

Operating Manual

pH/mV-Controller
Type M3020R



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Warranty

Mostec warrants this product to be free of manufacturing defects for a 2-year period after the original date of purchase. Within this period, defective products will be repaired free of charge provided that the defect occurred during normal operation. This warranty does not cover damage to the product resulting from ordinary usage such as front panel scratches, broken control elements and corrosion, etc. The customer is responsible for shipping and packing charges for products returned under warranty to Mostec. Mostec warrants this product beyond the 2-year warranty period for an additional 2 years in case of long term damages due to improper manufacturing. Such damages as poorly soldered joints or other assembly problems are also covered by the warranty. Transportation damages are not covered by the warranty and should be referred to the respective delivery service.

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A. Front Elements And Keyboard

This listing only refers to the main screen, which shows up 3 seconds after power on.

Nr.	element	function	page
a.	LED1	error for Pt 100, limit contacts, 1Wire, USB and ⌚	
b.	LED2	no function	
c.	LED3	limit contact 1.....	6,8,14
d.	LED4	limit contact 2.....	6,8,14
	F1 / F2	no function on home screen	
	F3	access to calibration menu pH7 and mV/pH.....	6,13
	F4	relay operation manual/auto.....	14
	ENT	setup menu, enter.....	5
	ESC	main menu, exit.....	6
	+	increase values.....	5 to 14
	-	decrease values.....	5 to 14



B. Setup Menu

Basically, all settings can be made in the user friendly customer menu. To change certain parameters during the process, you can change them in the home screen using the key **ENT**. If an alarm message is displayed on the main screen, it first has to be acknowledged to enable further parameter change. Adjusting the limit contact for the alarm relay in the setup menu is only possible if in the "Alarm SP1 enable" is set in the user menu. Same for "Alarm SP2 enable."

The setup menu may be quitted by pressing the (ESC)-key, or, waiting a few seconds with no key operation. Values can be altered with the (+) and (-)-key, or, depending on the menu, with the (F3)-key as well.

access to the menu item	menu item	change values
press ENT 1x	Xt on 1	0.00...20.00s
press ENT 2x	Xt off 1	0.00...20.00s
press ENT 3x	Xp 1 pband	0.01...7.00pH or 1...1000mV
press ENT 4x	W1 set point	0.01...14.00pH or -1000...1000mV
press ENT 5x	Xt on 2	0.00...20.00s
press ENT 6x	Xt off 2	0.00...20.00s
press ENT 7x	Xp 2 pband	0.01...7.00pH or 1...1000mV
press ENT 8x	W2 set point	0.01...14.00pH or -1000...1000mV
press ENT 9x	set temperature to manual/Pt-100	F3 sets from Pt100 to manual, keys + and – sets the temperature to +/- 0.1°C.
press ENT 10x	USB on/off	Turn on and eject the USB data logger.
press ENT 11x	Alarm 1	0.00...14.00pH or -1000...1000mV
press ENT 12x	Alarm 2	0.00...14.00pH or -1000...1000mV

C. Customer Menu

Access to menu: press and hold **ENT** for 3 seconds
 Navigation in the menu: keys **+** and **-**
 Access to a menu item: key **ENT** = ENTER
 Exit a menu item: key **ESC** = ESCAPE
 Adjust values: keys **+** and **-**

menu item	sub menu item	function/comment
1/6 Measurement settings	Calibrate sensor Sensor type Measure mode Input range Output range Temperature mode Digital filter	See section D
2/6 Controller settings	Rel1/2: Xt on Rel1/2: Xt aus Rel1/2: X pband Rel1/2: W set point Rel1/2: acid/base Rel1/2: norm/inv Rel1/2: LED norm/inv Rel1/2: min. valve time	See section E
3/6 Relay 3+4 settings	Rel 3/4: behavior Rel 3/4: set point Rel 3/4: norm/inv? Rel 3/4: LED norm/inv? Rel 3/4: turn on delay Rel 3/4: turn off delay Rel 3-4: hysteresis Rel 3-4: reference	See section F
4/6 Alarm settings	Alarm SP1/2: on/off? Alarm SP1/2: value Alarm SP1/2: behavior Alarm SP1/2:delay Alarm Rel: norm/inv? SP1-SP2: hysteresis	See section G
5/6 USB settings	Time setup Date setup Data log period Remove thumb drive	See section H
6/6 Device settings	Keyboard lock/unlock Language settings Custom label Factory setting Device info	See section I

