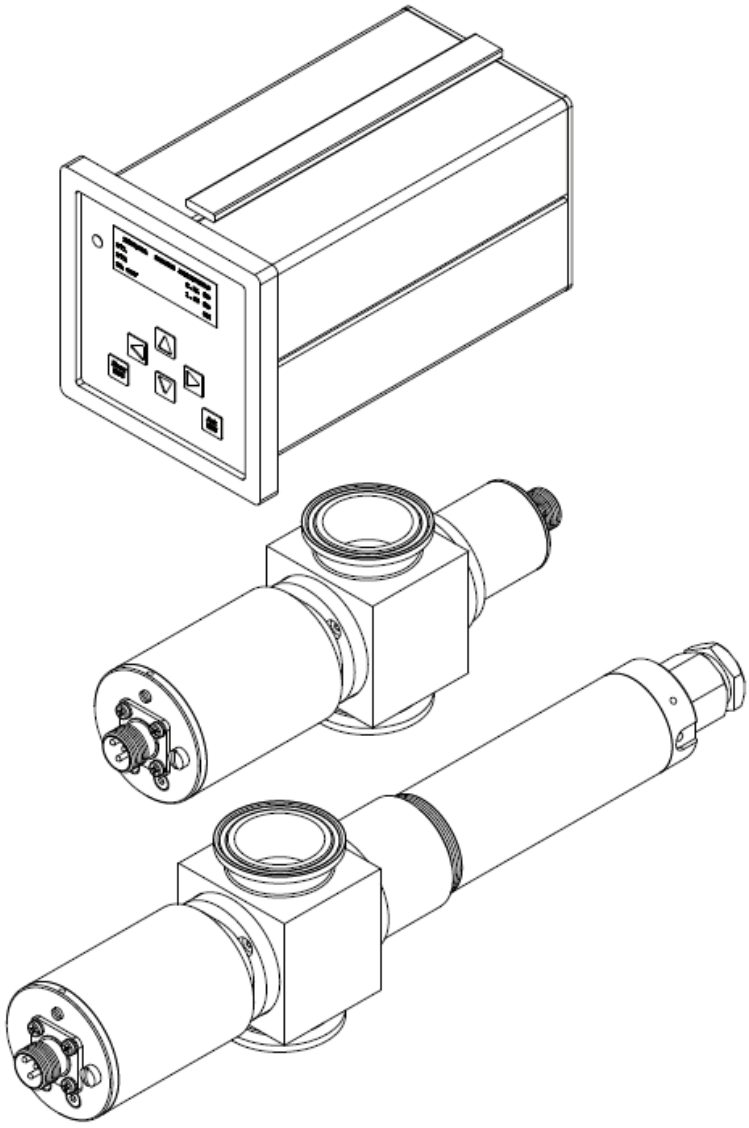
Operating Instructions

Model OUM980 Photometric Analyzer/ Model OUSAF22 Dual Beam Inline Color Sensor

Analyzer/Sensor to measure Spectral Absorbance



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1. Safety Instructions

1.1 Designated Use

Integra Model OUM980 is an analyzer for determining the absorbance of a liquid medium.

The analyzer is particularly suited for use in the following areas:

- Bio-Technology industry
- Waste water processing
- Chemical processing industry
- Food industry
- Pharmaceutical industry

Any other use than the one described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted. The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Installation, Start-Up and Operation

Please note the following items:

- Installation, electrical connection, start-up, operation and maintenance of the measuring system must only be carried out by trained technical personnel. The technical personnel must be authorized for the specified activities by the system operator.
- Technical personnel must have read and understood these Operating Instructions and must adhere to them.
- Before commissioning the entire measuring point, check all the connections for correctness. Ensure that electrical cables and hose connections are not damaged.
- Do not operate damaged products and secure them against unintentional commissioning. Mark the damaged product as being defective.
- Measuring point faults may only be rectified by authorized and specially trained personnel.
- If faults can not be rectified, the products must be taken out of service and secured against unintentional commissioning.
- Repairs not described in these Operating Instructions may only be carried out at the manufacturers or by the service organization.

1.3 Operational Safety

Relevant regulations and standards have been met. As the user, you are responsible for complying with the following safety conditions:

- Installation instructions
- Local prevailing standards and regulations.

EMC

This instrument has been tested for electromagnetic compatibility in industrial use according to applicable standards.
Protection against interference as specified above is valid only for an instrument connected according to the instructions in these Operating Instructions.

1.4 Return

If the device requires repair, please contact your local sales and service representative. Refer to the website on the back page of this manual on where to find your local sales and service support office. Please use the original packaging, if possible.

Notes on safety icons and symbols

Safety icons

Warning!
This symbol alerts you to hazards. They can cause serious damage to the instrument or to persons if ignored.

Caution!
This symbol alerts you to possible faults which could arise from incorrect operation. They could cause damage to the instrument if ignored.

Note!
This symbol indicates important items of information.

Electrical symbols

⎓ **Direct Current (DC)**
A terminal at which DC is applied or through which DC flows.

~ **Alternating Current (AC)**
A terminal at which (sine-form) AC is applied or through which AC flows.

Ground connecting
A terminal is already grounded using a grounding system.

Protective earth terminal
A terminal which must be grounded before other connections may be set up.

Alarm relay

Input

Output

2. General Information

The Model OUM980 Photometric Analyzer is used in conjunction with a Model OUSAF22 sensor to measure the spectral absorbance of process liquid in the VIS/NIR region of the electromagnetic spectrum.

Dependent upon the optical pathlength of the connected sensor, the instrument can measure up to 50 Optical Density (OD) units.

The Model OUM980 Photometric Analyzer is manufactured from state of the art digital electronics. Plant interface is through quick disconnect screw terminals on the back of the module. The user interface is comprised of a 6-button tactile feel keypad and 4 x 20 character alphanumeric LCD display.

2.1 How the Model OUM980 Photometric Analyzer Works

The Model OUSAF22 sensor generates two photocurrent (nA) detector signals based upon the amount of energy present at its lamp source (reference) and measurement point internally. The Model OUM980 unit computes the logarithmic ratio of these two signals and determines the absorbance of the liquid passing through the sensor. The absorbance value is expressed in optical density units (OD) and is displayed on the front panel. Two galvanic isolated analog current outputs, proportional to the OD reading, are simultaneously transmitted for connection to other instrumentation and recording devices.

2.2 Concentration and Absorbance Units

The concentration of an optically absorbing material in a mixture can be determined since it is related to the amount of light absorbed from a beam of light passing through it. The absorbance of a substance is directly proportional to the concentration of the material that causes the absorption. The Lambert-Beer Law describes this relationship of absorbance (A) to concentration. Essentially, the amount of radiation transmitted through the absorbing material decreases logarithmically with its increasing concentration.

Where $A = \log\frac{1}{T} = \log\frac{Io}{Ir}$ and $T = \frac{Ir}{Io}$

The above assumes that the optical pathlength remains constant. The optical density (OD) however, is defined as Absorption per unit length. Normalizing to an optical pathlength of 1cm, it follows that:

$$OD = \frac{1}{L}(A)$$

Where OD = Optical Density
A = Absorbance
L = pathlength in cm

2.3 Easy Interfacing

The Model OUM980 Photometric Analyzer incorporates a front panel display and two analog current output signals. The display on the front panel is an alphanumeric 4 x 20 character LCD. The display may be configured for process variable or analog current output measurements. Optical Density (OD) readings are normalized to a 1cm pathlength.

There are two analog current outputs from the unit. The range of each can be independently set to be any range within the measurement range of the instrument. One output is configured to operate with measurement baseline shift commands, while the other tracks full scale of the instrument.

The analog current outputs (4-20mA) will operate with loads up to 750 ohms. These outputs are galvanically isolated and conform to NAMUR Standard[i].

Model OUM980 is supplied as standard with four digital inputs and three digital output relays.

The digital inputs can be configured to perform a variety of functions such as baseline and sensor lamp off/on.

The outputs can be connected to a PLC for inclusion in a control scheme, for simple valve operation or for local indication (alarms) and annunciation. Alarm status indication is provided on the front panel display.

All digital inputs are optically isolated.

[i] NAMUR Standard Limit Detection when enabled is set to a BAD if the signal level is above 21 mA or below 3.6 mA for more than 4 seconds. The BAD status is cleared when the signal returns to the normal 4-20 mA range.

3. Installation

3.1 Model OUM980 Analyzer Installation

Before starting installation, inspect the analyzer, sensor, and supplied cable set for any signs of shipping damage. Report any visual damage or discrepancies to the factory and the shipper immediately.

The Model OUM980 Analyzer is a ¼ DIN enclosure which can be installed a variety of panel, wall and bench top housings. Refer to figure 3.1 for mounting dimensions. Mount or install the analyzer into an enclosure or area that is not subject to excessive vibration or shock and will protect the instrument from materials such as water and chemicals. Allow enough clearance behind it for cable access.

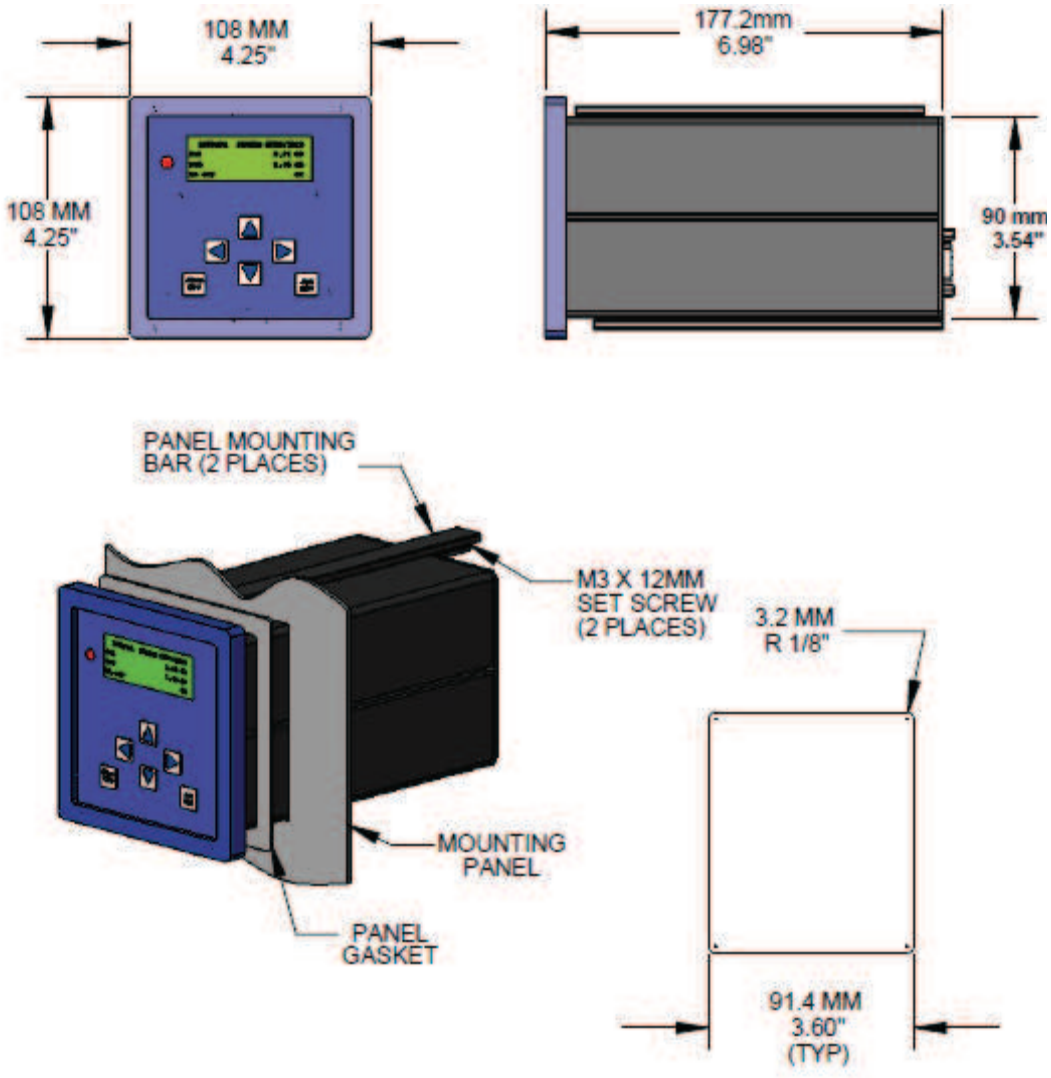


Figure 3.1 OUM980 Analyzer Mounting

3.2 Model OUM980 Cables and Wiring

All wiring terminals are located on the back panel of the Model OUM980. The analyzer/sensor interconnection cables supplied with the system have all been pre-terminated and labeled for ease of installation. The Model OUM980 has two (2) analog current outputs of 4 to 20mA. Both are capable of driving loads up to 750 ohms.

