PHCN-962
pH/ORP Controller
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It is the policy of OMEGA Engineering, Inc. to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

WARNING: These products are not designed for use in, and should not be used for, human applications.
Preface

This manual serves to explain the use of PHCN-962 series controller / transmitter. This instruction manual is written to cover as many anticipated applications of PHCN-962 series controller / transmitter.

The information presented in this manual is subject to change without notice as improvements are made, and does not represent a commitment of part of OMEGA ENGINEERING. OMEGA ENGINEERING can not accept any responsibility for damage or malfunction of the unit due to improper use of the instrument.

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SAFETY INFORMATION

OMEGA ENGINEERING. Controller / Transmitter shall be installed and operated only in the manner specified in the Instruction manual. Only skilled, trained or authorized person should carry out installation, setup and operation of the instrument.

Before powering up the unit, make sure that power source is connected to, is as specified in the top label. Failure to do so may result in a permanent damage to the unit.

⚠️ Proteet level against electric shock mainly depends on relevan installation rules.
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BEFORE USE

Thank you for using OMEGA ENGINEERING. PHCN-962 series controllers and transmitters.

Although this series of pH/ORP controllers / transmitters use advanced technology and meet the requirements of current safety rules, improper use can also threaten the safety of users, and / or cause harmful influences to factory and other equipments. Therefore, before using pH/ORP controllers / transmitters, relevant person must read and understand contents of this instruction manual.

Following symbols used in this instruction manual are to mark safety instruction and appendix information:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Warning Symbol" /></td>
<td>This symbol means contents and safety instructions and warning of potential dangerous. If they are neglected, person may be hunted and property may be damaged.</td>
</tr>
<tr>
<td><img src="image" alt="Pointer Symbol" /></td>
<td>This symbol means the contents are appendix information. If they are neglected, it will cause low efficient and even losing products.</td>
</tr>
</tbody>
</table>

Instruction manual should be kept accessible within the person who use pH/ORP controllers / transmitters.

If you have problems, which are not mentioned or cannot be explained in this manual, please contact with your suppliers. They will be very glad to help you.

IN USE

OMEGA ENGINEERING. pH/ORP controllers / transmitters, as described instruction manual, are intended to separate pH or ORP and temperature measurement.

Any other uses, or other unmentioned use in instruction manual, are not acceptable when they contradict the technical parameters.

Other conditions of right use include:

- Notice remarks and requirements stated in instruction manual.
- Notice local safety regulations about safe operation.
- Notice information and warning of products that are used together with the transmitters in the contract. (Chassis, electrode, etc.)
- Notice required using environment and working condition.
**SAFETY INSTRUCTION**

<table>
<thead>
<tr>
<th>pH / ORP transmitters should be installed and operated by qualified person who are familiar with the work.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitters with problems should not be installed and used.</td>
</tr>
<tr>
<td>pH / ORP transmitters should be used under the required working condition.</td>
</tr>
<tr>
<td>pH / ORP transmitters should be open and repaired by clients them selves.</td>
</tr>
<tr>
<td>Mollified pH / ORP transmitters should not be used. Producers and suppliers do not bear responsibility for the damage and lose caused by modifying instruments without permission. Clients should bear all the risks.</td>
</tr>
</tbody>
</table>

This instrument has a protection level of IP65. Please use waterproof cable glands when you connect the line. Also, please loose it when you open the cover. After connecting the line, please tighten the cable conductor according to the above table 3 with attached tie line, or it will cause danger because cable conductor or interface falls off when open the cover.

⚠️ Please make sure to cut the power when you open the cover to carry through any operation.
2 PRODUCT DESCRIPTION

2.1 DESCRIPTION OF INSTRUMENT SPECIALITY:

OMEGA ENGINEERING. pH / ORP transmitters are used to measure pH or ORP and temperature value. pH or ORP measured value can use PLC or LIT to control precisely adding medicine.

This kind of transmitters has two versions: one is installing way and the other is wall hanging installing way. Transmitters can be used as monitor in water treatment, in electrolytic water cleaning, in process of chemical industry, in food process, in cleaning water or wastewater treatment and in neutralization process.

This transmitter has many user-friendly and safety features which include:

- Menu-driven programs that easy to set-up.
- Strong interference protected design can be used in strong.
- IP65 all-day water and air proofing can be used in any adverse circumstances.
- Built-in memory backup to ensure that setup parameter and calibration information are not erased if power off or power off in abnormal condition.
- Can separately set process temperature (TST1) and Calibration temperature (TST2) by manual operation. Without doing trivial manual temperature setting. If the temperature sensor fails. Under automatic temperature compensation mode, instrument will automatically switch to process temperature (TST1) of manual temperature compensation to compensate. This can ensure that the instrument can be working normally. Please refer to procedures of Item 5.1.
- pH measured value can make offset adjustment (adjusting scope ±2PH) so that users can calibrate online. Please refer to procedures of Item5.2.
- Various choice of electric current output. 0/4-20mA Output scope can be set. (Over / pH). Please refer to procedures of Item5.3.
- Two routes of relay contacts, users can choose high-low meta control independently and freely.
- Separately adjustable high and low set point hysteresis (dead bands) prevent oscillating of relays around the set points.
- Various adding-medicine control mode, users can choose precise adding-medicine (PLC) and LIT. Two groups of relays can switch high-low point control freely. Please refer to procedures of Item 5.4.
- Two kinds of electrode input, users can choose balanced input and imbalanced input. Users can choose balanced input mode under the strong interference industrial situation. Please refer to procedures of Page 17.
- Large dual display LCD for easy reading with clear multiple annunciators, alarm status and operational message annunciators. Long-life micro-switch key can set easily.
- Can set time of instrument and electrode to reduce person management. Instrument will automatically appear “CAL” at regular time to call person to make calibration and maintain once. Please refer to procedures of Item 5.7.
- Automatically clean relay design. Users can set cleaning time and install cleaning equipment by themselves. Please refer to procedures of Item 5.7.
• Glass electrode and Metal antimony electrode can be chosen and be used under different industrial situation and HF measurement situation. Please refer to procedures of Item 5.8.
• During calibrating and setting, hold function freezes output current (0/4 20ma) and releases control relays.
• LED indicators signal control activities to monitor controller status from a distance.
• Ultraviolet rays proofing, LCE of blue back light (LCD=liquid crystal display)
• RS-485 output can set tandem transmitting rate and ID NO. by itself. Maximum 100 instruments can be connected with computer to provide convenience management for terminating machine.

