AutoFire® 4000 Kiln Controller

User's Guide for

Jen-Ken Glass Kilns

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and

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Introduction

This User's Guide explains the features and operation of the Model AutoFire®4000 Controller.

The controller has 12 keys for programming.

Orton controllers use P-I-D control algorithms to tightly control kiln temperature. This eliminates temperature cycling. Cycling occurs when the controller turns the kiln on or off in a way where the actual temperature does not closely follow the desired firing schedule.

Orton controllers store the firing program information in memory when turned off. If power is lost during a firing, the controller remembers how far the firing has progressed and determines if it can resume the firing when power is restored.

Controller Models

There are two basic controller models:

Single Zone – These use a single thermocouple (temperature sensor) to control the kiln temperature
Multi Zone – These use 2 or 3 thermocouples to independently control top, middle and bottom sections of a tall ceramic kiln.

Precautions

The controller is not a safety device. The controller operates relays to turn the kiln elements on and off. It is possible for relays to fail in the 'ON' position. The controller cannot protect against relay failure. To prevent over-firing, never leave the kiln unattended, especially at the end of a firing.

Controller accuracy and performance depends on the condition and position of the thermocouple sensors in use.

Getting Started

Read all precautions and instructions before using your controller.

If your kiln has manual control switches for the heating elements, turn all the dials to the highest settings.

Features

The AutoFire®4000 includes many standard features, a user-friendly keypad and robust temperature control software.

Firing Methods and Features

- **User Program** method: Create up to 35 custom firing schedules with unique heating and cooling rates, target temperatures and hold times. This method can be used for ceramics, heat treating, glass fusing, enameling or jewelry applications.
- **Delay** start - Use with either mode to delay start the kiln up to 100 hours (99hr.59min.)
- **Set-Point** Control - User Program option to hold kiln at temperature indefinitely.
- **Full On / Full Off** - User Program option to heat or cool the kiln as fast as possible.
- **Add Time –** Add additional hold time to firings already in progress.
- **Back –** Correct or make changes while programming without having to start over.
- **Program edit –** User Program option to change the active program settings during the firing without having to stop and restart the controller.

Advanced Options

- **Skip -** Skip ahead in the firing program
- **Alarm -** Program an alarm to sound when a specific temperature is reached.
- **Thermocouple Offset -** Adjust display temperature by as much as ±25°C (±45°F) to offset aging thermocouple(s).
- **Auxiliary Outputs -** Control a relay to switch on a vent fan or external alarm or safety relay.
- **Power Consumption –** Review the calculated cost or Kilowatt usage of the kiln firing.

Display Messages and Information

- **Program Review -** Review the current firing program before or during a firing.
- **Status -** Display the current status and actual heating/cooling rates of the firing.
- **Temperature Units -** Display Temperature in Fahrenheit (°F) or Centigrade (°C) Units
- **Computer Interface –** Monitor/Analyze kiln data from a PC using *AutofireDLS4* datalog software.

Keypad Overview

Numerical values for hold times, target temperatures and heating rates can be programmed by using the numerical keypad. Most keys have multiple functions for special features as described below.

Acts as a scroll UP button to change Option settings

Use to increase hold time for active firings

Use to program a delay start time
Acts as a scroll DOWN button to change Option settings

Use to select a custom User Program
Use to edit a User Program in progress

Use to display current program segment during a firing
Use to review the actual heating or cooling rate during a ramp segment

Use to review the entire program before or during a firing

Use to set a temperature for the alarm to sound

Use to review the Kilowatt power consumption or cost of the kiln firing.

Use to Skip ahead during a firing

Use during programming to enter values
Use to Start the firing

Use to access advanced controller options

Use to back up during programming
Use to Stop a firing or exit the options menu

Display Lights

The controller uses (4) numerical displays and 3 indicator lights. The 3 lights tell when the controller is turning on the relays to power the heating elements. The top light represents the top relay, the middle light represents the middle relay and the bottom light represents the bottom relay. For a single zone controller, if the controller is not configured for multiple relays, the middle light will represent all relays.

Two of the four decimal points on the display are also used as indicators. The decimal point on the far right is used to indicate if the controller is displaying temperature in degrees Fahrenheit (°F) or Centigrade (°C). If this decimal point is lit, the controller is set to display temperatures in °C.

The center decimal point (between the second and third digit) lights whenever the display is showing a time value. The decimal point separates Hours (on the left) from Minutes (on the right).

When the Controller is first turned on

The controller runs a brief self-diagnostic test. The display will light up and the audible alarm should beep. After a few seconds, the display will alternate between the kiln temperature and **IDLE. IDLE** is the mode where the controller is not actively firing the kiln or being programmed for a firing.

Starting a Firing

ENTER
START

The display shows **-ON-** for 5 seconds when the firing begins.
The display will show kiln temperature throughout the firing. The temperature display will alternate with alarm messages if any alarms occur. If the controller is programmed to hold at a specific temperature, the remaining Hold Time will alternate with the temperature during the active hold period.

Ending a Firing

BACK
STOP

When the controller completes the firing, the display alternates 4 messages: **CPLT** (Firing Complete); Firing Time (**hrs.mins**); Final Firing Temperature and Current Kiln Temperature. Press any key to return to **IDLE**. If you stop the firing before completion with the ***Stop*** key, the display will indicate **ABRT** (abort) in place of **CPLT**. Press ***Stop*** again to return to **IDLE**

Entering values

ENTER
START

Whenever a change is made from the keypad, you must press the ***Enter/Start*** key to load the changes. If the key is not pressed, the controller will simply wait for your next selection. Pressing the ***Enter/Start*** key will advance you to the next option if you are setting up a program or changing settings.

Note: If you are programming the controller options and no keys are pressed for 90 seconds, the controller will exit the options menu automatically.

Threshold Alarm

To sound an audible alarm when the controller reaches a temperature, press the ***#7/Alarm*** key. **ALAR** shows in the display alternating with the alarm temperature. You can use the numerical keypad to enter a new alarm temperature or press ***Enter*** to keep the existing value. Setting the value to zero disables the alarm feature. When the kiln reaches the alarm temperature, the display will flash **ALAR** and the buzzer will sound. Silence the alarm by pressing any key except ***Stop***. Pressing ***Stop*** ends the firing.

Use the alarm function in User Program mode. You can program the Alarm before you start the firing or reset it during the firing.

Program Review

To review the current program in the controller memory before or during a firing, press the ***#6/ProgReview*** key. The entire program will automatically scroll through the display and then return to normal operation. Delay time and Preheat time are included in the review.