In addition to the analog outputs, three (3) galvanic isolated digital outputs (N.O.) are available. These outputs are rated for both AC and DC voltages up to 280 volts at 125mA. These outputs are intended for dry contact or pilot applications.

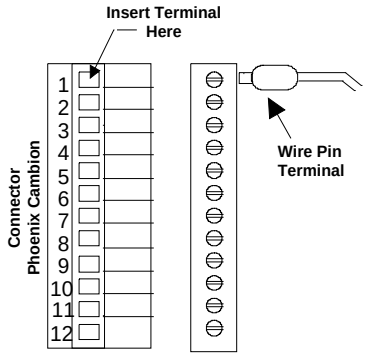


Figure 3.1: Wire Terminal Preparations

Cables installed for signal connection (i.e. analog outputs, lamp fail output) should be shielded twisted pairs.

Warning!
When routing the cables, separate signal cables from power wiring!

Caution!
Use dry contact only when connect digital input to analyzer!

Refer Figure 3.3 for wiring connection.

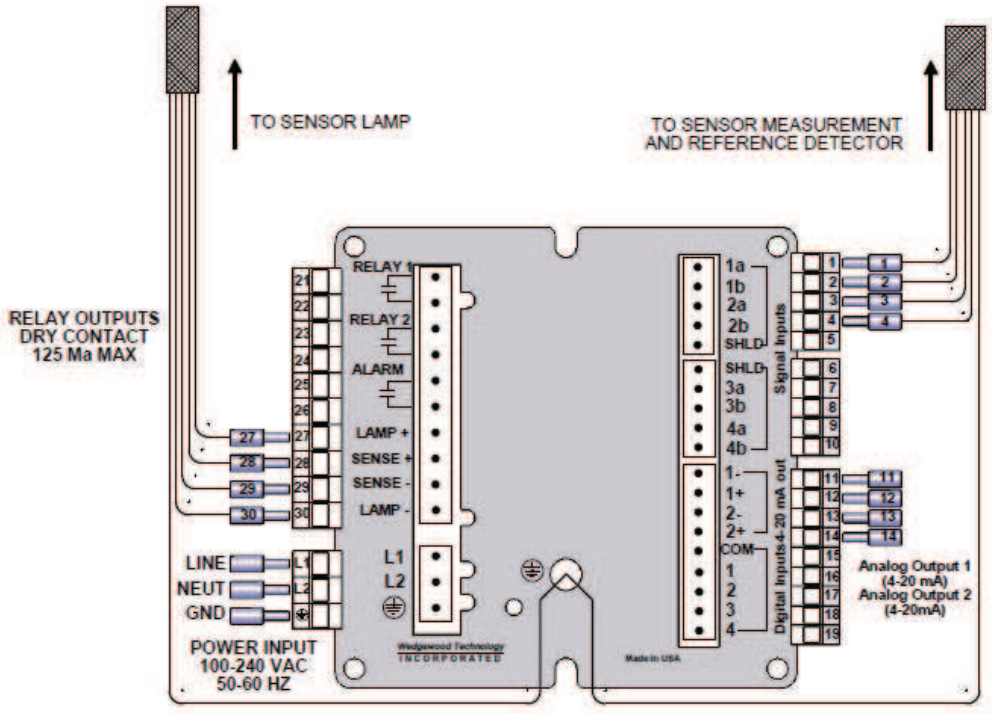


Figure 3.4: Model OUM980/OUSAF22 Dual Beam Wiring Diagram (AC Input Version)

3.3 DC Input Power Option

For instruments supplied for 24VDC operation, only the power input connection is changed. Figure 3.4 shows the connection detail for a 24VDC unit.

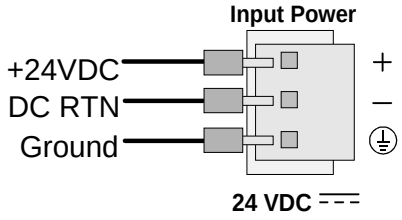


Figure 3.2: Integra DC Power Connection

3.4 Model OUSAF22 Sensor Installation

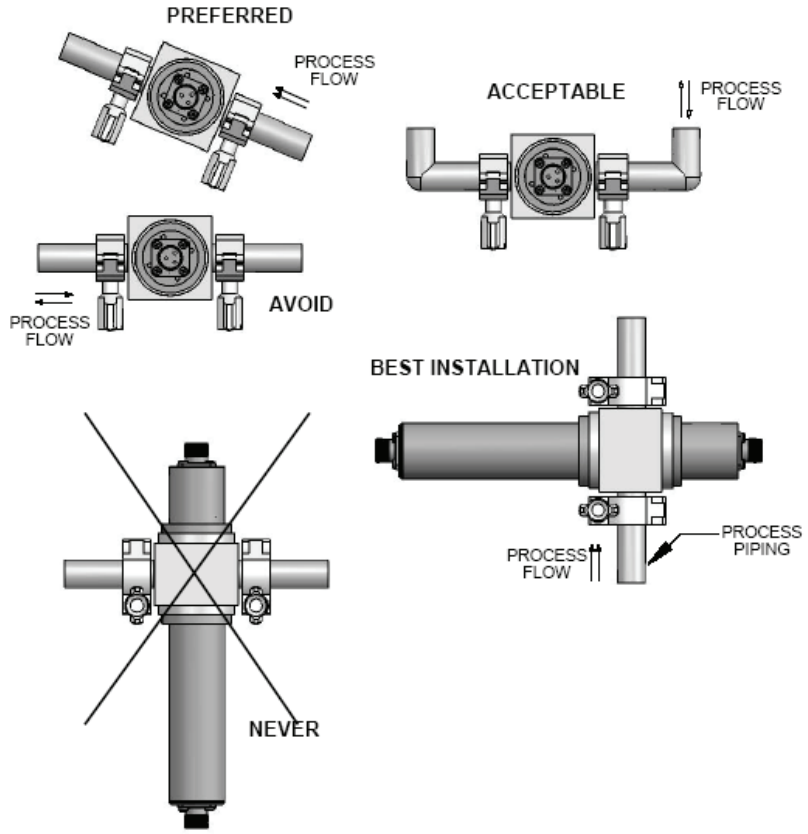


Figure 3.3: Recommended Orientation for Sensor Installation

Sensors can be installed either directly in a process line or in a by-pass line. They can be mounted either vertically or horizontally. If mounted horizontally, the sensor lamp and detector housings must be horizontal. This will insure that the optical window surfaces are in a vertical position, which will help prevent build up on the window surfaces. The sensor should be located upstream of pressure regulators. Operating sensors under pressure will help to avoid the possibility of air or gas bubble evolution, which can cause measurement noise and error.

When installing, allow adequate space for the connection of cables at the ends of the lamp and detector housings. Access to these areas is also important for connection/disconnection purposes. Sensor bodies should be supported when in line and care should be taken to ensure they are protected against damage caused by external forces such as carts on adjacent walkways.

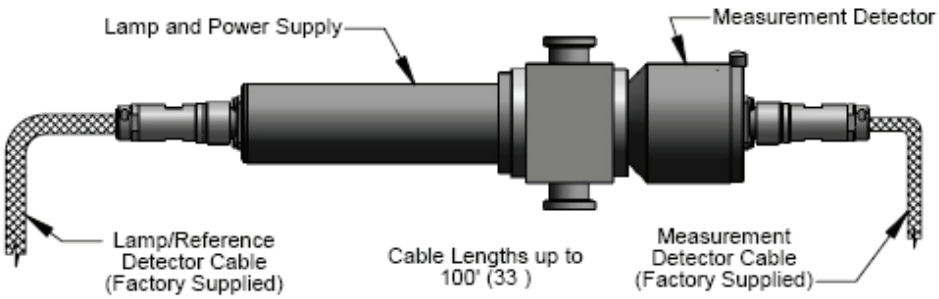


Figure 3.4: Typical OUSAF22 Sensor With Cables Connected.

3.5 Cable OUK20 Structure and Termination of Measurement Cable

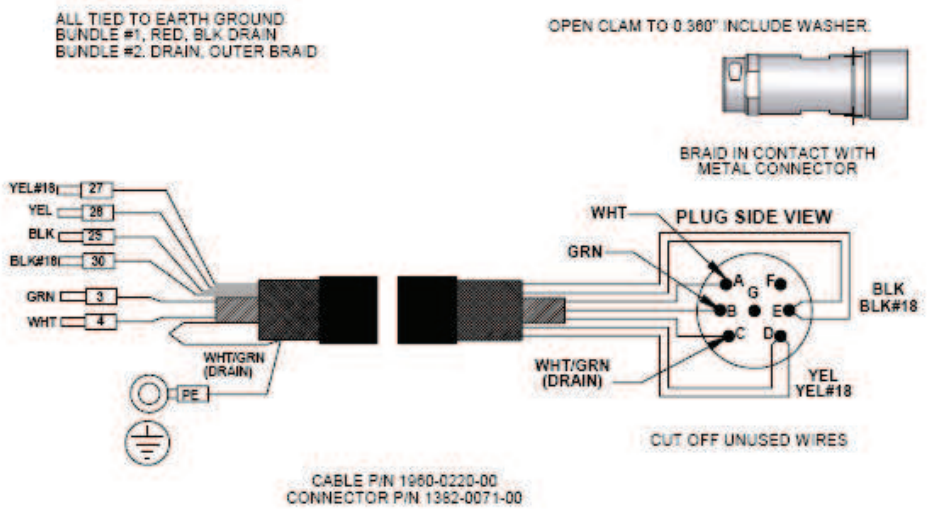


Figure 3.5: OUSAF22 Cable at Lamp Side

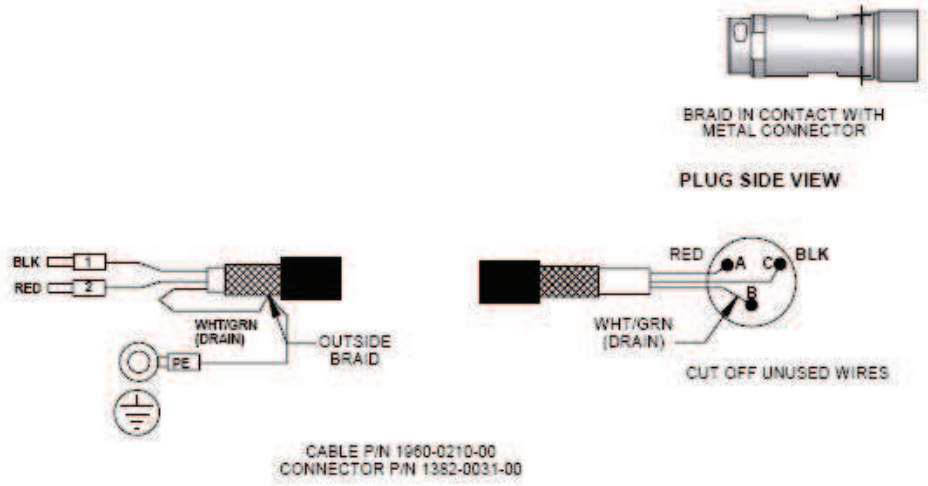


Figure 3.6: OUSAF22 Cable at Detector Side

3.6 Post-Connection Check

After wiring up the electrical connection, carry out the following checks:

Device Status and Specifications	Remark
Is the analyzer or the cable externally damaged?	Visual inspection

Electrical connection Remarks	Remark
Are the installed cables strain-relieved?	
No loops or cross-overs in the cable run?	
Are the signal cables correctly connected according to the wiring diagram?	
Are all screws terminals tightened?	
Are all cable entries installed, tightened and sealed?	
Are the PE distributor rails grounded (if present)? Grounding at place of installation	Grounding at place of installation

Caution!
Improperly grounding will lead to unreliable measurement result!

4. Operation

4.1 Quick Operation Guide

User has the following ways of operating the analyzer:

- On site via the keypad
- Via the digital input interface to perform process control functions remotely.

4.2 Display and Operating Elements

4.2.1 Operating Elements

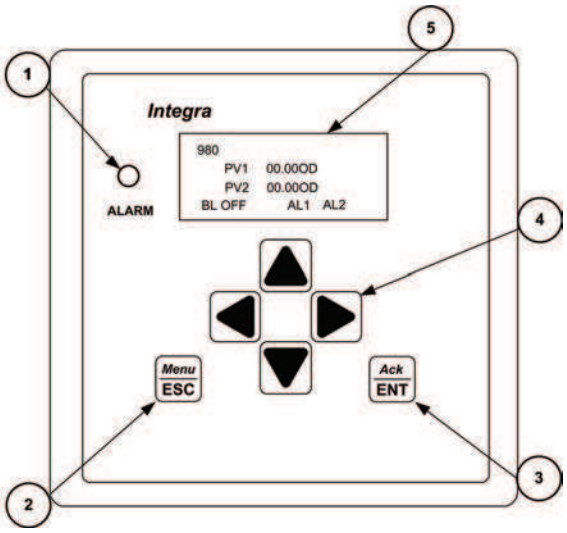


Figure 4.1: Operating Controls

1. LED for lamp warning functions and limit relay status.
2. Menu/ESC key serves two functions. Pressing Menu/ESC will always exit out of a screen and will not save any changes Entered. Pressing Menu/ESC from the main PV[ii] or Output screen will open the Sub-Menu screen.
3. Ack/ENT key accepts changes in a screen and continue forward through the screen
4. 4 keys navigate the user through the menus and screens.
5. LC display for displaying the measured values and configuration data LED.

[ii] PV is the Process Value for PV1 and PV2 and corresponds to Output 1 and Output 2 respectively.

4.2.2 Operation Legend

In this manual, the following operation legend will be used when describing operation procedure.

Enter/Acknowledge key

Escape/Menu key

Left or Right key

Up or Down key

Fig. 4.2: Operation Legend for Operation Instruction

4.3 Local Operation

4.3.1 Measuring Mode

The analyzer normally operates in measuring mode. Here, the relays and alarm LED are triggered by the analyzer according to process status. The analyzer will take configurable digital input to trigger certain function like BaseLine Zero[iii], Optical Zero[iv] etc...

During the measuring mode, the LCD screen will display as figure 4.3. The process value, unit and analyzer label will be displayed permanently. BaseLine, Alarm and Lamp Status will be display when conditions are met.

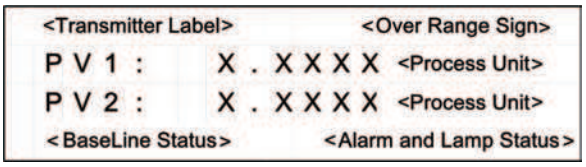


Figure 4.3: LCD display on measuring mode

[iii] BaseLine Zero when enabled offsets the PV to zero. This often used to subtract background absorbance prior to initiating a process.

[iv] Optical Zero is established during calibration and the set with a non-absorbing liquid in the flow cell. i.e. de-ionized water.

Table 4.1 shows the status display description and display condition.

Status Area Name	Displayed symbol	Description and Display criteria
Analyzer Label	"xxxxxxxxxxxx"	Editable up to 12 characters for user analyzer identification.
Process Unit	"OD"	Display "OD" under normal condition,
	"xxxxxx"	Displays user configured engineering unit if PV correlation function is activated.
Over Range Symbol	"OVER"	Displays if measurable range is reached.
BaseLine Status	"BL OFF"	Displays if BaseLine is not activated.
	"BL ON"	Displays if BaseLine function is activated.
	"BL SFT"	Displays if BaseLine and BaseLine Shift function are both activated.
Alarm	"AL x"	Displays if corresponding relays (1, 2, or both) are triggered.
Lamp Status	"LAMP LOW"	Flash if reference voltage is lower than 80% of initial value.
	"LAMP FAIL"	Displays if lamp reference signal is lost.
	"LAMP OFF"	Displays if lamp is turned off.
Cable Status	"CABLE FAULT"	Displays if lamp or signal cable has a faulty connection.

Table 4.1: Operation screen under measuring mode

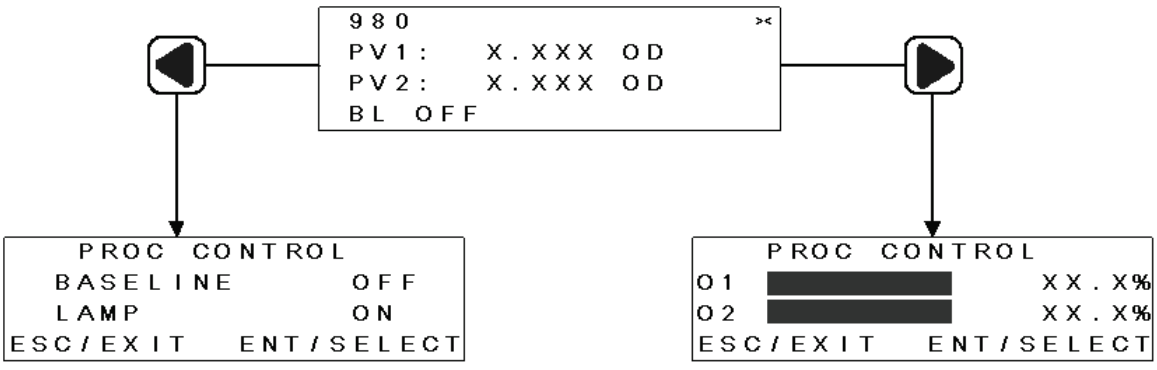


Figure 4.4: Operations under Measuring Mode

Under measuring mode, press  button will let you enter the process control screen, where user can operate process control routine. The detail of process control function will be listed in Chapter 6.

4.3.2 Configuration Mode

The configuration and calibration functions are arranged as function groups.

- Use Menu ESC key to enter the function group menu from measurement screen.
- Use ▼ ▲ arrow key to select the group from process set-up, maintenance, or system data.
- Use Ack ENT to confirm the change and input the value.
- If a modified setting is confirmed with Menu ESC , the old setting is retained.

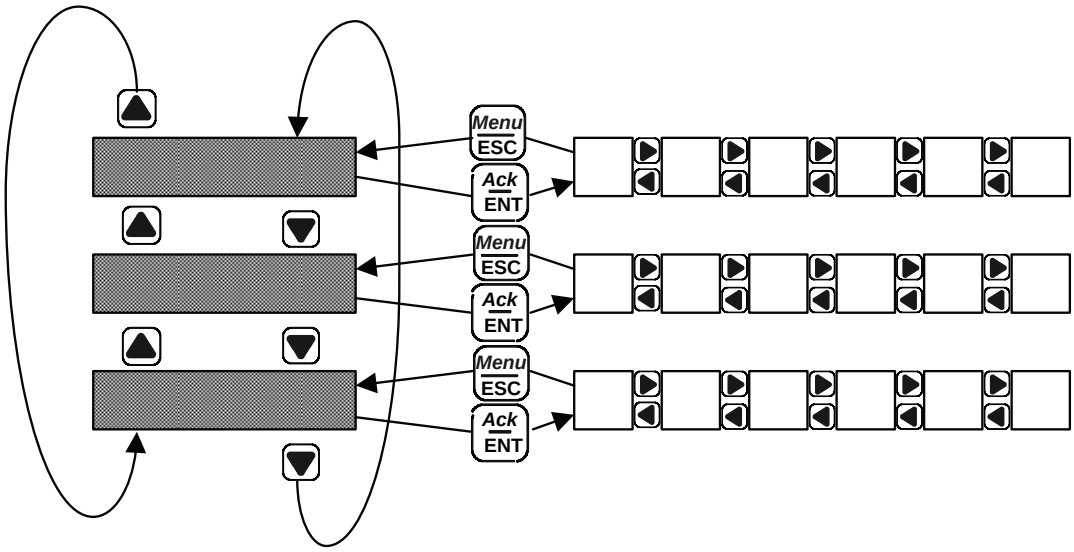


Fig. 4.5: Diagram of configuration structure

Input data

During the system configuration and set up procedure, user will need to input the data into the screen.
In the data input screen

- Use ◀ ▶ to move the cursor to select the digit to edit.
- To change the decimal point of the input data, place the cursor on decimal point, use ▼ ▲ to move the decimal point to the left or right.

Figure 4.6: Decimal Point Position Placement

4.4 Remote Operation

Remote operation function will provide user the ability to use off site dry contact to perform the process control. Short input channel pin to COMMON pin will trigger the input the channel.

Refer section 5.3.8 to configure and use digital input function for remote control.

Digital Input #	Description and Display criteria
1	Lamp On/Off
2	Enable BaseLine function
3	Update BaseLine value
4	Optical Zero
	Hold current process measurement (both display and analog output)

Table 4.2: Digital Input Functions

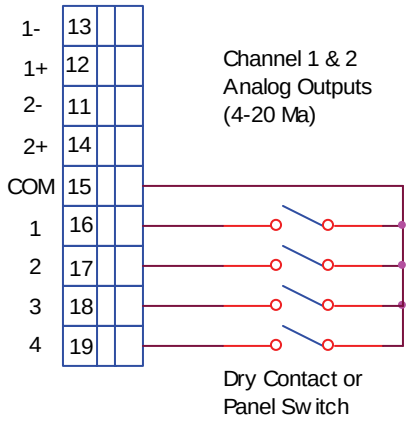


Figure 4.7: Typical Digital Input Wiring Diagram

5. Commissioning

5.1 Function Check

Warning!