2.2 MEASUREMENT AND CONTROL SYSTEM

Typical measurement system includes:
• pH/ORP on-line transmitter
• United or separated temperature sensing instrument Pt1000 of pH/ORP compound electrode.
• Suitable pH/ORP measurement electric cable.
• Immersion, flow or processing parts with or without grounding electrode.
• Terminating controlling parts, eg. Pump or value.
• 0/4~20mA can connect with recording instrument.
• RS485 can be used as multi-instrument communication.
• RL3 relay can be used as many controller and warning.
2.3 APPEARANCE

PHCN-962 Wall hanging installation
2.3.1 INTRODUCTION OF DISPLAY

Two liquid crystal regions show measured value and indication and parameters of various status.

Mode Indication:
- **MEA**: measurement mode
- **SET**: set-up mode
- **CAL**: calibration mode

Status Indication:
- **HOLD**: relay actions and electric current output are hold.
- **ATC**: automatic temperature compensation indication, manual temperature compensation is not displayed.
- **ERR**: error or warning indication
2.3.2 KEY INSTRUCTION

<table>
<thead>
<tr>
<th>KEY</th>
<th>Description</th>
</tr>
</thead>
</table>
| Mode switch key or quit key | • Confirm key  
• Entering sub-function form of function group in setting mode  
• Confirm setting parameter and value  
• Starting calibrating in calibration mode  
• Back light on and off switch in measurement mode |
| Choose function group in setting mode  
Set parameter and value  
(If hold on pressing, value changing will be quicker.) |

2.3.3 LED Induction

Relay Induction

SP1\SP2 LED show relevant working status of relays.

SP1\SP2LED light-on shows that relays are under working status.

2.3.4 Password

When entering calibration mode and setting mode, there are passwords. Passwords are set by factory and users can not modify them by themselves. Followings are those passwords:

<table>
<thead>
<tr>
<th>Password</th>
<th>Mode / Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>028</td>
<td>Calibration Mode</td>
</tr>
<tr>
<td>058</td>
<td>Set-up Mode</td>
</tr>
</tbody>
</table>
2.3.5 PREVIEW OF FUNCTION

Diagram showing the setup options:
- P01: TEMP SETUP
- P02: OFFSET SETUP
- P03: OUTPUT CURRENT SETUP
- P04: CONTROL MODE
- P05: RELAY1 SETUP
- P06: RELAY2 SETUP
- P07: ALARM RELAY SETUP
- P08: CONFIG SETUP
- P09: RS-485 SETUP
- P10: RESET SETUP
3 INSTALLATION AND ACCESSORY

INSTALLATION

Wall-hanging installation

113mm
122mm
151mm

(4.449)
(4.803)
(5.945)

213mm (8.386)
185mm (7.28)

151mm (5.945)

122mm (4.803)
**PHCN-962 series connection diagram**

**Warning:** Make sure to power off before connecting. The back panel consists of three connectors.

1. Temperature electrode positive terminal (PT1000)
2. Temperature electrode negative terminal (PT1000)
3. Temperature electrode sensing terminal (If use two-wire system, please use short circuit between 2 and 3).
4. COM (short circuit with 5 under normal status)
5. pH negative terminal
6. REF
7. pH value 4 — 20mA Output, negative terminal
8. pH value 4 — 20mA Output, positive terminal
9. 485A output
10. 485B output
11. Relay A (SP1)
12. Relay A (SP1)
13. Relay B (SP2)
14. Relay B (SP2)
15. Clearing Relay
16. Clearing Relay
17. Connect bigger earth wire
18. Alternating connect earth wire
19. Electric source input 110V/220V alternating current
MEASUREMENT MODE

When the controller is initially powered on, it automatically enters into the Measurement mode after the large dual LCD displays all segments briefly.

**Please notice:** in order to get exact measurement information, users should calibrate measurement system (transmitter and electrode).

MEA at the top of the LCD shows that the instrument is under the status of measuring. The upper display shows pH or ORP value, while the lower display shows temperature value under pH measurement mode of ORP under ORP measurement mode. Annunciator at the left lower side of the display show the value of transmitting output electric circuit, which as the way that users calibrate the output electric circuit.

Such annunciators or icons, as pH, mV, %, at the right side of the display show the current different measurement mode of transmitters.

In measurement mode, you can press \( \text{key} \) once or twice to enter into the function form of calibration or set password input.
Then input relevant password to enter into calibration mode or set up mode. Please refer to Item 3(Calibration Mode) or Item 4 (set up mode).

Press \( \text{key} \) under measurement mode, you can open or close back light of LCD.
4 CALIBRATION MODE

You can press 🔒 once under measurement mode and then input password 28 to get access to calibration mode. Please operate according to following squares.

4.1 ENTERING CALIBRATION MODE

1. Press 🔒 once under measurement mode and enter into function form for password input of calibration mode.

2. After entering function form of calibration password input, LCD will ask you to input password. Press ▲ or ▼ to input calibration password 28, then press ENTER to confirm the password.

3. Press ENTER to enter into calibration sub function form, if instrument is set up as pH measurement mode, lower display will show CAL pH. If instrument is set up as ORP measurement mode, lower display will show CAL ORP. If you want to calibrate, please refer to relevant items.(please refer to upper pictures).

NOTE: Anytime press 🔒 to quit calibration mode and return to upper function. If return to measurement mode, old calibration information will be kept and used. After returning to measurement mode, password will automatically set up form 28 to 000 when entering calibration mode.
4.2 pH CALIBRATION

This instrument can conduct one point or two points calibration in pre-set standard buffer liquid. The value of standard buffer solution is based on 25°C. You should use those standard buffer solution which matches above solution when you calibrate the instrument.

1. Entering calibration mode as Item 4.1 described. LCD will show CAL pH. (pH Calibration mode). 
   **Note:** If LCD shows CAL ORP, please switch pH and ORP measurement mode according to the procedures of Item 5.8.

2. Press key to enter into calibration, LCD will show slope and function form. The lower display will show ELE K=59.2, this function form shows the slope of last calibration. The upper display will show CAL and the main display zone will show SLOP. Press key to enter into calibration procedures, LCD main display zone will show actual measured value, the right lower display will show the value of standard solution which should be calibrated.

3. Put electrode into the first standard buffer solution. You should put temperature electrode into the same solution under the automatic temperature compensation mode. As the same, you should put liquid earth wire electrode into the solution at the same time in balanced input mode.

4. You can select one point calibration or two point calibration: Press key to calibrate at 6.86 or 7.00pH. The lower display shows BUFF 6.86(7.00) to tell user the standard solution value under current calibrating. BUFF will blink when calibrating. During calibrating process, instrument will automatically distinguish signals which electrode input. If the signal input in required time is stable and in the slope permit range of the formality, the instrument will regard the calibration as a legal calibration, it will record and modify the zero point information of the electrode. The lower display will show BUFF 1.68 to tell the standard solution value the second point of calibration. Users can press or key to select relevant calibration solution. (USA 1.68>4.01>10.01>12.45) (NST 1.68>4.01>9.18>12.45).
Press twice to quit one-point calibration and return to measuring status. Press to continue next point calibration.

