bentrup

THERMOCOMPUTER **TC S1**

value

1250°C

program **93** idle run **17.2** segment

display page A B C D

process value

1249°C
1251°C
1250°C

+ − value
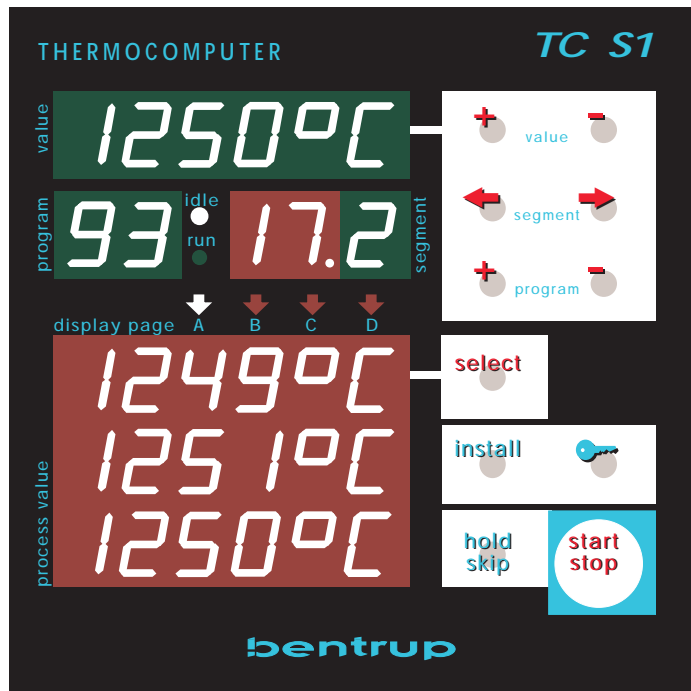
← segment →

+ − program

select

install

hold skip

start stop

bentrup

Universal Programmer
TC S1

Front Panel / Brief Description

(1) programme parameter resp. remaining segment time display

(2) segment number display: actual programme segment resp. segment to be changed (blinking). The green digit counts the parameters per segment (.0=time .1=temperature ...)

(3) key to change programme values: If a programme value is shown on display (1) change this value by using these keys. For larger value changes, simply press the corresponding key *and hold it pressed.*

(4) key to enter a programme: To enter a new programme or to check / change the values of the actually selected programme, select the segment number by these keys (segment display (2) **is blinking**) showing the actual segment. Each segment consist of a time first and then one or more programme parameters. Change the displayed value if required using keys (3).

(5) key programme, (13) display of actual programme selected: Select the desired programme by using these keys. Each pressing of a key selects the next resp. previous programme. Hold key pressed for large changes. The maximum number of programmes depends on the configuration. In most applications the maximum of 99 programmes is available.

(6) key select, (11) process value display, (12) page indicator: The most important 3 process parameters (e.g. the 3 actual temperatures of a 3 zone kiln) are displayed in window (11). To call up further process parameters (like setpoints, control channel output etc.) press key select. The exact type and sequence of these extra parameters is defined in the installation. Indicator (12) shows which „page" is currently shown.

