SERVOMEX
ANALYZERS
HIGH-PERFORMANCE GAS ANALYSIS

SERVOTOUGH Laser 3 Plus

OPERATOR MANUAL

Part Number: **07931001B**

Revision: **6**

Language: **ENGLISH UK/US**

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IMPORTANT INFORMATION

Continued safe and reliable operation of this equipment is conditional on all installation, operation and maintenance procedures being carried out in accordance with the appropriate manuals, by personnel having appropriate qualifications, experience and training.

Failure to observe the requirements of the manual may result in the user being held responsible for the consequences and may invalidate any warranty.

Servomex will accept no liability for unauthorized modifications to Servomex supplied equipment.

Servomex has paid particular attention to Health and Safety throughout this manual. Where special precautions need to be taken due to the nature of the equipment or product, an appropriate safety icon and warning message is shown. Special attention should be made to the Safety Chapter if available, where all such messages are summarized.

In line with our continuous policy of research and development, we reserve the right to amend models and specifications without prior notice.

This handbook is accurate at the date of printing but will be superseded and should be disregarded if specifications or appearance are changed.

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About this manual

Safety information

The following icons are used throughout this manual to identify any potential hazards that could cause serious injury to people or damage to the equipment:

This symbol warns of specific hazards which, if not taken into account, may result in personal injury or death.

This symbol warns of specific hazards from laser radiation.

This symbol warns of specific hazards from high temperatures.

This symbol warns of specific hazards from asphyxiation.

This symbol warns of specific hazards from nitrogen gas.

Other information provided by the manual

This symbol highlights where you must take special care to ensure the Analyzer or other equipment or property is not damaged.

Note: *Notes give extra information about the equipment.*

Hint: *Hints give helpful tips.*

Scope of the manual

This manual covers the 07931001B of the Laser 3 Plus.

Other documents for the Laser 3 Plus are listed below:

Document	Description	Document number
Service Manual	Optional manual us for use by qualified personnel and provides detailed servicing instructions.	07930002B
Functional Safety	Optional functional safety manual.	07930006B
Certification Manual	Details of Certification requirements.	07930008B

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1. Safety

1.1 General warnings and cautions

If the Laser 3 Plus is used in a manner not specified within this manual, the protection provided by the equipment may be impaired.

Failure to observe the requirements of the manual may result in the user being held responsible for the consequences and may invalidate any warranty.

Before you attempt to install, commission or use the Laser 3 Plus, read this manual carefully.

Do not attempt to install, commission, maintain or use the Laser 3 Plus unless you are trained and competent.

Ensure that Purge Port 3 of the Transmitter Unit, 'Enclosure Out', is free to vent to atmosphere before operation of the instrument.

Ensure that any parts which are removed for the purposes of installation are retained. They must be refitted in the event the instrument is transported to another location.

The Laser 3 Plus does not include any user-serviceable parts.

The Laser 3 Plus does not include any user replaceable fuses.

Do not use the Laser 3 Plus as Personal Protective Equipment (PPE).

If you do not install and use the Laser 3 Plus in accordance with the instructions in this manual, you may risk exposure to hazardous laser radiation.

The Laser 3 Plus may be attached to equipment that is hot. Always wear the appropriate PPE to minimize the risk of burns.

Where there is a risk associated with the release of potentially harmful gases into the operating environment, always use suitable monitoring equipment.

The gases included in the process being monitored may be toxic, asphyxiant or flammable.

Before you use the Laser 3 Plus, make sure that all connections are leak-free at full operating pressure to

prevent exposure of personnel and the environment to the hazardous gases.

The analyzer may fail if it is used with sample streams that contain substances not compatible with those listed in Section 2.8.

Make sure that you install the instrument to conform to all relevant safety requirements, National Electrical Code and any local regulations. The installation must be safe for any extremes of operating conditions which may occur in the operating environment of the Laser 3 Plus.

Do not install the analyzer on a surface which is subject to high levels of vibration or sudden jolts. Sample measurements may not be accurate and the analyzer may be damaged.

1.2 Laser safety

CLASS 3R LASER PRODUCT.

LASER RADIATION. The Laser 3 Plus is a Class 3R laser product. The laser light is not visible. Do not look into the laser beam. Avoid direct eye contact with the laser radiation.

The transmitter and receiver units both have a Laser On indicator. This is ON when the transmitter emits laser radiation from the optical window.

CLASS 3R LASER PRODUCT.

LASER RADIATION. Changes to settings or performance of procedures other than those specified in this manual may result in hazardous radiation exposure.

1.3 Certification

1.3.1 Hazardous area installations

Do not modify the unit, either mechanically or electrically, or the certification of the instrument will be invalidated and it may not operate safely.

Exposure to some chemicals may degrade the sealing properties of materials used in the following devices (North America only):

K1:	**Relay from Analyzer Main Board**	**Sealed Device**
K1:	**Relay from Option Board**	**Sealed Device**
K2:	**Relay from Option Board**	**Sealed Device**

Substitution of the following components may impair suitability for Division 2 (North America only):

K1:	**Relay from Analyzer Main Board**	**Sealed Device**
K1:	**Relay from Option Board**	**Sealed Device**
K2:	**Relay from Option Board**	**Sealed Device**

EXPLOSION HAZARD - Substitution of components may impair suitability for CL I, Div 2. (North America only).

Make sure that the operating environment is within the limits specified in the product data (section 2.6.5).

Do not install the Laser 3 Plus in a high-velocity dust-laden atmosphere.

Do not open the enclosure if an explosive atmosphere is present.

Do not open the enclosure if the Laser 3 Plus is energized.

It is a condition of certification that the unit must be installed following the appropriate national or international legislation or codes of practice. In particular, you must make sure that the correct glands are fitted to cable entries and that you do not compromise the weatherproofing of the enclosure.

All of the analyzer electrical connections are considered to be incendive and therefore must only be connected to safe area equipment.

The equipment is incapable of passing the dielectric strength test prescribed by the standards, and so this must be taken into account during installation by using an SELV power source with a prospective short circuit current not exceeding 40A.

1.3.2 Hazardous area variants

Do not use hazardous area variants with a process atmosphere that requires EPL Ga. (e.g. Zone 0). If they are used within this process atmosphere, the hazardous area certification may be invalidated.

Do not use hazardous area variants for oxygen enriched flammable samples; that is gases over 21% O_2. If they are used with gases containing over 21% O_2 the hazardous area certification may be invalidated.

Hazardous area variants are certified for use with a flammable process atmosphere at a pressure of 0.8 to 1.1 bar absolute (11.6 to 15.95 psi). If used with a flammable process atmosphere beyond these limits, the hazardous area certification may be invalidated.

1.4 Markings

The Laser 3 Plus includes these external markings. Their locations are shown in section 1.4.1.

Follow the appropriate safety instructions and be aware of any warnings about potential hazards.

1.4.1 Label locations

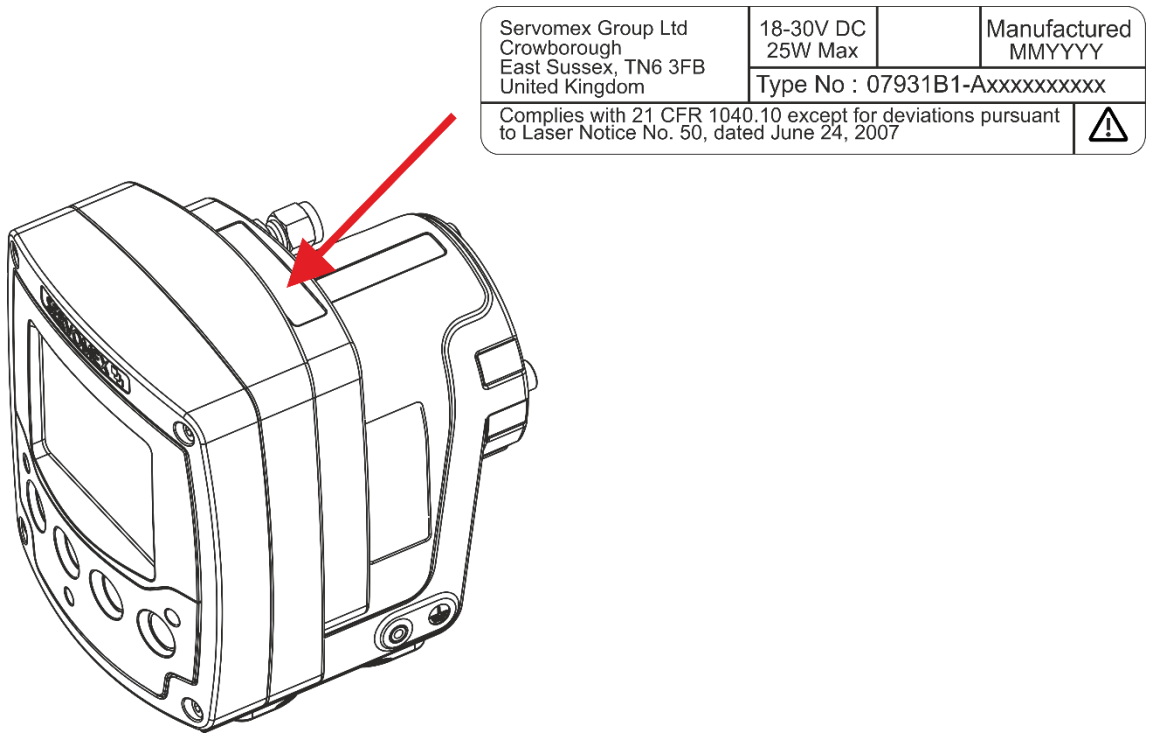


Figure 1-1: Laser 3 Plus transmitter unit rating label location

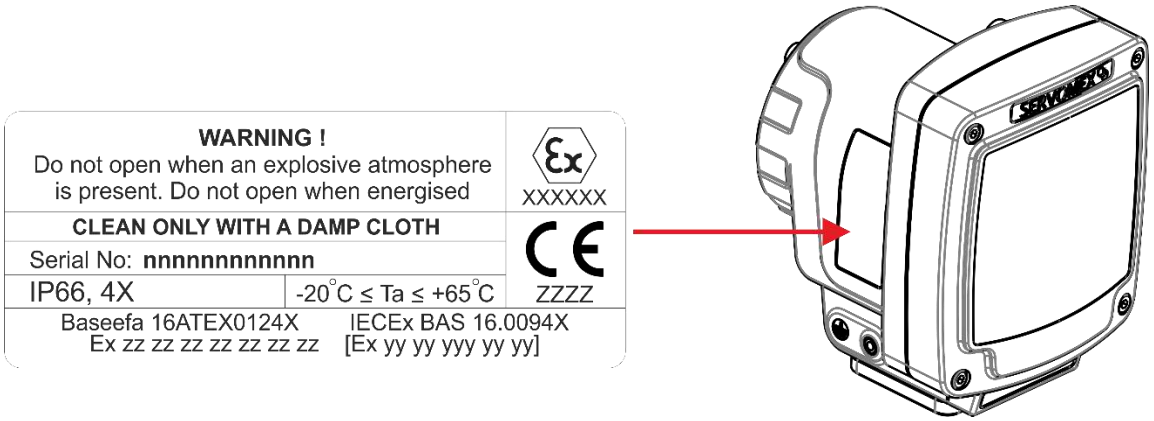


Figure 1-2: Laser 3 Plus receiver unit certification label location

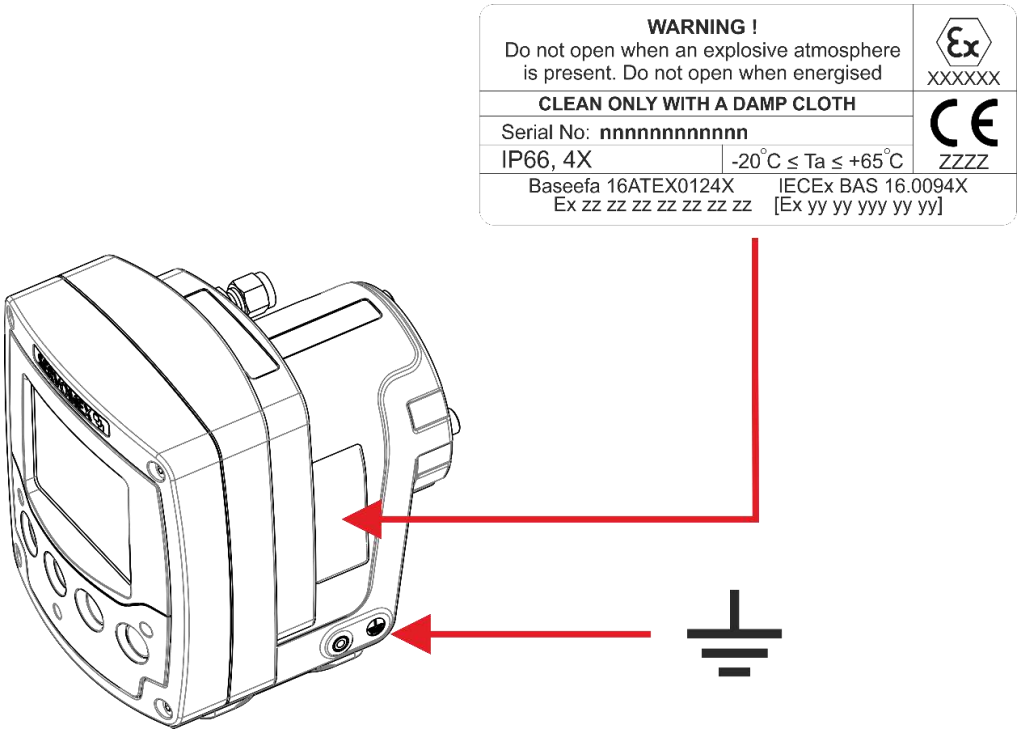


Figure 1-3: Laser 3 Plus transmitter unit certification label and EMC / function earth label location

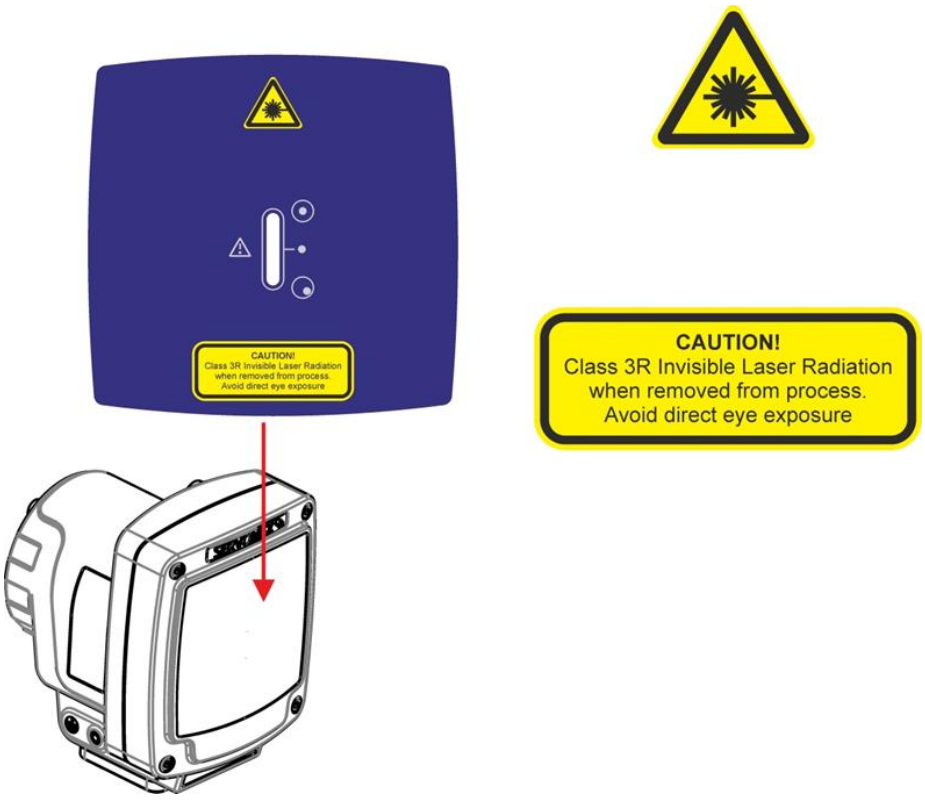


Figure 1-4: Laser 3 Plus receiver unit laser label location

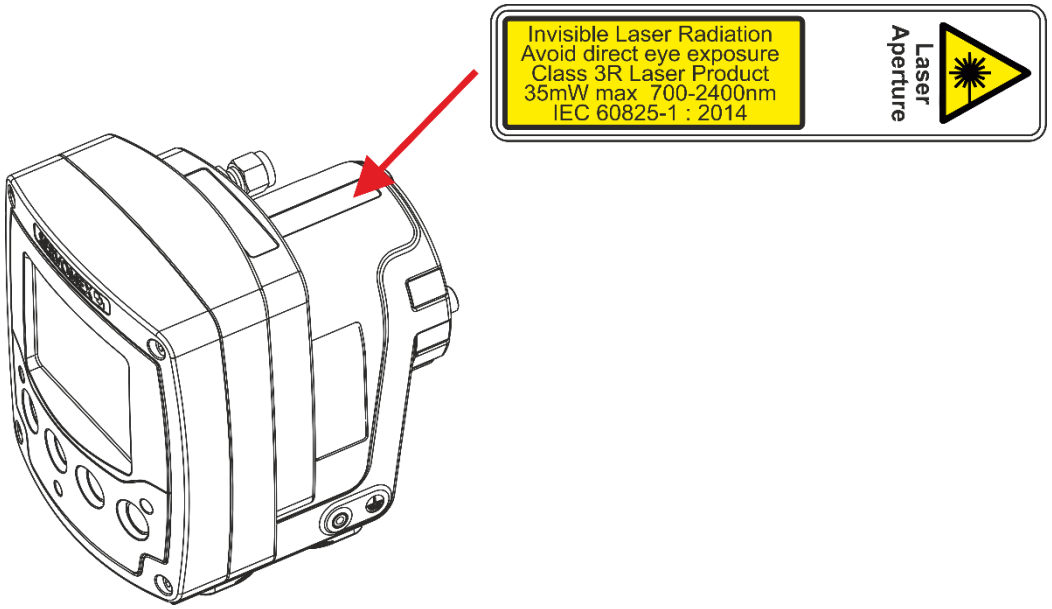


Figure 1-5: Laser 3 Plus transmitter unit laser label location

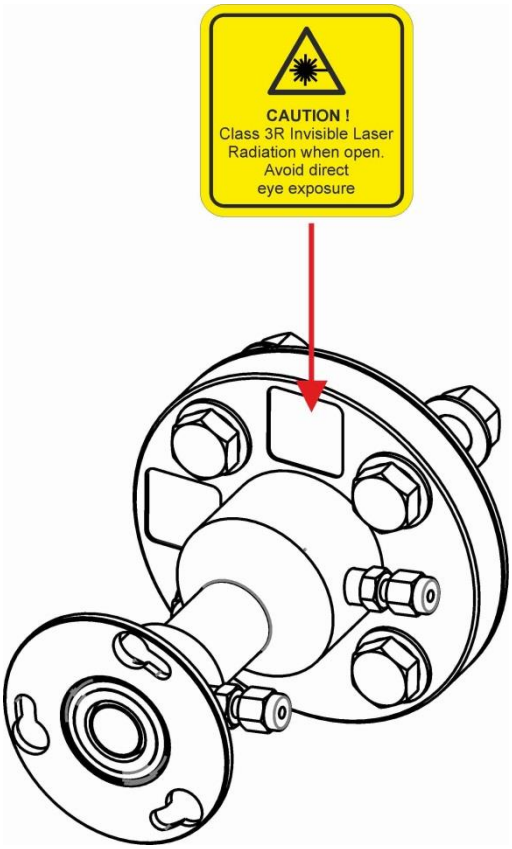


Figure 1-6: Laser 3 Plus mount laser label location

2. Introduction

2.1 Product description

The Laser 3 Plus is an advanced gas analyzer. It comprises a transmitter unit (TU) and a receiver unit (RU), with an optional AC to DC power supply, ancillary equipment and sample cell.

The laser radiation detected by a photodetector is amplified and transferred to the transmitter unit through a multi-core cable which connects the receiver and transmitter electronics. The same cable transfers the required power from the TU to the RU. Connectors at each end of the cable, and a removable gland plate, allow removal of the TU and RU for calibration or maintenance.

Flange mounts and window purge assemblies are provided to mount the transmitter and receiver to the process flanges. Quick-connect connections between the instrument and mounting assembly allows easy removal of the transmitter and receiver for calibration or maintenance.

For continuous in-situ applications, the Laser 3 Plus is installed directly across stacks, ducts and reactors typically employing path lengths of 0.1 to 25m (3.94" - 82ft.).

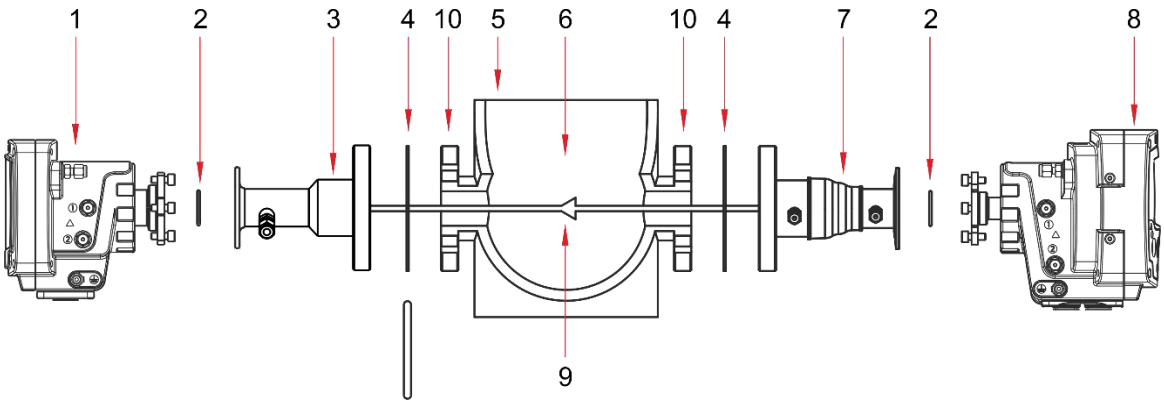


Figure 2-1: Laser 3 Plus example installation (exploded view)

1	Receiver Unit	**6**	Process gas
2	O-ring	**7**	Adjustable mount (2 variants)
3	Fixed mount or adjustable	**8**	Transmitter Unit
4	Gasket or O-ring	**9**	Non-visible laser beam path
5	Process pipe, stack, duct, etc.	**10**	Process flange and nozzle

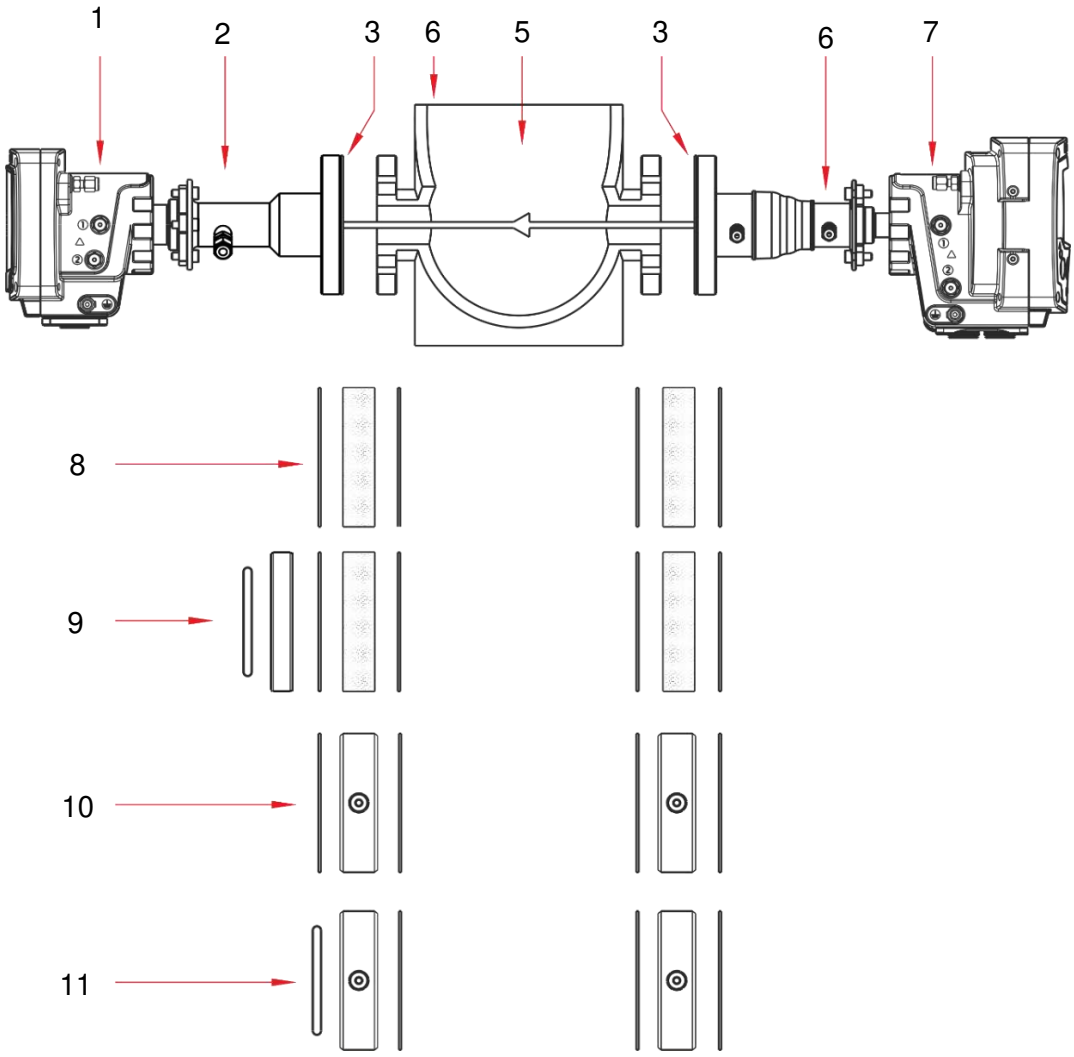


Figure 2-2: Laser 3 Plus installation: showing thermal spacer and isolation flange options

1	Laser receiver	**6**	Adjustable mount (2 variants)
2	Fixed mount or adjustable	**7**	Laser transmitter
3	Gasket	**8**	Thermal spacer (arrangement 1)
4	Process pipe, stack, duct, etc.	**9**	Thermal spacer (arrangement 2)
5	Process gas	**10**	Isolation flange (arrangement 1)
		11	Isolation flange (arrangement 2)

***Note**: Installation may vary depending on specific application and system requirements as items 3 and 6 are selectable options. If item 6 is required, it must be fitted to the TU side. Items 8, 9,10 and 11 are optional, additional gaskets, fasteners and adaptors may be required.*

2.2 Transmitter unit

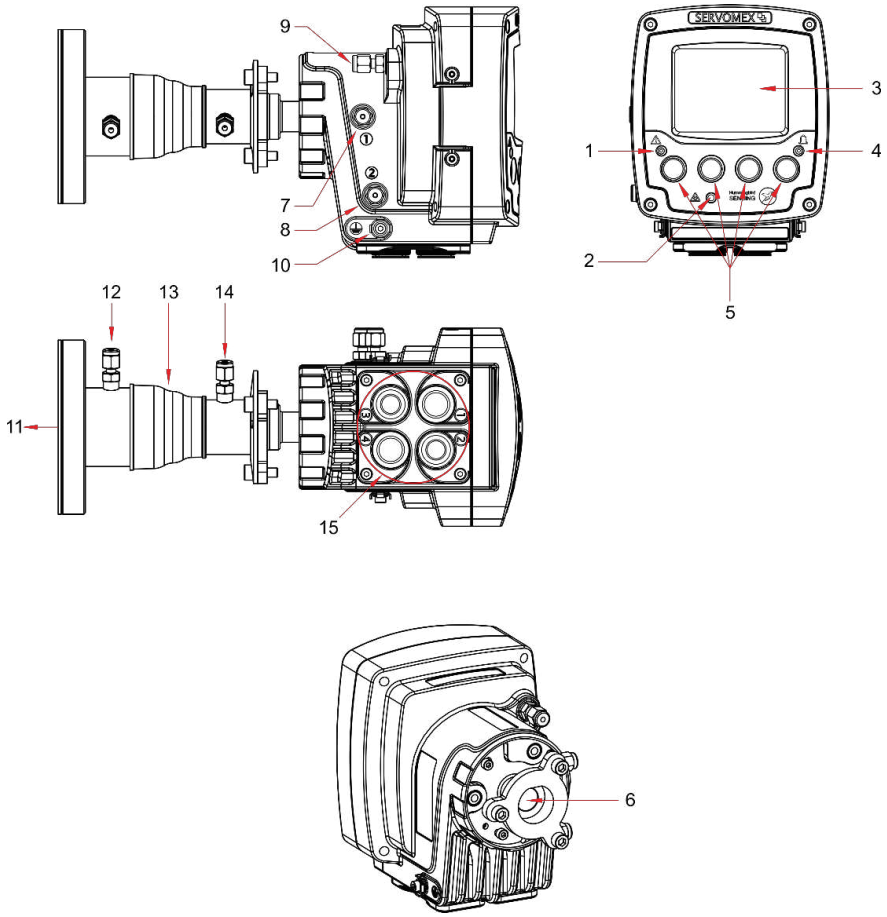


Figure 2-3: Transmitter unit: front, rear, side and under-side views

1	Fault LED (Fault status - amber)	**9**	Purge 3: Purge gas exit
2	Laser power ON indicator (Status ON -green)	**10**	Functional / EMC earth (ground)
3	Display	**11**	Window purge out *(standard)*
4	Alarm LED (Alarm status - red)	**12**	Window purge out *(option: isolation flange only)*
5	Pushbuttons	**13**	Adjustable mount (alternatively options available)
6	Optical window / transmitter aperture		
7	Purge 1: Laser diode gas “IN”	**14**	Window purge in
8	Purge 2: Enclosure gas “IN”	**15**	Cable entry glands: see section 7.4.2 2 x M16 x 1.5 mm (ports 2 and 3) 2 x M20 x 1.5 mm (ports 1 and 4)

2.2.1 Transmitter enclosure contents

Laser transducer	Laser diode source and thermal control
CPU board	Main CPU
Main board	Provides the standard connectivity including: 24 V DC power feed 0 / 4 to 20 mA output A status relay output Ethernet connectivity SD Card
Display with key inputs	A display (LCD) allows access to measurement and menu options
Option of an additional I/O board	Provides: A second 0 / 4 to 20 mA output Two 0 / 4 to 20 mA inputs Two additional status relay outputs
Customer connection terminals	Accessible terminals are provided for: 24 V DC power feed Analog outputs Analog inputs Relays MODBUS TCP

2.3 Receiver unit

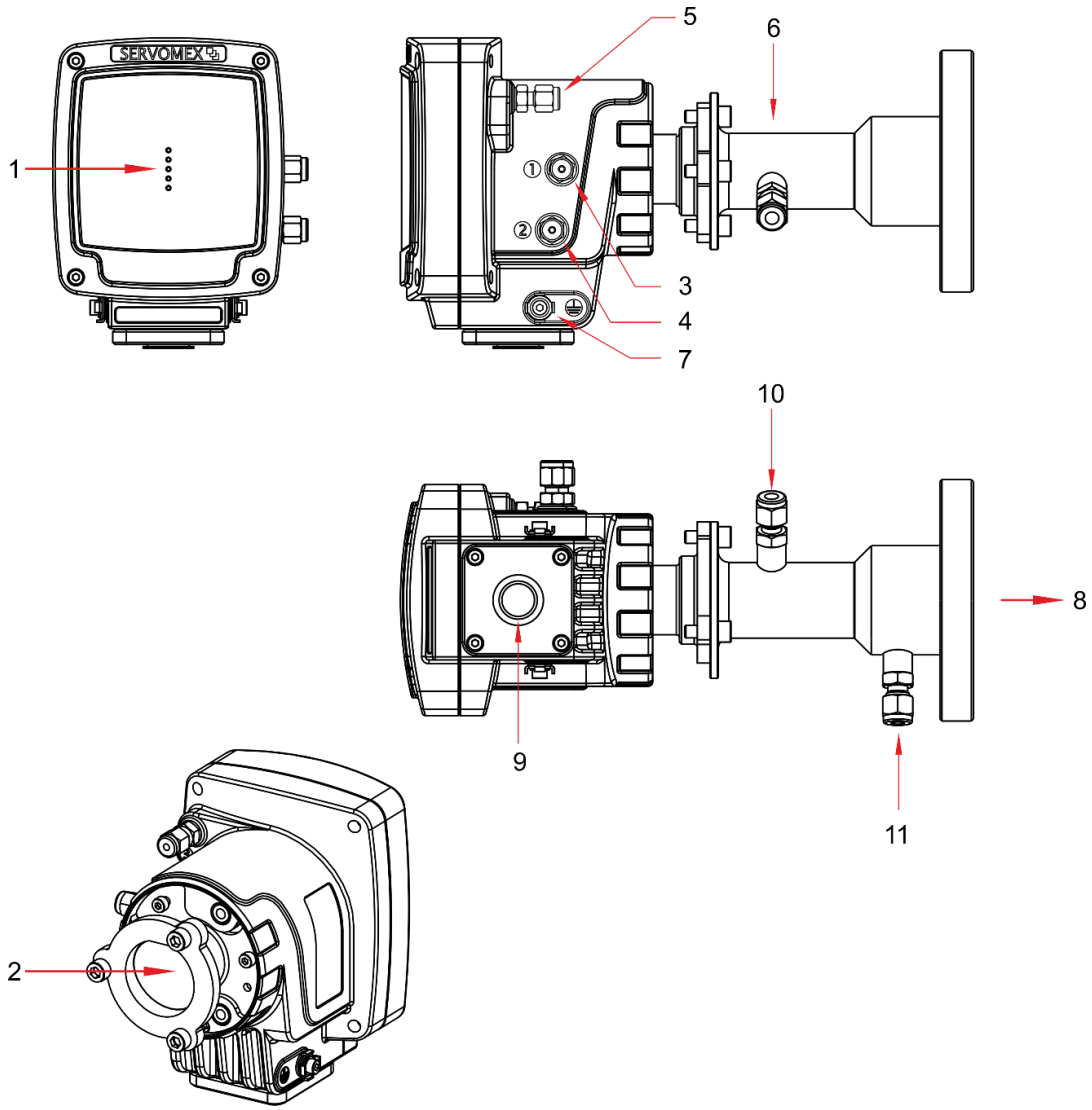


Figure 2-4: Receiver unit: front, rear, side and under-side views

1	Laser light ON indicator (green)	**7**	Functional / EMC earth (ground)
2	Optical window / receiver aperture	**8**	Window purge out *(standard)*
3	Purge 1: Detector module gas “IN”	**9**	Cable entry gland (1 off M20 x 1.5 mm)
4	Purge 2: Enclosure gas “IN”	**10**	Window purge in
5	Purge 3: Purge gas exit	**11**	Window purge out *(option: isolation flange only)*
6	Fixed mount (illustrated) may alternatively be configured with an adjustable mount		

2.3.1 Receiver enclosure contents

Detector board	Photodetector and mounting
Aspherical lens	Enables the laser light to be focused on the photodetector
Transmitter connection board	Provides connection between transmitter unit and receiver unit
LEDs	

2.3.2 Receiver unit indicator LEDs

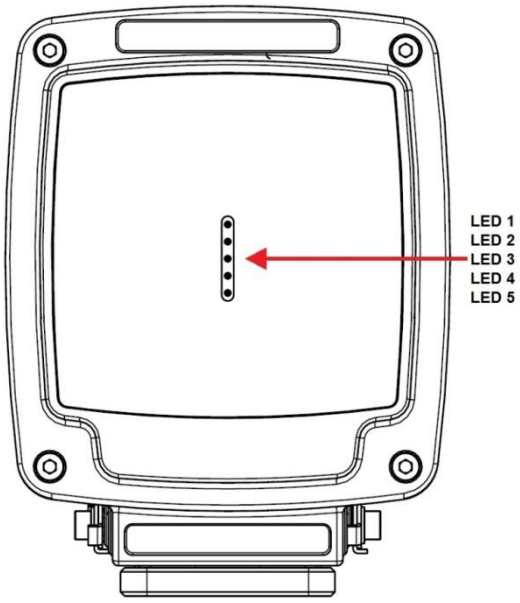


Figure 2-5: Receiver unit indicators

The receiver unit front panel contains the following indicator LEDs:

LED	Function	Color
1	Laser adjustment (usually OFF)	Illuminated Amber during alignment
2	Laser adjustment (usually OFF)	Illuminated Amber during alignment
3	Laser light ON	Illuminated Green when laser beam is on
4	Laser adjustment (usually OFF)	Illuminated Amber during alignment
5	Laser adjustment (usually OFF)	Illuminated Amber during alignment

Note: The receiver alignment LED feature is turned OFF by default

2.4 Mounting assembly (flange and window purge)

The mounting assembly comprises a stainless-steel tube with two circular flanges at either end.

The larger process flange has 4 or more circular holes; the smaller instrument flange has 3 axial keyhole slots.

Two purge ports are located on the sides of the tube.

There are two variants of the assembly:

- Fixed assembly
- Adjustable ball joint, two options

2.5 Power supply (optional)

The optional power supply is a third party* Input voltage: nominal 100 – 240VAC, Output 24 VDC (nom)

Input current at full load (typ.) 1.0A at 230VAC, 2.0A at 115VAC

Recommended circuit breaker (characteristic C or slow blow fuse) 5.0A

Die cast aluminum housing and is supplied with input and output connectors.

- Input connector: 3+PE, Cable outlet (mm): 12-14, wire gauge (max AWG): 14
- Output connector: 6+PE, Cable outlet (mm): 12-14, wire gauge (max AWG): 16
  *For further details refer to www.tracopower.com/products/tex120.pdf

2.6 Product specifications

2.6.1 Physical dimensions

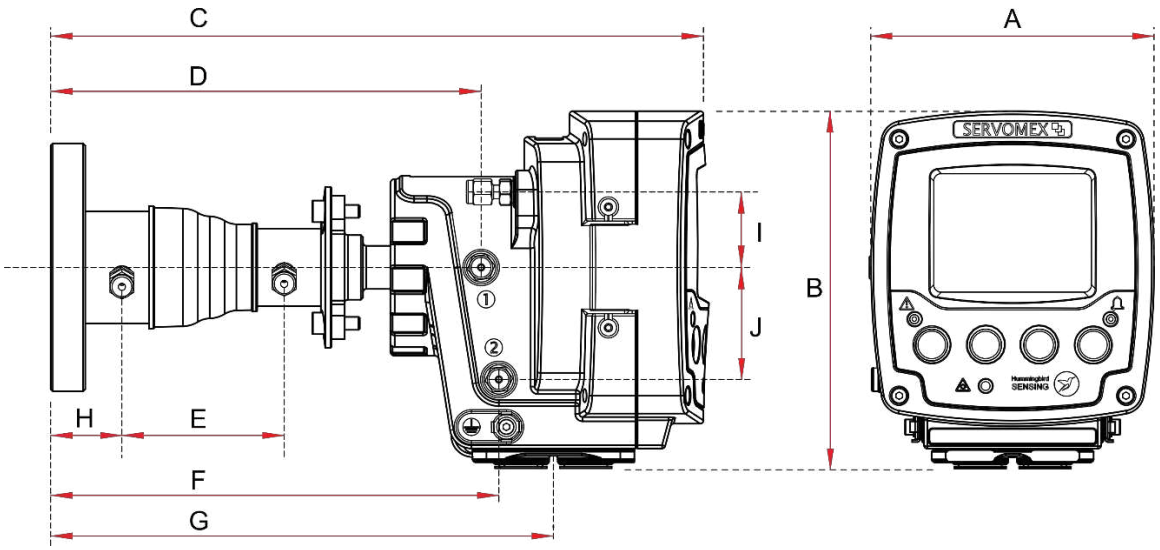


Figure 2-6: Transmitter unit dimensions

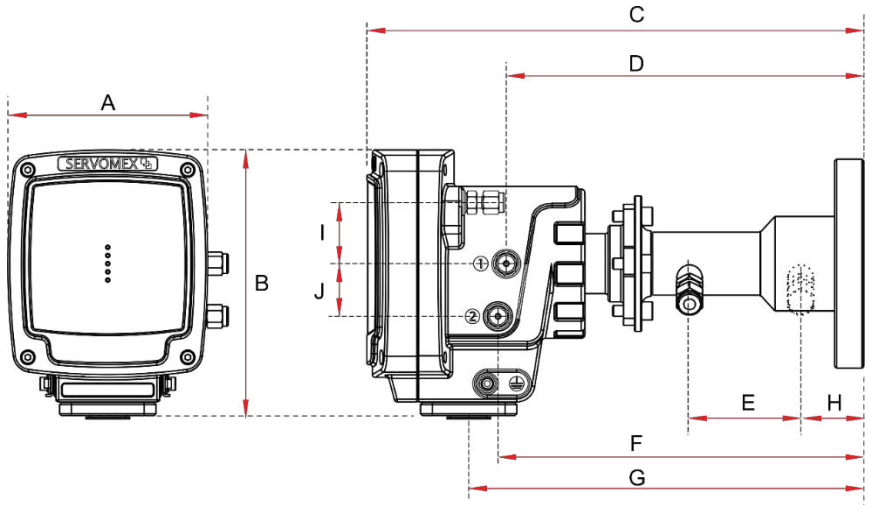


Figure 2-7: Receiver unit dimensions

Dimension	Transmitter unit mm (inches)	Receiver unit mm (inches)
A	131 (5.157)	110 (4.331)
B	165 (6.496)	150 (5.905)
C	305 (12.008)	279 (10.984)
D	202 (7.953)	203 (7.992)
E	75 (2.953)	65 (2.559)
F	210 (8.268)	207 (8.150)
G	235 (9.252)	224 (8.819)
H	35 (1.378)	35 (1.378)
I	35 (1.378)	34 (1.339)
J	52 (2.047)	29 (1.142)
Weight	2.0 kg (4.4lbs)	1.6 kg (3.52lbs)

2.6.2 Electrical specifications

Input power supply: SELV; 18 – 30VDC; 25W maximum

2.6.3 Connection details

Connection	Transmitter unit	Receiver unit
Cable glands	2 x M16 x 1.5mm 2 x M20 x 1.5mm	1 x M20 x 1.5mm
Purge 1	1/4” pipe connector	1/4” pipe connector

Connection	Transmitter unit	Receiver unit
Purge 2	1/4” pipe connector	1/4” pipe connector
Purge 3*	1/8” NPT(F)	1/8” NPT(F)

****Note:** Purge port 3 is supplied with an internal breather fitted. Do not block this port.*

2.6.4 Laser specification

Laser class:	Class 3R (according to IEC 60825-1)
Laser range:	Near-infrared (NIR) range: 700 to 2400 mm (depending on the gas to be measured)
Laser power:	35mW (max)

CLASS 3R LASER PRODUCT.

LASER RADIATION. The Laser 3 Plus is a Class 3R laser product. The Laser light is not visible. Do not look into the laser beam. Avoid direct eye contact with the laser radiation. Figure 2-1 shows the laser beam path.

The transmitter and receiver units both have a Laser On indicator. This is ON when the transmitter emits laser radiation from the optical window.

2.6.5 Environmental operating conditions

Operating and storage temperatures:	-20 °C to +65°C (-4 °F to 41°F)
Operating ambient pressure range:	80 to 110kPa (11.6 to 16psi) (hazardous areas)
Operating humidity:	0 to 80% RH (non-condensing) Note: An environmental purge may be required in locations where high humidity can be expected (see 7.6.2)
Maximum operating altitude:	4000m (13,120ft.) 2000m (6,560ft.) for hazardous area variants. Note: The optional power supply can only be used up to an altitude of 3000m (9,840ft.)
Ingress Protection classification:	IP66

2.6.6 Performance specifications

Technology:	Tunable laser diode absorption spectroscopy	
Optical path:	0.1 – 25m (4" - 82ft.)	
Maximum process pressures*:	Unclassified process:	150kPa a (22psi)
(*Without secondary protection)	Classified process:	110kPa a (16psi)
Maximum process flange temperature (classified process):	135°C (275°F)	
In-situ response time:	Application dependent	
Drift:	Application dependent	
Repeatability:	± detection limit or ± 1% of reading, whichever is greater (Application dependent)	
Linearity:	<1% FSR (Application dependent)	
T_{90}:	Application dependent	

For general commissioning activities the analyzer will be functional within 10 minutes, however Servomex recommend allowing 3 hours for the analyzer to stabilize.

2.7 Additional information

The following specifications are dependent on the configuration of the Laser 3 Plus that you originally purchased.

Equipment classification:	ATEX Cat 3 (Gases) ATEX Cat 2 (Dusts) IECEx EPL Gc (Gases) IECEx EPL Db (Dusts)
Area classification:	Safe area ATEX, IECEx & North America Zone 2 (Gases) ATEX & IECEx (Dusts) North American Class I, Div 2 (Gases) North American Class II, Div 2 (Dusts)
Optical path length:	0.1 m to 25 m (4" to 82ft)
Optical window, diode and enclosure purging:	None (low dust clean process) Instrument air

	N_2, inert gas
Beam:	Configuration dependent
Supply voltage:	SELV; 24VDC (standard) 110 Vac 50/60Hz (external power supply) 220 Vac 50/60Hz (external power supply))
High process gas temperature applications:	Max. 1500°C
Mounting flange:	DN25 / PN10 DN50 / PN10 ANSI 1” / 150lbs, pair ANSI 2” / 150lbs, pair ANSI 3” / 150lbs, pair
Isolation flanges:	DN50 / PN10 (pair) ANSI 2” / 150lbs, pair
Pressure isolating flanges:	DN50 / PN10 (pair) ANSI 2” / 150 lbs, pair
Insertion tubes for high dust / water:	316SS insertion tubes, 19.5 mm to 35 mm dia, pair
Calibration cell:	316SS for corrosive gases (except HF)
4 to 20 mA outputs, isolated current loop, 500 Ω maximum:	One 4 to 20 mA output Two 4 to 20 mA outputs (optional)
4 to 20 mA inputs for process temperature and pressure:	Two 4 to 20 mA inputs (optional)
Alarm outputs relay, 1A at 30 VDC/VAC:	One relay alarm output (standard) Three alarm outputs
Maximum current:	22mA
Input impedance:	50 Ω
Ethernet output:	MODBUS TCP
Instrument purging:	Process window (mandatory) Module purge (if specified) Enclosure purge (if specified) It is recommended that the enclosure is purged for all applications (see section 7.6.2)
Temperature range:	-20 °C to +65 °C (-4 °F to 149 °F)
Alignment tools:	Alignment tool with target

Purge gas filtration:	Dry and oil-free air (ISO 8573.1 Class 2-3) or N_2 99.99 Application specific
Flange and window purging:	Purge flow (application dependent) Transmitter and receiver window must be purged for proper operation.

2.8 Materials in contact with the sample

Item:	Material:
Flange:	316 stainless steel
Insertion tube:	316 stainless steel
O-rings:	Fluorocarbon Chemraz 505 *(optional)*
Process flange gasket:	Stainless steel and graphite composite
Optical windows:	Fused silica (optical coating) Sapphire (optical coating) (*optional)*
Optical window seal:	Loctite 595

Wetted materials must be compatible or clean for oxygen service at concentrations above 21% or equivalent at elevated pressure.

2.9 Unpacking

Remove the SERVOTOUGH Laser 3 Plus and its accessories from the packaging and inspect everything for any damage that may have occurred during transit.

If any item has been damaged, contact Servomex or its agent straight away.

Keep all packaging and shipping information.

Check that the parts supplied agree with your purchase specification.

Remove Silica Gel sachet before attempting to operate the instrument.

3. Transmitter user interface

3.1 Keypad

In all operating modes, the function of each pushbutton key is indicated by one of four corresponding icons on the transmitter unit display. The icons change dynamically. Pressing the appropriate keys navigates the operator through the various menus during setup, installation, calibration, etc.

3.2 Transmitter Unit Indicator LEDs

Refer to Figure 3-1: Transmitter pushbutton keys, screen icons and indicator LEDs. The transmitter unit front panel contains the following indicator LEDs:

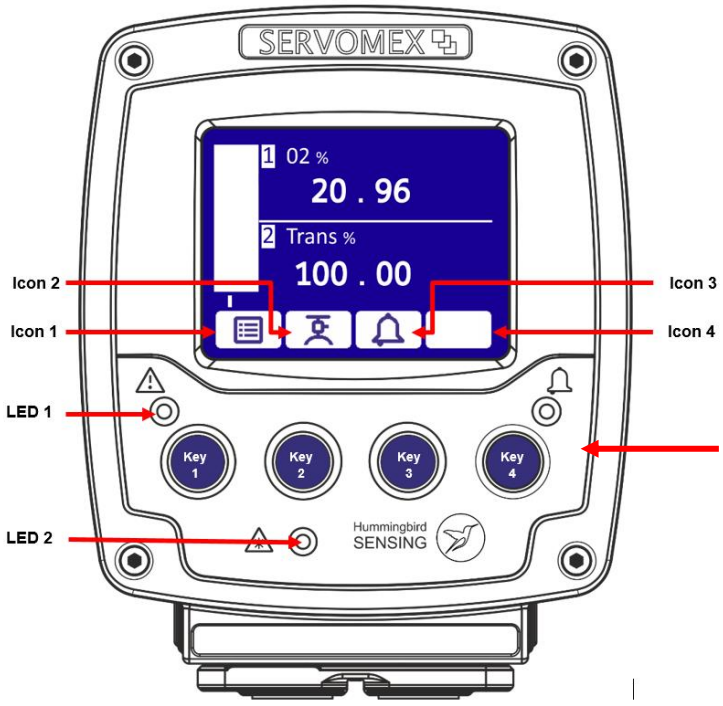


Figure 3-1: Transmitter pushbutton keys, screen icons and indicator LEDs

LED	Function	Color
1	Fault	Illuminated amber when a fault is raised
2	Laser ON	Illuminated green when powered - assume laser beam is on
3	Alarm	Illuminated red when an alarm is raised

3.3 Start-up screen

The start-up screen is displayed when you first switch on the unit as it carries out a self-test. The start-up screen shows the progress of the self-test and also displays the main analyzer software release and transducer software release codes.

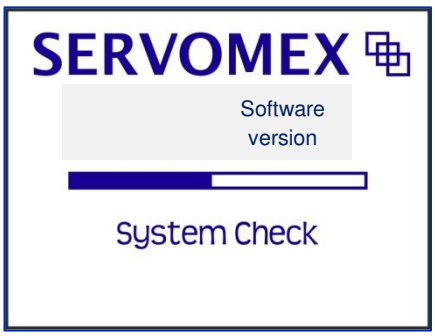


Figure 3-2: Start up screen

3.4 Measurement screen

When initialization is complete the display will default to the 'live' measurement screen. The measurement screen displays 2 measurements.

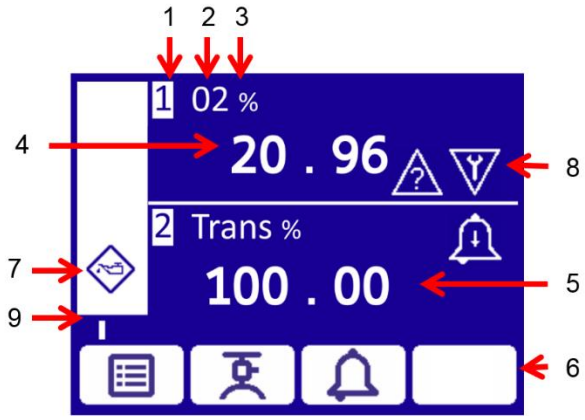


Figure 3-3: Example of a 'live' measurement screen

Item			
1	Measurement number	6	Soft key navigation icons
2	Measurement designation	7	System status icon
3	Measurement units	8	Measurement status icons
4	Live measurement reading	9	Software health indicator
5	Live transmission reading		

Note: *The lower half of the display can be configured to display values other than transmission, e.g. a second measurement or pressure or temperature. In this case, transmission will move to the system panel on the upper left section of the screen.*

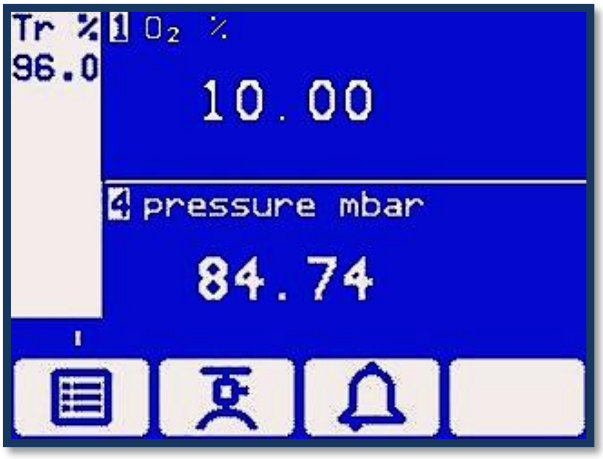


Figure 3-4: Example of second measurement screen

Note: *In the event of a fault that impacts the integrity of the transmitted laser beam; the transmission signal will 'freeze' at the last known reliable reading. Such a condition will be reflected in analyzer status messages.*

Note: *When measuring a **hot oxygen** process, if the temperature of that process falls below the level where that measurement becomes unreliable, the measurement display will revert to **Invalid**.*

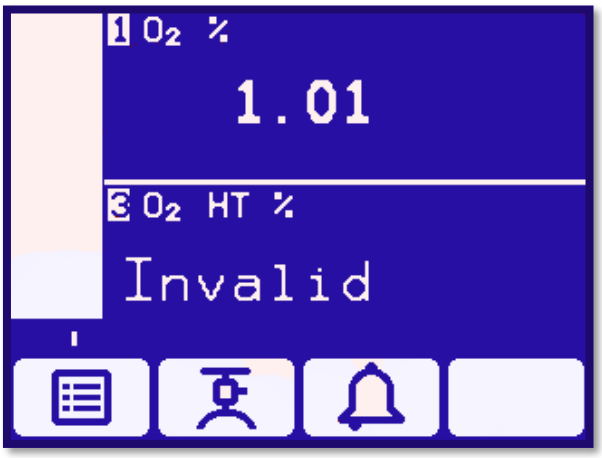


Figure 3-5: Example of an 'invalid' measurement screen

Note: *During this time, all other functions will remain active, however concentration faults will **not** be logged. This temperature threshold is a factory set parameter; it cannot be modified via the user interface.*

Note: *During normal operation the software health indicator (9) moves continuously across the screen below the status icon column. If the indicator stops moving the analyzer is not working correctly. The indicator will also stop moving when busy reading or writing to the SD card.*

Note: *If no soft-key is pressed for 10 minutes, the measurement screen will be displayed. You then have to re-enter the password to access any password protected screens.*

Note: *Holding down the*  *soft-key will clear the current security level and return the display to the measurement screen.*

3.5 Soft key legends

Four soft key navigation icons at the bottom of the screen correspond to the four soft keys on the front of the analyzer.

The icons that appear are:

Icon	Meaning	Function (when soft key is pressed)
	Menu	Displays the menu screen
	Calibrate	Displays the calibrate screen
	Alarm	LED Illuminated red when an alarm is raised
	Back	Cancels current screen and displays previous screen
	Accept	Accepts the data or option selected. A new screen may appear
	Edit	Allows highlighted data to be edited
	Up	Moves cursor up the list
	Down	Moves cursor down the list
	Left	Moves cursor to the left
	Right	Moves cursor to the right
	Blank	No effect

3.6 System and measurement status icons

The system status is displayed on the status icon column on the left of the screen. The measurement status is displayed on the right-hand side of each measurement reading. The status is shown with one of the following icons:

Icon	Meaning	System status	Measurement status
	Check function	Indicates that the analyzer is in a Service In Progress (S.I.P) state	Indicates a specific measurement is in a Service In Progress (S.I.P) state
	Failure	Indicates that a fault has been detected that affects the analyzer	Indicates that a fault has been detected that affects a specific measurement
	Maintenance	Analyzer requires maintenance	
	Out of specification	Indicates the analyzer is operating out of specification	Indicates a specific measurement is operating out of specification
	Warming	N/A	Indicates the laser module is heating or cooling to reach its temperature set point.
	High alarm	N/A	A high alarm for a specific measurement is activated
	Low alarm	N/A	A low alarm for a specific measurement is activated

Note: Status history may contain additional entries including informational data, marked with and “I”, for Servomex use only

3.7 Navigating the analyzer user interface

Use arrows to move the cursor up or down lists or menu items.

Press the up arrow  and down arrow  soft-keys to move highlighted option up or down the screen to highlight the screen option you want.

Press the accept soft-key  to select the option or display the screen you selected.

 Cross to cancel

When entering parameters, it may be possible to move the cursor to the left if more significant figures before the decimal point are required.

E.g. when entering temperature or pressure parameters, a minus sign can also be accessed.

