Honeywell

UDA2182
Universal Dual Analyzer
Product Manual

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Notices and Trademarks

Revision 0 Feb 2005

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Contact your local sales office for warranty information. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Industrial Measurement and Control

Honeywell
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Fort Washington, PA 19034

About This Document

Abstract

This document provides descriptions and procedures for the Installation, Configuration, Operation, and Troubleshooting of your UDA2182 Universal Dual Analyzer.

Contacts

World Wide Web

The following lists Honeywell's World Wide Web sites that will be of interest to our customers.

Honeywell Organization	WWW Address (URL)
Corporate	*http://www.honeywell.com*
Industrial Measurement and Control	*http://www.honeywell.com/imc*

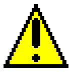
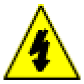
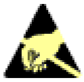
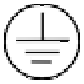
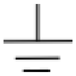
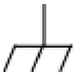
Telephone

Contact us by telephone at the numbers listed below.

	Organization	Phone Number	
United States and Canada	Honeywell	1-800-423-9883 1-800-525-7439	Tech. Support Service

Symbol Definitions

The following table lists those symbols used in this document to denote certain conditions.

Symbol	Definition
	This **CAUTION** symbol on the equipment refers the user to the Product Manual for additional information. This symbol appears next to required information in the manual.
	**WARNING** **PERSONAL INJURY**: Risk of electrical shock. This symbol warns the user of a potential shock hazard where **HAZARDOUS LIVE** voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible. Failure to comply with these instructions could result in death or serious injury.
	**ATTENTION,** Electrostatic Discharge (ESD) hazards. Observe precautions for handling electrostatic sensitive devices
	Protective Earth (PE) terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	Functional earth terminal. Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to protective earth at the source of supply in accordance with national local electrical code requirements.
	Earth Ground. Functional earth connection. NOTE: This connection shall be bonded to Protective earth at the source of supply in accordance with national and local electrical code requirements.
	Chassis Ground. Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

Contents

Tables

Figures

1 Introduction

1.1 Overview

Multi-function instrument

The UDA2182 Universal Dual Analyzer is the next level of dual channel analyzers providing unprecedented versatility and flexibility.
The UDA2182 can accept single or dual inputs from Honeywell pH, ORP (Oxidation Reduction Potential), contacting Conductivity and Dissolved Oxygen sensors. Measurements for Dual channel units can be arranged in any combination of measurement (See Model Selection Guide).

User interface

"Process Information at a Glance" is a unique feature of the UDA2182 graphical backlit LCD.

Two PV values with corresponding UOM (unit of measure), temperature, alarm state, scales, and limits, tagging, and status messages can be displayed simultaneously.

Ten dedicated keys provide direct access to Setup configuration menus and sub-menus and Calibration.

Easy to configure

Menu-driven configuration of the UDA2182 is intuitive, fast and easy. A Setup menu is provided for every configuration task. You will be permitted to configure only those parameters relevant to your application and supported by the Analyzer model you purchased.

In fact, Setup configuration screens will contain only prompts and menu choices that apply to your application.

Multi-language prompts guide the operator step-by-step through the configuration process assuring quick and accurate entry of all configurable parameters. Five languages are available via configuration: English, French, German, Spanish and Italian.

Inputs

Analytical measurements of pH, ORP, Conductivity and Dissolved Oxygen (ppm or ppb) can all be done in one analyzer. The unit can be used as a single input or dual input instrument – the user decides what measurements are included. The input boards are factory calibrated and easily replaced. Addition of additional relays or an analog output is done with a single board. The "Mix –n- Match" design reduces inventory and increases flexibility. A user can purchase a basic unit and then add input and output boards as needed.

Outputs

Two standard Analog outputs 0 –20 or 4–20 mAdc, 750 ohms maximum, isolated from inputs, ground, and each other, and independently assignable to any parameters and ranges Proportional to user-set output range(s) of selected parameter(s).

One optional Analog output 0 –20 or 4–20 mAdc, 750 ohms maximum, isolated from inputs, ground, and each other, and independently assignable to any parameters and ranges.

Relays

Two 4A SPDT alarm/control relays are standard; with an additional two 4A relays available as an option.

Infrared Communications

The infrared connection provides a non-intrusive wireless connection with the instrument and maintains its weathertight integrity when combined with the optional PIE (Process Instrument Explorer).

No need to get access to the back of the analyzer to communicate with the instrument, no need to take your screw driver to wire the communication cable, no wiring mistake possible. You can now duplicate an instrument’s configuration, upload or download a new configuration in a matter of seconds, just by pointing your Pocket PC in the direction of the instrument.

1.2 Features

Standard and solution temperature compensation

Measured pH temperature is compensated in one of two ways. Electrode temperature sensitivity is automatically compensated to display the correct pH value at temperature. In addition, displayed pH can be optionally normalized to a solution temperature of 25°C as determined by the current Solution Temperature Coefficient, which is expressed in units of pH/°C with precision to the hundredths decimal place. The parameter “Solu Temp Coeff” allows the selection of Pure Water, Ammonia, Phosphate, Morpholine, and Custom or None (User Entry).

Measured Conductivity and Resistivity can optionally be temperature compensated to 25°C for a specific solution type. TDS and concentration are always measured based on a specific solution type. The cell constant and measurement type determines which solution types are available for selection.

Dissolved Oxygen accurately measures the concentration of dissolved oxygen in water. The Analyzer energizes the probe and receives dissolved oxygen and temperature signals. Optional salinity compensation is provided. The Analyzer provides for Air or Sample calibration with ambient temperature and atmospheric pressure compensation.

Automatic buffer recognition

"Buffer Group" types NIST/USP, USA, or Europe determines the set of standard pH buffer values to be used for Zero and Slope calibration by automatic buffer recognition. Each of the available Buffer Groups is a set of 5 or 6 pH buffer standards.

Computed Variables

For units with dual inputs of the same measurement, computed values can be configured. For example with Dual Conductivity, %Rejection/Passage, Difference, or Ratio can be displayed and assigned to the outputs or alarms.

Password protection

Keyboard security protects configuration and calibration data. A password (up to four digits) can be configured. If the security feature is enabled, the password will be required to access configuration and calibration software functions.

Diagnostic/Failsafe Outputs

Continuous diagnostic routines detect failure modes, trigger a failsafe output value and identify the failure to minimize troubleshooting time. The UDA2182 Analyzer performs extensive self-diagnostics as a background task during normal operation. If a problem is detected, a message is displayed on the Message stripe to alert the operator. In addition, the operator can initiate keypad and display tests using Maintenance Menu functions.

High Noise Immunity

The analyzer is designed to provide reliable, error-free performance in industrial environments that often affect highly noise-sensitive digital equipment.

Watertight corrosion-resistant case

CSA Type 4X (NEMA 4X) rated enclosure permits use in applications where it may be subjected to moisture, dust, or hose-down conditions. The UDA2182 is designed for panel, pipe or wall mounting.

2 Specifications and Model Number

2.1 Specifications

UDA2182 Universal Dual Analyzer	
Display	Graphical LCD with white LED Backlight *Viewing Area:* 66.8 mm (W) X 35.5 mm (H) *Dot Pixels:* 128 (W) X 64 (H)
Display Ranges	*pH*: 0-14 pH *ORP*: -1600 to +1600 mV *Conductivity:* 0.01 Cell: 0-2 uS/cm displayable to 200 uS/cm; 0-0.2 mS/cm; 0-2,000 ppb TDS; 0-200 ppm TDS 0.1 Cell: 0-20 uS/cm displayable to 2000 uS/cm; 0-2 mS/cm, 0-2,000 ppb TDS; 0-2,000 ppm TDS, 1.0 Cell: 0-200 uS/cm displayable to 20,000 uS/cm; 0-20 mS/cm; 0-200 ppm TDS; 0-20 ppt TDS 10 Cell: 0-2,000 uS/cm displayable to 99999 uS/cm; 0-200 mS/cm; 0-2,000 ppm TDS; 0-200 ppt TDS 25 Cell: 0-20,000 uS/cm displayable to 99999 uS/cm; 0-500 mS/cm; 0-10% Concentration displayable to 20% 50 Cell: 0-20,000 uS/cm displayable to 99999 uS/cm; 0-1,000 mS/cm; 0-20% Concentration Temperature: -10 to + 110°C (14 to 230°F) *Dissolved Oxygen*: 0 - 200 ppm 0 - 20 ppb 0 –200 ppb 0 – 2000ppb Temperature: 0 – 60C (32 – 140F), must not freeze
Keypad	10 Button Membrane Switch w/Directional Functionality UV/Solvent/Abrasion Resistant
Case Material	GE Valox® 357 (un-reinforced thermoplastic polyester)
Performances (Under reference operating conditions)	*Accuracy:* 0.5% of reading *Output Accuracy:* +/- 0.01 mA *Drift:* Negligible *Repeatability:* 0.05% *Temperature Accuracy*: pH and Conductivity Thermistor: +/- 0.1°C from –10 to 100° C, +/- 1.0° C from 101° to 140° C pH 1000 ohm RTD: +/- 0.4° C D.O. Thermistor: +/- 0.1° C from 0 to 60° C *Reference Operating Conditions:* 25 +/- 1° C; 10-40% RH; 120 or 240 Vac
Operating Conditions	Ambient Temperature *Operating:* 0 to 60°C (32 to 140°F) *Storage:* -30 to 70°C (-22 to 158°F) *RH:* 5 to 90% max. Non-condensing up to 40°C (104°F). For higher temperatures the RH specification is derated to maintain constant moisture content *Vibration:* 5-15 Hz disp 8 mm pk to pk 15-200 Hz accel 2 G
Standard Analog Output	Two 0-20 mAdc or 4-20 mAdc, 750 ohms max., isolated from inputs, ground, and each other, Independently field-assignable to any parameters and ranges. Proportional to user-set output range(s) of selected parameter(s),

UDA2182 Universal Dual Analyzer	
Optional Analog Output	One 0-20 mAdc or 4-20 mAdc, 750 ohms max., isolated from inputs, ground, and each other. Independently field-assignable to any parameters and ranges
Control Loop/Outputs	*Control Loops:* 2 standard (one for each PV); current, pulse frequency, or time proportional *Control Loop Types:* PID (optional), Duplex (optional), On/Off (standard) *Auto-tuning:* Accutune II, fuzzy logic overshoot suppression, applicable to both control loops
Standard Alarm/ Control Relays	Two SPDT (Form "C") Relays Resistive Load Rating: 4A, 120/240 Vac
Optional Additional Alarm/Control Relays	Two SPDT (Form "C") Relays *Resistive Load Rating:* 4A, 120/240 Vac
Alarm/Control Settings	*Alarm/on-off control delay:* 0-100 seconds. *Alarm/on-off control deadbands:* individually set, from 1 count to full scale for pH, ORP, and temperature. *On/off cycle period:* 0 to 1000 seconds. *On/off percent "on" time:* 0 to 100%, 1% resolution. *Set point and proportional band limit ranges:* ±19.99 pH, ±1999 mV, -10 to 130°C, 1 count resolution. *DAT cycle period:* 1 to 1999 seconds. *PFT maximum frequency:* 1 to 200 pulses/minute. *PFT pulse width:* 50 ms, compatible with electronic pulse-type metering pumps.
pH Temperature Compensation	Conventional compensation for changing electrode output (Nernst response), plus selectable solution temperature compensation for high-purity water.
Auto Buffer Recognition (pH)	User Selectable *Available Buffer Series:* NIST/USP, US, and Euro
Conductivity Compensations	NaCl, HCl, H_2SO_4, PO_4, NaOH, NH_3, C_4H_9C, Pure Water, Custom (User Selectable)
Dissolved Oxygen Measurement	*Max flowrate (probe):* 950 ml/min with flow chamber; no dependence on stirring or flowrate *Atmospheric pressure:* 500-800 mm Hg with internal sensor, for calibration Calibration with either Air or Sample
Power Requirements	90 -264 Vac, 47-63 Hz, 15 VA. Memory retained by E^2PROM when power is off.
Wireless Interface	*Type:* Infrared (IR) *Length of Link:* 0 –1 M, 0 –15° Offset *Baud Rate:* 9600 *Data Format:* Modbus Protocol
Safety Compliance	UL/CSA General Purpose FM Approval for Class I, Div 2.
CE Compliance	*CE Conformity (Europe):* CE Mark on all models signifies compliance to EMC Directive 84/336/EEC and LVD Directive 73/23/EEC. *EMC Classification:* Group 1, Class A, ISM Equipment *Method of Assessment:* Technical File (EN61010-1; EN 61326) *Declaration of Conformity:* 51453667
Case Dimensions	156 mm X 156 mm X 150 mm (6.14" X 6.14" X 5.91") *Panel cutout:* 138.5 mm X 138.5 mm (5.45" X 5.45") *Panel thickness:* 1.52 mm (0.06") min, 9.5 mm (0.38") max
Enclosure Rating	CSA Type 4X (NEMA 4X) rated enclosure
Installation Ratings	*Installation Category (Overvoltage Category):* Category II *Pollution Degree:* 2 *Altitude:* 2000 m
Weight	Approx 3 lbs (6.6kg)
Mounting	Panel mounting-hardware supplied. Optional Wall and 1" to 2" pipe mounting. Select option appropriate in Model Number.

2.2 Model Number Breakdown

Introduction

The model number breakdown is presented in the tables that follow.

The basic model number consists of a key number. Appended to this key number are characters that identify the features in various categories. The meaning of the characters in each category is presented in a table identified below.

Key Number		Table I		Table II		Table III		Table IV		Table V
UDA2182	-	_ _ _	-	_ _ _	-	_ _	-	_	-	_ _

Key Number - Dual Input Analyzer	Stock Part No.	Selection	Availability
Analytical Analyzer	50003691-501	UDA2182	↓

TABLE I - Channel Inputs

Channel 1 Input	None	N/A	NN1	•
	pH/ORP	51453313-501	PH1	•
	Conductivity	51453316-501	CC1	•
	Dissolved Oxygen ppm	51453319-501	DM1	•
	Dissolved Oxygen ppb	51453319-502	DB1	•

TABLE II - Channel Inputs

Channel 2 Input	None	N/A	NN2	•
	pH/ORP	51453313-501	PH2	•
	Conductivity	51453316-501	CC2	•
	Dissolved Oxygen ppm	51453319-501	DM2	•
	Dissolved Oxygen ppb	51453319-502	DB2	•

TABLE III - Outputs and Relays

Additional Analog Output & Relays	No Additional Analog Output or Relays	N/A	NN	•
	Additional 4-20 mA/0-20 mA output & 2 additional relays	51453328-501	C3	•

TABLE IV - Communications		Stock Part No.	Selection	Availability
Communications	None	N/A	N	•
	Modbus RTU (RS-485) (Future Release)	N/A	M	

TABLE V - Options

Mounting Hardware	None (Panel mounting only)	N/A	0 _ _ _	•
	Pipe and wall mounting hardware	50001023-501	P _ _ _	•
Instruction Books	CD Only (English)	50003501-501	_ 0 _ _	•
	Additional Paper Copy:			
	English	70-82-25-119	_ E _ _	•
Certificates	None	N/A	_ _ 0 _	•
	Calibration & Conformance	N/A	_ _ C _	•
PID Control	No	N/A	_ _ _ 0	•
	Yes	N/A	_ _ _ C	•

2.3 CE Conformity (Europe)

This product is in conformity with the protection requirements of the following European Council Directives: 73/23/EEC, the Low Voltage Directive, and 89/336/EEC, the EMC Directive. Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed.

Product Classification: Class I: Permanently connected, panel-mounted Industrial Control Equipment with protective earthing (grounding) (EN61010-1).

Enclosure Rating:. The front panel of the analyzer is rated at NEMA4X when properly installed.

Installation Category (Overvoltage Category): Category II (EN61010-1)

Pollution Degree: Pollution Degree 2: Normally non-conductive pollution with occasional conductivity caused by condensation. (Ref. IEC 664-1)

EMC Classification: Group 1, Class A, ISM Equipment (EN61326, emissions), Industrial Equipment (EN61326, immunity)

Method of EMC Assessment: Technical File (TF)

ATTENTION

The emission limits of EN61326 are designed to provide reasonable protection against harmful interference when this equipment is operated in an industrial environment. Operation of this equipment in a residential area may cause harmful interference. This equipment generates, uses, and can radiate radio frequency energy and may cause interference to radio and television reception when the equipment is used closer than 30 meters (98 feet) to the antenna (e). In special cases, when highly susceptible apparatus is used in close proximity, the user may have to employ additional mitigating measures to further reduce the electromagnetic emissions of this equipment.

WARNING

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

3 Unpacking, Preparation, and Mounting

3.1 Overview

Introduction

This section contains instructions for unpacking, preparing, and mounting the Analyzer. Instructions for wiring are provided in Section 4 (power wiring) and Section 7. Software configuration is described in Section 6.

The UDA2182 Analyzer can be panel, wall, or pipe mounted.

Each unit has (4) 22.22mm[.87"] dia. holes on the bottom of the unit for lead wires and conduit fittings. The user supplies the conduit fittings.

ATTENTION

When installing the unit, you must select appropriate watertight fittings to insure watertight integrity.

What's in this section?

The topics in this section are listed below.

3.2 Unpacking and Preparing

Procedure

Table 3-1 Procedure for Unpacking and Preparing the UDA2182

Step	Action
ATTENTION	
For prolonged storage or for shipment, the instrument should be kept in its shipping container. Do not remove shipping clamps or covers. Store in a suitable environment only (see specifications in Section 2).	
1	Carefully remove the instrument from the shipping container.
2	Compare the contents of the shipping container with the packing list. • Notify the carrier and Honeywell immediately if there is equipment damage or shortage. • Do not return goods without contacting Honeywell in advance.
3	Remove any shipping ties or packing material. Follow the instructions on any attached tags, and then remove such tags.
4	All UDA2182 Analyzers are calibrated and tested at the factory prior to shipment. Examine the model number on the nameplate to verify that the instrument has the correct optional features. (See Section 2.2 for model number breakdown.)
5	Select an installation location that meets the specifications in Section 2. The UDA2182 can be panel-, wall-, or pipe-mounted (see Section 3.3).
ATTENTION	
Pipe mounting is not recommended if the pipe is subject to severe vibration. Excessive vibration may affect system performance.	
6	If extremely hot or cold objects are near the installation location, provide radiant heat shielding for the instrument.

3.3 Mounting

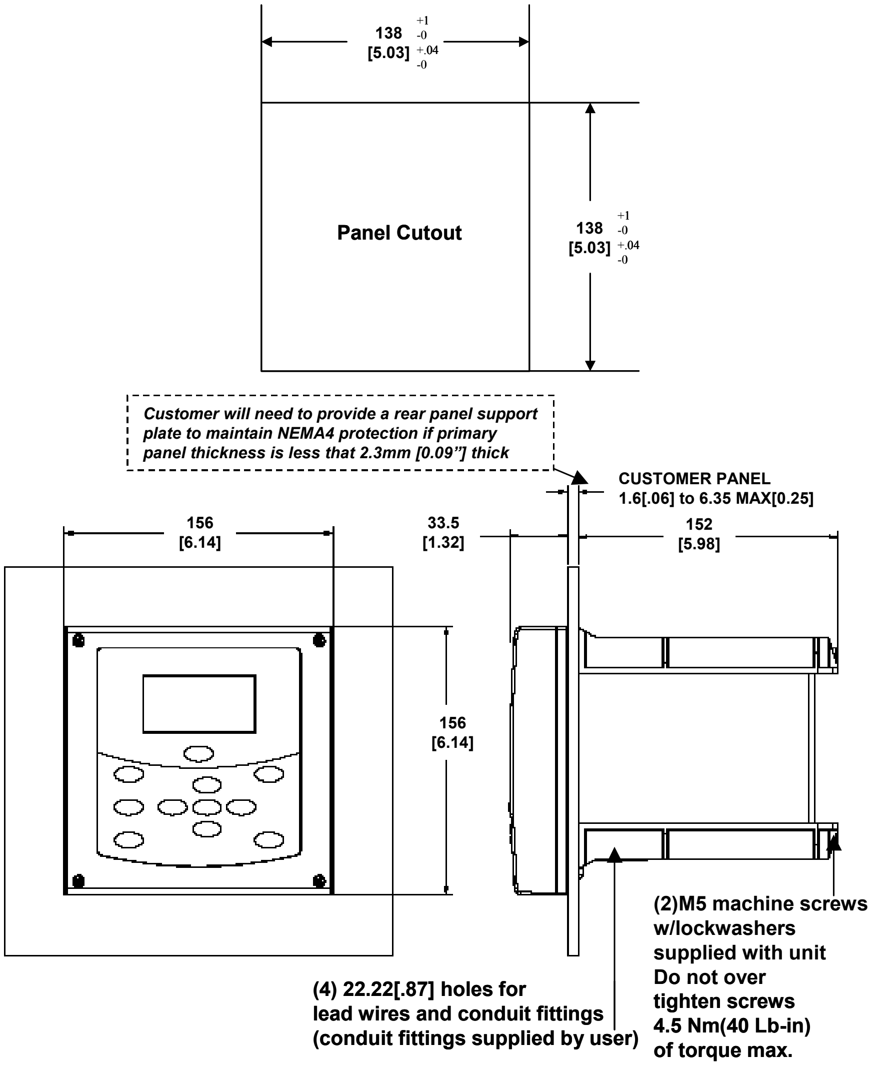
Introduction

The Analyzer can be mounted on either a vertical or tilted panel or can be pipe or wall mounted (option) using the mounting kit supplied. Overall dimensions and panel cutout requirements for mounting the analyzer are shown in Figure 3-1. Pipe mounting is shown in Figure 3-3. Wall Mounting is shown in Figure 3-4.

The analyzer's mounting enclosure must be grounded according to CSA standard C22.2 No. 0.4 or Factory Mutual Class No. 3820 paragraph 6.1.5.

Before mounting the analyzer, refer to the nameplate on the outside of the case and make a note of the model number. It will help later when selecting the proper wiring configuration.

Panel Mounting Dimensions



Customer will need to provide a rear panel support plate to maintain NEMA4 protection if primary panel thickness is less that 2.3mm [0.09"] thick

(2)M5 machine screws w/lockwashers supplied with unit Do not over tighten screws 4.5 Nm(40 Lb-in) of torque max.

(4) 22.22[.87] holes for lead wires and conduit fittings (conduit fittings supplied by user)

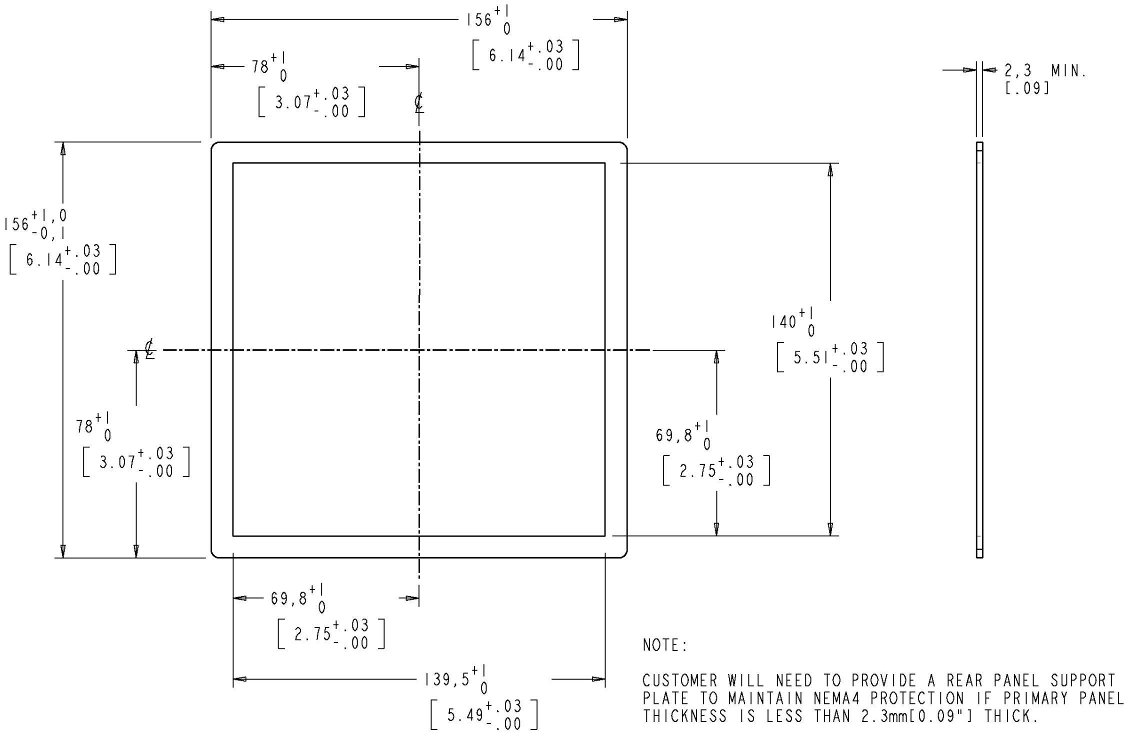
Figure 3-1 Panel Mounting Dimensions (not to scale)

Panel Mounting Procedure

Table 3-2 Panel Mounting Procedure

Step	Action
1	Mark and cut out the analyzer hole in the panel according to the dimension information in Figure 3-1.
2	Orient the case properly and slide it through the panel hole from the front. ***Customer will need to provide a rear panel support plate to maintain NEMA4 protection if primary panel thickness is less that 2.3mm [0.09"] thick – See* Figure 3-2.**
3	Remove the mounting kit from the shipping container and clamp the edges of the cutout between the case flange and the supplied U-bracket that is fastened to the rear of the case using (2) M5 X 16mm long screws and (2) M5 lock washers supplied.

Rear Panel Support Plate Dimensions



NOTE:

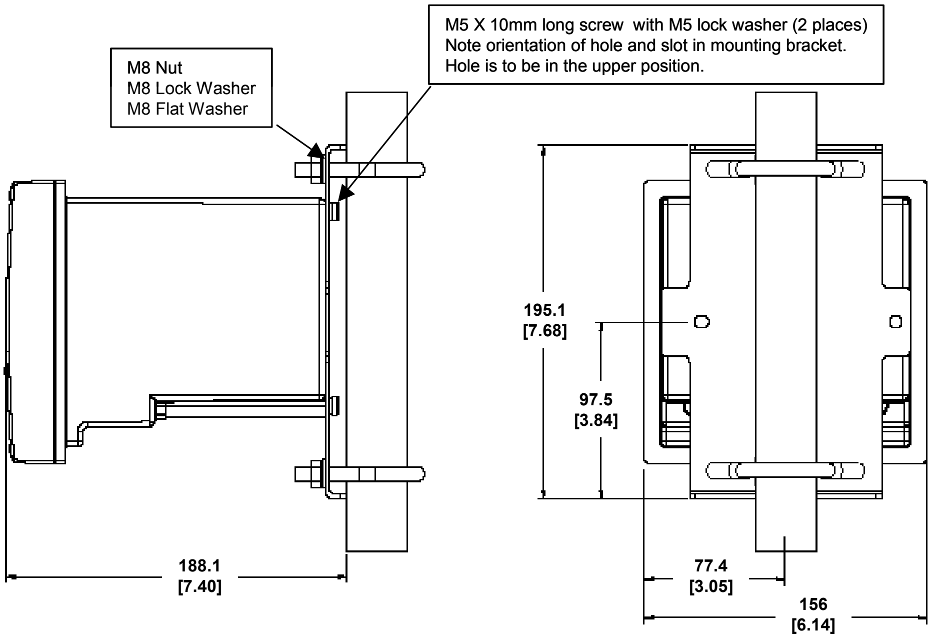
CUSTOMER WILL NEED TO PROVIDE A REAR PANEL SUPPORT PLATE TO MAINTAIN NEMA4 PROTECTION IF PRIMARY PANEL THICKNESS IS LESS THAN 2.3mm[0.09"] THICK.

Figure 3-2 Rear Panel Support Plate Dimensions

Pipe Mounting

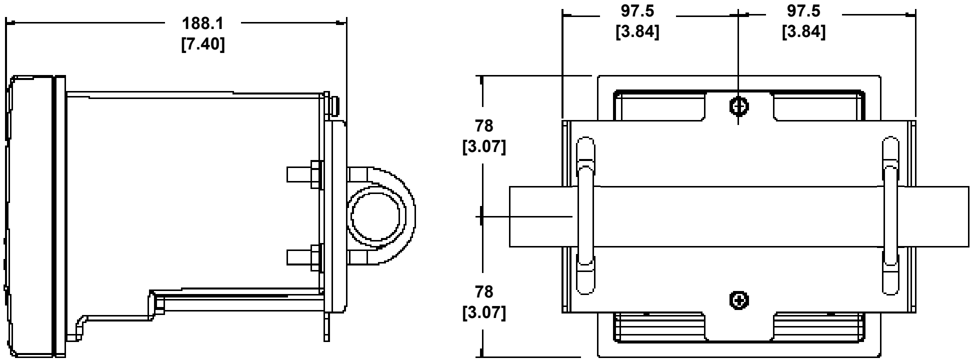
The analyzer can be mounted Vertically or Horizontally on a pipe. Use the bracket and hardware supplied in the mounting kit.
Select 1 inch or 2 inch U-Bolt.

ATTENTION
Pipe mounting is not recommended if the pipe is subject to severe vibration. Excessive vibration may affect system performance.



Do not over
tighten fasteners
4.5Nm (40 Lb-in) of
torque max.

1 or 2 inch Vertical Rear Pipe Mounting



1 or 2 inch Horizontal Rear Pipe Mounting

Figure 3-3 Pipe Mounting Dimensions (not to scale)

Wall Mounting Dimensions

The analyzer can be mounted on a wall. Use the bracket and hardware supplied in the mounting kit.

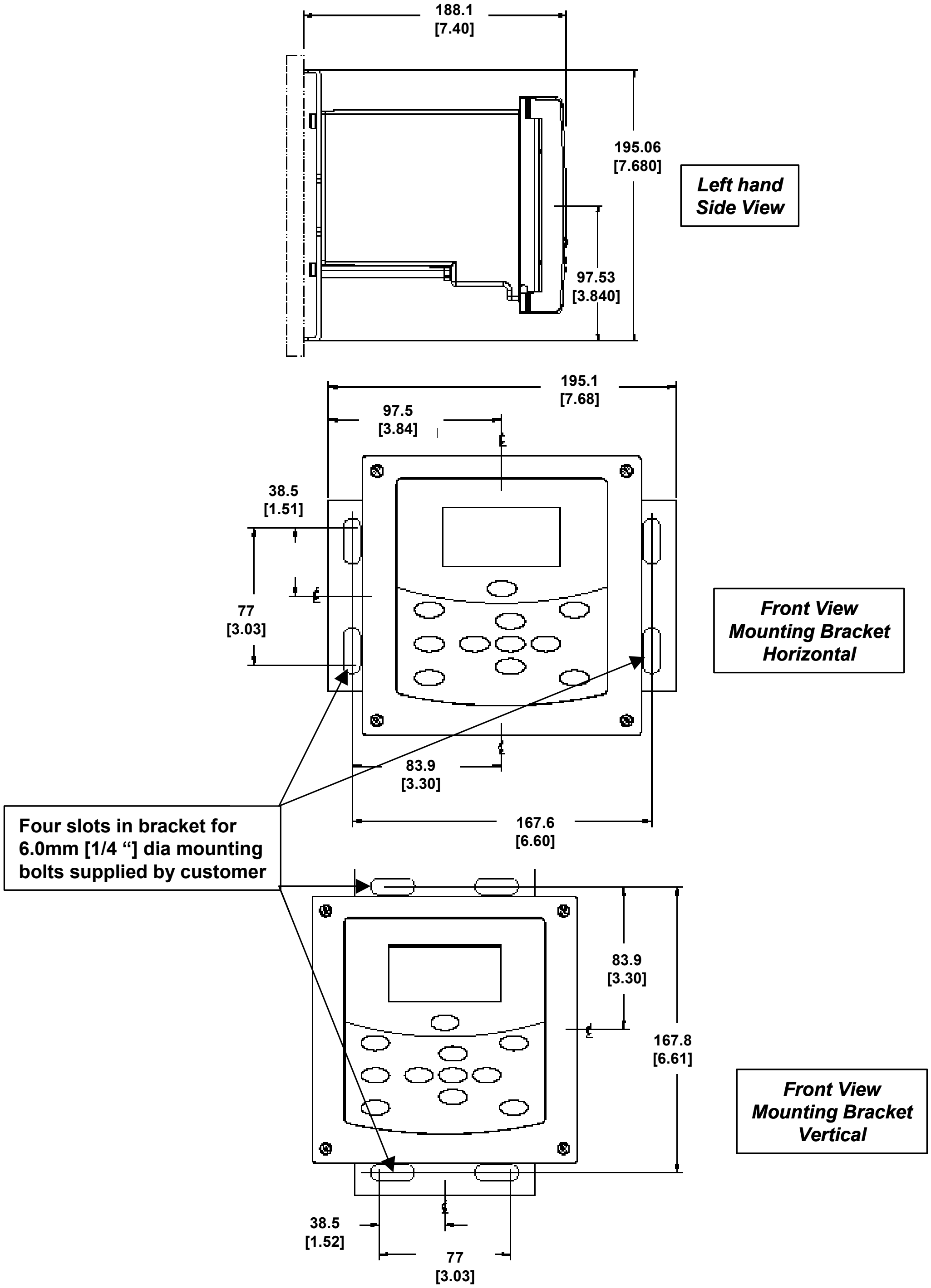


Figure 3-4 Wall Mounting Dimensions (not to scale)

4 Power Wiring

4.1 Overview

Introduction

This section contains instructions for installing ac power wiring for the Analyzer, in preparation for performing configuration setup as described in Section 6.

