

CAMBRIDGE PROCESS CONTROLS

401 *Plus* TEMPERATURE
PROGRAMMER/CONTROLLER

OPERATING INSTRUCTIONS

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1 DESCRIPTION

The 401 PLUS is a combined Temperature controller and Programmer, intended to fire electrically heated pottery kilns to a precise temperature/time program. Control of the entire firing cycle is fully automatic, giving accurate and repeatable firings. The user has a choice of 15 programs (P1-P10 user values, P11-P15 fixed), each of which will follow this sequence of 5 segments:

1. Start-up time delay.
2. A controlled heating ramp (in degrees/hour) from cold, up to the first set-point temperature.
3. A second controlled heating ramp (in degrees/hour), from the first set-point temperature, to the second set-point temperature.
4. A "soak" time, when the kiln temperature is held at the second set-point temperature.
5. The kiln will switch off at the end of this "soak" time, which completes the program. Energy used (kWh) can then be shown.

Program values for P1-P10, which are chosen by the user, are stored in memory, and will remain until changed.

During a firing, green lights on the graphic display show which part of the program is currently in operation, and when the program has finished.

Any segment of a program may be omitted if required.

Fault codes are displayed if problems occur during firing.

The instrument has a security lock system, and also calculates total energy used during each firing.

2 SPECIFICATION

Temperature display	0 to 1600°C (R,S)	1300°C (K)
Delay & Soak times	0 to 99 hours 59 minutes.	
Ramp rates	1 to 1000°C per hour.	
Set-point temperatures	0 to 1350°C (R,S) or limit value. 0 to 1200°C (K) or limit value.	

10 User value programs, with linking facility.
5 Fixed value programs

CONFIGURE SYSTEM

Set point limit	0 to 1350°C		
Maximum firing time	0 to 99hrs 59 minutes		
Kiln Kw rating	0 to 25.0 Kw	CODE	E
Security lock on/off	0 to 1	CODE	A

All program values are retained in memory.
Automatic switch-off at completion of the program.
Display shows kiln temperature, program values and status.
Fault code display.
Keyboard security lock.
Display of energy used (at completion of firing).
Thermocouple cold junction compensation.
Broken thermocouple protection.
Reverse thermocouple protection.
Available for use with type R,K,S thermocouples.
Wall mounting case.
Output relay provides power to kiln contactor coil.
220/240v 50/60 Hz AC input.

FIXED PROGRAM VALUES

Program No.	P11	P12	P13	P14	P15
Ramp 1	125	80	100	100	130 °C/Hr
Setpoint 1	450	200	100	160	940 °C
Ramp 2	140	120	120	115	110 °C/Hr
Setpoint 2	750	1000	1060	1120	1255 °C
Soak time	00.00	00.15	00.12	00.20	00.20 H/Min

Note that these values cannot be altered, but the delay time for each program may be set as required. Delay times for these fixed programs are not stored, and must be re-entered each time a fixed program is selected. The linking facility is not operative with these fixed programs.

3 INSTALLATION

IMPORTANT SAFETY NOTICE!

CPC recommend that this unit be installed by a qualified electrician, and that a heat fuse or similar over-temperature safety device be fitted to the kiln.

The unit should be fixed to a wall near to the kiln. Do not position it closer than 600mm to the kiln, to prevent damage due to radiated heat.

Hang the unit on two no.8 round head screws fixed to the wall, using the two "keyhole" slots on the rear face of the unit.

The screws should be spaced 110mm apart.

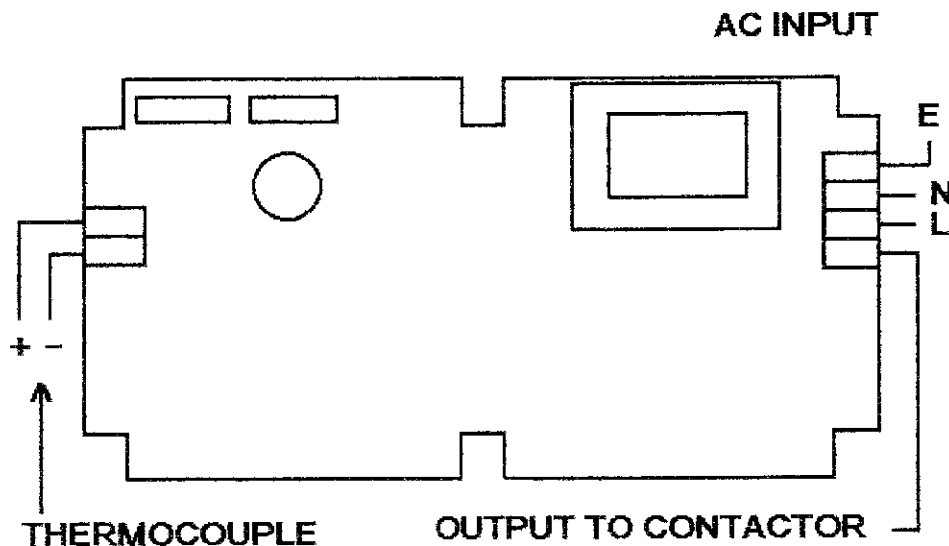
Wiring Connections

Colour }	Thermocouple
White }	Thermocouple
Brown }	AC Input live
Blue	AC Input Neutral
Green/Yel	Earth
Red	Output live
Black	Output neutral

CAUTION

Before fitting the connector plug to the kiln socket, check carefully that the pattern of pins on the connector plug matches exactly that of the kiln socket.

