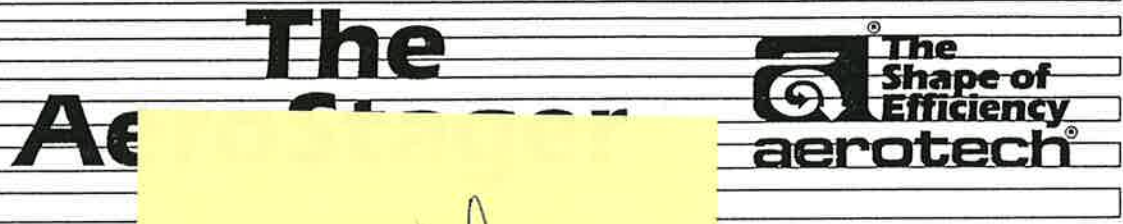
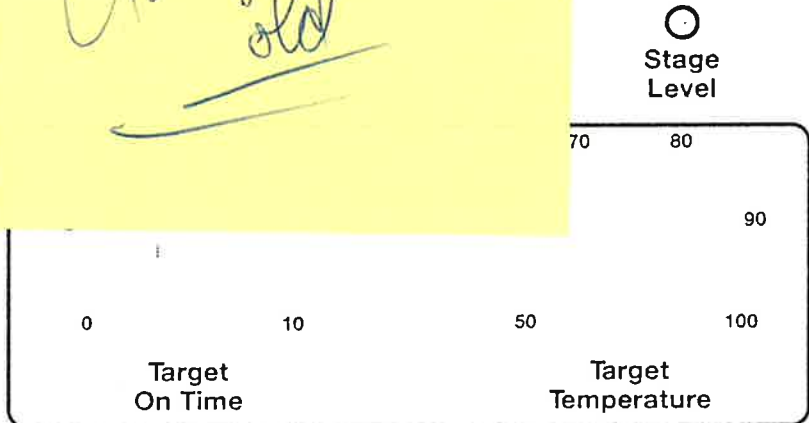


USER'S MANUAL
and
INSTALLATION GUIDE



ROLLER

*Original
old*



AEROTECH, INC.

Mason, MI 48854

02-90088-01

SR1000
AeroStager



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SHINWA ENVIRONMENTAL CONTROLLER

TABLE OF CONTENTS

- 1.0 General Features
- 2.0 User Interface
- 3.0 Staging Control
- 4.0 Timer Control
- 5.0 Automatic Reductions in Timer "On Time"
- 6.0 Selecting a Ventilation Program
 - 6.1 Selecting a Staging Program
 - 6.2 Custom Ventilation Programs
- 7.0 Interfacing the Shinwa EC to Heating Ventilating Equipment
- 8.0 Temperature Sensors
 - 8.1 Sensor Calibration
 - 8.2 Sensor Cable
- 9.0 Safety Aspects
 - 9.1 Help Display
- 10.0 Installations
- 11.0 Specifications
- A1.0 Technical Appendix

SHINWA ENVIRONMENTAL CONTROLLER¹

1.0 GENERAL FEATURES

The Shinwa Environmental Controller (EC) is a complete environmental control system. It can be used in a wide variety of applications where ever a specific environmental temperature is desired. Control features provided include the following:

1. User selected target or Desired Room Temperature (DRT, See Figure 1)
2. User selected "on time" using a 10 minute cycle for minimum ventilation (see Figure 1)
3. Thirteen stages of temperature control (1 stage of heat and 12 stages of cooling; note there are more stages available than relays)
4. Nine dry contact relays (5 A capacity)
5. Two relays can be assigned to a 10 minute repeating cycle with "on time" set by user dial
6. Inside and outside temperature monitoring
7. Minimum ventilation is temperature dependent
8. Cycle timer increases from minimum "on time" at or below desired room temperature (DRT) to 10 minutes (100% on) as house temperature rises above desired temperature over the first staging interval
9. Temperature rise between cooling stages can be set independently for each cooling stage (four staging programs are pre programmed, see TECHNICAL APPENDIX)
10. An energy saving function that adjusts the minimum ventilation setting
11. Multiple ventilation programs can be custom "programmed" and then user selected by simple dip switch settings, e.g. tunnel ventilation versus conventional house operation
12. The controller is disengaged (all relays released to open) if inside temperature sensor is damaged, e.g. controller reads inside temperatures below 35 °F or above 128 °F
13. Cycle timer can be assigned to activate at any ventilation staging level

Installation of the Shinwa EC is simple and easy (see diagrams given in Figures 2-4). Simply connect the two temperature sensors to their labeled terminals; run paired low amperage wire from the relay terminals to the relay boxes used to operate the exterior

¹This manual was updated on February 4, 1991; the manual applies to EC's Serial Numbers pv2026 and higher. Upgrades for existing units are available.

equipment; dial in the desired target temperature and the cycle "on time" (if needed); plug the Shinwa EC into a 120 volt AC circuit -- and the Shinwa EC is functioning.

2.0 USER INTERFACE

As opposed to other complicated computer control systems on the market, the Shinwa EC is simple to use and easy to understand. The user merely dials in the desired room temperature (DRT) and the desired "on time" for the cycle timer function using two clearly labeled dials (see Figure 1). Whenever the user is entering an "on time" or target temperature, the LED screen will accurately display the selected value. Temperature is displayed in 0.2 °F increments and "on time" is displayed in minutes and 5 second increments, e.g. 3.45 is 3 minutes and 45 seconds. After a setting remains unchanged for 4 seconds, then the LED screen will revert to displaying

inside temperature
outside temperature
timer "on time"
stage level

in a rotating sequence, with each number being displayed for 2 seconds. As these values are sequentially shown, an LED light will indicate which value is being shown.

3.0 STAGING CONTROL

Activation of heating or cooling relays is performed in relation to the target temperature as entered by the user and the current inside temperature. Figure 5 illustrates one of the possible sequences for the staging of the heating and ventilation equipment. In this example, the heating relay is set to activate 3°F below the target temperature and go off when the room temperature is 2.5 °F below target temperature (a 0.5 °F hysteresis about the set point). Cooling stages are activated according to the selected ventilation program above target temperature; again there is generally a 0.5 °F hysteresis about the activation set point for an individual stage, but on/off hysteresis are also set individually and selected by the installer via dip switch settings on the bottom board of the controller; see TECHNICAL APPENDIX).

