AutoFire® Kiln Controller

User's Guide

Model AF4X

Orton Ceramic Foundation

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Introduction

This User's Guide explains the features and operation of the Model AF4X Controller.

The controller has 3 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.

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.

If you have a Kiln-Sitter® on your kiln, you can use a Cone 10 bar under the sensing rod to shut off power if the kiln reaches high temperatures. This bar will last many firings and can act as a backup safety device for the firing.

Features

The AF4X includes many standard features, a user-friendly keypad and robust temperature control software.

Firing Methods and Features

- **User Program** method: Create up to 25 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.
- **Speed Programs:** 5 speed programs are preset with different fixed heating rates. These programs are single set-point (one step) programs.
- **Jewelry Programs:** 3 preset firing schedules for burnout. The various heating and cooling steps are preprogrammed. You can fire to a preset Jewelry schedule by simply selecting the jewelry program along with an adjustable final hold temperature.
- **PMC Programs:** 5 preset firing schedules for Precious Metal Clay. The heating steps are preprogrammed. You can fire to a preset PMC schedule by simply selecting the PMC Program. These programs are not adjustable.
- **Cone-Fire** method: Select a preset program for a specific cone number from Cone 022 to Cone 12. These programs are designed specifically for ceramic firings.
- **Speed** adjustments **-** Use with Cone-fire mode to speed up or slow down a firing and to adjust for load size or thick pieces of ware.
- **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.
- **Program edit –** User Program option to change the active program settings during the firing without having to stop and restart the controller.

Advanced Options

- **Cone Offset -** Use with Cone-Fire to adjust the firing temperature of the kiln by ±11°C (±20°F) to fine tune the controller to your kilns performance.
- **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 Output -** Control a relay to switch on a vent fan 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.
- **Temperature Units -** Display Temperature in Fahrenheit (°F) or Centigrade (°C) Units
- **Computer Interface –** Monitor/Analyze kiln data from a PC using *AutofireDLS4* datalog software.

Test Firing with Witness Cones

A test firing will help in learning the operation and features of the controller. Follow your kiln manufacturer's instructions for setting up your kiln.

Place a series of Orton Self-Supporting Cones on the middle shelf of your kiln so that they can be seen through a kiln peephole. Use a series of cones close to the final firing temperature (see Appendix C). For example, if firing to 1945°F (Cone 04), use a Cone 03, Cone 04, and Cone 05 for the test firing.

To evaluate heat distribution, place a set of cones on each shelf during the test firing. Most kilns fire more uniformly at Cone 06 than they do below Cone 06. Provide ventilation for the kiln in accordance with the kiln manual or VentMaster® instruction manual.

After the firing, examine the fired cones. Some variation in the bending of the cones may occur, depending on how the kiln was loaded and the location of the cones.

Keypad Overview

This key is for selecting a firing program and advancing through the programming steps. After programming is complete, use this button to Start and Stop the firing.

This key is used to step forward the display values for specific program settings Also use this button for access to the option menu.

This key is used to step backwards the display values for specific program settings. It is also used to activate the Program Review feature.

When using the Increase and Decrease keys to program number values, the values will change more rapidly if the key is held in.

In general, the user interface is very simple. Use the increase and decrease keys to change the display prompt, when you see what you want on the display, press the Program key.

Display Lights

The controller uses (4) numerical displays and 3 indicator lights. The bottom light tells when the controller is turning on the relays to power the heating elements. The top is lit when the controller is in programming mode, the middle light is lit when the controller is in Program review mode.

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

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.

Stopping a Firing

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**

Programming values

Whenever a change is made from the keys, you must press the ***Program/Start*** key to load the changes. If the key is not pressed, the controller will simply wait for your next selection. Pressing the ***Program/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.

Program Review

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

Repeating a firing

If power is not cycled off to the controller, you can repeat a firing without viewing the entire program, simply press the ***Decrease/review*** key when the controller display is showing the desired program group. The controller will scroll through the program review and advance directly to the Start prompt. Press the ***Program/Start*** key to set a delay time and again to begin the firing.

Program Sets

The controller contains several sets of preset programs. Each set can be turned on or off depending on the user preferences. To disable a program set, see the configuration appendix of this manual.

When first powered on, the controller will show **IDLE**, to view the program sets, press the ***Program/Start*** key. Then press the ***Increase/Option*** key to see all available program sets.

Note: some program sets may be disabled or turned off by the kiln manufacturer or supplier depending on the application.

Program sets include: **SPD** (Speed) – **JWL** (Jewelry) – **CLAY** (PMC) – **CONE** (Ceramics) – **USER** (custom)

User Programs

25 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.

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.

Heating/Cooling Rates

Each program step requires you to program the desired rate value.

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

The range of values available for a controlled ramp rate setting is 0-1798F per hour or 0-29.97F per minute.

To program a rate that heats or cools as fast as possible, Set the rate to **FULL**. **FULL** appears as a selection for 1799F/hour or 29.98F/min. Just above the maximum ramp rate. You can also find the **FULL** setting by pressing the ***decrease/review*** button one time when the display shows zero for the rate setting.

When the RATE option is set for TIME, the maximum ramp rate or **FULL** setting is 00.00, the range of controlled rates is 00.01 (1minute) to 99.58 (99hours.58minutes)

When the Ramp Rate is set to **FULL** 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 step, 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.

