



Technical Manual Compact Series



bentrup



Introduction

The Technical Manual provides supplementary information for technicians. It is not designed for the ordinary operator since it describes changes to your controller which could cause problems and severe malfunction if done without proper knowledge.

The Technical Manual applies to all controllers of the compact series TC44, TC66 and TC88. For demonstration sketches TC88 is used. However, all features and options are available on TC44 and TC66 too at very little modifications. The Technical Manual contains the following chapters:

Chapter A describes **Optional Features** fitted to your controller. Mostly these were included by demand of the kiln manufacturer for particular kiln operations (e.g. controlling a damper).

Chapter B describes the **Error Log** which allows calling up all previous errors. This feature is a helpful tool to trace kiln and operation problems.

Chapter C explains **Operating Parameters** which allow adaption of the controller to your application. Most applications are covered by the ex works parameters, however.

Chapter D lists **Technical Details** like electrical and mechanical data of the controller.

Displaying Current Controller Setup

To display current controller setup and firmware information press programme key while turning on the controller. The displays shows one after the other

- fig A - comp cable type (**S/R, J/K** or **CF** which stands for free configurable thermocouple), hardware revision (1), thermocouple type (**S, R, J, K**)
- fig B - firmware code and built code (e .g. **1.10F**)
- fig C - (if applicable) customized software code (e.g. **cu. 2**)
- fig D - (if applicable) serial number (**n. 72.** followed by **.456**)



Linking Programmes (Option, TC66 only)

If this option is installed the TC66 provides you with the feature to automatically continue with another programme if the current programme has completed. This can be used e.g. to start the biscuit firing automatically after the drying programme has been finished.

To link a programme proceed as follows: Select the cooling segment using the arrow keys **←/→**. After entering the cooling ramp (in °C/h) press the arrow key **→** again to enter the final ramp temperature (figure A).

Press the arrow key **→** again. By default the display reads **End**. Now use the **+/=** keys to select the programme number you want the controller to **continue** after reaching the final ramp temperature specified earlier (figure B).

Note that the programme link setting is saved with the programme. If you do not want to automatically start another firing after completion make sure that the programme link option is set to "End". If you link a programme to itself it will run infinite cycles (might be used for stress tests).

Damper Control (Option)

Some kilns are fitted with an automatic damper which closes at a certain temperature during heatup to let out the vapour from the kiln. After the firing when the kiln has reached a safe temperature the damper opens up again to speed up cooling.

To enter the **damper close temperature** press and hold the arrow key **←** for 3 seconds until the display reads **dpr.c** (damper close). Now adjust the open temperature using the **+/=** keys (figure C).

To enter the **damper open temperature** press and hold the arrow key **→** for 3 seconds until the display reads **dpr.o** (damper open). Now adjust the closing temperature using the **+/=** keys.

Use the arrow keys **←/→** to continue entering the firing curve or operate the controller as usual. Note that both operating temperatures of the damper are saved individually for each programme.

(A)



(B)



(C)



Error Log

Every error message of the controller is internally logged. Important events like stopping a firing by pressing the start stop button or changing specific parameters (like maximum kiln temperature or type of thermo-couple) are also logged. This allows detailed error tracking if a problem is reported by the user and an obvious cause can not be determined.

The last 30 error messages are logged and saved when turning of the controller. This allows even sending the controller to the dealer for reading the error log if a customer is not capable finding the cause.

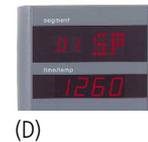
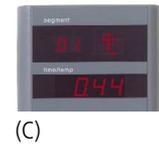
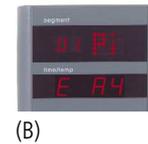
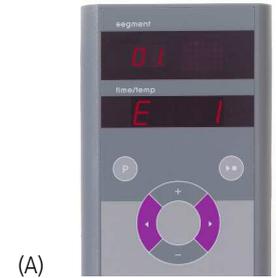
For example the controller reads **E A4** (heating problem of the kiln) when you enter your workshop next morning. Even worse, somebody played with the controller and therefore quit the error message. However, the error log provides you all details what happened during the night:

Press both **arrow keys** simultaneously to show the first entry of the log (fig A). The segment in which the error message occurred lights up. Now use the **▲** and **▼** keys to step through all 6 informations being displayed which is Error Message (fig B), segment time (fig C), setpoint temperature (fig D), kiln temperature (fig E), percentage of heating (fig F) and status of the control outputs (fig G, active output number lights up).

