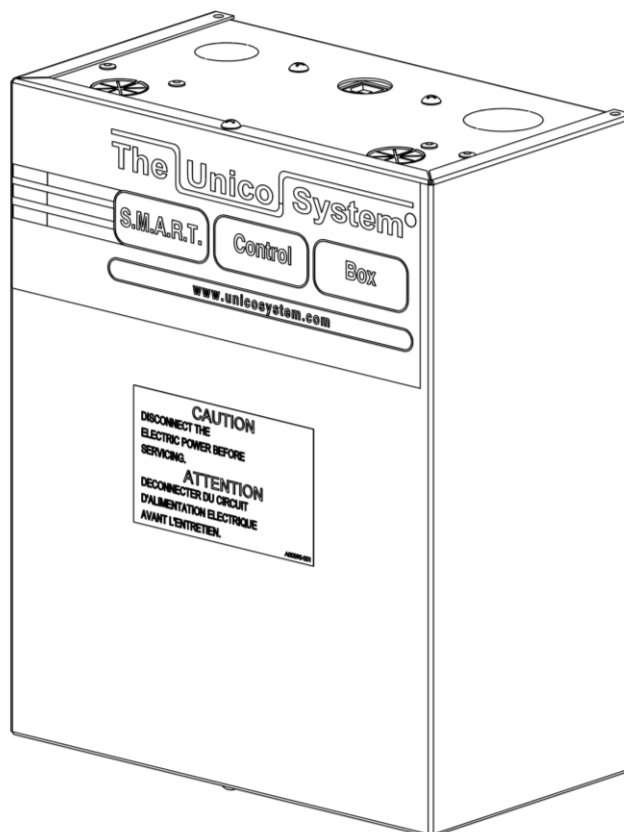# The Unico System ®

# S.M.A.R.T. CONTROL BOARD (SCB) INSTALLATION INSTRUCTIONS

**BULLETIN 30-039.003**

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# DESIGN & SPECIFICATIONS

## General

The information on the following pages is to provide the installer the necessary information to properly install the Unico software managed air flow rate and temperature S.M.A.R.T. control board (SCB). The SCB control board is available as part of the blower assembly or as part of retrofit kit that includes the motor and blower wheel.

**Part no.\***     **Description**
U1218L1-EC*   Fan Coil Unit with SCB control, where ' * ' is voltage
M2430BL1-EC*   Blower Module, 2430, with SCB and EC motor
M3036BL1-EC*   Blower Module, 3036, with SCB and EC motor
M3642BL1-EC*   Blower Module, 3642, with SCB and EC motor
M4860BL1-EC*   Blower Module, 4860, with SCB and EC motor
'x' indicates voltage (1=120V, 2=240V)
* There may be additional characters at the end for other options.

**Upgrade Kits (for units made after 2003),**
**includes motor, wheel, and control box**
A01543-K22   Upgrade Kit, EC2 (240V), 2430
A01543-K23   Upgrade Kit, EC2 (240V), 3642
A01543-K24   Upgrade Kit, EC2 (240V), 4860

**Optional Accessories/Replacement Parts**

A00175-G07   Control Box Assy with SCB, 240V
A00175-G10   Control Box Assy with SCB, 120V
A01426-002   Motor, EC, 1800RPM, 1/2 hp
A01426-003   Motor, EC, 1800 RPM, 1 hp
A01469-G03   Control Board, S.M.A.R.T. (for all blower models)
A01470-G01   Control Board, USB (laptop communication)
A01472-G01   Wire Harness, EC Motor, 240V
A01472-G02   Wire Harness, EC Motor, 120V
A01473-G01   Wire Harness, SCB/USB to ECM
A01474-G01   Wire Harness, SCB to USB
A01722-005   Chip, EEPROM (latest version upgrade)
~~A01002-013~~   ~~Fuse, Slow-blow, 2AG, 3A~~
A01412-001   Fuse, MINI-Blade, 2A
A00057-G04   Transformer, 208/230V-24V, 50VA
A00057-G05   Transformer, 100/120V-24V, 50VA
A01525-G01   Cable, Extension, ECM (CE), 59 inch (1.5 m)
A01525-G02   Cable, Extension, ECM (CE), 98 inch (2.5 m)

## Scope

The S.M.A.R.T. control board provides system control for Unico air handlers with EC motors. The control box comes with software (ECMConfig) and a USB cable to connect to a personal computer, which allows the user to set the precise airflow for each Mode of operation. Windows XP, 7, or 8 operating system is generally required; Use of a Windows emulator for Mac systems is possible, but not recommended. The ECMConfig software can also be downloaded from: http://tech.unicosystem.com/ .

This manual includes the instructions for the SCB board and the applicable firmware version as shown in Table 1. The firmware version can be checked on boards with version 3.19 and later by going to Help|About in ECMConfig version 4.5 and newer.

**Table 1. Control Board part number**

| Board P/N | Compatible Blower Models | Firmware Version* |
|---|---|---|
| A01469-G01 | 1218, 2430, 3642, 4860 | BV |
| A01469-G02 | 1218, 2430, 3036, 4860 | BV3036 |
| A01469-G03 | 1218, 2430, 3036, 3642, 4860 | 3_19 |

 * Actual firmware may be later revision

NOTE: P/N A01469-G03 replaces both A01469-G01 and A01469-G02. For clarity, and to support older installations, this manual will sometimes include instructions for the older, discontinued boards.

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[1] S.M.A.R.T. = Software Managed Air Rate and Temperature

## Features

Congratulations on your purchase of the finest and most versatile fan control on the market. This control board is only compatible with the Unico Electronically Commutated Motor (ECM). The control board comes standard with the following features:

**Multiple Configurations.** Compatible with refrigerant-cooling (AC) systems; refrigerant-heating (heat-pump) systems; chilled water systems, hot water systems, electric heat furnaces, and just about every practical combination of them.

**Soft-start/Soft-stop.** For the ultimate in quiet, the control board allows the blower motor to slowly ramp up to speed when it starts and slowly ramp down when it shuts off (total ramp time 45 seconds).

**ASHRAE 62.2 Compliance.** The SCB software will control the fan speed to provide the required amount of fresh air per ASHRAE Standard 62.2 (2010). See "Programming the SCB" for more information.

**Ventilation Mode.** The SCB is pre-configured to provide ventilation air at 50 percent of the High Cool airflow rate.

**Simplified Wiring.** The control box was developed with the contractor in mind. All wiring terminals are clearly labeled and are designed for point-to-point wiring (one wire per terminal). In addition, all terminal connections can be made without passing the cables through the slotted bushing. All wires can be inserted into the bushing after the terminal connections have been made. Never again will you have to disconnect and re-wire the board because the cable was not pre-inserted through the bushings.

**Accessories.** The control board provides separate relays and contacts to energize a separate Electronic Air Cleaner (EAC), ERV, HRV, UV light, or fresh air damper. We also provide a relay to energize a humidifier with a separate humidistat input for proper control. We even provide a feature to allow the humidistat to control the fan so that humidity can be added even if the fan is not already on. And, of course, the control is smart enough to sense when the system is trying to cool, so that humidity is not added if in cooling mode.

**Designed for the Unico Electric Furnace.** The control board is designed for single or multiple stage thermostats. Both will gradually turn on the electric heat but the multistage thermostat is more efficient as it limits the need for electric heaters more than a single stage thermostat. The SCB controller will not energize the third stage electric heat when the heat pump is calling. This reduces the possibility of overheating the electric elements. Without this feature, the user would be required to add a field installed relay or outdoor thermostat.

**Designed for Chillers and Air-to-water Heat Pumps.** The control is designed to operate a chiller or AWHP from the thermostat. For systems with multiple indoor units, the control board will communicate, making one the "Leader" and the others "Followers". In this way, each air handler knows whether the chiller is making hot or cold water and will turns on the blower as appropriate.

**Designed for Hot Water Heating Systems.** The control allows you to select whether the hot water heating is primary, secondary or emergency heat for single or multi-staged systems. Also, a timer function is included to operate the hot water pump when used with potable water 'combo' systems on a periodic basis; this prevents the water from becoming stagnant over time.

**2-Speed Condenser Compatibility.** The SCB is pre-programmed to operate the blower at 75% of full speed during low stage operation for heating or cooling. For systems that use 66% or 50% for low stage, this setting may be modified by using the ECMConfig software.

**Ideal for Zone-Damper Systems.** The SCB will control the fan for up to 2 zones with a single speed condenser or up to 3 zones with a two-stage condenser. For more information refer to the Unico Zoning Manual. A chilled or hot water system can have any number of zones. The SCB can be programmed to maintain almost constant duct pressure to avoid the need for bypass dampers at the air handler.

**Quality Design and Manufacture.** The board is made from high quality electronic parts and includes a conformal coating to eliminate problems with humidity, moisture, and dust. Each board is thoroughly tested at the factory.

## Switches

There are nine manual function switches on the SCB. All of the switches can be moved with the unit operating although changes to CFM, MOD, and AUX will not take effect until the board is turned off and then back on. Changing these switches and then cycling the power will erase any custom settings, so do not adjust them unless necessary.
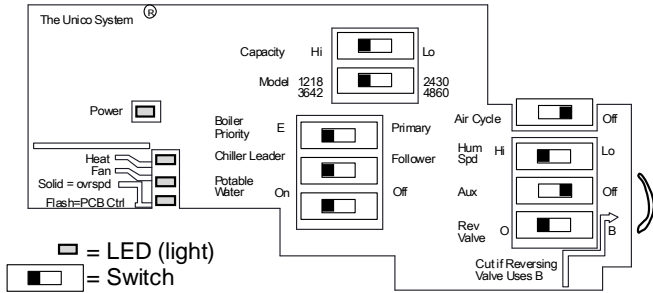


**Figure 2a.** Switch and LED layout. SCB boards manufactured prior to August 2014 (Part numbers A01469-G01 and A01469-G02)
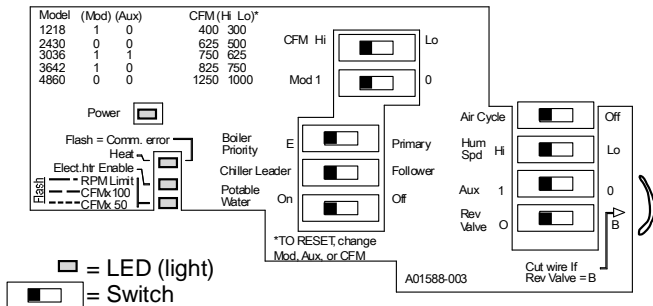


**Figure 2b.** Switch and LED layout. SCB boards manufactured after August 2014 (Part number A01469-G03)

**CFM** (High|Low, factory default = Hi). This switch sets the High Cool airflow rate in accordance with Table 2. The airflow for all other modes of operation are set to a percentage of the High Cool airflow as shown in Table 3. All airflows can be customized using the ECMConfig program. Moving this switch and powering the board off and on will erase any customized settings.

**Table 2.  Default high-cool airflow rate (CFM switch)**

| Blower Model | CFM Switch Setting | | | |
|---|---|---|---|---|
| | Low | | High | |
| | CFM | L/s | CFM | L/s |
| 1218 | 300 | 141 | 400 | 189 |
| 2430 | 500 | 236 | 625 | 295 |
| 3036 | 625 | 295 | 750 | 354 |
| 3642 | 750 | 354 | 875 | 413 |
| 4860 | 1000 | 472 | 1250 | 590 |

**Table 3.** Airflow defaults (for all modes)

| Operating Mode | Percentage of High Cool Airflow |
|---|---|
| High Cool (Y2) | 100% |
| Low Cool (Y1) | 75% |
| High Heat (W2) | 100% |
| Low Heat (W1) | 75% |
| Emergency Heat (E) | 100% |
| Fan Recirculation (G) | 50% |

**MOD** (1 | 0, no factory default). The control board must be set for the correct blower model. Control board A01469-G03 uses both the MOD and the AUX switches as shown in Table 4a. Control board A01469-G01 and A01469-G02 uses the MODEL switch as shown in Table 4b.

**Table 4a. Model selection for control board A01469-G03**

| Blower Model | MOD | AUX |
|---|---|---|
| 1218 | 1 | 0 |
| 2430 | 0 | 0 |
| 3036 | 1 | 1 |
| 3642 | 1 | 0 |
| 4860 | 0 | 0 |

**Table 4b. Model selection for control board A01469-G01 and A01469-G02**

| Blower Model | MODEL switch position | |
|---|---|---|
| | A01469-G01 | A01469-G02 |
| 1218 | 1218/ 3642 | 1218/ 4860 |
| 2430 | 2430/ 4860 | 2430/ 4860 |
| 3036 | n/a | 1218/ 3642 |
| 3642 | 1218/ 3642 | n/a |
| 4860 | 2430/ 4860 | 2430/ 4860 |

NOTE: For all control boards, changing the MOD switch and cycling the power will reset the program settings to the factory default.

**AUX** (1 | 0, factory default=0). Use this switch along with the MOD switch to set the blower model as shown in Table 4.

NOTE: For A01469-G03, changing the AUX switch and cycling the power will reset the SCB to the factory default. For A01469-G01 and A01469-G02, the AUX switch will not reset the program settings.

For control board part numbers A01469-G01 and A01469-G02 the AUX switch is used to change the behavior of the PCBctl LED. Refer to Table 7 for more information. For that board, the OFF position is "Normal" and will display error codes. The ON position is "Check

CFM" and will display the current blower airflow. These functions were combined in A01469-G03 and are always active.

**POTABLE WATER** (ON|OFF, factory default=OFF) For 'combo' systems, where potable water is circulated through the hot water heating coil, it is necessary to ensure that the water is never stagnant in the coil. The switch will activate a timer so that the HotW relay will energize a pump to circulate water once per day for 5 minutes regardless.

**AIR CYCLE** (ON|OFF, factory default=OFF) Used to periodically circulate air through the ducts to reduce the chance of moisture build up in the winter months. By default, the fan will run on Fan speed for 10 minutes every 8 hours even if there is no thermostat demand for heat or cool or fan. This timing, along with ASHRAE 62.2 compliant modes of operation, can be configured using the ECMConfig interface.