Target Temperatures

Each program step requires you to program a desired target temperature.

°F or ***°C*** 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 ***°F 1*** or ***°C 1***, the temperature for the second ramp step as ***°F 2*** or ***°C 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.

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 ***Program/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, use **CHGT** option. The controller will display the current setting and allow you to change it. See the Option menu section of this manual for more details.

Hold Time

Each program step requires you to program a desired 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 ***Program/Stop*** key is pressed.

Adding Time to a Hold

If the kiln is firing and you need to increase the hold time, use the **HLDT** option. The controller will display the current setting and allow you to change it. See the Option menu section of this manual for more details.

Shortening a Hold

To end a hold before the time has expired, use the **SKIP** option to advance to the next ramp. See the Option menu section of this manual for more details.

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 AOP1 output.

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.

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 ***Program/Start*** key. A program group will show on the display.

2. Press the ***Increase/Option*** key until the display shows **USER,** then press the ***Program/Start*** key.

3. Using the ***Increase*** or ***Decrease*** key, select the desired program number (PR01-PR25) then press the ***Program/Start*** key.

4. **RA 1** shows in the display indicating the rate value for the first ramp step. Use the ***Increase*** or ***Decrease*** keys to enter the desired heating rate. Then press ***Program/Start*** key.

5. **°F 1** or **°C 1** shows in the display indicating the target temperature for the first ramp step. Use the ***Increase*** or ***Decrease*** keys to enter the desired temperature. Then press ***Program/Start*** key.

6. **HD 1** shows in the display indicating the Hold time for the first ramp step. Use the ***Increase*** or ***Decrease*** keys to enter the desired time for the kiln to hold at the first target temperature. Time is entered as (Hours.Minutes). Then press ***Program/Start*** key.

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

8. Repeat steps 4 through 7 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 end the programming mode. For Time mode, the value should be set to 99.59.

The controller will advance to **STRT**. *The programmed firing schedule is automatically stored and ready to* START *the firing.*

9. If the Delay Start feature is active, the display will show **DELA** alternating with a Time value. use the ***Increase*** or ***Decrease*** key to set a time for the kiln firing to begin. Time is shown as (Hours.Minutes). If no Delay is needed, set zero hours and zero minutes (00.00). Then press the ***Program/Start*** key.

10. Press the ***Program/Start*** key to begin the firing.

Erasing A User Program

If 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**.

User Program Example

Use Program #1 (Bead Annealing)
To fire to 960ºF at 1500ºF/hour
30-minute hold at temperature
Cool down to 500ºF at 100ºF/hour
Shut off.

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

Press	Display Shows
PROGRAM START/STOP	…… A program group
INCREASE OPTION	..……..…… USER
PROGRAM START/STOP	……A program number
INCREASE OPTION	……PR01
PROGRAM START/STOP	……... RA 1 / 0
INCREASE OPTION	…… 1500

…….. °F 1 / 32

…… 960

……. HD 1 / 00.00

…….. 00.30

……. RA 2 / 0

……..…….….. STRT

……..……..... DELA / 00.00

……..……..-ON-

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 affect 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 ***Increase/Option*** Key to advance through the options menu. During a firing, not all options can be changed. To exit Options, select the **EXIT** prompt within the option menu.

To view an Option setting, press ***Program/Start*** key when the option code is displayed. Use the ***Increase*** or ***Decrease*** key to change the setting for the option. Press ***Program/Start*** after making the change.

Option List

SKIP	**Skip Step**	*Skip ahead in the running program*
HLDT	**Hold Time**	*Add Time to the current hold segment*
CHGT	**Change Temperature**	*Change the current target temperature*
DELA	**Delay**	*Change Delay start mode*
TC	**Thermocouple Type**	*Select thermocouple type (Type K, N, S or R*
ALAR	**Threshold Alarm**	*Set Alarm temperature*
DIAG/TEST	**Diagnostics**	*View output amps or test outputs.*
F/C	**Temperature Units**	*Change temperature units to °F or °C*
LIM	**Over-Temperature Limit**	*Set the maximum limit temperature*
COST	**Firing Cost**	*View calculated firing cost*
EXIT	**Exit option menu**	
OPT2	**Level 2 Options**	
OFST	**Cone Offset**	*Adjust firing temperature to match witness cones by ±20°*
TCOS	**Thermocouple Offset**	*Change a thermocouple temperature reading by ±25℃*
TEDE	**Temperature Deviation**	*Deviation value for alarms FTH, FTC, and LTDE*
HTDE	**High Temperature Deviation**	*Deviation value for alarm HTDE*
LOCK	**Program Lock**	*Lock or Unlock the programs to prevent changes*
AOP1	**Auxiliary Output #1**	*Enable a vent fan, external alarm or safety relay output on Output 1*
ELEC	**Electronics Temperature**	*Displays temperature of the electronics*
EXIT	**Exit option menu**	
OPT3	**Level 3 Options**	
COOL	**Cone-Fire Cooling**	*Enable or disable cooling option for Cone-fire*
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*
SFTY	**Safety Temperature**	*Displays maximum programmable temperature*
SOFT	**Software Version**	*Displays factory software version*
CFG	**Configuration Number**	*Displays factory configuration #*
RST	**Factory Reset**	*Reset all values to OEM settings.*

The options list will vary depending on the controller configuration. If the program loaded is not a CONE program, Cone fire options do not appear.