Note that all these informations were taken right at the moment of the error message. In the example shown old heating elements are most likely since the error happened at a very high kiln temperature (1254°C).

The error messages are explained in the operation manual. Additionally, the controller logs important user caused events as follows: E E2 = programme stopped, E E3 = programme holded, E E4 = programme continued.

Use the arrow keys to navigate through all entries of the error log. The log entry with the highest number is the oldest one. For security reasons log entries can not be deleted. Press both arrow keys again to return to normal display or wait 15 seconds.



Operating Parameters

The operating parameters allow adaptation of the controller to your application. In most applications the ex-factory settings are perfect and therefore no modifications are required.

Note that changing the parameters should be done by trained personal only since it can cause malfunction and even damage to the kiln. Most critical parameters are locked to further protect your kiln. Anyhow, do not change any operating parameter without considering consequences!

par. no.	operation parameter	default	set range	unit
S-01	thermocouple (fixed)		S, R, J, K	
S-02	max. temperature (fixed)		20-1600	°C
S-03	proportional range (P)	2.0	0.0-99.9	%
S-04	integral time (I)	200	10-8000	s
S-05	derivative time (D)	10	0-999	s
S-06	control output cycle time	30	1-99	s
S-07	control supervisory	Opt	Opt, Grd, OFF	
S-08	ramp units°C/h or h:min	Grad	Grad,time	
S-09	communication ID	0	0-63	
S-10	mode 2 nd ctrl. output (fixed)	1	0-9	
S-11	temperature units	°C	°C - °F	
S-12	1st ramp temperature (TC44 only)	°C	400-650	°C

To enter operating parameters hold the **programme key** pressed for 3 seconds. The controller enters installation showing the first parameter. On TC44 and TC66, initially the parameter number is shown (fig. A), on on TC88 the upper display reads the parameter number continuously (fig B).

Use the **arrow keys** to navigate through the parameters. If required modify the shown value using the **+** resp **-** keys. If you try to change a locked parameter the TC8 flashes "x" on the LED matrix (fig. C).

To Leave the installation and save the changes hold the **programme key** for 3 seconds until the display reads "**Save okay**" (fig D).

Refer to the next page for a detailed explanation of all operating parameters.



S-0 1: thermocouple (locked)

Type of thermocouple connected to the controller. Note that this setting is locked since it is usually set ex factory. However, controllers ordered as variable type (X) can be user set to any of the thermocouple types S, R, J or K. X type controllers have the CJC integrated in the controller plug.

S-0 2: maximum temperature (locked)

Maximum adjustable temperature in ∞ C (even in ∞ F mode). Never exceed this value over the temperature your kiln is approved.

S-0 3: proportional range

Parameter of the control loop in % of the maximum temperature, default value 2.0%

S-0 4: integral time

Parameter of the control loop in seconds, default value is 20s.

S-0 5: derivative time

Parameter of the control loop in seconds, default value is 10s

Note for S-03, S-04 and S-05: Do not temper with these values. Manually adjusting these values requires in depth knowledge of the control characteristics. The default values provide excellent results for most applications since they are overlayed with a continuous auto tune.

S-06: cycle time

Determines switching rate of the contactor. Frequent switching improves control accuracy but stresses the contactor. 30 seconds has been found a good compromise for most kilns with mechanical contactors. Reduce cycle time to 3 seconds when using solid state relays (SSR).



To unlock all parameters press both programme and  key on power up. Change of locked parameters is logged internally to track up unauthorized changes

S-07 control supervisory

Determines how the controller reacts if the kiln does not follow a controlled ramp (not on SKIP):

Opt- Optimal checking causing the controller to enter HOLD for up to 10 minutes if the kiln does not follow programmed ramp. Might cause firing entering HOLD frequently to give the kiln time to catch up.

Grd- Gradient checking of the kiln only, ie. controller checks if the kiln temperature increases during full power heating. Use this setting instead of Opt if you want a ramp to be processed exactly as programmed w/o any delays and your kiln load accepts a deviation in temperature gradient.