**HUM SPD** (HIGH|LOW, factory default = HIGH) Allows a separate humidistat to control the fan operation under certain conditions. A humidistat with a dry contact input is require to energize the fan and close the dry contact relay on the HumVlv terminals.

If the unit is not in cooling or heating (when it is off) the HumStat will turn on the fan to the speed set by the switch. In the default condition (Humidistat Control=HIGH) the relay will energize the fan at the high-heat speed. If the Humidistat Control switch is moved to the LOW position, the blower will run at the FAN airflow rate.

**REV VALVE** (B|O, factory default = O). This switch is set to O (meaning the reversing valve is energized in cooling mode) regardless of position unless the jumper wire is cut. If the reversing valve is energized on heating, the heat pump jumper wire (see next section) must be cut and this switch moved to the B position.

## CAUTION

**To prevent the potential of coil frosting for 'cooling-only' systems, be sure the jumper across R and O-b is in place. If not, the AFS may not work properly.**

Note: if the jumper wire is cut, make sure the reversing valve switch on the board is in the O position.

The control board knows whether the system is heating or cooling by comparing the O-b thermostat signal to the position of the REV VALVE switch. Refer to the notes in Table 5.

**CHILLER** (Leader|Follower, default=Leader). This switch controls the operation of both the chiller relay (ColdW) and the boiler relay (HotW). If the switch is in the 'leader' position, the ColdW relay will energize with any call to Y1 or Y2.

NOTE: For cooling-only chillers, always set the chiller to "leader". The "follower" function is only necessary for heat pump chillers.

For heat pump chiller systems, if there is more than one air handler connected to the system, we recommend that all air handlers be set to the same mode (either heating or cooling). Otherwise, the chiller could frequently switch between heating and cooling. This will not damage the equipment but is energy wasteful because the chiller must heat and cool a large volume of water every time it changes mode.

To prevent this switching behavior, use a manual switch to set the mode by sending an O-b signal to all air handlers, which must all be set as a "follower".

It is possible to automate this by setting one of the air handlers as "leader" and all others as "followers". This is not completely fool-proof though. The system can still switch back and forth if the leader is not calling for heat or cool (the unit appears to be off so there is no O-b signal). In this case, the "leader" air handler must use a heat pump thermostat. Always use a heat-cool thermostat when in "follower" mode.

By utilizing a manual leader switch or leader air handler, the leading air handler is the master controller and determines the temperature of the water by utilizing the O-b signal from the heat pump thermostat. Subordinate air handlers are followers and will only energize the blowers if the water is the correct temperature.

As recommended above, it is best to simulate the leader function by installing a manual switch create the O-b signal; this makes all the air handlers followers.

NOTE: When setting the unit to "follower", the W1 and W2 inputs will not energize the HotW relay even if the BOILER switch is set to PRIMARY because the system assumes that the system is a heat pump chiller.

**Table 5. When the ColdW (CW) and HotW (HW) relays**

| Switch Position | | Thermostat Input | | | | |
|---|---|---|---|---|---|---|
| Chiller | Boiler | Y1 | Y2 | W1 | W2 | E |
| Leader | Primary | CW | CW | HW | HW | - |
| | Emergency | CW | CW | - | - | HW |
| Follower* | Primary | CW | CW | CW | CW | - |
| | Emergency | CW | CW | CW | CW | HW |

| * ColdW will energize if the system is in the correct mode, i.e. heating if W1 or W2, or cooling if Y1 or Y2. If not in correct mode, only the fan will energize. | O-b input | Rev. Valve Switch | |
|---|---|---|---|
| | | O | B |
| | YES | Cooling | Heating |
| | NO | Heating | Cooling |

**BOILER PRIORITY** (Emergency|Primary, factory default = Primary). This switch controls when the HotW relay is energized as shown in table 5.

**Reset Factory Defaults.** It is possible to reset the airflow settings to their factory defaults at any time. This will erase any custom settings created with the software, therefore only do this if you do not have a computer connected and are unsure if the airflow has been modified.

To reset the airflow to the default, change the postion of one of the following switches, then turn the power off and then back on (cycle the power).

**Table 6. RESET switches (if power is cycled)**

| Part No. | Switches |
|---|---|
| A01469-G01 | CAPACITY, MODEL |
| A01469-G02 | |
| A01469-G03 | CAPACITY, MOD, AUX |

If you change the position of the switch with the power on, the A01469-G03 board will flash an error code indicating that a reset will happen if the power is cycled. If you accidently change a switch, simply switch it back again before you cycle the power. Then turn off the power to the SCB and then turn it on. The board will check the switch position each time it is first powered on. If the positions have been changed since the last time the board was on, the internal airflow values will be reset to the factory default.

Changing the postion of these switches when the unit is powered on or while it is off will have no effect unless the positions are different at the time it is turned on compared to the last time it was turned on.

## Jumpers

There are several jumpers on the SCB that are provided to make the most common wiring applications easier. These must be removed for some applications. The description of each jumper is listed below:
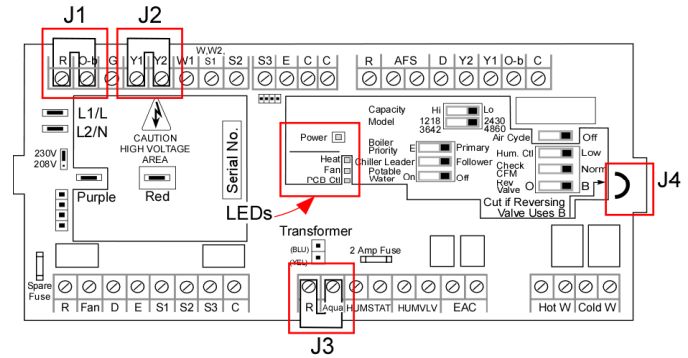


**Figure 3. Board layout**

**J1 : R/O-b** (thermostat block) jumper is required for all cooling-only systems. The board is preconfigured for heat-pump systems that energize the reversing valve in the cooling mode (i.e. require 'O'). The control senses the signal on the O-b terminal to determine whether it is in cooling or heating mode. Therefore, for cooling-only systems it is necessary to provide this jumper so the control knows it is in the cooling mode. For heat pump systems, this jumper must be removed.

**J2 : Y2-Y1** (thermostat block) jumper is used for the convenience of the installer when using a single-speed condenser. If the thermostat calls for cooling at the Y2 terminal the fan speed is high, whereas, at the Y1 terminal the fan speed is low. The jumper forces the fan to run on high during all cooling modes. Therefore, the jumper is in place to allow the installer the ability to use either terminal. For two-stage condensers, this jumper must be removed.

**J3 : R-Aqua** (accessories block) allows fan to energize without an optional aquastat when using a hot water system. If an aquastat is used, this jumper must be removed.

**J4 : Rev. Valve Jumper Wire** (permanent jumper on board) disables the Reversing Valve switch so that it is permanently in the 'O' position. For systems that have a reversing valve that is energized in heating and requires a 'B' connection, cut the jumper with wire snips and move the Rev.Valve switch to 'B'.

Note: The heat pump jumper wire must be cut for proper heat pump operation.

## LED Lights

There are four LEDs on the SCB board. Their locations are shown in Figure 3. Their labels are shown in Figure 2, and depend on control board model. Their functions are described below. For control board A01469-G03 use Table 7a. For control boards A01469-G01 and A01469-G02, use table 7b. For control boards A01469-G01 and A01469-G02, the PCBctl LED depends on the position of the AUX switch as follows:

**Table 7a. LEDs (A01469-G03)**

| LED | State | Meaning |
|---|---|---|
| Power (green) "heart beat" | Off | No power. Check voltage. |
| | Flashing | Board is functioning properly. |
| | Solid | The control board program has stopped. Turn power off and on to reset. Replace board if unable to reset. |
| Heat (red) | Off | System is not in heating mode |
| | Flashing (Long ON flashes) | Pending program reset. The MOD, CFM, or AUX switch has changed. |
| | Flashing (Short ON flashes) | No communication to the motor. Check cables and power to motor. |
| | Solid | System is in the heating or reheat (simultaneous cooling and heating) mode. |
| Elect. Htr. Enable (green) [Fan]* | Off | No call for fan or airflow less than 75% of programmed value; electric heater enable relay is off. |
| | Solid | Fan has reached 75% of programmed airflow; electric heater enabled relay is on. |
| Flash 'Check Airflow' (red) [PCBctl] | Off | Fan is not running. |
| | Long flash | 100 CFM |
| | Short Flash | 50 CFM (last flash in a sequence) |
| | Extra-long flash (1 sec) | Motor is at maximum RPM limit and cannot achieve desired air flow (flashes between airflow sequence) |
| | Solid | (Reserved for future use) |

**\*[] indicates the name of the LED for A01469-G01 and A01469-G02.

**Table 7b. LEDs (A01469-G01 and A01469-G02)**

| LED | State | Meaning |
|---|---|---|
| PCBctl (red) Normal Mode (Aux switch = OFF) | Off | Normal operation |
| | Blinking | Air Cycle mode, or in the Potable Water mode. |
| | Solid | Fan is at max RPM and is unable to achieve the programmed airflow. This normally indicates a restrictive duct system unless it is zoned system where the user has changed the maximum RPM. |
| PCBctl (red) Check CFM Mode (Aux switch = ON) | Long flash | 100 CFM for each long flash |
| | Short flash | 50 CFM (last flash in a sequence) |

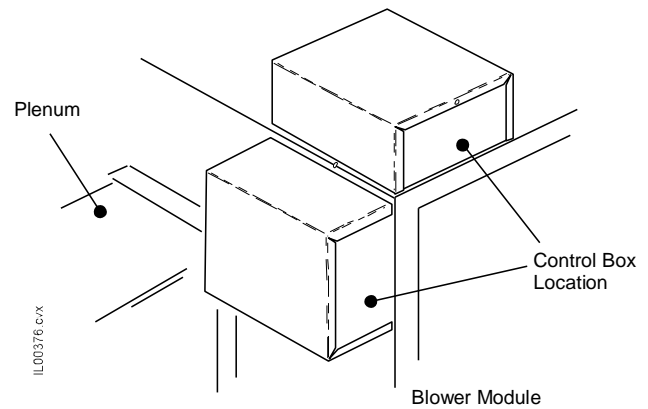The USB board has two LED lights.

**Table 8. USB board LEDs**

| LED 1 (green) | Flashing | SCB sending message to ECMConfig program |
|---|---|---|
| LED 2 (red) | Flashing | ECMConfig program sending message to SCB |

## Location and Mounting

Before installing the SCB, inspect thoroughly for shipping damages. Notify carrier immediately if there is any damage.



**Figure 4. Control Box Mounting Locations.**

The control box can be installed in either one of two positions on the modular air handler (Figure 4). Choose the position that allows the best access. The control box can be mounted remotely using an extension cable, part number A01525-G01 (5ft) or A01525-G02 (8ft).

### CAUTION

**THE CONTROL BOX MUST BE SCREWED TO THE AIR HANDLER OR REMOTE MOUNTED USING THE UNICO EXTENSION CABLE TO PROVIDE PROPER GROUND FOR THE MOTOR.**

The knock-out on top/front of the air handler must be removed to allow the motor cable connector to extend into the air handler space.

## Board Terminals

The following tables describe in detail the function of each terminal on the control board.

**Table 9. Thermostat Terminal Block Description**

| | | |
|---|---|---|
| **Inputs** | **R** | Power out. 24VAC power signal. |
| | **O-b** | Reversing valve input from thermostat. Can be either O or B, depending on the requirements of the outdoor unit. |
| | **G** | Fan input. Blower will operate at fan speed unless there is a call on Y1, Y2, W1, W2 or E. Refer to Tables 2 and 3 for default blower airflow settings. |
| | **Y2** | High Cool input. Will energize the blower at High Cool airflow and pass a signal to Y2 on the condenser terminal block. |
| | **Y1** | Low Cool input. Will energize the blower at Low Cool airflow and pass a signal to Y1 on the condenser terminal block. |
| | **W1** | Heat input (first stage of two-stage heat). Electric heater will not turn on with this signal. Blower will run at Low Heat airflow rate. |
| | **W/ W2/ S1** | Heat input (single stage heat, second stage of two-stage heat, or first stage electric heat) Powers S1 electric heat terminal (direct connection). Electric heater will energize when fan is at full speed (not ramping). Blower will operate at High Heat speed. |
| | **S2** | Heat input (third stage heat). Connects to S2 on the thermostat terminal block. Powers S2 on the electric heat terminal block (direct connection). Will not power the blower. |
| | **S3** | Heat input (third stage). Connects through a NC relay to S3 on the thermostat terminal block. Powers S3 electric heat terminal if operating in heat pump mode (signal present at Y2 or Y1). Will not power the blower. |
| | **E** | Emergency heat input. Powers E on the electric heat terminal block (direct connection from Thermostat Terminal Block terminal E input). Blower will operate at the Emergency airflow rate. |
| | **C** | Common. Used to power the thermostat, or an external relay, if required. |

Note: Factory ships with jumper across Y2 and Y1, and a jumper across R and O-b.
**The Y2-Y1 jumper must be removed for two-speed condensers.** The jumper is only a convenience so that either terminal may be used for single-speed condensers.
**The R-Ob jumper must be removed for heat pump systems.** The Rev.Valve switch must be set properly.

