User's Manual

TDLS200

Tunable Diode Laser Spectroscopy Analyzer

IM 11Y01B01-01E-A

Yokogawa Corporation of America

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IM 11Y01B01-01E-A
5th Edition

Introduction

Thank you for purchase the TDLS200 Tunable Diode Laser Analyzer. Please read the following respective documents before installing and using the TDLS200.

Notes on Handling User's Manuals

- This manual should be passed on to the end user.
- The contents of this manual are subject to change without prior notice.
- The contents of this manual shall not be reproduced or copied, in part or in whole, without permission.
- This manual explains the functions contained in this product, but does not warrant that they are suitable for the particular purpose of the user.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, when you realize mistaken expressions or omissions, please contact the nearest Yokogawa Electric representative or sales office.
- This manual does not cover the special specifications. This manual may be left unchanged on any change of specification, construction or parts when the change does not affect the functions or performance of the product.
- If the product is not used in a manner specified in this manual, the safety of this product may be impaired.

Yokogawa is not responsible for damage to the instrument, poor performance of the instrument or losses |resulting from such, if the problems are caused by:

- Improper operation by the user.
- Use of the instrument in improper applications
- Use of the instrument in an improper environment or improper utility program
- Repair or modification of the related instrument by an engineer not authorized by Yokogawa.

Drawing Conventions

Some drawings may be partially emphasized, simplified, or omitted, for the convenience of description. Some screen images depicted in the user's manual may have different display positions or character types (e.g., the upper / lower case). Also note that some of the images contained in this user's manual are display examples.

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Safety Precautions

Safety, Protection, and Modification of the Product

- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this user's manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If this instrument is used in a manner not specified in this user's manual, the protection provided by this instrument may be impaired.
- If any protection or safety circuit is required for the system controlled by the product or for the product itself, prepare it separately.
- Be sure to use the spare parts approved by Yokogawa Electric Corporation (hereafter simply referred to as YOKOGAWA) when replacing parts or consumables.
- Modification of the product is strictly prohibited.
- The following safety symbols are used on the product as well as in this manual.

DANGER

This symbol indicates that an operator must follow the instructions laid out in this manual in order to avoid the risks, for the human body, of injury, electric shock, or fatalities. The manual describes what special care the operator must take to avoid such risks.

WARNING

This symbol indicates that the operator must refer to the instructions in this manual in order to prevent the instrument (hardware) or software from being damaged, or a system failure from occurring.

CAUTION

This symbol gives information essential for understanding the operations and functions.

Note!

This symbol indicates information that complements the present topic.

This symbol indicates Protective Ground Terminal

This symbol indicates Function Ground Terminal (Do not use this terminal as the protective ground terminal.)

Warning and Disclaimer

The product is provided on an "as is" basis. YOKOGAWA shall have neither liability nor responsibility to any person or entity with respect to any direct or indirect loss or damage arising from using the product or any defect of the product that YOKOGAWA cannot predict in advance.

TDLS200

CAUTION

SAFETY should be considered first and foremost importance when working on the equipment described in this manual. All persons using this manual in conjunction with the equipment must evaluate all aspects of the task for potential risks, hazards and dangerous situations that may exist or potentially exist. Please take appropriate action to prevent ALL POTENTIAL ACCIDENTS.

AVOID SHOCK AND IMPACT TO THE ANALYZER THE LASERS CAN BE PERMANENTLY DAMAGED

Laser Safety & Classification according to FDA Regulations. The TDLS200 is Registered with the United States FDA as a Laser Product.

WARNING

THIS ANALYZER CONTAINS A LASER PRODUCT THAT IS GENERALLY IN ACCORDANCE WITH THE REGULATIONS FOR THE ADMINISTRATION AND ENFORCEMENT OF THE RADIATION CONTROL FOR HEALTH AND SAFETY ACT OF 1968 (TITLE 21, CODE OF FEDERAL REGULATIONS, SUBCHAPTER J). REFER SECTION 1002.10 OF THE REGULATIONS REFERENCED ABOVE.

CAUTION INVISIBLE LASER RADIATION AVOID DIRECT EXPOSURE
MAXIMUM OUTPUT POWER < 1 MW (Oxygen)
MAXIMUM OUTPUT POWER < 20 mW (other Gases) DURING NORMAL OPERATION THIS ANALYZER IS:
CLASS I LASER PRODUCT (according to IEC 60825-1)

CAUTION

The Instrument is packed carefully with shock absorbing materials, nevertheless, the instrument may be damaged or broken if subjected to strong shock, such as if the instrument is dropped. Handle with care.

Warranty and service

Yokogawa products and parts are guaranteed free from defects in workmanship and material under normal use and service for a period of (typically) 12 months from the date of shipment from the manufacturer. Individual sales organizations can deviate from the typical warranty period, and the conditions of sale relating to the original purchase order should be consulted. Damage caused by wear and tear, inadequate maintenance, corrosion, or by the effects of chemical processes are excluded from this warranty coverage.

In the event of warranty claim, the defective goods should be sent (freight paid) to the service department of the relevant sales organization for repair or replacement (at Yokogawa discretion). The following information must be included in the letter accompanying the returned goods:

- Part number, model code and serial
- Number
- Original purchase order and date
- Length of time in service and a description of the process
- Description of the fault, and the circumstances of failure
- Process/environmental conditions that may be related to the failure of the device.
- A statement whether warranty or nonwarranty service is requested
- Complete shipping and billing instructions for return of material, plus the name and phone number of a contact person who can be reached for further information.

Returned goods that have been in contact with process fluids must be decontaminated/ disinfected before shipment. Goods should carry a certificate to this effect, for the health and safety of our employees. Material safety data sheets should also be included for all components of the processes to which the equipment has been exposed.

DANGER

Dont install “general purpose type” instruments in the hazardous area.

CAUTION

The intrument is packed carefully with shock absorbing materials, nevertheless, the instrument may be damaged or broken if subjected to strong shock, such as if the instrument is dropped. Handle with care.

TABLE OF CONTENTS

1 QUICK START

Step	Title	Description
1.0	**Preparation**	Carefully un-pack and check equipment for any obvious damage. This includes flanges, Cables, Power Supplies, manuals and any other supplied options. NOTES: There are 14 ferrules in the accessory bag for tubing-piping. The number of ferrule that are required for actual tubing-piping are different by application. Please see tubing-piping figure specific to project for exact detail.
1.1		Ensure the process connections match the supplied process interface.
1.2		Ensure the appropriate utilities are available and ready for connection. These may include electrical power, nitrogen purge gas, instrument air, validation gas, etc.
1.3		Ensure you comply with any local and/or site specific safety requirements.
1.4		Read the appropriate sections of the Instruction Manual BEFORE starting any installation work – **Contact Yokogawa Laser Analysis Division or Local Agent if any doubts!**
2.0	**Installation**	If separate process isolation flanges have been provided for corrosive service, then install to the process/stack flange/isolation valves.
2.1		Attach the process interface (alignment flanges) to the site installed flanges (or isolation valves as appropriate).
		If installing Large Aperture Optics, ensure the detect system is correctly mounted and purged to prevent damage to the large optical element.
2.2		Carefully mount the Launch and Detect Units to their alignment flanges using the quick connect coupling.
2.3		Mount optional equipment such as Universal Power Supply (UPS), Universal Remote Display (URD), Remote Interface Unit (RIU), etc.
2.4	**Ambient Temperature**	The analyzer and some accessories (such as LAO, RIU, UPS, URD, alignment flanges, etc.) are suitable for -20 to +50oC ambient operating temperature. Accessories and Options are available to increase these the operating conditions – please consult Yokogawa for further details.
3.0	**Wiring**	Ensure that all wiring will enable the analyzer launch and detect units to be freely moved from their process location to an adjacent off-line calibration cell. This will entail the use of tray rated cables and/or flexible conduit and/or other suitable armored cable. Rigid conduit systems are not recommended.
3.1		Connect the appropriate electrical power supply. • 24 VDC to TB1 on the analyzer (launch Unit) backplane. Check that the actual voltage is >23.5VDC otherwise the SBC and other devices will not function! • 110/240 50/60 Hz to UPS or URD, then take 24 VDC to analyzer
3.2		Connect the Launch to Detect interconnect cable (supplied with analyzer) according to the supplied wiring detail (TB7 on the Launch and TB 13 on the Detect Unit).
3.3		Connect any analog I/O signals to the analog I/O Board. Outputs land on TB8 and Inputs land on TB9.
3.4		Connect any other equipment such as URD, Ethernet, solenoid valves, digital I/O, etc.
3.5		**Check terminations and ensure all cable shields are landed per supplied wiring details.**
4.0	**Utilities**	**NOTE! – All purge, Validation Gas and other gas utility lines should be thoroughly cleaned, dried and purged prior to connecting to the analyzer – Failure to do so can result in serious damage to the TDLS200 or contamination to the internal optical elements.** Connect the appropriate analyzer purge gas (nitrogen for oxygen analyzers) and make site connections per the supplied purge gas sequence details (including any Hazardous area purge system). Start the purge gas flow accordingly. ATEX purge requires dual regulators at the inlet purge gas supply to prevent overpressure damage in the event of a single regulator failure!
4.1		Connect the appropriate process window purge gas (nitrogen for oxygen analyzers) and make site connections per the supplied purge gas sequence details. Start the window purge gas flow accordingly – ensuring that any isolation valves are open.
4.2		Connect the appropriate analyzer on-line check gas flow cell gas (nitrogen for oxygen analyzers) and make site connections per the supplied purge gas sequence details. Start the purge gas flow accordingly.
4.3		Connect and check any other required utility connections (such as steam trace for heated isolation flanges or flow cells) or secondary window purges for lethal service gases. Start other utilities accordingly.

4.4		**Leak-check all connections and ensure pressure ratings are not exceeded!**
5.0	**Power-Up**	Apply power to the analyzer and using a multi-meter, check for 24VDC power at TB1 on the launch unit back plane.
5.1		Use the internal On-Off switch to power-up the analyzer.
5.2		Observe the various LED clusters on the backplane and FPGA boards. All blue LEDs located on the lower right side of the back-plane should be on.
5.3		Observe the Green power indicator on the SBC.
5.4		**Observe the LEDs on the analog I/O board.**
6.0	**Checking**	If there is an installed optional 6.5" Display and Keypad – Observe the Main Menu messages and status information.
6.1		If there is an installed optional Mini Display (4x20 VFD) – Observe the status line message.
6.2		If there is no installed User Interface, then connect a laptop PC via Ethernet to the SBC mounted on the backplane. Initiate the supplied VNC software from the laptop to initiate a VNC session with the 'blind' analyzer and observe the analyzer Main Menu via the laptop.
		At this time there may be one or more alarm message due to low transmission, out of range parameters or other – final system configuration is still required! **Please also note that the analyzer laser temperature control is disabled for the initializing period (5 minutes) – this means that even manual control of the laser temperature is disabled during this period.**
6.3	**Alignment**	Initially, observe the Transmission value through the appropriate user interface. The objective is to adjust alignment until the maximum transmission value is obtained. Perfect alignment in a clear process gas will yield close to 100% transmission.
		If the analyzer displays a Warning "Validation Required", this indicates there is no target gas absorption peak found at start-up. Introduce some measured gas into the optical path and re-start or perform a validation with target gas. This will ensure that the analyzer is correctly tuned to the measurement gas absorption peak. If this Warning cannot be cleared by either method, please contact Yokogawa Laser Analysis Division or your local agent for further assistance. If you have 100% certainty that the analyzer is already measuring the process gas and validation is not currently possible then, this alarm can be cleared via the Advanced Calibrate & Validate menu.
7.0	**Alignment – check**	Initially, observe the Transmission value through the appropriate user interface. The objective is to adjust alignment until the maximum transmission value is obtained. Perfect alignment a clear process gas will yield close to 100% transmission.
7.1		Start by adjusting the Launch unit alignment flange nuts up-down and left right. Look for increases and decreases in transmission strength to aid in the alignment.
7.2		When it has been maximized at the launch side, adjust the detect unit accordingly.
7.3		Further adjustment can be made by maximizing the raw detector voltage signal (available at test points on both launch and detect). The signal should be maximized and will not exceed 5.3V DC for low temperature (<600C process) or 9.9V DC for high temperature (>600C process).
7.4	**Detector Gain**	For Large Aperture Optics (LAO) systems, please refer to the Detector Gain Adjustment section of this User Guide to ensure correct functionality and adjustment.
8.0	**Configure BASIC**	By way of the appropriate user interface, the correct process parameters and other parameters can now be entered.
8.1		Enter the Basic Menu and go to Configure.
8.2	**Optical Path**	Enter in the correct optical path length.
8.3	**Gas Pressure**	Enter in the correct process gas pressure (if Active, see Advanced Configure).
8.4	**Gas Temperature**	Enter in the correct process gas temperature (if Active, see Advanced Configure).
8.5		If any other parameters are required to be set (such as analog I/O ranges, alarms levels, Auto Validation sequences) then the Advanced Menu needs to be accessed. **Advanced Menu access is Password protected and should only be used by skilled and trained persons - Contact Yokogawa Laser Analysis Division or Local Agent if any doubts!**

9.0	**Configure ADVANCED**	Using the correct password (Default 1234), enter in to the Advanced Menu, then the Configure.
9.1		Select the desired measurement units (English or Metric selected on an individual parameter basis).
9.2	**Optical Path**	Enter in the correct optical path length.
9.3	**Gas Pressure**	Select Fixed or Active. If Fixed, enter in the correct process gas pressure. If Active, enter in the 4-20mA input signal range proportional to the pressure range. “Control” mode is not applicable to TDLS200
9.4	**Gas Temperature**	Select Fixed or Active. If Fixed, enter in the correct process gas temperature. If Active, enter in the 4-20mA input signal range proportional to the temperature range. Active ambient and Active Peaks may also be used, refer to project specific and application specific details. “Control” mode is not applicable to TDLS200
9.5		Configure the system I/O by entering in to the System I/O sub menu in Configure.
9.6		If the Analog I/O board is installed, then select Analog Output and set the appropriate 4mA and 20mA values for Ch1 Concentration and Ch2 Transmission.
9.7		Select what mode (Block, Track or Hold) the 4-20mA outputs are to be when the analyzer is in Warning, Fault and Calibration Modes.
9.8		Configure Digital outputs – Warnings and Faults. Many of these will be factory preset so if unsure about any settings then leave as Factory Default. Select and set level for Alarm Limit to either the Measured Gas orTransmission.
9.9		Go to the Data screen and set the appropriate parameters for and ‘Spectrum Capture’. These will ensure the analyzer stores important information during operation that may be used to verify operation/status/diagnostics and other trouble shooting.
9.10		Go to the Trends screen and review/plot several of the listed parameters to check analyzer performance over a period of time.
9.11	**Non- Process Parameters**	If the application use gas containing the target gas (e.g. Oxygen measurement with Instrument Air Purge) then the Non-Process parameters should be configured as detailed later in this manual under the Software Section. Non-Process Parameters should also be configured if using a linelocking gas in the validation cell (e.g. CO for combustion).
10.0	**Normal Operation**	When the site/field configuration is complete and the analyzer has operated for at least two hours without any functional alarms, then perform an export data routine.
10.1		To Export Data, simply insert an empty USB memory stick in to a USB port on the launch unit back plane. The data transfer may take several minutes. **DO NOT REMOVE THE MEMORY STICK DURING THIS TIME!**
10.2		Close out the VNC software and disconnect the service PC – if connected.
10.3		Ensure the doors/lids are closed and tightly sealed.
10.4		The system is now in normal operation mode.
10.5		***We RECOMMEND sending all the Exported Data files to Yokogawa Laser Analysis Division along with any notes and comments. We will then be able to store these files on a master record for future reference.***

CAUTION

Please carefully read the appropriate Sections of this Instruction Manual. The TDLS200 Tunable Diode Laser (TDL) Analyzer is a technologically advanced instrument that requires the appropriate care when handling, installing and operating.

Failure to do so may result in damage and can void any warranties!

If there is any doubt about any aspect of the Instrument or its use, please contact Yokogawa Laser Analysis Division and/or your authorized Representative/Distributor.

2 INTRODUCTION AND GENERAL DESCRIPTION

The TDLS200 TDLS analyzer is designed to measure selected target gases in gas phase samples directly at the process point (across stack, across pipe, etc.), close coupled/by-pass leg or in full extractive systems (flow cell).

The analyzer measures free molecules on a path averaged basis. Unless there is an extractive sampling system up-stream that removes water (or other condensables) then the measurements are considered to be on a 'Wet Basis'.

Measurements are possible (with correct analyzer configuration) at the following conditions:

- Gas temperatures up to 1500°C (2730°F)
- Gas pressures up to 10 BarG (145 psig)
- High Particulate loading (as a function of mea surement path length)

Each application may differ in maximum limitations depending upon the combination of gas temperature, gas pressure, optical path length and concentration of the gas being measured. The standard analyzer is designed for operation in a Safe Area (General Purpose). The addition of a Purge System facilitates operation in Hazardous Areas in accordance with the relevant UL, CSA and ATEX standards for gaseous releases.

The basic TDLS200 analyzer comprises two units, the Launch Control Unit and Detect Unit. Various Process Interface configurations are available for connecting the analyzer to the measurement point. Several options may be added to the standard analyzer such as:

- Mini Display
- 6.5” screen and keypad
- Display sun shield
- Optional Universal Power Supply (with or without a Mini Display)
- Remote Interface Unit (not required for normal operation)
- Hazardous Area purge systems
- Other options may also be added.

2.1 Functional Description

Tunable Diode Laser Spectroscopy (or TDLS) measurements are based on absorption spectroscopy. The TDLS200 Analyzer is a TDLS system and operates by measuring the amount of laser light that is absorbed (lost) as it travels through the gas being measured. In the simplest form a TDLS analyzer consists of a laser that produces infrared light, optical lenses to focus the laser light through the gas to be measured and then on to a detector, the detector, and electronics that control the laser and translate the detector signal into a signal representing the gas concentration. Gas molecules absorb light at specific colors, called absorption lines. This absorption follows Beer's Law.

Using a Tunable Diode Laser as a light source for spectroscopy has the following benefits:

- **Sensitivity.** As low as 10^{-6} by volume, lower with path length enhancement.
- **Selectivity**. The narrow line width of the laser is able to resolve single absorption lines. This provides more choices of a particular peak to use for measurement, usually allowing one isolated peak to be used.
- **Power**. Diode lasers have power ranging from 0.5 mW to 20 mW. Also, being highly coherent this allows measurement in optically thick environments (high particulate loading).
- **Monochromatic**, no dispersive element (filter, etc.) required. Light source itself is selective.
- **Tunable** Wavelength can be swept across the entire absorption feature, this allows resonant (peak) and non resonant (baseline) measurement during every scan. By measuring the baseline and peak power at the detector, transmission can fluctuate rapidly by large amounts without affecting the measurement. This is useful for high particulate applications.

2.1.1 Measurement

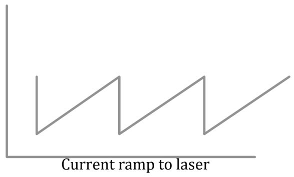


Figure 1.

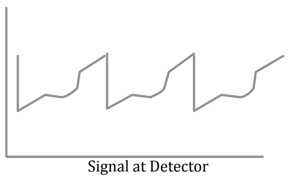


Figure 2.

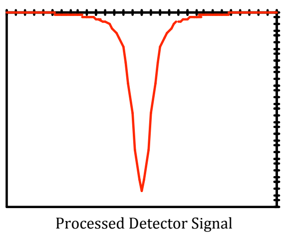
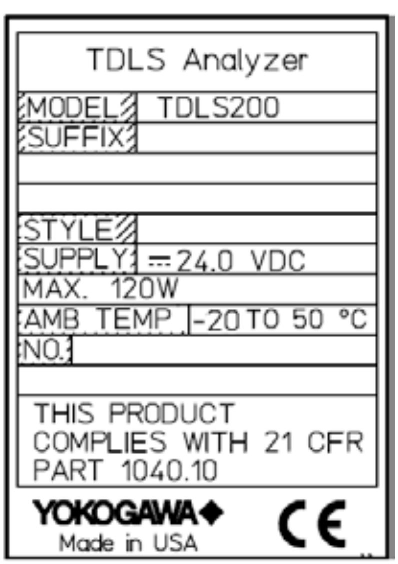


Figure 3.

- During measurement the laser is held at a fixed temperature. This is the coarse wavelength adjustment.
- A current ramp is fed to the laser. This is the fine wavelength adjustment. **Figure 1.**
- The current is ramped to scan across the wavelength region desired.
- The collimated light passes through the gas to be measured. The amount of light absorbed by the peak is proportional to the analyte concentration.
- The light is then focused on a detector. **Figure 2.**
- This signal is used to quantify the light absorbed by the analyte. **Figure 3.**

2.2 Instrument Check

Upon delivery, unpack the instrument carefully and inspect it to ensure that it was not damaged during shipment. If damage is found, retain the original packing materials (including the outer box) and then immediately notify the carrier and the relevant Yokogawa sales office.



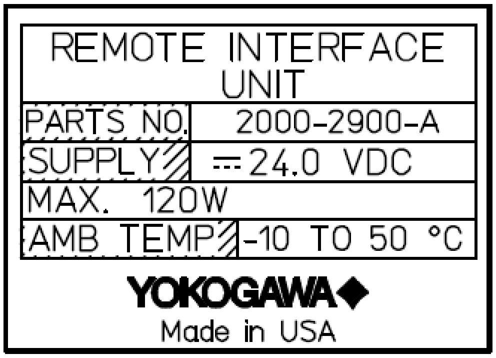
Make sure the model number on the nameplate of the instrument agrees with your order.

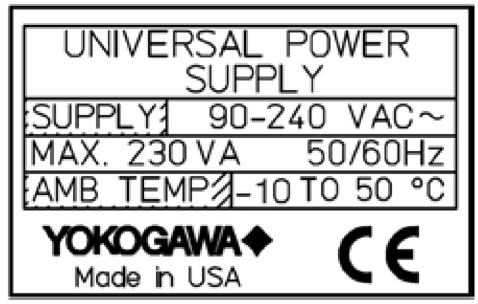
Note!

The nameplate will also contain the serial number and any relevant certification marks. Be sure to apply correct power to the unit, as detailed on the nameplate.

Note!

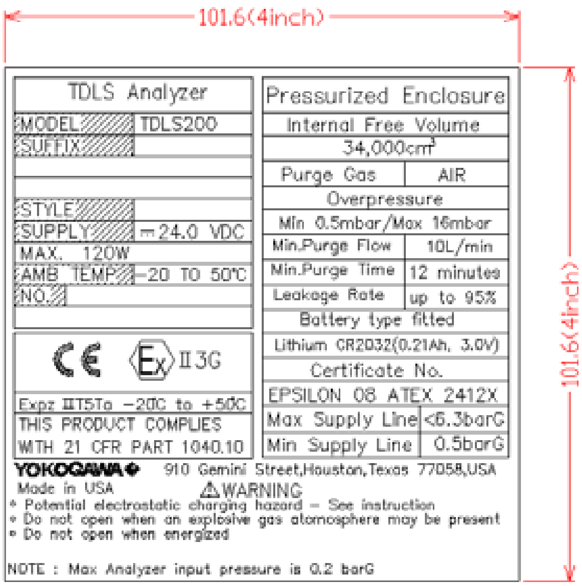
For products used within the European Community or other countries requiring the CE mark and/or ATEX classification, the following labels are attached (as appropriate):

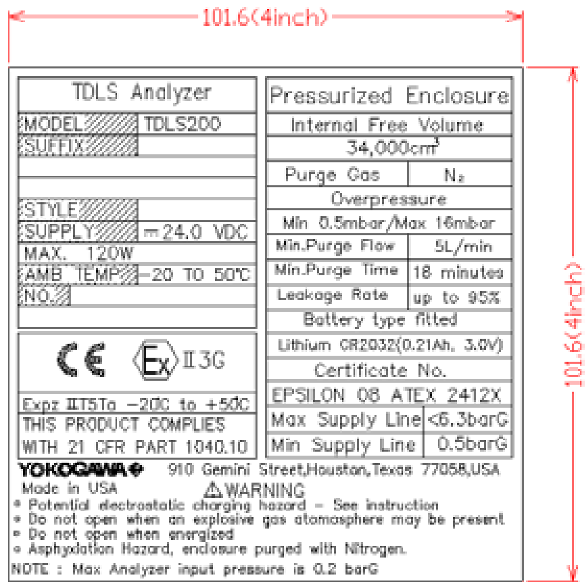




Note!

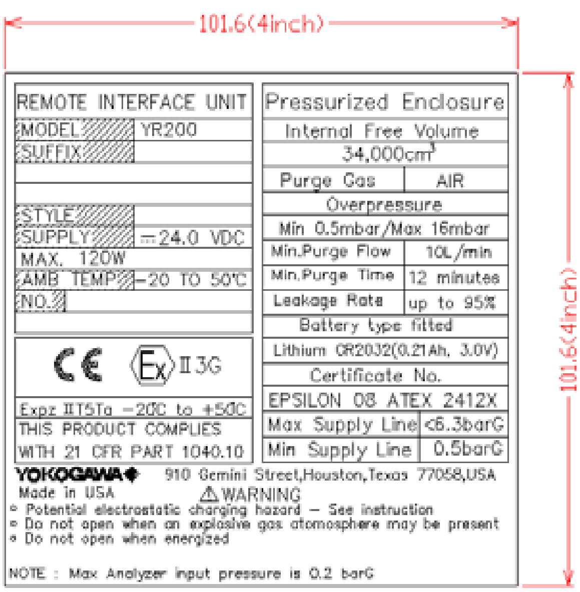
For Zone 2 (CAT 3) ATEX use the following labels will be attached as appropriate:

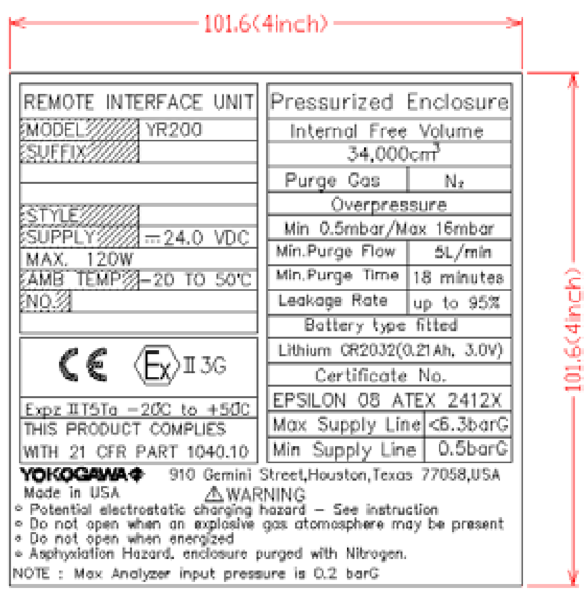




Note!

For YR-200 (Remote Interface Unit, RIU) Zone 2 (CAT 3) ATEX use the following labels will be attached as appropriate:





CAUTION - For Cleaning of the labels and LCD window, please use wet cloth to avoid electrostatic condition.

NOTE - ATEX Hazardous Area Operation:

Product MUST NOT be used in Zone 0 (CAT 1) locations
Product MUST NOT be used in Group I (Dust/Grain) locations
Product MUST NOT be used in Group III (Fibers) locations

Conditions of Certification

On loss off purge an alarm shell be made to inform the user, action shall then be taken by the user to ensure continued use is safe.

A functional test shall be carried out in accordance with clause 17.1 of EN 60079-2:2007 to verify the parameters of the Purge Control Unit when fitted.

A leakage test shall be carried out in accordance with clause 17.2 of EN 60079-2:2007. The manufacturer shall record and retain these results.

Only Lithium batteries specified in manual are to be used in this enclosure.

Special Conditions of Certification:

A suitability certified Purge Control Unit must be sued with the TDLS Analyzer that is capable providing the requirements listed on label/certificate and that either provides a suitable exhaust through a particle barrier of to a safe area.

When installed there shall be a minimum of two pressure regulators in the air/nitrogen supply line.

Materials of Construction

The analyzer incorporates a variety of materials in its construction and they should therefore be used in an appropriate manner. Any chemicals (liquid or gas) that may have a detrimental effect on the product's structural integrity should not be allowed come in contact.

The electronic enclosures are constructed from Aluminum Alloy AL Si 12 (ASTM A413) and have a protective epoxy powder coated surface finish.
The welded bodies are constructed of stainless steel grade 316
The fasteners are constructed of stainless steel grade 18-8
The windows (when fitted) are constructed of laminated safety glass

Maintenance Work by Qualified Personnel

Unqualified work on the product may result in severe personal injury and/or extensive damage to property. If the Warnings contained herein are not adhered to the result may also be severe personal injury and/or extensive damage to property.

This product is designed such that maintenance work must be carried out by trained personnel. Trained personnel are considered as below:

- Engineers familiar with the safety approaches of process analytical instrumentation (and/or general automation technology) and who have read and understood the content of this User Guide.
- Trained start-up/commissioning analyzer technicians who have read and understood the content of this Instruction Manual.

WARNING – Battery replace-

Replacement Battery Installation (Type CR2032 located on CPU).

The battery MUST be factory installed and cannot be installed by others at site (soldered connections, required) – Contact factory for further assistance

3 GENERAL SPECIFICATIONS

A. Measurement range: Dependent on application and Optical Path length. Typical 0- 100% for analysis of Oxygen or Carbon Monoxide. Measuring in ppm range is possible for Carbon Monoxide or Moisture.

B. Output signal: (3x) 4- 20 mA DC with maximum load of 900 Ohm
Three isolated outputs may be used for gas concentration, transmission, re-transmission of data inputs, dual range, or second gas measurement where applicable.
3.3 mA user configurable on warnings and faults, according to NAMUR NE43.

C. Output Span: Freely programmable within measuring range

D. Contact outputs: (3x) configurable relays for Status (Fault, Warning, In Validation, concentration level, etc.) Form C Single Pole Double Throw (SPDT) contact outputs with maximum 1A@24VDC or 0.5A@125 VAC

E. Valve control: (3x) Form C SPDT contact outputs with C connected to 24VDC power supply to activate calibration solenoid valves for zero, span and dynamic spiking (validation) gas. Maximum load 1A (max 10W/ valve for zero and span gas and dynamic spiking).

F. Current Input (2x) 4-20 mA inputs for Temperature and Pressure Compensation for loop powered or mains powered (115/220 VAC) mA transmitters for pressure and temperature.

G. Digital Communication: Ethernet IEEE 802.3 10/100 mbps, RI45

H. Data storage: USB1 and USB2 connection for data transfer using memory stick, data storage in CF card (result files, spectra capture, configuration data, etc.) Capture rate is configurable.

I. Warm-up time: 5 min for functioning, 60 min for full operation within specifications.

J. Power Consumption: 24 VDC, 4A

K. Accessories: 100-240 VAC, 50/60 Hz can be supplied to:
- Universal Remote Display (URD)
- Utility Panel(s)
- Optical Power Supply Unit

(These devices all supply 24 VDC to power the TDLS Analyzer)

L. Optical Path Length: Insitu standard, up to 30 meters allowed
Minimum, OPL .5 meter
Flow Cells, bypass installation, .5 meter recommended

Note: End User may supply 23.5 to 24.5 VDC direct to analyzer (typ.4A). Optional heat trace system may require additional and/ or alternate power supplies.

Environmental Specifications

A. Ambient Temperature: Continuous operation - 10ºC to 50ºC, start up temperature 0ºC to 50ºC. Extended temperature installation options are available please contact Yokogawa.

B. Humidity: 0- 90 % RH non-condensing or 0- 100% with correct purge gas specifications.

C. Area Classification: CE Marked for zone 2 ATEX group II Cat. 3G with purge system EEx pz II T5

Class 1 Div.2 Group BCD with integral purge kit

D. Weather resistance: IP65

E. Cable entries: ¾" FNPT threads (unused holes are plugged)

F. Gas Connections: Analyzer - ¼" welded Swagelok connection
Flow Cells - ⅜" and ¼" FNPT (other connections upon request)

G. Enclosures: Die Cast copper free Aluminum grade AL SI 12 with a powder coat exterior finish. The alloy is particularly resistant to salt atmosphere, Sulfur gases and galvanic corrosion.

Stainless Steel captive screws and optional keypad.

Laminated Safety Glass for optional display(s).

H. Sample Gas Temperature: Maximum 1500°C, Application Dependant

I. Sample Gas Pressure: Maximum (20 bar), Application Dependant

J. Mounting Flanges: 2" 150# ANSI RF or 3" 150# ANSI RF or adaptors for 4" 150# ANSI RF

K. Mounting Angle: Flange alignment tolerance within ±2 degrees

L. Weights, approx: Launch Unit 16kg x (35lbs), Detect Unit 5.5kg (12lbs)
2" 150# Alignment flange 4.5kg (10lbs), 3" 150# Alignment flange 9.5kg (15lbs)

M. Particulate loading: Maximum 95% transmission loss

Note: Each application may differ in maximum limitations depending upon the combination of gas temperature, gas pressure, optical path length and concentration of gas being measured.

Standard Accessories

Calibration Cell:
- Used for off-line calibrations and validations
- Stainless steel 316 with free standing frame
- Connects Launch and Detect with 72.6cm (28.6") OPL

Flow Cells:
- Used for extracted sample streams at any location
- 316SS low volume fixed alignment; 50ºC, 5.5 bar (80psig) max
- Enhanced for 200ºC, 20 Bar (290psig), Sapphire window, Kalrez o-rings and can be constructed from 316SS, Monel A400, Hastelloy C-276, Carpenter 20 and other materials on request to suit the process

Isolation Flanges:
- Used for additional protection for in-situ or by-pass installations
- 2” or 3” 150# or 300# ANSI RF, 4”150#, DN80 PN16 welded 5/8” or M16” bolt studs included sapphire 20 Bar (290 psig)
  or BK-7 5.5bar (80 psig) isolation window
- Kalrez window seal o-ring rated max 200ºC
- 316SS, Monel A400, Hastelloy C-276, Carpenter 20, other on request

Note: Must use in conjunction with alignment flanges

Utility Panel:
- Used for convenient field installation of utilities, configurations for
- Single, dual or four analyzers
- Manual or automatic on-line validation (controlled by analyzer)
- Safe area (GP), Div 2 purged or non-purged, ATEX CAT 2G components
- Purge flowmeters with integral needle valve, glass tube variable area
- Swagelok double ferrule stainless steel tube fittings and tubing standard
- Panel mounted or fiberglass (NEMA 4X/ IP65), with viewing window
- 5A 24VDC power supply, output to analyzer – requires VAC input power

Note: Custom configuration available to suit customer requirements

Integration:
- Used for convenient analyzer & extractive system/flow cell integration
- Free standing frame, galvanized steel with 304SS roof
- Fiberglass enclosure with powder coated steel frame
- Heat tracing and insulation for flow cells and sample handling
- 316SS and/or Monel A400 wetted parts – other on request
- Sample handling and conditioning systems to suit applications
- Stream switching manual or automatic (controlled by analyzer)

Note: Custom configuration available to suit customer requirements

Display and Software Functions

TruePeak Software has multiple levels, the default (or start page) is the Main Menu:

Main Menu Displays:
- Concentration & Units (% or ppm)
- Transmission %
- Status (warm-up, OK, Warning, Fault, etc.)
- Temperature (Fixed, Active Ambient or Active)
- Pressure (Fixed or Active)

Main Menu:

Basic Menu
- Configure, 3 functions
- View Spectra, 2 functions
- Data, 3 sub-menus
- Trends

Advanced Menu (User Password)
- Configure, 9 sub-menus
- Calibrate & Validate, 3 sub-menus
- Data, 4 sub-menus
- Trends,

Active Alarms
- List of active alarms

Shut Down Analyzer
- Instructions to close TruePeak local or VAC

Calibration Functions:

Off-line Calibrations:
- Zero calibration
- Zero off-set
- Span calibration
- Transmission
- Dark current
- peak search

Off-line Validations:
- Check gas #1
- Check gas #2
- Check gas #3

On-Line Validations:
- Manual
- Automatic

Setup Functions: Configuration:
- Process Path Length
- Pressure
- Temperature
- Units
- System I/O
- System
- Valve Control
- Laser Spectra & Control

Diagnostics:

Warnings include:
- Detector signal low
- Transmission low
- Spectrum noise high
- Process pressure out of range
- Process temperature out of range
- Concentration out of range
- Board temperature out of range
- Validation failure

Faults include:
- Laser temperature out of range
- Detector signal high
- Detector signal lost
- Peak center out of range

Output Settings:

Analog Output:
- Channel 1
- Channel 2
- Channel 3
- Warning Mode
- Fault Mode
- Field Loop Check
- AO CH calibration

Performance Specification

Precision: Application Dependent

Linearity: Typically $R^2 > 0.999$

Response time: 5 seconds, plus transport time for extractive systems when applicable

Drift: Application Dependant

Installation Specifications

Hazardous Area: Zone 1: Contact Yokogawa
Zone 2: ATEX group II Cat. 3G with purge system EEx pz II T5 (-20< Ta <50C)

By Design: Class 1, Grp. B,C & D, Division 2 or Division 1 - (Purged)

Maximum Distance between Launch and Detect:
30 m (±90ft)
Maximum interconnecting cable 50m

Wetted Parts: Analyzer & standard Alignment Flange - 316 SS, BK-7 Glass, Teflon encapsulated Viton and Silicone RTV sealant.

Optional: Isolation Flanges and Flow Cells - 316 SS, Sapphire, Kalrez -
Also available in Monel A400, Hastelloy C-276, Carpenter 20, Titanium Grade 2 and others on request.

Utilities:
Instrument Air may be used as a purge gas in principle for all of the below applications, but this will depend on the application type and the required precision of the measurement.

Oxygen Analyzer	N_2
CO Analyzer	N_2 or Instrument Air
CO_2 Analyzer	N_2 or other non-CO_2 containing inert gas
H_2O ppm Analyzer	N_2 with <20ppm levels H_2O for feed to optional Dryer Package
H_2O % Analyzer	N_2

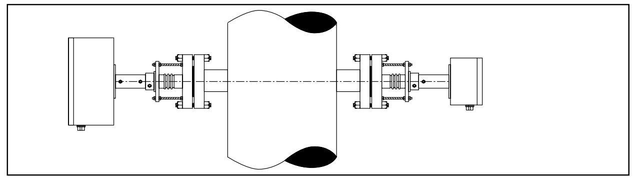
Flow Rate:
- 5-30 L/min for window purge
- 2 L/min for validation, calibration and optical purge

SIL Assessment:
The TDLS200 has a FMEDA assessment by exida and is classified as a Type B1 device in compliance with the following standards; IEC 61508 or EN 954-1. Functional Safety of Electrical/electronic/programmable electronic related systems; SIL 1 capability for single device.
* The TDLS200 is not SIL certified as standard; to be certified the unit must be specified and designed from the beginning to meet all SIL specifications.

Basic System Configuration

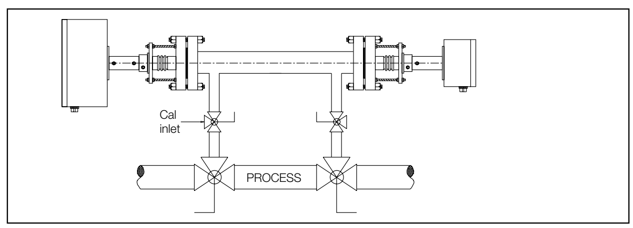
The TruePeak can be installed in a number of ways depending on process requirements. The most typical installation types are shown below, however other installation methods are possible, please contact Yokogawa with your application details.

Cross Stack/Pipe Configuration



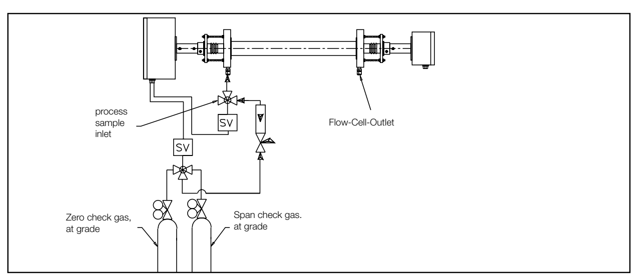
- Measures directly across process pipe or vessel
- Typically has nitrogen or other purge gas protecting process windows
- Span Validation via serial flow cell (see Operation Specifications).
- Full calibration requires removal from process
- May require pressure and temperature inputs (Application Dependant)
- Multiple methods to increase Optical Path Length (OPL) if needed
- 5 meter interconnection cable standard

Close Coupled Extractive / Bypass Configuration*



- Measures across a section of pipe where process flow is directed
- The measurement section can be isolated from process flow for full calibration/validation, zero and span
- Process pressure and temperature can be controlled or the analyzer may require pressure and temperature inputs (Application Dependant)
- Length of measurement section dependant on accuracy requirements and process conditions

Extractive Configuration*



- Sample is fully extracted from process (and may be conditioned before measurement).
- Flow cells are available with ability to purge in front of windows (balanced flow cell) if required.
- Process pressure and temperature can be controlled or the analyzer may require pressure and temperature inputs (Application Dependant)
- Length of flow cell dependant on accuracy requirements and process conditions

* Contact Yokogawa for further details

3.1 Model and Suffix Codes

Model	Suffix Code				Option Code	Description
TDLS200	---				----------------------------	Tunable Diode Laser
Type	-N				----------------------------	General Purpose (None CE)
	-G				----------------------------	General Purpose (CE)
	-D				----------------------------	Class I Div 2 BCD Purged
	-S				----------------------------	ATEX CAT 3/ zone 2 Purged
	-J				----------------------------	TIIS Hazardous Area
Gas Parameter		-X1			----------------------------	Oxygen (O_2) < 600°C, 0-25%
		-X2			----------------------------	Oxygen (O_2) < 1500°C, 0-25%
		-X3			----------------------------	Oxygen (O_2) <1500°C, 0-25%/ Temp
		-C1			----------------------------	Carbon Monoxide (CO) % <500°C
		-C2			----------------------------	Carbon Monoxide ppm (CO) <500°C
		-C3			----------------------------	Carbon Monoxide ppm (CO) <1500°C
		-C4			----------------------------	Carbon Monoxide (CO) ppm <1500°C + CH4 0-5%
		-A1			----------------------------	Ammonia (NH_3) up to 0-5,000ppm
		-A2			----------------------------	Ammonia (NH_3) 0-5,000ppm & 0-50% H2O
		-S1			----------------------------	Hydrogen Sulfide (H_2S) up to 0-50%
		-D1			----------------------------	Carbon dioxide (CO_2) High Range 0-1; 0-5%
		-D5			----------------------------	Carbon dioxide (CO_2) Extend. Range 0=5; 0-50%
		-H1			----------------------------	Water moisture (H_2O) min 0-30ppm Cl2 background
		-H2			----------------------------	Water moisture (H_2O) ppm non-hydrocarbon background
		-H3			----------------------------	Water moisture (H_2O) ppm Hydrocarbon background
		-H4			----------------------------	High moisture (H_2O) level min 0-5%
		-K1			----------------------------	Special Applications
Laser Interface			-N		----------------------------	None- Blind Controller
			-1		----------------------------	Integral Mini Display
			-2		----------------------------	Integral Color LCD Backlit
Interface				-N	----------------------------	No Process Interface Included
				-A	----------------------------	Large Aperture Optics with 3" 150# alignment bellows
				-B	----------------------------	Large Aperture Optics, with 4" 150# alignment bellows
				-2	----------------------------	2" 150# Alignment Bellows
				-3	----------------------------	3" 150# Alignment Bellows
				-4	----------------------------	4" 150# Alignment Bellows
				-5	----------------------------	DN50 Alignment Bellows
				-8	----------------------------	DN80 Alignment Bellows
Options					/U -----------------------	Ext.USB Port IP66 (NOT ATEX)
					/P -----------------------	Pressure Comp Curve
					/D -----------------------	Diverging Beam No Large Aperture Optics

4 ANALYZER COMPONENTS

Launch Unit:
- Main Electronics Housing
- User Interface (optional)
- Laser Assembly
- Check Gas Flow Cell (for On-Line Validation)

Launch Unit:
- Analyzer detachable from process interface for Off-Line calibration / service.
- Flanged O-Ring Alignment
- Flanged Metal Bellows Seal Alignment
- Flow Cell
- Isolation Flanges
- By-Pass Piping
- Custom designs for specific applications.

Detect Unit:
- Detect Electronics Housing
- Detector Assembly

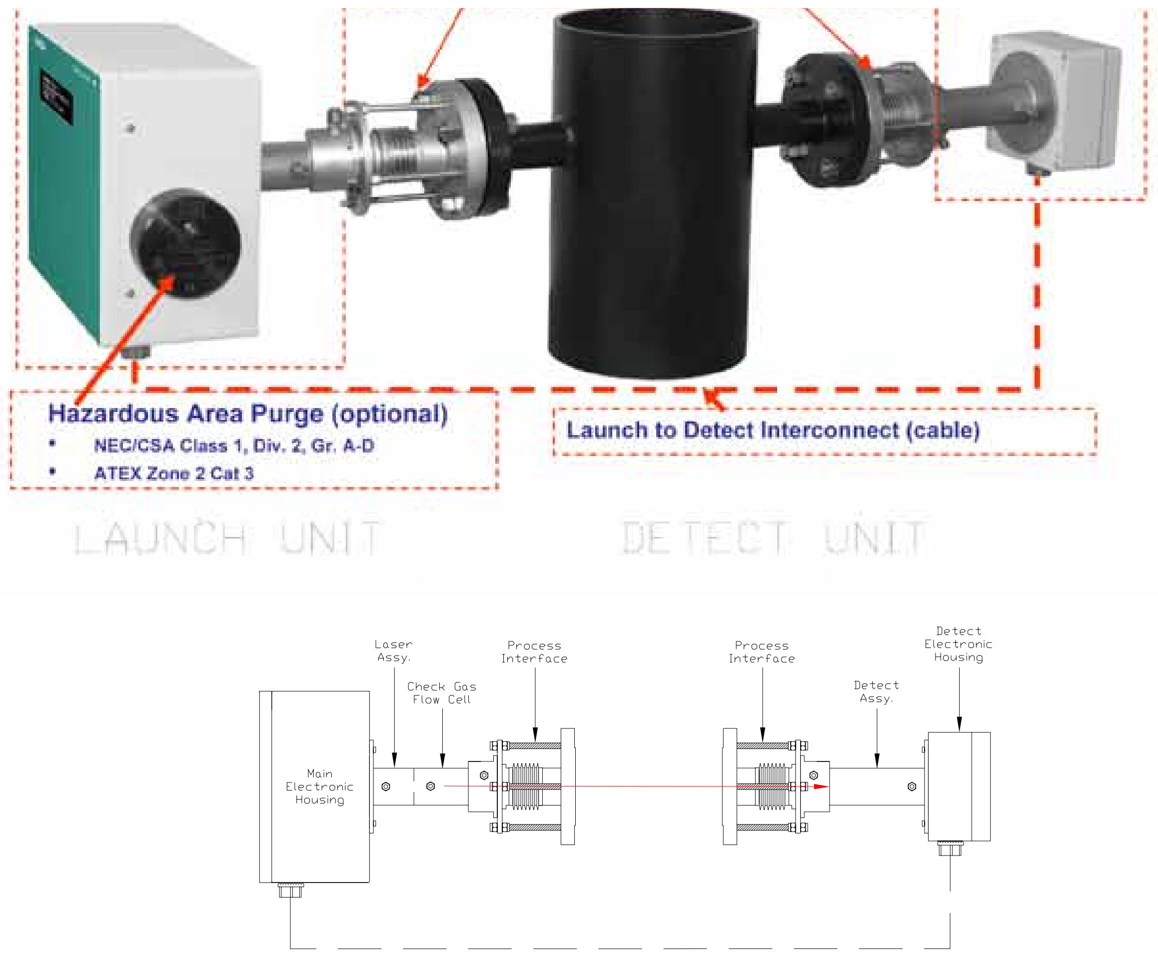


Figure 4 - System Overview

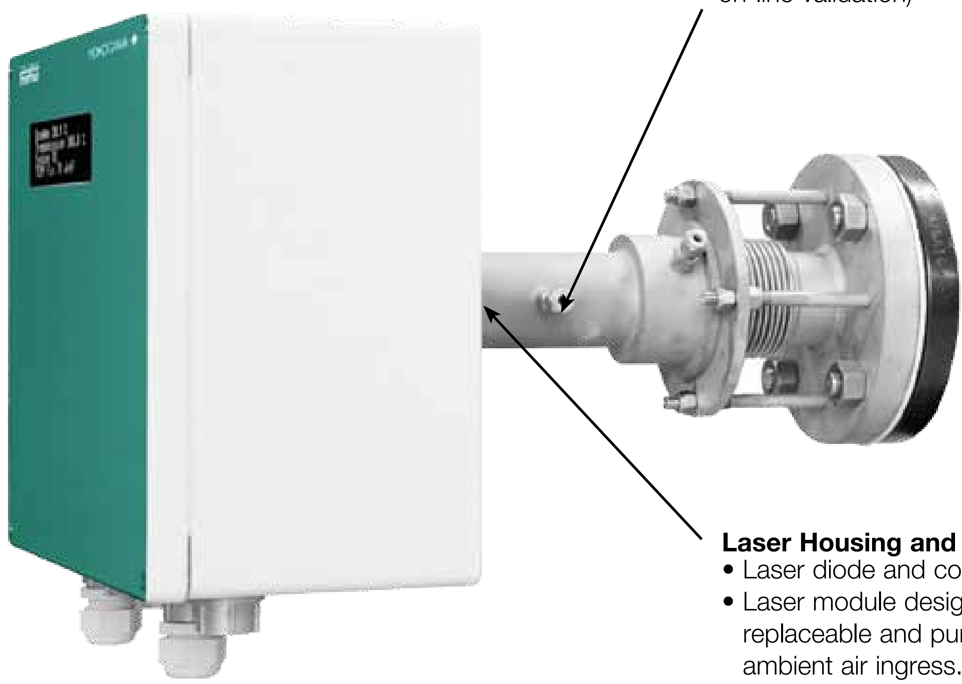
- The Launch Unit and Detect Unit are connected to each other via a Tray Rated 4-pair shielded twisted pair cable.
- The Launch Unit requires a single 24VDC power supply (by customer or via optional Power Supply Unit).
- Nitrogen purge gas is required to prevent ambient oxygen ingress however, for other target gases it may be possible to use Instrument Air for purging.
- The Process Interfaces are available in various formats, sizes and materials to suit the desired measurement/installation.
- The available Remote Interface Unit (RIU) can be located typically up to 100m (330ft) away from the Launch Unit. The RIU also requires a 24VDC power supply. The RIU connects to the Launch Unit on Ethernet (10-base-T 10/100) via CAT5e field rated cable.
- The available Universal Remote Display (URD) can be located typically up to 40m (120ft) away from the Launch Unit. The URD requires an AC power input that is connected to a universal power supply with 24VDC output power supply (for the analyzer). The URD connects to the Launch Unit via multipair sheilded twisted pair cable.

4.1 Launch Unit

Main Electronics Housing
- Back Plane circuit board
- Single Board Computer (SBC)
- FPGA signal Processing board
- Analog I/O circuit board
- Field electrical terminals are located on Back Plane (and optional Analog I/O board).
- Optional Mini Display (4x20 VFD) shown

Check Gas Flow Cell

Short cell (gas tight chamber) allows Zero Gas or Span gas to flow through the measuring path for on-line validation)



Laser Housing and Laser Module
- Laser diode and collimating lens assembly
- Laser module designed to be field replaceable and purged to prevent ambient air ingress.
- Housed in a stainless steel body with O-rings seals, attached to the main electronics housing.

Figure 5 - Launch Unit - Optional Keypad and Display

Figure 6 - Launch Unit-Optional Keypad & display

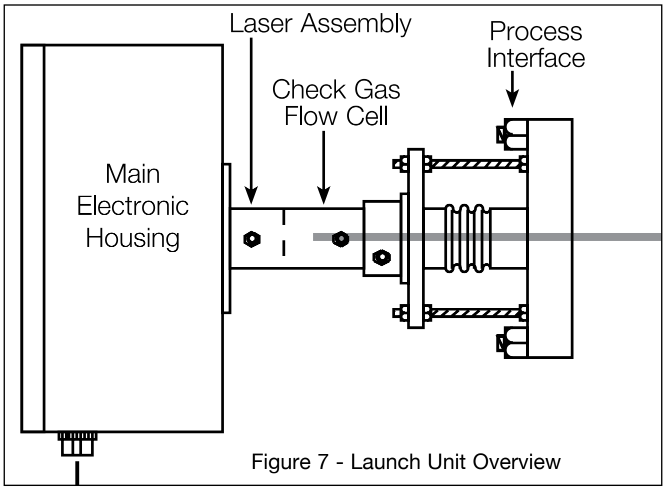


Figure 7 - Launch Unit Overview

4.2 Main Electronics Housing

Enclosure

Die cast copper free aluminum grade AL Si 12 alloy (A413.0) with a powder coat exterior finish. The copper free aluminum alloy is particularly resistant to salt atmospheres, sulfur gases and galvanic corrosion.