OFF- no checking of temperature increase at all. Note that this setting will cause overfiring if the thermocouple is pushed out of the kiln. Use this setting instead of Grd or Opt if your operation requires the kiln to be opened frequently which otherwise might cause **E A4** termination.

S-08 ramp units °C/h or h:min

Value type when entering controlled ramps. Can be °C per hour (e.g. 20°C/h or 2:00 to 400°C)

S-09 communication ID

ID of the serial communication. Reserved for future use.

S-10 operation mode of the 2nd output

Determines the function of the 2nd control output. 0-not used 1-safety contactor (default) 3-ON firing 4-ON during the firing but not programme delay 5-ON when firing completed

S-11 temperature units °C / °F

Celsius / Fahrenheit reading: 0-temperatures in °C 1-temperatures in °F

S-12 first ramp temperature (TC44 only)

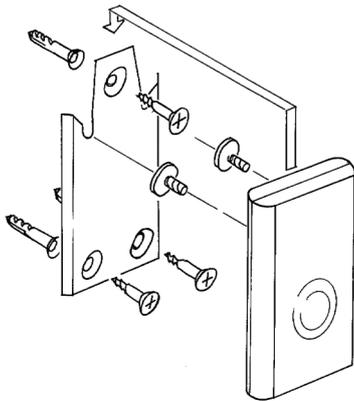
final temperature of the first ramp (default 580°C). Always set in °C.



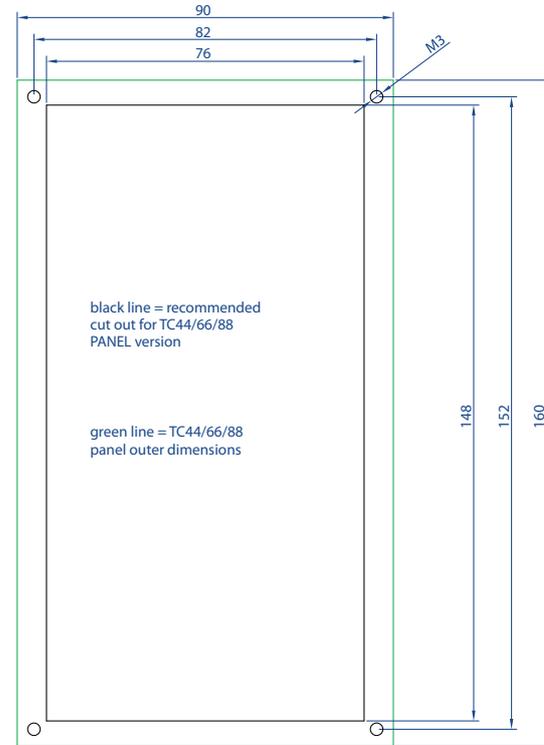
Technical Details

supply voltage	90-264V AC/DC
power dissipation	2 VA
fuse	0.5A lag
operating temperature	-15 to 65°C
storage temperature	-25 to +80°C
relative humidity	85% non condens.
data acquisition	dual slope 16 bit
digital filter comp.	50/60Hz
protection	IP53 (case model)

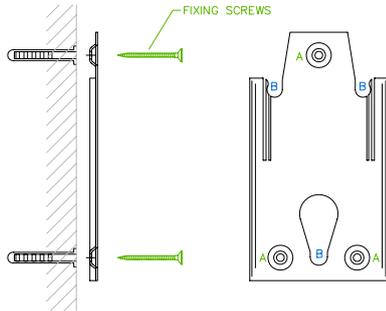
Wall Mounting Bracket (accessory)



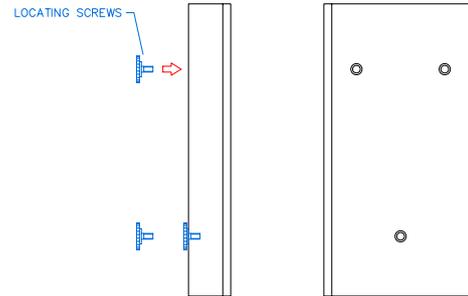
Panel Mounting Dimensions



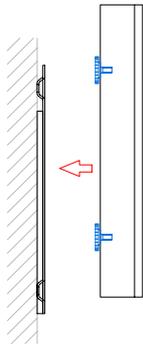
Step-by-Step Controller Mounting Instructions



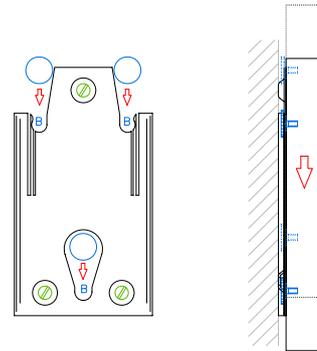
STEP 1 - FASTEN BRACKET TO WALL THROUGH COUNTERSUNK HOLES 'A' USING FIXING SCREWS PROVIDED.



