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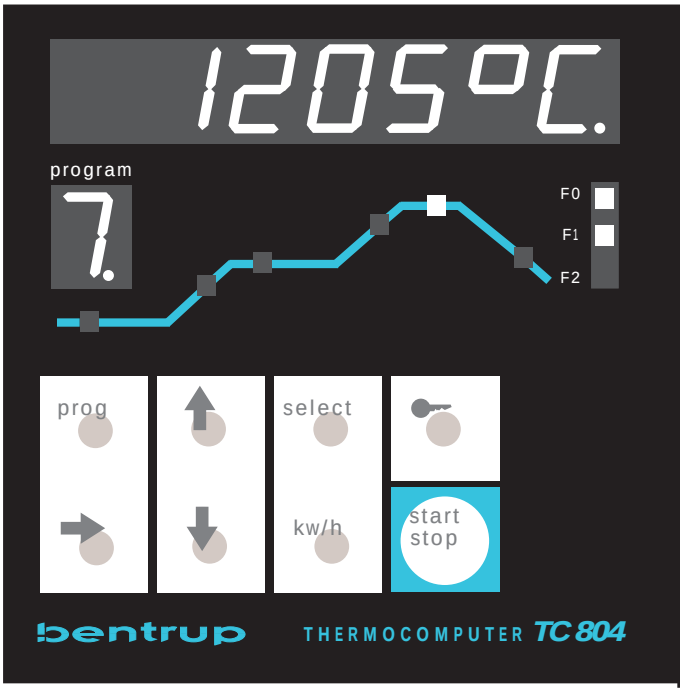
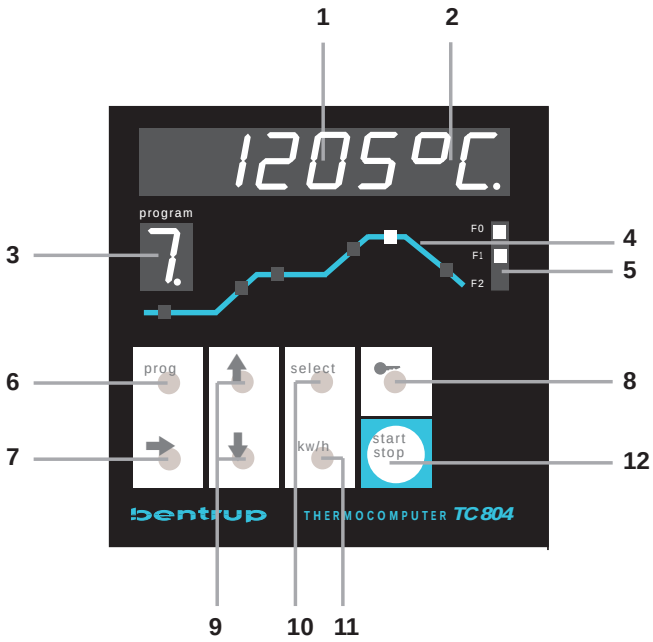
Operating Instructions



Universal Programmer TC 804

bentrup

Controllers Panel TC804 / Brief Description



(1) main display: reads actual temperature and programme values

(2) unit of the displayed value

(3) programme number: This windows continuously shows the number (#1 to #9) of the currently selected programme.

(4) sketch of the firing curve. The LED points either to the actual segment or to the programme value actually entered (LED blinking)

(5) output indicators: ON/OFF status of the control outputs F0 / F1 / F2.

(6) key programme select: Press this key to select programmes number #1 to #9. Each pressing of the key increments the programme number by one.

(7) To enter a new programme or to change the values of the actually selected programme, select the segment number by these keys (segment display (4) **is blinking**).

(8) Key to lock / unlock the keyboard (press and hold for 3 seconds). A locked display is indicated by the decimal point in display 3 (as shown)

(9) key to change programme values: If a programme value is shown in the main window, you can change it using these keys. For larger value changes, hold the key pressed.

(10) key to change the value of the EVENT bit

(11) key kw/h: To display power consumption since the last start of the firing. If the key is pressed 3 seconds, the TC804 enters the installation (For details see appendix B).