An externally hinged door opening to the left incorporates a weather tight gasket seal and four captive fastening screws (stainless steel). The external dimensions are approx 16” W x 12” H x 7” D (400mm x 300mm x 180mm).

The environmental protection rating is considered IP65 (EN 60529) or NEMA 4X.
Cable entries are located on the bottom face of the enclosure. They are typically ¾” Myers hubs that have ¾” NPT female threads. Each has a ground lug to facilitate the grounding of cable shields to the analyzer chassis.

When an analyzer has been supplied with the optional Mini Display (4x20 VFD), the normally blank (blind) door has a different configuration. The center of the door has a cut-out measuring approx 3” W x 1” H (75mm x 25mm). A clear laminated safety glass window is mounted to the inside of the door with stainless steel fasteners and a weather tight gasket. This allows for external viewing of the actual VFD display without opening the door.

When an analyzer has been supplied with the optional integral 6.5” display and keypad, then the normally blank (blind) door has a different configuration. The left hand side of the door has a cutout measuring approx 5” W x 4” H (130mm x 100mm). A clear laminated safety glass window is mounted to the inside of the door with stainless steel fasteners and a weather tight gasket. This allows for external viewing of the actual display without opening the door. The right hand side of the door accommodates a keypad (30 keys, stainless steel) which is also operated externally without opening the door.

Backplane Circuit Board

Large (approx. 10” H x 15” W) printed circuit board that mounts inside the enclosure. The board has several integral circuits and several connectors to accommodate various plug-in boards. The board is designed such that any field terminations are located along the lower edge of the board via pluggable terminal blocks for customer or field cable interface.

All components and devices on the board are designed for extended temperature (-20 to +80ºC) and low drift operation.

The Backplane Circuit Board contains the following integrated circuits:

- DC Power Input
- DC Power Distribution
- Watchdog Circuit
- Display Backlight Power Interrupt
- Alarm Relays
- Remote Calibration Initiation
- Calibration Valve Driver Relays
- Laser Temperature and Current Control
- Board temperature

DC Power Input

There are four pluggable screw terminals located on the lower right hand side of the Back Plane. These are used for connecting the 24VDC power input supply.

There is an adjacent On/Off miniature toggle switch and re-settable thermal fuse.

The single 24DVC power supply is distributed to various output power channels. Each output power channel has the appropriate DC-DC converter, regulator(s), filtering capacitors and status LEDs, etc.

Watchdog Power Interrupts
The power output channels for microprocessors have control logic lines (TTL activated). These allow for watchdog interrupt/reset functionality.

Alarm Relays
There are three alarm relay circuits on the board. These are capable of actuating Form C Single Pole Double Throw (SPDT) relays. The three connections of each relay (Common, Normally Open and Normally Closed) are routed through the board to field terminals.

The contacts are rated for a maximum of 1A @ 24VDC.

The pluggable field terminals are mounted on the lower edge of the board, just to the left side of the DC power input terminals. The appropriate relay(s) is actuated when there is an analyzer Warning, Fault and/or Level Alarm.

Remote Validation/ Remote Calibration Initiation
A validation/calibration routine can be initiated from a remote location (up to 300m away) using contact closures. The Back Plane has circuitry such that it can monitor for a return voltage. The return voltage comes from remote Volt Free Contacts (VFCs) at the customer DCS (or other control system).

The circuits include suitable protection against inadvertent shorting/grounding of the supply 24VDC or the application of excess power to the monitoring circuit. There are three sets of remote contact monitoring circuits on the Back Plane.

Valve Relays
There are three calibration valve relay circuits on the board. These are capable of actuating Form C SPDT relays. The common pole is connected to 24VDC power and the normally open pole is routed to the field terminal block. Digital ground is also routed to the terminal block TB3 as shown below.

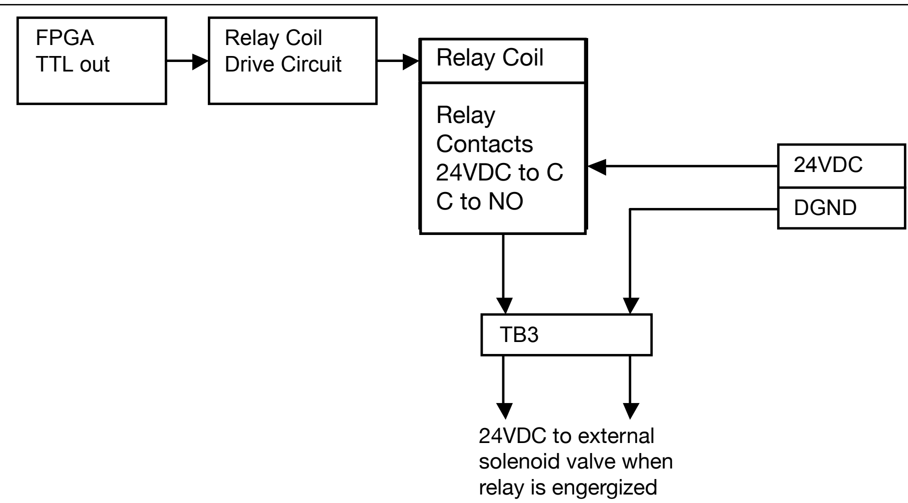


Figure 8 - Calibration Valve Relay Diagram

Connections of each relay (Common and Normally Open) are routed through the board to field terminals.

The contacts are rated for a maximum of 1A @ 24VDC (or 0.5A @ 125VAC).

The pluggable field terminals are mounted on the lower edge of the board, just to the left side of the DC power input terminals.

The appropriate relay(s) is actuated when a calibration gas check valve is to be initiated.

Laser Temperature & Current Control
The board has two main laser control function circuits, temperature control and laser current control.

Board Temperature
The board has a temperature sensing chip/circuit that monitors temperature of the board inside the main electronics enclosure. The sensor is located on the top edge of the Back Plane.

Backplane Circuit Board Power & Signal Routing
The Back Plane carries out several routing functions for both power and signals: I/O for Detect Unit is routed through the Back Plane from one set of pluggable field terminals (located lower left hand of Back Plane) to the appropriate destination. Terminals are provided for:

- Analog DC power (x3)
- Raw Detector Signal (differential voltage) (x2)
- Detect Unit Temperature (differential voltage) (x2)

Analog I/O Board outputs the analyzer results and reads input process gas compensation values (pressure and temperature). The board has power status LEDs as well as voltage test points for the input and output channels.

- Output channels (three) are ranged 0-20mA. They can be assigned to measured values Oxygen, Transmission or compensation signal re-transmission.
- Input Channels (two) are used by the analyzer to read active values for process gas temperature and/or process gas pressure. These are application dependant and may or may not be required inputs. There are two channels, one for temperature and one for pressure. Each may be used to read 4-20mA signals that are isolated or to read and loop power (with integral 24VDC) signals.

Optional Mini Display (4x20 VFD) mounts on the analyzer enclosure door. The display itself is an industrial grade 4 line 20 character vacuum fluorescence display (VFD) that is self illuminating (i.e. no back light required).

Optional 6.5" Display is an industrial grade 6.5" VGA color TFT LCD Module that has a built-in CCFL backlight. Both the display and interface board are mounted to a cover plate that attaches to the inside of the enclosure door.

Optional Keypad is an industrial rated 30 key unit that has a PS/2 (6-pos miniDIN) interface direct to the SBC. It has an Ingress Protection Rating of IP65 equivalent to NEMA 4X and is of low profile design.

Backplane Field Terminal Blocks:

- TB1 - 24VDC Power input 80 w (and optional purge power)
- TB2 – Remote Initiate Validate, calibrate and/or streamswitch
- TB3 – Solenoid Valve(s) Drivers (max 11 w each @24 VDC)
- TB4 – Alarm Contacts (Warning & Fault) Form-C
- TB5 – Alarm Contacts (user & optional Purge) Form-C, Purge is closed on pressure
- TB6 – Ethernet TCP/IP 10/100
- TB7 – Launch Control to Detect Interconnect
- TB14 – Remote Mini Display

Analog I/O Board

- TB8 – Analog Outputs, three 4-20mA isolated
- TB9 – Analog Inputs, two 4-20mA powered or loop powered

Optional Feed-through Board (URD only)

- TB10 – Ethernet to remote Analyzer via Interconnect Cable
- TB11 – to remote Analyzer via Interconnect Cable
- TB12 – Local Connections for RIU or URD + Field I/O

4.3 Laser Assembly

The laser assembly contains: Laser Diode, Collimating Lens, Module, Body, Window

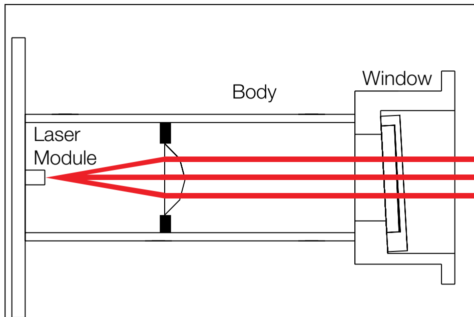


Figure 9 - Laser Assembly

Laser Assembly Body
Laser Assembly Body is a stainless steel mechanical pipe housing that accommodates the module and protects it from the environment. The body has two Swagelok style tube fittings welded on that serve as inlet and outlet ports for the nitrogen purge gas. The body attaches to the Main Electronics Housing with an O-Ring seal and several stainless steel fasteners. At the other end of the body there is a standard adaptor piece welded in place. This adaptor can fit several different Process interface systems as well as an off-line calibration cell. The adaptor also accommodates the standard Process isolation window holder.

Figure 10 - Laser Module

Laser Module
Laser Module is a mechanical component that holds both the laser diode and the lens holder. The assembly is factory set-up, permanently configured and **can be replaced in the field if necessary.**

Laser Diode is either a Vertical Cavity Surface-Emitting Laser (VCSEL) or Distributed Feedback (DFB) that outputs at wavelengths in the 750nm to 2400nm range (invisible) depending on the target gas being measured. The primary output wavelength of the laser is controlled by a thermoelectric cooling module (Peltier Element). The laser diode is permanently attached to the module. **Collimating Lens** is an optical component that collimates the diverging light source.

4.4 Check Gas Flow Cell (for On-Line Validation and/or Line Locking

The Check or Check Gas Flow Cell is a short chamber that exists between the laser collimating lens and the standard Process isolation window. The cell is sealed with double O-rings and is in series with the measurement optical path. The body has two Swagelok style tube fittings welded on that serve as inlet and outlet ports for the nitrogen purge gas or calibration check gas as appropriate.

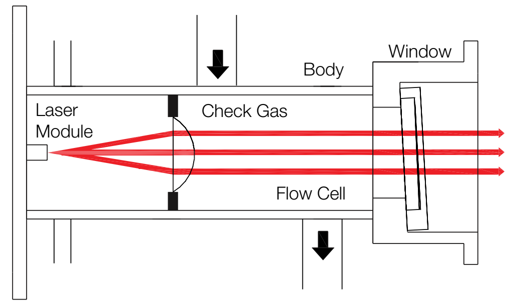


Figure 11 - Check Gas Flow Cell

The Check gas flow cell is used for performing on-line validations (or Dynamic Spiking) while the analyzer is mounted on the Process. This feature allows for the analyzer to be validated without removing it from the Process location.

By introducing a gas of known target gas concentration, at a given temperature and pressure, the analyzer can determine if the Validation routine has been PASSED or FAILED.

This cell can also be used for Line Locking applications, such as %CO for combustion applications. Refer to Non-Process Parameters for details of how to configure the software when implementing a line-locking application. Please also refer to project specific drawings for detail of how to configure the tubing/valving when implementing line locking.

The various parameters that enable the validation are all configurable within the TDLS200 software. Refer to the Validation and Calibration section of this User Guide for further details.

4.5 Detect Unit

Detect Electronics Housing

- Detector Circuit Board

Detector Housing and Detector Module

- Detector and focusing lens assembly
- Detector module designed to be field replaceable and purged to prevent ambient air ingress.
- Housed in a stainless steel body with O-rings seals, attached to the detect electronics housing.

Detect unit

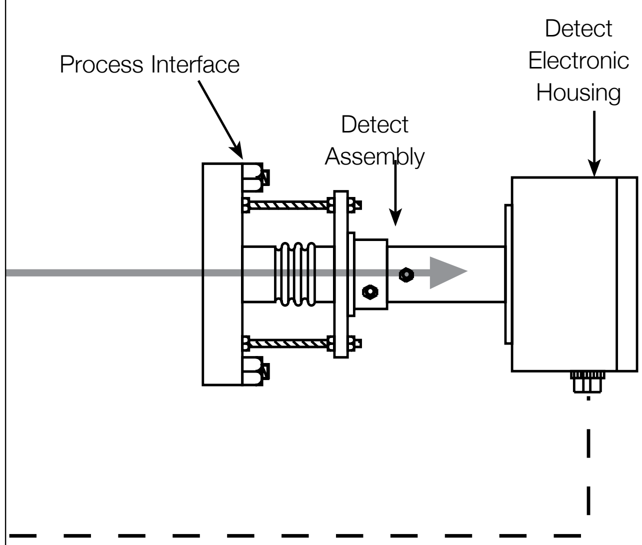


Figure 12 - Detect Unit

Detect or Electronics Housing

The Enclosure is die cast copper free aluminum grade AL Si 12 alloy (A413.0) with a powder coat exterior finish. The copper free aluminum alloy is particularly resistant to salt atmospheres, sulfur gases and galvanic corrosion. A removable cover (lid) incorporates a weather tight gasket seal and four captive fastening screws (stainless steel). The external dimensions are approx 7” W x 7” H x 4” D (180mm x 180mm x 100mm).

The environmental protection rating is considered IP65 (EN 60529) or NEMA 4X.

The cable entry located on the bottom face of the enclosure. It is typically a ¾” Myers hub that has a ¾” NPT female thread. It has a ground lug to facilitate the grounding of cable shields to the analyzer chassis.

Detector Circuit Board

Detector Circuit Board main function is to convert detector photocurrent into voltage and send it to be digitized.

LEDs are incorporated to provide simple diagnostic of available power. The board has a temperature sensing chip/circuit that monitors the ambient temperature inside the detect electronics enclosure. The sensor is located on the top edge of the detect board to ensure the maximum temperature reading is monitored.

The board is medium size (approx. 4” H x 6” W) printed circuit board that mounts inside the enclosure. The field terminations are located along the lower edge of the board via pluggable terminal block. All components and devices on the board are designed for extended temperature and low drift operation.

4.6 Process Interface

An appropriate Process Interface is selected to suit the process/stack installation. The analyzer is detachable from the process interface to facilitate Off-Line calibration and service.

Process Interface Options

There are several systems available as well as custom designs for specific applications.

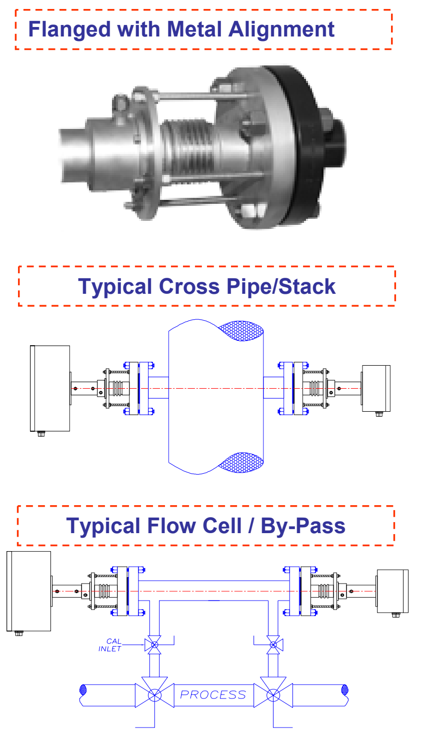


Figure 13 - Process Interface Examples

- Flanged O-Ring Alignment comprises typical 2” or 3”process flange with a large diameter O-Ring seal, typically used for stack or inert applications that are non-corrosive.
- Flanged Metal Bellows Seal comprises typical 2” or 3” process flange with a metal bellows seal and external mechanical alignment system, typically used when gas containment is important.
- LAO-Large Aperature Optics, for long path combustion application.
- Flow Cell may be used when the process gas has been extracted or is used in a by-pass flow loop. This allows for heat tracing (if necessary) and easy introduction of both Zero and Span gases.
- Isolation Flanges are supplied with process windows mounted in the flanges themselves typically for very corrosive and/or high pressure applications.
- By-Pass Piping may be used when the process gas line is of small diameter (typically <10”) and when no suitable section of pipe work exists on this which the analyzer can be mounted. By pass piping systems may be provided or supplied at site. Heat tracing may also be supplied or provided at site.
- Off Line Calibration Cell is used for off line verification of the system. This cell is used to flow Zero and Span gases when the analyzer is not connected to the process.

4.7 Analyzer Connections

Launch – Detect Interconnect
The two units are connected to each other via a four, twisted pair cable suitable for tray installation outdoors. Pluggable terminals strips are provided at both units to enable field termination of the cable. The cable pairs are individually shielded as well as an overall shield.

The cable specifications are as below.

Item	Specification
Number fo Pairs	4, individually shielded
Total Number of Conductors	9 (includes 1 comm.)
AWG	18 (0.75 mm^2)
Conductors	7 x 26 stranding, Bare Copper
Inner Shield	Aluminum Foil-Polyester tape, 100% coverage with 20 AWG tinned copper wire drain
Insulation	F-R PVC – Flame Retarding Polyvinyl Chloride
Outer Shield	Aluminum Foil-Polyester tape, 100% coverage with 18 AWG tinned copper wire drain
Outer Jacket	F-R PVC – Flame Retarding Polyvinyl Chloride Wall thickness 0.053” (1.35 mm) Typical 0.47” (12 mm) outside diameter
Operating temperature	-22 to 221°F (-30 to +105°C)
Min. Bend Radius	5” (127 mm)
Applicable Standards	NEC/(UL) PLTC, ITC, CMG
Flame Test	UL1581, FT4, IEEE 1202 & ICEA T-29-520
Suitability	Indoor, Outdoor, Burial and Sunlight Resistant Power Limited Tray Rated Cable
Nom. Conductor DC resistance @ 20˚C	5.86 Ohms/1000 ft (305 m)
Nom. Outer Shield DC resistance @ 20˚C	4.75 Ohms/1000 ft (305 m)
Max. Operating Voltage - UL	300 V RMS
Conductor Identification	Numbered pairs, black & white conductors
Typical Manufacturer & Part No.	Belden Type 1475 A

The maximum cable length should not exceed 150 ft (46 m).

Please ensure that the Launch to Detect cable is properly terminated and that all grounding and shielding details are correct per installation drawings-Espically important for CE/A TEX installations.

4.8 Communications

Stand Alone Options

The analyzer is capable of fully independent operation with no external computer or interface required. A number of options are available for a built in user interface (mounted on Launch Unit):

- Blind with no display or keypad. Access to the analyzer through; Ethernet connection (local or remote computer), Remote Interface Unit (RIU), Universal Remote Display (remote display only - no keypad) with menu access via external computer.
- Mini display which is an Integral display 4X20 smart VFD (cycles information). No keypad, menu access via local or remote external computer (Ethernet connected).
- Keypad with 6.5” display.
- Regardless of the user interface selected the analyzer will continuously record results, diagnostics and spectra. Data can be transferred from the analyzer via USB or Compact Flash.

Remote Interface Options

A number of options are available for remote access to the analyzer

Remote Interface Unit (RIU) model YR200 shown below, allows remote analyzer control and data transfer from analyzer to RIU (data can be transferred from RIU via USB memory stick or Compact Flash card.

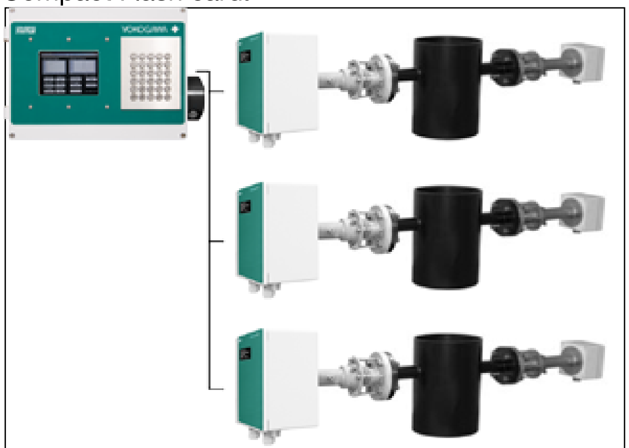


Figure 14 - Networked Analyzers

- Allows multi-unit field communication via central user interface
- Not required for individual analyzer operation, interface and data transfer only
- Connects with 1-8 analyzers via Ethernet switch
- Integral Keypad and 6.5” display

External Computer via Ethernet. A separate computer can be connected to the analyzers locally or through an Ethernet network to allow analyzer control and data transfer

The Remote Interface Unit (RIU) consists of:

- Back Plane circuit board
- SBC
- Display and Keypad
- Optional Analyzer Feed-through circuit board and/or Ethernet switch
- All field electrical terminals are located on the Back Plane.

A single RIU can be used in conjunction with up to 8 analyzers via Ethernet (more with additional/custom Ethernet switches).

The unit acts as a remote interface for the analyzer. Should the physical location of the actual analyzer(s) be inconvenient for easy access, then the RIU can be used.

It can be mounted up to 100m (330ft) away from the analyzer(s) using the standard 10-BaseT twisted pair wiring method. It communicates to the analyzer(s) through a Virtual Network Connection (VNC). If there is more than one analyzer connected to the RIU, then they are routed via an industrial Ethernet switch. Up to four analyzers can be routed through one RIU switch.

The RIU Enclosure is die cast copper free aluminum grade AL Si 12 alloy (A413.0) with a powder coat exterior finish. The copper free aluminum alloy is particularly resistant to salt atmospheres, sulfur gases and galvanic corrosion. An externally hinged door opening to the left incorporates a weather tight gasket seal and four captive fastening screws (stainless steel). The external dimensions are approx 16” W x 12” H x 7” D (400mm x 300mm x 180mm). Wall mounting brackets are included with the RIU.

The environmental protection rating is considered IP65 (EN 60529) or NEMA 4X. Cable entries are located on the bottom face of the enclosure. They are typically ¾” Myers hubs that have ¾” NPT female threads. Each has a ground lug to facilitate the grounding of cable shields to the chassis.

The RIU is supplied with standard integral display and keypad.

RIU Interconnect to Launch Control Unit(s)
When connecting just one analyzer to the RIU there are two twisted pair wires to consider , there are only four wires to be terminated to make the 10/100 Ethernet connection.

Figure 15 – Connecting RUI to Analyzer(s)

RIU Optional Ethernet Switch
If there is more than one analyzer connected to the RIU, then they are routed via an industrial Ethernet switch. Up to four analyzers can be routed through one RIU switch. The switch is powered by 24VDC from the back-plane and includes several status LEDs.

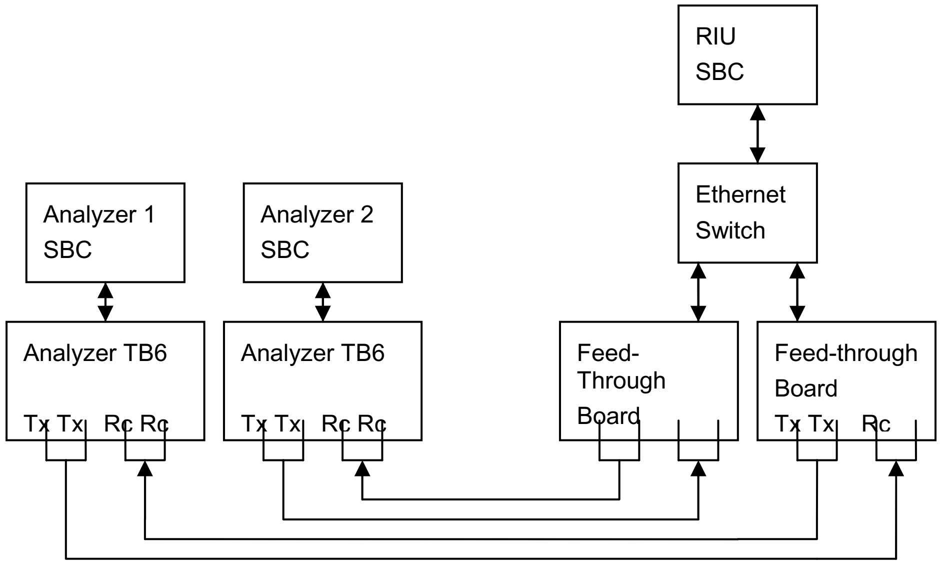


Figure 16 – RIU Ethernet Switch

RIU Optional Feed-through Board
To facilitate the connection of more than one analyzer to the RIU, an optional Feed-through board can be used. The board has pluggable screw terminals that allow for the landing of field cables from the analyzers at the RIU.

RIU Hazardous Area Purging
The standard RIU is designed for operation in Safe Areas (General Purpose). An optional Z-Type purge control system can be fitted to the RIU and it includes a local indicator and pressure switch alarm contacts. When applied, the purge system allows for operation in:-

- NEC/CSA Class 1, Division 2, Groups A-D
- ATEX Zone 2 CAT 3 (dual regulators at the inlet MUST be used)

The purge gas may be either Instrument Air or Nitrogen.

4.9 Purge Systems

The TDLS200 Analyzer requires a continuous nitrogen gas purge to prevent ambient oxygen ingress to the optical path, when oxygen is the measured gas. The flow rate can be minimized as long as it prevents any ambient oxygen ingress to the measurement optical path. Other purge gases may be used as long as they do not contain any of the measured gas and they are clean, dry, etc.

For hazardous area operation, the same nitrogen purge gas is used to purge the entire analyzer (including non-optical path sections such as the electronics). The process interface may also require purging to maintain clear windows, refer to Process Window Purge details separately.

Purging Analyzer for Safe Area.

The block diagram below shows the sections of the analyzer that require nitrogen purging. The purging should be carried in sequence typically as shown below.

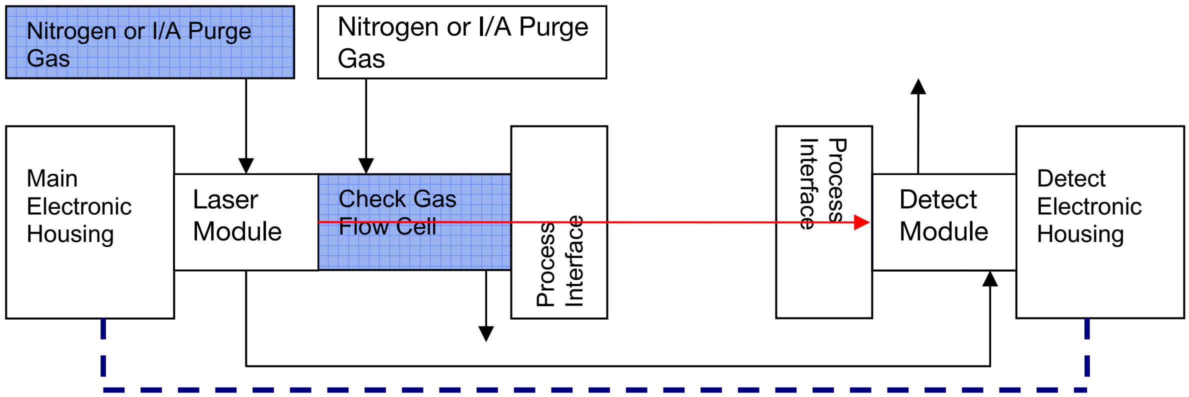


Figure 17 – Purging for Safe Areas

Purging Analyzer for Hazardous Areas

- NEC/CSA Class 1, Division 2, Groups A-D
- ATEX Zone 2 CAT 3

The block diagram below shows the sections of the analyzer that require nitrogen purging. A Z-Type purge control system is fitted the Main Electronics Housing and it includes a local indicator and pressure switch alarm contacts. The purging should be carried in sequence typically as shown below.

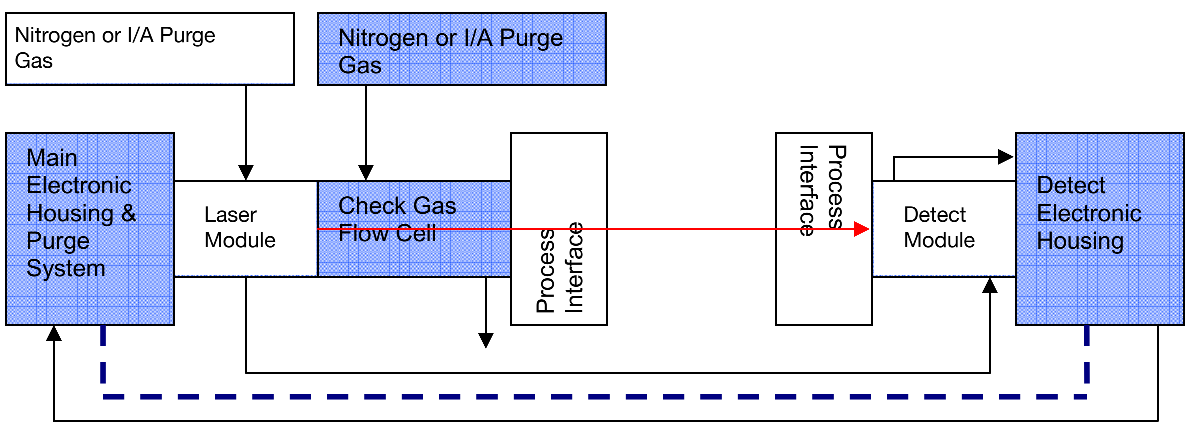


Figure 18 – Purging for Hazardous Areas

5 INSTALLATION AND WIRING

⚠ Note! Detailed Installation, Wiring, Utility Drawings are included on a Project Basis. Please contact Yokogawa for any project specific documentation to ensure correct installation. Drawings provided herein are considered for standard installation use only

5.1 Process Measurement Point Considerations

The following criteria should be considered when selecting the installation point in respect to the process conditions:

- **Process Gas Flow Conditions –** Laminar, homogenous gas concentration distribution conditions across the measurement point are recommended.

  For circular ducts/stacks this condition is generally at least three unimpaired diameters (D) before and after a process bend. For rectangular cross sections, the hydraulic ductdiameter (D) is derived from:

  D = (4 x duct cross sectional area) / duct circumference

  If neither situation exists or is possible, then distribution of the unimpaired section of duct should be 66% on the inlet side and 34% on the outlet side. Profiling of the proposed measurement point may be required to ensure that a correct installation point is selected.

- **Process Gas Temperature –** It is recommended that the analyzer be installed at a location where temperature fluctuations are minimized. Generally as a guide, if the temperature of the gas at the point where the analyzer is to be installed is to vary by more than +/-10°C (+/-18°F) then an “Active” input signal should be used for compensation.

  Ensure the analyzer has been selected and configured to suit the maximum operating gas temperature.

  Lower gas temperatures generally lead to better measurements.

- **Process Gas Pressure –** It is recommended that the analyzer be installed at a location where pressure fluctuations are minimized. Generally as a guide, if the pressure of the gas at the point where the analyzer is to be installed is to vary by more than +/- 0.05 Bar (+/- 0.725 psi) then an “Active” input signal should be used for compensation.

  Ensure the analyzer has been selected and configured to suit the maximum operating gas pressure.

  Ensure the process isolation windows have been selected and configured to suite the maximum design gas pressure.

  Lower gas pressures generally lead to better measurements.

- **Process Dust/Particulate Matter –** It is recommended that the analyzer be installed at a location where dust loadings are minimized. Dust and other particulate matter will reduce the optical transmission of the measuring laser beam. Within limits, the loss of optical transmission does not effect the measurement however a Warning alarm will be initiated when the transmission falls below allowable limits. The amount of dust loading is also dependant upon the optical path length – Consult Factory for further details.

  Lower dust loads generally lead to better measurements.

5.2 Position of Process Flanges for Launch and Detect Units:

Process flanges should be located on the process such that the Launch and Detect Units can be installed, accessed and removed in a safe and convenient manner.

The following criteria/Check List should be met at a minimum:

- Good, Safe Engineering practices
- Local codes and regulations for such equipment installation
- Appropriate hazardous area (if applicable) precautions
- Owner Company best practice and engineering standards
- Access for personnel to stand in front of launch and Detect Units
- Clearance for installation and removal of Launch and Detect (see below)
- Clearance for installation and removal of purge insertion tubes (if applicable)
- Access to process isolation valves
- Safe routing for interconnecting cables
- Ambient conditions in accordance with analyzer limits
- Access to appropriate utilities
- Adjacent space for mounting to Calibration Cell when off-line

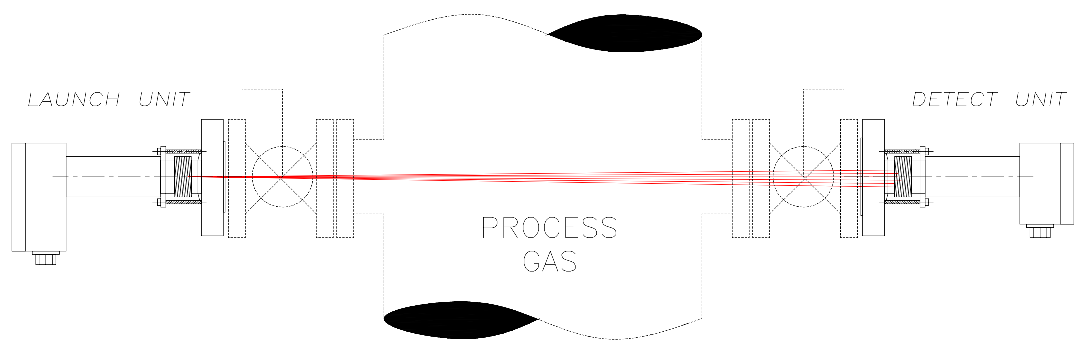


Figure 23 - Launch and Detect Unit-In -Situ Installation Overview

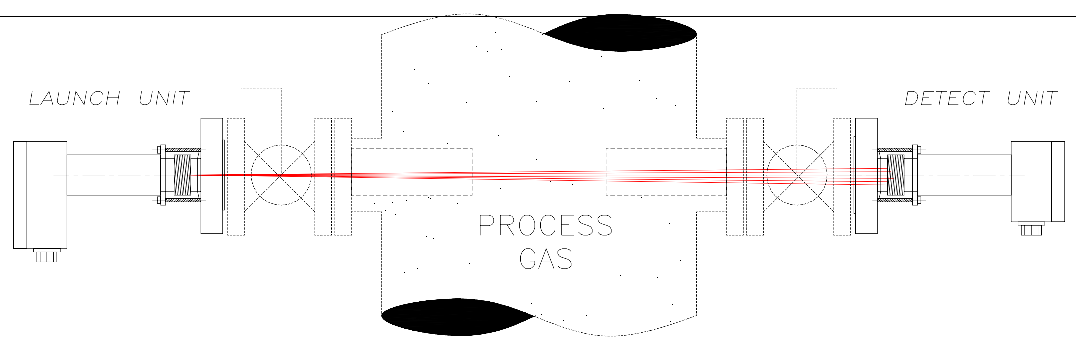


Figure 24 - Launch and Detect Unit-In-Situ with Insertion Purge Tube Installation Over-

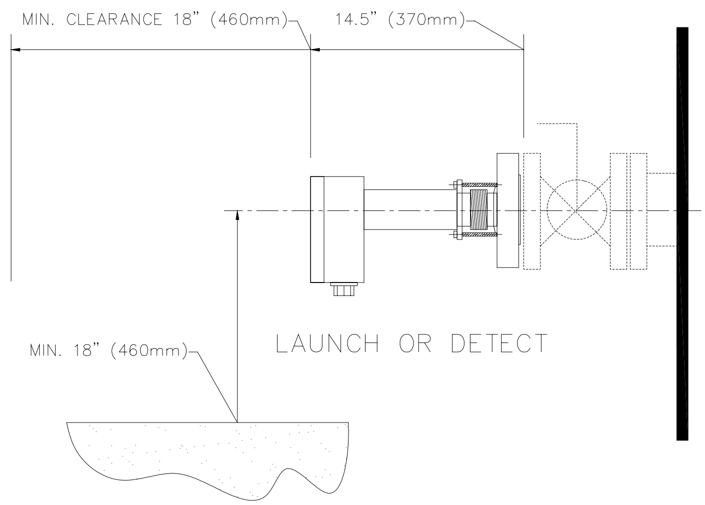


Figure 25 - Launch or Detect Unit Installation Dimensions

The standard flange sizes are either 2" or 3" 150# R.F. ANSI as well as DN50 and DN80. Please check the exact flange size specified and provided for the particular installation. Other flange sizes and a variety of materials (to suit the process) are available so please check these details prior to installing the flanges on the process.

⚠ Note: The process isolation valves should have at least a 1½" (38mm) diameter clear bore size (aperture) to ensure there is sufficient tolerance to align the laser beam after installation. Ducts and Stacks that have thin and flexible walls should be reinforced to ensure that the laser beam alignment is maintained at all times. Rigid mounting for the process flanges is highly recommended to ensure a lignment is maintained.

In situations where the process flanges are mounted to these thin and flexible duct/stack walls, a larger reinforcing plate should be welded around the mounting flange area to increase the attaching region. The figure below depicts a typical suggestion however; it is the installer's responsibility to ensure appropriately rigid installation is provided for the analyzer.

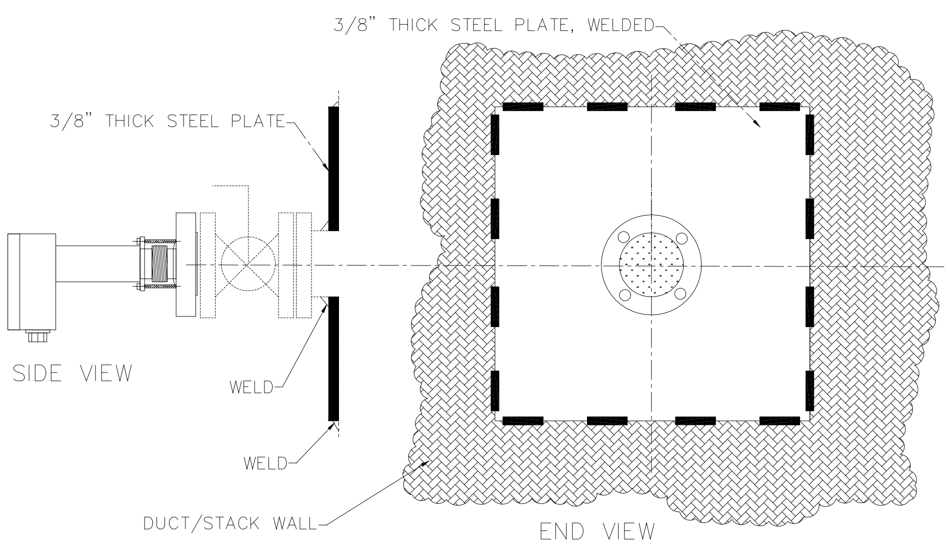


Figure 26 - Suggested Reinforcing Plate for Launch or Detect Unit Flanges- reduce flexing with mechnical reinforcement to duck/stack walls

5.3 Process Flange Welding Alignment and Line-Up

The Launch and Detect units are provided with alignment mechanisms that allow for some manual adjustment of the laser beam direction in both planes. It is however recommended that the following angular tolerances be adhered to as closely as possible.

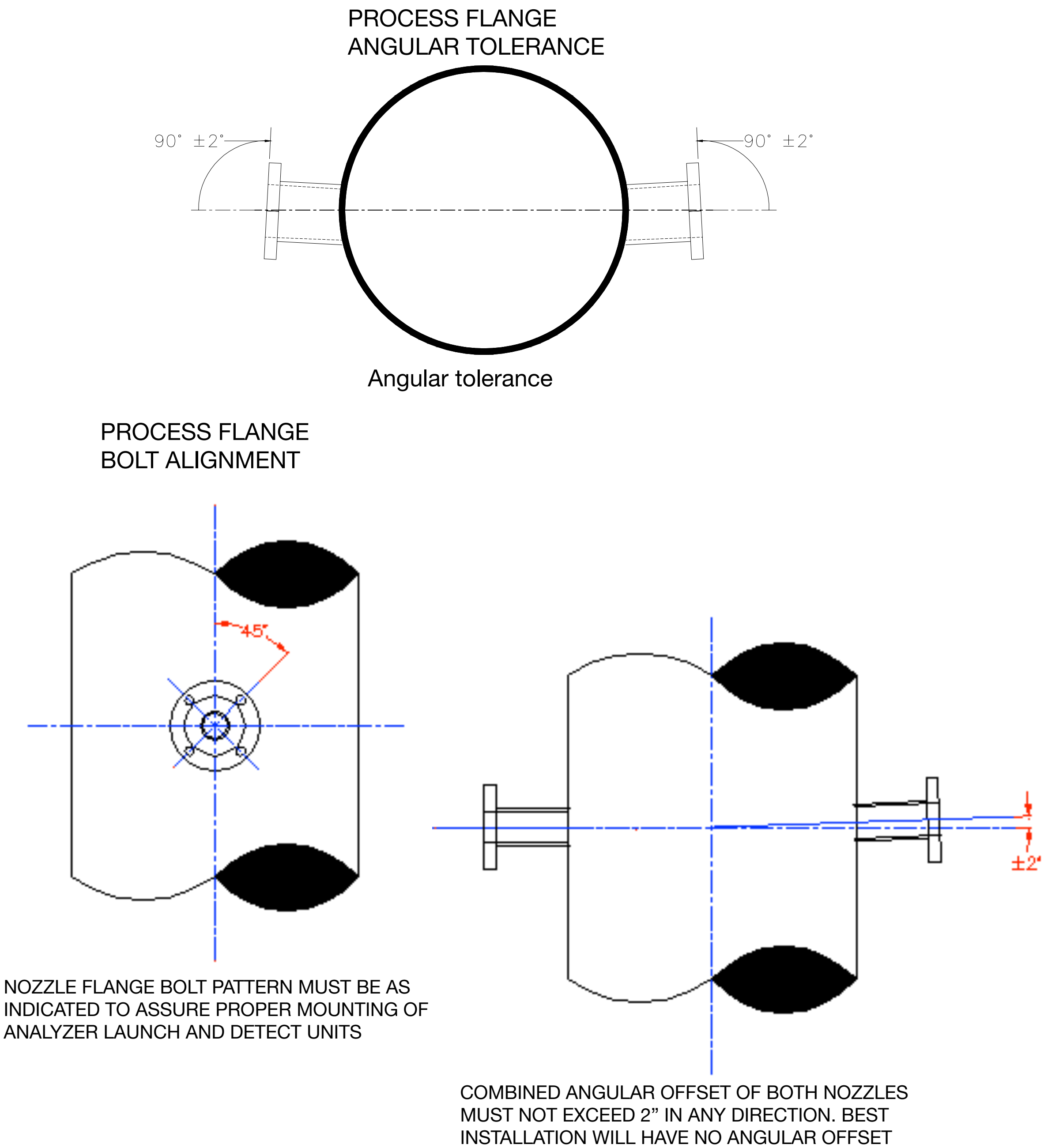
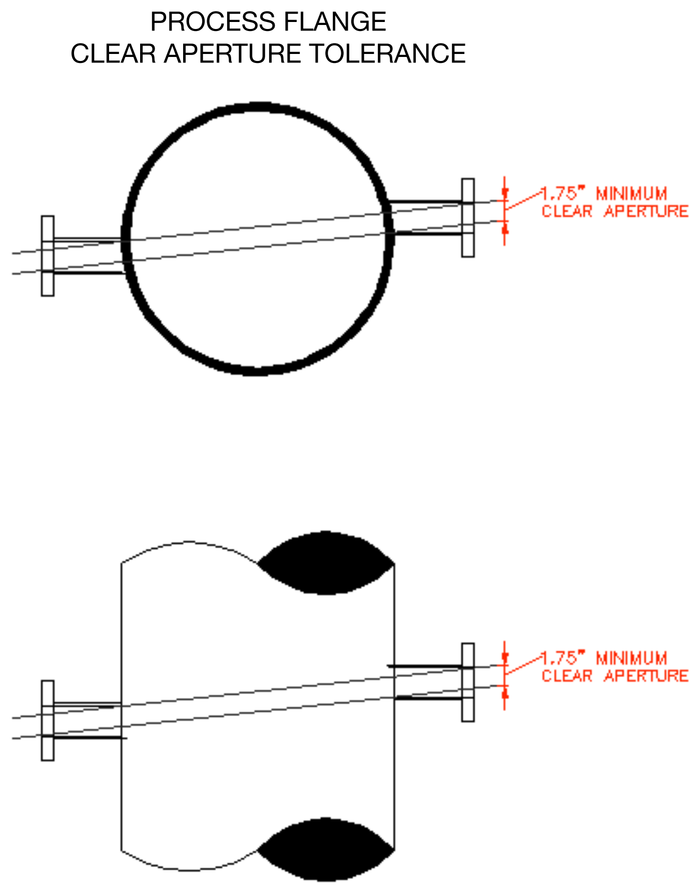


Figure 27 - Angular Alignment Tolerances for Launch or Detect Unit Flanges

5.4 Process Flange Clear Aperture

The Launch and Detect unit flanges (and insertion tubes if used) should be installed in such a way that a minimum clear through aperture (opening) diameter of 1 ½” (38 mm) when the distance between the 2” 150# flange faces does not exceed 6ft (~2 m).

⚠ Note: Larger clear through apertures may be required when operating over longer distances – CONSULT FACTORY for further details.



LATERAL OFFSET OF NOZZELS MUST BE MINIZED AS TO ALLOW FOR MINMUM 1.75” [45MM] CLEAR APERTURE.

BEST INSTALLATION WILL HAVE NO LATEAL OFFSET.

Figure 28 - Clear Aperture for Launch or Detect Unit Flanges

5.5 Mounting the Launch and Detect Units to the Process Flange

Securely bolt the Launch and Detect Units to the process flanges using the standard bolt holes provided. Ensure the correct size bolts, nuts, and gasket are used in accordance with the flange specifications and in accordance with the process specifications when applicable.

⚠ NOTE: If the process isolation valve flange is excessively hot due to the process temperature or radiant heat, then a thermal insolating flange gasket should be used in order to minimize the heat transfer to the analyzer flange face.

It is generally beneficial to make the flange of the Launch and Detect Units and the flange of the process concentric with each other. Due to the large clearance provided by standard flanges and bolts, it is possible to mount the two flanges in an un-concentric manner – this should be avoided to aid laser beam alignment.

5.5.1 Process Window Purge Gas Connection

In order to keep the process windows clean (prevent fouling by process gas) it is necessary to purge the windows with a clean dry gas of sufficiently low dew point.

When measuring Oxygen, Nitrogen should be used for purging the windows. The purge gas or nitrogen should be clean (<0.5 μ particulate), dry (-40°C dew point), oil free.

The process flanges are provided with two diagonally opposed inlet ports (typically ¼" OD tube). Use Swagelok (or equal) double ferrule tube fittings and connect both ports with ¼" OD stainless steel tubing to the purge gas supply. The exact purge gas flow rate will be dependant upon the process conditions that exist at the flange connection and therefore, the flow rate could be anywhere from 5lts/min to 50lts/min
(~10 SCFH to ~100 SCFH).

Ensure the purge gas line is clean and dry prior to connecting to the flange to ensure any condensate or debris is not blown on to the windows at initial start-up. The same applies to both Launch Unit and Detect Unit process flanges, with and without any insertion purge tubes installed.