Power Consumption

To review the current power consumption during or after the kiln firing, press the ***#8/Cost*** key. The display will show the calculated electric usage for the firing if the option ***KW*** is programmed with a known wattage rating for the kiln. In addition, the display will show a calculated firing cost if the ***CENT*** option is programmed with a known price for KWHR usage. *Note: These calculations are estimates and are dependent on the accuracy of the values set by the operator.*

Delay Start

To program the controller to begin a firing at a later time, press the ***#3/Delay*** key. **DELA** shows in the display. Using the numeric keypad, enter a time delay in Hours.Minutes format and press ***Enter.*** Delay must be programmed before the firing is started. Once the firing is started, the remaining delay time will count down on the display.

Note: you can skip or end the Delay time once the delay period has started by pressing the ***Enter/Start*** key.

Status

To review the current status of the controller during a firing, press the ***#5/Status*** key.
The current ramp segment is displayed. If the current status is a heating or cooling ramp, the display will also show the actual ramping rate. (See the RATE option for more information on how the actual ramp rate display can be modified) The controller returns to normal operation after 10 seconds.

Back

To step backwards during programming press the ***Back/Stop*** key. This will return you to the previous entry. The 'Back' feature can be used anytime during programming to make corrections. This prevents the need to start over when programming a User Program.

Repeating a firing

If power is not cycled off to the controller, you can repeat a firing without viewing the program, simply press ***Start*** when the controller is showing **IDLE**. Use the Program Review feature to verify that the program you want is loaded into memory.

User Programs

35 User Programs are available. The User Program mode allows you to customize your firing schedule and specify how fast the kiln heats or cools to any temperature. All Programs allow 20 ramp steps. Each ramp step consists of a heating rate (or cooling rate), a target temperature and a hold time.

Press the ***#4/UserProg*** key to begin programming. The message **USER** appears in the display. Use the numeric keypad to select which program you wish to create or modify. You must key in 1 - 35 Then press ***Enter***.

Temperature Units

If your controller is configured to display temperature values in °F, heating rates will be programmed as Degrees Fahrenheit per hour and target temperatures will be programmed as Degrees Fahrenheit. If your controller is configured to display temperature values in °C, heating rates will be programmed as Degrees Centigrade per hour and target temperatures will be programmed as Degrees Centigrade. To change the temperature units, see the *F/C* option.

User Program Heating/Cooling Rates

Rate is the speed of the ramp step. Rate is programmed as Degrees per Hour if the RATE option is set to HOUR. Some calculations may be required to determine your desired heating rate.

Example; if you know that you want to heat the kiln from room temperature (75°F) to 212°F over a 2 hour period, First determine the amount of temperature rise:

212 - 75 = 137 degrees

Then divide the amount of temperature rise (or drop) by the number of hours you would like it to take to get there. (For Example, 2 hours)

137 / 2 = 68.5 degrees per hour

Round the calculated rate to the nearest whole number and your heating rate would be 69 degrees/hour.

If you prefer to program heating and cooling rates in 'degrees per minute', adjust the RATE option in the options menu to MIN.

If you prefer to program heating and cooling rates in 'Hours and Minutes', adjust the RATE option in the option menu to TIME.

RA is the controller display for rate. Each rate segment will have its own number. The rate for the first ramp step will be displayed as ***RA 1***, the rate for the second ramp as ***RA 2*** and so on.

Maximum Ramp Rate for User Programs

When the Ramp Rate is set to **9999** degrees per hour or **99.99** degrees per minute or **00.00** Time, the controller will interpret this as full power for a heating ramp. This will allow the kiln to heat as fast as possible to the target temperature without rate control. If the ramp is a cooling, the controller will interpret the same values as no power and allow the kiln to cool as fast as possible without rate control.

A Program Review will show the message **FULL** to indicate the uncontrolled rate. Deviation alarms will not be active during the heating/cooling ramp.

Caution: Overshoot in temperature may occur when a kiln is heating at full power, especially at lower temperatures.

User Program Target Temperatures

Each ramp step requires you to program the desired target temperature.

℉ or ℃ is the controller display for target temperature. Like rate, each temperature segment will have its own number. The temperature for the first ramp step will be displayed as ***℉ 1*** or ***℃ 1***, the temperature for the second ramp step as ***℉ 2*** or ***℃ 2*** and so on.

Caution: Do not program target temperatures that exceed the temperature rating for your kiln. The maximum programmable value for target temperatures can be viewed in the *SFTY* option.

User Program Cooling Ramps

Cooling ramps are programmed the same as heating ramps. You must program the Rate for the cooling and the target temperature. The criteria for a cooling ramp is the target temperature must be lower than the preceding target temperature.

If you program a target temperature at the end of the firing that is below your room temperature, the controller will never be able to complete the firing. This may result in a **FTL** alarm. To avoid this alarm, manually stop the firing by pressing the ***Stop*** key or program a higher temperature to complete the firing

Changing a Target Temperature During a Firing

If the kiln is firing and you need to modify the current ramp target temperature (or hold time), Press the ***#4/UserProg*** key. The controller will display the current target temperature and setting. Use the numeric keypad to change the temperature value and press ***Enter***. The controller will next display the current ramp hold time and setting. This too can be modified if necessary. Press ***Enter*** again to exit the editing mode.

User Program Hold Time

Hold time refers to the amount of time you want the kiln to remain at the target temperature. Hold Time is often referred to as Soak or Dwell Time. Each ramp allows the option of programming a hold time. Hold time is programmed in Hours and Minutes. The decimal point light in the center of the controller display separates hours from minutes. The two digits to the left of the decimal point indicate hours while the right side indicates minutes.

Example;	A 1 hour hold time should be programmed as	**01.00**
or	A 30 minute hold time would be	**00.30**

During a Hold time, the controller will count-down the remaining time of the Hold on the display.

HD is the controller display for hold time. Each Hold segment will have its own number. The hold time for the first ramp step will be displayed as **HD 1,** the hold time for the second ramp step as **HD 2** and so on.

Set-Point Hold

You can program the controller to hold at a temperature indefinitely by programming a Hold Time of **99.59**. The controller will hold the kiln temperature until the ***Stop*** key is pressed.

Adding Time to a Hold

If the kiln is firing and you need to add time to the current ramp hold time, press the ***#2/AddTime*** key. 5 minutes will be added to the hold time each time the key is pressed. If the firing is in the first ramp, you can only edit the first ramp hold time. To edit the second ramp hold time, wait until the firing has progressed into the second ramp.

Shortening a Hold

To end a hold before the time has expired, use the Skip Step function to advance to the next ramp. Press the ***#9/Skip*** key to select the next available ramp step and press ***Enter***.

User Program Vent Fan (Optional)

If your controller has been configured to control an auxiliary vent fan, each ramp step will allow the fan to be turned on or off during the specified ramp. Refer to the Options section for additional details on the Auxiliary Output and Fan options.

FN is the controller display for vent fan. Each ramp will have its own fan setting. The fan setting for the first ramp step will be displayed as **FN 1,** the fan setting for the second ramp step as **FN 2** and so on.

