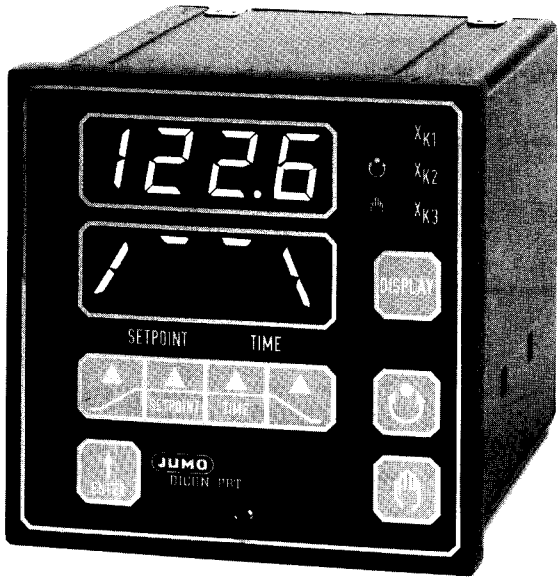
JUMO

MEASUREMENT AND CONTROL

JUMO DICON PRT Microprocessor Programm Controller

Housing to DIN 43 700 for flush panel mounting Bezel 96 x 96 mm



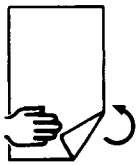
D 95.645

2.93/V 74089

Operating Instructions

M. K. JUCHHEIM GMBH & CO · W-6400 Fulda · Germany · Moltkestrasse 13–31
P.O. Box 1209 · Phone (06 61) 60 03-7 26 · Fax (06 61) 60 03-508 · Teletex 6619726

Please fold out this page
for reference
when using the
Operating Instructions



CONTENTS

1 DESCRIPTION

The JUMO DICON PRT is a program controller, size 96 x 96 mm. The unit has a depth of only 121.5 mm due to its state-of-the-art design, including SMD technology. It can be operated as single or double setpoint controller, as modulating controller, or as proportional controller. Three relay outputs are available as control, limit comparator or operating contacts depending on the control mode selected.
The operating and limit comparator contacts can be used to actuate additional functions such as "fan on", "solenoid valve on", "feed off" etc. while the program is running. The program controller has a 4-digit numerical display and a 4-character alphanumerical display. It is designed for direct operation from resistance thermometers in 3-wire or 4-wire circuit, thermocouples, and current or voltage signals. A self-calibrating input circuit ensures a very high class accuracy.
Input of the program does not require any special knowledge of programming. Only the three program sections of the program are entered with the keys. The control parameters can be entered with the membrane keys, called up at any time, and freely amended. Interactive operation leads to a dialogue between the user and the controller.
The program controller can be integrated into a data system through a V.24(RS232C) or RS422/485 interface.
Two external inputs for program stop, start, fast forward or programming/key block are provided. The unit is of modular construction and therefore particularly convenient to operate and service.

Design features of the controller

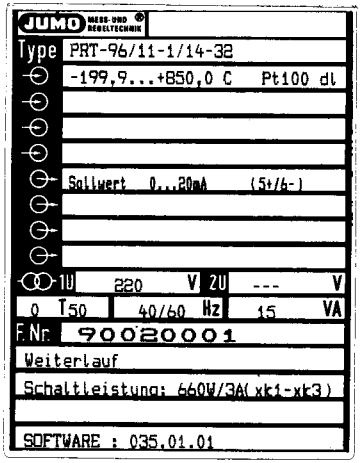
- Simple and user-friendly operation through clear separation of the functions
  - OPERATE
  - PARAMETERS
  - CONFIGURE
- Blockable levels to protect against unintentional changes
- Bright self-luminous displays:
  - 4-digit numerical LED display
  - 4-character alphanumerical LED display
- Operation through membrane keys
- Single-setpoint or double-setpoint controller, modulating controller or proportional controller
- Inputs for thermocouples, resistance thermometers, resistance transmitters and current or voltage signal
- Two external inputs for stop / start / key block / programming block / fast forward run
- Three outputs provided as standard for control contacts / limit comparators / operating contacts as relay, current, voltage or semiconductor relay output
- Interface V.24 (RS232C) or RS422/485, fully isolated (option)
- Self-optimisation for single setpoint, double setpoint and proportional controller
- Two isolated analogue outputs on proportional controller/process/setpoint/ operating contact (option)
- Supply for 2-wire transmitter, fully isolated

1.1 Type designation

The instrument label is affixed to the housing. It contains all the data on the controller function, the signal inputs and extra codes. The mains supply must agree with the supply voltage on the label.

PRT-96 / . . - . / . . - . . . - . .

- Program controller bezel 96 x 96 mm
- Controller function
- Limit comparator
- Operating contacts
- External inputs
- Interface
- Analogue outputs



Controller function

Description	Code
none	0
Single-setpoint controller with max. contact (relay de-energised for process above setpoint)	1
Single-setpoint controller with min. contact (relay de-energised for process below setpoint)	2
Double-setpoint controller	3
Modulating controller	4
Proportional controller	5

Limit comparators

Description	Code
no limit comparator	0
1 limit comparator	1
2 limit comparators	2
3 limit comparators (proportional controller only)	3

Operating contacts

Description	Code
no operating contacts	0
1 operating contact	1
2 operating contacts	2
3 operating contacts (proportional controller only)	3

External inputs

Description	Code
Stop / start	11
Stop / key block	12
Stop / programming block	13
Stop / fast forward	14
Start / key block	15
Start / programming block	16
Start / fast forward	17
Key block / fast forward	18
Programming block / fast forward	19

Interface

Description	Code
V.24 (RS232C)	24
RS422/485	26

Analogue outputs[1)]

Description	Code
Process output	31
Setpoint output	32
Logic output	33
Output 1 process and output 2 setpoint[2)]	34

Analogue outputs[1)]

Description	Code
Output 1 process and output 2 logic[2)]	35
Output 1 setpoint and output 2 logic[2)]	36
Output 1 logic and output 2 logic[2)]	37

Additional options[3)]

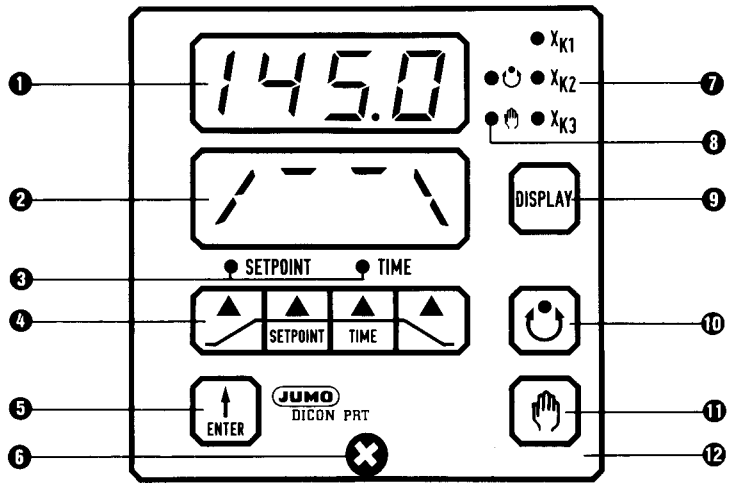
Logic output instead of relay or semiconductor relay output instead of relay.

[1)] only one analogue output available with built-in interface

[2)] on on-off controllers only

[3)] specify in full

1.2 Displays and controls



1 Numerical display
4-digit LED display for process, setpoint, residual time, and the parameter values during programming

2 Alphanumerical display
4-character LED display for profile and parameter symbols

3 LEDs
for setpoint and time

4 Increment keys
for data input

5 ENTER key
for entering inputs, selection of parameter and configuration level

6 Fixing screw
for program controller chassis

7 LEDs
for the switched outputs

8 LEDs
for automatic and manual operation

9 Display key
for changing the display

10 Auto start/stop key

11 Changeover to manual operation

12 Membrane keys:
front has protection IP 54

Programs

1

Program sections per program

3

Ramps

programmed by time or gradient

Program run time

1 min – 9999 h per program section

Program repeat

single run or cyclic repeat

Data input

simple input through interactive operator guidance

Displays

4-digit numerical LED display for process, setpoint, residual time and the parameter variables during programming.

4-character alphanumerical LED display for diagram and parameter symbols.

Self-optimisation

on single-setpoint and double-setpoint controller and proportional controller during manual operation

Controller for use with resistance thermometers

Input

Pt 100, Pt 500
in 3-wire or 4-wire circuit

Range (°C or °F)

−200+850.0°C

Line adjustment

not required with 3-wire or 4-wire circuit. When using a resistance thermometer in 2-wire circuit it is necessary to provide line adjustment. The line adjustment can be made through an external line adjustment resistor. $R_{adjustment} = R_{line}$.

Controller for use with thermocouples

Input

Cu-Con U (T), Fe-Con L (J), NiCr-Ni K, Pt10Rh-Pt S, Pt13Rh-Pt R, Pt30Rh-Pt6Rh B or MoRe5-MoRe41 to IEC or ISA

Ranges (°C or °F)

Cu-Con U
−200+ 600°C

Cu-Con T
−200+ 400°C

NiCr-Ni K
−200+1400°C

Pt13Rh-Pt R
0+1800°C

MoRe5−MoRe41
0+1990°C

Fe-Con L
−200+ 900°C

Fe-Con J
−200+ 900°C

Pt10Rh-Pt S
0+1800°C

Pt30Rh-Pt6Rh B
0+1820°C

Isolation

50 V
signal input from analogue output and analogue outputs from each other

Temperature compensation

normally internal;
external also available (to special order)

Controller for use with linearised transducers with current or voltage signal

Input

0 – 1 mA	Ri = 50 Ω
0(4)−20 mA	Ri = 2.5 Ω
0 −10 mV	Ri = 100 kΩ min.
0 – 1 V	Ri = 50 kΩ
0 −10 V	Ri = 500 kΩ

Indication range

relationship between value and voltage (current) can be configured

Controller for use with non-linearised transducers with current or voltage signal

Input

as for linearised transducers with current or voltage signal

Indication range

relationship between value and voltage (current) can be configured

Controller for use with resistance transmitters

Input

range: 0−30 Ω min., 0−10 kΩ max.; adjusted with keys at the configuration level, see Item 7.3

Indication range

determined at the configuration level

Outputs

3 switching outputs and up to 2 **fully isolated** analogue outputs (option) are available (can be used as control, limit comparator or operating contacts).

1. relay outputs with floating contact;
   rating: 660 W 3 A at 220 V 50 Hz, resistive load;
   contact life: approx. 10^6 operations at rated load
2. logic output 0/5 V or 0/20 mA, Ri = 240 Ω
3. semiconductor relay output
   220 V 50 Hz 1 A, p.f. 0.7 min.
4. analogue output
   (configuration from 0–20 mA to 4–20 mA set at the factory)

		burden
0 – 20 mA	/4 – 20 mA	500 Ω max.
can be changed to:		
– 20/0/ + 20 mA/ – 12/0/ + 20 mA		500 Ω max.
0 – 10 V	/2 – 10 V	500 Ω min.
– 10/0/ + 10 V	/ – 6/0/ + 10 V	500 Ω min.

Resolution of D/A converter
13 bit

Accuracy of output signal
0.25 % or better

General controller data

Controller type
single-setpoint or double-setpoint controller, modulating or proportional controller

Feedback
PD, PID, PI, P or PD/PID action

A/D converter
resolution 14 bit

Update rate
0.2 sec for process

Controller accuracy	ambient temperature error
when used with resistance thermometers and resistance transmitters	
0.05 % max.	0.01 % max. per 10°C
when used with thermocouples within working range	
0.25 % max.	0.05 % max. per 10°C
when used with linearised transducers with current signal	
0.05 % max.	0.05 % max. per 10°C
voltage signal 0–10 mV	
0.02 % max.	0.1 % max. per 10°C
voltage signal 0–1(10) V	
0.05 % max.	0.05 % max. per 10°C
These values include the linearisation tolerances.	

Signal circuit monitor
on sensor break or short-circuit all control outputs become inactive.
- The limit comparator relays and operating contacts drop out.
- The alarm relay moves to a defined setting.
- Program run stops.

