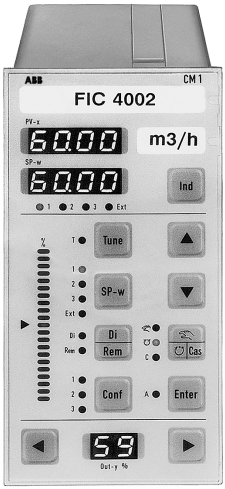
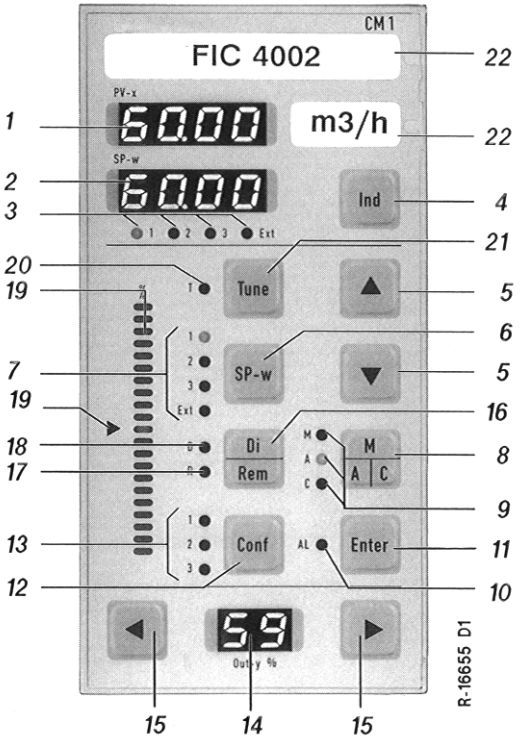
CM 1 Controller

Manual 42/61-50 EN Rev. 02



Front View



Front View

1	Process Display
2	Setpoint Display
3	Selected Setpoint Indication
4	Selection of Displayed Setpoint
5	Setpoint Adjustment Keys
6	Active Setpoint Selection
7	Active Setpoint Indication
8	Operating Mode Selection Manual/Automatic/Cascade
9	Operating Mode Indication
10	Alarm Indication
11	Enter/Alarm Acknowledgement
12	Operating Level Selection
13	Operating Level Indication
14	Output Display
15	Output Adjustment Keys
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Software version 003x
as of 01.93

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1 SHORT TECHNICAL DESCRIPTON

1-1. Functions

1-1.1 Features

The CM 1 process controller is a microprocessor-controlled, single loop process automation unit. As a compact, panel-mounted instrument with the front dimensions 72 x 144 mm (2.84" x 5.67") and a maximum installation depth of 230 mm (9") it can either be used as a local **stand-alone unit** or as an **integral part of a supervisory control system**.

The process controller CM1 is deployed on machines, plants, apparatuses, furnaces etc. in order to control and monitor temperature, pressure, flow rate or level measurements. Typical areas of application are in the fields of chemical processing, petrochemicals, metals, food and beverage industries.

The process controller CM1 must be installed to operate in locations which fulfill the mechanical and climatic conditions spelled out in the Technical Data. During commissioning, all safety instructions and general safety regulations relating to the erection and operation of electrical plants in this manual should be adhered to.

Operation may be realized directly by means of the **front panel keys** or remotely via **interface** from a PC or an operator station of the SENSYMAT process control system. Additionally, discrete inputs can be used for controlling important switching actions.

Pre-programmed **functions** stored in the memory provide solutions for a vast variety of even complex control tasks. The configuration procedure, i.e. the selection and interconnection of the corresponding functions, can either be realized by using the **front panel keys** or via **an interface** (from PC or operator station).

Direct and remote control as described above are also possible for setting the parameters, i.e. for adapting the controller to the process.

In order to facilitate the start-up of control systems, the CM 1 process controller has been provided with a **self-tuning function** which is started by depressing the "Tune"-key and serves for calculating the PID parameters. The calculated parameters are displayed by the controller and can be acknowledged, modified or ignored.

The CM 1 process controller provides the following functions:

- **P , PI , PD** or **PID control, standard, cascade control** or **override control,** control with **disturbance feed-forward** on **input** or **output**, **DDC control**
- **Standard fixed setpoint** (max. 3 adjustable and selectable values), **external setpoint (follow-up control)** or **external setpoint** with adjustable **ratio** and **bias** values **(ratio control)**
- Limit values for process value and deviation
- Setpoint and output ramp functions
- Setpoint and output limiting (HI/LO limits)
- Self-tuning of PID parameters
- Free assignment of analog and discrete inputs as well as discrete outputs to the different internal functions
- Digital filtering, linearization and square root extraction
- Adjustable scaling of analog inputs
- Access protection of the parameter and the configuration level

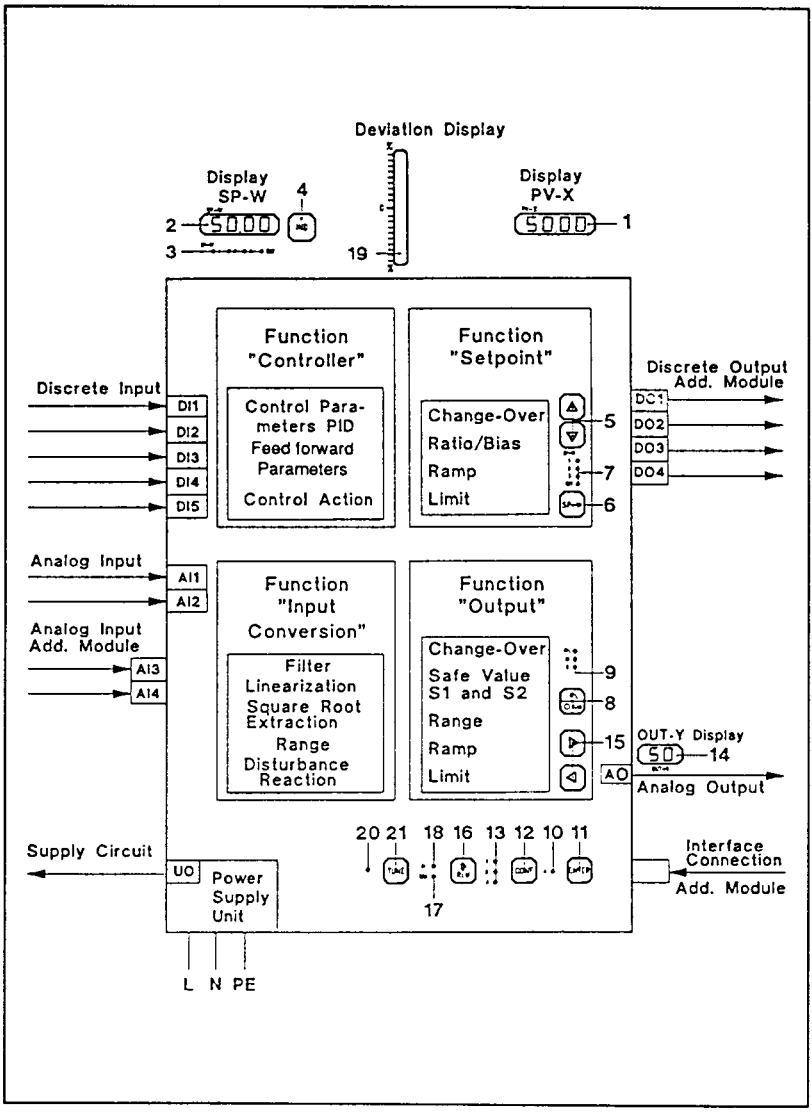


Figure 1 **Function Diagram**

The CM 1 process controller has a modular structure and is provided with 4 plug-in locations for optional modules.

The standard version includes the following inputs/outputs

- 2 analog inputs, 0/4 ... 20 mA, for process value, feed forward input, external setpoint signal, etc.
- 5 discrete inputs for external selection of setpoint, operating modes, etc.
- 1 analog output, 0/4 ... 20 mA
- 1 power supply output, 18 V, 30 mA, short-circuit proof

In addition, the following optional modules are available, which may be inserted from the rear.

- Analog input module Pt100
- Analog input module thermocouples
- Analog input module direct current/direct voltage
- Analog input module retransmitting slidewire
- Discrete output module with dry relay contacts
- Discrete output module 3-point step control output, optionally available with 2 dry relay contacts for alarms
- Interface module for communication with a PC or a process control system

Please refer to the table on page 16 and the following for technical data.

1-2 Safety

1-2.1 Safety instructions

The process controller CM1 has been designed and tested in accordance with DIN 57411, Part 1/VDE 0411, Part 1, saftety requirements for electronic measuring instruments and has been supplied in a safe condition. To retain the apparatus in safe condition, the safety instructions entitled "Caution" must be read and observed.

Failure to comply with these safety instructions can result in material damage, bodily injury or even death.

⚠ **Caution**

Connecting the Process Controller

Before any other connections are made, make sure that a protective ground terminal is connected to a protective conductor. The mains cable for the process controller must be equipped with a fuse.

Switching on the Process Controller

Before switching on the apparatus, make sure it is set to the voltage of the power supply. The mains plug shall only be inserted in a socket outlet provided with a protective ground contact. The protective action must not be negated by the use of an extension line without a protective conductor.

Making measurements

Any interruption of the protective conductor inside or outside the process controller is likely to make the apparatus dangerous. Intentional interruption is prohibited.

Balancing, Exchanging of parts, servicing, maintenance

When the apparatus is connected to its supply, terminals may be live and the opening of covers or removal of parts, (except those to which access can be gained by hand) is likely to expose live parts. Before balancing, maintenance, repair and exchange of any parts, the process controller shall be disconnected from all voltage sources before it is opened. In addition, care must be taken to avoid inadvertent contact with live parts.

Whenever work (maintenance/balancing) on a process controller becomes inevitable, it should be carried out by a person who is aware of the hazard involved.

Faults and unusual (operations)

Whenever operation hazards can be anticipated, the process controller shall be made inoperative and be secured againsy any inintended operation.

It must be assumed that the protection has been impaired when

- the process controller has visible signs of damage
- the process controller no longer functions
- the process controller has been housed in unfavourable conditions for a long time
- the process controller has been subjected to adversetransport conditions

1-2.2 Safety measures

1-2.2.1 Prior to commissioning

- Read the caution notices in the manual
- Check the process controller for mechanical damages
- Check to see if the operating voltage corresponds with the mains voltage and make sure that connection to the unit connector is correct
- Check the safety of the protective ground terminal
- Check to see if the signal connections have been made correctly
- Install the shut-down switch

⚠ **This apparatus may only be operated when properly installed.**

1.2.2.2 Start-up

- Connect the process controller with detachable terminal to the mains voltage
- Check the self-test and electrical functions (see function control)
- if the process controller functions trouble-free, disconnect it from the mains, plug on the connecting terminal, replug to mains and if necessary configure/parameterize the process controller
- In case of malfunction, disconnect the process controller from the power source and secure it against use.

1.2.2.3 When replacing parts or doing repairs

- Disconnect the process controller from the power source
- Remove the process controller
- Make sure there is equipotential bonding at the workplace (all units prone to electrostatic hazards)
- Open and/or dismantle the process controller using the fasteners provided
- Exchange or replace parts as described in manual
- Close or assemble the process controller as described in manual
- Make a visual check of the connections, switch on power and proceed as described in 1.2.2.2

1-3. Design

1-3.1 Modular Structure

The modularly structured CM 1 process controller consists of three main elements: the **front panel assembly**, the **mother board** and the **additional modules** (see figure 2).

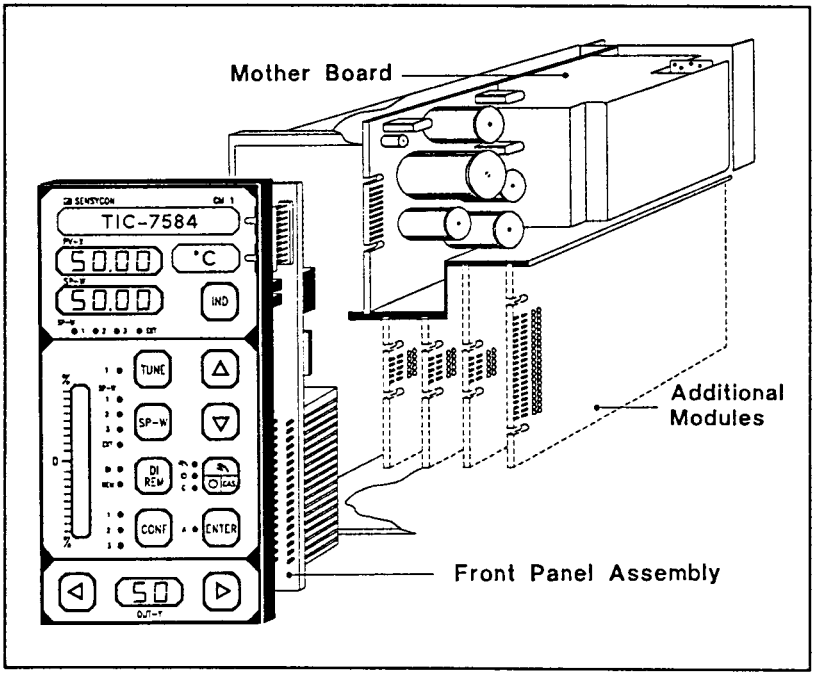


Figure 2 **Modular Structure of the CM 1 Process Controller**

1-3.2 Assemblies

The **front panel assembly** is made up of a foil-protected, splash water proof front panel with windows for label insertion, a front board with operating and display elements and a CPU board with processor, EPROM (software) and jumper for deactivating the access protection (active protection requires password or key, for details please refer to operating instructions, extended version). A joint gasket protects the controller from splash water permeation.

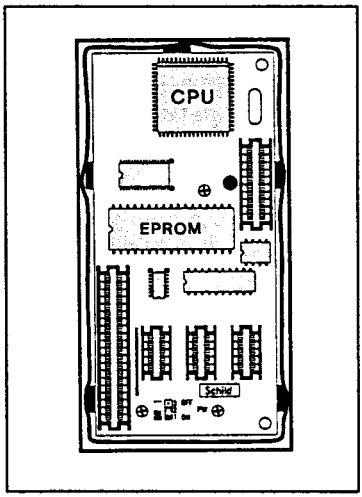


Figure 3 Front Panel Assembly Rear View

The **mother board** (fig. 4) includes the power supply unit with integral transformer, power stabilization and short-circuit proof output (18 V) as well as the circuits the standard CM 1 requires for basic signal processing.

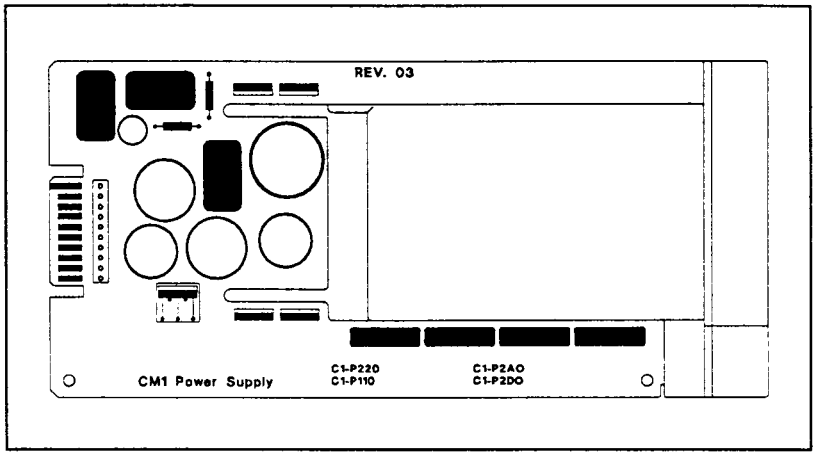


Figure 4 CM 1 Mother Board

The described components are located in a plastics housing that can easily and quickly be mounted by means of two mounting brackets (fig. 5).

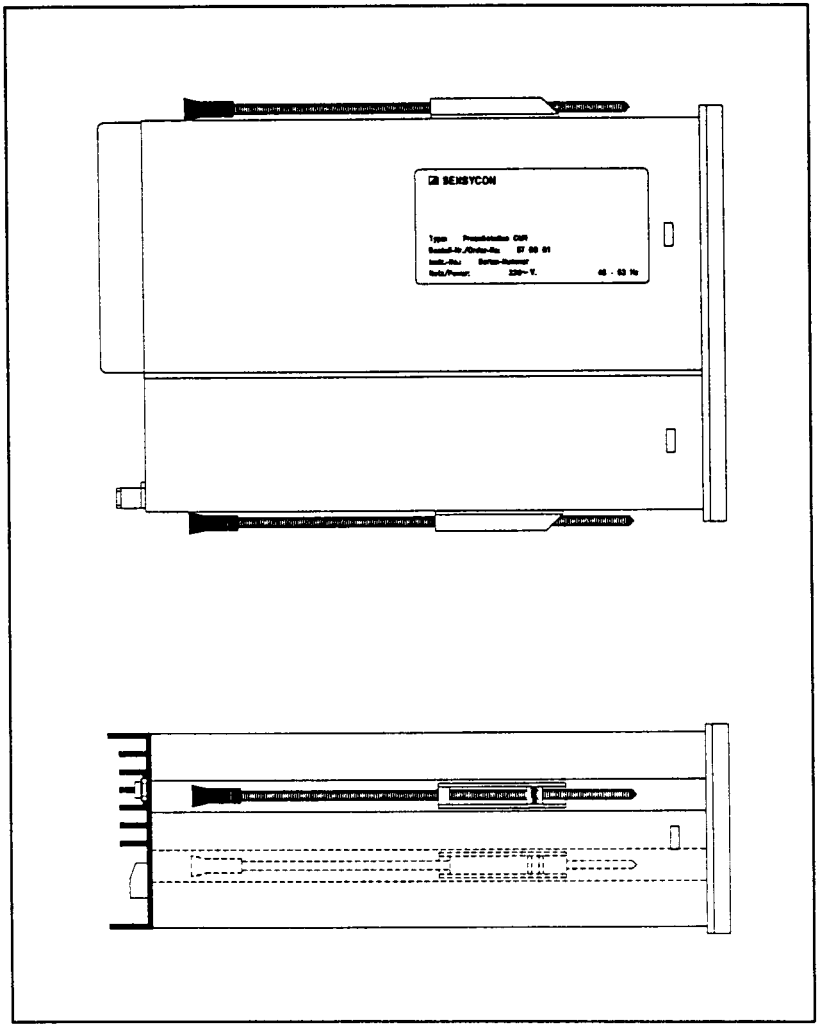


Figure 5 **Plastics Housing with Mounting Brackets**

Additionally, several optional **enhancement modules** are available, which can be inserted from the rear into dedicated plug-in locations (fig. 6).

The plug-in locations are assigned as follows:

Location 1	Interface module
Location 2	Discrete output module limit values or 3-point step control output module
Location 3 (AI 3) and 4 (AI 4)	Analog input module Pt100, thermocouples, current/ voltage or retransmitting slidewire

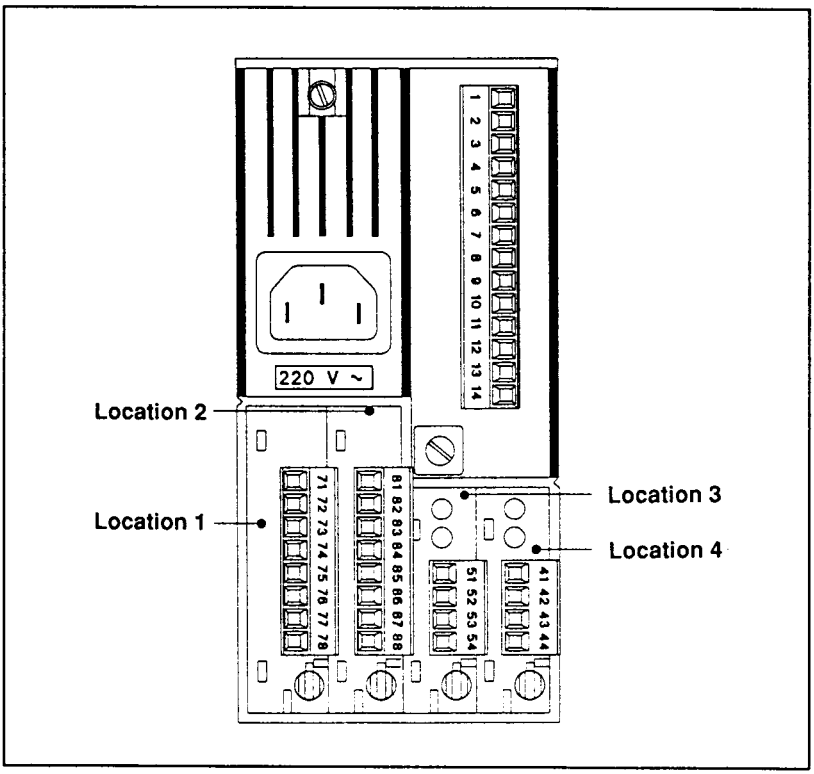


Figure 6 **CM 1 Process Control Station, Rear View**

1-4. Technical Data

1-4.1 Technical Data of Standard Version

General Data

Microprocessor	80 C 188
Data memory	EEPROM
CPU error	$\leq$ 0,6 x 10^{-6} (absolute error)
Cycle time	50 ms...99.99 s (configurable)
Hardware design	SMD
Reference potential	common zero potential for all inputs and outputs
Mounting	panel mounting, by screw-type mounting brackets (above and below)
Front dimensions	72 x 144 mm (2.84" x 5.67")
Installation depth	max. 240 mm / 9" (with power plug)
Mounting position	any

Digital Displays

PV and SP display	4-digit, 7-segment LED, green, with adjustable display range and decimal point, from -999 to 9999, min. resolution 0,001;
OUT display	2-digit, 7-segment LED, green, display range -9 to 109%, min. resolution 1%;
Dev. indication	21-segment LED bargraph display with 1 green (PV-SP=0) and 20 red (deviation) LEDs, configurable display range ($\pm$5/10/20%)
Power supply	220...230 V, 110...120 V o 24 V AC +10%, -15%, 48...63 Hz or 24 V AC/DC $\pm$25%
External fuse protection	0.3 A time-lag fuse for 220...230 V AC 0.6 A time-lag fuse for 110...120 V AC 1.25 A time-lag fuse for 24V AC 1.25 A time-lag fuse for 24 AC/DC
Power consumption	15 W or 20 VA with max. number of modules
Power connection	power plug (enclosed in package, for AC line) screw-type terminal (for 24 V AC/DC)

Grounding conductor connection	via grounding screw located on the rear of the controller or via power plug (for AC 220...230 V or 110...120V)
Signal wire connection	via disconnectable terminals for a max. wire gauge of 1,5 mm²
Temperature range	operation 0...+50°C (+32 ... +122 °F) storage: -20...+70°C (-4 ... +158 °F)
Protection class	I to VDE 0411
Inputs and outputs	Functional extra-low voltage with safe isolation to DIN VDE 0110 Part 410 for rated voltages up to U_{rat} = 250 V.
Test voltage	Inputs and outputs against power supply circuit: 4 kV. Power supply circuit against protectice conductor: 1.875 kV
Overvoltage category/ Degree of contamination	III / 2 (to DIN VDE 0110 Part 1/01.89)
Type of protection	front IP 65 to DIN 40050 housing IP 30 to DIN 40050 terminals IP 20 to DIN 40050
RFI immunity	in accord. with NAMUR regulations
Emission of spurious radiation	in accord. with requirements *
Climate class	KWF to DIN 40040
Housing material	ABS plastics
Weight	1.8 kg with max. number of modules
*** Declaration**	The CM 1 process controller is in accordance with the German order 1064/1984, Central Office document 163/1984 (device to DIN VDE 0871). The Federal Postal Administration has been informed on the distribution of this device and is authorized to control the observance of the above-mentioned orders.

Connection Data

Analog Inputs AI 1 and AI 2

Input signal range**	0...20 mA
With input conversion	4...20 mA
Input impedance	49.9 ohms ±0.1%
Overcurrent/reverse current limit	max. 40 mA
Resolution of A/D conversion	12 bits
Input filter (hardware)	RC network, critical frequency 7 Hz
Error	≤ 0,1% (related to input signal range)
Temperature influence	≤ 0,1 %/10 K (20° F)

Discrete Inputs DI 1 to DI 5

Range of signal voltage	status "0" = -40 ... +2 V status "1" = +4.2... +40 V
Input current	max. 4 mA
Reaction time	≥ 50 ms (min. adjustable cycle time)
Power supply	external or via 18 V terminal of the CM 1

Analog Output AO

Limits	short-circuit and open-circuit proof
Signal range	0/4 ... 20 mA
Selection range	0 ... 21.8 mA
Output load	max. 500 ohms
Resolution of D/A conversion	12 bits
Error	≤ 0.1 %
Temperature influence	≤ 0.1 %/10 K (20°F)

Transmitter Supply

Voltage	18 V
Load current	max. 30 mA, short-circuit proof

** **Input signal range** — By using the parameters 20...27, the range can be reduced. Related to the input signal range, the start of the actual range can be set to up to 80 %, while the span itself can be set to 20%.

1-4.2 Technical Data of the Additional Modules

1-4.2.1 Modules for the Analog Inputs Location 3 and 4

1. Direct Current/Direct Voltage

Type	C1-MUII0, galvanically separated C1-MUI0, galvanically interconnected	
Input signal range **	current: voltage:	-20...0...+20 mA, -50...0...+50 mA -1...0...+ 1 V, - 5...0...+ 5 V, -10...0...+10 V
Input impedance	current:	50 ohms ±0,1 % at ±20 mA, 20 ohms ±0,1 % at ±50 mA
	voltage:	100 kohms at ±1V, 500 kohms at ±5 V, 1 Mohms at ±10 V
Overcurrent protection	± 100 mA	
Overvoltage protection	± 30 V	
Separation voltage	750 Veff, 60 Hz (galv. separation)	
Error	≤ 0,2% (related to input signal range)	
Temperature influence	≤ 0,2%/10 K (20 °F)	
RFI influence	≤ 0,2% in accord. with NAMUR regulations	

2. RTD Pt100 — Type C1-MPT0

Element	platinum, 100 ohms at 0 °C (32 ° F), DIN 43 760	
Input signal range**)	range I changeable to range II	-50...+150°C (-58...+302 °F), -50...+600°C (-58...+1112 °F)
Wiring mode	2-, 3- or 4-wire	
Line resistance	2-wire: extern. adjust RL1+RL2 to 10 ohms 3-wire: RL1=RL2=RL3 ≤ 50 ohms 4-wire: RL1, RL2, RL3, RL4 ≤ 100 ohms, each	
Line break detection	included	
Overvoltage protection	terminal 1, 2, 3 ≤ 30 V	
Current	2 mA	
Error	≤ 0,2 % (related to actual range)	
Temperature influence	≤ 0,2 %/10 K (20° F)	
RFI influence	≤ 0,2 % in accord. with NAMUR regulations	

**) see remark on page 11

3. Thermocouples Type C1-MTCI0

Thermocouple type	J Fe-CuNi - iron/copper nickel, DIN IEC 584 E NiCr-CuNi - nickel chrome/copper nickel, DIN IEC 584 K NiCr-Ni - nickel chrome/nickel, DIN IEC 584 L Fe-CuNi - iron/copper-nickel, DIN 43 710 U Cu-CuNi - copper/copper nickel, DIN 43 710 R Pt13%Rh-Pt - platinum rhodium/platinum, DIN IEC 584 S Pt10%Rh-Pt - platinum rhodium/platinum, DIN IEC 584 T Cu-CuNi - copper/copper nickel, DIN IEC 584 B Pt30%Rh-Pt6%Rh - platinum-rhodium/platinum-rhodium DIN IEC 584
Input signal range**)	J: 0-400°C (32-752°F) (I), changeable to 0-1200°C (32-2192°F) (II) E:0-250°C (32-482°F) (I), changeable to 0-1000°C (32-1832°F) (II) K: 0-600°C (32-1112°F)(I), changeable to 0-1300°C (32-2372°F) (II) L: 0-400°C (32-752°F (I), changeable to 0-900°C (32-1652°F) (II) U: 0-400°C (32-752°F (I), changeable to 0-600°C (32-1112°F) (II) R: 0-1700°C (32-3092°F) (I) S: 0-1700°C (32-3092°F) (I) T: 0-400°C (32-752°F) (I) B: 0-1800°C (32-3272°F) (I)
Cold junction compensation	internal: ≤ 2°C (3.6°F) external: select. reference temp. 20°C (68°F) or 50°C (122°F)
Line break detection	included
Input impedance	> 1 Mohms
Overvoltage protection	±30 V
Separation voltage	750 Veff, 60 Hz (galv. separation)
Error	≤ 0,5 % (related to actual range)
Temperature influence	≤ 0,2 % / 10 K (20°F)
RFI influence	≤ 0,2 % in accord. with NAMUR regulations

**) see remark on page 11

4. Retransmitting Slidewire Type C1-MFG0

Input signal range **)	1000 ohms changeable to 500, 200 and 100 ohms
Supply voltage	0.5 V constant
Line break detection	included
Error	≤ 0,2 % (related to input signal range)
Temperature influence	≤ 0,2 % / 10 K (20°F)
RFI influence	≤ 0,2 % in accord. with NAMUR regulations

1-4.2.2 Modules for Discrete Output Location 2

1. Limit Values

Type	C1-M2DR0, 2 dry relay contacts C1-M4DR0, 4 dry relay contacts	
Max. contact load	voltage: current: power:	≤ 60 V AC, 120 V DC ≤0,5 A AC/DC ≤ 60 VA
Spark suppression	RC network, can be added	
Contact function	NO or NC contacts, selectable by solder link	

2. 3-Point Step

Type	C1-M1DPS0	without add. relay contacts
	C1-M1/2DPS0	2 dry relay contacts
Max. contact load 3-point step output	voltage: current: power:	250 V AC/DC 1 A AC/DC 250 VA
Spark suppression	integrated (68nF/270 ohms on solder pin)	
Max. contact load limit output	voltage: current: power:	250 V AC/DC 0,5 A AC/DC 125 VA

**) See remark on page 11

Contact function limit relay	NO or NC contacts, selectable by solder link
Electrical isolation	corresponds to overvoltage category II and degree of contamination 2 (to DIN VDE 0110Part 1/01.89)

1-4.2.3 Interface Module for Location 1

1. RS-232/485-Interface

Type	C1-MRS0 galvanically interconnected C1-MRSI1 galvanically separated
Interfaces	RS 232, RS 422 (half duplex) or RS 485, configurable
Transmission rate	1200, 2400, 4800 or 9600 bauds, configurable
Data word length	7 bits or 8 bits, configurable
Stop bits	1, 1.5 or 2 bits, configurable
Parity	no, odd or even, configurable
Protocol	RTU or ASCII, in accord. with MODBUS specification (configurable as required)
Error detection	LRC for ASCII and CRC for RTU
Cable length	RS 232 max. 10 m RS 485/422 max. 1000 m
Number of CM 1	1 CM 1 with RS 232 up to max. 31 CM 1 with RS 422 or RS 485
Transmission	- no hardware handshake - master slave principle in accord. with MODBUS specification - asynchronous - half duplex - RS 422 2- or 4-wire connection possible - RS 485 2-wire connection
Supported MODBUS functions	1 read output status 3 read output register 4 read input register 5 force single coil 6 preset single register 8 loop back test 15 force multiple coils 16 preset multiple register

1-4.3 Ordering Details

CM 1 Process Controller with Configuration and Parameter Setting via Front Panel

Housing dimensions	72 x 144 mm (2.84" x 5.67")
Standard version	2 analog inputs 0/4...20 mA 1 analog output 0/4...20 mA 5 discrete inputs 1 supply for external transmitters

Supply Voltage	Order No.
220...230 V, 48...63 Hz	61511-0-1000000
110...120 V, 48...63 Hz	61511-0-2000000
24 V, 48...63 Hz	61511-0-3000000
24 V AC/DC	61511-0-4000000

Scope of Delivery

All CM 1 process controllers are supplied with one manual (operating instructions, short version) and two mounting brackets.

The packages of the AC versions also include the corresponding power plug.

