Operating Instructions OI 2290

Celsitron baelz 2290
Electronic Constant Temperature Controller

Contents:

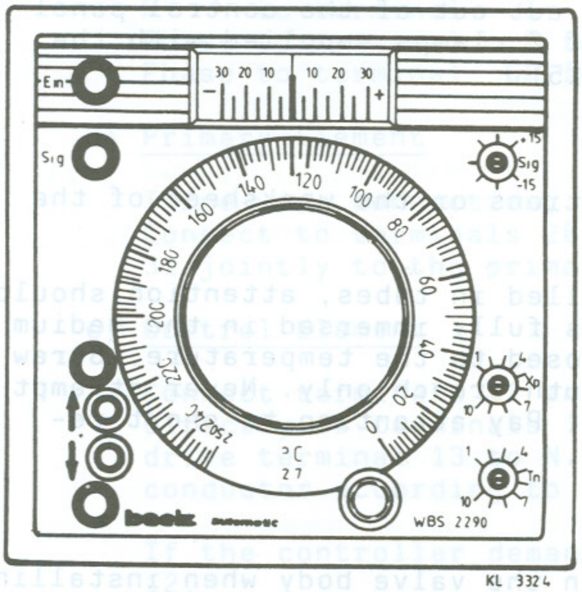

fig. 1: front view baelz 2290 with analog indication of deviation

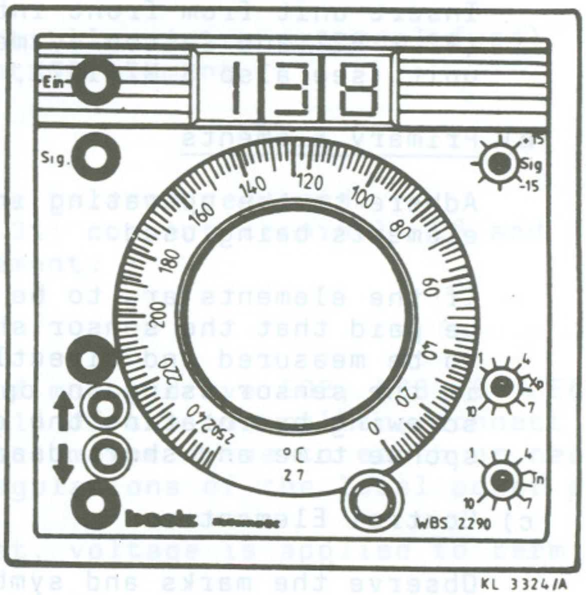

fig. 2 front view baelz 2290 with digital indication of actual value

Technical changes reserved!

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1. Application, Function

Unit for constant temperature control.
Its field of application is primarily in industrial plants. The controller is suitable for all heat and cooling control systems. Data acquisition is effected via primary elements of varying design for gaseous and liquid media.

The measured value of the controlled variable is compared with the setpoint and adjusted via a motorized control element with PI-behaviour.

The unit is so designed as to permit direct reading both of the deviation between setpoint and actual value and of the actual value as such.

The unit is inherently safe from the measuring circuit, i.e. the controller will give a closing command in case of failure of the measuring element ($R = \infty$). The closing command will also be given in case of a short circuit in the primary element transmitter ($R = 0$).

2. Assembly

a) baelz 2290

The controller is suited for front panel installation only. Insert unit from front into the cut-out of the control panel (92 x 92) and fasten by means of 2 clamps supplied with the unit (see also 3 MZ 1972, page 15).

b) Primary Elements

Adhere to the operating instructions or the worksheet of the elements being used.

If the elements are to be installed in tubes, attention should be paid that the sensor shaft is fully immersed in the medium to be measured and directly exposed to the temperature. Screw in the sensor using an open-mouth wrench only. Never attempt screwing by rotating the casing. Pay attention to short response time and short dead time.

c) Control Element

Observe the marks and symbols on the valve body when installing the control element. Refer also to the operating instructions and to the worksheet for the control element being used. Install as close to the consumer as possible.

d) Indicators (external)

According to operating instructions or worksheets of the indicators being used.

e) Setpoint variator (external)

According to operating instructions or worksheets of the variator being used.

3. Electrical Connection (refer to fig. 4)

a) The terminals with terminal connection diagram are located at the rear side of the unit.

b) Adhere to the rules as per VDE 0100 for installation. The measuring lines should be installed away from high voltage power cables. If this is not practicable (e.g. in case of cable conduits), we recommend to use shielded cables.

c) Power Supply

220 Volts, 50 to 60 cycles.
Connect unit to earth or neutral conductor according to the regulations of the local power plant.

Earth	to terminal	⏚
N	to terminal	1
Phase	to terminal	2 for controller (over external fuse)
Phase	to terminal	62 for control element

d) Primary Element

Three-wire connection; no line balance required.
Connect to terminals 28, 29, 31; connect terminals 29 and 31 jointly to the primary element.

e) Control Element

Connect terminals 12 and 14 of motor drive E02, E03, E4, E6 directly to terminals 12 and 14 of the controller; connect drive terminal 13 to N. Connect motor drive to earth or neutral conductor according to the regulations of the local power plant.

