Contents

1. Features

- 16 programs each with up to 32 segments
- 1 controlled heating / cooling ramp + soak per segment
- Soak periods 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
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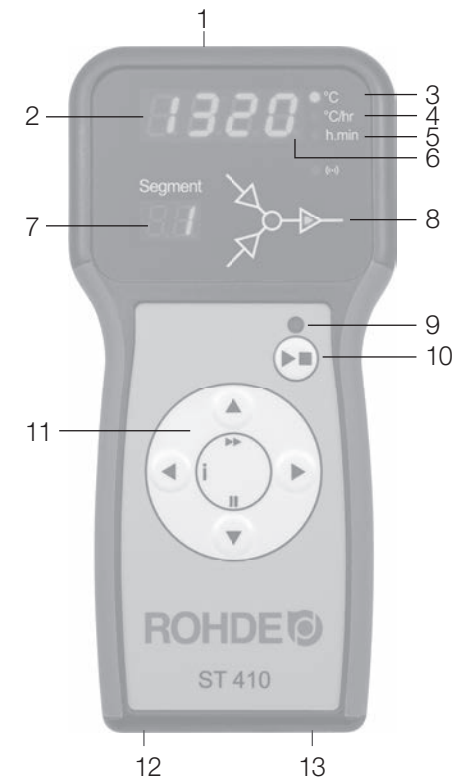
2. Introduction

You have chosen an ST 410 controller, a high-quality product. This controller incorporates the latest technological features and is the leader in its class.

After reading this manual you will be familiar with the functionality of the ST 410 controller. Please make sure that you fully understand the kiln manufacturer's safety instructions.

Make sure that the controller is mounted at a safe distance from the kiln and is not exposed to direct heat from exhaust air or radiation from the kiln.
Do not place the controller on top of the kiln.

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3. At a Glance

 1 USB Port
 2 Main display
 3 Temperature icon
 4 Ramp rate icon
 5 Time icon
 6 Kiln heating indicator
 7 Segment display
 8 Mimic display
 9 Firing indicator
10 Start/Stop key
11 Control keys
12 Fuse
13 Power ON/OFF switch

4. Quick Start Guide

• Switch on & wait for kiln temperature display.

• To run a firing program press the $(\blacktriangleright)$ key.

• To select a firing program press the $(\blacktriangle)$ or $(\blacktriangledown)$ keys.

• To start the selected program press the $(\blacktriangleright\!\bullet)$ key.

• To stop the firing at any time press the $(\blacktriangleright\!\bullet)$ key again.

• To review firing data press the $(\blacktriangleright)$ key to enter the programming mode.

• To change firing data press the $(\blacktriangle)$ and $(\blacktriangledown)$ keys to change the displayed value.

• Use the $(\blacktriangleright)$ 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 $(\blacktriangledown)$ key.

• To exit the programming mode either wait 20 seconds or press the $(\blacktriangleright\!\bullet)$ key to start firing.

• If the keyboard is locked then press the $(\blacktriangle)$ and $(\blacktriangledown)$ keys together and hold down for 5 seconds to unlock.

5. Turning On

8.8.8.8.:   When turned on the ST 410 performs a display test by lighting all of the display segments and illuminating all of the front panel indicator lamps. The controller will sound a short beep.

F1.0 0   The version number of the software embedded within the ST 410 is now displayed. If you need technical support you might be asked for this code together with the serial number.

t C.r   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.

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 $(\blacktriangle)$ and $(\blacktriangledown)$ keys together & hold down for 5 seconds to unlock.

ULOC   This now shows that the keyboard is UNLOCKED. To re-lock the keyboard press the $(\blacktriangle)$ und $(\blacktriangledown)$ keys together & hold down for 5 seconds.

If any mimic panel lamps are on then the ST 410 is firing. To stop the firing press the $(\blacktriangleright\!\bullet)$ key.

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

°C °F   **Note: During power up the SEGMENT display shows the operating units (°C/°F) of the ST 410 (Installer adjustable).**

6. Programming

A firing segment

1.1 Heating Ramp
1.2 Cooling Ramp
  2 Soak Temperature
  3 Soak Period

The LED indicator for symbols 1.1, 1.2, 2 and 3 shows the part of the selected segment that is currently being edited.

