DIGITAL

mV / ORP

CONTROLLER

PMV-1

USERS GUIDE

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TABLE OF CONTENTS

SPECIFICATIONS

Range:	0 to 1000mV with 1mV resolution
Display:	3 1/2 digit LCD display
Indicators:	LED lights indicate set point operation mode, flow and configuration status.
Calibration:	All calibration parameters are programmed into non-volatile memory.
Electrode:	BNC, external of housing.
Signal output:	4-20mA software configured over range 0-1000mV Screw terminals for fully isolated 4-20mA output located by removing front section. Maximum termination impedance for 20mA is 1000 Ohms.
Control range:	Set point range 0mV to 1000mV
Output relay:	240 VAC, 5 Amps max. Resistive load. 3 terminals provide earth, neutral and active. 5A fuse protects instrument and relay output.
Pulsed output:	Selected through setup program. Pulse width adjusts automatically in adaptive mode to suit dosing requirements. On time changes from continuous to minimum 1.5 seconds. Pulse “gradient’ programmed manually in normal proportional dosing.

Output relay:	240 VAC, 5 Amps max. Resistive load. 3 terminals provide earth, neutral and active. 5A fuse protects instrument and relay output.
Alarm relay:	Potential free contacts.
Power:	240VAC 50Hz 7VA max.
Housing:	Thermoplastic with transparent lid. Rated IP 55
Dimensions:	(W)130mm x (H)95mm x (D)85mm.

INTRODUCTION

The PMV-1 instrument measures and processes millivolts generated from an ORP electrode.

The 0 to +1000mV range will suit most dosing installations where an ORP measurement as input is used. The PMV-1 is particularly suitable for chlorine or bromine dosing.

The relay output can drive a 240V dosing pump or solenoid valve. Additional filtering is build into the relay output circuit to minimise interference usually caused by 240VAC solenoid valves being switched off.

The basic installation of a control system requires no more than simply fastening the unit to an instrument panel or wall, hard wire the pump cables via the cable glands and connect the electrode to the BNC socket situated on the bottom of the instrument.

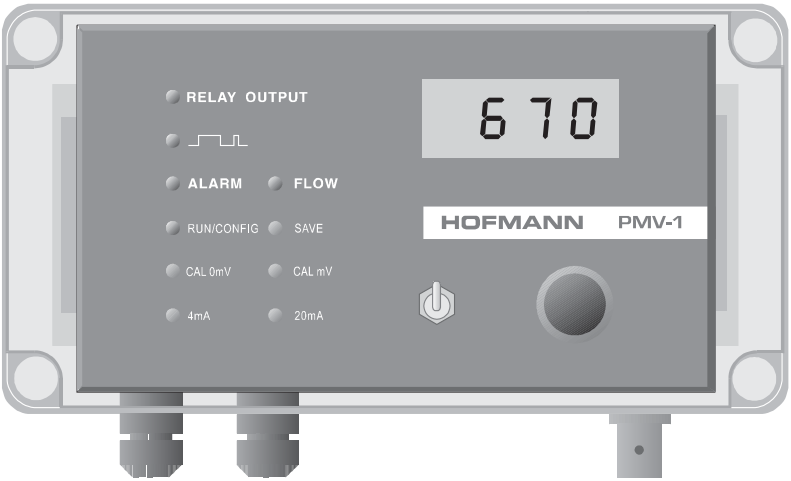

FIG 1 *PMV-1 controller*

The large LCD display shows either signal input, configuration or calibration values such as set point or high/low alarm as selected by an operator.

LED's show the operational status of the instrument or setup program currently available. Pressing the momentary switch prepares for performing configurations or calibrations. Rotating the encoder now clockwise and pressing the switch again enters the configuration menu to set up the instrument. Rotating the encoder anticlockwise and pressing the switch enters the calibration menu. You scroll through menus with the encoder knob and once a menu is selected values are then increased or decreased by rotating the encoder knob clock- or anti-clockwise. The desired value is selected and saved with the momentary push switch.
(See configuration)

