Mostec AG
Mess- und Regeltechnik
Lausenerstr. 13A
CH-4410 Liestal / Switzerland
Tel. 061/921 40 90
Fax 061/921 40 83

MOSTEC

Operating manual

pH / mV controller
type M8832N

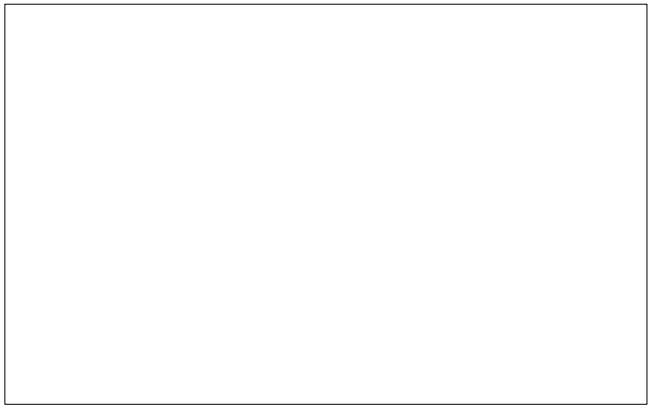
Description of the «leak proof housing»

At the front of the splash water proof casing, the inserted plug-in unit is sealed with silicon rubber material. A «SERTO» screw fitting to supply compressed instrument air is mounted on the rear panel. The signal and relay output terminals are also sealed with silicon rubber. As a result, the controllers application range is extended and prevents dirt or gases from entering the casing.

Mostec AG
Mess- und Regeltechnik
Lausenerstrasse 13A
CH-4410 Liestal
Switzerland
Tel: 061/921 40 90
Fax: 061/921 40 83

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 occured during normal operation. This warranty does not cover damage to the product resulting from ordinary usage such as front panel scratches, against control elements and corrosion, etc... The customer is responsable for paying shipping and packaging 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 covered by the warranty. Transportation damages are not covered by the warranty and should be referred to the respective postal delivery service.



Index

Example:

Given:

- Actual-value = 4 pH
- Setpoint = 7 pH
- P-band = 2 pH
- T_{on} = 5 sec. T_{off}= 20 sec.

For the controller M8832N, the dead-band is 10% of the P-band, therefore when the actual-value in this example reaches 7±0.2 pH, the controller will not inject reagents, and the instrument no longer controlls the pH. Final conclusion: for more precise controlling, a smaller P-band should be selected.

The P-band range is from 7.00 to 5.00 pH [(setpoint) - (P-band)]. Therefore as long as the actual-value is less than 5.00 pH, the base valve will be open constantly and by the addition of base, the actual-value moves slowly to 7 pH. In the moment where the actual-value exceeds 5 pH, the base valve begins to turn off and on (pulse-widthmodulation).

In the middle of the P-band, 6 .00 pH, the valve's turn-on/off times are 5, respectively 20 seconds. Ton and Toff refer always to the middle of the P-band (7 - (P-band/2). Before and after, these openning and closing times obey a logarithmic function, inside the P-band the amount of base is always less as the actual-value approaches 7 pH, then the openning and closing times will become respectively shorter and longer.

At 6.8 pH, the process enters the dead-zone and the actual-value remains constant and no additional base will be added.

At this point, the setpoint lies in the steep part of the titration curve, and from a control theory point of view, it is advisable that T_{on} is much greater than T_{off} for the following reasons:

- The regulation should not «overshoot», therefore inside the dead band the actualvalue should «stop» and not «overshoot».

- The controller should - shortly after injecting - have some time «to look» how the actual-value behaves after this «shoot». The longer the turn-off time is, the less critical is the regulation.

In case of non critical regulation, Toff can be reduced just until little overshooting occurs. Thus in batch type operations, expensive process time can be saved.

In case of problems concerning controll settings which have not been described in this manual, please contact Mostec AG directly.