D. Measurement settings

- 1) Press and hold **ESC** 3 seconds to enter the customer menu.
- 2) Go to menu item 1/6, "Measurement settings" with **+**.
- 3) Open menu item with **ENT**
- 4) Menu structure:

menu item	change values	function/comment
1/7 Calibrate sensor		See section J
2/7 Sensor type	Switch with + and - between the three sensors and confirm the selection with ENT Standard sensor types are pH-sensor direct and ISM 1-Wire sensor 2-Wire 4...20mA input is optional hardware	pH sensor direct: via pH plug 4...20mA input: 4mA equal -1000mV 20mA equal 1000mV ISM 1-Wire Sensor digital input Supported ISM InPro Sensor-types: - InPro 3250i - InPro 3253i - InPro 4260i - InPro 4800i - ...
3/7 Measure mode	Select with + between pH and mV, confirm it with ENT	The actual value, pH or mV, will be displayed on the main screen
4/7 Input range	Change with + and - between input range 0.00...14.00pH or -1000...1000mV, skip to next parameter or confirm the selection with ENT	Set the input range which corresponds to the selected signal current output
5/7 Output range	Change with + and - between output range 0.00...20.00mA, skip to next parameter or confirm the selection with ENT	Sets the signal current output range, which corresponds to the input range
6/7 Temperature mode	Switch with F3 between Hand and PT100 mode If Hand mode is selected change with + and - between 0.0...120.0°C, confirm the selection with ENT	Sets measure mode for temperature compensation
7/7 Digital filter	Change with + and - between 0...100 digit 1 digit = 1mV or 0.01pH, confirm the selection with ENT	Sets stabilization for measured value

E. Controller Settings

- 1) Press and hold **ESC** 3 seconds to enter the customer menu.
- 2) Go to menu item 2/6, "Controller settings" with **+**.
- 3) Open menu item with **ENT**
- 4) Menu structure:

Menu Item	Change Values
1/16 Relay 1: "Xt" on Turned on time relay 1 (mid of P-band)	Change values with + and - to change in +/- 0.01s steps, confirm the selection with ENT .
2/16 Relay 1: "Xt" off Turned off time relay 1 (mid of P-band)	Change values with + and - to change in +/- 0.01s steps, confirm the selection with ENT .
3/16 Relay 1: "Xp"-band P-band relay 1	Change the value with + and - , resolution is +/- 0.01pH.
4/16 Relay 1: "W", set point Set point relay 1	Change the value with + and - , resolution is +/- 0.01pH.
5/16 Relay 1: Acid/base Acid or base type relay 1	Change the value with + to control upward (Base) or to control downward (Acid), confirm the selection with ENT .
6/16 Relay 1: normal/inverted	Switch with + between normally open or normally closed contact, confirm the selection with ENT .
7/16 Relay 1: LED normal/inverted	Switch with + between normal or inverted indication, confirm the selection with ENT .
8/16 Relay 1: min. valve time Minimal turned on time relay 1 (for slow valve)	Change values with + and - to change in +/- 0.01s steps, confirm the selection with ENT . Should be 0.00s
9/16 Relay 2: "Xt" on Turned on time relay 1 (mid of P-band)	Change values with + and - to change in +/- 0.01s steps, confirm the selection with ENT .
10/16 Relay 2: "Xt" off Turned off time relay 1 (mid of P-band)	Change values with + and - to change in +/- 0.01s steps, confirm the selection with ENT .
11/16 Relay 2: "Xp"-band P-Band relay 2	Change the value with + and - , resolution is +/- 0.01pH.
12/16 Relay 3: "W", set point Set point relay 2	Change the value with + and - , resolution is +/- 0.01pH.
13/16 Rel 2: Acid/base Acid or base type relay 2	Change the value with + to control upward (Base) or to control downward (Acid), confirm the selection with ENT .
14/14 Relay 2: normal/inverted	Switch with + between normally open or normally closed contact, confirm the selection with ENT .
15/16 Relay 2: LED normal/inverted	Switch with + between normal or inverted indication, confirm the selection with ENT .
16/16 Relay 2: min. valve time Minimal turned on time relay 2 (for slow valve)	Change values with + and - to change in +/- 0.01s steps, confirm the selection with ENT . Should be 0.00s

F. Relay Settings

- 1) Press and hold **ESC** 3 seconds to enter the customer menu.
- 2) Go to menu item 3/6, "Relay 3+4 settings" with **+**.
- 3) Open menu item with **ENT**
- 4) Menu structure:

menu item	change values
1/13 Relay 1 behavior	Switch with + between upper and lower limit, confirm the selection with ENT
2/13 Relay 1 set point	Change values with + and - , Resolution is +/- 1mV or 0.01pH
3/13 Relay 1 norm/inv?	Switch with + between normal and inverted operation, confirm the selection with ENT
4/13 Relay 1 LED norm/inv?	Switch with + between normal and inverse operation, confirm the selection with ENT
5/13 Relay 1 turn on delay	Change the time delay with + and - , resolution is +/-1s
6/13 Relay 1 turn off delay	Change the time delay with + and - , resolution is +/-1s
7/13 Relay 2 behavior	Switch with + between upper and lower limit, confirm the selection with ENT
8/13 Relay 2 set point	Change the value with + and - , resolution is +/-1mV or 0.01pH
9/13 Relay 2 norm/inv?	Switch with + between normally open or normally closed contact, confirm the selection with ENT
10/13 Relay 2 LED norm/inv?	Switch with + between normally open or normally closed contact, confirm the selection with ENT
11/13 Relay 2 turn on delay	Change the time delay with + and - , resolution is +/-1s
12/13 Relay 2 turn off delay	Change the time delay with + and - , resolution is +/-1s
13/13 Relay 1-2 hysteresis	Change the hysteresis of both set points with + and - , resolution in range from 5 to 200 is +/- 1mV or 0.01pH