Take electrode out of the first standard solution, clean it and put it into the second standard solution.

5. If select one point calibration, instrument will show the slope, but zero point adopts new calibration value while the slope remains the value of last calibration. If select two point calibration, the lower display will show the next value of standard buffer solution. Use or key to selects the second standard buffer solution from the pre-set standard buffer solution. Take electrode out of the first standard solution, clean it and put it into the second standard solution. Press key, BUFF will blink. Instrument will modify the indication to the value of standard solution.

6. After finish the second calibration of standard buffer solution, instrument will automatically show SLOP on LCD main display zone. The right lower display shows the slope of electrode. Parameter of zero point and slope will be renewed after each calibration.
<table>
<thead>
<tr>
<th>NOTE: Press key to quit set up mode at any time. Instrument will return to measurement mode automatically.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NOTE: Transmitter will show <strong>ERR</strong> when calibration is error. Under this situation, press key to quit and calibrate again from step 1. It will show ERR again under following situations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Use wrong standard solution or standard solution is expired.</td>
</tr>
<tr>
<td>(2) Electrode is aging or not clean or bubble is broken.</td>
</tr>
<tr>
<td>(3) Electrode wire is broken or leakage because of joint corrosion.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTE: When calibrating under manual temperature compensation, transmitter will automatically switch to calibration temperature from pre-set measurement temperature. When leaving calibration mode, transmitter will switch to measurement temperature again. (Please refer to Item 5.2 for setting measurement temperature and calibration temperature)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NOTE: ELE K=59.1 presents the conversation coefficient 59.1mV/pH of pH electrode, which means each pH is converted by 59.1mV electric potential.</th>
</tr>
</thead>
<tbody>
<tr>
<td>For example: when slope is 90%, the conversation coefficient is 59.1 * 90%=53.19.</td>
</tr>
<tr>
<td>When the conversation coefficient is lower than 45mV, which is equal to 75%, users should change electrode. Instrument will show ERR automatically when the conversation coefficient is lower than 40mV, which is equal to 67% slope.</td>
</tr>
</tbody>
</table>
4.3 ORP CALIBRATION

If transmitter be set up as ORP measurement mode. You can only calibrate one point.

1. Entering calibration mode described as Item 4.1. LCD will show CAL ORP.

   NOTE: If LCD shows CAL pH. Please switch to ORP mode from pH mode according to procedures of Item 5.8.

2. Put ORP electrode into ORP standard solution (86mV).

3. Press key to begin calibrating. mV value displayed is the mV value output by ORP electrode. There is no offset value. The lower display will show U and blink. If one point calibration is finished, then, the lower display shows 255mv to tell user to change standard solution.

4. Clean electrode and put it into relevant standard solution. Press key to confirm. Instrument enters into calibration status. After calibrating, instrument automatically returns to slope display function form. Press to return to measurement mode and finish calibration process.
5 SET UP MODE

ENTERING SET UP MODE

In set up mode, transmitter can be set up according to your need.

1. Press \( \text{TSET} \) twice in measurement mode.

2. LCD ask you to input password. Use \( \text{UP} \) or \( \text{DOWN} \) to input the password.
   – Input 058 to change parameter.

3. Press \( \text{SELECT} \) to confirm.

\[ \text{NOTE} : \text{Press} \ \text{TSET} \ 	ext{twice to quit set up mode at anytime. Instrument will return to measurement mode automatically.} \]
## 5.1 P01: TEMPERATURE SET-UP SUB-FUNCTION

<table>
<thead>
<tr>
<th>Function Description</th>
<th>Screen Screenshot</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Press ( \square ) to enter from P01 screen. LCD main display zone show ON, which means automatic temperature compensation function, is open. User can press ( \uparrow ) or ( \downarrow ) to switch to OFF and close automatic temperature compensation function.</td>
<td>![Screen Screenshot]</td>
<td></td>
</tr>
<tr>
<td>2. Press ( \square ) when automatic temperature compensation function is open, instrument enters into modifying status of temperature measurement value. LCD main display zone show current measurement value of temperature. The lower display TOFS tell users that they can use ( \uparrow ) or ( \downarrow ) to modify current temperature display value. Press ( \square ) to confirm and return to P01 Sub-function form. Use ( \uparrow ) or ( \downarrow ) to select other sub functions or press ( \square ) to return to measurement status.</td>
<td>![Screen Screenshot]</td>
<td></td>
</tr>
<tr>
<td>3. In the status of manual temperature compensation, press ( \square ) and instrument enter set up status of manual temperature compensation user can use ( \uparrow ) or ( \downarrow ) to set up process temperature TST1 and calibration temperature TST2. Press ( \square ) to confirm and return to P01 Sub-function form or press ( \uparrow ) or ( \downarrow ) to select other sub functions to set up or press ( \square ) to return to measurement status. TST1 is the compensation temperature under normal measurement while TST2 is the compensation temperature under calibration. Since temperatures are not the same in calibration and normal measurement when instrument is used, two set up values under manual temperature compensation status are convenient. Users will not set manual temperature compensation value back and forth. For example, if user’s process temperature is 50.0(^\circ)C and the temperature of standard solution when calibrating is 10.0(^\circ)C, use can set TST1 as 50.0(^\circ)C and set TST2 as 10.0(^\circ)C for afterwards convenient use.</td>
<td>![Screen Screenshot]</td>
<td></td>
</tr>
</tbody>
</table>

---

**(Example)**

- **Temperature Compensation Setup**: Use the arrow keys \( \uparrow \) and \( \downarrow \) to set the temperature compensation values. Confirm with \( \square \) to apply the settings. Use \( \square \) to navigate between sub-functions or return to measurement status.

---

**Notes**

- Ensure the compensation function is active (ON) before proceeding.
- Use arrow keys to adjust temperature values.
- Confirm changes with \( \square \) to apply.
5.2 P02: OFFSET SET-UP SUB-FUNCTION

1. In P02 sub-function form, Press \[^{1}\] to set up. LCD main display zone shows pH actually measured value in pH measurement mode. The lower display shows POFS. The right lower display shows offset. LCD main display zone shows ORP actually measured value in ORP measurement mode. The lower display shows UOFS. The right lower display shows offset.

2. User can press \[^{\uparrow}\] or \[^{\downarrow}\] to adjust offset to modify measurement value. Press \[^{\text{ESC}}\] to confirm and return to P02 sub-function form. Use \[^{\uparrow}\] or \[^{\downarrow}\] to select other sub-function to set up.

