STAFFORD INSTRUMENTS

ST215

ST215 Temperature Programmer
User Handbook
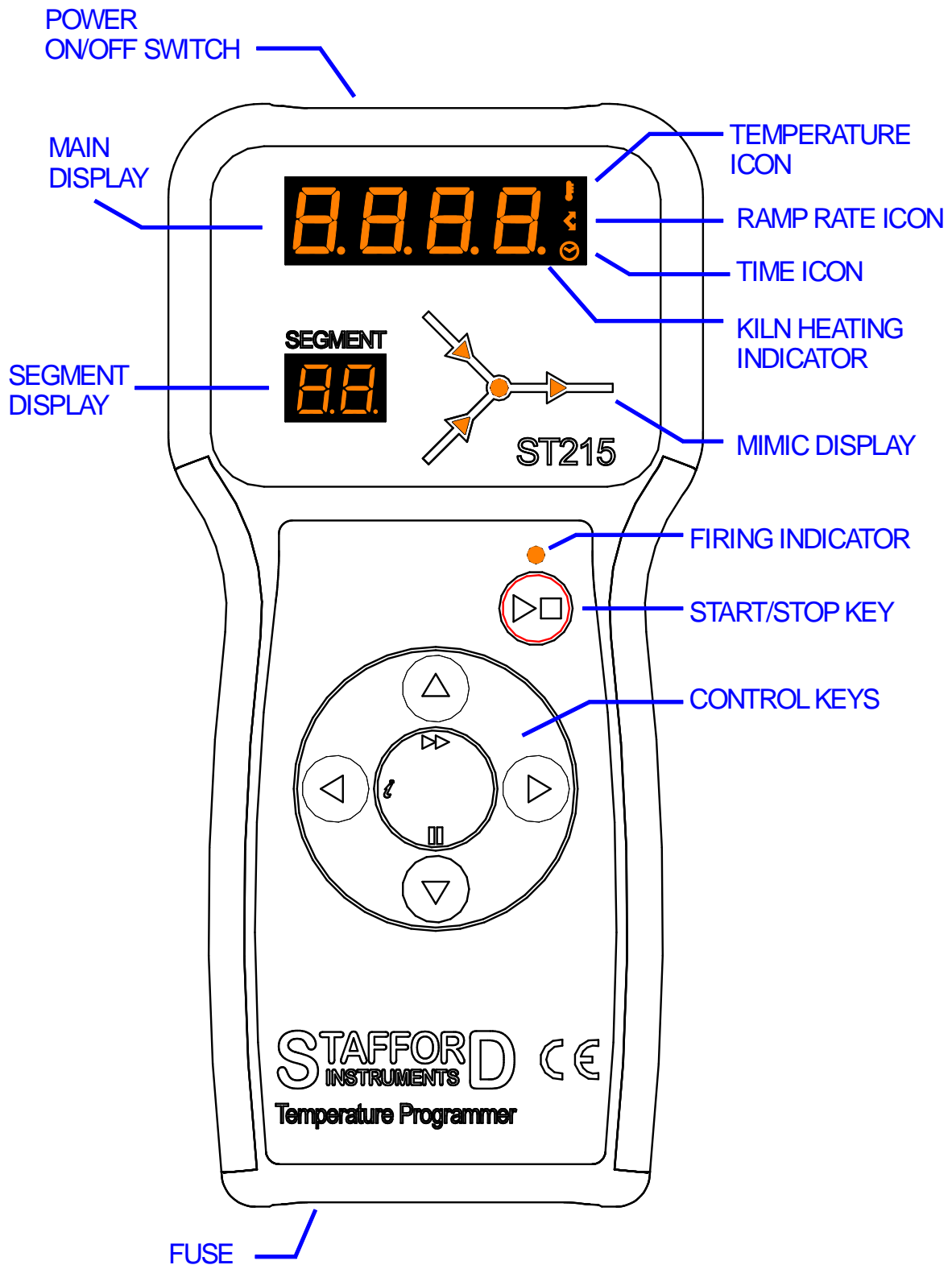