Accessories

Designation
Dummy plate for panel cutout 72 x 144 mm (2.84" x 5.67")
Operating instructions, extended version, German
Operating instructions, extended version, English

Additional Modules

Analog Inputs

Modul	Order No.
RTD Pt100	61517-4-0743432
DC/DV, galvanically interconnected	61517-4-0743433
DC/DV, galvanically separated	61517-4-0743434
Thermocouples	61517-4-0743435
Retransmitting slidewire	61517-4-0743436

Discrete Outputs

Module	Order No.
Limit values, 2 relay contacts	61518-4-0743437
Limit values, 4 relay contacts	61518-4-0743438
3-point step controller without limit contacts	61518-4-0743439
3-point step controller with 2 limit contacts	61518-4-0743440

Interfaces

Module	Order No.
RS 232/485 interface, galvan. interconnected	61519-4-0743441
RS 232/485 interface, galvan. separated for RS 422/485	61519-4-0743442

2-1. Mounting the CM 1 Process Controller

2-1.1 General Remarks

The CM 1 housing conforming to DIN standards and the mounting brackets simplify the mounting procedure and allow exact panel mounting into cabinets, machines and operator consoles. When mounting the CM 1, note that enough place, not only for the device itself, but also for the connections (esp. power plug, mind bending range of power cord) must be available.

If the additional modules are to be inserted or interchanged with the device remaining in place, the required depth is more than twice as much.

Make sure that ambient temperature will always be within the range of 0 ... +50 °C (32 ... 122 °F).

It is possible to arrange several CM 1 process controllers close to close (one upon the other or side by side). However, in this case ambient temperature must not exceed 40 ° C (104 °F).

2-1.2 Panel Mounting

It is recommended to cut out the opening (for exact dimensions please refer to pages 20/21) and to continue as follows:

- Insert the CM 1 in the panel-cutout from the front.
- Approach the mounting brackets from the rear to the openings of the housing , snap them in (first above, then below) and tighten them smoothly.
- Adjust the device and terminate the tightening of the mounting brackets.

Note that, before you can start the above-described mounting procedure, the threaded bar has to be screwed out of the mounting brackets far enough. Otherwise, the brackets, which have a clamping range of 0 - 40 mm (0-1.57"), will not snap in.

2-1.3 Dimension Drawings

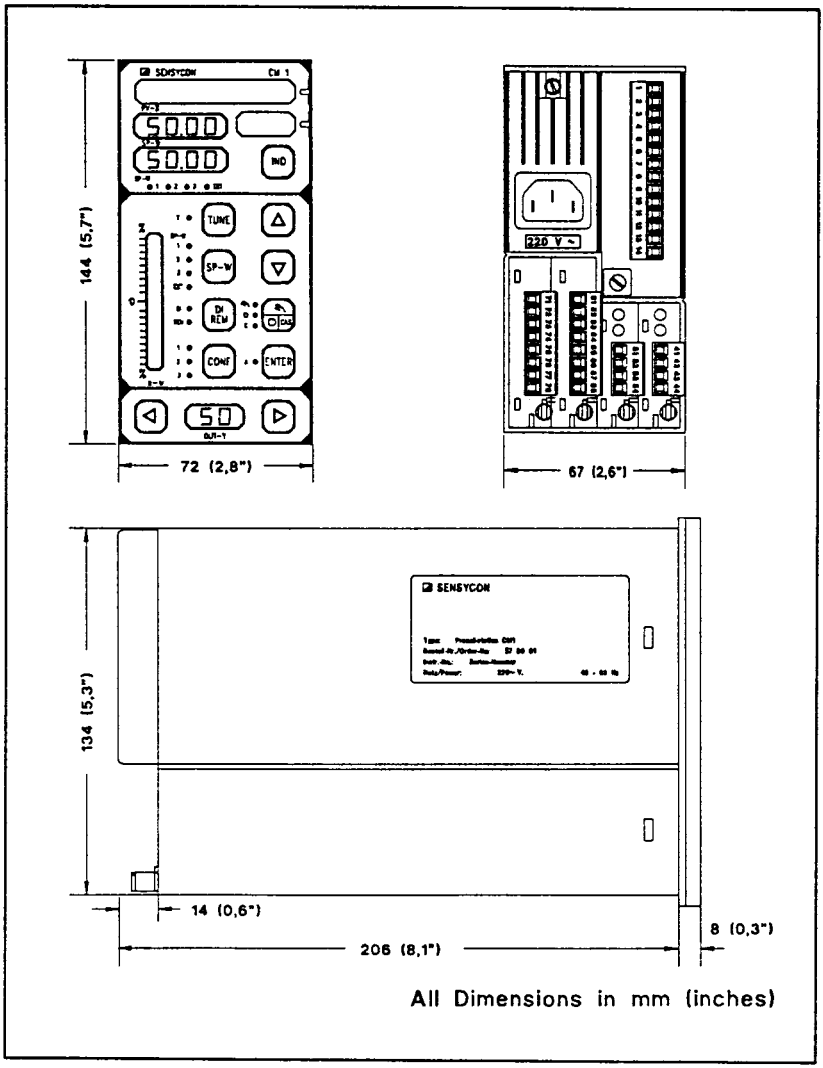


Figure 7 CM 1 Dimensions

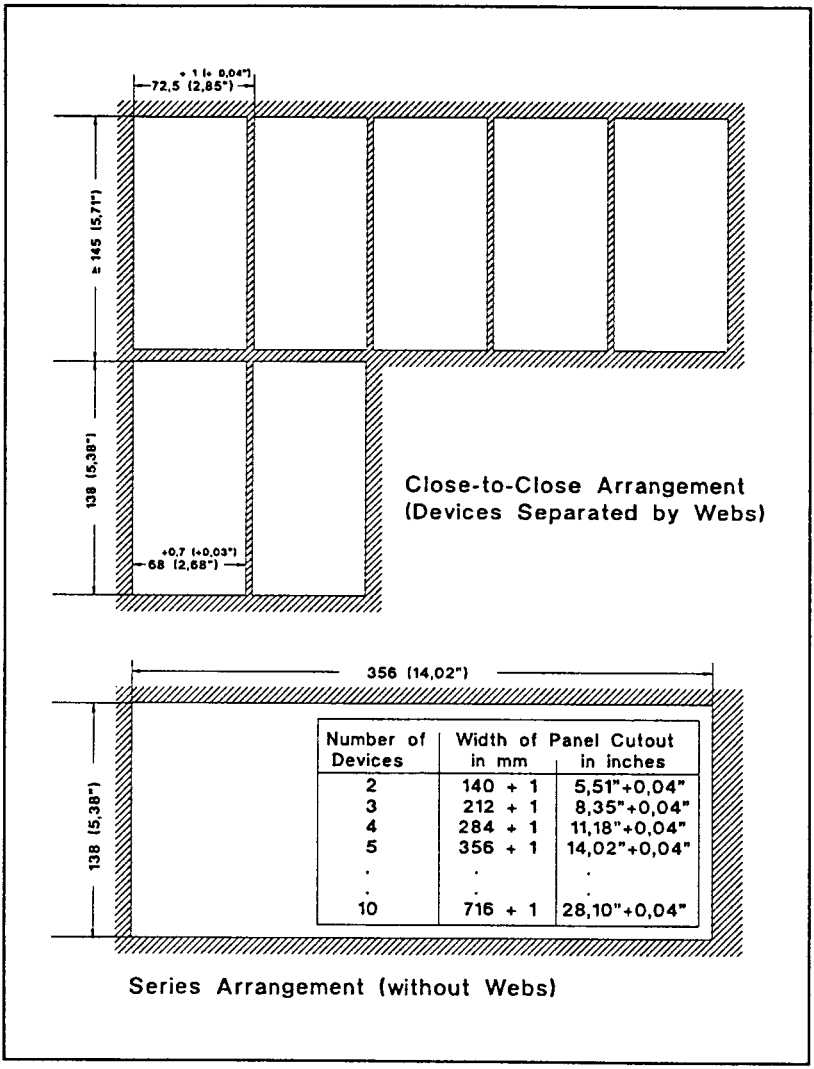


Figure 8 CM 1 Panel Cutouts

2-2. Connecting the CM 1 Process Controller

2-2.1 Power Connection

WARNING Connection of the CM 1 process controller must be realized in accordance with the German VDE regulation VDE 0100

Four types of CM 1 process controllers with different power supply units are available:

1. **AC 220...230 V** power supply unit and 3-pin power plug
2. **AC 110...120 V** power supply unit and 3-pin power plug
3. **AC 24 V** power supply unit and 2-pin power plug
4. **AC/DC 24 V** power supply unit and 2 screw-type terminals

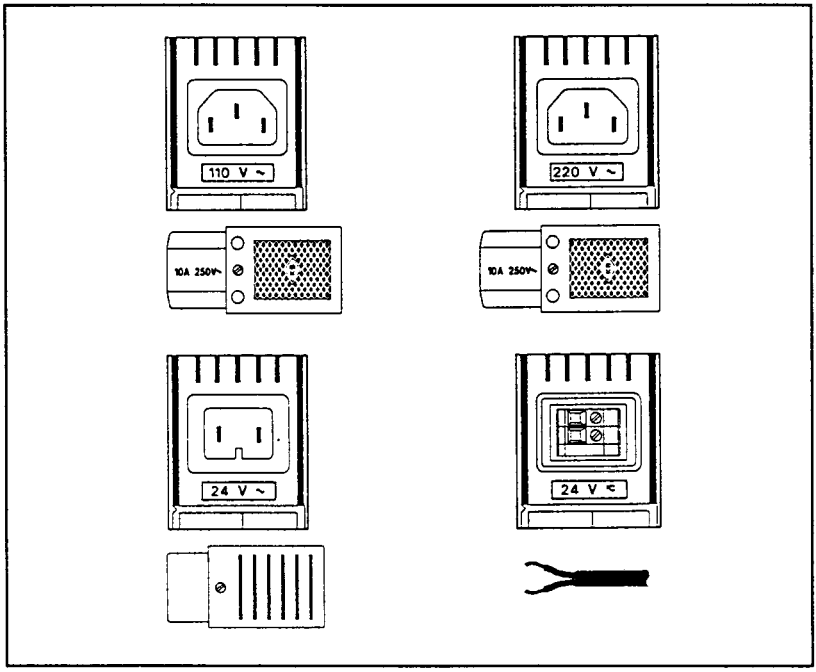


Figure 9 Types of Power Supply Units and Connections

CM 1 process controllers equipped with 110...120 V, 220...230 V (figure 10) and 24 V AC power supply units are connected by using the power plug enclosed in the package. Power supply to 24 V AC/DC devices is realized via 2 screw-type terminals (figure 11).

Figure 12 shows how to connect the power cable to the power plug.

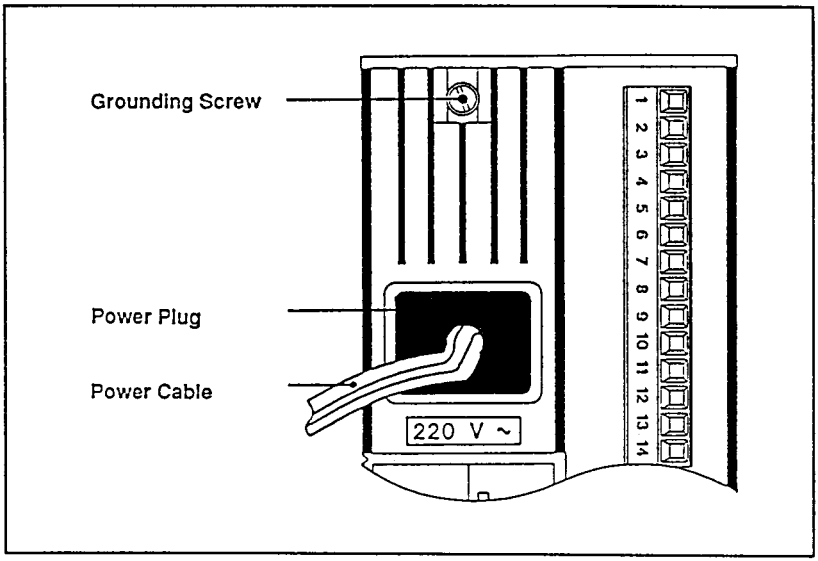


Figure 10 Connection of a 220 V AC Power Supply Unit

WARNING **The CM 1 process controller has no internal power switch. Thus, an external shutdown device has to be provided to enable disconnection from power!**

Make sure that the grounding conductor of 110...120 V and 220...230 V AC type devices is always reliably connected. In general, grounding conductor connection is realized via the power plug, but it is also possible to use the grounding screw for this purpose.

WARNING **Any grounding conductor disconnection inside or outside the unit may cause serious dangers and is not permitted.**

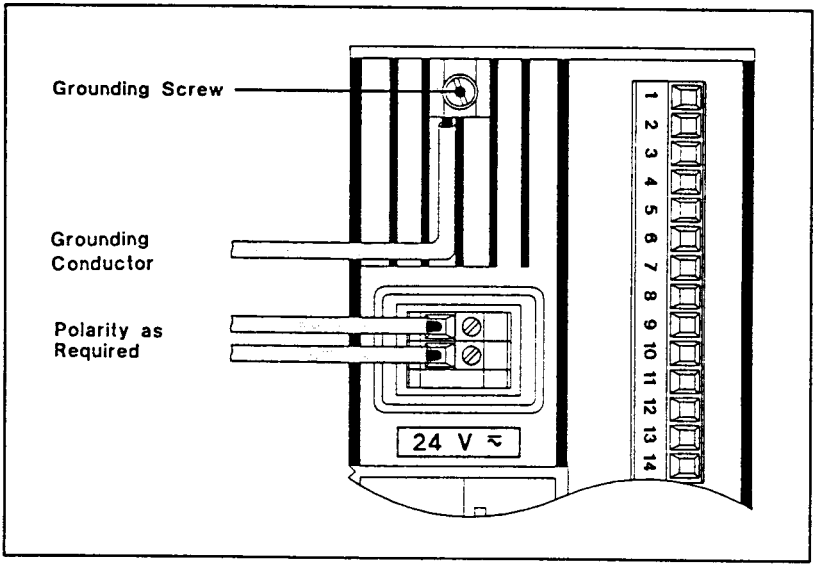


Figure 11 **Connection of a 24 V AC/DC Power Supply Unit**

The grounding conductor of 24 V AC and 24 V AC/DC versions also has to be connected thoroughly (see figure 11).

Figure 12 shows how to link the 110/220 V AC power cables to the CM 1 power plug.

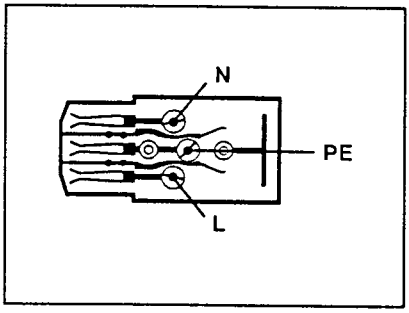


Figure 12 **Power Plug Connection**

2-2.2 Inputs/Outputs of the Standard CM 1 Process Controller

The disconnectable terminal block of the standard CM 1 consists of 14 terminals having the following assignment.

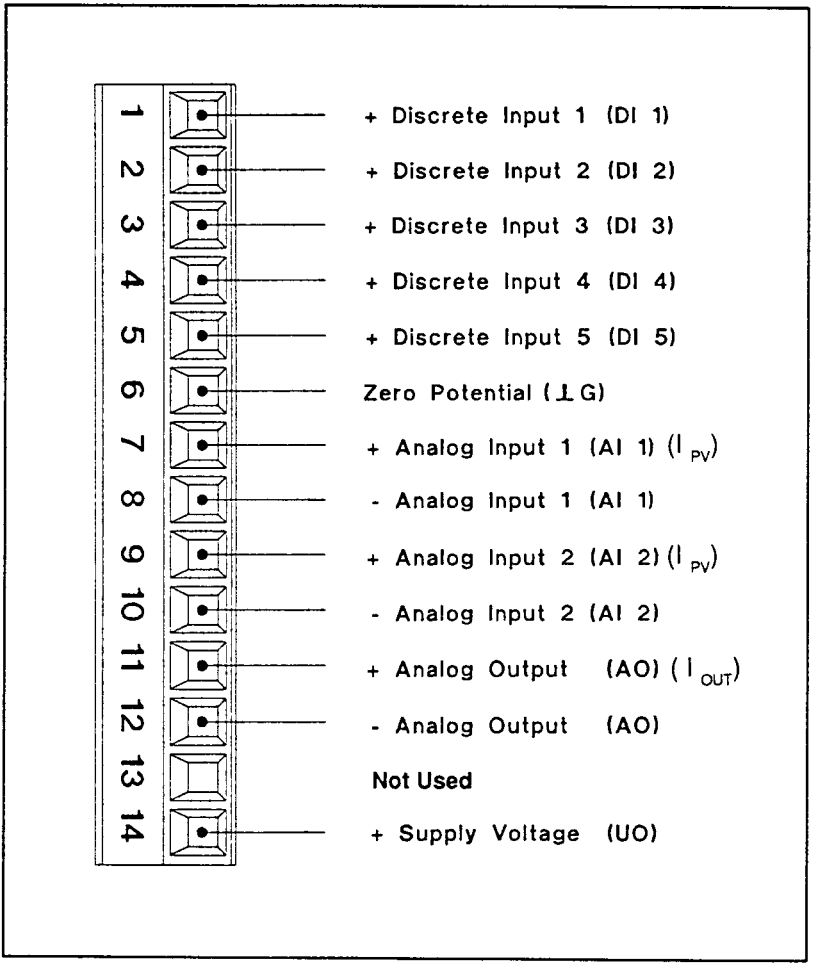


Figure 13 Standard CM 1 Terminal Assignment

In order to avoid signal disturbances, the CM 1 signal inputs and outputs have been provided with separate ground terminals for zero potential.

While an individual zero potential is assigned to each analog terminal (input or output), the zero potential of the discrete inputs is assigned to terminal 6, to which the zero conductors of all discrete signal cables have to be connected in the case of switching signals originating from an external source.

If the 18 V power supply unit serves for generating the switching signal voltage or for supplying external transmitters, no connection to the grounding terminal is required. However, terminal 6 must be used as the minus pole of the 18 V output when other devices are supplied. Note that the max. load of the supply circuit UO must not exceed 30 mA.

Figure 14 shows the standard CM 1 attachment circuits.

For terminal wiring the terminal block has to be disconnected!

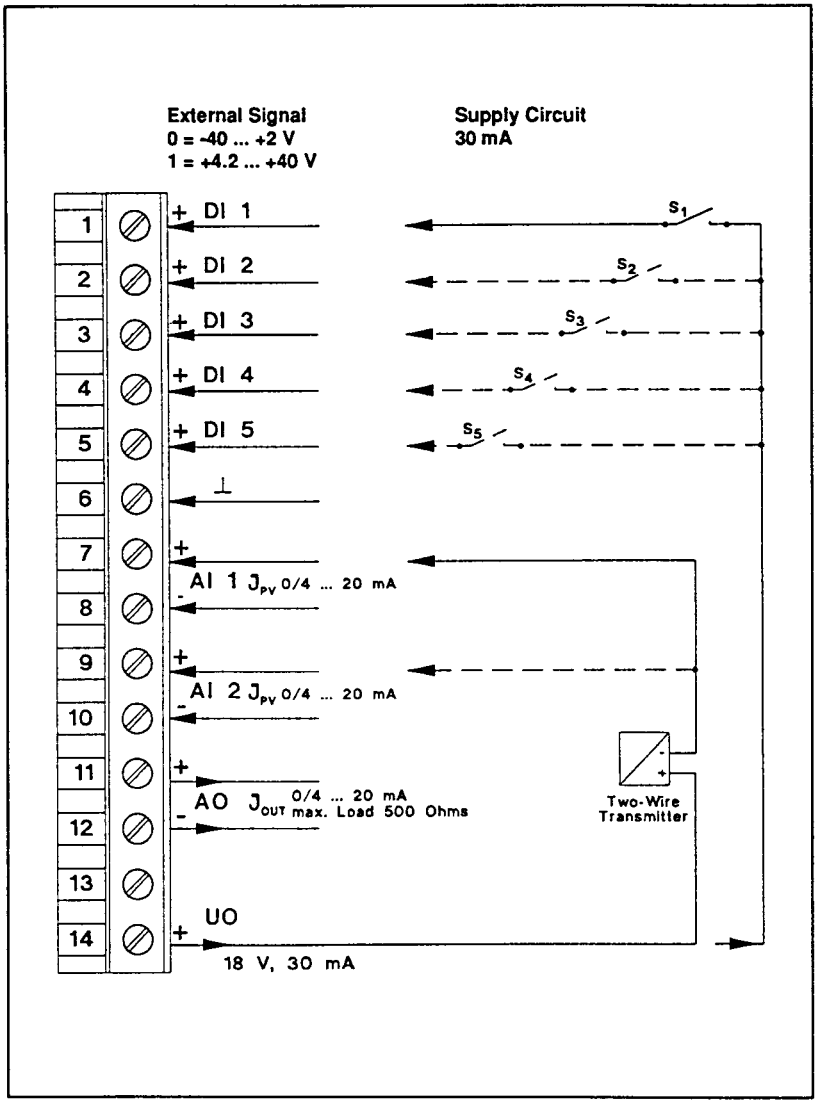


Figure 14 Standard CM 1 Attachment Circuits (General View)

2-2.3 Inputs/Outputs of the Additional Modules

WARNING **Before installing or removing the module(s), disconnect the CM 1 power plug and the module terminal blocks.**

The analog input modules have connector blocks consisting of 4 terminals and may be inserted into the plug-in locations AI 3 and AI 4 as required (figure 15).

The output modules limit value and 3-point step control as well as the RS 232/485 interface module are provided with 8-pole terminal blocks and have dedicated plug-in locations: the interface modules are assigned to location 1, the output modules to location 2 (figure 15). Before wiring the modules, disconnect the terminal blocks!

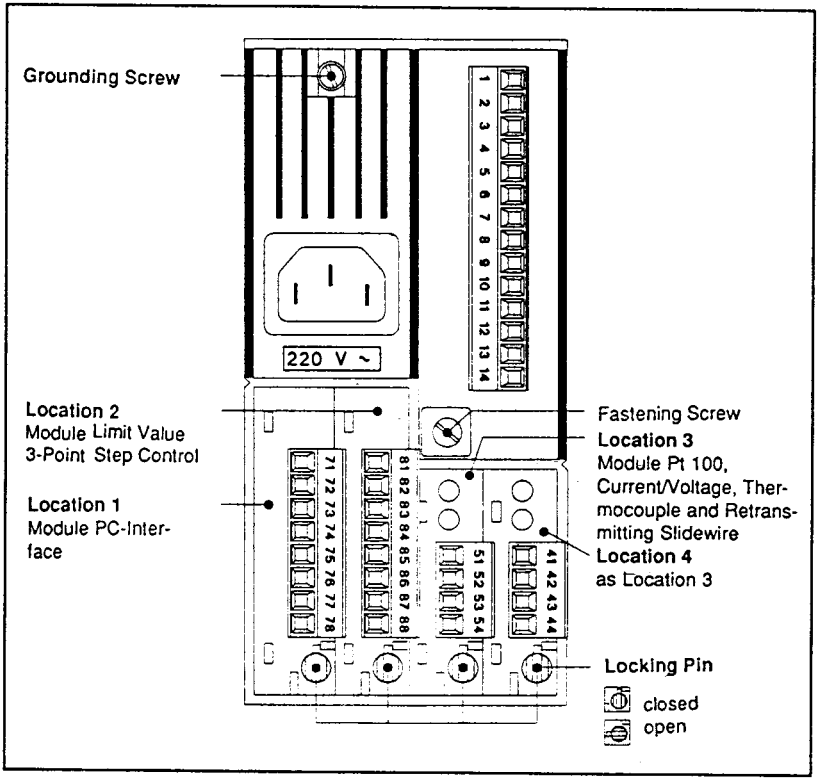


Figure 15 Plug-In Locations for Additional Modules

2-2.3.1 Analog Input Module Pt100

The Pt100 module (figure 16) converts the signal of an RTD Pt100 caused by variations in temperature into a voltage of 0...4.8 V. Connection of the RTD Pt100 to the module may be realized in a 2-, 3- or 4-wire mode. The module is provided with a line break detection enabling the user to constantly check on all Pt100 connections. Furthermore, it is possible to select the desired wiring mode as well as one out of two basic measuring ranges (-50...+150 °C/-58...+302 °F or -50...+600 °C/-58...1112 °F) by jumper setting.

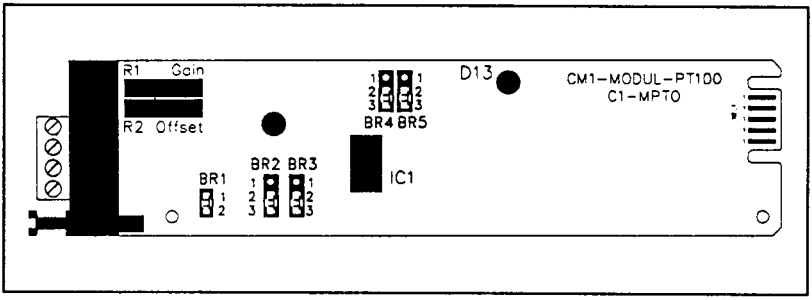


Figure 16 Analog Input Module Pt100

1. Connection Diagrams

The Pt100 module has a 4-pole, detachable terminal block. The terminals are assigned as shown in figure 17.

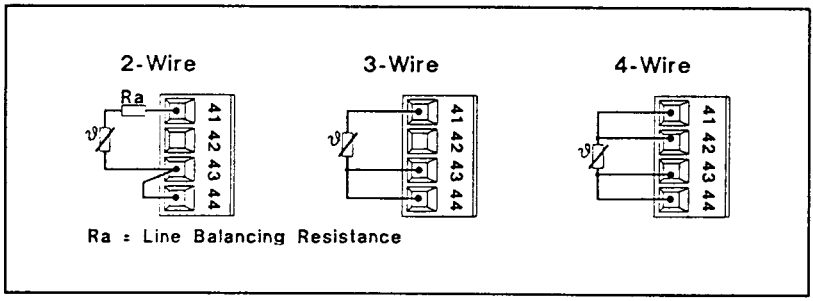


Figure 17 Connection Diagram of Pt100 Module

2. Wiring Mode Selection

The desired wiring mode is selected by setting the jumpers BR 1, BR 2 and BR 3.

Figure 18 shows the jumper positions and the assigned wiring modes.

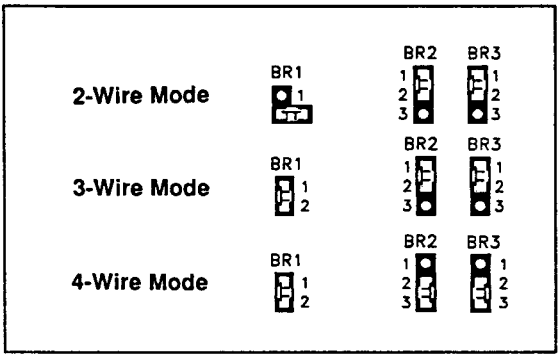


Figure 18 Wiring Mode Selection, Jumper Positions

3. Range Selection

The jumpers BR 4 and BR 5 serve for range selection.

As can be seen from figure 19, placing the jumpers in the lower position will select range I, placing them in the upper one will configure range II.

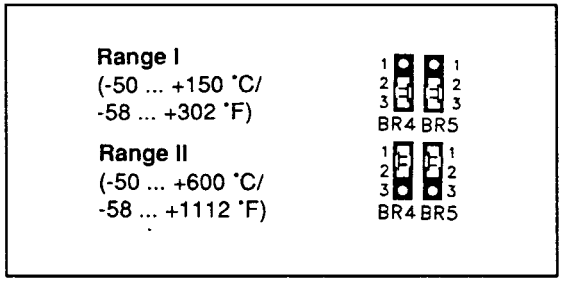


Figure 19 Range Selection, Jumper Positions

For range and zero balancing please refer to the operating instructions, extended version, or to the corresponding module leaflet.

2-2.3.2 Analog Input Module Current/Voltage

The galvanically connected or separated U/I modules (figure 20) convert U and I input signals into a voltage between 0 and 4.8 V.

Two measuring ranges are available for the current input and three for the voltage input, the desired one being selected by means of jumper BR 1. Jumper BR 2 serves for selecting the corresponding low pass filter.

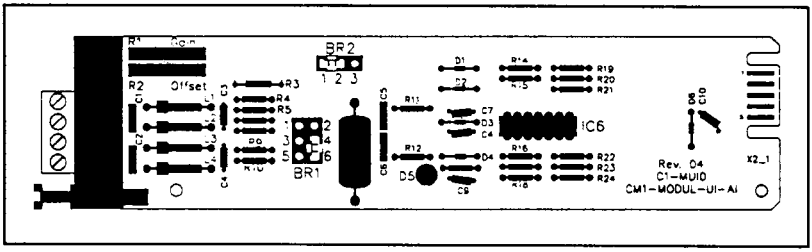


Figure 20.1 Analog Input Module Current/Voltage, Galvanically Connected

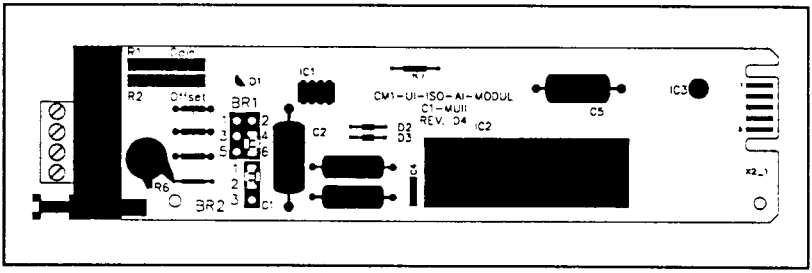


Figure 20.2 Analog Input Module Current/Voltage Galvanically Separated

1. Connection Diagrams

The current inputs are assigned to the terminals 21 and 22 (galvanically connected module) or 31 and 32 (galvanically separated module), while the voltage inputs are assigned to the terminals 23 and 24 (galvanic. conn. module) or 33 and 34 (galvan. separ. module) (see fig. 21). Disconnect the terminal block before wiring.

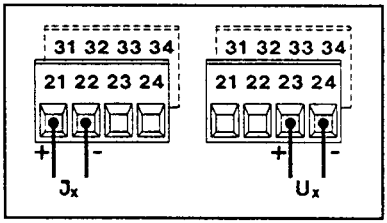


Figure 21 **Connection Diagramm**

2. Module Configuration

The combined jumper BR 1 serves for selecting the desired voltage range (out of 3) or current range (out of 2). Figure 22 shows the possible jumper positions and the respective ranges, as well the corresponding positions of BR 2 valid for both types of modules.

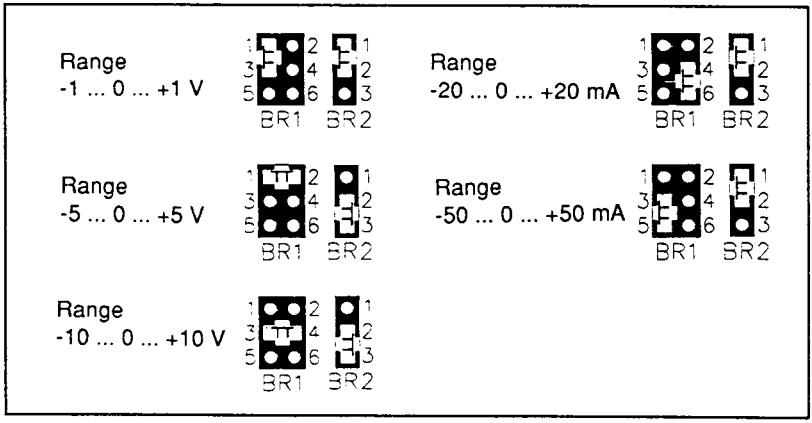


Figure 22 **Range Selection, Jumper Positions**

For range and zero balancing please refer to the operating instructions, extended version, or to the corresponding module leaflet.

2-2.3.3 Analog Input Module Thermocouples

The thermocouple module (figure 23) converts thermo-voltages into voltage signals between 0 and 4.8 V.

It is suitable for connection of all types of thermocouples, covers all kinds of measuring ranges and enables ciruits with internal or external reference junction. Selection is realized by jumper setting.

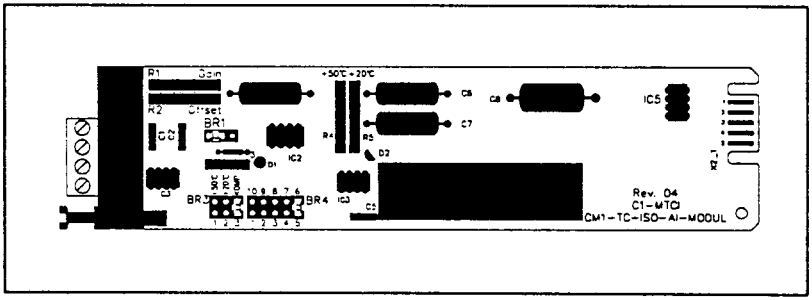


Figure 23 Analog Input Module Thermocouples

1. Connection Diagrams

The thermocouple is connected in that way as to make terminal 51 become the positive and terminal 52 the negative pole.

