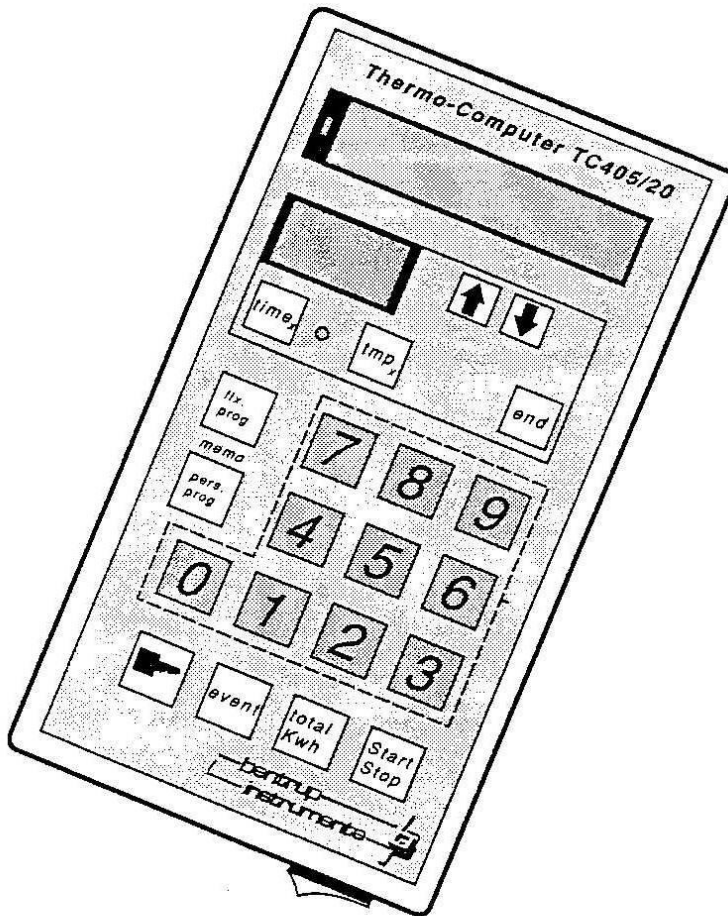




TC 405/20



Operating Instructions

Kiln Controller TC405/20

1.) General Information

By using the controller TC405 you can exactly determine the course of your kiln heating. Besides 6 standard courses which are already programmed you can feed in 9 further courses for your special use.

Your controller is delivered with a 5 pin connector. This flax establishes the connection with the power supply as well as the connection with the temperature sensor (PtRhPt Thermoelement). The regulation must not be exposed to high temperatures, extreme humidity or high mechanical use. A part from that one has to insure a stabile power supply.

In order to avoid unwanted usage the keyboard can be locked up by pressing the "key-button" for 3 seconds. The decimal point appearing on the very left side of the display indicates that the keyboard is locked. For unlocking you again have to press the "key-button" and **hold it again for about 3 seconds.**

2.) Getting Started

The power-on-switch is located on the bottom side of the case. After switching on the controller the kiln temperature appears on the display. If this is not the case, you have to check whether

- a) the fuse is switched on
- b) your kiln is connected with the power supply
- c) the controller's fuse has a defect (the fuse is located inside the controller)

3.) Explanations of the Terms

On the frontside of your controller are the following keys:

▲	select next segment of the course
▼	select previous segment of the course
t _x	displaying/changing the time
Tmp _x	displaying/changing the temperature
Ende	input of the course finishing

In this controller the burning-course will be given in as a number of temperature/time-values. So you have to put in the temperatures that the controller has to reach after another; for each temperature you also put in the time in that the controller has to reach the temperature. If you put 0 minutes as the time value the kiln will be heated up with the maximum power (or in a colling-segment: will be cooled down naturely).

Example:

If you want to start a course with heating up to 400°C in 300 min, then heating with maximum speed up to 1200°C with firing 20 min on 1200°C, you have to give in the following values:

segment 1:	400°C	300 min	(= 400°C in 300 minutes)
segment 2:	1200°C	0 min	(= 1200°C in 0 minutes, i.e. max. power)
segment 3:	1200°C	20 min	(= 1200°C in 20 minuten, i.e. dwell)

After finishing the 3rd segment the kiln cools down uncontrolled and a 'E' (for 'END') will be displayed on the ramp-display (the smaller display).

You are absolutly free by creating the form of your course for burning; of course you can have multiple heating an cooling segments.

3.1.) Program Delay

With your controller TC405/20 you can give in a program delay. You can use this function for instance if you want to start a firing process in the night.

This delay time is segment No. 0. Press the arrow-keys to select segment No. 0 and put in the delay time (in minutes) by using the keys 0 to 9.

4.) Programming a Course

The course will be determined by a sequence of temperature/time values. By using the arrow-keys you select the segment number (the segment number will be displayed in the lower (small) display). The upper display shows the temperature or time of the corresponding segment.

By pressing the key [Temp_x] you can display the temperature and change it by using the keys 0 to 9. By pressing the key [t_x] you can display/change the time for this segment.