Action after supply failure
normally continue or stop

Data back-up
through lithium battery,
Varta Type CR1/3N SLF,
life 5 years min.; nominal voltage 3 V

Supply
normally 220 V, +10 % –15 %, 40–60 Hz,
can be changed by internal solder links to
110 V, +10 % –15 %, 40–60 Hz;
other voltages to special order

Loading
15 VA approx.

Supply for 2-wire transmitter
20 V 40 mA, **fully isolated**

Electrical connection
through faston connectors to DIN 46 244/A, 4.8 x 0.8 mm

Permitted ambient temperature range
0 to 50°C

Permitted storage temperature range
–40 to +70°C

Climatic conditions
Class KWF to DIN 40 040,
relative humidity not exceeding 75 %
annual mean, no condensation

Housing
aluminium extrusions, black anodised,
with plug-in controller chassis (connected to ground)

Protection
to DIN 40 050
front IP 54
rear IP 20

Operating position
unrestricted

Weight
1200 g approx.

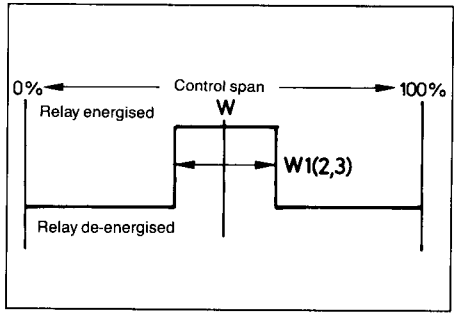
Limit comparators

The controller is provided with up to 3 limit comparators, depending on the model. The desired limit comparator function, the setpoint and the switching differential are adjustable at the configuration level.

Functions limit comparator lk1 to lk8

❶ Limit comparator lk1

Relay is energised when the process is within selected window, de-energised when the process is outside the window.
Adjustable window width: ±9999 digits

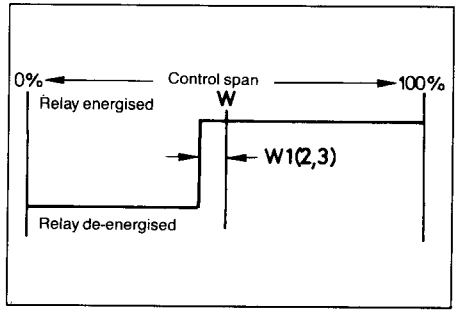


❷ lk2 as lk1

but relay action reversed

❸ lk3 low alarm contact only

Relay is de-energised when process is below alarm level.
Adjustable contact spacing: −9999 digits

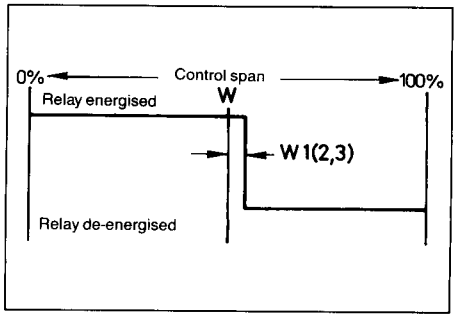


❹ lk4 as lk3

but relay action reversed

❺ lk5 high alarm contact only

Relay is de-energised when process is above alarm level.
Adjustable contact spacing: +9999 digits

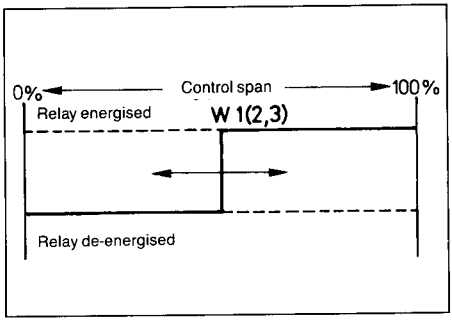


❻ lk6 as lk5

but relay action reversed

❼ Ik7 adjustable over the full control span
Relay is energised when process is above limit.
Adjustment range: ±9999 digits

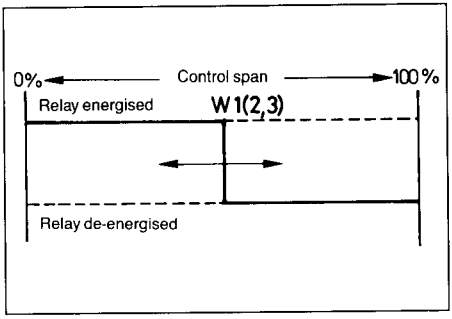
❽ Ik8 as Ik7
but relay action reversed



Alarm functions (relay X_{k3})

❾ Ik9 adjustable over the full control span
Relay is energised on failure or short-circuit of sensor.
Adjustment range: ±9999 digits

❿ Ik10 as Ik9
but relay action reversed



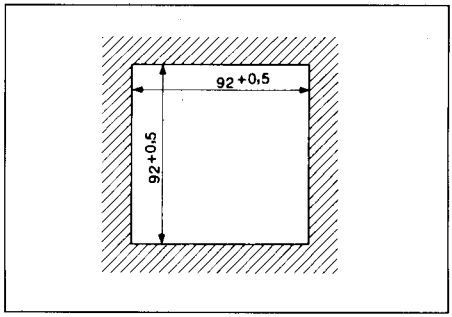
Limit comparator output
relay with floating changeover contact

Rating
660 W 3 A at 220 V 50 Hz, resistive load

Switching differential
X_d adjustable within the range 0.1–999.9 digits

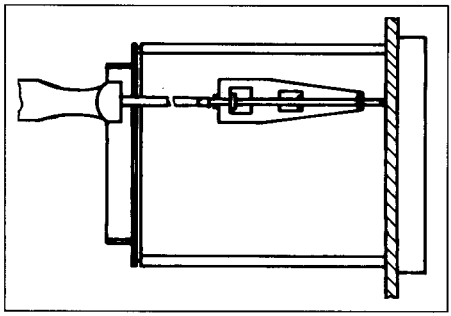
3.1 Location and climatic conditions

The instrument location should as far as possible be free from vibrations. Stray electro-magnetic fields, e.g. from motors, transformers etc., should be avoided. The ambient temperature at the instrument location should be between 0 and 50 °C at a relative humidity not exceeding 75 %. Corrosive air or fumes reduce the life of the instrument.

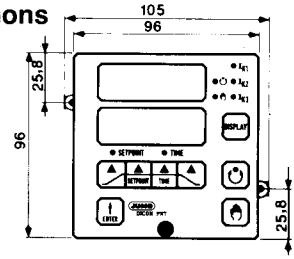


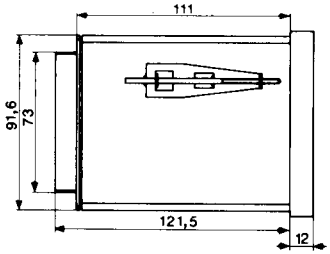
3.2 Fitting in position

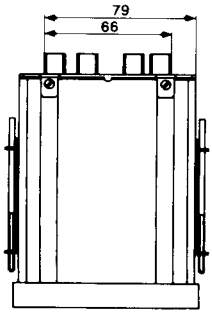
Insert the program controller from the front into the panel cut-out. From the rear of the panel slide the mounting brackets into the cut-outs at the sides of the housing. The flat sides of the brackets must lie against the housing. The brackets are then placed against the rear of the panel and tightened up evenly with a screwdriver.



3.3 Dimensions



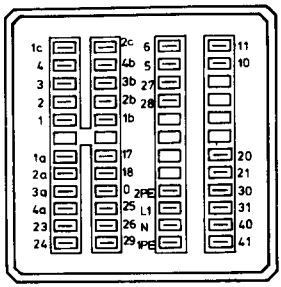




4 ELECTRICAL CONNECTION

The electrical connections are made in accordance with the connection diagram below. The choice of cable and the connection of the supply line must meet the requirements of VDE 0100 "Regulations on the Installation of Power Circuits with nominal voltages below 1000 V" or the appropriate local regulations.

Illustration on the right:
Rear view with faston connectors
to DIN 46 244/A, 4.8 x 0.8 mm



4.1 Connection diagram

Connection for		Terminals				
Analogue output 1		5 + 6 –				
Analogue output 2		27 + 28 –				
			Relay output	Semiconductor relay output	Logic output 0/5 V or 0/20 mA	
Relay or semiconductor relay or logic outputs	1	Xk1	20 (P) pole 21 (S) n.o. (closing)	20 21	20 + 21 –	
	2	Xk2	30 (P) pole 31 (S) n.o. (closing)	30 31	30 + 31 –	
	3	Xk3	40 (P) pole 41 (S) n.o. (closing)	40 41	40 + 41 –	
Voltage supply for 2-wire transmitter			11 + 10 – 20 V / 40 mA			
Supply as on label			L1 line N neutral 1 PE protective ground 2 PE connection for screen			
Serial interface RS232 (V.24)		RxD	23	Received data (receiving line)		
		TxD	25	Transmitted data (transmitting line)		
		CTS	24	Clear to send		
		RTS	26	Request to send (switch on transmitter)		
		GND	29	Signal ground		
Serial interface RS422		A(+) B(–)	23 24	Received data (receiving pair)		
		A(+) B(–)	25 26	Transmitted data (transmitting pair)		
		GND	29	Signal ground		
Serial interface RS485		A(+) B(–)	25 26	Transmitted/received data (transmitting/receiving pair)		
		GND	29	Signal ground		

* Contact protection circuit 22 nF, 56 Ω

** Varistor protection circuit 300 V

Input	Terminals			
Thermocouple	t	1 – 4 +		
Resistance thermometer in 3-wire circuit	w	1 2 3		
Resistance thermometer in 4-wire circuit	w...vl	1 2 3 4		
Voltage or current	e	1 – 2 +		
Resistance transmitter with 3-wire connection	w...wfg	1 2 3	S = slider E = end A = start	
External input 1	E 1	17 0		
External input 2	E 2	18 0		

4.2 Important notes on installation

- ☐ The choice of cable, the installation, and the connection to the supply must meet the requirements of VDE 0100 "Regulations on the Installation of Power Circuits with nominal voltages below 1000 V" or the appropriate local regulations.
- ☐ Work inside the unit must only carried out to the extent described and, like the electrical connection, only by qualified technicians.
- ☐ The unit must be isolated on both line and neutral from the supply when there may be contact with live components during work[1].
- ☐ An internal fuse or a current limiting resistance interrupts the supply circuit in case of a short-circuit. The external fuse of the supply should not exceed a value of 1 A (slow). In order to avoid welding of the contacts in the output relay in case of an external short-circuit in the load circuit, the latter has to be fused according to the maximum relay current[2].
- ☐ In addition to faulty installation, it is possible for incorrect settings on the controller (setpoint, data of parameter and configuration level, alterations inside the unit) to interfere with correct operation of the controlled process or cause damage. It is therefore important to provide always safety features independent of the controller, e.g. overpressure valves or temperature limiters/monitors, and ensure that setting is possible only by qualified technical personnel. Please observe the appropriate safety requirements in this connection. Adaptation (self-optimisation) cannot be expected to handle all possible control loops and unstable parameter configurations are theoretically possible. The process value reached should therefore be checked for its stability.
- ☐ There must be no magnetic or electrical fields in the neighbourhood of the instrument, e.g. due to transformers, radio telephones, or electrostatic discharges.
- ☐ Inductive loads (relays, solenoid valves etc.) should not be installed near the instrument and should be fitted with RC modules for interference suppression.
- ☐ In case of a very "noisy" supply (e.g. thyristor controls) the JUMO instrument should be fed through an isolating transformer.
- ☐ Supply fluctuations are permitted only within the limits of the voltage range indicated.
- ☐ Input, output and supply lines should be run separately and not parallel to each other. Out and return lines should be run next to each other and twisted together if possible.
- ☐ Screened and twisted cables should be used for sensor and interface lines. Do not run them close to current-carrying components or cables. The screen should only be grounded at one end at the controller (terminal 2PE or PE on the back panel).
- ☐ Ground the instrument to the ground line at terminal PE. This line should have the same cross-section as the supply lines. Run the ground lines to a common grounding point in a star-shaped layout, and connect this grounding point to the supply ground conductor. Do not loop the ground lines, i.e. do not run them from one instrument to the next.
- ☐ Do not connect any further loads to the supply terminals of the instrument.
- ☐ The instrument is not suitable for installation in areas subject to explosion hazard.

---

1) On instruments with removable chassis, the chassis is isolated from the supply when it is pulled out of the case.