The Shinwa EC has been uniquely programmed to utilize temperature dependent cycle timing of single speed fans. This is discussed next.

4.0 TIMER CONTROL

The Shinwa EC provides a unique timer control cycle. This function combines the best features of a repeating fixed cycle timer and a variable speed controller into a new control method. The timer cycle is always assigned to stage 1. If the current house temperature is:

AT or below target temperature
THEN cycle "on time" is the user
selected "on time"
ABOVE target temperature
THEN cycle time increases to 10
minutes "on time"
proportionately over the stage
interval bandwidth, e.g. 2 °F.

For example if the user had selected 2 minutes of "on time", a target temperature of 70 °F and a staging interval of 2 °F for stage #1, then

2 minutes "on time"	at	70.0 °F (or below)
4 minutes "on time"	at	70.5 °F
6 minutes "on time"	at	71.0 °F
8 minutes "on time"	at	71.5 °F
10 minutes "on time"	at	72.0 °F

The Shinwa EC adjusts the "on time" **once each minute** based upon the sensed inside temperature. This allows the timer fans to be adjusted as temperature changes so unwanted drops in house temperature will be eliminated.

The Shinwa EC can assign up to two relays to the timer cycle. If two relays are assigned, then each of the two relays still runs the same length of time. The two relays are programmed so that their cycles are a half cycle out of phase with each other. Thus, timer relay #1 is cycled on 0, 10, 20, 30...minutes, and timer relay #2 is cycled on 5, 15, 25, 35...minutes. This is important to maximize air quality and also to minimize temperature drops during timer activated fan cycling. See Figure 6 for an example of the cycle time sequencing if a four minute "on time" is selected.

Whenever the desired cycle time is changed by the user via the input dial on the cover of the Shinwa EC, then the microprocessor restarts the ten minute cycle. The processor also updates the required "on time" as a response to changes in inside temperature, once each minute. Thus, if a rise in temperature dictates an automatic increase in the cycle time being called for, this new calculated "on time" may not appear on the display screen for one minute.

5.0 AUTOMATIC REDUCTIONS IN TIMER "ON TIME":

AN ENERGY SAVING FEATURE

The majority of fuel usage occurs during the first 3 weeks of the grow out cycle for broilers. During this time, proper moisture ventilation is crucial to maintain good air quality and litter conditions. Unfortunately, changing air temperatures and humidities also changes the necessary ventilation rates to maintain proper house conditions. It is no secret that this is one of the most difficult aspects of poultry management. The Shinwa EC has a unique feature that utilizes temperature and humidity measurements to **maintain a fixed rate of moisture removal capacity**. Generally speaking, colder outside temperatures have lower moisture contents (even though the relative humidity may be higher). Accordingly, the required ventilation rate is also lower. The Shinwa EC utilizes an algorithm that adjusts the minimum "on time" in relation to the temperature humidity conditions that existed **when the user entered the desired "on time"** for the cycle relays. Table 1 shows the reductions in minimum "on time" for an inside and outside temperature condition of 75 °F and 50 °F when the "on time" was dialed in by the user.

Table 1. Reductions in "on time" as outside temperature drops for a fixed inside temperature of 75 °F.

	<u>Reference Minimum "On Time" entered, minutes</u>			
	3 min	5 min	7 min	%
T out				
50	3:00	5:00	7:00	100
40	2:15	3:45	5:15	75
30	1:50	3:00	4:10	60
20	1:30	2:30	3:30	50
10	1:20	2:10	3:00	37

50 °F was outside temperature when the "on time" was entered

Whenever the user changes the desired "on time", then the Shinwa EC also resets the reference conditions. The energy saving feature will not increase the desired "on time", and will not reduce the user entered "on time" to less than 25% of the entered value, or 30 seconds, whichever is greater. This is illustrated in the following example.

You enter 5 minutes of "on time" for minimum ventilation with an inside temperature condition of 85 °F and an outside temperature of 50 °F. If the outside temperature were to reduce to 20 °F, then the minimum "on time" would be automatically reduced. The LED display would now show 3.05 (minutes and seconds) although the "on time" setting would remain at 5 minutes.

Even with this reduction, the moisture being removed from the house will remain constant. This energy saving feature can also be deactivated if not desired by the user by a dip switch on the back of the top board of the controller.

6.0 SELECTING A VENTILATION CONTROL PROGRAM: A COMBINATION

Selecting the proper ventilation control program requires selecting both a ventilation program and a staging program. Together, these two programs define the way the Shinwa EC will operate the heating and ventilating equipment of the house.

6.1 Selecting a Ventilation Program

The Shinwa EC comes with four ventilation program formats, which can be selected by dip switch setting on the back side of the controller cover (requires opening the controller enclosure). These programs are simply different ways of assigning the nine relays to the different stages (Heat stage + 12 stages of cooling). Remember, the current stage that the controller is in is determined based upon the difference between inside temperature and desired room temperature (DRT), but relays are assigned to specific stages based upon the specific ventilation program chosen (switches VT1 and VT2). Although not practical, all nine relays could be assigned to activate on one stage, e.g. the highest stage of ventilation, even though the equipment assigned to this upper stage had been previously assigned to activate at any of the lower stages. The most common usage of this feature is where fans that were used in lower stages for moisture control during brooding and then were shut off during curtain ventilation--are reactivated during tunnel ventilation. Similarly, a stage may not activate any relays. The four pre-programmed relay assignments are given in the TECHNICAL

APPENDIX . Ventilation programs work in combination with staging programs to completely define when relays are activated; see Section 6.1.

6.2 Selecting a Staging Program

The Shinwa EC requires the installer to actually pre-select both a Ventilation Program (Switches marked as VT1 or VT2 on the back of the top controller board and discussed in Section 6.1) and to select a Staging Program. The Staging programs are marked as S1 and S2 and these are also on the back of the top board. The Shinwa EC comes with 4 default staging programs. These are used to define the staging differential for each stage in an independent manner and to also allow independently assigning the staging hysteresis into and out of a particular stage. This is truly a unique feature of the Shinwa EC. This feature is particularly useful where the activation of a particular device on a given stage would tend to lower the temperature quickly a sufficient amount to move the controller into the lower stage. Frustrated users refer to this as banging back and forth between stages. The Shinwa EC takes advantage of this feature by providing a tunnel/natural ventilation scheme (activated by S1 off + S2 on and using VT1 off + VT2 on). The pre-programmed options are all given in the TECHNICAL APPENDIX .