(7) key lock / unlock the keyboard: During a programme run, you can protect the controller against unauthorized use by locking the keyboard. If the keyboard is locked, the user can only call up process values by pressing key (6). Locking is done by pressing the key and holding it pressed for about 3 seconds (decimal point in the display (3) means locked keyboard). To unlock, press key (7) and hold it pressed for about 3 seconds again.
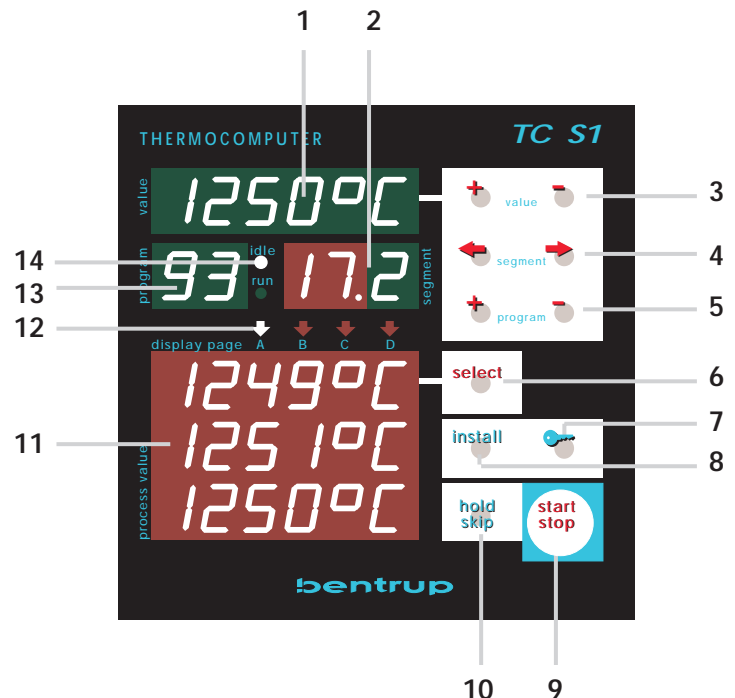
(8) key install: Pressing this key for 3 seconds enters installation. The installation is to adapt the TC-S1 to your individual application. Refer to the "Technical Operating Manual" for details.

(9) start / stop key, (14) programme run indicator: To start the selected programme, press key start / stop. The indicator (14) changes from IDLE to RUN indicating a running programme. To stop a programme, press start / stop again (indicator (14) changes back to IDLE). This interrupts controller operation.

(10) key hold: holds programme run, TC-S1 keeps controlling. This is used e.g. to hold programme run at the current setpoint in a ramp. During a hold the programme run indicator (14) shows both indicators RUN and IDLE

key skip: pressing this key and holding it for 3 seconds causes an immediate skip to the next segment during a programme run (disregarding whether the actual segment was completed).

Contents

General Information

Your brand new bentrup TC S1 represents the latest technology in kiln control concerning safety, precision and features available today. The TC S1 is one of the most powerful controllers of its size on the market. It incoporates a multichannel design with a complex system structure. The technical manual describes the powerful and very flexible function which can be used in your application.

Before operating your new TC S1 please read the manual carefully. This familiarizes you quickly with the numerous features of the TC S1.

Please also refer to the safety advice of your kiln manufacturer. Make sure that the control is placed at a safe distance from the kiln and is not exposed to direct heat or radiation from the kiln.

Basic Operation

The microprocessor controller TC S1 gives you an exact and reproducible control of your kiln. One firing curve is called a programme; a programme is split down into single segments. Each segment is defined as time and temperature. Following example A shows a simple temperature curve:

Example A: Typical Temperature Curve for Drying (simple application)

segment no.	time	temperature	comments
0	SKIP	20°C	immediate start at 20°C
1	2:00	150°C	slow temperature increase: within 2:00 hours up to 150°C
2	0:30	150°C	maintaining 30 minutes the temperature of 150°C
3	1:00	50°C	temperature decrease: within 1:00 hour down to 50°C
4	END		

Each segment consists of the time and the temperature to reach during this segment. A dwell (soak) is done simply by entering the same temperature as in the segment before (see segment 2 in example A).

"SKIP" (entered as a time) means the controller will make the segment as short as possible. If you enter

SKIP in segment 1 of example A, the controller will do an uncontrolled heat up to 150°C. In segment 0, SKIP means that the controller will start the programme right away.

Note
segment 0 is always required ! Even if you don´t want to delay the programme start, you have to enter segment 0 because it defines the starting temperature (20°C in the example).

In many applications, the controller controls not only one temperature of a system. Depending on your application, it might be desireable to control additional functions like

- the temperature of a 2nd kiln zone
- the damper / flap of a kiln
- an external signal to be activated in a particular segment (e.g. buzzer) etc.

