OPERATING INSTRUCTIONS FOR

LXT-220

Dissolved Oxygen Controller

P/N Mxxxxx

ECO:

DANGER

Toxic gases and or flammable liquids may be present in this monitoring system.

Personal protective equipment may be required when servicing this instrument.

Hazardous voltages exist on certain components internally which may persist for a time even after the power is turned off and disconnected.

Only authorized personnel should conduct maintenance and/or servicing. Before conducting any maintenance or servicing, consult with authorized supervisor/manager.

Teledyne Analytical Instruments

Warranty

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgements provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by TI/AI or an authorized service center. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

Important Notice

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of TI/AI at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

Teledyne Instruments/ Analytical Instruments, the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

Specific Model Information

Instrument Serial Number: _____

Instrument Range: _____

Calibrated for: _____

Safety Messages

Your safety and the safety of others is very important. We have provided many important safety messages in this manual. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:

GENERAL WARNING/CAUTION: Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily Injury and/or damage the instrument.

CAUTION: HOT SURFACE WARNING: This warning is specific to heated components within the instrument. Failure to heed the warning could result in serious burns to skin and underlying tissue.

WARNING: ELECTRICAL SHOCK HAZARD: Dangerous voltages appear within this instrument. This warning is specific to an electrical hazard existing at or nearby the component or procedure under discussion. Failure to heed this warning could result in injury and/or death from electrocution.

Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.

No Symbol

NOTE: Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.

CAUTION: THE ANALYZER SHOULD ONLY BE USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.

IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.

This manual provides information designed to guide you through the installation, calibration operation and maintenance of your new process controller. Please read this manual and keep it available.

Occasionally, some instruments are customized for a particular application or features and/or options added per customer requests. Please check the front of this manual for any additional information in the form of an Addendum which discusses specific information, procedures, cautions and warnings that may be peculiar to your instrument.

Manuals do get lost. Additional manuals can be obtained from TI/AI at the address given in the Appendix. Some of our manuals are available in electronic form via the internet. Please visit our website at: www.teledyne-ai.com.

Table of Contents

List of Figures ..... **ix**
List of Tables ..... **x**
Introduction **13**
1.1 Overview 13
1.2 Main Features of the Transmitter 14
1.3 Optional Features 14
1.4 Front Panel 16
1.5 Internal Connections 17
Installation **19**
2.1 Unpacking the Instrument 19
2.2 Mounting 19
2.3 Electrical Connections 20
2.3.1 AC Power 21
2.3.2 Sensor Wiring 21
2.4 Configuring the LXT-220 22
2.5 Calibration 22
Operation **23**
3.1 Using the Front Panel Keys 23
3.1.1 Menu Selection Keys 23
3.1.2 Calibrate Keys 23
3.2 Menus 24
3.2.1 Contrast 25
3.2.2 Main Menu 26
3.2.3 Output Graph 26
3.2.4 Parameter Selection Menu 27
3.2.4.1 Calibration Submenu 27

3.2.4.2 Setup Submenu 28
3.2.4.3 Status Menu 29
3.2.4.4 Exit/Stay Menu 30
3.3 Configuring the LXT-220 30
3.3.1 Password Protection 31
3.3.1.1 Changing Protection Level 33
3.3.1.2 Changing Operational Password 33
3.3.1.3 Changing Configuration Password 34
3.3.2 4-20 mA Output Assignments 35
3.3.3 Manual Mode Assignment 36
3.3.4 HART Output Assignments 38
3.3.5 Relay Assignments 40
3.3.6 Temperature Calibration 40
3.3.7 4-20 Trim 41
3.3.8 Input A/D Converter Trim 42
3.3.9 PID Assignments 43
3.4 Calibration 44
3.4.1 Manual Output Mode 44
3.4.2 Parameter Selection Menu 45
3.4.2.1 Buffer Menu 46
3.4.2.2 One-Point Buffer Calibration (Standardize) 46
3.4.2.3 Two-Point Buffer Calibration (Span) 47
3.4.2.4 Calibration Using a Grab Sample as a Standard 48
3.4.2.5 Calibration Error Detection & Electrode Operational Guidelines 49
3.4.2.6 Back-to-Factory Calibration 49
Maintenance 51
4.1 Routine Maintenance 51
4.1.1 Cleaning 51
4.1.2 Replacement of the Microprocessor: 51
Appendix 53
A.1 Specifications 53

A.4 Model Designation 55
Index..... 59

List of Figures

Figure 1-1: LXT-220 Front Panel....16
Figure 1-2: Internal Layout of the LXT-220 DO Controller 17
Figure 2-1: Opening the Front Panel....20
Figure 2-2: LXT-220 Electrical Connections....21
Figure 3-1: Available Menus and Submenus....25
Figure 3-2: Numerical Entry Using Front Panel Keys 32

List of Tables

Table 3-1: Protection Level Exceptions..... 33
Table 4-1: Troubleshooting..... 52

This is a general purpose instrument designed for liquid measurements in a non-hazardous area. It is the customer's responsibility to ensure safety especially when hot or flammable liquids are being analyzed since the potential of leaks always exist.

The customer should ensure that the principles of operating this equipment are well understood by the user. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the safety of this instrument.

Since the use of this instrument is beyond the control of Teledyne Instruments/ Analytical Instruments, referred as TI/AI, no responsibility by TI/AI, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.

Introduction

1.1 Overview

Teledyne's Model LXT-220 Dissolved Oxygen Controller is a robust and versatile instrument for the measurement and process control of dissolved oxygen in a liquid component. Highly customizable, the Model LXT-220 comes standard with a single 4-20mA current output but can have as many as five. The current output is field selectable and may be expanded to any range within the transmitter's full operating range. It can also be programmed as reverse acting; for example, a 4-20 mA output for a range of 0 to 10 ppm can be reversed to 10 to 0 ppm.

The standard instrument accepts a single input typically from a Teledyne SP1 or SP2 Dissolved Oxygen probe however a dual input option is available. This optional dual input extends the functionality of the instrument to accept conditioned input from a variety of sensors for specific process measurements such as:

- Second Dissolved Oxygen (DO) channel
- Resistivity/conductivity
- pH
- Oxidation-Reduction Potential (ORP)
- Specific Ion

For process control, the microprocessor based LXT-220 Transmitter employs a multi-bus system architecture for PID temperature control and sensor-specific process variable outputs such as DO, pH, ORP, Resistivity/Conductivity, and ion-specific element (ISE) output as a function of multiple inputs. Up to six field-configurable alarm or control relay outputs are available to the user to match individual process needs. These relays can be field configured as high or low alarms. Hysterisis (dead band) is defined by setting the ON and OFF relay values. These relays can be configured to any of the input parameters. (See Section 3.3.5).

The LXT-220 can be upgraded with pre-pHault Diagnostics & HART Communications option which alerts the operator to a pending DO, pH, ORP, or ISE electrode failure.

The LXT-220 is housed in a rugged NEMA-4X housing with all operator switches conveniently located on the front panel.

1.2 Main Features of the Transmitter

The LXT-220 Controller for dissolved oxygen applications incorporates the following standard features:

- Front panel membrane switches
- Menu driven backlit display with contrast adjustment
- Automatic Calibration. This allows calibration points to be defined upon initialization of the transmitter.
- An easy back to factory calibration menu allows the instrument to return to a predetermined factory calibration. The default parameters are: zero electrode offset and –157.5mV/FS slope.
- 4-20mA current output fully expandable to any range within the transmitter's full operating range. The output is field selectable and fully programmable. The current output can be configured to be reverse acting.
- Temperature Conversion. Temperature can be displayed in either Fahrenheit or Celsius. The units can be toggled from one to the other in the field with the conversion calculation performed automatically.

