pH/mV/ORP METER SIMULATOR

SMH-2

USERS GUIDE

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SPECIFICATIONS

Simulator

Range pH: 2-12pH in 1pH steps (CALIBRATE mode)

$^{+}$/-2pH continuous, centered on calibrate position. (SWEEP mode)

Range mV: -1000mV to +1000mV in 200mV steps (CALIBRATE mode)

$^{+}$/- 400mV continuous, centered on calibrate position. (SWEEP mode)

Output resistance: Selectable for 10kOhms direct and 100 MOhms high impedance output. *(pH electrode simulation)*

Stability: Drift at constant ambient temperature less than 0.01pH/day, non cumulative.

Change with temperature less than 0.01pH (0.05mV)/10^{o}C.

Temperature compensation: Internally fixed for pH at 20^{o}C (57mV/pH)

Output: Panel mounted BNC socket and 1 metre coaxial cable with BNC connector.

pH/mV Meter

Range:	0-14 pH 0.01 pH resolution
	$^{+}$/- 1999mV 1mV resolution
Display:	Liquid crystal display 3 1/2 digits
Input resistance:	suitable for electrodes up to 1000 MOhms membrane resistance
Temperature compensation:	Manual adjustment, 0-100^{O}C
Isopotential:	Pre-set at 7 pH .
Output:	Panel mounted BNC socket

SMH-2

Power supply:	9 volt battery NI-CAD preferred for longer performance. One battery will last for approximately 100 hours operation.
Indicator:	“LO-BAT” sign indicates low battery voltage. *(voltage has dropped below 8.2V)*
Dimensions:	82(W) x 152(H) x 30(D)mm.

INTRODUCTION

General considerations for testing controllers.

Good calibration instruments are essential for efficient and economical servicing of pH instruments and electrodes. The SMH-2 simulator provides the operator with such a versatile unit to calibrate and test any pH/ORP controller or display instrument. Connecting the simulator to a pH or ORP controller enables the operator to quickly determine the source of problems occurring in an installation.

. The SMH-2 simulator connected to a controller electrode input enables the operator to test the operation of the unit and pumps or valves attached. Using the CALIBRATE pH/mV function will test the accuracy of the controller while using the SWEEP pH/mV function tests all connected pumps or valves for their response to signal changes of the controller.

A 4-20mA current output connected to a central processing console can equally be tested for its functionality.

The electrode simulation featured with the SMH-2 enables the operator to test for possible controller input problems and cable impedance or cable leakage faults.

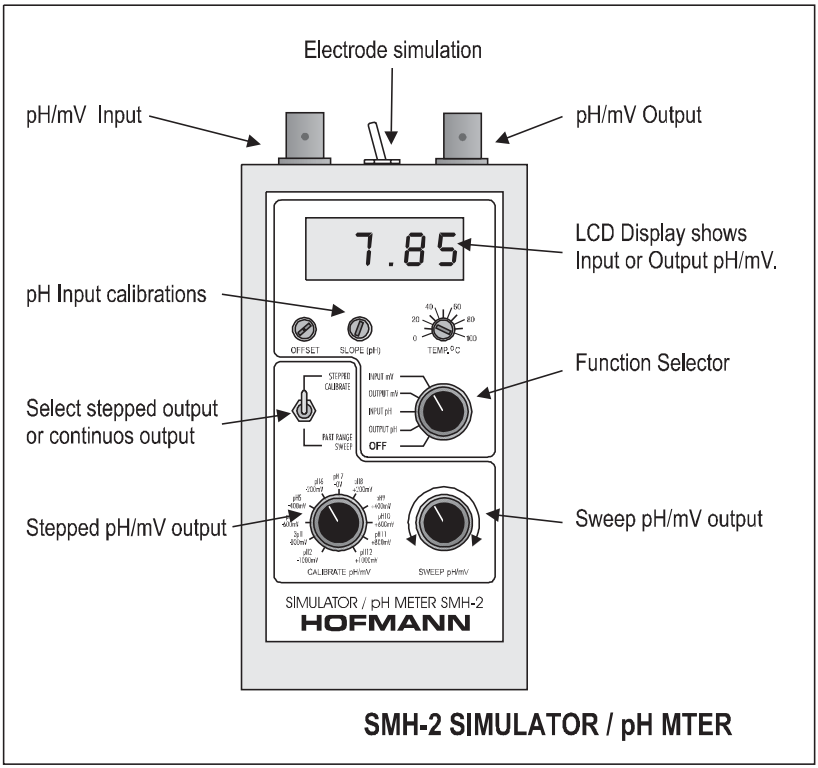
The pH/mV meter of the SMH-2 will further assist in troubleshooting an installation to determine existing faults. The pH or mV reading of the meter versus the installed controller will quickly point to a potential problem with the electrode or other equipment.