Typical equipment that might be controlled for Ventilation Program 3 (see TECHNICAL APPENDIX for description of programs) could be as follows:

- R1= Heater (may be multiple heaters hooked to this relay)
- R2= 36 inch single speed fan (10,000 cfm delivery) operated on timer
- R3= 36 inch single speed fan (starts on temperature rise)
- R4=curtain machine
- R5= first stage of tunnel ventilation
- R6= second stage of tunnel ventilation
- R7= third stage of tunnel ventilation
- R8= fourth stage of tunnel ventilation (pads/foggers)
- R9= fifth stage of tunnel ventilation (last set of large fans)

Ventilation Program 3 would function as follows:

- Stage H: Relay 1 (R1) on to activate heater; R2 on but in modulating mode according to timer cycle
- Stage 1: R2 on and modulating (Timer fans); Heater is shut off (R1 opens)
- Stage 2: R2 is now on for the complete 10 minute cycle, plus first set of single speed fans (R3) are now activated due to house temperature rise;
- Stage 3: curtain becomes power activated (initially will begin to open (R4)
- Stage 4: R2 now off; curtain closes (R3); first stage of tunnel ventilation (R5)
- Stage 5: curtain closed; second stage of tunnel ventilation (R5+R6)
- Stage 6: curtain closed; third stage of tunnel ventilation (R5+R6+R7)
- Stage 7: curtain closed; fourth stage of tunnel ventilation (R5+R6+R7+R8)
- Stage 8: curtain closed; fifth stage of tunnel ventilation (R5+R6+R7+R8+R9).

6.2 Custom Ventilation Programs

If one of the four pre-programmed ventilation schemes is not appropriate, the Shinwa EC can be custom programmed for your particular application. Generally speaking, one of the four ventilation programs in combination with one of the four staging programs (16 combinations) that have been pre-assigned should be satisfactory for most applications.

7.0 INTERFACING THE SHINWA EC TO HEATING/VENTILATING EQUIPMENT

It is recommended that all equipment be interfaced to the Shinwa EC via separate mechanical relays appropriately rated for their intended amperage loads. These exterior relays are then activated by the appropriate relays housed inside of the Shinwa EC.

8.0 TEMPERATURE SENSORS

Temperatures inside and outside the building are sensed by linear solid state devices. The temperature is measured in relation to the amount of current generated across the device. Once calibrated, these devices are very stable and accurate. Calibration is simply performed by adjusting a small resistance pot assigned to each temperature sensor circuit. Be sure to let the controller warm up for 5 to 10 minutes prior to performing any calibration. Generally, the sensors will not require any initial calibration, since they are calibrated prior to shipment. The calibration pots, when needed, are located on the bottom board, top right corner and are clearly labeled as "IN OUT/ SENSOR CAL". Accuracy of sensors should be checked periodically with a conventional thermometer, and recalibrated if necessary. It is best to calibrate the outside sensor after dark, when solar radiation effects will be eliminated.

If the inside temperature sensor is somehow damaged, the controller automatically deactivates itself. This is important since a damaged circuit would either read 30 °F (open circuit) or 132 °F (fused circuit). Either case could cause a disaster, since the rest of the functions of the controller would continue to operate based upon the incorrect inside temperature reading. This temperature error would either cause all the heaters to be activated while all but minimum ventilation is turned off (birds would be roasted!) or all the heat would be turned off and the highest stage of ventilation would be activated (birds or chicks would be frozen!).

8.1 Sensor Calibration

After installing the two temperature sensors, turn the unit on and let the unit warm up for at least 5 minutes. Turn the unit off, move dip switch#2 to on (up) labeled Cal n/y (see above and is located on the back of the display board). Power the unit up, and notice on the display which LED is lit to signify either the inside or outside sensor being displayed. The temperature reading now showing on the display is the converted analog signal. If the value is incorrect, then with a very small screw driver, adjust the appropriate pot on the rear board (these are square blue boxes with a set screw and are at the top right corner of the rear board mounted in the bottom of the computer box). The left pot, labeled IN is inside temperature and pot labeled OUT is the outside sensor. After approximately 1 hour, recheck the calibration. When finished with calibration, **return TEST mode dip switch to the off position, otherwise the unit will not function in the control mode.**

8.2 Sensor Cable

All sensors should be installed using twisted pair, shielded cable. Use 22 gauge wire. The shield wrapping should be connected in only one place, i.e. at the control board of the Shinwa EC

9.0 SAFETY ASPECTS

The Shinwa EC has been thoroughly tested prior to commercial release. Multiple levels of voltage surge protection have been installed. However, as with any control device (microprocessor or analog based), malfunctions may occur. **ALWAYS** provide some parallel control for heaters and coolers in addition to the control system installed for primary control.

9.1 Help Display

As discussed in Section 8.0, the Shinwa EC has a safety feature of deactivating the controller (display shows HELP) if the inside temperature circuit is damaged. If this happens, simply replace the inside sensor and/or the conducting wire between the sensor and the controller.

9.2 Electrical Surge Protection

It is advisable to install a secondary surge arrester on the circuit that is used to provide power to the Shinwa EC, and a Category A or B surge arrester on the service entrance. Remember, your building ground is essentially to minimize damage from voltage surges.

10.0 INSTALLATION

All installations should be performed by a qualified electrician. The diagrams provided in this manual can be used to assist the installer.

Several options may be selected for a particular installation via two sets of dip switches that are on the back of the display board. It is recommended that these settings be selected by the distributor prior to field installation.

Be sure to connect the sensors provided with the unit to its appropriate connection (labelled as inside or outside sensor). This will utilize the factory calibration that was performed for the sensors; otherwise the sensors will need to be recalibrated.