To choose an option on any screen:

If more options are available than can be shown on the screen, a scroll bar is displayed on the right-hand side of the screen. To scroll up and down the list, use the up arrow  and down arrow  soft-keys.

The scroll bar shows where you are in the list of options.

3.8 Menu structure

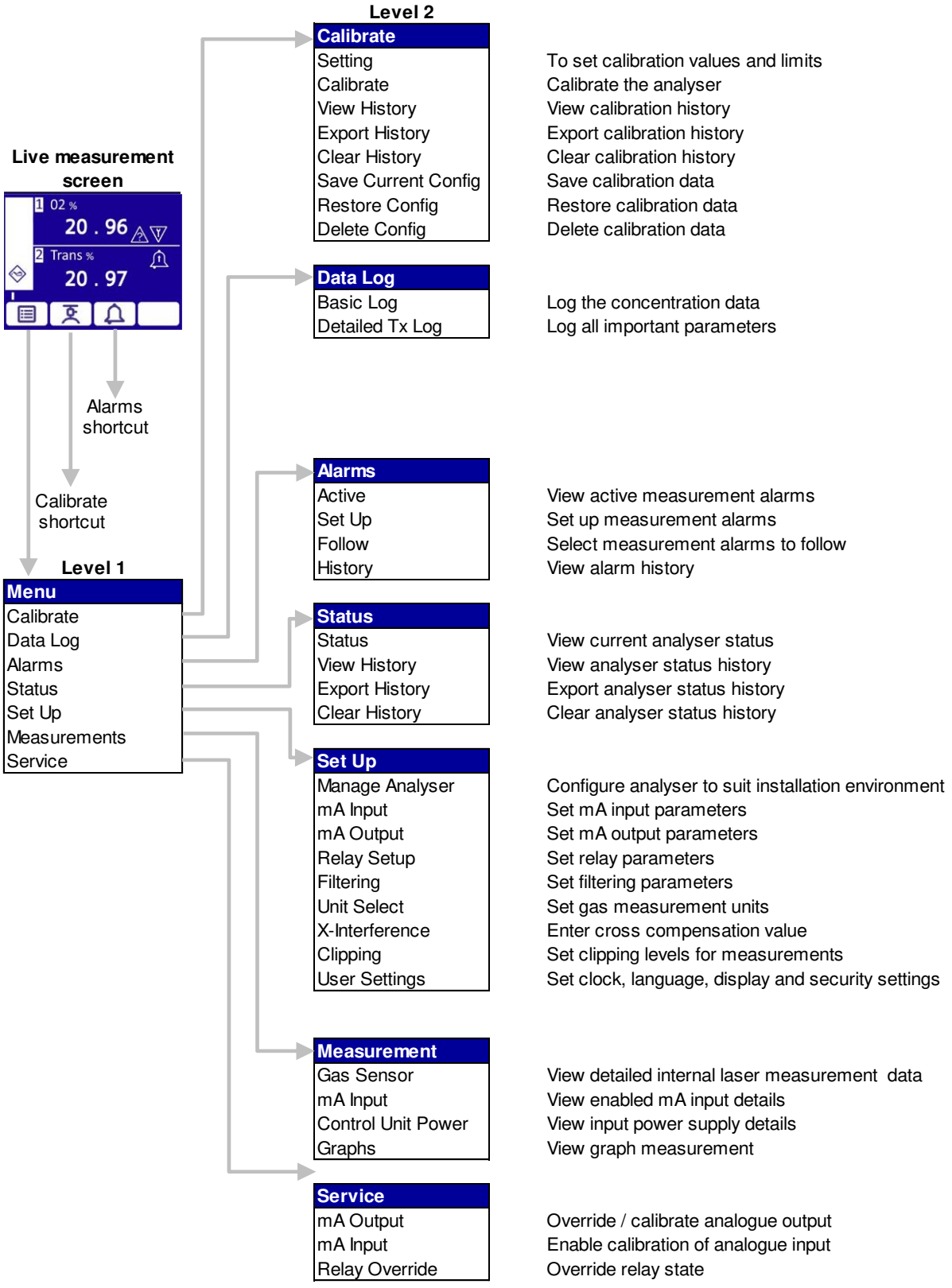


Figure 3-6: Top level menu structure

3.9 Edit on-screen data

You can edit data on any screen in the same way.

Press the edit soft-key  to edit a data item.

The screen changes to the appropriate screen, with the first digit highlighted.

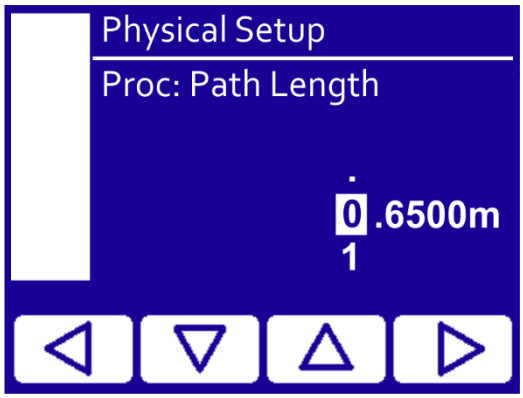


Figure 3-7: Edit screen

Soft-key	Function
	This soft key is available when the first digit is highlighted. Press this soft-key to exit the menu without changing any data
	Increases highlighted digit by 1
	Decreases highlighted digit by 1
	Moves cursor left to previous digit
	Moves cursor right to next digit

When the last digit is highlighted and you have changed it, press the accept soft-key  to accept the new data.

3.10 Password protection

Passwords must be set when the unit is first powered up to ensure proper operation.

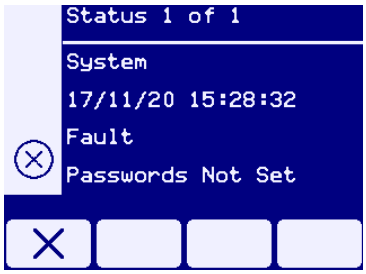
Passwords should be kept in a secure place.

Note: *Passwords are displayed as asterisks (*) when entered, for security purposes.*

Note: *The password remains active until 10 minutes after the last time you press a soft-key. If you do not press any soft-key within that time, you must re-enter the password.*

Note: *Holding down the [X] soft-key will clear the current security level and return the display to the measurement screen.*

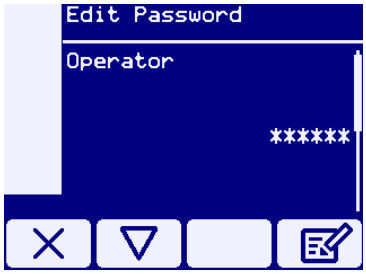
The Laser 3 Plus does not contain factory set operator or supervisor passwords. This means that when the Laser 3 Plus is first powered up after installation it does not have operator or supervisor passwords set. This is indicated by a maintenance fault being raised. This can be seen in the status log as shown below.



To clear the fault new passwords must be set

To do this, navigate to Settings, User Settings, Password, Set Passwords as shown below

Set both the operator and supervisor passwords



Note that although this screen looks like it is asking for an existing password it is in fact allowing a new password to be entered.

Once both operator and supervisor passwords have been set, the maintenance fault will be cleared.

If required, the operator and supervisor passwords can be cleared at any time with the Reset Passwords menu option. It is not necessary to be logged in at any level to reset the passwords. Once the passwords have been reset, the “Passwords Not Set” maintenance fault will be activated again until new passwords are set.

3.11 Configuration setting

There are a number of settings that can be saved/loaded to the instrument by different security password levels.

3.11.1 Measurement configuration

There are two forms of this file: the sensor settings and the users’ environmental settings.

The Configuration can be managed through “Manage Analyzer” menu.

3.11.2 Measurement sensor settings

This includes all sensor settings including laser diode characterization data, factory limits, application tuning data, calibration details, etc.

Note: This file can only be saved / loaded in internal memory via the built-in user interface.

It can be loaded by a Supervisor level user to facilitate recovery of an instrument that cannot be fixed by other means.

The Save Current Config menu will present 3 options:

- Operating default - to be used during normal operation
- Alternative – not normally required
- Custom – use to create exportable or multiple configurations during servicing and maintenance.

3.11.3 Measurement environmental configuration

This file contains sensor and analyzer settings intended to support environmental change e.g. moving the instrument from process to calibration tool.

The file contains everything except laser diode characterization data and calibration data.

The file can be saved / restored from internal memory or via the MicroSD card. The file can be saved in pre-named configurations for specific purposes or in user named files.

This file can be saved and restored by Supervisor level users.

3.11.4 Saving measurement settings

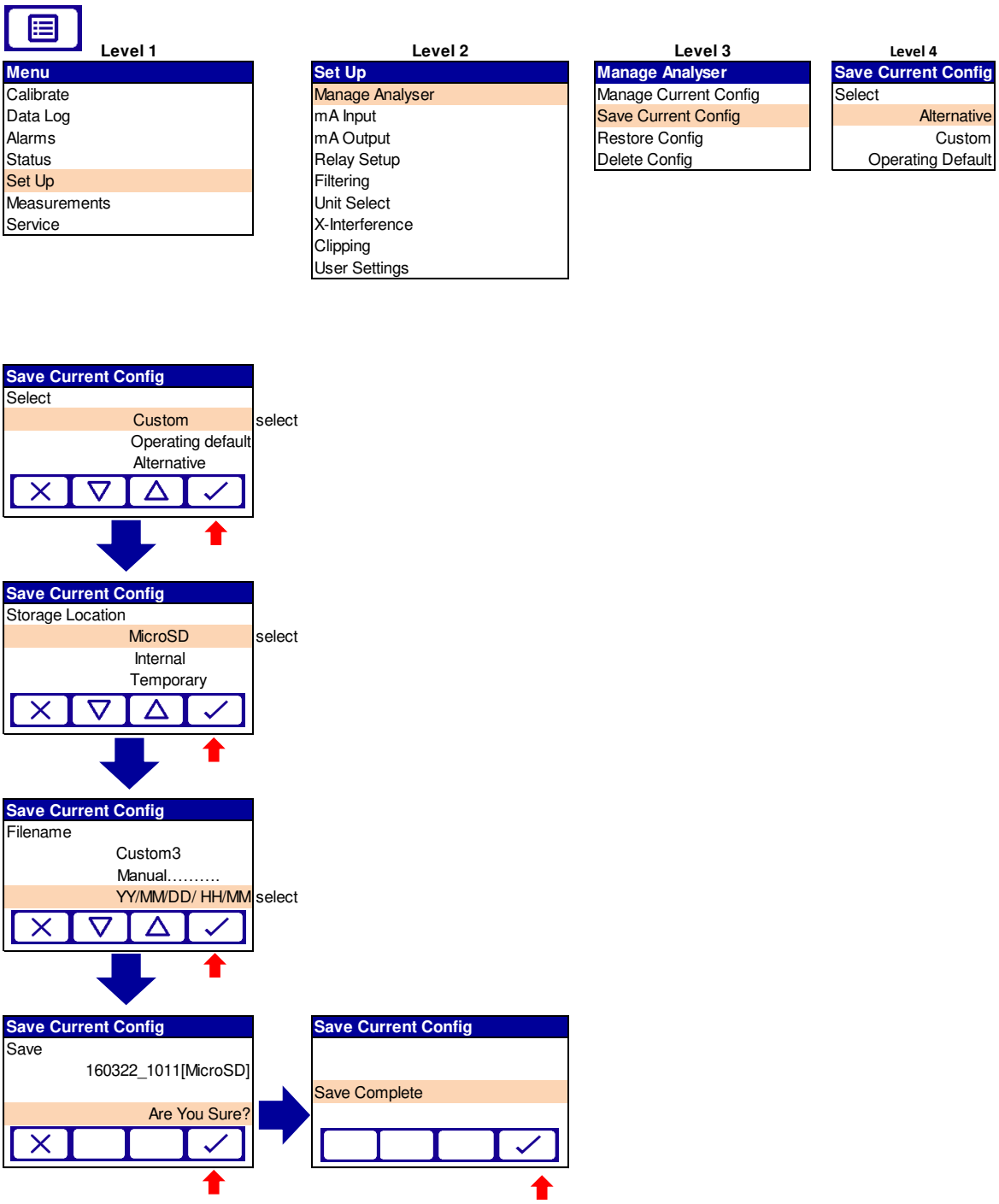


Figure 3-8: Saving sensor measurement (detailed) settings

3.11.4.1 Restore measurement settings

To restore a date and time stamped measurement backup from the microSD card.

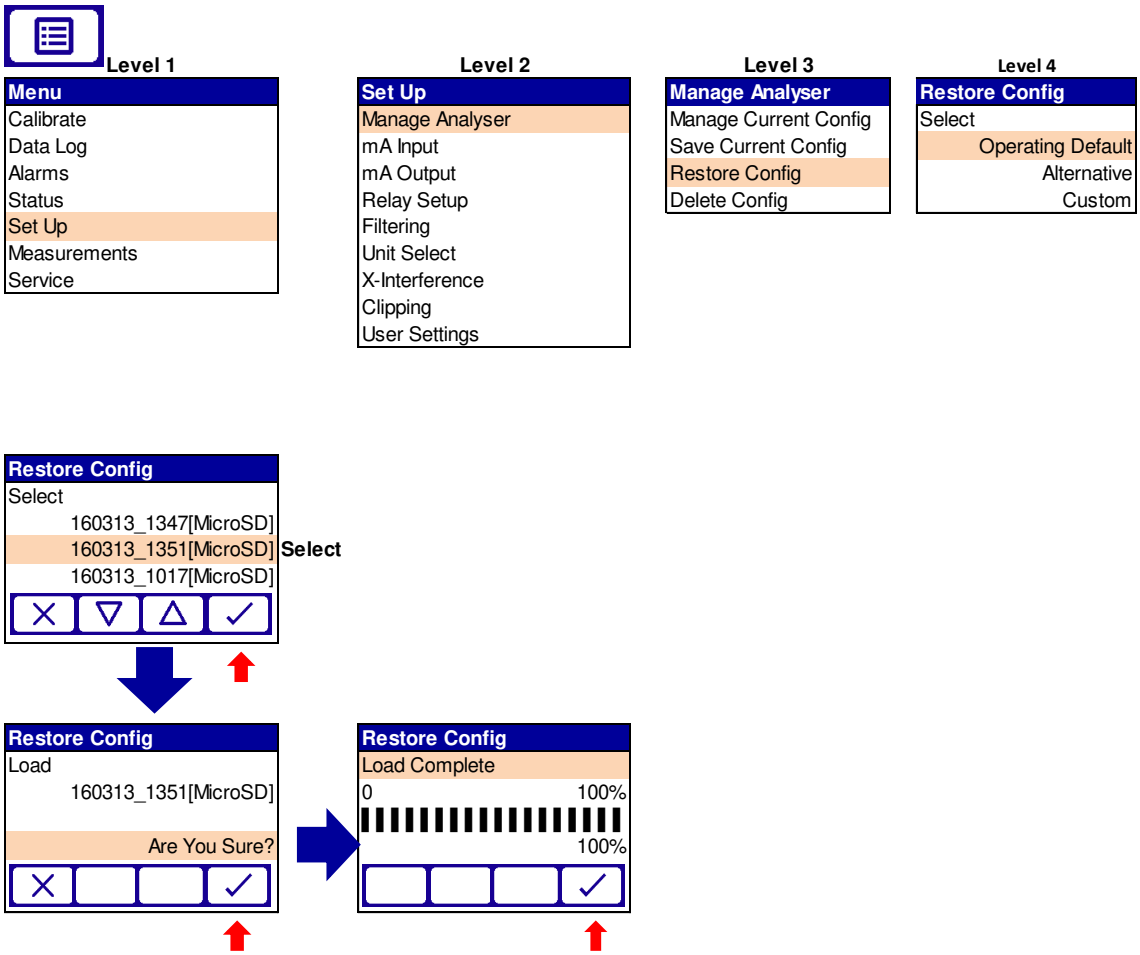


Figure 3-9: Restore measurement (detailed) settings

3.11.5 Measurement calibration configuration

This file contains only sensor data that changes as a result of customer gas calibration. Managed under the “Calibrate” menu.

The file can be saved / restored from internal memory or via the MicroSD card. The file can be saved in pre-named configurations for specific purposes or in user named files.

This file can be saved and restored by supervisor level users.

Backups of current calibrations are to be made before attempting to restore other calibrations.

Note: *This feature saves and restores the instrument calibration as well as the calibration configuration. By restoring, it will revert the analyzer calibration to the one stored in the backup.*

Note: *This feature can save all of the following options to internal memory located on the Main PCB.*

The custom option can only be saved to a suitable microSD card.

3.11.5.1 Save current calibration configuration

To save the current calibration configuration, perform the following steps:

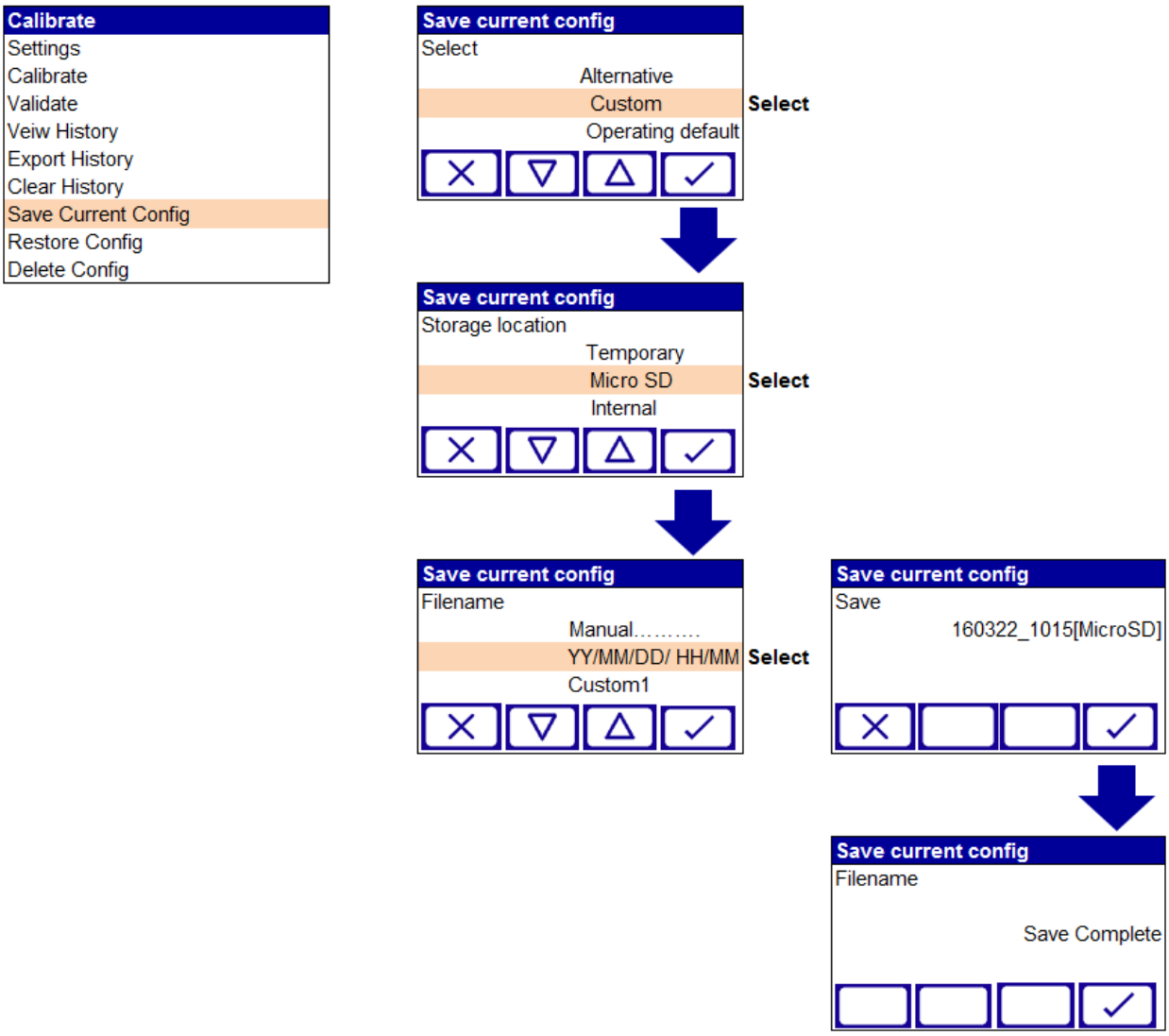


Figure 3-10: Save current calibration configuration

3.11.6 Restore calibration configuration

To restore a date and time stamped calibration backup from the microSD card.

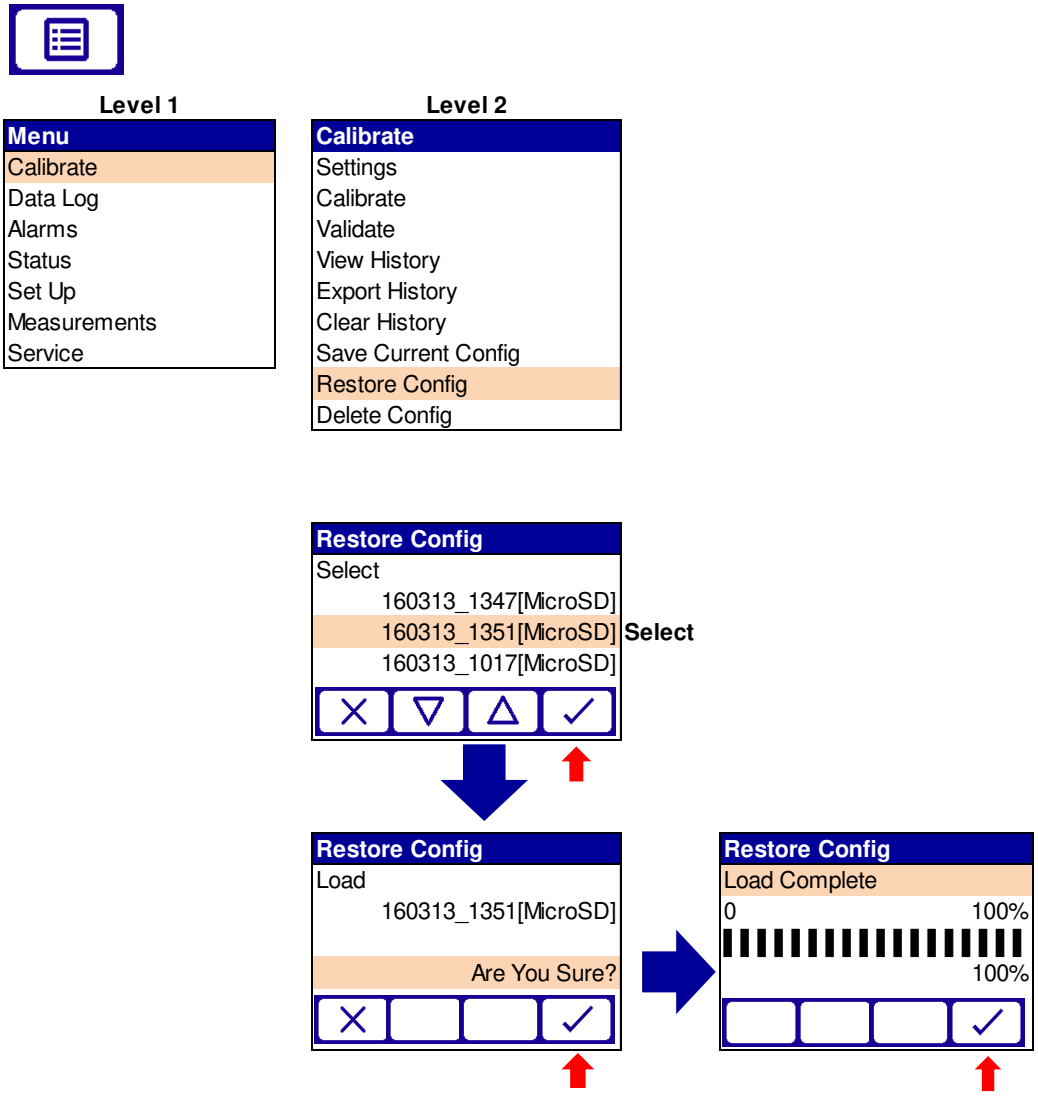


Figure 3-11: Restore configuration settings

3.11.7 Analyzer configuration (User settings) Saving/ loading

This information tells the unit “What product am I?”, “What facilities are enabled?” and also stores user settings (alarm levels, mA output config, Network etc.). It does not include the parameters of values related to the factory tuning of the analyzer hardware.

The Configuration can be managed through the “User setting” menu

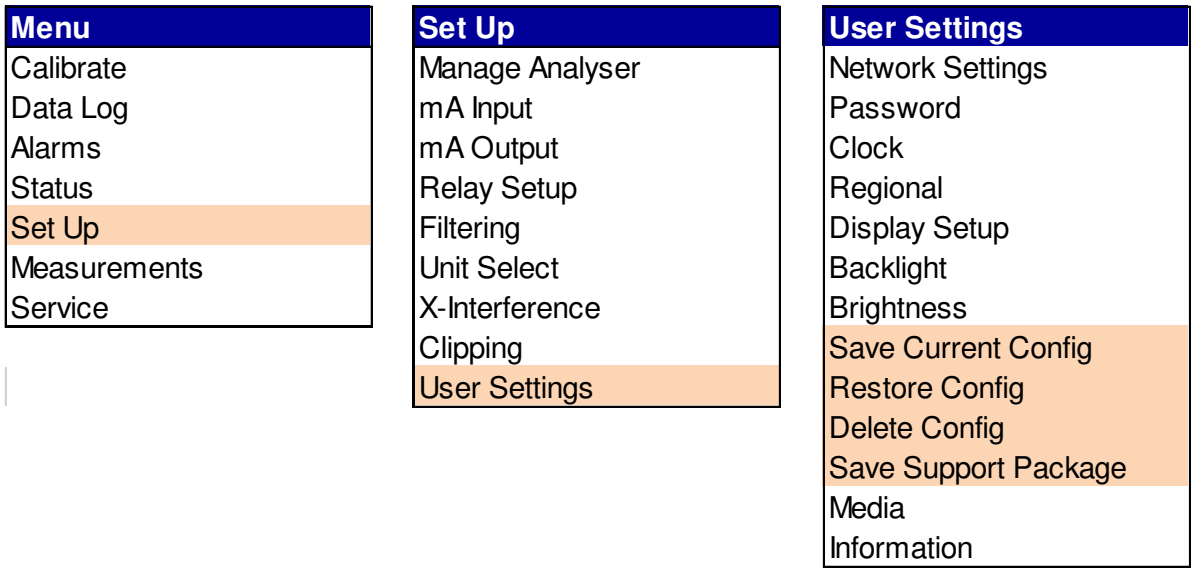


Figure 3-12: Save/ load Analyzer (non-sensor) configuration menu

Note: *This file can be saved / restored only to / from MicroSD card by Supervisor level user.*

Note: *It is advisable to leave a backup copy on an SD Card present in the Instrument.*

3.11.8 Support Package

A support package can be exported as a .zip file to the SD card (ref 5.3.1) which contains information to aid application optimization of diagnostics. The package contains:

- Alarm history
- Calibration history
- Data log (if enabled)
- Firmware version information
- A snapshot of measurement data values at time of export
- Origin file (information on analyzer the log was exported from)
- Status log
- Analyzer configuration parameters
- Transducer configuration parameters
- Graphical spectral data

The files are text or CSV files which can be copied from the SD card via a PC file explorer.

3.11.8.1 Saving a support package

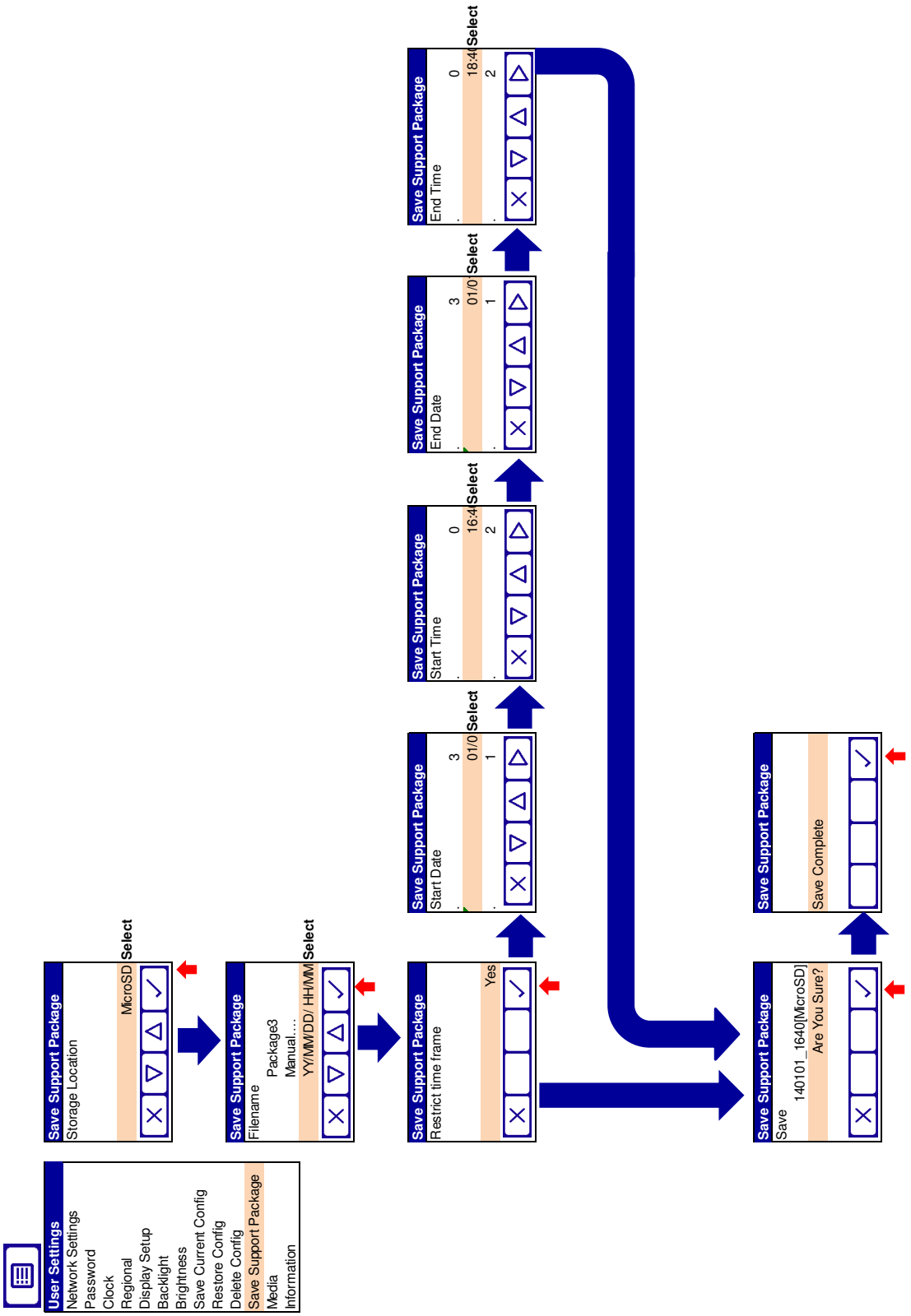


Figure 3-13: Save a support package

4. Configuration

4.1 User settings

4.1.1 Network settings

You must configure the network settings to suit the requirements of the network you have connected the analyzer to. Also see section 12 Appendix Modbus setup.

The values are Supervisor password protected. The analyzer supports IPv4 Mode and IPv6 Mode. See your network administrator to confirm which mode and the parameters to be entered.

To configure network settings

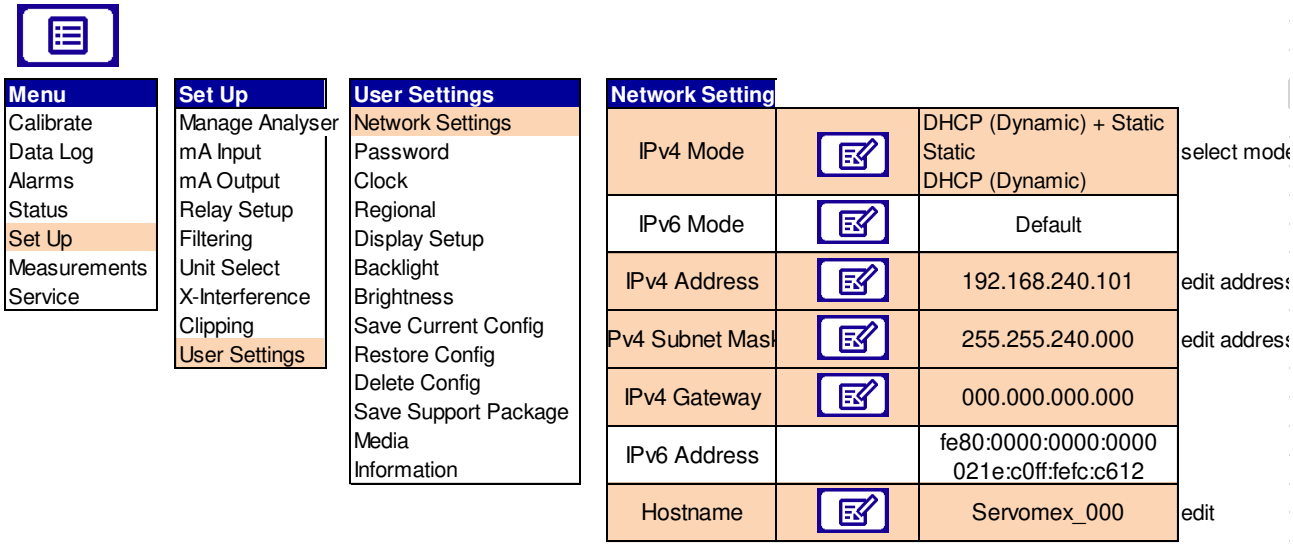


Figure 4-1: Network settings sequential menu

Note:*The IPv4 or IPv6 address must be set to a unique value in the network*

4.1.2 Set time and date

To set time and date

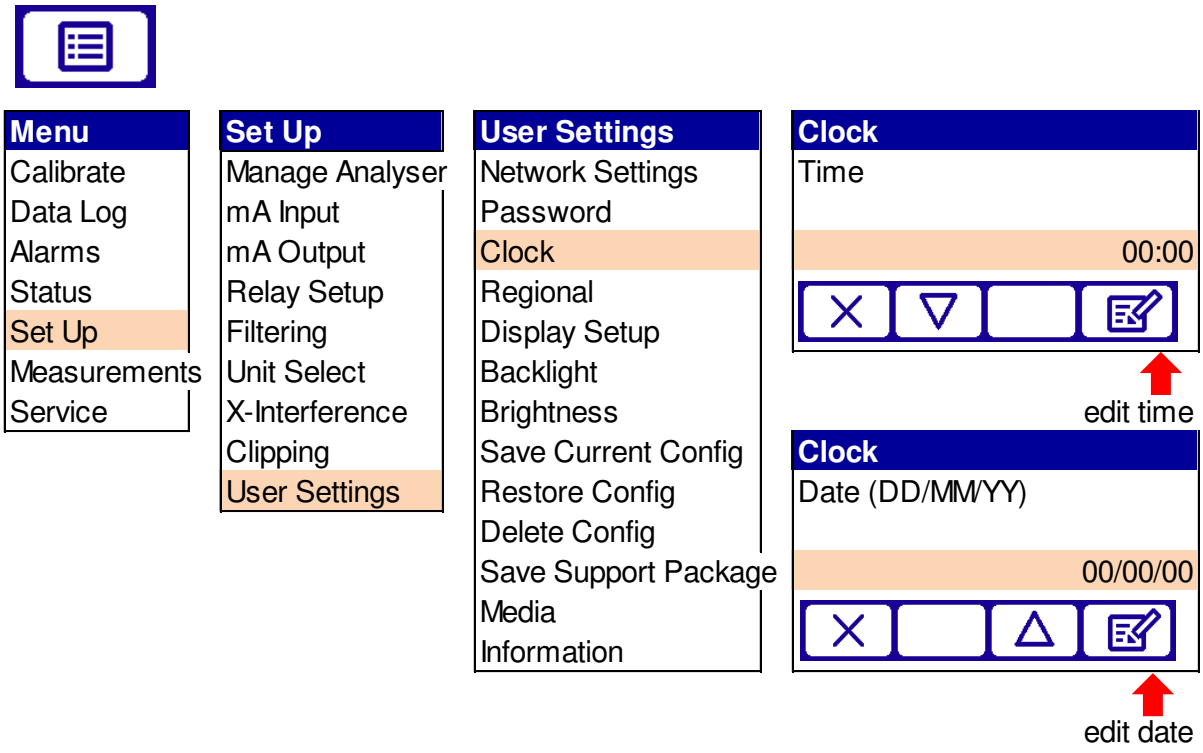


Figure 4-2: Set time and date menu

> ***Hint:*** *You can set the date format to dd/mm/yy or mm/dd/yy in the regional settings (section 4.1.3).*

Note: *After power outage, review system time and date to ensure consistency with your own system time.*

4.1.3 Regional settings

The regional settings enable the menu language, date format and measurement units to be changed.

To adjust regional settings

Menu
Calibrate
Data Log
Alarms
Status
Set Up
Measurements
Service

Set Up
Manage Analyser
mA Input
mA Output
Relay Setup
Filtering
Unit Select
X-Interference
Clipping
User Settings

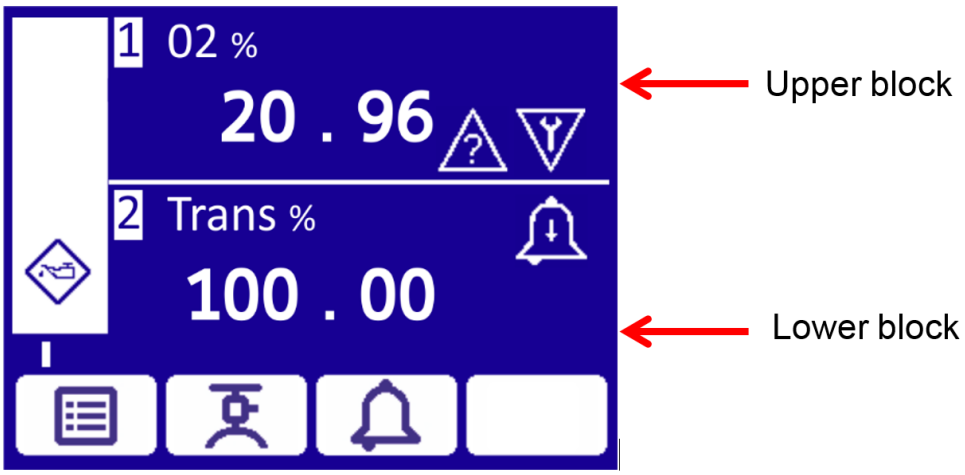
User Settings
Network Settings
Password
Clock
Regional
Display Setup
Backlight
Brightness
Save Current Config
Restore Config
Delete Config
Save Support Package
Media
Information

Regional				
Language		English Francais Deutsch		select language
Date Format		MM/DD/YY DD/MM/YY		select format
Decimal Format		, .		select format
Distance		cm m inches feet		select units
Pressure		mPa Pa kPa hpa MPa psi mm Hg ubar mbar bar		select units
Temperature		K °C °F		select units
Flow		l / hr m^3 / s ft^3 / s cm^3 / min ml / min ml / s l / s		select units
Current		A uA mA		select units
Voltage		V mV		select units
Resistance		Ohm kOhm		select units
Angle		Rad º		select units
Wavelength		nm		select units
Moisture		dew pt ºC ppm		select units

Figure 4-3: Regional settings sequential menu

4.1.4 Display set up

The live measurement screen is divided into 2 blocks, an upper block and a lower block. You can select which block will display a measurement reading.



To assign a measurement reading to upper and lower display blocks

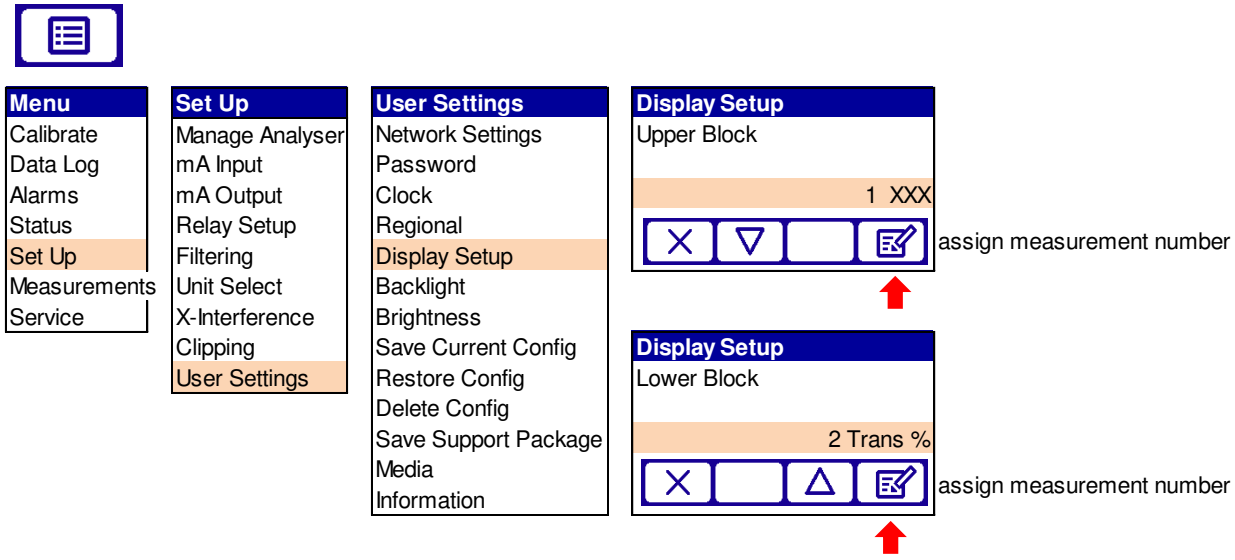


Figure 4-4: Upper and lower display block menu

Note: *There is facility to assign up to 5 measurements although only 2 may be displayed on screen at any one time.*

4.1.5 Adjust screen backlight timer

The screen is backlit. If you do not press a soft-key the backlight stays lit for the pre-set 'back light time' it will then switch off.

Note: *The timer is reset each time you press a soft-key, so the backlight remains on for the set time after the last soft-key press.*

To adjust screen backlight time

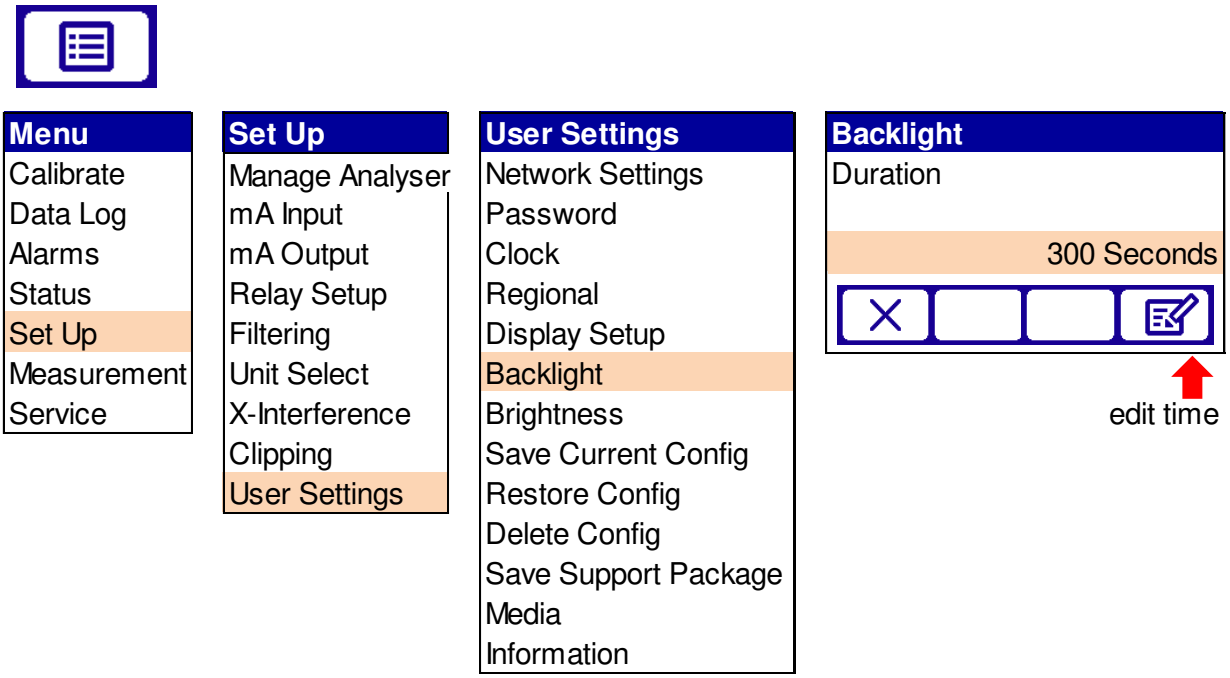


Figure 4-5: Screen backlight time menu

> ***Hint:*** *You can set the backlight duration from 0 to 999 seconds. If you want to leave the backlight permanently ON, set the backlight duration to 0 seconds.*

4.1.6 Adjust screen brightness

To adjust screen brightness

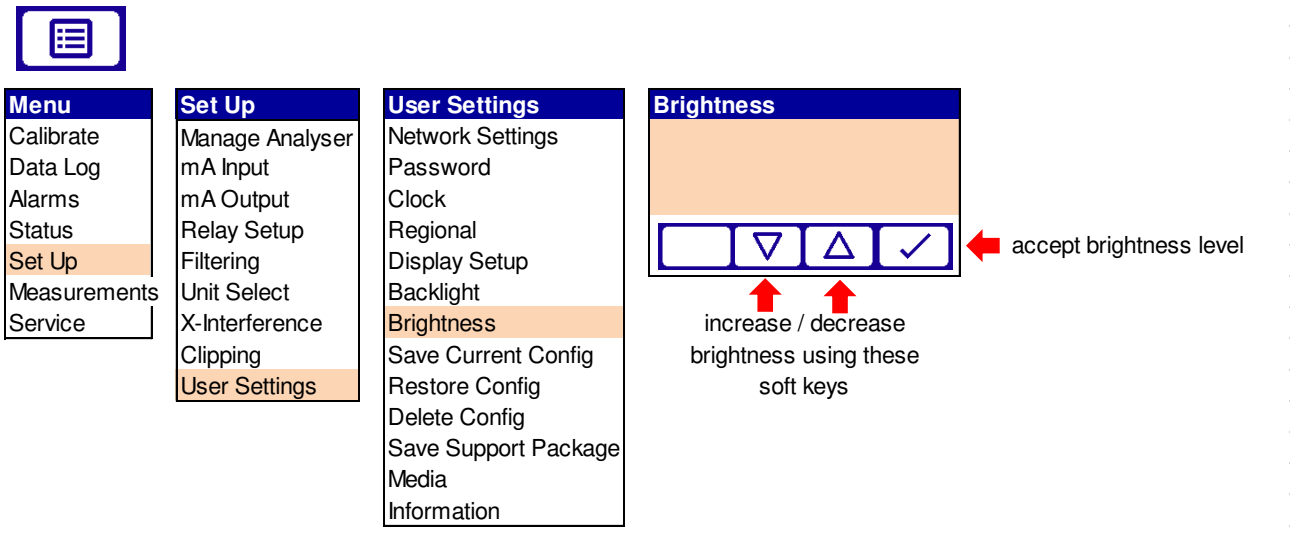


Figure 4-6: Screen brightness menu

Hint: *Press and hold the ▽ or △ soft-keys to quickly adjust the brightness settings.*

Note: *When you select the brightness setting the screen displays a non-editable alpha / numeric screen pattern.*

4.1.7 Media

The media page provides data on the SD card inserted in the analyzer.

4.1.8 Information

The information page provides key data for the analyzer:

- Instrument and transducer serial no.
- Transducer UID (unique identification)
- Control unit software
- Display adaptor software
- Analog output software

- Option board software (if fitted)
- Bootloader software
- Transmitter software
- Receiver software

4.2 Configure mA inputs

mA inputs are provided to allow the analyzer to make measurement corrections when there are external influences in the process such as sample gas temperature and pressure.

The analyzer can be supplied with an ‘Options PCB’ that provides two mA inputs for peripheral measurement devices.

The mA input provides a constantly updated input to the analyzer, in which the current represents the value being measured by the peripheral device.

4.2.1 To select either mA input 1 or 2

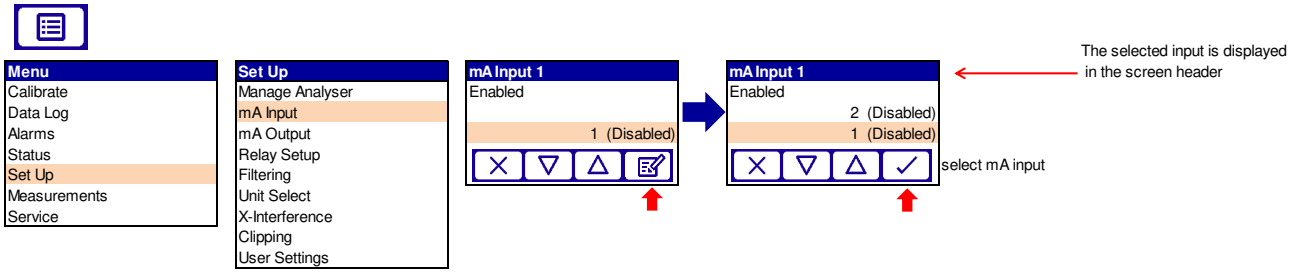


Figure 4-7: Select mA input

4.2.2 To enable or disable the selected mA input

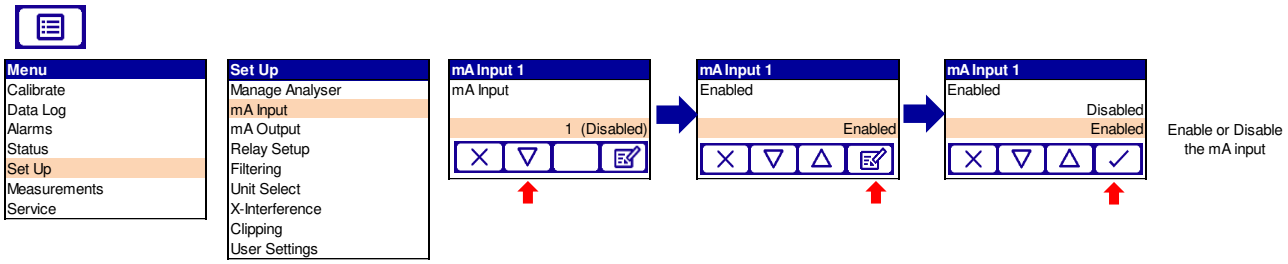


Figure 4-8: Enable or disable mA input

Once the mA input has been enabled it will need to be configured. The mA input parameters that must be set up are illustrated in Figure 4-9: mA input sequential menu.

4.2.3 To set the mA input parameters

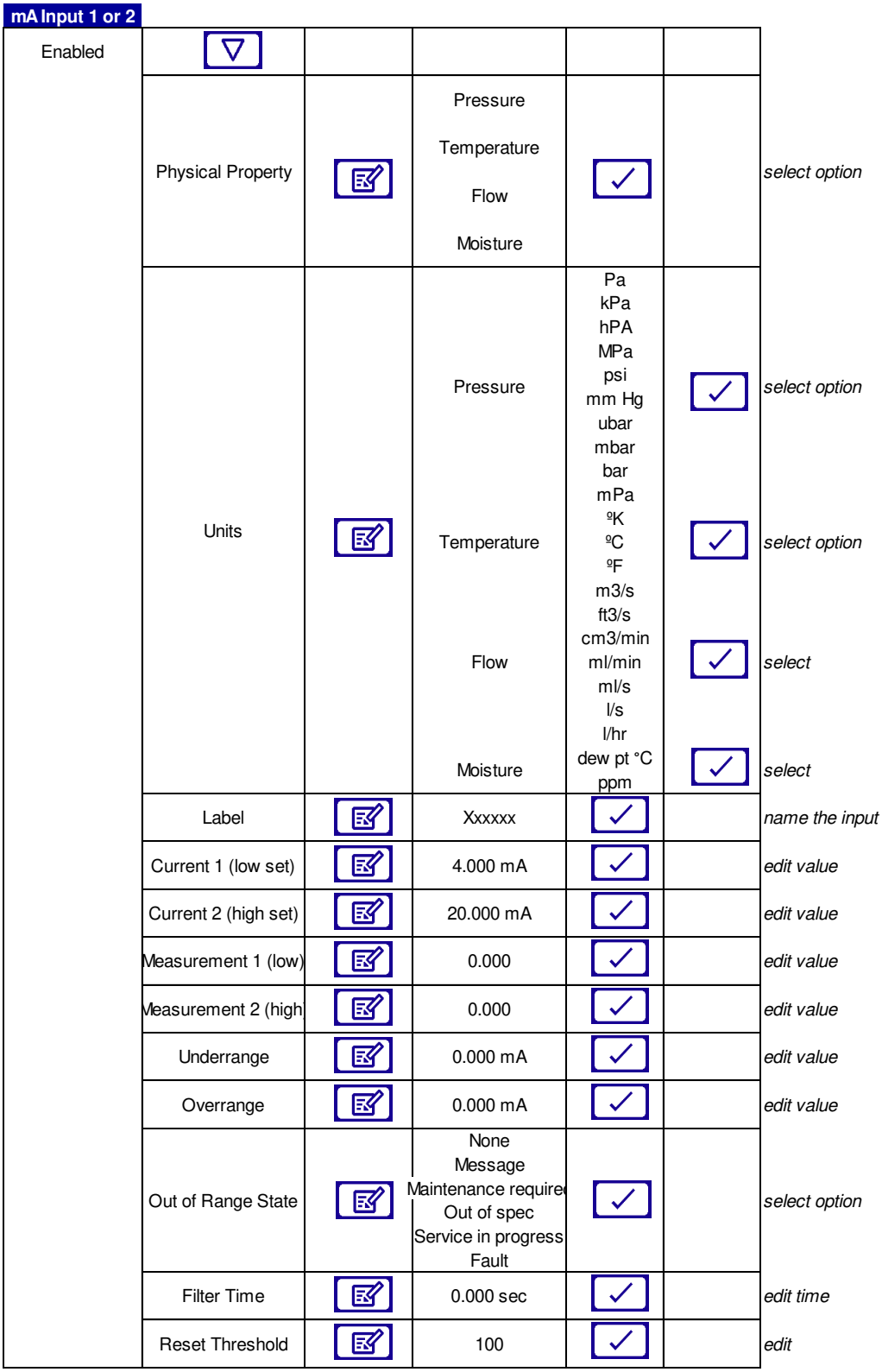


Figure 4-9: mA input sequential menu

4.2.4 Explanation summary of the mA Input parameter settings

Parameter	Function
Physical property	The option selected determines the mA input measurement type
Units	Assigns a measurement unit to the mA input. The options presented on the screen will be dependent on the physical property selected
Label	Assign an appropriate name to the mA input. For example: ‘Temp’ for temperature, ‘Press’ for pressure
Current 1 (low set)	This is the minimum measurement current for the connected mA input device. Typically 0 – 4 mA
Current 2 (high set)	This is the highest measurement current for the connected mA input device. Typically 20 mA
Measurement 1 (low)	Corresponding minimum measurement at Current 1 (low set) for the connected mA Input device
Measurement 2 (high)	Corresponding maximum measurement at Current 2 (high set) for the connected mA Input device
Under range	A tolerance value set below the current 1 (low set) value. It sets the lowest input current during normal operation
Over range	A tolerance value set above the current 2 (high set) value. It sets the highest input current during normal operation
Out of range state	This is the action you want the analyzer to take when the mA input values fall outside of the under range / over range values
Filter time	Filters the input over a given time period. This is used to ‘smooth-out’ the measurement values.
Reset threshold	Sets the threshold where you want the filter to ‘collapse’ and revert to a non-filtered state until the change in reading falls back below the reset threshold (currently selected units apply)

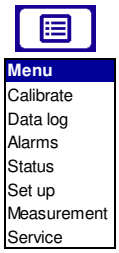
4.3 Settings Related to Process Conditions “Physical Set-up”

To provide an accurate measurement, process pressure, temperature and the length where the measured gas will occur should be known and correctly set into the analyzer.

Configuration includes setting the laser path length, process pressure and process temperature etc.

Note: *When the laser measurement signals have been optimized and the process environment set up has been completed Servomex recommend saving the configuration. See section 0*

The physical parameters that must be set up are illustrated in the following sequential menu table:



Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9	
Manage Current Config	Service Mode						
	Phase/Gain Settings						
	Measurement Signal						
	Physical Setup	Measurement Selection	Purge Compensation	✎	Enabled Disabled	✓	*select option*
			Proc:Path Length	✎	0.000	✓	*edit value*
			Proc:Pressure Source	✎	Transmitter Enclosure mA Input 1 or 2 User defined 0-4	✓	*select option*
			Proc:Pressure Source Offset or value	✎	Edit	✓	*edit value*
			Proc:Temperature Source	✎	Transmitter Enclosure Receiver Enclosure mA Input 1 or 2 User defined 0-4	✓	*select option*
			Proc:Temp. Offset Offset or value	✎	Edit	✓	*edit value*
	Detailed set up		***For Servomex trained Service operators only***				
Save Current Config							
Restore Config							
Delete Config							

Figure 4-10: Physical setup sequential menu

4.3.1 Pressure source selection

3 options are available for each segment

Option 1: External

External should be selected when the required pressure source is a mA input device.

