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Unidade de Física e Aceleradores, CTN

USERS MANUAL

Tube furnace
FRH-40/220/1 250

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1-zone for horizontal operation with dTron controller 16.1

Contend

1.   Technical Specifications

Inner diameter of the furnace	Approx.. 40 mm
Heated length	Approx.. 200 mm
Constant temperature zone	Approx.. 70 mm
Furnace dimensions	Approx.ϕ 300 x 345 mm long without fixing elements
Outside dimensions of the control unit	Approx. 430 x 220 x 370 mm (WxDxH)
Max. temperature	Approx. 1300°C
Continuous temperature	Approx. 1250°C
Heating up time to 1000°C	Approx. 20 min of empty furnace without insert tube with closed ends
Heating	Fibrothal heating-tube
Connection	230 V, 50 Hz, 0,86 kVA
Supply voltage of the furnace part	15 V transformer required

2.   Set-up

The tube furnace is constructed for working on a working table. The separate control unit is connected to the furnace via flexible lines and can be put on a working table or any other plane surfaces

3.   Special operating instructions

The inner lining of the furnace consists of ceramic fiber material and can mechanically only be strained a little. While putting the insert tube in the furnace make sure not to damage the inner lining.

<table>
<tr>
<td>CAUTION!</td>
<td>Please also note that prior to putting in the insert tube, the thermometer has to be loosened and pulled away upwards. After putting in the insert tube put the thermocouple back in the final position, this means it has to strike against the outer wall of the insert tube. Interlock thermoelement with adjusting screw on the adjusting ring.</td>
</tr>
</table>

4. First start-up

- Set working controller to desired value 500°C

- Switch on the furnace heating. Heat up to 500°C and hold for approx. 3 hours. This operation serves for removing chemically bound moisture in the fiber lining and for oxidizing volatile binder components.

- After finishing the low temperature drying process, the unit should be heated with a temperature gradient from 100°C/H to 1250°C, held for 2 hours and then be switched off (high temperature drying).

- The unit is ready for operation for the planned heat treatment purpose. However, please note that during the first 3-4 hours binder reactions might occur.

5. Operation

The furnace connection is effected by power plugs.

By operating the rocker switch from 0 to I ("device on") the readiness for operation of the tube furnace is established (indication by lighting up)
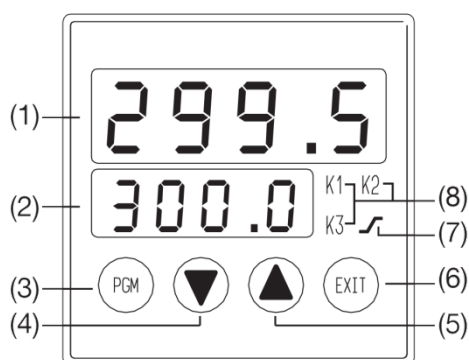
6. Controller

The furnace is equipped with a digital program controller dTRON 16.1.

<u>PID-controller type 703011 (dTRON 16.1)</u>

The controller was configured according to the furnace conditions. These values are not to be changed.

For operation, please read the user's manual. Please also pay attention to the following:

6.1   Displays and keys

(1) **Process value display**
   red, 10mm, 4 digits
(2) **Setpoint display**
   green, 7mm, 4 digits
(3) **PGM key**
   to select the parameters
(4) **Decrement key**
   to alter values
(5) **Increment key**
   to alter values
(6) **EXIT key**
   to quit the levels
(7) **LED for ramp/programme function**
   lights up when configured; green
(8) **LED for status indication**
   for outputs 1 to 3; yellow

6.2   Principle of operation

Generally, the following applies:

- Change to the next level with **PGM**

  (Press key for at least 2 sec!)

