompted.
6. Press the reset button the front panel.
7. Press OK and then Yes when prompted.

Analog Retransmit Setup

1. Go to the Setup screen.
2. Click on the Special Functions icon.
3. Scroll down to the bottom to see the Analog Retransmit icons.
4. Click on Analog Retransmit 1.
5. Select Channel 1 Cool PID and press Accept, then Back.
6. Click on Analog Retransmit 2.
7. Select Channel 2 Heat PID and press Accept, then Back.
8. Return to the main Setup screen.

Boost Heat Setup

1. Go to the Setup screen.
2. Click on the L-Values icon.
3. Scroll down to the bottom to see Boost Heat Turn On and Boost Heat Turn Off.
4. Click on the Boost Heat Turn-On icon.
5. This is the percentage of heat being called for before the Boost Heat is turned on. For quicker transitions, this number should be lower. For more stability this number should be higher. It defaults to 85% for use with three heaters. Note, this number must be greater then the Boost Heat Turn Off value. Make any changes as necessary and click Apply and Back.
6. Click on the Boost Heat Turn-Off icon
7. When the percentage of heat being called for drops below this percentage, boost heat is turned off. The default is 75% for use with three heaters. Note, this number must be less then the Boost Heat Turn On value. Make any changes as necessary and click Apply and Back.

Cascade Control Setup

To get the most out of HALT testing you must enable Cascade control for temperature using either a second RTD sensor, or a thermocouple connected to a UUT module. This section walks you through enabling and configuring the cascade control.

1. Connecting and configuring the UUT Module
    a. Connect the UUT module via serial cable to the Synergy Controller at P8 on the back of the controller.
    b. Connect up at least one T type thermocouple to the UUT module.
    c. Enable UUT sensors. Go to the Communications screen and click on the RS-485 icon. Change RS-485 Mode to User Comms. Set the Number of UUTs to 1 (or the number of UUT modules you have).
    d. Verify the UUT is properly connected and communicating by going to the Events screen and then clicking on the UUT Temperatures icon. You should see a temperature reading for the thermocouple or thermocouples you hooked up.
    e. When your UUT sensor is working properly, it is time to setup the Cascade system. Go to the Setup Screen.
2. Configuring Cascade control Sensor
    a. Click on the PID Settings icon.
    b. Click on the PID Channel 1 icon.
    c. Click the Cascade icon.
    d. If prompted to enter a Cascade Key, contact Tidal Engineering for the free key to unlock the Cascade feature.
    e. Click on the Settings icon.
    f. Click on Sensor Select, and press the Change button.
    g. In the Module column, select the UUT module your controlling thermocouple is connected to.
    h. In the UUT Sensor column, select which thermocouple you want to use for control.
    i. Press Accept to save the changes and return to the Cascade Settings screen.
3. Configuring Cascade Control temperatures
    a. From the Cascade Settings screen, you can change the Cascade High Limit and Cascade Low Limit. Those are the max and min temperatures the Synergy Controller will drive the air temperature during cascade control. These values should be set to match the range of testing to be done.
    b. The Cascade High Limit and Cascade Low Limit should be set at least 10% beyond the temperatures you want to drive to if possible. Note however, the wider the temperatures are set, the quicker the device under test's temperature will change, but the more unstable the final temperature will be. The narrower the temperature band, the slower the device under test's temperature may change, but the more stable the final temperature will be.
4. Enabling Cascade Control
    a. From the Cascade Settings screen, click the Back button once. You will see Enabled, Settings and PID's.
    b. Click on the Enabled icon.
    c. Select Enabled and press Accept, then press Back.
    d. Cascade is now enabled. You can press back to get to the main setup screen or modify cascade PID values as needed.

The Synergy Controller is now configured for a QualMark HALT/HASS chamber.

