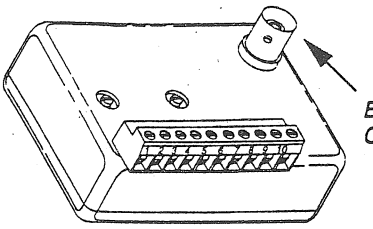
Preamp Application Guide

Preamp Model

PHMA



Compatible Instruments

The PHMA is a differential input pH 2-Wire transmitter. It can interface with many display and control devices requiring a 4-20mA input.

Temp. Comp. Notes

Auto TC is available in the preamp, using a 3KΩ @ 25°C BALCO element.

Power

12V to 36V DC, Single Supply, Current >25mA

Gain

ZERO and SPAN adjust.

Output

4-20mA, representing 0-14 pH or down to any 2 pH portion of that range, or ORP spans of ±20mV to ±2V.

Preamp Terminals

1 — (+) 4-20mA Output Signal. Connect the load device to this terminal. Do not connect the power source directly here.
2 — (–) 4-20mA Output Signal. This terminal MUST be connected directly to the negative side of the DC power source.
5 — 3K TC (For ORP ranges, put a fixed resistor of 1KΩ to 18KΩ between 5 and 6 to achieve desired range.)
6 — 3K TC
7 — Solution Ground
10 — BNC Connector (Reference)

OPERATING NOTES

(1) The unit ships with a 3.01KΩ resistor between terminals 5 and 6. If an auto TC is used (3KΩ @25°C BALCO element only) then the resistor must be removed and the BALCO element connected in its place.

(2) When used in the differential input mode, the jumper wire between terminals 7 and 10 must be removed and a lead run from 7 to a metal contact in the stream within 12 inches of the pH electrode. This metal piece is called a "solution ground". When it is used, the pH glass and reference cell potentials are individually compared to the potential of the solution ground electrode and these two values are then subtracted to give the pH potential. The advantage of this approach is that the reference cell is connected to the high impedance input of an amplifier, isolating it from ground loop currents. Ground loops occur when earth ground is connected to some part of the signal loop. If the reference cell is connected to DC common when this happens, a current will flow from the unwanted earth connection, through the reference, to the earth ground contacts in the sample stream. Because the reference cell has electrical resistance, the ground loop current will produce an error voltage across it that is added directly to the pH signal.

(3) Wire the unit exactly as shown on the label. It is particularly important to connect the negative side of the DC power source directly to preamp terminal 2.

(4) Internal protective resistors will prevent circuit damage from temporary reversed polarity of the power connections. Leaving the preamp in this condition for longer than 5 minutes will cause the resistor to overheat and probably open.

(5) The amplifier has a stiff filter stage which eliminates practically all noise spikes, but it also slows response so that the full effect of a step change in pH value will not be seen for 45 seconds. To reduce or eliminate this feature, remove the bottom cover of the amp and remove one or both of the capacitors from their sockets. Substituting smaller values for the caps will reduce the amount of filtration.

CALIBRATION PROCEDURE FOR PHMA, 0-14pH = 4-20mA

EQUIPMENT NEEDED: Millivolt source or working electrode, milliammeter, screwdriver.

NOTE: Standard PHMA polarity is designed for pH applications. Thus, a negative going voltage input (increasing pH) will cause the milliamp output to increase. 20mA will always represent a higher pH value than 4mA, and it cannot be set the other way.

(1) Connect a millivolt signal representing 0pH (+414mV) to the BNC connector on the PHMA. If using an actual pH electrode, place it in the lowest value buffer you have. (Pins 7 and 10 on the PHMA must be jumpered, or a wire run from pin 7 into the beaker with the buffer and pH electrode.

(2) Turn SPAN fully CCW (it is a 22 turn pot, so turn CCW until you hear a faint click, then turn it back CW 2 turns). Now adjust ZERO control for 4.0mA out.

(3) Change the millivolt input to 14pH (-414mV), or place the electrode in the highest value buffer you have.

(4) Adjust SPAN control for the proper reading. In the case of a millivolt input of 14pH (-414mV), this would be 20.0mA. For a pH electrode in buffer, you must calculate the millivolt value as shown in the table below.

EXAMPLE: Assume the first buffer value is 4, and the second is 10. You would set the output to 4.0mA in the 4 buffer, then put the electrode in 10 buffer. The difference between 4 and 10 buffers is 6 pH units, so find the value for 6 pH in the table below, and adjust SPAN to obtain that output, which is 10.86mA.

(5) Check the output again at the high and low values, fine-tuning ZERO and SPAN as required. This normally takes no more than two steps. If you are using a millivolt source, the calibration is complete.

