Sales Offices and Service Stations – Germany

Berlin
Heinz Konsolke
Bismarckstrasse 16 d-e
D-12169 Berlin
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
D-64291 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
D-99334 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
P. O. Box 11 03 65
D-45333 Essen
Phone (02 01) 66 30 71-74
Telefax (02 01) 66 87 80
Manager: Lothar Bläser

Giessen
M. K. Juchheim GmbH & Co.
Niederlassung Giessen
P. O. Box 11 08
D-35441 Biebertal
Phone (0 64 09) 81 00-0
Telefax (0 64 09) 81 00-49
Manager: Ingo Skrzipczyk

Hamburg
M. K. Juchheim GmbH & Co.
Aussenbüro Hamburg
Horstweg 20
D-22391 Hamburg
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
D-31542 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
D-50374 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
D-04105 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
D-39130 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
D-85221 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
D-91233 Neunkirchen am Sand
Phone (0 91 23) 1 45 46
Telefax (0 91 23) 8 26 73
Manager: Erwin Kolb

Stuttgart
M. K. Juchheim GmbH & Co.
Niederlassung Stuttgart
P. O. Box 12 45
D-73220 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) 4 04 84 40
Telefax (02) 4 07 81 05

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-123 376 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.
Taquigraf Garriga, 44
E-08014 Barcelona
Phone (03) 4 10 94 92
Telefax (03) 4 19 64 31

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

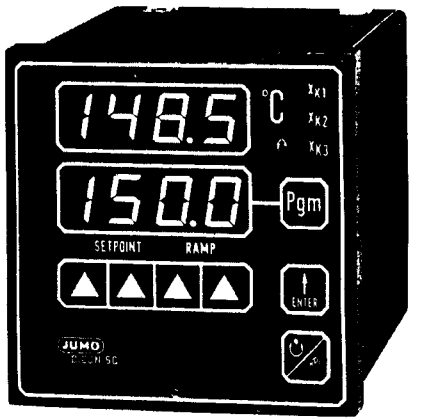
USA
JUMO PROCESS CONTROL INC.
735 Fox Chase, Coatesville, PA 19320
Phone 215-380-8002, 800-554-Jumo
Telefax 215-380-8009

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

JUMO
MESURE ET REGULATION

JUMO DICON SC
Universal Compact Controller for industrial and process control

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



B 70.3520 (D 97.540)

3.90/V 74173

Operating Instructions

M. K. JUCHHEIM GMBH & CO · P.O.Box 1209 · 36035 Fulda · GERMANY
Phone (06 61) 60 03-0 · Fax (06 61) 60 03-6 07 · Teletex 6619726

CONTENTS

		Page
1	**DESCRIPTION**	1
1.1	Type designation	2
1.2	Indications and controls	4
2	**TECHNICAL DATA**	5
3	**INSTALLATION**	9
3.1	Location and climatic conditions	9
3.2	Fitting in position	9
3.3	Dimensions	9
4	**ELECTRICAL CONNECTION**	10
4.1	Connection diagram	10
4.2	Inportant notes on installation	12
5	**OPERATION**	13
5.1	Planes and blockages	13
5.2	Displays	14
5.3	Displaying process and setpoint and changing setpoint	14
5.4	Manual operation	15
6	**PARAMETER PLANE**	16
6.1	Displaying and changing parameters	16
6.2	Parameter Table	17
7	**CONFIGURATION PLANE**	18
7.1	Displaying configuration data	18
7.2	Changing configuration data	19
7.3	Configuration Tables	20
8	**ACTION ON FAULTS**	27
8.1	Error messages	27
8.2	Action on supply failure	27
8.3	Action on failure or short-circuit of sensor	27
9	**INTERNAL ADJUSTMENTS**	28
10	**ADDITIONAL FUNCTIONS**	31
10.1	Meaning of the external contacts	31
10.2	Correction of process indication by user	32
10.3	Calibration of resistance transmitter for valve stroke retransmission (modulating controller)	32
10.4	Controller with ramp function	33
10.5	Function of logic inputs	36
11	**OPTIMISATION**	37

NOTE

All necessary settings and, where appropriate, alterations are described in these Operating Instructions.

If, however, any difficulties should arise during start-up you must not carry out any manipulation on the instrument which is not permitted. – You could endanger your rights under the instrument warranty. Please contact the nearest office or the main factory.

Phone (International + 49 661) 6003 727

1 DESCRIPTION

The JUMO DICON SC is a microprocessor controller with a 96 x 96 mm bezel and a depth of only 121.5 mm. The controller has a 4-digit numerical display and in addition a 4-character alphanumerical display which can be used either for comments on the displayed value or for indicating a second value. The unit can be operated as single or double setpoint controller, as modulating controller or as proportional controller. Three logic outputs are available as control contacts or limit comparators, depending on the control mode selected. A self-calibrating input circuit ensures minimal deviation, e.g. less than 0.05 % with resistance thermometers.
Controller data, such as controller architecture and feedback action, can be entered with the keys.
Self-optimisation is provided as standard.
The controller can be integrated into a data system through a V.24 (RS232C) or RS422/485 interface. It is of modular construction and therefore particularly convenient to operate and service. The plug-in controller chassis readily permits servicing and retrofitting of options.
Surface-mounted devices (SMD) result in a high packing density in this controller, together with extended functions and enhanced reliability.

The features of the controller

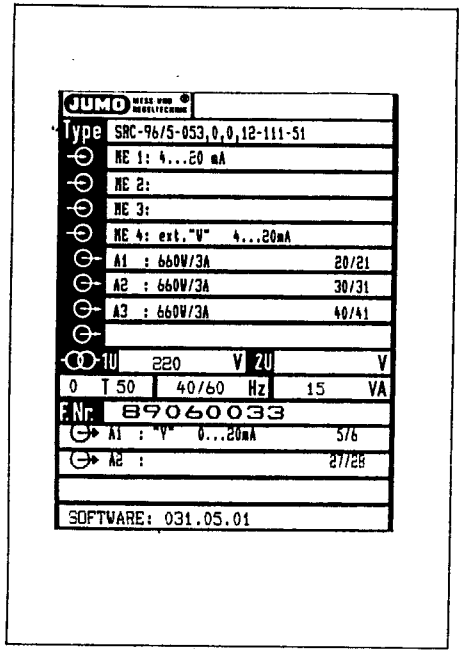
- Simple and user-friendly operation through clear functional separation:
  - OPERATE
  - PARAMETERS
  - CONFIGURE
- Blockable planes to protect against unintentional changes
- Bright self-luminous displays:
  - 4-digit numerical LED display
  - 4-character alphanumerical LED display
- Operation through membrane keys
- Can be configured as switching single-setpoint or double-setpoint controller, modulating controller or proportional controller
- Integral control station for bump-free auto/manual changeover
- 4 analogue inputs for: thermocouples, resistance thermometers, and current/voltage signal
- Analogue inputs for stroke retransmission, external setpoint, temperature difference control, display of second process variable
- Two logic inputs activated by external floating contacts (option)
- Free selection of setpoint limits
- Self-optimisation for single/double setpoint and proportional controller
- Two isolated analogue outputs (option)
- Three logic outputs
- Output signal on probe failure can be configured
- Ramp function (option)
- V.24 (RS232C) or RS422/485 interface with full isolation (option)
- Potentiometer input for stroke retransmission on modulating controller

1.1 Type designation

The type label is affixed to the housing. The type designation contains all the data on the controller function, the inputs and Extra Codes. The mains supply must agree with the supply voltage on the label.

SRC-96 / 5 - 053, 0, 0, 12 - 111 - 51

- SRC-96: Compact controller bezel 96 x 96 mm
- 5: Function: proportional controller
- 053: Input 1: current 4–20 mA
- 0: Input 2: not used
- 0: Input 3: not used
- 12: Input 4: external setpoint signal 4–20 mA
- 111: Logic outputs: 3 relay outputs for Xk1, 2 and 3
- 51: Interface: V.24 (RS232C)



Controller function

Description	Code
Single-setpoint controller with max. contact (relay de-energised for process above setpoint), action PD, PID or PD/PID[2] and 2 limit comparators. Feedback action and limit comparators can be configured	1
Single-setpoint controller with min. contact (relay de-energised for process below setpoint), action PD, PID or PD/PID[2] and 2 limit comparators. Feedback action and limit comparators can be configured	2
Double-setpoint controller, action PD, PID or PD/PID[2] and 1 limit comparator. Feedback action and limit comparator can be configured	3
Modulating controller, action PI or PID[2] and 1 limit comparator. Feedback action and limit comparator can be configured	4

Controller function

Description	Code
Proportional controller, action P, PI, PD or PID[2] and 3 limit comparators. Output signal, characteristic and limit comparators can be configured	5

[2] The factory settings are shown in the Parameter Table (see Section 6.2).

Inputs

Input 1 (Process signal)	Code
Resistance thermometers in 3-wire circuit	
Pt 100	001
Pt 500	002
Resistance thermometers in 4-wire circuit	
Pt 100	011
Pt 500	012
Thermocouples	
Cu-Con T	039
Fe-Con J	040
Cu-Con U	041
Fe-Con L	042
NiCr-Ni K	043
Pt10Rh-Pt S	044
Pt13Rh-Pt R	045
Pt30Rh-Pt6Rh B	046
MoRe5 – MoRe41	047
Linearised transducers with standard current signal	
0 – 1 mA	051
0 – 20 mA	052
4 – 20 mA	053
Linearised transducers with standard voltage signal	
0 – 50 mV	061
0 – 1 V	062
0 – 10 V	063
Non-linearised transducers	
0 – 1 mA (range *)	1. .**
0 – 20 mA (range *)	2. .**
4 – 20 mA (range *)	3. .**
Special range (range *)	900
Non-linearised transducers	
0 – 50 mV (range *)	4. .**
0 – 1 V (range *)	5. .**
0 – 10 V (range *)	6. .**
Special range (range *)	900

* specify in full

** the two dots must be replaced by the last two digits of the transducer code, e.g.: Code 241 means input 0–20 mA and linearisation to Cu-Con U.