1.3 Optional Features

The Model LXT-220 DO Controller is a versatile instrument designed to meet the needs for liquid analytics and process control across a wide range of applications. There are many options available for the transmitter including:

- **Dual Input:** An optional second input can be provided for pH, ORP, resistivity/conductivity, or Specific Ion. The second input can also be used as a second analysis for dissolved oxygen or as specific compensation for the primary input.

- **PID Output:** 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.
- **Multiple Output:** The standard LXT-220 DO Controller is provided with a single output. With the multiple output option, up to four additional outputs can be added. These outputs can be defined in the field as the process variable (DO, pH, ORP, resistivity, conductivity), 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.

Note: These isolated outputs are floating and require an external 24 VDC power source to operate. TI/AI can supply an internal 24 VDC power supply to power these outputs. Contact the factory for additional information.

- **Alarm Relays:** 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.
- **HART Output:** This option provides both digital and analog outputs that is useful for monitoring and controlling process variables in a multiple output instrument.
- **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.

1.4 Front Panel

The operator interfaces with the instrument from the front panel. Figure 1-1 shows a standard single channel LXT-220 DO instrument front panel. The panel includes the LCD display capable of outputting information in both a textural and graphical format. There are 6 membrane switches (keys) that control the operation of the unit. The keys are in two groups:

MENU SELECT: UP/DOWN (▲/▼) These keys are used to change the display menu and move the cursor vertically. Any menu can be accessed using the appropriate MENU SELECT key. These keys are also used to exit the calibration mode and save calibration data.

CALIBRATE KEYS: UP/DOWN/LEFT/RIGHT (▲/▼/◄/►) 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. These keys are also used to select an item from a menu. See Section 3.1)

The *vertical* CALIBRATE keys are used to perform numeric adjustments to displayed values. Pressing the ▲ CALIBRATE key will increase the value; pressing the ▼ CALIBRATE key will decrease the value.

Figure 1-1: LXT-220 Front Panel

1.5 Internal Connections

All user connections are made inside the unit on removable terminal blocks. Two conduit holes are provided on the NEMA-4X housing, one for low level DC signal and the other for 115VAC power wiring. Access to the terminal blocks is gained after removing the 4 captive jackscrews on the front of the instrument. Figure 2 shows the internal layout of the LXT-220 Controller. A label on the enclosure cover shows the terminal block arrangement for all the wiring along with the model number and the factory assignment of the output signals. These can be changed in the field if the application prefers a different arrangement.

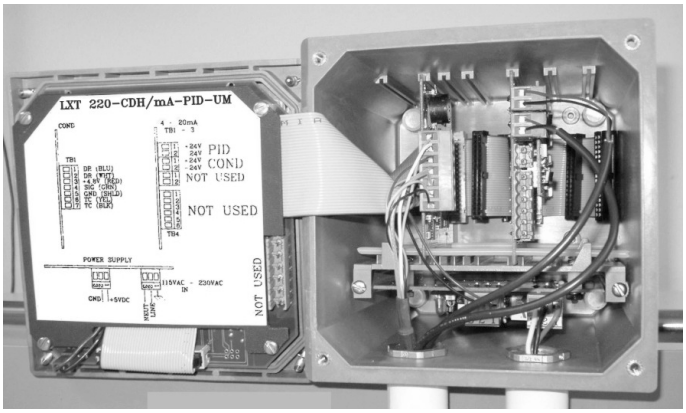


Figure 1-2: Internal Layout of the LXT-220 DO Controller

Installation

Installation of the LXT-220 Controller involves:

- Unpacking the instrument
- Mounting
- Making Electrical Connections
- Configuring the Instrument
- Calibration

2.1 Unpacking the Instrument

The LXT-220 Controller 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 TI/TAI.
3. Save the original packing material until you are satisfied with the contents. In the event the transmitter must be returned to the factory, the packing material will allow you to properly ship it to TI/TAI.
4. Familiarize yourself with the instrument before installation, and follow proper installation and wiring procedures.

2.2 Mounting

Three typical installation configurations are available for the LXT-220:

- Universal mounting plate

- Handrail mounting plate
- Panel mounting configurations.

U-bolts may be ordered separately. Refer to the following application drawings for mounting details:

4024011 Dimensions, wall & pipe mounting.
The unit is supplied with a universal-mounting bracket. Two slots on each side will accommodate U-Bolts for pipe mounting.

4024012 Dimensions, Panel Mounting. This installation uses 1/4" screws. Panel mounting is accommodated using the captive jackscrew that will cinch the instrument bezel against the panel.

2000268 Dimensions, handrail mounting.

These application drawings can be located in the back of this manual.

2.3 Electrical Connections

All electrical connections are made with connectors to a panel inside the NEMA-4X enclosure. To gain access to the panel, use a flat-blade screwdriver to remove the 4 captive screws on the front of the instrument and swing the panel out. See Figure 2-1.

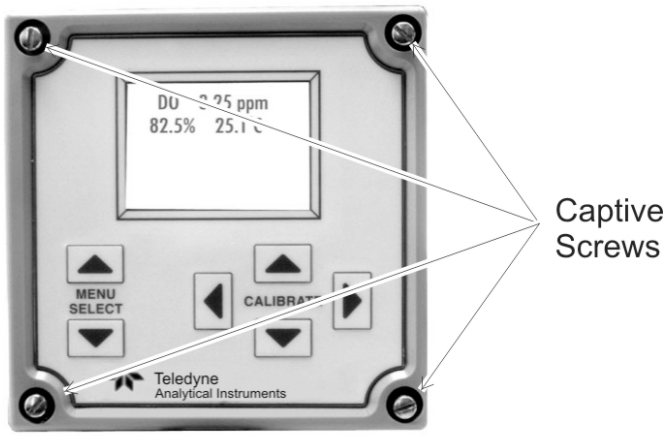


Figure 2-1: Opening the Front Panel

2.3.1 AC Power

The LXT-220 requires a 115 VAC 60 Hz power source. A 24VDC unit is available as an option.

CAUTION: MAKE SURE THE CIRCUIT BREAKER PROTECTING THE AC INPUT LINE IS OFF BEFORE WIRING THE LXT-220.

Application drawing 4024003 illustrates the proper power wiring for single channel LXT-220 as does the affixed label on the backside of the front panel. The wires are best fed through the right conduit as shown in Figure 2-2.

