



SERVOTOUGH SpectraExact 2500 INSTALLATION MANUAL

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WARNING, CAUTIONS AND NOTES

This publication includes **WARNINGS**, **CAUTIONS** and **NOTES** which provide, where appropriate, information relating to the following:

- **WARNINGS:** Hazards which will result in personal injury or death.
- **CAUTIONS:** Hazards which will result in equipment or property damage.
- **NOTES:** Alert the user to pertinent facts and conditions.

WARNING

- **LETHAL VOLTAGES: THE ELECTRICAL POWER USED IN THIS EQUIPMENT IS AT A VOLTAGE HIGH ENOUGH TO ENDANGER LIFE.**
- **BEFORE CARRYING OUT MAINTENANCE OR REPAIR THE EQUIPMENT MUST BE DISCONNECTED FROM THE ELECTRICAL SUPPLY. TESTS MUST BE MADE TO ENSURE THAT DISCONNECTION IS COMPLETE.**
- **IF FOR ANY REASON THE POWER SUPPLY CANNOT BE DISCONNECTED, FUNCTIONAL TESTING, MAINTENANCE AND REPAIR OF THE ELECTRICAL UNITS IS ONLY TO BE UNDERTAKEN AS A LAST RESORT AND MUST BE CARRIED OUT BY PERSONS FULLY AWARE OF THE DANGER INVOLVED.**

NOTE

This instruction manual for the 2500 Series range of analysers covers installation, routine maintenance and fault diagnosis procedures, and it should be thoroughly read and retained by the personnel responsible.

WARNING



- You must install and use the instrument in accordance with the requirements of this manual. 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 instrument must be installed by a suitably skilled and competent technician or engineer.
- You must not modify the instrument in any way (either mechanically or electrically). If you do, the certification of the instrument will be invalidated and it may not operate safely.

WARNING



- All servicing work must be carried out by a suitably skilled and competent technician or engineer.
- The 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.

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SECTION 1 INTRODUCTION

1.1 Introduction

This manual contains information regarding installation and hardware configuration of the Servomex 2500 Series analysers (2500GEN/EU1/EU2/DU1/EX1/EX2/DX1/FM2/DM2, 2510GEN/EU1/EU2/DU1/EX1/EX2/DX1/FM2/DM2/HTV, 2520GEN/EU2/DU1/EX2/DX1/FM2/DM2, 2550GEN/EU1/EU2/DU1/EX1/EX2/DX1/FM2/DM2 variants).

GEN – General Purpose/Safe area use.

HTV – High Temperature Variant.

EU2/DU1 – Certified for European areas that require EPL Gc or Db.

EU1 – Certified for European areas that require EPL Gb.

EX2/DX1 – Certified for International areas that require EPL Gc or Db.

EX1 – Certified for International areas that require EPL Gb.

FM2/DM2 – Certified for US Class I, II Div. 2 and Zone 2 or Zone 21 areas.

Note that the EU1, EU2, EX1, EX2, FM2 and DM2 versions can also be used where flammable samples are to be monitored in otherwise safe areas.

Note: for more information regarding Equipment Protection Levels, see Appendix B.

The Servomex 2500 Series has been designed and manufactured using Servomex quality systems, which have been certified to ISO9001.

A separate Quickstart manual is also supplied with the 2500, 2520 and 2550 analysers. This details software configuration and operation of the analyser. An alternative Quickstart manual is supplied with the 2510 analysers. Extra copies of either may be ordered from Servomex.

Some variants are supplied with a Safety Certificate Manual that details the hazardous area approvals and declarations applicable.

Details of the hardware and instructions for servicing, by qualified personnel only, are presented in the 2500 Service Manual which may be ordered from Servomex.

Technical assistance and spare parts are available from Servomex outlets (or their local agents) listed on the back cover.

Use this manual for:

Installation	To take commissioning to the point where the analyser is powered and operational. The installer is advised to read this manual completely before commencing installation.
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Use the Quickstart manual for:

Configuration	How to set up the clock, passwords, alarm levels, analogue outputs, relays and other parameters.
----------------------	--

Calibration	How to use the manual and automatic calibration/checking facilities.
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Review	How to review configuration and set-up information.
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1.2 General Description

The Servomex 2500 Series is a single beam, multi wavelength process analyser suitable for monitoring up to three components in a gas sample stream (2550). It is supplied configured to the customer's precise analytical requirements for a stated analysis in a specific background stream.

The general layout of the 2500 Series is shown in Figure 1.1. It has been designed for modern industrial environments with the emphasis on rugged construction, reliable performance, simple operation and easy servicing. The analyser is controlled using an on-board microprocessor, which gives flexibility to the user, enabling him/her to configure the operation of the 2500 to suit the particular process environment. The 2500 is operated via a very simple control panel, which is mounted on the analyser itself.

The gas or liquid sample to be analysed must be passed continuously through the analyser's sample cell. The 2500 is designed for continuous 24 hour/day operation and should not normally be switched off. Versions of the 2500 analyser are suitable for use in safe and hazardous areas. They are also designed to I.P. 65. (without electrical cell heater).

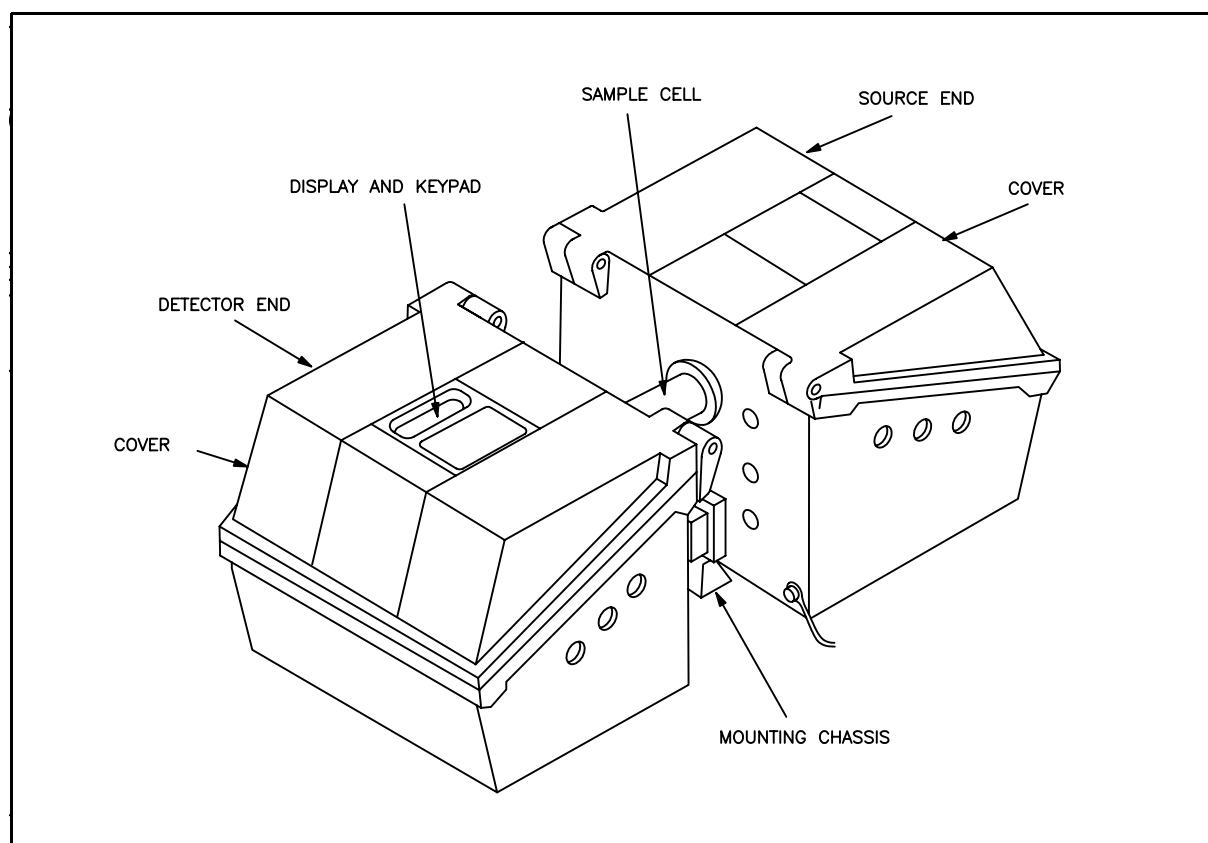


Figure 1.1 2500 Overall View

Note that the EU1, EU2, EX1, EX2, FM2 and DM2 versions can also be used where flammable samples are to be monitored in otherwise safe areas (see Safety Certificate Manual).

WARNING

The EU1 and EX1 versions are intended for use with a suitably certified Purge Control System (PCS). Do not install the EU1 or EX1 version in a hazardous area without a purge controller.

The analyser's software is menu driven and has been designed to be as intuitive as possible, enabling the user to fully operate and control the 2500 with the minimum of familiarisation.

NOTE

Full technical specifications for 2500 Series Analysers are presented in section 7 of this manual.

1.3 Basic Construction

The basic construction of the 2500 is shown in Figure 1.2. It comprises 2 cast end assemblies (with hinged opening/removable covers), connected by a rigid mounting beam, or chassis. The sample cell is mounted between the 2 end assemblies and is removable for cleaning. This configuration results in a single optical axis, i.e. straight through beam design, with no alignment adjustments necessary. The source end (right side) contains the soft U.V. or infrared source, which generates a broad beam of energy across the appropriate spectrum. This is mounted on the chopper box assembly, which contains the interference filters, mounted on a rotating chopper wheel. These filters select the appropriate wavelengths for the analysis for which the 2500 is configured. In most applications, there is one measurement wavelength and one reference wavelength for each measured component.

The infrared or visible beam, alternating in wavelength, is then focused through the sample cell, where energy at the measurement wavelength is selectively absorbed by the components being analysed. The remaining energy falls on the detector in the detector end.

The sample cell is a simple thick metal construction (316 stainless steel as standard) fitted with optical windows (each 6 mm thick) to allow passage of the beam. It is supported between the 2 ends of the 2500 by short cylindrical bosses, which may be scrubbed or purged, depending on application. The whole cell assembly is easily removed by loosening the two bosses and lifting it away, as described in Section 5.

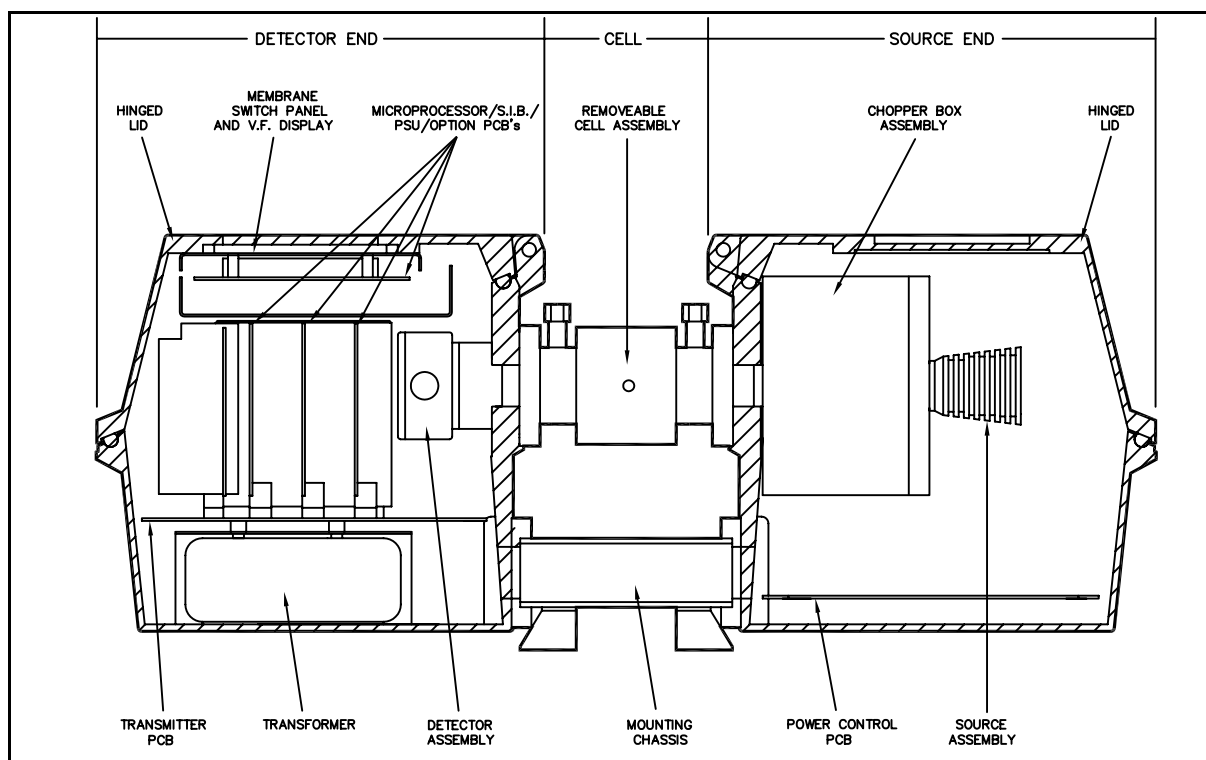


Figure 1.2 2500 Construction

The detector end (left side) contains the detector assembly and also the main electronic circuit boards. The display and control panel is also mounted in the hinged lid of this end.

1.4 Options and Accessories

The 2500 supplied may have been fitted with customer specified options and/or accessories. The full list of available items with brief descriptions is given here.

WARNING

The surface temperature of heated cells can reach or exceed 100°C

The following symbol is used on the heated cell:



CAUTION, HOT SURFACE

1.4.1 Heated Sample Cell – Electrical

Where fitted, this is powered and controlled by the 2500 itself and is suitable for gas samples. It may be used in both general purpose and some hazardous areas. The normal temperature setting for common gas applications is 60°C, although it may be supplied set to any temperature from 60 – 180°C for HTV variants or from 60 – 130°C for other versions.

1.4.2 Heated Sample Cell – Steam

Where fitted, this is a steam heating coil which must be supplied with low pressure steam by the user and vented to atmosphere, to maintain a cell temperature of approximately 100°C. This allows cell heating in hazardous areas up to Zone 1/Div. 1 classification, and is normally used with the EU1 and EX1 versions only.

1.4.3 Optional Output Cards

As standard, all 2500 Analysers have 2 analogue mA (current) outputs and 3 relay contact pairs. The analogue outputs are user configured as described in the Quickstart manual. The relay contacts are user-assigned to any combination of concentration alarms, fault alarm, or calibration in progress, as similarly described in the Quickstart manual. These standard outputs originate from the Sensor Interface Board (SIB PCB) of the 2500.

An additional output PCB is available as option:

The 02000/916 PCB provides an extra 2 x (mA) plus 2 x (relay) outputs

This additional output PCB can be fitted into the normally vacant slot 2 in the 2500.

These extra outputs are configured along with the standard outputs in the usual way (See Quickstart manual).

NOTE

Any or all of these analogue outputs may be configured as a voltage output by hardware link selection, as an alternative to current output.

1.4.4 Compensation Options

The output of any infrared analyser is affected by changes in sample pressure and sample temperature, unless compensation is applied. Alternatively, these parameters can be kept constant by a suitable sample conditioning system. Ambient (barometric) pressure will also affect sample pressure in the analyser if a gas sample is being simply vented to atmosphere. The following compensation options may be fitted to a 2500.

- **Sample Pressure Compensation**

A solid state pressure transducer is fitted and plumbed into one sample cell connection. A continuous pressure measurement over the range of the standard transducer, 0 – 345 kPa (0 – 50 psi), is made by the 2500. During calibration in the factory, an empirical sample pressure/span concentration relationship is determined and stored in memory to calibrate the compensation. Suitable for gas sample measurements only.

This option is detailed in Section 3.5.

WARNING

Standard transducers are not suitable for oxygen service.

- **Sample Temperature Compensation**

A type 'K' thermocouple in stainless steel sheath is supplied, and a continuous temperature measurement is made by the 2500 over the range -50 to 200°C (-58 to 392°F). During calibration in the factory, an empirical sample temperature/span concentration relationship is determined and stored in memory to calibrate the compensation. Suitable for gas or liquid samples, and for safe and hazardous area installations. Not available with heated cell.

1.4.5 Digital Communications Options

As standard, all 2500 Analysers are equipped with an RS-232 port for the output of configuration or measurement data to a printer, DCS or datalogger. As an alternative, the analyser can be fitted with one of the following bi-directional digital communications options:

- Modbus ASCII or Modbus RTU over RS-485
- Modbus TCP over Ethernet

When either of these options are fitted the standard RS-232 output is not available.

Appendix A describes how to access analyser data and control auto calibration using the Modbus protocol.

1.4.6 Application Options

A range of standard and special application options is available with the 2500 and it will have been supplied configured with one particular option to make the customer-specified measurements. Full details of the application configuration (i.e. optical materials, operating wavelengths, cell path length, wetted materials etc.) will be found on the Product Specification document in the front of this manual.

SECTION 2 INSTALLATION – GENERAL

2.1 Introduction

This section provides all the information required to install the 2500 analyser. The installer is advised to read this section through completely before commencing the installation.

2.2 Preparation

2.2.1 Tools

Installation of the 2500 requires the use of standard hand tools only, and an Allen key provided with the instrument to open the end case covers. Preparation of suitable mounting holes in support brackets or panels may require appropriate power tools.

2.2.2 Safety Precautions

The electrical power used in this equipment is at a voltage high enough to endanger life therefore normal electrical safety precautions must be observed. Where necessary a warning is placed prior to the procedure it refers to as shown in the following example:

WARNING

Always ensure that the electrical mains power supply is disconnected before commencing work.

WARNING

Electrostatic hazard: Clean display and keypad using a clean cloth moistened with water.

2.2.3 Unpacking and Inspection

WARNING

2500 analysers weigh in the range 25 kg (55 lbs) to 50 kg (110 lbs) and care must be taken when handling. Use 2 people if necessary and only lift using the yellow handles provided, not the sample cell.

Lift in the approved manner and remove the 2500 analyser from its packing and inspect for any damage incurred during transit. If any damage has occurred inform Servomex or their agents immediately. Retain packing, in case it is required to return the analyser to the supplier.

After the initial visual inspection, carry out the following checks. **Beware gas strut action of the hinged covers.**

- Check that the serial number of the 2500 (located inside source end and also marked on the external rating label) corresponds to the serial number given in the Manufacturing Data Sheet found at the front of this manual.
- Check that the specification sheet details are in order and agree with the purchase requirements. Pay particular attention to the Manufacturing Data Sheet supplied, and any Special Instrument Process Sheets attached.
- Check that the accessories are present and undamaged. Standard 2500 accessories provided are: Fuse kit, Allen key, Plastic plugs (refer to section 2.4.2) and Ferrites (refer to section 3.2).

2.3 Electrical Connection

WARNING



Use suitable circuit breaker located close to the instrument clearly marked as its disconnecting device. This must incorporate a suitable fuse or over-current protection device, set to or rated at no more than 6A. To comply with the relevant safety requirements this power disconnection device shall be approved to:

- **UL 489 for equipment use in the USA.**
- **CSA C22.2 No. 5.1 for equipment in Canada.**
- **IEC60947 for equipment used in the EU and the rest of the world.**

Only previously approved mains cables are to be used.

CAUTION

Specific voltage rating information is given on the label located on the outside of the 2500 Analyser and copied within the enclosure. Ensure that the analyser is correctly configured for the supply voltage.

The 2500 Analyser has no integral switch for disconnecting the electrical supply. The installer must include a means of isolating the electrical power by means of a switch or circuit breaker located close to the 2500 Analyser. It must be marked as the disconnecting device for the analyser and be easily accessible

The electrical supply to the 2500 Analyser **MUST** be protected by a suitable fuse or over current protection device rated at no greater than 6 Amps.

Where the main electrical supply is not referenced to ground, an isolating transformer must be fitted and its secondary winding suitably earthed. The following mains power cable requirements must be met:

- Three core cable with Line/Live (L), Neutral (N), Earth/Ground (E) conductors.

- The cable voltage rating should conform to the supply voltage. The type of cable used should conform to current local regulations, and be suitable for the installation environment. For use in areas exposed to weather or mechanical stress, armoured or sheathed cable is recommended.
- All electrical cables enter the body of the 2500 Analyser via user-supplied cable glands. These cable glands must be air tight and/or suitably approved if the units are to be purged and/or mounted in hazardous areas.
- The electrical supply connection terminals are suitable the following cable:

Flexible conductors	–	0.5 to 1.5mm ² (20 to 16 AWG)
Solid conductors	–	0.5 to 2.5mm ² (20 to 14 AWG)

Cables should be suitable for temperatures of at least 75°C.