**Table 10. Condenser Terminal Block Description**

| | | |
|---|---|---|
| | **R** | Power out. 24VAC power signal. |
| **Dry Contact Input (Rated 24VAC, 2 amp)** | **AFS** | Anti-frost switch input. The AFS is mounted on all refrigerant coils. When the AFS is closed and in cooling mode, the control will allow the Y1 or Y2 condenser terminals to be energized. If the AFS switch opens, the condensers will stop although the indoor blower will continue to operate. The AFS will not affect operation of the condensers if in the heating mode. The AFS switch will open at 34°F±3°F (1°C±1.6°C) and close at 60°F±3°F (15.5°C±2.8°C). The AFS contacts are normally open and close when the R-Ob jumper is removed for heat pump application. |
| **Input (24 VAC)** | **D** | Defrost input from the outdoor unit. Powers D on the electric heat terminal block (direct connection). The D terminal must be connected for all heat pumps. This prevents AFS nuisance trips from occurring if the outdoor unit control board energizes O-b during defrost. |
| **Outputs (24 VAC)** | **Y1** | Cool output. Will energize single-speed condenser or the first-stage of a two-stage condenser. |
| | **Y2** | Cool output. Will energize the second-stage of a two-stage condenser. |
| | **O-b** | Reversing valve output. Can be configured as either O or B, depending on the requirements of the outdoor unit. |
| | **C** | Common. Used to power the relays and controls in the condenser. |

**Table 11. Accessories Terminal Block Description**

| | | |
|---|---|---|
| | **R** | Power out. 24VAC power signal. |
| **Dry Contact Input** | **Aqua** | Aquastat input. Allows the option of using an aqua-stat to reduce the time it takes for the air to become hot when heating. The fan will not energize until the aquastat is satisfied. |
| | **HumStat** | Humidistat input. The HumVlv contacts will close whenever the humidistat calls for humidity and the unit is not in cooling. The fan will come on if necessary. |
| **Dry Contact Output (120VAC, 3 amp)** | **HumVlv** | Used to turn on humidifier (contacts close) when there is a call from the Humidistat. |
| | **EAC** | Used to energize an electronic air cleaner (EAC), ERV, HRV, or UV-light (contacts close when fan is on). Can also be software-configured to control a fresh air damper (contacts close as required by software algorithms.) |
| **Dry Contact Output (250VAC, 5 Amps)** | **HotW** | Used to energize either a boiler, valve, or pump. Contacts will close based on the inputs shown in Table 6. |
| | **ColdW** | Used to energize a chiller, valve, or pump. Contacts will close based on the inputs shown in Table 6. |
| **Note:** All boards ship from the factory with a jumper across R and Aqua. This jumper must be removed if an aquastat is used. | | |

**Table 12. Electric Furnace Terminal Block Description**

| | | |
|---|---|---|
| **Outputs** | **R** | Power out. 24VAC power signal. |
| | **Fan** | Fan proving output, connected through a relay directly from G on the thermostat terminal block. Once the motor reaches full speed, this relay closes sending a 24VAC signal to the electric heater to allow the heating elements to energize. The Unico Electric Furnace will not function unless this signal is present. |
| | **D** | Defrost output, direct connection from D on the condenser terminal block. Will send a signal to electric furnace defrost terminal to turn on the defrost elements to prevent cold blow during defrost. |
| | **E** | Emergency heat output, direct connection from E on the thermostat terminal block. Will energize all the electric furnace elements. |
| | **S1** | Heat output, direct connection from W/W1 on the thermostat block. Blower will operate at High Heat airflow, electric furnace S1 terminal will be energized, and accessory relays (HotW and ColdW) will energize in accordance with Table 5. |
| | **S2** | Heat output (second stage), direct connection from W2 on the thermostat terminal block. S2 terminal on electric furnace terminal block will be energized. The electric furnace requires that the S1 signal is present in order to energize the second stage heating element. |
| | **S3** | Heat output (third stage), connected through an NC-relay directly from S3 on the terminal block. Relay is energized and contacts open whenever Y1 or Y2 is energized. This prevents the third stage of electric heating elements from energizing when the heat pump is operating. The electric heater requires that the S1 signal is present in order to energize third stage electric heat. |
| | **C** | Common. Used to power the relays in the electric heater. |

## Wiring

**WARNING!**

**DISCONNECT ELECTRICAL SUPPLY BEFORE WIRING UNIT TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK.**

All electrical wiring must comply with all local codes and ordinances. Use a separate power supply with appropriate amp fuse or breaker and wire gauge for the specified amperage. Do not wire directly to condenser or add other equipment to the blower power circuit.

### CAUTION

**Be sure that the input power voltage matches the control box to prevent damage to the equipment.**

Once the control box is mounted to the cabinet, the motor can be connected from inside the air handler. Remove the appropriate air handler access panel. Connect the motor connector to the mating end of the control box wiring harness, pushing firmly to be sure the connector is seated.

Connect the control wiring for the external devices such as the thermostat, condenser, and electric furnace to the SCB using the appropriate wiring diagrams as shown below.

There are several knockouts on the sides of the control box to bring in the power lines. Use the most convenient ones to bring in line voltage and ground to the terminal block as shown in Figure 5.
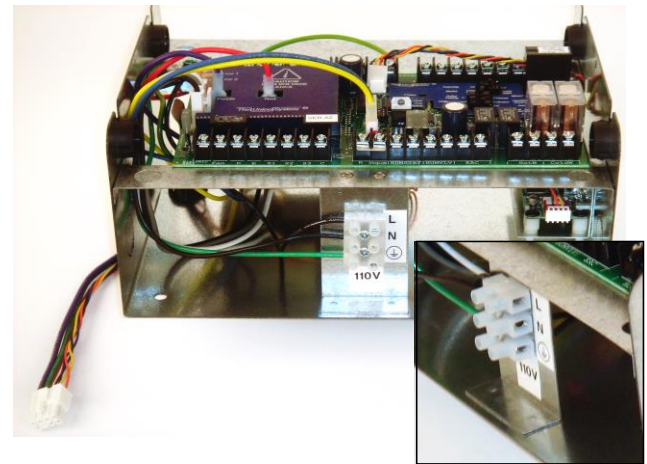


**Figure 5. Terminal block for incoming line voltage connections.**
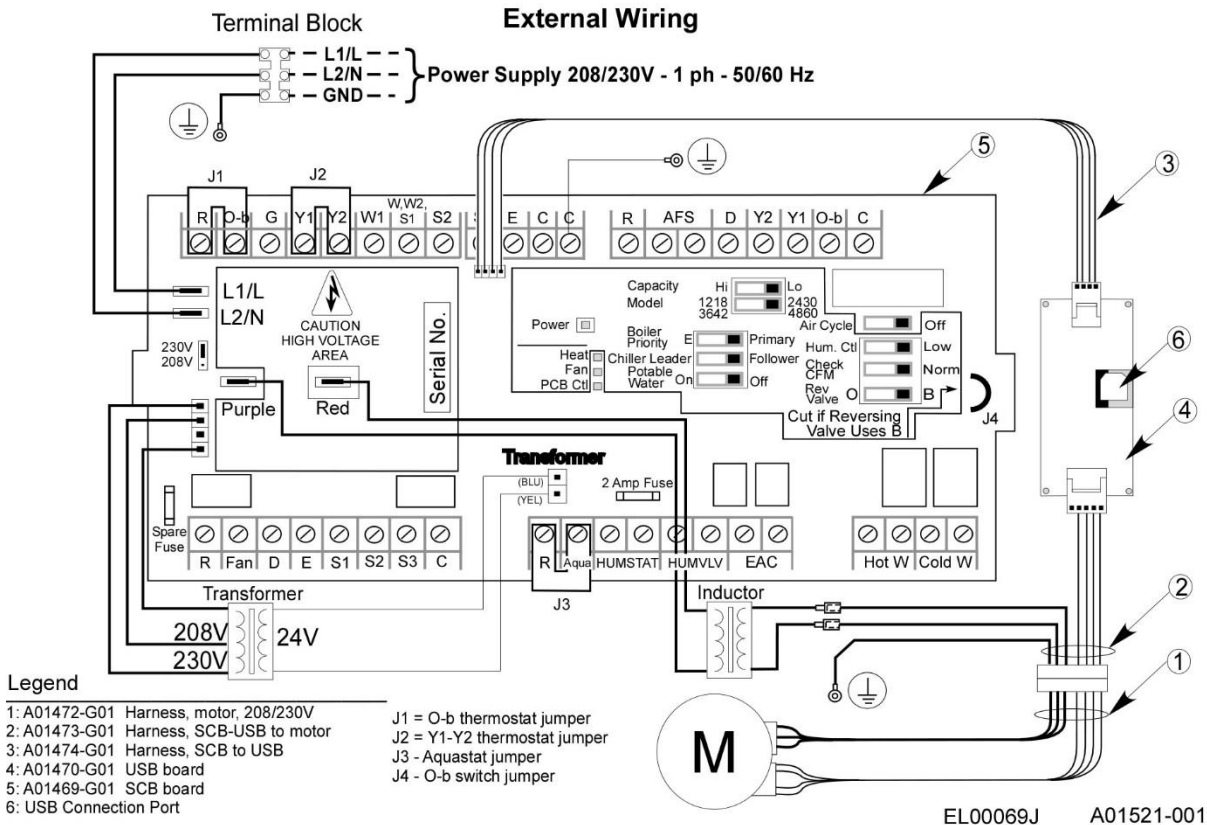


**Figure 6. Power and internal wiring diagram.**

## Wiring Configuration Diagrams

The SCB is compatible with most heating and cooling systems: cooling-only air conditioning, heat pumps, boiler systems, chiller systems, electric furnaces, and various combinations of each. The control board is organized by input type as shown in Figure 7.
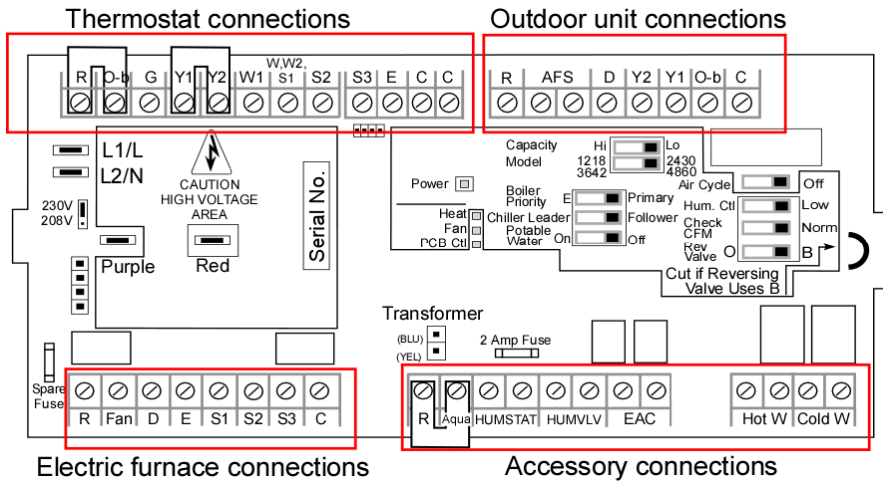


**Figure 7. Control board input/output connections**

## DIAGRAM 1.  Air Conditioning, no heat
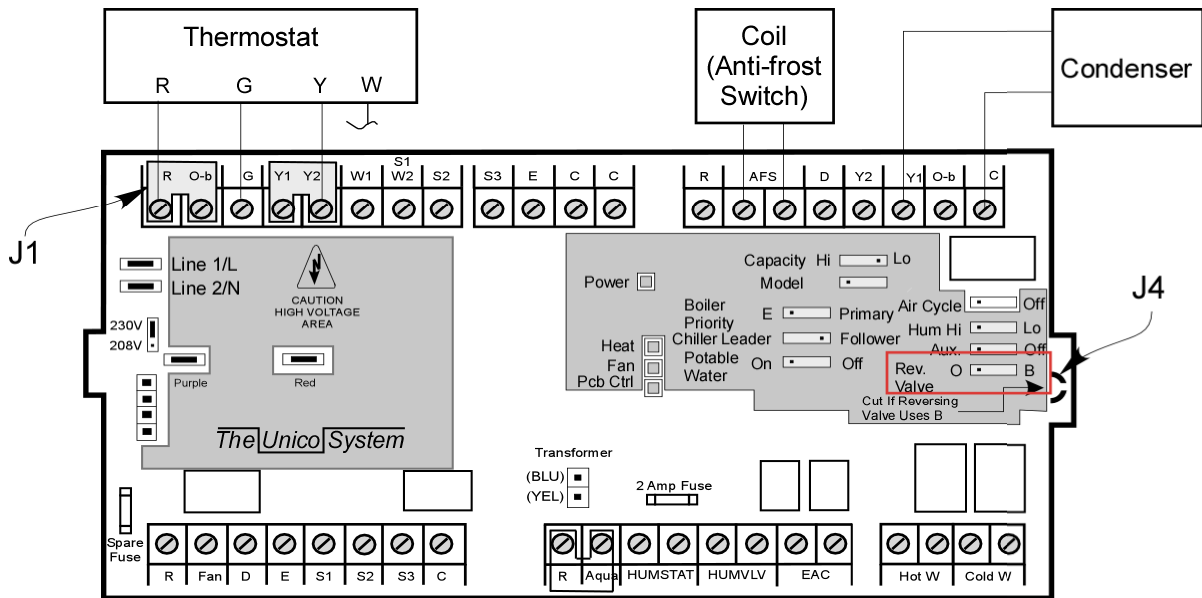


Note for A/C systems:

- Be certain that the jumper (J1) is in place between R and O-b. If the Rev. Valve switch jumper (J4) is cut, then move Rev. Valve switch to O.