- Change to the next parameter with **PGM**

- Return to standard display with **EXIT**

6.3 Further hints for program operation

It is possible to implement a setpoint programme with up to 4 profile segments. The segment setpoints (SP00 — SP03) and the segment times (t00 — t03) are set at the operating level. The time base can be configured in seconds or minutes (max. segment time 9999 min.).
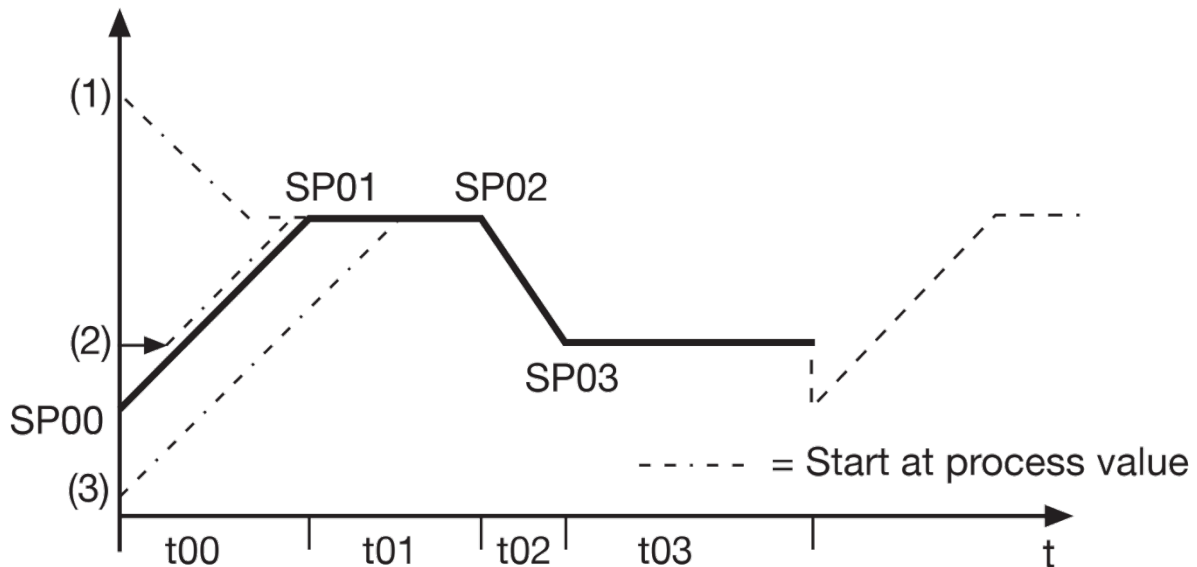
The programme starts at the process value, i. e. the profile is searched to find a setpoint which corresponds to the process value at the instant of start or power-on. ((1), (2), (3)). The profile then continues from this point. If the process value is outside the profile, a start is made at the first profile segment and the segment setpoint is then approached with the gradient of the first segment (positive or negative). The programme can either be run through once or repeated cyclically. In addition, a programme end signal can be output and the programme can be held.

Action on sensor break

On sensor break the programme is interrupted. The outputs act as for over-range or under-range (can be configured). When the fault has been rectified, the programme continues with the process value.

Action on power failure

When the supply is restored, the programme starts at the process value.

Programme stop

The programme is held by activating the programme stop via a logic input. The setpoint display flashes. After the programme stop has been de-activated, the programme continues with the setpoint at the time of the programme stop.

Re-starting the programme

- Re-start the programme with ▼ + ▲ or via the logic input

6.4   Self optimization

Self-optimisation determines the controller parameters for PID or PI controllers (for PI set dt=0!).