SEGMENT

ST215

STAFFORD INSTRUMENTS CE
Temperature Programmer

www.staffordinstruments.co.uk

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At a Glance

POWER
ON/OFF SWITCH

MAIN
DISPLAY

SEGMENT
DISPLAY

SEGMENT

ST215

TEMPERATURE
ICON

RAMP RATE ICON

TIME ICON

KILN HEATING
INDICATOR

MIMIC DISPLAY

FIRING INDICATOR

START/STOP KEY

CONTROL KEYS

STAFFORD INSTRUMENTS
Temperature Programmer

CE

FUSE

Quick Start Guide

Switch on & wait for kiln temperature display
To run a firing program set up previously press the ■ key
To stop the firing at any time press the ■ key again
To review firing data press the key to enter the programming mode
To change firing data press the & keys to change the displayed value
Use the key again as necessary to step to the next firing value or segment to be reviewed or changed
To mark the end of a program set a ramp rate to End with the key
To exit the programming mode either wait 20 seconds or press the ■ key to start firing
If the keyboard is locked then press the & keys together & hold down for 5 seconds to un-lock

Contents

Features

- 10 programs each with up to 16 segments
- 1 controlled heating / cooling ramp + soak per segment
- Soak peiods up to 99 hours 59 mins
- Ramp rates from 1 to 999°/hour + FULL
- Ideal for glass or ceramics use
- Programs can be altered while firing
- Program pause and advance facilities
- Keyboard lockable
- Delayed start facility - up to 99 hours 59 mins
- Power failure recovery
- Energy used display
- Setpoint display
- Buzzer Alarm & safety output
- °C/°F operation

Installation

Safety Warnings

**DISCONNECT BEFORE
REMOVING COVER
(NO USER SERVICEABLE PARTS INSIDE)**

<u>WARNING</u>

**ISOLATE KILN & PROGRAMMER FROM ELECTRICAL
SUPPLY BEFORE ATTEMPTING INSTALLATION OR
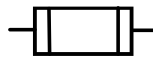REPAIR WORK**

Installer Information

Installation Category: II
Pollution Class: 2

100-240V ~ 50/60HZ 1.0A

Fuse: 3.15A Anti-surge
20mm x 5mm ceramic HRC

IP50

C E

EMC

This instrument is designed for use mainly in Domestic, Commercial & Light Industrial environments where electromagnetic interference may cause a loss of accuracy of the displayed temperature reading of up to 3°C. Specified accuracy will be restored when the interference is removed.

Contactor Coil Suppression

The coil of any mechanical kiln contactor *should be suppressed* with an RC suppressor. The RC suppressor must be connected directly across the coil terminals on the contactor. Suitable proprietary RC suppressors are often available from contactor manufacturers as add-on blocks.

Mounting

Mounting Location
Mount the instrument on a suitable reasonably vertical surface which will not get hot. Choose a position where the instrument is not exposed to direct heat from the kiln - especially when the kiln door or lid is open.

Mounting Bracket
This is a ±holsterqstyle ABS moulded bracket which can be attached with 2 screws. The bracket mounting holes are spaced 70mm. The instrument can be removed from this bracket for in-hand programming if required.

Connecting Lead

The ST215 is fitted as standard with a connecting lead and plug. The lead lengths can be either 2m or 3m. The plug type will be either a Harting Han7D or a Tyco CPC14. The wiring of the mating Han7D kiln socket follows an industry standard (as shown below). ***The wiring of the mating CPC14 kiln socket varies between kiln manufacturers!***

Han7D plug
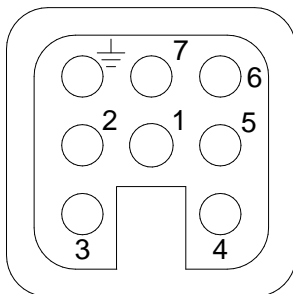
View on pins

CPC14 plug
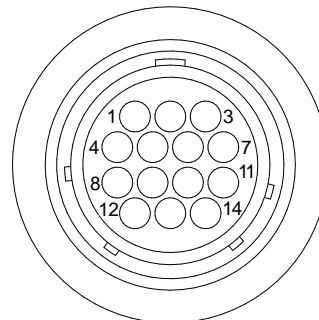
View on pins

Wire function	Wire colour	Han7D pin	CPC14 pin
Mains (L) supply	Brown	5	8
Mains (N) supply	Blue	2	9
Mains Earth	Green/Yellow	8/Earth	11 (or N/C)
Heating control output (L)	White/Black	6	14
Safety control output (L)	Yellow	7	12
Control output (N)	Black	1	13
Thermocouple +ve	Orange	3	1
Thermocouple . ve	White	4	2