5.6 Mounting the Process Interface – standard 2", 3". 4" 150# ANSI RF or DN - 50/80

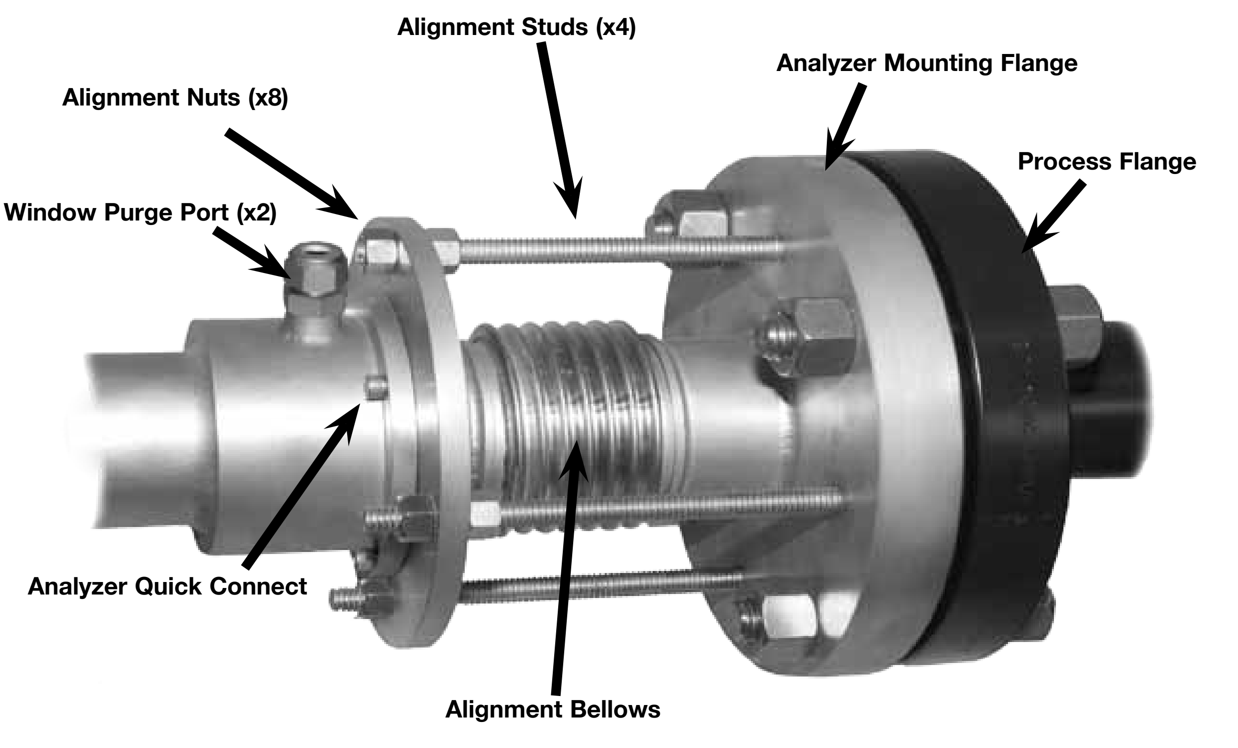


Figure 29 3" 150# Welded Metal Bellows Alignment Flange Shown above, with analyzer quick connect

5.7 Typical Purge Gas Configuration, In-Situ

Please refer to project specific details, the following is a typical standard in-situ configuration:

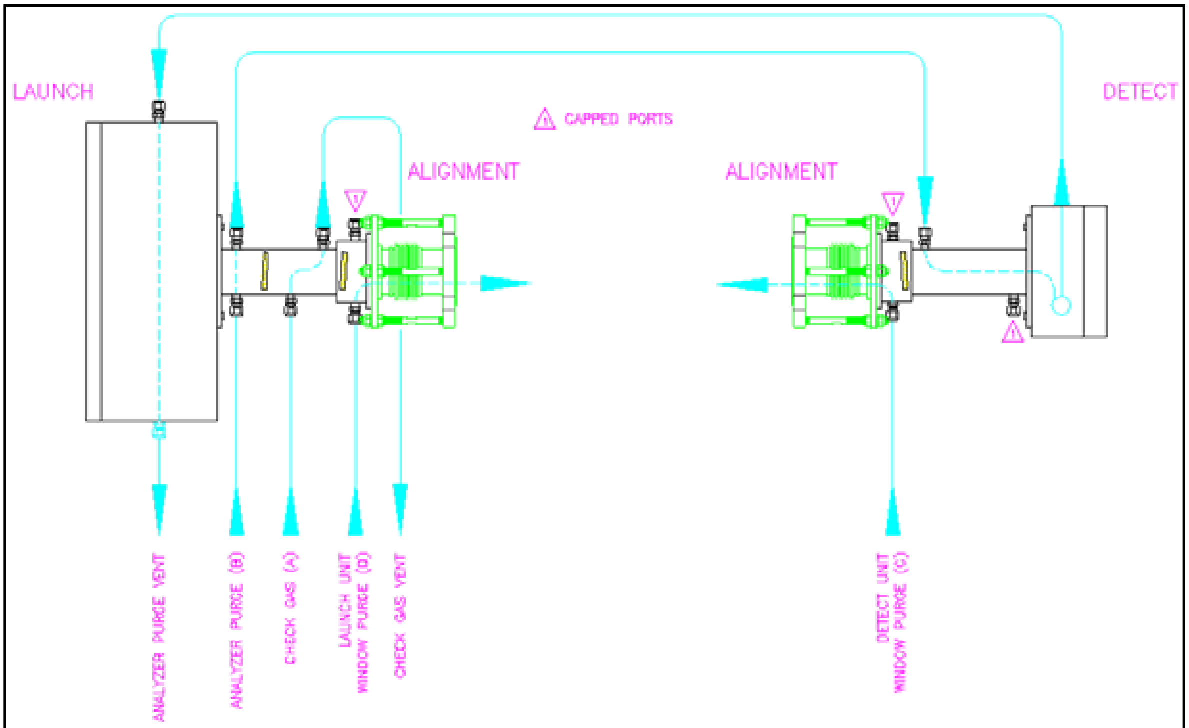


Figure 30

5.8 Typical Purge Gas Configuration, Extractive trace ppm H2O system:

Please refer to project specific details, the following is a typical standard enhanced flow cell configuration:

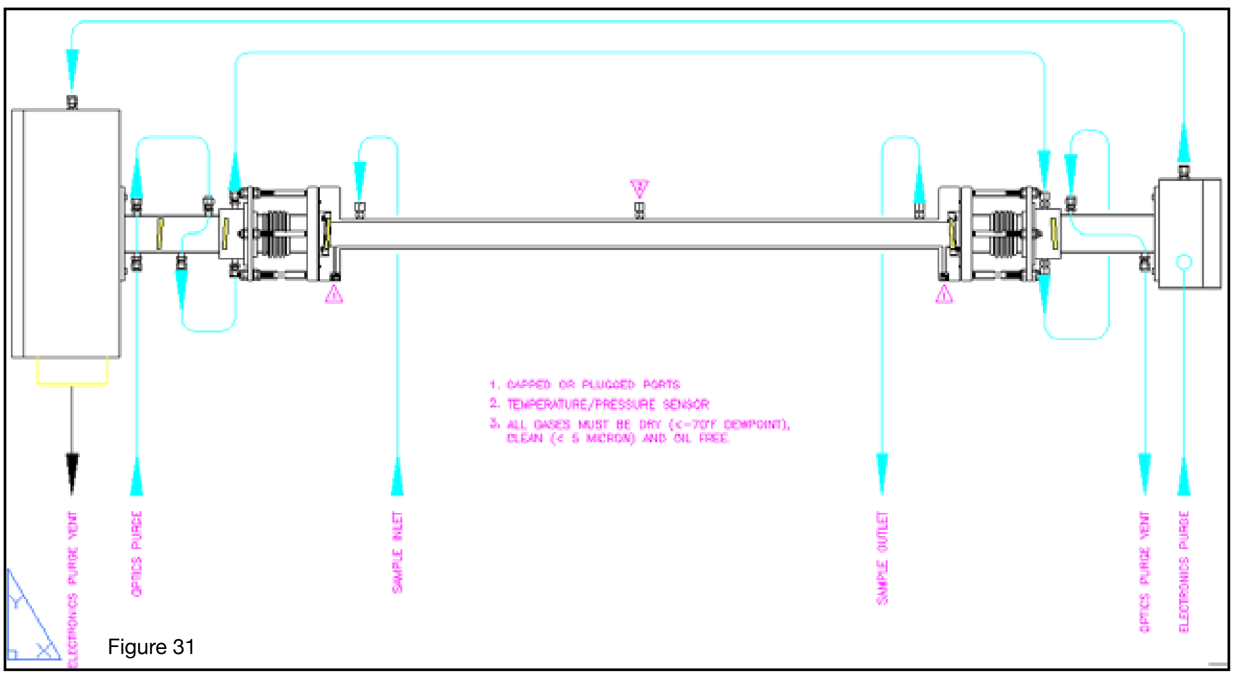


Figure 31

Typical Purge Large Aperture Optics (LAO) combustion O2, CO/CH4

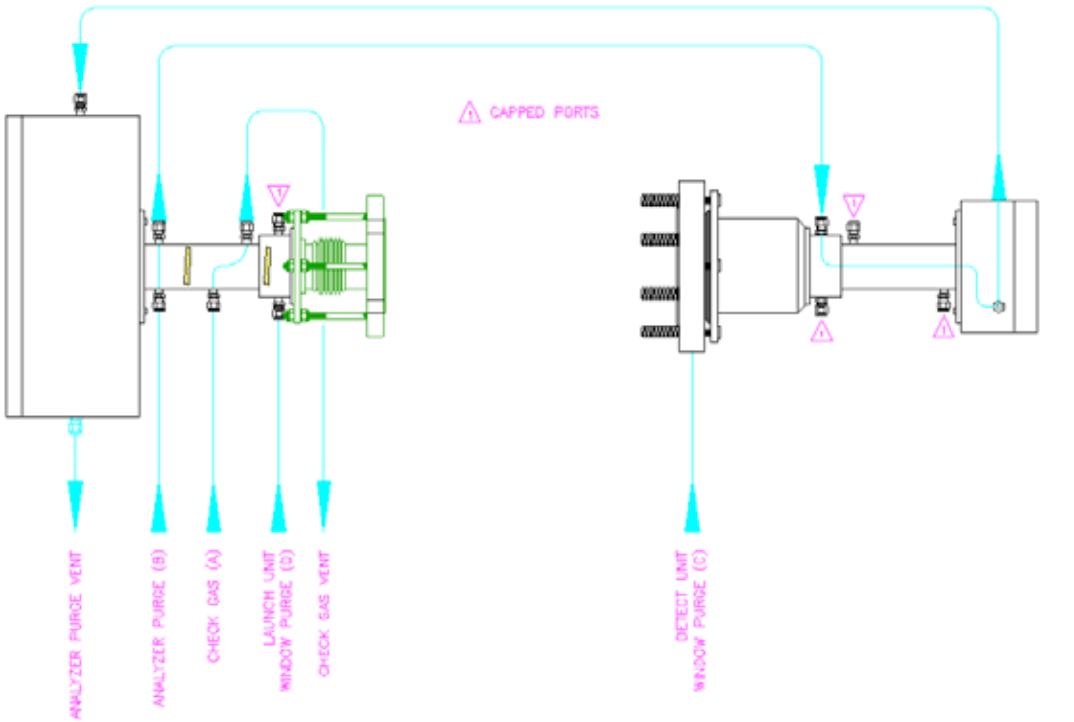


Figure 32

5.9 Dimensional Drawings

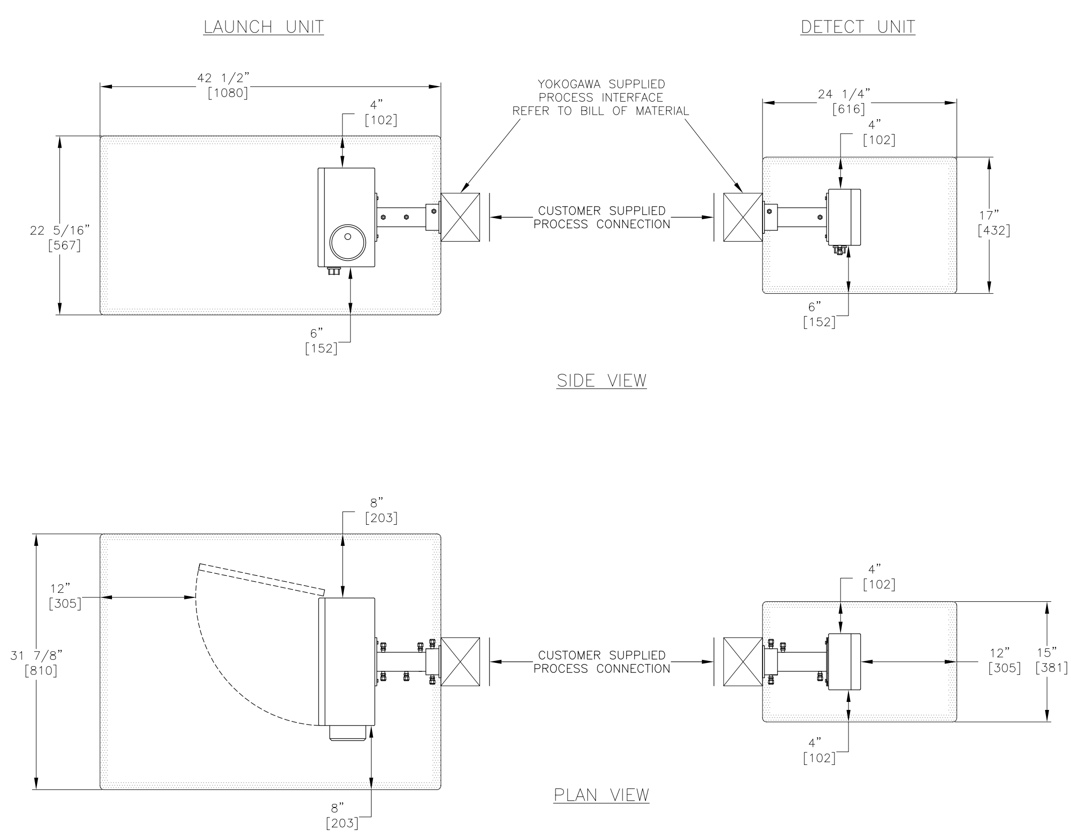


Figure 33 - General Installation Clearance Requirements

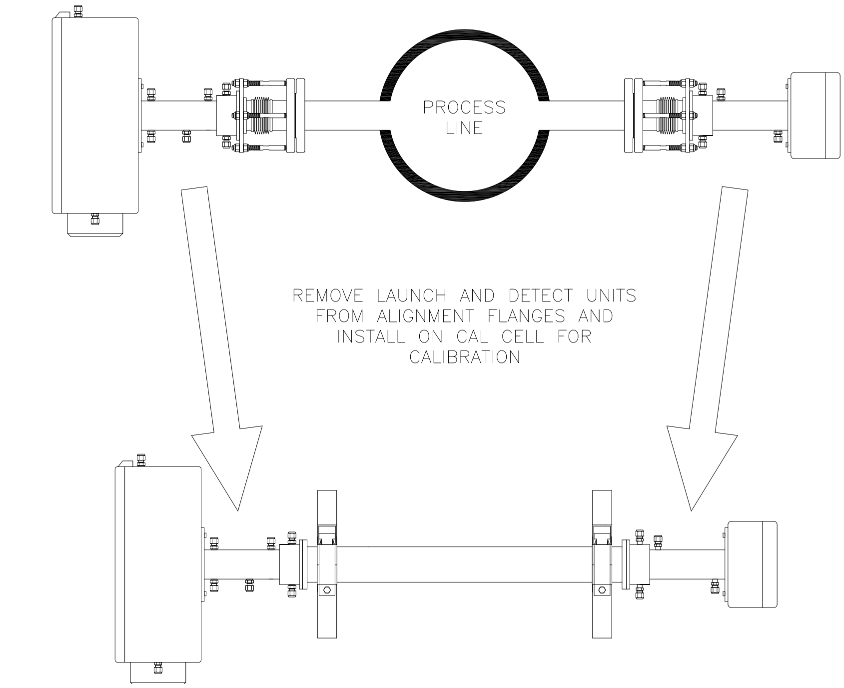


Figure 34 -Off-Line Calibration Overview

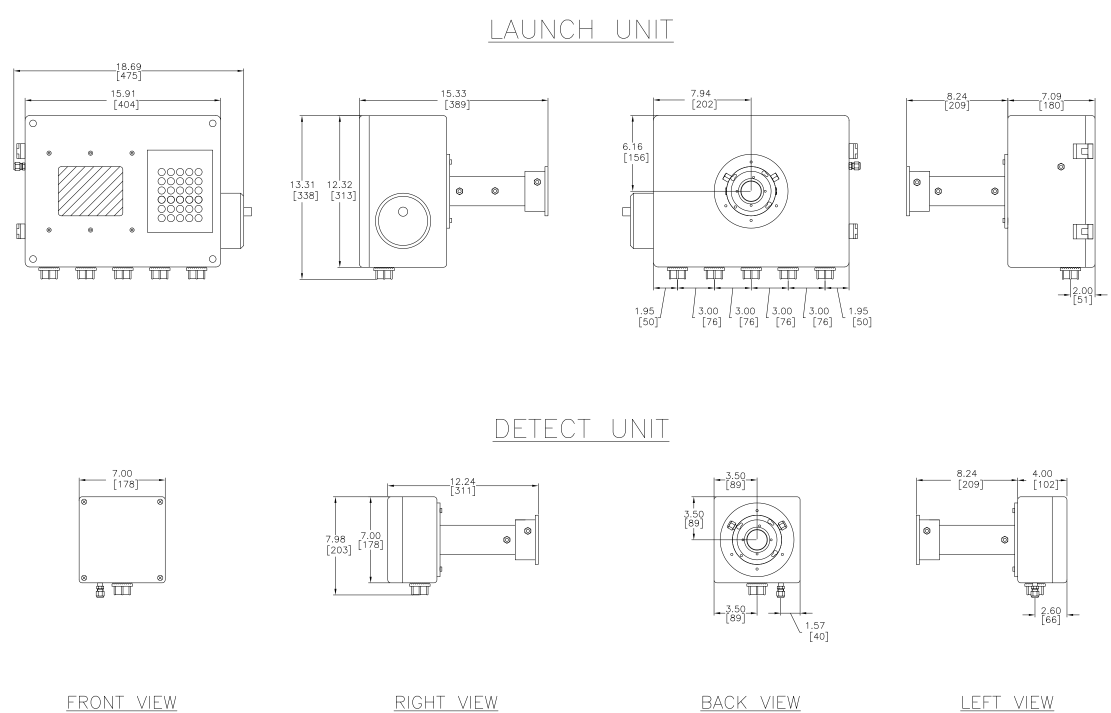


Figure 35 - Launch and Detect unit Dimensions

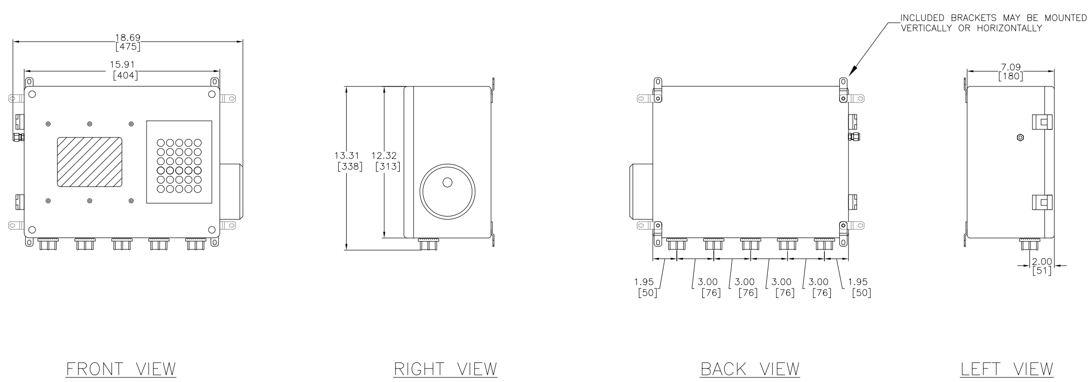


Figure 36 - Remote Interface Unit

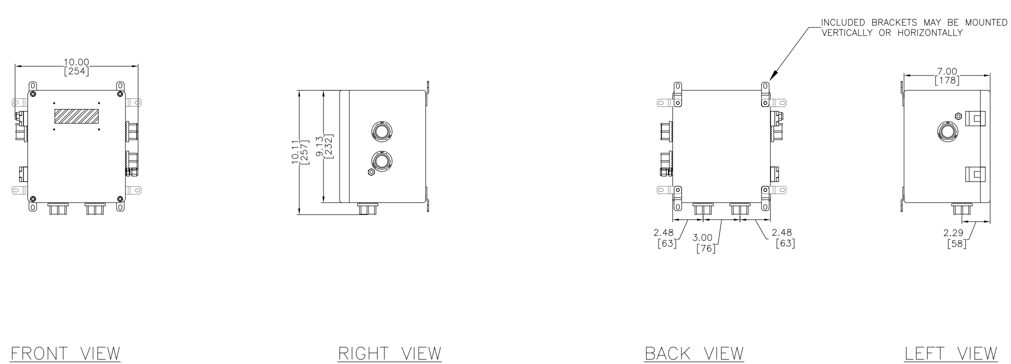


Figure 37 - Universal remote Display (URD)

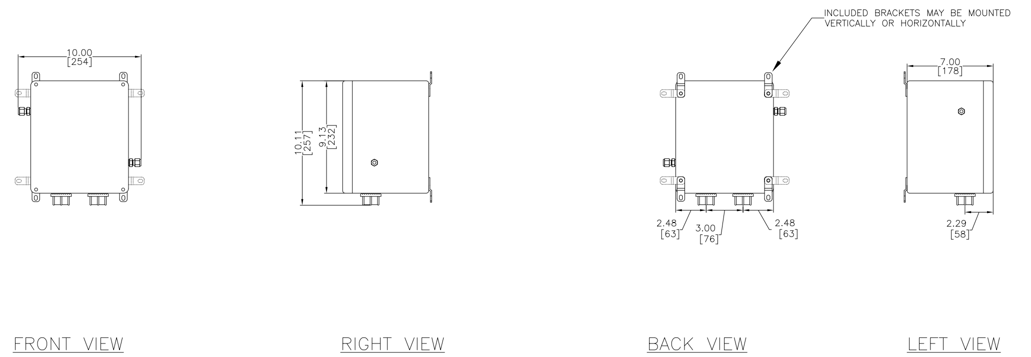


Figure 38 - Universal Power Supply (UPS)

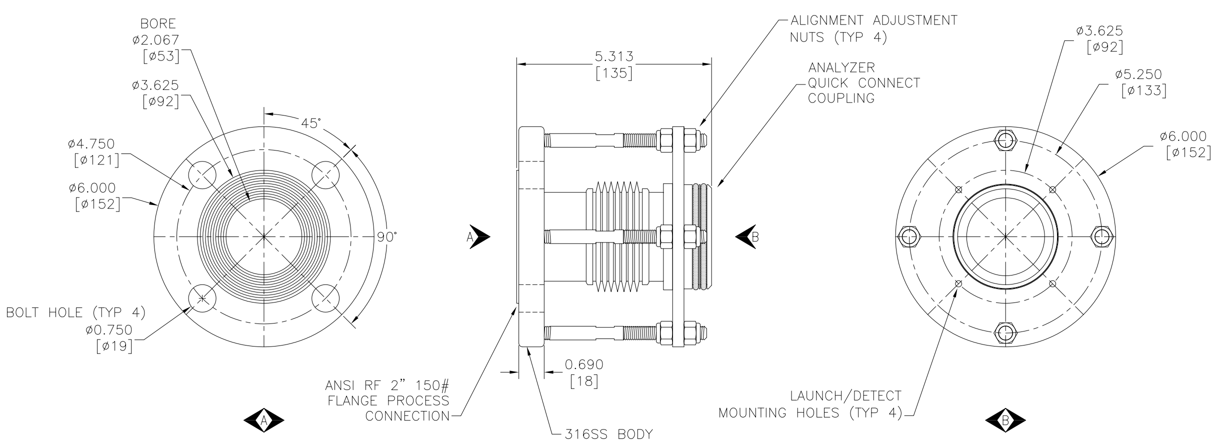


Figure 39 - Alignment Bellows * Other flange sizes available to meet application needs

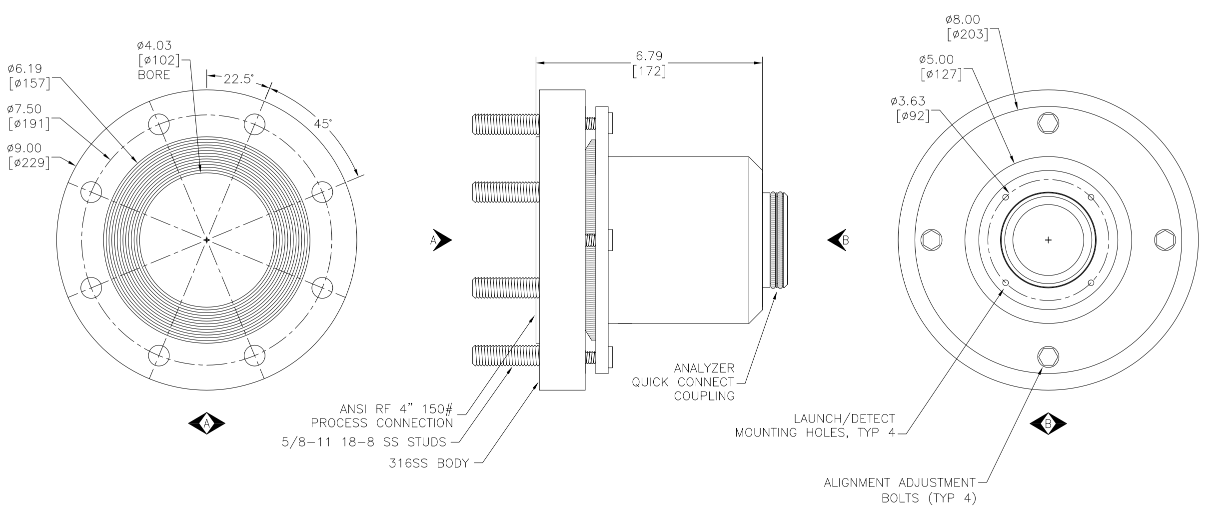


Figure 40 - Large Apenture * Other flange sizes available to meet application needs

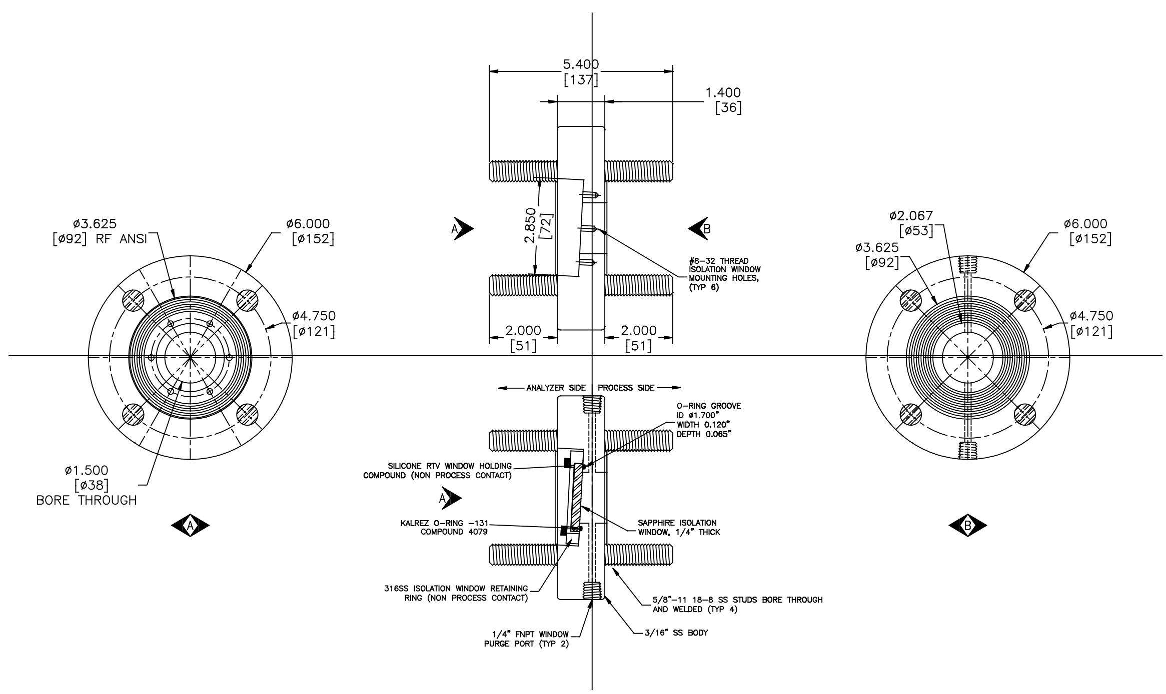


Figure 41 - Isolation Flanges, model IF200

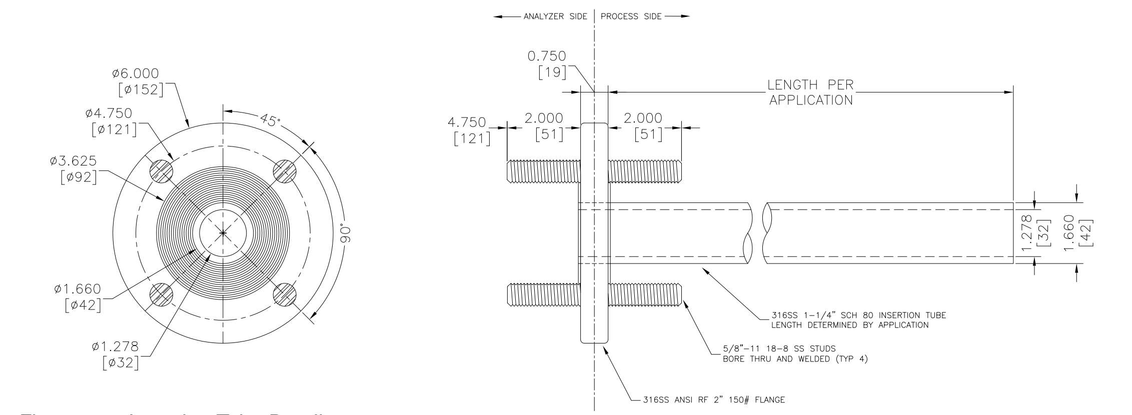


Figure 42 - Insertion Tube Detail

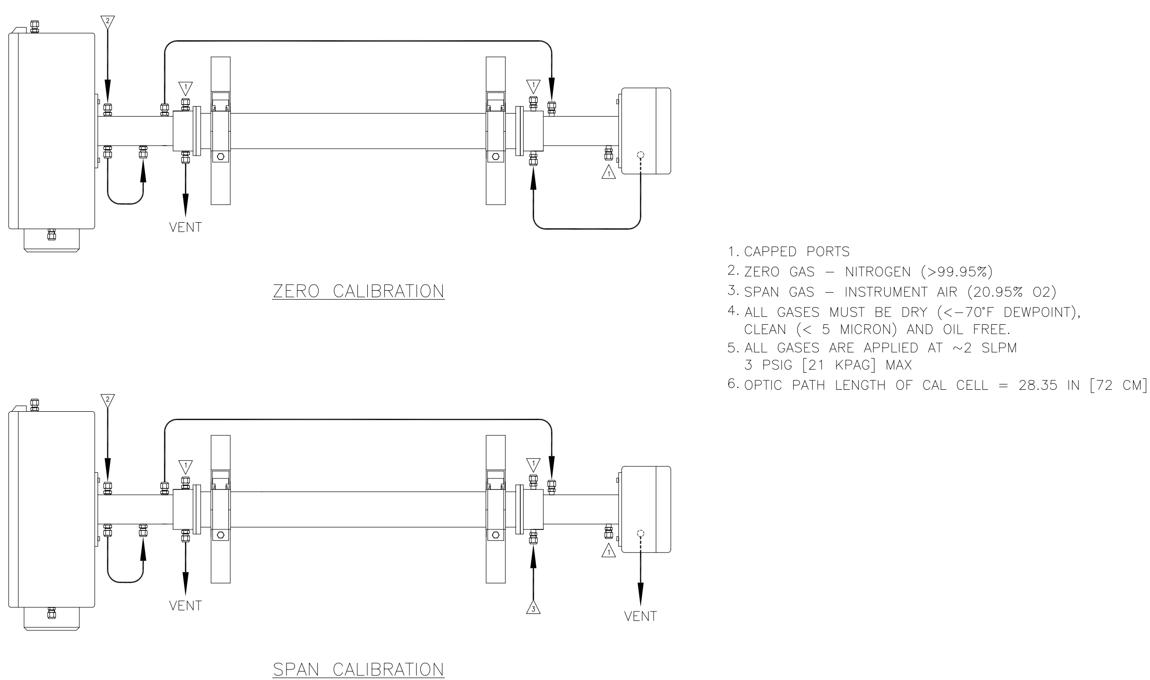
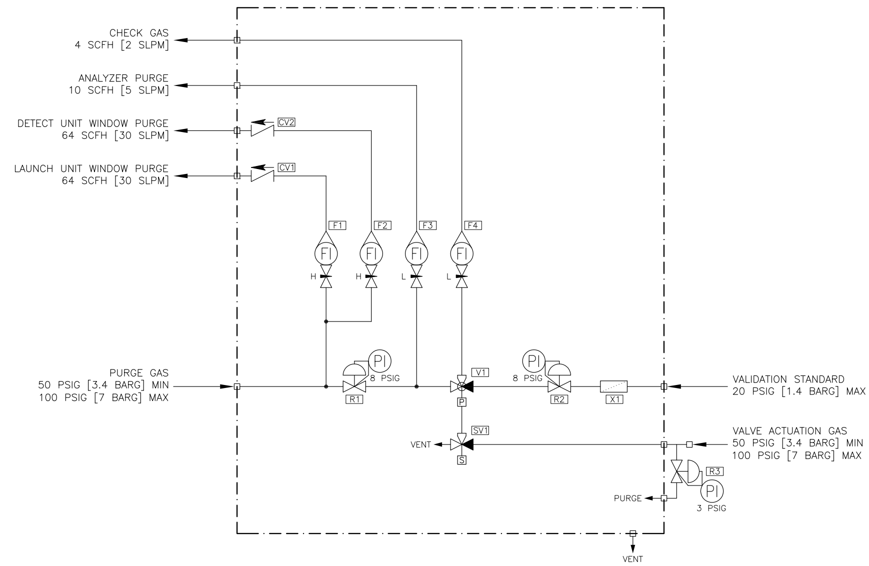


Figure 43 - Off-Line Calibration Gas and Purge Detail



NOTES
1. ALL TUBING SHALL BE 316SS, 1/4", 0.035" WALL UNLESS OTHERWISE INDICATED.
2. ALL TUBE FITTINGS SHALL BE SWAGELOK UNLESS OTHERWISE INDICATED.
3. ALL BULKHEAD CONNECTIONS ARE 1/4" TUBE UNLESS OTHERWISE INDICATED
4. ALL GAS SUPPLIES MUST BE CLEAN (<5 MICRON), OIL FREE AND DRY (<70 DEGF DEWPOINT)

Figure 44 - Utility Panel Tubing Detail Standard Single, Auto - validation

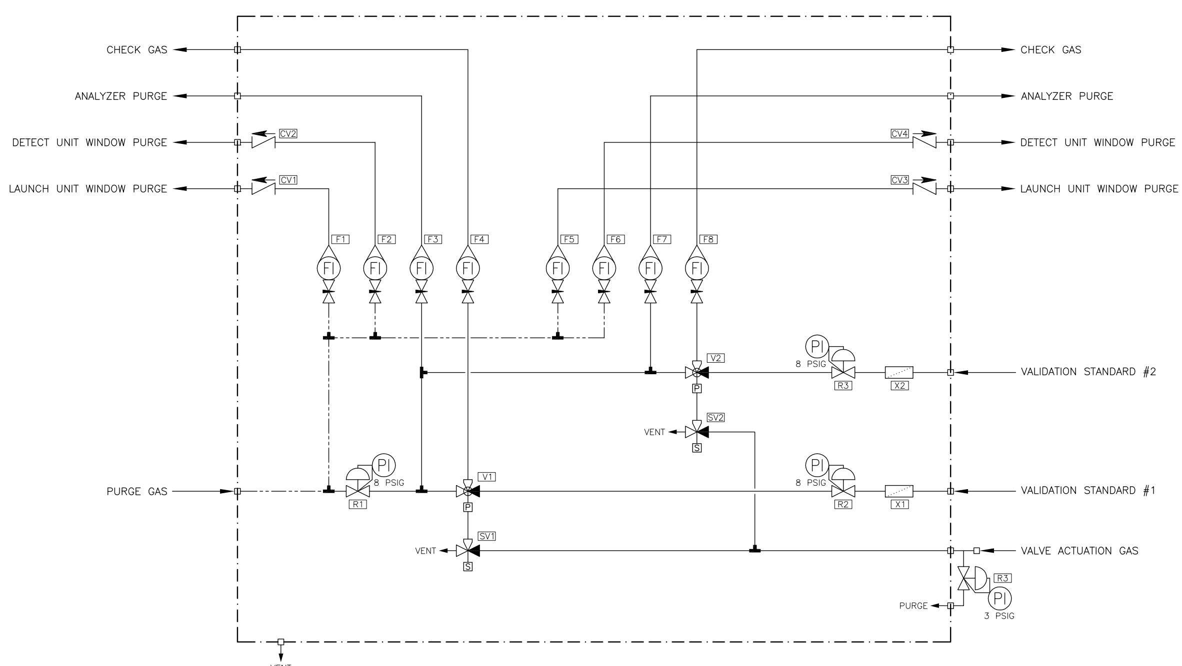


Figure 45 - Utility Panel Tubing Detail Standard Dual Auto - validation

5.10 Wiring

5.10.1 Wiring of Launch for the US version

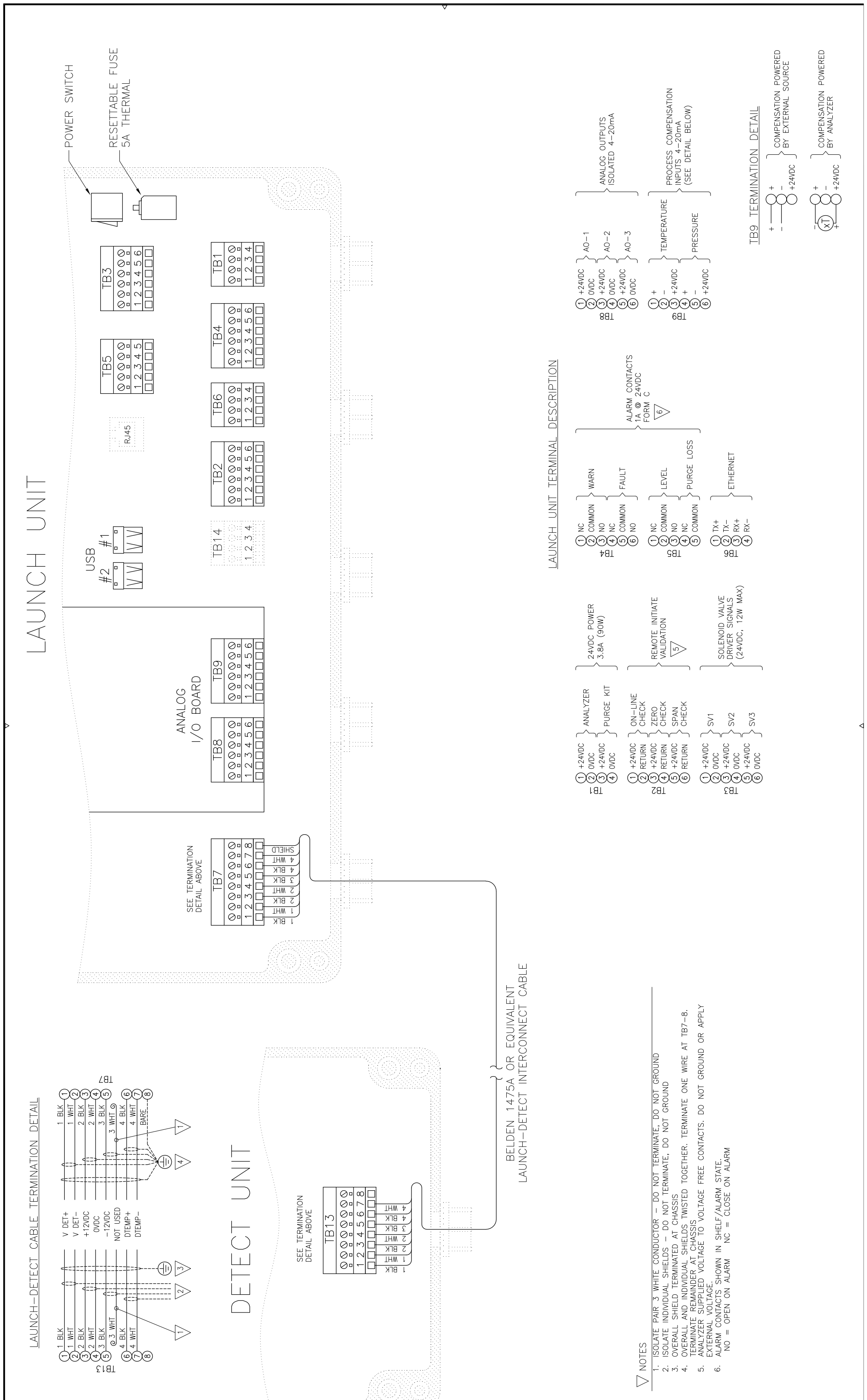


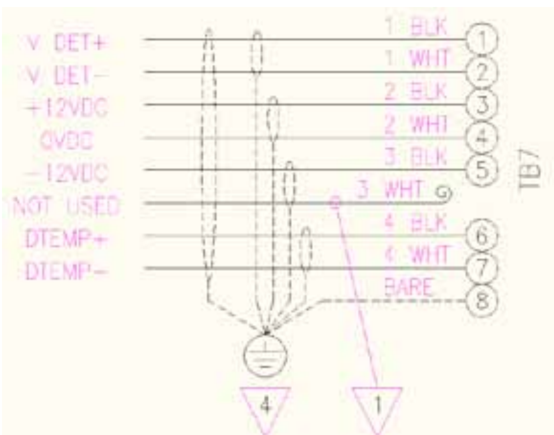
Figure 46

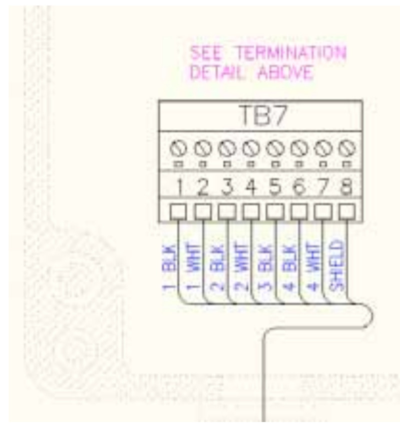
5.10.2 Launch and Detect Unit Wiring – Standard for CE/ATEX

SPECIAL NOTE: Noise sources magnetically coupled to the 4-pair launch to detect cable can cause errors to the measurement if the frequency and applied total voltage meet or exceed the following; Frequency range of 0.1 to 7.5 MHz and Total induced voltage of 3Vrms.

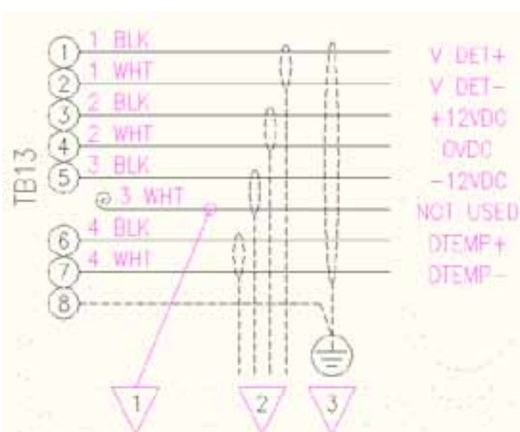
A combination of these parameters will cause measurement error outside of the analyzer performance specification. In practice, these potential errors can be easily avoided by routing the 4-pair launch to detect cable away from electromagnetic interference sources that could exhibit these parameters. Such sources might include power transformers, electric motors, electric welding machinery, high voltage power lines, etc. Analyzer grounding wires and any other I/O lines such as 8-pair launch to utility panel cable or A I/O cables to/from the DCS should also be installed with similar basic practices to also ensure there is no additional adverse influence on any of the I/O signals.

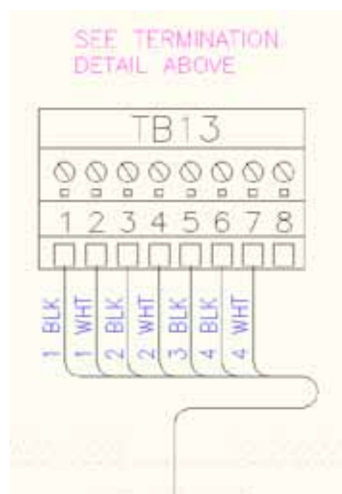
Launch Unit (to Detect) Terminations TB-7 (ensure 360° cable shield ground)





Detect Unit (to Launch) Terminations TB-7 (ensure 360° cable shield ground)

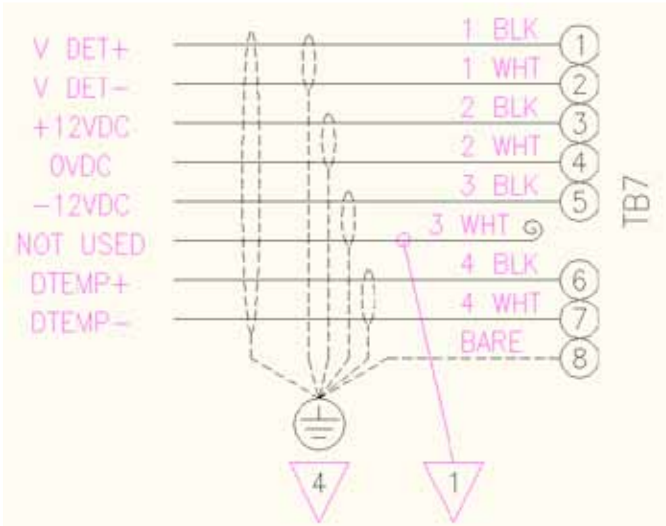


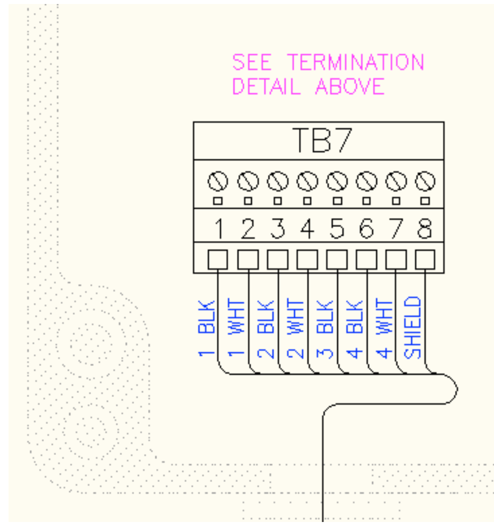


NOTES

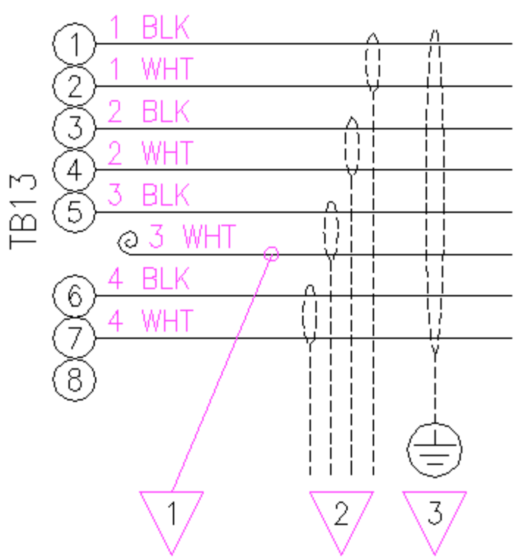
1. ISOLATE PAIR 3 WHITE CONDUCTOR – DO NOT TERMINATE, DO NOT GROUND.
2. ISOLATE INDIVIDUAL SHIELDS – DO NOT TERMINATE, DO NOT GROUND.
3. OVERALL SHIELD TERMINATED AT CHASSIS AND AT TB13–8.
4. OVERALL AND INDIVIDUAL SHIELDS TWISTED TOGETHER. TERMINATE ONE WIRE AT TB7–8. TERMINATE REMAINDER AT CHASSIS.
5. ANALYZER SUPPLIED VOLTAGE TO VOLTAGE FREE CONTACTS. DO NOT GROUND OR APPLY EXTERNAL VOLTAGE.
6. CABLE OVERALL SHIELD SHALL HAVE 360° GROUNDED CONTACT TO EARTH GROUND VIA GLAND AND HUB ASSEMBLY.

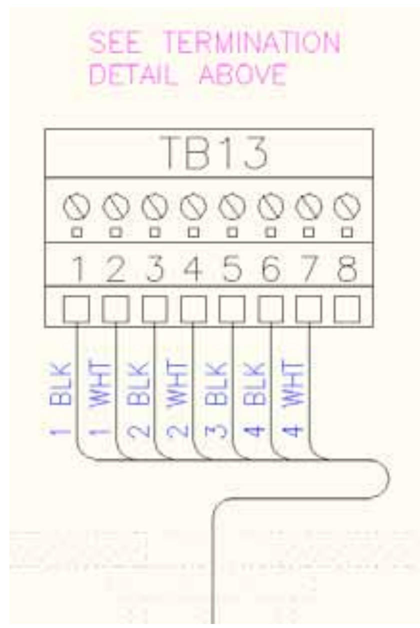
Launch and Detect Unit Wiring – Standard GP/Div2 (non CE/ATEX)
Launch Unit (to Detect) Terminations at TB-7





Detect Unit (to Launch) Terminations at TB-13

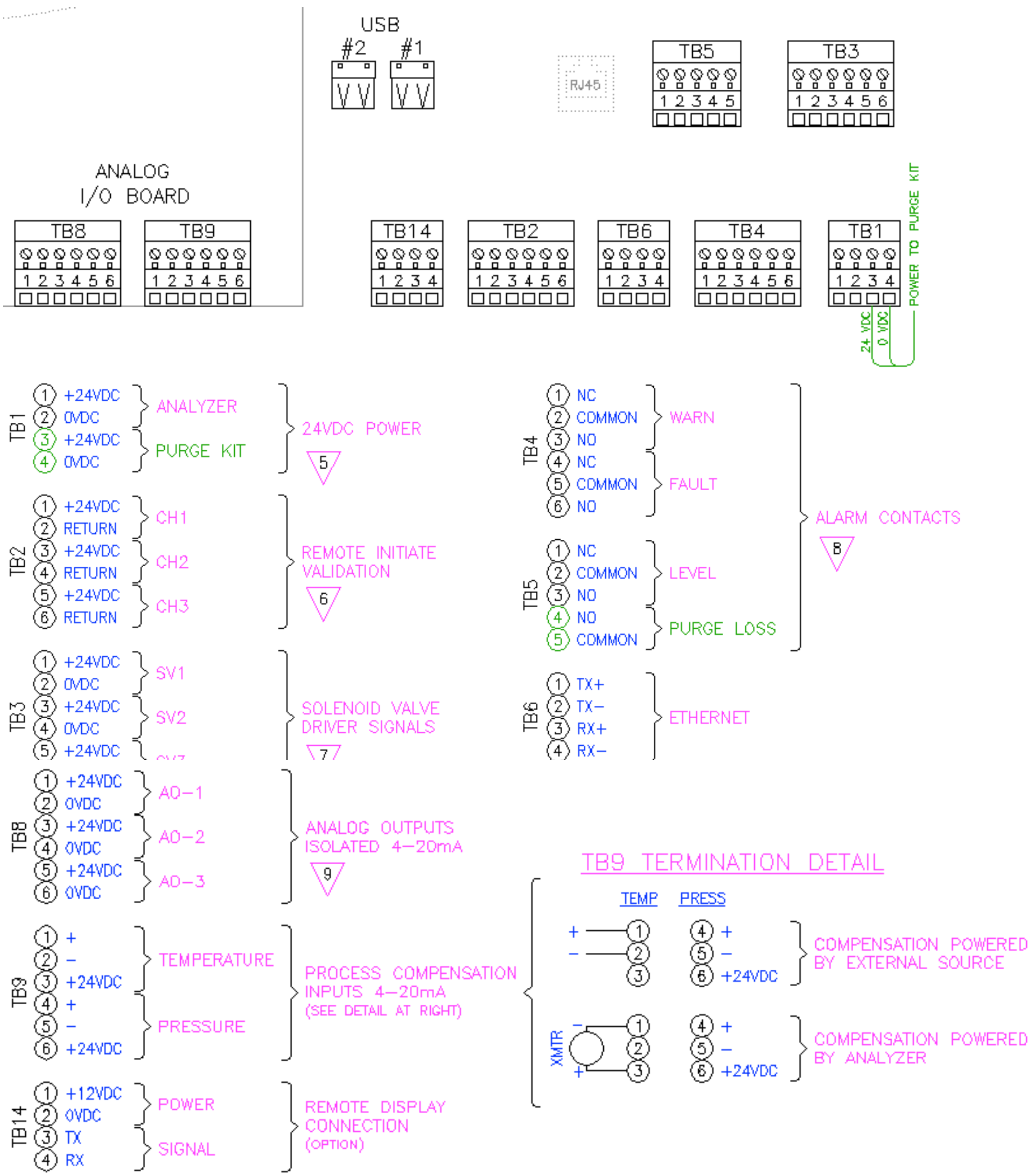




▽ NOTES

1. ISOLATE PAIR 3 WHITE CONDUCTOR – DO NOT TERMINATE, DO NOT GROUND.
2. ISOLATE INDIVIDUAL SHIELDS – DO NOT TERMINATE, DO NOT GROUND.
3. OVERALL SHIELD TERMINATED AT CHASSIS.
4. OVERALL AND INDIVIDUAL SHIELDS TWISTED TOGETHER. TERMINATE ONE WIRE AT TB7–8. TERMINATE REMAINDER AT CHASSIS.

5.10.3 Launch Unit Terminations CE/ATEX/GP/Div2 – all units:



SEE FOLLOWING NOTES:

Please NOTE that ALL analog output signals from TB-8 are POWERED BY THE ANALYER!
Outputs from TB-9 can be configured for POWERED inputs or LOOP POWERED external transmitter!

PLEASE CHECK CAREFULLY BEFORE APPLYING POWER TO THE ANALYZER!

▽ NOTES

1. ISOLATE PAIR 3 WHITE CONDUCTOR – DO NOT TERMINATE, DO NOT GROUND.
2. ISOLATE INDIVIDUAL SHIELDS – DO NOT TERMINATE, DO NOT GROUND.
3. OVERALL SHIELD TERMINATED AT CHASSIS.
4. OVERALL AND INDIVIDUAL SHIELDS TWISTED TOGETHER. TERMINATE ONE WIRE AT TB7–8. TERMINATE REMAINDER AT CHASSIS.
5. ANALYZER POWER SUPPLY MUST BE 24.0±0.5VDC REQUIRES MAX 4.0A (96W)
6. ANALYZER SUPPLIED VOLTAGE (24VDC) TO VOLTAGE FREE CONTACTS. DO NOT GROUND OR APPLY EXTERNAL VOLTAGE – DAMAGE TO ANALYZER WILL OCCUR.
7. ANALYZER PROVIDES 24VDC (12W MAX) FOR SOLENOID OR RELAY OPERATION.
8. FORM–C CONTACTS SHOWN IN SHELF/ALARM STATE. 1A @ 24VDC / 0.5A @ 125VAC NON–INDUCTIVE
   NO = OPEN ON ALARM NC = CLOSE ON ALARM
9. 4–20mA OUTPUT 900Ω MAX. 1500V ISOLATION.
10. REFER TO USERS MANUAL FOR OTHER DETAILS.
11. REFER TO FIELD WIRING DIAGRAM FOR TERMINATION DETAILS.

5.11 Hazardous Area Systems

The TDLS200 Analyzer requires a continuous nitrogen or I/A gas purge to prevent ambient oxygen ingress to the optical path, when oxygen is the measured gas. The flow rate can be minimized as long as it prevents any ambient oxygen ingress to the measurement optical path. Other purge gases may be used as long as they do not contain any of the measured gas and are clean, dry, etc. If using a purge gas that also contains the measured gas (e.g. purge with instrument air and measuring process/combustion oxygen) then the Non-Process Parameters software feature/parameters will have to be implemented.

For hazardous area operation, the same nitrogen purge gas is used to purge the entire analyzer (including non-optical path sections such as the electronics).

The process interface may also require purging to maintain clear windows, refer to Process Window Purge details separately.