Level 1 Options

Skip Step - SKIP

The Skip option allows you to end a ramp segment or hold period before the time has expired, use the **SKIP** option to advance to a later ramp in the program. This option is available only during an active firing.

Press the ***Increase/Option*** key until **SKIP** appears, then press ***Program/Start*** to see the next available ramp. Use the ***Increase/Option*** key to select a new ramp or to cancel, then press ***Program/Start*** to exit the option menu.

Hold Time - HLDT

The Hold time option allows you to edit a hold period for the current ramp step, use the **HLDT** option to add hold time in five minute increments. This option is available only during an active firing.

Press the ***Increase/Option*** key until **HLDT** appears, then press ***Program/Start*** to see the program step hold time. Use the ***Increase/Option*** key to increase the time, then press ***Program/Start*** to exit the option menu.

Change Temperature - CHGT

The target temperature can be changed during the active ramp step. Use the **CHGT** option to edit the temperature setting. This option is available only during an active firing.

Press the ***Increase/Option*** key until **CHGT** appears, then press ***Program/Start*** to see the program temperature. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

Delay Mode - DELA

To program the controller to begin a firing at a later time, use the Delay start feature. Enter a time delay in Hours.Minutes format. Delay time is set during the programming sequence just before the firing is started. Once the firing is started, the delay time will count down on the display.

The **DELA** option provides a preference for the delay start feature. The settings are:

DFLT - Resets the delay time value to zero after each firing
ALL - Retains the delay time value for all firings
OFF - Removes the delay feature from the programming sequence entirely.

Press the ***Increase/Option*** key until **DELA** appears, then press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

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

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 ***Increase/Option*** key until **TC** appears, then press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

Threshold Alarm -ALAR

To sound an audible alarm when the controller reaches a temperature, Use the **ALAR** option. 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.

Press the ***Increase/Option*** key until **ALAR** appears, then press ***Program/Start*** to see the program temperature. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

Note: You can program the Alarm before you start the firing or reset it during the firing. Setting the alarm value to 32F (0C) will disable the Alarm.

Diagnostics – DIAG / TEST

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. 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.

Press the ***Increase/Option*** key until **DIAG** appears, then press ***Program/Start*** to see the **TEST**. Use the ***Increase*** or ***Decrease*** key to see **AMPS** on the display, then press ***Program/Start*** to view the measurement. When done, the controller will exit the option menu.

The **TEST** Option allows the heater outputs to be turned on for 2 minutes while monitoring the thermocouple temperature. You can press ***Program/Start*** key to advance to the next output before the 2 minutes expires. **TEST** will also activate the Auxiliary output identified as **AOP1**.

Press the ***Increase/Option*** key until **DIAG** appears, then press ***Program/Start*** to see the **TEST**. then press ***Program/Start*** to start the test cycle. When done, the controller will exit the option menu.

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 ***Increase/Option*** key until **F/C** appears, then press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

Over-temperature Limit - LIM

The **LIM** Option allows the operator to set a value for the maximum temperature of the kiln.. The operator can set a value as low as 200F 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 ***Increase/Option*** key until **LIM** appears, then press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

Firing Cost - COST

To review the current power consumption during or after the kiln firing, use the **COST** option. 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.*

Press the ***Increase/Option*** key until **COST** appears, then press ***Program/Start*** key to view the calculation. Press ***Program/Start*** again to exit the option menu.

Level 2 Options

Cone Offset - OFST

This offset feature allows you to adjust the final heating step of the Cone programs. This is useful when the kiln does not quite bend witness cones to the desired angle. Cone Offset is a calibration feature that allows a temperature offset for the final heating ramp of the cone program.

First, start a CONE program to make the **OFST** option appear in the option menu. Press the ***Increase/Option*** key until **OPT2** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **OFST** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.
OFST settings are stored in memory and will apply to all future Cone fire programs.

Settings (°F)	*Settings (°C)*	*Meaning*
-20	-11	Decreases final ramp temperatures
-15	-8	Decreases final ramp temperatures
-10	-6	Decreases final ramp temperatures
-5	-3	Decreases final ramp temperatures
0	0	No adjustment in temperatures
+5	+3	Increases final ramp temperatures
+10	+6	Increases final ramp temperatures
+15	+8	Increases final ramp temperatures
+20	+11	Increases final ramp temperatures

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 the ***Increase/Option*** key until **OPT2** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **TCOS** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

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

If you want the kiln to fire Cooler, the display will show zero for offset, press the ***Decrease*** key to see **C-1**.Continue pressing until the desired thermocouple offset shows in the display (e.g. **C-10** for a 10° offset) and press ***Program/Start.***

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.

Press the ***Increase/Option*** key until **OPT2** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **TEDE** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

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. The range is 18ºF – 200ºF (10ºC - 111ºC)

Press the ***Increase/Option*** key until **OPT2** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **HTDE** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

Program Lock Mode - LOCK

The **LOCK** Option allows individual User Programs or a Cone Fire programs to be locked into memory, preventing the settings from being changed.