We recommend that you wait to install input and output wiring (See Section 7) until after Configuration Setup. During configuration the software will determine for you, which relay to use for each feature.

What's in this section?

The topics in this section are listed below.

4.2 General Wiring Practices

WARNING

Qualified personnel should perform wiring only.

Safety precaution

WARNING

A disconnect switch must be installed to break all current carrying conductors. Turn off power before working on conductors. Failure to observe this precaution may result in serious personal injury.

WARNING

An external disconnect switch is required for any hazardous voltage connections to the relay outputs.

Avoid damage to components

ATTENTION

This equipment contains devices that can be damaged by electrostatic discharge (ESD). As solid-state technology advances and as solid-state devices get smaller and smaller, they become more and more sensitive to ESD. The damage incurred may not cause the device to fail completely, but may cause early failure. Therefore, it is imperative that assemblies containing static sensitive devices be carried in conductive plastic bags. When adjusting or performing any work on such assemblies, grounded workstations and wrist straps must be used. If soldering irons are used, they must also be grounded.

A grounded workstation is any conductive or metallic surface connected to an earth ground, such as a water pipe, with a 1/2 to 1 megohm resistor in series with the ground connection. The purpose of the resistor is to current limit an electrostatic discharge and to prevent any shock hazard to the operator. The steps indicated above must be followed to prevent damage and/or degradation, which may be induced by ESD, to static sensitive devices.

Wiring for immunity compliance

⚠ In applications where either the power, input or output wiring are subject to electromagnetic disturbances, shielding techniques will be required. Grounded metal conduit with conductive conduit fittings is recommended.

Connect the AC mains through a fused disconnect switch.

Conform to code

Instrument wiring should conform to regulations of the National Electrical Code.

4.3 Power Wiring Considerations

Recommended wire size

Observe all applicable electrical codes when making power connections. Unless locally applicable codes dictate otherwise, use 14-gauge (2.081 mm^2) wire for ac power, including protective earth.

Power supply voltage and frequency within specs

The power supply voltage and frequency must be within the limits stated in the specifications in Section 2.

4.4 Installing Power Wiring

Procedure

WARNING

Turn power off at mains before installing AC Power Wiring.
Do not remove boards with power ON.

WARNING

The ground terminal must be connected to a reliable earth ground for proper operation and to comply with OSHA and other safety codes. If metal conduit is used, connect a bonding wire between conduits. Do not rely upon the conductive coating of the instrument case to provide this connection. Failure to observe this precaution may result in serious personal injury.

Table 4-1 Procedure for installing AC Power Wiring

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Check the tag on the outside of the case to be sure that the voltage rating of the unit matches the input voltage at your site.</td></tr>
<tr><td colspan="2">ATTENTION</td></tr>
<tr><td colspan="2">The Unit may be damaged if you apply power with the wrong voltage.</td></tr>
<tr><td>2</td><td>With Power off, open the case:
• Loosen the four captive screws on the front of the bezel.
• Grasp the bezel on the right side. Lift the bezel gently and swing the bezel open to the left.</td></tr>
<tr><td>3</td><td>Refer to Figure 7-1 for the location of the printed wiring board retainer. Loosen the two screws that hold the retainer and slide the retainer to the left until the retainer tabs disengage from the terminal boards.</td></tr>
<tr><td>4</td><td>Refer to Figure 7-1 for the location of the Power Supply/Analog Output/Relay Output board. Insert a screwdriver into the hole in the middle of the terminal board and pull out gently. Slide the board half way out. There is a notch in the terminal board into which you can slide the retainer tabs and hold the board in place while wiring.</td></tr>
</table>

5	Install a fused disconnect switch in the power line that will be connected to the Analyzer. •If a 230/240 Vac line is to be connected, use a 0.15 amp fuse. •If a 110/120 Vac line is to be connected, use a 0.30 amp fuse. Fuse must be a Time-Delay or Slo-Blo type.
6	Each unit has (4) 22.22mm[.87"] dia. holes on the bottom of the unit for lead wires and conduit fittings. Conduit fittings to be supplied by the user. Feed the power wiring through the wiring port on the bottom of the case. Connect the power wiring to terminals L1 and L2/N as shown in Figure 4-1. Attention: Terminal 1 must be connected to the ground stud on the grounding bar using a #14 AWG UL/CSA-approved wire.
7	Slide the retainer to the left then slide the terminal board back into place. Slide retainer to engage the tabs and tighten the screws.
8	Close the Bezel and secure four captive screws to a torque value of .20 Nm (1.5 Lb-in). Power up the unit. Do not apply power until the bezel is closed.

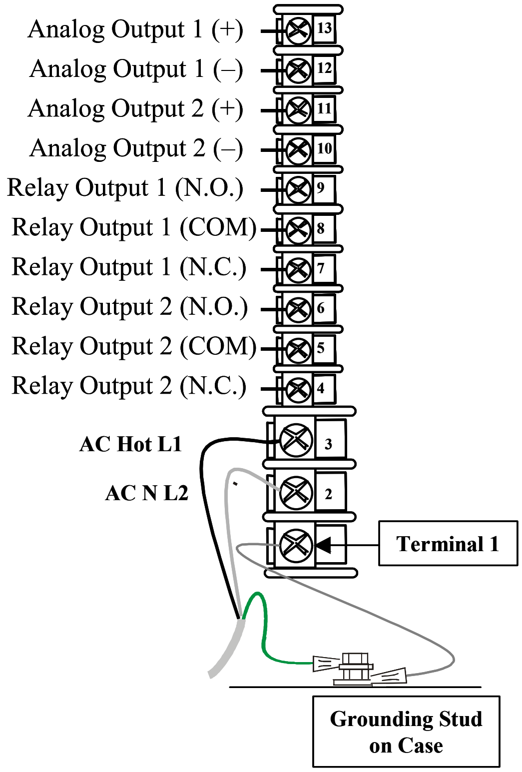


Figure 4-1 Power Wiring

5 Operating the Analyzer

5.1 Overview

Introduction

This section contains instructions for operating the Analyzer

What’s in this section?

The topics in this section are listed below.

5.2 Analyzer Overview

The UDA2182 Universal Dual Analyzer is the next level of dual channel analyzers providing unprecedented versatility and flexibility.

The analyzer can accept single or dual inputs from Honeywell pH, ORP (Oxidation Reduction Potential), contacting Conductivity and Dissolved Oxygen sensors.

Measurement for Dual channel units can be arranged in any combination of measurement.

Figure 5-1 UDA2182 Operator Interface (all display items shown)

5.3 Key Navigation

Table 1-1 shows each key on the operator interface and defines its function.

Table 5-1 Function of Keys

Key	Function
Display	• When process values are on display: Use DISPLAY to cycle between PV Displays, Control Displays, and Status Displays. • In Setup mode, calibration mode, or calibration edit mode, use DISPLAY to abort current mode and return to the last accessed online display.
Hold	• Engages hold of analog and digital outputs at their current values and any relays assigned to alarm events or control are deactivated.
Setup	• Selects the configuration main menu when online, in calibration mode, or at a calibration submenu.
Exit	• In configuration menu, exits submenu to parent menu. If at configuration main menu, selects current online display. • In configuration edit mode, aborts editing of current parameter. • When online, it acknowledges current alarm event to stop the flashing of the relay indicator and status message area.
Calibrate	• Selects the calibration main screen when online, in configuration mode or at another calibration screen.
▲ or ▼	• When a Setup configuration menu or configuration edit screen is on display: Use Up/Down keys to highlight a different item. • In configuration edit mode, it either selects the parameter character or numerical digit to change or selects an enumerated parameter value: Use Up/Down key to increment the value of the digit at the cursor. Increases/decreases the selected parameter value. • When in display mode, use up/down keys to adjust the contrast on the screen.
◀ or ▶	• In configuration edit mode, selects the character or digit to change. • In calibration mode, it selects the next or previous calibration screen. • In Display mode, It selects a single or dual display on a unit with dual input.
Enter	• In configuration menu, selects edit mode for selected parameter. • In configuration edit mode, saves edited parameter selection or value. • In calibration mode, selects parameters to reset and the next calibration screen.

5.4 Displays Overview

Viewing the Displays

To view display screens, push the Display key. Pushing the Display key repeatedly scrolls through screens which show the current status of pH/ORP, Conductivity, or Dissolved Oxygen Concentration and Control and lets you view a Status Display of Alarms, Logic, Inputs, Outputs, Relays, and Calculated Values.

Displays Shown

When only one input board is installed, the online screen displays **one PV** and it's units in a larger font size.

When two input boards are installed, the online screen displays **two PVs** and its units in a smaller font size. Press ◄► to see single PV screens.

When Control 1 or 2 is active (see Setup Group Control; Control Types), there is a display screen for each. There is a sub-screen that allows editing of the Setpoint value, Control Mode, and Output value.

Contrast Adjustment

When viewing a PV or Control display, you can adjust the contrast by pressing the ▲ or ▼ key.

Bargraphs Overview

Output Bargraphs will represent up to three current output values. On the display, the Bargraphs are the output in Engineering Units. The corner annunciators are the physical relay states(light – de-energized, dark – energized). The third output and the 3 and 4 relays are shown only when the source other than NONE is selected.

Online Functions

Table 5-2 Display Details Functions

<table>
<tr><th>Detail</th><th>Function</th></tr>
<tr><td>Process Variable Values</td><td>When two input boards are installed, the default online screen displays both PVs and their units of measure, as determined by the input boards, the probe (if memory-embedded) or any measurement configuration options that may be available. When only one input board is installed, the default online screen displays one PV and it’s units in a larger font size.

The currently selected PV type determines the numerical format and the units of measure on the online PV display. Measured PV is generally displayed in the highest decimal precision possible with five digits and has a potentially displayable range of 0.0000 to 99999. The exceptions are dissolved oxygen, pH, ORP and temperature, which are displayed with fixed decimal precision.

PV Type determines specific ranges and in the case of Conductivity, cell constant determines available PV Types. Each PV measurement and display is updated every 500ms maximum. Each temperature measurement and display is updated every 10 seconds maximum.

See the Specific Input configuration for available ranges.</td></tr>
<tr><td>Tag Name</td><td>A text string of the user’s choice appears at the top of all online displays.</td></tr>
<tr><td>PV Temperature</td><td>Each PV value is accompanied by a temperature value for all measurements except ORP, as ORP probes do not contain temperature sensors and no measurement compensation for temperature is required. Temperature values are displayed in units of degrees Fahrenheit or degrees Celsius as determined by configuration.

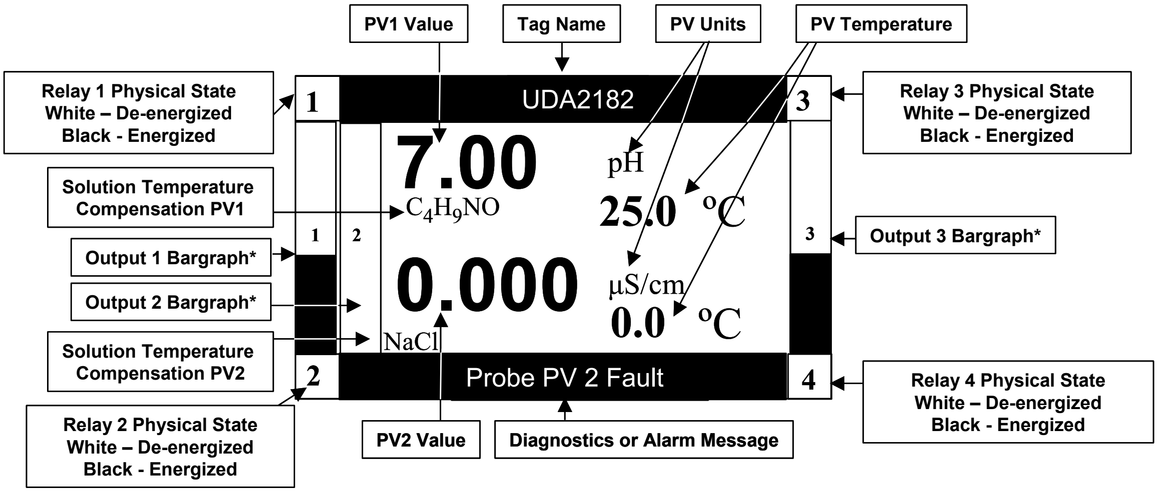
Measured temperature is always expressed in fixed tenths decimal precision and has a displayed range according to input type:
<table>
<tr><td>PH/ORP</td><td>-10.0 to 110.0°C or –14.0 to 230.0°F</td></tr>
<tr><td>Conductivity</td><td>-10.0 to 110.0°C or –14.0 to 230.0°F</td></tr>
<tr><td>Dissolved Oxygen</td><td>0 to 60.0°C or 32 to 140°F</td></tr>
</table></td></tr>
<tr><td>Status Messages</td><td>A text string appears on the bottom of all displays. Online displays provide messages relaying online diagnostics, alarms and other events. Offline screens display messages relevant to data entry and calibration. See Section 11.</td></tr>
<tr><td>Bargraphs</td><td>The Bargraphs will represent up to three output values. The corner indicators represent the physical state of the Relay Outputs [1,2,3,4].</td></tr>
</table>

*Note that all values and indicators on the main (input) display screen are maintained in the input setup group.

5.5 Displays

Two Input Display

Press Display. You will see:



On the display, the bargraphs are the outputs in Engineering Units, the corner annunciators are the physical relay states.

Figure 5-2 Example – Two Input Display

Single Displays

For **single displays** on a two input unit;

Press ◄► to display a single display for Input 1.

Press ◄► again to display a single display for Input 2.

Press ◄► again to return to a Dual Display.

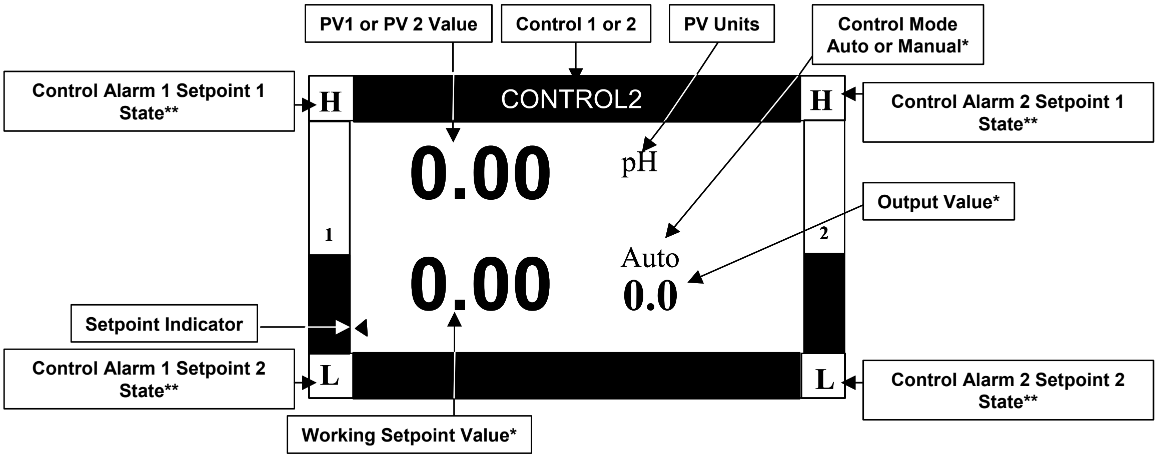
5.6 Control Displays

Overview

When Control 1 or 2 is active (see Setup Group Control; Control Types), there is a display screen for each. There is a sub-screen that allows editing of the Setpoint value, Control Mode, and Output value.

Selecting Control Display

Press **Display** until you see the Control Display screen. If Control 1 and 2 have been configured, press DISPLAY again. In each instance, you can edit the control parameters. See Table 5-3.



*These Control parameters can be edited. See Table 5-3.

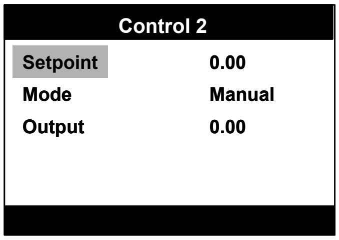
** These values for these Setpoints are set in Set Up Group “Control Configuration” – See Table 6-8.

Figure 5-3 Control 2 Display screen example

Changing Control Parameters on the Control Display

When either **Control Display is on the Display screen**, you can edit the Setpoint value, Control Mode, and the Output value.

Table 5-3 Changing Control Parameters on the Display

Press	Action
Enter	to access the Control Parameters. You will see:  Control 2 Setpoint 0.00 Mode Manual Output 0.00 Example – Control 2 Display
▲▼	to highlight the parameter you want to change.
Enter	to access the value or selection of each.
▲▼	to change the value or selection. Refer to "Section 6.4.1 – "***General Rules for Editing***".
Enter	to make the edit permanent.
Display	to return to the selected Control Display.

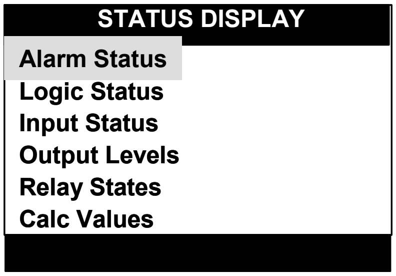
5.7 Status Display

Overview

The Status Displays let you see the status of the Alarm Status, Logic Status, Input Status, Output levels, Relay states, and the Calculated values(Calc Values available only if both inputs are identical).

Access to Status Displays

- Press Display until you see:



STATUS DISPLAY
Alarm Status
Logic Status
Input Status
Output Levels
Relay States
Calc Values

- Use the ▲▼ keys to highlight the Status Display required.
- Press Enter to display the parameters and the status of each.

Table 5-4 Status Display Details

Status Display	Parameter	Status (Read Only)	Status Definition
Alarm Status	Alarm 1 Alarm 2 Alarm 3 Alarm 4	ON OFF	ON = Latching Alarm in alarm. ***Acknowledge*** alarm by changing status to OFF. If status changes back to ON, alarm condition still exists.
Logic Status	Logic 1 Logic 2 Logic 3 Logic 4	ON Off	
Input Status	Input 1 Input 2 Digital In 1 Digital In 2	OK or Fail OK or Fail On or Off On or Off	Read Only – depends on the Input selected

Status Display		**Status (Read Only)**	
Output Levels	Output 1 mA Output 2 mA Output 3 mA	Output Level in Milliamps	Read Only – depends on the Output type selected at setup “Outputs”, “Output n”, “Source”: None Input 1 PV Input 1 Temp Input 2 PV Input 2 Temp Math 1 Math 2 Math 3 Math 4 Control 1 Control 2 See Table 6-3 for configuration.
Relay States	Relay 1 Relay 2 Relay 3 Relay 4	State of the relay	Read Only – state depends on the Output source selected at Relay Setup Group, parameter “Relay Types”: *Digital Output (On or Off)* *Time Proportional (Value)* *Pulse Frequency (Value)* See Table 6-4 for configuration.
Calc Values	Sum Difference Ratio %Passage %Rejection	Value	Value of the Calculated Value selected at “Setup Group “Inputs”, “Calc 1 or 2 PV, “Calc type”. See Table 6-2 for configuration. **Available only if both inputs are identical.**

5.8 Process Instrument Explorer Software

Overview

Process Instrument Explorer lets you configure your analyzer on a desktop/laptop or Pocket PC. For details see Process Instrument Explorer manual #51-52-25-131.

Features

- Create configurations with intuitive software program running on a Pocket PC, a Desktop or a laptop computer. ·
- Create/edit configurations live, just connect software to analyzer via IR port.
- Create/edit configurations offline and download to analyzer later via IR port.
- Infrared port available on every UDA2182.
- This software is available in English, Spanish, Italian, German and French.
- Generate Configuration Reports.

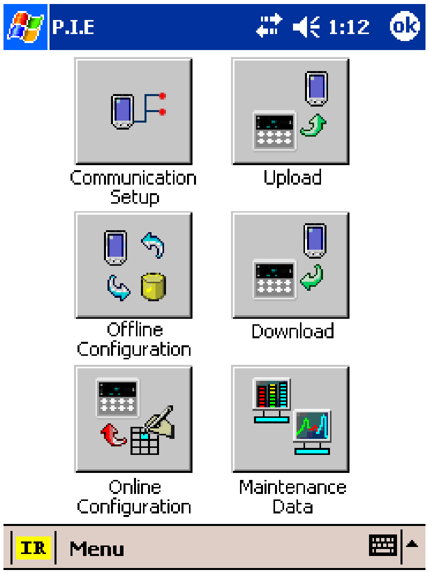


Figure 5-4 Screen capture of Process Instrument Explorer running on a Pocket PC

Infrared communications

The infrared connection provides a non-intrusive wireless connection with the instrument and maintains its waterproof integrity when used in conjunction with the optional PIE (Process Instrument Explorer Software).

No need to get access to the back of the analyzer to communicate with the instrument, no need to take your screw driver to wire the communication cable, no wiring mistake possible. You can now duplicate an instrument’s configuration, upload or download a new configuration in a matter of seconds, just by pointing your Pocket PC in the direction of the instrument.

It takes just a few seconds to upload a configuration from an instrument. You can then save the configuration file onto your PC or pocket PC for review, modification or archiving. Furthermore, this software also gives you important maintenance information on the analyzer: instantly, get information on the current operating parameters, digital inputs and alarm status, identify internal or analog input problems.

Question: What if I have several analyzers on the same panel? How can I be sure I am communicating with the correct one?

Answer: The infrared port of the analyzer is normally “off”. You activate the infrared port on a particular analyzer by pressing any key. You can now communicate with the analyzer. If no communications are received for 2 minutes, the port will be shut down again.

6 Configuration

6.1 Overview

Introduction

Configuration is a dedicated operation where you use straightforward keystroke sequences to select and establish (configure) pertinent setup data best suited for your application.

To assist you in the configuration process, there are prompts that appear in the Main Setup menu and associated sub menus. These prompts let you know what group of configuration data (Set Up prompts) you are working with and also, the specific parameters associated with each group.

What's in this section?

The topics in this section are listed below.

6.2 UDA2182 Block Diagram

Overview

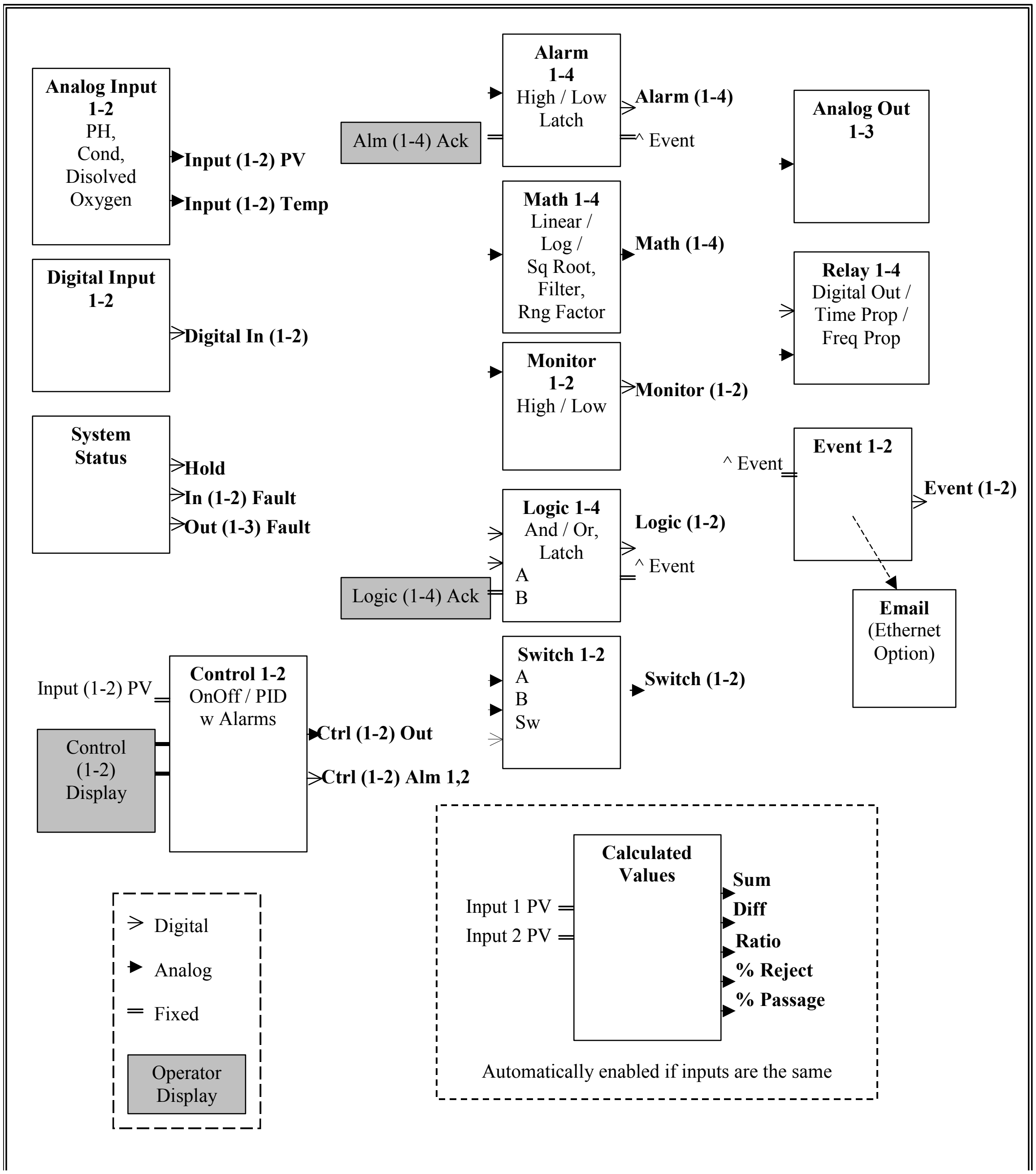
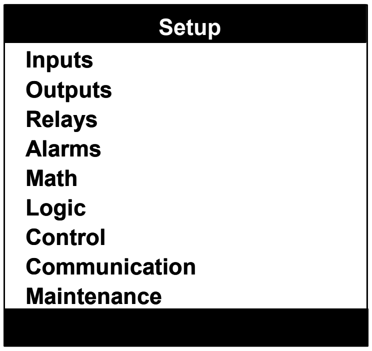


Figure 6-1 UDA2182 Block Diagram

6.3 Main Setup Menu

Accessing the Main Menu

Press. Setup. The main Menu will appear.



In some menus, you will have to scroll the menu to see all the selections.
Use the ▲▼ keys.

Refer to "**General Rules for Editing**" and Table 6-1 Basic Configuration Procedure to configure the following Setup Groups.

Setup Group Overview

Inputs Configuration (Table 6-2) – configure:

Input 1 and Input 2 for pH/ORP, Conductivity, or Dissolved Oxygen; and associated parameters
Calc Value 1 and 2 (both inputs must be the same) Select the Calculation type [Ratio, sum, etc.], High range and Low range.

Outputs Configuration (Table 6-3) – configure ***Output 1, 2, or 3 source***, % Range High and Low and associated parameters

Relays Configuration (Table 6-4) – configure **Relay 1, Relay 2, Relay 3, and Relay 4** for Relay Types Digital Out (Digital Output Relay), Time Prop (Time Proportional Output), Pulse Frequency (Pulse Frequency Type), and associated parameters.

Alarms Configuration (Table 6-5) - configure **Alarm 1 through 4** for Alarm's Source and associated parameters.

Math Configuration (Table 6-6) – configure **Math 1, 2, 3, and 4** for Input Source, Math Type, Range High Value, Range Low Value, and Filter time.

Logic Configuration (Table 6-7) – configure **Logic 1, 2, 3, and 4** for Input Source, Type, and associated parameters

Control Configuration (Table 6-8) **–** configure **Control 1 Type and Control 2 Type** for PID or On/Off control and associated parameters. (Only available if ordered.)

Communication Configuration (Table 6-9) – Configure **Mode, Address, and Enable Reset**

Maintenance Configuration (Table 6-10) – read the **Software version and Input types**, configure **Language, Temperature Units, Mains Frequency, enter a Tag Name and Password, run Display and Keyboard tests, read Output levels, read Relay States, and Reset the Unit.**

6.4 Basic Configuration Procedure

Introduction

Each of the Set Up groups and their functions are pre-configured at the factory.
If you want to change any of these selections or values, read the "General Rules for Editing" and follow the procedure in Table 6-1. This procedure tells you the keys to press to get to any Setup group and any associated parameter prompt.

6.4.1 General Rules for Editing

***Selecting a parameter for edit*:**

- Display the screen containing the parameter.
- Use the ▲▼ keys to highlight the parameter name.
- Press Enter to highlight the displayed current value.

***Editing a parameter having a text string as an assigned value*:**

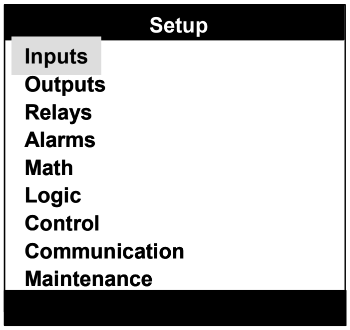
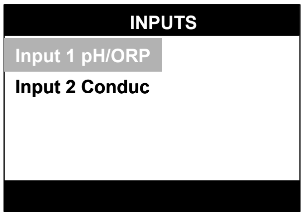
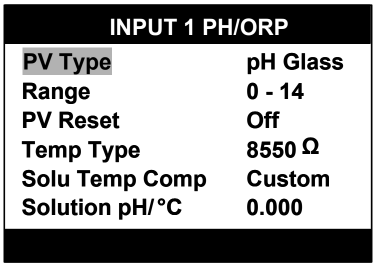
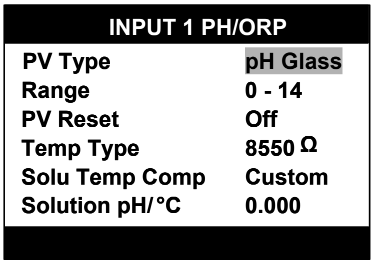
- Select the parameter as explained above.
- Use the ▲▼ keys to display other valid choices.
- When your choice is displayed, press Enter to select.

Editing a parameter having a numeric value

- Select the parameter as explained above.
- Use the ◀ ▶ keys to move the cursor to the digit to be changed. If you hold down the ◀ key, the cursor will move to the left and increment to the next highest digit available for the particular parameter. If you hold down the ▶ key, the cursor will move to the right and increment the next lowest digit available for the particular parameter.
- Use the ▲▼ keys to increment or decrement the value of the digit.
- Use the ◀ ▶ keys to move the cursor to the next digit. Repeat.
- When all digits have been changed, press Enter to store.

Basic Configuration Procedure

Table 6-1 Basic Configuration Procedure

Step	Operation	Press	Result
1	**Enter Set Up Mode**	Setup	 **Setup** **Inputs** **Outputs** **Relays** **Alarms** **Math** **Logic** **Control** **Communication** **Maintenance** The Main Menu is displayed. Use ▲▼ to scroll and select a setup group (Example – Inputs). The selection will be highlighted.
2	**Enter Set Up Group**	Enter	The Setup group selected is shown at the top of the screen and will display all the selections within that group.  **INPUTS** **Input 1 pH/ORP** **Input 2 Conduc** Press ▲▼ to highlight the desired selection. (Example – Input 1 pH/ORP)
3	**Enter the selection**	Enter	The list of parameters for that selection will be displayed.  **INPUT 1 PH/ORP** **PV Type** **pH Glass** **Range** **0 - 14** **PV Reset** **Off** **Temp Type** **8550 Ω** **Solu Temp Comp** **Custom** **Solution pH/°C** **0.000** Press ▲▼ to highlight the desired selection.
4	**Changing a parameter**	Enter or ▶	The displayed current value for the parameter is displayed.  **INPUT 1 PH/ORP** **PV Type** **pH Glass** **Range** **0 - 14** **PV Reset** **Off** **Temp Type** **8550 Ω** **Solu Temp Comp** **Custom** **Solution pH/°C** **0.000**

Step	Operation	Press	Result
5	**Change the Value or Selection**	▲▼	Depending on whether you are changing a text string or a numerical value, follow the " ***General Rules for Editing***" in section 6.4.1 to make the changes.
6	**Enter the Value or Selection**	Enter	Enters value or selection made into memory after another key is pressed. Repeat the procedure for changing any parameter for any group.
7	**To Abort the Changes Made**	Exit	Any changes made to a parameter value will revert to the original value before editing.
8	**Exit Setup Mode**	Exit	Until you see the main Setup screen.