Option 2: User defined 0-4

User defined fixed pressures can be entered and saved, to be used with stable process conditions.

Note:*User defined pressures should only be used when the pressure of the measured gas is constant and stable. Incorrect use will result in reported concentration errors if the purge gas or process gas pressure changes.*

Option 3: Transmitter enclosure

The analyzer is fitted with a pressure transducer mounted on the main process PCB inside the transmitter enclosure. The transducer will measure the pressure inside the enclosure. An offset can be applied to correct for differences in measurement gas pressure and the internal enclosure pressure.

Note*: The internal transmitter pressure sensor is factory calibrated. The offset is stored in the calibration certificate provided with the analyzer.*

Note*:If an environmental purge is fitted, the enclosure pressure may be higher than the atmospheric pressure, and an addition to the calculated offset should be applied.*

Note*: 0.01BarG difference between sample pressure and analyzer set pressure is equivalent to a 1% change in the analyzer reading (application dependent).*

4.3.2 Temp source selection

4 options are available for each segment

Option 1: External

External should be selected when the required temperature source is a mA input device.

Option 2: User defined 0-4

User defined fixed temperature can be entered and saved to be used with stable process conditions.

Note*:User defined temperatures should only be used when the temperature of the purge gas is constant. Changes in measured gas temperature will result in reported concentration errors.*

Option 3: Transmitter Enclosure

The transmitter enclosure is fitted with a thermistor mounted on the main process PCB. The thermistor will measure the temperature inside the enclosure.

Option 4: Receiver enclosure

The receiver enclosure is fitted with a thermistor mounted on the main process PCB. The thermistor will measure the temperature inside the enclosure.

An offset can be applied to correct for differences in measurement gas temperature and the internal enclosure temperature.

> ***Hint:*** *Under normal operating conditions the enclosure internal temperature is approximately 15 to 20°C above ambient.*

Note*: The internal temperature sensor is factory calibrated. The offset is stored in the calibration certificate provided with the analyzer.*

Note*:If an environmental purge is fitted, the value reported may be higher or lower than the ambient temperature dependent on the purge gas temperature, and an adjustment to the calculated offset should be applied.*

Note*: When the physical or user settings have been completed Servomex recommend saving the configuration. See section 0*

4.4 Configure mA outputs

4.4.1 mA outputs

There is 1 mA output provided on the standard analyzer configuration. An additional mA output is available if the analyzer is supplied with an ‘options PCB’. Supervisor level is required to configure mA output.

Each output can be assigned to one of 4 measurement properties (e.g. gas measurement 1 or gas measurement 2, or pressure or temperature [mA input]) or the transmission.

The mA output provides a constantly updated output, in which the current represents the value of the measurement.

The analyzer allows you to specify two separate range configurations for the mA outputs, range 1 and range 2.

The mA output can be selected as:

0 – 20 mA	0 mA represents the lowest sample measurement and 20 mA represents the highest sample measurement in the range specified
4 – 20 mA	4 mA represents the lowest sample measurement and 20 mA represents the highest sample measurement in the range specified

You can also specify how the mA output operates during calibration, a fault condition and under-range conditions.

Note: *For applications where the fault relay is not being used, configure the mA output to 4 -20 mA and jam low (default setting) for safety and to prevent any analyzer faults going undiagnosed. This is the safest mode of operation.*

The mA output parameters that you must set up are illustrated in the sequential menu table below:

mA Output

Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	
mA Output (1 or 2) Range Set up	Range	mA Output		1 2		*select option*
		Range		Auto Range 1 Range 2		*back to set up*
	Setup	mA Output		1 (Free) 2 (Free)		*select option*
		Measurement 1		1.- 2. Trans 3.- 4.-temperature 5.-pressure		*select option*
		Measurement 2				*extra measurement*
		Range 1 Low Level		0.000		*edit value*
		Range 1 High Level		0.000		*edit value*
		Range 2 Low Level		0.000		*edit value*
		Range 2 High Level		0.000		*edit value*
		During Calibration		Follow Freeze		*select option*
		Jam Condition		None High Low		*select option*
		mA Output Range		0-20 mA 4-20 mA		*select option*
		Underrange		4.000 mA		*edit value*
		Measurement	0.000			*view value*
		mA Output	0.000			*view value*

Figure 4-11: mA output sequential menu

4.4.1.1 To select either mA output 1 or 2

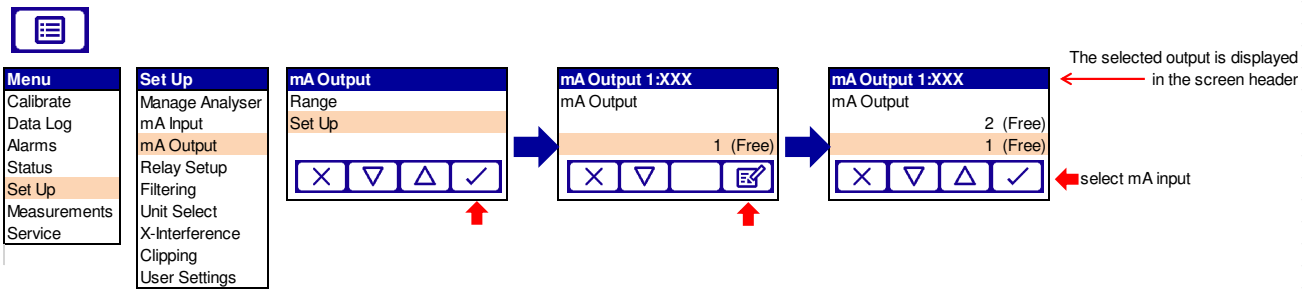


Figure 4-12: mA output selection menu

4.4.1.2 To select the range for either mA output 1 or 2

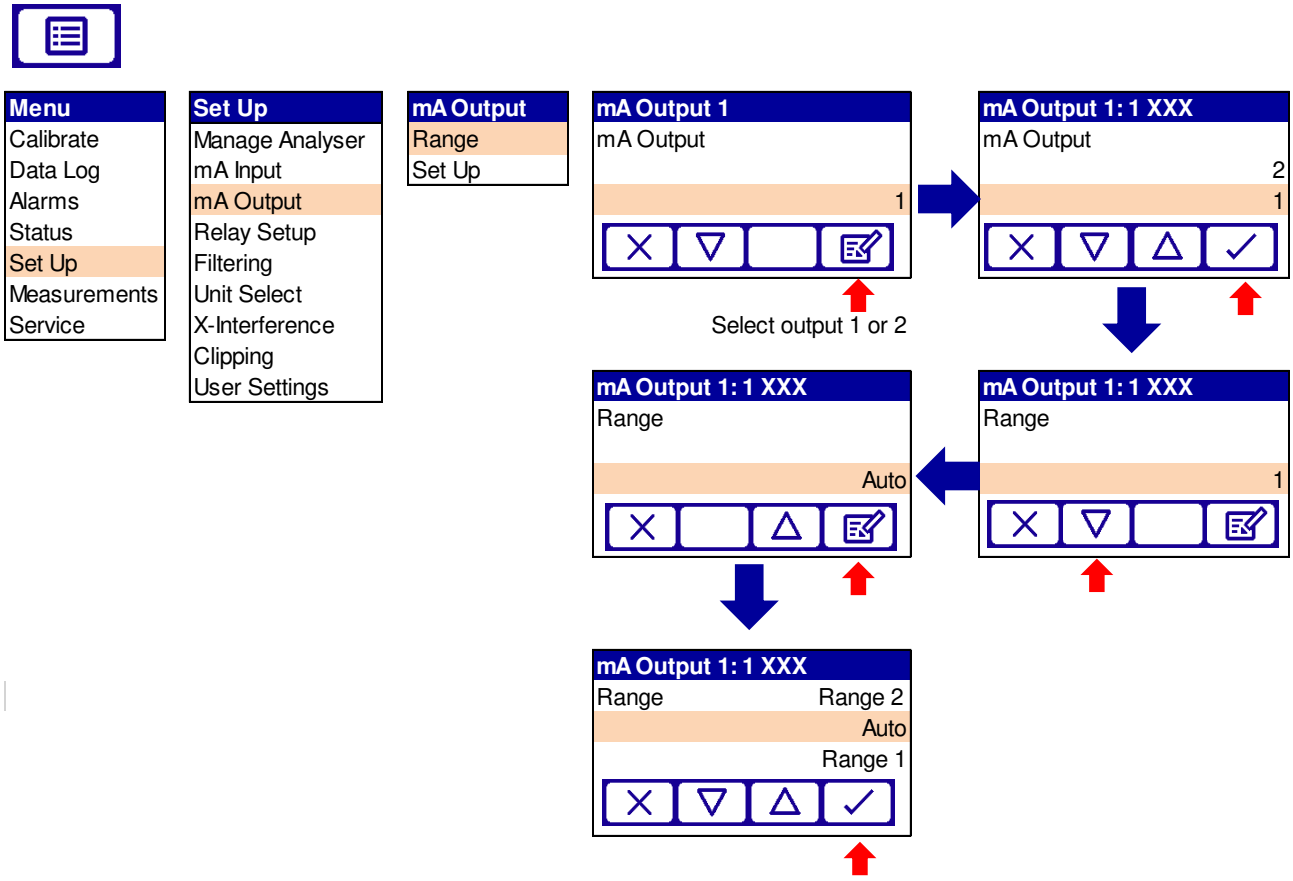


Figure 4-13: mA output range selection menu

***Note**: The option you select determines the mA output range associated with a measurement.*

Range	Function
Auto	The output automatically switches between range 1 and range 2 depending on sample measurements
Range 1	The output is set to use range 1
Range 2	The output is set to use range 2

***Note:** When more than one range is used, range 2 needs to be set to the higher range.*

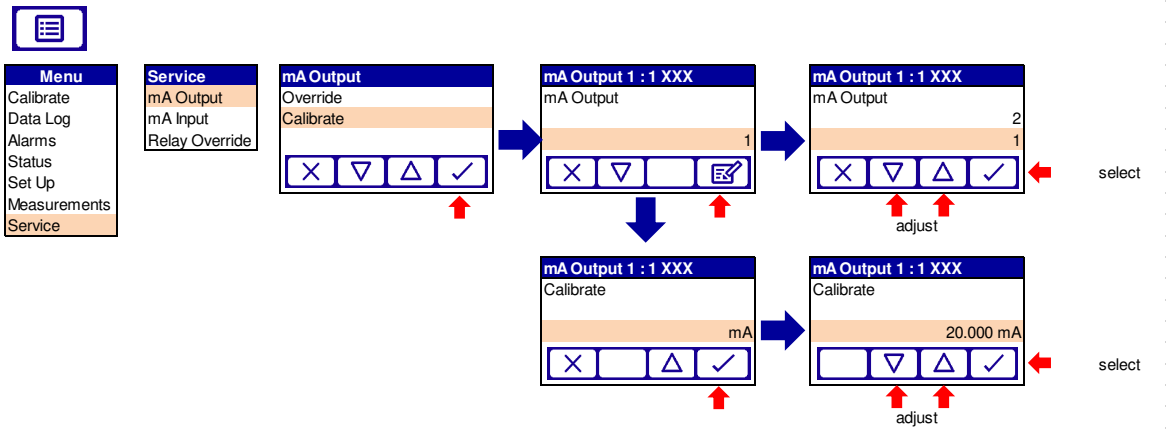
Once the mA Output channel and range has been selected the final configuration parameters will need to be set.

4.4.1.3 Explanation summary of the mA output parameter settings

Parameter	Function
Measurement	Selects 1 of 4 measurements properties to assign
Hot Measurement	Select the measurement to be reported above upper transition set point
Lower Transition	Lower set point temperature for a linear averaging transition switch between 2 measurement outputs
Upper Transition	Upper set point temperature for a linear averaging transition switch between 2 measurement outputs
Range 1 low level	Range 1 lowest sample measurement
Range 1 high level	Range 1 highest sample measurement
Range 2 low level	Range 2 lowest sample measurement
Range 2 high level	Range 2 highest sample measurement
During calibration	The option you select determines how the mA output operates during calibration Freeze the mA output freezes at its last output level as soon as the calibration screen is displayed The output only updates to reflect subsequent measurements when you exit the calibration screen Follow the mA output value, reflects the measurement value during calibration
mA Output range	0 – 20 mA 4 – 20 mA ***Default setting. Fail safe operation***
Under range	Any value below 4 mA This is only available if the 4 to 20 mA output range is selected. It sets the lowest output current during normal operation and allows negative gas concentrations to be monitored through the mA output For example, with an under range setting of 3.8 mA, the mA output can be less than 4 mA (indicating a zero-gas concentration), down to a minimum of 3.8 mA, where an output between 3.8 mA and 4 mA indicates a negative gas concentration
Range change poin	The range change-point This is only available when auto range is selected
Hysteresis	The range change hysteresis This is only available when auto range is selected

4.4.2 Calibrate the mA outputs

4.4.2.1 To calibrate the mA outputs



4.4.2.2 To override the mA outputs

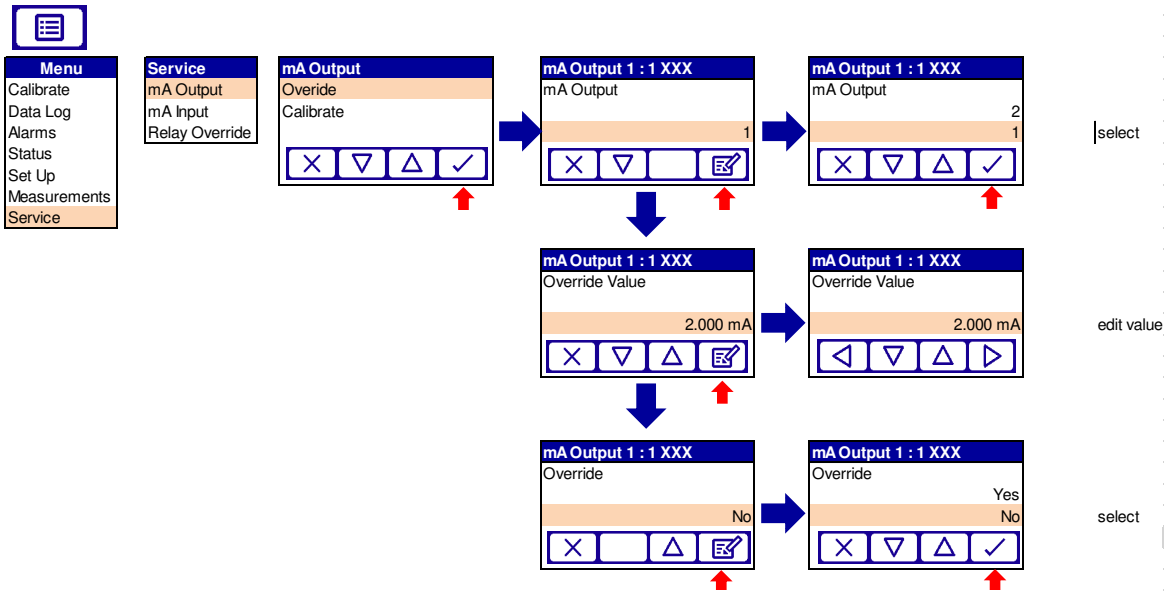


Figure 4-14: mA output calibration and override menu

Supervisor level is required to calibrate the mA outputs. Select the mA output to be calibrated, 1 or 2 and scroll down to calibrate screen. As soon as the mA output calibrate screen is shown, the nominal mA output value is set to 20 mA:

Use your control/monitoring equipment (connected to the analyzer) to report the actual output value.

Use the soft keys to increase or decrease the actual output value until your control / monitoring equipment indicates 20 mA output.

When the mA output has been correctly calibrated, press the soft key, the mA output service screen will then be displayed again.

Note: *The actual mA output value is controlled from the mA output calibrate screen as long as the screen is displayed. As soon as the mA service screen is no longer displayed, the mA output value will be updated to reflect the corresponding measurement unless the corresponding measurement as stated is jammed high or low.*

4.5 Configure measurement alarms

To view active measurement alarm status:

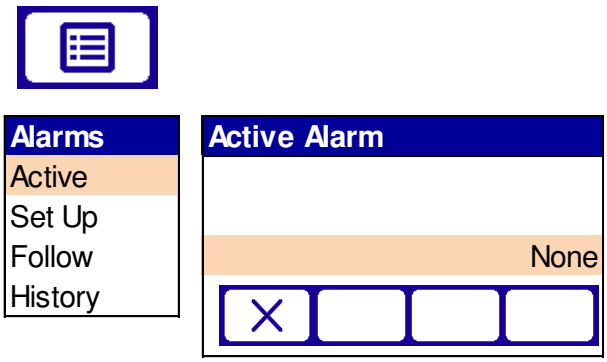


Figure 4-15: View active measurement alarm status menu

4.5.1 Alarm modes and levels

25 alarms are available to be allocated for the gas measurements or transmission.

You can configure each alarm to operate in one of three modes:

Alarm mode	Operation
None	An alarm is raised when a sample measurement is lower than the pre-set alarm level
Low alarm	An alarm is raised when a sample measurement is lower than the configured alarm level ***Note:*** *During calibration an alarm is only activated if you have set the alarm 'Follow' option to Yes*
High alarm	An alarm is raised when a sample measurement is higher than the pre-set alarm level ***Note:*** *An alarm is only activated during calibration if you have set the alarm 'Follow' option to Yes*

When an alarm is raised, the following things occur:

- An alarm icon is shown on the measurement screen. The number (1 or 2) in the icon identifies the alarm that has been triggered.
- The alarm LED on the front of the analyzer flashes on and off.
- If the alarm is assigned to a relay, the appropriate alarm relay is triggered.

4.5.2 Configure the measurement alarms

4.5.2.1 To select an alarm

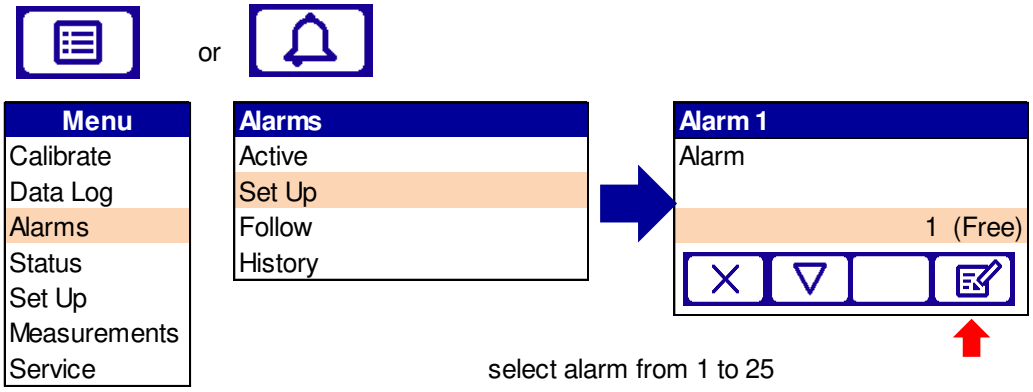


Figure 4-16: Select alarm menu

4.5.2.2 To assign alarm to a measurement

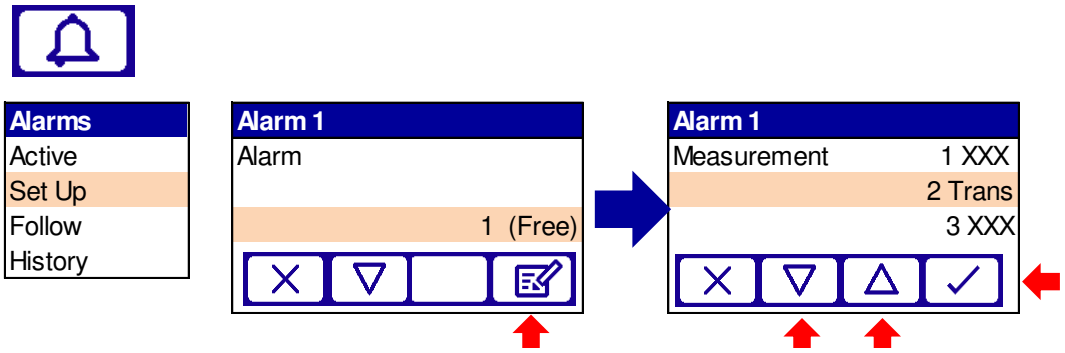


Figure 4-17: Assign alarm menu

4.5.2.3 To select alarm mode

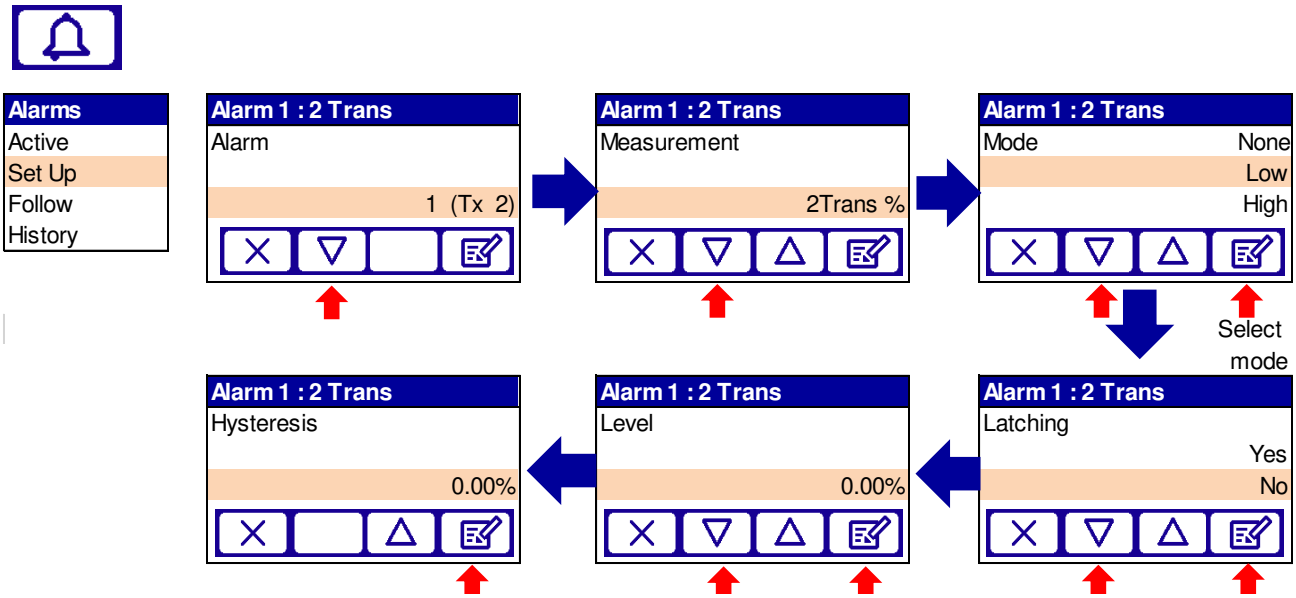


Figure 4-18: Select alarm mode menu

4.5.3 Latching and non-latching alarms

You can configure the two measurement alarms to be either latching or non-latching:

Alarm setting	Meaning
Latching	Once an alarm is raised, it remains activated until the alarm is manually unlatched
Non-Latching	Once an alarm is raised, it remains activated only until a subsequent 'good' sample measurement is made (i.e. one that would not trigger an alarm). The alarm condition is then reset

4.5.3.1 To select a latching mode

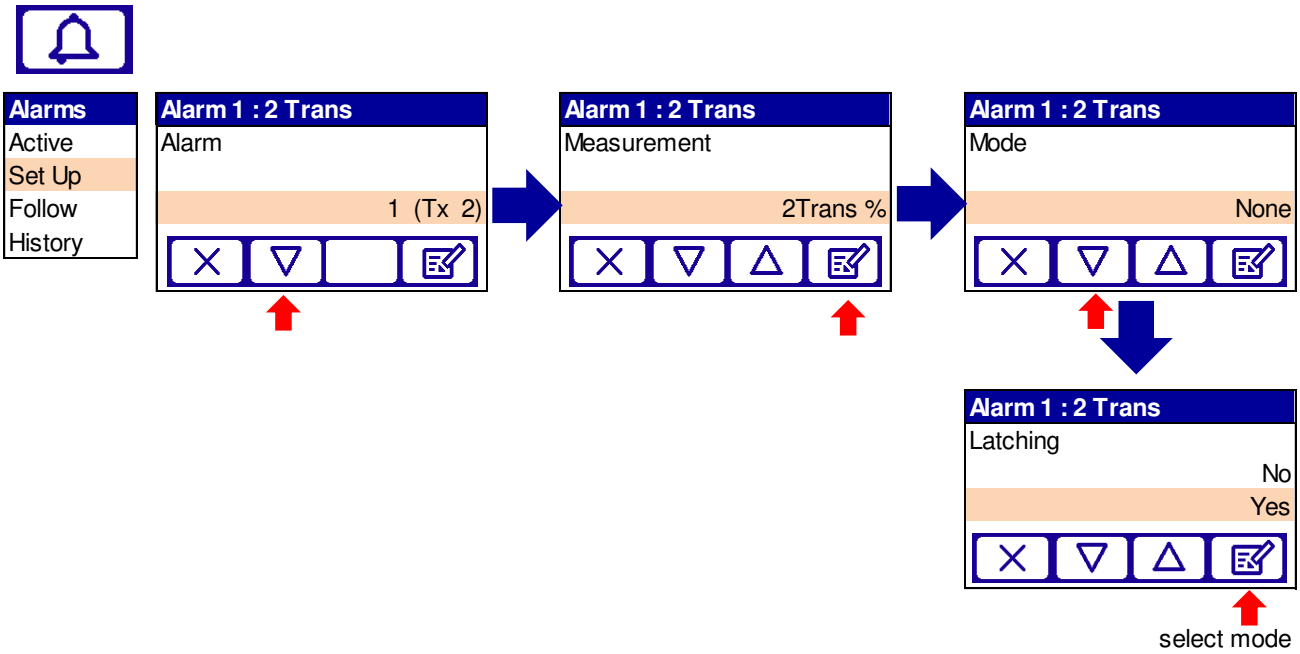
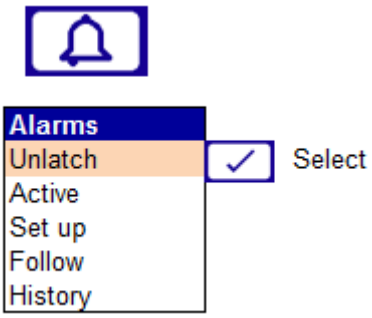


Figure 4-19: Select alarm latching mode menu

4.5.4 Unlatching



On selecting the currently latched alarms are unlatched

4.5.5 Hysteresis levels

The hysteresis level associated with a measurement alarm determines when an activated condition is deactivated. This depends on the alarm mode:

Alarm mode	Hysteresis effect
Low alarm	Once a low alarm condition is activated, the alarm condition is not deactivated until a sample measurement is above: Alarm level + hysteresis level
High alarm	Once a high alarm condition is activated, the alarm condition is not deactivated until a sample measurement is below: Alarm level - hysteresis level

***Example**: If a low alarm has an alarm level of 18% and a hysteresis level of 1%, the alarm is activated when a sample measurement is <18% and the alarm is not deactivated until a sample measurement is >19%.*

4.5.5.1 To set alarm level and hysteresis

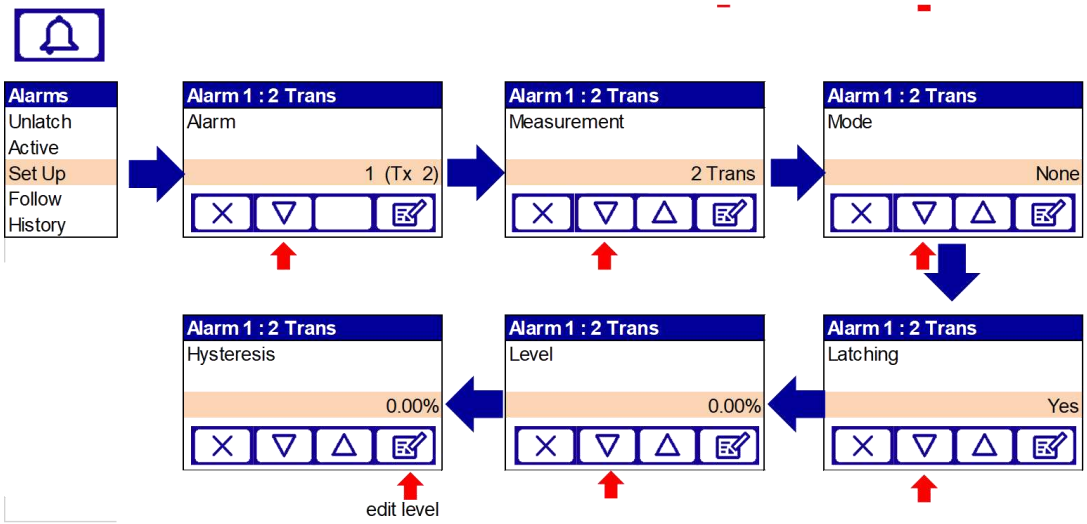


Figure 4-20: Set alarm level and hysteresis menu

Hint:	*If you configure one measurement alarm as low and the other as high, make sure that the high alarm and hysteresis levels are higher than the low alarm and hysteresis levels. If you do not, the analyzer can be permanently in an alarm condition until you correct the levels.*

Hint:	*Make sure that the measurement alarm and hysteresis levels are not too close to the expected sample measurements. If your sample gas concentrations contain minor variations that are acceptable, spurious alarms will be reduced.*

4.5.6 Follow option

Each measurement has a 'Follow' option:

If the 'Follow' option is set to 'No', the alarm will be inhibited during calibration.

If the 'Follow' option is set to 'Yes', the alarm will not be inhibited during calibration.

To set follow option

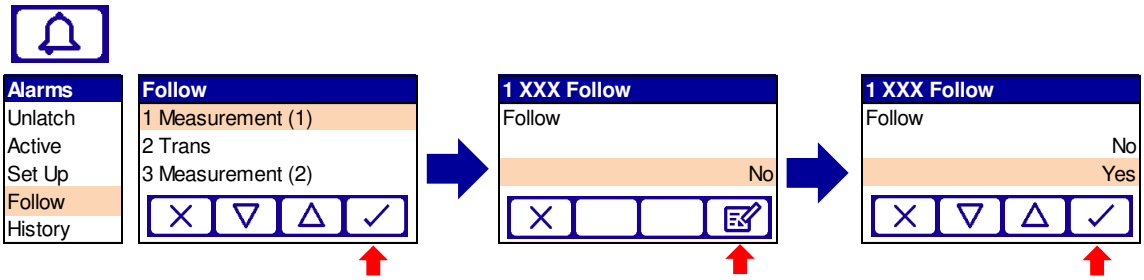


Figure 4-21: Set alarm follow menu

4.5.7 History (alarm)

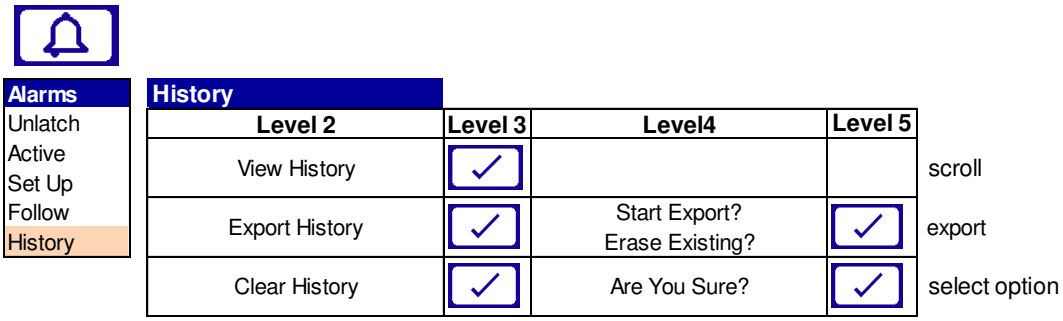


Figure 4-22: Alarm history menu

4.5.7.1 View history

The View history page enables the current log to be scrolled through to see each event in the alarm history.

Note: *In addition to configured alarms the alarm history also includes switch on event messages, showing dates and times for every instance of analyzer switch on.*

4.5.7.2 Export history

The current alarm history log will be exported to the selected log media.

4.5.7.3 Clear history

Clear history will clear the current alarm history log stored in the selected media.

Note: *You will be asked to confirm the action before clearing.*

4.6 Configure relay outputs

There is 1 relay provided on the standard analyzer configuration. 2 additional relays are available if the analyzer is supplied with an 'Options PCB'. Refer to section 2.2.1

4.6.1 To select relay 1, 2 or 3

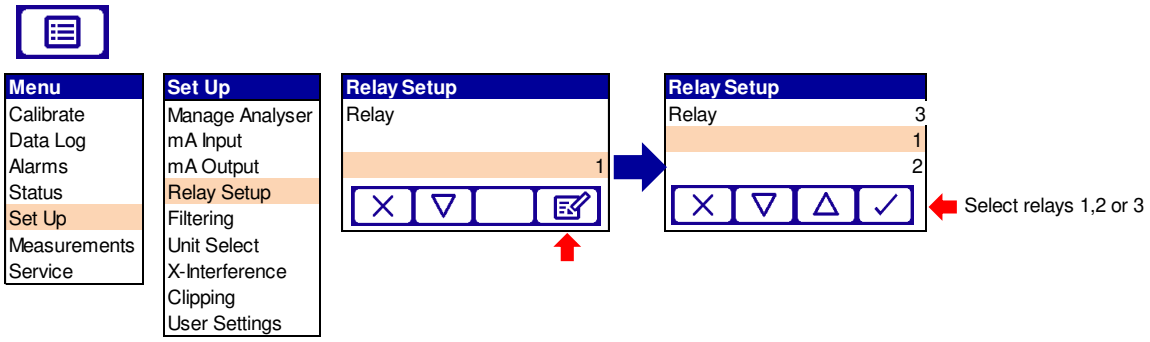


Figure 4-23: Relay output selection menu

Once the relay has been selected it will need to be configured.

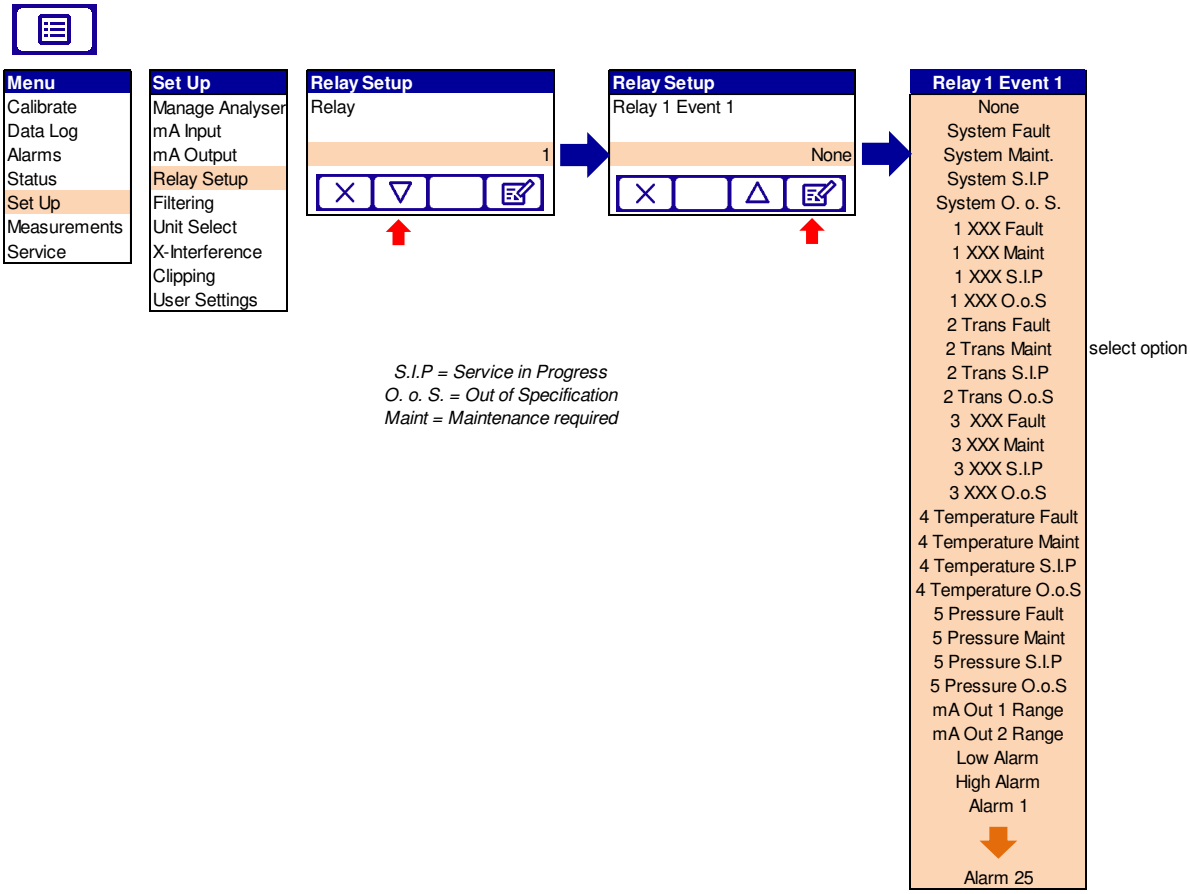


Figure 4-24: Relay output configuration menu

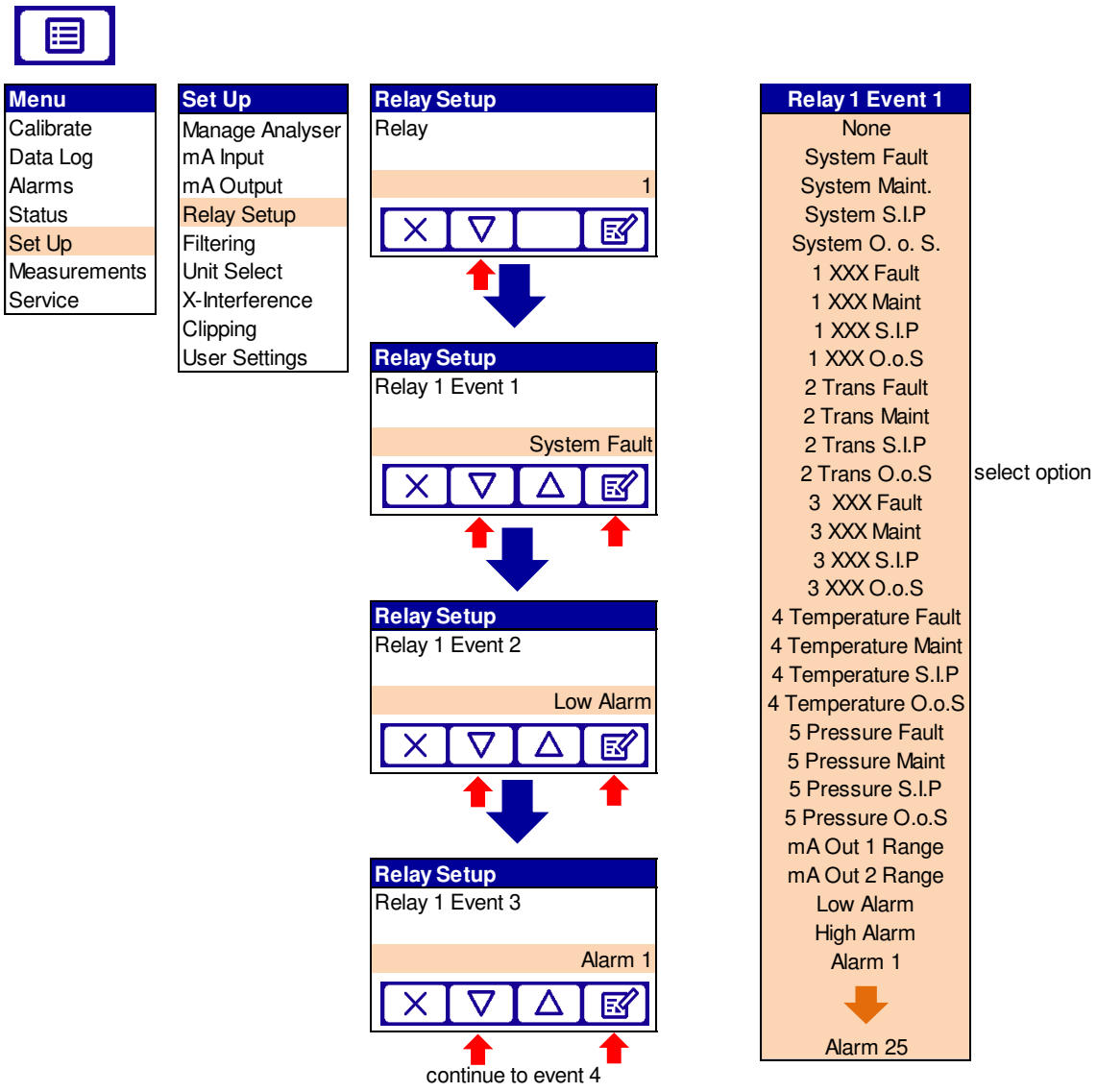
4.6.2 Relay event options

The relay event options that you can set are illustrated in the menu table below, also reference section 4.5

4.6.3 Explanation summary of the relay event options settings

Option	Meaning
None	None
System Fault	Generic – Non specific Analyzer in Fault
System Main	Generic – Non specific Analyzer requires maintenance
System S. I. P	Generic – Non specific Service in Progress
System O o S	Generic – Non specific System out of specification
1 TU 1 Fault	Measurement 1 – Fault specific to measurement 1
1 TU 1 S. I. P	Measurement 1 – Service in progress specific to measurement 1
1 TU 1 O o S	Measurement 1 – Measurement 1 out of specification
	Note: *There are up to 4 measurements available.* *1 TU to 4 TU.*
mA out 1 Range	Indicates which scaling range the Range 1 mA output uses
mA out 2 Range	Indicates which scaling range the Range 2 mA output uses
Low Alarm	1 or more Low Alarm thresholds have been exceeded
High Alarm	1 or more High Alarm thresholds have been exceeded
Alarm 1 to 25	User configurable alarms that can be assigned to a relay event

Repeat set up selection process for each of the 4 available events.



Note:*If you have more than 1 relay this process will need to be repeated for each.*

The analyzer can have up to four events. When the events have been assigned the relay coil state will need to be set.

4.6.4 To set the relay coil state

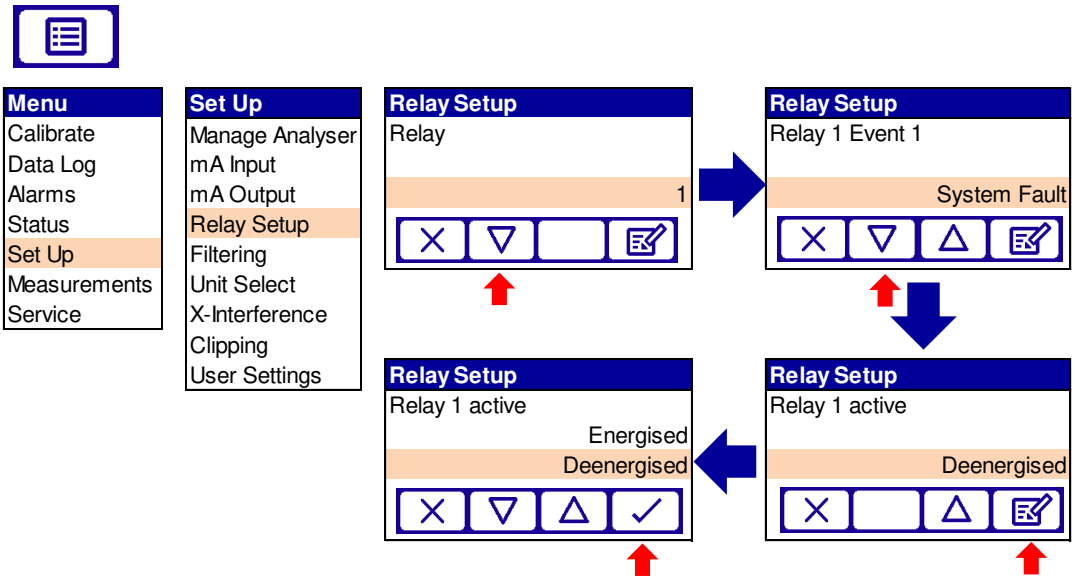


Figure 4-25: Relay coil state menu

Note: *You can specify the relay coil state (energized or de-energized) to meet any particular application requirement. For example, Relay 1 coil is de-energized during an active status when a measurement or analyzer fault is detected. Therefore, if the power to the analyzer fails, or the relay cable is disconnected, a fault is raised because this is electrically the same as if Relay 1 is de-energized. This is a 'fail-safe' situation. In some applications it is preferable that the relay is energized in an active status.*

4.7 Filtering

A rolling average filter can be applied up to 24 hours for measurements and transmission values.

4.7.1 To set filter times

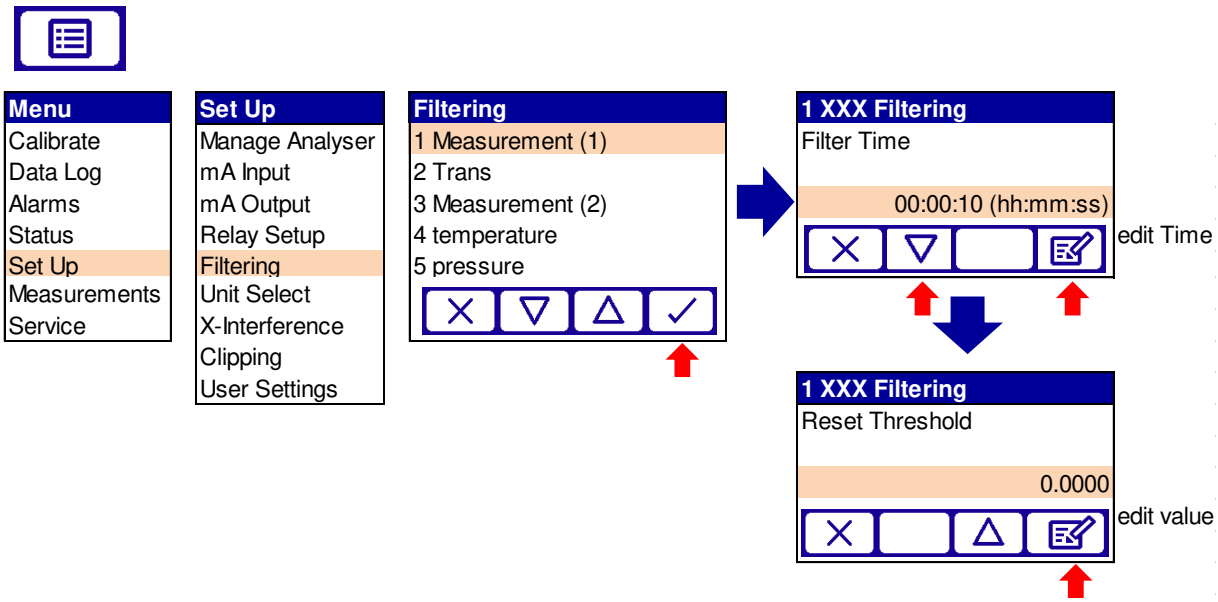


Figure 4-26: Filtering configuration menu

4.8 Unit select

You can change the measurement units shown on the display (and output). The following display units are supported:

Units	Meaning
%	volume %
ppt	parts per trillion
ppm	parts per million
vpm	volume parts per million
%	volume %
mg/m3	mg m-3 (milligrams per cubic meter)
mol/mol	mols per mol (or moles per mole)
% LEL	volume % of the Lower Explosive Limit

Note: *mg/m3 may differ from definition of mg/Nm3 (milligrams per Normal cubic meter) depending on local standards of normal temperature and pressure.*

4.8.1 To set measurement units

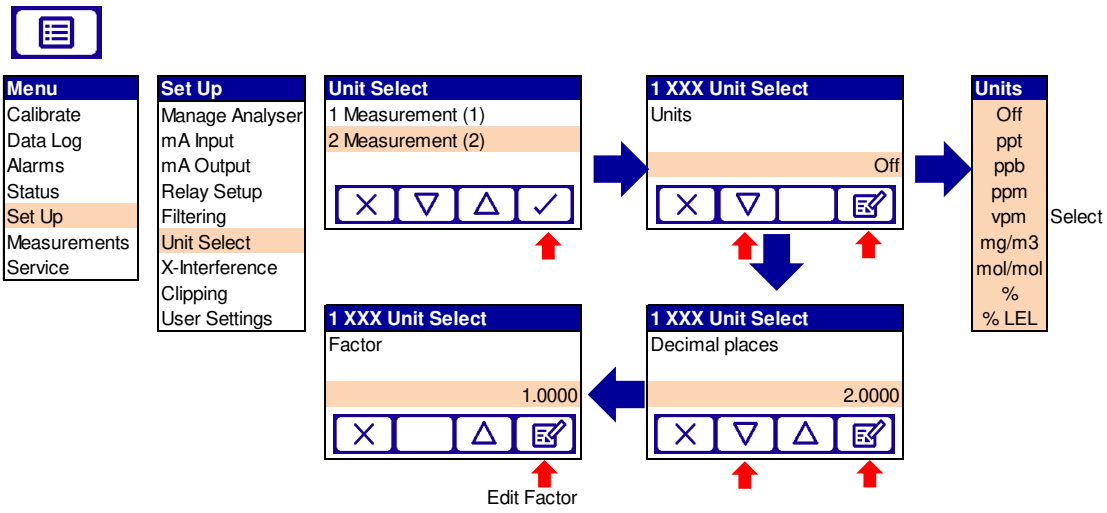


Figure 4-27: Set up units menu

Note: *Selecting the Units ONLY changes the displayed units, the correct "Factor" should be entered to convert the value to the correct figure.*

A list of conversion factors is listed in Section 0.

4.9 X-Interference offset

The X-Interference offset can be used to offset the measurement proportional to the concentration of an interfering background gas.

The offset can only be set to a maximum of +/-10 and should only be used for % level measurements. Care should be taken using this function of other units of measurement.

X-Interference offset should only be set after consultation with Servomex and only after an application review has been carried out.

.

4.9.1 To set the X-interference offset

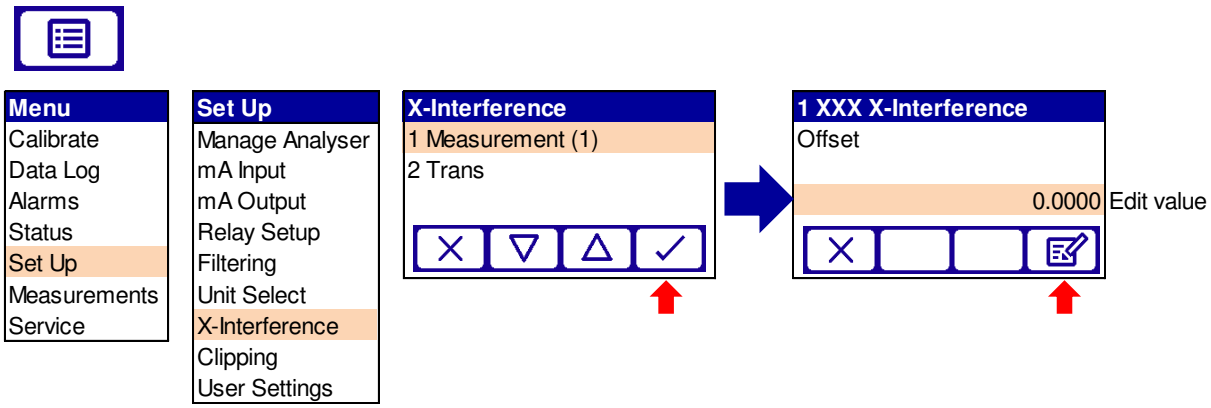


Figure 4-28: X - interference configuration menu

4.10 Clipping

When enabled, clipping is applied to all instances of a measurement, including displayed values, mA output values and values accessible through digital communications.

4.10.1 To set up clipping

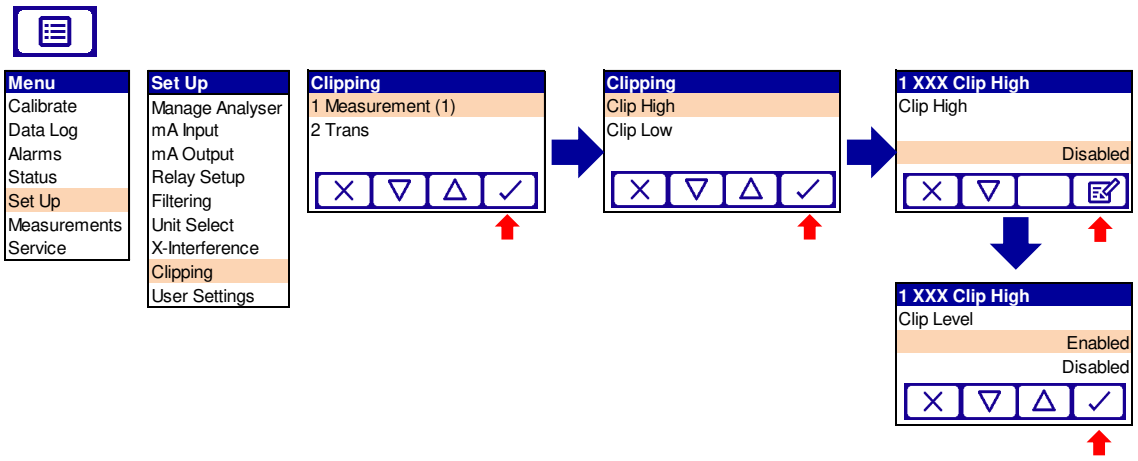


Figure 4-29: Set up Clipping menu

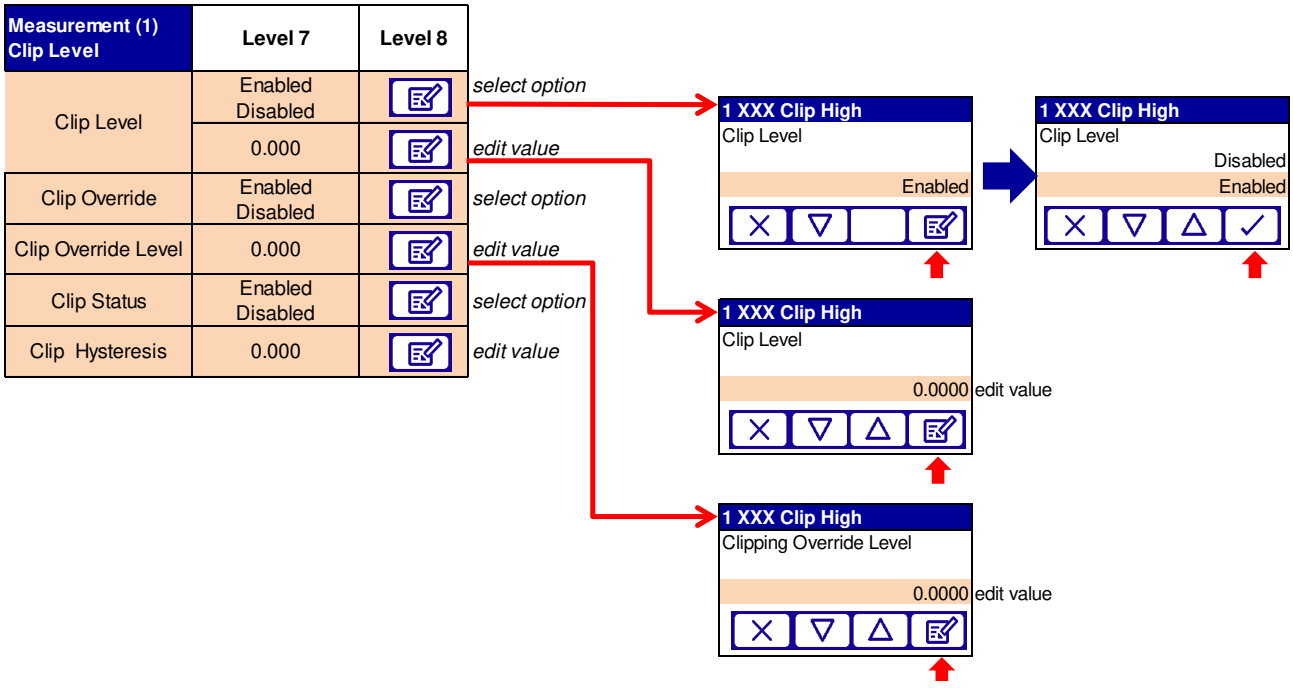


Figure 4-30: Clipping configuration menu

4.10.2 Clip level

Clip level is the threshold at which measurements are clipped, clipping levels should be entered in the same units as the measurement.