Configuring

To enter configuration mode power down the ST215. Press and hold down the ■
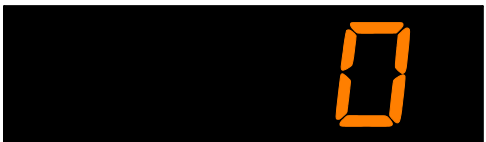key while powering up the ST215.

tC.5

When the thermocouple type is displayed release the ■ key.

P 14 -

The first configuration parameter number is now displayed (flashing 14). Refer to the table below for a description of the available configurable parameters.

P60 -

Change the parameter number with the & keys. To display the parameter value press the key.

0

The parameter value can now be altered with the & keys. To select another parameter press the key.

Pressing the ■ key at any time causes the configuration parameters to be stored. The ST215 will then reboot.

tout

*Note: in the above sequence if no key presses are detected for 30 seconds the instrument will time out and exit configuration mode **without saving any changes**. The buzzer will sound for 3 seconds.*

Configurable Parameters

No.	Function	Min.	Max.	Default	Notes
14	Kiln power rating	0	9999	0	1 unit = 0.1kW
60	Operating units °C/°F	0	1	0	0=°C, 1=°F

Configuration Notes

Parameter	Note
14	**Kiln Power Rating:** This parameter is required to enable the Energy Used feature to operate. Setting example - to set the kiln power rating to 6.2kW then set this parameter to 62. The power rating of a kiln can usually be found on a rating plate attached near the power inlet connection.
60	**Operating Units °C/°F:** When units are changed the controller will reload its default set of programs (in either °C or °F units as required). ***Warning! - this will over-write any existing firing programs!***

Turning On

8.8.8.8.

When turned on the ST215 performs a display test by lighting all of the display segments and illuminating all of the front panel indicator lamps.

F 1.03

The version number of the software embedded within the ST215 is now displayed. If you need technical support you might be asked for this code together with the serial number.

tC.S

Next displayed is the thermocouple type setting. This should match the type of thermocouple fitted to the kiln and can be R, S, K or N type (r,S,H,n).

20°

The final display will show the kiln temperature. All other lamps should be off.

LOC

If pressing any key causes LOC to appear then the keyboard has been locked. This is an anti-tamper feature. Press the ▲ & ▼ keys together & hold down for 5 seconds to unlock.

ULOC

This now shows that the keyboard is UN-LOCKED. To re-lock the keyboard press the ▲ & ▼ keys together & hold down for 5 seconds.

If any mimic panel lamps are on then the ST215 is firing. To stop the firing press the ■ key.

32.°

During firing the right-hand decimal point will light to show when heating power is being applied to the kiln.
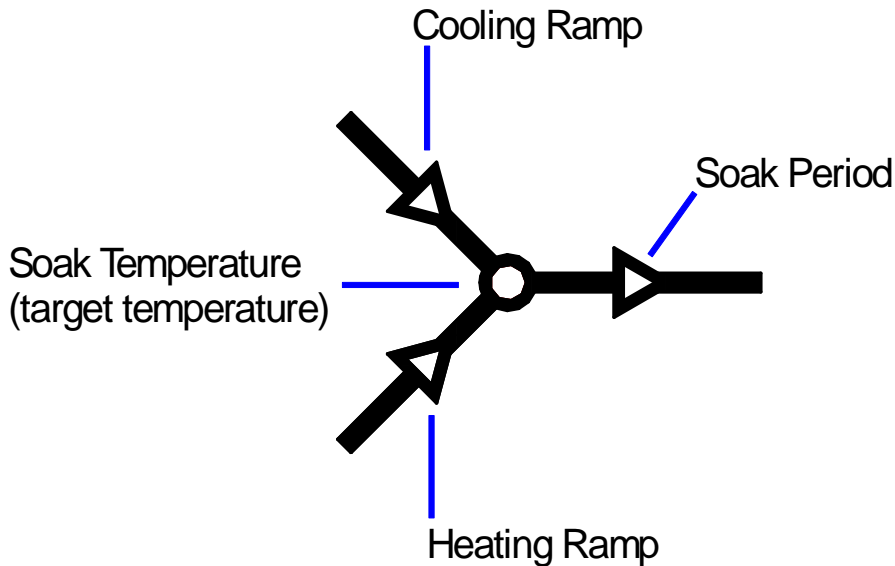
SEGMENT   **SEGMENT**