6.5 Inputs Configuration

Overview

This group lets you select pH/ORP, Conductivity, or Dissolved Oxygen Input type and the associated output parameters.

Accessing Inputs Menu

Press Setup to display the Main menu.

Use the ▲▼ keys to select “Inputs” then press Enter to enter the sub-menus.

Input 1 and Input 2 – pH/ORP, Conductivity, or Dissolved Oxygen are available for selection. Select PV type, read the range, reset the PV, select Temp Type, Solution Temp Compensation, Bias, Failsafe and Filter Time.
For Dissolved Oxygen, also select the Salinity type and Pressure type.

Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to “Section 6.4.1 – ”***General Rules for Editing***”.

Table 6-2 Inputs Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
Input 1 or 2 pH/ORP	PV Type	pH Glass pH HPW **pH Durafet (default)** ORP	The PV type determines the numerical format and the units of measure on the online PV display. Measured PV is generally displayed in the highest decimal precision possible to .001 and has a potentially displayable range of 0.000 to 99999. The exceptions are dissolved oxygen, pH, ORP and temperature, which are displayed with fixed decimal precision. PV Type determines specific ranges.
	Range	0.0 to 14.0 pH -1600 to 1600 ORP	Read Only
	PV Reset	**Off (default)** Enable	When changing from some PV Types to another, a pop-up box will notify you **“PV Ranges and Setpoints may require reset”** Press ENTER or EXIT. This sets the unit to default configuration. **Enable** - Resets all Output and Control ranges associated with that PV
	Temp Input (ORP only)	Enable Disable	Enable to allow “Temp Type” selection – see below.

<table>
<tr><th>Sub-menu selection</th><th>Parameter</th><th>Selection or Range of Setting</th><th>Parameter Definition</th></tr>
<tr><td></td><td>Temp Type</td><td>8550Ω Therm (default)
1000Ω RTD
Manual</td><td>8550Ω Thermistor

1000Ω Resistance Temperature Detector
Manual</td></tr>
<tr><td></td><td>Temp Deg F or C (Temp Type = Manual)</td><td>14.0 to 230.0ºF
default = 77ºF
-10 to 110ºC
default = 25ºC</td><td>Temp Deg F or C will appear depending on what Temperature Unit was selected in “Maintenance” setup group, parameter “Temp Units”.</td></tr>
<tr><td></td><td>Solu Temp Comp
(Not ORP)</td><td>None (default)
Custom
H_20
NH_3
PO_4
C_4H_9NO</td><td>
Enter “Solution pH/ºC” value
Pure Water
Ammonia
Phosphate
Morpholine</td></tr>
<tr><td></td><td>Solution pH/ºC
<i>(Solu Temp Comp = Custom)</i>
(Not ORP)</td><td>0.000 (default)
to
-0.050</td><td>Measured pH is displayed and transmitted normalized to a solution temperature of 25°C as determined by the current Solution Temperature Coefficient. This is expressed in units of pH/°C with precision to the hundredths decimal place. The parameter “Solu Temp Coeff” allows the selection of the following entries. Follow the “ <i>General Rules for Editing</i>” in section 6.4.1 to make the changes. <i>(-) Will appear when first digit to the right of decimal point is changed.</i>
<table>
<tr><th>Solution Type</th><th>Temp Coefficient</th></tr>
<tr><td>None (Default)</td><td>0.000</td></tr>
<tr><td>H_2O (Pure Water)</td><td>-0.016</td></tr>
<tr><td>NH_3 (Ammonia)</td><td>-0.032</td></tr>
<tr><td>PO_4 (Phosphate)</td><td>-0.032</td></tr>
<tr><td>C_4H_9NO (Morpholine)</td><td>-0.032</td></tr>
<tr><td>Custom</td><td>User Entry</td></tr>
</table></td></tr>
<tr><td></td><td>Bias</td><td>-99999 to 99999
default = 0.00</td><td>Bias Constant - is used to compensate the input for drift of an input value.</td></tr>
<tr><td></td><td>Failsafe</td><td>-99999 to 99999
default = 0.00</td><td>The output value to which the output will go to protect against the effects of failure of the equipment.</td></tr>
<tr><td></td><td>Filter Time</td><td>0 to 120
default = 0</td><td>A software digital filter is provided for dampening the process noise. This filter is applied before the limit functions.</td></tr>
</table>

Input 1 or Input 2 Conductivity

For every cell constant the PV type includes selections for both conductivity µS/cm and conductivity mS/cm.
Conductivity µS/cm displays µS/cm and provides standard range solution type selections: None, NaCl, NH3, C4H9NO.
Conductivity mS/cm displays mS/cm and provides wide range solution type selections: None, HCl, NaCl, H2SO4, NaOH.

Upper range limit defaults according to the table below:

For every cell constant the PV type also includes selections for either TDS ppb/TDS ppm or TDS ppm/TDS ppt.:
TDS ppb/ppm provide standard or wide solution type selections and
TDS ppm/ppt provide standard or wide solution type selections. Solution selections are the same as above with the exception of None.
Upper range limit defaults according to the table below:

Cell Const 0.01	Cell Const 0. 1	Cell Const 1	Cell Const 10	Cell Const 25	Cell Const 50
0 - 2 µS/cm *displayable to 200 µS/cm* 0 - 0.2 mS/cm 0 - 2000 ppb TDS 0 - 200 ppm TDS	0 - 20 µS/cm *displayable to 2000 µS/cm* 0 - 2 mS/cm 0 - 20000 ppb TDS 0 - 2000 ppm TDS	0 - 200 µS/cm *displayable to 20000 µS/cm* 0 - 20 mS/cm 0 - 200 ppm TDS 0 - 20 ppt TDS	0 - 2000 µS/cm *displayable to 99999 µS/cm* 0 - 200 mS/cm 0 - 2000 ppm TDS 0 - 200 ppt TDS	0 - 20000 µS/cm *displayable to 99999 µS/cm* 0 - 500 mS/cm 0 - 10 % conc *displayable to 20%*	0 - 20000 µS/cm *displayable to 99999 µS/cm* 0 - 1000 mS/cm 0 - 20 % conc

PV Type ***Select Cell Constant First***	**Cond µS/cm (default)** Cond mS/cm Concentrtn TDS ppb TDS ppm TDS ppt Resistivity	These selections are only available with regard to the Cell Constant selected (See "Cell Constant").
Range		Read Only

Cell Constant	Available Selectable PV Types Use the ▲▼ keys to select
0.01	Conductance µS/cm (default), Conductance mS/cm, TDS ppb, TDS ppm, Resistivity
0.1 (Default)	Conductance µS/cm (default), Conductance mS/cm TDS ppb, TDS ppm, Resistivity
1	Conductance µS/cm (default), Conductance mS/cm TDS ppm, TDS ppt,
10	Conductance mS/cm (default), TDS ppm, TDS ppt, Conductance µS/cm
25	Concentration (default), Conductance µS/cm, Conductance mS/cm
50	Concentration (default), Conductance µS/cm, Conductance mS/cm

PV Reset	**Off (default)** Enable	When changing from some PV Types to another, a pop-up box will notify you **"PV Ranges and Setpoints may require reset"** Press ENTER or EXIT. This sets the unit to default configuration. **Enable** - Resets all Output and Control ranges associated with that PV
Cell Constant	0.01 **0.1 (default)** 1.0 10.0 25.0 50.0	The Cell Constant is a value specific to a category of cells for the measurement range required. These parameters are automatically updated when a probe is attached to the input card or when a unit is powered up with a probe attached, and are retained through power down or probe detach. These probe parameter values are not editable.
Cal Factor	0.850 to 1.150 **default = 1.000**	The Cal Factor is a correction value applied to the cell's Cell Constant, which is unique to each cell to take into account tolerances in manufacture. **If a standard cell is attached to the sensor, the Cell Constant defaults to "0.1" and the Cal Factor defaults to "1.000". These standard cell parameter values are editable and are retained through a power cycle.**
TDS Factor **(only PV Type TDS)**	0.010 **1.000(default)** 2.000	The TDS Factor is a conversion value applied to conductivity to derive total dissolved solids, in units of ppm per µS/cm.
Temp Type	**8550Ω Therm (default)** 1000Ω RTD Manual	8550Ω Thermistor 1000Ω Resistance Temperature Detector Manual
Temp Deg C or F	-10.0 to 140.0ºC 14 to 284ºF	If "Manual" is selected at "Temp Type" -Temp Deg F or C will appear depending on what Temperature Unit was selected in "Maintenance" setup group, parameter "Temp Units".

<table>
<tr><td></td><td>Solu Temp Comp</td><td>None
Custom
H20
NH3
PO4
C4H9NO
HCl (default)
NaCl
H2SO4
NaOH</td><td>Measured Conductivity and Resistivity can optionally be temperature compensated to 25°C for a specific solution type. TDS and concentration are always measured based on a specific solution type. The cell constant and measurement type determines which solution types are available for selection, according to the table below:
<table>
<tr><th>Cell Constant</th><th>Available Selectable Solution Types
Use the ▲▼ keys to select</th></tr>
<tr><td>0.01</td><td>None (Conductivity/Resistivity only),
NaCl (µS/cm, mS/cm, TDS ppb, TDS ppm),
NH_3 (µS/cm, TDS ppb, TDS ppm),
C_4H_9NO (µS/cm, TDS ppb, TDS ppm),
H2SO4;HCL;NaOH (mS/cm)</td></tr>
<tr><td>0.1
(Default)</td><td>None (Conductivity/Resistivity only),
NaCl(µS/cm, mS/cm, TDS ppb, TDS ppm),
NH_3(µS/cm, TDS ppb, TDS ppm),
C_4H_9NO (µS/cm, TDS ppb, TDS ppm),
H_2SO_4;HCL;NaOH (mS/cm)</td></tr>
<tr><td>1</td><td>None (Conductivity only),
NaCl (µS/cm, mS/cm, TDS ppm, TDS ppt),
NH_3 (µS/cm, TDS ppm),
C_4H_9NO (µS/cm, TDS ppm),
H_2SO_4;HCL;NaOH (mS/cm, TDS ppt)</td></tr>
<tr><td>10</td><td>None (Conductivity only),
NaCl (µS/cm, mS/cm, TDS ppm, TDS ppt),
NH_3 (µS/cm, TDS ppm),
C_4H_9NO (µS/cm, TDS ppm),
H_2SO_4;HCL;NaOH (mS/cm, TDS ppt)</td></tr>
<tr><td>25</td><td>None (Conductivity only),
HCl (mS/cm, Concentration),
NaCl (µS/cm, mS/cm, Concentration),
H_2SO_4 (mS/cm, Concentration),
NaOH (mS/cm, Concentration)</td></tr>
<tr><td>50</td><td>None (Conductivity only),
HCl (mS/cm, Concentration),
NaCl (µS/cm, mS/cm, Concentration),
H_2SO_4 (mS/cm, Concentration),
NaOH (mS/cm, Concentration)</td></tr>
</table>
</td></tr>
<tr><td></td><td>Wire Len Units</td><td>**Feet (default)**
Meters</td><td rowspan="4">If you use a single wire gauge (16, 18, 20, or 22 AWG) in a length up to 1000 feet, simply specify the gauge and length.
If mixed wired gauges are used, or lead length or wire gauge are not within the stated ranges, refer to Appendix A.</td></tr>
<tr><td></td><td>Wire Len Feet</td><td>0 to 1000 ft
default = 0</td></tr>
<tr><td></td><td>Wire Len Meters</td><td>0 to 304.80
default = 0</td></tr>
<tr><td></td><td>Wire Size Units</td><td>AWG
Sq mm</td></tr>
</table>

	Wire Size AWG	16 AWG **18 AWG(default)** 20 AWG 22 AWG	
	Wire Size Sq mm	0.33 to 2.08 **default = 0.82**	
	Bias	-9999.00 to 9999.00 **default = 0.000**	Bias Constant - is used to compensate the input for drift of an input value.
	Failsafe	0.0 to 2000 **default = 0.000**	The output value to which the output will go to protect against the effects of failure of the equipment.
	Filter Time	0 to 120.0 **default = 0.000**	A software digital filter is provided for dampening the process noise and is applied before the limit functions.
Input 1 or Input 2 DO *Dissolved Oxygen*	PV Type	Pct Sat **DO Conc (default)**	The concentration of oxygen dissolved in water (or other liquid) may be described by either “dissolved oxygen **(DO) concentration**” or **percent saturation**. The units for DO are either parts per million - PPM (equivalent to milligrams per liter) or parts per billion - PPB (equivalent to micrograms per liter). The units of saturation are percent where 100% saturation is equivalent to the concentration of oxygen dissolved in air-saturated water. For instance, at 25°C and one atmosphere pressure, 8.24 ppm = 100% saturation. Although the ppm and ppb concentration units are the most frequently used units by far, % saturation may be appropriate for non-aqueous liquids like vegetable oil.
	Range	0 – 200 ppb, displayable to 20000ppb 0-20 ppm 0 – 100% sat, displayable to 120% sat	Read Only
	PV Reset	**Off (default)** Enable	When changing from some PV Types to another, a pop-up box will notify you **“PV Ranges and Setpoints may require reset”** Press ENTER or EXIT. This sets the unit to default configuration. **Enable -** Resets all Output and Control ranges associated with that PV
	Temp Type	**5000Ω Therm Default** 1000Ω RTD Manual	5000Ω Thermistor 1000Ω Resistance Temperature Detector Manual
	Temp Deg C or F (Temp Type = Manual)	0 to 60ºC 32 to 140ºF	Temp Deg F or C will appear depending on what Temperature Unit was selected in “Maintenance” setup group, parameter “Temp Units”.

	Salinity Type	 **Manual (default)** Conduc Input	Salinity is used to correct for salt in the process water. Manual Available only if conductivity board is present.
	Salinity ppt *"Manual" Salinity type only*	0.00 to 40.00ppt **default = 0.00**	(parts per thousand) as sodium chloride 0.0 = No selection
	Pressure Type	Manual **Sensor (default)**	Allows manual entry of atmospheric pressure compensation Internal sensor for atmospheric pressure compensation during air calibration
	Pressure mm Hg *(Manual Pressure type only)*	500.0 to 800.0 **default = 760 mmHg**	Atmospheric pressure compensation. Enter a value in mmHg.
	Bias	 -20.00 to 20.00 PPM -20000 to 20000 PPB **default = 0.000**	Bias Constant - is used to compensate the input for drift of an input value. If PPM Board is installed. If PPB Board is installed.
	Failsafe	 0.000 to 20.00 PPM 0.000 to 20000 PPB **default = 0.000**	The output value to which the output will go to protect against the effects of failure of the equipment. If PPM Board is installed. If PPB Board is installed.
	Filter Time	0 to 120.0 **default = 0.000**	A software digital filter is provided for dampening the process. The units are in time constant seconds.

6.6 Outputs Configuration

Overview

This group lets you select the signal that will be transmitted. You can select Input 1 or 2 PV, Math 1 through 4, or Control 1 or 2 and the associated output parameters.

Accessing Outputs Menu

- Press Setup to display the Main menu.
- Use the ▲▼ keys to select **"Outputs"** then press Enter to enter the sub-menu.
- **Output 1, Output 2, or Output 3** and their associated parameters are available for selection.
- Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to "Section 6.4.1 - ***General Rules for Editing***".

Table 6-3 Outputs Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
Output 1 **Output 2** **Output 3**	Source	None **Input 1 PV (default)** Input 1 Temp Input 2 PV Input 2 Temp Math 1 Math 2 Math 3 Math 4 Control 1 Control 2	Process Variable Source - Selects the signal (Engineering Units) that will be transmitted.
	High Range	-9999.00 to 9999.00 **default = 100**	High Range Value Engineering Unit - value of input that corresponds to 100 % output value.
	Low Range	-9999.00 to 9999.00 **default = 0**	Low Range Value Engineering Unit - value of input that corresponds to 0 % output value.
	Slew Time	0.000 to 999.00 in seconds **default = 0.000**	Slew Time is the maximum rate of change required to drive the output from full OFF (0% - typically 4 mA) to full ON (100% - typically 20mA).
	mA Range High	0 to 20 **default = 20**	Value of mA output that corresponds to 100 % output signal (for example: 20 mA).
	mA Range Low	0 to 20 **default = 4**	Value of mA output that corresponds to 0 % output signal (for example: 4 mA).
	mA Limit High	0 to 21 **default = 21**	Value of mA that you want to set the High Range Limit.
	mA Limit Low	0 to 21 **default = 3**	Value of mA that you want to set the Low Range Limit.

6.7 Relays Configuration

Overview

Programming the relays consists of selecting the relay type, identifying the input parameter, which activates the relay and selecting whether the relay is energized when the input parameter is on or off. The Relay group lets you select a relay type for up to four relays.

Accessing Relays Menu

- Press Setup to display the Main menu.
- Use the ▲▼ keys to select **"Relays"** then press Enter to enter the sub-menu.
- **Relay 1, Relay 2, Relay 3 or Relay 4** and their associated parameters are available for selection.
- Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to "Section 6.4.1 – "***General Rules for Editing***".

Table 6-4 Relays Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
Relay Types ***Set relay types first***	**Relay 1 Type** **Relay 2 Type** **Relay 3 Type** **Relay 4 Type**	**Digital Out** **Time Prop** **Pulse Freq**	**Digital Output Relay (default)** Time Proportional Output Relay Pulse Frequency Relay
Relay 1 **Relay 2** **Relay 3** **Relay 4** ***Digital Output Relay***	A **Digital Output Relay** allows connection to any Alarm, Control Alarm, Logic, Alarm Event, or Math signal.		
	Digital Source	**None (default)**	
		Alarm 1	Connects to Alarm 1
		Alarm 2	Connects to Alarm 2
		Alarm 3	Connects to Alarm 3
		Alarm 4	Connects to Alarm 4
		Ctrl1 Alm 1	Connects to Control 1 Alarm 1
		Ctrl1 Alm 2	Connects to Control 1 Alarm 2
		Ctrl2 Alm 1	Connects to Control 2 Alarm 1
		Ctrl2 Alm 2	Connects to Control 2 Alarm 2
		Logic 1	Connects to Logic 1

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
		Logic 2	Connects to Logic 2
		Logic 3	Connects to Logic 3
		Logic 4	Connects to Logic 4
		Event 1	Connects to Event 1
		Event 2	Connects to Event 2
		Event 3	Connects to Event 3
		Event 4	Connects to Event 4
		Math 1	"When a Digital Output Relay source is a Math block the relay will turn ON when the input to the math block is greater than the math blocks high range (> 100%) and it will turn OFF when the input to the math block is less than the math blocks low range (< 0.0) . When the input to the math block is between the high and low range the relay output will remain in its current state. This allows the Math block to be used for limit control of PV, Temperature, or calculated values with the math block range acting as control dead band.
		Math 2	
		Math 3	
		Math 4	
	Invert	Enable **Disable (default)**	The digital output relays "invert" parameter can be used to allow direct (invert disabled) or reverse (invert enabled) control actuation.
Relay 1 **Relay 2** **Relay 3** **Relay 4** ***Time Proportional Output Relay***	**Time proportional output** is a form of a process variable transmitter that pulses the relay as a pulse width modulated signal that is proportional to the process variable input signal over a configured PV range. The Time Proportional cycle time is configurable between 1 and 999 seconds while the duty cycle is directly proportional to the selected process variable.		
	Source	**None (default)** Input 1 PV Input 1 Temp Input 2 PV Input 2 Temp Math 1 Math 2 Math 3 Math 4 Control 1 Control 2	PV Source
	High Range	-99999 to 99999 **default = 100.00**	The high range is the PV based engineering unit value configured as the value that will produce a 100 percent (always active) duty cycle.
	Low Range	-99999 to 99999 **default = 0.00**	The low range is the PV based engineering unit value configured as the value that will produce a 0 percent (always inactive) duty cycle.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	Cycle Time	1 to 999 seconds **default = 10**	Cycle time is that time period, in seconds, the relay will be activated.
	Min Off Time	0 to 999 **default = 0**	Minimum off is that time period, in seconds, the relay will be activated.
	Min On Time	0 to 999 **default = 0**	Minimum On is that time period, in seconds, the relay will be activated.
Relay 1 **Relay 2** **Relay 3** **Relay 4** ***Pulse Frequency Output Relay***	**Pulse Frequency Output Type control (PFO)** is adjusts is cycle time (rather than the duty cycle) proportional to the calculated error signal within the configured proportional band. A pulse (at a configured duration) will be generated at a rate proportional to the calculated error within the proportional band. PFT Proportional Action is based upon the error signal between the process variable and the selected set point value and limited to 0 to 100 percent.		
	Source	**None (default)** Input 1 PV Input 1 Temp Input 2 PV Input 2 Temp Math 1 Math 2 Math 3 Math 4 Control 1 Control 2	PV Source
	High Range	-99999 to 99999 **default = 100.00**	The high range is the PV based engineering unit value configured as the value that will produce a 100 percent (Maximum Frequency) duty cycle.
	Low Range	-99999 to 99999 **default = 0.00**	The low range is the PV based engineering unit value configured as the value that will produce a 0 percent (always inactive) duty cycle.
	Cycle Time	0 to 999 **default = 10**	Sets Cycle Time for when error is equal to or greater than the proportional band. Within proportional band, the relay will cycle at a frequency proportional to the error.

6.8 Alarms Configuration

Overview

Alarm 1 through 4

Alarm selections can be connected to any Input PV, secondary variable (Temperature), or Calculated Value. Each alarm supports a setpoint type and value.
Alarm selections generate front panel alerts, support latching/acknowledge, with on delay timers.

Accessing Alarms Menu

- Press Setup to display the Main menu.
- Use the ▲▼ keys to select **"Alarms"** then press Enter to enter the sub-menu.
- Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to "Section 6.4.1 – "***General Rules for Editing***".

Table 6-5 Alarms Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
Alarm 1 **Alarm 2** **Alarm 3** **Alarm 4**	Source	**None (default)** Input 1 PV Input 1 Temp Input 2 PV Input 2 Temp Calc Value 1* Calc Value 2*	Process Variable Source – Process Variable to be monitored by the alarm. * Both inputs must be the same
	Type	None **High (default)** Low	Alarm actions may be High or Low.
	Setpoint Value	0 to 99999.9 in Engineering Units **default = 0.00**	Setpoint value in engineering units
	Latch	**Disable (default)** Enable	Enable allows latching of the alarm output until acknowledged. Refer to "Status Display" in Section 5.7 to acknowledge.
	Alm Hysteresis	0.0 to 9999.99 % **default = 0.00**	Hysteresis - A user-specified hysteresis value in the engineering units of the process variable source is provided. Hysteresis in engineering units can be set from 0 to the input span monitored variable.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	On Delay	0 to 999 seconds **default = 0.000**	An on-delay time value up to 999 seconds is available to prevent momentary alarm actions. Number of seconds the alarm is active before activating the Output.
	Event	**None (default)** Event 1 Event 2 Event 3 Event 4	Each alarm has an "Event" in its setup. Users can set each alarm event as "Event 1" through "Event 4". A Digital Output type relay source can be configured to "Event 1" through "Event 4". Now whenever an alarm with an "Event" set will activate the relay with a source set to that event. For example Alarm 1 Event = Event 1 Alarm 2 Event = Event 1 Alarm 3 Event = Event 2 Alarm 4 Event = Event 2 Alarm 5 Event = Event 3 Alarm 6 Event = Event 4 Relay 1 Digital Output Source = Event 1 Relay 2 Digital Output Source = Event 2 Relay 3 Digital Output Source = Event 3 Relay 4 Digital Output Source = Event 4 Whenever alarm 1, or 2 is active, relay 1 (and/or the Relay 1 output display annunciator) will be ON. (See note 1) Whenever alarm 3, or 4 is active, relay 2 (and/or the Relay 2 output display annunciator) will be ON. (See note 1)
NOTE 1: *When an Alarm is setup as EVENT 1 and that Event source is Relay, acknowledging the Alarm in the Alarm Status Display will de-energize the relay and cut off the Alarm. This happens even when the Alarm condition is still there.*			

6.9 Math Configuration

Overview

The Math group has four Math selections (Math 1, Math 2, Math 3, and Math 4). Math selections can be connected to any Input PV, secondary variable (Temperature), or Calculated Value.

Math selections generate a secondary range and limit for legacy type proportional or On/Off control. Math blocks include scaling for linear, log, and square root.

The Math Block can also be used for proportional control over the math blocks configured range for control of any Input PV, Temperature, or calculated values by connecting it to a current output, TPO relay, or FPO relay. Since multiple outputs can share a common math block, the output range of a math block can be split over multiple outputs or relays with each output or proportional relay using a specific portion of the % output range of the math block.

Accessing Math Menu

- Press Setup to display the Main menu.
- Use the ▲▼ keys to select **"Math"** then press Enter to enter the sub-menu.
- Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to "Section 6.4.1 – "***General Rules for Editing***".

Table 6-6 Math Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
Math 1 **Math 2** **Math 3** **Math 4**	Source	**None (default)** Input 1 PV Input 1 Temp Input 2 PV Input 2 Temp	**Input source** can be connected to any Input PV, secondary variable (Temperature), or Calculated Value.
	Type	None	No Math
		Linear (default)	Linear is simple linear scale used to retransmit the PV using the High Range as scaled 100% output and the Low Range is the scaled to 0% output. There is no restriction on the High and Low ranges. Setting the high range to a value less than the low range will invert the action of the math output. Limit out has no effect on the output.
		Log	Log allows for a two decade log (output = 100 / 2 * log (1 + (PV-low range)/(high range - low range)) / log (2). Limit out has no effect on the math output value.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
		Sqr Root	Square Root is the 100 * SqRoot(PV - Low Range)/(High Range - Low Range)). Limit out has no effect on the math output value.
	High Range	-99999 to 99999 **default = 100.0**	High Range Value Setting the math blocks High and Low Range equal will cause the connected digital output relay to be a high monitor compare function.
	Low Range	-99999 to 99999 **default = 0.000**	Low Range Value Setting the math blocks High and Low Range equal will cause the connected digital output relay to be a high monitor compare function.
	Filter Time	0 to 120 **default = 0.000**	A software digital filter is provided for dampening the process noise and is applied before the limit functions. The units are in time constant seconds.

6.10 Logic Configuration

Overview

The Logic group has four selections (Logic1, Logic 2, Logic 3, and Logic 4). Logic selections have 2 input sources and a selection for the Logic Type – “AND” or OR”.

The sources can be any Alarm, Control Alarm, Digital Input 1 or 2, Hold, or Output fault,

Accessing Logic Menu

- Press Setup to display the Main menu.
- Use the ▲▼ keys to select **“Logic”** then press Enter to enter the sub-menu.
- Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to “Section 6.4.1 – “***General Rules for Editing***”.

Table 6-7 Logic Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
Logic 1 **Logic 2** **Logic 3, or** **Logic 4**	In A Source		Logic Input A Source
		None (default)	
		Alarm 1 Alarm 2 Alarm 3 Alarm 4	Alarm 1 thru 4 – See Table 6-5 Alarms Configuration
		Ctrl 1 Alm 1 Ctrl 1 Alm 2 Ctrl 2 Alm 1 Ctrl 2 Alm 2	Control Alarms – See Table 6-8 Control Configuration
		Digital In 1 Digital In 2	Digital Input 1 Digital Input 2
		Hold	Engages hold of analog and digital outputs at their current values and any relays assigned to alarm events or control are deactivated.
		Out 1 Fault Out 2 Fault Out 3 Fault	These are the output open conditions. This allows an alarm to be triggered if the respective 4-20 mA output opens.
	In B Source		Logic Input B Source
		None (default)	
		Alarm 1 Alarm 2 Alarm 3 Alarm 4	Alarm 1 thru 4 – See Table 6-5 Alarms Configuration
		Ctrl 1 Alm 1 Ctrl 1 Alm 2 Ctrl 2 Alm 1 Ctrl 2 Alm 2	Control Alarms – See Table 6-8 Control Configuration
		Digital In 1 Digital In 2	Digital Input 1 Digital Input 2
		Hold	Engages hold of analog and digital outputs at their current values and any relays assigned to alarm events or control are deactivated.
		Out 1 Fault Out 2 Fault Out 3 Fault	These are the output open conditions. This allows an alarm to be triggered if the respective 4-20 mA output opens.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	Type	**None (default)** AND OR *Note: User must set to "OR" if only one input source is being used.*	None **AND** -Turns digital output ON when input IN A Source and IN B Source are ON. Thus, If *all* inputs are ON, then: OUT = ON. If *any* input is OFF, then: OUT = OFF. **OR** - Monitors Input A Source and Input B Source to set state of digital output signal. If A = OFF and B = OFF, then OUT = OFF. If A = ON and/or B = ON, then: OUT = ON.
	Invert	**None (default)** IN A IN B In A and B	You can invert Input A or Input B or both. If the input is inverted, an input line that is ON is seen as OFF
	Latch	**Disable (default)** Enable	Enable allows latching of the alarm output until acknowledged. Refer to "Status Display" in Section 5.7 to acknowledge.
	On Delay	0 to 999 seconds **default = 0.000**	An on-delay time value up to 999 seconds is available to prevent momentary alarm actions. Number of seconds the alarm is active before activating the Output.
	Event	**None (default)** Event 1 Event 2 Event 3 Event 4	Each Logic has an "Event" in its setup. Users can set each Logic event as "Event 1" through "Event 4". A Digital Output type relay source can be configured to "Event 1" through "Event 4". Now whenever a Logic with an "Event" set will activate the relay with a source set to that event. Whenever Logic 1, or 2 is active, relay 1 (and/or the Relay 1 output display annunciator) will be ON. (See note 1) Whenever Logic 3, or 4 is active, relay 2 (and/or the Relay 2 output display annunciator) will be ON. (See note 1)
NOTE 1: *When a Logic is setup as EVENT 1 and that Event source is Relay, acknowledging the Logic in the Logic Status Display will de-energize the relay and cut off the Alarm. This happens even when the Alarm condition is still there.*			

6.11 Control Configuration

Overview

Two Control functions provide:
PID (Option) - Proportional (P), Integral (I) and Derivative (D), (3-mode) control action based on the deviation or error signal created by the difference between the setpoint (SP) and the Process variable analog input value (PV). PID Tuning parameters are available.

Automatic tuning with Fuzzy Logic Overshoot Suppression can be configured.

Other parameters listed in this group deal with how the analyzer will control the process including: PV High and Low, Setpoint High and Low limits, the Control Algorithm and Action, Number of Tuning Parameter Sets and associated parameters, Setpoint Rate, Power-up Recall, Output Limits, Failsafe Output Value, Alarm setpoint type and value, and Alarm Hysteresis.

On/Off - Provide ON/OFF control. The output is either ON (100 %) or OFF (0 %).

Other parameters listed in this group deal with how the analyzer will control the process including: PV High and Low, Setpoint Limits, Control Action, Output Limits and Hysteresis, and Failsafe Output Value, Alarm setpoint type and value, and Alarm Hysteresis.

Accessing Control Menu

- Press Setup to display the Main menu.
- Use the ▲▼ keys to select **"Control"** then press Enter to enter the sub-menu.
- Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to "Section 6.4.1 – "***General Rules for Editing***".