Please find following example B the programme for a kiln with 3 temperature zones and one damper:

Example B: Typical Temperature Curve for Drying, 3 zone kiln with damper

seg.	time	temp.	zone 2	zone 3	damper	comments
0	SKIP	20°C	0°C	0°C	CLOSED	immediate start at 20°C, damper closed
1	2:00	150°C	0°C	0°C	CLOSED	ramp to 150°C, all 3 zones equal, damper closed
2	0:30	150°C	+5°C	-5°C	CLOSED	dwell at 150°C, 2nd zone at 155°C,3rd zone 3 145°C
3	SKIP	20°C	0°C	0°C	OPEN	uncontrolled cooling, damper opened
4	END					

Compared to the example A, now additionally to time and temperature further parameters are required in each segment.

Note
The above examples are typical only and reference should be made to kiln, clay and/or glaze manufacturer with regard to venting and cooling.

Entering a programme

We are going to enter the example A as programme number 1.

> **Note**
>
> As mentioned before, the exact number of parameters to be entered for each segment varies depending on your application. Your system manufacturer has adapted the TC S1 to your application. Therefore the following sequence might be different than shown. Refer to table of appendix A.
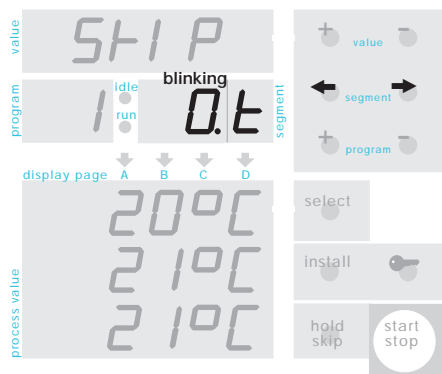
After power up, the TC S1 has selected programme number 1 automatically. Use the keys (4) to select the time of segment 0 (display (2) shows blinking „0.t"). Refer to the sketch shown on the left.

The display (1) shows the present value for time in segment 0.
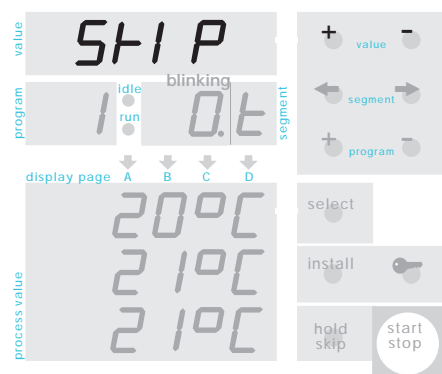
Now, use the keys (3) to change the time as required. SKIP is shown instead of time 0:00, so you must count down the time to get to SKIP. When you have completed this, the display will appear as shown.

You have now entered the time of segment 0, SKIP.

Note that the controller switches back from input mode if you don´t press any keys for 15 seconds. However, all changes made are kept.
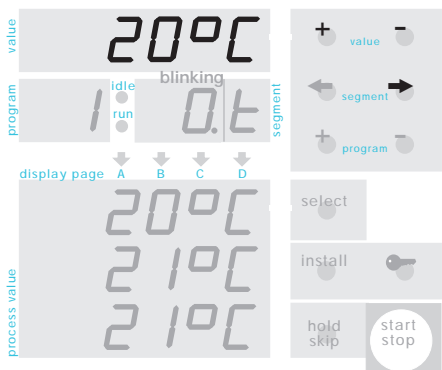
To enter the temperature 20°C in this segment, press the right hand side key (4) once and then change the displayed value to 20°C using the keys (3) again.

You have now completed segment 0. Time is SKIP, temperature 20°C. See next page to continue.
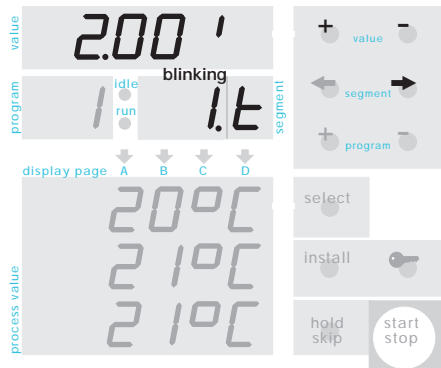
Now, enter the values for segment 1. Press the key (4) to the right hand side key once to step to the next segment (display (2) shows segment number 2).