Note: Press \[^{\text{ESC}}\] to quit set-up mode at anytime. Instrument will return to measurement mode automatically.
1. Press \( \text{ENT} \) to confirm in P03 sub-function. Entering set up of the sub-function.

2. The lower display shows CTYP. The upper display shows 4 (it means electric circuit output from 4 mA to 20 mA). User can press \( \text{▲} \) or \( \text{▼} \) select 0 (it means electric circuit output from 0 to 20 mA).

Press \( \text{ENT} \) to confirm and enter into set-up of transmitting range.

3. The lower display shows CURL while the upper display shows 0.00, which means that 0.00 mA transmitting range indicates 0.00 pH. User can press \( \text{▲} \) or \( \text{▼} \) to adjust the actual value. Press \( \text{ENT} \) to confirm. The lower display shows CURH while the upper display shows 14.00, which means 20.00 mA transmitting range indicates 14.00 pH. User can press \( \text{▲} \) or \( \text{▼} \) key to adjust the actual value. Press \( \text{ENT} \) to confirm and return to P03 sub-function firm. Use \( \text{▲} \) or \( \text{▼} \) to select other sub-functions and to set up.

For example, set CTYP to 0 or 4, set CURL to 2.00 and set CURH to 10.00, which means 014 to 20 mA output mode is selected as circuit output. 0/4.00 mA indicates 2.00 pH, 20.00 mA indicates 10.00 pH.

\[ \text{Note: Press} \ \text{ESC} \ \text{to quit set-up mode at anytime. Instrument will return to measurement mode automatically.} \]

\[ \text{Note: This parameter allows you to set range of circuit output, but transmitting high point and low point can't be overlapped.} \]
5.4 P04 : CONTROL MODE SUB-FUNCTION

1. Press in P04 sub-function form to enter into concrete set up procedure.

2. The lower display shows CNTR while the upper display shows LIT. (The control mode of instrument is under limited control mode). User can press or to select PLC mode (The control mode of instrument is under proportion control mode). Press to confirm and return to P03 sub-function form. Use or to select other sub-functions and to set up.

Note: Press to quit set up mode at any time. Instrument will return to measurement mode automatically.
5.5  P05 : RELAY 1 SET-UP SUB-FUNCTION

1. In P05 sub-function form. Press \[\text{SET}\] to enter into concrete set-up procedure.

2. The lower display shows SP1 while the upper display shows HI, which means set point 1 is under high-point control status. (If instrument control made is set up to LIT limited point control mode, relay begins to work when the measured value up to set value. If instrument control mode is set up to PLC proportion control mode, measured value must be raised to approach set value). Press \[\text{SET}\] to confirm and enter into next set up procedure.

3. The lower display shows SP1 U while the upper display shows concrete value. User of the function form can press \[\text{▲}\] or \[\text{▼}\] to adjust the value to confirm concrete set up value. Press \[\text{SET}\] to confirm and enter into next set up procedure.

4. This function form sets hysteresis band under limited control mode to protect relay, which may oscillate frequently around set point and be damaged. Controlling proportion range is set up under proportion control mode (this parameter is not lower than 5 under PLC mode) to confirm and adjust time period of adding medicine automatically. Press \[\text{SET}\] to confirm and enter into next set up procedure. Under proportion control mode, this function form is used to set time period of whole controlling circle. Press \[\text{SET}\] to confirm and return to P05 sub-function form. USE \[\text{▲}\] or \[\text{▼}\] select other sub-function and to set up.

Note: Press \[\text{ESC}\] to quit set up mode at any time. Instrument will return to measurement mode automatically.
5.6  P06 : RELAY 2 SET-UP SUB-FUNCTION

Working principle of this part is the same as which of P05 relay 1 set-up sub-function. Please operate according to P05.

NOTE:  Set-up value range of hysteresis band under limited control mode is from 0.00—2.00PH.

For example, if high point is 7.00pH and hysteresis band is 0.50pH, movement range of the relay is from 6.50pH to 7.00pH. If low point is 6.00pH and hysteresis band is 0.20pH, movement range of the relay is from 6.00pH to 6.20pH.

NOTE:  In PLC control mode, movements of the relay meet following formulas:

\[ C \times (VM - VS) \times U \times T / 14 \]

\( C \) is discriminate parameter for high / low point.
It is -1 when set to high point and it is 1 when set to low point.
\( VM \) is measured value.
\( VS \) is set value.
\( U \) is control parameter.
\( T \) is time constant (represent the whole movement circle of relay)

For example, set high point is 7.00pH, actual measured value is 6.50pH, control parameter is 10, time constant is 10 seconds.

\[ -1 \times (6.50-7.00) \times 10 \times 10 / 14 = 3.57 \text{ second} \]

According to the above formula, pickup time of relay is 3.6 second and release time is 6.4 seconds. If the result of above formula is negative, relay won’t move. If the result is move than T, relay keeps picking up until the result is less than T.
5.7 P07 : ALARM RELAY 3 SET-UP SUB-FUNCTION

1. Select P07 sub function, Press \(\text{SET} - \text{HOLD}\) to confirm. Enter into concrete set-up procedure.

2. Select concrete working mode. Press \(\uparrow\) or \(\downarrow\) to select suitable control mode.

   - CLE = relay 3 as cleaning control relay
   - CAL = relay 3 as calibrating indication relay
   - ALL = move with two relays simultaneously
   - SP1 = relay 3 moves with SP1 (limited control mode only)
   - SP2 = relay 3 moves with SP2 (limited control mode only)
   - OFF = relay 3 is off

   Press \(\text{ENTER}\) to confirm your set up.

   If user select CAL working mode, he can set calibration indicate intervals in the function form, use hours as the unit. In this way, instrument and electrode can keep their reliability.

   If user select CLE working mode, he can set cleaning time intervals in the function form, use hour as the unit; cleaning continuous time, use second as the unit. In this way, instrument and electrode can keep their reliability. User can install cleaning equipment to increase service life and reliability of electrode.

3. Press \(\text{SET} - \text{HOLD}\) to confirm and return to P07 sub-function form. Use \(\uparrow\) or \(\downarrow\) to select other sub-functions to set up.

NOTE : Press \(\text{ESC} - \text{ENT}\) to quit set up mode at any time. Instrument will return to measurement mode automatically.
1. In P08, Press to confirm and enter into concrete set up procedure.

2. Press to confirm. If you select ORP or voltage measurement mode, after to confirm, instrument will return to P08 sub-function form. If you select pH measurement mode, instrument will enter electrode-select function form automatically. The lower display shows SENS, and main display zone. Shows electrode kind, glass electrode or antimony electrode. User can use or to select the electrode kind he need. Then, press to confirm and enter into select items for standard solution. The lower display shows BUFF while the upper display shows NST (Nist standard) or USA (USA standard). User can use or to select items according to kind of standard solution. Press to confirm and return to P08 sub-function form. Use or select other sub functions to set up.