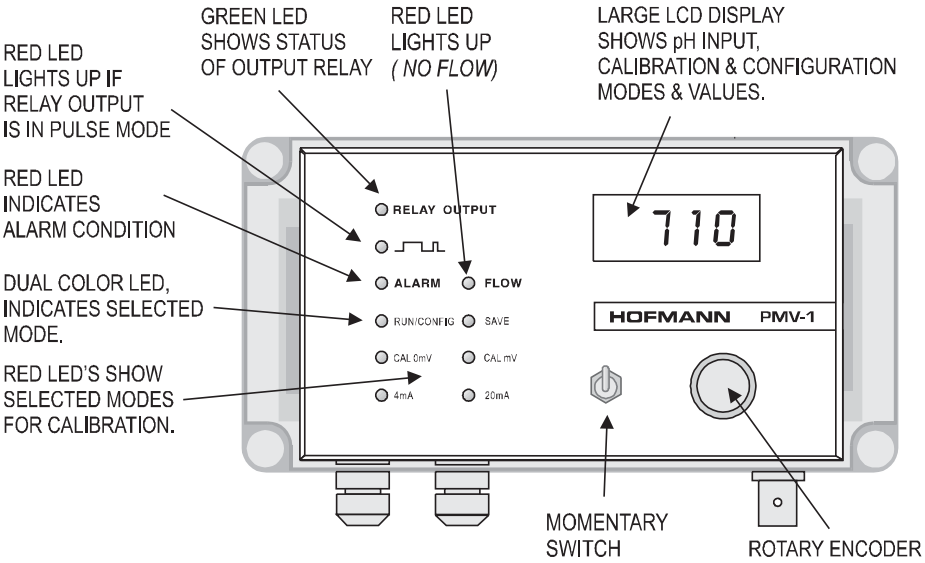

FIG 2 *LED' s show different mode of operation*

☞ *The rotary encoder only becomes active if invoked through the instrument configuration program. This feature avoids setpoint or calibration values being changed inadvertently.*

Three modes of set point control are possible:

Normal dosing

This is the normal dosing mode with simple on/off operation of the output relay. Up or down dosing is possible with normal dosing.

Normal Proportional dosing

The relay output starts to pulse with a shortening of the ON cycle and a lengthening of the OFF cycle as the mV moves toward the setpoint. The behaviour of the pulse mode can be modified by setting a “gradient” from 10 to 100. This configuration only becomes available if no.P is selected.

Up or down dosing is possible with normal proportional dosing.

Adaptive proportional dosing.

The relay output of the PMV-1 instrument is controlled through a complex algorithm that continuously monitors the difference between actual mV and set point. The output starts to pulse and varies the ON/OFF cycle as the mV-input approaches the set point value. The ON/OFF cycle however is also adjusted from a ‘correction factor’, which in turn is governed by the history of a previous dosing cycle. This makes for a fully dynamic dosing control, which adapts for widely varying conditions in a cooling tower or other plant installations.

Dosing for an excessive period of time without a corresponding increase in mV is recognized as a possible failure. The output begins to pulse, preventing overdosing.

The pulse output exhibits a very wide duty cycle. The ON and OFF times are both dynamic, both varying from 1.5 to 60 seconds.

Up or down dosing is possible with “Adaptive proportional Dosing”.

☞ *The program of the PMV-1 prevents gross overdosing in the event of a process upset or electrode failure. (Adaptive mode only)*

The PMV-1 features an alarm relay with potential free contacts. Low and high alarm points are set in the configuration menu.

The flow switch input is configured to operate as N/O or N/C. *(normally open or normally closed)* The output relay is locked out and the relay LED flashes if no flow is detected. The flow LED indicates this condition.

The inherent accuracy and range configuration of the 4-20mA constant current output together with full electrical isolation make it possible to interface into a microprocessor, logic controller or data logger to further expand the combination of installations with the PMV-1.

Wiring the PMV-1 is easy. Simply unclip the front panel to reveal all the terminals. The output terminal for the relay provides switched 240VAC with active, neutral and earth. A pump or valve can be wired directly without the need for additional junction terminals.

INSTALLATION

Select a position for the controller to be mounted on a wall, not facing into direct sunlight and protected from the weather elements as much as possible. The instrument should be installed within the distance of the sensor coaxial cable length. If this is not possible extra coaxial cable can be supplied to suit, however if cable lengths are to exceed 10 metres in length a preamplifier may be required. Remove the front transparent cover from the enclosure and gently separate the removable module from the rear enclosure. Disconnect the flat cable connector from the rear circuit board.

The instrument is fastened to a wall or sub panel by means of four screws. The mounting holes are revealed after removal of the front cover. *(See Fig.3)*

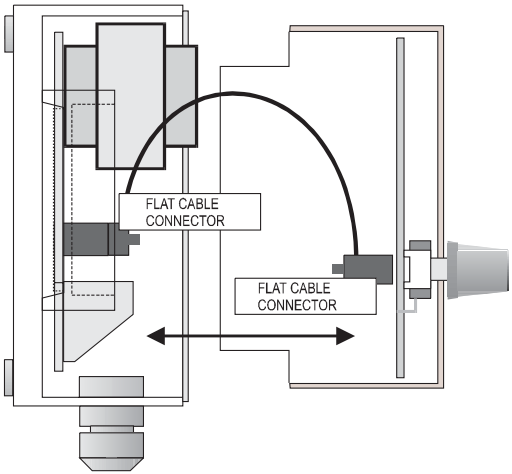

FIG 3 *CHASSIS & removable FACIA of the PMV-1*

The 3 terminals for the SET POINT each provide an earth, neutral and switched 240VAC active screw connector. A metering pump, solenoid valve or other device requiring 240V can be connected.