Input 2	Code
not in use	0
temperature difference input (sensor as input 1)	1
display of second process variable (sensor as input 1)	2
cold junction temperature (Pt 100 sensor in 3-wire or 4-wire circuit)	3

Inputs

Input 3	Code
not in use	0
stroke retransmission resistance transmitter with 3-wire connection	1

Input 4	Code
Input function:	
not in use	00
external setpoint	1.
external setpoint with ± setpoint correction from the front	2.
Input signal:	
0 – 20 mA	.1
4 – 20 mA	.2
0 – 10 V	.3

Logic outputs

Logic outputs	Code	Xk1	Xk2	Xk3
relay 3 A	1			
0/5 V or 0/20 mA	2			
semiconductor relay 1 A	3			

Extra Codes

Analogue output 1	Code
(of on-off controller)	
Function of output:	
process x	1.
setpoint w	2.
deviation xw	3.
second process variable	4.
with output signal:	
0 – 20 mA	.1
4 – 20 mA	.2
0 – 10 V	.3
– 20/0/ + 20 mA	.4
– 10/0/ + 10 V	.5

Analogue output 2	Code
Codes as for analogue output 1 (not available in conjunction with Code 51/52)	..

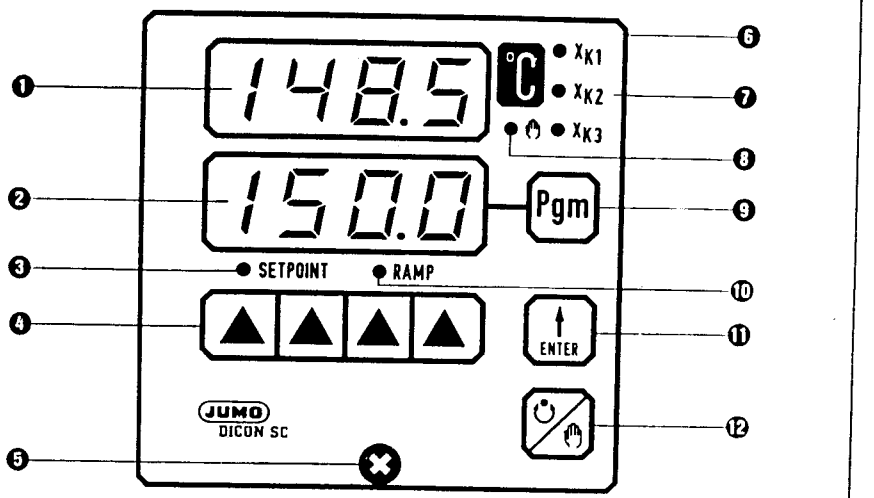
Interface	Code
V.24 (RS232C)	51
RS422/485	52

Ramp function	Code
with adjustable gradient and external stop (with Code 55)	54

2 logic inputs	Code
through external contacts	55

1 DESCRIPTION

1.2 Indications and controls



❶ **Numerical display**
4-digit LED display for actual value or other process variables

❷ **Alphanumerical display**
4-character text display for comments on numerical display or for indicating further process variables

❸ **LED for setpoint W**
(alight when the upper or lower display indicates the setpoint)

❹ **Increment keys**
with 4 keys any position in the display can be changed immediately

❺ **Fixing screw**
for the controller chassis

❻ **DIN housing for flush panel mounting**
bezel 96 x 96 mm

❼ **LEDs**
for on/off outputs

❽ **LED**
for manual operation

❾ **Programming key**
for parameter selection

❿ **LED for ramp function**

⓫ **Enter key**
for entering the inputs

⓬ **Auto/manual key**

2 TECHNICAL DATA

Controller for use with resistance thermometers

Input

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

Range (°C or °F)

−199.9+850.0 °C

Line adjustment

not required with 3-wire or 4-wire circuit. When using an existing resistance thermometer in 2-wire circuit it is necessary to provide line adjustment. This can be done either in the configuration plane or by means of 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 according to IEC or ISA

Ranges (°C or °F)

Cu-Con U − 200 + 600 °C	Fe-Con L − 200 + 900 °C
Cu-Con T − 200 + 400 °C	Fe-Con J − 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
MoRe5-MoRe41 0 + 1990 °C	

Isolation up to 5 V

Temperature compensation

internal; external available

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 − 50 mV	Ri = 100 kΩ min.
0 − 1 V	Ri = 50 kΩ
0 − 10 V	Ri = 500 kΩ

Control and display range

freely programmable

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

Input

as for linearised transducers with current or voltage signal

Ranges

characteristic can be configured

Controller for use with resistance transmitters

Input

range: min. 0−30 Ω, max. 0−10 kΩ, set through the keys in the configuration plane, see Section 10.3

Range

set in the configuration plane

Outputs

up to 3 switched outputs and up to 2 isolated analogue outputs are available.

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. Proportional output

as selected	burden
0 − 20 mA	500 Ω max.
4 − 20 mA	500 Ω max.
− 20/0/ + 20 mA	500 Ω max.
0 − 10 V	500 Ω min.
− 10/0/ + 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

can be used as single-setpoint or double-setpoint controller, modulating or proportional controller, with integral control station for bump-free auto-manual changeover

A/D converter
resolution 14 bit

Controller accuracy	ambient temperature error
when used with resistance thermometers and resistance transmitters	
0.05 % or better	0.01% max. per 10 °C
when used with thermocouples within working range	
0.25 % or better	0.05 % max. per 10 °C
when used with linearised transducers with current or voltage signal	
0.05 % or better	0.05 % max. per 10 °C

These values include the linearisation tolerances.

Signal circuit monitor
(sensor break or short-circuit)

1. Controller output
   The output moves to a predetermined defined value or the controller switches to manual operation.
2. Alarm relay
   The alarm relay (Ik9 or Ik10) takes on a defined status.
3. The limit comparators become inactive.

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

Supply
normally 220 V, +10 %/−15 %, 40−60 Hz, can be changed by internal solder links to 110 V, +10 %/−15 %, 40−60 Hz, (see Section 9); other voltages to special order

Loading
15 VA approx.

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 chassis (connected to ground)

Protection
to DIN 40 050
front IP 54
rear IP 20

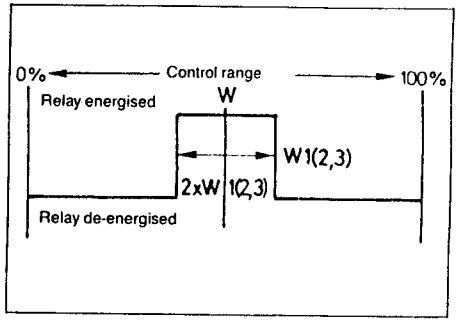
Operating position
unrestricted

Interfaces
V.24 (RS232C) or RS422/485
(isolated from the remaining electronics)
Instrument addresses (on RS422/485) can be configured.
Operation in communication mode

Limit comparator
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 in the configuration plane.

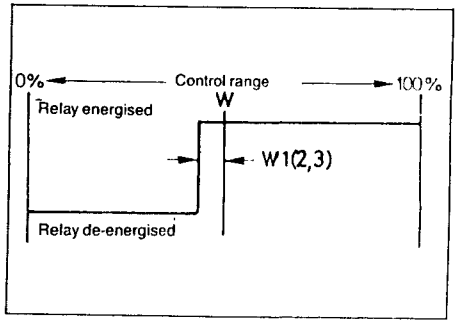
Functions Ik1–Ik8

❶ Limit comparator Ik1
Relay is energised when the process is within the set window, de-energised when the process is outside the window.



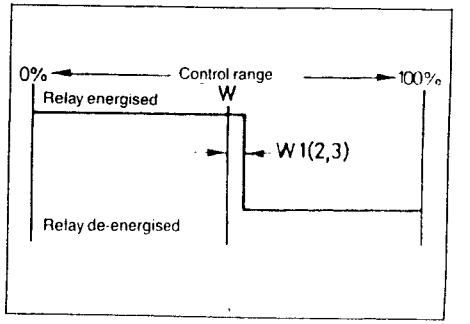
❷ Ik2 as Ik1
but relay action reversed

❸ Ik3, low alarm only
Relay is de-energised when process is below alarm setting.



❹ Ik4 as Ik3
but relay action reversed

❺ Ik5, high alarm only
Relay is de-energised when process is above alarm setting.

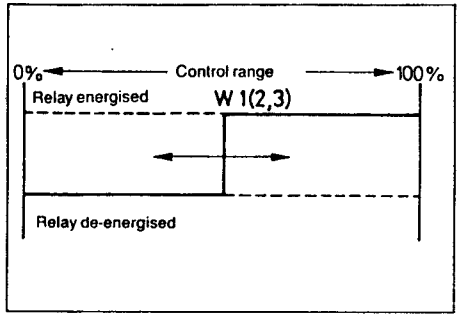


❻ Ik6 as Ik5
but relay action reversed

2 TECHNICAL DATA

❼ Ik7, adjustable over full control span
Relay is energised when process is above alarm setting.

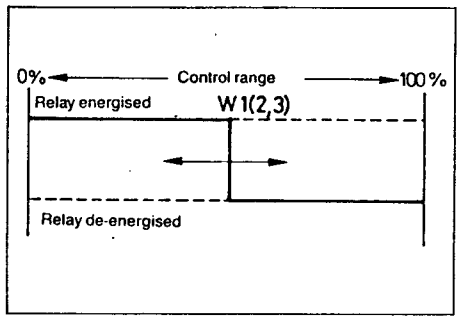
❽ Ik8 as Ik7
but relay action reversed



Alarm functions (relay Xk3)

❾ Ik9, adjustable over full control span
Relay is energised on failure or short-circuit of sensor.