☞ *A faulty controller or isolation problem caused by earth loops will show immediately if the pH electrode connected to the controller displays faulty or erratic values but connected to the SMH-2 shows correct pH or mV readings.*

The SMH-2 will perform as a reliable and accurate portable pH/mV meter if connected and calibrated to an electrode.

Features of the SMH-2

The LCD display always shows the value selected by the function switch. In “OUTPUT pH” the selected pH is shown, in “OUTPUT mV” the selected mV. The simulator always outputs the selected signal even if input meter mode is selected and displays an electrode input signal.This will help in some cases where comparisons in performance are made.



The OFFSET, SLOPE and TEMP. adjustments let you calibrate an electrode to achieve accurate measurements on site.

The “CALIBRATE pH/mV” selector lets you set pH in 1pH steps and mV in 200mV steps for controller calibrations. For testing set points etc. switch to “PART RANGE SWEEP” and with the “SWEEP pH/mV” knob sweep the range required.

The sweep range always centers on the value selected with the CALIBRATE knob and spans 1.4pH or 230mV above or below the CALIBRATE pH point. This gives a fine feel for accurate analysis of the response of a controller under test.

☞ *Change the battery as soon as possible if "LO BAT" appears as the accuracy of the SMH-2 will be affected.*

Changing a battery is easy. A commonly available 9V battery is used. Use a NI-Cad for longer operation. Undo the two screws at the bottom back of the simulator to replace a battery. A "LO BAT" in the top left of the LCD appears if the battery voltage is low.

The simulator still functions accurately when "LO BAT" appears. But it is advisable to change as soon as possible. The LCD display and signal output start to wander and are not accurate if the"LO BAT" sign is ignored too long.

☞ *Always switch of the simulator after use to ensure that the battery is not flat next time around.*

Using the SMH-2 simulator.

Calibrate one of your own electrodes with the SMH-2. This helps you establish the actual pH of the plant water once on site. Then connect the plant electrode to the meter input of the SMH-2 and the simulator output to the controller to find a potential problem in a treatment plant or pool.

The pH meter immediately shows you the condition of electrode and cable.

With the simulator find any problems associated with the controller, pumps or even the 4-20mA signal connected to a central processor. *(See chapter on Faults and the SMH-2)*

Testing and calibrating pH controllers.

Connect the simulator to the pH input socket of the controller. Switch the simulator to "STEPPED CALIBRATE". Select "DIRECT" and "OUTPUT pH" with the appropriate switches. The offset of a controller must always be tested or calibrated first. Select pH7 on the simulator and check

the controller. Carry out any adjustments necessary with the offset calibration. Now select pH2 or pH12 with the simulator and any deviations of the displayed value of the controller are calibrated according to the manufacturers instructions. Fine adjustments can be made by switching through the stepped pH range of the simulator and checking all selected pH values against the controllers displayed values.

Select “PART RANGE SWEEP” to test the operation of pumps or valves. Select the aprox. pH with “CALIBRATE pH/mV” and then sweep across the range to check for proper operation of pumps or valves.

☞ *When a pump or valve is activated with the simulator bear in mind that all controllers exhibit a deadband (hysteresis) of between 1-10% full scale placing the on and off points of the output at slightly different places on the sweep control.*

Temperature.

The SMH-2 simulator generates 57mV/pH. This is the equivalent output of a new pH electrode placed into a solution at 20^{o}C. pH. Controllers with a manual temperature compensation must be set to 20^{o}C. Instruments with automatic compensation should be operated by ensuring that the temperature electrode used is placed in 20^{o}C water.