**DIAGRAM 2.  Heat pump, no secondary heat**
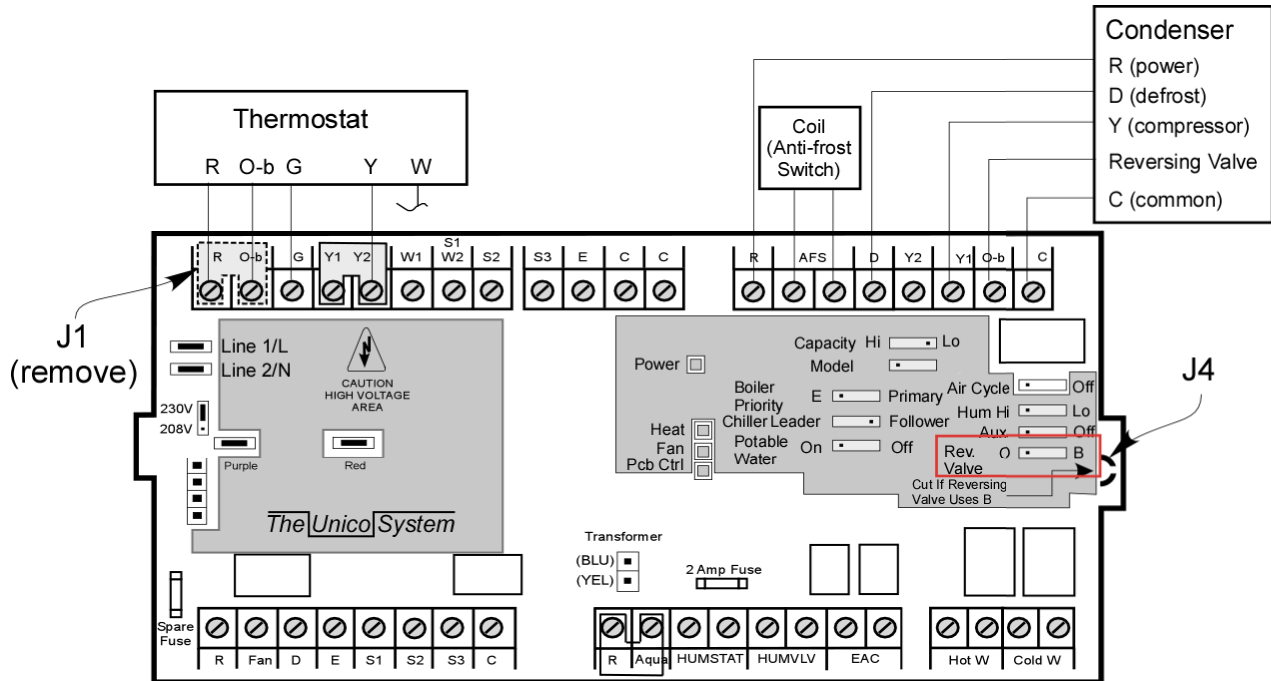


Notes for heat pump systems.

- Use a heat pump thermostat.

- Remove jumper (J1) between R and O-b on the thermostat block.

- If the reversing valve is energized in the heating mode, cut the heat pump jumper wire and be sure that the Reversing Valve switch is in the 'B' position. Connect 'B' from the thermostat to 'O-b' on the thermostat input terminal block on the board.

  If the heat pump reversing valve is energized in the cooling mode (i.e. requires the 'O' signal), it is not necessary to cut the reversing valve jumper wire. However, if the wire is cut, then move the switch to the 'O' position and connect 'O' from the thermostat to 'O-b' on the thermostat input terminal block on the board.

  **Note:** Most heat pumps use 'O'.

**DIAGRAM 3a. AC or Chilled Water with Primary Hot Water Heating option (boiler operation)**
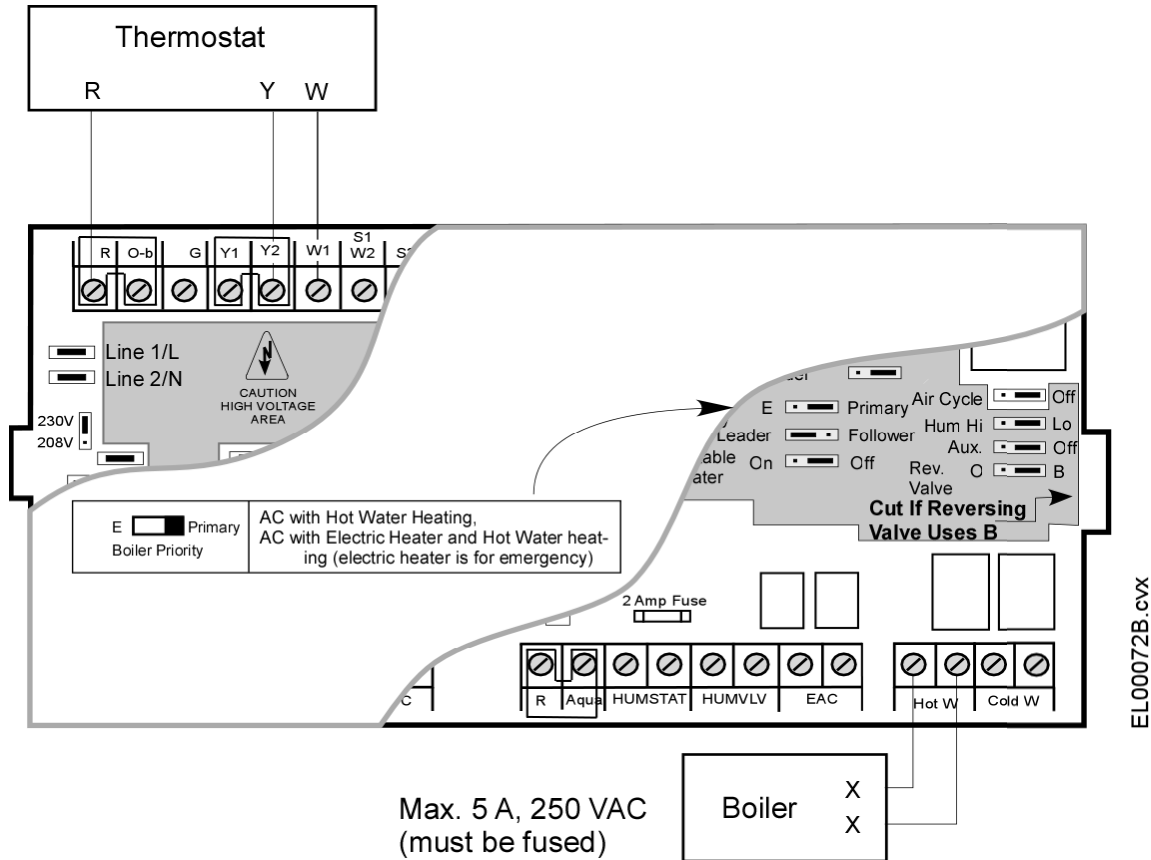


For proper boiler operation, select the appropriate Boiler Priority as shown. If an aquastat is used, refer to Diagram 3d. In boiler operation, the SCB provides a set of dry contacts to turn the boiler on (Hot W will close with signal on 'W'). The boiler itself must turn on any required pumps or valves in the system.

Please note that the Hot Water relay is rated for 5 amps at 250 VAC. For complete protection, be sure that the load on the relay is fused.

| DIAGRAM 3b. AC, Chilled Water, or Heat Pump with Emergency Hot Water Heating option | DIAGRAM 3c. Hot Water Heating option (pump or valve operation) |
|---|---|
|  |  |
| | If desired, the valve can have an end switch to power on the pump or boiler separately. If an aquastat is used, refer to Diagram 3d. |
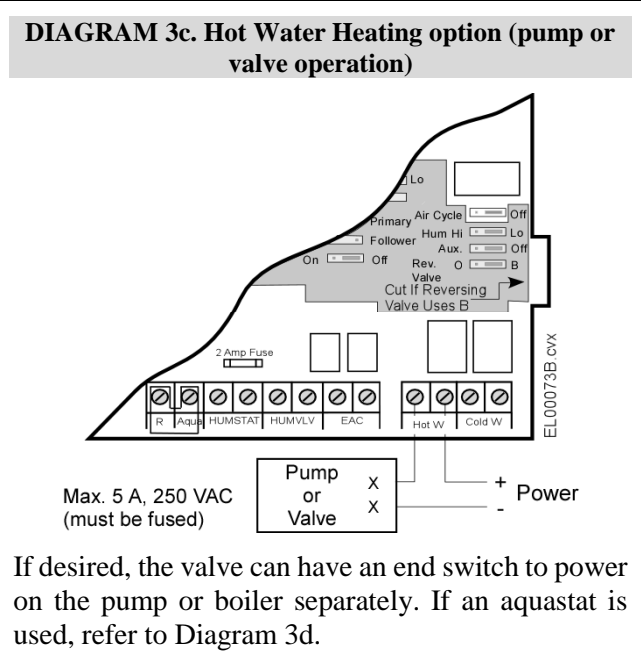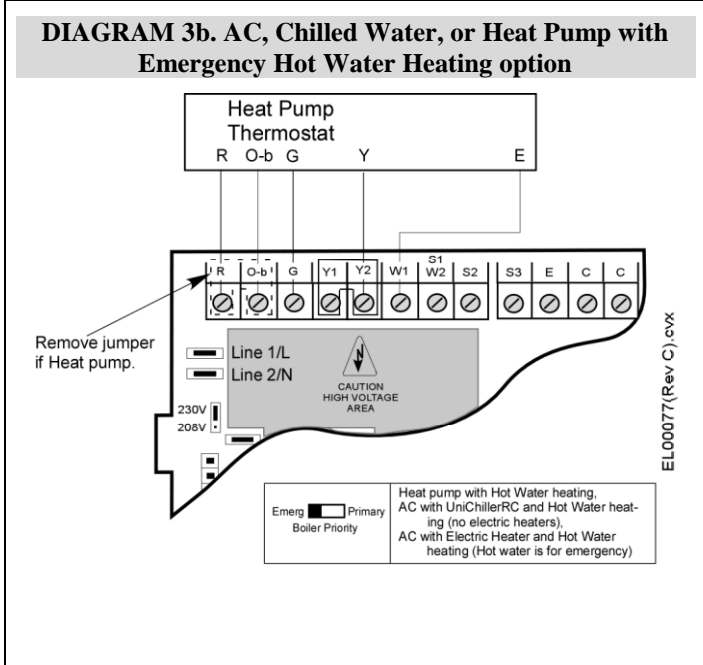
**DIAGRAM 3d. Aquastat Option (for hot water systems)**
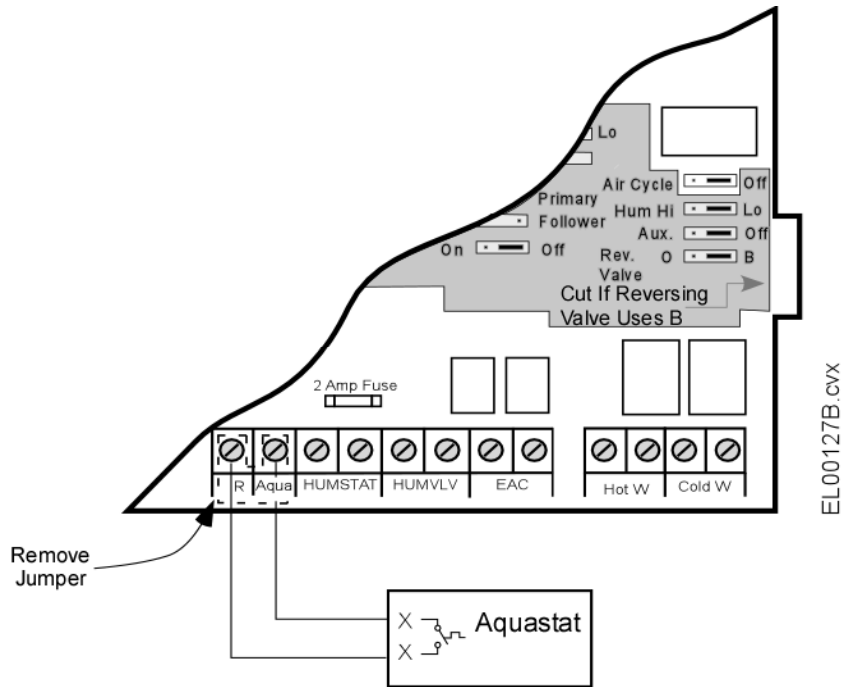


**DIAGRAM 4. AC with ELECTRIC HEAT**
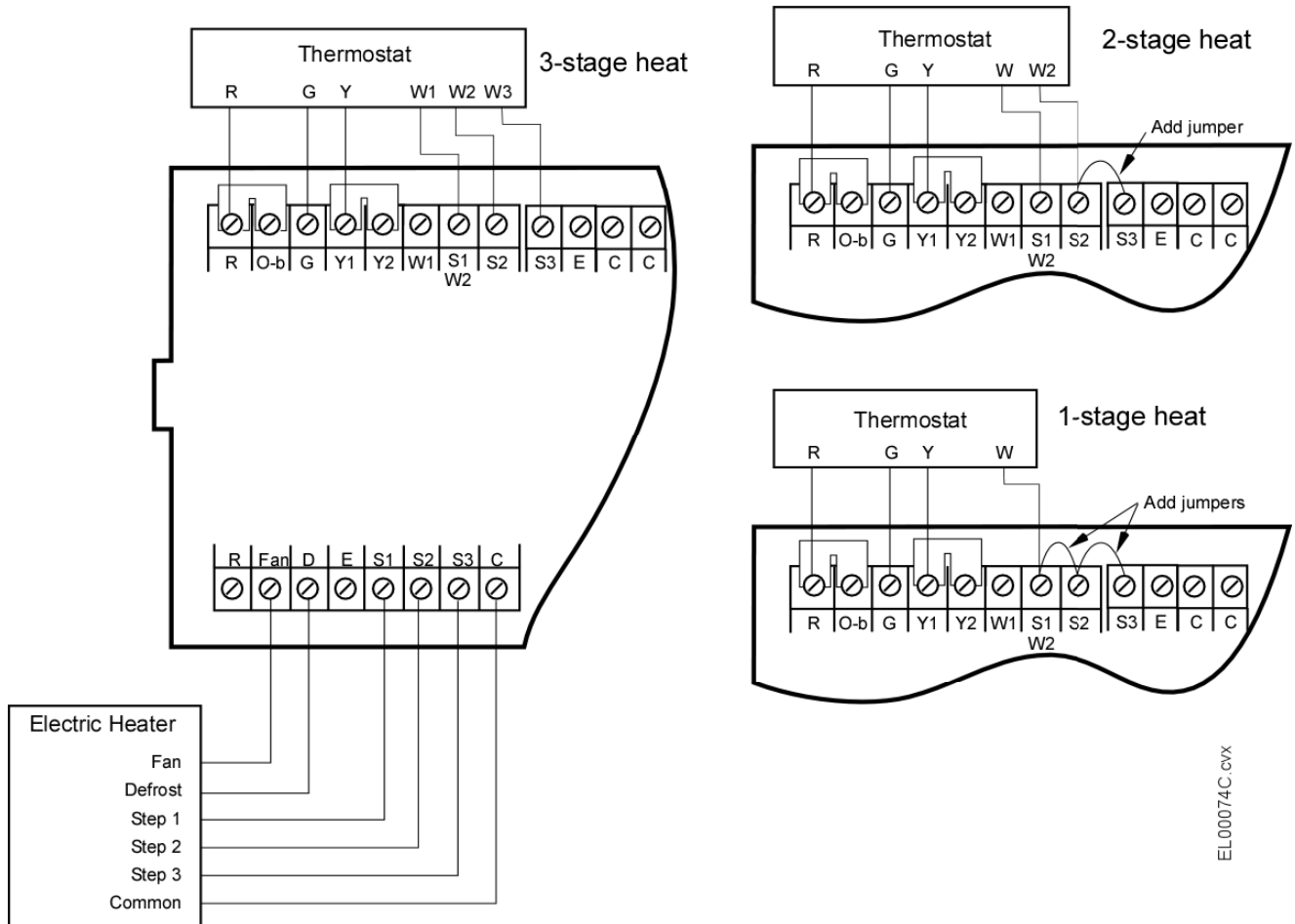


Refer to Diagram 1 to wire outdoor condenser unit.