Qualmark HALT/HASS T-19 Controller Settings

CALIBRATION	Value
Channel 1	
Calibration	0.00
Gain	100.00
Alarm High	-200.00
Alarm Low	500.00
Alarm Enabled when Off	Enabled
Channel 2	
Calibration	3.00
Gain	155.00
Alarm High	-10.00
Alarm Low	104.00
Alarm Enabled when Off	Disabled
PID VALUES	
Channel 1	
PID Heat	
Proportional Band	25.00
Reset	0.20
Rate	1.00
Cycle Time	5.00
Rate Band	7.00
PID Cool	
Proportional Band	35.00
Reset	0.20
Rate	1.00
Cycle Time	5.00
Rate Band	7.00
PID Cascade	
Proportional Band	4.00
Reset	0.01
Rate	0.00
Rate Band	0.00
Sensor ID	228.00
Cascade High	85.00
Cascade Low	-85.00
Channel 2	
PID Heat (Vibration)	
Proportional Band	250.00
Reset	0.50
Rate	0.00
Cycle Time	1.00
Rate Band	0.00

Special Functions

OT11	On/Off
OT17	Vacuum
OT18	Vent
Channel 1 Low Limit	-70.00
Channel 1 High Limit	170.00
Channel 2 Low Limit	-1.00
Channel 2 High Limit	100.00
Temperature Curve	DIN
Vaisala Compensation	Off
Analog Retransmit 1	Ch 1 Cool PID
Analog Retransmit 2	Ch 2 Heat PID

L-Values

1L1	10.00
1L2	50.00
1L3	20.00
1CTY	CAP
2L1	10.00
2L2	50.00
2L3	20.00
2CTY	CAP
L3	20.00
L4	80.00
L6	20.00
L7	10.00
L8	80.00
L9	50.00
L11	20.00
L12	10.00
L14	10.00
L15	1.00
LEV1	Drier
Boost Turn On	85.00
Boost Turn Off	75.00

Calibration

The calibration procedure for the Synergy Controller on a HALT/HASS chamber uses a three point calibration on the temperature channel and a two point calibration on the vibration channel. You will need an accelerometer and a vibration meter for the vibration calibration and a process calibrator and an RTD for the temperature calibration. Refer to Table 3 for equipment details. The calibration is done in 3 steps.

Table 3, Recommended Calibration Equipment List

Item No.	Model	Manufacturer	Description
1	Calibrated Accelerometer		Accelerometer
2	4151M13 Vibration meter or equal	Dytran	Vibration Monitor
3	725 Process Calibrator or equal	Fluke	3-Wire RTD compatible process instrument
4	S604PD40Z36T or equal	Minco	Pt. RTD, 100 Ohm

Step 1 – Connecting the accelerometer to the HALT/HASS chamber.

1. Stop the chamber if it is running and open the doors.
2. Run the cable for the accelerometer into the chamber.
3. Screw in the accelerometer into the bottom of the vibration table.
4. Connect the accelerometer cable into the meter.
5. Plug in the meter's power cable.

Step 2 – Calibrating Temperature

This procedure will use the Gain and Offset values available on the Setup screen under \Calibration\Calibration Channel 1.

1. Disable Cascade control when calibration temperature. Go to the Setup screen, under \PID Settings\PID CH1\Cascade and change the Enabled item to 'Disabled' for the duration of the calibration.
2. Close the chamber doors and turn the chamber on.
3. Set the temperature to 0C and wait for the temperature to settle there.
4. Adjust the Offset so that the reading equals the reading on the calibrated sensor.
5. Set the temperature to –50C (called TL_S) and wait for the temperature to settle.
6. Record the calibrated temperature sensor's reading at –50C (called TL_A).
7. Set the temperature to 150C (called TH_S) and wait for the temperature to settle.
8. Record the calibrated temperature sensor's reading at 150C (called TH_A).
9. Calculate and update the gain with the calculation: Gain = Gain * ((TH_S – TL_S) / ((TH_A-TL_A))

10. Go back and continue from step 2 until the temperature is within spec at the low end, high end and zero.
11. If you are not calibration Vibration next, re-enable Cascade mode if you disabled it in step 1. If you are going to calibrate Vibration next then wait until the end of the Vibration calibration to re-enable Cascade temperature control.