To set the fan to **On or OFF**, press ***#1*** or ***#3/Delay*** key.

Programming User Programs

During programming, default values may appear in the display. If the controller was previously programmed, the last settings will appear.

1. Press the ***#4/UserProg*** key. **USER** shows in display.

2. Using the numeric keypad, select the desired user program number; 1 - 9. *For Example*: you would press the #1 key to enter a program or to modify the existing program stored in the User Program #1 location. Then press ***Enter***

3. **RA 1** shows in the display indicating the rate value for the first ramp step. Use the numeric keypad to enter the desired heating rate. Then press ***Enter***

4. **°F 1** or **°C 1** shows in the display indicating the target temperature for the first ramp step. Use the numeric keypad to enter the desired temperature. Then press ***Enter***

5. **HD 1** shows in the display indicating the Hold time for the first ramp step. Use the numeric keypad to enter the desired time for the kiln to hold at the first target temperature. Time is entered as (Hours.Minutes). Then press ***Enter***

6. **FN 1** shows in the display (if available). Use the ***#1 or #3*** key to select a fan setting; either **OFF** or **ON** for the first ramp. Then press ***Enter***. The Fan option will not appear unless the auxiliary output option for the controller has been configured.

7. Repeat steps 3 through 6 to program additional ramp rates, temperatures and hold times. After you have programmed your final ramp, the controller should be displaying the next available **RA** number. If the value for the next available ramp rate is set to zero degrees per Hour or Minute, press ***Enter***. The controller will automatically exit the programming mode. For Time mode, the value should be set to 99.99.

Note: If the user program that you are working with was previously programmed, the values that have been stored in memory will appear for all the ramp settings. Whenever you enter a zero value for a rate **(RA #)**, all settings beyond that point will be erased. This feature can be used to erase an entire user program by entering a zero rate at **RA 1**.

8. When the controller has returned to **IDLE**, press ***Enter/Start*** to start the firing.

Selecting a Stored User Program

To select a stored User Program without making any changes to the ramps.

1. Press ***#4/UserProg*** key. **USER** will show in display.
2. Using the numeric keypad, select the desired User Program number; **1 - 35**.
3. Press the ***Back/Stop*** key to exit programming mode.
4. When the controller has returned to **IDLE**, press ***Enter/Start*** to start the firing.

User Program Example

Use Program #1 (Simple Glass Full Fusing), To fire at 400ºF/hour to 1170ºF, hold 40 minutes,

Then 500ºF/hour to 1480ºF, hold 10 minutes, Cool at Full to 900ºF, hold for 30 minutes Shut off.

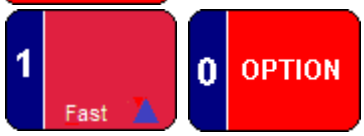
Follow these steps: starting with the controller at **IDLE**

Press	Display Shows
4 USER PROG	…….. USER
1 Fast	…….. 1
ENTER START	…….. RA 1
4 USER PROG, 0 OPTION, 0 OPTION	……400
ENTER START	…….. °F 1
1 Fast, 1 Fast, 7 ALARM, 0 OPTION	……... 1170
ENTER START	…….. HD 1
4 USER PROG, 0 OPTION	…….. 00.40
ENTER START	…….. RA 2
5 STATUS, 0 OPTION, 0 OPTION	……..….. 500
ENTER START	…….. °F 2

1 Fast, 4 USER PROG, 8 COST, 0 OPTION

..…….. 1480

…….. HD 2



…..…….. 00.10

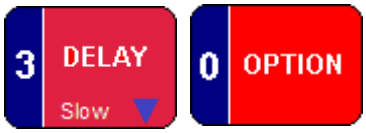
…….. RA 3

…….9999 (FULL)

…….. °F 3

…….. 900

…….. HD 3



……..…….. 00.30

…….. RA 4

…….. 0

…….. IDLE

…….. -ON-

To stop the kiln anytime during the firing, press ***Stop***. The controller display will indicate **ABRT** (Abort). Press ***Stop*** again to return to **IDLE.**

Alarms

Alarms are used to notify the operator of problems with the kiln performance or controller performance. Some alarms will terminate the kiln firing while others allow the firing to continue with the alarm condition on the display. Some alarms have no effect on the outcome of the kiln firing.

Thermocouple Alarms

- - - -	Thermocouple not detected during power up.
FAIL	Thermocouple failed during a firing, firing stopped
TC 2	Thermocouple failed while controller Idle
TCR	Thermocouple polarity reversed , firing stopped
LAG	Thermocouple temperature is lagging, firing stopped (kiln not heating)
OTL	Over Temperature Limit detected – firing stopped (check LIMIT option)
FTL	Firing too Long – kiln temperature has stalled, firing stopped

Deviation Alarms

*See **TEDE** option to adjust Deviation*

FTH	Fail to Heat - kiln is heating too slow, firing continues
FTC	Fail to Cool - kiln is cooling to slow, firing continues
LTDE	Low Temp Deviation - kiln is losing temperature, firing continues
HTDE	High Temp Deviation - kiln is overheating, firing stopped

Power Interruption Alarms

PF	Power failed, and firing was resumed
PF 1	Power failed during cooling and firing was stopped because cooling temperature exceeded
PF 2	Power failed during heating and firing was stopped because temperature was below 212°F
PF 3	Power failed during heating or hold, and firing was stopped because temperature dropped by 72°F

Diagnostic Alarms

BADP	Invalid User Program. Check current kiln temperature is below program temperature.
ETH	Electronics too Hot – controller temperature above 80°C, firing stopped
FE 1	Failed to read or write to memory device
FE 4	Errors detecting thermocouple input signal

Options Menu

Advanced settings and features are available through the Options menu. Press the ***#0/Option***

Key to advance through the options menu. During a firing, not all options can be changed. To exit Options, press the ***Stop*** key or wait 1 minute without pressing any key.

To view an Option setting, press ***Enter*** when the option code is displayed. Use the ***#1/Fire*** key or ***#3/Delay*** key to change the setting for the option. Press ***Enter*** after making the change.