NOTE: Press to quit set-up mode at any time. Instrument will return to measurement mode automatically.
5.9 P09 : TRANSMITTING RATE SUB FUNCTION

1. Press \( \text{SET} \) to confirm in P09 and enter in concrete set-up procedures.

2. The lower display shows \( \text{nb} \) while the upper display shows 001, which indicates that user is setting communication address ID NO. of the instrument, from 001 to 128. Use \( \uparrow \) or \( \downarrow \) to select necessary ID and press \( \text{SET} \) to confirm. Then enter into next set up function form.

3. The lower display of the instrument shows bt while the upper display shows 005, which indicates that user is setting communication rate function. Use \( \uparrow \) or \( \downarrow \) to select necessary communication rate. Press \( \text{SET} \) to confirm and return to P09 sub-function form. Use \( \uparrow \) or \( \downarrow \) to select other sub-function to set up.

4. Corresponding communication rate to codes.

<table>
<thead>
<tr>
<th>( \text{bt} )</th>
<th>000</th>
<th>001</th>
<th>002</th>
<th>003</th>
<th>004</th>
<th>005</th>
<th>006</th>
<th>007</th>
</tr>
</thead>
<tbody>
<tr>
<td>baud rate</td>
<td>300</td>
<td>600</td>
<td>1200</td>
<td>2400</td>
<td>4800</td>
<td>9600</td>
<td>19200</td>
<td>38400</td>
</tr>
</tbody>
</table>

Note: Press \( \text{ESC} \) to quit set-up mode at any time. Instrument will return to measurement mode automatically.
5.10 P10: REVERTING TO FACTORY DEFAULT SETTINGS

1. Press in P10 to enter into concrete set-up procedures.

2. The lower display of the instrument shows DEF while the upper display shows NO (YES). User can press ▲ or ▼ to select necessary items. If select YES, all settings will be reset to factory default. User’s setting will be lost.

NOTE: Press to quit set-up mode at any time.
Instrument will return to measurement mode automatically.
5.11 COMMUNICATION PROTOCOL

1、protocol setting

This instrument uses RS-485 communication. It’s can be connected with 1 to 64 instruments in 2 wires at the same time and communicate with PC. The distance of communication is around 1200M.

The data form is “N81”(1 start bit, 8 data bits,1 stop bit, NO verify check code)

The baud rate is 300 to 38400 bit/s (usually is 9600 bit/s)

Users have to set the ID(NB) of the instruments and the baud rate(BT) before connecting to RS-485

<table>
<thead>
<tr>
<th>BT</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud rate</td>
<td>300</td>
<td>600</td>
<td>1200</td>
<td>2400</td>
<td>4800</td>
<td>9600</td>
<td>19200</td>
<td>38400</td>
</tr>
</tbody>
</table>

Usually, the instrument is stand by in receiving status. Once it receives the correct ID then it will send out the data to PC. Finished sending it will enter to receive status again.

To avoid the conflict, each instrument has to use different ID(decided by NB)

All of the instruments and PC must use the same baud rate.(decided by BT)

2、Data form

All one-word data is from -32767 to +32767, using the hexadecimal number system, the high bit is sign.

All one-byte is integer.
The data is ASCII code :the start sign is @(40H), the end sign is CR(0DH)
The other data use the ASCII code to express the hexadecimal number system

All data should be between 30H to 39H and 41H to 46H. the instructions are form 51H to 5AH.

Double-byte sending: the low byte is the first, the high byte is the second

One-byte sending: the high nibble is the first, the low nibble is the second.

A full communication form is :40 ,ID, the sequence of the instruction,CRC,0D

The ID is the number of the instrument(NB)

CRC is the Circulation redundant codes verification
3. The communication instructions

1) RD: read floating data
2) RE: read the appointment data by start address and bytes (the large byte can not over 28 bytes)
3) RR: read all of data (8-word, 12-byte), totally 28 bytes.

4. Introduce the instructions (the ID is 1)

1) RD (read the floating data): PC send :40,30,31,51,44,CRCH,CRCL,0D(8 bytes)
   40: start byte
   30 31: the ID of instrument (the hexadecimal: 0～3FH, ASCII: 30 30 ～33 46); 51 44: instruction of R, D
   CRCH,CRCL: CRC
   0D: the end byte

   the response by instrument is “40, 30, 31, 52, 44, 30, 30,V1LH,V1LL,V1HH,V1HL,3X,V2LH,V2LL,V2HH,V2HL,3X,3X,3X,3X,3X,CRCH,CRCL,0D”

   40 : the start byte
   30 31 : the ID of instrument
   52 44 30 30 : the fixed data
   V1LH,V1LL, V1HH, V1HL: pH/ORP value
   3X: the position of decimal(32:pH mode, 2 decimal; 30:ORP/mV mode, no decimal)
   V2LH, V2LL, V2HH, V2HL: temperature value
   3X: the status of relay 1, 30 :open ;31:close
   3X: the status of relay 2, 30 :open ;31:close
   3X: the status of relay 3, 30 :open; 31:close
   3X: ERR status, 30 : correct; 31:error
   3X: parameter modify, 30: no modify; 31:modify
   CRCH,CRCL : CRC
   0D : the end byte

   Total : 24 bytes
2) RE (read the appointment data)
   The PC send : 40,31,52,45,30,30,adrH,adrL,lthH,lthL,CRH,CRL,0D (total 14 bytes)
   40 : the start byte
   30 31 : the ID of instrument (the hexadecimal: 0～3FH, ASCII: 30 ～ 33 46 );
   52 45 : the instruction R, E;
   30 30 : reserve
   adrH adrL : the address of the start parameter byte (the hexadecimal: 0～1BH );
   1theH 1theL : the count of the parameters (the hexadecimal: 1～1CH ; ASCII:
   30 31 ～ 31 43 );
   CRCH CRCL : CRC
   0D : the end byte

   The adr is the start address (00～1BH ), 1th is the count of the byte. The table is the relation of the adr and parameter.