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 ***Increase/Option*** key until **OPT2** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **LOCK** appears. Press ***Program/Start*** to see **PASS**. Use the ***Increase*** or ***Decrease*** key to set the passcode then press **Program/Start**. use the ***Increase*** or ***Decrease*** key to change the setting or to set a new passcode, then press ***Program/Start.***

Auxiliary Output 1 - AOP1

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

Settings	*Meaning*
NONE	No external relay functions
VFAN	Vent fan is enabled on output 2
ALRM	Alarm is enabled on output 2
SAFE	Safety Relay is enabled on output 2

Press the ***Increase/Option*** key until **OPT2** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **AOP1** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

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 ***Increase/Option*** key until **OPT2** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **ELEC** appears. Press ***Program/Start*** to see the result. Press ***Program/Start*** to exit the option menu.

Level 3 Options

Cone-fire Cooling Ramp - COOL

The Cooling Option is used for Cone-fire programs only. The controller programming sequence for Cone-fire can include a cooling step at the end of the firing or this option can be removed from the programming sequence.

Settings	*Meaning*
OFF	COOL options inactive and will not appear for Cone-fire
ON	COOL option active and will appear for Cone-fire

First, start a CONE program to make the **COOL** option appear in the option menu. Press the ***Increase/Option*** key until **OPT3** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **COOL** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

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 ***Increase/Option*** key until **OPT3** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **RATE** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

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, see the **COST** option.

Press the ***Increase/Option*** key until **OPT3** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **CENT** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

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, see the **COST** option.

Press the ***Increase/Option*** key until **OPT3** appears, then press ***Program/Start*** key, Press ***Increase/Option*** until **KW** appears. Press ***Program/Start*** to see the setting. Use the ***Increase*** or ***Decrease*** key to edit the setting, then press ***Program/Start*** to exit the option menu.

Safety Temperature - SFTY

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

Press the ***Increase/Option*** key until **OPT3** appears, then press ***Program/Start*** key. Press ***Increase/Option*** until **SFTY** appears. Press ***Program/Start*** to view the setting. Then press ***Program/Start*** again to exit the option menu.

Software Version - SOFT

SOFT displays the factory software version of the controller.

Press the ***Increase/Option*** key until **OPT3** appears, then press ***Program/Start*** key. Press ***Increase/Option*** until **SOFT** appears. Press ***Program/Start*** to view the version number. Then press ***Program/Start*** again to exit the option menu.

Configuration Number - CFG

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

Press the ***Increase/Option*** key until **OPT3** appears, then press ***Program/Start*** key. Press ***Increase/Option*** until **CFG** appears. Press ***Program/Start*** to view the configuration number. Then press ***Program/Start*** again to exit the option menu.

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 ***Increase/Option*** key until **OPT3** appears, then press ***Program/Start*** key. Press ***Increase/Option*** until **RST** appears. Use the ***Increase*** or ***Decrease*** key to edit the setting from **NO** to **YES** and press ***Program/Start***. 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.

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 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

Speed Programs

5 speed programs are preset firing schedules with different fixed heating rates. These programs are single set-point (one step) programs.

The 5 programs are;

Display code	Program	Rate	Target	Hold
SPD1	Speed 1	200F(111C)/hour	1112F(600C) *	00.00 *
SPD2	Speed 2	500F(278C)/hour	1112F(600C) *	00.00 *
SPD3	Speed 3	1000F(555C)/hour	1112F(600C) *	00.00 *
SPD4	Speed 4	1500F(833C)/hour	1112F(600C) *	00.00 *
SPD5	Speed 5	Full	1112F(600C) *	00.00 *

* The operator can adjust the final firing temperature and optional hold time
For information on rates, target temperatures and hold times, see the user program section of this manual.

Speed Program Example

To fire at Speed 4 (1500F per hour), to 960F with a 15 minute hold at temperature.

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

Press	Display Shows
	……. a program group
	..……..……. SPD
	…….……a Speed number
	…….SPD4
	……. o F 1 / 1112
	……. 960
	……. HD 1 / 00.00
	….……..……. 00.15
	……. STRT
	……..... DELA / 00.00
	……...……..-ON-

Jewelry Programs

The Jewelry programs are 3 preset firing schedules for burnout. The various heating and cooling steps are preprogrammed. You can fire to a preset Jewelry schedule by simply selecting the jewelry program along with an adjustable final hold temperature.

The 3 programs are;

Display code	Program	Rate	Target	Hold
5HR	5 Hour	300F(167C)/hour 101F(56C)/hour 700F(389C)/hour 450F(250C)/hour	300F(149C) 351F(177C) 1350F(732C) 900F(482C) *	00.20 00.10 01.30 99.59
8HR	8 Hour	300F(167C)/hour 101F(56C)/hour 349F(194C)/hour 301F(167C)/hour	300F(149C) 351F(177C) 1350F(732C) 900F(482C) *	01.00 00.30 01.30 99.59
12HR	12 Hour	300F(167C)/hour 101F(56C)/hour 211F(117C)/hour 225F(125C)/hour	300F(149C) 351F(177C) 1350F(732C) 900F(482C) *	01.00 00.30 03.00 99.59

* The operator can adjust the final hold temperature

For information on rates, target temperatures and hold times, see the user program section of this manual.

Jewelry Program Example

To fire an 8 hour program with an indefinite final hold temperature of 850F.

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

Press	Display Shows
	……. a program group
	..……..……. JWL
	…….a program number
	…….8HR

…… o F 4 / 900

…… 850

…… STRT

…….... DELA / 00.00

……..……..-ON-

PMC Programs

5 preset firing schedules are available for Precious Metal Clay. The heating steps are preprogrammed. You can fire to a preset PMC schedule by simply selecting the PMC Program. These programs are not adjustable.