Additional menu item for relay 3+4:

menu item	change values
13/14 Relay 3-4 reference	Switch with + between PT100 and pH/mV as reference for relay 3+4, confirm the selection with ENT

G. Alarm Settings

- 1) Press and hold **ESC** 3 seconds to enter the customer menu.
- 2) Go to menu item 4/6 "Alarm settings" with **+**.
- 3) Open menu item with **ENT**
- 4) Menu structure

menu item	change values	
1/10 Alarm SP1 enable	Switch with + between enable and disable, confirm the selection with ENT	
2/10 Alarm SP1 value	Change the value with + and - , the resolution is +/-1mV	
3/10 Alarm SP1 behavior	Switch with + between functions "lower limit" and "upper limit", confirm the selection with ENT	
	upper limit	Alarm relay is activated when the measured value is greater than the nominal value
	lower limit	Alarm relay is activated when the measured value is smaller than the nominal value
4/10 Alarm SP1 delay	Change the time delay with + and - , resolution is +/-1s	
5/10 Alarm SP2 enable	Switch with + between enable and disable, confirm the selection with ENT	
6/10 Alarm SP2 value	Change the value with + and - , resolution is +/-1mV	
7/10 Alarm SP1 behavior	Switch with + between functions "lower limit" and "upper limit", confirm the selection with ENT	
	upper limit	Alarm relay is activated when the measured value is greater than the nominal value
	lower limit	Alarm relay is activated when the measured value is smaller than the nominal value
8/10 Alarm SP2 delay	Change the time delay with + and - , resolution is +/-1s	
9/10 Alarm Rel norm/inv?	Switch with + between normal and inverse operation, confirm the selection with ENT	
10/10 SP1-SP2 hysteresis	Change the hysteresis of both set points with + and - , resolution in range from 5 to 200 is +/- 1mV or 0.01pH.	

Note:

An alarm message can be acknowledged by pressing **ENT** on main screen.

H. USB settings

- 1) Press and hold **ESC** 3 seconds to enter the customer menu.
- 2) Go to menu item 5/6 "USB settings" with **+**.
- 3) Open menu item with **ENT**
- 4) Menu structure:


menu item	change values	function/comment
1/4 Clock setup	Set with + between 12h and 24h format, confirm it with ENT	Set time format and time for data log mode
2/4 Date setup	Set with + between DDMMYY and MMDDYY format, confirm it with ENT	Set datum format and date for data log mode
3/4 USB log period	Set recording time interval from 1 to 7200sec with + and - . Resolution: 1sec	
4/4 Remove thumb drive	Switch with F3 between stop/start log	Finish the current log cycle before removing the thumb drive. When display shows "USB:wait for log" the thumb drive is ready for removing

USB characteristics

- Device accept only empty and FAT32 formatted thumb drives.
- Date and Clock settings keep stored within 3 hours without current supply.
- Device starts automatically with logging data when a thumb drive was found.
- ⌚: Device is concerned with the thumb drive. It takes up to 5 minutes. Do not remove the drive in this case.
- The data are stored in CSV format every 15 minutes. The file name characteristics:
"JJMMDDXX.csv"
JJ = last 2 digit of current year
MM = current month
DD = current day
XX = file counter 0-99
- The Data will appear in a spreadsheet program as the following.

Date	Time	mV	T[1/10°C]	pH[1/100 pH]
04.05.2011	12:12:55	174	199	400
04.05.2011	12:13:03	174	200	400
04.05.2011	12:13:04	174	200	400
04.05.2011	12:13:06	174	200	400
04.05.2011	12:13:07	174	199	399

A. USB error code

 E: xx	error description
01	drive not formatted
02	drive wrong formatted
03	drive is write protected
04	sector size not supported

I. Device settings

- 1) Press and hold **ESC** 3 seconds to enter the customer menu.
- 2) Go to menu item 6/6 "Device settings" with **+**.
- 3) Open menu item with **ENT**
- 4) Menu structure:

menu item	change values	function/comment
1/5 Keyboard lock/unlock	Set a code with + and - between 1 and 999 to lock or unlock the device, confirm the code with ENT	If the keyboard is locked, you won't be able to make changes in the settings, until you have unlocked it with the valid code. The only exception is the calibrating of the probe which works without any code. Note: Please contact us if you have forgotten the code.
2/5 Language setting	Set the required language with + and -	
3/5 Custom label	Change characters with + and - , switch position with F3 and F4 , confirm label with ENT .	Shows a custom label on main screen. At most 16 characters are possible.
4/5 Factory setting	Sets all values to default, confirm with ENT or leave with ESC	
5/5 Device info	Exit with ENT	Shows firmware version, serial number and calibrated point.

J. Calibrate The pH Sensor

Access to the calibrating screen is possible via main screen or via customer menu. For entering via main screen press **F3**, for entering via customer menu press **ENT**.