Terminology for the Mostec pH-controller M8832N

Actual-value: Value which is measered from the pH-electrode, compensated for the isothermal intersection point an~ **the electrode's temperature offset.**

Asymmetry: = isothermal intersection point. This is the operating point of the electrode at which zero millivolts is measured. This point is usually defined as 7.00 pH. Conventionally, there is an offset of a few mV and therefore it should be adjusted with «Asymmetry».

mV / pH: = electrode gain. At zero degree Celsius, the electrode should measure 54.196 mVpH. In practice, there is a deviation of a few % and therefore it should be adjusted with.

Temperature: The pH-electrode has a high positive temperature coefficient. The error is approximately +3.6% per 10 degree Celsius temperature rise. This error can be corrected with the external temperature sensor or with the temperature potentiometer.

Setpoint: This is the value that the controller should achieve.

P-Band: The range in which the controller demonstrates proportional behaviour (see example on page 11).

Dead-band: A zone in which the controller is unable to administer alkaline or acid. The servo units (pumps, valves, etc.) are not in operation.

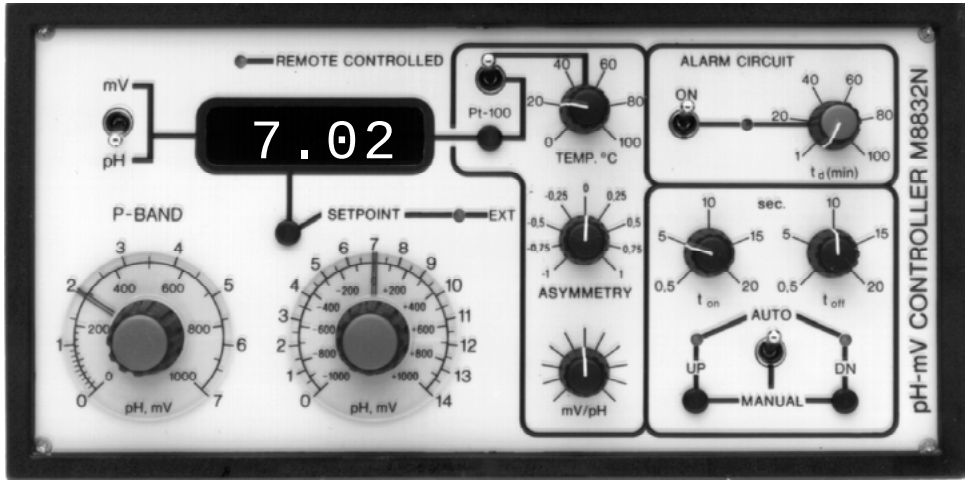
T_{on}: Servo-unit's turn-on-time (see example on page 11).

T_{off}: Servo-unit's turn-off-time (see example on page 11).

Alarm circuit: The alarm timer supervises the output signals to the servo-units. Should a servo-unit be turned on for a time period which is longer than that pre-selected, an alarm is activated. This can occur when the reagent tank is empty, or a stalled stirrer, or a defective electrode etc.

SU: This switch is used to initialize and program the controller. During normal operation, this switch must not be in the SU position or the error message EE2 is displayed and the controller can't work.