DIPSWITCH GROUP #1

SETTING	LABEL	FUNCTION
1	Min Timer Adj N/Y	Outside Temperature Feedback on timer cycle (does not reduce entered value by more than 75%)
2	CAL N/Y	Calibrate or operate Mode (in "ON" position, when powered up, the display cycles through all possible combinations and then locks on either inside temp reading -if switch#1 is in "y"- or outside temp reading-if switch #1 is in "n" position)

The user selects the desired staging program via switches labelled S1 and S2 as follows:

	S1	S2
Select Staging Program 1:	off	off
Select Staging Program 2:	on	off
Select Staging Program 3:	off	on
Select Staging Program 4:	on	on

DIPSWITCH GROUP #2

The user selects the desired ventilation program via dip switch settings as follows:

	VT1	VT2
Select Vent Program 1:	off	off
Select Vent Program 2:	on	off
Select Vent Program 3:	off	on
Select Vent Program 4:	on	on

11.0 SPECIFICATIONS

- Power Supply:** 110 V AC, 60 Hz (240 V AC by special order)
- Temperature Inputs:** 2 digital electronic, constant current (measures in °F)
Inside sensor range (30 to 132 °F)
Outside sensor range (0 to 102 °F)
- Display Resolution:** Inside Temperature 0.2 °F or °C (temperature)
Outside Temperature 0.2 °F
5 seconds (cycle "on time")
- Stages:** 1 heat stage and 12 cooling stages
- Heater Offset:** As assigned from Staging Programs, S1 and S2)
- Cooling Stage Differential:** As assigned from Staging Programs (S1 and S2)
- Hysteresis:** As assigned from Staging Programs (S1 and S2)
- Ventilation Programs:** Programmable assignment of relays stages (4 programs are pre-programmed; additional programs by special order)

TECHNICAL APPENDIX

The Shinwa EC is extremely powerful in terms of its flexibility to be programmed to meet specific field applications. However, this same flexibility can also be confusing. It is recommended that Shinwa EC's be pre-coded (via dip switch settings) by the distributor prior to field placement. The technical field representative should gain a thorough understanding of these features and program capabilities, so that a specific program (staging program plus a ventilation program) can be recommended to the user. **It is generally not necessary for the user to understand this feature.**

A Shinwa EC functions by sensing an inside temperature and then comparing this value to the desired room temperature. The particular stage that the unit is in at any time depends on the desired room temperature (DRT), the actual temperature, and which staging program has been selected. The staging program is selected by appropriate setting of the dip switch bank labelled S1 and S2 on the processor board.

To actuate equipment, the Shinwa EC utilizes one of four available ventilation programs. For a given stage, this ventilation program determines which control relays are active. The control relays are then connected to one or more power relays that actuate the equipment. Ventilation programs are selected by appropriate setting of the dip switch bank labelled VT1 and VT2 on the processor board.

Because there are four staging programs and four ventilation programs available, there are 16 possible combinations to which the Shinwa EC can be configured. To determine which combination is appropriate for a particular situation, the complete ventilation program and staging program settings are provided. Customized changes in either program are possible. Additional ventilation programs (beyond the four default programs supplied with the controller) merely requires swapping the programmable logic device (back side of top board of the controller). Contact Micro Ag, Ltd. for additional details.

The four default ventilation programs are given on the following pages.

Timer Offset. Normally, the cycle timer is used to provide minimum ventilation during cold weather or brooding. There can also be a need for a cycle timer function in hot weather to control duty time of misters and foggers. The modulating timer function can be made to function for higher temperatures, e.g. higher cooling stages, by utilizing the timer offset function. This allows the cycle timer function to be offset to become active at higher temperatures in relation to the desired room temperature (DRT). For example, if a 15 °F offset was assigned and a DRT of 70 °F were selected by the user input knob (front cover of controller), then the equipment controlled by cycle timer relay would become active at 85 °F (70 °F + 15 °F offset). The ramping function remains with the modulating function. This would be useful in increasing the "on time" of say misting equipment in response to rising temperatures. This is truly a unique capability of the Shinwa EC which is not mimicked by any other controllers on the market!

A 1.1 Selection of Ventilation Programs

VENTILATION PROGRAM 1

(VT1 OFF VT1 OFF)

STAGE	RELAYS								
	R1	R2	R3	R4	R5	R6	R7	R8	R9
Heat	C	MT1	MT2						
1		MT1	MT2						
2		C	C	C					
3		C	C	C	C				
4		C	C	C	C	C			
5		C	C	C	C	C	C		
6		C	C	C	C	C	C	C	
7		C	C	C	C	C	C	C	C
8		C	C	C	C	C	C	C	C

c= closed relay

m= modulating relay (timer cycle)

VENTILATION PROGRAM 2

(VT1 ON VT2 OFF)

STAGE	RELAYS								
	R1	R2	R3	R4	R5	R6	R7	R8	R9
Heat	C	MT1							
1		MT1							
2		C	C						
3		C	C	C					
4		C	C	C	C				
5		C	C	C	C	C			
6		C	C	C	C	C	C		
7		C	C	C	C	C	C	C	
8		C	C	C	C	C	C	C	C

c= closed relay

m= modulating relay (timer cycle)

VENTILATION PROGRAM 3

(VT1 OFF VT2 ON)

RELAYS

STAGE	R1	R2	R3	R4	R5	R6	R7	R8	R9
Heat	C	MT1							
1		MT1							
2		C	C						
3				C					
4					C				
5					C	C			
6					C	C	C		
7					C	C	C	C	
8					C	C	C	C	C

c= closed relay

m= modulating relay (timer cycle)

VENTILATION PROGRAM 4

(VT1 ON VT2 ON)

RELAYS

STAGE	R1	R2	R3	R4	R5	R6	R7	R8	R9
Heat	C	MT1	C						
1		MT1	C						
2		C	C						
3				C					
4				C					
5				C					
6			C		C				
7			C		C	C			
8			C		C	C	C		
9			C		C	C	C	C	
10			C		C	C	C	C	C
11			C		C	C	C	C	C
12			C		C	C	C	C	C

c= closed relay

m= modulating relay (timer cycle)

A1.2 Selecting a Staging Program

The Shinwa EC also permits the assignment of a temperature differential for each individual stage and a specific hysteresis into and out of each stage. While for most applications, identical staging differentials and hysteresis are normally desired, there are applications where variable staging differentials and hysteresis are necessary, e.g. natural ventilation systems that employ tunnel ventilation. The Shinwa EC label depicts a 10 minute cycle for the timing function. However, any cycle time desired can be programmed, but the pre-programmed selections all utilize a 10 minute cycle.