The terminals 53 and 54 remain unused. Before wiring, disconnect the terminal block.

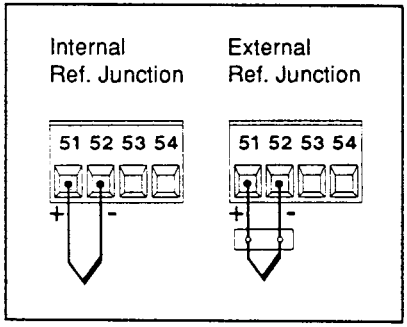


Figure 24 Thermocouple Module, Connection Diagram

2. Reference Junction Selection

The thermocouple module can be used as well with external as with internal reference junction.

The reference junction is selected by means of jumper BR 3. With the external junction , two reference temperatures (20 °C/68 °F or 50 °C/122 °F) are selectable (figure 25).

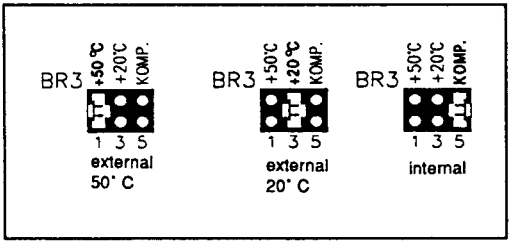


Figure 25 External/Internal Ref. Junction

3. Selecting the Type of Thermocouple

The type of thermocouple connected can be selected by setting jumper BR 4. Figure 26 shows the jumper positions for the types J, E, K, L, U, R, S, T and B.

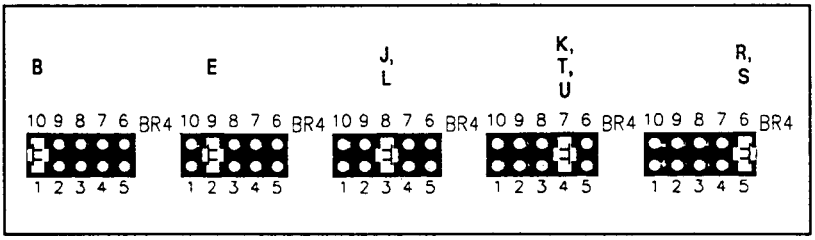


Figure 26 Thermocouple Selection, Jumper Positions

4. Range Selection

Selecting range I is realized by setting jumper BR I from position 1 to 2, selection of range II is achieved by placing the jumper from position 2 to position 3.

For range or zero balancing please refer to the operating instructions, extended version, or to the module leaflet.

Figure 27 Range Selection

2-2.3.4 Analog Input Module Retransmitting Slidewire

This module (figure 28) converts the voltage supplied by the retransmitting slidewire into a voltage signal between 0 and 4.8 V. As the slidewire is integrated in a bridge circuit with fixed resistors, the individual line resistances have no influence on the measurement.

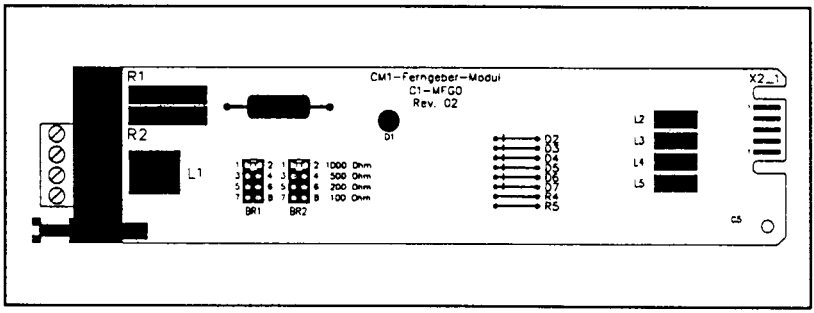


Figure 28 Analog Input Module Retransmitting Slidewire

Four values are selectable by jumper setting: 1000 ohms, 500 ohms, 200 ohms and 100 ohms. A line break detection enables the user to constantly check on each of the three retransmitting slidewire connections.

1. Connection Diagrams

Figure 29 shows how to connect the retransmitting slidewire to the detachable 4-pole terminal block of the module.

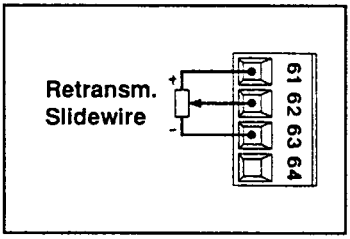


Figure 29 Connection Diagram

2. Range Selection

The jumpers BR 1 and BR 2 serve for selecting the range (1000, 500, 200 or 100 ohms) as required by the retransmitting slidewires connected

For range and zero balancing please refer to the operating instructions, extended version, or the corresponding module leaflet.

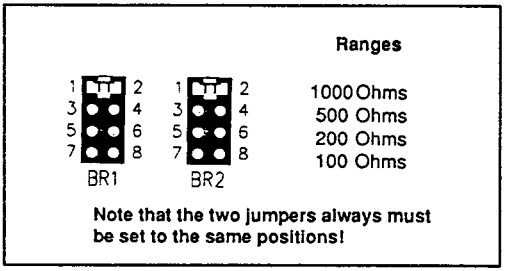


Figure 30 Range Selection

2-2.3.5 Discrete Output Module Limit Value

As can be seen from figure 31, this module is available with 2 or 4 limit contacts.

If an alarm occurs, the modules of both types provide discrete output signals for display and control purposes by means of their relay contacts. Depending on the solder link position, the contacts act as make (NO relay) or break contacts (NC relay).

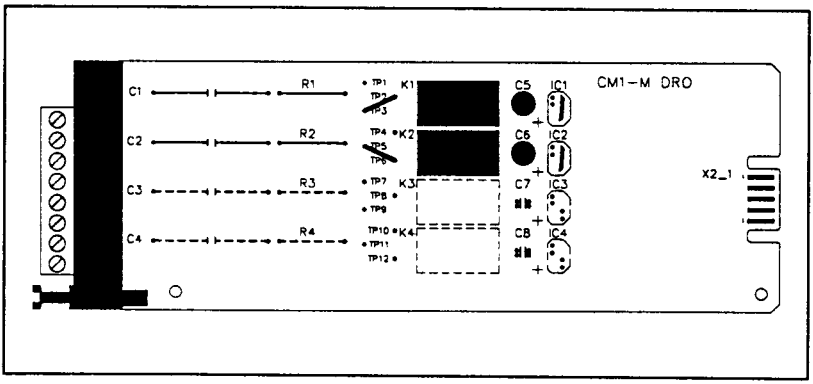


Figure 31 Discrete Output Module Limit Value

These modules are also equipped with several solder pins enabling installation of RC networks for spark suppression at the relay contacts. The user decides, whether RC networks shall be used or not and determines the RC network capacitance and resistance (depending on voltage/current)

1. Connection Diagram

Outside the module, the relay contacts are "dry". Thus, the module is provided with a disconnectable 8-pole terminal block. Figure 32 shows the terminal assignment.

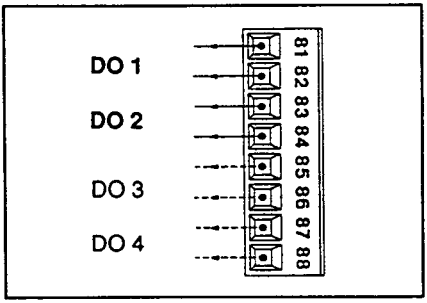


Figure 32 Connection Diagram

2. Module Configuration

Whether the relays K1 ...K4 act as NO or NC ones is defined by linking the solder pins TP 1 to TP 12 as shown in figure 19.

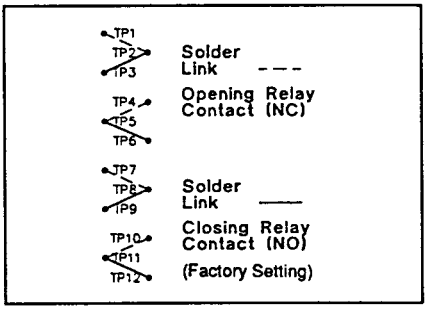


Figure 33 Module Configuration

2-2.3.6 Discrete Output Module 3-Point Step Control

This module (figure 34) converts the analog controller output into a 3-point step control output, thus enabling motor operator control.

By setting the corresponding parameters, the motor operator running time as well as the minimum pulse length and pause can be defined. The dry relay contacts are designed for a maximal load of 250 V, 1 A AC/DC. Spark suppression is ensured by the integrated RC network.

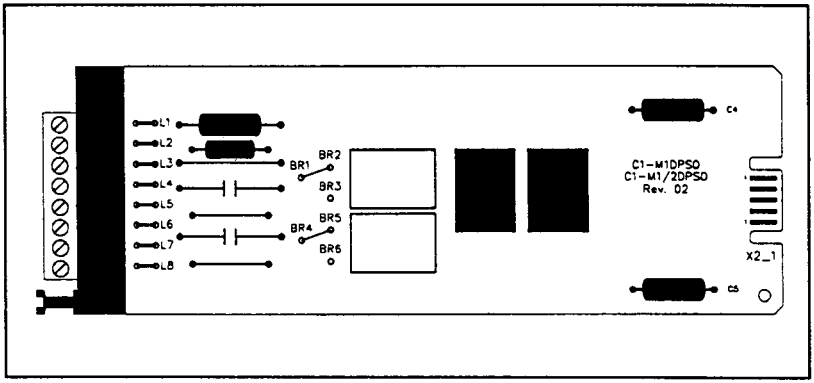


Figure 34 Discrete Output Module 3-Point Step Control

This module is optionally available with a simple step output or with 2 additional relay contacts (250 V, 0.5 A AC/DC) for alarms.

1. Connection Diagrams

Like the limit module, the 3-point step module is provided with a disconnectable 8-pole terminal block. The terminals 91 to 94 are assigned to the step output, while the terminals 95 to 98 remain unused in the case of simple step control.

If the module is used with additional alarm relays, these terminals are occupied by the relay contacts. Figure 35 shows the terminal assignment.

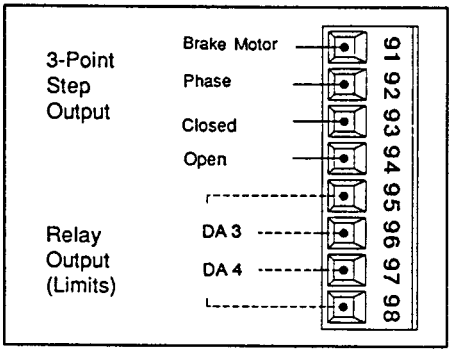


Figure 35 Connection Diagram

2. Module Configuration

In the case of the module version with additional relay contacts, the limit relays K3 and K4 can be configured as NO or NC ones by means of solder links. The respective positions are shown in figure 36.

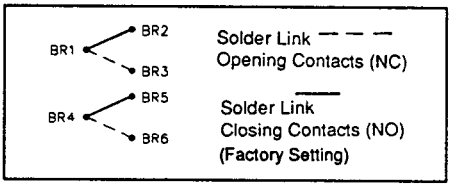


Figure 36 DO Relay (Limits), Functions

2-2.3.7 Interface Module

PC Interface RS 232/485

The serial interface module RS 232/485 (figure 37) provides selectable interface drivers for RS 232, RS 422 and RS 485.

While RS 232 enables to communicate with a single CM 1 process controller, communication with up to 31 CM 1 is possible via RS 422 and RS 485.

In the case of an open circuit or disconnected line, the RS 422/485 line and instrument terminator circuits are realized by setting jumpers on the interface module.

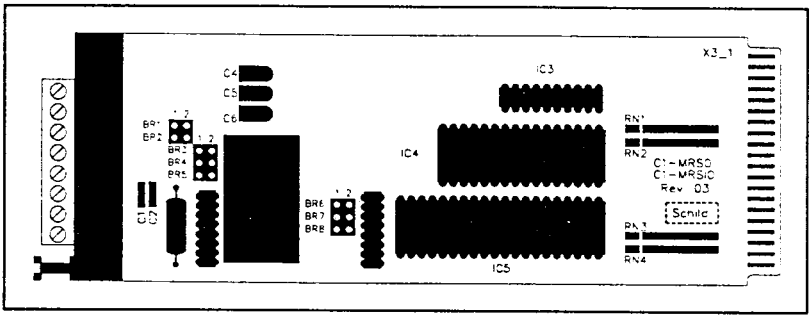


Figure 37 Serial Interface Module RS 232/485

1. Connection Diagram

The RS 232/485 interface module has a disconnectable 8-pole terminal block. The eight terminals are designated as no. 71 ... 78 (see figure 38). For wiring details please refer to the connection diagram in the respective module data sheet.

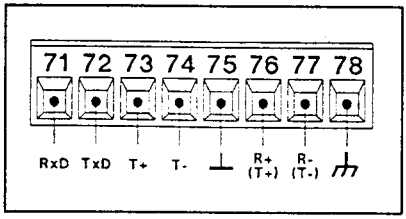


Figure 38 Connection Diagram

2. Module Configuration

8 jumpers, which are assigned as described below, are provided for activating the termination resistors.

Line balancing - BR 4, BR 7
CM 1 termination - BR3, BR 5, BR 6, BR 8
2-wire connection - BR 1, BR 2

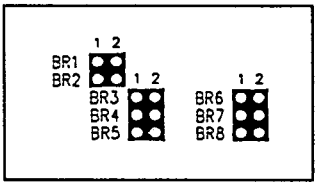


Figure 39 Jumper Positions

Which jumpers are to be set depends on the attachment circuits. Please refer to the connection diagrams in the respective module data sheet for more details.

3-1. First Use

As the basic CM 1 functions and parameters are preset in factory, a defined display pattern should appear when the supply voltage is applied and the input/output terminal block remains disconnected.

When used for the first time and with unchanged factory-set values, the CM 1 should indicate the following:

Process value PV	-	**0.00**
Setpoint SP	-	**50.00**
Displayed setpoint indication	-	**LED SP-W 1 is lighted**
Active setpoint indication	-	**LED SP-W 1 is lighted**
Operating mode selection	-	**Red LED (hand symbol) is lighted**
Deviation (PV -SP) indication	-	**Red bars in the lower part are lighted** (last segment is flashing)
Output value OUT	-	**0**

NOTE **This display pattern will only appear, if the values preset in factory have not yet been changed.**

Before the above-described display pattern appears, the CM 1 process control station carries out a self-test, during which "SELF" is indicated in the PV-X display and the code numbers 1 to 8 successively appear in the SP-W display (figure 40), each of them marking a determined function.

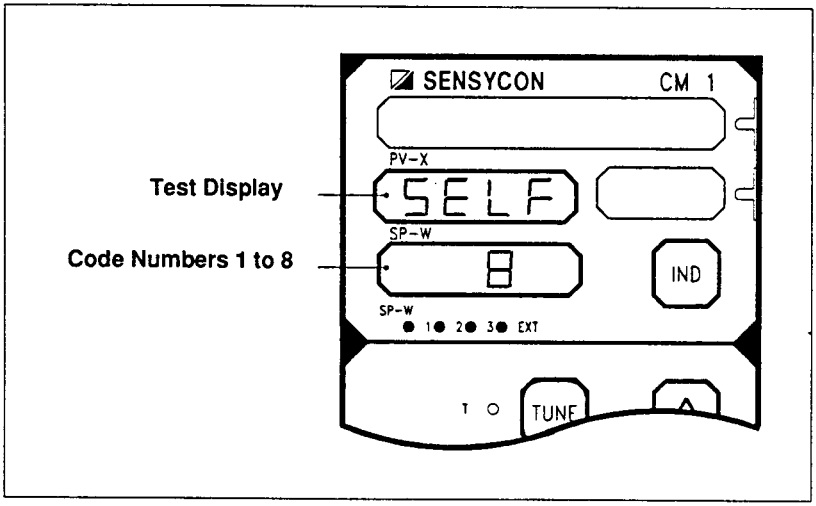


Figure 40 Selftest, Display Pattern

If the self testing routine is stopped at a certain code number, this interruption indicates that the process control station is defective and requires repair.

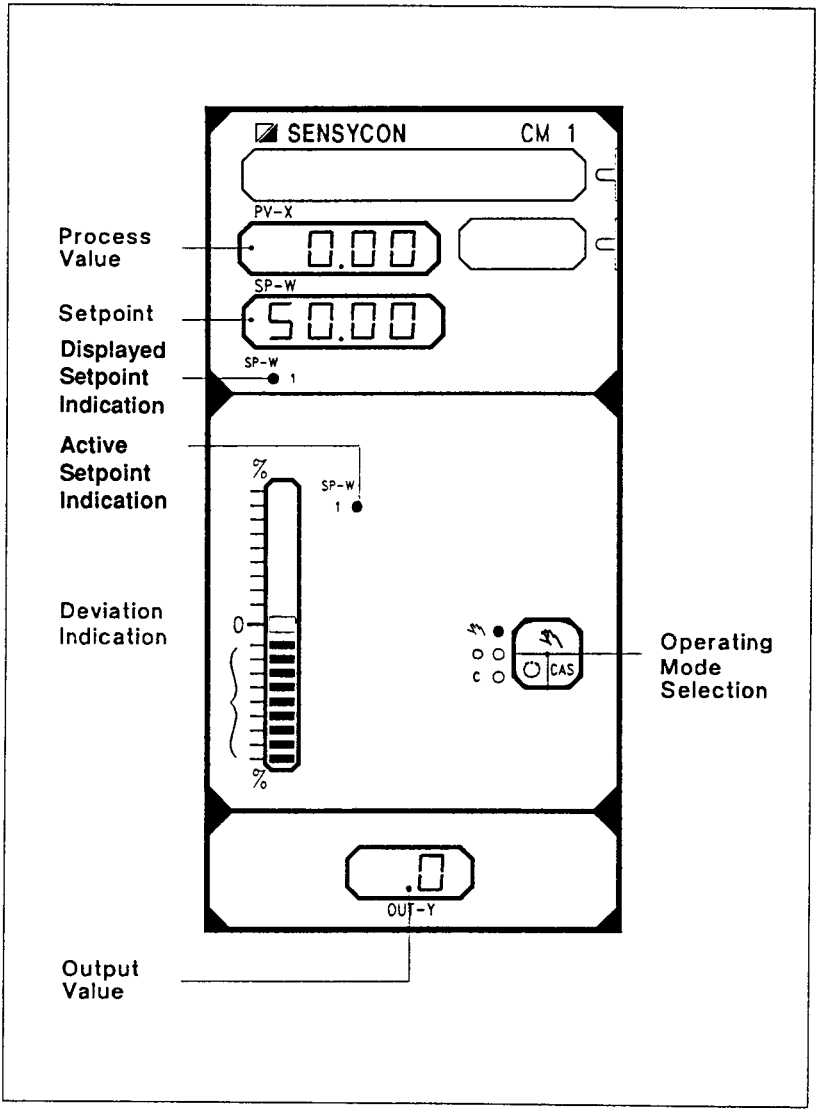


Figure 41 First Use, Display Pattern after Supply Voltage Application

3-2. Control Function

Another important test is the control function test. In this case, again, a determined display pattern indicates troublefree operation.

Short analog input 1 (terminal 7) and the analog output (terminal 11) in order to check the control function. When the supply voltage is applied and the automatic mode is selected by depressing the function key "Operating Mode Selection", the process control, station starts up and the following display pattern should appear (also see figure 42).

Process value PV	-	**50.00**
Setpoint SP	-	**50.00**
Displayed setpoint indication	-	**LED SP-W 1 is lighted**
Active setpoint indication	-	**LED SP-W 1 is lighted**
Operating mode selection	-	**Green LED (automatic symbol) is lighted**
Deviation (PV-SP) indication	-	**Green bar is lighted**
Output value OUT	-	**50**

NOTE **This pattern will only appear, if the values preset in factory have not yet been changed.**

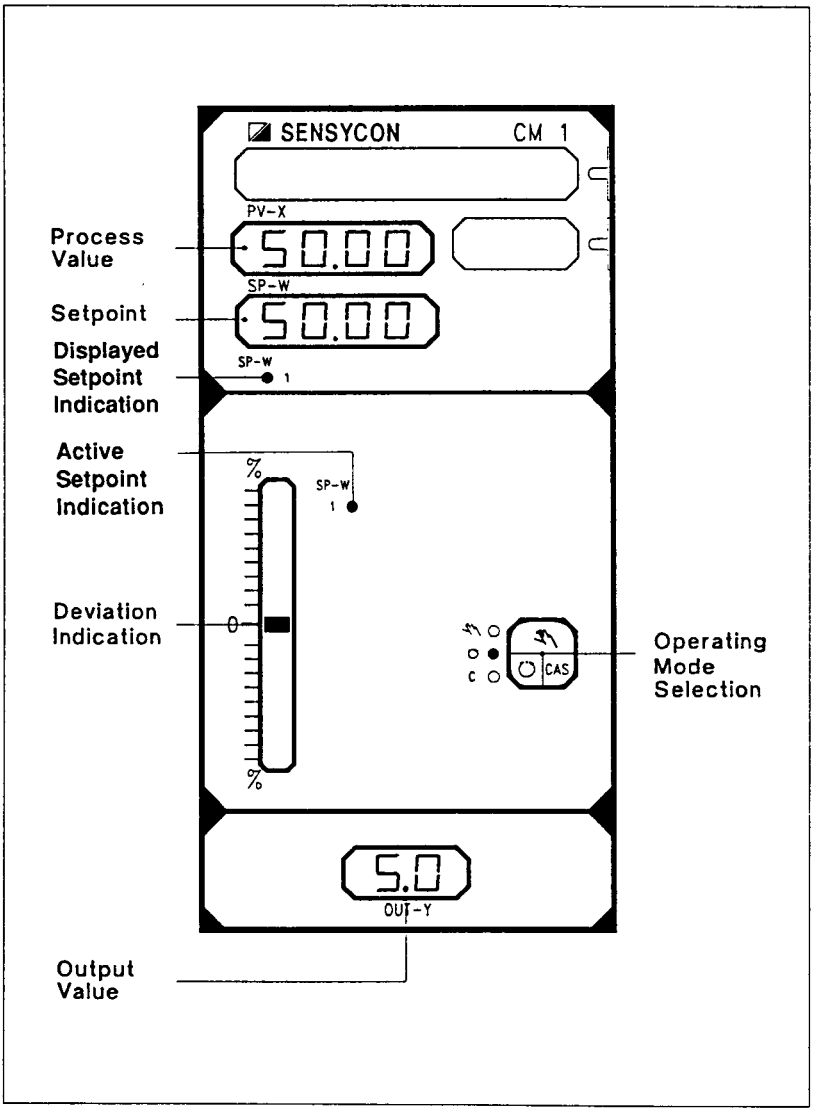


Figure 42 Control Function, Display Pattern

3-3. Software Revision

Each CM 1 software revision is marked with a code number that can be called up for display. If the first three digits of this number are identical with the ones indicated in the parameter table of this manual, **this parameter or configuration table, respectively is valid for your CM 1.**

The code number is called up by depressing the CONF key twice in order to reach parameter level 2. If the terminals 7 and 11 are still shorted and the automatic mode is selected, the following display appears:

Process Value PV	-	**50.00**
Code number	-	**0030** (example)
Displayed setpoint indication	-	**LED SP-W 1 is lighted**
Active setpoint indication	-	**LED SP-W 1 is lighted**
Operating mode selection	-	**Green LED (automatic symbol) is lighted**
Operating level selection	-	**LED 2 is lighted**
Deviation (PV-SP) indication	-	**Green bar is lighted**
Parameter number	-	**00**

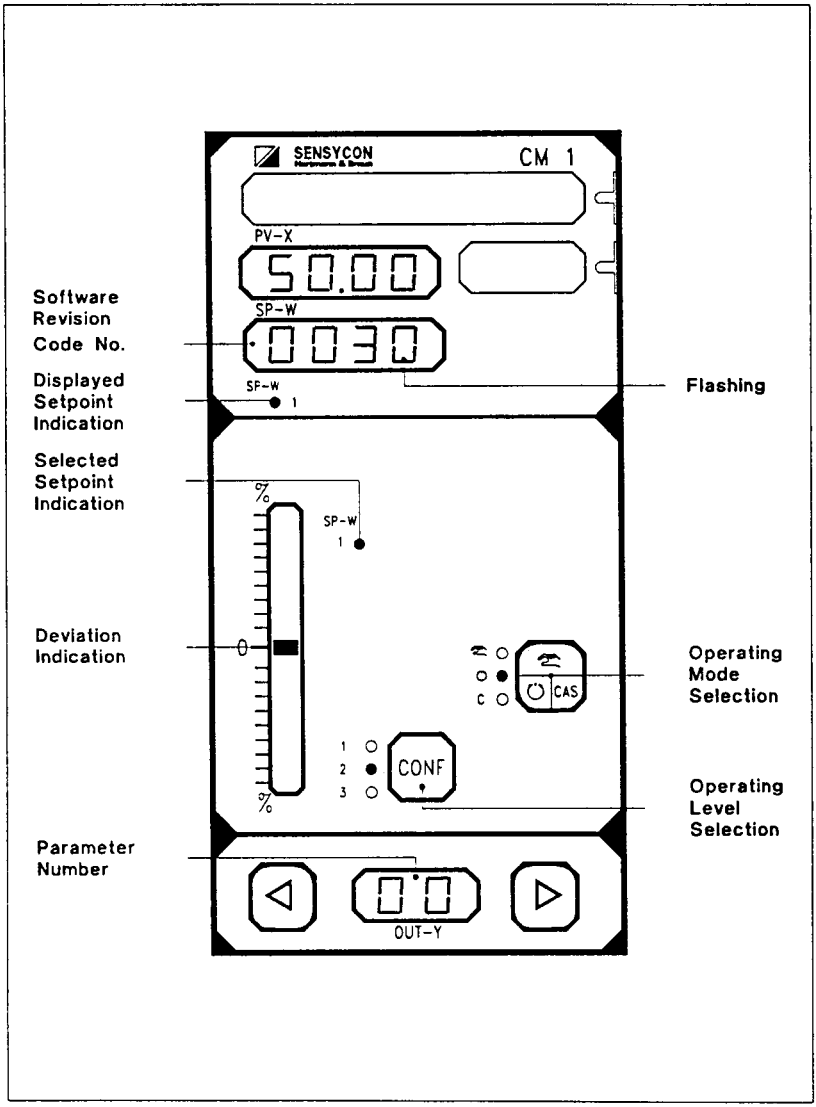


Figure 43 Indication of Software Revision Number

The software revision number is a 4-digit number encoded according to the following key (figure 46):

Digit 1	-	**Type of Instrument (CM 1)**
Digits 2/3	-	**CM 1 Version (Enhancements)**
Digit 4	-	**Internal (Program) Revision**

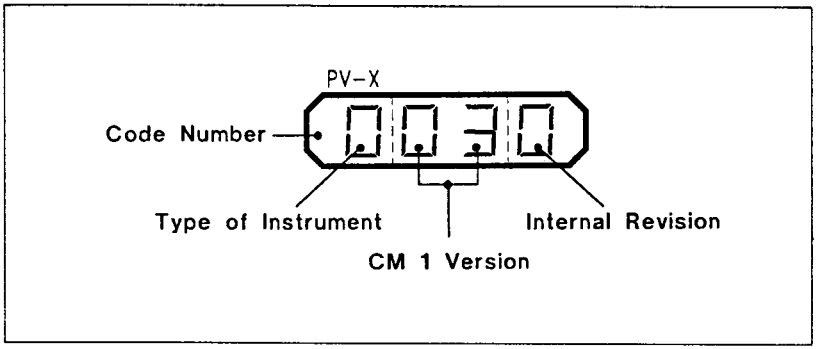


Figure 44 Code Number Key

Modifications of the fourth digit (internal revision) have no influence on the parameter or configuration table. In the parameter table, this digit is therefore designated as "x", "x" being any number between 0 and 9. In the case of an EPROM change, the process data remain stored in the memory.

If one of the digits 1 to 3 is modified, an EPROM change automatically leads to setting the CM 1 to the factory values. As a result, all process data, which have not been externally stored via an interface, are lost and have to be adjusted again.

4-1. Operating Level

On this level, the following items can be selected, entered or modified

- Setpoint (s)
- RATIO and BIAS
- Output
- Operating mode (manual/automatic/cascade)
- Local or remote control
- Start of self-tuning function (TUNE)
- Alarm acknowledgement
- Entry acknowledgement
- Change-over to parameter level 1

The following items are displayed:

- Process value and setpoint
- Identification of selected/displayed setpoint
- RATIO and BIAS values
- Operating mode
- Alarm and type of alarm
- Output
- Deviation
- Type of control (local or remote via discrete input or interface)
- TUNE (Self-tuning) and TUNE parameters

NOTE	**During operation it must be ascertained if the process controller has been configured as a fixed value controller, follow-up controller, cascade controller, override controller or ratio controller.**

4-2. Fixed -Value/Follow-Up Control

4-2.1 Functions of Keys and Displays

Figure 45 shows the signal diagram of a CM 1 process controller operating as a standard/slave controller. The active tactile keys and displays can be seen from figure 46.

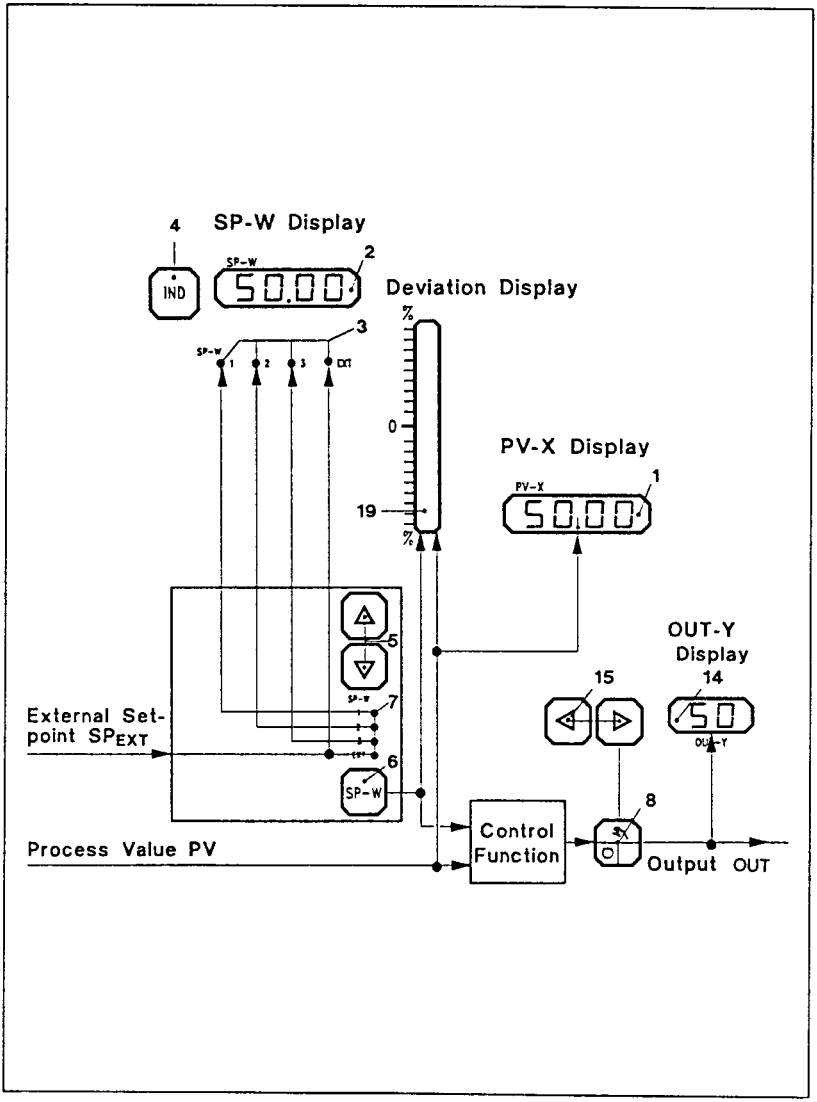


Figure 45 Fixed-Value/Follow-Up Control, Signal Diagram

Function Description (also refer to figure 46)

1 4-Digit, 7-Segment Display **PV-X**
Indicates process value PV; starts flashing, when process value reaches limit value.