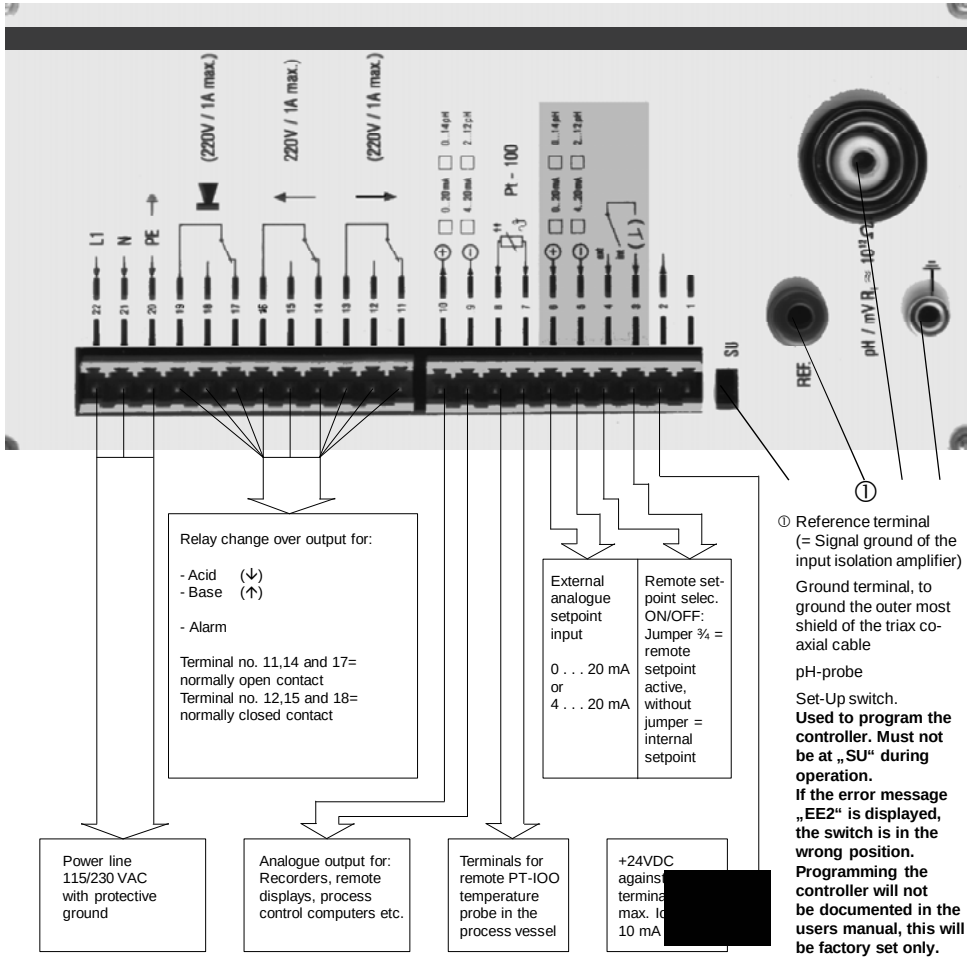
Front view



Specifications

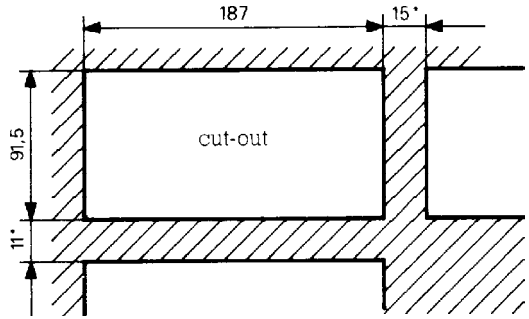
Controller principle:	Quasi-steady three-point P-controller with preselectable transfer function
Range:	0...±1000 mV and 0...14 pH
pH zero asymmetry:	±1 pH
pH-slope:	50 mV/pH to 62 mV/pH at 0°C
pH-temp. compensation:	0-100°C or automatic with Pt-100 platinium sensor, 2-conductor design
Temperature Display:	1. Manual 0. . .100,0°C 2. Pt-100 -10. . . +100,0°C ±1°C
Signal input:	Floating, with isolation amplifier, common mode voltage max. 500 VDC
Input impedance:	10^{12} ohm typical
Input bias current:	1 pA at 25°C typical
Temperature drift in relation to input:	50 µV/°C max.
Operating temperature:	10 to 45°C
Setpoint values:	0 . . . ±1000 mV or 0 . . .14 pH, adjustable with potentiometer and display
Proportional band:	0 . . .1000 mV or 0 . . . 7 pH In the P-band = Zero position, the controller works as a two-point switching controller
Dead band:	» 10% of «P»-band
P-band deviation:	± 2% of end values
Valve times:	0.5 to 20 or 0.05 to 2.0 seconds in relation to the mid of P-band
Alarm delays:	1-100 minutes or 1-100 seconds, can be switched off
Relay outputs:	«UP» valve: change-over contact 1 Amp./230 V, resistive load «DOWN» valve: switch-over contact 1 Amp./230 V, resistive load ALARM: change-over contact 1 Amp./230 V, resistive load
Current output:	0 . . . 20/4 . . . 20 mA for 0. . .14/2. . .12 pH and special ranges. Ri ³ 1 M, max. load 500 ohm at 20 mA
External setpoint:	0 . . . 20/4 . . . 20 mA for 0. . .14/2 . . .12 pH load=51 ohm
Power supply:	115/230V, 50-60Hz » 10 VA
Weight:	approx. 1.4 kg or 3 Lbs
Accessories:	Installation kit, 2 keys and manual
Optional equipment:	• Leakproof housing • Front panel available in different languages • Other signal outputs • Computer interface RS232C

