USER'S GUIDE

KilnTronics "08"

Indicating Kiln Soak/Shut-Off Controller

LIMITED WARRANTY

Our products are guaranteed to be free of defects in materials and workmanship for a period of one (1) year from the date of purchase.

Please return your WARRANTY REGISTRATION CARD immediately upon receiving your control system. We must otherwise use our factory shipping date as the effective date of purchase, unless you are able to provide some other proof of purchase upon application for warranty service.

Your rights under this warranty consist solely of requiring us to repair or, in our sole discretion, to replace, free of charge, F.O.B. our factory, any defective product received in good condition at the factory within one (1) year from the date of purchase, and determined by us to be defective as claimed. Any defect appearing more than one (1) year from the date of purchase will be deemed to be due to ordinary wear and tear. Our products are identified by serial numbers, and cannot qualify for warranty service if their serial number has been altered or obliterated, or is missing entirely.

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CAUTIONS - WARNINGS

1. NEVER LEAVE YOUR KILN UNATTENDED BEYOND THE SCHEDULED FIRING TIME.
2. Never place the controller on top of your kiln.
3. NEVER CONNECT THE TEMPERATURE SENSOR TO THE CONTROLLER WITHOUT ASSURING THAT THE THERMOCOUPLE ELEMENT HAS BEEN PROPERLY INSTALLED AND SECURELY FASTENED TO YOUR KILN.
4. No man-made product can be made fully failsafe. Automatic controls should be monitored or equipped with back-up safety devices to an extent which the user deems appropriate after carefully considering the possibility of failure, and the probable consequences thereof.
5. The safety of your kiln is ***YOUR RESPONSIBILITY***

FEATURES INVOLVING SAFETY

1. In the event of a sensor failure (eventual burn-out, or open sensor circuit), the controller will automatically provide a temperature indication exceeding 2500°F, which will cause the kiln to remain OFF.
2. Momentary power failures (due to lightening strikes, etc ...) will cause the controller to latch OFF, so as to prevent random start-ups, or re-firing previously shut-off loads, when the power is restored.
3. **The control system is OFF only when manually turned off.** Turn the controller off when not actually in use. ***To assure safety, turn the controller off when loading or unloading your kiln.***

INSTALLATION & HOOK-UP

Installation is easy. In most cases, everything is fully assembled and ready to use. The power line cable and kiln's power cable will have to be hard-wired to the power contactor inside of your new power controller. Otherwise, everything is pre-wired, so you can't go wrong.

In the beginning, 08 control systems were shipped either with a "field kit" box mounted on the side of the kiln, which contained a power contactor and fuse ... or with the contactor built right in as an integral part of the kiln's switch box.

Due to the limited space inside the switch box on most kilns, and the possibility of rather high ambient temperatures, the "integral" set up is no longer recommended. Field kit boxes (called "power controllers" herein) may still be mounted on the outside jacket of the kiln, near its bottom, if desired ... but a better way is now recommended. We're now suggesting the power controller be mounted on the wall, just above the 50-amp electrical receptacle which you've provided for the kiln (or just below its breaker box, if your kiln draws more than 50-amps or must otherwise be direct-wired).

This set up assures that the components of the control system will not be subjected to temperatures higher than room temperature, and also permits you to use the control system with any standard kiln (no modification or alteration of the kiln is required).

The following instructions apply to these "factory pre-wired" systems. If you have purchased a controller only and intend to connect it to your own power controls, refer to the wiring diagrams in the appendix for further hook-up details.

MOUNTING THE POWER CONTROLLER

1. The power controller is the heavy black box.

   NOTE - For 50-amp systems, the power connector on your kiln's cord and your wall receptacle must match. Standard replacement cords and wall receptacles are normally available from your local kiln dealer, if required.

2. Choose a location on the wall for your 50-amp, 250-volt grounding-type service receptacle (typically NEMA Type 6-50R) ... or near your kiln's electrical service if mounting a 63-amp (or larger) power controller. Make sure that the kiln's power cord will be able to reach the power controller's receptacle.
3. If you have to mount the power controller on a concrete or cement block wall, fasten a piece of 3/4" plywood, about 8"x 12" to the wall using masonry nails or sheet metal screws with plastic anchors, to provide a mounting surface for the unit.
4. To accurately locate the pilot holes for the power controller, make a rubbing of the back of the unit using a piece of paper and a crayon, transferring the exact hole locations onto the paper.

5. Tape the paper template to the wall or plywood mounting panel, at the chosen mounting location. Then start the four #8 x 3/4" pan head sheet metal screws (provided). Drive these screws straight, and almost fully into the wall or panel, then remove them and discard the template.
6. Remove the cover from the power controller and mount it at this location.

MOUNTING THE TEMPERATURE SENSOR

1. Most kilns have a sensor port opposite their peepholes. Use it, if you can. If you must use one of the peepholes, you will have to be careful about using the other peepholes for venting purposes, since the resulting drafts inside the kiln may affect the temperature measurement.
2. Push the thermocouple element all the way through the mounting hole. Its tip should protrude at least 2" into the firing chamber. Mark the locations of its two screw slots on the jacket of your kiln.
3. Carefully drill a 7/64" hole through the jacket of your kiln at these locations.
4. Push the sensor back into the hole and fasten it in place using the two #6 x 3/8" slotted hex head sheet metal screws (provided).

CHOOSING A LOCATION FOR THE SOAK/SHUT-OFF CONTROLLER

1. Most systems are provided with a "free-standing" type Soak/Shut-Off Controller ... meaning that you can place it at any convenient location; on a nearby shelf, table or workbench *BUT NOT ON TOP OF THE KILN!*
2. The control cable and thermocouple extension wires are only seven feet long, so don't plan on having the controller in the kitchen if your kiln's in the garage.
3. It's always a good idea to protect electronic things from extremes of temperature, since expansion and contraction can lead to early failures. And, needless to say, you'll want to make sure that the controller isn't going to wind up in a "busy" location where it'll accidentally be pushed off the back of a crowded workbench.

