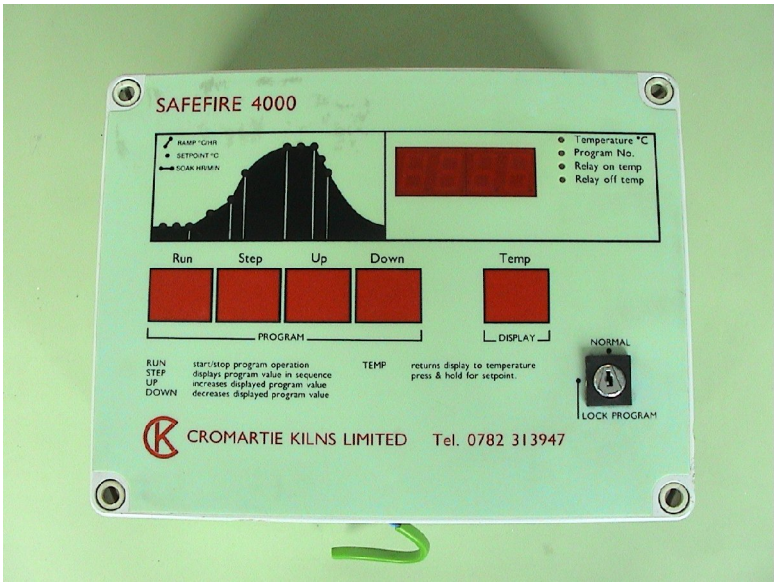
CROMARTIE KILNS LTD

SAFEFIRE 4000 KILN PROGRAMMER
OPERATING INSTRUCTIONS



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PARK HALL ROAD, LONGTON. STOKE-on-TRENT, ENGLAND. ST2 5AY
TELEPHONE: STOKE-on-TRENT (01782 313947)
FAX: (01782 599723)
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DESCRIPTION

The Safefire 4000 Controller is a combined Programmer and Temperature Controller, designed specifically for use with small pottery kilns. The system is Microprocessor based and contains all solid stated circuitry, and a range of extra facilities provides the user with a versatile, easy to use instrument. Control of the entire firing cycle is fully automatic, giving accurate and repeatable firings.

Installation, and connection to the kiln is easily carried out by referring to the installation section of this book.

The user may enter 10 complete firing programs which are stored in memory, and may be recalled for use or modification before a firing commences.

Programs are retained in memory for up to 3 months while the unit is switched off. The actual retention time will depend upon the charge condition of the internal battery, which is trickle-charged during normal operation. (Battery life is typically 5 – 7 years. Note battery is soldered to controller PCB)

A complete program will follow all, or part of this sequence:
A controlled heating ramp (linear in degrees per hour) up to the first set-point temperature.
Full-power heating up to the second set-point temperature.
A soak period, with the temperature maintained at the second set-point temperature.
A controlled cooling ramp (linear in degrees per hour) down to the third set-point temperature.
When the kiln has cooled to this temperature, power to the kiln is switched off and the kiln will continue to cool at its normal free rate. The 'End-of-program' display is shown on the unit.

The internal operating system of the unit gives the user a wide range of program options, depending on requirements. These are:

1. 'Full' program (see fig 1)
2. Each program segment may be omitted if required (see figs 2,3,4,5). By setting delay/soak times or segment set-points to zero, the relevant program segments are bypassed.

The auxiliary relay in the unit may be connected to external apparatus, such as a damper control motor, fan or alarm. This relay is designed to energise at a programmed temperature during the 'heating' part of the program, and de-energise at another programmed temperature during the 'cooling' segments. Alternatively it may be programmed to operate as a 'process relay, i.e. to energise at the start of the first heating ramp and de-energise when the 'END' condition is reached.

Another useful feature is the automatic continuation of a firing after a power cut. If a power cut occurs during a firing, the program will re-start (at a point in the program depending on the temperature and set-points) WHEN POWER IS RESTORED. However, if the power cut has been sufficiently long so that the kiln has cooled by more than 100°C from its last value, then the unit will terminate the firing, and power to the kiln will be switched off. The temperature which the kiln had originally reached is stored in memory, and may be displayed.
Please refer to the section on 'OPERATING NOTES' for a more detailed description of these features.

SPECIFICATION

Digital temperature display 1600°C span.
Delayed start facility, 0 to 99 hours 59 minutes.
1-heating ramp, 1 to 1000°C per hour, to first setpoint.
Full power to second setpoint.
3-Set Points, 0 to 1300°C
1-Soak Period, 00.00 to 99hr.59mins.
1-cooling ramp, 1 to 1000°C per hour, to final setpoint.
Automatic switch-off at the end of each program.
2-Term control, fixed P&I terms suitable for all kilns.
10-Stored programs facility.
Auxiliary relay for control of dampers or other apparatus.
Front panel 'mimic' display shows program sequence and operation.