NOTE: Please also refer to any separate Purge System Original Manufacturers Operating Instructions and Manuals in conjunction with this User Guide.

The Purge Systems are not manufactured by Yokogawa Laser Analysis Division.
Please also refer to separate detailed manufacturer's instructions and start-up information for any Zone 1 or Division 1 automatic purge controller unit operational details. Failure to follow the manufacturer's guideline can result in damages and/or non-functionality of the purging system!

5.11.1 Purging Analyzer for Hazardous Areas (with On-Line Validation)

- NEC/CSA Class 1, Division 2, Groups A-D
- **ATEX Zone 2 CAT 3 Dual regulators must be used on the inlet!**

The block diagram below shows the sections of the analyzer that require nitrogen purging. A Z-Type purge control system is fitted the Launch Unit and it includes a local indicator (Bright Green, rugged light) and pressure switch alarm contacts (open on loss of purge pressure). The purging should be carried in sequence typically as shown below. All purge gas connections are ¼" od Tube fittings.

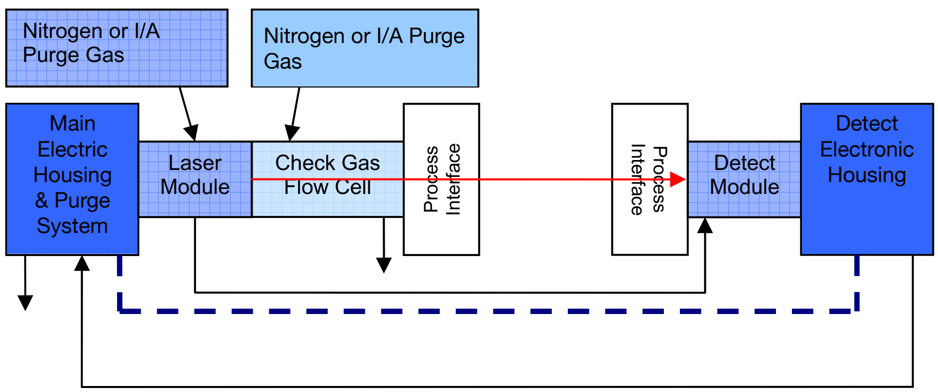


Figure 47 - Purge Flow Diagram when using on line validation

5.11.2 Purging Analyzer for Hazardous Areas (without On-Line Validation)

- NEC/CSA Class 1, Division 2, Groups A-D
- ATEX Zone 2 CAT 3 – Dual regulators must be used on the inlet!

The block diagram below shows the sections of the analyzer that require nitrogen purging. A Z-Type purge control system is fitted the Launch Unit and it includes a local indicator (Bright Green, rugged light) and pressure switch alarm contacts (open on loss of purge pressure).

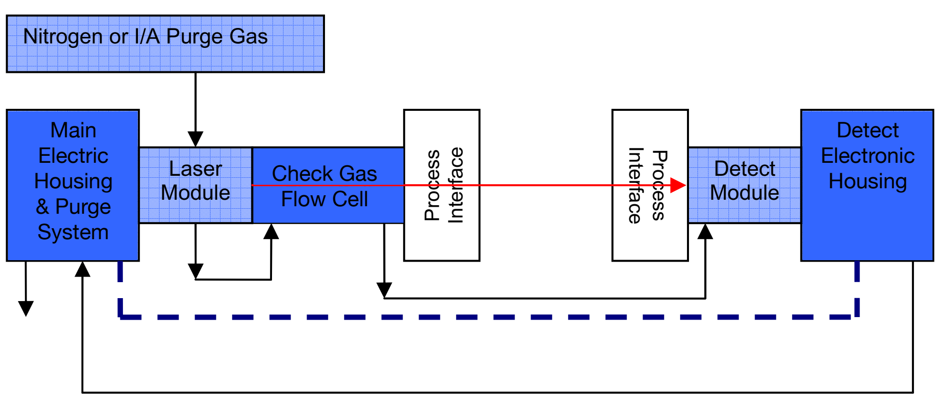


Figure 48 - Purge Flow Diagram when not using on line validation

5.11.3 Purging Analyzer and Universal Power Supply and/or URD for Hazardous Areas (with On-Line Validation)

- NEC/CSA Class 1, Division 2, Groups A-D
- ATEX Zone 2 CAT 3 – Dual regulators must be used on the inlet!

The block diagram below shows the sections of the analyzer that require nitrogen purging when using in conjunction with either or the Universal Power Supply and Universal Remote Display. AZ-Type purge control system is fitted the Launch Unit and it includes a local indicator (Bright Green, rugged light) and pressure switch alarm contacts (open on loss of purge pressure).

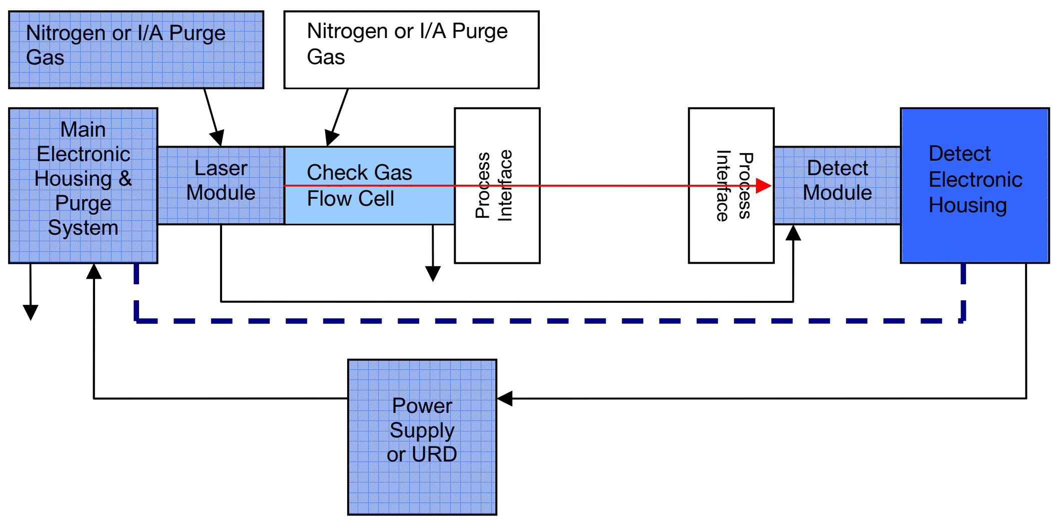


Figure 49 - Purge Flow Diagram when using on line validation

5.11.4 Purging Analyzer and Universal Power Supply and/or URD (not using On-Line Validation)

- NEC/CSA Class 1, Division 2, Groups A-D
- ATEX Zone 2 CAT 3 – Dual regulators must be used on the inlet!

The block diagram below shows the sections of the analyzer that require nitrogen purging. A Z-Type purge control system is fitted the Launch Unit and it includes a local indicator (Bright Green, rugged light) and pressure switch alarm contacts (open on loss of purge pressure). The purging should be carried in sequence typically as shown below. All purge gas connections are ¼” od Tube fittings.

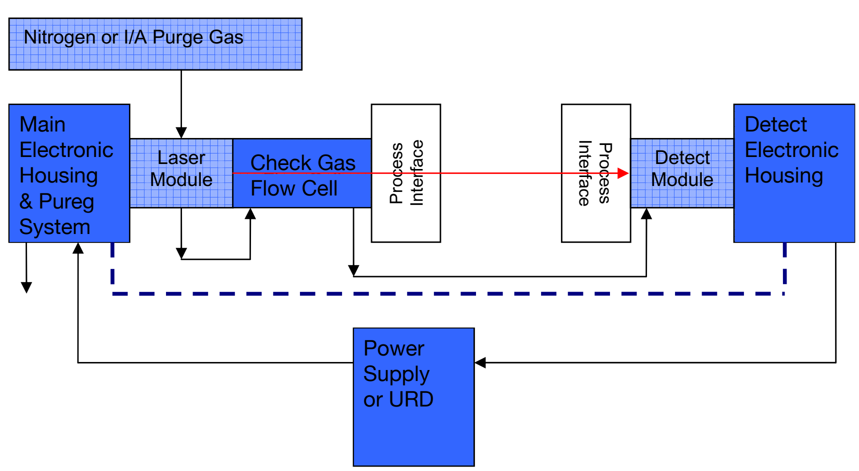


Figure 50 - Purging Analyzer for Hazardous Areas -NO- On-Line Validation

5.12 Cyclops Division 2/Zone 2 Purge Indictor, with switch

Type Z purging reduces the classification within a protected electronics enclosures from Division 2 or Zone 2 to nonhazardous. Failure to maintain pressure within the protected enclosure shall be detected by an alarm or indicator at the electronics enclosure. The dilution purge time shall be a manual operation and once the electronics enclosure has been purged of ignitable or flammable concentrations, only positive pressure of at least 0.20 inches H_2O (0.50 mbar) is required to be maintained within the electronics enclosure and it is not necessary to remove power from the protected equipment upon the loss of purge pressure. The CYCLOPS Z – Purge Indicator is used to provide safe monitoring of electrical equipment in Division 2 and Zone 2 hazardous areas, which can be used to prevent the possibility of fire or explosion inside the enclosure of energized electrical equipment, a protective gas supply is used to dilute potentially flammable materials to an acceptable level, creating a safe area for the electrical equipment within the enclosure. Positive pressure prevents the ingress of flammable materials in the surrounding atmosphere from entering into the enclosure, as long as positive pressure is maintained. After the enclosure is purged, power may be manually applied to the protected electrical equipment.

The CYCLOPS Z – Purge Indicator provides an objective evidence of the presence of adequate positive purge pressure within the electrical equipment enclosure. A normally open differential pressure switch continuously compares the pressure inside the monitored electronics enclosure with respect to the atmospheric pressure surrounding the electronics enclosure. When the monitored electronics enclosure register's a pressure of at least 0.20 inches H_2O (0.50 mbar) above the reference atmospheric pressure a manually controlled dilution time cycle may then begin. Typically, a minimum dilution time cycle is specified to ensure that at least five times the volume of free space in the electronics enclosure is exchanged before power is manually applied to the electrical equipment. (The number of exchanged volumes may be higher in some situations). After the manual dilution time cycle has elapsed and the monitored electronics enclosure pressure is being maintained above 0.20 inches H_2O (0.50 mbar), power may be manually applied to the electrical equipment within the purged electronics enclosure. The CYCLOPS Z – Purge Indicator is designed to indicate the presence of purge pressure from one pressure reference point. Several electronics enclosures can be installed in series with purge gas being introduced into the first electronics enclosure and the CYCLOPS Z – Purge Indicator monitoring the last electronics enclosure in the series; multiple electronics enclosures can now be monitored using only one CYCLOPS Z – Purge Indicator. The pressure inside the monitored electronics enclosures must maintain at least 0.20 inches H_2O (0.50 mbar) higher than the atmospheric pressure surrounding the electronics enclosure. This ensures that hazardous materials are not going to ingress into the pressurized and now protected electronics enclosures. If any of the electronics enclosures installed in the series door is opened, pressure will show to be below the required 0.20 inches H_2O (0.50 mbar) in all electronics enclosures. The exhaust vent which comes as part of the CYCLOPS Z – Purge Indicator casing, can exhaust purge gas from enclosures with volumes up to 15 cubic feet (425 liters).

Cyclops Features
Certified for installation and use in ATEX and IECEx for Type Z – Purge, II 3 G Ex nA nL [pz] IIC T6 For Zone 2 gas hazardous areas

Certified for installation and use in ATEX and IECEx for Type Z – Purge, II 3 G Ex nA nL [pz] IIC T6 For Zone 2 gas hazardous areas

Normal Operating Conditions	
Power	Certified for installation and use in ATEX and IECEx for Type Z – Purge, II 3 G Ex nA nL [pz] IIC T6 For Zone 2 gas hazardous areas
Manual Dilution Cycle Time To Energizing Electrical Equipment	Typically, dilution cycle time is to ensure that at least five (5) times the volume of free space in the enclosure of protective gas supply is exchanged before power is applied to the electrical equipment. Ten (10) times volumes for motors, generators and other rotating electrical machinery.
CYCLOPS Z – Purge Indicator, Minimum Pressure	Green indicator light remains on to show purge pressure being maintained above 0.20 inches H2O (0.50 mbar) in electronics enclosure being monitored.

WARNING: The number of exchanged volumes may be higher in some situations. Refer to TDLS-200 ATEX Purge Warning Labels for Details.

NOTE: Instrument Air and Nitrogen purge gases have different purge time requirement. It is important to use clean, dry purge gases to ensure the pressure switch contacts do not foul and cause subsequent operating issues (i.e. non-functionality of the Cyclops).

Utility Requirements	
Purge Protective Gas Supply Pressure to Pressure Regulator	20 psig (1.4 Bar) minimum (Suggested to compensate for enclosure leak rate)
Purge Protective Gas Supply Quality	Water and oil-free, - 40°F (- 40°C) dew point, particles ≤ 5μ, ISA grade hydrocarbon free
Power Input / Consumption	0.5 Watts maximum
Voltage CYCLOPS Z – Purge Indica-tor	4VDC model (19VDC to 28VDC) 47 to 63 Hz
Mains Supply Fluctuation	Not to Exceed 10%

Environmental Conditions	
Operating Temperature Range	- 40°F to 150°F (- 40°C to 65°C)
Used and Mounted	For Indoor and Outdoor Use

Casing Material Specifications	
Anodized Aluminum Weight	2.48 lbs (1.13 kg)
Anodized Aluminum Protection	NEMA 4 (IP66)

6 BASIC OPERATION

6.1 Menu Structure Map

Online Menu	Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Basic MENU	**Select A/O Mode** **-Block (mA value)** **-Track** **-Hold** *Password Protected	**Configure**	**Process Path Length** **Pressure*** **Temperature*** *(Similar to Process Path) **IP Address** **Serial No.** **Version**	**Old** New	
		View Spectra	**Raw Detect Spectrum** **Absorption Spectrum**	**Spectrum Capture** **Spectrum Capture**	
		Data	**Alarm History** **Cal History**	**View Data on-screen** **View Data on-screen**	
		Trends	**Refresh**	**Refresh Current Trend screen**	
			Gas 1 Concentration **STDEV of Gas 1 Concentration*** **Gas 2 Concentration*** **STDEV of Gas 2 Concentration*** **Transmission*** **Laser Temp Setpoint*** **Laser Temp in degC*** **Peak Center Position*** **Gas Temperature*** **Gas Pressure*** *(Similiar to Gas 1 Concentration)	**Min** Max Minutes	
ADVANCED *Password Protected	**Configure**	**Process Path Length**	**Current** **New**	**Confirmation of Change** **Confirmation of Change**	
		Pressure	**Fixed** **Active*** **Control*** *(similar to Fixed)	**Current-New** 4-20 mA & Backup Desired, Range, Center of Pressure control	**Confirmation of Change** **Confirmation of Change** **Confirmation of Change**
		Temperature	**Fixed** **Active Input*** **Active Ambient*** **Active Peaks*** **Control*** *(similar to Fixed)	**Current-New** 4-20 mA & Backup Offset Range of second peak option Desired range of tem control	**Confirmation of Change** **Confirmation of Change** **Confirmation of Change** **Confirmation of Change** **Confirmation of Change**
		Non-Process Parameter	**Path Length** **Pressure*** *(similar to Path Length)	**Current** New	
			Temperature	**Fixed or Active** value or offset	
			Concentration	**Gas 1 - Current** Gas 1 - New Gas 2 - Current Gas 2 - New	
			Alarm Selection	**Warning/ Fault** alarm PH threshold	
		Units	**Path Length**	**Select from in, ft, cm, m**	
			Pressure	**Select from psiA, barA, kPa, torr, atm**	
			Tempterature	**Select from °F, °C, °K**	

Online Menu	Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Advanced * Password Protected	**Configure**	**System I/O**	**Analog Output**	**Channel 1**	**Conc1/Conc2/Tran/Temp/Pres/ None** 4 mA- 20 mA
				Channel 2* ***(Always uses track mode)*** **Channel 3*** *(similar to Channel 1)	
				Warning Mode	**Block Mode** (mA value) Track mode Hold Mode **(**mA value)
				Fault Mode* *(similar to Warning)	
				Block Mode	**High (20 mA)** Low (3.3 mA)
				Field Loop Check	**CH 1 check, mA value** CH 2 check, mA value CH 3 check, mA value
				AO CH Calibration	**CH 1 Calibration** CH 2 Calibration CH 3 Calibration
		System I/O	**Digital Output**	**Warnings**	**Detector signal low** Transmission Low Spectrum noise hig Process pressure out of range Process temperature out of range Concentration out of range Board temperature out of range DO-Warning delay
				Faults	**Laser temperature out of range** Detector signal high Dectecor signal lost Measurement peak no response Peak center out of range + 2nd gas threshold Walidation failure + base concen-trations DO-fault delay
				User Alarm	**Conc/ Trans/ Val/ Cal** High/Low and limit DO-use alarm delay
		System	**Serial Number**		
			Laser Serial Number		
			Password	**Old Password** New password	**Confirmation of Change**
			Software Version		
			Date & Time	**New Date** New Time	
			System Temperature	**Launch Unit (°C)** Detect Unit (°C)	
			TCP/IP	Set new IP address, sub-net mask and default gateway	
			Adjustable Resistors	**Laser** Detect - R21 Detect - R22 Detect - R23	
		Valve Control	**Valve 1**	**Manual**	**On/Off**
				Time Sequence	**Next Valve Selection** Valve-on duration in minutes
			Valve 2* **Valve 3*** *(similar to valve 1)	**Restore Control**	**Remote control channel**
		Signal			
		Processing			
		Laser Spectra & Control	**Gas 1 Concentration**		
			Gas 2 Concentration		
			Gas temperature		
			Gas pressure		
			Transmission		
			Laser Temperature in °C		
			Peak Position		

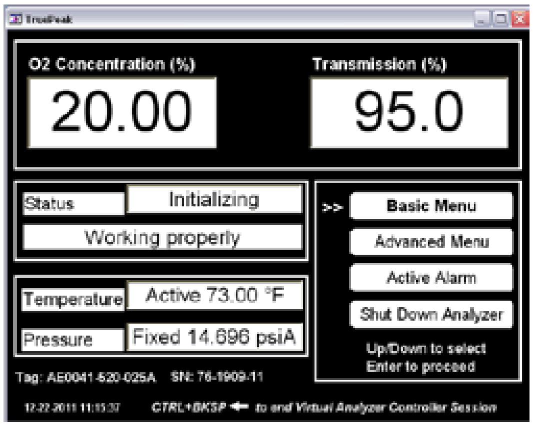
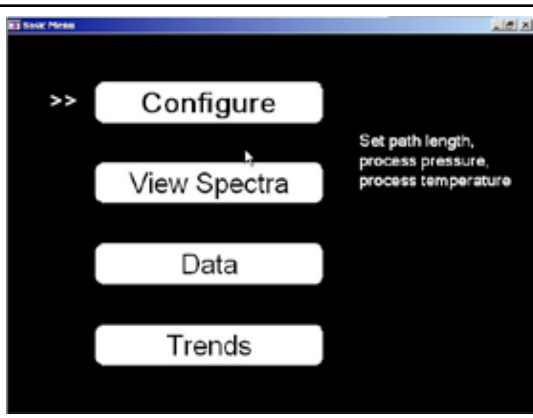
Online Menu	Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
ADVANCED *Password Protected	**Configure**	**Laser Spectra & Control**	**Peak Width**		
			Control Mode	**Manual** Automatic	
			Max Current Laser Temp Set* *(similar to Max Current)	**Current** New	
			Spectrum Capture		
			LTSP Limits	**Low** High	
			Fast Update	**Enable/Disable**	
	Calibration	**Offline Calibration**	**Zero Calibraton**	**Manual**	**pres, temp opl, gas, type, conc**
				Automatic	**Local Initate** Remote Initiate: control channel Time Initate: frequency Settings: valve, purge, tiime, AO mode gastype, conc, opl, temp, pres
				Restore	**Old Calibration** Factory Calibration
			Zero Offset	**Current** New	
			Span Calibration	**Manual**	
				Automatic	**Local Initiate** Remote Initiate: control channel Time Initiate: frequency Settings: conc, opl, temp, pres
				Restore	**Old Calibration** Factory Calibration
			Transmission		
			Dark Current		
			Peak Search	**Peak with Lower WL**	
				Opeak with Higher WL	
				All Peaks	
				Result Display	
		Offline Validation	**Validation Gas 1**	**Manual**	**Pres, temp, opi, gas, type, conc**
			Validation Gas 2* **Two Gas Validation *** *(similar to Gas 1)	**Automatic**	**Local Initate** Remote Initate: control channel Time Initiate: frequency Settings: conc, opl, temp, pres, gastype, valve,purgetimes, AO mode
		Online Validation	**Check Gas 1**	**Manual**	**Local Initate** Remote Initate: control channel Time Initiate: frequency Settings: conc, opl, temp, pres, gastype, valve,purgetimes, AO mode
		Clear Validation Alarms	**Check Gas 2*** *(similar to Gas 1)	Automatic	
	Data	**Alarm History**			
		Cal History			
		Spectrum Capture	**Manual**		
			Automatic	**Updated** Relative Absolute Warning Fault	

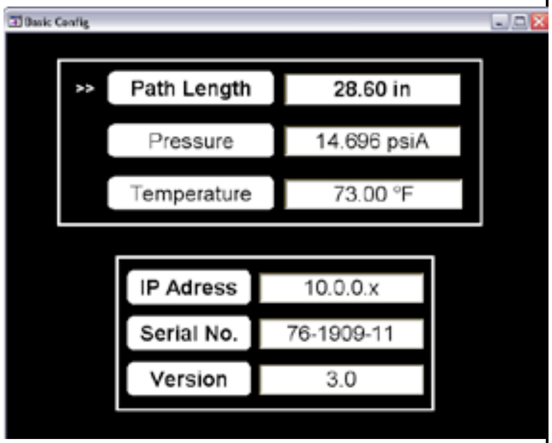
Online Menu	Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
		Trends	Refresh	Refresh Current Trend screen	
			Gas 1 Concentration STDEV of Gas 1 Concentration* Gas 2 Concentration* STEV of Gas 2 Concentration* Transmission* Laser Temp Setpoint* Laser Temp in DegC* Peak Center Position* Gas Temperature* Gas Pressure* *(Similar to Gas 1 Concentration)	Min Max Minutes	

	Display Text	Description
Line 1 - Measurement	O2 xx.x %	Measured gas and unit of measurement For Gas 1 and/or Gas 2 as configured
	moisture xx.x ppm	
Line 2 – Transmission or Second Gas Measurement	Transmission xx.x %	Laser light transmission strength (0-100% range)
	CH4 xx.x %	Second measurement gas and unit
Line 3 - Status	Initializing……	shown during the power-up and initialization of the analyzer
	System OK	Normal Operation condition with no active alarms
	WARNING Det Sig Low WARNING Trans Low WARNING Spectr Noise WARNING Gas Pres WARNING Gas Temp WARNING Gas Level WARNING Board Temp	WARNING Conditions
	FAULT Laser Temp FAULT Det Sig High FAULT Det Sig Lost FAULT Peak Response FAULT Peak Center	FAULT Conditions
	Zero Calibrating… Span Calibrating… Offline Validating… Online Validating…	Validation Status
	Data Transferring… Transfer Success Transfer Failure	Data Transfer Status
Line 4 - Information	Yokogawa TDLS SN 76-1xxx-05-xx AO1: CONC xx-xx%/ppm/ppb/mg/m3 or mg/Nm3 AO2: TRANS xx-xx% AO3: TEMP xx-xxF/C/K 10.0.0.35 TEMP Act/Con/Fox xx F/C/K PRES Act/Con/Fix xx.x PsiA/BarA/KPa/torr/atm OPL xx.x in/ft/cm/m Launch xx deg C Detect xx deg C	Analyzer Name Analyzer Serial No. Configured 4-20mA output for AO1, AO2, & AO3 Static IP Address Process Gas Temperature used for gas concentration calculation Process Gas Pressure used for gas concentration calculation Optical Path Length over which the analyzer is measuring the target gas Launch unit internal temperature Detect unit internal temperature

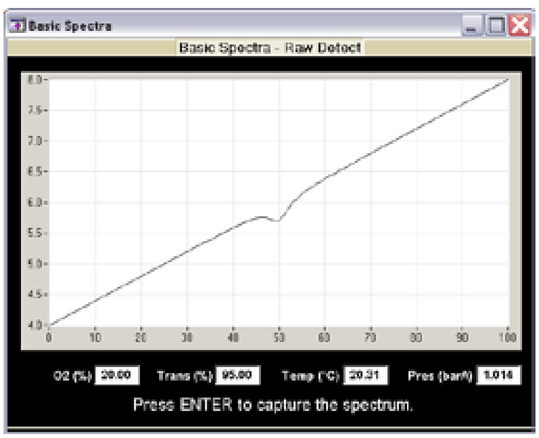
6.2 Software Guide

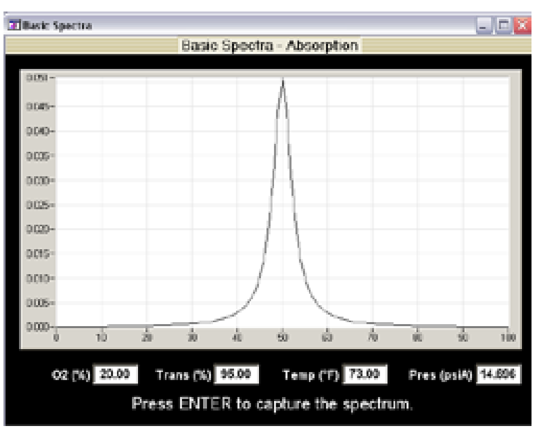
NOTE: At any time in the Main Menu, press the F5 key (only on Screen & Keypad versions) to toggle the LCD backlight on/off. If there is no keypad (or VNC) activity for 30 minutes then the LCD backlight will automatically switch off, press any key to restore backlight.

	**MAIN MENU (Home Page)** Display of Concentration & Transmission (or 2nd Concentration) Status Window – notification of initiating, working properly, warnings or faults Gas Temperature Gas Pressure Selection of Basic or Advanced Menu Tag No and Serial No. (SN.) configured to analyzer Active Alarm Display Button Analyzer Shut Down Button
	After selection of either Basic or Advanced Menu you will see the Output Selection screen. PLEASE note the RIGHT ARROW key access to the MENU (older version of software require no other key or Press 9 to access MENU) This allows control of the analog output while the user is working in the analyzer software. Enter mA value form 0-20. • Block will hold outputs at user selectable mA (example shows 3.8mA) until return to Main Screen but **NOTE CHANNEL 2 ALWAYS TRACKS!** • Track will allow outputs to continue to report concentration and transmission until return to Main Screen • Hold will hold outputs at their current value until return to Main Screen **NOTE CHANNEL 2 ALWAYS TRACKS!**
	**BASIC MENU** Configure – allows setting of Path Length, Gas Temperature, Gas Pressure View Spectra – user will select display of raw detector signal or absorption spectra Data – Alarm History, Calibration History Trends – Allows for the displaying of data in a trend format



BASIC CONFIGURE
PATH LENGTH – allows adjustment of the optical path (distance the laser is exposed to the process gas).
PRESSURE – allows adjustment of the gas pressure value if using fixed pressure. If the analyzer is using active pressure compensation (live signal fed from pressure transducer) no changes are allowed. Active pressure compensation settings are found in Advanced Menu.
TEMPERATURE – allows adjustment of the gas pressure value if using fixed pressure. If the analyzer is using active pressure compensation (live signal fed from pressure transducer) or active ambient, no changes are allowed. Active pressure compensation settings are found in Advanced Menu.
IP ADDRESS – displays the analyzer IP address
SERIAL NO. – displays analyzer serial number
VERSION – software version number

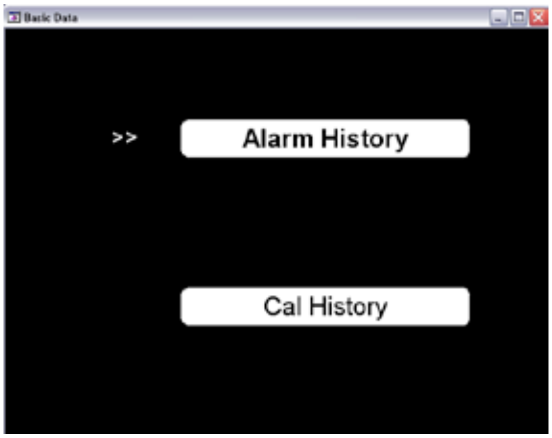
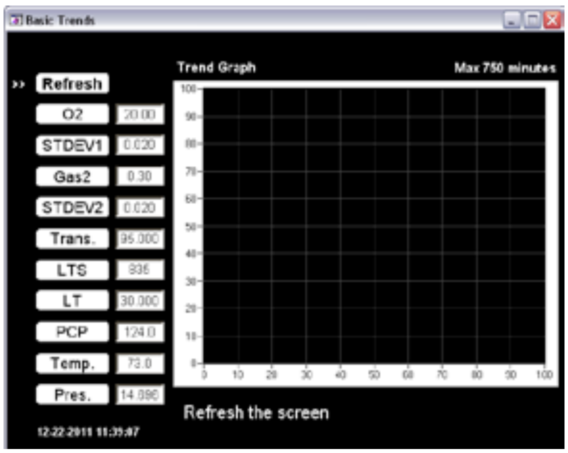


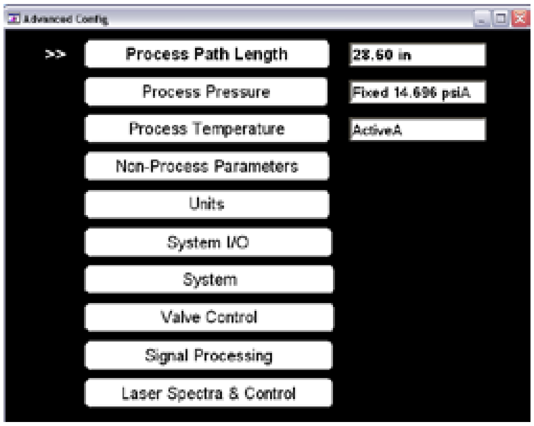


The spectra screen (raw detect, left or absorption, below) allows capture and view of current spectra.

The screen auto scales the vertical (Y) axis; this will result in a visually noisy spectra when at low gas levels.

In fact the spectra may not be noisy, but simply that the display range is extremely low.

<table>
<tr>
<td>
</td>
<td>The BASIC DATA MENU allows the user to select:
ALARM HISTORY – displays the last 17 alarms and faults with brief description, date and time
CALIBRATION HISTORY - displays the last 17 calibration events with adjustment amount, date and time</td>
</tr>
<tr>
<td>
</td>
<td>The TREND SCREEN is identical for BASIC or ADVANCED MENUS. It allows the user to trend up to the last 750 minutes (of current day) of data for:
REFRESH - The trend will NOT update automatically, use the refresh button to update the trend
CONC. – analyzer reading of gas concentration (shown here as O2, or whatever Gas 1 is configured)
STDEV1 – the standard deviation of 25 consecutive concentration readings (for gas concentration 1)
Gas2. – analyzer reading of gas 2 concentration
STDEV2 – the standard deviation of 25 consecutive concentration readings (for gas concentration 2)
TRANS. – transmission % of laser light through the process gas
LTS – analyzer laser temperature set point
LT – analyzer laser temperature
PCP – peak center position for the absorption peak
TEMP – process gas temperature
PRES – process gas pressure
Alongside the selection buttons the current value is displayed.
When selecting the information to trend user will be prompted to enter minimum value, maximum value and time to trend.</td>
</tr>
</table>

<table>
<tr>
<td>


</td>
<td>
ADVANCED CONFIGURE MENU
PROCESS PATH LENGTH – allows user to enter in a new optical path length (distance laser is exposed to process gas)
PRESSURE – allows selection of ACTIVE (analyzer fed pressure value from external transducer) or FIXED (value entered into software) process gas pressure. In Active mode, a Back-Up value can be entered, in case of active input failure. CONTROLLED is not applicable for TDLS-200.
TEMPERATURE – allows selection of ACTIVE (analyzer fed temperature value from external transducer), ACTIVE AMBIENT (ambient gas temperature derived from internal sensor) or FIXED (value entered into software) process gas temperature. In Active mode, a Back-Up value can be entered, in case of active input failure. ACTIVE PEAKS is used for special Oxygen applications only, please consult with Yokogawa directly. CONTROLLED is not applicable for TDLS-200.
NON-PROCESS PARAMETERS – allows mathematical subtraction of purge gases that contain the target gas. Example would be Instrument air purge when measuring Oxygen or CO line locking gas for combustion CO applications.
UNITS – selection as defined below, independently
SYSTEM I/O – allows set up and assigning of analyzer Analog and Digital I/O
SYSTEM – displays analyzer information (serial number, Fat date, password, software version, launch/detect unit temperatures, etc.), allows setting of date/time, TCP/IP.
VALVE CONTROL ¬– allows for manual and/or automatic control of the valve driver output signals
SIGNAL PROCESSING – Factory set parameters only
LASER SPECTRA & CONTROL – displays spectra and allows manual control of laser
</td>
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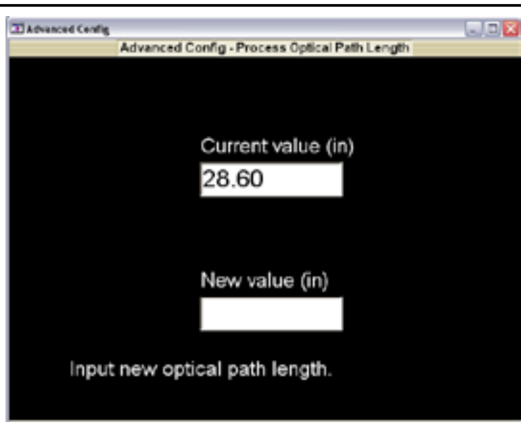
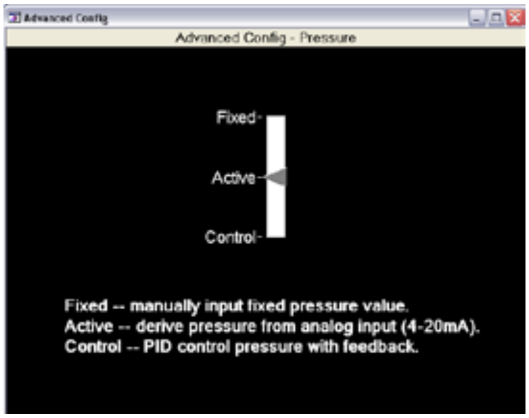
<tr>
<td>


</td>
<td>
PROCESS PATH LENGTH
Enter the distance over which the laser will be exposed to the process gas, this excludes any purge paths. Consider just the distance of process gas exposure to the laser beam path. Consult Yokogawa is any assistance required. For by-pass applications with window purges, typically the center line distance from inlet-outlet pipes is used. For combustion applications, the distance inside the refractory for example.

NOTE: for extractive applications, this will match the flow cell condition, typically 40”.

NOTE: when using an off-line calibration cell the standard optical path will be 28.6” (72.6cm)
</td>
</tr>
</table>

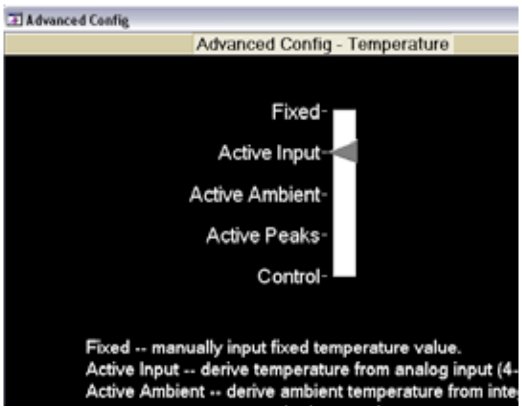


PROCESS PRESSURE

FIXED is used when the process gas pressure will not vary under normal operating conditions when the measurement is required. If there is any process pressure variation, then the results are typically affected proportionally according to gas law. Fixed is most suited to ~atmospheric conditions, such as vent lines and combustion.

ACTIVE is used when the highest degree of accuracy is required under variable process pressure conditions or when specified for the given application. The range must match the 4-20mA input range and a back-up value may be entered in case the input signal fails

CONTROL is not used in TDLS-200



PROCESS TEMPERATURE

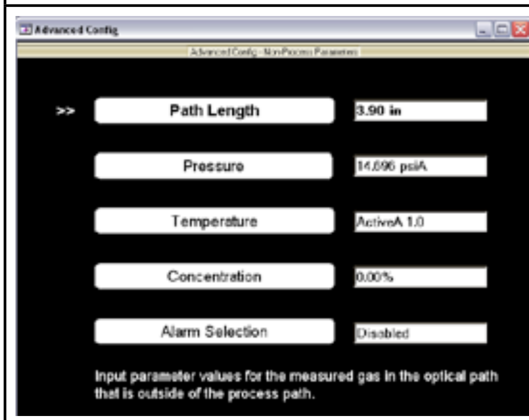
FIXED is used when the process gas temperature will not vary under normal operating conditions when the measurement is required. If there is any process temperature variation, then the results are typically affected according to the specific application.

ACTIVE INPUT is used when the highest degree of accuracy is required under variable process temperature conditions or when specified for the given application. The range must match the 4-20mA input range and a back-up value may be entered in case the input signal fails

ACTIVE AMBIENT is used when the process gas generally follows ambient temperature. It is not as accurate as an active input but it is more accurate than a Fixed value

ACTIVE PEAKS is used for special high temperature oxygen combustion application when the gas is above 800˚C – used only when approved by Yokogawa and not functional <800˚C

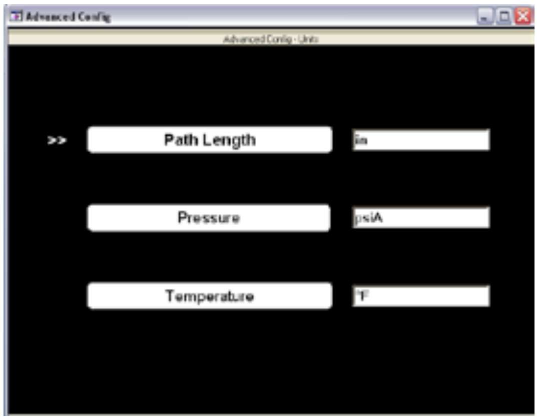
CONTROL is not used in TDLS-200



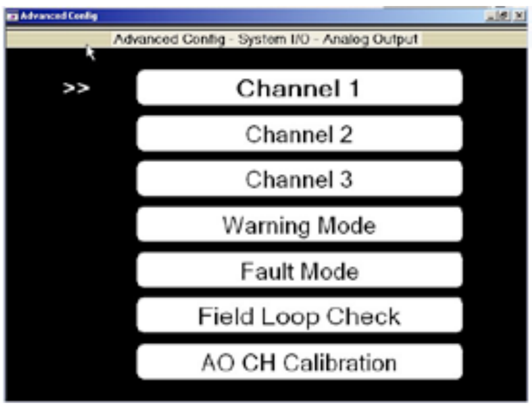
NON-PROCESS PARAMETERS

This software feature allows the user to enter all necessary parameters associated with the Non-Process Parameters configuration.

Refer to detail section of User Guide for more information and follow the on-screen directions for programming details

<table>
<tr>
<td>
</td>
<td>UNITS
Path Length, select the appropriate units of measure for Path Length: in/ft/cm/m

Pressure, select the appropriate units of measure for Pressure: psiA, barA, kPa, torr, atm

Temperature, select the appropriate units of measure for Temperature: F, C, K</td>
</tr>
<tr>
<td>
</td>
<td>SYSTEM I/O - ANALOG OUTPUT
CHANNEL 1 to 3 – configuring each 4 to 20mA channel to output Concentration, Transmission, Gas Temperature, Gas Pressure or None. NOTE, Channel 2 DOES NOT follow the Block/Track/Hold modes and is typically assigned to Transmission
WARNING MODE – setting of mA output response during analyzer warnings (Block, Track, Hold)
FAULT MODE – setting of mA output response during analyzer warnings (Block, Track, Hold)
FIELD LOOP CHECK – allows specified 4-20mA output levels to check and distinguish between the three analog output connections; select analog output channel 1, 2, or 3 to check and input new value to output
AO CH CALIBRATION – Pre-Calibrated at factory and not normally required. Allows calibration of 4 to 20mA output channels; follow onscreen instructions.</td>
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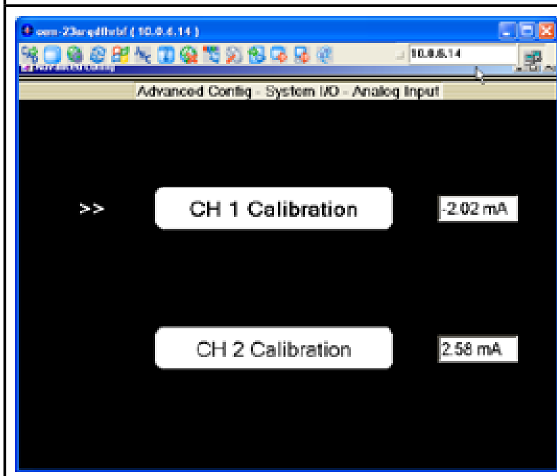
<td>
</td>
<td>SYSTEM I/O - ANALOG INPUT, Field Checking
Review the displayed mA values to field check the incoming analog signals</td>
</tr>
</table>

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SYSTEM I/O - DIGITAL OUTPUT
Setting of Digital Output assignments (DO 1-3)
CHANNEL 1 WARNINGS – Setting of levels that will trigger analyzer warning and subsequent DO
CHANNEL 2 FAULTS – Setting of levels that will trigger analyzer fault and subsequent DO
CHANNEL 3 USER ALARM – Setting of either Concentration or Transmission level (high or low), calibration/validation status that will trigger analyzer user alarm DO/status
FIELD LOOP CHECK – allows for convenient field loop checking of the digital alarm output contacts, follow the on-screen directions

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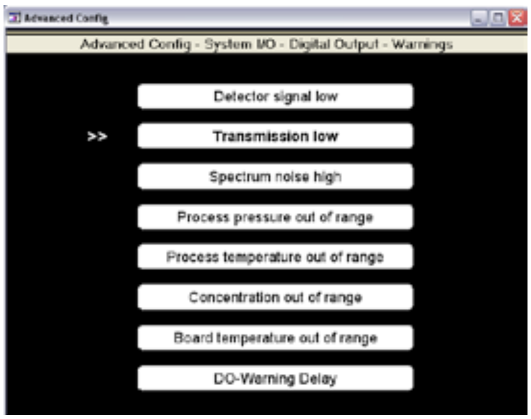

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<td>

CHANNEL 1 - WARNINGS
Menu allows setting of various analyzer WARNINGS conditions. WARNING is an event that will indicate that maintenance is require and the analyzer is still operational.
– PLEASE ADJUST WITH ONLY FACTORY ASSISTANCE – WARNINGS CONDITIONS ARE IMPORTANT SETTINGS

DETECTOR SIGNAL LOW – lower raw detector signal limit
TRANSMISSION LOW – lower limit of transmission. Note, when transmission falls below this value, the automatic peak tuning function is disabled. This is to prevent excessive noise (caused by low transmission) interfering with correct peak tuning.
SPECTRUM NOISE HIGH – factory set, do not adjust
PROCESS PRESSURE OUT OF RANGE – typically set for the min-max expected process pressure. Note, if operating outside the known conditions, measurement accuracy may be affected
PROCESS TEMPERATURE OUT OF RANGE – typically set for the min-max expected process temperature. Note, if operating outside the known conditions, measurement accuracy may be affected
CONCENTRATION OUT OF RANGE – set for any desired alarm points
BOARD TEMPERATURE OUT OF RANGE – used to indicate excessively hot-cold ambient conditions for the analyzer
DO-WARNING DELAY – to avoid single event alarms that have proven to be short terms events, enter a number of readings to delay before the alarm becomes active

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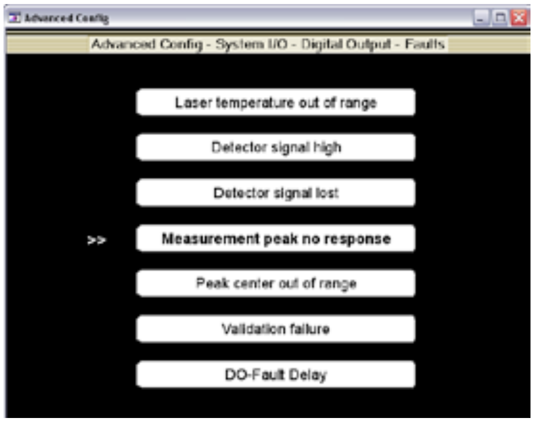


CHANNEL 2 FAULTS

Menu allows setting of various analyzer FAULT conditions. FAULT is an event that will eliminate the measurement integrity, it is an indication that maintenance is require and the analyzer is not operational.

– ONLY ADJUST WITH FACTORY ASSISTANCE – FAULT CONDITIONS ARE CRITICAL SETTINGS THAT CAN RESULT IN DAMAGE TO THE ANALYZER IF IMPROPERLY PROGRAMMED -

LASER TEMPERATURE OUT OF RANGE – upper and lower fault conditions for laser temperature

DETECTOR SIGNAL HIGH – upper raw detector signal limit

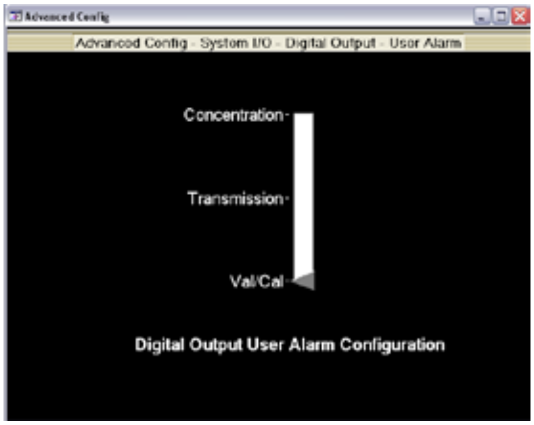
DETECTOR SIGNAL LOST – lower raw detector signal limit

MEASUREMENT PEAK NO RESPONSE – Used when Line Locking gas and/or Non-Process Parameters are enabled to detect the loss of absorption peak, i.e. the measured absorption peak falls below the set threshold value – consult factory for further details if attempting to implement Line-Locking gas and/or non-process parameters. **To disable this Fault (only under guidance from factory authorized personnel) please enter a value of -1**

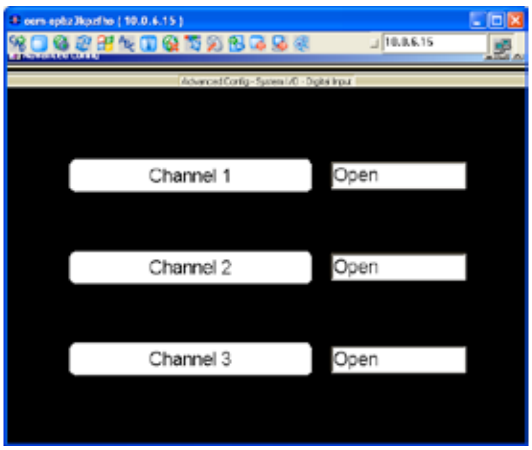
PEAK CENTER OUT OF RANGE – loss of peak center control

VALIDATION FAILURE – Allows the user to refine the most appropriate +/-% for validation PASS/FAIL criteria. Some process and conditions of application will require a large PASS/FAIL criteria (as much as +/-50%) due to the variables and dynamic nature of the application. On-Line Validation can be considered as Response Checking. Please consult Yokogawa for further information and help in determining what an appropriate Pass/Fail criteria is for the specific application.

DO FAULT DELAY - this feature allows the end user to minimize potentially non-impacting nuisance alarms by adding some delay before the analyzer reports the Fault Alarm



CHANNEL 3 - USER ALARMS
Enables digital output alarm for concentration value (High or Low), Transmission (High or Low) or Validation/Calibration (the contact changes state during a validation or calibration)



DIGITAL INPUT – STATUS CHECK
The user can check the status of remote Digital Inputs

<table>
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<td>
SYSTEM
Some settings are not adjustable by user, user adjustment is possible for:
PASSWORD – changes password for ADVANCED menu access
DATE & TIME – changes analyzer date and time
TCP/IP – the analyzers real IP address used for Ethernet communications can be changed via this menu option. External keyboard with Windows key no longer required as in older software versions.
ADJUSTABLE RESISTORS: After detector gain adjustment in the field, these values should be entered – these values are then stored to the syste.cfg file.
SETTINGS USED ONLY FOR STORING FACTORY DATA: Analyzer S/N, Laser S/N, Software Version,
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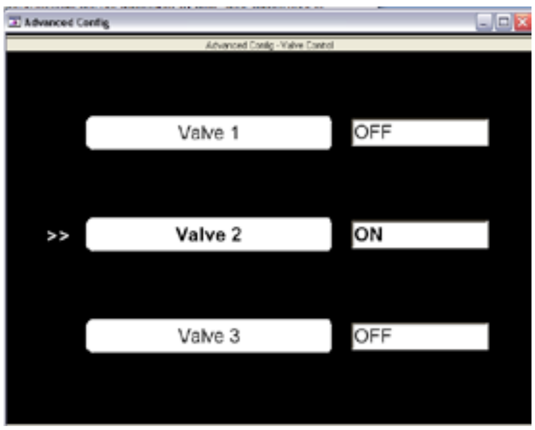
<td>


</td>
<td>
VALVE CONTROL
Typically used when the analyzer is configured with a flow cell in an offline application. These values can also be used manually to introduce on-line validation gases. Valve configuration conflicts will be noted on-screen if applicable
VALVE 1 – Manual (On-Off Toggle), Time Sequence (next valve and time seconds to next valve) or Remote Control (select D/I channel for control) capability, follow the on-screen directions to program Valve 1
VALVE 2 – Manual (On-Off Toggle), Time Sequence (next valve and time seconds to next valve) or Remote Control (select D/I channel for control) capability, follow the on-screen directions to program Valve 2
VALVE 3 – Manual (On-Off Toggle), Time Sequence (next valve and time seconds to next valve) or Remote Control (select D/I channel for control) capability, follow the on-screen directions to program Valve 3
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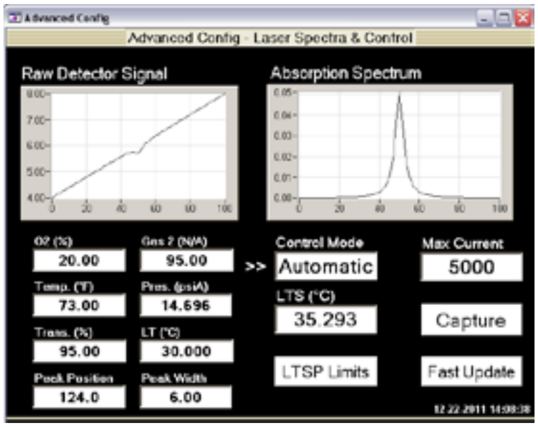
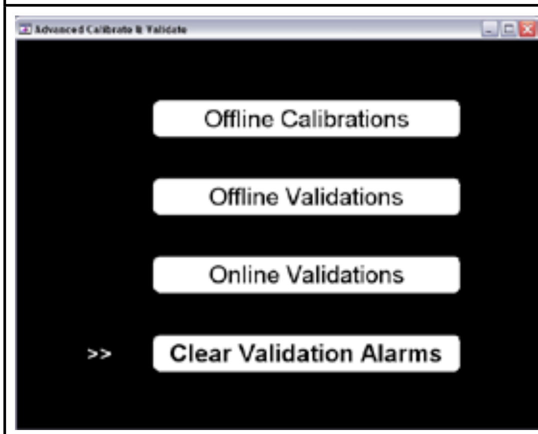
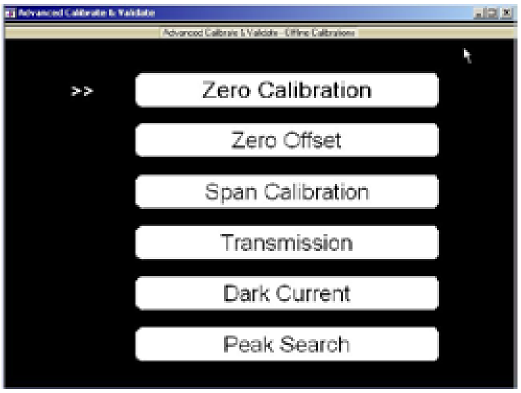


LASER SPECTRA & CONTROL
Displays Raw Detector Signal and Absorption Spectrum as well as Gas Concentration, Gas Temperature, Gas Pressure, Transmission, Laser Temperature, Peak Center Position and other parameters
CAPTURE – allows a manual spectra capture (user will be prompted to enter a unique file name for captured spectra)
CONTROL MODE – allows selection of Automatic (laser temperature is controlled to keep peak centered using peak center position as set point) or Manual (laser temperature is controlled using integral laser temperature sensor). Important auto-tune peak-height threshold values should not be adjusted without factory guidance – ONLY ADJUST WITH FACTORY ASSISTANCE
Manual adjustment of the laser temperature set-point (LTS) may be done with care and factory guidance – used only to re-adjust the absorption peak position if the peak has moved outside of the normal operating range – advanced troubleshooting.
LASER TEMP SETPOINT (LTS) – In manual mode allows adjustment of laser temperature – ONLY ADJUST WITH FACTORY ASSISTANCE. NOTE, the analyzer will return to automatic mode if un-touched for 30 minute!
LTSP LIMITS – setting of guard limits for laser temperature set point – ONLY ADJUST WITH FACTORY ASSISTANCE
MAX CURRENT – setting of center point for laser current ramp –ONLY ADJUST WITH FACTORY ASSISTANCE
FAST UP-DATE – this function can be Enabled (faster update times) or Disabled (normal operation) as necessary. When enabled, the analyzer up-date is approximate twice as fast as normal to allow for faster/easier alignment during commissioning or troubleshooting. Normal up-date time is restored automatically after 30 minutes when the screen saver/ backlight feature also enables



ADVANCED CALIBRATE & VALIDATE MENU
OFFLINE CALIBRATIONS – allows zero calibration, zero offset, span calibration, transmission adjustment,
OFFLINE VALIDATIONS – allows manual or automatic configuration of check gases 1 or 2 or a separate two gas check
ONLINE VALIDATIONS – allows manual or automatic configuration
CLEAR VALIDATION ALARMS – allows the user to clear the validation alarm if the user knows that the analyzer is functioning and tuned to correct absorption peak.