The alarm relay terminal has potential free contacts. *(N/O C N/C)* Adjacent is a 3 way terminal providing 240VAC active neutral and earth. This helps in wiring the alarm relay with an appliance requiring 240VAC. Wire a small loop from 'common' to active of the second terminal. The 240VAC appliance is now wired to 'normally open' of the alarm terminal, neutral and earth of the additional terminal. *(See Fig.4)*

It is imperative that all connections are wired through the cable gland and the transparent lid is always tight to ensure that no corrosive liquids inadvertently splash into the instrument.

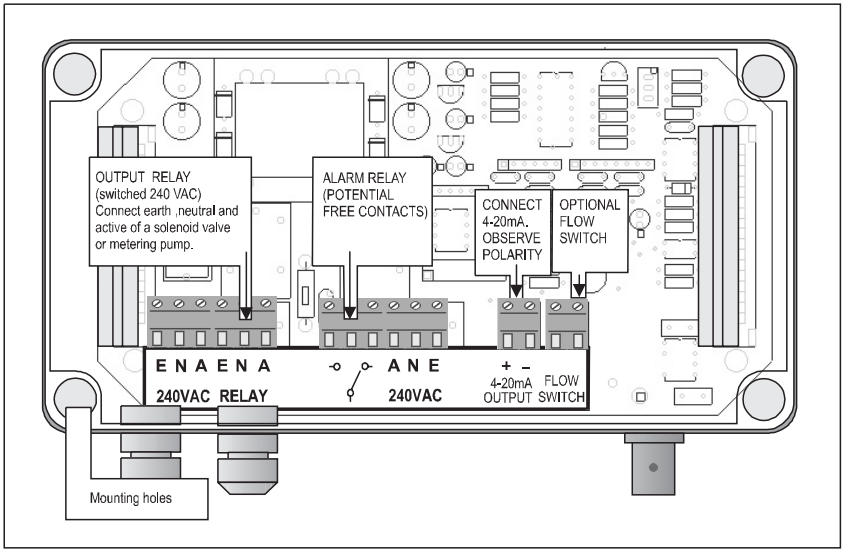

FIG 5 *Terminal layout of the PMV-1.*

You need to determine the N/O or N/C of a flow switch when connecting for proper configuration later on. Polarity does not matter when wiring a flow switch.

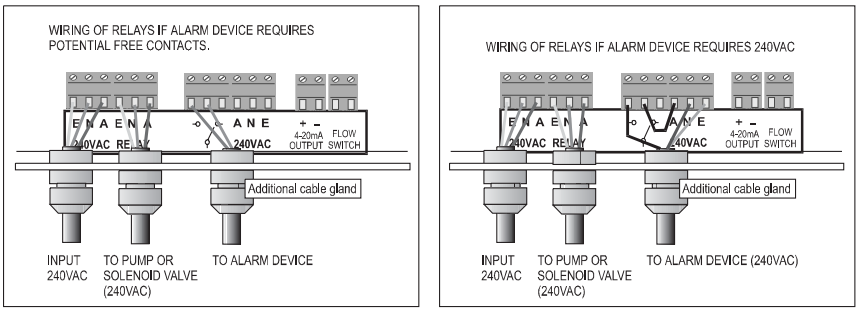

FIG 4 *Wiring examples for the relay outputs.*

☞ *The Set point relay terminals connect to earth, neutral and switched active 240V. (240VAC is supplied to these terminals when activated by the set point.)*

Signal output

The 4-20 mA signal current output can be used for event recording or to expand the control facilities for additional relay contacts. This output can be wired directly to a computer interface without causing earth loop problems. Correct polarity wiring is essential.

☞ *Correct polarity has to be observed when connecting the 4-20mA signal output.*

Installing the electrode

Select the appropriate position in the system for the electrode, and install the electrode so that it is vertical with the sensor tip facing down in the sample tee. Always install the sensor in a sample line that can be isolated, as the sensor has to be cleaned and checked regularly.

Special consideration must be given when placing an electrode in a treatment bath or pool. The point of injection of neutralising agent and placement of the electrode *(distance between them)* largely determines the dosing characteristics of the PMV-1.

Starting up the Instrument.

After you have installed the instrument and checked all the wiring and connections open the isolation valves to the sensor to allow water flow across it. Plug the power cord into the supply and switch on the PMV-1. The “RUN/CONFIG” LED will light up green and the digital display shows the measured input value.

CONFIGURATION

Looking at menus and values without changing or saving.

The PMV-1 is now in 'RUN' mode and processes the mV signal, output and alarm relays and the signal output. This condition is indicated with the green 'RUN/CONFIG' light. Turning the encoder knob has no effect.