These values are programmed using a simple keypad on the front panel. All programmed values are shown on the digital display.

Other features include:

Keyswitch to prevent unauthorised operation or program changes.
Setpoint limited at 1300°C
Battery back-up for data memory.
Suitable for use with type R thermocouple or type S from Jan 91.
Cold junction compensation included.
Digital thermocouple linearisation.
Solid state relay for contactor control.
All programs values may be changed during RUN.
Automatic restart of program if the power supply fails during a firing, provided that the kiln temperature has not fallen by more than 100°C.
Thermocouple break protection provided.
Wall mounted case.
Sealed membrane front panel.
Automatic detection and display of system fault conditions. Refer to Operating Notes for detailed description.

Note. For type K thermocouple versions, the following changes apply:

Digital temperature 1300°C span.
Setpoints, 0 to 1200°C
Setpoint limit at 1200°C.

INSTALLATION

The unit is intended to be fixed to a wall, adjacent to the kiln. Fix the unit to the wall, using the 4 bracket attachments, at least two feet from the kiln (so that the unit is not damaged by heat radiated from the kiln).

Connect the multiway plug (AMP) to the socket provided on the kiln.

For reference purposes, or if the unit is to be fitted to a kiln which does not have a multiway socket, the connections are as follows:

Pin 1	White	Thermocouple + input)
Pin 2	Blue	Thermocouple – input
Pin 5	Red	Relay common
Pin 6	Yellow	Relay N.O.
Pin 7	Pink	Relay N.C.
Pin 8	Brown	AC input LIVE
Pin 9	Blue	AC input NEUTRAL
Pin 10	Green	EARTH
Pin 13	Black	Supply to contactor coil
Pin 14	Orange	Supply to contactor coil

If a safety switch or heat fuse is to be incorporated, simply connect these items in series with one of the wires to the contactor coil. Do not make any other connections.

AC supply input is 220/240v 50/60Hz.

PROGRAMMING

Switch on the unit. The display will normally show the kiln temperature.
If the display is a fault code (F x) press any button to clear the display and refer to the Operating Notes section.

Turn the keyswitch to the 'Normal' position, which allows program values to be entered.
If any green LED lights are lit, press the 'RUN' button to extinguish them.
Press the 'STEP' button. The display will show the current program number selected (0-9). To change, press either 'UP' or 'DOWN'. When the required number is displayed, press 'STEP' again and the display will show DELAY time, in hours and minutes format. The 'mimic' display will show that the displayed value relates to 'DELAY'.
To set the DELAY time required (which is the time delay for the start of the firing) press the 'UP' or 'DOWN' buttons. A single press will increase or decrease the displayed time by 1 minute. If the button is held down, after the initial 1 digit change the display will start to increase or decrease, initially at a slow rate and then speeding up in order to et large values quickly. When the approximate delay time required is displayed, release the button. Final small adjustments can be then made by single presses of the appropriate 'UP' or 'DOWN' button.
Note that this technique applies nto all parameter entries. When the desired DELAY time is displayed, press the "STEP2 button. The mimic diagram will change to show that the first ramp value is now displayed.
Note that the ramp value is in degrees per hour. To enter the required value, press the 'UP' or 'DOWN' buttons as previously described.
Press 'STEP' when the required value is correctly shown on the display.
The next program value to be shown is the first SET-POINT, in degrees centigrade. This is the temperature which the kiln will rise to at the previously entered ramp rate. This value is limited to a maximum of 1300°C.
Continue pressing the 'STEP' button, and 'UP/DOWN' as required in order to set the remaining program values. The mimic diagram, or right hand LED column will show which program parameter is currently being displayed.
At the end of the program entry sequence, the display will revert to showing TEMPERATURE. All program values will then have been set, for the program number selected. If required, the program may be checked for correct values by just pressing 'STEP', and reading each displayed value.
Note that new program values 'ie which have been changed by using the 'UP/DOWN' buttons) will only be entered into memory when the 'STEP' button is pressed.
At any time, the display may be returned to TEMPERATURE by pressing the DISPLAY button.

Note that to by-pass any program segment, set the value to zero.
To load another program, change the ‘PROGRAM NO’. selected, and repeat the entire sequence described above.

OPERATING NOTES

To run a program, carry out the following sequence of operations:

Turn the keyswitch to the ‘NORMAL’ position.