4.10.3 Clip override

It is possible for the user to specify levels, beyond which, the measurement shall cease to be clipped. The default levels are 0.

4.10.4 Clip status

When enabled the facility is provided to raise an “Operation Out of Specification” status condition whenever the measurement value exceeds an enabled clipping level. This status shall persist if a clipping override level is exceeded.

4.10.5 Clipping Status Hysteresis

The user is able to enter a hysteresis value, in measurement units. This value is applied to the clipping level such that the measurement must move out of the clipping region by more than the hysteresis amount before the status indication is cleared. The default hysteresis value is 0.

4.11 Gain and phase settings

DC Gains 1 and 2 enable the signal to be optimized for the specific application; in addition, the phase of the measurement signal and reference burst must also be optimized. The gain setting may need to be changed due to long pathlengths, dust, and beam divergence which can reduce the amount of laser energy reaching the receiver.

4.11.1 To view photodiode DC Level

The DC photodiode level tells the user how much laser energy is being received by the detector. Setting it to a specific level (by adjusting alignment and gain) can help improve measurement accuracy and ensure transmission is maintained to an acceptable level.

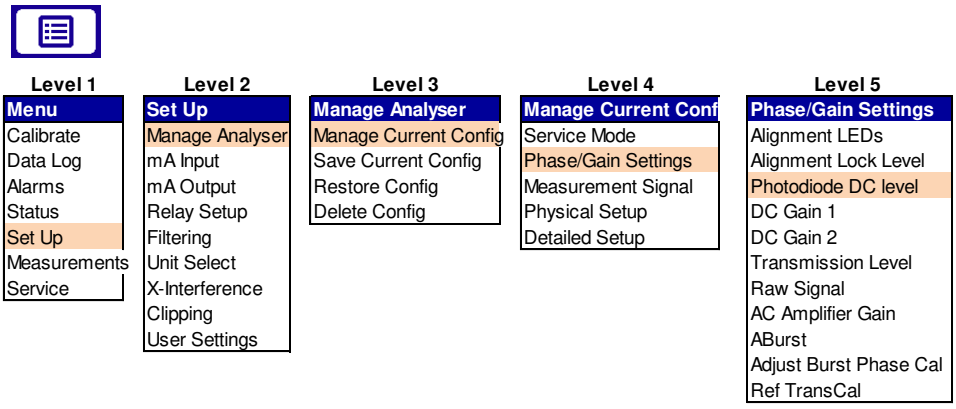


Figure 4-31: Gain and phase setting menu

DC Gain 1 and DC Gain 2 are typically set for each application and may need to be changed during commissioning to obtain optimum performance.

Note: *If the photodiode DC level is too high an error status will be raised and the analyzer will report incorrect readings.*

The photodiode DC level (DetSigV) must not exceed 3.5V DC.

In dusty processes, where the dust loads vary significantly, gain levels set when dust loads are either very high, or very low can cause zero detection (not enough laser energy) or saturation (too much laser energy) when dust levels revert to normal. Review the application and dust load variations and consult Servomex for advice on how to maximize operation of the analyzer in these situations.

Note: *Analyzer alignment is critical to obtaining a reliable measurement. Excessive gain levels used to compensate poor alignment can cause the measurement to become excessively noisy and reduce the LDL. See sections 7.3.1and 7.3.2.*

Note *You must use 'Adjust Burst Phase Cal' after changing the DC Gain. Do so with caution where process temperatures are above 900°C or gas concentrations in the process are high. See section 4.11.4.*

4.11.2 To adjust DC Gain 1 and Gain 2 settings

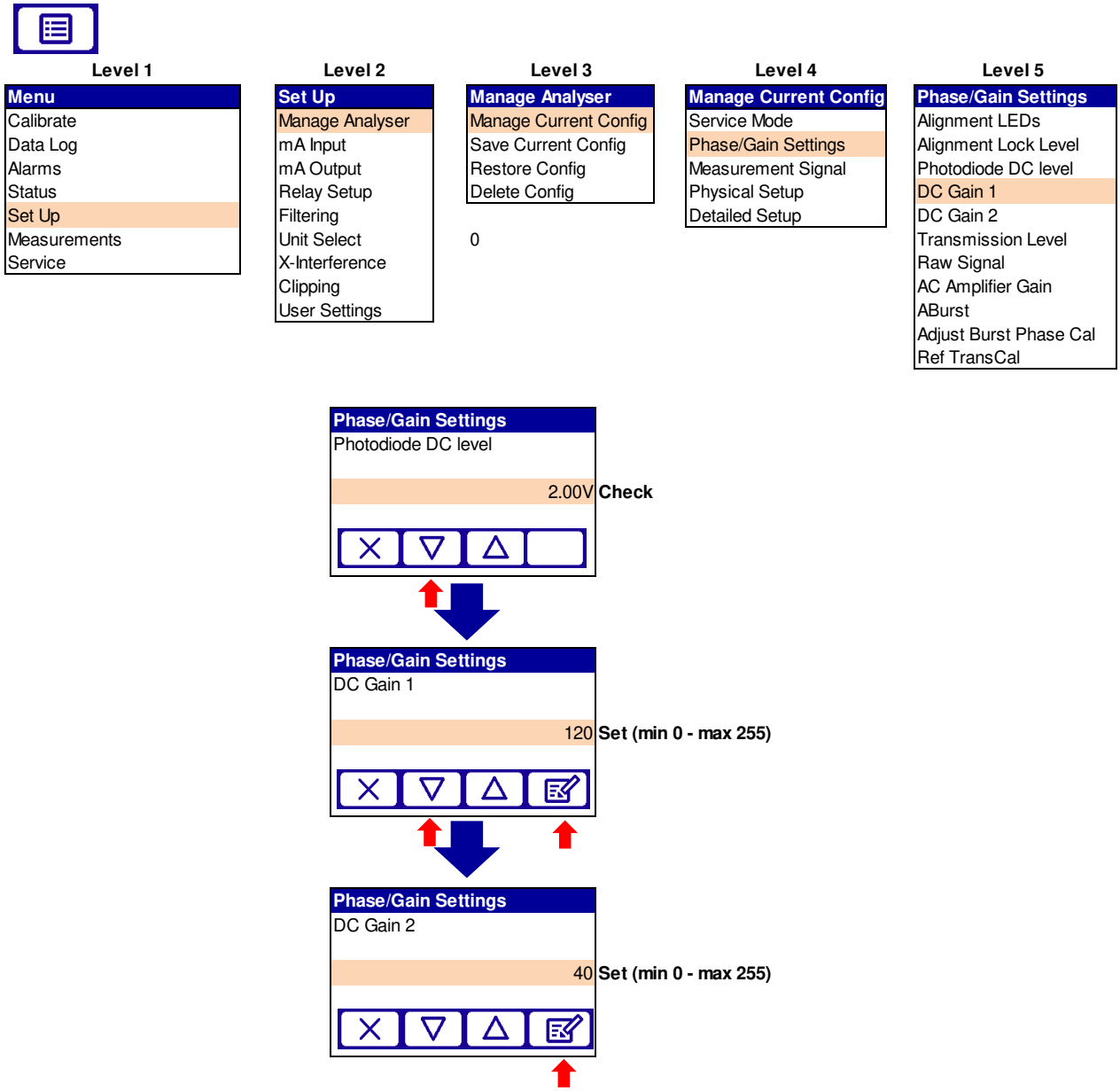


Figure 4-32: Adjust gain and phase menu

Note: *The target photodiode DC level will depend on the application and site characteristics. For example, dust levels and amount of beam divergence for long path length applications.*

The maximum DC gain level will depend on the gas measurement and pathlength. These limits are set as part of the measurement parameters.

Too high photodiode DC level will cause an XXXX error status and incorrect readings

4.11.3 Raw signal graph

To view the raw signal graph which shows the raw gas and ABurst signal and to check that both signals are not above 125,000 counts.

A raw signal above the limit will raise an error status and incorrect readings.

Excessive gas concentration for the path length used may result in unacceptably high raw gas signal.

Manage Current Config
Service Mode
Phase/Gain Settings
Measurement Signal
Physical Setup
Detailed Setup

Phase/Gain Settings	
Alignment LEDs	
Alignment Lock Level	
Photodiode DC Level	
DC Gain 1	
DC Gain 2	
Transmission Level	
Raw Signal	select
AC Amplifier Gain	
ABurst	
Adjust Burst Phase Cal	
Ref TransCal	

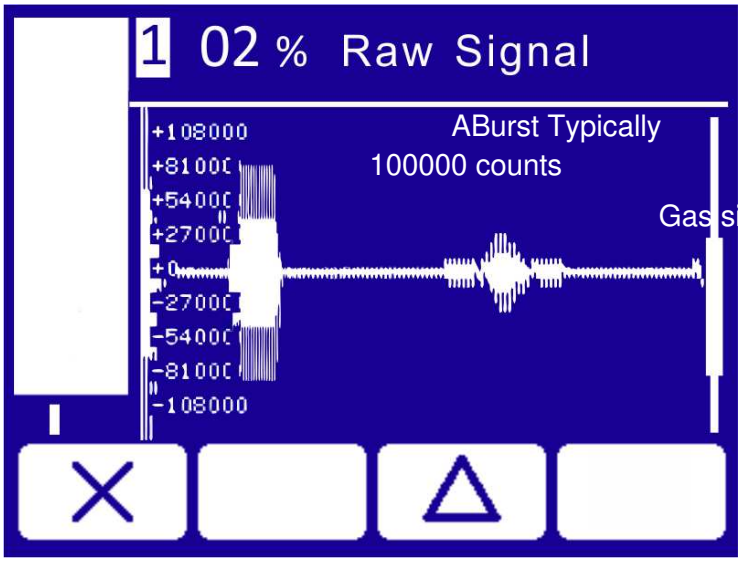


Figure 4-33: Raw signal graph example

When the gain adjustment and laser alignment have been optimized no further gain adjustments should be required.

4.11.4 Adjust burst phase cal

When the correct DC Voltage is achieved it is possible to synchronize the phase timing of the reference burst ref Figure 4-33 (ABurst) by selecting ‘Adjust Burst Phase Cal’. This is not to be confused with Adjust Gas Cal.

In case of actual process gas temperature above 900 °C after alignment of the transmitter and receiver with optimal photodiode DC level of 1-2V one should check raw CO signal between sample points 200 and 300.

If peak-to-peak signal amplitude exceed 40,000 – 80,000 at optimal detector signal voltage, one should avoid performing “Adjust Burst Phase Cal” as “hot” CO absorption lines appear around Aburst can distort Aburst signal, compromising optimal demodulation phase and as a result compromise CO+CH4 measurements without reporting fault.

“Adjust Burst Phase Cal” should only be done when CO is low and close to zero and CO raw signal is around zero.

In case of deviation in spectra from expected please save support package, describe installation and contact Servomex’s service to seek further advice on correct demodulation phase.

***Note**: Calibration may be compromised after using Adjust Burst Phase Cal.*

5. General analyzer information

5.1 Status

Allows you to view the current operational status of the analyzer (good operation, fault, maintenance, calibration etc.) with relative codes.

Each message status screen shows:

- Date and time of message
- The message type ("Fault", "Maintenance rqd", "Service in Progress", “Out of Spec” or “Information”)
- The message itself containing the Status code e.g. C17I00 WARMING

For the full list of status codes refer to the separately available Service Manual 07931002B.

Menu
Calibrate
Data Log
Alarms
Status
Set Up
Measurements
Service

Status				
Level 2	Level 3	Level4	Level 5	
Status	✓			*view*
View History	✓			*scroll*
Export History	✓	Start Export? Erase Existing?	✓	*export*
Clear History	✓	Are You Sure?	✓	*select option*

Figure 5-1: Status sequential menu

5.1.1 View history

The View history page enables the current log to be scrolled through to see each event in the history.

Each message shows:

- Date and time of message
- The message type ("Fault", "Maintenance rqd" "Service in Progress" or “Information”)
- The message itself
- The status of the entry "ON" or "OFF"

5.1.2 Export history

The current stored history log will be exported to the selected log media.

5.1.3 Clear history

Clear history will clear the current history log stored in the selected media. You will be asked to confirm the action before clearing. It is recommended to only clear the history when the log is full.

5.2 Measurement

Menu
Calibrate
Data Log
Alarms
Status
Set Up
Measurements
Service

Measurement				
Level 2	**Level 3**	**Level4**	**Level 5**	
Gas Sensor	✓	Measurement XX Transmission XX	✓	*scroll*
mA Input	✓			*scroll*
Control Unit Power	✓			*scroll*
Graphs	✓			*scroll*

Figure 5-2: Measurement menu

5.2.1 Gas sensor

Allows you to view the current status of the analyzer's gas sensor, measurements for any mA input devices and transmission level.

***Note**:Parameters cannot be changed only viewed*

5.2.2 mA input

Provides information on mA input devices:

- Measurement and units
- Calibrated current
- Filtered current
- Unfiltered current

5.2.3 Control unit power

Provides information on Input supply power and 12 V rail.

5.2.4 Graphs

Shows raw data and filtered graphs for each measurement.

5.3 Data Log

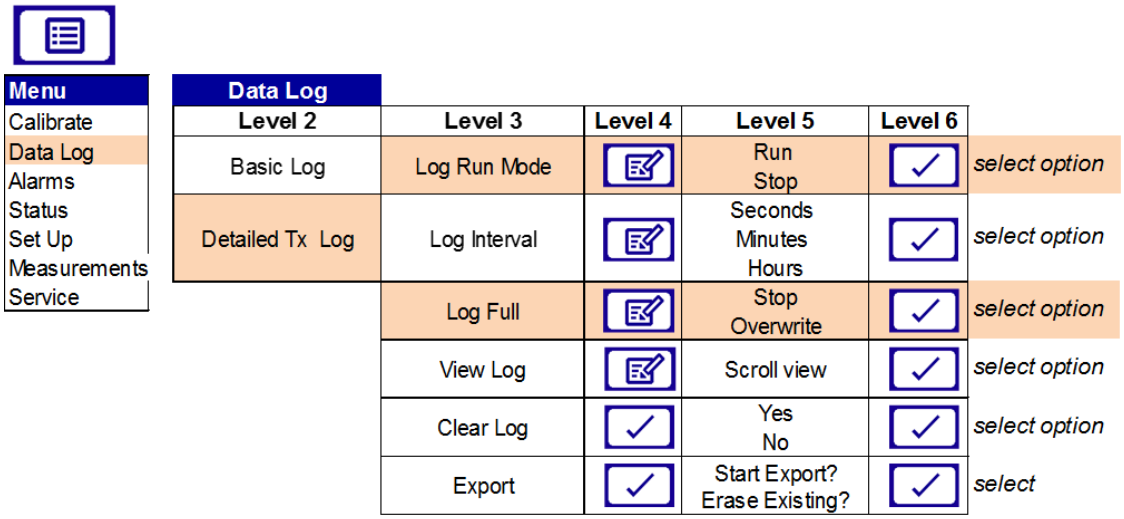


Figure 5-3: Data log sequential menu

5.3.1 Basic data log

The Basic data log function enables the measurement value and transmission value to be recorded and stored for future recall. The log can be exported to internal memory or SD card.

An exported data log contains, for each acquisition, the date/time, concentration, transmission, and if present, pressure and temperature as obtained from mA input.

Note: Please note, these values should be discarded if mA inputs are not enabled.

Note: *It is recommended that this file is saved over a period of 1 hour after first installation to monitor stability*

Basic Data Log internal file should be exported (see below) once the data logging action has been concluded. This will allow user to read this file in most available software such as Microsoft Excel etc.

Hint: *Values are separated by semicolons for ease of plotting and analysis.*

Hint: *Data log filename is 'datalog.txt' on microSD card*

Example Data log:

```
Servomex 07931B1/000051 ; O2 LT ; Trans ; Temperature ; Pressure

1.7 ; 24/04/15 ; 11:50:07 ; O2 LT ; 20.76 ; % ;  ;  ; Trans ; 101.08 ; % ;
;  ; Temperature ; 0.00 ; degC ;  ;  ; Pressure ; 0.00 ; bar ;  ;

1.8 ; 24/04/15 ; 11:50:08 ; O2 LT ; 20.76 ; % ;  ;  ; Trans ; 101.08 ; % ;
;  ; Temperature ; 0.00 ; degC ;  ;  ; Pressure ; 0.00 ; bar ;  ;

1.9 ; 24/04/15 ; 11:50:09 ; O2 LT ; 20.76 ; % ;  ;  ; Trans ; 101.08 ; % ;
;  ; Temperature ; 0.00 ; degC ;  ;  ; Pressure ; 0.00 ; bar ;  ;
```

5.3.2 Detailed data log

The Detailed data log function enables the transducer communications for a given time period to be recorded and stored. The log can be exported to internal memory or SD card and used to examine detailed transducer communications.

It contains information about all the derived quantities that contribute to the gas measurement (line width, amplitude, gas reference signal etc.) as well as the full spectra and all analyzer communications.

Note: *The detailed log is not enabled by default*

Note: *The detailed log is not interval based - it is real-time; therefore, data sets can get very large and therefore overwrite option is best*

Note: *If logging cannot start or continue due to a MicroSD card issue a Maintenance Required status, Data Logging error will be raised.*

5.3.3 Log run mode

The log can be set to run or stop. When in ‘run’, data is being logged by the unit. Operator password is required to change status.

Note: *When in “Run” mode it is not possible to view, clear, export or change the log media.*

5.3.4 Log intervals

The log interval sets the rate at which the data is logged.

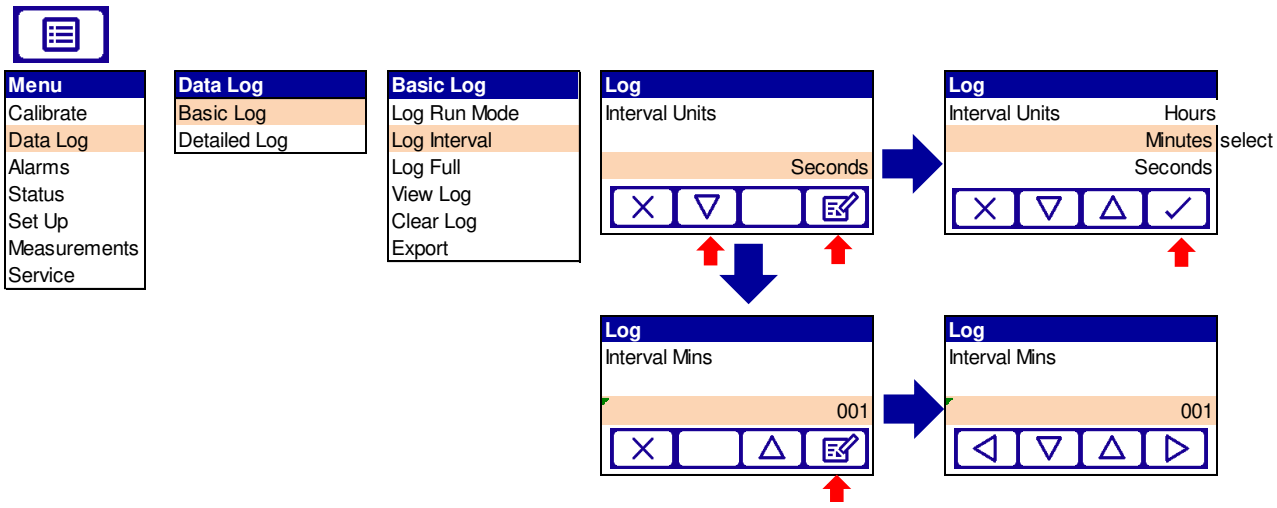


Figure 5-4: Adjust data log menu

5.3.5 Log full

When the internal log memory is full there are 2 options available:

Log full	Effect
Stop	The data in the log will be saved and no further data recorded
Overwrite	The data in the log will be progressively overwritten (oldest entry overwritten first) until the log is stopped

5.3.6 View log

The view log page enables the current log to be scrolled through so each data point can be viewed.

5.3.7 Clear log

Clear log will clear the current log stored in the selected media. You will be asked to confirm the action before clearing.

5.3.8 Log media

3 options available:

Log Media	Effect	Approx. Log time (1s interval)
SD Card	The data will be stored to the SD card 2GB if present	14 days
Internal RAM	The data will be stored to the internal RAM (Data will be lost in the event of a power down of the analyzer)	24 Hours
Internal NV	The data is stored to the non-volatile internal memory	2 minutes

Note: *If internal RAM is selected, data log is at risk and will be lost in the event of a power down of the analyzer.*

5.3.1 SD card

Only remove the transmitter enclosure cover to access the SD card if there is a negligible risk of pollution of the electronic circuits due to moisture, liquids, dirt, dust or other contamination.

Before you refit the covers, make sure that the sealing gaskets are clean, dry and undamaged. Replace and secure all covers as soon as possible after you complete your task within the enclosure.

When you use an SD card to transfer data logs from the analyzer, make sure that the transmitter enclosure cover is closed and secured, otherwise the EMC protection measures will be invalidated and the results recorded may not be valid.

When inserting or removing the SD card take care not to accidentally remove the metal card holder as, when open, the holder can slide backwards / out and be disconnected from the PCB. Before closing the enclosure ensure the holder is secure.

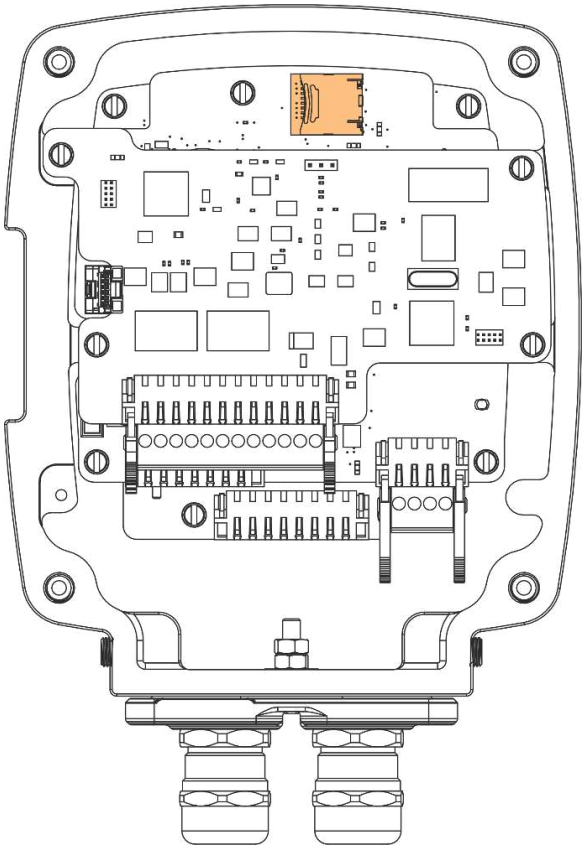


Figure 5-5: Micro SD connector

Note: *The Laser 3 Plus will support memory cards with capacity between 128Mb to 32Gb.*

Note: *The Analyzer software will use up to a maximum of 2Gb of storage memory for a single file. Large datalogs (> 200000 records) can take extended periods of time (> 10 minutes) to export to the micro SD Card The largest number of log records that can be stored on 2Gb SD Card is 775507 records taking approximately 30 minutes to export.*

Note: *MicroSD Card speeds do vary and can have a significant effect on export timings.*

Note:*Unformatted Micro SD cards are not supported by the analyzer. MicroSD cards should be formatted as* ***FAT32*** *format prior to insertion. If an unformatted card is inserted an error would be given only when a user attempt to use the card by turning logging on or saving settings.*

Note:*When inserting or removing the SD card take care not to remove the metal card holder as, when open, the holder can slide backwards and out. And be disconnected from the PCB.*

To open the cover, slide the latch to the left.

Insert the micro SD card into the slots in the cover.

Close the cover and push the latch to the right to secure it.

The SD card connector is used for:

- Data logging
- Software updates
- Settings (save / restore)

5.3.1.1 Export

The current log will be exported to the selected log media.

5.4 Saturation

There are three distinct types of saturation that can occur with the Laser 3 plus analyzer.

5.4.1 Photodiode DC level Saturation

This type of saturation is where too much laser energy gets to the detector. When the detector is saturated in this way, the measurement cannot be relied upon as the photodiode DC level can no longer respond accurately to increasing laser energy. In this situation, the analyzer will return an (X) on the display (E flag) and status history will show 'C29I00 SATURATION' and 'C35I00 STOPPED'. In order to avoid/stop this error appearing commissioning the analyzer should commence with lower DC1 or DC2 gains, and then consequently increase to reach recommended Photodiode DC level (below 1.5V for O2 and below 2V for NH3, CO, CO+CH4). Reference the note in section 4.11.1 regarding maximum photodiode DC levels.

5.4.2 Optical depth Saturation

Optical depth saturation occurs when there is too much absorbing gas which reduces the amount of laser energy reaching the photodiode at absorption line wavelengths to near zero. In this case, the sample becomes opaque at the absorption line wavelength and the analyzer will not respond to increasing amounts of absorbing gas and will instead report last correctly measured concentration with an (X) on the display (E flag) and status history will show 'C29I00 SATURATION' and 'C35I00 STOPPED'..

When an absorbing gas reaches a certain optical depth (defined in terms of %.m or ppm.m), the relationship between increasing concentration and increasing

absorption becomes non-linear. In this situation, further increases in absorbing gas concentration are not correctly interpreted by the analyzer – effectively causing it to under-read the real concentration. Further increases in gas concentration can lead to the reported concentration levelling off and then falling in extreme situations. When target gas concentrations rise to levels where optical depth saturation occur, the analyzer will report that it has entered a saturated state and the measurement will freeze at the last known good value. When the target gas concentration falls back below the saturation point (taking into account hysteresis effects), the analyzer will resume normal operation. Spectroscopic saturation events are recorded in the status log.

5.4.3 Raw signal saturation.

This type of saturation is when absorption is high (>125,000 counts) and the raw signal exceeds a certain level. When the analyzer is saturated in this way, the measurement cannot be relied upon as the raw signal and the analyzer can no longer respond accurately to increasing raw signal. In this situation, the analyzer will return an (X) on the display (E flag) and status history will show 'C29I00 SATURATION' and 'C35I00 STOPPED'.

Reduce DC1 and DC2 gains or check that actual concentration does not exceed specified range.

5.5 Drift

Although there is no mechanical drift mechanism within the Laser 3 Plus Analyzer, the TDL can experience a form of drift where the wavelength emission characteristic can vary very slowly over time. This drift can happen whether the TDL is powered or not such that an analyzer which has not been powered for a long period of time can drift outside of the permitted drift window and fail to lock onto the correct line (although the internal reference cell will ensure it will lock to an absorption line of some description).

In these circumstances, during commissioning the signal should be checked to ensure that the laser set point temperature is still correct for the required wavelength. Typically, this may be required for units that have lay idle for more than 6 months.

It is not recommended that customers modify the laser set point temperature as it can have a major impact on the measurement. Customers should contact Servomex if they believe there is an issue with this.

Note: *Locking to an incorrect absorption line can lead to inaccurate measurements as they may have different absorption amplitudes to that selected and tuned in the factory.*

6. Calibration

Item	Ref	Checked
1. Save the configuration settings	6.1	
2. Remove the transmitter and receiver units from the process	6.2	
3. Connect transmitter and receiver units to the calibration cell	6.3	
4. Reconfigure settings for offline calibration	6.4	
5. Save the calibration configuration settings	6.5	
6. Calibration settings	6.6	
7. Calibrate and verify correct concentration is displayed	6.7	
8. Saving calibration configuration	6.8	
9. Restore configuration settings	6.9	

Table 6-1: Calibration check list

The analyzer is factory calibrated using a certified gas mixture and is supplied with a calibration test report.

Servomex recommend that you verify the calibration of the instrument annually, using a certified test gas and the supplied calibration gas cell.

6.1 Save the configuration settings

Save all configuration data as described in sections below:

3.11.1 Measurement configuration

3.11.5 Measurement calibration configuration

3.11.7 Analyzer configuration (User settings) Saving/ loading

Note: *Save and store in a safe place with date and description so that the files can be used for future reference.*

6.2 Removing the transmitter and receiver units from the process

Before disconnecting the TU and RU from the process ensure there is no risk from exposure to potentially harmful gases.

Before disconnecting the TU and RU from the process ensure there is no risk from exposure to potentially harmful gases.

Before disconnecting the TU and RU from the process ensure there is no risk from exposure to potentially harmful gases.

Ensure the analyzer is powered off before disconnecting the TU and RU from the process.

Hint: *When physically un-coupling and removing the transmitter and receiver units care should be taken to avoid disturbing, and potentially misaligning, the balljoint flange.*

Note: *The calibration cell is supplied with a TU / RU connection cable fitted with terminal connectors. Therefore, when the TU / RU units are unplugged and un-coupled from the process, the connectors, cables and gland plates can remain with the process while the analyzer is being calibrated. Cover / protect, gland plate, connectors and cables during this time.*

Laser Disconnection Checklist
Remove purge connections from TU and RU (if required) Note that process window purge should be maintained
Loosen gland plates
Open covers of TU and RU, unclip electrical connectors and remove from enclosure
Remove gland plates and cabling
Dismount TU and RU by loosening the 3 mounting bolts
Place cap cover on TU and RU
Mount blanking plates on mounting / alignment assembly
Move to calibration area

6.3 Connecting transmitter and receiver units to the calibration cell

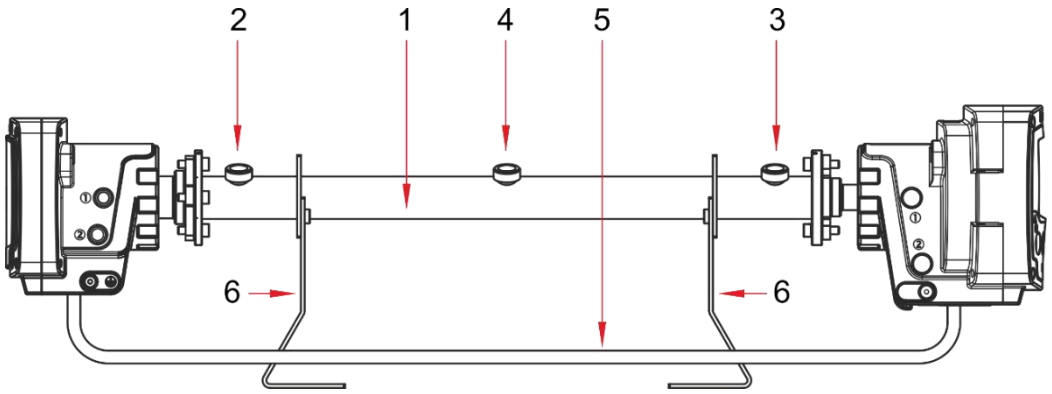


Figure 6-1: Offline calibration view

Ident.	Description
1	Calibration cell
2	Calibration gas IN
3	Calibration gas OUT
4	Pressure port (sensor)
5	Cable
6	Supporting brackets

Before fitting the analyzer to the calibration cell, check the windows are clear of process residuals. If required, clean the windows.

Only use a soft, clean cloth moistened with water to wipe clean the outside of the enclosure.

Optical glass window must be cleaned (only if necessary) with isopropanol only.

Electrically connect the transmitter and receiver using the cable and cable glands supplied with the calibration cell kit.

Ensure the cables and pipes connected to the analyzer and calibration cell are routed so that they do not present a trip hazard.

The pressure in the calibration cell must not exceed 1.5 bar absolute.

Before using the calibration cell, ensure all connections are leak free at operating pressure.

Calibration gases are potentially harmful ensure adequate ventilation is provided.

Purging gases are potentially harmful ensure adequate ventilation is provided.

Before disconnecting the TU and RU from the calibration cell ensure there is no risk from exposure to potentially harmful gases.

Ensure the laser beam is switched off before disconnecting the TU and RU from the calibration cell.

Note: *We recommend that you use an* ***absolute pressure sensor*** *to measure the gas pressure in the cell to provide the instrument with correct gas pressure during the verification and calibration procedure. If a pressure sensor is not fitted to the calibration cell, then a suitable blanking plug should be used.*

Note: *If only the ambient pressure is known or the pressure sensor is located far away from the cell, switch off the gas flow before calibration, wait for 1 minute for the readings to stabilize and then perform calibration. In this case the gas pressure is equal to the ambient pressure*

Note: *If a temperature sensor is not available, the receiver temperature sensor may be used as a proxy. Ensure system is thermally stable before calibrating.*

The transmitter and receiver should be connected to the calibration cell and be purged with a none absorbing gas, usually nitrogen, via **Purge Port 1, Measurement In,** ref Sections 2.2‘and 2.3.

Ensure that Purge Port 3, ‘Enclosure Out’, is free to vent to atmosphere.

After calibration is completed, the instrument must be returned to the correct process settings including path length, pressure and temperature.

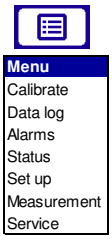
Transmitter and Receiver purge ports should also be checked, so that they are returned to the correct process and purge requirements at installation.

6.4 Reconfigure settings for off-line calibration

Adjust the ‘physical set up’ to suit the calibration cell environment. Path length, pressure source, temp source, analogue I/P.

Note: If the analyzer has been set with a long measurement filter the filter *should be reset to an appropriate time for example, 10 seconds to avoid a poor calibration result.*

Alternatively, if an offline calibration settings file has already been saved. Load the saved file as described in 0



Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9	
Manage Current Config	Service Mode						
	Phase/Gain Settings						
	Measurement Signal						
	Physical Setup	Measurement Selection	Purge Compensation		Enabled Disabled		*select option*
			Proc:Path Length		0.000		*edit value*
			Proc:Pressure Source		Transmitter Enclosure mA Input 1 or 2 User defined 0-4		*select option*
			Proc:Pressure Source Offset or value		Edit		*edit value*
			Proc:Temperature Source		Transmitter Enclosure Receiver Enclosure mA Input 1 or 2 User defined 0-4		*select option*
			Proc:Temp. Offset Offset or value		Edit		*edit value*
	Detailed set up		***For Servomex trained Service operators only***				
Save Current Config							
Restore Config							
Delete Config							

Figure 6-2: Physical setup sequential menu

Check photodiode DC voltage and signal amplitude. Adjust if required. Ref. 4.11

Calibration cell path length to be entered: 250mm, 500mm, 750mm or 1000mm

6.5 Saving the measurement sensor and environmental calibration settings

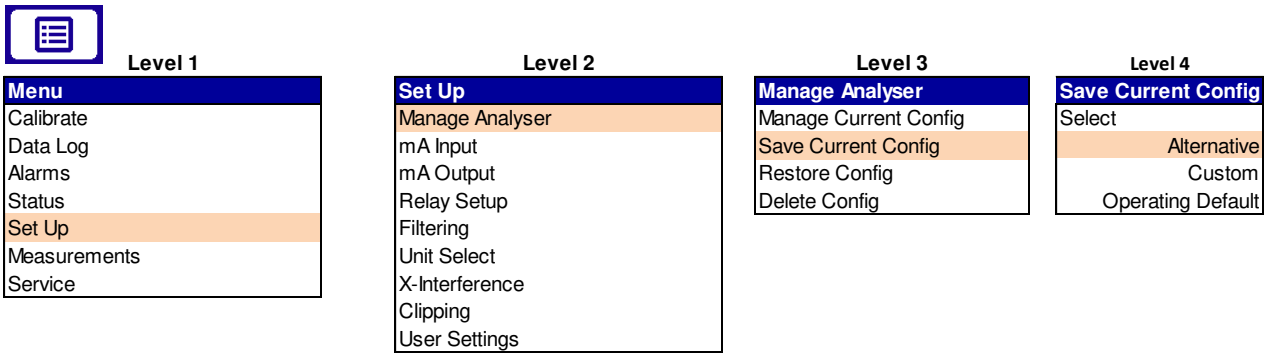


Figure 6-3: measurement sensor and environmental configuration menu

6.6 Calibration Settings

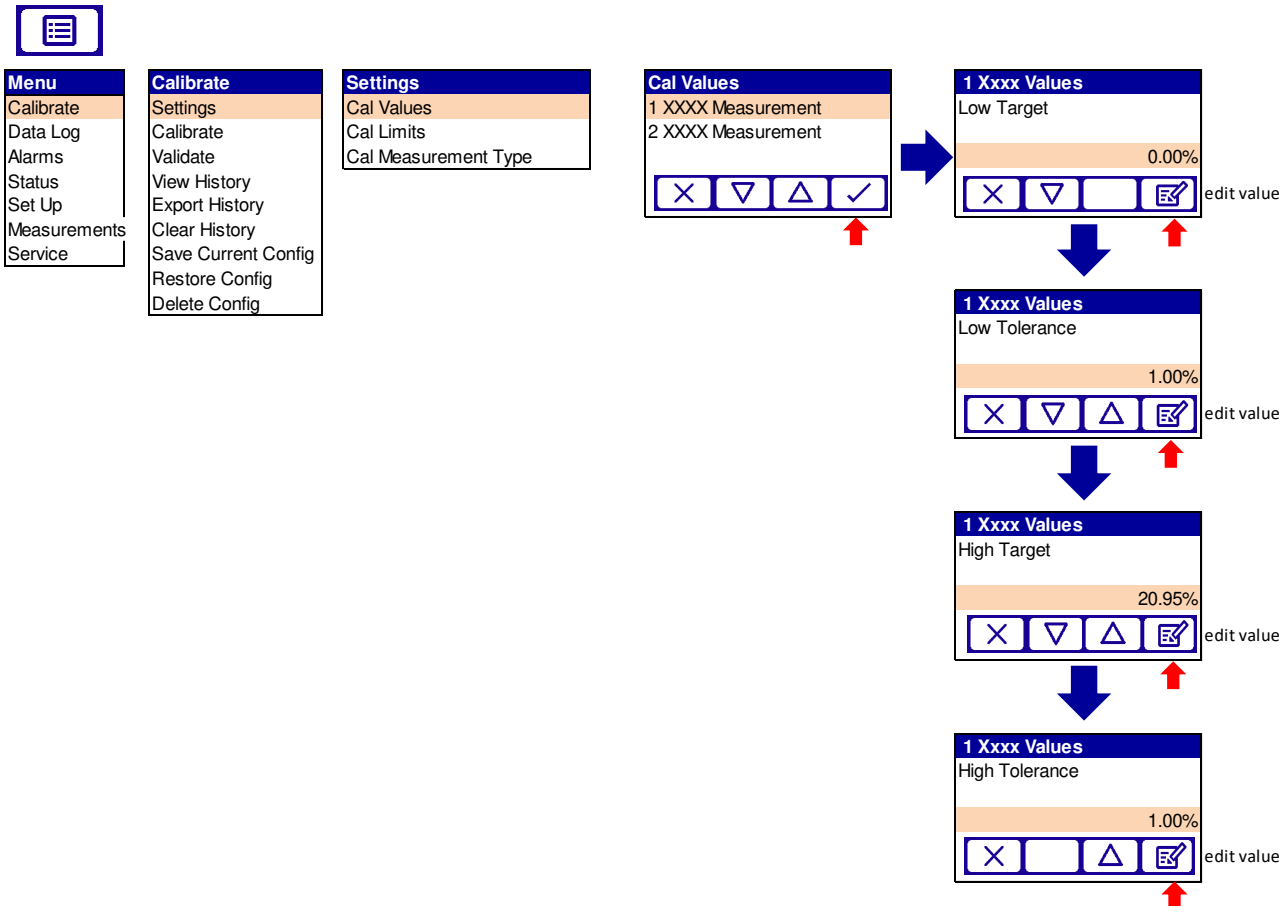
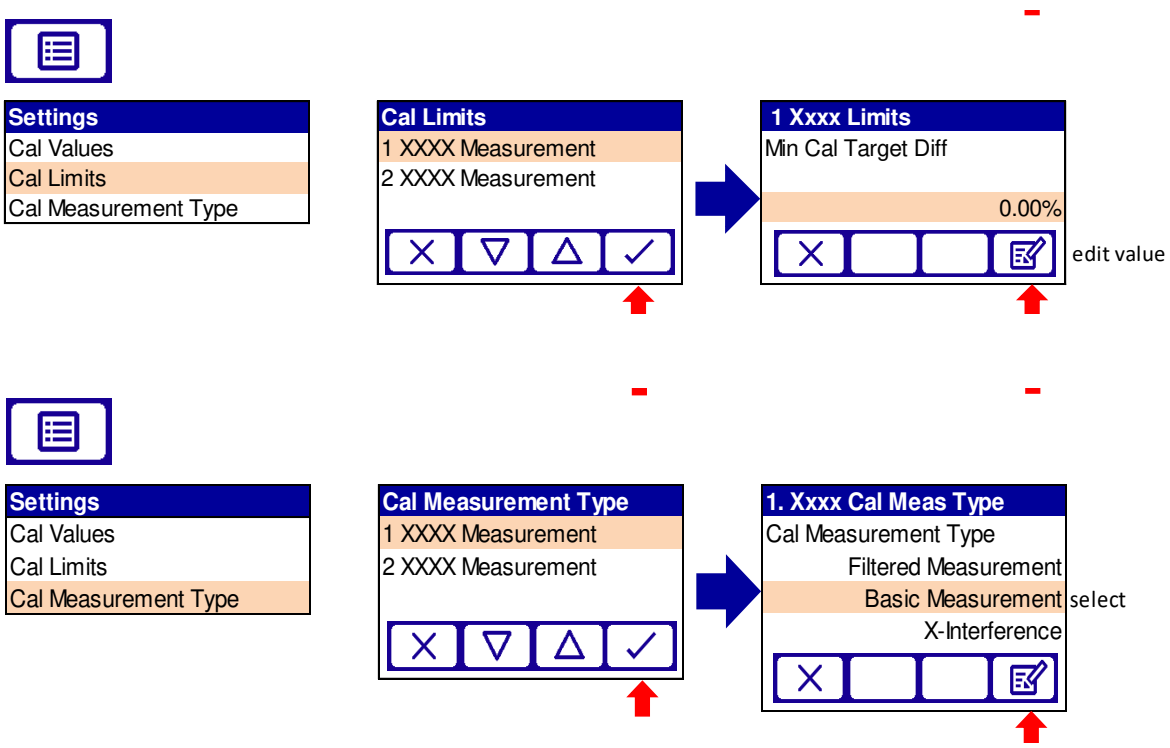


Figure 6-4: Calibration settings menu

Note: *"Target" refers to the target concentration of the calibration gas*

Note: *"Tolerance" refers to the tolerance of the measured reading against the "Target" concentration. A warning will be indicated if the measured concentration value is outside the "Tolerance" when asked to confirm calibration.*

Hint:	*You may wish to check the raw signal and filtered graphs to check correct location of second harmonic signal and 2F burst*



Basic cal measurement type: Uses raw transducer measurement, prior to any X-interference compensation or measurement filtering.

X- interference cal measurement type: Uses the X-interference compensated measurement prior to any measurement filtering.

Note*:X- interference must be enabled in set-up.*

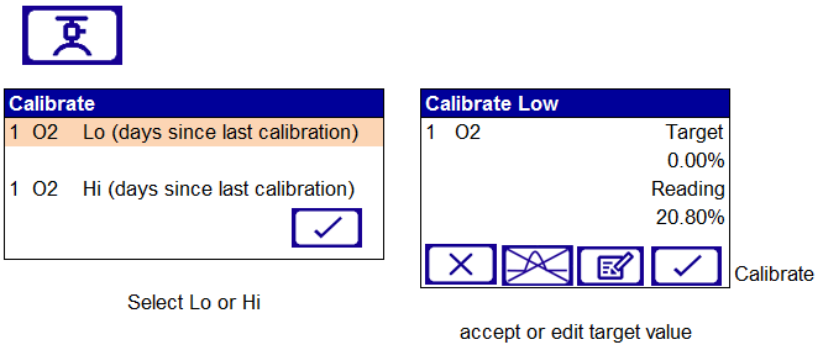
Note*:X- interference requires "Supervisor" password or above.*

6.7 Calibrate

Note: *Before you attempt to calibrate the system, let the instrument operate until stable.*

6.7.1 Calibration general sequence

If required, connect and start purging of dead volumes in TU and RU Purge 1 – Measurement or Environmental IN e.g. for an O_2 measurement.
Connect calibration gas and flush system for a minimum of 15 minutes, (30 minutes recommended). Typical flows between 500 to 1000 ml/min ***Note:*** *Measurement purge requires ventilation* ***Note:*** *Ensure zero readings for zero-gas concentration*
Wait for the system to reach a stable reading, measurement stability must be assured before requesting calibration
Check that the reading agrees with the concentration of certified gas within specified tolerance, then press calibrate



Flush calibration cell with inert gas before removal of analyzer
Remove analyzer and reinstall as per section 7.7.1

Hint: *When re-mounting the transmitter and receiver units care should be taken to avoid disturbing, and potentially misaligning, the mounting assembly.*

Note*: N2 should be used for purging during calibration to prevent atmospheric gases such as O2, CO2, and H2O present in the atmosphere, from interfering with the calibration process.*

There are two distinct calibrations for the instrument to be performed in correct sequence:

6.7.2 LO or zero calibration

During this process, you must flush the cal cell and all the dead volumes inside the analyzer with nitrogen for a duration of at least 15 minutes at flows between 500 ml to1000 ml/min. The customer must enter 0 in the box called CAL1C and enter all the parameters such as Pressure, temperature and pathlength before performing a LOW CAL.

> ***Hint:*** *The graph page should show a flat line in the gas line location.*

6.7.3 HI calibration

During this process, you must flush the cal cell with the gas from the calibration bottle for a duration of at least 15 minutes to 30 minutes (longer for adsorbing gases such as NH_3) at flows between 500 ml/min to 1000 ml/min.

The customer needs to enter their precise cal bottle concentration in pp,% or other units they have previously selected in the box called CAL2C in addition to ensure all the parameters such as Pressure, temperature and pathlength are set correctly before performing a HIGH CAL.

Note*:Ensure that measured gas concentrations reach maximum and stabilized with no oscillations, and that 2f harmonic graph are correct and as expected, only calibrate if 2f graph and line positions are in correct locations, the 2f burst has correct amplitude and the 2f signals are correct and of sufficient amplitude.*

Note*:When restoring a previous calibration, the time since last calibration will not be updated.*

6.8 Saving calibration configuration

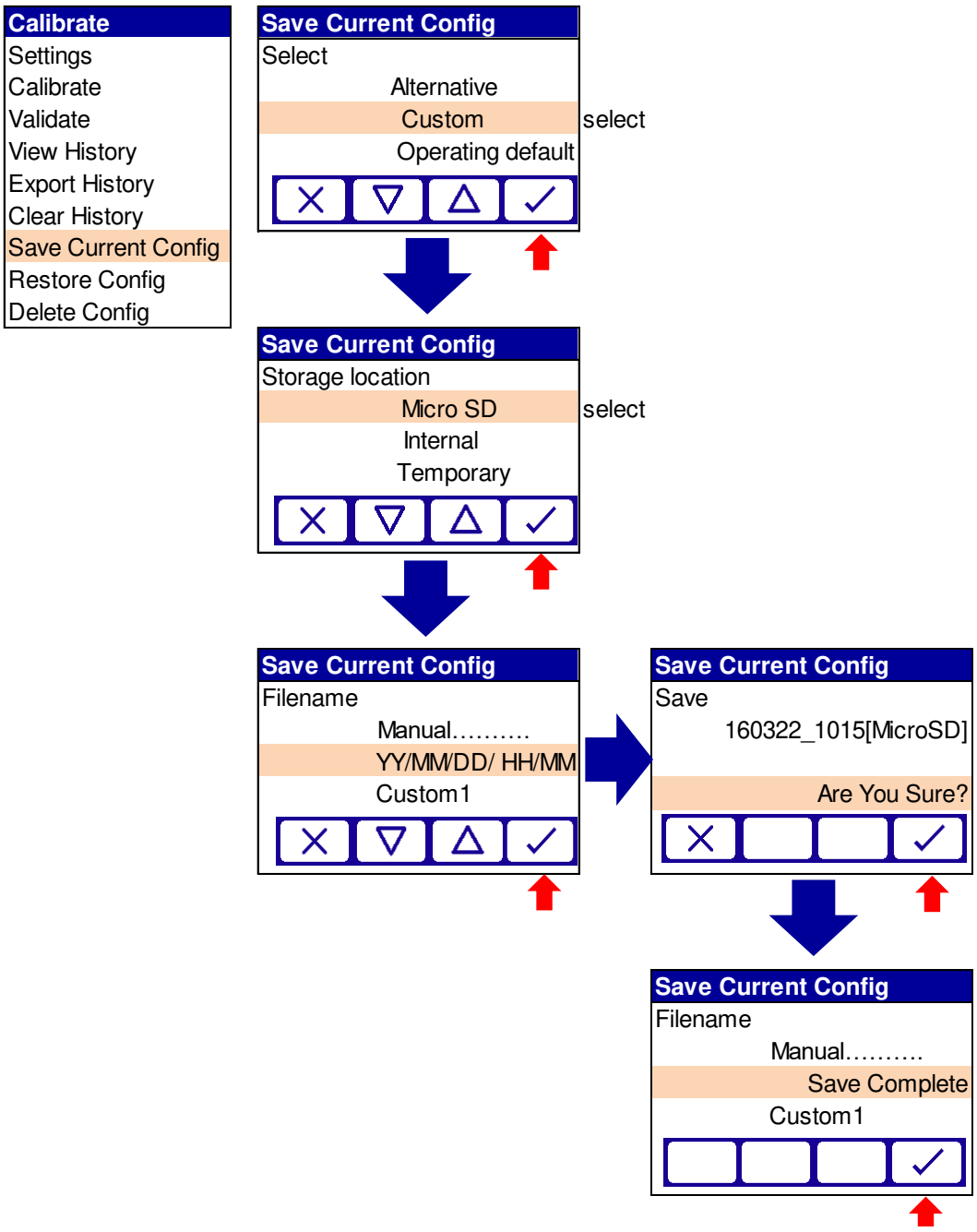


Figure 6-5: Save calibration configuration menu

The file can be saved / restored from internal memory or via the MicroSD card. The file can be saved in pre-named configurations for specific purposes or in user named files.

This file can be saved and restored by Supervisor level users.

6.9 Restore configuration settings

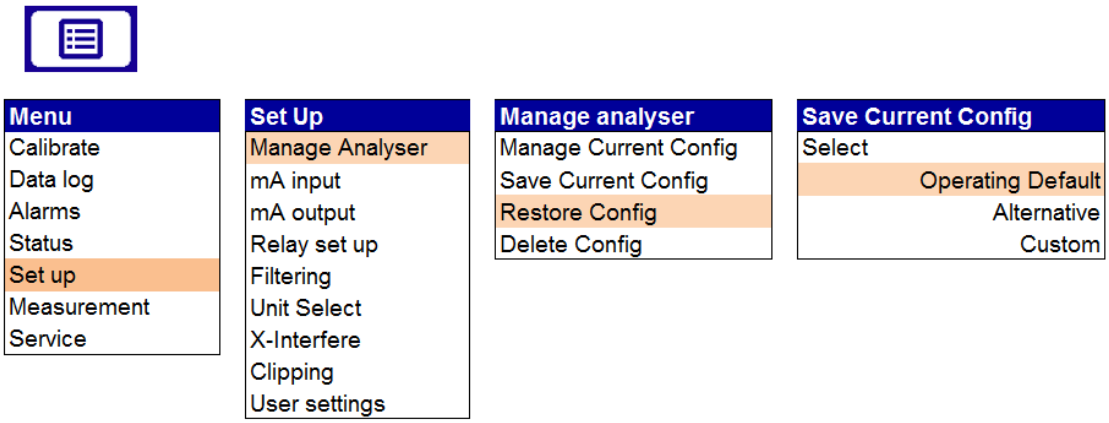


Figure 6-6: Restore physical configuration menu

Once configuration is restored ensure the analyzer is functioning within specified limits.

6.10 View Calibration history

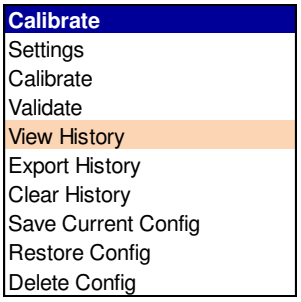


Figure 6-7: View calibration history

6.11 Dependent measurement calibration

In Laser 3 Plus variants where one of the measurements is available only at high temperatures, i.e. O2 (> 500 °C), a dependency between the two measurements has been implemented to calibrate the analyzer. The second measurement, unavailable at low temperature, cannot be selected. Instead it will become calibrated once calibration occurs for the first measurement. The range at which this measurement will be calibrated should also follow the initial range of the analyzer as provided by Servomex. Please note the accuracy of the calibration of the first measurement will have an effect on the quality of the calibration of the second measurement.

6.12 In-situ validation (in-line gas validation)

6.12.1 Process Overview

The Laser 3 Plus includes the ability to perform in-line gas validation. This allows the operator to check that the Laser 3 Plus is correctly measuring the target gas while the unit remains mounted on the live process.

The in-line validation process requires that a validation cell is mounted coaxially at the receiver end of the Laser 3 Plus. It must be possible to flow zero and span-gases into this validation cell.

During in-line validation, the effects of the process measurement are mathematically removed so that the Laser 3 Plus just measures the contents of the validation cell. The cell is filled with zero-gas and then span-gas. The Laser 3 Plus checks that the zero and span measurements are correct according to a set of user controllable parameters. The validation cell is then purged with zero-gas before the Laser 3 Plus returns to normal operation and the process measurement is restored.

In-line validation is a manual process that is initiated by the operator on the user interface. The UI then transitions through a sequence of steps to perform in-line validation. At each stage the operator is told what is happening and is given instructions for when to turn the zero and span-gases on and off.

At the end of in-line the validation, the test result is recorded in the calibration history.

6.12.2 Set up

To allow validation checks of the Laser 3 Plus analyzer when attached to the process, the optional validation cell must be fitted at the receiver end of the analyzer. Suitable O-ring and sealing materials must be specified for the specific application gasses.

The pressure in the In-line validation cell must not exceed 1.5 bar absolute.

Before using the in-line validation cell, ensure all connections are leak free at operating pressure.

Validation gases are potentially toxic, corrosive, flammable or asphyxiant; ensure adequate ventilation is provided.

In-line validation gases used must be well below the LEL of the gas (<25%) and be in an inert balance gas such as N2.

The in-line validation cell volume must not form a Zoned area.

Purging gases are potential asphyxiants ensure adequate ventilation is provided.

The Analyzer may fail if you use materials to connect the Laser 3 Plus to the process that are not compatible with the application gasses.

For analyzers with a duel measurement capability, span-gases in the in-line validation cell can affect the second measurement. It therefore should not be relied upon during the validation process.

Ensure the in-line validation cell is properly flushed with zero-gas by setting appropriate purge times on completion of the validation process, otherwise measurement accuracy in normal operation may be compromised.

Safety critical installations must ensure the validation gas supplies are monitored to ensure correct gases are present.

***Note**:As the test is performed swiftly, it is assumed that the process conditions will be reasonably stable during this procedure.*

***Note**:Filters must be turned off before validation. (Ref section 4.7)*

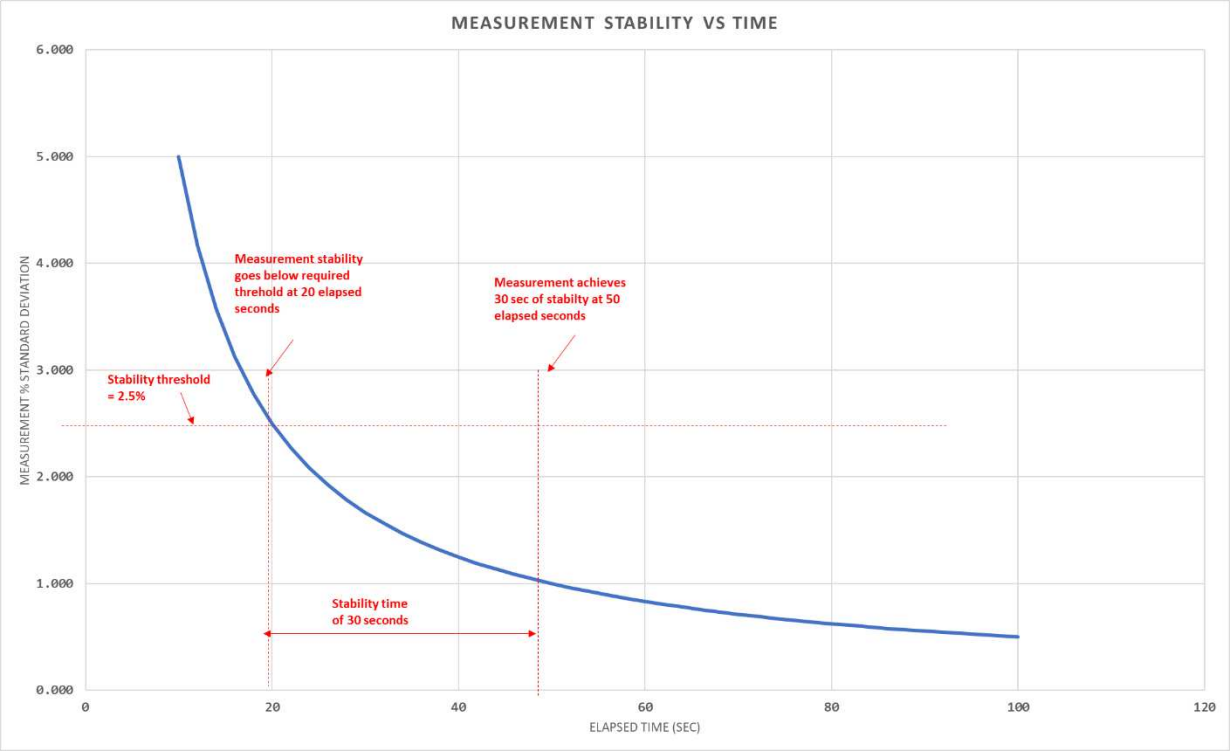
***Note**:Check the validation gas type and concentration.*

6.12.3 Stability Measurement

At various points during the validation process, the analyzer will check the stability of both the measurement concentration and the transmission. This is to ensure that a meaningful test result can be obtained. If at any point the measurement or transmission is found to be outside the stability criteria, the validation process will be halted and the analyzer will exit back to normal operation after informing the operator.