Note

If your TC S1 is configured for additional parameters per segment (as in example B), these are entered before moving to segment 1.

Change the displayed value to 2.00 hours using keys (3). Hold the key pressed for large value changes.

Press the key (4) again to enter the temperature for segment 1. Change the value to 150°C using keys (3).

Enter the further parameters in the same manner. Always step to the next parameter using key (4) after you have changed the programme values accordingly.
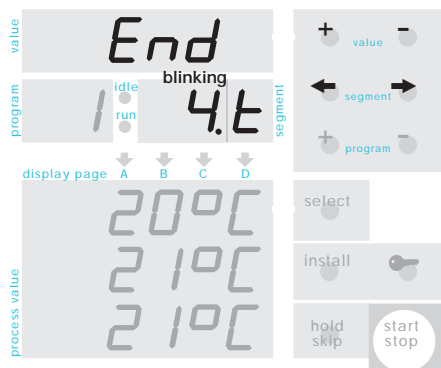
After completion of 3rd segment set the 4th segment time to END (decrease time value down, beyond SKIP). This tells the controller on programme run that the end of the process is reached.

You can review and change all values at anytime by using the keys (4). So you can step through the entire programme and check and if required change the values in any sequence.
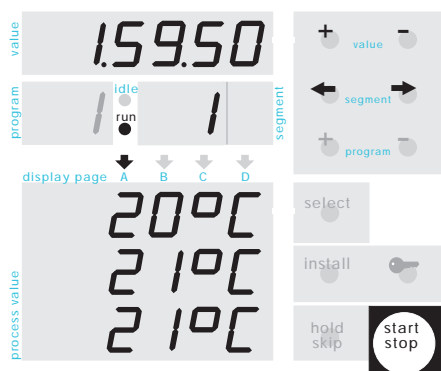
To start the process simply press key (9). The indicator (14) changes from IDLE to RUN indicating a running programme. The display (1) now counts backwards the time left in the actual segment which is shown on display (2) (not blinking).

The displays (11) show the actual process parameters (like kiln temperatur es, depending on application).

To stop the firing press key (9) again (indicator (14) reads IDLE). If you press key (9) again the programme is continued. Refer to a later section how to restart the programme completely from the beginning.

When the firing has completed successfully, the display (2) shows an **"E"** (for End).

Programmes
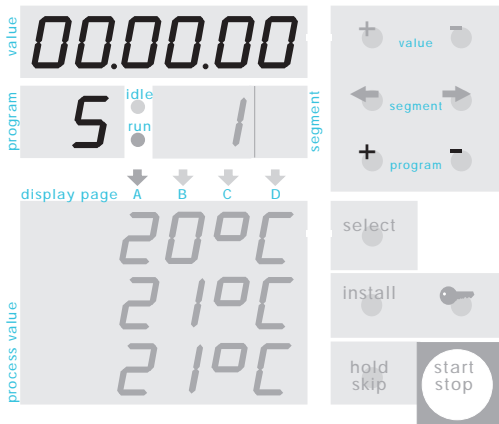
Up to 99 firing curves can be saved in your controller. To enter a firing curve as programme number 5 for instance, press key (5) multiple times until display (13) shows programme number 5. Enter the programme values as described in the previous example. The programme is saved automatically after a few seconds or after programme start.

To call up a programme already entered, press key (5) multiple times until display (13) shows the desired programme number. Press the key (9) and the programme run commences.

