bentrup

TC 405

Operating Instructions

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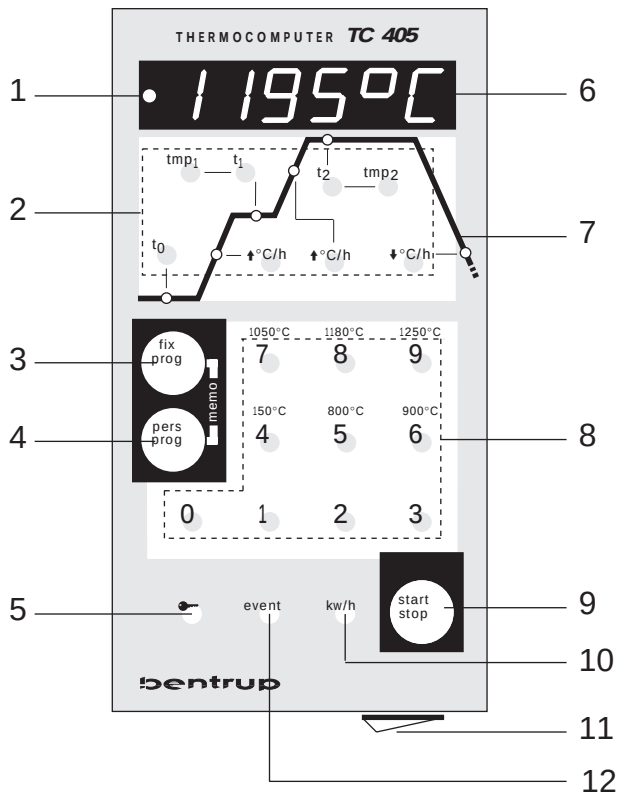
Brief Instructions

To	use this key
- start a fixed programme (e.g. no.5)	fix prog → 5 → start stop
- start a personal programme (e.g. no.3)	pers prog → 3 → start stop
- save a personal programme (e.g. as no.1)	fix prog + pers prog → 1
- to lock the controller	(about 3 seconds)

Controllers Panel



1	indicator kiln on/off (power relay)
2	keys for selecting the segments of the curve
3	key for calling up fix programs
4	key for calling up personal programs
5	key for locking the controller
6	display
7	firing curve with indicators
8	numeric keyboard
9	start/stop key
10	key for calling up the power consumption (and for installation parameters)
11	power switch (shown in "ON" position)
12	event key

Contents

General Information

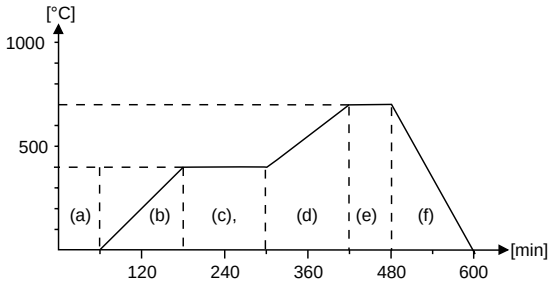
Your brand new bentrup TC405 represents the latest technology in kiln controls concerning safety, precision and features available today. The TC405 is one of the most popular controllers on the market.

Before operating the controller, please read and understand the manual carefully. This makes you familiar with all features and possibilities of your new controller quickly.

Security Advice

Refer to the security advice of the kiln manufacturer. Please also make sure that the controller is mounted at a safe distance from the kiln and that the control is not exposed to direct heat or radiation when the kiln is opened whilst it is hot.

The microprocessor controller TC405 provides your kiln with a precise and reproducible controlling unit. The firing course is shown as a firing curve consisting of six segments. An example is shown below :



This firing curve consists of the following segments:

a. programme delay (60 min.)

b. heating up to 400°C in 120 min. (200°C/h)

c. 1st dwell (120 min.)

d. heating up to 700°C in 120 min. (150°C/h)

e. 2nd dwell (60 min.)

f. cooling down (350°C/h)

Fixed programs and personal programs

Often used curves are already in series - saved as fixed programs in the controller. Anyway you are able to save 9 individual curves - personal programs - which let you consider your experience and special wishes. Both fixed and personal programs are called up simply by pressing the corresponding key (3) or (4) resp.

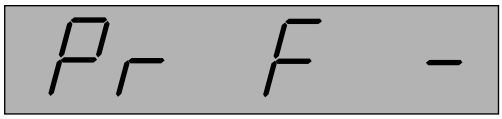
A seldom used curve can also be started without saving it as a programme. In this case put in all the required values (see “creating a new curve”) and then press the “start stop” key. If a curve is put in like this it will be lost after firing.