<table>
<tr>
<td>


</td>
<td>
OFFLINE CALIBRATIONS
ZERO CALIBRATION – manual or automatic calibration of Zero - ensure there is no absorption peak feature before performing a zero calibration, failure to do so can result is false low readings later when the un-desired target gas has been removed.
ZERO OFFSET – allows manual adjustment of Zero by applying a concentration offset – use only with factory guidance
SPAN CALIBRATION – manual or automatic calibration of Span – use only when sure the purge paths are correctly configured
TRANSMISSION – adjustment of transmission value
DARK CURRENT – DISABLED feature, Factory use only
PEAK SEARCH – DISABLED feature that initiates a system scan of absorption peaks to validate current peak selection is correct, Factory use only
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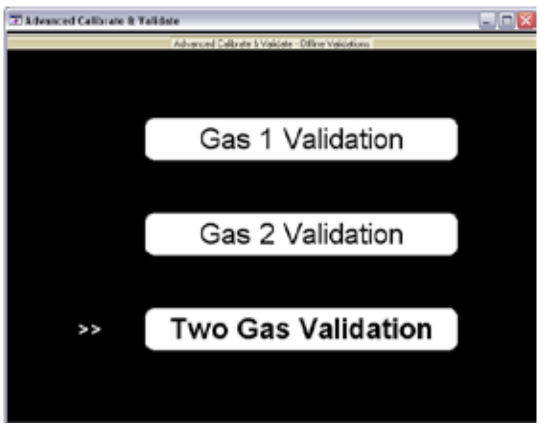
<td>


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<td>
OFFLINE VALIDATIONS
CHECK GAS 1 to 2 – allows manual or automatic configuration up to 2 check gasses.

Two Gas Validation – allows the user to configure two validation gas checks sequentially.

An example would be Oxygen analyzers used for Marine Vapor Recovery applications whereby a single “validation” command shall execute both a zero and span gas check.
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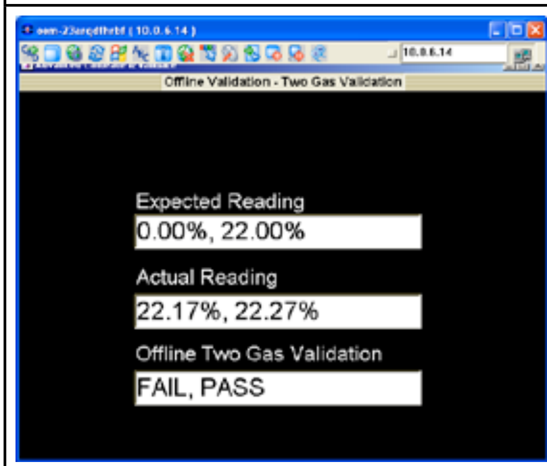
<td>


</td>
<td>
Results for the two gas off-line validation are shown for both gases along with their corresponding results
</td>
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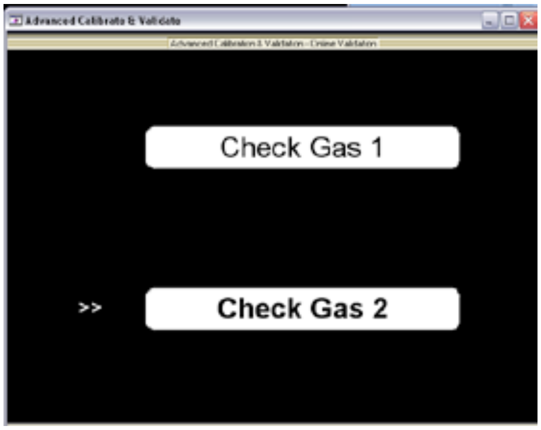
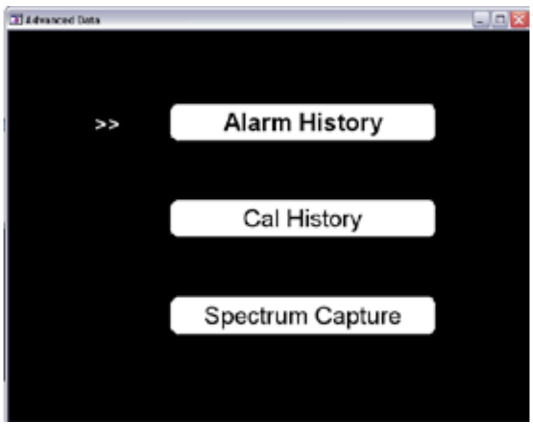
</table>



ONLINE VALIDATIONS

CHECK GAS 1 – allows user to select and configure the on-line validations for check gas #1. The configuration options include Manual or Automatic.
Automatic has selections for Local Initiate, Remote Initiate, Time Initiate as well as Settings for these options

CHECK GAS 2 – allows user to select and configure the on-line validations for check gas #2. The configuration options include Manual or Automatic.
Automatic has selections for Local Initiate, Remote Initiate, Time Initiate as well as Settings for these options



ADVANCED DATA MENU

ALARM HISTORY – shows chronological list of analyzer's most recent alarms
CAL HISTORY – shows chronological list of analyzer's recent calibrations
SPECTRUM CAPTURE – selection of; AUTOMATIC (user will be prompted to select capture interval, number of UPDATES to trigger capture, RELATIVE concentration level trigger which is a % of reading change, or ABSOLUTE concentration level to trigger capture); in addition the software will prompt for number of spectra to capture when a Warning or Fault occurs. MANAUL selection will result in spectra capture only when requested by user.

CAUTION! By setting a high spectrum capture rate (i.e. a low number between up-dates), the memory can very quickly fill up and because the system uses a First-In First-Out basis, you may lose many data files for results (.res) and spectrum (.spe). As a guide, spectrum is captured every 200-300 up-dates and 1-5 every Warning and 1-5 every Fault. The spectrum capture rate can be increased by lowering the up-dates value on a short term basis for a particular monitoring period but please ensure it is returned to normal rates.

An example could be the monitoring of a dirty process whereby transmission becomes very low during certain known process operating conditions. The spectrum capture rate could be changed to 2 for a 1 hour per period when these conditions exist and then set back to 200-300 after. This then gives a lot of spectrum data to review for the specific operating conditions.

6.3 Non-Process Parameters

Non-Process Parameters is the Yokogawa Laser Analysis Division term used to define regions of the optical path that may be purged with a gas containing the actual target (measured) gas. The most common application of this is to use Instrument Air (~20.9% O_2) as the purge gas for analyzers measuring Oxygen in the process.

Another common use of this feature is “Line Locking” whereby some target gas (typically %CO for CO/CH4 combustion analyzers) is locked into the validation cell at all times and therefore its absorption contribution must be accounted for.

The valve functionality of Line Locking has four stages as shown below.

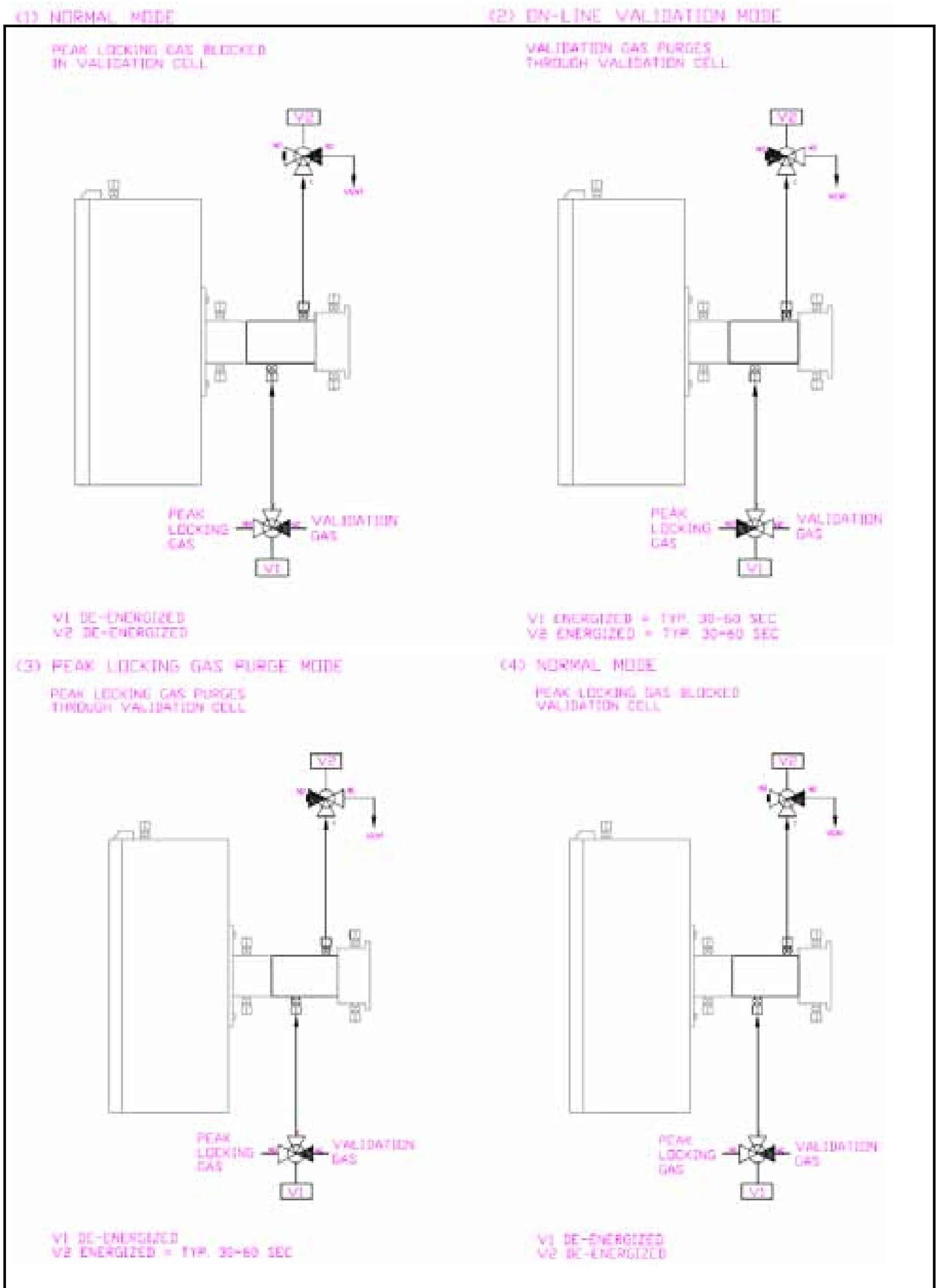


Figure 51

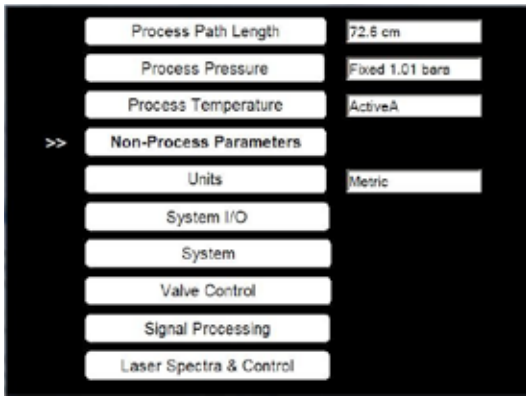
If measuring CO in the process gas and the purge gas is Instrument Air, then these parameters are not applicable because the CO concentrations typically found in Instrument Air are below practical detection limits.

In order for the analyzer to measure correctly under these purge conditions, the analyzer must know the correct parameters such that the measured output value has been compensated i.e. the oxygen in the purge gas has been taken into account when determining the process oxygen concentration.

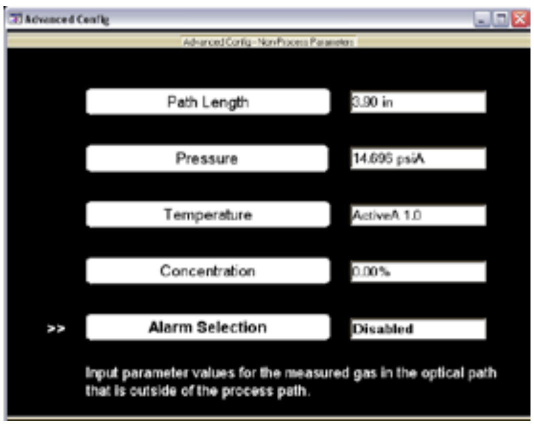
Oxygen present in the Instrument Air purge may exist in several section of the optical path including:

- Inside the Launch unit body, laser module section
- Inside the Launch unit body, online validation cell
- Inside the Launch unit alignment flange
- Inside the launch side process nozzle (and valve)
- Inside the Detect unit body
- Inside the Detect unit alignment flange
- Inside the Detect side process nozzle (and valve)

It is important that these dimensions are known as they will need to be programmed in – if in doubt, please contact Yokogawa Laser Analysis Division.**Calibration** – The analyzer **MUST** be calibrated (Zero and Span) as per the normal methods outlined in the standard User's Guide. When performing a Zero Calibration, ensure that the entire optical path is purged with Nitrogen. When performing a Span Calibration, ensure the correct procedures are followed!

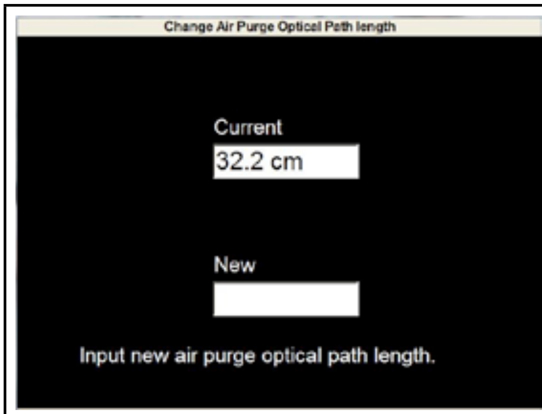


ADVANCED CONFIGURE MENU (UPDATED)
The Advanced Configure Menu has been updated with a sub-section titled **Non-Process Parameters.**

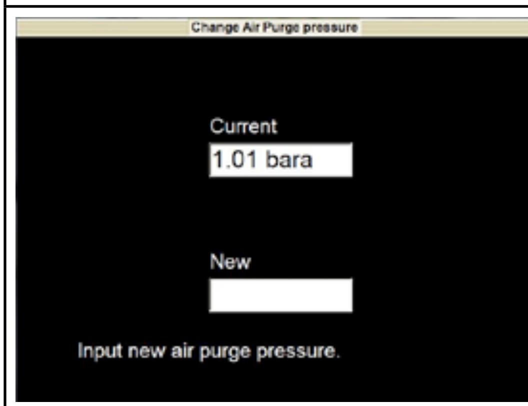


NON-PROCESS PARAMETERS
These non-process parameters are for the measured gas in the optical path but outside of the process path length.

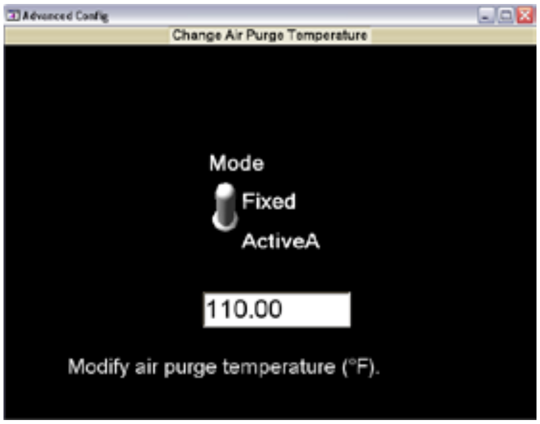
These parameters MUST be entered for an accurate measurement if the purge is not nitrogen (when measuring Oxygen) or when a line locking gas is being used (such as % CO for combustion CO/CH_4 applications)



NON-PROCESS PATH LENGTH
This is the optical path length between the laser and detector excluding the process path length.
The factory values entered include the analyzer internals and the alignment flanges. The distance of process isolation valves and process nozzles (on both Launch and Detect sides) MUST be added to the existing factory values.

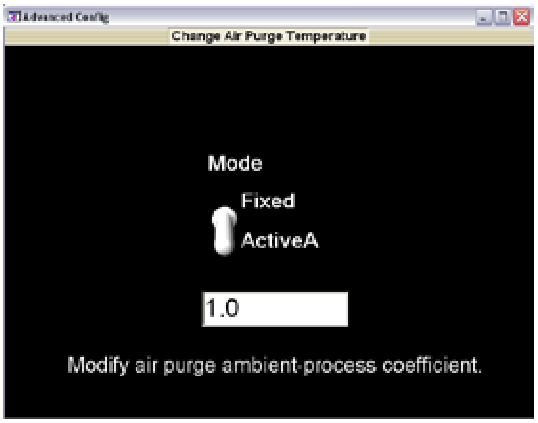


NON-PROCESS PRESSURE
This is the pressure of the non-process gas. Typically, this will be close to atmospheric pressure of 1.01 BarA or 14.7 PsiA. Check the actual operating conditions and enter the appropriate value. Contact Yokogawa if unsure.



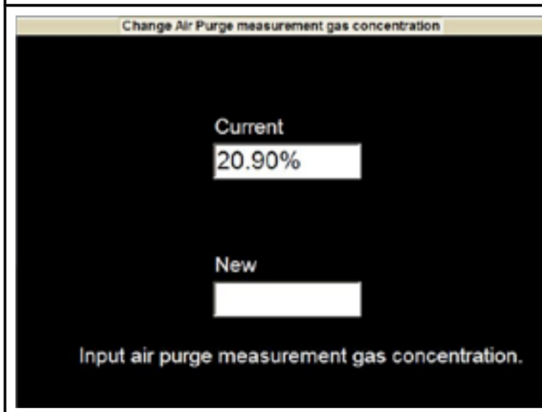
NON-PROCESS TEMPERATURE
This is the temperature of the non-process gas with two modes of input:

FIXED – manual input of fixed temperature value

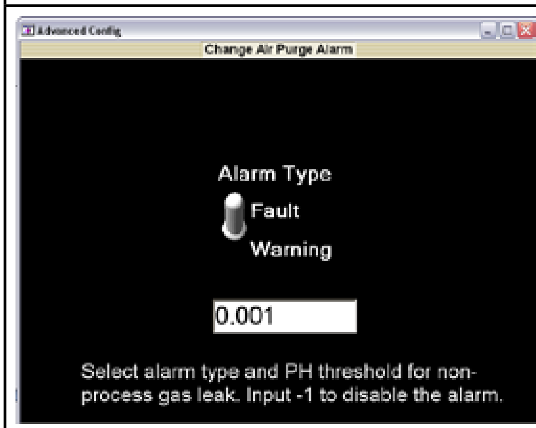


ACTIVE AMBIENT - ambient gas temperature derived from integral sensor on detector circuit with offset adjustment (typically -5 deg C) and an adjustable coefficient value (1.0 shown left).

To derive the optimum coefficient value, please contact Yokogawa with installation and application details. This will ensure the optimal coefficient value taking into account the temperature gradient from ambient to process gas temperature for the non-process purge gases.



NON-PROCESS ALARM SELECTION
This allows the selection or disabling of alarm when then non-process gas peak height falls below the entered threshold value.
In this example, the analyzer is configured to FAULT Alarm when the peak height is lower than 0.001 au (see absorption spectrum). This value can be determined with assistance from the Yokogawa factory to suit the specific application.
This alarm function can be used to help detect the leakage or loss of line locking gas, for example %CO on combustion CO/CH4 applications
To disable this alarm, simply enter -1 as the threshold value with the toggle in either Fault or Warning position.



NON-PROCESS ALARM SELECTION
This allows the selection or disabling of alarm when then non-process gas peak height falls below the entered threshold value.

In this example, the analyzer is configured to FAULT Alarm when the peak height is lower than 0.001 au (see absorption spectrum). This value can be determined with assistance from the Yokogawa factory to suit the specific application.

This alarm function can be used to help detect the leakage or loss of line locking gas, for example %CO on combustion CO/CH4 applications

To disable this alarm, simply enter -1 as the threshold value with the toggle in either Fault or Warning position.

6.4 Reference Peak Lock with 2nd Absorption Gas

In some measurement circumstances, instead of using the measurement gas (i.e. NH_3) absorption peak to lock the laser wavelength tuning range, the analyzer uses an a H_2O absorption peak near the NH_3 absorption peak as the reference. This is because in the typical application process, NH_3 concentration is normally zero or very low such that its absorption peak is not large enough for wavelength lock function. Moisture levels, however, are typically always high (about 10%) and therefore provide a large enough absorption peak for the wavelength locking function. Other applications using this same approach may include CO/CO_2 or in some combustion applications, measure CO and lock onto an adjacent H_2O peak.

There are two wavelength regions that need to be mathematically manipulated for an absorption spectrum: reference peak region and concentration prediction region. In the reference peak region, the H_2O peak position is calculated for the laser wavelength lock. In the concentration prediction region, area integration is performed for NH_3 concentration prediction. For example, the following spectrum is captured from a furnance test with a NH_3 analyzer. The reference peak region is at 150~180, and the measurement gas concentration prediction region is at 100~140.

For Off-Line Zero Calibration, make sure to purge Nitrogen (or dry Instrument Air) everywhere through the optical path so that there is no NH_3 or H_2O absorption in the spectra. For span calibration it is best to leave the laser temperature control as it is (there will be peak center out of range fault). Factory software access can further allow a change of the reference peak position set point to 124.5 (NH_3 peak locking in the example shown below), or use manual laser temperature control mode.

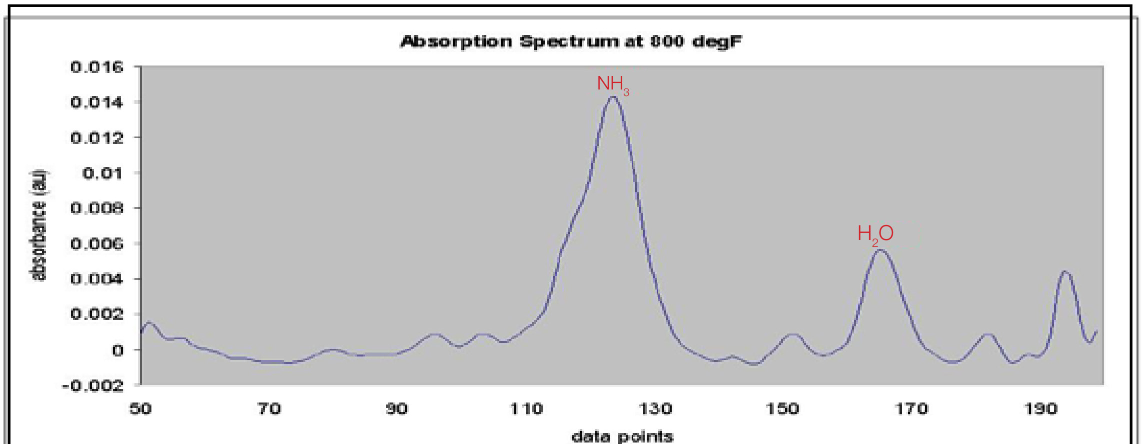
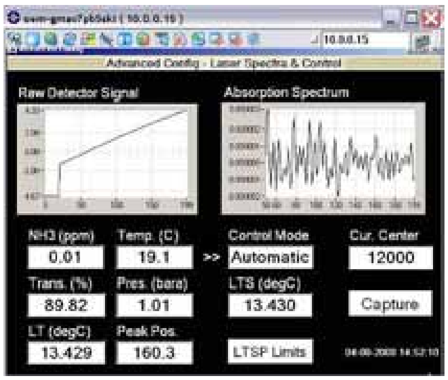


Figure 52 - Typical Process Gas Spectra with NH_3 and H_2O present

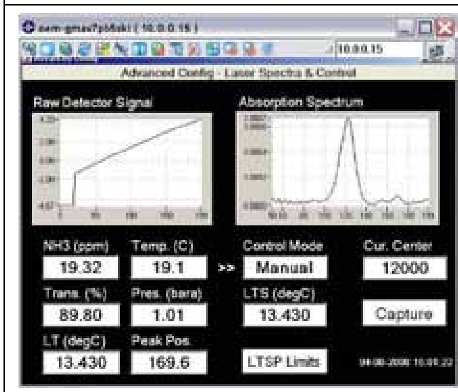
Following pages are the various “Laser Spectra & Control” screen captures that depict the different scenarios depending on what process gas(es) are present in the OPL and what gas is purged through the analyzer:

Note that the actual magnitude of the absorption units (au) as indicated on the “Absorption Spectrum” Y-Scale (vertical) will vary depending upon the actual gas concentrations, optical path lengths, gas temperatures and gas pressures.

Off-Line Calibration Conditions:

<table>
<tr>
<td>
</td>
<td>Process/Calibration OPL: N2
Analyzer Purge: N2

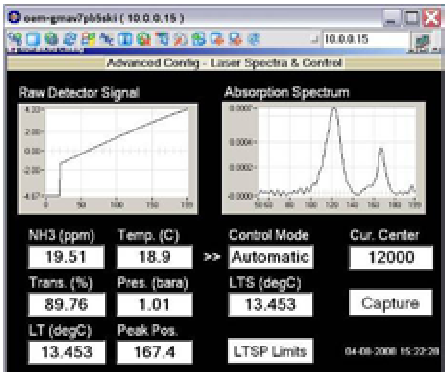
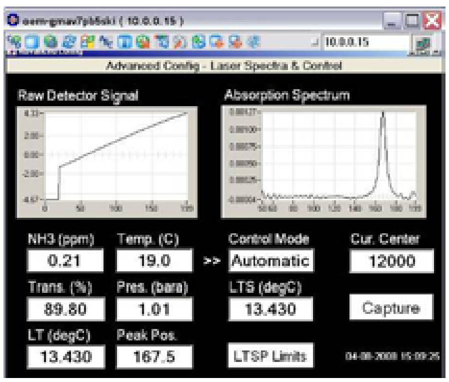
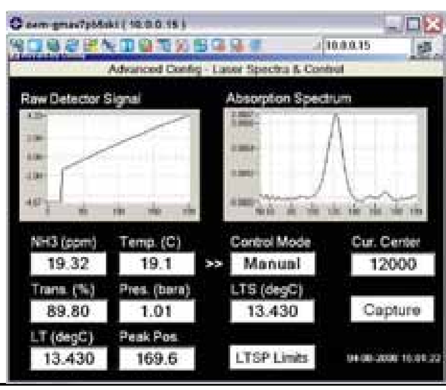
This is how the absorption spectra will appear when there is neither NH_3 nor H_2O in the entire optical path (Process OPL and Analyzer Purge).

This is the spectra appearance required for an Off-Line Zero Calibration of the analyzer.</td>
</tr>
<tr>
<td>
</td>
<td>Process/Calibration OPL: ~20ppm NH_3
Analyzer Purge: N_2
In this Absorption Spectra view, there is practically zero H_2O absorption peak in the approximate peak center position (PCP) 167 region.

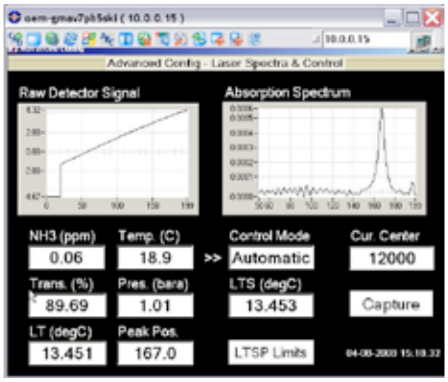
There is approximate 20 ppm NH_3 (@ approx PCP ~120) absorption in this spectra based on 72.6cm OPL, ambient temperature and ambient pressure.

This is the spectra appearance required for an Off-Line Span Calibration of the analyzer.</td>
</tr>
</table>

On-Line Process Conditions – Analyzer Purged with Nitrogen:

	**Process OPL: NH_3 and H_2O** **Analyzer Purge: N_2** In this Absorption Spectra view, the Process H_2O absorption peak can be seen at approximate peak center position (PCP) 167. This absorption peak is Process H_2O as there is no reference gas H_2O in the N_2 analyzer purge gas. There is also approximate 20 ppm NH_3 (@ approx PCP 120) absorption in this spectra based on 72.6 cm OPL, ambient temperature and ambient pressure.
	**Process OPL: Zero NH_3 + ~2% H_2O Air** **Analyzer Purge: N_2** In this Absorption Spectra view, the large process H_2O absorption peak can be seen at approximate peak center position (PCP) 167. There is no NH_3 absorption in the spectra .
	**Process OPL: ~20 ppm NH_3 + Zero H_2O** **Analyzer Purge: N_2** In this Absorption Spectra view, there is practically zero process H_2O absorbtion peak in the approximate peak center position (PCP) 167 region. There is approximate 20 ppm NH_3 (@ approx PCP ~120) absorption in this spectra based on 72.6 cm OPL, ambient temperature and ambient pressure.

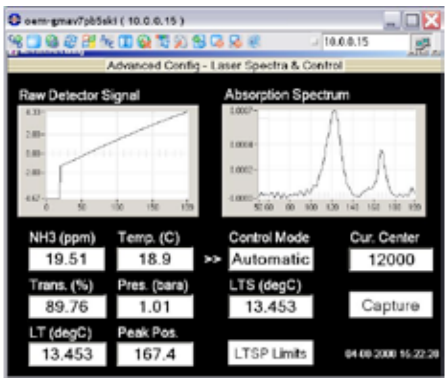
On-Line Process Conditions – Analyzer Purged with Nitrogen:
When purging with Instrument Air (as opposed to ambient air), the H_2O levels are much smaller (due to it having been dried and having a dew point typically in the order of -40˚C) and therefore the H_2O concentration is not large enough to produce an absorption peak that can be seen.



Process OPL: Zero NH_3 + Zero H_2O
Analyzer Purge: Air (typical ~2-4% H_2O)

In this Absorption Spectra view, the analyzer air purge H_2O absorption peak can be seen at approximate peak center position (PCP) 167.

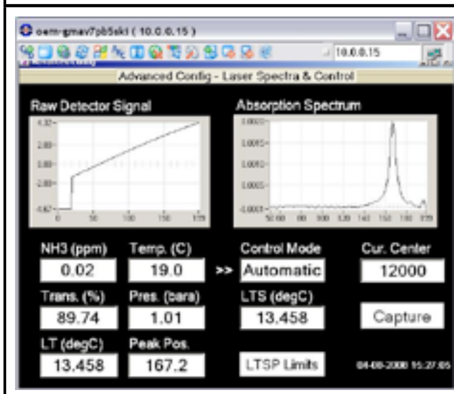
There is no NH_3 absorption in the spectra.



Process OPL: ~20 ppm NH_3 + Zero H_2O
Analyzer Purge: Air (typical ~2-4% H_2O)

In this Absorption Spectra view, the H_2O absorption (analyzer air purge) peak can be seen at approximate peak center position (PCP) 167.

There is approximate 20 ppm NH_3 absorption (approx 120PCP) in this spectra based on 72.6 cm OPL, ambient temperature and ambient pressure.



Process: Zero NH_3 + ~2% H_2O
Analyzer Purge: Air (typical ~2-4% H_2O)

In this Absorption Spectra view, the process gas H_2O (~2% 0.7 m @ STP) and analyzer air purge H_2O absorption peak can be seen at approximate peak center position (PCP) 167.

There is no NH_3 absorption in the spectra.

6.5 Large Aperture Optics

For in-situ application (typically large scale combustion systems) the optical path lengths are generally very long (7-30 m for large scale combustion and ethylene furnaces). Standard TDLS optics and laser beam configurations are unsuitable because of the mechanical stability of these large scale combustion systems. Yokogawa Laser Analysis Division therefore designed and developed the concept of a diverging beam (i.e. a laser beam that expands over distance) and a large aperture optics detector scheme (i.e. a large target for the laser to hit). The general concept of diverging beam and large aperture optics is shown below:

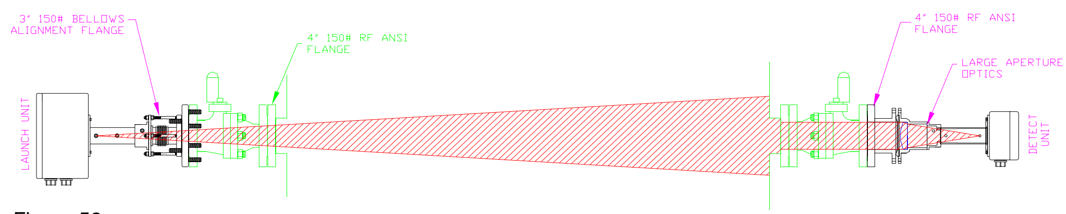


Figure 52

In a standard TruePeak TDLS200 analyzer, the laser beam exiting the launch unit is normally collimated parallel before hitting the opposing detect unit. The collimated beam size is typically less than 1" diameter. However, this optical layout is not appropriate for long-path applications (the dimension of process is longer than 30 feet). During initial installation, it is also difficult to align the laser beam so that it can hit the targeted detect unit over a long distance (small changes in the launch unit angle are magnified over long distances). Also it is almost impossible to keep good alignment with varying ambient and process conditions – especially during cold starts and shut-downs (the most extreme thermal changes on the mechanical structures).

To resolve the above issues, Yokogawa Laser Analysis Division has developed a diverging beam and large aperture optics strategy. At the launch side, the output laser beam has a small diverging angle. For example, the beam size is about 20" (~50 cm) diameter at 60' (~18 m) optical distance. The optical aperture at the receive unit is enlarged from the original 1¾" diameter. With these two changes, it is much easier to do initial alignment and keep good transmission during a wide range of operating conditions.

Please note that when an analyzer is mounted on the standard 0.726m (28.6") OPL off-line calibration cell, there is a large amount of laser light on the detector. Once moved onto a long path installation, the diverging beam power is spread out over a larger area and hence weaker, this means that once installed on the long path, the detector gain may require some manual adjustment (increase typically) – please use the following procedure.

6.5.1 Large Aperture Optics Installation, Alignment & Detector Gain

The alignment of the Large Aperture Optics (or LAO) is quite similar to the alignment method of a standard TDLS200. To prepare for the alignment you will need some form of screen at the analyzer this can be a launch unit with a screen and keypad, a mini display, or a laptop PC connected through VNC/Ethernet. Go into "Laser Spectra & Control" observe the "Trans. (%)". You will need to set up the alignment by first getting both the launch and detect sides as perpendicular to the optical plane as possible. This will allow for the initial signal to be found more easily. Note, the oxygen analyzers tend to be easier to align than CO/CH4 analyzers due to the optical/detection internal configurations.

Once this has been done, adjust the launch unit till a change in transmission can be seen. Do this by loosening the nuts from the launch unit and manually point the launch unit till some transmission is observed.

Note: the change in transmission might be very small depending on the incident angle on the detect optic. It is easy to pass over the correct launch alignment without knowing it. If a change cannot be found, repeat with smaller adjustments in both the X-axis and Y-axis. If no transmission can be established by movement of the launch unit, check the general alignment of the detect unit to ensure its axis is generally aligned with the launch unit axis.

Once some transmission is observed align the detect side so that the transmission is at a maximum. To do this, back off all four of the setscrews. With two people, one to do the adjustments and one to watch the transmission, slowly adjust the detect alignment by loosening one direction and tightening the opposite till the maximum transmission can be found. Place setscrews so that the alignment is secure.

With the detector aligned begin vertical adjustments of the launch unit using the studs for small, fine adjustments to attain maximum transmission. Once maximum transmission has been found in the vertical position, adjust the horizontal plane for maximum transmission. With maximum transmission found in the horizontal position repeat the alignment in the vertical position for maximum transmission. Once the maximum transmission has been found once again in the vertical direction, align the horizontal direction again to finalize maximum transmission alignment.

With the analyzer at maximum transmission, the beam needs to be centered on the detector. Adjust the laser vertical plane till transmission is almost lost i.e. the edge of the beam is almost missing the detector lens. Adjust the laser in the opposite vertical plane till the transmission is almost lost once again. Take note on how many quarter turns that it takes to get from one side of the beam to the other. Repeat back to the other side of the beam so that the transmission is almost lost once again. Make sure that the number of quarter turns is similar. Adjust the beam back by half the number of quarter turns needed. The beam will be centered vertically.

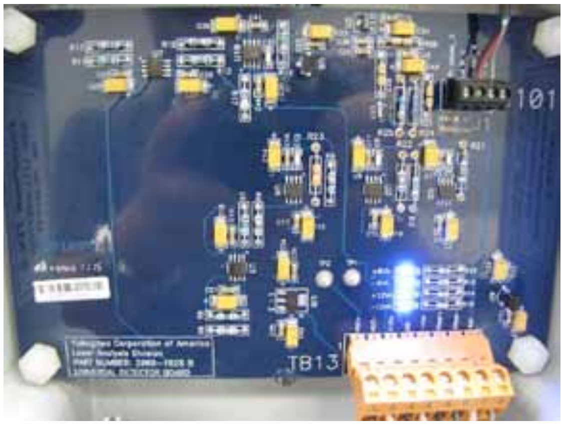
Repeat for the horizontal direction using quarter turns once again. This will fully center the beam on the detector. Now the detector will need to be aligned once again. Make sure that all backing nuts and setscrews are securely fastened.

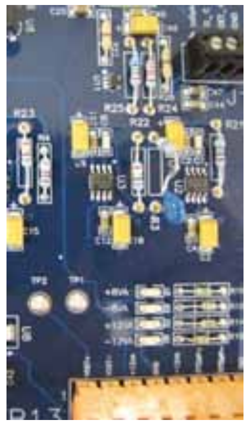
Carefully check the detector Large Aperture Optics bevel mounting seal is not leaking at the perimeter, this can happen if too much bias is asserted. For oxygen analyzer and combustion processes with negative pressure, this will cause false high readings as ambient air (20.9% O2) is drawn into the optical path via a gap at the bevel seal edge – please clamp down all bolts and adjust the large bevel flange to ensure a gas tight seal is maintained at all times.

6.5.2 Adjustment of Detector Gain for Large Aperture Optics

This section of the User's Guide gives the guidance and procedures to adjust the detector board gain after the analyzer is installed and powered up. This operation should be done by qualified personnel. Read instructions fully before starting this operation. Any doubts or questions, please contact Yokogawa.

PHOTOS OF DETECTOR BOARD





RESISTOR BAG

For a TDLS200 analyzer with diverging laser beam configuration (either with or without large aperture detector lens), a resistor bag is attached inside the detector box. The resistor bag contains the resistors with the following values. All of them are ¼ W, 5% tolerance metal film through-hole resistors.

Resistor Bag for Analyzers With Diverging Beam Optics										
Resistance (Ω)	100	1k	1.5k	2.2k	3.3k	5.1k	7.5k	11k	16k	24k
Quantity	1	2	2	2	2	2	2	2	2	2

Please record the factory gain resistors currently installed on the detector board:

R21 = ____________; R22 = ____________; R23 = ____________

PROCEDURE

1. **This procedure requires wearing a grounding strap connected to one of the grounding lugs of the analyzer to prevent any electrostatic damage.**

2. Open the detector enclosure and put on a grounding strap.

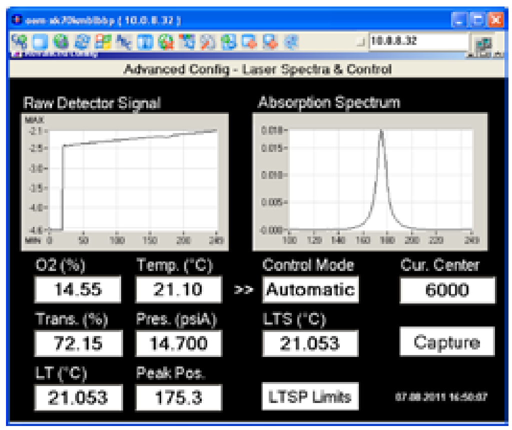
3. Identify the gain resistors R21, R22 and R23 on the detector board as shown in the photo above. They are all plugged in sockets instead of being soldered, easy to be modified by a pair of small pliers. The existing gain resistors have factory resistance values optimized on a calibration cell.

4. [Optional] For a high-process-temperature application and if the current process temperature is higher than 600°C, apply a multi-meter to measure the voltage across R21. If the measured voltage absolute value is greater than 5V, change R21 to the 100Ω resistor from the resistor bag. Keep the original R21 in the resistor bag as it can be used for future offline calibration.

5. Remove R22 and R23 from the detector board and replace them with the 11kΩ resistors from the resistor bag. Please keep the original R22 and R23 in the resistor bag as they can be used for future offline calibration.

6. Optimize the analyzer alignment for both the launch and detector sides. Stop the alignment if Detector Signal High fault activates.

7. In the TruePeak user interface software, navigate to Advanced Menu (password) -> Configure -> Laser Spectra & Control screen to check the raw detector signal. Write down the raw detector signal MAX and MIN values for later use.



8. Change R22 and R23 accordingly based on the current raw detector signal. Perform one item of the following selections (a, b, or c).

a. If Detector Signal High fault is active, change both R22 and R23 to the next smaller value available in the resistor bag, and then go back to **STEP 6**. For example, if the current R22 and R23 values are 11kΩ, the new R22 and R23 values should be 7.5kΩ. NOTE: please access Active Alarm in the main user interface panel to check if Detector Signal High fault is active.

b. If the raw detector signal is within requirement, remove R22 and R23 (and R21 if it was changed to 100Ω in **STEP 3**) and cut their leads properly to fit the sockets tight and low, and then go to **STEP 9**. NOTE: (1) for a low-process-temperature analyzer (with no capacitor on R3), the raw detector signal is within requirement if MAX is between 0.0 and 4.0; (2) for a high-process-temperature analyzer (with a capacitor on R3), the raw detector signal is within requirement if MIN is between -4.0 and -8.5.

c. If the raw detector signal is too low (other than a and b), change either R22 or R23 to the next greater value available in the resistor bag, and then go back to STEP 7. How to decide which resistor to change:
   i. If the current R22 value is greater than the current R23 value, change R23 to the next greater value available in the resistor bag.
   ii. If the current R22 value is same as the current R23 value, change R22 to the next greater value available in the resistor bag.
   iii. If the current R22 and R23 are already 24kΩ (the greatest value available in the resistor bag), please contact Yokogawa for assistance.

9. Close the detector enclosure. Write down the final values of R21, R22 and R23 below for record.

    R21 = ____________; R22 = ____________; R23 = ____________.

10. Keep the resistor bag and this procedure document by customer. DO NOT leave them in the detector box or throw them away.

11. Enter these new resistor values into the analyzer configuration under Advanced Menu, Configure, System, Adjustable Resistors Detect – R22, Detect R23 and Detect R-23. NOTE, all resistors values are entered in kOhm units.

6.5.3 Detector Gain Adjustment Service Tips

- How to remove a gain resistor? On the detector board, find the location of the gain resistor. Please note that the resistor is not soldered but resting in sockets. Carefully remove the resistor from the socket on the board. Since the analyzer is still powered on, please take extreme caution to prevent a short circuit on the board, i.e. loose wires or touching adjacent components with pliers or tool used to remove resistor.

- How to install a new gain resistor? First try the new resistor by molding and clipping the resistor leads to fit into the socket. Then carefully insert the resistor into the socket on the detector board. Since the analyzer is still powered on, please take extreme caution to prevent a short circuit on the board, i.e. loose wires or touching adjacent components with pliers or tool used to install resistor.

- Please keep the factory/original gain resistors in the resistor bag as they will be used in the future for offline calibration or test.

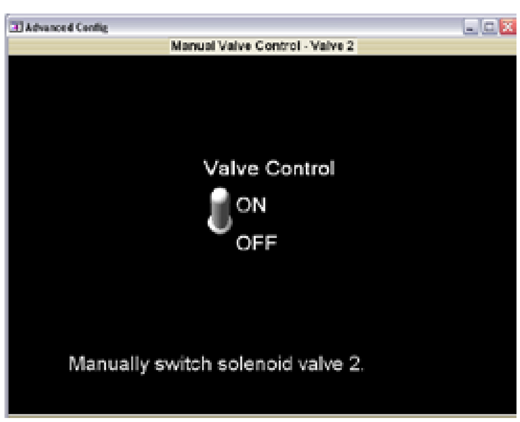
- The raw detector signal (MAX-MIN) is proportional to R21·R22·R23. Usually R21 is maintained as factory value. R22 and R23 are optimized in the field. We want to avoid the situation where one of R22 and R23 resistors has extreme low resistance and the other one has extreme high resistance. The analyzer gives best performance when R22 and R23 are balanced. Based on this relation between raw detector signal and gain resistors, service technician or customer can select R22 and R23 faster with the help of a calculator.

- Multiple alignment actions might be needed if Detector Signal High fault happens. Reduce the gain resistor first as described in STEP 8-a, and then optimize the alignment again.

6.6 Valve Control Logic

The TDLS200 has three valve driver outputs (24VDC, 11W max each) available at Launch unit connection terminal TB-3. those can be used for calibration/validation functions and/or stream switching functions if being used in an extractive installation. The valve control logic is outlined below:

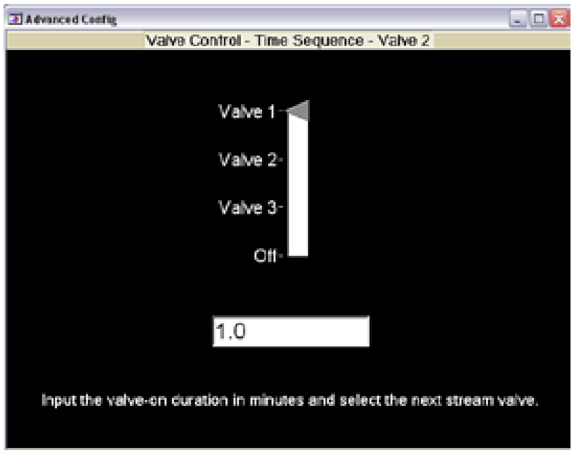
Manual Switch



- Turn the valve on.
  - o If time sequence is on, record valve_start[0] (current minute).
  - o No need to turn off other valves. Multiple valves can be on at the same time.
- Turn the valve off.

TIME SEQUENCE

- It can happen only when there is no active auto calibration or validation.
- When time counting is up,
    - o Turn off the current valve.



- o Turn on the next valve.
- o Start the new time counting.
- o Multiple valve time sequences are allowed. When configure the parameters, please pay attention. Time sequence is not recommended to use with remote control at the same time to avoid valve chaos.

REMOTE CONTROL

- **The remote initiate contacts are found at TB-2 and the external contact MUST BE VOLTAGE FREE. The TDLS200 circuits are low level current monitoring so any externally applied voltage/current may cause damage to the analyzer, hence use voltage free contact only.**
- It can happen only when no auto calibration or validation is on-going.
- Direct control from DCS and or local/remote switch(s)

- Contact signal -> valve on (please keep remote contacts closed for at least 10seconds to ensure the analyzer reads/registers the contacts at measurement up-date)
- Open signal -> valve off (please keep remote contacts closed for at least 10seconds to ensure the analyzer reads/registers the contacts at measurement up-date).

AUTO CALIBRATION & VALIDATION – see separate section of User Guide for details

1. Remember the current valve status.
2. Turn on the assigned valve, turn off other valves.
3. Resume the original valve status before auto calibration or validation.

AUTO ONLINE VALIDATION – see separate section of User Guide for details

1. Remember the current valve status.
2. Turn on the assigned valve(s), turn off other valves. Two valves could be open for auto online validation with blocked line lock gas in validation cell.
3. If only one valve is used, turn off the assigned valve. If two valves are used, turn off the first valve.
4. If two valves are used, turn off the second valve.

6.7 Introduction for H_2Oppm Measurements in Methane Gas

The measurement of H_2Oppm in methane gas (LNG/NG) is specifically outlined in this section. Items contained within this section will supersede any prior information within the User's Guide, particularly items pertaining to calibration methods. Please also note the special requirements needed for the flow cell measuring conditions as these can affect the measured H_2Oppm concentration values.

Spectroscopic detection of moisture in natural gas presents a specific challenge for traditional TDLS methods, because a weak (at low ppm moisture content) absorption line of water must be detected on a high absorption background of methane and other components (C2/C3) of the natural gas. This challenge has been successfully overcome with TDLS200 by using a special (previously proven) approach to spectroscopic data processing. However, reliability of results relies on stable and well defined conditions in the flow cell of the TDLS200 analyzer. **Note that typically temperature of the process/calibration gases within the flow cells is to be maintained at 50.0±0.5 ºC and the gas pressure controlled at 30±0.25 psig. Maintaining these conditions ensures well-defined absorption of methane and reliable ppm moisture concentration readings.**

At the same time, this method eliminates the need for routine analyzer calibrations (zero or span). This is due to the fact that the strength of molecular absorption is an intrinsic property of the chemical species. When the gas temperature, pressure, and its bulk composition are defined, absorption spectrum depends only on the absorption path length, which is also fixed in the supplied analyzers. These analyzers are factory calibrated and **Therefore, the H_2Oppm in Natural Gas analyzers DO NOT require actual field calibration by end users – they can however be Validated.** Calibration procedure described in the standard TDLS200 User Guide is intended for the different measurements/techniques of data processing and **must not** be used in these units. If applied to these H_2O-NGas analyzers, it will disrupt the file system with unpredictable/erroneous results requiring factory assistance to restore proper functionality.

At all times, the analyzer internal optics must be purged with dry nitrogen (<0.25 ppm H_2O content). Any moisture present within the analyzer internal optics purge gas (or on-validation cell purge gas) will be added to the actual process gas measurement of H_2Oppm.

DO NOT ZERO or SPAN CALIBRATE THE ANALYZER without prior written approval from the Yokogawa Laser Analysis Division Factory!

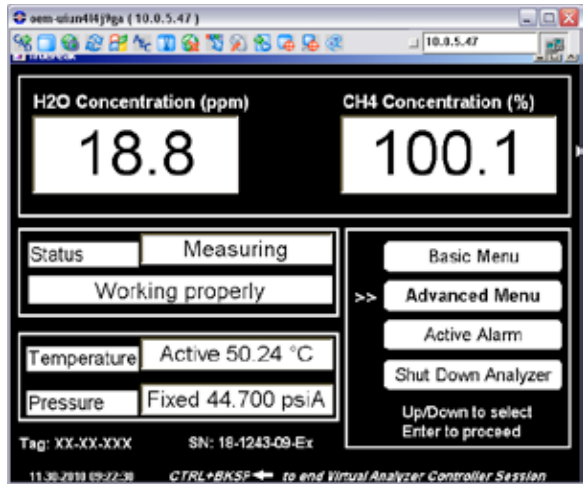
Validation (response check) of the analyzer can be performed in two possible ways:

(1) Off-Line Method (interrupting process flow through the cell): A pure dry (<5 ppm H_2O) methane (100% CH_4) validation gas can be supplied to the flow cell (at same flow conditions 50ºC and 30 psig); analyzer readings for CH_4 % must be 100±2%. Note, at this time the analyzer will also indicate any value of residual moisture in the pure dry methane validation gas standard.