(12) start / stop key: Press this key to start the actual programme. The controller shows a flashing decimal point on the main display to indicate a running programme. To stop the programme, press start / stop again (Decimal point stops blinking).

Kiln Controller TC804

1.) General Information

By using the controller TC804 you can determine the exact course of your kiln firing. You can program up to 9 firing curves according to your application.

The electrical connections to the TC804 are made by using receptables (6.3mm/2.8mm). The controller must not be exposed to high temperature, extreme humidity or mechanical demage and must be connected to a stable power supply.

To avoid use by unauthorized persons the keyboard can be locked by pressing the "key-button" for 3 seconds (only during a running program). The decimal point appearing on the program display (3) indicates that the keyboard is locked. To unlock press the "key-button" agai**for 3 seconds.**

2.) Getting Started

Upon switch ´on´ the TC804 shows the internal software version (e.g. "V 4.7": version 4.7) and then indicates the kiln temperature in the upper display. If this is not the case, you should check whether

a) the kiln control circuit 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 front of your controller are the following keys:

⇨	select next segment of the curve
(key)	key-button for locking the controller
⇧ ⇩	adjust displayed value
event	adjust the event output per segment
total kwH	display the power consumption of the previous firing
prog	select program for firing or changing
start/stop	start/stop the firing process

On the controllers frontside the firing course is shown as a firing curve consisting of six segments. A typical firing curve includes the following segments (hrs:min = hours:minutes reading):

a. program delay (hrs:min)
b. heat up ramp (°C per hour or hrs:min)
c. 1st dwell (°C and hrs:min)
d. heat up ramp (°C per hour or hrs:min)
e. 2nd dwell (°C and hrs:min)
f. cool down ramp (°C per hour or hrs:min)

Program delay:
The TC804 controller has a program delay function (segment a., see above) which can be used for delayed start. This can be used to take advantage of "off peak" electricity.

The TC804 provides the feature to have the 1st dwell (c.) at a higher temperature than 2nd dwell (e.). This can be helpful for glass applications: heat up to 1st dwell at e.g. 820°C, then cooling down to 560°C in segment (d.). After the 2nd dwell a slow cooling can be done by using segment (f.).

The ramp segments (b., d., f.) are equipped with two 2 special features that are activated by counting the value in the segment to the upper end (lower end resp.). The value "SKIP" causes the controller to heat up (cool down resp.) with maximum speed (i.e. uncontrolled). The value "END" causes the controller to end the firing disregarding the following segments. Last function can be useful e.g. for a simple drying program: segment (b.) 30°C/h to 150°C, 20 min dwelling and then program stop. Set ramp segment (d.) to "END" for this firing curve.

4.) Entering a Program

On delivery the 9 programs are unassigned. To enter a program curve proceed as follows:

- select the desired program no. by using key (6)
  (the controllers shows the firing temperature of each selected program)
- by pressing the key (7) you can select all segments of the curve
- by using the arrow keys (9) you can change the program values as required

After pressing the "start stop" key (12) the firing starts (the decimal point is flashing on the very right hand side of the display (1) indicating that a firing process is actually running. The display (1) shows the actual kiln´s temperature.

5.) Programs

You can store up to 9 programs in your TC804 controller. Therefore you can store your most useful firing cycles. To enter a program you have to call up a program number before entering the curve values. When you have finished entering the curve the controller saves it automatically.
To start a saved program proceed as follows: Press the button (6) multiple times until the desired program number appears on the program display (3). After pressing the button (12) the controller starts firing.

6.) Displaying Values while Firing

During a firing the controller indicates the kiln temperature on the upper display (during a delay start the controller indicates the remaining time in minutes/hours before the firing starts). The actual segment of the firing curve is also shown in display (4).

You can also change the firing curve while the program is running. Press button (7) to display the parameter of the firing curve and change them by using buttons (9). The display returns to kiln temperature 15 seconds after the last adjustment has been done.

Note: If you change the time for dwell of the actual running segment, you only change the value for this firing (i.e. the programs time value is not affected).