Option List

DIAG	**Diagnostics**	*View output amps*
TC	**Thermocouple Type**	*Select thermocouple type (Type K, N, S or R*
DIFF	**Temperature Difference**	*Displays difference between thermocouples (multi-zone only)*
F/C	**Temperature Units**	*Change temperature units to °F or °C*
TCOS	**Thermocouple Offset**	*Change a thermocouple temperature reading by ±25°C*
AOP1	**Auxiliary Output #1**	*Enable a vent fan, external alarm or safety relay output on Output 1*
AOP2	**Auxiliary Output #2**	*Enable a vent fan, external alarm or safety relay output on Output 2*
RATE	**Ramp Rate units**	*Select ramp rate units of degrees per hour, minute or Time*
CENT	**Cost per Kilowatt Hour**	*Set firing cost for Kilowatt Hours*
KW	**Kiln Power Rating**	*Set power consumption Kilowatts*
TEDE	**Temperature Deviation**	*Deviation value for alarms FTH, FTC, and LTDE*
HTDE	**High Temperature Deviation**	*Deviation value for alarm HTDE*
BAL	**Power Balance**	*Change power between top and bottom heating zones (if available)*
CADJ	**Center Power Adjust**	*Adjusts power to middle heating zone (if available)*
SFTY	**Safety Temperature**	*Displays maximum programmable temperature*
LIM	**Over-Temperature Limit**	*Set the maximum limit temperature*
T123	**Thermocouple Temperatures**	*Displays individual thermocouple temperatures (multi-zone)*
ELEC	**Electronics Temperature**	*Displays temperature of the electronics*
LOCK	**Program Lock**	*Lock or Unlock the programs to prevent changes*
CFG	**Configuration Number**	*Displays factory configuration #*
SOFT	**Software Version**	*Displays factory software version*
TEST	**Test System**	*Test controller inputs and outputs*
RST	**Factory Reset**	*Reset all values to OEM settings.*

The options list will vary depending on the controller configuration. Multi-zone options do not appear in single zone controllers.

Options Descriptions

Diagnostics - DIAG

Diagnostics allows the operator to check the current draw on the main supply line. The accuracy is +/-1amp. To accomplish this, the relays are switched on for a brief time period to get a measurement. independent relays are switched on at time intervals to test each heating zone.

If multiple AMP readings are available, the controller display will test each relay for 10seconds before automatically advancing to the next test cycle. The operator can also press ENTER to advance thru the test cycles.

During a firing, the test cycle is limited to full load amps with all relays energized.

Note: the controller must be equipped with a current transformer to achieve a result.

Thermocouple Type - TC

The **TC** Option allows Type "K", "N", "S", or "R" thermocouples. The setting must match the actual thermocouples in use.

Settings	*Meaning*
K	Type K
N	Type N
S	Type S
R	Type R

Press the ***#0/Option*** key until **TC** appears. Press ***Enter*** and use the ***#1*** or ***#3*** key to change the setting.

Temperature Difference - DIFF

The **DIFF** Option displays the temperature difference between the top and bottom thermocouples for multi-zone controllers. This feature is useful in determining temperature uniformity within a kiln during a firing.

Press the ***#0/Option*** key until **DIFF** appears. Press ***Enter*** to view the result.

Change Temperature Units – F/C

The **F/C** Option allows the temperature units to be displayed in either degrees Fahrenheit (°F) or degrees Centigrade (°C).

Press the ***#0/Option*** key until **F/C** appears. Press ***Enter*** and use the ***#1*** or ***#3*** key to change the setting.

Thermocouple Offset - TCOS

This offset adjusts the thermocouple reading on the controller up to ± 45°F(25°C). **TCOS** can be used to compensate for inaccurate temperature readings resulting from aged or poorly positioned thermocouples. Temperature offset applies to all firings.

To Program the offset, press ***#0/Option*** key until the display shows **TCOS** and press ***Enter***

If you want the kiln to fire Hotter, press #***1/Fire*** key and the display will show **H-1**. Continue pressing #***1*** until the desired thermocouple offset shows in the display (e.g. **H-15** for a 15° offset) and press ***Enter***.

If you want the kiln to fire Cooler, press #3***/Delay*** key and the display will show **C-1**. Continue pressing #***2*** until the desired thermocouple offset shows in the display (e.g. **C-10** for a 10° offset) and press ***Enter***.

Multi-zone: A separate offset can be selected for individual thermocouples: **TC 1** (top), **TC 2** (middle) and **TC 3** (bottom)

Auxiliary Output 1 - AOP1

The **AOP1** Option sets the Auxiliary relay output on Output #1 to the desired functions for controlling a Vent fan, External alarm or Safety relay. Setting the **AOP1** option to **VFAN** enables the **FAN** option for the **FN** ramp segment for User Programs.

Settings	*Meaning*
NONE	No external relay functions
VFAN	Vent fan is enabled on output pin 3
ALRM	Alarm is enabled on output pin 3
SAFE	Safety Relay is enabled on output pin 3
CPT	output pin 3 enabled during CPLT message only

Press the ***#0/Option*** key until **AOP1** appears. Press ***Enter*** and use the ***#1*** or ***#3*** key to change the setting.

Auxiliary Output 2 - AOP2

The **AOP2** Option sets the Auxiliary relay output on Output #2 to the desired functions for controlling a Vent fan, External alarm or Safety relay. Setting the **AOP2** option to **VFAN** enables the **FAN** option for the **FN** ramp segment for User Programs.

Settings	*Meaning*
NONE	No external relay functions
VFAN	Vent fan is enabled on output pin 2
ALRM	Alarm is enabled on output pin 2
SAFE	Safety Relay is enabled on output pin 2
CPT	output pin 2 enabled during CPLT message only

Press the ***#0/Option*** key until **AOP2** appears. Press ***Enter*** and use the ***#1*** or ***#3*** key to change the setting.

Ramp Rate Units - RATE

The **RATE** Option sets the units for programming and review of heating and cooling rates. The factory default setting is for Degrees per Hour.

Settings	*Meaning*	*MAX 'FULL' rate*
HOUR	Degrees per Hour	999°C (1799°F)/Hour
MIN	Degrees per Minute	16.65°C (29.97°F)/Minute
TIME	Time to Temperature (Hours. Minutes)	00.00 Hours. Minutes

Press the ***#0/Option*** key until **RATE** appears. Press ***Enter*** and use the ***#1*** or ***#3*** key to change the setting.

Kilowatt Hour Cost - CENT

The **CENT** Option allows the operator to set a value for the Kilowatt Hour usage of the electric service. This value is used to calculate a firing cost for review on the controller display. The value must be entered by the user, it can usually be found on your electric bill. Cost calculations first require a second value entry in the KW option. Cost calculations are only as accurate as the programmed variables. To view the COST calculations, press the #8 key during or after the kiln firing.

Press the ***#0/Option*** key until **CENT** appears. Press ***Enter*** and use the numeric keypad to enter the value, then press ***Enter*** *to save*.

Kilowatt rating - KW

The **KW** Option allows the operator to set a value for the Kilowatt rating of the kiln. This value is used to calculate a Kilowatt/Hour usage for review on the controller display. The wattage rating must be entered by the user, it can usually be found on the kiln manufacturer label. KWHR and COST calculations are only as accurate as the programmed **KW** value. To view the KWHR or COST calculations, press the #8 key during or after the kiln firing.

Press the ***#0/Option*** key until **KW** appears. Press ***Enter*** and use the numeric keypad to enter the value, then press ***Enter*** *to save*.