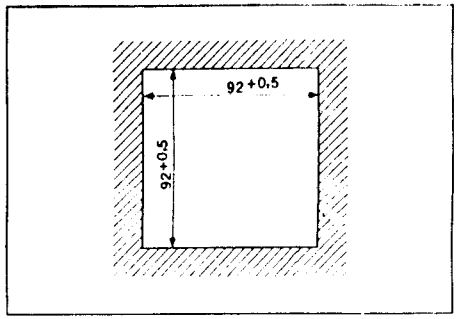
❿ Ik10 as Ik9
but relay action reversed



3 INSTALLATION

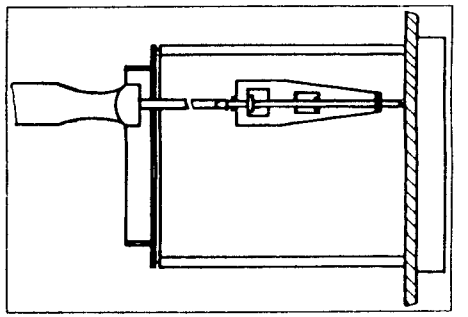
3.1 Location and climatic conditions

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 conditions or fumes reduce the life of the instrument.

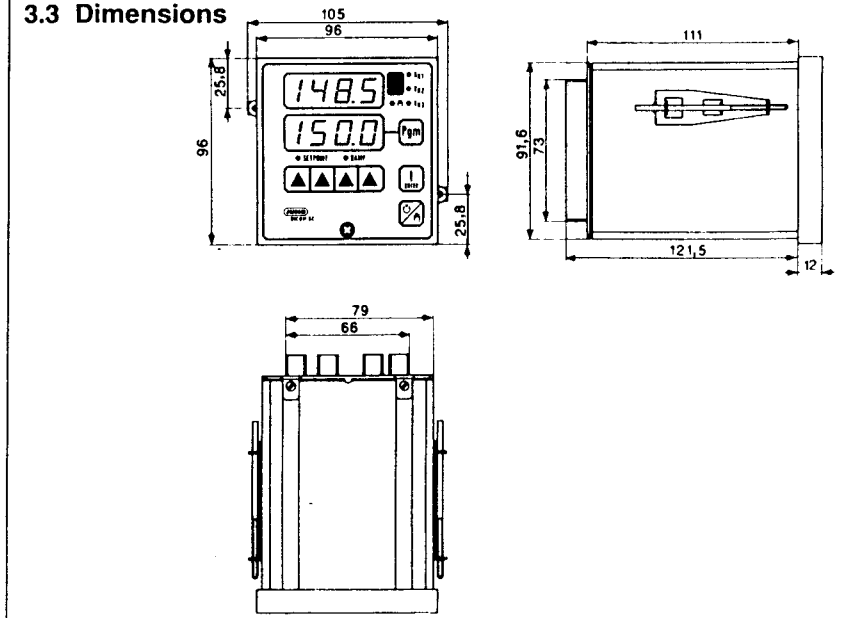


3.2 Fitting in position

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

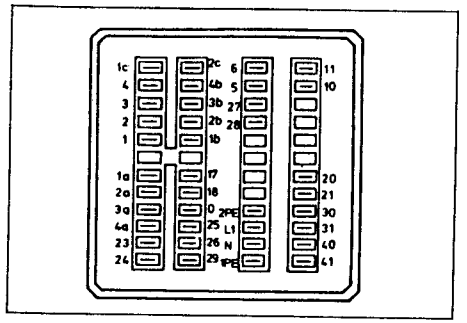


3.3 Dimensions



The electrical connections are made in accordance with the connection diagram below. The choice of cable and the installation 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



4.1 Connection diagram

Connection for			Terminals			
Proportional output 1			5 + 6 –			
Proportional output 2			27 + 28 –			
			Relay output	Semiconductor relay output	Logic control output i20/u5	
Relay or semiconductor relay or logic outputs	1	Xk1	20 (P) pole 21 (S) closing	20 21	20 + 21 –	
	2	Xk2	30 (P) pole 31 (S) closing	30 31	30 + 31 –	
	3	Xk3	40 (P) pole 41 (S) closing	40 41	40 + 41 –	
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		
		TxD	25	Transmitted data		
		CTS	24	Clear to send		
		RTS	26	Request to send		
		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 56 Ω, 22 nF

Inputs

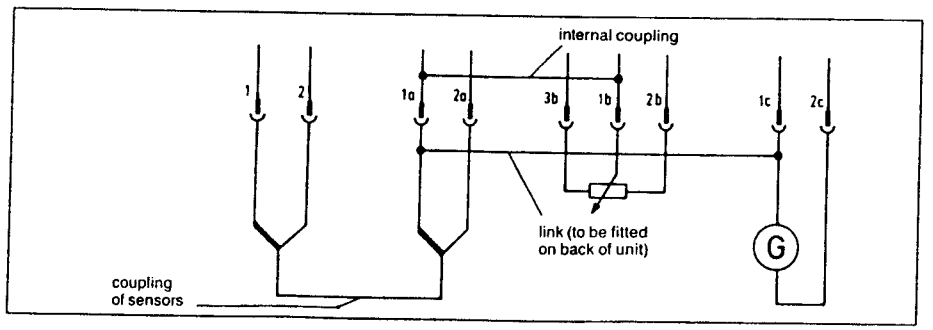
The controller has 4 analogue inputs. For functions of the inputs see instrument label and description on page 3.

Process 1	Input 2	Input 3	Input 4
resistance thermometer/ thermocouple/ current/voltage	resistance thermometer/ thermocouple/ current/voltage	resistance transmitter	current/voltage

Input	Terminals						
		Input					
		1	2	3	4		
Thermocouple	t	1 4	1a 4a			– +	
Resistance thermometer in 3-wire circuit	w	1 2 3	1a 2a 3a				
Resistance thermometer in 4-wire circuit	w...vl	1 2 3 4	1a 2a 3a 4a				
Current/voltage	e	1 2	1a 2a		1c 2c	– +	
Resistance transmitter with 3-wire connection	w...wfg			1b 2b 3b		S = slider E = end A = start	
External contact 1		17 + 0 GND					
External contact 2		18 + 0 GND					

4.2 Important notes on installation

- All sensor and signal lines should where possible be run separately from the control and supply cables.
- Where several electronic units are installed it is preferable for each to have a separate supply cable including ground.
- Screened cables should be used; they should only be grounded at one end at the controller (terminal 2PE or ground terminals of housing on the back panel).
- Where possible provide physical separation between electronic units and contactors.
- If there are inductive loads close to the unit, such as contactors, solenoid valves etc., it is advisable to reduce interference by fitting an RC module to the contactor coil.
- No control circuit (relay, contactor) should be connected to the supply terminals of the instrument.
- Please observe the appropriate safety regulations for overtemperature monitoring.
- When using several inputs the probes or transducers must be connected together at a single point. On this controller the inputs for current, voltage and thermocouple are decoupled from each other (5 V max.) between the terminals 1, 1a, 1b, 1c. The resistance and resistance transmitter inputs are connected together and to the other inputs. When connecting up several sensors the following example should be noted:



5.1 Planes and blockages

For clearer identification of the large number of possible programming inputs the controller data are arranged in three distinct planes: operating plane, parameter plane and configuration plane.

Operating plane/standard display

The two displays show actual value and setpoint. The setpoint can be changed. It is also possible to change over to manual operation.

Parameter plane

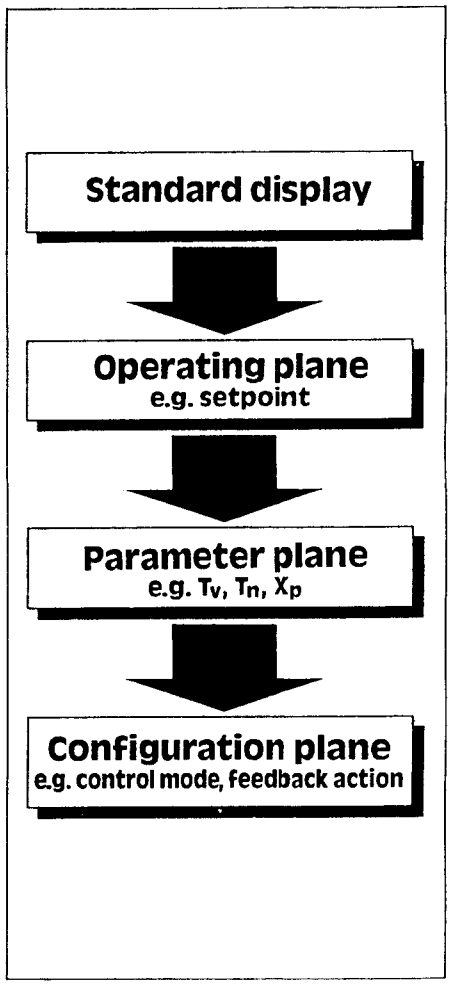
In this plane the controller can be matched to the process. The individual parameters are displayed sequentially as value and symbol. Only those parameters are indicated which correspond to the particular controller model (see Section 6).

Configuration plane

This plane serves to adapt the controller to the particular application. The control is out of action. The factory setting can be changed at any time however this is seldom necessary, e.g. when the control application is altered (see Section 7).

In addition it offers a choice whether the controller on switching on operates with the factory settings in the configuration plane or whether the data entered by the user are used (see Section 9).

The three planes can be blocked with internal switches (see Section 9).