2 4-Digit, 7-Segment Display **SP-W**
Can indicate the selected (current) setpoint or any of the other setpoints; also serves for displaying the type of alarm (LL, L, h, hh, YS-1,YS-2), the parameters and the error codes (E-..; AE-..).

3 LEDs **SP-W1, SP-W2, SP-W3** and **EXT**
Are lighted according to the setpoint selected for display.

4 Function Key **IND**
Serves for selecting the setpoint to be displayed (1, 2, 3, EXT), indicated by LEDs (3) **SP-W1** to **EXT**.

5 Function Keys **Setpoint Adjustment**
Used for setpoint adjustment, the upper one increasing, the lower one decreasing the setpoint value indicated by the SP-W display.

6 Function Key **SP-W**
Serves for selecting the setpoint to be used by the CM 1 for process control.

7 LEDs **SP-W1, SP-W2, SP-W3** and **EXT**
LEDs (7) assigned to the SP-W key (6); indicate, which of the 4 selectable setpoints is being used for process control.

8 Function Key **Operating Mode Selection**
Allows the operator to switch over from manual to automatic and cascade mode (cascade only if configured).

9 LEDs **Hand Symbol, Automatic Symbol** and **C**
Are assigned to operating mode selected (8) and lighted accordingly (**"Hand Symbol"** (red) = **manual** mode, **"Automatic Symbol"** (green) = **automatic** mode, **"C"** (green) = **cascade** mode (if configured).

10 LED **A**
Starts flashing when alarm limits are reached, remains lighted after alarm acknowledgement and is extinguished when alarm condition does no longer exist.

11 Function Key **ENTER**
Is depressed for alarm acknowledgement and PID parameter storage.

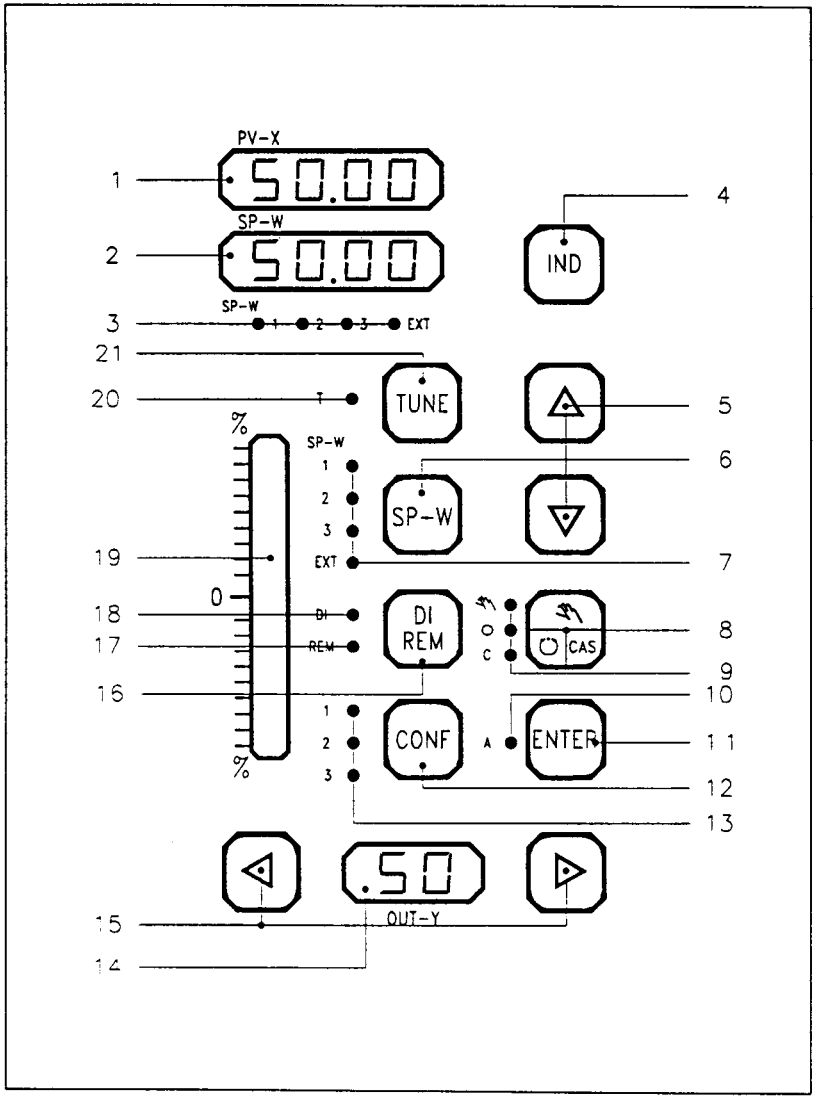


Figure 46 **Fixed Value/Follow-Up Control, Functions of Keys and Displays**

12 Function Key **CONF**
Serves for changeing over from the operating to the parameter and the configuration level.

13 LEDs **1, 2, 3**
Indicate the level selected: LED **1** = parameter level 1, LED **2** = parameter level 2, LED **3** = configuration level; if the operating level has been selected, none of these LEDs is lighted.

14 2-Digit, 7-Segment Display **OUT-Y**
Indicates output value OUT in %.

15 Function Key **Output Adjustment**
The right function key serves for increasing, the left one for decreasing the output value, adjustment is only possible in the manual mode. The complete procedure requires 15 sec.; adjustment range: -9 % to h9 = 109 %.

16 Function Key **DI/REM**
Serves for switching over from local to remote control and vice versa; is only active, when remote control (via discrete inputs or interface) was configured.

17 LED **REM**
Is flashing, when remote control via interface was configured but local control is active; is lighted, when remote control is selected by depressing the **DI/REM** key (remote control active).

18 LED **DI**
Is flashing, when control via DI was configured but local control is active; is lighted, when remote control is selected by depressing the **DI/REM** key (remote control active).

19 Deviation (**PV-SP**) Indication
If there is no deviation (PV-SP=0), the green bar in the middle is lighted. In the case of positive deviation, the upper red bars are lighted; when negative deviation occurs, the lower red bars are lighted. If deviation reaches an alarm limit, the bargraph display starts flashing.

20 LED **T**
Is lighted, if self-tuning has been configured and the TUNE key (21) is depressed; starts flashing, when parameter calculation is terminated and the parameters are ready for being taken over.

21 Function Key **TUNE**
Serves for starting and terminating the self-tuning of PID parameters.

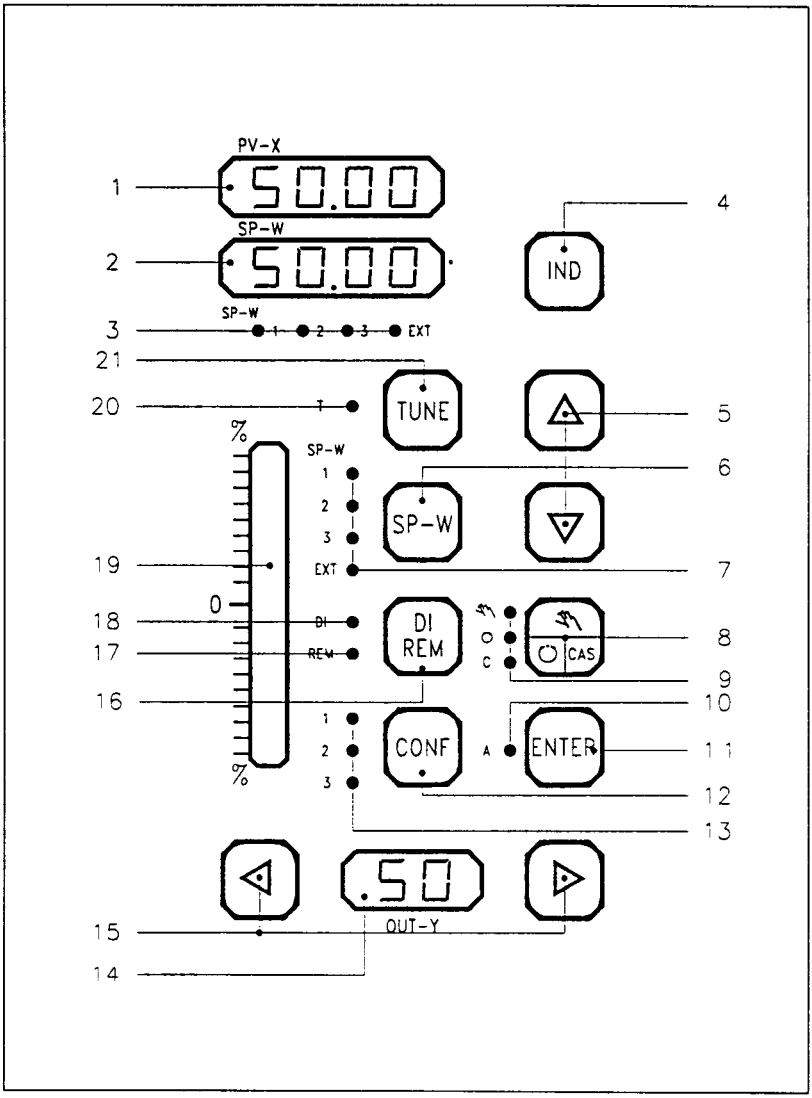


Figure 46 **Fixed-Value/Follow-Up Control, Functions of Keys and Displays**

4-3. Cascade Control

4-3.1 Functions of Keys and Displays

The CM 1 process controller can be configured to operate as a cascade controller. In this case, both the master and the slave are realized by a single CM 1. Figure 47 shows the corresponding signal diagram.

When the CM 1 is configured to operate as a cascade controller (refer to configuration table, 02/1/1), some of its tactile keys and displays have other functions than in the case of fixed-value/follow-up control. The functions depend on whether the CM 1 is used in the **manual**, **automatic** or **cascade** mode.

In the **manual** mode, the **output** of the **secondary controller** may be modified, in the **automatic** mode, the **secondary controller** is operating and if the **cascade** mode was selected, both the **primary controller** and the **secondary controller** are **active**.

General Remarks:

- In each operating mode, the **PV-X display** (1) indicates the process value of the primary controller.
- Depending on the operating mode selected, the **S-W display** (2) serves for displaying the primary setpoint, secondary setpoint, secondary process value or external setpoint of the primary controller. The type of value is indicated by the LEDs **SP-W** (3).
- The **OUT-Y display** (14) in all modes indicates the cascade control output.
- LED **C** (9) flashes in the **manual** and **automatic** mode and stops flashing when the **cascade** mode is selected.
- By means of the function key **SP-W** (6), the primary setpoint can only be changed over from setpoint 1 (**SP-W 1**) to the external setpoint (**EXT**) and vice versa.

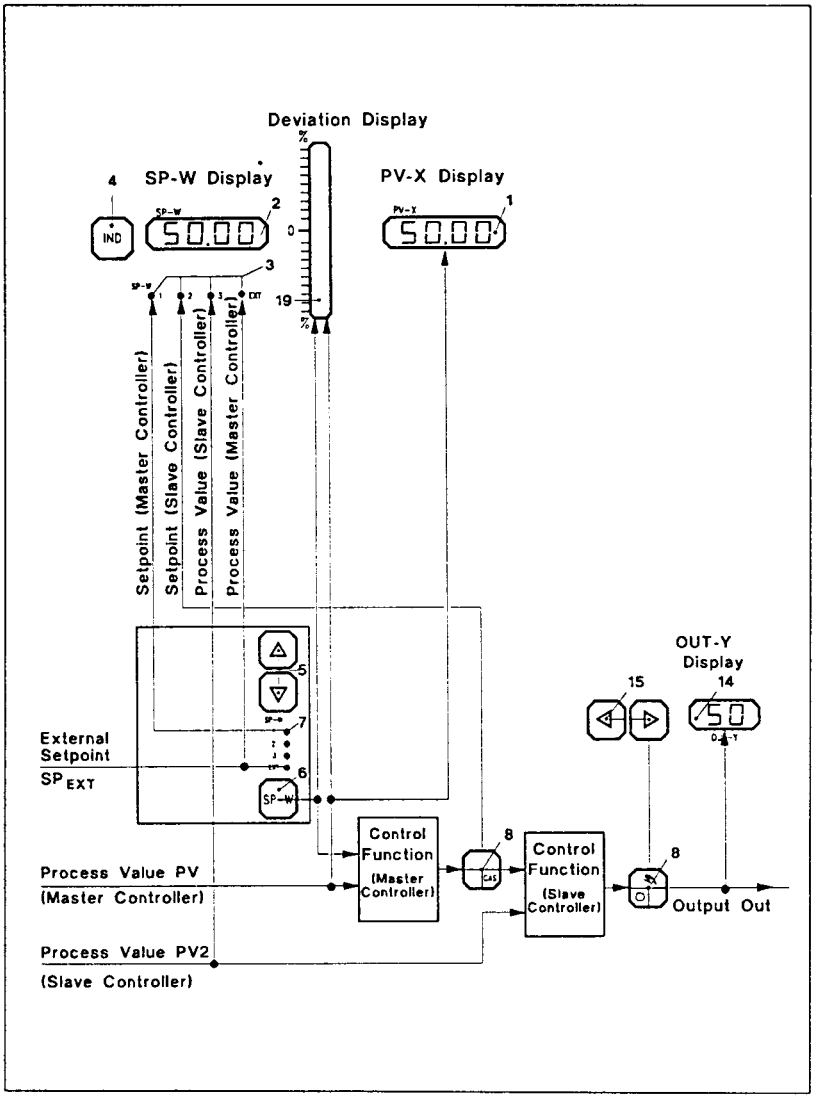


Figure 47 Cascade Control, Signal Diagram

General Functions of Keys and Displays (also refer to figure 48)

1 4-Digit, 7-Segment Display **PV-X**
Indicates in all operating modes the process value PV of the primary controller.

2 4-Digit, 7-Segment Display **SP-W**
Indicates the primary controller setpoint (together with LED **SP-W1**, item 3), the secondary setpoint (with LED **SP-W 2**), the secondary process value (with LED **SP-W 3**) and the external setpoint of the primary controller (with LED **EXT**).

3 LEDs **SP-W 1, 2, 3** and **EXT**
Are lighted according to the value displayed by the **SP-W** display.

4 Function Keys **IND**
Serves for selecting the value to be displayed by the **SP-W display** (indicated by the LEDs **SP-W1** to **EXT**).

5 Function Keys **Setpoint Adjustment**
Used for adjusting the setpoints indicated by the **SP-W** display.

6 Function Key **SP-W**
Serves for selecting the internal (SP-W 1) or external setpoint (EXT) of the primary controller.

7 LEDs **SP-W 1** and **EXT**
Indicate, whether the CM 1 operates as a standard controller with fixed internal SP (SP-W 1) or as a slave with external (EXT) setpoint.

8 Function Key **Operating Mode Selection**
Change-over from **manual** to **automatic** and **cascade** mode and v.v.

9 LEDs **Hand Symbol, Automatic Symbol** and **C**
Indicate the operating mode selected.

14 2-Digit, 7-Segment Display **OUT-Y**
Indicates the cascade control output.

15 Function Keys **Output Adjustment**
Enable output modification (increase or decrease) of the secondary controller in the manual mode.

19 Deviation (**PV-SP**) Indication
Indicates the deviation (PV-SP) of the primary controller.

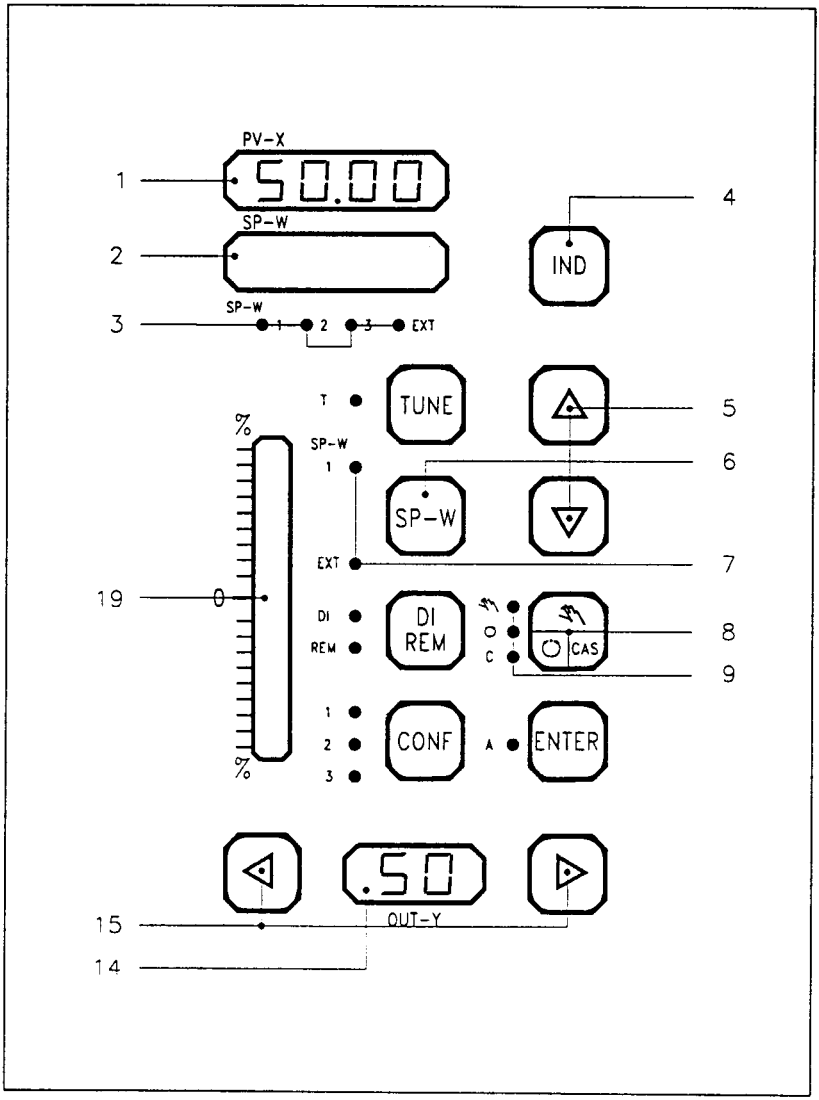


Figure 48 **Cascade Control, Functions of Keys and Displays**

4-3.2 Manual Mode, Special Functions of Keys and Displays

In the manual mode, the CM 1 shows the following display pattern (also see figure 49)

Display **PV-X** (1)	Process value of primary controller
Display **SP-W** (2)	Process value of secondary controller
LED **SP-W 3** (3)	Lighted (green)
LED **SP-W 1** (7)	Lighted (green)
LED **Hand Symbol** (9)	Lighted (red)
LED **C** (9)	Flashing
Display **OUT-Y** (14)	Output of secondary controller
Deviation indication	Deviation (PV-SP) of primary controller

In this operating mode the setpoint of the primary controller and the output of the secondary controller can be modified.

Modification of the primary controller setpoint is realized by using the function keys 5 (see figure 51).

The function keys 15 serve for increasing or decreasing the output value indicated in the "**OUT-Y**" display.

In addition, the values **SP-W 1** (primary controller setpoint) and **SP-W 2** (secondary controller setpoint) may be selected for indication in the **SP-W display** (2) by depressing the **IND** key (4). Note that, after 5 seconds, the **SP-W** display will automatically return to **SP-W 3**.

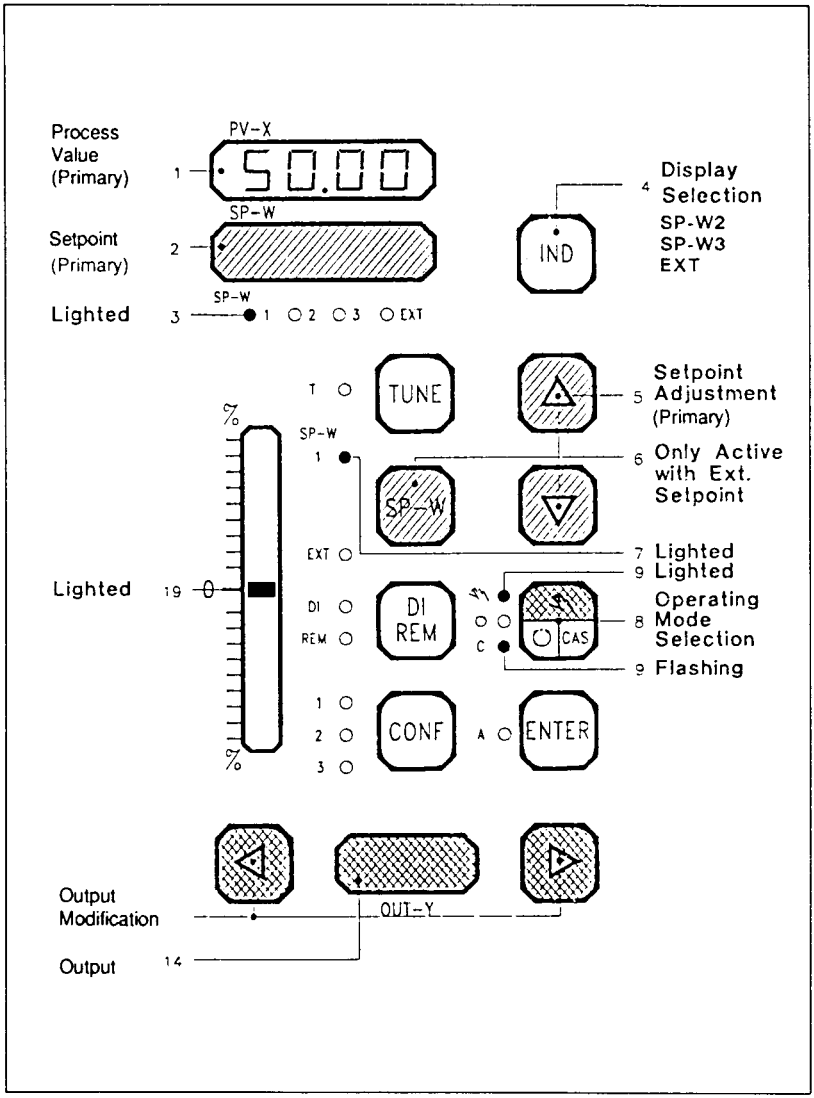


Figure 49 Manual Mode,Functions of Keys and Displays

4-3.3 Automatic Mode, Special Functions of Keys and Displays

The transfer from the manual to the automatic mode is realized bumplessly, as the setpoint of the cascade controller is tracked by the secondary input.

Having been changed over to the automatic mode by means of the function key **Operating Mode Selection**, the CM 1 shows the following display pattern (also see figure 50).

Display **PV-X** (1)	Process value PV of primary controller
Display **SP-W** (2)	Setpoint SP of secondary controller
LED **SP-W 2** (3)	Lighted (green)
LED **SP-W 2** (7)	Lighted (green)
LED **Automatic Symbol** (9)	Lighted (green)
LED **C** (9)	Flashing
Display **OUT-Y** (14)	Output of secondary controller
Deviation indication (19))	Deviation (PV-SP)of primary controller

In this mode, modification of the primary and secondary setpoints as well as display of the secondary process value is possible.

Depressing the corresponding function keys (5) will increase or decrease the setpoint displayed by the **SP-W** display and indicated by the LEDs **SP-W 1** (3) (primary setpoint) and **SP-W 2** (3) (secondary setpoint).

Selection of the setpoint to be modified is realized by using the **IND** key, which also permits to select **SP-W 3** in order to make the **SP-W** display indicate the secondary controller process value. Note that the **SP-W** display will automatically return to **SP-W 2** after 5 seconds.

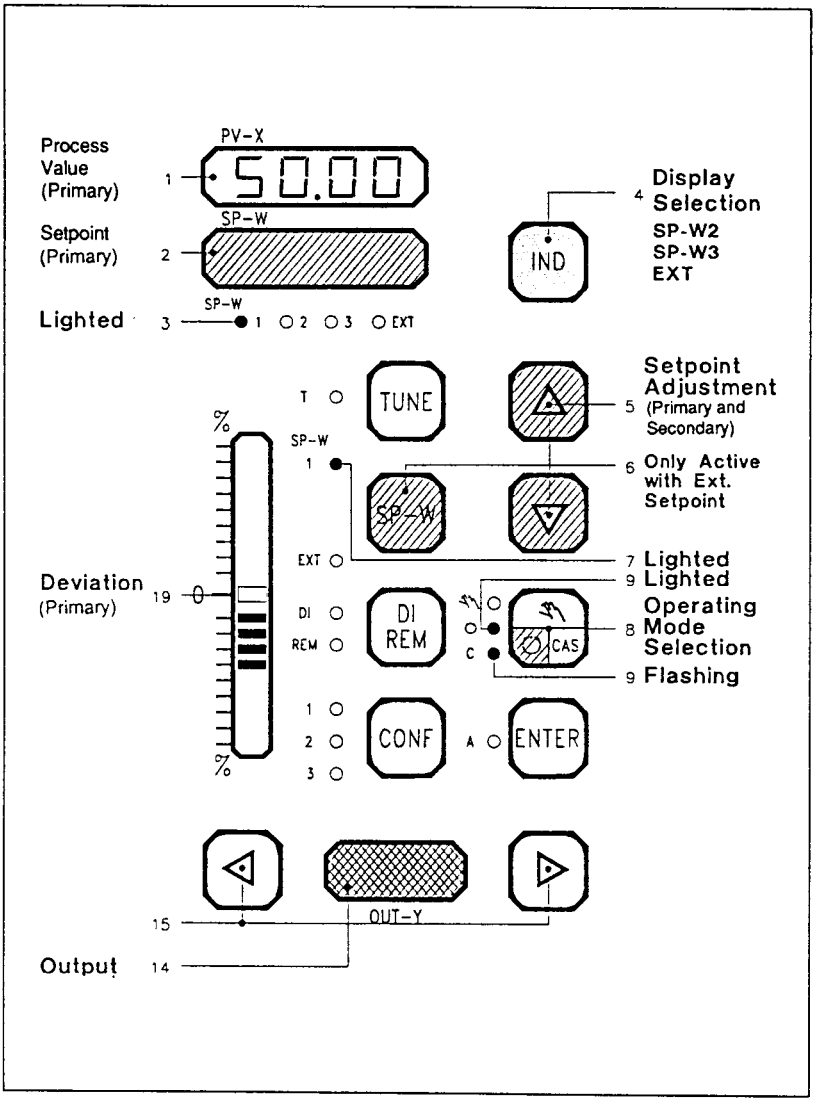


Figure 50 Automatic Mode; Functions of Keys and Displays

4-3.4 Cascade Mode, Special Functions of Keys and Displays

The transfer to the cascade mode is bumpless, because the primary controller output is tracked by the secondary controller setpoint.

For changing over, the function key **Operating Mode Selection** has to be depressed. In the cascade mode, LED **C** is permanently lighted. Moreover, the following display pattern appears (also see figure 51).

Display **PV-X** (1)	Process value of primary controller
Display **SP-W** (2)	Setpoint of primary controller
LED **SP-W 1** (3)	Lighted (green)
LED **SP-W 1** (7)	Lighted (green)
LED **C** (9)	Permanently lighted (green)
Display **OUT-Y** (14)	Output of secondary controller
Deviation indication	Deviation (PV-SP) of primary controller

In this operating mode, too, it is possible to modify the primary controller setpoint by using the corresponding function keys (5) and select display of the secondary controller setpoint and process value by depressing the **IND** key. The procedures are similar to those of the automatic mode.

Note that it is only possible to return to the automatic mode by selecting the manual mode before.

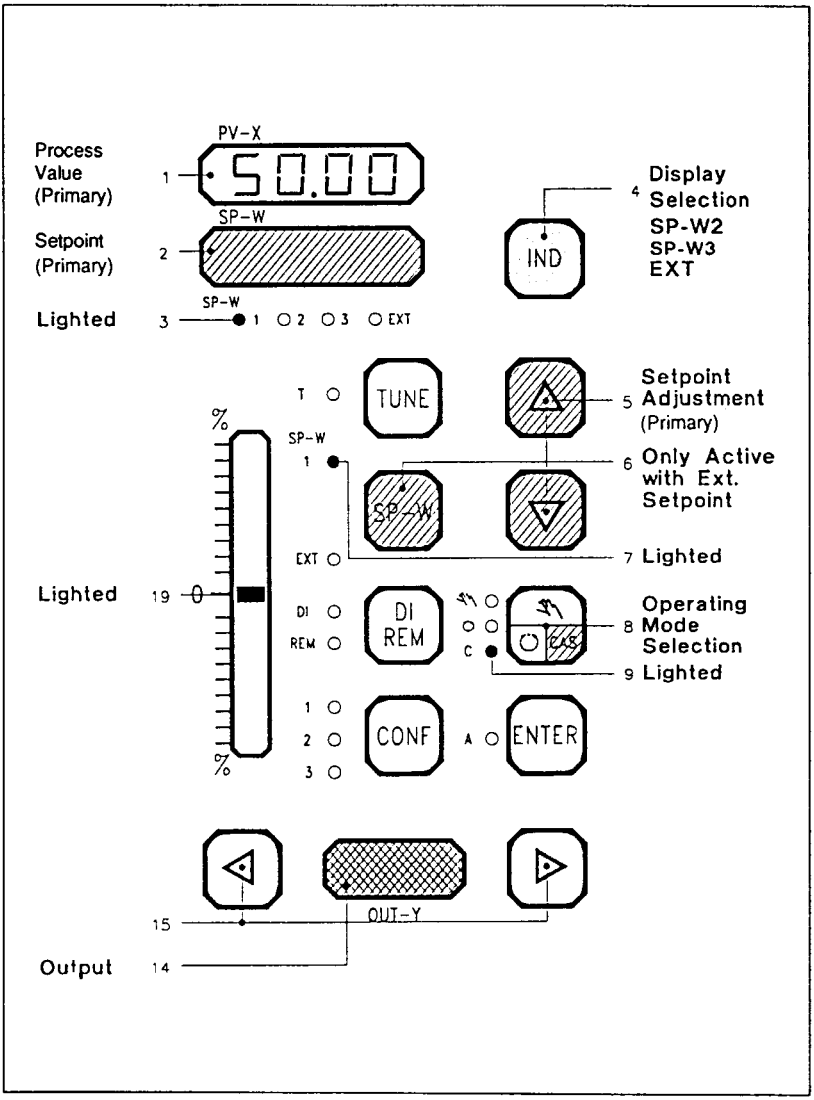


Figure 51 Cascade Mode, Functions of Keys and Displays

4-4. Ratio Control

4-4.1 Functions of Keys and Displays

Figure 52 shows the signal diagram of a CM 1 process controller configured to operate as a ratio controller (refer to configuration table 05/1.8 or 9). It can be seen that, in this mode, several functions are additionally available.

Among these functions, which may be displayed in **SP-W** (2), are the **RATIO** and **BIAS** values as well as the **setpoint of ratio control.** Depending on the configuration, the **RATIO** and **BIAS** values can be adjusted manually by using the CM 1 front panel keys or remotely by means of external signals (via separate analog inputs).

At the CM 1 , the **RATIO** and **BIAS** values are selected by depressing the **IND** key(4). The LEDs **SP-W 2** (RATIO) and **SP-W 3** (BIAS) (3) are lighted according to the selected value.

Whether the CM 1 operates as a standard controller or as a ratio controller is determined by depressing the **SP-W** key (6). Standard control is indicated by LED **SP-W 1** (7) and ratio control by LED **EXT** (7).