If any green LED’s are lit, press the ‘RUN’ button to extinguish them.

Press ‘STEP’ to show the current program number selected. Change if required, and enter the new value by pressing ‘STEP’. Note that the program number cannot be changed if the unit is in the ‘RUN’ mode.

Press the ‘RUN’ button. The program will now start, and the green mimic display LED’s will show the part of the program in operation. The power contactor in the kiln will switch on and off to maintain the correct rate of temperature rise in the kiln.

To prevent the program being accidentally (or deliberately !) changed, turn the keyswitch to the ‘PROGRAM LOCK’ position, and remove the key. The program may now only be examined (by pressing ‘STEP’) but cannot be changed.

If the display is showing kiln temperature, pressing and holding down the DISPLAY button will change the display to the internal SETPOINT value. This is the temperature at which the kiln should be, and will increase or decrease at a rate depending on the ramp rate programmed. Releasing the button reverts the display to kiln temperature.
As the temperature rises and the program goes through its sequence, the green LED’s will change to show the part of the program currently in operation.
If the program is in a ‘SOAK’ or ‘DELAY’ period, press the STEP button to display the relevant value will show the remaining time to complete that segment, i.e. the display will decrement towards zero at 1 minute intervals. The program will advance to the next segment when the display reaches zero.

When the program has completed, all the 5 green LED’s will light to show the END of PROGRAM condition.

To re-set the program, press the ‘RUN’ button once. This will re-load all the original program values, and extinguish all the green LED’s.
To re-start the program, press the ‘RUN’ button again. The entire sequence will then repeat.

If a power cut occurs during a firing, the program will continue when power is restored, if the kiln temperature has not fallen by more than 100°C during the power cut. If the temperature has exceeded this amount, the RUN mode will be cancelled, the program will terminate, and power to the kiln will be cut off. Pressing and holding down the ‘DISPLAY’ button shows the highest temperature that the kiln reached just before the power cut. A decision may then be made on the best way to complete the firing.

AUXILIARY RELAY operation.

The ‘RELAY ON TEMP’ and ‘RELAY OFF TEMP’ displays show the temperature values at which the relay will energise and de-energise respectively.

The RELAY ON function only operate (at the programmed temperature) during the two heating ramps. Similarly, the RELAY OFF function operates only during the cooling part of the program. I.e. during ramp 3 or END.

The relay can be connected to damper systems if required (maximum for relay contacts is 1 amp 240v resistive load). or by setting the RELAY ON temperature to a value greater than the highest set-point it can function as an alarm. The relay will then only energise if the kiln temperature equals or exceeds the ON setting.

Alternatively, by setting both the RELAY ON and RELAY OFF temperatures to zero, the relay will then energise at the start of the first heating ramp (i.e. after the end of any DELAY), and de-energise when the 'END' condition is reached.

FAULT CODES and DISPLAY

The unit incorporates a comprehensive fault detection and display facility. If a fault conditions occurs, the display will change to show the appropriate fault code number. If a fault condition occurs while a program is running, program operation will stop and the RUN mode will be cancelled.
Press any button to clear the fault code display.

FAULT CODES

F 1 Thermocouple open circuit e.g. broken or disconnected.

F 2 Thermocouple reversed connection. Occurs if the displayed temperature shows zero, 15 minutes after the start of a firing.

F 3 Ramp 2 12 hours max, time exceeded. Prevents over-long firings if for example an element has failed.

F 4 Power cut during a firing. Temperature drop exceeded 100°C during the power cut.

F 5 (flashing) current program values corrupted. See below.

F 6 All stored programs lost. This may occur if the internal battery has become discharged due to a long period of storage or non use. Re-entered program values.

For F 1, the display will automatically clear when the thermocouple fault is corrected. If a button is pressed to clear the fault code display before the thermocouple fault condition is corrected, the temperature value will show as 1999 degrees. This is an alternative F 1 condition display.

For F 5, the display will flash on and off, indicating that one or more of the program values is out of range, or has become corrupted, and represents an 'illegal' value for correct operation of the 4000 unit.
The 'RUN' mode will be turned off (if it was on) and power to the kiln will be switched off.
To correct this condition, press 'STEP' until the display shows ----. This indicates the program value which is out of range, or corrupted.
Press 'UP' or 'DOWN' to display the required program value, and then press 'STEP' to enter the value. The flashing display should then revert to normal, and the unit is ready to use. If the display continues to flash, this means that another program value is out of range. Continue to press 'STEP' and correct as before.

4 DIAGRAMS (not available on web folder)