Plane	Blockage	Controller data
Operating plane	Access possible	Adjustment by user
Parameter plane	Access possible	Set at the factory; user adjustment possible
Configuration plane	Blocked at the factory	Set at the factory; user adjustment possible

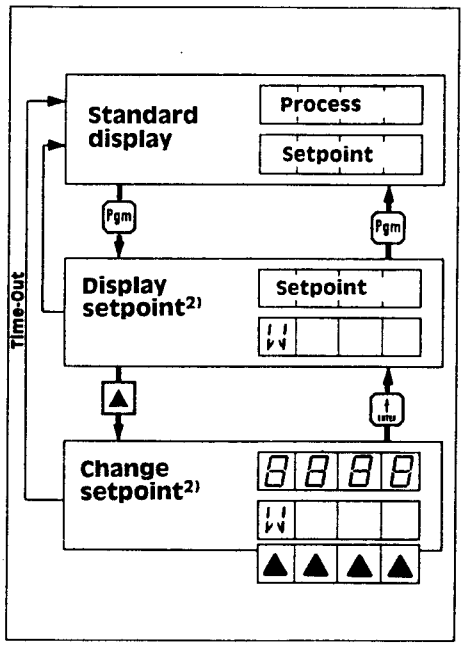
5.2 Displays

The top display shows the actual value and the bottom display shows the setpoint.

5.3 Displaying process and setpoint and changing setpoint

In the standard arrangement the process is shown in the upper display and the setpoint in the lower display. After pressing the "Pgm" key the top display shows the setpoint and the bottom display the parameter name W. The setpoint can be changed with the 4 increment keys. After an increment key has been operated the parameter name W flashes. Enter the value with the "ENTER" key. Further parameters can be displayed by pressing the "Pgm" key or the controller returns to the standard display.

If there is no input for 60 sec the controller returns automatically to the standard display (time-out).



1) In the configuration plane Code C 151 it is possible to include 1 or 3 additional setpoints in the operating plane.

5.4 Manual operation

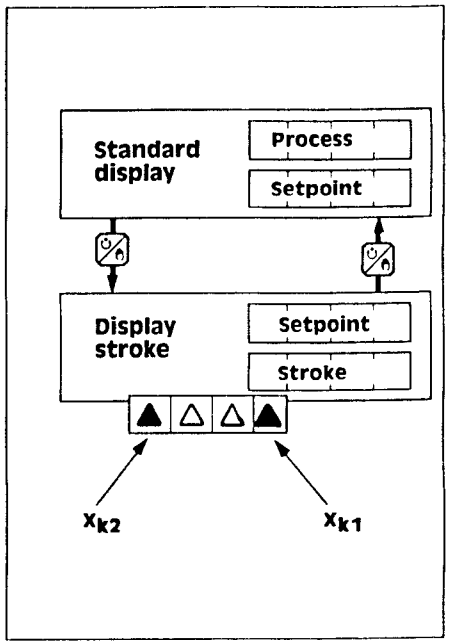
The controller is supplied with the manual operation blocked. This operating mode becomes accessible with the internal switch S 301.3 (see Section 9).

Note:

Manual operation is not possible with Xp1 or Xp2 = 0.

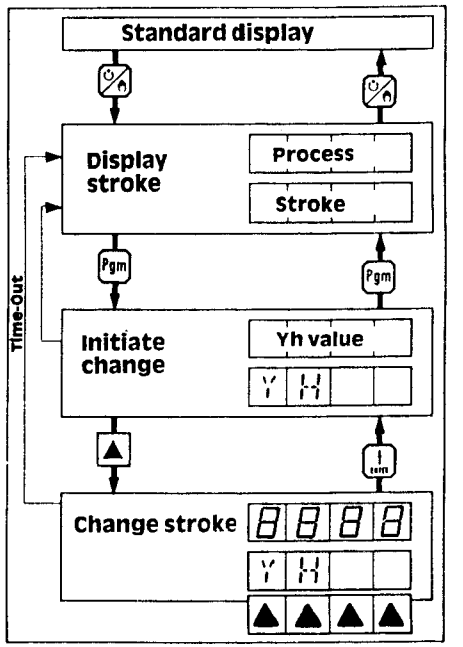
Modulating controller

The control loop is opened by pressing the auto/manual key. The two displays show the process and the actual stroke. The stroke is changed with the left and right increment keys within the range 0–100 %. The actuator opens or closes continuously while the key remains depressed. After operating the auto/manual key the controller returns to the standard display and is again on automatic operation.

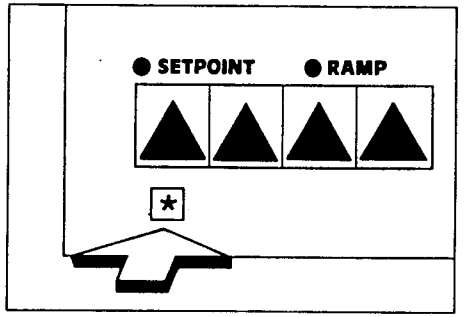


Single-setpoint, double-setpoint and proportional controller

The control loop is opened by pressing the auto-manual key. The two displays show the process and the actual stroke. After "Pgm" the stroke is shown in the top display, the bottom display shows the parameter name Yh. The stroke can be changed with the increment keys within the range 0–100 % (–100/0/+100 % on the double-setpoint controller). After operating the auto/manual key the controller returns to the standard display and is again on automatic operation.

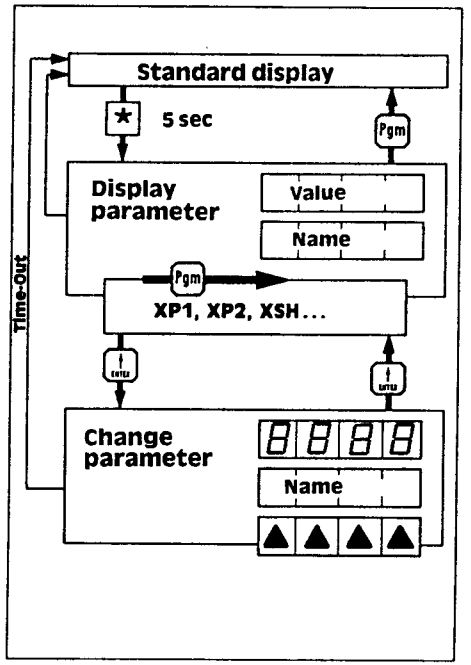


Access to the parameter plane is obtained by pressing the key (✳) for 5 seconds. The key is located on the controller front panel below the left increment key (not visible).



6.1 Displaying and changing parameters

The parameters are called up in sequence with the "Pgm" key. The parameters of the individual controller versions are listed in the Table on the opposite page.
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 entered with "ENTER", further parameters are displayed with "Pgm".
In case of inappropriate inputs the top display shows the minimum or maximum value permitted.



6.2 Parameter table

Single-setpoint controller with two limit comparators

Symbol	Parameter	Feedback action				Adjustment range	Factory setting
		none[1]	PD	PID	PD/PID		
XP	Proportional band	—	■	■	■	Xp1 = 0 – 9999 digit	0 digit
XD	Differential	■	—	—	—	Xd1 = 1 – 9999.9 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 %
RAMP[2]	Ramp slope	■	■	■	■	RAMP = 0.0 – 999.9 digit / min(h)	0.0 digit / min(h)[3]

Double-setpoint controller with one limit comparator

Symbol	Parameter	Feedback action				Adjustment range	Factory setting
		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	—	■	■	■	Cy1 = 0.1 – 99.9 sec	20.0 sec
CY2	Cycle time	—	■	■	■	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 %
RAMP[2]	Ramp slope	■	■	■	■	RAMP = 0.0 – 999.9 digit / min(h)	0.0 digit / min(h)[3]

Modulating controller with one limit comparator

Symbol	Parameter	Feedback action				Adjustment range	Factory setting
		none[1]	PI	PID	—		
XP1	Proportional band	—	■	■	—	Xp1 = 0 – 9999 digit	0 digit
XSH	Contact spacing	■	■	■	—	XSh = 0 – 999.9 digit	0 digit
XD1	Differential	■	—	—	—	Xd1 = 1 – 999.9 digit	1.0 digit
TN	Reset time	—	■	■*	—	Tn = 1 – 9999 sec	350 sec
RAMP[2]	Ramp slope	■	■	■	■	RAMP = 0.0 – 999.9 digit / min(h)	0.0 digit / min(h)[3]

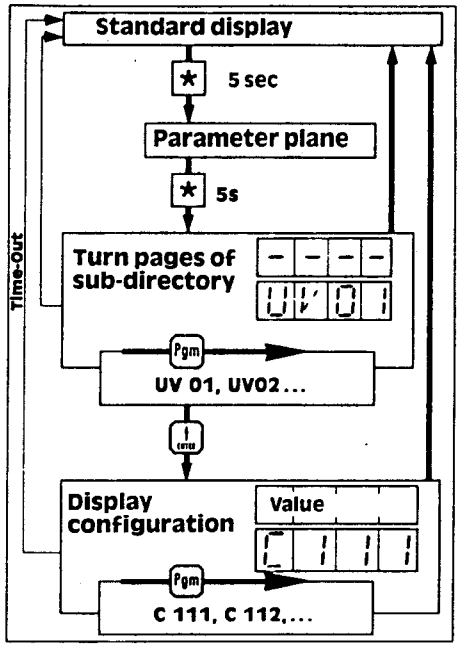
Proportional controller with three limit comparators

Symbol	Parameter	Feedback action				Adjustment range	Factory setting
		P	PI	PD	PID		
XP1	Proportional band	■	■	■	■	Xp1 = 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 %
RAMP[2]	Ramp slope	■	■	■	—	RAMP = 0.0 – 999.9 digit / min(h)	0.0 digit / min(h)[3]

■ adjustable ▭ factory setting * Tv = Tn/4.5 [1] Xp = 0 means "feedback switched off"
[2] option [3] 0.0 means "ramp function stopped", min/h can be configured in UV05, Code C151

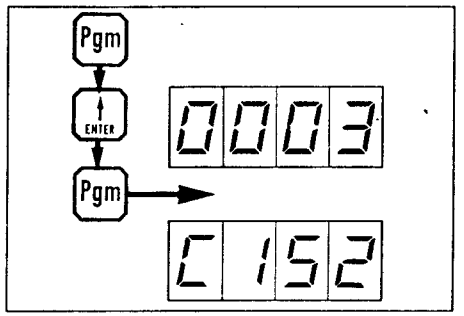
7.1 Displaying configuration data

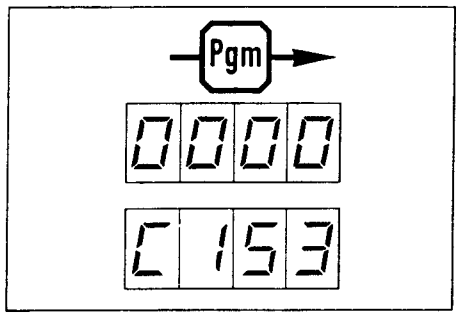
The configuration plane can only be accessed from the parameter plane.
The configuration data are divided into nine sub-directories UV01–09.
The step "Turn pages of sub-directory" permits rapid location of the configuration code.