Press the momentary switch. The LED changes to flashing red. Turn the knob clockwise. The LED changes to steady red and the display shows ***CnF***. Now press the momentary switch to move to the first configuration mode. The display shows ***UP***. Slowly rotate the knob to sweep through all the modes:

Dosing = ***UP***, Setpoint = ***500***, Dosing mode = ***no.d*** *(normal dosing)*

Low alarm mV = ***200***

High alarm mV = ***800***

Flow switch = ***OP*** *(normally open)*

4-20mA Signal = ***nor*** *(normal signal output)*

mV ***000*** = 4mA, mV ***1000*** = 20mA.

The corresponding LED light up for each of the above position to show which mode is indicated with the LCD display.

The next step shows ***End***, here you can exit back to 'RUN' by pressing the momentary switch or continue to step clock-wise or anti-clockwise to look at the configurations again. There is no need to exit manually as the PMV-1 automatically returns to 'RUN' after 2 minutes if left anywhere in the configuration or calibration menu.

☞ *The PMV-1 automatically returns to 'RUN' after 2 minutes if left anywhere in the configuration or calibration menu.*

If a program mode is entered inadvertantly by pressing the momentary switch simply press the switch again until the 'SAVE' LED flashes. The same mode or value is retained as was previously programmed.

Default values for the PMV-1 instrument

The PMV-1 is shipped with default values programmed in non-volatile memory.

Dosing = UP	***UP***
Setpoint = 500	***500***
Dosing Mode = normal dosing	***no.d***
Low Alarm mV = 200	***200***
High Alarm mV = 800	***800***
Flow Switch = Normally open	***OP***
4-20mA signal output mode = normal	***nor***
4mA = 000mV	***000***
20mA = 1000mV	***1000***

Of course all values can be customised through the configuration setup. Entered values are stored in non-volatile memory and are not lost through power failure.

Changing and Saving Values in Configuration.

This chapter only explains the different selections available and how to change modes or values. Look up "OPERATION" for more details of when to use different settings.

General:

Table 1 is an overall diagram of all the variables that can be changed in configuration. The LCD display shows a mode or value and the appropriate LED lights up to show the position presently showing. Pressing the momentary switch activates the encoder to change this value. This is indicated by the LED flashing. To save a change press the switch until the yellow "SAVE" LED flashes twice. The change is now saved in non-volatile memory and will be used by the PMV-1.

This manual from now on will say:

Pressing the momentary switch: **'PRESS'**

Pressing the momentary switch until the save LED flashes twice: **'SAVE'**

Clockwise direction of the encoder knob: **Rotate 'CW'**

Counter-clockwise direction of the encoder knob: **Rotate 'CCW''**

Either direction of the encoder: **"Rotate'**

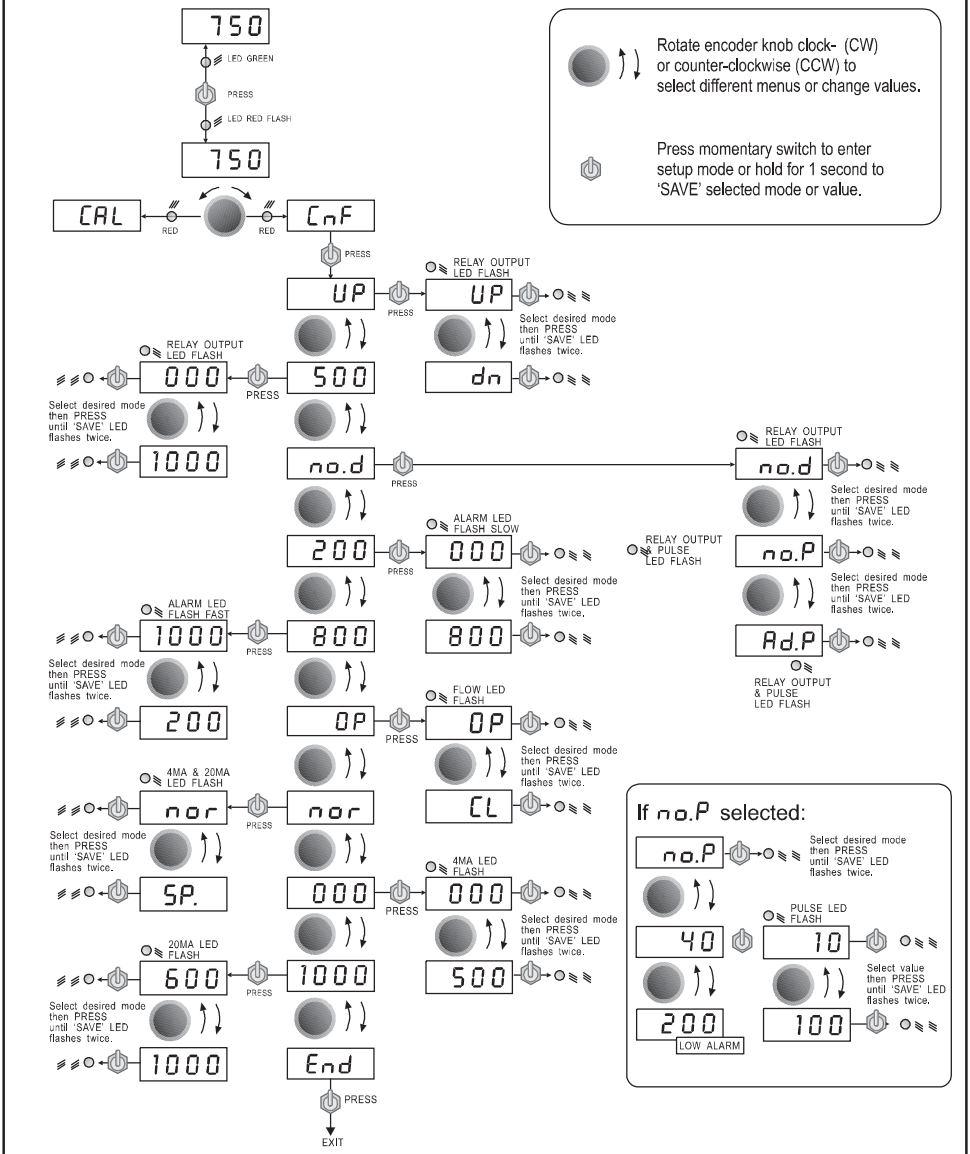

Table 1

CONFIGURATION DIAGRAM

When dialing up numbers such as a setpoint, the encoder steps in single digits if turned slowly. To change large numbers quickly rotate the encoder in a “flicking” manner.

☞ *To change large numbers quickly rotate the encoder in a “flicking” manner.*

Modes:

Dosing mode is selected for up [***UP***] or down [***dn***].
Setpoint is selected between ***000*** to ***1000*** mV.
Next select the relay output mode. There are three options.
Normal dosing [***no.d***], Normal Proportional dosing [***no.P***]
and Adaptive Proportional dosing [***Ad.P***]

Select a ‘gradient’ from 10 to 100 if ***no.P*** is selected. *(See Fig.6)*

A low and high mV alarm is set in the next menu. The alarm LED flashes slowly when dialing a low mV alarm, fast when dialing a high mV alarm. Low alarm range is from ***000*** to high mV alarm. High alarm range is from low mV alarm to ***1000*** mV.

☞ *A flashing LED indicates that a value can be modified in this position.*

Flowswitch configuration mode is selected for normally open [***OP***] or normally closed. [***CL***]

4-20mA output is configured for normal [***nor***] or setpoint [***SP.***] operation. The mV for 4mA and 20mA is selected with the next configuration. First the 4mA LED flashes to allow entering and ‘SAVE’ a mV for 4mA. Repeat this procedure for 20mA. 4mA range is from 000 to 500mV. 20mA range is from 600 to 1000 mV.

Only the 20mA slope is entered in mA Setpoint. Range for the mA slope is 50 to 500 mV. 4mA always is setpoint. It is important to note that dosing mode [***UP, dn***] is properly selected if ***SP.*** mode is used.

If additional changes are necessary rotate ‘CW’ or ‘CCW’ to return to any of the above mentioned options. Only a single configuration change can be made if necessary. There is no need to configure from beginning to end.

☞ *A single configuration change can be made if necessary. There is no need to configure from beginning to end.*

When all configurations are done step to the next menu [***End***] to exit. 'PRESS' returns to operating mode. The PMV-1 always returns to operating mode after 2 minutes if left in configuration or calibration mode.

The PMV-1 automatically returns to 'RUN' after 2 minutes if left anywhere in the configuration or calibration menu.