2.4 Installation

WARNINGS

- **The 2500 Series analysers are not suitable for use in hazardous areas unless the correct certification labels have been affixed by Servomex and a suitable purge control system is installed (EU1 and EX1 versions).**
- **The installer must be satisfied that the 2500 analyser installation conforms to the relevant safety requirements, national electrical code and any other local regulations, and that the installation is safe for any extremes of conditions which may be experienced in the operating environment of the analyser.**
- **With the exception of relay contacts, Signal input and output terminals of the analyser must only be connected to circuits that are separated from mains voltage by at least reinforced insulation.**
- **If the equipment is used in a manner not specified by the manufacturer the protection provided by the equipment might be impaired.**
- **Many process samples, gas streams and test samples are toxic, asphyxiant, corrosive, flammable or a combination of some or all of these. It is the responsibility of the installer to ensure that adequate precautions are taken during installation of the 2500 analyser, connection of samples, and during any other checks or tests. All sample line connections must be checked for no leaks.**
- **To avoid propagating brush discharges, the unit is not to be installed in a high velocity dust-laden atmosphere.**
- **The plastic cell cover (if fitted) may constitute an electrostatic charging hazard. Use a damp (but not wet) cloth to wipe clean the outer surface of the cover.**

2.4.1 Positioning

Sensible positioning and an accurate and secure installation will minimise maintenance, instrument breakdowns and will provide reliable service.

The location should be reasonably vibration free, subject to minimal fluctuations in ambient temperature and provide reasonable access to the instrument and the availability of any required services.

If the 2500 is to be mounted outside it must be suitably protected from all extremes of climatic conditions by a suitable insulated enclosure, paying particular attention to the ambient temperature range and the rate of temperature change specifications.

EU1 and EX1 versions must be used with a Purge Control System, which must meet the necessary pressurisation requirements, and be supplied with the necessary pressurisation and control components.

FM2/DM2 versions fitted with electrically heated sample cells must be installed in locations which provide adequate protection against the entry of solid foreign bodies and liquids capable of impairing safety.

WARNING

EU1 and EX1 versions must be used with a Purge Control System, which meets the necessary pressurisation and certification requirements as detailed in the Safety Certificate Manual.

If a gas sample conditioning system is to be connected it must be designed to provide a filtered, clean, non-condensing sample for the analyser with no risk of a possible carry- over of condensate into the sample cell.

If a liquid sample conditioning system is to be connected it must be designed to provide a filtered, single-phase sample for the analyser.

2.4.2 Mounting Details

The following paragraphs provide mounting information for the 2500 Analyser. Use the yellow lifting handles to manoeuvre the 2500 into position, using two people where necessary.

The analyser may be mounted vertically or horizontally, ideally at chest height for best visibility and ease of access, but with some restrictions (refer to Fig 2.1)

CAUTION

- **For Liquids the analyser should be mounted horizontally with the cell inlet port at the bottom.**
- **For Gases the analyser should be mounted horizontally with the cell inlet port on top, especially if there is risk of particulates or condensates in the sample.**
- **The 2500 may be mounted vertically for gas samples, provided the cell outlet is at the bottom. This is only suitable if there is no risk of particulates or condensates in the gas sample.**

When mounting the analyser ensure that the panel or brackets employed are adequate to take the weight and there is a minimum clearance above the casing of 500mm (20") to provide space to open the end covers.

Fig 2.2 provides mounting details and a table of mounting hole spacings for the various cell lengths. Be sure to identify the correct hole spacing.

When the 2500 is to be vertically mounted the display may be rotated 90° to bring it into a legible position. This is done by removing the internal metal cover and ribbon cable clamp, and removing the retaining bracket. The display unit can then be withdrawn a little and rotated. Reassemble the disturbed components in reverse order, carefully folding the ribbon cable to prevent any stress on it.

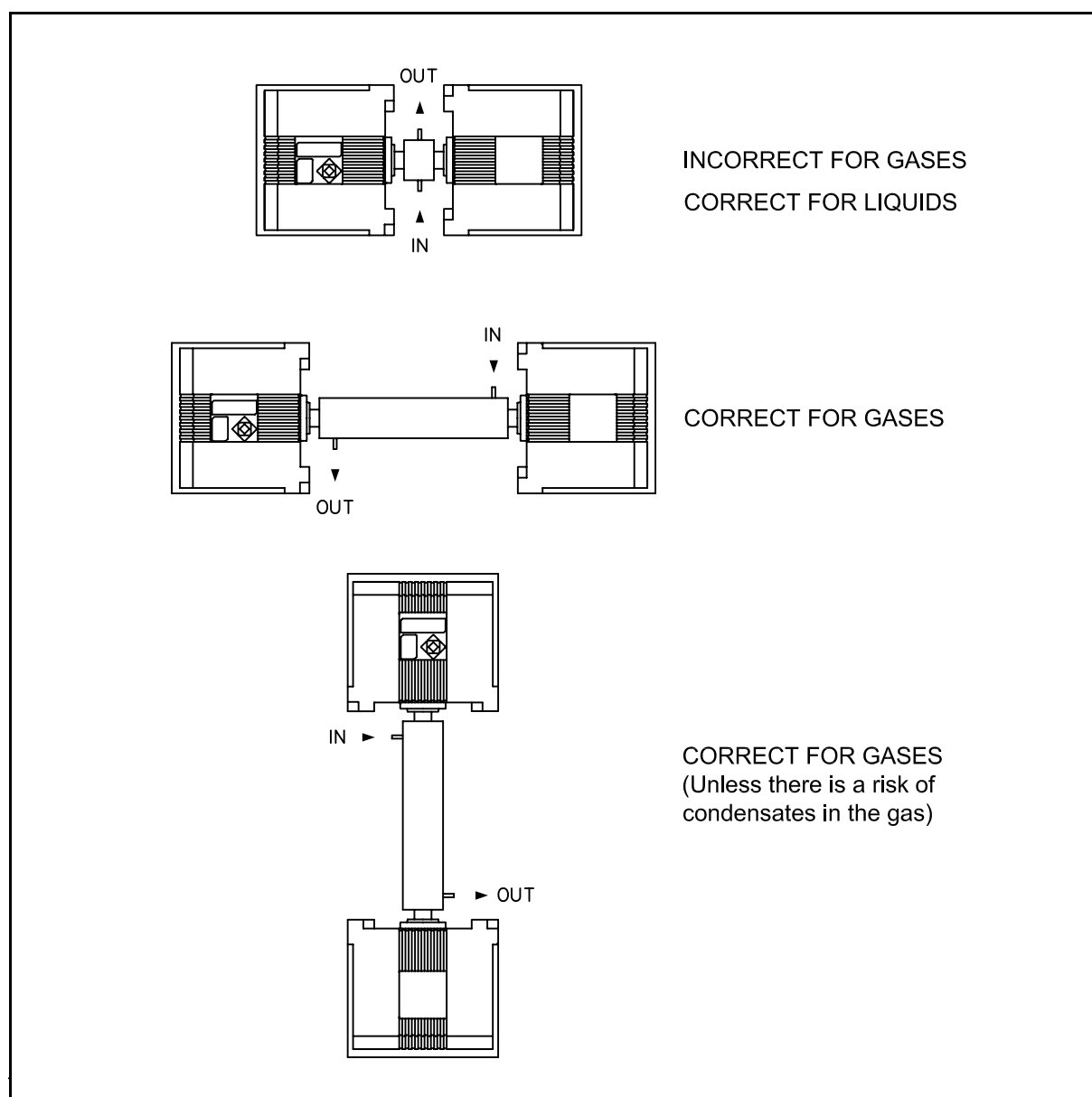


Figure 2.1 2500 Positioning Restrictions

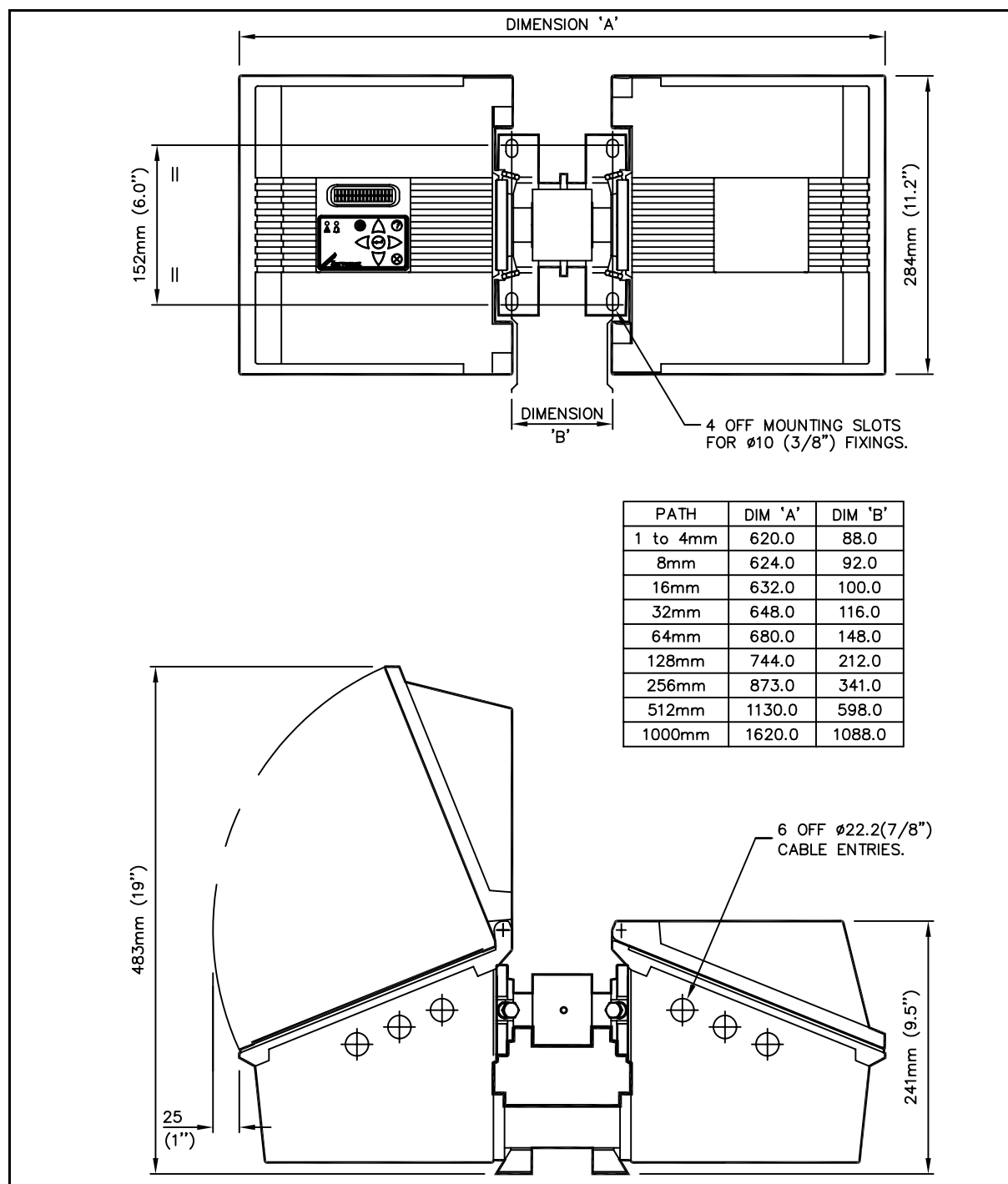


Figure 2.2 2500 Mounting Details

Once mounted, the two yellow lifting handles and their spacers **MUST** be removed by unscrewing the securing screws. Press the black pop-in plugs supplied into the vacant screw holes and retain the handles for possible future use.

2.5 Instructions Specific to Hazardous Area Installations

(Reference European ATEX Directive 94/9/EC, Annex II, 1.0.6.)

The following instructions apply to equipment covered by certificate numbers: Sira 09ATEX1341X, IECEx SIR09.0136X, Sira 10ATEX4015X, Sira 10ATEX 9016X and IECEx SIR 10. 0007X

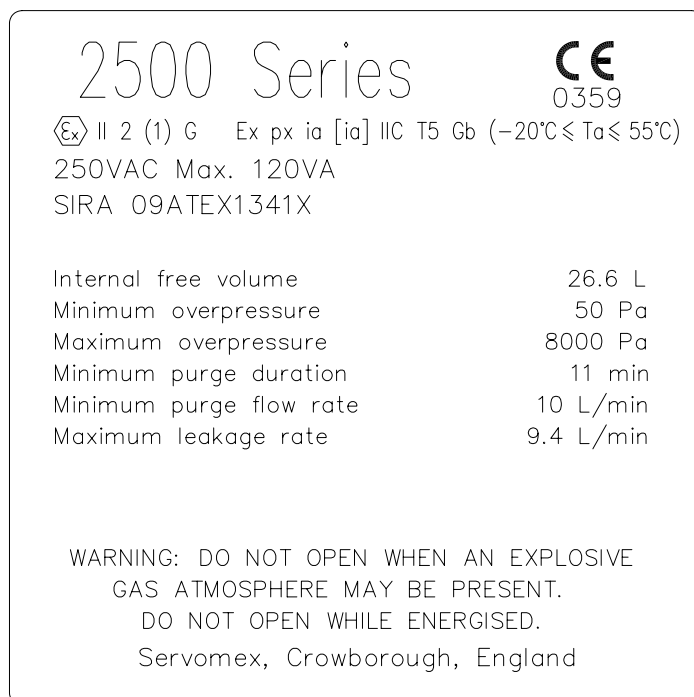
- 2.5.1** The equipment may be located where flammable gases and vapours of groups IIA, IIB and IIC may be present. The Ex n analyser may also be located where combustible dusts of groups IIIA or IIB may be present. The equipment is only certified for use in ambient temperatures in the range -20°C to +55°C for type 'p' approval and -10°C to +55 °C for Ex n approval, and should not be used outside these ranges.
(Note performance specification is 0°C to +55°C)
- 2.5.2** All cable entries or closing devices for unused entries shall be suitably certified to ensure that they comply with the general requirements of EN 60079-0:2009 and / or IEC 60079-0:2007.
- 2.5.3** For the IECEx certified analyser, all cable entries or closing devices must be IECEx certified.
- 2.5.4** To prevent propagating brush discharges, the analyser must not be mounted in a high velocity dust - laden atmosphere.
- 2.5.5** The equipment has not been assessed as a safety-related device (as referred to by Directive 94/9/EC, Annex II, clause 1.5).
- 2.5.6** Installation of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice (EN 60079-14 within Europe).
- 2.5.7** Repair of this equipment shall be carried out by the manufacturer or in accordance with the applicable code of practice (EN / IEC 60079-19).
- 2.5.8** If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

<u>Aggressive substances</u>	e.g. acid liquids or gases that may attack metals, or solvents that may affect polymeric materials.
------------------------------	---

<u>Suitable Precautions</u>	e.g. regular checks as part of the routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.
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2.6 Label Information

2.6.1 EU1 T5 (Unheated Cell)



2.6.2 EU1 T4 (Steam Heated Cell)



2.6.3 EX1 T5 (Unheated Cell)

2500 Series

Ex px ia [ia] IIC T5 Gb ($-20^{\circ}\text{C} \leq T_a \leq 55^{\circ}\text{C}$)
250VAC Max. 120VA

IECEX SIR09.0136X

Internal free volume	26.6 L
Minimum overpressure	50 Pa
Maximum overpressure	8000 Pa
Minimum purge duration	11 min
Minimum purge flow rate	10 L/min
Maximum leakage rate	9.4 L/min

WARNING: DO NOT OPEN WHEN AN EXPLOSIVE
GAS ATMOSPHERE MAY BE PRESENT.
DO NOT OPEN WHILE ENERGISED.
Servomex, Crowborough, England

2.6.4 EX1 T4 (Steam Heated Cell)

2500 Series

Ex px ia [ia] IIC T4 Gb ($-20^{\circ}\text{C} \leq T_a \leq 55^{\circ}\text{C}$)
250VAC Max. 120VA

IECEX SIR09.0136X


Internal free volume	26.6 L
Minimum overpressure	50 Pa
Maximum overpressure	8000 Pa
Minimum purge duration	11 min
Minimum purge flow rate	10 L/min
Maximum leakage rate	9.4 L/min

WARNING: DO NOT OPEN WHEN AN EXPLOSIVE
GAS ATMOSPHERE MAY BE PRESENT.
DO NOT OPEN WHILE ENERGISED.
Servomex, Crowborough, England

2.6.5 EU2 T4 and DU1 T80°C (Unheated Cell)

2500 Series


0359

 II 3 G Ex nA nC IIC T4 Gc
SIRA 10ATEX4015X

 II 2 D Ex tb IIIC T80°C Db IP66
SIRA 10ATEX9016X

RATED VOLTAGE = 240V MAX

$-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT

DO NOT OPEN WHEN ENERGISED

Servomex, Crowborough, England

2.6.6 EU2 T4 and DU1 T125°C (Heated Cell)

2500 Series


0359

 II 3 G Ex nA nC IIC T4 Gc
SIRA 10ATEX4015X

 II 2 D Ex tb IIIC T125°C Db IP66
SIRA 10ATEX9016X

RATED VOLTAGE = 240V MAX

$-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT

DO NOT OPEN WHEN ENERGISED

Servomex, Crowborough, England

2.6.7 EU2 T3 and DU1 T175°C (Heated Cell)

2500 Series


0359

 II 3 G Ex nA nC IIC T3 Gc
SIRA 10ATEX4015X

 II 2 D Ex tb IIIC T175°C Db IP66
SIRA 10ATEX9016X

RATED VOLTAGE = 240V MAX

$-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT

DO NOT OPEN WHEN ENERGISED

Servomex, Crowborough, England

2.6.8 EX2 T4 and DX1 T80°C (Unheated Cell)

2500 Series

Ex nA nC IIC T4 Gc

Ex tb IIIC T80°C Db IP66

IECEX SIR10.0007X

RATED VOLTAGE = 240V MAX

$-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT

DO NOT OPEN WHEN ENERGISED
Servomex, Crowborough, England

2.6.9 EX2 T4 and DX1 T125°C (Heated Cell)

2500 Series

Ex nA nC IIC T4 Gc

Ex tb IIIC T125°C Db IP66

IECEX SIR10.0007X

RATED VOLTAGE = 240V MAX

$-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT

DO NOT OPEN WHEN ENERGISED
Servomex, Crowborough, England

2.6.10 EX2 T3 and DX1 T175°C (Heated Cell)

2500 Series

Ex nA nC IIC T3 Gc

Ex tb IIIC T175°C Db IP66

IECEX SIR10.0007X

RATED VOLTAGE = 240V MAX


$-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT

DO NOT OPEN WHEN ENERGISED
Servomex, Crowborough, England

2.6.11 FM2 T4 and DM2 T80°C (Unheated Cell)

2500 Series




APPROVED

Non-Incendive
Class I, Division 2, Groups A,B,C,D T4
Class II, Division 2, Groups F, G T4
Dust-Ignition-Proof:
Class III, Division 1, 2 T4
Non-Sparking and Enclosed break:
Class I Zone 2 AEx nA nC IIC T4 Gc
Protection by Enclosure:
Zone 21 AEx tD T80°C IP6X Db
RATED VOLTAGE = 240V MAX
 $-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT
DO NOT OPEN WHEN ENERGISED
Servomex, Crowborough, England

2.6.12 FM2 T4 and DM2 T125°C (Heated Cell)

2500 Series




APPROVED

Non-Incendive
Class I, Division 2, Groups A,B,C,D T4
Class II, Division 2, Groups F, G T4
Dust-Ignition-Proof:
Class III, Division 1, 2 T4
Non-Sparking and Enclosed break:
Class I Zone 2 AEx nA nC IIC T4 Gc
Protection by Enclosure:
Zone 21 AEx tD T125°C IP6X Db
RATED VOLTAGE = 240V MAX
 $-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT
DO NOT OPEN WHEN ENERGISED
Servomex, Crowborough, England

2.6.13 FM2 T3 and DM2 T175°C (Heated Cell)

2500 Series



APPROVED

Non-Incendive
Class I, Division 2, Groups A,B,C,D T3
Class II, Division 2, Groups F, G T3
Dust-Ignition-Proof:
Class III, Division 1, 2 T3
Non-Sparking and Enclosed break:
Class I Zone 2 AEx nA nC IIC T3 Gc
Protection by Enclosure:
Zone 21 AEx tD T175°C IP6X Db
RATED VOLTAGE = 240V MAX
 $-10^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$

WARNING: DO NOT OPEN IF AN EXPLOSIVE
ATMOSPHERE MAY BE PRESENT
DO NOT OPEN WHEN ENERGISED
Servomex, Crowborough, England

SECTION 3 INSTALLATION – ELECTRICAL

WARNINGS

- **Lethal voltage:** mains AC power supplies are potentially lethal. The installer must ensure that the power supply has been isolated before commencing installation.
- **The installer must be satisfied that the 2500 analyser installation conforms to the relevant safety requirements, national electrical code and any other local regulations, and that the installation is safe for any extremes of conditions which may be experienced in the operating environment of the analyser.**

WARNING

The following symbols are used on the warning label fitted on the inside of the Source End Enclosure Cover.