HOOKING THINGS UP

1. Call up your electrician and have him connect the power line and kiln cables to the contactor terminals inside of the power controller, and to your 50-amp receptacle (if used). If you choose to make these connections yourself, ***PROCEED NO FURTHER UNTIL YOU HAVE ASSURED YOURSELF THAT ALL POWER HAS BEEN REMOVED FROM THE SERVICE CABLE WHICH WILL DELIVER POWER TO THE POWER CONTROLLER***.
2. The power controller requires a source of 208/240vac power. Long runs of undersized wire will not only present a ***FIRE AND SAFETY HAZARD***, but will also result in a voltage drop which will limit the kiln's heating capacity, and may cause the fuses in the power controller to blow every now and then for no apparent reason (a real nuisance!). Refer to your kiln's instruction book or the table provided in the Appendix of this manual and use the wire size recommended for your kiln, based on its current requirements and distance from the electrical service.
3. Observe that one side of the contactor inside the power controller is equipped with male type "quick connect"terminals, and that we have already made some connections at these terminals. Bring the service cable into the power controller, and connect it to this side of the contactor.

   Single Phase Power:

   Use the left and right contactor terminals, making no connection to its center terminal. Connect the ground wire from the cable to the power controller's chassis.

Three Phase Power:

Use all three contactor terminals, and connect the ground wire from service cable to the power controller's chassis.

4. In making these connections, be very careful about your workmanship. Strip the insulation from the wires very carefully to avoid cut or broken strands of wire, and make sure that every strand of each wire is properly inserted and secured inside of the compression terminals on the contactor. Loose strands of wire, or loose connections, can cause "hot spots" during operation of the system. Expansion and contraction then loosens the connection still more, and it gets still hotter ... and this process eventually burns up the contactor.
5. Connect the cable from the 50-amp receptacle (or from the kiln) to the opposite side of the contactor, in the same manner, so that when the contactor operates, it will connect the service cable to the kiln's cable, to provide heater current for the kiln. The ground wire from the kiln (usually GREEN) must be connected to the power controller's chassis.

WARNING

Never connect the sensor cable to the controller if the thermocouple element is not securely fastened to the kiln. If the sensor should happen to fall out of the kiln, an over-firing could easily result!

DANGER - HIGH VOLTAGE

POWER CONTROLLERS AND KILN SWITCH BOXES CONTAIN VOLTAGES WHICH RE HIGH ENOUGH TO PRODUCE ***LETHAL ELECTRICAL SHOCKS***.

NEVER OPERATE THIS EQUIPMENT WITH THE COVERS REMOVED.REFER SERVICING TO QUALIFIED PERSONNEL.

EXPLANATION OF THE CONTROLS

Refer to the front panel of your Soak/Shut-OFF Controller as you read through the following explanation of what each front panel feature is and does. Don't be afraid to push the buttons and turn the knob. You won't break anything.

ON/OFF SWITCH

This switch turns the controller on and off, and thereby serves as an on/off switch for the kiln. Push this switch in to turn the control system on; push it again to release it, turning the system off.

Important Point No 1: It's important for you to know that the controller has a built-in safety feature which assures that it will always start up in the "latched off" condition. This feature is activated whenever power is first applied to the controller ... which may be when you turn it on, or when power is restored following momentary power failures (caused by lightening strikes, or backing into the power pole at the end of the driveway). It assures an orderly, operator-directed start-up. It also assures that the equipment will not automatically restart itself, re-firing a previously completed, or partially fired, load.

Push the **POWER ON** switch in now. Note that the temperature indicator rises from 0°F to about 75°F, or whatever the actual kiln temperature is at the moment. Now push this button a second time ... it returns to its 'out' position, and the temperature indication now falls to zero.

Important Point No 2: It's also important for you to know that the controller never shuts itself off; it latches its output off, but otherwise remains fully operational. There will be more on this below, but for now just remember that the control system is really turned off only when you physically turn it off with this switch.

THE TEMPERATURE INDICATOR AND IT'S CONTROL SWITCH

Now please turn the controller on again, then put your hands in your pockets. The temperature indicating meter is now displaying the actual temperature in the kiln.

Have you noticed that, unlike your simple little pyrometer, this meter works only when you turn the power on?

If you had, good for you! If you hadn't noticed, notice it now. Your new controller provides you with a precision, fully compensated electronic potentiometric temperature measuring system. Thermocouple type temperature sensors produce a very small voltage which is roughly proportional to temperature. Your little pyrometer uses this weak "temperature signal" as its source of power. This is a neat trick, but unless carefully handled the so-called "limits of uncertainty" become rather broad. If you paid less than $100 for your pyrometer, its *real uncertainties* are about "11.1% of Span", so at cone 10, which should be 2381°F, it may read anything from 2117°F to 2643°F! Not too good, huh? Your new controller, on the other hand, is guaranteed to be within 1%, and is typically calibrated to within 1/4% of Span ... plus or minus only 6.25°F at cone 10 ... about the width of its pointer.

Important Point No 3: Don't check the controller for accuracy by comparisons with inexpensive pyrometers.

Important Point No 4: With the power turned off, the indicator's pointer should always rest exactly at the 0°F end-scale mark on the meter. Although age and vibration may cause this adjustment to shift, you can always restore it using a small screwdriver at the "mechanical zero adjustment" on the face of the meter. Never set it for room temperature, as you would your pyrometer, and never use it to compensate for suspected calibration errors.

The temperature indicator is also used to display another value: the *Limit* temperature setting. Push the **SET** button. The indicator pointer will swing to some new value between 0°F and 2550°F.

THE LIMIT SETTING CONTROLS

In a conventional firing, you might increase the kiln's temperature to some maximum value, then shut the kiln off and allow it to cool at its own rate. The "maximum value" will hereinafter be referred to as the *Limit Setting* when using this controller.

To set the limit temperature, push the **SET** button and turn the **TEMP ADJUST** knob until the temperature indicator's pointer rests exactly at the desired temperature setting. Whenever you want to check the limit setting, push the **SET** button. You may do this even when the kiln is firing: its only effect is to switch the indicator to the limit signal, so you can do this without upsetting the firing.

Important Point No 5: The **TEMP ADJUST** knob is always enabled, so once you set it, be careful not to accidentally bump it, thereby inadvertently changing its setting. Make it a practice to verify the limit setting as a last step, whenever you do anything else at the control panel.