Calling up a fix programme

The following is a list of fixed programs in the controller:

prog.-no.	to (min)	up (°C/h)	tmp.1 (°C)	t1 (min)	up (°C/h)	tmp.2 (°C)	t2 (min)	down (°C/h)
0*	0	60	1200	0	5	1200	0	999
4	0	30	150	10	999	150	0	999
5	0	100	600	0	999	800	10	999
6	0	100	550	0	999	900	10	999
7	0	180	400	0	999	1050	30	999
8	0	180	400	0	999	1180	30	999
9	0	180	400	0	999	1250	30	999

* progam no 0. is especially for initial firing of a new kiln !



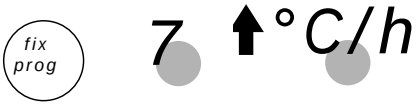
First turn on the controller. To start a firing e.g. with fixed programme no.5 (max. firing temperature 800°C), it must be first selected and then started. Press the key “fix prog” (3). In the display you´ll see the left shown display. Now press key no. “5” of the numeric keyboard (8). To start the programme press “start/stop” (9). From now on the displays shows the actual kiln temperature continuously. Every 15 sec. the max. temperature ot the selected programme is shown (flashing).

By pressing the “start/stop” key again you interrupt the running programme or let it continue. The decimal point flashing on the very right hand side of the display (6) indicates the the programme is running

Before and during the firing all the parameters of the selected programme can be shown by pressing the corresponding key (2). Then the corresponding value is shown for about 3 sec. on the display. The actual segment of the firing process is shown on the depicted curve (7) by indicators. When the firing is finished an "E." is displayed at the very left hand side on the display (6) (when kiln temperature reaches 150°C).

Calling up a personal programme

Entering a personal programme can be done in two different ways.



1. Changing a fixed programm

An example:

You may need a programme that is like fixed programme no “7”. But the heating segment should be 200°C/h and the 1st dwell should be at 600°C. This changed fixed programme shall be saved as personal programme “2” for future use. Every step is shown graphically on the left. At first call up the fixed programme no “7” as descibed in the last chapter. To change the value of the first heating phase push the key “up °C/h" in the left part of the printed firing curve.

On the display (6) the original value is shown (180°C/h).

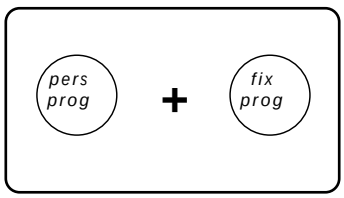
3 0 0

Now enter with the numeric keyboard (8) the new value of 200°C/h.

tmp_1

To change the 1st dwell temperature press the key “tmp1”. The display shows original value (400°C). Now enter your new value with the numeric keyboard (8).

6 0 0



To store this changed programme press the keys “fix-prog.” (3) and “pers.-prog” (4) simultaneously. The display shows (symbolic) message “memo-”. Enter the desired programme number "2". Now the programme is saved as personal programme no. 2 for future use. The personal programs stay resident even after power off. Of course you can redefine personal programs as often as you want.

The programme is now stored as personal programme no.2. To recall this programme you just have to press key "pers.prog" (4) followed by the corresponding programme number "2".

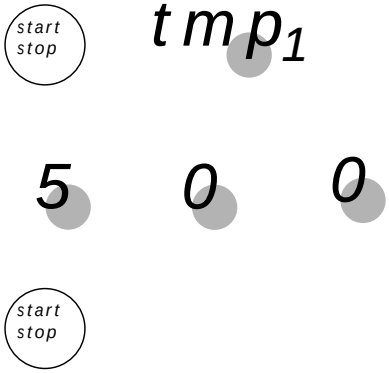
3

2. Creating a new firing curve

You often need a programme which is completely different from one of the fixed programs. In this case enter the new values by pressing the keys (2) for all parameters and put in the desired values using keyboard (8). After finished save this programme as explained in section 1.

Even after the firing process has been started you can change the firing curve.

Changing the curve during a firing



Example:

While running the programme you want to change the 1st dwell temperature to 500°C. Interrupt the programme by pressing the “start/stop”-key (9). Now select the segment by pressing the corresponding key (2) and enter the new value with the numeric keyboard (8). After pressing “start/stop” (9) again the firing process will continue with the new value.

When you change a segment that has already been finished the TC405 will start from the beginning.

Locking the controller

To prevent the TC405 from unauthorized use press the “key button” (5) for about 3 seconds. You will see the decimal point on the very left hand side of the display (6) indicating that the controller is locked. The TC405 keyboard is now locked.

To unlock the TC405 press the key (5) for 3 seconds again until the indicator goes off.

