ELECTRO-CHEMICAL DEVICES, INC.

SYSTEM C22
INSTALLATION and OPERATING MANUAL
for
pH and ORP

YORBA LINDA * CALIFORNIA * 92887 * USA
PREFACE

Your decision to purchase from Electro-Chemical Devices, Inc. has provided you with the finest analytical instrument available. Before you install and commission this product, we highly recommend that you read this instruction manual. If this is your first purchase from ECD, we suggest that you obtain factory-authorized training for those products purchased. At ECD, we believe our most knowledgeable customers are our most valuable customers.

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System C22, Installation and Operating Manual for pH and ORP
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Abbreviations used in this manual:
NEMA is an abbreviation for the National Electrical Manufacturers Association.
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**WARRANTY**

Electro-Chemical Devices, Inc. (ECD) warrants all products it manufactures to be free from defect in materials and factory workmanship, and agrees to repair or replace any product that fails to perform, as specified, within one (1) year after date of shipment. This warranty shall not apply to any product that has been:

1. Subjected to misuse, negligence or accident;
2. Connected, installed, adjusted or otherwise used not in accordance with the instructions furnished by ECD;
3. Repaired, modified or altered by persons not authorized by ECD, resulting in injury to the performance, stability or reliability of the product.

This warranty is in lieu of any other warranty, expressed or implied. ECD reserves the right to make changes in the design or construction of its products at any time, without prior notification, and without incurring any obligation to make any changes in previously delivered products.

Seller's sole liabilities and the buyer's sole remedies under this agreement shall be limited to a refund in the purchase price, or at ECD's discretion, to the repair or replacement of any product that proves, upon ECD's examination, to be defective, when returned to the factory, transportation prepaid by the buyer, within one (1) year of the product's original shipment date. Seller shall not be liable for damages consequential or incidental to defects in any product, for failure of delivery in whole or in part, for injuries resulting from its use, or for any other cause.

This warranty and the writing attached constitute the full understanding of seller and the buyer, and no terms, conditions, understanding, or agreement purporting to modify or vary the terms hereof shall be binding unless hereafter made in writing and signed by an authorized official of Electro-Chemical Devices, Inc.

This warranty does not cover pH, ORP or Specific Ion measurement, reference or combination electrodes or electrode cartridges that have been commissioned in service.

**IMPORTANT SERVICE INFORMATION**

Use only factory authorized components for repair. Tampering or unauthorized substitution of components may adversely affect the operation of this product and may void the warranty.

If service or repair is required please obtain the serialization information of the product(s) in question and call ECD's Service Department at:

(800) 729-1333 or (714) 692-1333

or through the ECD web page and e-mail at Service@ecdi.com

A Return Material Authorization (RMA) number must be obtained from the service department before returning any material to ECD. All material returned to ECD shall be shipped prepaid to the factory.

**UNPACKING THE INSTRUMENT**

Your Electro-Chemical Devices instrument has been carefully packaged to protect it from damage during shipment and dry storage. Upon receipt please follow the procedure outlined below.

1. Before unpacking, inspect the condition of the shipping container to verify proper handling by the carrier. If damage is noted, save the shipping container as proof of mishandling for the carrier.
2. Check the contents of the shipping container with the items and quantities shown on the packing list. Immediately report any discrepancies to ECD.
3. Save the original packing material until you are satisfied with the contents. In the event the transmitter must be returned to ECD, the packing material will allow you to properly ship it to ECD.
4. Familiarize yourself with the instrument before installation, and follow proper installation and wiring procedures.
1.0 GENERAL DESCRIPTION
The Electro-Chemical Devices' System C22-pH and C22-ORP (Oxidation Reduction Potential) Controllers are microprocessor-based Controllers for process control of pH and ORP. Incorporating microprocessor technology, the System C22 provides the following features:

1.1 Membrane Switches
Calibrations can be performed via membrane switches located on the front cover, removing the need to open the NEMA 4X enclosure and exposing components to the environment. No potentiometric adjustments are required. All adjustments and calibrations are software-based.

1.2 Display
A back lit Graphics Display is used to display data and menus.

1.3 Automatic Calibration
This feature allows calibration points to be defined upon initialization of the transmitter.

1.4 Back To Factory Calibration
Allows the transmitter to be returned to a predetermined factory calibration. The default parameters are zero electrode offset at 7.00pH or 0.00mV ORP and the ideal Nernstian slope for the appropriate measurement.

1.5 Current Output
A standard System C22 is provided with one 4-20 mA current output with the available option to have as many as five. The current output may be expanded to any range within the transmitter's full operating range (see specifications). The C22 allows the current output to be field selectable and programmable. The outputs can also be configured to be reverse acting; for example, a 4-20 mA output for a range of 0 to 14pH can be reversed to 14 to 0 pH.

NOTE: Isolated io's are floating and require external power to operate.
ECD can supply an internal 24-vdc power supply to power these outputs.

1.6 Temperature Conversion
This standard feature allows the temperature displays to be presented in Celsius or Fahrenheit. A toggle function in the Temperature Calibration Menu allows this selection to be performed in the field.

1.7 Dual Input (Optional)
An optional second input can be provided for pH, ORP, Dissolved Oxygen or Specific Ion. This input can be used as a second analysis or as specific compensation for the primary input.