For custom staging programs, contact the manufacturer directly. The default staging programs are as follows:

STAGING PROGRAM 1 (S1 OFF S2 OFF) (timer 10 minutes 0 secs; 0 °F offset)

STAGE LEVEL	STAGE DIFFERENTIAL	LOWER HYSTER	UPPER HYSTER
Heat	3.0 (offset)	not applic	0.5 °F
1	3.0	0.5	0.5
2	3.0	0.0	0.5
3	3.0	0.5	0.5
4	3.0	0.5	0.5
5	3.0	0.5	0.5
6	3.0	0.5	0.5
7	3.0	0.5	0.5
8	3.0	0.5	0.5

STAGING PROGRAM 2 (S1 On S2 OFF) (timer 10 minutes 0 secs; 0 °F offset)

STAGE LEVEL	STAGE DIFFERENTIAL	LOWER HYSTER	UPPER HYSTER
Heat	3.0 (offset)	not applic	0.5 °F
1	2.0	0.5	0.5
2	2.0	0.0	0.5
3	2.0	0.5	0.5
4	2.0	0.5	0.5
5	2.0	0.5	0.5
6	2.0	0.5	0.5
7	2.0	0.5	0.5
8	2.0	0.5	0.5

STAGING PROGRAM 3

(S1 OFF S2 On)
(timer 10 minutes 0 secs; 0 °F offset)

STAGE LEVEL	STAGE DIFFERENTIAL	LOWER HYSTER	UPPER HYSTER
Heat	3.0 (offset)	not applic	0.5 °F
1	3.0	0.5	0.5
2	3.0	0.5	0.5
3	6.0	1.0	0.5
4	3.0	3.0	0.5
5	3.0	0.5	0.5
6	3.0	0.5	0.5
7	3.0	0.5	0.5
8	3.0	0.5	0.5

STAGING PROGRAM 4

(S1 On S2 On)
(timer 10 minutes 0 secs; 0 °F offset)

STAGE LEVEL	STAGE DIFFERENTIAL	LOWER HYSTER	UPPER HYSTER
Heat	4.0 (offset)	not applic	0.5 °F
1	2.0	0.5	0.5
2	2.0	0.5	0.5
3	2.0	0.5	0.5
4	2.0	0.5	0.5
5	2.0	0.5	0.5
6	2.0	0.5	0.5
7	2.0	0.5	0.5
8	2.0	0.5	0.5
9	2.0	0.5	0.5
10	2.0	0.5	0.5
11	2.0	0.5	0.5
12	2.0	0.5	0.5

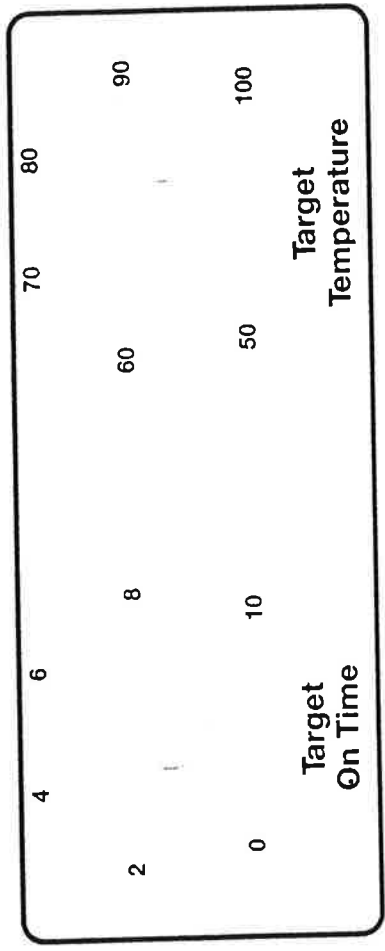
The AeroStager™

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Shape of
Efficiency®
aerotech®

ENVIRONMENTAL CONTROLLER



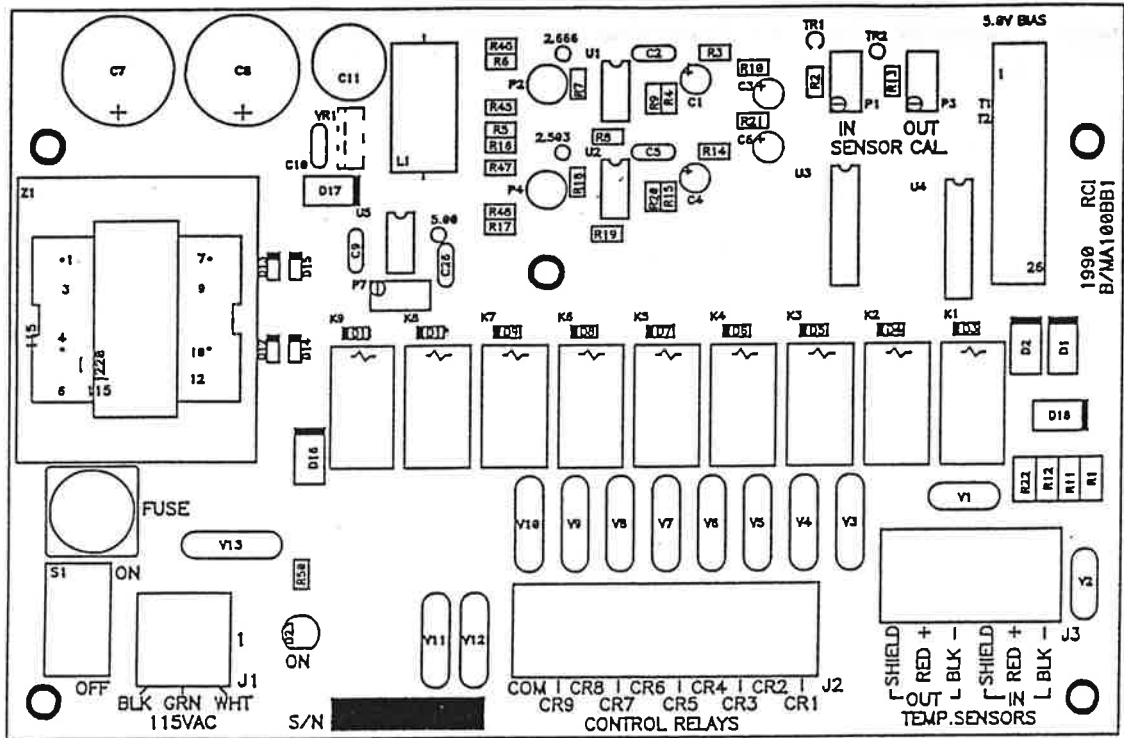
- ⊙ Inside Temp.
- ⊙ Outside Temp.
- ⊙ Minutes On Time
- ⊙ Stage Level