°C   **°F**

Note: During power up the SEGMENT display shows the operating units (°C/°F) of the ST215 (configurable - see page 7).

Programming

Cooling Ramp

Soak Period

Soak Temperature
(target temperature)

Heating Ramp

An ST215 firing segment comprises a ramp followed by a soak period. Two segments can be used for simple firing (biscuit firing for example) or several segments can be used per program for complex firing (crystal glazing or glass-making for example).

The ST215 ramps the kiln temperature at the required ramp rate until the kiln reaches the soak / target temperature. It then soaks (dwells) at the soak temperature for the soak period. It then runs the next segment until the end of the program is reached.

The ST215 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°/hour to 999°/hour or FULL (full power) or End (end of program).

The soak / target temperature is settable over the range 0 to 1400°C (2552°F).

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

Note: during soaking the ST215 display alternates every 15 seconds between kiln temperature and soak period remaining.

Altering a program

20° When not firing there are no indicators lit on the mimic panel, the run indicator is off and the display shows the current kiln temperature.

The controller settings can be reviewed by pressing the   key.

Pr. 1 The first push of the   key flashes the program number display. The required firing program can now be selected with the   & keys.

Note: holding down the ▲ or ▼ keys causes rapid change of the displayed value.

150° The next push of the   key displays the ramp rate in the range End, 1-999°/HR or FULL. This can be altered with the   &   keys. The heating ramp or the cooling ramp indicator on the mimic panel will flash. End marks the end of the program. FULL heats or cools as fast as possible.

600° The next push of the   key displays the soak temperature. This can be altered with the   &   keys. The soak temperature indicator on the mimic panel will flash.

00.15 The next push of the   key displays the soak period in hours:minutes. This can be altered in the range 00:00 to 99:59 with the   &   keys. The soak period indicator on the mimic panel will flash.

SEGMENT

2 The next push of the   key increments the segment number digit and firing data for the next segment can be entered.

End Program data entry is terminated if End is selected for a ramp rate with the   key. Program data entry is also automatically terminated if the maximum number of segments have been entered.

Note 1: 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°/hr to 999°/hr). If full power is required then push the ▲ key until FULL is displayed. To mark the end of the program push the▼ key until End is displayed

Note 2: to exit programming without cycling through all of the above steps wait 20 seconds without pressing any keys - the ST215 will revert to the idle display. Alternatively press the ■ key to exit programming and to begin firing immediately.

Note 3: the ◄ key can be used to reverse through the programming steps to correct errors or to exit programming mode.

Firing

To start a firing press the ■ key. The firing indicator lamp will flash.

With the firing indicator flashing an optional start delay up to 99 hours: 59 minutes can be entered with the ▲ & ▼ keys.

After 5 seconds, or immediately if the ■ key is pressed again, the firing will commence and the firing indicator lamp will remain lit.

To stop the firing prematurely at any time press the ■ key again. The firing indicator lamp will go out.

Hint: it is good practice to check that the program is correct by pressing the ► key & checking the program number & program contents before pressing the ►■ key to start a firing. It is also a good idea to have a written record of the contents of the firing programs kept and displayed near the kiln especially if there is more than one user of the kiln.

Note: during ramping the ST215 will perform either controlled heating or controlled cooling - as indicated on the mimic display. During soaking the ST215 display alternates every 15 seconds between kiln temperature and soak period remaining. At the end of each segment the segment number display will be incremented.