Temperature Deviation - TEDE

The **TEDE** Option sets a temperature deviation value to activate an audible and visual alarm. The temperature deviation applies to the following alarms - **FTH, FTC** and **LTDE**. The factory setting is 100°F (56°C). The alarms can be disabled by setting the value to zero. Use the numeric keypad to enter the desired deviation value and press ***Enter***.

Press the ***#0/Option*** key until **TEDE** appears. Press ***Enter*** and use the numeric keypad to enter the value, then press ***Enter*** *to save*.

High Temperature Deviation - HTDE

The **HTDE** Option sets a temperature deviation value to abort the kiln firing. The temperature deviation applies only to the **HTDE** alarm. The factory setting is 100°F (56°C). The alarm cannot be disabled. Use the numeric keypad to enter the desired deviation value between 18ºF – 200ºF (10ºC - 111ºC) and press ***Enter***.

Press the ***#0/Option*** key until **HTDE** appears. Press ***Enter*** and use the numeric keypad to enter the value, then press ***Enter*** *to save*.

Top/Bottom Balance - BAL

The B**AL** option is only available on single zone controllers that have been configured to operate independent relays for the top and bottom kiln sections. **BAL** changes the amount of power being supplied to the top and bottom heating elements by selecting a power percentage between 0% and 200%. This is the percentage of power going to the top heating elements. Values less than 100 reduce power to the top, while higher values increase power to the top. The Power to the bottom heating element is automatically changed. This feature can be used if the kiln is not heating uniformly.

100% is the factory default. This applies 100% of available power to both the top and bottom elements. Changing the setting to 150% would increase the power to the top elements by 50%, while decreasing power to the bottom elements by 50%. The B**AL** setting can be changed in increments of 10%

Press the ***#0/Option*** key until **BAL** appears. Press ***Enter*** and use the ***#1*** or ***#3*** key to change the setting.

Center Zone Adjustment - CADJ

The **CADJ** option is available on single zone controllers that have been configured to operate an independent relay for the center kiln section. **CADJ** allows changes in the amount of power supplied to the middle heating elements of the kiln by selecting a power percentage between 0% and 200%. Values less than 100 reduce the power to the center zone, while values greater than 100 will increase the power. This feature can be used if the kiln is not heating uniformly. 95 is the factory setting. The **CADJ** setting can be changed in increments of 10%.

Press the ***#0/Option*** key until **CADJ** appears. Press ***Enter*** and use the ***#1*** or ***#3*** key to change the setting.

Safety Temperature - SFTY

This option displays the maximum programmable temperature allowed by the controller.

Press the ***#0/Option*** key until **SFTY** appears. Press ***Enter*** to view the setting.

Over-temperature Limit - LIM

The **LIM** Option allows the operator to set a value for the maximum temperature of the kiln. This option is only available when the AOP1 or AOP2 option is configured for a safety relay operation. The operator can set a value as low as 32F or as high as the Safety Temperature **SFTY** temperature.

The controller will abort the kiln firing with alarm **OTL** if the actual thermocouple temperature is detected 1 degree above the LIM setting.

Press the ***#0/Option*** key until **LIM** appears. Press ***Enter*** and use the numeric keypad to enter the value, then press ***Enter*** *to save*.

Thermocouple Temperatures – T123

T123 displays the independent temperature readings for *Multi-Zone* controllers. These are **TC 1** for the top, **TC 2** for the middle and **TC 3** for the bottom thermocouple. For multi zone controllers, the average temperature reading is reported on the display during normal operation. This option can be used to verify temperature uniformity throughout the kiln.
The message **[- - - -]** indicates no temperature reading found.

Press the ***#0/Option*** key until **T123** appears. Press ***Enter*** to view the results.

Electronics Temperature - ELEC

ELEC displays the controller electronics temperature. This can be useful in monitoring the electronics temperature in hot environments or for diagnosing a controller problem. The **ETH** alarm will activate if the controller temperature is above 80°C (176°F)

Press the ***#0/Option*** key until **ELEC** appears. Press ***Enter*** to view the results.

Program Lock Mode - LOCK

The **LOCK** Option allows individual User Programs to be locked into memory, preventing the settings to be changed from the keypad. This feature is useful when only one particular program is used repeatedly to fire the kiln.

LOCK requires a passcode to enable this feature, the default passcode is '**3**'. Once enabled, the user can set a new passcode that is private. Lock options will appear at the end of each program sequence. If the passcode is entered during the program sequence, the program will no longer be available for editing without the passcode.

To turn off the lock feature, the passcode must be re-entered. To reset the passcode, see *RST* option

Press the ***#0/Option*** key until **LOCK** appears. Press ***Enter*** to see PASS, use the numeric keypad to enter the passcode, then press ***Enter.*** use the ***#1*** or ***#3*** key to change the setting or to set a new passcode, then press ***Enter.***

Configuration Number - CFG

CFG displays the factory configuration number. this identifies the controller model.

Press the ***#0/Option*** key until **CFG** appears. Press ***Enter*** to view the results.

Software Version - SOFT

SOFT displays the factory software version of the controller.

Press the ***#0/Option*** key until **SOFT** appears. Press ***Enter*** to view the results.

Test Inputs and Outputs - TEST

The **TEST** Option allows the heating elements for each zone to be turned on independently for 2 minutes while monitoring the thermocouple temperatures for each zone. In sequence, each zone turns on and displays the temperature for the corresponding thermocouple. You can Press ***Enter*** to advance to the next zone before the 2 minutes expires. **TEST** will also activate the Auxiliary outputs identified as **AOP1** and **AOP2**.

Reset - RST

The **RST** feature restores the original OEM values supplied with the controller. Do not perform a reset unless all other efforts to correct faults with the controller have failed. A reset may change important option settings for your kiln. Before attempting a reset, you should become familiar with the correct option settings for your controller. Most important is the **TC** option setting.

To reset, press the ***#0/Option*** key until **RST** is displayed and press ***Enter.*** Use the ***#1*** or ***#3*** key to change the setting from **NO** to **YES** and press ***Enter***. This will reset the controller settings. Verify the controller is accurately displaying temperature after the reset. You may need to adjust the **TC** setting for the thermocouple and the **F/C** setting for the display temperature.

Multi-Zone Control

Multi-zone controllers use more than one thermocouple to separately monitor and control different sections of the kiln. The temperature on the display represents the average temperature between the multiple thermocouples.

A multi zone controller can continue to operate as long as one thermocouple signal is present. However, thermocouple alarm messages should not be ignored. The controller can only perform zone control if all the thermocouple signals are available. If only one thermocouple signal is available, the controller will automatically switch to single-zone control.