- **Example:**

Which control mode is selected; Code 152?
Turn pages up to sub-directory UV05; after pressing "ENTER" and "Pgm" the display is as shown alongside. As seen from the configuration table, the number 3 in the top display represents the single-setpoint controller and min. contact.
After pressing "Pgm" all the codes of the sub-directory UV05 appear in sequence; this is followed by the pages of the subsequent sub-directory being turned over.

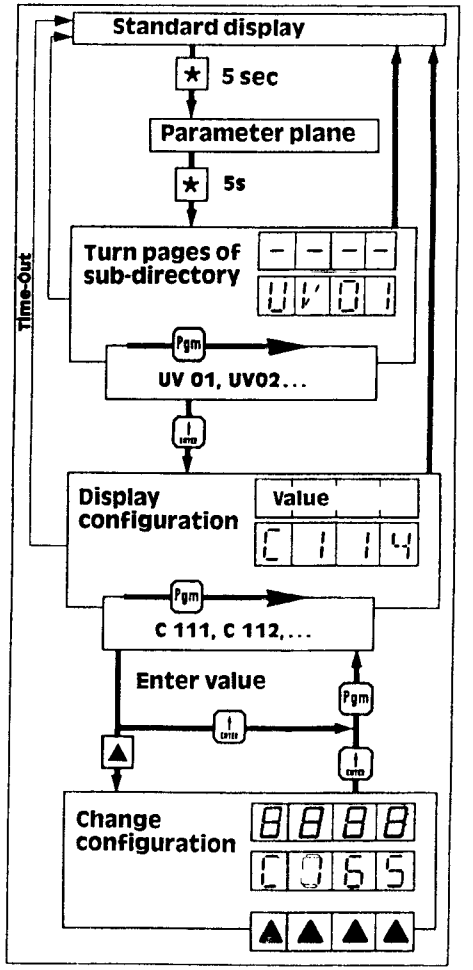




7.2 Changing configuration data

Access to the configuration plane is only possible after the plane has been unblocked and the data transfer of the factory-set parameters has been switched off (see Section 9).

Many changes in configuration data also require adjustment of other parameters. If, for example, the control action is changed from double-setpoint controller to single-setpoint controller, feedback action, proportional band etc. must also be set again. If a parameter has been omitted this would result in an undesirable or faulty control action.
The controller is therefore provided with operator guidance which only permits return to the operating plane or standard display after all the necessary changes have been made completely and logically.
Following an incorrect input the top display flashes and requests correction of the input.
Every unintentional change of a configuration parameter may result in a change to other parameters.
The status as supplied from the factory can always be restored by reading in the factory-set parameters.



Call-up configuration parameter, change it if required and confirm the input with "ENTER".
After pressing "Pgm" the next parameter to be changed is displayed. Flashing of both displays indicates that operator guidance is activated.
The value shown in the top display is either entered with "ENTER" or a new value is input.
When all the necessary parameters have been changed or acknowledged the controller returns to the standard display.

7.3 Configuration Tables

UV01	Inputs		Input 1	Input 2	Input 3	Input 4
C 111	Function **cannot be configured** Function depends on input board fitted	no function ____ 0 process ____ 1 reference temperature with temperature difference measurement ____ 2 display of a second process variable ____ 3 stroke retransmission ____ 4 external setpoint ____ 5 external reference temperature (Pt 100) ____ 6	1	0 2 3 6	0 4	0 5
C 112	Transducer **cannot be configured**	channel off ____ 0 resistance thermometer Pt 100 (500*) ____ 1 thermocouple (internal or external reference temperature) ____ 2 thermocouple (fixed external reference temperature) ____ 3 resistance transmitter with 3-wire connection ____ 4 current 0 – 20 mA or voltage 0 – 10 V* ____ 5 current 4 – 20 mA ____ 6 * if provided in hardware	1 2 3 5 6	0 1 2 3 5 6	0 1 4	0 5 6

On inputs 1 and 2:						
C 113	Linearisation **Items 2 – 10 can be configured**	linear – 1999 to + 9999 digit ____ 0 Pt 100(500*) – 199.9 + 850.0 °C ____ 1 Fe-Con L – 200 + 900 °C ____ 2 NiCr-Ni K – 200 + 1400 °C ____ 3 Pt10Rh-Pt S 0 + 1800 °C ____ 4 Pt13Rh-Pt R 0 + 1800 °C ____ 5 Pt30Rh-Pt6Rh B 0 + 1820 °C ____ 6 Cu-Con U – 200 + 600 °C ____ 7 MoRe5-MoRe41 0 + 1990 °C ____ 8 Cu-Con T – 200 + 400 °C ____ 9 Fe-Con J – 200 + 900 °C ____ 10 * if provided in hardware				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 **cannot be configured**	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 121	External reference temperature (see C 112)	range 0 + 100 °C standard setting: 50 °C	x	x	x	x
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	0.0	x	x	x	x
C 125[1]	End of range process	100.0	x	x	x	x
C 126[1]	Start of range input 2	0.0	x	x	x	x
C 127[1]	End of range input 2	100.0	x	x	x	x
C 128[1]	Start of range input 3	0.0	x	x	x	x
C 129[1]	End of range input 3	100.0	x	x	x	x
C12A[1]	Start of range input 4	0.0	x	x	x	x
C12B[1]	End of range input 4	100.0	x	x	x	x

[1] Only with current and voltage inputs
Standard setting: start of range 0 digit, end of range 100 digit. Other ranges can be selected.

UV03 Process value correction and adjustment of start and end of resistance transmitter for stroke retransmission			▲	▲	▲	▲
C 131	Special user correction to Section 10.2 (factory-set to 0)	X0 input 1	x	x	x	x
C 132		X1 input 1	x	x	x	x
C 133		X0 input 2	x	x	x	x
C 134		X1 input 2	x	x	x	x
C 135		X0 input 3 } see Section 10.3	x	x	x	x
C 136		X1 input 3 }	x	x	x	x
C 137		X0 input 4	x	x	x	x
C 138		X1 input 4	x	x	x	x

x = input within range of values

UV03 Measured values for programmed indication			▲	▲	▲	▲
C 139	Not programmable, values are only displayed (see Section 10.2)	X0' input 1 0	x	x	x	x
C 13A		X1' input 1 100	x	x	x	x
C 13B		X0' input 2 0	x	x	x	x
C 13C		X1' input 2 100	x	x	x	x
C 13D		X0' input 3 0	x	x	x	x
C 13E		X1' input 3 100	x	x	x	x
C 13F		X0' input 4 0	x	x	x	x
C 13G		X1' input 4 100	x	x	x	x

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

[1] not on proportional controller

[2] only if provided in hardware, see Section 9

UV05 Controller setting						
C 151	Controller and ramp function	controller controller with changeover from internal setpoint to external setpoint selection controller with external setpoint selection and correction controller with 1 extra internal setpoint controller with 3 extra internal setpoints	0 0 0 0 0	0 0 0 0 0		0 1 2 3 4
		no ramp function ramp function with gradient min ramp function with gradient h	0 0 0	0 0 0	0 1 2	
C 152	Controller type	proportional controller with falling characteristic[3] proportional controller with rising characteristic[3] single-setpoint controller with max. contact (relay de-energised for process above setpoint) single-setpoint controller with min. contact (relay de-energised for process below setpoint) double-setpoint controller modulating controller [3] First select controller output Y (C 141 or C 145)	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 1 2 3 4 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] [2] The feedback action is only effective for proportional band Xp ≠ 0	P PI PD PID PD/PID	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 1 2 3 4

x = input within range of values

UV06	Limit comparators		▲	▲	▲	▲
C 161	Limit comparator relay 1[1]	no function	0	0	0	0
		function Ik1	0	0	0	1
		function Ik2	0	0	0	2
		function Ik3	0	0	0	3
		function Ik4	0	0	0	4
		function Ik5	0	0	0	5
		function Ik6	0	0	0	6
		function Ik7	0	0	0	7
		function Ik8	0	0	0	8
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 relay 2[1]	no function	0	0	0	0
		function Ik1	0	0	0	1
		function Ik2	0	0	0	2
		function Ik3	0	0	0	3
		function Ik4	0	0	0	4
		function Ik5	0	0	0	5
		function Ik6	0	0	0	6
		function Ik7	0	0	0	7
		function Ik8	0	0	0	8
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 relay 3	no function	0	0	0	0
		function Ik1	0	0	0	1
		function Ik2	0	0	0	2
		function Ik3	0	0	0	3
		function Ik4	0	0	0	4
		function Ik5	0	0	0	5
		function Ik6	0	0	0	6
		function Ik7	0	0	0	7
		function Ik8	0	0	0	8
		function Ik9	0	0	0	9
		function Ik10	0	0	0	A
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 or limit comparators depending on the controller type.