CAUTION, ELECTRIC SHOCK HAZARD



CAUTION, CONSULT MANUAL

NOTE

When wiring up screw terminals refer to Appendix D for torque settings

3.1 Electrical Power Connections

For convenience the gas struts may be removed during installation by carefully levering them off. Ensure that the cable used is suited to the installation environment, and is the correct rating. Ensure that the fuse is suited to current rating of the analyser and that all glands and cable connections are secured firmly.

The mains power connection to this instrument is made via an electrical filter unit attached to the outside of the case. The power cable into this unit does not need to be screened.

WARNING (EU1 AND EX1 VERSIONS)

AC Power for Zone 1 (EU1 and EX1) versions may only be connected via a suitably certified Purge Control System. Refer to the PCS manual for details. The mains power connection to the instrument is made via the purged electrical filter unit attached to the outside of the case.

Refer to Figure 3.1 a) or b) for illustration.

To connect the 2500 analyser to the mains supply:

1. Isolate the mains AC supply at source.
2. Remove filter unit cover.
3. Fit suitable cable gland to the mains filter unit.
4. Insert cable through gland and secure.
5. Wire to terminals.
6. The mains AC supply is connected internally to TB30. The voltage selection is made by wire link on TB31 as illustrated in Figure 3.1 a) or b).
7. Connect the 2 external earthing studs to earth/ground. The RF earth provided must be **locally** earthed using as suitable solid conductor connected to a local physical earth to ensure optimum RFI protection. The external system earth must be connected to the mounting panel / cubicle / frame / local Intrinsically Safe earth, as appropriate.

DO NOT APPLY POWER YET.

NOTE

- | |
|---|
| <ul style="list-style-type: none">• When installed in hazardous locations, appropriate wiring practice must be used (e.g. within Europe installation must be in accordance with EN 60079-14)• To ensure the correct function of the analyser the mains input shall be protected from surges. |
|---|

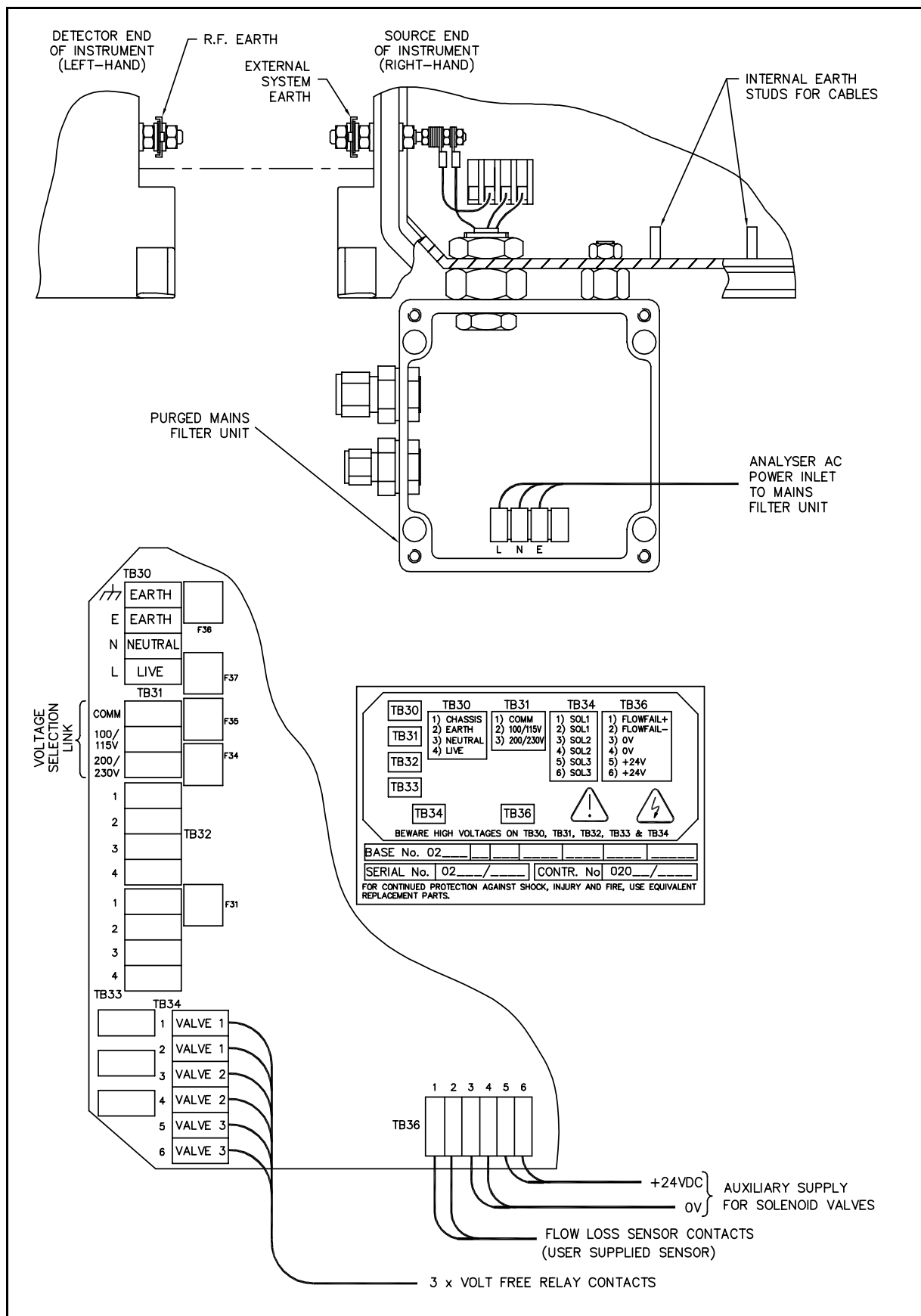


Figure 3.1a 2500 AC Power and Valve Connections (Purged Filter)

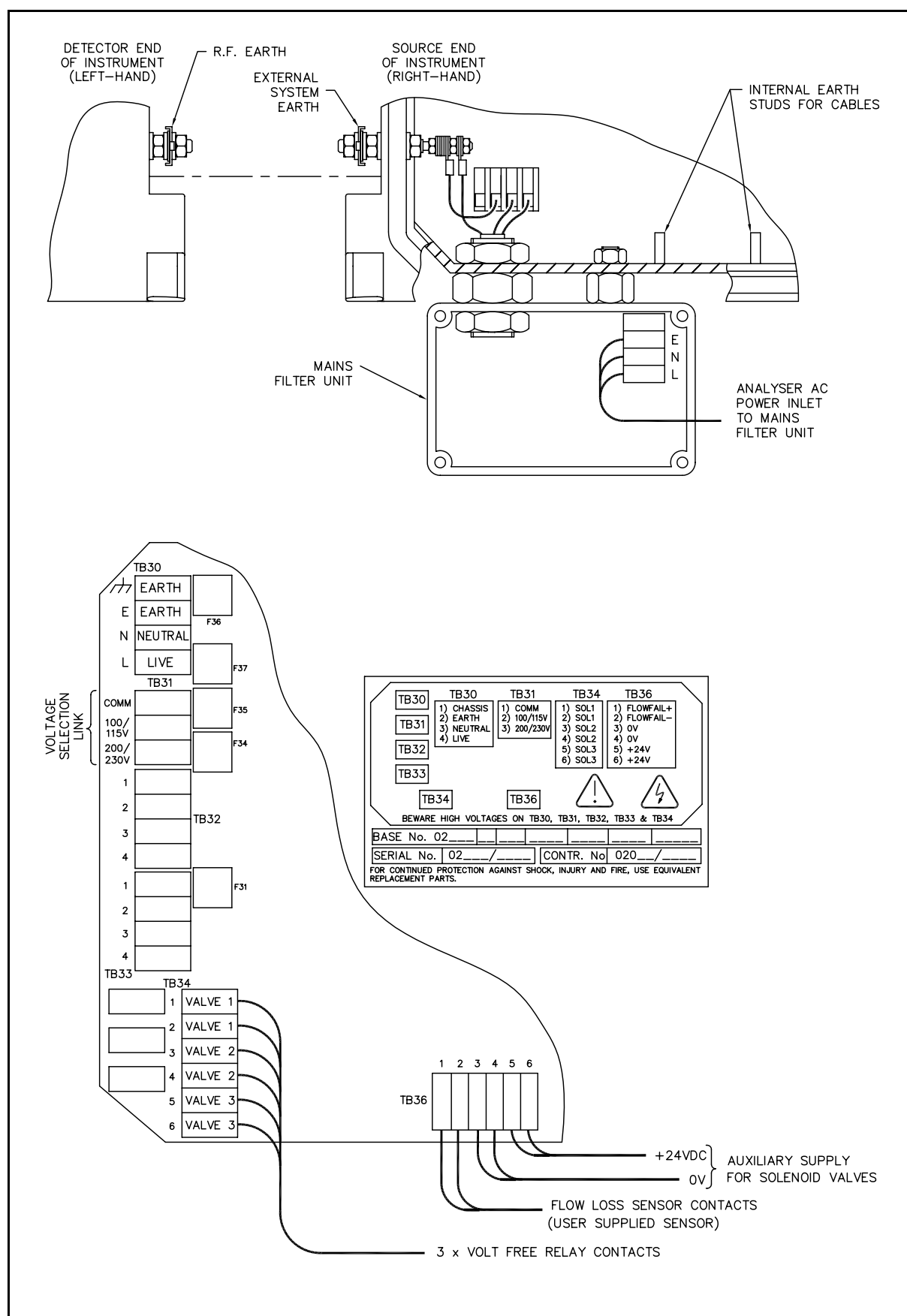


Figure 3.1b 2500 AC Power and Valve Connections (Non-Purged Filter)

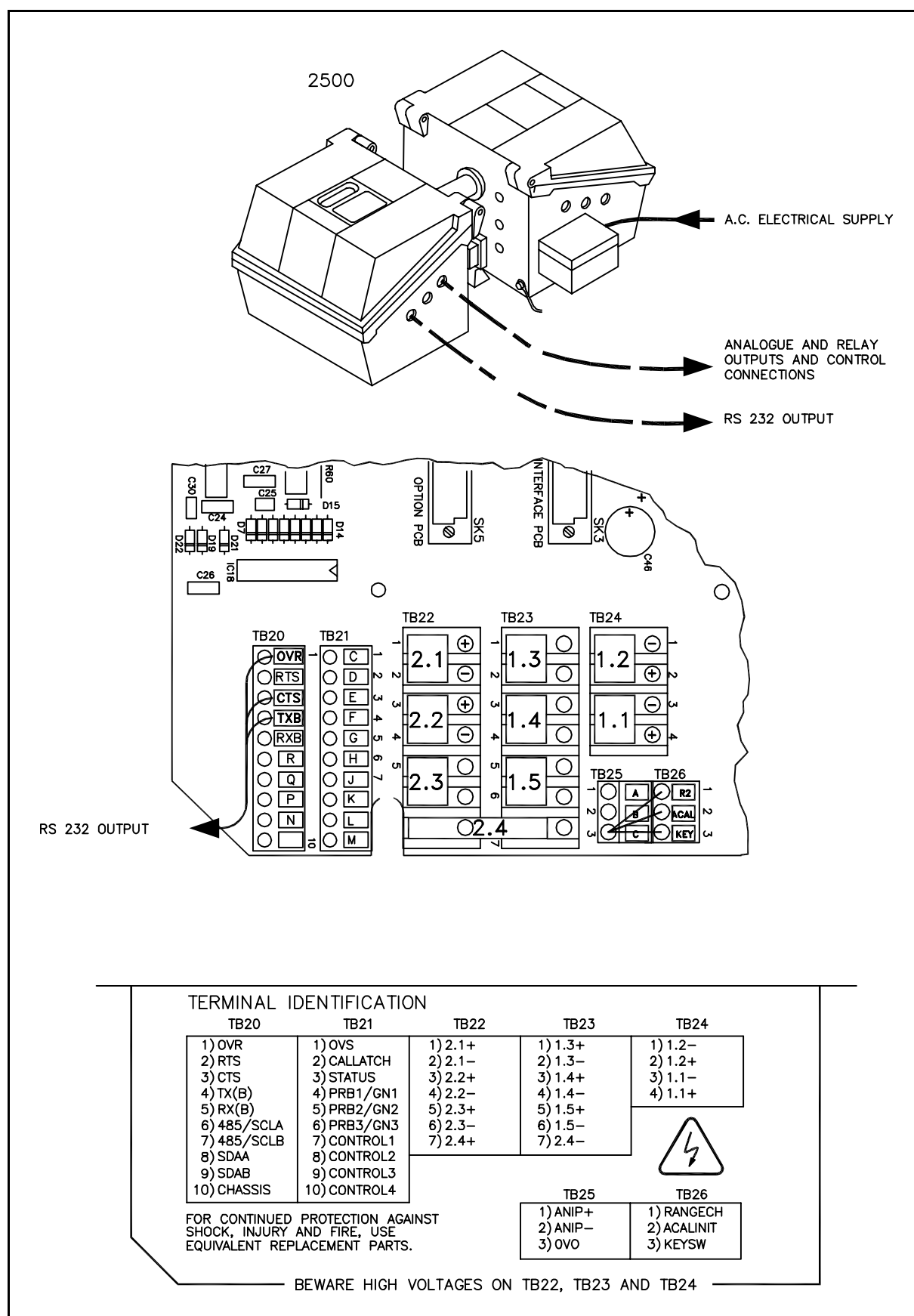


Figure 3.2 2500 Series Terminal Locations

3.2 Signal Connections

NOTE

All signal cables must have a braided overall screen or armour. The screen must be terminated at the point of entry to the case. This will be by using a gland, which makes a connection between the cable screen and the case. Beware of ground/earth loops if the screens are also connected at the user end.

Where two cables are passed through a single entry, a metal gland specifically intended for two separate cables shall be used.

To minimize the effects of interference from RF fields, each mA output cable pair, the RS485 cable (if fitted) and the Ethernet cable (if fitted) shall have two turns (one loop of the wire) through a Steward type 28B0562-200 or equivalent ferrite (Servomex Part No. 2824-0017). Refer to Figure 3.3.

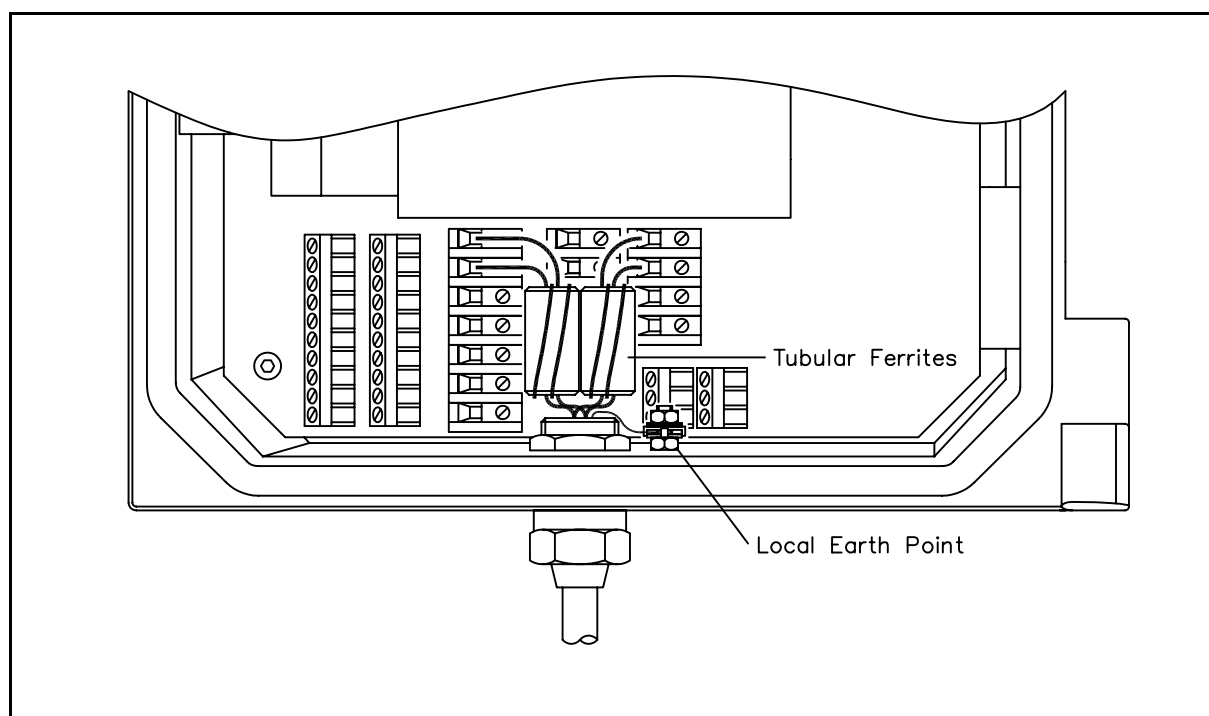


Figure 3.3 Signal Cable Connections

3.2.1 Analogue Outputs

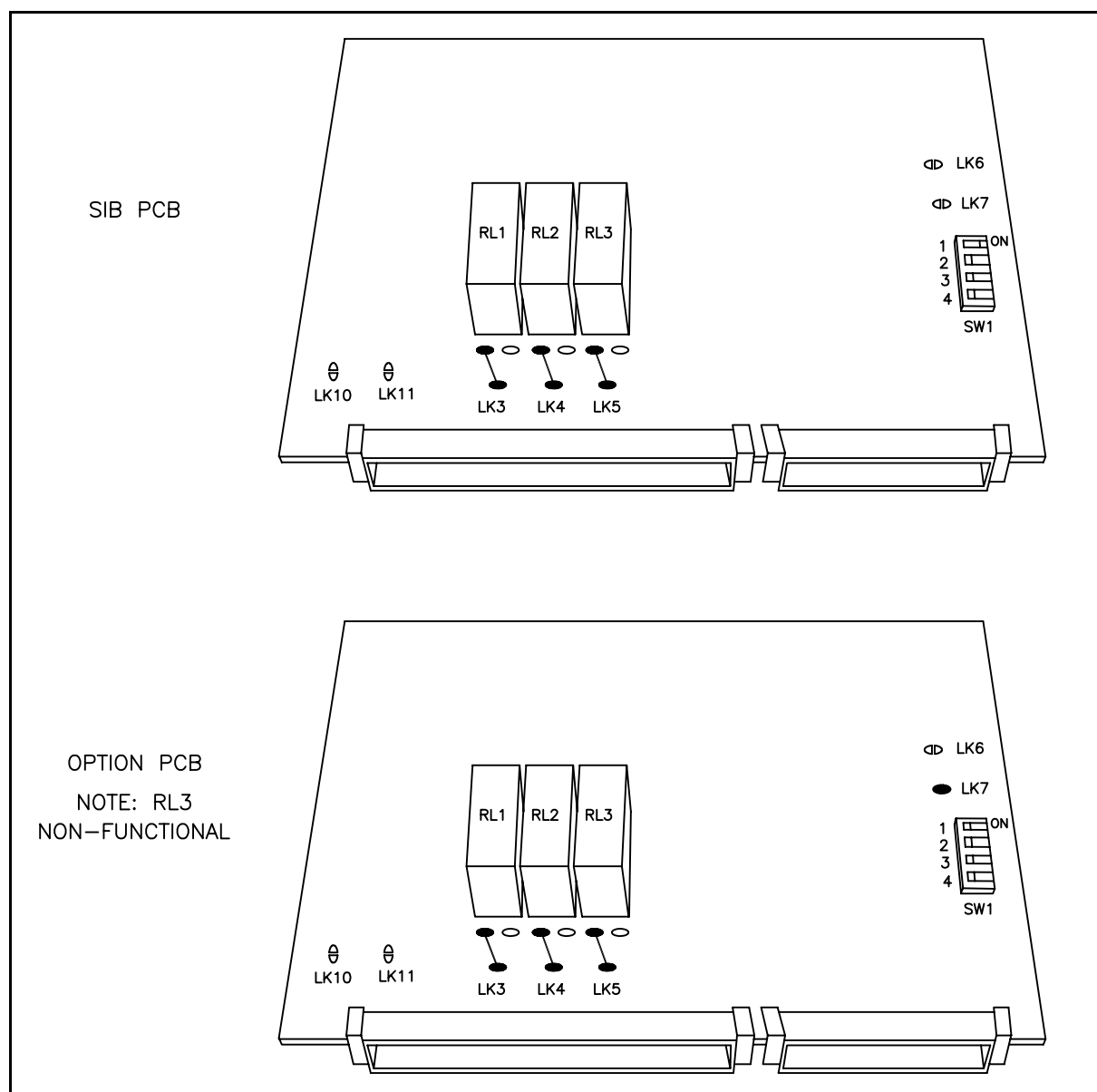


Figure 3.4 SIB and Optional Output PCB's

Each analogue output is supplied set for current output and may be configured by the user to be 0-20mA or 4-20mA, and be assigned a particular range of operation, in software. This is described in the Quickstart manual. In addition, a "Range 2" setting for each analogue output can also be configured in software. Maximum impedance is 1k ohm for current output. If desired, each analogue output may be changed to voltage output of either 0-10V or 2-10V, minimum impedance 1M ohms. This is done by soldering links into position "LINK 10" and "LINK 11" on the relevant SIB (Sensor Interface Board) PCB or Option PCB for the first and second analogue output respectively. See Section 3.2.2. In every case, fit a suitable gland, insert, secure and strip a suitable cable pair before connecting the cores to the appropriate terminals.