Additional Alarms are available with Multi-zone controllers;

TC 1	Top Thermocouple detected missing
TC 2	Middle Thermocouple detected missing
TC 3	Bottom Thermocouple detected missing
TCR1	Top Thermocouple reversed
TCR2	Middle Thermocouple reversed
TCR3	Bottom Thermocouple reversed
TCDE	Thermocouple Deviation - 180ºF (100ºC) deviation between two thermocouples, firing stopped
Flashing Lights	Indicates section of kiln with low power, firing continues without zone control

Hardware Options

Audible alarm buzzer

The audible alarm can be disabled by removing the circuit board jumper on the back side of the controller. remove the jumper shunt labeled BUZZ ENABLE along the top edge of the circuit board.

Door/Lid switch

An optional door switch can be installed and connected to the controller. If not used, a jumper shunt is placed at circuit board location labeled LID.

LID is also a display alarm that indicates when the switch connection is open.

The door switch acts as an optional safety device to prevent the relay outputs from being energized whenever the kiln door or lid is open.

Computer software

Computer software is available for remote monitoring and datalogging. The controller has a USB interface that outputs TIME, Temperature and Setpoint data. For more information on the optional computer software, contact Orton or visit www.ortonceramic.com

Appendix A – User Program Charts

User Program # 1

Ramp #	Rate: °/hr	Temperature	Hold Time	Vent Fan: on/off
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

User Program # 2

Ramp #	Rate: °/hr	Temperature	Hold Time	Vent Fan: on/off
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

User Program # 3

Ramp #	Rate: °/hr	Temperature	Hold Time	Vent Fan: on/off
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

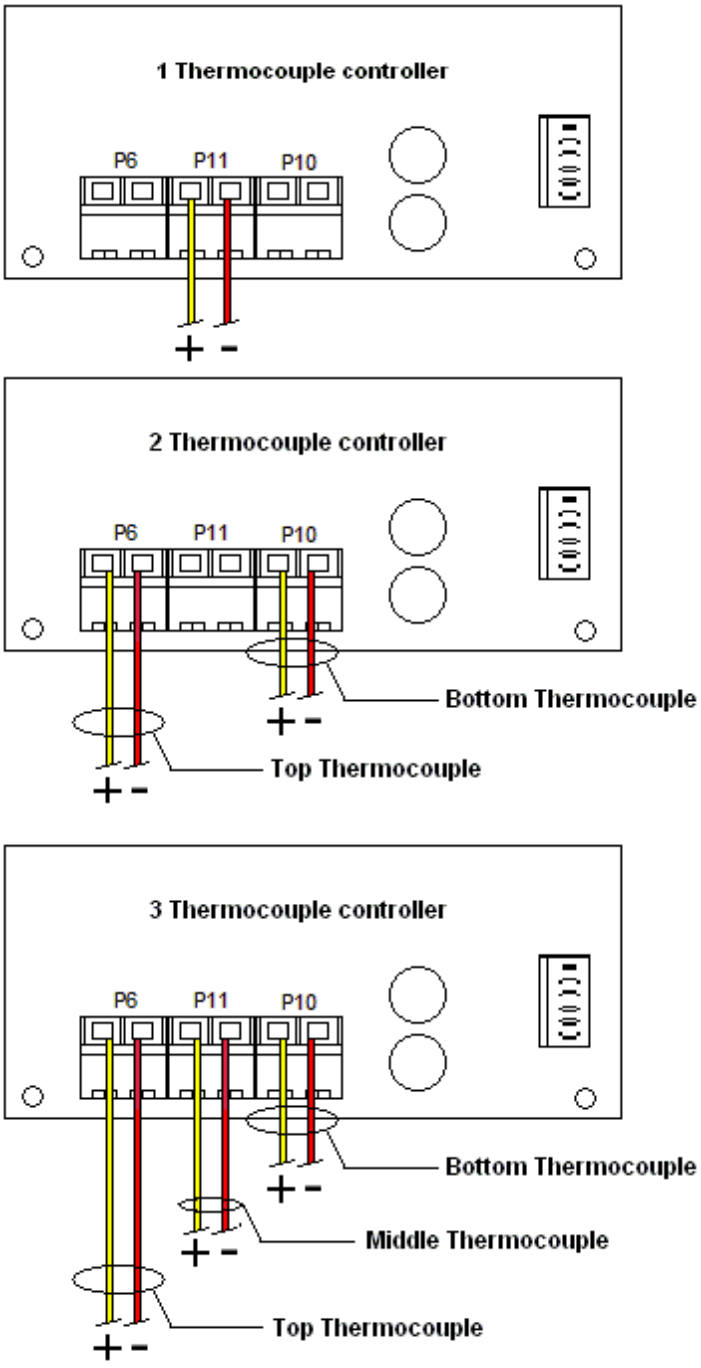
User Program # 4

Ramp #	Rate: °/hr	Temperature	Hold Time	Vent Fan: on/off
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