Table 6-8 Control Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
Control Types	Control 1 Type	**None (default)**	No Control
	Control 2 Type	On/Off	Provide ON/OFF control. The output is either ON (100 %) or OFF (0 %)
		PID (Option)	3 Mode Control. Proportional (P), Integral (I) and Derivative (D)
Control 1 **Control 2** **PID (optional)**	PV High	-99999 to 99999	PV High Range Value
	PV Low	-99999 to 99999	PV Low Range Value
	SP High Limit	-99999 to 99999	Setpoint High Limit Value - prevents the setpoint from going above the value set here.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	SP Low Limit	-99999 to 99999	Setpoint Low Limit Value - prevents the setpoint from going below the value set here.
	Control Alg	**PIDA (default)** PIDB Duplex A Duplex B *Note:* *In PID A, a step change in setpoint will result in a step change in output.* *In PID B, step changes in setpoint will not bump the output; the output will slew smoothly to the new value.*	**PID A** - is normally used for 3-mode control. The output can be adjusted somewhere between 100 % and 0 %. It applies all three control actions -Proportional (P), Integral (I), and Derivative (D) - to the error signal. **PID B** - Unlike the PID-A equation, the analyzer gives only an integral response to a setpoint change, with no effect on the output due to the Gain or Rate action, and gives full response to PV changes. **DUPA -** like PID A but provides an automatic method to switch tuning constant sets. **DUPB -** like PID B but provides an automatic method to switch tuning constant sets.
	Control Action	Direct **Reverse (default)**	**DIRECT** - PID action causes output to **increase** as process variable increases. **REVERSE** - PID action causes output to **decrease** as process variable increases.
	Accutune	Enable **Disable (default)**	When enabled, the analyzer will start controlling to the setpoint while it identifies the process and adjusts the Gain or Proportional Band (P), Rate (I), and Reset Time (D) tuning constants in response to setpoint changes and/or Process Variable disturbances.
	Fuzzy Logic	Enable **Disable (default)**	Fuzzy Overshoot Suppression minimizes overshoot after a setpoint change or a process disturbance. The fuzzy logic observes the speed and direction of the PV signal as it approaches the setpoint and temporarily modifies the internal control response action as necessary to avoid an overshoot. There is no change to the PID algorithm, and the fuzzy logic does not alter the PID tuning parameters. This feature can be independently Enabled or Disabled as required by the application to work with Accutune.
	Use Prop Band	Enable **Disable (default)**	When enabled, Proportional band is used instead of Gain (default). See “Gain or PB”.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	Use RPM	Enable **Disable (default)**	When enabled, Repeat per minute is used instead of Minutes per Repeat (default). See “Reset”.
	Gain or PB	Gain - 0.1% to 1000.0% PB – 0.1 to 1000.0% **default = 1.000**	Gain (default) - is the ratio of output change (%) over the measured variable change (%) that caused it. $G = \frac{100\ \%}{PB\ \%}$ where PB is the proportional Band (in %of Input Range) Proportional Band (PB) - is the percentage of the range of the measured variable for which a proportional controller will produce a 100 % change in its output.
	Rate	-0.035 to 10.000 **default = 0.000**	RATE action, in minutes affects the control output whenever the deviation is changing; and affects it more when the deviation is changing faster. The amount of corrective action depends on the value of Gain.
	Reset	-0.02 to 50 **default = 1.000**	RESET (Integral Time) - adjusts the control output according to both the size of the deviation (SP-PV) and the time it lasts. The amount of corrective action depends on the value of Gain. The reset adjustment is measured as how many times proportional action is repeated per minute (Repeats/minute) or how many minutes before one repeat of the proportional action occurs (Minutes/repeat - default).
	Tune Set 2	Enable **Disable (default)**	Enables or disables Gain or PB 2, Rate 2, and Reset 2.
	Gain or PB 2	0.1 to 1000.0 **default = 1.000**	Gain or PB2 for Tuning Set 2. Same as Gain or PB.
	Rate 2	-0.035 to 10.000 **default = 0.000**	Rate 2 for Tuning Set 2. Same as Rate.
	Reset 2	-0.02 to 50 **default = 1.000**	Reset 2 for Tuning Set 2 Same as Reset.
	Out High Limit	-5.00 to 105.00% **default = 100.0**	Output High Limit Value - is the highest value of output beyond which you do not want the automatic output to exceed.
	Out Low Limit	-5.00 to 105.00% **default = 0.000**	Output Low Limit Value - is the lowest value of output beyond which you do not want the automatic output to go below.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	Power Mode	Manual **Last (default)**	Mode permitted at power up.
	Power Out	**Failsafe (default)** Last	Output at Power up **FAILSAFE** - Failsafe output value. **LAST** - Same as at power down.
	Failsafe	-5.00 to 105.00% **default = 0.000**	Failsafe Output Value – The Output value to which the analyzer will go if there is a power down.
	Alm 1 SP1 Type	**PV High (default)** PV Low Dev High Dev Low SP High SP Low Output High Output Low No Alarm	High PV Alarm Low PV Alarm High Deviation Alarm Low Deviation Alarm High Setpoint Alarm Low Setpoint Alarm High Output Alarm Low Output Alarm No Alarm
	Alm 1 SP1 Value	-99999 to 99999 **default = 0.000**	Alarm 1 Setpoint 1 Value
	Alm 1 SP2 Type	Same as **Alarm 1 Setpoint 1** **PV Low (default)**	Same as **Alarm 1 Setpoint 1 Type**
	Alm 1 SP2 Value	-99999 to 99999 **default = 0.000**	Alarm 1 Setpoint 2 Value
	Alm 2 SP1 Type	Same as **Alarm 1 Setpoint 1** **Output High (default)**	Same as **Alarm 1 Setpoint 1**
	Alm 2 SP1 Value	-99999 to 99999 **default = 0.000**	Alarm 2 Setpoint 1 Value
	Alm 2 SP2 Type	Same as **Alarm 1 Setpoint 1** **Output Low (default)**	Same as **Alarm 1 Setpoint 1**
	Alm 2 SP2 Value	-99999 to 99999 **default = 0.000**	Alarm 2 Setpoint 2 Value
	Alm Hysteresis	0 to 100% **default = 0.000**	Alarm Hysteresis — an adjustable overlap of the ON/OFF states of each alarm.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
Control 1 **Control 2**	PV High	-99999 to 99999	PV High Range Value
	PV Low	-99999 to 99999	PV Low Range Value
	SP High Limit	-99999 to 99999	Setpoint High Limit Value - prevents the setpoint from going above the value set here.
	SP Low Limit	-99999 to 99999	Setpoint Low Limit Value - prevents the setpoint from going below the value set here.
	Control Action	Direct **Reverse (default)**	Direct - PID action causes output to **increase** as process variable increases. Reverse - PID action causes output to **decrease** as process variable increases.
	Out High Limit	-5.00 to 105.00% **default = 100.0**	Output High Limit Value - is the highest value of output beyond which you do not want the automatic output to exceed.
	Out Low Limit	-5.00 to 105.00% **default = 0.000**	Output Low Limit Value - is the lowest value of output beyond which you do not want the automatic output to exceed.
	Out Hysteresis	-5.00 to 105.00% **default = 0.000**	This is the limit hysteresis. This is the value in EU that the will act on the high and low limit values. Once the limit is active due to the output greater than the high limit or less than the low limit, the respective high or low limit output will not become inactive until the output is within the limit high - hysteresis and limit low + hysteresis respectively.
	Power Mode	Manual **Last (default)**	Manual Mode Last Mode – Auto or Manual
	Power Out	**Failsafe (default)** Last	Output at Power up Failsafe - Failsafe output value. Last - Same as at power down.
	Failsafe	-5.00 to 105.00% **default = 0.000**	Failsafe Output Value – The Output value to which the analyzer will go if there is a power down.
	Alm 1 SP1 Type	**PV High (default)** PV Low Dev High Dev Low SP High SP Low Output High Output Low No Alarm	High PV Alarm Low PV Alarm High Deviation Alarm Low Deviation Alarm High Setpoint Alarm Low Setpoint Alarm High Output Alarm Low Output Alarm No Alarm
	Alm 1 SP1 Value	-99999 to 99999	Alarm 1 Setpoint 1 Value

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	Alm 1 SP2 Type	Same as Alarm 1 Setpoint 1 **PV Low (default)**	Same as Alarm 1 Setpoint 1 Type
	Alm 1 SP2 Value	-99999 to 99999	Alarm 1 Setpoint 2 Value
	Alm 2 SP1 Type	Same as Alarm 1 Setpoint 1 **Output High (default)**	Same as Alarm 1 Setpoint 1 Type
	Alm 2 SP1 Value	-99999 to 99999	Alarm 2 Setpoint 1 Value
	Alm 2 SP2 Type	Same as Alarm 1 Setpoint 1 **Output Low (default)**	Same as Alarm 1 Setpoint 1 Type
	Alm 2 SP2 Value	-99999 to 99999	Alarm 2 Setpoint 2 Value
	Alm Hysteresis	0 to 100% **default = 0.000**	Alarm Hysteresis – an adjustable overlap of the ON/OFF states of each alarm.

6.12 Communication Configuration

Overview

The communication menu allows you to select the mode and address for the IR port. It will also allow configuration of other optional communication interfaces if they are installed.

Accessing Communication Menu

- Press Setup to display the Main menu.
- Use the ▲▼ keys to select **"Communication"** then press Enter to enter the sub-menu.
- Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to "Section 6.4.1 – "***General Rules for Editing***".

Table 6-9 Communication Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	Mode	**Address (default)**	Address mode allows the communication interface to respond to messages that reference the device address.
		Setup	Setup mode allows the communication interface to respond to messages only when the device is in setup mode.
	Address	0 to 255 **default = 0**.	Address for the device. Setting the Address to 0 will allow the device to respond to any address.
	Reset	On/Off **default = Off**	This allows the communication port to be restarted with the new communication parameters without requiring the restart of the entire unit. Setting to ON will reset the communication interface. The parameter will return to Off after the reset.

6.13 Maintenance Configuration

Accessing Maintenance Menu

- Press Setup to display the Main menu.
- Use the ▲▼ keys to select **"Maintenance"** then press Enter to enter the sub-menu.
- Press ▲▼ to highlight the desired menu selection then press Enter to display the group of parameters.

Refer to "Section 6.4.1 – "***General Rules for Editing***".

Table 6-10 Maintenance Configuration

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	SW Version	Software version number	Read Only
	Input 1 Type Input 2 Type	***Read Only***	pH/ORP - pH or Oxidation Reduction Potential Conductivity DO - Dissolved Oxygen
	Language	**English (default)** Italiano Deutsch Francais Espanõl	Multi-language prompts guide the operator step-by-step through the configuration process assuring quick and accurate entry of all configurable parameters. Select from English, French, German, Spanish and Italian.
	Tag name	0 to 21 Characters **default = UDA2182**	The real-time displays of process values show the instrument's tag name (or other configurable fixed sixteen-character string) at the top of the screen. Follow the " *General Rules for Editing*" to edit the character string.
	Password	**0000 (default)** to 9999 AAAA to ZZZZ	Setup configuration, calibration and maintenance functions can be password-protected. The password can be any number between 1 and 9999 or letters. (When the password is zero, the operator will not be prompted to enter a password.) Follow the " *General Rules for Editing*" to change the digits.
	Temp Units	º F **º C (default)**	Allow Degrees Fahrenheit on display. Allow Degrees Celsius on display.
	Mains Freq	**60 Hz (default)** 50 Hz	This function determines the frequency of AC line noise suppression for the input ADC circuitry.
	Display Test	**Off (default)** Enable	Display Test action occurs when the "**Enter**" key is pressed to accept the selection.

Sub-menu selection	Parameter	Selection or Range of Setting	Parameter Definition
	Keypad Test	**Off (default)** Enable	When the keyboard test is enabled, the Status Message area displays the name of the key currently pressed. **Note:** ***The keypad test will exit three seconds after no key is pressed.***
	Output Level 1 Output Level 2 Output Level 3	**Off (default)** 0% 25% 50% 75% 100% Low Limit High Limit	Output action occurs when the "**Enter**" key is pressed to accept selection. Actual output current is consistent with selected current range of 0 to 20 mA or 4 to 20 mA.
	Relay 1 State Relay 2 State Relay 3 State Relay 4 State	**Off (default)** Energized De-energized	Relay state action occurs when the "**Enter**" key is pressed to accept selection.
	Unit Reset	**Off (default)** Enable	Unit Reset initializes all calibration and configuration data to factory default values, with the exception of the Factory Temperature Calibration correction values

7 Inputs and Outputs Wiring

7.1 Overview

Introduction

This section contains instructions for wiring the inputs and outputs of the Analyzer.

What's in this section?

The topics in this section are listed below.

7.2 General Wiring Practices

WARNING

Qualified personnel should perform wiring only.

Safety precaution

WARNING

A disconnect switch must be installed to break all current carrying conductors. Turn off power before working on conductors. Failure to observe this precaution may result in serious personal injury.

WARNING

An external disconnect switch is required for any hazardous voltage connections to the relay outputs.

Avoid damage to components

ATTENTION

This equipment contains devices that can be damaged by electrostatic discharge (ESD). As solid-state technology advances and as solid-state devices get smaller and smaller, they become more and more sensitive to ESD. The damage incurred may not cause the device to fail completely, but may cause early failure. Therefore, it is imperative that assemblies containing static sensitive devices be carried in conductive plastic bags. When adjusting or performing any work on such assemblies, grounded workstations and wrist straps must be used. If soldering irons are used, they must also be grounded.

A grounded workstation is any conductive or metallic surface connected to an earth ground, such as a water pipe, with a 1/2 to 1 megohm resistor in series with the ground connection. The purpose of the resistor is to current limit an electrostatic discharge and to prevent any shock hazard to the operator. The steps indicated above must be followed to prevent damage and/or degradation, which may be induced by ESD, to static sensitive devices.

Immunity compliance

⚠ In applications where either the power, input or output wiring are subject to electromagnetic disturbances, shielding techniques will be required. Grounded metal conduit with conductive conduit fittings is recommended.

Conform to code

Instrument wiring should conform to regulations of the National Electrical Code.

Recommended maximum wire size

Table 7-1 Recommended Maximum Wire Size

Gage Number	mm^2	Description
14	2.081	power, relays, and PE (protective earth)
18	0.823	inputs
18	0.823	isolated outputs

Shielded wiring for locations with interference

In applications where plastic conduit or open wire trays are used, shielded 6-conductor 22 gage (0.326 mm^2) or heavier signal input wiring is required.

Avoiding interference

Instrument wiring is considered Level 1, per section 6.3 of IEEE STD. 518 for plant facilities layout and instrumentation application. Level 1 wiring must not be run close to higher level signals such as power lines or drive signals for phase fired SCR systems, etc. Unprotected input wiring in high electrical noise environments is subject to electromagnetic, electrostatic, and radio frequency interference pickup of sufficient magnitude to overload input filters. The best instrument performance is obtained by keeping the interfering signals out of the instruments altogether by using proper wiring practices.

References

Refer to the following when wiring the unit.

- IEEE STD. 518, Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs from External Sources.
- Appropriate wiring diagram supplied with electrode mounting or preamplifier module.

7.3 Inputs and Outputs

Introduction

The analyzer can accept single or dual inputs from Honeywell pH, ORP, contacting conductivity and dissolved oxygen sensors.

Two analog outputs standard

One additional output optional

Two electromechanical relays standard

Two additional relays optional

Two Digital Inputs

Wiring these inputs and outputs is described here.

Accessing the terminals

The wiring is easily accessible through the front and the boards can be pulled out to facilitate the wiring of sensor input.

Open the case.

Loosen the four captive screws on the front of the bezel.
Grasp the bezel on the right side. Lift the bezel gently and swing the bezel open to the left.

Wiring terminals and board location

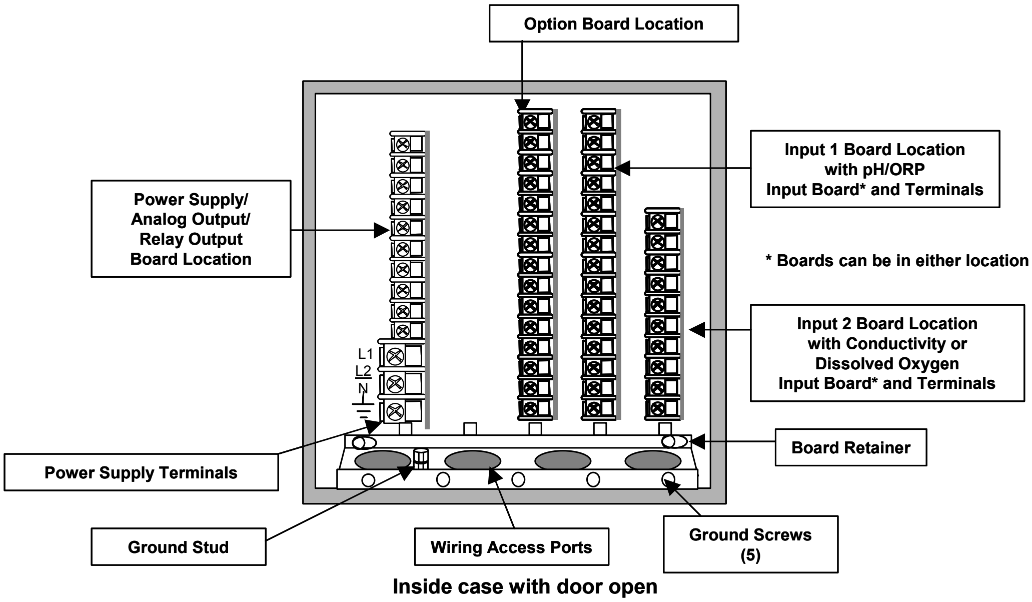


Figure 7-1 Wiring Terminals and board Location

Procedure

WARNING

While the unit is powered, a potentially lethal shock hazard exists inside the case. Do not open the case while the unit is powered.

Table 7-2 Procedure for installing Input and Output wiring

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Go to Configuration setup to view the displays showing analog input, relay, and analog output use. Note the assignments shown. You must wire the unit to match these assignments in order for the analyzer to work as expected (See Section 6).</td></tr>
<tr><td colspan="2">ATTENTION</td></tr>
<tr><td colspan="2">Turn off the power to the analyzer.
More than one switch may be required to remove power.</td></tr>
<tr><td>2</td><td>With power off, open the case:
• Loosen the four captive screws on the front of the bezel.
• Grasp the bezel on the right side. Lift the bezel gently and swing the bezel open to the left.</td></tr>
<tr><td>3</td><td>Refer to Figure 7-1 for the location of the terminal board retainer. Loosen the screws that hold the retainer and slide the retainer left until the retainer tabs disengage from the terminal boards.</td></tr>
<tr><td>4</td><td>Insert a screwdriver into the tab in the terminal board to be wired and pull out gently. Slide the board half way out. There is a notch in the terminal board into which you can slide the retainer tabs and hold the boards in place while wiring.</td></tr>
<tr><td>5</td><td>Connect the inputs from the electrode or cells to the terminals in accordance with the configuration setup assignments. Refer to the wiring diagram provided with the electrode or cell, and to Figure 7-2 through Figure 7-10</td></tr>
<tr><td>6</td><td>Analog outputs (In addition to the standard outputs, one more is available as an option). See Option Board Wiring - Figure 7-10). Connect the outputs from the Analyzer terminals in accordance with the configuration setup assignments. Refer to the wiring diagrams provided with the field devices receiving the signals, and to Figure 7-2 through Figure 7-10.</td></tr>
<tr><td>7</td><td>If the relay outputs are to be used, leave the unit open and powered down. The relays can be used for Time Proportioning Output, Pulse Frequency Output, and Digital Output control as well as alarm annunciation. (In addition to the standard relays, two more are available as an option. See Option Board Wiring - Figure 7-10). Connect the outputs from the Analyzer terminals in accordance with the configuration setup assignments. Refer to the wiring diagrams provided with the external device and to Figure 7-2 through Figure 7-10.
These relays can be programmed to de-energize or energize on alarm. Use the Maintenance configuration setup to specify relay state. (NOTE 1)</td></tr>
<tr><td colspan="2">CAUTION: Alarm circuits are not internally fused in the analyzer. Provision for fuses in external circuits is recommended.</td></tr>
</table>

8	Slide the retainer to the left then slide the terminal board back into place. Slide retainer to engage the tabs and tighten the screws.
9	Close the Bezel and secure four captive screws to a torque value of .20Nm (1.5 Lb-in). Power up the unit. Do not apply power until the bezel is closed.

Note 1: If set to de-energize on alarm, this means that when an alarm occurs (or the discrete control point becomes active), the relay coil will be de-energized. The NC contacts will then be closed and the NO contacts will be open. Conversely, during normal non-alarm operation (or when the control point is not active) the NC contacts will be open, and the NO contacts will be closed.

If de-energize on alarm is selected, a power loss will force all relays to the same position as an alarm condition.

7.4 Wiring Diagrams

Identify Your Wiring Requirements

To determine the appropriate diagrams for wiring your analyzer, refer to the model number interpretation in this section. The model number of the analyzer is on the outside of the case.

Wiring the Analyzer

Using the information contained in the model number, refer to the individual diagrams listed to wire the analyzer according to your requirements.

7.5 pH/ORP Wiring Diagrams

Durafet III

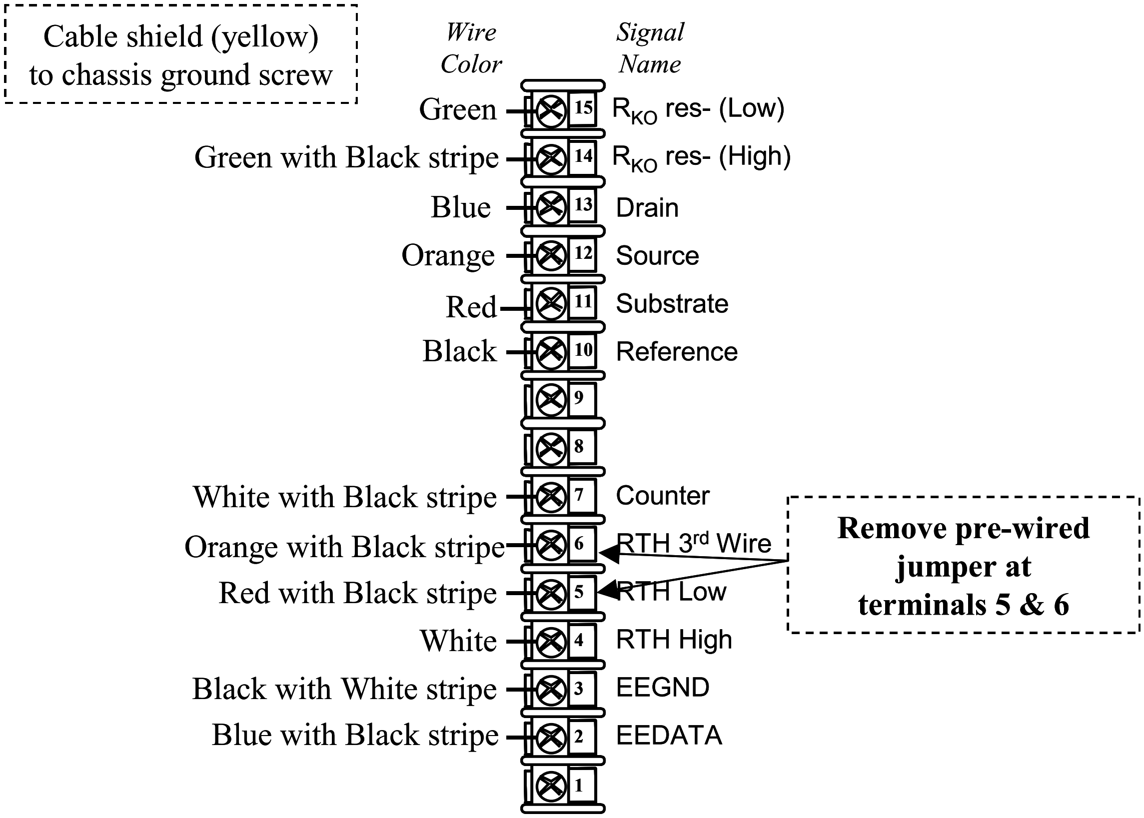
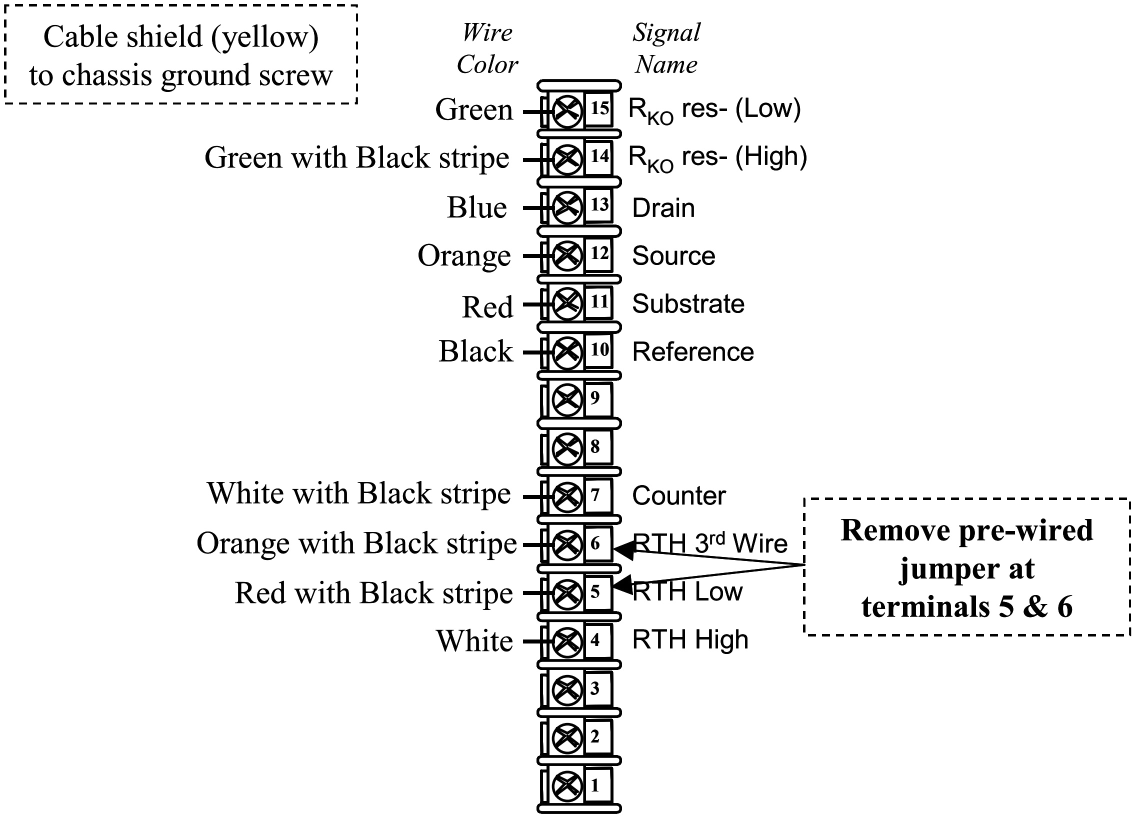


Figure 7-2 Terminal Designations for Durafet III Electrode

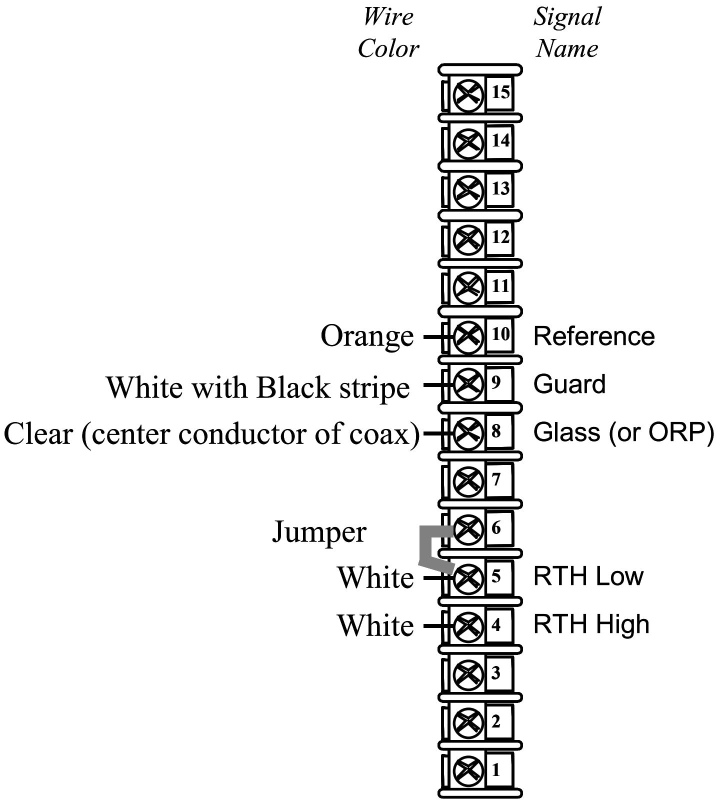
Durafet II



Some cables have connectors on the leads.
Cut off the connectors, skin and tin the leads
and then wire to the screw terminals on the boards

Figure 7-3 Terminal Designations for Durafet II Electrode

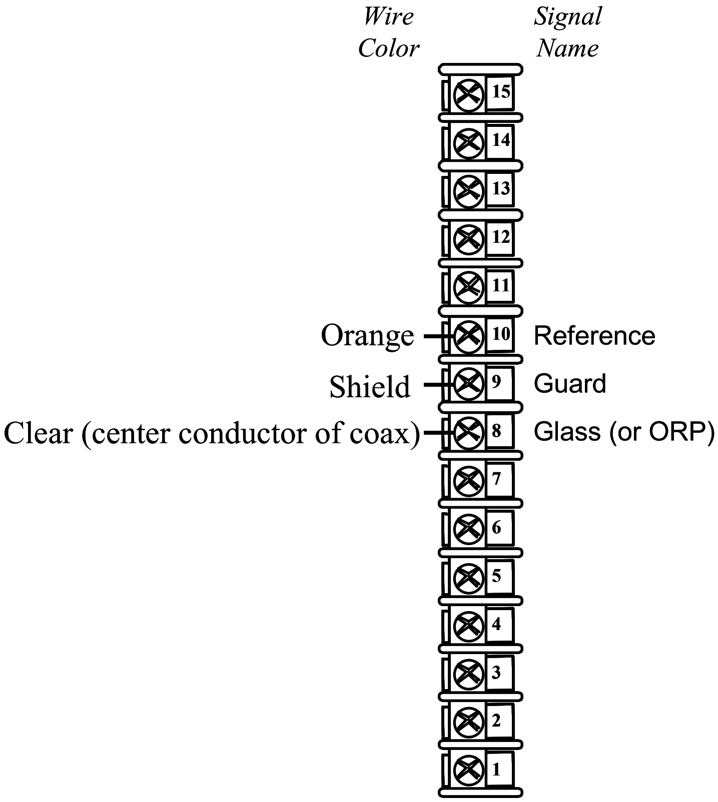
Glass Meredian II



*Some cables have connectors on the leads.
Cut off the connectors, skin and tin the leads
and then wire to the screw terminals on the boards*

Figure 7-4 Terminal Designations for Meredian II Electrode

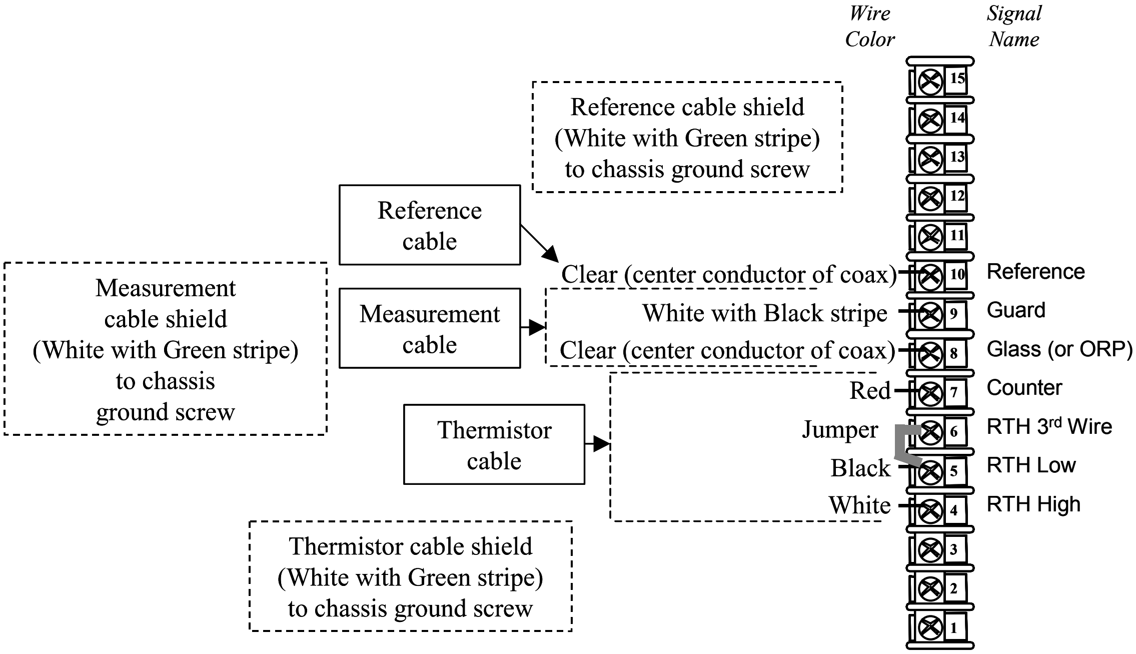
ORP



Some cables have connectors on the leads.
Cut off the connectors, skin and tin the leads
and then wire to the screw terminals on the boards

Figure 7-5 Terminal Designations for ORP

HPW7000



Some cables have connectors on the leads.
Cut off the connectors, skin and tin the leads
and then wire to the screw terminals on the boards

Figure 7-6 Terminal Designations for HPW7000 System

Conductivity

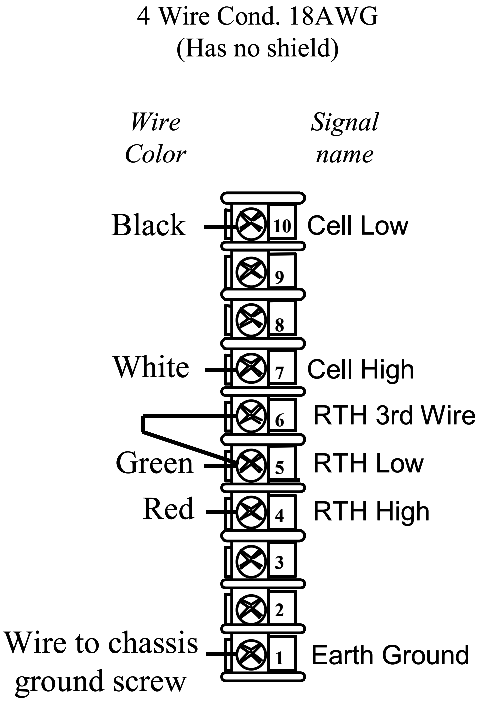
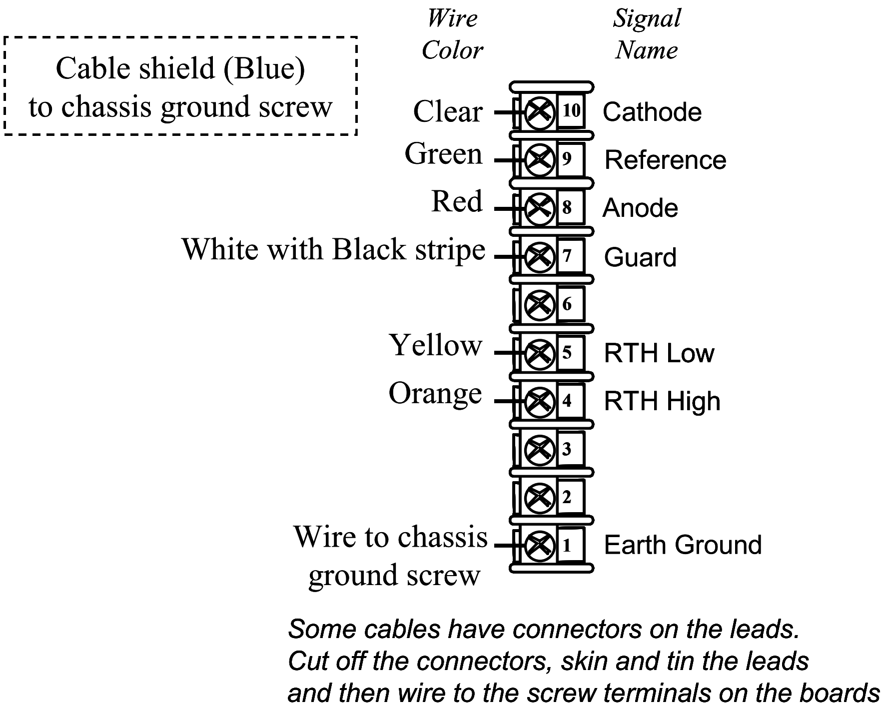


Figure 7-7 Terminal Designations for Conductivity

Dissolved Oxygen



*Some cables have connectors on the leads.
Cut off the connectors, skin and tin the leads
and then wire to the screw terminals on the boards*

Figure 7-8 Terminal Designations for Dissolved Oxygen

CAUTION

When installing the probe, the wiring must be done in the order shown below even if the analyzer is not powered. This is because the DO Input card is continuously supplying a voltage (bias) to the terminals.