- Check all connections for correctness.
- Make sure that the supply voltage is identical to the voltage written on the technical information!

5.2 Switching On

Familiarize yourself with the operation of the analyzer before it is first switched on. Please refer in particular to the "Safety Instructions" and "Operation" sections. After power-up, the device performs a diagnosis for 30 seconds and then goes to the measuring mode.

Lamp Initial Set-Up

If the analyzer is switched on for the first time with a new lamp, a “LAMP LOW” symbol will be shown on the display screen. And the front LED will be flashing and lamp alarm relay will be toggled. To remove this warning message, the lamp status has to be initialized from the software. The lamp low warning shows as follow

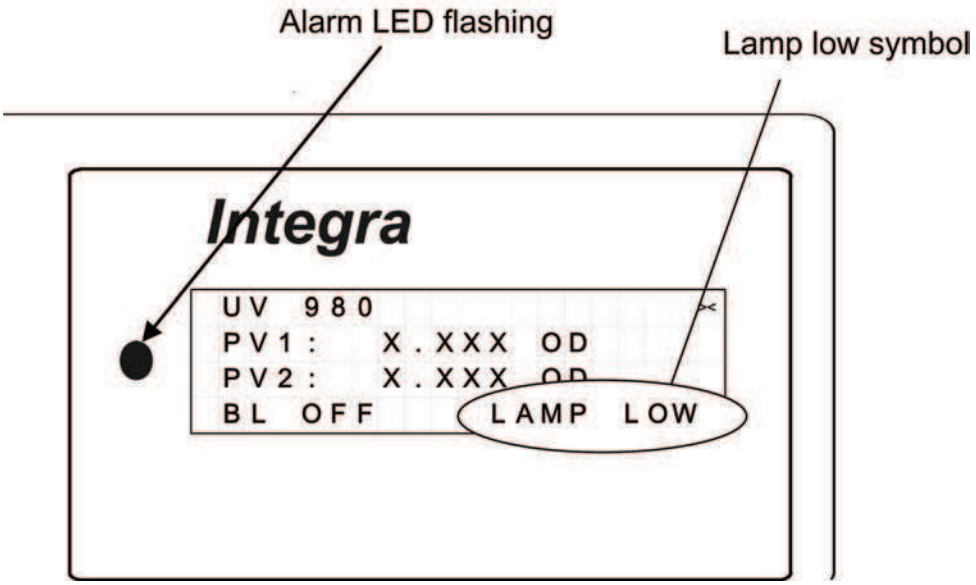
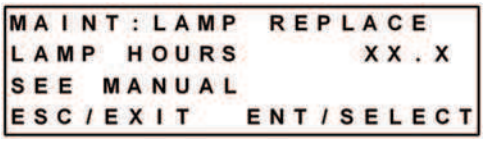
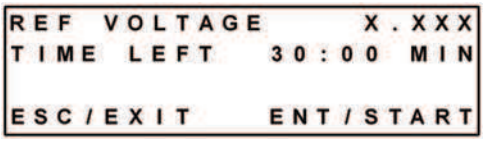
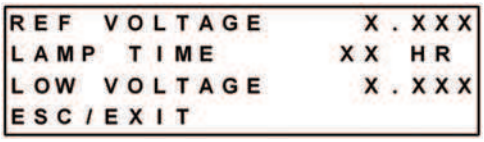


Figure 5.1: Lamp status during start-up

Reset New UV Lamp	
	Press Menu ESC, enter function group selection menu. Move the cursor to MAINTENANCE and press Ack ENT to enter.
	Press  to navigate to LAMP REPLACE, and press Ack ENT.
	The current lamp voltage will be displayed on the right upper corner. The timer will start counting down once the Ack ENT is pressed to warm up the lamp.
	Wait 30 minutes until the timer goes to 0:00
	The current lamp voltage will be displayed in the first line and lamp low threshold voltage will be calculated and display on the third line.
	Press Ack ENT to accept the setting and use Menu ESC to go back to measurement screen. The LED and lamp alarm relay will be reset.

5.3 Analyzer Configuration and Operation

After power-up and lamp setting, you must make some settings to configure the most important functions of the analyzer which are required for correct measurement.

The analyzer/sensor will be Plug& Play if been ordered together as complete solution!

If OUM980 Photometric Analyzer was ordered with OUSAF22 sensor and OUK20 cable, the factory will perform:

- New lamp set up
- Pathlength adjustment in analyzer according to sensor order
- Calibrate analyzer

If application data has been given, factory will perform optical density to engineering unit correlation and deliver correlation data with analyzer. Span and relay setting also can be performed in factory if requested.
If analyzer was ordered separately, the factory default setting will be loaded into the analyzer when analyzer is delivered.

5.3.1 Factory Default Setting

Parameters	Factory Default Value
Measurement Unit	OD
Measurement Pathlength	10mm
Output Span 1	2.0000 OD
Output Span 2	2.0000 OD
Relay 1 Set Point/Status	1.0000 OD/ Disabled
Relay 2 Set Point/Status	1.0000 OD/ Disabled
Process Value Correlation	Off (Curve #0)
BaseLine	Disabled
Password	Disabled

Table 5.1: Factory Default Setting

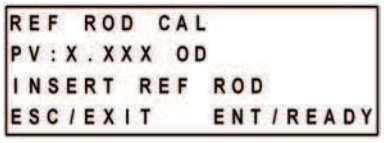
5.3.2 Sensor Calibration

Model OUM980 Analyzer supports 2 different calibration procedures: Liquid calibration and Filter Calibration

5.3.2.1 Liquid Calibration Procedure

A liquid solution of a known optical density (at the wavelength of the sensor) must be used for instrument calibration. The following procedure is used in factory. Calibration liquid can be chosen by user depending on application.

The Liquid Calibration screen appears only if an Easycal™ system is not installed and configured in the System Data section.

Liquid Calibration Procedure	
	Enter MAINTENANCE sub-menu to access SENSOR CAL function. Press Ack ENT to ent.
	Use ▼ ▲ to select LIQUID CAL, Press Ack ENT to enter liquid calibration process.
	Fill the sensor with a zero fluid. Press Ack ENT to record zero point.
	Enter the value of the standard solution being used to calibrate the system. The solution should be approximately ½ of the full range of the system. Press Ack ENT to continue.
	Fill the sensor with the standard calibrating solution. Wait until OD reading increase and stabilize. Press Ack ENT to record the data.
	Remove the calibration solution, and rinse repeatedly with a zero solution. OD reading should decrease and stabilize. Press Ack ENT to proceed.
	Remove the cover screw on the measurement detector and install the reference rod. Press Ack ENT to proceed.
	Remove the reference rod and install the cover screw on the measurement detector. Press Ack ENT to proceed. The unit records the values of the calibration solution and ref rod value and displays these values. The standard solution is used for calibration, while the ref rod is for checking calibration. Press Ack ENT to accept these values.

5.3.2.2 Easycal™ Set up and Calibration

The OUSAF22 dual beam sensors are fitted optical filter that has been selected to replicate the optical characteristic of the customer's process. The selection of this filter was based on submitted samples and was selected to represent the 'nominal' absorbance of that sample.

The **Easycal™** unit contains an optical that was selected based on laboratory measurement of the customer's submitted sample. This filter is placed into the optical measurement path of the instrument and displays an absorbance ratio process related. This filter has been scanned with a traceable source and actual absorbance at individual (measurement) wavelengths is ascertained.

The **Easycal™** allows the calibration without using liquid standards. Refer to the actual value of the **Easycal™** optical filter as noted on the Calibration Certificate supplied with the unit. The absorbance value should be entered into the Model OUM980 as part of the configuration setup.

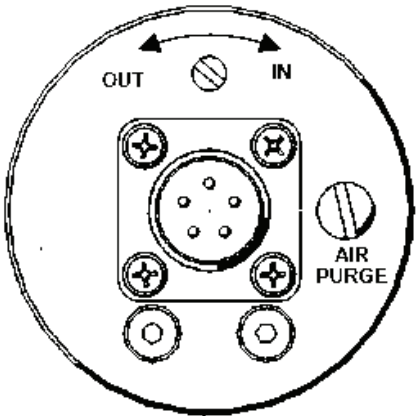
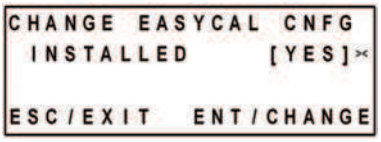
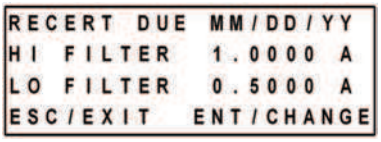
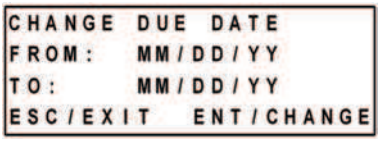
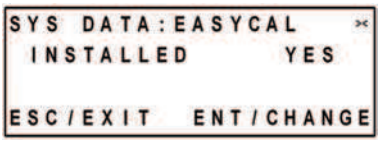


Figure 5.2: EasyCal™ Control for the OUSAF22 Dual Beam Sensor.

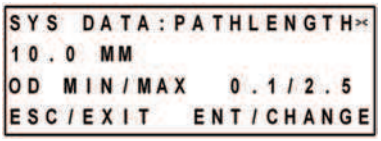
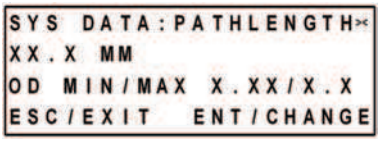
Easycal™ Installation	
	Enter SYSTEM DATA sub-menu to access CHANGE EASYCAL CNFG function. Press Ack/ENT to continue.
	Use ◀▶ to select [YES] or [NO] to decide if the Easycal™ is installed. To install, select [YES] and confirm.
	This screen displays the present NIST Filter Absorbance values and the re-certification date. Press Ack/ENT to change the date and filter values starting with the next screen.
	Move cursor to edit the day, month and year. Save data and move to next step.
	Refer NIST filter high absorption value listed on NIST filter certificate delivered with Easycal™. The value should be close to 1.0000 AU. Press Ack/ENT to continue and use the same procedure to input the low filter absorption value, close to 0.5000 AU.
	After put in both filter data use Ack/ENT to confirm the setting. Easycal™ data installation is finished.

Easycal™ Calibration Procedure	
	Enter MAINTENANCE sub-menu to access SENSOR CAL function. Press Ack/ENT to change. If Easycal has been installed. Analyzer will automatically enter Easycal™ procedure.
	Both high and low NIST filters absorption value will be displayed in this screen. User set certificate due date is displayed also. Press Ack/ENT after review the data.
	Assure both high and low filters are in OUT position. Press Ack/ENT to record zero point.
	Move HI filter adjustment screw to IN position. Press Ack/ENT to record high filter value.
	Move LO filter adjustment screw to IN position. Press Ack/ENT to record HI+LO value.
	Move HI filter adjustment screw to OUT position. Press Ack/ENT to record low filter value and perform calibration calculation.
	The screen then displays the low, high and high+low readings and % deviation from the certified value of each value. Review the deviation level and press Ack/ENT to accept the calibration result.