## DIAGRAM 5. Heat Pump with Emergency Heat
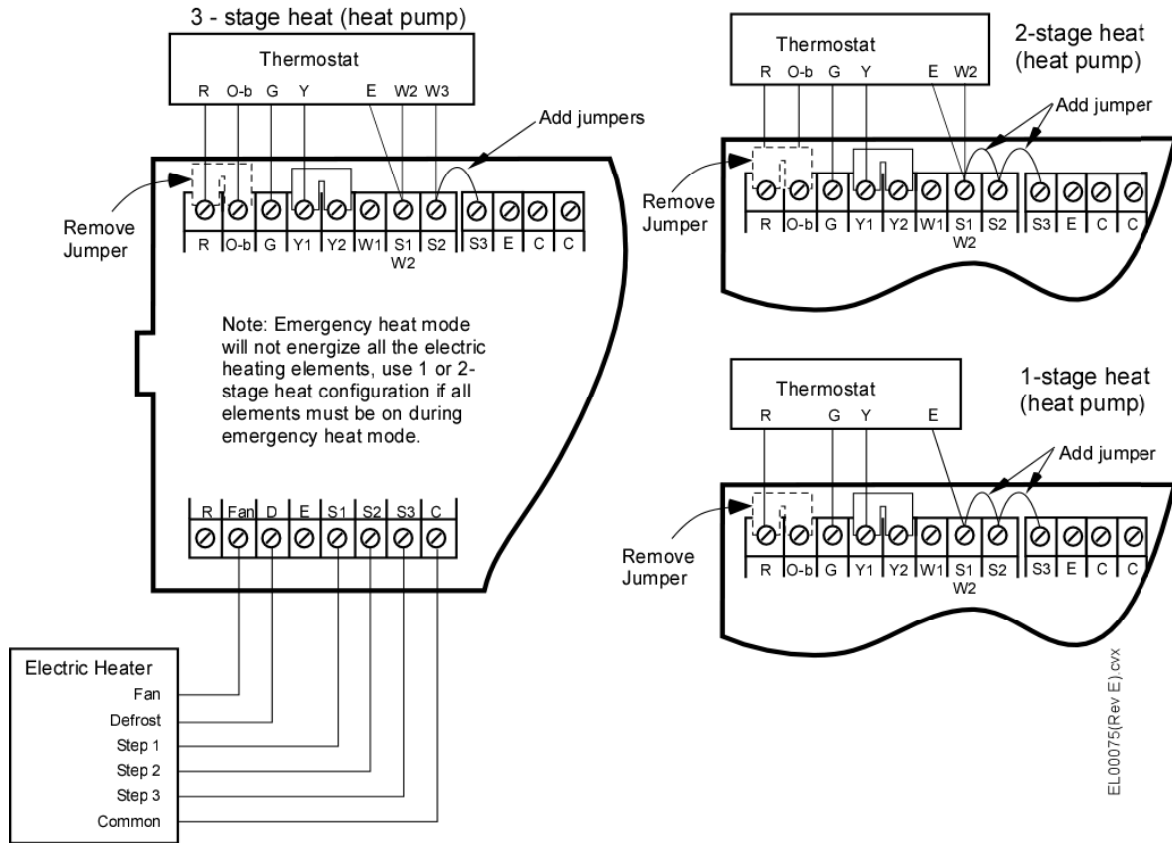


Refer to Diagram 2 to wire outdoor heat pump and for instructions for setting the reversing valve O-b switch.

For 2 or 3-stage heating, if hot water coil is used for emergency heat, then do not connect the thermostat E to W2 and refer to Diagram 3b.

### DIAGRAM 6. Emergency-Only Electric Heater
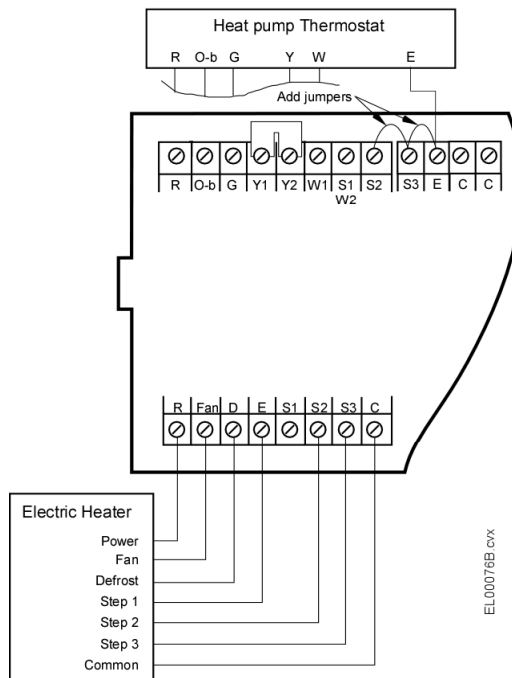
## Wiring to a Chiller

The Unico SCB controller is compatible with any chiller system that uses a dry contact input to energize the chiller, much like a boiler system. The following diagram illustrates one specific example where the chiller has its own R-Y-B-C inputs, like a heat pump. Refer to your chiller manufacturer's installation instructions for other types of systems. For more than one chiller or more than one air handler, we recommend the use of a stage controller.

**DIAGRAM 7. Single Chiller with One Air Handler (Intermittent Pump)**
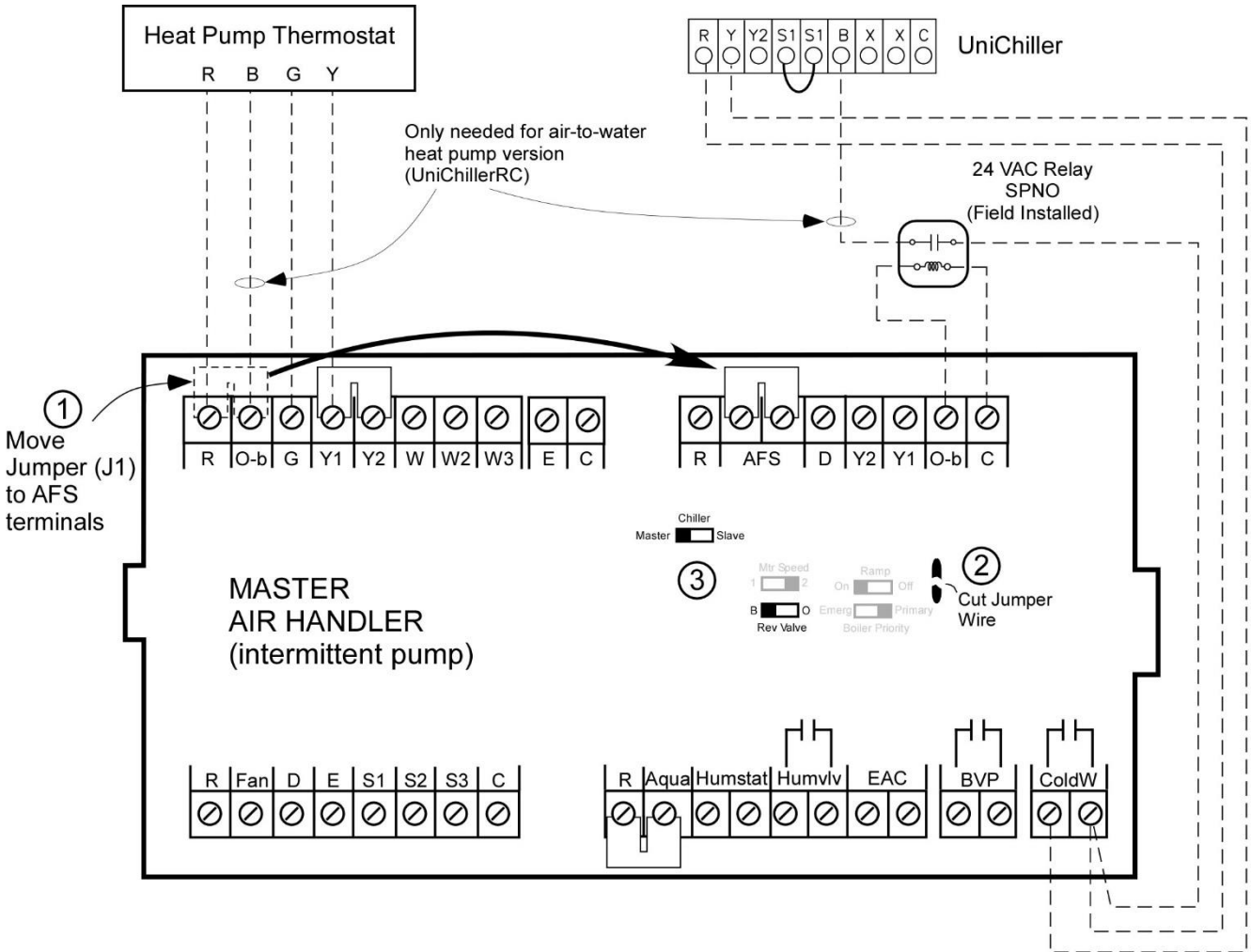
**DIAGRAM 8. Humidity System**



| (for line voltage power humidifier or humidifier valve) | (for 24 V power humidifier or humidifier valve) |
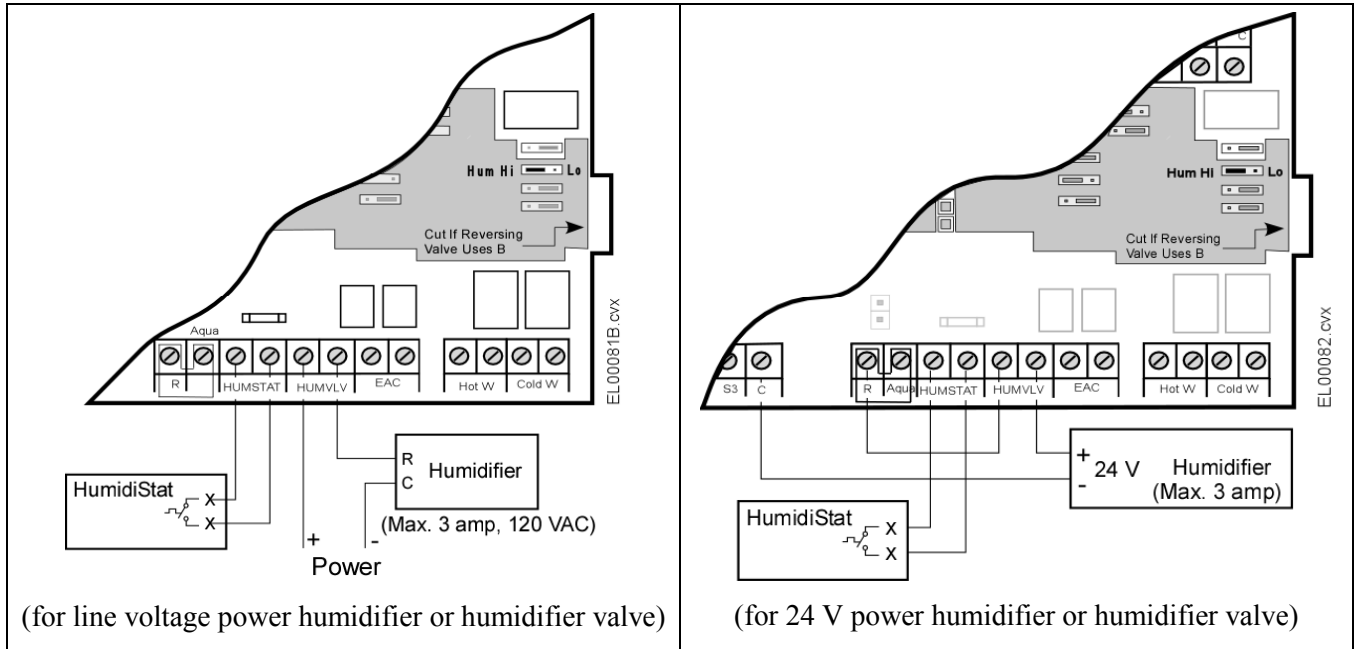
Set Humidity Control switch (Hum Spd) to proper position. The 'HI' position will energize the high cool fan airflow in response to a call for humidity from the humidistat unless the fan is already operating at high. The Humidity Valve relay (HumVIv) will then close and turn on the humidifier. If the switch is in the 'LOW' position, then the blower will operate at the Fan airflow rate, and the Humidity Valve relay will close and turn on the humidifier.