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WARNING

If, for whatever reason, your kiln is unable to attain temperatures as high as your limit setting (e.g., low-fire kiln, low voltage at the kiln, defective heaters or switches, etc.) the controller will not be able to shut it off at the limit, and an over-firing may result.

You should not leave your kiln unattended beyond the planned firing time. If you plan to do so, you should equip your control system with either an optional shut-off timer, or a program time clock, to provide a back-up safety device which will assure that the kiln is shut off within a reasonable period of time in the event that something goes wrong.

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SOAK/RESET SWITCH

This switch selects the operating mode of the controller. When pressed in (**"SOAK"** position), the controller operates just like any common temperature controller or thermostat, regulating the kiln's heat as necessary to keep the temperature at the *Limit* setting. When left in the out (**"SHUT-OFF"**) position, the controller will shut the kiln off when its temperature reaches the limit setting, permitting the kiln to cool at its own rate.

Push this switch in to select the **SOAK** mode; push it again to release it, which selects the **SHUT-OFF** mode.

PREFIRING CHECK-OUT PROCEDURE

Now let's check out the whole control system.

1. ***With the controller turned OFF***, let's check the mechanical zero adjustment of the temperature indicator. Line your eyeball up so that the width of the meter's knife-edge pointer is a small as you can make it. It should split the 0°F mark on the left end of the scale. If it's off a little bit, take out your pocket screwdriver and turn the adjustment of the front of the meter to make it read right.
2. Now press the **POWER ON** button. Check the meter; it should now read 75°F (... or whatever the kiln temperature actually is).
3. Assure that the temperature sensor is properly mounted. It must be (1) properly secured to the kiln, with it's tip protruding at least 2" into the firing chamber, (2) free of any obstructions - nothing should touch it ... and (3) there must not be any perceptible movement of the indicator's pointer when you hold the thermocouple cable firmly near the sensor and near the controller, and wiggle the cable. Check the tip for *"green rot"* ... if necessary, install a new element before starting the next firing.
4. Hold your finger on the **SET** button, and slowly turn the **TEMP ADJUST** knob slowly up and down, keeping your eye on the meter. The pointer should swing smoothly between about 0°F to just over 2500°F.
5. Press the **SOAK** button in. Then turn the **TEMP ADJUST** knob all the way up (fully clockwise) to a setting of 2500°F. Within a few seconds you should hear your kiln turn on.
6. Turn the **TEMP ADJUST** knob all the way down and observe that your kiln now turns off.
7. Press the **SOAK** button again to release it, then try turning the **TEMP ADJUST** knob to 2500°F again. This time the controller should be latched off and your kiln ***should not*** turn on.

TECHNICAL ASSISTANCE - FACTORY SERVICE

When problems arise, help is available at the addresses given at the end of this document.

Control system problems can often be diagnosed over the phone. If your phone is near enough to your control system to permit you to discuss the problem and work on the system according to our instructions during your call, we'll surely find the problem. Otherwise, "telephone troubleshooting" is effective only about 50% of the time.

If you have already determined that a particular component of your control system is defective, phone your dealer, or phone us to determine the warranty status of your unit, current service rates, and the correct shipping address. Our factory repair service is highly efficient and very reasonable ... not what you're used to at all! Generally, anything you return will be "rebuilt" by our production people, regardless of the reason returned. We then inspect it, test it, re-calibrate it and get it on it's way back to you ... usually within one or two working days.

If it's a warranty situation, all this happens with no charge to you, except possibly for shipping and insurance. If you're paying, you'll be billed whatever the standard rate is for each item you've sent to us for service ... and these rates are fixed "flat rates". We can tell you in advance exactly what the charges will be, and they'll remain the same regardless of how much time and material we have to put into your equipment to make it "like new" again!

Your dealer may be able to handle your service transaction for you. If not, pack your component up carefully and ship it to us via UPS, if possible. We can have UPS call for the package if UPS counter service is not conveniently available to you. All shipping costs are billed when we reship your unit to you. A concise service report is also provided.

SPECIAL NOTE FOR CANADIAN CUSTOMERS

Canadian customers are cautioned to execute the necessary Canadian customs forms prior to shipping controls for service. You should complete forms B13 and E15, which identify the equipment as your property and certify that the required service is not available in Canada. Our return shipment to you will otherwise be delayed in Canadian customs, and you might be reassessed duty on the value of equipment in question.

Other countries may have similar requirements ... please check with your local postal or customs authorities prior to shipping your property out of your country.

FIRING INSTRUCTIONS

GENERAL INFORMATION

Firing practices and techniques vary widely. There are probably as many different opinions as there are books on this subject ... and as you read more and more, you will find that conflicting information is commonplace. But there's a message in that, right? ... firing might not be so complex or critical as many writers and teachers suggest, and the limits of error are probably fairly wide. So rejoice; you can probably master it!

But while we're rejoicing ... let us not loose sight of the fact that firing is also "an art", and as your experience and skill increase, and as you attempt to create particular effects or duplicate previous results, you will become increasingly more concerned with its subtleties. Eventually, you'll forget about the basics and details, and set up each firing with no more forethought or difficulty than normally applied to the humming of a favorite tune. Then, when it comes to firing, you'll also insist on *"the Gospel According to You"* ... and why not? ... it works for you!

If you're already an expert, you might read the following just for entertainment ... to see what we say wrong (and to read some things that you forgot about a long time ago). If you're not an expert, welcome to our non-exclusive club. Let's get to it!

The stages in a bisque (or "biscuit") firing are generally summarized as follows:

Water Smoking

- ... occurring as the kiln temperature increases from room temperature to about 300°F (150°C). During this time, any free moisture in the clay boils away.

Dehydration

- ... removes most of the chemically bonded moisture (as opposed to "free moisture") as the temperature climbs through the 300 - 1100°F (150 - 600°C) range. A large volume of superheated (invisible) steam is generated during this period, and the vapor pressure in the kiln should be kept reasonably low by simple venting measures.

Oxidation

- ... occurs over the 750 - 1650°F (400 - 900°C) range, burning off most of the carbonaceous content of the clay. If the carbon is not completely oxidized, "black core" may form inside the body, or black spots may appear on its surface. At 1470°F (800°C) most of the moisture and carbon is gone, leaving the other constituents intact as a somewhat lighter and very porous piece. With experience, you may learn how to judge the firing result with the tip of your tongue ... since the suction of the dry biscuit will draw your moist tongue to it. If too porous, it has not been fired hard enough ... if too vitreous, it's been over-fired.