x = input within range of values

UV07	Interface			▲	▲	▲	▲
C 171	Instrument address	range: 0 – 31		x	x	x	x
C 172	Data format **cannot be configured**	parity bit	no parity				0
			parity odd				1
			parity even				2
		1 stop bit				1	
		2 stop bits				2	
		7 data bits			7		
		8 data bits			8		
		baud rate	9600	0			
			4800	1			
			2400	2			
			1200	3			
			600	4			
			300	5			
			150	6			
C 173	Special functions **cannot be configured**	terminal mode	OFF	0	0		0
			ON	0	0		1
		end character	CR	0	0	0	
			CR/LF	0	0	1	

UV08	Display			▲	▲	▲	▲
C 181	Alphanumerical display on standard display **cannot be configured**	setpoint		0	0		1
	Numerical display **cannot be configured**	process		0	0	0	
C 182	Parameters in the operating plane **cannot be configured**	controller output signal Y		0	0	1	0
		second process variable		0	1	0	0
C 183	Hold time (time-out) **cannot be configured**	standard setting: 60 sec		0	0	6	0

x = input within range of values

UV09	Special functions		▲	▲	▲	▲
C 191	Controller output signal on overrange or underrange[1]	0 – 100 % or – 100/0/ + 100 % _____ With an input of 101 the controller signal current before the error continues to be output.	x	x	x	x
	On modulating controller	100 output relay Xk1 energised 0 output relay Xk2 energised 101 output relays Xk1 and Xk2 de-energised				
C 192	Time constant of relay 1[2]	range: 0 – 60 sec _____ standard setting: 0 sec			x	x
C 193	Time constant of relay 2[2]	range: 0 – 60 sec _____ standard setting: 0 sec			x	x
C 194	Function of external contacts[3] (with Code 55)				K1[4]	K2[4]
		no function _____	0	0	0	0
		starting self-optimisation _____	0	0	1	1
		changeover auto/manual _____	0	0	2	2
		manual mode blocked _____	0	0	3	3
		keys blocked _____	0	0	4	4
		external stop of ramp function _____	0	0	5	5

[1] On single and double-setpoint controller and proportional controller

[2] min. switch-on time, e.g. for burner control

[3] If controller function 1 or 3 is configured in C 151, changeover takes place through external contact 1. If C 151 is configured as controller function 4, change-over takes place through contacts 1 or 2.

[4] The two contacts must not have the same function!

x = input within the range of values.

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:
Readin the factory-set data from the EPROM, i.e. switch off supply voltage; set internal switches 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.
The controller reads in the data set at the factory.
If Er 20 remains in the display after switching on, the controller must be returned to the factory for checking.

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.

8.2 Action on supply failure

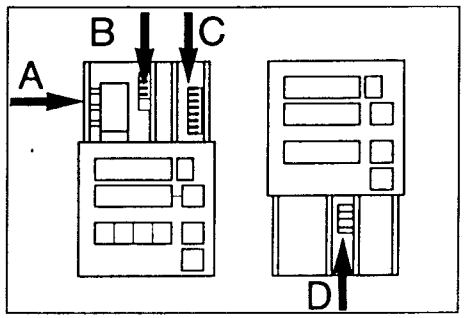
After supply failure the controller returns to the standard display. An exception is the configuration plane: after supply failure during a configuration procedure the controller returns to the last step performed.
The data are backed up by a lithium battery for more than 5 years.

8.3 Action on failure or short-circuit of sensor

See Technical Data, Section 2, or Configuration Table UV09, C191.

Analogue output

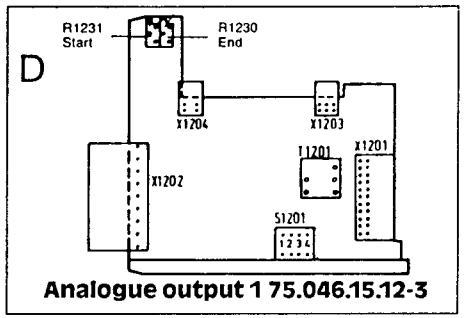
The output signal is set on DIL switches. The changeover between 0–20 mA and 4–20 mA is made through the software and is described in Section 7.3 (Code C 144). The controller is supplied fully adjusted. If a different output signal is selected on the switches S1001.1–S1001.4 or S1201.1–S1201.4, a slight re-adjustment of the output signal with the potentiometers R1030 and R1031 or R1230 and R1231 is advisable.



Analogue output 1

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

x = closed o = open

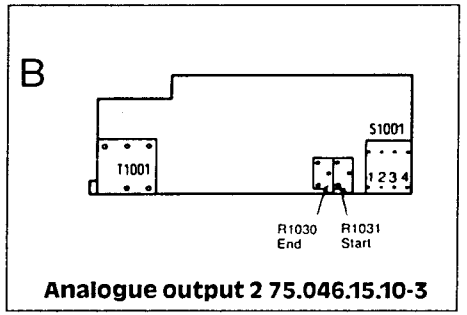


Analogue output 1 75.046.15.12-3

Analogue output 2

Code 30	S1001.1	S1001.2	S1001.3	S1001.4
0 + 10 V	o	x	x	o
– 10 + 10 V	x	x	x	o
0(4) + 20 mA	o	o	o	x
– 20 + 20 mA	x	o	o	x

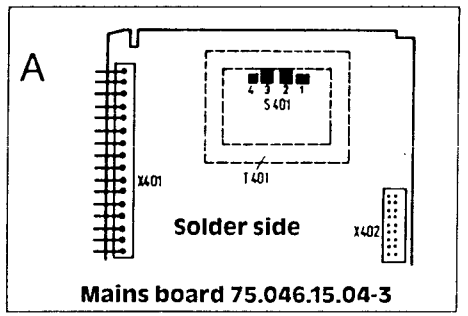
x = closed o = open



Analogue output 2 75.046.15.10-3

Voltage supply

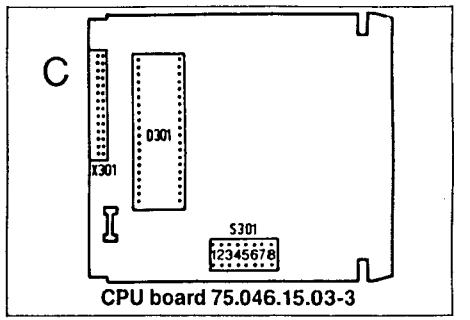
Voltage	Solder links
220 V	■ 1 ■ 2 ■ 3 ■ 4
110 V	■—■ 1 2 ■—■ 3 4



Mains board 75.046.15.04-3

☐: standard setting

Switch 7 is provided for service purposes only and is set to the top position at the factory.



CPU board 75.046.15.03-3

Plane blockage

Planes blocked	S 301	
	1	2
Operating plane (only call-up permitted) Parameter plane Configuration plane	↑	↓
Parameter plane Configuration plane	↓	↑
Configuration plane	↑	↑
No blockage	↓	↓

All planes are blocked; no access to the parameter and configuration planes. Process variables of the configuration plane can be called up but cannot be changed.

No access to these planes.

No access to this plane.

All planes can be accessed.

Self-optimisation

On fast control processes, better optimisation may be achieved by changing over switch S301.8.

Self-optimisation	S 301	
	8	
slow process, Tg > 2 min	↑	
fast process Tg < 2 min	↓	

☐: factory setting

9 INTERNAL ADJUSTMENTS

Data acceptance

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

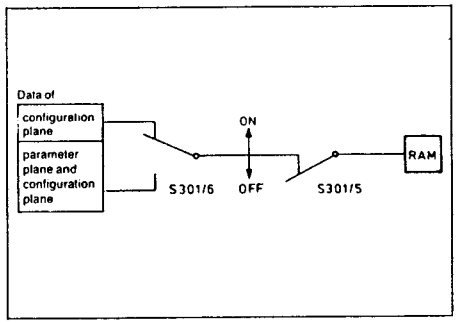
This means the parameters can be called up but cannot be changed.

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 setting or setting as supplied from the factory.

Factory-set data	S301. 5	S301. 6
yes	↑	
no	↓	
Acceptance in		
Configuration plane		↑
Configuration and parameter plane		↓



Manual operation

Manual operation is blocked at the factory. Switch S301.3 must be changed over when using the control station.

Manual operation	S301. 3	
blocked	↑	
free	↓	

Input filter

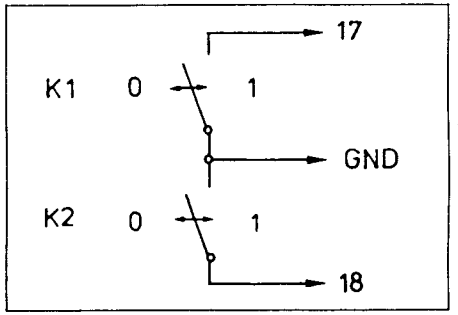
Digital filter for smoothing the input signal; time constant 1 sec.

Input filter	S301. 4	
on	↑	
off	↓	

□: standard setting

10 ADDITIONAL FUNCTIONS

10.1 Meaning of the external contacts



Selection of additional internal setpoints

Up to 4 internal setpoints can be used which can be selected by external floating contacts (configuration C 151).

The additional setpoints are set in the operating plane (see Section 5.3); the current setpoint W is displayed on operating the Pgm key.

A total of 5 setpoints are thus displayed in the operating plane, of which W is always identical with one of the additional 4 setpoints.