If there is a large deviation between process value and setpoint when SO is activated, a switching level is determined about which the process variable performs a forced oscillation during the SO procedure. The switching level is chosen so that the process value does not exceed the setpoint, if possible.
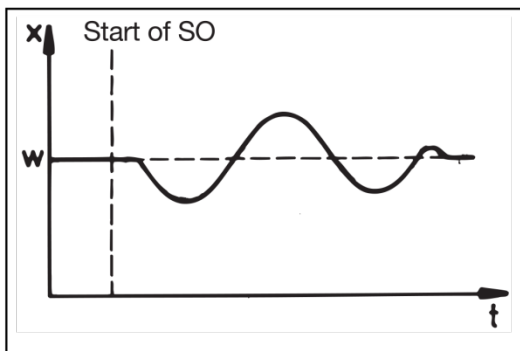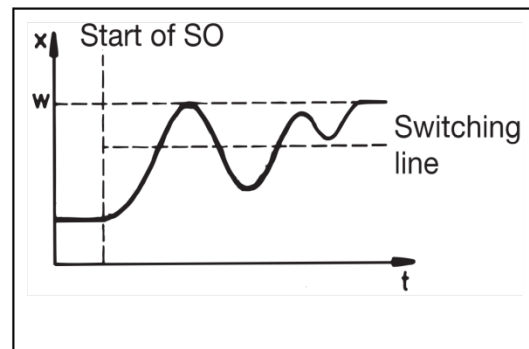
With a small deviation between setpoint and process value, e.g. when the control loop has stabilised, a forced oscillation about the setpoint is produced.

Starting self-optimisation

- Start SO with **EXIT**

  (hold down key for at least 2sec !)

- abort with **EXIT**

  (while self-optimisation is running)
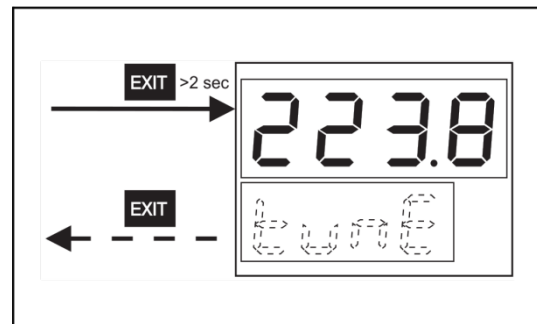
If "tune" does not flash any longer, self-optimisation is terminated and the controller functions with the parameters which have been established.

- Store the parameters with **EXIT**

  (Hold down key for at least 2 sec!)

Starting SO is not possible with active level inhibit.

The active parameter set is optimised.

With active ramp/programme function, the ramp/programme sequence is stopped during self-optimisation.

7. Maintenance

7.1 Furnace interior

Weekly clean-up of residues of heat treatment processes by using a vacuum cleaner

7.2 Contacts, wires, heating

Every 6 months check if connecting clamps are still fitted tightly, contact burn-offs, cable damages, damages on heat conductors.

7.3 Thermocouples

The thermocouple has to be checked every six months in regard to abrasion (high-temperature oxidation). If necessary, the thermocouple has to be exchanged.

7.4 Controllers

Check function and precision every 12 months.