Vitrification

- ... occurs when the fluxes present in the body soften and react with the clays, gradually changing it to a glass-like substance by fusion. If taken well beyond the proper firing temperature, the fluxes begin to boil, causing blistering and bloating. Vitrification occurs from about 1650°F (900°C) up to the firing temperature of the clay.

Points of special interest in the firing process focus around moisture removal and the processes known as "silica inversions". The rate of temperature increase through the 0 - 300°F (0 - 150°C) range must be slow enough to permit steam to escape through the clay without building up bubbles which will eventually burst and ruin the piece. At about 440°F (225°C), and through the range 1020 - 1070°F (550 - 575°C), the silica inversions cause a sudden expansion (if heating) or contraction(if cooling) of the body. If heated or cooled too rapidly through these inversions, the piece might be damaged or deformed by stresses which develop if its temperature is not perfectly uniform throughout its mass ... causing some areas to suddenly expand or contract before others.

Commercial green-ware and other typically thin pieces will usually tolerate firing rates up to 270°F (150°C) per hour. Thicker pieces will obviously require slower firing, as will pieces with thick sections, such as pots with heavy bases ... perhaps as slow as 100°F (55°C) per hour.

PYROMETRIC CONES

Firing instructions provided with materials, or in texts and magazine articles, frequently refer to cone numbers rather than temperatures, because the heat treating process involves both time and temperature. Pyrometric cones are special formulations which are designed to mature at different extremes of applied heat, are therefore useful in gauging the progress of a firing. The 'time vs temperature' relationship is reflected in the tables furnished in standard cone charts.

As you can see, a "cone 6" firing can result from a variety of schedules ...

to 2194°F (1201°C) in 20.5 hours,
to 2232°F (1222°C) in 8.27 hours,
to 2291°F (1255°C) in 4.24 hours,
... etc.

When firing with the controller, you must establish the *Limit* setting on the basis of the terminal firing rate (i.e., the rate of temperature change at the end of the firing), using the data presented in this table as a guide.

Example:

- Firing to cone 6, you intend to approach the limit temperature at a rate of 270°F (150°C) per hour. So you turn to the tables, find "Cone Number" 6 in the first column, then move your finger across the page to the "270°F/Hr" (or "150°C/Hr") column, to find the suggested limit setting ... which is 2232°F (or 1222°C).

This matter of rate vs limit setting naturally applies to the final few hundred degrees of the firing, and you must also consider the nature of the load ... is the rate slow enough to assure a reasonable degree of temperature uniformity throughout just prior to shut-off? On the other hand, if you're firing to a high temperature ... say, over 2100°F ... you might well expect that your kiln will not have enough heating capacity to maintain a 270°F/Hr rate, so the "final approach" will occur at some slower, kiln dependent, rate. Experience will help you decide how much to "fudge" on the limit setting to compensate for this "kiln lag".

OVERTIME OR OVER-TEMPERATURE - OVER-FIRED WARE!

This is a simple, but often overlooked point ... its important that you remember it. You can see from the Cone Charts that firing is a matter of (1) temperature and (2) time. Too much, or not enough, of either ... and the results will be poor; perhaps a complete loss. Keep this in the back of your mind: *if you come up with an over-fired load, it can just as well be the result of too much time, as too much temperature.*

Suppose that you're firing to a fairly high temperature ... near the limit of your kiln's capability. Its getting late, and everything's gone fine up to this point, so you trustingly retire thinking that the kiln will shut off in an hour or so anyway. But then the maintenance people at the power plant shut down one of the generators for a quick oil change during the 'off peak' hours. Your line voltage just dropped 5% ... and so did your kiln's heating capacity.

Eventually the sun comes up. After breakfast you go down to unload the kiln ... ouch! Its still a bit too warm. That's odd, looks like it switched off ok. Humm ... Oh well, let's open it up anyway ...

YECHT! ... over-fired!

You'll probably never find out why this happened ... and for a long time your confidence in the control system will be shaken. It happened, of course, because the volt-loss during the night was just enough to make your kiln "stall out" just below the *Limit* setting. So it just sat there and cooked all night long, until the power come back up; then it finally shut off. Even though the temperature never got higher than the *Limit* setting, the ware was fired far too long at that high temperature, and melted down.

There are other ways that this can happen and, as you've probably guessed, it does happen. This is one of the hazards firing with electric kilns. The main point is this: **IF YOU CAN'T BE ON HAND TO ASSURE THAT THE KILN SHUTS-OFF ON SCHEDULE, ADD A SHUT-OFF TIMER OR PROGRAM TIME CLOCK TO YOUR CONTROL SYSTEM AS A BACK-UP DEVICE**

That's the main point. But remember also that if a load has fired properly according to your schedule, but appears to be a little overfired, shorten the firing schedule next time. This can be accomplished simply by reducing the *Limit* setting somewhat. The reverse would apply to an underfiring, of course, maybe you rushed it too much.

BASIC (BISCUIT) FIRINGS - Step by Step

1. Perform the prefiring check-out procedure.
2. Push the **POWER ON** button in.
3. Hold the **SET** button in, and adjust the **TEMP ADJUST** knob to move the indicator pointer to the desired shut-off temperature, as determined above (see "Pyrometric Cones)".
4. Set your kiln's switches according to its manufacturers instructions. Prop the lid open using an inch-thick piece of firebrick, and pull the peep hole plugs.

5. Depress and release (push - push) the **SOAK** button to reset the shut-off latch. The **SOAK** button must now be "out".

6. The firing has now begun. The **HEAT ON** light will come on, any you will hear the contactor in the Power Controller click on.

7. Allow the controller to regulate the firing. Close the cover at about 300°F (150°C) and begin installing the peep hole plugs. The controller will latch the kiln off when the temperature reaches the *Limit* setting.

8. At 1100°F (600°C) the kiln should be fully closed up.

During the Firing ..

7. Pushing the **SET** button during the firing will not upset the process, and the shut-off setting may be rechecked at will ... do it; its a good habit to get into. The limit setting may also be changed during the firing, except that when changed to a value lower than the kiln's temperature, the shut-off function will be tripped. To clear that condition, simply set the limit higher than the kiln's temperature, then press and release (push - push) the **SOAK** button.

