Programme Controllers

TC 20xx Series

Bedienungsanleitung

Operating Instructions

TC 2010

TC 2044

TC 2066

TC 2088

bentrup

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Universalregler TC2010

1 - Sollwertanzeige

2 - Prozess/Istwertanzeige

3 - Einheiten/Matrixanzeige

4 - Prozessstatus oder

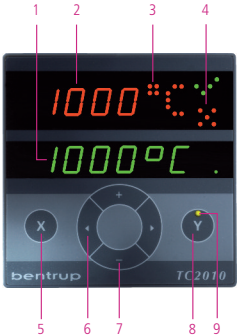
5 - Abfragetaste Prozesswerte

6 - Pfeiltasten zur Sollwert**auswahl**

7 - +/− Tasten zur Sollwert**änderung**

8 - Rücksetztaste (Fehler quittieren)

9 - Reglerstatus **stop** / **aktiv** / **hold**



Generic Controller TC2010

1 - setpoint value display

2 - process value display

3 - units / maxtrix display

4 - process state or

5 - calling up additional process values

6 - arrow keys to **select** setpoint

7 - +/− keys to **change** setpoint

8 - reset or quitting error key

9 - controller state **stop** / **active** / **hold**

Die TC2010 ist eine intelligente Mikroprozessor-Regelung mit weitreichenden Anpassungs- und Ein/Ausgabefeatures bei einfachster Bedienung.

Je nach Erfordernis hat der Anlagenhersteller Ihre TC2010 auf einen der folgenden Betriebsmodi eingestellt (Festlegung in der Konfiguration):

Bedienungsanleitung vor der Benutzung aufmerksam durchlesen

Please read through this booklet carefully before using your controller

Your TC2010 is an intelligent microprocessor based controller providing extended adaptability and input/ouput options combined with highly user friendly operation.

Depending on the demands of the application your system builder has set your TC2010 to one of the following operating modes (see configuration):

Stetigregler (häufigste Anwendung)

Der über die ➕/➖ Tasten eingestellte Sollwert (1) wird vom Regler angefahren und gehalten. Die aktuelle Prozesstemperatur wird in (2) angezeigt. Die Statusanzeige (4) wechselt von ✖ auf 〰 wenn die Temperatur den Regelbereich erreicht (d.h. Heizen/Kühlen <100% oder Abweichungsalarm AUS).

Je nach Anwendung kann zusätzlich die **Aufheizgeschwindigkeit** (in °C/h) eingestellt und die Haltezeit begrenzt werden. In diesem Fall können die Werte über die **Pfeiltasten** angewählt und über die ➕/➖ **Tasten** verändert werden (Bild A).

(A)

Setpoint Control (most common application)

The setpoint (1) entered using the ➕/➖ keys is achieved and held by the controller. Display (2) indicates the current process temperature. The state display (4) changes from ✖ to 〰 once the temperature is in control range (ie. heating/cooling <100% or deviation alarm is OFF).

Depending on application additionally the **heat up rate** (as °C/h) as well as the dwell time can be defined. Select these values using the **arrow keys** and adjust them using the ➕/➖ **keys** (fig A).

Temperaturwächter

In dieser Betriebsart schaltet der TC2010 ab, wenn der über die ➕/➖ **Tasten** eingestellte Grenzwert (1) überschritten wird. Die Statusanzeige (4) wechselt hierbei von 〰 auf ✖ und der Reglerstatus (9) auf **stop**. Erst durch Rücksetzen mit der **Taste Y** wird die TC2010 wieder aktiviert (Bild B).

Die bei Übertemperatur erreichte Höchsttemperatur wird beim Drücken der **Taste X** auf der Prozesswertanzeige (2) dargestellt.

(B)

Temperature Watchdog

With this operation mode the TC2010 switches off if the limit setpoint adjusted by using **keys** ➕/➖ is exceeded. In this case the state display (4) changes from 〰 to ✖ and controller state (9) indicates **stop**. Press the **reset key Y** to resume TC2010 operation (fig B).

The maximum temperature found during this scenario is shown on the process display (2) when pressing **key X.**

Zonenregler (Slave)

Bis zu 32 Regler TC2010 können z.B. an einem TC2088 (Master) als Zonenregler (Slave) betrieben werden. Prozessstart und Sollwert werden digital vom Master ausgesendet. Nach Anwahl der Sollwertdifferenz über die **Pfeiltasten** wird der Offset der Zone in Anzeige (1) dargestellt und über die **+/− Tasten** eingestellt (Bild A).

Die Statusanzeige (4) wechselt von ⁘ auf ⁙ wenn die Zone im Regelbereich arbeitet (d.h. Heizen/Kühlen <100% oder Abweichungsalarm AUS).

(A)

Zone Controller (Slave)

Up to 32 controllers TC2010 can be slaved on to e.g. a TC2088 master controller in a multi zone application. Process activation and setpoint are transfered from the master digitally. If required an offset temperature can be entered in display (1) using the **+/− keys** after selecting offset setpoint using the **arrow keys** (fig. A).

The state display (4) changes from ⁘ to ⁙ once the zone operates in control range (ie. heating/cooling <100% or deviation alarm OFF).

Signalkonverter/Grenzwertgeber

In dieser Betriebsart können beliebige Messsignale ausgewertet, angezeigt und ggf. als Analog- oder Digitalwert ausgegeben werden. Der TC2010 verfügt über diverse Ein/Ausgabeoptionen (Analog, RS232/485, USB); ebenso können verschiedene Grenzwerte die Schaltausgänge ansteuern. Auch der Einsatz als Trennverstärker ist möglich.

Nebenstehend ist ein TC2010 als Anzeige und Messwertumformer für Zirkonoxyd-Sonden dargestellt (Anzeige (1) Isttemperatur, Anzeige (2) CO in % und Ausgabe als 4-20mA Signal (Bild B).

(B)

Signal Converter / Limiter

This operation allows the controller to process and display various kinds of sensor signal. Also they can be converted into miscellaneous analogue and digital signals. The TC2010 provides various input/output capabilities (analogue,RS232/485,USB); additionally settable limit operations can be triggered. Another option is using TC2010 for signal isolation.

Refer to the picture enclosed for a TC2010 used as signal conversion and display for Zircon-Oxide probes to display temperature on display (1) and CO (%) on display (2); CO value is sent as 4-20mA analogue signal (fig B).

Werteabfrage (alle TC2010 Modelle)

Über die **Taste X** können die aktuellen Prozesswerte und der Zustand der Schalt- und Analogausgänge (falls vorhanden) abgefragt werden.

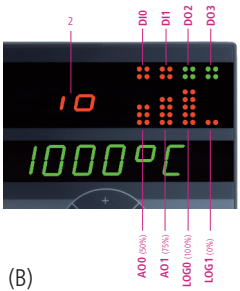
In der Prozesswerteanzeige (2) erscheint der Heiz/Kühlwert (in %) und der Zustand (AN/AUS) der Schaltausgänge **DO0** und **DO1** (Bild A).

(A)

Falls der TC2010 mit Ein/Ausgabeoptionen bestückt ist, wird der Zustand durch erneutes Betätigen der **Taste X** dargestellt (Display (2) **"io"**).

Der Status der Digitaleingänge **DI0** und **DI1** erscheint ebenso wir der Schaltzustand von **DO2** und **DO3** oben in der Matrixanzeige (Bild B).

Der aktuelle Ausgangswert von **AO0** und **AO1** (z.B. 4-20mA) als Balken dargestellt. Wenn **LOG0** und **LOG1** für Stetigausgabe konfiguriert sind (z.B. bei Solid-State-Relais-Ansteuerung), wird der Ausgangswert ebenso als Balken dargestellt, andernfalls als roter Leuchtblock unterhalb DO2/DO3.



(B)

Calling up Process Values (all TC2010 Models)

Press **key X** to call up current process values and status of the switching and analogue outputs (if available).

Process display (2) reads the current heating/cooling (as %). The ON/OFF status of the control outputs **DO0** and **DO1** are indicated in the matrix (fig. A).

If your TC2010 is fitted with IO options press **key X** to show current status (display (2) reads **"io"**).

The status of the digital inputs **DI0** and **DI1** is shown as well as the current state of the switching outputs **DO2** and **DO3** (fig. B).

Current signal output of **AO0** and **AO1** (e.g. 4-20mA) is shown as indicating bar. If **LOG0** and **LOG1** are configured for continuous control (e.g. when driving Solid-State-Relays) the output value is shown also as indicating bar; otherwise as ordinary block indicator below DO2/DO3.

Programmregler TC2044

Der Programmregler TC2044 verlangt nur wenige Einstellmöglichkeiten und ist somit innerhalb von Minuten verstanden. Die Brennkurve ist auf einfache Anwendungen der Keramik abgestimmt (Bild A):

a. in Stufen einstellbares Aufheizen auf 580°C

b. ungeregeltes Aufheizen auf in Stufen einstellbare Endtemperatur

c. in Stufen einstellbare Haltezeit

d. ungeregeltes Abkühlen

Im Vergleich zu analogen Regelanlagen bietet der TC2044 präzisere Brennergebnisse, hohe Betriebssicherheit und Überwachung bei einfachster Bedienung.

Temperaturkurve einstellen und starten

Nach dem Einschalten erscheint nach einigen Sekunden die aktuelle Prozesstemperatur. Wählen Sie über die **Pfeiltasten** die Aufheizphase an. Auf der Anzeige erscheint der aktuell eingestellte Temperaturanstieg in °C pro Stunde (Bild B).

(A)

(B)

Programme Controller TC2044

The programme controller TC2044 requires very little programming and therefore is understood within a minute. The temperature profile is adapted to simple ceramic applications (fig. A):

a. in steps adjustable controlled heat up to 580°C

b. uncontrolled heat up to final temperature adjustable in steps

c. in steps settable dwell

d. uncontrolled cooling

Compared to analogue controls TC2044 provides more precise process results, highest operation safety and supervisory with simple handling.

Adjusting and Starting a Process

A few seconds after powering up the controller it is showing the current process temperature. Select the heat up segment using the arrow keys. The display now reads the current setting in °C per hour (fig. B).

Über die **+/− Tasten** stellen Sie die Anheizgeschwindigkeit in °C pro Stunde ein. Mögliche Werte sind 30, 60, 120, 240, 360, 480°C/h oder **SKIP** für ungeregeltes Aufheizen (Bild A).

Mit den Pfeiltasten wählen Sie den nächsten Programmabschnitt an und stellen dabei die gewünschte Temperatur über die **+/− Tasten** ein. Die Temperatur ist in 5°C-Schritten von 400°C bis 1320°C (abhäng von der Anwendung) einstellbar.

Über die Pfeiltasten gehen Sie zum nächsten Programmabschnitt, um die Haltezeit einzustellen. Mögliche Zeiten sind 0, 0:10, 0:20, 0:30 Minuten oder 1 Stunde.