The 5 programs are;

Display code	Program	Rate	Target	Hold
CLA1	PMC+ Fast	FULL	1650°F(899°C)	00.10
CLA2	PMC+ Slow	1500°F(833°C)/hour	1470°F(799°C)	00.30
CLA3	PMC3 Slow	1500°F(833°C)/hour	1110°F(599°C)	00.45
CLA4	PMC	FULL	1650°F(899°C)	02.00
CLA5	PMC Gold	FULL	1290° F(699°C)	01.30

PMC Program Example

To fire PMC+ at a slow rate.

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

Press — Display Shows

…… a program group

..……..…… CLAY

…….a program number

…….CLA2

…… STRT

…….... DELA / 00.00

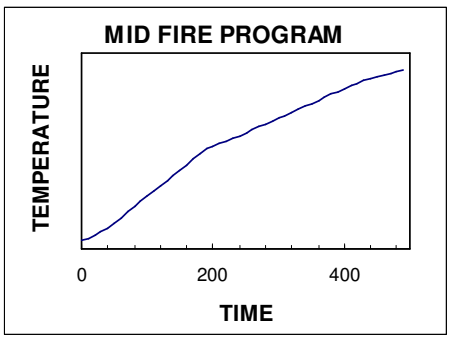
……..……..-ON-

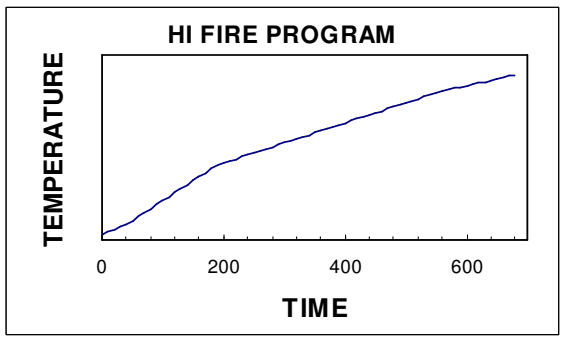
Cone-Fire – How it works

When firing to a cone number, the controller constantly monitors the actual heating rate of the kiln. If the kiln does not fire as rapidly as programmed, the controller re-calculates and adjusts the top firing temperature to compensate for the slower firing rate. This process more accurately fires to the cone number selected. When the heating rate slows, cones deform at slightly lower temperatures. At faster heating rates, cones deform at slightly higher temperatures. This ability to recalculate and to fire to a cone value is a unique, patented feature of all Orton controllers.

Orton Controllers contain three preset program groups for firing to a cone number – Low Fire, Mid Fire, and High Fire. Each of the programs can be adjusted for speed, hold time and cooling rate. The standard programs are designed to fire normal loads of thin ware ceramics. When a kiln is more heavily loaded or when thick ware is fired, additional firing time is needed. Experiment to determine the best firing conditions. The preset firing programs in the controller are:

Program	**Product Fired**	**Cone Range**	**Firing Time**
Low Fire	Decal, Luster, China	Cones 022 – 011	3 - 5 hours
Mid Fire	Glaze, Bisque, Earthenware	Cones 010 - 01	6 - 8 hours
High Fire	Stoneware, Porcelain	Cones 1 – 10	9 - 11 hours





Note: the Conefire Programs can be removed from the controller selections. To disable a program set, see the configuration appendix of this manual.

Cone-Fire Programs

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

11. Press the ***Program/Start*** key. A program group will show on the display.

12. Press the ***Increase/Option*** key until the display shows **CONE,** then press the ***Program/Start*** key.

13. Using the ***Increase*** or ***Decrease*** key, select the desired Cone number then press the ***Program/Start*** key.

14. **SPD** shows in the display indicating the Speed setting, use the ***Increase*** or ***Decrease*** key to select Fast, Standard or Slow then press the ***Program/Start*** key.

15. **HOLD** shows in the display indicating the optional Hold time at the end of the firing, **HOLD** will be alternating with a Time value. use the ***Increase*** or ***Decrease*** key to set a time for the kiln to hold at the top cone temperature. Time is shown as (Hours.Minutes). If no Hold is needed, set zero hours and zero minutes (00.00). Then press the ***Program/Start*** key.

16. **COOL** shows in the display indicating the optional Cooling ramp at the end of the firing, **COOL** will be alternating with a rate value. use the ***Increase*** or ***Decrease*** key to set a cooling rate for the kiln to cool to 392ºF(200ºC). The maximum cooling rate is limited to 180ºF(100ºC)/hour. If no controlled cooling is needed, set the rate value as zero. Then press the ***Program/Start*** key.

    The controller will advance to **STRT**. *The programmed firing schedule is automatically stored and ready to* START *the firing.*

17. If the Delay Start feature is active, the display will show **DELA** alternating with a Time value. use the ***Increase*** or ***Decrease*** key to set a time for the kiln firing to begin. Time is shown as (Hours.Minutes). If no Delay is needed, set zero hours and zero minutes (00.00). Then press the ***Program/Start*** key.

18. Press the ***Program/Start*** key to begin the firing.

Cone Fire Advanced Options

There is one Advanced Option available for Cone Fire programs only. It is *Cone Offset*. For information on this option, see the Options Section.