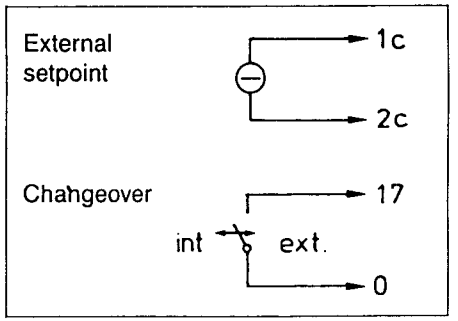
Depending on the switch position (K1, K2) the current setpoint W is equal to W1, W2, W3 or W4.

Example:
If setpoint W is programmed in switch position K1 = 0 and K2 = 1, W equals W3.

	K1	K2
Setpoint 1:	0	0
Setpoint 2:	1	0
Setpoint 3:	0	1
Setpoint 4:	1	1

External setpoint selection

The external setpoint is set as proportional current 0(4)–20 mA or voltage 0–10 V (configuration C 112). The changeover from internal to external setpoint is made with an external floating contact.



External setpoint selection with setpoint correction from the front (C151)

The actual external setpoint can be corrected with the keys.
Example: display 170.3, desired display 175.3. The setpoint displayed is overwritten with the desired setpoint using the increment keys. All external setpoints are then corrected automatically, in the example by +5 °C.

For further functions of the external contacts see Section 10.6!

10.2 Correction of process indication by user

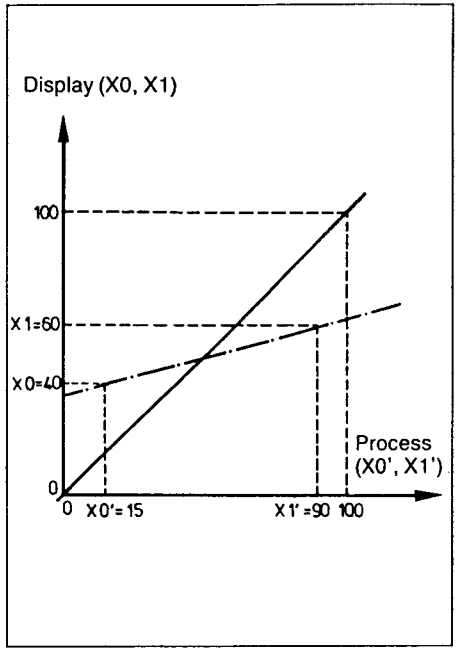
A process indication differing from the desired or actual value can be corrected with the keys. This is useful, for example, in order to match the indication of several instruments or to compensate for the resistance of the sensor cable. Two values are input, the intermediate values are interpolated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

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).
With a process value of 90, 60 is programmed in parameter X1 (C 132).

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 setting X0 must equal X1. First X1 and then X0 is programmed to the same value. The error message ERR 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 100.



———: display before correction X0 = X0'; X1 = X1'
– – – –: display after correction

10.3 Calibration of resistance transmitter for valve stroke retransmission (on modulating controller)

The start and end can be calibrated in sub-directory UV03, Code C 135 and C 136.
Resistance transmitters between 0 – 30 Ω min. and 0 – 10 kΩ max. can be connected to the controller.
Calibration of start value:
set transmitter to start position, select Code C 135, enter 0 % and press "ENTER".
Calibration of end value:
set transmitter to end position, select Code C 136, enter 100 % and press "ENTER".

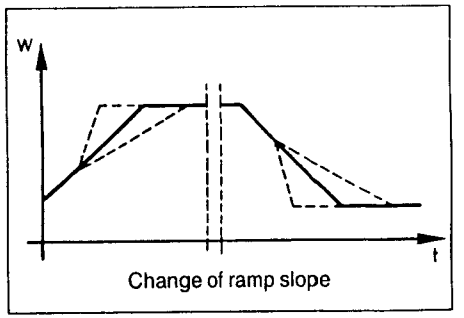
10.4 Controller with ramp function

It is possible to set a rising or falling ramp function followed by a soak phase.

WR = ramp setpoint (instantaneous setpoint)
W = final value of ramp
RAMP = slope of ramp

On reaching the end of the ramp WR equals W.

The setpoint W is the final value of the ramp which is to be reached at the programmed slope RAMP. The standard display shows the instantaneous setpoint.



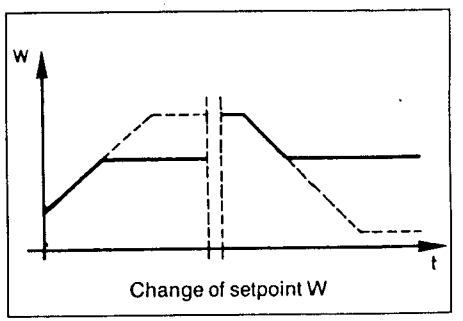
Change of ramp slope

Significance of the setpoint for the limit comparators

The settings of the limit comparators Ik1 to Ik6 during the ramp function normally refer to the ramp setpoint.

Significance of the setpoint for the analogue output:

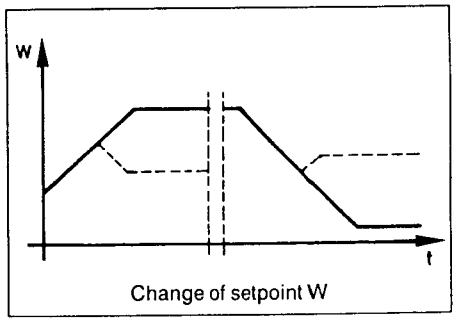
The setpoint output can be selected in the configuration plane in UV04 analogue output with Code C 131; this output then produces the value of the ramp setpoint setting.



Change of setpoint W

Settings

Parameter	Plane
Ramp function	Configuration plane Code C 151
W	Operating plane
RAMP	Parameter plane



Change of setpoint W

Action after configuration

On starting the configuration the ramp function is interrupted; the outputs become inactive; the actual value changes. When configuration has been completed the controller accepts the actual value measured at that time as the setpoint and continues the ramp function.

Action on supply failure, sensor short-circuit and failure

If the supply fails the ramp function is interrupted; the outputs become inactive; the process value changes. When the supply is restored the controller accepts the process value measured at that time as the ramp setpoint and continues the ramp function with the selected parameters.

Action during manual operation

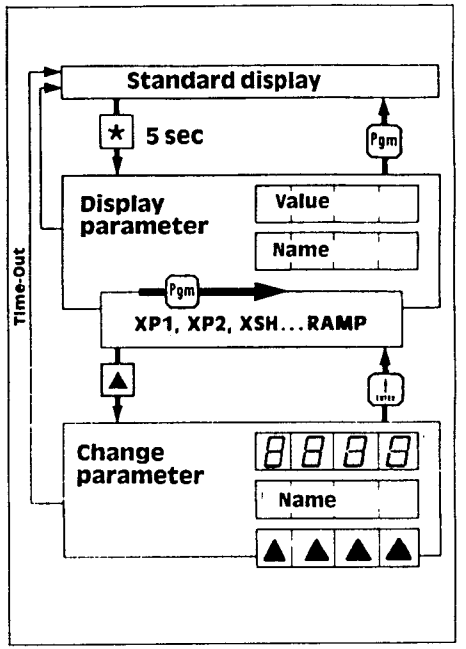
During manual operation the automatic control is discontinued. The process value is continuously accepted as the ramp setpoint. On changing to automatic operation the ramp function continues with the selected parameters.

External stop (with Code 55)

With Code 55 the configuration parameter C 194 can be used to configure an external input as external stop. Closing the external contact holds the ramp function, opening the external contact continues the ramp function. When an external stop is recognised, the alphanumerical display configured as setpoint in the standard display flashes for the duration of the external stop.
There is no provision for a stop through a key function; this can however be achieved in practice by programming RAMP = 0 from the keys or the serial interface.
(In this case the setpoint in the standard display does not flash.)

Setting the ramp slope

The parameter plane is reached by pressing the key (✳) for 5 sec. This key is located at the bottom left of the controller front panel below the left increment key (not visible). Using the "Pgm" key select the parameter RAMP (final parameter). The parameters of the various controller models are listed in the parameter table, Section 6.2. When one of the increment keys is operated to change the parameter, the parameter name RAMP flashes in the lower display.

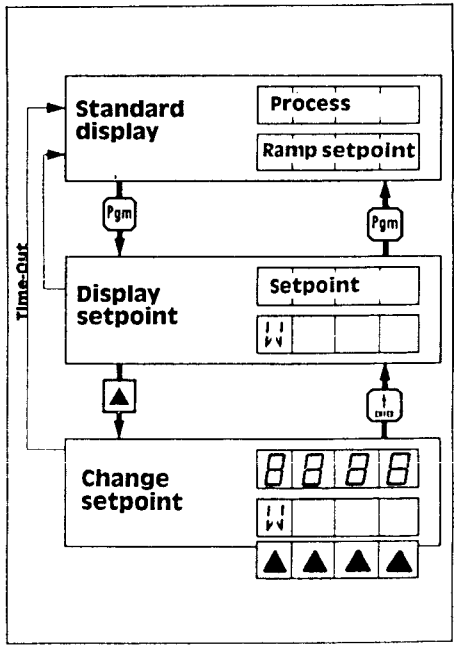


Setting the setpoint (final value) of the ramp

In the standard display the upper display shows the actual value and the lower display the setpoint. On pressing the "Pgm" key the upper display shows the setpoint, the lower display the parameter name W. The setpoint can be changed with the 4 increment keys. After an increment key has been operated the parameter name W is flashing. The value is entered with the "ENTER" key.

