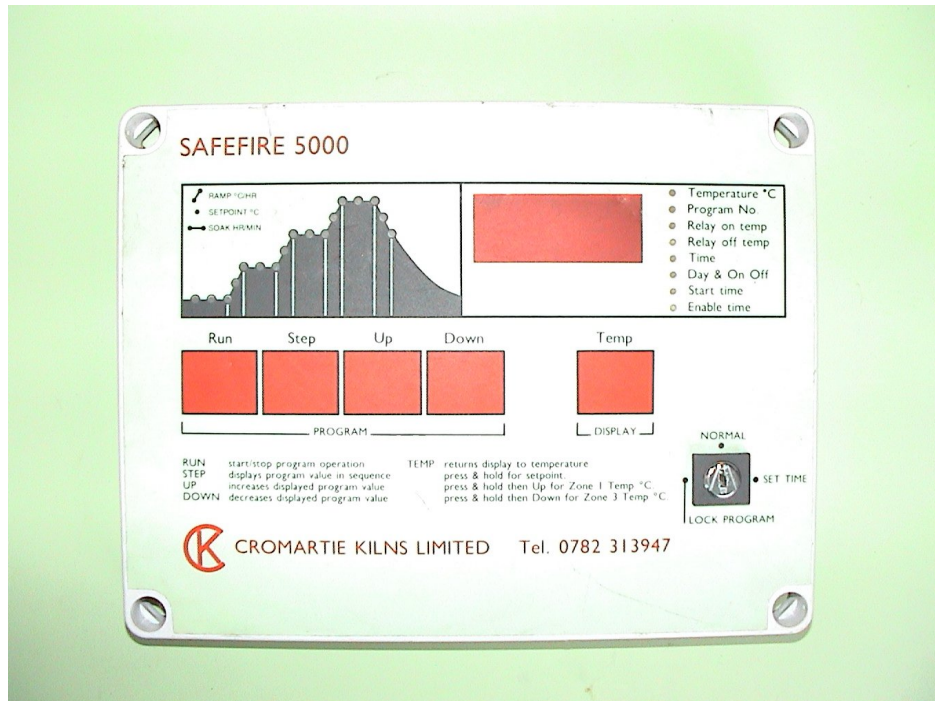


# CROMARTIE KILNS LTD

## SAFEFIRE 5000 KILN PROGRAMMER OPERATING INSTRUCTIONS



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## DESCRIPTION

The Safefire 5000 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, followed by an optional soak period at the setpoint value. This sequence may be followed by two more optional Ramp / Soak program segments. These two ramps may be either heating or cooling ramps as required, according to the relative setpoint values programmed.

After the third Soak segment, a final cooling ramp is available, to provide a controlled cool down to the last setpoint temperature.

When the kiln has cooled to this temperature, power to the kiln is switchd off and the kiln will continue to cool at its normal free rate. The 'End-of-program' display (all the green lights illuminated) 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,). By setting soak times and / 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' segment or during the power-off cool down.. 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.  
Digital temperature display 1600°C span.  
7-Day, 24 hour time clock.  
Programmable switch-on time.  
Programmable 'ENABLE' time, preventing switch-on before this time.  
3-heating ramps, 1 to 1000°C per hour.  
3-Set Points, 0 to 1300°C  
3-Soak Periods, 00.00 to 99hr.59mins.  
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.  
Controlled 'cool' ramp after the last 'soak' period.  
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 / time clock changes.  
Setpoint limited at 1300°C  
Battery back-up for data memory.  
Suitable for use with type R thermocouple.  
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.

## TIME CLOCK OPERATION

Press the 'STEP' button until the 'TIME' lamp illuminates. The display will show the present time in a 24 hour format (i.e. 00.00 = midnight).

Turn the keyswitch to the 'SET TIME' position, which will allow the clock settings to be changed. Using the UP / DOWN buttons, set the displayed value to the correct time, and press the 'STEP' button to load and restart the time clock. The clock will restart at the instant the 'STEP' button is pressed.

The display will then change to 'DAY & ON / OFF'.

This display shows only 2 numbers, the left hand digit corresponds with the day (1-7), and the right hand is the ON/OFF command for that day (1 or 0).

First, using the 'UP' button, set the 'DAY' number to 1, which will represent Monday. Then press the 'DOWN' button to alternately change the right hand digit to either a 1 (if a firing is allowed on that day) or a 0 (if no firing allowed).

Then press 'UP' again, to change the 'DAY' to 2 (corresponding to Tuesday), and repeat the above procedure to set the ON/OFF display. Continue through to day 7 (Sunday).

The sequence may finally be checked by pressing the 'UP' button, noting the corresponding ON or OFF code for each day. Finally, leave the display showing the day number corresponding to the actual day of the week, and press 'STEP'. This will program the clock with the correct day, and store the ON / OFF sequence into memory.

After pressing 'STEP', the next parameter displayed will be 'START TIME', which is the actual time that the firing will commence on each of the days previously programmed to be 'ON'. Use the 'UP / DOWN' buttons to enter the required time. Note that this time may be entered without the keyswitch necessarily set to the 'SET TIME' position.

Press 'STEP' again. The display will show 'ENABLE TIME'. This time setting is the earliest time that the kiln may be set to switch on, and prevents operation outside authorised times, for example to ensure use only during cheap rate electricity periods. Use the 'UP / DOWN' buttons to set the required 'ENABLE TIME', and press 'STEP' to enter the value. The display will now have returned to 'TEMPERATURE', showing that all programmable values have been entered. Return the keyswitch to the 'NORMAL' position.

## 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. If you are in any doubt regarding these connections, please contact CROMARTIE KILNS before switching on.

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

## PROGRAMMING

Switch on the unit. The display will normally show the kiln temperature.