8. Spare- and working parts

8.1 Heating module

Fibrothal-heating tube   2 pieces
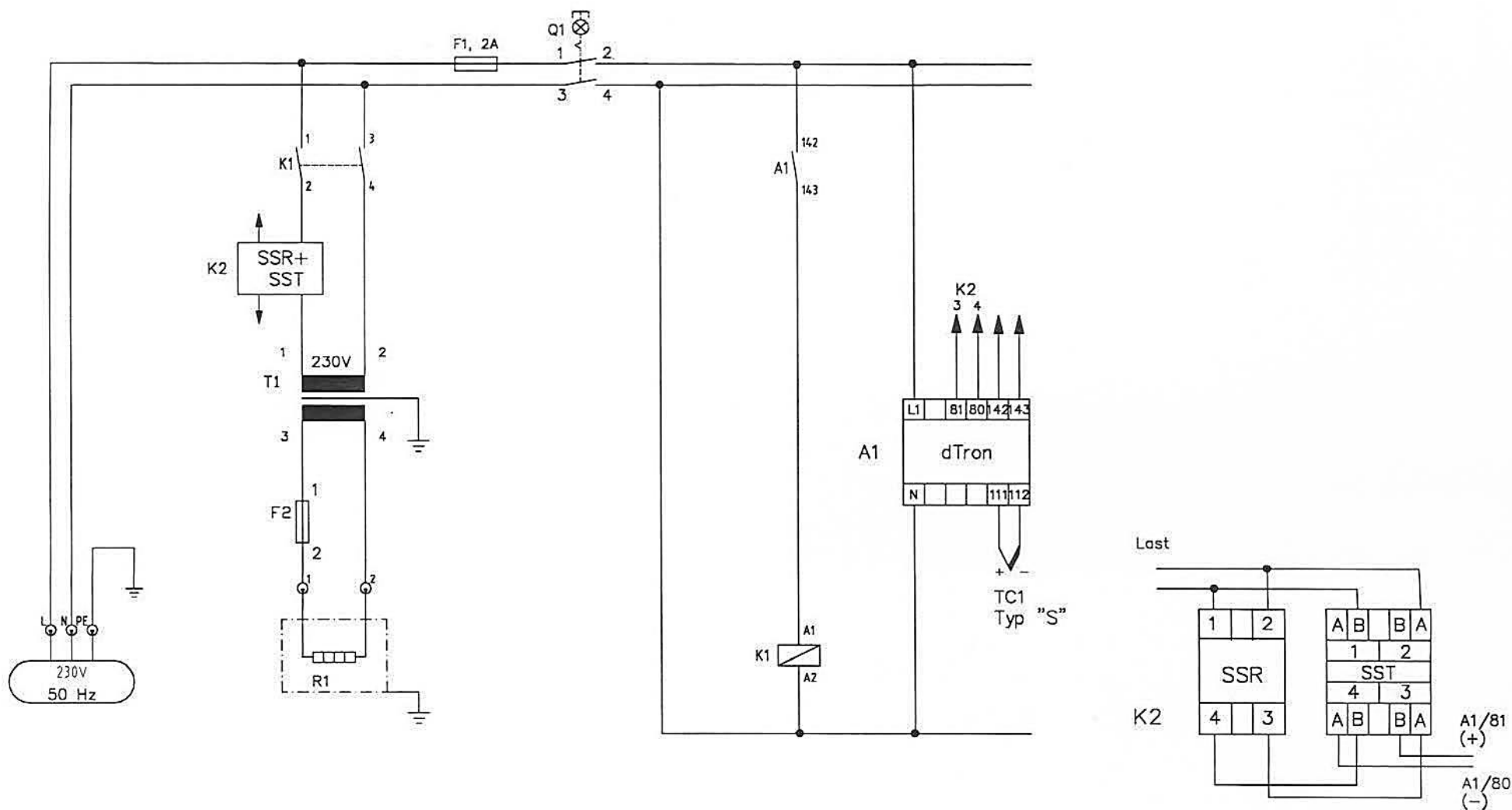RAC 40/200/860 W, 15 V

8.2 End discs

Fibrothal   outer ϕ 160 mm   2 pieces

                inner ϕ 40 mm

                  50 mm thick

8.3 Thermocouple

PtPh-Pt/ TB 08/6/S/1/EL 105/HL 30/C 799   2 pieces

8.4 Electronic devices

According to constructional selection temperature controller type dTRON 16.1

F1, 2A   Q1 ⊗
1   2
3   4

K1
1   3
2   4

K2   SSR+ SST

A1
142
143

K2
3 4

L1 81 80 142 143

A1   dTron

N   111 112

TC1
Typ "S"

1   230V   2
T1

3   4

F2
1
2

1   2
R1

230V
50 Hz

L N PE

A1
K1
A2

Last

SSR
1   2
4   3

A B   B A
1   2
SST
4   3
A B   B A

K2

A1/81
(+)

A1/80
(−)

Einspeisung	K1: Schütz F1: 2A ; Q1: Netzschalter	A1: Alarmrelaiskontakt	K2: Hlr+Softstartmodul
	T1: Trafo230V/15V	K1: Spulenanschluß	
	K2: SSR+SST		
	F2: 63A; R1: Ofenanlage	A1: Regler dTron 16.1	

			Datum	16.04.02		linn	FRH/V 1250	Regler dtron 16.1	=
			Bearb	C.Pappe		Elektro Therm		Zeichnungs Nr.	BLATT
Aenderung	Datum	Name	Gepr.		Urspr.	Ers.f.	Erst.d.		41.3518	FOLGE