If the controller demands heat, voltage is applied to terminal 12.

If it is too warm, the voltage is on terminal 14.
In case of wrong direction of operation interchange the connections between controller and motor drive either at terminals 12, 14 of the controller or at teminals 12, 14 of the motor drive.

Please also see the operating instructions for the control element involved.

f) <u>Indicators</u> (external)

Actual value indicator to be connected to terminals 50 and 51. Connect indicator for deviation between setpoint and actual value to terminals 50 and 71.

g) <u>External Setpoint Variator</u>

Connect to terminals 44, 45 , 50. Connect slider to 44. Internal setpoint potentiometer must be disjoint.

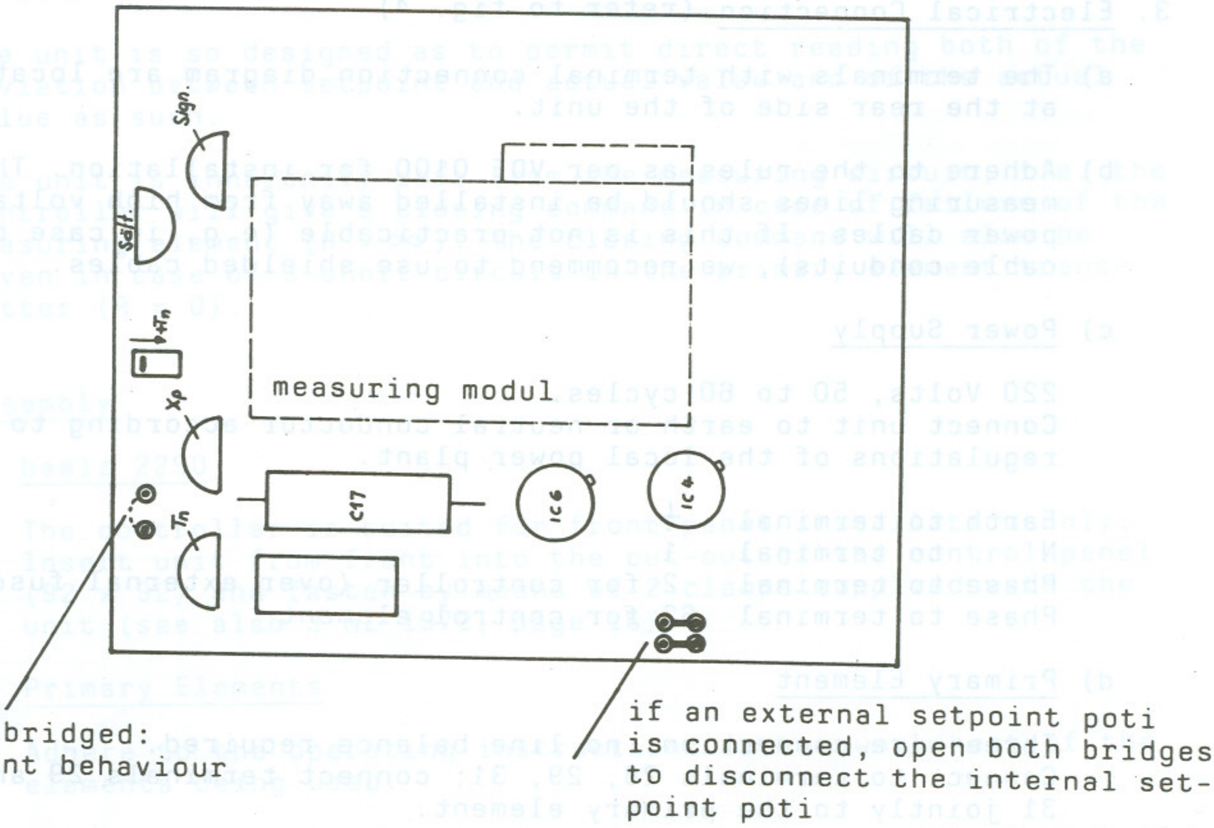


fig. 3: variator side of the right card

h) <u>Signal Output</u>

Potential-free changeover contact to terminals 58, 59, 60. Terminal 59 is the joint connection. The signal output is working by the static current principle, i.e. in case of overload the relay becomes deenergized.

<u>General:</u> If the equipment as per items f and g is not connected, the corresponding terminals remain free.