"ISM InPro" probes from Mettler-Toledo can't be calibrated, the function isn't activated yet.

display	navigation / change values	comment
Customer menu: 1/6 Measurement settings 1/7 Calibrate Sensor Alternative: main screen	Press ENT Press ENT Press F3	Calibrating screen will be displayed.
Calibration pH7 Buffer solution "7.00pH"	Set the pH value with + and - to the value of the buffer; it is usually in the range of 7.00pH \pm 0.50pH. Insert the probe into the buffer and press ENT	The controller will calibrate the pH value as soon as the pH-electrode is in the correct range and the measured value is stable.
Buffer temperature "25.0°C" and actual measured pH value	Set the temperature of buffer with + and - , wait for stable displayed pH value then press ENT to calibrate the sensor	Note: The pH-electrode can't be calibrated if the offset of the probe is greater than +/- 0.6pH off the buffer value, because the pH-electrode is considered defective.
Calibration mV/pH Buffer solution "4.00pH"	Set the pH value with + and - to the value of the buffer; it is usually in the range of 4.00pH to 9.00pH. Insert the probe into the buffer and press ENT	The controller will calibrate the pH value as soon as the pH-electrode is in the correct range and the measured value is stable.
Buffer temperature "25.0°C" and actual measured pH value	Set the temperature of buffer with + and - , wait for stable displayed pH value then press ENT to calibrate the sensor	Note: The pH-electrode can't be calibrated if the offset of the probe is greater than +/- 0.6pH off the buffer value, because the pH-electrode is considered defective.
Save data? "pH7 = 2.3mV" "mV/pH = 57.5mV (20°C)"	Press ENT to save the calibrated values or discard the values with ESC	

K. Operating Mode Of The Limits

Mode switching is possible only on the main screen.

Automatic Control

Press the auto/manual key **F4** to point the arrow to auto.

⇒ In this position, the device controls the outputs according to limit settings.

If an output turns on, the corresponding lamp is on, LED 3 or 4.

Manual Control

Press the auto/manual key **F4** to point the arrow to the manual symbol.

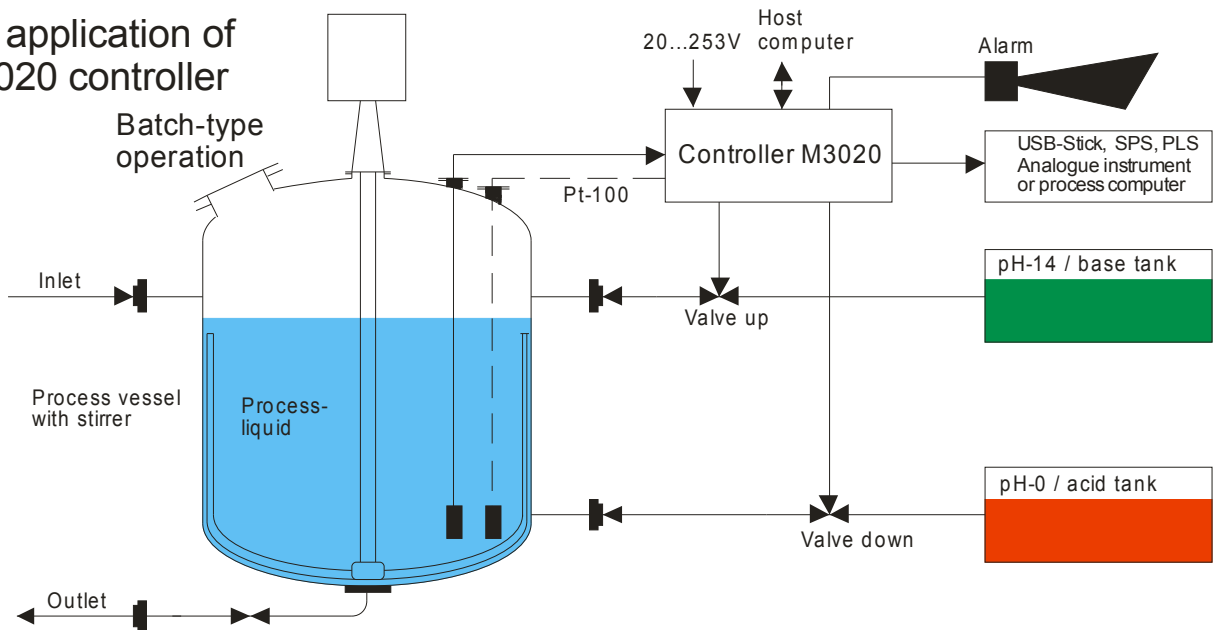
⇒ In this position, you may switch the outputs manually with the keys **+** for output 1 and for output 2.

If an output turns on, the corresponding lamp is on, LED 3 or 4.

Option output 3 and 4 are controlled with keys **F1** and **F2**.