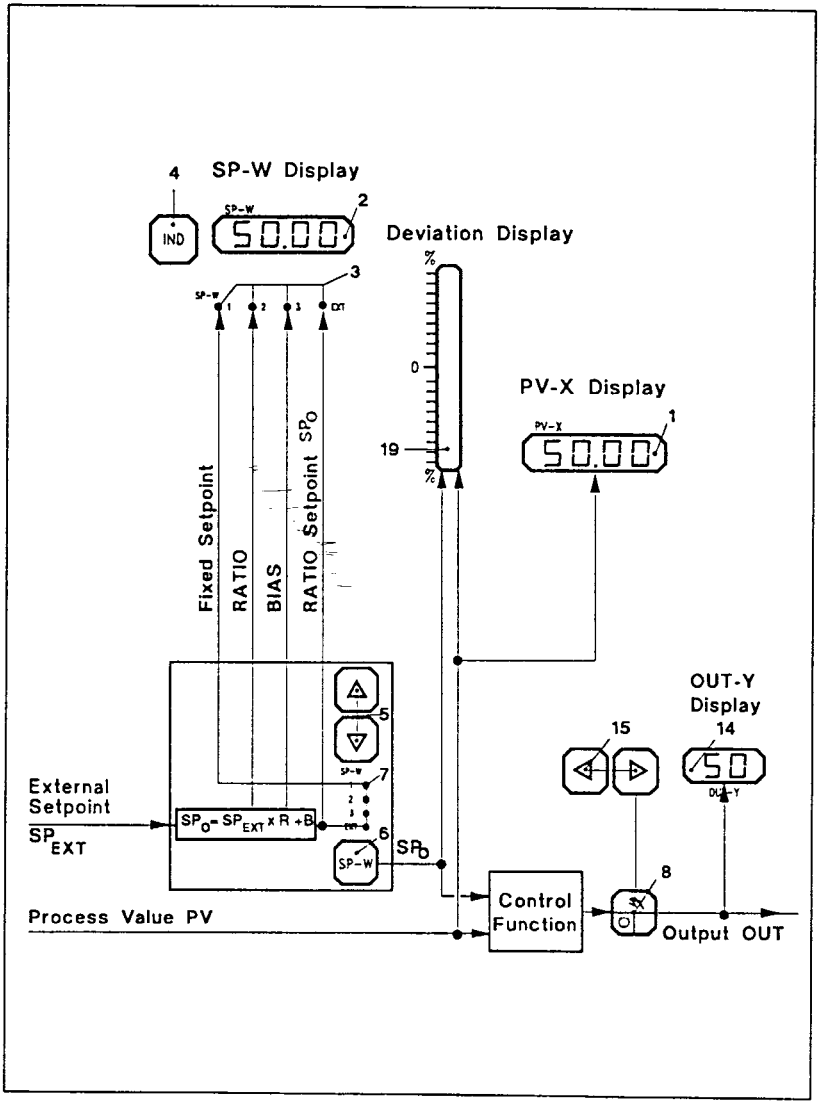


Figure 52 Ratio Control, Signal Diagram

General Functions of Keys and Displays (also see figure 53)

1 4-Digit, 7-Segment Display **PV-X**
Indicates the process value PV of the controller.

2 4-Digit, 7-Segment Display **SP-W**
Indicates the controller setpoint **SP** (together with LED **SP-W 1**) (3), the **RATIO** value (with **SP-W 2**), the **BIAS** value (with LED **SP-W 3**) and the **ratio setpoint SP** $_0$ (with LED **SP-W EXT**).

3 LEDs **1, 2, 3** and **EXT**
Are lighted according to the value displayed by **SP-W** (2).

4 Function Key **IND**
Serves for selecting the value to be displayed by **SP-W** (2) (indicated by LEDs **SP-W 1** to **EXT**) (3).

5 Function Keys Setpoint Adjustment
Used for adjusting fixed standard setpoint, RATIO and BIAS values.

6 Function Key **SP-W**
Change-over from **standard control SP-W 1** (7) to **ratio control SP-W EXT** (7) and vice versa.

7 LEDs **SP-W1** and **EXT**
Indicate, whether the CM 1 operates as a fixed-value or as a ratio controller.

8 Function Key **Operating Mode Selection**
Change-over between **manual** and **automatic** mode.

9 LEDs **Hand Symbol** and **Automatic Symbol**
Indicate the operating mode selected.

14 2-Digit, 7-Segment Display **OUT-Y**
Indicates the controller output.

15 Function Keys **Output Adjustment**
Enable output modification (increase or decrease) in the manual mode.

19 Deviation (PV-SP) Indication
Indicates the difference between the values indicated in **PV-X** (1) and **SP-W** (2) for **standard** and **ratio control.**

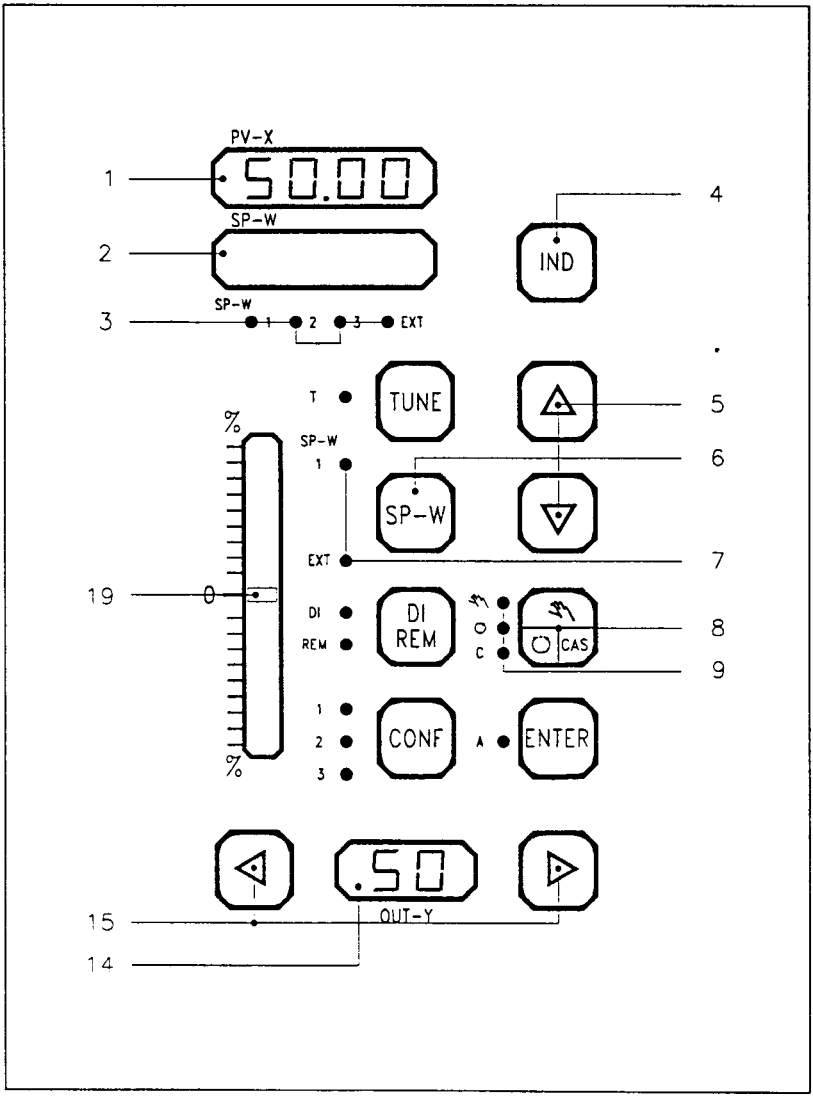


Figure 53 Ratio Control, Functions of Keys and Displays

4-4.2 Manual Mode, Special Functions of Keys and Displays

When a CM 1 operating as a ratio controller is in the **manual** mode, it shows the following display pattern (also see figure 54)

Display **PV-X** (1)	Process value of standard controller
Display **SP-W** (2)	Setpoint of standard controller
LED **SP-W 1** (3)	Lighted (green)
LED **SP-W 1** (7)	Lighted (green)
LED **Hand Symbol** (9)	Lighted (red)
Display **OUT-Y** (14)	Output of standard controller
Deviation indication (19)	Deviation PV-SP

In the **manual** mode, the standard controller **setpoint** and **output** as well as the **RATIO** and **BIAS** values may be modified and /or set by using the corresponding function keys (5).

Note that **RATIO** and **BIAS** have to be selected for display in **SP-W** (2) by means of the **IND** key (4), first, and that the **SP-W** display as well as the assigned LEDs (**SP-W 2/3**, item 3) will automatically return to the setpoint (**SP-W 1**) after 5 seconds, if none of the keys is depressed during this time.

Modification of the ratio setpoint (SP-W EXT, (3)) which can also be selected by depressing the IND key, is not possible.

The standard controller output indicated in the OUT-Y display (14) can be increased or decreased, slowly or quickly, as required, by means of the corresponding function keys (15).

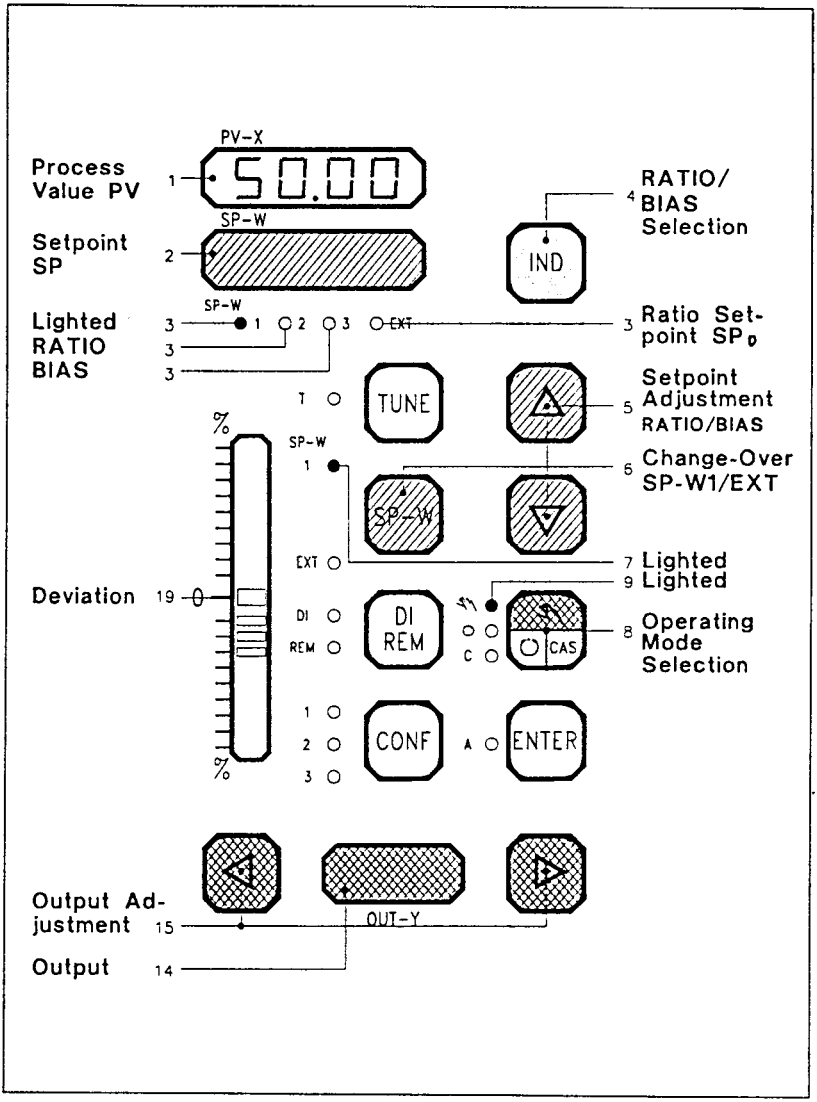


Figure 54 **Manual Mode, Functions of Keys and Displays**

4-4.3 Automatic Mode, Special Functions of Keys and Displays

The transfer to the automatic mode is realized bumplessly (by tracking the controller output to the manual output).

Depressing the function key **Operating Mode Selection** will change over the CM 1 from the **manual** mode (indicated by LED **Hand Symbol**, red) to the **automatic** mode (indicated by LED **Automatic Symbol**, green). In this mode, the CM 1 shows the following display pattern (also see figure 55).

Display **PV-X** (1)	Process value of standard controller
Display **SP-W** (2)	Setpoint of standard controller
LED **SP-W 1** (3)	Lighted (green)
LED **SP-W 1** (7)	Lighted (green)
LED **Automatic Symbol** (19)	Lighted (green)
Display **OUT-Y** (14)	Output of standard controller
Deviation indication (19)	Deviation PV-SP

In the **automatic** mode, **setpoint**, **RATIO** and **BIAS** adjustment is realized by means of the corresponding function keys (5) as in the **manual** mode. It is not possible to modify the **output** in this mode.

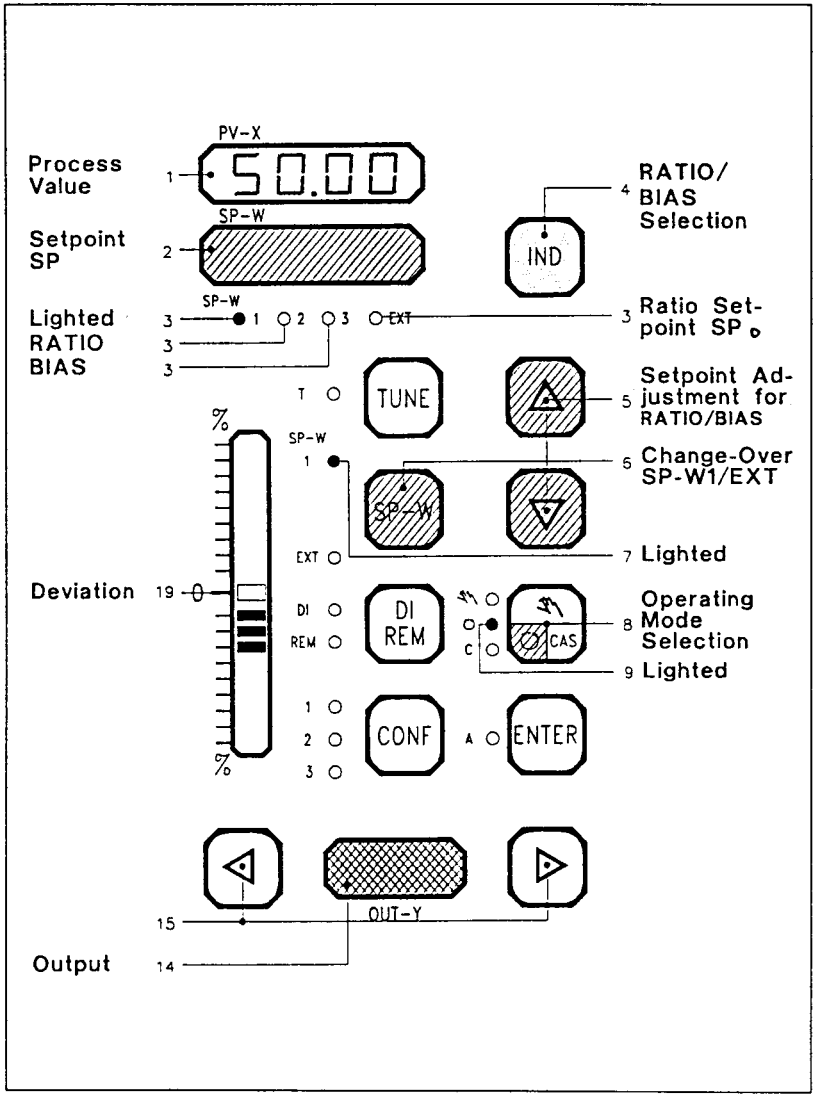


Figure 55 Automatic Mode, Functions of Keys and Displays

4-4.4 Ratio Mode, Special Functions of Keys and Displays

Change-over to the ratio mode is achieved by depressing the **SP-W** key (6). The ratio mode is indicated by LED **SP-W EXT** (7).

Figure 56 shows the corresponding display pattern:

Display **PV-X** (1)	Process value of ratio controller
Display **SP-W** (2)	Setpoint of ratio controller
LED **SP-W EXT** (3)	Lighted (red)
LED **SP-W EXT** (7)	Lighted (red)
LED **Automatic Symbol** (9)	Lighted (green)
Display **OUT-Y** (14)	Output of ratio controller
Deviation Indication (19)	Deviation PV-SP

In this mode, loop control is only possible by means of **RATIO** or **BIAS** modification.

Like in the manual and automatic mode, the setpoints **SP-W 1** (3), **SP-W 2** (3) and **SP-W 3** (3) can be selected for display in **SP-W** (2) by means of the **IND** key (4). The displayed value can be increased or decreased by depressing the corresponding function keys (5).

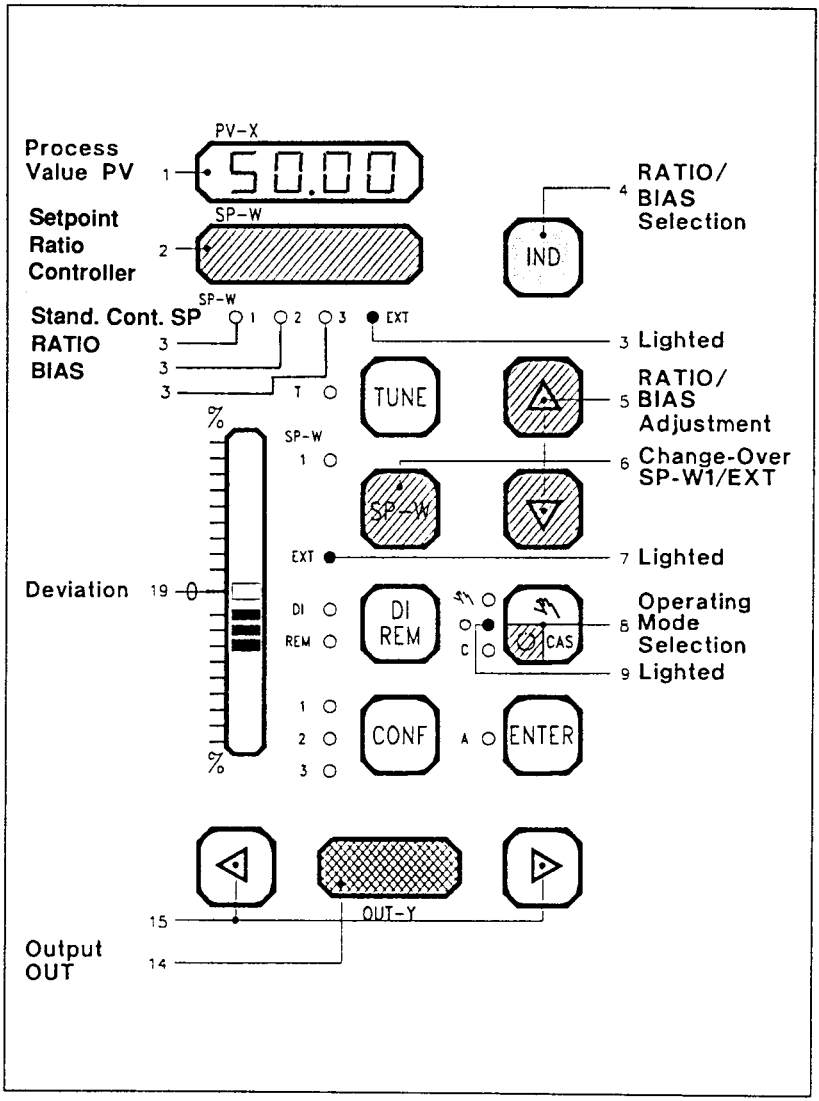


Figure 56 Ratio Mode, Functions of Keys and Displays

4-5 Override control

4-5.1 Functions of keys and displays

Process station CM 1 can be used for override control in addition to standard/follow-up, cascade or ratio control. PID 1 is the main controller and is assigned the process value PV. PID 2 is the override controller which operates with the auxiliary process value PV2. Change-over between the two controllers is regulated by a minimum-maximum selection. Fig. 1 shows the simplified signal diagram of the override control.

The override control is configured in function block 2, either as override control minimum selection (02/1.2) or as override control maximum selection (02/1.3).

Main controller PID 1 can be operated with an internal (standard control) or external (follow-up control) setpoint. The corresponding setpoint configuration is performed in block 5, where the responses 0, 3, 4 and 7 are permissible. Error message 40 (selected configuration is incorrect) appears with responses 1 and 2, 5 and 6, and 8 and 9.

With 1 and 2 as well as 8 and 9, the procedure is the same as with configuration 0 (standard control). With 5 and 6, the procedure is the same as with configuration 4 (standard/follow-up control).

Following configuration, some of the display elements have different meanings than with standard/follow-up control.

In principle, the following applies:

- Depending on controller operation, the **PV-X** display (1) shows the actual value (process value PV) of the main controller or the actual value (process value PV2) of the override controller.

- Depending on controller operation, the **SP-W** LEDs (3) of the **SP-W** display (2) show the setpoint of the main controller with standard value (SP) or follow-up control (SPExt) or the setpoint of the override controller (SP2).

- The **OUT-Y** display (14) shows the output value of the main or override controller. The output value can be changed with function keys **15** in the manual mode.

- The setpoint for the main controller can be switched between **SP-W 1** (7) and **EXT** (7) with function key **SP-W** (6).

- The setpoints (SP and SP2) are set with function keys **5** following selection with **IND**.

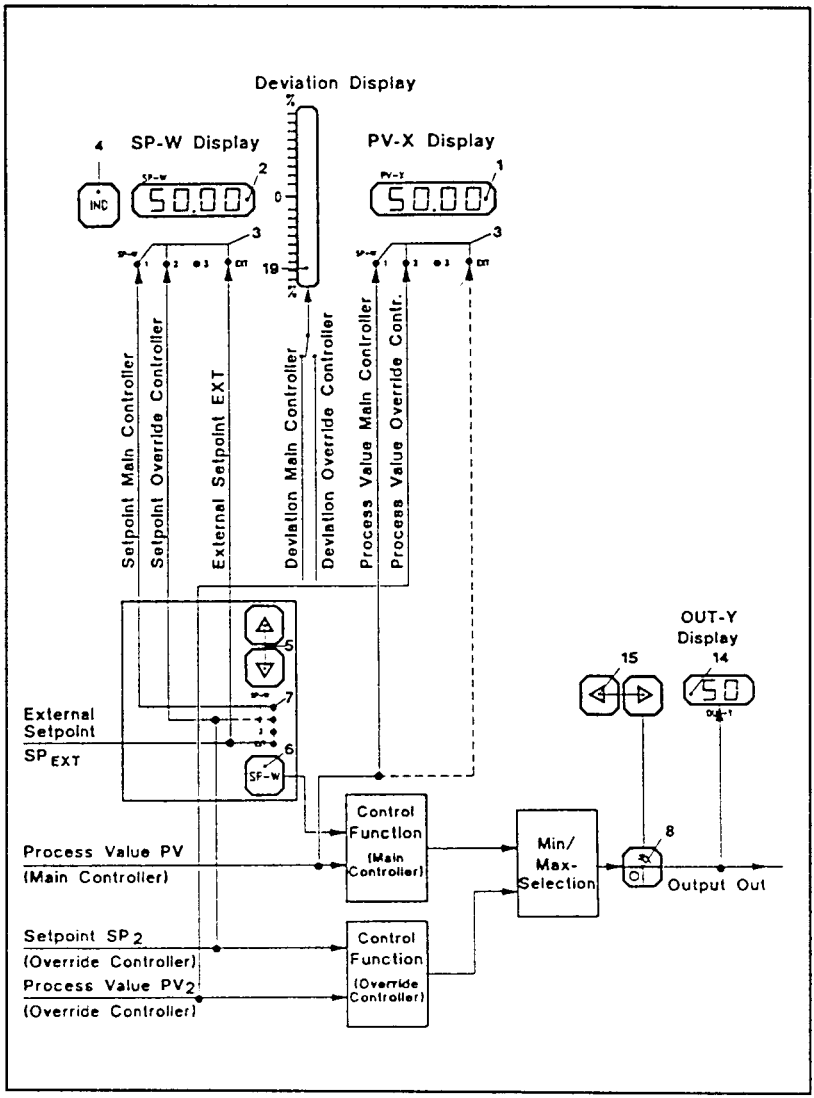


Fig. 57 Override control, Signal diagram

Overview of functions (Fig. 58)

1 4-Digit, 7-Segment Display **PV-X**
Displays actual value x of the main controller and actual value PV2 of the override controller in every mode.

2 4-Digit, 7-Segment Display **SP-W**
In conjunction with **SP-W1** (3) this function displays the setpoint of the main controller, with **SP-W2** (3) it shows the setpoint of the override controller, and with **SP-W EXT** (3) it displays the external setpoint of the main controller.

3 LEDs **1, 2** and **EXT**
Light up to indicate which setpoint is displayed in **SP-W** (2).

4 Function Key **IND**
The setpoints assigned to the **SP-W 1, 2** and **EXT** LEDs (3) can be displayed in SP-W (2) with the IND key.

5 Function Keys **Setpoint Adjustment**
These keys are used to alter the setpoints displayed in **SP-W** (2).

6 Function Key **SP-W**
This key is used to select the internal (SP-W 1) or external (EXT) setpoint of the main controller.

7 LEDs **SP-W 1, 2** and **EXT**
These LEDs display whether the main controller is working with an internal (SP-W 1) or external (EXT) setpoint, or whether the override controller is active (SP-W 2 flashes).

8 Function key **Operating Mode Selection**
Change-over between **manual** and **automatic** mode.

9 LEDs **Hand** Symbol and **Automatic** Symbol
These LEDs display the mode selected.

14 2-Digit, 7-Segment Display **OUT-Y**
This function displays the controller output.

15 Function Keys **Output Adjustment**
These keys permit the output value of the main or override controller to be adjusted upwards or downwards in manual mode.

19 Deviation Indication
This function displays the deviation of the active controller.

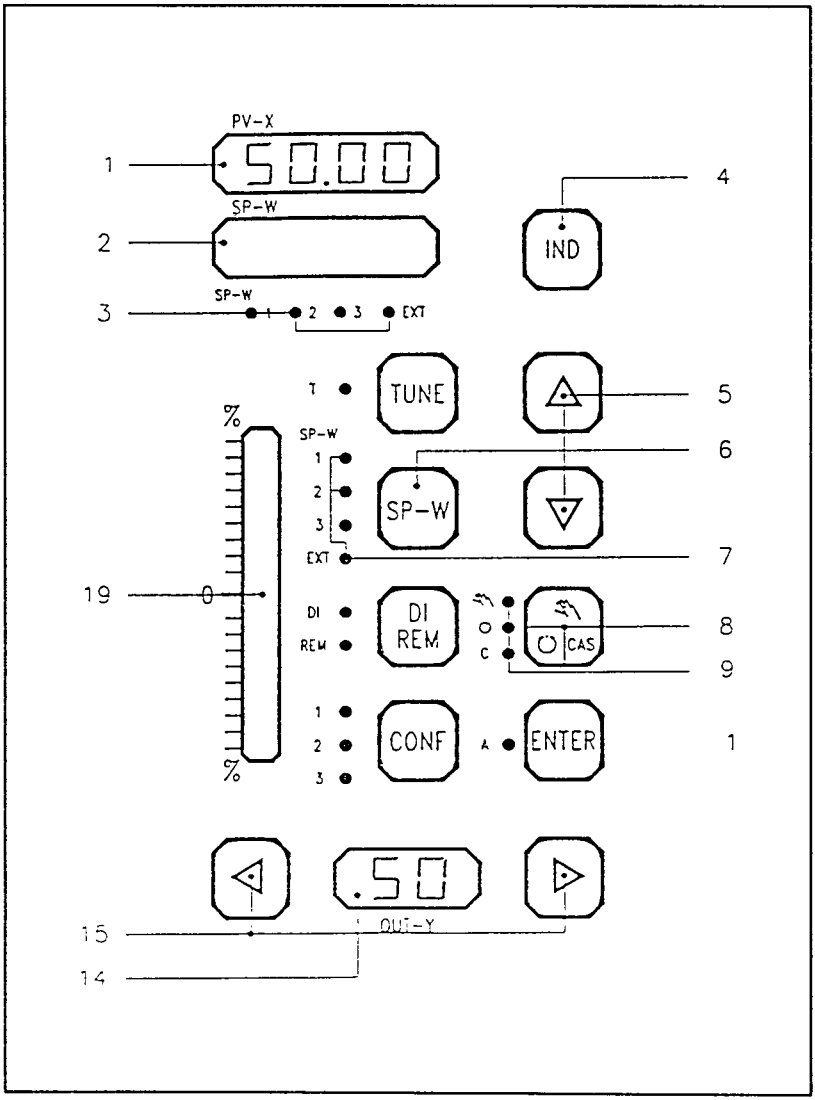


Fig. 58 **Override control, Functions of Keys and Displays**

4-5.2 Control and setting options in "manual" mode

The following image appears when the configured process station is switched on (Fig. 59):

Display **PV-X** (1)	Main controller process value PV
Display **SP-W** (2)	Main controller setpoint SP
LED **SP-W 1** (3)	Lighted (green)
LED **SP-W 1** (7)	Lighted (green)
LED **Hand** Symbol (9)	Lighted (red)
Display **OUT-Y** (14)	Main controller output value
Deviation indication (19)	Main controller deviation

The setpoints of the main and override controllers and their output values can be altered in **"manual"** mode.

Press function keys **5** to alter the setpoints and function keys **15** to alter the output values.

In addition to the display of the main controller internal ssetpoint, the main controller external setpoint and the override controller setpoint can also be displayed for monitoring and setting purposes.

Press function key **IND** to obtain the **SP-W 2** (override controller setpoint) and **SP-W Ext** (main controller external setpoint) values in the **SP-W** display (2).

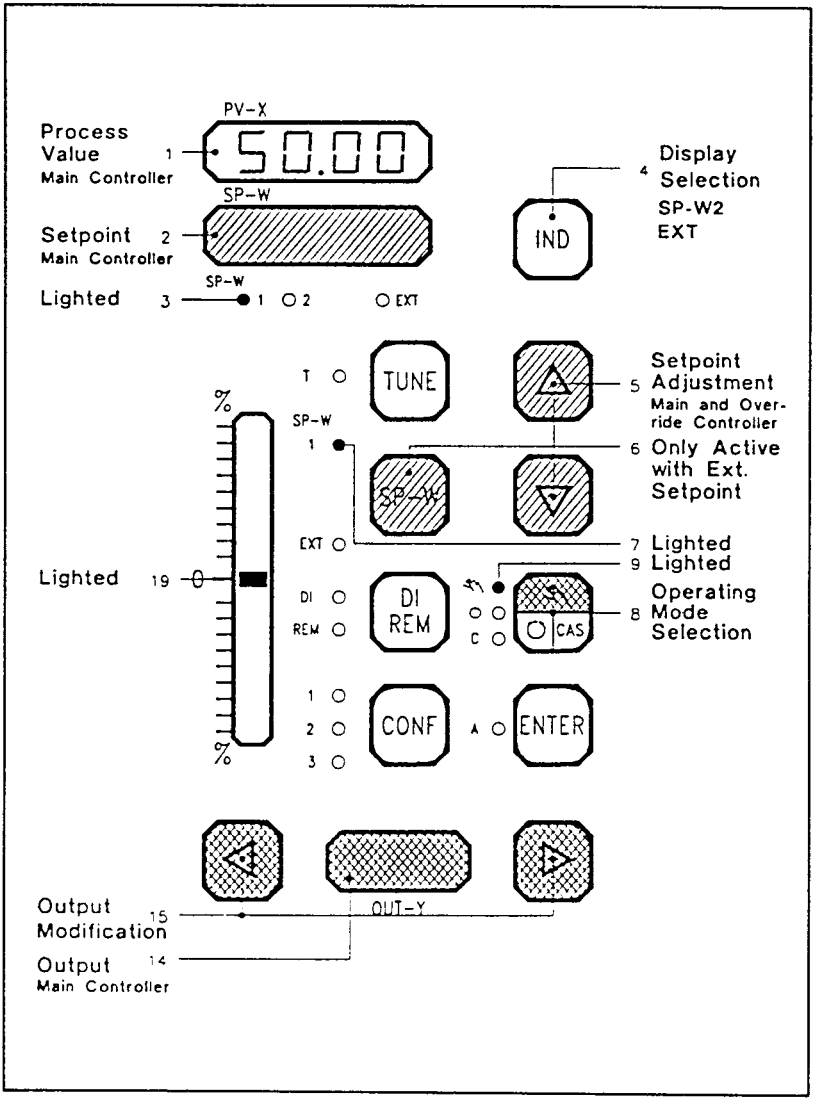


Fig. 59 "Manual" Mode, Function of Keys and Displays

4-5.3 Control and setting options in "automatic" mode

Case I

Following change-over to **"automatic"** mode with mode key (8), override control is initiated, whereby the main controller is active initially. The front panel displays the following image (Fig. 60):

Display **PV-X** (1)	Main controller process value PV
Display **SP-W** (2)	Main controller setpoint SP
LED **SP-W 1** (3)	Lighted (green)
LED **SP-W 1** (7)	Lighted (green)
LED **Automatic** Symbol (9)	Lighted (green)
Display **OUT-Y** (14)	Main controller output value
Deviation indication (19)	Main controller deviation

The setpoints of the main controller and the setpoint of the override controller can be altered in this mode. Press function keys **5** to make the alterations.

Press function key **IND** (4) to select the override controller setpoint in **SP-W 2** (3) or the external main controller setpoint in **SP-W Ext** (3).