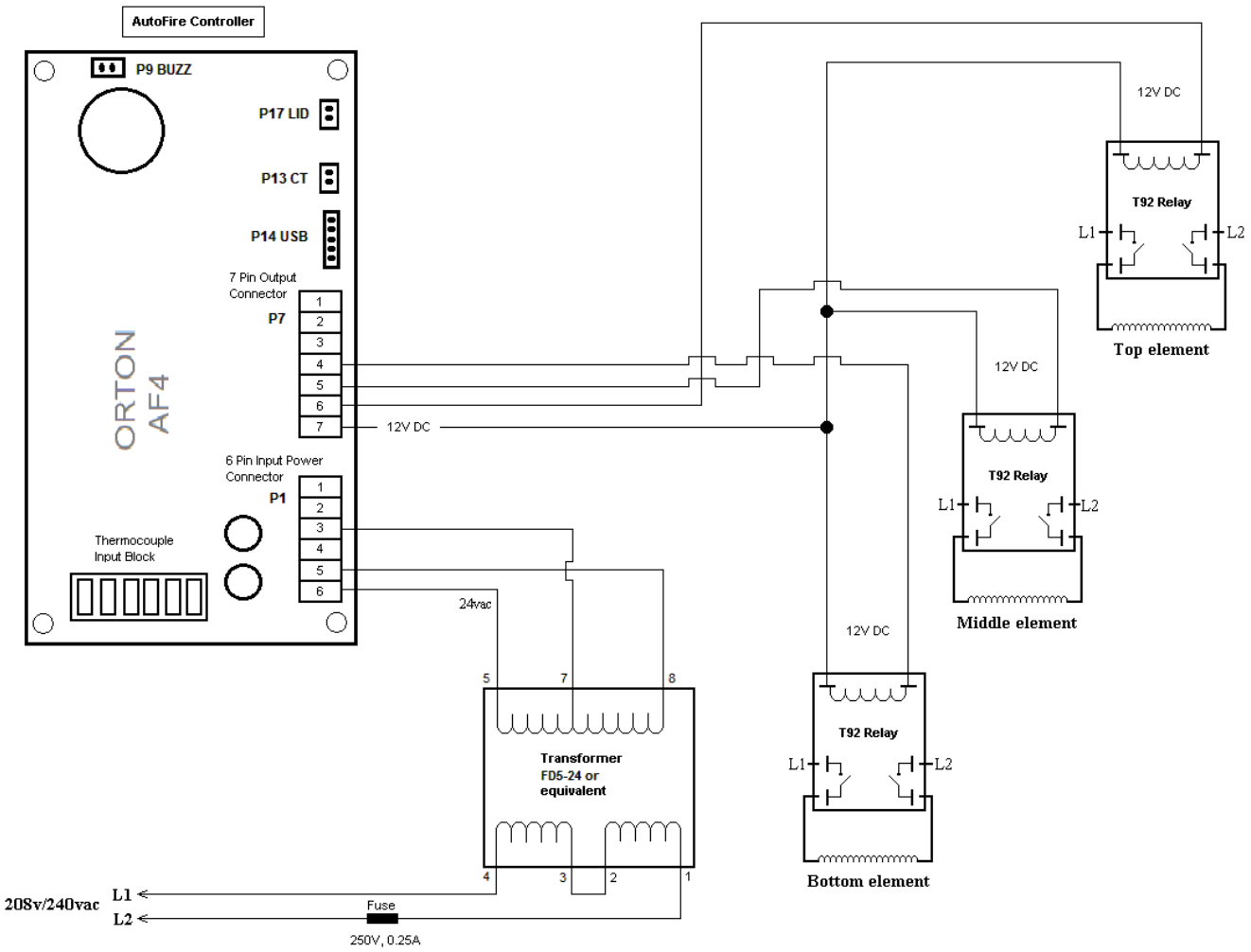
Appendix B – Connecting Thermocouples

For thermocouples, the color-coded wires should always include a red wire. The red wire is the negative leg.

For Type K, the positive leg is yellow.
For Type N, the positive leg is orange.
For Type S and Type R, the positive leg is black.



Appendix C – Typical Wiring Diagram



The JEN-KEN AutoFire 4000 Fusing Program Schedules for Your Controller

The new AutoFire 4000 controller software has undergone a major software update! The first 9 programs are blank, they are for you to use when you want to create a new and unique firing schedule for any project you have in mind. Once programmed they remain in the controller memory until you chose to change them. Programs 10 through 34 are preprogrammed by us to assist you as you learn and grow as an artist! You can alter and change these programs as well. Any changes made to existing preprogrammed schedules will remain in the controller memory until you chose to alter them.

Program 11 is a full fuse for pieces smaller than 10 x 10 and **program 12** is a full fuse for pieces larger than 10 x 10.

Program 13 is a contour fuse for pieces smaller than 10 x 10 and **program 14** is a contour fuse for pieces larger than 10 x 10.

Program 15 is a tack fuse for pieces smaller than 10 x 10 and **program 16** is a tack fuse for pieces larger than 10 x 10.

Program 17 is a fire polish for pieces smaller than 10 x 10 and **program 18** is a fire polish for pieces larger than 10 x 10.

Program 19 is a slump program for pieces smaller than 10 x10 and **program 20** is a slump program for pieces larger than 10 x 10.

Program 21 is a program for draping 2 layers of glass. Be sure to keep an eye on your glass when using this schedule!

Program 22 is a program for deep slumping or texture.

Program 23 is a fast fuse program for brick pieces smaller than 10 x 10 and **program 24** is a fast fuse for brick pieces larger than 10 x 10.

Program 25 is a fiber contour for small pieces and **program 26** is a fiber contour for large pieces. **Program 27** is a fast tack program. **Program 28** is for large fiber tack fusing. – This when using an all fiber kiln with a fiber shelf. For example: the JenKen Profusion 26.

Program 29 is for pot melts.

Programs 30 and **31** are for screen drips.

Program 32 is for fusing and annealing dammed thick slabs of glass.

Program 33 is for flatting bottles on the kiln shelf. **Program 34** is for then slumping bottles on a mold.

Finally, **program 35** is for open face mold casting.

We hope that you will find these programs useful in your journey into the fired arts! If you have any questions, please call us.

Note: Firing schedules may need to be adjusted as you learn how your kiln fires. These schedules are meant to be a starting point for you to learn from and adjust as you advance and your kiln ages

Program 11 Full Fuse < 10x10 Brick

RAMP	°F	Hold
400	1170° (632C)	0.40
500	1480° (804C)	0.10
Full	900° (482C)	0.30
	OFF	

Program 12 – Full Fuse > 10x10 Brick

RAMP	°F	Hold
300	1170° (632C)	1.00
400	1480° (804C)	0.10
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 13 – Contour < 10x10 Brick

RAMP	°F	Hold
400	1170° (632C)	0.40
500	1400° (760C)	0.10
Full	900° (482C)	0.30
	OFF	

Program 14 – Contour > 10x10 Brick

RAMP	°F	Hold
300	1170° (632C)	1.00
400	1400° (760C)	0.10
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 15 – Tack < 10x10 Brick

RAMP	°F	Hold
400	1170° (632C)	0.40
500	1350° (732C)	0.10
Full	900° (482C)	0.30
	OFF	

Program 16 – Tack > 10x10 Brick

RAMP	°F	Hold
300	1170° (632C)	1.00
400	1350° (732C)	0.10
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 17 – Fire Polish < 10x10 Brick

RAMP	°F	Hold
300	1000° (538C)	0.00
500	1325° (718C)	0.05
Full	900° (482C)	0.30
	OFF	

Program 18 – Fire Polish > 10x10 Brick

RAMP	°F	Hold
250	1000° (583C)	0.00
400	1325° (718C)	.05
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 19 – Slump < 10x10 Brick

RAMP	°F	Hold
300	1000° (583C)	0.00
400	1220° (660C)	0.20
Full	900° (482C)	0.30
	OFF	

Program 20 – Slump > 10x10 Brick

RAMP	°F	Hold
250	1000° (583C)	0.00
400	1220° (660C)	.20
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 21 – Drape 2 Layers

RAMP	°F	Hold
300	1000° (583C)	0.00
400	1170° (632C)	.15
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 22 – Deep Slump / Texture

RAMP	°F	Hold
300	1000° (583C)	0.00
400	1260° (682C)	0.30
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 23 – Fast Fuse < 10x10 Brick

RAMP	°F	Hold
500	1170° (632C)	0.20
Full	1480° (804C)	0.10
Full	900° (482C)	0.30
	OFF	

Program 24 – Fast Fuse > 10x10 Brick

RAMP	°F	Hold
400	1170° (632C)	0.40
500	1480° (804C)	0.10
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 25 – Fiber Contour Small Pieces

RAMP	°F	Hold
500	1170° (632C)	0.20
Full	1400° (760C)	0.10
Full	900° (482C)	0.40
	OFF	