WARNING (EU1 and EX1 VERSIONS)

Where the 2500 is located in an area that requires EPL Gb, a suitable Relay Box should be used to isolate the outputs. This Relay Box should be switched from the Purge Control System.

Each analogue output (and each relay output) has an individual identity in software. This identity is a number, which relates to the "slot" in which the PCB (SIB or Option PCB) containing the actual output (or relay) physically resides.

For example, the first analogue output is from the standard SIB PCB which resides in "slot 1" and therefore its software identity is "1.1" (i.e. first slot first output channel). The second analogue output is "1.2", and the first relay output is "1.3", etc.

The following tables show the physical locations for connections to the analogue outputs.

Table 3.1 – Analogue Output Connections		
Output	Software ID	Terminal Connections
Analogue 1	1.1	TB 24-4 (+) and TB 24-3 (-)
Analogue 2	1.2	TB 24-2 (+) and TB 24-1 (-)
Analogue 3*	2.1	TB 22-1 (+) and TB 22-2 (-)
Analogue 4*	2.2	TB 22-3 (+) and TB 22-4 (-)

*option PCB

Terminal locations are as illustrated in Figure 3.2.

3.2.2 Analogue Output Link Selections on Sensor Interface Board (SIB) PCB

After connecting up the required analogue outputs, the user should make the following hardware link selections on the SIB PCB and (where fitted) Option PCB(s). Refer to Figure 3.3.4 for general schematic of both these types of PCB. Carefully remove the PCB for link selection and be sure to replace it in the correct slot and in the correct orientation.

- **Current/Voltage**

Each output may be individually selected as current (0/4-20mA) or voltage (0/2-10V). Factory setting is CURRENT.

Analogue o/p No.1	Current:	Link 10 – OPEN
	Voltage:	Link 10 – CLOSED (solder link)
Analogue o/p No.2	Current:	Link 11 – OPEN
	Voltage:	Link 11 – CLOSED (solder link)

- **Action on System Failure**

To enhance fail-safe operation, each output may be selected to drive HIGH (to 20.5mA/10.2V) or LOW (to 0 mA/0V.) if the 2500 detects a system failure (Shutdown state, i.e. serious fault and measurement invalid). Factory setting is **HIGH**.

Analogue o/p No.1	HIGH on Shutdown: SW1/3 OFF
	LOW on Shutdown: SW1/3 ON
Analogue o/p No.2	HIGH on Shutdown: SW1/2 OFF
	LOW on Shutdown: SW1/2 ON

- **Delay on Fail Safe Action**

The detection of system failure (Shutdown, i.e. serious fault/measurement invalid) is practically instantaneous and therefore a sufficiently large, rapid, mains transient or brown-out may also cause the fail-safe action described above to occur immediately. In installations where this would be undesirable, the fail-safe action may be delayed for 5 seconds to overcome such possible transient effects.

Factory setting is **NO DELAY**.

Both Analogue o/p	DELAY on fail-safe:	SW1/1 OFF
	NO DELAY on fail-safe:	SW1/1 ON

3.2.3 Relay Outputs

NOTE

Each relay output is supplied set for NC (i.e. Normally Closed under "Safe" condition) operation, and may be assigned to a particular alarm or signalling function in software. This is described in the Quickstart manual.

User selection of NC or NO operation is described in Section 3.2.4. As with the analogue outputs, each relay has its own software identity relating to the slot in which the PCB, on which it is physically located, resides. The following tables show the physical locations for connections to the relay outputs. All relay outputs are rated 240VAC/1.0A or 30VDC/1.0A. In each case, fit suitable glands and cable and connect to the relevant terminals. Select the correct procedure according to the architecture.

Table 3.2 – Relay Output Connections

Output	Software ID	Terminal Connections
Relay 1	1.3	TB 23-1 and TB 23-2
Relay 2	1.4	TB 23-3 and TB 23-4
Relay 3	1.5	TB 23-5 and TB 23-6
Relay 4*	2.3	TB 22-5 and TB 22-6
Relay 5*	2.4	TB 22-7 and TB 23-7

*option PCB

Terminal locations are as illustrated in Figure 3.2.

3.2.4 Relay Output Link Selection

After connecting up the required relay output, the NC/NO selections may be altered on the SIB PCB and (where fitted) output Option PCB(s). Refer to Figure 3.4 for general schematic and carefully remove and replace the PCB as before, if a change is to be made.

Normally Closed/Normally Open (NC/NO)

The factory setting of all relay output wire links is soldered in the NC position. This means that the contacts will open to signal an alarm. The contacts will also be open if there is no power applied to the 2500, i.e. they are fail-safe. If, however, it is required to change to NO operation (i.e. close to signal an alarm) this can be done by cutting and reordering the wire links as listed below.

WARNING

Setting the relays to Normally Open (N.O.) operation will mean that there is no fail-safe action since any loss of cable continuity will prevent an alarm being signalled.

NOTE

Regardless of N.O./ N.C. setting, the relays will always be in "alarm" state wherever there is no power applied to the 2500, or when they are unassigned.

Relay o/p No. 1	N.C. Link 3 – A	N.O. Link 3 – B
Relay o/p No. 2	N.C. Link 4 – A	N.O. Link 4 – B
Relay o/p No. 3	N.C. Link 5 – A	N.O. Link 5 – B

3.3 Control Connections

NOTE

All control cables must have a braided overall screen or armour. The screen must be terminated at the point of entry to the case. This will be by using a gland, which makes a connection between the cable screen and the case. Beware of ground/earth loops if the screens are also connected at the user end.

Where two cables are passed through a single entry, a metal gland specifically intended for two separate cables shall be used.

As standard the following connections are provided on the 2500, and these are made to the 2500 Analyser PCB's utilising a suitable gland in an adjacent hole. Refer to Figure 3.2 and Table 3.3.

Table 3.3 – External Control Connections

PCB	Function	Connections
Transmitter PCB 02500904A	Range Change	TB26 – 1 TB25 – 3
Transmitter PCB 02500904A	Auto calibration Initialise	TB26 – 2 TB25 – 3
Transmitter PCB 02500904A	Password Keyswitch	TB26 – 3 TB25 – 3
Power Control PCB 02500911A	Flow Failure	TB36 – 1 TB36 – 2

3.3.1 Range Change Input

Every analogue output can be independently scaled in software to represent some or all of the calibrated range of the instrument, as described in the Quickstart manual. However, under some process conditions (e.g. plant start-up) it may be desirable to have different output ranges on demand. When the Range Change Input is used all analogue outputs will change to their user-designated "Range 2" settings. Note that "Range 2" settings can be identical to "Range 1" settings if desired.

NOTE
"Range 2" is selected as long as contacts remain closed.

Range 2 settings selected by Contact closure between:

TB26 – 1 and TB25 – 3

3.3.2 Auto calibration Initiation Input

Auto calibration/Autocheck may be triggered by the user from the control panel or by using the 2500's own real time clock system. Alternatively, it may be triggered at will using a manual remote switch, by a host device closing a contact, or by means of a Modbus command (where a digital communications option is fitted).

Auto calibration initialised by contact closure between:

TB26 – 2 and TB25 – 3

NOTE
<ul style="list-style-type: none">• Contacts must be closed for at least 2 seconds but no more than 59 seconds.• Remote initiation starts the "one cycle" routine using all the user-set parameters. It will not repeat unless contact closure is made again.• User is advised to set the Auto calibration period in software to zero (i.e. internal timer disabled) when using remote Auto calibration initiation, to prevent duplication of Auto calibrations.

3.3.3 Password Keyswitch Input

As an alternative to the use of passwords via the control panel, a simple Keyswitch can be connected which enables access to both Operator and Supervisor levels without password demands. The user must first set SW1/8 to ON on the Microprocessor PCB, to enable this feature. See the Quickstart Manual for more details.

Keyswitch setting selected by Contact closure between: **TB26 – 3 and TB25 – 3**

WARNING

If the Keyswitch is left "ON" (contacts closed), access is continuously available to all normally protected areas of the software.

3.3.4 Sample Flow Sensor Input

If the sampling system supplying the process sample to the 2500 is fitted with a loss of flow sensor, this can be connected to the 2500 to enable the "loss of sample flow" diagnostic to operate, which in turn triggers the analyser's Fault alarm. See Figure 3.1.

2500 Power Control PCB 02501911A

Loss of flow diagnostic triggered by contact closure between: **TB36 – 1** and **TB36 – 2**.

NOTE

In common with all fault diagnostics this alarm will only be cleared by restoration of flow/opening of contacts.
--

WARNING

Where the 2500 analyser is in a hazardous area, suitable protection concepts must be used to connect the loss of flow sensor to the 2500 analyser.

3.3.5 Solenoid Valve Drives

Auto calibration routines are provided as standard on the 2500, and if they are to be used, suitable 3-way solenoid valves can be plumbed into the sampling system as shown in Fig 3.5. Two or three valves may be used and all should be located conveniently close to the 2500. Each valve is switched via the 2500 Power Control PCB relays as illustrated. The valves are selected for operation by the 2500 as shown in Table 3.4 and Table 3.5. Connect the valves to the appropriate terminals using suitable screened cables and glands, and attach screens to the nearest earth stud with the minimum length of screen. See Figure 3.1.

The Auto calibration relay contacts are rated at 240VAC/1.0A, 30VDC/1.0A. The contacts are fitted with an R-C snubber (100R + 47nF) to provide transient protection when used with AC solenoids. 220/240Vac solenoid valves with a power rating less than about 6VA are not recommended because the 'leakage' current through the snubber may prevent low power solenoids from de-energising correctly.

Solenoid valves may use an external power source, or the internal 24VDC/12VA power source may be used. When using the internal power source, ensure that the 12VA rating is not exceeded. DC solenoid valves must have built-in suppression diodes fitted across the coil to protect the relay contacts.

WARNING

If installation is in a hazardous area, use suitable certified solenoid valves.

NOTE

Valve (SV3) reverts to OFF in Shutdown (Serious Fault) condition. The use of the optional 3rd "Sample/Inert valve will prevent sample entering the 2500 sample cell while the cell or chopper box under temperature diagnostic is activated, i.e. heated cell is not fully warmed up. This can be used whether or not Auto calibration is used and will be appropriate in some applications: e.g.

- if there is a possibility of condensation forming in the sample cell during warm up, then nitrogen or another purge gas must be used to flush the cell during it's warming up period.
- if a hazardous sample is being monitored, the cell should be purged in the event of a serious fault.

3.3.6 Externally Powered Solenoid Valve Connections

Connect via solenoid valve relays as detailed. Ensure that the relay rating is not exceeded.

Table 3.4 – Externally Powered Solenoid Valve Connections

	Valve State (ON=Current Flow Through Solenoid)		
	Span/Zero Valve SV1 TB34 – 1 TB34 – 2	Cal/Sample Valve SV2 TB34 – 3 TB34 – 4	Sample/Inert Valve SV3 TB34 – 5 TB34 – 6
Cell or Chopper Box Under Temperature	either	either	OFF(Inert)
NORMAL STATE OFF	OFF (Zero)	ON(Sample)	ON(Sample)
Zero Sample Required	OFF (Zero)	ON(Cal.)	ON(Sample)
Span Sample Required	ON(Span)	ON(Cal.)	ON(Sample)

3.3.7 Internally Powered Solenoid Valve Connections

Connect to solenoid valve relays SV1, SV2 and SV3 as detailed below. Take care to ensure that internal 12VA (total) rating of the 24VDC supply is not exceeded.

Table 3.5 – Internally Powered Solenoid Valve Connections			
	Valve State (ON=Current Flow Through Solenoid)		
	Span/Zero Valve SV1 TB34 – 1 (-) TB36 – 6 (+)	Cal/Sample Valve SV2 TB34 – 3 (-) TB36 – 5 (+)	Sample/Inert Valve SV3 TB34 – 5 (-) TB36 – 5(+)
Cell or Chopper Box Under Temperature	either	either	OFF(Inert)
NORMAL STATE OFF	OFF (Zero)	ON(Sample)	ON(Sample)
Zero Sample Required	OFF (Zero)	ON(Cal.)	ON(Sample)
Span Sample Required	ON(Span)	ON(Cal.)	ON(Sample)

NOTE
To ensure internally powered solenoid valve function, fit links between: TB34 – 2 and TB36 – 4 TB34 – 4 and TB36 – 3 TB34 – 6 and TB36 – 3

CAUTION
TB36 terminals 5 and 6 (+24V) are always live and should not be grounded.

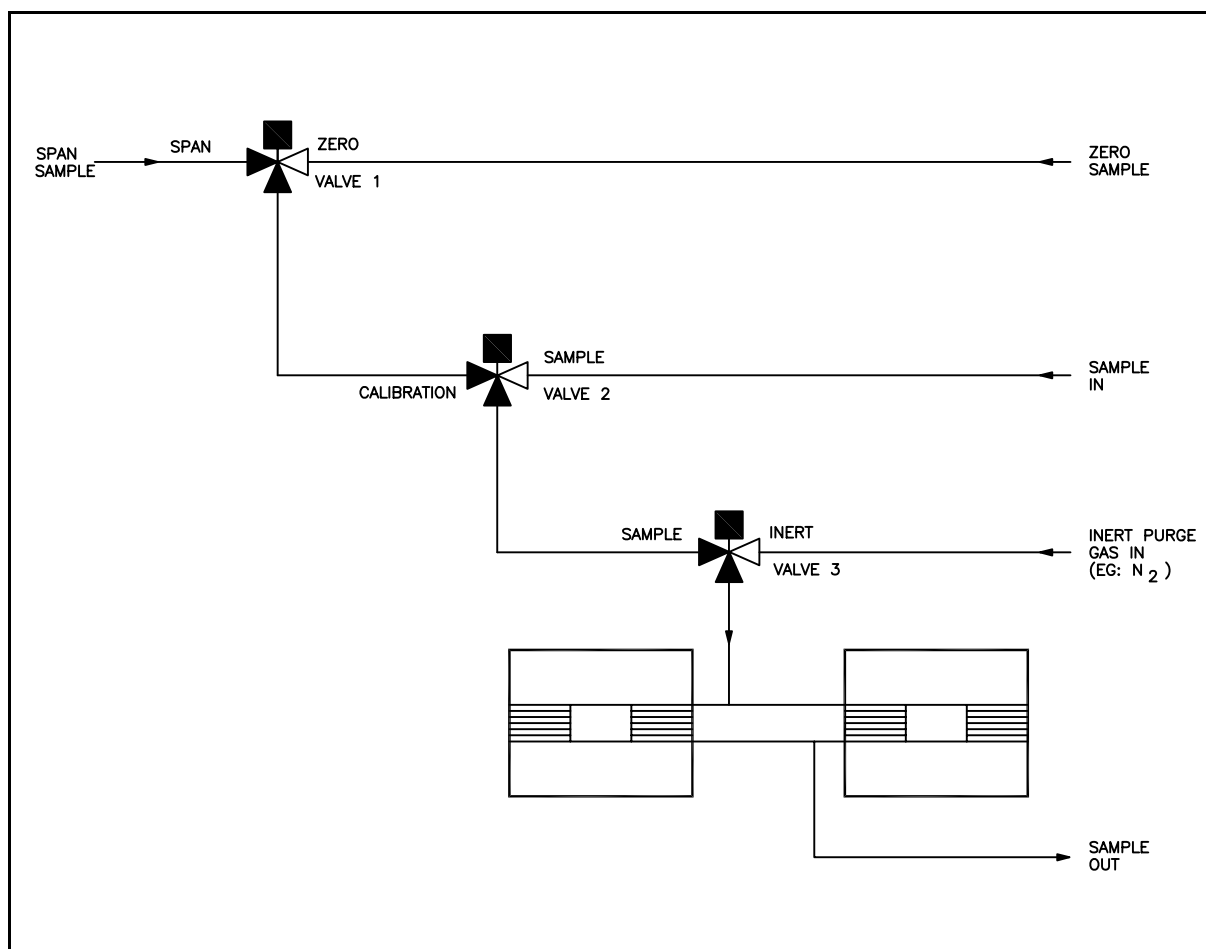


Figure 3.5 Auto calibration Valve Configuration

3.4 Digital Connections

NOTE

All digital cables must have a braided overall screen or armour. The screen must be terminated at the point of entry to the case. This will be by using a gland, which makes a connection between the cable screen and the case. Beware of ground/earth loops if the screens are also connected at the user end.

Where two cables are passed through a single entry, a metal gland specifically intended for two separate cables shall be used.

Digital connections in RS/EIA-232 format are provided for attaching a local portable printer to receive set-up information directly down loaded from the 2500, or to report measurement and analyser status information to a DCS or data logger.

3.4.1 RS-232 Connection

See the Quickstart manual for configuration of the RS-232 port and operation of this function. See Figure 3.2 and Table 3.9 for connections. The format of the serial data stream is as follows:

Table 3.6 – Serial Data Format		
Item	Size	Description
<CR>	1 byte	Carriage return character (ASCII code 13).
<i>date;</i>	8 bytes	dd/mm/yy or mm/dd/yy depending on user settings.
<i>time;</i>	8 bytes	hh:mm:ss
<i>number of components</i>	1 byte	1 byte Number of components fitted (range 1-3)
<CR><LF>	2 bytes	Carriage return and Line Feed characters (ASCII codes 13 and 10 respectively).
<i>component 1 formula;</i>	Max 6 bytes	Chemical formula defined for component 1.
<i>component 1 concentration;</i>	Max 5 bytes	Concentration for component 1 as defined for measure display.
<i>component 1 units;</i>	Max 3 bytes	Units defined for component 1.
<i>component 1 alarm status;</i>	4 bytes	One byte for each alarm. Set to alarm number (1,2,3 or 4) when alarm is raised, <space> when alarm not raised
<i>component 1 Auto calibration status;</i>	1 byte or 15 bytes	Indicates Auto calibration phase. 0 = Not in Auto calibration 1 = In span preflush 2 = In zero cal 3 = zero corrected. This is then followed by two additional values, which are separated by commas, each 6 bytes that represent the zero before calibration and the zero after calibration respectively. 4 = In span cal 5 = span corrected. This is then followed by two additional values, which are separated by commas, each 6 bytes that represent the span before calibration and the span after calibration respectively. 6 = In post flush
<CR><LF>	2 bytes	Carriage return and Line Feed characters (ASCII codes 13 and 10 respectively).
Note: The data for components 2 and 3 will only be present on a 2550 instrument.		
<i>component 2 formula;</i>	Max 6 bytes	Chemical formula defined for component 2. (if fitted)

Table 3.6 – Serial Data Format		
<i>component 2 concentration;</i>	Max 5 bytes	Concentration for component 2 as defined for measure display. (if fitted)
<i>component 2 units;</i>	Max 3 bytes	Units defined for component 2. (if fitted)
<i>component 2 alarm status;</i>	4 bytes	One byte for each alarm. Set to alarm number (1,2,3 or 4) when alarm is raised, <space> when alarm not raised. (if fitted)
<i>component 2 Auto calibration status;</i>	1 byte or 15 bytes	Indicates Auto calibration phase. 0 = Not in Auto calibration I 1 = In span preflush 2 = In zero cal 3 = zero corrected. This is then followed by two additional values, which are separated by commas, each 6 bytes that represent the zero before calibration and the zero after calibration respectively. 4 = In span cal 5 = span corrected. This is then followed by two additional values, which are separated by commas, each 6 bytes that represent the span before calibration and the span after calibration respectively. 6 = In post flush
<CR><LF>	2 bytes	Carriage return and Line Feed characters (ASCII codes 13 and 10 respectively).
<i>component 3 formula;</i>	Max 6 bytes	Chemical formula defined for component 3. (if fitted)
<i>component 3 concentration;</i>	Max 5 bytes	Concentration for component 3 as defined for measure display. (if fitted)
<i>component 3 units;</i>	Max 3 bytes	Units defined for component 3. (if fitted)
<i>component 3 alarm status;</i>	4 bytes	One byte for each alarm. Set to alarm number (1,2,3 or 4) when alarm is raised, <space> when alarm not raised. (if fitted)

Table 3.6 – Serial Data Format		
<i>component 3 Auto calibration status;</i>	1 byte or 15 bytes	Indicates Auto calibration phase. 0 = Not in Auto calibration 1 = In span preflush 2 = In zero cal 3 = zero corrected. This is then followed by two additional values, which are separated by commas, each 6 bytes that represent the zero before calibration and the zero after calibration respectively. 4 = In span cal 5 = span corrected. This is then followed by two additional values, which are separated by commas, each 6 bytes that represent the span before calibration and the span after calibration respectively. 6 = In post flush
<CR><LF>	2 bytes	Carriage return and Line Feed characters (ASCII codes 13 and 10 respectively).
Note: End of 2550 specific data		
<i>fault status;</i>	1 byte	Set to 'F' when fault is active, <space> when no fault active
<i>fault numbers;</i>		List of fault numbers of active faults, separated by ','. Fault numbers are defined in table 3.7.
<CR><LF>	2 bytes	Carriage return and Line Feed characters (ASCII codes 13 and 10 respectively).
<i>Chopper temperature; °C;</i>	Max 4 bytes	Chopper temperature as displayed in diagnostic display.
<i>Compensation temperature; °C;</i>	Max 4 bytes	Compensation (detector) temperature as displayed in diagnostic display.
<i>cell/sample temperature; °C;</i>	Max 5 bytes	Cell/sample temperature as displayed in diagnostic display.
<i>source voltage; V;</i>	Max 5 bytes	Source voltage as displayed in diagnostic display.
<i>Intensity 1;Intensity 2; Intensity 3;Intensity 4; Intensity 5;Intensity 6;</i>	Max 6*6 bytes	Intensity channel values – diagnostic values representing up to six input positions used for measure and reference signals.
<CR><LF>	2 bytes	Carriage return and Line Feed characters (ASCII codes 13 and 10 respectively).