5.3.3 Change Pathlength Setting

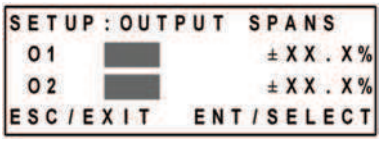
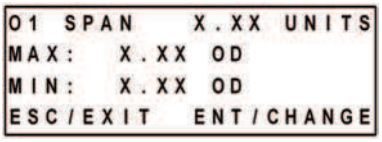
If sensor pathlength need to be changed by user, the corresponding change will need to be performed to OUM980 Analyzer also.

Refer to Chapter 6 Sensor and Analyzer Maintenance to perform sensor pathlength adjustment. This section only covers corresponding analyzer setting to match the measurement result.

Pathlength Setting	
	Enter SYSTEM DATA sub-menu to access PATHLENGTH function. Press Ack ENT to continue.
	The FROM value is the present pathlength Value. Use ◀ ▶ to position the cursor and ▼ ▲ to select wanted digit. Repeat for each digit position. When new pathlength has been selected, press Ack ENT to confirm the change.
	The SYS DATA: PATHLENGTH is displayed together with the new values for pathlength and OD MIN/MAX.

5.3.4 Setup Output Span

The 4~20mA span setting will provide user capability to achieve maximum resolution for preferred measurement range.

Change 4~20mA Output Span	
	Enter PROCESS SET-UP sub-menu to access OUTPUT SPANS function. Use ▼ ▲ to move the cursor to O1 and press Ack ENT to select.
	This screen will display the current output span MIN/MAX span based on pathlength or process value correlation setting. Press Ack ENT to change the span.
	In this screen the current value for span is the FROM value. Position the cursor as done previously and select the number for that position. Repeat as needed for each digit position. When the new span has been entered, press Ack ENT and confirm the sanity check to accept.

Use same procedure above to change Channel 2 output span.

5.3.5 Output Relay Set Point and Configuration

Change Output Relay Set Point

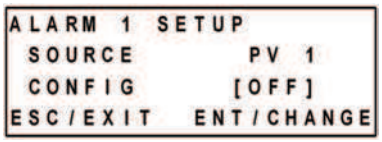
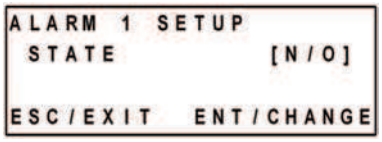
Change Relay Set Point	
	Enter PROCESS SET-UP sub-menu to access OUTPUT SPANS function. Use ▼▲ to move the cursor to ALx and press Ack/ENT to select.
	In this screen the current value for span is the FROM value. Position the cursor as done previously and select the number for that position. Repeat as needed for each digit position. When the new relay set point has been entered， press Ack/ENT and confirm the sanity check to accept.

Configure Output Relays

The Alarm Setup screen allows configuration of PV, Hi/Lo/Off, and NO/NC operation. ▼▲ is used to select the parameter and ◀▶ is used to change the state. Press Ack/ENT to continue.

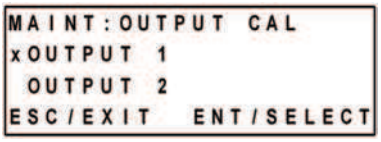
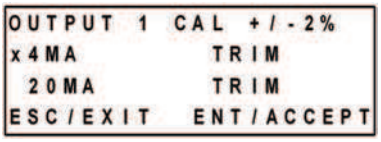
Functions		Description
Trigger Condition	HIGH	Triggered if process value higher than set point.
	LOW	Triggered if process value higher than set point.
	OFF	Relay disabled
Input Mapping	PV1	Process value #1
	PV2	Process value #2
Relay Operation Mode	NO	Normally open
	NC	Normally close
Hysteresis		Set relay hysteresis
Delay		Delay trigger timer (Sec)

Table 5.2: Output Relay Configuration

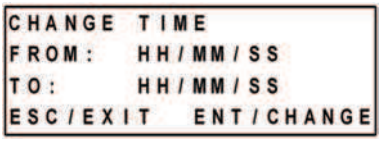
Configure Output Relay	
	Enter from MAITENANCE sub-menu. Scroll to the ALARM CONFIG screen. Use ▼▲ to select the ALx line. Press Ack/ENT to select and confirm.
	The 'ALARM 1 SETUP' screen will appear. Select the SOURCE option, PV1 or PV2.
	Next with ▼▲ select the CONFIG option. Use ◀▶ to select OFF, HIGH and LOW.
	Press ▼▲ to scroll down to ALARM 1 SETUP STATE screen. ◀▶ selects either normally open (N/O) or normally closed (N/C) alarm state of the relay contacts. Select the N/O option and press Ack/ENT to accept and confirm.
	The CHANGE ALARM 1 DELAY is next displayed. Set the needed delay. Delay time unit is second. Press Ack/ENT to accept and confirm.
	The CHANGE ALARM 1 HYSTS option controls the alarm hysteresis. If the alarm set point is set 1.00 OD and the hysteresis is 0.100 OD, an alarm condition exists at 1.00 OD and will stay in alarm until the PV is 0.90 OD or less. Hysteresis can be called the deadband between an alarm on and off condition. Set the hysteresis to 0.100 OD and press Ack/ENT to accept and confirm.

5.3.6 Current Output Calibration

This function calibrates 4~20mA current output to assure the measurement accuracy.

Calibrate 4~20mA Output	
	Enter MAINTENANCE Sub-Menu to access OUTPUT CAL function. Move cursor to OUTPUT 1 and press Ack/ENT to select this channel.
	Move the cursor up and down to select the value need to be trimmed. Use ◀▶ to trim 4mA or 20mA. The trimming resolution is 1% per step. Press Ack/ENT to accept and confirm the trimming.
	Follow same procedure to trim OUTPUT 2.

5.3.7 Date and Time Setting

Set Clock	
	Enter MAINTENANCE sub-menu to access SET CLOCK function. Use ▼▲ to select the CUR DATE line.
	Press Ack/ENT to select the DATE option and then the CHANGE DATE Screen is displayed with the current date. Use ◀▶ to position the cursor and ▼▲ to change the mm/dd/yy numbers. When the wanted date is entered, press Ack/ENT to accept and confirm.
	Press Ack/ENT to select the TIME option and then the CHANGE TIME Screen is displayed with the current time. Use ◀▶ to position the cursor and ▼▲ to change the hh/mm/ss numbers. When the wanted time is entered, press Ack/ENT to accept and confirm.

5.3.8 Configuration and Use Digital Input

Configure Digital Input	
	Enter MAINTENANCE sub-menu to access DIGITAL IN function. Press Ack ENT to continue.
	The following screen displays the current configuration of the external digital inputs. Use the to scroll through the **DISABLE** and **STANDARD CONFIG** When disabled the external digital inputs are inoperative.
	When in **STANDARD CONFIG**, the digital inputs are configured as; 1 Lamp On-Off 2 Baseline On-Off 3 Baseline Update 4 Hold/Optical Zero Digital Input #4 can be set as Optical Zero function if wanted. Press Ack ENT to accept and confirm.

5.3.9 Process Control

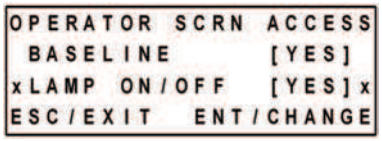
From main measurement screen, press to enter process control screen.

Functions	Status	Description	Remote Trigger
BaseLine	ON	Enable baseline	Digital Input 2
	UPDATE	Update baseline value	Digital Input 3
	OFF	Disable baseline	Digital Input 2
Lamp Switch	ON	Turn on lamp	Digital Input 1
	OFF	Turn off lam	Digital Input 1
Optical Zero	-	Make current measurement at 0.	Digital Input 4
Optical Check	-	Start sensor check	-

Table 5.3: Process Control Functions

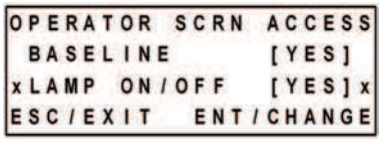
5.3.9.1 Access of Process Control

The authority of access of process control function can be configured in OUM980 Analyzer. The access control is password protected. See 5.3.9.6 for password protection.

Configure Process Control Access	
	Enter SYSTEM DATA sub-menu to access ACCESS function. Press Ack ENT to continue.
	Select the option to configure. Note: The Response is in brackets [ ]. With bracketed responses use for changes. Select 'YES' for each option. There are 4 options to configure. When all changes are made, press Ack ENT to accept and confirm the entries and return to top screen.

5.3.9.2 Baseline (AutoZero)

To operate the baseline function, the Process Control Screen must be assigned as an authority for the user. If assigned the authority, use to open the Process Control Screen. Use to select baseline and select as follows: To initiate a new baseline use "On", to remove an existing baseline use "Off". To change an existing baseline setting to a new setting use "Update". If the baseline was previously "On" when a power interruption occurred, the analyzer will retain its last saved baseline setting and return to that setting when power is restored, and the analyzer and the baseline control will remain "On". Baseline function replaced the AutoZero function in the 800 series analyzer.
If a Baseline Shift value has been entered, activating the baseline shift will cause the 4~20mA output channel 2 to "Shift" to the entered % value. Both PV display would indicate "0". The PV screen will also indicate BL SFT in lieu of BL ON when a shift value has been entered (>0%).

Configure Process Control Access	
	Enter SYSTEM DATA sub-menu to access ACCESS function. Press Ack ENT to continue.
	Select the option to configure. Note: The Response is in brackets [ ]. With bracketed responses use for changes. Select 'YES' for each option. There are 4 options to configure. When all changes are made, press Ack ENT to accept and confirm the entries and return to top screen.

5.3.9.3 Optical Zero

Optical Zero is a function to provide an over all zero to offset the initial background optical noise in OUSAF22 sensor. User can also use optical zero to setup the process zero (e.g. DI water optical density etc...).

5.3.9.4 Lamp Switch

Use this function to switch lamp on and off.

Note!
Lamp alarm relay status will be affected.

5.3.9.5 Optical Check

When the **Easycal**™ is used in conjunction with an initial liquid standard calibration procedure, the **Easycal**™ can be deemed a secondary standard for routine system checking. Calibration can be traced to the controlled standard used to verify the original calibration solutions or process samples and can therefore satisfy validation procedures. During initial calibration of a sensor/analyzer pair, liquid standards should be used to calibrate the full-scale response of the system. After calibration, by filling the sensor with water and ensuring the analyzer reads zero, a value for the **Easycal**™ can be obtained by setting the **Easycal**™ in the 'ON' position (see Figure 5.2) and note the analyzer display reading. At any time in the future, setting the **Easycal**™ 'ON' position the instrument will display the the same value when the sample cell is filled with clear water.

Note!
All analyzers must be re-calibrated with liquid standards if there are any changes made to the optical chain, including replacement of seals or lamp.

All Model OUM980 Photometric Analyzers with standard OUSAF22 Sensors (without **Easycal**™ option) are calibrated at the factory using liquid standards. Please refer to the Test Sheet accompanying your instrument for the factory determined reference rod value.

5.3.9.6 Password Protection

OUM980 support the password function to protect the analyzer from unauthorized operation.