1.8 PID Output (Optional)
An optional PID output is available and provides a 4-20 mA, three-mode control signal. Proportional band is adjustable from 0.1 to 1,000%. Reset and Rate are adjustable from 0.00 to 100 repeats per minute and 0.00 to 1,000 minutes, respectively. The PID output can be assigned and configured to any of the available outputs.

1.9 Multiple Output (Optional)
The standard C22 is provided with a single output; however, the multiple output option provides up to four additional outputs. Outputs can be defined in the field as the process variable (pH or ORP) temperature, or PID. The additional outputs are fully isolated from the inputs and the primary output and are "floating" so they can have either a positive or negative common.

1.10 Alarm Relays (Optional)
Up to six alarm or control relays are available for the primary channel, or divided between the two channels on dual output transmitters. Relay outputs can be field configured as high or low alarms. Hysteresis (dead band) is defined by setting the "ON" and "OFF" relay values. The relays can be configured to any of the input parameters (see section 4.2)

1.11 Optional Software
   Differential Output: Provides an output expressed as the difference between two inputs.
   Ratio Output: Provides an output expressed as the ratio of two inputs. This is applicable to percent rejection in some applications.
   Averaged Output: Provides an output expressed as the average of two inputs.

1.12 Identification
The full model number, as found on the pack slip and on the serialization tag, is a list of alphanumeric characters used to designate certain features of the transmitter.

2.0 INSTALLATION
Before installing the System C22, it is important to review the mounting and wiring installation procedures described below.

2.1 Mounting
Three typical installation configurations are available for the System C22: universal mounting plate, handrail mounting plate and the panel mounting configurations. U-bolts may be ordered separately. Refer to the following application drawings for mounting details:
4024011 Dimensions, wall & pipe mounting 4024012 Dimensions, panel mounting 2000268 Dimensions, handrail mounting
The application drawings can be located in the back of this manual.

2.2 Power Wiring
The System C22 requires a 115 VAC Power source.
Application drawings 4024002 illustrate the proper power wiring for single channel System C22.
2.3 Sensor Wiring
A conditioned input is required from the sensor or electrode to the System C22 for proper operation. ECD models S10 and S17 sensors will provide the required conditioning. The application drawing 4024002 illustrate the proper sensor wiring:

NOTE:
A label located on the back of the from panel has the specific wiring diagram for the C22 controller

3.0 FAMILIARIZATION
This section will provide an overview of the front panel key functions and the display menus for the system C22 single channel pH and ORP units. Multiple channel transmitters will have the same menus. For information about other C22 features, such as additional outputs (Temperature and PID), Diagnostics, and Hart please refer the appropriate supplemental manual.

3.1 Key Functions
Cursor positions or numeric adjustments are performed by pressing the appropriate keypad. The C22 uses an “underscore” cursor in each of the menus. Holding down the keypad will automatically scroll the cursor or numeric values. Please note that simultaneous pressure on both vertical keys or any combination of keys other than the two horizontal CALIBRATE keys is not recommended.

3.1.1 Menu Selection Keys
The MENU SELECTION keys are used to change the display menu and move the cursor vertically. Any menu can be accessed by the use of the appropriate MENU SELECTION key. These keys are also used to exit the calibration mode and save calibration data.

3.2 Display Menus and Screens
When the C22 is first powered, a Copyright Display will appear for a few seconds, then the C22 will display the Main Menu. The Copyright Display provides the software “version” number and the software serial number. ECD will require this information if software updates are to be performed.

3.2.1 Contrast Menu
Display contrast can be adjusted to allow for variations of ambient lighting and viewing angle by using this menu. The Contrast Menu is the same for all system C22 controllers and is always located as the uppermost menu. To access this menu from the Main Menu, press the upper MENU SELECTION key.

3.2.2 Main Menu
This menu appears after the copyright display when power is first applied to the System C22. The main menus shown to the right depict a two-channel instrument. To access the following menus in a two-channel instrument scroll down for channel 1 and scroll up for channel 2. For a single channel instrument scrolling down accesses all menus. The Main Menu displays the measured process variable, temperature, and the current output in percent of full-scale. While in this menu, the current output can be adjusted and locked in a manual mode to provide an undisturbed output during sensor calibrations.

Out put Graph
This screen displays the output current that is set up in the Main screen. The X-axis of the graph display is factory set to ~30 minutes. The setup screen sets the Y-axis (the sensitivity). If the graph were assigned to a current output the sensitivity would be that of the 4 to 20 mA output.

3.2.3 Parameter Selection Menu
This menu allows the user to select what function they would like to perform. BUFFER section enters the calibration menus (standardize & Span). SETUP section enters the configuration setup of the instrument. STATUS section allows the user to view the calibration engineering data (mV input from the sensor and the Isopotential from the last cal). Each section is entered by placing the cursor under the first letter of the section you wish to enter and pressing the two horizontal calibrate keys simultaneously.

3.1.2 Calibrate Keys
The horizontal CALIBRATE keys are used to enter the calibrate mode and move the cursor horizontally. To enter the calibrate mode, both horizontal CALIBRATE keys must be pressed simultaneously. Once in the calibrate mode, the cursor can be positioned by pressing the appropriate individual CALIBRATE key. The vertical CALIBRATE keys are used to perform numeric adjustments to displayed values. To use these keys, the C22 must be in the calibrate mode. Pressing the upper CALIBRATE key will increase the value; pressing the lower CALIBRATE key will decrease the value.