There are 4 values that can be displayed during a firing without interrupting the firing:

- program setpoint (by pressing⇧ button)
- actual kiln heating in % of power,(by pressing⇩ button)
- time remaining in a segment (by pressing the "event"-button)
- power consumption of firing (button (11); will be reset to zero after selection of new program)

After 2 seconds the display changes automatically back to the normal indication.

7.) Reaction to a break down of Power Supply

You can adjust the reaction to a power break down:

- stop firing with displaying the error message F0 (0)
- continue firing if the break down was shorter than 30 Minutes (1)
- continue firing after the power supply is established again (2)

The number in brackets is the value you have to adjust in the configuration table of you controller (see appendix). The controller is preadjusted to mode (1) (continue if break down < 30 min).

8.) Direct Control

In certain applications it may be useful to take direct control of the firing process (e.g. for glass fusing). Therefore you have the following functions (only while program is running):

8.1.) Immediate skipping to the next Segment

The user sees that the time in the actual segment is too long that means that the controller is supposed to continue with the next segment. By pressing the button "event" (10) for 3 seconds the controller will skip to the next segment immediately.

8.2.) "Hold" in the actual Segment

The user sees that the goods need more time than the duration of the segment provides. By pressing the key "prog" (6) for 3 seconds you can set the controller to hold mode: The holding times can be extended in addition the given temperature during the ramps stays constant (the setpoint is no longer driven up or down). This hold mode is indicated by a "h" in the program display (3). The hold mode is released by pressing the "prog" button (6) again for 3 seconds.

8.3.) Predefined "Hold"

The user can set the kiln to the hold mode (see above) at a predefined segment of the firing. The time value of the segment where the controller has to enter the "hold" mode will be set to "hold" (this is done by increasing the time to maximum value + 1). Please note that the controller will stay in hold mode until the user continues the program by pressing the prog button (6) for 3 seconds.

9.) Maximal Range for Values

a.) times .....0:00 to 80:00 hours
b.) ramps.....0 to 700°C, SKIP, END
c.) temperatures.....20°C - (depending on kiln)

10.) Additional Event Output

Your controller TC804 can be configured for up to two additional event outputs. You can program these event outputs for every segment "ON" of "OFF". By using this you can control any additional instruments for firing (flaps, gas control, warning signals etc.).
After you have selected a segment by using the buttons (7,8) press the button [event] (10). The display shows "E1" or "E2" (event 1 or 2) and the actual programmed status, 0=ON or 1=OFF. You can change the status by pressing one of the keys (9). This information (ON of OFF) has to be programmed for every segment of the curve and will also be saved in a program.

Appendix A:
Error Messages of the TC800 Series Controllers

During firing TC800 series controllers check all units of the kiln. If a problem occurs the controller displays "Er " followed by a number (Error No.) and an optional secondary code that is shown in the program display.

Er 1: no program is selected or program values bad

If you try to start firing without having previously selected a valid program the controller shows this error message. Select a program by pressing the button (12)

Er 2: 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 of heating element failure

In some applications it is required to supress this checking. Refer to parameter 4. (appendix B).

Er 3: Thermocouple or electrical link (cable) is defect

Check all connections and wires (connectors, cable damage, thermocouple destroyed ..)

Er 4: Thermocouple polarity incorrect

possible cause of fault : temperature sensor itself incorrect polarized
temperature sensor colder than -15°C

Er 5: safety alarm activated

If one of the additional outputs is confugured as a safety alarm and the alarm conditions occured, this message will be shown.
Check all units of your kiln (relay contactors, solid stated relay etc.)

Er 6: Error on data acquisition

The controller has determined a problem on data acquisition. The secondary code (shown in program display) analyzes the problem:

1: temperature values unsteady (problem on connectors of other high sensitive parts)
2: internal problem in power supply (contact manufacturer)
3: maximum temperature exceeded (see parameter list, could be caused by problems in relay contactor or other components in the electronic system)

Er 7: problem in external unit

If your controller is equipped with an optional expansion board (e.g. 0-20mA I/O) this error message point to a problem in this unit. For further details see manual of the corresponding board.