L. Typical Application

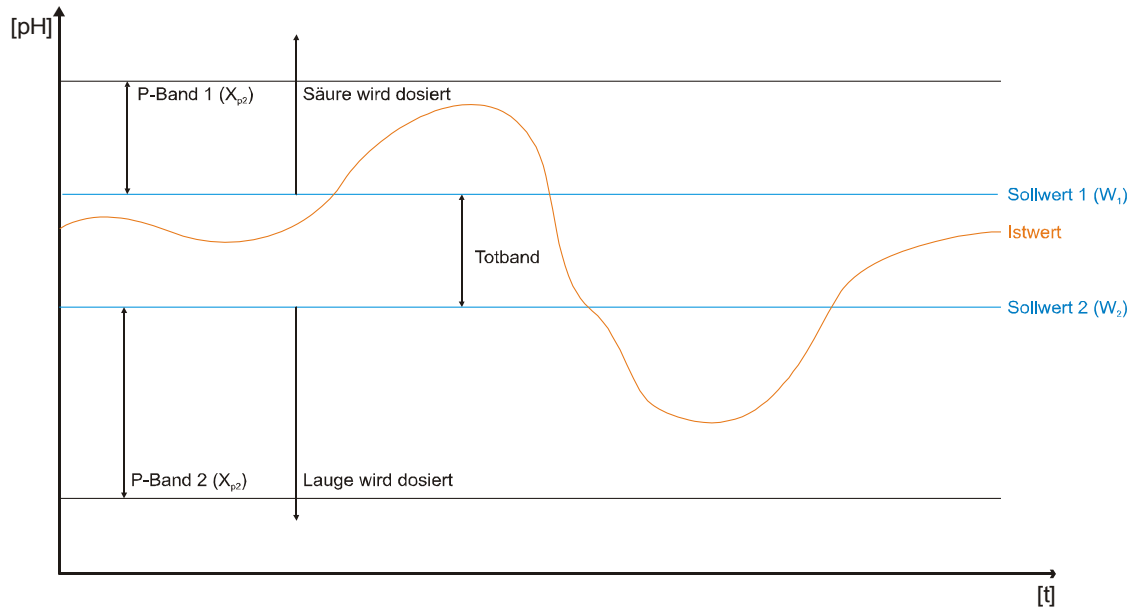
Typical application of the M3020 controller



M. Controller with two different set points [W]

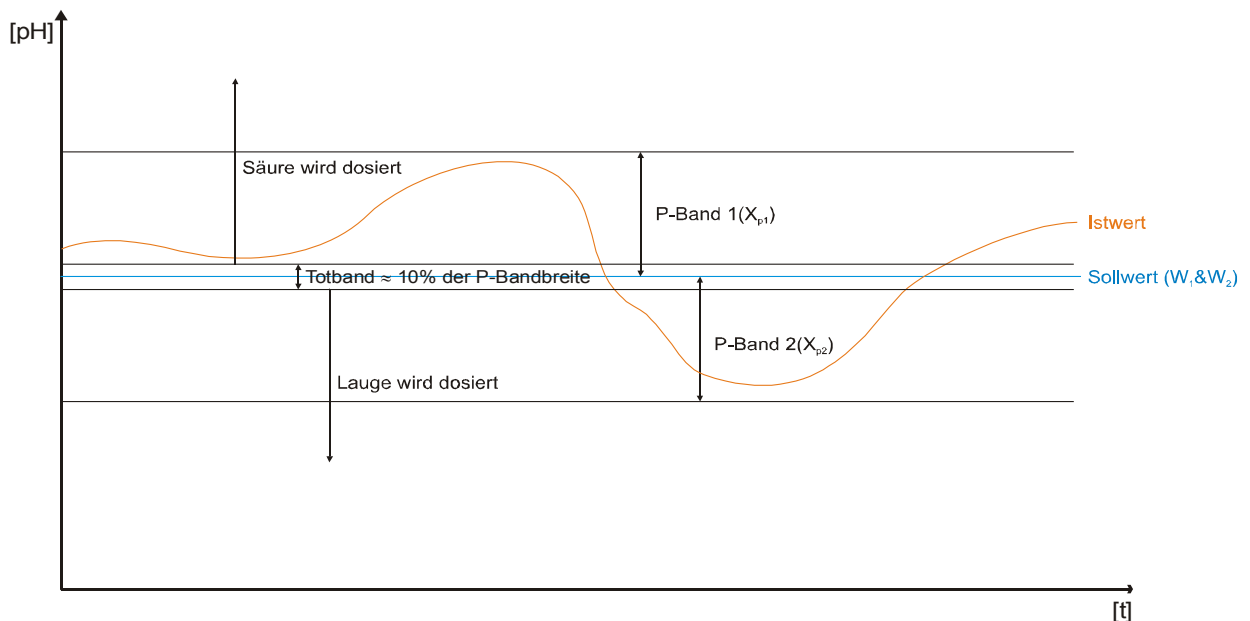
Between set point 1 (W_1) and set point 2 (W_2) the controller is inactive. Within the P-band (X_{p1} or X_{p2}), the controller handles the valves (acid or base) by its internal control mechanism. With these settings, the inactive zone can be determined individually.

Caution! W_1 must be larger than W_2 unless controller direction are changed at menu item "controller settings".



N. Controller with two identical set points, inactive zone = 10% p-band [W]

In mode set point 1 (W_1) = set point 2 (W_2) the dead band is 10% of p-band. p-band 1 controls the acid valve and p-band 2 the base valve. Within the p-band (X_{p1} or X_{p2}), the controller handles the valves (acid or base) by its internal control mechanism.