Table 3.6 – Serial Data Format		
<i>checksum;</i>	4 bytes	ASCII representation of 16 bit checksum (modulo 65536), calculated by adding all data preceding the checksum together.
<CR><LF>	2 bytes	Carriage return and Line Feed characters (ASCII codes 13 and 10 respectively).
<CR><LF>	2 bytes	Carriage return and Line Feed characters (ASCII codes 13 and 10 respectively).

Serial port parameters are as follows:

Baud rate: 2400

Parity: Even

Stop Bits: 1

Data Bits: 8

Handshake: hardware

Example Data:

Note: Checksums have not been calculated

Normal Operation Example Output

```
<CR>09/01/99;13:42:30;2;<CR><LF>CO;0.5;%; 2 4;0;<CR><LF>CO2;3.8;%; ;0;<CR><LF> ;;<CR><LF>50.0;51.5;183.2;5.0;
123456;521452;319322;4235421;478525;368965;<CR><LF>????;<CR><LF><CR><LF>
```


Table 3.7 – Fault Number Reference	
Fault Number	Display Message
1	OPTICAL BENCH POWER FAILURE
2	SOURCE VOLTAGE HIGH
3	SOURCE VOLTAGE LOW
4	INFRARED SOURCE FAILURE
5	CHOPPER MOTOR OUT OF LOCK
6	SAMPLE FLOW FAILURE
7	CHOPPER TEMP HIGH
8	CHOPPER TEMP LOW
9	CHOPPER TEMP SENSOR FAILURE
10	CELL TEMP HIGH
11	CELL TEMP LOW
12	CELL TEMP SENSOR FAILURE
13	SAMPLE TEMP SENSOR FAILURE
14	PRESSURE SENSOR FAILURE
15	BAD REFERENCE VOLTAGE
16	COMPENSATION T SENSOR FAILURE
17	DETECTOR SIGNAL HIGH
18	DETECTOR SIGNAL LOW
19	Reserved
20	Reserved
21	Reserved
22	AUTO CAL BAD PREFLUSH
23	ZERO OUT OF TOLERANCE
24	SPAN OUT OF TOLERANCE
25	Reserved
26	Reserved
27	Reserved
28	Reserved
29	Reserved
30	PASSWORD VIOLATION
31	SYSTEM CLOCK INOPERATIVE
32	SYSTEM ADC INOPERATIVE
33	DEFAULT SYSTEM DATA CORRUPTION
34	CALIBRATION DATA CORRUPTION
35	UTILITY DATA CORRUPTION
36	ALARM/RELAY DATA CORRUPTION
37	ANALOGUE ASSIGN DATA CORRUPTION
38	BAD SPAN IGNORED

Some characters defined by the 2500 are non-standard characters, i.e. not part of the ASCII character set. These either occupy the ASCII codes above 127 or redefine an ASCII code as another character. When these characters are used, for example in the component formula, they will be substituted with a valid ASCII character prior to output on the RS232. The non-standard characters and their substitute values are as follows:

Table 3.8 – ASCII Characters		
ASCII Code	Character	Substitute Character
126	?	<space>
127	?	<space>
128	0	0
129	1	1
130	2	2
131	3	3
132	4	4
133	5	5
134	6	6
135	7	7
136	8	8
137	9	9
138	?	<space>
139	?	<space>
140		<space>
141	??	<space>
142	°	<space>
143	£	<space>

Table 3.9 – RS232 Connections		
2500 Terminals	Connector	External RS232 Terminals
0V (Ref.)(0VR)	TB20 – 1	Signal GND/0V
Clear to Send (CTS)	TB20 – 3	Data Terminal Ready (DTR)
Transmit (Tx)	TB20 – 4	Receive (Rx)

WARNING

Do not use an uncertified dcs, datalogger or printer in a hazardous area.

3.4.2 Modbus RS-485 Connection

Modbus communications over an RS-485 interface requires the Communications Board RS-485 option PCB 02500912. This is fitted vertically above the Power Control PCB in the source end assembly.

When connected to a Modbus network the analyser may be an end-point node on a single cable (Cable 1), or it may be a mid-point node with two cables (Cable 1 and Cable 2). These connections are made as shown in Table 3.10.

Table 3.10 – Modbus RS-485 Connections	
Field connections to PCB 02500912	Connecting Cable
TB3 Pin 1	“A” from Cable 1
TB3 Pin 2	“B” from Cable 1
TB3 Pin 3	“A” from Cable 2 (if fitted)
TB3 Pin 4	“B” from Cable 2 (if fitted)

Note that if Cable 2 is not fitted, a link must be made between TB3 Pin 4 and TB3 Pin 5 to provide the correct cable termination. Cables must be looped through a ferrite (see section 3.2)

See the Quickstart manual for the selection and configuration of Modbus communications.

3.4.3 Modbus TCP Ethernet Connection

Modbus TCP communications over Ethernet requires the Communications Board Ethernet option PCB 02500913. This is fitted vertically above the Power Control PCB in the source end assembly.

Ethernet cabling should use shielded (STP) CAT 5 cable or better.

The cable should first be passed through the appropriate gland and looped through a ferrite (see section 3.2) and then assembled onto a standard RJ45 connector. The cable screen/shield must be terminated as instructed. The table below list the functions of each connector pin.

Pin 1	Transmit +
Pin 2	Transmit -
Pin 3	Receive +
Pin 6	Receive -
Pin 4, 5, 7, 8	Not used

For guidance, the tables below show the corresponding wire colours specified in TIA/EIA-568A and TIA/EIA-568B for patch leads as viewed from the back of the plug with the tab facing down. It is the responsibility of the installer to ensure the correct connections are made.

Table 3.11 – TIA/EIA-568A Wiring							
1	2	3	4	5	6	7	8
White/Green	Green	White/Orange			Orange		

Table 3.12 – TIA/EIA-568B Wiring							
1	2	3	4	5	6	7	8
White/Orange	Orange	White/Green			Green		

See the Quickstart manual for the selection and configuration of Ethernet Communication.

3.5 Pressure Transducer Connections – (If Supplied)

The pressure transducer cabling is terminated to the source end right hand side (RHS) of the analyser.

The pressure transducer is supplied pre-wired to the analyser. The cabling is connected to PCB 02500911A TB35 as shown in Table 3.13

Table 3.13 – Pressure Transducer Connections		
PCB 02500911A	Interconnecting Cable	Pressure Transducer
TB35 – 5 (signal +)	Identified '1'	Terminal 1 (+)
TB35 – 1 (signal -)	Identified '2'	Terminal 2 (-)

The general layout of the pressure transducer option is illustrated in Figure 3.6.

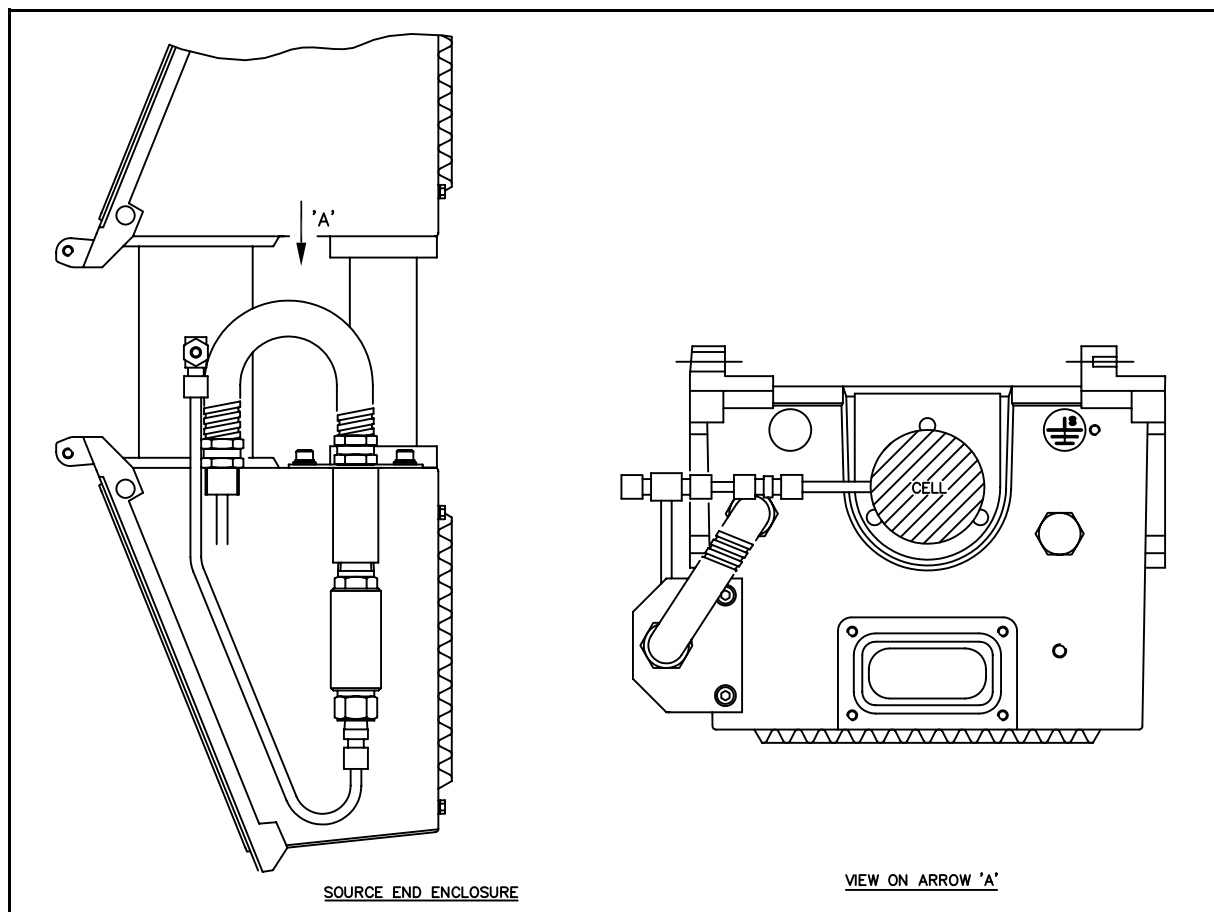


Figure 3.6 Typical Pressure Transducer Assembly

SECTION 4 INSTALLATION GAS CONNECTIONS

4.1 Purge Connections (EU1/EX1)

The next phase of the installation is to connect up any safety purge system required for safe operation in a hazardous area.

4.1.1 General Purge Connections

WARNING (EU1 AND EX1 VERSIONS)

Where appropriate, the user must refer to the detailed instructions provided in the manual supplied with the Purge Control System, and use them in conjunction with the following instructions.

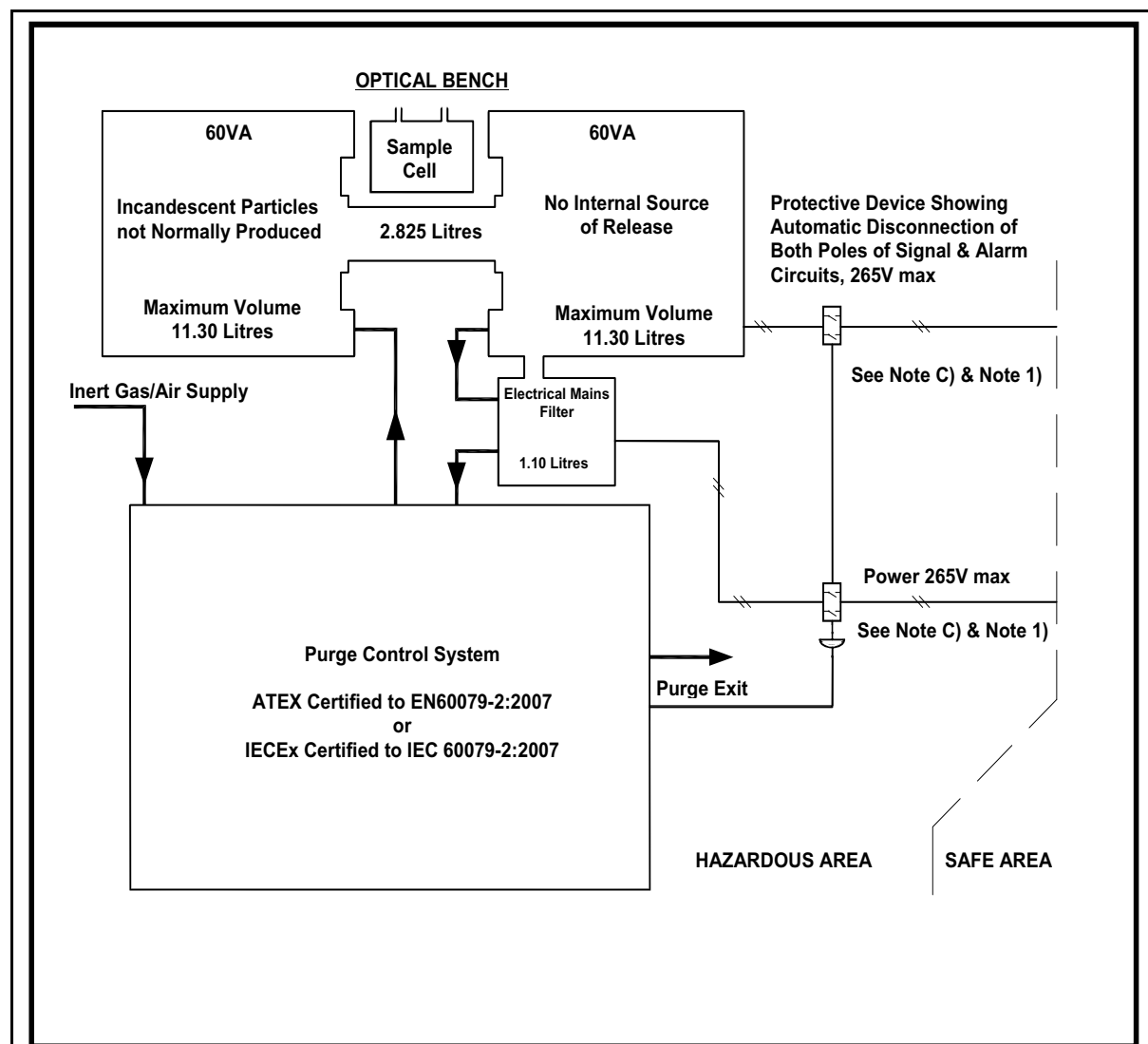


Figure 4.1 Purge Connection Schematic

The general schematic for a hazardous area purge system is shown in Figure 4.1.

WARNINGS (FIGURE 4.1)	
1.	If this component is mounted in a hazardous area it should be protected by one of the types of protection listed in EN/IEC 60079-0.
2.	All cable glands for use in electrical cable entries shall be of a type which seals and clamps the cable.

NOTES (FIGURE 4.1)	
a	<p>The purge control system (PCS) shall be suitably certified to EN/IEC 60079-2:2007 and shall have the following characteristics:</p> <p>(Note: if the 2500 series equipment is affixed with the IECEx label, then the PCS unit must be IECEx certified):</p> <p>Minimum permitted purge rate 10 L/min Minimum permitted purge duration 11 minutes Minimum overpressure 0.5 mbar (50 Pa) Maximum overpressure 80 mbar (8000 Pa)</p>
b	All monitoring shall be carried out in the return leg.
c	The PCS shall include an automatic device that operates when overpressure falls below the minimum prescribed value. The device shall operate a pressure switch that can be used for an alarm and/or isolation purposes.
d	When the PCS is used to protect the series combination of enclosures, the protective gas supply shall be connected from the PCS to the first enclosure and serially connected to the remaining enclosures.
e	Overpressure shall be monitored by the PCS unit to ensure that the minimum overpressure is maintained and the maximum overpressure specified (80 mbar) is not exceeded.
f	When the certified PCS unit is located in an area that requires EPL Gb and if the certified PCS unit is not fitted with a normally closed relief vent, a protective device shall be fitted to prevent sparks or incandescent particles from being ejected.
g	The PCS is required to carry out a purge cycle after a pressure loss before power can be restored to the equipment.
h	The PCS shall contain a pressure sensing element which is factory set to a level not less than the specified minimum (50 Pa, 0.5 mbar) and shall measure pressure at the point in the system where the lowest pressure occurs.
i	The PCS shall supply a flow rate of protective gas not less than 10 standard litres per minute and shall incorporate an automatic device to monitor flow during the purge time specified below.
j	The PCS shall maintain the minimum specified overpressure during the purge phase and afterwards.

NOTES (FIGURE 4.1)	
k	The PCS shall incorporate a purge timer that shall be set to not less than the minimum specified (11 minutes). The purge timer shall be re-set to zero if either the minimum overpressure or minimum purge flow is not maintained.
l	The PCS shall incorporate a device to ensure that power is not connected to the apparatus being protected until the specified purge time has elapsed.

4.2 End Boss Purge Connection

Depending on application, fittings for 1/8" o.d. tube may be provided to purge the end bosses on either side of the sample cell and these should now be connected. Refer to the following application notes and Figure 4.2 where necessary.

4.2.1 Introduction

The 2500 measuring cell is mounted on two short tubes or "end bosses" which preserve the integrity of the optical system, while providing thermal isolation. The measuring cell and the analyser enclosure are both independently sealed using windows or lenses and elastomeric seals. The end bosses form the interface between the two, and the implications of a cell window leak must be considered when flammable, corrosive or toxic gases are measured.

Under ideal circumstances, the gas in the end bosses should be totally transparent to the wavelengths of infrared energy used for the measurement. However, simply filling the bosses with nitrogen and sealing them is not always satisfactory, because the elastomeric seals are permeable and atmospheric gases such as carbon dioxide or water vapour can leak in. Specifically, a problem will arise when the gas being measured is also carbon dioxide or water vapour, or when the measurement is cross sensitive to either of those gases: the effect of a gradual ingress of the atmospheric gases will be seen as drift in the measurement. A further problem arises with low-level measurements of carbon monoxide. In this case it is out-gassing of carbon monoxide from the seals themselves which can cause drift.

4.2.2 End Boss Scrubbers

Problems, relating to cross interference within the end bosses, can usually be resolved by fitting chemical "scrubbers" to the end bosses. These are small metal housings packed with a chemically active material, which absorbs or reacts with the problem gas. A number of materials are available which absorb water vapour (molecular sieve), carbon dioxide (soda lime) and carbon monoxide (Hopcalite).

When a 2500 is specified, a suitable scrubber material is stipulated for the end bosses, where necessary, and the analyser will be delivered with these scrubbers fitted.

NOTE
If the analyser is dismantled for any reason, the scrubbers must not be left exposed to normal atmosphere for more than a few minutes or they will be exhausted. Similarly, after long-term use they may need to be replaced, and this must always be with the correct type.

4.2.3 End Boss Vents

When a flammable, severely corrosive or toxic gas or liquid is present in the sample cell, either as the sample or a background gas, additional issues arise.