Connecting – Shield wire first, then in this order:

Red
Green
Coax (clear)
Yellow
Orange

Disconnecting – Go in reverse

Orange – first
Yellow
Coax (clear)
Green
Red
Shield Wire

Outputs

Power Supply/Analog Output/Relay Output Card

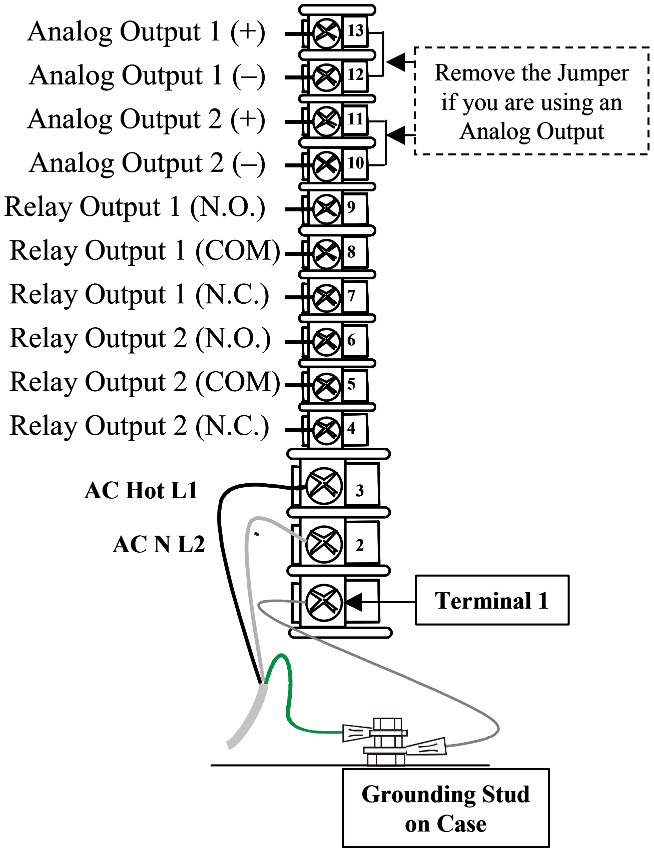
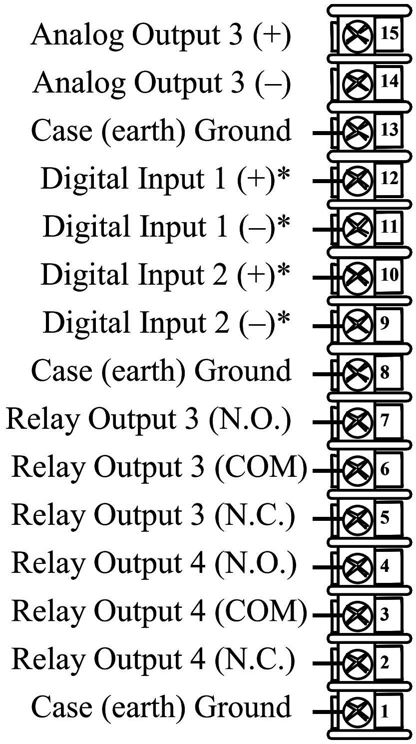


Figure 7-9 Terminal Designations for Power, Analog Output, and Relay Output

Option Card



* Contact Closure only

Figure 7-10 Terminal Designations for Option Board

8 Input Calibration

8.1 Overview

Introduction

The section describes the calibration procedures for the following:

Input Cal – calibrate ***Input 1*** **and** ***Input 2*** **for** ***pH/ORP*****,** ***Conductivity***, ***or Dissolved Oxygen.***

For other Calibration Procedures refer to the sections listed below.

Output Cal – calibrate ***Analog Output 1, Analog Output 2, and Analog Output 3*** (See Section 9).

Temp Input Cal – calibrate ***Temperature 1*** **and** ***Temperature 2*** **for** ***pH/ORP*** **or** ***Conductivity*** (See Section *10).*

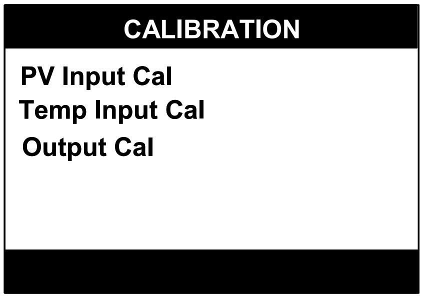
What's in this section?

The topics in this section are listed below.

8.2 Calibration Menu

Accessing the Main Calibration Menu and sub-menus

Press Calibrate. The Main Calibration Menu will appear.



Use the ▲▼ keys to highlight the "**PV Input Cal**" selection.

Press Enter to display the sub-menu for that selection.

Depending on the Input board installed, you can select from:

IN 1 or 2 pH/ORP Cal
IN 1 or 2 Conduc Cal
IN 1 or 2 DO Cal

Use the ▲▼ keys to highlight the Input selection for calibration.

Refer to the following sections for "calibration instructions":

8.5	**pH Calibration**	Page 81
8.6	**ORP Calibration**	Page 91
8.7	**Conductivity Calibration**	Page 97
8.8	**Dissolved Oxygen Calibration**	Page 103

8.3 pH/ORP and Conductivity Overview

pH/ORP Calibration

Calibration of pH or ORP measuring instruments is necessary because similar electrodes may produce slightly different potentials in the same solution, requiring a corrective adjustment at the measuring instrument. Also, electrode outputs change over a period of time, making periodic recalibration necessary for best performance. Determine recalibration intervals based on operating experience.

Conductivity

Each type of cell has an associated cell constant entered during Configuration Setup. (See Section 6.5. This number is part of the cell model number. However, for greater precision, every Honeywell cell is individually tested at the factory, and a calibration factor unique to that cell is determined. The cal factor for a cell can be found on the plastic tag hanging from the cell lead wires. Instructions for entering this cell cal factor are in Section 0.

For some conductivity applications even greater accuracy is required. For those applications it is possible to perform a calibration trim procedure. The Analyzer’s reading can be adjusted while the associated cell is measuring a reference solution of known conductivity, as described in Section 8.7. The same procedure can be used to adjust the Analyzer’s reading while the cell is in the process, if a reference instrument is used to determine the conductivity of the process. In this case the process fluid becomes the “reference solution”.

Calibration trim is recommended for acid concentration applications above 5%.

Calibration trim can be reset as described in Section 8.7.

For accurate measurement of total dissolved solids (TDS) a conversion factor is entered for each cell as described in Section 0.

ATTENTION

Any time a unit reset is performed; the TDS Value will be reset to 1.0. Calibration trim and cal factor will either be reset for legacy cells or re-read from smart probes.

8.4 Recommendations for Successful Measurement and Calibration

Selection and care of electrode system or cell essential

Successful measurements and calibration depend upon selection and care of the electrode system or cells. Always prepare electrodes or cells and their mountings in accordance with the instructions supplied with them, observing temperature, pressure and flow limitations. Note the following recommendations:

pH/ORP Calibration

- Rinse electrodes thoroughly between buffer solutions.
- Always use HOLD, or otherwise deactivate control or alarm circuits before removing electrodes from the process.
- Standardize with a buffer solution, which is at about the same temperature and pH as the sample solution.
- Inspect and, if necessary, clean and/or rejuvenate the electrode system periodically according to experience and conditions.

Conductivity Calibration

- For most accurate temperature measurement and compensation, insulate the outer body of the cell to minimize the effect of ambient conditions on process temperature measurement.
- Rinse the cells thoroughly with de-ionized water before immersing in a reference solution.
- Always deactivate control or alarm circuits before removing cells from the process.
- Do calibration trim with a reference solution, which is at about the same temperature and conductivity as the process solution.
- Inspect and, if necessary, clean the cells periodically according to experience and conditions.

ATTENTION

For successful measurement in pure water applications where plastic piping is used, you may have to provide an earth ground for the cell. Run a wire from the black electrode terminal of the cell to one of the earth ground screws.

8.5 pH Calibration

Introduction

pH instrument calibration consists of standardization and slope adjustments. Standardization is a pH Offset adjustment to compensate for electrode drift. Slope adjustment is a span adjustment to match the gain of the instrument to the electrode output response.

The analyzer supports two methods of calibration:

- With the **"Buffering"** method described in this section, you use your electrode system to measure two reference solutions ("buffers") having known pH values, then adjust the analyzer so that its readings match the actual pH of each.

ATTENTION

The two reference solutions must have a pH difference of at least 2.

- With the **"Sample"** method described in this section you measure your process, both with your electrode system and with a separate (accurately calibrated) meter, then adjust the analyzer so that its reading matches the meter.

Calibrating pH Electrodes Using Automatic Buffer recognition

Analyzer stores information on multiple buffers

The UDA2182 Universal Dual Analyzer contains (in its permanent memory) information on several commonly used buffer solution standards in three groups, including the pH versus temperature characteristics of each.

By command, the instrument will automatically select one of these buffers in the selected group and use its values in the calibration process. Automatic checks are included to ensure that reasonable and correct values are entered.

The procedure for using the automatic buffer recognition feature in an actual calibration is provided in Table 8-2.

The standard pH Buffer values are listed in Table 8-1.

Calibration functions

Calibrating the pH Offset (Standardization) –. In auto buffer recognition calibration, you can select one of the other buffer pH values directly above or below the recognized buffer value in the current buffer group. (See Table 8-1.)

Calibrating the Slope - In auto buffer recognition calibration, you can select one of the other buffer pH values directly above or below the recognized buffer value in the current buffer group. (See Table 8-1.)

Table 8-1 Standard pH Buffer Values

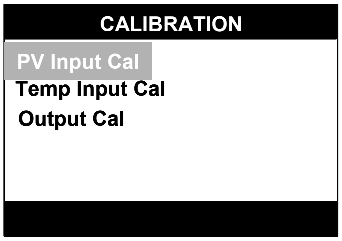
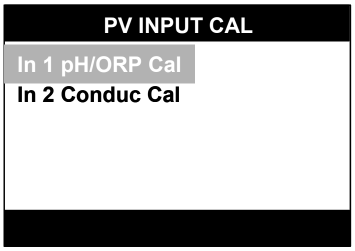
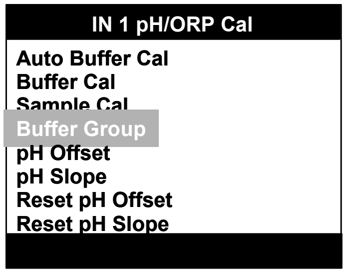
Temperature °C		**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**
Group	***Buffer***											
NIST/USP	**1.68**	1.67	1.67	1.67	1.67	1.68	1.68	1.68	1.69	1.69	1.70	1.71
	4.01	4.01	4.00	4.00	4.00	4.00	4.01	4.01	4.02	4.03	4.04	4.06
	6.86	6.98	6.95	6.92	6.90	6.88	6.86	6.85	6.84	6.84	6.83	6.83
	9.18	9.46	9.40	9.33	9.28	9.23	9.18	9.14	9.10	9.07	9.04	9.01
	12.45	13.42	13.21	13.01	12.80	12.64	12.45	12.30	12.13	11.99	11.84	11.71
USA	**2.00**	2.01	2.01	2.01	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	4.00	4.01	3.99	4.00	3.99	4.00	4.00	4.01	4.02	4.03	4.04	4.06
	7.00	7.13	7.10	7.07	7.05	7.02	7.00	6.99	6.98	6.97	6.97	6.97
	10.00	10.34	10.26	10.19	10.12	10.06	10.00	9.94	9.90	9.85	9.82	9.78
	12.00	12.60	12.44	12.28	12.14	12.00	11.88	11.79	11.66	11.53	11.43	11.32
Europe	**1.00**	0.98	0.98	0.99	0.99	1.00	1.00	1.01	1.01	1.01	1.01	1.02
	3.00	3.02	3.02	3.02	3.02	3.00	3.00	2.99	2.99	2.98	2.98	2.97
	6.00	6.03	6.02	6.01	6.00	6.00	6.00	6.00	6.01	6.02	6.04	6.05
	8.00	8.15	8.11	8.07	8.03	8.00	7.97	7.94	7.91	7.88	7.87	7.86
	10.00	10.22	10.17	10.12	10.05	10.00	9.95	9.90	9.86	9.82	9.78	9.74
	13.00	13.81	13.60	13.39	13.19	13.00	12.83	12.68	12.53	12.38	12.25	12.11

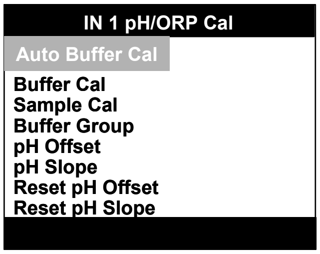
Procedure

Make sure you have selected “PV Type –pH Glass, pH Durafet, or pH HPW ” in the Inputs configuration - Table 6-2.

Refer to Section 6.4.1 – ***General Rules for Editing***.

Table 8-2 Calibrating pH Electrodes Using Automatic Buffer Recognition

Step	Action	Screen
1	Prepare containers of two standard reference solutions.	
2	Press Calibrate	 CALIBRATION PV Input Cal Temp Input Cal Output Cal Use ▲▼ to select **PV Input Cal**
3	Press Enter	 PV INPUT CAL In 1 pH/ORP Cal In 2 Conduc Cal Use ▲▼ to select **Input 1 or 2 pH/ORP Cal**
4	Press Enter	 IN 1 pH/ORP Cal Auto Buffer Cal Buffer Cal Sample Cal Buffer Group pH Offset pH Slope Reset pH Offset Reset pH Slope Use ▲▼ to select **”Buffer Group”**
5	Press Enter	Use ▲▼ to select **NIST/USP (default)** USA, or Europe

6	Press **Enter**	 Use ▲▼ to select **"Auto Buffer Cal"**
7	• Put the unit in "Hold" mode • Remove the electrode from the process. • Rinse the electrode thoroughly with distilled or de-ionized water	
8	***Calibrating the pH Offset*** Press **Enter** Follow the prompts at the top and bottom of the screen.	**"Place probe in Buffer 1"** The display will show the pH of the buffer 1 solution as measured by the electrode system. The reading will be automatically adjusted to match the known pH value stored in the UDA2182 memory. **"Press Enter when stable"**
9	Once the reading is stable Press **Enter**	**"Buffer 1 stability check"** Use ▲▼ to change the value of the Buffer. **"Up/Down changes Buffer"**
10	Rinse the electrode thoroughly with distilled or de-ionized water	
11	***Calibrating the Slope*** Press **Enter** Follow the prompts at the top and bottom of the screen.	**"Place probe in Buffer 2"** The display will show the pH of the buffer 2 solution as measured by the electrode system. The reading will be automatically adjusted to match the known pH value stored in the UDA2182 memory. **"Press Enter when stable"**

12	Once the reading is stable Press **Enter**	**“Buffer 2 stability check”** Use ▲▼ to change the value of the Buffer.
13	If the calibration fails, an error message will be displayed across the bottom stripe of the screen. Make necessary adjustments and re-calibrate.	***Error Messages:*** Buffer span too low Slope(Percent Theoretical Slope) underrange Slope (Percent Theoretical Slope) overrange Solution Unstable Temp Too Low Temp too High See Table 11-2 for definitions

Buffering Method of Calibrating pH Electrodes

Recommended for most applications

This technique is recommended for best accuracy in most applications.

Materials

Materials required are:

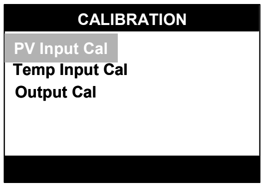
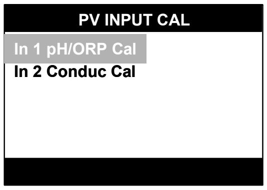
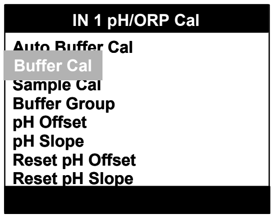
- Two standard buffer reference solutions that are at least 2 pH apart from one another.
- A container for each, large enough to immerse the electrode to measuring depth.
- Distilled or de-ionized water to rinse the electrode.

Procedure

Make sure you have selected “PV Type –pH Glass, pH Durafet, or pH HPW ” in the Inputs configuration - Table 6-2.

Refer to Section 6.4.1 – ***General Rules for Editing***.

Table 8-3 Procedure for Buffering Method of Calibrating pH Electrodes

Step	Action	Screen
1	Press **Calibrate**	 Use ▲▼ to select **PV Input Cal**
2	Press **Enter**	 Use ▲▼ to select **Input 1 or 2 pH/ORP Cal**
3	Press **Enter**	 Use ▲▼ to select **Buffer Cal**
4	• Put the unit in "Hold" mode • Remove the electrode from the process. • Rinse the electrode thoroughly with distilled or de-ionized water	
5	*Standardization (adjust instrument zero)* Press **Enter** Follow the prompts at the top and bottom of the screen.	**"Place probe in Buffer 1"** The display will show the pH of the buffer 1 solution as measured by the electrode system. **"Press Enter when stable"**

6	Once the reading is stable Press **Enter**	**“Change to Buffer 1 value”** Use ▲▼ to change the value to match the actual pH of the Buffer 1 solution at its current temperature.
7	Rinse the electrode thoroughly with distilled or de-ionized water.	
8	*Percent Theoretical Slope Adjustment* Press **Enter** Follow the prompts at the top and bottom of the screen.	**“Place probe in Buffer 2”** The display will show the pH of the buffer 2 solution as measured by the electrode system. **“Press Enter when stable”**
9	Once the reading is stable Press **Enter**	**“Change to Buffer 2 value”** Use ▲▼ to change the value to match the actual pH of the Buffer 2 solution at its current temperature. **“Enter to save, Exit to cancel”**
10	If the calibration fails, an error message will be displayed across the bottom stripe of the screen. Make necessary adjustments and re-calibrate	***Error Messages:*** Buffer span too low Slope (Percent Theoretical Slope) underrange Slope(Percent Theoretical Slope) overrange Solution Unstable See Table 11-2 for definitions

Sample Method of Calibrating pH Electrodes

Recommended where pH is stable, or for high-purity water applications

This method is recommended only where the pH is stable and changes very slowly. It is also recommended for high-purity water measurement applications. Special instructions for high-purity water applications are provided below.

Materials

To use the sample method, follow the instructions in Table 8-4.

Materials required are:

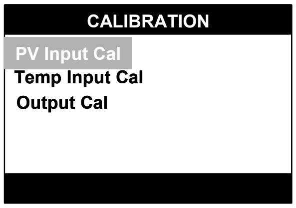
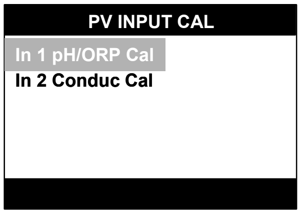
- A clean beaker for collecting the sample.
- A calibrated portable instrument for measuring pH of the sample.
- Distilled or de-ionized water to rinse the electrode.

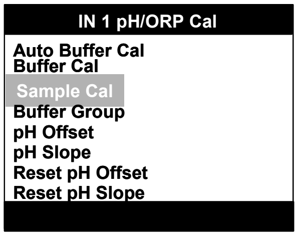
Procedure

Make sure you have selected “PV Type –pH Glass, pH Durafet, or pH HPW ” in the Inputs configuration - Table 6-2.

Refer to Section 6.4.1 – ***General Rules for Editing***.

Table 8-4 Procedure for Sample Method of Calibrating pH Electrodes

Step	Action	Screen
1	Prepare the Calibration meter.	
2	Press Calibrate	 Use ▲▼ to select **PV Input Cal**
3	Press Enter	 Use ▲▼ to select **Input 1 or 2 pH/ORP Cal**

4	Press Enter	 Use ▲▼ to select **Sample Cal**
5	• Put the unit in “Hold” mode • **DO NOT** Remove the electrode from the process.	
6	Press Enter Follow the prompts at the top and bottom of the screen.	**“Place probe in Sample”** The display will show the pH of the process as measured by the electrode system. **“Press Enter when stable”**
7	Collect a beaker of the process sample from a point near the electrode mounting and measure its pH value with a calibrated portable instrument. **Special instructions for high-purity water applications** For a high purity water application, do not remove the sample from the process for measurement. Bring the portable instrument to the sampling site and measure a continuously flowing sample that has not been exposed to air. This prevents lowering the sample pH by absorption of carbon dioxide from the air.	
8	Once the reading is stable, press Enter	**Change to Sample Value”** Use ▲▼ keys to change the displayed value to match the value on the portable meter. **“Enter to save, Exit to cancel”**
9	If the calibration fails, an error message will be displayed across the bottom stripe of the screen. Make necessary adjustments and re-calibrate	Error Messages: See Table 11-2.

Viewing and resetting pH Offset and (Standardization) pH Slope

If the calibration is suspect, you can reset the pH Offset and pH Slope and calibrate again.

In the same screen as “Sample Cal”, use the ▲▼ keys to highlight “Reset pH Offset” or “Reset pH Slope”.

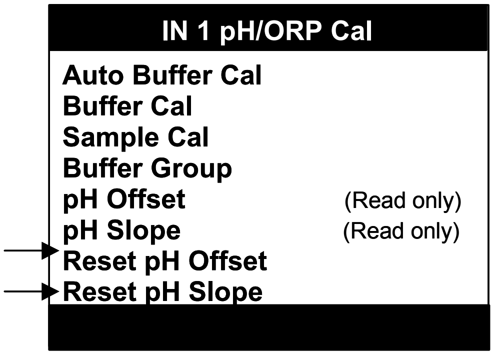


Figure 8-1 Resetting pH Offset and pH Slope

Press **ENTER**. The pH Offset or pH Slope will be reset to (default).

8.6 ORP Calibration

Introduction

ORP calibration consists of adjusting the reading of the analyzer to match a known value. There are two types of ORP calibration supported:

- To calibrate the system to compensate for changes in electrode potentials over time, the ORP electrode is placed in a reference solution of known ORP value, and the analyzer reading is adjusted to match this value, as described in Section 8.6. Instructions for preparing standard solutions are also provided below. These solutions are stable for only short periods of time (less than 8 hours) and are only approximations of ORP potentials.
- To calibrate the UDA2182 only, not the whole system including electrodes, apply a known millivolt signal to the Analyzer instead of input from the electrode, then adjust the UDA2182 reading to match the actual millivolt input, as described in Table 8-7.

ORP Calibration Using Reference Solution

Recommended to adjust for changes in electrode potential over time

An ORP measuring system can be checked by measuring a solution having a known oxidation-reduction potential, then adjusting the UDA2182 to match. Although a reference solution provides only an approximation of ORP potential, the system can be adjusted periodically to compensate for changes in electrode potential over time.

Materials

The materials required to use the ORP standardization method are:

- A solution with a known oxidation-reduction potential. (See *"Instructions for preparing solution"* below.
- A container for the solution, large enough to immerse the electrode to measuring depth.
- Distilled or de-ionized water to rinse the electrode.

Instructions for preparing solution

To prepare an ORP standardization solution, dissolve 0.1 g of quinhydrone powder in 5 cc of acetone or methyl alcohol (methanol). Add this to not more than 500 cc of a standard pH reference solution (buffer), about 1 part saturated quinhydrone to 100 parts buffer solution. The oxidation potential of this solution is listed below for several temperatures. The polarity sign shown is that of the measuring element with respect to the reference element.

These solutions are unstable and should be used within eight hours of preparation.

All mV values in Table 8-5 have a ± 30 mV tolerance.

Table 8-5 Oxidation-Reduction Potential of Reference Solutions at Specified Temperature

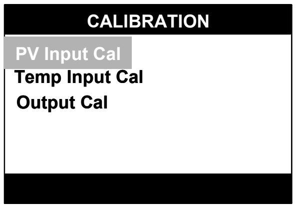
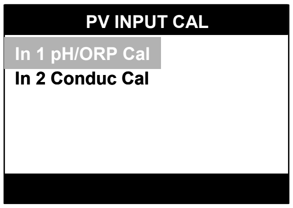
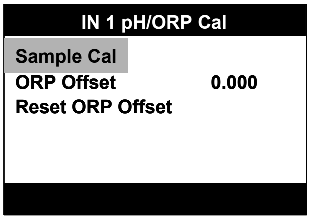
pH Buffer Solution (Honeywell Part Number)	Temperature 20 °C	25 °C	30 °C
4.01 @ 25 °C (31103001)	267 mV	263 mV	259 mV
6.86 @ 25 °C (31103002)	100 mV	94 mV	88 mV
7.00 @ 25 °C (not available from Honeywell)	92 mV	86 mV	80 mV
9.00 @ 25 °C **(not available from Honeywell)	–26 mV	–32 mV	–39 mV
9.18 @ 25 °C (31103003)	–36 mV	–43 mV	–49 mV

Procedure

Make sure you have selected "PV Type –ORP" in the Inputs configuration - Section 0.

Refer to Section 6.4.1 – ***General Rules for Editing***.

Table 8-6 Procedure for Calibrating ORP System Using a Reference Solution

Step	Action	Screen
1	Press **Calibrate**	CALIBRATION PV Input Cal Temp Input Cal Output Cal Use ▲▼ to select **PV Input Cal**
2	Press **Enter**	PV INPUT CAL In 1 pH/ORP Cal In 2 Conduc Cal Use ▲▼ to select **Input 1 or 2 pH/ORP Cal**
3	Press **Enter**	IN 1 pH/ORP Cal Sample Cal ORP Offset 0.000 Reset ORP Offset

4	Put the unit in "Hold" mode Remove the electrode from the process. Rinse the electrode thoroughly with distilled or de-ionized water	
5	Press **Enter**	
6	Follow the prompts at the top and bottom of the screen.	**"Place probe in Sample"** The display will show the Oxidation Reduction Potential of the reference solution as measured by the electrode system. **"Press Enter when stable"**
7	Once the reading is stable Press **Enter**	**"Change to Sample value"** Use ▲▼ to change the value to match the actual oxidation-reduction potential of the reference solution at its current temperature. **"Enter to save, Exit to cancel"**
8	Press **Enter**	This will standardize the unit.
9	Take the unit out of "Hold" and return to the calibration menu.	
10	If the calibration fails, an error message will be displayed across the bottom stripe of the screen.	**Error Messages** Refer to Table 11-2.

ORP Calibration Using Voltage Input

Calibrates Analyzer only

The procedure described in this sub-section calibrates the Analyzer only. It does not involve compensating for electrode drift. Instead, a known millivolt signal is applied to the analyzer input terminals in place of the signal from the electrode, and the UDA2182 is adjusted so that its reading matches the known input.

ATTENTION

This procedure can only be used when measuring ORP *only*

Materials

The materials required to calibrate the Analyzer using a voltage input are:

- A source of a known millivolt signal.
- A screwdriver to fit the Analyzer input terminal screws and the terminal retainer.

Procedure

Make sure you have selected "PV Type –ORP" in the Inputs configuration – Section 0.

Refer to Section 6.4.1 – ***General Rules for Editing***.

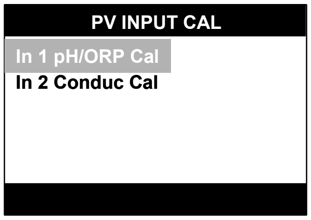
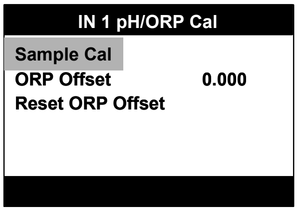
To calibrate the ORP Analyzer using Voltage Input, follow the instructions in Table 8-7.

WARNING

This procedure should be performed by qualified personnel only. Disconnect the power before opening the instrument case. A potentially lethal shock hazard exists inside the case if the unit is opened while powered. More than one switch may be required to disconnect power.

Table 8-7 Procedure for Calibrating ORP Analyzer Using Voltage Input

Step	Action	Screen
1	Turn off the power to the Analyzer. More than one switch may be required to disconnect power.	
2	With the power off open the case: Loosen the four captive screws on the front of the bezel. Grasp the bezel on the right side. Lift the bezel gently and swing the bezel open to the left. (The bezel and display assembly is mounted on pivot arms.)	
3	Refer to Figure 7-1 for the location of the terminal board retainer. Loose the screws that hold the retainer and slide the retainer right or left until the retainer tabs disengage from the terminal boards.	

4	Insert a screwdriver into the tab in the terminal board to be wired and pull. Slide the board half way out. There is a notch in the terminal board into which you can slide the retainer tabs and hold the boards in place while wiring.	
5	Label and remove the input wiring from the input terminals. Terminals 8 and 10. (See Figure 7-5 Terminal Designations for ORP).	
6	Feeding the test wiring through the conduit hole in the case, connect a voltage supply to the 8 and 10 input terminals • To apply a signal in the range 0 to 1600 mV, connect the plus to 8 and the minus to 10. • To apply a signal in the range -1 to -1600 mV, connect the plus to 10 and the minus to 8. Slide the Input board back and close the case and power up the unit. Do not apply power until the case is closed.	
7	Press Calibrate	 **PV INPUT CAL** In 1 pH/ORP Cal In 2 Conduc Cal Use ▲▼ to select **Input 1 or 2 pH/ORP Cal**
8	Press Enter	 **IN 1 pH/ORP Cal** Sample Cal ORP Offset 0.000 Reset ORP Offset
9	• Put the unit in "Hold" mode	
10	Press Enter	The display will show the Oxidation Reduction Potential in Millivolts. The value should match the Input signal.
11	Ignore the instructions to put the electrode in the reference solution. Instead, apply an appropriate millivolt signal (between –2000 and 2000 mV) to the input terminals. To obtain a negative value, you must reverse the input to the unit as described in Step 5.	