To exit the calibrate mode, press either of the MENU SELECTION keys.

Graph
3.2.4 Buffer Section:
Allows the user to perform a 1 or 2 point buffer calibration (standardize & Span)

3.2.5 Electrode Standardize:
Provides the means with which to perform a one-point calibration (standardize) or the first point of a two-point calibration. For pH this point is typically 7.00 pH and ORP this point is typically 0.00 mV. Before entering the calibrate mode, the menu provides historical data from the last calibration. The top line displays the buffer, or calibration point, at which the last calibration was performed. The bottom line displays the temperature compensated mV value the electrode generated at the buffer point. Please note that temperature compensation is not performed for ORP. When in the calibrate mode, the bottom line displays the real-time, or active, millivolt value.

3.2.6 Electrode Span calibration:
Provides the means to perform the span calibration, or the second point of a two-point calibration. Before entering the calibrate mode, the menu provides historical data from the last calibration. The top line displays the buffer, or calibration point, at which the last calibration was performed. For pH, the bottom line displays the electrode slope, or efficiency, in millivolts per pH (mV/pH). ORP express efficiency in absolute millivolts per millivolt (mVa/mV). When in the calibrate mode, the bottom line displays the real-time, or active, millivolt slope value.

3.2.7 Exit / Stay menu:
This menu confirms that the user wishes to leave the section that they are currently in. This menu will show up each time that the C22 is prompted to leave the current section before it goes back to the parameter selection menu. Press the appropriate menu selection key either to stay in the current section or exit and return to the parameter selection menu.

3.2.8 Setup Section:
This section allows the user to configure the pre set up parameters in the system C22 controller. To set up additional parameters or to change to current preset parameters refer to the instrument configuration section in this manual. Configurable parameters include the 4 to 20 mA outputs, the relay contacts, PID control, and Hart.

3.2.9 Current Outputs:
Current output ranges are adjusted in this menu. The top line defines the 4 mA point, while the bottom line defines the 20 mA point. Between these points, the output current is linear with respect to the sensor input. The system C22 can contain up to 4 current outputs. Refer to the instrument configuration section of the manual to preset up the outputs.

3.2.10 Relay Contacts:
Relay on off set points are adjusted in this menu. The top line defines the point in which the relay is energized (on) and the bottom line defines the point in which the relay is de-energized (off). The system C22 can contain up to 6 sets of relay contacts. Refer to the instrument configuration section of this manual to preset up the number of contacts.

3.2.11 Status Menu:
Allows the user to view engineering information pertaining to the electrode as an informational screen only. The top line displays the real-time (active) absolute millivolt value (mVa) the electrode is generating, not compensated for temperature variations. The bottom line displays the electrode isopotential from the last calibration. The isopotential (electrode offset) is the value at which the electrode output is zero millivolts. A perfect pH electrode will indicate an isopotential of 7.00 pH. Replace the electrode if the isopotential is less than 6.00 pH or greater than 8.00 pH.

A perfect ORP electrode will indicate an isopotential of 86 mV @ 25°C. Replace the electrode if the isopotential is less than 36 mV or greater than 136 mV @ 25°C.

This information is extremely helpful in determining the diagnostic status of a pH or ORP electrode. In conjunction with regular calibrations, the Electrode Diagnostic Screen provides valuable information to track electrode performance.
4.0 INSTRUMENT CONFIGURATION

To reconfigure the instrument, scroll to the bottom of the main menu, where the 'Configure/Trim' option is displayed. Push both calibration keys to enter the configuration mode. This mode should be password protected if access to the keyboard is unrestricted.

4.1 Password Protection:

You may need some familiarity with the password capabilities of the instrument even if you decide not to use them, because a mischievous visitor could activate them.

Password protection can be selectively turned on for the operational and configuration displays. The operational and configuration passwords can be different. Passwords are entered using only the right four keys, and the passwords are numbers consisting only of the digits 1 to 4. No digits are shown on the keyboard. It is necessary to remember that the top key is 1, the right key is 2, the bottom key is 3, and the left key is 4. After the password is entered press either menu key.

If the wrong password is entered three consecutive times all password access is disabled, and the main display shows "Err PW". The instrument continues to function normally, but none of the password-protected settings can be changed. Normal operation is restored by momentarily turning off power. No keyboard commands are required to restore normal password protection. The "Err PW" display is cleared by any keystroke, but when attempting to enter a password the display will still show 'disabled'.

If the password is lost then turn off the power, and then reapply it. Within one second of the time that text first appears on the screen press the rightmost key on the keyboard. The screen will go blank to acknowledge the key, but there is no other visible indication that the key is recognized, and after a few seconds the instrument will begin functioning normally, except that the configuration password has been disabled for 60 seconds. The operational password remains in effect. Immediately enter the configuration mode and choose a new password. This method will not work if the key is down at the time power is applied. The key must be depressed shortly after text first appears.

The following displays control the password settings.

Operate password level: 3 no PW

None of the operational displays are password protected if the protection level is 0. If it is not zero then, with the exceptions shown in this table, all displays that affect the operation of the instrument are protected. A "N" entry in the table means that the display is not protected.