Rear view



Front panel cut-out:

(Units are mm)



* Distance from one instrument to the next

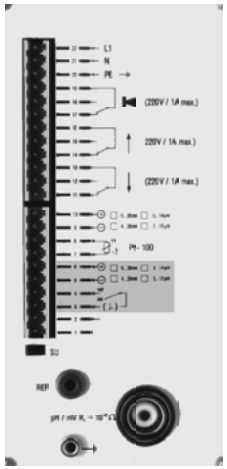
Adapting the controller to a titration curve

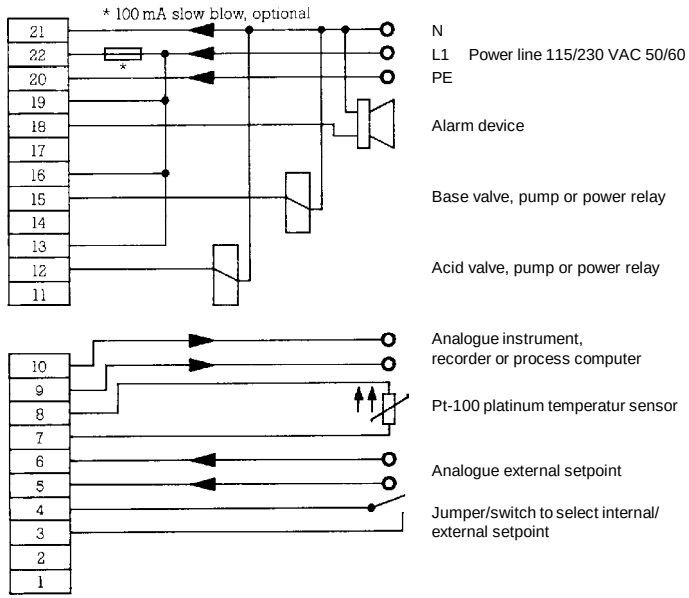
If fast acting electric valves are used for a given process, it is preferable to keep the valve switching times or the time ratio between «T_{on}» and «T_{off}» as low as possible. If hydraulic or pneumatic valves are required, the periods have to be increased because of the relatively large opening 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 endpoint, **«T_{on}» must always be shorter than «T_{off}».** In extreme cases, «T_{on}» = minimum and «T_{off}» = maximum 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 setpoint 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.

Connection example





N
L1 Power line 115/230 VAC 50/60 Hz
PE

Alarm device

Base valve, pump or power relay

Acid valve, pump or power relay

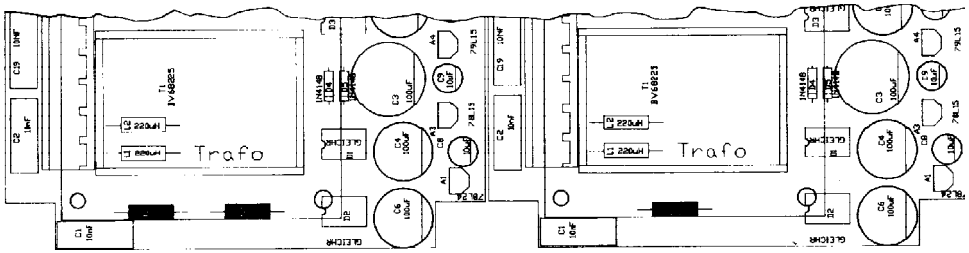
Analogue instrument, recorder or process computer