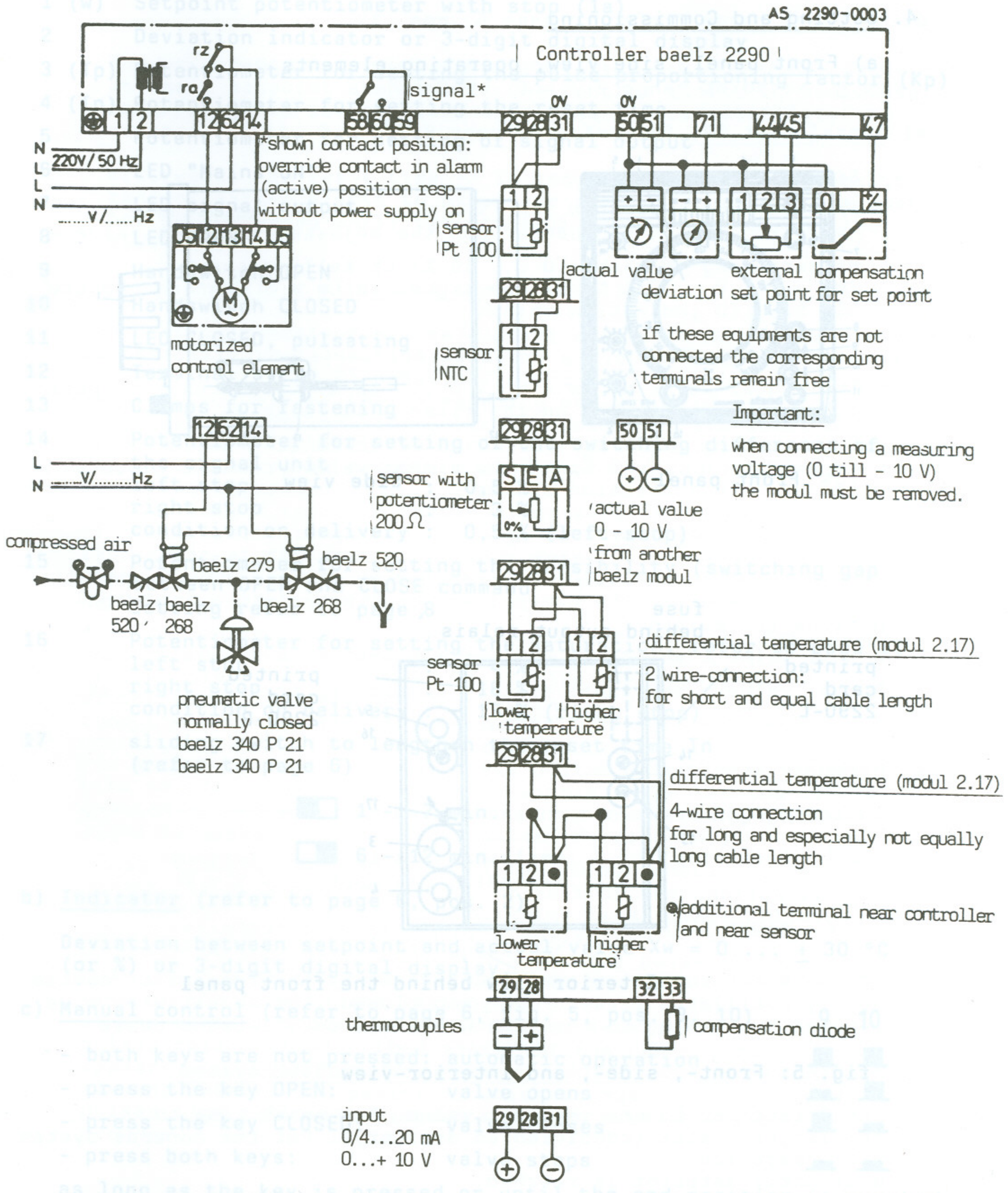
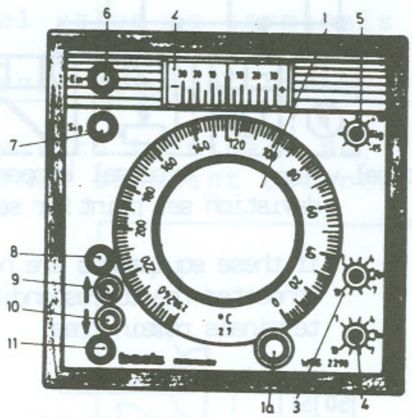