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10. Temperature uniformity profile
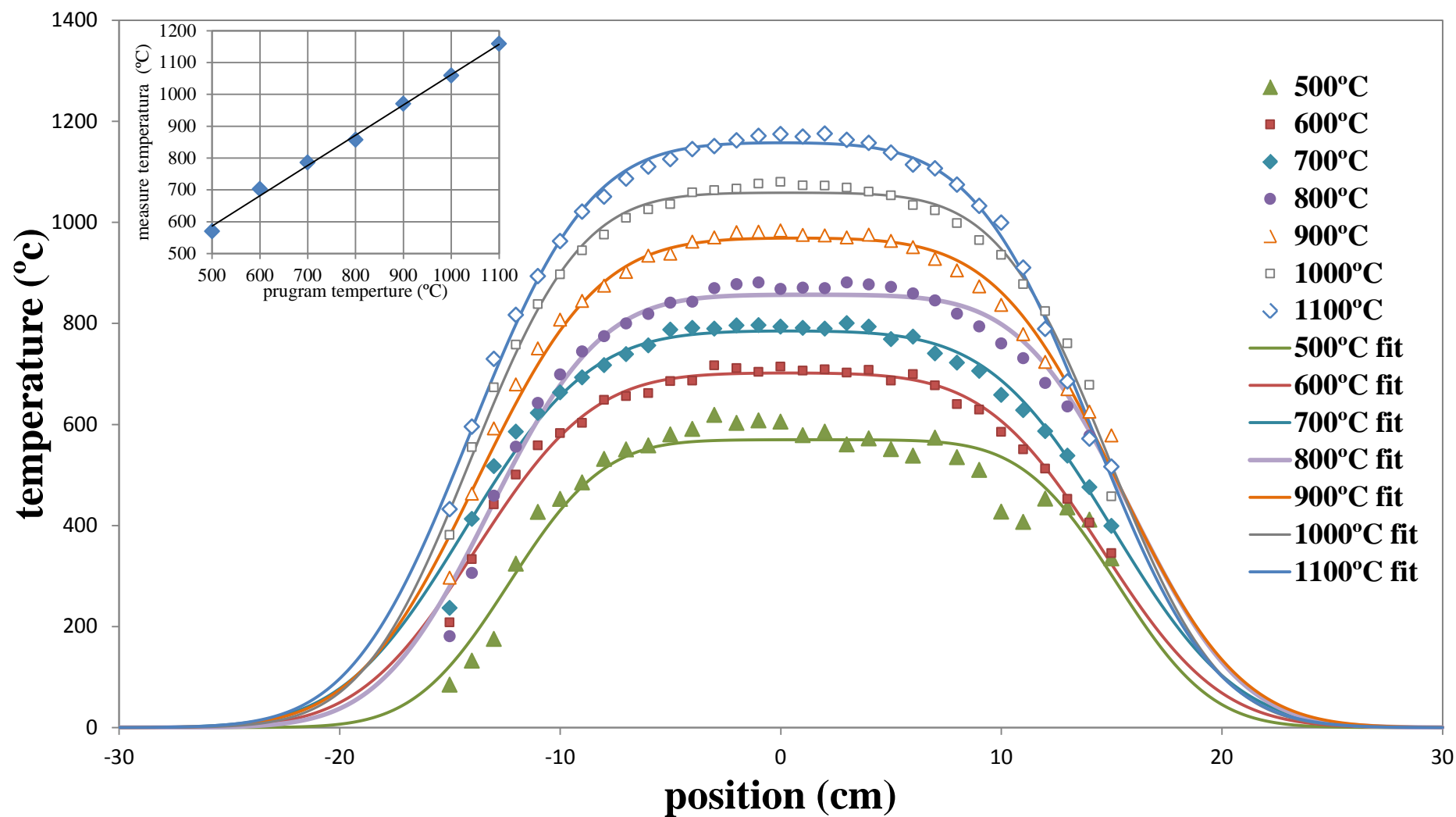
program temperature = 1.047 × target temperature - 112.62