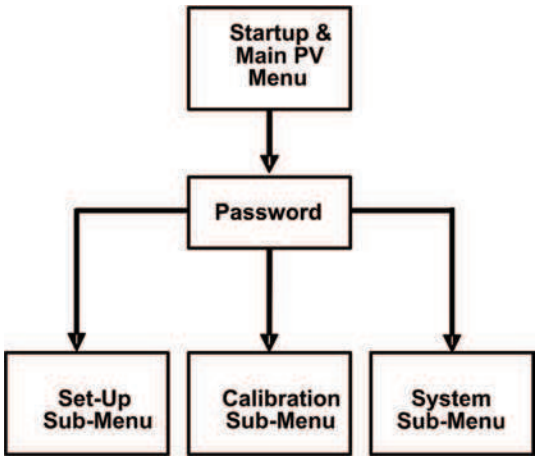


Figure 5.3: Password protection level

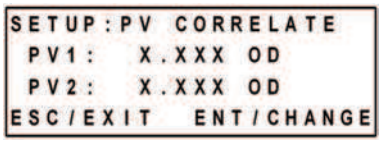
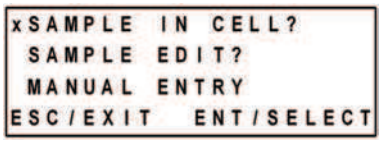
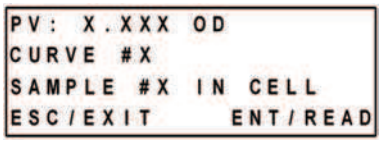
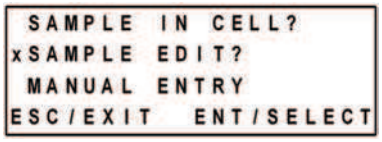
Password Protection	
	Enter SYSTEM DATA sub-menu to access PASSWORD function. Press Ack ENT to continue.
	When in the ENTER OLD PASSWORD screen, the CURSOR highlights the left digit position. Use the ◀▶ to wanted digit position. Use ▼▲ to scroll thru 0-9 for each digit position. Move the cursor to the desired digit and enter a number. When the old password number has been entered, press Ack ENT to accept. Note: When "0000" is set a password, the password protection mode is disabled.
	When in the Ack ENT ER NEW PASSWORD screen, the CURSOR highlights the left digit position. Use the ◀▶ to wanted digit position. The ▼▲ scrolls thru 0-9 for each digit position. Move the cursor to the desired digit and enter a number. Repeat as wanted for each cursor position. Any password number up to 4 digits can be entered. When the password number has been selected, press Ack ENT twice to accept. The Password for MENU access is now the number entered.

5.3.9.7 Process Value Correlation

In OUM980 Analyzer, user can define and store 3 linearization tables to correlate the optical density measurement to specified process parameter measurement. Each table supports up to 16 points of measurement value. User can switch correlation curves to fit different application.

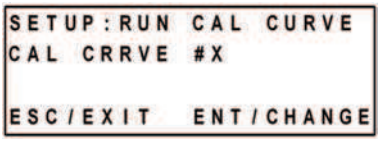
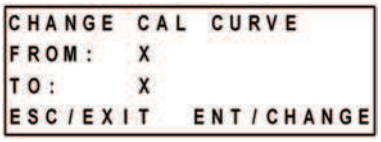
Caution!
The overall course of the curve must be continuously rising. Horizontal or vertical segments or a zigzagging of the curve are not permitted.

Data points may be entered into the linearization table randomly; the software performs sorting automatically as needed. It is possible to increase accuracy in a certain segment of a linearization table later. To do so it is not necessary to enter all data points again, but to enter only additional data points.

Process Value Correlation Set Up	
	Enter PROCESS SET-UP sub-menu to access PV CORRELATE function. Press Ack/ENT to continue.
	The next screen asks which curve (1-3) you want to edit and store the correlation table. Scroll with ◀▶ to select curve number. Press Ack/ENT to continue.
	If the original sample value is not put in yet. Select SAMPLE IN CELL? By scrolling with ▼▲ to select. Press Ack/ENT to continue.
	The next screen asks if process sample is in the cell and displays measurement value. If this value is within the Min/Max acceptable press Ack/ENT to read and store.
	The next screen asks if another sample is to be measured. Press Ack/ENT to read another sample, press Menu/ESC if finished all samples.
	Confirm the number of point to build correlation curve and press Ack/ENT to store original sample data.
	SAMPLE EDIT is used to put in the target correlation value and unit. Press Ack/ENT to continue to put in data.
	The next screen asks if the user would like to change the original sample point OD value. If this value needs to be changed, use ▼▲ and ◀▶ to change value. Press Ack/ENT to continue.

	The next screen is for entry of target correlation values that can be assigned to the original correlated measured value. i.e. 1.32 measured units to 9999.9 units. The FROM value is the last entered value on the 'ENTER USER VALUE' screen. Enter the new value using  and  to position the cursor and select the number for each required position. If a different position is required for the decimal point, do this first. Press  twice to change and accept.
	Repeat above procedure until all correlation points have been entered.
	When all the sample points have been edited, the Change Units screen is next. The engineering unit can be entered is limited to 6 alpha-numeric characters.(i.e. gr/l, %, mg/l, cel/cc, etc.). Press  twice to change and accept entry.
	The Max/Min values are calculated for entered values and units. These values are the new limits for output span and relay setting and the displayed Process Display PV value and units.

Note!
If the OD to correlation unit table is predefined and does not need liquid sampling, use MANUAL EDIT option to entry the table to analyzer. The procedure is similar to SAMPLE EDIT.

Switch Correlation Curves	
	Enter PROCESS SET-UP sub-menu to access RUN CAL CURVE function. Press  to continue.
	The next screen asks which curve (0-3) you want to execute. Curve #0 is the default OD measurement. Curves 1-3 are user defined. Scroll with  to select curve number. Press  to select and confirm. NOTE: Entering a curve with Process Correlate will automatically set it as the current active curve.

6. Maintenance

6.1 Maintenance Outline

Once the unit is in operation, there is no requirement to access the interior of the Model OUM980 Photometric Analyzer housing for normal day-to-day operation and calibration.

Certain malignance need to be performed for OUSAF22 sensor. The service and maintenance interval time is application dependant.

Note!
Check list of maintenance!

- Lamp Replacement
- O-Ring Replacement
- Filter Replacement
- Pathlength Adjustment
- Sensor window and gasket replacement

Caution!
The procedures described in this section should only be carried out by qualified maintenance staff.

Model OUSAF22 sensors contain sensitive optical components and should be handled carefully. Particular care must be taken to prevent contamination of these components.

Warning!
Please refer to EXP-1 lamp instructions to replace lamp for hazardous area versions.

Caution!
Clean all optical components with a suitable lint free lens cleaning tissue and ethanol.

Both the High Luminescence and Gas-Filled Lamps are replaced identically.

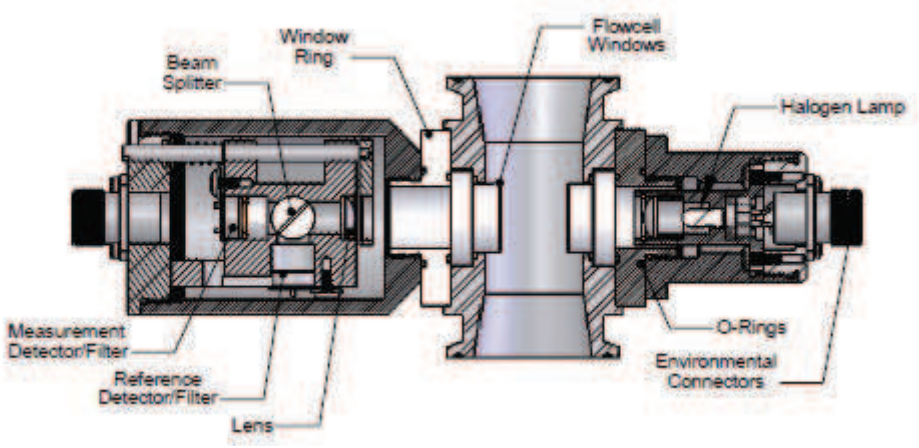


Figure 6.1: Cross-Sectional View of a Typical OUSAF22 Sensor

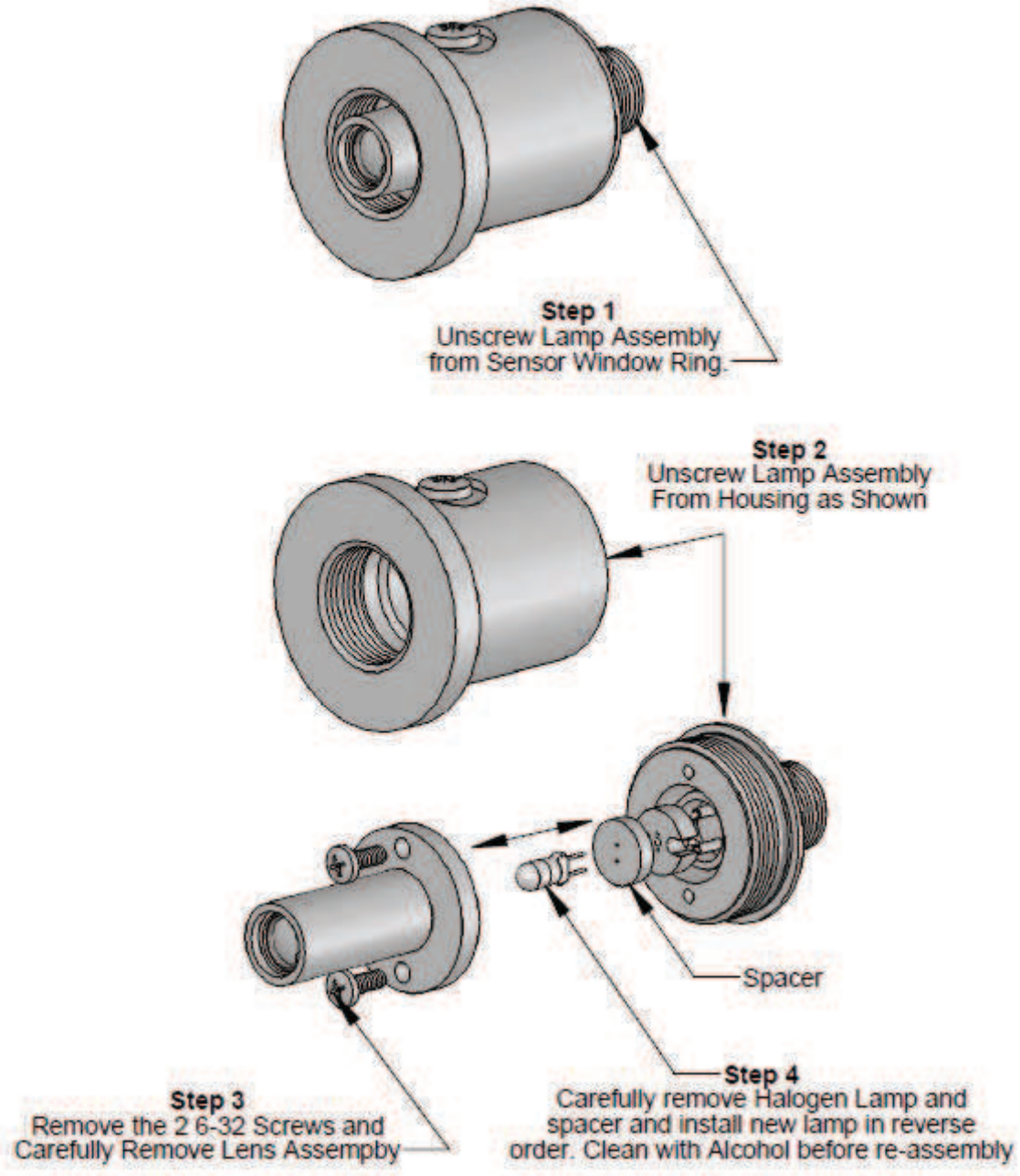


Figure 6.2: Illustrative Standard Lamp Replacement Procedure

6.2 OUSAF22 Measurement Detector/Filter Replacement

We recommend returning the complete system (sensor, cable and transmitter) for recalibration yearly. Please contact your local sales and service support. Refer to the website on the back page of this manual on where to find your local sales and service support office.