The stability of both the measurement and the transmission is calculated as a percentage Standard Deviation. The Standard Deviation values are calculated five times per second.

In order to be judged as being stable, both the measurement and the transmission Standard Deviation must be below a preset threshold level and must remain below that level for a preset period of time. Both the stability threshold level and the stability time can be set by the operator.



The graph above illustrates a typical scenario where a measurement is initially unstable – that is, the measured concentration or transmission is varying outside limits that would be considered normal operation. The standard deviation falls over time as the measurement stabilizes. It passes through the stability threshold level and remains below the threshold until the stability time has elapsed. At that point the measurement would be judged to be stable.

6.12.4 In-line Validation Process Flow

The In-line Validation process is structured as a sequential series of steps where the operator is informed at each stage of any action that they need to take. The table below shows the complete sequence of steps through the validation process. There are two columns of screen displays in the table. The column on the left shows the sequence that is followed if each step in the procedure was successful, i.e. the process is stable, and the span concentration is within the permitted range. The third column on the right shows steps occurring if the validation has failed. When such a condition is detected the sequence will be terminated early.

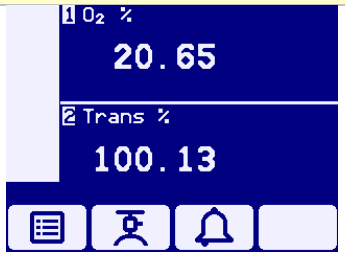
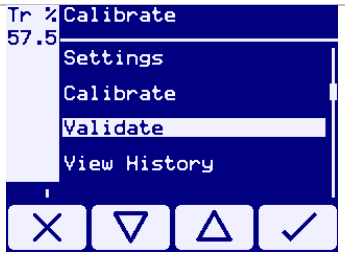
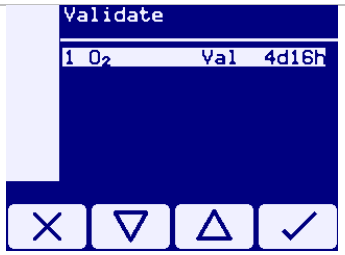
For example, in the following scenarios the validation might be terminated earlier:

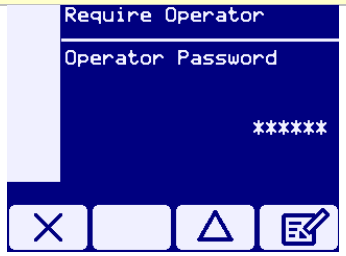
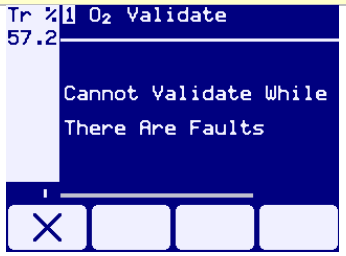
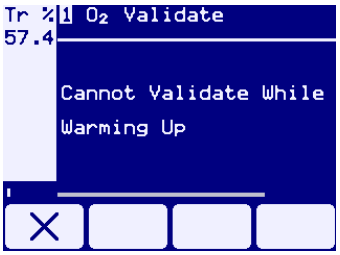
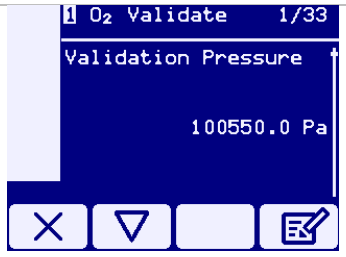
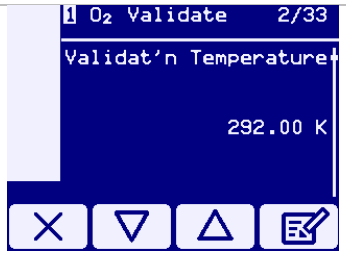
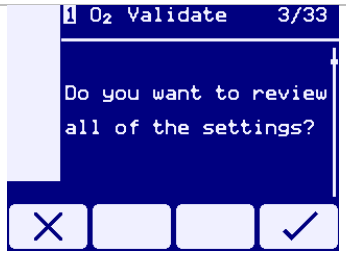
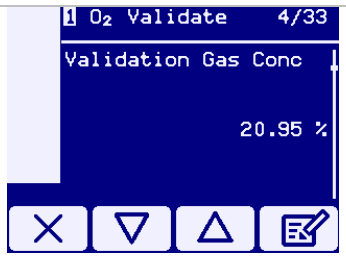
1. The analyzer is in warming mode when validation is selected.
2. The analyzer is in fault mode when validation is selected.
3. The process measurement is not sufficiently stable to allow a meaningful validation result to be obtained.

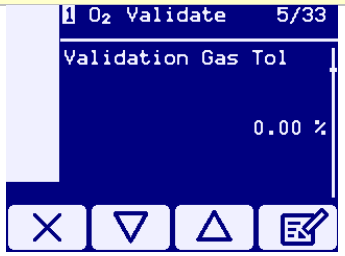
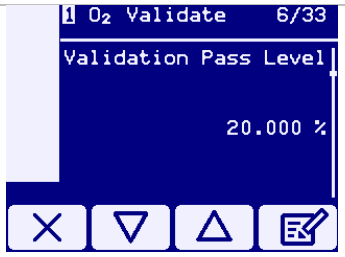
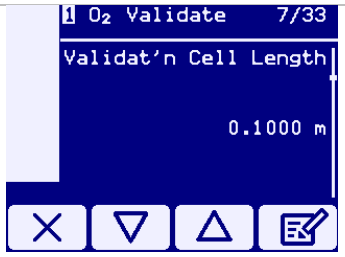
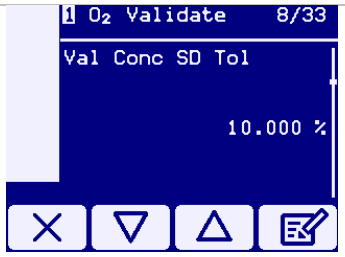
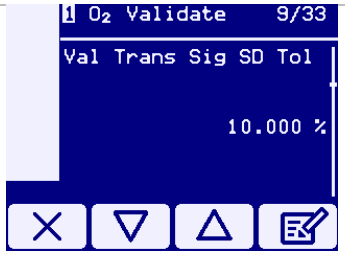
Note that if a failure occurs while the validation cell contains span-gas, the operator will be instructed to purge with zero-gas before the analyzer returns to normal process measurements.

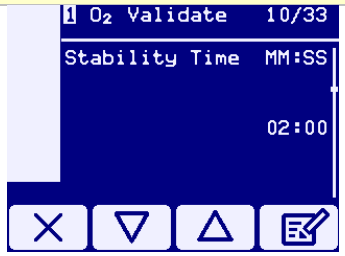
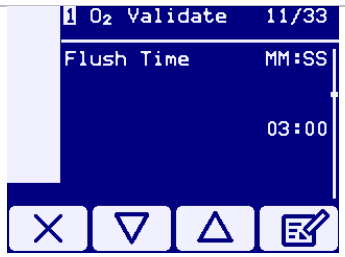
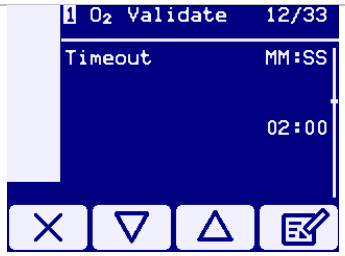
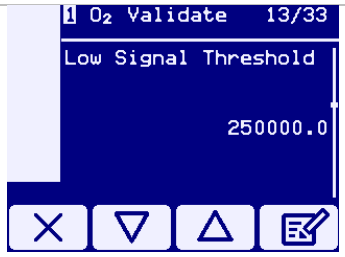
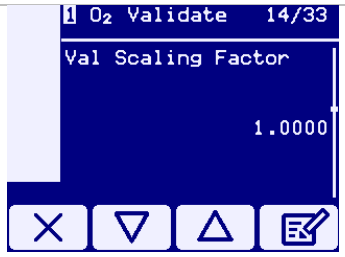
6.12.5 Transient Faults During Validation

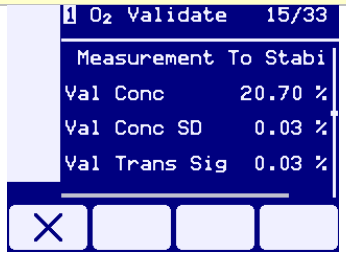
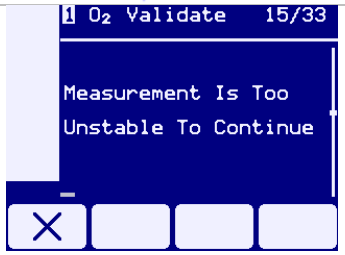
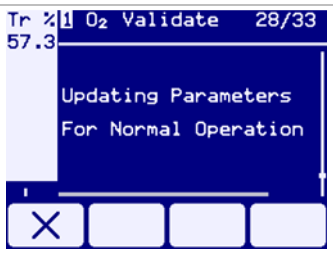
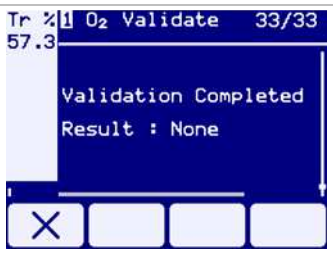
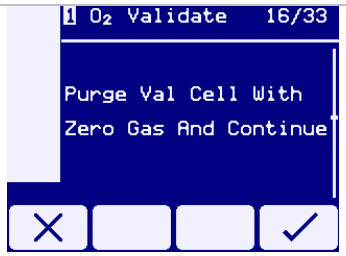
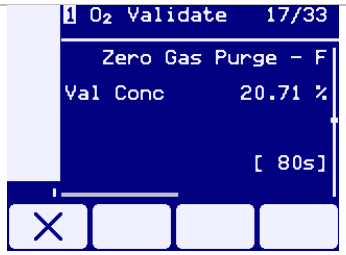
At various stages during the validation process, parameters within the analyzer are changed to values that are needed for validation. When a parameter is changed it can result in a transient fault being registered by the analyzer. The fault will disappear once the analyzer has matched the expected condition. Note that transient faults observed during the validation procedure can safely be ignored, as their occurrence is expected at some stage of the validation procedure itself. However, any pre-existing fault condition might cause the validation procedure to fail and it will be again reported once the procedure has finished or has been terminated. The Service In Progress flag is raised while in-line validation is in progress in order to indicate to the user the analyzer is operating within this mode.

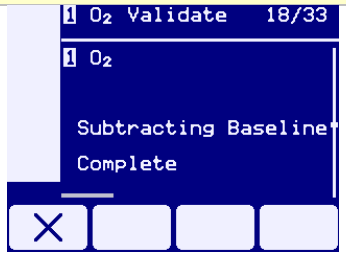
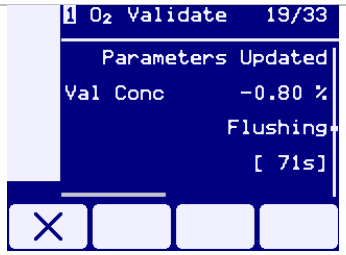
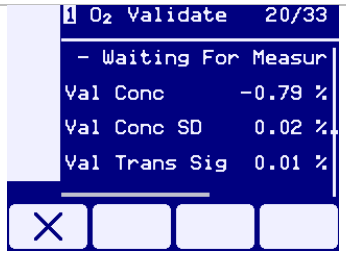
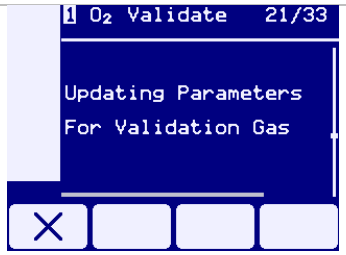
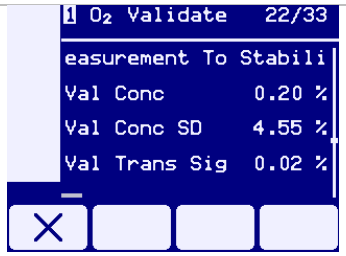
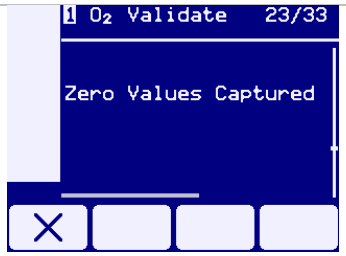
Step No	Display		Description
	All Good Path	Failure Path	
1			Initial display before starting validation
2			To initiate validation, go to the Calibrate menu and select the Validate option.
3			Select which measurement stream you wish to validate. In this example only the O2 stream is available for validation. For each stream, the number of days since validation was last performed is displayed. In this example validation was last performed 4 days and 16 hours ago. A value of 9999 means that this measurement has never been validated. Once the measurement has been selected press the down arrow to continue.
			

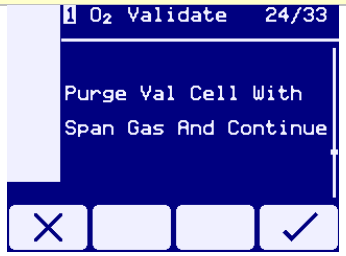
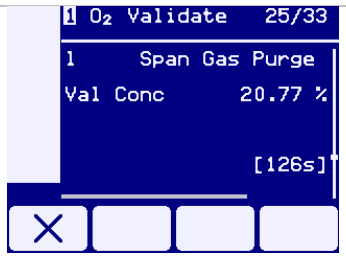
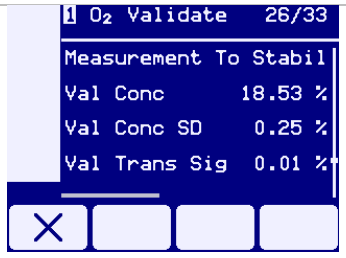
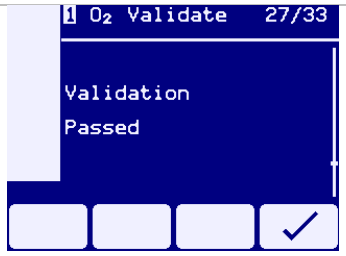
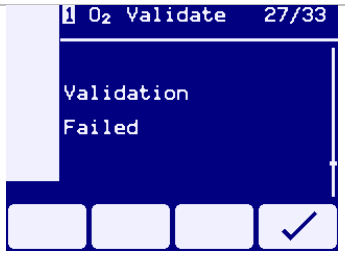
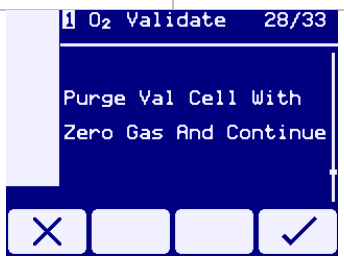
Step No	Display		Description
	All Good Path	Failure Path	
4		 	If the system has a fault currently active, then a message will be displayed saying that validation cannot continue. It will then exit back to the top level calibrate menu If no fault is present, then enter the operator password to continue validation. This step will be skipped if you are already logged in at operator level or above. At this point the analyzer will raise the Service In Progress flag. If the system is in warming mode, then a message will be displayed saying that validation cannot continue.
5			Enter the pressure in the validation cell. In this example the cell is at atmospheric pressure.
6			Enter the temperature in the validation cell
7			At this point you have the choice whether to review and edit all the validation settings or jump to the start of the validation process. Bypassing the settings will result in the stored settings being used. Press ☑ to review or ☒ to jump. If you select jump, the process will immediately go to step 17.
8			Choose the span target value. This will usually be the concentration of the span-gas.

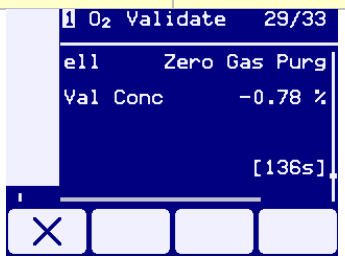
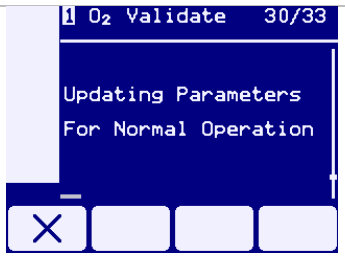
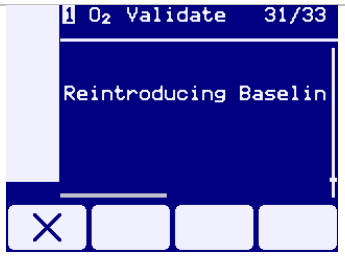
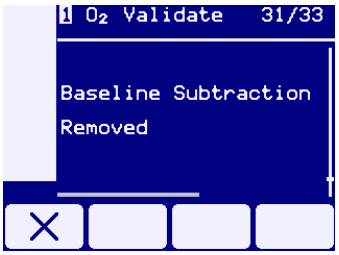
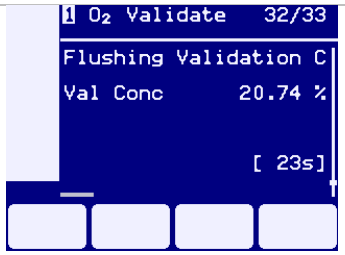
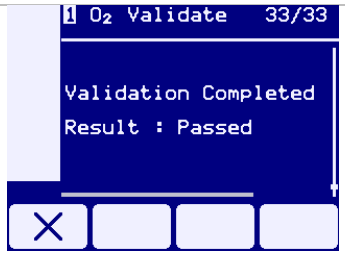
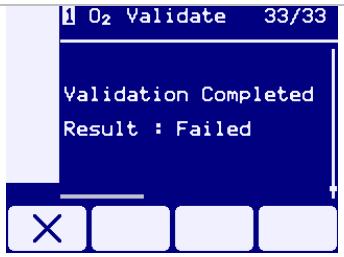
Step No	Display		Description
	All Good Path	Failure Path	
9			Enter the tolerance of the validation gas. This will be the tolerance on the validation gas bottle. NOTE THIS FEATURE IS DEPRECATED AND THIS VALUE SHOULD BE MAINTAINED AS EQUAL TO ZERO. Uncertainties related to the gas bottle can alternatively be set at step number 10
10			Enter the permitted tolerance on the span concentration calculated by the analyzer. This is expressed as a percentage of the span concentration. For example, a Validation Pass Level of 5%, with a 21%O2 validation test gas bottle would correspond to successful validation if the reported validation readings would be between 20%O2 and 22%O2.
11			Enter the length of the validation cell. Standard lengths for Servomex supplied in-line validation cells are either 0.1m or 0.2m. You cannot enter a number <0.1m
12			Enter the permitted stability of your process concentration expressed as percentage standard deviation of the span concentration. At all stages of the validation process, the analyzer will wait for the measurement concentration to achieve this stability before proceeding refer to section 6.12.3 for more details of the process stability measurement.
13			Enter the permitted stability of your process transmission expressed as percentage standard deviation.

Step No	Display		Description
	All Good Path	Failure Path	
14			Enter the minimum time period that the concentration and transmission must be stable for. The minimum stability time is 30 sec.
15			Enter the flush time. During the validation process, when validation gas is applied, the analyzer will wait for this length of time before attempting to calculate measurement stability. The flush time should take into account factors such as the length of pipework between the gas bottle and the validation cell. The minimum flush time is 30 sec. A flush time of 2 min should be sufficient for most applications.
16			Enter a timeout value. The analyzer will use this timeout when waiting for the measurement to achieve stability. In the example of the picture, if each validation condition is not fulfilled within a 10 min period, the analyzer would exit the validation procedure.
17			Enter the Low Signal Threshold for validation. This should be high enough to ensure that validation is performed in low signal mode. 250000 is the default value and should be ok for most applications.
18			It is possible to apply a constant scaling factor to the span measurement. Enter the scaling factor here. If no scaling is required, the scaling factor should be 1.0. Note: scaling factors are only effective for pathlength <1.0 m.

Step No	Display		Description
	All Good Path	Failure Path	
19			The analyzer will now check for stability of concentration (Val Conc StDev) and transmission Val Tran StDev). The analyzer would automatically continue to the next step once the criteria is met or it has timed out.
20			If the process is not stable, the operator will be told that validation cannot continue. The normal process parameters will then be restored and the validation process will exit.
21			
22			This message saying, “Validation Completed”.is displayed at the end of validation for both pass and fail scenarios. It is an indication that validation has finished and does not mean that validation has passed.
21			If the process is stable, the operator will be instructed to turn on zero-gas to the validation cell and press ☑ to continue.
			Zero-gas purge will now take place. The Laser 3+ will wait for the user set flush time to elapse.

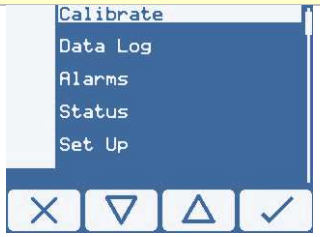
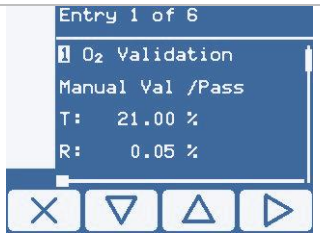
Step No	Display		Description
	All Good Path	Failure Path	
22			The analyzer will now subtract the signal spectrum as target gas might be present within the process sample. In this way, only the signal caused by the occurrence of target gas within the validation cell will be measured. Subtraction of the baseline is now complete.
			Analyzer parameters have been updated. The analyzer will now wait for zero-gas to flush through the validation cell. The displayed concentration should drop to zero during this period.
26			The analyzer is now waiting for stability. Once stability has been achieved, the zero concentration will be recorded. If stability is not achieved the operator will be informed and the validation process will be terminated as shown earlier.
			
			
27			Stability has been achieved and the zero concentration at zero has been recorded.

Step No	Display		Description
	All Good Path	Failure Path	
28			Apply span-gas to the validation cell and then press ☑ to continue. Note that you can press ☑ immediately after applying span-gas as the analyzer itself will apply a flush time.
			
			
			
31			The operator is now informed whether the validation has passed or failed. A pass means that the calculated span concentration was within the permitted range.
32			The operator is now instructed to purge the validation cell with zero-gas. Note that in case of the Combustion O2 analyzer variant, the normal condition for the purge might be Instrument Air if Nitrogen is not available at site. If that is the case Nitrogen purge of the in-line gas cell will be required, only for the validation test, in order to produce a change in Oxygen concentration from the gas cell.

Step No	Display		Description
	All Good Path	Failure Path	
33			The analyzer will now wait for zero-gas to flush through the validation cell. It will wait for the flush time that was entered in step 15.
34			The process parameters will now be restored to the normal process measurement parameter set.
35	 		Baseline subtraction is now turned off.
36			The analyzer waits for a period equal to the flush time to allow the normal process measurement to stabilize. Note that the validation process will exit at the end of this period regardless of whether stability has been achieved.
37			The validation process is now complete.

6.12.6 Viewing Validation Results

The Laser 3+ analyzer records the results of all validation operations. The validation results can be viewed as follows:

Step No	Display	Description
1		Select “Calibrate” from the top-level menu.
2		Select “View History”.
3		You can then see all of the recorded results for both calibration and validation. Use the up and down arrows to scroll between records. The right arrow can be used to see more parameters within each record. T = Span Target concentration R = Span concentration Result

6.13 Automatic In-Situ Validation

The Laser 3 Plus includes the ability to run an automated version of the in-situ validation described in the previous section.

The automated version of in-situ validation is controlled entirely by Modbus. There is no user interaction via the user interface. It is designed for remote operation via a customer interface such as an HMI (Human Machine Interface).

Auto Validation is performed collaboratively between the Laser 3 Plus and the HMI. The main reason why the HMI needs to play a role in auto validation is that the Laser 3 Plus does not have the ability to control external gas valves. This will need to be done by the HMI under the direction of the Laser 3 Plus to control the flow of zero and span-gases into the validation cell.

This means that auto validation can only be performed on a system that has been specifically configured to do so and which includes a suitable HMI plus all necessary pipework and valves.

Note that a separate document has been produced by Servomex which provides guidelines and assistance for a third party wishing to produce a HMI capable of collaborating with the Laser 3 Plus to perform auto validation. It has the document No 07900C039 and is available on request.

6.13.1 Safety Warning When Performing Auto Validation

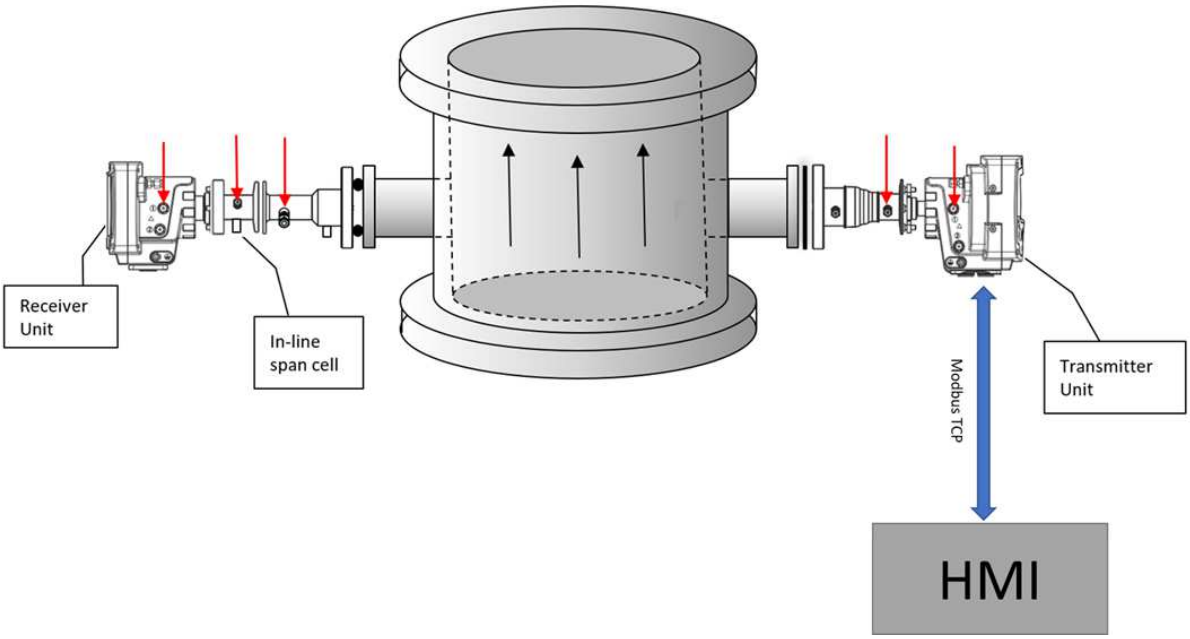
It is extremely important before running auto validation to verify the correct operation of the following:

- All pipework, valve blocks, flow meters etc. are connected correctly with no leaks or damage.
- Zero and span-gases are able to flow into the validation cell when commanded.

Failure to adhere to this may result in auto validation producing an incorrect result. It may also result in the Laser 3 Plus producing an incorrect measurement when it exits auto validation and returns to normal operation.

6.13.2 System Configuration For Auto Validation

The diagram below shows a simple functional view of a Laser 3 Plus setup on process with an in-line validation cell attached ready to perform auto validation.



As shown in the diagram, communication between the Laser 3 Plus and the HMI is via Modbus TCP. There is a two-way flow of data between the Laser 3 Plus and the HMI.

Examples of data going from the HMI to the Laser 3 Plus would include:

- User settable parameters
- The command to start auto val

Examples of data going from the Laser 3 Plus to the HMI would include:

- The required state of the zero and span-gas valves
- Zero and span measurements
- Fault indicators
- The state of the auto val process
- The auto val pass/fail result

Note that although there is a two-way flow of data over Modbus TCP between the Laser 3 Plus and the HMI, the Laser 3 Plus is a Modbus slave. The HMI must assume the role of Modbus master. All Modbus TCP transactions must be initiated by the Modbus master. This means that if the HMI requires data from the Laser 3 Plus, it must ask for it. The Laser 3 Plus as the slave cannot initiate a transaction by itself.

6.13.3 Measurement Stability

There is an important difference between manual validation and auto validation. During manual validation, if the measurement is found to be outside the user defined

stability criteria, the validation process will be aborted. The requirement for auto validation is different. Here the process will continue regardless of whether the measurement meets the stability criteria.

6.13.4 Modbus TCP Communications

As mentioned in the System Overview section, all communication between the Laser 3 Plus and the HMI is via Modbus TCP with the HMI assuming the role of Modbus master.

The complete Modbus map for auto validation is contained in section 12.1.14 of this operator manual.

6.13.5 Modbus Registers

A concise version of the auto validation Modbus map is contained in section 12.1.14. The table below expands on that and gives more information for each register.

Register Name	M1 Address	M2 Address	Read/ Write	Notes
Start / Stop Auto Val	50001	50081	R/W	1 = Start auto validation 0 = Stop auto validation
Validation test result	50002	50082	R	0 = test result not available 1 = test in progress 2 = test failed 3 = test passed
Auto validation state	50003	50083	R	0 = auto validation is not running 1 = auto validation is running
Auto validation state machine current state	50004	50084	R	0 = IDLE 1 = INIT 2 = INITIALSTABILITYWAIT 3 = ZEROGASON_1 4 = ZEROGASFLUSH_1 5 = TURNONBLS 6 = BLSFLUSH 7 = BLSSTABILITYWAIT 8 = SETPARAMSFORPROCESSZERO 9 = WAITFORPROCESSZERO 10 = WAITFORSPANGASON 11 = SPANGASFLUSH 12 = SPANSTABILITYWAIT 13 = SETPARAMSFORPROCESSSPAN 14 = WAITFORPROCESSSPAN 15 = ZEROGASON_2 16 = FINALZEROGASFLUSH 17 = AUTOVALFAIL 18 = RETURNTONORMALOPERATION 19 = FINALFLUSH 20 = FINISHINGUP
Power interruption occurred	50005	50085	R	0 = a power interruption did not occur during auto val 1 = a power interruption occurred auto val If this flag is set, it can be cleared by doing a complete auto val.
Validation cell was not purged	50006	50086	R	0 = the validation cell was correctly purged at the end of auto val 1 = the validation cell was NOT correctly purged at the end of auto val If this is 1 at the end of auto val it may mean

Register Name	M1 Address	M2 Address	Read/ Write	Notes
				that there is span-gas in the cell which may give incorrect measurements If this flag is set, it can be cleared by doing a complete auto val with the cell being successfully purged at the end.
Debug message	50007	50087	R	Reading this address causes some debug information to be printed to the system log. This is for Servomex use only.
Auto Val supported for this measurement	50008	50088	R	0 = Auto val not supported 1 = Auto val supported
Correct password received	50009	50089	R	0 = password not received 1 = password received - auto val is now enabled
Requested zero-gas state	50024	50104	R	The analyzer uses this address to tell the HMI when to turn the zero-gas on or off. The HMI should monitor this register and set the zero-gas state accordingly 0 = HMI should turn off zero-gas 1 = HMI should turn on zero-gas
Requested span-gas state	50025	50105	R	The analyzer uses this address to tell the HMI when to turn the span-gas on or off. The HMI should monitor this register and set the span-gas state accordingly 0 = HMI should turn off span-gas 1 = HMI should turn on span-gas
Set Stability Time	50026	50106	R/W	The measurement must be within the stability criteria for this length of time before taking a zero or span measurement. Unit = sec
Set Flush Time	50027	50107	R/W	Allow the zero or span-gas to flush through for this length of time before looking for a stable zero or span measurement. Unit = sec
Set Timeout	50028	50108	R/W	If the measurement is not stable after this length of time, carry on with auto validation regardless. Unit = sec
set validation pressure	50041	50121	R/W	set validation pressure for auto val on measurement 1
set validation temperature	50043	50123	R/W	set validation temperature for auto val on measurement 1
set validation gas concentration	50045	50125	R/W	set validation gas concentration for auto val on measurement 1
set validation gas tolerance	50047	50127	R/W	set validation gas tolerance for auto val on measurement 1
set validation pass level	50049	50129	R/W	set validation pass level for auto val on measurement 1
set validation cell length	50051	50131	R/W	set validation cell length for auto val on measurement 1
set validation concentration standard deviation tolerance	50053	50133	R/W	set validation concentration standard deviation tolerance for auto val on measurement 1
set validation transmission standard deviation tolerance	50055	50135	R/W	set validation transmission standard deviation tolerance for auto val on measurement 1
set low signal threshold	50057	50137	R/W	set low signal threshold for auto val on measurement 1

Register Name	M1 Address	M2 Address	Read/ Write	Notes
set scaling correction factor	50059	50139	R/W	set scaling correction factor for auto val on measurement 1
Measurement Concentration	50061	50141	R	The current value of validation concentration. This can be read at any time during auto val
concentration standard deviation	50063	50143	R	The current value of validation concentration standard deviation. This can be read at any time during auto val. The std dev is expressed as a percentage of the current validation concentration
transmission standard deviation	50065	50145	R	The current value of validation transmission standard deviation. This can be read at any time during auto val. The std dev is expressed as a percentage of the current transmission
zero measurement scaled to cell length	50067	50147		The zero measurement calculated by the Laser 3 Plus during auto validation
span measurement scaled to cell length	50071	50151		The span measurement calculated by the Laser 3 Plus during auto validation
Final zero threshold	50075	50155		The cell concentration measurement must be below this level after the final zero flush. If it is not, then a Maintenance Required fault will be raised on exiting auto validation. This is to alert the user that there may be span-gas in the validation cell and that subsequent measurements may be incorrect.
Password	50077	50157		Set to operator password to enable auto validation The password must be entered before each run of auto val

6.13.6 Modbus Transaction Frequency

Modbus is not a high-speed data interface. Experience with the Laser 3 Plus has shown that a minimum 100mSec delay should be enforced between successive Modbus transactions. If attempts are made to read or write Modbus registers any faster than this it may result in bus errors.

6.13.7 Modbus Addresses That Should Be Monitored Continuously By The HMI

The Laser 3 Plus does not have the ability to control the gas valves so this responsibility has to be assumed by the HMI. The Laser 3 Plus uses a set of Modbus addresses to tell the HMI when to turn the gases on and off.

The registers are

- Requested zero-gas state
- Requested span-gas state.

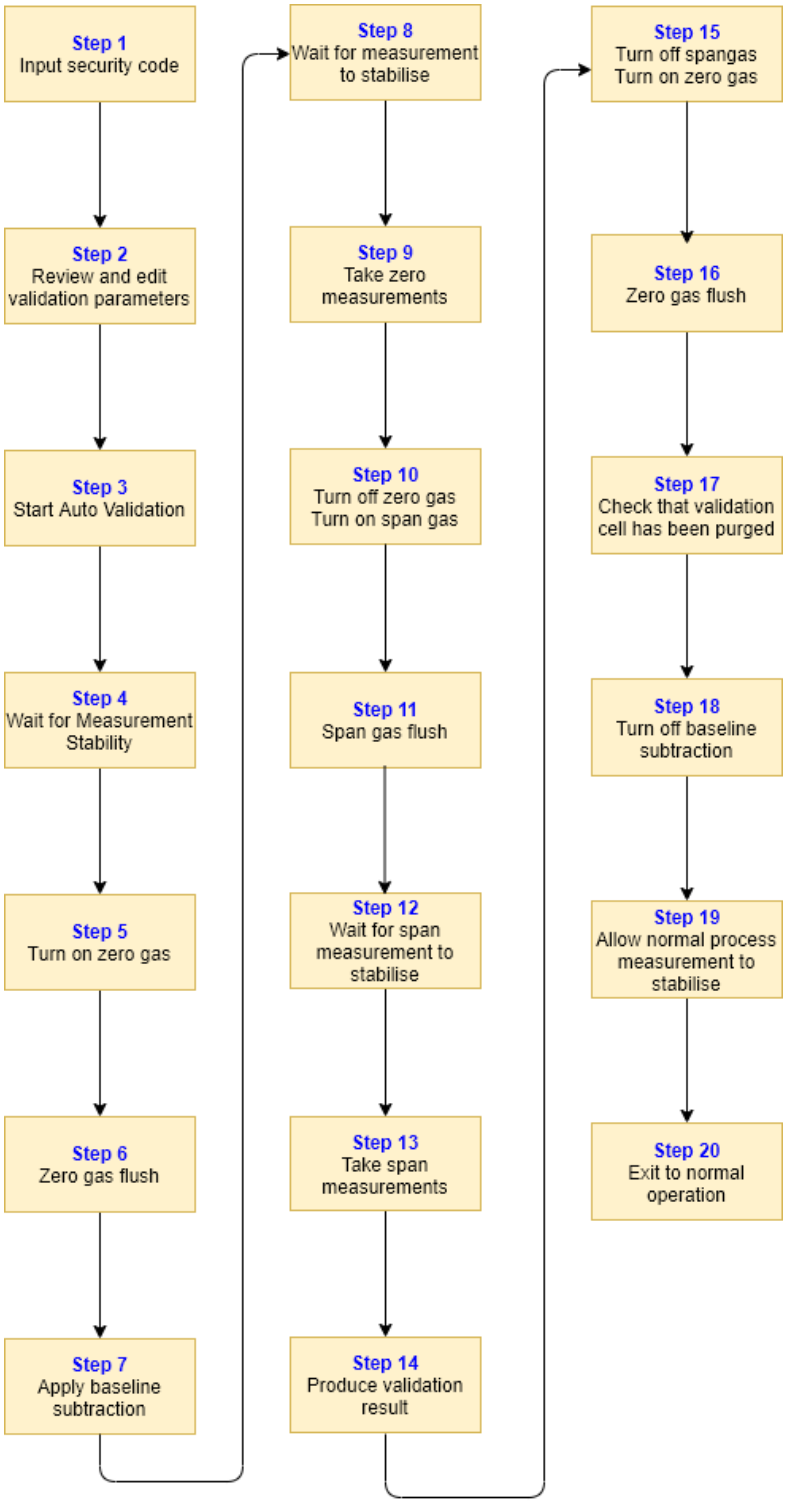
Refer to the Modbus map in section 12.1.14 for the register addresses.

The HMI should read these addresses every few seconds during auto validation so that it knows when to turn the gases on and off. It is only necessary to read the registers for the measurement being validated.

Reading back a 0 means the gas should be turned off. Reading back a 1 means the gas should be turned on.

6.13.8 Auto Validation Process Flow

The diagram below shows the process flow through the complete auto validation sequence.



6.13.8.1 Step 1. Input the Auto Validation Access Code

Auto validation is accessed through Modbus. This is not a secure interface and there is no easy way of making it properly secure. However, in order to provide a basic level of access control to auto validation, it is necessary to enter an access code before running auto validation.

The access code is a number between 0 and 999999 and the value is equal to the operator password currently set for the Laser 3 Plus in question.

Once the access code has been sent, it remains active until a complete run of auto validation has happened. Once auto val completes, access is removed until the access code is entered again. Aborting auto validation part way through will also clear the access code.

You can also read back on Modbus whether the correct passcode has been received by the Laser 3 Plus for the measurement in question. If the register returns 1 then the correct passcode has been received for that measurement and auto val will be allowed to start when commanded. If the address returns 0 then the correct passcode has not been received and auto val will not be allowed to start.

The registers are

- Auto Validation Pass Code
- Correct password received

Refer to the Modbus map in section 12.1.14 for the register address.

6.13.8.2 Step 2. Review and Edit Validation Process Parameters

Note that although this has been put as step 2, it is in fact entirely optional. Note also that you don't have to input the access code to edit the validation parameters. They can be edited at any time.

Things to note:

1. As long as you edit the parameters before starting auto validation, the values you enter will be used in the next run of auto validation.
2. The parameters are saved in non-volatile memory, so they are preserved across power cycles.
3. If you don't edit the parameters, then the currently saved values will be used.
4. There is one set of parameters per measurement. So e.g. on a CO+CH4 there is one set of parameters for CO and one set for CH4. Choose the appropriate Modbus register block for the measurement that you wish to edit.
5. The parameters are common with manual validation, so anything you edit for auto val will also affect manual val and vice versa.

Guidance on setting the various parameters is given in the table below:

Parameter Name	Units	Guidance
Validation pressure	Pressure units currently in use in the Laser 3 Plus	Set this to the pressure in the in-line validation cell. This is usually atmospheric pressure: 101325 Pa.
Validation temperature	Temperature units currently in use in the Laser 3 Plus	Set this to the temperature of the validation gas. This is usually room temperature at 296 K
Validation gas concentration	% or ppm	Set this to the concentration of the validation gas bottle.
Validation gas tolerance		This parameter is currently not used and should be set to zero
Validation pass level	Percent Difference %, This is the absolute value of the difference in % between the validation result and the validation bottle you are prepared to accept for your application.	Refer to section 6.13.8.15 for details of how the test result is calculated and therefore how the pass level should be set.
Validation cell length	Length units currently in use in the Laser 3 Plus	Set this to the length of the validation cell
Validation concentration standard deviation tolerance	%	The concentration standard deviation is a standard deviation value expressed as a percentage of the target measurement. Concentration standard deviation tolerance is used as the lower threshold when calculating whether the measurement is stable. Refer to section 6.13.8.5 for an explanation of how measurement stability is calculated. When setting this parameter, it should be set as low as possible to ensure an accurate validation measurement.
Validation transmission standard deviation tolerance	Counts	The transmission standard deviation is a raw value in counts that is the standard deviation of the current transmission ADC count. The transmission standard deviation tolerance is the lower threshold to be used when calculating whether the measurement is stable. When setting this parameter, it should be set as low as possible to ensure an accurate validation measurement.
Stability Time	Seconds	This is the continuous length of time that the process or the validation measurement must meet the stability criteria for to pass the stability test. Around 60 seconds is usually a good value.
Timeout	Seconds	If the measurement hasn't passed the stability test by the time this timeout has elapsed, then the stability test will be abandoned and auto validation will automatically advance to the next stage. Around 300 seconds is usually a good value.
Flush time	Seconds	Once the Laser 3 Plus has asked for either the zero-gas or span-gas to be turned on it will wait for this length of time for the gas to fully purge through the valves, pipework and validation cell. The correct value for the flush time is dependent on the physical configuration of the application and the level of surface adhesion of gas molecules, for example, NH3 and CO require higher flush times than O2 and N2.

Parameter Name	Units	Guidance
Low Signal Threshold	ADC counts	This should be set at a level that ensures that validation is performed in low signal mode. LSM is best suited to validation due to the extremely short path length. 250000 should be used for all applications apart from CO and CO+CH4 which should use 500000
Final zero threshold	%	This is the threshold for testing the validation cell concentration after the final purge. It should be set low enough that it gives confidence that the cell has been correctly purged. Care needs to be taken that it is not set so low that the test fails because of process drift that has occurred during validation.

6.13.8.3 Step 3. Start Auto Validation

Once the access code has been entered, auto validation can be started. Simply write a 1 to the appropriate address to start auto validation.

The register is

- Start or stop auto validation

Refer to the Modbus map in section 12.1.14 for the register address.

Things to note:

1. Auto Validation will not start if the analyzer is currently warming or in fault. The HMI can monitor these on Modbus.
2. Out of spec (“E”) faults are suppressed during auto validation. This is the same as manual validation and is designed to stop spurious faults from being reported. These can temporarily occur during validation as measurement parameters are changed. As the system response changes and settles to the new parameters, things can go out of spec for a few seconds. Once auto validation has finished and the measurement has been restored to normal, any remaining E faults are logged and reported in the usual way.

6.13.8.4 Aborting Auto Validation

It is possible to stop a running instance of auto validation. Write 0 to the same register that was used to start auto validation.

Auto Validation will not stop instantly as the system has to be restored to normal operation. This may involve purging the validation cell with zero-gas if it currently contains span-gas.

The Laser 3 Plus will know where abouts it is in the auto validation sequence and will automatically perform all necessary steps to correctly return the system to normal operation.

6.13.8.5 Step 4. Wait For Measurement Stability

The analyzer now checks that the measurement is stable. The criteria for judging that the measurement is stable are as follows:

Both the concentration standard deviation and transmission standard deviation for the measurement being validated must be below a certain level and must remain below that level for a continuous period of time.

Both the threshold levels and the stability times are settable parameters. If the stability criteria are not met within a timeout period, the auto validation process continues regardless. This is different from manual validation where an unstable measurement will cause validation to be aborted.

For the concentration, the stability threshold parameter is a standard deviation value expressed as a percentage of the target measurement. For the transmission, the standard deviation is just a raw value that is the standard deviation of the current transmission ADC count.

So for example a concentration standard deviation threshold value of 5.0, a transmission standard deviation threshold value of 15.0 and a stability time of 60 means that the standard deviation of the concentration must remain below 5% and the standard deviation of the transmission must remain below 15 continuously for 60 seconds.

The registers are

- concentration standard deviation
- transmission standard deviation
- Set Stability Time
- Set Flush Time
- Set Timeout Time

Refer to the Modbus map in section 12.1.14 for the register address.

6.13.8.6 Step 5. Turn On Zero-Gas

The analyzer will now ask for the zero-gas to be turned on. Just to reiterate, the Laser 3 Plus does not have the ability to control the external gas valves, so control of the zero and span-gas valves must be done by the HMI / purge panel. The Laser 3 Plus will indicate on particular Modbus registers whether the valves should be turned on or off.

Reading a 1 on a register means the valve should be turned on. Reading a 0 means the valve should be turned off.

The HMI should monitor these registers every few seconds so that it knows when to activate the valves

The registers are

- Required zero-gas valve state

- Required span-gas valve state

Refer to the Modbus map in section 12.1.14 for the register address.

Note that once the Laser 3 Plus asks for the zero-gas valve to be turned on, it assumes that this happens correctly and automatically proceeds to the next step which is zero-gas flush.

6.13.8.7 Step 6. Zero-gas Flush

The Laser 3 Plus will now wait for the zero-gas to flush through the validation cell. The flush time is a settable parameter.

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once the zero-gas flush has been completed.

6.13.8.8 Step 7. Apply Baseline Subtraction

The Laser 3 Plus will now apply baseline subtraction. This will remove the effect of the process measurement so that the validation span measurement will only measure the span-gas in the validation cell.

Note that as mentioned in the system overview section, baseline subtraction is not a perfect process. It takes a snapshot of the measurement spectra and then subtracts it from all future spectra until you turn off baseline subtraction. If the measurement does not drift and is not noisy then this should result in a concentration of 0%. However, in reality the measurement is noisy to a greater or lesser extent and the process itself will probably drift over time. This means that the concentration will probably not be exactly zero. Any non-zero component of the process measurement will appear as an error in the validation measurement.

This is why the first stage of validation (step 4) is to check that the process is stable enough to allow validation to proceed and to obtain meaningful results.

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once baseline subtraction has been applied.

6.13.8.9 Step 8. Wait for Measurement to Stabilize

Once we have applied baseline subtraction, we again have to wait for the measurement to stabilize. The measurement once it has stabilized should be about 0%.

The process is exactly the same as for step 4.

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once baseline stabilization has been completed.

6.13.8.10 Step 9. Take Zero Measurements

Now that we have zero-gas flushed through the validation cell and baseline subtraction is turned on, the analyzer will record the zero measurement.

The zero measurement will now be available for reading over Modbus.

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once the zero measurement has been recorded.

6.13.8.11 Step 10. Turn On Span-gas

The analyzer will now ask for the span-gas to be turned on and the zero-gas to be turned off.

The process is exactly the same as previously described for turning on the zero-gas.

As soon as it has asked for span-gas to be turned on, the Laser 3 Plus will proceed to the next step which is span-gas flush.

6.13.8.12 Step 11. Span-Gas Flush

The Laser 3 Plus will now wait for the span-gas to flush through the validation cell. The process is exactly the same as for the zero-gas flush in step 6.

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once span-gas flush has been completed.

6.13.8.13 Step 12. Wait for Span Measurement to Stabilize

Once we have completed the span-gas flush, we again have to wait for the measurement to stabilize. The measurement, once it has stabilized should be the validation gas concentration plus or minus a tolerance.

The process is exactly the same as for step 4.

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once span measurement stabilization has been completed.

6.13.8.14 Step 13. Take the Span Measurement

Now that we have span-gas flushed through the validation cell, and the measurement is stable, the laser 3 Plus will record the span measurement.

The span measurement will now be available for reading over Modbus.

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once the span measurement has been recorded

6.13.8.15 Step 14. Produce the Validation Test Result

Now that the Laser 3 Plus has taken both the zero and span measurements it can calculate the validation test result based on the parameters that have been set by the user.

The table below shows the data used in the test result calculation and the calculation steps that give the validation test result.

Data used in the calculation	
ValPassLevel	User settable. This is the threshold for the validation result
ValConc	User settable. The concentration of the validation gas
ValTol	User settable. The tolerance of the validation gas
span measurement	The calculated span measurement
zero measurement	The calculated zero measurement
The calculation steps	
step 1	bumpConc = span measurement - zero measurement
step 2	diff = abs(bumpConc - ValConc)
step 3	result = abs(diff - ValTol) / ValConc * 100
step 4	if result < ValPassLevel the test has PASSED otherwise the test has FAILED

The test result data is available on a Modbus register as described in section 12.1.14

6.13.8.16 Step 15. Turn off span-gas

The analyzer will now ask for the span-gas to be turned off and the zero-gas to be turned on.

The process is exactly the same as previously described.

The Laser 3 Plus will automatically proceed to the next step which is zero-gas flush.

6.13.8.17 Step 16. Zero-gas Flush

The Laser 3 Plus will now wait for the zero-gas to flush through the validation cell. The flush time is a settable parameter.

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once the zero-gas flush has been completed.

6.13.8.18 Step 17. Wait For Stability

The Laser 3 Plus now again waits for the measurement to stabilize. The process is exactly the same as described previously

There is no involvement from the HMI in this step and the Laser 3 Plus will automatically proceed to the next step once the stability check has completed.

6.13.8.19 Step 18. Check that validation Cell has been Purged

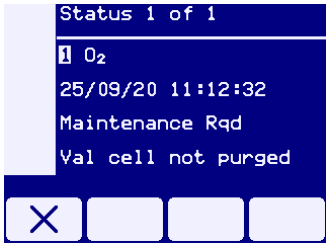
The Laser 3 Plus will now check that the validation cell has been purged correctly. This involves checking that the measured concentration is below a threshold value. This threshold concentration is user settable via Modbus.

The registers are

- Final zero threshold
- Validation cell not purged

Refer to the Modbus map in section 12.1.14 for the register address.

If the measurement is not below the threshold, the Laser 3 Plus will raise a maintenance required flag with the status “Val Cell Not Purged”. It will be present in the status log as shown below:



The reason for raising this status flag is safety related. If the cell is not purged properly then on exit from auto validation it may still contain span-gas. This could result in the analyzer producing an incorrect process measurement. There would be no other fault or anything to let the user know that the measurement may not be correct.

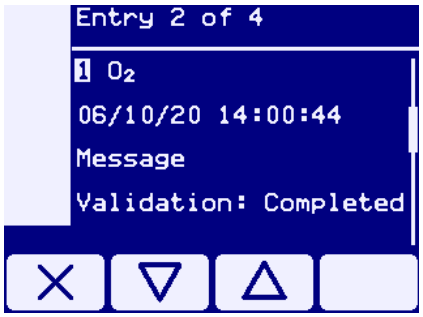
This status flag is persistent across power cycles. The only way to clear it is to run another auto validation cycle. If at the end of the next cycle the cell measurement is below the threshold, the status flag will be cleared.

6.13.8.20 Step 19. Turn Off baseline Subtraction And Exit

Once the cell purge check has been completed, the analyzer will turn off baseline subtraction. This will allow the normal process measurement to be re-established. It takes several minutes for the measurement to return to normal as it is heavily filtered and it takes time for a change in concentration to make its way through the filters. So the analyzer will wait for a period to allow this stabilization to take place. Note that the in-service flag remains active at this time so that any connected system knows not to trust the measurement.

There is no involvement from the HMI in this stage.

At the end of this final stabilization time, the analyzer will automatically return to normal operation and the in-service flag will be deactivated. An entry will be logged in the status history saying that auto validation has been completed successfully. Note that successfully completing auto validation is not saying whether the test passed or failed. It is merely saying that the test procedure got through to the end without being aborted or any fatal faults occurring.

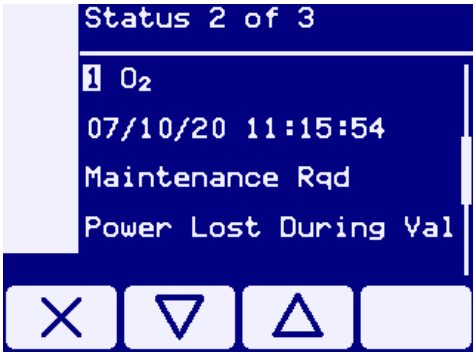


In order to see whether auto validation has passed or failed there are two methods.

- The test result can be read back on its own Modbus register. The Modbus map in section 12.1.14 shows which register to use and what the different register values mean.
- Look at the result in the calibration history. On completion of auto val, a cal history entry is created. This contains the pass/fail status together with other data relevant to validation

6.13.9 Power Interruptions During Auto Validation

If there is a power interruption during auto validation, then a maintenance level fault will be logged when the analyzer is next powered on. It can be seen in the status log as shown below:



This is a safety feature that is similar to the check at the end of auto val that the cell has been purged correctly. If the power is interrupted at a random time during auto validation, it may be at a point when the cell contains span-gas. When the analyzer repowers, the cell may still contain the span-gas. This is an unsafe condition as the analyzer will be producing an incorrect measurement with no indication to the user that anything is wrong. So this maintenance flag is raised to indicate that the measurement may not be correct.

To clear the maintenance flag, run a complete manual or auto validation cycle and it will be automatically cleared.

7. Installation

7.1 Installation preparations

Before you can use your Laser 3 Plus, you must make a few preparations first.

Required tools and equipment

You will need the following tools and equipment to install and commission the Laser 3 Plus:

Tool or equipment	Quantity	Used for
18 mm open-ended wrenches	2	M12 bolts and nuts
24 mm open-ended wrenches	2	M16 bolts and nuts and M16 blanking plugs
M4 socket driver or 7 mm open-ended wrench	1	M4 internal screen nuts
30 mm open-ended wrench	1	Ball joint locking nut on adjustable alignment flange
5 mm Allen key	1	M6 instrument / quick connect locking bolts
3 mm Allen key	1	Lid and gland plate screws transmitter and receiver units and external earth screws Alignment screws on adjustable alignment flange
2.5 mm flat head screwdriver	1	Electrical connections
Anti-Seizure paste Copperslip or equivalent		Mounting hardware
Fittings or blanks		Purge connections
Alignment tool		May be used for flange alignment and analyzer mounting
RJ45 connectors and crimping tool		Cable connections
Micro SD card		Backing up post commissioning

Table 7-1: Pre-installation check list

Note:*Other wrenches required as appropriate for M16 and M20 cable glands, adaptors and/or conduit being fitted.*

7.1.1 Items to remove before installation

The Transmitter Unit of the Laser 3 Plus is shipped with all ports blocked. In order for safe operation of the unit, the fitting on purge port 3 (back of the unit) should have the blanking nut removed and replaced with the nut and ferrule accessory supplied in a separate bag. The blank nut must be retained in the event of transport to another location.

Ensure that Purge Port 3 of the Transmitter Unit, 'Enclosure Out', is free to vent to atmosphere before operation of the instrument.

The transmitter unit is also shipped with a small bag of silica gel inside the enclosure unit. Ensure that this bag of gel is removed before operating the instrument. If the bag has ruptured during transit, ensure that any particles of silica gel are removed from the instrument before operation.

Remove Silica Gel sachet before attempting to operate the instrument.

The Gland plate on the transmitter unit is shipped with all gland entries sealed with a stopping plug. Ensure that any plugs that are removed during the course of wiring the instrument, are retained in the event that the instrument needs to be transported to another location.

Ensure that any parts which are removed for the purposes of installation are retained. They must be refitted in the event the instrument is transported to another location.