(2) On-Line Method (no interruption of process flow through the cell) to observe a step change in the H_2O ppm output value: Nitrogen gas with typical 100-120 ppm H_2O (+/-10 ppm) content can be switched through the on-line validation cell at 10psig (for example, equipped with a 10 psig pressure relief valve on validation cell outlet). The analyzer readings for H_2O will be increased by approximately 10-12 ppm (based on 110 ppm*pathval.cell/pathflow cell) or roughly equivalent to 10% of the cylinder certified H_2O ppm value. This is an observation only of step change to the introduction of H_2O into the optical path, sometimes considered a “response check” or “analyte spiking”.

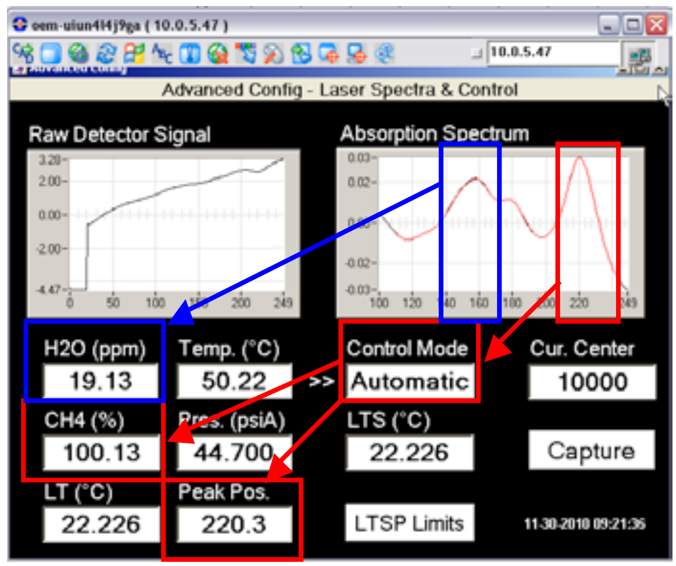
Normal Operation – TDLS200 TruePeak Software Main Menu

The analyzer is configured to measure not only H_2O ppm but it will also indicate the CH_4 % concentration value, as shown on the Main Menu display below: Note that the flow cell gas temperature is also shown as Active (based on flow cell sensor active input) and pressure is input as a Fixed value (shown in psiA units, based on the external sample system regulator fixed setting).



Note, during normal process operation with 90-100% methane gas flowing in the cell, the laser temperature set point (LTSP) is configured to control the methane peak position at data point 220 (as shown red in absorption spectrum, right):

The actual measurement of H_2O ppm absorption peak is made in the data point region of 160 – note that H_2Oppm is not visible to the eye within this absorption spectrum when <100 ppm (as shown blue in absorption spectrum, right):



6.8 Introduction to Gas Temperature Predictions with High Temperature Oxygen Measurements

For some high temperature oxygen measurements operating at the correct conditions, the analyzer can predict the gas temperature as well as the oxygen concentration. The TruePeak TDL analyzer scans a tunable diode laser over a small wavelength range across measurement gas absorption line profile. The measurement gas concentration can be predicted from the absorption peak with combustion parameters of optical path length, gas temperature and gas pressure. The gas temperature has significant effect on the absorption line intensity, typically weaker absorption at higher temperature for oxygen. However, there are several oxygen lines whose absorption intensity has different temperature response. By simultaneously comparing two oxygen lines with different temperature effect on absorption intensity, we can calculate the gas temperature.

The following graph illustrates an example. At 800 degC, there are two oxygen absorption peaks, and their ratio is 8.6. At 1500 degC, the left oxygen absorption peak increases while the right peak drops significantly. The peak ration is 2.2. So by calculating the peak ratio of these two oxygen peaks, the gas temperature can be predicted.

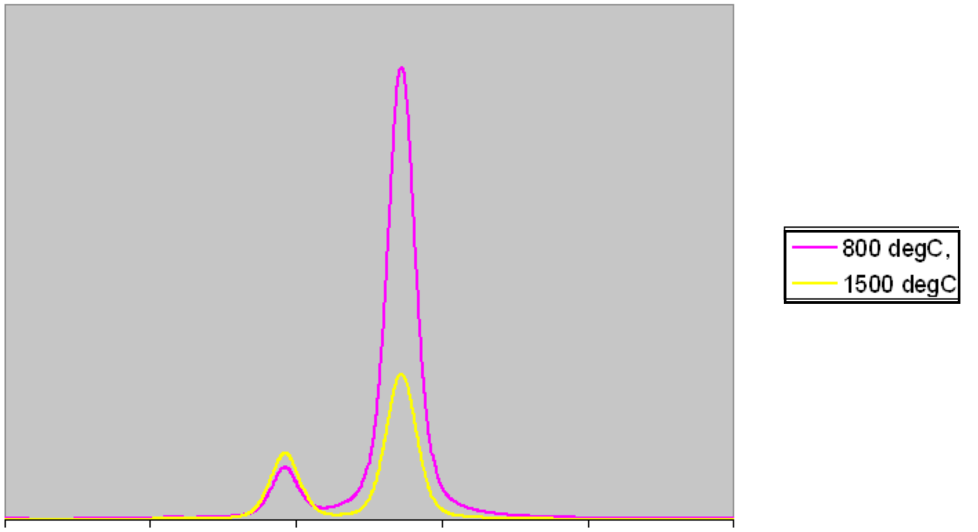


Figure 54

The requirements for accurately predicting process gas temperature with high temperature oxygen analyzers:

- Gas temperature should be higher than 750˚C so it's ideal for combustion zone gas applications (typical measured range 750-1,500˚C or 1380-2,730˚F).
- It needs sufficient oxygen absorption so longer path length and/or higher oxygen levels are preferred – contact Yokogawa Laser Analysis Division with application details

6.9 Controlling the Analyzer Remotely or Locally via external PC/Laptop

A number of methods are available to connect to the TDLS200 analyzer.

- Direct Access with optional Keypad and Display
- Direct Access using VNC and an external computer (Ethernet)
- Remote Access using VNC via network (external computer)
- Remote Access using optional Remote Interface Unit (RIU with VAC software)

Whether directly connected, or connected via network, operating the analyzer with an external connection allows two basic functions:

- Remote control of the analyzer via TDLS200 software allows full control of the analyzer. The user will see the same screen with the same access functions as if controlling using a built in keypad and display.
- Data transfer via VIRTUAL ANALYZER CONTROLLER (VAC) software allows download of data files to/from the analyzer.

6.9.1 Instructions for Connecting an External Computer to the Analyzer

Requires Windows 98SE or later (on computer to be connected to the analyzer) and crossover Ethernet cable. The analyzer is provided with a CD that includes the VNCviewer program. Windows 7 will support the Ultra-VNC software and associated functionality. Contact your local Yokogawa agent for a free copy of the necessary "VNCviewer.exe" file that will enable the VNC connection with the analyzer. This VNCviewer.exe file should be loaded on to the connecting PCs desktop ready for use when connecting with the analyzer.

- **From Control Panel – Network Connections, make sure Ethernet Local Area Connection is set to Enabled status. Disable wireless and any other networking connections.**
- **Connect crossover Ethernet cable from client system to Analyzer.**
- **On the computer, go to Control Panel – Network Connections - Local Area Connection, Internet Protocol (TCP/IP) Properties.**
    - Set IP to 10.255.255.254 & Subnet Mask to 255.0.0.0. Select OK to accept changes on Internet Protocol (TCP/IP) and Local Area Connection Properties.
    - Start Ultra-VNC software, running from Desktop using the Guide below:

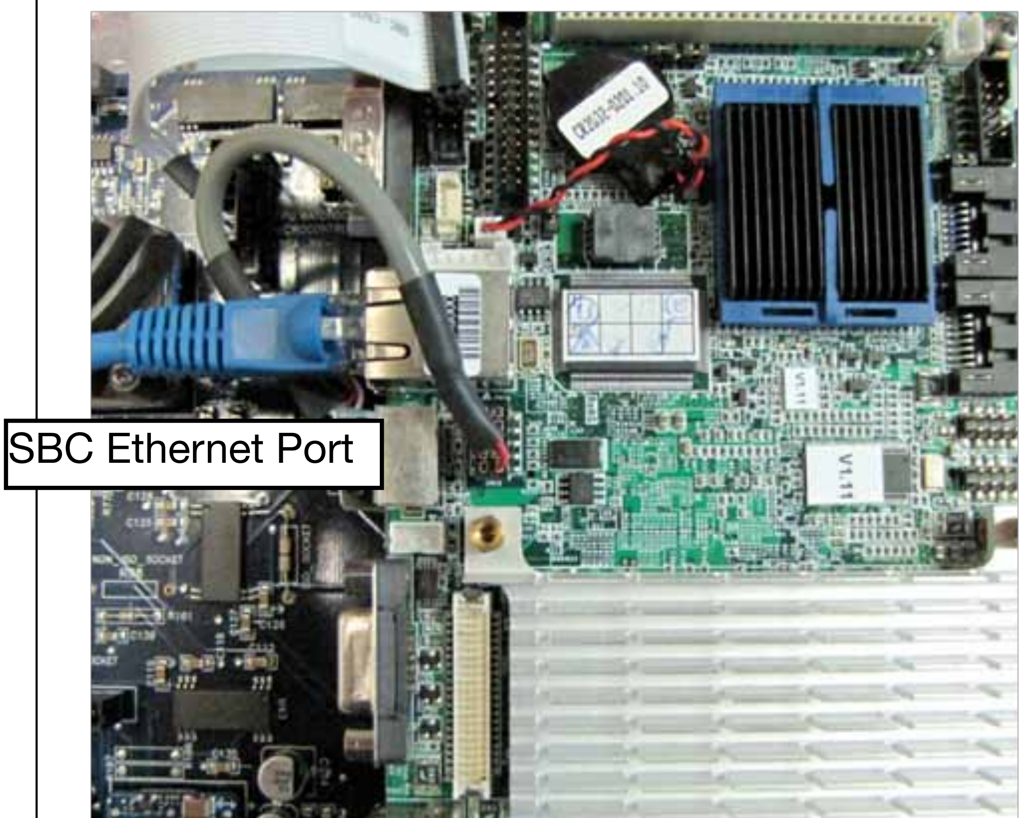


Figure 55 - Connecting External Computer to the analyzer

6.9.2 Using Ultra-VNC Software

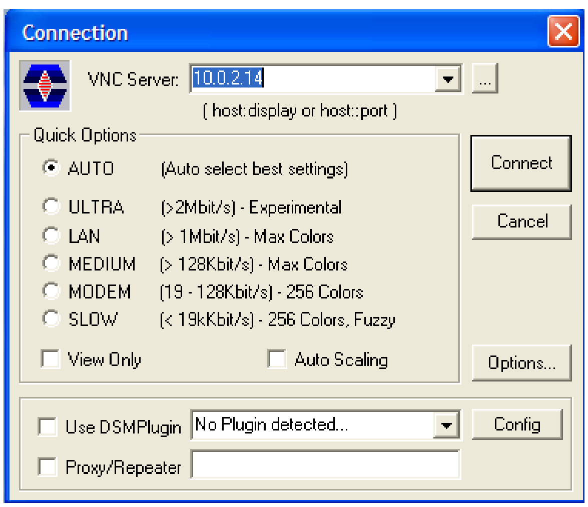
Start the Ultra-VNC software by double-clicking on the “vncviewer.exe” ICON (as shown below):

Within the VNC Server field, enter the correct IP address for the analyzer to which you are connecting then click on “Connect” button. If a successful connection is established then use the default password for entering the VNC connection screen is 1234 – see screen below that shows an example IP address of 10.0.2.14 (for an analyzer Serial number XX-1214-XX etc.):

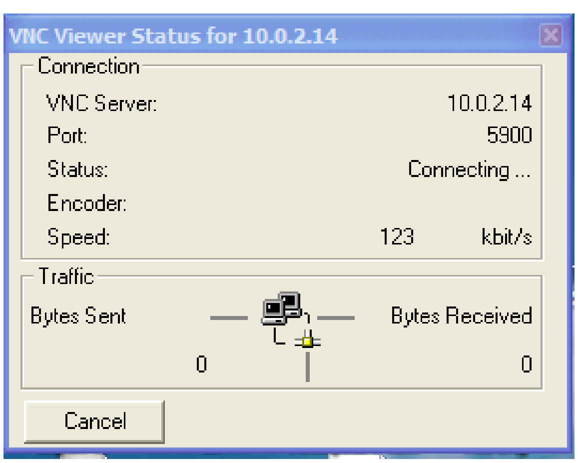
For analyzers with Serial/Tracking number XX.2xxx-xx, use IP address 10.0.20xx, for example 76H-2018-12-Ex would have an IP address 10.0.20.18

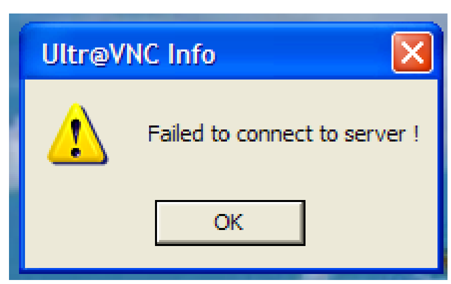
For analyzers with Serial/Tracking number XX.3xxx-xx, use IP address 10.0.30xx, for example 23-3007-13-Ex would have an IP address 10.0.30.7

⚠ DO NOT attempt to change of the “Quick Options” or any other settings on this menu!



If the analyzer connection cannot be established (see error message below) then check the PC IP settings, connection wires/Cat5 cable and IP address.

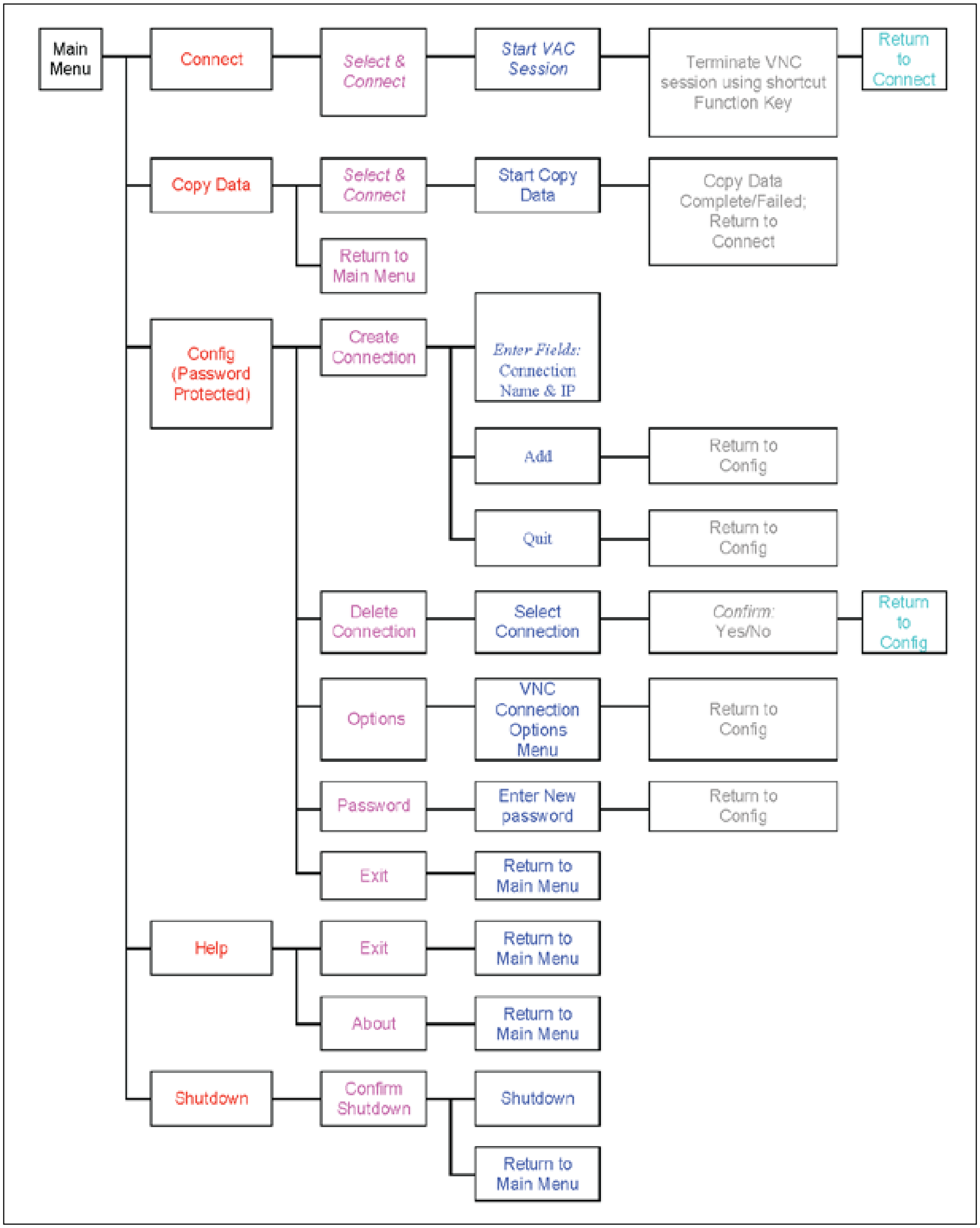




6.9.3 OPTIONAL Remote Interface Unit (RIU)

The OPTIONAL RIU runs the Virtual Analyzer Controller (VAC) software described below.

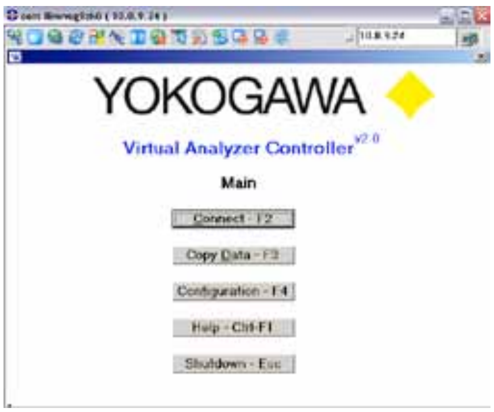
6.9.4 Virtual Analyzer Controller (VAC) Operating Software Map



6.9.5 OPTIONAL Virtual Analyzer Controller (VAC) Operating Software Guide

ALWAYS "END VNC SESSION" TO ANALYZER WHEN DONE – THIS WILL PREVENT THE ANALYZER AND/ OR RIU FROM 'HANGING'. DO NOT LEAVE THE RIU PERMANENTLY CONNECTED TO ANALYZER – CONNECT ONLY WHEN IN USE

6.9.6 Virtual Analyzer Controller (VAC) Operating Software Guide

	The RIU VAC software is designed to allow communication between an analyzer and an appropriate interface. The primary functions of the software are: Create a virtual network computing connection to an analyzer thus allowing for control of the analyzer, typically for start-up, service, calibration, etc. Allow for file transfer from an analyzer to a local USB port (for memory device) Create connections by name and/or IP address
	After selecting "Connect F2" you will be allowed to select the analyzer (with description and IP address) you wish to control remotely. This will allow full analyzer control as if you were at the analyzer itself. Please remember that when you have finished working on the analyzer via this RIU VAC software, you must END SESSION to the analyzer by pressing the Control+Backspace keys simultaneously – DO NOT SHUT DOWN analyzer!!!
	After selecting "Copy Data – F3" you will be allowed to select the analyzer (with description and IP address) you wish receive data from. This will initiate a data transfer for all results and configuration files stored on the analyzer. **NOTE:** Please ensure there is a 'clean' (or empty) SanDisk USB memory stick inserted into either of the two USB ports of the RIU. When copying data from an analyzer via the RIU, a dedicated folder with the serial number is NOT created, the data files are dumped to the root directory of the USB stick.

After selecting “Configuration – F4” you will be asked to Enter Password – the default password is 1234, then press F2 to proceed and then you will be allowed to select the analyzer (with description and IP address) you wish to configure.

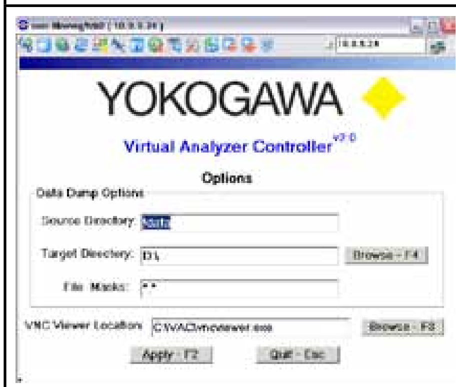
You will be given the following menu choices:

Create Connection - F2: This will allow programming of Tag Name and IP Address for future connections

Delete Connection - F3: This is to delete an existing connection

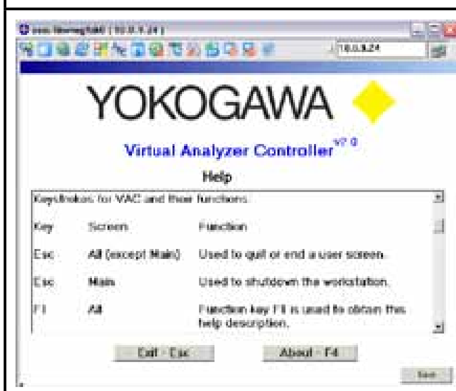
Options - F4: (see next section)

Password - Ctl-Ins: Allows changes to the access password



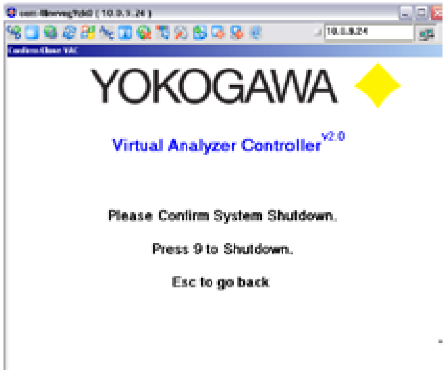
VAC Options (Configuration Menu):
Data Dump Options. This sets the directories to receive data from (analyzer) and send data to (on system running VAC software)
Source Directory: This is the analyzer data file folder; it should not be changed without factory consultation.
Target Directory: This is the remote computer or RIU directory to receive data files
File Masks: These are the extensions of the files to be transferred; it should not be changed without factory consultation.
VNC Viewer Location specifies the location of the software to remotely control an analyzer; it should not be changed without factory consultation.

APPLY-F2 must be selected to save changes



From the VAC Main Menu Ctrl-F1 will bring up the Help Screen.

This will give at system text help describing the shortcut keys and their function.

 	To shut down the RIU, press the Esc key and the screen will appear as shown. Press 9 to continue with the shut-down process and when the RIU screen turns white, the power can be switched off. Note, there is no watch-dog in the RIU so un-like the TDLS-200, it will not automatically re-start after a period of time if power is not switched off. **ALWAYS “END VNC SESSION” TO ANALYZER WHEN DONE – THIS WILL PREVENT THE ANALYZER AND/OR RIU FROM ‘HANGING’!** **DO NOT LEAVE THE RIU PERMANENTLY CONNECTED TO ANALYZER – CONNECT ONLY WHEN IN USE**

7 ROUTINE MAINTENANCE

The TDLS200 TDL analyzer requires little routine maintenance if it has been installed, set-up and calibrated correctly. This section will outline the routine maintenance procedures.

7.1 Maintaining Good Transmission

The % Transmission of the laser light through the process is the most important variable to consider for routine maintenance and troubleshooting. Under normal operating conditions (nonfailure) transmission will be affected by:

- Alignment of the Launch and Detect units (covered below)
- Window fouling. For most applications where solids or liquids are expected in the process a window purge is recommended (see installation section)
- Particulate in the process. Particulate in the process will block the laser light to some extent. To maximize performance in particulate laden processes it is important to maximize alignment and ensure windows are clean.

7.1.1 Maintaining Clean Windows

If the window purge supplies have been set-up correctly on a reliable supply line, then under normal operating conditions there should be no window fouling. Window fouling may be caused by one or more conditions:

- Loss of window purge gas flow/pressure which then allows the dirty process gas to contact the windows and leave deposits.
- Loss of window purge gas flow/pressure which then allows the hot process gas to contact the window, condense any liquids and leave deposits.
- Over pressure of the process gas which allows the process gas to overcome the window purge gas and contaminate the window.
- Contact on the window by an incompatible gas (such as HF on the standard BK-7 Borosilicate crown glass).
- Contamination of the purge gas supply, either by particulate matter, oil or other.

If the windows are contaminated they may be cleaned using the following procedure:

- Remove analyzer from process (isolate, etc. if necessary).
- Use a clean, dry instrument air or nitrogen pressure supply to first blow off any particulate matter.
- Using warm water and mild soap detergent, gently clean the window surface with a soft, non-abrasive cloth.
- If the deposits do not come off then use a small amount of IPA (Isopropyl Alcohol) and a soft, non-abrasive cloth.
- Use the same clean, dry instrument air or nitrogen pressure supply to blow dry the surface.
- Carefully check the entire surface of the window from different angles to ensure it is thoroughly cleaned and ready for service.
- If the window does not appear to clean up well, then replace the window assembly with a new one.
- If the window appears to have an etched surface then it has probably been contaminated with HF or other similar corrosive gas.

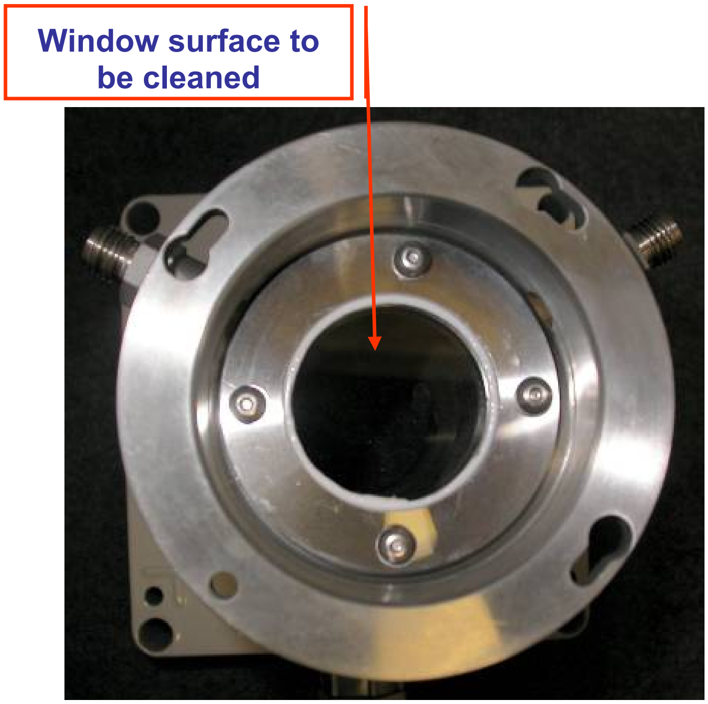


Figure 56 - Window Replacement

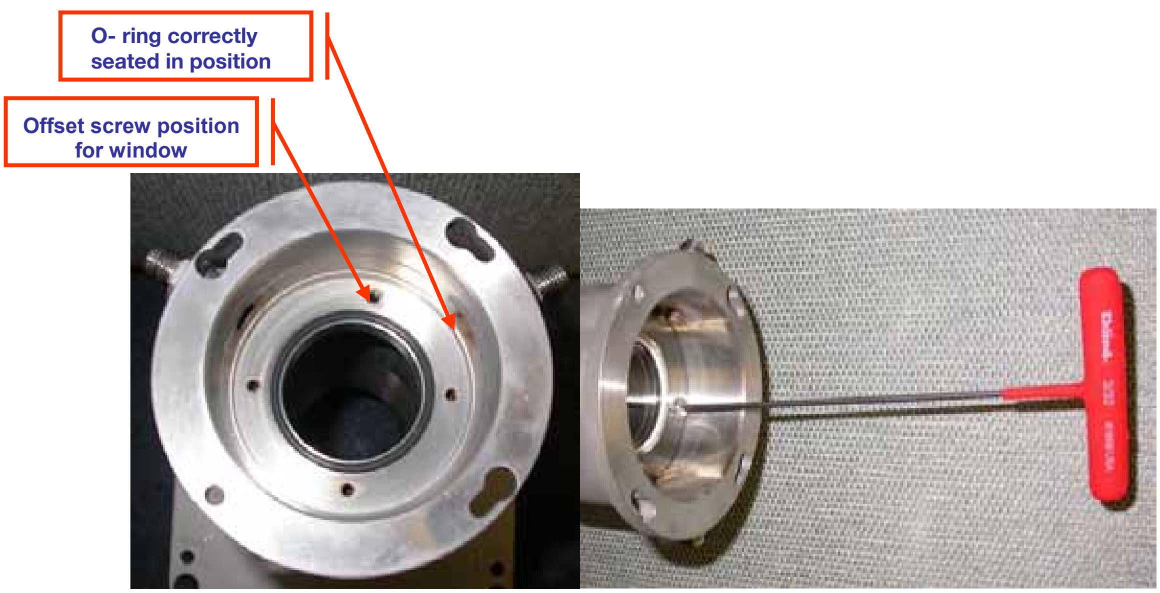


Figure 57 - Window Cleaning

7.1.2 Replacing Windows

If the windows are contaminated they may be cleaned using the following procedure:

- If the analyzer has not yet been shut down, then please shut-down the analyzer properly and remove power to ensure the laser if OFF
- Remove Launch or Detect (as appropriate) from the process interface by removing the one fixed hole fastener (5/32" Allen Wrench), loosening the remaining three fasteners and then twisting and pull off the unit.
- Remove the four retaining screws (3/32" Allen Wrench, T-Handle) and lock washers from the window holder recessed inside the quick connect body.
- Remove the window that requires replacement.
- Ensure the new replacement window is of the same specification as the window being removed. Standard Windows are 0.25" Thick wedged, BK-7 borosilicate crown glass mounted in stainless steel retaining ring.
- The window holder assemblies can only be installed in one way by virtue of the mounting hole placement.
- Ensure a new O-Ring (of same specification) is installed at the same time. Viton is the standard material however, certain applications may require other materials – check original specifications.
- With the new O-Ring in position, carefully locate the new window holder in place with the smooth glass surface against the O-Ring.
- Carefully tighten all four screws (ensuring the lock washers are in place) using a T-handle wrench. Keep tightening all the fasteners in turn by ¼ turns thus ensuring an even torque loading.
- Hand tighten the screws until they are very firmly tightened (a T handle wrench as shown below will torque its own shaft by about ¼ turn when the screws are fastened securely).

7.2 Alignment

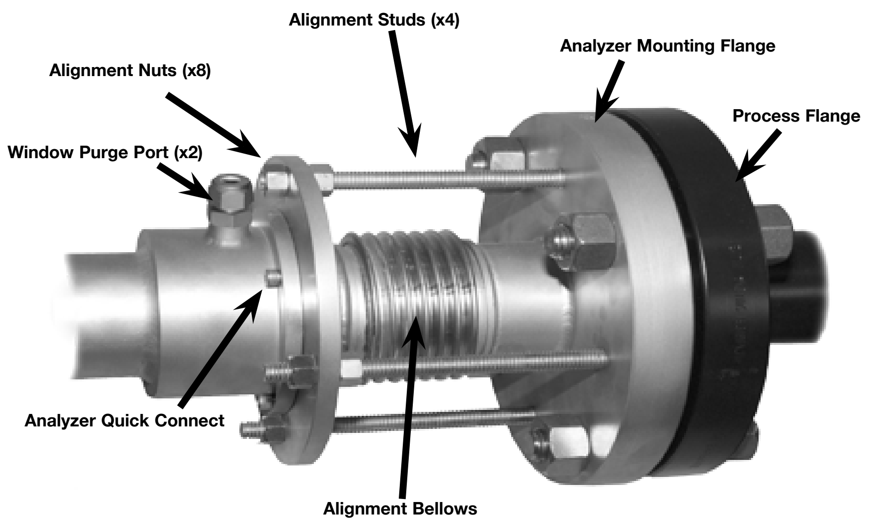


Figure 58 - Alignment Mechanism

7.3 Data Reporting, Storage and Retrieval

The TDLS200 analyzer has been designed with extensive data reporting capabilities. All data is available in the analyzer as a text file for import into a spreadsheet for analysis
Data stored in the analyzer:

- Results. Every measurement the gas concentration, transmission, diagnostic data are stored.
- Spectra. The analyzer records spectra at a timed interval, in the event of an analyzer warning or fault (including concentration values) and manually via the user interface.
- Calibration History is stored during every calibration or validation event.
- Alarm Fault History
- Events History which includes any changes made to the system settings

All data can be retrieved using a USB flash drive (at the analyzer), via the RIU, or over an Ethernet connection.

Please refer to Section 10 for complete details of the available data

8 Validation and Calibration

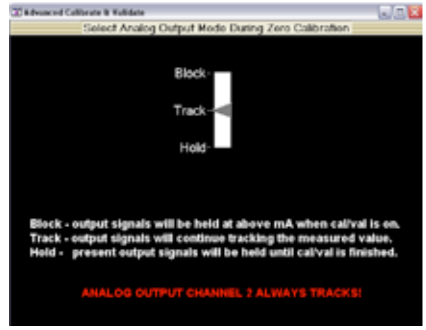
There are several methods that can be used to validate and/or calibrate the TDLS200 analyzer. Generally, we recommend routine validation of the analyzer either on-line (if appropriately set-up) or off-line. when the process gas can be isolated from the optical path (such as extractive enhanced flow cell).

Actual calibration should only be performed if certain performance criteria have not been met during the validations and should only be performed by appropriately qualified personnel.

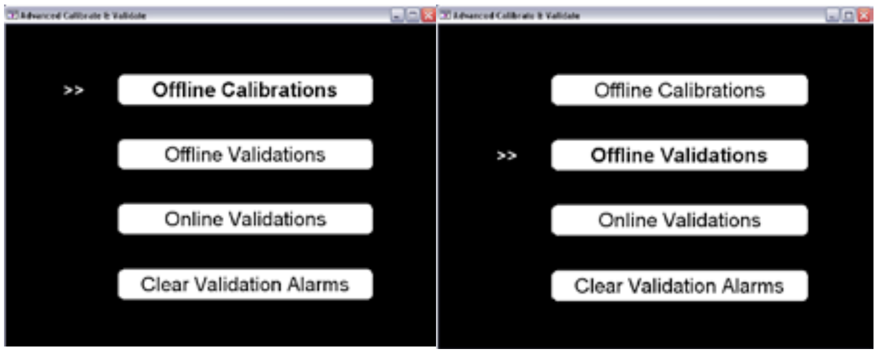
The options for Validation and Calibration are:

Validate On-Line Manual	Analyzer remains attached to process and also considered as a gas response check method	Use integral on-line check gas flow cell	Manual introduction of check gas and follow manual procedure via user interface (at RIU, local LCD or PC with VNC-Viewer)
Validate On-Line Automatic Initiated by: - Remote Contact - Local User Interface - Pre-Set Timer - URD Laptop VAC - RIU User Interface	Analyzer remains attached to process and also considered as a gas response check method	Use integral on-line check gas flow cell	Automatic introduction of check gas (requires appropriate hardware, valves, etc.) and implements automatic procedure from selected initiation method
Validate Off-Line (or Cal Check) Manual (Zero - Span)	Analyzer removed from the process alignment flanges	Use off-line calibration cell	Manual introduction of zero or span gas and follow manual procedure via user interface
Calibrate Off-Line Manual (Zero – Span)	Analyzer removed from the process alignment flanges	Use off-line calibration cell	Manual introduction of zero or span gas and follow manual calibration procedure via user interface
Analyzers with extractive flow cells and by-pass piping	Analyzer can remain in its off-line position	Use flow cell or bypass piping and introduce cal gases	Manual or automatic introduction of Zero and Span gases for validation or calibration (when equipped with appropriate hardware, valves, etc.)

Please note that you can select the block mA value for automatic Off-Line Zero Calibration, Off-Line Span Calibration, Off-Line Validations and On-Line Validations:



8 .1 Off-Line Manual/Automatic Checking and Off-Line Calibration



To perform either “Offline Calibrations” or “Offline Validations”, the Launch unit and Detect unit need to be removed from their respective process interface and connected to an Off-Line Calibration Cell. If the analyzer is installed on an extractive flow cell (enhanced flow cell or low volume flow cell) then it is already capable of being validated/calibrated in off-line mode.

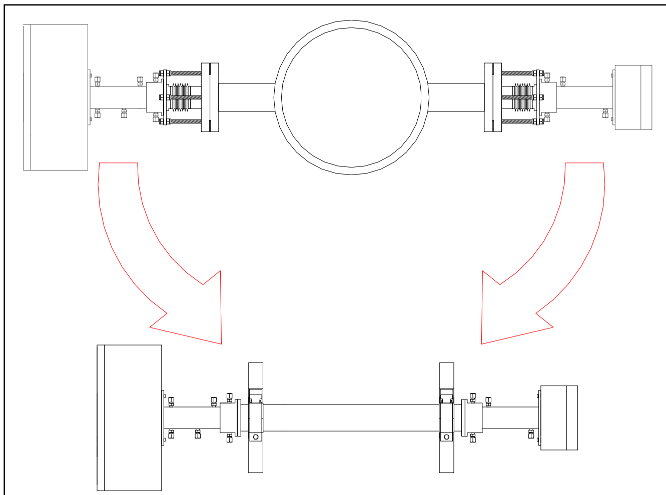


Figure 59

Before removing the units from the process, ensure that the process gas and window purge gas are correctly isolated to prevent excessive pressure (process or purge gas) from being released or from over-pressuring the analyzer.

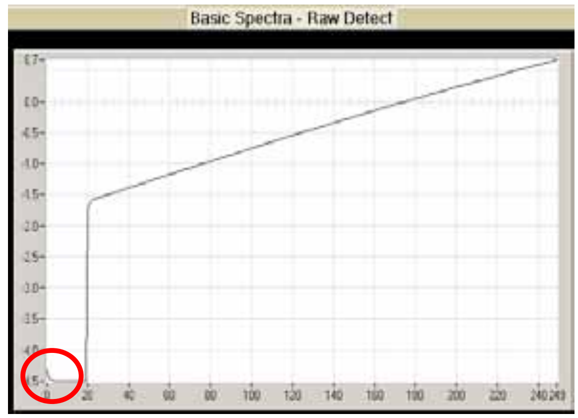
AVOID SHOCK AND IMPACT TO THE ANALYZER PERMANENT LASER DAMAGE MAY OCCUR

Moving the analyzer to the off-line calibration cell:

1	If the process gas is at a positive pressure, Isolate the analyzer from the process and shut-off the window purge gas flow to prevent excessive pressure building up on the window.
2	If the process is at or near negative pressure then be aware that ambient air will be drawn in to the process/stack when the analyzer is removed from its interface.
3	Remove the detect unit by loosening three of the Allen screws (5/32” Allen wrench). The three to loosen by one turn are top left, top right and lower left. The screw located lower right is to be fully removed.
4	Carefully twist the detect unit anti-clockwise until the Allen screw heads align with their openings, then pull the detect unit away from the alignment flange using an slight twisting action – Take care not to damage the O-Rings.
5	Carefully place the detect unit adjacent to the off-line calibration cell taking care not to contaminate the window.
6	Repeat same removal process for the Launch unit and place it VERY CAREFULLY adjacent to the off line calibration cell.
7	Check to see that there are three Allen Head screws in the top left, top right and lower left positions and that they are backed out to clear the analyzer quick connect. Attached the Detect unit to one end of the off-line calibration cell – Carefully slide the unit over the O-Rings making sure the O-Rings are not damaged/cut during mounting. Twist the analyzer in to the vertical position. Hand tighten the three screws – do not fully tighten at this time.
8	Insert the Allen screw to the lower right position and tighten. Tighten all other Allen screws now also
9	Repeat same mounting process for the Launch unit and handle it VERY CAREFULLY
10	With the appropriate user interface, observe the transmission (75-100%) level to ensure correct mounting and alignment. Note, there is no means for alignment adjustment when mounted to the calibration cell other than as noted below.
11	Connect all purge tubes as required (see below) and leak check accordingly – note that any hazardous gases (CO, H_2S, CH_4, etc.) should be vented to safe area in accordance with any local requirements. **Note, any leaks can cause erroneous results and can present hazardous situations!**

Procedure for Alignment Optimization on Calibration Cell

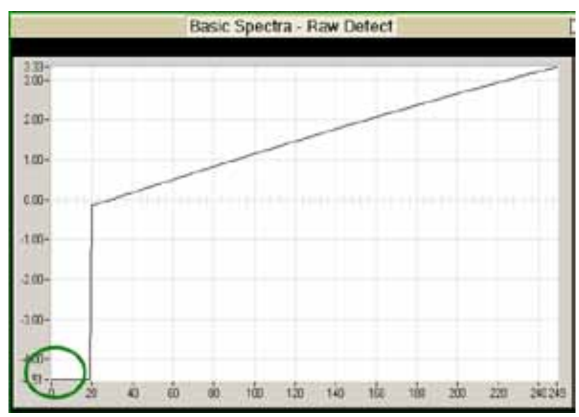
1. The launch unit should be adjusted so that the transmission is maximized for off-line calibration
2. Ensure launch unit alignment nuts are securely fastened so that the launch unit cannot move it's alignment position
3. To optimize the detect unit alignment, make small adjustments in alignment nuts of detect alignment flange while increasing the transmission value
4. When the transmission value is maximized, observe the Raw Detector Signal to ensure the initial 20 data points are at the baseline condition (i.e. flat data points from 0-20).
5. If the value of these 0-20 data points decline (i.e. not a flat line) then this is an indication of some small misalignment of the system
6. (see POOR alignment example right)

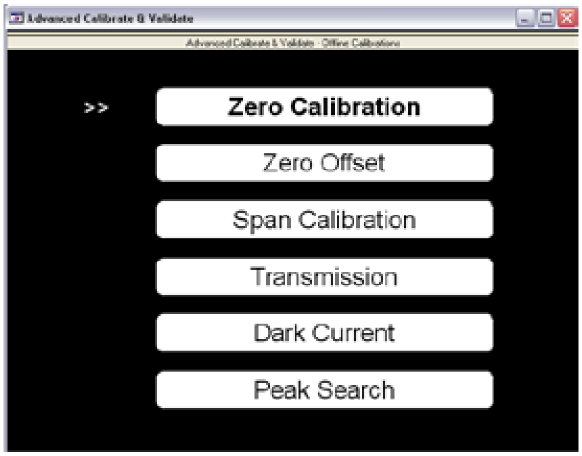
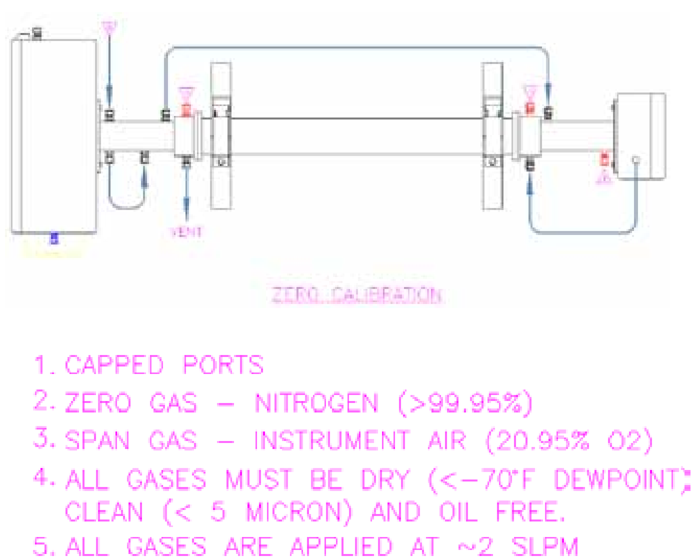


Carefully make small adjustments in the alignment of launch unit to minimize the slope at the start of the raw detector ramp. Then, Carefully make small adjustments in the alignment of detect unit to minimize the slope at the start of the raw detector ramp for good alignment

(see GOOD alignment example right)

7. Ensure transmission level is still good
8. Apply manual force to the launch unit (vertical and horizontal) to ensure the transmission remains stable and that the system is mechanically tight. If there is any movement or change in transmission then ensure all alignment nuts are secured and check again for mechanical stability.
9. Apply manual force to the detect unit (vertical and horizontal) to ensure the transmission remains stable and that the system is mechanically tight. If there is any movement or change in transmission then ensure all alignment nuts are secured and check again for mechanical stability.



12	With the appropriate user interface, go to either Basic Menu (to Check Zero or Span) or Advanced Menu (to Check Zero or Span and/or perform actual Calibration).
13	Follow the detailed on-screen instructions when check the analyzer zero and/or checking the span 
14	We do not recommend calibrating the Zero unless some core spare parts have been replaced (such as laser module or FPGA board). If the Zero reading appears incorrect, then ensure all data results and spectra have been stored and send the files to Yokogawa Laser Analysis Division for further evaluation. Apply zero gas using the appropriate gas flow path as show: 

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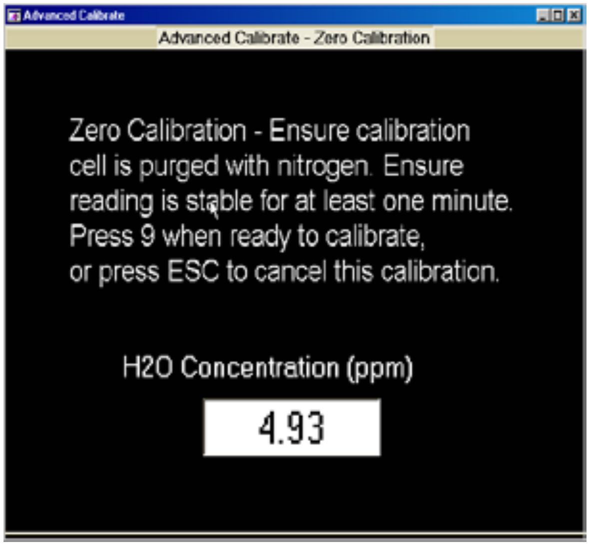

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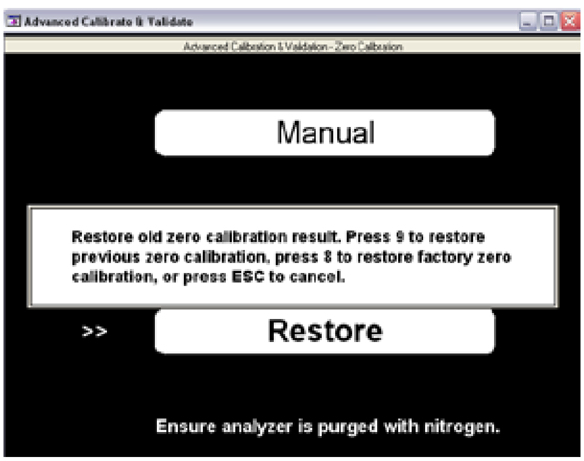
After Zero calibration is completed, double check the absorption spectrum to ensure there is no absorption peak present or that there is no negative absorption peak (indicating that the zero gas had not fully purged the optical path). Perform the zero calibration again in either case or check with your local Yokogawa representative.
If there is reason to restore either zero calibration, then please follow the on-screen instructions:



When an acceptable zero has been established, arrange the purge tubes as shown below and then follow the on-screen instructions for Span calibration.
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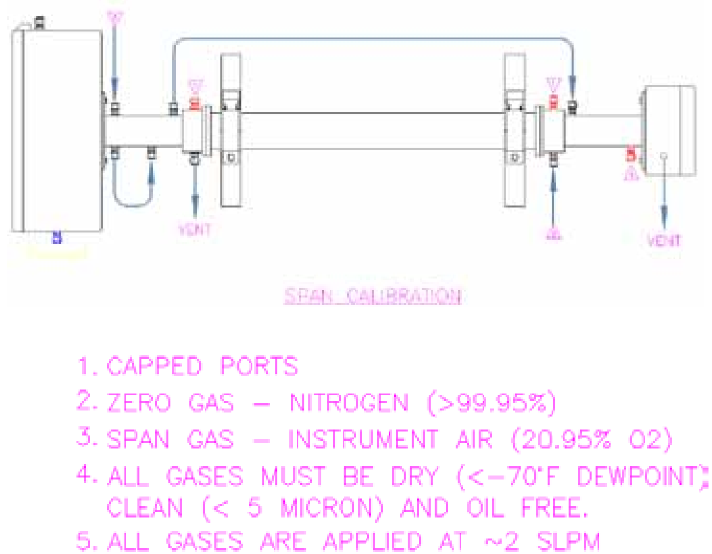
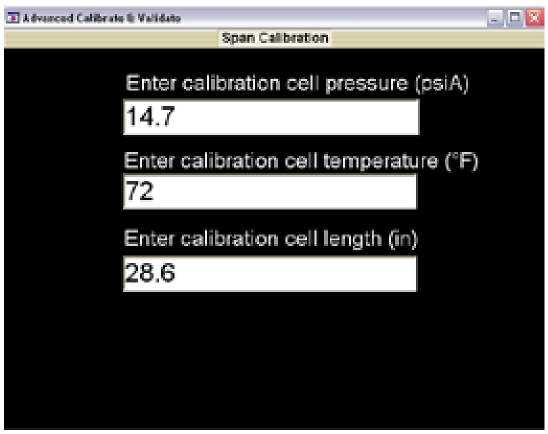
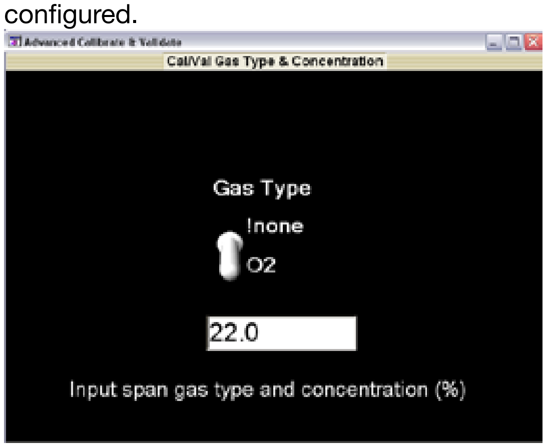
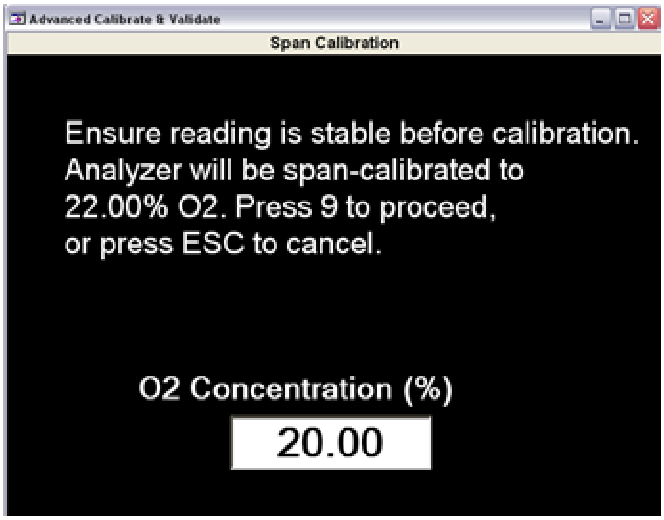




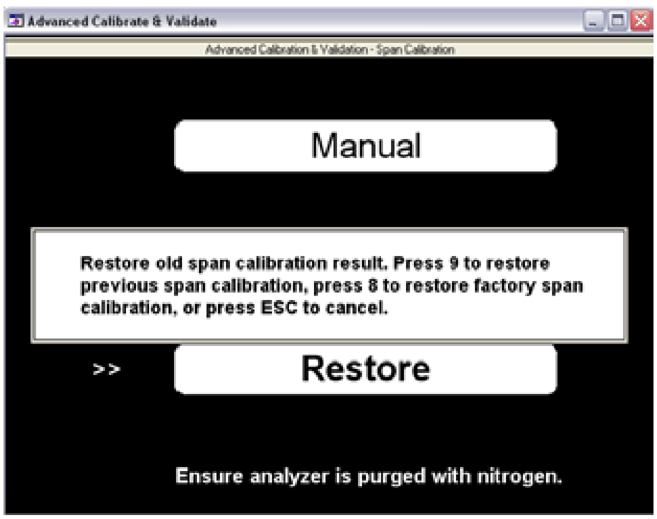
After entering cell pressure, cell temperature and cell length (28.6" or 72.6cm) the following option will appear on the basis of two gas measurement option. Please toggle to either of the two gases configured within the analyzer or as in the example below, there is no second measured gas configured.