An ST410 firing segment comprises a ramp (heating ramp or cooling ramp) and segment temperature followed by a soak period. Two segments can be used for simple firing (biscuit firing for example) or several segments
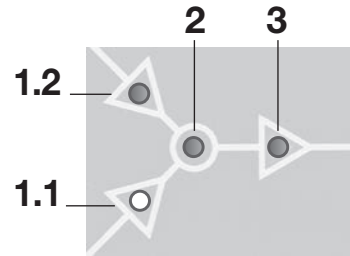can be used per program for complex firing (crystal glazing or glassmaking for example).

The ST410 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 ST410 is capable of both positive (heating) ramps and negative (cooling) ramps. The type of ramp is clearly shown on the mimic display during firing.

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

The soak / target temperature is settable over the range 0 to 1320°C (2552°F).

The soak period is settable over the range 00:00 (no soak) to 99 hours 59 mins.

Note: During soaking the ST410 display alternates every 15 seconds between kiln temperature and soak period remaining.

7. 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.

Pr.1   **Program location:** The controller settings can be reviewed by pressing the ► key. The first push of the ► key flashes the program number display. The required firing program can now be selected with the ▲ and ▼ keys. Note: Holding down the ▲ and ▼ keys causes rapid change of the displayed value.

150‹   **Heating rate/Cooling rate:** The next push of the ► key displays the ramp rate in the range END, 1–999°C/h or FULL. This can be altered with the ▲ and ▼ 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'   **Target temperature:** The next push of the ► key displays the soak temperature. This can be altered with the ▲ and ▼ keys. The soak temperature indicator on the mimic panel will flash.

00.15∘   **Soak time:** 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 ▲ and ▼ 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: To exit programming without cycling through all of the above steps wait 20 seconds without pressing any keys - the ST410 will revert to the idle display. Alternatively press the ►■ key to exit programming and to begin firing immediately.

Note 2: The ◄ or ► keys can be used to reverse through the programming steps to correct errors or to exit programming mode.

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8. Firing

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

`00.00°` **Setting the delayed start time (delayed start facility):** With the firing indicator flashing an optional start delay up to 99 hours: 59 minutes can be entered with the ⊙ and ⊙ 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.

Note 1: 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 2: During ramping the ST 410 will perform either controlled heating or controlled cooling - as indicated on the mimic display. During soaking the ST 410 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 ST 410 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 ST 410 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 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.

9. Cooling

Upon completion of firing the ST 410 lights all lamps on the mimic display and the kiln is allowed to cool naturally.

`120°C`

`HOt` While the kiln temperature is above 40°C the display alternates every 5 seconds between the kiln temperature and HOT.

`39'`

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

To return the ST 410 back to idle condition ready for the next firing press the ⊡ key (or turn off the power to the instrument).

10. Operating Notes

Kiln too slow If the ST 410 is programmed to heat the kiln at a faster rate than the kiln is capable of then the ST 410 will turn on full power and proceed to the next ramp or soak segment when the kiln temperature has risen to the correct temperature.

Likewise if the ST 410 is programmed to cool the kiln at a faster rate than the kiln is capable of then the ST 410 will apply zero power and proceed to the next ramp or soak segment when the kiln has cooled to the correct temperature.

Heating & Cooling Ramps The ST 410 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 ST 410 to restart the firing from the beginning. The ST 410 will look at the current kiln temperature and if this is greater than the required soak temperature then the ST 410 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. This is a better option than using the ⊙ key. The program advance feature is however available to recover quickly from ⊙ key operation if required (see "Adjusting While Firing" section).

Memory All programs & necessary data are remembered when the ST 410 is turned off. In the event of power failure during firing the ST 410 will automatically resume firing when power is returned.

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

11. Adjusting While Firing

Firing values can be adjusted while the ST 410 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 ST 410 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 ▲ to obtain the ▶▶ (*advance*) function. The ST 410 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 ST 410 will switch to soak at the current kiln temperature. If soaking then the ST 410 will advance to the next segment if any, or else it will end the firing.

Changes made to the operation of the ST 410 in this way are temporary and are not stored.

Program Pause Facility

While firing press and hold down the (▼) key to obtain the **II** (*pause*) function. The ST 410 will sound a short beep and the executing program will pause at the current kiln temperature. To release the pause repeat the above action.