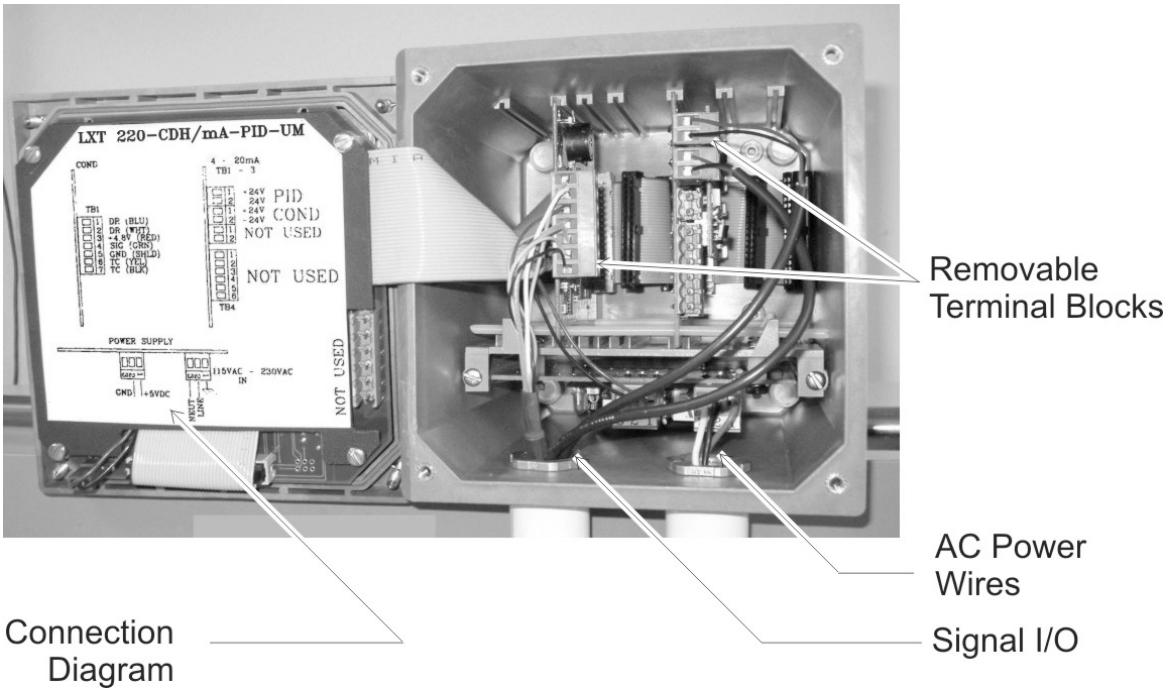


Figure 2-2: LXT-220 Electrical Connections

2.3.2 Sensor Wiring

A conditioned input is required from the sensor or electrode to the LXT-220 for proper operation. Teledyne's SP1 and SP2 sensors will provide the required conditioning. The application drawing 4024003

illustrates the proper sensor wiring and is also shown on the affixed label on the backside of the front panel.

2.4 Configuring the LXT-220

The LXT-220 Controller is used for measurement and control for a wide range of liquid analytical applications. This manual describes the configuration for use in dissolved oxygen measurement and control applications. If your instrument included optional features such as dual channel input for handling other specific measurement processes, a second manual will be included to describe the setup and operational parameters specific to that function.

Configuring the instrument is described in Section 3 of this manual.

2.5 Calibration

Prior to using the instrument for the first time, the LXT-220 must be calibrated. The specific calibration procedure used depends on the application. Among other things, the calibration routine establishes the correspondence between the 4-20mA output signal and the application dependant measurable parameter. This manual describes operation for dissolved oxygen measurements and process control for the LXT-220.

Calibration can be performed without disturbing control or recorder functions using a manual output mode (see Section 3.4.1). Typically, the calibration is done using either a one point buffer calibration (standardization) or two point (span) calibration. There is also a Back to Factory calibration feature which resets the LXT-220 to “typical electrode” for electrode potentials. As the electrode ages it will deteriorate and the mV/FS will decay and eventually require replacement. If the membrane is torn or coated the calibration will be either sluggish or out of range. This feature restores the instrument to the predetermined factory calibration point of zero electrode offset and –157.5 mV/FS quickly.

The calibration routines require a familiarity with the instrument operation and is described after fundamental operational parameters are discussed in Section 3.

Operation

No one instrument has all the options described in this document. Some options must be specified at the time the instrument is purchased, and are not field-alterable. The instrument can be returned to the factory for re-programming if your requirements change.

3.1 Using the Front Panel Keys

Cursor positions or numeric adjustments are performed by pressing the appropriate keypad. The LXT-220 uses an "underscore" cursor in each of the menus. Holding down the keypad will automatically scroll the cursor or numeric values.

Note: Simultaneous pressing 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:

1. Change the display menu and move the cursor vertically. Any menu can be accessed by the use of the appropriate up or down MENU SELECTION key.
2. Exit the calibration mode and save calibration data.

3.1.2 Calibrate Keys

1. 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.
2. Once in the calibrate mode, the cursor can be positioned by pressing the individual right-hand or left-hand horizontal CALIBRATE keys.

3. With the cursor on a user selectable menu item, for instance SETUP in the Parameter Selection Menu, pressing both horizontal CALIBRATE keys will take you to the next lower level of screens: 4-20 mA screen, Relay Setup screen, etc.
4. The *vertical* CALIBRATE keys are used to perform numeric adjustments to displayed values. To use these keys, the LXT-220 must be in the calibrate mode. Pressing the upper (▲) CALIBRATE key will increase the value; pressing the lower (▼) CALIBRATE key will decrease the value.

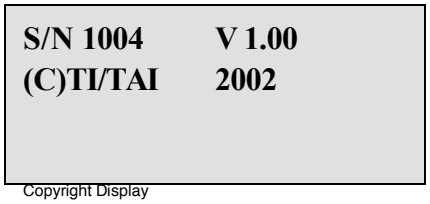
To exit the calibrate mode, press either of the MENU SELECTION keys.

3.2 Menus

The LXT-220 contains a series of menus and submenus from which different functions can be accessed. Even though the display only shows 4 menus per screen, you can scroll through all available menus by using the MENU SELECT ▲ and ▼ keys.

The menus available in the standard LXT-220 instrument configured for single channel dissolved oxygen controllers are shown in Figure 3-1.

When the instrument is first powered up, a copyright display will appear for a few seconds. This screen displays the serial number and software version for your instrument. After a few seconds the display changes to the main menu. From the main menu, you can scroll up (▲) to the contrast menu or down (▼) through the available menus for your controller.



Copyright Display

Some menus allow you to choose from several options. To select an option or item, scroll to the option using the MENU SELECT ▲/▼ keys. When the cursor is next to the item of interest select the item by simultaneously pressing both the left and right (◄/►) CALIBRATE arrow keys on the right side of the front panel.

There may be additional menus not shown in Figure 3-1 depending on the options you selected.

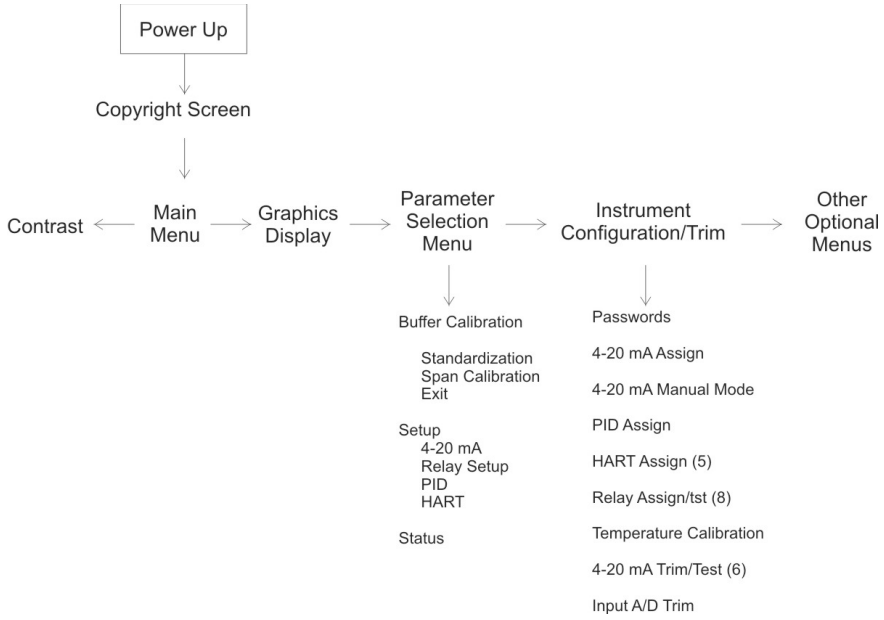
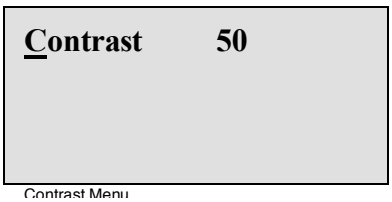


Figure 3-1: Available Menus and Submenus

In this manual, screens with a gray background are related to dissolved oxygen measurement or control while white background screens relate to a second channel process, for instance, ORP related screens. When there is only one gray screen the information applies to both process applications, for example, the contrast screen discussed next adjusts the contrast for all screens.