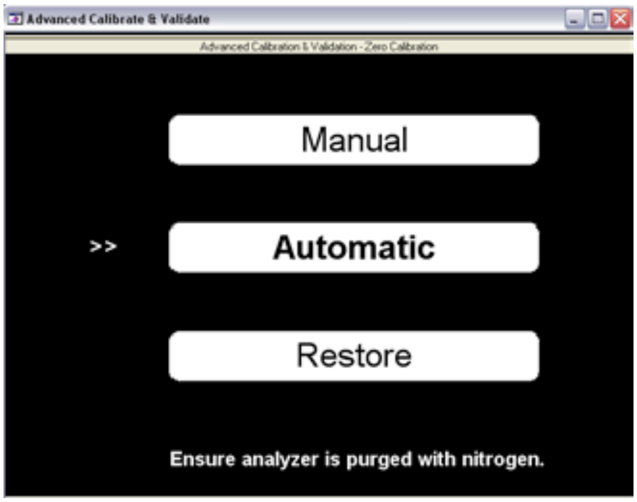
Note, after entering the desired span gas value, the following display will prompt you to press 9 to actually perform the calibration or escape to cancel. Note, the concentration that is being displayed and up-dated in the lower box is the currently measured value before the calibration is performed. After calibration, please check the results and consult with Yokogawa if any questions or concerns.

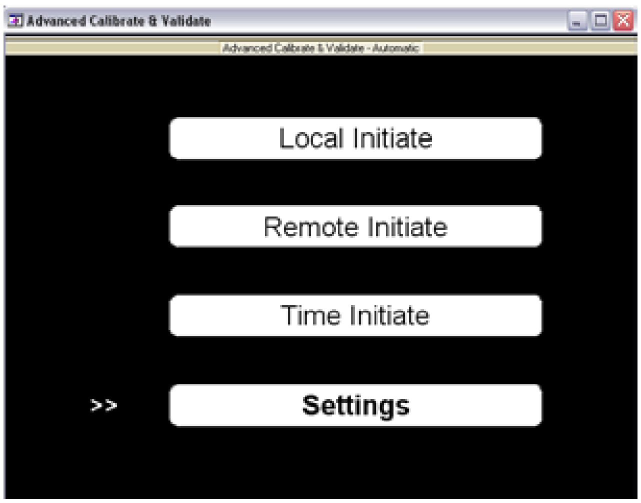


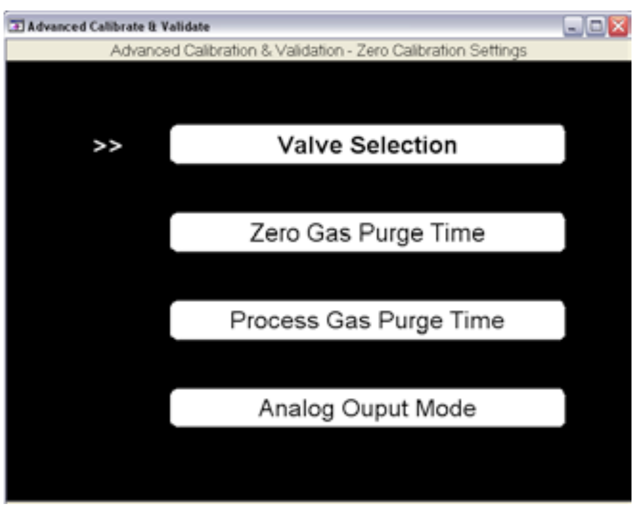
If there is reason to restore either a Span calibration, then please follow the on-screen instructions:



For Automatic Off-Line Calibrations, used only on extractive applications please follow the on-screen instructions:


Advanced Calibrate & Validate
Advanced Calibration & Validation - Zero Calibration
Manual
>> Automatic
Restore
Ensure analyzer is purged with nitrogen.


Advanced Calibrate & Validate
Advanced Calibrate & Validate - Automatic
Local Initiate
Remote Initiate
Time Initiate
>> Settings


Advanced Calibrate & Validate
Advanced Calibration & Validation - Zero Calibration Settings
>> Valve Selection
Zero Gas Purge Time
Process Gas Purge Time
Analog Ouput Mode

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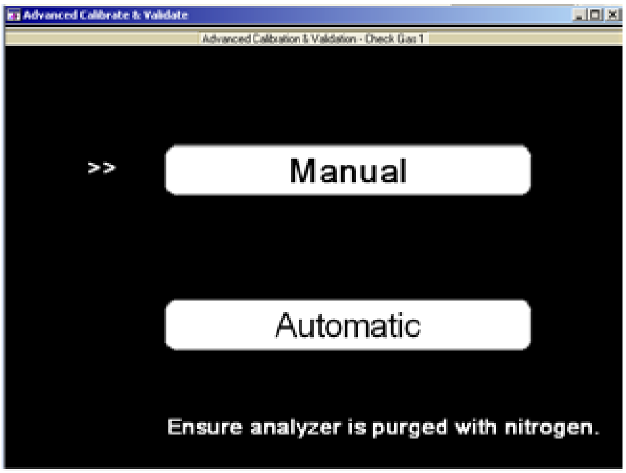

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MANUAL OFFLINE VALIDATIONS

Enter into the Advanced Menu, Calibrate & Validate section, Off-Line Validations. Choose Check gas 1, 2 or two gas validation and select Manual Validation.

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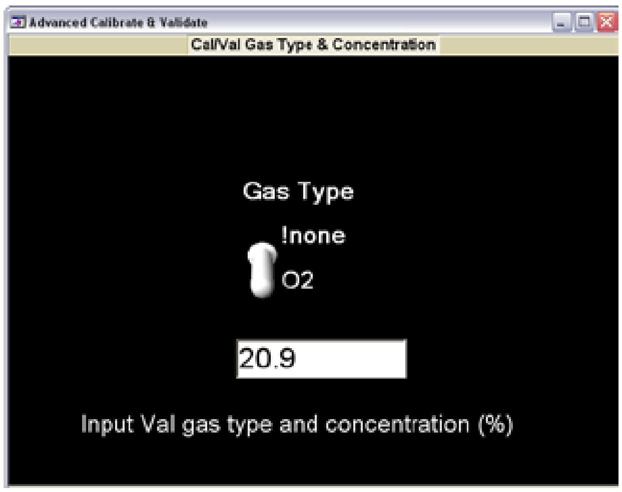
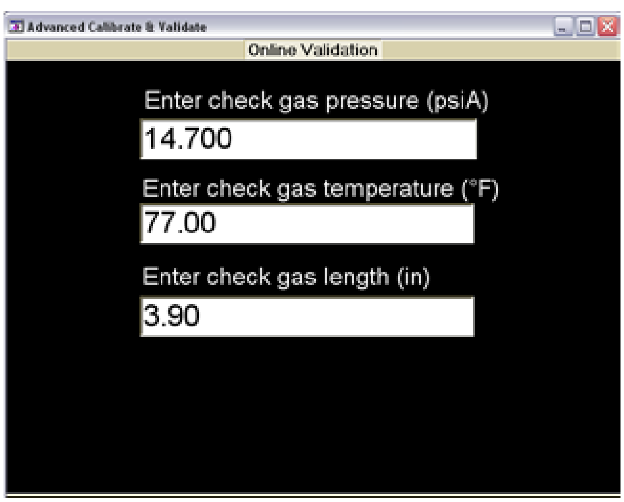
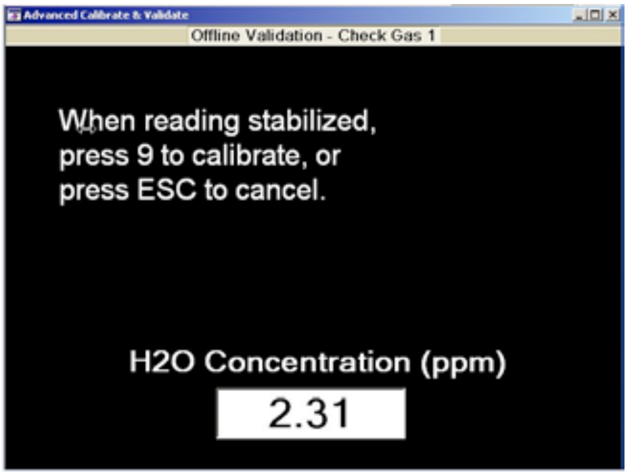




</td>
<td>

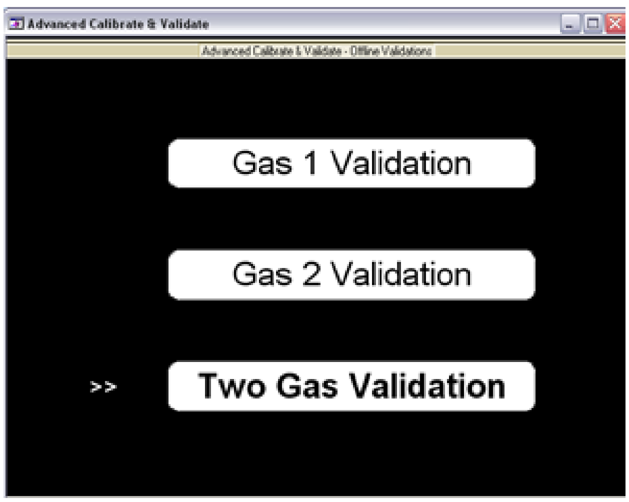
Following the on screen directions, enter in the pressure, temperature, cell length, & concentration of the gas within the off-line line check gas flow cell. Press Enter to proceed.

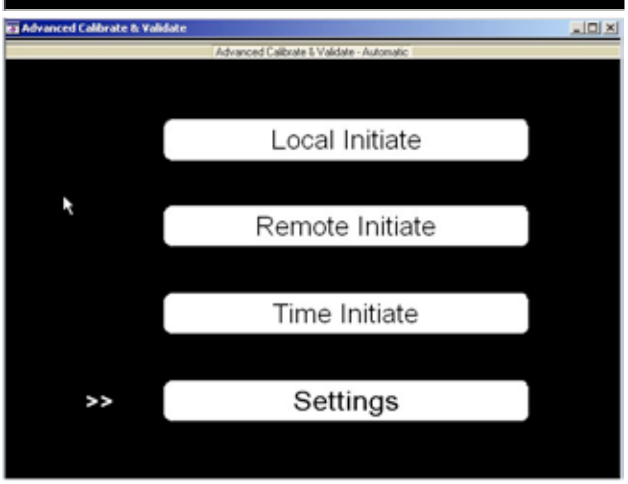
</td>
</tr>
</table>



MANUAL OFFLINE VALIDATIONS

Enter into the Advanced Menu, Calibrate & Validate section, Off-Line Validations.
Choose Check gas 1, 2 or 3 and select Manual Validation.



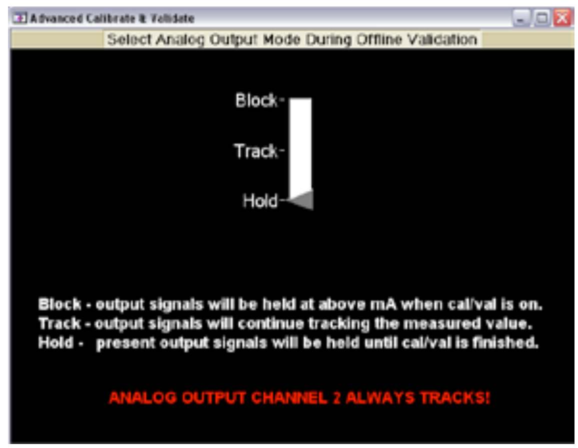


AUTOMATIC OFFLINE VALIDATIONS

The Validations may be for Gas 1, Gas 2 or Two Gas Validation (such as Zero & Span Check, or 20% & 80% FS checks as required by some regulatory applications).
The Offline Validations can also be automatically configured. Refer to later section for details.
Local Initiate will start the automatic online validation sequence when selected. It will use the existing 'Settings' (see below for details on 'Settings').
Remote Initiate will enable/disable monitoring of the selected "Remote Initiate" contacts on TB-2 within the Launch Unit. When enabled, the analyzer will detect the chosen contact closure and automatically start the online validation sequence.
Time Initiate will allow input of a specified time to automatically start online validation sequence once every day, every week, every 2 weeks, or every 4 weeks.

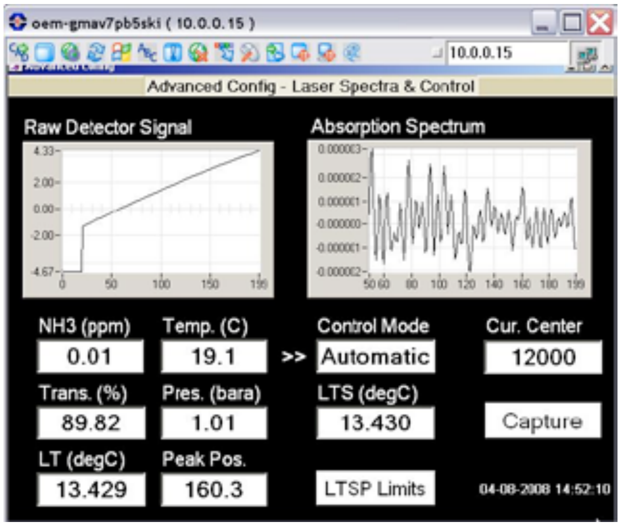
There are several critical parameters that must be preconfigured in the TDLS200 software when using the automatic validation sequence. These parameters MUST be correctly set otherwise the analyzer will report false/incorrect validation results.

- Check Gas Concentration specifies the concentration (ppm or %) of the gas within the offline flow cell.
- Check Gas Pathlength specifies the optical path length of the offline flow cell (typically 20", 30", 40", 60" or 80" – please check the flow cell configuration for details).
- Check Gas Temperature can be selected for either Fixed or Active.
    - o If Active Temperature, then follow on screen instructions. This is typical for a heat traced controlled flow cell that has an active 4-20mA signal proportional to the cell temperature
    - o If Fixed Temperature, then enter in the temperature of the gas within the offline flow cell. Remember that this value will be used whenever the auto validate is used so try to select a value that is representative of when the auto validate might take place (day/night, etc.) Press ENT to proceed.
- Check Gas Pressure specifies the pressure at which the gas within the offline line flow cell.
- Valve Selection specifies which analyzer's solenoid valve driver is used for the check gas.
- Check Gas Purge Time specifies how long the check gas will purge the flow cell – please allow sufficient time for volume exchanges to ensure only the validation gas is being measured and that all previous process gas has been thoroughly purged out.
- Process Gas Purge Time specifies how long process gas will purge the flow cell before up-dating the results and making the 4-20mA signals real-time. Please ensure that the time is sufficient to ensure all validation gases have been purged from the flow cell and that only process gas is being measured as the 4-20mA outputs will return to live mode when the validation is completed
- Analog Output Mode specifies Block, Track, or Hold of all 4 to 20 mA output during offline check. Note that the mA value of the Block mode can be set elsewhere in the software.



8.2 Off-Line Calibration for Reference Peak Locking Applications:

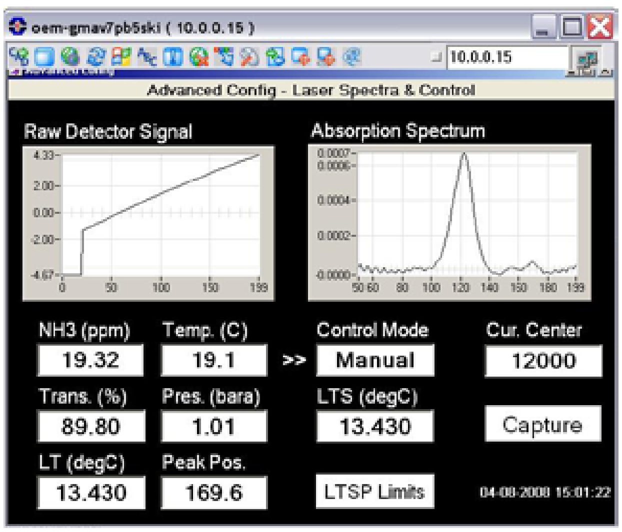
Zero and Span calibrations MUST be performed as per normal off-line procedures, without using and Reference Line locking gases.



Process/Calibration OPL: N2
Analyzer Purge: N2

This is how the absorption spectra will appear when there is neither NH3 nor H2O (or any other target gas for the given application) in the entire optical path (Process OPL and Analyzer Purge).

This is the absorption spectra appearance required for an Off-Line Zero Calibration of the analyzer.



Process/Calibration OPL: ~20ppm NH3
Analyzer Purge: N2

In this Absorption Spectra view, there is practically zero H2O absorption peak in the approximate peak center position (PCP) region.

There is approximate 20ppm NH3 (@ approx PCP ~120) absorption in this spectra based on 72.6cm OPL, ambient temperature and ambient pressure.

Note, other target gases such as CO, CO2, HCN, etc. will also require only target gas absorption spectrum at the time of off-line calibration.

This is the typical absorption spectra appearance required for an Off-Line Span Calibration of the analyzer.

8.3 On-Line Validation

The basic concept of on-line validation is to add a known gas concentration via an integral check gas flow cell while still measuring the process gas concentration under relatively controlled conditions.

The controlled (or known) conditions for the addition of the validation (or check) gas are:

- Pressure of the check gas being introduced (typically atmospheric)
- Temperature of the check gas being introduced (typically ambient)
- Length of the cell in which the check gas being introduced (typically 3.7-4.0")
- Concentration of the check gas being introduced (application specific)

The fundamental procedure performed is:

- Introduce the known check gas
- Enter the know validation parameters via software
- After purging the check gas flow cell for a period, take measurement
- Re-Introduce the original purge gas (typically Nitrogen or I/A)
- After purging the gas flow cell for a period, take a third reading Second measurement
- The analyzer then calculates what the expected 'addition' should be from the known parameters and compares the 'Expected Value' to the 'Actual Value' and determines a PASS or FAIL situation

⚠ NOTE: It is better to perform on-line validations when the process is relatively stable. Some processes are very dynamic so it at all possible, try to perform the validation during a more stable process operating period. This will help ensure the validation is meaningful.

8.4 ON-LINE VALIDATION OVERVIEW:

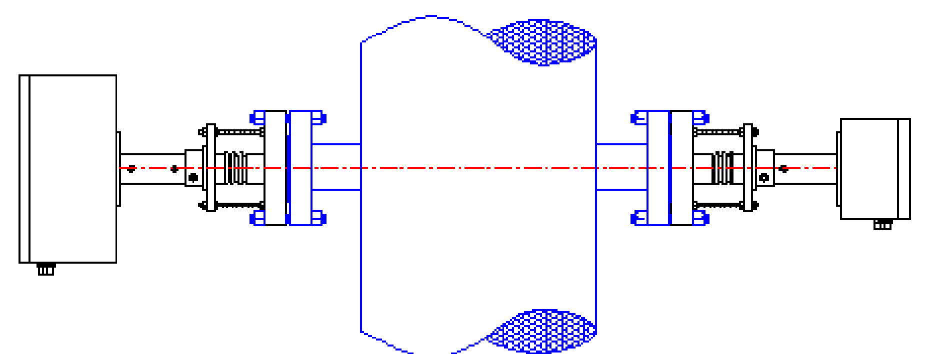
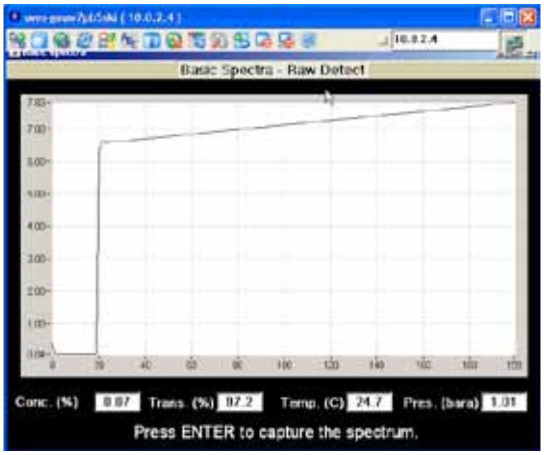


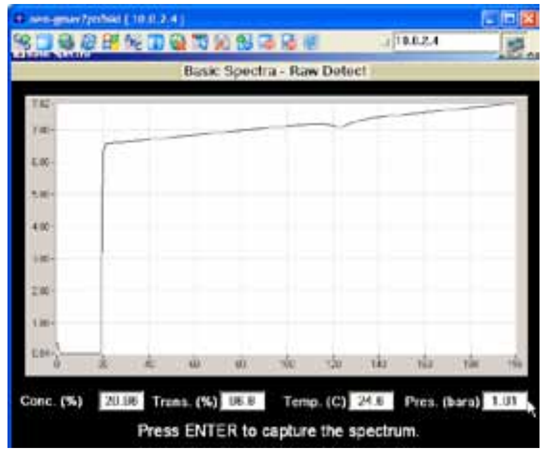
Figure 60

A tunable diode laser emits light energy within a very narrow wavelength range which is controlled by the analyzer itself, typically no more than 0.1nm across the entire scan region. This therefore allows laser scanning across just one absorption peak and baseline (zero absorption) regions on either side. The analyzer scans this region approximately 1,000 times per second while accumulating the spectra in memory. The scanning (i.e. wavelength adjustment) is controlled by rapid adjustment of the electrical drive current on the diode itself.

A tunable diode laser emits light energy within a very narrow wavelength range which is controlled by the analyzer itself, typically no more than 0.1nm across the entire scan region. This therefore allows laser scanning across just one absorption peak and baseline (zero absorption) regions on either side. The analyzer scans this region approximately 1,000 times per second while accumulating the spectra in memory. The scanning (i.e. wavelength adjustment) is controlled by rapid adjustment of the electrical drive current on the diode itself.

Below is the typical ‘Raw Detector Signal’ received from the detect unit. On the left it is shown with no oxygen present and on the right it is shown with some oxygen present.

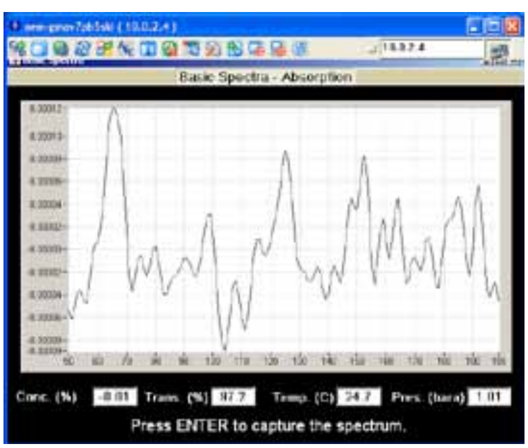


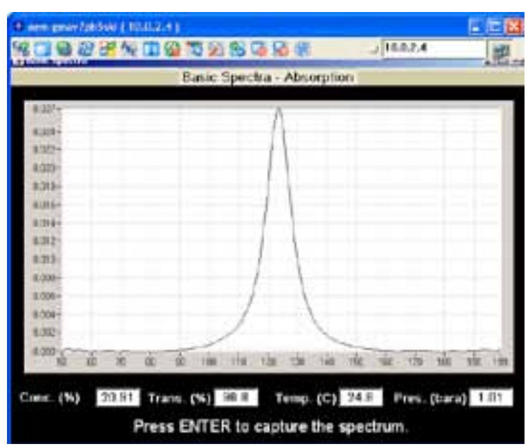


Raw Detect Signal, No Oxygen present

Raw Detect Signal – Oxygen Present

The TruePeak TDLS200 uses the raw detector signal to produce the actual absorption spectra (see below, note the vertical scale in Absorbance Units is different between the two spectra) which is then used to calculate the peak area. It is the peak area that is proportional to the oxygen concentration with given process parameters. The given process parameters used in the oxygen concentration calculation are the optical path length, gas temperature and gas pressure. These known parameters are pre-determined and programmed into the analyzer. If the process gas temperature and/or pressure are varying under normal operation then these values can be actively input via process transmitters. In this case, the analyzer uses active values for the gas temperature and/or pressure and a pre-programmed value for the optical path length.



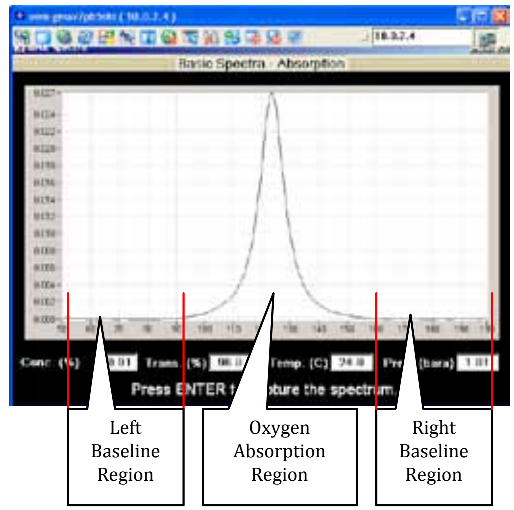


Absorption Spectra, No Oxygen present

Absorption Spectra – Oxygen Present

Instrument Span Drift: The analyzer does not contain measurement components that can wear, decay and generally drift in one direction. These are items that are used in conventional analyzers that determine the requirement for routine span gas calibrations. With TDLS analyzers, the measurement drift is limited to essentially optical elements only and these effects are fixed values. The amount of drift does not change over time as the actual optical elements do not change. The changes within the optical elements that cause the drift relate to dimensional changes under varying ambient temperatures. These small changes are quantified during factory testing to ensure they are within allowed instrument specification and they do not change with time.

Calculating Oxygen Concentration: Given that the optical path length, gas temperature and gas pressure are known, and fundamental optical drift has been predetermined, the only aspect of measurement that can now affect the true peak area is the quantity of oxygen molecules in the optical path. The true peak area measurement is ensured because the laser scans wavelength from a non-absorbing region (see data points 50-90) through the oxygen absorption region (see data points 91-159) and on to another non-absorbing region (see data points 160-200). The two regions of non-absorbing spectra allow for a base-line to be drawn below the absorption curve and subsequent true peak area calculation.



On-Line Validation; By knowing the above measurement principles it is possible to understand that the TDLS200 is capable of performing on-line validations to verify analyzer measurement performance. When the analyzer is initially calibrated off-line using protocol certified gas standards, the area of the absorption peak is assigned a calibration coefficient. This coefficient is then used in a series of equations to correct for optical pathlength, gas temperature and gas pressure. Obviously, when factory calibrating the analyzer, the measurement conditions are different to that of the process. Typically the analyzers are calibrated with a 28.6" long optical path and ambient temperature and pressure (75deg F and 14.7psiA). The relationships of pathlength, temperature and pressure are well known and proven and therefore can be used to correct for other conditions such as a furnace with 60" optical path operating at 600 deg F and 14.6psiA.

When an on-line validation is performed, the analyzer is adding a known area to the absorption peak. The oxygen concentration of the validation gas is known (typically 20.9% O2), the optical path length is known (the validation cell has a 4" OPL), the gas temperature is known (ambient is measured by the analyzer) and the gas pressure is also known (the validation cell vents to atmosphere). Therefore, the analyzer knows what additional peak area should be measured during a validation cycle.

A validation cycle consists of first capturing a process gas only spectra (1), then adding the validation gas to the validation cell and capturing a spectra (2) and then removing the validation gas and finally capturing a second process gas only spectra (3). Spectra (1) and (3) are then averaged spectra as they represent the process gas only before and after validation. Spectra (2) is the combination of process and validation gas so when the averaged (1)(3) spectra is subtracted, the peak area remaining is that of the validation gas (at 4" OPL, ambient temperature and pressure). This area measured for validation gas should therefore match the expected value because all other parameters are known.

If the measured true peak area matches that of the calculated peak area then the analyzer passes 'On-Line Validation'.

The On-line Validation interval is user selectable.

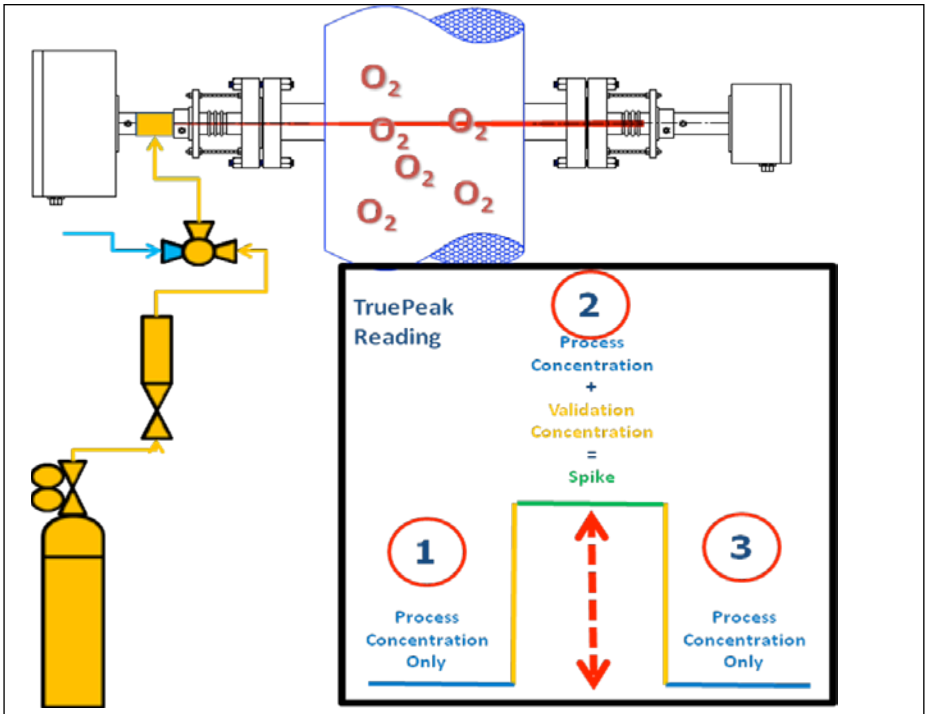


Figure 61

- Daily (Recommended for low level or critical applications)
- Weekly
- Bi-weekly
- Monthly

8.5 Performing Manual OnLine Validation

This will require the appropriate valves, tubes and tubes fittings such that the integral on-line check gas flow cell can be purged with either normal purge gas (typically Nitrogen) or the check gas (instrument air is acceptable for Oxygen analyzers in most applications). The flow path shall be as below:

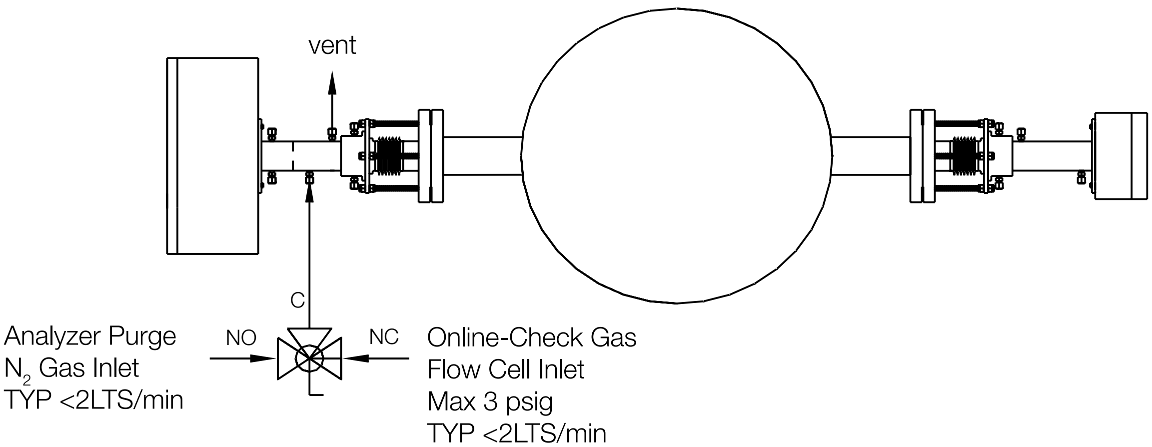
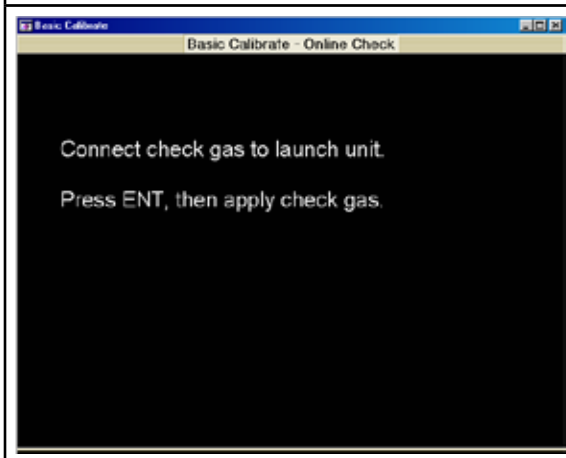
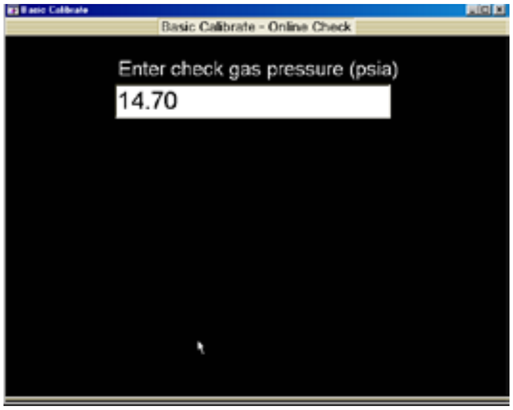
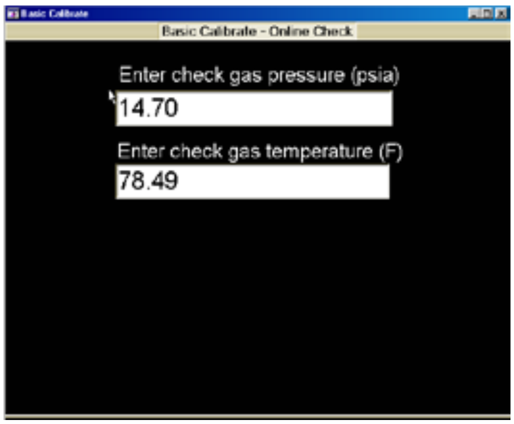


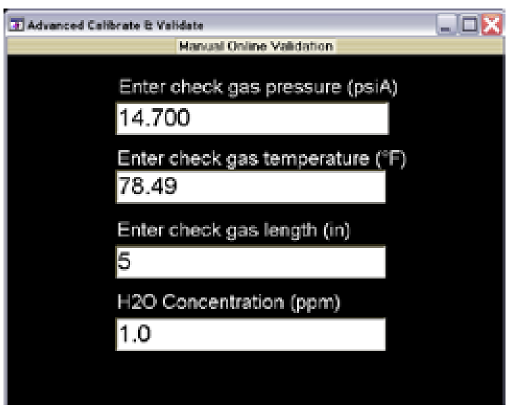
Figure 62 - Manual On-Line Validation (manual valve actuation)

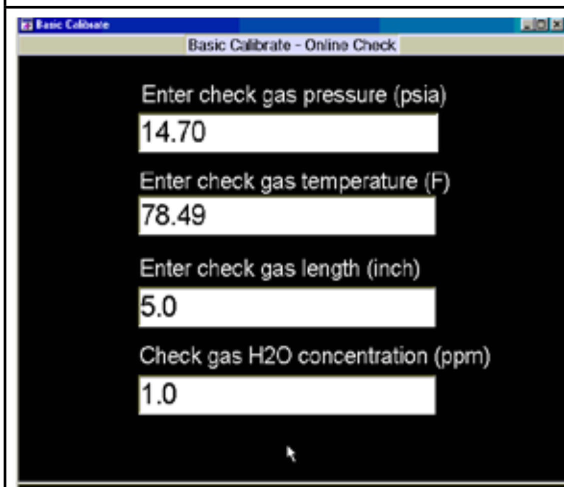
Via the user interface (laptop PC and VNC Viewer or installed 6.5” Display and Keypad) follow this sequence:

	Enter into the Advanced Menu, Calibrate & Validate section. Enter On-Line Validations then Manual Validation
	Ensure the check gas is ready to start purging the integral on-line check gas flow cell BUT DO NOT start the flow yet. The standard purge gas (typically Nitrogen) should still be flowing through this cell at this time. Press ENT and then switch to flowing the check gas through the cell

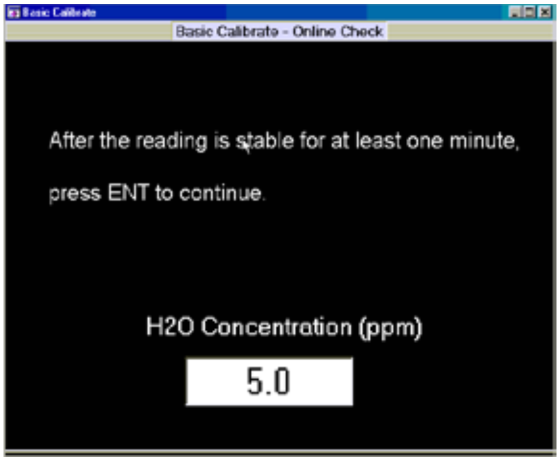
<table>
<tr><td>
</td><td>Following the on screen directions, enter in the pressure of the gas within the on-line line check gas flow cell. Typically this cell is vented to atmosphere so an atmospheric pressure value (14.7 psiA or 1.01barA) will work.

Press ENT to proceed.</td></tr>
<tr><td>
</td><td>Enter in the temperature of the gas within the on-line line check gas flow cell. Typically this cell is the same temperature as ambient. Use a thermometer, DVM with appropriate thermocouple attachment or radio to the control room for an ambient reading.

Press ENT to proceed</td></tr>
<tr><td>
</td><td>The length of the on-line check gas flow cell has been already entered (a default value) and should be in the order of 3.5 to 5.5” (or 75 to 115mm).

Press ENT to proceed.</td></tr>
<tr><td>
</td><td>Enter in the concentration of the Check Gas (20.9% for instrument air – Oxygen analyzers only). If using a cylinder of cal gas, then check the cylinder certification label and its expiration date to be sure.

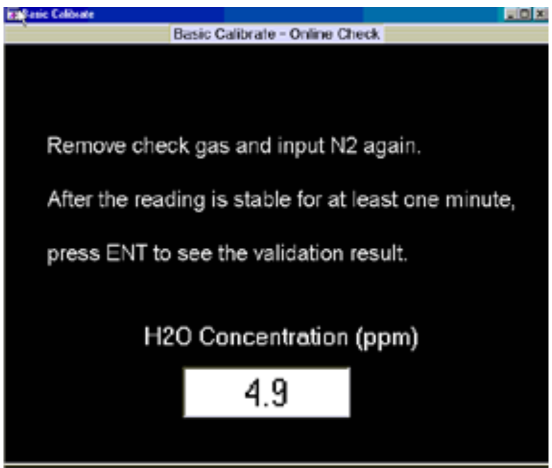
Press ENT to proceed.</td></tr>
</table>



Wait for the reading to stabilize.

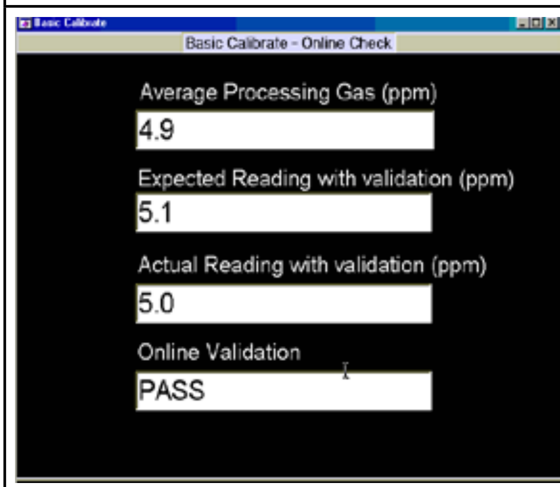
Many processes are dynamic but judge for yourself when you believe the check gas has fully purged the integral check gas flow cell – typically at least one minute depending on the location of the switching valve.

Press ENT to proceed.

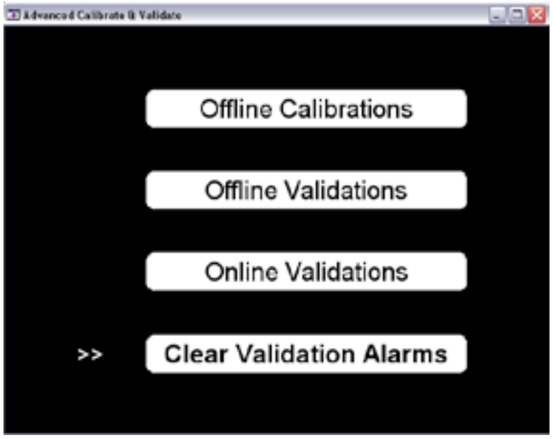


Re-apply the original purge gas (typically Nitrogen) and again wait for the reading to stabilize (as the check gas is being purged from the check gas flow cell).

Press ENT to proceed.



Observe the on-screen results. If there is some doubt about the result, the Validation may be performed again as many times as required.

	If the validation fails, repeat the validation after checking the parameters are correct and ensuring there is sufficient purge gas time. If the failure is due to a known non-related event (such as incorrect validation gas value or non-functioning valve) then the validation alarm can be cleared as shown.

8.6 Performing Automated On-Line Validation

This will require the appropriate automatic valves (solenoid valves and/or pneumatically actuated valves), tubes and tubes fittings such that the integral on-line check gas flow cell can be purged with either normal purge gas (typically Nitrogen) or the check gas (instrument air is acceptable for Oxygen analyzers).

The analyzer can drive one 24 VDC solenoid operated valve (external, optional valve or customer supply) with a max 10W rating. Typical Automatic On-Line validation will use one of the following approaches:

- A 3-way solenoid actuated valve that directly switches between the purge gas (typically nitrogen) and the check gas.
- A 3-way solenoid valve that is used to pilot a pneumatically actuated 3-way ball valve
- A 3-way solenoid valve that is used to pilot a pneumatically actuated manifold style valve (such as the Swagelok T series or Parker R-Max or even NESSI platforms)

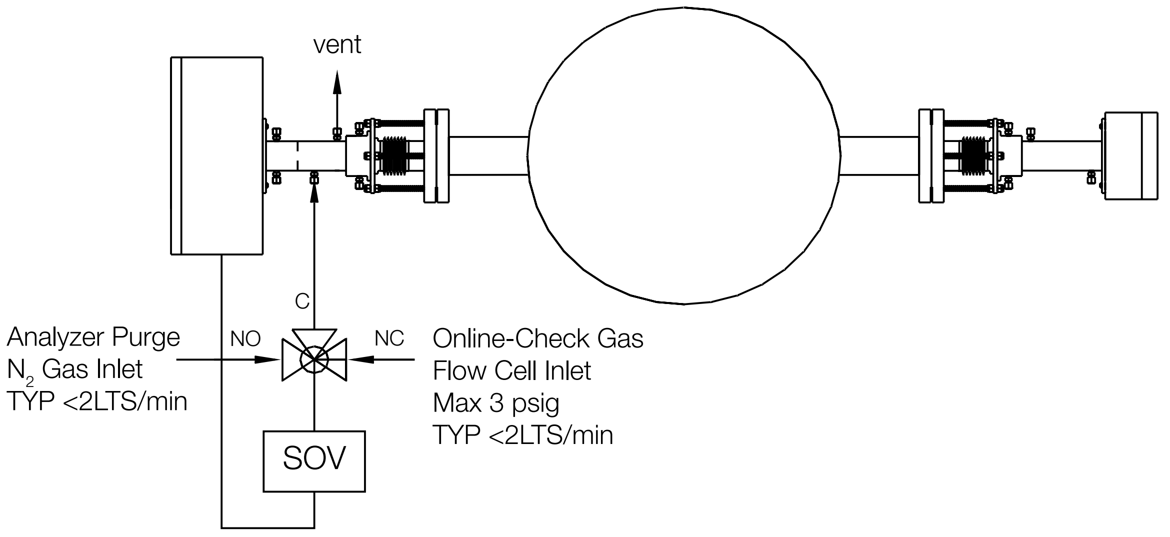


Figure 63 - Automated On-Line Validation (electric solenoid valve)

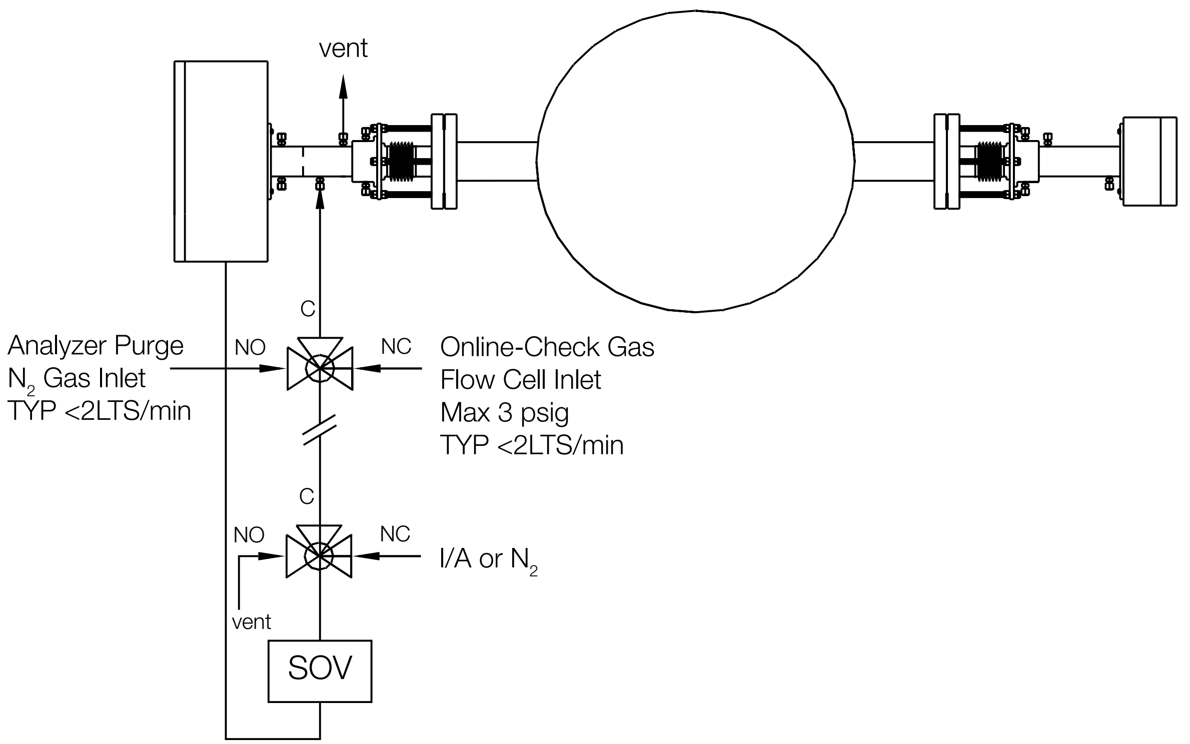
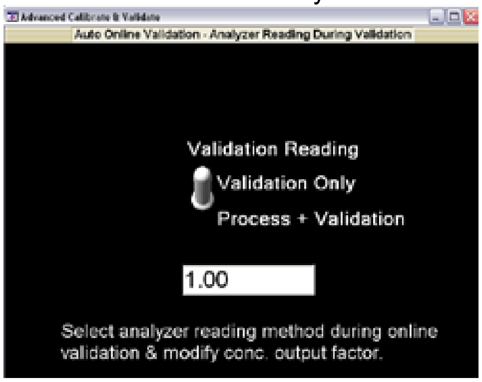
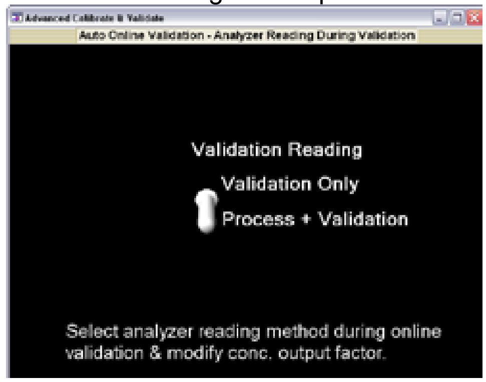


Figure 64 - Automated On-Line Validation (pneumatic solenoid valve)

Before proceeding with an automatic validation sequence, ensure all settings are correct.

Types of Validation Reading:
There are two different ways in which the validation reading can be presented.





Validation Only: When this method is selected, the analyzer will calculate AND output the result as the actual gas value e.g. instrument air if validated correctly would show AND output 20.9% O2 as the validation result. Another example would be 5% CO being the validation gas value and the hence the calculated AND output value (when Track is selected for 4-20mA) would also be 5%. In some cases, the output range might be scaled below the validation gas value (e.g. 0-10% O2 while validating with 20.9% O2). In these cases, the Validation Only result can be scaled down to fit within the configured 4-20mA output range.

Example: 0-5,000ppm CO is set for 4-20mA output range. 5% CO is used for the validation gas. To make the Tracked 4-20mA output read 5,000ppm during validation at the DCS, the Factor should be 0.1. To make the 5% CO validation gas read 2,500ppm (at the DCS), the factor should be set to 0.05.

Process + Validation: When this method is selected, the analyzer will calculate AND output the result as a response relative to the process conditions. The displayed result on screen will be shown as Expected result (say 20.9% O2) compared to actual result (say 20.7%O2) however, if Track mode is selected for the 4-20mA then the mA will track the result as if the validation gas was process gas.

Example: If the validation gas is introduced without the analyzer knowing, and the process reading changes by 2% O2 then this should be addition amount during each validation. So if process reading is 5% O2 then, when an on-line validation is performed the reading (and Tracked 4-2mA) will change to 7% O2.
Example: If the introduction of 5% CO causes a 600ppm change in the process reading, then this will be the expected step change in reading (and Tracked 4-20mA) during on-line validations.

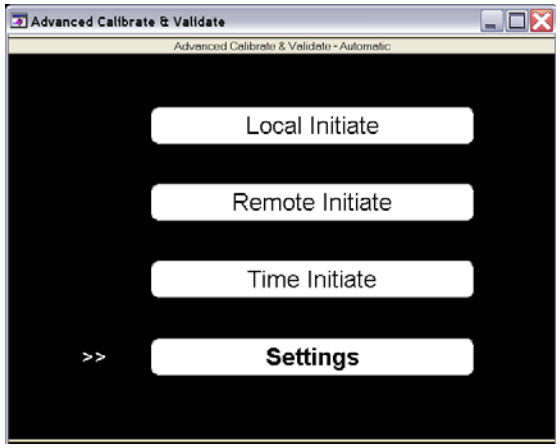
Initiating Validation:
There are several ways in which the Automatic Validation sequence can be initiated:

- Remote Contact – The analyzer has the ability to monitor a pair of voltage free contacts. These contacts would typically be located at the DCS or a simple switch located near the analyzer. The analyzer continuously monitors the remote contacts (or switch) for a return voltage (24 VDC generated by the analyzer). When the contacts close, the return voltage is sensed and the Auto Validation sequence is initiated.
- Local User Interface – The TDLS200 software allows for the user (either through a laptop PC running VAC software or via installed 6.5" display & Keypad) to initiate the Auto Validation sequence. The operator would be at the analyzer in this case.
- Preset Timed – The TDLS200 software allows for the analyzer to automatically initiate the Auto Validation sequence based on a user configurable timed basis.
- URD & Laptop PC with VAC software – The TDLS200 software allows for the user through a laptop PC running VAC software to initiate the Auto Validation sequence. The operator would be at the URD with the laptop PC plugged in to the Ethernet port on the URD Feed Through board.
- RIU with VAC software – The TDLS200 software allows for the user through an RIU running VAC software to initiate the Auto Validation sequence. The operator would be at the RIU in this case.

Selecting Automatic Validation Initiation

From Online Validations – Automatic menu, the following options may be selected.

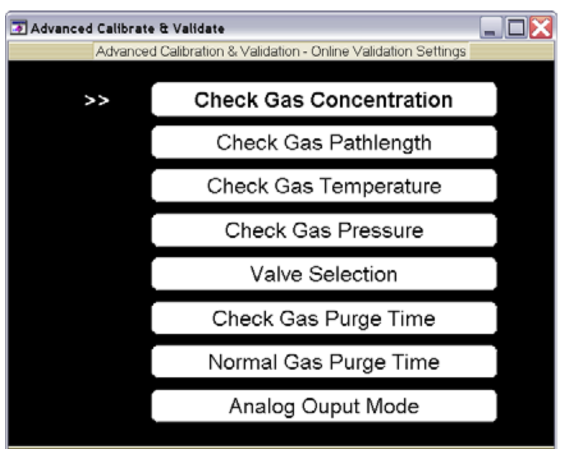
- Local Initiate will start the automatic online validation sequence when selected. It will use the existing 'Settings' (see below for details on 'Settings').
- Remote Initiate will enable/disable monitoring of the selected "Remote Initiate" contacts on TB-2 within the Launch Unit. When enabled, the analyzer will detect the chosen contact closure and automatically start the online validation sequence.
- Time Initiate will allow input of a specified time to automatically start online validation sequence once every day, every week, every 2 weeks, or every 4 weeks.