Information: The ST215 operates by calculating the amount of energy required by the kiln every 30 seconds (installer adjustable). If for example 40% of full energy is required to maintain a particular ramp rate or a particular soak temperature then the ST215 will apply heating power to the kiln for 12 seconds every 30 seconds. The kiln heating indicator will light for 12 seconds every 30 seconds. If the kiln has a mechanical contactor then a loud click will be heard both when the kiln heating indicator lights up and when it goes out. If full heating power is required then the kiln heating indicator will remain lit. If full cooling is required the kiln heating indicator will remain off.

Cooling

Upon completion of firing the ST215 lights all lamps on the mimic display and the kiln is allowed to cool naturally.

While the kiln temperature is above 40°C the display alternates every 5 seconds between the kiln temperature and HOt.
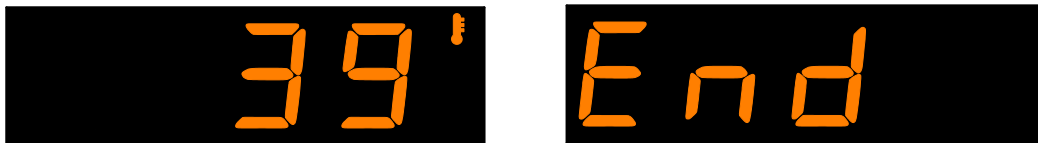
When the kiln has cooled to less than 40°C the display alternates every 5 seconds between the kiln temperature and End.

To return the ST215 back to idle condition ready for the next firing press the ■ key (or turn off the power).

Operating Notes

Kiln too slow

If the ST215 is programmed to heat the kiln at a faster rate than the kiln is capable of then the ST215 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 ST215 is programmed to cool the kiln at a faster rate than the kiln is capable of then the ST215 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 ST215 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.

■ Key Operation

If the ■ key is pressed during a firing then the firing will be halted (not paused). Pressing the ■ key again will cause the ST215 to restart the firing from the beginning. The ST215 will look at the current kiln temperature and if this is greater than the required soak temperature then the ST215 will automatically *cool* from current temperature to the soak temperature. This may not be what is desired so the ■ 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 next section). This is a better option than using the ■ key. The program advance feature is however available to recover quickly from ■ key operation if required.

Memory

All programs & necessary data are remembered when the ST215 is turned off. In the event of power failure during firing the ST215 will automatically resume firing when power is returned (this feature can be disabled - contact supplier).

Delayed Start

By default the delayed start time period is initialised to 00:00 for each firing.

Adjusting While Firing

Firing values can be adjusted while the ST215 is firing. Also there are program pause and program advance features that are particularly useful for glass work.

Adjusting Firing Values

While firing operate the   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   &   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 ST215 will return to its normal running display 20 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.

Program Advance Facility

While firing press and hold down the   key for 3 seconds to obtain the ▸▸ (advance) function. The ST215 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 ramping then the ST215 will switch to soak at the current kiln temperature.
If soaking then the ST215 will advance to the next segment if any, or else it will end the firing.

Changes made to the operation of the ST215 in this way are temporary and are not stored.

Program Pause Facility

While firing press and hold down the   key to obtain the ‖ (pause) function. The ST215 will sound a short beep and the executing program will pause indefinitely at the current kiln temperature. To release the pause repeat the above action.

While paused, the kiln temperature display will alternate periodically with a scrolling PAUSEd display and a beep will be sounded.

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. If left too long at high temperatures kiln damage could result. Pause will automatically release after a time period of 2 hours.

Error Messages

If the ST215 detects a problem the buzzer will sound and an error message will be displayed. This error message will alternate with a display of kiln temperature. The segment number display will show where the error occurred.

To obtain more information on the error operate the   key. The first press will display the maximum temperature reached in the firing. The second press will display the length of time that the error has been present. The buzzer will mute.

Err.1 Heating error. The kiln temperature is not increasing as required. The kiln has been on full power for 15 minutes but the temperature has not increased by at least 3°C.

Possible causes: kiln door or lid not closed properly or door switch faulty or needs adjusting. Heater element open circuit or elements too old. Electrical power phase failure or contactor failure.

Err.2 Thermocouple or thermocouple wiring open circuit. Get thermocouple and wiring checked. Replace thermocouple if necessary.

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

Err.4 Cooling error. The kiln has been on zero power for 30 minutes but the kiln temperature has not fallen by at least 1°C.