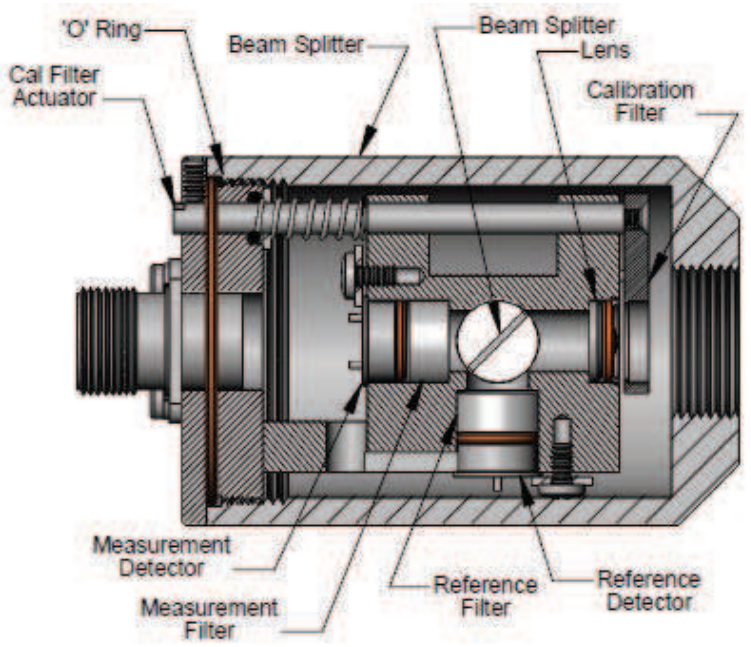


Figure 6.6 – OUSAF22 Detector Assembly

1. **The detector assembly is attached to the sensor with a threaded window ring. The detector assembly is removed by unscrewing it off the window ring. Removal of the detector assembly does not break the liquid integrity of the sample cell.**
2. After removal of the detector assembly, unscrew the detector endplate from the detector housing.
3. To replace either filter, remove the retaining screw on the detector, and carefully remove the detector. Remove the o-rings in the cavity and gently tap the filter out of the detector block (note: the “mirror” side is directed towards the light source).
4. Replace filter/detector in reverse order.
5. After detector/filter replacement, the detector assembly may require alignment and the system to be re-calibrated.

6.3 Sensor Wavelength Change

Should it be required to change the operating wavelength of the sensor, both the measurement and reference filters must be changed. When changing filter wavelength, follow the same procedures as describe above.

6.4 Sensor Window and Gasket Replacement

Sensor optical pathlength is established by the window type(s) used. Each analyzer-sensor pair is configured for a given pathlength. Windows must be replaced with the same type to maintain pathlength. The illustration below is a typical flowcell assembly. Figure the available window types and possible pathlengths for sensors up to 2" line sizes. Replacement of windows or window seals, changing window spacing or other maintenance requiring the disassembly of the sensor uses the following procedure:

Note:
To replace and/or change the windows and seals, the sensor must be removed from the process line.

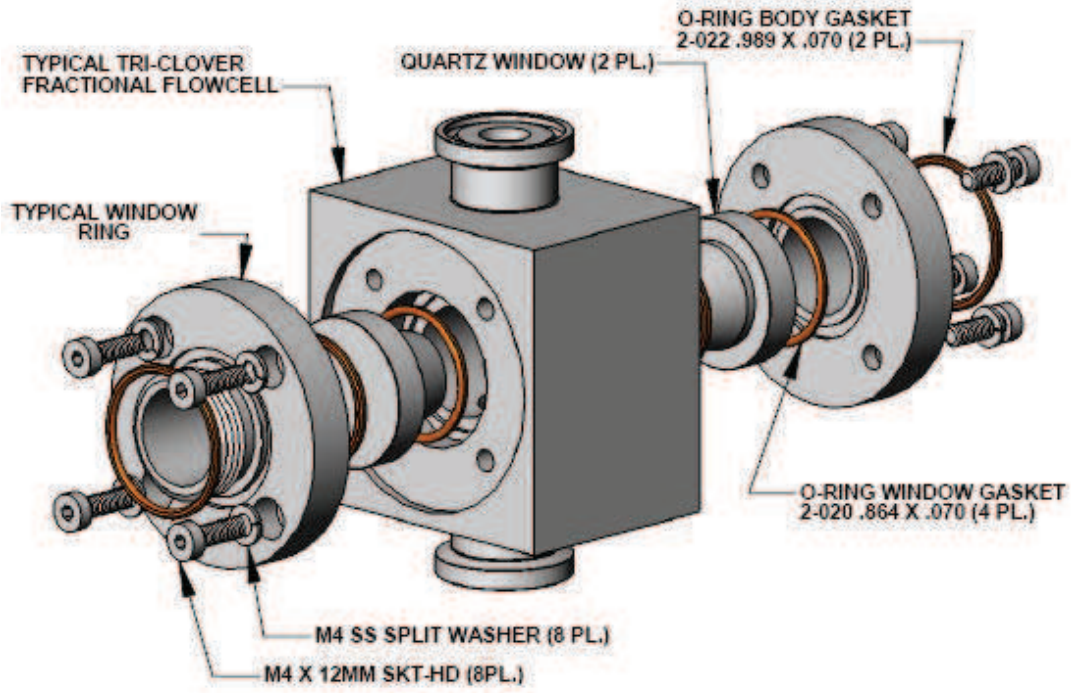


Figure 6.3: Typical Flowcell/Window Replacement

1. Remove the lamp and the detector housings from the sensor body.
2. Remove the 4 socket head screws from each window retaining ring and remove the rings. Be careful to loosen the screws evenly and alternately around the window retaining ring. If the window is ‘stuck’, apply Acetone to the window seal area and let soak for several minutes. This may assist in freeing the windows from the seals.
3. Gently push/ease the windows out of the sensor.
4. Inspect the window area and clean as necessary. Inspect the windows for any signs of abrasive wear or chipping. If any is apparent, replace the windows. Discard the 'O' rings and replace with new ones of the same material type. Re-assemble the sensor in the reverse order, taking care to cross-tighten the window retaining ring screws evenly to prevent uneven seating. If the sensor pathlength has been changed, the analyzer module must be configured to reflect the new pathlength. After every re-assembly of an OUSAF22 sensor, it is necessary to carry out a liquid or Easycal™ calibration with its associated analyzer.

Note!
Upon re-assembly, insure that the lamp assembly is mounted on to the side of the flow cell with the “shorter” length of the two windows.

5. Remove the lamp and the detector housings from the sensor body.
6. Remove the 4 socket head screws from each window retaining ring and remove the rings. Be careful to loosen the screws evenly and alternately around the window retaining ring. If the window is ‘stuck’, apply Acetone to the window seal area and let soak for several minutes. This may assist in freeing the windows from the seals.
7. Gently push/ease the windows out of the sensor.
8. Inspect the window area and clean as necessary. Inspect the windows for any signs of abrasive wear or chipping. If any is apparent, replace the windows. Discard the 'O' rings and replace with new ones of the same material type. Re-assemble the sensor in the reverse order, taking care to cross-tighten the window retaining ring screws evenly to prevent uneven seating. If the sensor pathlength has been changed, the analyzer module must be configured to reflect the new pathlength. After every re-assembly of an OUSAF22 sensor, it is necessary to carry out a liquid or **Easycal™** calibration with its associated analyzer.

Note!
Some window faces may not be parallel to each other. This is normal, especially with fire-polished quartz windows. Take care to ensure pathlength gauge does not scratch window faces.

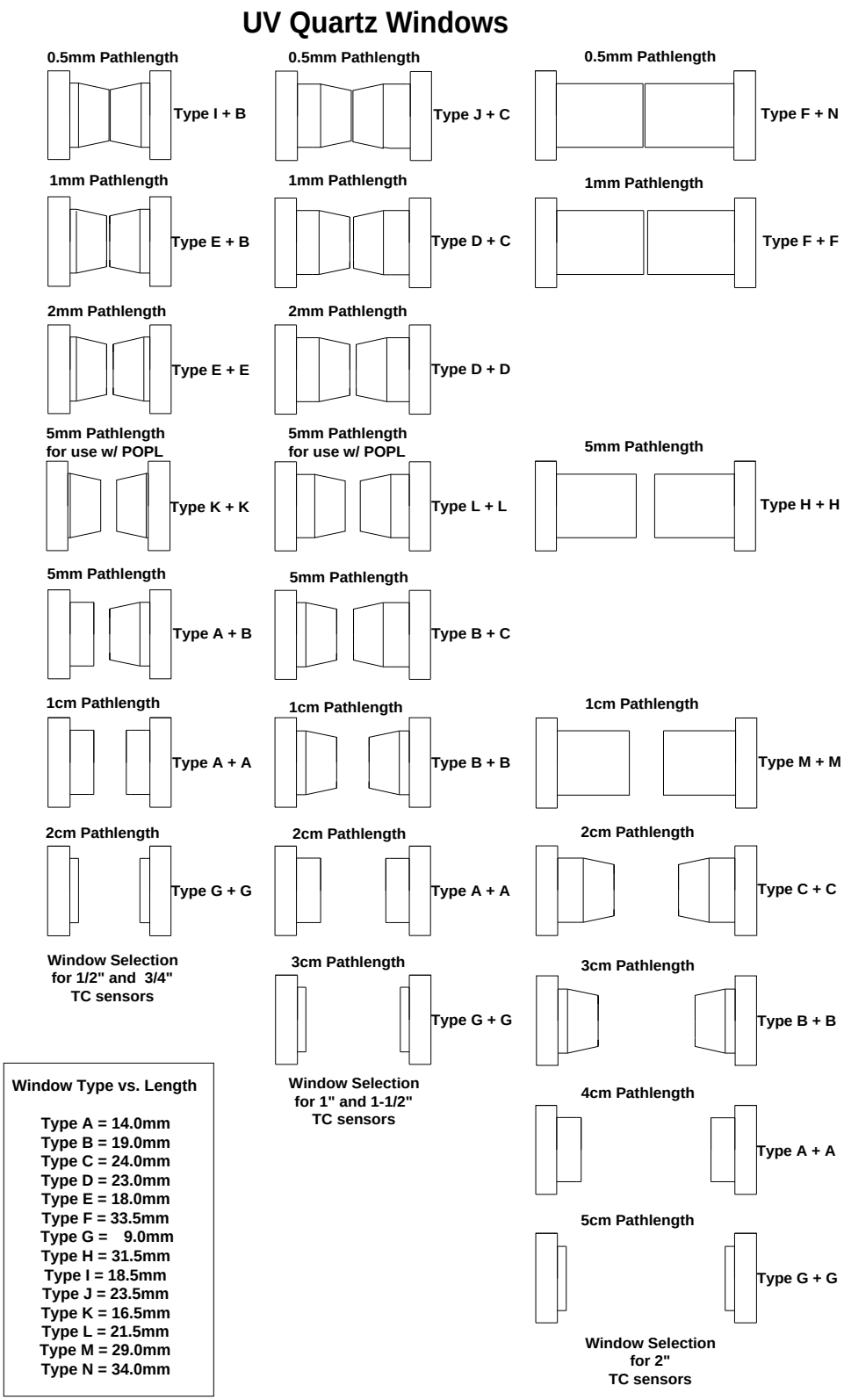


Figure 6.4: Window Type vs. Sensor Pathlength

7. Replacement Parts List

7.1 Model OUM980 Photometric Analyzer

DESCRIPTION	Reference No.	Part Number
Fuse, AC Input 3.15A GDA Ceramic	1678-0017-00	63006917
Fuse, DC Input 1A MST	1678-1000-00	63006930
Fuse, Relays/Alarm 125mA MSF	1678-0125-00	63006925