Settings for Validation:

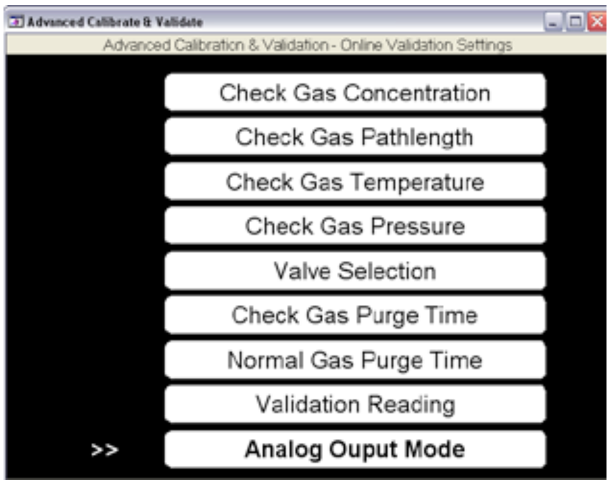
There are several critical parameters that must be preconfigured in the TDLS200 software when using the automatic validation sequence. These parameters MUST be correctly set otherwise the analyzer will report false/incorrect validation results.

The settings are configured as below:



- Check Gas Concentration specifies the concentration (ppm) of the gas within the online check gas flow.
- Check Gas Pathlength specifies the length (in) of the check gas flow cell.
- Check Gas Temperature can be selected for either Fixed or Active.
  - o If Active Temperature, then follow on screen instructions.
  - o If Fixed Temperature, then enter in the temperature of the gas within the online check gas flow cell. Typically this cell is the same temperature as ambient. Remember that this value will be used whenever the auto validate is used so try to select a value that is representative of when the auto validate might take place (day/night, etc.) Press ENT to proceed.

- Check Gas Pressure specifies the pressure at which the gas within the online line check gas flow cell. Typically this cell is vented to atmosphere so an atmospheric pressure value (14.7 psiA or 1.01barA) will work.
- Valve Selection specifies which analyzer's solenoid valve driver is used for the check gas.
- Check Gas Purge Time specifies how long the check gas will purge the check gas flow cell.
- Normal gas Purge Time specifies how long N_2 will purge the check gas flow cell.
- Validation Reading specifies the type of reporting method for the validation concentration (see earlier explanation of these types).
- Analog Output Mode specifies Block, Track, or Hold of all 4 to 20 mA output during online check.



9 TROUBLESHOOTING

The TDLS200 Analyzer troubleshooting is fairly simple for a process analyzer. First, virtually all components used in the system have a long Mean Time Between Failures (MTBF) with rated life of components typically exceeding 15 years (when operating within their stated specifications). Second, most probable failures and problems are diagnosed by the system, generating internal warning and fault conditions.

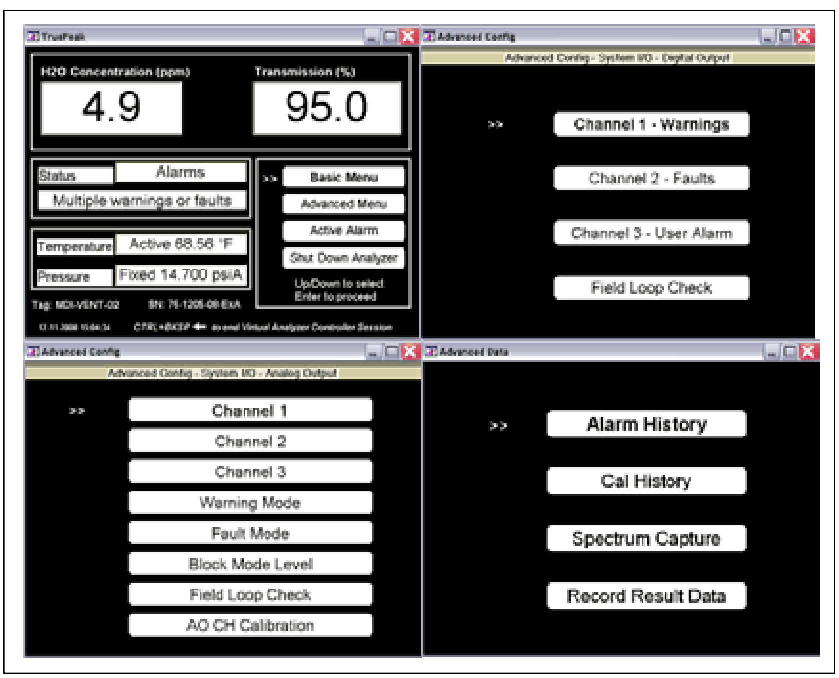
The intent of this guide is to provide common troubleshooting steps, it does not detail specific repair procedures (such as laser module replacement), as these are unlikely and are detailed in other sections of the manual. Routine maintenance procedures are also detailed in other sections of the manual.

The most common issues are divided into two categories:

- Warnings. These are conditions which will affect the analyzer reading but not cause complete loss of measurement integrity. An example would be reduction of transmission (amount of laser power at the detector) which could indicate misalignment or window fouling, where the measurement is still being made, but further loss of transmission will cause loss of measurement.
- Faults. These are conditions where the measurement is lost, or degraded past the point of reliability. An example would be loss of transmission, which could indicate complete missalignment or laser failure.

The TDLS200 system will diagnose many common warnings and faults, taking the following actions:

- The analyzer generates a status flag that is displayed on the main screen; if only one warning/fault is present the system will display this on the screen. The “ACTIVE ALARM” menu selection will allow the user to view all active Warnings and Faults
- The system will log the warning/fault in a log file along with a description, time-triggered and time-cleared.
- The 4-20 mA signal can change to 3.3 mA under a fault or warning condition (user changeable).
- The digital output of the analyzer will trigger (Channel 1 – Warnings, Channel 2 – Fault, Channel 3 – Concentration or Transmission)
- The analyzer will capture spectra for diagnostic assistance
- The Results file will indicate a Warning (1) or Fault (2) in the continuous Results file



9.1 Common Troubleshooting Steps

For most conditions the troubleshooting steps are common. In general, the most common issues with the analyzer revolve around ensuring an adequate amount of the laser light is received at the detector.

- **Check Status LEDs**. This will ensure that power is routed properly to the system components. Status LEDs are listed below:

Blue LED # (from left to right)	**Voltage VDC**	**Use**
D20	+5	Laser temp control power supply
D26	-15	Isolated power supply
D27	+15	Isolated power supply
D24	+8	DFB laser driver power supply
D23	-8	DFB laser driver power supply
D22	-12	DFB laser driver power supply
D16	-12	Detector board power supply
D19	-12	VCSEL laser driver power supply
D6	-15	Analog I/O board power supply
D12	-15	FPGA board power supply
D18	+12	VCSEL laser driver power supply
D7	+12	LCD power supply
D8	+24	Main power supply
D9	+15	Analog I/O board power supply
D10	+5	SBC power supply
D11	+15	FPGA board power supply
D13	+5	FPGA board power supply
D14	+6	FPGA board power supply
D15	+12	Detector board power supply
D17	+12	General 12V power supply

- **Adjust Analyzer Alignment.** Adjusting the alignment will ensure the analyzer has not physically changed to the point where the laser beam is off center (at detect unit). While monitoring transmission % adjust the alignment in all directions (by a small amount) until you see the transmission increase. Fine tune the adjustment to ensure maximum alignment.
- **Initiate On-Line Validation** (if fitted). On-line validation will provide an indication of whether the analyzer is responding to gas changes. During this step, manually record the amount of analyzer reading change. detector.
- **Record Results.** Download data files from the analyzer for e-mail to Yokogawa.
- SPECIAL NOTE – Parts removal (if necessary) should be done so with great care! There are electrostatic sensitive devices (such as the Laser Diode Module!) that can be damaged if not handled correctly. **DO NOT CUT WIRES TO REMOVE ANY ITEMS PARTS!!!**
- **THE LASER DIODES MODULES AND DETECTOR MODULES ARE ELECTROSTATIC SENSITIVE – IMPROPER HANDLING CAN CAUSE PERMANENT DAMAGE AND SUBSEQUENT REPLACEMENT OF PARTS.**

9.1.1. Trouble Shooting Procedure for Lost and/or Low Transmission

For a TDLS analyzer to function correctly there must be a suitable amount of the laser light reaching the detector. There are several factors (or combinations of) that can affect the amount of light that is detected:

- **Alignment:**
  The mechanical alignment of the laser beam with the detector unit
  - The beam not directed at the detector window
  - The detector not aligned with the incoming laser beam
  - Miss-aligned flanges and/or nozzles

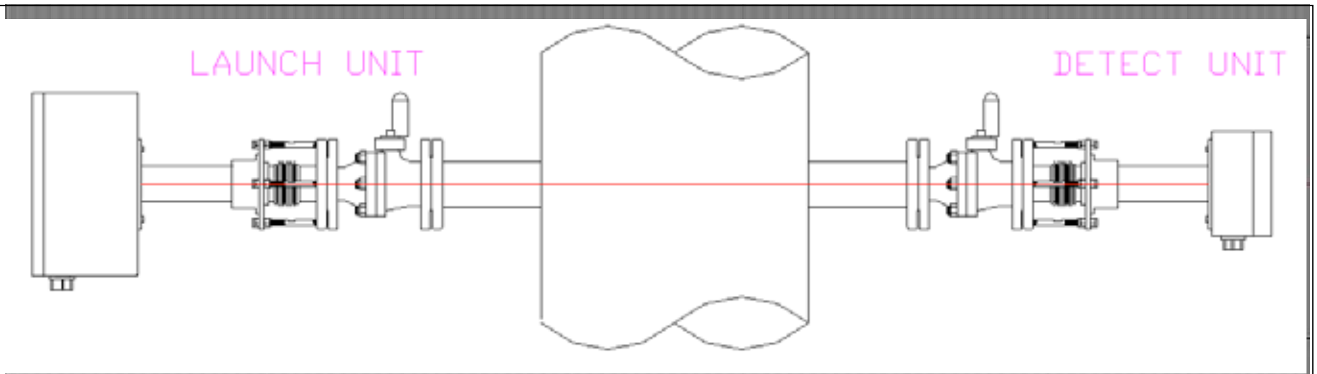
- **Plugging:**
  The quality of the ‘clear aperture’ through which the beam travels
  - Physical obstructions inside the nozzles and/or piping
  - Dirt or residue fouling of the process windows
  - Mechanical obstructions

- **Particulate:**
  The process gas optical clarity
  - Excessive smoke density/opacity and/or particulate matter that prevents sufficient light from reaching the detector

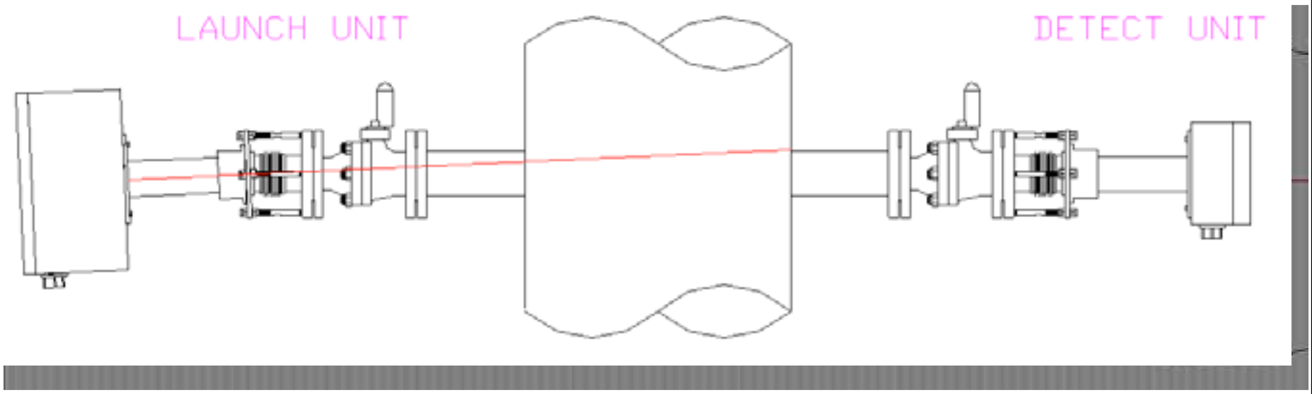
- **Weak Laser:**
  The output power of the laser module itself
  - Weak or dead laser diode source not outputting sufficient light

This procedure will help new and existing installations with respect to troubleshooting situations that incur lost and or low (or even none) transmission. Transmission is a relative value for light power received at the detector. Typically, a functional analyzer with clean windows mounted on an off-line calibration cell the transmission will be anywhere from 90 to 100% (sometimes a little over 100%). Additional isolation windows can further reduce transmission, typically by an additional 30% for Sapphire isolation windows and by up 20% for BK-7 windows (BK-7 not typically recommended by isolation flanges – pending process conditions).

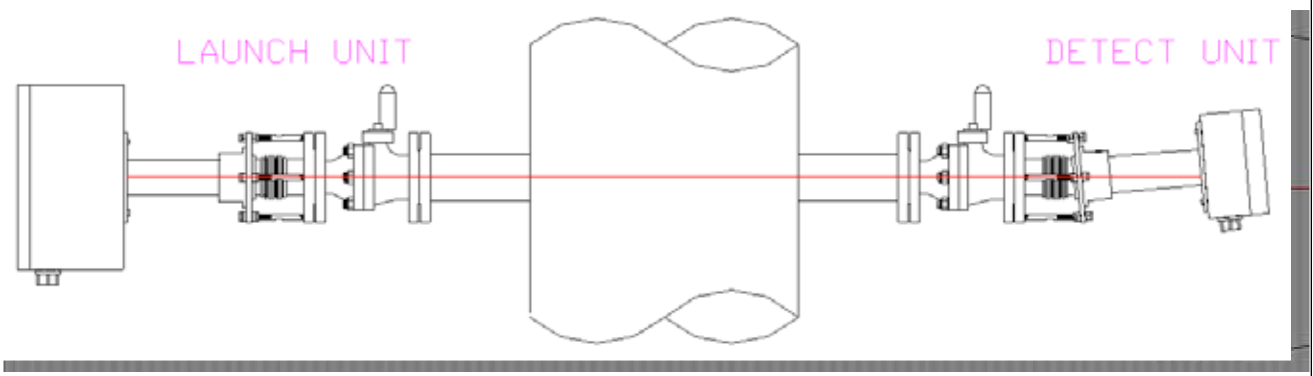
Resolving Low Transmission:



Above – Good Launch and Detect Alignment



Above – Poor Launch Unit Alignment



Above – Poor Detect Unit Alignment

Figure 65

1. **Alignment Adjustment**

a. Sometimes the original mechanical alignment of the analyzer may change due to mechanical/thermal properties of the installation or perhaps the alignment nuts not being fully tightened originally. In these situations the analyzer can simply be realigned.
b. Adjust the mechanical alignment using small adjustments of typically one quarter turn per nut at a time and allowing for at least two measurement up-dates before making further adjustments.
c. Start by adjusting the laser launch unit in the vertical plane i.e. direct the launch unit up and then down while observing transmission (or detector signal voltage). If no improvement is achieved then ensure the alignment is set back to the best possible vertical position.
d. Then proceed with launch unit horizontal adjustment, again using quarter turns per nut and waiting for 2 measurement up-dates before making the next adjustment. If no improvement is achieved then ensure the alignment is set back to the best possible horizontal position.
e. Now adjust the laser detect unit in the vertical plane i.e. direct the detect unit up and then down while observing transmission (or detector signal voltage). If no improvement is achieved then ensure the alignment is set back to the best possible vertical position.
f. Then proceed with detect unit horizontal adjustment, again using quarter turns per nut and waiting for 2 measurement up-dates before making the next adjustment. If no improvement is achieved then ensure the alignment is set back to the best possible horizontal position.
g. Repeat steps b through d again to ensure maximum transmission level.
h. If transmission is still limited then the issue could be with associated with the actual mechanical installation. It may be that the nozzles and/or flanges attached to the process are in fact out of tolerance.

2. **Quality of Clear Aperture through Process**

Sometimes, the original clear aperture through the process can become impaired/fouled/plugged (see image to left) by material deposited from the process gas inside the nozzles. The deposits are usually solid formations (crystalline formations from cooled vapors created when the cool purge gas mixes with the hot process gas) and/or very sticky/viscous/tar like substances that may have to be mechanically removed.

a. After having optimized alignment per above, the launch and detect units should be removed to facilitate an inspection of the process nozzles
b. If the installation incorporates 'Process Isolation Flanges' (see image and diagram below) then the analyzer and alignment flanges can be removed and the nozzle insides can be inspected without compromising the process seal.

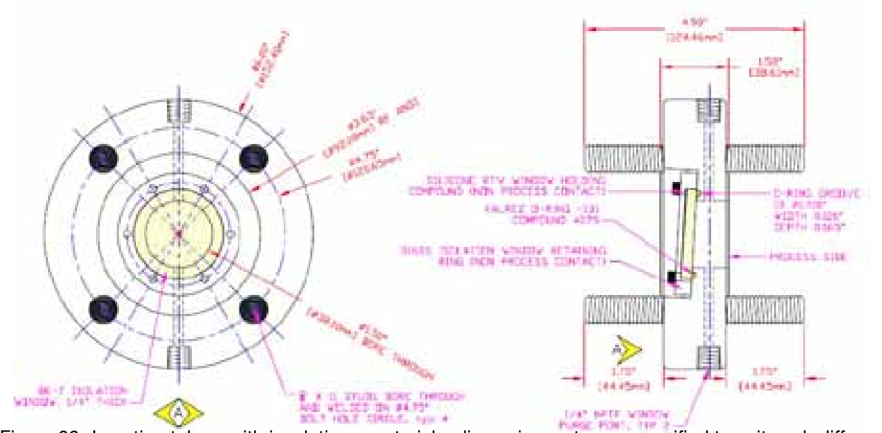


Figure 66- Insertion tubes, with insulation - materials, dimensions, etc. are specified to suit each different application

If possible to isolate the process flow through the measurement section of the process pipe/stack then proceed to shut it off accordingly to facilitate full, safe unrestricted access.

c. If the process gas cannot be isolated (as is typically the case), then **"Process Inspection Port"** must be used (see below/next page). These essentially replace the analyzer units (launch and/or detect) while maintaining the process window purge integrity to allow for visual inspection of the active process conditions. Note: The rating is the same as for the standard analyzer, max 5.5 Barg (80psig) and for gas temperatures above 50°C (120°F) window purge gas must be flowing.

d. To inspect the launch unit nozzle, first the process isolation valve has to be closed carefully while coordinating the shut-off of window purge gas flow. If the process is operating at negative pressure and the ingress of ambient oxygen is not desirable then the nitrogen purge gas must be maintained as the process valve is closed off. Once closed, the nitrogen purge gas can be shut-off and then carefully relieved from the section between valve and window (typically loosen a tube fitting).

e. Once the process valve is closed and window purge gas shut-off (and pressure relieved), then the launch unit can be removed from the alignment flange. Remove the Allen screw from the lower right position and loosen the remaining three, rotate counter clockwise then remove and place carefully on solid location (typically the floor/decking). **CAUTION – the process isolation valve may leak so observe any local safety procedures associated with the particular process unit/area.**

f. Mount the "Process Inspection Port", install the lower right Allen screw and securely fasten all four screws. Connect the purge gas tubing and start the purge gas flow while opening the process isolation valve. Using a flash light, the process nozzle can now be viewed through the window.

g. Use the reverse procedure to remove and re-install launch unit.

h. Use the same procedure for the detect side however use **CAUTION because the launch unit laser diode source will now be visible** (if the analyzer is still powered on) through the detect side window (laser source is inside launch unit body).

i. Remove any obstructions in the nozzles in accordance with any local standards/procedures. If the obstructions are a re-occurring event, then please contact your local agent or Yokogawa for advice on how to prevent/reduce the events.

j. Some typical remedies for nozzle obstructions include:
   i. Increasing the window purge gas flow/pressure
   ii. Using smaller bore nozzles/inserts
   iii. Using insertion tubes, also with smaller bore
   iv. Insulating the nozzles, to reduce cold spots
   v. Any combination of or all of the above
   vi. Worst case; relocate the analyzer to a cleaner location e.g. downstream after an ESP, after a knock-out drum, after a filter/scrubber, etc

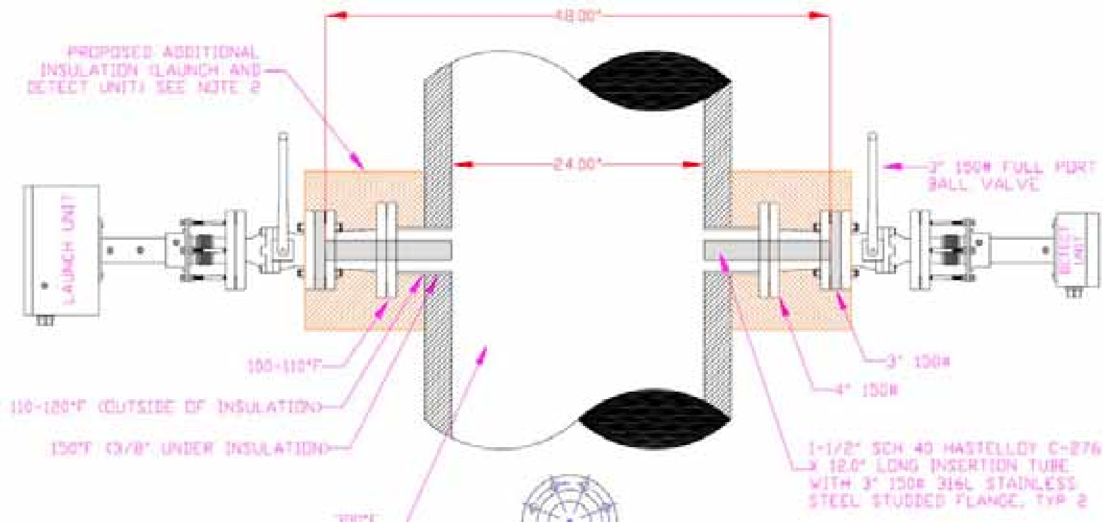


Figure 67 - *Insertion tubes, with insulation – materials, dimensions, etc. are specified to suit each different application*

3. High Particulate Loading

Some process streams contain high quantities of dirt/dust/particulate matter that will reduce the level of laser light that can reach the detector. Typically this information is known in advance of analyzer installation and should generally be accounted for during the design, engineering and specification phase of the project. The "Application Questionnaire" asks for this process information. Sometimes it may not be known what the levels are and the analyzer may be tried on the application anyway. Some processes (such as waste incineration, thermal oxidation, etc.) will have varying levels of dirt/dust/particulate.

The only proven method for improving transmission through these particulate laden processes is to reduce the path length and ensure a good purge is functional. Insertion tubes up to 8ft long each have successfully been used in coal fired power plants for several years, typically on ammonia slip measurements after the SCR but before the ESP.

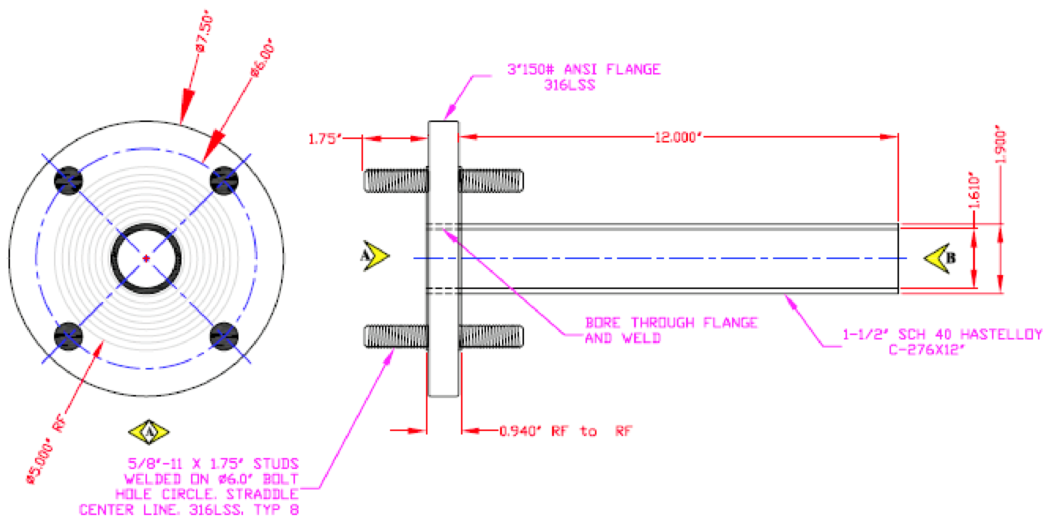


Figure 68

Please consult **Yokogawa** with specific information about the dust loadings within the process such that a proper evaluation can be made. If it is then determined that a reduction in optical path length will have a significant improvement on the transmission level (or at least improve it to the point whereby analyzer performance is acceptable) then Analytical Specialties will advise further detail on the project specific insertion tube requirements. Often, the insertion tubes have to be constructed of materials that are compatible with the process media e.g. acidic, corrosive, gases may require insertion tubes of Hastelloy C-276 or Monel A-400.

4. Weak or No Laser Output

a. If it has been determined that the process aperture is clear, the gas is clean and the system has been fully aligned in all directions and yet there is still little or no transmission, then the laser output power may be weak or even dead.

b. There is only one certain method to determine if a laser has lost output power and that is to directly place the detect unit in front of the launch unit (as per diagram below). Before doing so, ensure that both process windows are clean.

CAUTION: The laser diode light source will be exposed when the launch unit is accessible in this way so ensure precautions are taken to avoid direct eye exposure to the laser light!

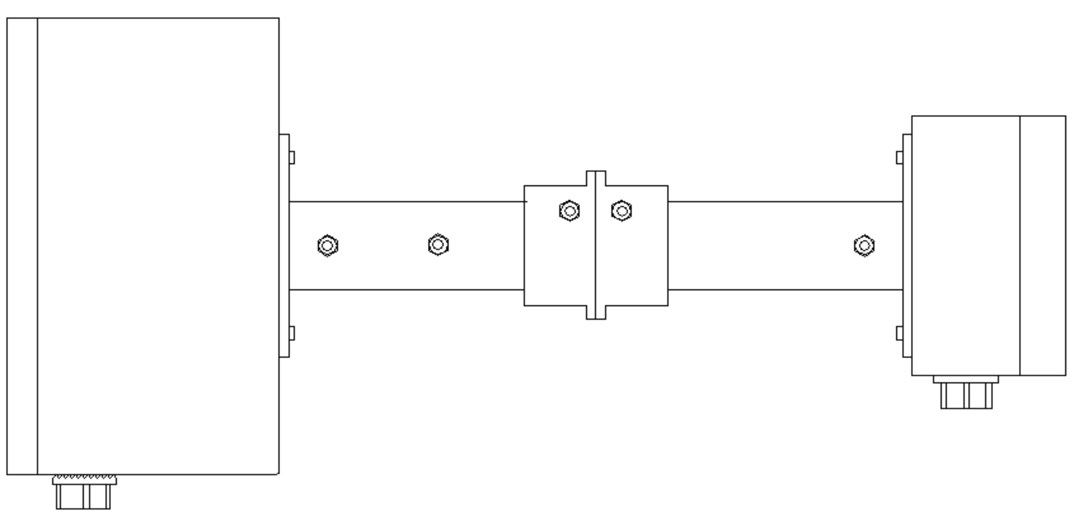


Figure 69

If there is any sign of a transmission signal then try adjusting the angles very slightly to see if any stronger signal can be obtained. If, after adjusting the direct angle between the two units there is still no transmission then the laser diode (and or detector) has failed. Please contact Yokogawa Laser Analysis Division for further assistance and information pertaining to Laser Module replacement. If a weak signal is achieved then this is an indication that the laser module has weak output power. Please contact Yokogawa Laser Analysis Division as this may be caused by dirt/contamination on one of the internal optical surfaces (usually caused by contaminated purge gas).

9.1.2 Off Process (or Off-Line)

- **Clean Process Windows.** Visually inspect and clean analyzer windows.
- **Check Analyzer with Validation Standard.** Mount the analyzer on a calibration or flow cell and perform Basic Menu zero and span check – capture spectrum for each condition.
- **Record Results.** Download data files from the analyzer for e-mail to Yokogawa Laser Analysis Division

9.2 Field Up-Gradable Files and Software from Factory

The analyzer has the capability to upload certain software and files that are supplied by the factory for field use. Any files that are to be uploaded to the TDLS-200 should be done so via the factory supplied SanDisk USB memory stick and only when instructed to do so by factory (or factory authorized personnel).

Please also ensure that the USB is inserted only into the allocated analyzer for which the files were intended otherwise, damage and files corruption may occur. Please also ensure (before copying any of the following factory supplied up-load files) the USB stick is empty.

Available field up-loadable files include:

√ "TruePeak.exu" in USB memory to upgrade "TruePeak.exe".
√ "TruePeak.uiu" in USB memory to upgrade "TruePeak.uir".
√ "system.upl" in USB memory to replace "system.cfg".
√ "system.lau" in USB memory to replace "system.las".
√ "zero00.upl" in USB memory to replace "zero00.spe".
√ "span00.upl" in USB memory to replace "span00.spe".

9.3 Analyzer Warnings

Warning	Action Steps
Detector Signal Low. This is based on the amount of signal generated by the detector.	Refer to Low or Lost Transmission procedure
Transmission Low. This is the most important diagnostic feature of the analyzer. Transmission is a measurement of the laser power striking the detector. It is an arbitrary number (%) that can be calibrated. The analyzer, mounted on a calibration cell in the factory, is calibrated at 100% transmission when leaving the factory.	Adjust analyzer alignment Clean windows Check on calibration/flow cell Set analyzer so that Launch and Detect Unit flanges are butted together Refer to Low or Lost Transmission procedure
Spectrum Noise High. This is based on a measurement of the noise (standard deviation) of the absorption peak baseline regions.	Adjust analyzer alignment Clean windows Check on calibration/flow cell Set analyzer so that Launch and Detect Unit flanges are butted together

Warning	Action Steps
Process Pressure out of range. The gas pressure range for the application is programmed into the analyzer.	Check pressure transducer feed to analyzer Check to ensure software setting (Advanced Menu, Configure) is correct
Process Temperature out of range. The gas temperature range for the application is programmed into the analyzer.	Check pressure transducer feed to analyzer Check to ensure software setting (Advanced Menu, Configure) is correct
Concentration out of range. The process pressure range for the application is programmed into the analyzer.	Check to ensure software setting (Advanced Menu, Configure) is correct
L or D unit temp out of range. The Launch Unit and Detect Unit have built in temperature sensors. This diagnostic is triggered if they sense the ambient temperature is outside of the analyzer design range (-5 to 55C)	Check purge system flows and excessive heat output from SBC and/or other electronic components Look for excessive heat output from adjacent processes and/or radiant process and/or direct sunlight

9.4 Analyzer Faults

For analyzer faults it is recommended that you contact Yokogawa Laser Analysis Division immediately. There is typically no user intervention that should be attempted unless specifically diagnosed or directed by Yokogawa.

Yokogawa Laser Analysis Division personnel will step you through diagnostic and repair steps.

Laser Temperature Out of Range. This is an indication that the system can not control the laser temperature, resulting in wavelength instability of the laser.

Detector Signal High. Detector is saturated (i.e. too much detector signal gain) or has been damaged. If using on a high temperature application in excess of 700 ˚C then please check to ensure the analyzer was specified for high temperature service. Detector Signal High fault alarm can occur when high temperature infrared radiation saturates a standard low temperature gas configured analyzer. Refer to “Adjustment of Detector Signal Gain” for further assistance.

Detector Signal Lost. The analyzer is not receiving a detector signal – please check all electrical connections and follow the procedure for Troubleshooting Low or Lost Transmission.

Peak Center Out of Range. Indication that the system can not keep the peak centered in the scan range. Please review the absorption spectra to check the actual peak position, check that some target gas in the optical path – capture spectra and send to Yokogawa Laser Analysis Division or local agent for further assistance.

10 DATA FILES AND FORMAT

The TDLS200 analyzer is capable of automatically storing many important pieces of information. We would recommend that the data files are downloaded periodically and stored at a local drive for future reference. Also, if there is any sign of potential trouble with the analyzer and/or the process, please download files as soon as possible to ensure potentially helpful data is stored/saved off-line.

All the files are stored in simple ASCII text format for easy importing to MS Excel spreadsheets (or other data manipulation software as appropriate).

The rate at which data is captured may be configured from within the TDLS200 software. There are several files that are stored in the system:

Example of files contained within the serial number specific data export folder (or the !Data folder when viewing through a File Transfer function on Ultra-VNC connection)

092407	.res	**Daily Results** Allows for review of daily results and diagnostic data on a measurement-by-measurement basis	Daily Results - in the form of ASCII data files that can be opened with Microsoft “Notepad” as simple .txt file formats. The content can then be copied and pasted into Microsoft Excel spread. Each day as a separate file name in the MMDDYY format with the .res file extension (meaning result). Each file starts with the first up-dated measurement set of data for that date and then sequentially contains every up-dated measurement set of data in the same dated file until the end of that date. A new dated file is created each day. Files are deleted automatically on a First-In/First-Out (FIFO) basis if the allowable Data folder has no spare memory.
092407	.spe	**Daily Spectra** Allows for review of daily results and diagnostic data on a measurement-by-measurement basis	Daily Spectra - in the form of ASCII data files that can be opened with Microsoft “Notepad” as simple .txt file formats. The content can then be copied and pasted into Microsoft Excel spread. Each day as a separate file name in the MMDDYY format with the .spe file extension (meaning spectra). Each file contains spectra captured automatically during that day depending on what rate of spectra capture has been set-up. Typically, the analyzer will capture one spectrum every 300 measurement up-dates (if the capture rate is set 300 up-dates). Additionally, if the analyzer goes into “Warning” of “Fault” mode during that day, there will be spectra captured during these times (typically configured for 5 captures in each mode). A new dated file is created each day. Files are deleted automatically on a First-In/First-Out (FIFO) basis if the allowable Data folder has no spare memory.
--------	.cap	**Capture** Individually named spectra capturedmanually	These files are the individually named spectra that are “Captured” by the user at any given date or time during operation. Each file can have up to 8 numerals in its name which are entered at the time the “Capture” is performed. **Example:** 110307.cap 100008.cap

alarms	.his	**Alarms History** A historical log of analyzer alarm events	Alarm History - in the form of ASCII data files that can be opened with Microsoft "Notepad" as simple .txt file formats. The content can then be copied and pasted into Microsoft Excel spread. Each Alarm incident is logged with the date (MM-DDYYYY) and time that it occurred, the Mode (Warning or Fault or User Alarm), the specific condition within the Mode (e.g. Detector Signal Lost) and the state (ON or OFF). **Example:** 10-10-2007 13:21:36 Fault(peak center out of range) OFF 10-10-2007 19:00:25 Warning(detector signal low) ON
alarms	.bak	**Alarms History Back-Up** A back-up of the historical log of analyzer alarm events	larm History Back-up - When the alarms.his file exceeds 100KB size the contents is saved to this .bak file and the .his file is emptied. This .bak file is in the form of ASCII data files that can be opened with Microsoft "Notepad" as simple .txt file formats. The content can then be copied and pasted into Microsoft Excel spread. Each Alarm incident is logged with the date (MM-DD-YYYY) and time that it occurred, the Mode (Warning or Fault or User Alarm), the specific condition within the Mode (e.g. Detector Signal Lost) and the state (ON or OFF). **Example:** 10-10-2007 13:21:36 Fault(peak center out of range) OFF 10-10-2007 19:00:25 Warning(detector signal low) ON
calibr	.his	**Calibration History** A historical log of analyzer calibrations	Calibration History - in the form of ASCII data files that can be opened with Microsoft "Notepad" as simple .txt file formats. The content can then be copied and pasted into Microsoft Excel spread. Each Calibration and/or Validation event is logged with the date (MM-DD-YYYY) and time that it occurred, the Mode (Calibration or Validation), the specific type (Transmission Calibration, Zero Calibration, etc.) and the 'K' (constant) factor used for the event **Example:** 11-14-2007 14:11:19 span_calibrate 612814.89 9250.84 152665.88 11-14-2007 14:50:16 transmission_cal 14.95
calibr	.bak	**Calibration History Back-Up** A back-up of historical log of analyzer calibrations	Calibration History - When the calibr.his file exceeds 100KB size the contents is saved to this .bak file and the .his file is emptied. This .bak file is in the form of ASCII data files that can be opened with Microsoft "Notepad" as simple .txt file formats. The content can then be copied and pasted into Microsoft Excel spread. Each Calibration and/or Validation event is logged with the date (MM-DD-YYYY) and time that it occurred, the Mode (Calibration or Validation), the specific type (Transmission Calibration, Zero Calibration, etc.) and the 'K' (constant) factor used for the event **Example:** 11-14-2007 14:11:19 span_calibrate 612814.89 9250.84 152665.88 11-14-2007 14:50:16 transmission_cal 14.95

calibr	.pik	**Calibration Pick List - Factory Use Only**	FACTORY PERSONNEL ONLY
S S1 S2	.dat	**Chemometric Model File**	Parent spectra for chemometric model used only for specialized applications that utilize the TruePeak CLS measurement capability.
span00	.spe	**Span Calibration Spectra** Absorption Spectrum and coefficients at time of calibration	This file is essential to the analyzer calibration - if this file does not exist or is corrupted, modified or otherwise tampered with then the analyzer calibration is invalid. It contains essential information relating to the Span Calibration of the analyzer.
span01 to span10	.spe	**Historical Span Calibration Spectra** Previous Absorption Spectrum and coefficients at time of previous calibrations	span01 through span09 are previous files with span01 being the most recent. The most recent previous span01 can be restored in the analyzer as ‘Previous Calibration’. The factory calibration which can also be restored in the analyzer is named span10.
system	.cfg	**System Configuration** All essential analyzer & installation specific parameters required by the analyzer for the given application & installation	This file is essential to the analyzer - if this file does not exist or is corrupted, modified or otherwise tampered with then the analyzer cannot function. It contains analyzer specific parameters relating to every detail of the measurement, calibrations, compensation factors, I/O configurations, Valve control configurations, signal processing, etc. This file is used by FACTORY PERSONNEL ONLY to evaluate if the configuration is appropriate for the analyzers intended use.
system	.his	**System History** A historical log of configuration changes	System Configuration History - in the form of ASCII data files that can be opened with Microsoft “Notepad” as simple .txt file formats. The content can then be copied and pasted into Microsoft Excel spread. Each configuration change is logged with the date (MM-DD-YYYY) and time that it occurred, the parameter (e.g. opl) and the new value. Also, whenever the analyzer is startedup or shut-down the ‘TruePeak Open/Close” parameter will be logged. **Example:** 11-20-2006 08:13:10 opl(inch) 39.96 43.31 11-20-2006 08:13:26 temperature(F) 509.0 86.0 11-20-2006 08:13:40 pressure(psi) 14.50 14.50

system	.bak	**System History Back-Up** A back-up of historical log of configuration changes	System Configuration History - When the system.his file exceeds 100KB size the contents is saved to this .bak file and the .his file is emptied. This .bak file is in the form of ASCII data files that can be opened with Microsoft “Notepad” as simple .txt file formats. The content can then be copied and pasted into Microsoft Excel spread. Each configuration change is logged with the date (MM-DD-YYYY) and time that it occurred, the parameter (e.g. opl) and the new value. Also, whenever the analyzer is started-up or shut-down the ‘TruePeak Open/Close” parameter will be logged. **Example:** 11-20-2006 08:13:10 opl(inch) 39.96 43.31 11-20-2006 08:13:26 temperature(F) 509.0 86.0 11-20-2006 08:13:40 pressure(psi) 14.50 14.50
valspe	.his	**Validation Spectra** All spectra captured during On-Line and Off-Line Validations	Spectra captured for historical Validations (On-Line and Off-Line) are stored in this file.
valspe	.bak	**Validation Spectra Back-Up** Backed-up spectra captured during On-Line and Off-Line Validations	When the valspe.his file exceeds 1MB size the contents is saved to this .bak file and the .his file is emptied. This .bak file is Spectra captured for historical Validations (On-Line and Off-Line) are stored in this file.
zero00	.spe	**Zero Calibration Spectra** Absorption Spectrum and coefficients at time of calibration	This file is essential to the analyzer calibration - if this file does not exist or is corrupted, modified or otherwise tampered with then the analyzer calibration is invalid. It contains essential information relating to the Zero Calibration of the analyzer.
zero01 to zero10	.spe	**Historical Zero Calibration Spectra** Previous Absorption Spectrum and coefficients at time of previous calibrations	zero01 through zero09 are previous files with zero01 being the most recent. The most recent previous zero01 can be restored in the analyzer as ‘Previous Calibration’. The factory calibration which can also be restored in the analyzer is named zero10.
system	.las	**System Laser** At the time of current download	Laser related parameters for production, service and troubleshooting, including: Serial Number of module Laser temperature Ambient T-Comp curves Thermister parameters Laser drive current parameters Laser temperature out of range Fault settings Laser driver resistor (R18 for VCSEL, R76 DFB)
memory	.res	**File Size Management** for Results	FACTORY PERSONNEL ONLY - used by TruePeak software to manage the .res files
memory	.res	**File Size Management** for Spectra	FACTORY PERSONNEL ONLY - used by TruePeak software to manage the .spe files

10.1 Configuring Data Capture:

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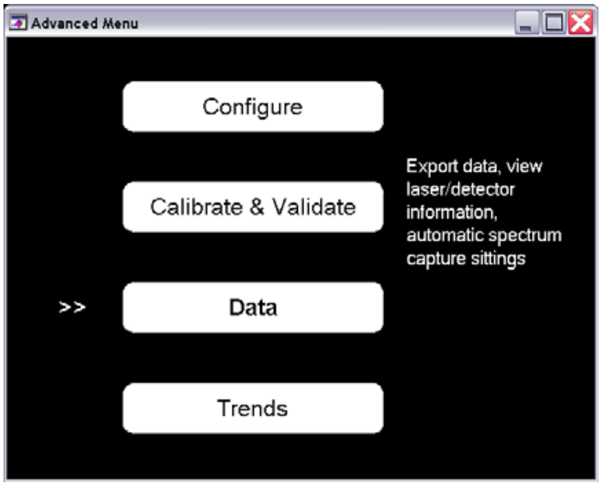
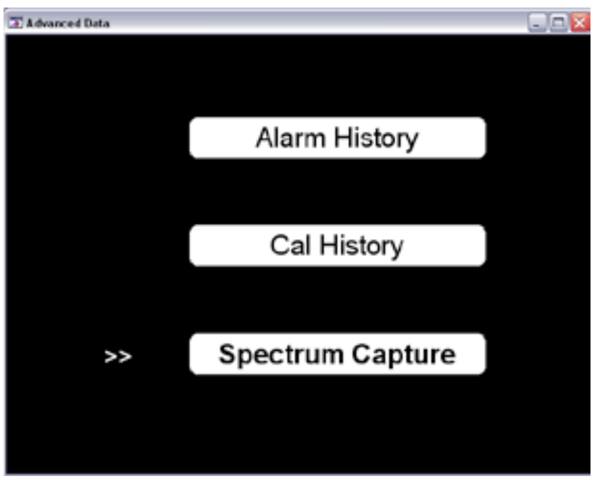
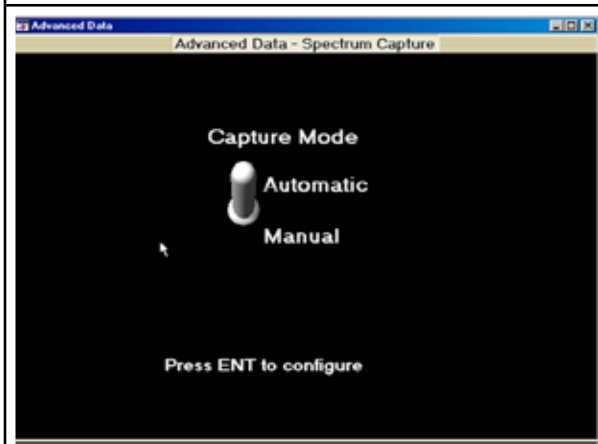
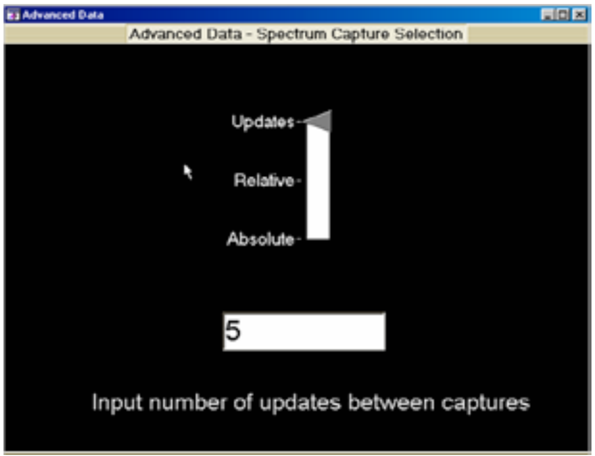
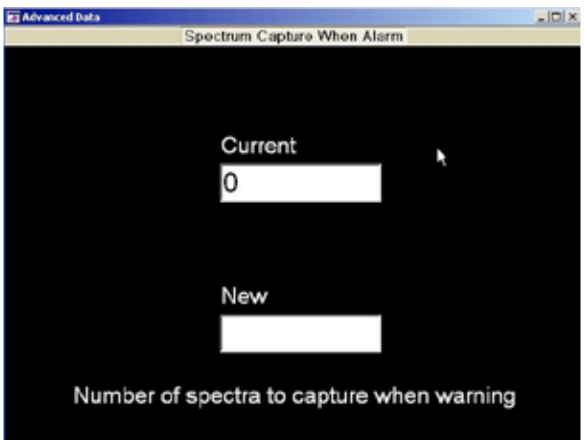
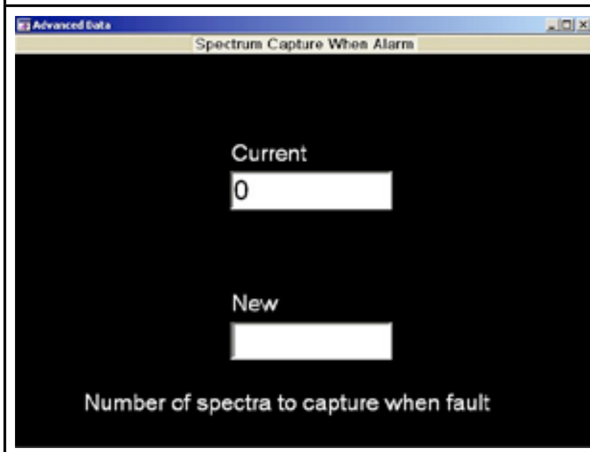
<tr>
<td>


</td>
<td>Select Data</td>
</tr>
<tr>
<td>


</td>
<td>To select the Spectrum capture, stay in Advanced Menu user mode and the Data sub section – select Spectrum Capture</td>
</tr>
<tr>
<td>


</td>
<td>To store spectrum automatically, select Automatic. If you do not wish to store any spectrum file during normal analyzer operation, then select Manual mode.</td>
</tr>
</table>

	analyzer to capture spectrum files and under what condition. The default condition is related to the number of measurement however, the user can select Relative or Absolute changes pending the site specific conditions/ requirements. Typical updates between capture value would be 300 The more frequently spectrum are stored then the larger the MMDDYY.spe files will become. NOTE: Capturing every spectrum for one day can create a single day file in excess of 30MB – Choose the parameters carefully to prevent memory overload!
	Determine whether or not the analyzer should capture spectrum files under a WARNING condition. Note, this may be useful to do so however, if the Warning alarm conditions are not set correctly then there could be excessive files created for less meaningful Warning alarm conditions. An example is a low transmission warning alarm set at 70% for an application that often runs at less than 70% transmission.
	Determine whether or not the analyzer should capture spectrum files under a FAULT condition. Note, this may be useful to do so however, if the Fault alarm conditions are not set correctly, then there could be excessive files created for less meaningful Fault alarm conditions. These files are often useful for Factory based diagnostics.

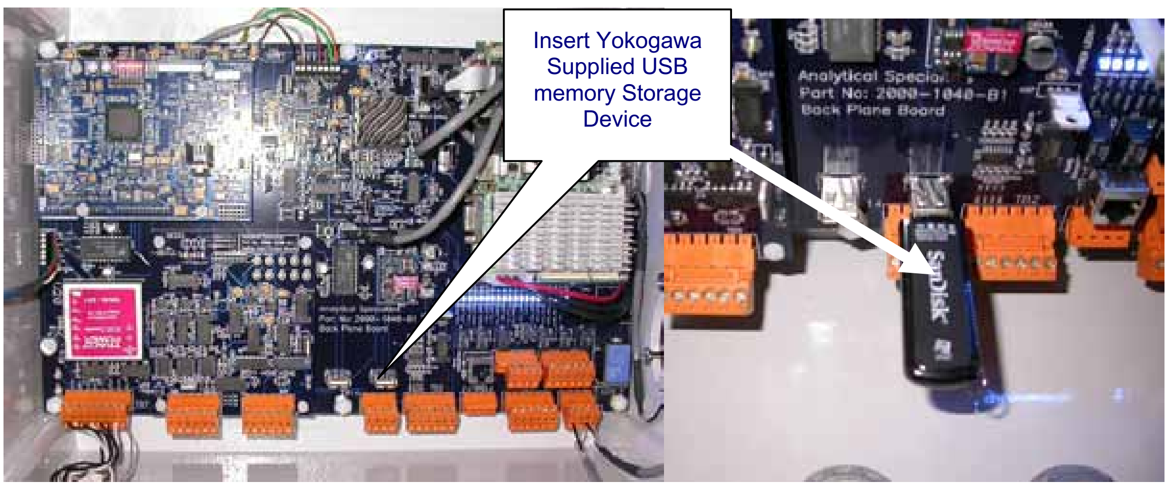
10.2 Downloading (Transferring/Exporting) the Data:

All the files can be easily transferred from the analyzer to the supplied USB memory device.

NOTES: Please use the supplied “Sandisk” USB memory device with when getting data from the analyzer. Each analyzer is supplied with one pre-tested USB memory devices -please retain them and use with each appropriate analyzer.

If an un-recognized USB memory device is used, then the MS Windows XPe operating system may attempt to install new hardware. This will not affect the normal operation of the analyzer however, if you have a full display interface operational a Windows based pop-up may ask for a system reboot.

Do not attempt to plug in any other USB based products (keyboards, WiFi, etc.) in to the USB ports – Windows based hardware conflicts may occur.



Simply insert the memory device and wait for the Data Transfer to complete. Do not remove the device before the transfer is complete. The analyzer will advise via the user interface when Data Transfer is complete. For totally blind units (i.e. no user interface) wait for the indicating LED to stop blinking/flashing for at least 5 minutes to ensure the transfer is complete.

Revision Record

Manual Title: Model TDLS200 Tunable Diode Laser Spectroscopy Analyzer
Manual Number: IM 11Y01B01-01E-A

Edition	Date	Remark (s)
1st	April 2008	Newly Published
2nd	April 2009	Revisions: Formatting was corrected.
3rd	April 2010	Revisions: General specifications, page 3, were added to the document, and dimensional drawings were added.
4th	August 2011	Revisions: Dimensional drawings in section 5.9 were corrected and updated. Caption titles and figure numbers were added to all figures within the document. Page 4 and page 5 specifications were added.
5th	Feburary 2012	Revisions: 1. Quick start section 1 was modified. 2. Section 2 added note about area classification. 3. Section 2.1 corrected the power range statement. 4. Data plate information in section 2.2 was updated. 5. Section 4.3 corrected Figure 7 valve relay diagram, updated Field terminal block indications. 6. Section 4.6 Added process Interface option. 7. Reformated Section 5 & updated area classification information. Added Seciton 5.12 8. Updated software basic structure information. 9. Deleted section 7.3 Analog Signal field Loop check, and made section 7.5 Validation and Calibration its own Section, now becoming Section 8. 10. Removed section 8.3.1 & 8.4 11. Removed Sections 4.10-4.13

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