**DIAGRAM 9. Electronic Air Cleaner (EAC), Recovery Ventilator (ERV or HRV), or UV light connection**



| (for line voltage EAC or UV light) | (for 24 V power EAC or UV light) |
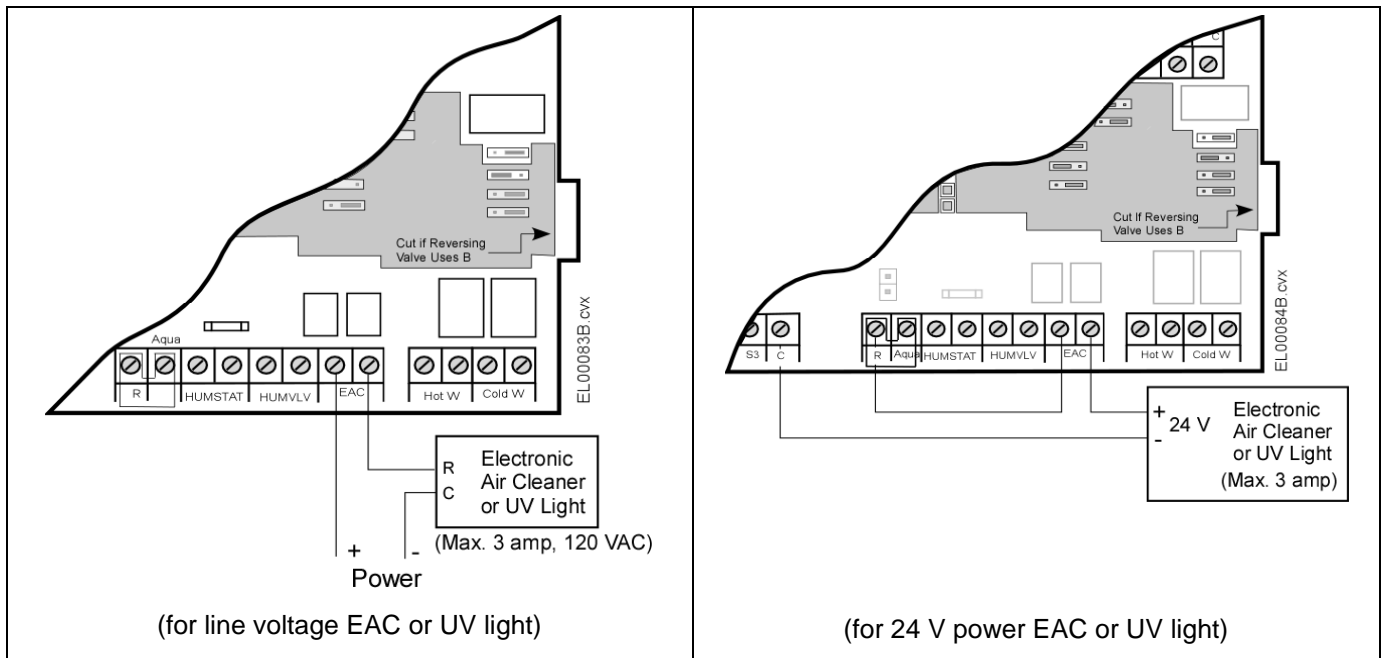
Diagram 9 shows how to connect an ERV, HRV, or EAC that you want to turn on whenever the blower is on. Call Unico customer service for instructions if the device needs to operate on a predetermined time schedule.

**DIAGRAM 10. Two-Stage (100/75) Condensers and Heat Pumps**

Two-stage condensers and heat pumps generally operate between 50% and 75% capacity at low stage. By default, Unico configures the low stage airflow rates(Y1) of the SCB to be 75% of the high stage airflow(Y2). See Figure 3 for more information. If your outdoor unit uses a different low stage capacity ratio, you can easily adjust the airflows to match by using the ECMConfig program. For more information on how to make this change, refer to the section below titled: *Programming the SCB*.
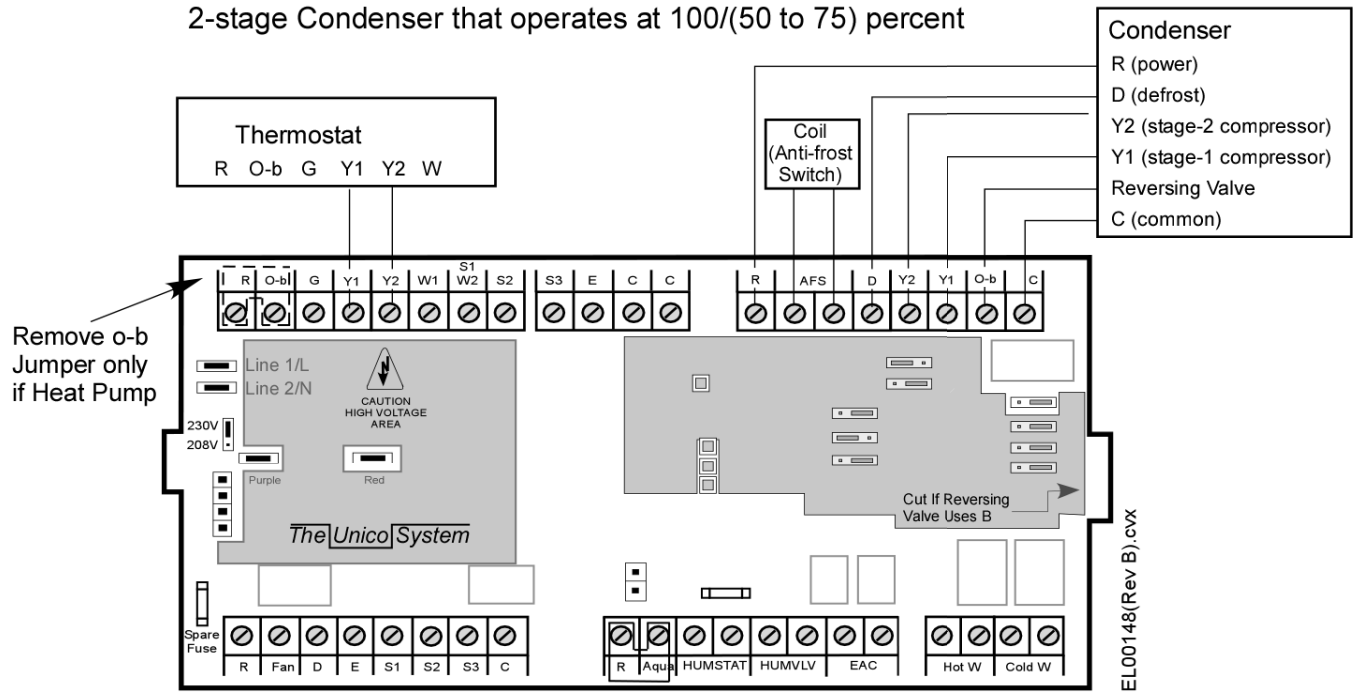
### External Wiring of the SCB

The SCB connects to the EC motor using a combination of three different wiring harnesses. Each wiring harness uses either a quick disconnect or Molex plug for ease of termination.

**Table 13. Wiring Harness Description**

| # | P/N | Description |
|---|-----|-------------|
| 1 | A01473-001 | Wiring Harness, SCB/USB Connects to SCB and USB Board, Supplies power and communication to the Motor Harness. |
| 2 | A01474-G01 | Wiring Harness, SCB Data Cable" |
| 3 | A01472-G01 | Wiring Harness, Motor, 230V Connects directly to the Motor. **(208-230V ONLY)** |
| 4 | A01472-G02 | Wiring Harness, Motor, 110V Connects directly to the Motor. **(110V ONLY)**. |
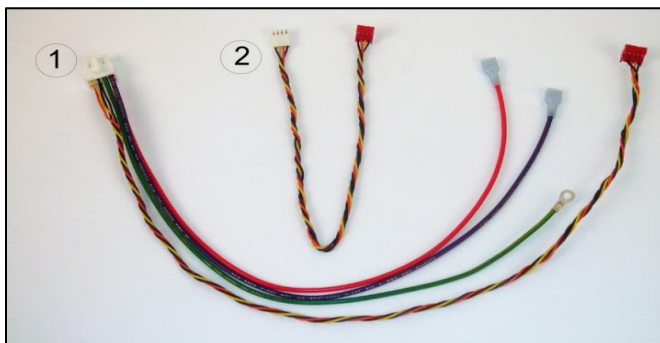


**Figure 8. SCB Harness and Data Cable**
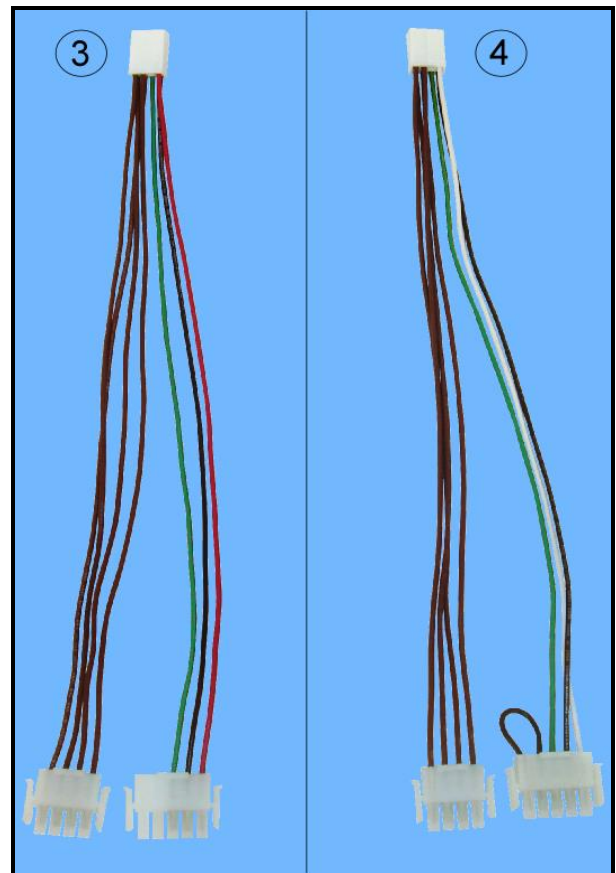


**Figure 9. Motor Harness: (3) 208-230V, (4) 110V**

### Wiring Harness Pin Positions

# CAUTION!

**Using the -G02 (110V) Motor Harness at a supply voltage of 230V will damage the motor.**

(1) A01473-G01 (SCB Harness)
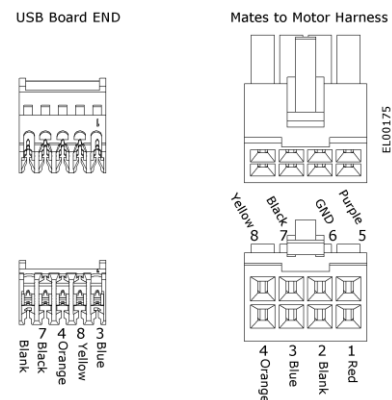
(2) A01474-G01 (Data Cable)
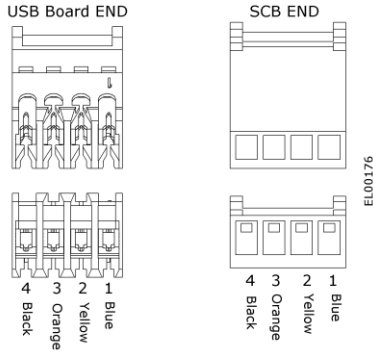


(3) A01472-G01 (230V Motor Harness)
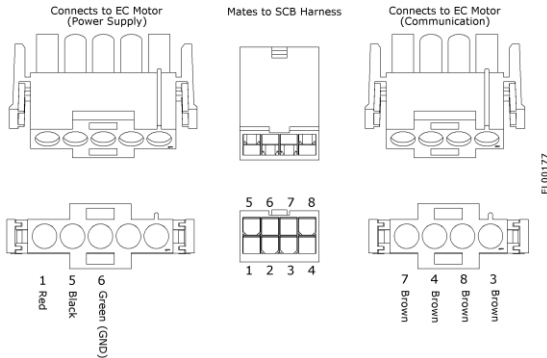


(4) A01472-G02 (110V Motor Harness)
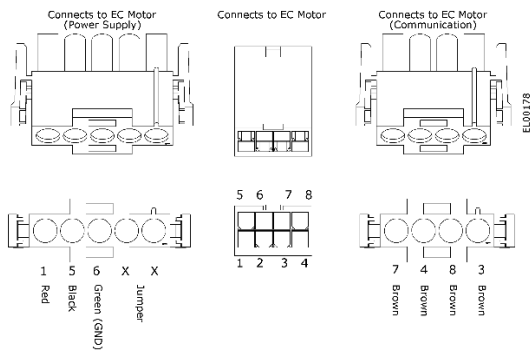


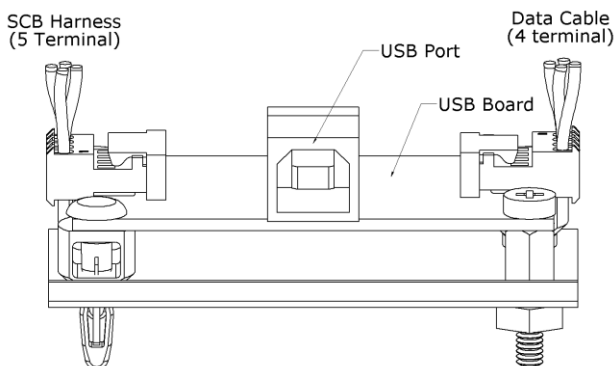Cable Connections to the USB Board



Note: Cables attach to the USB Board with leads facing up

**Figure 10. USB board.**

## Programming the SCB

The SCB switches allow the user to select from two different default high-cool airflow rates for each model blower by changing the position of the "CFM" or "Capacity" switch, depending on the model of the control board [refer to Table 3 for the default values]. These settings are based on design airflow requirements for refrigerant cooling coils and should be sufficient for most applications. The default airflow for all other modes of operation are a percentage of the high-cool value and can be found in Table 2. However, if the installation calls for a modification, each airflow can be individually modified using the Unico ECMConfig program.

**Compatibility.** The ECMConfig software requires the use of a Windows XP/7/8 operating system. Use of a Windows emulator for Mac systems may be possible, but is not supported. The software requires .NET version 3.5 or later. The ECMConfig installer will automatically check for this.

**Installation.** A software installation CD ships with every SCB control box. This software can also be downloaded from: http://tech.unicosystem.com/ . If you have an older version of the software, you will first need to uninstall it. The installer will search your operating system for the correct .NET framework and automatically install it if it is not found. If using the CD, simply insert and follow the instructions. If the installer does not automatically begin, go the the Start button, select RUN and type "*drive*://ECMconfig.msi".