Er 8: bad parameter list

After power on the controller checks all values of the parameter list. If the adjusted values do no fit to the current configuration or any other problem in the paramter list is found this error message is displayed. See secondary error code (on program display) for further details:

1: zero calibration offset invalid
2: checksum invalid
3: jumper setting does not fit to configured thermocouple
4: jumper setting does not fit todo0.0 (F0)-output configuration

For further details see parameter list in appendix B. To be able to re-configure software settings, you can suppress this error message by unlocking the controller like in appendix B described.

Er 9 : internal hardware problem

The controller performs a self-test after every start up. If this message will be displayed, please ask you dealer for further assistance.

Er 0: firing interrupted because of power breakdown

If the firing process has been interrupted by a power breakdown (see chapter "Reaction on Power Breakdown"), the controller shows this message. The program segment shows the ramp number where the power breakdown happened.
Note: This message also appears when the controller was turned off by the user before firing was completed (e.g. during last cooling segment). In this case the message doesn´t have any meaning.

Appendix B:
How to configure the controller TC800 series

To get the best performance, you have to adjust some parameters that determine the operation of the controllers. The parameters are pre-setted to standard values that ensure proper operation in most cases. But for optimal usage, we recommand to set the parameter list. This has only to be done once.

Changing the Parameters

To avoid unauthorized changing, the parameters are locked. For unlocking proceed as follows: Turn off the controller, press button [total kwh] and turn on the controller again (hold button pressed). The controllers shows a "C" for "configuration" on the program display. The controller is now in configuration mode with the following consequences:

- by pressing the [prog]-button the self-adjust-firing can be started (see below)
- a error message "Er 8" is supressed to allow new configuration
- the parameter list can be changed

To get in the parameter menu press the button "total KwH" and hold it for about 4 seconds. Now the display shows the first configurable value. You can change the value by pressing the buttons (9). Next parameter will be called up by pressing the button (7) and so on.
Important: To ensure that all values will be saved correctly you have to leave this menu by pressing the button (7) until all parameters are stepped through. Bad operation will cause an "Err 8" error !

Code	Usage	value range	unit
0	configuration code	0-100	-
1	total operation hours counter	0-9999*	h
2	reaction on power break down	0-2	-
3	%-heating in case of T/C error	0-60	%
4	power consumption of kiln	0-160	kWh
5	type of thermocouple: S - R - K - J* etc.	0-7	-
6	max. adjustable temperature*	20-1800	°C
7	max. allowed % of heating	0-100	%
8	proportional band	0.0-99.9	%
9	integral time**	10-8000	s
A	minimum time for ON cycles**	0-15	s
B	minimum time for OFF cycles**	0-15	s
C	derivative time	0-999	s
D	cylclus time**	1-100	s
E	hysteresis**	0.5-25	°C
F	reserved	-	-
0.	unit for temperatures (°C or °F)*	0-1	-
1.	unit for ramps (rate - time)***	0-1	-
2.	condition for entering next segment	0-2	-
3.	lock hour display for time	0-1	-
4.	suppress heating check (see Err 2)	0-1	-
5.	lock program changes	0-1	-
6.	output type do0.0 (F0)	0-3	-
7.	output function do0.1 (F1)	0-15	s
8.	optional parameter for do0.1 (F1)	0-4000	-
9.	output function do0.2 (F2)	0-15	s
A.	optional parameter for do0.2 (F2)	0-4000	-
B.	communication interface mode	0-255	-
C.	operation of I/O-expansion board	0-255	-
D.	no. of zones on master operation	0-16	-
E.	final temp. on program end(not for TC805/6)	0-1800	°C

* parameter locked to prevent from unauthorized change. Please request additonal code from manufacturer

** depending on the proportional band (0.0% or >0.0%) some parameters are skipped

*** On TC805/6: starting temperature on 1st ramp 20°C or actual kiln temperature

Explanation of the Paramters

0: This is a free adjustable value to inform further users about the origin/type of configuration. It can be used e.g. to leave a mark in the controller.
1: The controller summarizes all operation cycles of the kiln heating elements. This parameter shows you the total time in hours and is very helpful for checking the kilns lifetime (warranty etc.). For resetting additional code required
2: reaction on power break down:

0- stop firing (see Error message Er 0)
1- resume firing if power break down less than 20 minutes
2- resume firind unconditional

3: If a problem during firing occurs and the controller is forced to interrupt in some applications a small (uncontrolled) heating may be useful. This prevents from fast temperature decrease. For security reasons this percantage value is limited to 60%.
4: The controllers takes this value to calculate the power consumption. The power consumption can be called up by pressing the [total kwh] - button during firing (see manual).
5: type of thermocouple: the controller can be adjusted to on of the following thermocouples:

0- Typ S (Pt 10%)
1- Typ R (Pt13%)
2- Typ K (NiCr)
3- Typ J (FeCu)

Important note: This adjustment requires also proper setting of one JUMPER on the controller board. For parameter 0 and 1 the T/C JUMPER has to be setted on S/R position, for parameter 2 and 3 to K/J position. The controller checks the JUMPER position after every restart and displays "Err 8" code 3 in case of failure.
6: This value limits the maximum temperature that can be programmed (usually the maximum kiln temperature). For changing of parameters 4 and 5 additional code required.
7: This value can be used to limit the maximum heating power (to use on kilns that are not allowed to have the maximum power of heating). The value is given in percent.
8: proportional band - control parameter, self adjust feature see below. A value of 0.0% causes the controller to operate as a hysteresis controller with D-function. Might be required for very fast reacting kilns.
9: integral time, control parameter, self adjust feature see below (not required if prop.band =0.0%)
A: minimum ON cyclus time (on PB=0.0% only): Some applications require to extend the minimum cyclus time (e.g. on some gas kilns very short heat cycles are not allowed on low temperatures)
B: minimum OFF cyclus time (on PB=0.0% only): see above, but OFF time is extended if required.
C: derivative time, control parameter, self adjust feature see below
D: The cycle time determines frequency of switching. A short time (e.g. 10 sec) causes a very smooth heating but a high loss of the relay contactor. A long time increases the lifetime of the relay but results in unsteady kiln heating. A time of 30 seconds is the best value for most applications.
E: Hysterisis: (on PB=0.0% only): A low hysterisis provides faster and accurate control; see above
F: Reseved for future applications
0.: Units °C / °F: Changing this parameter to 1 causes the controller to switch to °F display. All values will be processed in °F. (Tmp(°F) = Tmp(°C) * 9 / 5 + 32).
1: this is to select the way to determine the ramp values (not on TC805/6):

0- ramps determined by rate (2-700°C/h, SKIP, End)
(e.g. ramp 450°C/h to next hold temperatur 600°C)
1- ramps determined by time (End, SKIP, 2-999 min)
(e.g. ramp takes 100 min to next hold temperature 600°C)

on TC805/6: The starting temperature for calculating the 1st ramp can be selected:

0- temperature of 20°C
1- actual kiln temperature

Selection 1 causes the kiln to determine the ramp direction (cooling / heating) by comparing the actual kiln temperature with the temperature of the first ramp. Example: Assuming that the 1st ramp temperatur is 100°C and the kiln has already 200°C from last firing. On selection 1 the kiln will perform the 1st ramp as a cooling starting from 200°C down to 100°C. On selection 0 the kiln will proceed with ramp 2 immediately.

2.: condition for entering to next segment:

0- segment will be finished when kiln temperature matches segment temperature

1- segment will be finished when the programmed time is elapsed

2- segment will be finished when both conditions are met

Selection 0 is the default. Selection 1 should be taken the firing process has to fit to a fixed timetable. Use selection 2 if the kiln temperature is very unsteady and so a short temperature peak isn´t allowed to cause the controller to enter the next segment.

3. Lock hour display for time:

0- default: times will be entered starting from 0:00 til 80:00 hours

1- times will be entered starting from 0 to 999 minutes

4.: Suppress heating check:

For security reasons the controllers checks the temperature gradient of the kilns continously and displays an error message (Err 2) if the kiln temperature increase is too low even in full power heating. For some applications this checking has to be suppressed (e.g. the kiln door has to be opened during firing; because of the heat escaping the kiln the controller will display an error Err 2 after a while; to avoid this use selection 1 of this parameter)

5.: lock program changes: To protect the programs against unauthorized changes set this parameter to selection 1. Can be used to save the once adjusted program set against unintentional change.