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AEROTECH, INC. **Mason, MI 48854**

BOTTOM PROCESSOR BOARD



BACK OF TOP PROCESSOR BOARD

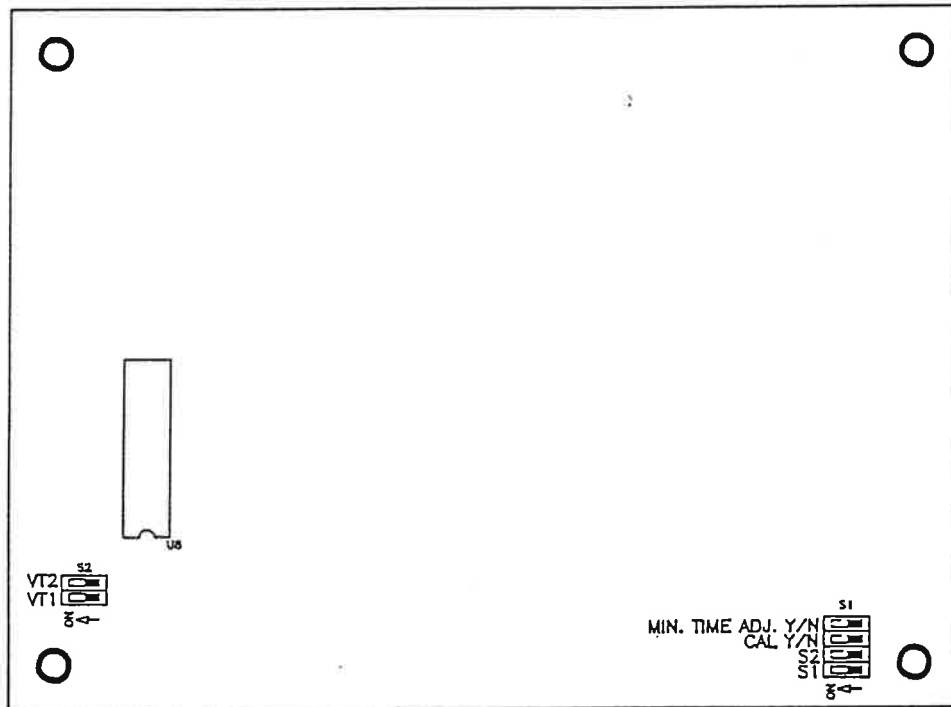


Figure 2. Line diagrams of the Shinwa EC for bottom board, which accepts all wiring connections (CR1-CR9, Common, and temperature sensors (IN and OUT)); back of top processor board is shown where the ventilation programs are selected (VT1 + VT2) and Staging Programs (S1 + S2), calibrate toggle switch and the timer reduction option.