Further hints

Firing course with only one dwell temperature

You need a programme with only one dwell. The kiln required to heat up with e.g. 150°C/h until it reaches 1000°C followed by a dwell of 30 minutes. Cooling should be done 500°C/h. Enter the following values:

t_0 .....0 min
↑°C/h .....150°C/h
tmp_1 .....1000°C
t_1 .....0 min
↑°C/h (this value doesn´t have any meaning) .....999°C/h
tmp_2 .....1000°C
t_2 .....30 min
↑°C/h .....500°C/h

Dwell 2 temperature higher than dwell 1

The TC405 gives you the choice to make the first dwell at a higher temperature then the second dwell. In this case the kiln heats up to the first firing temperature, dwelling for the given time (t1) and then cooling down to the second temperature dwelling again (applications like crystal glaze or simple glass fusing or slumping)

Reaction on a power breakdown

In case of a power breakdown the firing process is interrupted. After the power comes up again the controller will continue exactly from the point at which it was interrupted.

Caution!

A power failure longer than 30 minutes causes the automatic termination of the programme because theoutcome of the firing is likely to be unsatisfactory

Maximum values

The maximum valid programme values are listed below:

programme delay (t_0)	0 min to 9999 min
1. heat up rate	2°C to 999°C/h*
1. dwell time (t_1)	0 min to 9999 min
1. dwell temp. (tmp_1)	20°C to 1320 °C**
2. heat up rate	2°C/h to 999°C/h*
2. dwell time (t_2)	0 min to 9999 min
2. dwell temp. (tmp_2)	20°C to 1320 °C**
cooling (°C/h)	2 °C/h to 999°C/h*

**the value of 999°C/h sets the controller to the maximum speed heating or cooling respectively.*

*** controller is adjusted to the maximum kiln temperature*

Displaying the power consumption

The TC405 gives you the possibility to call up the power consumption of the last firing. To use this feature you have to programme the kilns power once. Refer to the section "Setting the parameters". Press key "kwh" to read the power consumption since the last firing has been started. The display switches back after 2 seconds.

event

3

event

. . .

Option: Linking Programmes

This option of your controller is included on request only. Ask you kiln supplier if you like to use this feature.

TC405 provides you with a very useful feature: You can link programmes, ie. you can cause the control for instance to continue with programme no. 2 after programme number 1 has finished. This can be used eg. to start the biscuit firing automatically after the drying programme.

Linking programmes is done as follows: After you have entered your first programme press the "event" key. The display reads "none". Enter the programme number which you would like to be started automatically after the first programme is finished. The display shows "Con #" where # is 1 to 9 (pers. prog. 1 to 9).

Press the "event" key again, the display shows the final temperature of the first programme, at which point the second programme will commence. Change this temperature using the digit keys if required.

To switch off the programme link, enter programme Nº 0. the display shows "none".

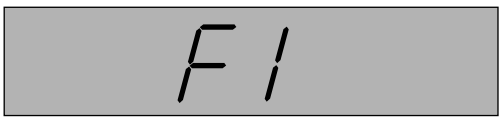
Important Note

The programme numbers refer to the personal programmes only. Should you wish to link a fixed programme, this should be re-entered and saved as a personal programme.

Caution: If a programme is saved using the link feature, the link is stored as well. Check when loading programmes to avoid unintentional linking

Error messages

The integrated microprocessor inside your TC405 performs continous checking of the firing process. In case of any malfunction the display will show an error message pointing to the problem. Following is a description of the possible error messages:



The kiln doesn´t follow the required temperature increase

This error message **points clearly to a kiln problem**. Possible cause:

- broken fuse
- the door (lid) contact is open
- a heating element is broken
- the heating elements are too old

  (esp.with high firing temperatures)
- the thermocouple has a short circuit
- a power phase failed
- a problem with the power relay

Problem on temperature acquisition

The controller continuously checks the validity of the measured temperature values during the firing process. If any problem occurs an error message is given. The right part of the display shows a number which defines the error

1- acquired temperature too high

2- safety relay contactor was activated

3- measured temperature flacking (contact problem)

If this error message occurs refer to your local dealer.

Thermocouple or thermocouple circuit defect

Possible cause:

- thermocouple broken
- thermocouple wiring bad
- contacts of the connecting plug bad

Impossible values on data acquisition

Possible cause:

- thermocouple polarized bad
- thermocouple temperature less than -15°C

Values for heating or cooling out of range

The range of values for the heating and cooling segments is from 2°C/h to 700°C/h.

Values for dwell temperatures out of range

These temperatures must be between 20°C and maximum kiln temperature (e.g. 1320°C, depending on the kiln).

Error detected during power-up self check

On every power-up the controller performs a self check. If an error is detected the controller shows F8 (ROM error) or F9 (hardware error). Please contact your local dealer.

Setting the parameters

Because your TC405 can be used in a wide range of applications some operating parameters of the controller are adjustable. These parameters have been set by your kiln manufacturer so usually no further adjustments are necessary.