3.2.1 Contrast

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 LXT-220 controllers and is always located as the uppermost menu. To access this menu from the Main Menu, press the ▲ MENU SELECT key.



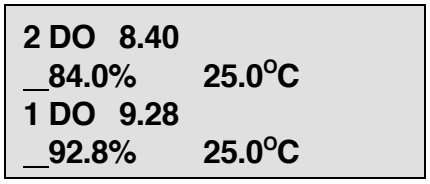
Contrast Menu

Procedure:

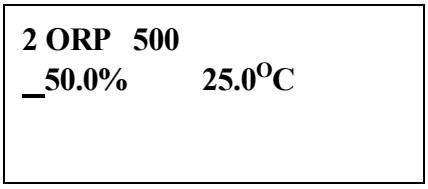
1. Press the upper MENU SELECTION key to reach the Contrast Menu.
2. Press both horizontal CALIBRATE keys simultaneously to enter the calibrate mode. Observe the cursor move to the last digit.
3. Using the horizontal CALIBRATE keys, position the cursor under the digit to be adjusted.
4. Increase or decrease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

3.2.2 Main Menu

This menu appears after the copyright display when power is first applied to the LXT-220. 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. The screens below are for 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.



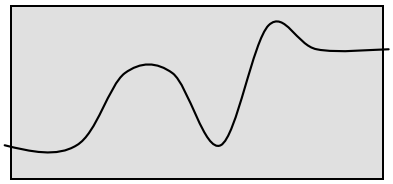
Main Menu, pH



Main Menu, ORP

3.2.3 Output Graph

This screen graphically displays the output current that is set up in the Main screen. The X-axis of the graph display is factory set to ~150 samples (~15min @ 6 sec or .1min/sample). 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.



Graph

3.2.4 Parameter Selection Menu

Parameter Selection Menu

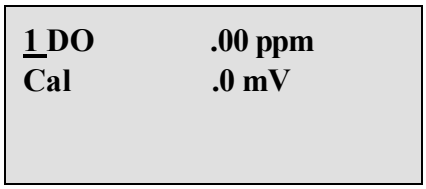
This menu allows you to select what function you would like to perform.

With the cursor on BUFFER, if you press ◄ and ► together the LXT-220 will enter the calibration menus (standardize and span).

Scrolling to and choosing SETUP brings you to where you can configure and setup the instrument. The STATUS section allows the user to view the calibration engineering data (mV input from the sensor and the zero potential 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. The Parameter Selection Menu is discussed in detail in Section 3.4.2.

3.2.4.1 CALIBRATION SUBMENU

Choosing BUFFER from the Parameter Selection Menu brings up a submenu that allows the user to perform a 1 or 2 point buffer calibration (standardize & span). This menu is described in detail in Section 3.4.2 *Calibration*.



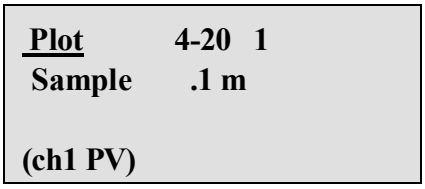
Zero Calibration Menu DO

3.2.4.2 SETUP SUBMENU

Choosing SETUP from the Parameter Selection Menu brings up the first of a series of screens that allows the user to configure some initial parameters in the LXT-220 controller. These parameters are:

- 4 to 20 mA outputs
- relay contacts
- PID control
- HART

You can also setup how the graphic display plots the current output using the Plot function. The menu below shows the Plot function. In this case, the process variable assigned to Channel 1 is plotted and sampled every 6 seconds (.1 min).

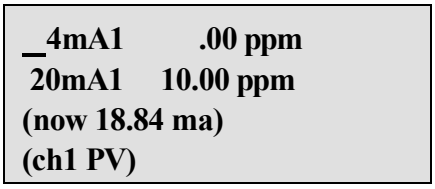


Current output menu

To set up additional parameters or to change to current preset parameters refer to Section 3.3 *Configuring the LXT-220* in this manual.

3.2.4.2.1 CURRENT OUTPUT SETUP

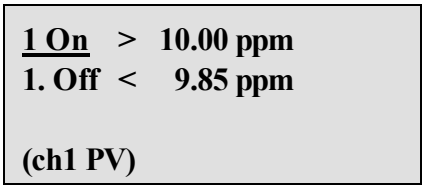
This menu is used to set or adjust the current output range with the process variable. The top line defines the 4 mA point, while the bottom line defines the 20 mA point. Between these points, the output current is linear with respect to the sensor input. The standard LXT-220 provides a single output channel but options are available to expand the number of current outputs to 4. See Section 3.3 Configuring *the LXT-220* in this manual for information on assigning other parameters to additional outputs.



Current output menu

3.2.4.2.2 RELAY CONTACTS

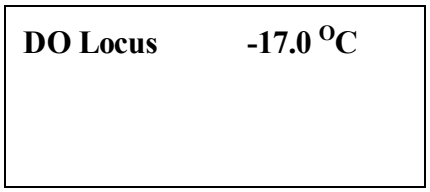
Relay on/off set points are adjusted in this menu. The top line defines the point in which the relay is energized (on) and the bottom line defines the point in which the relay is de-energized (off). The LXT-220 can contain up to 6 sets of relay contacts. Refer to Section 3.3.5 *Relay Assignments* to set up the number of contacts.



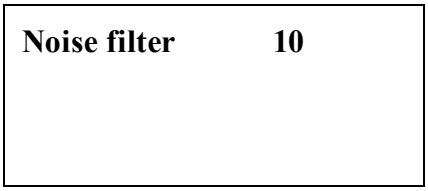
Relay set up menu

3.2.4.2.3 DO LOCUS AND NOISE FILTER SETTINGS

The Locus is the temperature where the different concentrations are equal and is referenced for temperature compensation. The noise filter is adjustable from 1 to 20 to dampen any distracting fluctuations on the sensor



Electrode Data menu ORP

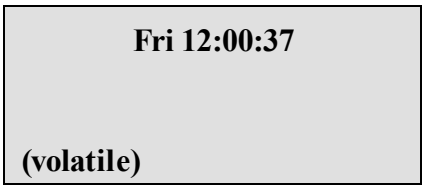


Electrode Data menu ORP

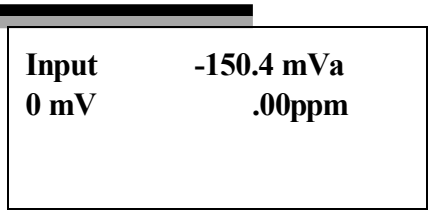
3.2.4.3 STATUS MENU

This menu allows the user to view the time of day clock and the 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, uncompensated for temperature variations. The bottom line displays the electrode zero potential from the last calibration.

This information is extremely helpful in determining the diagnostic status of an electrode. In conjunction with regular calibrations, the Electrode Diagnostic Screen provides valuable information to track electrode performance.



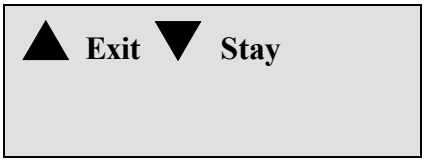
Time of day clock



Electrode Data menu ORP

3.2.4.4 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 LX-



Exit / Stay menu

220 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.