<table>
<thead>
<tr>
<th>adr</th>
<th>para</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>TST1</td>
</tr>
<tr>
<td>01</td>
<td>TST1</td>
</tr>
<tr>
<td>02</td>
<td>TST2</td>
</tr>
<tr>
<td>03</td>
<td>TST2</td>
</tr>
<tr>
<td>04</td>
<td>SP1U</td>
</tr>
<tr>
<td>05</td>
<td>SP1U</td>
</tr>
<tr>
<td>06</td>
<td>SP2U</td>
</tr>
<tr>
<td>07</td>
<td>SP2U</td>
</tr>
<tr>
<td>08</td>
<td>CURL</td>
</tr>
<tr>
<td>09</td>
<td>CURL</td>
</tr>
<tr>
<td>0A</td>
<td>CURH</td>
</tr>
<tr>
<td>0B</td>
<td>CURH</td>
</tr>
<tr>
<td>0C</td>
<td>POFS</td>
</tr>
<tr>
<td>0D</td>
<td>POFS</td>
</tr>
</tbody>
</table>

   If adr>1BH or adr+1th>1BH, the return the error code: 40,31,52,45,2A,2A,CRH,CRL,0D
   The 2A 2A is the error sign

   If the address range is correct then the instrument will send back data :
   40,30,31,52,45,D1,D2,D3,……Dn,CRH,CRL,0D
   40: the start byte
   30 31 : the ID
   52 45 : the fix data
   D1～Dn : parameters from instrument to PC
   CRCH, CRCL: CRC
   0D : the end byte

3) RR (read all of parameters) the PC send : 40,31,52,52,CRH,CRL,0D (8 bytes)
   40: the start byte
   30 31 : the ID

   52 52 : the instruction of R, R
   CRCH, CRCL: CRC
   0D : the end byte
The instrument response: 40, 30, 31, 52, 52, D1, D2, ……, D55, D56, CRH, CRL, 0D (64 bytes)

40: the start byte
30 31: ID
52 52: the fix data
D1~D56: the parameter of sending (8 double byte, 12 byte, total 28 bytes)
CRCH, CRCL: CRC
0D: the end byte

4. Notice for programming the communication program

If the instrument receives the data with the start byte is 40 and the count of sequence data over 16 bytes and did not find the 0D then the data is invalid. The instrument will not do any response.

If the sequence data is not between 00H to 0FH, the sequence data is invalid. The instrument will not do any response. But the other errors, ex: the wrong instruction, the wrong address, the wrong parameter counts, the wrong CRC and so on, the instrument will response the wrong information.

All parameters, please see the following table, some parameters are include decimal.

<table>
<thead>
<tr>
<th>para</th>
<th>TST1</th>
<th>TST2</th>
<th>SP1U</th>
<th>SP2U</th>
<th>CURL</th>
<th>CURH</th>
<th>POFS</th>
<th>HOR</th>
<th>AAA</th>
<th>FUNC</th>
</tr>
</thead>
<tbody>
<tr>
<td>decimal</td>
<td>1</td>
<td>1</td>
<td>0/2</td>
<td>0/2</td>
<td>0/2</td>
<td>0/2</td>
<td>0/2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>para</th>
<th>R3OP</th>
<th>TOFS</th>
<th>SEC</th>
<th>SP1D</th>
<th>SP1T</th>
<th>SP2D</th>
<th>SP2T</th>
<th>NB</th>
<th>BT</th>
<th>CONF</th>
</tr>
</thead>
<tbody>
<tr>
<td>decimal</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0/2</td>
<td>0</td>
<td>0/2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The PC display the reading values should be include the decimal.

TOFS is the correct value of temperature, the setting range is 0~200, the display range is -100~100, so the PC should be subtract 100 and display with sign.

1) FUNC is the display mode of instrument: 0=mV; 1=ORP; 2=pH
2) R3OP is the mode of relay 3: 0=NOR; 1=SP1; 2=SP2; 3=ALL; 4=CAL; 5=CLE
3) AAA is the reserve parameters
4) CONF is a byte parameter, the define is following,
   Bit 7: temperature compensation: 1=automation 2=manual
   Bit 6: current output, 1=4~20mA; 0=0~20mA:
   Bit 5: SP1, 1=HI; 0=LO;
   Bit 4: SP2, 1=HI; 0=LO;
   Bit 3: control mode, 1=PLC; 0=Lit;
   Bit 2: electrode selection, 1=ANTI; 0=GLAS;
   Bit 1: buffer, 1=NST; 0=USA;
   Bit 0: reserve
6 TECHNICAL PARAMETERS

6.1 TECHNICAL PARAMETERS FORM

<table>
<thead>
<tr>
<th>PHCN-962 Transmitter / Controller</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>pH Range</td>
<td>-2.00 to 16.00 pH</td>
</tr>
<tr>
<td>Analytical degree &amp; precision</td>
<td>0.01 pH and ± 0.01 pH</td>
</tr>
<tr>
<td>mV Range</td>
<td>-1999 to 1999 mV</td>
</tr>
<tr>
<td>Analytical degree &amp; precision</td>
<td>± 1 mV / ± 1 mV</td>
</tr>
<tr>
<td>Temperature</td>
<td>-9.9 to 130 °C</td>
</tr>
<tr>
<td>Analytical degree &amp; precision</td>
<td>0.1 &amp; ± 0.5 °C</td>
</tr>
<tr>
<td>Temperature electrode</td>
<td>Pt 1000</td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>Automatic (± 10 °C offset adjustment) / manual</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set point and control function</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Control function</td>
<td>Limited point / proportion</td>
</tr>
<tr>
<td>Cleaning circle</td>
<td>From 1 to 999 hours</td>
</tr>
<tr>
<td>Cleaning time</td>
<td>From 1 to 999 seconds</td>
</tr>
<tr>
<td>Control hysteresis band</td>
<td>0.01 to 2 pH</td>
</tr>
<tr>
<td>ORP hysteresis band</td>
<td>1 to 200 mV</td>
</tr>
<tr>
<td>Relay output</td>
<td>Three SPST relays, 250V1A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RS-485</td>
<td>client program</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electric current information and connection</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric source</td>
<td>110 or 220 V AC / 60 or 50 Hz</td>
</tr>
<tr>
<td>Signal output / load</td>
<td>0/4 – 20 mA isolated current output</td>
</tr>
<tr>
<td>Signal output load</td>
<td>600 Ω</td>
</tr>
<tr>
<td>pH / ORP input</td>
<td>BNC (10¹³ impedance)</td>
</tr>
<tr>
<td>Connection terminal</td>
<td>Removable plug-in unit</td>
</tr>
<tr>
<td>Main fuse wire</td>
<td>250 mA, anti-surge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alarm function</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Function (switch able)</td>
<td>Close</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Display</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LCD( liquid crystal display)</td>
<td>Big-size screen of crystal display, blue back light</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EMC Specification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electromagnetic emission</td>
<td>EN 50081-1</td>
</tr>
<tr>
<td>Electromagnetic induction</td>
<td>EN 50082-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental conditions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Working temperature</td>
<td>-10 to 50 °C (14 to 122 °F)</td>
</tr>
<tr>
<td>Humidity</td>
<td>10 to 95% (no frozen dew)</td>
</tr>
<tr>
<td>Protection grade</td>
<td>NEMA 4X, IP 65</td>
</tr>
</tbody>
</table>
## 6.2 PARAMETER SETTING AND FACTORY PRELIMINARY VALUE