Durch Drücken der Taste **Start-Stopp** wird das Programm gestartet. In der Programmkurve leuchtet der aktuelle Abschnitt, in der Anzeige steht die aktuelle Prozesstemperatur. Der blinkende Dezimalpunkt und der grüne Leuchtpunkt in der **Start-Stopp**-Taste zeigen den Programmlauf an (Bild B).

Während des Programmlaufs können die Werte eingesehen, aber nicht geändert werden. Bei aktivem Schaltausgang leuchtet der Punkt do0 bzw. do1.

Der Programmlauf wird beendet, wenn in der Abkühlphase 150°C erreicht sind. Die eingestellte Brennkurve bleibt auch nach dem Ausschalten des Reglers erhalten.

(A)

(B)

Adjust the heat up rate in °C per hour using the **+/− keys**. Available settings are 30, 60, 120, 240, 360, 480°C/h or **SKIP** for uncontrolled heating (fig. A).

Select the next segment using the arrow keys. Adjust the final temperature using the **+/− keys**. The final temperature can be set in steps of 5°C between 400°C and (depending on your application) 1320°C.

Step to the next segment by the arrow keys to set the dwell time. Available settings are 0, 0:10, 0:20, 0:30 minutes or 1 hour.

Pressing the **start-stop** key starts the process. From now on the firing curve shows the current segment while the display reads the current kiln temperature. The flashing decimal point and a green LED in the **start-stop** key indicate a programme running (fig. B).

During a programme run the values of the temperature profile can be displayed but not changed. The set firing curve is saved also after power off.

The current status of the control outputs is shown by the indicators do0 resp.do1. The process is completed when the temperature has dropped below 150°C. Caution: do not open the kiln while hot!

Programmregler TC2066

Der Programmregler TC2066 ist auf die typischen Anwendungen in der Keramik zugeschnitten. Die Temperaturkurve des TC2066 besteht aus folgenden Segmenten (Bild A):

a. Vorlaufzeit (bis 9 Stunden 59 Minuten z.B. für Programmstart in der Nacht)

b. Aufheizen (geregelt 1 bis 999°C pro Stunde oder ungeregelt "SKIP") auf Zwischentemperatur

c. Aufheizen (geregelt 1 bis 999°C pro Stunde oder ungeregelt "SKIP") auf Endtemperatur

d. Haltezeit (bis 9 h 59 min)

e. Abkühlen (geregelt 1 bis 999°C pro Stunde oder ungeregelt "SKIP") bis 150°C

Programme

Der TC2066 speichert 6 Temperaturkurven als Programme, die Sie aufrufen können, um sie nicht jedesmal neu eingeben zu müssen. Sie können diese Programme selbst verändern. Die Werte bleiben auch nach dem Ausschalten des Reglers erhalten. Nebenstehende Tabelle zeigt die werksseitige Belegung dieser Programme Nr. 1 bis 6 (Bild B).

(A)

P # 	a h:min 	b °C/h 	 °C 	c °C/h 	 °C 	d h:min 	e °C/h
1	0:00	30	150	SKIP	150	0:00	SKIP
2	0:00	100	600	SKIP	800	0:10	SKIP
3	0:00	100	600	SKIP	900	0:10	SKIP
4	0:00	180	400	SKIP	1050	0:30	SKIP
5	0:00	180	400	SKIP	1180	0:30	SKIP
6	0:00	250	820	SKIP	560	0:10	80

(B)

Programme Controller TC2066

The programme controller TC2066 is designed for the specific needs of ceramics. The temperature profile consist of the following segments (fig A):

a. programme delay (up to 9 h 59 min e.g. to take advantage of "off peak" electricity)

b. heating up (controlled 1 to 999°C per hour or uncontrolled "SKIP") to intermediate temperature

c. heating up (controlled 1 to 999°C per hour or uncontrolled "SKIP") to final temperature

d. dwell (up to 9 h 59 min)

e. cooling down (controlled 1 to 999°C per hour or uncontrolled "SKIP") to 150°C

Programmes

The TC2066 saves up to 6 temperaure profiles as programmes. This saves time and avoids errors. All values of the programme can be changed and are saved also after power off.

The programme table (fig B) shows the ex factory settings of the programmes no. 1 to 6 (fig B).

Programm wählen und Prozess starten

Wählen Sie das für Ihre Anwendung geeignete Programm aus (das Ändern von Programmen wird im nächsten Abschnitt beschrieben). Im folgenden Beispiel wird ein Schrühbrand 800°C gestartet (Programm Nr. 2):

Kurz nach dem Einschalten des Reglers erscheint die aktuelle Prozesstemperatur. Drücken Sie nun die **Programmtaste** so oft, bis auf der Anzeige **P2** (=Programm Nr. 2) steht (Bild A).

Danach wird auf der Anzeige die Endtemperatur des ausgewählten Programms dargestellt. Der entsprechende Abschnitt der Brennkurve blinkt auf.

Durch Drücken der Taste **Start-Stopp** Taste wird der Prozess gestartet. In der Temperaturkurve leuchtet der aktuelle Abschnitt, in der Anzeige steht die aktuelle Prozesstemperatur. Der blinkende Dezimalpunkt und der grüne Leuchtpunkt in der **Start-Stopp**-Taste zeigen den Programmlauf an (Bild B).

Während des Programmlaufs können die Werte eingesehen, aber nicht geändert werden. Bei aktivem Schaltausgang leuchtet der Punkt do0 bzw. do1.

(A)

(B)

Selecting and Starting a Programme

Select the proper temperature profile (programme) depending on your application (see next section how to modify a programme). The following example demonstrates starting a biscuit firing 800°C (programme no. 2):

Power on the controller by the mains switch. After a few seconds the current device temperature is shown. Now press the **programme key** several times until the display shows **P2** which stands for programme no. 2 (fig A).

Thereafter the final temperature of the choosen programme is displayed (accomplished by the unit LED showing "°C"). The corresponding segment of the temperature profile lights up.

Pressing the **start-stop** key starts the process. From now on the sketch on the controllers panel shows the current segment while the display reads the current device temperature. The flashing decimal point and a green LED in the **start-stop** key indicate a programme running (fig. B).

During programme run the values can be checked but not adjusted. The current state of the control outputs do0 resp. do1 is shown by the indicators.

Brennkurve verändern

Die 6 Brennprogramme der TC2066 können Sie auf Ihre Anwendung anpassen. Um beispielsweise die Endtemperatur von Programm Nr. 4 auf 1065°C zu ändern, wählen Sie über die Programmtaste Programm Nr. 4 aus. Nach einigen Sekunden erscheint die ursprüngliche Endtemperatur 1050°C. Über die + bzw. − **Tasten** können Sie den anzeigten Wert auf 1065°C ändern. Für größere Werteänderungen halten Sie die + bzw. − **Taste** gedrückt (Bild A).

(A)

Über die **Pfeiltasten** können Sie die weiteren Abschnitte der Brennkurve einsehen und ggf. verändern. Mit der Start-Stopp Taste kann das Programm jederzeit gestartet werden (Bild B).

In Rampen wird der Anstieg in °C pro Stunde ("**r**ate") eingegeben (für Zeiteingabe s. Umstellmöglichkeit in der Konfiguration).

Die Änderungen der Programme bleiben auch nach dem Ausschalten erhalten. Beachten Sie daher, dass die in dieser Anleitung abgebildete Programmtabelle nicht mehr aktuell ist, wenn Sie die Werte auf Ihre Bedürfnisse angepaßt haben.

(B)

Adjusting a Firing Curve

The 6 temperature profiles (programmes) can be adapted to your applications. For instance to change the final temperature of programme no. 4 to 1065°C, select programme no. 4 by pressing the programme key several times. After a short moment the final temperature of 1050°C is shown. Use the + resp. − **keys** to change the temperature to 1065°C. Hold the + resp. − **key** pressed for major changes of the value (fig A).

Use the **arrow keys** to navigate through the segments of the temperature profile. All displayed programme values can be changed if needed. You can commence the programme at any time pressing the start-stop key (fig B).

All changes of the programmes are saved also after power off. Therefore note that the programme table shown in the beginning of this chapter is not current any more once you have adapted the temperature profiles to your applications.

Vorlaufzeit

Über die Vorlaufzeit kann der Programmlauf in die Nacht verlegt werden. Wenn Sie z.B. die Werkstatt um 17 Uhr verlassen und ab 22 Uhr Nachtstromtarif gilt, stellen Sie eine Vorlaufzeit von 5:00 Stunden ein. Nach dem Start wird die verbleibende Zeit angezeigt (Bild A).

Anzeigen während des Programmlaufs

Während des Brandes wird die aktuelle Prozesstemperatur und der Programmabschnitt angezeigt. Über die Pfeiltasten können die aktuellen Programmwerte abgefragt werden (Bild B, **SKIP**, Programmabschnitt blinkt), ohne den Prozess zu unterbrechen. Während einer Haltezeit wird die noch verbleibende Zeit angezeigt. Nach 15 Sekunden wechselt die Anzeige auf die aktuelle Prozesstemperatur und Programmabschnitt zurück.

Um einen Wert zu ändern, halten Sie den Prozess über die Start-Stopp Taste an und starten ihn danach wieder. Der Prozess wird an der gleichen Stelle fortgesetzt, außer wenn ein bereits durchlaufenes Segment geändert wurde (das Programm wird dann ab diesem Segment ausgeführt).

(A)

(B)

Programme Delay

The programme delay is used for a delayed start of the process. For starting e.g. at 10 PM and leaving the workshop at 5 PM, enter a programme delay of 5:00 hours. After pressing the start-stop key the display reads the remaining time (fig. A).

Readings during the Firing

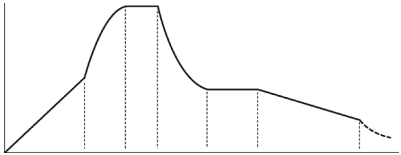
Usually during programme run the controller shows device temperature and current segment. By pressing the arrow keys you can check the values of the firing curve (corresponding segment is flashing) without interrupting the process. During a dwell the remaining time is shown. After 15 seconds the display returns to current segment and device temperature (fig. B, **SKIP**).

To change a value press the start-stop key and restart the process after modification. The process is continued at the same point if no segment is modified which has already been processed (this causes the process to start at this segment).

The process is completed when the device temperature has dropped below 150°C. Caution - do not open the kiln while hot

Programmregler TC2088

Der Programmregler TC2088 erlaubt eine völlig flexible Temperaturkurve z.B. mit mehrfachem Aufheizen, Halten und Abkühlen. Die Temperaturkurve ist in bis zu 10 Segmente unterteilt, pro Segment wird Zeit und Endtemperatur eingestellt. Je nach Temperatur des vorherigen Segments entsteht ein Aufheiz-, Halte- oder Abkühlsegment (Bild A).



seg	1	2	3	4	5	6	7
h:min	6:00	SKIP	0:10	SKIP	1:00	5:00	End
°C	550	810	810	510	510	460	

(A)

Bei der TC2088 können 3 Temperaturkurven als Programm abgespeichert werden. Bei der TC2088**e** stehen 300 Segmente zur Verfügung (siehe Konfiguration, z.B. 20 Programme zu je 15 Segmenten).