(6) If you are using buffers, SPAN is now set, but ZERO must be finalized. To do this, set the ZERO control to obtain the milliamp value for the buffer the electrode is in. For example, if the electrode is still in 10 buffer, set the output to 15.43mA.

NOTE: To align for spans smaller than 0-14pH use essentially the same procedure as outlined above. Be sure to set the output for 4.0mA for the lowest value buffer. Then calculate the required milliamp span for the next highest buffer and adjust SPAN for the proper milliamp spread. Finally, adjust ZERO for the correct milliamp value for the buffer being read. Example - Assume you wish to have the 4-20mA output correspond to a range of 7 to 10 pH and the buffer values available are 4 and 7. Adjust the output for 4.0mA in the 4 buffer. Next, go to the 7 buffer. Since the full scale span you want is 3 pH units, set SPAN for 20.0mA out. Finally, with the electrode still in the 7 buffer, set ZERO for 4.0mA out. Calibration is now complete. Note that at least one buffer value must fall inside or at the end of your range of interest.

0 pH = 4.00 mA
1 pH = 5.14 mA
2 pH = 6.29 mA
3 pH = 7.43 mA
4 pH = 8.57 mA
5 pH = 9.71 mA
6 pH = 10.86 mA
7 pH = 12.00 mA
8 pH = 13.14 mA
9 pH = 14.29 mA
10 pH = 15.43 mA
11 pH = 16.57 mA
12 pH = 17.71 mA
13 pH = 18.86 mA
14 pH = 20.00 mA

At 25°C, a change of 1 pH will produce a voltage change at the electrode of 59.16mV. The voltage at 7 pH is zero millivolts. Voltage output goes positive below 7.0 pH, and negative above that value. Above 25°C, the voltage at the electrode increases 0.1984mV per °C per pH away from 7.0, and it decreases by the same amount below 25°C.

NOTES UNLESS OTHERWISE SPECIFIED:

DRAWN 9/9/95	TITLE		
CHECKED	**PHMA CALIBRATION, 0-14pH**		
APPROVED	SCALE	DRAWING NO.	REV.
	SHEET		

IMPORTANT OPERATING FEATURES

POWER & LOAD CONNECTIONS - The PHMA must be connected exactly as shown on the wiring label next to the terminal strip. The negative side of the power supply must tie directly to terminal 2. Connecting the load device to terminal 2 first may create a common mode voltage offset large enough to damage the input stages.

PLC's & COMPUTERS - It is common to see earth ground connected to some part of the input stage of digital devices. If this is the case, SOLUTION GROUND must be used or unstable readings will result. See next note.

SOLUTION GROUND - This refers to a third electrode, plain metal, somewhere in the stream within about a foot of the electrode, and connected to terminal 7 of the preamp. Make sure there is no jumper between 7 and 10 when using solution ground. Conversely, there must be a jumper there if you are not using solution ground. When using solution ground, the glass and reference cell both are electronically isolated from any earth ground paths that might exist in the signal receiver or wiring. The solution ground electrode must be included in any buffer tests conducted in beakers (a wire connected to 7 and dangled in the beaker will do). Alternatively, connect a jumper from terminal 7 to 10 to enable beaker tests without the need for a solution ground electrode. When in doubt about whether or not there is an earth ground connection in the system, use solution ground to be on the safe side.

DC FILTRATION - The PHMA contains a powerful electronic filter stage which eliminates AC noise signals. This causes the reading to change very slowly (up to one minute required to see fulleffect of step change). To speed up response for calibration, or operation in quiet systems, the filter can be eliminated or retuned. Remove the 4 screws holding the bottom cover in place and note the two capacitors plugged into small gold sockets. Removing these capacitors will give near instantaneous response, with no appreciable rejection of noise spikes. Replacing them with smaller values will increase speed of response at the expense of noise rejection. Most pH preamps do not have noise rejection filters, so it is acceptable to remove the caps entirely in many cases.

PLC COMMON TERMINALS - On some of these devices, one side of the input signals will allbe tied together. If this is the negative side, no problem. If it is the positive side of the signal, however, then multiple PHMA's cannot be used, since their signals are already tied together on the negative sides by virtue of the fact that terminal 2 of each PHMA is tied to the negative side of the power supply. Tying all the positive sides together would then produce an average of all the PHMA signals. If the positive commonality at the PLC inputs cannot be removed, then a loop-powered isolator module may be required for each signal. Consult factory if you are having problems of this sort.