8. The kiln can be held at any temperature during the firing for "soak" purposes, simply by pushing the **SOAK** button in when the kiln reaches the desired soak temperature. This holds the kiln at that level until the **SOAK** button is released.

9. Remember that the limit setting must always be set somewhat higher than your preset soak temperature, since the controller will shut down the kiln whenever the temperature indication goes higher than the limit setting.

GLAZE FIRINGS

NOTE - Glaze firings may be done using the same methods as suggested for bisque firings, with the following exceptions ...

1. Proceed slowly for the first hour or two, to drive away any surplus moisture retained in the ware as a result of the glaze application. The operation can then often be expedited, if desired, up to the firing temperature of the glaze.

2. If the kiln has fired faster than 270°F (150°C) per hour, it would probably be a good idea to slow down over the last hundred degrees to permit time for the glaze to heal over any craters which might have been formed by escaping gas ... else soak the kiln at the firing temperature for thirty minutes prior to shut-off. To use this latter method, you'll have to be on hand as the kiln approaches the shut-off point. Just prior to shut-off, push the **SOAK**button in and turn the **SET** knob all the way up (clockwise), but remember ... *YOU* will have to shut the kiln off after the soak period, since the controller's shut off function is now disabled!

3. For good glossy glaze, let the kiln drop slowly for the first 200°F (100°C) after it shuts off. Then speed up the cooling rate down to 1375°F (750°C) by partially pulling the top peep hole plugs. At this point, close the kiln up again and permit it to cool at its own rate down to 300°F (150°C), where you may slowly begin to open it up to expedite the final cooling process.

CRYSTALLINE GLAZE

1. As always, start with a prefiring check-out.

2. Push the **POWER ON** button in.

3. Press the **SOAK** button in.

4. Set the **TEMP ADJUST** control at 2400°F.

5. Depress and release (push - push) the **SOAK** button to reset the shut-off latch, and observe that the **HEAT ON** light comes on.

6. Watch the temperature closely as it approaches 2400°F, and let the kiln soak at 2400°F (1315°C) for about 20-minutes.
7. Then reduce the *Limit* setting to 2100°F (1150°C).
8. Crystal growth is a function of soak time at this set point (2100°F/1150°C). For small crystals soak here for four to five hours. For larger crystals, soak at this temperature for 8 to 10 hours.
9. Push the **SOAK** button to release it, then turn the **TEMP ADJ** control all the way down (counter-clockwise). This will trip the shut-off latch, turning the kiln off.
10. Allow the kiln to cool according to your customary practice.

Appendix

CONE CHARTS

WIRING DIAGRAMS

DN470327: for 110-120vac Systems, original relay output configuration (28Kb)

DN470328: for 208-240vac Systems, original relay output configuration (29Kb)

DN470326: for 110-120vac Systems, dc pulse output (modified controls) (30Kb)

DN470325: for 208-240vac Systems, dc pulse output (modified controls) (31Kb)

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TEMPERATURE EQUIVALENTS FOR ORTON™ STANDARD PYROMETRIC CONES

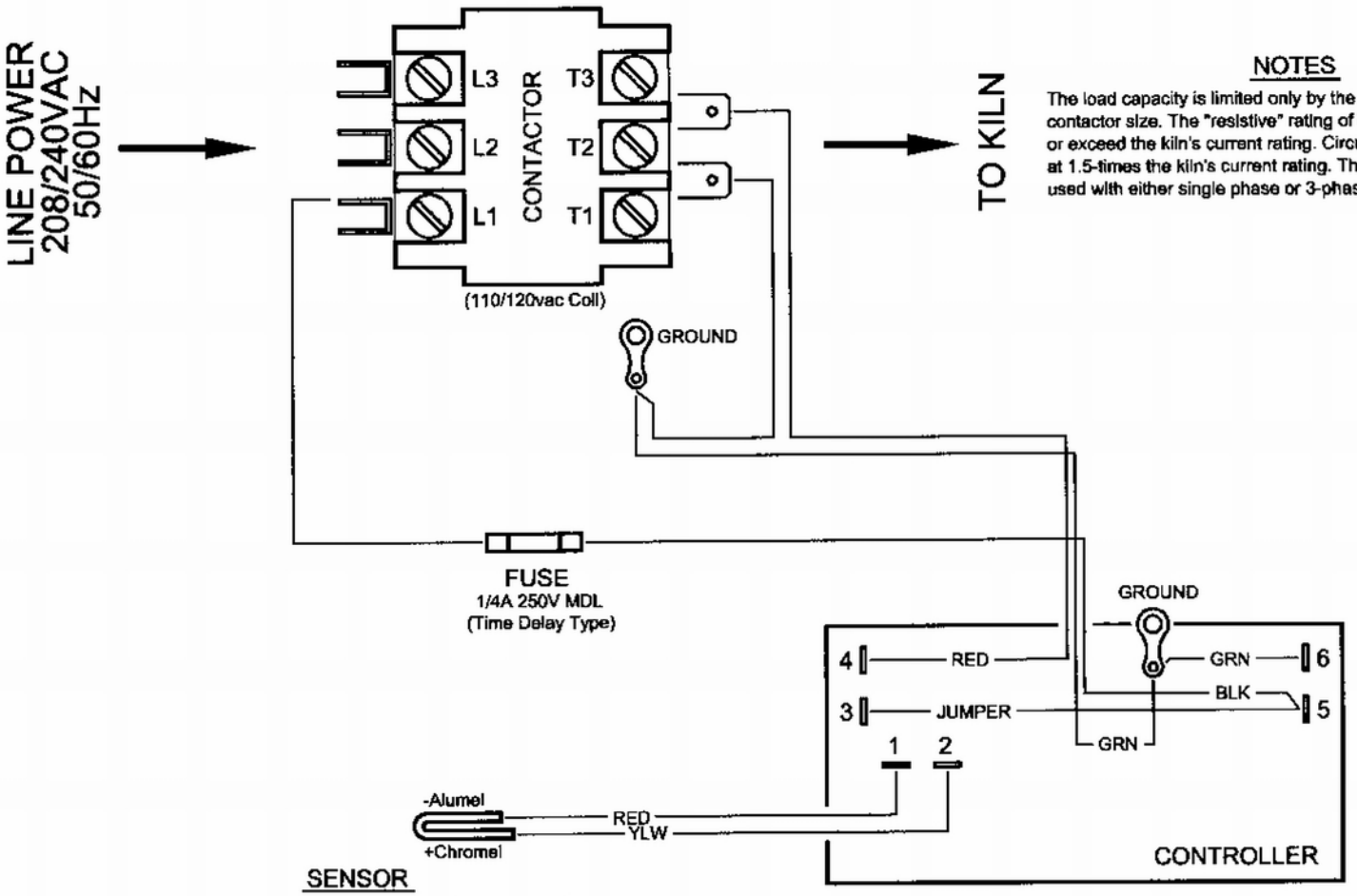
(As Determined at the National Bureau of Standards)