Cone Fire Example

To fire to Cone 06, Fast firing speed (20% faster), 15 minute hold at cone temperature, No controlled cooling

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

Press	Display Shows
	..... A program group

..…….…… CONE

…….A cone number

…….06

…… SPD / STD

…… FAST

…… HOLD / 00.00

…..……..……. 00.15

…… COOL / 0

…… STRT

……..... DELA / 00.00

……..……..-ON-

Reference Section

Appendix A – Low Fire Cone Programs

Cones O22 to O11

The low fire range is typically used to fire decals or decorations. Some decals, lusters, and gold have a limited firing range and may need to be fired more slowly.

The complete firing schedules for Cones **O22** to **O11** are shown below. The standard firing time is about 3-5 hours.

Degrees F

Low Fire Cone #	Ramp 1 Degrees/hour	Target °F	Ramp 2 Degrees/hour	Target °F
022	396	979	108	1087
021	396	1004	108	1112
020	396	1051	108	1159
019	396	1144	108	1252
018	396	1211	108	1319
017	396	1252	108	1360
016	396	1314	108	1422
015	396	1348	108	1456
014	396	1377	108	1485
013	396	1431	108	1539
012	396	1474	108	1582
011	396	1499	108	1607

Degrees C

Low Fire Cone #	Ramp 1 Degrees/hour	Target °C	Ramp 2 Degrees/hour	Target °C
022	220	526	60	586
021	220	540	60	600
020	220	566	60	626
019	220	618	60	678
018	220	655	60	715
017	220	678	60	738
016	220	712	60	772
015	220	731	60	791
014	220	747	60	807
013	220	777	60	837
012	220	801	60	861
011	220	815	60	875

Appendix B – Mid Fire Cone Programs

Cones O10 to O1

This firing range is used to fire earthenware and low temperature glazes. If the ware is not thoroughly dried, a preheat cycle can be added. With lead-free glazes, a 10 to 20 minute hold is beneficial.

Earthenware or other bodies containing ball clays, talc, and kaolin contain compounds such as water, carbon, and sulfur that are burned-off during the firing. The body will lose about 10% of its weight. In addition, a physical change in any silica present can cause cracking of ware unless the heating rate is slowed near 1063°F (573°C). This change occurs during both heating and cooling.

The complete firing schedules for Cones **O10** to **O1** are shown below. The standard firing time is about 7-9 hours.

Degrees F

Mid Fire Cone #	Ramp 1 Degrees/ hour	Target °F	Ramp 2 Degrees/ hour	Target °F	Ramp 3 Degrees/ hour	Target °F	Ramp 4 Degrees/ hour	Target °F
010	324	1022	153	1112	180	1549	108	1657
09	324	1022	153	1112	180	1580	108	1688
08	324	1022	153	1112	180	1620	108	1728
07	324	1022	153	1112	180	1681	108	1789
06	324	1022	153	1112	180	1720	108	1828
05	324	1022	153	1112	180	1780	108	1888
04	324	1022	153	1112	180	1837	108	1945
03	324	1022	153	1112	180	1879	108	1987
02	324	1022	153	1112	180	1908	108	2016
01	324	1022	153	1112	180	1938	108	2046

Degrees C

Mid Fire Cone #	Ramp 1 Degrees/ hour	Target °C	Ramp 2 Degrees/ hour	Target °C	Ramp 3 Degrees/ hour	Target °C	Ramp 4 Degrees/ hour	Target °C
010	180	550	85	600	100	843	60	903
09	180	550	85	600	100	860	60	920
08	180	550	85	600	100	882	60	942
07	180	550	85	600	100	916	60	976
06	180	550	85	600	100	938	60	998
05	180	550	85	600	100	971	60	1031
04	180	550	85	600	100	1003	60	1063
03	180	550	85	600	100	1026	60	1086
02	180	550	85	600	100	1042	60	1102
01	180	550	85	600	100	1059	60	1119

Appendix C – High Fire Cone Programs

Cones 1 to 10

The firing range of higher temperature bodies, such as stoneware and porcelain varies between Cone 4 and Cone 10. These bodies are fired nearly to vitrification and can shrink up to 16%. As with earthenware bodies, water, carbon, and sulfur are potential burnout materials and venting is important to remove gases generated. With the presence of silica, the firing needs to be slowed near 1063°F (573°C) to prevent cracking.

Typical porcelain bodies are formulated from kaolin, feldspars, silica, and ball clays. The weight loss during firing can be around 10 to 12% and shrinkage can approach 20%.

Porcelain bodies require good temperature uniformity at their final firing temperature. If slightly overfired, the body may warp or blister. On maturing, the body becomes its own "glaze." A hold time is usually desirable for best fired results.

The complete firing schedules for Cones **1** to **12** are shown below. The standard firing time is about 10-12 hours.