12	Once the reading is stable, if it does not match the input signal, press Enter	**"Change to Sample value"** Use ▲▼ to change the value to match the Voltage being applied to the input terminals.
13	Press Enter	This will standardize the unit.
14	Take the unit out of "Hold" and return to the calibration menu.	
15	Turn off the voltage source and turn off power to the Analyzer. Do not open the case until power is disconnected.	
16	Reconnect field wiring removed in Step 5.	
17	Re-insert the terminal board into the case.	
18	Close the case and power up the unit. Do not apply power until case is closed.	

Viewing and Resetting ORP Offset

If the calibration is suspect, you can reset the ORP Offset and calibrate again.

In the same screen as "Sample Cal", use the ▲▼ keys to highlight "Reset ORP Offset".

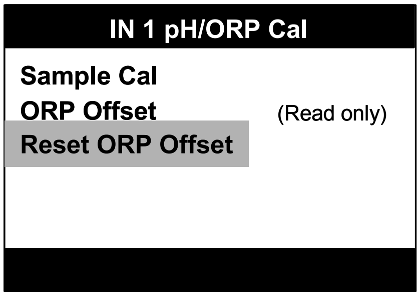


Figure 8-2 Resetting ORP Offset

Press ENTER. The ORP Offset will be reset to 0.000 (default).

8.7 Conductivity Calibration

Introduction

Each type of cell has an associated cell constant entered during Configuration setup (see Section 0). This number is part of the cell model number. However, for greater precision, every Honeywell cell is individually tested at the factory, and a calibration factor unique to that cell is determined. The cal factor for a cell can be found on the plastic tag hanging from the cell lead wires. Instructions for entering this cell cal factor are in Section 0.

For some conductivity applications even greater accuracy is required. For those applications it is possible to perform a calibration trim procedure. The Analyzer's reading can be adjusted while the associated cell is measuring a reference solution of known conductivity, as described in Table 8-9. The same procedure can be used to adjust the Analyzer's reading while the cell is in the process, if a reference instrument is used to determine the conductivity of the process. In this case the process fluid becomes the "reference solution".

Calibration trim is recommended for acid concentration applications above 5%.

Calibration trim can be removed as described in this section.

For accurate measurement of total dissolved solids (TDS) a conversion factor is entered for each cell as described Table 6-2 (Input1, Input 2, Conductivity).

Entering the Cal Factor for each cell

Introduction

Each type of cell has an associated cell constant; this number is part of the cell model number. The constant for each cell is entered during Input setup. However, for greater precision, every Honeywell cell is individually tested at the factory, and a calibration factor unique to that cell is determined. The cal factor for a cell can be found on the plastic tag hanging from the cell lead wires.

Procedure

If you have not done so already, refer to Table 6-2 (Input1/Input2/Conductivity) to enter the cal factor for each cell

Determining and Entering the TDS Conversion Factor

Introduction

The UDA2182 measures conductivity. However, the process value can be displayed in terms of total dissolved solids (TDS). If a TDS solution temperature compensation type was specified during Input setup (Section 6.5), then the same menu in will contain an entry for the TDS conversion factor for each cell.

Determining TDS conversion factor

To determine the TDS conversion factor, it is first necessary to establish the total dissolved solids in a representative sample of the process. The formal determination of TDS is a laboratory standard method performed on a weighed grab sample of the process fluid. To summarize how a obtain a TDS value:

- Suspended solids, if present, are filtered out.
- All water is evaporated.
- The residue is dried and weighed.
- The result is divided by the original sample weight to obtain ppm TDS.

For detailed guidance in determining the official TDS, see “Standard Methods for the Examination of Water and Wastewater,” jointly published by the American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington, DC.

To determine the conversion factor needed by the Analyzer, first use the laboratory procedure summarized above to give an official TDS value. Next divide the TDS value by the conductivity of the sample to yield the conversion factor for that particular process fluid. The conversion factor is then entered into the analyzer to normalize the TDS readout.

With power plant cation conductivity measurements, ion chromatography results may be used to establish the conversion factor for readout in ppb chloride or sulfate ion. Nominal values are 83 ppb per µS/cm for chloride ion and 111 ppb per µS/cm for sulfate ion. The analyzer does not provide temperature compensation in TDS for chloride or sulfate ions.

Out-of range-values forced to closest limit

As long as the entered TDS value is within the acceptable limits for a given cell constant, the Analyzer accepts the value. If a value is outside the accepted range, the unit will not display an error message; instead it will force the value to either the high or low limit of the range of the cell constant. Refer to Table 6-2 (Input1/Input2/Conductivity) for TDS conversion factor defaults.

Calibrate the Analyzer before entering TDS conversion factor

If you intend to enter a cal factor or use calibration trim, do so before entering the TDS conversion factor as described here.

If you use calibration trim, first set the solution temperature compensation in Table 6-2 to the non-TDS choice for your process. For example, if you plan to use “NaCl” set the solution temperature compensation type to “NaCl” temporarily for calibration purposes. (Solution temperature compensation type is the one Input setup parameter that can be changed without triggering a cold reset.)

Next, perform the calibration. Once calibration has been completed, go back to Input setup and set the solution temperature compensation type to the TDS choice, for example “NaCl”.

At this point you are ready to enter the TDS conversion factor as described in Table 6-2.

Performing Calibration Trim

Introduction

For most applications entering the cal factor for each cell will achieve satisfactory system performance. However, it is possible to perform a calibration trim procedure in which the Analyzer and cell combination are used to measure a reference solution of known conductivity; the reading of the Analyzer is adjusted to match.

The same procedure can be used to adjust the Analyzer’s reading while the cell is in the process, if a reference instrument is used to determine the process conductivity. In this case, the process fluid becomes the “reference solution”.

Calibration trim is recommended for acid concentration measurements above 5%.

Materials

To perform calibration trim using a standard reference solution, follow the instructions in Table 8-9.

Materials required are:

- A reference solution of known conductivity near the point of interest, with the temperature controlled (or measured and compensated) to within ± 1 °C. Conductivities of potassium chloride solutions are provided in Table 8-8. Solutions must be prepared with high-purity de-ionized, CO_2-free water, and dried potassium chloride.
- For acid concentration applications, a certified reagent grade solution with the temperature controlled.
- A container for the reference solution, large enough to immerse the cell to measuring depth.
- De-ionized water to rinse the cell.

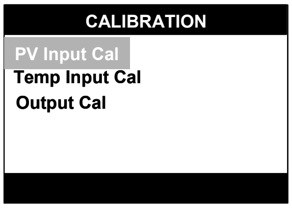
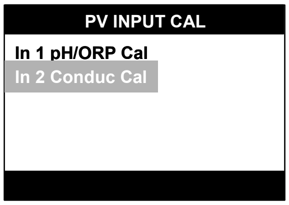
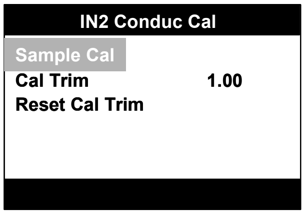
Table 8-8Conductivity of Potassium Chloride Solutions at 25 °C

Concentration M*	Conductivity (microSiemens per cm)
0.001	147.0
0.005	717.8
0.01	1,413
0.02	2,767
0.05	6,668

* M = Molarity; 1M = 74.555g potassium chloride per liter of solution

Procedure

Table 8-9 Procedure for Performing Calibration Trim Using a Reference Solution

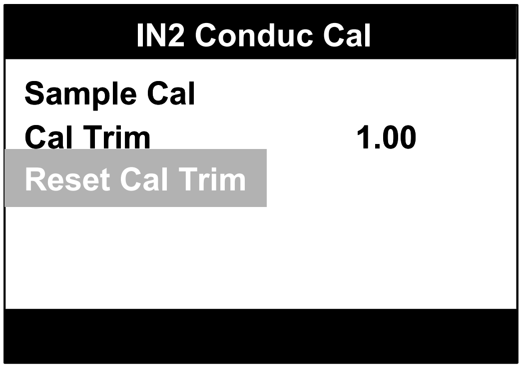
Step	Action	Screen
1	Press **Calibrate**	 **CALIBRATION** PV Input Cal Temp Input Cal Output Cal
2	Press **Enter**	 **PV INPUT CAL** In 1 pH/ORP Cal In 2 Conduc Cal Use ▲▼ to select Input 1 or 2 Conduc Cal
3	Press **Enter**	 **IN2 Conduc Cal** Sample Cal Cal Trim 1.00 Reset Cal Trim
4	• Remove the cell from the process. • Rinse the cell thoroughly with de-ionized water.	

5	Press **Enter**	
6	Follow the prompts at the top and bottom of the screen.	**“Place probe in Sample”** The display will show the conductivity of the reference solution as measured by the cell and Analyzer system. **“Press Enter when stable”**
7	Once the reading is stable, Press **Enter**	**“Change to Sample value”** Use ▲▼ to change the value to match the actual conductivity of the reference solution at its current temperature. **“Enter to save, Exit to cancel”**
8	Press **Enter**	This will save the Calibration Trim Value. If the calibration trim adjustment is successful, the calibration menu will again be displayed. Return the cell to the process. Repeat the operation for the other cell.
9	If the calibration fails, an error message will be displayed across the bottom stripe of the screen.	**Error Messages** Refer to Table 11-2.

Resetting Calibration Trim

If the calibration is suspect, you can reset the Calibration Trim and calibrate again.

In the same screen as “**Sample Cal**”, use the ▲▼ keys to highlight “**Reset Trim**”.



IN2 Conduc Cal

Sample Cal

Cal Trim 1.00

Reset Cal Trim

Figure 8-3 Resetting Calibration Trim

Press **ENTER**. The Calibration Trim will be reset to 1.00 (default).

8.8 Dissolved Oxygen Calibration

Overview

The analyzer supports three methods of Dissolved Oxygen calibration:

Air Calibration - is done with the probe removed from the process. This is the recommended method of calibration and should be completed unless the process set-up prohibits removing the probe. This is recommended prior to installation as it saves system parameters that are used in optimizing error diagnostics.

If the probe has just been removed from a sample low in dissolved oxygen, it takes longer to complete a calibration than that of a probe that is already near ambient conditions (sample high in dissolved oxygen).

Sample Calibration - Sample calibration allows a calibration based on a known dissolved oxygen concentration where a DO value may be entered that is based on a reference measurement. Sample calibration is usually executed by leaving the probe in the measured sample and adjusting the Analyzer to agree with the sample dissolved oxygen measured with a properly calibrated portable dissolved oxygen meter whose probe is held very close to the process probe.

For those situations where sample calibration is preferred, it is recommended that an Air Calibration be performed before the probe is put into service. It is also good practice to Air Calibrate the probe once every 2 - 4 months of service.

Pressure Compensation - The concentration of oxygen dissolved in air-saturated water depends on the air pressure. This dependence is automatically compensated for during air calibration using a pressure sensor built into the Analyzer. The purpose of the pressure calibration is to insure that the atmospheric oxygen level is known at the time of air calibration. Pressure compensation is only employed at the time of Air Calibration.

In this section there is also a procedure for running a **Probe Bias Scan**.

Do’s and Don’ts for Dissolved Oxygen Calibration

Do check the key parameters on the Display screen before performing an air calibration for the first time. The parameters should be within the following ranges:

Pressure: 500 to 800 mmHg

Salinity: 0.0 if not being used

Temperature should be a stable reading

Don’t perform a probe bias test while the probe is in normal measurement service.

Don’t perform an air calibration while the probe is in either the ppm or ppb process water.

Don’t perform a sample calibration when the Dissolved Oxygen reading is in the 0.0 - 2.0 ppb range.

Don’t measure the dissolved oxygen in gas streams or air streams. This product measures dissolved oxygen in water.

Calibrating a Dissolved Oxygen Probe Using Air Calibration Method

Introduction

This is the simplest and most commonly used method of calibration.

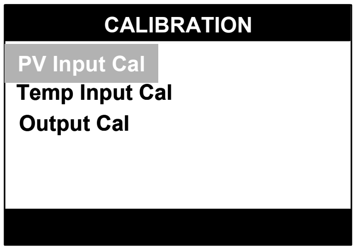
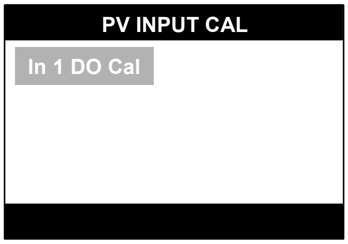
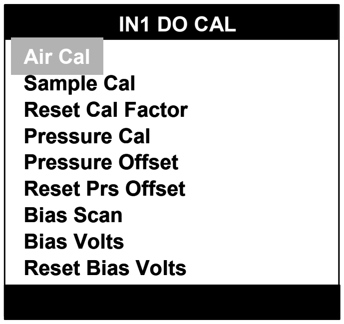
ATTENTION

If “Initial Installation”, power probe and analyzer for 24 hours before first air calibration.

1. Assure that the probe has been powered for at least one hour.
2. Press the Hold button, if required.
3. Expose the probe to air (or air-saturated water) until the temperature and DO value reading stabilizes.

Procedure

Table 8-10Calibrating a Dissolved Oxygen Probe Using Air Calibration Method

Step	Action	Screen
1	Press **Calibrate**	
2	Press **Enter**	 Use ▲▼ to select **Input 1 or 2 DO Cal**
3	Press **Enter**	 Use ▲▼ to select **Air Cal**

4	Press **Enter** Follow the prompts at the top and bottom of the screen.	**“Place probe in air”** The display will show the live Dissolved Oxygen value. **Press Enter when ready”**
5	Press **Enter**	**“Cal stability check”** This screen remains until the Air Calibration is complete. At that time the previous screen is displayed indicating that the air calibration is complete. **“Wait for cal complete”**
6	If the calibration fails, an error message will be displayed across the bottom stripe of the screen.	**Error Messages** Readings Unstable Cal Factor Underrange Cal Factor Overrange Refer to Table 11-2.
Air Calibration is not completed until both the probe temperature and the probe signal are stable. If the probe has just been removed from a sample low in dissolved oxygen or with temperature significantly different from the air temperature, it takes longer to reach stability than if the probe were already near ambient conditions when calibration was initiated.		

Calibrating a Dissolved Oxygen Probe Using Sample Calibration Method

Introduction

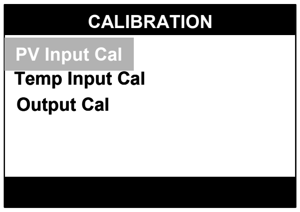
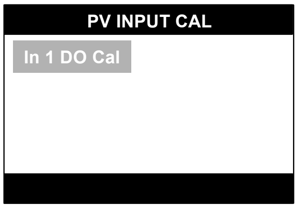
Sample calibration allows a calibration based on a known dissolved oxygen concentration. It is similar to air calibration except that the known DO value may be entered. Assuming an accurate reference is available, use the sample calibration method rather than air calibration if any of the following conditions apply:

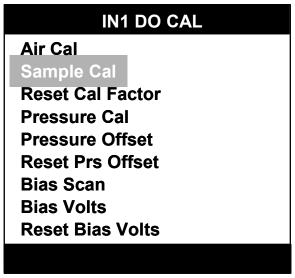
- The air is below freezing (32°F, 0°C), or hot (above 104°F, 40°C) or very dry (below 20% relative humidity).
- The probe is mounted such that it is much easier to measure the concentration of the DO in the water independently than to expose the probe to air. Such mounting is not recommended but is sometimes necessary.
- The measurement interruption for air calibration cannot be tolerated.

Sample calibration is usually executed by leaving the probe in the measured sample and adjusting the analyzer to agree with the sample dissolved oxygen measured with a properly calibrated portable dissolved oxygen meter whose probe is held very close to the probe of the analyzer. Alternatively, the probe may be removed from the measured sample and placed in a sample of known dissolved oxygen concentration.

Procedure

Table 8-11Calibrating a Dissolved Oxygen Probe Using Sample Calibration Method

Step	Action	Screen
1	Power the probe for at least one hour. (power the probe for 24 hours if initial installation)	
2	Press **Calibrate**	
3	Press **Enter**	 Use ▲▼ to select **Input 1 or 2 DO Cal**

4	Press **Enter**	 Use ▲▼ to select **Sample Cal**
5	- Put the unit in "Hold" mode, if required.	
6	Press **Enter** Follow the prompts at the top and bottom of the screen.	**"Place probe in sample"** Immerse the probe in the sample of known DO concentration and wait until the DO reading is stable. **"Press Enter when stable"**
7	Once the reading is stable, press **Enter**	**Change to sample value"** Use the arrow keys to change the displayed value to match the value of the known sample DO concentration **"Enter to save, Exit to cancel"**
9	Press **Enter**	When the value displayed equals the known sample DO concentration.
10	If the calibration fails, an error message will be displayed across the bottom stripe of the screen. Make necessary adjustments and re-calibrate	***Error Messages:*** Cal Factor Underrange Cal Factor Overrange See Table 11-2.

Calibrating the Integral Pressure Sensor

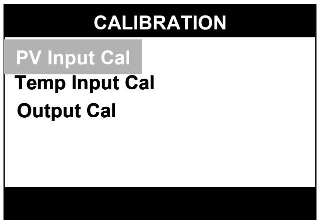
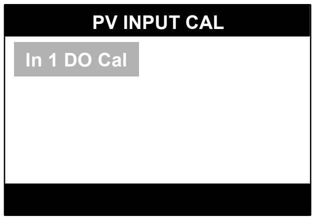
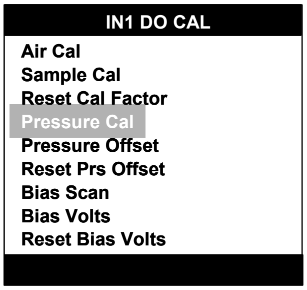
Introduction

The concentration of oxygen dissolved in air-saturated water depends on the barometric pressure. This dependence is automatically compensated for during air calibration using a pressure sensor built into the Analyzer. The purpose of the pressure calibration is to calibrate that pressure sensor. However, this sensor has been factory calibrated and should not require re-calibration.

Procedure

Determine the true ambient barometric pressure, such as from a calibrated pressure transmitter or a mercury barometer. Absolute barometric pressure is required - not the "relative" sea-level pressure normally reported by the weather bureau.

Table 8-12Calibrating the Integral Pressure Sensor

Step	Action	Screen
1	Press **Calibrate**	
2	Press **Enter**	 Use ▲▼ to select **Input 1 or 2 DO Cal**
3	Press **Enter**	 Use ▲▼ to select **Pressure Cal**

4	Press Enter Follow the prompts at the top and bottom of the screen.	**"Pressure Sensor Cal"** Display shows the barometric pressure value in mm Hg.
5	Once the reading is stable, press Enter	**Change to sample value"** Use the arrow keys to change the displayed value until the displayed pressure in mmHg agrees with the known pressure. **"Enter to save, Exit to cancel"**
6	Press Enter	Indicates completion of the adjustment to the value.
7	If the calibration fails, an error message will be displayed across the bottom stripe of the screen. Make necessary adjustments and re-calibrate	***Error Messages:*** See Table 11-2.

Running a Probe Bias Scan

Introduction

The dissolved oxygen probe is an electrochemical cell, which produces an electric current that is directly proportional to the concentration of oxygen dissolved in the sample in which the probe tip is immersed. (When the probe is in air, the current is identical to that produced when the probe is in air-saturated water.) This current is a direct measurement of oxygen level. Usually, the probe is operated at -0.55V with respect to a reference electrode within the probe. **(The minus sign is omitted from the screen as well as from the following discussion.)** However, in some applications, the performance of the DO probe can be enhanced by using other bias voltages. The purpose of this test is to evaluate whether the probe bias voltage should be adjusted. Possible interference with probe performance may also be inferred from the Probe Bias Test (PBT).

Test initiation

When the test is initiated, the bias voltage is adjusted down from its original value (usually 0.55V) at 25 mV/sec until 0V is reached. Then the bias voltage is driven up to 1.0 V at 25 mV/sec and finally, it is driven down again until it has returned to the value it had just before the test was initiated. During this voltage sweep, the probe current is monitored and the graph of current as a function of voltage is displayed.

If during the test the probe current rises above a factory-set upper limit, the bias voltage is returned to its pre-test value at 25 mV/sec and the test is terminated without completing the full 1.0 Volt sweep. (The bias voltage test may also be terminated at any time by pressing the “EXIT” button.)

Display Graph

Under normal conditions, the completed display shows a graph of current as a function of voltage with the following features: from approximately 0 to 0.2 volts a fairly rapid increase in current is observed; from approximately 0.2 to 0.8 volts, the current exhibits a “flat” region where it is nearly independent of voltage and at some voltage above about 0.8 volts, the current rises quickly.

A typical current-voltage curve is shown below. The Sweep Bias millivoltage (along the bottom of the graph) is a voltage from 0 -1V that is applied to perform the test. The Operating Bias millivoltage is the current position of the cursor on the graph and represents the current bias voltage. The horizontal axis numerals are in hundreds of millivolts.

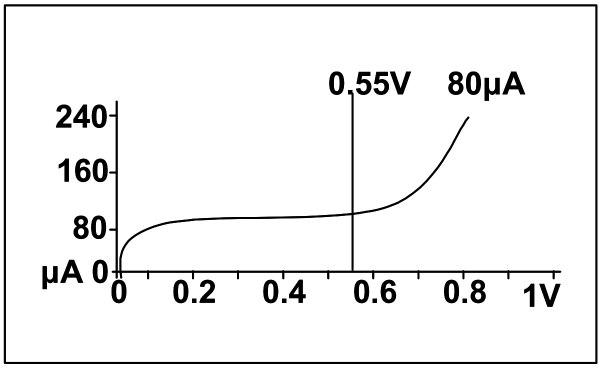


Figure 8-4 Display of Probe Bias Test Done in Air

Note that the curve is quite flat at 0.55V. This means that even rather large changes in the probe current-voltage characteristic do not affect the current (and, thus, probe sensitivity) at 0.55V. In general, the curve formed by decreasing voltage is not identical to that formed by increasing voltage. This hysteresis is a function of the voltage scan rate and may be ignored.

The interpretation of figure shown above is as follows:

As the bias voltage of the oxygen-consuming electrode (relative to an internal reference electrode) is increased, there is an initial increase in current as more and more of the oxygen that approaches the electrode is reacted. However, at about 0.2V, the current stops rising and a flat region, independent of voltage, is observed. It is in this region that probe current is determined by oxygen mass transport limitation. Increasing the voltage cannot increase the current because oxygen movement is diffusion limited. Finally, at a voltage exceeding 0.8 volts, a second process (**water reduction**) begins to occur and the current again rises. To achieve stable results, the probe should be operated within the flat region so that small changes in the probe characteristics result in negligible changes in probe current.

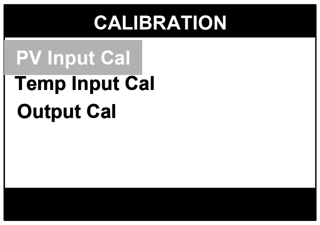
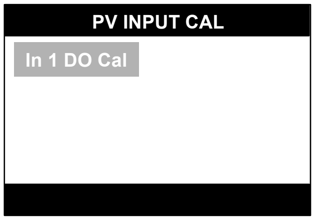
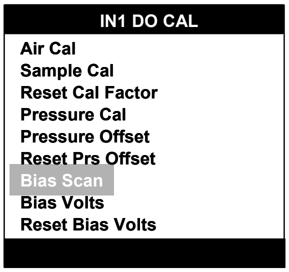
In some industrial wastewater applications, particularly those in petroleum refineries, active gases dissolved in the wastewater can cause this current-voltage characteristic to shift, moving the flat region to other, usually lower, voltages. Also, in some very rare instances, the chemical treatment of boiler water can cause this current-voltage characteristic to shift, moving the flat region to other, usually lower, voltages.

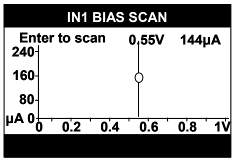
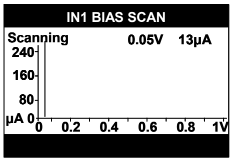
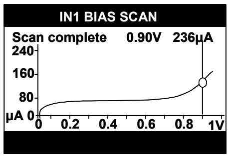
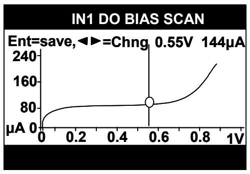
To summarize, the Probe Bias Test automatically varies the probe voltage while displaying the probe current as shown in the figure. At the completion of the test an opportunity to change the bias voltage is provided. Thus, even where significant gaseous contamination might otherwise interfere with the response of the probe to dissolved oxygen, this advanced feature allows the probe to operate.

(If the results of the probe bias test should ever be significantly different from those shown in the figure, Honeywell Service should be consulted.)

Procedure

Table 8-13 Running a Probe Bias Scan

Step	Action	Screen
1	Press Calibrate	
2	Press Enter	 Use ▲▼ to select **Input 1 or 2 DO Cal**
3	Press Enter	 Use ▲▼ to select **Bias Scan**

Step	Action	Screen
4	Press **Enter** to initiate the Bias Scan screen **At any time press “Exit” to abort scan.**	You will see:  **µA may be 0, 40, 80, 120**
5	Press **Enter** to start scan	**Scan in Progress (Example)** The bias voltage is adjusted down from its original value (usually 0.55V) at 25 mV/sec until 0V is reached. 
		Then the bias voltage is driven up to 1.0 V at 25 mV/sec until “Scan complete” appears 
		and finally, it is driven down again until it has returned to the value it had just before the test was initiated. During this voltage sweep, the probe current is monitored and the graph of current as a function of voltage is displayed.  At the completion of the test an opportunity to change the bias voltage is provided. Press ◀ ▶ to change the bias voltage, or
6	Press **Enter** to save	Screen returns to **“IN1 DO CAL**” screen. Bias Volts will be indicated on the screen

Resetting Pressure Offset or Bias Volts

If the calibration is suspect, you can reset any of these values and calibrate again.

In the same screen as “**IN 1 DO Cal**”, use the ▲▼ keys to highlight “**Reset Prs Offset**” or “**Reset Bias Volts**”.

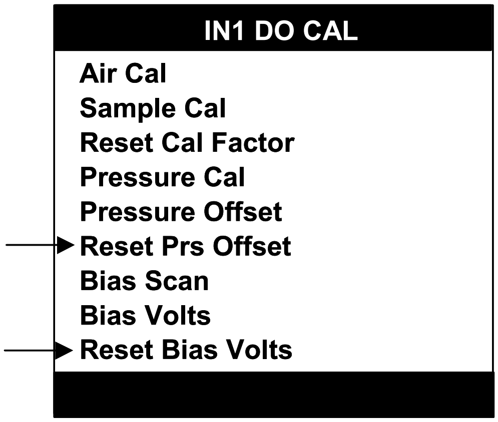


Figure 8-5 Resetting Pressure Offset or Bias Volts

Press **ENTER**. The selected value will be reset to(default).

9 Outputs Calibration

9.1 Overview

Introduction

The section describes the calibration procedures for the following:

Output Cal – calibrate ***Analog Output 1, Analog Output 2, and Analog Output 3***

For other Calibration Procedures refer to the sections listed below.

PV Input Cal – calibrate ***Input 1*** **and** ***Input 2*** **for** ***pH/ORP***, ***Conductivity*** **or Dissolved Oxygen** (See Section 8)

Temperature Cal – calibrate ***Temperature 1*** **and** ***Temperature 2*** **for** ***pH/ORP*** **or** ***Conductivity*** (See Section *10)*

What's in this section?

The topics in this section are listed below.

9.2 Output Calibration

Introduction

The UDA2182 is available with two standard and one optional analog outputs. The output signals can be adjusted to trim the high and low output current or voltage values over a range of ± 0.4 % of span to compensate for component tolerance variations.

Required equipment

Output calibration involves connecting a meter to the Analyzer's output terminals.
The meter required for output calibration depends on the type of outputs.

- **Current outputs:** current meter capable of resolving 0.01 mA over the range 0 to 20 mA dc
- **Voltage outputs:** a 250 ohm ± 0.05 % shunt and a volt meter (capable of measuring 1 to 5 Vdc within 1 mV)

A screwdriver to fit the terminal block screws and the screw securing the terminal board retainer is also required.

Procedure

To calibrate outputs, follow the procedure described in Table 9-1 Procedure for Calibrating Analyzer Outputs. The output terminals are inside the case as shown in Figures 6-1 through 6-6.

WARNING

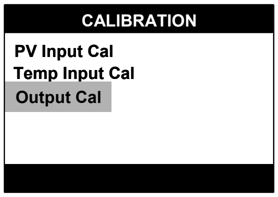
While the unit is powered, a potentially lethal shock hazard exists inside the case. Do not open the case while the unit is powered. Do not access the output terminal as described below while the unit is powered.

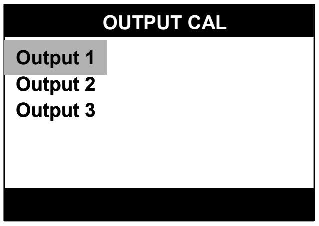
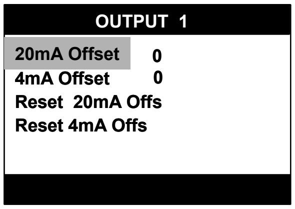
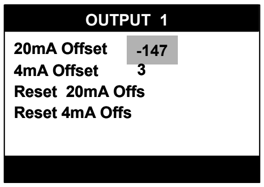
WARNING

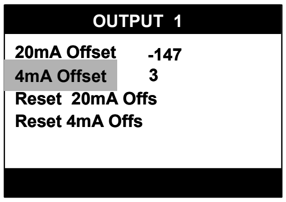
A disconnect switch must be installed to break all current carrying conductors. Turn off power before working on conductors. Failure to observe this precaution may result in serious personal injury.

Procedure

Table 9-1 Procedure for Calibrating Analyzer Outputs

Step	Action	Screen
1	**Turn off the power to the Analyzer**. More than one switch may be required to disconnect power.	
2	**With the power off**, open the case: Loosen the four captive screws on the front of the bezel. Grasp the bezel on the right side. Lift the bezel gently and swing the bezel open to the left.	
3	Refer to Figure 7-1 for the location of the terminal board retainer. Loose the screws that hold the retainer and slide the retainer right or left until the retainer tabs disengage from the terminal boards.	
4	Insert a screwdriver into the tab in the terminal board to be wired and pull. Slide the board half way out. - Refer to Figure 7-1 for the location (Output 1 and 2 – Power Supply/Analog Output/Relay Output card) (Output 3 – Option card) and slide the board half way out. There is a notch in the terminal board into which you can slide the retainer tabs and hold the boards in place while wiring.	
5	Label and remove the field wiring from the output terminals. Output 1 – Terminals 12– and 13+ Output 2 – Terminals 10– and 11+ Output 3 – Terminals 14– and 15+	
6	Feeding the test wiring through the conduit hole in the case and connect the appropriate type meter to the specific output terminals Be sure to observe the correct polarity. Slide the Input board back and close the case and power up the unit. **Do not apply power until the case is closed.**	
7	Press Calibrate	 CALIBRATION PV Input Cal Temp Input Cal Output Cal Use ▲▼ to select "Output Cal"

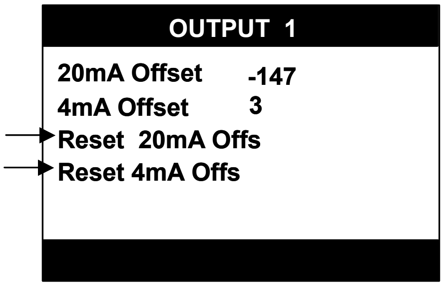
8	Press Enter	 **OUTPUT CAL** **Output 1** **Output 2** **Output 3**
9	Press Enter	 **OUTPUT 1** **20mA Offset 0** **4mA Offset 0** **Reset 20mA Offs** **Reset 4mA Offs** Use ▲▼ to select ” 20 mA Offset”
10	Press Enter	 **OUTPUT 1** **20mA Offset -147** **4mA Offset 3** **Reset 20mA Offs** **Reset 4mA Offs** The right most digit will be “blinking”
11	To correct the value on the meter: • Use the ▲▼ keys to increment or decrement the value of the digit • Use the ◀ ▶ keys to move the cursor to the next digit. • Repeat as required to achieve a 20mA reading on the test meter • When all digits have been changed, press “Enter” to store the 20mA value. Press “Exit” to cancel. The previous value is retained.	