Step 3 – Calibrating Vibration

This procedure will use the Gain and Offset values available on the Setup screen under \Calibration\Calibration Channel 2.

1. Close the chamber doors and turn the chamber on.
2. Set the chamber to an ambient temperature of 25C.
3. Set the vibration to 10G (called VL_S) and wait for the vibration to settle there.
4. Record the calibrated accelerometer's reading at 10G (called VL_A).
5. Set the vibration to 40G (called VH_S) and wait for the vibration to settle there.
6. Record the calibrated accelerometer's reading at 40G (called VH_A).
7. Calculate and update the gain with the calculation: Gain = Gain * ((VH_S-VL_S) / (VH_A – VL_A))
8. Go back and continue from step 2 until the difference between the vibration setpoints and readings is about equal on the high and low side.
9. Once the difference between the vibration setpoints and readings is about equal on the high and low side then adjust the offset value up or down as needed to bring them both within spec.

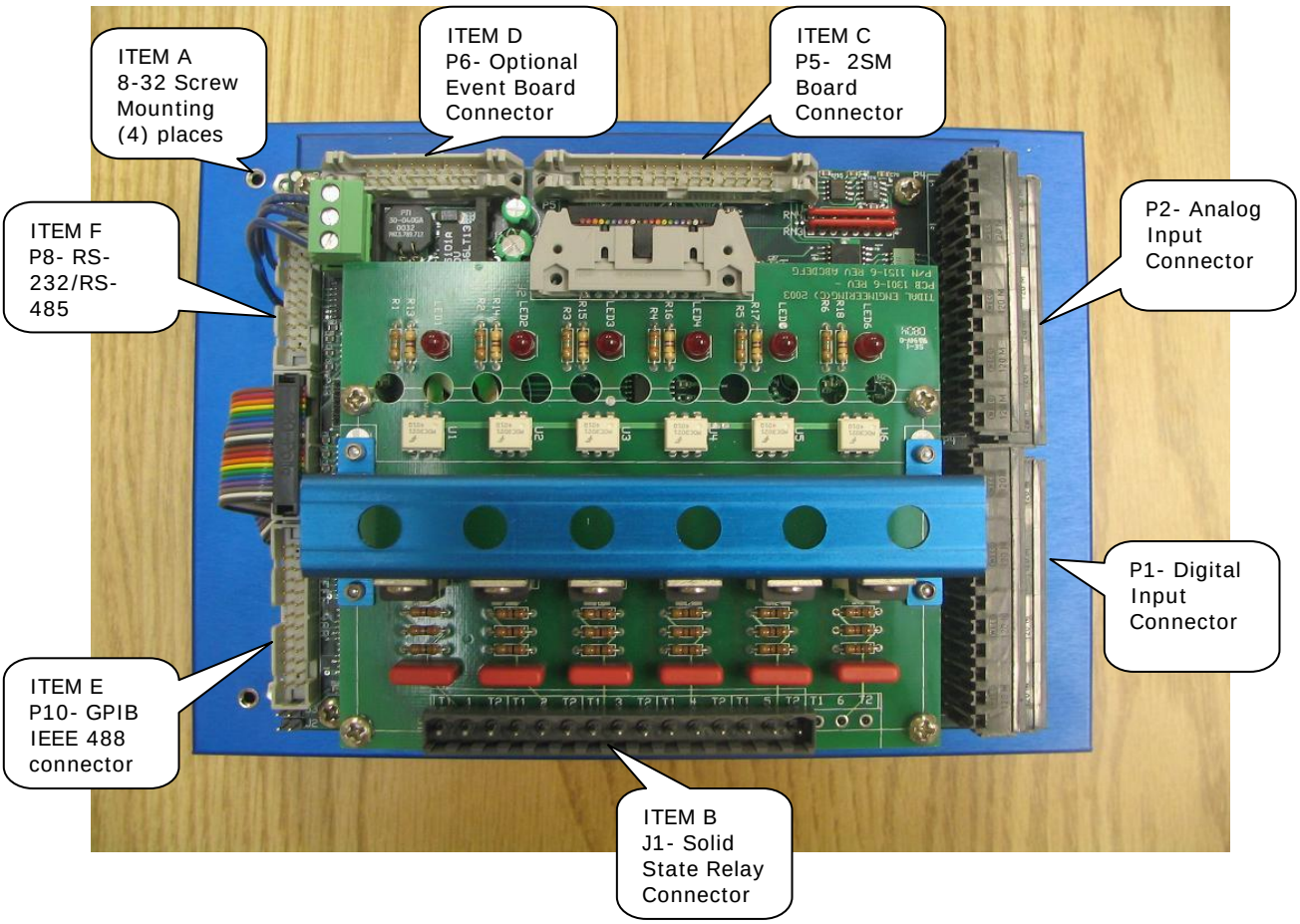


Figure 3, Synergy Controller Back view

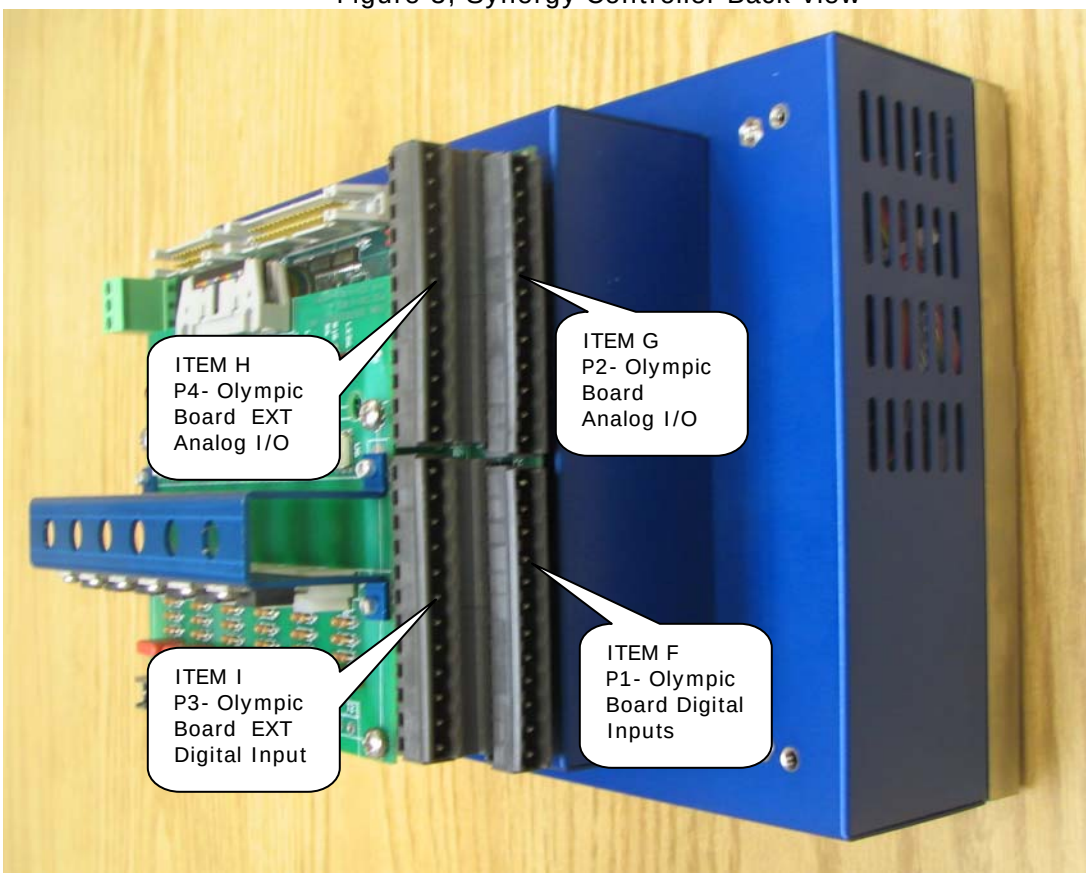


Figure 4, Synergy Controller Back view

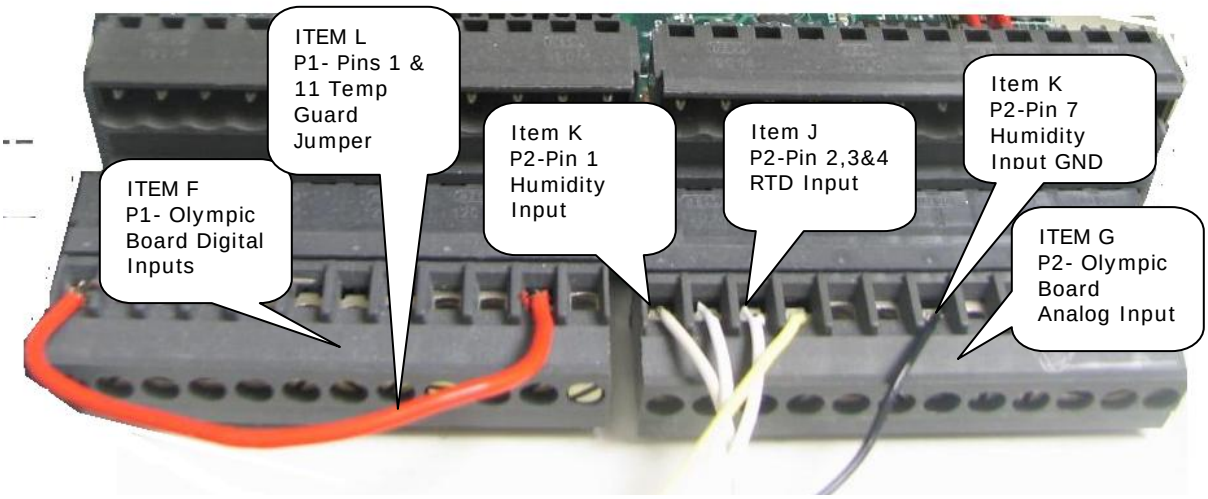


Figure 5, Synergy Controller Back view

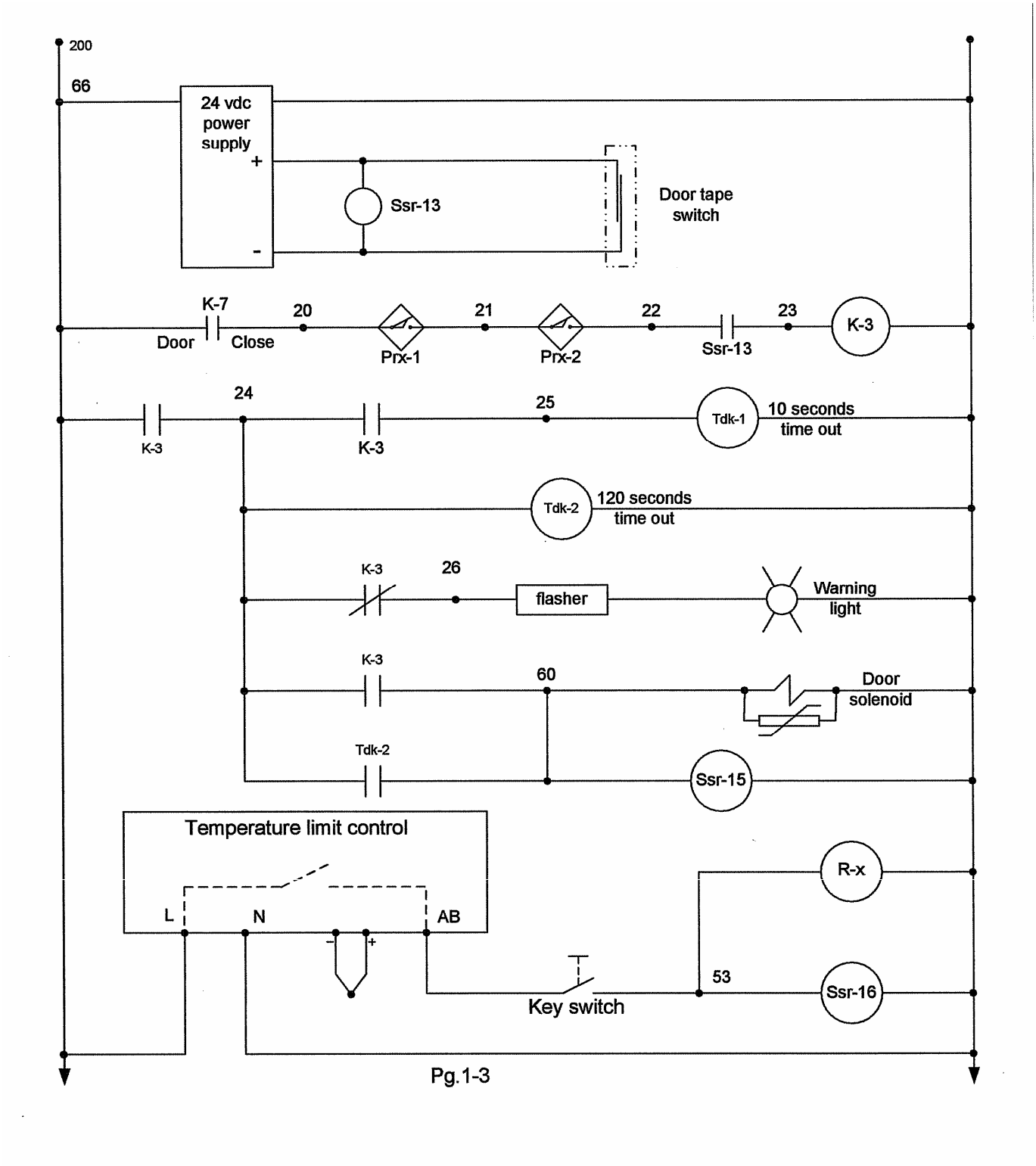


Figure 6, Wiring Diagram Part 1

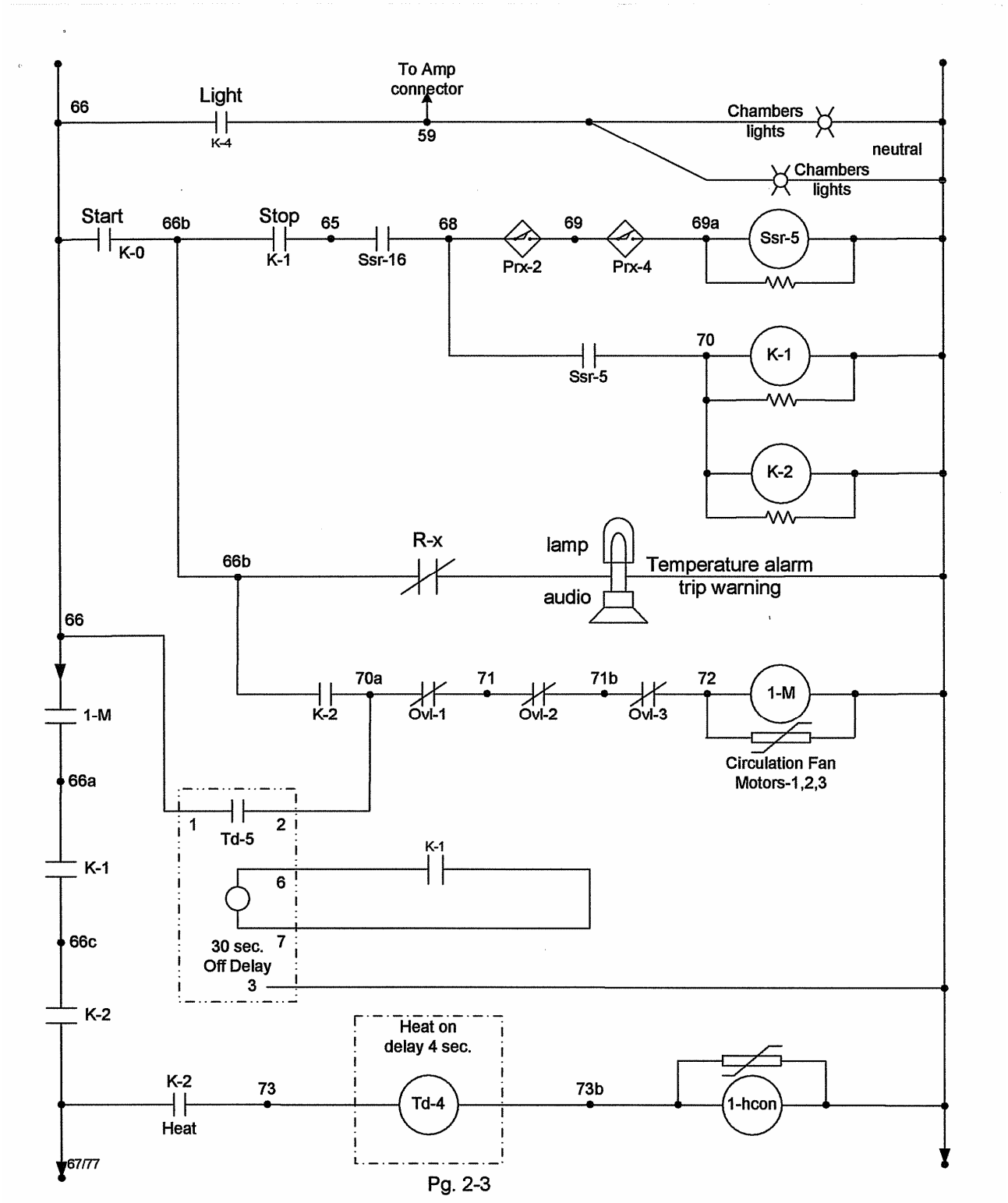


Figure 7, Wiring Diagram Part 2