3.3 Configuring the LXT-220

To initially configure or reconfigure the instrument, use the left-side ▲ and ▼ MENU SELECT keys to scroll to the bottom of the menus list and stop when the CONFIGURE/TRIM option is displayed. Simultaneously depress the◄ and ► keys to enter the configuration mode. This mode should be password protected if access to the keyboard is unrestricted. The new configuration remains in effect through indefinite power outages.

The configuration mode is a submenu grouping of 9 or more functions that can be set by the user to tailor the instrument to a particular application. The following 7 functions appear in groups of 4 for a standard instrument:

PASSWORDS

4-20 ASSIGN

4-20 MANUAL MODE

RELAY ASSIGN/TST

°C/°F & TEMP CAL

4-20 TRIM/TEST

INPUT A/D CONVERTER TRIM

Some instruments have two channels measuring two unrelated quantities, and in those cases both channels can be configured from the same configuration menus.

Depending on options selected 2 additional submenus could appear:

PID ASSIGN

HART ASSIGN

Scroll down to the item of interest, and then simultaneously depress the ◄ and ► keys to access the sub-menu for that item.

3.3.1 Password Protection

It is worthwhile to become familiar with the password capabilities of the instrument even if you decide not to use them, as it is possible that one gets set by mistake and you need to change or erase it.

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. See Figure 3-2.

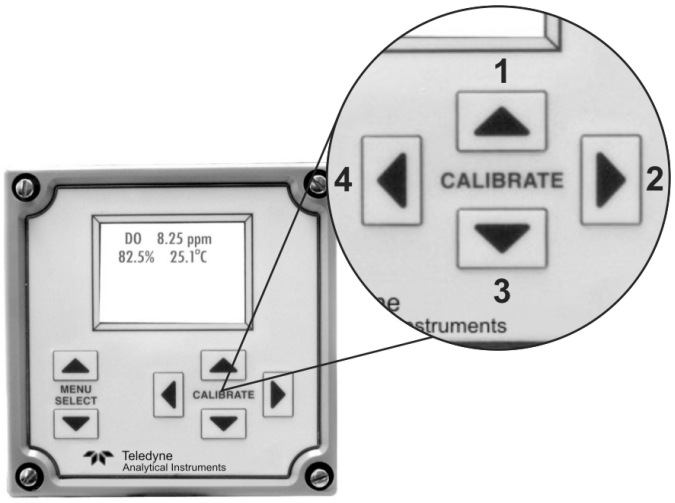


Figure 3-2: Numerical Entry Using Front Panel Keys

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 operational displays can be modified with a single password entry.

If the wrong password is entered three consecutive times in accessing a protected display 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 and you want to gain access to protected screens and/or enter a new password, 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 press, but there will be no other visible indication that the key is recognized. 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.

Note: 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

The protection level for the operational displays is the number on the left side of the second line. 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 Table 3-1, all displays that affect the operation of the instrument are protected. An N entry in the table means that the display is not protected.

Table 3-1: Protection Level Exceptions

level	contrast	man out	1-point buf
1	N	N	N
2	Y	Y	N
3	Y	N	Y
4	Y	Y	Y

3.3.1.1 CHANGING PROTECTION LEVEL

To change the protection level, navigate using the right side (CALIBRATE) ◄/ ► keys to the old protection level number (3 in the above screen). Adjust the numerical value using the right side (CALIBRATE) ▲/▼ keys and then accept the input by pressing either of the left side MENU SELECT) ▲/▼ keys. The old operational password is erased if the protection level is changed to 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.

3.3.1.2 CHANGING OPERATIONAL PASSWORD

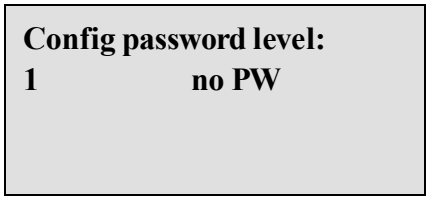
To enter a new operational password, navigate to the old password (or no PW) using the (CALIBRATE) ◄/ ► keys and select by pressing both (CALIBRATE) ◄/ ► keys simultaneously. This brings up the new operational password screen.

Press both (CALIBRATE) ◄/ ► keys again to enter a new operational password. 1 to 8 digits may he entered. Press either of the menu keys to accept the new password when done.

Note: A new password will not be accepted unless the protection level has already been set to a value greater than 0.

3.3.1.3 CHANGING CONFIGURATION PASSWORD

To change the configuration password, use the MENU SELECT ▲/▼ keys to navigate to the PASSWORD menu and select it by pressing both CALIBRATE ◄/ ► keys simultaneously. Use the MENU SELECT ▲/▼ keys to bring the cursor to the Configure password level screen.



To enter a new configure password, navigate to the old password (or no PW) using the (CALIBRATE) ◄/ ► keys and select by pressing both (CALIBRATE) ◄/ ► keys simultaneously. This brings up the new configure password screen.

Press both (CALIBRATE) ◄/ ► keys again to enter a new configure password. 1 to 8 digits may he entered. Press either of the menu keys to accept the new password when done.

Note: A new configure password will not be accepted unless the protection level has already been set to 1.

These two displays work the same as the corresponding operational displays, except that the protection level can only be 0 or 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 usually smaller than that. The maximum number of digits allowed in a password, or the number actually used, cannot be determined by entering trial passwords. A two or three digit password is therefore moderately effective if systematic attempts at breaking the code are not anticipated, but short passwords should nevertheless be avoided in a critical process.

3.3.2 4-20 mA Output Assignments

The next group of displays are used to assign the 4-20 mA outputs.

Note: The LXT-220 has been configured at the factory for your specific application as specified at the time of the order.

Using the MENU SELECT ▲/▼ keys, scroll down to the 4-20 mA ASSIGN option and select it by pressing both CALIBRATE ◄/ ► keys simultaneously. The screen will display 4-20 1: 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
ch2 temp	Channel 2 temperature
ch2 PID	Channel 2 PID controller output

The channel 2 options are only shown on two channel instruments, and specialized instruments may show additional options.

To change the output assignment, first push both CALIBRATE ◄/ ► keys, causing the cursor to move to the right. Then use the right-side CALIBRATE ▲/▼ keys to scroll through the list of options. The list is

cyclic. Use either of the MENU SELECT ▲/▼ keys to accept the selection and move the cursor back to the left. The displayed selection remains in effect until changed and the selection is remembered through power outages of indefinite length.

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 4-20mA 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 software cannot determine how many 4-20 outputs are installed, so the 'missing' selection might not reflect the actual configuration.

Output #4 is dedicated to HART, and its assignment is discussed in the HART section. If the instrument is not connected to a HART network then the fourth output can be used like any of the other outputs. The fourth output is only present if the instrument was purchased with the HART option.

A span display will be present in the setup menu for each 4-20 output that is assigned to a source unless the source is a PID controller. PID controllers have different setup displays, and they are in the same section. If the source is associated with channel 2 then the display will be in the channel 2 group. The new assignment is not usable until the setpoints or PID parameters are specified in the operational displays.

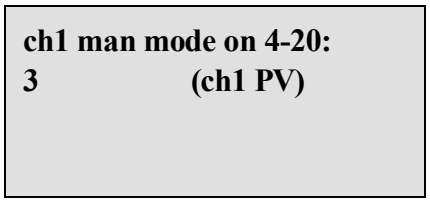
The third line of the display will show a line such as (ch1 man mode) if an assignable manual mode control is associated with the output. The line will begin with a question mark if making the current selection permanent would result in a manual mode assignment conflict. Refer to Section 3.3.3 *Manual Mode Assignment* for more information.