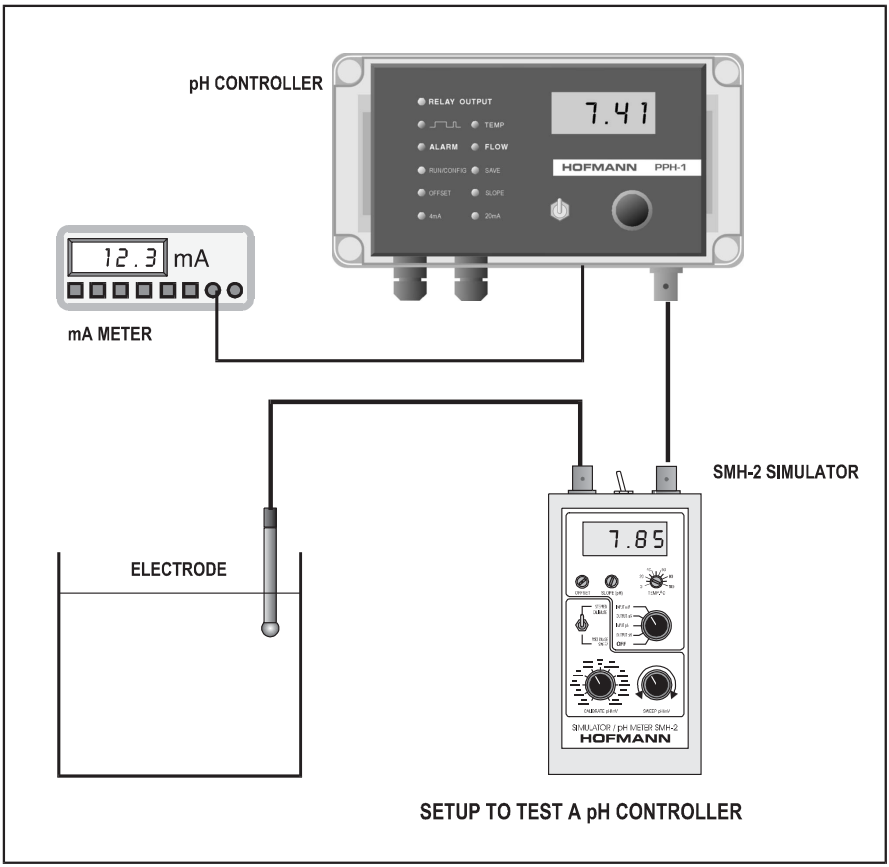
☞ *The mV output of a pH electrode increases from approx. 54mV/pH at 0^{o}C to 70mV/pH at 100^{o}C. a factor of 1.3. An uncompensated controller therefore exhibits an error of approx. 1pH with a temperature deviation of 100^{o}C or 0.1pH error for each 10^{o}C temperature deviation. Just how accurate the temperature compensation of the installation has to perform depends on the accuracy of the pH measurement and control required.*

Testing for high impedance problems.

Connect the simulator to the BNC input; select pH7 and switch to CALIBRATE. Select the DIRECT mode and ensure that the value of the controller reads 7.0pH. Switch to 100 MOhms, allow the reading to settle for 10 seconds and verify that the value does not deviate more than 0.5pH from pH7.0

Switch the simulator to pH 2 or 12 and repeat the procedure. This and the previous operation will test for excessive impedance loading occurring within the controller and repairs must be carried out for reliable operation if the values displayed are lower or higher than specified.

The coaxial cable can be tested in a similar fashion. After testing the controller reconnect the cable and with a BNC adapter connect the simulator in place of the pH electrode. Use the 100 MOhms mode, select pH 7.0 and observe the value displayed. A faulty or corroded cable will pull the signal and appear to lock the reading to anywhere between pH3 and pH12 depending on the nature and severity of the fault that is causing an electrolytic reaction in the cable.



SETUP TO TEST A pH CONTROLLER

Testing an ORP controller.

Switch the mode selector to “CALIBRATE pH/mV”. Select “OUTPUT mV” and DIRECT output mode with the appropriate switches. Controllers with an analog or digital readout are checked and calibrated with the simulator by selecting a mV output of -1000 to +1000mV in steps of 200mV. Any deviations of the value displayed by the controller under test are adjusted with the appropriate calibrations. *(Follow manufacturers instructions.)*

Calibration of Redox electrodes.