<table>
<thead>
<tr>
<th>Level</th>
<th>contrast</th>
<th>man out</th>
<th>1-point buf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>3</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>4</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

The old operational password is erased if the protection level is 0. Changing from 0 to another value has no effect until a new password is entered. The display shows "no PW" if the password has been erased.

After successfully entering the operational password it remains valid for 60 seconds after exiting the calibration mode on that display. During that time a second display can be accessed without re-entering the password. The 60-second timer starts again when exiting the calibration mode on that display also, so that any number of displays can be modified with a single password entry.

New opr password

Press both calibration keys to enter a new operational password. 1 to 8 digits may be entered. Press either of the menu keys when done. A new password will not be accepted unless the protection level has already been set to a value greater than 0.

Config password level: 1 no PW

Configuration password access is in effect if the level is 1. Access is unrestricted if it is 0. The old configuration password is erased if the protection level is 0. Changing from 0 to 1 has no effect until a new configuration password is entered. The display shows "no PW" if the password has been erased.

New conf password

Press both calibration keys to enter a new configuration password. 1 to 8 digits may be entered. Press either of the menu keys when done. A new password will not be accepted unless the protection level has already been set to 1.

The configuration password is rarely used and the configuration settings are more sensitive, so the password should use more digits than the operational password. With eight base 4 digits the odds of breaking the code in three tries are 3 in 65536 if the user knows that there are 8 digits. The user will not know the number of digits that you chose, so the odds are smaller than that. The maximum number of digits allowed in a password cannot be determined by entering trial passwords.

4.2 Output Assignment 4-20 mA

(NOTE: The instrument has been factory configured to your order specifications.

The only reason to access this configuration menu is if you are adding new hardware or your parameters have changed). The next group of displays are for assigning the 4-20 mA outputs. The first is 4-20: ... (where "..." is one of the following selections).

Missing Not installed
Unused Installed but not currently used
ch1 PV Channel 1 process value
ch1 temp Channel 1 temperature
ch1 PID Channel 1 PID controller output
ch2 PV Channel 2 process value
analog output to other sources, but other assignments are non-standard, and the units displayed by the remote system will not be correct.

The engineering units for the upper and lower range limits as being the same as those of the primary variable. It is possible to assign the 4-20 supplying the HART analog output is normally assigned to the same source as the primary variable, and the HART displays show the span settings must be readjusted or be resent when the HART analog output assignment is changed.

If command 35 is to be used to set the limits then the HART 4-20 output must be selected first, because the output span does not exist until an assignment is made. The displayed selection remains in effect until changed, and the selection is remembered through power outages of indefinite duration.

Up to two 4-20 outputs can be assigned to the same source. There is no error indication if more than two are assigned to the same source, but there will be no span display for the third. A span display will otherwise be present in the main menu for each 4-20 output that is assigned to a source. If the source is associated with channel 2 then the span display will be in the channel 2 group. The new assignment is not functional until the setpoints in the span display are set. If a PID controller is selected as a source then its support displays will also be present.

The next two displays are for the second and third 4-20 outputs. Some units do not have all three outputs, but the displays will show three output options anyway, as the additional outputs can be retrofitted. The 'missing' assignment should be selected for uninstalled outputs. The output assignments are changed in the same way as for the 4-20 outputs, including the HART output. When in the manual mode the 4-20 output is controlled from the keyboard. Zero percent corresponds to a current of 4 mA, and 100 percent corresponds to a current of 20 mA. If a 4-20 output is used to control the process then the manual mode is normally assigned to that output, although the instrument does not require this choice.

To change the assignment push both calibration keys, then use the right side up and down keys to change the number.

On two channel instruments the next display is the manual mode assignment for channel two.

4.4 HART Output Assignments
If the instrument was purchased with the HART option then the next five displays are for assigning the HART digital and analog outputs. The first of these displays is

HART 1: ...
HART command #3 requests four variables from the instrument. Each of these variables can be assigned to any of the sources shown in the 4-20 assignment section. Each variable has a unit's code, which identifies the variable as being pH, millivolts, degrees C, etc. The unit's code is supplied automatically, depending on the assignment and the instrument configuration. If command 3 is not used then only the first output assignment will be reported. If any output is assigned to 'missing' or 'unused' then that value will be reported as 'not a number', and the units field will be 'not used'.

The first digital output assignment is referred to as the primary variable in the HART system. The next three displays assign the second, third, and fourth variables. The assignments are changed in the same way as for the 4-20 outputs.

It is not possible to assign more than one HART digital output to the same source. There is no error indication, but it should not be done.

HART analog: 4
4-20 output #4 is dedicated to HART. This output normally carries the digital information superimposed on the 4-20 mA current. But if the HART system uses the multi-drop mode then the current output of 4-20 #4 is disabled, with only the digital signal remaining. Several instruments are connected in parallel in the multi-drop mode, so analog signaling is not possible. The current that would have been output is still reported digitally, as a percentage, and that will be sufficient for some applications. If an actual 4-20 current is required then one of the other 4-20 outputs must be used to supply it, and this display is used to make the assignment. The specified 4-20 must in turn be assigned to an appropriate source.