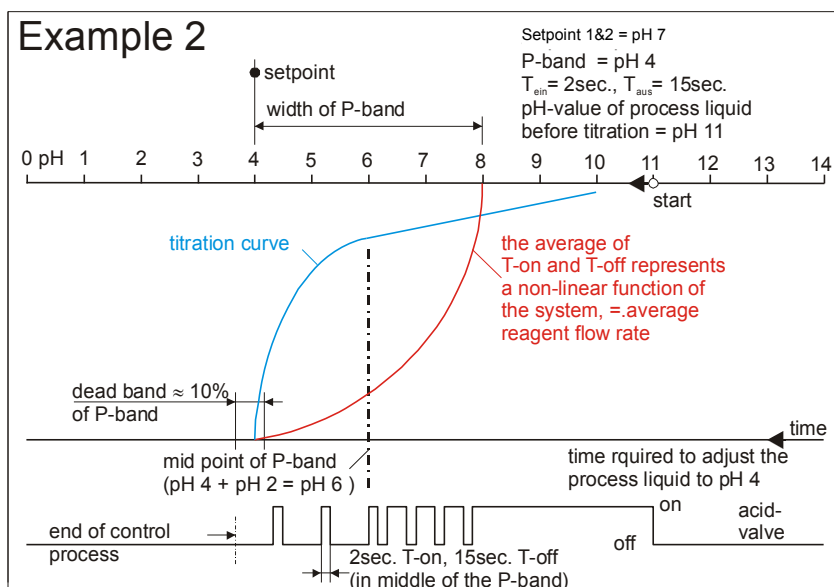
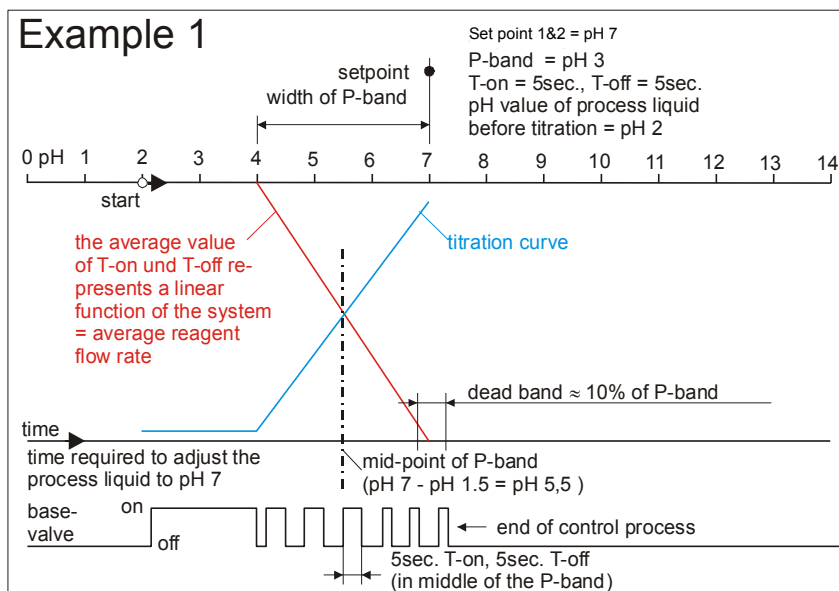
O. Controller mode – Adapting the controller to a titration curve

If fast acting electric valves are used for a given process, it is preferable to keep the valve switching times or the time ratio between t-on and t-off as low as possible. If hydraulic or pneumatic valves are required, the periods have to be increased because of the relatively large opening and closing times of these valves.

The added or delivered reagent quantities must have a certain ratio to the volume of the process vessel to make sure that the reaction does not last too long and to avoid too much reagent being added, because it would cause the control system to oscillate.