**Connecting your computer.** After the software is installed, connect your computer to the control box using the included USB cable (Type A/B). Start the program and apply power to the control box. Your computer should immediately recognize the control box and the software will indicate that it is connected.



**Figure 11. Location of USB (computer) port**

**Startup and Main Tab**

Upon startup, you will see a temporary 'splash' screen, and then the Main tab of the ECMConfig program. There are three Tabs: Main, Air Cycle and Switches. The Main tab is used to set the Airflow and RPM Limit for each Mode of operation. It also provides information on the current airflow and fan RPM, as well as the Model number of the blower as identified by the motor size and position of the MOD and AUX switches. The blower model and any calls from the thermostat will be highlighted on this screen, as shown in Figure 12. If the highlighted model is not what is installed, set the switches to the correct position for your model blower as shown in tables 4a and 4b, and cycle the power to the SCB.

**Communication Status**

At the bottom of the ECMConfig window is a graphic that shows the blower, USB board, SCB board and your computer, and indicates the current communication status between each component. Moving dots indicate that communication between two adjoining components has been established and red "X' marks indicate that there is no communication. Red error messages will be displayed that indicate the source of the problem. The most likely problem is no power to the SCB or motor, or a bad cable. See table 14 for more details.
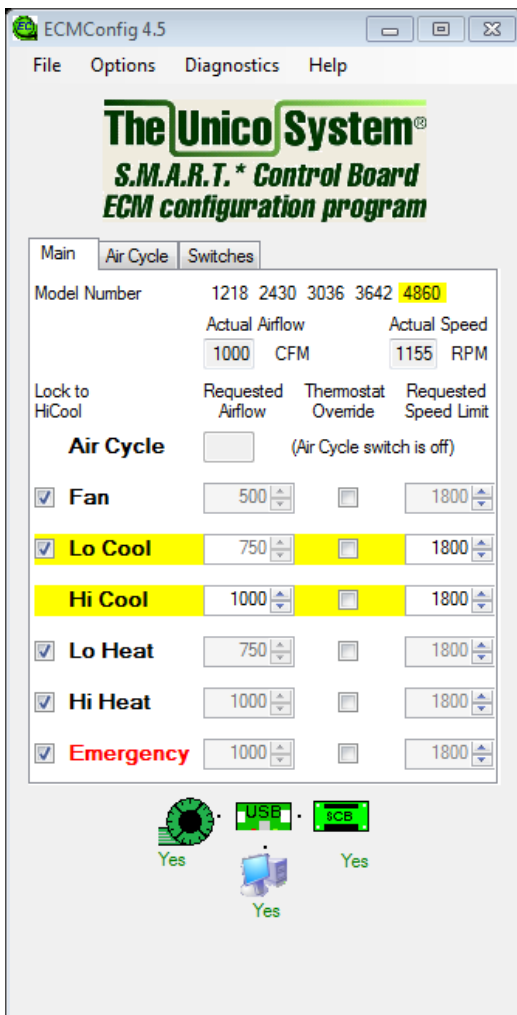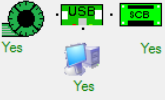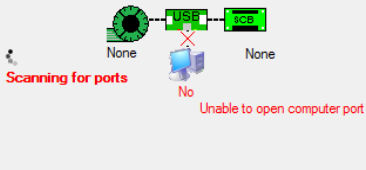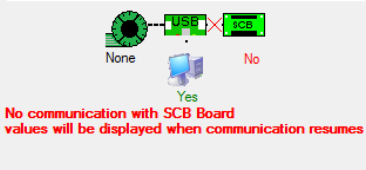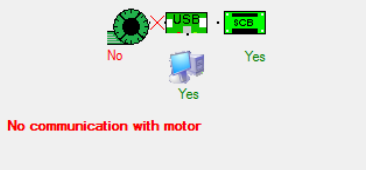


**Figure 12.** ECMConfig Main Tab. Model number and thermostat calls highlighted.

**Table 14. Communication Error codes.**

| Symbol | Error Message/Symbol | Interpretation | Action |
|---|---|---|---|
|  | Normal Operation Shown. | Proper Communication Established. | None. |
|  | Unable to open computer port. Scanning for ports.<br><br>"X" between Computer and USB board. | Computer cannot communicate with USB board.<br><br>USB board or cables may be faulty or disconnected.<br><br>The COM port assigned to the USB board may be too high. | 1.) Check for loose USB cable.<br><br>2.) Check that Red, Green LEDS on USB board are flashing.<br><br>3.) Check Device Manager. Set COM port value to 16 or less.<br><br>4.) Reinstall Software. |
|  | No communication with SCB board.<br><br>"X" between USB board and SCB board. | Computer cannot communicate with SCB board.<br><br>SCB cable is not connected or is faulty. | 1.) Check that the SCB board has power.<br><br>2.) Reseat multi-colored cable between USB board and SCB., cable A01474-G01 |
|  | No communication with motor.<br><br>"X" between USB board and motor. | SCB cannot communicate with the motor. | 1.) Check power to the motor. Check power wires on cables A01473-G01 and A01472-G0x<br><br>2.) Check the 4-wire twisted data cable (part of A01473-G01) connected between the USB board and the motor cable.<br><br>3.) Check 4 black data wires (part of cable A01472-G0x) from motor to USB board. |

## Actual Airflow

This is the current actual airflow. This value will fluctuate as the motor ramps to achieve the Requested Airflow. Once Actual Speed is stable (no longer increasing), the "Actual Airflow" is accurate.
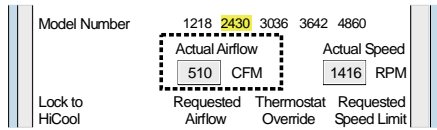

Figure 13.  Real Time Actual CFM

## Actual Speed

The program queries the motor for the motor speed in revolutions per minute. This value is exact and will fluctuate somewhat as the motor attempts to hold the airflow constant.
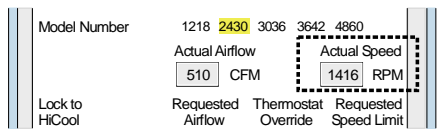

Figure 14.  Real Time Motor Speed

## Lock to HiCool

If this box is checked, the airflow will be locked to the High Cool (Y2) mode at the default percentage shown in Table 3. You must uncheck this box before you can change the requested airflow for a particular mode. This will change the input box for requested airflow from gray to white, indicating that you can edit its contents.
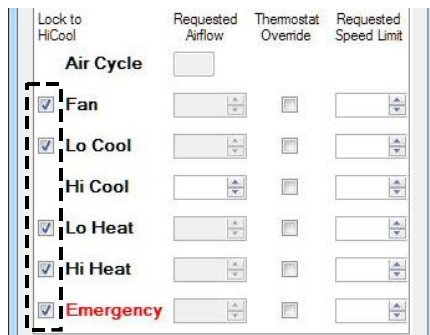

Figure 15. Lock to Hi Cool.

## Air Cycle Indicator

The program indicates the mode of operation by highlighting the mode in yellow. It is possible to have more than one mode highlighted. For example, if the Air Cycle switch is in the "on" position and the thermostat is calling for low cooling, then both of those modes will be highlighted. The program will display the words "Air Cycle" when that mode is operating.
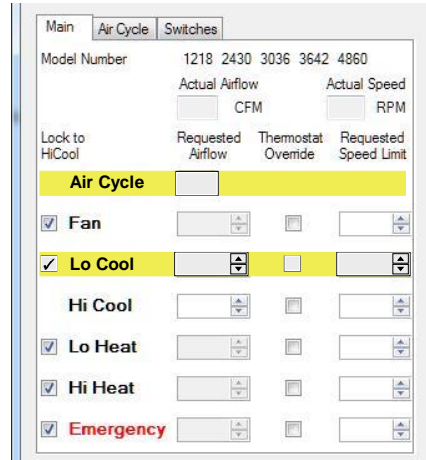

Figure 16.  Air Cycle mode
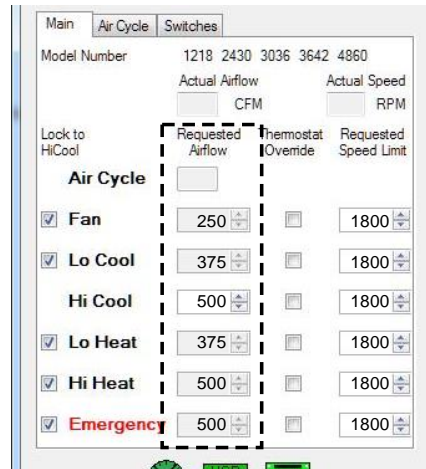
## Requested Airflow


Figure 17.  Requested Airflow

The airflow for each mode can be modified individually. To modify the airflow enter the desired value with the number pad or use the up/down arrows to change incrementally. Any changes are saved to the SCB memory immediately. The program will not allow you to enter a value outside the minimum and maximum airflows as shown in Table 15.

Table 15. Airflow range by model number.

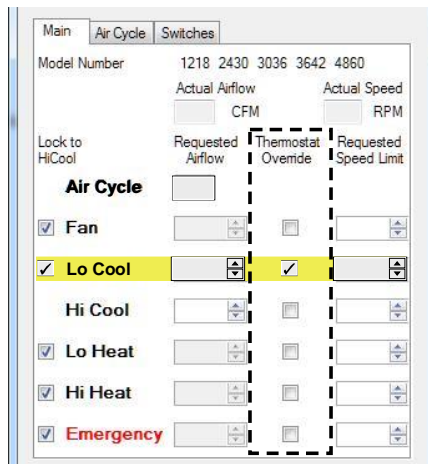| Blower Model | Minimum Airflow | Maximum Airflow |
|---|---|---|
| | CFM (L/s) | CFM (L/s) |
| 1218 | 100   (47) | 500 (236) |
| 2430 | 200   (95) | 750 (353) |
| 3036 | 300 (142) | 900 (425) |
| 3642 | 300 (142) | 1200 (566) |
| 4860 | 400 (189) | 1500 (707) |

**Thermostat Override**



**Figure 18.  Thermostat Simulation**

Thermostat Override acts to simulate a thermostat call and can be used to troubleshoot the system. These settings will not be retained in the SCB once the computer is disconnected. To simulate the operation of the thermostat, disconnect the physical thermostat wires from the terminal block, then simply click on the check box for the Mode of operation you are troubleshooting. This will activate the blower and relays on the SCB; it will not turn on the condensing unit.

**Air Cycle Tab**

The latest versions of the firmware and software include fresh air algorithms that meet the requirements of the ASHRAE 62.2 (2010) residential ventilation standard when the system is installed with a fresh air intake duct. These algorithms are embodied in our Air Cycle Auto Modes, and allow the system to periodically draw in fresh air even when there is no call from the thermostat. There are two different 62.2 compliant modes: *MaxComfort* and *EnergySaver*. Use of a fresh air damper is required to fully realize the benefits of these Modes of operation. The system will draw in air through the fresh air duct whenever the system is running if no fresh air damper is installed.

*MaxComfort Mode.* This Mode works to bring in most fresh air while the system is either heating or cooling. This reduces temperature swings caused by bringing in unconditioned fresh air. In this mode, the program will continuously track the inventory of fresh air for the previous four hours on a rolling basis. If the fresh air delivered dips below the amount required, the blower will automatically turn on at the Auto Mode airflow rate and will run until the airflow requirements have been satisfied. If enough fresh air
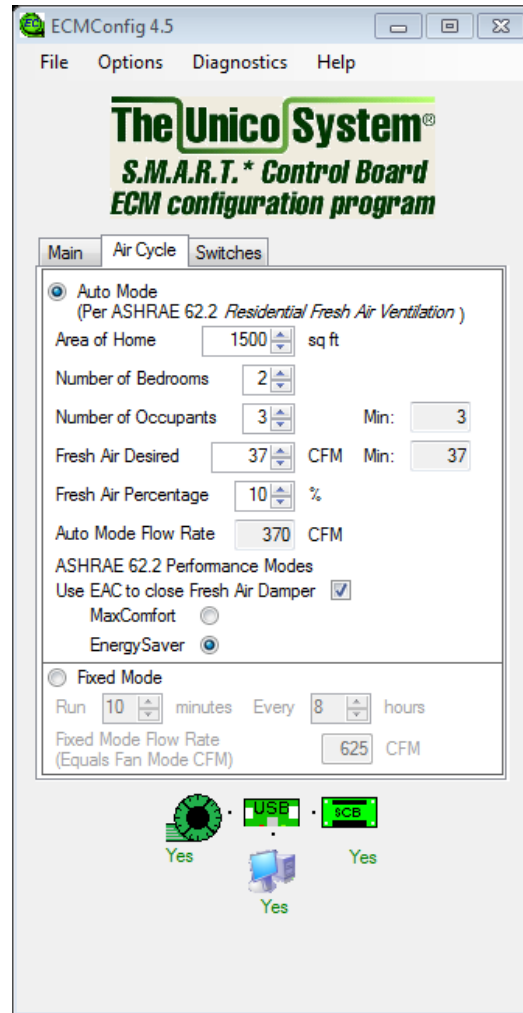


**Figure 19.  Air Cycle Tab. Auto Mode Selected.**

is brought in during heating and cooling operation, the blower will not need this additional runtime.

When used with a fresh air damper, MaxComfort Mode will bring in up to twice the amount of fresh air required in a four hour period while the system is operating so that it can remain off for as long as possible while there is no call from the thermostat. If there is no damper installed, the system will bring in fresh air whenever the system is running, and may over-ventilate the home.

*EnergySaver Mode.* This Mode brings in the minimum amount of fresh air required by the Standard. This technique minimizes the amount of energy required to condition the outside air. In this Mode, the program will continuously track the inventory of fresh air for each four hour block of time. This is not a rolling time frame. At the start of each period, the fresh air inventory starts at zero. This will start the blower at the Auto Mode flow rate if there is not already a call from the thermostat. The blower will run until the fresh air delivered meets the

requirement for that four hour period. If there is never a call from the thermostat, the blower will run at this ventilation rate continuously. If there is a call from the thermostat, then the system will close the fresh air damper once the four hour inventory requirement has been met.