`PAUS`   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 an Installer-defined time period.

12. USB Datalogger module for ST 410

General Description

This optional module enables a USB FLASH memory drive to be connected to the controller. Its main function is to write time-stamped data files to the memory drive for datalogging. It can also read configuration and /or user-program data files into the controller.

FLASH Memory Drive Specification

These must be type 1 or type 2 drives. Type 3 drives (with blue insulator) do not work. The drives must be formatted as FAT32 or FAT16 (NTFS format does not work). The module has been tested with several makes of 8G, 16G and 32 GByte drives. Low cost Sandisk 8G and 16G FLASH drives work straight out of the packaging. There is a "Drive mounted" indicator LED next to the USB connector – if this illuminates then the inserted FLASH drive is acceptable.

The drive can be inserted at any time (with the controller either powered or un-powered). It can also be removed at any time – but preferably not while the controller is writing data to the drive. The "Drive Mounted" LED will turn off when the drive is removed.

Real Time Clock Function

This datalogger module incorporates an accurate battery backed date and time of day clock. It compensates for leap years. It does not automatically compensate for daylight saving in summer and winter. This clock is used to time stamp data within the datalogger files. It is also used to date and time stamp the actual file.
Note: The date and time stamp of the file is the time the file was last written to (not the time when the file was first created). The (replaceable) clock battery (CR1220) is sized to last at least 5 years.

Clock Adjustment

With the controller turned on and not firing: press and hold down the (◄) key for 5 seconds.
You are now in date setting mode. The date is shown in YY.MM.DD format (2018.03.28 illustrated):

`18.03`
`28`

Navigate to the flashing digit with the (►) or (◄) key. Change the flashing digit with the (▲)(▼) keys. Move onto the next digit with the (►) key.

Move to the time setting mode by pressing the (►) key from the flashing day display. The time is now shown in HH.MM.SS format (09:15:20 illustrated):

`09.15`
`20`

Navigate to the flashing digit with the (►) or (◄) key. Change the flashing digit with the (▲)(▼) keys. Move onto the next digit with the (►) key. Leave the time setting mode either by waiting 15 seconds or by pressing the (►) key from the flashing seconds display.

Data logging

Data logging commences when a firing is started. Datalogging finishes when the firing is complete and when the kiln has cooled to 100°C. A file: LOGnnn.CSV is created on the FLASH drive. The first file to be created will be LOG000.CSV. Subsequent firings will generate LOG001.CSV … up to LOG999.CSV. Only 1000 log files are allowed. It is best to move the LOG files to another storage disk after just a few firings—because it takes about 1 second to index each existing file on disk before a new file can be created. So for example if there are files LOG000.CSV to LOG100.CSV on disk there would be a delay of just over 100 seconds before LOG101.CSV could be created and logging could be commenced.
The files created are in "Comma Separated Variable" (CSV) ASCII format and can be directly imported into Microsoft Excel Spreadsheets.

Logging Interval

This can be adjusted over the range 5 to 300 seconds (default 60 seconds) using parameter P50 with the controller in configuration mode (see page 39, Parameter Configuration).

Log File Format

Year	Mon.	Day	Hour	Min.	Sec.	Kiln Temp.	Set Point	Amb. Temp.	Prog.	Seg.	Status
2018	4	1	20	8	52	26,7	28	24	7	1	Heating Ramp
2018	4	1	20	9	7	26,7	28	24,2	7	1	Heating Ramp
2018	4	1	20	9	22	26,7	29,2	24	7	1	Heating Ramp
2018	4	1	20	9	37	26,7	29,2	24	7	1	Heating Ramp
2018	4	1	20	10	52	26,7	30,5	24	7	1	Heating Ramp
2018	4	1	20	10	7	26,7	30,5	24	7	1	Heating Ramp
2018	4	1	20	10	22	26,7	31,7	24	7	1	Heating Ramp
2018	4	1	20	10	37	26,7	31,7	24	7	1	Heating Ramp
2018	4	1	20	10	52	26,7	33	23,9	7	1	Heating Ramp

13. Error Messages

If the ST 410 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 2°C.