		Screen
12	Use ▲▼ to select ” 4 mA Offset” and repeat the process.	OUTPUT 1 20mA Offset -147 4mA Offset 3 Reset 20mA Offs Reset 4mA Offs
13	Press “Enter” to store the 4mA Offset value. Press “Exit” to cancel. The previous value is retained.	
14	If the calibration is suspect, you can reset the 20mA and 4mA Offset and calibrate again.	
	⚠ ⚡ To calibrate additional Outputs, repeat the above steps Including powering down the unit before changing the connections to the output terminals. When output calibration has been completed, re-install the field wiring removed in step 5. **Disconnect power before opening the case.** Close the case and power up the unit. **Do not apply power until the case is closed.**	

Viewing and resetting 20mA and 4mA Offset

If the calibration is suspect, you can reset the 20mAand 4mA Offset and calibrate again.

In the same screen as "**20mA and 4mA Offset**", use the ▲▼ keys to highlight "**Reset 20mA Offset**" or "**Reset 4mA Offset**".



OUTPUT 1
20mA Offset -147
4mA Offset 3
Reset 20mA Offs
Reset 4mA Offs

Figure 9-1 Resetting Output 1 Offsets (example)

Press **ENTER**. The 20mA Offset or 4mA Offset will be reset to 0(default).

10 Temperature Input Calibration

10.1 Overview

Introduction

The section describes the calibration procedures for the following:

Temp Input Cal – calibrate **(T1) *Temperature 1* or (T2) *Temperature 2* for *pH/ORP* or *Conductivity***

For other Calibration Procedures refer to the sections listed below.

PV Input Cal – calibrate ***Input 1* and *Input 2* for *pH/ORP*, *Conductivity* or Dissolved Oxygen** (See Section 8)

Output Cal – calibrate ***Analog Output 1, Analog Output 2, and Analog Output 3*** (See Section 9)

What's in this section?

The topics in this section are listed below.

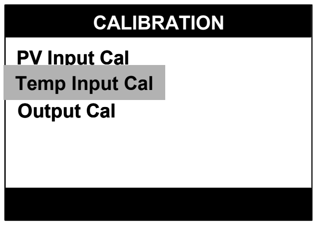
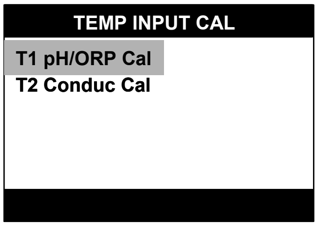
10.2 Temperature Input Calibration

Introduction

Temperature Input Calibration lets you monitor a live temperature reading while continuing to monitor the sample. The currently displayed temperature value can be edited through a series of prompts on the screen.

Procedure

Table 10-1 Procedure for Calibrating the Temperature Inputs

Step	Action	Screen
1	Press Calibrate	 Use ▲▼ to select **”Temp Input Cal”**
2	Press Enter	 Use the ▲▼ keys to highlight the desired “Temperature Input” selection.
3	Press Enter	
4	Press Enter	
5	Follow the prompts at the top and bottom of the screen.	**“Place probe in sample”** The display will show the temperature of the reference solution as measured by the probe and Analyzer system. **“Press Enter when stable”**

6	Once the reading is stable, Press **Enter**	**“Change to sample value”** Use ▲▼ to change the value to match the actual temperature of the reference solution at its current temperature. **“Enter to save, Exit to cancel”** **Limit is ± 5ºC (± 9ºF)**
7	Press **Enter**	This will save the Temperature Offset value. If the calibration is not successful, an error message will be displayed.
8	If the calibration is suspect, you can reset the Temperature Offset and calibrate again.	

Viewing and resetting Temperature Offset

If the calibration is suspect, you can reset the Temperature Offset and calibrate again.

In the same screen as "**Temp Cal**", use the ▲▼ keys to highlight "**Reset Tmp Offset**".

T1 pH/ORP CAL

Temp Cal

Temp Offset (Read only)

Reset Tmp Offset

Figure 10-1 Resetting temperature offset

Press **ENTER**. The Temperature Offset will be reset to (default).

11 Diagnostics and Messages

11.1 Overview

Introduction

This section contains information on status and alarm messages, as well as on diagnostics and system error messages. All these messages are displayed on the "Status Message" stripe. If more than one message is active, the display will cycle through all the messages, then repeat.

What's in this section?

The topics in this section are listed below.

11.2 System Status Messages

Overview

The following table lists all the error messages that can appear for Measurement errors, Input errors, Output errors, and Alarm Conditions.

Table 11-1 Status Messages

Status Message	Definition
HOLD ACTIVE	Analog outputs are held at their last active levels and relays are de-energized by pressing the "HOLD" button, until cancelled by pressing the "HOLD" button again.
n = 1,2, or 3	**Measurement Errors**
TEMP n UNDERRANGE	Measured temperature is less than the minimum range value according to measurement type, where: ***n*** is 1 (Input 1) or 2 (Input 2).
TEMP n OVERRANGE	Measured temperature is greater than the maximum range value according to measurement type, where: ***n*** is 1 (Input 1) or 2 (Input 2).
PV n UNDERRANGE	Measured PV is less than the minimum range value according to measurement type, where ***n*** is 1 (Input 1) or 2 (Input 2).
PV n OVERRANGE	Measured PV is greater than the maximum range value according to measurement type, where ***n*** is 1 (Input 1) or 2 (Input 2).
Input Errors – Output(s), for which Input is source, will go to failsafe level	
PROBE TEMP n INPUT FAULT	Probe temperature sensor at Input ***n*** is defective.
PROBE PV n INPUT FAULT	Probe PV sensor at Input ***n*** is defective.
PROBE n INPUT OUT OF SOLUTION	Probe at Input n is out of solution
TEMP n INPUT OPEN	Probe temperature sensor at Input ***n*** is not connected. Check Wiring.
PV n INPUT OPEN	Probe PV sensor at Input ***n*** is not connected. Check Wiring.
Output Errors – Output in error goes to failsafe level	
OUTPUT n OPEN	Analog output n current is less than 3 mA and is less than output minimum mA value. Check wiring.
Alarm Conditions	
ALARM n ACTIVE	Alarm number ***n*** is currently active.

11.3 Calibration Diagnostics

pH/ORP/DO

All of the possible errors are detected during a probe calibration and will abort the calibration process with the message "FAIL" appearing briefly, followed by a return to the online pH/ORP/DO display. At that point, the specific error will be displayed as described. In addition, any of following errors may occur during probe calibration and abort the calibration process.

Table 11-2 Probe Calibration Diagnostics

Status Message	Definition
BUFFER SPAN TOO LOW	The span between pH buffer 1 and pH buffer 2 is less than 2 pH. Use a set of buffers that are at least 2 pH apart. As a warning status, will clear when an appropriate buffer 2 value is selected. As an error message, will abort calibration and preserve original slope value.
SLOPE UNDERRANGE	Resulting pH slope is less than 80%. Calibration is aborted and original slope value is preserved.
SLOPE OVERRANGE	Resulting pH slope is greater than 105%. Calibration is aborted and original slope value is preserved.
CAL FACTOR UNDERRANGE	Resulting DO calibration factor is less than 0.001268. DO calibration is aborted and original calibration factor is preserved.
CAL FACTOR OVERRANGE	Resulting DO calibration factor is greater than 0.040580. DO calibration is aborted and original calibration factor is preserved.
PROBE CURRENT TOO LOW	DO probe current is less than 5 µA. DO bias scan is aborted and original bias voltage is preserved.
PROBE CURRENT TOO HIGH	DO probe current exceeds the greater of 133% of the probe current at last successful calibration or 160 µA. During DO bias scan, scan is aborted and original bias voltage is preserved.
READINGS UNSTABLE	DO air PV or temperature readings too unstable for successful air calibration. Calibration is aborted and original calibration factor is preserved.
SOLUTION UNSTABLE	pH solution PV or temperature readings too unstable for successful auto buffer calibration. Calibration is aborted and original zero offset (for buffer 1) or slope value (for buffer 2) is preserved.
SOLUTION TEMP TOO LOW	pH solution temperature readings less than minimum of 0 degrees C. Auto buffer calibration is aborted and original zero offset (for buffer 1) or slope value (for buffer 2) is preserved
SOLUTION TEMP TOO HIGH	pH solution temperature readings greater than maximum of 100 degrees C. Auto buffer calibration is aborted and original zero offset (for buffer 1) or slope value (for buffer 2) is preserved

11.4 Background Diagnostics

Introduction

Background diagnostic errors are only detected when in online mode. The following errors are listed in order of highest to lowest priority. If more that one error is detected simultaneously, only the higher priority error will be displayed. If the higher priority error is non-latching and it clears, the lower priority error will be displayed if still present.

Table 11-3 Background Diagnostics

SYSTEM ERROR MESSAGE	CONDITION AND ACTION
The following background diagnostic errors are latched and force the output to failsafe level. These errors may only be cleared by Unit Reset or power cycle and are detected only when online PV or temperature is displayed.	
CONFIG MEM FAULT	Configuration EEPROM memory is defective. Unit Reset is required. Generated by a bad CPU EEPROM CRC. If error reoccurs, unit must be serviced.
PROCESSOR FAULT	Processor Flash memory is defective.
INPUT BD MEM FAULT	Input board memory read failure has occurred. Replace or operate with current factory calibration values.
PROBE MEM FAULT	Probe memory read or write failure has occurred. Replace or operate with current calibration values.

12 Accessories and Replacement Parts List

12.1 Overview

Introduction

This section provides part numbers for field-replaceable parts and for accessories.

What's in this section?

The topics in this section are listed below.

12.2 Part Numbers

Introduction

Part numbers for field-replaceable parts and accessories are provided in Table 12-1.

Table 12-1 Part Numbers

Kit/Part Number	Description	Quantity
51453313-501	pH Input Card	1
51453316-501	Conductivity Input Card	1
51453319-501	ppm Dissolved Oxygen Input Card	1
51453319-502	ppb Dissolved Oxygen Input Card	1
51453518-502	Bezel Assembly	1
51453540-501	Power Supply Card	1
51453328-501	Additional Analog & (2) Relay card	1
51453322-501	CPU Card	1

13 Appendices

13.1 Table of Contents

13.2 Appendix A – Entering Values for Lead Resistance Compensation

Introduction

If you use standard Honeywell cell lead lengths of 7 or 20 feet connected directly to the Analyzer, no compensation for lead resistance is necessary. Similarly, if a junction box is used to extend the leads up to 150 feet, no compensation is required. However, if longer leads are used (greater than 150 feet), signal quality can be adversely affected unless you enter information that will permit the UDA2182 to compensate for lead resistance.

For lengths up to 1500 feet, simply specify the gauge and length as described in Table 6-2 Inputs Configuration. Note that the maximum wire size for sensor inputs at the input terminal board is 18AWG.

If mixed wired gauges are used, or lead length or wire gauge are not within the stated ranges, the UDA2182 can still perform the compensation. However, you must first calculate the lead resistance, and then put it in terms of the available settings for AWG gauge and length.

The resistance of each available gauge choice (in copper wire) is:

16 AWG = 4.0 ohms per 1000 feet

18 AWG = 6.4 ohms per 1000 feet

20 AWG = 10.2 ohms per 1000 feet

22 AWG = 16.1 ohms per 1000 feet

For example, suppose each lead between the cell and Analyzer consists of 500 feet of 14-gauge wire and 1000 feet of 18-gauge wire.

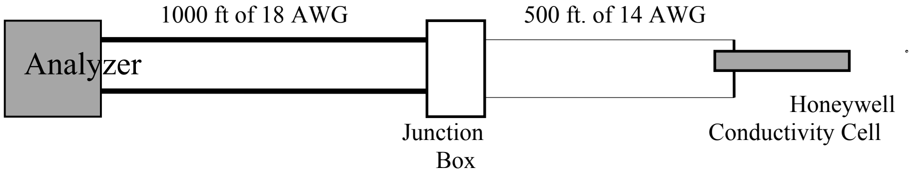


Figure 13-1 Example of a Conductivity Loop

Because there are two different types of wire used in each lead to the cell in this example, the total lead resistance is calculated as follows:

(2 x 0.5 x 2.5) + (2 x 1 x 6.4) = 16.9 ohms

Since the analyzer only allows entry of one wire gauge type, we allow for the worst-case condition by dividing the total resistance by the resistance per thousand feet of the higher resistance gauge wire. In our example this would be:

16.9 ohms ÷ 6.4 ohms per thousand feet of 18 AWG wire = 2,640feet

The length to enter is one-half this number, 1320 feet, because the Analyzer already accounts for the fact that there is always a pair of conductor wires in the system loop. Therefore, in our example we would use the procedure in Table 6-2, and specify the wire gauge as 18 AWG and the length as 1320 feet.

13.3 Appendix B - Cyanide Waste Treatment

Introduction

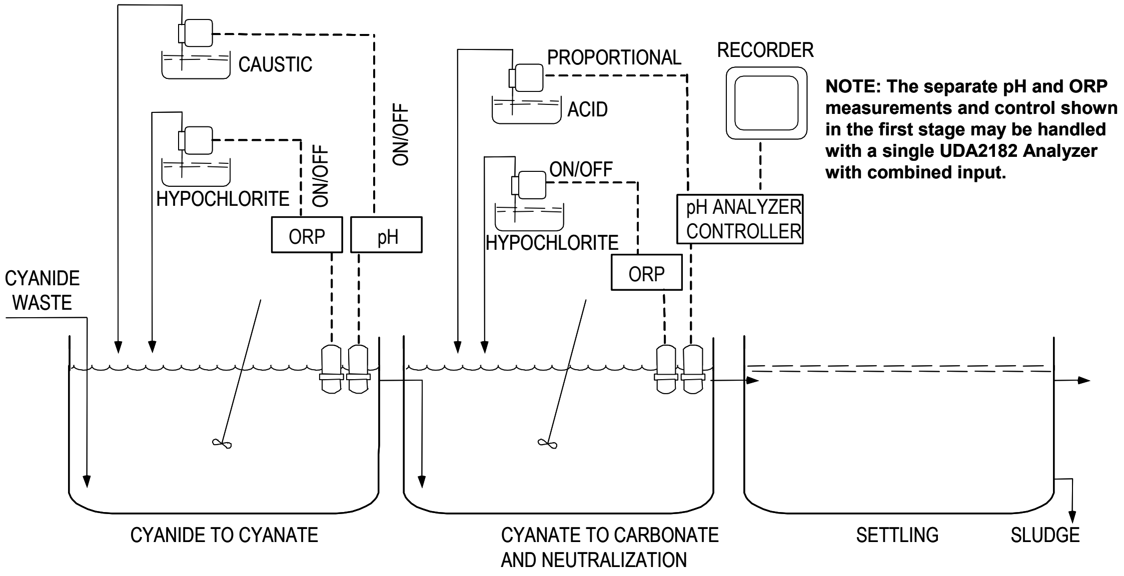
Uses of cyanide solutions

Cyanide solutions are used in plating baths for zinc, cadmium, copper, brass, silver and gold. The toxic rinse waters and dumps from these operations require destruction of the cyanide (typically to a level below 0.1 ppm) before its discharge.

Technique for cyanide destruction

The technique most often used for cyanide destruction is a one or two-stage chemical treatment process. The first stage raises the pH and oxidizes the cyanide to less toxic cyanate. When required, the second stage neutralizes and further oxidizes the cyanide to harmless carbonate and nitrogen. The neutralization also allows the metals to be precipitated and separated from the effluent.

Consistent treatment and stable control in this type of process requires well-mixed reaction tanks with enough volume for adequate retention time. See Figure 13-2. Retention time is calculated by dividing the filled or usable tank volume by the waste flowrate. Typically it is 10 minutes or more.



NOTE: The separate pH and ORP measurements and control shown in the first stage may be handled with a single UDA2182 Analyzer with combined input.

Figure 13-2 Cyanide Treatment System

First Stage of Cyanide Destruction

Raise pH and oxidize cyanide

Sodium hydroxide (caustic) is used to raise the effluent to about 11 pH, which will promote the oxidation reaction and ensure complete treatment. The oxidizing agent is usually sodium hypochlorite, NaOCl. The reaction for the first stage is given below using the NaOCl and with cyanide expressed in ionic form (CN$^-$). The result is sodium cyanate (NaCNO) and chloride ion (Cl$^-$).

$$NaOCl + CN^- \rightarrow NaCNO + Cl^-$$

This first-stage reaction is analyzed and controlled by independent control loops: caustic addition by pH control and oxidizing-agent addition by ORP control (redox potential or ORP, oxidation-reduction potential). Often an ON-OFF type of control using solenoid valves or metering pumps can be used. The pH controller simply calls for more caustic whenever pH falls below 11. The ORP controller calls for additional hypochlorite whenever ORP potential falls below about +450 mV. (The metal ORP electrode is positive with respect to the reference electrode.)

Titration curve

The ORP titration curve in Figure 13-3 shows the entire millivolt range if cyanide is treated as a batch. For continuous treatment, operation is maintained in the oxidized, positive region of the curve near the +450 mV setpoint. The ORP setpoint can vary between installations, depending upon pH, the oxidizing agent, the presence of various metals in solution, and the type of reference electrode used. Determine the exact setpoint empirically at that potential where all the cyanide has been oxidized without excess hypochlorite feed. This point can be verified with a sensitive colorimetric test kit or similar check for cyanide.

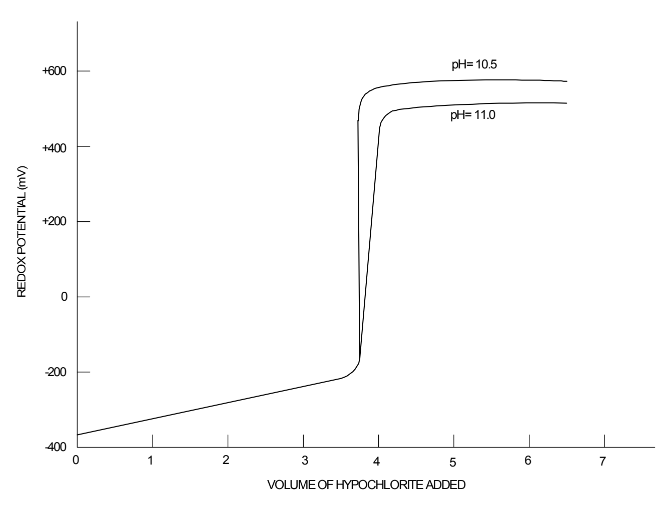


Figure 13-3 First Stage Cyanide Oxidation - Typical Titration Curve

Importance of pH control

As shown in Figure 13-3, pH has a direct effect on the ORP potential and must be closely controlled to achieve consistent ORP control, especially if hypochlorite is used as the oxidizing agent. Hypochlorite raises pH, which lowers the ORP potential, which in turn calls for additional hypochlorite -- a runaway situation. To avoid this situation, use close pH control and locate the ORP electrode at a distance from the hypochlorite addition point.

Reliable measurement with gold electrode

For this application, a gold ORP electrode gives a more reliable measurement than does a platinum electrode, because platinum may catalyze additional reactions at its surface and is more subject to coating than gold. Note that the solubility of gold in cyanide solutions does not present a problem as it is in contact, primarily, with cyanide. In fact, a slight loss of gold serves to keep the electrode clean.

Second Stage of Cyanide Destruction

Neutralize and further oxidize cyanate

The wastewater is neutralized in order to promote additional oxidation and to meet the discharge pH limits. Typically, sulfuric acid is added to lower the pH to about 8.5. At this pH the second oxidation occurs more rapidly.

WARNING

Failure to comply with these instructions could result in death or serious injury.

An interlock must be provided to prevent the addition of acid before the positive oxidation of ALL cyanide. Failure to observe this precaution can result in the generation of highly toxic hydrogen cyanide.

Additional chlorine or sodium hypochlorite (NaOCl) can be added in proportion to that added in the first stage, or by separate ORP control to complete the oxidation to sodium bicarbonate ($NaHCO_3$) in the following reaction:

$$2NaCNO + 3NaOCl + H_2O \rightarrow 2NaHCO_3 + N_2 + 3NaCl$$

ORP control in the second stage is very similar to that in the first stage, except that the control point is near +600 mV. Control of pH in the second stage is more difficult than in the first stage, because the control point is closer to the sensitive neutral area. Proportional type pH control is often used.

Removal of suspended metal hydroxides

Following the second stage, a settling tank and/or a filter can be used to remove suspended metal hydroxides. However, further treatment may be required to lower concentrations of some metals below their hydroxide solubilities.

Batch Treatment

Sequence of steps

Continuous treatment is shown in Figure 13-2. However, all of the reactions can be achieved with semi-automatic batch control. Only a single tank with a pH controller and an ORP controller are required. The steps are sequenced, and the pH and ORP setpoints are changed to give the same results as for the continuous treatment. Caustic is added to raise pH to 11; then hypochlorite is added to raise the ORP potential to about +450 mV while more caustic is added as required to maintain 11 pH.

WARNING

Failure to comply with these instructions could result in death or serious injury.

An interlock must be provided to prevent the addition of acid before the positive oxidation of ALL cyanide. Failure to observe this precaution can result in the generation of highly toxic hydrogen cyanide.

Then the acid can be added to neutralize the batch and further oxidation will complete the cyanate-to-carbonate conversion. A settling period can then be used to remove solids, or the batch can be pumped directly to another settling tank or pond.

ORP Potential a Measure of Status of Reaction

Cyanide is reducing ion

An oxidation-reduction reaction involves the transfer of electrons from the ion being oxidized to the oxidizing agent. In cyanide destruction, chlorine or hypochlorite accepts electrons from the cyanide, oxidizing it, while simultaneously the hypochlorite is reduced to chloride. ORP potential is a measure of the status of the oxidation-reduction reaction; i.e., the gold electrode detects the solution’s ability to accept or donate electrons. The hypochlorite, an oxidizing ion, accepts electrons, which makes the electrode more positive. The cyanide, a reducing ion, provides electrons and makes the electrode more negative. The net electrode potential is related to the ratio of concentrations of reducing and oxidizing ions in the solution.

Potential cannot be used as monitor of effluent

This electrode potential is extremely sensitive in measuring the degree of treatment in the reaction tank. However, it cannot be related to a definite concentration of a cyanide or cyanate; therefore it cannot be used as a monitor of final effluent concentration.

Importance of clean electrode

Reliable ORP measurement requires a very clean metal electrode surface. Routinely clean the electrodes with a soft cloth, dilute acids, and/or cleaning agents to promote fast response.

13.4 Appendix C – Chrome Waste Treatment

Use of Chromates

Corrosion inhibition

Chromates are used as corrosion inhibitors in cooling towers and in metal-finishing operations including bright dip, conversion coating, and chrome plating.

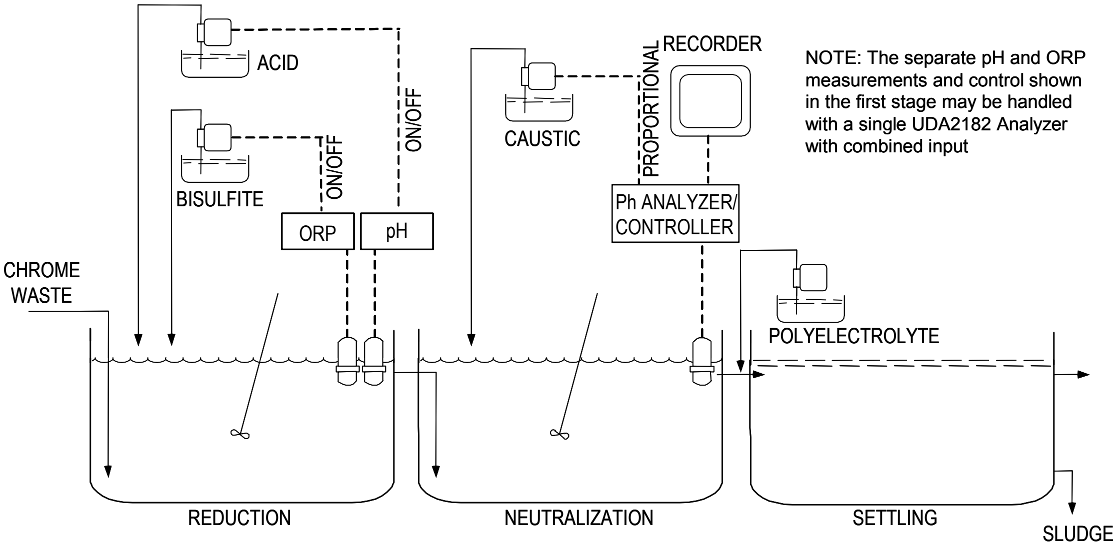
Necessity for removal of chromium ion from wastewater

The wastewater form rinse tanks, dumps, and cooling tower blowdown contains toxic soluble chromium ion, Cr^{+6}, which must be removed, typically to a level less than 0.5 ppm before discharge.

Technique for chrome removal

The technique most often used for this chrome removal is a two-stage chemical treatment process. The first stage lowers the pH and adds the reducing agent to convert the chrome from soluble Cr^{+6} to Cr^{+3}. The second stage neutralizes the wastewater, forming insoluble chromium hydroxide, which can then be removed.

Consistent treatment and stable control in this type of process requires well-mixed reaction tanks with enough volume for adequate retention time (see Figure 13-4). Retention time is calculated by dividing the filled or usable tank volume by the waste flowrate. Typically, it is ten minutes or more.



NOTE: The separate pH and ORP measurements and control shown in the first stage may be handled with a single UDA2182 Analyzer with combined input

Figure 13-4Chrome Treatment System

First Stage of Chrome Removal

Lower pH and add reducing agent

Sulfuric acid is used to lower the pH to about 2.5, which promotes the reduction reaction and ensures complete treatment. The reducing agent may be sulfur dioxide, sodium sulfite, sodium bisulfite, sodium metabisulfite, sodium hydrosulfite, or ferrous sulfate. The reaction is given below. The chromate is expressed as chromic acid, CrO_3, with a +6 charge on the chromium and the reducing agent is expressed as sulfurous acid, H_2SO_3, which is generated by sulfites at low pH. The result is chromium sulfate, $Cr_2(SO_4)_3$, with a +3 charge on the chromium. The reaction is expressed as:

$$2CrO_3 + 3H_2SO_3 \rightarrow Cr_2(SO_4)_3 + 3H_2O$$

This first stage reaction is analyzed and controlled by independent control loops: acid addition by pH control; reducing-agent addition by redox potential or ORP (oxidation-reduction potential) control. Often an ON-OFF type of control using solenoid valves or metering pumps can be used. The pH controller simply calls for additional acid whenever the pH rises above 2.5. The ORP controller calls for additional reducing agent whenever the ORP potential rises above about +250 mV. (The metal ORP electrode is positive with respect to the reference electrode.)

Titration curve

The ORP titration curve in Figure 13-5 shows the entire millivolt range if Cr^{+6} chrome is treated as a batch. With continuous treatment, operation is maintained in the fully reduced portion of the curve near the +250 mV setpoint. The ORP setpoint can vary between installations, depending on pH, reducing agent, presence of additional contaminants and dissolved oxygen, and the type of reference electrode used. Determine the exact setpoint empirically. This ORP setpoint should be at a potential where all of the Cr^{+6} has been reduced without excess sulfite consumption, which can release sulfur dioxide gas. This point can be verified with a sensitive colorimetric test kit or similar check.

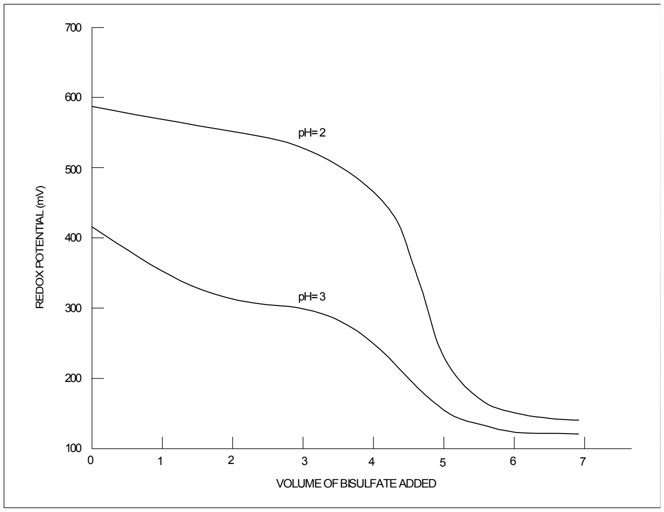


Figure 13-5 Chrome Reduction - Typical Titration Curve

Chrome reduction is slow enough that 10 to 15 minutes may be required for a complete reaction and this time increases if pH is controlled at higher levels. The pH also has a direct effect on the ORP potential as shown in Figure 13-5. Therefore, pH must be controlled to achieve consistent ORP control.

Second Stage of Chrome Removal

Neutralize the wastewater

In this stage the wastewater is neutralized to precipitate the Cr^{+3} as insoluble chromium hydroxide, $Cr(OH)_3$. Another reason is to meet the discharge pH limits. Sodium hydroxide or lime is used to raise the pH to 7.5 to 8.5 in the following reaction.

$$Cr2(SO_4)_3 + 6NaOH \rightarrow 3Na_2SO_4 + 2Cr(OH)_3$$

pH control point close to neutral point

Control of pH in the second stage is more difficult than in the first because the control point is in the sensitive area closer to the neutral point. Although this reaction is fast, for stability, a retention time of at least 10 minutes is usually needed for continuous treatment. Proportional pH control is often used in this stage.

Remove suspended chromium hydroxide

Subsequently, a settling tank and/or filter will remove the suspended chromium hydroxide. Flocculating agents are helpful in this separation.

Batch Treatment

Sequence of steps

Continuous treatment for chrome removal is shown in Figure 13-4. However, all of the reactions can be achieved with semi-automatic batch control. Only a single tank with a pH controller and an ORP controller are required. The steps of the treatment are sequenced, and the pH setpoint is changed to give the same results as for the continuous treatment. Acid is added to lower pH to 2.5; then reducing agent is added to lower ORP potential to +250 mV. After waiting a few minutes to ensure a complete reaction (and possible test for Cr^{+6}), the sodium hydroxide is added to raise pH to 8 as in the second stage of the continuous treatment. The settling period then begins, or the batch is pumped to a separate settling tank or pond.

ORP Potential a Measure of Status

Sulfite is reducing ion

An oxidation-reduction reaction involves the transfer of the electrons from the reducing agent to the ion being reduced. In the chrome removal application, sulfur in the sulfite ion donates electrons to reduce the chromium; simultaneously the chromium oxidizes the sulfur. The ORP potential is a measure of the status of the oxidation-reduction reaction; the platinum or gold electrode detects the solution's ability to accept or donate electrons.

Sulfite (SO_3^{+2}), a reducing ion, donates electrons which makes the electrode more negative. The chromium, an oxidizing ion, Cr^{+6}, accepts electrons and makes the electrode more positive. The net electrode potential is related to the ratio of concentrations of reducing and oxidizing ions in the solution.

Potential cannot be used as monitor of effluent

This electrode potential is extremely sensitive in measuring the degree of chrome treatment in the reaction tank. However, it cannot be related to a definite concentration of chrome and, therefore, cannot be used as a final effluent monitor of chrome concentration.

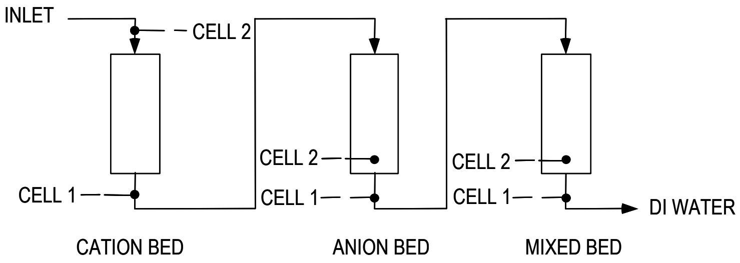
Importance of clean electrode

Reliable ORP measurements require a very clean metal electrode surface. Clean the electrodes routinely with a soft cloth; dilute acids, and/or cleaning agents to promote fast response. Control at low pH levels in the first stage of treatment has also been found to help maintain clean ORP electrodes.

13.5 Appendix D – Two-cell Applications

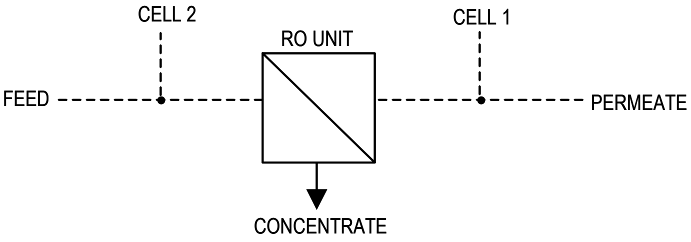
Ion Exchange

Ion exchange operations can achieve especially precise control using the conductivity ratio of two points with each bed. Ratio measurement accounts for feedwater variations when the upstream point is measured at the cation bed inlet. With the upstream point in the bed as shown for following stages, it can identify exhaustion before breakthrough.



Reverse Osmosis

Reverse Osmosis efficiency is monitored by comparing inlet and outlet conductivity (or TDS). Automatic calculations of Percent Rejection or Percent Passage are provided. If readout is in resistivity, cell locations are interchanged. Temperature readout assists with normalized performance comparisons.