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 the first RAMP rate, in degrees/hour.

To see the required RAMP rate press the 'UP' or 'DOWN' buttons. A single press will increase or decrease the displayed value by 1. 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 set large values quickly.

When the approximate value required is displayed, release the button. Final small adjustments can then be made by single presses of the appropriate 'UP' or 'DOWN' button.

Note that this technique applies to all program parameter entries. When the desired RAMP rate is displayed, press the 'STEP' button. The next program value to be shown is then 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 indicator light column will show which program parameter is currently being displayed.

Note that when the display sequence reaches the time clock settings, it is only possible to change these (i.e. time, day and on/off for the day, and enable time) if the keyswitch is set to the 'SET TIME' position.

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 display value.

Note that new program values (i.e. 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 red 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'.

Press the 'RUN' button. The program will now start, and the green mimic display LED's will show that the program is in 'DELAY' mode, waiting until the required switch-on time is reached. If an immediate start to the firing is required, without using the timed start facility, simply keep the RUN button pressed for about 2 seconds. The timed start will be bypassed if that 'DAY & ON/OFF' is set to a '1'.

When the firing commences, 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 returns the display to kiln temperature.

As the temperature rises and the program goes through its sequence, the green lights will change to show the part of the program currently in operation.

If the program is in a 'SOAK' period, pressing 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 8 green lights will illuminate 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 lights.

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 drop 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.

The program may be 'skipped' to the next segment, by pressing the 'UP' button when the display is showing kiln temperature. This facility allows programs to be started at any required point, without changing the complete program.

## 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 will only operate (at the programmed temperature) during the first three ramps. Similarly, the RELAY OFF function operates only during the cooling part of the program. I.e. during ramp 4 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 operate in the 'process' mode, i.e. it will switch on at the start of the first heating ramp, and switch off 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 Not used
- 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 and time clock 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 5000 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.

CROMARTIE KILNS LTD

SAFEFIRE 5000L (LOOPED PROGRAMME VERSION)  
KILN PROGRAMMER  
OPERATING INSTRUCTIONS

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## 5000L KILN PROGRAMMER

### OPERATING INSTRUCTIONS

This version of the 5000 instrument has the facility of linking together selected programs, to produce one or more new composite programs.

This allows a more complex temperature / time profile to be generated, with a maximum of 30 separate heat / cool ramps, associated set points and soak times, together with a final cool ramp.

The linking facility is selectable, and the instruments can also be used as a standard 5000, i.e. with 10 separate programs.

The system is designed so that programs with adjacent program numbers may be linked together. For example,

#### PROGRAM NO's

#### FUNCTION

0	3 ramps, sp's and soaks plus cool ramp
L1, L2, L3, 4	12 ramps, sp's and soaks plus cool ramp
L5, 6	6 ramps, sp's and soaks plus cool ramp
L7, L8, 9	9 ramps, sp's and soaks plus cool ramp

This arrangement will give a total of 4 separate programs.

### OPERATING INSTRUCTIONS

The operation of some push button keys and the program number display is slightly different to the 5000 book description.

When entering program values, the 'UP' and 'DOWN' keys now operate in a roll through zero manner.

The program number is changed by using the 'UP' key only (with roll through zero).

The linking facility (shown by "L" with the program number) is toggled ON and OFF by using the 'DOWN' key, when the display is showing program number.

# CROMARTIE KILNS LTD

## SAFEFIRE 5000 3 ZONE KILN PROGRAMMER OPERATING INSTRUCTIONS

This information is to be read in conjunction with the SAFEFIRE 5000 instruction booklet.

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DESCRIPTION

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TIME CLOCK OPERATION

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## DESCRIPTION

The Safefire 5000/3 programmer is a variant of the 5000 unit, and is designed to operate a 2 or 3 zone furnace.

Operation of the unit is identical to the 5000 system, the only difference being the way in which the front panel buttons are pressed to show the extra two zone temperatures.

Note that Zone 2 is the master unit, which follows the program. Zones 1 and 3 are slaves.

3 standard thermocouples are required (not differential). If any thermocouple should break or go open circuit, then power to all 3 zones is cut off.

The 3 T/C inputs are electrically isolated.

If a 2 zone furnace is used, use only Zone 1 and Zone 2 thermocouple inputs. Link zone 3 T/C + and – together, and ignore Zone 3 output connections.

## CONNECTIONS

The 37 pin connector supplied with the instrument should be wired as follows:

Pin No.	Function
1	Thermocouple 1 +
5	Thermocouple 1 -
3	Thermocouple 2 + (master)
7	Thermocouple 2 – (master)
4	Thermocouple 3 +
9	Thermocouple 3 –
16	Aux. Relay common
17	Aux. Relay n/o
18	Aux. Relay n/c
19	Zone 1 contactor coil
26	Zone 1 contactor coil
20	Zone 2 contactor coil (master)
27	Zone 2 contactor coil (master)
21	Zone 3 contactor coil
28	Zone 3 contactor coil
34	AC Live input 240v
35	AC Neutral input
36	Earth

Note that gold plated connector socket pins should be used for the 6 thermocouple connections, and the correct type of compensating cable must be fitted between the socket and thermocouple heads.

## OPERATING INSTRUCTIONS

The 5000 unit temperature display normally shows Zone 2 temperature value, when first switched on or when the DISPLAY button has been pressed.

To display Zone 1 temperature, press and hold down the DISPLAY button, then press UP. The display will show Zone 1, and the Zone 1 indicator on the numeric display will light. Note that this is not a decimal point!

When the DISPLAY button is released, the display will revert to Zone 2 temperature.

For Zone 3 temperature display, carry out the same procedure but using the DOWN button.