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CAMBRIDGE PROCESS CONTROLS

202 PROGRAMMER/CONTROLLER

OPERATING INSTRUCTIONS

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Issue P4 Apr. 88
SW 202v6



DESCRIPTION

The 202 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 state 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 existing wiring of 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 on the charge condition of the internal battery, which is trickle-charged during normal operation.

A complete program will follow all, or part of this sequence:

A controlled heating ramp (linear in degrees/hour) up to the first set point temperature, followed by an optional soak period at the set point 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, being automatically selected according to the relative set point values programmed. After the third Soak segment, a final cooling ramp can be selected, to provide a controlled cool down to the last 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 (all the green LED 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 or ventilation fan. 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 last 'cooling' segment, or during the power-off cool down. Alternatively it may be programmed to energise during the entire firing cycle.

Another 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.

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.

4-Set Points, 0 to 1350 C.

3-Soak Periods, 00.00 to 99hr.59mins.

1-Cooling ramp.

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 limit at 1350 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 program 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 mounting case.
Sealed membrane front panel.
Optional RS232 serial communications facility, for operation/monitoring by remote computer.
AC supply voltage 240v 50/60 Hz.

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

Digital temperature display 1300 C
4-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 a no.8 or no.10 woodscrew to the wall, at least two feet from the kiln (so that the unit is not damaged by heat radiating from the kiln).
Hang the unit on this screw by placing it over the 'keyhole' cut-out at the rear of the unit.
Remove the two screws holding the terminal cover, at the bottom of the unit. Fix the unit to the wall by two more screws, using the slots provided. (see diagram)

Connect up the wiring as shown on the connection diagram.

It is essential that the EARTH wire is connected, for both safety and operational reasons.

Note that if the auxiliary relay is to be connected, an extra cable gland may be required.

Replace the terminal cover before switching on, and remember to ALWAYS disconnect the AC supply to the unit, and to the kiln, before subsequently removing this cover.

IMPORTANT SAFETY NOTICE

CPC strongly 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.

PROGRAMMING

Switch on the unit. The display will show the kiln temperature. Turn the key switch 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 set the required RAMP rate press the 'UP' or 'DOWN' buttons. A single press will increase or decrease the displayed time 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 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 1350 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.

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 key switch 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 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 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' 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 key switch to the 'PROGRAM LOCK' position, and remove the key. The program may now only be examined (by pressing 'STEP') but cannot be changed. When 'DAY & ON/OFF' is displayed, the on/off status for each day may be displayed (but not changed) by pressing 'UP' or 'DOWN'.

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, 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 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 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.

If the 'RELAY ON' and 'RELAY OFF' temperature values are both set to zero, the relay will then operate in the process mode, i.e. it will energise when power is first applied to the kiln, and remain energised until the 'END' condition is reached.

DISPLAY

If the display is flashing on and off, this indicates 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 202. 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 '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.

TIME CLOCK OPERATION

Press the 'STEP' button until the 'TIME' lamp illuminates. The display will show 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 required on that day) or a 0 (if no firing required).

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 START 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 return to 'TEMPERATURE', showing that all the programmable values have been entered. Return the keyswitch to the 'NORMAL' position.

Note that if the 'START TIME' is earlier than the 'ENABLE TIME', it will not be possible to start the program with the 'RUN' button. The earliest START TIME that may be set is the same as the ENABLE TIME value.

If this facility is not required, i.e. a switch-on is allowed at any time in the 24 hour period, set the 'ENABLE TIME' to 00.00.