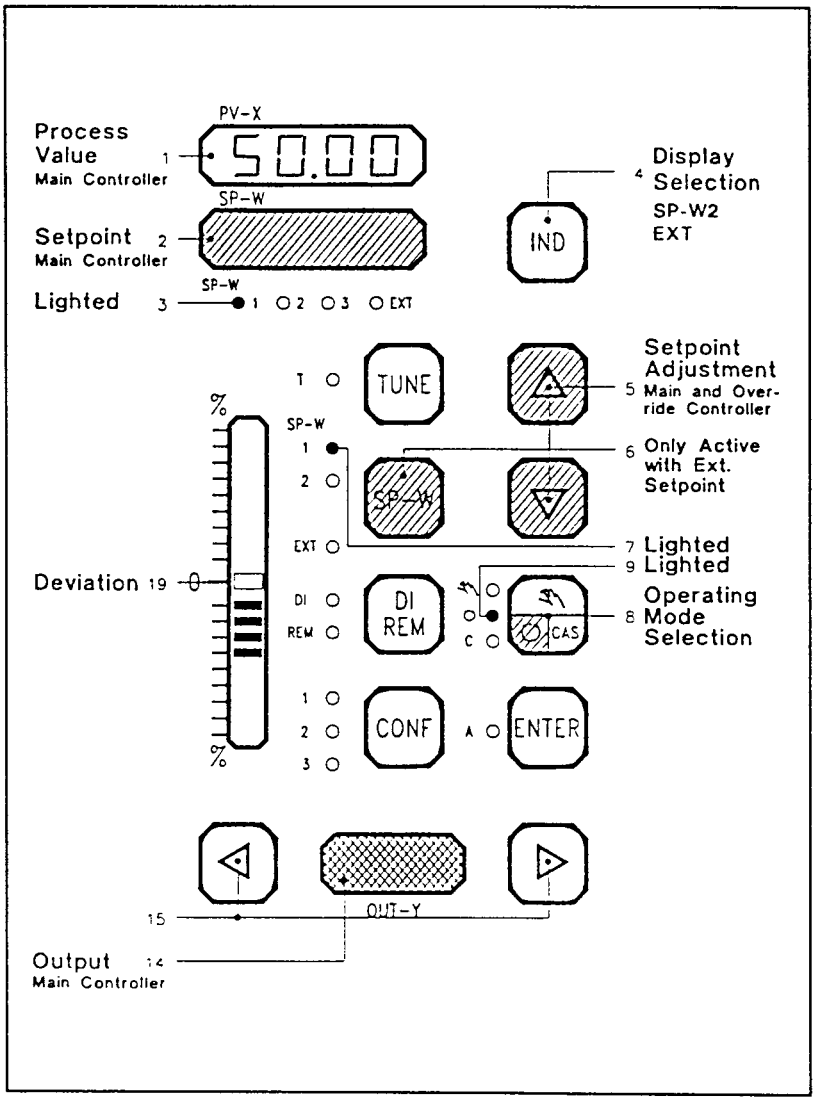


Fig. 60 **"Automatic I" Mode, Functions of Keys and Displays**

Case II

In the event of override control, the control functions are performed by the override controller. LED **SP-W 2** (7) flashes if the override controller is in operation.

The displays in Fig. 61 are switched as below:

Display **PV-X** (1)	Override controller process value PV2
Display **SP-W** (2)	Override controller setpoint SP2
LED **SP-W 2** (3)	Lighted (green)
LED **SP-W 2** (7)	Flashes (General indication of "override controller in operation")
LED **Automatic** Symbol (9)	Lighted (green)
Display **OUT-Y** (14)	Override controller output value
Deviation indication (19)	Override controller deviation

The setpoint of the override controller and the setpoints of the main controller can be altered in this mode. Press function keys 5 to make the alterations.

Press function key **IND** to select the main controller setpoint in **SP-W 1** (3) or the main controller external setpoint in **SP-W Ext** (3).

If **"manual"** mode is selected during control, the CM1 process station displays the values of the controller currently in operation.

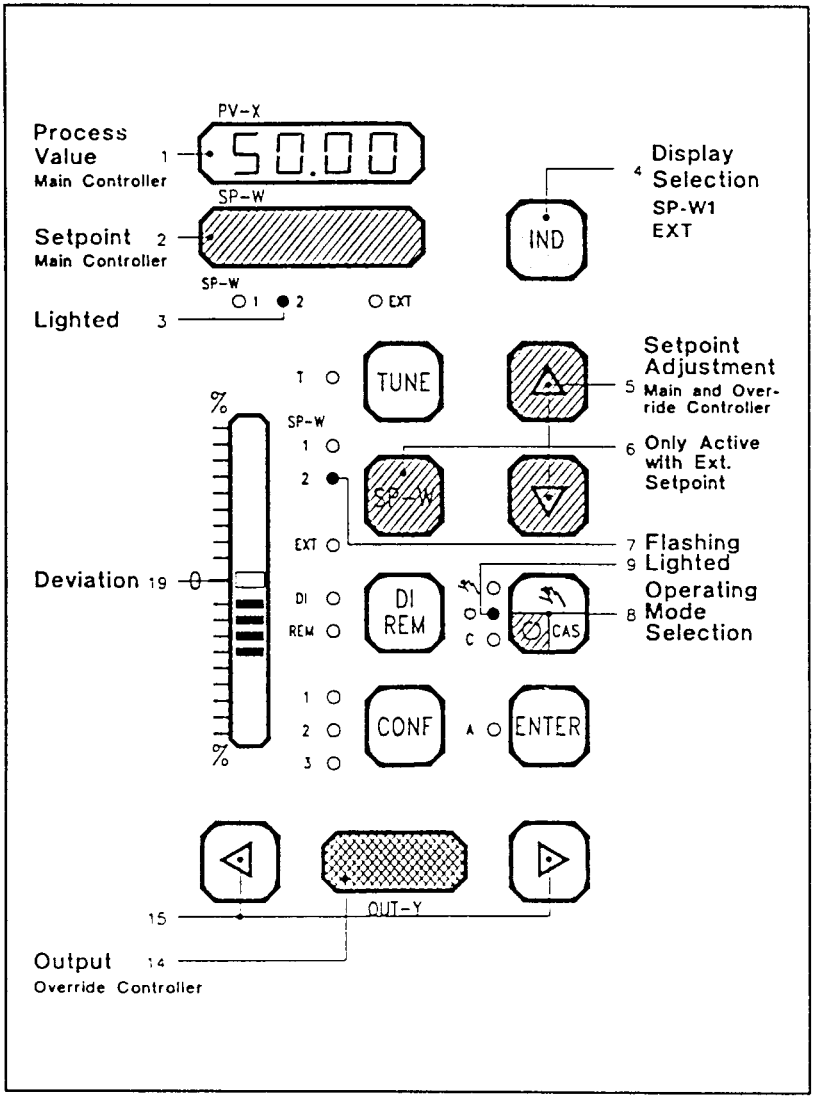


Fig. 61 **"Automatic II" Mode, Functions of Keys and Displays**

4-6. Self-Tuning

The self-tuning function simplifies the adaptation of the controller to the control loop. By means of this function the PID parameters are calculated and prepared for being taken over. It can be started in the **manual**, **automatic** and **cascade** mode by depressing the **TUNE** key.

The following controllers can be optimized with the self-tuning functions:

Fixed-value/follow-up control:	individual controllers
Cascade control:	primary and secondary controller
Override control:	Main and override controller

When using this function, please note:

1. The self-tuning fuction is only active if this was configured before (please refer to configuration table function 01/5.1 or 01/5.1 and 02/6.1 respectively).

2. The self-tuning function requires the setting of certain parameters (please refer to parameter table, parameters 80/81 or 84/85, respectively).

The identification time and the amount of change have to be set in advance.

General Functions of Keys and Displays (Figure 62)

1 4-Digit, 7-Segment Display **PV-X**
Indicates the current process value

2 4-Digit, 7-Segment Display **SP-W**
Indicates the values calculated for the parameters K_P, K_I and T_D. Which of these parameters is indicated can bee seen from the OUT-Y display (14), where the corresponding character (P,I,d) appears after the IND key is pressed.

3 LEDs **SP-W1, SP-W2,SP-W3** and **EXT**
Are lighted according to the active setpoint.

4 Function Key **IND**
By depressing the IND key the values calculated for the parameters can successily be called up for display in SP-W (2).

5 Function Keys **Parameter Modification**
The parameter values indicated by SP-W (2) can be increased by depressing the upper and decreased by depressing the lower key.

7 LEDs **SP-W1, SP-W2, SP-W3** and **EXT**
Are lighted according to the active setpoint

9 LEDs **Hand Symbol** and **Automatic Symbol**
Are lighted according to the operating mode (**manual** or **automatic**) selected.

11 Function Key **ENTER**
Depressing the ENTER key will store all values calculated for P, I and D. The values will then be used by the controller .

14 2-Digit, 7-Segment Display **OUT-Y**
Displays the character (P, I or d) indicating the type of the calculated parameter.

19 Deviation (PV-SP) Indication
Displays the deviation PV-SP during parameter calculation. After calculation of the PI(D) parameters, it serves for indicating the expected step response of the closed loop.

20 LED **T**
Lighted,when self-tuning was configured and is started by pressing the TUNE key; starts flashing, when the parameters after calculation are ready for being taken over.

21 Function Key **TUNE**
Serves for starting or terminating (in advance) the tuning function.

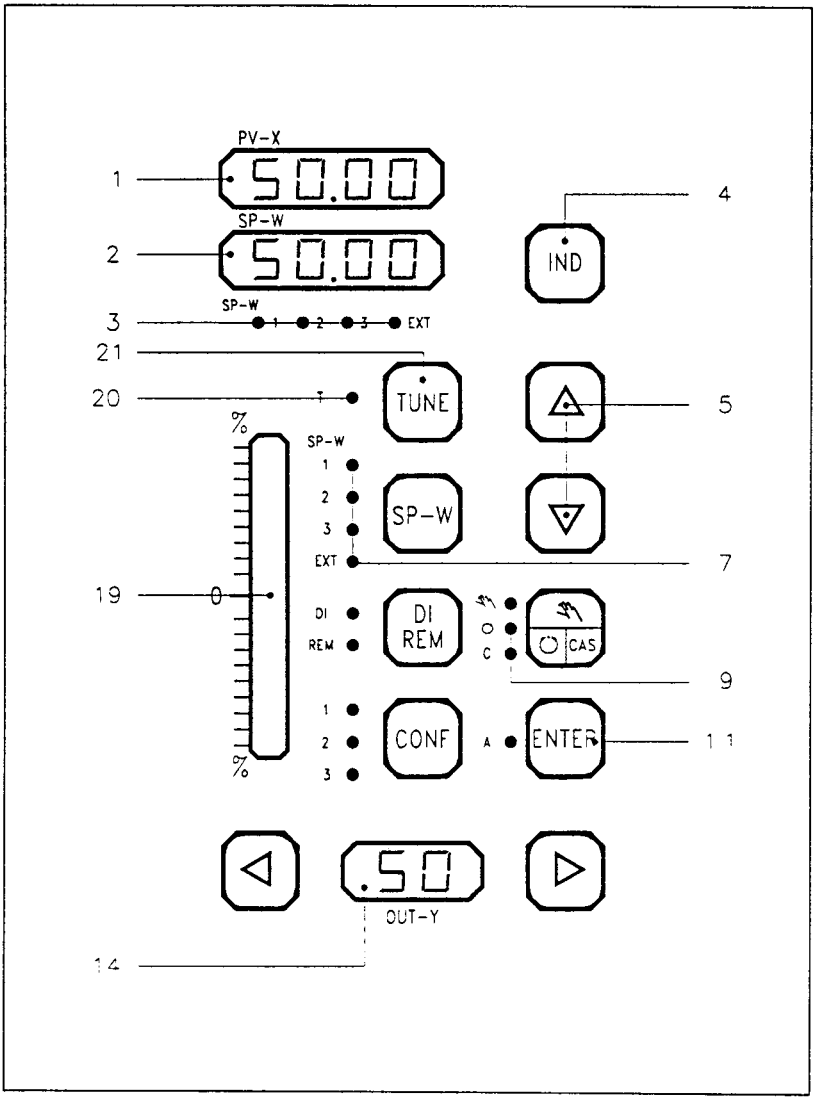


Figure 62 Self-Tuning Mode, Functions of Keys and Displays

4-7. Peculiarities of 3-Point Step Control

The 3-point step control output can be used with external or internal reset for all controller types.

The output function is indicated in **OUT-Y** (14).

In the manual mode the output may be increased or decreased by depressing the left or right function key (15). In order to enable the user to distinguish rising from falling output signals, graphic symbols are displayed with internal and points with external reset.

Internal Reset

Position **Manual** and **Automatic** (09/X.13 not configured)

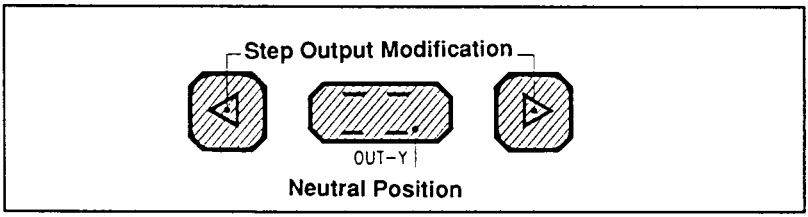
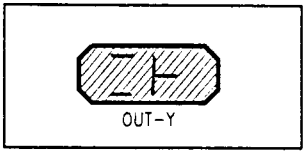
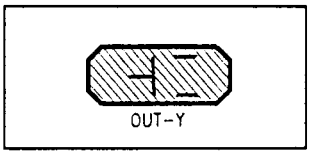


Figure 63 3 -Point Step Control Output, Internal Reset



In Position "Open":
Symbol on the Right



In Position "Closed":
Symbol on the Left

External Reset

Position **Manual** and **Automatic**

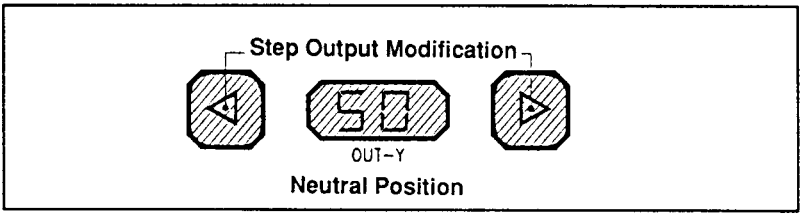
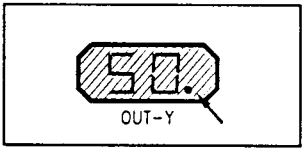
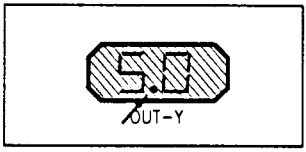


Figure 64 3-Point Step Control Output, External Reset

In Neutral Position: Number Between 0 and h0 (100)
(09/X.13 Must be Configured)



In Position "Open":
Point on the Right
Output Active



In Position "Closed":
Point on the Left
Output Active

4-8. Examples

The following examples are intended to serve as exercises and shall be an aid for making the user acquainted with CM 1 operation.

All examples are based on the values preset in factory and a shorted connection between the anlog input (AI 1) and output (AO).

Example 1: **Setpoint Modification**

Example 1 shows the CM 1 operating as a standard controller in the automatic mode. The following display pattern appears:

Process value **PV-X**	=	50.00
Setpoint **SP-W 1**	=	50.00
Output **OUT-Y**	=	50
Deviation PV-SP	=	0.

The displayed setpoint can be increased by depressing the upper and decreased by using the lower function key (5). Short-time depressing will change the setpoint by one unit, long time depressing will scroll the values.

The new value will immediately be valid and will be stored in the configuration memory after 1 minute. The process value and output will change accordingly (only in automatic mode !).

If further setpoints (indicated by **SP-W 2** and **SP-W 3**, (3)) have been configured, they can be selected by means of the **IND** key and be set or modified by means of the function keys (5).

However, only the setpoint selected by depressing the SP-W key (6) and indicated by the corresponding LED is the active one .

It is also possible to select setpoint **EXT** (7), provided that the corresponding function was configured accordingly (configuration table, function 05/1.4...7 fixed-value/follow-up control).

Depressing the **IND** key will show the user whether all setpoints are configured and which values were defined.

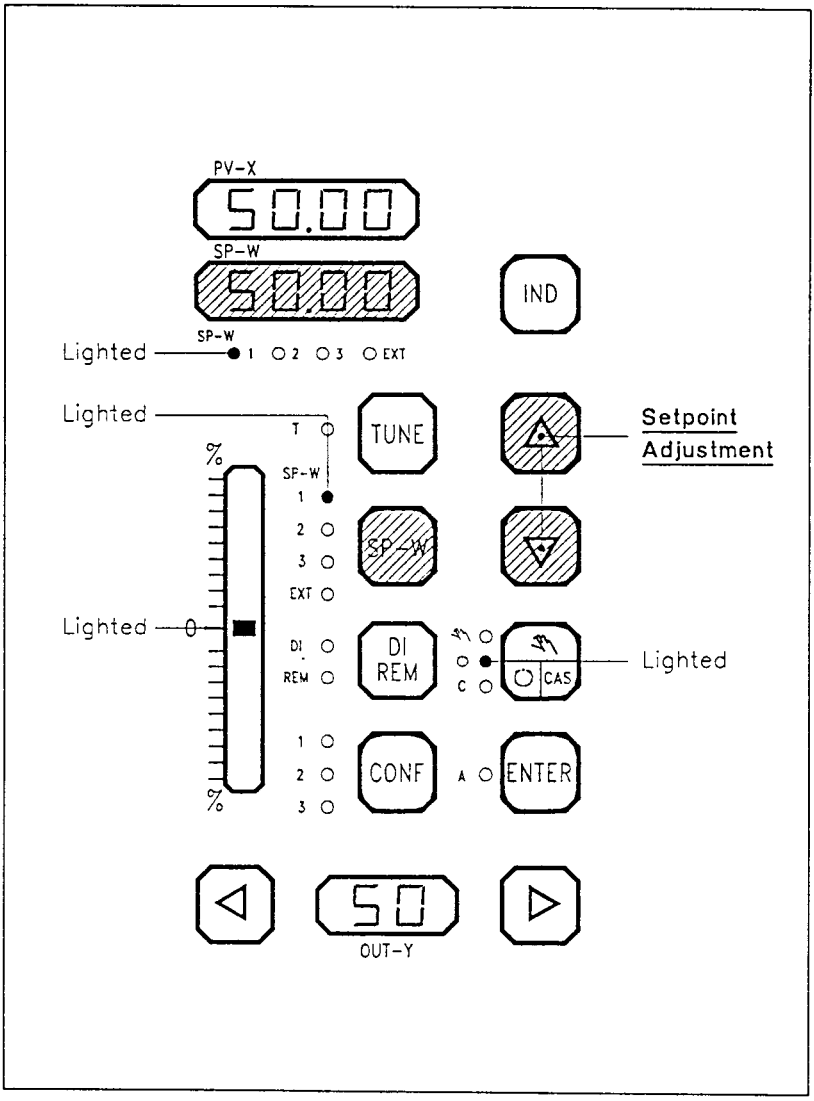


Figure 65 Example 1: Setpoint Modification

Example 2: **Output Modification**

For output modification, the operator first of all has to depress the function key **Operating Mode Selection** to switch over to the **manual** mode. The new status will be indicated by LED **Hand Symbol**.

Subsequently, the output value may be increased to h 9 = 109 % by means of the right adjustment key (15) or decreased to - 9 = - 9 % by using the left key.

For example, if the output value is reduced to zero, the **OUT-Y** display (14) as well as the **PV-X** display (1) will indicate "**0**". In addition, the lower red bars of the **xw** display (deviation indication) (19)are lighted. An output value of 100 will make the **OUT-Y** display show "**h0**" and the **PV-X** display indicate "**99.99**". In this case, the upper red bars of the deviation indication (19) will be lighted.

Several output modification rates are possible and may be selected by:

Short-Time Depressing: Output modification is realized in invisible steps (0,1%). The output value will not be displayed before addition is terminated and a defined percentage is reached.

Long-Time Depressing: After the key has been depressed for about 1 second, automatic increase or decrease is started. Modification speed will first rise in 1% steps. After five steps and after the next number divisible through 5 is reached, modification speed rises to 5% steps. The whole procedure will require about 15 seconds.

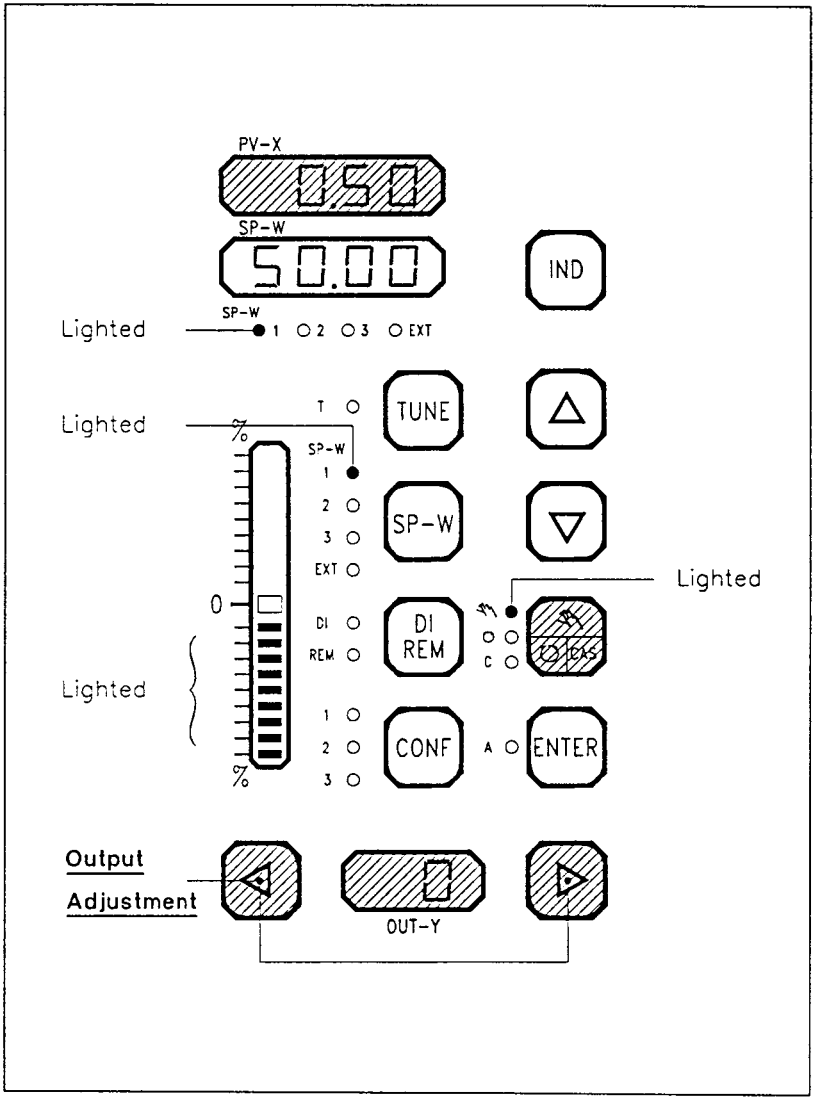


Figure 66 Example 2: Output Modification

Example 3: **Alarm Annunciation**

Figure 64 shows an example of limit exceeding (h). An alarm has been triggered, when PV $\geq$ 60.00 (limits depend on the type of plant and therefore have to be configured by the user; in factory, Hi and Lo limits are set to the maximum or minimum value, respectively).

The flashing **PV-X** display indicates the process value having triggered the alarm, the **SP-W** display indicates the **type of alarm**. LED **A** is flashing in the same rhythm.

When the alarm is acknowledged by means of the **ENTER** key (11), the **PV-X** display (1) and LED **A** stop flashing and the **SP-W** display (2) indicates the setpoint. When the process value falls short of the limit and no further alarms occur, LED **A** (10) is extinguished.

It is possible to display again all alarms already acknowledged (provided that they are still active) by depressing the **ENTER** key for 3 seconds.

The alarm indication in **SP-W** can be suppressed by configuration. The alarm indication is displayed by continuous burning of the LED as long as the alarm function is on.

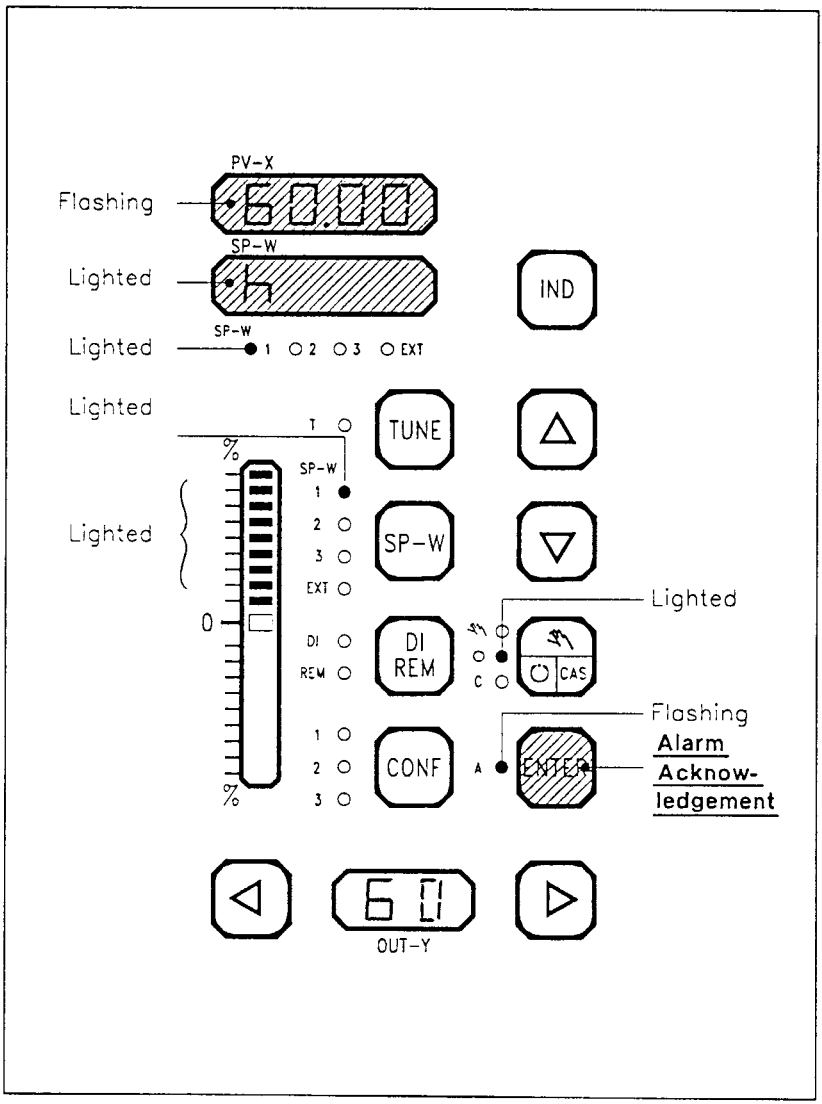


Figure 67 Example 3: Alarm Annunciation

Example 4: **Self-Tuning**

After the TUNE key (21) has been depressed, LED **T** is lighted in order to indicate that loop identification has been started.

If the self-tuning procedure is started in the manual mode, the **OUT-Y** display (14) changes corresponding to the predetermined amount of change (parameter 81). If self-tuning is started in the automatic mode, the **SP-W** display (2) changes accordingly.

As soon as loop analysis and parameter calculation are terminated, LED **T** (20) starts flashing.

The calculated parameter value is then indicated by the **SP-W** display (2). A letter simultaneously displayed in the **OUT-Y** display indicates what type of parameter has been calculated.

Depressing the IND key (4) will call up and display the other parameters calculated.

First "**P**" is indicated by the **SP-W** display (2), then "**I**" and "**d**". A value for "**d**" is only displayed if "**D**" was configured (function 01/2.1 or 2). Otherwise, "0000" will appear in the display.

The function keys (5) can be used for manually readjusting **P I (D)** parameters. The modification can be seen from the reaction curve on the deviation indication.

Parameter storage after termination of the procedure is achieved by using the **ENTER** key (11). Depressing the **TUNE** key will terminate the self-tuning function in advance. In both cases LED **T** is extinguished and the current setpoint and output values appear again in the corresponding displays (**SP-W** (2) and **OUT-Y** (14).

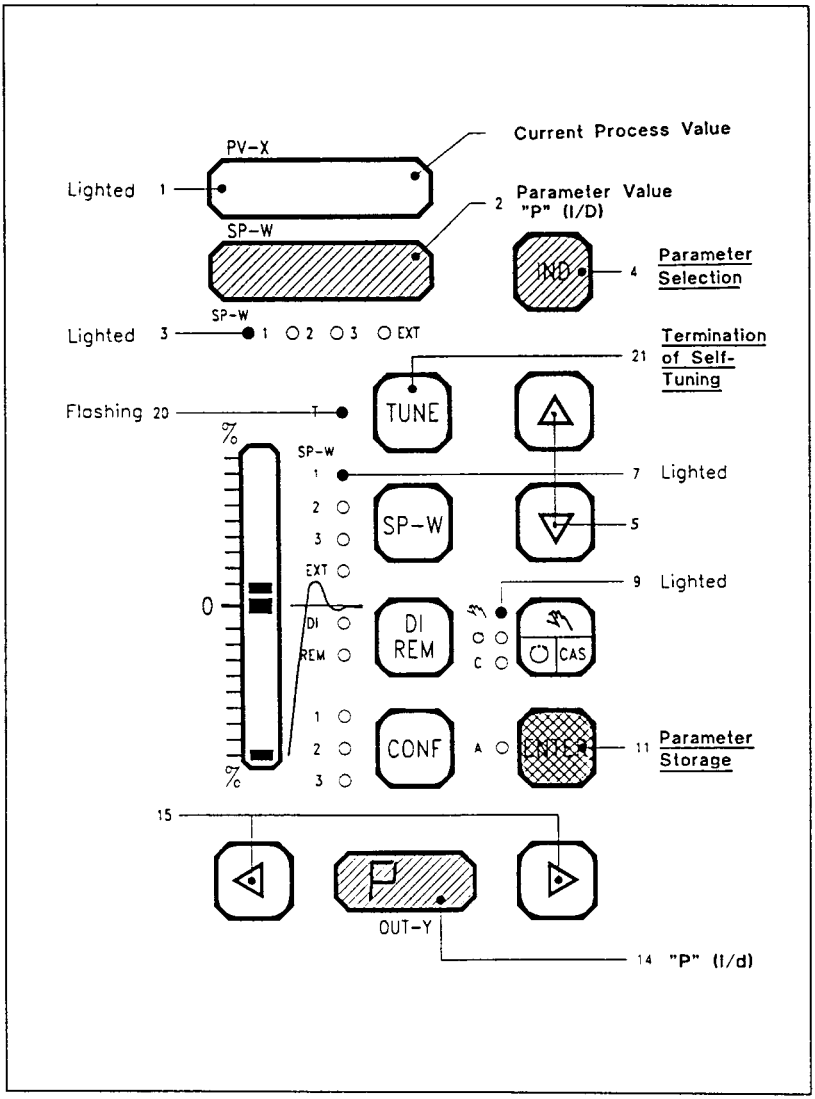


Figure 68 Example 4: Self-Tuning

Example 5: **Change-Over from Operating Level to Parameter Level 1**

Depress the **CONF** key (12) to change over from the operating level to parameter level 1. Lighting of LED **1** (13) indicates that the CM 1 is in parameter level 1.

In case no parameters were released for this level, "no" is indicated by the **OUT-Y** display (14), while the **SP-W** display (2) shows **4 dashes**. The process value as well as the deviation indication (19) and LED **SP-W** (3) remain unchanged. For returning to the operating level depress three times the **CONF** key (12).

If parameters were released for this level, the **OUT-Y** display (14) indicates the first released parameter number and **SP-W** displays the parameter value.

Parameters can now be adjusted.