7.1.2 Installation location

Make sure that you mount the Laser 3 Plus on a structure that is able to support its mass (refer to 2.6.1 for the transmitter unit and for the receiver unit).

The environmental operating conditions for the Laser 3 Plus are listed in Section 2.6.5.

Make sure that all floors and platforms are clear and free from obstructions, and that the engineer has sufficient space to move freely and change posture.

The Analyzer may fail if you use materials to connect the Laser 3 Plus to the process that are not compatible with the process environment.

When you decide where to place the Laser 3 Plus in the process, we recommend a minimum of 5 stack diameters of straight duct before and 2 stack diameters of straight duct after the measurement point. Recommended distance from the process wall, duct or pipe to the welded flange is a minimum of 100 mm. This will need to be increased, or thermal break added, for process temperatures above 135°C.

7.1.3 Analyzer placement

You should place the transmitter and receiver units so they are easily accessible. A person should be able to stand in front of the transmitter to view the display and access the alignment mounting to make adjustments. Cabling exiting the Analyzer should also be considered.

Each unit requires at least 500 mm (19.7 ") of free space (measured from flange to the stack and outwards).

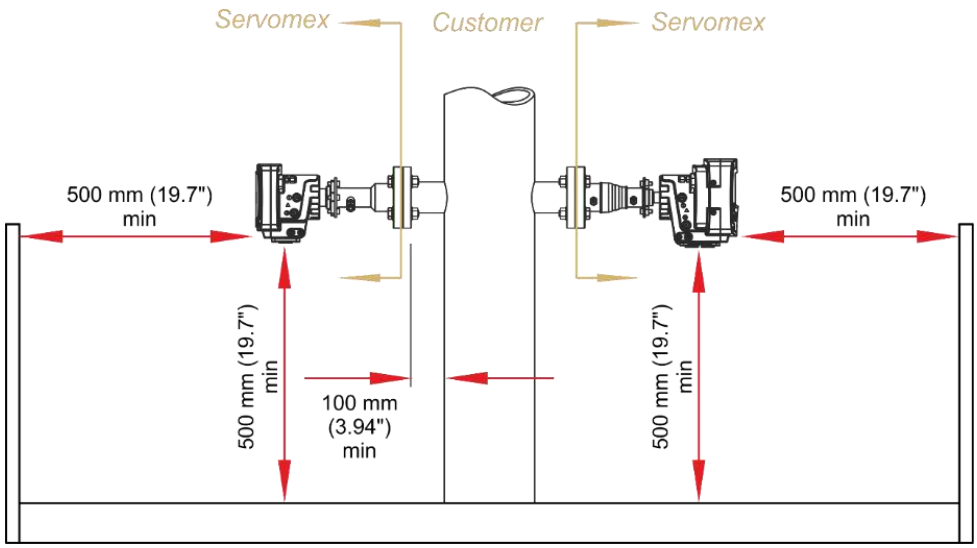


Figure 7-1: Laser 3 Plus installation distances

7.1.4 Process flanges

The Laser 3 Plus attaches to process flanges that must be welded either to the relevant process pipework, duct or furnace wall or, for pipework up to 150 mm (6 ") in diameter, to a spool piece supplied by Servomex.

The user can attach the laser analyzer mounting assemblies (fixed or adjustable) to the process flange either directly with appropriate gaskets, or via an isolation valve or an isolation window, depending on your application. If your process is corrosive, toxic or flammable, you must use isolation valves that are mechanically and chemically compatible with the process. When these valves are closed, you can easily remove the analyzer from the installation for maintenance procedures without stopping the process.

Always wear the appropriate PPE to minimize the risk of burns.

The maximum process pressures for the Laser 3 Plus are listed in Section 2.6.6. For installations based in the European Union, in all applications operating above the maximum process pressures, the Pressure Equipment Directive (PED) applies and an appropriate isolation flange must be fitted.

Install and use the isolation flanges in accordance with their manufacturer's instructions.

If the process gas temperature is greater than 135 °C (275 °F), make sure that you provide adequate thermal isolation to ensure that the maximum temperature reached by the process flange to which the Laser 3 Plus is fixed does not exceed 135 °C (275 °F).

When using thermal spacers, do not exceed a maximum torque of 25 Nm for fixing bolts, otherwise damage may occur to the spacer.

Hint: *Servomex can provide thermal spacers for a range of flange sizes.*

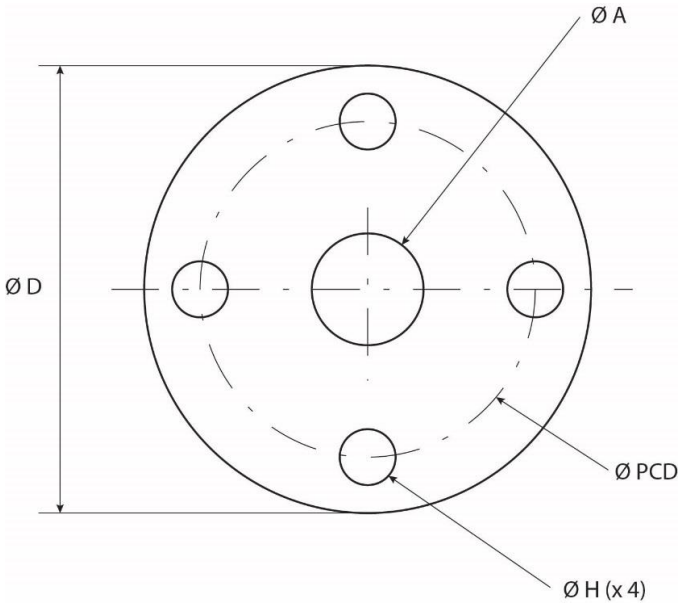
It is important that the process flanges are aligned correctly as they are critical to ensuring the successful alignment and maximum transmission of the Laser 3 Plus.

Avoid installing near reflective surfaces, particularly those found within the process. Stray or reflected light entering the analyzer can impact its performance.

The Laser 3 Plus requires 2 holes of at least 25 mm (1") in diameter to be cut diametrically opposite to each other in order to enable the laser beam to pass through the process gas.

Note: *The size of the hole depends on the process flange that you are using, application and path length.*

The flange dimensions are listed in and the following tables.



(x 8 for 4” ANSI)

Figure 7-2: Laser 3 Plus flange dimensions

7.1.4.1 Process flange dimensions

DIN PN10 flange dimensions (dimensions in mm (inches))

Overall diameter, ØD	Hole pitch circle diameter, ØPCD	Hole diameter, ØH (equi-spaced)	Hole diameter, ØA	Flange designation
115.0 (4.528)	85.0 (3.346)	14.0 (0.551)	25.0 (0.984)	DN25
165.0 (6.496)	125.0 (4.921)	18.0 (0.709)	50.0 (1.968)	DN50

ANSI Class 150 Flange Dimensions (dimensions in mm (inches))

Overall diameter, ØD	Hole pitch circle diameter, ØPCD	Hole diameter, ØH (equi-spaced)	Hole diameter, ØA	Flange designation
108.0 (4.252)	79.4 (3.126)	15.9 (0.626)	34.4 (1.354)	ANSI 1” 150 #

Overall diameter, ØD	Hole pitch circle diameter, ØPCD	Hole diameter, ØH (equi-spaced)	Hole diameter, ØA	Flange designation
152.4 (6)	120.7 (4.752)	19.1 (0.752)	61.1 (2.405)	ANSI 2” 150 #
190.5 (7.5)	152.4 (6)	19.1 (0.752)	90.3 (3.555)	ANSI 3” 150 #
228.60 (9)	190.50 (7.5)	19.1 (0.752)	116 (4.566)	ANSI 4” 150 #

7.1.4.2 Process flange alignment tolerances

The transmitter and / or receiver instrument flanges are provided with an alignment mechanism that allows limited manual adjustment of the laser beam direction in 2 planes.

So that this operates correctly after the instrument is installed, use the following tolerances for positioning and attaching the process flanges.

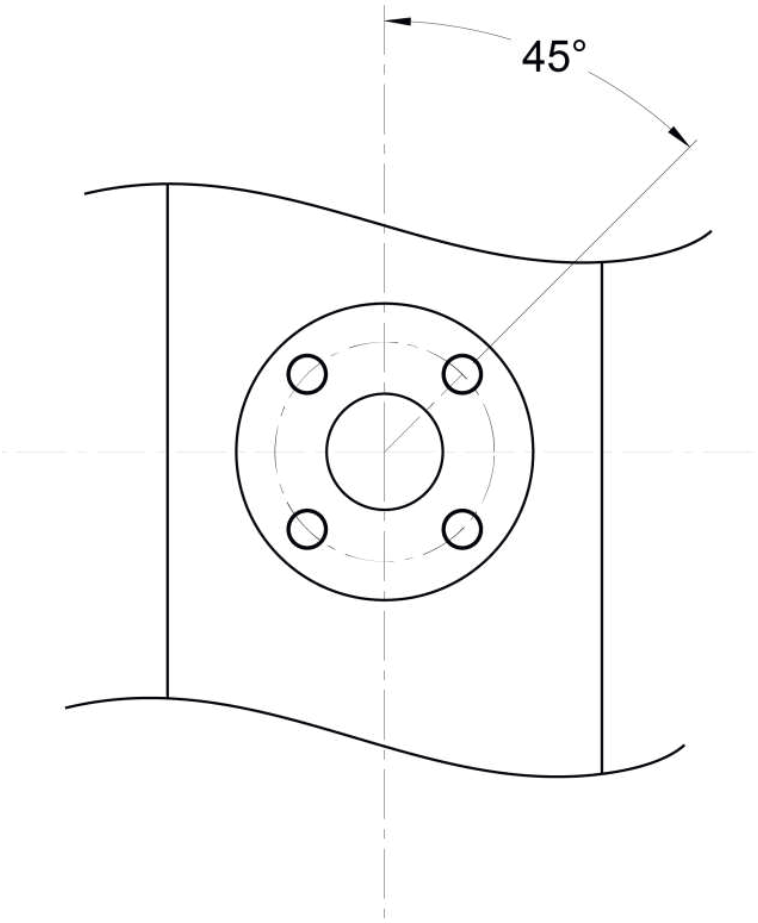


Figure 7-3: Process flange bolt arrangement (4 bolt pattern)

The flange bolt pattern must be:

4 bolt pattern	45 °
8 bolt pattern	22.5 ° (not shown)

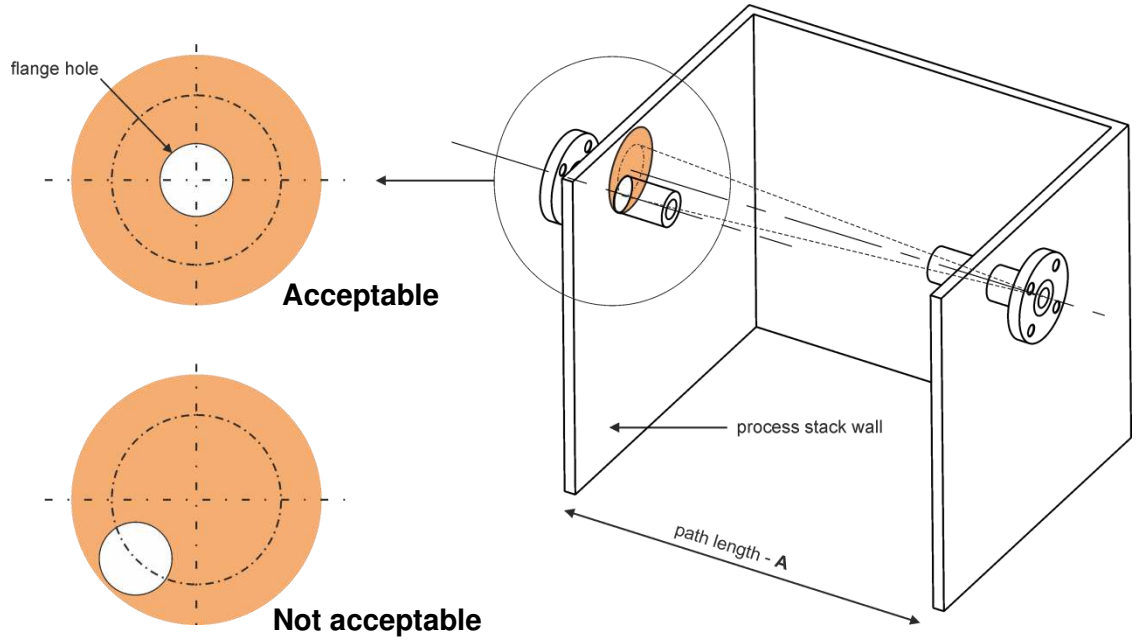


Figure 7-4: Process flange positioning tolerance

Note:*Failure to align the transmitter and receiver flanges may adversely affect the performance. Tolerance to misalignment is dependent on divergence, path length and measurement. For further advice contact Servomex or local representative.*

7.1.5 Mounting rigidity

Make sure that the flue wall is strong enough to support the weight of the Laser 3 Plus transmitter and receiver units, including the mounting flanges and unsupported cables.

Install the Laser 3 Plus on a structure that is capable of supporting the weight of the transmitter unit (TU) and receiver unit (RU). If the structure is not strong enough, you will experience alignment problems during commissioning and operation.

The following illustrations of a high temperature mounting arrangement for the TU and RU, where the units have been mounted 200 mm (7.87”) from the process wall. Particular attention is required on the TU as the extra weight may require reinforcement of the process wall to counter the moment produced by the distance from the process wall.

Always allow for the weight of the cable in addition to the weight of the TU and RU.

The 'free-hanging' un-supported weight of cables should not exceed the weight of the unit.

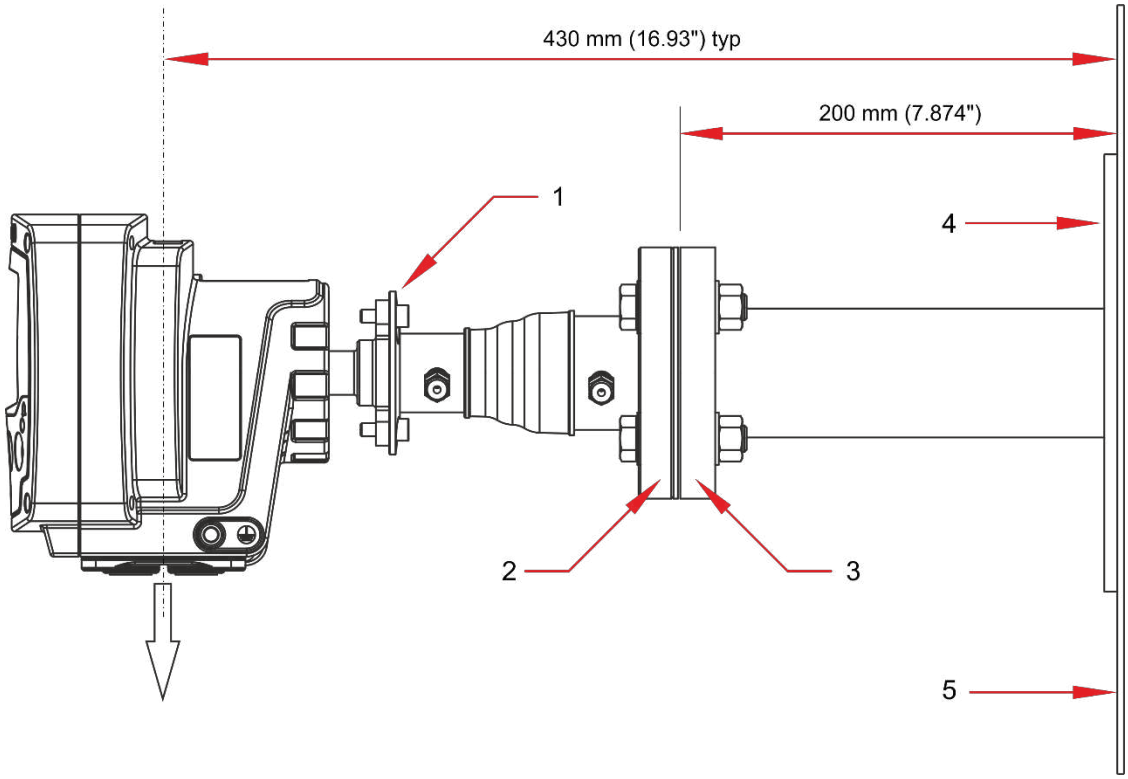


Figure 7-5: Transmitter unit mounting arrangement (example shown with adjustable mount)

1	Analyzer mounting flange
2	Adjustable mount flange
3	Process flange
4	Process flange reinforcement plate
5	Process wall
Transmitter Unit =	2.0 kg (4.4 lb.)
Flange =	3.5 kg (7.7 lb.)
Unsupported cable weight =	3.5 kg (7.7 lb.)
Total =	9.0 kg (19.8 lb.)

If the process wall is not strong enough to support the TU or RU, Servomex recommend that you use a reinforcement plate.

Note:*It is your responsibility to assess and design the reinforcement plate that you will use in your installation, subject to local conditions.*

This reinforcement plate could be part of the process flange (as shown in diagrams) or a separate reinforced section of the process wall.

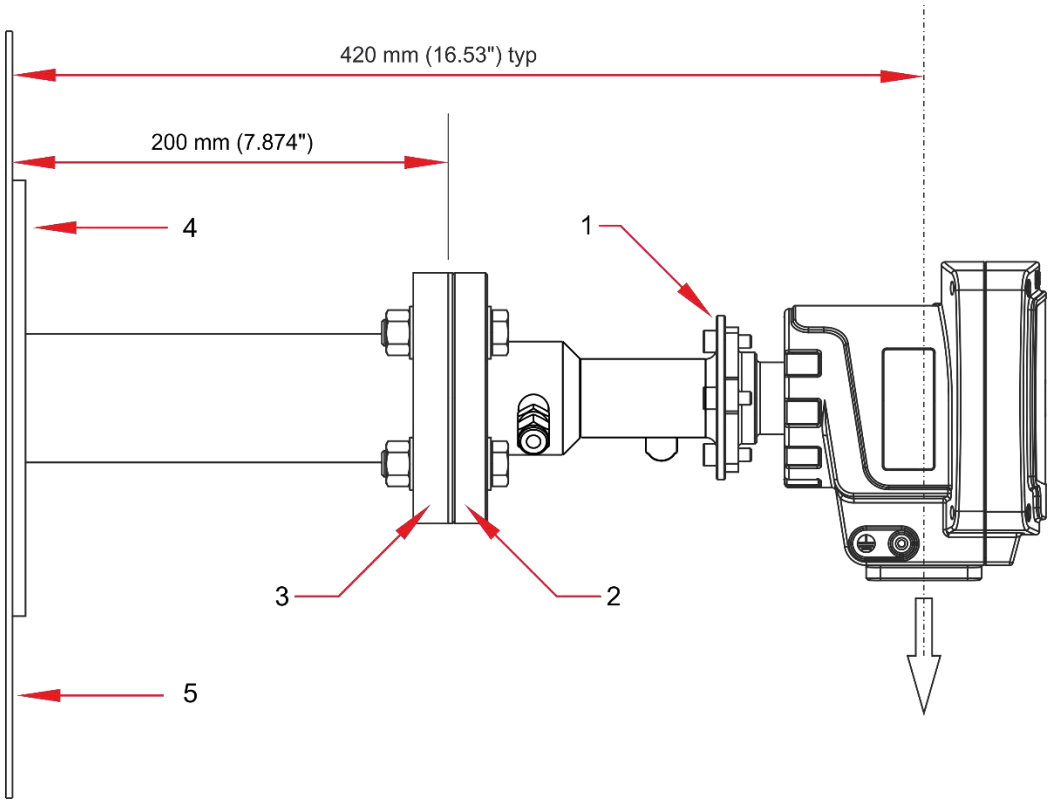


Figure 7-6: Receiver unit mounting arrangement (example shown with fixed mount)

1	Analyzer mounting flange
2	Fixed mount flange
3	Process flange
4	Process flange reinforcement plate
5	Process wall
Receiver Unit =	1.6 kg (3.5 lb.)
Flange =	2.5 kg (5.5 lb.)
Unsupported cable weight =	2.0 kg (4.4 lb.)
Total =	6.1 kg (13.4 lb.)

As the TU weighs considerably more than the RU, support for the RU is less of an issue. However, you should use a similar mounting arrangement for consistency.

Note:*An alternative to the reinforcement plate is to provide ceiling or floor supports to hold the weight of the TU or RU, although these may impact on the ease of alignment and adjustments.*

7.2 Installation overview

This section gives an overview of the installation procedures. It details the signal inputs and outputs available in the Laser 3 Plus transmitter and receiver units and outlines any conditions of use that you should consider before you install the instrument.

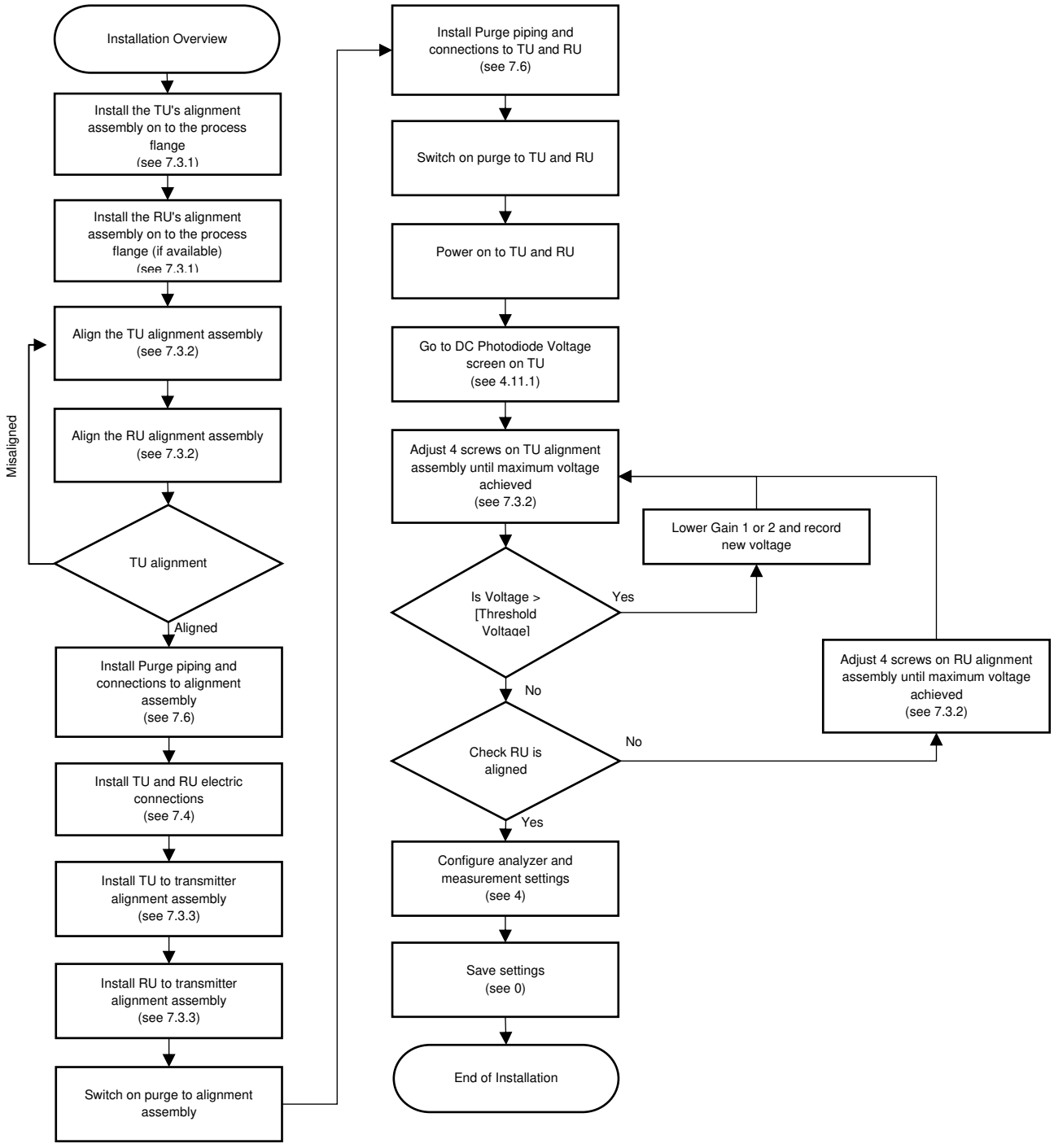


Figure 7-7: Installation overview

7.2.1 Safety

Do not install the Laser 3 Plus in a high velocity dust-laden atmosphere.

You are responsible for ensuring that:

- **The instrument is installed correctly and safely**
- **The laser beam is enclosed during operation**
- **The sampling system is leak free (if being used in bypass extractive configuration)**
- **The venting system is appropriate for the gases you are sampling**
- **The installation does not introduce trip hazards**
- **Appropriate PPE is used for installation, servicing and decommissioning**

Lubricate flange mounting threads with supplied anti-seize paste before you install the Laser 3 Plus.

The optical windows in the receiver and transmitter units are installed in the factory. Do not touch the optical windows as any contamination will adversely affect the performance of the Laser 3 Plus. For cleaning guidance see section 8.3.

Regularly inspect, test and replace seals to ensure that all external connections are always leak-free at full operating pressure.

The equipment is incapable of passing the dielectric strength test prescribed by the standards, and so this must be taken into account during installation by using an SELV power source with a prospective short circuit current not exceeding 40A.

7.2.2 Pre-installation checks

Use this checklist to ensure that all the prerequisites have been set up before you start to install the system:

Item	Checked
Check the services are installed (purge panel, power)	
Check the process flanges are fitted correctly	
Check the cable lengths are correct	
Check the cables are stripped correctly	
Unpack and check the components	
Check the tools list	
Mount the PSU or check the availability of a local 24 V supply	

Table 7-2: Pre-installation check list

7.2.3 Installation

Make sure that the flanges on the process walls are mounted and aligned correctly (Section 7.1).

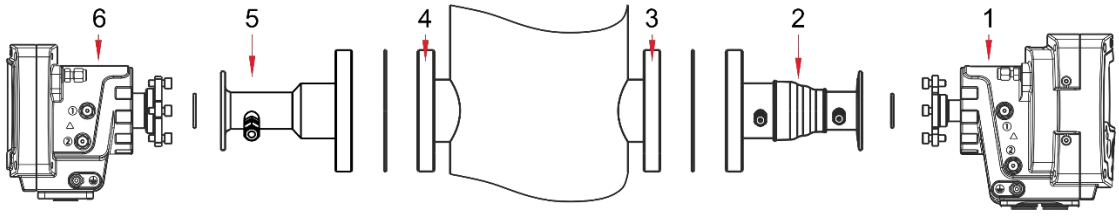


Figure 7-8: Laser 3 Plus in-situ installation

1	Transmitter unit
2	Transmitter alignment assembly
3	Process flange and nozzle
4	Process flange
5	Receiver mounting / alignment assembly
6	Receiver unit

7.3 Process connections

7.3.1 Fitting the transmitter and receiver alignment assemblies

Before you fit the transmitter and receiver alignment assembly to the process:

Make sure that there are no dangers from the release of potentially hazardous gases, for example, toxic, flammable, asphyxiant or hot gases.

Never look into a live process through the eye piece as this may result in hazardous radiation exposure and permanent eye damage.

Always use adequate eye protection to prevent injury from ejected dust or dirt and high levels of IR radiation that may be present.

Make sure that the exposed metal parts of the process are at the same potential as that of its surroundings. If not, use suitable protective equipment to provide protection against the risk of electric shock.

Make sure that the Laser 3 Plus is switched off.

***Note**:The mounting / alignment assemblies are adjustable; the receiver alignment / purging flange may be fixed for shorter path lengths.*

Bolt the transmitter and receiver instrument flanges to the process flanges using the standard bolts, nuts and washers provided.

***Note**: Use an anti-seize paste on these threads only. Anti-seize paste must not be used on any other fasteners, nor be allowed to contaminate the optics.*

The tolerances of the standard flanges, bolts and holes allow them to be misaligned from concentric. Therefore, when you fasten the flanges, make sure that the two flanges are concentric to aid laser beam alignment.

***Note:**If the process flange temperature is in excess of 135 °C, use a thermal spacer insulating flange gasket to minimize heat transfer to the instrument flanges.*

Ensure flange O-rings are fitted to the analyzer mounting flanges.

***Note:**Orientate the mounting assembly so that the purge connections are pointing to the left (as viewed looking at the process wall) to ensure the TU and RU mount vertically.*

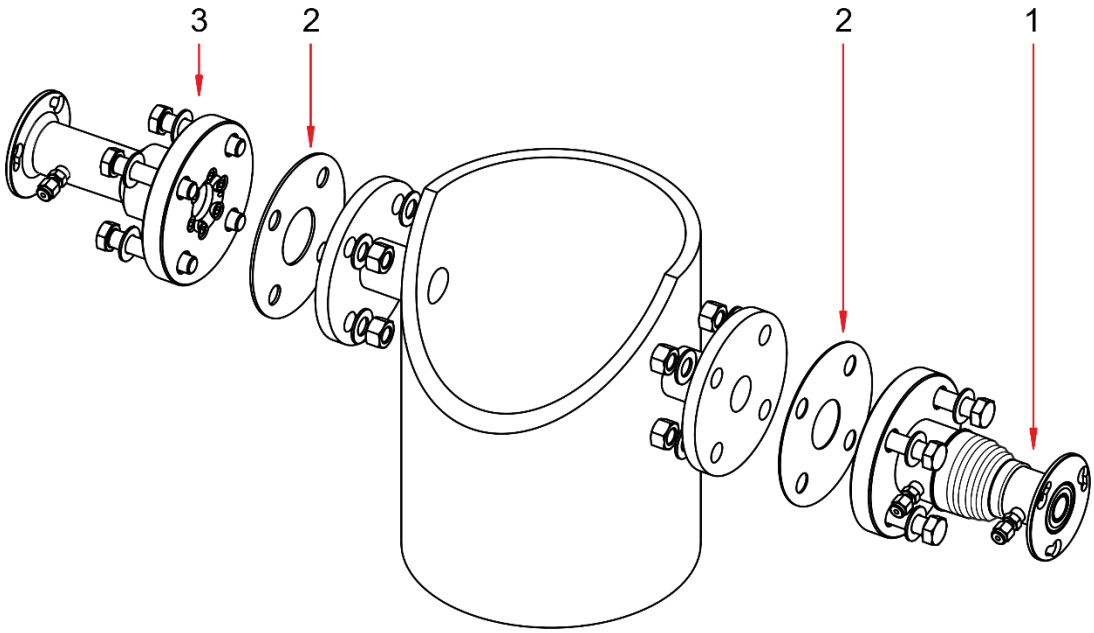


Figure 7-9: Example of mounting / alignment assembly fitting exploded view

1	Transmitter alignment assembly
2	Gasket
3	Receiver alignment assembly

7.3.2 Alignment of the transmitter and receiver alignment assemblies

Do not use the alignment tool if the process flange is hot (> 60°C), or if the process contains potentially hazardous gases.

Only use the light source supplied by Servomex with the alignment tool.

Make sure that there are no dangers from the release of potentially hazardous gases, for example, toxic, flammable, asphyxiant or hot gases.

Always use adequate eye protection to prevent injury from ejected dust or dirt and high levels of IR radiation that may be present.

Never look into a live process through the eye piece as this may result in hazardous radiation exposure and permanent eye damage.

Refer to	
Step 1	Switch on to light source in order to check operation before fitting then fit the alignment tool light source assembly to the Analyzer flange (fixed or adjustable) on the RU side of the process using 3 off M6 x 16 screws. Switch the light source on
Step2	Fit the alignment tool eye piece assembly to the Analyzer flange (adjustable) on the TU side of the process using 3 off M6x16 screws. Peel back the protective boot on the ball joint assembly to reveal the adjusting screws (Figure 7-10)
Note:	*Ensure all the M6 x 16 screws are tight before beginning the alignment process.*
Step 3	Loosen the adjustment nuts and screws by turning anti-clockwise. Ref (Figure 7-25)
Step 4	For correct alignment the light source must be in the center of the eye piece. If the eye piece is off target adjust the TU/RU alignment assembly tighten the adjustment screws to lock the assembly in position. This is easiest to do with two hex keys, one to loosen and the other to tighten.
Note:	*All adjusting screws have a right hand M6 thread and give an angular resolution of 1.8º per screw turn. The ball joint may be adjusted by ±4º in each direction*
Step 5	When all adjustments are complete, ensure all screws are locked in place
Hint:	*Taking care not to change the position of the assembly during steps 5 and 6*
Step 6	Remove the alignment tool scope assembly and replace the boot immediately
Step 7	Switch off the alignment tool light source assembly and remove it from the RU
Step 8	If the analyzer has been supplied with an adjustable, rather than fixed mounting assembly at the receiver end, fit the alignment tool light source assembly to the analyzer flange on the TU side of the process as described in step 1. Fit the alignment tool scope assembly to the RU side of the process as described in step 2 and repeat steps 4 to 7, to align and secure the second analyzer mounting assembly.
Note:	*The adjustable receiver mount is adjusted by a combination of set screws and mounting screws, see* Figure 7-26*.*

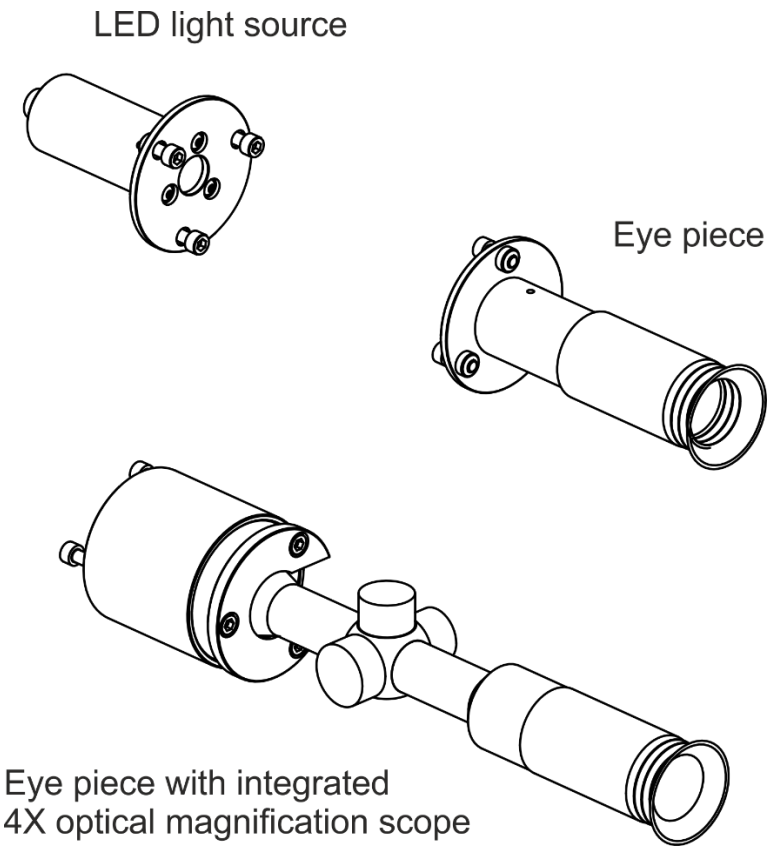


Figure 7-10 Alignment tool

The alignment tool comprises a LED light source and eye pieces which are fitted to an adaptor on each opposing flange. Align in accordance with tolerances in section 7.1.4 by lining up the eye piece with the light source until the LED source is concentric to the relative bores and eye piece.

For extended path lengths (over 5 meters) an eye piece with integrated scope is available with an optical magnification factor of 4X and crosshair target.

The alignment tool is NOT Ex certified.

It CANNOT be used where a FLAMMABLE atmosphere is present in the 'Outside atmosphere' or the 'process atmosphere'.

It MUST NOT be used where an EXPLOSIVE atmosphere is present in the 'outside atmosphere' or the 'Process atmosphere'.

The alignment tool must not be used where there is a risk of exposure to hazardous gases contained in the process.

7.3.3 Fitting the transmitter and receiver on the flange

Inspect all joints when you have connected the Laser 3 Plus to the process.

Do not apply power to the transmitter unit before both the transmitter and receiver units are fitted to the Analyzer flanges and front panels have been closed. This ensures that there is no risk of exposure to laser light.

Make sure that there is enough space at the base and sides of the enclosure to open the covers and to route cables and pipework without tight bends.

Note:*Although the following diagrams show the TU, use the same technique for the RU.*

Check the O-ring is in place on the transmitter / receiver flange before installation.

Loosen the 3 x M6 screws and align them with the corresponding keyhole slots on the flange joint (Figure 7-11).

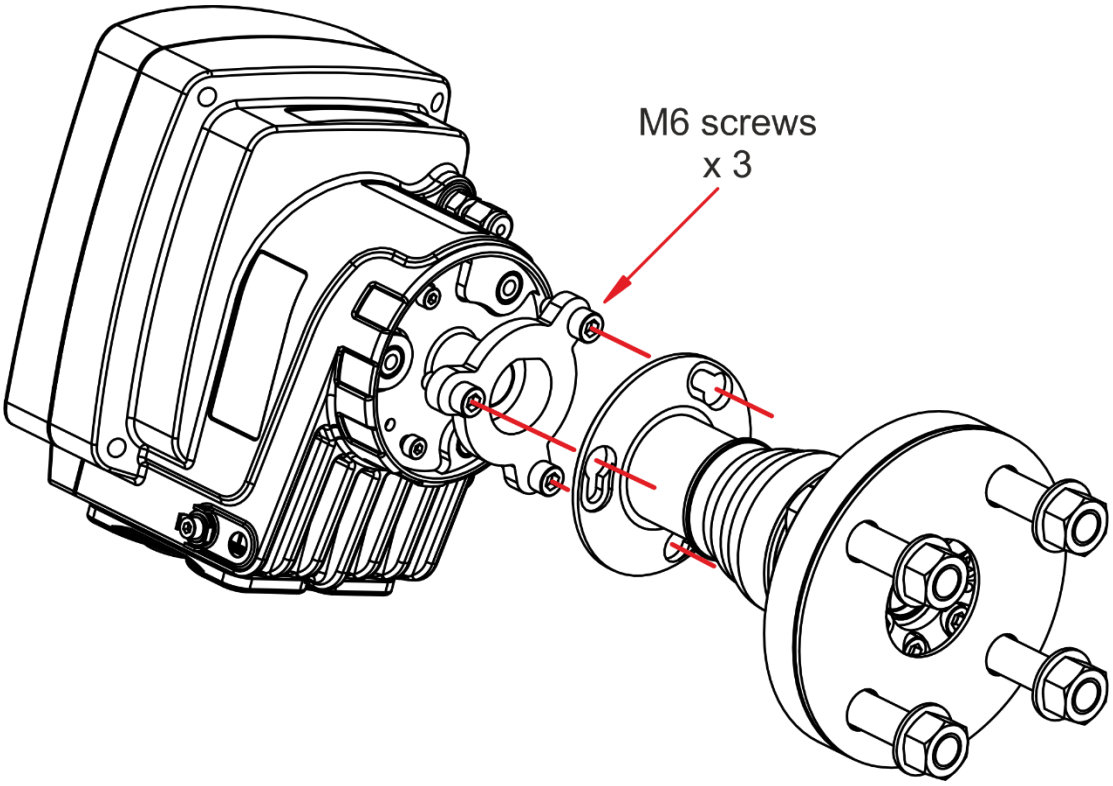


Figure 7-11: Align M6 screws with the flange joint

Rotate the enclosure until it stops at the end of the keyhole slots.

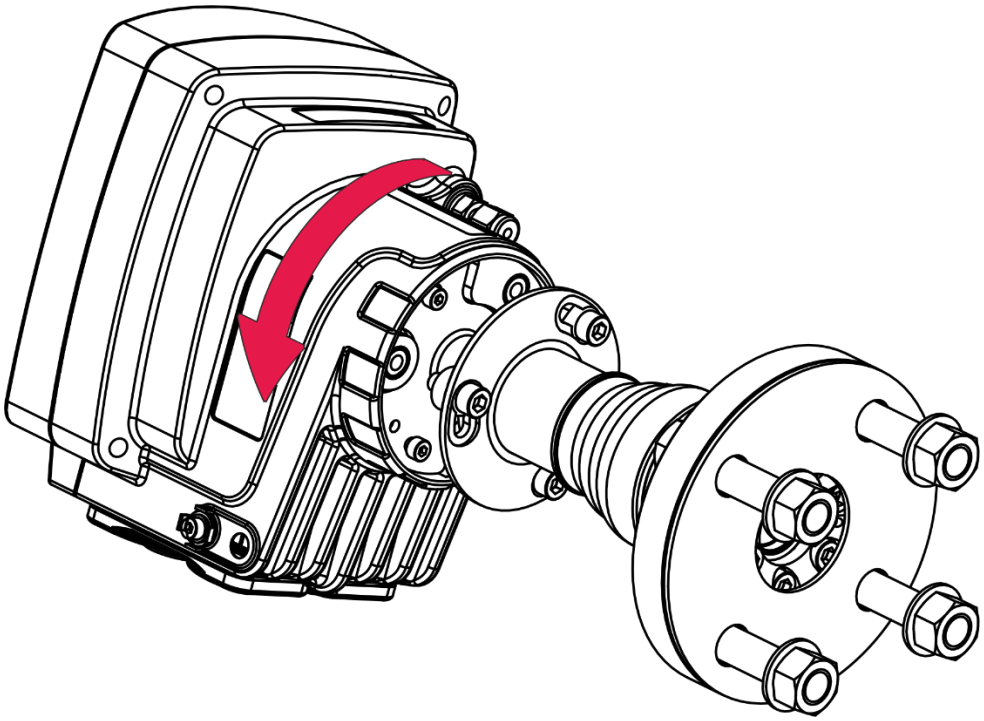


Figure 7-12: Rotate the enclosure

Tighten the 3x M6 screws to secure the flange.

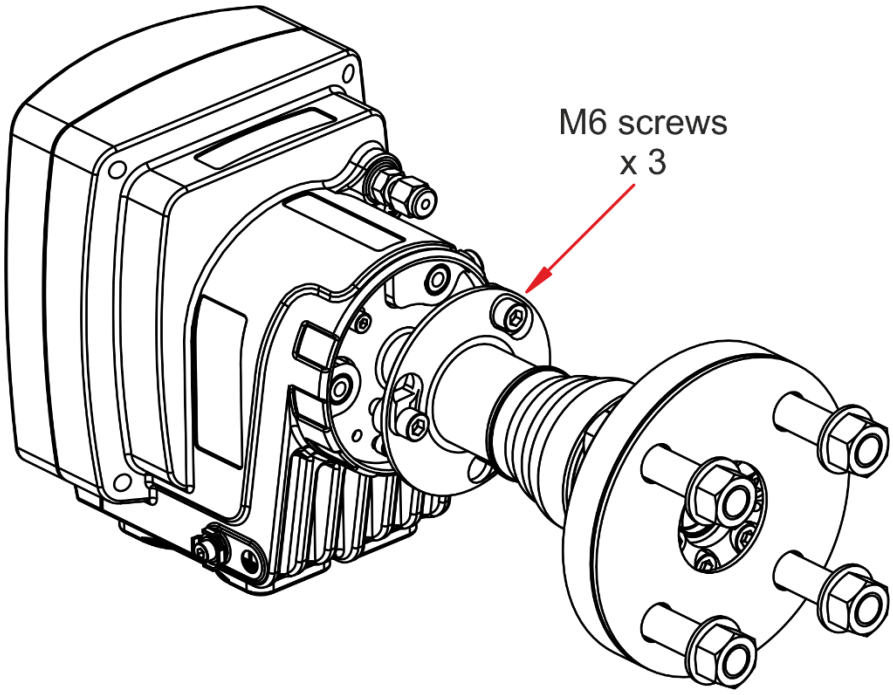


Figure 7-13: Tighten the M6 screws

7.4 Electrical connections

7.4.1 General safety

Make sure you read and understand the warnings and cautions in this section before you proceed

Make sure that you install the instrument to conform to all relevant safety requirements, National Electrical Code and any local regulations. The installation must be safe for any extremes of operating conditions which may occur in the operating environment of the Laser 3 Plus.

It is a condition of certification that the unit must be installed following the appropriate national or international legislation or codes of practice. In particular, you must make sure that the correct glands are fitted to cable entries and that you do not compromise the weatherproofing of the enclosure.

The Laser 3 Plus does not incorporate an integral on/off switch. You must provide a means of externally isolating the electrical supply from the Laser Analyzer. Use a suitable switch or circuit breaker located close to the Laser Analyzer clearly marked as the disconnecting device for the Laser Analyzer. This must also incorporate a suitable fuse or over-current protection device, set to or rated at no more than 3 A. To comply with the relevant safety requirements this power disconnection device must be approved to:

- **UL 489 for equipment used in the USA**
- **CSA C22.2 No. 5.1 for equipment used in Canada**
- **IEC 60497 for equipment used in the EU and the rest of the world**

Equipment connected to the DC power input, mA and Ethernet outputs, relay terminals and mA input terminals must be separated from AC mains voltages by at least reinforced insulation or equivalent.

All of the electrical connections to the Laser 3 Plus are considered to be incendive and must only be connected to safe area equipment.

Only remove enclosure covers (that is gland plates and enclosure doors) if there is a negligible risk of pollution of the electronic circuits due to moisture, liquids, dirt, dust or other contamination.

Before you refit the covers, make sure that the sealing gaskets are clean, dry and undamaged. Replace and secure all covers as soon as possible after you complete your task within the enclosure.

Disconnect all cables from the Laser 3 Plus when you carry out insulation testing on them.

Make sure your electrical supply can provide the necessary maximum power consumption of 25 W.

7.4.2 Glands and cable entries

The following instructions apply to installations that must comply with electrical safety requirements of IEC 61010 and Local Hazardous Area requirements.

To meet IEC61010 and Hazardous Area requirements, the cables glands used with the Laser 3 Plus must:

- Be made of metal or have a flammability rating of V-1 or better
- Be rated for temperatures from -20 °C to +75 °C (-4 to 167 °F)
- Be selected to provide cable strain relief. The effectiveness of the strain relief must withstand pulling and twisting as specified in the relevant safety standard applicable to the installation
- Be UL or CSA approved if you are installing the Laser 3 Plus in the USA or Canada. Blanking plugs must also be UL or CSA approved
- Maintain the IP66 level of environmental protection classification specified for the Laser 3 Plus

Fit suitable blanking plugs to any unused cable entries. These must be made of metal or have a flammability rating of V-1 or better.

Hint: *As the gland plates are completely removable, feeding cable through glands, cutting, trimming and connector fitting may be completed in advance while the gland plate is not fitted to the analyser and pre installation.*

7.4.2.1 Cable screens

- The screens of all the cables connected to the analyzer must be terminated within metal glands.

7.4.2.2 Cable strip lengths

Strip all cables to the dimensions shown in Figure 7-14: Cable strip lengths below.

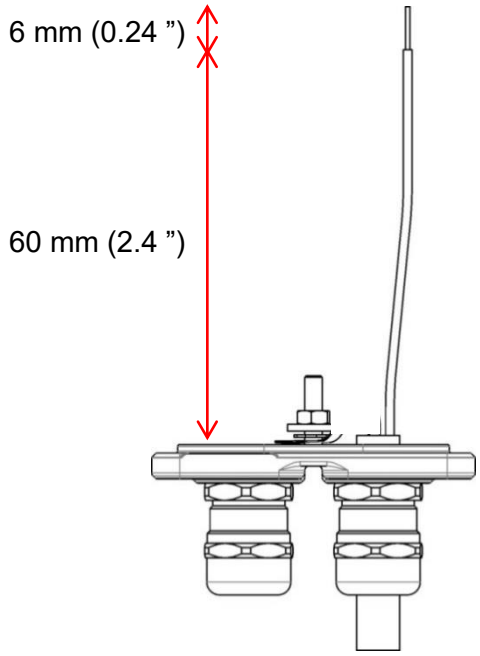


Figure 7-14: Cable strip lengths

7.4.2.3 Cable gland and blanking plug sizes

7.3.4.2.1 Receiver unit

Use one M20 x 1.5 mm cable gland in the receiver unit.

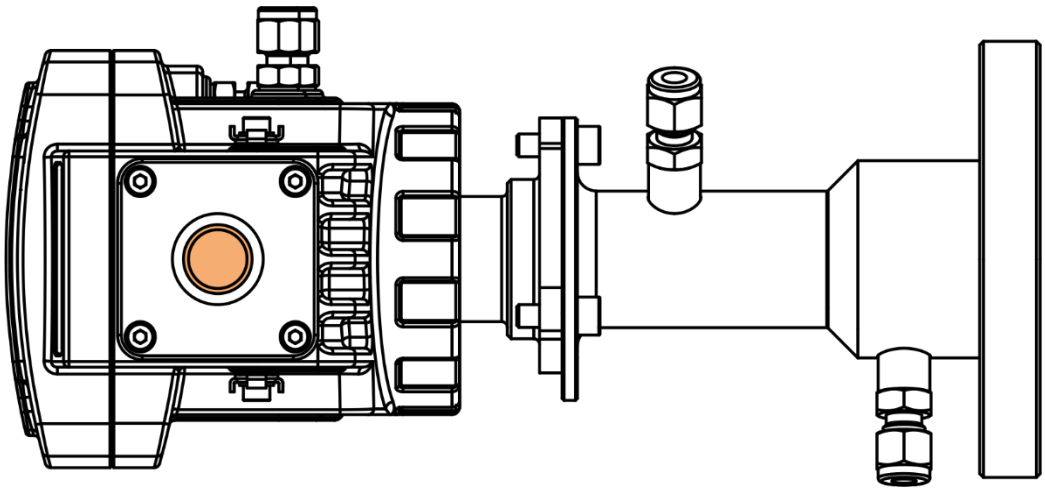


Figure 7-15: Receiver unit cable gland position

7.3.4.2.2 Transmitter unit

Use the following cable glands or blanking plugs in the transmitter unit:

Ports 2 and 3	2 x M16 x 1.5 mm
Ports 1 and 4	2 x M20 x 1.5 mm

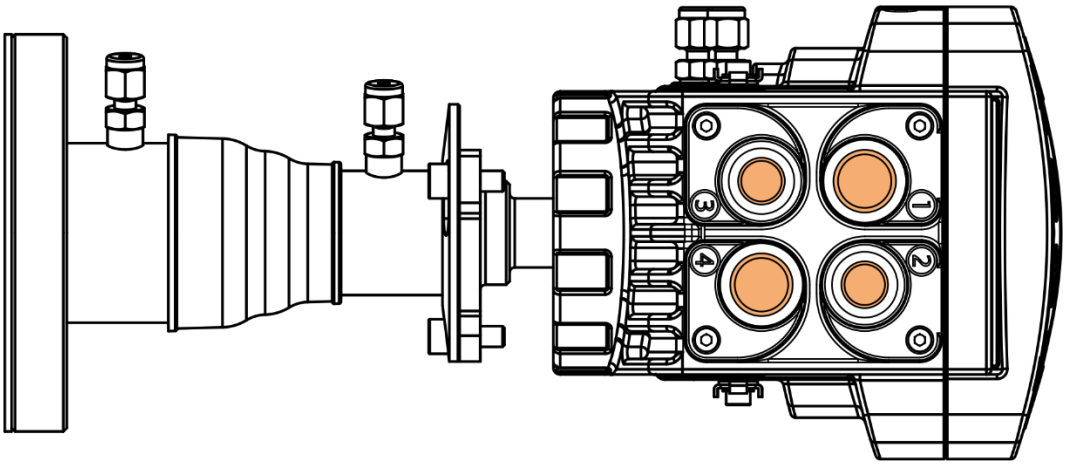


Figure 7-16: Transmitter unit cable gland positions

Note:*The cable glands and blanking plugs must be certified to IP66.*

7.5 Functional earth / ground requirements

Use a suitable conductor to connect the Analyzer external earth (ground) terminal to a local equipotential earth (ground) point. You can use flexible or solid conductors, up to 10mm^2 (7 AWG) up to a maximum length of 2m (6’ 6.75”).

7.5.1 Power cable connections

You can connect the Laser 3 Plus to a 24 VDC supply on site (voltage range of 18 to 30 VDC).

Make sure that the electrical supply voltage shown on the rating label is correct for the available electrical supply. Do not install the equipment if the incorrect voltage is shown and contact Servomex or your local Servomex agent immediately.

Make sure that the DC power for the Laser 3 Plus is not derived directly from an AC supply that is rated at more than 300 VAC.

Make sure that the DC power for the Laser 3 Plus is suitably approved for the environment in which it is to be installed and used.

7.5.2 To comply with EMC requirements

In order to comply with the relevant EMC protection requirements:

- Always connect the functional earth (ground) terminal on the base of the receiver unit (item 7 in Figure 2-4) and transmitter enclosures (item 10 in Figure 2-7) to a local EMC earth (ground). You can use flexible or solid conductors up to 10mm^2 (7 AWG). Make sure that the conductor is no longer than 2m (6’ 6.75”).
- Make sure that all input and output cables (DC power, mA output, mA input, Ethernet, relay output) and the cable that connects the transmitter and receiver units are screened. Terminate the screens at the cable glands
- The screens of all the cables connected to the analyzer must be terminated within metal glands.
- The equipment must not be directly connected to a power supply which supplies buildings for domestic purposes.

To comply with EMC requirements, make sure that the power supply for the Laser 3 Plus:

- meets the immunity and emission requirements of the environment in which it is being operated
- is not a DC supply network that powers other equipment without the application of suitable protection against surges or fast transient bursts

To connect the DC supply cable to the Laser 3 Plus:

1. With the power OFF, pass the DC electrical supply cable through a suitable cable gland fitted to the base of the power / interface compartment of the TU.
2. Connect the DC supply directly to the 7-way main connector.

The DC power cable must have the following specification:

Cable type	Screened
Number of cores	2
Rating (temperature)	-20 to +75 °C (-4 to 167 °F)
Cable conductors	0.2 to 1.5 mm^2 (28 to 14 AWG) Single core or standard
Insulation thickness	0.25mm Minimum
Only one conductor may be fitted to each terminal	
Approvals	Relevant to local requirements
Cable external diameter	Within the range specified for the selected cable gland (opt. power supply selected, 14mm (Max))

Note: *Under certain conditions of high ambient temperature a higher temperature rated cable may be required.*

7.5.3 Identification and location of electrical terminals

To open the transmitter unit, loosen the 4x M4 captive screws on the front panel (A in

Figure 7-17). The front panel hinges open (B in Figure 7-17) to show the electronics and connectors.