Any difference in the pin/socket positions will cause damage to the programmer if connected and switched on. If in doubt, or a difference exists, contact your instrument supplier.



4 CONFIGURING THE INSTRUMENT

Some operating modes and values can be set up in this section, which will control the way that the instrument works, according to requirements.

To enter CONFIGURE mode, switch off, then press and hold down the DOWN button. Switch on and then release the button. The number display will show --- Press the STEP button once. The displays will show two red lights, and 1350 (SET POINT LIMIT). This value is the maximum setpoint temperature that can be entered when programming, and prevents the operator entering too high a value.

Use the UP/DOWN buttons to display the required value, then press STEP. Displays will show red lights, and 99.59 hrs/mins. This is the maximum allowed total firing time, and typically would be used to prevent over-fires due to a kiln element failing and preventing the kiln reaching top temperature. This time must be carefully calculated to prevent cut-off before the end of a normal firing. Leave at 99.59 hrs/mins if this feature is not required.

Press STEP again to display the kiln kW value (Exx.x)
Using the UP/DOWN buttons, set the value to your kiln kilowatt rating, which will be stamped on the kiln or in the instruction book. This enables the 401+ to calculate the total energy consumed during a firing. Leave at 0 if you do not wish to use this facility.

Press STEP again to display the security lock off/on condition (A 0). Use the UP/DOWN buttons to change to A 1.
A 0 selects security lock OFF.
A 1 selects security lock ON.

Press STEP again to return to --- display. the unit is now configured to your requirements. Press UP to return to normal operation, the unit is now ready for use, or continue to press STEP to review the configure values. Exit by pressing UP when the display shows ---

5 PROGRAMMING

When the instrument is switched on, the numeric display will show the kiln temperature. To store or change values for a program, unlock the keyboard (see section 8) and press the STEP and UP/DOWN buttons as shown here:

Note that this procedure applies only to P1-P10

STEP	(display Program number)
UP or DOWN	to change Program number
STEP	(display DELAY hours. minutes)
UP or DOWN	to change delay
STEP	(display 1st. RAMP RATE degrees/hr)
UP or DOWN	to change ramp rate
STEP	(display 1st. SETPOINT temperature)
UP or DOWN	to change setpoint
STEP	(display 2nd. RAMP RATE degrees/hr)
UP or DOWN	to change ramp rate
STEP	(display 2nd. SETPOINT temperature)
UP or DOWN	to change setpoint
STEP	(display SOAK TIME hours. minutes)
UP or DOWN	to change soak time
STEP	(display linking on/off)
UP or DOWN	to select linking on/off
STEP	(display kiln temperature)

As the STEP button is pressed, red lights on the mimic diagram display will correspond to the displayed program value. An illustration of these displays is printed on the top left-hand corner of the mimic diagram on the instrument.

A single press of the UP or DOWN buttons will change the displayed value by 1. If the button is held down, the displayed value will continue to change, initially at a slow rate and then speeding up. When the approximate required value is shown, release the button. Final small corrections can then be made by single presses of the UP or DOWN buttons. Then press STEP when the correct value is shown, which will store the new value and then display the next program value in the sequence.

To omit a program segment (i.e. delay, 1st. ramp, 2nd. ramp or soak period) set the time or setpoint temperature to zero.

LINKED PROGRAM OPERATION

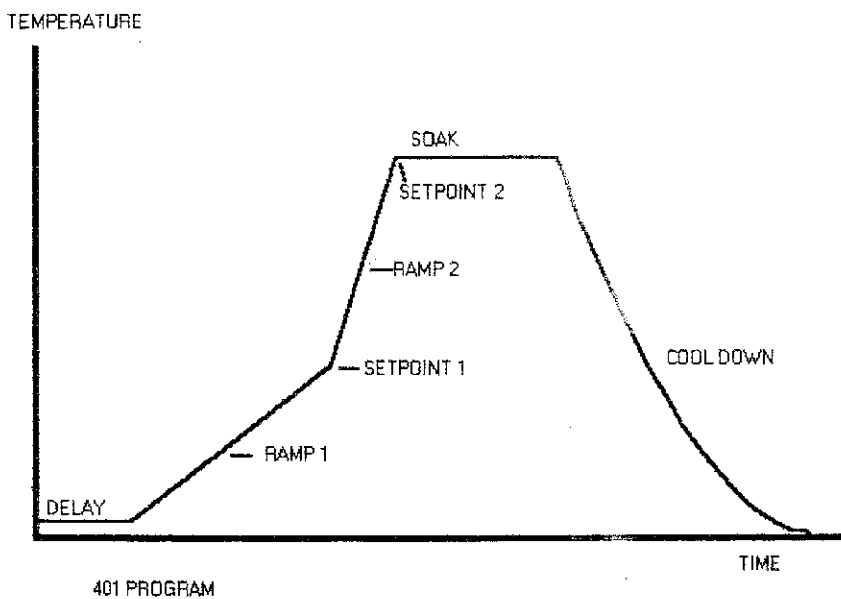
This facility enables some or all of the 10 separate user programs to be linked together, to form complex programs.