*Fixed Mode.* This mode turns on the blower at the Fan airflow rate according to a schedule set by the user. For example(See Figure 20), 10 minutes every 8 hours. Simply fill in the two fields in the Fixed Mode section of the Air Cycle tab to determine how long and how often the air will circulate. This mode can be used to circulate air within the house, or also to bring in fresh air if there is a fresh air intake duct installed with the system.

**Complying with ASHRAE 62.2**

ASHRAE 62.2 is a fresh air and indoor air quality standard that applies to low-rise residential buildings. Complying with ASHRAE 62.2 is only necessary if it is required by your municipality. Please check your local building codes to determine if and when you need to comply. For more information on the standard, visit www.ashrae.org.

**System Configuration for ASHRAE 62.2 Compliance**

In order to configure your system to comply with ASHRAE 62.2, you must input certain information about the installation into the Auto Mode fields. Below are descriptions of each entry. See Figure 19 for the program screen.

*Area of Home.* Enter the area of the home that is to be conditioned.

*Number of bedrooms*. Enter the number of bedrooms in the home. Other rooms do not need to be considered.

*Number of occupants*. The minimum number of occupants is calculated automatically by the program. This is a feature of the ASHRAE 62.2 standard, and cannot be reduced. If the actual number of occupants is greater than the minimum indicated, that number may be entered in the field to the left of the minimum value.
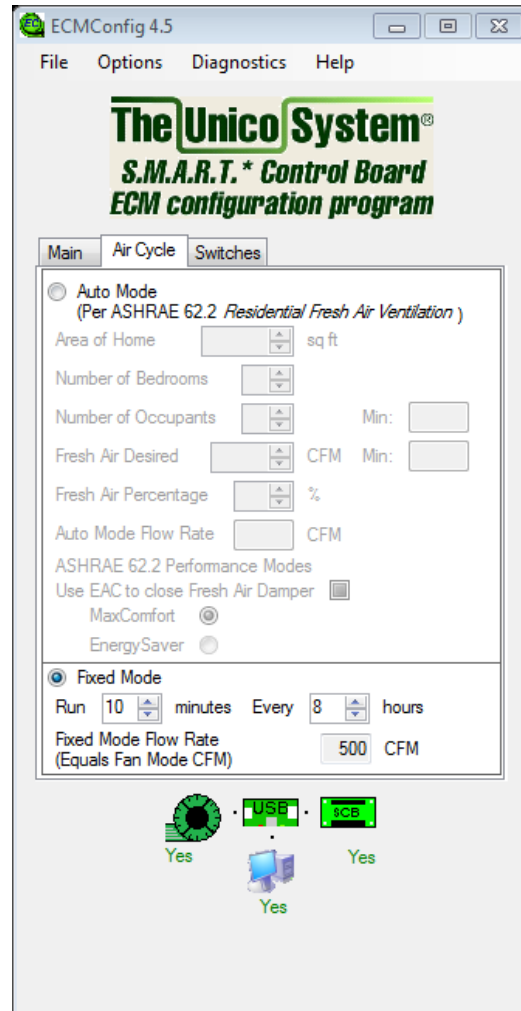


**Figure 20. Air Cycle Tab. Fixed Mode Selected.**

*Fresh Air Desired.* The minimum amount of fresh air required to comply with 62.2 will be calculated by the program. If more fresh air is desired, simply enter the amount in the field to the left of the minimum value.

*Fresh Air Percentage.* To calculate the fresh air required, the program needs to know how much fresh air is being brought in, as a percentage of the total system airflow. This must be measured during system setup.

Use the following procedure to determine the percentage of fresh air:

1. Turn the blower on at high speed and measure the airflow. This value may be obtained from the Main Tab of the ECMConfig interface.

2. Measure the airflow at the fresh air intake duct.

3. Divide the amount of fresh air from Step 2 by the total blower airflow from Step 1. This is the Fresh Air Percentage.

4. Enter this percentage into the program.

The program will then automatically determine the blower airflow rate required to deliver the proper amount of fresh air. If this calculated rate is out of the allowed range for the blower, the program will display an error message. This error can only be corrected by increasing the percentage of intake air that is fresh air(e.g. by increasing the size of the fresh air intake duct), or by reducing the amount of fresh air desired.

## Switches Tab

The latest software now includes a way to check the position of the switches on the control board without opening up the cover. This window is useful when diagnosing a problem. There are no settings in this window.
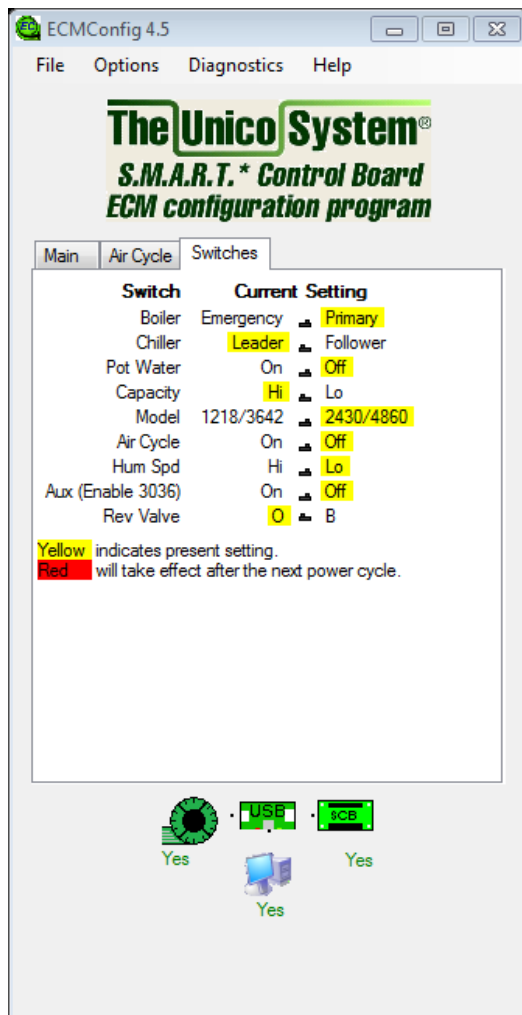


**Figure 21. Switches Tab.**

## ECMConfig Program Menus

The ECMConfig program has several dropdown menus with configurable settings. Each menu is described below.

### File

*Save/load.* To save the customized settings to your computer, select the 'Save' button. You will be prompted to enter a file name and a location. This is a useful feature if you want to have a record of how you configured the unit or if you want to duplicate the same settings in another installation. The 'Load' button will retrieve any saved settings. Again, it will prompt you for the file name and location. It is unnecessary to press 'Save' to store the airflow settings into the SCB memory. This happens automatically.

### Options

*Fresh Air Damper Configuration.* The latest versions of the firmware and software include the option to repurpose the EAC relay to open or close a fresh air damper. The damper configuration menu allows the user to set this relay as a normally open or normally closed relay, depending on how the damper motor is configured. If the damper seems to close when it should be open, or vice versa, simply change this setting to reverse the action.

*Units of Measure.* To change between English (CFM) and SI (m$^3$/s) units, go to Options|Units in the menu.

### Diagnostics

*Fresh Air Monitor.* The fresh air monitor will display the amount of inventory of fresh air in five minute intervals for the last four hours on a rolling basis. This is useful if you have a concern about how much air is being introduced into the home. The Air Cycle Mode, Damper State, along with several other quantities are also reported. Bucket "0" contains the most recent data, and Bucket "47" contains the oldest airflow data.
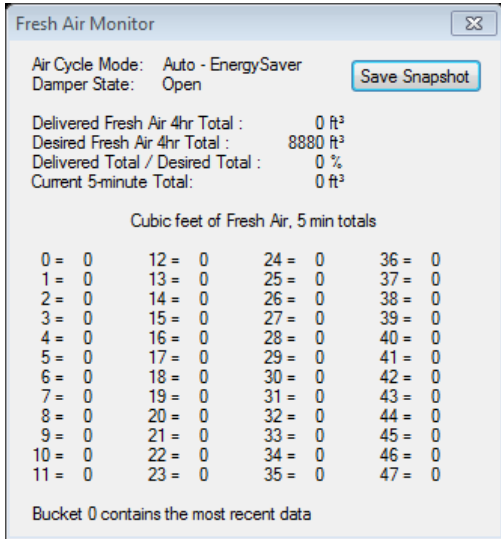
**Figure 22. Fresh Air Monitor.**

*Motor Status.* The motor status indicator will display the current motor status and will show whether there have been any errors in the last 24 hours. This is useful if you suspect the motor is tripping due to high amperage or air temperatures.
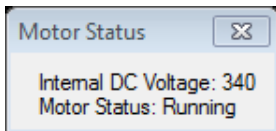


**Figure 23. Motor Status**

*Service Logger.* The service logger will save the data from the fresh air monitor to the computer continuously until it is turned off. This function turns the program into a data-logger. If you open the data file with Excel, you can plot the operation of the blower and the airflow. This can be used to verify compliance with ASHRAE 62.2.
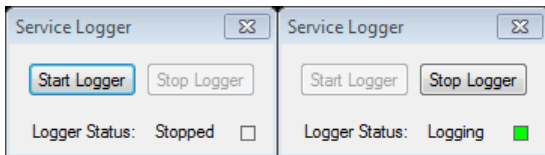


**Figure 24. Service Logger**

## Help Menu

There are a number of help screens that explain in detail each of the screen inputs and menu functions, along with a list of error messages.
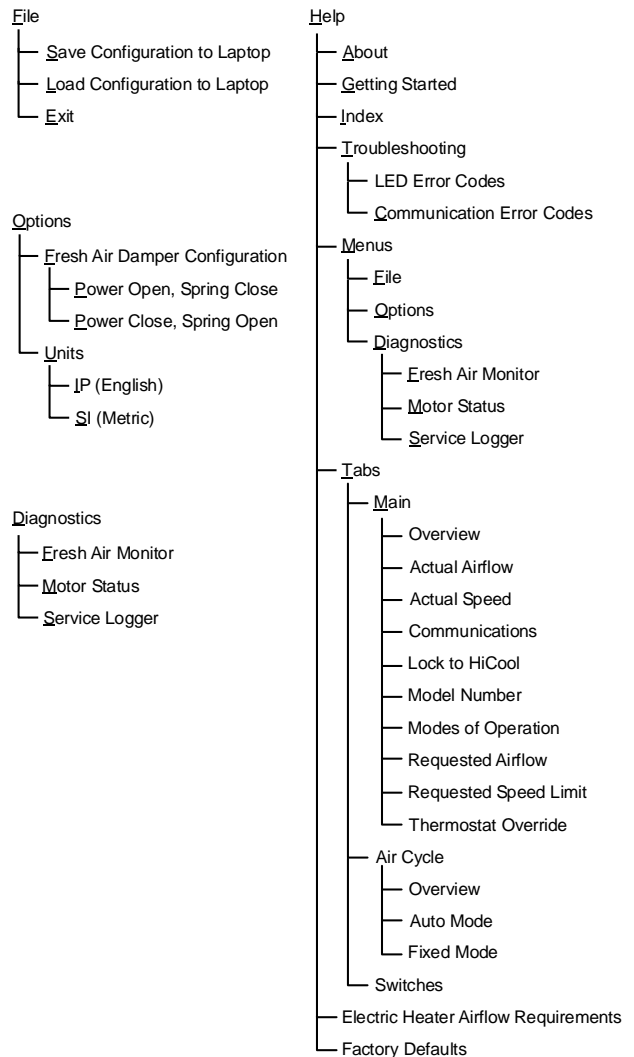


**Figure 25. ECMConfig Menu Structure.**

## Troubleshooting

### Default Airflow seems too High/Low

Check that the **MOD switch** on the SCB is in the correct position. If not, select the appropriate model and cycle the power.

Note: If the model switch is set for 1218 and is connected to a ½ hp motor, the blower will spin counter-clockwise. If the model switch is set for 2430 the blower will spin clockwise.

Check the air flow against the default setting listed in Table 2. The Flash LED (previously PCB Ctrl LED) will flash the actual airflow in CFM. A long flash indicates 100 cfm and a short flash at the end of the long flashes indicates 50 cfm (example: 7 long flashes followed by a short flash indicate an actual airflow of 750 cfm). If the blower reaches its RPM limit, an extra-long flash will occur between the CFM sequences. The maximum motor speed is 1800 RPM which is the default limit. Check to see that the limit is not too low. If motor speed limit is at 1800 RPM then add more outlets or change the plenum design to decrease the duct friction.

### Fan does not run

**"Power" LED off?** SCB is not receiving power. The SCB LED's are activated by 24V. Check to make sure the transformer is getting 230V or 110V and then check to make sure the output of the transformer is delivering 24V (Common problem is a loose connection).

**"Power" LED on but not flashing?** SCB has power but processor is not executing. Disconnect power, wait 10 seconds, reconnect power.

**Is the thermostat energizing G, W or Y?** Check if 24Vac exists from C to G, W, Y1, Y2, or E. If no voltage exists on any of these, check connection between SCB and the thermostat. Check connection at the thermostat or replace the thermostat.

If 24Vac does exist on G, W, or Y check the Heat LED on the SCB. Flashing indicates the motor has lost communication. Inspect the connections between control box and the motor. Disconnect and reset the motor connector. Check that the motor is free to turn.

### Fan runs without demand from thermostat

The software in the board will automatically turn the fan on for the following conditions:

1. The humidistat is calling for humidity and there is no call for heating.

2. The winter cycling function is activated (fixed mode).

3. The fresh air cycling function is activated.

4. The blower is ramping down after shut down.

**Is "Power" LED flashing?** If not, the processor has stopped executing, remove and reapply power.

### Heat pump compressor runs in heat mode but does not run for air conditioning.

AFS (automatic frost switch) input is open. The AFS terminals must be connected to a frost switch.

### Heat pump compressor runs but is cooling when it should be heating or heating when it should be cooling.

**Is the "Reversing Valve" switch set properly?** (If the outdoor reversing valve requires 24vac for heating, then the Reversing Valve switch should be switched to "B" and the jumper wire must be cut.

### 3rd stage electric heat (S3) does not energize

**Is the thermostat demanding heat pump operation?** This is normal. The third stage is disabled during heat pump operation.