Using the keys ▲ and ▼ you select the next segment and put in the values as described. The chronological order of giving in the values is not determined.

After giving in the last temperature/time value you have to press the key [Ende]. The controller shows the word "End-" and the number of the programmed temperature/time values. Pressing the key [Start Stop] starts the firing. The key [Ende] has the effect of cutting of all further segments after the segment that is actual displayed. While firing the controller finishes firing after reaching an segment with a temperature value of 0°C (ending mark).

Technical comment: Pressing the [Ende] key sets the temperature of the next segment to 0°C.

5.) Programs

Your controller is established with two different types of programs:

5.1) Fixed Programs

These fixed programs are determined by the manufacturer of the controller and are not changable. The values of the 6 programs (= 6 different firing courses) are described below:

program	No.	1:min	°C	min	2:°C	min	3:°C
drying 150°C	4	300	150	20	150		
firing 800°C	5	360	600	20	800	10	800
firing 900°C	6	300	550	30	900	10	900
glaze 1060°C	7	150	400	60	1060	30	1060
glaze 1200°C	8	150	400	80	1200	30	1200
glaze 1250°C	9	150	400	100	1250	30	1250

Example: starting a glaze firing 1060°C

a.) Press [Fix.Prog] (Display: "Pr F-" = program fixed)

b.) Press [7] (Display: "Pr F-7")

c.) Press [Start Stop] (flashing decimal point indicates that the controller starts firing, i.e. that you leaved the mode of putting in values)

5.2) Free adjustable Programs

The values of these "personal" programs can be determined by the user and be changed as often as you like. You can store up to 9 of these programs in your controller. These programs will be saved even if you switch off your controller.

Starting such a program is similar to starting a fixed program; the only difference is that you have to press the key [pers.prog] instead the key [fix.prog].

Your controller is able to store maximal 60 temperature/time values. Depending on the number of segments per program you can store 3 to 9 programs. If the controller's memory is busy the controller shows "FULL". For deleting a program you only have to store a program with the length of 0 segment on the same program number (the old program will be deleted).

After you have given in the values for the program you can store it as a personal program by pressing both keys [Fix.Prog.] and [Pers.Prog.] simultaneously (display shows "memo"). Now you have to press one of the number keys (1 to 9) to determine the program number for this personal program.

6.) Displaying Values while Firing

While firing the controller shows on the upper display the kiln temperature (while a program delay this display shows the remaining time in minutes until start firing). The lower display shows the actual segment.

Every 15 seconds the display flashes for short time displaying the maximal temperature of the programmed firing course; the lower display shows

- for heating up
- for dwell
- for cooling down

Some additional informations can be called up while firing (without interrupting firing): Press key [time_x] for displaying the remaining time in a dwell. The actual setpoint can be displayed by pressing the key [tmp_x]. After 2 seconds the display changes automatically back to the normal indication.

7.) Reaction to a break down of Power Supply

If there is a break down of the power supply, the procedure of firing is interrupted. After the power supply is established again the controller continues firing exactly at the point of the break down. If the power failure exceeds about 30 minutes, the controller stops firing (because the kiln is probably cooled down to a much). This function of resuming the firing is only available on personal programs!

8.) Adjustable maximal Values

- a.) delay of starting the program (t₀) 9999 min
- b.) time t_x 9999 min
- c.) temperatures Tmp_x (depends on kiln) 1320 °C

The programmed speed of heat up must not exceed 1000°C/h (see error message F7).

9.) Special features

While firing a segment will be finished if the required temperature is achieved. If the kiln temperature - for instance - is hanging behind the setpoint temperature the real segment duration is a little bit longer than programmed.

10.) Additional Event Output

Your controller TC405/20 can be equipped with an additional event output. You can program this event output for every segment "ON" or "OFF". With this event output you can control any additional instruments for firing (flaps, gas control, warning signals etc.).

Press the button [event] (the display shows the actual status, ON or OFF). You can change the status by pressing one of the keys 1 to 9. This information (ON or OFF) has to be programmed for every segment of the curve and will be saved in a personal program too.

Error Messages of the Controller TC 405/20

F1 : Kiln does not follow the required temperature increase

Although the kiln heats with full power the temperature increase during the heat up is too small (at least 1°C per 16 min). The cause of fault must be recognized exactly to avoid problems with further firing procedures.

possible cause of the fault : required temperature increase exceeds kiln power
 fuse defect
 door switch opened
 heating elements too old

F2 : Maximal firing time exceeded

If the time for heating up to the next segment temperature exceeds 12 hours the controller shows this error message.

possible cause of fault : heating elements too old
 break down of a part of the power supply

F3 : Temperature acquisition error

This error message appears on the display if the temperature acquisition fails.

possible cause of fault : temperature sensor defect
 connection of temperature sensor defect

F4 : Temperature sensor badly polarized

possible cause of fault : temperature sensor itself badly polarized
 temperature sensor colder than 5°C

F5 : Bad heating or cooling values

One or more temperature values exceeding the maximal allowed temperature. See values as described in section 8.) of this manual. This error message shows the number of the bad segment too.