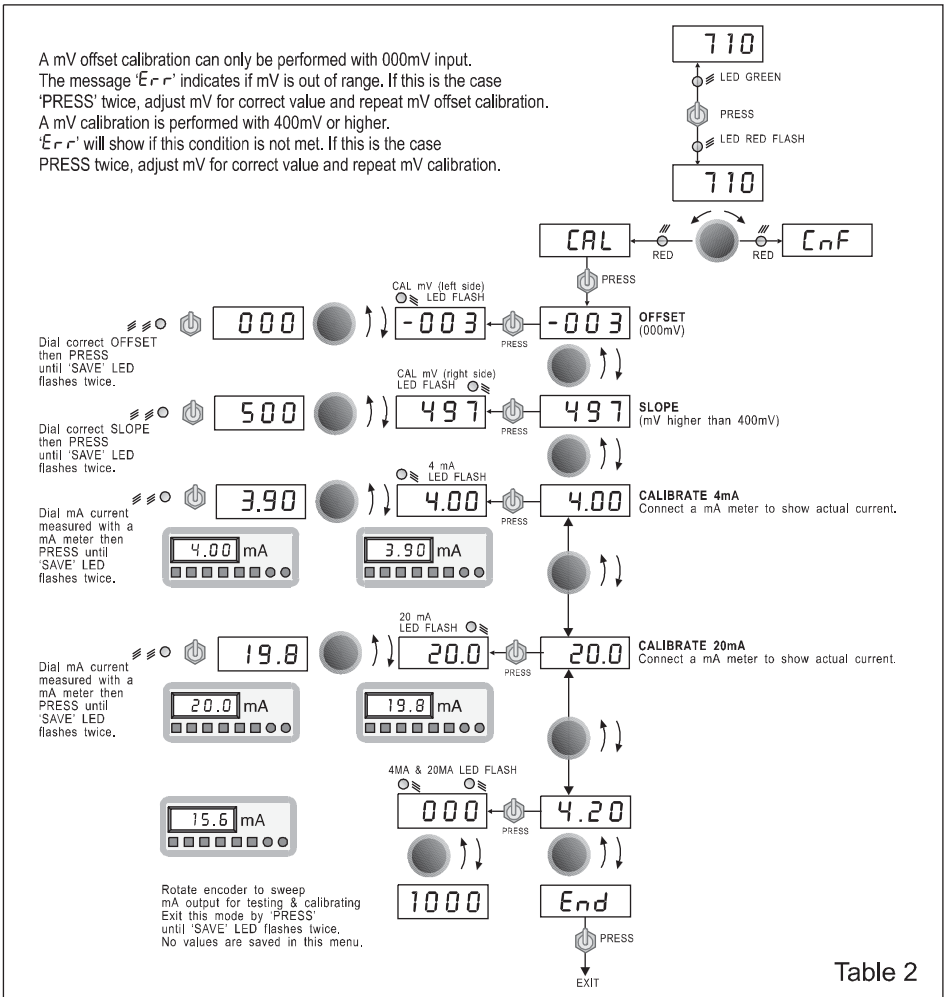

Table 2

CALIBRATION DIAGRAM

OPERATION

Initial check of the PMV-1.

After the instrument is properly installed, an ORP electrode or mV simulator connected and the power applied, the “RUN” LED will light up. The output relay may latch depending on the current mV measured. Sweeping across the range with a simulator will activate the relay and “RELAY OUTPUT” LED at some point, provided the mV value of the simulator is within the range of 0 - 1000 mV.

Calibrating the PMV-1.

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 very unusual to get wrong readings with redox electrodes when using redox buffer solutions. The use of redox buffers therefore is restricted to a simple function test of a redox electrode.

The mV offset and mV slope calibration modes of the PMV-1 are mainly used to correct minor instrument offset or gain errors of the input section.

mV offset calibrations should be carried out first, however mV offset and mV gain calibrations can be performed separately and need not be done consecutively.

Set the simulator to read 000mV *(no signal output).*

‘PRESS’ and ‘Rotate CCW’ to go to CAL. ‘PRESS’ turns on the CAL mV *(left side)* LED. ‘PRESS’ again, the LED now flashes and the display shows “live” mV input. ‘Rotate’ until 000 shows on the display and ‘SAVE’. mV offset is now calibrated.

Rotate ‘CCW’ goes to ***End*** then ‘PRESS’ to exit. Rotate ‘CW’ proceeds to the mV CAL *(gain)* calibration.

A mV gain calibration can only be performed with more than 400mV input. The display shows ***Err*** if a value outside these parameters is present. If this happens 'PRESS' two times, the display shows "live" mV to allow the operator to correct for a valid mV offset value. 'PRESS' now returns to the calibration menu to repeat the procedure.

☞ *Set the simulator mV output higher than 400mV.*

'PRESS' turns on the CAL mV *(right side)* LED. 'PRESS' again, the LED now flashes and the display shows "live" mV input. 'Rotate' until the correct mV value shows on the display and 'SAVE'. The mV reading of the PMV-1 is now accurate.

Rotate 'CCW' two times goes to ***End*** then 'PRESS' to exit. Rotate 'CW' proceeds to mA calibrations. *(See 4-20mA output)*

Selecting Mode of Operation.

Dosing

Adding chemicals such as chlorine or bromine to water encreases the mV reading. The PMV-1 has to stop the pump or valve at the mV entered for setpoint. The mV reading of the water to be treated therefore is below the desired mV value, (selected SET POINT) therefore dosing is set to ***UP***.

In a situation where the mV reading of the water is reduced the water to be treated is above the desired mV value, *(selected SET POINT)* therefore dosing is set to ***dn***.

Setpoint

Once input mV reaches selected setpoint mV the output relay switches off. A deadband of 15mV is used in normal mode. The relay output switches on again at 15mV above/below setpoint. *(depending on UP/dn mode)*

Dosing mode

In normal dosing mode [***no.d***] the output relay simply switches on and off below or above the setpoint. *(depending on UP/dn mode)*

In normal Proportional mode [***no.P***] the relay output starts to pulse on and off once the input mV moves toward the setpoint. The diffence of input mV versus setpoint mV is controlled by the amount of “gradient” set in the configuration program. The lowest setting of 10 starts the output relay pulsing if 240 mV below/above setpoint. The on/off ratio gradually reduces until the relay switches off at setpoint.