Following the parameter list if you require any changes:

displ. code	description	default	unit
O	power of kiln	0,0	kWh
r	printer-rate	0	cm/h
E	type of thermocouple(0=Pt10, 1=Pt13, 2=Ni)*		-
H	maximum temperature of the kiln*	1320	°C
P	proportionalband	2.0	%
I	integral time	200	s
d	derivative time	10	s
t	cyclus time	30	s
F	reserved *	1	-
L	disable error message F1 (heat up check)	0	-
h	heating elements operation hours counter*	0.0	h
°	max. temp. reached on last firing	-	°C
V	version code of the internal software*	5.6	-

* for changing these values additional manufacturer code is required

To change the parameters the controller first has to be switched in the parameter mode: Turn on the controller while pressing key "kwh" (10). When the controller shows the kiln temperature press the key (10) again and hold it down for about 3 seconds til the display (6) switches to the first parameter of the above list. On the right hand side of the display (6) the actual value of the parameter is shown together with the display code. Use the numeric keyboard for changing the value.

By pressing the key "total kwh" (10) you can go step by step through the parameter list. After having finished all entries escape the parameter mode by pressing the key "total kwh" (10) until the display goes off. The controller comes up in normal operation mode a few seconds later.

O power rating of the kiln. This value is only used for calculating the power consumption

r applies only if the controller is equipped with an optional printer output. Parameter determines the length of the printout in cm per hour. Maximum length is 60 cm/h

E type of thermocouple. Locked to avoid unauthorized change.

H maximum allowed temperature of the kiln. For changing additional code required.

P,I,d control parameters. Changing these values without detailed knowledge of the meaning can cause worse results in firing accuracy. Parameter set suits a wide range of kilns.

t determines the cyclus time of the control output. A short cyclus times ensures smooth heating but reduces the lifetime of the power relay. A long cyclus time can result in temperature oscillations. A typical value for proper operation is 30 sec.

F reserved

L disable error message F1: For certain applications it might be required to suppress the checking of the kilns heating. "1" disables checking; disable **only** if really required !

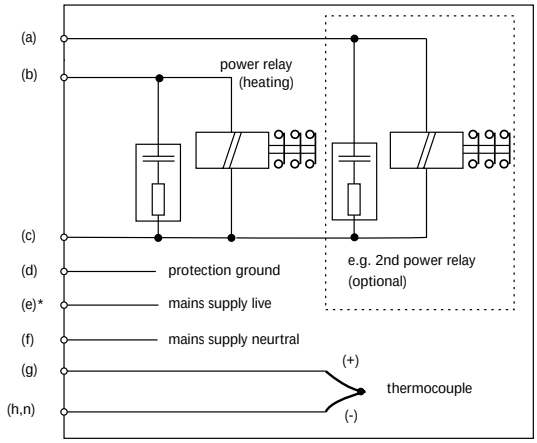
h total operation time of the the kiln heating elements. All heating cycles of the kiln will be summarized allowing the lifetime of the heating elements to be checked. For resetting to zero additional code required

° maximum temperature reached on last firing. This value is useful if a problem is encountered during the firing because it shows at which temperature it occurred. Automatic reset after each power up / restarting the controller or loading a programme.

V version code of the internal software (current version 5.6, value read only)

Technical Informations

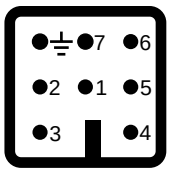
Schematic of a Kiln



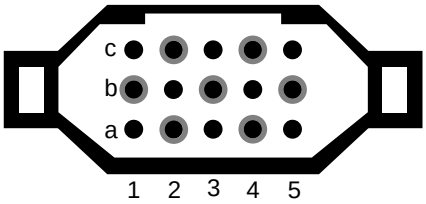
a ... n: electrical links for the controller

Pin Assignment

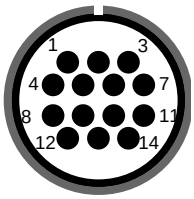
HAN 7 D



HAN 15 D



CPC14



connect.	function	HAN7D	HAN15D	CPC14
a	additional control output (live)	7	C3	12
b	control output power relay (live)	6	A3	14
c	control output power relays (neutral)	1	B3	13
d	protection earth *	⏚	PE clamp	11
e	mains supply live	5	A1	8
f	mains supply neutral	2	B1	9
g	thermocouple +	3	B5	1
h	thermocouple - (type S, R)	4	C5	2
n	thermocouple - (type K, J)	4	A5	3

Important Note

Please compare type of thermocouple used in the kiln with the controllers thermocouple input marked on the back of the controller. Mismatch can cause severe damage of kiln and contents