7.2 Model OUSAF22 Inline Sensor

DESCRIPTION	Reference No.	Part Number
High Luminescence Lamp	A011-0680-22	63009261
Gas-Filled Lamp	A011-2200-00	63009277
Interference Filter - 430nm	1410-0430-00	63006560
Interference Filter - 490nm	1410-0490-00	63006566
Interference Filter - 520nm	1410-0520-00	63006568
Interference Filter - 720nm	1410-0720-00	63006583
Type 'A' Quartz Window	1420-0140-01	63006635
Type 'B' Quartz Window	1420-0190-03	63006649
Type 'C' Quartz Window	1420-0240-03	63006659
Type 'D' Quartz Window	1420-0230-03	63006654
Type 'E' Quartz Window	1420-0180-03	63006644
Type 'F' Quartz Window	1420-0335-01	63006665
Type 'G' Quartz Window	1420-0090-01	63006630
Type 'H' Quartz Window	1420-0315-01	63006663
Type 'I' Quartz Window	1420-0185-03	63006647
Type 'J' Quartz Window	1420-0235-03	63006657
Type 'K' Quartz Window	1420-0165-03	71000344
Type 'L' Quartz Window	1420-0215-03	63006652
Type 'M' Quartz Window	1420-0290-01	63006662
Type 'N' Quartz Window	1420-0340-01	63006667
Window Gasket Kit, Viton	A000-0662-01	63009117
Window Gasket Kit, Kalrez	A000-0662-03	71041399
Window Gasket Kit, EPR(EDPM)	A000-0662-05	63009119
Window Gasket Kit, Silicone	A000-0610-00	63009100

8. Technical Information

8.1 Photometric Analyzer OUM980

8.1.1 Input

Measured Variable	Dual Channel Current from Model OUSAF22 Inline Sensor
Range	5 decades of absorbance signal from each detector
Digital Input	4 Channels, dry contact
Keyboard	6 push buttons keyboard

8.1.2 Output

Current Output	2 channel, 4~20mA NAMUR Compatible	
Resolution	12bit	
Isolation	O1 to PE	500 VDC
	O2 to PE	500 VDC
	O1 to O2	500 VDC
Signal on Lamp Alarm	3.6mA or 21.5mA in case of error	
Actual Current Output Range	3.8mA to 20.5mA	
Load	750 ohm Max.	
Front Panel Display	4x20 Character LC display	
Alarm LED	On front Panel, Red LED	
General Relay Output	2 Channel, Solid State Relays	
Relay Operation	Above/Below trigger configurable; NO/NC configurable	
Relay Delay	0~60 sec configurable	
Lamp Alarm Relay	1 Channel, NC	
Lamp Power Supply	3 to 5 vdc, 1.5A Max.	

8.1.3 Power Supply

Supply Voltage	85~265 VAC, 24VDC as option
Power Consumption	12 VA Max.
Mains Fuse	3.15 A

8.1.4 Performance

Sensor Photo Current Input	100pA to 1mA
Linearity	0.3% Max.
Repeatability	0.3% Max.
Accuracy	0.3% Max.
Initial Drifting	<0.5% for first 24 hours

8.1.5 Environment

Temperature (Monitor)	0~55°C
Temperature (Sensor)	0~70 °C
Relative Humidity	95%
Degree of Protection	IP 65 (front panel), IP 30 (housing)

8.1.6 Mechanical Construction

Dimensions	L x W x D: 102 x 102 x 177 mm
Weight	1.213 kg
Material	Aluminum (polyester coating on front panel)
Degree of Protection	IP 65 (front panel), IP 30 (housing)

8.2 Absorbance Sensor OUSAF22

8.2.1 Input and Output

Measured Input Variable	Process absorption and optical density
Output Signal	Photo detector current (100pA~ 1uA)

8.2.2 Mechanic Construction

Weight	1.225 kg (flow cell not included)
Housing Material	Stainless steel 316L

8.2.3 Environment

Temperature (Environment)	0~70°C
Temperature (Process)	0~90 °C Continuous up to130°C for 2 hours
Relative Humidity	95%
Degree of Protection	IP 65
Maximum Pressure in Flow Cell	33 Bar/500 psi. 100 Bar option available

8.2.4 Power Supply

Supply Voltage	3-5 vdc
Power Consumption	4 VA continuous 8 VA start up in-rush

8.2.5 Optical Specifications

	Line Size	**Pathlengths Available**
Wavelengths Available	VIS/ NIR 400nm-1700nm	
Filters	Interference filters, stray light .01% maximum.	
Detectors	Blue Enhanced Silicon or Germanium detectors, hermetically sealed.	
Lamps	Lens End Gas Filled Incandescent or Halogen Lamps	

9. Ordering Information

9.1 Color Analyzer OUM980

	Power Supply			
	1			100-250 VAC
	4			24 VDC
		Transmitter Unit		
		A		Optical Density
		Y		Special version, TSP no.to be spec
			Calibration	
			1	Single order/spare part
			2	With sensor/cable order position
			9	Special version, TSP no.to be spec
OUM980				Complete Order Code

9.2 Sensor OUSAF22

	Wavelengths Combination					
	A					430nm / 720nm
	B					490nm / 720nm
	C					520nm / 720nm
	Y					Special version, TSP no.to be spec
		Calibration/Validation				
		0				Embedded validation filter
		9				Special version, TSP no.to be spec.
			Lamp			
			C			High Luminescense lamp
			D			Gas filled high output lamp
			Y			Special version, TSP no.to be spec.
				Lamp Approval		
				0		None-hazardous area
				1		FM Class I, Div 1, Gr B,C,D
				2		ATEX II 2G Eexd IIC T5
					Assembly	
					A	Single order/spare part
					B	Assembled to flow cell, Position
					Y	Special version, TSP no.to be spec
OUSAF22						Complete Order Code

9.3 OUK20 Cable Set

	Sensor	
	1	OUSTF10
	2	OUSAF21/OUSAF22
	3	OUSAF23

	Transmitter	
	A	OUS900 Serie
	B	OUS600 Serie
	C	OUS700 Serie

	Cable Length	
	10	10 ft / 3m
	15	15 ft / 4,5 m
	25	25 ft / 7,5 m
	50	50 ft / 15 m
	88	..... ft; cable
	89	..... m; cable

	Barriere	
	A	Standard (non-hazardous area)
	B	FM, Busbar
	C	ATEX, Busbar
	D	FM, DIN Rail
	E	ATEX, DIN Rail

OUK10					Complete Order Code

9.4 Model OUA260 Flow Cell

Sensor Type	
A	for AF4x
B	for AF12/OUSAF22/OUSAF23
C	for AF13
D	for TF10
E	for B60x

Process Connection	
A1	Triclover 316L
A2	Triclover Kynar
B1	Flange ASME RF Class 150, 316SS
B2	Flange ASME RF Class 300, 316SS
D1	Female NPT, 316SS
D2	Female NPT, Kynar
E1	Swagelock BVCO
E2	Swagelock Tube
F1	Tube Stub
Y9	Special version, TSP-no. to be spec

Mean Diameter	
A	0.25"
B	0.375"
C	0.5"
D	0.75"
E	1" Low Volume
F	1" Standard
G	1.5"
I	2"
J	2.5"
K	3"
L	4"
Y	Special version, TSP no.to be spec.

Optical Pathlength	
1	0.5 mm with POPL
3	1 mm with POPL
4	2 mm Standard
5	2 mm with POPL
6	5 mm Standard
7	5 mm with POPL
8	10 mm Standard
9	20 mm Standard
10	30 mm Standard
11	40 mm Standard (for TF instruments)
12	50 mm Standard
13	60 mm Standard
14	70 mm Standard
15	80 mm Standard
16	90 mm Standard
80	Not Needed (B60x)
99	Special version, TSP no.to be spec.

Window Material	
A	Pyrex
B	Quartz
C	Sapphire
X	Without Windows

Sealing Material	
1	EPDM - FDA
2	Kalrez - FDA
3	Silicone - FDA
4	Viton - FDA
9	Special version, TSP no.to be spec.

Air Purge	
A	Not used
B	Standard
Y	Special version, TSP no.to be spec.

Certificate	
1	Basic Package
3	Life Science Package
9	Special version, TSP no.to be spec.

Options	
A	No Options
B	Mounting Holes
Y	Special version, TSP no.to be spec.

OUA260										Complete Order Code

9.5 Model OUA260 Compatibility Chart

Please refer to the following tables to determine compatible options. Check marks indicate compatibility.
Combinations without check marks are not Standard Products.
Please contact factory for Technical Special Products (TSP)
Please also see the next page for additional information

			Line Size										
			A 0.25"	B 0.375"	C 0.5" (LV)	D 0.75"	E 1" LV	F 1" Std	G 1.5" LV	I 2"	J 2.5"	K 3"	L 4"
Process Connection	A1	TriClamp® SS	✓		✓	✓	✓		✓	✓	✓	✓	✓
	A2	TriClamp® Kynar	✓		✓	✓							
	B1	RFF 150						✓		✓		✓	✓
	B2	RFF 300						✓		✓		✓	✓
	D1	FNPT SS			✓	✓		✓		✓			
	D2	FNPT Kynar			✓			✓		✓			
	E1	Swage BVCO	✓	✓	✓								
	E2	Swage Tube	✓	✓	✓	✓	✓						
	F1	Tube Stub		✓									

			Line Size												
			A 0.25"	B 0.375"	C 0.5" (1)	C 0.5" (2)	C 0.5" (3)	D 0.75"	E 1" LV	F 1" Std	G 1.5" LV	I 2"	J 2.5"	K 3"	L 4"
Pathlength	01	0.5 mm/POPL	✓	✓	✓	✓		✓	✓		✓				
	03	1 mm/POPL	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
	04	2 mm	✓	✓	✓	✓		✓	✓		✓				
	05	2 mm/POPL	✓	✓	✓	✓		✓	✓		✓				
	06	5 mm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
	07	5 mm/POPL	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
	08	10 mm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	09	20 mm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	10	30 mm				✓	✓		✓	✓	✓	✓	✓	✓	
	11	40 mm					✓			✓		✓	✓	✓	✓
	12	50 mm					✓			✓		✓	✓	✓	✓
	13	60 mm											✓	✓	✓
	14	70 mm												✓	✓
	15	80 mm													✓
	16	90 mm													✓

(1) TriClamp® and Swagelock Flowcells (A1, A2, E1, E2)

(2) Kynar NPT Flowcells (D2)

(3) SS NPT Flowcells (D1)

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