Bei einer Zeiteingabe in Segment Nr. 0 wird der Prozess verzögert gestartet (z.B. wg. Nachtstrom).

Als Beispiel soll die abgebildete Temperaturkurve als Programm Nr. 2 (**P2**) eingegeben werden. Nach dem Einschalten des Reglers erscheint die aktuelle Prozesstemperatur. Drücken Sie nun die **Programmtaste** so oft, bis auf der oberen Anzeige **P2** erscheint, unten wird die Maximaltemperatur des gewählten Programmes gezeigt (Bild B).

(B)

Programme Controller TC2088

The programme controller TC2088 is the flexible all purpose solution of the compact series allowing firing profiles e.g. multiple heat up, dwells and cooling. The firing curve is divided in up to 10 segments which are defined by time and temperature. In relation to the previous segment this determines heating, dwelling or cooling segment (fig. A).

On TC2088 3 firing curves are saved as programmes. The TC2088**e** provides 300 segments which are distributed as defined by configuration (e.g. 20 programmes 15 segments each).

Segment 0 is for a delayed programme start. For instance enter 5:00 hours if you want the firing to begin at 10:00 PM but start the programme at 5:00 PM when leaving the workshop.

Refer to the firing curve shown above which we are going to enter as programme no. 2 (**P2**). Power on the controller by the mains switch. After a few seconds the current kiln temperature is shown. Now press the **programme key** several times until the display shows **P2** (fig. B).

Über die **Pfeiltasten** wählen Sie die Zeiteingabe von Segment 01 an (blinkt währenddessen). Über die **+/− Tasten** stellen Sie die Segmentzeit (6:00 Stunden) ein. Für große Werteänderungen halten Sie die **Taste** + bzw. − gedrückt. Nach Betätigen der rechten Pfeiltaste stellen Sie die Endtemperatur des Segments (550°C) ein.

In jedem Segment werden Zeit und Temperatur eingestellt. Während der Zeiteingabe leuchtet zur Unterscheidung in der Segmentanzeige der Dezimalpunkt auf. Die sich im aktuellen Segment ergebende Form wird rechts oben grafisch dargestellt (Bild A).

(A)

Mit der rechten Pfeiltaste gelangen Sie zum nächsten Segment 02. Stellen Sie als Segmentzeit **SKIP** für ungeregeltes Aufheizen ein (Taste − lange drücken) und anschließend 810°C als Endtemperatur des Segments. Die Grafikanzeige rechts oben stellt ungeregeltes Aufheizen dar (Bild B).

(B)

Geben Sie nun Schritt für Schritt alle Segmente der Beispielkurve ein. Haltezeiten werden in der Grafik als waagrechte Linie dargestellt. Im 7. und letzten Segment geben Sie als Zeit "End" ein (Taste − lange drücken) und zeigen damit der TC2088 das Ende des Temperaturprofils an.

Use the **arrow keys** to select the time of segment 01 (segment display flashing). Set the time of 6:00 hours using the **+/− keys**. For major value changes hold the **key** + resp. − pressed. Press the arrow to the right key to proceed to the temperature reading. Set the value to the final temperature of segment 01 which is 550°C.

For each segment time and temperature needs to be entered. For better differentiation the decimal point of the segment lights up when entering a time. The resulting shape of the current segment is shown on the upper right hand display as a dot matrix (fig A).

Navigate to the next segment 02 using the arrow keys. Set **SKIP** as segment time for uncontrolled heat up (hold key − pressed) and 810°C as the final temperature of this segment. The dot matrix indicates an uncontrolled heating segment (fig B).

Enter the temperature curve segment by segment by repeating the steps as described above. Dwell segments are displayed as a horizontal line. In the 7th segment enter "End" as segment time (press and hold key −). This indicates to the controller the end of the programme.

Prozess starten

Durch Drücken der Taste **Start-Stopp** wird der Programmlauf gestartet. In der Segmentanzeige steht die Nummer des aktuellen Abschnitts, auf der unteren Anzeige die aktuelle Prozesstemperatur. tuelle Prozesstemperatur. Der blinkende Dezimalpunkt und der grüne Leuchtpunkt in der **Start-Stopp**-Taste zeigen den Programmlauf an. Die Grafikanzeige stellt die Form des aktuellen Segmentes dar, den Ablauf erkennen Sie am blinkend durchlaufenden Punkt (Bild A). Nach Prozessende erscheint auf der Segmentanzeige "End".

Anzeigen während des Programmlaufs

Über die **Pfeiltasten** kann jederzeit die aktuelle Temperaturkurve abgefragt werden (Segmentanzeige blinkt), ohne den Prozess zu unterbrechen. Während einer Haltezeit wird die noch verbleibende Zeit angezeigt. Nach 15 Sekunden wechselt die Anzeige auf Prozesstemperatur und Segmentanzeige zurück (Bild B).

Um einen Wert zu ändern, halten Sie den Prozress über die Start-Stopp Taste an und starten ihn danach wieder. Der Prozess wird an der gleichen Stelle fortgesetzt, außer wenn ein bereits durchlaufenes Segment verändert wurde (das Programm wird dann ab diesem Segment ausgeführt).

(A)

(B)

Starting the Process

Pressing the **start-stop** key starts the process. From now on the firing curve shows the current segment while the lower display reads the current process temperature. The flashing decimal point and a green LED in the **start-stop** key indicate a programme running. The dot matrix display reads the shape of the current segment, the progress is shown by a flashing dot stepping through the matrix (fig. A).

On successful completion of the programme the segment display indicates "End".

Readings during the Process

By pressing the **arrow keys** you can check the values of the temperature curve (flashing segment display) without interrupting the process. During a dwell only the remaining time is shown. After 15 seconds the display returns to current segment and process temperature (fig. B).

To change a value press the start-stop key and restart the process after modification. The process is continued at the same point if no segment is modified which has already been processed (this causes the process to start at this segment).

Anzeige von Sollwert und Restzeit

Um beim Programmlauf den aktuellen Sollwert anzuzeigen, drücken Sie die **Taste** + (es erscheint **SP** für **S**et**p**oint). Zur Anzeige der Restzeit im aktuellen Segment drücken Sie die **Taste** − (es erscheint **rt** für **r**emaining **t**ime). Nach 3 Sekunden schaltet die Anzeige zurück (Bild A).

Manuelle Ablaufsteuerung

Hierzu bietet der TC2088 folgende Optionen:

Um den **aktuellen Sollwert** zu verändern, drücken Sie die **Taste** + für 3 Sekunden (Sollwert blinkt). Mit den Tasten + bzw. − können Sie nun den Sollwert ändern. In einer Rampe wird hierbei nur die Restzeit manipuliert, in einer Haltezeit werden die Temperaturen des Programms (aktuelles u. vorhergehendes Segment) geändert.

Um **Zeit und Temperatur anzuhalten**, drücken Sie die **Taste** − 3 Sekunden lang (Segmentanzeige blinkt **hold**). Für einen programmierten Halt setzen Sie die Segmentzeit auf "hold". Zeit und Temperatur werden gehalten, bis die **Taste** − erneut 3 Sekunden gedrückt wird, **hold** erlischt (Bild B).

Um sofort ins **nächste Segment** zu springen, drücken Sie die **Tasten** + **und** − 3 Sek. lang.

(A)

(B)

Calling up Setpoint and Remaining Time

To call up the current setpoint during a firing press **key** + (segment display reads **SP**).To call up remaining time of the current setpoint press key − (segment display reads **rt**). The display returns to normal after 3 seconds (fig. A).

Manual Process Control

Your TC2088 provides the following options:

To adjust the **current setpoint** press **key** + for 3 seconds (flashing setpoint). Now use the keys + resp. − to change the setpoint temperature. In a ramp only the remaining time is manipulated, in a dwell the actual temperatures of the firing curve (current and previous segment) are modified.

To **hold time and temperature** press **key** − for 3 seconds (segment displays flashing **hold**). To enter hold automatically set time to "hold" in a particular segment. Time and temperature are held until **key** − is pressed again for 3 seconds, **hold** disappears (fig. B).

To **skip immediately to the next segment** press **key** + **and** − for 3 seconds.

Allgemeine Informationen (alle Modelle)

Nach einem Netzausfall wird der Prozess fortgesetzt (in Rampen mit der aktuellen Temperatur). Bei Abfall >50°C wird der Prozess aus Qualitätsgründen unterbrochen.

Die Zeit in einer Rampe wird entsprechend verkürzt, wenn die Prozesstemperatur über dem Anfangswert liegt.

Falls der Prozess in einer geregelten Rampe dem geforderten Anstieg nicht folgen kann, verweilt der Regler auf der Temperatur (Leuchtpunkt in der Start-Stopp Taste zeigt **orange**). Sobald die Temperatur aufgeholt hat, wird die Rampe fortgesetzt. Einstelloptionen hierzu sind im Technischen Anhang beschrieben.

Fehlermeldungen

Thermoelement defekt, nicht angeschlossen, Messleitung unterbrochen, Steckerkontakte verschmutzt oder defekt (overrun = Messbereichs-Überlauf)	
Thermoelement verpolt, ggf. falscher Thermoelement-Typ bei Ofentemperatur weit unter 0°C (underrun)	
Kaltpunkt-Fühler (CJC) im Anschlußkabel defekt (invalid)	
Brand wurde wegen eines Problems bei der Temperaturmessung (s.o.) abgebrochen (Überlauf im Regelkanal)	

General Information (all Models)

After a power breakdown the process is continued (during ramps at current temperature). If the temperature dropped >50°C the firing is interrupted to ensure quality.

The time in a ramp is reduced accordingly if the process temperature is higher than the initial ramp temperature.

If the process is unable to follow in a controlled ramp the controller stops increasing temperature (LED at start-stop key changes to **orange**). Once the process temperature has caught up the ramp continues. If this happens again and again the actual time of a ramp will be longer than programmed. For details see the Technical Section.