2) Technical data

5.1 Levels and blocks

For clearer identification of the large number of possible programming inputs the controller parameters are arranged at three distinct levels: operating level, parameter level and configuration level.

Operating level

In the base status the top display shows the process and the bottom display the horizontal centre segments. During automatic operation the bottom display indicates in addition the program profile. The display key can be used to indicate the setpoint and the residual program time.

Parameter level

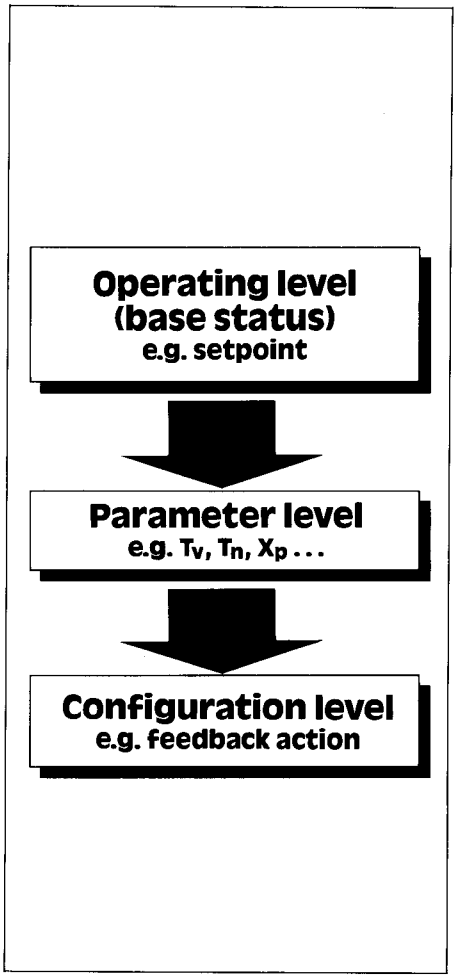
On this level the controller can be matched to the process. The individual parameters are displayed sequentially as value and symbol.

Configuration level

The factory settings can be displayed and partly modified (see Chapter 7).

Internal switches are used to set whether the controller operates with the factory-set data of the configuration level when it is connected to the supply, or whether the data input by the user are used (see Chapter 9).

The three levels can be blocked by internal switches (see Chapter 9).



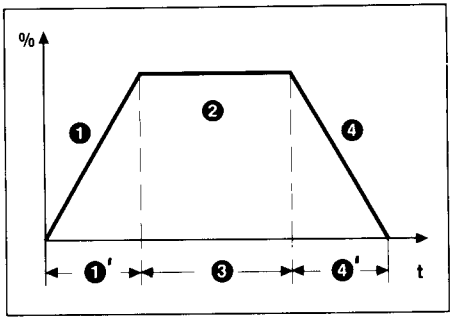
Level	Blockage	Controller data
Operating level	Access possible	Adjustment by user
Parameter level	Access possible	Set at the factory; user changes possible
Configuration level	Blocked at the factory	Set at the factory; some user changes possible

5.2 Program input

The control range is shown on the instrument label. Setpoints outside the set range are not accepted. The display is flashing with the permitted value.

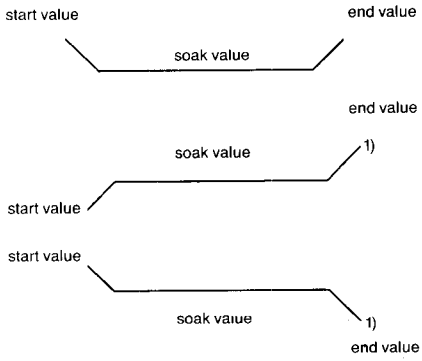
The following program parameters are input:

❶ Up ramp (gradient) or
❶' Up ramp (time)
❷ Soak value
❸ Soak time
❹ Down ramp (gradient) or
❹' Down ramp (time)

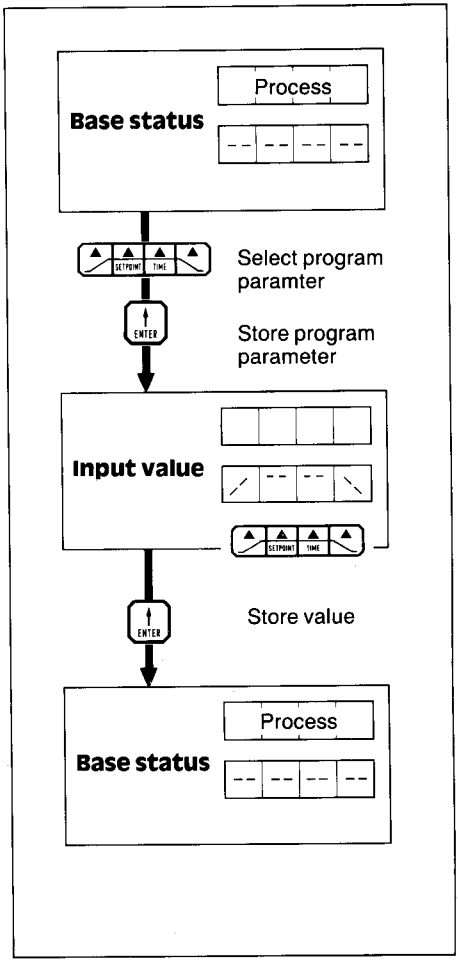


Examples of the setpoint profile

The following setpoint profiles can be realised through the appropriate programming of the start and end value (in UV 09, C 195, C 196):



1) The display shows the reversed ramp



Program settings by switches on the CPU card (see page 34)

programmed	
start temp./current process	S 302.1
program repeat	S 302.2
programming of time or gradient	S 302.3
decimal places of gradient	S 302.4/5
time base of soak phase	S 302.6
time base of up and down ramps	S 302.7

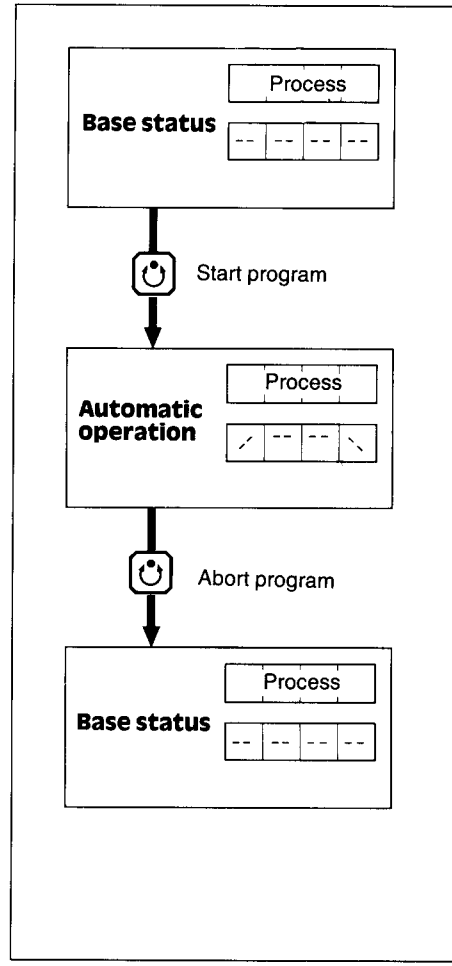
Data check and data correction of setpoint profile

The data check is performed in the same way as the programming of the setpoint profile. If required the values for up ramp / soak value / soak time / down ramp are simply overwritten.

5.3 Automatic operation

5.3.1 Program start and abort

The program can be started and aborted at any time with the "auto" key.



Program stop

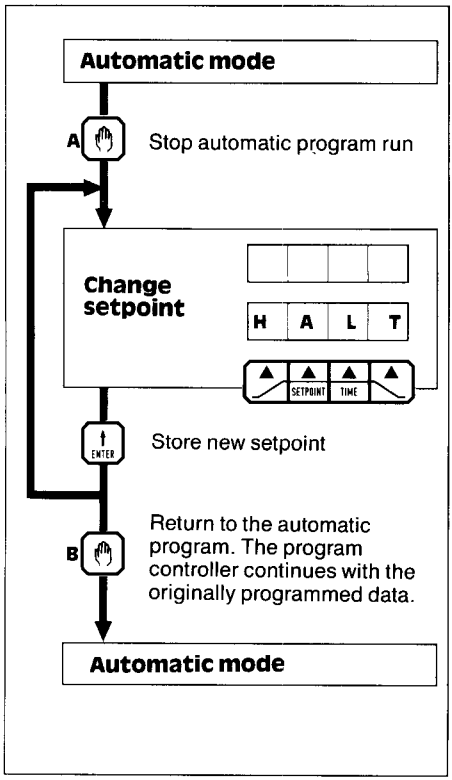
The program can be stopped at any time with the "Hand" key.
Static changes can then be made (see Item 5.3.3.).

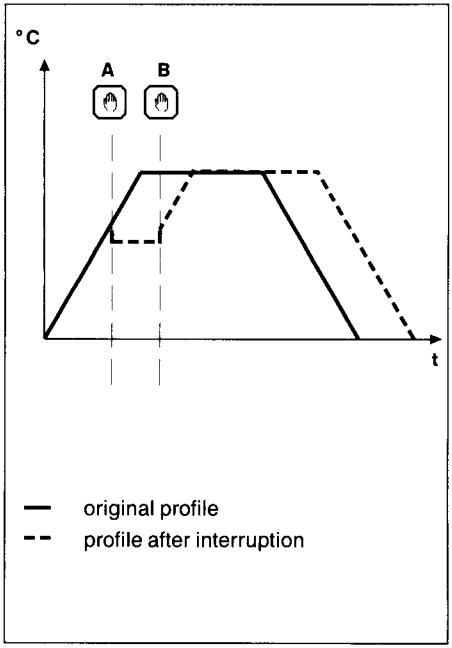
5.3.2 Displays during automatic operation

The process is displayed during automatic operation. Setpoint and residual running time can be displayed during the program run by pressing the "DISPLAY" key.

5.3.3 Static changes

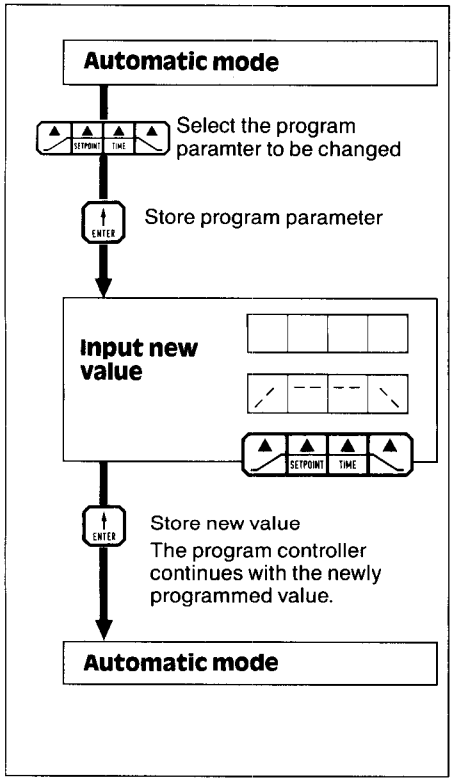
The program is stopped at any point with the "Hand" key. In this operating status the setpoints can be altered.
These values are retained until the "Hand" key is operated again and the instrument returns to the automatic program. The remaining program is then processed with time offset.
The changes are not stored so that the original values are again used when the program is started again.