	LARGE CONES		small			
CONE	Heating Rate in °F/Hr			Color	Firing Stage	Customary Firing
	108°F/Hr	270°F/Hr	540°F/Hr			
		302		"black	free water “boils” out	
		437		heat"	alpha to beta cristobalite inversion	
		1022			alpha to beta quartz inversion	
		1067				
022	1085	1112	1165		dehydration	
021	1116	1137	1189		90% complete	
020	1157	1175	1231			
019	1234	1261	1333	dull		overglaze colors
018	1285	1323	1386	red		enamels and gold
017	1341	1377	1443			ceramic decals
016	1407	1458	1517			
015	1454	1479	1549			glass sagging
014	1533	1540	1596			chrome & red glaze
013	1596	1566	1615			
012	1591	1623	1650	cherry		
011	1627	1641	1680	red	most of	lustre glaze
010	1629	1641	1686		organic matter	
09	1679	1693	1751		now burnt	
08	1733	1751	1801	cherry	away	low firing lead &
07	1783	1803	1846	red to		fritted glazes
06	1816	1830	1873	orange	teracottas	porous biscuit-low
05	1888	1915	1944		mature	fire earthenware
04	1922	1940	2008	orange		
03	1987	2014	2068	changing		
02	2014	2048	2098	to		
01	2043	2079	2152	yellow/	earthenware	industrial earthen
1	2077	2109	2154	orange	matures	ware, bisque and
2	2088	2124	2154			bone china glost
3	2106	2134	2185	yellow/		
4	2134	2167	2208	orange	teracottas	
5	2151	2185	2230	yellow to	melt, increasing	
6	2194	2232	2291	lt. yellow	formation	semi-porcelain
7	2219	2264	2307		of beta type	salt glaze
8	2257	2305	2372	yellow	cristobalite	stoneware
9	2300	2336	2403	with white		bone china bisque
10	2345	2381	2426	tinge		& some porcelain
11	2361	2399	2437	intense		porcelain
12	2383	2419	2471	yellow-		
13		2455		white		
14		2491				
15		2608				

TEMPERATURE EQUIVALENTS FOR ORTON™ STANDARD PYROMETRIC CONES

(As Determined at the National Bureau of Standards)

CONE	LARGE CONES Heating Rate in °C/Hr		small	Color	Firing Stage	Customary Firing
	60°C/Hr	150°C/Hr	300°C/Hr			
		150		"black	free water “boils” out	
		225		heat"	alpha to beta cristobalite inversion	
		550			alpha to beta quartz inversion	
		575				
022	585	600	630		dehydration	
021	602	614	643		90% complete	
020	625	635	666			
019	668	683	723	dull		overglaze colors
018	696	717	752	red		enamels and gold
017	727	747	784			ceramic decals
016	764	792	825			
015	790	804	843			glass sagging
014	834	838	870			chrome & red glaze
013	869	852	880			
012	866	884	900	cherry		
011	886	894	915	red	most of	lustre glaze
010	887	894	919		organic matter	
09	915	923	955		now burnt	
08	945	955	983	cherry	away	low firing lead &
07	973	984	1008	red to		fritted glazes
06	991	999	1023	orange	teracottas	porous biscuit-low
05	1031	1046	1062		mature	fire earthenware
04	1050	1060	1098	orange		
03	1086	1101	1131	changing		
02	1101	1120	1148	to		
01	1117	1137	1178	yellow/	earthenware	industrial earthen
1	1136	1154	1179	orange	matures	ware, bisque and
2	1142	1162	1179			bone china glost
3	1152	1168	1196	yellow/		
4	1168	1186	1209	orange	teracottas	
5	1177	1196	1221	yellow to	melt, increasing	
6	1201	1222	1255	lt yellow	formation	semi-porcelain
7	1215	1240	1264		of beta type	salt glaze
8	1236	1263	1300	yellow	cristobalite	stoneware
9	1260	1280	1317	with white		bone china bisque
10	1285	1305	1330	tinge		& some porcelain
11	1294	1315	1336	intense		porcelain
12	1306	1326	1355	yellow-		
13		1346		white		
14		1366				
15		1431				