The controller starts up and begins the ramp function

If there has been no input for 60 sec the controller automatically returns to the standard display (Time-out)



10.5 Function of logic inputs

(with Code 55)

The following functions can be set up through floating contacts (terminals 0, 17, 18). The desired function can be configured in UV09, Code 194.
There is a choice of using either contact 1 (0/17) or contact 2 (0/18) for the function.

It is not permissible to use both contacts for the same function.

(1) Start of self-optimisation
(2) Changeover auto/manual
(3) Manual mode blocked
(4) Keys blocked
(5) External stop on ramp function

With function 2 the switch S301.3 has to be in the ON position (bottom position)
(see Section 9).

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 oscillation in case of an external disturbance or if the setpoint is changed.

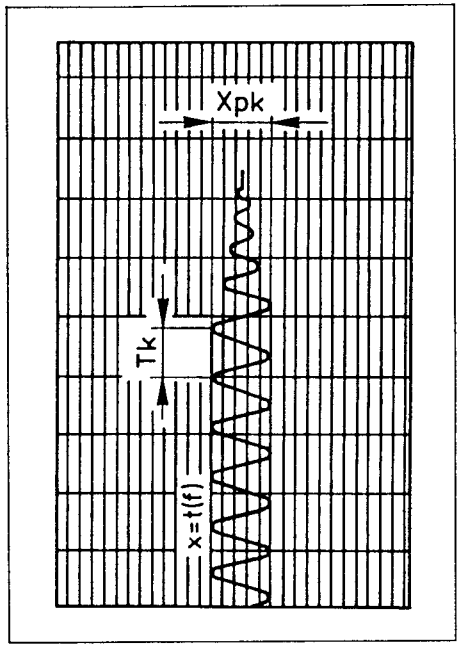
When precise process characteristics are available the control parameters for a defined operating point can be determined precisely by an involved mathematical procedure. In practice, however, precise characteristics are rarely available, and practical adjustment criteria have therefore been developed 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 base 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 can 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 Yp2 onmaximum. The proportional band Xp is then reduced slowly (by 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:

$Xp = 1.7\ Xpk \qquad Tn = 0.5\ Tk$

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

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

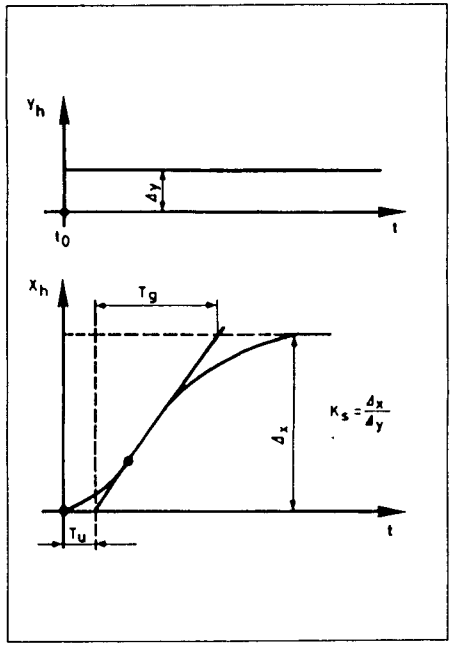
$$Ks = \frac{\Delta x}{\Delta y} = \frac{\text{output change}}{\text{input change}}$$

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_o 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.



Optimisation according to CHIEN, HRONES and RESWICK

Aperiodic control action of minimum duration, optimised for control

$$Xp = 1.7\frac{Tu}{Tg} \cdot Ks \cdot Yhs$$

$Tn = Tg$

$Tv = 0.5\ Tu$

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.

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

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

Example:

Δt = 3 min

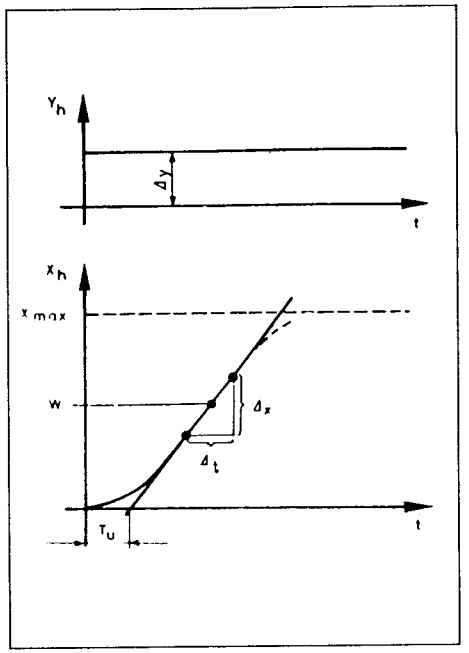
Δx = 90 °C $Vmax = \frac{\Delta x}{\Delta t} = \frac{90\ °C}{3\ min} = 30\ \frac{°C}{min}$

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

Xp = 49.8 °C

Tn = 2 Tu = 2 min

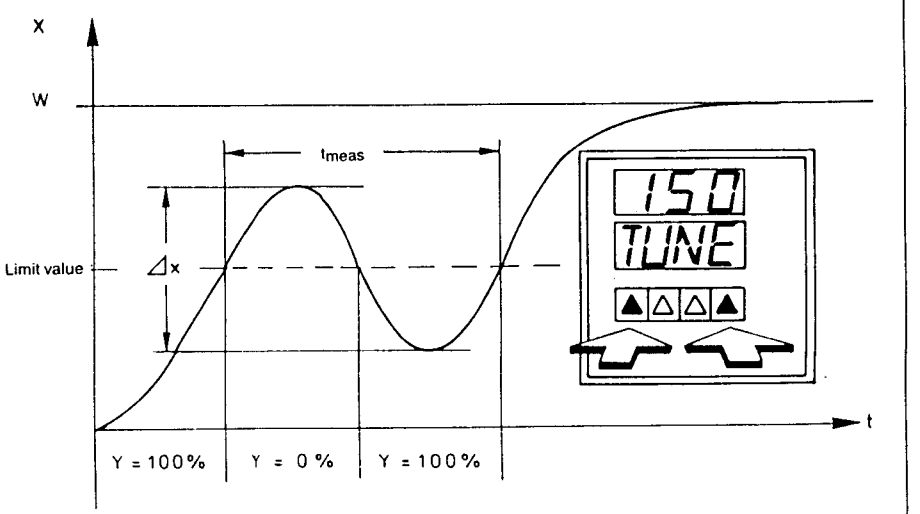
$$Tv = \frac{Tn}{4.5} = 27\ sec$$



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 SC



Oscillation, shown greatly magnified.

The controller is supplied with self-optimisation. 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 process is started by simultaneously pressing the left and right increment keys. 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 (limit value) between process and setpoint 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 after the limit value has been reached again.
The calculated control parameters are automatically transferred to the parameter plane 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 the following parameters:

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

CY = Tn/10, CY2 = CY1

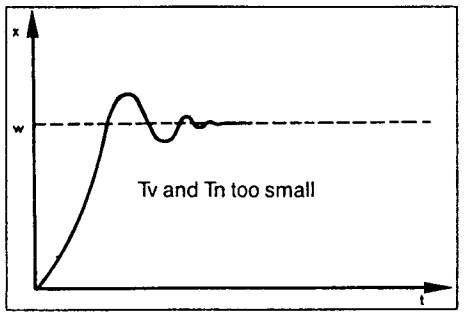
The parameters determined by optimisation can always be displayed and modified.
After the start of self-optimisation the controller is automatically set to PID action.

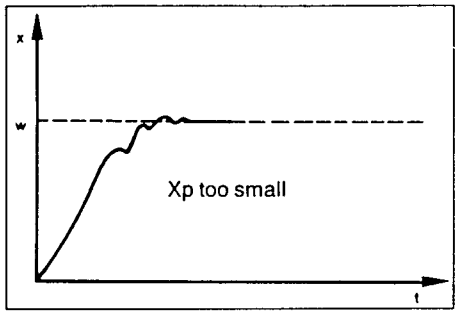
The optimisation procedure can be aborted at any time with the two centre increment keys.

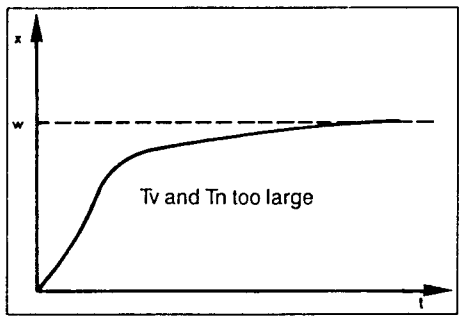
Checking the optimisation for PID action

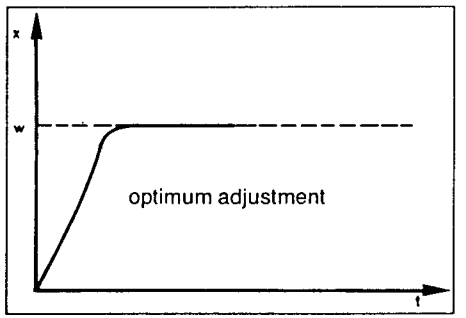
The optimum adjustment of the controller to the process can be checked by recording a start-up with closed process loop.

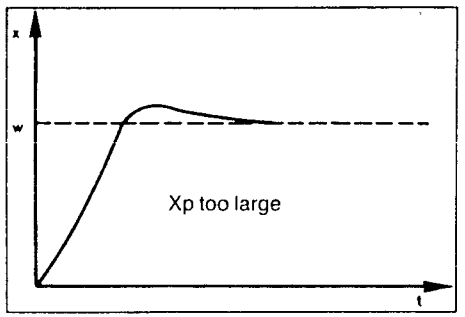
The diagrams below indicate possible incorrect adjustments and the correction required.











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 less damped control action.

mm	inch	mm	inch
0.8	0.031	91.6	3.61
4.8	0.19	$92^{+0.5}$	$3.62^{+0.02}$
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
79	3.11		