If the HART analog output is assigned to a different output than #4 then #4 cannot be assigned to anything. It must be set to 'missing' or 'unused'.

The span settings for the selected 4-20 output correspond directly to the HART lower and upper range limits, and they can be set either from the keyboard or with command #35. If they are changed with the command then the new value will be shown on the instrument's span display for the selected output. If they are changed from the keyboard then those values are reported digitally over the HART network.

If command 35 is to be used to set the limits then the HART 4-20 output must be selected first, because the output span does not exist until an assignment is made. The span settings must be readjusted or be resent when the HART analog output assignment is changed.

The 4-20 supplying the HART analog output is normally assigned to the same source as the primary variable, and the HART displays show the engineering units for the upper and lower range limits as being the same as those of the primary variable. It is possible to assign the analog output to other sources, but other assignments are non-standard, and the units displayed by the remote system will not be correct.
If the 4-20 selected for the HART analog output is assigned to 'missing' or 'unused' then the digital representation of the output current will be 'not a number', but with up to four digital variables still being transmitted.

4.5 Relay Assignments
The next 8 displays are for the relay assignments. The first of the relay displays is

Relay 1: ...
Where ... represents an item from the same list that is used for the 4-20 assignments. The procedure for selecting a relay assignment is the same as for the 4-20 outputs.

Up to two relays can be assigned to the same source, so one relay can be used to control the process, and another relay can be used as an alarm if the process value is out of limits.

The relay configuration menu provides for 8 relays, but most units do not have that many relays installed. Some units do not have any relays installed, but the relay menu will be present anyway, as the relays can be retrofitted. The software cannot determine how many relays are actually present, so the 'missing' selection might not reflect the actual configuration.

A display showing the relay setpoints for each relay is present in the main menu. If the relay is assigned to a channel 2 function then the display will be in the channel 2 group. The display is not shown if the 'missing' or 'unused' selection is made. A new relay assignment is not necessarily functional until the setpoints in the span display are set. If a PID controller is selected as a source then its support displays will also be present.

4.6 Temperature Calibration
The next display is for calibrating the process temperature displayed by the instrument.

The bottom line shows the measured temperature. Place the cursor on the top line then press both calibration keys. Adjust the number so that the displayed temperature agrees with that measured by a thermometer.

The number shown on the top line is simply added to the temperature that the instrument measures. There is no slope correction.

When the cursor is on the bottom line and both calibration keys are depressed the instrument toggles between degrees C and degrees F. All temperature displays on both channels use the selected system of units. The scale and units code in the HART temperature output is also controlled by this selection.

On two channel instruments the next display trims the channel 2 temperature.

4.7 Trim 4 to 20
The next six displays are for trimming the 4-20 outputs. The 4-20 outputs are calibrated at the factory and will never need re-calibration in most applications. Periodic re-calibration is not recommended.

The cursor moves to the right when both calibration keys are depressed and the output current is set to 4.00 mA, overriding the output assignment. Measure the 4-20 output #1 current with an ammeter, and adjust the number on the top line until the meter reads 4.00 mA.

The next display is for trimming the 20 mA point of output #1, and it works the same as the 4 mA trim. The 4 mA and 20 mA trims do not interact, and the endpoint trims are linearly interpolated for other output values.

The 4-20 #4 output must be trimmed by standard commands sent over the HART communication link.

4.8 Input A/D Converter Trim
This display is used to calibrate the analog to digital converter that is used to measure the process value. The bottom line shows the measured input voltage. The scale factor on the top line is adjusted until the displayed voltage is the same as that of a volt meter connected to the input. If the process is stable then the voltage can be the output of a sensor, but it is better to replace the sensor with a fixed voltage source. For good accuracy, the calibration voltage should be a substantial portion of the full scale voltage. It can be of either polarity. The input zero point error is automatically removed, so there is no adjustment for it.

The normal input range is +/- 600 millivolts, but ORP and some specific ion units use a +/-1200 millivolt range. On conductivity units the analog voltage is not externally accessible, but conductivity systems do not have millivolt displays, so no calibration is required. On conductivity units this display is only used for factory testing.

The input scale factor is calibrated at the factory and will never need re-calibration in normal applications. Periodic re-calibration is not recommended, as most units will remain accurate to within about 0.2 percent for many years. Further, any inaccuracy in the displayed millivolts is calibrated out when buffer calibrations are performed, so there is no requirement that the displayed millivolts be highly accurate. If the scale is accidentally changed and it is not convenient to perform a voltmeter calibration then simply set the scale factor to 1.0000. Most units are accurate to 2 percent with that setting, which is adequate for most applications.

On two channel units the next and last display is for trimming the channel 2 analog input.
5.0 MAINTENANCE
Because the C22 is microprocessor-based and does not have mechanical potentiometers, there is minimal maintenance required for the instrument. However, if service of the internal components is required always turn off the power to the instrument.

5.1 Cleaning
Although the NEMA 4X enclosure can withstand harsh environments, it may become necessary to clean the front panel if it becomes coated or dirty. Cleaning the front panel can be performed with a detergent and water. DO NOT USE ACETONE, ACIDS OR CAUSTIC SOLUTIONS ON THE ENCLOSURE SURFACE.

Before cleaning, the integrity of the enclosure seals should be inspected. Also check the conduit fittings and seals to make sure moisture does not enter the enclosure while cleaning.