Error Messages

Thermocouple broken, not connected, thermocouple circuit interrupted, connections dirty or damaged ("overrun")	
Thermocouple polarized bad, eventually wrong type if kiln temperature far below 0°C ("underrun")	
Cold-Junction-Compensation (CJC) of the lead broken ("invalid")	
Firing terminated due to temperature acquisition problem (as described above, "control loop overrun")	

Prozess wurde wegen Übertemperatur (Überschreiten der max. Programmtemperatur um mehr als 20°C) abgebrochen. Abschaltung über Sicherheitsschütz (falls vorhanden). Häufigste Ursache ist ein klebender Leistungsschütz		Process terminated due to over temperature (maximum programmed temperature exceeded more than 20°C). Device has been cut off by the safety contactor (if fitted). Mostly caused by stuck contactor contacts
Prozess wurde wegen Heizproblem (zu geringem Temperaturanstieg trotz 100% Heizen) abgebrochen. Häufigste Ursachen sind defekte Heizspirale, fehlende Netzphase, defekter Schützkontakt, Thermoelement-Kurzschluß		Process terminated due to heating problem (slow increase in tempeature at 100% heating). Caused by broken heating elements, missing mains phase, broken contactor contact, thermocouple short circuit.
Geregelte Rampe wurde fortgesetzt, obwohl der geforderte Temperaturanstieg trotz Wartezeit nicht erreicht werden konnte (Meldung erscheint nur für 1 Minute)		Controlled ramp continued although the programmed rise or drop in temperature was not achieved even after adding a dwell (message displayed for 1 min)
Ungeregelte Rampe (SKIP) wurde beendet, obwohl die Segmenttemperatur nicht erreicht werden konnte (verhindert Selbstblockade, Meldung nur für 1 Minute)		Uncontrolled ramp (SKIP) completed since the segment temperature could not be reached (to avoid deadlock scenario; informational message displayed for 1 minute)
Der Brennvorgang wurde nach einem Netzausfall automatisch fortgesetzt (Meldung erscheint nur für 1 Minute)		Process is continued automatically after a power breakdown informational message displayed for 1 minute)
Der Prozess wurde nach einem Netzausfall abgebrochen, weil die Qualität des Ergebnisses nicht sichergestellt werden kann (z.B. durch zu großen Temperaturabfall)		Process is terminated after a power breakdown since the quality of the load is not ensured (e.g. temperature dropped too much)
Internes Reglerproblem, technischer Service beim Hersteller erforderlich (C1-ADC defekt, C2-ADC unpräzise, C3-COM)		Internal controller problem, manufacturer service required (C1-ADC broken, C2-ADC drift check failed, C3-COM)
Internes Reglerproblem, technischer Service beim Hersteller erforderlich (D1-CPU, D2-RAM, D3-I2C Bus, D4-EEPROM, D5-Kalibrierung, D6-NVM, DA-Master Konfig.)		Internal controller problem, manufacturer service required (D1-CPU, D2-RAM, D3-I2C bus, D4-EEPROM, D5-calibration, D6-NVM, DA-master configuration)

Technical Section (english only)

Mechanical & Electrical **Installation**

Add'l **Process Values** & Logs

Configuration

Programme Controllers **TC 20xx**

Mechanical Installation

TC20xx come in a standard 72x72mm DIN case for panel mounting. The recommended panel cutout dimension is 68,5 x 68,5 mm, the controllers depth is 105mm (115mm space for leads etc.). Use the two stainless steel brackets to fix the controller into the panel. Do not overtighten the screws to avoid case distortion.

Ambient Conditions

Make sure that the ambient temperature does not exceed 50°C (122°F). Maximum power dissipation of TC20xx controllers is 8W only. TC20xx controllers are tolerant to humidity as long it is non-condensing. If enviromental conditions might cause this issue install climatization in your control panel. Especially during winter, allow controller to warm up to room temperature before powering up. This allows condensing water which builds up on cold surfaces to evaporate before electrical damage occurs.

Although TC20xx controllers complies to highest passive EMC levels we recommend to keep away from high noise emitting components like contactors or lines driven by frequency inverters. The use of noise suppressing devices is always recommended. Note that even if such noise does not affect controller operation it will cause induction to all signal lines. TC20xx controllers are fitted with intelligent filters, however, compensation is limited by physical laws.

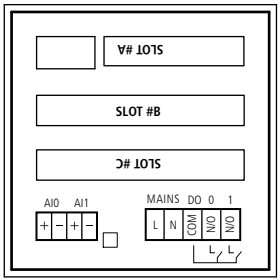
Electrical Installation

Electrical links of TC-20xx controllers are pluggable screw type connectors (PHOENIX). Please refer to the sketch on the right hand side. Depending on the configuration, expansion boards are installed in slots A, B and C. The connections of the base model are as follows:

mains - power supply 85-264V AC/DC (on request 24V AC/DC)

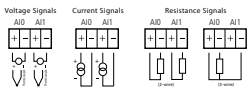
AI0 / AI1 - 2 signal inputs (thermocouple, resistance, current or voltage input, set to signal type ex works). Non isolated. Refer to sketch on the right hand side for connection details

DO0 / DO1 - switching outputs 6A/250V each. Designed to directly drive contactors etc.



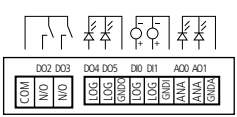
Expansion Boards

Your TC 20xx controller can be fitted with expansion boards to suit your application. Up to 3 expansion boards can be inserted in slot A, B and C (Note: Slot A and C are upside down!).



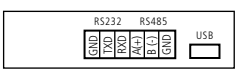
Multi Purpose IO Board

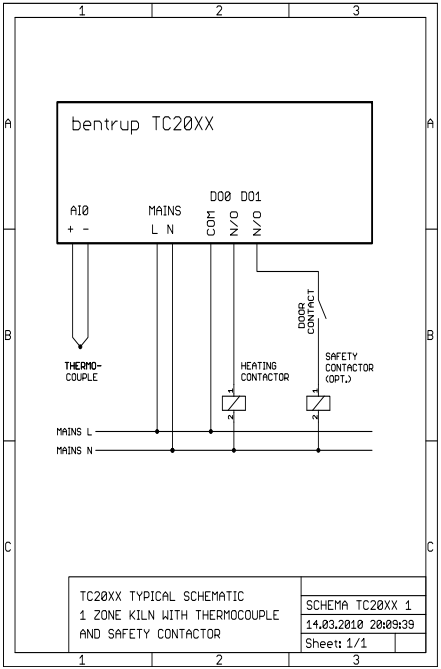
This board is installed in Slot A only. It is customized as ordered with up to 2 additional switching outputs (SW2, 6A/250V), 2 logic outputs (DO2, driving SSRs 12V/50mA each), 2 logic inputs (12 to 24V) and 2 analog outputs (set by configuration to 0-5V/0-10V/0-20mA/4-20mA, burdon 500R).

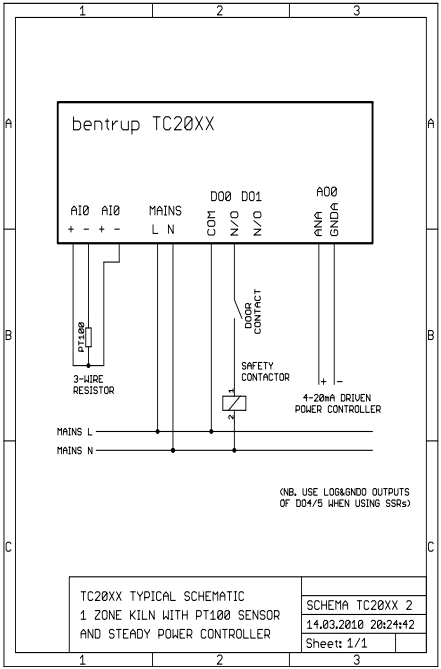


Communication Board

The COM board provides either RS232/RS422/RS485 communication or an USB interface. It is installed in Slot B or C.




bentrup TC20XX
AI0
+ -
MAINS
L N
DO0 DO1
COM
N/O
N/O
DOOR CONTACT
THERMO-COUPLE
HEATING CONTACTOR
SAFETY CONTACTOR (OPT.)
MAINS L
MAINS N
TC20XX TYPICAL SCHEMATIC
1 ZONE KILN WITH THERMOCOUPLE
AND SAFETY CONTACTOR
SCHEMA TC20XX 1
14.03.2010 20:09:39
Sheet: 1/1


bentrup TC20XX
AI0 AI0
+ - + -
MAINS
L N
DO0 DO1
COM
N/O
N/O
AO0
ANA
GNDA
PT100
3-WIRE RESISTOR
DOOR CONTACT
SAFETY CONTACTOR
4-20mA DRIVEN POWER CONTROLLER
MAINS L
MAINS N
(NB. USE LOG&GNDO OUTPUTS OF DO4/5 WHEN USING SSRs)
TC20XX TYPICAL SCHEMATIC
1 ZONE KILN WITH PT100 SENSOR
AND STEADY POWER CONTROLLER
SCHEMA TC20XX 2
14.03.2010 20:24:42
Sheet: 1/1

Additional Process Values (TC2088 only)

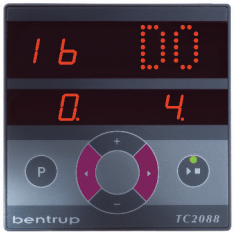
In more complex installations it might by required to monitor additional process values (individual input signals on averaged inputs, mV of an input etc.). In complex configuration mode (see next chapter) you can define a list of parameters to be shown during programm run.

After programe is started press both arrow keys simultaneously to enter additional process value display. Now using the arrow keys you can navigate through the list of process values defined in the configuration such as input values (IN), analog input signals (AI), control loop state (LP), analog output values (AO), digital output values (DO) etc.

For example fig A. shows the current status of the digital outputs DO (output DO0 and DO4 active).

Fig B. shows the current mV input signal of AI2 (4.209 mV). The first digit on the lower display reads the input number (example AI **2**)

After 15 seconds the display reverts back to normal reading.



(A)

(B)

Event and Error Logs (all controller models)

All controller error messages are internally logged together with the important process parameters at the time of the event (e.g. maximum kiln temperature and state of the control outputs) are also logged. This allows detailed error tracking if a problem is reported by the user and a cause is not obvious. The most recent 30 error messages are logged and saved when turning off the controller. For example the controller reads E A4 (heating problem of the kiln) when you enter your workshop next morning. Even worse, if somebody played with the controller and therefore quit the error message, the error log provides you with all details of what happened during the night:

Press both arrow keys simultaneously to show the first entry of the log (fig A, note that depending on controller model actual display layout might be slightly different). The lower display shows the Error Log Entry number and the segment indicates when the error occured.

Use the arrrow keys to navigate through the data recorded at the time of the error. In the example described above "E A4" is recorded.

Use the arrow keys to navigate through the parameters which were recorded at the moment where the error message occured up. Showing all process parameters usually it is easy to create an error picture. In our example old heating elements are most likely since the error happened at a very high kiln temperature (1254°C, fig B.).

Refer to page 17 for a listing of all error codes. Additionally, the controller logs important user caused events as follows: E E2 = programme stopped, E E3 = programme held, E E4 = programme continued.

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.

(A)

(B)

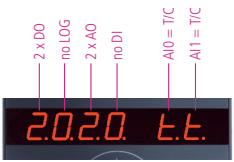
Hardware & Software Configuration

To display current hardware and software configuration press and hold **key P** before TC20xx is powered up. Current detailed software revision state is shown (e.g. 1.91) as well as customization code (e.g. cu 2) if applicable (blank on standard version).