Additional Displays

The display (11) is used to show all different kind of process values like actual kiln temperatures, setpoints, channel output / status, analog input / output status, digital input / output status. The 3 lines of display (11) show one process value each. Press the key (6) to switch to the next set of 3 process values. The indicator (12) shows which set of process values is currently displayed (A, B, C, D). The system manufacturer has adapted the TC-S1 to your application (refer to the Technical Manual for details).
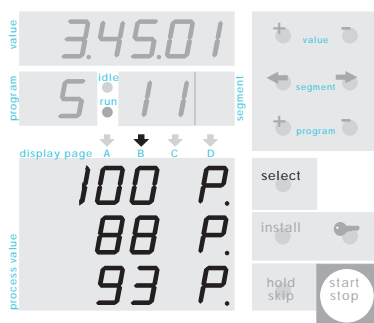
The sketches on the left hand side show and example for a three zone kiln: Page (A) reads the actual temperatur of each zone, page (B) the control output (in % heating / cooling) resp. channel status and page (C) reads informations like the status of the output relais, 2nd line an analog intput value and 3rd line the actual time.

Check the table in appendix B where your system manufacturer has entered the sequence according to the configuration.

Special Displays

When operating the TC S1, you will sometimes encounter messages with a special meaning. Please find below the exact appearance and what they mean.

on. E4

When entering a programme, sometimes ON / OFF information is required (e.g. damper OPEN / CLOSE). This is defined by EVENTs. The example shows event number 4 presently set to ON.

ouEr

"over": The actual value (e.g. kiln temperature) has overrun, ie. is out of bounds. Usually, this points to an open input (no sensor connected or sensor resp. circuit is open)

undEr

"under": as above, but value underrun. Check the defined boundaries in the input configuration.

i nuAL

"inval": as above, but value invalid. Means the TC S1 was unable to create this value because of missing data.Check cross-referenced inputs and configuration.

ch. oFF

"ch.off": Control channel is off. This means that no programme is running or the control channel is inactive at the moment (e.g. in conditional PID mode).

ch. Grd

"ch.grd": Control channel cancelled operation due to gradient check failed. The TC S1 found that the unit connected to this channel (e.g. kiln) could not comply to the minimum heat up requested by the channel configuration. Auto-Reset on next start.

ch. our

"ch.ovr": Control channel cancelled operation due to assigned input value failed. The channels remain in this mode for safety reasons until next restart of the programme.

APPL.Err

"Appl.Error": Application Error. This is a user definable error message which appears blinking on the display (1). The exact meaning depends on the configuration, usually this message is used to point to a problem in one of the control channels.
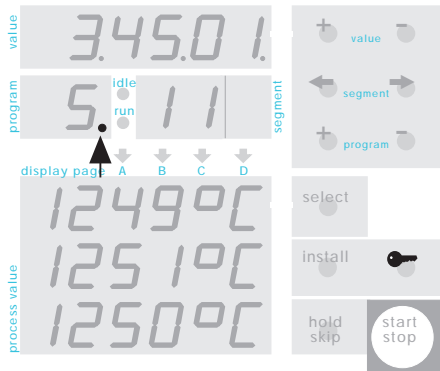
Err 3.FE
or other code

"Err.<x.y>": Internal Error. x / y points to the cause of the problem. Ask your system manufacturer for assistance or refer to the Technical Manual.

Keyboard Locking

To avoid unauthorized use, you can lock the keyboard of the controller after the programme is started. Only the key (6) is still operable to call up values.

To lock the keyboard, press the key (7) and hold it pressed for 3 seconds until the decimal point in window (13) appears. Unlocking is done in the same way.

Immediate Segment Skip

Sometimes it is required to skip to the next segment during a programme run immediately. The TC S1 provides this feature by pressing and holding key (10) for 3 seconds. The TC S1 will skip immediately to the next programme segment.

Restarting a Programme

When selecting a programme, it always starts from the beginning, ie. from segment 0. If you had to interrupt the firing in a later segment and would like to restart from the beginning, simply recall the programme by pressing the key (5) + and thereafter key (5)- .