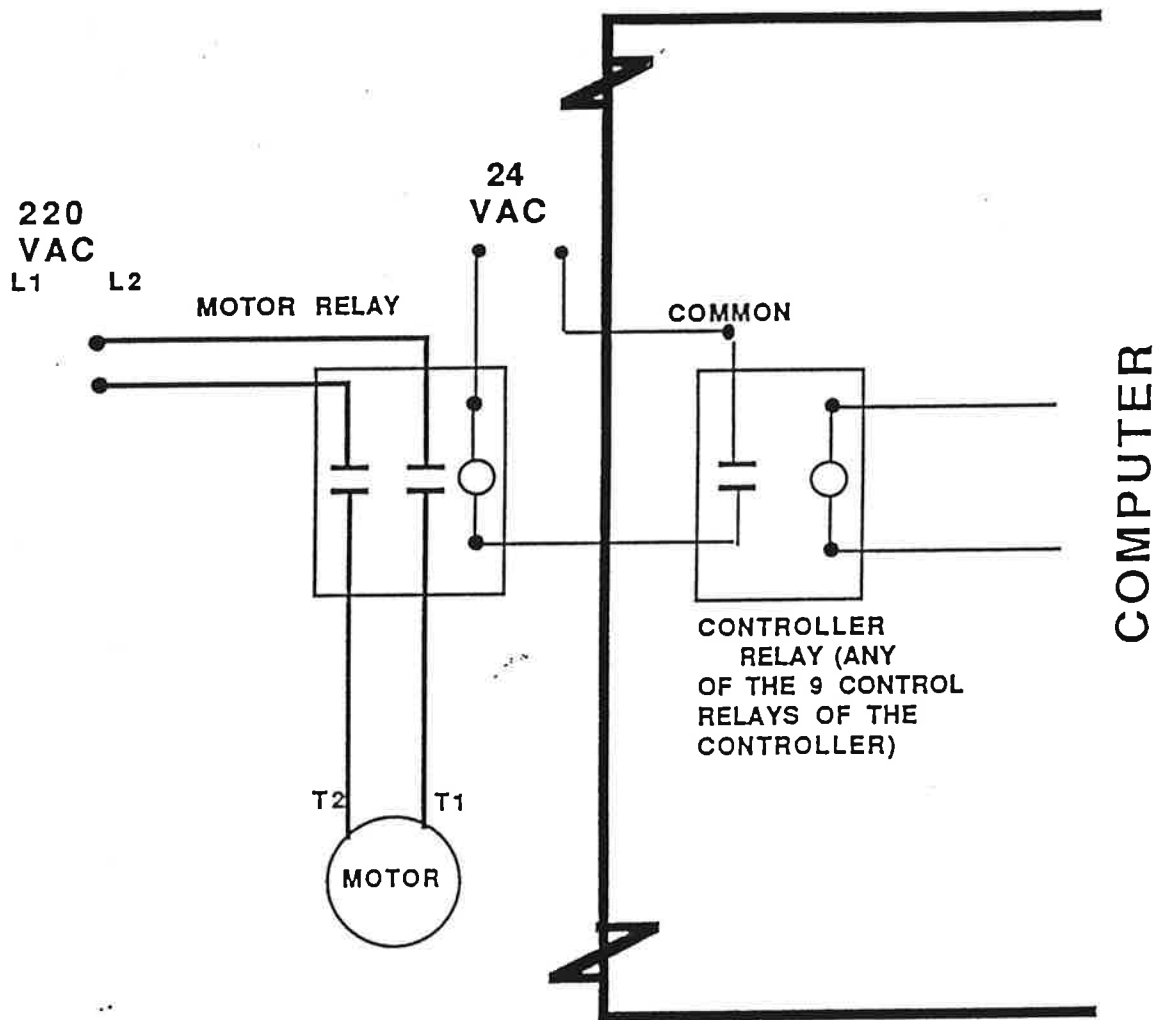


Figure 3.

Generic wiring diagram for the environmental controller and a 220 volt motor. A double pole double throw power relay is used to activate the motor. DO NOT BREAK both L1 and L2 in the power relay if a backup thermostat is also used!

SIMPLIFIED WIRING DIAGRAM

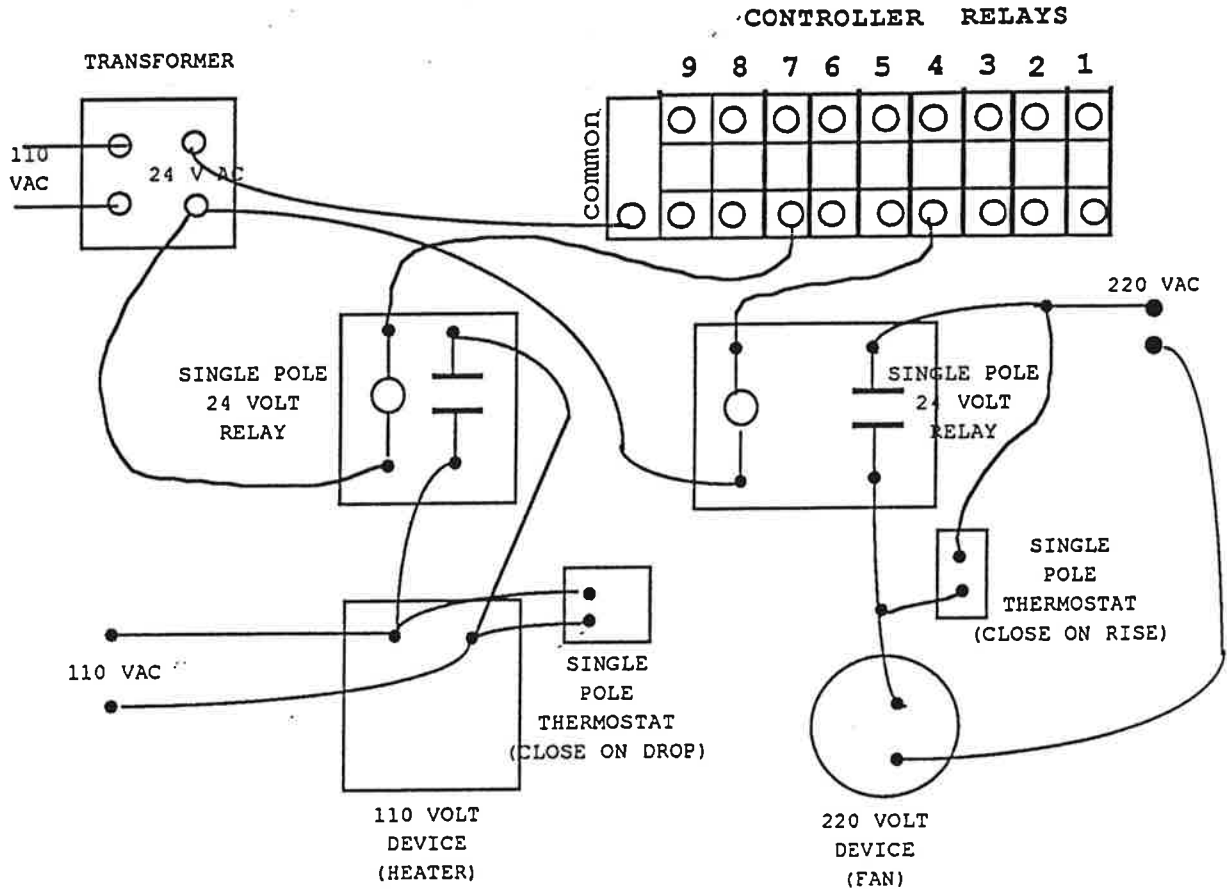


Figure 4.

This schematic illustrates wiring a heater and a fan with mechanical backup thermostats. For the heater, control relay #4 is wired to the coil of a power relay, and the heater circuit is connected to both the power relay contacts and the thermostat. If the temperature drops below the value set on the thermostat, the heater will run regardless of the state of the control relay. The connection and operation of the fan circuit is similar, except that the thermostat closes on a rise in temperature. NOTE: do not connect both legs of a power circuit to a power relay with thermostat override, because if either the control relay or the power relays fail, the equipment cannot run even with the thermostat switched "on".