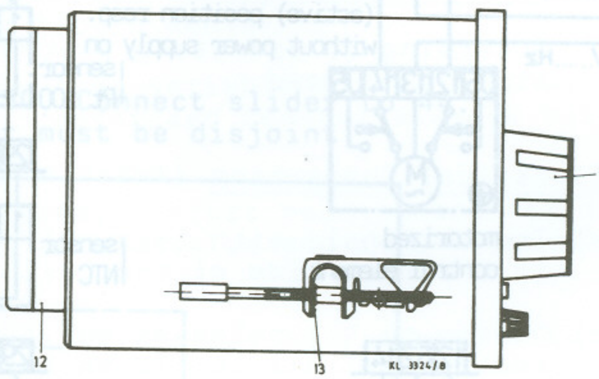
fig. 4: electrical connection

4. Setting and Commissioning

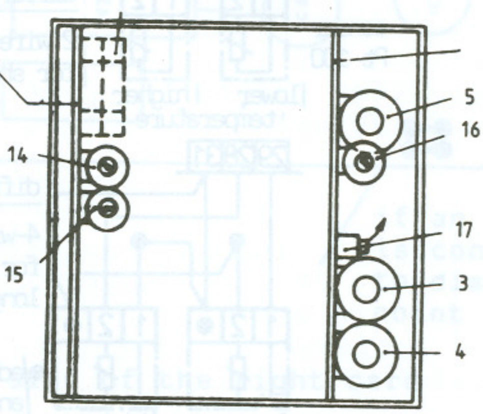
a) Front panel, side view, operating elements



Front panel



Side view



Interior view behind the front panel

fig. 5: Front-, side-, and interior-view

1 (w) Setpoint potentiometer with stop (1a)

2 Deviation indicator or 3-digit digital display

3 (Tp) Potentiometer for setting the pulse proportioning factor (Kp)

4 (Tn) Potentiometer for setting the reset time

5 Potentiometer for setting of signal output

6 LED "Mains ON"

7 LED signal output

8 LED OPEN

9 Handswitch OPEN

10 Handswitch CLOSED

11 LED CLOSED, pulsating

12 Terminal strip

13 Clamps for fastening

14 Potentiometer for setting of the switching difference of the signal unit
left stop : 0,5 %
right stop : 3 %
condition on delivery : 0,5 % (left stop)

15 Potentiometer for setting the sensibility (switching gap between OPEN and CLOSE command
Setting refer to page 8

16 Potentiometer for setting the saturation, refer to page 11
left stop : 4 %
right stop : 18 %
condition on delivery : 18 % (right stop)

17 sliding switch to lengthen the reset time Tn
(refer to page 6)
1 - 7 min.
6 - 12 min.

b) Indicator (refer to page 6, pos. 2)

Deviation between setpoint and actual value Xw = 0 ... ± 30 °C (or %) or 3-digit digital display.

c) Manual control (refer to page 6, fig. 5, pos. 9, 10) 9 10

- both keys are not pressed: automatic operation
- press the key OPEN: valve opens
- press the key CLOSED: valve closes
- press both keys: valve stops

as long as the key is pressed or until the end position is reached.

1) Remark. refer to page 11

d) Setpoint range (refer to page 6, pos. 1)

The individual setpoint ranges are determined via a code (e.g. setpoint range 2.7 = 0 - 250 °C).

e) Signal unit SA, SB (refer to page 6, pos. 5, 14)

- Signal unit SA:

  The set signal value W_s (W_s = W ± ... 15 %), adjustable by potentiometer (5), depends upon the adjusted setpoint value W.

  By exceeding (W_s = W + 0 ... 15 %) or falling short (W_s = W - 0 ... 15 %) of the signal value W_s : contact closure 58, 59, LED indication shines

- Signal unit SB:

  The signal value W_s (W = W_B ± 0 ... 15 %), adjustable by potentiometer (5), depends on the fixed base value W_B.

  By exceeding (W_s = W_B + 0 ... 15 %) or falling short (W_s = W_B - 0 ... 15 %) of the signal value: contact closure 58, 59, LED indication shines

f) Three point behaviour

The three point behaviour is produced by short circuiting the bridge 3P, whereby the controller supplies only 3 switch conditions (no pulses!).

Actual value $<$ setpoint: contact closure at terminals 62, 12

Actual value $>$ setpoint: contact closure at terminals 62, 14

Actual value = setpoint: contact 62, 12 and 62, 14 are open

g) Response sensitivity E:

Switching gap between open and closed commands:

↺	left stop 1:	smallest sensitivity = largest switching gap approx. ± 0,6 %
↻	right stop 10:	greatest sensitivity = smallest switching gap approx. ± 0,2 %

If the motor control element controlled by the controller continuously oscillates between open and closed, the sensitivity E is reduced by turning to the left until the oscillations cease.

h) Adaptation of the controller to the controlled system

Set P-range Xp to the smallest value. Set reset time to the largest value (condition on delivery). Put the control system into operation.
Wait until setpoint is reached.

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Reduce P-range Xp step by step and observe the control behaviour at small setpoint changes. If the control starts to oscillate, the P-range Xp is increased until the desired stability is reached.