If the enclosure cover must be removed, it is wise to clean and inspect the gasket seal. If the seal is damaged, replace the gasket. Always keep the gasket lightly lubricated with a silicone grease.

5.2 Replacement of the Microprocessor: Contact Factory

IMPORTANT:
Never interchange PROMs from one transmitter to another. Doing so will affect transmitter performance.

6.0 CALIBRATION

6.1 Manual Output Mode
To perform calibrations without interfering with control or recorder functions, the C22 incorporates a manual output mode. The current output is set to the desired level and saved until changed or released from the manual mode.

NOTE: Prior to any calibration the C22 transmitter should be placed into the manual mode.

Procedure:
1. If not at the Main Menu, press the appropriate MENU SELECTION key to reach the Main Menu.
2. Press both horizontal CALIBRATE keys simultaneously to enter the calibrate mode and observe the "M" appear in front of the % current output value; The current output is now locked in the manual mode.
3. Using the horizontal CALIBRATE keys, position the cursor under the digit to be adjusted.
4. Increase or decrease the value by pressing the appropriate vertical CALIBRATE key.
5. When the desired value is reached, exit the calibrate mode by pressing either MENU SELECTION key. The current output will be held at the filed value.

To release manual output:
1. Return to the Main Menu by pressing the appropriate MENU SELECTION key.
2. Observe that the "M" appears in front of the % current output value. The "M" signifies that the output is being held at the displayed value.
3. Press the left-hand CALIBRATE key and observe the "M" disappear, releasing the SYSTEM C22 from the manual output mode. The % output value will return to the real-time current output.

6.2 Contrast Adjustment

Procedure:
1. Press the upper MENU SELECTION key to reach the Contrast Menu (upper most menu).
2. Press both horizontal CALIBRATE keys simultaneously to enter the calibrate mode. Observe the cursor move to the last digit.
3. Using the horizontal CALIBRATE keys, position the cursor under the digit to be adjusted.
4. Increase or decrease the value by pressing the appropriate vertical CALIBRATE key.
5. To file the contrast value and exit the calibrate mode, press either MENU SELECTION key.

6.3 One and two point Buffer Calibration:
To perform a buffer calibration use the menu selection keys to reach the Parameter Selection Menu. Place the cursor under the B in Buffer and press the two horizontal calibration keys. The controller will automatically access the calibration menus. Once in the calibration menu follow the appropriate calibration procedure for a one point (Standardization) or a two point (span) calibration.

6.4 One-Point Buffer Calibration (Standardize)
Because all pH and ORP electrodes experience minor variations, buffer calibrations are necessary before installing the electrodes in service. Also, occasional calibrations are necessary to compensate for electrode degradation while in service. For measurement specifics refer to the pH/ORP sensor manual.

Procedure:
1. Be sure that the cursor is located under the “1” as illustrated
2. For diagnostic reasons note the pH and mV values from the prior calibration.
3. Clean the electrode and insert the sensor into the desired buffer.
4. Press both horizontal CALIBRATE keys simultaneously to enter the calibrate mode. Observe the diagnostic value on the bottom line change from historical data to a real-time value and that the term "CAL" has disappeared.
5. To change the buffer point, position the cursor under the desired digit using the left-hand CALIBRATE key.
6. Increase or decrease the value by pressing the appropriate vertical CALIBRATE key.
7. Wait for the real-time mV value to stabilize.
8. To file the calibration and exit the calibrate mode, press either MENU SELECTION key.

6.5 Two-Point Buffer Calibration (Span)
When first installing an electrode, a two-point buffer calibration should be used to compensate for electrode slope variations or efficiency.

Procedure:
1. Perform a one-point calibration as outlined in section 6.4.
2. Press the appropriate MENU SELECTION key to reach the Electrode Span Menu and locate the cursor under the "2" as illustrated.
3. For diagnostic reasons note the pH and mV values from the prior calibration.
4. Press both horizontal CALIBRATE keys simultaneously to enter the calibrate mode. Observe the diagnostic value on the bottom line becomes a real-time value and that the term "CAL" has disappeared.
5. To change the buffer point, position the cursor under the desired digit using the left-hand CALIBRATE key.
6. Increase or decrease the value by pressing the appropriate vertical CALIBRATE key.
7. Wait for the real-time mV value to stabilize.
8. To file the calibration and exit the calibrate mode, press either MENU SELECTION key.

A perfect electrode slope (efficiency) is -59.1 mV/pH and ORP is 1mV/mV. If the value falls below -50.0 mV/pH or ORP .9 mV/mV, the electrode should be serviced or replaced.

IMPORTANT
If a flashing asterisk appears during or after calibration, the electrode may require service, or the buffer solution may be contaminated. Refer to section 5.6 for details.

NOTE:
Comparing the millivolt values before and after the calibration provides a valuable diagnostic tool in determining the degradation of the electrode. Large differences between calibrations may indicate coating or damage to the measurement half-cell.

6.6 Calibration Using a Grab Sample as a Standard
The system C22 allows easy standardization to a grab sample value by placing the process value into the first calibration point.