<table>
<thead>
<tr>
<th>NO.</th>
<th>Indication</th>
<th>Parameter Name</th>
<th>Symbol</th>
<th>Contents</th>
<th>Remark</th>
<th>Valid range</th>
<th>Factor value</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>P1 TC</td>
<td>LOCK LOC</td>
<td>LOC</td>
<td>Password for entering function</td>
<td></td>
<td>0~200</td>
<td>0</td>
</tr>
<tr>
<td>02</td>
<td></td>
<td>ATC AtC</td>
<td>AtC</td>
<td>Auto temperature compensation</td>
<td></td>
<td></td>
<td>ON/OFF</td>
</tr>
<tr>
<td>03</td>
<td>TC</td>
<td>TSET1 tSt1</td>
<td>tSt1</td>
<td>Temperature set up of manual</td>
<td>Only valid for manual</td>
<td>-10.0~100.0°C</td>
<td>25.0</td>
</tr>
<tr>
<td>04</td>
<td>TC</td>
<td>TSET2 tSt2</td>
<td>tSt2</td>
<td>Calibration temperature set up</td>
<td></td>
<td>0.0~60.0°C</td>
<td>25.0</td>
</tr>
<tr>
<td>05</td>
<td>TC</td>
<td>TOFS tOFS</td>
<td>tOFS</td>
<td>Temperature measurement offset</td>
<td>Only valid for manual</td>
<td>-10.0~10.0°C</td>
<td>0.0</td>
</tr>
<tr>
<td>06</td>
<td>P2 OFS</td>
<td>POFS POFS</td>
<td>POFS</td>
<td>PH value measurement offset</td>
<td>Only valid for PH mode</td>
<td>-2.00~2.00PH</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>P3 OFS</td>
<td>VOFS VOFS</td>
<td>VOFS</td>
<td>mV value measurement offset</td>
<td>Only valid for ORP mode</td>
<td>-200~200mV</td>
<td>0</td>
</tr>
<tr>
<td>07</td>
<td>P3</td>
<td>CTYP CtyP</td>
<td>CtyP</td>
<td>Type of current output</td>
<td></td>
<td>0/4~20mA</td>
<td>4</td>
</tr>
<tr>
<td>08</td>
<td>CUr</td>
<td>CURL CUrL</td>
<td>CUrL</td>
<td>Low limit of transmitting output</td>
<td>PH mode: 0.01PH unit</td>
<td>-1999~1999</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>CUr</td>
<td>CURH CUrH</td>
<td>CUrH</td>
<td>High limit of transmitting output</td>
<td>ORP mode: 1mV unit</td>
<td>-1999~1999</td>
<td>1400</td>
</tr>
<tr>
<td>09</td>
<td></td>
<td>CNTR Cntr</td>
<td>Cntr</td>
<td>Control way of relay 1, 2</td>
<td></td>
<td></td>
<td>Lit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SP1 SP1</td>
<td>SP1</td>
<td>Way set up of relay 1</td>
<td></td>
<td></td>
<td>Lite/LO</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>SP1U SP1U</td>
<td>SP1U</td>
<td>Setting value of relay 1</td>
<td>PH mode: 0.01PH unit</td>
<td>-1999~1999</td>
<td>400</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>SP1D SP1d</td>
<td>SP1d</td>
<td>Relay 1 hysteresis / proportion</td>
<td>ORP mode: 1mV unit</td>
<td>0~200 (2.00)</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>SP1T SP1t</td>
<td>SP1t</td>
<td>Relay 1 circle (second)</td>
<td>Only valid for PLC</td>
<td>0~200 seconds</td>
<td>20</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>SP2 SP2</td>
<td>SP2</td>
<td>Way set up of relay 2</td>
<td></td>
<td></td>
<td>HI / LO</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>SP2U SP2U</td>
<td>SP2U</td>
<td>Setting value of relay 2</td>
<td>PH mode: 0.01PH unit</td>
<td>-1999~1999</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SP2D SP2d</td>
<td>SP2d</td>
<td>Relay 2 hysteresis / proportion</td>
<td>ORP mode: 1mV unit</td>
<td>0~200 (2.00)</td>
<td>10</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>SP2T SP2t</td>
<td>SP2t</td>
<td>Relay 1 circle (second)</td>
<td>Only valid for PLC</td>
<td>0~200 seconds</td>
<td>20</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>R3OP r3OP</td>
<td>r3OP</td>
<td>Working mode of relay 3</td>
<td></td>
<td></td>
<td>OFF/SPI/SPI/</td>
</tr>
<tr>
<td></td>
<td>rL3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>INT HOr</td>
<td>HOr</td>
<td>Interval (hour)</td>
<td>valid for calibration and cleaning mode</td>
<td>0~999</td>
<td>100</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>DUR SEC</td>
<td>SEC</td>
<td>Operating time (second)</td>
<td>valid for cleaning mode</td>
<td>0~200</td>
<td>30</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>FUNC FUnC</td>
<td>FUnC</td>
<td>PH / ORP/mV select</td>
<td></td>
<td></td>
<td>PH</td>
</tr>
<tr>
<td>20</td>
<td>CONF</td>
<td>SENS SenS</td>
<td>SenS</td>
<td>Antimony / glass electrode select</td>
<td>Only valid for PH mode</td>
<td></td>
<td>Anti/GLAS</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>BUFF buFF</td>
<td>buFF</td>
<td>USA/nST standard select</td>
<td></td>
<td></td>
<td>NIST/USA</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>NB nb</td>
<td>nb</td>
<td>Set ID number for 485</td>
<td></td>
<td>0~63</td>
<td>1</td>
</tr>
<tr>
<td>23</td>
<td></td>
<td>BT bt</td>
<td>bt</td>
<td>Communication rate</td>
<td></td>
<td>0~7</td>
<td>5</td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>DEF dEF</td>
<td>dEF</td>
<td>Reverting to factory default setting</td>
<td>Reset to factory default parameter.</td>
<td>YES/NO</td>
<td>NO</td>
</tr>
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</table>
APPENCLIX 2 – pH TEMPERATURE CORRESPONDING TO pH BUFFER SOLUTION

Following form shows standard pH value of pH standard buffer solution under different temperature