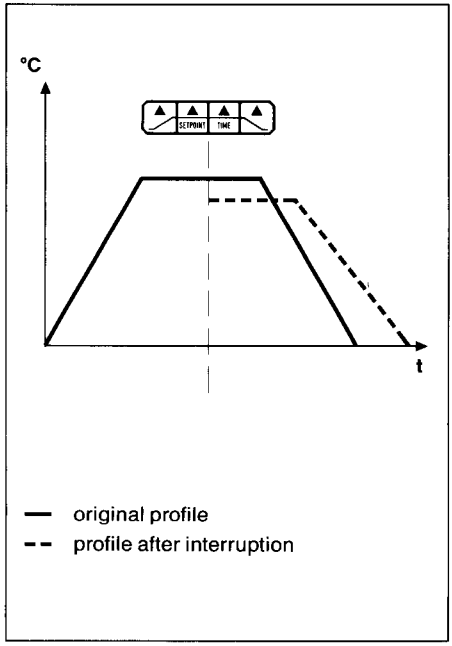




5.3.4 Temporary changes

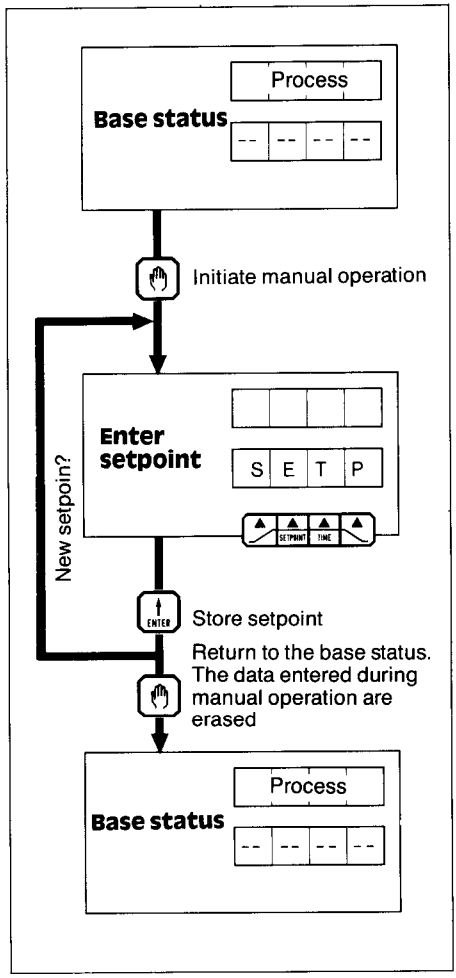
In this operating mode it is possible to change program parameters of the current program. The required program parameter is selected with the increment keys.
The changed value is entered with the "ENTER" key.



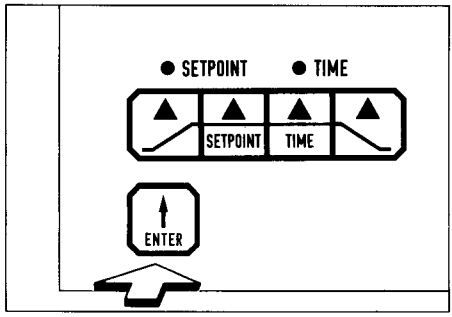


5.4 Manual operation

During manual operation fixed setpoints can be set and controlled manually.
Manual operation is initiated with the "Hand" key, the LED "Hand" lights up.
The setpoint is input with the increment keys.
The input is stored with the "ENTER" key.
On pressing the "Hand" key the program controller returns to the base status. The data entered during manual operation are erased.



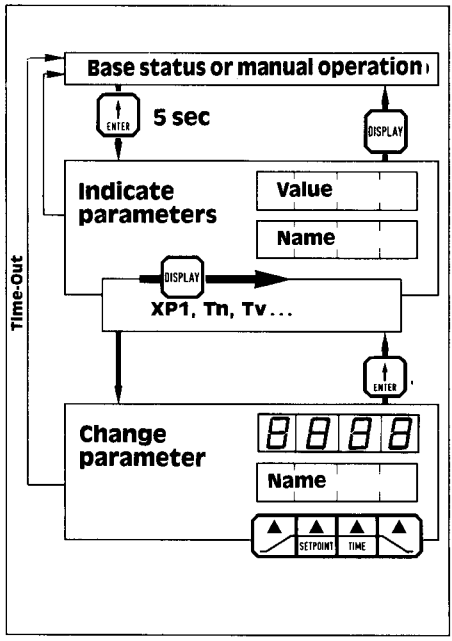
Access to the parameter level is obtained by pressing the "ENTER" key for 5 seconds.
It can be selected from the base status or from manual operation.
Access to the parameter level is only possible if the level is unblocked and if the data transfer of the factory-set parameters is switched off (see Chapter 9).



6.1 Displaying and changing parameters

The parameters are called up in sequence with the "DISPLAY" key. The parameters of the individual controller versions are listed in the Parameter Table alongside. After the last parameter the controller automatically returns to the standard display. When one of the increment keys is pressed for changing the parameter, the parameter name (e.g. Tv, Tn) flashes in the bottom display. After the changed value has been stored with "ENTER", further parameters are displayed with "DISPLAY".
In case of inappropriate inputs the top display shows the minimum or maximum value permitted.

All the controller parameters of the parameter table on the next page are indicated (" ■ " and "—"). In accordance with the controller version and the feedback structure, inputs are accepted only on " ■ ", inputs on "—" are not accepted.



6.2 Parameter table

Single-setpoint controller

Symbol	Parameter	Feedback action				Adjustment range[2]	Factory setting[2]
		none[1]	PD	PID	PD/PID		
XP	Proportional band	—	■	■	■	Xp = 0 – 9999 digit	0 digit
XD	Differential	■	—	—	—	Xd = 0 – 999.9 digit	1.0 digit
TV	Derivative time	—	■	—*	■	Tv = 1 – 999 sec	80 sec
TN	Reset time	—	—	■	■	Tn = 1 – 9999 sec	350 sec
CY	Cycle time	—	■	■	■	Cy = 0.1 – 99.9 sec	20.0 sec
Y1	Max. valve stroke	—	■	■	■	Y1 = 0 – 100 %	100 %

Double-setpoint controller

Symbol	Parameter	Feedback action				Adjustment range[2]	Factory setting[2]
		none[1]	PD	PID	PD/PID		
XP1	Proportional band (heating contact)	—	■	■	■	Xp1 = 0 – 9999 digit	0 digit
XP2	Proportional band (cooling contact)	—	■	■	■	Xp2 = 0 – 9999 digit	0 digit
XSH	Contact spacing	■	■	■	■	XSh = 0 – 999.9 digit	0 digit
XD1	Differential (heating contact)	■	—	—	—	Xd1 = 0 – 999.9 digit	1.0 digit
XD2	Differential (cooling contact)	■	—	—	—	Xd2 = 0 – 999.9 digit	1.0 digit
TV	Derivative time	—	■	—*	■	Tv = 1 – 999 sec	80 sec
TN	Reset time	—	—	■	■	Tn = 1 – 9999 sec	350 sec
CY1	Cycle time (heating contact)	—	■	■	■	Cy1 = 0.1 – 99.9 sec	20.0 sec
CY2	Cycle time (cooling contact)	—	■	■	■	Cy2 = 0.1 – 99.9 sec	20.0 sec
Y1	Max. valve stroke	—	■	■	■	Y1 = 0 – 100 %	100 %
Y2	Min. valve stroke	—	■	■	■	Y2 = 0 to – 100 %	– 100 %

Modulating controller

Symbol	Parameter	Feedback action				Adjustment range[2]	Factory setting[2]
		none[1]	PI	PID	—		
XP	Proportional band	—	■	■	—	Xp = 0 – 9999 digit	0 digit
XSH	Contact spacing	■	■	■	—	XSh = 0 – 999.9 digit	0 digit
XD	Differential	■	—	—	—	Xd = 1 – 999.9 digit	1.0 digit
TN	Reset time	—	■	■*	—	Tn = 1 – 9999 sec	350 sec

Proportional controller

Symbol	Parameter	Feedback action				Adjustment range[2]	Factory setting[2]
		P	PI	PD	PID		
XP	Proportional band	■	■	■	■	Xp = 0 – 9999 digit	100 digit
TV	Derivative time	—	—	■	■	Tv = 1 – 999 sec	80 sec
TN	Reset time	—	■	—	■	Tn = 1 – 9999 sec	350 sec
Y1	Max. valve stroke	■	■	■	■	Y1 = 0 – 100 %	100 %
Y2	Operating point	■	—	■	—	Y2 = 0 – 100 %	50 %

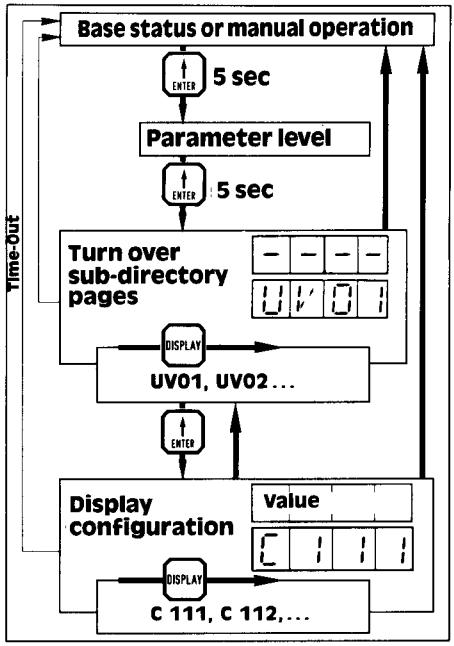
■ adjustable ▭ factory setting * $T_v = T_n/4.5$ [1] Xp = 0 means "feedback switched off"

[2] all parameters with "digit" have to be multiplied as follows: x0.1 when using 1 decimal place, x0.01 when using 2 decimal places etc.

7.1 Displaying configuration data

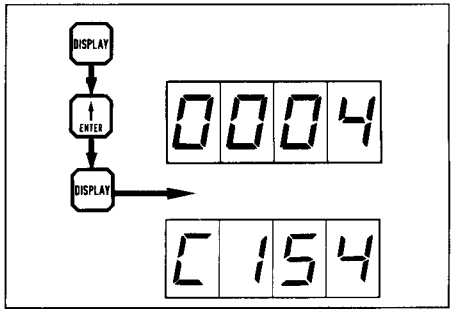
The configuration level can be accessed from the base status and the manual operation through the parameter level.
The configuration data are divided into nine sub-directories UV01–09.
The step "Turn pages of sub-directory" permits rapid location of a configuration code.

Access to the configuration level is only possible if this level is unblocked and if the data transfer of the factory-set parameters is switched off (see Chapter 9).



Example:

Which feedback structure is shown in the alphanumerical display at Code 154?
Turn pages up to sub-directory UV05 (using the "DISPLAY" key); after pressing "ENTER" and "DISPLAY" the display might be as shown alongside. As seen from the configuration table, the number 4 in the top display represents the feedback structure PD/PID. After pressing "DISPLAY" the pages of the subsequent sub-directories are turned over.

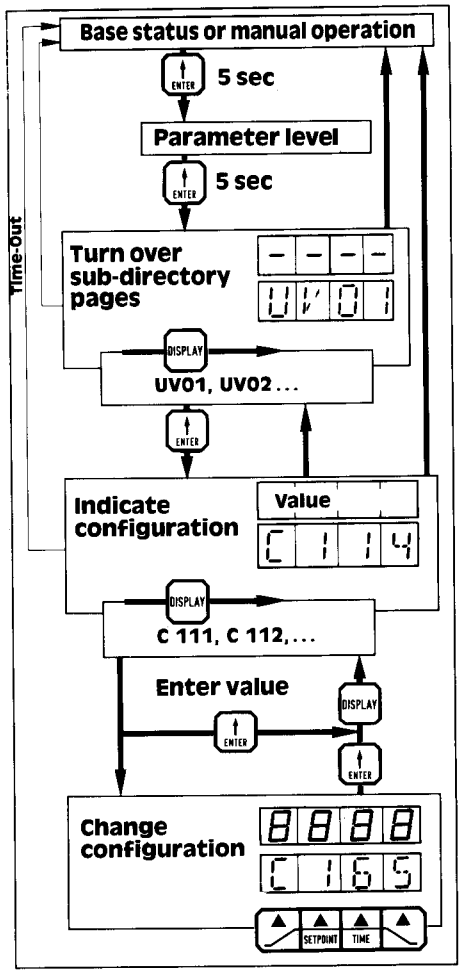


7.2 Changing configuration data

Many changes in configuration data also require adjustment of other parameters. If, for example, the feedback action is changed, the control parameters must also be altered. If a parameter is omitted this would result in an undesirable or faulty control action.

Select configuration parameter, change it if necessary, and enter the input with "ENTER". Following an incorrect input the top display flashes and requests correction of the input. On pressing "DISPLAY" the next parameter is indicated.
The status as supplied from the factory can always be restored by reading in the factory-set parameters (see Chapter 9, Data Transfer).

In Sub-directory UV06, changing the limit comparator function Ik results in a request for the input of the parameters "Ik switching differential" and "Ik value", as shown by the operator guidance (both displays flashing).