6.: the output do0.0 (F0) can be used in different ways. This is to select the required mode:

0- normal operation,do0.0 (F0) is output for heating the kiln

1- as above, but for solid state relays

2- ON during the total firing (can be used on 0-20mA operation)

3- OFF

Important Note: Depending on the operation the do0.0 (F0) JUMPER has to be setted to "RELAY" (for mechanical relay contactor) or to "SOL.STATE" (for solid state relay). The controller checks the proper setting of this JUMPER and displays an "Err 8" code 4 in case of failure.

7.: operation of the do0.1 (F1)-output:

0- OFF

1- switches accordingevent-bit no.1

2- switches according event-bit no. 2

3- ON during whole firing (e.g. for pilot flame on gas kilns)

4- ON during firing, OFF during t0

5- ON when firing has finished

6- ON if actual temperature higher than value x (see Parameter 8.)

7- ON if actual temperature lower than value x (siehe Parameter 8.)

8- ON if actual temperature higher than setpoint + x°C (see Parameter 8.)

9- ON if actual temperature lower than setpoint - x °C (see Parameter 8.)

10-ON if actual temperature in setpoint range of x°C (deviation alarm) (see Parameter 8.)

11- control output cooling (see appendix D)

12- beeper signal on temperature drop in fusing applications (TC803 fusing)

13- security function: ouput is ON as long as the kiln temperature doesn´t exceed the programs maximum temperatur plus x°C (see parameter 8.). If the kiln temperature goes too high this output is deactivated to turn off kiln power and the controller displays "Er 5". Don´t select parameter 8. too small to avoid that the the security circuit reacts too sensitive (default value 30°C).

14- ON if a error message occurs

15- reserved for future applications

8.: paramet- for do0.1 (F1)-output (see above)
9.: operation of the do0.2 (F2)-output (see above)
A.: parameter für do0.2 (F2)-output (see above)
B.: communication interface mode:

0- no data stream
1- RS422 standard data stream
2- as above, but additional information for multizone operation
3- reserved

C.: operation of the expansion board: In case of an installed expansion board you have to determine the operation by setting this parameter:

0- no I/O-board installed
1- thyristor driver 0-20mA
2- output of setpoint 0-20mA
3- output of actual temperature 0-20mA
4- additional input O_2-sensor
5- reserved

D.: In case of multizone operation (with TC802-Z zone controller) the no. of zones has to be adjusted:

0- no multizone operation
1- multizone operation 1 zone
2- multizone operation 2 zone
3- ...

The controllers needs this information to synchronize heat cycles of all zones. This results in very steady heating (e.g. 30 seconds cylce time and 3 zones: zone 1 is activated, after 10 seconds zone 2 and then again after 10 seconds zone 3. After 10 seconds the 1 zone is activated again and so on)
E.: This is to determine the temperature where the controller stops to control the kiln temperature during the last decrease ramp. Also the "End" signal (see parameter E.) is determined by this value (not required for TC805/6).

Appendix C:
Control Parameters and Self-Optimization

The control algorithm of you TC800 series controller is mainly determined by the 3 parameters P, I and D.
Explanation:
- P is the proportional band (in % of the maximum temperature). This value determines the range of temperature over that controller switches the kiln heating from 100% to 0%
- I is the integral time (in seconds). This time determines the how fast the controllers minimizes the remaining temperature deviation to zero (note: Too small values cause the kiln temperature to oscillate)
- D is the derivative time (in seconds). This value describes the kiln speed

Your controller is equipped with a self-optimization-feature. During a special firing process the controller can find out the best P, I , D values for optimal performance. On delivery there are standard parameters adjusted to ensure proper operation for nearly all kilns and applications. In most cases there is no need to perform the self optimization procedure.