Some important parameters are locked for security reasons. DO NOT CHANGE parameters if you are not aware of the consequences. Changes to important parameters are logged by the controller. Press additionally key ➖ during power up to unlock all parameters. On TC2010 and TC2088 the matrix shows the corresponding icon if parameters are unlocked ("unlo" on TC2044 and TC2066). See example shown in fig. A.

(A)

After 3 seconds the display reads current hardware configuration (fig. B): number of digital outputs, number of logic outputs, number of analog outputs, number of digital inputs and signal type of inputs AI0 and AI1 (t=thermocouple, U=0-10V, I=0/4-20mA, r=Pt100; ex factory set by hardware jumpers).



(B)

Finally the serial number is shown (only if set, example S/N 122450, fig C). Thereafter controller enters normal operation.

(C)

Operating Parameters Configuration

The configuration allows you easily to adapt the controller to your application. Your system builder will have preconfigured the TC20xx accordingly so normally it is not necessary to enter the configuration.

Entering Configuration

Press and hold key **P** (resp. **X** on TC2010) to enter configuration. After 3 seconds controllers display reads 1st parameter. Depending on current configuration mode display reads either "S-01" on **simple configuration** resp. "0.0.0" on **complex configuration**.

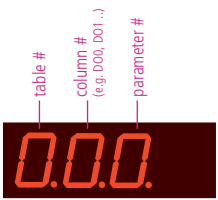
Simple configuration mode provides sufficient flexibility for most applications. Set type of thermocouple, maximum operating temperature, PID control parameters and control output characteristics and your TC20xx is ready to work. Use arrow keys to select parameter number (S-xx) and ⊞/⊟ to change if required. Refer to the list of parameters on pages 26 and 27.

Complex configuration mode allows to configure all analog and digital inputs and outputs in detail. Control loops and programme tables can be fine tuned individually. Use the cursor cross to navigate through the parameter tables shown on page 28 et seqq. To change the selected parameter press **P** and use ⊞/⊟ keys. After pressing **P** again you are back in parameter navigation. For most easy configuration we recommend using free of charge Windows Utility 'WinConfig' available on www.bentrup.com to configure the TC20xx.

Changing Configuration Mode

Unlock the controller as described on page 24. While in configuration mode press and hold key **start stop** for 3 seconds until current configuration mode is displayed: **CFg. CPL** (complex) or **CFg. SIM** (simplex). Use keys ⊞/⊟ to change and then press and hold key start stop for 3 seconds to save and initialize new mode. NOTE: All configuration is lost.

simple configuration display



complex configuration display

Simple Configuration Mode Table

TC2010/TC2044/TC2066/TC2088 table version 1.90

Simple Config Mode Parameters
Following parameters determine controllers operation. Some parameters are skipped depending on controller model and hardware fitted

S-01: temperature signal type	*(options tc S, R, K, J, PT100/2, PT100/3, 0-10V, 4-20mA)*
Type of signal connected to the controller. Note that this setting is usually locked to avoid unauthorized change. Adjustments are limited to the physical signal input set ex factory:	
tc S, tc R, tc K, tc J – thermocouple (type selection according to IEC584)	
Pt100.2, Pt100.3 – temperature resistor (according to IEC 751) connected via 2-wires or 3-wires for lead compensation.	
0-10V, 4-20mA – linear input signal, 0V/4mA equals to 0°C, 10V/20mA equals to parameter S-02.	
S-02: maximum temperature	*(value range 50 to 1600)*
Maximum adjustable temperature in °C (also in °F mode). Do not exceed allowed temperature of your heating device. Locked to avoid unauthorized change.	
S-03: prop. band %	*(value range 0.0 to 999.9)*
Control parameter "proportional band" in % of maximum value, default value 2.0%	
S-04: integral time	*(value range 0 to 9999)*
Control parameter "integral time" in seconds, default value 200s	
S-05: derivat. Time	*(value range 0 to 9999)*
Control parameter "derivative time" in seconds, default value 10s	

S-06: cyclus time (resp. DO0 as safety output)	*(value range 0 to 100)*
Cyclus time (seconds) of the heating control output DO0 (pulse width modulated). Shorter cycles improve accuracy but decrease contactors lifetime (recommended 30s). Set to "0" makes DO0 a safety output (only if an analog output is set to 0).	
S-07: heat up checking	*(options OPt, Grd, oFF)*
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 10 minutes if the kiln does not follow programmed ramp. Might cause firing entereing HOLD frequently to give the kiln time to catch up.	
Grd = Gradient checking of the kiln only, ie. controller checks if the kiln temperatures increases during full power heating. Use this setting instead of OPt if you want a ramp to be process 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	*(options time, Grad)*
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	*(value range MAS, OFF, 0 to 63)*
Sets the communication ID of the controller. Make sure that this ID fits the setting in the communication software (e.g. bentrup WinControl). Each ID must be unique on the network. MAS sets the controller as a Master in Master/Slave environments (disables communication with host systems like WinControl).	
S-10: operation mode of the DO1 output	*(value range 0 to 5)*
Function of 2nd control output. 0=unused / 1=safety contactor / 2=EVENT / 3=ON during the firing / 4= as 3 but off during seg. 0 / 5=ON when firing completed.	
S-11: temperature units °C / °F	*(options °C, °F)*
Celsius/Fahrenheit reading: 0 = temperatures in °C 1 = temperatures in °F	

S-12 (TC2044): first ramp temperature	*(value range 20 to 1000)*
Final temperature of the first ramp (default 580°C). Always set in °C	
S-12 (TC2066): default setpoint display	*(value range OFF, ON)*
On particular customized version only: show program setpoint as default reading.	
S-12 (TC2088e): segments per program	*(value range 5 to 99)*
Number of segments per program. Less number of segments results in more programs (total 300 seg). Example: 10 segments per program->30 programs.	
S-12 (TC2010): operating mode	*(value range 0 to 5)*
Determines TC2010 operating mode - refer to the manual for details: 0=signal converter, reading and limiter / 1=setpoint controller / 2=setpoint controller with adjustable heat up ramp / 3=setpoint controller with adjustable heat up ramp and dwell / 4=watchdog controller / 5=slave contoller for master/slave operation	

following parameters are available ONLY if digital inputs are fitted:

S-13: DI0 operation mode	*(value range OFF, 0 to 5)*
0 = program start from the beginning / 1 = program start at current segment / 2 = program stop / 3 = ON-program start from the beginning, OFF-program stop / 4 = ON-program start at current segment, OFF-program stop / 5 = ON-program HOLD, OFF-program continue	
S-14: DI1 operation mode	*(value range -10000 to 10000)*
options refer to S-13	

following parameters are available ONLY if digital outputs DO2/DO3 are fitted:

S-15: DO2 operation mode	*(value range OFF, 0 to 8)*
0=heating (value contains cyclus time) / 1=safety output / 2=EVENT (value contains event no.) / 3=ON during firing / 4=ON during the firing except segment 0 / 5=ON when firing completed / 6=cooling (value contains cyclus time)/ 7=ON if temperature > value / 8=ON if temperature < value	
S-16: DO2 value	*(value range -10000 to 10000)*
optional value for operation mode DO2	
S-17: DO3 operation mode	*(value range OFF, 0 to 8)*
options refer to S-15	
S-18: DO3 value	*(value range -10000 to 10000)*
optional value for operation mode DO3	

following parameters are available ONLY if logic outputs DO4/DO5 are fitted:

S-19: DO4 operation mode	*(value range OFF, 0 to 8)*
options refer to S-15	
S-20: DO4 value	*(value range -10000 to 10000)*
optional value for operation mode DO4	
S-21: DO5 operation mode	*(value range OFF, 0 to 8)*
options refer to S-15	
S-22: DO5 value	*(value range -10000 to 10000)*
optional value for operation mode DO5	

following parameters are available ONLY if analog outputs are fitted:

S-23: AO0 signal type	*(value range OFF, 0-10V, 0-20mA, 4-20mA)*
Signal type of analog output AO0	
S-24: AO0 operation mode	*(value range OFF, 0 to 8)*
0=heating / 1=cooling / 2=setpoint (range 0°C to temperature set by parameter S-02) / 3=process value (range 0°C to S-02)	
S-25: AO1 signal type	*(value range OFF, 0-10V, 0-20mA, 4-20mA)*
Signal type of analog output AO1	
S-26: AO1 operation mode	*(value range OFF, 0 to 8)*
options refer to S-20	

Complex Configuration Mode Table

TC2010/TC2044/TC2066/TC2088 Configuration Table V1.90

Table 0: misc. adjustments

The following miscellaneous settings determine general operation parameters:

00: Segments/Prg	*(value range 2 to 99)*
Maximum number of segments per program. Entering a smaller number increases number of program to be saved in your controller. In most applications a maximum of 20 segments is suitable. Note: Changing this parameter purges program memory	
01: ramp mode(s)	*(options TIME, GRAD, BOTH)*
Specifies how to define ramps: **TIME**: Ramps entered as segment time **GRAD**: Ramps entered as gradient (e.g. 200°C/h) **BOTH**: Ramps can be entered as segment time as well as gradient	
02: lock programs	*(options OFF, ON)*
Allows locking of all programs to avoid any unauthorized changes	
03: communicat. ID	*(value range OFF to 62)*
ID of the controller for external communication. Each ID must be unique on the network. SCADA software (e.g. WinControl) uses this ID to identify controller(s).	
04: fctn.on pow.up (TC2044/2066/2088)	*(value range 0 to 3)*
Function after power up: 0=IDLE, 1/2=restarting the program if conditions were met (<1=time limit in seconds/2=.. minutes). 3=automatic program start	

04: Operating Mode (TC2010)	*(value range 0 to 5)*
Determines TC2010 operating mode - refer to the manual for details: 0=signal converter, reading and limiter / 1=setpoint controller / 2=setpoint controller with adjustable heat up ramp / 3=setpoint controller with adjustable heat up ramp and dwell / 4=watchdog controller / 5=slave contoller for master/slave operation	

Table 1: analog input

Specifies the analog input signals for the controller. Analog inputs are used to connect sensors like thermocouples, resistors, voltage/current signals to the controller. You can exactly define signal type (voltage, resistance, current) as well as signal range, signal conversion and correction, unit etc. The most common signal types are predefined. Each column of the table defines one process value which are named IN00, IN01 etc. The maximum number of analog input depends on the hardware.