7.3 Configuration tables

Values which can be configured are marked by shading.

UV01	Input					
C 111	Function	process	1	0	0	0
C 112	Transducer	resistance thermometer Pt 100 (500*) thermocouple resistance transmitter with 3-wire connection current 0 – 20 mA or voltage 0 – 10 V*) current 4 – 20 mA *) if provided in hardware	 1 2 4 5 6	 0 0 0 0 0	 0 0 0 0 0	 0 0 0 0 0
C 113	Linearisation	linear – 1999 to + 9999 digit Pt 100(500*) – 199.9 + 850.0°C Fe-Con L – 200 + 900 °C NiCr-Ni K – 200 + 1400 °C Pt10Rh-Pt S 0 + 1800 °C Pt13Rh-Pt R 0 + 1800 °C Pt30Rh-Pt6Rh B 0 + 1820 °C Cu-Con U – 200 + 600 °C MoRe5-MoRe41 0 + 1990 °C Cu-Con T – 200 + 400 °C Fe-Con J – 200 + 900 °C *) if provided in hardware			 1	0 1 2 3 4 5 6 7 8 9 0
C 114	Selection °C/°F	temperature °C temperature °F	0 0	0 0	0 0	0 1
C 115	Decimal place	no decimal place one decimal place two decimal places*) three decimal places*) *) only possible with C113 = 0	0 0 0 0	0 0 0 0	0 0 0 0	0 1 2 3

UV02 Scale with resistance transmitter and current input			▲	▲	▲	▲
C 122	Minimum setpoint	range to DIN IEC	x'	x'	x'	x'
C 123	Maximum setpoint	range to DIN IEC	x'	x'	x'	x'
C 124[1)]	Start of range process		x	x	x	x
C 125[1)]	End of range process		x	x	x	x

x: input within range
x': indication as specified in order
[1)] only with current, voltage and resistance transmitter inputs
Standard setting: start of range 0 digit, end of range 100 digit. Other ranges can be selected.
☐ = can be configured

UV03 Customer correction of process variable to Item 10.2			▲	▲	▲	▲
C 131	Customer correction to Item 10.2	X0 input	x	x	x	x
C 132	(factory setting X0 = 0 and X1 = 1)	X1 input	x	x	x	x
C 139	Measured values for programmed indication Not programmable (see Item 10.2)	X0' input 1 0	x'	x'	x'	x'
C 13A		X1' input 1 100	x'	x'	x'	x'

x: input within range
x': indication according to change in C 131 and C 132
☐ = can be configured

UV04	Analogue outputs					
C 141	Function output 1	no function	0	0	0	0
		process x	0	0	0	1
		setpoint w	0	0	0	2
		control deviation xw	0	0	0	3
		controller output Y	0	0	0	5
		logic output (operating contact)	0	0	0	6
C 142[1]	Calibration output 1	value at 0 % output signal (signal start)	x'	x'	x'	x'
C 143[1]		value at 100 % output signal (signal end)	x'	x'	x'	x'
C 144	Signal output 1[2]	0 – 20 mA[2]	0	0	0	0
		4 – 20 mA[2]	0	0	0	1
C 145	Function output 2	no function	0	0	0	0
		process x	0	0	0	1
		setpoint w	0	0	0	2
		control deviation xw	0	0	0	3
		controller output Y	0	0	0	5
		logic output (operating contact)	0	0	0	6
C 146	Calibration output 2	value at 0 % output signal (signal start)	x'	x'	x'	x'
C 147		value at 100 % output signal (signal end)	x'	x'	x'	x'
C 148	Signal output 2[2]	0 – 20 mA	0	0	0	0
		4 – 20 mA	0	0	0	1

[1] not on proportional controller
[2] only if set in hardware, see Chapter 9
x' = indication as order specification

UV05	Controller setting		▲	▲	▲	▲
C 152	Controller type	proportional controller with falling characteristic	0	0	0	0
		proportional controller with rising characteristic	0	0	0	1
		single-setpoint controller with max. contact (relay de-energised for process above setpoint)	0	0	0	2
		single-setpoint controller with min. contact (relay de-energised for process below setpoint)	0	0	0	3
		double-setpoint controller	0	0	0	4
		modulating controller	0	0	0	5
C 153	Stroke period (on modulating controller)	range: 15 – 600 sec standard setting: 60 sec	x	x	x	x
C 154	Feedback action[2]	P	0	0	0	0
		PI	0	0	0	1
	[2] The feedback action is only effective for proportional band Xp ≠ 0	PD	0	0	0	2
		PID	0	0	0	3
		PD/PID	0	0	0	4

x = input within range
☐ = can be configured

UV06	Limit comparators or operating contacts		▲	▲	▲	▲
C 161	Limit comparator or operating contact relay 1[1]	no function	0	0	0	0
		function lk1	0	0	0	1
		function lk2	0	0	0	2
		function lk3	0	0	0	3
		function lk4	0	0	0	4
		function lk5	0	0	0	5
		function lk6	0	0	0	6
		function lk7	0	0	0	7
		function lk8	0	0	0	8
		operating contact	0	0	1	0
C 162	Switching differential relay 1	range: 1 – 9999 digit standard setting: 1 digit	x	x	x	x
C 163	Value relay 1	range: ±9999 digit	x	x	x	x
C 164	Limit comparator or operating contact relay 2[1]	no function	0	0	0	0
		function lk1	0	0	0	1
		function lk2	0	0	0	2
		function lk3	0	0	0	3
		function lk4	0	0	0	4
		function lk5	0	0	0	5
		function lk6	0	0	0	6
		function lk7	0	0	0	7
		function lk8	0	0	0	8
		operating contact	0	0	1	0
C 165	Switching differential relay 2	range: 1 – 9999 digit standard setting: 1 digit	x	x	x	x
C 166	Value relay 2	range: ±9999 digit	x	x	x	x
C 167	Limit comparator or operating contact relay 3[1]	no function	0	0	0	0
		function lk1	0	0	0	1
		function lk2	0	0	0	2
		function lk3	0	0	0	3
		function lk4	0	0	0	4
		function lk5	0	0	0	5
		function lk6	0	0	0	6
		function lk7	0	0	0	7
		function lk8	0	0	0	8
		function lk9	0	0	0	9
		function lk10	0	0	0	A
		operating contact	0	0	1	0
C 168	Switching differential relay 3	range: 1 – 9999 digit standard setting: 1 digit	x	x	x	x
C 169	Value relay 3	range: ±9999 digit	x	x	x	x

[1] The relays are available as control contacts, limit comparators or operating contacts depending on the controller version.

x = input within range

☐ = can be configured

UV06	Limit comparators or operating contacts		▲	▲	▲	▲
C 16A	Limit comparator Program stopped when limit is exceeded	no function	0	0	0	0
		function lk1	0	0	0	1
		function lk2	0	0	0	2
		function lk3	0	0	0	3
		function lk4	0	0	0	4
		function lk5	0	0	0	5
		function lk6	0	0	0	6
		function lk7	0	0	0	7
		function lk8	0	0	0	8
C 16B	Switching differential	range: 1 – 9999 digit standard setting: 1 digit	x	x	x	x
C 16C	Value	range: ± 9999 digit	x	x	x	x

x = input within range

☐ = can be configured

UV07	Interface			▲	▲	▲	▲
C 171	Instrument address	range: 0 – 31		x	x	x	x
C 172	Data format	parity bit	no parity	0	0	0	0
			parity odd	0	0	0	1
			parity even	0	0	0	2
		1 stop bit		0	0	1	0
		2 stop bits		0	0	2	0
		7 data bits		0	7	0	0
		8 data bits		0	8	0	0
		baud rate	9600	0	0	0	0
			4800	1	0	0	0
			2400	2	0	0	0
			1200	3	0	0	0
			600	4	0	0	0
			300	5	0	0	0
			150	6	0	0	0
C 173	Special functions	terminal mode	OFF	0	0	0	0
			ON	0	0	0	1
		end character	CR	0	0	0	0
			CR/LF	0	0	1	0

x = input within range

☐ = can be configured

UV08	Software version / time-out					
C 181	Software version number		x'	x'	x'	x'
C 183	Hold time (time-out)	range: 0 – 225 sec			6	0

x' = indication to order specification

UV09	Special functions		▲	▲	▲	▲
C 192	Time constant of relay 1[1]	range: 0 – 60 sec			x'	x'
C 193	Time constant of relay 2[1]	range: 0 – 60 sec			x'	x'
C 194	Functions of external inputs				E1[2]	E2[2]
		no function	0	0	0	0
		keys blocked	0	0	1	1
		Pgm blocked	0	0	2	2
		external fast forward run	0	0	3	3
		external start	0	0	4	4
		external stop	0	0	5	5
C 195	Start value[3]	range start/end of control range	x	x	x	x
C 196	End value[3]	range start/end of control range	x	x	x	x
C 197	Operating contact 1	1 = On 0 = Off		⟋	⎯	⟋
				0	0	0
				0	0	1
				0	1	0
				0	1	1
				1	0	0
				1	0	1
				1	1	0
				1	1	1
C 198 C 199 C 19A	Operating contact 2 Operating contact 3 Operating contact 4	programming as in C 197				

[1] Minimum ON time, e.g. in burner controls

[2] Both inputs (E1 and E2) must not have the same function

[3] Factory-set to start of control range

x': Display within range

x: Input within range

☐ = can be configured

8.1 Error messages

Er 10:

The voltage of the built-in lithium battery is insufficient to protect the data in case of supply failure.

Remedy:

The error message can be cancelled with any key. Arrange for the battery to be changed within 4 weeks.

Er 11:

Despite a fault in the processor sequence the "watchdog" (internal monitoring circuit) was not activated.

Remedy:

Cancel the error message by switching the supply off and on again. Return the controller for checking as soon as possible.

Er 20:

The data in the working memory are partially erased.

Remedy:

Read in the factory-set data from the EPROM, i.e. switch off supply, set internal switch S 301.5 to position ↑ and S 301.6 to position ↓ and switch supply on again. The error message may appear again for about ½ sec after switching on: this is not significant. The controller reads in the data set at the factory. The programs should be checked and entered again if necessary.

Er 21:

Internal program data (programmer module) are corrupted (they are checked after the program has been run).
This error can be acknowledged with the "ENTER" key (but this does not correct it).

Remedy:

Erase the program which was called up, and input it again.

Er 30:

Incorrect process correction through input X0 = X1 or X1 = 0.

Remedy:

The error message can be cancelled by pressing any key.
The parameters X0 and X1 are automatically set to the standard setting, i.e. the incorrect input is ignored. If necessary repeat the process correction.

Er 40:

The display capacity is exceeded.

Remedy:

Check the process value; in case of current or voltage input check C 124 and C 125.

If the fault cannot be rectified, please return the program controller to the supplier with full details of the fault.

Do not return the chassis without the case!

If this should not be possible, the chassis or the individual electronic assembly has to be protected by **electrically conducting foil**.

The employees of our Technical Offices, Subsidiaries or Agents will always be pleased to provide advice and to service your instruments.

8.2 Action on supply failure

Version "Continue"

The instrument continues the program at the exact point where it was interrupted.
There is no report that there was a supply failure.

Version "Stop"

The instrument does not continue the program.
The bottom display shows "stop".

- On pressing the 

key the program continues from the exact point where it was interrupted.

- On pressing the  key the program is aborted.

Supply failure during manual operation

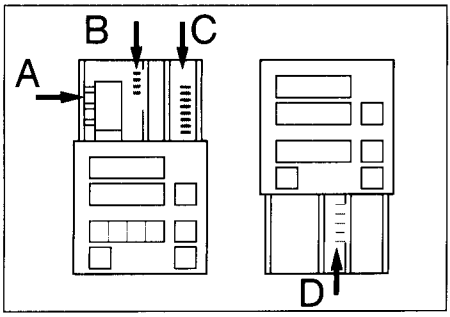
During manual operation the instrument returns to the status before supply failure when the supply is restored. The setpoint settings and the status of the relays are indicated as they were just before the supply failure.

8.3 Action on sensor failure or short-circuit

The control contacts, limit comparators and operating contacts are de-energised.
The alarm relay (if programmed) moves to a defined status.
With resistance thermometer or thermocouple input the top display flashes 1999 (–1999).