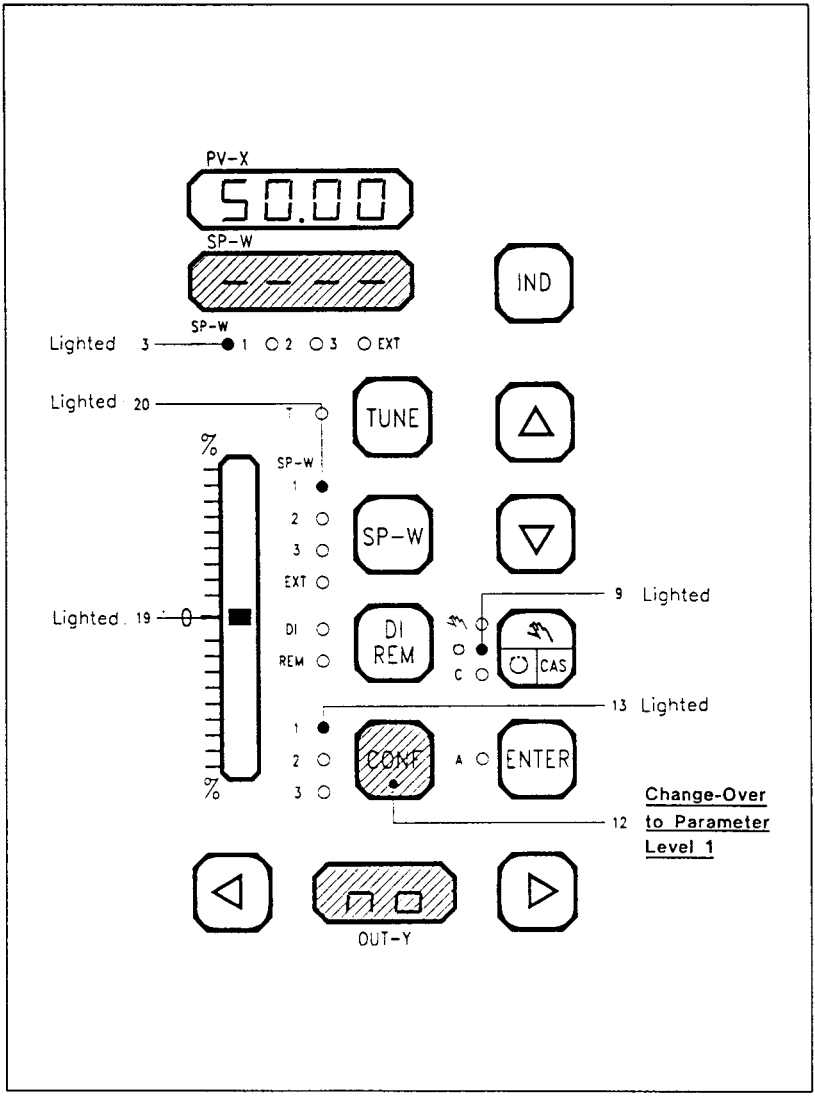


Figure 69: Example 5: Change-Over from Operating Level to Parameter Level 1

4-9. List of Possible Functions and Required Steps

4-9.1 Standard / Slave Controller

Functions Standard / Slave Controller	Operating Mode		Key (s)	Displays		Steps
	Man.	Auto.		Flashing	Lighted	
Display Setpoint	X	X	IND		SP-W 50.00 SP-W ● 1 ● 2 ● 3 ● Ext	Press IND key : if configured, LEDs SP-W1, 2, 3 and EXT are lighted successively. The setpoint displayed (except for EXT) can be modified.
Select Setpoint	X	X	SP-W		SP-W ● 1 ● 2 ● 3 ● Ext	Press SP-W key : if configured, LEDs SP-W1,2,3 and EXT are lighted successively. The setpoint selected is active and can be modified (except for EXT).
Modify Setpoint	X	X	△ ▽		SP-W 50.00	Press upper key : value increases Press lower key : value decreases
Modify Output	X		◁ ▷		50 OUT-Y	Change over from automatic to manual mode, press keys. Right key : value increases Left key : value decreases
Select Manual Mode		X	MAN AUTO		Hand Symbol ●	Press function key "Operating Mode Selection", corresponding LED is lighted.
Select Automatic Mode	X				Automatic Symbol ●	

Functions Standard / Slave Controller	Operating Mode		Key (s)	Displays		Steps
	Man.	Auto.		Flashing	Lighted	
Change Over from DI to Front Panel Operation	X	X	DI REM	DI ●	DI ●	Only possible, if operation via DI or interface is configured. DI/REM key serves for changing over from operation via DI or interface to front panel operation and v. v. Remote : LEDs are lighted Local: : LEDs flash
Change Over from Interface to Front Panel Operation	X	X		REM ●	REM ●	
Acknowledge Alarms and Display them Again	X	X	ENTER	A ●	A ●	Alarm condition : LED A flashes Press ENTER key : LED A is lighted Display alarm again : press ENTER key for 3 seconds.
Start / Terminate Self - Tuning	X	X	TUNE	T ●	T ●	Press TUNE key : if configured, LED T is lighted. Self-tuning is started and T flashes until termination of parameter calculation. Press ENTER to store, press TUNE again to terminate self-tuning.
Change Over to Parameter Level 1	X	X	CONF		SP-W 1 ● — — — — OUT-Y	Press CONF key : if parameter level 1 is not released, LED 1 is lighted and SP-W indicates 4 dashes. If level 1 is released, OUT-Y indicates the parameter no. and SP-W the parameter value.

4-9. List of Possible Functions and Required Steps

4-9.2 Cascade Controller

Functions Cascade Controller	Operating Mode			Key (s)	Displays		Steps
	Man.	Auto.	CAS		Flashing	Lighted	
Display Primary/Secondary EXT Setpoint or Secondary Process Value	X	X	X	IND		SP-W 50.00 SP-W ● 1 ● 2 ● 3 ● Ext	Press IND key : if configured, LEDs SP-W1, 2, 3 and EXT are lighted successively. The setpoint displayed (except for EXT) can be modified (in position CAS, primary controller setpoint, only)
Select Internal / External Setpoint	X	X	X	SP-W		SP-W ● 1 ● 2 ● 3 ● Ext	Press SP-W key : if configured, LED EXT is lighted . The setpoint selected is active and can be modified (except for EXT).
Modify Setpoint	X	X	X	△ ▽		SP-W 50.00	Press upper key : value increases Press lower key : value decreases
Modify Output	X			◁ ▷		50 OUT-Y	Change over from automatic/cascade to manual, press key. Right key : value increases Left key : value decreases
Select Man. Mode			X	CAS		Hand Symbol ●	Press function key "Operating Mode Selection", corresponding LED is lighted.
Select Auto. Mode	X					Automatic Symbol ●	
Select Cascade		X				Cascade Symbol C ●	

Functions Cascade Controller	Operating Mode			Key (s)	Displays		Steps
	Man.	Auto.	CAS		Flashing	Lighted	
Change Over from DI to Front Panel Operation	X	X	X	DI REM	DI ●	DI ●	Only possible, if operation via DI or interface is configured. DI/REM key serves for changing over from operation via DI or interface to front panel operation and v. v. Remote : LEDs are lighted Local: : LEDs flash
Change Over from Interface to Front Panel Operation	X	X	X		REM ●	REM ●	
Acknowledge Alarms and Display them Again	X	X	X	ENTER	A ●	A ●	Alarm condition : LED A flashes Press ENTER key : LED A is lighted Display alarm again : press ENTER key for 3 seconds.
Start / Terminate Self - Tuning	X	X	X	TUNE	T ●	T ●	Press TUNE key : if configured, LED T is lighted. Self-tuning is started and T flashes until termination of parameter calculation. Press ENTER to store, press TUNE again to terminate self-tuning.
Change Over to Parameter Level 1	X	X	X	CONF		1 ● SP-W — — — — OUT-Y	Press CONF key : if parameter level 1 is not released, LED 1 is lighted and SP-W indicates 4 dashes. If level 1 is released, OUT-Y indicates the parameter no. and SP-W the parameter value.

4-9. List of Possible Functions and Required Steps

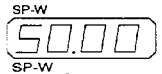
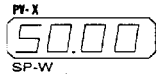
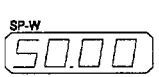
4-9.3 Ratio Controller

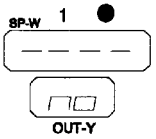
Functions Ratio Controller	Operating Mode		Key (s)	Displays		Steps
	Man.	Auto.		Flashing	Lighted	
Display Standard Controller Setpoint, RATIO and BIAS Value or Ratio Controller Setpoint	X	X	IND		SP-W 50.00 SP-W ● 1 ● 2 ● 3 ● Ext	Press IND key : if configured, LEDs SP-W1, 2, 3 and EXT are lighted successively. The setpoint displayed (except for EXT) can be modified.
Change Over from Standard to Ratio Controller	X	X	SP-W		SP-W ● 1 ● 2 ● 3 ● Ext	Press SP-W key : LED EXT is lighted. EXT cannot be modified.
Modify Stand. Controller Setpoint, RATIO and BIAS	X	X	△ ▽		SP-W 50.00	Press upper key : value increases Press lower key : value decreases
Modify Output	X		◁ ▷		50 OUT-Y	Change over from automatic to manual mode, press keys. Right key : value increases Left key : value decreases
Select Man. Mode		X	CAS		Hand Symbol ●	Press function key "Operating Mode Selection", corresponding LED is lighted.
Select Auto. Mode	X				Automatic Symbol ●	

Functions Ratio Controller	Operating Mode		Key (s)	Displays		Steps
	Man.	Auto.		Flashing	Lighted	
Change Over from DI to Front Panel Operation	X	X	DI REM	DI ●	DI ●	Only possible, if operation via DI or interface is configured. DI/REM key serves for changing over from operation via DI or interface to front panel operation and v. v. Remote : LEDs are lighted Local: : LEDs flash
Change Over from Interface to Front Panel Operation	X	X		REM ●	REM ●	
Acknowledge Alarms and Display them Again	X	X	ENTER	A ●	●	Alarm condition : LED A flashes Press ENTER key : LED A is lighted Display alarm again : press ENTER key for 3 seconds.
Start / Terminate Self - Tuning	X	X	TUNE	T ●	T ●	Press TUNE key : if configured, LED T is lighted. Self-tuning is started and T flashes until termination of parameter calculation. Press ENTER to store, press TUNE again to terminate self-tuning.
Change Over to Parameter Level 1	X	X	CONF		SP-W 1 ● — — — — OUT-Y	Press CONF key : if parameter level 1 is not released, LED 1 is lighted and SP-W indicates 4 dashes. If level 1 is released, OUT-Y indicates the parameter no. and SP-W the parameter value.

4-9. List of Possible Functions and Required Steps

4-9.4 Override Controller

Functions Override Controller	Operating Mode Man.	 Auto.	Key (s)	Displays Flashing	 Lighted	Steps
Indicate Setpoint of Main Override Controller	X	X	IND	SP-W ● 1 ● 2	SP-W  SP-W ● 1 ● 2 ● Ext	Press IND key: if configured, SP-W 1, 2 and EXT light up successively. The setpoint displayed (except EXT) can be modified. If the LEDs flash, 1, 2, or EXT indicate that this controller is not in function.
Indicate Process Value of Main Overrride Controller	X	X	IND	SP-W ● 1 ● 2	PV-X  SP-W ● 1 ● 2 ● Ext	Press IND key: if configured, SP-W 1, 2 and EXT light up successively. The setpoint of the selected controller is displayed. If the LEDs flash, 1, 2, or EXT indicate that this controller is not in function.
Modify Process Value	X	X	△ ▽		SP-W 	Press upper key : value increases Press lower key : value decreases
Modify Output	X		◁ ▷		 OUT-Y	Change over from automatic to manual mode, press keys. Right key : value increases Left key : value decreases
Select Man. Mode		X			Hand Symbol ●	Press function key "Operating Mode Selection", corresponding LED is lighted.
Select Auto. Mode	X				Automatic Symbol ●	

Functions Override Controller	Operating Mode		Key (s)	Displays		Steps
	Man.	Auto.		Flashing	Lighted	
Change Over from DI to Front Panel Operation	X	X	DI REM	DI ●	DI ●	Only possible, if operation via DI or interface is configured. DI/REM key serves for changing over from operation via DI or interface to front panel operation and v. v. Remote : LEDs are lighted Local: : LEDs flash
Change Over from Interface to Front Panel Operation	X	X		REM ●	REM ●	
Acknowledge Alarms and Display them Again	X	X	ENTER	A ●	●	Alarm condition : LED A flashes Press ENTER key : LED A is lighted Display alarm again : press ENTER key for 3 seconds.
Start / Terminate Self - Tuning	X	X	TUNE	T ●	T ●	Press TUNE key : if configured, LED T is lighted. Self-tuning is started and T flashes until termination of parameter calculation. Press ENTER to store, press TUNE again to terminate self-tuning.
Change Over to Parameter Level 1	X	X	CONF			Press CONF key : if parameter level 1 is not released, LED 1 is lighted and SP-W indicates 4 dashes. If level 1 is released, OUT-Y indicates the parameter no. and SP-W the parameter value.

5-1. Parameter Level

The parameter level allows on-line adaptation to the process. In order to enable the user to work with and without password protection it was divided into the levels 1 and 2.

On parameter level 1 only those parameters can be set that have been released by configuration. In case no parameters have been released for this level, "no" appears in the OUT-Y display (14) and parameter level 2 must be selected to continue. This is done by pressing the CONF key (12) again. If level 2 is password-protected, the correct password has to be entered to access this level. It is also possible to annul the password protection by means of the discrete input (see example, chapter 5-2).

On parameter level 2, all parameters (incl. the password) can be called up and modified.

Among the paramters, which are listed in the parameter table, are:

- all PID parameters
- digital low-pass filter
- linearization
- ranges of the PV-X and SP-W display
- setpoint and output ramp and limit functions
- limits
- safe output values
- analog input conversion
- feedforward parameters
- 3-point step output
- RATIO / BIAS
- pressure and temperature compensation
- TAG number and password entry

NOTE: Before starting the parameter setting always check whether the software revision number of your CM 1 is identical with the one indicated in the parameter table. The number is called up on parameter level 2 by entering 00 and is then displayed in SP-W (2).

5-1.1 Functions of Keys and Displays

On the parameter levels, the tactile keys and displays have the following functions:

1 4-Digit, 7-Segment Display **PV-X**
Indicates the current process value PV.

2 4-Digit, 7-Segment Display **SP-W**
Parameter level 1: the parameters released for this level are indicated; in case no parameters are released, 4 dashes appear.Parameter level 2: "PASS" is displayed. After password entry, the first parameter appears.

3 LEDs **SP-W 1**, **SP-W 2**, **SP-W 3** and **EXT**
Are lighted according to the selected setpoint.

4 Function Key **IND**
The IND key serves for selecting (from the right to the left) the digit for parameter and password value setting. The selected digit flashes. Additionally, the decimal point can be "moved" by using the IND key.

5 Function Keys **Number Selection**
Used for selecting (in steps or continuously) numbers (0 to 9) or a minus symbol for password and parameter adjustment.

7 LEDs **SP-W 1**, **SP-W 2**, **SP-W 3** and **EXT**
Indicates which of the 4 available setpoints is active.

9 LEDs Marked by **Hand Symbol**, **Automatic Symbol** and **C**
Indicate the operating level selected.

11 Function Key **ENTER**
Is to be pressed to enter the numbers selected.

12 Function Key **CONF**
Serves for switching over from parameter level 1 to parameter level 2 and to the configuration level.

13 LEDs **1**, **2** and **3**
Indicate the selected level.

14 2-Digit, 7-Segment Display **OUT-Y**
Displays the selected parameter number.

15 Function Keys **Parameter Number Selection**
Depressing the right function key once selects the next-higher, depressing the left key the next-lower parameter. Permanent depressing automatically scrolls the parameter numbers.

19 Deviation (**PV-SP**) Indication
Indicates the current deviation (PV-SP).

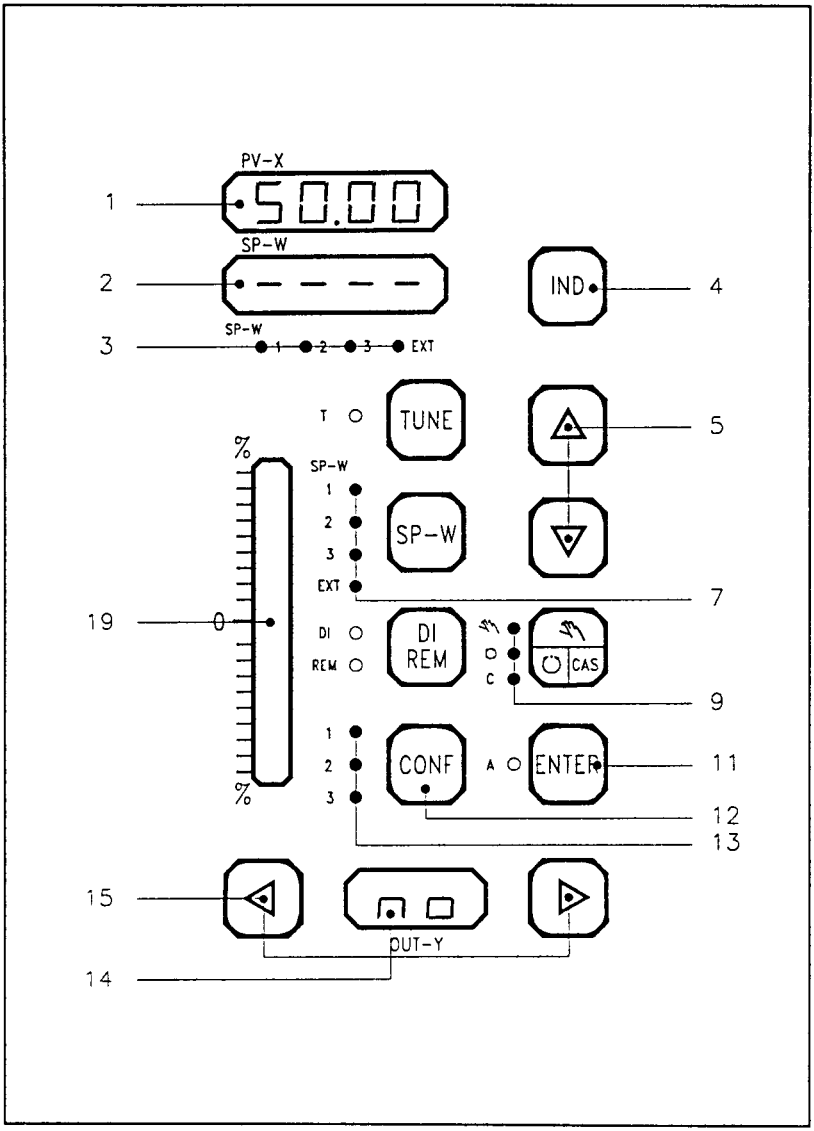


Figure 70 Parameter Level, Functions of Keys and Displays

5-2. Examples

The parameter setting can easily be realized by means of the parameter table which informs the operator on the parameter types and numbers, the ranges and the factory setting.

The following examples shall illustrate the setting procedure:

5-2.1 Example 1 How to Select Parameter Level 2

If the **CONF** key (12) is depressed, the prompt "**PASS**" (the right "**S**" flashing) appears in the **SP-W** display (2), provided parameter level 2 is password-protected. In case no passsword protection has been configured, the first parameter is indicated (for more detailed information, please refer to parameter table).

If the "**PASS**" prompt is displayed, access is only possible after password entry.

The function keys **Number Selection** and **IND** are used for password entry. The "Number Selection" keys serve for modifying the flashing **SP-W** display (2) digit, valid entries being the numbers **0** to **9**. The "flashing" is "moved" to the next digit by means of the **IND** key. When the numbers are selected, the characters of the word **PASS** are automaticaly overwritten.

For acknowledging the complete password the **ENTER** key (11) is depressed. In case a wrong password is entered, the CM 1 returns to the operating level.

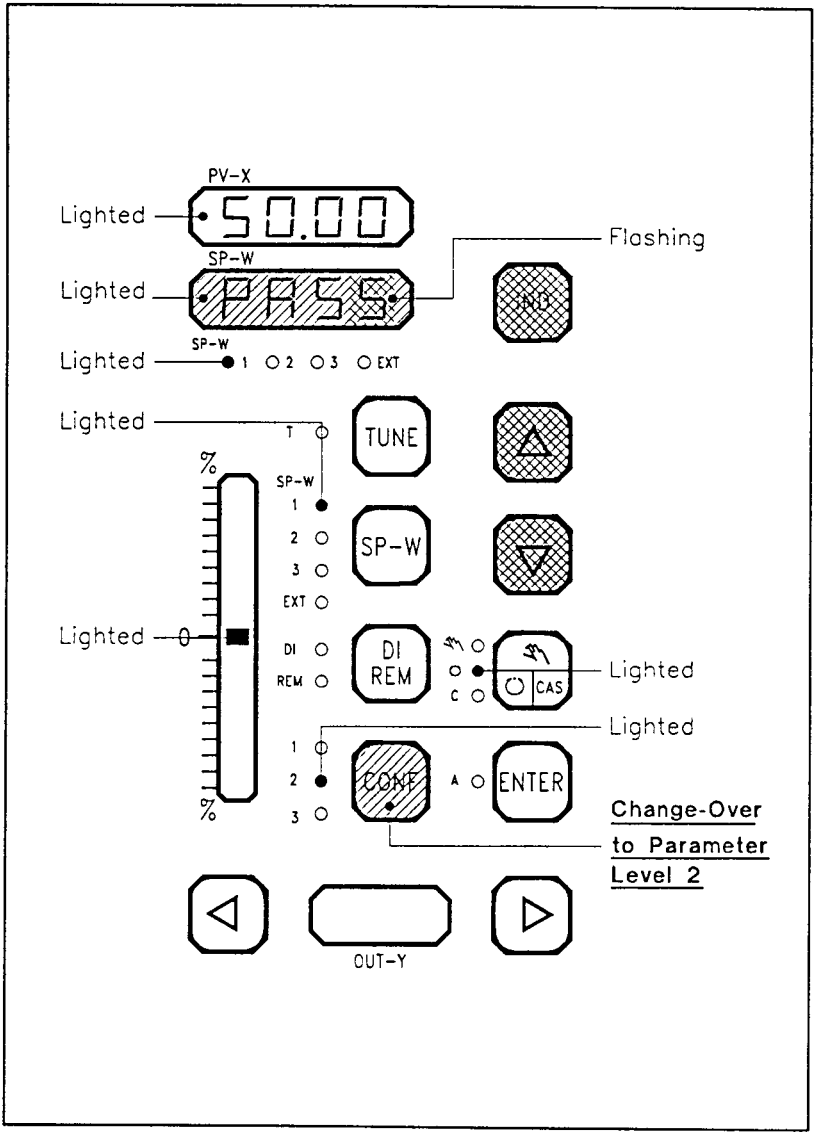


Figure 71 Example 1 Change-Over to Parameter Level 2

5-2.2 Example 2: Parameter Selection and Adjustment

If a valid password has been entered and acknowledged by depressing the **ENTER** key (11), the software revision number appears in the **SP-W** display (2), while the **OUT-Y** display (14) indicates **00**.

The parameter numbers may be called up, then.

Depressing the right function key (15) will make the first parameter number (**01**) appear in the **OUT-Y** display (14); the **SP-W** display will indicate **1.00** (factory setting).

If depressing is continued, the next (second, third, etc.) parameter number will be displayed, as well as the corresponding parameter value.

Modification of the displayed parameter value is realized by means of the function keys **Number Selection** (5). Depressing these keys will increase (upper key) or decrease (lower key) the flashing number.

The **IND** key is used to skip to the next digit (= "move" the "flashing"). Depressing the **ENTER** key will acknowledge the adjusted value.

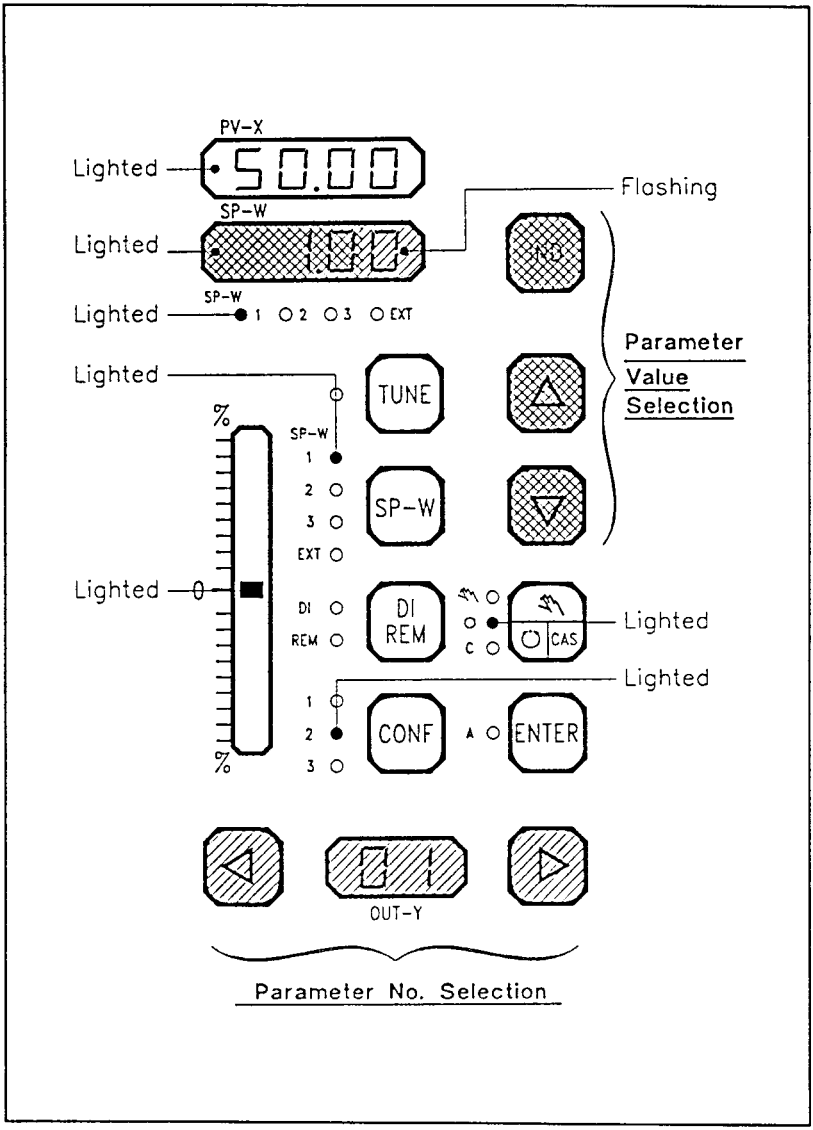


Figure 72 Example 2 Parameter Selection

5-3. Parameter Table

Sets of Parameters

Number	Parameter
01 ... 06	PID 1 parameters, primary controller
08 ... 12	PID 2 parameters, secondary controller
14 ... 16	3-point step control output
18 ... 19	Feedforward parameters (K_{vs}, T_{ds})
20 ... 27	Analog input scaling
30 ... 33	Display range for PV and SP
35 ... 42	Limits
45 ... 48	Setpoint ramp and limits PID 1
49 ... 52	Setpoint ramp and limits PID 2
53 ... 59	OUT hold time, ramp, limits and safe values
60 ... 65	RATIO / BIAS
66 ... 69	Digital low pass filter
70 ... 78	Linearization
80 ... 81	Self-tuning of PID 1
84 ... 85	Self-tuning of PID 2
90 ... 95	Pressure and temperature compensation
98 ... 99	TAG number entry
h0	Password

No.	Parameter	Selectable Values Min.	Max.	Preset Value	Units	Resolution	Operating Value
00	Software-Revision			003x			
	PID 1 Parameters						
01	Proportional gain Kp	0.01	99.99	1.00	-	0.01	
02	Reset rate Ki	0.00	9999	10.00	1/min	0.001	
03	Derivative amplif.Kv	0.01	99.99	4.00	-	0.01	
04	Derivative time T_D	0.00	99.99	0.00	min	0.01	
05	Manual reset of P and PD controllers	0.01	99.99	50.00	%	0.01	
06	SCAN time	0.050	99.99	0.050	sec	0.01	
	PID 2 Parameters						
08	Proportional gain Kp	0.01	99.99	1.00	-	0.01	
09	Reset rate Ki	0.00	9999	10.00	1/min	0.001	
10	Derivative amplif. Kv	0.01	99.99	4.00	-	0.01	
11	Derivative time T_D	0.00	99.99	0.00	min	0.01	
12	Manual reset of P and PD controllers	0.01	99.99	50.00	%	0.01	
	Parameters 3-Point Step Control Output						
14	Motor run time	1.00	1000.	60.00	sec	0.001	
15	Min. pulse length	0.00	1.00	0.10	sec	0.01	
16	Min. pause length	0.00	1.00	0.10	sec	0.01	
	Feedforward Parameters						
18	Lead amplif. Kvs	0.01	99.99	1.00	-	0.01	
19	Lead time T_{Ds}	0.01	99.99	0.01	min	0.01	
	Analog Input Scaling						
20	AI 1 - Start of range	0.00	80.00	00.00	%	0.01 %	
21	AI 1 - End of range	20.00	99.99	99.99	%	0.01 %	
22	AI 2 - Start of range	0.00	80.00	00.00	%	0.01 %	
23	AI 2 - End of range	20.00	99.99	99.99	%	0.01 %	
24	AI 3 - Start of range	0.00	80.00	00.00	%	0.01 %	
25	AI 3 - End of range	20.00	99.99	99.99	%	0.01 %	
26	AI 4 - Start of range	0.00	80.00	00.00	%	0.01 %	
27	AI 4 - End of range	20.00	99.99	99.99	%	0.01 %	

No.	Parameter		Selectable Values Min.	Max.	Preset Value	Units	Resolution	Operating Value
00	Software-Revision				003x			
	Display Ranges							
30	PV and SP displ. min		-999	9999	0.0	EU	0.001	
31	PV and SP displ. max		-999	9999	99.99	EU	0.001	
32	PV_2/SP_2 display min		-999	9999	0.0	EU	0.001	
33	PV_2/SP_2 display max		-999	9999	99.99	EU	0.001	
	Limits							
35	PV min-min	PV2 min	-999	9999	-999	EU	0.001	
36	PV min	PV min	-999	9999	-999	EU	0.001	
37	PV max	PV max	-999	9999	9999	EU	0.001	
38	PV max-max	PV2 max	-999	9999	9999	EU	0.001	
39	Dev. min-min	Dev2 min	0.000	9999	9999	EU	0.001	
40	Dev. min.	Dev min	0.000	9999	9999	EU	0.001	
41	Dev. max	Dev max	0.000	9999	9999	EU	0.001	
42	Dev. max-max	Dev2 max	0.000	9999	9999	EU	0.001	
	Setpoint PID 1							
45	Ramp, increasing		0.00	9999	9999	EU/sec	0.001	
46	Ramp, decreasing		0.00	9999	9999	EU/sec	0.001	
47	Min (Lo) limit		-999	9999	-999	EU	0.001	
48	Max (Hi) limit		-999	9999	9999	EU	0.001	
	Setpoint PID 2							
49	Ramp, increasing		0.00	9999	9999	EU/sec	0.001	
50	Ramp, decreasing		0.00	9999	9999	EU/sec	0.001	
51	Min (Lo) limit		-999	9999	-999	EU	0.001	
52	Max (Hi) limit		-999	9999	9999	EU	0.001	
	Output							
53	Out hold time		0.01	99.99	0.50	sec	0.01	
54	Ramp, increasing		0.000	9999	9999	%/sec	0.001	
55	Ramp, decreasing		0.000	9999	9999	%/sec	0.001	
56	Min (Lo) limit		-9.0	109.0	-9.0	%	0.1	
57	Max (Hi) limit		-9.0	109.0	109.0	%	0.1	
58	Safe value S1		-9.0	109.0	50.0	%	0.1	
59	Safe value S2		-9.0	109.0	50.0	%	0.1	

No.	Parameter	Selectable Values Min.	Max.	Preset Value	Units	Resolution	Operating Value
00	Software-Revision			003x			
	RATIO / BIAS						
60	Min RATIO value for AI = 0 %	0.01	99.99	0.10	-	0.01	
61	Max. RATIO value for AI=100%	0.01	99.99	1.00	-	0.01	
62	Min RATIO display	0.001	9999	0.100	-	0.001	
63	Max RATIO display	0.001	9999	1.000	-	0.001	
64	Min BIAS value for AI=0 %	-999	9999	0.000	EU	0.001	
65	Max BIAS value. for AI=100 %	-999	9999	9999	EU	0.001	
	Digital Low-Pass Filter						
66	Input AI 1	0.00	99.99	0.00	sec	0.01	
67	Input AI 2	0.00	99.99	0.00	sec	0.01	
68	Input AI 3	0.00	99.99	0.00	sec	0.01	
69	Input AI 4	0.00	99.99	0.00	sec	0.01	
	Linearization						
70	Input 10 %	0.000	0.999	0.100	%	0.001	
71	Input 20 %	0.000	0.999	0.200	%	0.001	
72	Input 30 %	0.000	0.999	0.300	%	0.001	
73	Input 40 %	0.000	0.999	0.400	%	0.001	
74	Input 50 %	0.000	0.999	0.500	%	0.001	
75	Input 60 %	0.000	0.999	0.600	%	0.001	
76	Input 70 %	0.000	0.999	0.700	%	0.001	
77	Input 80 %	0.000	0.999	0.800	%	0.001	
78	Input 90 %	0.000	0.999	0.900	%	0.001	
	Self-Tuning PID 1						
80	Identification time	0.05	99.99	1.00	sec	0.01	
81	Amount of change	0.00	99.99	5.00	%	0.01	
	Self-Tuning PID 2 (only Secondary Controller, Cascade Control)						
84	Identification time	0.05	99.99	1.00	sec	0.01	
85	Amount of change	0.00	99.99	5.00	%	0.01	

No.	Parameter	Selectable Values min.	Selectable Values max.	Preset Value	Units	Resolution	Operating Value
00	Software-Revision			003x			
	Pressure and Temperature Compensation						
90	Calc. temperature	-999	9999	0.00	EU	0.001	
91	Calc. pressure	0.000	9999	0.00	EU	0.001	
92	Scaling temperature compensation 0%	-999	9999	0.00	EU	0.001	
93	Scaling temperature compensation 100%	-999	9999	0.00	EU	0.001	
94	Scaling pressure compensation 0%	-999	9999	0.00	EU	0.001	
95	Scaling pressure compensation 100%	-999	9999	0.00	EU	0.001	
	TAG Number Entry (only for System-integrated CM1)						
98	Characters			...-	-		
99	Numbers	0	9999	0	-		
	Password						
h0	Password entry	0000	9999	0000	-	1	

6-1. Configuration Level

The configuration level is accessed by three times depressing the **CONF** key (12) and confirming with **ENTER**. A password only has to be entered if this level is password-protected.