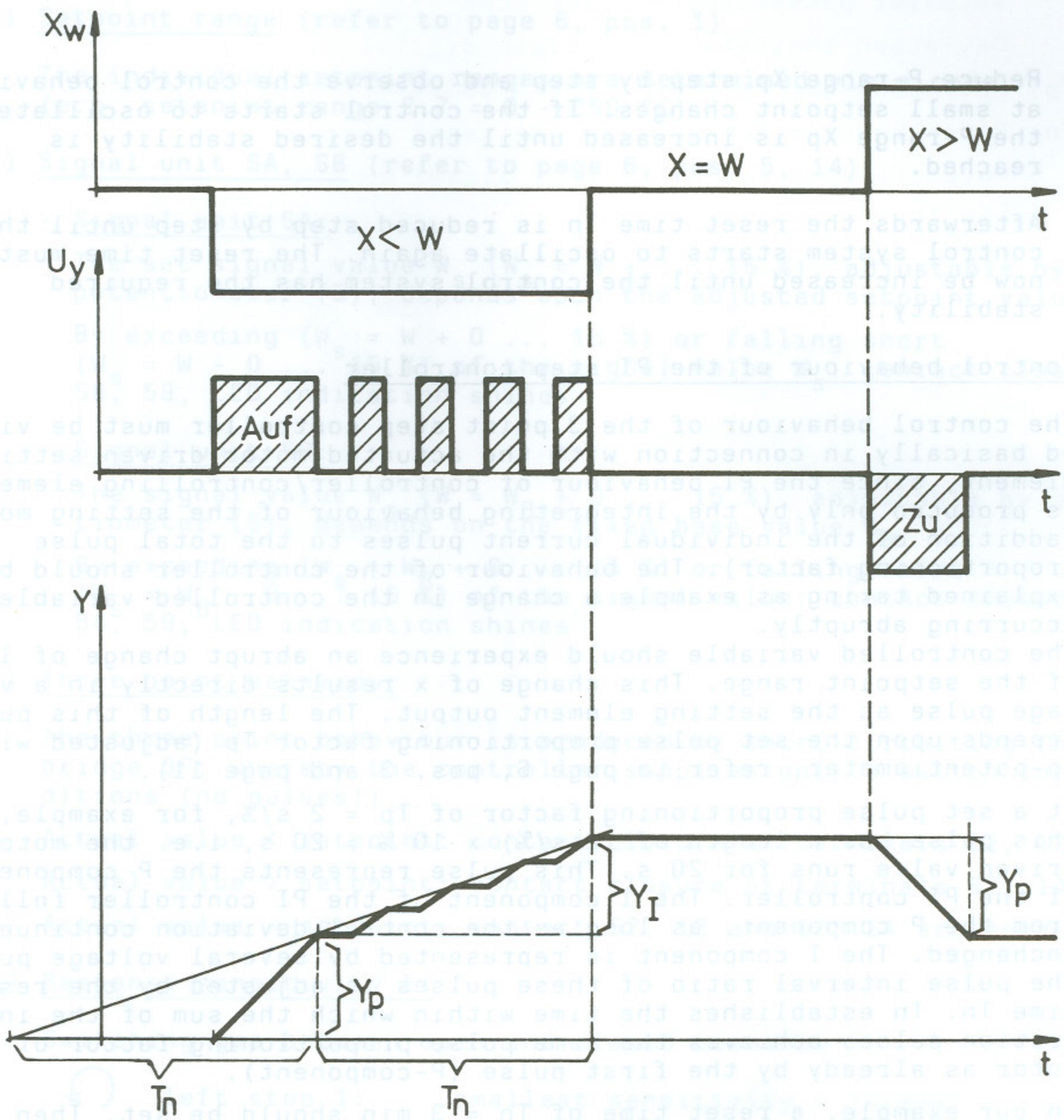
Afterwards the reset time Tn is reduced step by step until the control system starts to oscillate again. The reset time must now be increased until the control system has the required stability.

5. Control behaviour of the PI step controller

The control behaviour of the 3 point step controller must be viewed basically in connection with the actuated motor driven setting element, since the PI behaviour of controller/controlling element is produced only by the integrating behaviour of the setting motor (addition of the individual current pulses to the total pulse proportioning factor). The behaviour of the controller should be explained taking as example a change in the controlled variable x occurring abruptly.
The controlled variable should experience an abrupt change of 10 % of the setpoint range. This change of x results directly in a voltage pulse at the setting element output. The length of this pulse depends upon the set pulse proportioning factor Tp (adjusted with Xp-potentiometer, refer to page 6, pos. 3 and page 11).

At a set pulse proportioning factor of Tp = 2 s/%, for example, this pulse has a length of (2 s/%) x 10 % = 20 s, i.e. the motor driven valve runs for 20 s. This pulse represents the P component of the PI controller. The I component of the PI controller follows from the P component, as long as the control deviation continues unchanged. The I component is represented by several voltage pulses. The pulse interval ratio of these pulses is adjusted by the reset time Tn. Tn establishes the time within which the sum of the integration pulses achieves the same pulse proportioning factor of the motor as already by the first pulse (P-component).

In our example, a reset time of Tn = 3 min should be set. Then firstly at a control deviation of 10 % of the control range (setpoint range) a pulse of 20 s duration takes place. After that the control element is actuated with pulses the pulse-interval ratio of which is such that every 3 min so many pulses have occurred that the sum of the switchon times is the same as the switchon time of the first pulse lasting 30 s.
If the control deviation continues to exist, further integration pulses follow as described above. If the control deviation disappears, no further pulses follow, i.e. the motor driven setting element retains its position, which it has reached by the previous pulses. The following diagram shows an example for such a control process.