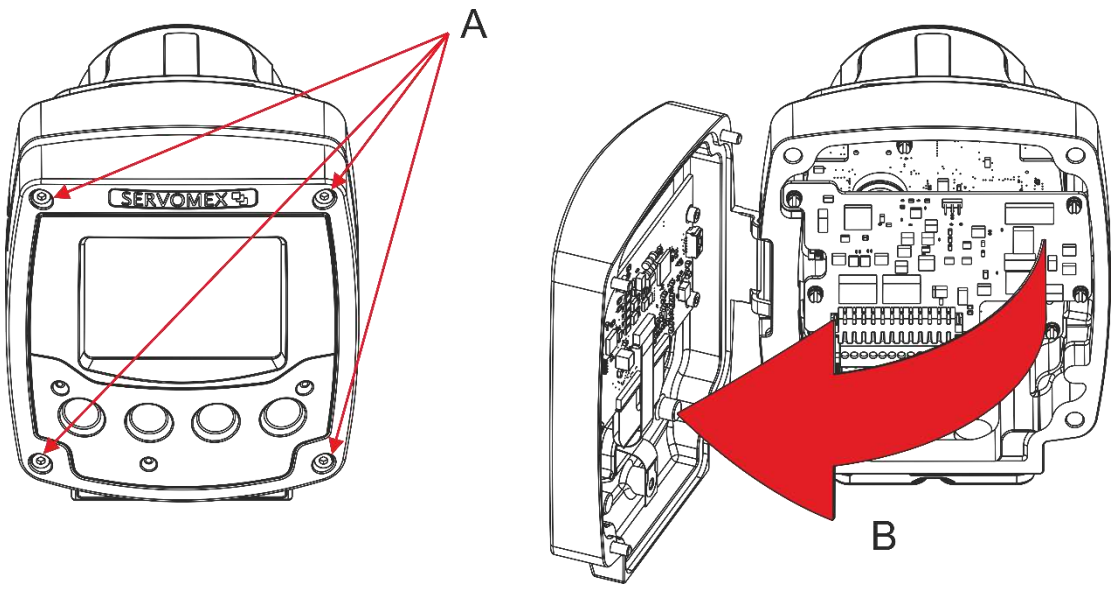


Figure 7-17: Opening the transmitter unit

7-way main connector

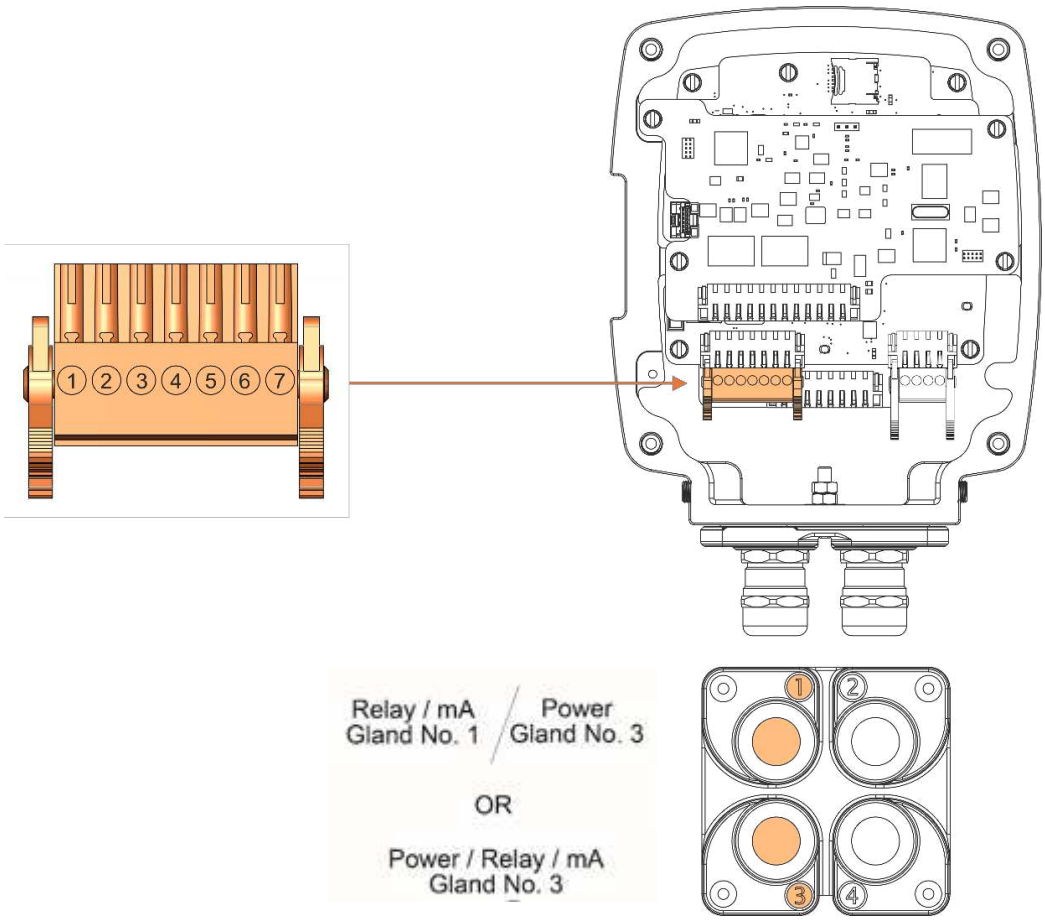


Figure 7-18: 7-way main terminal and entry glands

Terminal	Signal
1	18 to 30 V DC (nominally 24 V DC)
2	0 V
3	Relay N/O
4	Relay COM
5	Relay N/C
6	mA Output +
7	mA Output -

Screw terminal torque 0.2-0.25 Nm

- **All unused screw terminals must be tightened.**
- **Ensure connector latches “click” into place and are engaged fully.**
- **Ensure wires are routed away from PCBs.**

8-way transmitter and receiver unit connector

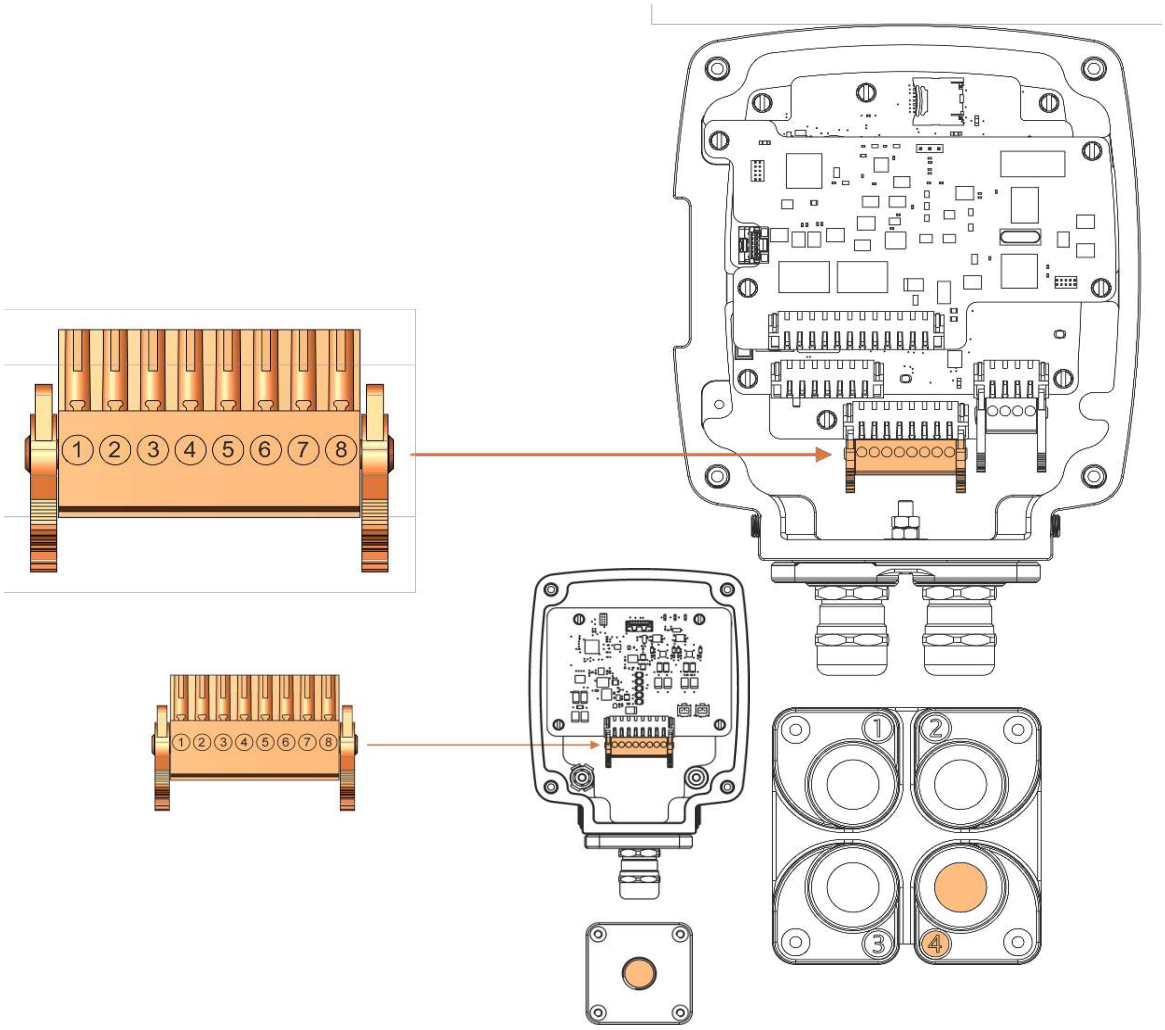


Figure 7-19: 8-way transmitter to receiver connector

Terminal	Signal	
1	TU RU comms A	(Twisted Pair 1)
2	TU RU comms B	(Twisted Pair 1)
3	+12 V DC	(Twisted Pair 2)
4	0 V	(Twisted Pair 2)
5	Signal 1 + (Measurement)	(Twisted Pair 3)
6	Signal 1 - (Measurement)	(Twisted Pair 3)
7	Signal 2 +	(Twisted Pair 4)
8	Signal 2 -	(Twisted Pair 4)

Screw terminal torque 0.2-0.25 Nm

Ensure connector latches “click” and are engaged fully.

Before you remove the receiver unit cover, turn off the power to the transmitter unit to ensure that there is no risk of exposure to the laser beam.

The connection cable must have the following specification:

Cable type	Screened
Number of cores	8
Configuration of cores	Twisted pairs
Rating (current / voltage)	300 V_{RMS}
Characteristic impedance	100 Ω
Rating (temperature)	-20 to +75 °C (-4 to 167 °F)
Cable conductors	0.2 to 1.5 mm^2 (28 to 14 AWG)
Flammability	VW-1
Approvals	Relevant to local requirements
Cable external diameter	Within the range specified for the selected cable gland
Maximum length	100 m

Note: *Under certain conditions of high ambient temperature a higher temperature rated cable may be required.*

Ethernet connector

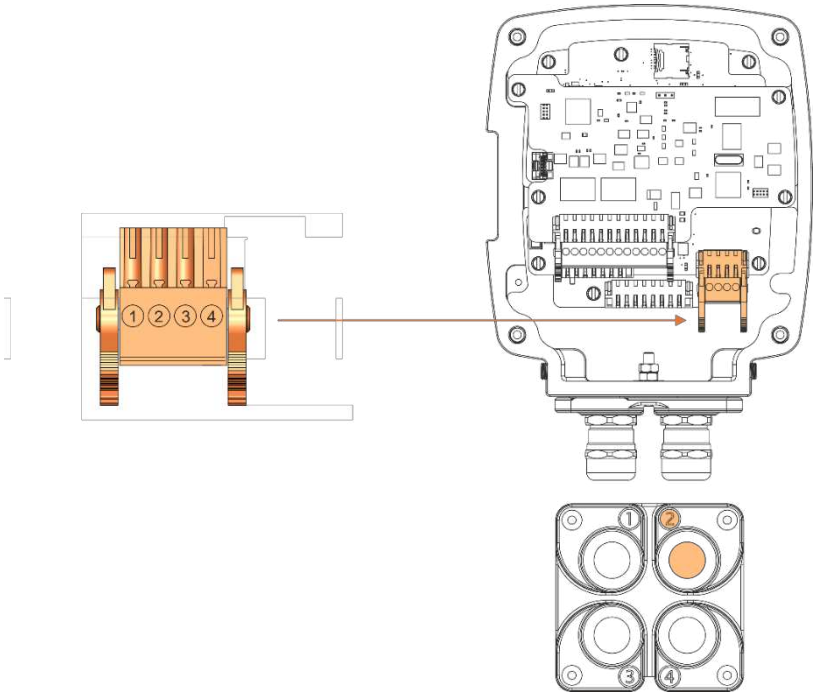


Figure 7-20: Ethernet connections

RJ-45 Pin	T-568A Wire Color	T-568B Wire Color	Signal	07900922 Connector Pin
1	Green/White	Orange/White	Tx +	2
2	Green	Orange	Tx -	1
3	Orange/White	Green/White	Rx +	4
4	Blue	Blue	-	
5	Blue/White	Blue/White	-	
6	Orange	Green	Rx -	3
7	Brown/White	Brown/White	-	
8	Brown	Brown	-	

A 4-way Weidmuller plug is used hence a modified Ethernet cable is required to connect to the instrument. The table below shows the two standards of wiring RJ-45 connectors and the corresponding signal names and 07900922 connections

Note: *The instrument supports Auto-MDIX (auto cross-over) so you can use either a straight or cross-over cable.*

Hint: *Installation of an Ethernet cable to a designated area suitable for remote connection to a PC is recommended.*

12-way option board connector

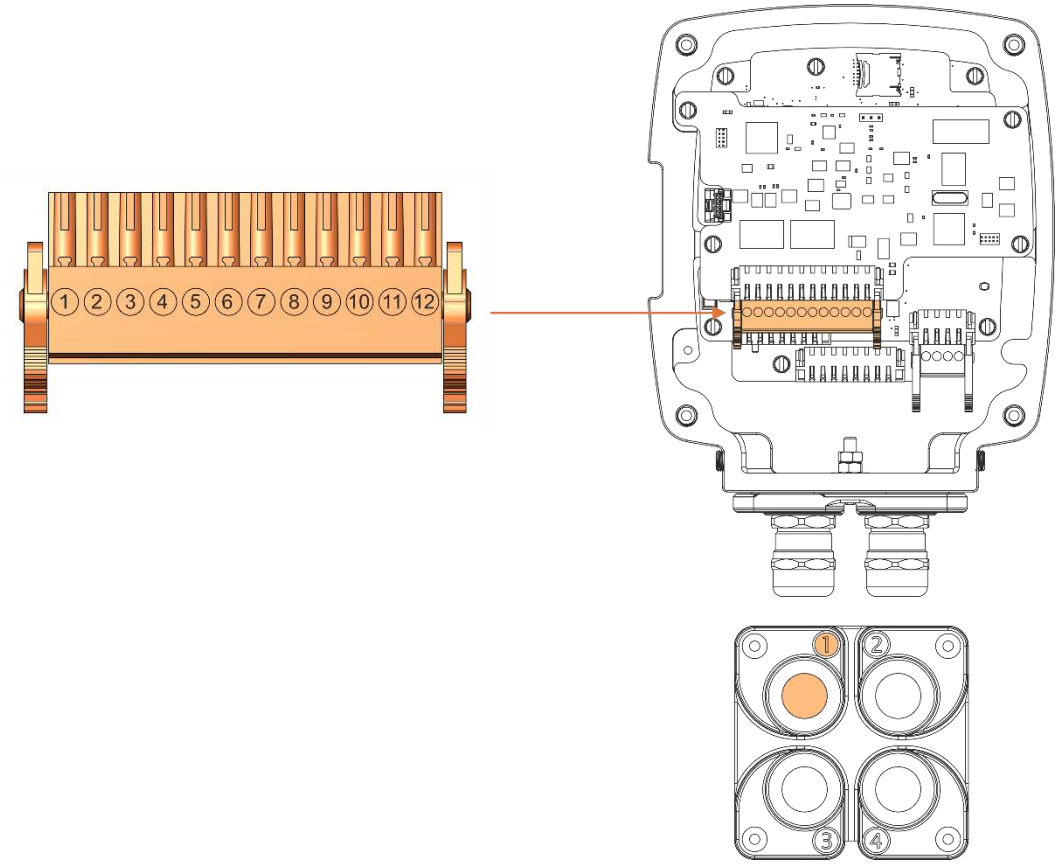


Figure 7-21: 12-way options board connections

Terminal	Signal	Terminal	Signal
1	mA Input 1 +	7	Relay 1 N/C
2	mA Input 1 -	8	Relay 2 N/O
3	mA Input 2 +	9	Relay 2 COM
4	mA Input 2 -	10	Relay 2 N/C
5	Relay 1 N/O	11	mA Output +
6	Relay 1 COM	12	mA Output -
	Screw terminal torque 0.2-0.25 Nm		

All unused screw clamps must be tightened.

Ensure connector latches “click” and are engaged fully.

Care must be taken not to connect the loop power supply directly to the mA input, or to short-circuit the transmitter whilst the loop is powered.

Note:*These connections are included on an optional PCB.*

7.6 Purge connections

Note:*Purge connections are listed in section 2.6.3.*

7.6.1 Alignment / purging assemblies

Make sure the purge gas pressure is above that of the process being monitored to avoid exposure to hazardous gases leaking from the process.

Make sure that the flange purges are connected and operational before you connect the transmitter and receiver units to the process. If you do not do this, the Laser 3 Plus optics could be damaged by the hot process.

Hint:	*Servomex recommend that the purge gas is supplied using flexible piping to minimise strain on the alignment assembly.*

The instrument windows are kept clean by setting up a positive flow of air through the alignment / purging flanges and into the stack. This purging prevents particles settling on the optical windows and contaminating them.

Use non-hazardous gas for purging. The purge gas must be dry and clean. Specific gas selected is application dependent.

Hint: *For Fixed pipe installations a typical flow rate is between 20 and 30l min^{-1}. For all other configurations, set an initial purge flow in the flange to approximately 1/10 of the gas velocity in the duct.*

After you have completed the installation, optimize the purge flow for your specific application.

Note: *Purge flows that are too low may cause blockage or contamination of the 07931 series Laser.*

Note: *Purge flows that are too high may cause dilution of the measurement gas.*

If in doubt, please contact Servomex or local representative for further advice

Note:*The air quality should conform to the standard set by ISO 8573.1, Class 2-3: particles down to 1 micron should be removed, including coalesced liquid water and oil, and a maximum allowed remaining oil aerosol content of 0.5 mg/m^3 (4.99423685 × 10-4 oz/cubic foot) at 21 °C (70 °F) (instrument air).*

Note: *Some instruments require nitrogen purging grade 3.0 or higher, for example, O_2 instruments for temperatures below 500 °C (932 °F).*

If in doubt, please contact Servomex or local representative for further advice

Transmitter purge connections

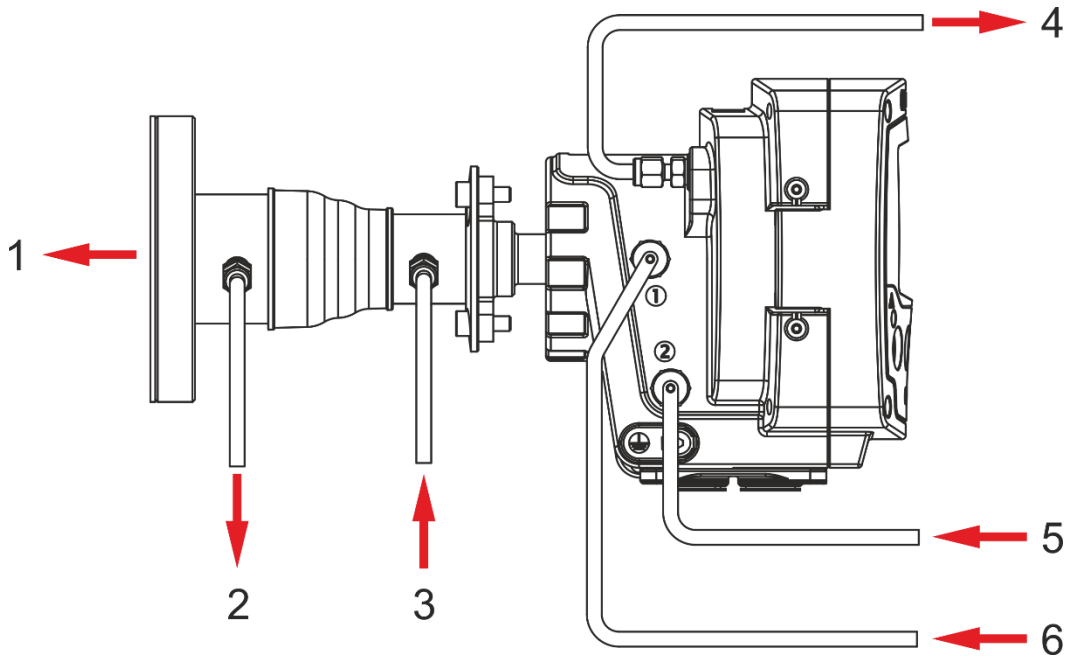


Figure 7-22: Transmitter purge

Ident.	Description
1	Window purge OUT *(standard)*
2	Window purge OUT *(option for isolation flange only, cap if not required)*
3	Window purge IN – Max flow of 10 $lmin^{-1}$
4	Purge 3 – Purge gas exit - **DO NOT BLANK**
5	Purge 2 – Enclosure gas IN (only if a measurement purge is also required) or blanking plug
6	Purge 1 – Laser module gas IN (50ml min^{-1} nominal), or blanking plug

Receiver purge connections

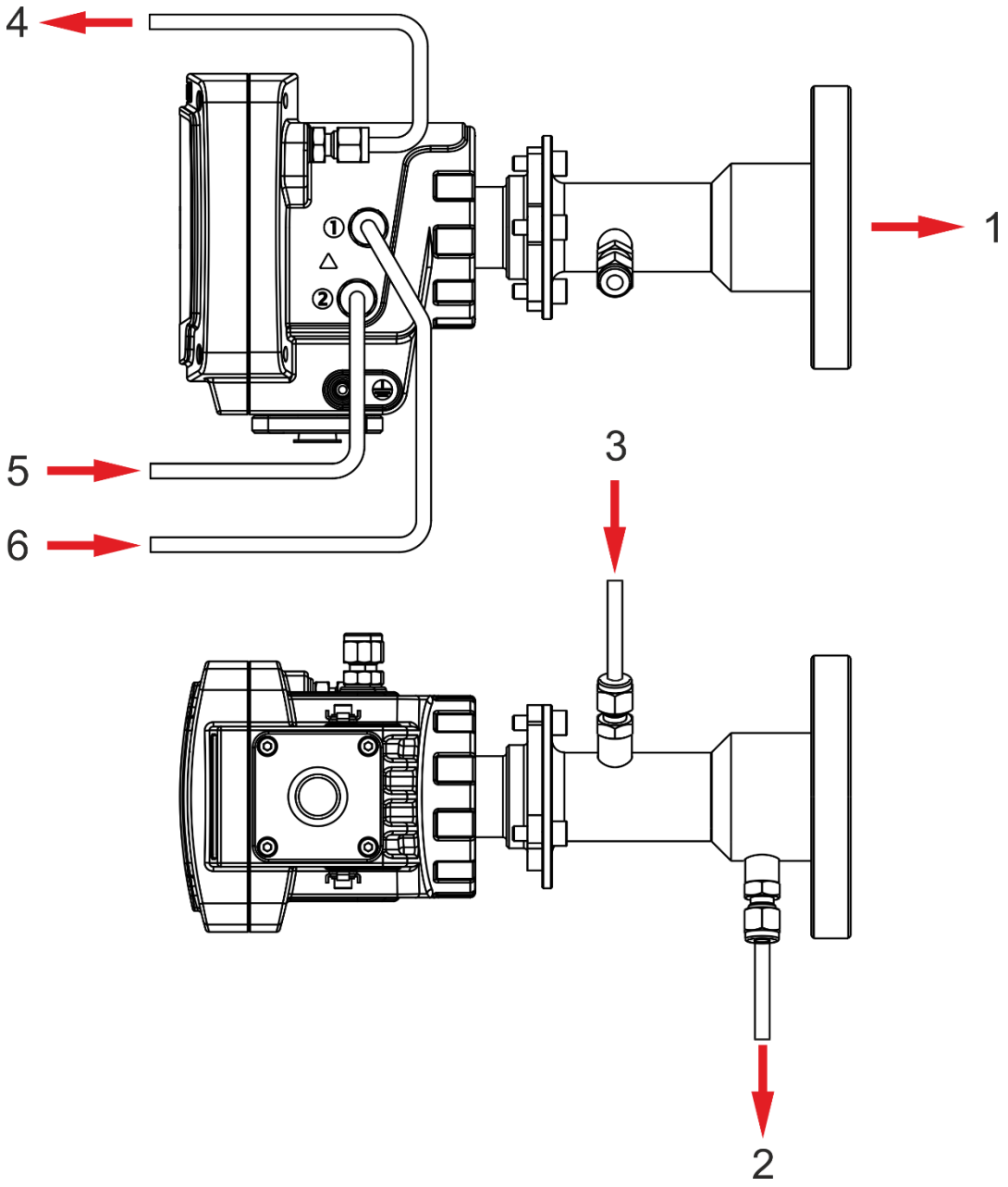


Figure 7-23: Receiver purge

Ident.	Description
1	Window purge OUT *(standard)*
2	Window purge OUT *(option for isolation flange only, cap if not required)*
3	Window purge IN - Max flow of 10 $lmin^{-1}$
4	Purge 3: Purge gas exit - **DO NOT BLANK**
5	Purge 2: Enclosure gas “IN” or blanking plug
6	Purge 1: Detector module gas “IN” (50ml min^{-1} nominal) or blanking plug

7.6.2 Enclosure environmental / measurement (instrument) purge

Make sure that you vent purge gases carefully to avoid creating a hazard.

If using toxic, asphyxiant or flammable sample or calibration gases, always purge the enclosures with non-hazardous gas during operation to reduce the risk of hazardous concentrations accumulating within the analyzer. Purge the enclosures for a suitable time before opening to ensure any concentrations are reduced to safe levels. Open transmitter or receiver enclosures in a force ventilated open area, or in another appropriate environment in which any hazardous gases are directed away from the user.

Make sure that the vent for environmental / measurement (Instrument) purge gas is clear and unobstructed so that the Laser 3 Plus enclosure does not become pressurized or its IP rating compromised.

Ensure the pressure of the measurement purge exceeds the pressure of the environmental purge gas to avoid backflow.

If the purge delivery system cannot be flow limited, the performance of the analyzer may be degraded and the equipment may be physically damaged.

For applications where purging of the transmitter and receiver units is required for measurement or cooling, you must make sure that the direction of flow is as shown in Figure 7-22: Transmitter purge and Figure 7-23: Receiver purge.

The transmitter and receiver units have internal optical surfaces. The purge gas must be clean, and you may need to add additional filtering. Use Nitrogen or other non-hazardous gas as a purge gas. Make sure that the purge flow is less than 0.1 liters/minute (0.004 cubic ft/min) to avoid pressure build up inside the units.

Note: *In ambient environments where dew points may exceed 15°C, Servomex recommends the use of measurement and environmental purge with dp <15°C for the Transmitter unit (Ident 6 in Figure 7-22) in order to prevent condensation.*

Note: *Some instrument air may contain small amounts of oil and water which will quickly damage the optical windows, mirrors and lens in the receiver and transmitter units. Ensure proper precautions are taken to avoid this.*

7.7 Commissioning

7.7.1 Installation checklist

Item	Checked
The transmitter and receiver units are secure and firmly mounted	
The supply voltage is the same as the unit supplied	
The units are correctly earthed / grounded	
Connection is made from the transmitter to the receiver unit	
Connections are made to the mA outputs (as required)	
Connections are made to the mA inputs (as required)	
Connections are made to the alarm relays (as required)	
Network connection is made (as required)	
PCB connector latches are secure and engaged fully	
All wiring terminations are secure and tight	
All screws in unused terminals are secure and tight	
Cable glands are secured and made weather-tight	
Cables are dressed neatly within the transmitter and receiver units	
Hazardous area safety requirements are complied with	
External electrical connections are correctly labelled	
The transmitter and receiver unit covers are secured and weatherproof	
Gas fittings and connections are tightened and labelled	
Purge panel flow meters are set to recommended flow rates for the specific application and recorded (Flows should be verified at the Analyzer to ensure there are no leaks or splits in the lines.	

Table 7-3: Mechanical installation check list

When the Mechanical installation check list is complete, switch on the power.

To confirm the TU and RU are working correctly:

- Check the laser LED light on the transmitter and receiver front panels are **ON**
- Check the transmitter unit display is working

7.7.2 Alignment for optimum measurement

7.7.2.1 Overview

Note: *The Laser 3 Plus is factory calibrated however Servomex recommend the Analyzer is locally calibrated before installation.*

The transmission optimization process is an iterative process required to be completed when the unit is in-situ and should be completed before final measurement commissioning steps and software configuration.

Item	Section	Checked
Physical Alignment	7.3.2	
Alignment of the TU (Laser gain adjustment process)	7.7.2	
Receiver unit alignment	7.7.2	

Table 7-4: Alignment check list

7.7.2.2 Alignment of the TU (Laser gain adjustment process)

Before the Analyzer can be used it must be set up and the laser adjusted and aligned correctly so that the receiver diode is receiving the optimum laser intensity

The following steps describe the process.

Note: *Servomex recommend saving current settings before starting the gain adjustment.*

The physical alignment of the ‘ball joint’ flange will need to be adjusted to ensure the output is within this range.

Step 1	Peel back the boot on the transmitter mounting assembly to show the ball-joint alignment screws Figure 7-24
Step 2	Adjust the 4x screws to change alignment until maximum Photodiode DC voltage achieved.
Note:	*Only small adjustments should be made (half turn maximum per iteration).*
Step 3	If signal greater than ***1.5*** V, Lower Gain 1 or Gain 2 and note new level of signal.

Step 4	Repeat Steps 2 -3 until the maximum Photodiode DC voltage achieved is between ***1.2V*** and ***1.5V***
Step 5	When all adjustments are complete, gradually tighten all adjusting M6 screws A, B, C and D and nuts, then replace covers (Figure **7-25**), taking care not to change the position of the assembly.
Step 6	Adjust Phase burst cal See section 4.11.4

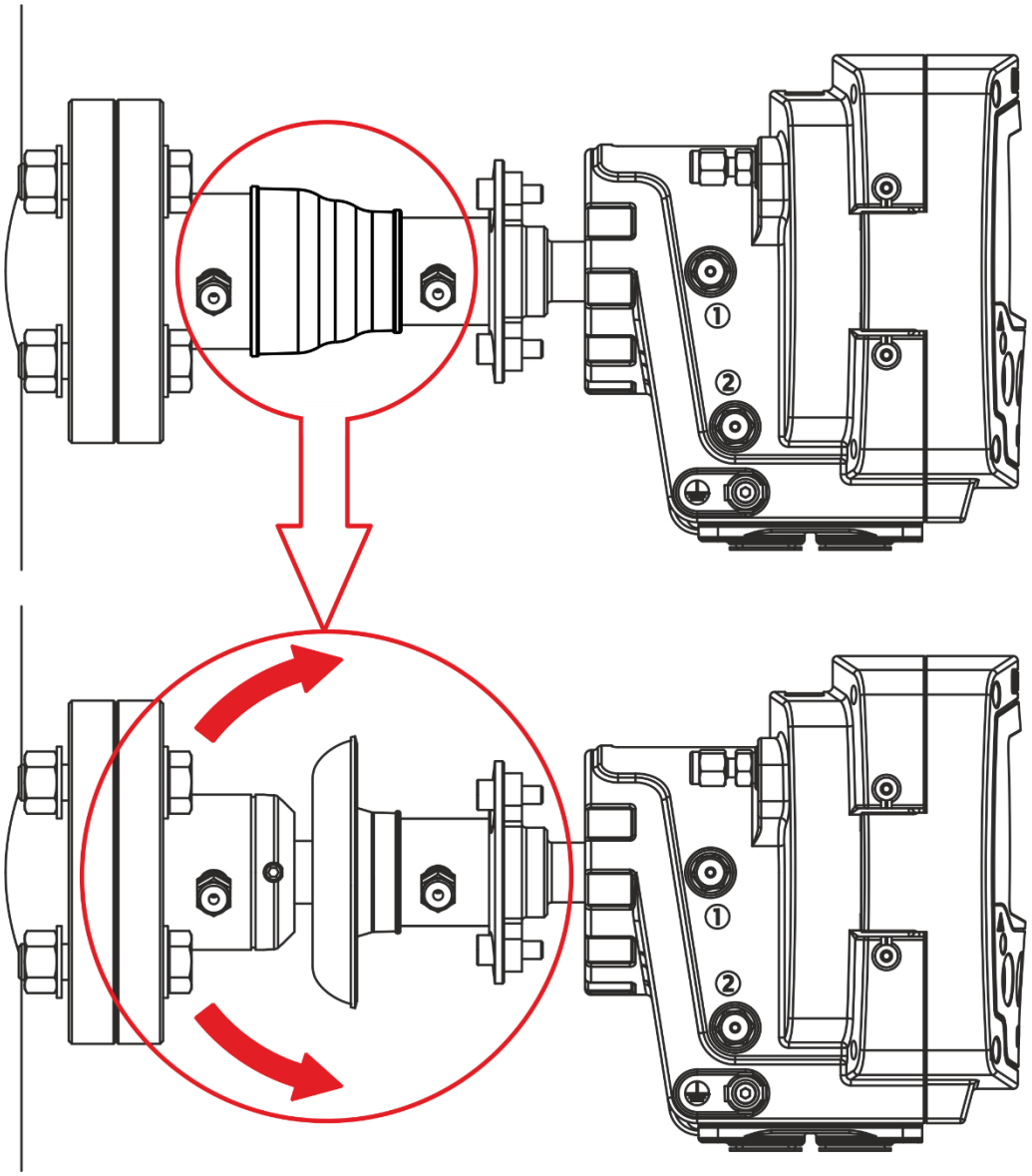


Figure 7-24: Peel back the boot

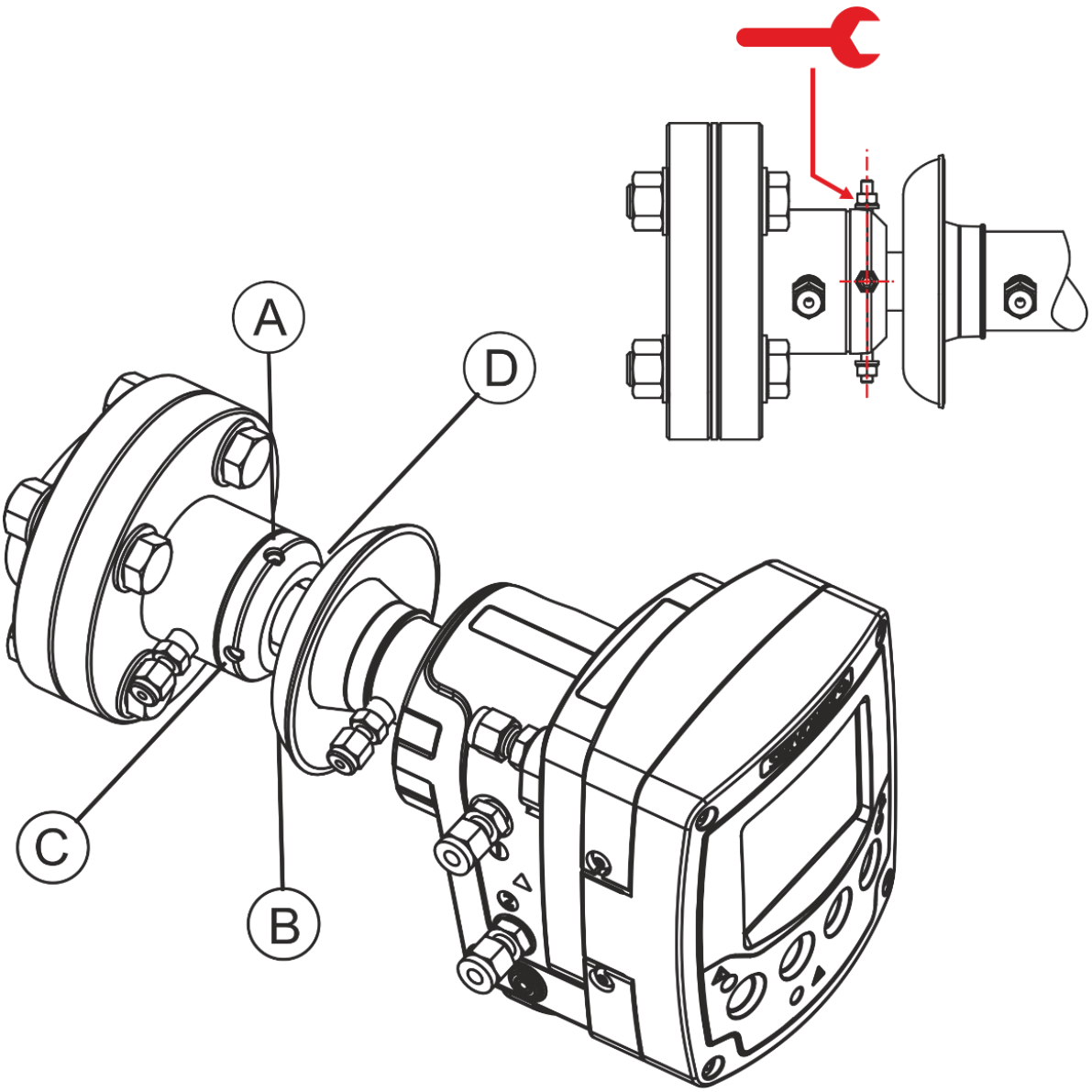


Figure 7-25: Installation: ball-joint adjustment screws

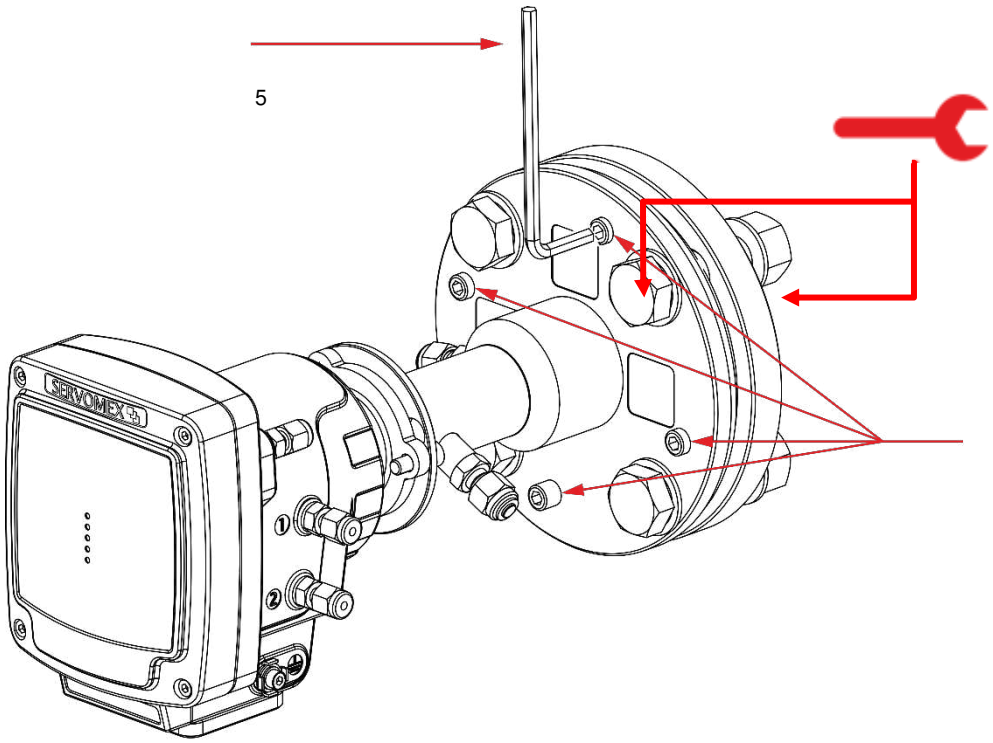


Figure 7-26: Installation: Large O-ring adjustment screws

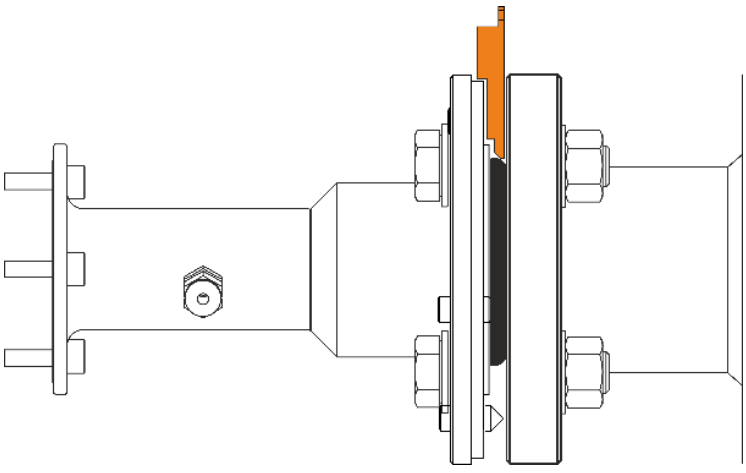


Figure 7-27: Installation: Large O-ring initial setting

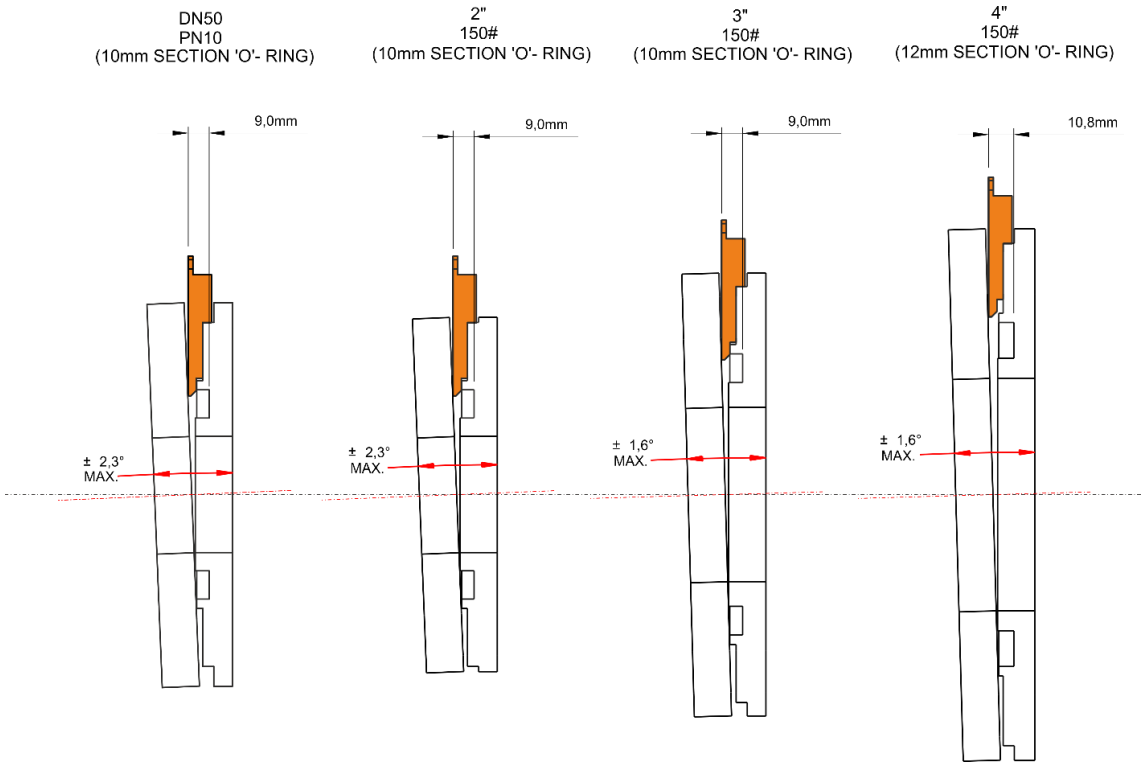


Figure 7-28: Installation: Large O-ring compression check

"No Go" tool to be used to check minimum O-ring compression has not been exceeded.

7.7.2.3 Receiver unit alignment

Step 1	Unscrew 4 Set Screws on the RU adjustable flange until they do not protrude the RU adjustable flange
Step 2	Using the Gap Gauge 07931503, tighten the 4 x M16 nuts / bolts on the receiver flange to leave an equal gap of 6.0 mm around perimeter of the RU adjustable flange – see Figure 7-27
Step 3	To align using the LEDs, watch the receiver alignment LEDs on the receiver unit as you tighten in turn each of the 4 M16 adjusting screws.
Note:	*The LEDs flash according to the direction of the adjustment.* *The first and fifth LEDs will illuminate when a large change in alignment has occurred, whereas, the second and fourth LEDs will illuminate when a small change in alignment has occurred (either positive or negative – see Figure 7-29).* *The first and fifth LEDs will remain illuminated when the photodiode DC level has exceeded a pre-set voltage threshold and adequate alignment is achieved.*

Step 4	When all adjustments are complete, tighten the 4 M10 set screws in order to lock the position
Note:	*Depending on application details it may be required to readjust the photodiode DC level several times to ensure the target DC voltage level does not exceed 2.7 volts. To check the DC voltage level refer to 4.11.1.*

Note: *The receiver alignment LEDs can only be used when the receiver is fitted with an adjustable mount (not a fixed mount), and you are adjusting the mount at the receiver end.*

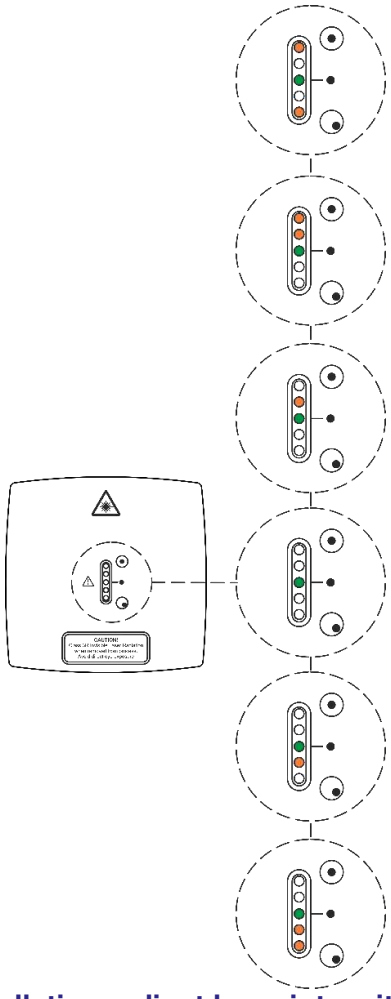


Figure 7-29: Installation: adjust laser intensity on the photodiode

1	Aligned – tuning target voltage met	**4**	Shows LASER power ON. LASER hazard
2	Large improvement	**5**	Small misalignment
3	Small improvement	**6**	Large misalignment

Note: *The pre-set voltage threshold in the "tuning target" is a configurable setting at the "Technical user" level and can be accessed in the "detailed set-up" menu under the "gain" menu.*

7.7.3 Software configuration

Note:*Settings should be saved on arrival of the Analyzer.*

Item	Ref	Checked
Configure the password settings	**Error! Reference source not found.**	
Configure the network settings	4.1.1	
Configure the time and date to your region	4.1.2	
Configure the regional settings	4.1.3	

Table 7-5: Software configuration check list

7.7.4 Measurement configuration

Item	Ref	Checked
Configure the mA inputs	4.2	
Configure the process pressure settings	4.3.1	
Configure the process temperature settings	4.3.2	
Configure the mA outputs	4.4	
Configure measurement alarms	4.5	
Configure the relays	4.6	
Configure filtering options	4.7	
Save settings	0	

Table 7-6: Measurement configuration check list

8. Service

8.1 Service functions

8.1.1 mA output override

To set the mA output override levels and activate override.

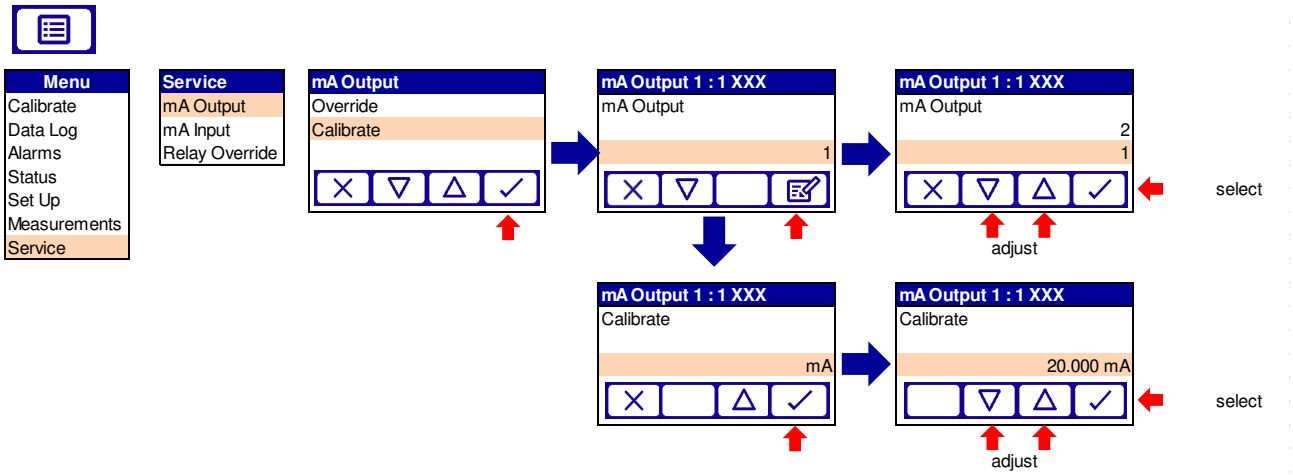


Figure 8-1: mA override menu

8.1.2 mA output calibration

To select and calibrate mA outputs

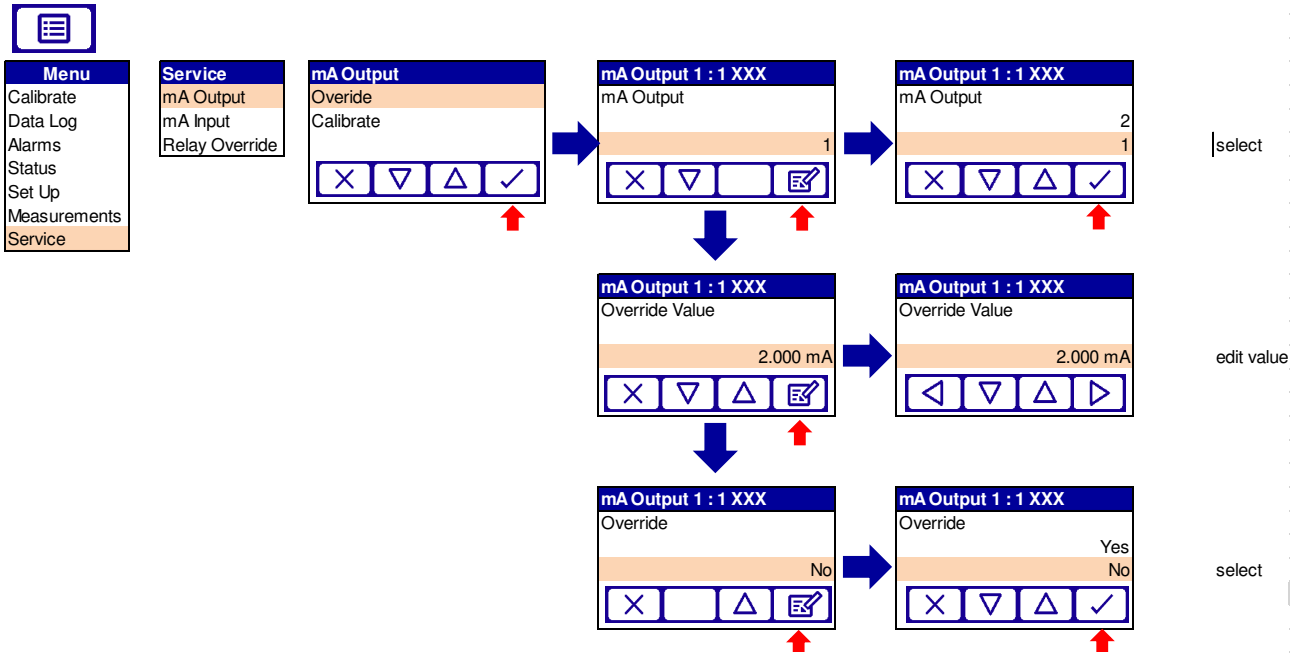


Figure 8-2: mA output calibration menu

8.1.3 mA input

To set and calibrate mA input

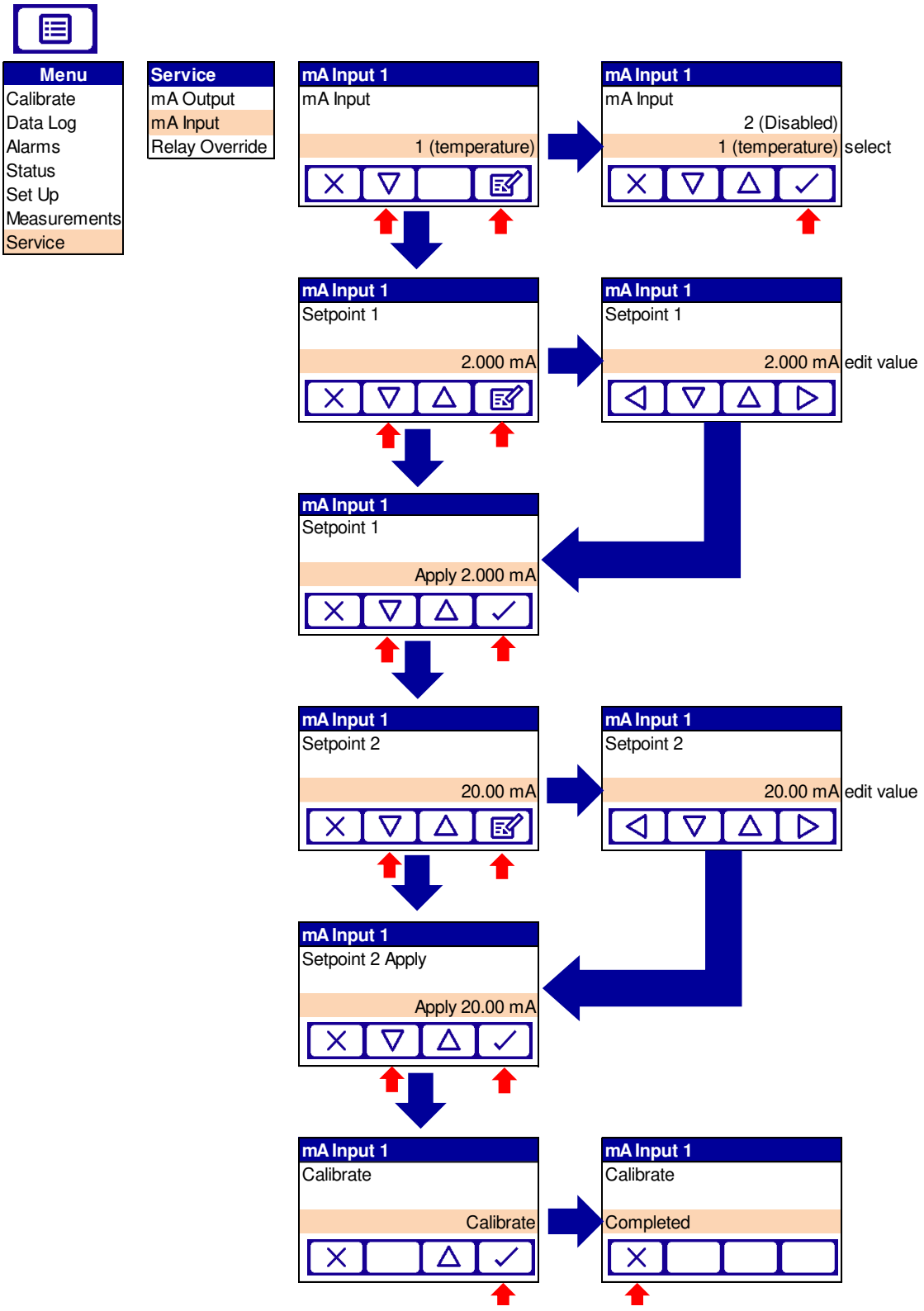


Figure 8-3: mA input menu

8.1.4 Relay Override

To set and calibrate mA input

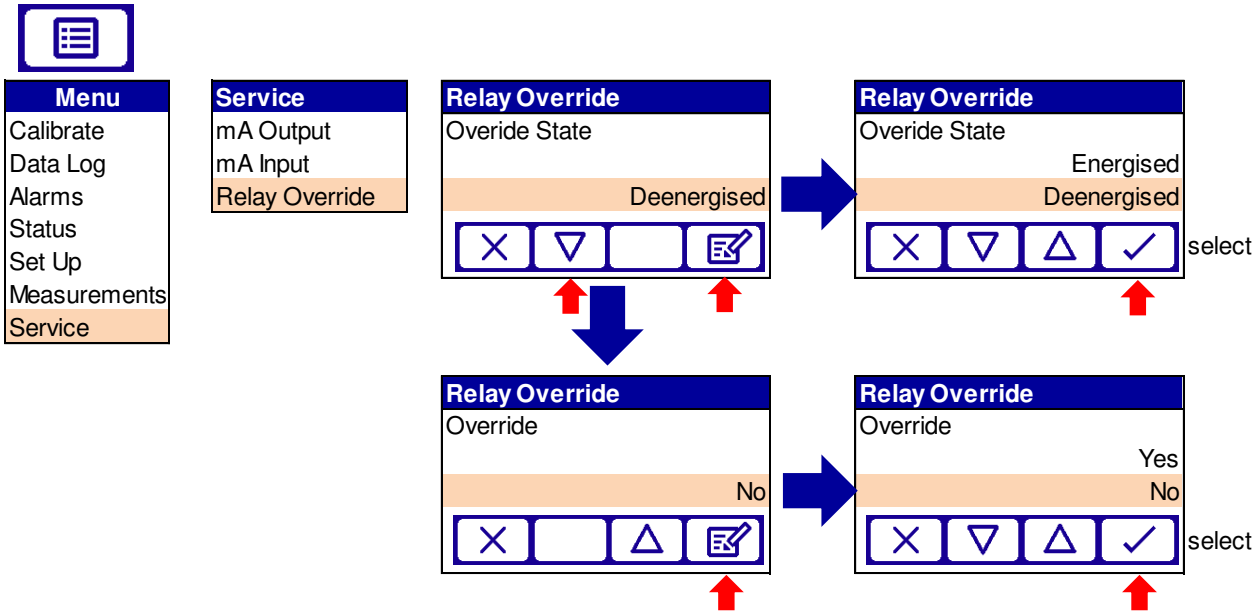


Figure 8-4: Relay override menu

8.1.5 Service Mode

To activate service override

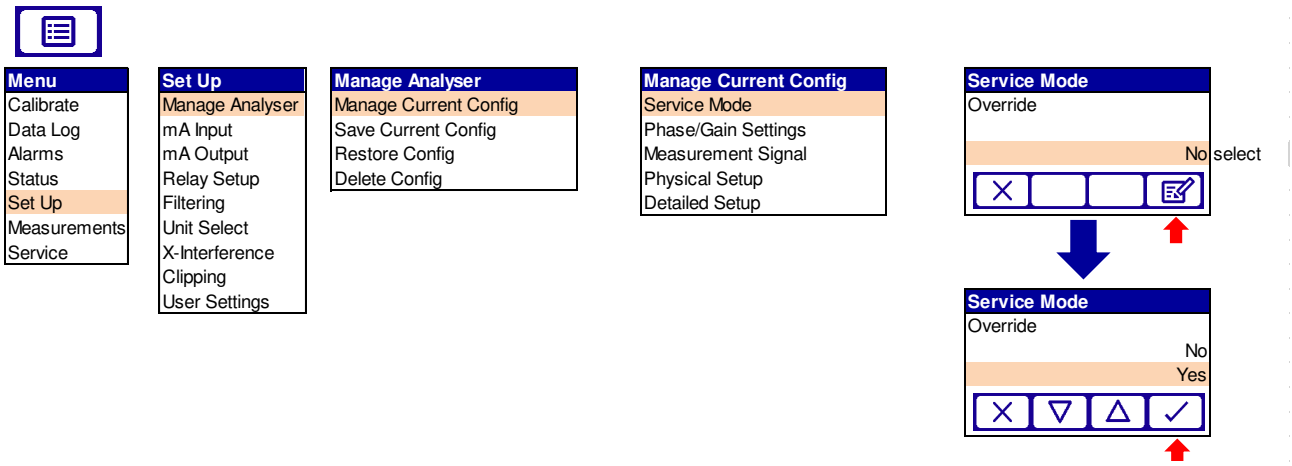


Figure 8-5: service override menu

8.2 Routine maintenance

Make sure that all gas connections to the process are regularly tested for leaks. If you find any, do not use the equipment until you have corrected the faults.