Program 26 – Fiber Contour Large Pieces

RAMP	°F	Hold
400	1170° (632C)	0.40
500	1400° (760C)	0.10
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 27 – Fast Tack

RAMP	°F	Hold
500	1350° (732C)	0.10
Full	900° (482C)	0.30
	OFF	

Program 28 – Large Fiber Tack

RAMP	°F	Hold
400	1350° (732C)	0.10
Full	900° (482C)	1.00
100	700° (371C)	0.00
	OFF	

Program 29 – Pot Melt

RAMP	°F	Hold
500	1000° (538C)	0.00
Full	1600° (871C)	1.30
Full	1475° (802C)	0.30
Full	900° (482C)	1.00
100	600°(316C)	0.00
	OFF	

Program 30 – Screen 1st to Drip

RAMP	°F	Hold
500	1000° (538C)	0.00
Full	1600° (871C)	1.30
Full	1475° (802C)	0.30
Full	900° (482C)	1.00
100	600° (316C)	0.00
	OFF	

Program 31 – Screen 2 to Clean Edges

RAMP	°F	Hold
200	1000° (538C)	0.20
500	1475° (802C)	0.30
Full	900° (482C)	0.60
100	600° (316C)	0.00
	OFF	

Program 32 – Fusing/Annealing Dammed Thick Slabs < 1.25

RAMP	°F	Hold
300	1175° (635C)	1.00
400	1500° (816C)	0.10
Full	900° (482C)	3.50
24	700° (371C)	0.00
48	100° (38C)	0.00
	OFF	

Program 33 – Bottles Flat on a Shelf

RAMP	°F	Hold
300	1000° (538C)	0.00
500	1475° (802C)	0.15
Full	900° (482C)	0.40
	OFF	

Program 34– Bottles in a Mold

RAMP	°F	Hold
300	1000° (538C)	0.00
500	1400° (706C)	0.15
Full	900° (482C)	0.40
	OFF	

Program 35 – Open Face Mold Casting

RAMP	°F	Hold
300	1000° (538C)	0.20
300	1400° (706C)	1.20
Full	900° (482C)	1.30
100	600 (316C)	0.00
	OFF	

Autofire® Kiln Controller

Limited Warranty

This limited warranty is given only to the immediate purchaser ("Buyer") of the Autofire® Kiln Controller ("AF4000"). This limited warranty is not transferable. The Edward Orton Jr. Ceramic Foundation ("Orton") warrants the controller motherboard and keypad installed on the Autofire® Kiln Controller ("Warranted Components") to be in good working order under normal operating conditions for a period of two (2) year from the date of purchase. Should the Warranted Components fail to be in good working order at any time during the stated two (2) year period, Orton will, at its option, repair or replace the Warranted Components as set forth below. The liability of Orton is limited to replacement and/or repair at its factory of the Warranted Components that does not remain in good working order. Repair parts or replacement products will be furnished on an exchange basis and will be either reconditioned or new. All replaced parts or products become the property of Orton. Following receipt of notice from Buyer of a valid warranty claim and the Autofire® Kiln Controller containing the Warranted Components, Orton will perform its obligations under this limited warranty within 10 business days.

Limited warranty service may be obtained by delivering the Autofire® Kiln Controller during the warranty period to your Orton Autofire® Supplier or to The Edward Orton Jr. Ceramic Foundation, 6991 Old 3C Highway, Westerville, Ohio 43082 and providing written proof of purchase and a description of the defect or problem. Buyer must insure the shipment of the Autofire® Kiln Controller or assume the risk of loss or damage in transit, prepay shipping charges to the service location, and use the original shipping container or equivalent. Buyer will be responsible for shipping and handling charges in excess of US $50.00 incurred by Orton in returning the Autofire® Kiln Controller to the Buyer after completion of limited warranty service.

This warranty does not apply to any damage to the Autofire® Kiln Controller resulting from:

1. Operation beyond electrical rating.
2. External sources including, but not limited to, chemicals, heat abuse and improper care.
3. Improper or inadequate maintenance by Buyer.
4. Parts or equipment not supplied by Orton.
5. Unauthorized modification or misuse.
6. Operation outside environmental specifications.
7. Improper installation.
8. Over firing (melting of materials being fired) regardless of the cause of the over firing.

Warranted Components returned for service where no warranted defect is found will be subject to service, and shipping and handling fees.

If the Warranted Components are not in good working order as warranted above, Buyer's sole remedy shall be repair or replacement of the Warranted Components as provided above. To the extent permitted by law, ALL EXPRESS AND IMPLIED WARANTIES FOR THE WARRANTED COMPONENTS INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO THE TWO-YEAR WARRANTY PERIOD COMMENCING ON THE DATE OF PURCHASE, AND NO OTHER WARRANTY WHETHER EXPRESS OR IMPLIED WILL APPLY TO THIS PERIOD. To the extent permitted by law, ORTON'S REMEDY AND BUYER'S SOLE REMEDY IS LIMITED SOLELY AND EXCLUSIVELY TO REPAIR OR REPLACEMENT AS SET FORTH HEREIN. ORTON SHALL NOT BE LIABLE FOR, AND BUYER'S REMEDY SHALL NOT INCLUDE ANY INCIDENTAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY KIND WHATSOEVER, WHETHER A CLAIM IS BASED UPON THEORY OF CONTRACT, NEGLIENCE OR TORT. Buyer shall determine suitability of the Autofire® Kiln Controller for the intended use and assume all risk and liability therewith. Some states do not allow this exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

The above limitation does not apply in the event that any Warranted Components are determined by a court of competent jurisdiction to be defective and to have directly caused bodily injury, death or property damage; provided that in no event shall Orton's liability exceed the greater of $1,000.00 or the purchase price of the specific Autofire® Kiln Controller that caused such damage.

Service may also be obtained on Warranted Components no longer under warranty by returning the Autofire® Kiln Controller prepaid to Orton with a description of the problem and Buyer's name and contact information. Buyer will be contacted with an estimate of services charges before any work is performed.

Customer Satisfaction Policy

If for any reason you are not completely satisfied with the performance of the Orton Autofire® Kiln Controller or the conditions of this warranty, return the Autofire® Kiln Controller in good working condition, transportation and insurance prepaid, within 30 days of purchase date to your Orton Autofire® Kiln Controller supplier or The Edward Orton Jr. Ceramic Foundation, 6991 Old 3C Highway, Westerville, Ohio 43082 and your purchase price will be refunded. Prior to returning your Autofire® Kiln Controller contact Orton for an authorization number and include with your shipment. For Autofire® Kiln Controllers ordered in error, a restocking charge will apply.

Customer Support

Orton technicians are available by phone for support and troubleshooting. If you have questions regarding the performance or operation of the kiln controller. Contact your kiln supplier, kiln manufacturer or Orton directly at 614-895-2663. Tech Support hours are Monday-Friday 8:00AM – 4:30PM EST