Degrees F

Hi Fire	Ramp 1	Target	Ramp 2	Target	Ramp 3	Target	Ramp 4	Target
Cone #	Degrees/ hour	°F	Degrees/ hour	°F	Degrees/ hour	°F	Degrees/ hour	°F
1	324	1022	153	1112	162	1863	108	2079
2	324	1022	153	1112	162	1872	108	2088
3	324	1022	153	1112	162	1890	108	2106
4	324	1022	153	1112	162	1908	108	2124
5	324	1022	153	1112	162	1951	108	2167
6	324	1022	153	1112	162	2016	108	2232
7	324	1022	153	1112	162	2046	108	2262
8	324	1022	153	1112	162	2064	108	2280
9	324	1022	153	1112	162	2084	108	2300
10	324	1022	153	1112	162	2129	108	2345

Degrees C

Hi Fire	Ramp 1	Target	Ramp 2	Target	Ramp 3	Target	Ramp 4	Target
Cone #	Degrees/ hour	°C	Degrees/ hour	°C	Degrees/ hour	°C	Degrees/ hour	°C
1	180	550	85	600	90	1017	60	1137
2	180	550	85	600	90	1022	60	1142
3	180	550	85	600	90	1032	60	1152
4	180	550	85	600	90	1042	60	1162
5	180	550	85	600	90	1066	60	1186
6	180	550	85	600	90	1102	60	1222
7	180	550	85	600	90	1119	60	1239
8	180	550	85	600	90	1129	60	1249
9	180	550	85	600	90	1140	60	1260
10	180	550	85	600	90	1165	60	1285