Procedure:
1. Record the pH value of the process when the sample is extracted.
2. Record the pH value of the grab sample.
3. Calculate the difference between the two values as follows:
4. Immediately before making the calibration adjustment, note the current pH value on the display and add the pH differential to the current value. This "total adjusted" value is entered as the buffer value.

6.7 Calibration Error Detection & Electrode Operational Guidelines
If the slope calibration performed in section 6.5 is not within the predetermined limits of the instrument, a flashing asterisk (*) will appear.

The presence of the asterisk indicates a potential calibration problem. In general, if the asterisk appears, the integrity of the electrode, the buffer solutions or the handling procedure should be questioned. See the pH/ORP sensor manual for specifics on the electrode.

6.8 Back-to-Factory Calibration
This feature allows the system C22 to be reset to "ideal electrode" (Nernst equation) for electrode potentials. According to the Nernst equation, an ideal pH electrode has a zero isopotential at 7.00 pH and a slope of -59.16 mV per pH unit, an ORP electrode has an ideal slope of 1 mV per ORP. This feature is very useful in providing a reliable starting point if the SYSTEM C22 has been mis-calibrated.

IMPORTANT: Ideal instrumentation calibration does not imply ideal system calibration.

The following procedure for returning the System C22 to factory calibration can be used for both standardize and span calibrations.

Procedure at the Standardization Menu:
1. Position the cursor under the "C" in "Cal."
2. Press both horizontal CALIBRATE keys simultaneously and observe the cursor briefly move to the right. The default setting is complete.
3. This procedure is required at BOTH of the calibration points.
# 7.0 SYSTEM C22 Model Number Designators

Basic System C22 controller is 110VAC powered, in a 1/2 DEN, NEMA 4X enclosure, back lit graphics display, with a membrane keypad. Requires an external 24vdc to power the outputs (see options section for the internally generated 24vdc)

## MODEL NUMBER EXAMPLE: C22-PH/MA-PS2-UM

### Base Model:
- **C22**: System C22 controller

### CHANNEL 1 INPUT:
- **PH**: pH
- **ORP**: Oxidation Reduction Potential (REDOX)
- **DO**: Dissolved Oxygen (specify ppm or %)
- **PION**: Specific ion
- **CDL**: Conductivity, Low range (20uS or less)
- **CDH**: Conductivity, High range (50uS to 50mS)
- **CDT**: Conductivity Toroidal (electrodeless greater than 50mS)
- **RS**: Resistivity (0 to 50 megohms)

### CHANNEL 2 INPUT:
- **PH**: pH
- **ORP**: Oxidation Reduction Potential (REDOX)
- **DO**: Dissolved Oxygen (specify ppm or %)
- **PION**: Specific ion
- **CDL**: Conductivity, Low range (20uS or less)
- **CDH**: Conductivity, High range (50uS to 50mS)
- **CDT**: Conductivity Toroidal (electrodeless greater than 50mS)
- **RS**: Resistivity (0 to 50 megohms)

### Channel 3 INPUT:
- **EX**: Input from an external 4 to 20mA device
- **EX1**: Input from an external relay contact device

### * SENTINEL DIAGNOSTIC:
- **DIAG1**: Sentinel Diagnostic on channel 1
- **DIAG2**: Sentinel Diagnostic on channel 2

### ** NUMBER OF 4 TO 20 MA OUTPUTS:
- **1mA**: One 4 to 20mA Current Output
- **2mA**: Two 4 to 20mA Current Outputs
- **3mA**: Three 4 to 20mA Current Outputs
- **4mA**: Four 4 to 20mA Current Outputs
- **5mA**: Five 4 to 20mA Current Outputs
- **6mA**: Six 4 to 20mA Current Outputs

### HART
- **HT**: Hart protocol option
TYPE OF RELAY CONTACTS:
SS  SOLID STATE 240VAC 3amp
C   Form C (SPDT)

NUMBER OF RELAY CONTACTS:
/2  Two relay contacts
/4  Four relay contacts
/6  Six relay contacts
/8  Eight relay contacts

MOUNTING HARDWARE:
UM  Universal mounting plate
PM  Panel mounting hardware
HM  Handrail mounting plate (including 2” hardware)

OPTIONAL POWER REQUIREMENTS:
PS1  Standard powered by 120VAC
PS2  24 vdc Internally generated to power the 4 to 20 mA output cards
     Standard. (if customer does not require 24vdc subtract $40)
PS3  C22 controller powered by 24vdc

SPECIAL OPTIONS
F2  Output = function of dual inputs: ratio, free chlorine,
     differential, average: SPECIFY!
*** %C  Percent (%) ion concentration display only
     (Available for Conductivity only)
PA  Signal conditioner mounted inside transmitter enclosure.
AV  Field selectable time average (2 to 32 seconds)
T1  Periodic timer
T2  One-Shot timer
LG  Logic Gates Field configurable
PT  Special temperature input from sensor 1000 ohm pt
PID 3 mode proportional control
TPC Time Proportional Control (Requires 2 solid state relay contacts)
GO2 Gaseous Oxygen (O2)

For options not listed, consult factory for price and availability.

*  Diagnostic Feature is only available on pH, ORP, and Pion. If the diagnostic option is selected
    the sensor and electrode must also contain the diagnostic option for the feature to function.
** 4 to 20mA Current outputs are field configurable. If the outputs are to be configured by ECD
    at time of shipment the output parameters must be specified. If not specified the outputs will
    be configured as standard 4 to 20mA outputs corresponding to the specified input.
*** If an output is required along with the display a second output must be specified.