00: input mode	*(value range END to RES)*
specifies the analog input signal type. Choose the appropriate kind of signal conversion:	
01: average cyc.	*(value range 1 to 11)*
Averages the analog input signal. Used to eliminate signal interference as well as to improove signal steadyness. Setting this option to "1" disables the filter. A higher setting causes higher smoothening (low pass frequency is 1/n Hz). A setting of 4 suits most applications.	
02: units	*(options °C, °F, °K, dg, mV, mA, O2, CO, %, ev, mb, m^3, m^3h, kh, kwh, Pa, AT, lda)*
Specifies the unit of the process value	

03: trim +/- %	*(value range -10.0 to 10.0)*
Allows full scale input signal correction. Some applications require compensation of deviations caused by design. Example: Setting this parameter to -5.0% will cause the process value to be trimmed to 95°C instead of 100°C. **Note**: This parameter should be used with care since on most applications deviations errors should to be compensated by eliminating the real cause of the deviation rather then compensating on the controller	
04: offset +/-	*(value range -10.0 to 10.0)*
Allows zero offset signal correction. Adjust this parameter if you need to adjust the input offset value. **Note**: This parameter should be used with care since on most applications deviations errors should to be compensated by eliminating the real cause of the deviation rather than compensating on the controller	
05: min value	*(value range -99 to 1999)*
Minimum value of the process value. Specifies the lower value limit of the process parameter. Any lower value is considered as underrun (causing an error)	
06: max value	*(value range -99 to 1999)*
Maximum value of the process value. Specifies the upper value limit of the process parameter. Any higher value is considered as overrun (causing an error)	
following parameters apply on selection **T/C** only:	
07: thermocouple	*(options S, R, K, J)*
Select the IEC code of the thermocouple used	
08: external CJC	*(value range OFF, IN00 to IN01)*
Could junction compensation temperature. Set to "OFF" for internal compensation (recommended). Make sure that proper compensating wire is used	
following parameters apply on selection **LIN** only:	
17: signal type	*(options OFF, 0-20mV, 0-50mV, 0-5V, 0-10V, 0-20mA, 4-20mA, -500R2, -500R3)*
Type of input signal. Set this parameter to fit the signal of the device connected to the physical input. **Note:** Adapt the jumper settings of the physical input accordingly (done automatically on some devices)	
18: val.@zeropoint	*(value range -9.9 to 199.9)*
Process value at lower reference of input value. Example: A pressure transducer supplying 4 to 20mA at -250 to +250 Pa. Set this parameter to "-250" since this is the process value at the lower reference of 4mA	
19: val.@fullscale	*(value range -9.9 to 199.9)*
Process value at upper reference of input value. Example: A pressure transducer supplying 4 to 20mA at -250 to +250 Pa. Set this parameter to "250" since this is the process value at the upper reference of 20mA	
following parameters apply on selection **NTC** only:	
27: NTC base value	*(value range 0 to 32000)*
Base resistance in Ohms of NTC used (at 25°C). Very common are 10kOhm NTCs, i.e. setting this parameter to 10000.	
28: NTC B-coefficient	*(value range 0 to 10000)*
B-Constant of the NTC used. Check manufacturer documents. Typical value is 3960	
following parameters apply on selection **RES** only:	
37: resist.type	*(options PT100)*
Type of the resistance sensor used	
38: signal type	*(options -500R2, -500R3)*
Type of input signal. Set this parameter to fit the signal of the device connected to the physical input. **Note:** Adapt the jumper settings of the physical input accordingly (done automatically on some devices)	

Table 2: analog output

Analog outputs drive analog devices like steady power control units (thyristor controls), voltage controlled frequency converters or recorders. The analog output provides a voltage (0 to 10V) or current (0/4-20mA) signal. Either a process value (e.g. heating, cooling) or a process value (e.g. setpoint 0-1400°C) can be sent to an analog output.

00: output mode	*(options END, PRZ, ANA)*
Sets the operation mode of the analog output:	
PRZ: Analog output uses control loop output to drive a heating resp. cooling device. Example: Provide a 4-20mA steady output signal (according to 0 to 100% heating) for driving a thyristor	
ANA: Sets the analog output to send an internal process value as analog signal within adjustable range. Example: Use this mode to create a 0 to 10V output signal according to 0°C to 1000°C programme setpoint	
01: destination	*(value range OFF to AO1)*
Selects the physical output of the signal	
02: output type	*(options 0-5V, 0-10V, 0-20mA, 4-20mA)*
Select output signal type 0-10V/0-20mA/4-20mA	
following parameters apply on selection **PRZ** only:	
03: channel source	*(value range LP00 to LP01)*
Selects the control loop used to drive the output. The options MX../A resp. MX../G are the outputs of the air / gas mixer (for combustion devices)	
04: output charact	*(value range 0 to 4)*
Specifies the operation range of the output. Used to assign an output to either heating range, cooling range or both rances. Typically the heating output is set to "0 to +100%" and the cooling output (eg. for controlling a fan) is set to "0 to -100%". Both outputs assigned to the same control loop. The available settings are	
0=0% to +100% / 1=+100% to 0% / 2=0% to -100% / 3=-100% to 0% / 4=-100% to +100% / 5=+100% to -100%	
05: outp.% on IDLE	*(value range 0 to 100)*
Whenever the controller is IDLE the output provides this value	
06: outp. % on ERR	*(value range 0 to 100)*
Whenever the controller is in ERROR status the output provides this value. Note that this only applies on system errors and not an operation error on a single loop	
07: min. output %	*(value range 0 to 100)*
Lower output signal limit. The output is limited to the given value. Can be used to obtain permanent minimum heating. Care should be taken since high settings might interfere with the control loop	
08: max. output %	*(value range 0 to 100)*
Upper output signal limit. The output is limited to the given value. Can be used to limit the maximum heating of a kiln. Note that limiting can cause problems if the applications lacks of heating power (gradient check errors etc.)	
following parameters apply on selection **ANA** only:	
13: outp. param.	*(value range SP00 to CH19)*
Selects a process value sent to the analog output. The output is set proportional over the given range of "lower base value" and "upper base value". Example: Assuming a signal type 0 to 10V / lower base value 0°C / upper base value 1000°C the output provides 7,5 V on a process value of 750°C	
14: lower base val	*(value range -99 to 1999)*
Sets the lower base value for a process value output. For details refer to the example given at "outp. param."	
15: upper base val	*(value range -99 to 1999)*
Sets the upper base value for a process value output. For details refer to the example given at "outp. param."	

Table 3: digital output

Digital outputs are used to switch any kind of ON/OFF devices as well as motorized valves (using 2 digital outputs in sequence). Depending on controller hardware the output is either a switching relay output (8A / 250V) or a logic output (OFF=0V / ON=12V). The following parameters select the kind of operation (control outputs, alarms, events etc.). Digital outputs used by the PLC must **not** be assigned in this section

00: output mode	*(options END, PRZ, MOT, LIM, PRC, EVE)*

Selects an operation mode of the digital outputs:

PRZ: Used to drive a digital output (ON/OFF) according to the value requested by a control loop, ie. converts a loop output value to pulse width modulation (PWM). Used to control the heating contactor for instance

MOT: Used to drive a servomotor by the the control loop output. Two digital outputs (OPEN and CLOSE) are assigned (digial output for CLOSE is assigned to the following output number automatically). The control value is converted into OPEN resp. CLOSED pulses according to travel time etc.

LIM: Output works as limit signal (also called alarm output). Any kind of comparison of process values versus or constant values can be done

PRC: Indication of selectable process conditions. Can be used to activate an output on programme end, process errors, process holds etc.

EVE: Used to configure the output as program event. Can be programmed to ON or OFF for each segment. During program run the output is set accordingly

01: destination	*(value range OFF, DO0 to DO6)*

Selects the physical output of the signal

following parameters apply on selection **PRZ** only:

02: loop source	*(value range LP00 to LP01)*

Selects the control loop used to drive the output

03: output charact	*(value range 0 to 5)*

Specifies the operation range of the output. Used to assign an output to either heating range, cooling range or both rances. Typically the heating output is set to "0 to +100%" and the cooling output (eg. for controlling a fan) is set to "0 to -100%". Both outputs assigned to the same control loop. The available settings are 0=0% to +100% / 1=+100% to 0% / 2=0% to -100% / 3=-100% to 0% / 4=-100% to +100% / 5=+100% to -100%

04: outp.% on IDLE	*(value range 0 to 100)*

Whenever the controller is IDLE the output provides this value

05: outp. % on ERR	*(value range 0 to 100)*

Whenever the controller is in ERROR status the output provides this value. Note that this only applies on system errors and not an operation error on a single loop

06: min. output %	*(value range 0 to 100)*

Lower output signal limit. The output is limited to the given value. Can be used to obtain permanent minimum heating. Care should be taken since high settings might interfere with the control loop

07: max. output %	*(value range 0 to 100)*

Upper output signal limit. The output is limited to the given value. Can be used to limit the maximum heating of a kiln. Note that limiting can cause problems if the applications lacks of heating power (gradient check errors etc.)

08: cyclus time	*(value range 0 to 100)*

Cyclus time (in seconds) of the digital output. The output value is converted into an ON and OFF period accordingly (T on + T off = T cyclus). Decreasing the cyclus time improves accuracy but might decrease lifetime of the heating device. A typical value for contactors on kilns is 30

following parameters apply on selection **MOT** only:

12: channel source	*(value range LP00 to LP01)*

Selects the control loop used to drive the output

13: output char. *(value range 0 to 5)*

Specifies the operation range of the output. Used to assign an output to either heating range, cooling range or both rances. Typically the heating output is set to "0 to +100%" and the cooling output (eg. for controlling a fan) is set to "0 to -100%". Both outputs assigned to the same control loop. The available settings are 0=0% to +100% / 1=+100% to 0% / 2=0% to -100% / 3=-100% to 0% / 4=-100% to +100% / 5=+100% to -100%

14: outp.% on IDLE *(value range 0 to 100)*

Whenever the controller is IDLE the output provides this value

15: outp.% on ERR *(value range 0 to 100)*

Whenever the controller is in ERROR status the output provides this value. Note that this only applies on system errors and not an operation error on a single loop

16: travel time *(value range 0 to 250)*

Enter the time (in seconds) for the servomotor to operate a complete cycle from fully close to fully open

17: delay 1/10s *(value range 0 to 150)*

Delay time of the servomotor on direction changes. This parameter (given as 100ms units) is used to compensate for gearbox lags etc.