The construction of the cell window seal is such that any leak of the seal or failure of the window will result in the sample gas entering the end boss, but not being released to the surrounding atmosphere or directly into the analyser enclosure. This is a deliberate safety feature of the design. However it is necessary that steps are taken to deal with the leak so that no permanent hazard arises, and permanent sealing of the end bosses and the use of scrubbers is not generally acceptable. Instead, the end bosses will be supplied with adaptors for connecting vent or purge lines.

If the measurement is not affected by atmospheric gases, then a single vent connection of at least 4mm I.D. should be made to each end boss, which will vent to atmosphere in a safe location where release of the sample will not cause a hazard. If the sample pressure exceeds 50kPa (7 psi), the vent should be 8mm I.D., and the sample cell outlet connection should be fitted with a non return valve, and the sample cell inlet connection should be fitted with a restrictor which will limit the total flow to less than 10 litres/min in the event of total window failure.

4.2.4 End Boss Purge

If the measurement is affected by atmospheric gases, then in addition to the vent described above, the second connection to each end boss should be connected to a supply of dry (1) nitrogen (2) regulated to a flow of 100ml/min using a suitable flow meter. Ensure that the end boss purge is always vented to atmospheric pressure and the pressure within the end boss dead volume space does not exceed 17kPa (2.5psi).

Suitable precautions should be made to ensure that, in the unlikely event of a catastrophic failure of the cell window /sealing, sample gas is prevented from contaminating the purge gas supply.

(1) Dry means a dew point of below -30 deg C.

(2) Dry CO₂-free air may also be used in most applications except low-level CO₂.

Hazardous Area Certification – flammable samples, additional note

The analysers are certified for use in either Zone 2 / Div. 2 or Zone 1. In all cases this certification does not permit the analyser (or any part of its enclosure) to be exposed to a permanently flammable atmosphere. Sealing the end-bosses with scrubbers when measuring a flammable sample would mean that should there be a cell window leak, the part of the enclosure that the end boss seals against would become exposed to a permanently flammable atmosphere. Purging or venting the end bosses resolves this issue.

Direct purging is the preferred option but alternatively relieving case inserts may be fitted. These inserts use a special window/o-ring assembly to prevent any of the sample leaking past the cell window seals to pass into the enclosures. In the event of a complete window failure pressure relief occurs and vents the sample to atmosphere.

NOTE

Vent lines, if required, should be connected to end boss bottom tapplings. Purge gas should be connected to top tapplings when required. When not required, top tapplings should be plugged.

IF FITTED, COMMENCE END BOSS PURGE FROM THIS POINT ONWARDS.

WARNING

Where the sample is corrosive or toxic, the vent lines from the end bosses must take away any potential leakage to a safe disposal point.

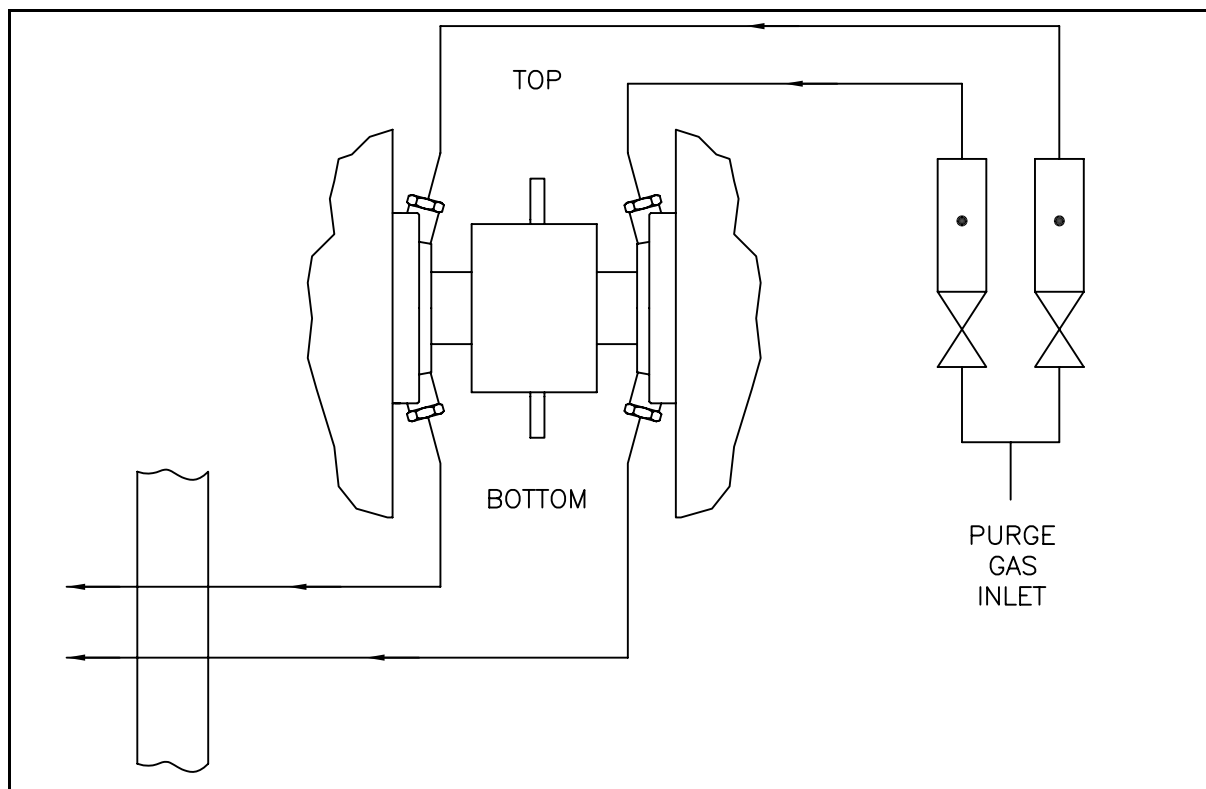


Figure 4.2 Cell End Boss Connection

4.3 Steam Heated Cell

Some 2500's are fitted with steam heated cells, and at this stage suitable low pressure steam, typically at 14-21kPa (2-3 psi) venting to atmosphere after the cell, should be connected ready for use, but do not pass steam into the heating coil yet. Fittings for 1/8" o.d. tube are normally provided.

4.4 Process Stream Connection

4.4.1 Basic Operation

The process stream connections to and from the 2500 sample cell inlet and outlet should now be made. The inlet and outlet are 1/4" o.d. stubs. Connections will normally be from a local sample conditioning system. Ensure that any pressure compensation transducer is correctly fitted. Ensure that all connections are made securely with the correct compression fittings, of suitable materials. Gas samples should enter the cell from above. (Refer to Figure 2.1).

Do NOT pass process samples into the 2500 yet.

4.4.2 High Integrity Operation

This is the recommended mode of operation and where appropriate, the process sample can be routed via the "Sample/Inert" solenoid valve, controlled by the 2500, which will only permit sample to enter the sample cell when it is fully warmed up and no serious faults are present. See Section 3.3.5.

Do NOT pass process samples into the 2500 yet.

WARNING
In either case for toxic/flammable samples ensure that the sample inlet line has a suitable restrictor inserted to limit sample flow in case of catastrophic failure of sample tubing/cell connections.

4.5 Power-Up

1. Confirm that all electrical and plumbing connections have been correctly made as described in the preceding sections.
2. Ensure purge gas is applied to the Purge Controller (Where Fitted).
3. Apply power to the 2500 (via the Purge Control System for EU1 & EX1 Versions).
4. Apply steam to any steam-heated cells fitted.
5. The 2500 will show the start-up and Identity display as follows:
 - Self-checks (Fault and Alarm LEDs tested)
 - System O.K.
 - Analyser identity/Software revision number.
 - Serial number and order number.
 - Calibration (measurand, range, units).
 - Commence measurement.

6. The normal measurement display will then appear and the 2500 will be operational.

NOTES
<ul style="list-style-type: none">• The measurement will not be valid at this point since process sample is not yet flowing.• If a heated cell is fitted, it will not yet be up to temperature and the intermittent "warming up" message will be displayed. Depending on set point and/or environment this may take several hours to reach temperature and the message to cease.• The 2500 chopper box will also take up to 2 hours to reach specified temperature and the "warming up" message will also be displayed until this is accomplished.

WARNING
Check for no leaks of sample at full operating pressure and temperature before proceeding. This is especially important for toxic/flammable samples.

While the analyser is warming up, the software configuration to suit the user's particular requirements may now be accomplished. Proceed to the Quickstart Manual for details of configuration. Note that during the warming up period, all outputs and alarms are live and fully operational. All diagnostics are also operational, EXCEPT cell temperature and chopper box temperature. These last two diagnostics only become operational once the temperature set points have been reached or after 2 hours (for chopper box) or 10 hours (for cell) have elapsed from power-up.

At this point process sample may be turned on and allowed to flow through the 2500 sampling system.

NOTE
Where the 3rd (sample/inert) solenoid valve is in use (see Section 3.3.5) the inert medium will automatically be supplied to the analyser until the cell reaches correct temperature.

SECTION 5 FAULT DIAGNOSIS AND CELL MAINTENANCE

5.1 Introduction

A fault will be signalled wherever any parameter measured by the 2500's diagnostics becomes out of tolerance. Any Fault condition will be indicated by the Fault LED on the control panel being illuminated.

The Fault signal can be assigned to a Relay, as described in the Quickstart Manual.

Faults are categorised as either:

1. **General Faults** – parameter out of tolerance, intervention is required as soon as possible. The analyser is still operational and measuring.
2. **Serious Faults (Shutdown)** – performance seriously degraded, measurement withdrawn and analogue outputs driven HIGH (or low, as configured in Section 3.2.2).

NOTE
For detailed instructions on all Service and Maintenance operations for suitably skilled personnel, please refer to the 2500 Series Service Manual.

5.2 Diagnostics

The diagnostics listed in Table 5.1 (2500, 2520 & 2550) and in Table 5.2 (2510) can be interrogated via the DIAGNOSTICS function in DISPLAY menu. See Quickstart Manual.

Table 5.1 – Diagnostic Displays (2500, 2520, 2550)	
Display	Description
CHOPPER TEMP °C	Chopper box temperature
COMPENSATION °C	Detector temperature
CELL TEMP °C	Cell temperature (if enabled)
SAMPLE TEMP °C	Sample Temperature *
[Measurement 1] ABS au	Absolute absorbance units (M1)
[Measurement 2] ABS au	Absolute absorbance units (M2) *
[Measurement 3] ABS au	Absolute absorbance units (M3) *
SAMPLE PRESSURE (units)	Sample pressure *
SOURCE VOLTS V	Source voltage
MOTOR DRIVE % SET POINT %	Motor drive power and set point
DETECTOR SIG M1	Detector signal level (M1) measurement
DETECTOR SIG M2	Detector signal level (M2) measurement *
DETECTOR SIG M3	Detector signal level (M3) measurement *
DETECTOR SIG R1	Detector signal (R1) reference
DETECTOR SIG R2	Detector signal (R2) reference *
DETECTOR SIG R3	Detector signal (R3) reference *
TEMP CORR M1	Temperature Correction (M1)
TEMP CORR M2	Temperature Correction (M2) *
TEMP CORR M3	Temperature Correction (M3) *
TEMP CORR R1	Temperature Correction (R1)
TEMP CORR R2	Temperature Correction (R2) *
TEMP CORR R3	Temperature Correction (R3) *

* (IF FITTED).

Table 5.2 – Diagnostic Displays (2510)	
Display	Description
CHOPPER TEMP °C	Chopper box temperature
COMPENSATION TEMP °C	Detector temperature
CELL TEMP °C	Cell temperature (if enabled)
SAMPLE TEMP °C	Sample temperature (if enabled)
SAMPLE PRESSURE (units)	Sample pressure (if fitted)
SOURCE VOLTS	Source voltage
ABSORBANCE au	Absolute absorbance units
MOTOR DRIVE % SET POINT %	Motor drive power and set point
DIFFERENCE SIG	Difference signal
DETECTOR SIG N	Detector signal (nitrogen)
DETECTOR SIG G	Detector signal (gas)
TEMP CORR D	Temperature correction (difference signal)
TEMP CORR N	Temperature correction (nitrogen)
TEMP CORR G	Temperature correction (gas)

5.3 General Fault Conditions

When the Fault LED is illuminated, the DISPLAY FAULTS function should be used to determine the nature of the fault. The diagnostics (Section 5.2) may assist in defining the cause, together with the comments given in Table 5.3. Action to cure the fault should be taken as soon as possible.

Table 5.3 – General Fault Messages		
Display Message	History Log Entry	Description/comments
SOURCE VOLTAGE HIGH	SOURCE HIGH	Possible Power Control PCB fault
SOURCE VOLTAGE LOW	SOURCE LOW	Possible Power Control PCB fault
SAMPLE FLOW FAILURE	FLOW FAIL	User Sample Flow Alarm active
CHOPPER TEMP HIGH	CH TEMP HIGH	Ambient temp. too high/control problem
CHOPPER TEMP LOW	CH TEMP LOW	Ambient temp. too low/control problem
CHOPPER TEMP SENSOR FAILURE	CH TEMP FAIL	Chopper sensor failed/disconnected/outside range.
CELL TEMP HIGH	CELL T HIGH	Possible Power Control PCB fault
CELL TEMP LOW	CELL T LOW	Possible Power Control PCB fault
CELL TEMP SENSOR FAILURE	CELL T FAIL	Cell sensor failed/disconnected/outside range
SAMPLE TEMP SENSOR FAILURE	SAMPLE T FAIL	Sample sensor failed/disconnected/outside range
PRESSURE SENSOR FAILURE	NO PRESSURE	Sample sensor failed/disconnected/outside range
BAD REFERENCE VOLTAGE	REF OLT FAIL	Possible Transmitter PCB fault
DETECTOR SIGNAL LOW	DET SIG LO	Probable cell contamination – clean cell
COMPENSATION T SENSOR FAILURE	COMP T FAIL	Detector sensor failed/disconnected
ZERO OUT OF TOLERANCE	ZERO OUT TOL	Failed Autocalibration – bad zero sample – use One Cycle or Manual Zero

Table 5.3 – General Fault Messages		
SPAN OUT OF TOLERANCE	SPAN OUT TOL	Failed Autocalibration – bad span sample – use One Cycle or Manual Span
AUTOCAL BAD PREFLUSH	BAD PREFLUSH	Failed Autocalibration – bad preflush – use One Cycle
PASSWORD VIOLATION	BAD PASSWORD	3 consecutive Password failures
SYSTEM CLOCK INOPERATIVE	BAD CLOCK	Reset time or replace Clock chip
DEFAULT SYSTEM DATA CORRUPTION	BAD SYS DATA	Factory calibration corrupt – use Associate
SYSTEM ADC INOPERATIVE	BAD ADC	Possible SIB PCB fault
CALIBRATION DATA CORRUPTION	BAD CAL DATA	User calibration corrupt – repeat calibration
UTILITY DATA CORRUPTION	BAD UTI DATA	Utility file corrupt – renew all entries
ALARM/RELAY DATA CORRUPTION	BAD RLY DATA	Alarms/Relays file corrupt-renew all entries
ANALOGUE ASSIGN DATA CORRUPTION	BAD ANL DATA	Analogue output file corrupt-renew all entries
BAD SPAN IGNORED	BAD SPAN	Coarse span adjustment limit exceeded – Check span sample

NOTE
DETECTOR SIGNAL LOW may briefly occur at power-up.

5.4 Serious Fault (Shutdown) Conditions

If the Fault LED is illuminated and the Analogue Outputs have been driven HIGH (or LOW, depending on selection), a Serious Fault exists and the Measurement Display will show "Measurement Invalid".

Immediate action should be taken to rectify the fault, and qualified service personnel should be called.

The SERIOUS FAULT messages listed in Table 5.4 will result in a Shutdown.

Table 5.4 – Serious Fault Displays		
Display Message	History Log Entry	Description/comments
INFRARED SOURCE FAILURE	SOURCE FAIL	Source failure
CHOPPER MOTOR OUT OF LOCK	OUT OF LOCK	Motor or timing failure
DETECTOR SIGNAL HIGH	DET SIG HI	Possible loss of IR filter, loss of liquid sample.

NOTE
<ul style="list-style-type: none">• Detector Signal High may also occur and cause temporary shutdown on liquid analysers if there is no liquid sample in the cell, e.g. at initial power-up. Check for loss of flow if sensor fitted. Try Manual Zero on good zero sample if sample flowing.• The user interface remains operational during Shutdown and can be used to diagnose the likely cause of the fault via the Fault Display and Fault History.

5.5 Cell Maintenance

As a guide the cell should be removed for cleaning when the Reference detector signals (Section 5.2) fall below 50% of their original values. In aggressive sample conditions, the loss of signal may be due to general corrosion or pitting of the cell windows. In this case the cell windows may have to be replaced. Otherwise, the cell and windows can be dismantled and carefully cleaned and all items (except O-rings) re-used. See Figure 5.1 for general construction of the cell.

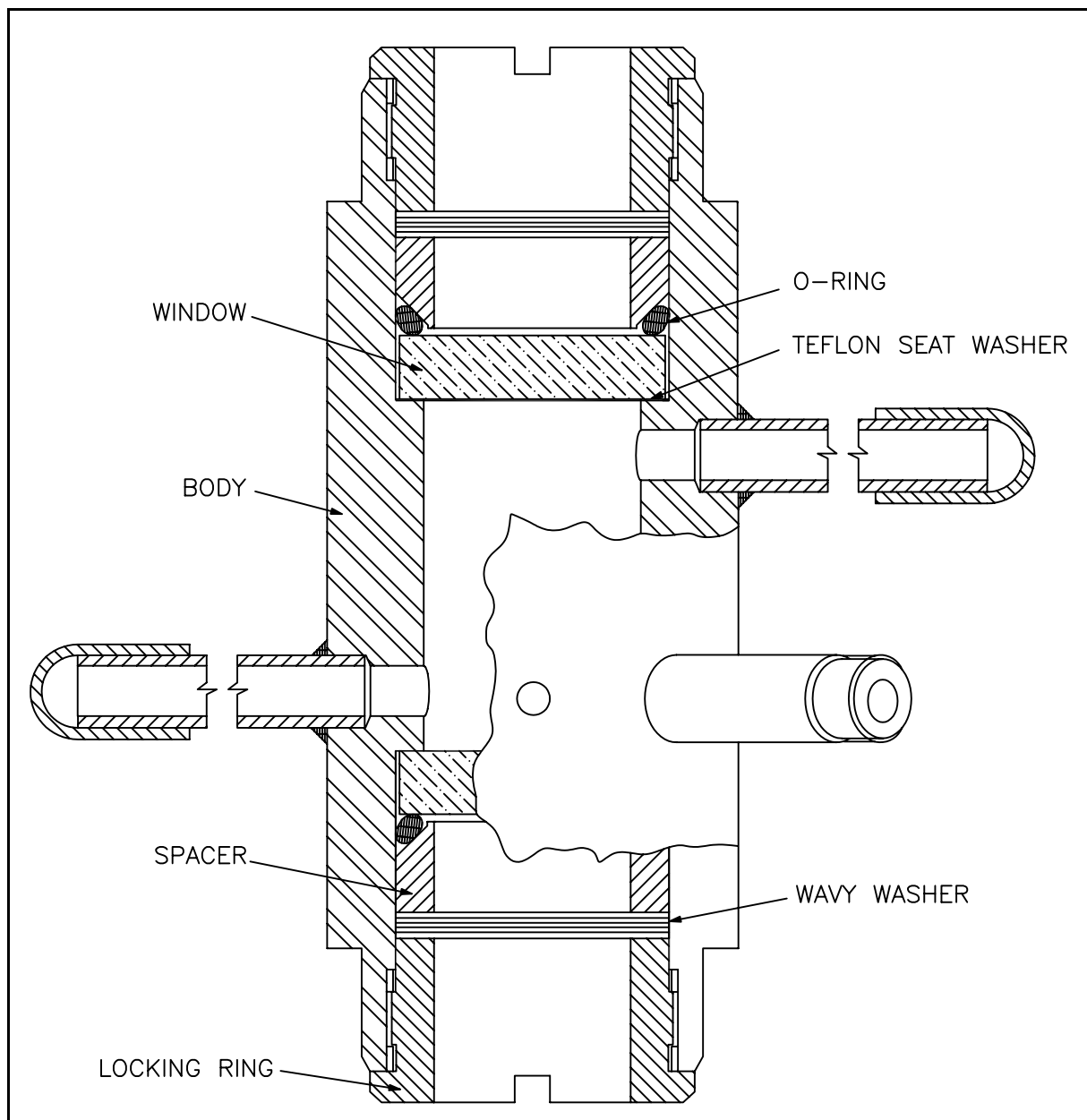


Figure 5.1 General Cell Construction

CAUTION

Use only Servomex supplied spare parts. The use of inferior replacement components may degrade the performance and safety of the instrument.