Output configuration options:
MA  4-20 mA, standard
TMP 4-20 mA, Temperature (adjustable -100 to +200°C)
PID 4-20 mA, 3 mode control
% (ion) mA  % concentration for display and 2nd output (Conductivity only)
DIAG Sentinel Reference Diagnostic
## APPENDIX A

### SPECIFICATION SUMMARY

#### C22 SERIES SYSTEM

<table>
<thead>
<tr>
<th><strong>INPUT MEASUREMENT PARAMETERS</strong></th>
<th><strong>REPEATABILITY</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity, Resistivity, pH, Specific Ion concentrations, Dissolved Oxygen &amp; ORP</td>
<td>+/- 0.1%</td>
</tr>
<tr>
<td>Plus external events &amp; analog inputs can be integrated logically or operational modifiers.</td>
<td><strong>TEMPERATURE COMPENSATION</strong></td>
</tr>
<tr>
<td><strong>OUTPUTS</strong></td>
<td>Automatic, -30 to +140°C, RTD. Accuracy within +/-1.0°C over a 0 -100°C span.</td>
</tr>
<tr>
<td>4-20 Ma, Hart or RS232</td>
<td><strong>50/60 Hz NOISE REJECTION</strong></td>
</tr>
<tr>
<td>Up to a maximum of 6 analog outputs.</td>
<td>Greater than 70 db</td>
</tr>
<tr>
<td><strong>POWER REQUIREMENTS</strong></td>
<td><strong>INPUT/OUTPUT ISOLATION</strong></td>
</tr>
<tr>
<td>24 vdc 0.25A or line power (115VAC, 220VAC)</td>
<td>Maximum 300 volts between process input and any 4-20 mA output (single and multiple channel outputs). External inputs must be isolated.</td>
</tr>
<tr>
<td><strong>MAXIMUM LOOP IMPEDANCE</strong></td>
<td><strong>CALIBRATION</strong></td>
</tr>
<tr>
<td>800 ohms on 4-20ma outputs with internal 24VDC.</td>
<td>Auto Calibration allows the definition of two calibration points, saved in memory, during the initial start-up. This will allow subsequent standardize and span calibrations with only 2 keystrokes. Calibration parameters are initiated by the configuration settings.</td>
</tr>
<tr>
<td><strong>OPERATING TEMPERATURE</strong></td>
<td><strong>CONFIGURABILITY (Setup mode)</strong></td>
</tr>
<tr>
<td>-4 °F to +158 °F (-20 °C to +70 °C)</td>
<td>Parameter graph, Relays (up to 8) solid state or SPDT mechanical, 8 internal clocks &amp; timers (one shot or periodic), 4 current outputs (4-20ma) &amp; 2 PID current outputs, logical function (and/or gates) can all be setup as desired in the configuration menu’s.</td>
</tr>
<tr>
<td><strong>DISPLAY</strong></td>
<td>5 A switching mechanical relays, .065-3A 230VAC solid state with 600W total load without additional heat sinking precautions.</td>
</tr>
<tr>
<td>2.5”x1.75” Supertwist backlit graphic LCD.</td>
<td><strong>Password Protection</strong></td>
</tr>
<tr>
<td><strong>ENCLOSURE</strong></td>
<td>Multilevel password configuration allows selection of protected parameters in operational &amp;/or configuration routines.</td>
</tr>
<tr>
<td>NEMA 4X, weatherproof</td>
<td><strong>Sentinel Compatible (2 channels)</strong></td>
</tr>
<tr>
<td>1/2 DIN (5.67 x 5.67 x 3.50)</td>
<td>Built in concentration curves for conductivity measurements. (HCl, H₂SO₄, NaOH, NaCl, HF, HNO₃, KOH, etc)</td>
</tr>
</tbody>
</table>

**shipping weight**

Standard: 4 lbs.

**accuracy**

+/- 0.10% of full scale

**linearity**

+/- 0.05% of full scale

**sensitivity**

+/- 0.05%

**stability**

+/- 0.2% per year @ 0 to 70 °C

**response time**

1 second to reach 90% of the change.

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Electro-Chemical Devices, Inc
Bringing Simplicity To A Solution
CARD MODULE/PWR SUPPLY

TB1
1 - SIG 1 (WHT)
2 - REF (RED)
3 - +V (GRN)
4 - –V (BLK)
5 - TC (YEL)
6 - TC (BLU)

CHANNEL 1
PH, DO, OR ORP SENSOR

POWER SUPPLY

+5VDC GND 1
+24VDC 1
-24VDC 1
+24VDC
-24VDC

TB5
6 - PH TC 2
5 - PH TC COM
4 - GND
3 - +5V
2 - PH REF
1 - PH SIG 2

CHANNEL 2
PH, DO, OR ORP SENSOR

4 - 20mA
TB1 - 2

OUTPUT 1 - PH, DO, OR ORP

OUTPUT 2 - PH, DO, OR ORP

SENSORS MAY BE PH, DO, ORP,
OR ANY ION SPECIFIED SENSOR

NOTES: UNLESS OTHERWISE SPECIFIED.