

Notes



ST315

User Handbook



ST315 Temperature Programmer

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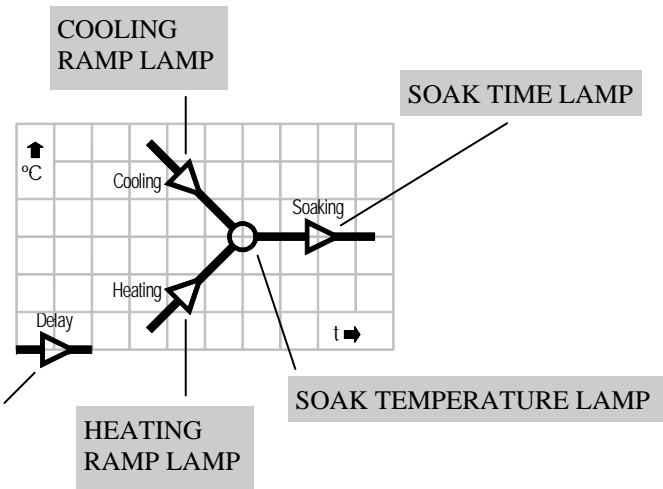
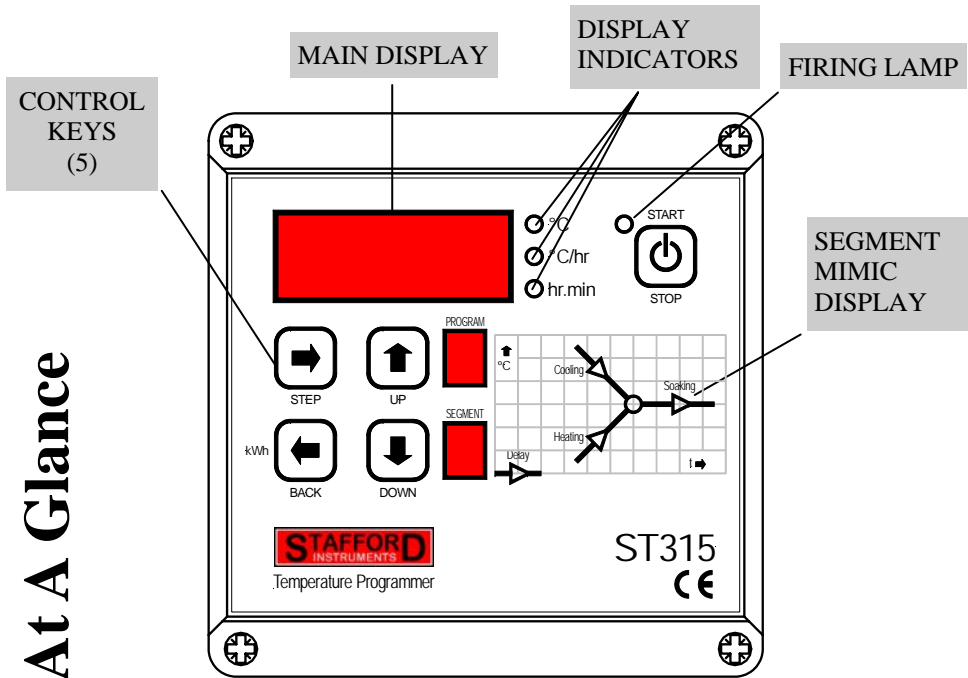
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Further copies of this handbook may be found at <http://www.stafford-inst.co.uk/docs/st315/user315.pdf>

At A Glance

At A Glance



Notes

Other Features

Energy Used Display

Pressing the **◀** button at any time shows the amount of electrical energy used in kW hours. If pressed during a firing it shows the energy used so far. After a firing it shows the total energy used for that firing. This information is stored while power is off and is only reset to zero when a new firing is started.

If the value displayed is always **0.0** then the kiln power rating has not been configured into the ST315—see installation handbook.

Keyboard Lock Facility

The keys on the ST315 can be locked so that pressing them has no effect. This is an anti-tamper feature used to ensure that the operation of the ST315 or the program data cannot be altered by un-authorized people. The ST315 can be locked when it is idle (not firing) or while it is firing. It cannot be locked while it is being programmed.