Contrary to pH electrodes, redox *(metal electrodes)* do not exhibit changes in slope or zero point. Nevertheless one may occasionally experience wrong redox measurements, most frequently the cause being a contaminated electrode. Cleaning and/or regeneration of the electrode will cure the problem.

It is therefore apparent that adjustments to an mV/ORP controller are only necessary for the purpose of recalibration and testing the accuracy of the instrument.

COMMON FAULTS WITH pH / mV MEASUREMENTS

DISPLAY DOES NOT CHANGE

- Corroded co-axial cable
- BNC terminal shorted
- Faulty electrode
- Faulty controller
- Wet connections BNC or electrode
- Not calibrated correctly
- Electrode acid or alkaline bound
- Static electrical charge

DISPLAY INCORRECT

- Electrode not calibrated with buffers
- Dirty electrode
- Poisoned electrode
- Wet connection
- Cracked electrode glass
- Fowled electrode
- Sodium error
- Organic media
- Temperature compensation incorrect
- Wet or corroded co-axial cable
- Ground loop from instrument to earth
- Faulty controller

DISPLAY ONLY SHOWS pH 7.00 or 000mV

- BNC connector shorted
- Damaged co-axial cable
- Faulty instrument

DISPLAY ONLY SHOWS pH 0.00 , 14.00 or -1 *(OVER RANGE)*

Open circuit electrode input
Damaged or broken co-axial cable
Electrode earth loop
Faulty instrument

ERRATIC DISPLAY

Interference from central processor through 4-20mA output
Earth loop from instrument to ground
Co-axial cable exceeds 10 metre in length
Radio transmission signals
Co-axial cable running parallel to power cables
Co-axial cable in steel conduit
Excessive electrical noise
Power supply unstable
Corrosion in instrument

SLUGGISH RESPONSE

Dirty or fouled electrode
Electrolyte spent or poisoned
Incorrect electrolyte in electrode
Incorrect glass of electrode
Sodium error
Organic media

HOW TO INVESTIGATE INCORRECT READINGS

The behavior of a pH or mV reading displayed at a controller reveals a great deal about possible faults present in a treatment plant. Is the reading displaying the correct pH value?

The most common cause for an incorrect pH reading is a dirty or contaminated electrode damaged or corroded co-axial cable or the calibrations are wrongly set up.

First measure the actual pH value with a calibrated portable pH meter such as the SMH-2 and check if the controller compares within approx. 0.5pH of the pH value measured.

Next connect the plant electrode to the input of the SMH-2 and check the pH value displayed.

A new electrode will be required if the value obtained is largely different from the value given by your simulator. Cleaning the old electrode may be a short term answer.

Next check the controller for proper functioning. Connect the simulator output and step through the pH range with the output switch set to "DIRECT' to establish the controller's response. The controller's display should follow the simulator. Repeat the same procedure with the simulator output switched to 100MOhms. The controller should again follow the signal within 0.2pH. If the display goes off scale *(shows 0.00 or 14.00)* or large deviations occur, the frontend amplifier of the controller is faulty and must be returned to the manufacturer for repair.

By now you should have established if the fault is in the cable/electrode or the controller.

☞ *Electrodes are by no means permanent 'fixtures' in a treatment plant. They need regular replacing to insure reliable and continued operation.*

How to investigate an erratic DISPLAY

The first step is to establish the source of the erratic display. Connect the simulator set at pH 7 first in DIRECT mode and then in 100MOhm mode.

An erratic display even with the simulator connected in DIRECT mode most certainly indicates a faulty controller, very likely caused by accumulated corrosion inside the instrument. The controller must be returned to the manufacturer.

An erratic display only with 100MOhm selected indicates a fault in the frontend of the controller. Replacing the input amplifier is the only cure. The instrument must be returned to the manufacturer. This test may also indicate a possible strong high frequency source *(radio transmission)* near the installed controller.

An erratic display only with the electrode connected is certainly caused by nearby interference. Better shielding, changing location or repositioning of the controller, removing the source of interference etc. is the only solution to this problem.

If disconnecting the 4-20mA signal wires running to a central processor eliminates an erratic display, several remedies are possible. HOFMANN controllers have a floating 4-20mA output. *(Electrical isolation*) It is therefore possible to ground the minus side of the 4-20mA output to the earth terminal of the 240VAC. This most likely will correct this type of noise interference.