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>pH 1.00</th>
<th>pH 4.01</th>
<th>pH 6.86</th>
<th>pH 7.00</th>
<th>pH 9.00</th>
<th>pH 9.18</th>
<th>pH 10.01</th>
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<tbody>
<tr>
<td>0</td>
<td>0.96</td>
<td>4.01</td>
<td>6.98</td>
<td>7.12</td>
<td>9.33</td>
<td>9.47</td>
<td>10.32</td>
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<tr>
<td>5</td>
<td>0.99</td>
<td>4.01</td>
<td>6.95</td>
<td>7.09</td>
<td>9.24</td>
<td>9.38</td>
<td>10.25</td>
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<tr>
<td>10</td>
<td>0.99</td>
<td>4.00</td>
<td>6.92</td>
<td>7.06</td>
<td>9.16</td>
<td>9.32</td>
<td>10.18</td>
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<tr>
<td>15</td>
<td>0.99</td>
<td>4.00</td>
<td>6.90</td>
<td>7.04</td>
<td>9.11</td>
<td>9.27</td>
<td>10.12</td>
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<td>20</td>
<td>1.00</td>
<td>4.00</td>
<td>6.88</td>
<td>7.02</td>
<td>9.05</td>
<td>9.22</td>
<td>10.06</td>
</tr>
<tr>
<td>25</td>
<td>1.01</td>
<td>4.01</td>
<td>6.86</td>
<td>7.00</td>
<td>9.00</td>
<td>9.18</td>
<td>10.01</td>
</tr>
<tr>
<td>30</td>
<td>1.01</td>
<td>4.01</td>
<td>6.85</td>
<td>6.99</td>
<td>8.95</td>
<td>9.14</td>
<td>9.97</td>
</tr>
<tr>
<td>35</td>
<td>1.01</td>
<td>4.02</td>
<td>6.84</td>
<td>6.98</td>
<td>8.91</td>
<td>9.10</td>
<td>9.93</td>
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<tr>
<td>40</td>
<td>1.01</td>
<td>4.03</td>
<td>6.84</td>
<td>6.97</td>
<td>8.88</td>
<td>9.07</td>
<td>9.89</td>
</tr>
<tr>
<td>45</td>
<td>1.01</td>
<td>4.04</td>
<td>6.83</td>
<td>6.97</td>
<td>8.85</td>
<td>9.04</td>
<td>9.86</td>
</tr>
<tr>
<td>50</td>
<td>1.01</td>
<td>4.06</td>
<td>6.83</td>
<td>6.97</td>
<td>8.82</td>
<td>9.01</td>
<td>9.83</td>
</tr>
<tr>
<td>55</td>
<td>1.01</td>
<td>4.08</td>
<td>6.83</td>
<td>6.97</td>
<td>8.79</td>
<td>8.99</td>
<td>9.81</td>
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<tr>
<td>60</td>
<td>1.02</td>
<td>4.10</td>
<td>6.84</td>
<td>6.98</td>
<td>8.76</td>
<td>8.96</td>
<td>9.79</td>
</tr>
<tr>
<td>70</td>
<td>1.02</td>
<td>4.12</td>
<td>6.85</td>
<td>6.99</td>
<td>8.72</td>
<td>8.92</td>
<td>9.76</td>
</tr>
<tr>
<td>80</td>
<td>1.02</td>
<td>4.16</td>
<td>6.86</td>
<td>7.00</td>
<td>8.68</td>
<td>8.89</td>
<td>9.74</td>
</tr>
<tr>
<td>90</td>
<td>1.02</td>
<td>4.20</td>
<td>6.88</td>
<td>7.02</td>
<td>8.65</td>
<td>8.85</td>
<td>9.73</td>
</tr>
</tbody>
</table>
Appendix 3 – hysteresis band

Simple Explanation on the Function of Hysteresis Band

The controller relay activates when the set-point is reached. In the reverse direction, it closes. Relay continues to be active till the value reaches the amount set by hysteresis band.

SP1 Set to LO
SP2 Set to HI

RELAY ON
RELAY OFF

4.0 4.5 7.0 9.5 10.0

SP1 SP2

FORWARD DIRECTION
REVERSE DIRECTION

HYSTERESIS BAND
(DEFAULT = 0.5 pH)

The controller relay activates when the set-point is reached. In the reverse direction, it closes. Relay continues to be active till the value reaches the amount set by hysteresis band.
APPENCLIX 4 – CONTROL MOVEMENT

General Instructions Concerning Controller Setting

Control characteristic of P-Controller as proportional controller

Control characteristic of P-Controllers as limit value switch Control signal of pulse length control
Control signal and pulse length control

Output of relay controlled by hysteresis band is time. Crile T for open or close is constant. Different value comes from limited value, increase or decrease of open time is in accordance with proportion range.

Following applications:
\[ t_{ON} + t_{OFF} = T \text{ (Const.)} \]

- greater divergence \( \Rightarrow \) greater \( t_{ON} \)
- \( X_p \) exceeded \( \Rightarrow \) \( t_{ON} = T \) (relay remains picked up)
### ACCESSORY 5 – ABBREVIATIONS IN FUNCTION FORM

<table>
<thead>
<tr>
<th>Character</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEA</td>
<td>Measurement mode</td>
</tr>
<tr>
<td>CAL</td>
<td>Calibration mode</td>
</tr>
<tr>
<td>ENT</td>
<td>Confirm</td>
</tr>
<tr>
<td>OFS</td>
<td>Zero point offset</td>
</tr>
<tr>
<td>SET</td>
<td>Set up</td>
</tr>
<tr>
<td>ATC</td>
<td>Automatic temperature cor</td>
</tr>
<tr>
<td>SP1</td>
<td>Set point 1</td>
</tr>
<tr>
<td>SP2</td>
<td>Set point 2</td>
</tr>
<tr>
<td>LO</td>
<td>Low limit</td>
</tr>
<tr>
<td>HI</td>
<td>High limit</td>
</tr>
<tr>
<td>CNtr</td>
<td>Control</td>
</tr>
<tr>
<td>Lit</td>
<td>Limited point control</td>
</tr>
<tr>
<td>PLC</td>
<td>Pulse length control</td>
</tr>
<tr>
<td>RL3</td>
<td>Relay</td>
</tr>
<tr>
<td>OUT</td>
<td>Output signal</td>
</tr>
<tr>
<td>CONF</td>
<td>Configuration</td>
</tr>
<tr>
<td>CLE</td>
<td>Clean</td>
</tr>
<tr>
<td>GLAS</td>
<td>Glass electrode</td>
</tr>
<tr>
<td>ANTI</td>
<td>Antimony electrode</td>
</tr>
<tr>
<td>DEF</td>
<td>Default</td>
</tr>
<tr>
<td>CUR</td>
<td>Output electric circuit 1</td>
</tr>
</tbody>
</table>
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OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of 13 months from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

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Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

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3. Repair instructions and/or specific problems relative to the product.

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2. Model and serial number of the product, and
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