3.3.3 Manual Mode Assignment

In the manual output mode, the current output is manually set to the desired level and saved until changed or released from the manual mode. The main menu display shows the process value and a 4-20 mA percent

output field for each channel. The manual mode assignment allows the percent output display to be associated with any of 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.

Cross-channel assignments are allowed in that the selected 4-20 can be assigned to something on the other channel. Cross-channel assignments can usually be avoided, and they should be avoided when possible.



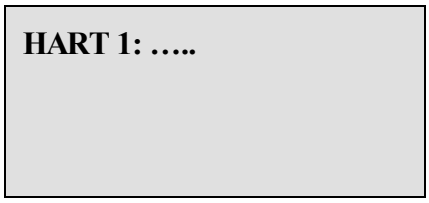
To change the assignment simultaneously depress both CALIBRATE ◄/ ► keys, then use the right-side CALIBRATE ▲/▼ keys to change the selection. One of the selections is “none”, and with that selection the percent output field is not present in the operational display. The bottom line shows the signal that the selected 4-20 is assigned to. On two channel instruments the next display is the manual mode assignment for channel two.

Each 4-20 output can have only one manual mode control assigned to it. If one already exists for the current selection it will be preceded by a question mark. Some instruments have more than two manual mode controls in the operational displays, and they must all he assigned to different 4-20 outputs if they are activated.

The other manual mode controls are built-in in some instruments. An example would he the weight-percent display of a conductivity unit. The manual mode field appears in a separate display in these cases, and it is independent of the manual mode assignments for the main display. The manual mode capability is automatically activated when a 4-20 is assigned to one of these functions. The percent output field does not appear in the operational display unless a 4-20 is assigned to it.

Conversely, when changing the 4-20 assignments a conflict can arise if a 4-20 with a pre-existing manual mode control is reassigned to

a function with its own manual mode output. The 4-20 assignment display will show if the output is associated with an assignable manual mode. Regardless of the cause, the affected operational display manual mode fields will begin with a question mark when a conflict exists. When that happens refer to the manual mode configuration displays, and



the question marks there will show where the problem lies.

No contention occurs unless two different displays are actually in the manual mode for the same 4-20, so the question marks in the displays can be ignored if the assignments are made for diagnostic purposes.

3.3.4 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:

where… represents one of the items from the 4-20 mA assignment list in Section 3.3.2.

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 units code, which identifies the variable as being pH, millivolts, degrees C, etc. The units 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".

HART analog 1:

The first digital output assignment is referred to as the primary variable in the HART system.

HART analog 2:, HART analog 3:, HART analog 4:

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. See Section 3.3.2 *4-20mA Output Assignments*.

It is not possible to assign more than one HART digital output to the same source. The current selection will be preceded by a < symbol on the display if making it permanent would result in duplication.

HART analog: 5

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 #5 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. But 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.

Note: If the HART analog output is assigned to an output other than #5, then #5 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.

3.3.5 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. See Section 3.3.2 *4-20mA Output Assignments*.

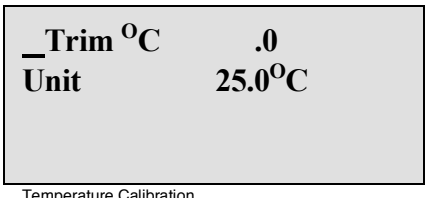
Up to two relays can be assigned to the same source, so one relay can be used to control the process, and another relay can be used as an alarm if the process value is out of limits.

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 nevertheless be present 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.

3.3.6 Temperature Calibration

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



Temperature Calibration

The bottom line shows the measured temperature. To change the displayed temperature so it agrees with a measured value, place the cursor on the top line then simultaneously depress both CALIBRATE ◄/ ► keys. Use the right-side CALIBRATE ▲/▼ keys to 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.

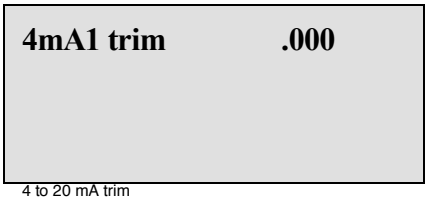
To toggle between degrees C and degrees F, place the cursor on the bottom line and simultaneously depress both CALIBRATE ◄/ ► keys. This will change the unit. Press both keys again to toggle back to the original unit.

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.

3.3.7 4-20 Trim

The next six displays are used to trim the 4-20 outputs. The 4-20 outputs are calibrated at the factory and will never need recalibration in most applications. Periodic recalibration is not recommended.



4 to 20 mA trim

As in the other menus, the cursor moves to the right when both CALIBRATE 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.

Note: The 4-20 #5 output must be trimmed by standard commands sent over the HART communication link.

3.3.8 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 voltmeter 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 optimum 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.

Input A/D converter trim

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 recalibration in normal applications. Periodic recalibration 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.

3.3.9 PID Assignments

Two independent Proportional Integral Derivative (PID) controllers are available as options on all instruments, including one channel units. The sub-menu for assigning the controller inputs is:

PID A: …..
PID B: …..

Where . . . . represents one of the items from the 4-20 mA assignment list in Section 3.3.2. The PID controller outputs in turn represent separate signal sources, and various outputs can be assigned to them.

Not all signal sources are suitable as inputs to a PID processor, and an asterisk on the display marks the selections that are unavailable. Potentially useful sources, such as the process value, temperature, and quantities derived from the measured process value(s) are normally available. The assignment should be set to "unused" if no controller is needed. This will prevent the PID setup displays from appearing in the operational section.

Either PID processor can be assigned to a signal from either channel, and they can both be assigned to signals on the same channel, but they cannot be assigned to the same signal on the same channel. The current selection will be preceded by a question mark on the display if making it permanent would result in duplication.

Up to two 4-20 mA outputs and up to two relays can be assigned to each PID processor output. The output of the PID processor is discarded if nothing is assigned to it.

If a 4-20 mA output is assigned to a PID processor there will be no display for it in the setup section of the operational displays, as the 4-20 output scaling is fully specified by the PID setup parameters in the same section. If relays are assigned to a PID output there will be setpoint

displays for them in the setup section, and they can be used for alarm purposes or otherwise. The bottom line of the display will identify the relay as being assigned to a PID output, and it will also show what the input to the PID processor is assigned to.

A 0% relay setpoint refers to the minimum PID output, which corresponds to a current of 4 mA on any current loops assigned to the PID, and a 100% setpoint corresponds to a 20 mA current. When 4-20 mA outputs are assigned to a PID output, it is helpful to assign one of the manual mode displays (Section 3.3.3) to one of the them so that the percent output of the controller will be visible in the operational displays.

See Section 3-5 *Proportional Control Setup and Configuration* for configuring and setting up the optional PID control feature.

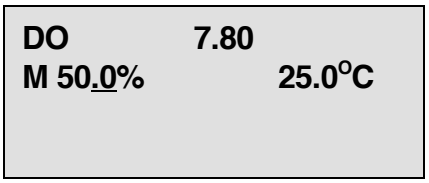
3.4 Calibration

Calibration involves performing either a one-point standardization calibration or two-point span calibration. These choices are available after choosing BUFFER from the Parameter Selection Menu

3.4.1 Manual Output Mode

In order to perform calibrations without interfering with control or recorder functions, the LXT-220 incorporates a manual output mode. In the manual output mode, the current output is set to the desired level and saved until changed or released from the manual mode. On LXT-220s with the optional PID controller output on channel 2, the current output displayed is the PID controller output. The following procedure demonstrates the use of the manual output.