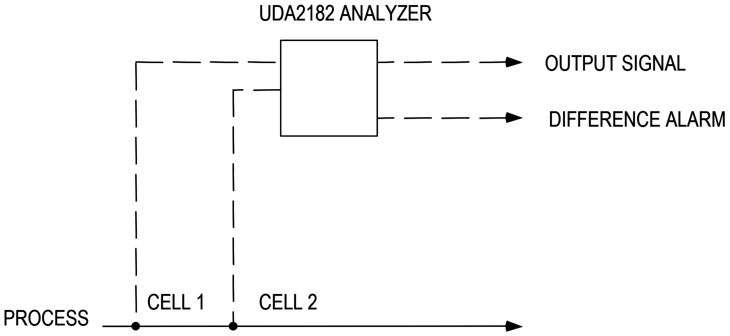


Percent Passage = $\frac{Cell1}{Cell2}$ x100 Typical Range is 0 to 20%

Percent Rejection = $(1- \frac{Cell1}{Cell2})$ x100 Typical Range is 80 to 100%

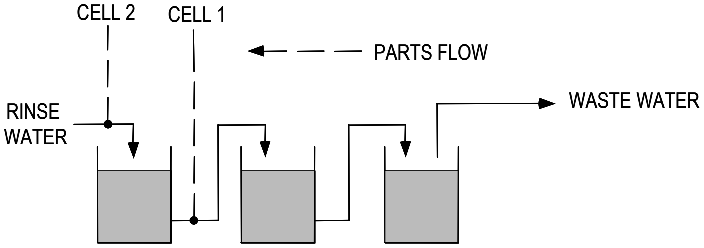
Conductivity/Resistivity/TDS Difference

Conductivity/Resistivity/TDS difference using redundant cells on critical processes can provide a valuable diagnostic capability. If the difference in measurements exceeds the alarm points, an operator is summoned for corrective action. Monitoring may be switched to the alternate cell during maintenance. For deviation in either direction, two different alarms (+ and -) are used. A difference kind of diagnostic can be provided by a precision check resistor in place of one cell to give continuous Analyzer/Controller checking at one value. Also see 13.10 Appendix I – Discussion on Chemical Interferences on Measured DO Currents.



Parts Rinsing

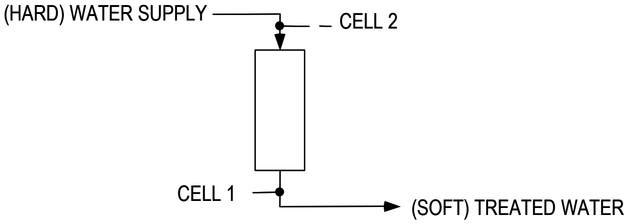
Parts rinsing is usually controlled by conductivity to obtain adequate rinsing without wasting excess water, whether a single stage or a counter-current series of tanks. The two-cell ratio approach can determine whether inadequate rinsing is due to low flowrate or due to poor supply water quality.



Conductivity Ratio = $\frac{Cell1}{Cell2}$ Typical Ratio Range is 0.1 to 1.1

Softener Monitor

Softener monitoring by conductivity ratio gives a continuous indication of performance. Sodium is typically more conductive than the hardness minerals it displaces, yielding a higher conductivity at the outlet. A ratio approaching 1 indicates that hardness ions are breaking through and that regeneration is needed.

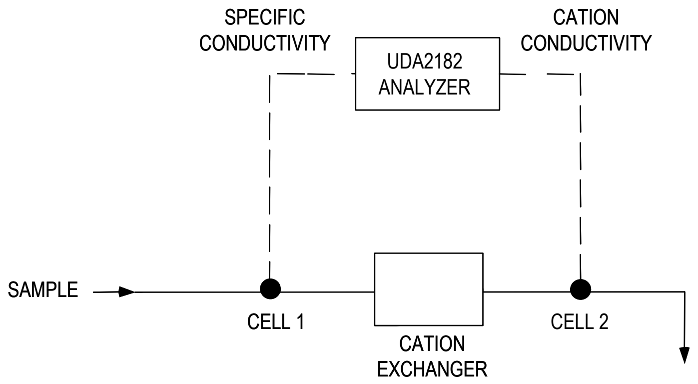


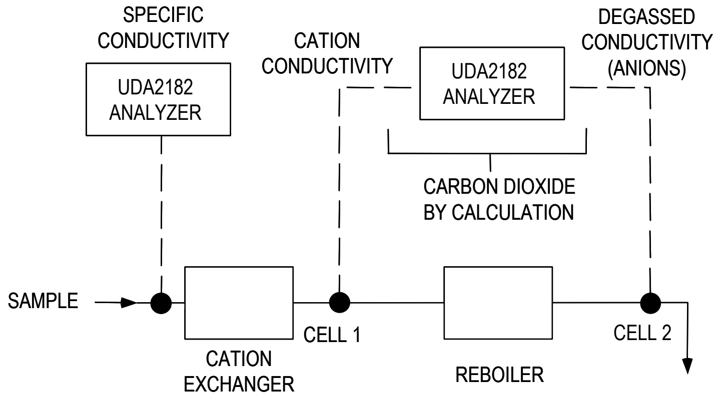
Softening Ratio = $\frac{Cell1}{Cell2}$ Typical Ratio Range is 1 to 1.25

Steam Power Measurements

The three conductivity measurements in power plants relate to water chemistry parameters as follows:

- Specific conductivity -- chemical treatment level
- Cation conductivity -- total anion contaminants
- Degassed conductivity -- non-volatile anion contaminants
- Cation minus degassed conductivities -- carbon dioxide





Sodium Hydroxide and Hydrochloric Acid Concentration Measurements

The measurement range of sodium hydroxide by conductivity is limited by temperature. The conductivity is limited by temperature. The conductivity of sodium hydroxide reaches a maximum value near 14% at 0º C and 29% at 100º C. Near the maximum there is poor resolution and no reliable way to know which side of the peak is being measured. Therefore, the UDA2182 measurement range is restricted by temperature to assure reliable values. Maximum concentrations are 10% at 0º C, 13% at 25º C and 20% at 75º C and above, with linear interpolation between these points. Operation above these limits gives a flashing display.

The measurement range of hydrochloric acid is restricted to less than 15.5% above 40º C and less than 18% below 40º C.

13.6 Appendix E – Using a Precision Check Resistor (For Conductivity)

Introduction

The operation of the Analyzer/Controller can be verified by replacing the input from a cell with a precision check resistor across the Analyzer/Controller input terminals. In addition, an 8550 ohm resistor (Honeywell Part No. 31233300) can be wired in place of the inputs from the temperature compensator to simulate 25° C, the reference temperature. The unit will display a simulated "process value" appropriate for the check resistor installed. (Equations showing the relationship between resistor rating and displayed value are provided below.) If the displayed value is incorrect, the Analyzer/Controller should be serviced.

This technique can be used two ways:

- Offline - Install the precision check resistor temporarily in place of the input from either cell to check the operation of the Analyzer/Controller. When correct operation has been verified, remove the resistor and replace the field wiring.
- Online - To provide a constant check of the Analyzer/Controller's operation in a critical process, connect the conductivity cell to the Cell 1 input terminals; instead of a Cell 2 input, install a check resistor at the Cell 2 input terminals. The Cell 2 "process value" should always be the appropriate value for the resistor (see equations below). Configure an alarm to monitor this value.

Set cal factor and calibration trim for ideal conditions

When a check resistor is used instead of cell input, the Analyzer/Controller must be set for theoretically ideal conditions to achieve display of the appropriate value for the installed resistor. This means that you set the cell calibration factor to 1.00 and remove the calibration trim for the cell input being replaced by the check resistor.

Calculations for conductivity, resistivity, and TDS

To verify instrument operation at any point of measurement, calculate the check resistance needed to simulate that value. (It is assumed that you have selected a display measurement value that is within the range of your cell constant; see 2.1for ranges.) The equation used depends on the measurement type. For concentration check values see the table on the following page.

$$\text{Conductivity check resistance (ohms)} = \frac{\text{Cell Constant (cm}^{-1}\text{)} \times 10^{6}}{\text{Conductivity (microSiemens/cm)}}$$

$$\text{Resistivity check resistance (ohms)} = \text{Cell Constant (cm}^{-1}\text{)} \times \text{Resistivity (ohm-cm)}$$

$$\text{TDS check resistance (ohms)} = \frac{\text{Cell Constant (cm}^{-1}\text{)} \times 10^{6}}{\text{TDS (ppm)/TDS factor}}$$

(TDS factor has units of ppm/microSiemens-cm^{-1})

Example 1: To determine the check resistor value needed to simulate conductivity measurement of 10 µS, use cell constant 0.1 and perform the following calculation:

$$10 \text{ k ohms} = \frac{(0.1) \text{ x } (1{,}000{,}000)}{10}$$

Example 2: To determine the check resistor value needed to simulate resistivity measurement of 10 M ohms, use cell constant 0.01 and perform the following calculation:

$$100 \text{ K ohms} = (0.01) \text{ x } (10{,}000{,}000)$$

Concentration values

Obtain the appropriate check resistance value from the table below.

Table 13-1Data for Concentration Range Measurements

Material/Weight % Concentration	**Simulation Resistance (ohms) @ 25º C** **Cell Constant**		
	10	25	50
Hydrochloric Acid (HCl)			
0		∞	∞
1		242.5	485.0
4		68.9	137.7
Sulfuric Acid (H2SO4)			
0	∞	∞	∞
1	215.5	538.7	1077.4
4	56.0	140.0	280.0
Sodium Chloride (NaCl)			
0	∞	∞	∞
1	574.1	1435.1	2870.3
4	195.2	398.0	796.1
Sodium Hydroxide (NaOH)			
0	∞	∞	∞
1	189.2	473.0	946.1
4	54.0	135.1	270.1

13.7 Appendix F – Noise Testing, Dissolved Oxygen Application

Hints for Reducing Noise

Specifications for proper operation of Honeywell dissolved oxygen (DO) probes demand that the alternating current (AC) voltage signal (noise) between anode and shield connections and cathode and shield connections be less than 1 mV AC.

While it is the user's responsibility to assure that this specification is met, the following are some hints that have been successful in reducing these signals to the required value in a variety of installations.

1. First eliminate external connections as a source of excess AC noise.
2. After installation of all wiring, use a digital voltmeter to check the following voltages:

Anode - Shield	1.2 to 2.0 VDC depending on oxygen level less than 1 mV AC. In low ppb measurements, this value may be zero.
Cathode - Shield	< 1 mV DC less than 1 mV AC

3. Any readings greater than the limits shown above indicate electrical noise that should be corrected.
4. Systematically remove external connections to the Analyzer, noting if the voltage drops within the acceptable limit.
5. If a noise source is identified, improved shielding, grounding or re-routing of that cable may be required. (In attempting to reduce AC noise, do not ground the shield as this shunt filtering is designed to reduce electromagnetic interferences {EMC}.)
6. If the measured voltages are greater than procedures states, one at a time remove an external connection (ex., isolated outputs and relays) and re-measure the AC signal. If the AC signal has decreased after disconnecting one of these connections, then this was the source of the noise.
7. If the noise remains at a value greater than 1 mV AC after disconnecting all external connections described in step 1, disconnect the shield wire from Terminal 7 and connect it to instrument ground inside the case.
8. If the noise remains at a value greater than 1 mV AC after performing step 2, reconnect the shield wire to Terminal 7 and connect an additional (jumper) wire from ground to the shield connection, Terminal 7.

If these steps fail to reduce the Anode-Shield and Cathode-Shield AC signals to the specified 1mV AC or less, obtain an isolated transformer and power the analyzer from that.

13.8 Appendix G – DO Probe and Analyzer Tests

Before performing an air leak detection, it is necessary to determine that both Probe and Analyzer are working properly.

Assumptions:

- The probe and analyzer should be connected, the analyzer powered-up, and the probe in the process water for at least 24 hours prior to testing.
- No additional configuration should be done.
- The process is as it would be normally. All equipment in the process is online and contributing to the process. This is to ensure that the Probe and Analyzer are working in a known environment.

Check for probe membrane leakage

If the probe has membrane leaks, incorrect readings may occur. Follow this procedure to check for probe membrane leakage:

1. Remove probe from analyzer and process.
2. Using either the flow chamber or original protective adapter, screw this piece on the probe. If using the adapter, wrap electrical tape around the adapter to seal the holes.
3. Next, wrap electrical tape around the hole on the side of the probe. The intent is to create a reservoir for the sealed probe.
4. Position probe with the membrane pointing up.
5. Make a solution of salt water using 2 T. of salt and 8 oz. of water.
6. Fill the probe (via the adapter or flow chamber opening) with the salt water until water is overflowing from the top of the reservoir.
7. If using the adapter or a PVC flow through chamber, place a wire (uncurled paper clip) in adapter or flow through chamber opening such that one end is immersed in the salt water solution. If using a Stainless Steel (SS) flow chamber, you do not need the wire.
8. Using a DVM that can measure Mohms, attach one DVM lead to the paper clip (or touch side of SS flow through chamber) and the other DVM lead to the cathode(black lead). Measure the impedance between the Cathode and the wire(probe side). If the probe has no leakage problem, this resistance will be greater than 1 Mohm. Go to Step 10. If the reading is in the k ohms or ohms range, there is a leak in the membrane, which can cause erratic readings in the probe. Stop any further testing until the probe is replaced.
9. If you are here, it has been confirmed that there are no membrane leaks in the DO probe. Remove the tape and wire from probe and rinse probe with tap water. Go to Steps 9 – 16 on the following pages.

Check that analyzer is working

1. Remove power from analyzer.
2. Disconnect the probe and put the following resistor values on the terminal block of the analyzer:
    - Jumper (bare wire) - Anode(8) to Ref(9)
    - 10k resistor - Ref(9) to Cathode(10)
    - 5k resistor across thermistor leads - 4 and 5
3. Turn analyzer back on.
4. If you see a reading of between 5 and 10 ppm or 5000 and 10000 ppb at 25°C, the analyzer is working correctly.
5. If not, the analyzer maybe the problem. Consult Honeywell TAC for support.

Check that the analyzer and probe are working together correctly.

1. If not already done, connect the probe to the analyzer and power up the analyzer. Put probe in a bucket of water for approx. 1 hour so it can stabilize before proceeding.
2. Expose probe to ambient air for 3-5 minutes or until the temperature is stable.
3. Press the Display key on the Analyzer until the following parameters **DO**, **TEMP**erature, **SAL**inity, and **PRESS**ure are showing on the analyzer's display.
4. Perform a Visual Check on these parameters while the probe is in ambient Air:
5. The Temperature is not flashing and is between 15 - 35 Deg C.
6. DO's Barometric Pressure is approx. in the range of 500 to 600 mmHg
7. The Salinity value should be 0.0 PPT. (Indicates that Salinity is turned OFF).
8. If any of the above parameters are incorrect, make the necessary changes to correct them so that they are as stated above.
9. Perform an air calibration.
10. When air calibration is completed, look at the DO value and the Temperature on the Analyzer's display.
11. Confirm that these two parameters are correct by comparing them to values in Table 13-1. If the measured values are not similar to the table, the probe is suspect, call *TAC for assistance.
12. With probe still in air, perform a Probe Bias Test under the Maintenance Menu.
13. When completed, the display should look exactly like Figure 8-4 under Probe Bias Test. If it does, move to Step 16.
14. If the problem is a shift of the curve either to the left or right of the cursor, move the cursor so that it is positioned on the flat portion of the curve. At this point, the probe is suspect and should be sent to the Technical assistance Center for analysis. If the

problem is that the cursor is positioned too far to the left or right of the flat portion of the curve, then move the cursor back to the flat portion of the curve.

15. Perform another Air Calibration to correct any changes that occurred during the PBT.
16. If you reached this point, you have both a working probe and analyzer that are calibrated to one another correctly.

13.9 Appendix H – Parameters Affecting Dissolved Oxygen Measurement

The actual quantity of oxygen that can be present in solution is governed by the partial pressure of the gas in the atmosphere, the solubility in solution, the temperature and purity of the solution.

Pressure

UDA2182 Universal Dual Analyzers include an internal pressure sensor and software algorithm that automatically compensates for atmospheric pressure variations during calibration. Pressure variations have a direct effect on the dissolved oxygen concentration during normal measurement so no pressure compensation is applied at that time. The information given below is only for reference to published solubility tables and is not needed for operation of the Analyzer.

The equilibrium concentration of oxygen dissolved in a liquid is directly proportional to the partial pressure of oxygen in the vapor phase with which the solution is in contact. Dry air, which contains 20.9% oxygen, will have an oxygen partial pressure of 159 mmHg if the total pressure is 760 mmHg. Tables of oxygen solubility are normally referenced to this value. An altitude or pressure correction must be made when conditions differ from this level. The correction is made using the following equation:

$S = S' (P - p)/(760 - p)$
where:

S is the solubility at barometric pressure of interest (P)
S' is the solubility at 760 mmHg at a given temperature
P is the barometric pressure
p is the partial pressure of water at the given temperature

Temperature

Honeywell dissolved oxygen probes and analyzers include temperature sensors and an automatic temperature compensation algorithm. The algorithm takes the raw oxygen signal from the probe (which is proportional to the partial pressure of oxygen) and converts it into the actual concentration of oxygen at the measuring temperature. The algorithm is based on the decreasing solubility of oxygen with increasing temperature and on the probe temperature coefficient.

Salinity

The significant effect of dissolved solids on reducing oxygen solubility is well documented. However, the partial pressure of oxygen (raw oxygen probe signal) is the same whether in pure or saline water. Since the actual solubility is reduced, a correction must be made when measuring brackish, sea or other water containing much more than 1 ppt (1000 ppm) of dissolved solids. The Analyzer includes a salinity correction algorithm, which uses input from a fixed value of salinity in ppt (parts-per-thousand) entered from the front panel. Suspended and settled solids have negligible effect on solubility, but may affect the transfer rate of oxygen when in excess of 2%.

13.10 Appendix I – Discussion on Chemical Interferences on Measured DO Currents

There are four contributors to measured current:

Faradaic Currents

Faradaic currents are those resulting from oxidation or reduction of chemical species. The reduction of oxygen to water, the oxidation of water to oxygen, and the oxidation of hydrogen, hydrazine or sulfur dioxide, are examples of Faradaic currents.

Residual Currents

Residual currents are unwanted Faradaic currents caused by impurities in the probe electrolyte. These impurities are metals (e.g. lead, zinc) in electrolyte reagents, which are capable of being reduced at the cathode and give rise to zero offset currents at “zero ppb oxygen”.

Electrode Conditioning Currents

The platinum cathode and anode materials are actually made up of conducting platinum oxides. These oxides exist at the molecular level. The actual platinum surface state strongly affects the observed Faradaic currents. Before methods of wire conditioning were established, upwards of 96 hours was needed to allow these conditioning currents to stabilize. Once wire-conditioning methods were established, it now takes approximately 24 hours for these conditioning currents to completely stabilize. Electrode conditioning currents occur on first probe power-ups, following power interruptions of more than 1 second (back-up power is provided for the probe to prevent this current during a power outage of 1 hour or less) and following a Probe Bias test.

Charging Currents

The Dissolved Oxygen (DO) probe consists of closely spaced bi-filar platinum windings separated by a high dielectric constant material. This is a description of a capacitor; the capacitance of a DO probe is in the hundreds if microFarads. When the probe is scanned during a Probe Bias Test(PBT) at 25mV/sec, an appreciable charging current is observed. This is equivalent to several hundred ppb dissolved oxygen.

The purpose of the PBT is to verify the optimum operating range of the current/voltage curve. It further allows one to determine if a reference shift has occurred. Most importantly, it allows one to select to identify a new bias point, if one is needed. To employ this diagnostic, the user should be in air or air saturated water (ppm current is in uA range). A PBT should not be performed in a ppb application (ppb current is in nA range), due to charging and electrode currents being at a maximum value (µA range) during one of these scans. Furthermore, the final current rise during the PBT produces both hydrogen and oxygen gases within the probe. Time is needed before these gases can re-establish equilibrium with the outside sample. Therefore, the PBT should be limited to air level conditions and adequate time should be allowed for probe recovery following a PBT.

Faradaic Interferences

The DO probe responds to oxygen partial pressure as follows:

$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O \qquad (1)$$

Reaction (1) is a chemical reduction in which dissolved oxygen is reduced to water. This reduction occurs at the working electrode, commonly referred to as the cathode. The equal and opposite (oxidation) reaction occurs at the counter electrode (anode). Any gaseous substance, which is permeable through the membrane and is capable of being oxidized or reduced (electroactive) at the working electrode will interfere. Cl_2, O_3, H_2, N_2H_4 and SO_2 are examples of interfering dissolved gases.

$$Cl_2 + 2e^- \rightarrow 2Cl^- \qquad (2)$$

$$H_2 \rightarrow 2H^+ + 2e^- \qquad (3)$$

Reaction (2) is a reduction and hence a positive interference will be observed; reaction (3) is an oxidation, which will result in a negative interference. All amperometric probes are subject to reduction or oxidation interference as shown above. In addition to the direct interference shown in these two equations, the equilibrium probe provides an additional indirect interference. In normal probe operation oxygen is consumed at the working electrode and an equal amount of oxygen is produced at the counter electrode. In a positive interference condition, such as (2) above, chlorine is reduced at the working electrode and an equivalent amount of oxygen is produced at the anode. This oxygen is electroactive, along with the dissolved chlorine and is a contributor to the measured current.

In the absence of dissolved oxygen and in a negative interference situation as in (3), hydrogen gas is consumed at the working electrode and the opposite reaction, the reduction of water to hydrogen gas occurs at the counter electrode. In this hydrogen interference mode, the probe is both consuming and producing equal amounts of hydrogen, and is operating in a hydrogen detection equilibrium mode.

In cases of electrochemical interference, if the interference is positive, dissolved oxygen will be produced at the counter electrode giving a perceived higher oxygen reading. If the interference is negative, dissolved hydrogen gas will be produced at the counter electrode giving a perceived zero oxygen reading.

Sulfite Based Zero Testing

Often as a quick check to determine if a DO probe can reach 0.0 ppb, the user will immerse the probe in a sulfite-based solution. While sulfite is known to be a convenient oxygen scavenger, its effectiveness depends on factors such as temperature, solution pH and trace impurities. What's worse is that sulfites are produced by bubbling sulfur dioxide gas through caustic solutions. Sulfur dioxide, if present in solution, will diffuse through the probe membrane, react with the alkaline probe electrolyte to form electrolyte sulfites and produce a negative interference by the reaction:

$$SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^- \qquad (4)$$

As opposed to reaction (1), reaction (4) is an oxidation; electrons are on the opposite sides of the equations and hence the measured current for (4) is opposite (interfering) the oxygen reduction signal. The sum of (1) and (4) is the reaction by which sulfites scavenge oxygen, namely:

$$O_2 + 2SO_3^{2-} \rightarrow 2SO_4^{2-} \qquad (5)$$

From the above discussion it is apparent that while sulfite oxygen scavenging can be beneficial, the existence of dissolved SO_2 gas is detrimental. To further complicate the situation is the fact that at least 10 different SO_2/Sulfite species exist in solution, and that the equilibrium between these species is slow. The primary parameters that establish equilibrium conditions are total sulfite concentration and pH. Sodium bisulfite ($NaHSO_3$) and sodium meta bisulfite ($Na_2S_2O_5$) are acid sulfite forms; because acidity favors SO_2 formation these materials should be avoided. While sodium sulfite (Na_2SO_3) is the best starting material, before use, an optimum pH of 9-10 should be obtained and divalent metal catalyst should be added to speed up that species equilibrium. Testing done at the Honeywell Engineering labs shows it is impossible to create a consistently optimum solution preparation for zero probe calibration using sulfites.

However, a Honeywell proven low ppb DO test using Nitrogen, an oxygen displacer, is recommended in Appendix L of this manual.

13.11 Appendix J – Percent Saturation Readout

In some special applications, it is desirable to read out in percent saturation rather than concentration. These are usually in non-aqueous solutions where the normal temperature compensation of the Series UDA2182 Analyzer for the solubility of air/oxygen in water does not apply. The percent saturation readout disables this solubility part of the temperature compensation. The readout is 100% when measuring in air or in a solution saturated with air, regardless of the temperature. Thus an air calibration will always produce approximately a 100% saturation readout. With this readout, salinity should be left at zero since the normal salinity correction also does not apply to non-aqueous media.

When percent saturation readout is selected, the on-line displays read in percent saturation, however, all the dissolved oxygen settings in the Analyzer remain in concentration units (ppm or ppb). Therefore, percent saturation alarms, output, etc. Should be used only if the process temperature is nearly constant.

For example, assume it is desired to have an alarm setpoint at 75% saturation while operating at 20°C. The corresponding setpoint is the 0.75 x 9.07 = 6.80 ppm.

Table 13-2 Dissolved Oxygen Solubility vs. Temperature

(From Standard Methods for the Examination of Water and Wastewater)

Sample Temperature (°C)	Solubility ppm, mg/L)
0	14.60
1	14.19
2	13.81
3	13.44
4	13.09
5	12.75
6	12.43
7	12.12
8	11.83
9	11.55
10	11.27
11	11.01
12	10.76
13	10.52
14	10.29
15	10.07
16	9.85
17	9.65
18	9.45
19	9.26
20	9.07
21	8.90
22	8.72
23	8.56
24	8.40
25	8.24
26	8.09
27	7.95
28	7.81
29	7.67
30	7.54
31	7.41
32	7.28
33	7.16
34	7.05
35	6.93
36	6.82
37	6.71
38	6.61
39	6.51
40	6.41
41	6.31
42	6.22
43	6.13
44	6.04
45	5.95
46	5.86
47	5.78
48	5.70
49	5.62
50	5.54

13.12 Appendix K – Leak Detection in PPB Applications

Before performing an air leak detection, it is necessary to determine that both the probe and analyzer are working properly. Refer to Probe and Analyzers tests in Section 13.8

1. First, check to see that the probe contains an O-ring. Per the probe directions, an O-ring must go into a probe that is used in ppb applications. This creates a tight seal between the probe and flow chamber. MAKE SURE THIS O-RING IS IN THE PROBE.
2. Unless already in air, open the probe to air for 30 seconds.
3. Put it back into the process again.
4. Allow the DO to drift down to the 20-30 ppb range. The 20-30 ppb range was chosen because the reading was low enough that the drift was small with respect to the changes observed for various flow rates but high enough that changes could be observed.
5. At this range, vary the flow rate from 10 to 100 ml/min. These low flow rates were selected for two reasons. The first, the tester may only have a 0 - 100 ml/min flow indicator. The other reason, is a leak that exists at this low flow, will cause a change in the DO reading.
6. If the DO value at 10 ml/min exceeds the DO value at 100 ml/min, a leak is present in the sampling line.
7. Fixing the leak may require plastic tubing to be replaced with metal tubing, tape to be put on fittings, and/or fittings at the bottom of the probe to be tightened securely.
8. Now, repeat Steps 2 - 6 until the flow can be changed from >100 ml/min to 10 ml/min with no change in the DO value.

13.13 Appendix L – Procedure for Low Level ppb Dissolved Oxygen Testing

Overview

The purpose of this procedure is two-fold. First, using a controlled environment, new probes and/or analyzers can be tested to determine if each is performing correctly before being installed in the field. Second, this procedure can be used to re-test the performance of an existing analyzer and/or probe.

You may choose to use this set-up for a zero calibration test. However, a zero calibration test would require, as a minimum, modifications to two of the test parameters. One modification would require a closed loop water system. The sample water must be tapped directly from the customer’s process water. The other modification would be the gas. For zero calibration, a high purity nitrogen gas (very expensive) must be piped into the process sample. Since Honeywell can neither control the quality of the gas the customer purchases nor the quality of the process water used, the company will not guarantee the accuracy of the results of a zero calibration done by this modified method.

Equipment Needed

One Tank of Oxygen in Nitrogen gas mixture

One pressure regulator/shutoff valve

Wash bottle - used to add moisture to the sample gas before the gas reaches the probe. (Without addition of moisture, the Nitrogen gas would dry out the probe membrane.)

One Beaker - used to vent the gas sample

One Dissolved Oxygen probe - used to make DO measurement

One Dissolved Oxygen flow through chamber - provide a closed environment

One Honeywell Model UDA2182 Analyzer - monitors and displays DO value.

Oxygen Measurement Procedure

1. Connect probe and energize the electronics.
2. Allow probe to sit in tap water for 1 hour.
3. Perform an air calibration per the manual instructions.
4. Set-up equipment as shown in Figure 13-6.
5. Install probe into sealed flow chamber and connect to wash bottle piping.
6. Set room temperature to 25°C and sparge water with nitrogen overnight. Reading should be less than 1 ppb.
7. Remove probe from flow chamber and expose to 25°C air for 2 hours.
8. Perform an air calibration.
9. Return probe to flow chamber and resume nitrogen sparging.

10. When analyzer indicates that DO level is below 20 ppb, change gas to 250 ppm O_2 in nitrogen. Run until equilibrated (4-6 hours). After equalization, note barometric pressure and temperature.
11. Compare reading with calculated value

To Calculate True Value

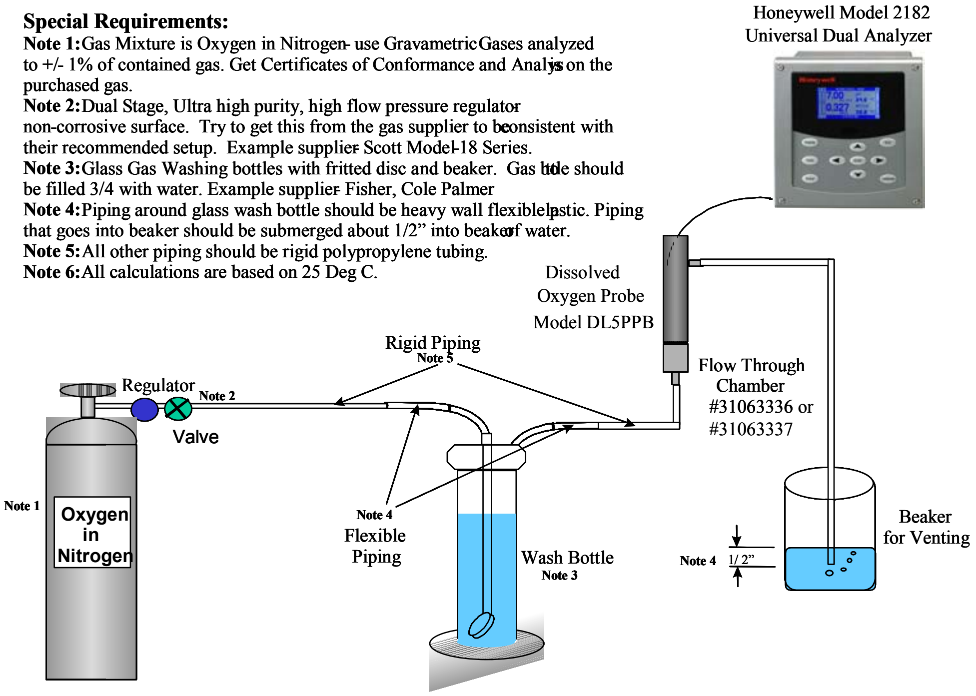
$$\frac{\text{*Air Sat. Value at T °C} \times \text{known gas } O_2 \text{ Value}}{20.9\%} \times \frac{\text{Barometric Pressure}}{760 \text{ mmHg}} = \text{True Value}$$

Example Calculation

At 25°C using 250 ppm O_2 in N_2 at 770 mm Hg

$$\text{True Value} = \frac{8.24 \times 10^{-6} \times 250 \times 10^{-6}}{20.9 \times 10^{-2}} \times \frac{770}{760} = 9.986 \times 10^{-9} \text{ or } 10 \text{ ppb}$$

* If the temperature of the process water is not at 25°C, use O_2 Solubility Tables in Table 13-2 and the process water temperature to determine the Air Saturated O_2 value.



Special Requirements:

Note 1: Gas Mixture is Oxygen in Nitrogen- use Gravametric Gases analyzed to +/- 1% of contained gas. Get Certificates of Conformance and Analysis on the purchased gas.

Note 2: Dual Stage, Ultra high purity, high flow pressure regulator- non-corrosive surface. Try to get this from the gas supplier to be consistent with their recommended setup. Example supplier- Scott Model-18 Series.

Note 3: Glass Gas Washing bottles with fritted disc and beaker. Gas bottle should be filled 3/4 with water. Example supplier- Fisher, Cole Palmer

Note 4: Piping around glass wash bottle should be heavy wall flexible plastic. Piping that goes into beaker should be submerged about 1/2" into beaker of water.

Note 5: All other piping should be rigid polypropylene tubing.

Note 6: All calculations are based on 25 Deg C.

Figure 13-6 Suggested ppb Dissolved Oxygen Test Set-up

14 Index

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