NOTES UNLESS OTHERWISE SPECIFIED:

DRAWN 9/9/95	TITLE **PHMA OPERATING NOTES**		
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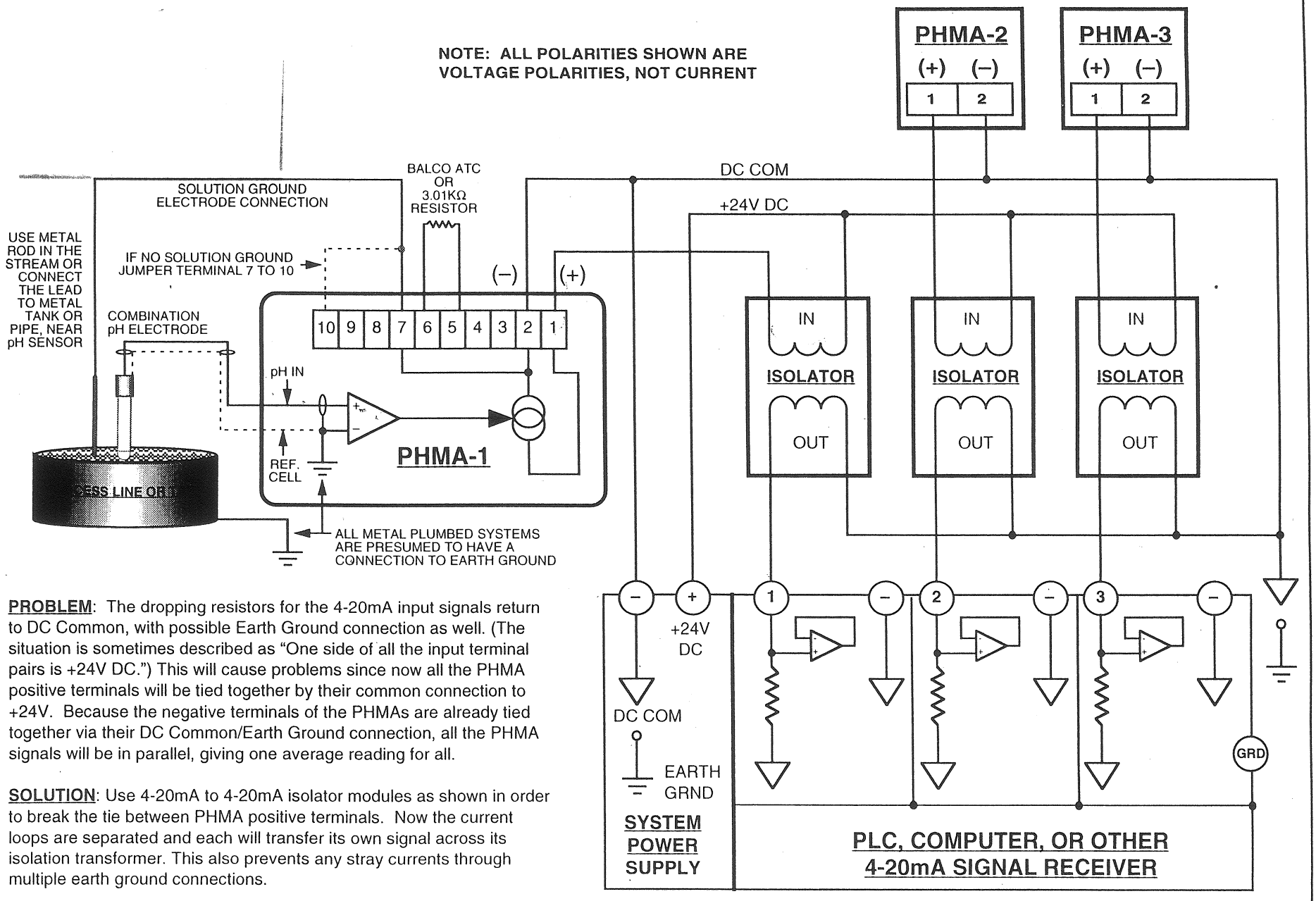