Possible causes: contactor failure (contacts welded?) or thermocouple connection intermittent or high resistance.

Err.5 Kiln temperature overshoot. The kiln temperature exceeds the desired temperature by a preset limit as shown below:-

Desired Temperature	Overshoot allowed
Less than 100°C	+60°C
More than 100°C but less than 200°C	+50°C
More than 200°C but less than 600°C	+30°C
More than 600°C	+20°C

Err.6

Maximum firing time exceeded. The length of the firing has exceeded a supplier selectable limit. Default: unlimited.

Err.7

Maximum room temperature exceeded. The internal temperature of the ST215 has exceeded a supplier selectable limit. Default: 50°C.

Possible causes: kiln room vent fan failure, kiln room too small, ventilation grills blocked, damper or bung left open, controller mounted too close to kiln.

All these error messages cause the ST215 to terminate the firing. The buzzer alarm will sound once per second. To reset the ST215 turn off the power to the instrument and have the fault investigated and rectified by your installer or kiln service engineer.

Note: these error messages are provided to detect kiln faults and so offer some protection to the kiln.

Technical note: these error messages will cause the safety relay to open.

Firing Program Errors

Err.P

Program Error. This error message is displayed if a potential error is detected within the firing program when the ■ key is pressed to start a firing. The buzzer alarm will sound 3 times and the segment display will show the suspect segment number. To clear this error press the ▬ key. The ST215 will now enter programming mode to allow the suspect program to be viewed and altered if necessary. If a fault is found then correct it. If no fault is found then press the ■ key again to force the firing program to start. A potential programming error is defined as a very low ramp rate to a very low temperature. Such a programming fault might cause very long firing times with potential kiln damage.

Other Features

Energy Used & Setpoint Displays

Operate the   key at any time to show the amount of electrical energy used in kWh. 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 - see page 7.
Operating the   key a second time shows the current set-point (the temperature which the ST215 is currently trying to achieve).

Keyboard Lock Facility

The keys on the ST215 can be locked so that pressing them has no effect. This is an anti-tamper feature used to ensure that the operation of the ST215 or the program data cannot be altered by un-authorised people. The ST215 can be locked when it is idle (not firing) or while it is firing. It cannot be locked while it is being programmed.

Press the   &   keys together & hold down for 5 seconds to lock or to unlock.

Power Failure Recovery

If power fails during firing then the ST215 recovers as follows:-
For power failure during start delay the ST215 times off the remaining start delay when power returns. For power failure during ramping the ST215 continues the ramp it was previously executing. For power failure during soaking the ST215 ramps back up to soak temperature at the correct ramp rate then applies the remaining soak period. This recovery scheme can be disabled if required (refer to supplier) - the ST215 will then lock up with FAIL displayed and kiln off in the event of power failure.

Sample Ceramics Programs

The ST215 is provided pre-programmed with the ceramic firing programs below. These programs may be modified as required.

Program Number	Program Name	Segment 1 Ramp Rate °C/hr	Segment 1 Soak Temp °C	Segment 1 Soak Time hr.mn	Segment 2 Ramp Rate °C/hr	Segment 2 Soak Temp °c	Segment 2 Soak Time hr.mn	Segment 3 Ramp Rate °C/hr
1	Drying 150°C	50	150	00.20	End	-	-	-
2	Drying 200°C	50	200	00.20	End	-	-	-
3	Onglaze firing 750°C	150	750	00.15	End	-	-	-
4	Biscuit firing 800°C	100	600	00.10	150	800	00.05	End
5	Slow Biscuit firing 850°C	80	600	00.10	100	850	00.05	End
6	Biscuit firing 950°C	100	600	00.10	150	950	00.05	End
7	Earthenware 1050°C	150	300	00.05	130	1050	00.20	End
8	Stoneware 1150°C	150	300	00.05	130	1150	00.20	End
9	Stoneware 1240°C	150	300	00.05	130	1240	00.20	End
10	Stoneware 1280°C	150	300	00.05	130	1280	00.20	End