Analogue output

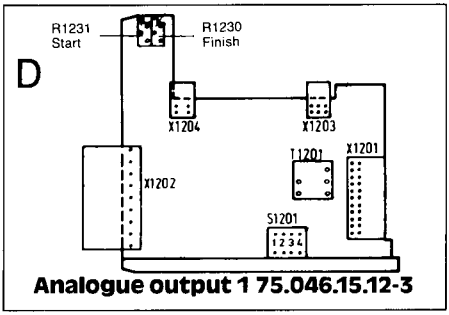
The output signal is set on DIL switches. The changeover between 0–20 mA and 4–20 mA is made at the factory.
The controller is supplied fully adjusted.
If a different output signal is selected on the switches S1001.1–S1001.4 or S1201.1–S1201.4 a slight re-adjustment of the output signal with the potentiometers R1030 and R1031 or R1230 and R1231 is recommended.



Analogue output 1

Output signal	S1201.1	S1201.2	S1201.3	S1201.4
0(4) – 20 mA	o	o	o	x
– 20(–12)/0/+ 20 mA	x	o	o	x
0(2) – 10 V	o	x	x	o
– 10(– 6)/0/+ 10 V	x	x	x	o

x = closed o = open
(The values in brackets apply to the configuration 4 – 20 mA.)

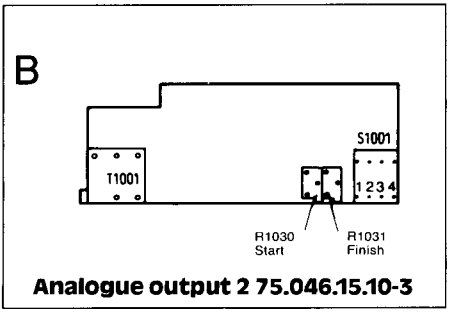


Analogue output 1 75.046.15.12-3

Analogue output 2

Output signal	S1001.1	S1001.2	S1001.3	S1001.4
0(4) – 20 mA	o	o	o	x
– 20(–12)/0/+ 20 mA	x	o	o	x
0(2) – 10 V	o	x	x	o
– 10(– 6)/0/+ 10 V	x	x	x	o

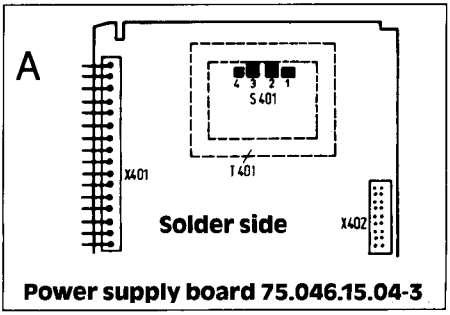
x = closed o = open
(The values in brackets apply to the configuration 4 – 20 mA.)



Analogue output 2 75.046.15.10-3

Supply

Voltage	Solder link
220 V	4 3 2 1
110 V	4 3 2 1

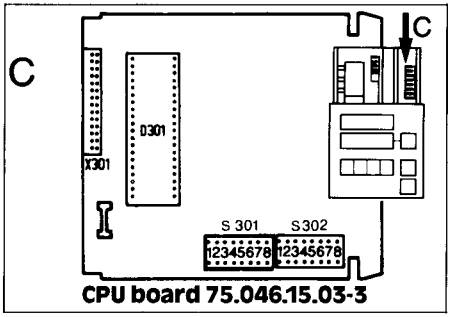


Power supply board 75.046.15.04-3

☐: standard setting

CPU board

The following functions are set with DIL switches on the CPU board.
The position of the CPU board inside the program controller is marked with "C" in the illustration alongside.



CPU board 75.046.15.03-3

Blocking of levels

Levels blocked	S301.1	S301.2
Parameter level Configuration level	↓	↑
Configuration level	↑	↑
not blocked	↓	↓

No access to these levels. → Parameter level, Configuration level

No access to this level. → Configuration level

All levels can be accessed. → not blocked

Self-optimisation

On fast control processes, better optimisation may be achieved by changing over switch S301.3.

Self-optimisation	S 301.3	
slow process, Tg > 2 min	↑	
fast process Tg < 2 min	↓	

☐: factory setting

Input filter

Digital filter for smoothing the input signal; time constant 1 sec.

Input filter	S301.4	
on	↑	
off	↓	

Data transfer

Configuration data and parameter data are read from the EPROM into the working memory (RAM) when S301.5 is ↑ and S301.6 is ↓.

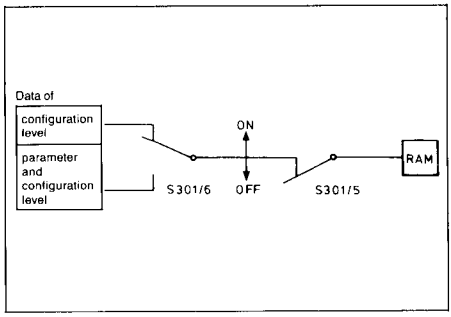
This means the parameters can be called up but cannot be changed.

In position S301.5 ↑ and S301.6 ↑ (factory setting) only the parameter data can be changed.

In position S301.5 ↓ the data transfer is switched off and the controller can be freely re-programmed.

With switch position S301.5 ↑ and S301.6 ↓ it is always possible to return to the base status or the status as supplied from the factory.

Factory data	S301.5	S301.6
yes	↑	
no	↓	
Transfer into		
configuration level		↑
configuration and parameter level		↓



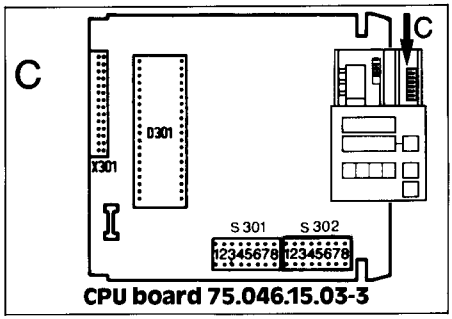
Status after supply failure or reset

Version	S301.7	S301.8
continue	↑	↑
stop	↓	↑

▭ : factory setting

CPU board

The following functions are set with DIL switches on the CPU board.
The position of the CPU board inside the program controller is marked with "C" in the illustration alongside.



CPU board 75.046.15.03-3

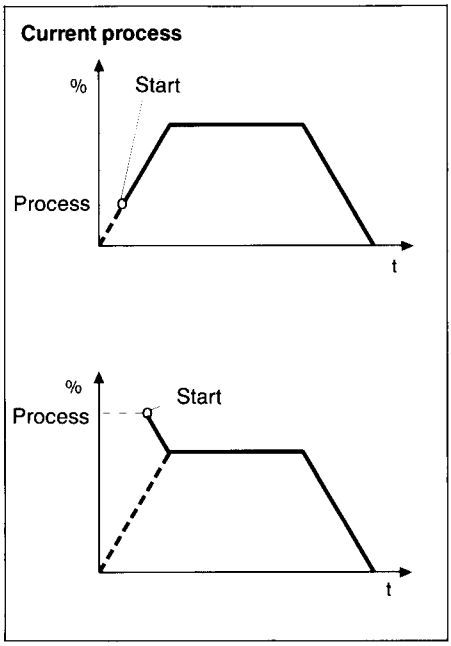
–Start temperature

Programmed start temperature

The start temperature can be programmed at the configuration level in UV 09/C 195. Factory setting is the start of range.

Current process

The programm always starts at the current process.



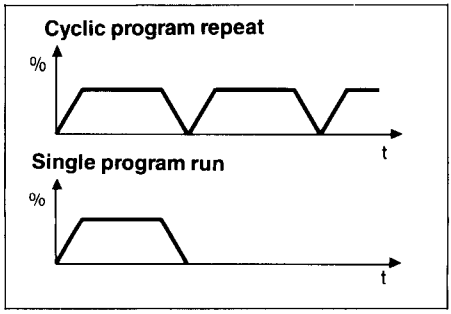
Start temperature	S 302.1
Programmed start temperature	↑
Current process	↓

–Program repeat

With cyclic program repeat the program run is repeated n times; with single program run the program controller returns to the base status at program end.

Program repeat	S 302.2
cyclic repeats	↑
single program run	↓

☐: factory setting



Programming of time or gradient

Input in value per hour or value per minute →

Input in hours or minutes →

Programming of time or gradient	S 302.3
Gradient programming	
Time programming	

Decimal places of gradient

Decimal place of gradient	S 302.4	S 302.5
no decimal place		
one decimal place		
two decimal places		
three decimal places		

If the DIL switches 3, 4 and 5 are altered, the parameters of the program profile are erased.

☐: factory setting

Time base of soak period

Time base of soak period	S 302.6
Hours	
Minutes	

Time base of up ramp and down ramp

Time base of up ramp and down ramp	S 302.7
Hours	
Minutes	

If the DIL switches 6 and 7 are altered, the parameters of the program profile are erased.

□: factory setting

10.1 Function of the external inputs

Two external inputs are provided which are activated through one floating contact each.
The inputs are as follows:

Code*	Terminals 0/17	Terminals 0/18
11	stop	start
12	stop	keys blocked
13	stop	programming blocked
14	stop	fast forward run
15	start	keys blocked
16	start	programming blocked
17	start	fast forward run
18	keys blocked	fast forward run
19	programming blocked	fast forward run

* see Extra Codes
or configuration level C 194

External start

The effect is the same as the "Program On/Off function"

The program is started with the first pulse.
With the second pulse the program is aborted.

External stop

The action corresponds to the "hand" function during automatic operation. The time base is stopped. The current values are retained. After releasing the "external stop" the remainder of the program is run.

External block keys/programming

- key block
  protection against unauthorised operation (all keys are blocked)
- programming block
  protection against unauthorised programming
  (input of program parameters is not possible)

External fast forward

When the external fast forward is activated the program is run for the first 5 sec at 1 digit per sec and then continues at 25 digits per sec.
During the up ramp and down ramp the display shows the setpoint and during the soak period the residual running time.

10.2 Fast forward

On pressing the ENTER key, it is possible to move to a defined setpoint in the program at the fast forward speed.
During fast forward the program runs for the first 5 sec at 1 digit/sec and then continues at 25 digits/sec.
During the up ramp and down ramp the display shows the setpoint and during the soak period the residual running time.

10.3 Correcting process indication to customer specification

A process indication differing from the desired or actual value can be corrected with the keys. This is useful, for example, in order to match the indication of several instruments or to compensate for the resistance of the sensor cable.
Two values are input, the intermediate values are interpolated or extrapolated by the controller.

If X0 ist changed the diagram is displaced in parallel from the old value to the corrected value.

If only X1 is changed, the slope in the diagram is rotated about the point 0 °C (0 °F).

Changing X0 first and the X1 is described in the following example.

Example:

When the process value is 15 the process indication should be 40.
When the process value is 90 the process indication should be 60.

Programming:

With a process value of 15, 40 is programmed in parameter X0 (C 131). The correction causes the indication to be displaced in parallel by 25. The end value indicated is also changed from 90 to 115.

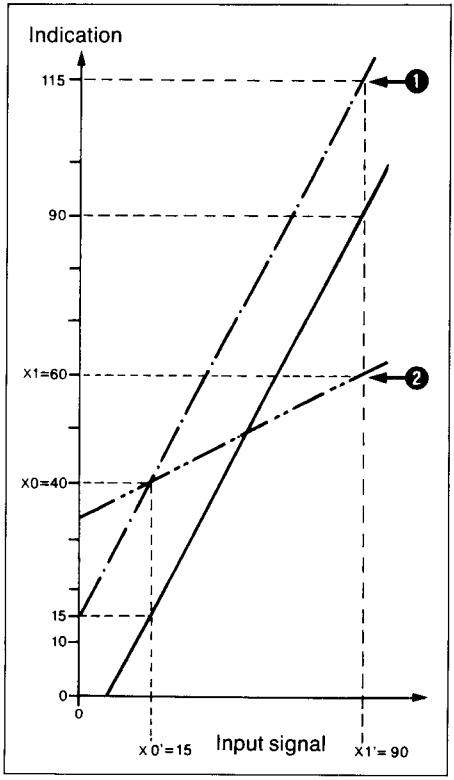
❶

60 is now programmed in parameter X1 (C 132).