WARNING

- **Lethal voltages:** mains AC power supplies are potentially lethal. The maintainer must ensure that all mains power supplies are disconnected from the supply before maintenance work is started.
- **Purge the measuring cell and associated pipework with an inert gas before work is started.**
- **It is the users responsibility to ensure that work is carried out in an adequately ventilated space – taking due account of risks associated with release of flammable or toxic samples. Attention is also drawn to the risks associated with the release of asphyxiants.**

To remove the cell assembly from the 2500 proceed as follows:

Flush the cell thoroughly with Nitrogen and disconnect the process connections.

Where fitted, remove cell heater connections:

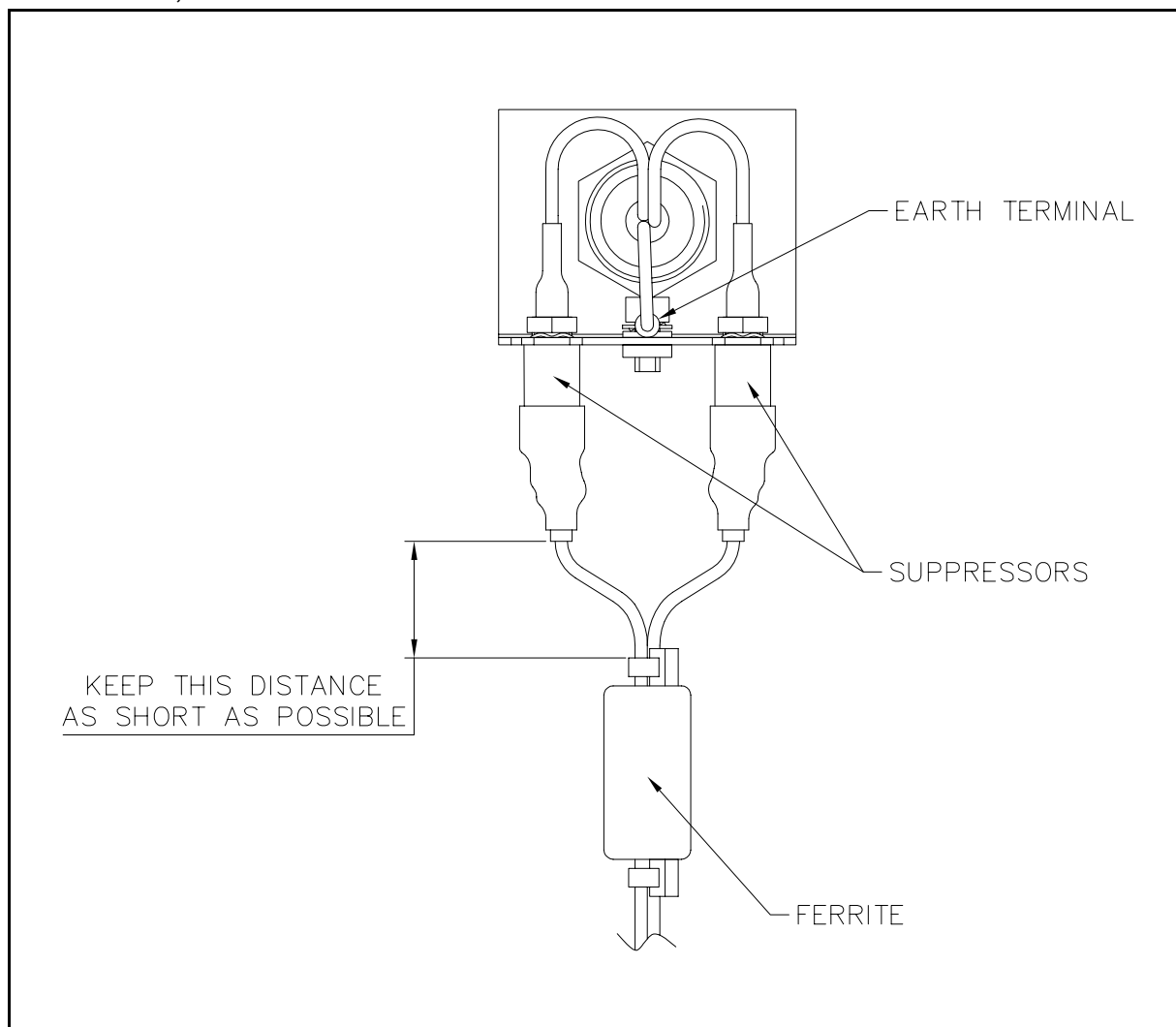


Figure 5.2 Suppressor Mounting Details

Unscrew the cell heater wiring connections from inside the source enclosure at terminal blocks TB32-4 and TB33-4. Loosen the two suppressors from the mounting bracket and undo the earth terminal (refer to Figure 5.2, taking care not to drop the screw or the shakeproof washer into the enclosure). Remove the cable ties that hold the ferrite and slide it off of the wires. Loosen the gland nut on the exterior of the enclosure and carefully feed the suppressors through the gland one at a time.

Allow sufficient time for the cell assembly to cool (this may take some hours).

Remove any purge connections from the end bosses if fitted. Slacken 3 x M6 socket screws securing the cell bosses at either end of the sample cell.

Carefully disconnect the cell thermocouple from the cell body. Support the cell assembly and pull the bosses inward from the ends of the 2500 sufficient to enable the cell to be removed and taken to a workshop for maintenance. If necessary, slacken the screws holding the source end casting onto the mounting chassis to permit easy removal.

CAUTION

Do not pull or strain heater connection leads at any stage.

If the scrubbers (if fitted) are not to be removed, leave the bosses on the analyser and blank the open ends of the bosses using the 2 blanking plugs (02500460), supplied with the Special Tools Kit S2500979, to preserve the existing scrubbers. Otherwise take the entire cell and boss assembly to a workshop.

Working on a clean bench in a suitable environment, dismantle the cell. Pull the end bosses off the cell body. Note that these items are one-piece stainless steel. If the bosses are fitted with absorbent scrubbers, these should be removed and replaced (A variety of types may be fitted – see spares list for appropriate part numbers).

WARNING

Special materials are used for the windows. Some of these are toxic (e.g. barium fluoride, zinc selenide, etc.) these substances must be handled in accordance with the relevant local standards.
--

The windows are usually ground from optical grade single crystal material and as such may be EXTREMELY EXPENSIVE. The windows may have special anti-reflective coatings and they may easily be damaged by brittle fracture. The standard material chosen by Servomex is Calcium Fluoride. This material is non-toxic and reasonably robust. However, some applications may require materials such as Barium Fluoride, Zinc Selenide, etc. which are toxic and must be handled with extreme care. See the Manufacturing Data Sheet at the front of this manual for details of the windows fitted.

Windows should be kept optically clean, i.e. free from dirt, scratches, grime, grease, fingerprints etc. When handling windows it is recommended that cotton gloves or finger cots be worn.

WARNING – ZINC SELENIDE

If windows of zinc selenide are fitted and have been damaged by acidic attack (e.g. acidic condensate or organic acids have entered the cell) it will be likely that some of the zinc selenide will be reduced to selenium metal. This is highly toxic and on no account should attacked zinc selenide material be handled with bare fingers. Such material should be bagged and disposed of according to local regulations.

Cleaning of the cell windows should be carried out using cotton buds or lens tissue, detergent and/or a suitable solvent such as Isopropanol. Avoid abrasive cleaning compounds, as these will damage the optical surface.

WARNING

The use of some solvents (iso-propyl alcohol, alcohol etc.) constitutes a hazard. These substances must be handled in accordance with the relevant local standards.

To remove the cell windows proceed as follows:

Ensure that the end bosses have been removed from the cell body. Starting at one end first, unscrew and remove one locking ring with a cell key (supplied in Special Tools Kit Servomex p/n S2500979). Remove the 5 wavy washers, spacer, and 'O' ring being careful not to damage them or the window. To remove the window, seal the outlet and with the cell in a vertical position, connect a hand operated aspirator (Servomex p/n 2387-0514) to the inlet. Apply a gentle pressure to lift the window up squarely and remove it. Finally remove the PTFE gasket. Dismantle the other end of the cell in a similar manner.

The 'O' ring spacer is threaded internally. The Special Tools Kit Servomex p/n S2500979 contains an extractor, which screws into the spacer to aid removal.

The windows may now be carefully cleaned. The cell body may also be cleaned as necessary.

Ensure all items are thoroughly clean and dry before reassembling, which is the reverse procedure but with the following points noted:

- The windows should be 'floated' into place squarely using a hand aspirator or equivalent, reversing the removal procedure.
- Use new 'O' rings and other cell sealing kit items making sure that all dust, hairs etc, are rigorously excluded from them. Ensure the window surfaces are also free from solvent residues or finger grease.
- The locking ring has a coated thread to prevent seizure – PTFE tape is not required. The locking ring should be tightened down in stages, pausing for a moment between stages until the metal faces of the cell body and locking ring meet when fully tightened, with no gap between them. Where Teflon 'O' rings

are being used, this will require significant torque, with longer pauses. **DO NOT** use the cell inlet/outlet stubs as levers.

After re-assembly, perform a leak check on the cell using a manometer before installing it in the 2500. Do not submerge the cell or fill it with water.

Re-installation of the complete cell assembly onto the 2500 is the reverse of the dismantling process with the added requirement that, unless fitted with a purge, the end bosses should be briefly flushed with clean dry nitrogen after the cell has been mounted and then new absorbent scrubbers should be quickly screwed into them. Be sure to fully tighten the screws holding the source end casting onto the mounting chassis if they have been slackened.

Finally, connect up the cell thermocouple to the cell body, reconnect the cell heater connections (where fitted) remembering to refit the ferrite and secure it with cable ties as close as possible to the suppressor bracket (see Figure 5.2 for details). Connect up any purge connections and the process connections. Return the analyser to service as described in Section 4.5.

Reset zero if necessary on a true zero sample.

5.6 Routine Leak Checks

WARNING

It is the users responsibility to keep all sample connections to the 2500 sample cell, purge connections (if fitted) to the end bosses and steam coil connections completely free from leaks. All plumbing connections should therefore be regularly inspected for signs of leakage and urgent corrective action taken if any are found. This is especially important for process samples, which are flammable, toxic, liquid, or any combination of these.

SECTION 6 SPARES LISTS

6.1 Spares List

The following spares list applies to all versions of the 2500 covered by this manual.

The 2500's Model and Serial Number MUST be advised when ordering spares.

NOTE
For certified versions EU1, EU2, DU1, EX1, EX2, DX1, FM2 and DM2 only the boards listed may be used as spares

6.1.1 General

Table 6.1 – General Spares List	
Description	Part Number
Power Supply	S2000925
Display/Keypad Assembly	S2501999
Keypad Assembly	02501998
Sensor Interface PCB	02000934
Option PCB	02000916
Transmitter PCB	S2500904A
Motor Connection PCB	S2500906
Power Control PCB	S2501911A
Interconnecting Ribbon Cable Assembly 1-256mm path	S2500928A
Interconnecting Ribbon Cable Assembly 512mm path	S2500928B
Interconnecting Ribbon Cable Assembly 1000mm path	S2500928C
Display Ribbon Cable Assembly	S2500929
Interconnecting Cableform 1-256mm path	S2500944A
Interconnecting Cableform 512mm path	S2500944B
Interconnecting Cableform 1000mm path	S2500944C
Fixings Kit (All fasteners)	S2500974
Seals Kit (All Seals excluding Cell Seals)	S2500975
Chopper Box Insulation	S2500977
Kit, Transformer 115/230V Spare	02500978B
Kit, Transformer 100/200V Spare	02500978A

Table 6.1 – General Spares List	
Special Tools Kit	S2500979
Enclosure Earth Studs	S2500984
Chopper Motor	S2500986
Gas Strut Kit	S2500989
Fuse Kit*	02501996
Multi component Adaptor PCB (2550 only)	S2550901
10 x Gas Filter Correlation Adaptor PCB (2510 only)	S2510901A
40 x Gas Filter Correlation Adaptor PCB (2510 only)	S2510901B
Processor PCB + Firmware (2510 only)	S2510965B
Processor PCB + Firmware (2500, 2520, 2550)	S2500965B
Chopper Box Thermal Fuse (98°C)	2536-0329
Communications Board (RS485)	S2500912
Communications Board (Ethernet)	S2500913

* Use only the recommended spares fuse kit (02501996) when replacing the fuses to ensure continued safe operation of the product.

The fuse kit contains:

- Fuse (F30 and F33) 1A 250V, 20mm x 5mm 'T' Antisurge, LBC 35A (Min).
- Fuse (F31 and F32) 2A 250V, 20mm x 5mm, High breaking capacity, Quick acting 'F' Ceramic body.
- Miniature fuse (F34 and F35) 2.5A 250V, 20mm x 5mm, Time lag, High breaking capacity, Ceramic tube.
- Miniature fuse (F36) 3.15A 250V, 20mm x 5mm, Time lag, High breaking capacity, Ceramic tube.
- Miniature fuse (F37) 1A 250V, 20mm x 5mm, Time lag, High breaking capacity, Ceramic tube.
- Miniature fuse (F38) 800mA 250V, 20mm x 5mm, High breaking capacity, Quick acting 'F' Ceramic body.

6.1.2 Sample Cell Spares

Table 6.2 – Sample Cell Spares	
Description	Part Number
Thermocouple (300mm Sheath)	02500502A
Cell Servicing Kit	S2500981
Cell Seals Kit (Viton + PTFE)	S2500982A
Cell Seals Kit (Chemraz)	S2500982B
Special Tools Kit	S2500979
PTFE Tape	1835-3026
Hand Aspirator	2387-0514

6.1.3 Source Units

(Refer to Final Specification Sheet)

Table 6.3 – Source Unit Spares	
Description	Part Number
Long Wave, CaF ₂	S2500931C
Long Wave, BaF ₂	S2500931B
Long Wave, ZnSe	S2500931A
Long Wave, CaF ₂ (Q-SIL potted)	S2501961C
Long Wave, BaF ₂ (Q-SIL potted)	S2501961B
Long Wave, ZnSe (Q-SIL potted)	S2501961A
Replacement Short Wave 10W Halogen Lamp	2552-2204
Soft UV CaF ₂ (2520 Only)	S2520933A

6.1.4 Detector Units

(Refer to Final Specification Sheet)

Table 6.4 – Detector Spares	
Description	Part Number
CaF ₂	S2501905A
CVDFET	S2501905C
KRS-5	S2501905B
Photodiode (2520 Only)	S2600905

6.1.5 Windows

(Refer to Final Specification Sheet)

Table 6.5 – Window Spares	
Description	Part Number
CaF ₂	S2500980A
BaF ₂	S2500980B
ZnSe	S2500980C
Quartz	S2500980D
Glass	S2500980E
Sapphire	S2500980G

6.1.6 Scrubbers

(Refer to Final Specification Sheet)

Table 6.6 – Scrubber Spares	
Detector / Cell Boss Scrubber (H ₂ O) Marked 'W'	S1200921
Detector / Cell Boss Scrubber (H ₂ O/CO ₂) Marked 'CW'	S1200922
Detector / Cell Boss Scrubber (H ₂ O/CO ₂ /CO) Marked 'H'	S1200924
Scrubber Sachet Kit, H ₂ O Mix	S2000510
Scrubber Sachet Kit, H ₂ O/CO ₂ Mix	S2000511
Scrubber Sachet Kit, H ₂ O/CO ₂ /CO Mix	S2000512

6.2 Recommended Spares

Quantity for 2 years.

Table 6.7 – Recommended Spares			
Item	Part Number	1-3 Analysers	4-9 Analysers
Fuse Kit	02501996	2	4
Cell Servicing Kit	S2500981	2	4
PTFE Tape	1835-3026	1	1
Chopper Motor	S2500986	1	1
Cell sealing Kit	Refer to application	2	5
Hand Aspirator	2387-0514	1	1
Windows	Refer to application	2	4
Chopper Box Scrubber	Refer to application	2	4
Detector & Cell Boss Scrubber	Refer to application	2	4
Source	Refer to application	1	2
Detector	Refer to application	0	1
Microprocessor PCB	Refer to application	0	1
Sensor Interface PCB	02000934	0	1
Power Supply	S2000925	0	1

NOTE
Scrubbers should be used as soon as received, or otherwise they must be stored in their original unopened packaging in an airtight container, or preferably in a desiccator. Scrubbers should be used on a "first in, first out" basis.

SECTION 7 INSTRUMENT SPECIFICATIONS

7.1 Generic 2500 Series Performance

7.1.1 Environmental Specifications

Table 7.1 – General Environmental Specifications	
Operating Temperature	GEN, EU1, EU2, DU1, EX1, EX2, DX1, FM2, DM2, HTV 0-55°C (32-131°F)
Operating Humidity	0-95% RH, non-condensing
Storage Temperature	-25°C(-13°F) to +70°C (158°F)
Storage Humidity	0-95% RH, non-condensing
Altitude	Up to 3000 M
Installation Category II Pollution Degree II	Over-voltage impulse to withstand up to 2500V in accordance with IEC 60664-1
Rate of Ambient Temperature Change	Less than $\pm 25^{\circ}\text{C/h}$, ($\pm 45^{\circ}\text{F/h}$) Change
Warm-up Time	Typically 2-10h, depending on application and environment

7.1.2 Dimensions

Length: Max 1620mm, (63.7") min 620mm (24.2")
Height: 241mm (9.5")(allow 500 mm (20") to open end covers)
Width: 284mm (11.2")
Weight: from 25 kg (55 lb) to 50 kg (110 lb)

7.1.3 Power Supply

115/230V AC $\pm 15\%$, 50/60Hz or 100/200V AC $\pm 15\%$, 50/60Hz.

120 VA without optional electrically heated cell.

300 VA with optional electrically heated cell.

Power Supply

Voltage Effects: Less than $\pm 1\%$ fsd for $\pm 15\%$ change.

Power Supply

Frequency Effects: Less than $\pm 1\%$ fsd for 47 to 53 Hz or 57 to 63 Hz.

7.1.4 Performance Characteristics (each component)

Table 7.2 – Performance Characteristics	
Intrinsic Error*	Less than $\pm 1\%$ fsd
Repeatability	$\pm 0.5\%$ fsd
Output Fluctuation (Noise)	Less than 1% fsd (peak-peak) at minimum T_{90} [†]
Linearity Error	Typically less than $\pm 1\%$ fsd
Short Term Zero Drift:	Less than $\pm 1\%$ fsd per week (2500) Less than $\pm 1\%$ fsd per week (2510) [‡] Less than $\pm 2\%$ fsd per week (2520, 2550)**
Response Time (T_{90})	User adjustable from 11s minimum (electronic only, excludes sampling)
Obscuration	Less than $\pm 3\%$ fsd zero error for 50% broadband obscuration of cell windows
Influence Errors	Dependant on application (see specification details)

* Error when used under reference conditions.

[†] 2510 HCl measurement is less than 2% fsd (peak-peak) at minimum T_{90} .

[‡] 2510 HCl measurement is less than 2% fsd Zero Drift.

For 2510 measurements below 100ppm fsd, drift performance will be dependant on application.
Contact Servomex for more information.

** 2550 drift performance will be dependant on application. <1% is available for certain measurements.
Contact Servomex for more information.

7.1.5 Performance Characteristics – EMC

Configuration of equipment:

Fitted with an unscreened power cable. Also included were two separate mA output cables, each individually screened. Each signal pair was fitted with ferrite bead (Servomex part No. 2824-0017). The screens and drain wires were terminated at the glands.

Results:

Met the requirements of EN 61326, Table 4, Class B (Equipment for use in domestic establishments) in respect of conducted and radiated emissions.

Met the requirements of EN 61326, Table A1 (Equipment for use in industrial establishments) in respect of electrostatic discharges, fast transients/bursts, surges, conducted RF disturbances, voltage dips and interrupts.

An additional error of 5% FS over the intrinsic error given in Table 7.2 may be observed at some frequencies under the influence of radiated RF fields specified for industrial environments.

Connection of additional or other signal/control cables and pressure compensation could lead to a deterioration in performance at some RF frequencies.