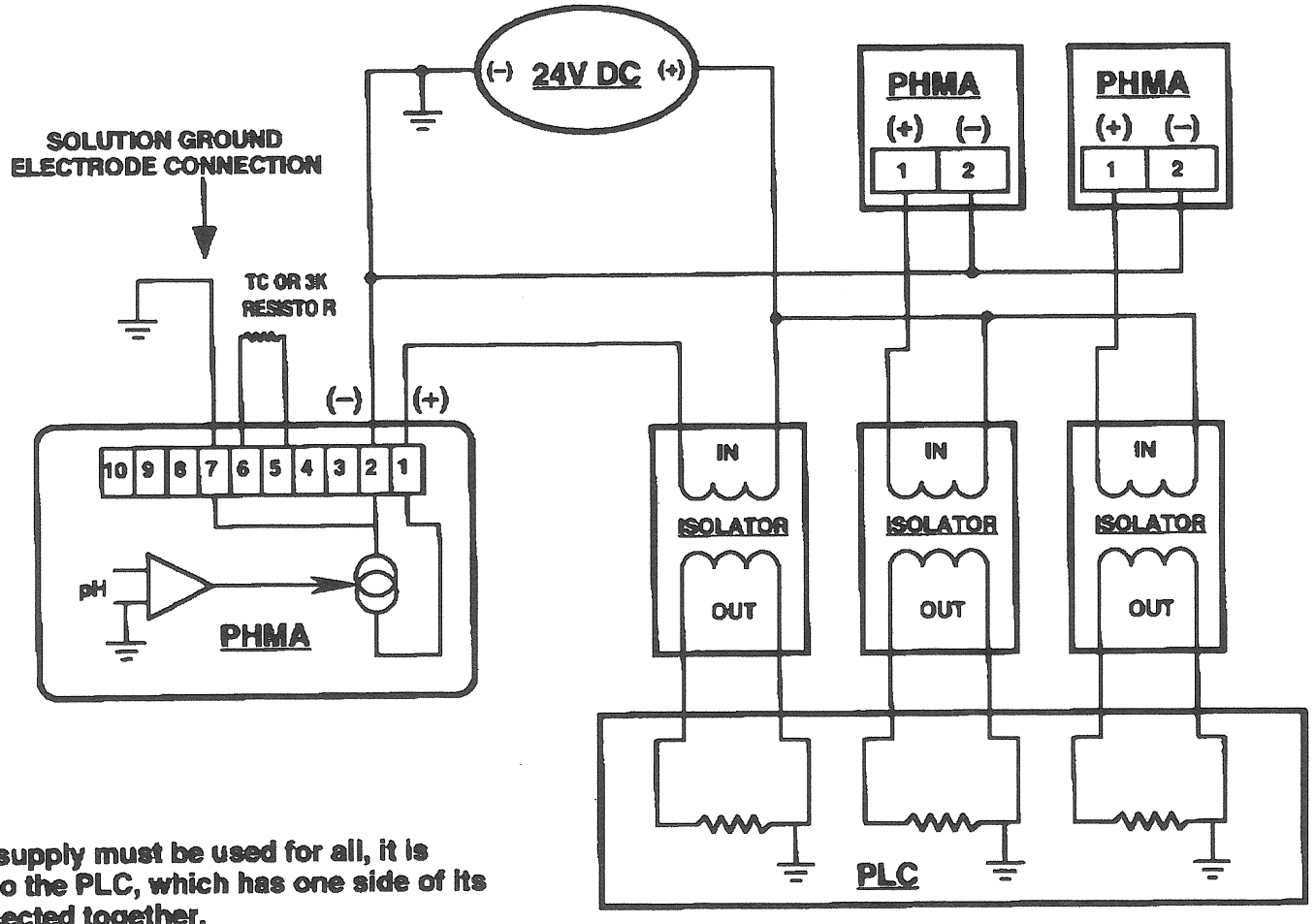
PROBLEM: The dropping resistors for the 4-20mA input signals return to DC Common, with possible Earth Ground connection as well. (The situation is sometimes described as "One side of all the input terminal pairs is +24V DC.") This will cause problems since now all the PHMA positive terminals will be tied together by their common connection to +24V. Because the negative terminals of the PHMAs are already tied together via their DC Common/Earth Ground connection, all the PHMA signals will be in parallel, giving one average reading for all.

SOLUTION: Use 4-20mA to 4-20mA isolator modules as shown in order to break the tie between PHMA positive terminals. Now the current loops are separated and each will transfer its own signal across its isolation transformer. This also prevents any stray currents through multiple earth ground connections.

WHEN EARTH GROUND IS TIED TO DC COMMON, YOU MUST USE SOLUTION GROUND TO PREVENT GROUND LOOP ERRORS!

WIRING A PHMA WITH A GROUNDED POWER SUPPLY

4/25/97



4-20mA SIGNAL RECEIVER -- MAY BE A PLC, COMPUTER, RECORDER OR OTHE R

SITUATION:

One power supply must be used for all, it is connected to the PLC, which has one side of its inputs connected together.

SOLUTION:

Connect as shown, using ordinary isolator modules and power supply on preamp side. Use solution ground if power supply is grounded, as shown.