❷

Display of X0' (C 139) = 15
Display of X1' (C 13A) = 90

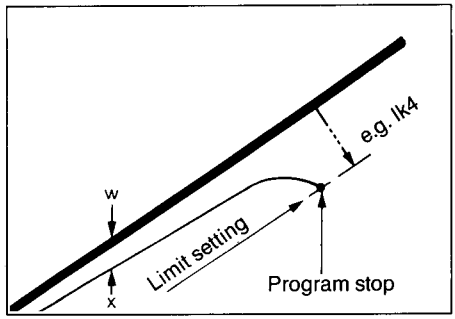
The corrections should be performed near the start of range and the end of range so that X0' and X1' are sufficiently far apart.
To restore the base status X0 must equal X1. First X1 and then X0 is programmed to the same value. The error message Er 30 appears and can be cancelled with any key. At the same time X0 and X0' are set to 0 and X1 and X1' to 1.



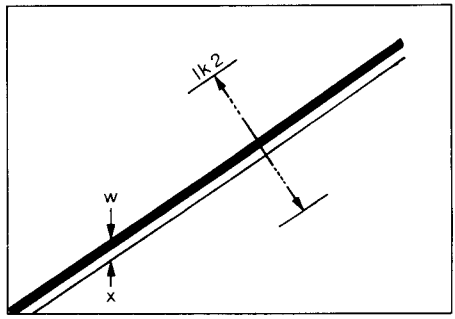
❶ —·— after correction of X0
❷ ---- after correction of X0 + X1

10.4 Program stop when limit setting is exceeded

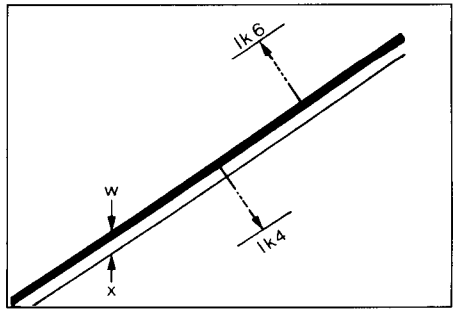
With this function the program run can be held during automatic operation if setpoint and process are drifting apart or drifting together. A limit comparator whose function can be set in the sub-directory UV 06 (C 16A, C 16B and C 16C) of the configuration level monitors the upward or downward deviations of the **process x** from the **setpoint w.**
The functions of the limit comparators are described under "Technical data", page 7.



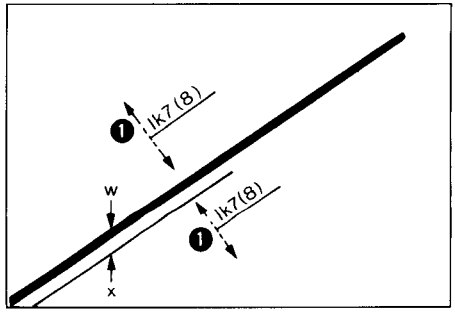
Limit comparator Ik2 monitors the deviation within a window whose width is adjustable within the range of ±9999 digits.
The window is symmetrical to the setpoint of the program controller.



Limit comparator Ik4 monitors a downward deviation; limit comparator Ik6 reacts when the limit setting is exceeded. The adjustable contact spacing from the setpoint is ±9999 digits.



The limit comparators Ik7 **or** Ik8 are adjustable over the full control span ❶ independently from the setpoint of the program controller.



When the process returns to a value within the limits selected the program controller continues with the program run.

Optimum adjustment means:

1. Good start-up action, i.e. start-up curve as steep as possible without overshoot.

2. Good disturbance and control correction, i.e. to ensure rapid control action without oscillations in case of an external disturbance or if the setpoint is changed.

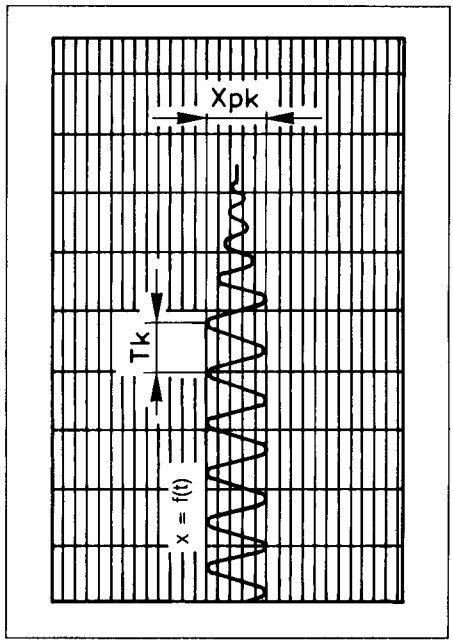
When precise process characteristics are available the control parameters for a defined operating point can be determined precisely by an involved mathematical procedure. In practice, however, precise characteristics are rarely available, and practical adjustment criteria have therefore been developed which have proved satisfactory.
Even here the assumed conditions (e.g. sudden changes of the disturbance or setpoint at the loop input) are in most cases only approximately correct so that the results obtained can only be considered as a rough indication.
In practice it is useful to record a curve of the process variable under operating conditions in order to ascertain the optimum setting by stepwise changes of one parameter at a time.
A basic setting for controllers with PID action, based on measured parameter values, can be obtained by the procedure described below.

Oscillation method according to "ZIEGLER" and "NICHOLS"

This method applies to processes which may be rendered unstable for brief periods (Tg/Tu at least 3). The controller is operated initially with the following settings: on switching controllers PD action with minimum Tv and CY; on proportional controllers P action; Xp1 or Xp1 and Xp2 on maximum. The proportional band Xp is then reduced slowly (i. e. increasing the controller gain) to determine the stability limit at which the process performs undamped oscillations of constant amplitude. This test gives

a) the critical oscillation amplitude Xpk

b) the critical oscillation period Tk



The optimum settings are then:

Xp = 1.7 Xpk Tn = 0.5 Tk

$$Tv = \frac{Tn}{4.5}$$

Adjustment according to the process characteristics

Not all control loops can be rendered unstable for brief periods. This method is therefore based on the process loop data.
The transfer function (response to a sudden setting or disturbance change) is used to evaluate the following characteristic values:

Ks = process transfer coefficient

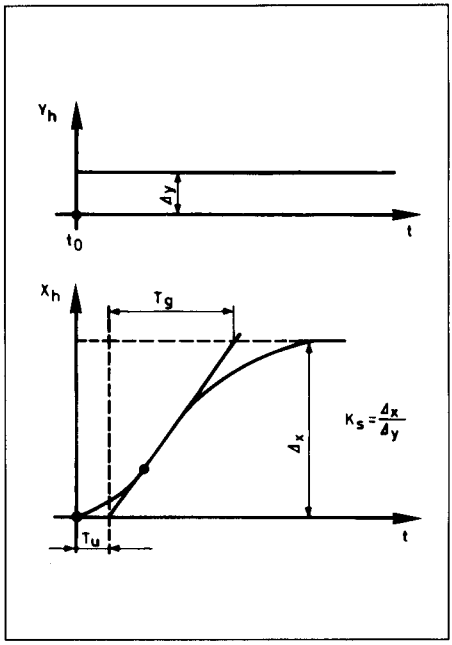
$$Ks = \frac{\Delta x}{\Delta y} = \frac{\text{output change}}{\text{input change}}$$

Tu = delay time and
Tg = response time

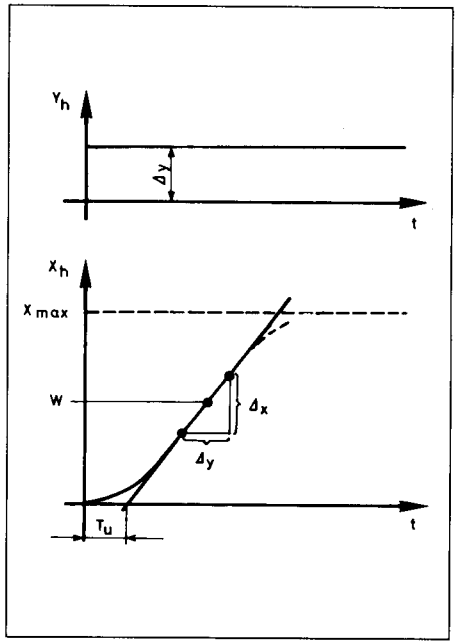
The controllability of the process loop can be estimated from the ratio Tu/Tg.

For Tu/Tg less than 0.1	satisfactory control
0.1–0.3	just controllable
more than 0.3	difficult to control

The transfer function should be recorded near the operating point (setpoint). The input to the process is changed suddenly at time t_0 by an amount Δy within the total adjustment range Yh (for example 10 % of Yh). The result is a transfer function with values for Δx, Tu and Tg.



If the power supplied cannot be changed in steps the transfer function is recorded with a 100 % change in power. As the process does not always permit this due to technical reasons, there is another possibility for determining the control parameters. It evaluates the maximum rate of rise of the transfer function.



$$Vmax = \frac{\Delta y}{\Delta t}$$

$$Xp = 0.83\ Vmax \cdot Tu$$

This gives the following values for PID controllers based on the example above:

$Tu = 2\ min$

$\Delta t = 3\ min$

$\Delta x = 90\ °C$

$$Vmax = \frac{\Delta x}{\Delta t} = \frac{90\ °C}{3\ min} = 30\ \frac{°C}{min}$$

$$Xp = 0.83\ Vmax \cdot Tu = 0.83 \cdot 30\ \frac{°C}{min} \cdot 2\ min$$
$$= 49.8\ °C$$

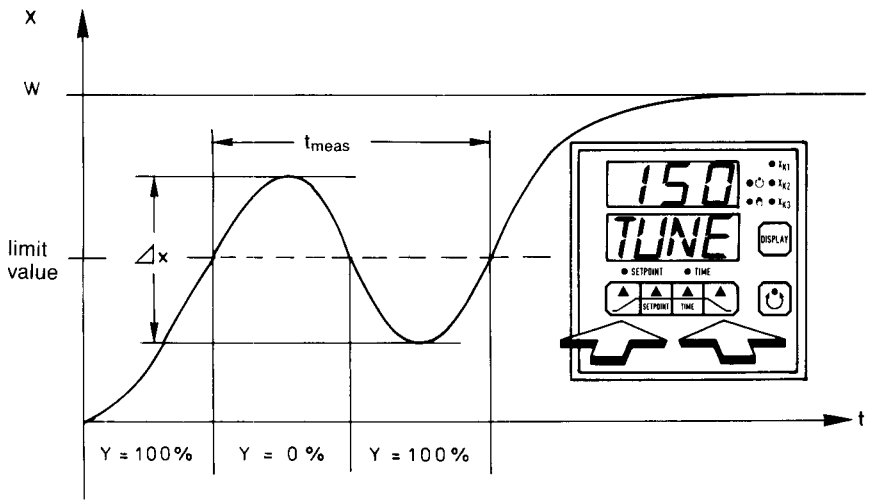
$Tn = 2\ Tu = 4\ min$

$$Tv = \frac{Tn}{4.5} = 54\ sec$$

Empirical rules for parameter setting

Control action	Setting
P	Xp = Vmax · Tu(°C)
PI	Xp = 1.2 · Vmax · Tu(°C) Tn = 3.3 Tu
PD	Xp = 0.83 · Vmax · Tu(°C) Tv = 0.25 · Tu(min)
PID	Xp = 0.83 · Vmax · Tu(°C) Tn = 2 · Tu(min) Tv = Tn/4.5(min)
PD/PID	Xp = 0.4 · Vmax · Tu(°C) Tn = 2 · Tu(min) Tv = 0.4 · Tu(min)

Self-optimisation of DICON PRT (during manual operation, Item 5.4)



Oscillation, shown greatly magnified

The controller incorporates a self-optimisation facility. This applies to single and double setpoint controllers as well as to proportional controllers. The optimisation procedure is based on the "Ziegler" and "Nichols" adjustment rules. The controller is optimised for setpoint response. The setpoint response of a control loop refers to the change in the process variable for a sudden change in the setpoint.

A condition for activating self-optimisation is a difference between process and setpoint of at least 10 % of the control span; this is necessary in order to achieve useful results.

The optimisation procedure is started by simultaneously pressing the right and left increment keys (with the controller on manual operation). During optimisation the word "TUNE" is flashing in the alphanumerical display. The controller output signal is set to maximum (Y = 100 %) or minimum (Y = 0 %) depending on whether the setpoint is above or below the process variable. When half the difference between process and setpoint (limit value) has been reached, the output signal Y is reversed.