7.1.6 Sample Specification

Table 7.3 – Sampling Specification	
Sample Temperature	0-180°C/32-356°F (see sampling influences)
Sample Pressure (gauge)	0-10bar/0-1000kPa (0-150psi) (for special high pressure operation consult Servomex)
Sample Flow (typical)	GAS 0.2-5.0 litres/min LIQUIDS 0.3-1.0 litres/min (constant flow rate preferred)
Sample Wetted Materials	Refer to Final Specification Sheet

7.1.7 Sample and Ambient Performance

Table 7.4 – Sample and Ambient Influence	
Sample Pressure Stability	Output may change up to $\pm 1.6\%$ fsd for a $\pm 1\%$ change in sample (Gas Analysers) pressure. With optional empirical sample pressure compensation, effect is reduced to $\pm 1\%$ fsd or less for a 20% change in sample pressure for most typical samples.
Sample Temperature Stability	Output may change up to $\pm 0.3\%$ fsd for gases for a $\pm 1^\circ\text{C}$ change in sample temperature. With optional empirical sample temperature compensation, effect is reduced to $\pm 1\%$ fsd or less for a 20°C change in sample temperature for most typical samples.
Sample Flow Stability	Depends on cell volume and vent conditions but for unheated cells the primary effect is less than $\pm 1\%$ fsd change in output for flow rate changes of $\pm 10\%$.
Ambient Temperature Influence (2500 & 2550)	Less than 1% fsd zero drift due to rate of ambient temperature change of 25°C/hr (45°F/hr) over a maximum of 25°C (45°F) change.
Ambient Temperature Influence (2510)	3% fsd per 10°C (18°F) change.
Ambient Temperature Influence (2520)	Less than 2% fsd zero drift due to rate of ambient temperature change of 25°C/hr (45°F/hr) over a maximum of 25°C (45°F) change.

7.1.8 Solenoid Valve Relays

3 x Solenoid valve relays with volt free contacts rated 240VAC/1.0A, 30VDC/1.0A.

1 x 24VDC/12VA auxiliary supply for solenoid valves

7.1.9 Analogue Outputs

2 x mA outputs, plus 3 x relay outputs. Optionally additional 2 x mA, plus 2 x relay outputs.

All analogue mA outputs are assignable and selected as 0-20mA or 4-20mA (max. impedance 1KOhm) or alternatively 0-10V or 2-10V (min. impedance 1MOhm).

Dual ranges on every Analogue output. Optional additional mA outputs should be specified for 3 component analysers.

All relay outputs are assignable contact pairs selected by links as NC or NO, and are rated 240VAC/1.0A, 30VDC/1.0A.

7.1.10 Serial Output

Single ASCII data logging output port (RS232).

Table 7.5 – Serial Output Specification	
Baud Rate	2400
Parity	Even
Stop Bits	1
Data Bits	8
Handshake	Hardware

7.1.11 Modbus RS-485

Modbus serial communication over RS-485 interface using option board. Note that these settings are independent from those in section 7.1.10

Table 7.6 – Modbus RS-485 Specification		
Protocol	Modbus ASCII & RTU	
Modbus Address	1 to 247	Default = 247
Baud Rate	9K6/4K8/2K4/19K2	Default = 9K6
Parity	EVEN/ODD/NONE	Default = EVEN
Stop Bits	1/1.5/2*	Default = 1
Data Bits	7/8*	Default = 7 (ASCII), 8 (RTU)

* Note:- Stop & Data bits may only be set if Modbus ASCII mode is selected. Modbus RTU will use fixed settings of Data = 8 and Stop = 2 (for parity = NONE) or Stop = 1 (for parity not set to NONE).

7.1.12 Ethernet

Communication over Ethernet using option board.

This provides a 10/100M Ethernet interface and uses the Modbus TCP protocol.

User interface allows the IP address, subnet mask and gateway address to be entered. All fields default to zeros. A provisional subnet mask is generated whenever an IP address is entered that falls into a different class. This can then be modified if required.

7.1.13 Inputs

Terminals for external switch contacts are provided for:

- Range change
- Autocalibration/Autocheck initiate
- Key switch (password)
- Flow Sensor

7.1.14 Ingress Protection

Designed to IP65 (without electrical cell heater).

7.1.15 Optical Purge

Where used, end bosses each require 100ml/min clean, dry purge gas (see Section 4.2) delivered at up to 17kPa (2.5 psi).

7.1.16 Alternative Purge Controller (2500 EU1 & EX1 Only)

Minimum flow rate = 10 SLPM for 11 minutes.

Minimum overpressure = 0.5 mBar.

Maximum overpressure = 80 mBar.

Refer to Certification Manual (Certificate SIRA 09ATEX1341X and IECEx SIR09.0136X) for definitive requirements and operational parameters.

SECTION 8 CE MARKING AND OTHER SAFETY APPROVALS

8.1 EMC and Electrical Safety

- The Analyser complies with the European Community “Electromagnetic Compatibility Directive”:
 - Emissions: Equipment suitable for use in domestic establishments and in establishments directly connected to a low voltage supply which supplies buildings for domestic purposes.
 - Immunity: Industrial locations.
- The analyser complies with the European Community “Low Voltage Directive” by the application of:
 - EN61010-1 and rated for Over-Voltage Category II, Pollution Degree 2.
- This ISM device complies with Canadian ICES-001.
- Cet appareil ISM est conforme à la norme NMB-001 du Canada.
- The analyser complies with part 15 of the US FCC Rules for Class B equipment. It is suitable for operation when connected to a public utility power supply that also supplies residential environments.

8.2 ATEX Directive and other non-European Hazardous Area approvals

ATEX Directive 94/9/EEC

NOTE

Depending on the variant ordered an additional Safety Certificate Manual may be supplied. This contains all the relevant safety certificates and declarations for the EU1, EU2, EX1, EX2, FM2 and DM2 variants.

WARNING

The installer and/or the user of the analyser must be satisfied that the installation complies with any "Special Conditions for Safe Use" or "Schedules of Limitations" contained in the Certificates included in the separate certification manual.

Table 8.1 – 02500 Safety Approvals

Variant	Certification
GEN/HTV	Only suitable for installation in a non-hazardous area.
EU1	The 2500 Series EU1 version is ATEX CAT 2 equipment certified to Type 'p' standard EN 60079-2 and is suitable for use in European areas that require EPL Gb. The analyser is marked Ex px ia [ia] IIC T5 Gb for unheated cells and Ex px ia [ia] IIC T4 Gb for steam heated cells.
EU2/DU1	<p>The 02500 Series EU2 version is ATEX CAT 3 equipment certified to Type 'n' standard EN 60079-15, and is suitable for use in areas that require EPL Gb. The analyser is marked Ex nCL IIC T3 Gc for cell temperatures up to 130°C and Ex nCL IIC T4 Gc for cell temperatures up to 80°C.</p> <p>The 02500 Series EU2 version is ATEX CAT 2 equipment certified to Dust standard IEC 60079-31 and is suitable for use in areas that require ELP Db. The analyser is marked Ex tb IIIC T175°C Db IP66 for cell temperatures up to 130°C and Ex tb IIIC T125°C Db IP66 for cell temperatures up to 80°C and Ex tb IIIC T80°C Db IP66 for unheated cells.</p> <p>Special condition of this certificate is:</p> <p>To avoid propagating brush discharges, the unit is not to be installed in a high velocity dust-laden atmosphere.</p>

Table 8.1 – 02500 Safety Approvals	
EX1	The 02500 Series EX1 version is IECEx certified to Type 'p' standard IEC60079-2 and is suitable for use in areas that require EPL Gb. The analyser is marked Ex px ia [ia] IIC T5 Gb .
EX2/DX1	<p>The 02500 Series EX2 version is IECEx certified to Type 'n' standard IEC 60079-15 and is suitable for use in areas that require EPL Gc. The analyser is marked Ex nCL IIC T3 Gc for cell temperatures up to 130°C and Ex nCL IIC T4 Gc for cell temperatures up to 80°C or unheated cells.</p> <p>The 02500 Series EX2 version is also IECEx certified to Dust standard IEC 60079-31 and is suitable for use in areas that require EPL Db. The analyser is marked Ex tb IIIC T175°C Db IP66 for cell temperature up to 130°C and Ex tb IIIB T125°C Db IP66 for cell temperatures up to 80°C and Ex tb IIIB T80°C Db IP66 for unheated cells.</p> <p>Special condition of this certificate is:</p> <p>To avoid propagating brush discharges, the unit is not to be installed in a high velocity dust-laden atmosphere.</p>
FM2/DM2	<p>The 02500 Series FM2/DM2 version is approved for operation in US Class I, II Div. 2 and Zone 2 or Zone 21 locations without safety purging.</p> <p>02500 Series FM2/DM2 units fitted with electrically heated sample cells must be installed in locations which provide adequate protection against the entry of solid foreign bodies and liquids capable of impairing safety.</p>

APPENDIX A- Modbus Data Mapping

When fitted with one of the optional communication boards, the 2500 series analysers are capable of bi-directional digital communications based on the Modbus protocol.

The following facilities are provided:-

- Access to measurements
- Access to measurement diagnostic values
- Access to alarm states
- Access to detailed fault flags
- Ability to start and stop autocalibration
- Ability to read or modify autocalibration setup
- Ability to monitor autocalibration progress

Access to these facilities is achieved through reading (and in some cases writing) Modbus registers and coils / discrete inputs as detailed below.

A.1 Floating Point Numbers

All floating point numbers are represented in 32 bit IEEE754 format and must therefore be transmitted in Modbus messages as two registers.

The following coil / discrete input controls the order in which pairs of registers representing floating point values is transmitted. This control setting applies to all floating point values read and written.

This bit may be set using function code 05. Its current state may be read with function codes 01 and 02.

Coil/ Discrete I/P Number	Coil/ Discrete I/P Address	Name	Comments
301	300	Floating Point Register Order	Changes the order of the Modbus register when dealing with 32-bit floating point numbers. 0= Big-endian, e.g. Register number 1 = high word Register number 2 = low word (default) 1 = Little-endian, e.g. Register number 1 = low word Register number 2 = high word

A.2 Measurement Summary

This block of registers allows all primary measurement components to be read in single query.

This register data is read-only and may be accessed with function codes 03 and 04.

Register Number	Register Address	Name	Data Type	Comments
1	0	Number of measurements	integer	Number of fitted measurement components
2-3	1-2	Measurement 1	float	Measurement component 1
4-5	3-4	Measurement 2 *	float	Measurement component 1
6-7	5-6	Measurement 3 *	float	Measurement component 1

* Note that measurements 2 and 3 are optional and may only be present in 2550 instruments. Where not fitted these values will be zero.

A.3 Measurements Detail

This register data is read-only and may be accessed with function codes 03 and 04.

Register Number	Register Address	Name	Data Type	Comments
101-102	100-101	Measurements 1	float	Measurement 1 value
103-105	102-104	Measurement 1 formula	string	Measurement 1 chemical formula (max 6 chars)
106-107	105-106	Measurement 1 units	string	Measurement 1 units (max 3 chars)
108-110	107-109	Reserved		
111-112	110-111	Measurement 2 *	float	Measurement 2 value
113-115	112-114	Measurement 2 formula*	string	Measurement 2 chemical formula (max 6 chars)
116-117	115-116	Measurement 2 units *	string	Measurement 2 units (max 3 chars)
118-120	117-119	Reserved		
121-122	120-121	Measurement 3 *	float	Measurement 3 value
123-125	122-124	Measurement 3 formula*	string	Measurement 3 chemical formula (max 6 chars)
126-127	125-126	Measurement 3 units *	string	Measurement 3 units (max 3 chars)
128-130	127-129	Reserved		

* Note that measurements 2 and 3 are optional and may only be present in 2550 instruments. Where not fitted these values will be zero.

A.4 Measurement Diagnostics

This register data is read-only and may be accessed with function code 03 and 04.

Register Number	Register Address	Name	Data Type	Comments
201-202	200-201	Sample pressure	float	Sample pressure (zero if not fitted)
203-204	202-203	Chopper temperature	float	Chopper temperature as °C
205-206	204-205	Compensation temperature	float	Compensation (detector) temperature as °C
207-208	206-207	Cell/Sample temperature	float	Cell/Sample temperature as °C
209-210	208-209	Source voltage	float	Source voltage
211-212	210-211	Intensity 1	float	Intensity channel values representing the input positions used for measurement and reference signals.
213-214	212-213	Intensity 2	float	
215-216	214-215	Intensity 3	float	
217-218	216-217	Intensity 4	float	
219-220	218-219	Intensity 5	float	
221-222	220-221	Intensity 6	float	
223-230	222-229	Reserved		

A.5 Alarms

This coil / discrete input data is read-only and may be accessed with function code 01 and 02.

Coil/Discrete I/P Number	Coil/Discrete I/P Address	Name	Comments
1	0	Measurements 1 Alarm 1	Alarm condition indicated by bit = 1
2	1	Measurements 1 Alarm 2	
3	2	Measurements 1 Alarm 3	
4	3	Measurements 1 Alarm 4	
5-8	4-7	Reserved	All bits = 0
9	8	Measurements 2 Alarm 1 *	Alarm condition indicated by bit = 1
10	9	Measurements 2 Alarm 2 *	
11	10	Measurements 2 Alarm 3 *	
12	11	Measurements 2 Alarm 4 *	
13-16	12-15	Reserved	All bits = 0
17	16	Measurements 3 Alarm 1 *	Alarm condition indicated by bit = 1
18	17	Measurements 3 Alarm 2 *	
19	18	Measurements 3 Alarm 3 *	
20	19	Measurements 3 Alarm 4 *	
21-24	20-23	Reserved	All bits = 0

* Note that measurements 2 and 3 are optional and may only be present in 2550 instruments. Where not fitted these values will be zero.

A.6 Fault Data

This coil / discrete input data is read-only and may be accessed with function code 01 and 02.

Coil/Discrete I/P Number	Coil/Discrete I/P Address	Name	Comments
101	100	Fault status	Bit = 1 indicates fault condition present
102	101	Optical bench power failure	Bit = 1 indicates specified fault condition present
103	102	Source voltage high	
104	103	Source voltage low	
105	104	Infrared source failure	
106	105	Chopper motor out of lock	
107	106	Sample flow failure	
108	107	Chopper temperature high	
109	108	Chopper temperature low	
110	109	Chopper temperature sensor failure	
111	110	Cell temperature high	
112	111	Cell temperature low	
113	112	Cell temperature sensor failure	
114	113	Sample temperature sensor failure	
115	114	Pressure sensor failure	
116	115	Bad reference voltage	
117	116	Compensation temperature sensor failure	
118	117	Detector signal high	
119	118	Detector signal low	
120-122	119-121	Reserved	All bits = 0
123	122	Auto-cal bad pre flush	Bit = 1 indicates specified fault condition present
124	123	Zero out of tolerance	
125	124	Span out of tolerance	
126-130	125-129	Reserved	All bits = 0

131	130	Password violation	Bit = 1 indicates specified fault condition present
132	131	System clock inoperative	
133	132	System ADC inoperative	
134	133	Default system data corruption	
135	134	Calibration data corruption	
136	135	Utility data corruption	
137	136	Alarm / relay data corruption	
138	137	Analogue assignment data corruption	
139	138	Bad span ignored	

A.7 Autocalibration Setup

These registers allow the autocalibration settings to be read using function codes 03 and 04 and to be written using function codes 06 and 16 (see note 1).

Register Number	Register Address	Name	Data Type	Comments
301	300	Select low / high	Integer	Zero = low autocalibration only. Non-zero = low & high calibration.
302	301	Mode	Integer	Zero = check only. Non-zero = calibrate
303-304	302-303	DV lag	float	Required delay in minutes
305-310	304-309	Reserved		
311-312	310-311	Measurement 1 low target	float	Concentration of low calibration gas for measurement 1
313-314	312-313	Measurement 1 high target	float	Concentration of high calibration gas for measurement 1
315-320	314-319	Reserved		
321-322	320-321	Measurement 2 low target (see note 2)	float	Concentration of low calibration gas for measurement 2
323-324	322-323	Measurement 2 high target (see note 2)	float	Concentration of high calibration gas for measurement 2
325-330	324-329	Reserved		
331-332	330-331	Measurement 3 low target (see note 2)	float	Concentration of low calibration gas for measurement 3
333-334	332-333	Measurement 3 high target (see note 2)	float	Concentration of high calibration gas for measurement 3

Notes:-

1. Any attempt to write a register in the above range, whilst an autocalibration is in progress, will return an exception response 06 (slave busy). Register values will not be updated.
2. Measurements 2 & 3 are optional and may only be present in 2550 instruments. Where not fitted reading these values will return zero.
3. The DV lag should be expressed in units of minutes to the nearest 0.5 minutes. Other values will be automatically rounded to conform before being written.

A.8 Autocalibration control

The following coils / discrete inputs control the autocalibration process. Control actions are initiated by setting the specified bit = 1 for between 2 and 59 seconds and then setting the bit = 0. The autocalibration configuration, including the selection of calibration or check, is determined by the analyser settings.

These bits may be set using the function code 05. Their current state may be read with function codes 01 and 02.

Coil/Discrete I/P Number	Coil/Discrete I/P Address	Name	Comments
201	200	Start autocalibration	Initiates an autocalibration/autocheck using the predefined calibration setting.
202	201	Stop autocalibration	Terminate a running autocalibration / autocheck process (however initiated).

A.9 Autocalibration Status

This register data is read-only and may be accessed with function code 03 and 04.

Register Number	Register Address	Name	Data Type	Comments
401	400	Autocalibration Phase	Integer	Value indicates autocalibration phase as follows:- 0 = Not in autocalibration 1 = In span pre flush 2 = In zero calibration 3 = Zero corrected 4 = In span calibration 5 = Span corrected 6 = In post-flush
402-403	401-402	Measurement 1 zero pre-calibration	float	These values are updated during phase 3 of the autocalibration sequence.
404-405	403-404	Measurement 1 zero post-calibration	float	
406-407	405-406	Measurement 1 Span pre-calibration	float	These values are updated during phase 5 of the autocalibration sequence.
408-409	407-408	Measurement 1 Span post-calibration	float	
410	409	Reserved	float	
411	410	Autocalibration phase *	float	Value indicates autocalibration phase as follows:- 0 = Not in autocalibration 1 = In span pre flush 2 = In zero calibration 3 = Zero corrected 4 = In span calibration 5 = Span corrected 6 = In post-flush
412-413	411-412	Measurement 2 zero pre-calibration *	float	These values are updated during phase 3 of the autocalibration sequence.
414-415	413-414	Measurement 2 zero post-calibration *	float	
416-417	415-416	Measurement 2 Span pre-calibration *	float	These values are updated during phase 5 of the autocalibration sequence.
418-419	417-418	Measurement 2 Span post-calibration *	float	
420	419	Reserved		
421	420	Autocalibration Phase *	Integer	Value indicates autocalibration phase as follows:- 0 = Not in autocalibration 1 = In span pre flush 2 = In zero calibration 3 = Zero corrected 4 = In span calibration 5 = Span corrected 6 = In post-flush

422-423	421-422	Measurement 3 zero pre-calibration *	float	These values are updated during phase 3 of the autocalibration sequence.
424-425	423-424	Measurement 3 zero post-calibration *	float	
426-427	425-426	Measurement 3 Span pre-calibration *	float	These values are updated during phase 5 of the autocalibration sequence.
428-429	427-428	Measurement 2 Span post-calibration *	float	

* Note that measurements 2 and 3 are optional and may only be present in 2550 instruments. Where not fitted these values will be zero.

APPENDIX B - Equipment Protection Levels.

Traditional Relationship of Equipment Protection Levels (EPLs) to Zones

Equipment Protection Level (EPL)	Zone
Ga	0
Gb	1
Gc	2
Da	20
Db	21
Dc	22

For more information on Equipment Protection Levels (EPLs) refer to Annex D of IEC 60079-0:2007 or EN60079-0:2009.

Appendix C - Disposal In Accordance With The Waste Electrical and Electronic Equipment (WEEE) Directive.

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

The analyser is not intended for disposal in a municipal waste stream, but shall be submitted for material recovery and recycling in accordance with any appropriate local regulations.

For additional information and advice on the disposal of the analyser, contact Servomex.

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Jarvis Brook
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TN6 3FB
England
Tel: (44) 1892 652181
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Global email: info@servomex.com





If you send the analyser to Servomex or your local Servomex analyser for disposal, it must be accompanied by a correctly completed decontamination certificate.

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

Appendix D - Terminal Torque Settings.

The table below shows the required torque settings for screw terminals when wiring up the equipment.

Screw Terminal Torque Settings	
Comp Ref	Torque Setting
TB3	0.2 - 0.25 Nm
TB20	Refer to table below
TB22	0.4 - 0.5 Nm
TB23	0.4 - 0.5 Nm
TB24	0.4 - 0.5 Nm
TB25	Refer to table below
TB26	Refer to table below
TB30	0.4 - 0.5 Nm
TB31	0.4 - 0.5 Nm
TB33	0.4 - 0.5 Nm
TB34	0.4 - 0.5 Nm
TB35	Refer to table below
TB36	0.4 - 0.5 Nm

Torque Settings for Alternative Connector Types			
Connector Type	Identification		Torque Setting
	Colour	Visual	
Weidmuller MK8	ORANGE		0.4 - 0.5 Nm
Weidmuller Omnimate LM5.08	ORANGE		0.4 - 0.5 Nm
Phoenix Contact SMKDSN	GREEN		0.5 - 0.6 Nm
Phoenix Contact SMKDSP	GREEN		0.5 - 0.6 Nm