bentrup

TC 802

```
1221.
```
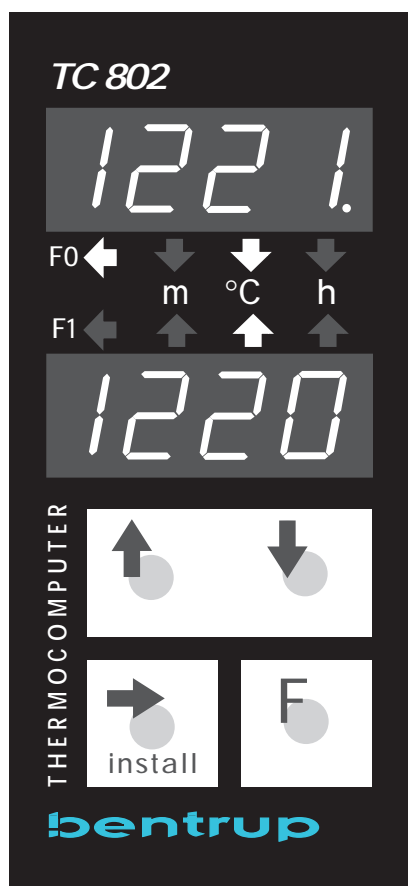F0
m °C h
F1
```
1220
```

THERMOCOMPUTER

install

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Controller
TC 802

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Front Panel TC802 / Brief Instructions

(1) Display of the actual temperature (flashing decimal point indicates a programme running)

(2) Unit of the (upper) value (1)

(3) Unit of the (lower) value (4)
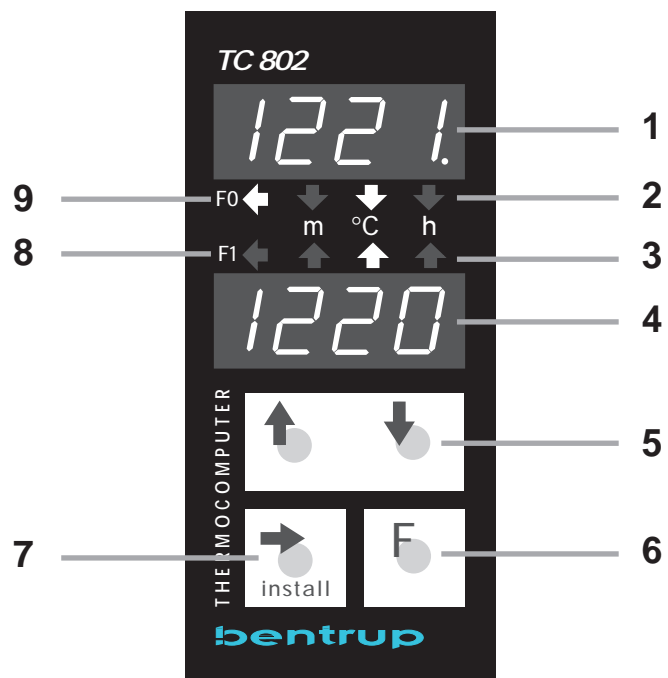
(4) Display of the setepoint temperature

(5) keys to change the setpoint value

(6) function key. Usually no used.

(7) Key to call up the actual power output in % (shown on display (4), e.g. "P100" means 100%). On pressing this key 3 seconds the controller enters the installation. This installations is used to adapt the controller initially to your application. For details see appendix A.

(8) status display ON / OFF of the 1st relay output (Default control output)

(9) status display ON / OFF of the 2nd relay output (e.g. alarm output)

General Information

The controller TC802 is based on latest microprocessor technology. The exact operation is guaranteed by exact signal acquisition and processing of the results and the precise control algorithms. A special feature are the extended self check and supervisory circuits which are no common in this class of instruments. These featurer making the TC802 a very reliable and safe component in your application.

By using very compact design it was possible to integrate all functions on a single board in a 48x96mm DIN size panel mounting case. For service and extensions the unit can simply be unplugged.

Getting Started

After power up the display (1) shows the software version code (e.g. V 4.7) and following the kilns temperature. If not, please check the mains supply and the fuse inside of the controller (0.5A lag 5x20mm).

Controller Operation

When power supply is established, the TC802 controls the system coneected to (e.g. kiln) to get to the setpoint temperature as fast as possible and maintains this temperature until the controller is turned off. The display (1) reads the actual temperature, the display (4) reads the setpoint. The indicators (2) and (3) point to the unit of these valuies.

Changing the Setpoint

Use the keys (5) to change the setpoint. For larger value changes, keep the key pressed. The adjusted setpoint is saved also after power down, ie. on next power up the controller will recover to the setpoint which was adjusted the last time.

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Further Displays

The indicators (8) and (9) show the actual status ON / OFF of the 1st (F0) resp. the 2nd (F1) relay output.

By pressing the key (7) the controllers shows the actual power output (in %) on the display (4).

Notes on the Installation Manual

The controller TC802 is a member of the powerful TC800 programme controllers. The installation and therefore also the operating instructions of the installation (resp. configuration) are identical; however, some of the parameters and error messages are not required because of the less complex structure (e.g. unused parameters 2, 4, 1., 2., 3., 5., B., D., E.).

Maximum Values

The setpoint can be set in the range starting from 20°C up to the maximum allowed value defined in the Configuration.

For safety reasons this maximum temperature should be set to the limits of your system.

Appendix A:
Error Messages of the TC800 Series Controllers

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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.)

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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 onTC805/6):
> 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 setpoin 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

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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

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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

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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:

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Appendix E:
Assignment of the Receptables

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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).

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