18: update time *(value range 0 to 250)*

Rate in seconds the servomotor position is updated. Decreasing this rate causes more stress to the servomotor

19: hyst. %/steps *(value range 0 to 100)*

Hysteresis for updating the servomotor position. Decreasing this rate causes more stress to the servomotor. In most application a hysteresis of 1% is recommended

20: compare mode *(options 1>2+c,1<2+c dif<c, dif>c)*

Selects the kind of equation of the equation given as **limit 1 ? limit 2 + limit const**. The "?" stands for ">=", 1 stands for "<=", 2 is "limit 1 - limit 2 less then limit const", 3 is "limit 1 - limit 2" more than limit const. Add 4 to disable signal during SKIP. The digital output is ON when the equation is true. Example: To activate the output whenever the actual temperature exceeds the setpoint more than 30°K (= over temperature alarm) set the parameters as follows: compare more = 0 / limit 1 = IN00 / limit 2 = SP00 / limit const = 30

21: limit 1 *(value range OFF, SP00 to CH19)*

Selects the process value used as "limit 1" in the equation. Can be a setpoint, an actual temperature, a loop (loop) output or "OFF" to insert "0" in the equation. For detailed explanation including an example refer to "compare mode"

following parameters apply on selection **LIM** only:

22: compare mode *(options 1>2+c, 1<2+c, dif<c, dif>c)*

Selects the kind of equation of the equation given as **limit 1 ? limit 2 + limit const**. The "?" is replaced depending on this parameter: 0 stands for ">=", 1 stands for "<=", 2 means "limit 1 - limit 2 less then limit const", 3 means "limit 1 - limit 2" more than limit const. Add 4 to disable sigal during SKIP. The digital output is ON when the equation is true. Example: To activate the output whenever the actual temperature exceeds the setpoint more than 30°K (=overtemp. alarm) set the parameters as follows: compare more=0/limit 1=IN00/limit 2=SP00/limit const = 30

23: limit 1 *(value range OFF, SP00 to CH19)*

Selects the process value used as "limit 1" in the equation. Can be a setpoint, an actual temperature, a loop (loop) output or "OFF" to insert "0" in the equation. For detailed explanation including an example refer to "compare mode"

24: limit 2 *(value range OFF, SP00 to CH19)*

Selects the process value used as "limit 2" in the equation. Can be a setpoint, an actual temperature, a loop (loop) output or "OFF" to insert "0" in the equation. For a detailed explanation including an example refer to "compare mode"

25: limit const *(value range -99 to 1999)*

The constant value used as "limit const" in the equation. For detailed explanation including an example refer to "compare mode"

26: output on IDLE *(value range 0 to 2)*

Defines the state of the digital output when the controller is IDLE: 0 = same as during programme run / 1 = OFF / 2 = ON

27: output on ERR	*(value range 0 to 2)*
Defines the state of the digital output if the controller is in system error: 0 = same as during programme run / 1 = OFF / 2 = ON	

following parameters apply on selection **PRC** only:

32: process mode	*(value range 0 to 18)*
Selects the process state the digital output is indicating: 0=programme run (also ON during segment 0 and at the end of the firing) / 1=programme run (also ON during segment 0) / 2=programme run / 3=end of the firing / 4=any loop error / 5=programme HOLD / 6=OFF / 7=ON / 10/11/12=mixer in air excess/stochiometric/cooling mode / 13=programme continues after power breakdown / 14=do0.6 and not do0.7 / 15=do0.6 and do0.7 / 16=not do0.6 and do0.7 / 17=control loop off band / 18=programme interrupted due to off band / 19=any monitored loop error / 20=final temperature matches in all monitored loops / 21=any monitored loop in control range / 22=any monitored loop out of control range	

following parameters apply on selection **EVE** only:

42: EVENT number	*(value range 0 to 10)*
Digital output operating as programme EVENT number #. This identifier must match the EVENT number specified in the programme table	
43: output on IDLE	*(value range 0 to 1)*
Defines the state of the digital output when the controller is IDLE: 0 = OFF / 1 = ON	
44: output on ERR	*(value range 0 to 1)*
Defines the state of the digital output if the controller is in system error: 0 = same as during programme run / 1 = OFF / 2 = ON	

Table 4: digital input

Digital inputs provide various options. They can be used to create a process value depending on the pulse frequency. As well they can be used to control programme execution in different ways. The optional PLC uses digital inputs too. **Note:** PLC provides you with total flexibility of the controller. If you are using the PLC of the controller you must **not** do any adjustments in this digital input section since all features are programmed by PLC networks

00: input mode	*(value range OFF, 0 to 5)*
Action on input activation: 0=programme starts all over again / 1=programme starts / 2=programme stops 3=ON:programme starts all over again OFF:programme stops / 4=ON:programme stops OFF:programme stops / 5=programme HOLD	
01: signal source	*(value range DI0.0 to DI0.2)*
Physical input assigned for the action defined before	

Table 5: program table

The program table determines the parameters and the sequence to be entered for each program segment. The first program parameter is always a time followed by a temperature. Depending on the application the following program segment parameters are offset temperatures (for multizone kilns), program events etc. The parameter sequence after the 1st temperature is variable; however, keeping all program EVENTs togather saves program memory

00: value type	*(options END, TIME, VAL-L, ---, VAL-S, EVENT)*
Select the kind of value in each column of the programme table:	
TIME: Very first column of the programme table to hold the segment time	
VAL-L: Programme value in the range of -10000 to 10000. Typically used for any	

kind of absolute value (like kiln temperature etc.)

VAL-S: Programme value in the range of -127 to 128. Typically used for any kind of relative values (like offset temperature for zones)

EVENT: EVENT value, ie. holds ON or OFF. When requiring multiple events defining them one after the other saves programme memory

01: designator	*(alphanumerical characters)*
Used to give each programme table column an individual name (consisting of up to 3 alphanumeric letters)	

following parameters apply on selection **TIME** only:

02: lower time lim	*(value range -101 to 0)*
Limits the value range entered as a time. Note that the values smaller than minus 2 enable the programme link feature (-3 = allow linking to programme number 1, -4 = allow linking to programme number 2 etc.)	
03: upper time lim	*(value range 1 to 599)*
Upper limit when adjusting the time. The 1000 steps beyoind this limit stand for setting the gradient as centigrade kelvin per period	

following parameters apply on selection **VAL-L** only:

12: value unit	*(options °C, °F, °K, dg, mV, mA, O2, CO, %, ev, mb, m³, m³h, kh, kwh, Pa, AT, lda)*
Specifies the unit of the programme table value	
13: lower val. lim	*(value range -99 to 1999)*
Lower limit of the programme table value. Used to limit the programm values within the operation range of the kiln	
14: upper val. lim	*(value range -99 to 1999)*
Upper limit of the programme table value. Used to limit the programm values within the operation range of the kiln	

following parameters apply on selection **VAL-S** only:

32: value unit	*(options °C, °F, °K, dg, mV, mA, O2, CO, %, ev, mb, m³, m³h, kh, kwh, Pa, AT, lda)*
Specifies the unit of the programme table value	
33: lower val. lim	*(value range -128 to 127)*
Lower limit of the programme table value. Used to limit the programm values within the operation range of the kiln	
34: upper val. lim	*(value range -128 to 127)*
Upper limit of the programme table value. Used to limit the programm values within the operation range of the kiln	

following parameters apply on selection **EVENT** only:

42: EVENT number	*(value range 0 to 3)*
This unique identifier assigns the EVENT in the programme table for the digital output	

Table 6: process flow

Following settings specify how any unusual conditions during programme run (such as a broken temperature sensor, slow heating, control loop errors etc.) are handled. Also the criterias to enter the next segment during programme run can be adjusted to your application

00: time in ramps	*(options KEEP, UPDAT)*
If the temperature of the pilot input (IN00) is higher than the start temperature of the ramp the time of the ramp can be either kept or reduced accordingly	

KEEP: Segment time is kept, setpoint begins as programmed

UPDAT: Segment time is reduced accordingly. Example: Segment 0 at 0°C, segment

1 "2 hours up to 500°C". Assuming a kiln temperature of 250°C when starting the firing, the time is reduced to 1 hour (causing a setpoint of 250°C)

01: monitor lp	*(value range -CH01 to CH01)*

Adjust the loops to be monitored for process problems. This allows to pick only the loop(s) which are relevant for the process. Either a single loop or a range of loops (e.g. ch00 to ch02 on a 3 zone kiln, entered as "-ch02") can be selected.

02: temp match %o	*(value range 0.0 to 100.0)*

An uncontrolled ramp (SKIP) is terminated if the actual temperature matches the final segment temperature. Since the controller slows down temperature towards the end to avoid over/undershoot it might take more time to reach the temperature. Use this parameter to specify when the segment temperature is considered as reached. Example: 2.0 ppm of 1320°C (max. loop temperature) = 2.64°C, SKIP segment ends at 997.36°C assuming a final ramp temperature of 1000°C

03: num of matches	*(value range 1 to 250)*

An uncontrolled ramp (SKIP) is completed if the temperature matches the specified number of cycles (0.5s each). This ensures a segment is not terminated if the temperature overshoots for a short period. Example: Setting of 6 waits for 3 seconds to complete the current segment assuming the temperature matches continuously

04: end of SKP seg	*(options DISR, WAIT.X, INFIN)*

An uncontrolled ramp (SKIP) usually is only completed if the actual temperature reached the final ramp temperature. The following options are considered:

DISR: Causes the controller to disregard the temperature, ie. to leave a SKIP segment immediately

WAIT.X: Causes the controller to wait for temperature match, but maximum for the specified time (see next parameter). This option is strongly recommended on multi zone kilns, e.g. at a time of 10 minutes. Otherwise the process might deadlock itself. For instance in a cooling SKIP, the thermocouple of zone 2 has a little deviation and therefore zone 2 is heated 4°C higher; if the heating affects zone 1 this zone will never cool down as neccessary. The time begins to count if the first zone starts to control. Once the time is elapsed the segment is finished disregarding the zone temperatures

INFIN: Causes the controller to wait for temperature match for infinite time

05: max wait (sec)	*(value range 0 to 9999)*

wait time in seconds for the feature specified previously

06: act.on LP unco	*(options DISR, WAIT.BR, WAIT.CO, INFI, INFI, INFI)*

In a controlled ramp it might happen that the kiln temperature can not follow the requested increase although the controller asks for maximum heating (resp. the requested decrease in a cooling segment). The following actions can be selected:

DISR: Causes the controller to disregard temperature

WAIT.BR: Causes the controller to hold the process to allow the temperature time to catch up. If the kiln couldn't catch up within the specified time (see next parameter) the firing is interrupted (break). This hold sate (same as hold used during programme run) can also be released manually by pressing the hold skip button

WAIT.CO: Causes the controller to hold the firing but - after the time has elapsed - continues the firing disregarding the temperature

INFI: Causes an immediate break if the temperature can not follow.