STEP 2 - FIT LOCATIONSCREWS PROVIDED INTO 3 (RESP. 2 ON TC44/TC66/TC88) POSITIONS ON REAR OF INSTRUMENT



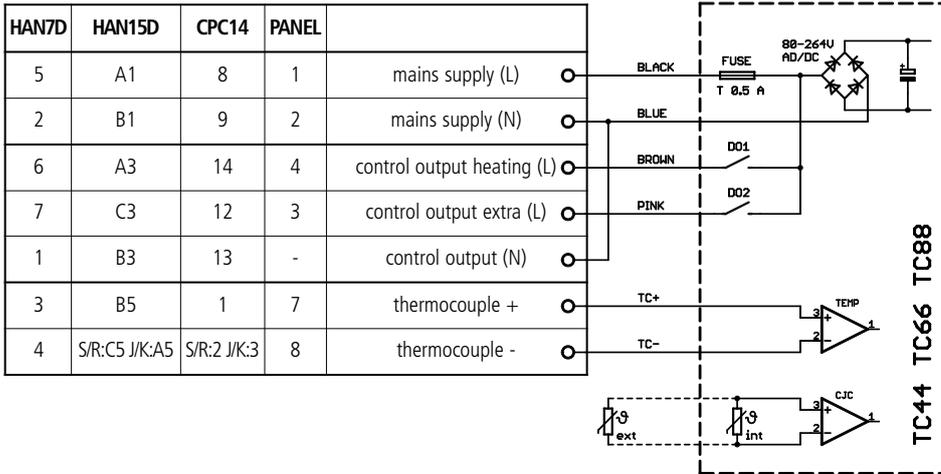
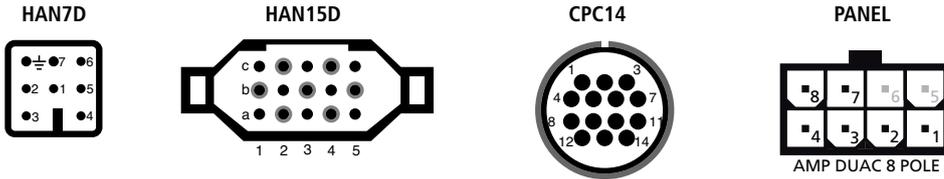
STEP 3 - PLACE INSTRUMENT ON FACE OF BRACKET



STEP 4 - SLIDE INSTRUMENT DOWN APPROX. 25mm TO LOCK IN FINAL POSITION WITH LOCATING SCREWS IN NOTCHES 'B'

Electrical Details

Caution! Under no circumstances open the controller. The fuse is accessible from the outside. Sketches show the top view of plugs (resp. socket on panel model). Note that some kiln manufacturer use pin assignments different from the ones shown below.



Facsimile Message

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INDUSTRIESTEUERUNGEN

EU declaration of conformity

We hereby declare that the listed products comply with the requirements of the EU Directives stated by meeting the following standards:

type of product :	kiln controller
mode specification	compact series TC44, TC66, TC88
referring EU-regulations	EG regulation low voltage (73/23/EEC) EG regulation EMC (89/336/EEC)
applied harmonized standards:	EN 61010 (LV directive) EN 50082-2 (EMC suppression) EN 55011 Class B (EMC emission) EN 61000-3-2/3 (EMC emission)

This product must be installed and operated by competent personnel. When this product is connected to other components/machines, the builder/assembler must ensure that the whole machine complies with the relevant EU Directives before use. Any unauthorized changes to the product will result in this declaration becoming void.

Fernwald, November 3rd 2007



Reinhard Bentrup, Managing Director

bentrup

operating instructions compact series V1.3
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