Note: Prior to any calibration, The LXT-220 controller should be placed into the manual mode



Main Menu, DO

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" appearing in front of the % current output value. The "M" signifies that the manual output is locked in the manual mode.
3. Using the horizontal CALIBRATE keys one at a time, position the cursor under the digit to be adjusted.
4. Increase or decrease the value by pressing the appropriate vertical ▲/▼ CALIBRATE key.

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. This "M" signifies that the transmitter output is in manual.
3. Press only the left-hand ◄ CALIBRATE key and observe the "M" disappear, releasing the LXT-220 from the manual output mode. The % output value will return to the real-time current output.

3.4.2 Parameter Selection Menu

Scroll down from the main menu to reach the parameter set up menu. Once in the Parameter set up menu select the function you would like to enter.

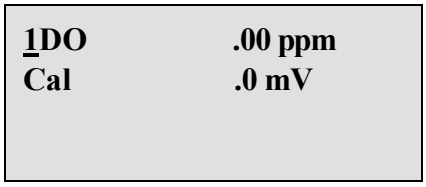
- BUFFER: Perform a 1 or a 2 point calibration
- SETUP: Set up the range of the 4-20 mA output
- STATUS: Information only. Shows the data stored from the last calibration.

3.4.2.1 BUFFER MENU

From the parameter selection menu chose the top line (the BUFFER command) and press the two horizontal ◄► CALIBRATE keys simultaneously to enter the BUFFER calibration submenu. Both the one-point calibration (standardize) and the two-point (span) calibrations are available within this menu. The procedures for each calibration function are given below.

3.4.2.2 ONE-POINT BUFFER CALIBRATION (STANDARDIZE)

Because all dissolved oxygen 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 dissolved oxygen sensor manual.



Standardization menu pH

Procedure:

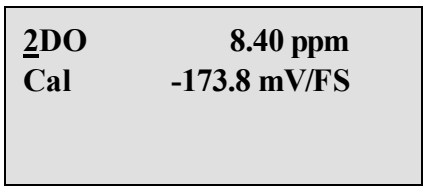
1. Be sure that the cursor is located under the "1" as illustrated.
2. For diagnostic reasons note the ppm and mV values from the prior calibration.

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 save the calibration and exit the calibrate mode, press either MENU SELECTION key.

A perfect electrode slope (efficiency) is typically greater than -150. mV/FS. If the value falls below -100.0 mV/FS, the electrode should be serviced or replaced.

3.4.2.3 TWO-POINT BUFFER CALIBRATION (SPAN)

When first installing an electrode, the second cal point establishes the slope variations or efficiency. The span is typically done in air which is the saturation point of the solution when in equilibrium.



Span calibration menu pH

Procedure:

1. Perform a one-point calibration as outlined in Section 3.4.2.2.
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 DO and mV/FS 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 typically greater than -150.0 mV/FS. If the value falls below -100.0 mV/FS, 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.***

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.

3.4.2.4 CALIBRATION USING A GRAB SAMPLE AS A STANDARD

The LXT-220 allows easy standardization to a grab sample value by placing the process value into the first calibration point.

Procedure:

1. Record the O_2 value of the process when the sample is extracted.
2. Record the O_2 value of the grab sample.
3. Calculate the difference between the two values as follows:

(Grab sample value) - (Displayed value) = differential

4. Immediately before making the calibration adjustment, note the current value on the display and add the differential to the current value. This "total adjusted" value is entered as the buffer value.

3.4.2.5 CALIBRATION ERROR DETECTION & ELECTRODE OPERATIONAL GUIDELINES

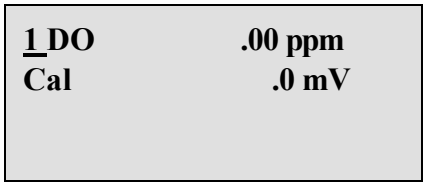
If the slope calibration performed in Section 3.4.2.3 is not within the predetermined limits of the instrument, a flashing asterisk (*) will appear.

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 dissolved oxygen sensor manual for specifics on the electrode.

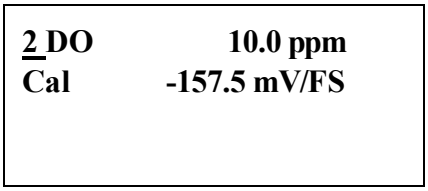
3.4.2.6 BACK-TO-FACTORY CALIBRATION

This feature allows the LXT-220 to be reset to "typical electrode" for electrode potentials. As the electrode ages it will deteriorate and the mV/FS will decay and will eventually require replacement. If the membrane is torn or coated the calibration will be either sluggish or out of range.

The following procedure for returning the LXT-220 to factory calibration can be used for both standardize and span calibrations.



Standardization menu DO @ factory default settings



Standardization menu @ factory default settings

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.

Maintenance

4.1 Routine Maintenance

Aside from normal cleaning routine maintenance is limited to recalibration. For recalibration, see Section 3.4 *Calibration*. However, if service of the internal components is required always turn off the power to the instrument.

4.1.1 Cleaning

Although the LXT-220 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.

CAUTION: 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.

4.1.2 Replacement of the Microprocessor:

For replacement of the microprocessor, contact the factory.

CAUTION: NEVER INTERCHANGE EPROMS FROM ONE TRANSMITTER TO ANOTHER. DOING SO WILL AFFECT TRANSMITTER PERFORMANCE.

Table 4-1: Troubleshooting

SYMPTOM	POSSIBLE CAUSES	SUGGESTED ACTION
The LCD does not display.	No power to the instrument.	Check power supply to be sure the correct voltage is being supplied to the transmitter.
	Contrast level is set too low.	Set contrast level to a higher value. Because the contrast menu is always the top menu, it can be reached by pressing the upper MENU SELECTION key at least 12 times. Enter the calibrate mode and increase the value.
	Sensor or signal conditioner has a short that draws too much power from the transmitter.	Check the sensor for proper operation. To verify, disconnect all sensor wires and cycle power off, then on.
	The PROM has not been properly installed in the socket.	Check orientation of the PROM to the socket. Make sure the pins are fully inserted and are not bent.
Readings are not linear at the low end of the range.	The sensor range is not compatible with the instrument.	Verify the sensor range. Install a sensor with the correct range.
Erratic readings.	Air bubble in sensor.	Check orientation of sensor.

Appendix

A.1 Specifications

Packaging: NEMA-4X weatherproof enclosure suitable for general purpose application

Power Requirements: 115/220 VAC or optionally 24 VDC 0.25A

Display: Menu driven Supertwist LCD. Simultaneously displays process ID, Process value in Eng. units, % output and temp in °C or °F.

Sensor: Application specific

Input Measurement Parameters:
Conductivity, Resistivity, pH, Specific Ion, Dissolved Oxygen, ORP.
Also, external events and analog inputs can be integrated logically or operational modifiers.

Outputs: 4-20 mA, HART or RS232 up to a maximum of 6 analog outputs.

Response Time: 90% of step change in 1 second

Accuracy: ±0.10% of full scale

Linearity: ±0.05% of full scale

Sensitivity: ±0.05%

Stability: ±0.2% per year @ 0 to 70°C

Repeatability: ±0.1%

Input/Output Isolation: Max 300V between process input and any 4-20mA output

Maximum Loop Impedance: 800Ω on 4-20 outputs with internal 24VDC

Digital Interface: HART option

Operating Temperature: -4° to 158°F (-20° to 70°C)

Dimensions: 5.67" H, 5.67" W, 6.97" D

Temp. Compensation: Automatic, -30 to 140°C, RTD. Accuracy within ±1.0°C over a 0-100°C span.