Do not attempt to maintain or service the Laser 3 Plus unless you are trained and competent.

Service personnel must verify the safe state of the equipment after all repairs. If you do not:

- **people may be injured**
- **the protective facilities incorporated into the design of the instrument may not operate as intended**
- **sample gas measurements may not be accurate, or**
- **the instrument may be damaged**

The Laser 3 Plus may be attached to equipment that is hot. Always wear the appropriate PPE to minimize the risk of burns.

Turn off the power to the Laser 3 Plus before you attempt to remove the transmitter and receiver units from the process, remove the receiver unit enclosure cover for any other maintenance work. This ensures that the laser beam is switched off and there is no risk of exposure to hazardous laser radiation.

Sample gases may be toxic, asphyxiant or flammable.

Before you remove the Laser 3 Plus from the process, make sure that it does not contain any potentially hazardous or heated gases, or is at a pressure below atmospheric pressure.

8.3 Cleaning

Only use a soft, clean cloth moistened with water to wipe clean the outside of the enclosure.

Optical glass window must be cleaned with lint free cloth, isopropanol can be used if required.

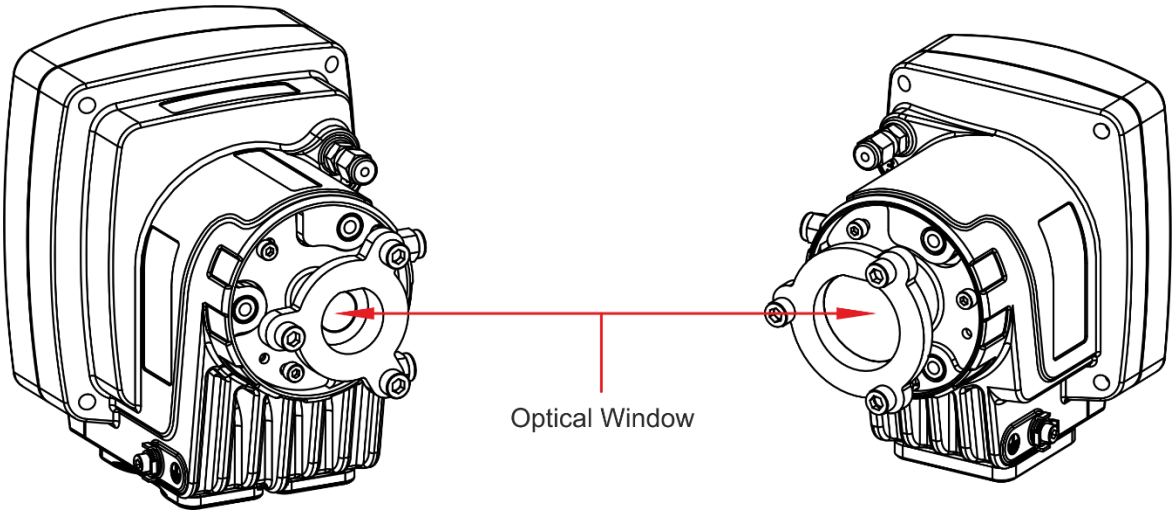


Figure 8-6: Optical windows

8.4 Routine checks

The Laser 3 Plus contains no moving parts and does not need to be fitted with any consumables. You only need to carry out simple maintenance procedures every 3 to 4 months. Carry out the following regular checks to ensure continuous and safe operation of the analyzer.

8.4.1 Daily

Check optical transmission

The frequency of checking depends on the level of process condensates, particulates and vibration.

You can do this automatically if you use instrument output (option), or via a warning relay.

8.4.2 Weekly

Check purge flow rates

Use a flow meter on the purge panel to check the purge flow rates are the same as at the time of commissioning.

8.4.3 Monthly

Check LEDs and display

Check the LEDs and displays are legible on the receiver and transmitter units. Clean them if necessary.

8.4.4 Three-monthly

Check purge flow rates

Use the flow meters on the purge panel to check the purge flow rates are the same as at the time of commissioning.

Leak check the purge fittings.

8.5 Alignment / purging flanges

Do not disconnect the pipes from the alignment / purging flanges if there is a risk to personnel or the environment from exposure to the potentially hazardous gases contained in the process being monitored.

Failure of the purge will severely damage the optical surfaces of the Laser 3 Plus.

Test the alignment / purging flanges for leaks at regular intervals as required for the specific process and installation conditions.

Inspect the pressure of the flange and window purge at regular intervals to ensure it is higher than that of the process as required for the specific process and installation conditions.

8.6 Enclosure purge and breather (if fitted)

Check the flow rates of the purge panel at regular intervals to ensure it is operating correctly.

Inspect the breather (if fitted) at regular intervals to ensure it has not become blocked or otherwise damaged.

8.7 User replaceable spare parts

There are no user replaceable spare parts.

All Laser 3 Plus returned to Servomex or one of its appointed agents for servicing, disposal, or any other purpose must be accompanied by a completed decontamination certificate.

9. Certification information

9.1 Hazardous area approval and certification

9.1.1 Equipment certification standards

The standards to which the equipment has been certified are listed below:

ATEX

EN 60079-0:2012

EN 60079-7:2015

EN 60079-11:2012

EN 60079-28:2015

EN 60079-31:2014

IECEx

IEC 60079-0:2011 Edition 6

IEC 60079-7:2015 Edition 5

IEC 60079-11:2011 Edition 6

IEC 60079-28:2015 Edition 2

IEC 60079-31:2013 Edition 2

9.1.2 Europe and IECEx

ATEX	Ⓔx II 3(2)G Ⓔx II 3G(1D) Ⓔx II 2(1)D Ⓔx II 2D(2G) Ⓔx II 3G Ⓔx II 2D
Coding (ATEX and IECEx)	Ex ic ec nC op is IIC T4 Gc [Ex op is IIC T4 Gb] Ex ic ec nC op is IIC T4 Gc [Ex op is IIIB T135°C Da] Ex tb IIIB T135°C Db [Ex op is IIC T4 Gb] Ex tb IIIB T135°C Db [Ex op is IIIB T135°C Da] Ex ic ec nC op is IIC T4 Gc Ex tb [Ex op is] IIIB T135°C Db

Ambient Temperature range	-20 °C to +65 °C
Certification number (ATEX)	Baseefa16ATEX0124X
Certification number (IECEx)	IECEx BAS 16.0094X

9.1.3 North America

SGS	
Non-incendive (USA and Canada	Class I, Div 2, Groups A, B, C & D T4 Class II, Div 2, Groups F & G T4 Class III, Div 1 T4 Class I, Zone , Group IIC T4
Enclosure	IP66, 4X
Ambient Temperature range	-20 °C to +65 °C
SGS Contract Number	710216

9.2 Label Information

Figure 9-1: ATEX / IECEx labels

Figure 9-2: SGS North American labels

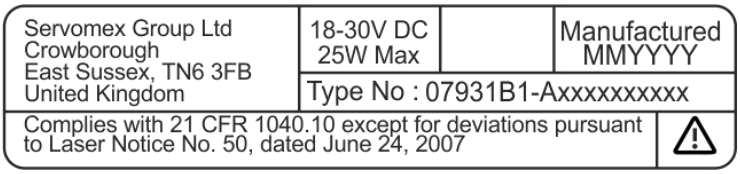


Figure 9-3: Rating label

9.3 EMC

Europe	The Laser 3 Plus complies with the European Community Electromagnetic Compatibility Directive: Emissions Class A: Equipment suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes. Immunity: Industrial.
Canada	This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.
US	The Laser 3 Plus complies with Part 15 of the FCC Rules for Class A equipment. It is not suitable for operation when connected to a public utility power supply that also supplies residential environments.

9.4 Electrical Safety

The Laser 3 Plus has been assessed to IEC61010-1 for electrical safety including any additional requirements for US and Canadian national differences.

Overvoltage Category: Category II.

Pollution Degree: 2.

Servomex Group Limited is a BS EN ISO 9001 and BS EN ISO 14001 certified organization.

9.5 Product Disposal

This product is not considered to be within the scope of the Waste Electrical and Electronic Equipment (WEEE) Directive.

This product is not intended for disposal in a municipal waste stream but must be submitted for material recovery and recycling in accordance with any appropriate local regulations.

Note: *All label certification markings (SGS or ATEX / IECEx) must be permanently defaced to ensure marking is not identifiable before the disposal of the product.*

Additional advice and information on the disposal of this product in accordance with the requirements of the WEEE Directive can be obtained from:

Servomex Group Limited,
Jarvis Brook,
Crowborough,
East Sussex,
TN6 3FB,
England
+44 (0)1892 652181
Fax: +44 (0)1892 662253
www.servomex.com

All Laser 3 Plus returned to Servomex or one of its appointed agents for servicing, disposal, or any other purpose must be accompanied by a completed decontamination certificate.

9.6 EU REACH regulations

EU REACH Regulations (1907/2006 (as amended)):

For information on Substances of Very High Concern (SVHCs) included in Servomex products see: www.servomex.com

10. Index

11. Appendix Display unit conversion

When you select display units as described in Section 4.8, you must ensure that you also enter the correct unit conversion factor, as shown in the table below:

To convert from *	to †	use the units conversion factor	applicable gas(es)
%	ppm	10000	any
ppm	%	0.0001	any
ppm	vpm	1	any
ppm	mg/m3	1.4277	O2
"	"	0.750	NH3
"	"	1.2492	CO
"	"	1.9631	CO2
%	mg/m3	14277	O2
"	"	7500	NH3
"	"	12492	CO
"	"	19631	CO2
ppm	%LEL	0.0008	CO
%	%LEL	8	CO
%	mol/mol	0.01	any
ppm	mol/mol	#	#

* Measurement default units † Selected display units # This conversion is not supported

Note: *To return to the measurement default units, select the "off" units selection option and set the units conversion factor to "1": see Section 4.8*

12. Appendix Modbus setup

12.1 Implementation guide for Modbus communications

12.1.1 Introduction

This appendix details the implementation and use of the Modbus protocol in the analyser.

12.1.2 Supported function codes

For simplicity, only the following function codes will be supported.

Function	Description	Usage
01	Read coils	Read calibration status, pump state, etc.
02	Read discrete inputs	Read faults and alarm states.
03	Read holding registers	Read settings.
04	Read input registers	Read measurements, units, etc.
05	Write single coil	Change modes, perform calibration etc.
06	Write single register	Change single setting.
08	Sub Function 00 = Return query data	Diagnostic to test communications.
16	Write multiple registers	Change multiple settings.

12.1.3 Exception codes

If an error should occur while processing a message one of the following exception codes will be returned by the instrument.

Code	Condition	Meaning
01	Illegal function	Requested function code is not supported.
02	Illegal data address	The combination of data address and transfer length is invalid for this function.
03	Illegal data value	A value contained in the query data field is not an allowable value. This indicates a fault in the structure of the remainder of a complex request. This does NOT mean that a value to be stored in a register is incorrect as Modbus has no means of determining what is legal for any particular register.
04	Slave device failure	An unrecoverable error occurred while the unit was attempting to perform the requested action.

12.1.4 Addressing

Addresses in Modbus ADU (application data unit), run from 1 – N, whereas addresses in the Modbus PDU (protocol data unit) run from 0 – N. This appendix gives addresses in the ADU model. Depending on the particular Modbus master, addresses may have to be entered as they are given or have 1 subtracted from them. For example, to read register 101 an address of 100 may be needed.

Note: *Slave ID: 247*

12.1.5 Floating point numbers

Floating point numbers (e.g. 12.34, –1012.32, etc.), are digitally represented using the IEEE–754 format. Single precision floating point numbers are used throughout and they require 32 bits of data. Since a Modbus register holds 16 bits it takes 2 registers to represent a floating-point number. We default to having the most significant word of the float, bits 16 – 31, in the first register, and the least significant word, bits 0 – 15, in the next register. This order can be reversed by setting a coil in the system control mapping.

12.1.6 System data

				Supports Function Code							
Base Address	**Block**	**Base Address Offset**	**Parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**16**
3001	0	0-9	Instrument Serial Number			Yes					
		10-19	Control Unit Firmware			Yes					
3021	1	0-9	Display Adapter Firmware			Yes					
		10-19	Analog Output Firmware			Yes					
3041	2	0-9	Option Board Firmware			Yes					
		10-19	Transmitter Firmware			Yes					
3061	3	0-9	Receiver Firmware			Yes					
		10-19	Bootloader Firmware			Yes					
3981	49	0	NumberOfInternalTransducers			Yes					
		1	Reserved			Yes					
		2	NumberOfTransducers			Yes					
		3	NumberOfMeasurements			Yes					
		4	NumberOfAins			Yes					
		5	NumberOfAouts			Yes					
		6	NumberOfAlarms			Yes					
		7	NumberOfRelays			Yes					
		8	NumberOfDins			Yes					
		9	Reserved			Yes					
		10	Number of legacy flow alarms			Yes					
		11	Number of Legacy Heaters			Yes					
		12	Number of Legacy Sample Heater			Yes					
		13	Number of Field Buses			Yes					
		14	Number Of Ovens			Yes					
		15	Number Of Network Cards			Yes					
		16	NumberOfResources			Yes					

12.1.7 System Settings

				Supports Function Code							
Base Address	**Block**	**Base Address Offset**	**Parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**16**
2001	0	0	Floating point order	Yes				Yes			
		1	User interface busy	Yes							
		2	Disable user interface	Yes				Yes			
		3	Audible alarm	Yes				Yes			
		4	ResponseDelay			Yes			Yes		Yes
		5	Language			Yes			Yes		Yes
		6	Date format			Yes			Yes		Yes
		7	Decimal format			Yes			Yes		Yes
		8	Backlight Time			Yes			Yes		Yes
		9	clock: Hrs			Yes			Yes		Yes
		10	clock: Mins			Yes			Yes		Yes
		11	clock: Seconds			Yes			Yes		Yes
		12	date: Year			Yes			Yes		Yes
		13	date: Month			Yes			Yes		Yes
		14	date: Day			Yes			Yes		Yes
		15	CalLink			Yes			Yes		Yes
2021	1	0	Temperature Units			Yes			Yes		Yes
		1	Pressure Units			Yes			Yes		Yes
		2	Flow Units			Yes			Yes		Yes
		3	Moisture Units			Yes			Yes		Yes
		4	Distance Units			Yes			Yes		Yes
		5	Current Units			Yes			Yes		Yes
		6	Voltage Units			Yes			Yes		Yes
		7	Resistance Units			Yes			Yes		Yes
		8	Angle Units			Yes			Yes		Yes
		9	Wavelength Units			Yes			Yes		Yes

12.1.8 System control

Base Address	Block	Base Address Offset	Parameter	Supports Function Code 1	2	3	4	5	6	8	16
1	0	0	Service in Progress			No			Yes		Yes
0=Not in Service Mode, 1=Service Mode. Instrument MUST be set to Service in Progress before any calibration or override actions are performed											

12.1.9 Measurements

Base Address	Block	Base Address Offset	Parameter	Supports Function Code 1	2	3	4	5	6	8	16
1001	0	0	Number Of Measurements			Yes					
	0	1	Repeat (safeguard)			Yes					
	0-49	2(n-1) + 2	Measurement n			Yes					

12.1.10 TU Calibration Data

					Supports Function Code							
Base Address	**First Block Number**	**Block**	**Base Address Offset**	**Parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**16**
16241	0	Tx (n)	0	Reserved			Yes			No		No
			1	Reserved			Yes			No		No
			2	AVFinishing			Yes			No		No
			3	AVFailState			Yes			No		No
			4	Number of Cal / Val Points			Yes			No		No
			5	Select Cal/val point			Yes			Yes		Yes
			6	LastCal/val Point n Reading			Yes			No		No
			8	LastCalPoint n Target			Yes			No		No
			10	LastCalPoint n Delta			Yes			No		No
			12	CalRefGain			Yes			No		No
			14	ZeroSigCalRef			Yes			No		No
			16	Last Cal point n Time			Yes			No		No
			17	Last Cal point n Date			Yes			No		No
			19	Cal point passed/failed			Yes			No		No

AVFinishing 0=Not Finishing, 1=Finishing

AVFailState 0=Not in Fail State, 1=In Fail State

12.1.11 TU Live info

					Supports Function Code							
Base Address	**First Block Number**	**Block**	**Base Address Offset**	**Parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**16**
6961	0	Tx (4n-1)	0	Transducer Type			Yes					
			1	Tag Number			Yes					
			2	Name			Yes					
			11	Measurement			Yes					
			13	Pressure Compensated Measurement			Yes					
			15	Filtered Measurement			Yes					
6981	1	Tx (4n)	0	Alarm Active	Yes							
			1	Fault	Yes							
			2	Service in progress	Yes							
			3	Out of Specification	Yes							

			4	Maintenance required	Yes
			5	Transducer maintenance fault	Yes
			6	Transducer error	Yes
			7	Transducer fatal fault	Yes
			8	WarmingOn	Yes
			9	Reserved	Yes
			10	Reserved	Yes
			11	Calibration fault	Yes
			12	Communication fail	Yes
			13	Transducer not detected	Yes
			14	Reserved	Yes
			15	Remote calibration/val denied	Yes
7001	2	Tx (4n+1)	0	Clipping Active	Yes
			1	Remote service in progress	Yes
			2	Transducer calibration mode	Yes
			3	Reserved	Yes
			4	Incorrect transducer type	Yes

12.1.12 TU Settings

					Supports Function Code							
Base Address	**First Block Number**	**Block**	**Base Address Offset**	**Parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**16**
12881	0	Tx (n)	0	Name			Yes			No		No
			9	Units			Yes			No		No
12901	56		0	Filter Time			Yes			Yes		Yes
			2	Filter Reset Threshold			Yes			Yes		Yes
			4	Unit selection (scaling Factor)			Yes			Yes		Yes
			6	PMR			Yes			No		No
			8	Cross Interference correction			Yes			Yes		Yes

12921	112	0	Clip Low Enabled	Yes	Yes	Yes
		1	Clip Low Level	Yes	Yes	Yes
		3	Clip Low Override Enable	Yes	Yes	Yes
		4	Clip Low Override Level	Yes	Yes	Yes
		6	Clip Low Hysteresis Enable	Yes	Yes	Yes
		7	Clip Low Hysteresis Level	Yes	Yes	Yes
		9	Clip High Enabled	Yes	Yes	Yes
		10	Clip High Level	Yes	Yes	Yes
		12	Clip High Override Enable	Yes	Yes	Yes
		13	Clip High Override Level	Yes	Yes	Yes
		15	Clip High Hysteresis Enable	Yes	Yes	Yes
		16	Clip High Hysteresis Level	Yes	Yes	Yes

12.1.13 TU Control

				Supports Function Code							
Base Address	**Block**	**Base Address Offset**	**Parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**8**	**16**
4001	0	0	Calibration mode on/off	Yes				Yes			
		1	Reserved	No				Yes			
		2	Reserved	No				Yes			
		3	Capture and enable baseline subtraction	Yes				Yes			
4021	1	0	Invoke calibration n			Yes			Yes		Yes
		1	Calibration point n gas			Yes			No		No
		2	Reserved			Yes			Yes		Yes

12.1.14 Auto Validation

				Supports Function Code							
Base Address	Block	Base Address Offset	Parameter	1	2	3	4	5	6	8	16
50001	0	0	Start or stop auto validation			Yes			Yes		
		1	Validation test result			Yes					
		2	Auto validation state			Yes					
		3	Auto validation state machine current state			Yes					
		4	Power interruption occurred			Yes					
		5	Validation cell was not purged			Yes					
		6	Debug message			Yes					
		7	Auto Val supported for this measurement			Yes					
		8	Correct password received			Yes					
50021	1	3	Requested zero-gas state			Yes					
		4	Requested span-gas state			Yes					
		5	Set Stability Time			Yes					
		6	Set Flush Time			Yes					
		7	Set Timeout			Yes					
50041	2	0	set validation pressure			Yes					Yes
		2	set validation temperature			Yes					Yes
		4	set validation gas concentration			Yes					Yes
		6	set validation gas tolerance			Yes					Yes
		8	set validation pass level			Yes					Yes
		10	set validation cell length			Yes					Yes
		12	set validation concentration standard deviation tolerance			Yes					Yes
		14	set validation transmission standard deviation tolerance			Yes					Yes
		16	set low signal threshold			Yes					Yes
		18	set scaling correction factor			Yes					Yes
50061	3	0	Measurement Concentration			Yes					
		2	concentration standard deviation			Yes					
		4	transmission standard deviation			Yes					
		6	zero measurement scaled to cell length			Yes					
		8	zero measurement scaled to process path length			Yes			Yes		

	10	span measurement scaled to cell length	Yes	
	12	span measurement scaled to process path length	Yes	
	14	Final zero threshold	Yes	Yes
	16	Auto Validation Pass Code	Yes	Yes

13. Appendix French Translation of Warnings

1.1 General warnings and cautions

If the Laser 3 Plus is used in a manner not specified within this manual, the protection provided by the equipment may be impaired.

Si La Laser 3 Plus est utilisée d'une manière non spécifiée dans ce manuel, la protection fournie par l'équipement peut être altérée.

Failure to observe the requirements of the manual may result in the user being held responsible for the consequences and may invalidate any warranty.

L'utilisateur sera tenu responsable des conséquences s'il ne respecte pas les procédures du manuel et pourrait entrainer l'annulation de la garantie.

Before you attempt to install, commission or use the Laser 3 Plus, read this manual carefully.

Avant d'essayer d'installer, d'une commission ou d'utiliser la Laser 3 Plus, lisez attentivement ce manuel.

Do not attempt to install, commission, maintain or use the Laser 3 Plus unless you are trained and competent.

Ne pas essayer d'installer, de commission, de maintenir ou d'utiliser la Laser 3 Plus sauf si vous êtes formé et compétent.

The Laser 3 Plus does not include any user-serviceable parts.

La Laser 3 Plus ne comporte aucune pièce réparable par l'utilisateur.

The Laser 3 Plus does not include any user replaceable fuses.

La Laser 3 Plus ne comporte pas de fusibles remplaçables par l'utilisateur.

Do not use the Laser 3 Plus as Personal Protective Equipment (PPE).

Ne pas utiliser La Laser 3 Plus en tant qu'équipement de protection individuelle (EPI).

If you do not install and use the Laser 3 Plus in accordance with the instructions in this manual, you may risk exposure to hazardous laser radiation.

Si vous n'avez ni installé ni utilisé La Laser 3 Plus conformément aux instructions de ce manuel, vous vous risquez à l'exposition d'une radiation laser dangereuse.

The Laser 3 Plus may be attached to equipment that is hot. Always wear the appropriate PPE to minimize the risk of burns.

La Laser 3 Plus peut être fixée à l'équipement qui est chaud. Toujours porter les EPI appropriés afin de minimiser le risque de brûlures.

Where there is a risk associated with the release of potentially harmful gases into the operating environment, always use suitable monitoring equipment.

Lorsqu'il existe un risque lié à la libération de gaz potentiellement nocifs dans l'environnement d'exploitation, utilisez toujours un équipement de surveillance approprié.

The gases included in the process being monitored may be toxic, asphyxiant or flammable.

Before you use the Laser 3 Plus, make sure that all connections are leak-free at full operating pressure to prevent exposure of personnel and the environment to the hazardous gases.

Les gaz inclus dans le processus de surveillance peut être toxique, asphyxiant ou inflammable.

Avant d'utiliser la Laser 3 Plus, assurez-vous que toutes les connexions sont sans fuites avec une pression de fonctionnement complète, afin d'éviter l'exposition du personnel et de l'environnement à des gaz dangereux.

Make sure that you install the instrument to conform to all relevant safety requirements, National Electrical Code and any local regulations. The installation must be safe for any extremes of operating conditions which may occur in the operating environment of the Laser 3 Plus.

Assurez-vous que vous installez l'appareil conformément à toutes les exigences de sécurité applicables, National Electrical Code et aux règlements locaux. L'installation doit être protégée de toutes conditions extrêmes de fonctionnement, qui peuvent se produire dans l'environnement d'exploitation de la Laser 3 Plus.

1.2 Laser safety

CLASS 3R LASER PRODUCT.

LASER RADIATION. The Laser 3 Plus is a Class 3R laser product. The Laser light is not visible. Do not look into the laser beam. Avoid direct eye contact with the laser radiation.

The transmitter and receiver units both have a Laser On indicator. This is ON when the transmitter emits laser radiation from the optical window.

PRODUIT LASER DE CLASSE 3R.

RAYONNEMENT LASER. La Laser 3 Plusest un produit laser de classe 3R. La lumière laser n'est pas visible. Ne pas regarder dans le faisceau laser. Évitez le contact des yeux avec le rayonnement laser.

L'émetteur et le récepteur ont tous deux un indicateur laser « ON ». Il est « ON » lorsque l'émetteur émet un rayonnement laser à partir de la fenêtre optique.

CLASS 3R LASER PRODUCT.

LASER RADIATION. Changes to settings or performance of procedures other than those specified in this manual may result in hazardous radiation exposure.

PRODUIT LASER DE CLASSE 3R.

RAYONNEMENT LASER. Toutes modifications apportées aux paramètres ou à l'exécution de procédures autres que celles spécifiées dans ce manuel peuvent entraîner l’exposition à des rayonnements dangereux.

1.3 Certification

1.3.1 Hazardous area installations

Do not modify the unit, either mechanically or electrically, or the certification of the instrument will be invalidated and it may not operate safely.

Ne modifiez pas l'unité, que ce soit mécaniquement ou électriquement. La certification de l'instrument sera invalide et ne pourra pas fonctionner en toute sécurité.

Exposure to some chemicals may degrade the sealing properties of materials used in the following devices: (North America only)

K1:	**Relay from Analyzer Main Board**	**Sealed Device**
K1:	**Relay from Option Board**	**Sealed Device**
K2:	**Relay from Option Board**	**Sealed Device**

L'exposition à certains produits chimiques pourrait dégrader l'étanchéité des propriétés des matériaux utilisés dans les appareils suivants: (Amérique du Nord uniquement)

K1:	**Relais de Analyseur de Conseil Principal**	**Sealed Device**
K1:	**Relais de l'Option Board**	**Sealed Device**
K2:	**Relais de l'Option Board**	**Sealed Device**

Substitution of the following components may impair suitability for Division 2: (North America only)

K1:	**Relay from Analyzer Main Board**	**Sealed Device**
K1:	**Relay from Option Board**	**Sealed Device**
K2:	**Relay from Option Board**	**Sealed Device**

La substitution de composants suivants peut altérer l'adéquation Division 2: (Amérique du Nord uniquement)

K1:	**Relais de Analyseur de Conseil Principal**	**Sealed Device**
K1:	**Relais de l'Option Board**	**Sealed Device**
K2:	**Relais de l'Option Board**	**Sealed Device**

EXPLOSION HAZARD - Substitution of components may impair suitability for CL I, Div 2. (North America only)

RISQUE D'EXPLOSION – La substitution de composants peut altérer l'adéquation pour les emplacements de Classe I, Division 2. (Amérique du Nord uniquement)

Make sure that the operating environment is within the limits specified in the product data (section 2.6.5).

Assurez-vous que l'environnement d'exploitation est dans les limites spécifiées dans les données du produit (section 2.6.5).

Do not install the Laser 3 Plus in a high-velocity dust-laden atmosphere.

Ne pas installer La Laser 3 Plus dans une atmosphère chargée de poussières.

Do not open the enclosure if an explosive atmosphere is present.

Do not open the enclosure if the Laser 3 Plus is energized.

Ne pas ouvrir en atmosphère explosive.

Ne pas ouvrir sous tension.

It is a condition of certification that the unit must be installed following the appropriate national or international legislation or codes of practice. In particular, you must make sure that the correct glands are fitted to cable entries and that you do not compromise the weatherproofing of the enclosure.

C'est une condition de certification que l'unité doit être installée en respectant la législation ou les codes de pratique nationale, internationale appropriés. En particulier, vous devez vous assurer que les glandes appropriés sont installés aux entrées de câble et que vous ne compromettez pas l'étanchéité de l'enceinte.

All of the Analyzer electrical connections are considered to be incendive and therefore must only be connected to safe area equipment.

Tous les moniteurs connexions électriques sont considérés comme incendiaires et doivent être uniquement connectés à l'équipement des zones de sécurité.

The equipment is incapable of passing the dielectric strength test prescribed by the standards, and so this must be taken into account during installation by using an SELV power source with a prospective short circuit current not exceeding 40A.

L'équipement est incapable de passer le test de résistance diélectrique prescrit par les normes, ce qui doit être pris en compte lors de l'installation en utilisant une source d'alimentation SELV avec un courant de court-circuit potentiel n'excédant pas 40A.

1.3.2 Hazardous area variants

Do not use hazardous area variants with a process atmosphere that requires EPL Ga. (e.g. Zone 0). If they are used within this process atmosphere, the hazardous area certification may be invalidated.

Ne pas utiliser des variantes de zones dangereuses avec une atmosphère de processus qui nécessite EPL Ga. (Par exemple, la Zone 0). Si elles sont utilisées dans cette atmosphère de processus, la certification d'une zone dangereuse peut être invalidée.

Do not use hazardous area variants for oxygen enriched samples; that is gases over 21% O_2. If they are used with gases containing over 21% O_2 the hazardous area certification may be invalidated.

Ne pas utiliser des variantes de zones dangereuses pour les échantillons enrichis en oxygène; qui est plus de 21% des gaz O_2. S'ils sont utilisés avec des gaz contenant plus de 21% d'O_2 à la certification d'une zone dangereuse peut être invalidée.

Hazardous area variants are certified for use with a flammable process atmosphere at a pressure of 0.8 to 1.1 bar absolute (11.6 to 15.95 psi). If used with a flammable process atmosphere beyond these limits, the hazardous area certification may be invalidated.

Variantes de zones dangereuses sont certifiées pour une utilisation avec une atmosphère de processus inflammable à une pression de 0,8 à 1,1 bar absolu (11,6 à 15,95 psi). Si elle est utilisée avec une atmosphère inflammable processus au-delà de ces limites, la certification d'une zone dangereuse peut être invalidée.

4.11.3 Raw signal graph

A raw signal above the limit will raise an error status and incorrect readings.
Un signal brut au delà de la limite emettra une erreur de status et des lectures incorrectes.

Excessive gas concentration for the path length used may result in unacceptably high raw gas signal. AC amplifier gain requires adjustment in this case. See section 4.11.3.

Une concentration excessive de gaz sur toute la longueur du trajet utilisé pourra entrainer un signal brut trop élevé. L'amplificateur AC nécessite un réglage dans ce cas. Voir la section 4.11.3.

5.3.1SD card

Only remove the transmitter enclosure cover to access the SD card if there is a negligible risk of pollution of the electronic circuits due to moisture, liquids, dirt, dust or other contamination.

Before you refit the covers, make sure that the sealing gaskets are clean, dry and undamaged. Replace and secure all covers as soon as possible after you complete your task within the enclosure.

Ne retirez le couvercle du boîtier du transmetteur pour accéder à la carte SD s'il y a un risque négligeable de pollution des circuits électroniques en raison de l'humidité, les liquides, la saleté, la poussière ou toute autre contamination.

Avant de vous remonter les capots, assurez-vous que les joints d'étanchéité sont propres, secs et en bon état. Replacez et fixez tous les capots dès que possible après que vous avez terminé votre tâche au sein de l'enceinte.

When you use an SD card to record measurements from the Laser 3 Plus, make sure that the transmitter enclosure cover is closed and secured, otherwise the EMC protection measures will be invalidated and the results recorded may not be valid.

Lorsque vous utilisez une carte SD pour enregistrer des mesures de la Laser 3 Plus, assurez-vous que le couvercle du boîtier du transmetteur est fermé et sécurisé, sinon les mesures de protection CEM sera invalidée et que les résultats enregistrés ne sont pas valables.

6 Calibration

6.2 Removing the transmitter and receiver units from the process

Before disconnecting the TU and RU from the process ensure there is no risk from exposure to potentially harmful gases.
Avant de déconnecter les TU et RU du processus, assurez-vous qu'il n'y a aucun risque d'exposition à d'éventuels gaz nocifs.

Ensure the analyzer is powered off before disconnecting the TU and RU from the process.
Assurez-vous que l'analyseur soit sur position OFF avant de déconnecter les TU et RU du processus.

6.3 Connecting transmitter and receiver units to the calibration cell

Ensure the cables and pipes connected to the analyzer and calibration cell are routed so that they do not present a trip hazard.

Assurez vous que les câbles et les tuyaux raccordés à l'analyseur et à la cellule d'étalonnage sont acheminés de manière à ce qu'ils ne présentent pas de danger.

The pressure in the calibration cell must not exceed 1.5 bar absolute.

La pression de la calibration de la cellule ne doit pas excéder 1.5 bar.

Before using the calibration cell, ensure all connections are leak free at operating pressure.

Avant d'utiliser la cellule de calibration, veillez à ce que les connections ne fuient pas lors de la pression.

Calibration gases are potentially harmful ensure adequate ventilation is provided.

Les gaz d'étalonnage sont potentiellement nocifs ; veuillez à ce que la pièce soit correctement ventilée.

Purging gases are potentially harmful ensure adequate ventilation is provided.

Les gaz de purge sont potentiellement nocifs ; veuillez à ce que la pièce soit correctement ventilée.

Before disconnecting the TU and RU from the calibration cell ensure there is no risk from exposure to potentially harmful gases.

Avant de déconnecter le TU et le RU de la cellule de calibration, veillez à ce qu'il n'y ait aucun risque d'exposition à des gaz nocifs.

Ensure the laser beam is switched off before disconnecting the TU and RU from the calibration cell.

Assurez vous que le faisceau du laser soit en position OFF avant de déconnecter le TU et le RU de la cellule de la calibration.

Ensure that Purge Port 3, 'Enclosure Out', is free to vent to atmosphere.

Assurez vous que la purge Port 3, 'Enceinte' est libre d'évacuer l'atmosphère.

After calibration is completed, the instrument must be returned to the correct process settings, including Purge Compensation being 'Enable' if applicable. Other settings include path length, pressure and temperature.

Une fois l'étalonnage complet, l'instrument doit etre re-régler

Transmitter and Receiver purge ports should also be checked, so that they are returned to the correct process and purge requirements at installation.

Les ports de purge de l'émetteur et du récepteur doivent également être verifiés de manière à ce qu'ils reviennent au processus original

6.12 In-situ validation (in-line gas validation)

The pressure in the In-line validation cell must not exceed 1.5 bar absolute.

La pression dans la cellule de validation en ligne ne doit pas dépasser 1,5 bar absolu.

Before using the in-line validation cell, ensure all connections are leak free at operating pressure.

Avant d'utiliser la cellule de validation en ligne, assurez-vous que toutes les connexions sont étanches à la pression de service.

Validation gases are potentially toxic, corrosive, flammable or asphyxiant; ensure adequate ventilation is provided.

Les gaz de validation sont potentiellement toxiques, corrosifs, inflammables ou asphyxiants; assurer une ventilation adéquate.

In-line validation gases used must be well below the LEL of the gas (<25%) and be in an inert balance gas such as N2.

The in-line validation cell volume must not form a Zoned area.

Les gaz de validation en ligne utilisés doivent être bien en dessous de la LIE du gaz (<25%) et être dans un gaz d'équilibre inerte tel que N2.

Le volume de la cellule de validation en ligne ne doit pas former une zone zonée.

Purging gases are potential asphyxiants ensure adequate ventilation is provided.

Les gaz de purge sont des asphyxiants potentiels pour assurer une ventilation adéquate.

7.1 Installation preparations

7.1.1 Items to remove before installation

Ensure that Purge Port 3 of the Transmitter Unit, 'Enclosure Out', is free to vent to atmosphere before operation of the instrument.

Assurez-vous que Purge Port 3 de l'unité de l'émetteur, 'Enclosure Out', est libre d'évacuer l'atmosphère avant l'opération de l'instrument.

Remove Silica Gel sachet before attempting to operate the instrument.

Retirez le sachet de gel de silice avant d'essayer de faire fonctionner l'instrument.

Ensure that any parts which are removed for the purposes of installation are retained. They must be refitted in the event the instrument is transported to another location.

Assurez-vous que toutes les pièces qui ont été enlevées aux fins d'installation sont conservées. Ils doivent être installés dans le cas où l'instrument est transporté vers un autre endroit.

7.1.3 Analyzer placement

Make sure that you mount the Laser 3 Plus on a structure that is able to support its mass (refer to 2.6.1 for the transmitter unit and for the receiver unit).

The environmental operating conditions for the Laser 3 Plus are listed in Section 2.6.5.

Assurez-vous de monter la Laser 3 Plus sur une structure capable de supporter sa masse (voir 2.6.1 pour l'émetteur et pour l'unité réceptrice).
Les conditions environnementales d'exploitation du Laser 3 Plus sont énumérées à la Section 2.6.5.

Make sure that all floors and platforms are clear and free from obstructions, and that the engineer has sufficient space to move freely and change posture.

Assurez vous que toutes les pièces et les surfaces de travail aient le champ libre afin de laisser l'espace suffisant au technicien pour bouger librement et changer de position.

7.1.4 Process flanges

Always wear the appropriate PPE to minimize the risk of burns.

Toujours porter les EPI appropriés afin de minimiser le risque de brûlures.

The maximum process pressures for the Laser 3 Plus are listed in Section 2.6.6 For installations based in the European Union, in all applications operating above the maximum process pressures the Pressure Equipment Directive (PED) applies and an appropriate isolation flange must be fitted.

Les pressions de processus maximales pour La Laser 3 Plus sont énumérés dans la section 2.6.6 Pour les installations situées dans l'Union européenne, dans toutes les applications fonctionnant au-dessus des pressions de processus maximum de la directive des équipements sous pression (PED) s'applique et une bride d'isolement approprié doit être installé.

Install and use the isolation flanges in accordance with their manufacturer's instructions.

Installez et utilisez les brides d'isolation en conformité avec les instructions de leur fabricant.

If the process gas temperature is greater than 135 °C (275 °F), make sure that you provide adequate thermal isolation to ensure that the maximum temperature reached by the process flange to which the Laser 3 Plus is fixed does not exceed 135 °C (275 °F).

Si la température des gaz de procédé est supérieure à 135 °C (275 °F), assurez-vous que vous fournissez isolation thermique suffisante pour que la température maximale atteinte par la bride de procédé à laquelle La Laser 3 Plus est fixé ne dépasse pas 135 °C (275 °F).

When using thermal spacers, do not exceed a maximum torque of 25Nm for fixing bolts, otherwise damage may occur to the spacer.

Lors de l'utilisation d'entretoises thermiques, ne dépassez pas un couple maximal de 25 Nm pour les boulons de fixation, sinon des dommages pourraient survenir sur l'entretoise.

Never look into a live process through the eye piece as this may result in hazardous radiation exposure and permanent eye damage.

Ne jamais regarder a travers un processus en cours car cela pourrait endomager l'oeil et avoir des consequences irreversibles.

The Flange Alignment Tool is NOT Ex certified.

It CANNOT be used where a FLAMMABLE atmosphere is present in the 'Outside atmosphere' or the 'Process atmosphere'.

It MUST NOT be used where an EXPLOSIVE atmosphere is present in the 'Outside atmosphere' or the 'Process atmosphere'.

The alignment tool must not be used where there is a risk of exposure to hazardous gases contained in the process.

La bride d'alignement Tool n'est pas certifié Ex.

Il NE DOIT PAS être utilisé là où une atmosphère explosive est présente dans «l'atmosphère extérieure» ou «l'atmosphère du processus».

Il NE DOIT PAS être utilisé là où une atmosphère explosive est présente dans «l'atmosphère extérieure» ou «l'atmosphère du processus».

L'outil d'alignement ne doit pas être utilisé lorsqu'il existe un risque d'exposition à des gaz dangereux contenus dans le processus.

7.1.5 Mounting rigidity

Make sure that the flue wall is strong enough to support the weight of the Laser 3 Plus transmitter and receiver units, including the mounting flanges and unsupported cables.

Assurez-vous que la paroi de conduit est assez solide pour supporter le poids des Laser 3 Plus émetteur et le récepteur, y compris les brides de montage et les câbles non pris en charge.

7.2 Installation overview

If using toxic, asphyxiant or flammable sample or calibration gases, always purge the enclosures with non-hazardous gas during operation to reduce the risk of hazardous concentrations accumulating within the analyzer. Purge the enclosures for a suitable time before opening to ensure any concentrations are reduced to safe levels. Open transmitter or receiver enclosures in a force ventilated open area, or in another appropriate environment in which any hazardous gases are directed away from the user.

Si vous utilisez de l'échantillon toxique, asphyxiant ou inflammable ou des gaz d'étalonnage, toujours purger les enceintes avec du gaz non dangereux pendant le fonctionnement afin de réduire le risque de concentrations dangereuses accumulées dans l'analyseur. Purger les enceintes pendant un temps donne avant l'ouverture pour s'assurer que toutes les concentrations sont réduites à des niveaux sûrs. Ouvrez les enceintes de l'émetteur ou du récepteur dans une zone ouverte et ventilée ou dans un autre environnement approprié dans lequel les gaz dangereux sont dirigés loin de l'utilisateur.

7.2.1 Safety

Do not install the Laser 3 Plus in a high-velocity dust-laden atmosphere.

Ne pas installer La Laser 3 Plus dans une atmosphère chargée de poussières à haute vitesse.

You are responsible for ensuring that:

- **The instrument is installed correctly and safely.**
- **The laser beam is enclosed during operation.**
- **The sampling system is leak free.**
- **The venting system is appropriate for the gases you are sampling.**
- **The installation does not introduce trip hazards.**
- **Appropriate PPE is available for installation, servicing and decommissioning.**

Vous êtes responsable de veiller à ce que:

- **L'appareil est installé correctement et en toute sécurité.**
- **Le faisceau laser est enfermé pendant le fonctionnement.**
- **Le système d'échantillonnage ne présente pas de fuites.**
- **Le système d'évacuation est approprié pour les gaz vous échantillonnage.**
- **L'installation ne crée pas de risques de trébuchement.**
- **EPI approprié est disponible pour l'installation, l'entretien et le déclassement.**

Regularly inspect, test and replace seals to ensure that all external connections are always leak-free at full operating pressure.

Inspecter, tester et remplacer les joints pour s'assurer que toutes les connexions externes sont toujours sans fuite à une pression d'exploitation complète.

The equipment is incapable of passing the dielectric strength test prescribed by the standards, and so this must be taken into account during installation by using an SELV power source with a prospective short circuit current not exceeding 40A.

L'équipement est incapable de passer le test de résistance diélectrique prescrit par les normes, ce qui doit être pris en compte lors de l'installation en utilisant une source d'alimentation SELV avec un courant de court-circuit potentiel n'excédant pas 40A.

7.3 Process connections

7.3.1 Fitting the transmitter and receiver mounting/ alignment assembly

Before you fit the transmitter and receiver mounting / alignment assembly to the process:

Avant de vous correspondez au émetteur et le récepteur de montage / assemblage alignement du processus:

Make sure that there are no dangers from the release of potentially hazardous gases, for example, toxic, flammable, asphyxiant or hot gases.

Assurez-vous qu'il n'y a aucun danger de la libération de gaz potentiellement dangereux, par exemple, toxiques, inflammables, asphyxiants ou gaz chauds.

Always use adequate eye protection to prevent injury from ejected dust or dirt and high levels of IR radiation that may be present.

Toujours utiliser une protection oculaire adéquate pour prévenir les blessures de la poussière ou de la saleté éjectée et des niveaux élevés de rayonnement infrarouge qui peuvent être présents.

Make sure that the exposed metal parts of the process are at the same potential as that of its surroundings. If not, use suitable protective equipment to provide protection against the risk of electric shock.

Assurez-vous que les parties métalliques du processus sont au même potentiel que celle de ses alentours. Si non, utiliser un équipement de protection approprié pour fournir une protection contre le risque de choc électrique.

Make sure that the Laser 3 Plus is switched off, or the transmitter unit is disconnected from the process.

Assurez-vous que le Laser 3 Plus de la Série est éteint, ou l'émetteur est déconnecté du processus.

7.3.2 Alignment of the transmitter and receiver mounting / alignment assemblies

Do not use the alignment tool if the process flange is hot (60 °C), or if the process contains potentially hazardous gases.

Ne pas utiliser l'outil d'alignement si la bride de processus est chaude (60 ° C), ou si le processus contient potentiellement des gaz dangereux.

Only use the light source supplied by Servomex with the alignment tool.

Utilisez uniquement la source de lumière fournie par Servomex avec l'outil d'alignement.

Make sure that there are no dangers from the release of potentially hazardous gases, for example, toxic, flammable, asphyxiant or hot gases.

Assurez-vous qu'aucun danger ne pourrait provenir de potentiels gaz dangereux, par exemple gaz toxiques, inflammable, asphyxiant ou encore chauds.

Always use adequate eye protection to prevent injury from ejected dust or dirt and high levels of IR radiation that may be present.

Toujours utiliser une protection adéquate pour vos yeux afin de prévenir toute blessure causée par la poussière ou la saleté et d'un haut niveau de radiation.

7.3.3 Fitting the transmitter and receiver on the flange

Inspect all joints when you have connected the Laser 3 Plus to the process.

Inspectez tous les joints lorsque vous avez connecté La Laser 3 Plus à ce processus.

Do not apply power to the transmitter unit before both the transmitter and receiver units are fitted to the Analyzer flanges and front panels have been closed. This ensures that there is no risk of exposure to laser light.

Ne mettez pas l'unité de l'émetteur avant l'émetteur et le récepteur sont montés sur les brides de l'analyseur et les panneaux avant ont été fermés. Ceci garantit qu'il n'y a aucun risque d'exposition à la lumière laser

Never look into a live process through the eye piece as this may result in hazardous radiation exposure and permanent eye damage.

Ne jamais regarder a travers un processus en cours car cela pourrait endommager l'œil et avoir des conséquences irréversibles.

7.4 Electrical connections

7.4.1 General safety

Make sure that you install the instrument to conform to all relevant safety requirements, National Electrical Code and any local regulations. The installation must be safe for any extremes of operating conditions which may occur in the operating environment of the Laser 3 Plus.

Assurez-vous que vous installez l'appareil de se conformer à toutes les exigences de sécurité applicables, National Electrical Code et des règlements locaux. L'installation doit être protégée de tout extrême de conditions de fonctionnement qui peuvent se produire dans l'environnement d'exploitation de la Laser 3 Plus.

It is a condition of certification that the unit must be installed following the appropriate national or international legislation or codes of practice. In particular, you must make sure that the correct glands are fitted to cable entries and that you do not compromise the weatherproofing of the enclosure.

C'est une condition de la certification que l'unité doit être installée en respectant la législation ou des codes de pratique nationale ou internationale approprié. En particulier, vous devez vous assurer que les glandes appropriés sont installés aux entrées de câble et que vous ne compromettent pas l'étanchéité de l'enceinte.

The Laser 3 Plus does not incorporate an integral on/off switch. You must provide a means of externally isolating the electrical supply from the Laser Analyzer. Use a suitable switch or circuit breaker located close to the Laser Analyzer clearly marked as the disconnecting device for the Laser Analyzer. This must also incorporate a suitable fuse or over-current protection device, set to or rated at no more than 3 A. To comply with the relevant safety requirements this power disconnection device must be approved to:

- **UL 489 for equipment used in the USA.**
- **CSA C22.2 No. 5.1 for equipment used in Canada.**
- **IEC 60497 for equipment used in the EU and the rest of the world.**

La Laser 3 Plus ne comporte pas un interrupteur intégré marche / arrêt. Vous devez fournir un moyen d'isoler l'extérieur de l'alimentation électrique à partir de l'écran de Laser. Utilisez un coupe-circuit ou un interrupteur approprié situé près du moniteur laser soit marqué comme dispositif de déconnexion de l'écran de Laser. Il doit également intégrer un fusible approprié ou surintensité dispositif de protection, mis ou évalué à plus de 3 A. Pour se conformer aux exigences de sécurité de ce dispositif de sectionnement doit être approuvée à:

- **UL 489 pour les équipements utilisés aux Etats-Unis.**

- CSA C22.2 No 5.1 pour les équipements utilisés au Canada.
- IEC 60497 pour les équipements utilisés dans l'UE et le reste du monde.

Equipment connected to the DC power input, mA and Ethernet outputs, relay terminals and mA input terminals must be separated from ac mains voltages by at least reinforced insulation or equivalent.

L'équipement connecté à l'entrée d'alimentation en courant continu, mA et Ethernet sorties, les bornes du relais et les bornes d'entrée mA doit être séparé de réseaux à courant alternatif de tensions par une isolation au moins armé ou équivalent.

All of the electrical connections to the Laser 3 Plus are considered to be incendive and must only be connected to safe area equipment.

Toutes les connexions électriques au La Laser 3 Plus sont considérés comme incendiaire et ne doit être connecté à l'équipement des zones de sécurité.

Only remove enclosure covers (that is gland plates and enclosure doors) if there is a negligible risk of pollution of the electronic circuits due to moisture, liquids, dirt, dust or other contamination.

Before you refit the covers, make sure that the sealing gaskets are clean, dry and undamaged. Replace and secure all covers as soon as possible after you complete your task within the enclosure.

Enlever les recouvrements de l'enceinte (c'est plaques passe-câbles et portes de l'enceinte) s'il y a un risque négligeable de pollution des circuits électroniques en raison de l'humidité, les liquides, la saleté, la poussière ou toute autre contamination.

Avant de remonter les capots, assurez-vous que les joints d'étanchéité sont propres, secs et en bon état. Replacez et fixez tous les capots dès que possible après que vous ayez terminé votre tâche au sein de l'enceinte.

Make sure your electrical supply can provide the necessary maximum power consumption of 25W.

Assurez-vous que votre alimentation électrique peut fournir la consommation de puissance maximale nécessaire de 25W.

7.4.2 Glands and cable entries

The following instructions apply to installations that must comply to electrical safety requirements of IEC 61010 and Local Hazardous Area requirements.

Les instructions suivantes s'appliquent aux installations qui doivent se conformer aux exigences de sécurité électrique de la CEI 61010 et les exigences locales de zones dangereuses.

7.5 Functional earth / ground requirements

Make sure you read and understand the warnings and cautions in sections 7.4.1 and 7.4.2 before you proceed.

Assurez-vous de lire et de comprendre les avertissements et les mises en garde dans les sections 7.4.1 et 7.4.2 avant de poursuivre.

7.5.1 Power cable connections

Make sure that the electrical supply voltage shown on the rating label is correct for the available electrical supply. Do not install the equipment if the incorrect voltage is shown and contact Servomex or your local Servomex agent immediately.

Assurez-vous que la tension d'alimentation électrique indiquée sur la plaque signalétique est correcte pour l'alimentation électrique disponible. Ne pas installer l'appareil si la tension incorrecte est affichée et contacter Servomex ou votre agent Servomex local immédiatement.

Make sure that the DC power for the Laser 3 Plus is not derived directly from an ac supply that is rated at more than 300 Vac.

Assurez-vous que l'alimentation en courant continu pour La Laser 3 Plus n'est pas directement dérivée d'une alimentation en courant alternatif qui est évalué à plus de 300 Vac.

Make sure that the DC power for the Laser 3 Plus is suitably approved for the environment in which it is to be installed and used.

Assurez-vous que l'alimentation en courant continu pour La Laser 3 Plus est convenablement approuvée pour l'environnement dans lequel il doit être installé et utilisé.

7.5.3 Identification and location of electrical terminals

All unused screw clamps must be tightened.

Ensure connector latches “click” and are engaged fully.

Ensure wires are routed away from PCBs.

Toutes les bornes à vis non utilisées doivent être serrées. Assurez-vous que les loquets des connecteurs «cliquent» en place et sont bien engagés. Assurez-vous que les fils sont dirigés loin des PCB.

Before you remove the receiver unit cover, turn off the power to the transmitter unit to ensure that there is no risk of exposure to the laser beam.

Avant de retirer le couvercle de l'unité de réception, coupez l'alimentation de l'émetteur de s'assurer qu'il n'y a pas de risque d'exposition au rayon laser.

7.6 Purge connections

7.6.1 Alignment / purging assemblies

Make sure the purge gas pressure is above that of the process being monitored to avoid exposure to hazardous gases leaking from the process.

Assurez-vous que la pression du gaz de purge est supérieure à celle du processus surveillé pour éviter l'exposition à des gaz toxiques dégagées par le processus.

7.6.2 Enclosure environmental / measurement (Instrument) purge

Make sure that you vent purge gases carefully to avoid creating a hazard.

Assurez-vous que vous évacuer les gaz de purge soigneusement pour éviter de créer un danger.

8.2 Routine maintenance

Make sure that all gas connections to the process are regularly tested for leaks. If you find any, do not use the equipment until you have corrected the faults.

Assurez-vous que toutes les connexions de gaz dans le processus sont régulièrement testées pour des fuites. Si vous en trouvez, ne pas utiliser l'appareil jusqu'à ce que vous avez corrigé les fautes.

Do not attempt to maintain or service the Laser 3 Plus unless you are trained and competent.

N'essayez pas de maintenir ou entretenir la Laser 3 Plus, sauf si vous êtes formé et compétent.

Service personnel must verify the safe state of the equipment after all repairs. If you do not:

- **people may be injured**
- **the protective facilities incorporated into the design of the instrument may not operate as intended**
- **sample gas measurements may not be accurate, or**
- **the instrument may be damaged.**

Le personnel de service doit vérifier l'état de sécurité de l'équipement après toutes les réparations. Si vous ne le faites pas:

- **les gens peuvent être blessés**
- **les équipements de protection incorporée dans la conception de l'instrument peuvent ne pas fonctionner comme prévu**
- **mesures de gaz d'échantillon peuvent ne pas être exacts ou**
- **l'appareil peut être endommagé.**

The Laser 3 Plus may be attached to equipment that is hot. Always wear the appropriate PPE to minimize the risk of burns.

La Laser 3 Plus peut être fixé à l'équipement qui est chaud. Toujours porter les EPI appropriés afin de minimiser le risque de brûlures.

Turn off the power to the Laser 3 Plus before you attempt to remove the transmitter and receiver units from the process, remove the receiver unit enclosure cover or any other maintenance work. This ensures that the laser beam is switched off and there is no risk of exposure to hazardous laser radiation.

Coupez l'alimentation au La Laser 3 Plus avant de tenter de retirer les unités émettrices et réceptrices du processus, retirez le couvercle du boîtier de l'unité de récepteur ou tous autres travaux d'entretien. Ceci assure que le faisceau laser est coupé et qu'il n'y a pas de risque d'exposition à un rayonnement laser dangereux.

Sample gases may be toxic, asphyxiant or flammable.

Before you remove the Laser 3 Plus from the process, make sure that it does not contain any potentially hazardous or heated gases, or is at a pressure below atmospheric pressure.

Les échantillons de gaz peuvent être toxiques, asphyxiants ou inflammable.

Avant de retirer La Laser 3 Plus du processus, assurez-vous qu'il ne contient pas de gaz potentiellement dangereux ou chauffées, ou est à une pression inférieure à la pression atmosphérique.

8.5 Alignment / purging flanges

Do not disconnect the pipes from the alignment / purging flanges if there is a risk to personnel or the environment from exposure to the potentially hazardous gases contained in the process being monitored.

Ne pas débrancher les tuyaux des brides d'alignement / de purge s'il y a un risque pour le personnel ou l'environnement de l'exposition aux gaz potentiellement dangereuses contenues dans le processus contrôlé.