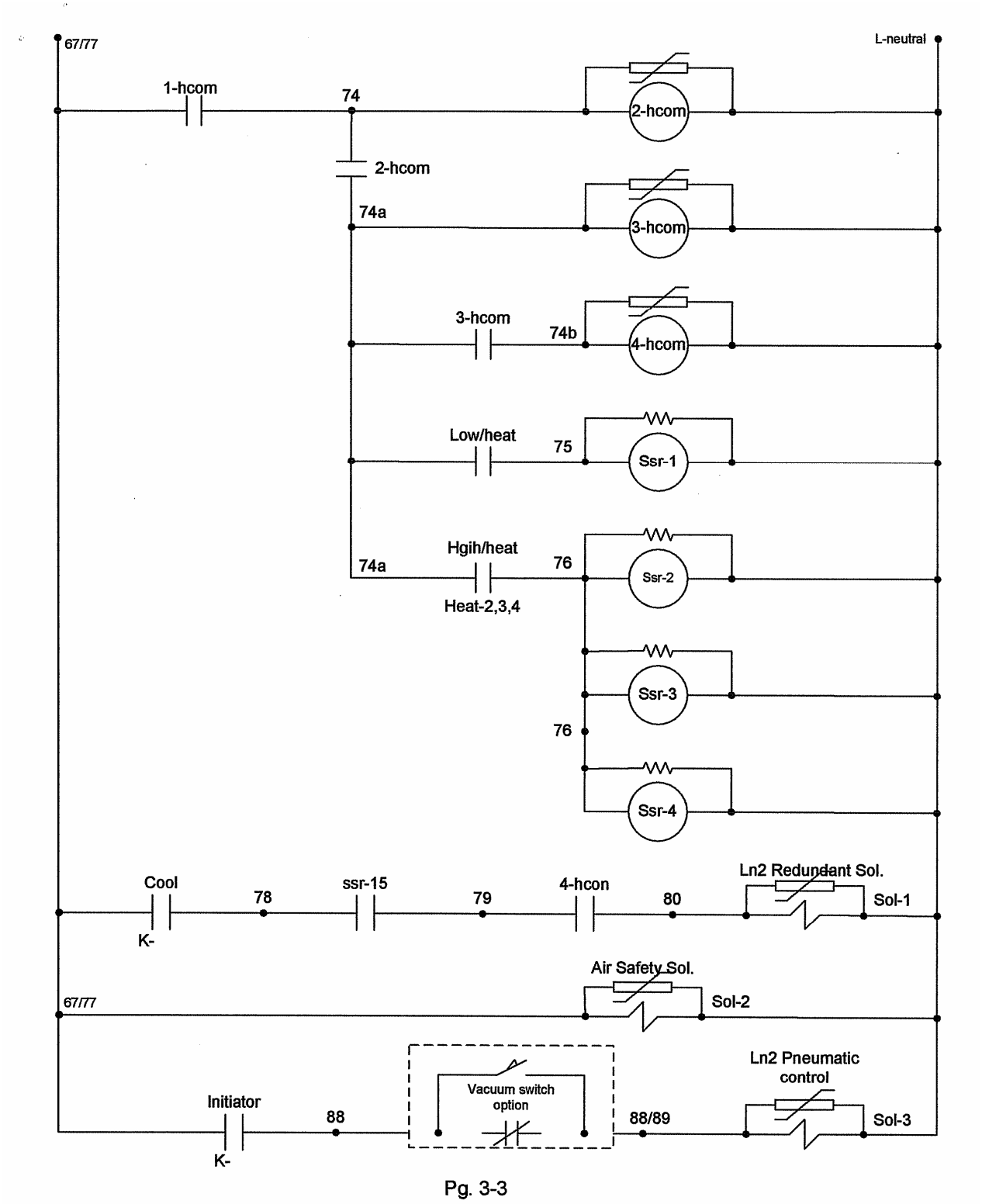


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Figure 8, Wiring Diagram Part 3

For further information concerning the operation of the Synergy Controller please consult the Tidal Engineering website at http://www.tidaleng.com.
Once there, please feel free to download the free SimpleComm and Synergy Manager applications at http://www.tidaleng.com/download.htm.

SimpleComm can be used to verify connections to the Synergy Controller and as a simple remote control program for use with Ethernet, GPIB and serial connections.

SynergyManager can be used to write temperature profiles for the controller on the PC as well as collect data, chart and log the Synergy Controller's operation.

About Tidal Engineering

Headquartered in Randolph, NJ, Tidal Engineering Corporation has been designing and building award winning embedded hardware and software for test and measurement and data acquisition applications since 1992. The company further provides product development services together with engineering support, and is recognized for technical expertise in such areas as Embedded IEEE 488, and turnkey SCADA (Supervisory Control and Data Acquisition) systems. Tidal's products are available exclusively through ADI American Distributors Inc., an ISO-9002 certified distributor of electronic and electromechanical components and assemblies.

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