T_n = reset time

U_Y = Voltage at controller output (temperature)

Y = Stroke of control element

Y_P = Stroke initiated by P-behaviour (here 20 s pulse)

Y_I = Stroke initiated by I-behaviour (pulse-interval)

X_W = control deviation $X_W = X - W$

fig. 6: impulse behaviour of the PI controller

6. Remark for the relation between Xp, Kp, Tp, saturation:

Kp : gaine

Xp : P-range (refer to page 6, pos. 3)

Tp : pulse proportioning factor (refer to page 6, pos. 3)

saturation (refer to page 6, pos. 16) indicates a max. value of Xw, then continuous impulses follow.

The controlled variable can't be standardized because of the missing fixed feedback of the valve (control element). An auxiliary variable was adopted, which was defined as pulse proportioning factor Tp.

$$Tp \sim \frac{1}{Xp} \sim Kp$$

The pulse proportioning factor is inversed proportional to the P-range and is equivalent to the amplifier factor (proportional value) Kp.

For an optimal Xp the pulse proportioning factor Tp can be adjusted as follows:

$$Tp = \frac{1}{Xp} \times \frac{Y100}{Vy}$$

Y100 — valve stroke (mm)

Vy — setting speed of the valve (mm/sec.)

The setting range for Tp is dependent on the set saturation (refer to page 6, fig. 5, pos. 16).

set saturation	scale of Xp (Kp)	pulse proportioning factor Tp
18 %	1 (10) ... 10 (1)	8 sec./% Xw ... 1,2 sec./% Xw
4 %	1 (10) ... 10 (1)	45 sec./% Xw ... 6 sec./% Xw

7. Technical Data

Mains connection	220 V, + 10 %, - 15 %, 50/60 c/s
Mains fusing	1 A, internally or externally
Fuse output relais	3,15 A (internally)
Power input without control element	5 VA
Protection class	terminals IP00-housing IP42
Permissible ambient temperature	0 - 50 °C
Primary element	Pt 1 x 100 Ohm at 0 °C. Three-wire connection. No line balance required.
Output signal	220 V, 50 to 60 cycles I max. = 0,8 A Pulses for motor control element
Responsiveness	± 0,2 ... ± 0,6 % (setpoint range), internally adjusted to ± 0,4 %.
P-range Xp as pulse proportioning factor	1 - 10 = 45 - 6 sec./% at saturation = 18 % 1 - 10 = 8 - 1,2 sec./% at saturation = 4 %
Reset time Tn	1 - 10 = 1 - 7 min or 1 - 10 = 6 - 12 min (change-over possible through internal switch)

Indicator

Deviation between setpoint and actual value internally	0 ... ± 30 °C
Deviation between setpoint and actual value externally	0 ... + 20 % (500 mV/%)
Actual value externally	0 - 10 V
Weight	0,8 kg

8. Troubleshooting

a) Is the specified mains voltage being applied to terminals No. 1 and 2? LED (6) indicates "Mains ON".

b) Check primary element and its connection to the controller for interruptions and short-circuiting. (Test primary element with a resistance measuring bridge (cf. characteristic curve)). If the sensor is interrupted or short-circuited, the controller switches to "Close" in either case.

If the primary element is defective, the controller may be checked by connecting an equivalent resistance.

The zero-point of the controller must be obtained when setpoint and actual value are identical.

c) Is the control element alright?
Check in accordance with the corresponding operating instructions for proper electrical and mechanical functioning.

Important: Is the control valve seat and taper tight? Depending on the size of the leak a leaking control valve may cause temperature deviations from the setpoint and thus affect the controller result.

Is the dirt trap alright?

d) If you find the controller itself to be the cause for the trouble, a serviceman should be called or a replacement controller should be used.