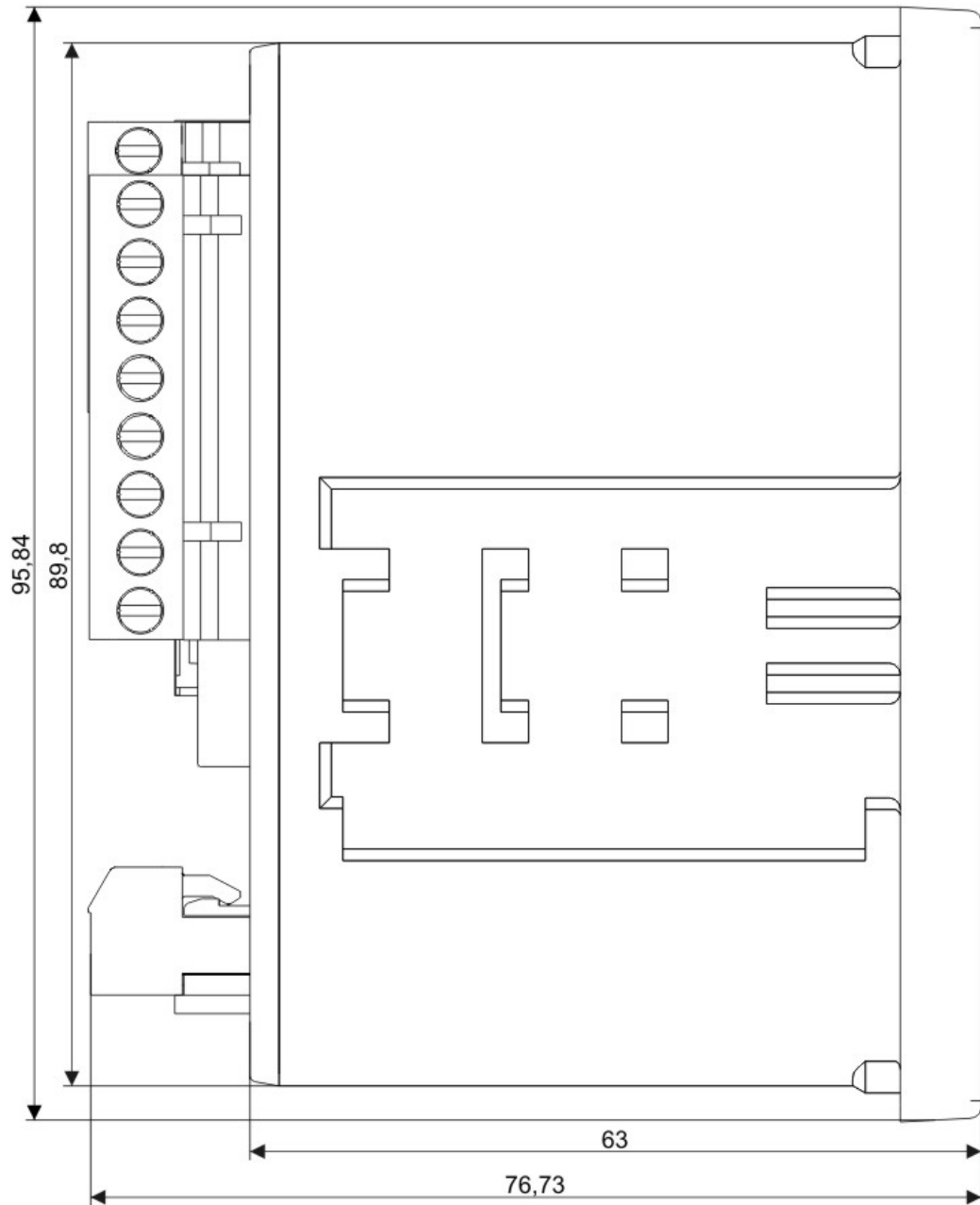
In case of relatively flat titration curves in which the pH value is roughly proportional to the reagent added t-on should be set to equal t-off. However, if the titration curve is steep at the end-point, **t-on must always be shorter than t-off**. In extreme cases, t-on = 1 sec and t-off = 20 sec must be selected. Optimum time conditions are to be determined empirically. During the first run, t-on is kept very small as compared to t-off. If the neutralization lasts relatively long, t-on must be, increased until there is no "overshoot" of the control process (opening of the other valve when the set point value is exceeded).

By changing the p-band together with t-on and t-off, the controller can be adapted to any desired titration without causing the system to oscillate.