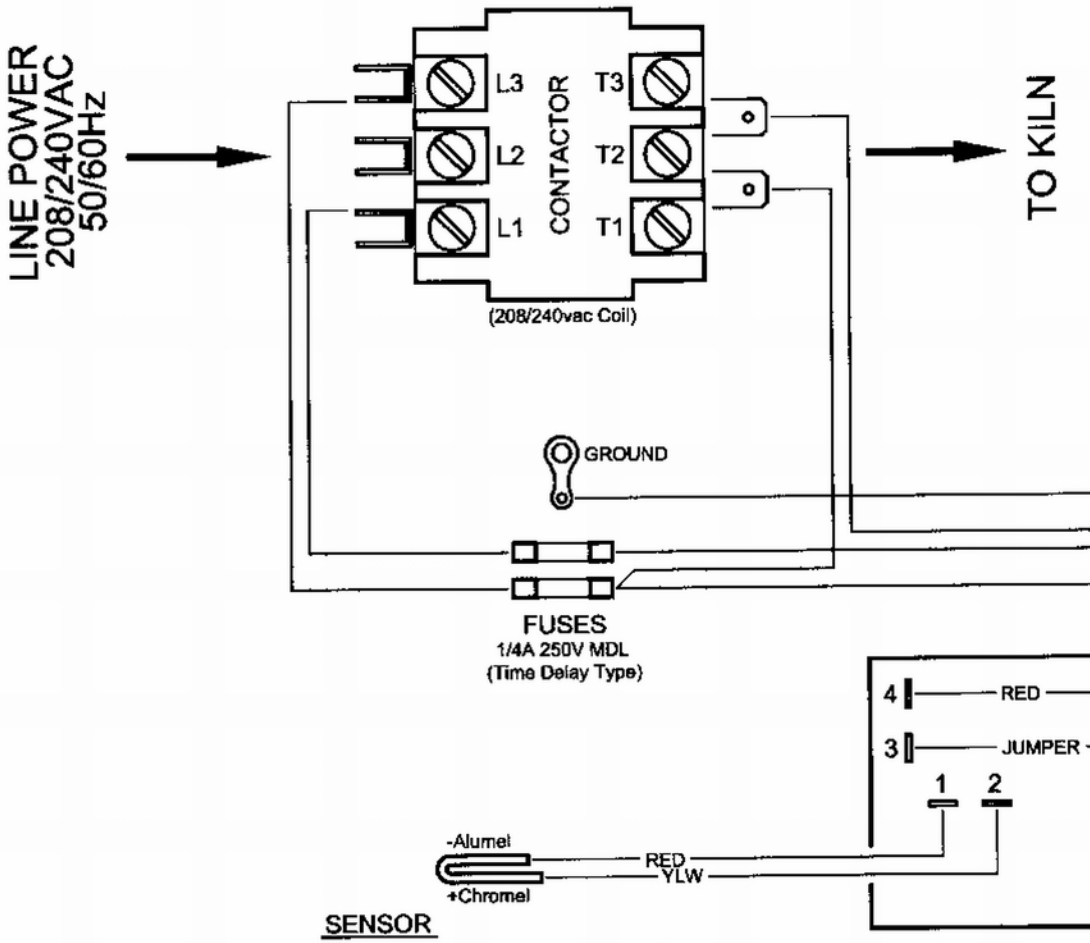
NOTES

The load capacity is limited only by the electrical service and the contactor size. The "resistive" rating of the contactor must equal or exceed the kiln's current rating. Circuit breakers should be sized at 1.5-times the kiln's current rating. Three-pole contactors may be used with either single phase or 3-phase kilns.

SENSOR

Use only "ISA Type T" (Chromel vs. Alumel) thermocouples, and thermocouple extension wire between the sensor and the controller.

WIRING DIAGRAM 110/120vac - Relay Contact Output		
1992		26May97
KilnTronics Models 07/2, 08/2 & 09/2		
		470327



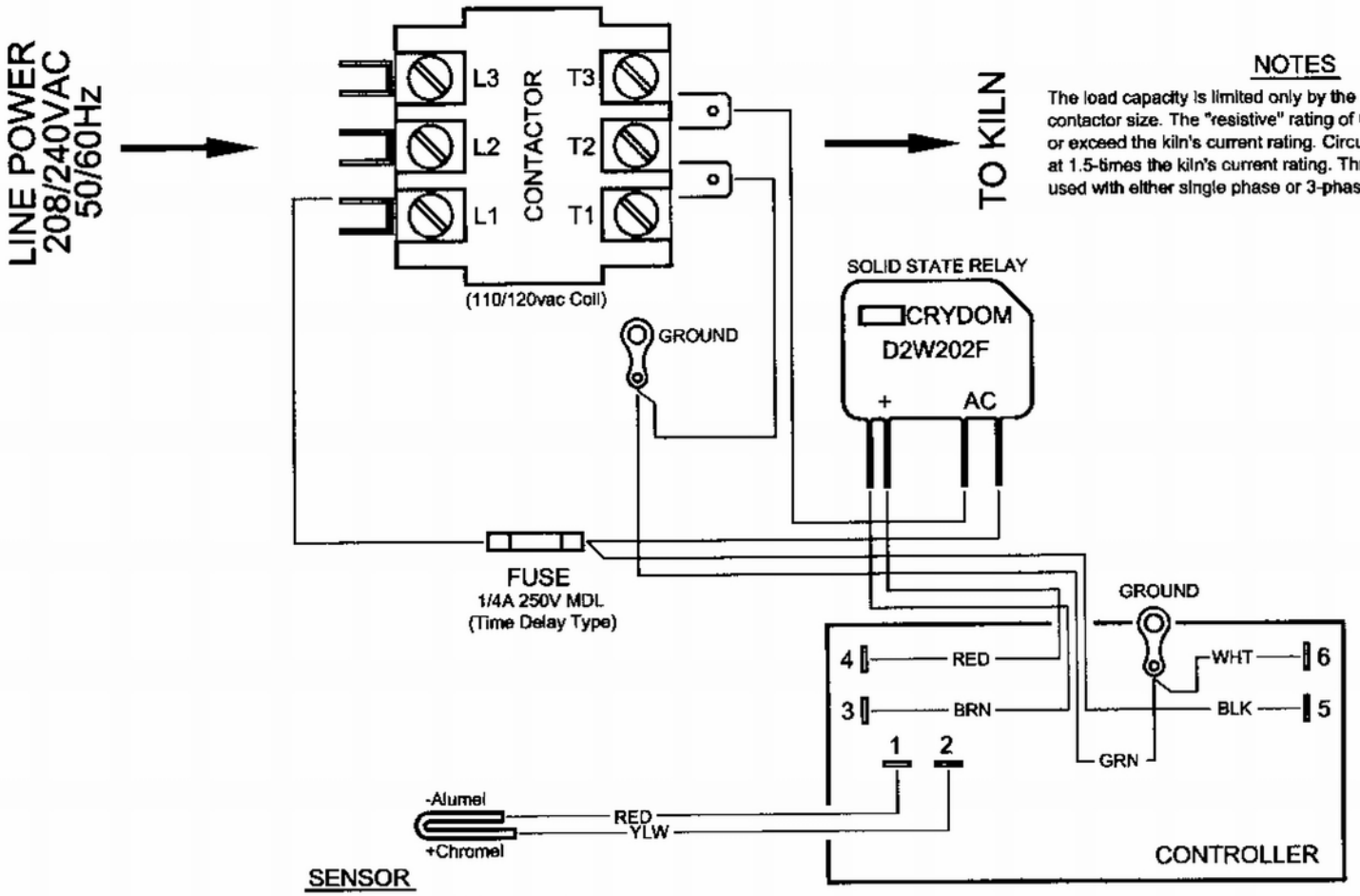
NOTES

The load capacity is limited only by the electrical service and the contactor size. The "resistive" rating of the contactor must equal or exceed the kiln's current rating. Circuit breakers should be sized at 1.5-times the kiln's current rating. Three-pole contactors may be used with either single phase or 3-phase kilns.