Read "pH and CONDUCTIVITY MEASUREMENTS and the interfacing with COMPUTERS" This paper is supplied with every HOFMANN controller equipped with a 4-20mA current output.

How to investigate a DISPLAY that does not change.

The fault will be quickly located with the plant electrode connected to the pH input and the controller connected to the simulator output of the SMH-2.

The cause most likely is a corroded co-axial cable, if the SMH-2 pH meter indicates a non-changed reading from the cable/electrode. The corrosion of inner wire and outer copper shield together with the infiltrated acid starts to generated enough potential to override the electrode signal. Electrodes can be acid or alkaline bound through poisoning of the electrolyte. This can lead to a 'frozen' electrode signal output.

The above mentioned cases apply to readings anywhere in the pH range. If the reading is frozen on or near pH7 the cause is more likely to be a shorted co-axial cable *(through physical damage)* shorted BNC plug or shorted BNC socket.

Moisture in the cable, BNC plug or controller will also cause a shorting of the electrode signal, resulting in a static reading near pH7.

The instrument is faulty and has to be returned to the manufacturer if stepping the pH with the SMH-2 simulator has no effect on the controller's display.

☞ *Many years of field service experience has shown that faults in treatment plants, pools etc. are caused mostly by: faulty electrodes, damaged or corroded co-axial cables, incorrect calibration, damaged or incorrect wiring, interference from other machinery etc.*

How to investigate an EARTH or GROUND LOOP

Earth or ground loops distort the electrical signal into the controller. The pH or mV reading of the controller becomes erroneous affecting the complete dosing cycle.

The earth point of a pH system can only be via the electrode's junction point. Any connection to earth on the controller side will generate a current to flow through the water, electrode, co-axial cable and the controller's circuitry, thus "pulling' the signal. In severe cases this "pulling" can cause a controller to go off-scale.

A suspected ground loop in a faulty system can be detected in several ways. Use a cup of water from the treatment plant. Remove the plant electrode and measure the pH of the water in the cup. A ground loop is present if the pH measured in the cup is correct but the pH measured with the electrode returned to the plant differs.

Another way to detect a ground loop is to temporarily remove the earth wire *(240VAC INPUT)* from the controller. A ground loop is present if the pH reading of the controller changes.

The resistance *(conductivity)* of the water in a typical treatment plant fluctuates continuously. This results not only in an erroneous but also in an unstable pH or ORP reading at the controller if a loop is present.

How to investigate a GROUND LOOP within a Controller

A loop present in a controller can be caused by internal corrosion, instrument malfunction, component failure etc.

The power **must** be switched off to check for an internal loop. Disconnect the electrode and any 4-20mA signal cables connected. Relay connections can be left in place. Select the highest OHM range on your multimeter *(20MOhm or higher)* and connect the probes to the outer sleeve of the BNC socket and the earth terminal of the 240VAC input. Some resistance may show initially, caused by internal charging from the multimeter voltage but after a few seconds the reading must show “infinite” resistance to indicate there is complete isolation.

The same procedure is required to check for isolation between BNC and the 4-20mA signal output and from BNC to BNC if the controller is a dual instrument *(DPH-2).*

Internal isolation faults usually cannot be repaired on site and the controller must be returned to the manufacturer for repair.

☞ *A loop present in a controller can be caused by internal corrosion, instrument malfunction, component failure etc.*

WARRANTY

We, **HOFMANN ELECTRONICS,** guarantee this unit against defects due to faulty manufacture or breakdown of components for a period of twelve month from the date of purchase, subject to the following provisions:

- The guarantee will cover original failure of parts and natural defects due to manufacturing causes. Otherwise repair charges are to be to the owners cost.
- The warranty does not cover any carriage costs.

The warranty is void if:

- The instrument is damaged due to rough handling or transport after purchase.
- The article has not been used in accordance with the operating instructions.
- Any parts in the instrument have been changed or have been altered in any way.
- The serial number is removed or defaced.

All other warranties and conditions, express or implied, are void.

- SMH-2 SERIAL No.

Due to a continuing effort to improve the product the manufacturer reserves the right to change or alter the product without notices.

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