Appendix D – 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				

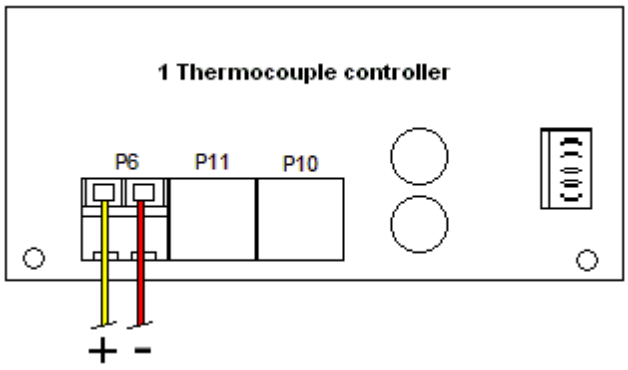
User Program # 2

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

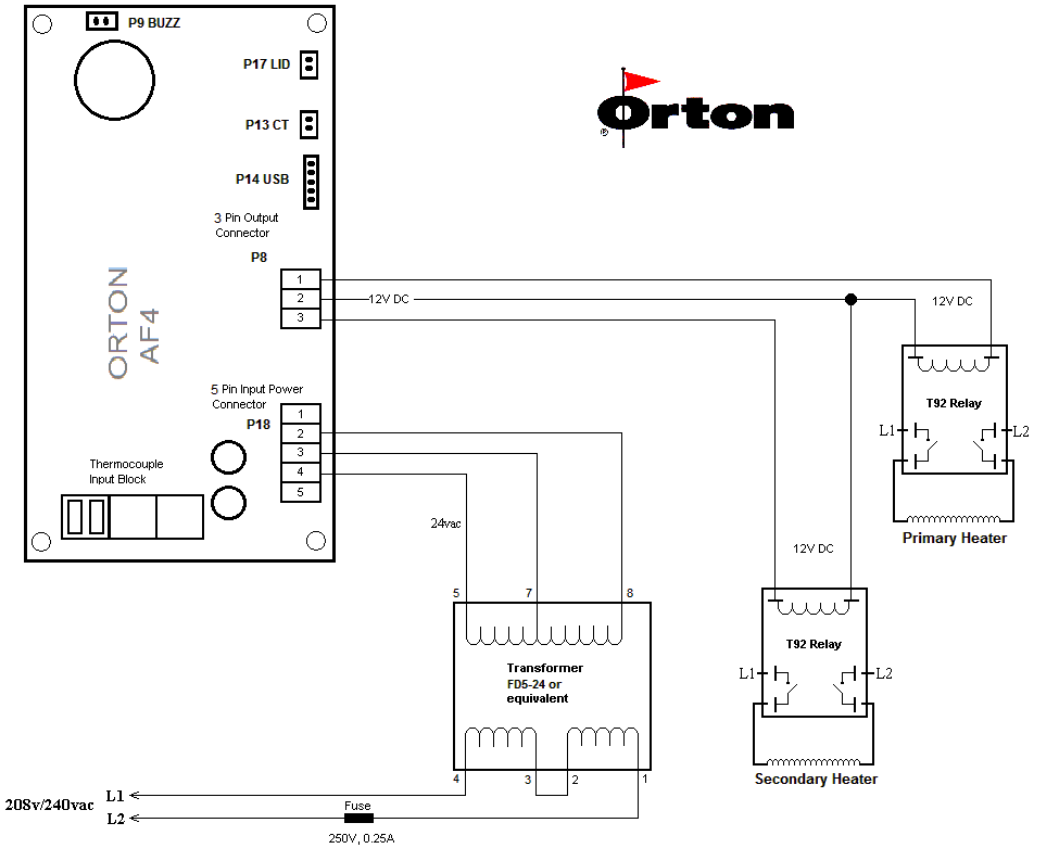
Appendix E – Connecting Thermocouples

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

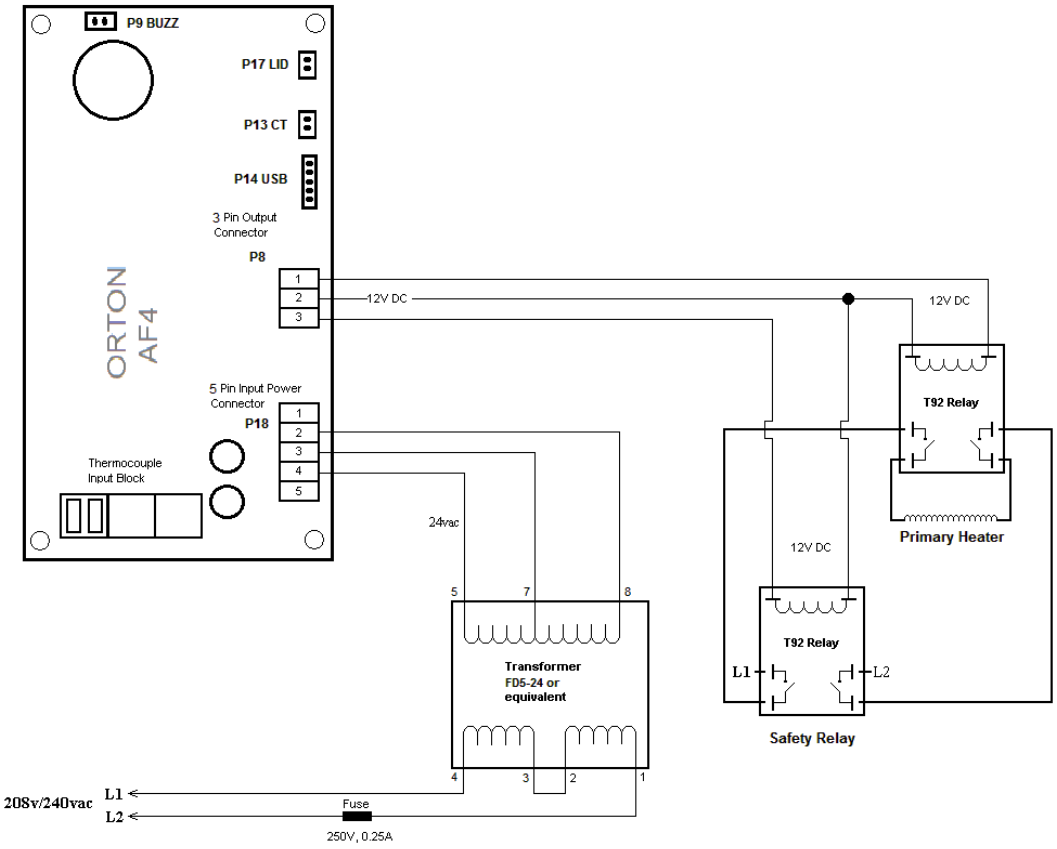
For Type K, the positive leg is yellow.
For Type N, the positive leg is orange.
For Type S and Type R, the positive leg is black.



Appendix F – Typical Wiring Diagram, 2 Heaters



Appendix G – Typical Wiring Diagram, 1 Heater, 1 safety relay



Appendix G – Configuration Options

The configuration menu allows you to enable or disable the preset program groups and adjust some of the common default settings for the controller.

To access the configuration menu. Press and Hold all 3 keys during power on. The display will show **RST**

Press the ***Program/Start*** key, the display will show **MODE/1**

Press the ***Program/Start*** key, the display will show **SPD**
Press the ***Increase/Option*** key to select **YES** or **NO** for Speed program group
Press the ***Program/Start*** key, the display will show **JWL**
Press the ***Increase/Option*** key to select **YES** or **NO** for Jewelry program group
Press the ***Program/Start*** key, the display will show **CLAY**
Press the ***Increase/Option*** key to select **YES** or **NO** for PMC program group
Press the ***Program/Start*** key, the display will show **CONE**
Press the ***Increase/Option*** key to select **YES** or **NO** for Cone program group
Press the ***Program/Start*** key, the display will show **CLAY**
Press the ***Increase/Option*** key to select **YES** or **NO** for PMC program group
Press the ***Program/Start*** key, the display will show **USER**
Press the ***Increase/Option*** key to select **YES** or **NO** for User Program group

Press the ***Program/Start*** key, the display will show **TC**
Press the ***Increase/Option*** key to select a thermocouple type setting
Press the ***Program/Start*** key, the display will show **F/C**
Press the ***Increase/Option*** key to select a temperature unit setting
Press the ***Program/Start*** key, the display will show **PID**
Press the ***Increase/Option*** key to select a Kiln type BRICK or FIBER
Press the ***Program/Start*** key, the display will show **SPCL**
Press the ***Increase/Option*** key to select **ON** or **OFF** for rapid heating
OFF – heats as fast as possible to setpoint when rate is FULL
ON – Slows heating to prevent overshoot prior to reaching setpoint when rate is FULL
Press the ***Program/Start*** key, the display will show **SFTY**
Press the ***Increase/Option*** key to set the max firing temperature
Press the ***Program/Start*** key, the display will show **USR**
Press the ***Increase/Option*** key to select the number of user programs
Press the ***Program/Start*** key, the display will show **AOP1**
Press the ***Increase/Option*** key to select function for the secondary relay output
Press the ***Program/Start*** key, the display will show **DELA**
Press the ***Increase/Option*** key to select a Delay start mode

Press the ***Program/Start*** key, the display will show **IDLE**

From **IDLE**, you can program up to 10 custom user programs that will be preset and unavailable for editing. You must enter the complete programs into PR01-PR10 before powering off the controller.

Power off and restart the controller.

Autofire® Kiln Controller

Limited Warranty

This limited warranty is given only to the immediate purchaser ("Buyer") of the Autofire® Kiln Controller ("AF4X"). 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