- °C
- °C/hr
- hr.min

If the left-hand decimal point in the display is lit then the ST315 is locked. Press and hold in both the **↑** & **↓** keys for 5 seconds to unlock the ST315.



- °C
- °C/hr
- hr.min

If the left-hand decimal point in the display is not lit then the ST315 is not locked. Press and hold in both the **↑** & **↓** keys for 5 seconds to lock the ST315.

Power Failure Recovery

If power fails during firing then the ST315 recovers as follows:-
 For power failure during start delay the ST315 commences firing immediately when power returns. For power failure during ramping the ST315 continues the ramp it was previously executing. For power failure during soaking the ST315 ramps back up to soak temperature at the correct ramp rate then applies the full soak period. This recovery scheme can be disabled if required (see installation handbook) - the ST315 will then lock up with **FAL** displayed and kiln off in the event of power failure.

Quick Start Guide

Switch on & wait for kiln temperature display
To run a firing program set up previously press the START/STOP key
To stop the firing at any time press the START/STOP key again
To review firing data press the ➡ key to enter the programming menu
To change firing data press the ↑ & ↓ keys to change the displayed value
Use the ➡ key again as necessary to index to the next firing value or segment to be reviewed or changed
To mark the end of a program set a ramp rate to <i>End</i> with the ↓ key
To exit the programming menu either wait 10 seconds or press the START/STOP key to start firing
If the keyboard is locked then press the ↑ & ↓ keys together & hold down for 5 seconds to unlock

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Features

- 9 programs each with up to 9 segments
- 1 controlled heating / cooling ramp + soak per segment
- Soak times up to 99 hours 59 mins
- Ramp rates from 1 to 999°C/hour + full
- Ideal for glass or ceramics use
- Programs can be altered while firing
- Program pause/un-pause + segment advance facilities
- Keyboard lockable
- Delayed start facility - up to 99 hours 59 mins
- Power failure recovery
- Energy used display
- Alarm buzzer & optional alarm output



- °C
- °C/hr
- hr.min

Error 7. Maximum room temperature exceeded. The internal temperature of the ST315 has exceeded an installer selectable (30—70°C) limit.

Possible causes are: room vent fan failure, ventilation grills blocked, kiln room too small, damper or bung left open

All error messages cause the ST315 to terminate the firing with all the keys locked. **An alarm buzzer sounds once per second.**

SWITCH KILN OFF!

To reset the ST315 turn off the power to the instrument and have the fault investigated by your installer or kiln service engineer to rectify the fault.

Note: these error messages are provided to detect kiln faults and so offer some protection to the kiln. For increased protection the use of a heat fuse or other independent over-temperature trip is recommended—such as the Stafford Instruments ST101.

Technical note: any error message will cause the auxiliary alarm relay (if fitted) to open—see installation handbook for details.

Error Messages



- °C
- °C/hr
- hr.min

Error 1. The kiln temperature is not increasing as required. The kiln has been on full power for 1 hour but the kiln temperature has not risen by at least 8°C.

Possible causes are: kiln door or lid not closed properly, heater element failure, elements too old, power phase failure, contactor failure or thermocouple short-circuit.



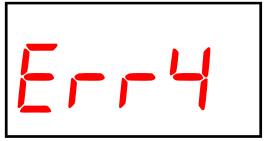
- °C
- °C/hr
- hr.min

Error 2. Thermocouple or thermocouple wiring open circuit. Get thermocouple and wiring checked. Have thermocouple replaced if necessary.



- °C
- °C/hr
- hr.min

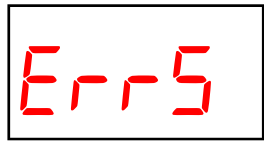
Error 3. Thermocouple reversed (kiln temperature apparently less than -40°C). This is an installation fault. Get wiring checked.



- °C
- °C/hr
- hr.min

Error 4. Kiln temperature too high. The kiln has been on zero power for 30 minutes but the kiln temperature has not fallen by at least 1°C

Possible causes are: contactor failure or thermocouple connection intermittent or high resistance.