Setting the gradient to the maximum of 100 starts the output relay pulsing when 10 mV below/above setpoint giving a very steep gradient. The on/off ratio reduces very rapidly. *(See Fig.6)* for ‘gradient’ versus pulse output.

Up or down mode is possible with normal Proportional dosing.

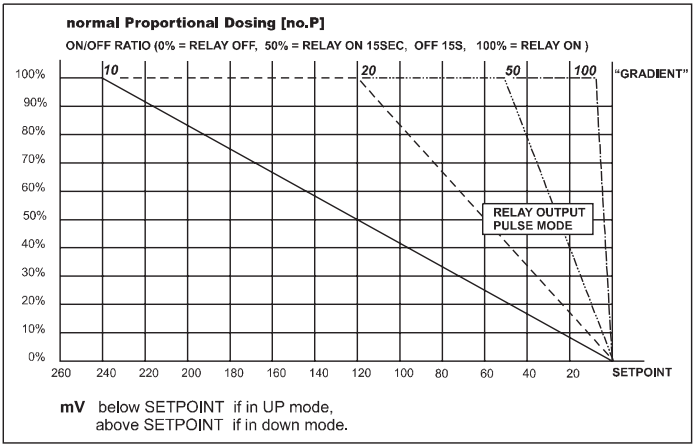

FIG 6 *Normal Proportional Dosing.*

In Adaptive Proportional mode [***Ad.P***] the relay output is controlled through a complex algorithm that continuously monitors the difference between actual mV and set point. The output starts to pulse and varies the ON/OFF cycle as the mV-input approaches the set point value. The ON/OFF cycle however is also adjusted from a ‘correction factor’, which

in turn is governed by the history of a previous dosing cycle. This makes for a fully dynamic dosing control, which adapts for widely varying conditions in a cooling tower or other plant installations.

Dosing for an excessive period of time without a corresponding movement in mV is recognized as a possible failure. The output begins to pulse, preventing overdosing.

The pulse output exhibits a very wide duty cycle. The ON and OFF times are both dynamic, varying from 1.5 to 30 seconds.

Up or down mode is possible with Adaptive Proportional dosing.

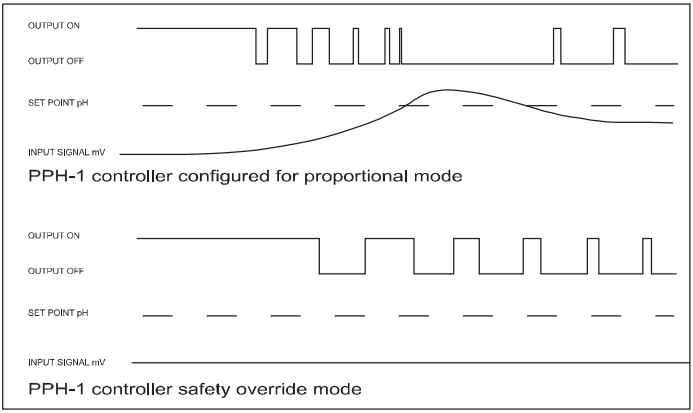

FIG 7 *Adaptive Proportional Dosing.*

The time taken for the PMV-1 to register the neutralising effect of the chemicals injected depends on the mixing and retention time of the plant installation. The distance between the injection point of neutralising agent and the electrode greatly effects the quantity released into the system.

Therefore which dosing mode to use largely depends on an installation and can possibly only be determined on site after some initial running of the plant.

Alarm

A second relay with potential free contacts controlled through configured low and high alarm mV points can be connected to an alarm device or use the potential free relay contacts for event monitoring or recording digital data into a central processor system. The relay can be used as a

second setpoint control output. The adjacent 240VAC terminal assists if a device requiring active, neutral and earth is wired to the alarm terminals. *(See Fig.4)*

Flow-switch

A flow-switch connected to the PMV-1 prevents dosing chemicals if for any reason the water flow has stopped. Two types of flow-switches exist: The term “normally open” is used if the contacts are open with flow and close if flow stops. Select OP mode if this type of switch is used.

The term “normally closed” is used if the contacts are closed with flow and open if flow stops. Select CL mode for this type of switch.

If it is not certain what type of switch is in the system operate the PMV-1 and configure for OP or CL until normal operation of the relay output is established with water flowing. If no water flows through the system the PMV-1 prevents the relay from switching and flashes the green LED.

4-20mA signal output.

The PMV-1 features two modes of operation for the 4-20mA signal output. In normal operation [***nor***] a “window” is configured by selecting a low mV for 4mA and a high mV for 20mA current. The 4mA point is selected between 000 and 500 mV. The 20mA point is selected between 600 and 1000 mV.