SENSOR

Use only "ISA Type T" (Chromel vs. Alumel) thermocouples, and thermocouple extension wire between the sensor and the controller.

WIRING DIAGRAM 208/240vac - Relay Contact Output		
SCALE		DRAWN BY GLW
DATE 1992		REVISED 26May97
USED ON ***KilnTronics*** Models 07/2, 08/2 & 09/2		
PART NO		DRAWING NO 470328



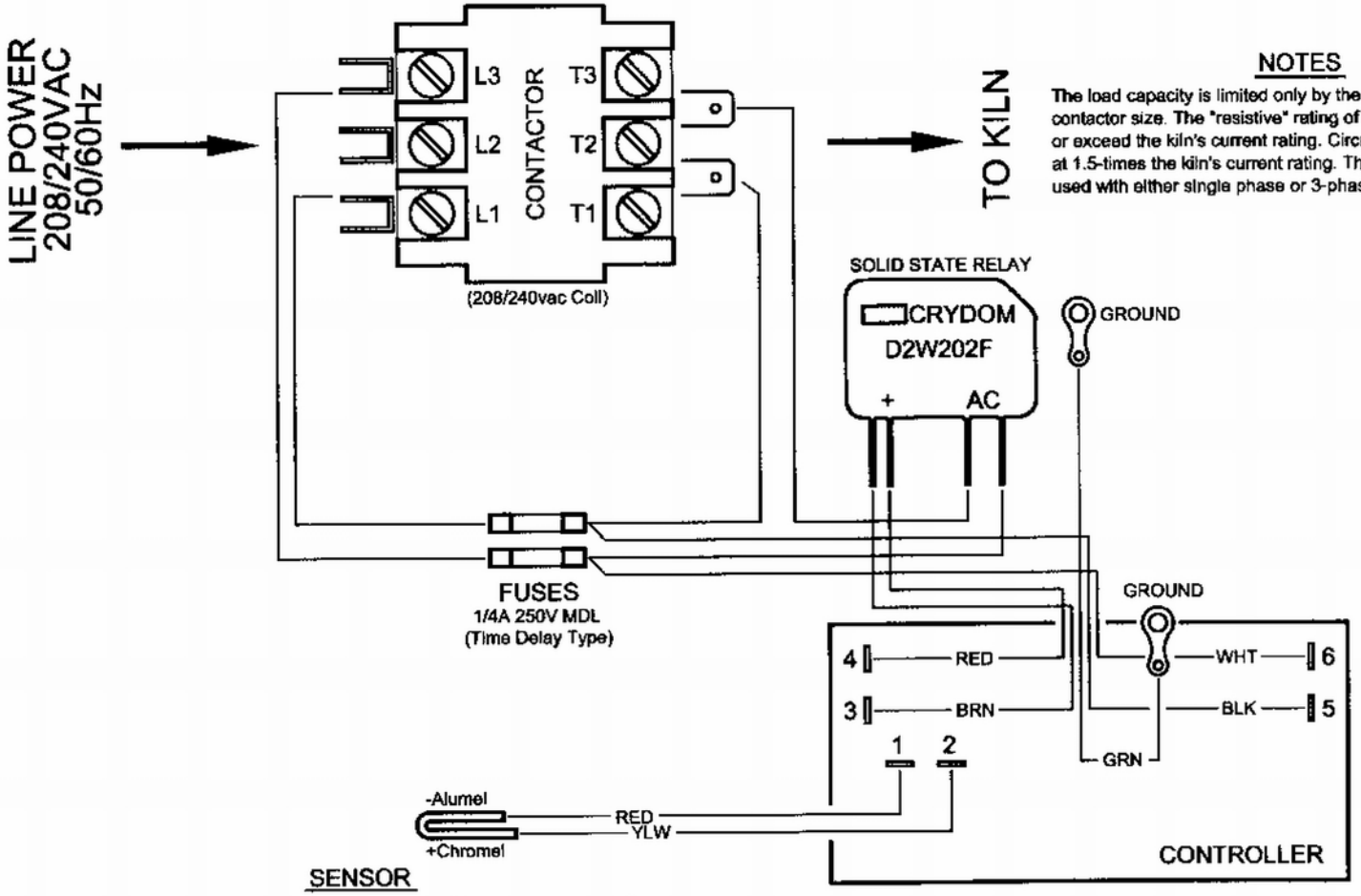
NOTES

The load capacity is limited only by the electrical service and the contactor size. The "resistive" rating of the contactor must equal or exceed the kiln's current rating. Circuit breakers should be sized at 1.5-times the kiln's current rating. Three-pole contactors may be used with either single phase or 3-phase kilns.

SENSOR

Use only "ISA Type T" (Chromel vs. Alumel) thermocouples, and thermocouple extension wire between the sensor and the controller.

WIRING DIAGRAM 110/120vac - DC Output	
DATE: 1992	DRAWN BY: GEN REVISED: 26May97
KilnTronics Models 07/2, 08/2 & 09/2	
PART NO:	DRAWING NO: **470326**



NOTES

The load capacity is limited only by the electrical service and the contactor size. The "resistive" rating of the contactor must equal or exceed the kiln's current rating. Circuit breakers should be sized at 1.5-times the kiln's current rating. Three-pole contactors may be used with either single phase or 3-phase kilns.

SENSOR

Use only "ISA Type T" (Chromel vs. Alumel) thermocouples, and thermocouple extension wire between the sensor and the controller.

WIRING DIAGRAM 208/240vac - DC Output	
DATE 1992	Approved by GLW 26May97
KilnTronics Models 07/2, 08/2 & 09/2	
	470325