Pt-100 platinum temperatur sensor

Analogue external setpoint

Jumper/switch to select internal/ external setpoint

Power supply board. Selecting the proper line voltage 115/230 VAC.
View to the component side of the PC board.



115 VAC 50/60 Hz: Jumper B2 and B3 placed 230 VAC 50/60 Hz: Jumper B1 placed

Operation of the controller

Function of the operating controls

1a **«mV» measuring range:** When this switch is in the «mV» position, it is possible to control redox or other processes which generate mV signals to indicate actual values. With the instrument set to this measuring range, «ASYM», «mV/pH», «Temp.°C» controls are out of operation.

1b **«mV» measuring range:** In this range, the actual value is the pH signal that has been derived from the formula
UpH(mV)= 54.196 [1+(0.003661·Tc)]
in relation to 0°C The pH setpoint can be set anywhere between the full operating range of 0-14 pH. In this case the temperature dependence, electrode slope and asymmetry can be compensated for.

2 «Manual/Pt-100» switch: This switch is used to change from manual temperature compensation to a platinium sensor located in the process liquid (in most cases, this sensor is housed next to the pH electrode). **If the switch is in the «Pt-100» position and the sensor is not wired to the instrument, the instrument works with a temperature of 20°C.**

3 «Temp.» potentiometer: A manual control to compensate the temperature coefficient of the pH electrode.

4 «Asymmetry» potentiometer: Is used to adjust the zero mV point of the pH signal (pH = 7)

5 «Slope» potentiometer: Serves to adjust the slope of the pH electrode by means of a calibration (buffer) solution.

6 «Setpoint» potentiometer: This control is used to set the «mV» or «pH» setpoint.

7 «P-band» potentiometer: Serves to adjust the width of the proportional band (amplification). A low P-band means strong amplification and vice versa.

8 «Auto/Manual» switch: This switch is used to control valves either through the controller or manually. In manual mode the valves can be controlled by two push buttons. Two light emitting diodes indicate the valve position. If a given lamp lights up, the corresponding valve is open. «Up» means process to more positive redox potentials or higher pH values. «Down» means process to more negative redox potentials or lower pH values.

9 «T_{on}/T_{off}» potentiometer: These two controls are used to adjust the valve opening or closing time in relation to the midpoint of the P-band. If both potentiometers are adjusted to the same value, the open and close times of the corresponding valve are equal and in the center of the P-band. In this case, the transfer function of the system would be linear. These controls make it possible to adjust the controller to the shape of a titration curve so that even with a titration curve having a steep end-point the transfer behavior remains linear and the control system does not begin to oscillate. The maximum nonlinearity ratio is about 1 to 40 (0.5 to 20 seconds). The dead band of this P-controller in which none of the two valves is actuated, represents about 10% of the P-band.

10a Alarm circuit: The opening of one of the two valves (in the «Auto» operating mode only) starts a delay timer which can be adjusted from one to 100 minutes or 1 to 100 seconds. If a valve remains open for a period that is longer than the preselected period, an alarm signal is triggered. Depending on the application, this can have the following meanings:

1. The pH-electrode is defective.
2. Reagent tank is empty.
3. Defective circuitry.
4. Defective controller or wiring to controller.
5. Defective stirrer.
6. Process flowrate in waste water treatment plant is too high.
7. Valve is stuck in the open or close position, etc.

The alarm is displayed by a LED at the front panel.

10b If the alarm circuit is not used, it can be switched off.