To perform the self optimization, proceed as follows:
Unlock the controller like described in appendix B and press the [prog] button. The controller then shows the default optimization temperature (600°C). The controller will heat up the kiln til this temperature and will find out the best P,I,D values by monitoring the kilns reaction. You can adjust this optimization temperature by using the buttons (9). The adjusting temperature should be about half the maximum kiln temperature. Pressing the button (7) will start the self-optimization process (segment display indicates ´A´for self-adjust)

After the firing is finished (segment display is off) the controllers saves the calculated values automatically. These values can be called up by stepping through the parameter list (see appendix B). Note: If the controller is switched to a proportional band of 0.0% the self optimization function is not available.

Appendix D:
Cooling Output

On very slow cooling kilns a external cooling can be required. This can be done by flaps or fans. Your TC800 series controller can be programmed to control cooling instruments by configuring one of the additional function outputs (see appendix B). Further information upon request.

Configuration List TC800 Series Controllers

Customer: **Date:**

Order Number: **Kiln:**

Code	Usage	value range	adjusted	unit
0	configuration code	0-100	_____	-
1	total operation hours counter	0-9999*	_____	h
2	reaction on power break down	0-2	_____	-
3	%-heating in case of T/C error	0-60	_____	%
4	power consumption of kiln	0-160	_____	kWh
5	type of thermocouple: S - R - K - J* etc.	0-7	_____	-
6	max. adjustable temperature*	20-1800	_____	°C
7	max. allowed % of heating	0-100	_____	%
8	proportional band	0.0-99.9	_____	%
9	integral time**	10-8000	_____	s
A	minimum time for ON cycles**	0-15	_____	s
B	minimum time for OFF cycles**	0-15	_____	s
C	derivative time	0-999	_____	s
D	cylclus time**	1-100	_____	s
E	hysteresis**	0.5-25	_____	°C
F	reserved	-	_____	-
0.	unit for temperatures (°C or °F)*	0-1	_____	-
1.	unit for ramps (rate - time)***	0-1	_____	-
2.	condition for entering next segment	0-2	_____	-
3.	lock hour display for time	0-1	_____	-
4.	suppress heating check (see Err 2)	0-1	_____	-
5.	lock program changes	0-1	_____	-
6.	output type do0.0 (F0)	0-3	_____	-
7.	output function do0.1 (F1)	0-15	_____	s
8.	optional parameter for do0.1 (F1)	0-4000	_____	-
9.	output function do0.2 (F2)	0-15	_____	s
A.	optional parameter for do0.2 (F2)	0-4000	_____	-
B.	communication interface mode	0-255	_____	-
C.	operation of I/O-expansion board	0-255	_____	-
D.	no. of zones on master operation	0-16	_____	-
E.	final temp. on program end(not for TC805/6)	0-1800	_____	°C

Remarks:

Appendix E:
Assignment of the Receptables

The electrical connections are made by using receptables (6.3mm and 2.8mm). There are located on the back side of the controller. See below for assignement:

LINE power Supply 220V/50/60Hz (live)

N power Supply 200V/50/60Hz (live back)

PE (Protection Earth)

used by internal filters (supression EARTH)

COM: common contact of relays

N/O: normal open contact (short to COM when relay energised)

N/C: normal closed contact (short to COM when relay de-energised)

do0.0 (F0), do0.1 (F1), do0.2 (F2):

connections of the corresponding relay, „do“ stands for „digital output“

AI0.0 (T/C)+ : thermocouple +

AI0.0 (T/C)- : thermocouple -

RXTX+: communication interface + (optional)

RXTX-: communication interface - (optional)

EXP-X: input/Output of expansion board (optional, e.g. for 0-20mA thyristor)

EXP-Y: input/Output of expansion board (optional)

COM: common-conection of expansion board (optional)

Important note for VLCD (very low currency devices): The relay outputs are bridged with an RC-combination of 0.033uF+150R to supress sparks on switching. By using very low currency devices, this can cause problems because of the remaining currency that can flow over this RC-bridge even when the relay is de-energies (i.e. in OFF-position). If this is the case, adjust the JUMPER for do0.0 (F0) inside the controller (and re-configure parameter list) or use load resistors. Further informations can be required directly from us.

Important note by using relay contactors: Relay contactors generate electromagnetical noise when switching. These can interfere with electronic devices. To supress these noise please use an RC-bridge an the relay contactor coil (also required by the FCC restrictions).