On the configuration level, the controller structure, i.e. the type and extent of the controller function is defined (configured). The configuration is always realized off-line, i.e. with switched-off functions and frozen analog output. All functions listed in the configuration table can be selected and entered.

Every CM 1 process controller supplied to the customer is provided with a basic configuration including a predefined controller structure, input and output assignment as well as analog input conversion and parameter release (see configuration table, preset values).

The configuration procedure consists of 4 steps:

1. Selecting a function
2. Selecting a question
3. Answering the question
4. Storing by pressing the **ENTER** key

Configurable are:

- PID 1 and PID 2 control, self-tuning (function **01/02**)
- Reaction on controller mode (manual/automatic/cascade) modification, reaction in case of restart after power failure (function **03**)
- Output signal, action of output display, output limiting, reset of 3-point step control (function **04**)
- Control mode (standard/cascade/ratio) and setpoint selection, pressure and temperature compensation (function **05**)
- Local/remote control (function **06**)
- Feedforward (function **07**)
- Square root extraction and linearization of analog inputs (function **08**)
- Analog input assignment (function **09**)

- Change-over via discrete inputs, direction of action of the discrete inputs (function **10**)

- Alarm definition and direction of action of the discrete outputs, relay opening function (function **11**)

- Parameter release for parameter level 1 (function **12**)

- Range definition of the deviation indication (function **13**)

- Repetition rate of the PV-X, deviation and OUT displays, floating point display, the possibilities of terminating the alarm indication (function **14**)

- Communication with a PC and a process control system (function **15**)

6-2. Functions of the Keys and Displays

After change-over to the configuration level (LED 3 (13) and confirmation by pressing ENTER, the CM 1 automatically switches over to manual operation (off line) and releases the tactile keys and displays required for configuration.

2 4-Digit, 7-Segment Display **SP-W**
Indicates the code numbers (separated by a point) of the questions and answers

3 LEDs **SP-W 1**, **SP-W 2**, **SP-W 3** and **EXT**
Are lighted according to the last setpoint selected for display.

4 Function Key **IND**
Is depressed to select the questions (code numbers to the left of the point).

5 Function Keys **Answer Selection**
Serve for selecting the desired answer (code numbers to the right of the point) for the question. The upper key is used for counting up, the lower one for counting down.

7 LEDs **SP-W 1**, **SP-W 2**, **SP W 3** and **EXT**
Indicate the setpoint that was active before the CM 1 was switched over to the configuration level.

9 LEDs **Hand Symbol**, **Automatic Symbol** and **C**
After configuration level selection (by **CONF** key), LED **Hand Symbol** starts flashing; after acknowledgement (by **ENTER** key), LED **Hand Symbol** remains lighted.

11 Function Key **ENTER**
Is depressed for releasing the configuration level and acknowledging answer entries.

12 Function Key **CONF**
Serves for changing over from parameter level 2 to the configuration level and for returning to the operating level.

13 LEDs **1**, **2**, **3**
LED **3** starts flashing after change-over to configuration level and remains lighted after **ENTER** key has been depressed to acknowledge the selected level.

14 2-Digit, 7-Segment Display **OUT-Y**
Indicates the number of the selected function.

15 Function Keys **Function Selection**
Serve for selecting the desired function. A single stroke of the right function key selects the next higher, a stroke of the left key the next lower function number. Continuous depressing scrolls the numbers.

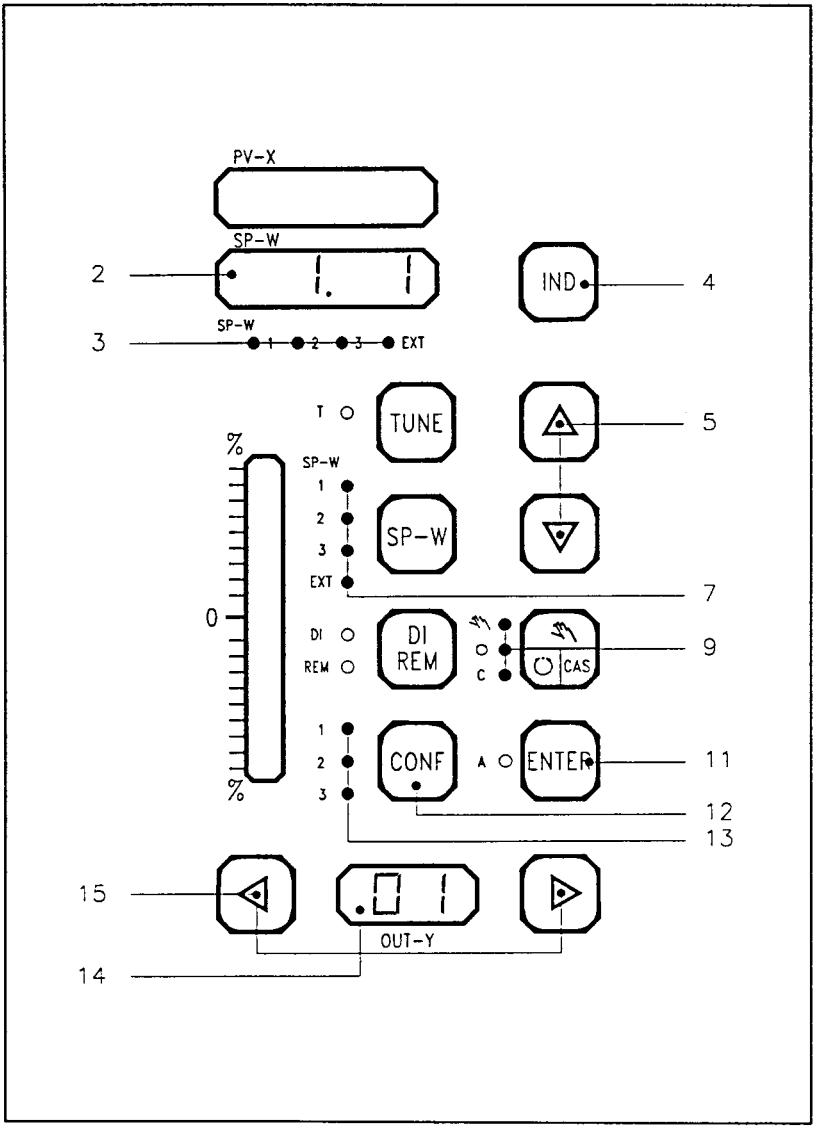


Figure 73 Configuration Level, Functions of Keys and Displays

6-3. How to Select the Configuration Level

If the **CONF** key (12) is depressed three times, the **SP-W** (2) and the **OUT-Y** display (14) are extinguished. The LEDs **3** (13) and **Hand Symbol** (9) start flashing.

If the **ENTER** key (11) is depressed, the LEDs terminate flashing but remain lighted. Simultaneously, the number of the first function appears in the **OUT-Y** display (14). The **SP-W** display indicates the number of the corresponding questions and answers (also refer to "Functions of Keys and Displays").

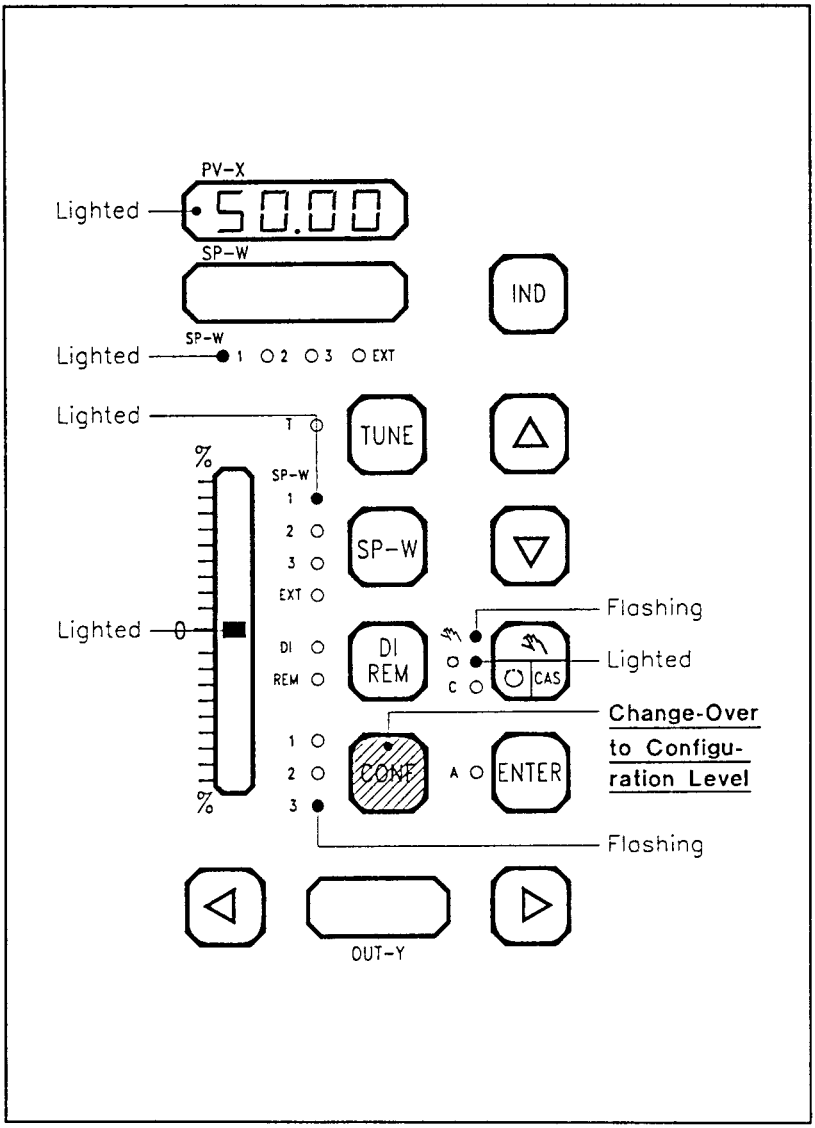


Figure 74 Change-Over to the Configuration Level

6-4. Configuration Table

Functions

Number	Function
01	PID 1 control
02	PID 2 control
03	Controller mode modification (manual/automatic/cascade)
04	Output and output display (OUT-Y)
05	Control mode and setpoint selection
06	Local/remote control
07	Feedforward
08	Analog input conversion
09	Analog input assignment
10	Functions of discrete inputs
11	Functions of discrete outputs
12	Parameter release for level 1
13	Range of deviation (PV-SP) indication
14	Repetition rate of digital displays (PV, PV-SP, OUT)
15	Communication with PC and process control system

Function	Question	Answer	Description	Preset Value	Operating Value
01			**PID 1 Control** (Primary Controller, Cascade Control))		
	1	0	Direct action: increasing deviation-> increasing OUT		
		1	Reverse action: increasing deviation -> decreas. OUT	1	
	2	0	No derivative	0	
		1	Derivative of PV		
		2	Derivative of DEV		
	3	0	No (integral) reset		
		1	(Integral) reset of deviation	1	
	4	0	Without start-up function	0	
		1	With start-up function		
	5	0	Without self-tuning function	0	
		1	With self-tuning function		
02			**PID 2 Control** (Secondary Controller, Cascade Control)		
	1	0	Without secondary controller	0	
		1	As a secondary controller		
		2	As an override controller, MINIMUM selection		
		3	As an override controller, MAXIMUM selection		
	2		Control action:		
		0	Direct: increasing dev. -> increasing OUT	0	
		1	Reverse: increasing dev. -> decreasing OUT		
	3	0	No derivative	0	
		1	Derivative of PV		
		2	Derivative of DEV		
	4	0	No (integral) reset		
		1	(Integral) reset of DEV	1	
	5	0	Without start-up function	0	
		1	With start-up function		
	6	0	Without self-tuning	0	
		1	With self-tuning		
	7	0	Limits are not used	0	
		1	Limits are used		
03			**Controller Mode Modification**		
	1	0	Automatic only, restart with last output		
		1	Man/Auto/Casc. - Manual change-over, bumpless in both directions (casc. only 02/1.1) restart with last output	1	
		2	Man/Auto/Casc., add. setpoint tracking in manual mode restart with last output		
		3	Man/Auto/Casc., but restart in manual mode with last output		
		4	Man/Auto/Casc., add. setpoint tracking in manual mode, but restart in manual mode with last output		
		5	DDC control (+ SP tracking for DDC control)		

Function	Question	Answer	Description	Preset Value	Operating Value
04			**Output, Output Display**		
	1	0 1 2 3 4 5 6 7	Output : 0...20 mA display : 0...100 % Output : 0...20 mA display : 100...0 % Output : 4...20 mA display : 0...100 % Output : 4...20 mA display : 100...0 % 3-point step, internal reset and OUT to AO 3-point step, external reset and Out to AO 3-point step, internal reset and PV to AO 3-point step, external reset and PV to AO	0	
	2	0 1	Output limiting in automatic mode, only Output limiting in automatic, cascade and manual mode	0	
05			**Control Mode and Setpoint Selection**		
	1	0 1 2 3 4 5 6 7 8 9	Standard, with setpoint SP1 Standard, with SP 1 and SP2 Standard, with SP 1, SP 2 and SP 3 External SP control without change-over Standard/follow-up control, with SP 1 Standard/follow-up control, with SP 1 and SP 2 Standard/follow-up, with SP 1, Sp 2 and SP 3 Standard/follow-up, with SP tracking for follow-up Standard/ratio, with SP 1 Standard/ratio, with SP 1 tracking for ratio	0	
	2	0 1 2	**No pressure compensation of process value** Pressure compensation [PSIG] Pressure compensation [BAR, absolute]	0	
	3	0 1 2	**No temperature compensation of process value** Temperature compensation [FAHRENHEIT] Temperature compensation [CELSIUS]	0	
06			**Local / Remote Control**		
	1	0 1 2 3	LOCAL (local control via front panel) DI (control via discrete inputs) REMOTE (control via serial interface) DI/REMOTE (control via serial interface and DI)	0	
			Disable REMOTE/DI (DI/REM key)		
	2	0 1	not allowed allowed (change-over from DI/REMOTE to LOCAL and vice versa)	1	

Function	Question	Answer	Description	Preset Value	Operating Value
07			**Feedforward**		
	1	0 1 2 3 4	No disturbance input To PV, direct action To PV, reverse action To OUT, direct action To OUT, reverse action	0	
08			**Analog Input Conversion**		
	1	0 1 2	**AI 1** - No input conversion Square root extraction Linearization, adjustable by parameters no. 70 ... 78	0	
	2	0 1 2	**AI 2** - No input conversion Square root extraction Linearization, adjustable by parameters no. 70 ... 78	0	
	3	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	**AI 3** - No input conversion Square root extraction Linearization, adjustable by parameters no. 70 ... 78 RTD Pt100 range I (-50...150°C) (-58...302°F) RTD Pt100 range II (-50...600°C) (-58...1112°F) TC type J range II (0...1200 °C) (32...2192°F) TC type J range I (0...400 °C) (32...752°F) TC type E range II (0...1000 °C) (32...1832°F) TC type E range I (0...250 °C) (32...482°F) TC type K range II (0...1300 °C) (32...2372°F) TC type K range I (0...600 °C) (32...1112°F) TC type L range II (0...900 °C) (32...1652°F) TC type L range I (0...400 °C) (32...752°F) TC type U range II (0...600 °C) (32...1112°F) TC type U range I (0...400 °C) (32...752°F) TC type R range I (0...1700 °C) (32...3092°F) TC type S range I (0...1700 °C) (32...3092°F) TC type T range I (0...400 °C) (32...752°F) TC type B range I (0...1800 °C) (32...3272°F) Retransmitting slidewire	0	
	4	0 19	**Analog input conversion, AI 4** See AI 3, answers 0...19	0	
	5	 0 1	**Reaction *) to disturbances affecting AI 3** Input = 0 % (for Pt100, TC, retransm. slidew. Input = 100 %	0	
	6	 0 1	**Reaction *) to disturbances affecting AI 4** Input = 0 % (for Pt100, TC, retransm. slidew.) Input = 100 % *) Line break Pt100, thermocouple break	0	

Function	Question	Answer	Description	Preset Value	Operating Value
09			**Analog Input Assignment**		
	1		**Analog Input AI 1**	1	
		0	Unused		
		1	Process value PV		
		2	Setpoint SPext		
		3	Feedforward		
		4	DDC input OUT ext		
		5	Min (Lo) limit for OUT		
		6	Max (Hi) limit for OUT		
		7	PID reset, EXTERNAL RESET		
		8	RATIO		
		9	BIAS		
		10	Secondary process value PV 2		
		11	Temperature compensation		
		12	Pressure compensation		
		13	External reset 3-point step control		
	2		**Analog Input AI 2**	0	
		0	Unused		
		1	Process value PV		
		2	Setpoint SPext		
		3	Feedforward		
		4	DDC input OUT ext		
		5	Min (Lo) limit for OUT		
		6	Max (Hi) limit for OUT		
		7	PID reset, EXTERNAL RESET		
		8	RATIO		
		9	BIAS		
		10	Secondary process value PV 2		
		11	Temperature compensation		
		12	Pressure compensation		
		13	External reset 3-point step control		
	3		**Analog Input AI 3**	0	
		0	Unused		
		.	See AI 2, answers 1 ... 13		
		.			
		13			
	4		**Analog Input AI 4**	0	
		0	Unused		
		.	See AI 2, answers 1 ... 13		
		.			
		13			

Function	Question	Answer	Description	Preset Value	Operating Value
10			**Functions of Discrete Inputs**		
	1	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	**DI 1** - Unused Change-over SP 1 <-> SP 2 Change-over SP 2 <-> SP 3 Change-over standard control <-> follow-up control or standard control <-> ratio control Change-over automatic <-> manual Change-over automatic <-> cascade Change-over automatic <-> DDC Change-over to safe value Y S-1 Change-over to safe value Y S-2 Change-over to safe value Y S-1 w. interlocking Change-over to safe value Y S-2 w. interlocking Setpoint ramp OFF Change-over PID 1 control action Locking of parameters/configuration data Change-over AI 1 <-> AI 2 Change-over AI 3 <-> AI 4 SP adjustment enabled <-> disabled OUT adjustment enabled <-> disabled ENTER for alarm acknowledgement	0	
	2	0 18	**DI 2** - Unused See DI 1, anwers 1 ... 18	0	
	3	0 18	**DI 3** - Unused See DI 1, answers 1 ... 18	0	
	4	0 18	**DI 4** - Unused See DI 1, answers 1 ... 18	0	
	5	0 18	**DI 5** - Unused See DI 1, answers 1 ... 18	0	
	6	 0 1	**Action of DI 1** Direct: external 0 (- 40 ... + 2 V) = internal 0 external 1 (+ 4.2 ... + 40 V) = internal 1 Reverse: external 0 (-40 ... +2 V) = internal 1 external 1 (+4.2 ... +40 V) = internal 0	0	
	7	0 1	**Action of DI 2** See DI 1, answers 0 and 1	0	
	8	0 1	**Action of DI 3** See DI 1, answers 0 and 1	0	
	9	0 1	**Action of DI 4** See DI 1, answers 0 and 1	0	
	10	0 1	**Action of DI 5** See DI 1, answers 0 and 1	0	

Function	Question	Answer	Description	Preset Value	Operating Value
11			**Functions of Discrete Outputs**		
	1	0 1 2 3 4	**Min-min (LoLo) limit for PV** - No alarm Discrete output DO 1 (not with 3-point step control) Discrete output DO 2 (not with 3-point step control) Discrete output DO 3 Discrete output DO 4	0	
	2	0 1 2 3 4	**Min (Lo) limit for PV** - No alarm Discrete output DO 1 (not with 3-point step control) Discrete output DO 2 (not with 3-point step control) Discrete output DO 3 Discrete output DO 4	0	
	3	0 1 2 3 4	**Max (Hi) limit for PV** - No alarm Discrete output DO 1 (not with 3-point step control) Discrete output DO 2 (not with 3-point step control) Discrete output DO 3 Discrete output DO 4	0	
	4	0 1 2 3 4	**Max-max (HiHi) limit for PV** - No alarm Discrete output DO 1 (not with 3-point step control) Discrete output DO 2 (not with 3-point step control) Discrete output DO 3 Discrete output DO 4	0	
	5	0 1 2 3 4	**Min-min (LoLo) limit for deviation** - No alarm Discrete output DO 1 (not with 3-point step control) Discrete output DO 2 (not with 3-point step control) Discrete output DO 3 Discrete output DO 4	0	
	6	0 1 2 3 4	**Min (Lo) limit for deviation** - No alarm Discrete output DO 1 (not with 3-point step control) Discrete output DO 2 (not with 3-point step control) Discrete output DO 3 Discrete output DO 4	0	
	7	0 1 2 3 4	**Max (Hi) limit for deviation** - No alarm Discrete output DO 1 (not with 3-point step control) Discrete output DO 2 (not with 3-point step control) Discrete output DO 3 Discrete output DO 4	0	
	8	0 1 2 3 4	**Max-max (HiHi) limit for deviation** - No alarm Discrete output DO 1 (not with 3-point step control) Discrete output DO 2 (not with 3-point step control) Discrete output DO 3 Discrete output DO 4	0	

Function	Question	Answer	Description	Preset Value	Operating Value
	9		**Alarm summary**	0	
		0	No alarm		
		1	Discrete output DO 1 (not with 3-point step control)		
		2	Discrete output DO 2 (not with 3-point step control)		
		3	Discrete output DO 3		
		4	Discrete output DO 4		
	10		**Action DO 1** (not with 3-point step control)	0	
		0	If process value > limit -> relay contact closed		
		1	If process value > limit -> relay contact open		
	11		**Action DO 2** (not with 3-point step control)	0	
		0	If process value > limit -> relay contact closed		
		1	If process value > limit -> relay contact open		
	12		**Action DO 3**	0	
		0	If process value > limit -> relay contact closed		
		1	If process value > limit -> relay contact open		
	13		**Action DO 4**	0	
		0	If process value > limit -> relay contact closed		
		1	If process value > limit -> relay contact open		
	14		**Relay opens**	1	
		0	After alarm end		
		1	After acknowledgement		
		2	After acknowledgement and alarm end		
	15		**Keep-alive, self-test**	0	
		0	No alarm		
		1	Discrete output DO 1 (not with 3-point step control)		
		2	Discrete output DO 2 (not with 3-point step control)		
		3	Discrete output DO 3		
		4	Discrete output DO 4		
	16		**DO activation after alarm acknowledgement**	0	
		0	No alarm signal to DO		
		1	Alarm signal to DO 1 (not with 3-point step control)		
		2	Alarm signal to DO 2 (not with 3-point step control)		
		3	Alarm signal to DO 3		
		4	Alarm signal to DO 4		

Function	Question	Answer	Description		Preset Value	Operating Value
12			**Release of Additional Parameters for Level 1**			
	1	0 1	**Parameters no. 00 ... 19**	no yes	0	
	2	0 1	**Parameters no. 20 ... 27**	no yes	0	
	3	0 1	**Parameters no. 30 ... 42**	no yes	0	
	4	0 1	**Parameters no. 45 ... 50**	no yes	0	
	5	0 1	**Parameters no. 53 ... 59**	no yes	0	
	6	0 1	**Parameters no. 60 ... 65**	no yes	0	
	7	0 1	**Parameters no. 66 ... 69**	no yes	0	
	8	0 1	**Parameters no. 70 ... 78**	no yes	0	
	9	0 1	**Parameters no. 80 ... 99**	no yes	0	
13			**Display Range for Deviation**			
	1	0 1 2	dev.+/- 5 % dev. +/- 10 % dev. +/- 20 %		0	

Function	Question	Answer	Description	Preset Value	Operating Value
14			**Repetition Rate of Digital Displays**		
	1	0 1 2 3	0.1 seconds 0.5 seconds 1 second 5 seconds	1	
	2		**Format of PV and SP Displays**		
		0 1 2 3 4	Floating point display 1.000 decimal point after 1. digit 10.00 decimal point after 2. digit 100.0 decimal point after 3. digit 1000. decimal point after 4. digit	2	
	3		**Terminating alarm indication**		
		0 1 2	Without acknowledgement (when alarm ends) With acknowledgement Without display and acknowledgement	1	
	4		**Format of PV 2 and SP 2 display**		
		0 1 2 3 4	Floating point display 1.000 decimal point after 1. digit 10.00 decimal point after 2. digit 100.0 decimal point after 3. digit 1000. decimal point after 4. digit	2	
	5		**Changeover SP-W 1 ... SP-W Ext.**		
		0 1	No automatic changeover Automatic changeover	1	

Function	Question	Answer	Description	Preset Value	Operating Value
15			**Communication**		
	1	0 1 : 31	**Station Number for Communication** No communication Communication under number 1 Communication under number 31	0	
	2	0 1 2 3	**Interface Baud Rate** 1200 bauds 2400 bauds 4800 bauds 9600 bauds	3	
	3	0 1 2	**Interface Parity** No Odd Even	2	
	4	0 1	**Data Word Length** 7 bits 8 bits	1	
	5	0 1 2	**Stop Bits** 1 bit 1.5 bits 2 bits	0	
	6	0 1 2	**Type of Interface** RS 232 RS 422 RS 485	0	
	7	0 1	**Communication Protocol** ASCII RTU	1	

Error Code	Error	Debugging
E-01	**Self-tuning function** cannot be installed.	Press ENTER key to acknowledge error, inform manufacturer
E-03	The closed **loop** is **unstable**.	Press TUNE key to abort self-tuning and ENTER key to acknowledge error. Raise SCAN time identification (1/6...1/12 T_{95}) (parameter 80/84), increase setpoint (parameter 81/85), restart self-tuning by pressing TUNE key again.
E-04	**No PID controller**.	Press TUNE key to abort self-tuning and ENTER key to acknowledge error. Raise SCAN time identification (1/6...1/12 T_{95}) (parameter 80/84), increase setpoint (parameter 81/85), restart self-tuning by pressing TUNE key again.
E-10	**Communication via interface disturbed.**	
	- Wrong configuration	Press ENTER key to acknowledge error, correct configuration (function 15), switch off and on the CM 1 to take over the new configuration

Error Code	Error	Debugging
E-10	- **Connection cable is defective** or **not properly connected**	Press ENTER key to acknowledge error, check connection and, if necessary, replace cable
	- **Transmission error**	Press ENTER key to acknowledge error and establish communication again
E-20	Preset **scan time too small,** was automatically increased by 10 milliseconds.	Press ENTER key to acknowledge error.
E-30	Incorrect **calibration** of the **analog inputs** and/or the **analog output**. The CM1 installs the corresponding default values.	Recalibrate or return station to manufacturer.
E-31	The **parameters** and/or the **configuration data** stored in the **EEPROM** have been **disturbed.**	Press ENTER key to acknowledge error; check, whether data were lost; enter corresponding parameters and setpoints again.

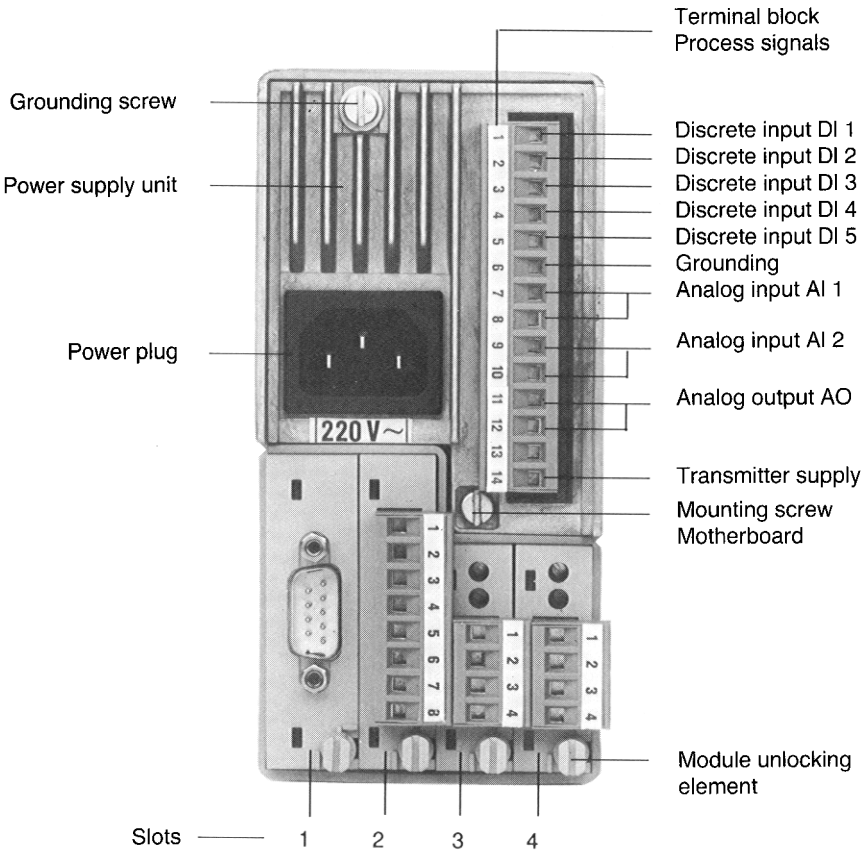
Error Code	Error	Debugging
E-32	The **data** of the latest **operating mode** used **and**/or the latest **setpoints** stored in the EEPROM are **lost**, CM 1 initializes manual mode, setpoints of 50% and first output of 0%.	Press ENTER key to acknowledge error; check, which data were lost; enter setpoints again.
E-34	The **parameters** and **configuration data** were reset to the **factory setting**.	Press ENTER key to acknowledge error. Message appears after changing the EPROM software. Reconfigure the CM 1.
E-40	**Selected configuration is incorrect,** e.g slave controller (function 02) and standard controller with 3 setpoints (function 05).	Press ENTER key to acknowledge error, verify and correct configuration.
AE 3	**Thermocouple break or PT100 line break** at **analog input AI 3;** depending on the configuration (function 08/6.X), 0% or 100% is used as PV.	Press ENTER key to acknowledge error, eliminate thermocouple/line break.
AE 4	**Thermocouple break or PT100 line break** at **analog input AI 4;** depending on the configuration (function 08/5/X), 0% or 100% is used as PV.	Press ENTER key to acknowledge error, eliminate thermocouple/line break.

7-1 Software versions

With the use of the new CM1 software version 0030 a new software version 0030 for the interface module mustbe used too. Otherwise problems in communication will occur. The following table will give you an overview on the different combinations and their consequences.

	CM1	Interface	Effect
Software	0030 and following	til 0022-1	Error 0011 Interface ignored
Software	0030 and following	from 0030	Complete Functions
Software	til 0023	til 0022-1	Complete Functions
Software	til 0023	from 0030	Interface ignored

Rear



Additional modules

Subject to technical changes.
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