9. Spare Parts

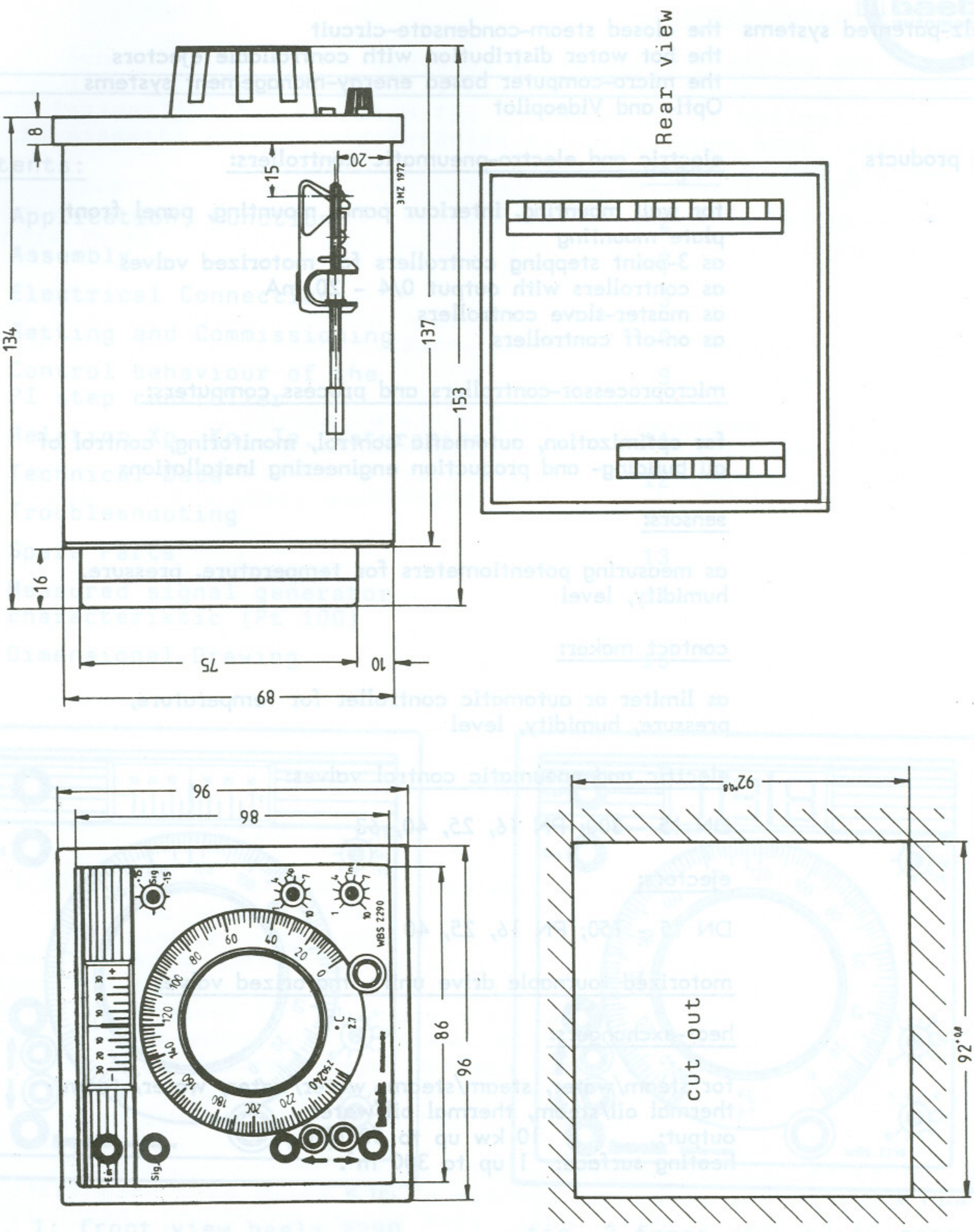
The unit consists of the following components:

1. Casing of black plastic material
2. Front frame
3. Left-side printed card - 2290-L with power supply, output relay and amplifier
4. Right-hand printed card - 2290-R with measuring bridge and feedback
5. Rear cover plate with terminals, transformer and signal relay 2290-U
6. Front panel made of aluminium with deviation indicator, setting potentiometer, 2 handswitches, 4 LED's, 3 parameter setting potentiometers (signal Xp, Tn) and printed board 2290-O
7. Front panel made of aluminium with digital display of actual value (3 digits), setting potentiometer, 2 handswitches, 4 LED's, 3 parameter setting potentiometers (signal, Xp, Tn) and printed board 2290 digital display 01 and 2290 digital display 02.