Programme HOLD
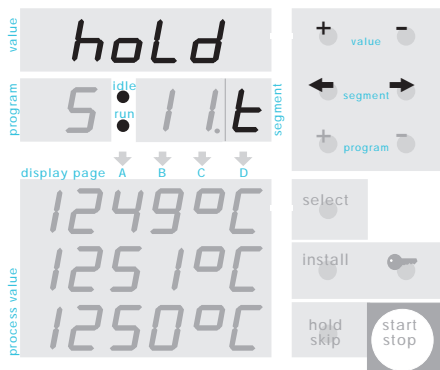
The hold mode is to freeze the present programme status during a process, ie. to stay at the present setpoint (and segment) as well as to hold the timer (in a dwell). The hold mode can be initiated in two ways:

To initiate the hold **manually** during a running programme, press the key (10). Both indicators (14) IDLE and RUN are on indicating programme hold.

To initiate the hold **automatically**, set the time of the corresponding segment to "HOLD". If the firing reaches this segment, the controller will enter hold (both indicators (14) IDLE and RUN on).

To release the hold, you have to press the key (10) again (indicator (14) shows RUN only).

This feature should be used carefully to avoid the firing unintentionally holding "forever". But combined with an EVENTs buzzer, this feature can be very helpful if user access is required on a firing process.

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Reaction to a Power Breakdown

In the event of a power breakdown the firing process is interrupted. After power is established again the firing process is continued from that point at which it was interrupted. The decision whether to resume programme run or not can be depended from time, process values or also EVENTs. Refer to the configuration for details.

Actual length of the Segments

Usually, on firing a programme segment is finished when the temperature of this segment is matched. If the kiln is unable to reach the temperature in the given time the segment will be extended accordingly. A detailed adaption is also possible. Refer to the configuration for details.

Any further functions required ?

The TC S1 is one of the most flexible and powerful instruments of its class. The configuration keeps many hundreds of functions available which covers most requests. Whatever you need in your application, you will find the answer in the configuration. The configuration is described in a seperate booklet.

For the first time, it might be a little bit difficult to understand all the possibilities. So we are glad to support you, just let us know what functions you require to change or to add.

Appendix A: Customized Programme Table

Sequence of Values to be entered on each Programme Segment

The type and range of values to be entered for each programme segment depends on your application. These have been set by your system manufacturer accordingly. The following table shows the values the controllers prompts you for when entering a programme:

display (2) green		range / unit	description
t.	time	SKIP-99:99h	segment time
1.	temperature	_____	_____
__	_____	_____	_____
__	_____	_____	_____
__	_____	_____	_____
__	_____	_____	_____
__	_____	_____	_____
__	_____	_____	_____
__	_____	_____	_____
__	_____	_____	_____
__	_____	_____	_____

Comments:

_____

_____

_____

_____

_____

Appendix B: Process Value Display (11)

Sequence of Process Values Called up by the Select Key (6)

The type and meaning of values which are displayed by pressing the select key (6) depends on your application. These have been set by your system manufacturer accordingly. The following table shows which values are displayed and what they mean (fill in explanation (like „zone 1 temp") in the empty boxes):