07: max hold (sec)	*(value range 0 to 9999)*

wait time in seconds for the feature specified previously

08: uncontr = ..LP	*(options ALL, ANY)*

Selects the criteria the controller judges the kiln as "non following the temperature increase":

ALL: all loops out of control (maximum or minimum heating)

ANY: any loop out of control

Table 7: programme setpoint

The programme setpoints are calculated according to the programme resp. temperature curve entered by the operator. Some adjustments are possible for easy operation. Automatic setpoint calculation required for cascade control systems is also entered by the following settings

00: setpoint type	*(options END, CON, MOD, CHA)*

The following basic types creating a setpoint can be selected:

CON: Use initial value of the programme segment only. Typical applications are offset values for zone temperatures or flap positions

MOD: Programme setpoint modulated by the segment time. This is the common setting causing the programme setpoint to count upwards resp. downwards over the segment time (e.g. within 2:00 hours from 0°C up to 1000°C)

CHA: Setpoint calculated by cascade control algorithm - for details refer to the example below

following parameters apply on selection **CON** only:

01: table source	*(value range CH/Z1 to TA05)*

Selects the column of the programme table used for setpoint calculation. TA01 is the 1st column, ie. usually the pilot temperature

02: offset src SP	*(value range OFF, SP00 to SP01)*

Defines a setpoint which refers to an existing setpoint, ie. the setpoint is calculated by adding an offset setpoint to it. Used e.g. for the setpoint of the slave zones of a multizone kiln. Using this option allows the operator to enter the temperature of the slave zones as offset (temperature difference) relative to the master zone setpoint.

03: idle setpoint	*(value range -99 to 1999)*

Setpoint if the controller is not on programme run. Used to hold a temperature during a programme IDLE. Entering "0" switches off this option

04: error setpoint	*(value range -99 to 1999)*

Setpoint if the controller is in error state. Used to ensure a certain temperature is maintained during ERROR. Entering "0" switches off this option

following parameters apply on selection **MOD** only:

11: table source	*(value range CH/Z1 to TA05)*

Selects the column of the programme table used for setpoint calculation. TA01 is the 1st column, ie. usually the pilot temperature

12: offset src SP	*(value range OFF, SP00 to SP01)*

Defines a setpoint refering to an existing setpoint, ie. the setpoint is calculated by adding an offset to it. Used e.g. for the setpoint of the slave zones of a multizone kiln. Using this option allows the operator to enter the temperature of the slave zones as offset (temperature difference) relative to the master zone setpoint.

13: idle setpoint	*(value range -99 to 1999)*

Setpoint if the controller is not on programme run. Used to hold a temperature during a programme IDLE. Entering "0" switches off this option

14: error setpoint	*(value range -99 to 1999)*

Setpoint if the controller is in error state. Used to ensure a certain temperature is maintained during ERROR. Entering "0" switches off this option

following parameters apply on selection **CHA** only:

21: based on SP	*(value range SP00 to SP01)*

Selects the programme setpoint used on a cascade control

22: charg.ctrl.LP	*(value range LP00 to LP01)*

Selects the master control loop. A cascade control is used on applications where a very lag workpiece (e.g. an large piece made of aluminium) needs heat treatment. In an ordinary kiln it will take extended time until the workpiece has reached 600°C if the kiln is dwelling at 600°C. When using a cascade control the main sensor is connected directly to the workpiece and an additional sensor checks kiln temperature. The kiln is controlled at a higher temperature to faster heat up workpiece; once the temperature is getting closed kiln temperature is reduced accordinly. The master control loop is configured as normal, ie. using the programme temperature as setpoint and the target temperature as actual temperature. The output of this

loop is used to create a 2nd temperature setpoint according to the settings in this section. This setpoint and the actual ambient temperature are assigned to the slave control loop driving directly the heating device of the kiln. Note that the master control loop is configured as heating/cooling loop with a wide proportional range and slow integral time (P/I/D = 10.0% / 400 s / 0 s)

23: max. temp.diff	*(value range -99 to 1999)*

Limits the maximum temperature difference between workpiece and kiln temperature. Used to limit temperature stress to the workpiece. A high limit, however, speeds up the process

24: max envir.temp	*(value range -99 to 1999)*

Limits the maximum ambient temperature. Used to avoid damage of the kiln. A high limit, however, speeds up the process

Table 8: control loops

Different control algorithms are available to fit your application

00: ctrl.algorithm	*(options END, PID, C-PID, D-HYS, P-DIR)*

Depending on your application different control algorithms are available

PID: Default control algorithm suitable for most applications

C-PID: As before, but heating and cooling can be activated independently. Useful e.g. for gas kilns where availability of heating and cooling depends on burners resp. cooling device operation. Activation by any digital output

D-HYS: Hysteresis control for heating devices which require either temperature deviation or do not allow short cyclic activation (e.g. discontinuous burners)

P-DIR: Direct control. The setpoint is directly converted into a control value refering to the given value boundaries. Typical application is setting a flap position directly (e.g. 0 to 100%)

01: setpoint chn	*(value range SP00 to CH19)*

Selects the setpoint used for the control loop

02: input chn	*(value range SP00 to CH19)*

Selects the process value used for the control loop

03: power % on ERR	*(value range -100 to 100)*

Predefined process output if an error occurs in the loop e.g. if the process value failed (overrun, underrun, invalid), process value exceeded the limit set in loop configuration or the gradient check failed

04: maximum value	*(value range 0 to 9999)*

Maximum process value. Used to limit the process input value for safety reasons as well as setting the operation range. If the process value exceeds the limit the control loop enters error state which can only be cleared by re-starting the programme or pressing CE key. Set this value slightly above the actual operation range to allow little overshooting

05: grdnt check s	*(value range 0 to 3600)*

Gradient check used for safety reasons. Prevents the unit from damage if the feedback signal (e.g. the thermocouple) fails. Checking the increase of the process value is performed on maximum output (typically +100%). This parameter defines the checking period in seconds. Set to "0" to disable checking.

06: grdnt chk dif	*(value range 0 to 9999)*

Required increase of process value during checking period on maximum heating

07: ctrl charact	*(value range 0 to 3)*

Depending on the application select the operation range of the control loop as follows: 0=0% to 100% / 1=100% to 0% / 2=-100% to +100% / 3=+100% to -100%

following parameters apply on selection **PID** only:

08: prop. band %	*(value range 0.0 to 999.9)*
Control parameter "proportional band" in % of the maximum value	
09: integral time	*(value range 0 to 9999)*
Control parameter "integral time" in seconds	
10: derivat. time	*(value range 0 to 9999)*
Control parameter "derivative time" in seconds	
11: prop. shift	*(value range 0 to 4)*
Operating range of the proportional band: 0=prop. band below setpoint / 1=prop. band one quarter above setpoint / 2=.. half above setpoint / 3=.. three quarters above setpoint. In most applications a setting of "1" ensures best results (ie. fast reaching the setpoint with minimum overshoot)	

following parameters apply on selection **C-PID** only:

18: prop. band %	*(value range 0.0 to 999.9)*
Control parameter "proportional band" in % of the maximum value	
19: integral time	*(value range 0 to 9999)*
Control parameter "integral time" in seconds	
20: derivat. time	*(value range 0 to 9999)*
Control parameter "derivative time" in seconds	
21: prop. shift	*(value range 0 to 4)*
Operating range of the proportional band: 0=prop. band below setpoint / 1=prop. band one quarter above setpoint / 2=.. half above setpoint / 3=.. three quarters above setpoint. In most applications a setting of "1" ensures best results (ie. fast reaching the setpoint with minimum overshoot)	
22: hyster. units	*(value range 0.0 to 99.9)*
Hysteresis of the control loop. The hysteresis is specified as absolute value. A small value results in higher accuracy but causes higher switching rates. A large value causes less accuracy due to larger oscillations of the process value	
23: derivat. time	*(value range 0 to 9999)*
Control parameter "derivative time" in seconds	

following parameters apply on selection **D-HYS** only:

28: hyster. units	*(value range 0.0 to 99.9)*
Hysteresis of the control loop. The hysteresis is specified as absolute value. A small value results in higher accuracy but causes higher switching rates. A large value causes less accuracy due to larger oscillations of the process value	
29: derivat. time	*(value range 0 to 9999)*
Control parameter "derivative time" in seconds	
30: min. ON time	*(value range 0 to 120)*
Minimum time for output activation specified in seconds. Used to supress short time output activation. A typical application is when driving certain types of burners which need a minimum startup time (ignition sequence)	
31: min. OFF time	*(value range 0 to 120)*
Minimum time for output deactivation specified in seconds. Used to supress short time output deactivation. A typical application is when driving certain types of burners which should not be interrupted for short periods	

following parameters apply on selection **P-DIR** only:

38: lower val.base	*(value range -99 to 1999)*
Sets the lower base value which corresponds to 0% control loop output	
39: upper val.base	*(value range -99 to 1999)*
Sets the upper base value which corresponds to 100% control loop output	

Table 9: infobox

Defines the process parameters displayed on the controller. Each infobox defines one process parameter to show. See page 22 how to display these values

00: infobox type	*(options END, SPACE, VAL, VAL-B, VALx2, CHAN, DOx, AOx, MOT, STAT, DIx, AI, PRC.I)*
Selects the kind of information shown on the infobox	
SPACE: blank	
VAL/VAL-B/VAL2: Displays a process value	
LOOP: Displays a loop status	
DOx: Displays a group of 6 digital outputs	
AOx: Displays an analog output	
MOT: Displays position and movement of a servomotor output	
STAT: Displays current process information	
DIx: Displays a group of 3 digital inputs	
AI: Displays an analog input	
PRC.I: Displays current process information	
KWH: Displays electrical power consumption	

following parameters apply on selection **VAL/VAL-B/VALx2** only:

11: display value	*(value range SP00 to CH19)*
Selects the process value to be shown	

following parameters apply on selection **LOOP** only:

41: Loop info	*(value range LP00 to LP01)*
Selects the loop to be shown	

following parameters apply on selection **DOx** only:

51: DOx output	*(value range DO0 to DO6)*
Selects a digital output to display	

following parameters apply on selection **AOx** only:

61: AOx output	*(value range AO0 to AO1)*
Selects an analog output to display	

following parameters apply on selection **MOT** only:

71: step.mot.info	*(value range SM0 to SM6)*
Used to display position and movement of a servomotor. Select the column number of the digital output which must be defined for servomotor operation	

following parameters apply on selection **DIx** only:

91: DIx digital input	*(value range DI0)*
Selects a group of 3 digital inputs to display	

following parameters apply on selection **AI** only:

101: AIx analog input	*(value range AI0 to AI1)*
Selects an analog input to display	

following parameters apply on selection **PRC.I** only:

111: Process Information	*(value range SP00 to CH19)*
Current process information	

following parameters apply on selection **KWH** only:

121: power ratng.kw	*(value range 0.0 to 99.9)*
Enter the total power of the kiln. The calculation assumes all zones having the same amount of power	

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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	series TM100, TC44, TC60, TC66, TC60/8, TC88, TC2010, TC2044, TC2066, TC2088, TC405, TC605, TC405/30, TC503, TC504, TC505, TC507, TC-S1, TC-S2, TC-M2, DIGIT450/600/700
refering EU-regulations	EG regulation low voltage (2006/95/EC) EG regulation EMC (89/336/EEC)
applied harmonized standards:	EN 61010 (LV directive) EN 61000-6 (EMC supression) 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.

Reinhard Bentrup, MD
Fernwald, 8. April 2008

Note: We reserve the right to make any technical changes without prior notice