NOTES:

- * Other differentials may be assigned to individual stages via switches S1 and S2
- * 2 timer relays can be assigned to stage #1

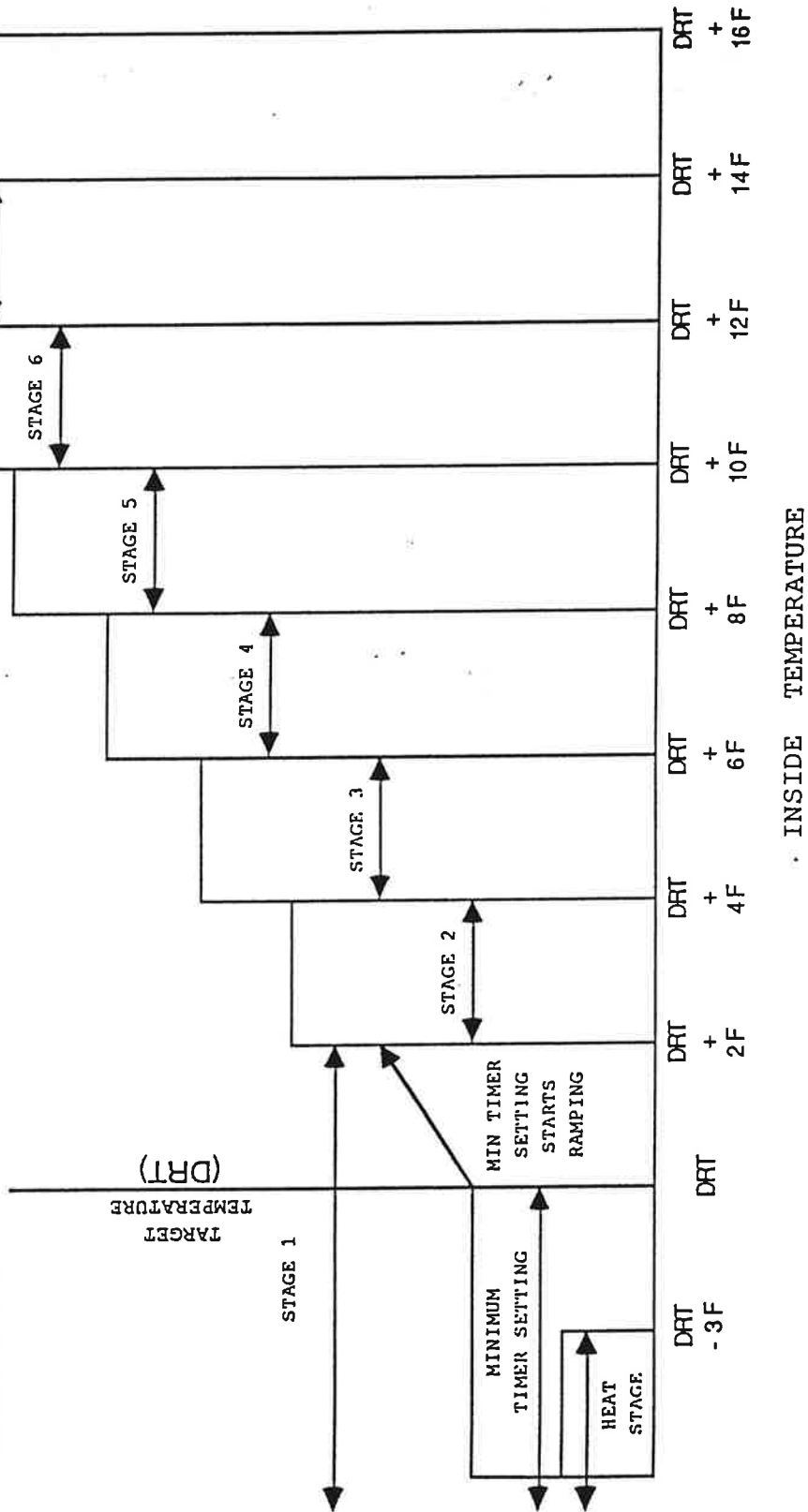


Figure 5. Heating and cooling stages in relation to desired room temperature (DRT). Uniform staging differential between stages with a 3 F heater offset.

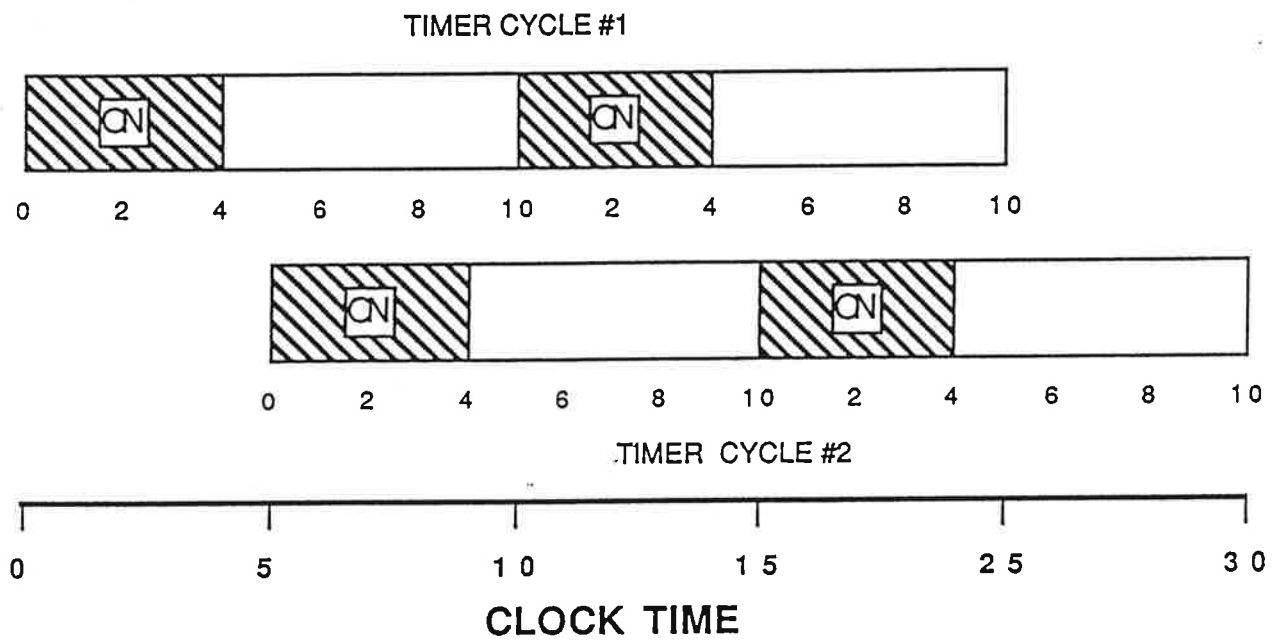


Figure 6. Cycle timer sequencing when two timer relays are used and the user entered "on time" is 4 minutes. Note that both timers activate for the same time, but are out of phase by 5 minutes on a 10 minute cycle.