display page   A   B   C   D   select

process value

display page   A   B   C   D   select

process value

display page   A   B   C   D   select

process value

display page   A   B   C   D   select

process value
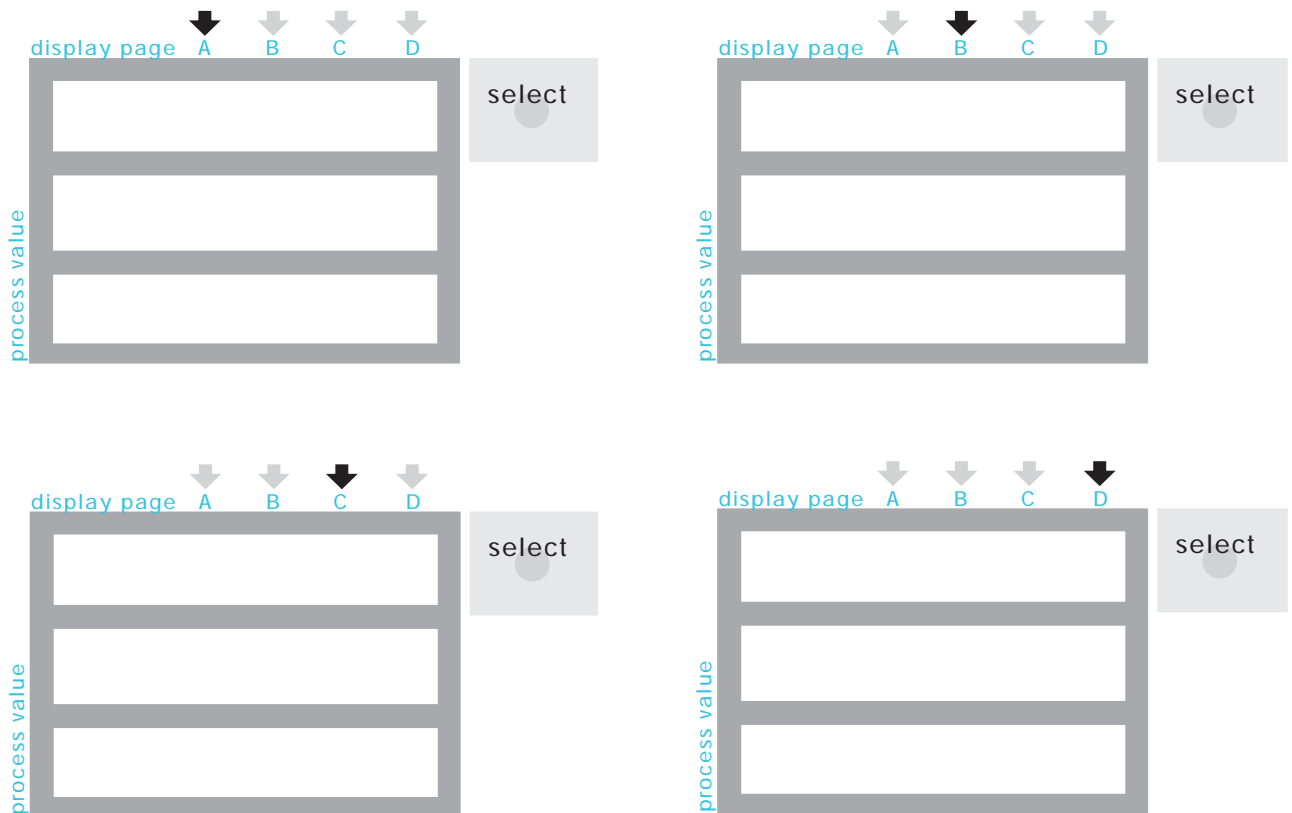
Comments:

_____

_____

_____

_____

_____

Appendix C: Error Message Codes

$$Err \quad 3.FE$$

(Example: Error, code 3.FE)

If the controller finds any hardware unit inoperable (either internal or external on the SYSBUS) it comes up with this type of error message. Below is a listing of the error codes.

Error Code	Description
1.x	problem on internal signal acquisition (SYS_CVs). x points to the exact origin.
2.x	signal converter (AD) validation failed. x points to range. Service required.
3.x	systembus error. The signal flow on the bentrup systembus (SYSBUS) is interrupted or failed. Check all cables, contact, wiring, terminal connector (!) etc. If initially an error 4.x comes up, check the setup (see explanation below).
4.x	systembus setup error. The systembus units actually connected to the SYSBUS do not fit to the units defined in the configuration. See the Technical Manual for details. This error message is not severe, ie. it is only a mismatch in the setup.
8.0	general hardware error. Service required.
8.4	CPU RAM checksum error. Power off and restart controller. If the error messages comes up again immediately, service required.
8.x5	programme memory (x) is missing / defect
8.6	configuration memory missing / defect
8.7	clock / timer circuit missing / defect
8.8	calibration data missing / defect. recalibrate system.
8.9	relay output driver problem. Power off and restart controller, if the error message comes up again immediately, service required
8.99	software license expired - contact your supplier for further authorization