- °C
- °C/hr
- hr.min

Error 5. Kiln temperature overshoot. The kiln temperature exceeds the desired temperature by at least 10°C / 20°C (installer selectable).



- °C
- °C/hr
- hr.min

Error 6. Maximum firing time exceeded. The length of the current firing has exceeded an installer selectable (10—999 hours) limit.

Turning On

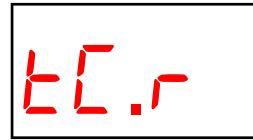


When turned on the ST315 performs a display test by briefly illuminating all of the display digits and all of the front panel lamps.



The version number of the software embedded within the ST315 is now displayed. If you ever need technical support you will be asked for this code together with the ST315's serial number.

Next displayed is the thermocouple type to which the ST315 is set. This thermocouple type setting should match the type of thermocouple fitted to the kiln and can be R, S, K or N type.



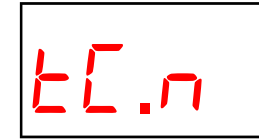
'R' type thermocouple



'S' type thermocouple



'K' type thermocouple



'N' type thermocouple



- °C
- °C/hr
- hr.min

The final display should show the kiln temperature (20°C shown here) with the '°C' indicator on. All other lamps should be off.



- °C
- °C/hr
- hr.min

If the left-hand decimal point is on then the keyboard is locked. This is an anti-tamper feature. Press the **↑** & **↓** keys together & hold down for 5 seconds to unlock.

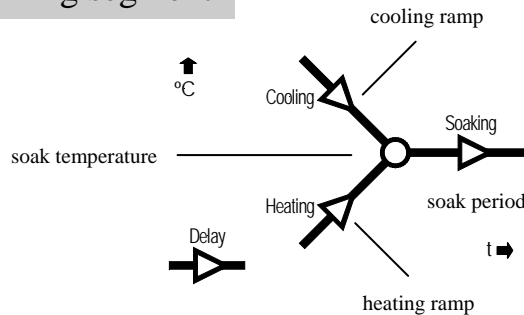


- °C
- °C/hr
- hr.min

If any mimic panel lamps are on then the ST315 is firing. Press the START/STOP key to stop the firing. During firing the right-hand decimal point will light to show when the kiln is heating.

Programming

A firing segment



An ST315 firing segment comprises a ramp followed by a soak period. Two segments can be used for simple firing (biscuit firing for example) or up to 9 segments can be used per program for complex firing (crystal glazing or glass-making for example).

The ST315 ramps the kiln temperature at the required ramp rate until the kiln reaches the soak temperature. It then soaks (dwells) at the soak temperature for the soak time. It then runs the next segment until the end of the program is reached.

The ST315 is capable of both positive (heating) ramps and negative (cooling) ramps—as used in glassmaking for annealing. The type of ramp is clearly shown on the mimic display during firing.

The ramp rate is settable in the range 1°C/hour to 999°C/hour or *FULL* (full power) or *End* (end of program).

The soak temperature is settable over the range 0 to 1320°C.

The soak time is settable over the range 00.00 (no soak) to 99 hours 59 mins.

Note: during soaking the ST315 display alternates every 5 seconds between kiln temperature and soak time remaining.

Program Pause Facility

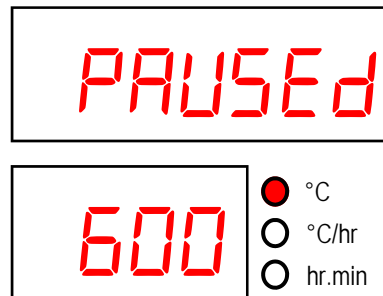
While firing press and hold down the \downarrow key for about 4 seconds. The ST315 will pause the executing program. To un-pause the program press and hold down the the \downarrow key again for about 4 seconds. The effects of pausing are as follows:-

If paused during ramping the kiln temperature will be held (soaked) **indefinitely** at the current kiln temperature. The ramp will continue when un-pause is selected.