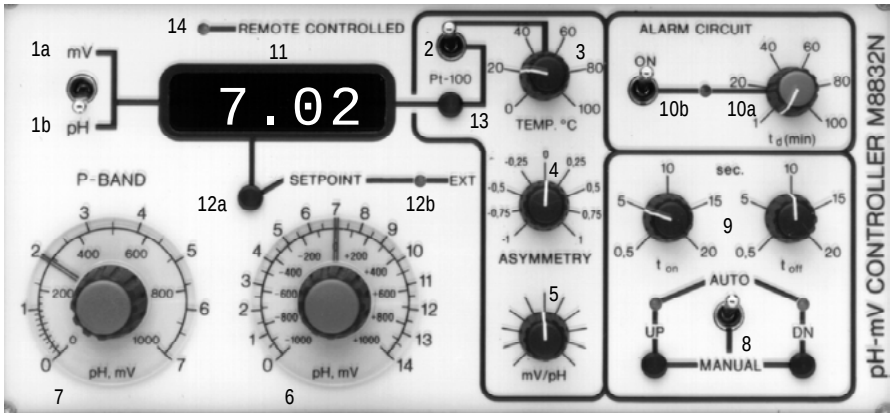
11 **Digital LED display:** It displays the actual values, the temperature, the setpoint value and error messages.

12a Pressing this button changes the display from actual value to setpoint value.

12b **Remote control light.** This LED is on when the controllers setpoint comes from an extemal source as an analogue current signal with a jumper installed between the terminal 3 and 4. The intemal set point on the front panel is off.

13 Change over switch to display the actual temperature in ° C. When the switch «Pt-100» is in the UP posihon then the accurate manual temperature setting is displayed. In the DOWN (Pt-100) position it displays the temperature of the remote Pt-100 sensor.

14 **LED remote controlled.** This lamp is on when the controller is remotely controlled by the RS232C or the RS485 interface from a host computer.



Instrument design

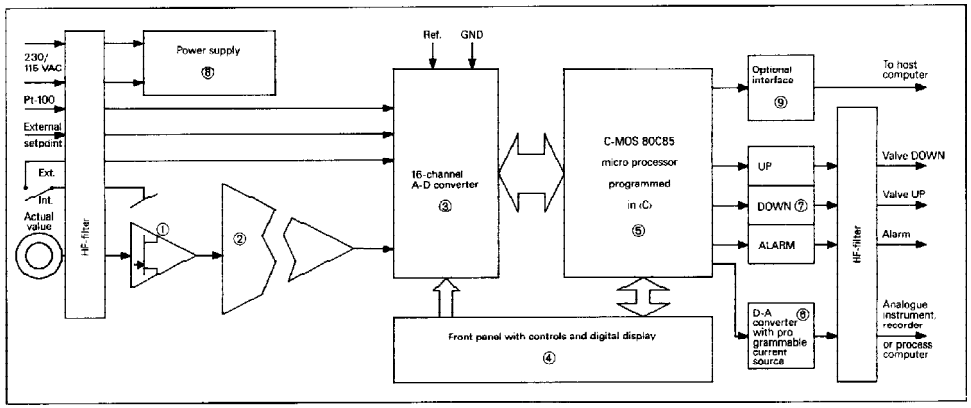
The system consists of the following components:

① High impedance FET amplifier
Isolation amplifier for the pH-probe signal
16-channel A-D converter
Front panel with controls and digital display
Micro computer
D-A converter
Relays for valves and the alarm
Power supply
Option: Interface with several standard configurations to remote control the controller or to read back process values.

All the electronic components are located on four printed circuit boards. The rear panel has two terminal strips with 10- and 12-pole screw plugs to connect the controller to the external wiring.

A 13-mm pH-plug with teflon insulation is used for the probe signal. The integrated isolation amplifier isolates the pH-probe signal from the control processor ground. The processor ground is floating against protective ground.

The printed circuit boards are build in a plastic case which is shielded with a conductive nickel coating. The transparent polycarbonate door, fitted with rubber gasket and lock, is splash water proof.



Typical application of the M8832N controller