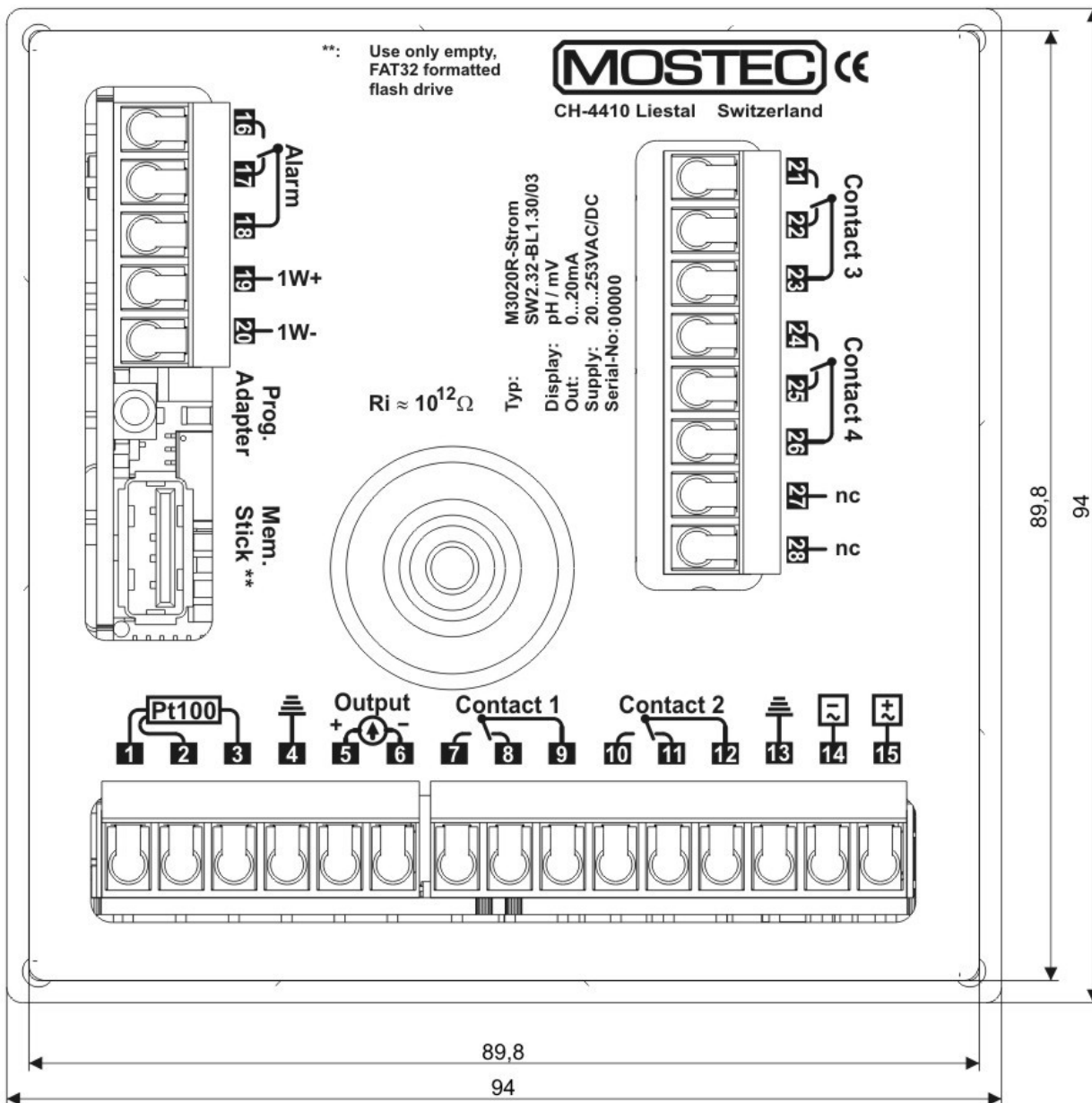


P. Mechanical Dimensions

Side view:



Rear view:



Q. Technical Data

Measuring range:	0,00 to 14,00pH	-1000 to +1000mV
Resolution:	0,01pH	1mV
Accuracy:	0,01pH	3mV
Long term stability, 1 year:	0,02pH	6mV per year at 23°C
Display:	Graphic LCD 128x128 pixel	
Pixel size:	0.4x0.4mm	
Temperature drift:	max. 50µV/°C	
Max. humidity:	non condensing	
Input impedance:	1000G-Ohm, 10e12-Ohm	
Input bias current:	max. 1,5pA	
Temperature:	-3.0...120.0°C temperature compensation by Pt-100, 3-wire, or by hand.	
Relay control:	Switchable between automatic or manual in the main screen by key F4	
ENT key:	quick access to the settings in the main screen or save parameters	
ESC key:	access to the main menu, press and hold 3sec, or exit menu item	
+ / - key:	set values or control relays	
F1 / F2 key:	control relays 3 and 4 on the main screen	
F3 key:	fast access to the probe calibration on the main screen	
F4 key:	switch between automatic and manual on the main screen	
Programming functions:	adjustable caption display and various setting options via software	
Input variant:	Analog and digital ISM InPro (3250i,3253i,4260i,4800i...) or Analog and 2-wire transmitter (M2920)	
Option 2-wire transmitter:	20V/24mA, range: 4...20mA = -1000...+1000mV	
Signal current output:	0...20mA, galvanically isolated, adjustable over full range	
Max load:	500Ohm	
Output impedance:	typ. >1M-Ohm	
Relay contact:	0...14pH, adjustable over the full range	
Hysteresis:	5 - 200 digits adjustable	
Limit value status:	displayed with green lamps for contact 1/2, no lamps for optional contact 3/4	
Relay outputs:	floating changeover contacts, Max. 6A, 2A at 230V continuous, inductive	
Alarm functions:	2 programmable switching thresholds, Pt-100 alarm if wires are broken, 1Wire alarm if wires are broken and USB alarm if the stick/media is full. The alarm is displayed with the red lamp and on the display. Alarm can be acknowledged.	
Alarm relay:	same specifications as above.	
USB:	logger function, programmable log-time, 1 to 7200 sec. Use only FAT32 formatted, empty USB flash drives. Stop log mode before removing.	
Supply:	20..253VAC/DC, up to 3W	
CE-conformity:	fulfilled	

(n.o. normally open contact, n.c. =normally closed contact, c.o. =changeover contact)

1	Pt-100 sense -	10	contact 2 n.o.	19	digital input + ISM InPro/*
2	Pt-100 -	11	contact 2 n.c.	20	digital input - ISM InPro/*
3	Pt-100 +	12	contact 2 c.o.	21	contact 3 n/o
4	PE Pt-100 and current output	13	PE supply	22	contact 3 n/c
5	current output +	14	N supply	23	contact 3 c/o
6	current output -	15	L1 supply	24	contact 4 n/o
7	contact 1 n.o.	16	alarm contact n.o.	25	contact 4 n/c
8	contact 1 n.c.	17	alarm contact n.c.	26	contact 4 c/o
9	contact 1 c.o.	18	alarm contact c.o.	27-28	do not connect!

Terminals:	plug-in terminals on the back panel
pH/mV plug:	13mm DIN plug with Teflon insulation / BNC available on request
Weight:	304g
Hardware:	2 quick-mounting clips 1 operating instructions with wiring diagram
Warranty:	2 years
Other options:	– special measuring range / signal output – custom functions – transparent door Ip55 – custom home screen / logo – 2 additional relay outputs (contact 3/4) – 2-wire transmitter input (* 19 = Supply, 20 = input)