50/60Hz Noise Rejection: Greater than 70 db.

Calibration: Auto calibration allows the definition of two calibration points, saved in memory, during the initial startup. This will allow subsequent standardization and span calibrations with only 2 keystrokes. Cal parameters initiated by configuration settings.

Configurability: Parameter graph. Relays (up to 8) solid state or SPDT mechanical, 8 internal clocks and timers (one-shot and periodic), 4 current outputs (4-20mA) and 2 PID current outputs, logical function (and/or gates) can all be setup as desired in the configuration menus.
5A switching mechanical relays, .065-3A 230VAC solid state with 600 W total load without additional heat sinking precautions.

Password Protection: Multilevel password configuration allows selection of protected parameters in operational and/or configuration routines.

Sentinel Compatible: 2 channels

Conc. Curves: Built-in for conductivity measurements: HCl, H_2SO_4, NaOH, NaCl, HF, HNO_3, KOH, etc.

A.2 Model Designation

The standard LXT-220 controller is 110VAC powered unit in a 1/2 DIN, NEMA 4X enclosure. It incorporates a backlit graphics display and a membrane keypad. This instrument requires an external 24VDC to power the outputs. An option is available for an internally generated 24VDC powered instrument.

The instrument is configured at the factory for the customer's application and so there are many different model designators.

The following codes will help in identifying a specific instrument configuration.

Base Model:

LXT-220	LXT-220 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 then 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 then 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

PS3 LXT-220 controller powered by 24 VDC

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 Teledyne 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

As an example:

MODEL NUMBER EXAMPLE: LXT-220-PH/MA-PS2-UM

This indicates the LXT-220 Controller for pH applications with a standard single 4-20mA output. The controller has an internal 24 VDC power supply to power the output card. The instrument is equipped with a universal mounting plate.

Index

A to D converter trim, 42
AC power. *See* power
accuracy, 42, 53
address, 55
air, 47
alarm, 13, 15
  HI, 13
  LO, 13
alarm relay, 40
analog to digital converter, 42
ASSIGN, 35
assigning parameters, 28
assignment conflict, 36, 37
auto calibration, 54
automatic calibration, 14
back to factory calibration, 14, 22, 49
backlit graphics display, 57
BUFFER, 27, 44, 46
CALIBRATE key, 16, 23
  numerical equivalence, 31
calibrate mode, 23
calibration, 22, 44
calibration menu, 27
calibration voltage, 42
caution sign, iv
change the protection level, 33
changing output assignment, 37
cleaning, 51
command #3, 38
command #35, 39
concentration curves, 54
conductivity, 13, 14, 53
conduit, 21
conduit hole, 17
configuration password. *See* password
CONFIGURE/TRIM, 30
configuring LXT-220, 30
connections, 17
contrast, 52
contrast menu, 24, 25
copyright, ii
copyright display, 24
cross-channel assignment, 37
current output, 26
  configure, 28
decreasing a value, 16
dedicated output, 39
default parameters, 14
diagnostic feature, 59
digital interface, 54
digital signal, 39
dimensions, 54
display, 14, 16, 53
display contrast, 25
dissolved oxygen, 13, 14, 24, 53
dissolved oxygen electrode, 46
dual channel input, 22
dual input. *See* input
dual input option, 13
efficiency, 47
electrical connections, 20
electrode, 29
electrode degradation, 22, 46
electrode diagnostic screen, 29
electrode failure, 14
electrode performance, 29
electrode potential, 22
electrode slope, 47, 48
electrode variation, 46
enclosure. *See* NEMA-4X
Err PW, 32
erratic reading, 52
error detection, 49
EXIT/STAY MENU, 30
external event, 53
factory calibration point, 22
feature codes, 57
features, 14
figures listing, ix
flashing asterisk, 49
front panel, 16
gasket, 51
grab sample, 48
gray screen, 25
HART, 14, 15, 28, 36, 38, 40, 53, 54
HART analog output, 39

HART assignment, 38, 39
hysteresis, 15
hysterisis, 13
impedance, 54
incrementing a value, 16
input, 13, 27
  conditioned, 21
  dual, 14
input range, 42
installation, 19
internal clock, 54
internal layout, 17
internal power supply, 15
isolation, 53
keyboard control, 37
LCD. *See* display
linear, 28
linearity, 53
locus, 29
low level DC signal, 17
main menu, 24, 26
manual mode, 26, 37
manual mode assignment, 37
manual output mode, 22, 36, 44
manuals, additional, v
measurable parameter, 22
membrane, 22, 49
membrane switche. *See* switch
menu options, 24
MENU SELECT key, 16, 23
menus, 24
microprocessor, 13
microprocessor replacement, 51
missing assignment, 36
model designation, 57
mounting bracket, 20
mounting plate
  handrail, 20
  universal, 19
multi-bus architecture, 13
multi-drop mode, 39
NEMA 4X, 57
NEMA-4X, 14, 17, 20, 53
no display, 52
noise filter, 29
noise rejection, 54
non-linear reading, 52
numeric adjustments, 16, 23
one point calibration, 22
one-point calibration, 44, 46
opening the front panel, 20
operating temperature, 54
operation, 23
operational password, 32
options, 14
ORP, 14, 22, 42, 53
output, 13, 28
  analog, 53
  assignment, 35
  averaged, 15
  configure, 28
  correspondence, 22
  current, 14, 36, 54
  current, adjust, 26
  dirrerential, 15
  floating, 15
  graphic display, 26
  isolated, 15
  multiple, 15
  PID, 15, 43, 54
  ratio, 15
  signal factory assignment, 17
output configuration options, 60
oxidation-reduction potential. *See* ORP
panel mounting, 20
parameter selection menu, 27, 45
password, 31, 54
  configuration, 34
  operation, 33
percent output display, 37
pH, 14, 53
PID, 13, 15, 28, 36, 40, 43
  minimum output, 44
PID assignment, 43
plot function, 28
power, 17, 21, 53
pre-pHault diagnostics, 14
primary variable, 38
probe, 13
process control, 13, 40
process variable display, 26
proportional band, 15
protection level, 32, 34
question mark, 36, 37, 43
rate, 15
relay, 15, 29, 54
  configure, 28
relay assignment, 40
relay configuration menu, 40
relay output, 13

relay setpoints, 40
release manual output, 45
repeatability, 53
reset, 15
resistivity, 13, 14, 53
response time, 53
restore password, 32
reverse acting, 13, 14
routine maintenance, 51
RS232, 53
safety information, iv
saturation point, 47
scale factor, 42
sensitivity, 53
sensor
  SP1 & SP2, 21
sensor orientation, 52
sensor wiring, 22
serial number, iii, 24
SETUP, 27, 28, 46
shipping damage, 19
slope variation, 47
software, 15
software version, 24
span calibration, 22, 44
span display, 36
span setting, 39
specific compensation, 14
specific ion, 13, 14, 42, 53
specifications, 53
stability, 53
standardization, 22, 44, 46
STATUS, 27, 46
STATUS menu, 29
submenus, 24
Supertwist, 53
switch, 14, 16
tables listing, x
technician symbol, iv
Teledyne address, 55
temperature calibration, 40
temperature compensation, 54
temperature control, 13
temperature conversion, 14, 41
terminal block, 17
timer, 32, 54
trim, 41
troubleshooting, 52
two point calibration, 22
two-point calibration, 44, 46
typical electrode, 22, 49
U-bolt, 20
undisturbed output, 26
warning sign, iv
warranty, ii
weatherproof, 53
web address, 55
website address, v
white screen, 25
wiring, 21
wiring label, 17, 21
zero electrode offset, 14, 22
zero potential, 27, 29