This shows that mV can be traced over the entire 1000mV range or as little as 100 mV. *(See Fig.8)*

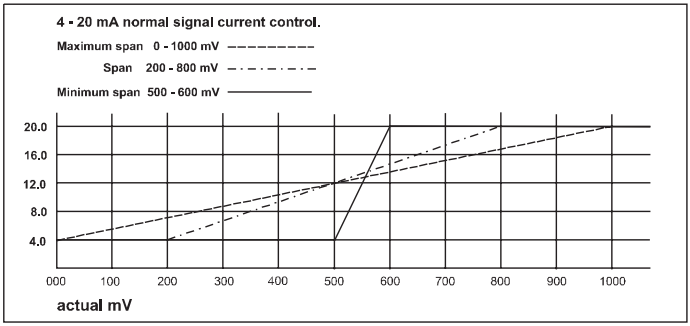

FIG 8 *4-20mA normal Signal current control.*

Choosing setpoint control [***SP.***] fixes the 4mA to the programmed setpoint. The signal current increases as the actual mV moves away from the setpoint. In ***UP*** mode the signal current increases as the mV falls below the setpoint. In ***dn*** mode the signal current increases as the mV rises above the setpoint. *(See Fig.9)*

The amount of current increase versus mV is governed by the programmed slope that can be selected from 50 to 500mV. *(Do not confuse the term "slope here with the slope calibration of mV).*

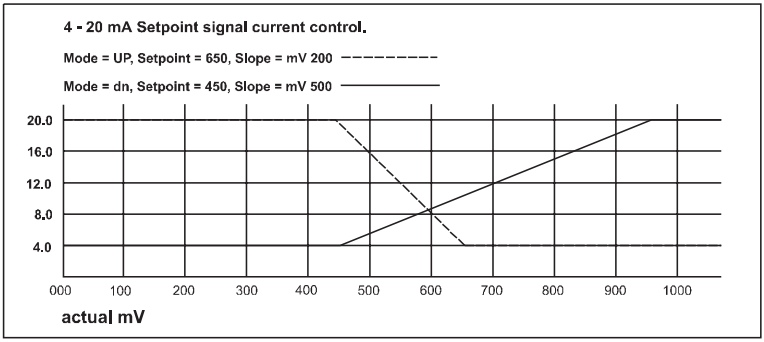

FIG 9 *4-20mA Setpoint Signal current control.*

Example:

Mode is ***UP***, setpoint is 650 m and mA slope is set at 200 mV.

Signal current output is 20mA as long as the mV is below 450 mV, starts to decrease as the mV moves to 950 at which point signal current is 4mA.

Calibrating 4mA and 20mA with a multimeter.

A real current calibration is carried out by connecting the multi meter across the terminals *(no termination resistor is required)* to measure the mA current.

The meter can also be connected in series in an already existing installation. *(See Fig.10)*

Enter calibration [***CAL***] and 'Rotate' until the 4mA LED lights up. 'PRESS' to enter 4mA calibration. The display shows 4.00. Dial the measured mA with 'Rotate'. 'SAVE' and the actual current is corrected to

4.00mA. Move to 20mA and proceed the same way. If a calibration is not exactly accurate the first time simply repeat the procedure until the current output reads correctly.

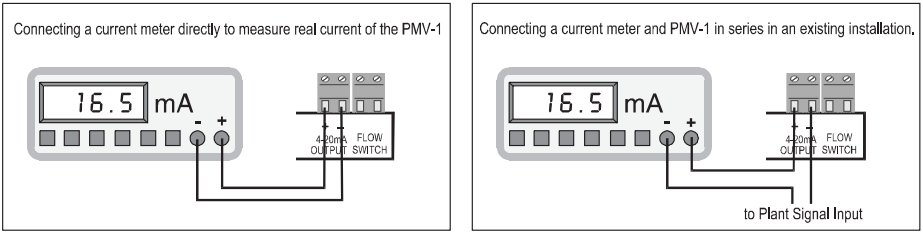

FIG 10 *Calibrating 4-20mA with a multimeter.*

Using the PMV-1 as a 4-20mA Simulator

Entering 4.20 mode enables the operator to sweep the 4 to 20mA signal current for testing, setting up or calibrating an installation for accurate and correct performance between signal output and connected appliance or computer interface.

4.20 mode is only a utility program to assist for testing and no modes or values are changed or saved when using or exiting this mode.

The current output is controlled by rotating the encoder within the range as configured in the 4mA and 20mA setup.

The displayed mV generates exactly the same mA signal current as the mV input in 'RUN' mode. When finished with the simulator mode exit with 'SAVE'.

☞ *No modes or values are changed or saved when using 4.20 mode.*

Options:

Turn-Lock Fasteners for speedy and convenient screw fixing aid.
(No screwdriver required to fasten lid.)

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

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.

- PMV-1 SERIAL No.