After the overshoot or undershoot the process passes again through the limit value. The output signal Y is reversed once more, followed by another undershoot or overshoot. The measuring process is terminated when the limit value has been reached again.
The calculated control parameters are automatically transferred to the parameter level of the controller and the control process begins.
From the difference between the maximum and the minimum of the amplitude (Δx) and the duration of the period (t_{meas}) the controller calculates:

XP1, XP2 = XP1, Tn, Tv = Tn/4

CY = Tn/10, CY2 = CY1

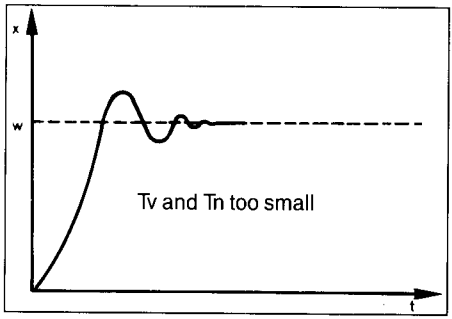
The parameters determined by optimisation can always be called up and modified.
After the start of self-optimisation the controller is automatically set to PID action.

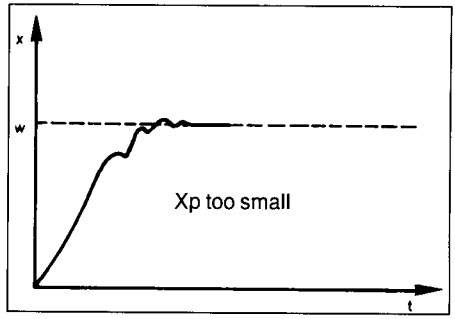
The optimisation procedure can be aborted at any time with the two centre increment keys.

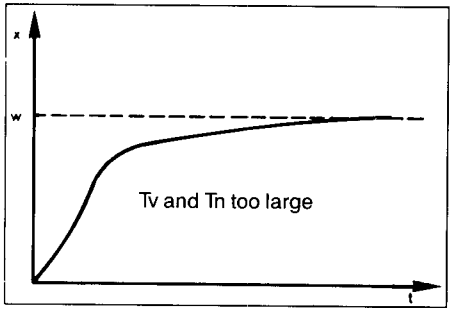
Checking the optimisation for PID action

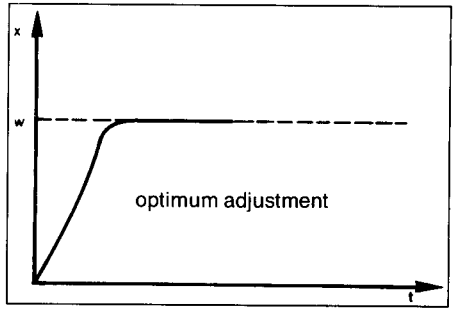
The optimum adjustment of the controller to the process can be checked by recording a start-up with closed process loop.

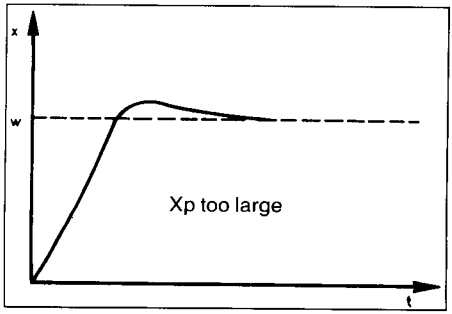
The diagrams below indicate possible incorrect adjustments and the correction required.









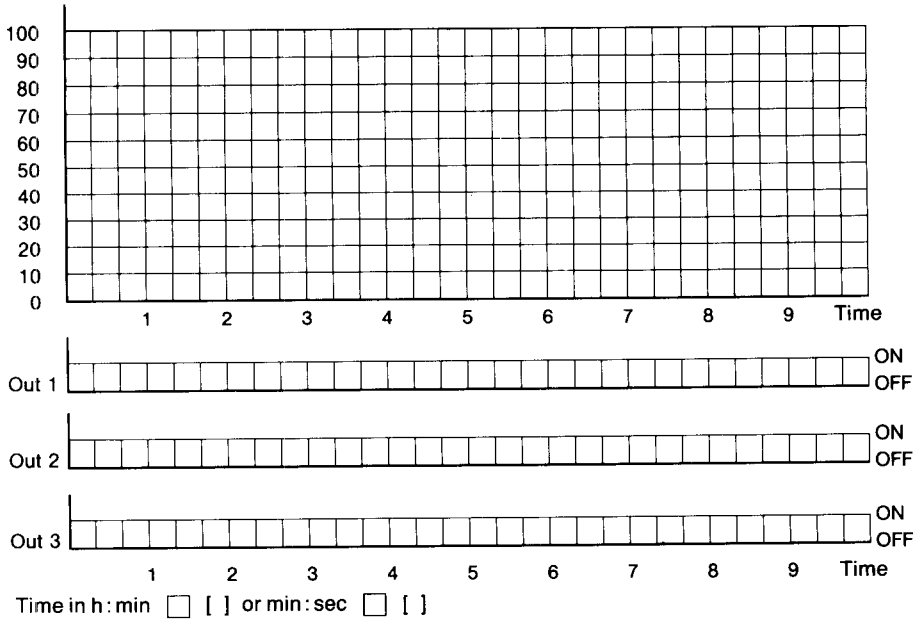


This shows that increased Xp and increased Tn both result in a more stable and more sluggish control action. Smaller Xp or Tn produces a control action with less damping.

mm	inch	mm	inch
0.8	0.031	79	3.11
4.8	0.19	91.6	3.61
12	0.47	96	3.78
25.8	1.02	105	4.13
66	2.60	111	4.37
73	2.87	121.5	4.78

12 PROGRAMME DATA CHART

Sample chart



Time in h : min ☐ [ ] or min : sec ☐ [ ]

NOTES

Sales Offices and Service Stations – Germany

Berlin
Heinz Konsolke
Bismarckstrasse 16 d-e
W-1000 Berlin 41
Phone (0 30) 7 95 30 21
Telefax (0 30) 7 95 30 25
Telex 1 82 997

Darmstadt
M. K. Juchheim GmbH & Co.
Niederlassung Darmstadt
Weiterstädter Strasse 135
W-6100 Darmstadt-Arheilgen
Phone (0 61 51) 35 08-0
Telefax (0 61 51) 35 08 81
Manager: Wolfgang Vogl

Erfurt
M. K. Juchheim GmbH & Co.
Außenbüro Erfurt
Friedrich-Engels-Straße 12
O-5215 Ichtershausen
Phone (0 36 28) 7 57 63
Telefax (0 36 28) 7 57 63
Manager: Bernd Westerhoff

Essen
M. K. Juchheim GmbH & Co.
Niederlassung Essen
Alte Bottroper Strasse 45
W-4300 Essen 11
Phone (02 01) 66 30 71-74
Telefax (02 01) 66 87 80
Manager: Lothar Bläser

Giessen
M. K. Juchheim GmbH & Co.
Aussenbüro Giessen
Am Eichelbaum 14
W-6300 Giessen-Wieseck
Phone (06 41) 59 57 und 59 58
Telefax (06 41) 5 45 00
Manager: Robert Büchele

Hamburg
M. K. Juchheim GmbH & Co.
Aussenbüro Hamburg
Horstweg 20
W-2000 Hamburg 65
Phone (0 40) 6 01 77 55-56
Telefax (0 40) 6 01 07 34
Manager: Ing. grad. H. Schirner

Hannover
M. K. Juchheim GmbH & Co.
Niederlassung Hannover
Gehrenbreite 2
W-3052 Bad Nenndorf
Phone (0 57 23) 50 47-49
Telefax (0 57 23) 7 54 11
Manager: Dipl.-Ing. G. Werwitzke

Cologne
M. K. Juchheim GmbH & Co.
Aussenbüro Köln
Bonner Ring 17a
W-5042 Erftstadt-Lechenich
Phone (0 22 35) 50 71
Telefax (0 22 35) 7 13 07
Manager: D. Grosskinsky

Leipzig
M. K. Juchheim GmbH & Co.
Außenbüro Leipzig
Gustav-Adolf-Straße 38
O-7010 Leipzig
Phone (03 41) 28 52 81
Telefax (03 41) 28 52 81
Manager: Hans-Jürgen Paul

Magdeburg
M. K. Juchheim GmbH & Co.
Außenbüro Magdeburg
Parzellenweg 1a
O-3016 Magdeburg
Phone (03 91) 5 61 44 06
Telefax (03 91) 5 61 44 06
Manager: Frank Sperling

Munich
M. K. Juchheim GmbH & Co.
Aussenbüro München
Himmelreichweg 23
W-8060 Dachau
Phone (0 81 31) 8 32 40
Telefax (0 81 31) 8 22 69
Manager: W. Neuwert

Nürnberg
M. K. Juchheim GmbH & Co.
Aussenbüro Nürnberg
Schäferweg 3
W-8567 Neunkirchen am Sand
Phone (0 91 23) 1 45 46
Telefax (0 91 23) 8 26 73
Manager: Karl Reutel

Stuttgart
M. K. Juchheim GmbH & Co.
Niederlassung Stuttgart
P. O. Box 1245
Einsteinstrasse 42
W-7312 Kirchheim unter Teck
Phone (0 70 21) 8 20 11
Telefax (0 70 21) 5 95 05
Telex 7 267 708
Manager: Ing. grad. R. Geier

Europe and USA

Austria
JUMO Mess- u. Regelgeräte Ges.m.b.H.
Pfarrgasse 48, A-1232 Wien
Phone 02 22/67 95 33-0
Telefax 02 22/67 95 33 59, Telex 13-30 76

Belgium
JUMO AUTOMATION
S.P.R.L./P.G.M.B.H./B.V.B.A.
Industriestrasse 18, B-4700 EUPEN
Phone (087) 740 440
Telefax (087) 740 203
Telex 49 067 (JUMO B)

Denmark
JUMO Måle- og Reguleringsteknik A/S
Fabriksvænget 16, Postboks 80
DK-4130 Viby Sj
Phone (0 42) 39 30 06
Telefax (0 42) 39 43 63

France
JUMO Régulation S.A., Actipôle Borny
7, rue des drapiers, B. P. 5200
F-57075 Metz-Cedex 3
Phone 87.37.53.00, Telefax 87.74.20.92
Telex 930.464

Italy
JUMO Italia s.r.l.
Piazza Esquilino 5, I-20148 Milano
Phone (02) 40 09 21 41
Telefax (02) 4 98 99 48

Netherlands
JUMO Meet- en Regeltechniek B. V.
Postbus 115, NL-1380AC Weesp
Phone (0 29 40) 90 76/1 39 91
Telefax (0 29 40) 1 95 77

Russia
JUMO Meß- und Regeltechnik AG
Krasnopresnenskay Nab., D. 1/2, Kv. 132
RF-123 367 Moskau
Phone (0 95) 2 05 06 71
Telefax (0 95) 2 05 06 71
Telex 411700 (for JUMO S)

Spain
JUMO SERCON S.A.
C/.Sánchez Pacheco, 72, 3
E-28002 Madrid
Telefon (01) 5 19 33 66,
(01) 5 19 33 67, (01) 5 19 33 68
Telefax (01) 5 19 33 69

Sweden
JUMO Mät- och Reglerteknik AB
Karbingatan 32, Box 22073
S-250 22 Helsingborg
Phone 0 42-12 36 60
Telefax 0 42-20 16 15, Telex 72 058 jutex S

Switzerland
JUMO Mess- & Regeltechnik AG
Seestr. 67, CH-8712 Stäfa
Phone (01) 9 28 21 41
Telefax (01) 9 26 67 65

United Kingdom
JUMO Instrument Co. Ltd.
Temple Bank, Riverway
Harlow, Essex CM20 2TT
Phone (02 79) 63 55 33
Telefax (02 79) 63 52 62

USA
JUMO PROCESS CONTROL INC.
735 Fox Chase, Coatesville, PA 19320
Phone 215-380-8002, 800-554-Jumo
Telefax 215-380-8009

Representatives in:
Argentina, Brazilia, Canada, Chile, Czechoslovakia, Egypt, Finland, Greece, Hungary, India, Indonesia, Iran, Republic of Ireland, Israel, Norway, Portugal, Singapore, Venezuela, Yugoslavia