F6 : Adjusted temperature too high

F7 : Adjusted temperature too low

The programmed temperature increase in a segment is too low (< 1°C/h) or too high (> 1000°C/h). This error message shows the number of the bad segment too.

F8 and F9 : Error during self test

After every power on the controller performs a self test. If it detects an internal error the message F8 or F9 will be displayed. In this case contact your dealer.

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Configuring the Controller TC405/20

Some parameters of the controller TC405/20 can be configured by the user or by the manufacturer of the kiln. The manufacturer of the controller delivers the controller with standard parameters that fit to the most kilns. But for optimal results we recommend to make the following adjustments (this procedure has only to be done once).

1.) Adjusting the Parameters

The parameters are locked to prevent the adjusted parameters for erroneous changing. For unlocking you have to turn off the controller, press the button [total kWh] and turn the controller on **while pressing [total kWh]**. On the lower display appears an "C" for configuration.

Now you have to press the button [total kWh] and hold it for 3 seconds. The display shows the first configuration parameter (see table below). Pressing the button [total kWh] switches to the next parameter in the table; for changing the parameter use the digit keys 0 to 9.

par.no.	parameter	preadjusted	unit
0	power of kiln	0,0	kWh
1	printer rate (protocol length)	0	cm/h
2	type of thermocouple (0:Pt10, 1:Pt13, 2:Ni)	-	-
3	maximal adjustable temperature ¹⁾	1320	°C
4	cyclus time (relay switch rate)	30	s
5	proportional range	2	%
6	integral time	200	s
7	derivative time	5	s
8	cyclus time cooling output ²⁾	50	s
9	overlap area ²⁾	80	%
A	configuration (not used)	0	-

The cyclus time (see 4) determines the switching rate of the relay. A high switching rate (e.g. 10 seconds) results a very smooth heating of the kiln but a high consumption of the relay. On the other hand a long cyclus time protects the relay but results a hard heating of the kiln.

A cyclus time of 30 seconds is a good value for the most applications.

The parameters 5 to 7 referring to the controlling algorithm. For full automatical adjustment of these parameters see next section.

Notes:

¹⁾ additional code required (ask manufacturer)

²⁾ only used if controller is equipped with cooling output (optional)

2.) Self Adjust Feature

Your controller TC405/20 is able to adjust itself on the temperature behavior of you kiln. There is a special (pre-programmed) firing process necessary.

Without this self-adjustment your controller is working fine never the less. But after the self-adjust your controller has an controlling accuracy that is better than controllers for ceramic kilns ever had !

To perform the self adjustment proceed as follows:

Unlock the controller as described in section 1.) and then press the key [fix.prog]. The controller TC405/20 then shows **not** the usual display for colling up a fixed program but an 'A' in the lower display (for Adjust) and an adjust temperature in the upper display (default value 600°C).

This temperature is the optimizing temperature; after pressing [start stop] the kiln will heat up to this temperature and calculate the needed parameters by looking at the temperature increase/decrease while this firing process. Normally the optimizing temperature should be about the half of the maximal temperature (or the temperature you wish to have the smallest temperature deviation).

After pressing the button [Start Stop] the process of self adjusting starts. Depending on the kiln this firing process can take up to a few hours. If the "A" on the lower display disappears the process is finished. Now the controlling parameters (6,7,8) can be displayed by pressing [total kWh] for 3 seconds and read out the values (see table).

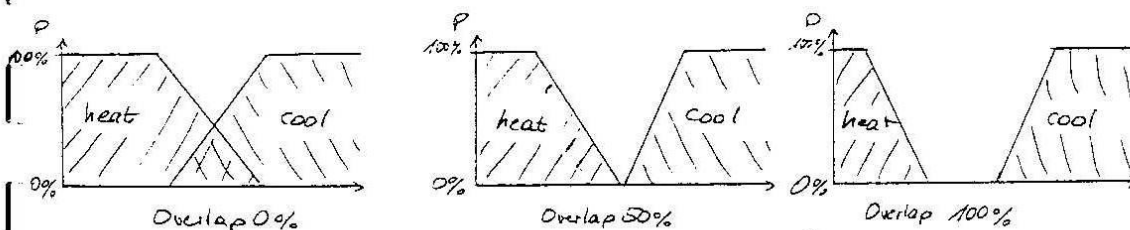
3.) Cooling Output

The parameters no. 8 and 9 refer to the optional cooling output (see table). The controller has to be ordered if you by the controller.

In many applications it is necessary to have flaps or ventilators for an exactly linear determined cooling even kiln temperature is very low.

Instructions of adjusting the cooling cylus time see cylus time for heating.

The overlap (parameter No.9) determines the zone of overlap actions of the heating and cooling output. 0% means that the cooling output starts switching if the heating output has less than full heating. 50% means that the cooling output starts switching if the heating output in not switching any more. An overlap of 100% lets a distance of one proportional range between action of heating and cooling output. For normal applications we recommend an overlap of 80%.



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