If paused during soaking then the soak time will be **extended indefinitely**. The remainder of the soak period will be resumed when un-pause is selected.

Segment advance (\uparrow key held down for about 4 seconds) can also be used to terminate the pause. This will advance the segment and will immediately terminate a paused soak—advancing to the next segment (if any).

Changes made to the operation of the ST315 in this way are temporary and are not stored.



As a warning during pause a double beep is sounded every 10 seconds, the display scrolls *PAUSED* for 5 seconds then shows the kiln temperature for 5 seconds.

WARNING - PROGRAM PAUSE

The program pause facility should be used with care. Program execution is suspended and the kiln will be held at its current temperature indefinitely.

If left too long at high temperatures kiln damage could result.

Adjusting While Firing

Firing values can be adjusted while the ST315 is firing. Also there are program pause/un-pause and segment advance features that are particularly useful for glass work.

Adjusting Firing Values

While firing operate the \rightarrow key to select the required parameter as shown by a flashing lamp on the mimic display. The firing value is shown on the main display and can now be adjusted with the \uparrow & \downarrow keys in the usual way. The contents of the current segment or any segment still to be executed can be changed. Firing will still carry on as normal while these changes are being made. The ST315 will return to its normal running display 10 seconds after key presses cease (or immediately after *End* is displayed).

Changes made to programs in this way are stored and are used for subsequent firings.

Segment Advance Facility

While firing press and hold down the \uparrow key for about 4 seconds. The ST315 will sound a short beep and the executing program will immediately advance one step as indicated by lamps on the mimic panel. The effect of this is as follows:-

If a start delay is currently executing then the ST315 will terminate this and start firing immediately.

If ramping is currently executing then the ST315 will switch to soak at the current kiln temperature.

If currently soaking then the ST315 will advance to the next segment if any, or else it will end the firing.

Changes made to the operation of the ST315 in this way are temporary and are not stored.

Altering a program

When the ST315 is not firing there are no lamps lit on the mimic panel, the run lamp is off and the display shows the kiln temperature with the $^{\circ}\text{C}$ indicator lit.



If the left-hand decimal point is on then the keyboard is locked. Press the \uparrow & \downarrow keys together & hold down for 5 seconds to unlock.

The controller settings can be reviewed by pressing the \rightarrow key.



The first push of the \rightarrow key flashes the program number display. This can be altered from 1 to 9 with the \uparrow & \downarrow keys.

Note: holding down the \uparrow or \downarrow keys causes rapid change of the displayed value.



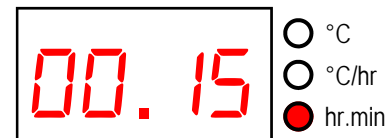
The next push of the \rightarrow key displays the start delay time in the range 00.00 to 99.59 (99 hours 59 mins). This can be altered with the \uparrow & \downarrow keys. The DELAYED START lamp on the mimic display will flash.



\rightarrow then displays the ramp rate in the range 1 to 999 $^{\circ}\text{C/hr}$ or *FULL* or *End*. This can be altered with the \uparrow & \downarrow keys. The HEATING RAMP or COOLING RAMP lamp on the mimic display will flash.



\rightarrow then displays the soak temperature in the range 0 to 1320 $^{\circ}\text{C}$. This can be altered with the \uparrow & \downarrow keys. The SOAK TEMPERATURE lamp on the mimic display will flash.



The next push of the \rightarrow key displays the soak time in the range 00.00 to 99.59 (99 hours 59 mins). This can be altered with the \uparrow & \downarrow keys. The SOAK TIME lamp on the mimic display will flash.



A further push of the \rightarrow key increments the segment display digit and firing data for the next segment can be entered.



- °C
- °C/hr
- hr.min

Data entry is terminated if *End* is selected for a ramp rate with the **↓** key. Data entry is also automatically terminated if 9 segments have been entered.