10. Characteristic Curve: Pt 100 Ohm at 0 °C acc. to DIN 43760

Temp. °C	Ohm	Temp. °C	Ohm	Temp. °C	Ohm	Temp. °C	Ohm
0	100,000	75	129,000	150	157,330	225	185,030
+ 1	100,390	76	129,382	151	157,704	226	185,394
2	100,780	77	129,764	152	158,078	227	185,758
3	101,170	78	130,146	153	158,452	228	186,122
4	101,560	79	130,528	154	158,826	229	186,486
5	101,950	80	130,910	155	159,200	230	185,850
6	102,340	81	131,290	156	159,542	231	187,214
7	102,730	82	131,670	157	159,944	232	187,578
8	103,120	83	132,050	158	160,316	233	187,942
9	103,510	84	132,430	159	160,688	234	188,306
10	103,900	85	132,810	160	161,060	235	188,670
11	104,290	86	133,188	161	161,432	236	189,034
12	104,680	87	133,566	162	161,804	237	189,398
13	105,070	88	133,944	163	162,176	238	189,762
14	105,460	89	134,322	164	162,548	239	190,126
15	105,850	90	134,700	165	162,920	240	190,490
16	106,240	91	135,080	166	163,292	241	190,854
17	106,630	92	135,460	167	163,664	242	191,218
18	107,020	93	135,840	168	164,036	243	191,582
19	107,410	94	136,220	169	164,408	244	191,946
20	107,800	95	136,600	170	164,700	245	192,310
21	108,188	96	136,980	171	165,150	246	192,674
22	108,576	97	137,360	172	165,520	247	193,038
23	108,964	98	137,740	173	165,890	248	193,402
24	109,352	99	138,120	174	166,260	249	193,706
25	109,740	100	138,500	175	166,630	250	194,130
26	110,128	101	138,880	176	167,000	251	194,492
27	110,516	102	139,260	177	167,370	252	194,854
28	110,904	103	139,640	178	167,740	253	195,216
29	111,292	104	140,020	179	168,110	254	195,578
30	111,680	105	140,400	180	168,480	255	195,940
31	112,065	106	140,778	181	168,850	256	196,302
32	112,452	107	141,156	182	169,220	257	196,664
33	112,838	108	141,534	183	169,590	258	197,026
34	113,224	109	141,912	184	169,960	259	197,388
35	113,610	110	142,290	185	170,330	260	197,750
36	113,996	111	142,668	186	170,700	261	198,110
37	114,382	112	143,046	187	171,070	262	198,470
38	114,768	113	143,424	188	171,440	263	198,830
39	115,154	114	143,802	189	171,810	264	199,190
40	115,540	115	144,180	190	172,180	265	199,550
41	115,926	116	144,558	191	172,548	266	199,910
42	116,312	117	144,936	192	172,916	267	200,270
43	116,698	118	145,314	193	173,284	268	200,630
44	117,084	119	145,692	194	173,652	269	200,990
45	117,470	120	146,070	195	174,020	270	201,350
46	117,856	121	146,446	196	174,388	271	201,710
47	118,242	122	146,822	197	174,756	272	202,070
48	118,628	123	147,198	198	175,124	273	202,430
49	119,014	124	147,574	199	175,492	274	202,790
50	119,400	125	147,950	200	175,860	275	203,150
51	119,784	126	148,326	201	176,228	276	203,508
52	120,168	127	148,702	202	176,596	277	203,866
53	120,552	128	149,078	203	176,964	278	204,224
54	120,936	129	149,454	204	177,332	279	204,582
55	121,320	130	149,830	205	177,700	280	204,940
56	121,704	131	150,206	206	178,068	281	205,298
57	122,088	132	150,582	207	178,436	282	205,656
58	122,472	133	150,958	208	178,804	283	206,014
59	122,856	134	151,334	209	179,172	284	206,372
60	123,240	135	151,710	210	179,540	285	206,730
61	123,624	136	152,086	211	179,906	290	208,520
62	124,008	137	152,462	212	180,272	295	210,300
63	124,392	138	152,838	213	180,638	300	212,080
64	124,776	139	153,214	214	181,004	310	215,620
65	125,160	140	153,590	215	181,370	320	219,160
66	125,544	141	153,964	216	181,736	330	222,680
67	125,926	142	154,338	217	182,102	340	226,200
68	126,312	143	154,712	218	182,468	350	229,700
69	126,696	144	155,086	219	182,834	360	233,190
70	127,080	145	155,460	220	183,200	370	236,670
71	127,464	146	155,834	221	183,566	380	240,150
72	127,848	147	156,208	222	183,932	390	243,610
73	128,232	148	156,582	223	184,298	400	247,070
74	128,616	149	156,956	224	184,664		

11. Dimensional Drawing



3 MZ 1972

fig. 7: dimensional drawing

Baelz delivery program for production installations and building technology

Experiences	Baelz-Automatic handles since more than 70 years with heat technology and 50 years with control technology.
Baelz-patented systems	the closed steam-condensate-circuit the hot water distribution with controllable ejectors the micro-computer based energy-management systems Opti- and Videopilot
Our products	<u>electric and electro-pneumatic controllers:</u>

for wall mounting, interiour panel mounting, panel front plate mounting
as 3-point stepping controllers for motorized valves
as controllers with output 0/4 - 20 mA
as master-slave controllers
as on-off controllers

<u>microprocessor-controllers and process computers:</u>

for optimization, automatic control, monitoring, control of all building- and production engineering installations

<u>sensors:</u>

as measuring potentiometers for temperature, pressure, humidity, level

<u>contact maker:</u>

as limiter or automatic controller for temperature, pressure, humidity, level

<u>electric and pneumatic control valves:</u>

DN 15 - 300; PN 16, 25, 40, 63

<u>ejectors:</u>

DN 15 - 150; PN 16, 25, 40

<u>motorized tournable drive units, motorized valves</u>

<u>heat-exchangers:</u>

for steam/water, steam/steam, water/water, water/steam, thermal oil/steam, thermal oil/water
output: 10 kw up to 50 MW
heating surface: 1 up to 300 m².

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