After programming the SOAK TIME on any program, the next press of the STEP button displays the linking value L0 through to L10. These are changed by using the UP/DOWN buttons.

L0 means that linking is off, i.e. the chosen program will finish after the soak time has completed. For L values between 2-10, this means that the selected program will jump to the L program number when the soak time has completed. The delay period for that program will be ignored.

Programs are linked in an ascending adjacent sequence, but the last one selected must terminate in L0. For example, 2 linked program groups could consist of P1+P2, and P4+P5+P6.

The entire linked program sequence may be examined by pressing STEP.



6 RUNNING A PROGRAM

Program operation is shown by green lights on the mimic diagram display. No green lights showing means that the program is not operating, and the kiln is not firing.

A single green light shows that the program is operating (in the segment displayed). All 4 green lights showing indicates that the program has completed, and the kiln is switched off.

To stop or cancel a program, press RUN. This will turn off all the green lights and set the programmer ready for program operation.

To start a program, press the RUN button. One green light will show which of the program segments (i.e. delay, 1st. ramp, 2nd. ramp or soak) is in operation. The green light will move along the mimic diagram as the program progresses to the next segment.

When the program has completed, all the green lights will show together.

Note that the program number (P1-P15) can be changed only if no green lights are showing.

If the linking facility is selected, the first program of the current linked sequence is automatically selected when the RUN button is pressed. When running a linked program sequence, the instrument automatically changes the program number at the appropriate time.

7 DISPLAYS

As well as showing kiln temperature, program values etc. the display can show other information.

When a program is running, and the display is showing kiln temperature, pressing (and holding down) the DOWN button causes the display to show the program value currently in operation, i.e. either the remaining delay or soak time, or the temperature at which the kiln should be according to the program. When the DOWN button is released the display reverts to showing kiln temperature.

The entire program (including all linked program values if selected) can be checked at any time by pressing the STEP button. The display will change back to showing kiln temperature automatically 15 seconds after the STEP button was pressed if values have not been altered with the UP/DOWN buttons.

When the display is showing the END condition (all green lights on) or no program operation (no green lights on), pressing and holding down the DOWN button changes the display to Kilowatt-hours, i.e. the total energy used during the previous firing. When the RUN button is next pressed ON, the kWh value is reset to zero .

Fault code displays are also shown if problems occur during a firing.

F 1	Broken or open circuit thermocouple (1999°C shown)
F 2	Reversed thermocouple connection (0°C temp. shown)
F 3	Maximum firing time exceeded
F 4	A program value is out of range

The program is cut off if a fault code shows. Press any button to clear the display

8 NOTES

SECURITY KEYBOARD LOCK

This is a simple security lock, intended to prevent inadvertent operation or program changes without the need to remember PIN numbers.

If the security lock is ON (see CONFIGURE) then the lock must be released before programs can be entered or changed, or a program started or stopped.

When the lock is ON, only the STEP button (to view program values) and the DOWN button (to view current operating segment value) will operate.

To release the lock, press and hold down the DOWN button for 10 seconds. During this time, the TEMPERATURE light will flash on and off. When the lock is released, this light will stop flashing. The lock is now released and normal operation is allowed. If the button is released before the 10 second period has elapsed, the timer is reset to 10 seconds and the procedure must be repeated.

The lock will automatically re-engage 50 seconds after the last time any button was pressed. During this time any button press will reset the 50 second period, this allowing adequate time to enter or change programs.

If the security lock is OFF then the unit will operate normally without any of the above procedure. If the DOWN button is pressed and the TEMPERATURE light does not flash on and off, then the lock is OFF.

When a program is running, and the number display is showing kiln temperature, the UP and DOWN buttons have extra functions.

Pressing the UP button forces the program to advance to the next segment. Each time the UP button is pressed the green light will move along the mimic diagram.

When a program is running, the remaining DELAY and SOAK TIMES may be checked by using the DOWN button. See section 7 - DISPLAYS.

Note that when the kiln is firing, the extreme right-hand decimal point on the numeric display will light when the kiln contactor switches on. This is simply an indication of "power-on" to the kiln.

If the display is flashing on and off, this means that the program contains an out of range value. Press the STEP button until the display shows —, which is the out of range value. Then re-enter the correct value, using the UP/DOWN buttons, and press STEP to enter. The display should stop flashing. If it continues to flash, another program value is affected, continue with this procedure until clear.