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

`Err.5` Kiln temperature overshoot. The kiln temperature 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 an installer selectable limit.

`Err.7` Maximum room temperature exceeded. The internal temperature of the ST 410 has exceeded an installer selectable limit.

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 ST 410 to terminate the firing. The alarm buzzer will sound once per second. To reset the ST 410 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.

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 alarm buzzer will sound 3 times and the segment display will show the suspect segment number. To clear this error press the ▶ key. The ST 410 will now enter programming mode to allow the suspect program to be viewed and altered if necessary.

If no fault is found then press the ⏭ key again to force the firing program to start.

14. Other Features

Energy Used & Setpoint Displays

Operate the ◀ key at any time to show the amount of electrical energy used in kWh. During a firing the energy used so far is shown. After a firing the total energy used for the firing is shown. 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 39, Parameter Configuration).

Operating the ◀ key a second time shows the current set-point (the temperature which the ST 410 is currently trying to achieve).

Keyboard Lock Facility

The keys on the ST 410 can be locked so that pressing them has no effect. This is an anti-tamper feature used to ensure that the operation of the ST 410 or the program data cannot be altered by un-authorised people. The ST 410 can be locked when it is idle (not firing) or while it is firing. It cannot be locked while it is being programmed.

`LOC`   Press the ▲ und ▼ keys together and hold down for 5 seconds to lock or to unlock.

Power Failure Recovery

If power fails during firing then the ST 410 recovers as follows:
For power failure during start delay the ST 410 times off the remaining start delay when power returns. For power failure during ramping the ST 410 continues the ramp it was previously executing. For power failure during soaking the ST 410 ramps back up to soak temperature at the correct ramp rate then applies the remaining soak period.

Parameter Configuration

The ST 410 offers the possibility to change different operating parameters:
1) kiln output to determine the energy consumption in kW
2) time interval of USB recording in seconds (s)
3) temperature unit in °C or °F

These values can be adjusted in the controller's parameter level.
While turning on the controller push the ▶■ key until "tC.S" is displayed.
The controller displays the first available parameter immediately after releasing the ▶■ key. The display shows „P14-".

Push the ▲ and ▼ keys to select the parameter number. Push the ▶ key to show the selected parameter. This value can be changed with the ▲ and ▼ keys.

After setting all parameters, push the ▶■ key to save your changes. The controller display gets darker and the controller restarts. The controller is now in operating mode again and can be used in the usual way.

The ST 410 offers the possibility to change parameter numbers 14, 50 and 60.

The following table describes each parameter:

Nr.	Function	Min.	Max.	Default setting	Remark
14	Kiln output in kW	0	9999	0	1 unit = 0.1 kW
50	USB recording interval in s	5	300	60	
60	Temperature display in °C or °F	0	1	0	0 = °C; 1 = °F

15. Sample Ceramics Programs

Program Number	Program Name	Seg 1 Ramp Rate °C/h	Seg 1 Soak Temp °C	Seg 1 Soak Time h:m	Seg 2 Ramp Rate °C/h	Seg 2 Soak Temp °C	Seg 2 Soak Time h:m	Seg 3 Ramp Rate °C/h
1	1050°	100	1050	00:00	FULL/SKIP	1050	1:30	END
2	Bisque firing 950°	60	600	00:00	100	950	00:00	END
3	Earthenware 1050°	150	900	00:00	100	1050	00:30	END
4	Stoneware 1250°	150	900	00:00	60	1250	00:05	END

Note:

The preset controller programs are simple sample programs for biscuit, earthenware and stoneware firing. These programs must be checked before firing to allow the firing temperature, heating rates and dwell times to be adapted to the materials used.

The variety of ceramic bodies, engobes, glazes and decorative colours as well as different types, sizes and performances of kilns used and individual furniture set assemblies, types and quantities of products to be fired make it difficult to make generally applicable recommendations.

We advise against using uncontrolled full power heating ramps (FULL) to protect heating elements and the kiln from unnecessary wear and to allow for repeatable firing results.

* We recommend that you use preset program No. 1 "Initial firing" for the initial firing of your kiln, new heating elements (oxidation firing) and new furniture material (stilts and batts)..
Open the air supply and exhaust air openings during initial firing. Please consult the instruction manual for the kiln.

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