ST215 User Handbook

Sample Glass Programs

Program No.	Program Description	Seg 1 Ramp Rate °C/hr	Seg 1 Soak Temp °C	Seg 1 Soak Time hr:mn	Seg 2 Ramp Rate °C/hr	Seg 2 Soak Temp °C	Seg 2 Soak Time hr:mn	Seg 3 Ramp Rate °C/hr	Seg 3 Soak Temp °C	Seg 3 Soak Time hr:mn	Seg 4 Ramp Rate °C/hr	Seg 4 Soak Temp °C	Seg 4 Soak Time hr:mn	Seg 5 Ramp Rate °C/hr
1	4-6mm Float Glass Fuse	150	538	00:10	FULL	840	00:20	FULL	538	00:45	182	427	00:15	End
2	4-6mm Float Glass Slump	150	538	00:00	200	700	00:15	FULL	538	00:15	182	427	00:00	End
3	6mm Bullseyeï Fuse	222	677	00:30	333	795	00:10	FULL	482	01:00	83	371	00:01	End
4	6mm Bullseyeï Slump	167	640	00:10	FULL	482	01:00	56	371	00:01	End	-	-	-
5	6mm Spectrum System 96ï Fuse	200	500	00:00	FULL	804	00:12	FULL	540	00:40	150	510	00:20	End
6	6mm Spectrum System 96ï Slump	155	704	00:20	FULL	540	01:30	FULL	510	00:10	26	371	00:00	End
7	Bottle Firing Cycle	170	510	00:00	250	780	00:10	FULL	510	01:00	70	400	00:30	End
8	Low Stain	200	570	00:10	FULL	516	00:30	100	300	00:00	End	-	-	-
9	High Stain	200	665	00:10	FULL	550	00:20	FULL	516	00:30	100	300	00:00	End

Characteristics

Electrical

Power supply
Voltage range: 90 - 264VAC
Frequency: 50/60Hz
Power: Controller 4VA (max)
            Switched outputs 125VA

Fuse: 3.15A slow-blow HRC
            20mm x 5mm ceramic

Control Relays (2)
Contact type: SPST NO
Switched Line voltage O/P @500mA max
(for contactor driving)

Thermocouple
R,S,K & N type.

Lead & Connector
2m or 3m flexible grey polyurethane lead
Fitted with either Han7D or CPC14 connector

Environmental

Operating temperature range: -10°C to +55°C
Storage temperature range: -10°C to +55°C

Error Handling

Thermocouple failure detection
Thermocouple reversal detection
Heater failure detection
Kiln over-temperature detection
Room over-temperature detection
Lock-up on error facility
Firing run time hours limiter
User program check
Buzzer Alarm

Other

Keyboard lock facility & indication
Kiln heating indicator
Program running indicator
Energy used display
Power on/off switch

Mounting Bracket

Material: ABS flame retardant UL 94V-0
Colour: Black RAL9011
Fixing slot centres (vertical): 70mm
Fixing slot size: 8mm x 4mm

Temperature

Temperature setting
Range: 0 to 1400ºC (R/S) 0 to 1200°C (K/N)
Resolution: 1ºC

Control Accuracy
P.I.D. Control
Reading accuracy: ±0.25% FSD ±1 digit

Time

Start delay range: 00:00 to 99hr 59min
Soak time range: 00:00 to 99hr 59min
Resolution: 1 min

Ramps

Ramp rate: 1 to 999°/hour or FULL
Ramps can be heating or cooling

Enclosure

Material: ABS flame retardant UL 94V-0
Sealing: IP51
Size: 80/68mm(W), 165mm(L), 28mm(D)
Colour: Black/Dark Grey
(RAL9011/RAL7012)

Weight

Instrument + cable + wall bracket: 0.460kg (max)

Packaging

Packaged size: 248 x 185 x 58mm
Packaged weight: 0.570kg (max)

CE This instrument complies with Council Directive 89/336/EC (EMC) & Council Directive 2006/95/EC (safety)

Council Directives 2002/96/EC & 2003/108/EC
The crossed out bin symbol, placed on this product, reminds you of the need to dispose of the product properly at the end of its life. Electrical & Electronic Equipment should never be disposed of with general waste but must be separately collected for proper treatment. In this way you will assist in the recovery, recycling & reuse of many of the materials used in this product.