*Note: available ramp rate displays are: End, 1 ... 999 & FULL. If End is shown but another segment is required then push the **↑** key to obtain the required ramp rate (in the range 1°C/hr to 999°C/hr). If full power is required then push the **↑** key until FULL is displayed.*

Note: to exit programming without cycling through all of the above steps wait 10 seconds without pressing any keys—the ST315 will revert to the idle display. Alternatively press the START/STOP key to exit programming and to begin firing immediately.

*Note: the **←** key can be used to reverse through the programming steps to correct errors or to exit programming mode.*

Cooling

Upon completion of firing the ST315 lights all lamps on the mimic display and the kiln is allowed to cool naturally.



- °C
- °C/hr
- hr.min



- °C
- °C/hr
- hr.min

While the kiln temperature is above 40°C the display alternates every 5 seconds between the kiln temperature and *Hot*



- °C
- °C/hr
- hr.min



- °C
- °C/hr
- hr.min

When the kiln has cooled to less than 40°C the display alternates every 5 seconds between the kiln temperature and *End*

To return the ST315 back to idle condition ready for the next firing press the START/STOP key (or turn off the power to the instrument).

Operating Notes

Kiln too slow

If the ST315 is programmed to heat the kiln at a faster rate than the kiln is capable of then the ST315 will turn on full power then wait until the kiln temperature has risen to the correct temperature before proceeding to the next ramp or soak segment.

Likewise if the ST315 is programmed to cool the kiln at a faster rate than the kiln is capable of then the ST315 will apply zero power then wait until the kiln has cooled to the correct temperature before proceeding to the next ramp or soak segment.

Heating & Cooling Ramps

The ST315 is capable of controlled ramps for both heating and cooling. The type of ramp required is determined by comparing the required soak temperature to the soak temperature in the previous segment and is shown on the mimic display.

STOP key operation

If the START/STOP key is pressed during a firing then the firing will be halted (not paused). Pressing the START/STOP key again will cause the ST315 to restart the firing from the beginning. The ST315 will look at the current kiln temperature and if this is greater than the required soak temperature then the ST315 will automatically *cool* from current temperature to the soak temperature. This may not be what is desired so the STOP key should only be used to halt the firing in an emergency.

The program can be paused or program data can be changed while the controller is firing (see page 14). This is a better option than using the STOP key. The segment advance feature (see page 14) is however available to recover quickly from STOP key operation if required.

Memory

All programs & necessary data are remembered when the ST315 is turned off. In the event of power failure during firing the ST315 will automatically resume firing when power is returned (this feature can be disabled; see installation handbook).

Delayed Start

The delayed start time period is set to 00.00 when the ST315 is turned on.

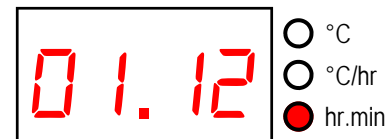
Firing

To start a firing press the START/STOP key. The RUN lamp will light. To stop the firing prematurely press the START/STOP key again.

Hint: it is good practice to check that the program is correct by pressing the \blacktriangleright key & checking the program number & program contents before pressing the START/STOP key to start a firing.



If the left-hand decimal point is on then the keyboard is locked & the ST315 will not respond to the START/STOP key. Press the \uparrow & \downarrow keys together & hold down for 5 seconds to unlock.



If a delayed start has been set then pressing the START/STOP key causes a time delay to start. The time remaining is shown on the display—this counts down once per minute. The DELAYED START lamp on the mimic panel will light. The centre decimal point will flash once per second.



If no delayed start has been set (00.00) then pressing the START/STOP key causes firing to commence immediately. Either the Heating or Cooling lamp on the mimic panel will light. If kiln heating is required then the right-hand decimal point on the display will light while heating power is being applied to the kiln.

Information: The ST315 operates by calculating the amount of energy required by the kiln every 30 seconds. If for example 40% of full energy is required to maintain a particular ramp rate or a particular soak temperature then the ST315 will apply heating power to the kiln for 12 seconds every 30 seconds. The right-hand decimal point in the display will light for 12 seconds every 30 seconds. If the kiln has a contactor then a loud click will be heard both when the decimal point lights up and when it goes out. If full heating power is required then the decimal point will remain lit. If full cooling is required then the decimal point will remain off.

